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THE

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ELECTRICIAN

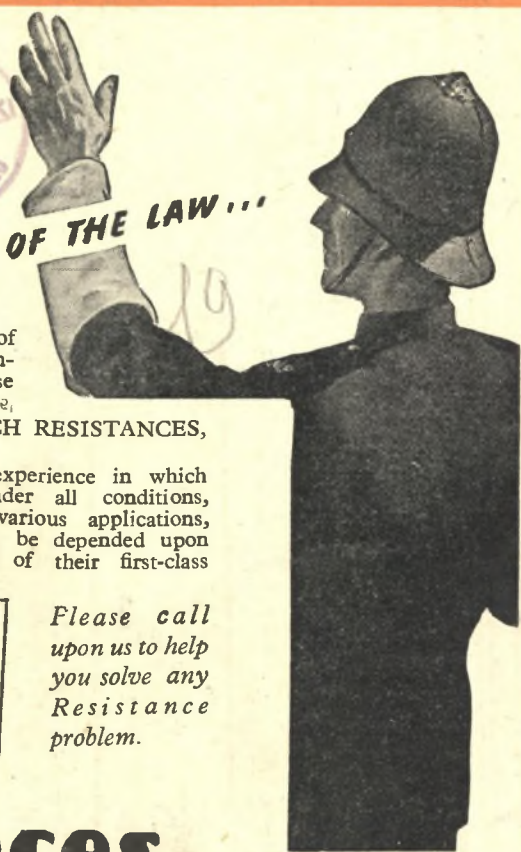
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№ 34



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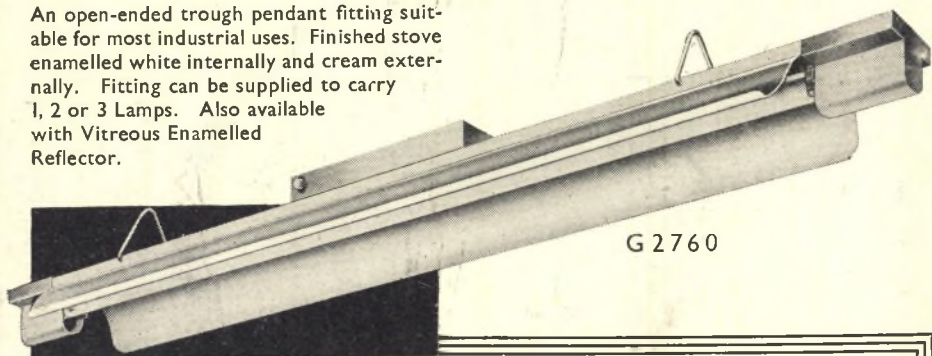
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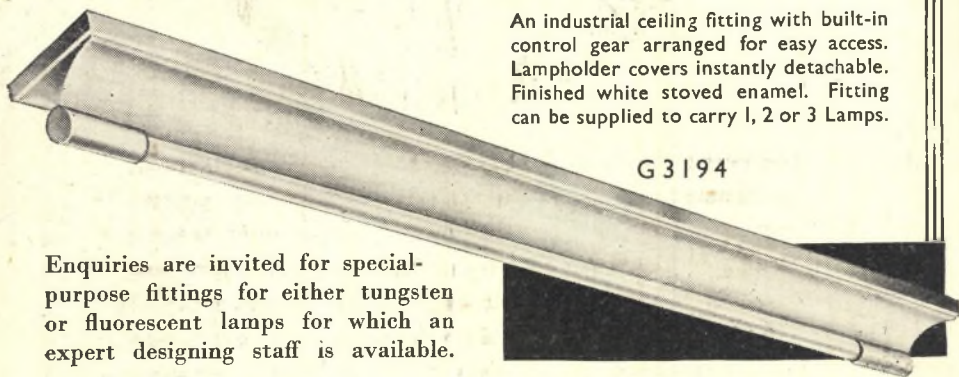
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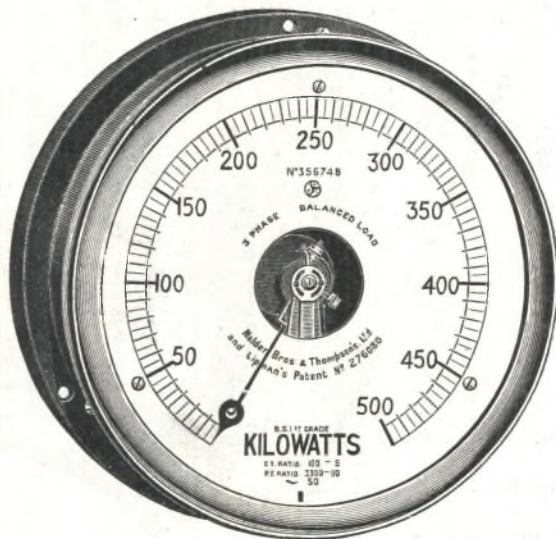
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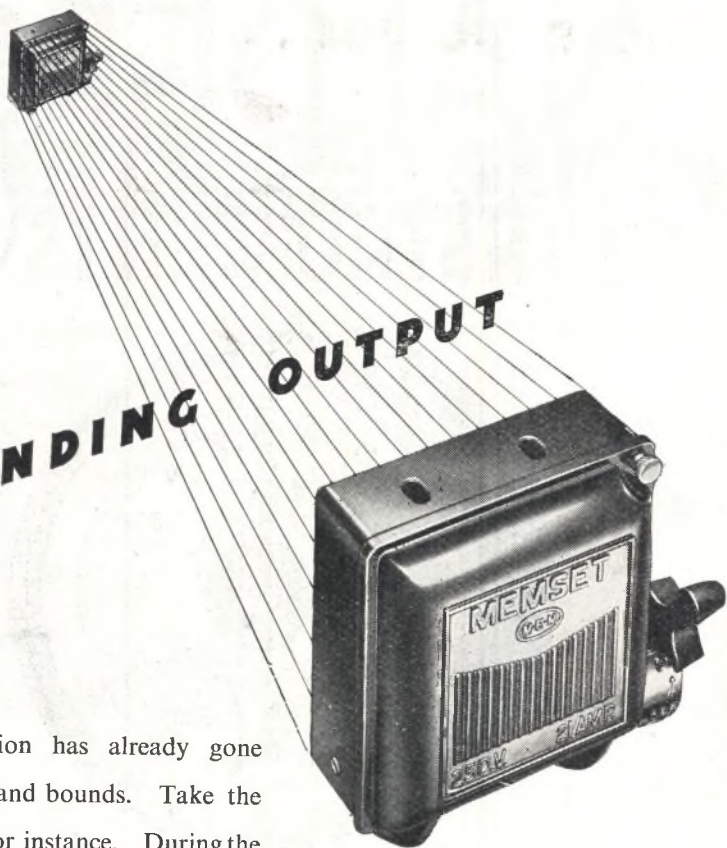
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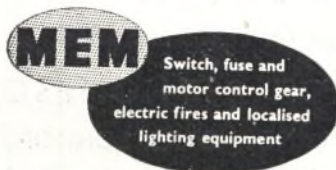
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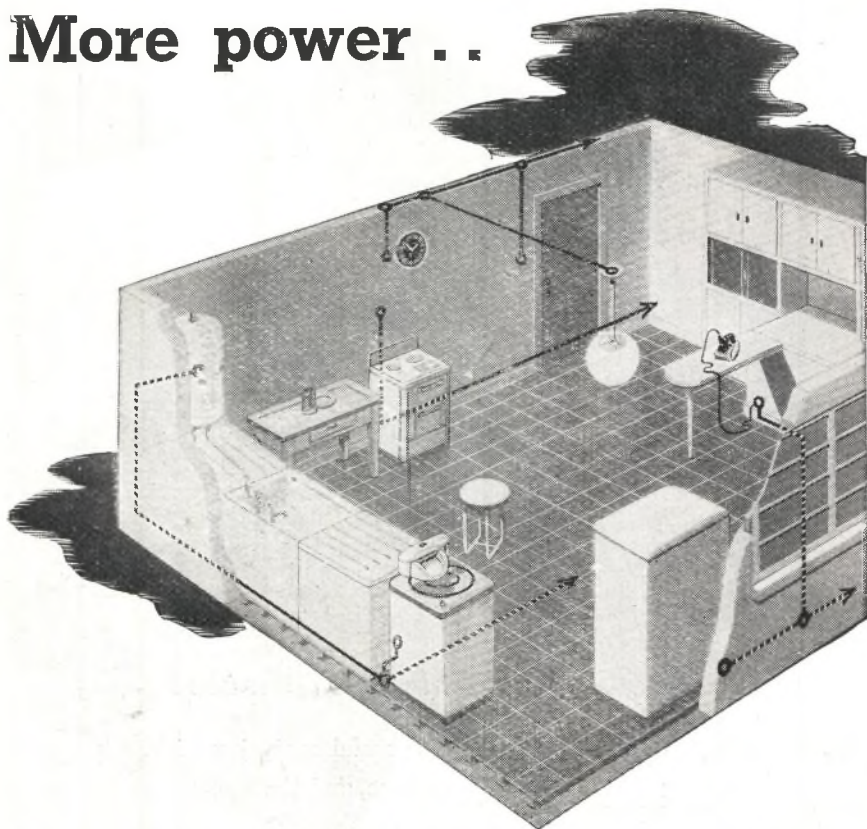


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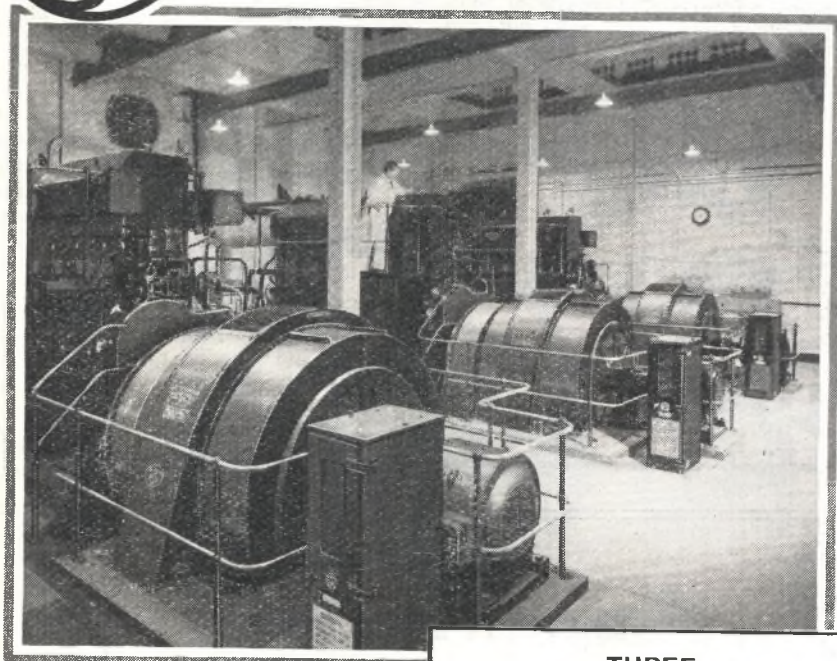
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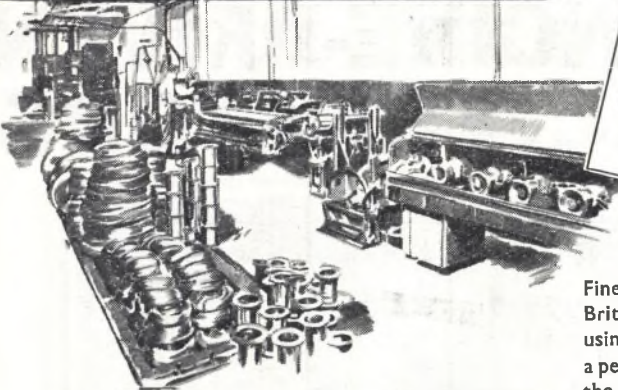
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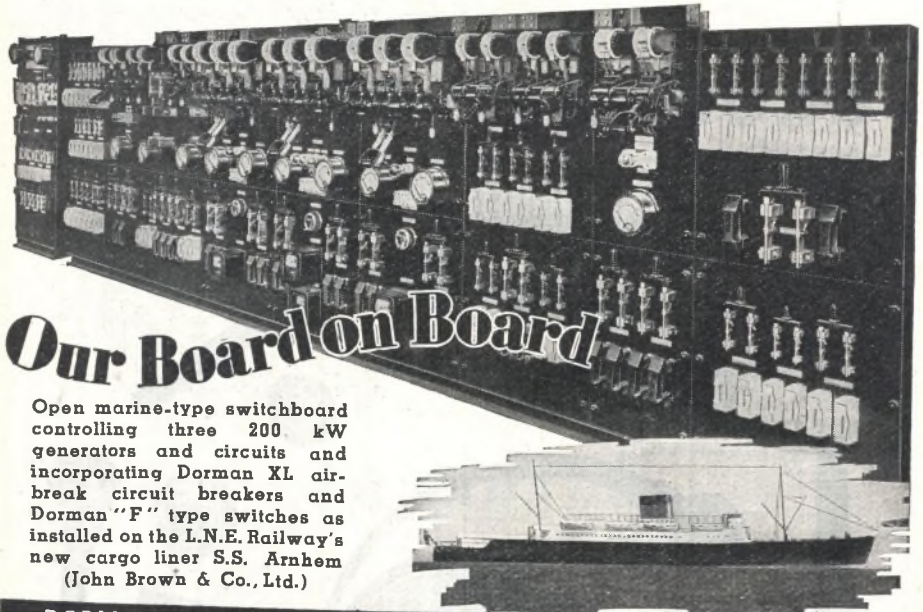
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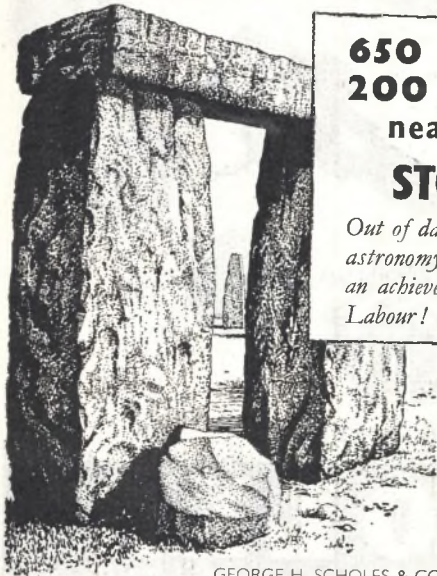
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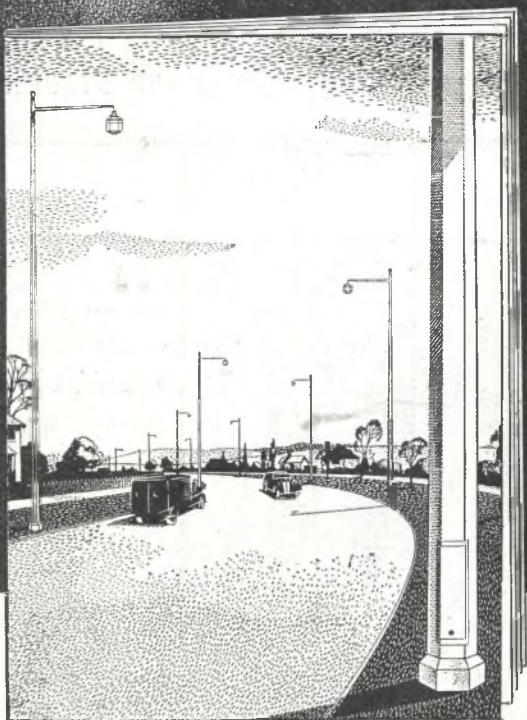
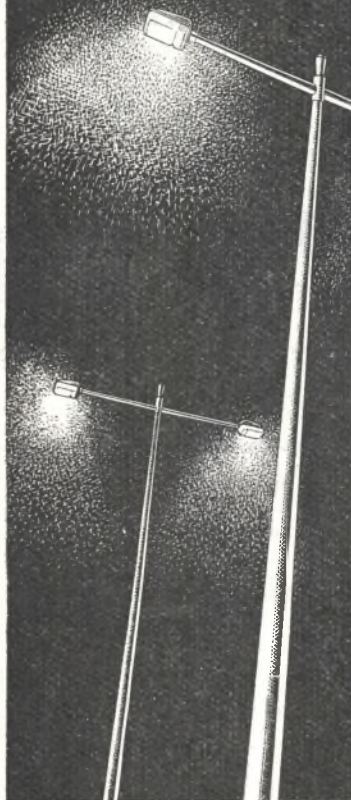
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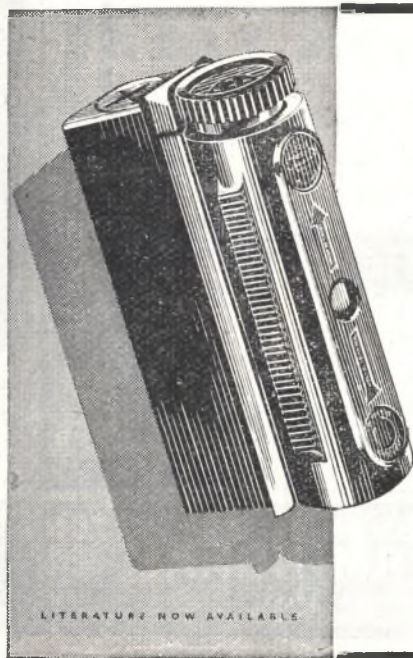
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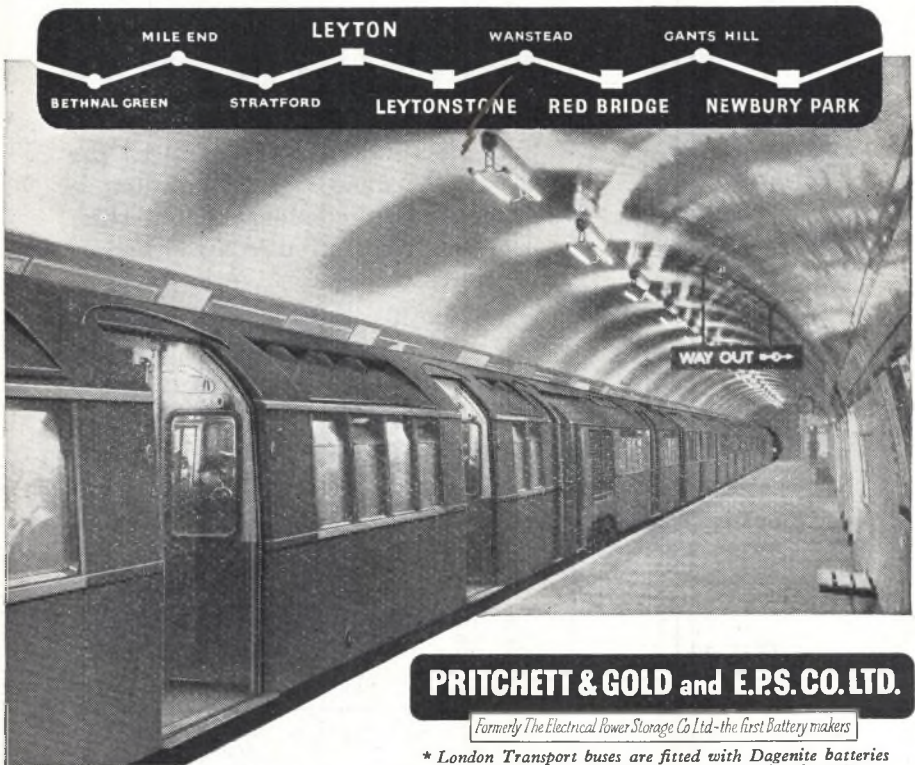
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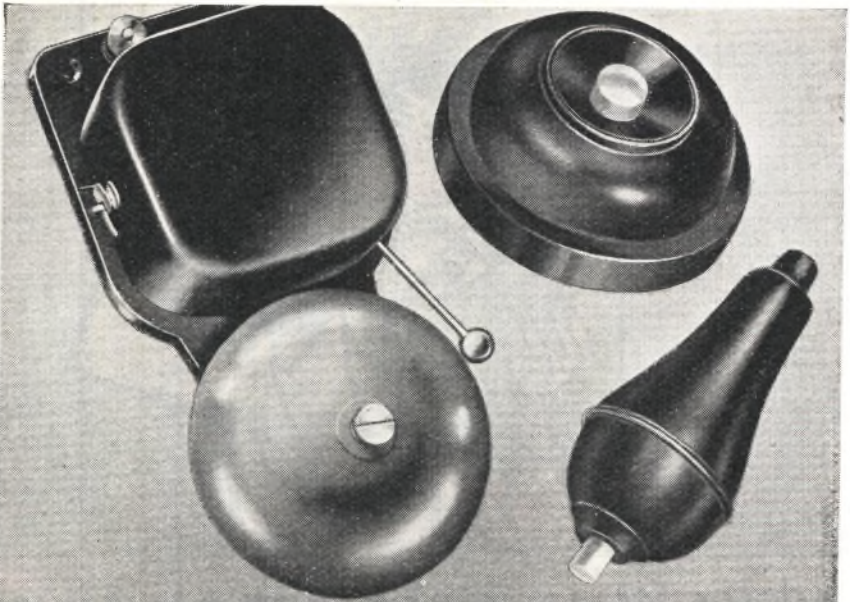
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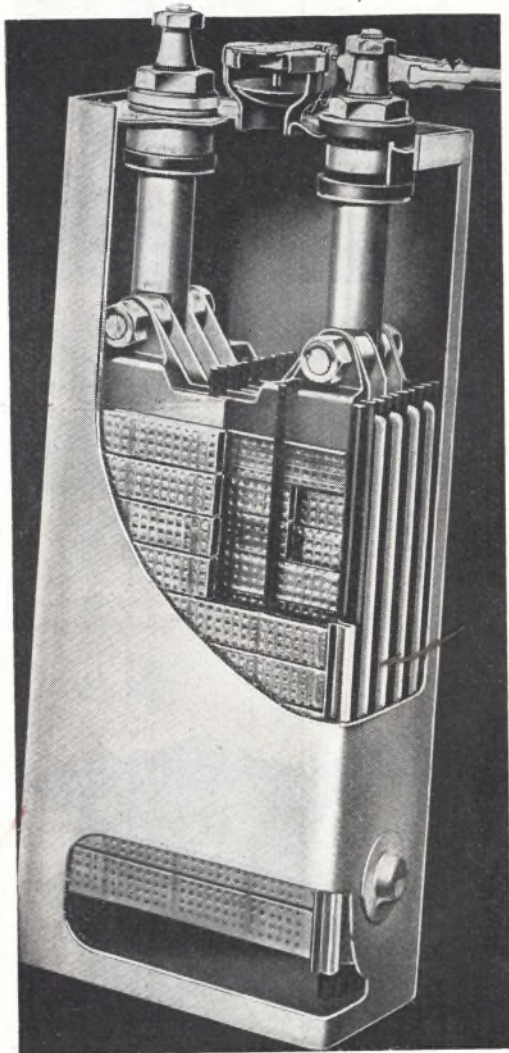


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12 SEPTEMBER 1947

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ALLEGATIONS, often repeated, that the present structure of patent law permits abuse of monopoly rights were effectively disposed of in the interim reports of the Departmental Committee set up to consider what changes were desirable in the Patents and Designs Acts. Last week, the Committee, under the chairmanship of Mr. KENNETH SWAN, K.C., published its final report, in which it finds, after an inquiry extending over three years, "no indication of any general desire for any fundamental change in the present system of encouraging and rewarding invention by the grant of patents."

During the course of the inquiry, however, a number of suggestions put forward by witnesses representative of industry, scientific research organisations, private inventors and patent agents came under consideration, and many of these have been embodied in the substantial list of recommendations now presented to the Board of Trade.

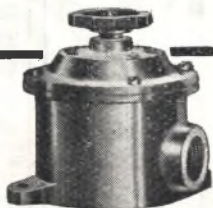
In their interim reports, the Committee suggested an extension of the system of granting licences where a wider use of a patent could be made; that the Comptroller should be given power to reject applications on the ground of lack of "subject matter," and that two special judges, possessing technical or scientific qualifications and experienced in patent litigation, should be appointed to hear all patent actions.

Of the recommendations contained in the final report, perhaps the most important is that advocating the removal



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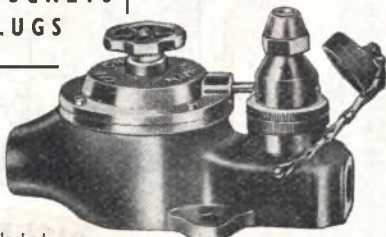


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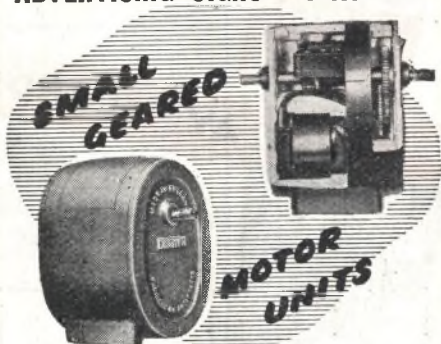
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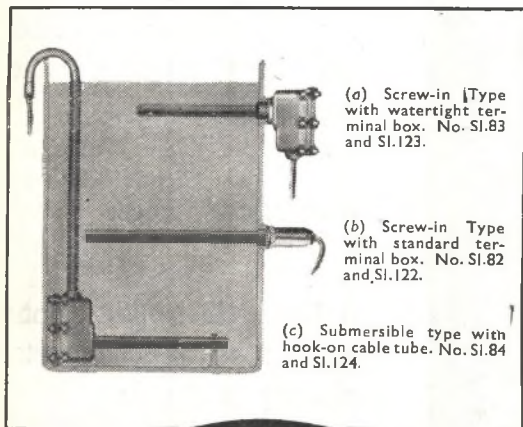
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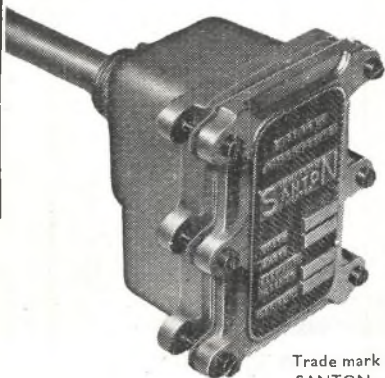
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of the limitation, imposed in 1919 to curb the flood of applications from German dyestuffs manufacturers, which prevents substances produced by chemical processes from being claimed in the specification. This proposal will be welcomed particularly by the sections of the electrical industry concerned with the development of insulating materials and dielectrics. If accepted, it will end a thoroughly unfair discrimination under which those who invent a chemical product, possibly after years of costly research, are at present forced either to patent the method of manufacture—a roundabout and seldom satisfactory stratagem—or to surrender monopoly rights altogether.

Patents Procedure

OF the other proposals, many have as their object the simplification and cheapening of procedure and the removal of inconsistencies, anomalies and anachronisms which experience and recent decisions have brought to light. The compromise solution suggested for safeguarding the rights of the employee-inventor *vis-à-vis* his employer, under which the benefit of an invention may be apportioned between the two parties, would help to remove a frequent cause of ill-feeling and, still more important, encourage the employee not working under a specific research contract to pursue inquiries outside the strict course of his duties. Machinery which is proposed for enabling manufacturers contemplating a new product to ascertain whether or not they would infringe an existing patent is another welcome suggestion. With regard to the nationalised industries, the Committee assumes that these will not have the same extensive rights as those possessed by the Crown, and in discussing the latter's use of patented inventions, the view is supported that licensees, as well as the patentee, may have a claim to compensation.

Coal Stocks

DISTRIBUTED stocks of coal at the end of July reached 11 985 000 tons, of which electricity generating stations held 3 531 000 tons, reported to be the highest total since 1942, when the average was 3 707 000 tons. These figures are con-

tained in the August Digest of Statistics, which also records an increase of 185 in the number of railway wagons made during June, compared with the month before; against the encouraging tone of these figures, however, is the fact that due to the strike in the Yorkshire pits some 250 000 tons of coal were lost to industry last week, and a further 200 000 tons or so have gone the same way since. It was pointed out in *THE ELECTRICIAN* two weeks ago that the coal stocks then held by power stations were equal to about five weeks' demand on present electricity consumption figures, but if the industrial production needed to meet the export drive reaches the volume hoped for, the load upon our generating capacity may cause winter stocks of coal to be drawn upon at a rate greater than at present anticipated. Should this prove to be the case, the loss of output incurred by the Yorkshire mines of the National Coal Board may seriously react upon the electricity supply industry, particularly if an early cold snap heralds the winter months, and notice of this possibility should be taken by the Ministry of Fuel by advancing the present rate of stock-building.

New Export Plan

THE terms of the Government's new export programme which are to be announced by Sir STAFFORD CRIPPS, President of the Board of Trade, to-day, Friday, when he addresses a meeting of representatives of employers' organisations and trade unions at the Central Hall, Westminster, are awaited with lively interest—not unmixed with some anxiety. More controls and restrictions entailing greater and prolonged sacrifices will, unless accompanied by inspired and resolute leadership, have a negative effect. If the Government fails on this occasion to produce a well-considered, practical scheme giving reasonable promise of success, it will further undermine the confidence of organised labour, and of those industrialists and employers who have not only shown their willingness to co-operate in any national policy that will carry us safely through the present emergency, but who have, through the F.B.I., submitted to the Government proposals to meet the crisis. In this connection it is to be hoped that the discussions which Mr. MORRISON, as

acting Prime Minister, Mr. BEVIN, Mr. DALTON, Sir STAFFORD CRIPPS and other Ministers had with representatives of the Federation last week will have had some effect, for manufacturers, called upon to produce the essential goods for the overseas markets, require not only an assurance that there will be available adequate supplies of materials, but also clearer instructions as to how and where they can secure priority for obtaining them.

A Materials Problem

ON the last point raised in the preceding note, there appears at present to be some uncertainty as to procedure, for in a letter to the "Daily Telegraph" last week Sir THOMAS EADES, vice-chairman and managing director of the Automatic Telephone and Electric Co., Ltd., stated that he has no information, directly or indirectly, from any department of the Government on how to secure priority for materials for executing orders from hard currency areas which his company has on its books, though if assured of such materials in the proper volume and at the right times, his company could employ some 2 000 to 3 000 additional people. Sir THOMAS adds that neither he nor his managers or superintendents could afford time to go round to half a dozen Government departments to ascertain just what was necessary to secure the necessary priorities, and he asks what steps should be taken. With efficient direction by the Ministry concerned such a position could not arise.

The Electricity Act

THE publication on Tuesday of the Electricity Act serves as a reminder, if one is needed, that the future structure of the supply industry in this country has been finally determined, at least for some years to come. There have been many who, from sincere conviction, have opposed nationalisation as being at worst inimical to the interests of the country and at best a hazardous experiment at the present time. The decision, however, has now been taken, and even those who were among the bitterest critics of the Bill when it was first presented, will wish that the change-over to State-ownership next April will be

accompanied by as little dislocation as possible, and that the industry under its new direction will continue to be inspired by the same progressive spirit as has animated it in the past. On a later page, a review is given of the changes made between the first drafting of the Bill and its incorporation on the statute book. That the Act is the better for the searching criticism—with which this journal is proud to have been associated—offered both within and without Parliament there can be no doubt. But, while from no part of the Act does it follow that the industry is now set on a retrograde path, neither can it be said that continued progress and expansion are automatically ensured. These qualities depend on the human element, and in the past have resulted largely from the initiative allowed to individual engineers. The first appointments to the Central Authority are evidence that, for the present at least, this fact will be recognised. It will be the problem of the future to ensure that it is not forgotten.

U.S. Plant Shortage

AT a time when the discrepancy between the industrial capacity of the United States and that of the remainder of the world is an everyday topic of conversation, it is interesting to learn that the prospect of a shortage of U.S. generating capacity is now engaging the serious attention of public utility authorities. A demand in excess of supply in many industrial areas, necessitating at least a national appeal for economy, if not some actual restriction on non-essential consumption, is now thought to be likely this winter. Last year, with a total national capacity of 50 million kW, the reserve had fallen to below ten per cent., a figure considered critical. Now, the power industry estimates that a net addition of ten million kW will be required in the next few years. During June this year, the average weekly output of the industry was about 4 600 million kWh, representing an increase over the previous year of 13 per cent. Extensions to grid networks are expected to provide some relief to the more seriously overloaded stations, however, and it is not thought that a situation of "crisis" dimensions will arise.

Portrait—Prof. Willis Jackson

BORN in Burnley, Lancs, in 1904, Willis Jackson was educated at the local Grammar School and entered Manchester

University, where he graduated with 1st class Honours in Electrical Engineering in 1925. Even at this early stage he had decided upon an academic career, and following a year's research work at Manchester for the M.Sc. degree, he held an appointment as lecturer in Electrical Engineering at the Technical College, Bradford, from 1926 to '29. Realising the need for industrial experience, he then joined the Metropolitan-Vickers Electrical Co., Ltd., as a college apprentice. Towards the end of this course, however, the appeal of academic life re-asserted itself and he joined the staff of Prof. Miles Walker at the College of Technology, Manchester. Much that has happened to him since that time Jackson attributes to the guidance and inspiration which he received from Miles Walker, and on the latter's retirement he arranged to join E. B. Moullin, now Professor of Electrical Engineering at Cambridge, in the Engineering Laboratory, Oxford. From October, 1933-36, Jackson devoted himself largely to extending the research work on dielectric materials which he had started at the College of Technology, but at the same time he acted as Tutor in Engineering Science to a number of the Oxford colleges. In 1936 he took the D.Phil. degree of Oxford, and in the same year was made a Doctor of Science of the University of Manchester.

At this stage he returned to the works of the Metropolitan-Vickers Electrical Co. as a research engineer and for the next 2½ years acted also as personal assistant to Dr., now Sir Arthur, Fleming. The attraction of University life remained, however, and his long-standing ambition was realised when, in 1938, he was appointed to the chair of Electrotechnics at his mother University, Manchester.

Throughout the war period Prof. Jackson spent a considerable proportion of his time in London as a member of Govern-

ment Scientific and Technical Committees and at the associated Signals and Radar Research Establishments of the Ministry of Supply and M.A.P., but he continued his teaching work at Manchester University and was responsible there for a Ministry of Supply research team engaged particularly on very high frequency and dielectric investigations.

About a year ago he severed his long connection with Manchester to take up his present appointment as Professor of Electrical Engineering at the Imperial College of Science and Technology, London, in succession to Prof. C. L. Fortescue.

Prof. Jackson was a member of the I.E.E. Council from 1938 to 1941, was re-elected in 1945 and has been Chairman of the Institution's Radio Section during the past session.

For his published papers in the journal he has been awarded six I.E.E. premiums, including the Duddell and Ambrose Fleming premiums.

His present outside scientific activities include membership of the Scientific Advisory Council of the Ministry of Supply, of the Radio Research Board and of the Executive Committee of the N.P.L., while on the educational side he is a member of the Central Advisory Council for Education in England of the Ministry of Education. He is a member of the Athenæum Club, Pall Mall, plays tennis as a diversion from his professional interests, but claims that gardening is his main hobby and relaxation. He is married, has two daughters and lives in Cheam, Surrey.

During his chairmanship of the I.E.E. Radio Section he has shown himself to be a ready speaker, capable of the subtle humour for which Lancashire may be said to have some fame.



The Electricity Act

The Electricity Act, which received the Royal Assent on August 13, was published in final form at the beginning of this week. During the course of its passage through Parliament, a total of nearly nine hundred amendments were put down against the Bill, of which about 360 were accepted. In its original form, the Bill was summarised at length in our issue of January 17, and the more important alterations were reported in our pages as they were agreed to by Government spokesmen in Standing Committee "E," the House of Commons and the House of Lords. The following resumé outlines some of the changes which have taken place in the original structure, with particular emphasis on those amendments concerned with the overall composition of the nationalised industry. Many amendments rectifying drafting obscurities and a series of important changes in the proposed mechanism for taking over company- and municipally-owned undertakings have, for reasons of space, been ignored.

THE basic duties of the British Electricity Authority—to generate or acquire supplies of electricity, to provide bulk supplies to Area Boards, while co-ordinating distribution by the Boards and exercising a general control over their policy, and also to provide supplies itself to certain classes of consumers—remain unchanged in the Act. In the clause defining the duties of the Boards, however, a certain tightening of the phrasing has the effect of making the promotion of economical methods of generation, transmission and distribution, etc., part of the "exercise and performance" of the functions of the Boards instead of, as before, an object of their policy. Further, the Area Boards are now required to "secure, as far as practicable, the development and extension of supplies to rural areas." To a sub-section dealing with the simplification of tariffs has been added a phrase requiring also standardisation of methods of charges. Additional functions of the Central Authority and Area Boards include the assistance of persons outside the scope of the Act, when requested, in research affecting the supply of electricity. The Authority and Area Boards, when making provision for advancing the skill of employees and for improving the efficiency of equipment, will now consult with any organisation appearing to them to be appropriate.

MANUFACTURING POWERS

In the important section dealing with the power of the Authority to manufacture plant and fittings, a sub-section has been added making it clear that this power does not extend to manufacture for export purposes.

Alterations have been made to the constitution of the Central Authority and the Area Boards. The Authority will now consist of a chairman and not less than four nor more than six other members. An additional qualification for which mem-

bers of the Authority may be selected by the Minister is experience in the generation and supply of electricity. Four other members (previously "not more than four") will be appointed from chairmen of the Area Boards, in rotation, while an additional member, as in the original Bill, will be *ex officio* the chairman of the North of Scotland Board. A minimum size has also been set for the Area Boards, which are to consist of a chairman and not less than five nor more than seven other members. Again, experience of electricity supply is recognised as a possible qualification for membership. An additional member will be the chairman of the Consultative Council in that area.

MINISTER AND THE B.E.A.

In defining the boundaries of the Area Boards, the Minister will now make his decision after consultation with the Central Authority. A similar requirement to consult with the Boards concerned is laid upon the Minister when any variation of area boundaries or the formation of a new area takes place.

In his relations with the Central Authority, the Minister will give directions of "a general character" and prepare, in consultation with the Authority, a general programme for measures of reorganisation or such works of development as would involve substantial outlay on capital account.

Consultative Councils, of which one will exist in the area of each Area Board, have had their composition more precisely defined as a result of amendments. Consisting, as before, of not less than twenty nor more than thirty persons, appointed by the Minister, they will also take not less than half nor more than three-fifths of their membership from a panel of persons nominated from among members of local authorities in the area. The remainder of the membership will be appointed, after

consultation with such bodies as the Minister thinks fit, to represent agriculture, industry, commerce, labour and the general interests of consumers, and other persons or organisations interested in electrical development in the area. A member of the House of Commons may be a member, but not the chairman, of a Consultative Council.

The general effect of several amendments concerned with the duties and privileges of the Consultative Councils has been to strengthen their position; for example, the Authority will now consult with the Councils when representations have been made that a defect exists in the Area Board's general plans and arrangements. An additional clause allows for Councils, after consultation with the Central Authority, to make representations direct to the Minister. The Minister, in considering these representations, will consult both the Area Board and the Council concerned.

In the clause dealing with the presentation of an annual report by the Central Authority, the Minister may notify the Authority that certain Ministerial directions shall be excluded from the report, if in his opinion, it is in the interests of national security to do so. In the original drafting, the phrase "national interest" appeared in the place of "interests of national security." Reports which the Minister will lay before Parliament annually are that of the Central Authority, those of each of the Area Boards and a report with respect to the exercise of his own functions.

Those sections of the Act dealing with compensation to holders of securities and local authorities have been modified considerably in points of detail. An important additional provision makes available the sum of £5 000 000 for compensation of local authorities in respect of severance. The amounts to be paid to individual authorities are to be determined in a manner to be prescribed later.

FIXING TARIFFS

Under "financial provisions," an addition to the original drafting permits different tariffs to be fixed for different area boards. The tariffs fixed are to be framed to show the principles on which the charges are made as well as the prices to be charged. The Central Authority will order the tariffs to be published in such manner as in their opinion will "secure adequate publicity for them." An Area Board is itself permitted to enter into agreement with a consumer for supplies, at tariffs to be fixed in the agreement, but the Board must not show undue preference to any consumers or class of consumers and, equally, shall not exercise any

discrimination against them. The Central Authority is authorised to secure the compliance of Area Boards with this subsection.

In the preparation of their accounts, the Central Authority and Boards are to provide separate information in respect of generation, distribution and each of their other main activities, and to indicate as far as possible the financial and operating results under each heading. Copies of these accounts are to be made available to the public at a reasonable price.

An entirely new clause (No. 48) deals with the acquisition of non-statutory undertakings. Where these undertakings have incurred capital expenditure on projects approved by the Minister at any time after November, 19, 1945, they may, within a year from the passing of the Act, apply to be taken over.

It is now laid down that where supplies are given to railways, the charges made and other terms and conditions should not be such as to result in any financial loss to the Electricity Board concerned.

CONDITIONS OF EMPLOYMENT

A modification made to the clause describing the nature of the machinery to be set up for settling terms and conditions of employment has the effect of making this a task of the Central Authority, where previously it had been that of the Electricity Boards. The Central Authority must also seek consultation with the organisations concerned to promote and encourage measures affecting the safety, health and welfare of employees, and discuss matters relating to efficiency in the operation of the Boards' services. These functions will be exercised by the Authority in consultation with the Area Boards and North of Scotland Board.

In a new clause (No. 58) provision is made for the compensation of officers of "electricity associations," where these are wound up as a consequence of the Act. Bodies having amongst their objects "the promotion of the interests of electricity undertakers or the interests of the officers of electricity undertakers," may, after the satisfaction of all their debts and liabilities, have their remaining assets applied in whole or part for compensation purposes.

The boundaries of the South-Eastern Electricity Board, as stated in the First Schedule of the Act, are enlarged from their original position to include a part of Middlesex originally within the London Board area, and will thus consist of "parts of Kent, Middlesex, Surrey and Sussex." The Scilly Isles are included in the area of the South-Western Board and the East Anglian Board is renamed the Eastern Board.

Fuel Economy Conference

ABSTRACTS FROM PAPERS READ AT THE HAGUE

PAPERS covering a wide range of subjects related to the efficient use of fuel were read at the Fuel Economy Conference of the World Power Conference, which opened at The Hague, on September 2. Information on electrical developments that have taken place since 1939 and are planned was also exchanged. Sir Johnstone Wright, chairman of the Central Electricity Board, headed the British delegation, and Mr. J. Eccles, president of the I.M.E.A., and Liverpool city electrical engineer, was chairman of Section A5, which discussed "Production: Electric Energy." Others who attended the conference were Prof. J. D. Cockcroft, F.R.S. (director, Atomic Energy Research Establishment, Harwell), Dame Caroline Haslett (director, E.A.W.), Mr. Henry Nimmo (Electricity Commissioner) and Mr. I. V. Robinson (B.E.A.M.A.).

L'INGENIEUR GENERAL PIERRE SALMON (Minister of Industrial Production, France) stated that the output of the collieries in France had become normal thanks to the employment of 40 000 prisoners of war and the use of new machinery. The production of electric power by means of coal-fuelled power stations was ensured by 250 generating stations, each of which was linked up with the general network. During the occupation, fuel consumption increased from 1.1 to 4 lb./kWh, chiefly on account of the bad quality of the coal and its unsuitability for the furnaces in which it was consumed. Hydro-power equipment was installed during the war years only very slowly and to such an extent that it did not assist the enemy's war effort. The French modernisation and equipment plan provides for the building of new hydro-electric stations which are to increase production by 9.6 thousand million kWh in five years.

DR. ING. ZDENEK RYSKA (Czechoslovakia), in the course of his paper on "Electronic Control of Combustion in Steam Boilers," described methods hitherto employed to regulate combustion, compared them with the new electronic method, stated several of the results obtained, particularly the elimination of fluctuation of some important physical values which influence the operation of boilers, and indicated the chief advantages of electronic control of combustion processes. "The control of the steam generating process by electronic regulation," he stated, "improves the efficiency

with which boilers can be operated to an extent which was previously unattainable."

M. W. KARRER (Switzerland) stated that the gas turbine, in the form of an air turbine, could be embodied in steam power plants and, like the back-pressure steam turbine, could be used to secure additional power with a low fuel consumption. He showed by the aid of energy-flow diagrams and by numerical examples that increased output, equal in amount to that of the back-pressure steam plant, could be obtained and that the efficiency at which the additional output was secured was considerably higher than the values realised to-day with any type of pure steam power plants.

MR. LENNART HOGEL (Sweden) spoke of the metallurgical uses of high-frequency furnaces in Sweden. It was a characteristic feature of the development of high-frequency melting furnaces in Sweden, he said, that the unit capacities were large in comparison with those used in other countries, and the trend was towards still larger units. High-frequency furnaces for heat treatment had been developed on lines that were entirely different from foreign practice. The upper frequency limit of the motor-generator sets was 40 000 cycles a second. The furnace coils were of very robust construction, were completely embedded in ceramic material, and surrounded by packets of laminated transformer iron. Thus they were more or less similar in design to transformer coils. The purpose in view was to design furnaces adapted to severe operating conditions and to reduce losses as far as possible.

SIR JOHNSTONE WRIGHT (chairman, Central Board) contributed a paper on "Co-ordination of Electricity Supply—the British Grid in War-time," in which he reviewed the experience of the British grid system under the acute strain imposed by war conditions.

M. AILLERET (France) presented a study of the way in which the voltages of great transmission systems increase in relation to the power transmitted and showed how the theoretical laws which can be deduced have been verified in the development of the French electrical grid. He sketched briefly a method of analysis of the great transmission systems by defining the systematic transmission of power between areas where there is a surplus of available hydro-electric power and

consuming areas. Finally he showed the repercussions of the contingencies of estimates of transfer on the construction of grids and called attention to the importance of technical solutions which prepared for the changeover to a higher voltage, without prematurely fixing the date.

M. P. HOUBIN (France) said that the district heating system of Paris, which is to be extended shortly from 18½ miles to 26 miles, is supplied by a back-pressure heating and power plant at Ivry-sur-Seine. At its peak output, this system now allows of an annual saving of 40 000 tons of first grade coal, and 224 tons of light oil. When the system has been fully developed to a length of 56-62 miles, it will enable annual savings to be made of 364 000 tons of coal and 1 000 tons of oil.

MR. TH. THELANDER (Sweden), in a paper on "Some Results of Electric Traction on the Swedish State Railways," demonstrated that the electrification of the Swedish State railways had yielded very good returns, but its results were even more important. If electrification had not been carried out, he said, it seemed highly probable that steam operation could not have been developed to such an extent as to be able to cope with the volume of traffic handled by the electrified lines during recent years. Electrification had saved Sweden from a transportation crisis which would have had serious consequences in many fields. The State authorities, therefore, had very good reasons for resolving upon further development of railway electrification. The electrification of a further 240 miles of route is expected to be completed in 1949, and at the end of that year the total length of electrified route on the Swedish State railways will be at least 3 230 miles. This year the Riksdag voted the first grant for a programme covering the electrification of a further 770 miles.

Mr. WARD F. DAVIDSON (U.S.A.) considered the possibilities of using nuclear energies for power production. It had been shown, he said, that when quite exacting conditions had been satisfied, a self-sustaining nuclear reaction might be established which would release heat energy at the rate of about 4.5×10^6 kWh per kg. of fissionable material entering into the reaction. If this reaction in U235 or Pu239 proceeded in the presence of the naturally abundant materials such as U238 or Th232, a "recycling" process might be established which resulted in the utilisation of at least part of the added materials. Much difficult and costly analytical and experimental work had to be done, however, before even the first workable power plant was in operation. There were problems of suitable materials,

selection of suitable heat transfer fluids, adequate shielding of the plants and the disposal of reaction products. An estimate indicated that nuclear power plants might be able to deliver power at costs comparable with those from coal-burning plants, but constructional and labour costs and fixed charge rates were likely to be several times greater during the first years of operation. There seemed, however, to be good reason to expect that within a decade it would be possible, technically, to have nuclear power plants of several thousands of kW capacity.

M. L. KOWARSKI (France) thought that the arrival of nuclear energy as an economic factor of some importance could be expected within years, rather than decades. Its rate of development in France was dependent upon the progress made in certain foreign countries, such as the United States and Great Britain, and on the international political situation. The anticipation of the future benefits of atomic power, however, must not lead to any cessation or slackening in the efficient exploitation of the classic sources of power.

PROF. J. D. COCKCROFT, F.R.S. (Great Britain), remarked that the number of cycles through which the metal in a natural uranium reactor could be put was at present uncertain: it might, with developments in design, permit a total heat generation substantially greater than the heat of fission of the total U235 content of the pile. In most nuclear reactors so far built, the uranium metal rods had been sheathed by aluminium to prevent corrosion by the coolant and to prevent the escape of radioactive products into the coolant, and this limited the temperature of operation to the safe stress of aluminium from the point of view of "creep"—about 300° to 400° C. This temperature limit would probably be increased by the use of other sheathing metals or refractories. The coolant would probably consist of helium or CO₂, and could be circulated direct through a gas turbine or through a heat exchanger or steam raising boiler. The thermodynamic efficiency obtainable would be 15 per cent. at the lowest, and it was expected that developments would raise this to 25 to 30 per cent. Speaking of the possibilities of secondary reactors burning plutonium or U233, Prof. Cockcroft said these reactors might "breed" nuclear fuel from quantities of U238 or thorium placed around the pile. If this could be achieved, and it was vital for a world utilisation of nuclear energy on a large scale, the consumption of fissile material needed to supply world energy requirements would be 170 tons per annum.

(To be continued.)

Marine Jet Propulsion

First Sea-Going Installation Described

THE first ship to be propelled at sea by a gas turbine was publicly demonstrated on the Solent last week. The characteristics of the simple cycle gas turbine include low overall specific weight and size with rapid starting, and these qualities make it suitable for light vessels where high speeds may be required for limited periods and at short notice.

In M.G.B. 2009, the naval craft chosen for the experimental installation, normal cruising and astern power is provided by two 1 250 B.H.P. internal combustion reciprocating engines, each driving its own propeller through a reduction gear. Maximum ahead power is obtained by bringing into operation a completely independent Metropolitan-Vickers gas turbine of 2 500 S.H.P., which drives a third propeller through speed reduction gearing to supplement the reciprocating engines.

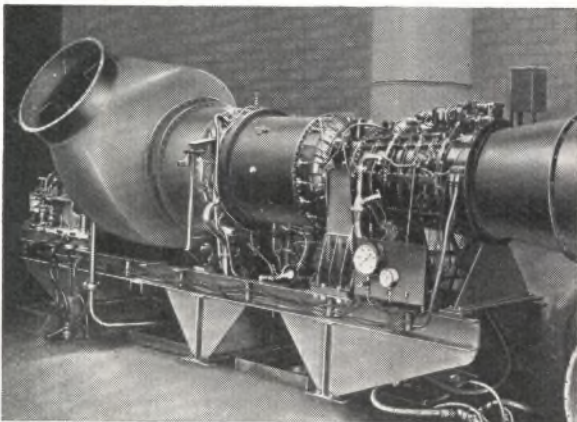
For the gas generator portion of the plant an engine already developed by the company is employed. New features of design are confined mainly to the power turbine and its gears and to certain modifications to the control system. The complete plant comprises a gas generator consisting of a compressor, combustion chamber and a turbine driving the compressor, this being followed by a power turbine mechanically independent of the compressor turbine and coupled by a reduction gear to the propeller shaft. This lack of mechanical connection between the rotors of the gas generator and the gas turbine enables the latter to adjust itself easily to the power-speed characteristics of the load.

The compressor is a nine-stage axial flow machine with aerofoil section blades of aluminium alloy, while the rotor is provided with a conical extension piece to the end of which is secured an extension for the mounting of the turbine disc. This combined rotor is carried in two ball bearings with the turbine disc overhung. An annular type combustion chamber, characterised by "straight through" flow, is employed. The turbine driving the compressor is of the two-stage type with a disc of molybdenum-vanadium steel.

Rotating independently of the compressor turbine, the power turbine has four stages,

the central shaft being carried in two ball bearings.

From the power turbine, the drive is taken through a flexible quill shaft to a double-helical single-reduction gear. A self-synchronising clutch mechanism (Hydraulic



Gas turbine plant assembly on bench test

Coupling and Engineering Co., Ltd.) is incorporated to permit the gas turbine propeller to rotate idly when the reciprocating engines alone are in use.

Control of a gas turbine engine of this type is effected solely by regulating the quantity of fuel admitted to the combustion chamber of the gas generator, but this portion of the plant has a minimum running speed. On starting up, therefore, external means are required to bring the speed up to the self-sustaining speed. This is effected by means of a 24 V d.c. starting motor, ignition taking place when the generator has been run up to about 800-1 000 r.p.m. The machine becomes fully self-sustaining at about 2 000 r.p.m., at which point the starting motor is then switched off, the machine then accelerating to the idling speed of about 3 000 r.p.m. under the control of a servo-operated automatic starting valve. The time for starting up the gas generator from cold to idling speed is of the order of 45 seconds. An overspeed governor prevents the speed exceeding the maximum selected value.

During bench tests, which commenced in April last year, an output of 2 550 B.H.P. was obtained at the design shaft speed of 1 087 r.p.m. with a gas generator speed of 7 220 r.p.m., the specific fuel consumption (1 lb. of fuel per B.H.P./hr.) being 1.06 lb.

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.

SIR JOHN M. KENNEDY, who is 68 next month, became chairman of the



SIR JOHN KENNEDY

Electricity Commissioners on Monday, September 8. He succeeded Sir Cyril Hurcomb who resigned to become chairman of the British Transport Commission. Sir John Kennedy was appointed an Electricity Commissioner in July, 1934, and he has been deputy chairman of the Commissioners since January, 1938.

MR. E. P. HARDY, progress engineer at the Acton works of the L.P.T.B. since 1928, has been appointed progress and planning engineer in the department of the Chief Mechanical Engineer (Railways), L.P.T.B. Mr. Hardy, who is 63, was trained in electrical engineering and workshop practice at King's College, London. Entering the service of the London United Tramway Company in 1908, he became assistant mechanical engineer in 1913, and in 1917 was transferred to the London Electric Railway with the post of assistant for rolling stock to the Mechanical Engineer.



MR. H. V. CROSSE

MR. H. VICTOR CROSSE, whose portrait is reproduced on this page, has, as was announced in our issue of August 22, been appointed southern area manager for Ekco-Ensign Electric, Ltd.

MR. C. L. KENT has been appointed London office manager for the Wardle Engineering Co., Ltd., at 34, Victoria Street, London, S.W.1, in succession to the late Mr. Gunner.

MR. H. C. HASTINGS, who has retired from the position of chief of the control gear engineering department of the British Thomson-Houston Co., Ltd., after

49 years' service with the company, and his successor, Mr. C. J. Sarjeant, are the



MR. H. C. HASTINGS



MR. C. J. SARJEANT

subjects of portraits reproduced on this page. Biographical details were given in our last issue.

SIR BEN LOCKSPEISER, chief scientist to the Ministry of Supply, and Sir Henry Tizard, chairman of the Defence Research Policy Committee of the Advisory Council on Scientific Policy, sailed for New York in the "Mauretania" last week. They have gone at the invitation of the Canadian Government to inspect Canadian defence establishments.

MR. P. M. EDINBOROUGH has joined the staff of Frank Westerman (Wholesale), Ltd., in the capacity of general manager. After twelve years with the A.E.I. group in administrative capacities, he became general manager for Elexcel, Ltd., leaving at the end of six years to take up the position of commercial and sales manager with Britmac Electrical Co., Ltd. From 1940 to 1947 Mr. Edinborough served in the manpower



MR. P. EDINBOROUGH

office of the Ministry of Labour and National Service, latterly operating on the Government's "Training Within Industry" scheme. As general manager, Mr. Edinborough will reorganise the elec-

trical department, which has grown to large proportions. Mr. R. J. Sharpe continues as radio and appliances sales manager.

MR. R. BEARDSMORE, at present with the Birmingham electricity undertaking, has been appointed assistant meter superintendent in the Lincoln electricity department.

MR. L. G. ASTON, who was the electrical engineer and manager at Brierfield, before taking up a similar appointment at Dorchester on September 1, received a gold propelling pencil from the employees of Brierfield electricity department, on September 5. Mr. J. Robinson, technical assistant, made the presentation. Mr. Aston's successor is Mr. G. E. W. Hird.

MR. JOHN B. LANGMUIR, Director of Welfare, National Coal Board, met at the

of the City of Prince Albert, Saskatchewan, and Sherbrooke, Quebec. In 1923 he joined the staff of Nesbitt, Thompson



MR. WILMOT interested in a process at the factory of Scottish Cables, Ltd.

and Co., Ltd., Montreal, and two years later became assistant commercial manager of the Power Corporation of Canada and Southern Canada Power Co., Ltd. Mr. Pawson is a director of the Northern British Columbia Power Co.

MR. WILMOT, Minister of Supply, during his brief tour of selected Scottish industrial establishments, visited the works of the Scottish Cables, Ltd., Renfrew, on September 3. On his arrival, Mr. Wilmot was greeted by Mr. William Fraser, chairman and managing director, and conducted on a tour of the factory.

MR. C. B. COLSTON, chairman and managing director of Hoover, Ltd., on the occasion of the first annual sports recently, opened the seven acre ground which the company has bought for their Sports and



MR. C. B. COLSTON, chairman and managing director of Hoover Ltd., opening the company's new sports ground at Wembley. On the right is Mr. W. PUCKEY, director and general works manager

Social Club at Wembley. A putting green, tennis courts and cricket pitches are also to be laid out.



Group taken at Olympia showing MR. J. KIRK (N.C.B.), MR. G. COOK, MR. J. JONES, MR. A. NICHOLAS (director and general manager, South Wales Switchgear, Ltd.), MR. T. JONES, MR. J. B. LANGMUIR (Director of Welfare, N.C.B.), MR. J. SMILLIE (electrical and mechanical engineer, Miners, Welfare Committee), and MAJOR C. B. DE FALLE (director, South Wales Switchgear)

stand of South Wales Switchgear, Ltd., at the Industrial Wales Exhibition, Olympia, London, three disabled Welsh ex-miners who had erected the 1 000 kV power transformer exhibited. The men had an aggregate of 100 years' service in the mines before being invalided out suffering from silicosis and are now working successfully in the heavy electrical industry.

MR. HERBERT E. PAWSON, who has been elected president of the Canadian Electrical Association, was employed at the Middlesbrough Corporation electricity works before leaving this country for the United States in 1910. He joined the General Electric Co., Schenectady, N.Y., and afterwards became superintendent in operation, New River Division, Appalachian Power Co., Virginia. After serving with the Canadian Forces during the 1914-18 war, he became electrical manager

Patent Law Reform

Final Recommendations of the Departmental Committee

“**T**HAT there is no indication of a general desire for any fundamental change in the present system of encouraging and rewarding invention by the grant of patents” is the conclusion of the Departmental Committee on the Patents and Designs Acts, whose report to the Board of Trade was published last week. The Committee was appointed in April, 1944, under the chairmanship of Mr. Kenneth R. Swan, K.C., to consider the question of legal proceedings arising from the Acts, to report on “the provisions of the Acts for the prevention of the abuse of monopoly rights,” and to make recommendations to encourage the use of inventions and the progress of industry and trade. Two interim reports, published in April, 1945, and April, 1946, were made. The final report (Cmd. 7206, H.M.S.O., 1s. 6d. net), makes a number of recommendations on points of detail.

Among these recommendations are:—

Applicants.—The assignee of an invention, as well as the inventor, should be entitled to prosecute an application for the grant of a patent.

Employee-Inventors.—Considering the objection that the reward which an employee receives in return for an invention is in many cases inadequate or unfair, the Committee recognises that three possibilities exist: beneficial ownership may belong wholly to the employee, as where the invention is in no way attributable to his employment; alternatively, an employee may be expressly engaged and paid to exercise his skill in solving the particular problem from which the invention results. The third possibility is that both employer and employee may be entitled to share in and derive benefit from the invention. It is, therefore, recommended that provision should be made in the Acts for apportioning the benefit between the two parties where no written contract exists and where the Court is satisfied that neither party is entitled to exclusive benefit.

Date of Patent.—The date of filing a complete specification should be regarded as the date of the patent, but where a complete specification is preceded by a provisional specification, the effective priority date, in so far as the earlier document discloses the invention, should be the date of filing the provisional specification. Disconformity between a provisional and complete specification should no longer constitute a ground of objection to the grant.

Crown Use of Patents.—The powers at present held by the Crown under emergency legislation for the use of patents during the war period should be permanently incorporated in the Act, in order to be immediately available in the event of any future outbreak of war. The rights of an applicant for a patent should be guarded in cases where the Crown makes use of his invention before the patent is granted. Referring to the nationalised industries, the Committee assumes they will not be regarded as Government departments, and that the use of the products of any manufacture they undertake would not be regarded as being used for the services of the Crown.

Chemical Products.—Under the 1919 Act, substances “produced by chemical processes or intended for food or medicine” cannot be claimed *per se* in the specification. It is now proposed that this limitation should be removed and that not only processes of manufacture but new substances (as long as they are not found in nature) should be eligible for the grant of a patent.

Exclusive Licensees.—In order that an exclusive licensee may recover compensation for any loss he may have suffered in consequence of an infringement, it is recommended that the law should be amended to enable an exclusive licensee to sue in his own name.

Declaratory Judgments.—Where any person desires to manufacture an article which might be alleged by a patentee to constitute infringement, he should, if unable to obtain a satisfactory reply from the patentee, be enabled to bring an action against him for a declaration that the manufacture proposed would not constitute infringement.

Exploitation in the Public Interest.—All patents in respect of State-owned or State-subsidised inventions should be treated as a public asset, vested in a single central body with a staff competent to estimate the potential value of the inventions concerned. It is also recommended that the possibilities of setting up in this country a research institution, similar to the Mellon Institute of Industrial Research and the Armour Research Foundation in the U.S.A., should be explored.

Patent Office.—The extension of the Patent Office building and the installation of fluorescent lighting in the library are recommended.

British Association Meeting

MECHANISATION OF MINES—X-RAY AND BUTT WELDS

SUMMARIES of addresses delivered and points from discussions at the Dundee meeting of the British Association were given in our last issue. Below are abstracts from further papers.

Mr. Forrest S. Anderson (Anderson, Boyes and Co., Ltd.), took for his subject "Mechanisation of Mines with Special Reference to Coal Cutting Machinery."

Mechanical coal cutting developed slowly at first, but later at a steadily increasing rate until over 70 per cent. of the coal mined in this country to-day was machine cut. Up to 1939 there was a steady improvement in output, but since then there had been a decline until 1944, when the drop was arrested, and in 1946 the graph took an upward turn again.

PRESENT-DAY COAL CUTTERS

To-day, the design of the coal-cutter was almost entirely stabilised with the chain-type machine, whether applied for longwall, or room and pillar work. There were, however, many forms of this type specially adapted for particular duties, and a brief description was given of the principle of these and how they functioned.

The longwall chain cutter was regarded as the simplest, and was employed in great numbers in this country. In America all machines of that type were d.c., whereas in this country they were a.c. Trolley wire locomotives were used very widely in America for haulage purposes and this made it very simple to use d.c. at the face. Moreover, in America they did not pay so much attention to safety devices as we did in this country, and it was a common practice to drive coal cutting machines by hanging a pair of grips on a trolley wire. Further, the majority of American mines were very shallow and there was no gas, so that the conditions were quite different from those in the majority of coal mines in this country, where every care was taken to make the machines as safe as possible.

Approximately 70 per cent. of the coal cutting machines in Great Britain were powered by electric motors, and of those by far the greater number were of the squirrel-cage type. While d.c. was used to only a limited and diminishing extent in this country for coal face work, it was almost universally employed in American mines. Compressed air was still used here for face work, particularly in specially gassy mines, but the proportion of air-driven machines to electrical machines was steadily diminishing.

In the design of coal cutting machinery,

the two outstanding factors of importance, particularly for this country, were strength and minimum physical dimensions. The duty which it had to do called for high power, and the conditions under which it had to operate demanded great strength to withstand crushing, due to falls of rock and coal, in addition to much abuse in operation. On the other hand, the physical dimensions must be kept as low as possible. Moreover, working in a dusty atmosphere the machines must be totally enclosed and the electric motors must be of flameproof construction on account of the prevalence of gas. The success with which those limitations must be met was well exemplified in the design of a longwall machine for narrow seams, where a 40 H.P. machine had been provided which was only 12 in. high by 26 in. wide by 7 ft. 10 in. long, admittedly an extreme case. The arc-shearer was a rather more complicated machine and was designed to make a holing cut at any height on the face. It was also arranged to make shearing or vertical cuts at suitable points, with the object of giving further assistance in the preparation of the coal for loading. It incorporated also its own lifting carriage, so that it was highly mobile and might move about from place to place under its own power. Other machines cut only at floor level or roof level or in the middle of the seam.

POWER LOADING OF COAL

Referring to power loading, Mr. Anderson said American methods had found many useful applications in this country and particularly in areas where only a limited extraction of the coal was permitted. The most notable development in longwall power loading was the A.B. Mecco-Moore cutter loader invented by Mr. M. S. Moore, who recently died. In the early days of the war it was sponsored by the Mechanisation Advisory Committee of the Ministry of Fuel and Power and, with their assistance and the combined efforts of a colliery company and the manufacturers, it was claimed that a machine had been developed which had achieved outstanding success. It combined a coal cutter and a loader in one machine, which operated in such a way that the coal was prepared for loading and filled on to the face conveyor in the one combined operation. The cutter was very similar to the usual longwall cutter, except that it had two cutting jibs, one

operating at floor level and the other at some intermediate position, usually located about the middle of the seam. Attached to the rear of the cutter was the loader, which was fitted with special picks arranged so that, as the bar rotated they helped to break up the coal and feed it on to the loader belt. The machine was hauled along the face by its own haulage and, as it travelled, the pressure of the roof crushed and broke down the coal. Much ingenuity and experiment were necessary before the desired results were obtained. The essence of success was in the advantage taken of natural features in the coal and the inducement of fractures by taking suitable advantage of roof pressure. Even where some of the seam characteristics that were desirable for that class of work were absent success had been obtained by additional work, and the author considered that great credit was due to those colliery companies who, by their initiative and perseverance, had extended the scope of the cutter-loader. Its sphere of application was limited at present by natural mining conditions, and particularly by seam thickness. The first design was deliberately arranged for seams over 4 ft. thick, since it was from those that the greatest output of coal could be looked for. The field had now been extended, however, by the introduction of a design which would operate in suitable seams down to 3 ft. in thickness, and it was confidently anticipated that as more experience was gained, there would be further developments which would overcome the natural difficulties for which a solution had not been found so far.

ROOM FOR INCREASED EFFICIENCY

Pointing out that power loading was still in its infancy, in this country, the author said it was therefore not possible to show its effect on a large scale, on the industry as a whole. By the end of 1946 over 100 000 tons of coal per week were being loaded by power loaders but this only represented about 3 per cent. of the output of the country. Nevertheless, it showed a very pronounced increase over the previous three years. The technical possibilities of power loading had been established and, as mining conditions could be adjusted, personnel trained and more machines put to work, its influence on the efficiency of the industry would be more clearly felt.

The author added that in certain aspects the mining industry in this country presented a dismal picture to-day, but never in his experience had there been so much activity and effort directed towards the improvement and advance of mining

methods. That, he said, was at least a hopeful and encouraging sign for the future of this basic industry.

The paper was illustrated with a large number of slides showing various types of apparatus, and so on.

WELDED BOILER DRUMS

Mr. W. D. Garrick gave an extensive paper on "X-ray Examination of Butt Welds in Pressure Vessels," based on experience with welded drums for Yarrow boiler installations, and said that for a number of years X-ray examination had been a fundamental requirement of every code governing the fabrication of fusion-welded pressure vessels. Accumulated experience had established that this was the most successful form of non-destructive test, and, further, that the expense involved was more than offset by the value of the information obtained.

The interpretation of weld radiographs depended not only on an understanding of the various characteristic images, but also on the processes by which the radiograph was produced. Such factors as density, definition, contrast and shape were affected by the technique employed, and it was possible to produce a uniformly clear radiograph from a faulty weld while, on the other hand, the radiograph of a satisfactory weld might exhibit shadows suggesting internal flaws.

X-ray tubes in general use ranged from 60 to 1 000 kV, and with the latter it was possible to penetrate 8 in. of steel within an economic time. For work on pressure vessels, a semi-portable equipment was commonly used.

Improved welding technique based on the results obtained by X-ray examination was now widely experienced, and the necessity for cutting out and re-welding after X-ray examination was seldom necessary. When it was necessary, only a small percentage of the total length of the welded joint was involved. Given good technique and proper interpretation, the users could obtain not only a pictorial record, but also the means whereby the actual welding could be improved to a degree commensurate with the importance of a pressure vessel.

Replying to Dr. R. V. Southwell, F.R.S. (chairman), the author said the power used varied considerably for different purposes. For instance, a 250 kV apparatus was capable of examining steel up to a thickness of 3 in., within a reasonable time. There were three or four sets operating in this country at 1 000 000 V capable of examining steel to a depth of 8 or 10 in., and a set was about to be put into commission operating at 2 000 000 V.

New Telephone Installation

Increased Facilities at Bouverie House

INCREASED telephone facilities with speedier operation, are provided by the new private branch exchange recently installed by Post Office engineers at the head offices of Benn Bros., Ltd., publishers of *THE ELECTRICIAN* and other journals, Bouverie House, Fleet Street, London. The number of exchange lines has been increased by four to sixteen, there are 100 internal extensions and five external private lines. There are now three operators where there were two previously.

The new lamp-signalling switchboard, officially described as "Section Switch P.M.B.X. No. 1A," is of the latest type. The complete installation consists of a suite of three operating positions, separate apparatus racks and a power plant. The dimensions of an operating position are: height 4 ft. 6 in., width 2 ft. 2 in., depth over keyshelf 2 ft. 6 in. The height of the keyshelf is 2 ft. 6 in. The low keyshelf and also the low overall height of the suite makes the provision of special chairs for the operators unnecessary.

The face equipment of each position is divided into two panels, and the lines accommodated on the switchboard are arranged over four panels in such a way

that the whole of the lines are available to each operator. A proportion of the lines on each board terminates on a lamp with which is associated a jack (socket) into which the operator plugs to answer a call. Above the calling lamps are the jacks which allow the operator to plug in to call any line connected to the switchboard. The jacks are arranged in strips of 20,

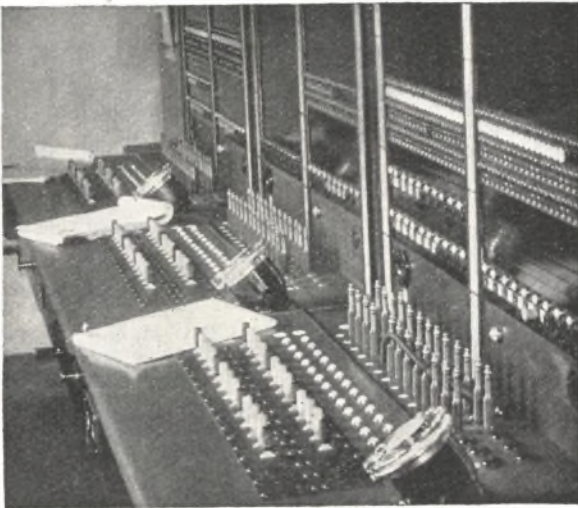
and each board can accommodate 30 strips. Each keyboard is equipped with twelve pairs of connecting cords terminated on plugs; the ultimate capacity is sixteen. Two lamps for the supervision of the call and switching levers (termed keys) are provided for each cord circuit. The keys allow of ringing and dialling on the calling cord and ring-back on the answering cord; the speaking condition is common to both cords. A key is provided to switch in a hand-operated generator should the ringing power fail. The dial position is on the right-hand side of the keyshelf immediately in front of the hinge, a sloping mounting being used to facilitate dialling.

The apparatus for the cord circuits, operator's circuit, pilot and cord test circuits only, is accommodated in the rear of the position. The relays are all of the latest Post Office type. Exchange line and interswitchboard line apparatus, made up in the form of relay sets, and the rest of the apparatus, are accommodated on racks outside the switchboard.

The arrangements in regard to operating are such that one operator deals with all calls from the public exchange and from the private lines; the other operators deal

with the extension lines. The operating positions can be switched together so that one operator can deal with all calls during slack periods, and provision is made for selected extensions to be permanently connected to the public exchange when no operator is on duty such as at night-time or week-ends.

The neat layout of the switchboard is indicated by the illustration.



Keyshelf with keys, supervisory lamps, plugs, cords and dials. Above this (working upwards), are seen the lamps and jacks for the exchange lines, private lines and internal extensions. Below the keyshelf are the handles of the hand generators.

THREE-PHASE INDUCTION MOTORS

VIEWS ON STARTING, REVERSAL AND ELECTRICAL BRAKING

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

Concluded from p. 693

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

11. *Braking at super- and sub-synchronous speed.*⁹—With sub-synchronous braking two stator phases are connected in parallel, and the motor connected single-phase to the line (see Fig. 18). This simple method of braking has the advantage, as compared with economical braking at super-synchronous speed, that it can be used both at low speeds and below the synchronous speed. As is known, the three-phase induction motor acts as a generator when driven at super-synchronous speed and returns energy to the network. With sub-synchronous braking, the braking torque (which may be also negative) has a similar effect on the torque of single-phase induction motors. The pulsating single-phase field may be split into two fields rotating in opposite directions, as with single-phase induction motors. However, whereas with the single-phase motor these two fields have equal amplitudes, with sub-synchronous braking the amplitudes of these fields are different. The stator winding as shown in Fig. 18a may be substituted by a longitudinal and a transversal winding, Fig. 18b. It can be proved that the two substitute windings do not interfere with each other.

The phase B-O and the phases O-Y and O-R connected in parallel, carry the line current J_L whereas the transversal winding substituted for the short circuited O-Y-R winding carries the current J_T . The torque of the field rotating in the same sense as the rotor, may be expressed by (32); that of the field rotating in opposite direction to the rotor by equation (33).

$$M_R = \frac{P}{\omega} m_2 J_{2R} \frac{R_2}{s} = C \cdot \frac{R_2}{s} J_{2R}^2 \dots\dots\dots(32)$$

$$M_0 = - \frac{P}{\omega} m_2 J_{20}^2 \frac{R_2}{s} = - C \cdot \frac{R_2}{s} J_{20}^2 \dots\dots\dots(33)$$

- p = The number of pole pairs.
- ω = The circular frequency = $2\pi f$.
- m_2 = The number of rotor phases.
- R_2 = The resistance of one rotor phase.

- s = The slip.
- J_{2R} = The rotor current component having the same sense of rotation as the rotor.
- J_{20} = The rotor current component having opposite sense of rotation to the rotor.

Ignoring the resistance of the stator winding (the longitudinal and transversal resistances R_L and R_T) the currents may be expressed by the approximate formulae (34) to (37).

$$J_T = j \frac{U_1}{K} \frac{2R_2(1-s)}{s(2-s)} \dots\dots\dots(34)$$

$$J_{2R} = - \frac{U_1}{K} \left(G \frac{R_2}{2-s} + jH \right) \dots\dots\dots(35)$$

$$J_{20} = - \frac{U_1}{K} \left(G \frac{R_2}{s} + jH \right) \dots\dots\dots(36)$$

$$J_L = \frac{U_1}{K} \left[A \frac{R_2}{s(2-s)} + j \left(B - C \frac{R_2^2}{s(2-s)} \right) \right] \dots\dots\dots(37)$$

where

- U_1 = The primary voltage.
- R_L = The resistance of the longitudinal winding.
- R_T = The resistance of the transversal winding.
- A, B, C, G, H, K = Constants, the numerical value of which chiefly depend upon the reactance of the motor, and can be determined by calculation or by experiment.

The rotor current may be computed by equation (38) :

$$J_2 = \sqrt{J_{2R}^2 + J_{20}^2} \dots\dots\dots(38)$$

The braking torque essentially depends upon the resistance of the rotor, upon its reactance and upon the slip ; it is independent of the noxious current carried by the transversal winding (the phases connected in parallel)

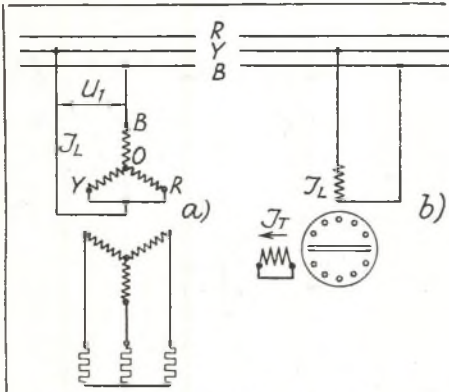


Fig. 18.—Connections for sub-synchronous braking of a three-phase induction motor : (a) = the actual connections ; (b) = the substitute connections

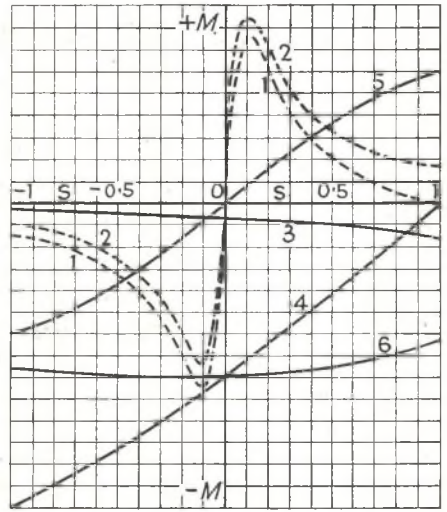


Fig. 19.—Sub-synchronous braking of a three-phase induction motor : (1 and 4) = the resulting torque of the motor ; (2 and 5) = the torque component having the same sense of rotation as the rotor field ; (3 and 6) = the torque component having opposite sense of rotation to the rotor field. Curves 1, 2 and 3 relate to values of $R_2/x_{2\sigma} = 0.2$; curves 4, 5 and 6 relate to values of $R_2/x_{2\sigma} = 4.0$

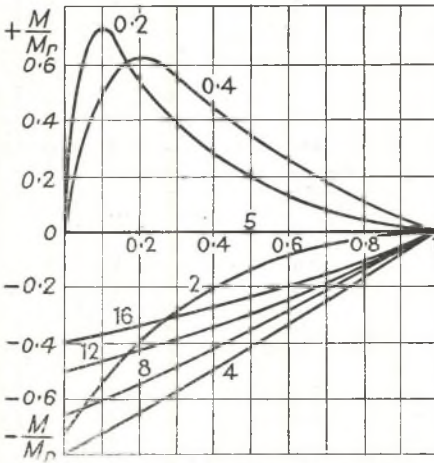


Fig. 20.—Sub-synchronous braking of a three-phase induction motor. The ratio of braking torque (M) and rated motor torque (M_R) are represented as a function of slip for values of $R_2/x_{2\sigma} = 0.2$ to 16

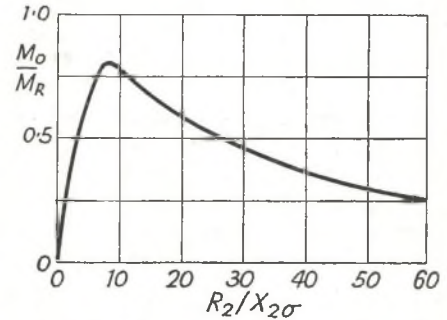


Fig. 21.—The ratio of motor torque component having opposite sense of rotation to the rotor field (M_0) and rated motor torque (M_R) represented as a function of $R_2/x_{2\sigma}$

causing the heating of the winding only. Fig. 19 shows the braking torque when braking at sub-synchronous speed. $x_{2\sigma}$ denotes the leakage reactance of the rotor. For a rotor without any braking resistor $R_2/x_{2\sigma} = 0.2$ is a usual value. In this case the motor exhibits a braking torque for negative slips, above the synchronous speed only. Below the synchronous speed— at positive slips—the torque is likewise positive, viz. driving. However, for $R_2/x_{2\sigma} = 4$, the torque is always negative, as also

for braking above and below the synchronous speed. Fig. 20 shows the torque for different values of $R_2/x_{2\sigma}$ as a percentage of the rated motor torque. The torque has a driving tendency for $R_2/x_{2\sigma} = 0.2$ to 0.4, and a braking tendency for $R_2/x_{2\sigma}$

amounting in value to between 2 and 16.

For practical purposes the linear characteristics are of importance. For $s = 1$ all characteristics pass through O; the motor cannot develop any torque at standstill. Fig. 21 shows the component M_0 of the motor torque—which rotates in the opposite direction to the rotating field—as a

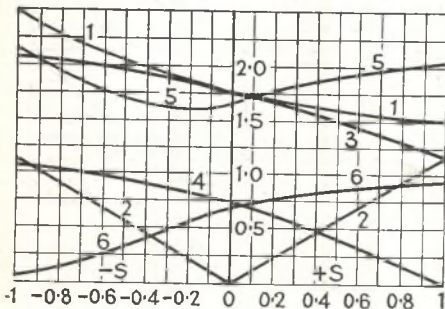


Fig. 22.—Characteristic curves of a three-phase induction motor braked at sub-synchronous speed. All curves are represented as a function of slip: 1 = the ratio of rotor current to rated rotor current J_2/J_{2N} ; 2 = the ratio of rotor current component having the same sense of rotation as the rotor field to rated rotor current, J_{2R}/J_{2N} ; 3 = the ratio of rotor current component having opposite sense of rotation to the rotor field to rated rotor current, J_{2O}/J_{2N} ; 4 = the ratio of current flowing in the transversal winding to rated stator current, J_T/J_{1N} ; 5 = the ratio of current flowing in the longitudinal winding to rated stator current, J_L/J_{1N} ; 6 = the primary power factor

function of $R_2/x_{2\sigma}$. The torque M_0 is represented as a percentage of the rated torque M_R . Fig. 22 shows as a function of the slip, the respective rotor and stator currents, their components and the primary power factor. The magnitude of the braking currents will be found moderate as compared

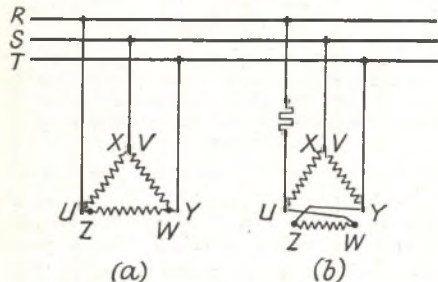


Fig. 23.—Connections for sub-synchronous braking: (a) = motoring; (b) = braking

with the currents at counter current braking; they vary but slightly between $s = -1$ and $s = +1$. For the sake of completion another sub-synchronous braking connection⁸ is mentioned. (See Fig. 23.)

The braking effect is introduced by the exchange of the terminal connections of one stator phase. The asymmetry of the currents caused by that connection can almost entirely be eliminated by the insertion of a series resistance into phase S or T.

12. Braking by changing the number of poles.—This method of braking is actually a modification of the braking at supersynchronous speed. It can be used in two cases:

A. If the stator has two or more independent windings; or windings suitable for connections giving a different number of poles; and if the rotor is either of the squirrel cage type, or wound for the same number of poles as the stator.

B. The motor has a stator winding normally connected in delta.

In case A, when changing over from the smaller number of poles to the higher one, the motor will be braked down to the speed given by the smaller number of poles.

In case B, the delta connection may be opened and the motor connected to two

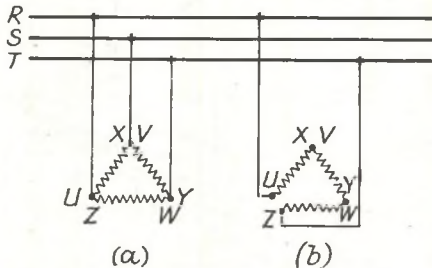


Fig. 24.—Super-synchronous braking by changing the number of poles: (a) = motoring; (b) = trebling the number of poles

phases of the line, as shown in Fig. 24. Thus the original number of poles will be trebled.

13. References.—

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Continued on page 772

Aircraft Electrical Equipment

New Developments at S.B.A.C. Static Exhibition

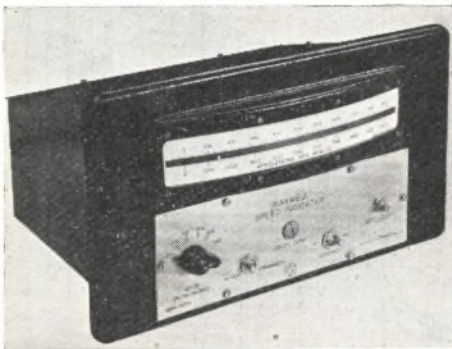
ELECTRICAL manufacturers made a large and important contribution to the static exhibition held by the Society of British Aircraft Constructors, at Radlett, Herts, this week, and the wide variety of instruments and other equipment displayed indicated the extent to which the requirements of aircraft designers and constructors are being met and even anticipated, and also the progress that has been made in the development of devices to ensure the safety and comfort of passengers and crew. Below are given brief details of some of the exhibits of electrical interest. The exhibition, which opened on Tuesday, concludes to-day.

The "Maxwell" precision speed indicator, displayed by the British Thomson-Houston Co., Ltd., was designed by them to provide an absolute standard of speed measurement. It finds extensive application in aero-engine testing and similar work, where an immediate indication of r.p.m., with errors not exceeding 0.1 per cent, is desirable. The scale is easily read and can be expanded at will. The light spot pointer is exceptionally quick in action and critically damped. The accuracy depends on stable electrical components. It is not affected by temperature either of the instrument or of the drive, or by the length of connecting lead. The instrument is self-checking. It will function off many existing a.c. generators when it is impracticable to fit the standard type, or even from amplified electrical impulses. The makers believe it to be the most accurate tachometer ever devised. On the same stand are magnetos, actuators, booster coils, a.c. and d.c. motors, switches, circuit-breaking devices, Mazda lamps and lighting equipment.

The exhibits of the Chloride Electrical Storage Co., Ltd., included Exide batteries made in 12 V units and having capacities of 38 Ah and 60 Ah, and weighing only 13 ozs. per ampere-hour capacity, for non-aerobatic aircraft; unspillable batteries in two sizes, for aerobatic civil and Service aircraft; and batteries for ground starting aircraft engines.

The English Electric Co., Ltd., are showing d.c. and a.c. motors for actuators, reaching new levels in power for small size, interchangeable from 20 W to 2 200 W (1/35 h.p. to 3 h.p.); similar motors, with gear drives, for standard hydraulic pumps, air compressors and a new de-icing pump of small size and large capacity. Linear actuators ranging from tab trimming type of 160 lbs. rating, to the undercarriage

type as supplied for new 25-passenger aircraft for tail incidence duty of 27 000 lbs. ultimate strength, for a weight under 25 lbs.; a series of rotary actuators developed for fuel valves (one sec. opera-



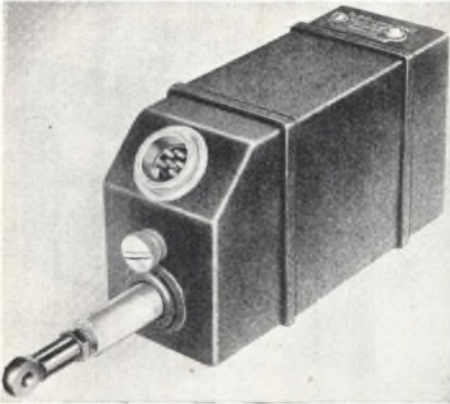
A precision speed indicator, shown by the British Thomson-Houston Co., Ltd.

tion, weight 2 lbs.), cabin air valves, hydraulic control valves, and similar duties up to 150 in.-lb. torque; alternators and geared drives, supplying variable or constant frequency for general power services, aerofoil and propeller de-icing and for instruments and radio. The latter include the smallest 15 to 22 kVA (6 in. sq. for 12 000 r.p.m.) and the 5 kVA for dual voltage (115 V and 208 V) in combination. New model generators of 9 kW at 120 V, as applied to flight controls for the largest aircraft, are also of outstanding interest.

Ferranti, Ltd., have on view one of their recent developments in the hyperbolic navigational computer; and the new gyroscopic gun sight in which the difficulties experienced in using the ring and bead gun sight in aircraft are completely eliminated. No calculations or estimations of range, crossing speeds or windage effect need be made; all are instantly and automatically computed by this new sight. It is only necessary to keep the target within the graticule pattern, with the result that the guns are automatically and continuously laid off with the necessary lead angles. A simple changeover device makes the sight instantly suitable for rocket firing against ground targets with almost equal precision.

One of the most interesting navigational instruments in the exhibition is a new radio compass which has been developed to meet the specification of the R.A.F. by

General Electric Co., Ltd., working in close collaboration with the Royal Aircraft Establishment, Farnborough. It embodies most advanced electronic and "servo" practice. All remote controls are electrical so that no limit is imposed upon the distance between the various units, while the elimination of mechanical backlash reduces possible error. The loop aerial



The "Jaguar" electric actuator, one of the Plessey exhibits

takes on a compact and flattened form, only a few inches in depth, and is now housed in existing aircraft, in a shallow "blister" whose air resistance is one-third that of the old standard loop. For new machines, the loop is sunk into the aircraft body, with a cover moulded to the curvature of the fuselage. With the new radio compass it is only necessary to tune in the beacon and, automatically, the loop takes up its correct position and the indicators for both pilot and navigator give their readings of the bearing. If, for some reason, this automatic operation is not required, the loop may be driven round, under manual control, and the operator may determine the minimum signal position aurally. The accuracy of the compass is to within one degree or less.

Examples of the latest radio equipment for aircraft and the aeronautical services are to be seen on the stand of Marconi's Wireless Telegraph Co., Ltd. The wide range shown includes communication sets for the medium, high-frequency and very high-frequency bands, and navigational aids of advanced design in which new standards for size, weight and performance have been achieved. Outstanding among the airborne equipment is the new automatic radio compass (type A.D. 7092) of miniaturised design, and capable of being used with broadcasting stations, radio

beacons and "simultaneous" radio ranges anywhere in the band 150 kc/s.-2 mc/s. Another new development is a compact unit, comprising localiser and marker receivers for use with the standard 7-metre beam approach system which is still in use at many airfields. The screening harness shown on the stand has been developed for the Alvis "Leonides" engine and incorporates several unusual features.

The Metropolitan-Vickers Electrical Co., Ltd., is displaying a complete "Beryl" jet propulsion engine and a selection of lamps and lighting equipment used in the aircraft industry. The first jet flying boat fighter—the Saunders-Roe SR/A1—which made successful test flights in the Solent recently, was equipped with two "Beryl" engines. The "Beryl" is an axial-flow jet engine, rated at 3 850 lb. take-off thrust at 7 700 r.p.m. Starting is effected by a small electric motor, which can be housed conveniently in the nose cap at the front of the compressor.

Metrovick and Cosmos lamps, include the new 20 W and 15 W tubular fluorescent lamps with which the company's illuminating engineers are now carrying out experimental aircraft lighting installations.

A selected range of aircraft accessories is being shown by the Plessey Co., Ltd. These comprise aero-engine cartridge starters and cartridge breeches, actuators, ignition harness, wiring systems, plugs and sockets, a range of pumps and portable crimping pliers for making solderless connection to cables. A working demonstration is given of the "Jaguar" electric actuator operating an engine air intake system (in section). The "Jaguar" has been designed to operate a load of 100 lbs., with a 100 per cent. overload, through a stroke of 3 ins. in 6 secs.

Accompanying a wide range of lead-acid accumulators specially designed for use in civil and service aircraft for starting, lighting and radio, exhibited by Pritchett and Gold, Ltd., is a ground starter trolley fitted with two 6HZW21-G batteries. Other exhibits include ground starter batteries, and civil aircraft batteries. All are fitted with Porvic, micro-porous plastic separators.

(Continued from p. 770)

9. Archiv für Elektrotechnik, 1934, p. 447.
 10. Siemens Zeitschrift, 1933, p. 225.
 11. S. A. Vincze: "Starting, Reversal and Electrical Braking of Three-phase Induction Motors," Budapest, 1937, pp. 10 and 12.*
 12. D. B. Hozason: "Recent Developments in Electric Motors," Metrowick Gazette, June, 1939.
 13. S. Hopferwieser: "The Electric Drive of a Plate Edge Planing Machine," Brown Boveri Rev., July, 1939.
 14. K. Sachs and A. Mehl Dahl: "Progress in Brown Boveri Design during 1939," Brown Boveri Rev., Vol. XVII, 1940, p. 35.
- * Read before the Engineering Section of the Hungarian Electrotechnical Association, April 4, 1935.

Electricity Supply

Lancaster.—A scheme for mains extensions, estimated to cost £66 430, has been approved by the Electricity Committee.

Boston.—Spontaneous combustion caused by the hot weather is thought to have started a fire which burned for three days in a coal dump at the electricity works.

Stockton-on-Tees.—The distribution system in the Eaglescliffe area is to be reinforced by an 11 kV feeder cable and other works at a cost of £28 000, and the scheme is to be submitted to the Commissioners for approval. Tenders are to be invited for the erection and equipment of a new sub-station.

Barrow-in-Furness.—The Electrical Engineer has received verbal instructions from the C.E.B. to proceed with negotiations for the purchase of land and the use of water for a new power station. It is anticipated that official instructions for its construction will be issued in the near future.

Blackburn.—The C.E.B. has issued instructions for the carrying out of the fourth extension to the generating station at Whitebirk. This is estimated to cost over £1 500 000 and is to be ready by July, 1951. The third extension now in progress—one 40 000 kW turbo-alternator and three 150 000 lbs. per hr. boilers.—is to be ready by September, 1950.

Worthing.—The Corporation is to apply to the Electricity Commissioners for approval of an arrangement with the Sussex Electricity Supply Co., Ltd., for supply to the rural area west of Worthing. The cost of providing the necessary cables to connect to the company's extra high tension line in Littlehampton, and for the necessary switchgear, will be approximately £4 000.

Burnley.—In order to obviate interference with cotton production, local industrialists propose to meet the demand for cutting the peak load by economising in factory lighting. They have sent a joint letter to the deputy Borough Electrical Engineer suggesting a reduction in the lighting load of 25 per cent. by using lamps of a lower wattage and by the removal of one lamp in every four.

Sheffield.—An effective display of electrical equipment of interest to gardeners, horticulturalists and farmers was staged by the Electricity Department at a Food Production Show held recently in Endcliffe Park. Arranged under the auspices of the Corporation Parks Committee, the show has been an annual event in recent years,

and the Electricity Department has taken an increasing part, this year occupying a complete marquee. The display included



A display of electric farming and horticultural equipment, staged by the Sheffield electricity department at a recent "Food Production" show

electrical hatching and rearing equipment for the poultry farmer, soil and greenhouse heating equipment, sterilising plant for dairy farmers and ice cream manufacturers and miscellaneous appliances such as pumps, hedge clippers and wood cutting machinery. A representative selection of domestic equipment was also shown.

Bradford.—Subject to the consent of the Electricity Commissioners, the Corporation is to carry out a scheme for the provision, erection and equipment of a traction sub-station at Northcote Road, Undercliffe, and the laying of medium voltage cables in connection with the conversion of the Undercliffe tramway route to trolley-bus operation, at a total estimated cost of £12 623.

Kirkcaldy.—A net surplus for the year of £2 354 which, added to a surplus of £4 443 brought forward from the previous year, gives a closing surplus of £6 797, is reported in the annual statement of the Engineer and Manager (Mr. J. G. Curtis) for the year ending May 15, 1947. The total revenue for the year, including £4 565 received from the sale of disused generating plant, was £97 224, and total expenditure was £94 870. The report states that, as the general plant in the department's power station ceased to be used on May 15, 1946, all the energy purchased during the year was imported from the C.E.B. The cost of this was £59 753 for 18 129 800 units, equivalent to .870d. per unit sold. Sales reached a re-

cord figure of 16 496 718 units, an increase of 12 per cent. on the previous year, and the average price received per unit sold was 1.319d. More than half the total sales were taken for domestic purposes on the two-part tariff. The maximum load on the undertaking during the year was 5 795 kW.

Accrington.—Contracts for the turbines and boilers for the new Huncoats station have been allocated provisionally to the General Electric Co., Ltd., and to Messrs. Simon Carves and Co., Ltd., respectively, and Messrs. A. Reyrolle and Co., Ltd., have been awarded the contract for the supply of 33 kV switchgear. The Corporation has been notified that the National Coal Board is willing to enter into an agreement for the reservation of an enlarged pillar of coal beneath the proposed station, in consideration of a payment to the Board of £17 000. The offer has been approved subject to the mining engineer's report being satisfactory from the Corporation's point of view and to the agreement of the C.E.B. Proposals which have been put forward by the Electricity Committee as a means of balancing up the existing tariffs to compensate for increased coal prices recommend increases for the domestic rateable value consumer, the flat-rate heating consumer and the quarterly power consumer. Those on the flat rate for lighting (chiefly shopkeepers) are not affected, nor are houses which are not on rateable value tariffs. The flat rate lighting charges are 3d. and 3½d. a unit. The Ministry of Transport has given consent to proceed with a new main road lighting system, with the exception of a trunk road portion in the centre of the town, along which it was proposed to have clear lighting. The Ministry has suggested that sodium lighting should be adopted.

West Midlands.—The annual report of the West Midlands J.E.A. for the year ended December 31, 1947, states that the maximum load on the system during the year was 298 450 kW, compared with 305 850 kW in the previous year. The maximum demand of the Authority itself was 267 290 kW, compared with 254 030 in 1945. There was a corresponding fall in units generated during the year, from 1 068 646 860 to 1 065 788 172, and units sold decreased from 994 426 187 to 988 260 486, including an export of 5 575 360 units as compared with 96 316 720 units in 1945. The C.E.B. programme for 1947 provides for an output of 1 145 000 000 units from the Authority's selected stations, of which it is estimated that the Authority's own requirements will amount to 1 074 300 000 units. Progress on the extension of the Ocker Hill generating station by the installation of two 30 000 kW turbo-alternators and five

150 000 lbs. per hr. boilers has been, it is reported, slower than was scheduled. Extensions at Walsall, however, have made good progress during the recent fine weather, and it is hoped that the first stage will be generating by the scheduled date of September, 1948. Two 30 000 kW sets, steamed by five 150 000 lbs. per hr. boiler units, are being installed, to be followed by two further 30 000 kW sets and four boilers which are scheduled for completion by September, 1949. The estimated cost of the two stages is £4 947 000, giving an overall capital cost of £41.22 per kW installed. A request has been made by the C.E.B. that the Authority should make provision for an ultimate capacity there of 180 000 kW, by the addition of two further 30 000 kW sets. At the Authority's Ironbridge (200 MW) and Wolverhampton (30 MW) generating stations, the yearly average thermal efficiencies registered were 23.29 and 22.05 per cent., respectively.

Toronto Hydro System

CONTINUED growth of the system is reflected in the annual report of the Toronto Hydro-Electric System for the year ending December 31, 1946, which shows a peak load for the year of 465 521 H.P., compared with 442 134 H.P. in the previous year, and record sales of 1 538 853 797 kWh., compared with 1 461 114 646 kWh. Purchases of energy from the Hydro-Electric Power Commission of Ontario cost \$8 201 303, or 54.7 per cent. of the gross income of \$14 980 257. In the previous year, \$7 973 627, representing 55.9 per cent. of the gross income for that year, was so spent. The balance of income for the year was \$1 458 295, of which \$1 300 000 was allocated as provision for the renovation of street lighting systems and other capital assets. A net income of \$158 295 was carried to reserve for the stabilisation of rates.

Of the sum allocated for renovation, etc., \$800 000 has been set aside for extensions to the street lighting system, a similar sum having been authorised in the previous year. Orders have been received it is stated, for the lighting of approximately 65 miles of main thoroughfares and traffic streets in the city and the work of installation has been pressed forward as rapidly as material and skilled labour permitted. The present programme will involve, finally, a capital expenditure on fixtures and brackets estimated at \$2 000 000. The remaining \$500 000 allocated will be employed on improvements to the system, including the placing of high voltage lines underground.

Welding Symposium

Modern Developments and Future Trends Discussed

THE application of welding to the construction of jet engines, and developments in stud-welding and in the design and operation of a.c. welding plant were among the subjects covered by the symposium of the Institute of Welding which opened at Olympia, London, yesterday, and will conclude to-day.

MR. H. E. LARDGE, in his paper on "Welding in the Development of Jet Propulsion Engines," gave an outline of the part played by the various welding and allied processes in the manufacture and development of sheet metal work for engines of the single-stage centrifugal compressor-cum-single stage turbine variety. After describing early investigations and methods employed, the author gave, as a matter of interest, details of the amount of welding on the combustion equipment for the Rolls-Royce B. 37/1, or "The Derwent 1" engine, as follows: 3,354 structural spotwelds, 4,682 tacking spotwelds, 215 ft. of stitchwelding, 250 ft. of seam welding, 32.5 ft. of carbon-arc welding on the discharge nozzle assembly and 23.4 ft. of other fusion welding.

When it was realised, he added, that the peak production figure was twenty-five sets of equipment per week of that one model, it could be fairly claimed that welding, when done under reasonable technical control, was consistent and safe as the number of test or service failures directly attributable to faulty welding was very low indeed.

MR. E. C. DAVIES described some recent developments in the operation of a.c. welding plant and made reference to a few promising investigations.

Dealing first with the transformer type plant for manual welding, the author said it could be stated that the present state of popularity among users in this country, and to a rapidly increasing extent in U.S.A. and elsewhere, was due to: (1) The availability of suitable electrodes; (2) low first cost; (3) low installation cost, as the plant was weatherproof and might be used in the open without further protection; (4) low running cost owing to high electrical efficiency and negligible maintenance charges; and (5) absence of arc-blow. In cases where the power factor must be improved, the present solution lay in connecting a suitable static condenser across the primary terminals.

With modern electrodes the welding transformer might be used with confidence for work on steel and most of the ferrous alloys. So far, however, electrodes for

aluminium and its alloys and some of the bronze rods were not suitable for use with normal 50 cycle welding plant.

In the field of automatic a.c. welding a number of innovations had been introduced recently with the object of simplifying the plant and reducing welding costs. A new form of arc control had been developed which eliminated much of the external apparatus previously used, and had proved to be particularly applicable to the submerged arc process.

MR. J. K. JOHANNESSEN, in a paper on "Some Aspects of Welding Repairs," reviews present trends in the application of welding to repairs and also outlines the applications of welding to modern mining practice, steam plant, marine and submarine work, variables in deposits and base materials, and electrode specialisation.

The duty of the welding engineer, in his capacity as repairs consultant to his client, the author states, is not only to repair, but by placing suitable reinforcement strategically in relation to the operative stresses, or by redesign, to effect their redistribution in order to eliminate future failure.

MR. A. H. BENT deals with stud-welding technique as applied to rectified transformer equipment. Certain non-ferrous materials can be used as studs, he states, and steel studs can be welded quite easily to the stainless steel. Studs can be welded to almost any type of steel, including armour plate to thicknesses ranging from 16 gauge upwards, but it must be remembered that the energy in the arc, although only for a short duration, is of high value and penetration in the parent metal is considerable, so that it is not possible to weld the very large studs to thin gauge materials unless very special precautions are taken and then it is problematical. Tests taken on one of those equipments in use gave the following particulars which were typical: Average tensile breaking load—approximately 30 tons per sq. in. Position of break—in the stud material.

Exhaustive investigations into the metallurgical strength of the stud weld have been carried out by plant manufacturers and users, the results being highly satisfactory. Conditions existed as in arc-welding, the weld metal being sound, free from porosity and inclusions, with good penetration. The time taken for stud welding on the whole was much less than that required for any other form of welding.

Lamp Sales Publicity

Showcards and Window Displays for the Coming Season

IN the forthcoming lamp season Crompton Parkinson, Ltd., will continue for Crompton lamp advertising their present prestige theme, drawing attention to the



A new Crompton cut-out with a fuel economy message

outstanding work accomplished by Colonel R. E. Crompton in the field of lighting. Display material available consists of a new Crompton cut-out, approximately 12 in. by 10 in., in two planes and in eight colours. As will be seen from the illustration, this carries a fuel economy message. For Kye lamps a large cut-out will be available, size approximately 29 in. by 19 in., featuring a price economy appeal in the caption "A shining light for a shilling."

The company are returning to their pre-war practice of issuing small attractive price lists to the trade for distribution to the buying public. The leaflet ties up with the national and provincial, Press campaign. Stockists will receive a much more comprehensive price list of twelve pages or so. Special window dressings for both Crompton and Kye lamps will be available to retailers especially requiring them.

Subject to limitation on space, Siemens advertisements will appear from time to time in national newspapers, also in the leading provincial Press, in order to keep the company's lamps in the minds of the public. In view of the urgent necessity for speeding up output in all essential industries, special attention will be devoted to improved lighting in factories with Siemens' general service lamps, "Sieray" fluorescent tubular lamps and lighting

equipment, and to this end display advertisement will appear in the principal trade journals stressing the economy of good lighting in making possible increased production, and offering, without obligation, the skilled advice of lighting engineers on all matters appertaining to planned factory lighting.

Now available are attractive newly designed showcards of "Big Ben" printed in eight colours, size 9½ in. by 14½ in., with the slogan "Siemens' Lamps as Reliable as Big Ben," and a new lamp display cut-out, size 24 in. by 19 in., with the caption "Light is Life."—The latter is printed in ten colours and fitted with a lock rubber strut at the back, forms a most attractive centre piece. The company has a dealers' window dressing service and will welcome the opportunity to instal attractive lamp displays, using the above as the central feature.

No broadcast of price lists will be made but lamp price lists are available for the trade on request. Lamp supplies continue



A newly designed "Big Ben" showcard advertising Siemens' lamps

to be short owing to pressing demands for export and essential industries, but every effort will be made to meet all orders.

Industrial Information

E.I.B.A. Berks. and Bucks. Branch

The Berks and Bucks branch of the Electrical Industries Benevolent Association is to be re-formed on an active footing. For this purpose, a general meeting is being held at the Ship Hotel, Reading, on Wednesday, September 24, at 3 p.m. All electrical people in the area are invited to attend.

Northampton Polytechnic

Part-time day courses in electrical engineering, electrical communication; an intermittent full-time course in electrical engineering and installations; and evening courses in electrical engineering, radio engineering, electrical installations, cable jointing, telecommunications engineering, and illuminating engineering, are being held at the Northampton Polytechnic, St. John Street, London, during the session commencing Monday, September 29. Enrolments commence on September 15.

Three-Day E.D.A. Conference

A three-days conference under the auspices of North-Western and North Wales Area Committee of B.E.D.A. will be held at Southport, September 22-24. There will be morning and afternoon sessions each day. Papers to be read include: "The Organisation of the Consumer Service," by Mr. O. Howarth (Lancashire Electric Power Co., Ltd.); "The Future of Electricity Supply," by three consumers; "Electricity in Sparsely

engineer, Liverpool); "Recent Developments in Street Lighting," by Mr. E. W. Robinson (Lighting Service Bureau). The conference luncheon will be held in the Floral Hall at the invitation of Southport Corporation.

Exhibition of Photography

Because of the large number of entries and the lack of accommodation in the society's house at 16, Princes Gate, London, S.W.7, the ninety-second annual exhibition of the Royal Photographic Society is to be divided into two parts as follows:—Part I—Pictorial and Colour: Saturday, September 13, to Sunday, October 5, inclusive. Part II—Scientific, Nature, Record and Technical: Saturday, October 11, to Saturday, November 1.

Golden Jubilee

Founded in 1897, the Tudor Accumulator Co., Ltd., is celebrating its Golden Jubilee this month. In the early days when batteries carried the night electricity load the company instituted a system of "maintenance agreements," whereby electric light plants were installed in public institutions and in private houses and maintained regularly. Before the war the company installed one of the largest batteries ever supplied, weighing 1 500 tons, and capable of discharging at up to 10 000 A at 600 V in Rio de Janeiro as a



At the Engineering and Marine Exhibition, Olympia, London. On the left is a view of the Diesel engine stand of the English Electric Co., Ltd. On the right the President (Mr. V. S. WIGMORE) and members of the Council of the Society of Engineers discuss the new aluminium spot-welder on the stand of Philips Electrical, Ltd.

Populated Rural Areas," by Mr. S. G. Roper (North Wales Power Co., Ltd.); "Practical Aspects of Street Lighting," by Mr. C. C. Smith (deputy city lighting

standby for the city's tramway system. In 1912, a fleet of 'buses running between Liverpool Street and Victoria Station, London, was operated entirely by batteries,

and thus the company was one of the earliest to introduce this form of propulsion. Also at this time the company initiated the conversion of vehicle lamps from oil to electricity, supplied from the traction batteries. Large plant batteries, the company's speciality for so long, are still required in great quantities in switchgear operation, post office telephones, and emergency lighting equipment. During the war years, the main task of the company was the production of submarine and torpedo-firing batteries.

New Scottish Company

The recently-formed Scottish Electro-Plating Co. plans to start operations early this month in Ancrum Works, Dundee. The proprietor is Mr. C. T. A. Shearer, who has for the last few years been technical director and general manager of United Motors, Ltd. He trained with the General Electric Co., Ltd., and later with the Gramophone Co., Ltd., specialising in the production of cathode-ray tubes and thermionic radar devices.

Borough Polytechnic

The prospectus of the Borough Polytechnic, Borough Road, London, S.E.1, for the 1947-48 session, commencing September 15, is now available. In the Department of Electrical Engineering and Physics there will be in the evenings, classes for those taking the ordinary National Certificate course and the Higher National Certificate course in electrical engineering and radio engineering, and courses in radio leading to the examinations of the City and Guilds of London Institute; courses in electrical installation work, electric cable jointing, electric lifts engineering, telecommunications engineering, and illuminating engineering. There will also be part-time day courses in electrical engineering, electrical installation work and radio engineering throughout the session.

Lamps for Edinburgh Festival

Eighty of the "Thistle" lanterns, illustrated on this page, two on each of 40

columns, were supplied by the General Electric Co., Ltd., in connection with the



A pair of "Thistle" lanterns supplied by the G.E.C. and erected at Princes Street for the Edinburgh Festival

lighting scheme planned for the Edinburgh Festival. They are to be retained as an integral part of the lighting of Princes Street. The optical system consists of the company's combination of dome and bowl refractor used to give accurate control of light distribution when employing large wattage Osram filament lamps for main road lighting.

Metrovick at War

"Contribution to Victory" is the title of a handsome 200-page book, compiled by Frank Rowlinson for the Metropolitan-Vickers Electrical Co., Ltd., as a record of the company's work during the recent war. Like other war diaries published by the major electrical manufacturers, it



Seen at the Industrial Wales Exhibition: The stand of the British Electrical Development Association (left), and a view of the display of South Wales Switchgear, Ltd.



makes absorbing reading not only for the story it tells of the scale of production achieved, often on specialised equipment for which no previous experience was available, but for the wide range of goods, many of them unconnected with electrical engineering, which were simultaneously produced under the direction of a single organisation. Giving the longest chapter to radar, in which field the company built the first transmitter and subsequently made a significant contribution to the needs of all three fighting services, the book describes activities ranging from heavy bomber production and the building of mobile power stations for the U.S.S.R. to delicate instrument work on "automatic pilots" and stabilising mechanisms for naval guns. Even in statistical form, the war-time achievements of British industry are impressive: described, as they are in this book, in terms of difficulties overcome, inventive skill and managerial foresight, they are more so.

Upside Down

A small block, Fig. 12, showing a diagram of stator connections for d.c. braking, was inadvertently placed upside down on page 691 in our last issue.

A Swedish Contract

Decca Navigator, Ltd., are to supply the Swedish Government with a complete Decca navigator system for hydrographic survey in Sweden and surrounding seas. This is the second contract of this type obtained by the company within a year.

Avoiding Peak Periods

This month's "Cheerful Rationing" card, issued by the Electrical Association for Women, opens with hints to housewives on planning to avoid the use of electricity during peak periods. There are several autumn recipes and hints on storing and preserving fruits.

E.A.W. Area Meeting

A meeting of the South East England Area (Northern Section) was held at E.A.W. headquarters on Monday. Under the chairmanship of Ald. Mrs. Armitage, president of Watford branch, a talk on "My Visit to Canada" was given by the assistant secretary, Miss Vera Norvick. Miss M. G. Reading, area organiser spoke about the formation of the latest branches. The E.D.A. films "Simple Home Repairs" and "The Electric Iron" were shown. The Mayoress of Watford, Mrs. North, was one of the guests of honour.

Magnesium Freed

A Ministry of Supply Order which came into force recently frees all forms of magnesium and magnesium alloys from

licensing and removes price control. The Ministry now ceases to sell magnesium direct to consumers. Arrangements have been made for supplies to be distributed by F. A. Hughes and Co., which will sell pure metal to all United Kingdom consumers at 1s. 2d. a pound delivered. It is understood that there are substantial stocks of magnesium in the country. The Ministry hopes by abolition of control to encourage its use as a light alloy. The price of 1s. 2d. is approximately the world price. During operation of the control the price was 1s. 6d.

A.P.L.E. Conference

Philips mercury, sodium or fluorescent lamps will be used by the Brighton Lighting and Electrical Engineering Co., Ltd., the Engineering and Lighting Equipment Co., Ltd., the Revo Electric Co., Ltd., and the Wardle Engineering Co., Ltd., in their street lighting demonstrations in conjunction with this year's A.P.L.E. conference at Southport, from September 15-19.

Coal Conservation

SPEAKING to a gathering of Rotarians in London, on September 4, Mr. V. W. Dale, general manager of the British Electrical Development Association, said that cheap coal in this country had been a doubtful blessing, because it had encouraged almost criminal waste and extravagance in all spheres. The irresponsibility of many fuel users in the past could not be overlooked in any assessment of responsibility for our troubles; indeed, persistence of decrepit methods and the continued use of obsolete fuel burning apparatus could scarcely fail to extend the present crisis.

Seven to ten million tons of coal a year could be saved ultimately by the adoption of a national scheme of railway electrification. In the mining industry alone sufficient coal could be saved in one year by the use of mains electricity to meet the whole of the light, heat and power needs of a domestic community of 25 000 people, for more than a century.

Mr. Dale expressed the opinion that coal conservation was not only a fuel-getters' problem; the solution was difficult enough, but it might well be rendered unsolvable in our generation unless fuel users, too, realised their share of responsibility and planned at the earliest opportunity to mechanise production on the basis of maximum fuel efficiency. In due time, with the co-operation of the basic industries and the public services, something like 20 000 000 tons of coal could be saved every year.

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:—

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

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

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

Manchester, September 22.—Supply and delivery, during 12 months ending October 31, 1948, of accessories for use with domestic appliances. Specifications from Chief Engineer and Manager, Electricity Department, Town Hall, Manchester, 2.

Weymouth and Melcombe Regis, September 27.—Supply and delivery of transformers. Specification from Borough Electrical Engineer and Manager, Electric House, Westham Road, Weymouth.

Winchester, September 27.—Supply and installation of a complete central heating system for west wing of the Guildhall, the existing coke-fired boiler to be replaced by either electric, oil or coke-fired boiler, and new piping and radiators to be installed. Specifications from the City Engineer, Guildhall, Winchester; deposit, £2 2s.

Edinburgh, September 30.—Supply of p.i. cables for 12 months commencing January 1, 1948. Specifications from the Engineer's Office, Dewar Place, Edinburgh.

Portsmouth, September 30.—Supply, delivery and erection of:—(a) one (alternatively two) 15 MVA, 33/11 kV, type O.N. transformer; (b) four 5 MVA, 33/11 kV, type O.N. transformers; (c)

one earthing transformer; (d) seven liquid type neutral earthing resistors. Specifications from Engineer and Manager, 111, High Street, Portsmouth.

Bristol, September 30.—Installation of self-starting synchronous electric clock control (approx. 11 000) for street lighting. Particulars from City Engineer, 7, College Fields, Bristol, 8.

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, 208-212, East India Dock Road, Poplar, E.14.

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.

Electrical Statistics

IN July the average weekly consumption of coal by authorised electricity undertakings was 404 000 tons, compared with 420 000 tons in June. The weekly average consumption in July of last year was exactly the same (404 000 tons). The distributed stocks held by authorised electricity undertakings at the end of July amounted to 3 531 000 tons, contrasted with 3 127 000 tons in June and 1 727 000 tons in July last year. The amount of electricity generated during the month was 2 866 million kWh, which was 24 million kWh more than in June and 102 million kWh more than in July of last year.

Company News

CHRISTY BROS. AND CO., LTD.—A satisfactory result of the year's trading, with a turnover amounting to £554 181 and a profit of £81 741 (£36 905), was announced by the chairman, Mr. Frank Christy, at the annual meeting. Mr. Christy said it was still uncertain how the Electricity Act would affect the company, but in the meantime their cautious policy would provide the surest safeguard if the business had to be substantially readjusted as a result of Government policy. Bearing these matters in mind, the directors thought it wise not to increase the dividend beyond the 17½ per cent. paid last year.

GLOBE TELEGRAPH AND TRUST CO., LTD.—When he addressed shareholders at the recent general meeting, Sir Edward Wilshaw (chairman) said that the Government had acquired compulsorily from the underlying holdings of Cable and Wireless (Holding), Ltd., all the outstanding shares in Cable and Wireless, Ltd., the operating company, but the amount of compensation to be paid for them still remained to be determined. The matter would be referred to arbitration, but it was not anticipated that this would take place before early next year. Their interest in Cable and Wireless (Holding), Ltd., represented about 40 per cent. of the total book cost of their invested funds, and 60 per cent. of their income was derived from this source. Receipts of the company, the Chairman said, were £368 870, showing a decrease of £40 431, but the corresponding figures for last year included a dividend from Cable and Wireless (Holding), Ltd. The total sum available for allocation was £348 926, and it was proposed to declare the same final dividends on both classes of stock as last year. These dividends, together with those paid in the interim, would absorb £177 472, leaving £171 454 to be carried forward, and showing an increase of £19 531 over the previous year.

TELEPHONE PROPERTIES, LTD.—In his report to shareholders for the year to December 31, 1946, Sir Alexander Roger (chairman) said that in Caracas, Venezuela, the installation of the first unit of automatic equipment for a new telephone exchange building at Los Caobos had been completed and the official opening and initial "cutover" of new subscribers was recently made. The exchange was designed for an ultimate capacity of 25 000 lines, and during the first two or three years the company would have 10 000 lines of plant installed. The new exchange at Chacao, also in the Caracas area, would house in the first instance some 2 600 lines

of automatic plant, and it was expected that service would commence later this year. New automatic exchange plant was also being installed in areas in other parts of the country—Maracaibo, Ciudad, Bolivar and Barquisimeto, and good progress was being made. Caracas, Sir Alexander continued, had 8.1 telephones per 100 inhabitants, a figure only surpassed in the South American continent by Buenos Aires, which had 9.7 per 100. This emphasised that the Venezuelan Nacional company, with the help of its British associates, was providing a service which, in spite of world-wide shortages and difficulties, could be ranked with the highest in South America. Demand for service continued to outstrip all new additions, although in 1946 they had been able to despatch to Venezuela over £200 000 of British plant and equipment.

Company Meeting

Thorn Electrical Industries Increased Lamp Production

The annual ordinary general meeting of Thorn Electrical Industries, Ltd., was held on September 5 in London.

Mr. Jules Thorn (chairman and managing director) said that during the year under review the output of their lamp factories was increased despite all difficulties, including supplies of raw materials, and their consistently high quality and extensive national advertising had still further enhanced the popularity of Atlas lamps, now in the front rank of the industry.

Their laboratories had been working for some years on the development of fluorescent lamps and fittings, and large sums of money had been expended on research in that field. New fluorescent lamp-making equipment should enable them considerably to increase production some time next year.

Their lamp cap production had been moved to their own freehold factory in Enfield. The Ferguson radio factory had produced a range of quite outstanding receivers and radiograms which had been very well received by trade and public alike. The company was also producing a television set. In the domestic appliance field, their Mary Ann electric iron was selling successfully, and, apart from their Mary Ann two-way vacuum cleaner, they were working on the development of new cleaners and appliances.

Turning to the accounts, the net profit of the company and its subsidiaries amounted to £42 876 for the year, an increase of £15 154 on last year's figure. The inclusion of a full year's net earnings of Ferguson Radio Corporation had contributed to that improved result, which had been achieved despite adverse circumstances in a period of difficulty culminating in the disaster of the fuel crisis. The directors recommended a dividend of 25 per cent. on the ordinary shares.

The consolidated balance sheet of the group showed further gains in financial strength, and the total assets now exceeded £1 000 000.

The report was adopted.

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.

JACKSON BROS. (LONDON), LTD., Waddon, wireless manufacturers.—July 4, charge, to Westminster Bank, Ltd., securing all moneys due or to become due to the bank; charged on land and buildings, Old Palace Road, Croydon, with fixtures. *Nil. December 14, 1943.

PARA ELECTRIC RAILWAYS AND LIGHTING CO., LTD., London, E.C.—July 28, £20 000 5½ per cent. prior lien debenture stock, part of an amount already registered. *£524 238. November 14, 1946.

Satisfactions

A. F. BULGIN AND CO., LTD., Barking, wireless manufacturers.—Satisfaction July 23, of a charge registered August 24, 1939.

ARVIN ELECTRIC, LTD., Southend-on-Sea.

—Satisfaction July 29, of debenture registered April 20, 1937.

N. S. ACCUMULATORS, LTD., London, S.E.—Satisfaction July 17, £2 000, registered October 17, 1938.

County Court Judgments

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

SQUIRES, Mr. R. A., 2, Station Road, Brixton, radio dealer. £14 2s. 9d. June 9.
MCKAY, ROBT. (formerly trading as Quick Service), 71, Raglan Road, Leeds, electrical dealer. £11. June 18.

THOMPSON, WM., 45, Victor Street, Hull, electrician. £16 1s. 4d. June 16.

GRIFFITH, HUGH, Bridgfield, Barmouth, electrical and radio engineer. £12 7s. 1d. June 18.

Release of Trustees

BADER, Kaspar Erwin, formerly 25, Selborne Gardens, Hendon, N.W., now 53, Canons Drive, Canons Park, Edgware, Middlesex, consulting engineer, lately carrying on business at Westmoreland Road, Hendon, electrical equipment manufacturer. Court: High Court of Justice. Trustee's Name, Address and Description: Sydney Harold Gillett, 24, Basinghall Street, London, E.C.2. Chartered Accountant. Date of Release: August 12, 1947.

Metal Prices

	Monday,		September 8	
	Price	Inc.	Dec.	Dec.
Copper—				
Best Selected	per ton £130 10 0	—	—	—
Electro Wire bars	" £132 0 0	—	—	—
H.O. Wires, basis	" £149 10 0	—	—	—
Sheet	" £173 10 0	—	—	—
Bronze Electrical quality				
1% Tin—				
Wire (Telephone) basis per ton	£172 5 0	—	—	—
Brass (80/40)—				
Rod basis	per lb. 1s. 1½d.	—	—	—
Wire	" 1s. 6¼d.	—	—	—
Iron and Steel—				
Pig Iron (E. Coast Hematite No. 1)	per ton £8 19 0	—	—	—
Galvanised Steel Wire (Cable Armouring) basis 0.104 in.	" £34 5 0	—	—	—
Mild Steel Tape (Cable Armouring) basis 0.04 in.	" £21 15 0	—	—	—
Lead Pig—				
English	" £91 10 0	—	—	—
Foreign or Colonial	" £90 0 0	—	—	—
Tin—				
Ingot (minimum of 99.9% purity)	" £442 10 0	—	—	—
Wire, basis	per lb. 5s. 6¾d.	—	—	—
Aluminium Ingots	per ton £80 0 0	—	—	—
Spelter	" £70 0 0	—	—	—
Mercury (spot)	per bott. £16 0 0	—	—	—
(ex. warehouse)				

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

Coming Events

Friday, September 12 (To-day)

ROYAL PHOTOGRAPHIC SOCIETY.—London. At 16, Princes Gate, S.W.7. Opening of the Society's Annual Exhibition. Part I—Pictorial and Colour. To October 5.

INSTITUTE OF WELDING.—London. At the Addison Restaurant, Olympia. "The Development and Application of Stud Welding," by A. H. Bent. 2.30 p.m. "Some Aspects of Welding Repairs," by L. K. Johannessen. 5 p.m.

Saturday, September 13-14

I.E.E. TRANSMISSION SECTION.—Summer Visit to Yorkshire.

Monday, September 15

BIRMINGHAM ELECTRIC CLUB.—Presidential Address. 6.50 p.m.

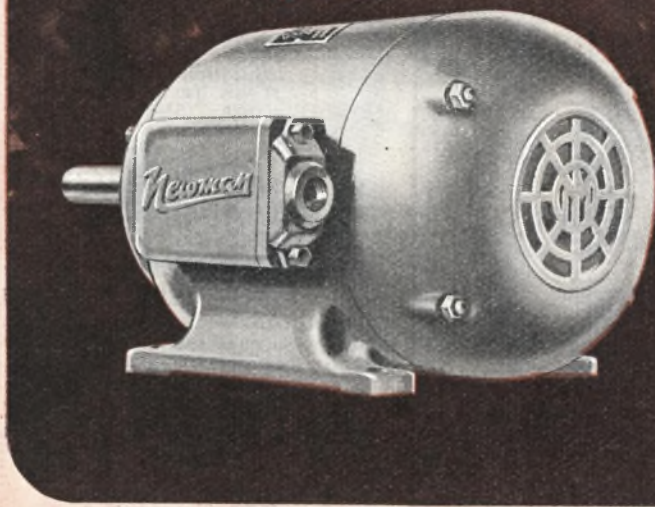
ASSOCIATION OF PUBLIC LIGHTING ENGINEERS.—Annual Conference at Southport, until September 19.

Wednesday, September 17

LANCASHIRE AND CHESHIRE RADIO AND ELECTRICAL GOLFING SOCIETY.—At the Sandiway Golf Club. Competition for Captain's Prize.

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September

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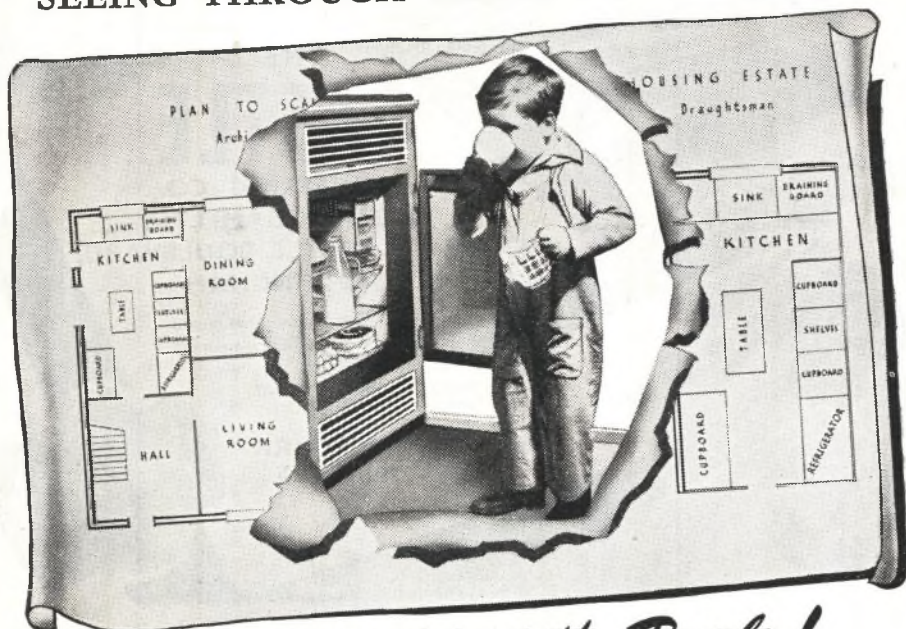
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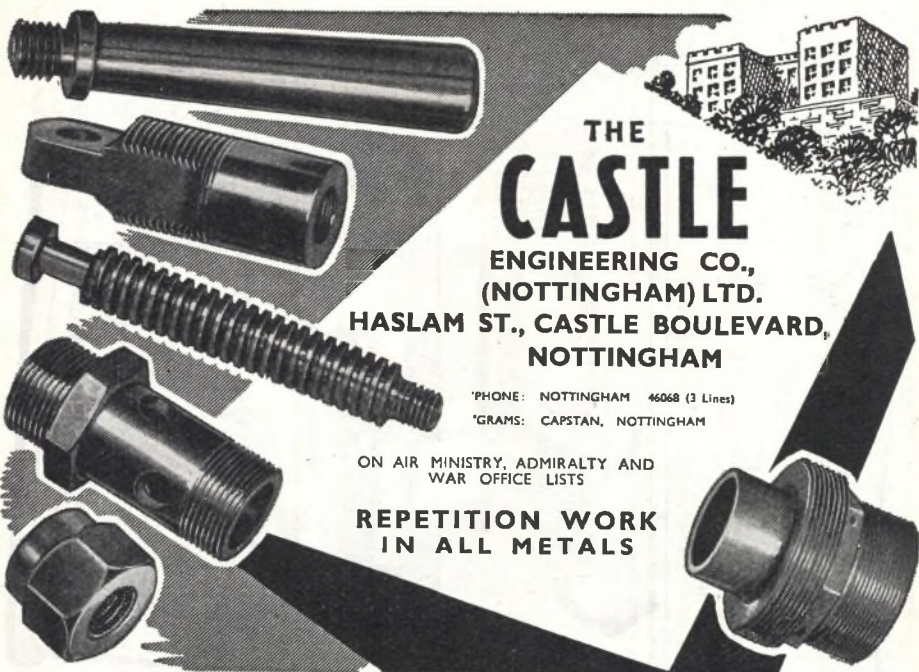
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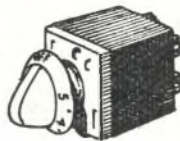
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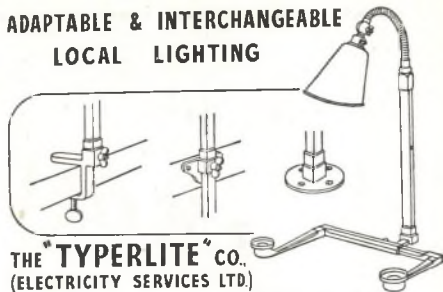
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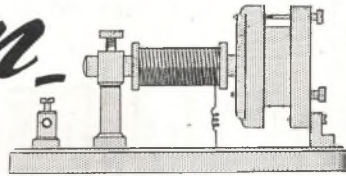
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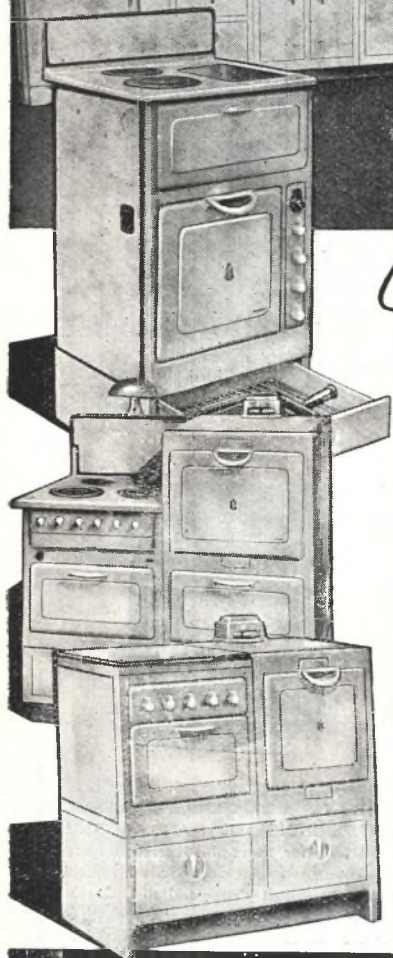
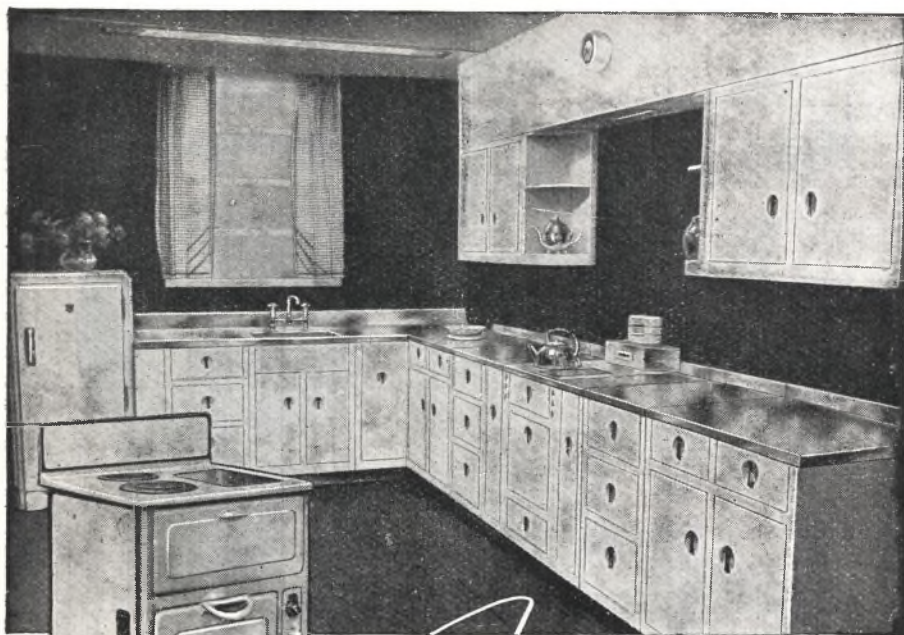
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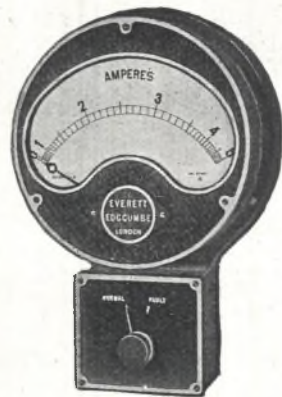
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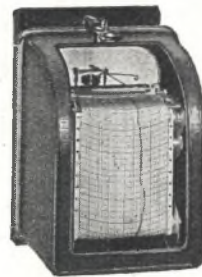


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Nalder Bros. & Thompson Ltd. ...	729
Newman Industries Ltd. ...	783
Nife Batteries Ltd. ...	752
Pritchard & Gold & E.P.S. Co., Ltd. ...	744
Reyrolle, A., & Co., Ltd. ...	735
Rotunda Ltd. ...	801
Sankey, Joseph, & Sons Ltd. ...	802
Santon Ltd. ...	751
Scholes, George, & Co., Ltd. ...	736
Scophony Ltd. ...	746
Simmonds & Stokes Ltd. ...	750
Stainless Steel Wire Co., Ltd. ...	800
Sunvic Controls Ltd. ...	787
Symonds, R. H., Ltd. ...	734
Tarmac Ltd. ...	803
Thorn Electrical Industries Ltd. ...	748
Trapinex Ltd. ...	749
Universal Tools Ltd. ...	786
Walker Crossweller & Co., Ltd. ...	750
West Insulating Co., Ltd. ...	800
Westinghouse Brake & Signal Co., Ltd. ...	Cover iii
Whiteley B. S. & W., Ltd. ...	742
Wilcox, Ed., & Co., Ltd. ...	738
Zenith Electric Co., Ltd. (The) ...	784

EARTH FAULT INDICATION

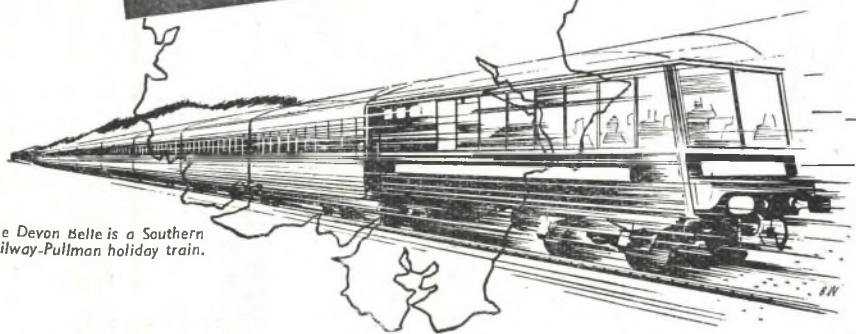


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Edgcombe**
Colindale Works,
LONDON, N.W.9
Telephone: Col. 6045



EVERETT EDGCOMBE SUPERSCALE LEAKAGE INDICATORS AND RECORDERS are available for three-phase earthed systems—where the neutral point is accessible or inaccessible—two-phase—single-phase—and all D.C. systems. An outstanding feature is the low range which facilitates the detection and removal of faults in the early stage of development.

*The observation cars of the
'DEVON BELLE' are wired with
LIVERPOOL CABLES*



The Devon Belle is a Southern Railway-Pullman holiday train.



are manufactured to the standards of the Cable Makers' Association and more than meet the exacting requirements made upon them.

THE LIVERPOOL ELECTRIC CABLE COMPANY LTD
LINACRE LANE • BOOTLE • LIVERPOOL • 20

CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

COUNTY BOROUGH OF EAST HAM.

MALE GENERAL DIVISION CLERKS—ELECTRICITY DEPARTMENT.

APPLICATIONS are invited for the above appointments in the Electricity Department at salaries in accordance with the age scale of the General Division of the National Salary Scales plus London allowance and cost of living bonus. Present inclusive annual salaries are:—

£99 14s. age 16, rising to a maximum of £389 16s. at age 30.

Applicants must be over 16 years and not over 30 years of age at date of appointment and must possess an educational qualification of not less than School Certificate examination standard.

The appointments will be subject to the provision of the Local Government Superannuation Act, 1937, to the Council's Conditions of Service for official staff in force from time to time, and successful candidates will be required to pass a medical examination.

Applications, on forms obtainable from the undersigned, must reach me not later than 19th September, 1947.

Canvassing in any form will disqualify.

Town Hall,
EAST HAM, E.6.
29th August, 1947.

H. A. EDWARDS,
Town Clerk.

(133)

IMPERIAL CHEMICAL INDUSTRIES LTD., WILTON WORKS require **DRAUGHTSMEN** to assist with the design and detailing of a large new works. Successful candidates will be appointed to the established staff. Preference will be given to applicants who hold the Higher National Certificate or higher qualification and have the appropriate experience, as follows:

DRAUGHTSMEN

ARCHITECTURAL: Design of offices, laboratories, houses, welfare and general industrial buildings.

CIVIL: Design of roads, railways, drains and water services.

STRUCTURAL: Design of buildings and structures, and design and detailing of reinforced concrete work for industrial buildings.

MECHANICAL: Design of pipework for steam, gas and water, compressed air stations, lay-out of chemical plant, etc.

POWER STATION: Design and lay-out of modern h.p. boiler plant and power plant.

ELECTRICAL: Lay-out of plant electrical installations, including motors, starters, distribution boards, cables and lighting, and necessary calculations.

INSTRUMENT: Lay-out of mechanical and electrical instrument installations for chemical plant. Preference for men experienced in modern automatic control instruments for temperature pressure and flow.

Applications, giving full details, should be submitted to the Personnel Manager, Imperial Chemical Industries, Ltd., Wilton Works, P.O. Box 54, Middlesbrough, Yorks., quoting advertisement reference ICI/X/29. (130)

CABLE PLUMBER JOINTERS, experienced on cables at least up to 11 kV, wanted by large firm of Cable Manufacturers for important contracts in Gloucester and South Wales districts. Opportunity of permanent employment for suitable applicants.—Box L.G.J., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4. (129)

FOREMAN required, experienced in laying all types of power cables and erecting modern factory installations, by large firm of Cable Manufacturers. Long term employment offered to suitable applicant on large contract in South Wales.—Box L.G.L., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4. (128)

SITUATIONS VACANT

THE MUNICIPAL COMMISSIONERS OF SINGAPORE invite applications for the following appointments on the permanent staff of the Electricity Department, the appointment to be in the first instance on three years' agreement.

(a) TECHNICAL ASSISTANT.

Applicants should be Corporate Members of the Institute of Electrical Engineers, have sound technical and practical experience in the design of High Tension and Low Tension Networks and technical planning associated with a large supply undertaking. Preference given to candidates holding an Engineering Degree.

Salary \$7 680, \$8 160, \$8 640 per annum respectively for the three years of agreement, rising thereafter (if service be continued) to a maximum of \$9 600, plus such cost of living allowance as may be approved by the Commissioners from time to time. This at present would be \$2 520 and \$1 440 per annum for married and single candidates respectively on commencing salary.

(b) SHIFT CHARGE ENGINEER.

Applicants should have a thorough practical engineering training with good technical education and experience in the operation of large steam turbo-alternators, switchgear, high pressure boilers and auxiliary plant.

The installed capacity of the Municipal Commissioners' Power Station is at present 32 000 KW; extensions are in hand to increase this to 62 000 KW.

Commencing salary \$5 760, \$6 000, \$6 300 per annum respectively for the three years of agreement, rising thereafter (if service be continued) to a maximum of \$7 200, plus such cost of living allowance as may be approved by the Commissioners from time to time. This at present would be \$2 160 and \$1 380 per annum for married and single candidates respectively on commencing salary.

A higher commencing salary with similar increments may be granted if the experience and qualifications of the candidate warrant it. Free quarters will be provided.

(c) ASSISTANT DISTRICT ENGINEER.

Applicants should be unmarried and be Graduates of the Institute of Electrical Engineers or have equivalent qualifications and have had experience on Direct and Alternating Current Systems, the laying and jointing of high and low pressure armoured cables, the erection and maintenance of high and low tension overhead lines, switchboards, transformers, protection, etc.

Salary \$5 400, \$5 700 and \$6 000 per annum respectively for the three years of agreement, rising thereafter (if service be continued) to a maximum of \$8 400, plus such cost of living allowance as may be approved by the Municipal Commissioners from time to time. This at present would be \$1 380 per annum on commencing salary.

GENERAL CONDITIONS.

A selected candidate will be required to pass a medical examination and become a member of the Superannuation and Provident Fund under the rules of which he must contribute $\frac{7}{8}$ per cent. of his salary. A free passage will be provided together with half-pay during the voyage. Eight months' leave with full pay is normally granted after four years' service. The exchange value of the dollar is 2s. 4d. sterling.

Applications, endorsed "Technical Assistant, Shift Charge Engineer, or Assistant District Engineer, Singapore," stating age, place of birth, details of education, qualifications, training and experience, accompanied by three copies of three recent testimonials, must be lodged with Messrs. Peirce & Williams, No. 1, Victoria Street, Westminster London, S.W.1 (Agents to the Municipal Commissioners), not later than 13th October, 1947. Further information if desired, can be obtained from the Agents. (134)

DESIGN and Development Engineer required by firm manufacturing small switches and similar mechanisms. Good progressive position offered to man with suitable experience.—Box L.G.M., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4. (143)

SITUATIONS VACANT

CITY AND COUNTY BOROUGH OF BELFAST ELECTRICITY DEPARTMENT.

APPLICATIONS are invited for the following positions:
(a) MECHANICAL ENGINEER (to supervise plant maintenance).

It is desirable that applicants have a University Degree in Mechanical Engineering and/or be Corporate Members of the Institution of Mechanical Engineers. They must have a sound mechanical engineering training and experience in the maintenance of watertube boilers, steam turbines and ancillary plant, preferably in modern power stations.

The salary is in accordance with Grade 6, Class J, of the National Joint Board Schedule of Salaries for Technical Engineers on the staff of Authorised Undertakers. The scale is £616 per annum for the first two years, £630 for the third and fourth years, and £644 after the fourth year.
(b) POWER STATION CHEMIST.

It is desirable that applicants have a University Degree in Chemistry and have experience of feed water treatment and boiler water conditioning for 650 lb./sq. in. 850° F. plants, testing coals and oils and combustion control.

The commencing weekly wages will be equivalent to Grade 7 or 8, Class J, of the National Joint Board Schedule, depending on applicant's qualifications. The respective scales are £563 per annum for the first two years, £576 for the third and fourth years, and £589 after the fourth year, and £521 per annum for the first two years, £533 for the third and fourth years, and £544 after the fourth year.

(c) JUNIOR ASSISTANT (SHIFT) ENGINEER for the Harbour Power Station.

It is desirable that applicants have a University Engineering Degree or Higher National Certificate in Electrical or Mechanical Engineering and/or be Corporate Members of the Institution of Electrical or Mechanical Engineers. They must have a sound engineering training.

The commencing weekly wages are equivalent to Grade 9a, Class J, of the National Joint Board Schedule. The scale is £389 per annum for the first two years, £398 for the third and fourth years, and £408 after the fourth year.

In the case of positions (b) and (c) upon the completion of twelve months' satisfactory service the position will be established on the Salary List, and shall be terminable during the first twelve months by one week's notice and thereafter by one calendar month's notice on either side.

Preference will be given to ex-Service candidates possessing the required qualifications.

Candidates for any position must not be more than 40 years of age on November 1st, 1947. In computing applicants' ages for the purpose of the age qualification clause, any periods of war service in H.M. Forces will be deducted from applicants' actual ages, provided that this will not apply to applicants whose actual ages would be over 45 years on the date of taking up duty.

Applications must be made on official forms, which can be obtained from the City Electrical Engineer and General Manager, Electricity Department, East Bridge Street, Belfast, and, with copies of not more than three recent testimonials, should reach the Town Clerk, City Hall, Belfast, not later than 4 p.m. on Friday, September 26th, 1947.

Canvassing, oral or written, if proved to the satisfaction of the appointing authority, will be disqualify.

JOHN DUNLOP,
Town Clerk.

City Hall,
BELFAST.
September 3rd, 1947.

(160)

DRAUGHTSMAN wanted for West London area, with experience of electricity meters and/or instrument work. Write stating age and experience.—Box L.G.O., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4. (148)

ELECTRICAL Wholesalers require competent Representative with car to cover London and part of Home Counties. Must have good connections and references. Excellent commission basis only.—Apply: Box L.G.C., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4. (113)

STRUCTURAL DESIGNER and Structural Draughtsman in London area for work in connection with overhead lines, radio towers, etc. Five-day week, superannuation fund, good prospects.—Apply in writing to: Staff Officer, British Insulated Callender's Cables Ltd., Norfolk House, Norfolk Street, W.C.2. (152)

SITUATIONS VACANT

WANTED. Electrical Engineer, University Degree, preferably with practical and commercial industrial experience, to take charge of new H.F. Plant. Applicants should state salary required.—Apply: Personnel Manager, John Garrington & Sons Ltd., Bromsgrove. (135)

SITUATIONS WANTED

CABLE Joiner, high or low tension, seeks engagement.—Box L.G.L., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4. (142)

CONTACT with Principal desired, view to using wide knowledge of Printing Processes, Print-buying and preparation of printed matter to greatest advantage.—Box L.G.N., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4. (147)

LONDON University graduate, B.Sc. (Eng.) Hons., Graduate I.B.E., 29, married, having six years Services experience on mechanical and electrical equipment (not radar) and one year development experience in electronics with large firm outside London, seeks situation within the London area. Minimum salary £450 per annum.—Box L.G.Q., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4. (155)

SITUATION FILLED

LINCOLN Corporation Electricity Department. Assistant Meter Superintendent. All applicants are thanked.

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. ELECTRICS
31, Fortune Green Road, N.W.6. Hampstead 8132. (150)

AIR CONDITIONING and HEATING INSTALLATIONS. Offers wanted for a quantity up to 150. Comprising motor, blower, filters, heating elements, ducts, silence cabinet, spares and maintenance kit, 200-250 volts, 50 cycles supply. New and unused in the maker's original packings. Ideal lines for the export market. Offers may be made for either whole or part of the total quantity ex our Leeds warehouse.—Wireless Instruments (Leeds) Ltd., 54-56, The Headrow, Leeds, 1. Tel. 22262. (51)

ALL SIZES and Speeds of Brand New Electric Motors. Ex stock.—11, King Edward Buildings, Bury Old Road, Salford, 7, Lancs. (43)

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

ALUMINIUM Sheets, Dural and Pure, 8 ft. x 4 ft., 6 ft. x 3 ft., 16-22 gauge; "Perspex," Corrugated and Flat. Unlicensed.—Henry Moat & Son Ltd., Atom Works, Newcastle-on-Tyne, 1. (146)

AVAILABLE ex stock, large quantity Electric Cable, 14/012 Single F'proof; T.C. 28/012, 250 volts; P.V.C. Insulated, 44/012 V.I.R. Single and many others. Attractive prices.—Write details: Box 5000, Magna, 82-94, Seymour Place, W.1. (144)

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)

FOR SALE

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)

ELECTRIC MOTORS, $\frac{1}{4}$ h.p. and $\frac{1}{2}$ h.p. 230 volt. Several new and used available for immediate delivery.—Victa Engineering Company, Maidenhead. (138)

SWITCH Boxes. One to four switch.—Garside, 33, Midland Road, Frizinghall, Bradford. (139)

FIVE NEW A.C. BALL-BEARING MOTORS, $\frac{1}{2}$ h.p., 230 v., single-phase, 2 800 r.p.m. Available from stock.—Box L.G.D., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4. (114)

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 Selfridges). Mayfair 0618-8960. (89)

FLUORESCENT Lighting Units. New Designs. New Prices. 5-ft. Reflector, Swallow or Batten, from £5 18s., 4-ft. Reflector £4 18s. 6d., 4-ft. Batten £4 9s. 6d. All self-contained and complete with Tubes. Call or write for new September lists.—Moss Bros., 53, Goodge Street, W.1. MUS. 5385. (90)

FLUORESCENT Light Reflectors. Many types available from stock or made to order in steel, aluminium, Perspex, glass, etc.—Garran Engineering Co., Ltd., Caerphilly, S. Wales. Tel. 3262. (44)

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. 800 Rotary SWITCHES, well-known make. 30 amps. A.C./D.C., 12s. 6d. Paxoline TUBING, 79 in. by 2 in. by $\frac{1}{4}$ in. wall, 4s. each. Large stocks ex-government radio spare parts and components. Also ex-government receivers, oscillators, etc.—Alec Davis, 8, Percy Street, London, W.1. (91)

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)

LADDERS, Trestles, Steps and Hand Carts from Ramsay and Sons (Forfar) Ltd., Forfar. (10)

LARGE variety Single, Two and Three-core P.V.C. Wire and Cable; also P.V.C. Sleeving, at bargain prices. All sizes stocked.—R. Lowther, 8, Paton Street, Manchester. 1. (145)

MERCURY Switches, all types. For details apply manufacturer, Quicksilver Tube Mfg. Co., The Grays, High Street, Harlington, Middlesex. (60)

METRO-VICK Mains Transformers, new and unused, ex-Ministry of Supply, 4 kVA, oil-filled, input 230 v., 50 cycles, output 18 000 v. packed in manufacturer's crate, £15 car. fwd.; 3 $\frac{1}{2}$ kVA, oil-filled, input 230 v., 50 cycles, output 21 000 v., £15 car. fwd. Substantial discounts can be given for quantity orders.—Wireless Instruments (Leeds) Ltd., 54-56, The Headrow, Leeds, 1. Tel. 22262. (66)

MODERN Low Temperature Oven by Birlec Ltd., thermostatically controlled and complete with all equipment. Internal size of oven 4 ft. 9 in. by 3 ft. by 3 ft. Type NO. 1671, 24 kW, 400 v., 35 amps., 3-phase, 50 cycles. Temperature range 400° C. Condition as new. Inspection.—Commercial Structures Limited, Staffa Works, Staffa Road, E.10. (123)

FOR SALE

ONE Diesel driven ALTERNATOR, 25kVA or near, 3-phase, 400 v., 50 cycles, with switchboard and control gear. Ready for work.—Park Street Works, Wellington, Salop. (163)

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)

STATIONARY Petrol Engines, 1 h.p. to 4 $\frac{1}{2}$ h.p. Ready to run. £20 to £38 10s. Suitable for machinery, lighting plants, sawbenches, compressors, etc. Immediate delivery from stock.—Victa Engineering Company, Maidenhead. (137)

TIME SHEETS. Our stock-printed Time Sheets are remarkably cheap compared with specially printed ones. On decent quality 8 in. by 10 in. paper: 100, 3s. 6d.; 500, 15s.; 1 000, £1 7s. 6d. Post free. Send for sample.—F. H. Brown Ltd., P.O. Box 26, Burnley, Lancs. (16)

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., Caledonia 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., CALEDONIA WORKS, HALIFAX. (9)

3 $\frac{1}{2}$ in. SCREWDRIVING Lathes. Motor driven £52 4s., or belt driven £38. Hollow spindle, compound slide, 18 in. between centres. Immediate delivery from stock. Terms arranged.—Particulars: Victa Engineering Company, Maidenhead. (136)

15 x 3 SWITCHPLUGS. All sizes Switchplugs, Sockets, Plugs, Multiplugs, Switches, Lampholders, Pattonholder, 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)

400/3/50, 12 kVA output Motor Alternators (Motor 220 v. D.C.), 350-375 v., 57-53 amps. ditto, 500 cycles (Motor 220 v. D.C.). Also 230/1/50, 15 kVA Alternator, c/w Exciter.—Burchell's Limited, London Road, Peterborough. (158)

450 SATCHELWELL Thermostats, tubular type. W.O. variable 10° 90° 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.

EKOK 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, 5 $\frac{1}{2}$ in. high, 3 $\frac{1}{2}$ in. dia. Large quantities available, sample 2s. per return; discount on quantities.

WOOD SWITCH BLOCKS: 3 $\frac{1}{2}$ in. round and square, 6 in. by 3 in. by $\frac{1}{2}$ in.; 9 in. by 3 in. by $\frac{1}{2}$ 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.

METROPOLITAN DISTRIBUTION LTD., TRURO. (79)

FOR SALE

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)

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)**BI-UNI.** The new Push-Button Flush Fitting Domestic Switch. Wholesale enquiries only.—Send for details: **SCEMCO LTD.,** Scemco House, 6 and 7, Soho Street, London, W.1. Gerrard 1461 (3 lines). (TC106)**15 AMP. SWITCHED SOCKET** for 3-pin plug top. Of robust design. Manufactured to B.S.S. requirements. Steel casing 5 in. by 3½ in. by 2½ in., finished Cream. With 5 knock-out entries for ½ in. conduit.—Full details from: **SCEMCO LTD.,** Scemco House, 6 and 7, Soho Street, London, W.1. Gerrard 1461 (3 lines). (TC107)

SALES BY AUCTION

G.



R.

By Order of Ministry of Works.

MINISTRY OF WORKS DEPOT,
CHART ROAD, ASHFORD.

Important Sale of

VALUABLE BUILDERS' MATERIALS, ELECTRICAL
EQUIPMENT AND ENGINEERING STORES.**Messrs. GEERING & COLYER**are instructed to sell the above by Auction, on **WEDNESDAY** and **THURSDAY, SEPTEMBER**
24th and **25th, 1947.****On View:** September 22nd and 23rd.**Catalogues** of the **AUCTIONEERS, ASHFORD, KENT.**
(159)

SALES BY AUCTION

G.



R.

By Order of the Minister of Supply.

Sale by Auction of

RADIO, RADAR AND ELECTRICAL EQUIPMENT
comprisingChokes, Transformers, Receivers, Speakers, Valve Holders, Switches, Condensers, Variable Trimmers (*Fired and Ceramic*), Prefabricated Assemblies, A.G.S. Power Units, Sleeving, Plugs and Sockets, Indicators, Dust Cores, Motors, Meters, Aerials, Headphones, Relays, Leads, Cover Glasses with Filters, etc., Remote Control Gear, and a large quantity of surplus Metal Parts, etc.

Also

Photographic Equipment and Material, Aircraft General Standard Stores, Sundry Lots of Textiles, Plastic, miscellaneous Pressure Gauges, Fire Extinguishers, Nuts and Bolts, Kits, Canvas, miscellaneous Paint, Varnish and Cellulose, hinges, washers, screws, etc., etc., at

Ministry of Supply Store No. 877/136,**L.P.T.B. DEPOT, WATFORD BY-PASS,****NEAR ELSTREE, HERTS,**

on

TUESDAY and **WEDNESDAY,****SEPTEMBER 16th** and **17th, 1947,**

commencing at 11 a.m. each day.

Auctioneers:

GODDARD & SMITH,

Head Offices: 22, King Street, St. James's, S.W.1.

On View: Monday, September 15th, 1947, 9 a.m. to 12 noon, 1.30 p.m. to 4 p.m., and morning of Sale, 9 a.m. to 10.45 a.m.**Catalogues:** Price 6d. of the Auctioneers. (156)

G.



R.

By Order of the Minister of Supply.

M.O.S. DEPOT, 46, CORNHOLME, near TADMORDEN,
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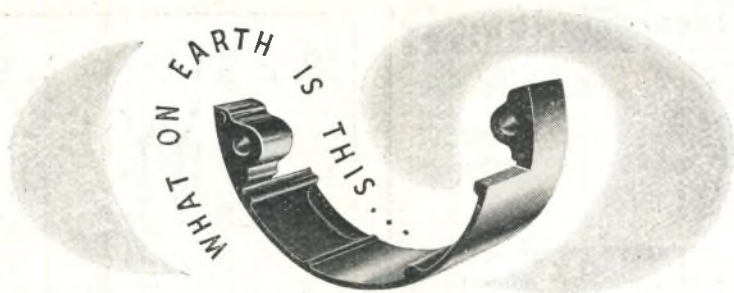
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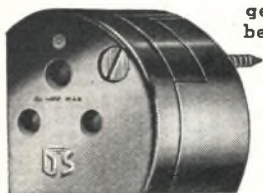
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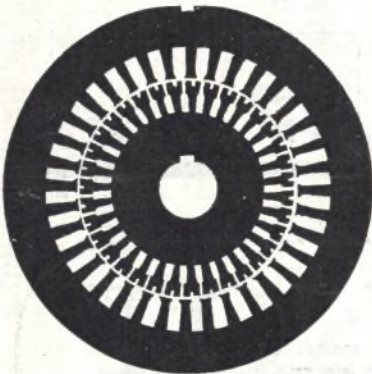
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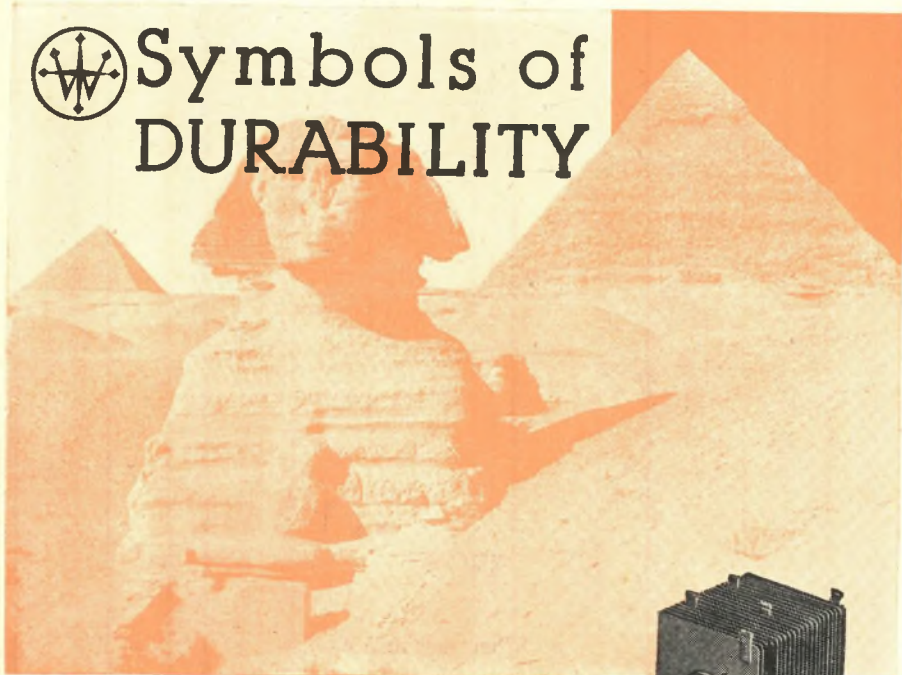
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