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THE TECHNICAL NEWSPAPER OF THE ELECTRICAL INDUSTRY

22 AUGUST 1947
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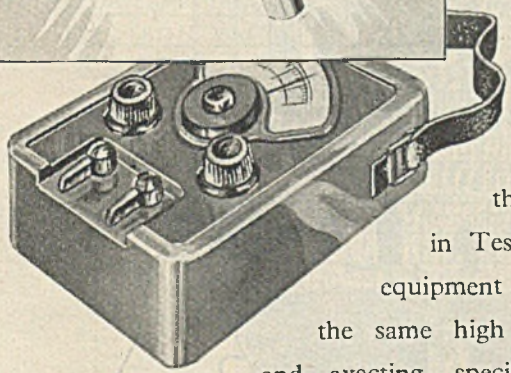

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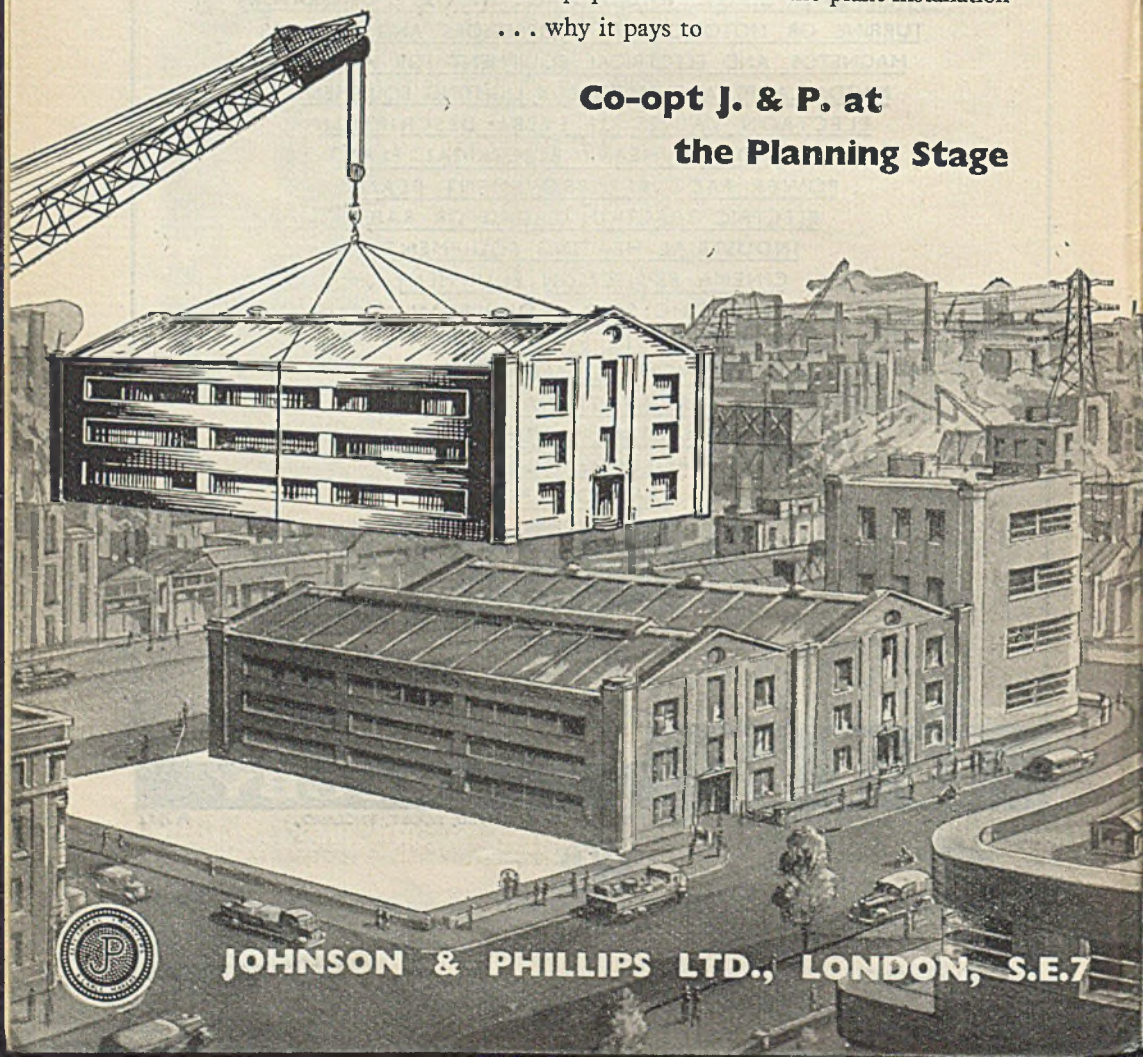

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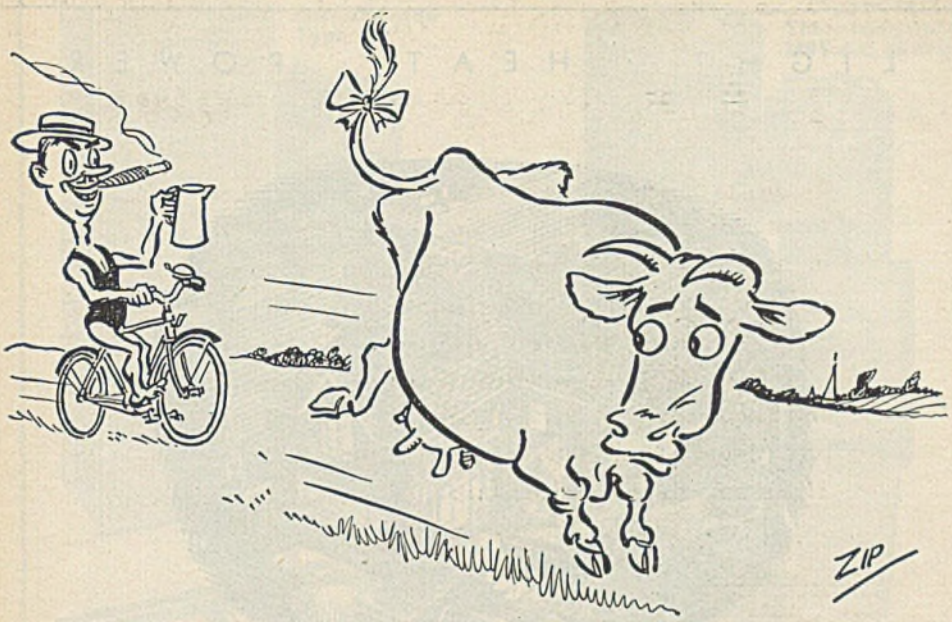

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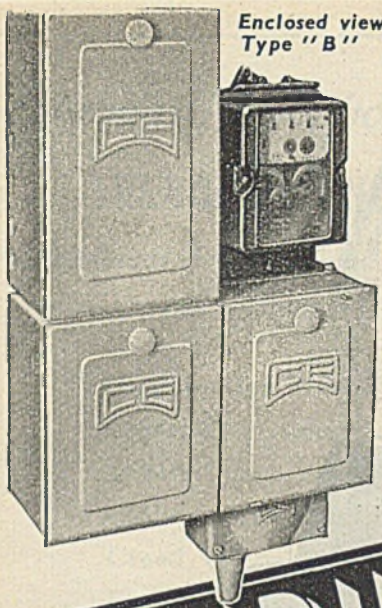

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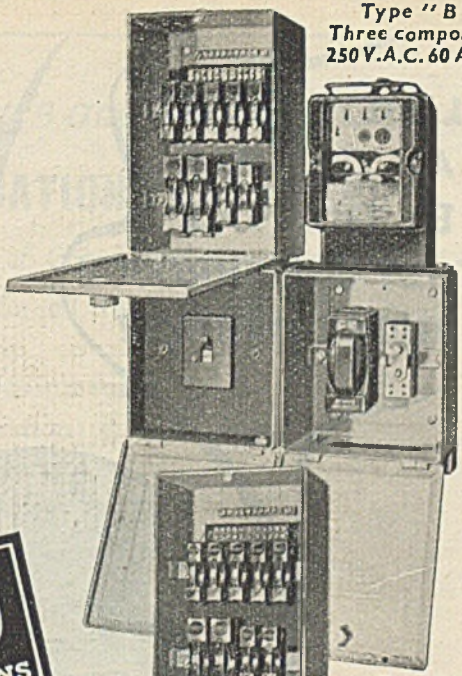

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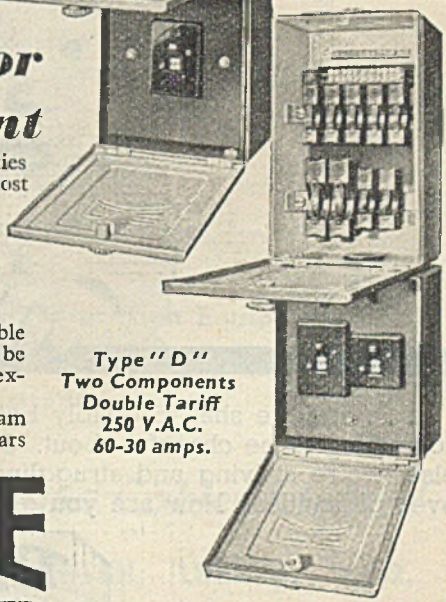

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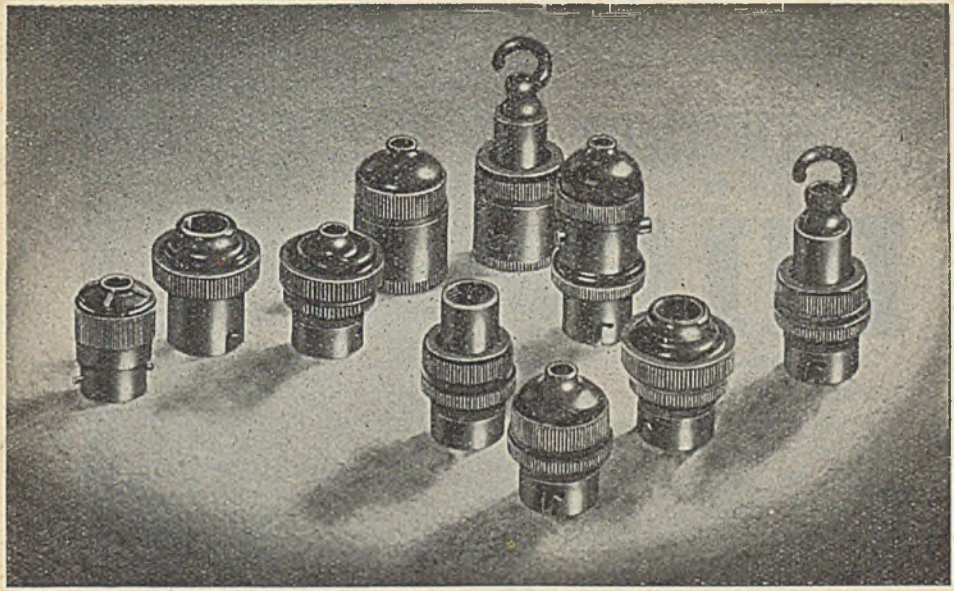

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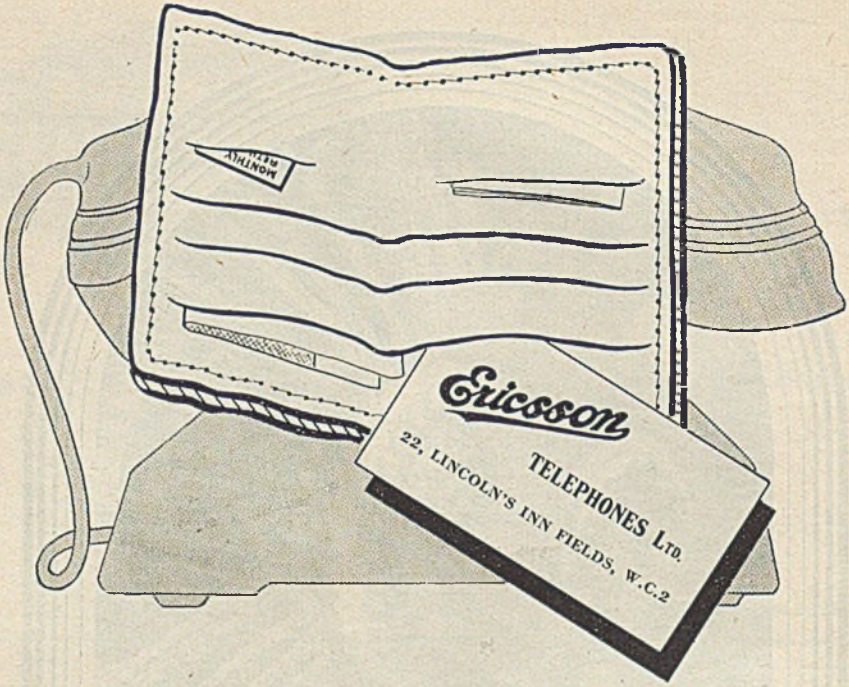

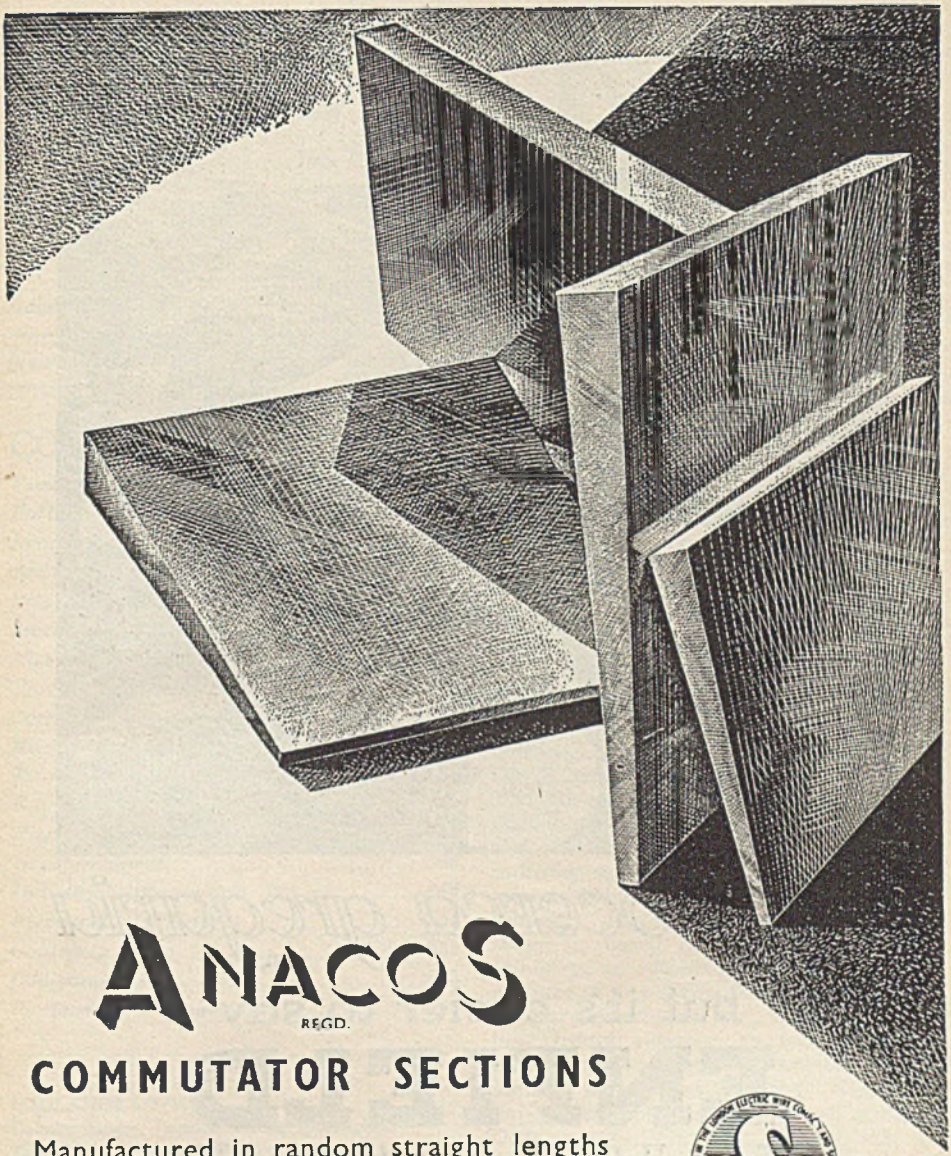

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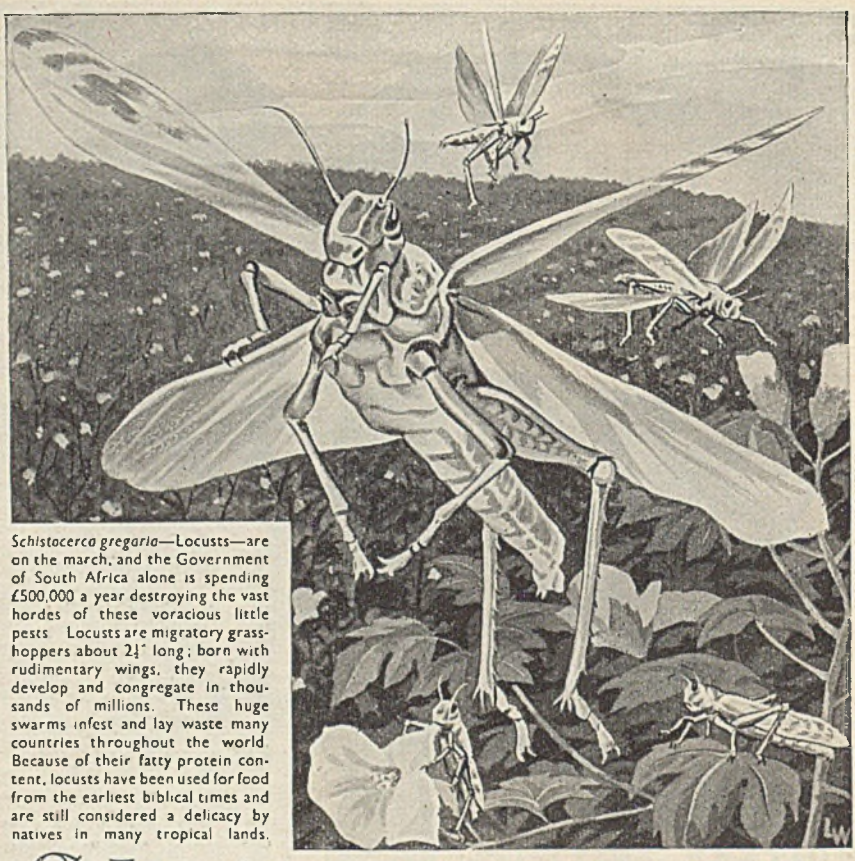

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Engagement Orders

THE Control of Engagement Order, of which the electrical industry had considerable experience during the war, will, it is anticipated, be re-instated in new form on October 1. The effect of the Order, as before, will be that employers will not be able to engage or seek to engage by advertisement or public notice, employees falling within its scope except through the Ministry of Labour; neither will workers be permitted to obtain employment other than through the Ministry.

The experience of the war years proved that the direction of labour was not only wasteful, but so far as the electrical industry was concerned, something of a mixed blessing. The reason for this criticism, apart altogether from political issues, is based on the fact that the Ministry of Labour officials, in the absence of any intimate knowledge of the industry concerned, can, when interpreting Orders relating to technical personnel, only think in terms of the number of workers directed. The most important factor in the operation of an Order controlling the movement of labour, however, must, if it is to be of any real assistance in increasing output, be to direct to the industry in question only those who have at least some knowledge of the industry, or are mentally alert enough to be able to absorb instruction in matters relative to it; a factor which, though perhaps appreciated by the Ministry, is understandably difficult for Civil Service clerks to cater for.

Rightly or wrongly, our understanding of the proposals in the new Order will

require employees at present engaged in essential industries to remain in that employment, while those employed in non-essential industries will not be affected unless they seek new employers. In the latter event they will fall within the scope of the Order and be directed by the Ministry to essential industry. It is not yet clear what may be regarded as essential or non-essential industry—and in view of the exporting value of practically every form of industry, the definitions will be hard to determine—but until a worker is both unemployed and prepared to seek a new job, he or she will be unaffected by the Order. In those circumstances the proposals would appear to be negative of both purpose and result, unless supplies of fuel and raw materials were withheld from the less essential industries to force dismissals. If such a policy is in the minds of those now framing the Order it must be abandoned forthwith, for though it would doubtless provide the Ministry of Labour with names upon its books, its effect upon productive industry, both essential and non-essential, and upon our export trade, would not only be disastrous, but, since it is not proposed to move workers away from their homes, would also create unemployment in those places where recruits for essential jobs outnumbered vacancies.

Request and Hope

THE electrical industry to-day, is regarded in official circles as having an appreciably higher priority value than during the war for, as important as it was from a national point of view in those years, not until the post-war period, were arrangements put into effect for making good the leeway lost in generating plant replacements and extensions; not until the post-war years was the industry given preferential treatment with respect to steel and other raw materials for the manufacture of generation equipment. Soon after the conditions created by load shedding and the fuel crisis last winter had convinced the Government that the warnings of the electrical industry were not the political propaganda the Minister of Fuel declared them to be—at the I.M.E.A. Convention at Blackpool—the Ministry of Supply, it will be remembered, put into operation machinery designed to ensure adequate labour and materials for the manufacture of heavy electrical plant and boilers. That machinery is still operating, and because of it, there is reason to expect that on and after October 1, the industry may have directed to it, under the new Engagement Order, some of the labour falling within the scope of that Order. If such should prove to be the case, may we beseech the powers-that-be to apply to their interpretation of the new Order an intelligence greater than that displayed with respect to the old?

About the Grid

ONE of the results of load shedding and restriction in current consumption has been an increase in the general interest displayed in electrical matters. This is indicated by the number of inquiries which have reached the Central Board during recent months—particularly from schools, colleges, and other educational institutions—and to satisfy this demand for information, an illustrated brochure entitled "The Grid" has been prepared for free distribution. From the point of view of the electrical industry the book does not contain much that is particularly new, but draws a good deal on material given in the annual reports of the Board and elsewhere; it is, in fact, simply an attempt—and a very good attempt—to present a co-ordinated and comprehensive account of the grid and its place in the development of the supply industry. It is a book which has been wanted for some time, and should do much to help the non-technical public appreciate the reasons for the inconveniences to which they are sometimes subjected during cold spells, etc., and the difficult position in which the generation side of the industry found itself at the end of the war.

Load Shedding Next Winter

ARRANGEMENTS are being drawn up in the supply industry for meeting the load next winter in such a way as to reduce the hazards of shedding, and a statement upon the procedure to be adopted is given in this issue. In brief, preliminary target figures will be communicated to electricity undertakings by the area managers of the Central Board, based upon information with respect to anticipated demand, supplied each week between October and March next by the undertakings themselves.

These weekly figures will enable adjustments to be made in the preliminary target values before the winter really commences, but if any difficulty arises in reaching agreement with the area managers, the Commissioners may be referred to. When load has to be shed to reach the target figure, everything possible will be done to maintain supplies to those industrial undertakings who have, to the satisfaction of the Regional Boards, arranged to spread their loads or who have shown that they are unable to do so, but even if load has to be reduced below the target level, efforts will still be made to maintain the most important industrial supplies.

Supply Cuts by Rota

AUTHORITIES are now considering what steps to take to reduce load, and in this connection the rota scheme being adopted by a number of undertakings has much to commend it. This is a scheme by which the distribution network is divided into (say) five sections which can be switched out in daily rotation. By this means load shedding is confined to one particular section of the network on one working day of the week, and consumers connected to that section can reasonably rely on immunity from load shedding on other days. With regard to target directions, supply authorities will be expected to observe them in full, and any necessary action taken to enforce them will be officially supported.

Steel and Electrical Plant

THE ways of all Governments are peculiar, but reviewed against a background of hard industrial facts, those of the present residents at Westminster are more difficult to understand than most. The Ministry of Supply is, it is claimed, doing all in its power to increase and to hasten the production of heavy electrical plant in order to make good the shortage in national generating capacity. Among the requirements to meet those conditions is a much needed increase in the supply of electrical steels, and it would be reasonable in the circumstances, therefore, to expect that the steel industry would be encouraged by the Government to not only carry on as best it can with the coal and other shortages to which it has been subjected, but to make every effort to increase its output. Instead, the industry is to be disturbed in its operation by the uncertainty which full-scale nationalisation plans are likely to carry in their wake. Whether or not the industry should be nationalised is, so far as this note is concerned, quite beside the point, in that the major occupation of the industry should be to produce more and more steel, and that of the Government to encourage that production. There can be little doubt that the early nationalisation proposals with respect to electricity supply would have had an appreciable effect upon development had generating plant, transmission line poles, cables, etc., been available, and there seems no ready reason for thinking that any nationalisation programme for the steel industry may not be equally disturbing. A condition which may ultimately be reflected in the manufacture of heavy electrical plant.

Technical Man-Power in Industry

THE electrical industry has on many occasions drawn attention to the scarcity of technical man-power and the importance of research in the restoration of our economic stability, but in a statement by the Association of Scientific Workers last week, criticism was made to the effect that from a national point of view the best use is not being made of existing resources. The association considers that the application of science and technology to industry is not sufficiently recognised in the official economic recovery programmes, and makes two proposals which, it believes, would allow technical man-power to contribute more effectively to the national effort. These are, in brief, that the technical man-power engaged in less essential work should be reduced in numbers and a greater concentration should be made on work likely to have early practical results. Among the less essential needs the association counts defence, where the scientific strength, it suggests, should be cut by at least a third. We have no knowledge of the facts upon which the association bases its statement, but having some experience of research conditions in the electrical industry, any suggestion that existing resources in the industry are not being put to their best use would not only be resented but would be unfounded.

Portrait—Mr. Samuel Ferguson

THE name Samuel Ferguson has long been associated with switchgear, but in earlier days it identified its owner as a student of the Manchester School of Technology, and was later recorded in the books of Messrs. Dorman and Smith, as belonging to a pupil engaged in that organisation.

Some indication of the character of the man, even at that early age, is given by the fact that during his four years' pupilage with the D. and S. organisation, for the most part spent in the drawing office, Mr. Ferguson in order to gain a better knowledge of workshop practice, attended the factory at 6 a.m. each day, before assuming his normal morning duties.

Leaving D. and S. to take up an appointment as draughtsman on h.t. switchgear with Ferranti, Ltd., Mr. Ferguson subsequently became chief draughtsman in that company's Contract Department, vacating the position in 1913 when Ferranti, Ltd., decided to discontinue switchgear manufacture. Convinced that there was scope for switchboard production in the industry, however, Mr. Ferguson, with the concurrence and good wishes of his old employers, started with Mr. George Pailin the business Ferguson and Pailin, which though to-day under other control, still bears their names in a different form.

In 1926, the B.T-H. Co., Ltd., made an offer for the shares of Ferguson Pailin, Ltd., which by then had become a limited company, and the two companies, on the offer being accepted, became associated, with Mr. Ferguson acting as managing director of the latter for sixteen years.

In 1937, Mr. Ferguson formed an organisation, Cooke and Ferguson, Ltd., to take over a structural engineering business and to introduce electrically-welded fabrication work. A short time before war broke out, this company was called upon to undertake a large amount of work for the Admiralty, together with the manufacture of air screw hubs and large components for Manchester bombers—those deep winged machines which preceded the Lancaster. In consequence of this work, the structural steel side of the business was given up, and Mr. Ferguson became the sole proprietor.

In 1942, Mr. Ferguson resigned the position as managing director of Ferguson Pailin, Ltd., to assume a like position with Cooke and Ferguson, Ltd.; and during the same year he acquired the business of Victor H. Iddon, Ltd.

During the war years three further factories were added to the original 65 000 sq. ft., raising the employment potential of the Cooke and Ferguson organisation from 40 in 1937 to 2 000.

Mr. Ferguson was awarded the John Hopkinson premium for a paper on "A General Survey of the High Tension Switchgear Field," which he read before the I.E.E. in 1926; he has a flair for finance and economics and has been a member of the Executive of the Manchester Engineering Employers' Association for many years. He has also served on the B.E.A.M.A. Council. He is a long standing member of the Manchester Rotary Club, was elected vice-president, but war-work prevented him from proceeding to the presidency.

In March, 1945, Mr. Ferguson gave an address before the Manchester Engineering Council on the 40-hour week, which together with an address on the same subject by a Mr. E. Jennison was subsequently printed in booklet form and presented to the Economics League for inclusion in that non-political body's literature.

Mr. Ferguson includes among his hobbies and pastimes . . . long country walks and golf. He lives at Wilmslow, Cheshire, and his wife is the well-known author Ruby Ferguson. He has two sons, both of whom are engaged in their father's business.

Load Spreading Next Winter

Maximum Demand Targets for Period October to March

WHILE it is hoped that the arrangements being made by the Regional Boards for Industry for spreading the load next winter will result in a substantial reduction in the maximum demand on the grid system, occasions are still likely to arise when load shedding will be necessary. The Central Electricity Board, the Commissioners and the Electricity Joint Committee have, therefore, been considering various schemes for avoiding the difficulties which occurred last winter.

As a result of these deliberations, a scheme has been evolved by which each undertaker will have a target maximum demand to which his load must be reduced when called upon to do so by the Central Board either directly or indirectly.

PAST EXPERIENCE

It will be remembered that during last winter the national plant/load position was such that load had to be shed on most working days during the period November to February. The most acute period occurred in late January, 1947, when the amount of load shed was in the region of 2 000 MW and duration of shedding was on occasion as much as 12 hours in one day.

The method then adopted for shedding was for the C.E.B. control to issue instructions in one or more areas to all the undertakers taking direct supplies from the board, to reduce their loads, by steps of 5 per cent., as necessary to prevent the frequency falling below 48.0 cycles.

The objections to this procedure were the impossibility of making the necessary arrangements with consumers in sufficient time to avoid risk of danger to workpeople and damage to equipment; lack of discrimination between undertakers having a large proportion of industrial load and those whose loads were mainly domestic; the lack of discrimination between undertakers and consumers who had made voluntary reductions in their demands, by load staggering or other means, and those who had not co-operated in this way; the lack of any prior indication of the probable magnitude of the cuts to be imposed, or conversely of the individual maximum loads which might be accepted having regard to the plant actually available.

In the absence of special measures for limiting peak loads, the plant/load position in the coming winter will be more serious, in similar weather conditions, than that experienced last winter. Consideration is, therefore, being given to a new procedure for reducing load which is free from the above objections. Proposals have been made from a number of sources that advance information should be given of the maximum undertaking loads which could safely be carried during the winter period and investigations have been made into the practicability of these proposals.

The maximum demands upon the board, estimated by the individual undertakers early in 1947 for next winter, are not a suitable basis for a scheme of "target" maximum demands since there are indications that a large proportion of those estimates was unduly influenced by the abnormal demands set up during the fuel crisis.

The maximum demands on the board actually recorded in January and February, 1947, are also unsuitable as undertakers were affected to varying extents by the fuel shortage.

In all the circumstances it is felt that the maximum demands actually recorded during the months of November and December, 1946, would form the most suitable basis. Moderately cold weather had been experienced during this period, but there was no evidence that the shortage, or threatened shortage, of solid fuel had yet materially affected the demands. With the adoption of such a basis it would, of course, be necessary to take into account prospective development both in industrial and non-industrial loads for the ensuing year.

Undertakers were therefore asked to give information regarding the respective percentage contributions to the peak loads recorded in November-December, 1946, of public lighting and traction, industrial consumers, general consumers, and also to give the additional industrial load which they expected to connect by next winter.

At the same time an estimate was made, on the most up-to-date information, of the plant capacity which would be available in each of the board's areas throughout the period October, 1947, to March, 1948.

ANTICIPATED DEMAND

These plant figures, amounting in January, 1948, to a total of 9 530 000 kW, represent the simultaneous demand which can be met at standard frequency provided that no unexpected plant emergency arises. On the diversity actually experienced in November-December, 1946, the corresponding aggregate of area maximum demands in January, 1948, would be 9 742 000 kW, and the sum of the demands

of individual undertakings would be 10 030 000 kW. There is no reason to suppose that inter-area diversity, which is largely governed by geographical conditions, would be affected by a target scheme. On the other hand, the limitation of individual undertaking demands to a predetermined target level must necessarily reduce very materially the diversity between individual demands within an area. It was felt, therefore, that the targets should be based on the assumption that the individual demands would equal the simultaneous demand of each area, thus limiting the provision for diversity to that represented by inter-area diversity. From the foregong it will be seen that the individual targets will in total be approximately 9 742 000 kW for the month of January, 1948.

A THIRD REDUCTION DIFFICULT

The Government has laid down a general target reduction for industry of 33⅓ per cent. of the maximum industrial loads recorded last winter. It will undoubtedly be difficult for industry to achieve such an overall reduction, especially as there is an appreciable proportion of continuous process work on which no reduction is practicable. It would, therefore, be unwise in preparing a scheme of target loads to assume that this 33⅓ per cent. reduction would be fully achieved.

Calculation of the undertaking target peak loads for the month of January, 1948, have been made on a number of alternative bases, of which the most suitable appears to be one which assumes that public lighting and traction loads would be met in full; that the contribution of industrial consumers would be reduced by some 20 per cent. from that anticipated for January, 1948; the contribution of general consumers would be limited to 10 per cent. above that recorded in November/December, 1946.

Industrialists have complained that they are being called upon for drastic economies, while other classes of consumer are not being asked for an equivalent degree of sacrifice. In comparing the proposed 20 per cent. reduction in industrial load with the apparent increase of 10 per cent. in the demand of other consumers, it must be borne in mind that in the absence of fuel shortage, the demand of general consumers is substantially higher in January/February than in the preceding November/December, whereas industrial demand shows little change; in assessing the industrial component of the proposed targets full allowance has been made for anticipated new loads, which amount to an increase of over 10 per cent. on the industrial contribution in November/December, 1946, whereas no specific allowance has been made for the necessary increase in the demand of general consumers consequent on such factors as the progress of rehousing. The total allocation of kilowatts for general consumers included in the targets on the foregoing basis represents a reduction of some 12 per cent. on the demands for those consumers included in the undertakers' estimates for next winter.

The targets for individual undertakings supplied directly by the board, which result from these calculations can only be regarded as provisional, as they cannot take full account of all the local circumstances which might affect an undertaker's demand, particularly his industrial demand and any bulk supplies given to other undertakings. It is therefore assumed that these provisional targets will be examined and will be adjusted as necessary within the target allocated to each board area.

As the generating plant available will be lower in the months other than January it will be necessary to adopt correspondingly lower targets for those months. The most convenient method of defining these lower targets is to express them as percentages of the target allocations for January, 1948.

SUGGESTED PROCEDURE

It is considered that the following procedure should be adopted: (a) That provisional target demands for January, 1948, with the appropriate percentage deductions for other periods, should be issued immediately to all undertakings taking direct supplies from the C.E.B. (b) That provisional target demands for undertakings taking indirect supplies should be assessed by the board's district managers. (c) That all undertakers should be asked to send to the board's district manager, commencing with the first week in September, particulars of the weekly recorded maximum demands of their undertakings. (d) That any necessary adjustment to the provisional target demand for each undertaking should be made before the end of September, in order that firm target demands can be adopted at the beginning of October. Subsequent adjustments to individual targets can be made during the remainder of the period. (e) That load shedding should continue to be carried out only to the instructions of C.E.B. control. (f) That with the introduction of the target scheme the first load shedding instruction should be to "reduce load to target," and whenever possible advance notification of this instruction should be given during the preceding evening.

About Transformers

by G. O. CASTELL, M.I.E.E.

The Design and Insulation of Transformer Windings

The first of this series appeared in THE ELECTRICIAN *of August 15 and dealt with the design and construction of Transformer Cores. In this, the second article of the series, the author considers the design and insulation of Transformer Windings.*

THE designer of transformers is faced with the problem of combining within a transformer winding, three essential qualities, which are, unhappily, not complementary; these are electrical strength, mechanical strength and thermal efficiency,

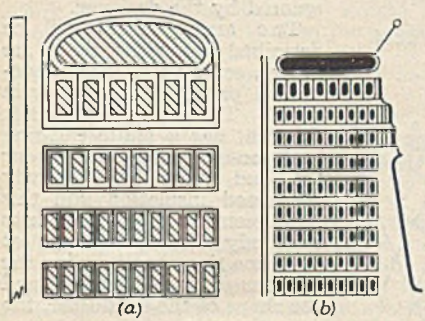


Fig. 1.

and all are necessary if a transformer is to give a satisfactory performance in service. Unfortunately, none of the best insulating materials has a good heat conductivity and few, particularly of those sufficiently flexible to be included in a winding, are mechanically strong. Likewise, the combination of generous oil ducts with adequate support and clamping for every turn in a stack of coils is not easy to devise, and only by using the highest quality material and the best selection for each particular duty can the desired result hope to be achieved. Electrical strength implies the maintenance of insulation between turns, between coils, between windings and from windings to all earthed metal, not only under all normal operating voltages, but also under the stresses set up by the transient over-voltages which may be caused by switching or lightning strokes.

The power frequency voltage tests called for in the various national specifications, although not identical, are of the same order and have been found suitable to prove the major insulation. By the term major insulation is meant the insulation between windings and from windings to ground, and it is here that the main voltage stress falls during normal steady state conditions. The stresses due to transient over-voltages fall in greater part upon the inter-turn and inter-coil insulation, and it is impossible to foresee their magnitude, or the exact position of their impact without complete design data. In the United States a surge test level has become established for each of the various voltage classes of transformers and is incorporated in the American test standards; the Central Electricity Board is seeking to do likewise in this country and it is probable that these, or similar values, will ultimately form the subject of a B.S.I. publication. It is becoming increasingly common practice amongst transformer users to specify a surge test level, and omit any specific reference to the value of inter-turn insulation or the reinforcing of

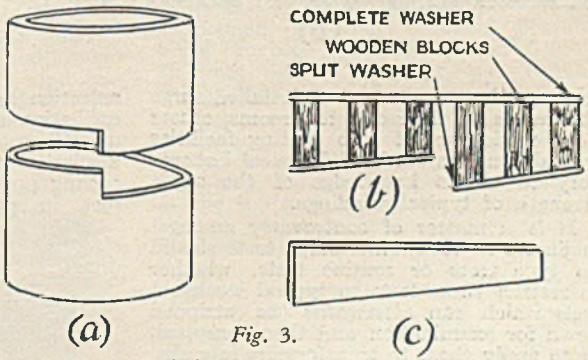


Fig. 3.

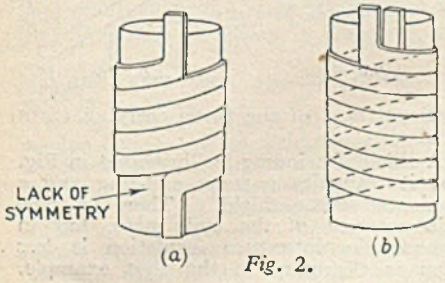


Fig. 2.

end turns or tapping turns; this permits the designer to meet the prescribed test in any way that research and experience have shown to be successful. Many manufacturers have built or had installed surge generators for their own test rooms, others have made use of the testing facilities available at the National Physical Laboratory to obtain knowledge of the surge strength of typical windings.

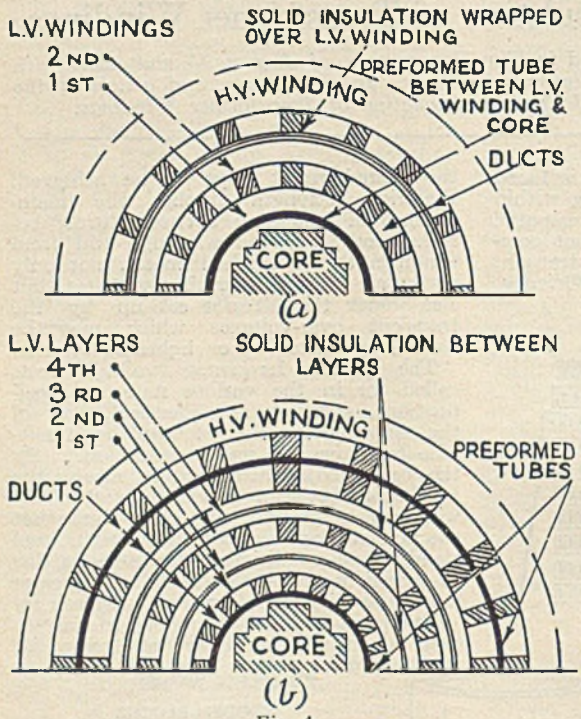


Fig. 4.

It is a matter of controversy amongst engineers as to whether surge tests should be type tests or routine tests, whether to restrict these tests to typical stacks of coils which can afterwards be stripped down for examination and then scrapped, or to apply them to transformers intended for service. Protagonists of the former course maintain that it is impossible to be absolutely certain whether a winding has sustained damage; others maintain that properly taken oscillograms will reveal any breakdown of insulation and many transformers have, of recent years, been put into service after undergoing surge tests.

Methods of disposing the insulation in a high voltage coil stack vary between designs, but the first essential must always remain the same; to know the maximum voltage stress which can occur at any point and then introduce adequate insulation without by so doing, shifting the stress to another and less well-protected part of the winding.

When calculating these maximum voltages the values obtained are expressed as a proportion of the peak value of any applied surge; in practice this value is controlled by the flash-over value of the transformer bushings or by the limiting spark gaps if such are fitted. It is usual for the line insulators to have a slightly lower flash-over value than the bushings of the associated transformers, but this added margin of safety is always ignored by the designer.

Two arrangements will be described herewith; there are others, some varying in fundamental principle, some only in detail. The first illustrated in Fig. 1a, has a static end-ring and co-ordinated insulation; the end turns have heavily reinforced insulation and this reinforcement is graded into the body of the winding; at the same time, by changing the number of turns per coil and the shape of the conductor, the surge impedance is maintained as nearly as possible constant throughout the winding. Any point at which an abrupt change of surge impedance occurs is the source of voltage reflection under transient conditions, and oscillation accompanied by voltage build-up will result, The increased thickness of insulation on the end turns introduces some cooling problems, and these are generally met in part by increasing the cross-sectional area of the turns carrying extra insulation.

Fig. 5.

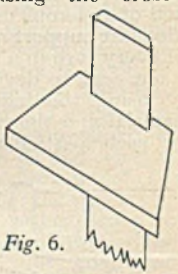


Fig. 6.

A shielded winding is illustrated in Fig. 1b; it embodies a static end-ring and a graduated static shield. There is some reinforcement of the end turns, but in general the inter-turn insulation is less than is necessary in the first example.

This makes cooling easier and the coil stack is stronger mechanically, but the shields themselves introduce cooling and insulating problems.

For high voltage windings, the interturn insulation is invariably good quality paper, applied in many laps each of only 2 or 3 mils in thickness; for medium voltages paper is also often used, but in this case it will probably consist of two or three laps, each of 5 mils thick. Some manufacturers favour a single covering of cotton over the paper and particularly if varnish impregnation is used, it makes a coil cleaner and stronger to handle in the erection stage. The turns of low voltage windings are usually insulated with cotton applied either in the form of woven tape or filaments; if the winding consists of many separate conductors wound in parallel, as would be required for a heavy current, the individual strips may be of bare copper and the complete bunch hand-taped as it is wound. Small round wires are often enamelled, with a covering of cotton or silk added if they are required for high voltage windings; in the past, enamels have been somewhat unreliable, but the modern synthetic covering of the polyvinyl acetal or the nylon type provides a very high grade insulation within a small compass, mechanically robust and able to withstand any impregnation. When these materials become more generally available they will undoubtedly influence transformer design, particularly for small high voltage work.

There are three types of coils in common use for power transformers, spiral, round wire section or cross-over coils, and sectional disc coils. There are a few types less often used and then generally for special purposes; these will be described,

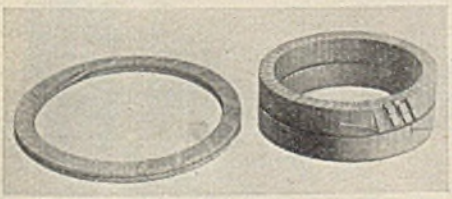


Fig. 7.—Pair of structural disc coils and a pair of round wire section, or cross-over, coils

together with their special applications, later in the series.

Spiral coils are those in which each layer occupies the complete winding length, they are generally wound upon a foundation consisting of a rigid preformed barrel such as Bakelite. In the smallest sizes they may consist of one layer only, but in the larger range, two or four layers are used. The use of an even number of layers has several advantages, if Fig. 2a is examined, it will be seen that due to its helical form the single layer coil is not symmetrical about its vertical axis, and this causes a distortion of the magnetic field with an increase in stray losses and some loss of control over reactance. Fig. 2b shows how an even

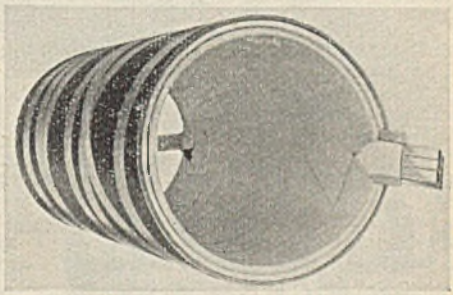


Fig. 8.—Two-layer spiral coil with barrel of flexible insulating material, wound direc tover outer layer

number of layers makes the coil symmetrical and also allows the start and finish to come out naturally close together; by this means the magnetic field due to the leads is greatly reduced, stray losses in the clamping structures are avoided and, as spiral windings often carry heavy currents, this can be an important consideration.

Spiral coils are naturally strong and self-supporting, the only problem presented being provision for adequate end-packing; the best method is to fit solid Bakelite collars to the ends of each layer.

Since the helices top and bottom are complementary, a Bakelite tube of suitable dimensions can be cut, as in Fig. 3a, on a band saw and the two pieces will fit, one at the top and one at the bottom of the layer. Another form of end-packing is illustrated in Fig. 3b; this consists of a " cage " with wooden or Bakelite blocks between two pressboard washers, held in place by an adhesive, dowel pins, or by taping. For small coils a piece of flexible insulating board can be cut as in Fig. 3c, taped to the conductor and wound on with the end turn.

The cooling of spiral coils is obtained by vertical ducts, maintained by introducing rectangular strips of wood, Bakelite or pressboard of appropriate thickness and extending the full length of the winding and the end packing. Wherever a duct is required, it is good practice to make these strips support about thirty per cent. of the winding perimeter. Thus, a two-layer coil might be wound direct on to a Bakelite cylinder and a duct introduced between the layers, while a four-layer coil might have

a duct between the tube and the first layer, and between layers two and three. Solid insulation consisting of pressboard sheets would be inserted between the first and second and between the third and fourth layers, as shown in Fig. 4, from which it will be noticed that every conductor is in direct contact with the oil.

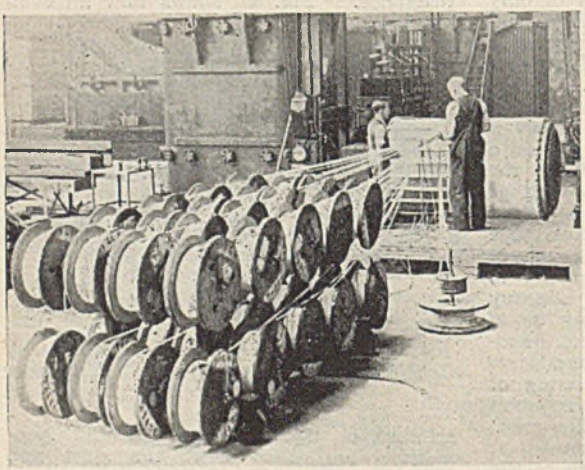


Fig. 9.—Heavy current spiral coil in course of winding

When two or more conductors are wound in parallel, it is necessary to take precautions, if each is to carry its correct proportion of the current, to ensure that the resistance and reactance of all are approximately equal. When only two conductors, arranged radially, are used, a simple half twist at the middle of the coil is sufficient, but a heavy current winding utilising up to thirty-six conductors requires a very complicated and well-designed series of transpositions.

Round wire section coils are suitable for windings carrying currents up to about 20 A, and are generally used for the high voltage windings of small transformers. They are wound on wooden formers between adjustable cheeks and consist of a number of layers, each of a number of turns. The insulation between layers consists of two thicknesses of paper or varnished linen, arranged to embrace the end turn of the layer as shown in Fig. 5; this method, together with a number of tape-ties included during the winding, ensures that the coil is self-supporting and can be removed from the former and freely handled during further processes.

A complete winding consists of a number of round wire sections, eight or more, arranged in a stack with insulating spacers between coils. The coils are usually connected in pairs with one coil inverted; this brings the starts of the two coils, which are, of course, on the inside diameter, adjacent to one another, and enables a small joint to be made without the necessity of a long connection from the back to the front of the coil. The heat generated by the ohmic losses in the turns at the centre of the coil has to pass through many thicknesses of insulation before it finds its way into the cooling oil, and, consequently, unless care is taken in the design stage, hot spots are liable to develop.

Sectional disc coils consist of flat circular sections containing a number of turns, wound one on top of the other radially. The conductor used is generally one, sometimes two, rectangular strips wound on the larger dimension; disc coils are liable to collapse during handling unless the conductors used are suitably dimensioned; they are, however, very strong when built into stacks and properly clamped. To avoid joints on the inside diameter of the coils, they are usually wound in double sections by the following method: first a length of conductor sufficient to wind one section, is wound loosely at one end of the former, following

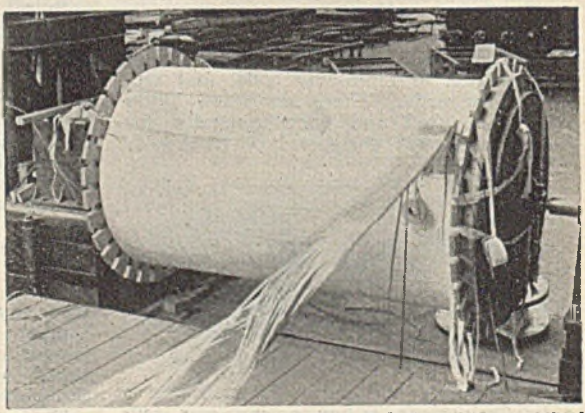


Fig. 10.—Transposition conductors in heavy-current spiral winding. It will be appreciated that every wire drum seen on the rack in Fig. 9 has to be changed in position when making each transposition

which one section is wound normally; the loose conductor is then wound back and used to wind the second section of the pair in the reverse directions. Disc sections are assembled in stacks with insulating spacers between each section and thus, as in spiral coils, every conductor is in contact with the oil and the cooling obtained is excellent. Sometimes, in the smaller sizes, pressboard washers are inserted between sections forming a pair and spacers between pairs only, and this saves a little on the leg length; the washer has to be placed in position during the winding of the coil.

There is also a technique for avoiding outside joints, and the result is termed a continuous disc winding; first, a section is wound normally, then the conductor is taken back to the former and a second section is wound outwards; this second section is then collapsed without breaking the conductor and wound from the outside inwards towards the former by slipping the spiral of turns one within the other by hand, and working them as tight as possible. Thus, the stack consists of normal sections and sections which have been collapsed and rewound, situated alternately. Special hand tools have been devised for the purpose, and considerable practice and skill are required of the operative, but even with the best the section which has been collapsed is never quite as sound mechanically as the next not so treated. It is debatable whether the continuous disc winding justifies itself, particularly as trouble at the joints of a normal disc winding is practically unknown.

When wound, the coils undergo a drying and a vacuum impregnating treatment such as was described in the series dealing with " The Inside of Electrical Machines " in this journal. Until recent years, a copal and linseed oil-based varnish has been used almost exclusively as the impregnant, but latterly synthetic resins have been produced for the purpose, and the latest development is a synthetic resin which requires no solvent.

The solvent, a white spirit, which has been used in conjunction with the older type of varnish, has been something of a nuisance. It is added only to reduce the viscosity of the varnish to a degree suitable to the process used, and then in order to avoid trouble the greatest care has to be taken to remove every trace of it during the stoving. The volatilised solvent has either to be exhausted away to waste to the probable annoyance of the local public, or else recovered by expensive plant; the only thing that can be said for it is that it is necessary. In these circumstances, the solventless varnish must be regarded as a natural development; many manufacturers are investigating its possibilities.

Some manufacturers, instead of using varnish, impregnate in transformer oil after thoroughly drying the coils. This method has much to commend it, since insulating materials soaked in oil show a smaller difference in specific inductive capacity to the body of the oil itself, than the same materials impregnated with varnish. However, the protection and cleanliness which varnish affords during the erection stage is lost, and if the transformer has to be lifted in service for adjustment or repair, the coils are not only " softer " to handle, but show a greater tendency to pick up moisture.

Mention has been made of axial spacers between section coils or disc coils; these take various forms of which a typical example is illustrated in Fig. 6; the spacer is usually about 6 mm. thick and the number to the circle is adjusted so that between thirty and forty per cent. of the coil perimeter is supported. The spacers maintain radial oil ducts which provide both cooling and insulation, and the dovetailed strips by which the spacers are keyed into position, form radial spacers by which the coils are located and axial ducts maintained.

The major insulation between windings takes the form of a solid barrier, either a Bakelite or similarly preformed tube, spaced from the windings and located by vertical insulating strips, or in the smaller sizes and if cooling arrangements will permit, several thicknesses of a flexible insulating sheet wound directly over a spiral coil; see Fig. 4.

(To be continued.)

The official opening of the new sports ground provided by the Electrical Apparatus Co., Ltd., St. Albans, for its employees, took place on Saturday, August 9, when the first sports meeting since 1938 was staged. The ground has an area of 11 acres with two hard tennis courts and provision for grass courts which are contemplated. It was a " red letter " day in the history of the company for occasion was taken to present long service recognitions to 38 employees, who had been with the firm for periods ranging from 25-37 years, and it also marked the end of a nine weeks' production drive. The long service recognitions, together with production and sports prizes were presented by Mr. R. H. Barbour, chairman of the company. Teas and refreshments were served, and an attractive programme of amusements was arranged for the children. The day's events closed with dancing.

Electrical Personalities

We are always glad to receive from readers news of their social and business activities for publication in this page. Paragraphs should be as brief as possible.

MR. FELIX A. ROGERS announces that, due to increasing pressure of his many duties connected with the apparatus division of the B.E.A.M.A., he has found it necessary to delegate his office as secretary to the Electrical Fair Trading Council to Mr. Arthur S. Lowe, who, on and from October 1, will devote his full time to the work of the Council and its committees. Mr. Lowe is 43 years of age, and for the last 27 years has been with W. T. Henleys Telegraph Works Co., Ltd., acting in a technical and commercial capacity, mainly on the sales side, and latterly as deputy to the London manager.

MR. A. S. LOWE

MR. H. VICTOR CROSSE, lately with Verity's, Ltd., became southern area manager for Ekco-Ensign Electric, Ltd., from August 1. He is now at the London Office, 5, Vigo Street, W.C.1.

MR. D. MAXWELL BUIST, export director of the British Electrical and Allied Manufacturers' Association, is at present on a short visit to Austria, on behalf of the Board of Trade and British electrical manufacturers, to investigate future electrical developments in that country.

DAME CAROLINE HASLETT, director of the E.A.W., is leaving for Germany early next week, at the request of the Foreign Office, on a lecture tour. Her audiences will be mainly industrial workers and her subjects will cover the whole field of industrial and domestic economy, including house-planning and, no doubt, electrical labour-saving equipment and devices. From Germany, Dame Caroline will go to Holland to attend the World Power Conference.

MR. F. J. WILKINS, previously an assistant control engineer with the Coventry Corporation, who has been appointed a junior assistant engineer in the Sheffield electricity department, points out that in the announcement of the appointment which appeared in our issue of August 1, his name was incorrectly given as "F. J. Williams."

MR. G. J. MOODY has been appointed by Enfield Cables, Ltd., as area manager for Scotland and Northern Ireland and will operate from the company's branch office at 81, Mitchell Street, Glasgow, C.1; Mr. G. Jessop has been made area manager for Northern England with headquarters at the office branch, 28, York Place, Leeds, 1; Mr. A. J. Betts has become area manager for the Midlands and South Western areas with offices at 1, Broad Street Chambers, Birmingham, 1; and Mr. J. C. Colebrooke has been appointed area manager for London and Southern areas, operating from Victoria House, Southampton Row, London, W.C.1.

MR. L. G. ASTON, electrical engineer and manager of the Brierfield electricity department, who, as announced in our last issue, is taking up the appointment of electrical engineer at Dorchester, on September 1, was born at Willesden, where he served as a pupil of a former borough electrical engineer, Mr. A. W. Blake, and became mains assistant, and assistant mains engineer. In 1941 he joined the staff of the Director of Electrical Engineering, Admiralty, at Bath, where his duties were mainly concerned with electricity supplies and equipment for Fleet shore establishments. He went to Brierfield in his present position in July, 1946.

MR. L. G. ASTON

Under ideal conditions, a sports meeting and gala was held by Philips (Blackburn) Works, Ltd., in Witton Park, Blackburn, on August 16. There was an attendance of about 10 000 people. Mr. E. Marsden (welfare officer) introduced Mr. C. de Wit (managing director) who extended a cordial welcome to the townspeople. Two bands and a concert party were engaged and other features of the programme were the children's fancy dress parade, a baby

show and the election of the "Radio Queen." The three judges—Delya, the well-known stage and radio artiste, Ald. D. B. Worden and Mr. Dominic Roche, a principal of the Red Rose Players Repertory Co.—selected, from among 25 entrants, Miss Audrey Coop to hold the title of "Radio Queen."

Left to right: DELYA (*stage and radio artiste*) MR. C. DE WIT (*managing director*), MISS AUDREY COOP ("*Radio Queen*"), ALD. D. B. WORDEN *and* MR. D. ROCHE, *at the sports and gala of Philips (Blackburn) Works, Ltd.*

MR. GARDINER, of Crompton Parkinson, Ltd., at the conclusion of the Essex Inter-firms Athletics Competition on the Crompton Parkinson ground, on August 11, handed the cup to Mr. D. Willman, chairman of the Ekco Social and Sports Club. The Ekco club won the trophy comfortably with a total of 569½ points after four matches in this year's series of athletic contests against Marconi (529 points), Hoffman (410 points), Crompton Parkinson (283½ points). A meeting was held on each company's ground.

Members of the Sports and Social Club of the Blackburn electricity undertaking had a motor trip to the Lake District, on Sunday, August 17, a party of 84 men and women being accommodated in three coaches. The weather was ideal and Mr. Pemberton, who had made arrangements for the event, was heartily thanked for his assistance.

MR. F. H. WEBB, manager of the Newcastle branch of Siemens Electric Lamps and Supplies, Ltd., died on August 12, aged 52 years. He joined the company in London on November 1, 1908, and in March, 1936, was appointed branch manager at Newcastle.

Swann Diplomas

THE second examination under the Swann Diploma Scheme was held on May 28 and 29, at Derby, Edinburgh, Manchester, and London, and the examiners' report indicates the value of, and the need for, such a scheme.

The following candidates were awarded the Swann Diploma for electrical installation and maintenance work: William Brooks, Bolton, Lancashire; Thomas E. Christian, East Dulwich, London; William J. Gardner, Southall, Middlesex (with credits in administration and organisation of work); Edward J. Moore, Sidcup, Kent (with credits in administration and planning of installations); Allan Spencer, Blackburn, Lancashire; Walter G. Street, Falkirk, Stirlingshire (with credit in organisation of work); James R. C. Waterston, Blackhall, Edinburgh (with credits in technical ability and organisation of work).

The following passed in Part I of the examination and may enter again for Part 2 within two years: Sidney P. Bausmann, Standford-le-Hope, Essex; Henry J. Doughty, Stafford; William J. Phillips, Gravesend, Kent.

Members of the Blackburn Electricity Undertaking Sports and Social Club, about to leave for a trip to the Lake District

Electrical Developments in India

From Our Own Correspondent

THE report of the Electricity Department of the Government of Madras for 1945-46 shows that the progress of the department during the year was, on the whole, satisfactory, notwithstanding the restrictions and controls which continued throughout the period.

In view of the Dominion status of India and Pakistan, the following notes relative to electrical developments now taking place are of interest. Our correspondent draws special attention to the projected hydro-electric schemes, and to the large-scale developments already operating.

The aggregate demand upon the Government systems during the year was 60 870 kW, as against 59 125 kW in 1944-45. The total number of units generated was 327.35 millions, as against 301.14 in 1944-45, and the gross revenue from the departmental undertakings was Rs. 11 644 000, as against Rs. 10 294 000 in 1944-45; an increase of 13 per cent.

The total number of consumers served, including the Government, was 134 125, as on March 31, 1946, of whom 100 634 were in the area covered by the Government undertakings, 20 905 were served directly by the electricity department, and 79 729 licencees distributed Government power. The remaining 33 491 consumers were served by sub-generating licencees; one noteworthy feature was that there was an increased demand and consumption of electricity for agricultural purposes.

During the period under review the water level at Mettur was unsatisfactory and the station had to be closed down from January 16 to 30, 1946, the lake level having gone below the limits of power generation. Supply over the whole system was, however, continued without inconvenience by using the relief available from Pykara and by enforcing restrictive measures.

Several major electrical schemes were sanctioned during the year. These included the Moyar hydro-electric scheme estimated to cost Rs. 19 310 000, rising to Rs. 26 800 000 in five years; an extension to the power station at Basin Bridge, Madras, estimated to cost Rs. 11 025 000, rising to Rs. 24 417 000 in 10 years; and extensions to the Vizagapatam station, estimated to cost Rs. 2 291 000, rising to Rs. 2 700 000 in five years. An agreement was reached with the Orissa Government on the Machkund hydro-electric scheme, which is capable of an ultimate development of 100 000 kW; the Madras Government's share is estimated to cost Rs. 42 011 000, rising to Rs. 58 760 000 in 10 years.

The Madura thermal station scheme was sanctioned in April, 1946, at an estimated cost of Rs. 8 800 000. Proposals for the purchase of power from the Jog Falls Scheme of the Mysore Government for distribution in the Ceded Districts were sanctioned by the Government in August, 1946.

There was little progress or development in licensed electric supply undertakings; the number under the Indian Electricity Act continued to be 81 and no applications for new licences under the Act were received. The restrictions imposed in the previous years on the working hours of oil engine generating stations continued, but the feasibility of partially relaxing such restrictions was under study at the close of the year.

The first completed generating plant of 12 MW capacity, the Jog Hydro-Electric Works—the largest single hydro-electric station in India—has now been tried out.

By the end of the year four generators will be in use and the first stage of the scheme will be complete. When this is achieved, a further 48 000 kW will be available for distribution in Mysore State. Further stages in the scheme are on hand and will be completed by 1950, when the Jog scheme will generate 120 000 kW.

Mr. Hayath said that it is the intention of the Mysore Government to encourage the use of electricity for irrigation, as well as industrial domestic purposes. The per capita consumption of electricity in Mysore is already the highest in India and this will increase considerably with the completion of the Jog scheme. There are a large number of distribution lines covering a greater part of Mysore State, so that current has now reached even some of the smallest villages in the State. Mr. Hayath added that the Jog works will supply sufficient power for working the furnaces in the Bhadravati Iron Works.

THREE-PHASE INDUCTION MOTORS

VIEWS ON STARTING, REVERSAL AND ELECTRICAL BRAKING

by S. A. VINCZE, Dipl. Ing., A.M.I.E.E.

The following pages deal with the mechanical, electrical and thermal phenomena which arise during the starting, reversing and electrical braking of three-phase induction motors, especially with the direct-across-line starting, the star-delta starting, starting with stator starter, starting with auto-transformer-starter, the Kusa starting, and the starting with rotor starter. Different braking methods, e.g. the braking by direct current, braking at super- and sub-synchronous speed, the counter current braking, and braking methods by changing the number of poles are discussed, without any claim being made to have covered the whole subject. An experimental-graphical method for the determination of torque-speed curves of motors is given.

ELECTROMOTORS connected to a system of constant pressure do not attain their speed suddenly. The acceleration requires a time of finite duration and the final speed will be reached gradually. Two phenomena covering each other, electrical and mechanical appear during the period of starting. The switching on, of the motor causes an electrical equalising phenomenon. This substantially consists in a dying away d.c. component superimposed upon the starting current. This equalising current causes the rise of the exciting and armature currents of d.c. motors and superimposes a dying away d.c. field upon the a.c. field of single- and poly-phase a.c. motors.

Simultaneously with the electrical switching on phenomenon, the mechanical starting phenomenon of much longer duration takes place. The motor and the masses connected with it, accelerate under the effect of the free starting torque. The time lapse of the electrical switching on phenomenon depends upon the electromagnetic time constant of the motor, viz. upon the self induction and resistance of the circuit, whereas the duration of the mechanical starting phenomenon depends upon the starting torque of the motor, upon the torque of the load, and upon the momentum of inertia of the driven system. It is assumed in the following that the duration of the electrical equalising phenomena is very short in comparison with the mechanical starting phenomenon. Hence the equalising currents cease during the standstill of the motor, and the mechanical starting process takes place under stable electrical conditions. This assumption practically complies with three-phase induction motors.

1. *General Considerations.*—The fundamental equation of dynamics

$$P = P_M - W = m\frac{dv}{dt} \quad \text{.....(1)}$$

suggests the following :

The free force = mass × acceleration.

Similarly — in the case of revolving motion—the more convenient equation

$$M = M_M - M_L = 0\frac{d\omega}{dt} \quad \text{.....(1A)}$$

states that :

The free torque = momentum of inertia × angular velocity.

In the above equations and in the following

P = The free force [kg].
P_M = The driving (motor) force [kg].
W = The mechanical resistance [kg].
$m = \frac{G}{g}$ = The mass of the driven system [kgs^{2}m^{-1}].
G = The weight of the driven system [kg].
g = 9.81 [m/s/s].
v = The velocity of the driven system [m/s].
t = The time of acceleration, sec.
M = The free torque [kg m].
M_M = The driving (motor) torque [kg m].
M_L = The load torque (the torque of resistance) [kg m].
$0 = \frac{GD^2}{4g}$ = The momentum of inertia of the driven system [kg ms^2].
D = The diameter of gyration [m].
GD^2 = The flywheel-effect of the revolving system [kg m^2].
$\omega = \frac{n\pi}{30}$ = The angular velocity of the revolving system [s^{-1}].
n = The speed of the revolving system, r.p.m.
π = 3.1415...

It is convenient to reduce linearly moving masses into revolving ones by equation (2). The kinetic energy A of masses having a linear revolving motion is

$$A = \frac{mv^2}{2} = \frac{0\omega^2}{2}[\text{kg m}] \quad \text{.....(2)}$$

If several revolving masses are present it is advisable to reduce by equation (3)[1]

[1] A complete bibliography will be given at the end of the article, which because of its length will be carried over four issues.

the momentum of inertia of all driven masses into one single momentum of inertia 0, having an angular velocity ω_A.

$$\frac{0\omega^2_A}{2} = \frac{0_A\omega^2_A}{2} + \frac{0_B\omega^2_B}{2} + \frac{0_C\omega^2_C}{2} + \ldots + \frac{0_N\omega^2_N}{2} \quad \ldots\ldots(3)$$

0_A to 0_N = Momentum of inertia of the individual masses.

ω_A to ω_N = The angular velocities of the individual masses.

0 = The common momentum of inertia of all individual masses reduced to the angular velocity ω_A.

The free force is exclusively responsible for the acceleration. It is the difference

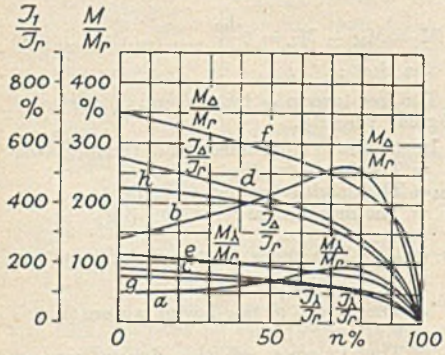


Fig. 1.—(a) The torque of a 22 kW 1 500 r.p.m. eddy current type three-phase squirrel cage motor when connected in star and, (b) when the motor is connected in delta. (c) The stator current when the motor is connected in star and, (d) when the motor is connected in delta. (e) The torque of a 30 kW, 1 500 r.p.m. double squirrel cage type motor when connected in star and, (f) when connected in delta. (g) The stator current when the motor is connected in star and, (h) when the motor is connected in delta. Both torque and current are represented as a ratio of their rated values and as a function of the speed

of the motor force P_M and of the mechanical resistance W. Similarly the free torque M is the difference of the motor torque M_M and of the load torque M_L. Whether the motor and the system coupled with it, will accelerate or not, depends solely upon the magnitude of the free force, with respect to the magnitude of the free torque.

The system being either in rest or in motion, will remain in rest or move with constant speed as long as $M_M = M_L$. In that case

$\frac{d\omega}{dt} = 0$, and ω = constant.

If $M_M > M_L$ then the system will accelerate, if $M_M < M_L$ then M and with it $\frac{d\omega}{dt}$, becomes negative and the system will slow down. Generally as well, P_M, W, m, t, as M_M, M_L, 0, and t, are variable. The torque of the motor (see Fig. 1)[2, 6] is usually a function of the speed. The load-torque is in some

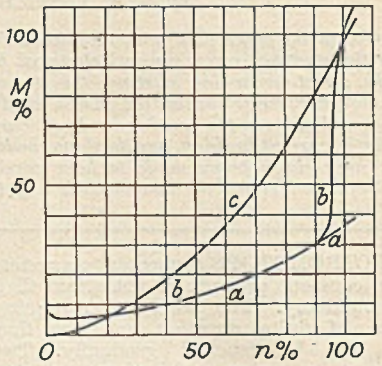


Fig. 2.—The torque of a centrifugal pump as a function of the speed. (a) With the sluice gate closed. (b) With the sluice gate open. (c) The torque of a centrifugal fan as a function of the speed.

cases approximately constant; e.g. with cranes, lifts, lathes, etc.; in other cases a function of the speed, e.g. with centrifugal pumps and fans (see Fig. 2), ship's propellers, etc., whereas in other cases it may be a function of the distance, e.g. with reciprocating compressors, excenterpresses, shears, etc. The mass, in relation to the momentum of inertia of the driven system is, in general, constant, but in certain cases it may be variable, e.g. with centrifugals.

The integration of the differential equations (1) and (1A) is possible with simple means, only in the case of a simple relationship between the functions P, W, M, and 0, or if their magnitudes happen to be constant. Assuming the latter case, the generally

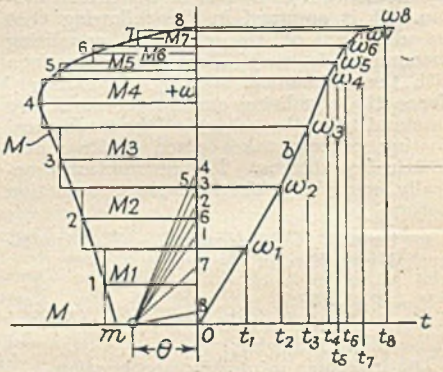


Fig. 3.—Graphical integration of equation (6)

known equations (5) and (5A) can be derived from (1) and (1A) :

$$t = \frac{m}{P}\int_{v_0}^{v} dv = \frac{m}{P}(v - v_0) \quad \ldots\ldots\ldots\ldots\ldots(5)$$

$$t = \frac{\theta}{M}\int_{\omega_0}^{\omega} d\omega = \frac{\theta}{M}(\omega - \omega_0) \quad \ldots\ldots\ldots\ldots\ldots(5A)$$

v_0 and ω_0 being respectively the initial speeds before, and v and ω resp. the final speeds after, acceleration, attained during the time t. However, the graphical method of integration of equations (1) and (1A) is always applicable. It will be simple if M_M and M_L are given graphically, e.g. as a function of the speed.

2. *The graphical integration of the fundamental equations of dynamics.*—We transform equation (1A) into a form given by (6)

$$\frac{d\omega}{dt} = \frac{M_M - M_L}{\theta} = \frac{M}{\theta} \quad \ldots\ldots\ldots\ldots\ldots(6)$$

We draw the M curve into the upper left hand side field of a rectangular coordinate system (see Fig. 3) showing on the positive axis of ordinates, the angular velocity, ω on the negative axis of abscissas, the torque M. Subtracting the load torque curve, point for point, from the motor torque curve, we obtain the free torque curve. Fig. 3 shows already the free torque M only. The method is applicable to equation (1) also, substituting in (6) P for M, v for ω and m for θ respectively. We set the distance $\overline{0m} = \theta$, and substitute a stepped curve for the continuous curve M. The torque is approx. constant between two limits of the step. The smaller the steps, the better the approximation. We apply the differential equation to each step. Transferring the distances M_1, M_2, M_3, etc. respective to $\overline{01}$, $\overline{02}$, $\overline{03}$, etc., on the ω axis, and drawing parallel lines to $\overline{m1}$, $\overline{m2}$, $\overline{m3}$, etc., from 0 to ω_1, from ω_1 to ω_2, from ω_2 to ω_3 resp. and so on, in the right hand side field of the coordinate system, parts $\overline{0\omega_1}$, $\overline{\omega_1\omega_2}$, $\overline{\omega_2\omega_3}$, etc., of the angular velocity curve are obtained. It is easily understood that the construction depends upon the following proportion :

$$\frac{\overline{t_1\omega_1}}{\overline{0t_1}} = \frac{\overline{01}}{\overline{0m}} = \frac{d\omega_1}{dt_1} = \frac{M_1}{\theta}$$

triangle 01m being similar to triangle $0t_1\omega_1$.

Completing the construction we find the curve of the angular velocity ω. The steepness $\lambda = \frac{d\omega}{dt}$ of the curve is a measure of the angular acceleration and simultaneously of the smoothness of starting. The attainable top speed, no doubt, will be reached at a point where $M = 0$. Should at any point of the M curve the free torque become negative, then we transfer the torque in negative direction (downward the ordinate axis) and proceed thus with the construction. It will be seen that in this case the angular velocity decreases and deceleration is obtained. (In Fig. 3 there are positive torques only.) The introduction of correct scales μ renders the construction correct as to quantity also. Choosing as time scale μt [mm] = 1 [sec] as torque scale μ_M [mm] = [1 kg m], as scale for the angular velocity $\mu\omega$ [mm] = 1 [sec^{-1}], the scale for the momentum of inertia is given by the equation

$$\mu_\theta = \frac{\mu_t \mu_M}{\mu_\omega} = 1[\text{kg m s}^2] \qquad \mu_\theta \text{ in [mm]}$$

3. *Experimental graphical determination of the torque-speed curve of motors.*—The above construction yields a handy method for the determination of the torque speed curve.[11] We secure a flywheel, e.g. a larger belt pulley to the shaft of the motor and determine the combined momentum of inertia of the rotor plus flywheel.[3] In order to lengthen the starting time and simultaneously to minimise the heating, it is appropriate to feed the motor with a reduced pressure during the test. We start the motor and record the speeds attained during acceleration as a function of the time. We compute the respective angular velocities from the recorded speeds and plot them as a function of the time in the upper right hand field of a rectangular co-ordinate system. Carrying out in inverted succession the construction given under (2), we find the free torque curve of the motor at reduced pressure, and reckon it over for the rated pressure.

(To be continued)

Correspondence

The Editor welcomes the free expression in these columns of genuine opinions on matters of public interest, although the disclaims responsibility alike for the opinions themselves and the manner of their expression

13A Fused Plug Socket

[To the Editor]

Sir,—Owing to the holidays I have only just seen the article by " Supervisor " in The Electrician of July 18, the implication of which seems to be that a 13A fuse affords as good protection as one of 3A.

Whilst it is agreed that a 13A fuse should be adequate to protect a 13A circuit, it would be unfortunate if the impression got abroad that a large fuse will afford better protection than a small one. Even if one considers only the case of a short circuit, a 5A flexible would be better protected by a fuse of 5A rating than it would be by a 13A fuse.—Yours faithfully,

H. W. Baxter.

ELECTRICAL INDUSTRY IN POLAND

In view of the efforts expected of the British electrical industry to expand exports, the following brief review of conditions in Poland will be of interest. Reconstruction and repair of damage in war devastated areas are being carried out for the most part with machinery obtained from Sweden, Czechoslovakia, Italy and the United States. Commercial talks are proceeding with the electrical industry of France for the supply of 50 MW turbo-alternators, but, though it is known by our correspondent that purchases from the British electrical industry are extensive, details of them have not yet been made public.

IN Poland to-day there are eighteen electrical engineering works, of which five are in the western territories, and reports concerning them indicate that substantial expansion plans are being carried out both in the central and western parts of the country.

According to official statistics the total output of goods in these areas in the first quarter of this year amounted to 6 372 metric tons, of which cables accounted for 4 172 tons. Other manufactured goods included low and high tension distribution equipment, lighting fittings and lamps, thermo-electrical equipment, electro-medical plant, meters, etc. Preliminary returns for the second quarter of 1947 indicate a 20 per cent. increase in production over the preceding three-month period.

A typical electrical engineering concern is the M.2 (formerly Rohn-Zielinski) works at Cieszyn, turning out fractional and medium horse-power motors. The works were founded in 1920, and by 1926 were producing motor starters and motors of capacities up to 25 H.P. In 1926 the concern was taken over by the Polish Brown-Boveri interests and began production of motors under a Swiss Brown-Boveri licence. A period of further development followed, until the war interrupted output and the buildings sustained substantial damage. Post-war production includes fractional and other motors up to 125 H.P. and the manufacture of motors for coal cutting machinery, a high priority job in the present stage of the country's economic development. The initial batch of motors for this type of plant was delivered only last January, and it is reported that the cutting of up to 60 000 sq. yards of coal seam has been accomplished without overhaul. The design of three types of motor by the same works for use in blast furnaces is receiving close Government attention.

Compared with pre-war, the number employed in the works remains unchanged at just over 500, despite the fact that the output has increased by 30 per cent. compared with the 1939 level.

In the western territories acquired by Poland after the war, notably in the Lower Silesian area, there are a number of electrical machinery works as well as those concerned with tele-communication and radio equipment. Although the value of their output does not exceed 5 per cent. of the country's total, plans have been drawn up whereby it is hoped by 1949 to increase the output by about 25 per cent. The most important concerns in this area are the Electric Meters and Clock Works at Swidnica with an output of 300 single-phase meters a day; the production of three-phase meters will, it is expected, start before the end of the year. Another Swidnica concern specialises in the production of electrical equipment for motor vehicles as well as fractional motors for small tools.

The buildings of the former Wroclaw (Breslau) 'Famo' Locomotive Works have now been allocated to a concern proposing to start production of large motors for the mining, metallurgical and electric traction industries. The manufacture of alternators, a wholly new departure in Polish electrical engineering, will also be undertaken.

Electric lamp production is now reaching some 522 000 a month, and it is thought that by the autumn the country will be self-supporting in this respect. The country's requirements for insulating material are to a large extent met by the Gliwice (Gleiwitz) mica works.

Long-range planning reports to hand show that the development department of the Union of Poland's Electrical Engineering Industry is now designing a series of transformers ranging from 320 to 1 600 kVA. At first only the smaller transformers will be produced. The difficulties facing the industry are largely concerned with shortages of raw material and semi-manufactures; supplies of steel rod and sheet metal for transformers are particularly short.

Manufacturing difficulties and large-scale devastation of capital equipment during the war, will for a good number of years make Poland dependent on foreign supplies of heavy electrical plant such as boilers,

turbo-sets and transformers, and according to Press reports, imports from Czechoslovakia will include high-pressure boilers, turbo-generators, armatures and spare parts for turbines of Czech manufacture already in operation.

Swedish deliveries scheduled to be completed by the end of 1947 will include steam turbo-sets and boilers for power stations and industrial concerns. The overall capacity of imported Swedish generating plant is expected to reach 150 000 kW, while the total steam output of boilers is likely to be in the region of 250 ton/hr. Preliminary negotiations have also begun to ensure electrical equipment deliveries from 1950 onwards.

Commercial talks with the French electrical industry are now reported to be entering their final stage, and when complete will provide the country with several turbo-sets rated at about 50 000 kW. A similar pattern of orders has been placed with the Swiss electrical engineering industry, including turbo-sets, estimated to have a total capacity of 120 000 kW. It is expected that transformers and electrical equipment for high tension networks will be imported from Italy.

Deliveries from the British zone of occupation in Germany will eventually include missing parts for existing turbines, as well as new turbo-sets and electrical apparatus. Purchases of electrical equipment from the United States and Britain are known to be extensive, but details of these have not yet been made public.

During June the generated output amounted to 261 086 000 kWh, the heaviest demands being made by the Upper Silesian coal mining region. Other industrial areas, particularly Lower Silesia, Lodz and Cracow showed a considerable increase in consumption.

It is proposed to construct in Poland an electricity grid on the lines of that in this country, but the present economic state of the country is a delaying factor. It has, however, been decided to carry out the plan over a number of years, and work so far done includes the erection of a h.t. transmitting line linking the Lower Silesian provincial grid with Lodz, the textile manufacturing centre. It is practically certain that this 220 kV line will be put into service before the end of the year.

This year will also be marked by the servicing of the transmission line linking Warsaw with a group of hydro-electric stations at Roznow, in the Carpathian piedmont. The line was built during the occupation, but the approach of active hostilities put an end to usefulness. During the fighting all sub-stations were either destroyed or damaged and only a part of the looted equipment has so far been found and returned to the owners.

During 1947 six hundred villages will be included in a rural electrification scheme, about one-fifth of the cost of which is being borne by the State, the remainder being paid for by the communes themselves.

Two-Way Radio Facilities for Press

OUR contemporary, "The Newspaper World," points out that the beginning of a big step forward in Press communications in this country is foreshadowed by a decision of the G.P.O. to allocate seven frequencies for exclusive Press use for two-way radio communication.

The licence which the G.P.O. is prepared to grant newspapers relates to a fixed receiving and transmitting station at head office and to mobile units consisting of vehicles equipped with two-way radio communication and, when available, to a new type of "walkie-talkie" set which is being designed.

The allocation of these frequencies will not be confined to voice broadcasting but it will be possible to use them for portable photo-transmission apparatus.

The frequencies to be allocated are in the high frequency band or optical range and are expected to restrict direct communication to a distance of 15-20 miles. By means of relays, however, the distances covered are unlimited.

It is pointed out in "The Newspaper World" that although Post Office regulations do not permit direct connection between the receiver and the Post Office network it is understood that this can be overcome, and that there will be, in practice, no obstacle to speedy transmission of messages or pictures to a newspaper office, via the Post Office system.

Mobile two-way radio mounted in vehicles is likely to be used before the "walkie-talkie" sets, as new equipment of the latter type is being designed and has yet to be officially approved.

It is understood that the Post Office proposes giving newspapers applying for a licence, coverage for all the permitted frequencies and the same authority estimates that some 200 transmissions could be spread over the country without interference with each other.

Equipment and Appliances

New Immersion Heaters

A range of immersion heaters recently introduced by the Campbell Engineering Co., Ltd., of Sherman Works, Bromley, Kent, are known as "Pillar" heaters. Available in sizes from 250 W to 4 kW, they are of the flat-bladed type, with blades constructed of heavily tinned solid drawn copper. All models larger than 1 in. B.S.P. fixing thread are wired for rotary three-heat control switches. On standard models, the head is finished in cream stove-enamel, but a "de luxe" model is made in which the visible parts are chromium finished. The heaters are supplied for 200-220 and 220-240 V.

An example of the Pillar heater

Vibrationless Mountings

In those locations where it is necessary to mount lamps on heavily vibrating machinery, the number of bulb replacements can be appreciably reduced, it is claimed, by the use of the "Protectafil" spring suspension mountings made by J. E. Wildbore, of 26, Marlborough Street, Oldham. The mounting, which is made in sizes suitable for lamps between 100 and 1 500 W, is designed to be readily fitted to existing junction boxes, and the spring shock-absorber inside is placed so as to allow considerable swinging of a lamp pendant. A fitting is made, also, for mounting standard 80 W fluorescent tubes.

New Welding Electrodes

What is said to be the first all-British arc-welding electrode designed specifically for pressure vessel welding was recently introduced by Murex Welding Processes, Ltd., of Waltham Cross, under the name of the Type P.V. electrode. In addition to giving a high standard of radiographic cleanliness, the new electrode is said to provide weld deposits of excellent mechanical properties. Average results obtained on a number of all-weld specimens made with No. 6 gauge and $\frac{1}{4}$ in. diameter electrodes are given as: Yield point, 24.2 tons p.s.i.; ultimate stress, 29.9 tons p.s.i.; elongation on $1\frac{1}{2}$ in., 31.4 per cent.; reduction of area, 50.6 per cent. These all-weld specimens were machined out of "u" and "v" butt welds in $\frac{3}{4}$ in. boiler quality steel and tested after stress relieving at 600° C. Specimens from the same butt welds were subjected to Izod and bend tests, the results being equally satisfactory. The new electrode was designed for ease of running in the downhand position in deep-groove multi-run welds, and it is suitable for both d.c. and a.c., although d.c. is recommended for the best radiographic results. It is available in various gauges to suit all plate thicknesses. While primarily intended for pressure vessel welding, the electrode may be used advantageously, say the manufacturers, for work which is to be vitreous enamelled or for vacuum tight equipment.

New Magnet Material

To meet the need for a suitable magnet material which can be formed into any shape with the minimum, or if possible total elimination, of expensive machining operations, the Plessey Co., of Ilford, have introduced a material known as "Caslox." This is a pressed powder substance consisting of a mixture of iron cobalt oxides and a small quantity of plastic binder. The new material can be moulded and once the necessary tools are made, as with plastics or similar mouldings, magnets can be pressed out rapidly in any quantity. "Caslox," it is stated, is particularly suitable for use in small motors and generators, and the small magnet of a magnetic gramophone pick-up head, telephone and hearing-aid ear pieces are further examples of its uses. Its potential applications cover a wide field in the manufacture of radio, measuring instruments, electrical and similar equipment where short magnets of large area are required to work effectively in open magnetic circuits. The density is 3.2 grammes per c.c., it is a reasonably good insulator and has a specific resistance of 0.5 by 10^6 ohms per cm. cube. It has a very high coercive force and, therefore, the influence of disturbing magnetic fields is small.

Thistle Lamps for Scottish Exhibition

New thistle-shaped lamps have been placed on standards in Princes Street, Edinburgh, for the "Enterprise Scotland" Exhibition, which is to be opened on Monday. The lamps hang in pairs on either side of flower-baskets from thirty-six standards.

Electricity Supply

Leyton.—An agreement for bulk supply to the Corporation from the County of London E.S. Co., Ltd., has been approved by the Electricity Commissioners.

Hammersmith.—Authority has been given for the execution of works necessary to provide permanent electricity showrooms in six vacant shops in Nigel Playfair Avenue, at a cost of £8 050.

Croydon.—Croydon Electricity Committee have arranged for winter street lighting to remain the same as last year, which will result in a saving of 48 per cent. on pre-war consumption.

Lincoln.—Units sold during the year ending March 31 totalled 56 510 455, compared with 51 587 230 in 1946, an increase of 9.55 per cent. The total units purchased from the C.E.B. were 59 624 046 (54 032 198) and units generated for the C.E.B. by the undertaking amounted to 18 649 250 (13 113 020). The maximum demand on the generators during the year was 10 869 kW (10 710) and the maximum load on the undertaking 17 855 kW (15 498). There were, at the end of the financial year, 18 313 consumers, compared with 17 765, and the average price per unit sold was 1.008d. The total income from sale of current was £244 881 (£229 122) and total expenditure £215 434 (£190 024), giving a gross profit of £38 018 (£45 529). The net profit, after meeting all loan charges, was £8 037 (£7 348). Delay is reported in the work of extending the generating station, but it is expected that the first new machine will be commissioned during the autumn. A second machine and associated boilers will not be available before 1948.

Bolton.—The gross profit of the undertaking for the year's working was £2 497, compared with £74 603 in the previous year. Deducting debt charges, etc., of £31 951 (£55 270), a debit balance for the year of £29 454 remained, compared with a credit balance of £19 333 for 1945-46. No contribution was made this year to relief of local rates. With a balance in hand at the commencement of the financial year of £225 232 (£205 899) the undertaking has carried forward to 1948 £195 778. The total of units sold in 1946-47 was 152 444 569 (132 556 555) and 168 036 230 units were purchased from the C.E.B. The inclusive cost to the undertaking per unit sold was 1.036d., compared with .973d. and the average price obtained per unit was .98d., compared with 1.03d. A maximum demand of 56 450 kW (47 980) and a load factor of 33.98d. per cent. (35.30) were registered.

Accrington.—An application by the Corporation to the Electricity Commissioners for consent to erect a new generating station at Huncoat will be considered at an inquiry by the Commissioners on August 27. The estimated cost of the proposed station is over £5 000 000. The Central Board has already approved the scheme on the grounds of urgent need.

Liverpool.—In his annual statement, Mr. J. Eccles (city electrical engineer) reports an increase in units generated of 135 million kWh over the previous year, sales within the undertaking representing an increase of 83 million units. With 257 000 kW of plant installed at Clarence Dock and 66 000 kW at Lister Drive, the undertaking experienced a maximum load of 224 250 kW, compared with 201 150 kW in 1945-46, but the maximum load supplied from the two stations, at 301 570 kW, was 3 870 kW less than in the preceding year. Units sent out totalled 1 373 950 260, against 1 238 481 720, and the net export to the C.E.B. was 525 004 300 units, compared with 478 373 600 units. Within the undertaking, 733 585 533 (650 574 482) units were sold. The total income from the year's working was £3 626 507 (£3 177 276) and the total expenditure £3 409 407 (£3 097 958), leaving a surplus of £217 100, compared with £79 318. Of this, £100 000 (£50 000) was contributed to the general rate. The average price received per unit sold was 1.083d. (1.079d.), and the number of consumers rose by nearly 8 000 during the year to 199 412.

Sheffield.—Accounts for the year ended March 31, 1947, show that the capital expenditure of the undertaking is now £12 847 092, of which £567 591 was expended during the year, i.e., mains, services, sub-stations, £166 894; Neepsend power station, £278 943; and Blackburn Meadows, £121 754. Total revenue was £2 602 727, leaving a final deficiency of £173 737. The amount of debt outstanding is £5 372 742, or 41.82 per cent. of the total capital expenditure. The total plant installed and in commission during the year was 292 000 kW, but on March 26, 1947, the l.p. plant at Neepsend was taken out of commission, leaving the total plant capacity at March 31 at 267 000 kW. Installation of the No. 3 set of 50 000 kW and three 190 000 lb./hr. boilers at Neepsend was nearing comple-

tion and the main contracts for No. 4 set of 50 000 kW and three 190 000 lb./hr. boilers, also at Neepsend, were let and work is proceeding. Units generated for the year were 1 194 415 320, of which 198 267 480 were exported to the Central Board. The corresponding figures for the previous year were units generated, 1 077 833 920; units exported, 178 221 070. The m.d. on the generating stations during the year was 258 580 kW as compared with 233 610 kW for the previous year. No assisted wiring installations were connected during year. Of these installations 7 755 have been purchased by consumers and 47 627 have become the property of consumers by reason of having consumed 800 units. The number of such installations connected under the scheme is 59 695. Total units sold for all purposes amounted to 855 177 352 against 775 799 399, an increase of 10.23 per cent. The average price obtained per unit sold was .686d., compared with .660d. for the previous year. Total cost per unit sold was .744d. as against .719d. The number of consumers connected was 169 908, an increase of 3 094 or 1.85 per cent., and the total load connected for all purposes amounted to 730 238 kW, an increase during the year of 35 245 kW. It was anticipated that the tariff increases imposed in April, 1946, would have been sufficient to balance the revenue account. The winter weather, with the attendant fuel crisis, however, had a serious effect on the income of the undertaking, while costs generally increased more than was anticipated. The present financial year is the jubilee year of the undertaking, the date being January 1, 1948.

Erne Scheme.—While nothing definite has been said by either Government on the subject of joint action in working out the Erne hydro-electric scheme, there is a feeling that the passing of the Northern Ireland Powers Extension Act will help to bridge the gap which separates Eire from Northern Ireland. The new Act gives Northern Ireland, heretofore denied powers to deal with such matters, as electrical joint action with Eire, drainage, alterations of standard levels of Lough Erne and the River Erne, the variations of which cause a lot of damage in wet seasons, the generating of electricity, storage and distribution, and the ultimate rural electrification of all Ireland, which at the moment is impossible, or at least very difficult, because of the political border. The present spell of dry weather is giving the work at Ballyshannon and Belleek a much better chance of progress than when the river was in flood, as it was in the spring and early summer. Salmon and trout fishing, of which the Erne is a big producer, must, it is reported, suffer because of the hydro-electric scheme.

In Parliament

Some Electrical Replies Before the Recess

Generation Statistics.—In a written reply, the Minister of Fuel and Power said the source of power used for electricity generated in Great Britain during 1945 and 1946 was as follows:—

Electricity Generated.	1945 %	1946 %
(*a*) from steam plant fired by coal, coke or oil ...	96.68	96.99
(*b*) from water power	3.07	2.76
(*c*) from oil engines	0.12	0.13
(*d*) from waste heat and refuse steam plant ...	0.13	0.12
	100.00	100.00

Automatic Telephones, Charges.—Asked whether he would arrange for an automatic register of charges to be attached to telephones, where desired, as was already operated in Switzerland, the Postmaster-General replied that the use of a device of that kind was being considered in connection with the problem of extending subscribers' dialling beyond the present range of local calls.

Purchase Tax, Heaters.—The Chancellor of the Exchequer was asked what steps he was taking to prevent the evasion of the purchase tax on gas and electric heating appliances by the purchase and assembly of the component parts in the workshop of local authorities or private firms. Mr. Dalton replied that it would not be in the public interest to disclose the steps which were being taken. Nobody should take advantage of a tax of that kind and seek to evade it by improper action.

Uganda Hydro-Electric Station.—Mr. Creech Jones, Secretary of State for the Colonies, said the Government of Uganda proposed to construct a hydro-electric power station at Owen Falls, on the Victoria Nile. It was not expected that this station would be completed before 1952 and, as an interim measure, pending the completion of the first stage, it was proposed to erect two temporary thermal stations, one at Kampala and the other at Jinja. The Government of Uganda would acquire the interests of the East Africa Power and Lighting Co.

Industrial Information

Express Diesel-Electric Loco's

As the first major step in the scheme for the displacement of steam engines over a wide area by Diesel-electric or all-electric traction, the Southern Railway Company has ordered three express Diesel-electric locomotives capable, under certain conditions, of hauling main line passenger expresses at speeds of 100 m.p.h. They will be made in the company's workshops at Brighton, and are expected to be in service next year. Each locomotive will have a 1 600 H.P. Diesel-engined generator which will supply electric power to six axle-hung traction motors mounted on the bogies. The Diesel- electric equipment is being produced by the English Electric Co., Ltd. The body and underframe will be mounted on two 8-wheeled bogies, three of the axles in each bogie being driven. Each unit will weigh approximately 120 tons in working order, and will be 62 ft. in length. A driver's cab will be fitted at each end, whilst the portion of the body between the cabs will house the Diesel generator, auxiliary machinery, control apparatus, and fuel tanks. The units are so designed to enable two of them coupled together to haul the heaviest trains of 500 tons at express speeds under the control of one crew. In the first instance the locomotives will operate on the West of England route between Waterloo, Exeter and Plymouth.

An illustration of the Southern Railway's new double-unit 3 200 H.P. Diesel-electric locomotive to be introduced on main line services to the West of England

I.E. (India) Hyderabad Centre

The hon. secretary (Mr. A. E. L. Collins) has notified us that the address of the Hyderabad Centre of the Institution of Engineers (India) is now in Khairatabad, Hyderabad-Deccan, India.

Transformers for 220 kV Service

The English Electric Co., Ltd., has been awarded by the State Electricity Commission of Victoria a contract for the supply of tranformers for the first 220 kV system to be operated in Australia. The contract comprises seven 18 000 kVA, type OFB, single-phase transformers for installation at the Commission's power station at Yallourn, and four 16 666 kVA, type ON, single-phase transformers for the Kiewa No. 4 power station. The company already has in course of manufacture transformers of 64 000 kVA, ratio 225/112.5/10.5 kV three-phase, for Finland, and a 40 000 kVA single-phase, forming a three-phase group of ratio 242-121/15.75 kV, for Russia; also three arc-suppression coils of 24 000 kVA rating, for operation on a 220 kV system in Finland. These coils are believed to be the largest and highest voltage units yet ordered from this country.

Change of Name

P. Higson and Co., River Street, Bolton, Lancs., makers of "Eeto" cylinder and tank jackets and pipe laggings, have changed their name to Eeto Insulations.

"Monitor" Safety Alarm System

With reference to the paragraph, in THE ELECTRICIAN of August 8, concerning this system, our attention has been drawn to the fact that the word "Monitor" was registered in Great Britain in 1921 for automatic alarm and like safety devices for use in connection with power plant, and is the property of "Monitor" Patent Safety Devices Ltd., of which Mr. C. L. Stokoe is the managing director. The word was also registered in twelve other countries, including the U.S.A. and Canada.

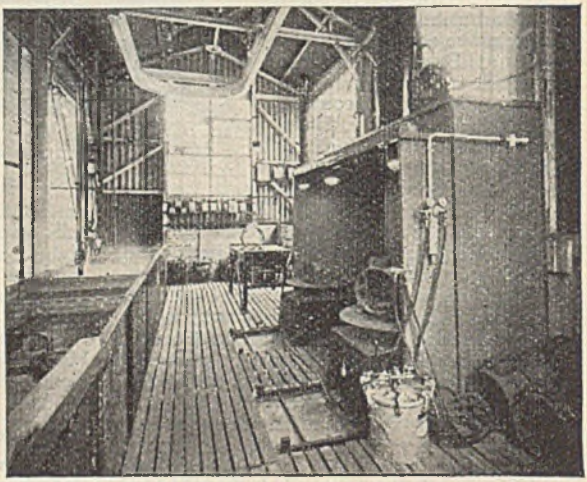
B.A. Meeting at Dundee

The British Association for the Advancement of Science is holding its annual meeting at Dundee, commencing on Wednesday, August 27. The programme for the succeeding days up to September 3 will include, in the physics section, a discussion on "Peace-time Applications of Nuclear Fission," introduced by Prof. J. D. Cockcroft, F.R.S., at 10 a.m. on August 28; Presidential Address by Sir Edward Appleton, F.R.S., on "Earth, Stars and Radio," at 10 a.m. on August 29, followed by a discussion on "Radio Applications in Astronomy and Meteorology"; a discussion on "Infra-red Radiations and Their Applications," at

10 a.m. on September 3. For the Engineering Section there will be an excursion to the Tummel-Garry hydro-electric scheme on August 30, and on September 1 at 10 a.m., Mr. J. Henderson will speak on "Scottish Water Power Development, With Special Reference to Electrical Problems," and at 11 a.m., Mr. P. G. M. Dawe will discuss "The Mechanisation of Oscillation in Phase-shift Oscillators."

Protection Against Rust

With the object of preventing rust, the General Electric Co., Ltd., has installed in its Witton engineering works a new pickling and priming shop for the treatment of cast and fabricated ferrous components. Immediately they leave the foundry or welding departments, the components are subjected to a process involving pickling and washing, followed by the application of a sealed protective phosphate film and a final spraying with a suitable primer paint. The paint is thoroughly mixed in an electrically-driven mixing machine, before entering the pressure vessel of the spraying apparatus. A powerful exhaust fan removes all fumes.



View of the pickling shop at the G.E.C. Witton works, showing the treatment tanks and paint spraying booth

The Grid Described

One of the most interesting official publications produced since the end of hostilities is an illustrated brochure entitled "The Grid," just issued by the Central Electricity Board. It is the first time that the story of the grid in relation to the electricity supply of Great Britain has been told so fully—there are twenty-three pages, apart from an appendix giving a list of selected stations. A picture of a 487 ft. grid tower for the Thames crossing at Dagenham, superimposed on a map of the grid system forms a striking frontispiece in two colours. The historical background in the first chapter covers briefly the development of the supply industry up to the setting-up of the Central Electricity Board, whose constitution and functions are explained. This is followed by the inauguration of the grid scheme, and the construction of the national transmission system costing up to the end of 1946 £40 million, and comprising approximately 5 161 miles of transmission lines, about 3 675 miles of which operate at 132 000 V, and the remainder at 66 000 and lower voltages; and 348 switching and transforming stations, with an aggregate transforming capacity of some 13 920 200 kVA. The book is not for sale, but a copy may be had on application to the Board's Public Relations Officer at Trafalgar Buildings, 1, Charing Cross, S.W.1.

L.N.E.R. Electrification Scheme

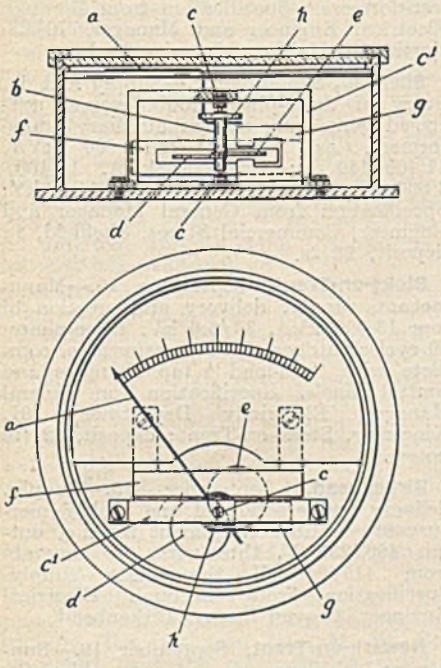
The Minister of Transport has approved resumption of the work on electrifying the L.N.E.R. Manchester-Sheffield main line, together with the lines from Barnsley Junction to Wath and from Fairfield to Trafford Park and Manchester Central, a total of 75 route miles, or 300 track miles, including sidings. The scheme, which will cost approximately £6 millions, was well in hand and all the main contracts had been placed before the outbreak of war in 1939, when the work had to be suspended. It was, however, possible to complete at Doncaster the first 1 870 H.P. mixed traffic electric locomotive, which underwent successful trials on the Manchester-Altrincham electric line in the autumn of 1941. Certain modifications of a minor character were subsequently carried out and the locomotive has recently made further trial runs on the Manchester-Altrincham line. The overhead line conductor system, using 1 500 V d.c., which is the higher voltage standard system authorised by the Ministry of Transport, will be employed. Electric locomotives will haul all trains between Manchester and Sheffield and will be fitted with electrically-heated boilers so as to maintain steam heating in the passenger trains. Between Manchester (London Road), Hadfield, and Glossop, however, a suburban service will be provided by multiple unit electric trains.

Electrical Inventions

The abstracts below, which are prepared with the permission of the Controller of H.M. Stationery Office, are written from the viewpoint of general interest and do not attempt to define the scope of the inventions, nor indicate in which features novelty lies. Specifications may be obtained from the Patent Office, price 1s. each, or 1s. 1d. abroad.

Moving Iron Meters

The specification describes an instrument of the moving-iron attraction type, and puts forward a method of locating the counter-balance plate so that the overall



size of the instrument can, it is claimed, be materially reduced.

In the upper figure, *a* represents the pointer of a meter mounted on an axle *b* supported between bearings *c*, *c*, carried by a frame c^1. Mounted on the same axle are a disc of magnetic material *d* and a disc of non-ferrous material *e*, the discs being on opposite sides of the pointer and so positioned that they counter-balance each other. Within the casing is a flat open coil *f*, into the magnetic field of which the disc *d* is drawn when the coil is energised. The non-ferrous disc *e* is arranged to move between the pole of a permanent magnet *g* for damping purposes. The instrument is provided with the usual light hair-spring *h*.

When the coil is energised and the disc *d* is drawn into the coil, the non-ferrous disc *e* moves into the field of the permanent magnet *g*. Then, by reason of the two discs being located on opposite sides of the centre line of the pointer, they balance each other. If there were no other considerations, the specification states, counter-balancing of the magnetic plate would best be carried out by locating the plate so that its centre line lay on a line passing centrally through the pointer and on the other side of the axle. This construction, however, would involve locating the coil so that the dimensions of the instrument would be increased. The method patented is said to avoid this difficulty, and at the same time provide effective damping of the movement.

Dr. Felix Neumann and the Electrical Instrument Co. (Glasgow). Application date, March 23, 1945: Complete Specification accepted, June 23, 1947. No. 589 518.

City and Guilds

THE 1946 report of the Council of the City and Guilds of London Institute states that 104 students entered for the final (internal) B.Sc. (Engineering) Degree examination of the London University, of whom 89 passed, 13 with first-class honours and 37 with second-class honours. In addition, two passed the B.Sc. (Engineering) examination as external students, one with first-class honours and the other with second-class honours. For each of the five subjects comprising the telecommunications group in the Department of Technology a substantial number of examinees came forward, although there was a net decrease of 92 in the total for 1946 (14 941) compared with the number who sat in 1945. Among subjects yielding increased numbers of examinees were: electrical engineering practice, with 1 182 examinees—an increase of 85; and electrical installation work, with 454 examinees—an increase of 83. Candidates at centres in the Commonwealth or Empire and elsewhere overseas, who took the examinations in telecommunications and electrical engineering practice, numbered 1 399 and 1 096, respectively.

Contracts Open

WE give below the latest information regarding contracts for which tenders are invited. In the case of overseas contracts, particulars are to be had from the Board of Trade, Millbank, London, S.W.1 (corner Horseferry Road), unless otherwise stated :—

Reigate, August 22.—Supply of: (a) six units, each comprising three oil-immersed, 11 kV, 300 A switches and six eight-way isolator and fuse units; (b) six 500 kVA, three-phase, 50 cycles, oil-immersed transformers. Specifications from Engineer and Manager, Electric House, Linkfield Corner, Redhill, Surrey.

Dover, August 25.—Supply and delivery of mercury discharge street lighting equipment. Specification from Borough Electrical Engineer, Electricity Offices, Ladywell, Dover.

Barking, August 25.—Supply and delivery of one 10/15 cwt. electric vehicle. Specification from Borough Electrical Engineer, Electricity House, Ripple Road, Barking, Essex.

Cheadle and Gatley, August 25.—Supply, delivery and erection of two 500 kVA and one 600 kVA oil-cooled transformers, with manually-operated "on-load" tap changers. Specifications from Engineer and Manager, 19, High Street, Cheadle, Cheshire; deposit, £1 1s.

Stoke Newington, August 25.—Supply and delivery of e.h.t. and h.t. p.i. mains cables, and excavation and laying of cables for one year ending September 30, 1948. Particulars from Borough Electrical Engineer, Electricity Department, Edwards Lane, London, N.16.

Manchester, August 27.—Manufacture, supply, delivery and erection at various points on aqueduct between Thirlmere and Manchester of 15 sets of electrically-driven axial flow propeller type pumps (73 pumps in all), together with main switch and motor starting gear, etc., each set to deal with between 54 and 60 million galls. per day. Specification from Secretary, Waterworks Offices, Town Hall, Manchester, 2; deposit, £2 2s.

Kingston-upon-Hull, August 29.—Supply of Diesel-driven loco' shunting crane, capable of lifting 5 tons at 16 ft. radius to 1¼ tons at 35 ft. radius; jib, 35 ft.; suitable for operating a Priestman ring discharge single chain operated grab, for handling coal, 34-27 cu. ft. capacity. Offers to General Manager, Ferensway.

Newport, Mon, August 29.—Electrical installations in 334 houses on Gaer Estate. Specification from Borough Electrical Engineer, Electric House, Dock Street, Newport, Mon; deposit, £1 1s.

Halifax, September 1.—Manufacture, delivery and putting into service of two 20 MVA, 33/6.6 kV type "ON" main transformers and two earthing/auxiliary transformers. Specification from Borough Electrical Engineer and Manager, 19/23, Northgate, Halifax; deposit, £1 1s.

Sheffield, September 2.—Supply and delivery of three-phase double-wound self-cooled generating station auxiliary transformers, as follows: ten 600 kVA, 11 400/440 V; two 600 kVA, 11 400/3 000 V; one 5 000 kVA, 33/11.3 kV. Specification from General Manager and Engineer, Commercial Street, Sheffield, 1; deposit, £2 2s.

Stoke-on-Trent, September 10.—Manufacture, supply, delivery and erection of four 15 000 kVA, 33/6.6 kV, three-phase, 50 cycles outdoor static transformers, complete with "on-load" tap changers and control panels. Specification from General Manager, Electricity Department, 31, Kingsway, Stoke-on-Trent; deposit, £2 (in notes).

Birkenhead, September 15.—Supply, delivery and erection of one 80 kW mercury arc rectifier equipment for d.c. output 460/230 V, three-wire, to operate from 415/240 V three-phase supply. Specification from Borough Electrical Engineer, Craven Street, Birkenhead.

Newark-on-Trent, September 19.—Supply and delivery of: (a) p.i. cable; (b) two 300 kVA distribution transformers. Specification from Borough Electrical Engineer, Municipal Buildings, Baldertongate, Newark.

Middlesbrough, September 19.—Supply and delivery, over two years, of: (a) 250 kVA, three-phase, 11 kV, indoor transformer; (b) 500 kVA, three-phase, 11 kV, indoor transformer; (c) oil and compound-filled, metal-clad circuit-breaker and oil-break isolators, suitable for use on 11 kV system; (d) sub-station type distribution feeder panels. Specifications from Borough Electrical Engineer, Corporation Electricity Works, Snowdon Road, Middlesbrough.

Iraq.—Supply of 12 slow or medium speed Diesel-driven generating sets, 440/500 V, d.c., compound-wound, rating about 100 kW, to suit engine builders' standard design. Specification from Crown Agents for the Colonies, Ref. W/Iraq 7750, 4, Millbank, London, S.W.1.

Company News

W. G. ALLEN AND SONS (TIPTON) LTD.—Pft. to March 31, after deprecn. and inc. tax, and allowing for E.P.T. refund £7 271 (£9 198). To gen. res. nil (£5 978), fin. ord. div. 5% (7½%) mkg. 7½% (10%); fwd. £7 208 (£7 065). Current assets £260 191 (£254 891), current liabilities £156 289 (£225 698).

GREENWOOD AND BATLEY, LTD.—Trdg. prft. to Mar. 31 £37 058 (£91 236), plus E.P.T. recoverable £36 937 (£20 844), other income £12 231 (£9 178), mkg. £86 226 (£121 258). To deb. int. £4 000 (same), fees £2 894 (£2 894), deprcn. £17 000 (£20 000), prfts. tax £950 (nil), inc.-tax £8 538 (£35 745), lvg. £52 844 (£58 619). To contings. £10 000 (same), fin. ord. div. 10%, making 15% (same), fwd. £72 628 (£62 392).

PARMITER HOPE AND SUGDEN, LTD.—Trdg. pft., after exes. to March 31, £48 370 (£33 952), plus E.P.T. recoveries on defd. reprs. £5 344 (nil). To deprecn. £2 220 (£1 866), cap. and patent exes. £800 (£1 263), tax £27 133 (£20 763), defd. reprs. and rehabilitation £5 570 (nil), lvg. £17 990 (£10 060). To gen. res. £5 000 (nil), ord. div. 30% (25%) bonus nil (25%); fwd. £59 741 (£56 453). Co. was made public April 1, 1946. Cap. incrsd. from £3 710 to £53 710. Blce.-sheet shows curr. assets £124 591 (£105 142), curr. liabs. £57 061 (£51 056).

ALLEN WEST AND CO., LTD.—At the annual general meeting, held recently in Brighton, the Chairman (Mr. M. W. H. Lancaster) said the company depended, like all other manufacturing businesses, on power, production and raw materials, and he would not attempt to make prophecies. If any of those items fell short of what they required, the company, together with its personnel, was bound to suffer. They had, however, sold their output for many months to come, and had taken steps to combat to some extent shortages of power, while owing to the result of their researches, they were able to use alternative materials when available.

GLOBE TELEGRAPH AND TRUST CO., LTD.—Total rev. to June 30 £368 870 (£409 301). To taxn. £155 037 (£178 955), N.D.C. and prfts. tax £3 745 (£1 486), and after exes., etc., net rev. £197 003 (£215 118). Fin. ord. div. 2%. mkg. 5%, tax free (same), gen. res. nil (£28 545, equal to spec. div. of 5% recvd. from Cables and Wireless Hldg.); fwd. £171 454 (£151 923), invests. at cost £5 198 820 (£5 151 012). incldg. £1 085 000 cost of £1 000 000 ord. stk. of Cables and Invest. Trust, the remaining invests. costing £4 113 820 had mkt. value date of accts. £7 750 283. Invests. on acct. of gen. res. £167 026, mkt. value £170 107.

PIRELLI GENERAL CABLE WORKS CO., LTD.—Net profit, after tax, £339 688 (£91 052); div. 8% and bonus 12%, less tax.

NORTHMET. POWER CO., LTD.—Interim div. of 3% (same) declared on the ord. stk. will be paid, less income tax, on Sept. 23 to holders registered on August 28, 1947.

ELECTRICAL SWITCHGEAR AND ASSOCIATED MANUFACTURERS, LTD.—Accts. for yr. to Mar. 31 show loan int. from subsid. co. £3 167 (£35 550), plus fees £2 (£1). After tax £1 143 (£15 837), dirs.' fees £600 (same), admin. exes. £27 (same), net prft. £1 399 (£19 087). Subsid. co. Brookhirst Switchgear, engaged throughout yr. in substantl. reorg. of productn. and shows only small prft. and has not declrd. any div. In these circumstances, dirs. do not recommend any ord. div. (20%) and, after payment of pref. div., carry-fwd. £15 614, agst. £17 378 brot. in. Additnl. finance required by subsid. co. £237 000 provided by Natal Industries, which holds all ord. stk. of co.

BELLISS AND MORCOM, LTD.—Trdg. prft. yr. to March 31 £104 327 (£81 120), plus trade invests. income gross £2 405 (£2 955), inc. from other invests. gross £25 109 (£25 865), mkg. £131 841 (£129 981, incldg. £20 041 E.P.T. repayable and excess tax res.); deduct deprcn. £16 490 (£16 035), dirs.' fees £1 118 (£1 300), other remun. of dirs. £6 610 (£7 350), tax prov. £46 940 (£49 936), defrd. reprs. £5 000 (nil), lvg. net prft. £55 683 (£55 360). To pensions £130 000 (nil), 5% pref. div. £3 526 (£3 206), intm. 4% (same), ord. £13 074 (£11 885), fin. 10% (same) £32 685; fwd. £50 940 (£174 542).

DAVEY, PAXMAN AND CO., LTD.—The Government-sponsored programme for the manufacture of emergency Diesel-generating sets was referred to at the annual meeting by Mr. G. R. Sharpley (chairman). By virtue of the expansion of the company's facilities which had taken place during the war, he said, they had been able to embark on the production and supply to home industry of sets to a total capacity of 150 000 kVA, to be delivered by the autumn of 1948. A vigorous campaign had been undertaken to apprise in-

dustry of the availability of these sets and as a result they already had a record order book, while orders continued to be received at a satisfactory rate for engines both for that and other applications. The company had also continued to supply large numbers of Diesel engines and generating sets for rehabilitation purposes in devastated areas of the Empire, where they were playing an important part in resuscitating the basic materials industries. The boiler and general engineering side of the business had also booked substantial orders, and, given adequate supplies, especially of steel, he believed they could look forward to a greatly increased output.

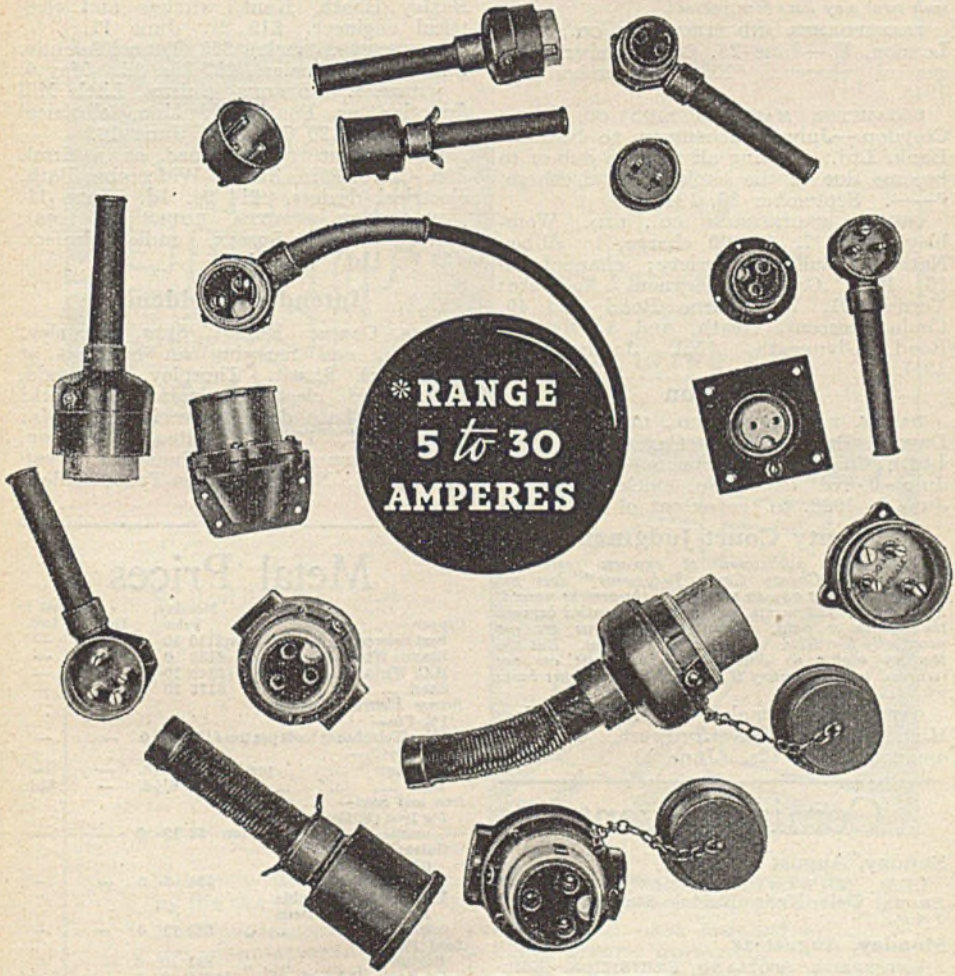
MORGAN CRUCIBLE CO., LTD.—Speaking at the company's annual meeting, the chairman (Mr. P. Lindsay) said that in his opinion a sellers' market was a very mixed blessing to British industry. It forced up prices of imports, and so added to the problem of balance of payments. The stimulus and opportunities and prices it offered to exports were offset by the cost and shortages of all materials necessary to their manufacture. It had also an undesirable psychological and sociological effect —detrimental to the incentive and initiative of individuals and disruptive of social bonds and principles. Turning to the winter coal crisis, the chairman said their company had been able to survive it without serious dislocation of production, thanks to oil-firing and operation of standby power plant. On the other hand, they had not escaped the aftermath in the form of shortages of supply of piece-parts and material and had had to make serious inroads into stocks. In consequence, bottlenecks in production during the current year were probable. Referring to the overseas manufacturing subsidiaries, Mr. Lindsay said that the most important, the Morganite Company of New York, had suffered considerably from the difficulties of reconversion, but would, in time, make a valuable contribution to the prosperity of the parent company. The Australian company appeared to be recovering, while recently established units in Canada and South Africa, though still leaning on the parent organisation, were beginning to justify the policy which had brought them into being.

PALESTINE ELECTRIC CORPORATION, LTD.—Presiding at the annual meeting, Viscount Samuel, chairman, said that uninterrupted progress was being made. The company's power stations had operated efficiently throughout the year, and all demands for electricity had been met. Over 288 million units were generated, an increase of 15.3 per cent. compared with 1945. The maximum load was over 62 000 kW, compared with 55 000 kW in the previous year. Total units sold during 1946 amounted to 233 million, representing an increase of nearly 34 million, or 17 per cent. Consumers connected as at December 31, 1946, numbered 107 474, compared with 94 910 at the end of 1945, an increase of 13.2 per cent. The gross revenue amounted to £P.2 127 451, as compared with £P.1 804 870, an increase of £P.322 581, or 17.8 per cent. The transmission and distribution lines had been extended during the year by 118 kM, making a total of 1 448 kM of h.t. lines and 1 458 kM of l.t. distribution lines in operation at the end of 1946. A problem which confronted the electricity supply industry almost everywhere was the insufficiency of installed plant to meet the increased post-war demands for power. Owing to the policy consistently pursued by the corporation of comprehensive planning for years ahead, it had been possible to meet successfully the ever-growing demand, both during the war years and since. In his statement last year the Chairman had reported the placing of orders for two turbo-generator sets of 12 000 kW and 30 000 kW for the Reading and the Haifa power stations respectively. Since then further orders had been placed for an additional 30 000 kW turbo-generator to be installed in the Reading station, which would have to be extended to house the new plant. Notwithstanding all the difficulties experienced with regard to deliveries it was anticipated that the first new unit in the Reading station, namely, the 12 000 kW set, would be in commission before the end of the year, and that the 30 000 kW set would be put into commission in the Haifa station in the course of next year.

MIRRLEES WATSON CO., LTD.—In a statement circulated with the report and accounts, the chairman, Mr. D. M. Semple, said that their condensing and pump departments had contracts in hand for power stations both in this country and abroad. One of particular interest was pumping plant for the hydro-electric scheme at Loch Sloy. There had been a heavy demand for steam ejector air pumps, and during the year they developed a carbon-lined ejector for the chemical industry. There was increased demand for small steam turbines which they built —from 1 to 400 H.P. Eighty-four were ordered during the year. Roscru Imo pumps had been supplied or were on order for many new developments, such as the atomic energy programme, conversion from coal to fuel oil, operating governor gear in hydro-electric plant, and operating tilting trucks.

Industrial
PLUGS AND SOCKETS

"... ...and we must take the current when it serves
or lose our ventures." SHAKESPEARE (1564 - 1616)



*PAMPHLETS ON REQUEST

REYROLLE
HEBBURN CO. DURHAM ENGLAND

Commercial Information

Mortgages and Charges

NOTE.—*The Companies Act of* 1908 *provides that every mortgage or charge shall be registered within* 21 *days after its creation, and that every company shall, in its annual summary, specify the total amount of debt due from it in respect of mortgages or charges. The following mortgages and charges have been registered. The total debt prior to the present creation, as shown in the annual summary, is given—marked with an *—followed by the date of the summary, but such total may have been reduced.*

TRANSFORMER AND ELECTRICAL CO., LTD., London, E.—June 25, £3 000 debentures; general charge. *Nil. September 30, 1945.

ROTAMETER MANUFACTURING CO., LTD., Croydon.—July 4, debenture, to National Bank, Ltd., securing all moneys due or to become due to the bank; general charge. *——. September 30, 1946.

TRUVOX ENGINEERING CO., LTD., Wembley.—July 7, £4 100 charge, to Abbey National Building Society; charged on 15, Park Green, Treeynon, Aberdare; Vernal, 51, Westbourne Road and 49, Cimla Crescent, Neath, and 4, Meadow Road, Glynneath. *Nil. January 13, 1947.

Satisfaction

DAVEY, PAXMAN AND CO., LTD. (formerly Davey, Paxman and Co. (Colchester), Ltd.), Colchester, engineers.—Satisfaction July 9, of debenture stock registered June 7, 1938, to the extent of £79 080.

County Court Judgments

NOTE.—*The publication of extracts from the "Registry of County Court Judgments" does not imply inability to pay on the part of the persons named. Many of the judgments may have been settled between the parties or paid. Registered judgments are not necessarily for debts. They may be actions. But the Registry makes no distinction. Judgments are not returned to the Registry if satisfied in the Court books within* 21 *days.*

GATENBY, — (male), c/o Mrs. Harries, High Street, Haverfordwest, electrical engineer. £47 12s. June 13.

KIERNAN AND JEFFREY (a firm), 141, Stanstead Road, Forest Hill, radio dealers. £15. June 10.

RAE MOTORS, LTD., R/O, 8, Weston Chambers, Weston Road, Southend-on-Sea, electrical engineers. £84 1s. 3d. June 12.

FRYER, W. (male), 27, Lyndhurst Road, Bexley Heath, Kent, wireless and electrical engineer. £19 2s. June 11.

JONES, C. A. (male), 362, Tunnel Avenue, S.E.10, radio dealer. £27 12s. 9d. May 6.

WILKS, J. AND SONS (a firm), Little Mill Junction, nr. Pontypool, Mon, electrical engineers. £20 7s. 10d. June 16.

BAXTER AND RAINE (sued as a firm), 26b, Claverhouse Street, Widcombe, Bath, electrical dealers. £14 9s. 1d. June 11.

WOOLCOCK ELECTRA HOUSE (a firm), Hurst Green, Sussex, radio dealers. £33 2s. 11d. June 12.

Intended Dividend

SIMS, George Robert, Syra, Thornley, Durham, and carrying on business at Hartlepool Street, Thornley, aforesaid, motor and electrical engineer. Court: Durham. Late day for receiving proofs: August 27, 1947. Trustee: Ferguson, Arthur Kenneth, Gibb Chambers, Westgate Road, Newcastle-upon-Tyne, Official Receiver.

Coming Events

Sunday, August 24

I.E.E., N. WESTERN STUDENTS' SECTION.—Annual Visit: Hydro-Electric Station, Chester. *9 a.m.*

Monday, August 25

ENTERPRISE SCOTLAND EXHIBITION.—Edinburgh. At the Royal Scottish Museum. *Until September 30.*

Wednesday, August 27

BRITISH ASSOCIATION. — Dundee. *Until September 3.*

Thursday, August 28

INDUSTRIAL WALES EXHIBITION.—London. At Olympia. *Until September 13.*

ENGINEERING AND MARINE EXHIBITION.—London. At Olympia. *Until September 13.*

Metal Prices

		Monday, Price	Inc.	August 18 Dec.
Copper—				
Best Selected ...	...per ton	£130 10 0	—	—
Electro Wire bars ...	„	£132 0 0	—	—
H.C. Wires, basis ...	„	£149 10 0	—	—
Sheet	„	£173 10 0	—	—
Bronze Electrical quality 1% *Tin*—				
Wire (Telephone) basis	per ton	£172 5 0	—	—
Brass (60/40)—				
Rod basis	per lb.	1s. 1¾d.	—	—
Wire	„	1s. 6⅛d.	—	⅜d.
Iron and Steel—				
Pig Iron (E. Coast Hematite No. 1)	...per ton	£8 19 0	—	—
Galvanised Steel Wire (Cable Armouring) basis 0.104 in. ...		£34 5 0	—	—
Mild Steel Tape (Cable Armouring) basis 0.04 in.	„	£21 15 0	—	—
Lead Pig—				
English	„	£91 10 0	—	—
Foreign or Colonial ...	„	£90 0 0	—	—
Tin—				
Ingot (minimum of 99.9% purity) ...	„	£442 10 0	—	—
Wire, basis ...	... per lb.	5s. 6¾d.	—	—
Aluminium Ingots	...per ton	£80 0 0	—	—
Spelter		£70 0 0	—	—
Mercury (spot) ... (*ex. warehouse*)	per bott.	£16 0 0	—	£1 3s. 6d.

Prices of galvanised steel wire and steel tape supplied by C.M.A. Other metal prices supplied by B.I. Callender's Cables, Ltd.

What will the Kitchen of TOMORROW look like?

One thing is certain: the domestic electrical appliance will find an increasingly important place in the well equipped modern kitchen, and the principal factor the planners of this overcrowded age will bear in mind is the vital need for economy in space . . . . . To this end DIAMIX have also planned; and our range of electrical kitchen equipment is now in greater demand than ever before . . . . by the retailer with an eye to attractive display and ready sale; and by the housewife with limited kitchen space, but an unlimited urge to acquire the best.

Please write or phone for New Season's catalogues of Toasters, Cookers, Thermostatic Irons, Fires and Boiling Rings.

Order these best selling lines now for immediate delivery.

The "Junior" Cooker (above)
Ideal for small home. 2 heat switch for oven and grill, separate control for ring. Chromium and pastel shades.

The "Push Button" Cooker (below)
Measures 16″ × 11″ × 12″. Push button heat control for oven, grill and hotplate. Vitreous enamel finish.

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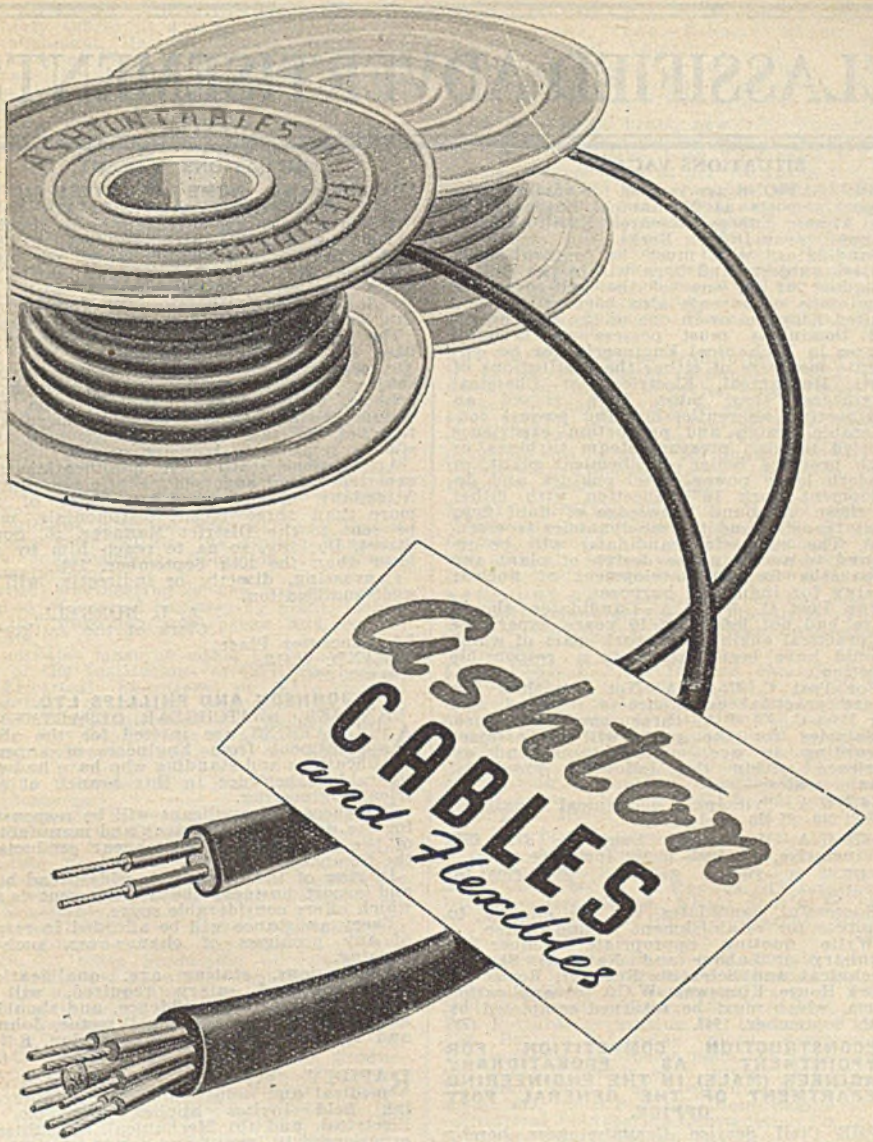
INDEX TO ADVERTISERS IN THIS ISSUE



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CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

APPLICATIONS are invited for various temporary posts as Mechanical Engineers at the Atomic Energy Research Establishment, Harwell, near Didcot, Berks.

Candidates, who must be natural born British subjects and born within the United Kingdom or in one of the self-governing Dominions of parents also born within the United Kingdom or in one of the self-governing Dominions must possess an Honours degree in Mechanical Engineering or be corporate members of either the Institutions of Civil, Mechanical, Electrical or Chemical Engineers; they must have served an engineering apprenticeship and possess considerable design and production experience related to high pressure steam turbines, or high pressure boiler or chemical plant, or modern large power diesel engines and development work in connection with either of these. A sound knowledge of fluid flow, heat transfer and thermo-dynamics is essential. The successful candidates will be required to assist in the design of plant and apparatus for the development of nuclear energy for industrial purposes.

For Post C. 474/47 A.—Candidates should have had not less than 10 years' experience of practical engineering work—part of which should have been gained in a responsible position.

For Post C. 476/47 A.—Not less than five years' practical experience is required, and for Post C. 475/47 A.—three years' experience.

Salaries for the posts will be assessed according to age, qualifications and experience within the following provincial (male) scales:—

C. 474/47 A.—Principal Mechanical Engineer, £1 240 - £1 420 inclusive.

C. 476/47 A.—Mechanical Engineer, £720 - £960 inclusive, or £990 - £1 190 inclusive.

C. 475/47 A.—Design Engineer, £330 - £720 inclusive.

Successful candidates will be eligible to compete for establishment in due course.

Write quoting appropriate number to Ministry of Labour and National Service, Technical and Scientific Register, Room 171, York House, Kingsway, W.C.2, for application form, which must be returned completed by 30th September, 1947. (71)

RECONSTRUCTION COMPETITION FOR APPOINTMENT AS PROBATIONARY ENGINEER (MALE) IN THE ENGINEERING DEPARTMENT OF THE GENERAL POST OFFICE.

THE Civil Service Commissioners hereby remind prospective candidates for the above mentioned competition that the closing date for the receipt of completed application forms from Service candidates is the 1st October, 1947, or a date four months after completion of their service, whichever is the earlier.

The last day for the receipt of application forms has otherwise passed.

Persons who are still entitled to make application can obtain the detailed regulations and application form from the Secretary, Civil Service Commission, Burlington Gardens, London, W.1, quoting No. 1501. (72)

EFFICIENT Traveller for electrical goods required.—Criterion Electric Ltd., Mount Pleasant, Alperton, Wembley. (73)

SITUATIONS VACANT

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APPLICATIONS are invited for the appointment of STATIC SUB-STATION ATTENDANT, Leatherhead. Wages 2s. 3d. per hour, plus 3d. per hour for rotating shifts (48 hours per week), in accordance with the scheduled rates of wages of District Council (No. 9) for the Electricity Supply Industry.

The person appointed will be required to pass a medical examination by the Authority's medical adviser, and to become subject to the Authority's Superannuation Scheme, which applies generally the provisions of the Local Government Superannuation Act, 1937, including the provisions of that statute relating to transfer values.

Applications, stating age, qualifications and experience, and endorsed "Static Sub-Station Attendant," accompanied by copies of not more than three recent testimonials, must be sent to the District Manager, 56, South Street, Dorking, so as to reach him by not later than the 10th September, 1947.

Canvassing, directly or indirectly, will be a disqualification.

A. L. BURNELL,
Clerk of the Authority.

5-6, Lancaster Place,
STRAND, W.C.2.
August, 1947. (77)

JOHNSON AND PHILLIPS LTD.

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APPLICATIONS are invited for the above appointment from Engineers of superior qualifications and standing who have had considerable experience in this branch of electrical engineering.

The successful applicant will be responsible for the design, development and manufacture of the L.T. and H.T. Switchgear products of the Company.

In view of the Company's widespread home and export business the appointment is one which offers considerable scope.

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ELECTRONIC ENGINEER OR PHYSICIST to conduct development work on the registration of printed webs of paper or similar material (North West District).—Apply Box L.F.Y., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4. (58)

SITUATIONS VACANT

APPLICATIONS are invited for the post of Safety Officer at Atomic Energy Research Establishment, Harwell, Didcot, Berks.

Candidates must be natural born British subjects born within the United Kingdom or a self-governing Dominion of parents similarly born.

Duties: To be responsible for compiling special safety regulations and observance thereof, ensure safe condition of all engineering plant and equipment, maintain records under statutory regulations.

Candidates must either be Corporate Members of Institutions of Civil, Mechanical or Electrical Engineers or have passed recognised exempting examinations and have experience in factory administration and services, including electrical equipment, testing of cranes and pressure vessels.

Salary between £720 - £960, according to qualifications.

Permanency by competition possible.

Write quoting D. 239/47—A. to Ministry of Labour and National Service, Technical and Scientific Register, Room 171, York House, Kingsway, London, W.C.2, for application form, which must be returned completed by 27th September, 1947. (69)

APPLICATIONS are invited for the post of Assistant Electrical Engineer at the Atomic Energy Research Establishment, Harwell, near Didcot, Berks.

Candidates must be natural born British subjects born within the United Kingdom or a self-governing Dominion of parents similarly born.

Duties: Engineering of new projects, maintenance of special engineering plant, including its protection, switchgear and control circuits.

Candidates must be either Corporate Members of the Institutions of Civil, Mechanical or Electrical Engineers or have passed recognised exempting examinations, have served an apprenticeship and had experience in the Test Department of a large manufacturing concern. Knowledge of electronics desirable.

Salary between £355 - £720, according to qualifications.

Permanency by competition possible.

Write quoting D. 240/47—A. to Ministry of Labour and National Service, Technical and Scientific Register, Room 171, York House, Kingsway, London, W.C.2, for application form, which must be returned completed by 27th September, 1947. (70)

DRAUGHTSMEN. — Senior Development Draughtsmen with experience on the design for mass production of commercial radio and allied apparatus required by large manufacturer in the East London area. —Applicants should state age, experience and salary required, to Box L.F.Z., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4. (62)

DRAUGHTSMEN with experience of production drawing in connection with commercial radio and allied apparatus required by large light engineering concern in the East London area.—Write stating age, experience and salary required, to Box L.G.A., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4 (63)

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RESEARCH Laboratories of the General Electric Co. Ltd., North Wembley, Middx., require a physics or electrical engineering graduate with a knowledge of and preferably some experience in small transformer design. Apply by letter only to the Director, stating age, experience and academic qualifications. (41)

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at 11 o'clock punctually each day.

VIEW DAYS: THURSDAY AND FRIDAY, AUGUST 28th and 29th, MONDAY, SEPTEMBER 1st, and MONDAY, SEPTEMBER 8th.

From 10 a.m. to 4 p.m.; and on Sale Days from 9 a.m. to 10.30 a.m.

CATALOGUE: Covering complete sale, price 6d. (postal orders only), may be had of the Auctioneers, Bruton, Knowles and Co., Albion Chambers, Gloucester (telephone Gloucester 2267), or George Hone, Tewkesbury (telephone Tewkesbury 10). NOTE: Applications for catalogues to be sent in envelopes marked ASH top left hand corner.

ADMISSION WILL BE BY CATALOGUE ONLY. (47)

WANTED

ELECTRICAL Steel SHEET or LAMINATIONS of reputable make, .014 in. to .020 in. thick will be purchased for cash in any quantity by Davenset Electrical Works, Leicester. (31)

DIE-CASTING Machine wanted urgently, prefer No. 12 EMB. Cash waiting, will collect, distance no object. Phone, Colwyn Bay 3191, or write—Roncraft Ltd., Conway Road, Colwyn Bay. (40)

A.C. MOTORS, all sizes and voltages, best prices offered.—JOHN PHILLIPS AND CO. ELECTRICS, 31, Fortune Green Road, Hampstead, N.W.6. Hampstead 8132. (30)

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VACUUM CLEANER REWINDING SERVICE, commutators and Bearings. Prompt delivery and full guarantee.—Thomas Anderson, 117, Bowes Street, Blyth, Northumberland. 'Phone: Blyth 405. (7)

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SCEMCO, LTD., Fluorescent Lighting Specialists, announce their **AGENCY SERVICE** to Electrical Traders and Electrical Contractors. Applicants for "Selling Rights" of "**SCEMCO**" Fluorescent products in their individual districts are invited to apply for further details. Two Trade References must accompany initial enquiry. Applicants will be treated in rotation, priority being given to the 5 000 Electrical Traders and Contractors already on our Mailing List. Summary of "**SCEMCO**" Agency Service:—(1) **SCEMCO LTD.** will forward to their Accredited Agents, all Direct Consumer orders and enquiries they receive as a result of the SCEMCO Advertising Media. (Trade Press, Local Press, Exhibitions, Mail Order.) (2) **SCEMCO** Accredited Agent to receive, apart from Trade Discount of 25 per cent. and Cash Discount of 2½ per cent., an additional Agency Commission of 5 per cent. on all Sales in the allotted territory. (3) **SCEMCO** Accredited Agent to receive full benefits of the "Scemco Guarantee" regarding the replacement of Fittings and Components. (4) **SCEMCO LTD.** retain the right to nullify an Agency Agreement by one month's notice in writing should the Accredited Agent's service in any way prove unsatisfactory, and **SCEMCO LTD.** agree to the Accredited Agent having the same facility. This notice inviting Agency Applicants from Electrical Traders and Contractors will be closed on or before 30th September, 1947.—Scemco Ltd., 6/7, Soho Street, and at 18, Soho Square, London, W.1. Tel.: GERrard 1461/2/3. (25)

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NOTICE

UNIVERSITY OF MANCHESTER.

THE next session commences on Thursday, 2nd October, 1947.

PATENT AGENTS

KINGS PATENT AGENCY, LTD., B. T. King, A.I.Mech.E. (Patent Agent), 146A, Queen Victoria Street, London, E.C.4. ADVICE, Handbook, and Consultations free. 'Phone: City 6161.

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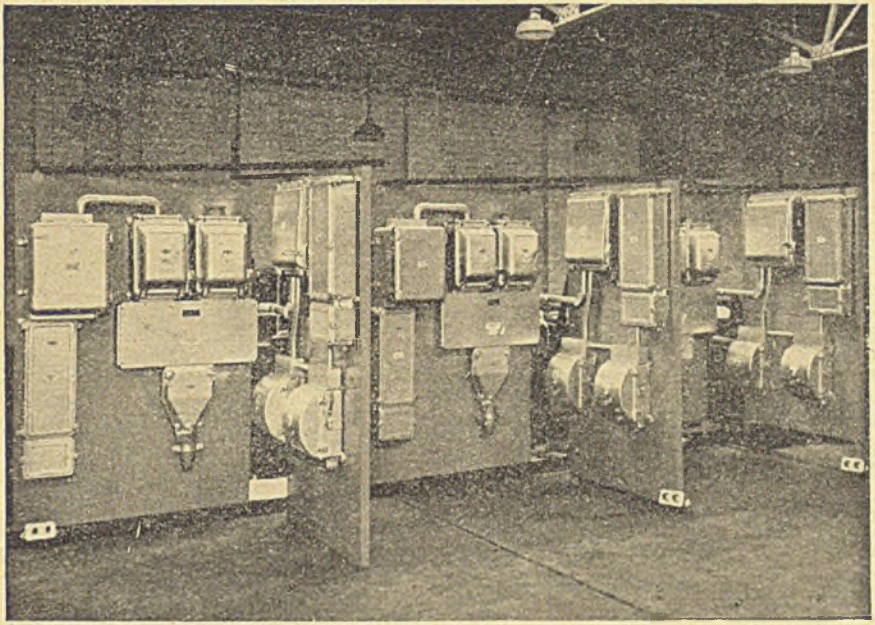

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