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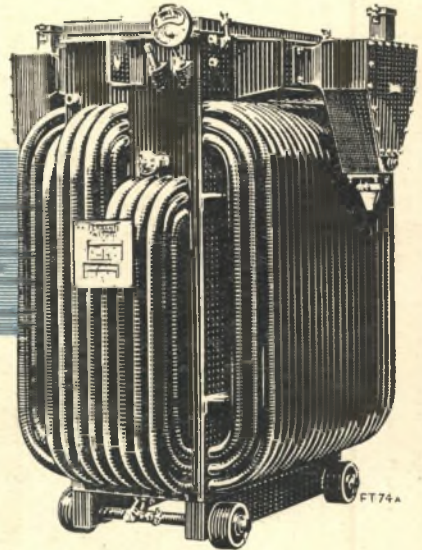
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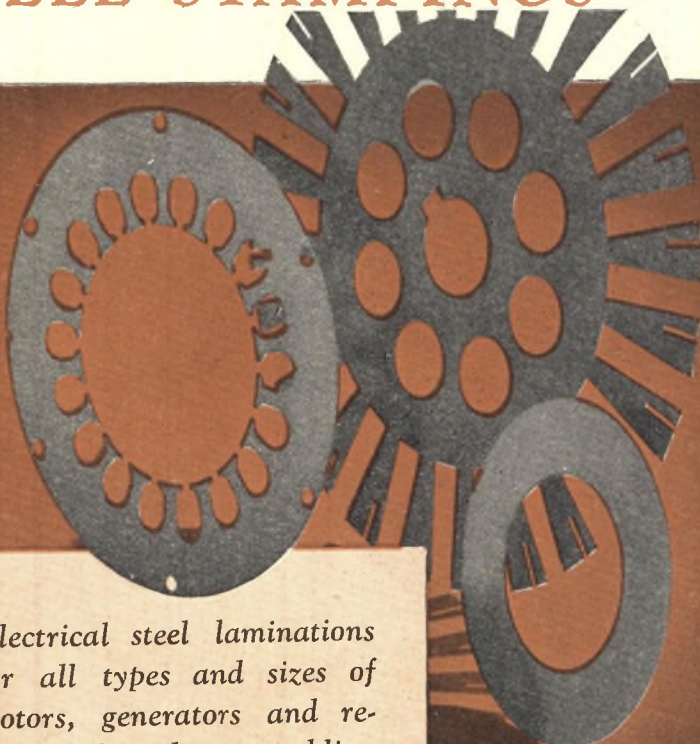
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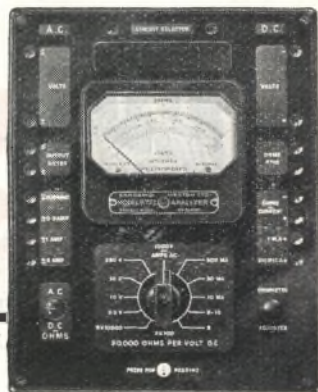


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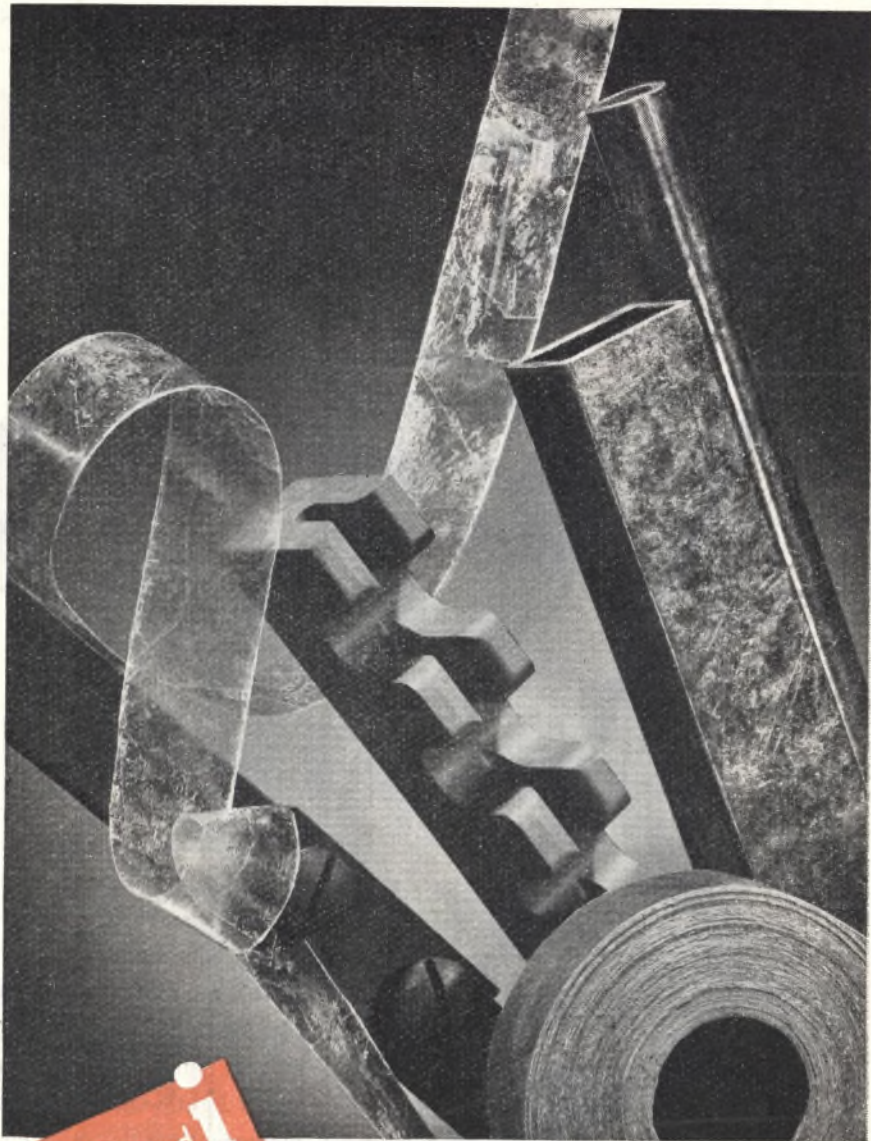
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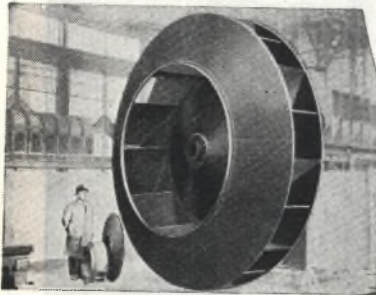
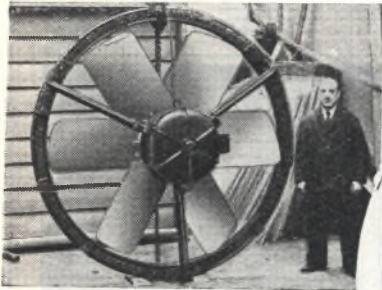


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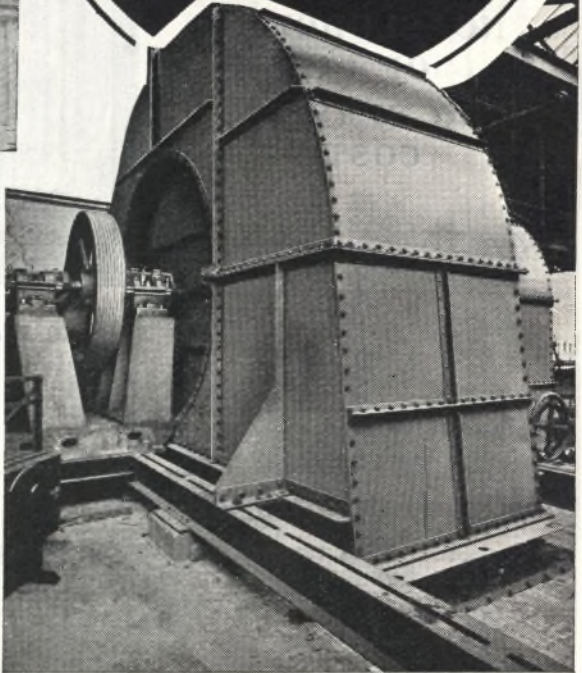
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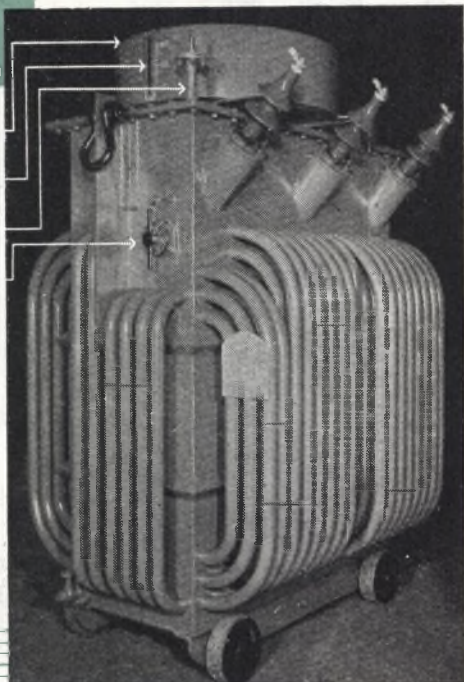
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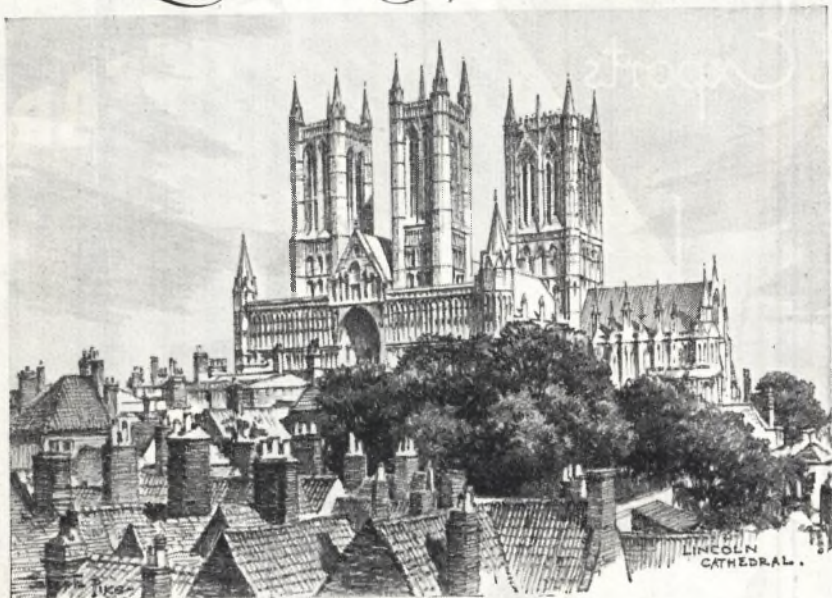
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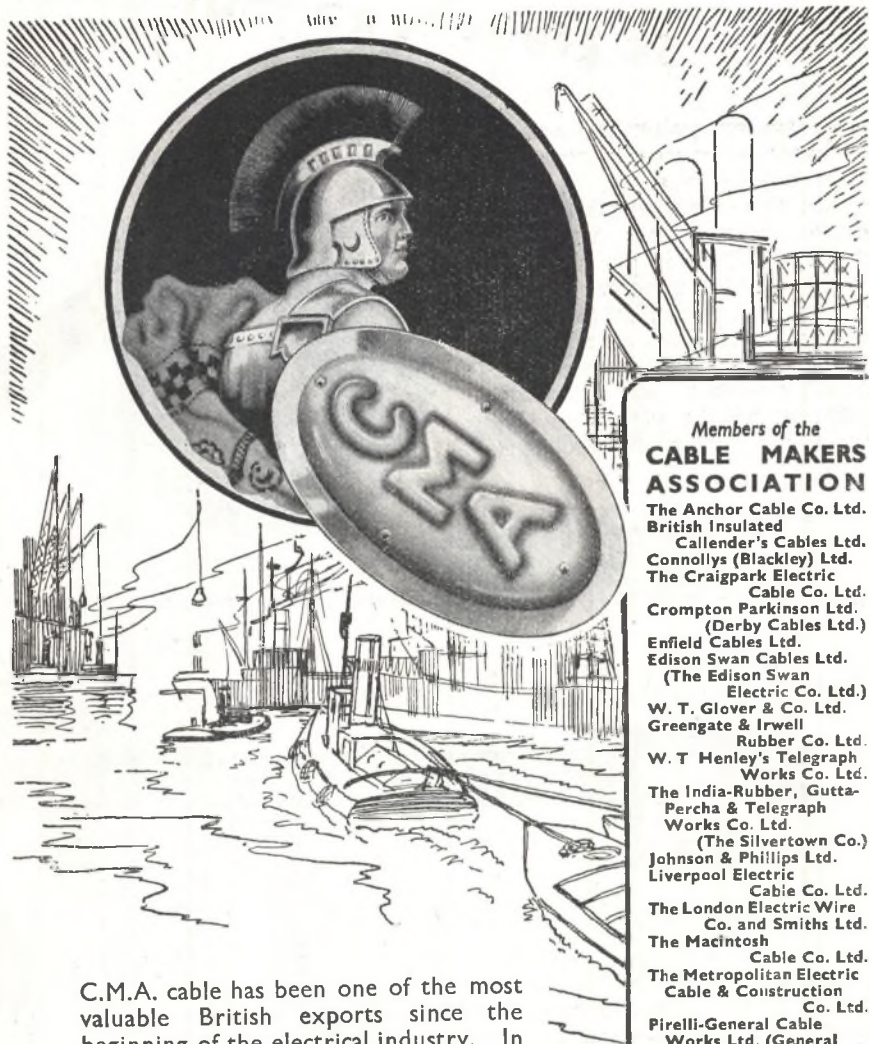
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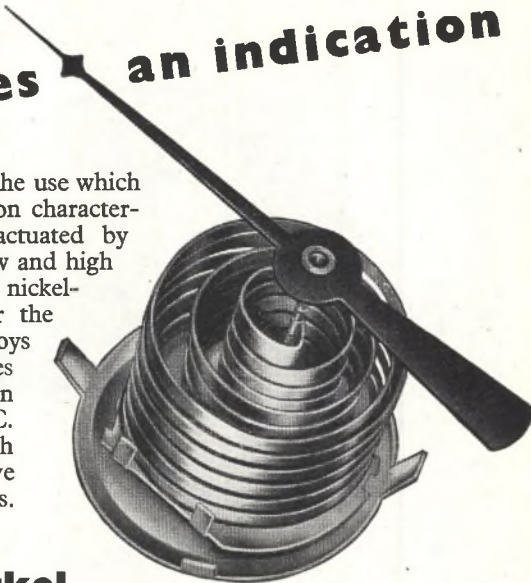


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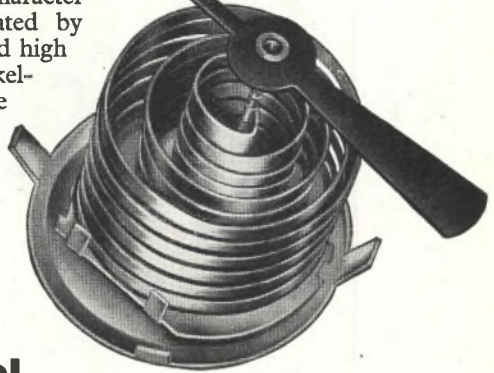
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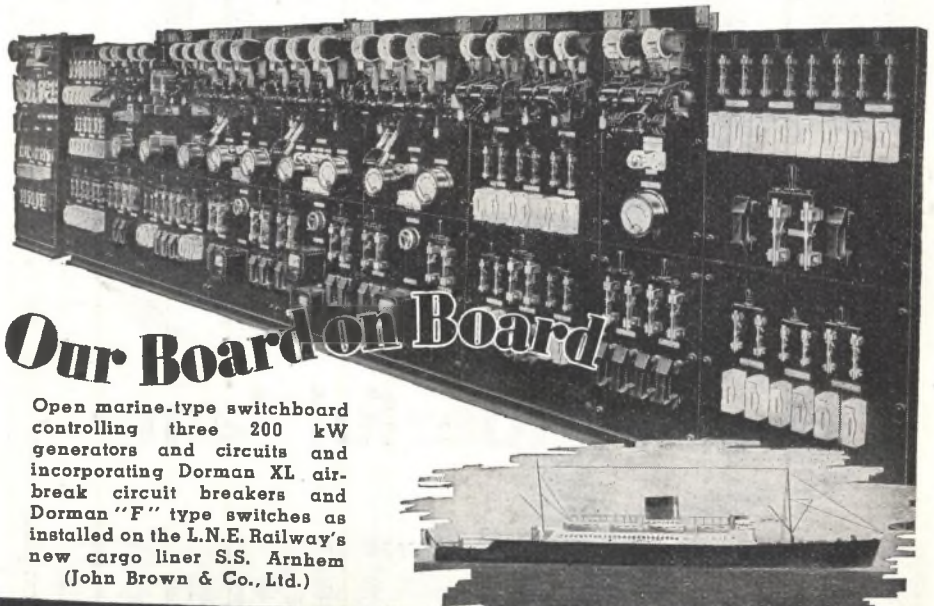
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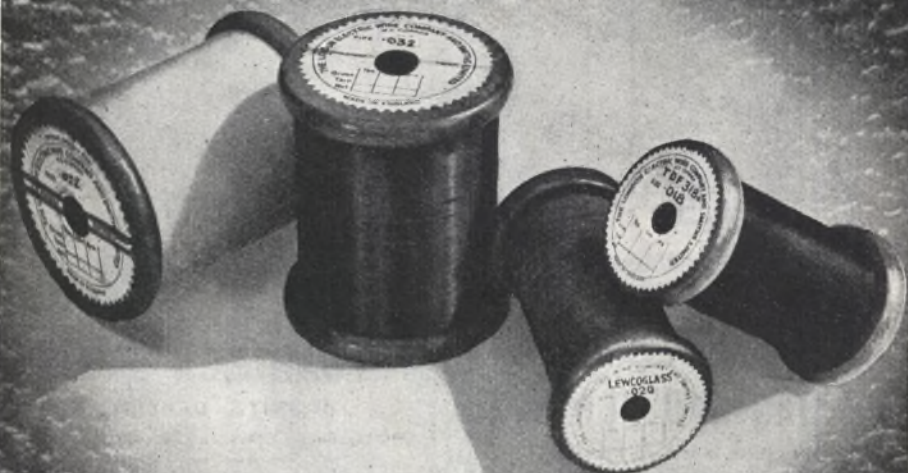


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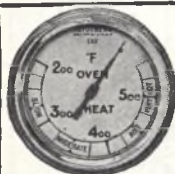
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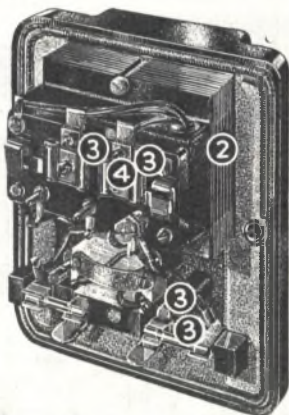
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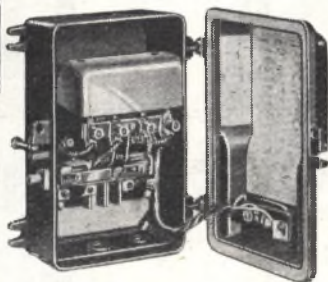
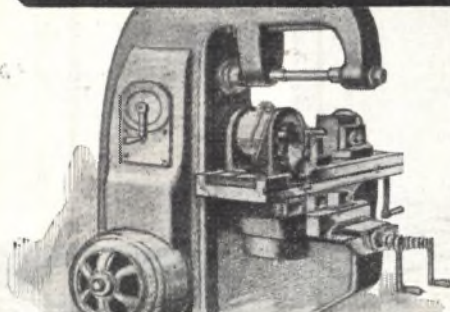


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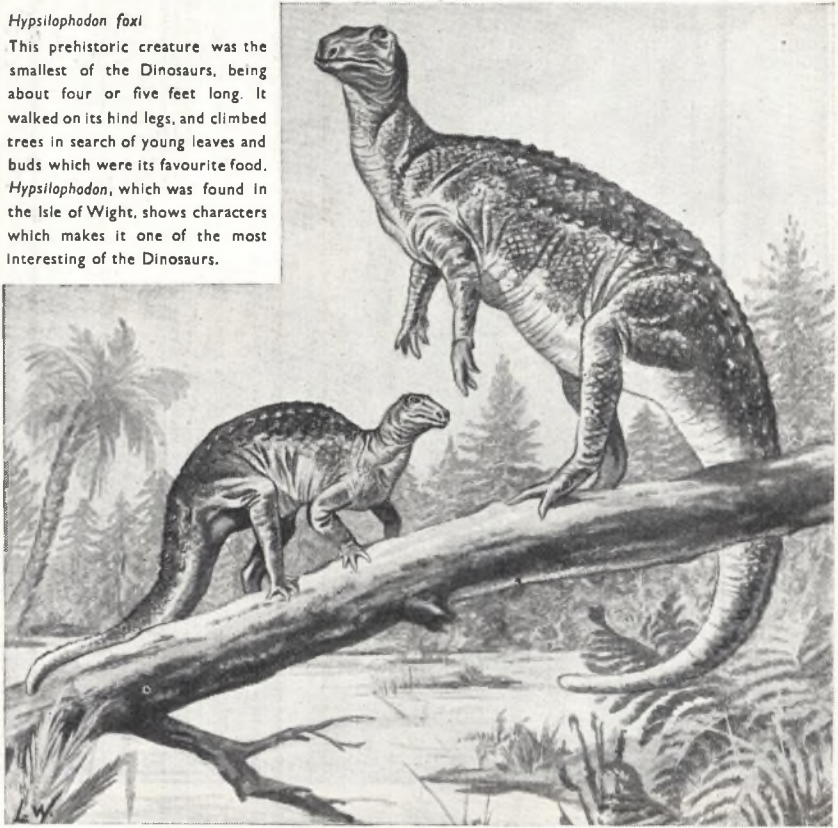
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3 OCTOBER 1947

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Winter Prospects

THE opinion often expressed in these columns, that the electricity supply position in the coming winter may be as serious, if not worse, than last, were confirmed when Sir GUY NOTT-BOWER, deputy secretary of the Ministry of Fuel, revealed to a Press conference last week that the anticipated gap between available generating capacity and estimated demand will be greater, by 500 000 kW, than in the coldest days of last winter. In the week before the January coal crisis brought industry to a comparative standstill, maximum demand was running at about 11 000 MW, with 9 000 MW of plant available to meet it. By next Christmas, the available capacity on the grid will, it is expected, have increased to 9 500 MW, but against this, demand is expected to rise to 12 000 MW, leaving an estimated deficiency of 2 500 MW, compared with 2 000 MW last winter. The total installed capacity will be something over 12 000 MW, of which between 13 and 14 per cent. will be non-available for various reasons, among which over-age plant and the effect of poor quality coal supplies must rank high.

Almost equally disturbing is the situation regarding coal stocks. Basing figures on an estimated weekly winter consumption of 700 000 tons, the Ministry last week announced that stocks at power stations now stand at between five and six weeks' supply. This is an improvement on the situation existing at the same time last year, when about three weeks' stock were held, but, as if to endorse the statement made in these notes a fortnight ago, the Ministry of

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Fuel agrees that there is little chance of the "safety level" of eight weeks' supply being reached, and that there is still a danger, if the weather should be unduly severe, of yet another coal crisis before the end of winter. "We hope," was all Sir GUY would say, "that with the co-operation of consumers and without abnormally bad luck we shall be able to get through." This official admission is, in fact, the only respect in which the situation may be said to be better than last year, when a completely unwarrantable optimism was being displayed by Minister and official spokesmen alike.

Problem of Domestic Load

NEXT week, the plans for industrial load staggering are to become operative all over the country, and for a variety of reasons, including the attitude of some sections of organised labour to shift-working hours, it is apparent that far from the original target of a one-third spread in load being met, a reduction of about 20 to 25 per cent. is all that can be expected. There is, therefore, no reason to suppose that the forecast of the Ministry of Fuel that "it is quite possible that we shall be brought up against heavy load shedding if it is a cold winter," is in any way over-pessimistic. One of the problems seeking solution is how to meet the demand of the domestic consumer, whose consumption has increased from 6 000 million units per annum in 1938 to 12 000 million in the current year. During the summer the Government again considered the war-time rationing proposals, only to dismiss them on the ground that they would, among other things, fall inequitably on those consumers who have already reduced their demand to a minimum. The expedient of "price disincentives," in the form of a discouragingly large increase in cost per unit, was, quite rightly, also rejected. If the domestic load is to be reduced, therefore, there remains but one alternative, that of voluntary economy. A campaign to that end is now under way.

Local Fuel Saving Committees

THE current domestic economy campaign is distinguished from its predecessors by being on a local basis. Comprising in most cases representatives of

the local municipality, the local gas and electricity undertakings, women's organisations and other local bodies, fuel savings committees are being established in towns and cities throughout the country. Delegates from these committees will in the course of the next few weeks attend meetings to be held in the majority of the larger towns, where they will be addressed by a Minister, and where they will discuss ways and means of impressing the gravity of the situation on consumers in their localities. The general public, which has been exhorted to save or economise in one direction or another since 1939, is now understandably showing an appreciable immunity to national campaigns, and it may be that useful results will emerge from the decision to place the task of public education on those who know, and are known by, their own townspeople.

The F.B.I. and Power Stations

IN a letter to "The Times" last week Sir NORMAN KIPPING, Director-General of the F.B.I., asked whether there was any likelihood, in view of the industrial re-organisation and deferment of re-equipment which the export drive will entail, of the growth in demand for electric power keeping pace with the £450 000 000 extension programme announced recently by the C.E.B. Incidentally, he inquired, what proportion of the current growth in demand would disappear if there were no shortage of solid fuel? Sir NORMAN's misgivings are understandable, but there is little reason to suppose that the Central Board's estimates will prove excessive, if the balance of trade position is to be appreciably improved. Of the 10 000 MW of new plant, 2 500 MW is needed to close the existing gap between demand and available supply, and a large part will go, not to increase the national capacity, but to replace the growing proportion of existing generating equipment which is over-age and consequently inefficient. Further, although the contemplated economies in capital expenditure may prevent many industries from carrying out new programmes of electrification in the near future—in time they will be forced to do so—industrial demand as a whole will obviously keep in step with rising production, and the

plans for agriculture, with their emphasis on dairy-farming, will result in a heavier rural load. To Sir NORMAN'S last question, two answers suggest themselves. First, that the end of the coal shortage for domestic consumers appears to be several years off; second, that the record of the domestic load in pre-war years, when coal was both cheaper and abundant, was one of continuous growth.

The Electron Jubilee Discourse

HIMSELF a brilliant exponent of the art of public demonstration, J. J. THOMSON would have wholly approved of the masterly experimental discourse on "The Electron Liberated" delivered in his honour by Sir CLIFFORD PATERSON, F.R.S., at the Central Hall, Westminster, last week. With the polish of a first-class conjuror, supported by the authority of a distinguished scientist, Sir CLIFFORD gave an entertaining and instructive address which was followed with rapt attention equally by a party of school-children in the gallery and a group of notable electrical engineers in the front row. In the course of an hour, he touched on nearly every important aspect of modern electronics, illustrating each point by demonstrations, the timing and success of which can only be appreciated by those who have themselves experienced the unwillingness of complex devices to behave satisfactorily before an audience. The delivery of the address itself was probably the least strenuous part of the task, which must have begun, in the preparation of script and building of apparatus, many weeks before. At the Central Hall, the appreciation of this work by the audience was unmistakable, and well deserved.

Radiolympia

A FITTING tribute to the work of J. J. THOMSON is to be seen at the Radio Exhibition at Olympia, which opened for ten days on Wednesday. The tribute is all the more impressive for—in no way intended to coincide with the electron jubilee—it shows the latest developments in the electronic field, both with respect to the broadcasting of sound and television and the application of electronics to industry. Many of the applications to which Dr. ALLIBONE referred at the I.E.E. meet-

ing last week, may be seen in operation or inspected, and if any confirmation was needed of our claim last week that it is upon the discovery of 1897 that modern-day electronic engineering is founded, it is in evidence this week at the Olympia show.

Misuse of Membership Initials

THE Council of the Institution of Electrical Engineers are deeply concerned at the increase in recent months of cases of the wrongful use of initials indicative of membership of the institution, by persons who are not entitled to use them. Our attention has been drawn to the fact that the Council are preserving their customary vigilance in these matters, and in the general interest of the public and of the profession are making energetic use of all proper measures which may be open to them to stop the practice; in particular to obtain satisfactory undertakings from offenders that they will refrain from further offence. Where such an undertaking has not been forthcoming, the Council have hitherto not hesitated to take proceedings in the High Court for an Order of the Court calling upon the offender to abandon the use of the initials and to deliver up for destruction any stationary or other printed matter exhibiting a wrongful use of initials, and they intend to continue this policy. Meanwhile, employers should, in their own interest, when interviewing prospective employees, carefully check any claims to I.E.E. membership.

Business Efficiency

THE first Business Efficiency Exhibition to be held since the war, was opened at Olympia on Wednesday, and though it does not reveal anything strikingly new in office machines and systems, there will be noted a significant change in emphasis in application, as a result of the war. The exhibition is being held because of its educational value in demonstrating the strides made in office equipment since pre-war and it shows also the increasingly important part which electricity plays in the efficient running of commercial undertakings; a part in the development of which the supply industry might claim to have shared very appreciably.

Impression of Radiolympia

Examples of Progress Since the 1939 Exhibition

THE first post-war National Radio Exhibition, organised by the Radio Industry Council, was opened on Wednesday at Olympia, and will remain open until October 11.

In the eight years since the last Radiolympia, war-time research on radar and radio communication has led to important advances in the ultra-high frequency field, in servo control mechanisms and in the design of components. The main interest in the present exhibition lies, therefore, in a study of the effects of these developments on the products shown. While the circuits of the average domestic receiver show little radical departure from those of pre-war days, the miniaturisation of components and the use of new materials is much in evidence, and in the many television receivers displayed, advantage has been taken of the progress made in the design of scanning circuits and cathode-ray tubes.

EMERGENCE OF ELECTRONICS

Possibly the most striking distinction between the exhibition and its predecessors is the emergence of "electronics" as an industrial technique of considerable importance. This is apparent on the stands of the majority of the larger manufacturers where are shown examples of industrial controllers, radio-frequency heaters and various specialised instruments, all owing much to war research. Another newcomer is radar, and on several stands there are instruments developed from apparatus designed for the Services and now coming into increasing use for sea and air navigation.

One of the first radar sets to be commercially developed is the Metropolitan-Vickers "Seascan" equipment, a centrimetric set of the P.P.I. type which was recently installed on the "Queen Mary." With four ranges, this set can detect objects up to a maximum range of 30 miles and, by virtue of a very short transmitted pulse, give clear indications down to 50 yards. The same company is also showing new radio and testing apparatus. These include a low-powered marker beacon for use on airfields, a portable signal generator, a "midget" cathode-ray oscilloscope and an electronically-stabilised power unit.

Associated with radar is a new product demonstrated by Ferranti, Ltd., by means of a working model. It is known as the hyperbolic navigational computer, and has

been designed to convert automatically the information obtained by radar navigational systems into terms of range and bearing. Two industrial products shown are a yard breakage detector and an electronic cloth guiding device, both recently developed for the textile industry. On the stand are also some specially designed lamps and valves and a test instrument, known as the "Tesvac," which is a portable source of high frequency energy for detecting air leaks in evacuated envelopes.

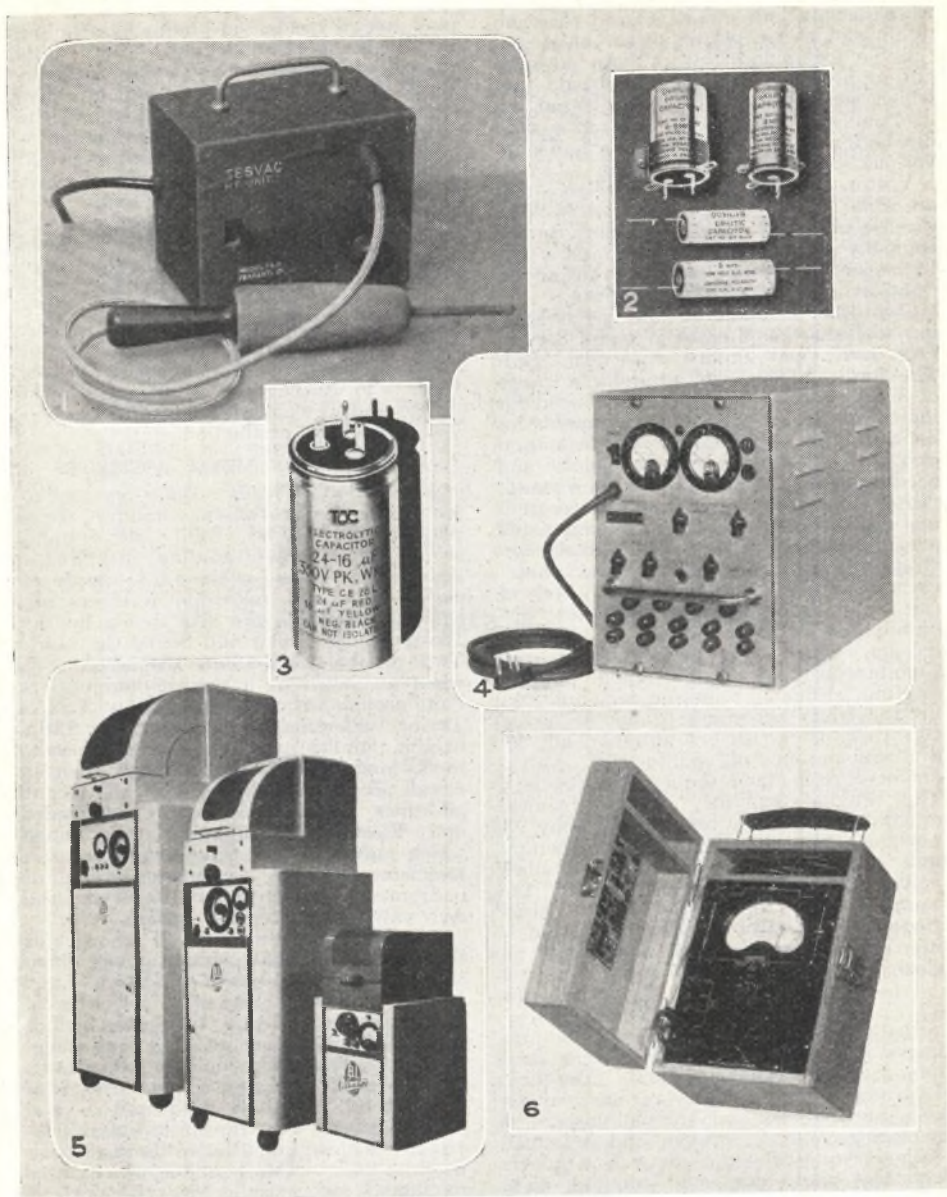
Marine radar is also featured on the stand of the British Thomson-Houston Co., Ltd., this time in the form of a prototype equipment developed for merchant ships and already being tested on a number of vessels. A micro-wave detector of moving objects is used to demonstrate the principles on which the proximity fuse was designed. Other demonstrations show an electronic-amplidyne position-control servo mechanism and a thyratron-controlled motor in operation. Industrial equipment made by the company is represented by a new resistance welding control panel, a high frequency heater, a photo-cell relay and a variety of specialised valves.

With four stands in the exhibition, the E.M.I. group are showing one of their war-time radar developments, "Rebecca," which is now becoming a widely used fitting for guiding aircraft to the runway. Another development is a film scanning unit for television, and amongst industrial items are several r.f. heaters. On the stand of Marconi's Wireless Telegraph Co., Ltd., a marine radar on which the picture received on the P.P.I. screen may be compared instantly with the chart is shown, as well as a variety of directionfinders and blind approach guides for aviation. Representative examples of the company's broadcasting and television transmitting equipment are also on view.

MAGNETIC SORTING BRIDGE

In addition to a 5 kW r.f. heater, the General Electric Co., Ltd., show a magnetic sorting bridge, a device for keeping a continuous check on the mechanical and chemical properties of ferro-magnetic parts as they are made. Specimens are rapidly compared with a standard part, any deviation of the product being shown by means of a shift on a c.r.t. trace. A magnetic tape recorder and a 1 kW f.m. transmitter are among other exhibits.

Another company exhibiting r.f. heating equipment is B.I. Callender's Cables, Ltd.,



SEEN AT RADIOLYMPIA

This year's radio exhibition—the 15th since the series started in 1922 and the first since the outbreak of war interrupted the 1939 show soon after its opening—is the largest, in terms of both stand space and the number of exhibitors, yet to be held. Special features include a section devoted to industrial applications of electronics. The illustrations above, which are representative of the range of products displayed, show: (1) the Ferranti "Tevvac," for testing the vacuum in evacuated systems; (2) various sizes of Dubilier "Drilitic" condensers; (3) a T.C.C. dual-section electrolytic condenser; (4) an electronic stabilised-voltage power unit, shown by the Metropolitan-Vickers Electrical Co., Ltd.; (5) large and small industrial radio-frequency heaters, shown by B.I. Callender's Cables Ltd.; (6) the "Vampire," a new test set exhibited by Everett, Edgcombe and Co., Ltd.

whose sets include one developed for seam welding of thermoplastic sheets and forms suitable for soldering work. An all-wave anti-interference aerial for domestic use, which acts as a "T" type aerial on medium and long waves and as a true dipole for short waves is shown, as are various special wires and cables.

Visitors to the Cable and Wireless stand are able to see in operation a working wireless-telegraph circuit relaying to the company's station at Barbados, and a new high-speed photo-electric transmitter, capable of 800 words per minute.

Two other companies showing r.f. heating sets are the Mullard Wireless Service Co., Ltd., and Philips Electrical, Ltd. The former display in addition, a range of silica transmitting valves developed for industrial heaters, one being capable of delivering up to 75 kW at 30 Mc/s, and electronic flash tubes, photo-cells and accelerometers. On an information stand, visitors' technical questions are answered, and on another the company have erected a model electric railway system to demonstrate some of the properties of photo-electric cells for industrial control, both of the "start-stop" variety and for discriminating between objects of different colours. Three 00 gauge trains run simultaneously over common tracks, starting, stopping, shunting and building-up the trains according to the colour of the trucks is carried out automatically by a combination of photo-cells, valve-operated relays and sequence controllers. The Philips exhibits include medical apparatus, such as a mass radiography X-ray unit, and a 300 W short-wave therapy unit embodying a special type of silica valve. The industrial products of the company are represented by a high-frequency generator for hardening, soldering, sintering or moulding metals and an electronic welding control unit.

NEW INSTRUMENT DESIGNS

Instruments for laboratory and factory-inspection purposes form the major item on several stands. Salford Electrical Instruments, Ltd., display various moving-coil, moving-iron and thermal meters, a resistance-capacity bridge and a small cathode-ray oscilloscope, as well as quartz crystals, photo-cells and toroidal cores and coils. An interesting new tester using a patent rectifier circuit, is seen on the stand of Everett Edgcumbe and Co., Ltd. This is known as the "Vampire," and measures power in four ranges up to 5 kW, as well as current and voltage. They also show a 500 V insulation tester, said to give a better waveform than the conventional d.c. generator, and two all-purpose test sets.

The Edison Swan Electric Co., Ltd., dis-

play several specialised products, including the electro-encephalograph and its associated low-frequency wave analyser, shock therapy equipment and an electronic stimulator. On another stand, the company show an office intercommunication system, loudspeakers, pick-ups and valves and cathode-ray tubes. Dawe Instruments, Ltd., exhibit a sound level meter for determining the acoustic fidelity of radio receivers, and have a special display which illustrates the use of stroboscopic light for loudspeaker cone analysis. A useful receiver tester, comprising a crystal-checked signal generator, audio-frequency tone source and an output meter, is shown by Marconi Instruments, Ltd., who display, in addition, a test bridge and instruments for use in receiver and component production.

HIGH TENSION METAL RECTIFIERS

A new double-beam cathode-ray oscilloscope is a feature of the Standard Telephones and Cables, Ltd., stand, and several new types of rectifier, including a series of rod units for the e.h.t. supply of oscilloscopes and television receivers are shown. Rectifiers are also shown by the Westinghouse Brake and Signal Co., Ltd. Two of the e.h.t. units displayed will, when employed in a voltage-doubler circuit, provide an output of 8 kV at 8 mA. Taylor Electrical Instruments, Ltd., exhibit multi-range measuring instruments and specialised equipment such as circuit analysers and bridges, while recent additions to the Automatic Coil Winder and Electrical Equipment Co.'s range which may be seen include an electronic testmeter—a valve voltmeter type of instrument working up to 10 kV—and the Avo valve characteristic meter.

Several manufacturers well known for their components have stands, among them the Dubilier Condenser Co. (1925), Ltd., who show a comprehensive selection of capacitors and resistors, the latter including high stability and precision wire-wound types, the Telegraph Condenser Co., Ltd., whose exhibit includes a new design of "Micadisc" capacity bush and several h.t. condensers for transmitters and television receivers, and Electro-thermal Engineering, Ltd., with a stand on which valve retainers, resistance cords, thermostatic switches and cord switches are to be seen. The Plessey Co., Ltd., show trimmers, chokes, electrolytic condensers, switches, transformers and a number of television coils and other components.

The British Vacuum Cleaner and Engineering Co., Ltd., show, through their associate, the Magneta Time Co., a range of p.a. amplifiers with outputs from 10 W to 100 W. Car radios and aerials and special receivers designed for export are

seen on the stand of E. K. Cole and Co., Ltd., in addition to the company's normal range of domestic receivers. The exhibits include a large radio-gramophone covering a wide audio band.

Specialised insulating materials are to be seen on the stand of De La Rue Insulation, Ltd., whose products include laminated boards, a laminated plastic material in coloured sandwich form intended for the engraving of instrument dials and panels and various decorative plastic materials for radio cabinets. A selection of thermoplastic extrusions, varying in size from less than 1 mm. to 6 in. is shown on the stand of Teneplas, Ltd., the material mainly used being P.V.C. The company also display some examples of polythene extrusions. Another stand displaying a range of insulated wires is that of the Sterling Cable Co., Ltd., who are also exhibiting high-frequency coaxials. Duratube and Wire, Ltd., display wires and cables insulated with "Duratuf S." P.V.C., including screened types for communications equipment. Other applications of P.V.C.

exhibited by this company are for decorative strips, carrying handles for portable receivers and thread for binding wiring assemblies. Resistance line cords and the assembly of cable forms for the radio industry are shown by Ripaults, Ltd., on a stand which also displays cables, wires and insulated and screened sleeveings.

Domestic aerials for radio, television, cars, and a model from a new range designed for frequency-modulation reception are shown by Aerialite, Ltd. The latter are horizontally polarised and suitably dimensioned to form an efficient beam. Cables exhibited by the company include a coaxial feeder and a balanced twin low-loss feeder, both designed for television and f.m., up to 1 000 Mc/s.

A demonstration showing how the bit temperature of a soldering iron may be determined whilst joints are being made is given by Multicore Solders, Ltd., where a special feature is a production belt on which girls may be watched assembling a radio sub-chassis.

St. Pancras Electricity Jubilee

A DEMONSTRATION of the effect of varying shades of artificial light on colour in women's wear and the possibilities of fluorescent lighting in decorative art, was given at a fashion parade which followed a lecture on this source of illumination, arranged by Thorn Electrical Industries, Ltd., in conjunction with the St. Pancras electricity department, as part of the celebration of the 50th anniversary of the undertaking, at St. Pancras Town Hall, London, on Monday.

Introduced by Mr. A. Stanley Shier, a director of Thorn Electrical Industries, Ltd., who presided, the Mayor said St. Pancras was the first London borough to have an electricity undertaking. This was in 1891, and but for the war its jubilee would have been celebrated in 1941. Now, because of present conditions, the celebrations were on the austere side and would take the form of a party that evening for the employees of the undertaking. Last week there was an exhibition showing the facilities that were available by the way of public services. Last year the undertaking generated and sold 98 million units, the gross revenue exceeded £686 000 and, despite the fact that concessions totalling £6 000 were made to consumers, there was a profit of £22 000.

The lecture, in two parts, on "Fluorescent Lighting," was delivered by Dr. J. W. Strange, chief chemist of the Thorn Electrical research laboratories, and Dr. H. H. Ballin, manager of the illuminating engineering department.

Dr. Strange described the various methods of starting the electrical discharge in a fluorescent tube and introduced the "Quickstart" unit, recently developed by the company and designed for almost immediate starting of the lamp, even under conditions of excessive voltage drop, as experienced last winter. The unit consists of an auto-transformer, the primary winding of which is connected across the fluorescent tube, with the secondary winding in two separate sections—one across each cathode. When the lamp is switched on, practically the whole mains voltage appears across the filament transformer primary and the cathodes are heated by current from the secondary windings. As soon as the cathodes are hot (this usually takes about half a second) the lamp strikes and the voltage across the primary of the transformer falls to the lamp voltage, about 110, and the cathode voltages are correspondingly reduced. Starting is assisted by the proximity of an earthed shield inducing an electrostatic field. It is claimed that rapid starting of an installation designed for 230 V is obtained at mains voltages below 180, and once started the lamp will remain alight at voltages considerably lower than 180; that lamp life and efficiency are not reduced and that the additional running losses introduced by the "Quickstart" unit are small.

Dr. Ballin spoke of the application of fluorescent lamps to store and domestic lighting.

Discovery of the Electron

Public Demonstration of Modern Electronics

THAT part of the electron jubilee celebrations arranged for the non-technical public began on Thursday evening, September 25, when Sir Clifford Paterson, F.R.S., delivered before a large audience in the Central Hall, Westminster, an experimental discourse entitled "The Electron Liberated." Many parties of school-children and students were present, and the demonstrations with which Sir Clifford illustrated almost every point of his talk were applauded. Drawn from the research laboratories, of which Sir Clifford is director, of the General Electric Co., Ltd., the apparatus was well calculated to show to the best advantage in a large auditorium the many aspects of modern electronic engineering.

LIGHT AND SOUND

After a short introduction by Prof. M. L. E. Oliphant, Sir Clifford began by demonstrating the three kinds of electrical phenomena on which Thomson based his work, these taking the form of lightning strokes, the carbon arc and the glow discharge. A short reference to thermionic emission was illustrated with two modern radio valves, one very large and the other small and, after demonstrating the nature of speech waveforms on a cathode-ray tube, Sir Clifford came to a short musical interlude, in which a discharge lamp in the gallery, light-modulated by a gramophone record, transmitted to a photo-cell receiver and amplifier installed on the stage.

The final and most spectacular part of the discourse was concerned with discharge lighting in its various forms. The disadvantages of modern street-lighting from the aesthetic point of view were pointed out with the aid of two lady assistants dressed in bright-coloured dresses who stood in turn before filament, sodium and h.p. mercury vapour lamps. In contrast, they were lighted by a modern form of film studio discharge floodlight and the accuracy obtainable with this new development was effectively shown. A familiar brewer's advertisement, pasted on a rapidly rotating disc, illustrated the property of high-powered stroboscopic flash lamps of making moving objects appear stationary. The discourse ended with an attractive series of experiments designed to indicate the range of colours and increase in light efficiency obtainable with fluorescent powders.

Before Sir Clifford Paterson delivered his

address at the Central Hall on September 25, the electron jubilee celebrations had opened in the morning at the Royal Institution, when Prof. J. A. Crowther spoke on the history of the discovery and the early development of the electron and reviewed the pre-electron age of physics, detailing the course of events by which the electron was established, despite scepticism and opposition, as a "respectable" member of the scientific community. Prof. Crowther then quoted from Thomson's historic lecture the pronouncement concerning "corpuscles," from which the new electronic era might be said to date. Although that pronouncement was spoken of as the discovery of the electron, there was no evidence that Thomson at the time identified his corpuscle either with the "electron" of Johnstone Stoney (who had used the term in 1891 to describe a fundamental unit of electrical charge, comparable with the atom as a fundamental unit of mass), or with Larmor's "freely mobile intrinsic strain in the ether." The identification of the corpuscle as an atom of pure electricity was still to come. What the pronouncement contained, for the first time, was the conception of the atom as a structure which could be explored, an atom whose properties, chemical and physical, one might hope to explain in terms of the number of corpuscles it contained. This opened up an almost limitless field of exploration.

THEORETICAL PHYSICS

Continuing the meeting, Prof. R. E. Peierls gave a lecture on "Electrons in Modern Theoretical Physics," first describing Bohr's study of the hydrogen atom and tracing the evidence which led to the breakdown of classical mechanics. From this had arisen the Quantum Theory and wave mechanics, in which some of the older notions of classical mechanics were abandoned, and it was realised that the difference that had been drawn between light and material particles, between waves and corpuscles, was not as fundamental as had been thought. The phenomenon of super-conductivity had so far persistently refused to be explained. Whether there was some basic property of the electron that was not as yet known, or whether we had merely not been sufficiently intelligent to see from the laws that were known in which way the super-conductivity came out, had not yet been discovered. Personally, he was inclined to believe that the second view was correct.

The I.E.E. and the Electron

Unveiling of Portrait of Sir J. J. Thomson— Commemorative Addresses

THE celebrations in connection with the discovery of the electron were continued on September 26 at the Institution of Electrical Engineers, when the proceedings commenced with the unveiling by Sir George Thomson of a portrait of his father, Sir Joseph J. Thomson, painted by Mr. Francis Hodge.

Mr. V. Z. de Ferranti, president, was in the chair.

ELECTRON IN RESEARCH

The first lecture was then given by Sir George Thomson, who spoke on "The Electron in Research." He said that it was at least as important, and in his opinion more amusing, to discover new effects which had never been suspected before, even if one could not explain them. This view had always been held by his father, who had been gratified when such discoveries were made as a result of his work. The conception of the electron had led to many such discoveries, both directly and indirectly. There was hardly an experiment now in progress which did not make use of the thermionic valve in some form or other.

It had been known for many years that electrons possessed wave properties, just as light waves possessed particle properties; and therefore any optical instrument had an electron analogue. The two which had been most developed were the microscope and the electron diffraction camera, which was in essence a grating spectrometer in which, however, unlike its optical analogue, we were interested in finding out facts about the grating rather than about the radiation. The electron microscope followed its optical analogue closely, and this was true whether electrostatic or magnetic lenses were used. As regards orders of magnitude, voltages were of the order of 50 000, sometimes ranging to 300 000 for special purposes. Maximum magnifications were of the order of 20 000, although 500 000 could be reached, about equally divided between the two stages. To these were often added a final optical stage, applied either to the photograph itself or to the fluorescent screen. Overall magnifications of the order of 300 000 were not uncommon. In electron diffraction, the electrons, acting like waves, were diffracted by the regular arrangement of the atoms in a crystal, like light by a ruled grating.

The lecturer then showed, with the aid of lantern slides, some specimens of the results obtained, and pointed out that this type of analysis was specially useful in dealing with surface layers. Electron diffraction also fitted in well with examination in the electron microscope, since a specimen could be examined by diffraction, without shifting it from the microscope, i.e., by cutting out the lenses, except the condenser, though in practice rather more complicated methods were used, and use was made of one of the lenses to focus the diffraction pattern and so improve its sharpness.

The subjects which he had in mind, and for which electron diffraction had proved valuable, included the nature of the polish layer on metals and some crystals, the orientated growth of crystals on crystalline substrates, the orientation of molecules of lubricants, and the chemical changes on the surface of solids, especially when these involved the growth of a crystal conformably with a substrate. In addition, the diffraction of electrons by gaseous molecules had become a standard method for investigating the distances between the atoms in a variety of compounds and was of value to chemists.

As an example of the way in which the methods of electron diffraction and the electron microscope could be made complementary to one another, the lecturer gave a description of some recent work by Raether in Germany on the polishing of rocksalt.

HIGH VOLTAGE GENERATION

On the subject of the generation of high voltages, Sir George Thomson said that from the research point of view nuclear physics required energies at the very lowest of the order of a million volts, while many problems required more. To test the fascinating possibilities of creating pairs of mesons or pairs of protons would require about 200 MEV and 2 000 MEV respectively, as a minimum. On the practical side, X-rays of tens of millions of volts were likely to come into common use, and this implied electrons of corresponding energies to generate them. He then limited his remarks to those methods of producing high energy particles which were applicable to electrons.

The standard methods were those based on the use of transformers and condensers,

which were well established; but it should be said that though satisfactory for smaller energies, they got very cumbersome over about 2 MV. The other methods were the Van de Graeff electrostatic generator, the Betatron, the Synchrotron, with its variant the Microtron, and the Linear Accelerator. Between the last three there was competition as to which was the more practical and economical—or perhaps the least ruinously expensive—for reaching very high energies. The lecturer then gave a detailed description of these methods.

GRAEFF ELECTROSTATIC GENERATOR

The principle of the Van de Graeff electrostatic generator was extremely simple. It consisted in spraying charge in the form of ions on to a moving belt, and so carrying it mechanically to the high potential electrode to which it was discharged through a comb of points. The machine was satisfactory for energies up to about 2 MV. The Betatron was in essence a transformer in which an electron stream, bent into a circular path by a magnet, acted as a single turn of a secondary. There were thus essentially two magnetic fields, one which by its variation produced a tangential force on the electrons, and the other which held the latter in their orbits. It was not difficult to see that the two must be linked together, and in fact increase proportionally, if the orbit of the electron was not to change much in size during the acceleration, and this was very desirable for practical reasons. A simple calculation showed that if the fields started from zero, the field at the orbit must be one half the mean flux density through the orbit. Various attempts to use a method of this kind had been made, but Kerst seemed to have been the first to produce a practical machine. Betatrons for large energies were large machines. One that the lecturer had seen recently at Schenectady which gave 100 MV weighed 130 tons, one giving 50 MV and designed for medical therapy weighed 10 to 12 tons, and a small one of 10 MV had been designed for industrial radiography and could be tilted to suit the needs of the moment.

PRINCIPLE OF THE SYNCHROTRON

The principle of the Synchrotron could best be seen by writing the general equation for a particle describing a circle in a magnetic field in the form $Hr = \frac{mVc}{e}$ which was true relativistically if m was the relativistic mass. The time in the orbit

$$= \frac{2\pi r}{V} = \frac{2\pi mc}{He} = \frac{2\pi}{He} \frac{W}{c}$$

where W is the total energy including that of the rest mass. In the ordinary cyclotron heavy particles were used for which $m \approx m_0$. Hence the period was nearly constant, and the particle could be given a kick in phase, each time it went round by using an alternating field of constant frequency between the *dees*. For very high energies this became impossible, even for heavy particles, and the frequency must be modulated or H varied. With electrons, W was not even nearly constant, though the speed was, being nearly that of light. It was not practical to change the frequency sufficiently to allow for the change in W , so this was kept constant and H varied. Since the frequency and speed were constant the radius of the path was constant, in contrast with what happened with the ordinary cyclotron, and so the magnetic field needed only to be maintained over an annulus. This was a great economy. The acceleration was a comparatively gradual one, extending over a large part of the time during which the magnetic field was increasing. Hence the particles did not each time need to receive the full energy which the alternating field could give. This made for stability.

LINEAR ACCELERATOR

The Linear Accelerator was a very promising device consisting of a number of boxes between which the electron was pulled, but there were difficulties in the synchronous running of large numbers of magnetrons in phase, and it would require a good deal of development before voltages in hundred millions were reached.

On the whole the lecturer thought the immediate future seemed to be with the air-cored synchrotron, which might reach 1 000 MV fairly soon.

In conclusion, he said that it was possible that in the future high energy electrons might be used directly in therapy. The actual therapeutic action of X-rays was, of course, due to the electrons which they ejected from the tissues, so that qualitatively one would expect the action of X-rays and electrons to be similar. They differed, however, in the depth in the body at which the action took place. Electrons had a more or less definite range and exerted their greatest effort shortly before they came to an end, which was what was needed therapeutically. It avoided damage to the skin and to parts deeper in the body than that which it was desired to treat. Electrons might also be used for sterilising; their relatively short range being an advantage here, if only a layer of a few millimetres was to be treated.

The Electron in Industry

Developments Which Have Come About Since 1897

A SECOND lecture at the I.E.E. on September 26 was on the subject of "Electrons in Industry," which was delivered by Dr. T. E. Allibone. The dividing line between research and industry was, he said, never very clearly defined, and in the applications of the electron this line was almost non-existent. The lecturer then proceeded to describe the most recent industrial applications of the electron in various forms of vacuum discharge tubes.

In 1897 Sir J. J. Thomson had described the properties of the corpuscle emitted by atoms in a discharge tube from glowing carbon filaments, and from the metal surfaces irradiated by ultra-violet light. The beam of cathode-rays—or electrons—had become of immense value, because the electron was so light that very little energy had to be supplied to deflect the beam instantaneously, and because the beam caused phosphorescence of certain crystalline materials when it struck them. From those early beginnings, an industry had developed which at present produced 100 000 cathode-ray tubes in this country and would soon be producing a million tubes a year.

CATHODE-RAY TUBE

Modern developments of cathode-ray tubes had concentrated on the electron optics of the beam and on increasing its energy. The initial impetus for this arose from engineering requirements, the desire to examine electrical transients of very short duration. For this, the accelerating voltage applied to the electron beam had to be increased from 1 or 2 kV to 50 or 100 kV, and the beam had to be focused by magnetic lenses. Initially the whole energy of the beam had been utilised by placing a photographic film inside the vacuum chamber to record the trace. With high voltage oscillographs of this kind, practically all the most advanced industrial requirements had been met and traces could be recorded passing across the photographic film with a speed as high as about one-fifth of that of light. Such oscillographs had been extensively used to study transient phenomena on transmission lines, in transformers and switch-gear short-circuits. For the recording of oscillations of centimetric wavelength a micro-technique had been evolved to reduce the size of the deflecting electrodes. These were only .2 in. long, so that transit

time errors were eliminated, and loss of sensitivity was compensated for by reduction of the electron image size to microscopic dimensions by the choice of a very short focus high quality magnetic lens; the oscillogram suitably enlarged or viewed through a microscope showed remarkable detail at 10^9 or 10^{10} cycles per second, though the deflection amounted to only 0.1 mm.

IMPETUS OF TELEVISION

While these industrial developments had been made for transient analysis, changes had also been made to the more familiar glass cathode-ray tube under the impetus of television and the requirements of radar, so that to-day it was possible to photograph the oscillograph fluorescent screen with a good camera and record transients moving across the screen, nearly as rapidly as could be recorded by internal photography.

A great step in the improvement of the sealed-off tube was to aluminise the inside of the phosphor. As a result of this and other improvements in electron optics, a simple design of acceleration in a single stage to about 30 kV had been evolved with magnetic focusing so that the spot appeared on a flat glass screen with extremely minute proportions. With the aid of a wide aperture camera, these deflections on the screen could be recorded photographically, even if they were moving across the screen at speeds of thousands of centimetres per microsecond.

Projection television was very likely going to be achieved with a fairly small sealed-off cathode-ray tube, and a mirror and Schmidt lens projection system. Apart from television, the greatest industrial application of the cathode-ray tube was in variations of radar. Radar plots of thunder-storm cloud positions were useful to the transmission line operating engineer to enable him to isolate sections of transmission lines directly in the path of a storm and so avoid interruption to supply by flashovers and breakdowns.

On the subject of thermionic emission, the lecturer said that two years after his recognition of the electron, Thomson had shown that the negative charge emitted from a glowing carbon filament had a mass to charge ratio, identical with that of the cathode-ray corpuscle. This he had done by accelerating the corpuscles and deflecting them magnetically, so that they moved

in cycloidal paths. The electron emitted thermionically was destined to become even more important than that released in the gas discharge. England's output of thermionic valves was 20 million a year, and that of the United States ten times greater.

THERMIONIC EMISSION

Thermionic emission had developed along four main directions—the emission from pure metals like tungsten; from thorium held in a base of tungsten, giving comparable current densities at 700° C. lower than from pure tungsten; from several of the alkaline earth oxides, Barium and Strontium oxides giving comparable current densities as yet 700° C. lower than thorium; and finally emission combined with ionisation in a gas such as mercury, and more recently hydrogen.

The use of tungsten was now limited to those valves where bombardment of the filament by high energy positive ions might occur, as in the very high voltage rectifiers and X-ray tubes, or in the continuously evacuated thermionic valves and ionisation gauges in which cracking of oil vapour was occurring continuously.

Very high-powered triodes had been made in the first place, mainly for communication purposes, but the lecturer thought it was likely that their chief function would be in the direction of industrial use, such as industrial induction heating and dielectric heating. Striking development of X-ray tubes had been made in America for very high voltage acceleration of electrons. The tubes contained very many electrodes separated by short insulating cylinders, so that although no more than 15 kV was applied to any adjacent pair of electrodes, a tube such as this withstood many millions of volts. Such tubes were used industrially for metallurgical examination of welded vessels, apart from their use in nuclear physics.

HIGH FREQUENCY HEATING

The various developments in thermionic emission found application in a thousand different ways. The biggest uses were in induction heating, dielectric heating and in the realm of communication engineering. Induction heating at high frequency was universally used in the lamp and valve industry and to some extent at very high frequencies in the metallurgical industry. Dielectric heating employed a far higher frequency range; its great merit was in the ability to supply heat uniformly throughout the mass of a dielectric, so that the temperature of the inside could rise quickly above that of the outer skin. The pre-heating of moulding powders was an extensive application of this, as well as to

the manufacture of plywood and the rapid heating of deep frozen foodstuffs.

The importance of the electron was no more abundantly clear than in the realm of communication. Without the valve amplifier we could hardly imagine modern civilisation.

Television was possibly the greatest potential industrial application of photo-emission, secondary emission and cathode-ray oscillography. The lecturer then gave a description of the television camera to illustrate the technique now being perfected, and concluded his remarks on photo-emission by referring to the extreme photosensitivity of these surfaces to light. They could respond to wavelengths twice as long as the eye could see. If an infra-red image was focused on the surface, if the emitted electrons were accelerated and allowed to strike a phosphorescent screen, there was obtained a simple image converter, or light transformer, from an invisible wavelength to visible light.

THOMSON AND FLUORESCENT LIGHTING

Thomson had examined a light transformation, of great importance to industry at the present time. He had shown that in a low pressure gas discharge a great amount of ultra-violet light was present, and carefully demonstrated that the phosphorescence of glass walls was due to this ultra-violet light and not due to the bombardment of the walls by atoms or electrons. Modern fluorescent lighting depended solely on this fact: it converted the ultra-violet light into light of longer wavelength.

Finally, there were the possibilities in the realm of high tension d.c. transmission. Several large transmission schemes had been erected with mercury vapour valves. The rectifier and inverter was easily the largest user of electronic power in the whole field of electronic engineering. It rectified thousands of kilowatts for electrolytic processes, traction, welding control, d.c. supplies for factory processes, and now high voltage direct current transmission. The troubles of these devices centred around the development of arcs in the inverse or non-conducting half cycle; current opinion was that discharge began by the creation of high electric fields between the anode when at negative potential, and small non-conducting particles on the anode. Here field emission began and an arc developed. Maintenance of great cleanliness and elimination of sharp microscopic points—by polishing and by electrolytic polishing—were widely adopted techniques in the whole of valve construction in order to eliminate the onset of field emission.

Portrait—Mr. D. B. Hoseason



AN engineer administrator for the past 20 years, with opportunities to study the systems of such concerns as Siemens-Schuckert and A.E.G., Berlin, the larger factories in the U.S.S.R., and in other countries in Western Europe, Mr. D. B. Hoseason is the Director of Studies at the Administrative Staff College at Henley-on-Thames.

This college was founded by industry, the banks and commercial concerns to provide 3-month courses in higher administration. The entrants to the college must already be managers or assistant managers, preferably in their early thirties, and must be sponsored by their employing firms or authorities. The programme of instruction is mainly by study groups and debates, a method in which Mr. Hoseason is particularly experienced as he has for many years taken an active part in study groups and debating. He was formerly President of the Metropolitan-Vickers Debating Society, and has always been an active participant in the discussions at I.E.E. meetings.

Born at Leek, Staffordshire, in 1899, Mr. Hoseason was educated at Borden Grammar School, Kent, and joined the then British Westinghouse Electrical Manufacturing Co., Ltd., in 1915 as a trade apprentice fitter. He obtained his engineering education at the Manchester

As an industrial administrator, Mr. Hoseason believes that the first step in administration is the formation of a team. He has therefore always taken a special interest in the selection, training and placing of men. When with the Metropolitan-Vickers Electrical Co., Ltd., he introduced various schemes of training for junior engineers, and at the Brush Company he took over at an early stage the direction of the apprenticeship scheme. The Brush Craft Selection School for Trade Apprentices was the first of its type in this country and the Training Scheme for Professional Electrical Engineers had many novel features about it.

College of Technology by evening class work, and with a break of 2½ years' war service he eventually became an Associate of the Manchester College of Technology.

On returning to Trafford Park in 1919, he was for a short time in the research department and eventually became a motor designer. In 1925 he was appointed engineer-in-charge of motor development and in 1928 chief engineer of the Metro-Vick motor department. In December, 1940, he joined the Brush Electrical Engineering Co., Ltd., as electrical director. In July, 1945, he was appointed assistant managing director of the company and at the same time took charge of the turbine department and the majority of the feeder departments. He held this position until February, 1947, when he took over his present office of Director of Studies at the Administrative Staff College.

Mr. Hoseason has presented a number of papers before the I.E.E. and has been awarded various Premiums including the Willans and the John Hopkinson. He became an Associate Member at 24 years of age, and was elected a full Member at 31. He has been a Member of the Council since 1942 and takes the office of Vice-President in the forthcoming session. He is a Member of various I.E.E. Committees including the General Purposes, Education and Training and the Local Centres Committees. He is a Member of the "Mechanicals," of the American Institute of Electrical Engineers and was recently appointed to the Mechanical Engineering Research Board of the D.S.I.R. He was a member of the joint committee of the B.E.A.M.A., Radio Industry Council and the I.E.E. whose report on the practical training of professional engineers was reviewed in *THE ELECTRICIAN* of July 18, 1947.

About Transformers*

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

The Mechanical Design of Windings

THE ability of a transformer winding to withstand the mechanical stresses to which it will be subjected in normal service—and normal service must be expected to include a number of system faults of varying severity—depends in the main upon two factors; the actual support and clamping of the coils and the electro-magnetic balance between the primary

winding apart. The effect of having the windings differing in length is shown in Fig. 1c, and if the centres do not coincide the conditions depicted in Fig. 1d will result.

The desired effect is easy to obtain when dealing with two simple windings, but the introduction of reinforced insulation for end turns, radial cooling ducts, and above all, the fitting of tappings, are all disturbing factors which need special treatment in the design of all but the smallest transformers.

An artificial thinning of the ampere-turns of one winding by introducing some suitable packing, will balance the reinforcement or radial ducts in the other, but to balance a winding fitted with tappings on every tapping position needs special methods, a few typical examples of which will be described.

Fig. 2a shows a simple method, suitable only for small transformers, and then only if the tapping range is not large; tappings are taken from the centre of one winding and a space is introduced at the corresponding position in the other, sufficient to balance with the mid-tapping position. Fig. 2b illustrates a similar arrangement, but the tappings are here taken from two positions in the winding; a considerable improvement is obtained by this simple

and secondary windings. Of the two, the latter is by far the more important. If the windings are balanced, all the mechanical force between concentric coils, set up by the flow of current, is radial, tending to burst the outer coils and crumple the inner; the copper with which they are wound will be sufficiently strong in itself to withstand these forces in all normally designed transformers.

If, however, the balance is not perfect a vertical component of the radial force will appear, and if the balance is bad this component will reach such proportions that any winding must sustain damage. For, no matter how rigid may be the clamping, the insulation will prove the weakest part of the assembly and become crushed, to be followed by an electrical failure.

To obtain an electro-magnetic balance, the two windings must be of the same effective length and the distribution of the ampere-turns between the two windings must be symmetrical. Thus, Fig. 1a shows balanced windings, diagrammatically, all the forces being radial. In Fig. 1b is seen the effect of cutting out a section in the centre of the outer winding as by tappings; the mechanical forces are then trying to force the two halves of the

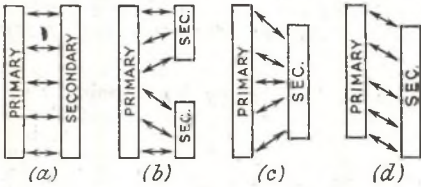


Fig. 1

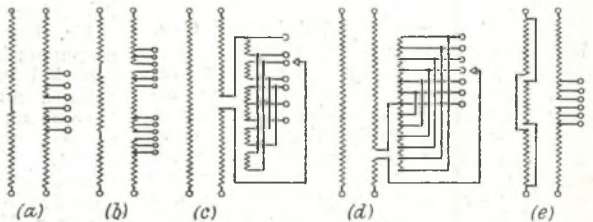


Fig. 2

modification. If the turns between each tapping can be arranged to fill the complete winding length, an excellent balance is obtained and this method is often applied to tappings on low voltage windings, but it is not economically permissible for high voltage windings, except on the very largest transformers. Another arrangement giving a good balance is to have all the tappings grouped in one layer occupying the complete winding length, and independent of the main body of

* Parts I and II of this series were published in THE ELECTRICIAN of August 15 and 22, respectively.

ampere turns. The tapplings should cut sections out as nearly as possible, equally above and below the centre line. Two

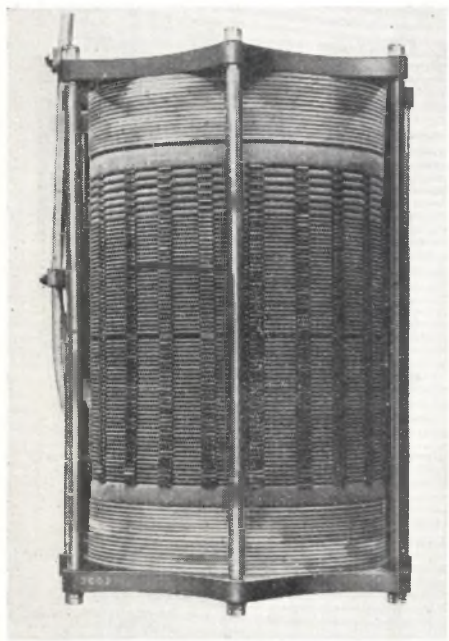


Fig. 3—Complete limb of coils ready for assembly on the core

variations of this arrangement are shown; in Fig. 2c the outer tapping layer is interconnected and sections are cut out alternately above and below the centre line; in Fig. 2d the tapping sections are wound in two coils connected in parallel from the centre of the limb, and thus turns are tapped out from above and below the centre line simultaneously.

A less commonly used, but very effective method is illustrated in Fig. 2e. The tapplings are taken from the centre of one winding, and, occupying the corresponding position in the other winding, is an auxiliary coil containing the full number of turns and connected in parallel with the main turns. The current carried by the auxiliary coil will vary with the tapping in use and will always be sufficient to balance the ampere-turns existing in the tapping section of the first winding.

The practice of fitting tapplings at the end of a winding is not permissible in any but the very smallest transformers. It will be understood that when the end or the centre of a winding has been mentioned, it is the physical position which is meant; the electrical position will not affect the mechanical forces involved and

other considerations will dictate the electrical position chosen for the tapplings. As, for instance, when tapping a high voltage winding which is connected in star with the star point earthed, it is good practice to situate the tapplings at, or close to, the earthed end of the winding. By this means the insulation necessary for the tapping leads, both between phases and to earth, is greatly reduced, with a corresponding reduction in cost and increased reliability in the transformer, and if an on-load tap changer should be involved the advantage gained is very considerable. The tapplings are arranged as in Fig. 1d. Again, it is sometimes an advantage to locate the tapplings in the series connection between the legs of a two-limb core type single-phase transformer, but if this is done the series connection must be made from the physical centre of the limbs.

The basis of the mechanical design of a transformer winding must be the employment of a process which will thoroughly pre-shrink the insulation used, so that once the coils are erected and clamped, any further movement due to shrinkage is negligible. Many transformer specifications still contain clauses regarding the taking up of any slackness which may develop in the coil stack by means of adjustable clamping, either automatic or by hand. These clauses must be regarded as a relic of the old days when

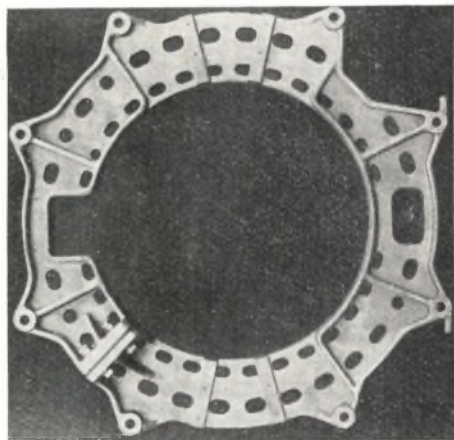


Fig. 4—A steel coil clamping ring of the type used in the assembly shown in Fig. 3, above

impregnating processes had not reached their present standard. Shrinkage did take place in service and as a choice of evils it was probably better to take up the slackness. If no shrinkage takes place subsequent to assembly, the presence of adjustable clamping screws, although

unnecessary, can do no harm, but if they lead to the slightest carelessness either in process or erection, with the underlying idea that any small discrepancies can be taken up by the clamping, then they are a bad thing. It must be obvious that unless exactly the same change takes place in both windings, and this would be a coincidence too great to hope for, any adjustment made after the windings have been properly assembled must inevitably upset the electro-magnetic balance between windings for which the designer has striven and schemed. A fault on the system to which the transformer is connected may then produce sufficient vertical force to crush the insulation, and this will, in turn, permit of further tightening up. The vicious circle thus set up, can only end in the breakdown of the transformer.

Fig. 3 shows a typical coil assembly, the spacers between the coil sections, consisting of a heavily compressed insulating material, are carefully arranged in vertical columns so that pressure is never transmitted through an unsupported coil element. Likewise, the vertical insulating strips which key the spacers into position, those which locate the insulating barrel between the high tension and low tension windings, and those which maintain the vertical oil ducts within the low tension windings, are all arranged in radial lines. The major end insulation, in this case of

the whole of the coil end surface. The steel end rings, of which a typical example is illustrated in Fig. 4, clamp both primary

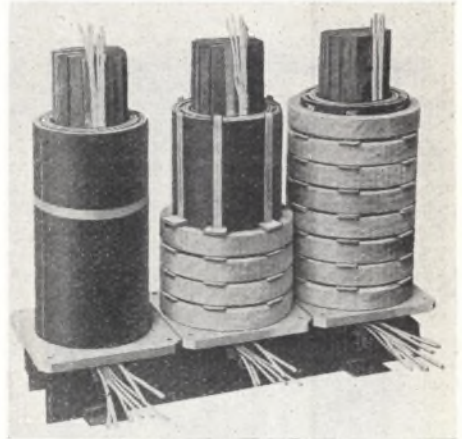


Fig. 6—A small transformer in the course of erection, showing the insulated clamping board which clamps the h.v. winding only

and secondary windings so that no relative movement can possibly take place. In addition, it enables all the windings for one limb to be handled as a unit, which is an advantage during manufacture and greatly facilitates not only the transport and storing of spare coils, but also repair operations, if these should be necessary on site. All the members of such a clamping structure must be earthed and they must also be insulated one from the other, so that no closed electrical path may be found for stray currents. The rings themselves must not, of course, form a closed-turn round the core leg, and a break must be made electrically without detracting from the mechanical strength. Sturdy lugs welded to the ring can be seen in the illustration; the pad between them is of an insulating material and the bolts holding the lugs together are insulated with Bakelite tubes and washers.

Some designers prefer to apply clamping pressure by means of screws operating through threaded projections welded to the top core clamps and bearing down upon a rigid clamping ring. It is usual when employing this method to clamp the two windings independently, each having its own clamp ring and "pinching" screws. In Fig. 5a the clamp ring is at earth potential and bears on to the coils through a solid insulating ring. In Fig. 5b the clamp ring is connected electrically to the end of the winding upon which it bears direct. This ring will form an effective static charging ring, but in this

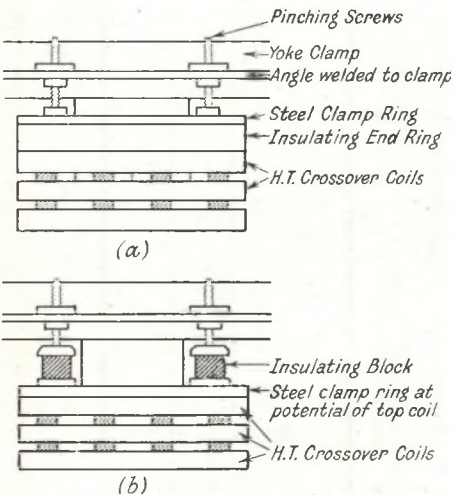


Fig. 5

specially treated wood, is in the form of a solid ring which ensures that the pressure exerted by the steel tie rods, and transmitted through the rigid steel end rings, shall be distributed evenly over

case it is necessary to introduce an insulating link between the clamping screw and the ring. Under fault conditions, if there is any vertical component of the force generated, the screws will be operating in compression which is not the best way of utilising their mechanical strength, and in the second case, an insulating material strong enough to maintain an effective clamping pressure beneath the screws is difficult to obtain. Although some precautions must be taken, this type of clamping rarely suffers from the development of closed circuits and stray currents. There is some danger that the clamping pressure may fall upon the core bolts and their insulation, with the possibility of the insulation becoming impaired, and although tie rods between top and bottom core clamps can obviate this danger, very careful adjustment is required. For transformers of less than about 200 kVA rating, clamping screws in any form are dispensed with and the coils wedged, by means of their end packing, between the yokes of the core, while brackets welded to the core clamps support the overhanging portion of the windings. A further method of coil clamping, applied to transformers up to about 500 kVA, is seen in Fig. 6. The low voltage—a spiral winding is simply wedged between the core yokes; the high voltage—a stack of cross-over coils is clamped between two boards of insulating material, by means of steel tie rods. As indicated in Fig. 1b, a high voltage winding with tappings in the centre tends to be forced apart axially from the centre; this method, therefore, supplies good clamping just where it is needed in an effective, simple and cheap manner.

The cooling of an oil immersed transformer takes place in two stages, first the heat has to be transferred from the coils to the oil, which may be termed the intermediate coolant; from thence the heat must be passed to the true cooling medium, the ambient air, or less commonly, to water. This latter stage will be discussed elsewhere. The first heat transfer requires that a sufficient coil surface be in contact with a free flow of oil. We have seen how oil ducts are introduced into the windings, and in Fig. 4 will be seen the various slots in the clamping ring designed to allow a free path for the oil to and from all the winding ducts. The stepping of the packets of core steel in the yokes is designed to improve the magnetic characteristics of the core; at the same time it improves the flow of oil from those ducts which have their termination under the yokes.

In the smaller sizes of transformer, where the clamping is not so complete, it is common practice to castellate to the

depth of about 20 mm., the ends of the barrels between windings and also the ends of the pieces of Bakelite tube forming end packing for spiral coils. In addition, the vertical spacing strips are arranged to end about 20 mm. short of the full leg length; both of these measures make easier the path of the oil from the inner ducts.

(To be continued.)

Batti-Wallahs' Society

AN extremely interesting address on "The Origin and Development of the Livery Guilds of the City of London" was given by Mr. Edgar P. Angus, a member of the Goldsmiths' Company and of the London and Middlesex Archaeological Society, at the monthly luncheon of the Batti-Wallahs' Society in London on September 25. The president, Col. H. J. Wellingham, occupied the chair.

Mr. Angus said there are seventy-nine livery guilds and in 1939 thirty-five had halls of their own. Seventeen were utterly destroyed during the raids on London; of the remaining eighteen, fifteen were damaged to a greater or lesser degree and only three escaped entirely. The Goldsmiths' Company had contributed £400 000 to the City and Guilds of London Institute and the Cloth Workers' Company had also donated a large sum to that institute.

Mr. Angus gave some interesting facts concerning the origin of the guilds, their customs and influence in the City of London, and said that up to 1835 one could only obtain the freedom of the City of London by being a member of a livery company. To-day the benefit of the freedom is purely sentimental. In the olden days only a freeman could sell by retail in the City and only a freeman could take apprentices.

Cmdr. S. Harper-Bill, who proposed a vote of thanks to Mr. Angus, said the Horners' Company, of which he is a liveryman, had admitted the plastics industry into their livery.

The President referred to the fact that one of the old members of the society, Mr. J. T. Corneille (of Veritys, Ltd), was sailing for South Africa on October 16, and, on behalf of the Batti-Wallahs, wished him a good voyage and a happy sojourn there.

Mr. L. C. W. Turner, a new member, and Mr. P. Dallison, superintendent engineer of the P. and O. Line, were introduced by Mr. M. Whitgift, "mate" and hon. secretary, who announced that Dr. T. E. Allibone would be the guest speaker at the next luncheon on October 30, and Sir Arnold Gridley would address the society on November 27.

• 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. D. W. COATES, chief accountant of the Central Electricity Board since



MR. D. W. COATES



MR. E. R. WILKINSON

it was set up in 1927, and Mr. E. R. Wilkinson, commercial manager of the C.E.B. since 1927, have received similar appointments under the British Electricity Authority. In addition to having had a varied experience in general practice, Mr. Coates was successively, between 1917 and 1921, chief accountant, financial secretary and financial adviser to the Mines Department of the Board of Trade and, on the setting up of the Ministry of Fuel and Power in 1942, he was lent by the Central Electricity Board to the Ministry

the Sea Fish Commission, 1933-35, and a member of the Land Fertility Committee, 1937-1941. Mr. E. R. Wilkinson received his engineering training at the Dick Kerr works of the English Electric Co., Ltd., and, after gaining practical works experience, concentrated on power station design, operation and production costs. For four years prior to joining the C.E.B., Mr. Wilkinson was engaged with Messrs. Merz and McLellan on power projects for various parts of the world and on many of the investigations into co-ordination of generation and standardisation of frequency which preceded the Electricity (Supply) Act, 1926.

SIR RONALD MATTHEWS, chairman of the Brush Electrical Engineering Co., Ltd., on behalf of the company, presented a gift of £100 to Mr. Harry Fraser upon



SIR MONTAGUE HUGHMAN, chairman, Henley organisation, distributing trophies at the works' swimming gala



SIR RONALD MATTHEWS, chairman, Brush Electrical Engineering Co., Ltd., presenting £100 to MR. HARRY FRASER, who has completed 63 years' service with the company

to be finance director of the Coal Division. Mr. Coates was honorary accountant of

his retirement last week, after 63 years of unbroken service. Mr. Fraser joined the company in 1884, at the age of 13. He became a specialised slotter and worked for 40 years in the dynamo shop. For the last 9 years he has been employed in the heavy engine department.

SIR MONTAGUE HUGHMAN, chairman of W. T. Henley's Telegraph Works Co., Ltd., distributed the trophies at the conclusion of the Henley swimming gala at Plumstead Baths on September 19. These included a cup, presented by the City Livery Club for annual competition, and awarded to the department of the Henley organisation scoring the highest number of points in indoor and outdoor sports. When points were totalled up it was found that the teams from the Gravesend works and the North Woolwich

works had drawn. The latter will hold the cup for the first six months, and Gravesend for the second.

MR. J. Y. COCHRANE, of Manchester, has been appointed second assistant mains engineer in the Tynemouth electricity department.

MR. O. G. COOK, chief electrical engineer and manager to Bingley U.D.C., has been elected chairman of the I.M.E.A. Mid-East England Centre. He has been vice-chairman for the last two years and is a member of the I.M.E.A. Council.

MR. T. B. NUTTER, who recently retired from the position of chief electrical engineer, received a writing bureau from the staff of the Burnley electricity department at a dinner in his honour.

MR. ALAN P. GOOD, managing director of the Brush Electrical Engineering Co., Ltd., at a small ceremony last week formally handed over to the trustees of the Brush Sports and Social Club, at the Loughborough works, the title deeds of the sports ground which has been purchased by the employees, each of whom made a weekly contribution of 7d. over a period of years.

DR. S. WHITEHEAD, director of research, British Electrical and Allied Industries Research Association, is the author of the thirteenth of a series of articles on industrial research to be published in the Board of Trade Journal as an information service to industry. It is

entitled "Britain's Electrical Industry is Found on and Lives by Research," and appears in the current issue.

MR. J. ECCLES, president of the I.M.E.A. and city electrical engineer, Liverpool; Mr. F. Newey, city electrical engineer, Lincoln; Mr. W. N. C. Clinch, general manager, the Northmet Power Co.; Mr. C. R. Heathcock, managing director, Midland Electric Corporation for Power Distribution, Ltd.; and Mr. L. Howles, general manager, South Wales Electric Power Co., have been appointed to serve on the sub-committee which the Electricity Supply Joint Committee have set up to consider the prescription of target maximum demands for each undertaking and selective load shedding, in consultation with representatives of the Ministry of Fuel and Power, the Electricity Commission and the C.E.B.

Obituary

MR. T. C. CHRISTIANSON, of the switchgear sales department of the Metropolitan-Vickers Electrical Co., Ltd., on September 20 in Edinburgh. After experience with the Newcastle Electric Supply Co. in Australia, acting on behalf of Messrs. Merz and McLellan and the English Electric Co., Ltd., Mr. Christianson joined Metropolitan-Vickers in August, 1922. For the last 25 years he had been associated with switchgear matters, on which he was a recognised authority. He was a member of the I.E.E.

Business Efficiency Exhibition

TIME and labour-saving machines and equipment, largely electrically-operated, occupy 80 stands at the Business Efficiency Exhibition, which opened in the Empire Hall, Olympia, London, on Wednesday, October 1, and will conclude on October 11. An additional feature is a series of lectures given by industrial specialists.

Electrically-operated typewriters, displayed on two or more stands, promise relief in busy offices. Requiring only the lightest touch, they call for less effort, give perfect clarity, increased speed and greater output. An electrical envelope sealing machine will seal, label and sort 20 000 envelopes an hour. An electronic multiplier does instantaneous multiplications, a high-speed sorting machine deals with 600 punched cards a minute, and another is sensitive to pencil marks and will reproduce these on punched cards. Among many other electrically-driven machines, one automatically feeds, prints and cuts labels at the rate of 9 000 an hour.

An electronic dictating machine, with

microphone electric recording, not hitherto shown, will record telephone conversations and across-desk conversations with staff. A portable electronic dictating machine for home or business use can be carried like an attache case.

Other exhibits include time-recording equipment which is automatically controlled and corrected by a master clock, internal telephone systems, a variety of counting, accounting and tabulating machines, and microfilm recording and reading units.

Among the exhibitors are the following:

The Addressall Machine Co., Ltd.; the Automatic Telephone and Electric Co., Ltd.; British Tabulating Machine Co., Ltd.; Burroughs Adding-Machines, Ltd.; Comptometer, Ltd. (Felt and Tarrant); Dapag (1943), Ltd.; the Dictaphone Co., Ltd.; Dictograph-Telephones, Ltd.; Gestetner, Ltd.; the International Coin Counting Machine Co., Ltd.; the International Time Recording Co., Ltd.; Kodak, Ltd. (Recordak Division); London Computer, Ltd.; Magneta Time Co., Ltd.; Miles Aircraft, Ltd.; Powers-Samas Accounting Machines, Ltd.; the Reliance Telephone Co., Ltd.; Rubery Owen and Co., Ltd.; Sterdy Telephones, Ltd..

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:—

Plympton St. Mary, October 6.—Works as follow: (a) supply, delivery, laying and jointing of .15 sq. in., 33 kV and .30 sq. in., 6.6 kV underground cables, with pilots and telephone cables; (b) supply, delivery and erection of: 1.—one 18 panel, 6.6 kV, 250 MVA switchboard, consisting of two 800 A and fifteen 400 A units and a bus section switch; 2.—one eight panel, 6.6 kV, 250 MVA switchboard, consisting of one 800 A and six 400 A units and a bus section switch; 3.—one 11 panel, 6.6 kV, 250 MVA switchboard, consisting of two 800 A and eight 400 A units and a bus section switch; (all switchgear to be of the compound-filled type); (c) supply and delivery to site of three 33/6.6 kV, three-phase, 7 500 kVA transformers, type O.N. Specifications from Clerk to the Council, Council Offices, Plympton, S. Devon.

Poplar, October 9.—Supply and delivery of nine 500 kVA transformers, 6 000/415 V. Specification from Borough Electrical Engineer and General Manager, London, E.14.

Plympton St. Mary, October 17.—Supply and delivery of domestic apparatus: (a) electric cookers; (b) immersion type water heaters; (c) electric wash boilers; (d) electric kettles. Specification from Clerk to the Council, Council Offices, Plympton.

Stoke-on-Trent, October 17.—Tenders invited for purchase of used electric plant, comprising one oil engine direct-coupled to d.c. generator, 15 kW, 200 V, with switchgear, and one d.c. 12 H.P. motor-driven booster set. Specification from General Manager, Electricity Dept., 31, Kingsway, Stoke-on-Trent.

Luton, October 18.—Installation of electric light in third section of Luton Technical College. Specification from County Architect, Shire Hall, Bedford; deposit, £2 2s.

Birmingham, October 20.—Supply, for twelve months, of electric kettles, cookers, wash-boilers, circulator water heaters, cooker control units, circulator water heater control panels. Specifications from Chief Engineer and Manager, City of Birmingham Electric Supply Dept., 14, Dale End, Birmingham, 4.

Birmingham, October 20.—Supply, delivery and erection of electric lighting equipment, comprising floodlights, fittings,

lanterns, concrete columns and associated apparatus for the railway sidings and roadways at Hams Hall "B" power station. Specification from Chief Engineer and Manager, City of Birmingham Electric Supply Dept., 14, Dale End, Birmingham, 4; deposit, £2.

Pretoria, November 11.—Supply, delivery and erection of: (a) piping equipment and (b) circulating water pumps and equipment, for first stage of "B" power station. Specifications from City Electrical Engineer in Pretoria or from the consulting electrical engineers, Messrs. Merz and McLellan, Carliol House, Newcastle-on-Tyne, 1; deposit, £2 2s.

Weymouth and Melcombe Regis.—Supply, delivery and erection of 250 MVA, 11 kV, polyphase metalclad switchgear with remote-control panel, to be installed at Weymouth generating station. Specification from Borough Electrical Engineer, Electric House, Westham Road, Weymouth.

Radiolympia Film Shows

DURING the course of the National Radio Exhibition, scientific and technical films will be shown each day in the cinema hall off the Grand Hall gallery.

"They're Called Electrons," produced by the Edison Swan Electric Co., Ltd., is the first of a series of instructional films in which photography is combined with cartoon work to explain the subject simply. Three films on electronics are also shown by the British Thomson-Houston Co., Ltd., the titles being "Electronics," "Electronics in Industry," and "Resistance Welding."

Radar is the subject of several programmes. In a Ministry of Supply film called "R.D.F. to Radar," the development of radar from its earliest experimental days is described. As an aid to marine navigation, radar features in "The Decca Navigator," a film made by the Decca Record Co., Ltd., to explain how this system works, and in two films shown by the Metropolitan-Vickers Electrical Co., Ltd. The titles of the latter are "Radar Goes to Sea," showing the general applications of the principle to navigation, and "Radar Record," a film record on a P.P.I. screen of a sea voyage.

The G.P.O. is exhibiting "North Sea" on October 6-11; "Night Mail" on October 7; "Copper Web," a film about the telephone system, on October 9; "Line to Tschierwa Hut" on October 4, and "How the Telephone Works" on October 8.

E.D.A. AREA CONFERENCES

SUCCESSFUL MEETINGS AT SOUTHPORT AND SCARBOROUGH

SOME 139 delegates representing 52 undertakings in north-west England and north Wales, attended the Area Autumn Conference of the E.D.A. at Southport from September 22 to 24. Lt.-Cdr. E. J. Cook, chairman of the Area Committee, presided.

Mr. V. W. Dale (E.D.A. general manager and secretary) in his opening remarks said that it was more than probable that the cost of electricity would go up in the future but the increased cost would be equated by the increased cost of other commodities, in particular other fuels. Electrification of the mines would save more than 4 000 000 tons of coal yearly, and electrification of the main line railways between 7 000 000 and 10 000 000 tons.

Mr. O. Howarth (Lancashire E.P.Co.) gave a paper on the organisation of consumer service and dealt with the principal functions of a consumer service organisation. The form of organisation which his company had adopted for dealing with network consumers—the vast majority of domestic consumers—was described. Specialists' services were provided by encouraging the area consumers' engineers to become specialists in some particular application or group of applications of electricity. Replying to points raised in the discussion, Mr. Howarth said the Lancashire E.P.Co. encouraged their staff to take courses of training. If staff were properly trained, they were trained for the industry, not merely for the undertaking. Generally speaking, the cost of the consumer service was spread over the whole of the undertaking.

RURAL ELECTRIFICATION

Mr. S. G. Roper (North Wales Power Co., Ltd.) dealt with "Electricity in Sparsely Populated Rural Areas," and said that many supply undertakings, especially the larger ones, already had their own methods of training staff to deal with service within their own areas, but the time had arrived when some larger scale methods of training should be made available to deal with rural development. The technical adviser required should, in the future, have specialised training, especially in view of the fact that the complete electrification of the undeveloped rural areas would have to be carried out on an uneconomical basis. There were comparatively few farms where, after deciding to change over to electrification, the farmer had called in an adviser to design his lay-

out on the most modern lines. It too often happened that this was done in patchwork fashion, and the farmer merely removed the belt driving an ancient piece of machinery from an old engine pulley and put it on an electric motor. There was too little liaison between the manufacturer of farm machinery and the electrical industry, but two recent examples of where co-operation had produced modern and efficient machinery and apparatus had been the Essex grinding mill and the heat storage principle of steam raisers for sterilisation. If supply authorities had more trained specialists engaged on rural applications of electricity, the development of further apparatus would be more rapid.

STREET LIGHTING

Mr. C. C. Smith (city lighting engineer's department, Liverpool) discussing practical aspects of street lighting, said that future trends could not be mentioned without special reference to the possibilities of the application of the fluorescent tube to street lighting. The fluorescent tube had many good features, low source brightness, pleasing colour, high lumen output and large dimensions of source. This latter was possibly a debatable merit as some would argue that, in addition to requiring an extraordinarily large lantern to house the source, there was also the difficulty of careful optical control. On the other hand, point sources of high brilliance, whilst considerably facilitating accurate optical control, were prone to promote glare and were not to be preferred to larger sources of low brightness, which produced such large illuminated areas on the road surface, even under most unfavourable conditions. The obvious place for the application of the fluorescent lamp in street lighting was in the civic centre, and the development of a new type of lantern was an essential prerequisite for its unbounded success. As regards plastics, the most likely field for development was in the replacement of glassware rather than for lantern bodies in lieu of metal castings and pressings. Particularly was this so where glass had to be shaped, for, although the initial cost of the material was higher, the processing costs in the case of glass, for bending and shaping, tended to offset the initial advantage and made the prices of the finished article more comparable, possibly enabling the lower replacement rate of the plastic ware to sway the balance in its favour. Such applications

were in the experimental stage, and possible difficulties in heat dissipation and susceptibility to electrostatic attraction of dust had yet to be investigated.

Mr. E. W. Robinson (E.L.M.A., Lighting Service Bureau) thought that fluorescent lighting was the only really important street lighting development since 1938-39. Apart from the use of such lighting and the possibility of its extended use in both A and B class roads, present tendencies were directed to modifications of the present well-tried methods and apparatus. Controlled cut-off was gaining ground; horizontal burning m.v. lamps were likely to find considerable use in lanterns giving controlled cut-off; increased standardisation of mounting heights was likely, following the M.O.T. report; increased uniformity of street lighting was likely due to centralised guidance where routes ran through different local government areas; increased attention would be paid to the daylight appearance of street lighting poles and lanterns, including more attention to homogeneous lanterns and poles, designed as one unit; increased attention would be paid to bright surrounds and to extraneous visual aids (painting, screens, etc.); greater use of plastics and light metals for lantern construction was expected, stimulated by the requirements of fluorescent lighting; increasing research was being conducted on methods of obtaining measurements of visibility as a criterion of street lighting; and greater use of totally enclosed lanterns even for group B applications was expected.

Coun. A. M. Hogg, J.P. (Kearsley), advocated control over workmanship and materials to see that all installations were carried out according to regulations.

Mrs. J. A. Wood (Preston) looked forward to the time when there would be electrically-operated robots to do housework.

THE SCARBOROUGH MEETING

A two-day area conference opened at Scarborough on September 24, when papers were read by Mr. W. J. Jones, director of the E.L.M.A., Mr. G. F. Moore, borough electrical engineer and general manager, Keighley, and Mr. C. A. Cameron Brown, Edmundsons' Electricity Corporation, Ltd.

Mr. Jones chose for his subject the practice and economy of fluorescent lighting, in which he reviewed efficiency, colour, temperature, linear source and brightness. The luminous efficiency of fluorescent compared with filament lamps was, he said, three times greater. Distortion of the apparent colour of objects was less with fluorescent daylight and warm white lamps than with filament

types. Where the colour changed the result remained constant, whereas light from filament lamps caused changes of colour if the voltage varied. With respect to the heat radiated and convected from light sources, it was claimed that fluorescent systems generated only one-quarter compared with filament lamps, making them more adaptable for installation in confined spaces. To prevent uncomfortable glare and at the same time retain vitality, hammered, rolled and dimpled clear glass and plastic fittings were recommended.

SPACE HEATING

Space heating was dealt with by Mr. Moore, who expressed the view that householders were using this form of heating habitually, for higher standards of comfort; and it was therefore reasonable to argue that the bulk of the domestic space heating load would be maintained and increased. After advancing arguments to support his views, Mr. Moore suggested that the conference should endorse a vigorous policy designed to attract both the background and intermittent space heating load of the country at a rate consistent with the essential development of the industrial load, because it was in the national interest to ensure that the available man-hours be more usefully employed than in implementing the recommendations of the Simon report; that the costly effects of atmospheric pollution would be mitigated to a greater extent than by the continued use of solid fuel; that improved annual load factors would accrue to areas of the new authority if the background heating load was secured than would be the case if left with only the "topping-up and cold snap" loads; that though atomic energy may gradually displace the use of coal in the production of electricity, space heating appliances would still retain their 100 per cent. working efficiency.

Full farm electrification was the subject covered by Mr. Cameron Brown, when the opinion was expressed that, as a service and in proportion to the rest of the charges applicable to farms, electricity was of more value to the farmer than he generally acknowledged. Farmers had on the whole been paying too little for the service given them, and he suggested a fixed minimum charge of £10 per annum; a floor area sliding scale, so that rambling farms would not be penalised, and a running charge of 1d. per kWh with a ¾d. "inducement rate" for approved off-peak loads. Equipment and methods which restricted load demand without restricting the electricity services should be encouraged.

Electricity Supply

Southend-on-Sea.—The electricity department secured first prize for a decorated vehicle bearing slogans encouraging consumers to be economical in the use of electricity, which took part in the local hospital carnival recently.

Fleetwood.—Losses recorded by the electricity undertaking for the year ended March 31, 1947, were £2 031, against an estimate of £696. Increased charges have been recommended.

Blackburn.—The Electricity Committee has recommended that in view of the increase in coal costs, the extra charge to small consumers, now $7\frac{1}{2}$ per cent., should be increased to 10 per cent., and that the unit charge for the summer quarter should be changed from three units a penny to two.

Warrington.—The Central Electricity Board has issued a direction for the Corporation to proceed with the installation of one 20 MW turbo-alternator, complete with ancillary plant, and one 200 000 lbs. per hr. boiler, with ancillary plant, buildings and civil engineering works at the Howley station.

Liverpool.—A direction has been received as to the firms with whom negotiations should be opened for the supply of plant for a £2 750 000 extension to the Clarence Dock station. The programme provides for the installation of a 50 000 kW turbo-alternator and an auxiliary set of 1 500 kW, as well as two 350 000 lbs. per hr. boiler units.

Bolton.—Directions have been received for the extension of the Back-o'-th'-Bank station by the installation, ready for commercial operation in July, 1951, of a 30 000 kW set, a 1 250 kW house set, two 180 000 lbs. per hr. boilers and the necessary buildings and civil engineering works. The Electricity Committee has applied to the Commissioners for consent to the extensions.

Islington.—Subject to the approval of the Ministry of Transport the Borough Council is to make arrangements for the installation of fluorescent lighting in Holloway Road between Seven Sisters Road and Camden Road, including the two crossings. The Electricity Committee has recommended acceptance of a tender at £1 489, of the British Thomson-Houston Co., Ltd., for the carrying out of the work and provision of all necessary fittings.

Manchester.—The C.E.B. has asked that

the £6 742 000 station now being built at Carrington should have its capacity increased from 120 MW to 180 MW, at an



The prize-winning decorated vehicle, bearing fuel economy slogans, entered by the electricity department in a recent Southend hospital carnival

extra cost of £3 859 900. The first stage of the station is scheduled to be in operation by the end of 1949, and the Board has requested that the addition be in "full commercial operation" by July, 1951. When completed, the station will have three 60 MW sets and five 360 000 lbs. per hr. boilers.

Bingley.—Following an inquiry before the Electricity Commissioners into an Ilkley Council claim, which has been regarded as a test case, the U.D.C. is to receive a refund of £12 946. It has not yet been decided how the refund will be dealt with. Last March it was announced that the Ilkley Urban Council would give its users a 45 per cent. discount in that quarter, plus five per cent. for prompt payment, as a result of a substantial refund from the Yorkshire Electric Power Co. At the time it was also stated that about 20 local authorities in the West Riding received bulk supplies from the company, and that while there was nothing to prevent them making similar applications, the company had not had time to go into the general position.

Wolverhampton.—A gross surplus on the trolley vehicle account of £87 387 is shown in the annual accounts of the

Transport Committee. Adding a surplus of £38 217 on the motor omnibus account, there remained a total surplus of £126 604, giving a balance of £49 792. Of this, £10 000 was allocated to rate relief and £34 400 for the provision of deferred vehicle purchase. The total mileage of trolley vehicles during the year was 5 324 508, the average number of vehicles in use per day being 122. Passengers carried totalled 76 396 159 and 11 997 175 units were used for traction and vehicle lighting, representing a number of units per vehicle mile of 2.253. The average working expenses per vehicle mile, including power cost, were 19.487d.

Arrangements for Load Shedding.—In connection with the steps being taken to mitigate the effects of load shedding this winter, it has been suggested that any such load shedding could be carried out on a more selective basis, where the main distributing centres and sub-stations are manned and are in touch by telephone with the main control centre of the undertaking. Where effective arrangements of this kind are not already in operation, undertakers are asked to consider whether their present arrangements can be improved by, *inter alia*, the installation of telephones at additional sub-stations and distributing centres. The Ministry of Fuel has been informed by the Post Office that within reasonable limits applications by electricity undertakers for the installation of additional telephones for the above purposes will be given a high degree of priority. The Post Office have, however, made it clear that there can be no question of installing new exchange facilities at central control points before the coming winter. If in any particular case delay or difficulty is experienced in regard to the provision of additional telephone services, undertakers are asked to furnish the Commissioners with details so that they can consider whether the case is one which can usefully be taken up with the Post Office.

Stretford.—Details of a scheme devised to encourage domestic consumers to play their part in the winter fuel economy campaign have been sent to us by Mr. H. G. Bell, chief engineer and manager of the Stretford and District Electricity Board. Any consumer who achieves an economy of at least 10 per cent. during either of the winter quarters, 1947-48, as compared with the corresponding quarter in the previous year, will be given an additional discount equal to the saving achieved. For example, a consumer showing a saving of 25 per cent. would be given a further discount of five shillings in the pound. Staff limitations would make it impossible for the Board to arrange to check each individual consumer's account and make the necessary comparison. This

duty has been left to the consumer, but has been simplified as far as possible. The meter readers on their rounds will leave at each house a small leaflet on which will be entered the units used by the consumer in the relevant quarters. This leaflet will also give details of the scheme. Any consumer finding himself entitled to the discount will then make a claim on a standard form to be obtained from any of the show-rooms or offices of the board. On receipt at the office, the form will be subject to scrutiny, and where credit is due, the necessary credit note will be issued. The Board have undertaken to finance the whole scheme from their own resources, and the decision of the Chief Engineer and Manager will be final and binding in all matters appertaining to claims. It is felt, Mr. Bell adds, that this plan has the merits of simplicity and should offer a very real incentive to domestic consumers to reduce their demand on the public supply.

Yorkshire.—A circular letter sent out to approximately 1 000 of the 8 000 industrial power users who are consumers of the Yorkshire Electric Power Co., Electrical Distribution of Yorkshire, Ltd., the Tadcaster Electricity Co., Ltd., and the North Lincolnshire and Howdenshire Electricity Co., Ltd., states that because of the inconvenience to industrialists of starting load spreading schemes in the middle of a week, the East and West Ridings Regional Board for Industry has decided that within its region such schemes shall start from Monday, October 6. Amongst the approved schemes are a two-cycle rota scheme and a three-cycle rota scheme. In order to avoid confusion and wasted effort throughout their areas, the Yorkshire Electric Power Co. and its associated companies hope that their consumers will adopt one or other of these schemes without alteration. If an alteration seems to a consumer to be essential he is asked to communicate the alteration he proposes and the reason for it to his electricity supplier so that it may be examined and if need be discussed or modified before approval. The alternative schemes referred to are: Two-cycle rota scheme; early period, 7 a.m. to 11 a.m. and 12 noon to 4 p.m. with three hours on Saturday morning; late period, 11 a.m. to 3 p.m., 4 p.m. to 6.40 p.m. and 7 p.m. to 9.20 p.m.; three-cycle rota scheme: early period, 7 a.m. to 11 a.m. and 11.45 a.m. to 4 p.m.; middle period, 7 a.m. to 11.45 a.m. and 12.30 p.m. to 5.30 p.m.; late period, 11 a.m. to 3 p.m. and 4 p.m. to 8.30 p.m. For the purpose of operating these schemes the areas of the companies are being treated as a single area sub-divided into six districts lettered "A" to "F."

Industrial Information

Power Driven Circulators

The new British S.S. for Power Driven Circulators for Heating Plants (B.S. No. 1394: 1947) is for direct-coupled motor-driven and belt-driven centrifugal, axial flow or mixed flow pumps used to create a flow in water mains for heating purposes at temperatures not exceeding 200° F. and static heads not exceeding 100 ft. Copies can be obtained from the British Standards Institution, 24, Victoria Street, London, S.W.1, price 2s., post free.

Illumination Design Courses

The 50th London illumination design course, arranged by the E.L.M.A. Lighting Service Bureau, will be held at the Bureau, 2, Savoy Hill, Strand, London, from October 13 to November 17. It is a refresher course for the electrical industry, and lectures, beginning at 7 p.m., will be given on consecutive Mondays for six weeks. Similar refresher courses will be held on consecutive Wednesdays, commencing at 6.30 p.m. on October 8, and ending on November 12, at Victoria Hall, Norfolk Street, Sheffield; and on consecutive Tuesdays, beginning at 6 p.m. on October 14 and concluding on November 18, at the electricity department's show-rooms, Paradise Street, Birmingham.

Cold Cathode Lighting

Cold cathode lighting has been installed by the General Electric Co., Ltd., at the Pantheon store of Marks and Spencer, Ltd., 173, Oxford Street, London. It is in the front part of the store, which was previously lighted by 16 tungsten pendants. The lighting scheme comprises a built-in feature in each of the 6 ft. square panels of the hung ceiling, with the gear in the void, employing 30 ft. of 120 MA intermediate white tube arranged in two 15 ft. lengths, one each to a transformer. Each tube takes the form of a double "U," two identical tubes set face to face, forming one complete unit. The two small boxes shown in each of the units contain the turn-round of one tube and the electrodes of the other, the latter being turned up at 90° to their respective tubes and projected upwards inside the false ceiling into suitable electrode boxes. The stepped motif in the centre conceals the

access entry to the gear in the void between the hung ceiling and the concrete slab approximately 24 in. above. All the wiring is behind the ceiling. Light output from a single unit is slightly more than that from a standard G.E.C. cold cathode fitting employing 3 ft. by 8 ft. 6 in. 120 MA tubes. The electrical contractors were H. Cripps and Co., Blandford Street, W.1.

Battery-Electric v Motor Van

A Brush battery-electric vehicle in a test run on a normal early morning delivery round to newsgagents in Leicester and district in competition with a fleet of motor vans, completed a nine-mile round, making 30 stops, in two minutes less time than that usually taken by a motor van.

Society of Inventors' Exhibition

The closing date for application for stands at the exhibition to be held by the Birmingham branch of the Society of Inventors at the Chamber of Commerce, New Street, from December 15 to 21, has been extended to October 21, and Mr. B. Thornton Clark, 244, Stoney Lane, Yardley, Birmingham, 25, will furnish inquirers with details.

Radio Noise Survey

A survey of existing knowledge of the sources of radio noise is contained in "Radio Research Special Report No. 15—A Survey of Existing Information and



The new fluorescent lighting installation at the Pantheon Store of Marks and Spencer, Ltd., comprises 16 fittings, one in each of 16 panels

Data on Radio Noise over the Frequency Range 1-30 Mc/s," published for the Department of Scientific and Industrial

Research by the Stationery Office (price 3s.). It has been prepared in the Radio Division of the National Physical Laboratory, where some 180 published papers on the subject, as well as data and measurements made available by certain commercial and Government organisations operating radio services in Great Britain, were examined.

Purchase Tax on Towel Rail

The Eralite Manufacturing Co., Ltd., of 194, The Broadway, Wimbledon, announce that the Chaudelaine towel rail is subject to purchase tax at the rate of 66 $\frac{2}{3}$ per cent. of the wholesale price, and is not free of tax as previously advertised.

Appointment of Agent

The Dubilier Condenser Co. (1925), Ltd., have appointed Mr. R. N. Walker, 104, Overcliffe Drive, Southbourne, Bournemouth, to succeed the late Mr. F. G. Lawrence, as their agent in the counties of Hampshire, Dorset, Sussex, Berkshire, Wiltshire, and the part of Surrey south of a line from Frinley to Caterham.

Quality Control

The B.S. for Fraction-defective Charts for Quality Control (B.S. 1313), just issued by the British Standards Institution, describes the simplest and cheapest form of quality control, by the examination of the fraction defective in samples; it sets out accepted methods which are easy to use and can satisfactorily and profitably replace 100 per cent. examination. Copies may be obtained from the sales department, 24, Victoria Street, London, S.W.1, price 6s., post free.

Courses for Electrical Apprentices

Part-time day courses for apprentices in the electrical engineering industry are being held in the electrical engineering department of the Liverpool City Technical College. The classes come under the supervision of an electrical advisory committee composed of representatives from the Liverpool University, Automatic Telephone and Electric Co., Ltd., City Electrical Engineers' department, Electrical Contractors' Association, the G.P.O. telephone department, and the E.T.U. There are also evening classes in electrical engineering and telecommunications engineering.

"Telacites" Reunion

On November 22, the seventh anniversary of the destruction of their Tyseley works by enemy action, J. H. Tucker and Co., Ltd., King's Road, Tyseley, Birmingham, 11, are having a formal opening of the newly-reconstructed office block and are anxious that all who have at any time and in any way been associated with the company since 1892 should send their present addresses so that individual invita-

tions to a reunion of "Telacites" may be sent out. Those who cannot attend will receive a brochure commemorating the occasion.

Reports from Germany and Japan

Further reports compiled by British and American Committees investigating wartime scientific and technical developments in Germany and Japan, and now available at Stationery Office sales offices, are the following: B.I.O.S. 1446, Some Targets of Ceramic Interest in the Berlin Area (3s. 6d.); F.I.A.T. 1071, Chlorinated Polyvinyl Chloride (2s.); B.I.O.S./Jap./P.R. 241, New High Permeability Magnetic Material Developed in Japan (1s.); B.I.O.S. 1478, Manufacture of Polyvinylidene Chloride (2s. 6d.); F.I.A.T. 1048, Polystyrene Manufacture at the I.G. Farbenindustrie Plant at Schkopau (1s.).

Heating and Ventilating of Schools

Prepared by a committee of the Building Research Board, D.S.I.R., "Post-War Building Studies No. 27—Heating and Ventilation of Schools," has been published for the Ministry of Works by the Stationery Office (price 6d.). The purpose is to offer some general guidance in the initial stages of planning a new school. Accordingly, although the desirable conditions of warmth, etc., in schools are set out in some detail, only general observations are made regarding methods of heating and ventilation. The importance of adequate thermal insulation is emphasised.

Fluorescent Street Lighting

The tenth of a series of informative Lighting Bulletins issued by the lighting section of the British Thomson-Houston Co., Ltd., Bridle Path, Watford, Herts, is entitled "The Application of Fluorescent Lamps to Street Lighting." It is based on a paper read by the authors, Messrs. L. J. Davies and W. D. Sinclair (B.T.H. laboratory), at the conference of the Association of Public Lighting Engineers in London in September, 1946, and is of historic interest in that it describes the first two fluorescent street lighting installations, installed at Rugby and at Bond Street, London. The booklet is illustrated with diagrams and photographic reproductions.

Market Surveys

B.E.S.T.E.C., the export organisation for British manufacturers of engineers' tools and precision equipment, reports increasing sales to hard currency areas as a result of the survey being carried out in Latin America by the general manager (Latin American sales), Mr. A. G. Noble. Directors of B.E.S.T.E.C. have surveyed markets in the Middle East, India, Australia, New Zealand, Union of South Africa,

Rhodesia and Portuguese East Africa. Mr. H. S. Holden, vice-chairman of B.F.S.T.E.C., and Mr. S. J. Harley, managing director of the Coventry Gauge and Tool Co., Ltd., are examining the prospects in the Canadian market. In addition, Mr. J. P. Ford, B.E.S.T.E.C.'s general manager, has gone to investigate markets in Austria, Hungary and Czechoslovakia.

Exhibition of Brush Electric Vehicles

The Woodcote Motor Co., Ltd., of Epsom, are holding in their showrooms from October 6 to 11 a Brush electric vehicle exhibition. The display will be open for inspection between 10 a.m. and 6.30 p.m. each day.

Synthetic Refractory Compounds

Zirconal, Ltd., has been formed in conjunction with Silicon (Organic) Developments, Ltd., 11, Cavendish Place, London, W.1, as a production unit for the manufacture of synthetic Mullite and Zircon refractory compounds, using the Silester bonding process. They are fully equipped to make semi-permanent moulds and dies, crucibles, furnace equipment, electrical and other components where thermal and electrical resistance are required.

Controlled Furnace Atmosphere

For the purpose of preventing decarburisation of steels during heat treatment, the research department of Wild-Barfield Electric Furnaces, Ltd., Elecfurn Works, Watford By-Pass, Watford, Herts, has developed the "Paragen" burners, using paraffin oil, to introduce a controlled atmosphere into the furnace chamber. This method is claimed to be completely successful.

New Osram Catalogue

After an enforced absence of eight years, the Osram lamp catalogue has reappeared with new features indicating developments which have taken place in that period. Many types of lamps are no longer listed and others are making their initial appearances. Apart from the fluorescent lamps, the latter include the 250 W infra-red lamp with internal reflector, the 60 W metal filament radiant heat lamp and the British pre-focus bulb. A list of E.L.M.A. lamp classifications is included, together with a useful ready reckoner. The catalogue contains 52 pages and is well illustrated.

Engineering Economics

Entitled "An Introduction to Engineering Economics for Civil Engineering Students," a handbook (price 1s.) has been issued by the Post-War National Development Committee of the Institution of Civil Engineers primarily for civil

engineering students to enable them to appreciate more fully the application of economics to their professional work. Problems and examples are given and solutions are worked out so that the student can appreciate how the principles laid down in the book should be applied to meet various definite problems. The handbook concludes with some valuation tables and an appendix dealing with mathematical derivations.

Automatic Emergency Lighting

To ensure continuity of lighting, "Keepalite" automatic emergency lighting equipment, manufactured by the Chloride Electrical Storage Co., Ltd., Clifton Junction, near Manchester, has been ordered by the Gorseinon General and Maternity Hospital, Glam.; the Maternity Home, Westwood Hill, Sydenham; the Samaritan Hospital, London; the Coliseum Cinema, Whitby; and the Cinema, Ledbury.

Corrosion-Resisting Materials

The results of exhaustive tests on condenser tubes made from 10 per cent tin-bronze, demonstrating that alloy's resistance to corrosion, are given in the current issue of "Tin and its Uses," published by the Tin Research Institute, Fraser Road, Greenford, Middx. Pre-tinning of steel before painting is claimed to provide the most nearly perfect protective coating so far devised.

Laminated Insulating Material

An admirably produced illustrated brochure, entitled "Permal," issued by the New Insulation Co., Ltd., of Gloucester, deals with the various applications of this electrical insulating material which is claimed to combine exceptional strength with lightness, to possess dielectric qualities of a high standard, to be non-hygroscopic, not affected by mineral oils, to be hard-wearing and weather resistant. "Permal" may be sawn, planed, turned, drilled, tapped and screwed.

Diesel-Driven Trawler

The new trawler "Star of Scotland" constructed by Hall, Russell and Co., Ltd., for the Walker Steam Trawl Fishing Co., Ltd., ran successful trials off Aberdeen recently. The vessel in several respects is noteworthy, in particular by the adoption of Diesel engine propulsion; it is the first motor-driven trawler built for Aberdeen trawler owners, although by no means the first motor-driven trawler which has left the Hall, Russell yard. An electric-driven trawl winch is fitted, having two barrels each carrying 500 fathoms of warp; the necessary current for the winch is supplied by a Diesel engine driv-

ing a variable voltage generator. Steering gear is fitted in a compartment aft and is of the electric-hydraulic type with tele-motor control from the wheelhouse. The fish room has a capacity of about 6 000 cu. ft. and an electrically-operated refrigerating plant is installed. Electric light is fitted, current being supplied from Diesel driven generators in the engine room, of which there are two, in addition to the special generator for winch. One floodlight and four projectors are fitted for night fishing. Navigational equipment includes wireless telephone, direction finding apparatus, echo sounders, and electric log with recorder. The propelling machinery consists of a British Polar, two-cycle Diesel engine developing 700 B.H.P. in normal service.

Terrestrial Magnetism

The year's activities of the Department of Terrestrial Magnetism, Carnegie Institution, Washington, reviewed by the Director in his annual report, just issued, covered geomagnetic investigations, studies of terrestrial electricity, the ionosphere, cosmic-rays and nuclear physics. By means of a new technique for recording phenomena in the upper layers of the atmosphere, it was found for the first time that during magnetic storms rapidly moving clouds of charged, or ionised, matter rush to the ionosphere, moving in from long to short range and out again at intervals of a few minutes. The clouds are of fundamental significance in their influence on radio transmission and travel at a speed of about a mile a second.

Radar Prevents Delay

The advantage of marine radar equipment is illustrated by the experience of the Port Line's cargo passenger ship, "Port Pirie," which was fitted with a Metropolitan-Vickers' "Seascan" radar-set by Siemens Brothers and Co., Ltd., not long ago. While other ships were forced to remain at anchor at Antwerp because of fog, the "Port Pirie" left guided by radar alone. Arriving in the Thames on a Monday, the vessel was able to start loading immediately. The ships left behind in Antwerp were held by fog for three days.

Research in Industry

Under the title of "Science and the Economic Crisis," the executive committee of the Association of Scientific Workers have published a leaflet putting forward suggestions for "improving industrial and agricultural techniques, based on scientific research and the best engineering practice." Pointing out that an increase in the average efficiency of coal utilisation from 20 to 25 per cent. would be equivalent to an annual increase in coal pro-

duction of 50 million tons, the statement recommends: the enlargement of the Cabinet Advisory Planning Board by the addition of three scientific and three technical members; the diversion of at least a third of the scientific manpower, laboratories and equipment at present engaged on defence work into civilian industry; the pooling of scientific research and development work and a redeployment of technical resources from inessential industries into more important work. The representation of scientific workers on production committees is also urged.

Trade Publications Received

A special high-frequency number of "The Brown Boveri Review," from British Brown-Boveri, Ltd., Artillery Mansions, 75, Victoria Street, London, indicating the chief directions in which the company are working in Switzerland in the construction of transmitters, valves, frequency modulation, and high-frequency generators for industrial purposes.

The latest publication of Aerialite, Ltd., Castle Works, Stalybridge, Cheshire, under the title "Ashton Radio Cables." Produced in colours and illustrated, it describes the wide range of cables, cords and leads made by the company.

Brookhirst Switchgear, Ltd., Northgate Works, Chester, announce that their new thirty-six page illustrated catalogue No. 27, dealing with "batch-produced" control equipment for short delivery, is now available. Other publications also available are No. MC1, Motor Control; No. MT1, Electric Control of Machine Tools; No. 540, Brookhirst-Pearson Regulator; No. 481, Isofuse (switch-fuse); No. 547, Type 754 Cam-operated Switch; No. 549, Type 765 Compressor Starting Auxiliaries; No. 554, "Joystick" Control Switch; No. 557, Spindle Control Switch; No. 562, Cone-Pivot Voltage Relay.

Lamp Sales

THORN Electrical Industries, Ltd., are extending their Atlas lamp advertising in national daily, evening and Sunday newspapers and magazines. The current campaign is based on the "Next time I'll get an Atlas" theme, picturing in a semi-humorous manner everyday domestic situations in which the prospective user is lamp-brand conscious. The chain of Atlas outdoor poster sites is being extended and the Atlas slogan "For Staying Power" will continue to be featured. Attractive sales aids as well as lantern slides and printing blocks for local use, will be available to retailers. Rubber doormats reproduced in three colours and incorporating the well-known "little man" design, are also supplied to Atlas dealers.

Company News

VICKERS, LTD.—Int. div. on ord. for yr. 1947 4% (actual), less tax, payable October 28.

LLANELLY AND DISTRICT ELECTRIC SUPPLY CO., LTD.—Int. div. on 660 000 ordinary shares, 2% actual, less tax (same), payable October 22, 1947.

W. T. HENLEY'S TELEGRAPH WORKS CO., LTD.—Int. div. on ord. 5%, less tax, payable November 13. Co. announces net U.K. rate of tax payable on this div. is 8s. 7½d.

FERRANTI, LTD.—Net prft., according to prelim. statement, £105 293. For 1945-46, net prft. was £77 007 (after taking credit for £225 000 estimated E.P.T. repayable), after provn. for income-tax, depreciation, etc. Co. is paying div. of 6% (same), tax free, on £300 000 issued ord. capital for yr. ended June 30 last.

HACKBRIDGE AND HEWITTIC ELECTRIC CO., LTD.—The company has organised a Canadian company, Hackbridge and Hewittic Electric Co. of Canada. It will be headed by Mr. M. K. Pike, who has for many years been associated with the Northern Electric Co.

POWER CORPORATION OF CANADA, LTD.—Gross earnings to June 30, \$1 811 043 (\$1 727 011). To exes. \$219 753 (\$212 166), tax \$156 012 (\$172 770), net earnings \$1 435 278 (\$1 342 075). To int. \$358 823 (\$437 875), surplus \$1 076 455 (\$904 200), and brot. in, adjusted to include transfer of \$106 215 from res. of loans from subsid., \$2 506 607. To divs. on cum. pref. \$300 000 (same), on non-cum. pref. \$300 000 (same), on common \$223 182 (\$133 909), pensions \$15 000 (\$20 000), re-advancing \$35 000 (nil), fwd. \$2 749 880.

WELLMAN SMITH OWEN ENGINEERING CORP., LTD.—Trdg. prft. to Mar. 31, inclgd. £130 096 held in res. on contracts completed in prev. periods now in excess of requirements, sundry income and after providing for deprecn. on same basis as in prev. yr., amtd. to £188 551 (£173 597), taxn. £150 000 (£146 338), lvg. net prft. £38 551 (£27 257). Brot. in £47 172 (£46 645), intm. div. 5% (same) pd. Dec. 28, £6 945 (£6 314). To gen. res. £10 000 (same), special deprecn. £10 000 (nil), fin. div. 7½% (£10 418) (same), mkg. 12½%; fwd. £48 360.

A. REYROLLE AND CO., LTD.—The company, whose output of products last year was valued at £6 750 000, has increased its capital to £2 000 000 by the creation of 750 000 unclassified £1 shares. The issued capital consists of £102 500 of 7% cumulative preference stock and £1 017 647 of ordinary stock. The company has also

applied for 22 500 "B" ordinary shares in Heaton Foundry Co., of Newcastle-on-Tyne. The capital of this concern was recently raised to £40 000 and now consists of 10 000 "A" ordinary, 22 500 "B" ordinary and 7 500 other shares of £1 each.

JAMES HOWDEN AND CO., LTD.—When the annual meeting was held recently in Glasgow, the chairman (Mr. C. W. Hume) said that while the fuel and power crisis had to some extent affected the output and employment in the factories during the early months of 1947, it also had the effect of bringing a very large proportion of the company's production into a position of the highest priority, for their products were used extensively in the equipment of power stations. In spite of difficulties, the output from their main works at Scotland Street constituted the highest in the history of the company. In the MacLellan Street factory a high level of production has also been achieved, but much ingenuity and improvisation have been necessary to overcome shortages of materials and bottle-necks. The demand was extensive and he believed it would be possible during the present year to maintain or increase their output.

Metal Prices

	Monday, Price	September 29 Inc. 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), per ton	£172 5 0	—
Brass (60/40)—		
Rod basis per lb.	1s. 1½d.	—
Wire	1s. 6½d.	—
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 99.8% purity)	£442 10 0	—
Wire, basis per lb.	5s. 6¾d.	—
Aluminium Ingots per ton	£80 0 0	—
Spelter	£70 0 0	—
Mercury (spot) per bott.	£16 0 0	—
(ex. warehouse)		

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

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.

FRANBREC, LTD., London, E.C., electrical contractors.—July 29, £600 debentures, general charge. * Nil. December 31, 1945.

HALE ELECTRIC CO., LTD. (formerly HALE ELECTRICAL CO., LTD.), London, W.—July 31, debenture, to Lloyds Bank, Ltd., securing all moneys or to become due to the Bank; general charge. * Up to £25 000, Bankers. January 14, 1946.

HANKOW LIGHT AND POWER CO., LTD., London, E.C.—July 31, charge, to Char-

tered Bank of India, Australia and China, securing all moneys due or to become due to the Bank; charge on premises in Hankow, China. * Nil. November 20, 1946.

Application for Discharge

SPENCER, William Thomas, 376, Oldham Road, Newton Heath, Manchester, electrician. Court: Manchester. Hearing: October 13, 10 a.m. at the Court House, Quay Street, Manchester.

Dividend

SIMS, George Robert, Syra, Thornley, Durham, and carrying on business at Hartlepool Street, Thornley, as motor and electrical engineer. Court: Durham. Amount per £—9s. 8d. (supplemental), payable October 3, at the Official Receiver's Office, Gibb Chambers, Westgate Road, Newcastle-on-Tyne, 1.

Coming Events

Friday, October 3 (To-day)

ILLUMINATING ENGINEERING SOCIETY, BIRMINGHAM CENTRE.—At the Crown and Cushion Hotel. Buffet Dance.

ROYAL STATISTICAL SOCIETY, INDUSTRIAL APPLICATIONS SECTION.—London. At the E.L.M.A. Lighting Service Bureau. "The Organisation of a Market Research Department," by A. S. Wharton. 6 p.m.

LEICESTER ELECTRICAL SOCIETY.—At the Trocadero Ballroom. Dance.

SCOTTISH ENGINEERING STUDENTS' ASSOCIATION.—Edinburgh. At the Royal British Hotel. Address by V. P. Mackay. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—London. Informal Meeting. 6.30 p.m.

Saturday, October 4

INSTITUTE OF ECONOMIC ENGINEERING, MIDLAND REGION.—Birmingham. At the Chamber of Commerce. "Time Study Allowances," by S. Walford. 2.30 p.m.

I.E.E., N. MIDLAND STUDENTS' SECTION.—Leeds. Visit to A. Kershaw and Sons. 2.15 p.m.

Monday, October 6

I.E.E., N. EASTERN CENTRE.—Newcastle-on-Tyne. At the Neville Hall. Under the auspices of the N. Eastern Branch of the Institution of Mechanical Engineers. "Parsons—the Man and His Work," by Sir Claude D. Gibb. 6 p.m.

I.E.E., MERSEY AND N. WALES CENTRE.—Liverpool. Chairman's Address, by P. C. Barnes. 6.30 p.m.

Tuesday, October 7

E.L.M.A. LIGHTING SERVICE BUREAU.—Manchester. At the Engineers' Club, Albert Square. Illumination Design Course. Until October 21.

I.E.E., E. MIDLAND CENTRE.—Loughborough. Chairman's Address, by J. P. Tucker. 6.30 p.m.

LUTON ELECTRICAL SOCIETY.—At the Technical College, Park Square. "The

Application of Radiant Heat," by D. M. Adams. 7.30 p.m.

I.E.E., N. WESTERN CENTRE.—Manchester. Chairman's Address, by R. A. S. Thwaites. 6.30 p.m.

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS, LONDON CENTRE.—At the I.E.E. "Some Recent Developments in the Design of Short Wave Receiving Stations," by J. Neale. 5 p.m.

I.E.E., N. MIDLAND CENTRE.—Leeds. At the Corporation Electricity Department. Chairman's Address, by E. S. Ritter. 6.30 p.m.

Wednesday, October 8

SILVER JUBILEE CONGRESS OF THE ROYAL SOCIETY FOR THE PREVENTION OF ACCIDENTS.—Hove. At the Town Hall. Industrial Safety Section; "Training Supervisors in Safety Methods," by E. Lord. 10 a.m.

"Noise Abatement in Industry," by Dr. A. J. King. 2.15 p.m. At the Dome. Home Safety Section; "Electricity in the Home—Its Use and Abuse," by H. W. Swann. 2.15 p.m.

I.E.E., N. EAST SCOTLAND SUB-CENTRE.—Aberdeen. Chairman's Address, by D. J. Harvey. 7.30 p.m.

E.L.M.A. LIGHTING SERVICE BUREAU.—Sheffield. At the Large Institute, Victoria Hall, Norfolk Street. Illumination Design Course. Until November 12.

I.E.E., S. MIDLANDS STUDENTS' SECTION.—Birmingham. At the James Watt Memorial Institute. "Neon Lighting," by D. T. Thompson. 7 p.m.

Thursday, October 9

I.E.E.—London. Inaugural Presidential Address, by P. Good. 5.30 p.m.

I.E.E., N. EAST SCOTLAND SUB-CENTRE.—Dundee. Chairman's Address, by D. J. Harvey. 7 p.m.

Friday, October 10

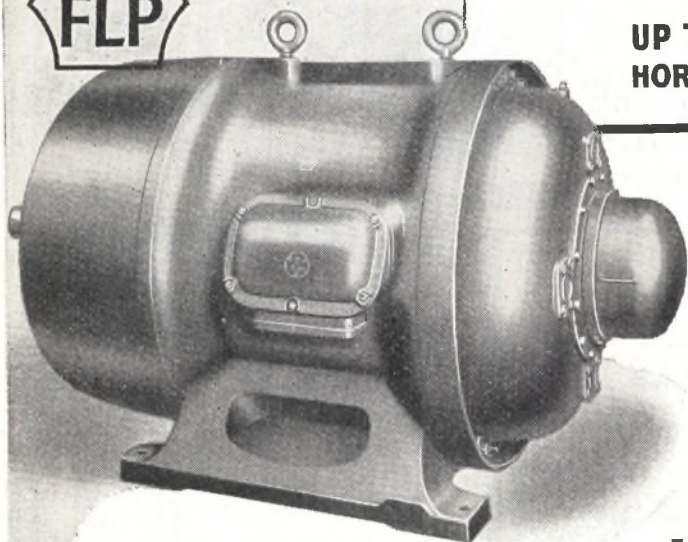
JUNIOR INSTITUTION OF ENGINEERS.—London. "Machinator: Quo Vadis?" by L. S. Atkinson. 6.30 p.m.



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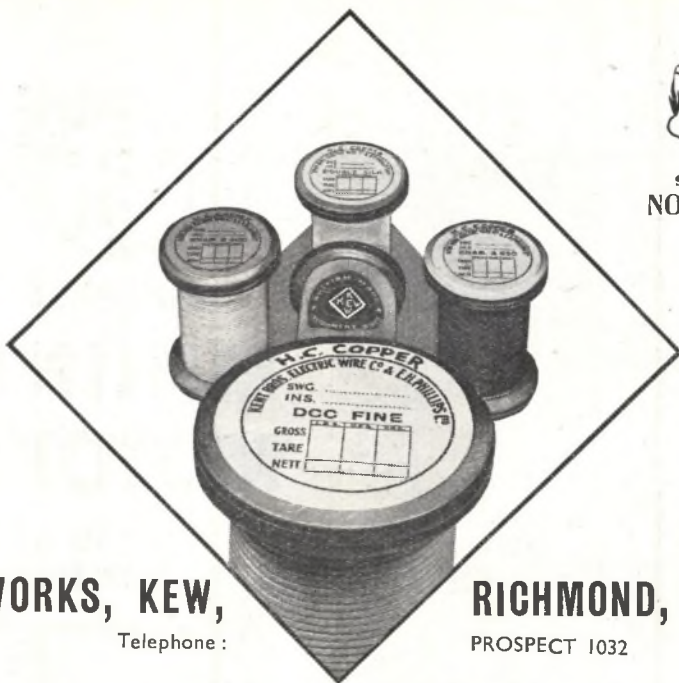
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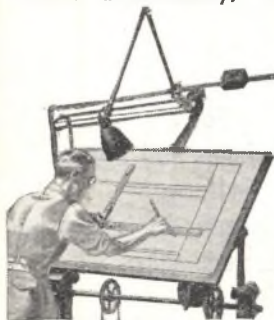
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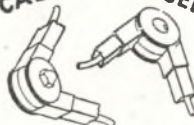
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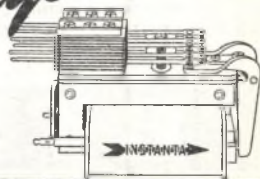
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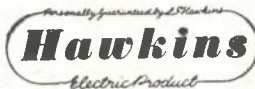
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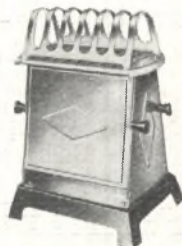
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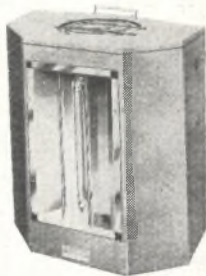
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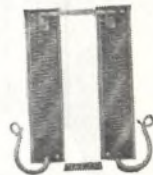
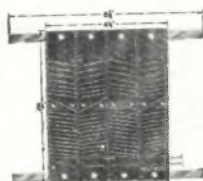
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(211)

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APPLICATIONS are invited from suitably qualified candidates for the following appointments:—
ASSISTANT MAINS ENGINEER.

Candidates must have had a good technical education and experience in general mains work, including H.T. and L.T. switchgear, laying and jointing H.T. and L.T. cables, testing and connecting in substations and kiosks; experience of D.C./A.C. change over would be an advantage. The duties include participation in the standby rota.

Candidates must have passed the graduateship examination of the I.E.E. or hold equivalent qualifications.

The salary and conditions are in accordance with Grade 8a, Class E, £387-£404 per annum (plus 5% London Area), of the N.J.B. Schedule.

SHIFT CHARGE ENGINEER.

Candidates must have had a good technical education and experience in the running and operation of Diesel generating plant, rotary converters, etc.

The generating station operates in parallel with the C.E.B. Grid and experience in the operation of E.H.T. switchgear and the parallel running of alternators would be an advantage.

The salary and conditions are in accordance with Grade 8, Class B, £354-£363 per annum (plus 5% London Area), of the N.J.B. Schedule.

The above appointments will be subject to the provisions of the Local Government Superannuation Act, 1937, and the successful candidates will be required to pass a medical examination.

Applications in candidate's own handwriting, stating age, qualifications, experience, present appointment and when able to take up duties, together with copies of not more than three recent testimonials suitably endorsed, must be sent to the Borough Electrical Engineer, Electricity Offices, Church Street, Epsom, so as to reach him not later than the first post on Monday, October 20th, 1947. Canvassing will disqualify.

Town Hall,
The Parade,
EPSOM,
Surrey.

September 26th, 1947.

EDWARD MOORE,
Town Clerk.

(229)

COUNTY BOROUGH OF EAST HAM.

APPOINTMENT OF ASSISTANT TO INSTALLATIONS
ENGINEER.

ELECTRICITY DEPARTMENT

APPLICATIONS are invited for the above appointment from persons with sound technical training and who have had considerable experience in the preparation of estimates and specifications for all classes of installation work for new public buildings, schools, canteens and housing programmes. The successful applicant will be required to work under the direction of, and assist, the Installations Engineer. Candidates should possess the Higher National Certificate in electrical engineering, or equivalent qualification.

The salary will be in accordance with Class F, Grade 8b, of the National Joint Board Schedule, at present £405 6s. per annum, rising to £421 ls. per annum.

The successful candidate will be required to pass a medical examination and the appointment will be subject to the Local Government Superannuation Act, 1937.

Applications, on forms to be obtained from the undersigned, accompanied by copies of not more than three recent testimonials, must reach me not later than October 25th, 1947.

Canvassing in any form will be a disqualification.

Town Hall,
EAST HAM, E.6.
September, 1947.

H. A. EDWARDS,
Town Clerk.

(213)

SITUATIONS VACANT

CENTRAL ELECTRICITY BOARD.

SOUTH EAST AND EAST ENGLAND DISTRICT.

FIRST ASSISTANT CONTROL ENGINEERS. GENERAL ASSISTANT ENGINEERS.

THE Central Electricity Board have vacancies at their Control Centre in London for the following:—

(a) First Assistant Control Engineers, age not exceeding 35. Commencing basic salary £435 per annum, rising to £560 per annum.

(b) General Assistant Engineers, age not exceeding 30. Commencing basic salary £300 per annum, rising to £425 per annum.

To the basic salary will be added a temporary salary adjustment in accordance with the arrangements in force from time to time. At present this temporary salary adjustment is £62 8s. per annum. There is also a London Area allowance of 5 per cent. with a minimum of £25 per annum on basic salaries below £500 per annum.

Applicants for either of the above vacancies must have technical qualifications up to Grad.I.E.E. standard. Experience in a power station or a manufacturer's works is essential in the case of (a) and is desirable in the case of (b).

Applicants should state their age and give full particulars with dates of education, technical training, experience, degrees, diplomas, etc.

The selected applicant will be required to undergo a medical examination and, if approved, will be required to join the Board's Superannuation Scheme.

Applications must be submitted, in writing, to the District Manager, Central Electricity Board, Aldwych House, London, W.C.2, and be received by him not later than Saturday, October 18th, 1947. (233)

CENTRAL ELECTRICITY BOARD.

THE Central Electricity Board have vacancies in their Head Office Technical Department for the positions of:—

ASSISTANT ENGINEER, DEVELOPMENT SECTION. ASSISTANT ENGINEER, SWITCHGEAR SUB-SECTION. ASSISTANT ENGINEER, METERING SUB-SECTION.

The commencing basic salary will be £500-£650, depending on qualifications. To the basic salaries will be added war-time payments in accordance with the arrangements in force from time to time. At present the additional payment on these basic salaries is £62 8s. per annum.

Applicants for the position of Assistant Engineer in the Development Section should have sound knowledge of system design and will be required to assist in the preparation of schemes of development of transmission lines and substations.

Applicants for the position of Assistant Engineer in the Switchgear Sub-Section should have a sound knowledge of the design and layout of indoor and outdoor substations and will be required to assist in the preparation of specifications for such apparatus, checking of tenders, prices, drawings and diagrams and other general switchgear engineering work.

Applicants for the position of Assistant Engineer in the Metering Sub-Section should have sound knowledge of the design and operation of integrating and indicating meters and will be required to assist in the preparation of specifications, checking of tenders, prices, drawings, diagrams, and other general metering work.

Applicants should state age, and give full particulars, with dates of education, technical training, practical experience, degrees, diplomas etc.

Selected applicants will be required to undergo a medical examination and, if approved, will be required to join the Board's Superannuation Scheme.

Applications must be submitted, in writing, to the Chief Engineer, Central Electricity Board, Trafalgar Buildings, 1, Charing Cross, London, S.W.1, and be received by him not later than Monday, October 13th, 1947. (221)

WANTED for Engineering Office, Electrical Engineer, recent graduate or H.N.C. standard with test bed or similar industrial experience. Work is in connection with Power Plant for Telephone Exchange Contracts and alternative experience could be in connection with Exchange Equipment if technically qualified on the power side. Applicants should give full particulars of education and technical training with chronological outline of any experience, and state what salary they regard as commensurate therewith.—Ref. 231, Siemens Brothers & Co., Ltd., Woolwich, S.E.18. (185)

SITUATIONS VACANT

COUNTY BOROUGH OF BRIGHTON.

ELECTRICITY DEPARTMENT.

APPLICATIONS are invited for the following appointments at the Southwick Power Station:—

Shift Charge Engineer, Class J, Grade 7 (£563-£589). Assistant Shift Charge Engineer, Class J, Grade 8a (£487-£510).

Senior Control Room Operator (Shift), Class J, Grade 9 (£425-£445).

Junior Control Room Operator (Shift), Class J, Grade 10 (£355-£371).

It is anticipated that the station will be reclassified "K" in the near future.

The appointments will be subject to the provisions of the Local Government and Other Officers Superannuation Act, 1937, and the selected candidates will be required to pass a medical examination.

Applications, which must be made on the prescribed form to be obtained from Mr. H. Pryce-Jones, M.Eng., Engineer and Manager, Brighton Corporation Electricity Department, Electric House, Castle Square, Brighton, 1, are to be delivered to him not later than first post on Monday, October 27th, 1947.

J. G. DREW,
Town Clerk.

Town Hall,
BRIGHTON.
September 27th, 1947.

(235)

IMPERIAL CHEMICAL INDUSTRIES LTD.

WILTON WORKS.

Advertisement—Ref. No. 101/X/32.

CONSTRUCTION MANAGER. IMPERIAL CHEMICAL INDUSTRIES LTD., WILTON WORKS, invite applications for the senior appointment of **CONSTRUCTION MANAGER.** The successful candidate will be directly responsible to the Chief Engineer for construction of a new chemical works, involving the setting up of a complete organisation, and the execution of the civil, mechanical and electrical work by Contractors and direct labour. He must be fully conversant with modern methods of construction, and control of large numbers of men. Considerable experience in this or similar types of construction work is essential.

The successful candidate will be appointed to the established staff. Applications, giving full details, should be submitted to the Personnel Manager, I.C.I. Wilton Works, P.O. Box 54, Middlesbrough, quoting advertisement reference No. 101/X/32. (165)

IMPERIAL CHEMICAL INDUSTRIES, LTD., WILTON WORKS.

ADVERTISEMENT REFERENCE NO. 101/X/33.

CONSTRUCTION ENGINEERS. IMPERIAL CHEMICAL INDUSTRIES LTD., WILTON WORKS, invite applications for the following appointments:—

(1) **SENIOR MECHANICAL CONSTRUCTION ENGINEER** to supervise the installation of mechanical equipment in connection with large scale chemical plants. Applicants should be fully conversant with modern construction equipment and methods and should have experience in the installation of general plant equipment and pipework. Experience essential in the control of site workers of the various trades.

(2) **BOILERS CONSTRUCTION ENGINEER** to supervise the erection by contractors of water tube boilers and auxiliary equipment. Experience essential in the erection of H.P. boiler plant. Preference will be given to applicants with some experience with pulverised fuel and oil firing equipment.

(3) **ELECTRICAL (PLANT) CONSTRUCTION ENGINEER** for the erection of plant electrical installations including motors, starters, distribution boards, cables and lighting. Experience essential in erection and installation of above equipment in large chemical or engineering works.

The successful candidates will be appointed to the established staff. They will be responsible to the Construction Manager and may later be transferred to the maintenance staff. Applications, giving full details of experience, qualifications and salary required, should be submitted in writing to the Personnel Manager, Imperial Chemical Industries Ltd., Wilton Works, P.O. Box 54, Middlesbrough, Yorks, quoting advertisement reference No. 101/X/33 and appropriate vacancy. (197)

SITUATIONS VACANT

LONDON AND HOME COUNTIES JOINT ELECTRICITY AUTHORITY.

APPLICATIONS are invited for the appointment of LINESMAN (OVERHEAD POWER).

Applicants should have had experience in the construction and maintenance of 11 kV and L.T. overhead lines and services.

Wages, 2s. 5d. per hour, 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 "Overhead Linesman," giving names and addresses of not more than three persons to whom reference may be made, must be sent to District Manager, 56, South Street, Dorking, Surrey, so as to reach him by not later than October 20th, 1947.

Canvassing, directly or indirectly, will be a disqualification.

A. L. BURNELL,
Clerk of the Authority.

5-6, Lancaster Place,
Strand, W.C.2.
September, 1947.

(212)

METROPOLITAN BOROUGH OF ISLINGTON.

Electricity Department.

APPOINTMENT OF TECHNICAL STAFF.

APPLICATIONS are invited for the following permanent appointments:—
SHIFT CHARGE ENGINEER.

Salary and conditions of service will be in accordance with the National Joint Board Agreement, Class G, Grade 8, at present £490 7s., rising to £499 16s. per annum.

Applicants should have had a sound general education and technical training, and experience in the control and operation of steam generating plant and main switchgear.
JUNIOR CHARGE ENGINEER.

Salary and conditions of service will be in accordance with the National Joint Board Agreement, Class G, Grade 9, at present £539, rising to £414 15s. per annum.

Applicants should have had a sound technical training in mechanical and electrical engineering, preferably with some experience of the repair, maintenance and operation of steam raising plant and turbo generators. Consideration will, however, be given to those who have been unable to obtain practical experience but who have the necessary technical qualifications.

The above appointments will be subject to the provision of the Local Government Superannuation Act, 1937, and the successful candidates will be required to pass a medical examination. Candidates are required to disclose in writing whether to their knowledge they are related to any member of or holder of any senior office under the Council.

Canvassing, either directly or indirectly, will be a disqualification. The Council are unable to make any arrangements for the provision of housing accommodation for the successful candidates. Application forms, which may be obtained from the Engineer and General Manager, Electricity Department, 341-343, Holloway Road, N.7, should be completed and returned to him, together with copies of recent testimonials, in appropriately endorsed envelopes by not later than October 11th, 1947.

H. DIXON CLARK,
Acting Town Clerk.

Town Hall,
Upper Street,
N.1.

(234)

APPLICATIONS are invited for two Plumber-Joiners, skilled in all classes of E.H.T. and L.T. cables and switchgear, for Central Scotland. Wages and conditions in accordance with N.J.L.C., No. 13 (Scottish) District, Zone A.—Applications, stating previous experience, should be sent to: The Manager, Scottish Central Electric Power Co., Woodlands, St. Ninians Road, Stirling. (232)

SITUATIONS VACANT

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 has passed except that for those who were less than 20 years of age on June 1st, 1946, the latest date for sending in the form is January 1st in the year following their 20th birthday.

Such candidates can obtain the detailed regulations and application form from the Secretary, Civil Service Commission, Burlington Gardens, London, W.1, quoting No. 1501. (214)

SHEFFIELD CORPORATION ELECTRICITY DEPARTMENT.

APPOINTMENT OF ENGINEERING ASSISTANT (ELECTRICAL).

APPLICATIONS are invited for the position of Engineering Assistant (Electrical) in the Construction Department of this Undertaking.

The duties relate principally, but not exclusively, to power stations. They include preparation and checking of drawings and diagrams, preparation of wiring and cabling schemes for execution by direct labour or by contract, obtaining tenders for electrical equipment, and site supervision and testing as required.

Applicants must have a sound technical training, preferably with experience in the manufacture of power station equipment, and must be experienced in the layout of switchgear, plant, cabling, station auxiliaries and auxiliary supplies.

The salary will be in accordance with Class "M," Grade 9, of the N.J.B. Schedule, present commencing value £521 per annum.

The appointment will be subject to the provisions of the Local Government Superannuation Act, 1937. Applicants must preferably be not more than 40 years of age, or have had previous Local Authority service carrying transfer value within the meaning of the Act.

The selected candidate would be required to pass a medical examination.

Applications, on forms to be obtained from the undersigned, to be received, with copies of not more than three testimonials, by Monday, October 20th, 1947.

Canvassing, or any communication, to a member of the Council, either directly or indirectly, is prohibited and is a disqualification.

JOHN R. STRUTHERS,
General Manager and Engineer.

Sheffield Corporation Electricity Department,
Commercial Street,
SHEFFIELD, 1,
September, 1947.

(205)

ELECTRICAL Engineer of British nationality required by electricity undertaking in South East Europe supplying about 200,000 consumers. Should be B.Sc., A.M.I.E.E., or equivalent. Maximum age 34, with special experience in meter and relay testing and maintenance. Knowledge of French an advantage. Salary according to qualifications.

—Apply, stating age, qualifications and experience, to: Box 544, c/o Dawsons, 28, Craven Street, W.C.2. (225)

MISCELLANEOUS

ALL Cable Buyers are invited to refer to the Magna Wire & Cable Co. advertisement on page 1021. (220)

BATTERY Chargers Modernised. Your old Charger made like new by specialists Conversion from valve to metal rectification. Send for interesting leaflet "Q.D." on this service.—Runbaken Electrical Products, Manchester, 1. (11)

AUCTIONEERS & VALUERS

RICHARDS & PARTNERS, Auctioneers and Valuers of PLANT AND MACHINERY AND INDUSTRIAL PROPERTY, Granville House, Arundel Street, London, W.O.2. Telephone: TEMple Bar 7471. (13)

FOR SALE

A NUMBER of New Switchboards from surplus disposal at low prices: 25 for 110 v. D.C. 5/20 amps., complete; 25 for use with alternators up to 5 kW, 230/300 v., 1-ph., 50 cycles, with automatic voltage regulators. All panels complete with costly apparatus.—Full details from: The Electroplant Co., Wembley, Middlesex. (120)

A.C./D.C. Motors can be supplied from stock or at short notice.—JOHN PHILLIPS AND CO. ELECTRICIANS 31, Fortune Green Road, N.W.6. Hampstead 8132. (150)

ALTERNATORS, all sizes from 2-120 kVA, for quick delivery.—Apply to: The Electroplant Company, Wembley, Middlesex. (119)

APPROX. 250 Commutators, deep copper section, 45 section, 2½ in. diam., 1½ in. wide, ½ in. bore, 8s. each or £30 per 100.—J. Bateson Ltd., Gibraltar Works, Parkinson Lane, Halifax. (188)

BRITISH Electric Co. (Beco) Ltd. can supply most types of A.C. and D.C. Motors from stock.—British Electric Co. (Beco) Ltd., Electra House, 25-29, Lower Road, Rotherhithe, S.E.16. Bermondsey 3449. (20)

ELECTRIC HOIST BLOCKS, capacity 5 cwt. to 7 tons. Reasonable delivery.—A. Morgan and Co., 50, Wilkin Street, London, N.W.5. Telephone: GUL. 1147. (24)

ELECTRIC MOTORS, ½ h.p., 3,000 r.p.m., D.C., 200-250 v. Also 110 N. Stock delivery, £6 each.—JOHN E. STEEL, Bingley, Yorks. Phone 1066. (TC113)

ELECTRIC MOTORS, A.C. and D.C. We supply all types and sizes of Electrical Machinery: Slow Speed Reduction Gears can be supplied to customers' requirements with short deliveries.—Send your enquiries to The Electropower Co., Ltd., 3, Retreat Close, Kenton, Middlesex. Tel.: WORDSWORTH 4928. (14)

FLUORESCENT LIGHTING UNITS, 5 ft. Reflector or Swallow, £5 18s.; 4 ft. Reflector, £4 18s. 6d.; 4 ft. Batten, £4 9s. 6d. All self-contained and complete with new tubes. Call or write for September lists. Also 80 watt silent tapped Chokes, 27s. 6d.; 40 watt ditto, 25s. Bi-pin Holders, P/P Condensers, 4 ft. Tubes.—MOSS BROS., 53, Gooch Street, W.1. Mus. 5385. (TC114)

FLUORESCENT Lighting. 4 ft. and 5 ft. single, double and triple lamp fittings manufactured by B.T.-H., G.E.C. Siemens, Ediswan, Crompton, etc., complete with ring gear and lamps, supplied immediately from stock ready for installation, or can be installed by us (in London area only). All fittings and gear fully guaranteed. Full range demonstrated in our showrooms.—Apex Industries Limited, 27, North Audley Street, W.1 (near Serldidges). Mayfair 0618-9960. (89)

FLUORESCENT Starter Unit. New single unit type, Long life obviating renewals. Used with any fitting. Samples and prices from sole manufacturers.—E. W. Engineering Co., Ltd., 407, Nether Street, Finchley, N.3. Finchley 5974. (109)

FOR SALE. Large quantity of new Starter Cable 61/036 at £12 per 100 yards.—Apply: G. A. Day Ltd., London Road, Portsmouth. (168)

JUNCTION Electric Irons, complete with Stand, Switch connector, and Flex, again available, very prompt deliveries (beautifully chromium plated). The finest of its kind in the world, A.C., D.C., in all voltages, with wide range of electrical accessories.—Distributors: Brooks and Bohm Ltd., 90, Victoria Street, London, S.W.1. (27)

KICK SWITCHES, 15 amp., suitable for fires, convectors, wash boilers, etc. Send 5s. P.O. for sample.—SEDWAY ELECTRIC LTD., 80-81, Gt. Hampton Street, Birmingham, 18. Phone: NORthern 2084. (TC110)

LADDERS, Trestles, Steps, Handcarts, etc.—From: Ramsay & Sons (Forfar) Ltd., Forfar. Phone 172. (10)

FOR SALE

LAMPS, large stock of SEDWAY LAMPS, 25 W to 150 W, available from stock. Also SEDWAY 1 kW and 2 kW reflector FIRES, and 12 in. rod ELEMENTS. Send for price list.—SEDWAY ELECTRIC LTD., 80-81, Gt. Hampton Street, Birmingham, 18. Phone: Northern 2084. (TC109)

LAMP FITTINGS, Circular Bowl Type, complete to ceiling rose. Large number with lamp bulbs. In small or large lots to clear.—Particulars from: DISPOSALS SERVICE, London Street Chambers, Norwich. (218)

QUANTITY of 3-way S.P. and Neutral, 500 v., 15 amp., 1/0. Fuseboards. Also quantity of 5 ft. Fluorescent Tubes, D/B, used one month only for exhibition lighting, 20s. each.—MOSS BROS., 53, Gooch Street, W.1. Mus. 5385. (TC115)

ROD FIRE ELEMENTS and ceramic rods from 750 w. to 1 000 w., 110 v. to 250 v., 9 in. to 12 in., constant supplies, good delivery, suitable for export. Clip in and screw in types. Best quality guaranteed, keenest prices. Manufacturers and wholesale trade only. Rods made to requirements. Cheapest and best on the market. Samples by request.—Sole Agent: Richard Voss, 6, Merton Way, Hillingdon, Middlesex. (59)

STANDARD Fuses, 15 amp., vit. porcelain body, arranged for front wiring and back busbar connection, or completely assembled units as required for incorporation into fuse boards. Available from stock or short delivery for larger quantities.—"Renas," 107, Albert Road, South Norwood, S.E.25. Phone: Addiscombe 6055-6-7. (179)

STRONG WOOD BOXES. 14 in. x 8½ in. x 7½ in., also 11 in. x 8½ in. x 6½ in. and 12 in. x 8½ in. x 3½ in. inside measurements, all complete with lids, 2s. 6d. each; reduction quantities. Ex works. Sample of any size box, passenger train, 3s. 6d.—F. Turner & Co., Colliery Buildings, Bredbury, Cheshire. 'Phone: Woodley 3106. (182)

SWITCH Boxes for conduit or rubber covered. One to four switch. Special boxes for plugs, etc. Loose lids for standard metal boxes.—Garside, Dept. S.B., 33, Midland Road, Frizinghall, Bradford. (177)

SWITCHPLUGS, 15 amp., 3-pin. We are now accepting orders for delivery December-January. Price on application. All other types of accessories held in stock.—Write for our 1948 price list.—L. Benn & Co., Ltd., 81, City Road, London, E.C.1. (178)

T.R.S. Telephone Cables, 4-core to 52-core. Samples on request.—L. E. Butler, 225, Cheney Manor Road, Swindon. (189)

TINNED ARMATURE BINDING WIRE. All sizes from 16 s.w.g.—28 s.w.g. supplied from stock on 7lb., 14 lb., or 28 lb. reels.—Frederick Smith and Co., Wire Manufacturers, Ltd., Caledonian Works, Halifax. (46)

TINNED STEEL ARMATURE BINDING WIRE. All even numbered sizes from 16 s.w.g.—28 s.w.g. supplied from stock on 7 lb., 14 lb., or 28 lb. reels. FREDERICK SMITH & CO., WIRE MANUFACTURERS, LTD., CALEDONIAN WORKS, HALIFAX. (9)

TWO Six-headed Cotton or Paper Lapping Machines and one Eight-headed ditto, to take cables up to ¾ in. diameter. One Bryce Transformer, 3 460-400 volts, 400 kVA, 50 cycles, 3-phase, delta primary-Star secondary. One Hackbridge Transformer, 3 460-300 or 200 volts, 500 kVA, ditto. One T.C.C. Transformer, 3 460-300 or 200 volts, 400 kVA, ditto. Two Hackbridge Transformers, 3 460-400 volts, 50 kVA, ditto. One bank of three Crompton Parkinson, 11 000 volts, T.A.P. Circuit Breakers, triple pole. Two C.I. Vacuum or Impregnating Pans, 8 ft. diameter by 3 ft. 2 in. deep, fitted with internal steam coils. Other plant available from stock. Enquiries solicited.—H. D. Douglas & Co., 2, Caxton Street, S.W.1. Telephone: Abbey 6344. (219)

VACUUM Cleaner, Spares and Accessories. Belts, Brushes, Bearings, Fans, Dustbags, etc. Largest stock of spares in the country. Repairs, rewinding, etc.—Reliance Vac Spares, Ltd., 152-154, Broadway, Bexley Heath, Kent. (TC116)

FOR SALE

V.I.R. Lead-cased Cables, new, on drums: 500 yards 61/103, 8 000 yards 37/083, 2 600 yards 7/036, 4-core, 4 500 yards, 7/036, 5-core.—Enquiries to: S. J. Barnett & Co. Ltd., Barkingside Metal Works, Mossford Green, Ilford, Essex. Telephone: Valentine 2201. (231)

15 x 3 SWITCHPLUGS. All sizes Switchplugs, Sockets, Plugtops, Multiplugs, Switches, Lampholders, Batton-holder, Junction Boxes, Ceiling Roses, Adaptors, Connectors, Elements, etc. Immediate delivery.—Douglas Turner Ltd., 13a, Edge Street, London, W.8. (157)

30 AND 50 kVA Diesel engine-driven Alternating Sets, 400/230 volts, 3-phase, 50 cycles. For delivery in October. Alternators and Switchboards can also be supplied.—The Horseshoe Supply Co. (Spalding), Ltd., Horseshoe Road, Spalding. (141)

33.5 kVA Portable Alternating Set, 46 h.p. "Allen" 4 cyl. water cooled petrol/paraffin engine, direct coupled to a 33.5 v, 400 v., 3-phase, 50 cycles Alternator. Complete with switchboard. Motor Generator Set on chassis. Morris 4 cyl. petrol driven engine with automatic governor, 25 h.p. direct coupled to a Mawdasley Generator, 220 v., A.C./D.C., 57 amps., in continuous rating.—Apply: C. S. Ltd., Staffa Works. Staffa Road, E.10. (208)

450 SATCHWELL Thermostats, tubular type. W.O. variable 10° 30° C., suitable for immersion heaters: 3 000 wire wound potentiometers by Fox and B.E.R., 50 watt, 50 ohm and 500 ohm, 20 watt loading. All brand new tested stock offered, substantially discounted for quantities.—Partridge, Wilson and Co., Ltd., Davenset Electrical Works, Leicester. (33)

CIRCUIT BREAKERS: 15 amp. 250 v. Single Pole complete with automatic overload cut-out; robust moulded construction. Accepted by most supply undertakings as efficient switch fuses if used in conjunction with our Distribution Boards.

DISTRIBUTION BOARDS: 5 and 15 amp.; 2, 3, 4 or 6 way; D.P. or S.P. and N.P.; wood cases; improved design and finish. No permit required.

EKCO and SMITHLITE FLUORESCENT FITTINGS: Complete; ex stock. Large quantities available; carriage paid.

INSULATORS: Suitable for overhead service cables. Bakelite, brass inserts; screwed P.O. thread for pin mounting; vertical type with drip groove, 5½ in. high, ¾ in. dia. Large quantities available, sample 2s. per return; discount on quantities.

WOOD SWITCH BLOCKS: ¾ in. round and square, 6 in. by 3 in. by ¼ in.; 9 in. by 3 in. by ½ in., and 6 in. by 6 in. by 1 in. White Enamelled and Walnut Finish from 6s. 6d. to 6s. 3d. per dozen respectively. Large quantities available, sample 2s. per return. Discount for quantities and for natural finish.

CLOTHES HORSE RAILS designed for Electric Dryer; in light steel tubing. Stove enamelled any colour. Quantity deliveries four weeks.

METROPOLITAN DISTRIBUTION LTD., TRURO. (210)

DYNAMO & MOTOR REPAIRS LTD., Wembley Park, Middlesex.

Telephone: Wembley 3121 (4 lines).

Also at Phoenix Works, Belgrave Terrace, Soho Road, Handsworth, Birmingham.

Telephone: Northern 0898.

REBUILT MOTORS AND GENERATORS.

Long deliveries can often be avoided by purchasing rebuilt secondhand plant. We can redesign or replace surplus plant of any size.

SEND US YOUR ENQUIRIES.

OVER 1 000 RATINGS ACTUALLY IN STOCK HERE. (5)

SACKS and BAGS in excellent condition for all commodities, as low as 6d. each.—Write: John Braydon Ltd., 230, Tottenham Court Road, W.1. Tel. No. Museum 6972. (8)

FOR SALE

FLUORESCENT LIGHTING. 1 000 Fittings complete with Tubes always in stock. Send for our 20-page List Price illustrated catalogue. Generous terms to Export, Wholesale and Trade.—Apply: **SCEMCO LTD.**, Scemco House, 6 and 7, Soho Street, London, W.1. Gerrard 1461 (3 lines). (TC101)

FLUORESCENT LIGHTING. Instantaneous starting control units for 5 ft. 80 watt lamps. The **CONSTEAD PLUS** and **THE SCEMCO UNIT** dispenses with starter switch trouble. Guaranteed to strike tubes regardless of Supply Voltage reduction. Each unit guaranteed.—For full details apply: **SCEMCO LTD.**, Scemco House, 6 and 7, Soho Street, London, W.1. Gerrard 1461 (3 lines). (TC102)

FLUORESCENT LIGHTING. 4 ft. 40 watt and 5 ft. 80 watt Flush and Trough type fittings complete with tubes and Guaranteed control gear.—For details apply: **SCEMCO LTD.**, Scemco House, 6 and 7, Soho Street, London, W.1. Gerrard 1461 (3 lines). (TC103)

FLUORESCENT LIGHTING. Two Exceptional Value Lines. "The Scemco **COMPENDIUM**" Sets for 3 ft. 30 watt and 4 ft. 40 watt fluorescent lamps.

Sets comprise: Fluorescent lamp, lamp holders, starter lamp and holder, choke, power factor and radio suppression condensers.—Write for full details: **SCEMCO LTD.**, Scemco House, 6 and 7, Soho Street, London, W.1. Gerrard 1461 (3 lines). (TC104)

FLUORESCENT LIGHTING. Speciality fittings designed to your own requirements and specifications. Estimates and sketches submitted **FREE** of charge of genuine enquiries.

Apply: **SCEMCO LTD.**, Scemco House, 6 and 7, Soho Street, London, W.1. Gerrard 1461 (3 lines). (TC105)

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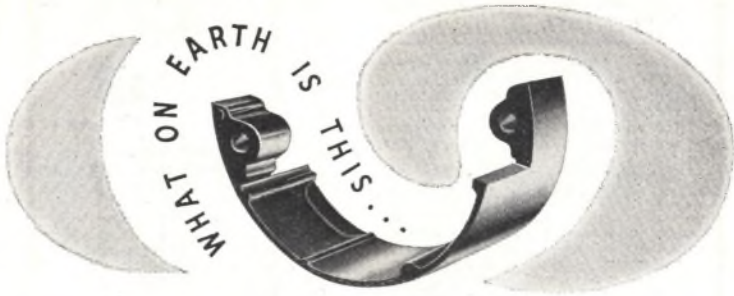
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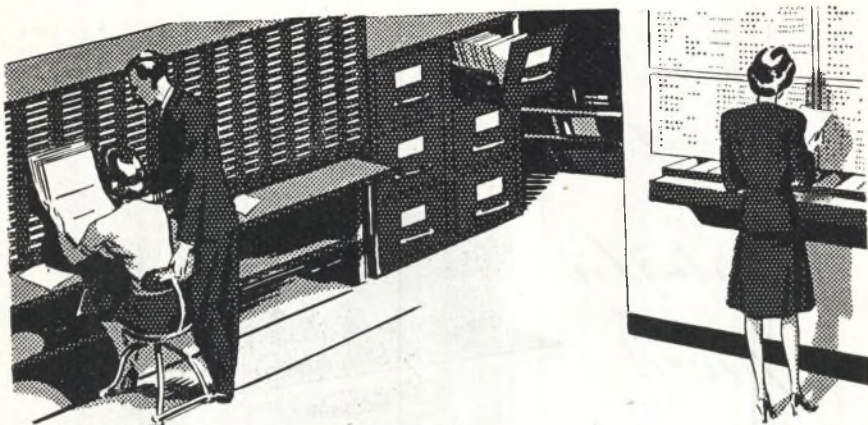
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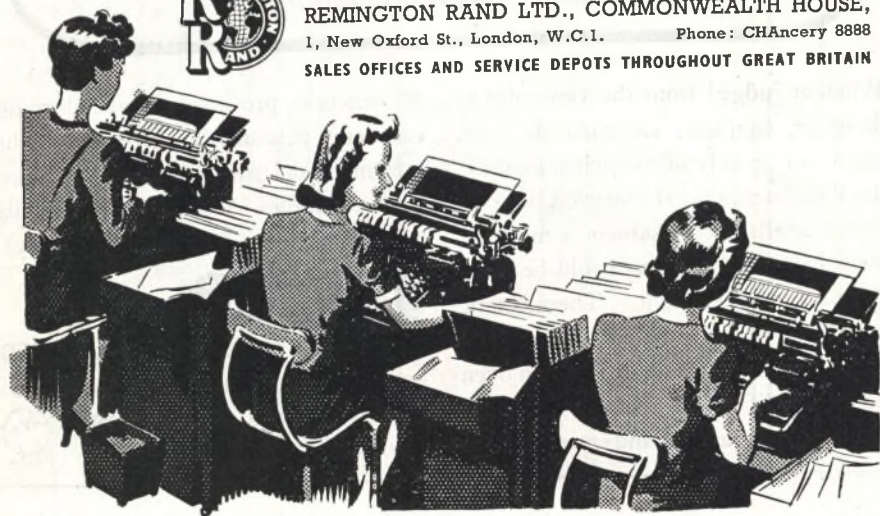
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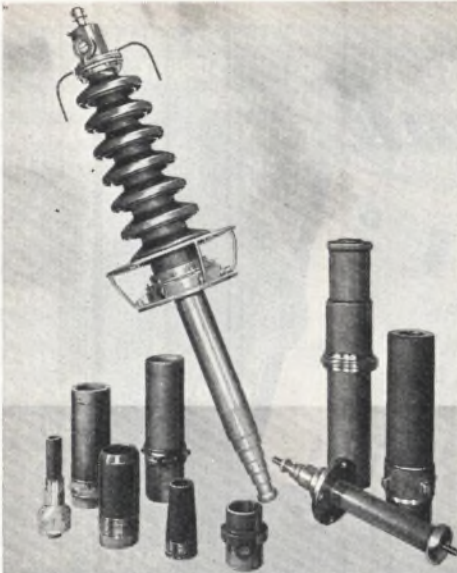
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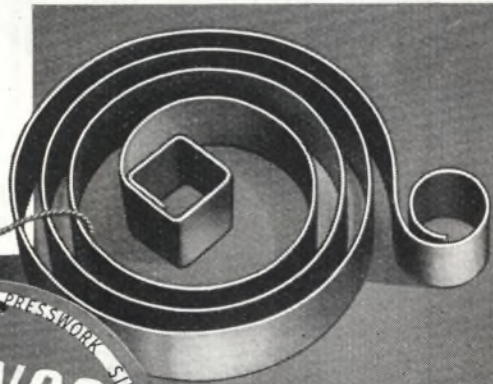


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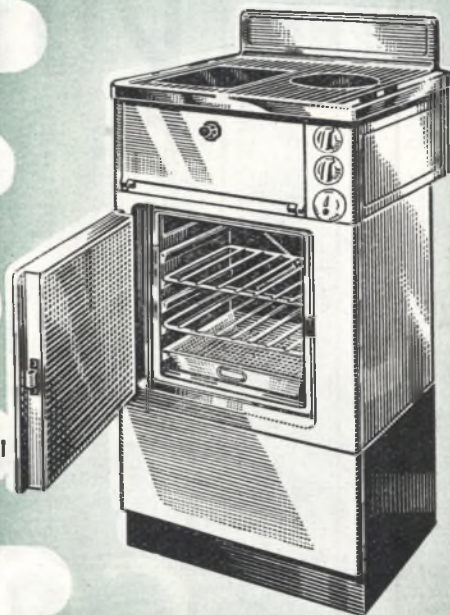
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