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THE P. 60/46/II

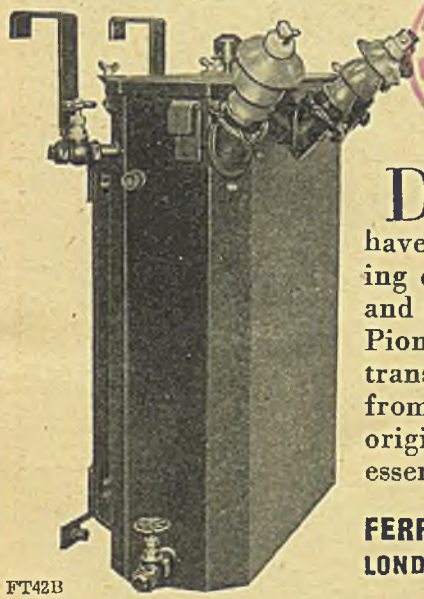
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202

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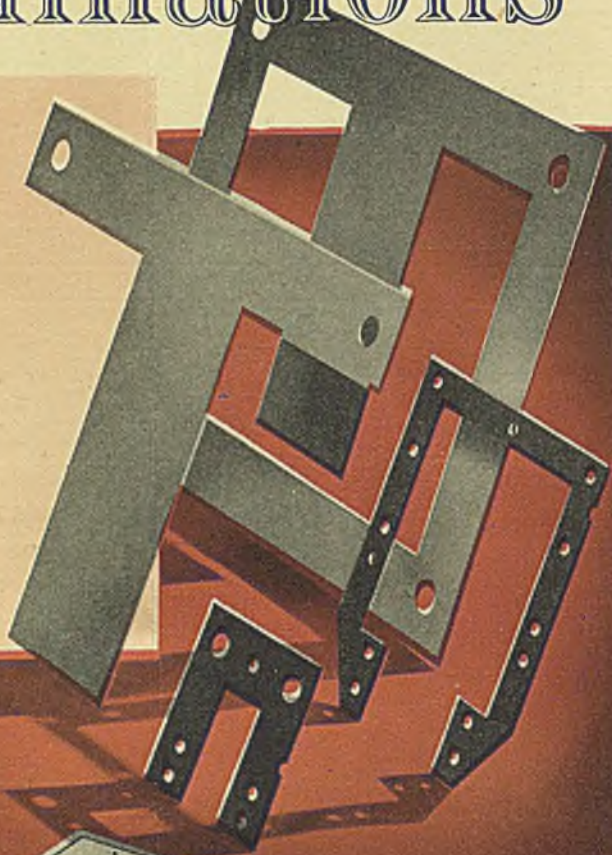
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is still better when heard and not
seen and that the studio audience is
too noisily pleased with its free seat.
Radio Programmes—P8

roll in the word. I think
Any tendency to diva
ality on behalf of two possible

W...one or tw
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Ivor
Somerset M
Rettlers"
Globe in
house on
Dorothy
Nesbitt it
Alec C
Tacture
Jack. Ha
start a
in Prag
Clunes's
the Arts
by Beat
Wilman.
Henry
are reviv
by Monat
who has
this cour
P. G. W
will app
taken b
Welch
back a
in the

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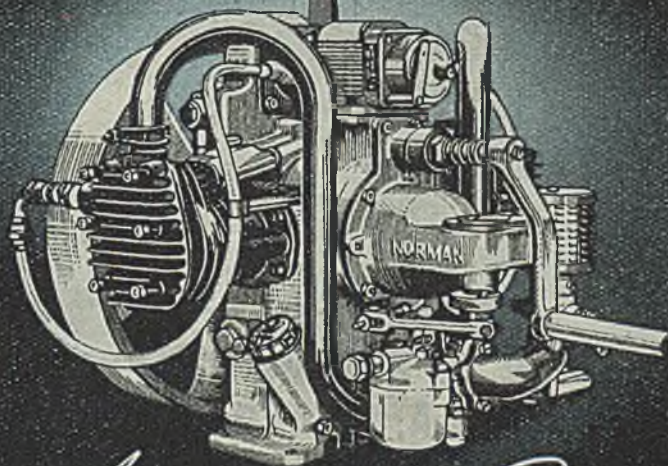
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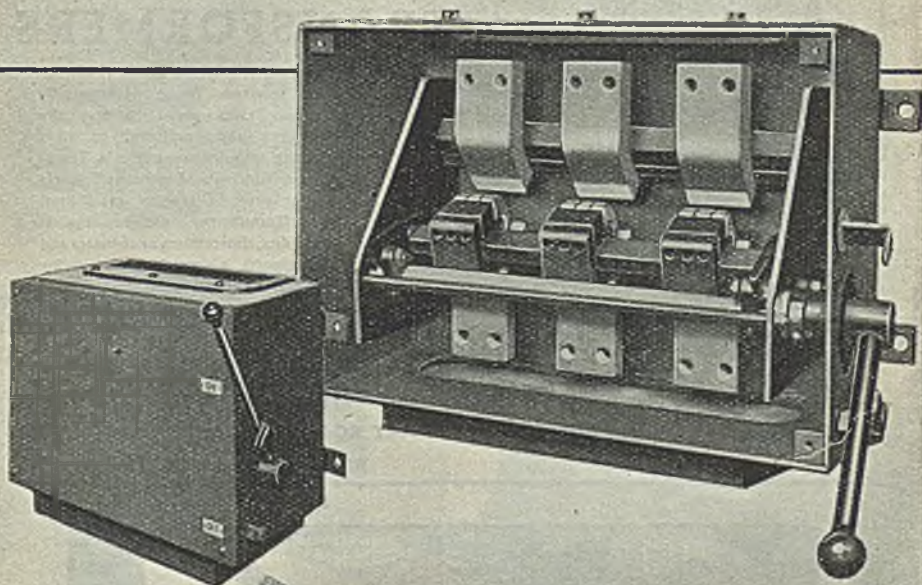
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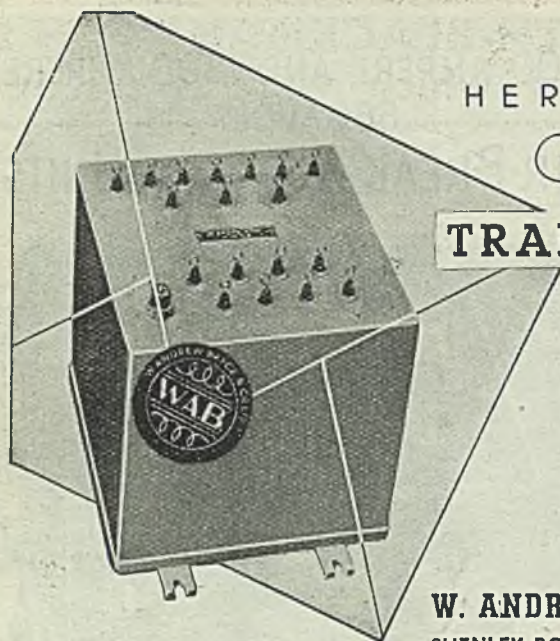
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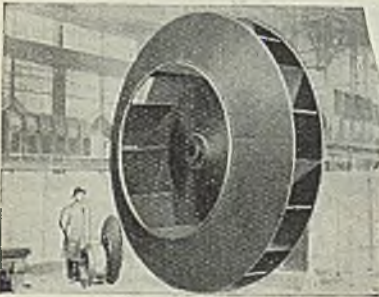
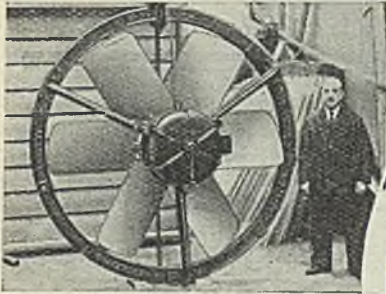
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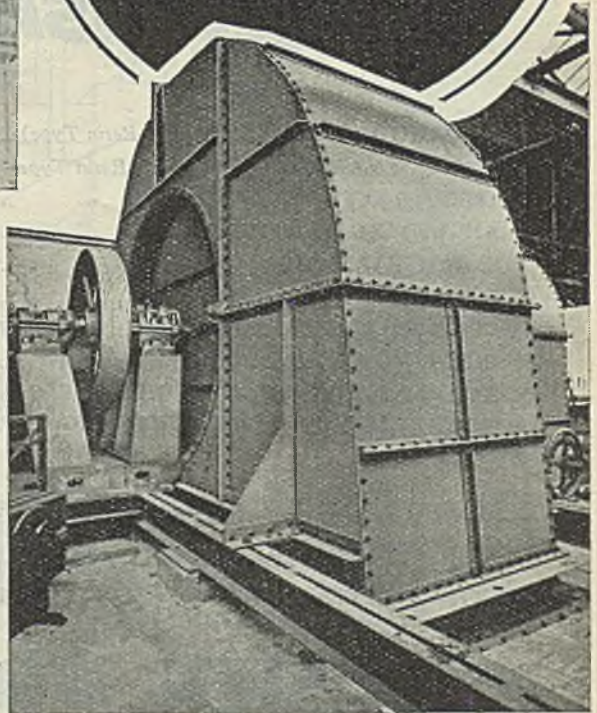
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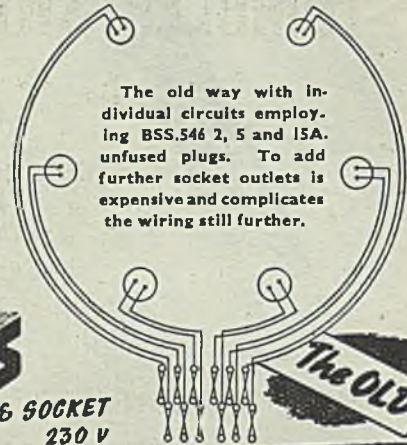
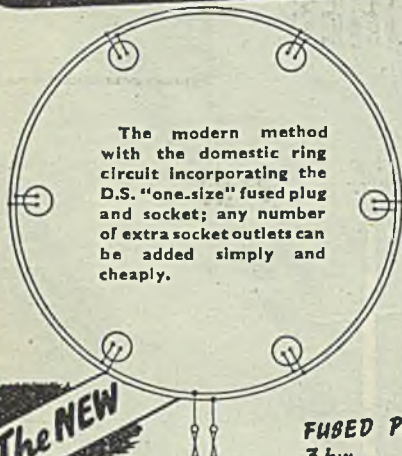
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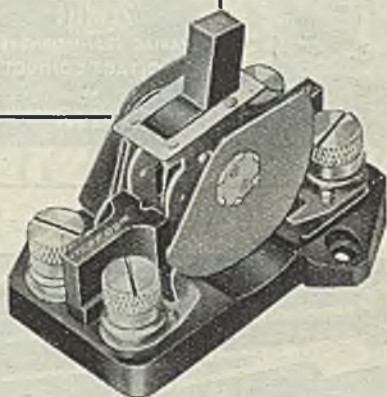
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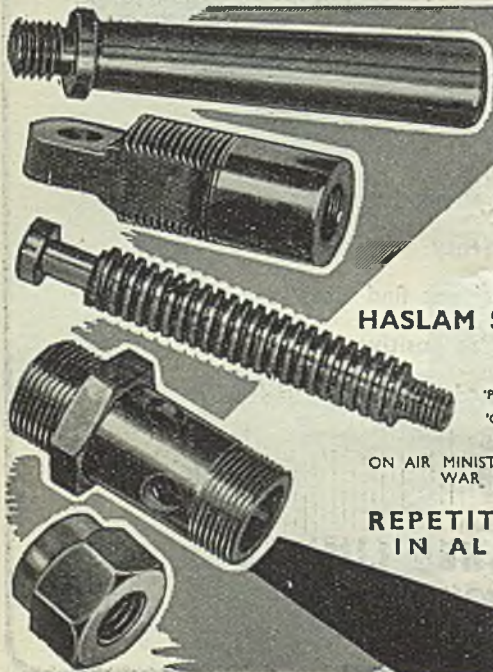
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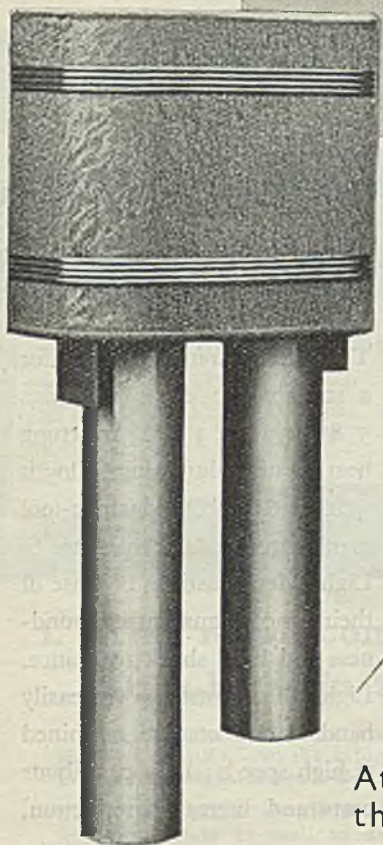
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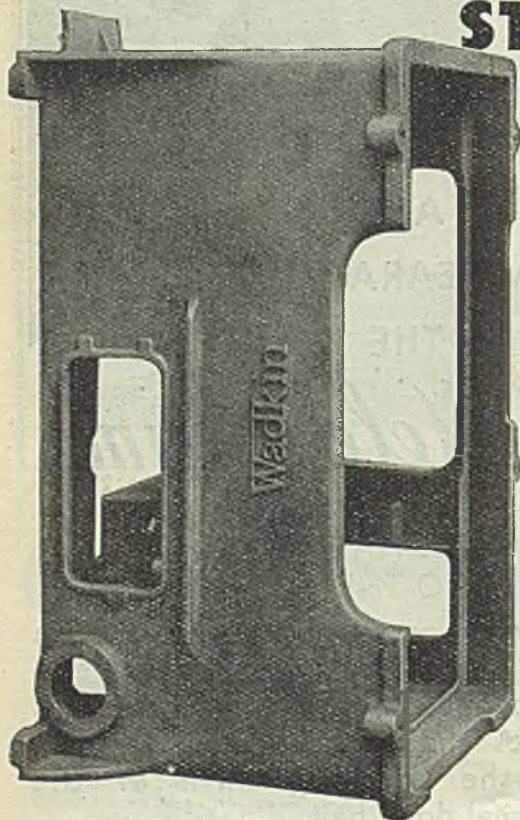
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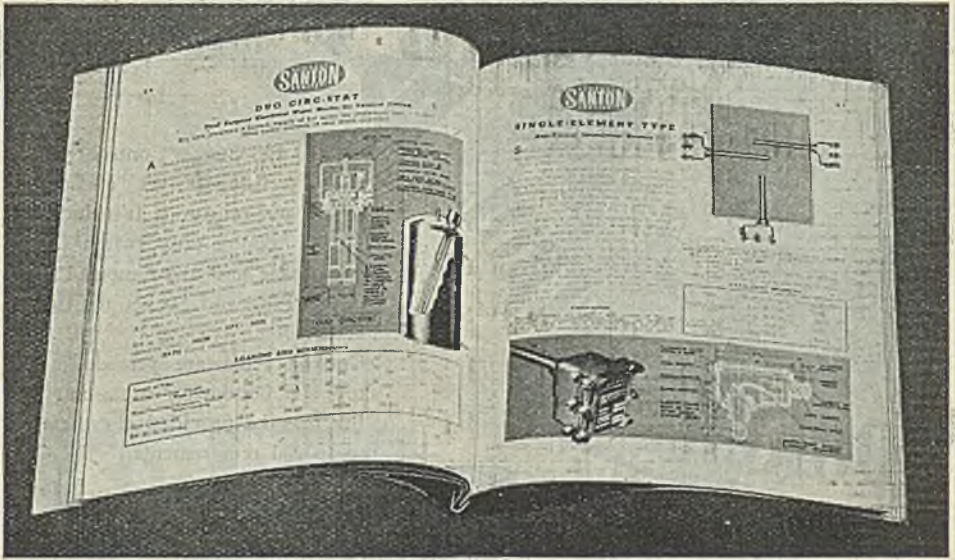
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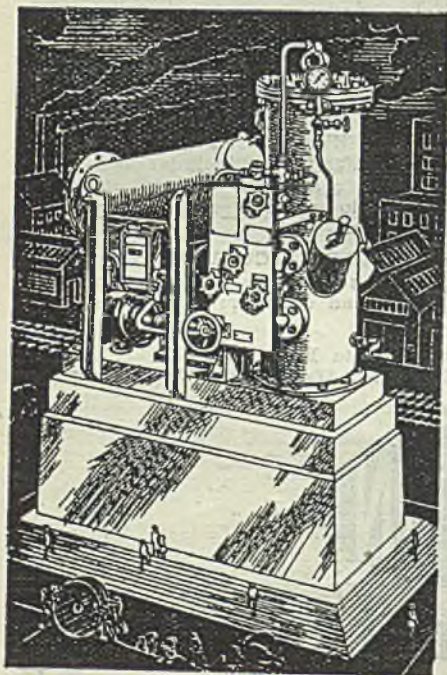
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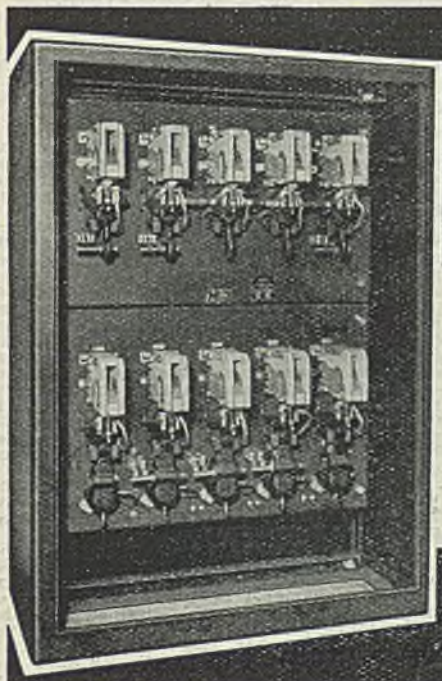
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The successful applicant will be required to pass a medical examination, and reside within easy access of the Borough.

Applications stating age, whether married or single, present appointment and salary, experience and qualifications, accompanied by copies of not more than three recent testimonials, should be forwarded to the Town Clerk, Municipal Offices, London Fruit Exchange, Duval Street, E.1, not later than 12 noon on the 30th November, 1946.

Candidates are required to state whether they are related to any member or senior officer of the Council. Canvassing, directly or indirectly, will disqualify.

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Applicants should have a sound technical education and possess technical qualifications admitting to Corporate Membership of the Institution of Electrical or Mechanical Engineers.

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Applicants should have served an Apprenticeship to Mechanical Engineering and have technical qualifications at least equal to the Higher National Certificate in Mechanical Engineering, and be capable, under the direction of the Mechanical Maintenance Engineer, of supervising the erection of new plant, detailing drawings from site measurements and compiling maintenance records and costs. Experience with the running and maintenance of high pressure steam plant is essential.

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(including consolidation addition).

There will be prospects of promotion to higher grades.

Candidates now serving in H.M. Forces must send in their application forms in time to reach the Civil Service Commission not later than six months after the completion of their service. All other candidates must send them in by 1st April, 1947, except that for candidates who are under 18 years old on the 1st April, 1947, the latest date for sending in the form is the 1st January following their 18th birthday.

Copies of the Regulations and Forms of Application may be obtained from the Secretary, Civil Service Commission, Burlington Gardens, London, W.1, or from the Chief Officer, Civil Service Commission, at the following addresses, quoting No. 1679:

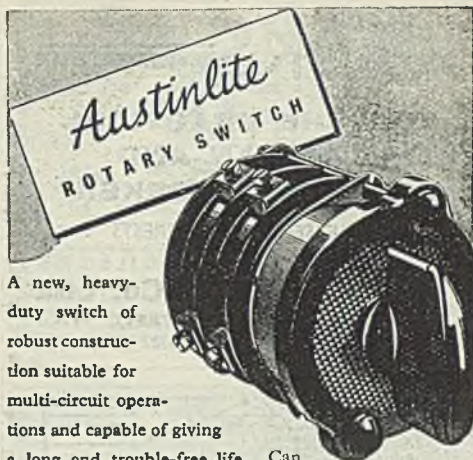
(India) 10, Underhill Lane, Delhi.
 (Egypt) 8, Sharia Tolumbat, Garden City, Cairo.
 (Italy) c/o. G.H.Q., C.M.F.
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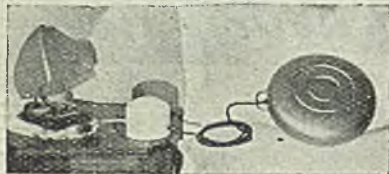
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SITUATIONS VACANT

LONDON AND HOME COUNTIES JOINT ELECTRICITY AUTHORITY

(Surbiton and Twickenham Districts).

APPLICATIONS are invited for the appointments of junior female showroom attendants at the Surbiton and Twickenham district undertakings of the Authority.

The Scheme of Conditions of Service of the National Joint Council for local authorities' administrative, etc., services will apply to the appointments. Salary will be in accordance with the General division of such Scheme. The salaries in this division range from £120 per annum at 20 years of age to £264 per annum at 30 years of age. The salary mentioned includes the weighting for the London area. In addition to the above basic salary, there is a cost-of-living bonus, which is now £59 16s. per annum at age of 21 years and over.

Candidates must have been educated to matriculation standard. They should have had experience in the showroom of an electricity supply undertaker or electrical contractor, and be conversant with domestic electrical apparatus. Age not to exceed 26 years.

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

Applications, stating age, qualifications and experience, and endorsed "Junior female showroom attendant," accompanied by copies of not more than three recent testimonials, must be sent to the District Manager of the Authority at 22, Claremont Road, Surbiton, or 42, York Street, Twickenham, as the case may be, so as to reach him by not later than Tuesday, the 26th November, 1946.

Canvassing, directly or indirectly, will be a disqualification.

A. L. BURNELL,
Clerk to the Authority.

5-6, Lancaster Place,
STRAND, W.C.2.
7th November, 1946.

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY.

(City and Guilds College.)

THERE is a vacancy in the Electrical Engineering Department, on the side of electrical machine and power, for an Assistant Lecturer. The appointment is for a period of three years with salary of £400 p.a. with F.S.S.U. superannuation. An Honours Degree and some practical experience of heavy electrical engineering are essential.

Applications, accompanied by full statement of qualifications, and with references, should be sent to the Head of the Electrical Engineering Department, City and Guilds College, Exhibition Road, London, S.W.7.

DRUGHTSMEN (SENIOR) required for lay-out of electrical services, sub-stations and lighting for new wide strip mill. Must be familiar with electrical controls of tandem mills and reversing mills. Office situated Newport, Monmouthshire; later may move to Banbury.—Apply Northern Aluminium Company, Ltd., General Engineering Department, Banbury.

ARMATURE Winders and Improvers required, A.C. and D.C., top rates, good working conditions.—Electrical Power Repairs (Gillingham) Ltd., Strover Street, Gillingham, Kent.

SITUATIONS VACANT
CITY AND COUNTY BOROUGH OF BELFAST.
ELECTRICITY DEPARTMENT.

APPLICATIONS are invited for the following positions:—

(a) Mains Engineer.

Applicants must have a sound engineering training, have a University degree in Electrical Engineering or be Corporate Members of the Institution of Electrical Engineers. They must not be more than 40 years of age on the 1st December, 1946.

The salary for the position is in accordance with Grade 5, Class J, of the National Joint Board Schedule of Salaries for Technical Engineers on the staff of Authorised Undertakers. The scale is £651 for the first two years, £666 for the third and fourth years, and £682 after the fourth year.

(b) Assistant Technical Engineer.

Applicants must have a sound engineering training, have a University degree in Electrical Engineering or be Corporate Members of the Institution of Electrical Engineers. They must not be more than 40 years of age on the 1st December, 1946.

The commencing wages for the position are £8 2s. 11d. per week, being in accordance with Grade 9, Class J, of the National Joint Board Schedule of Salaries for Technical Engineers on the staff of Authorised Undertakers. The scale is £425 for the first two years, £435 for the third and fourth years, and £445 after the fourth year. Upon completion of twelve months' satisfactory service the position will be established on the Salary List.

(c) Meter Engineer.

Applicants should have served an apprenticeship with a Meter manufacturer or in the Meter Department of a Supply Authority and possess the Higher National Certificate in Electrical Engineering or be Corporate Members of the Institution of Electrical Engineers. It is desirable that applicants have experience in the operation of a Class "A" testing station. They must not be more than 40 years of age on the 1st December, 1946.

The salary for the position is in accordance with Grade 8b, Class J, of the National Joint Board Schedule of Salaries for Technical Engineers on the staff of Authorised Undertakers. The scale is £456 for the first two years, £466 for the third and fourth years, and £477 after the fourth year.

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

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, 29th November, 1946.**

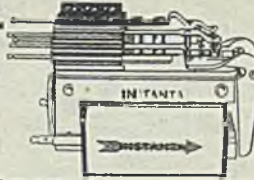
Canvassing, oral or written, if proved to the satisfaction of the appointing authority, will disqualify.

JOHN DUNLOP,
 Town Clerk.

City Hall, BELFAST.
 8th November, 1946.

DRAUGHTSMEN.—Applications are invited from Senior and Junior Switchgear Draughtsmen with experience of general switchboard work, high and low voltage, control panels, diagrams, etc. Applicants should state age, experience and salary required to Employment Officer, Messrs. Johnson and Phillips Ltd., Victoria Way, Charlton, S.E.7.

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ELECTRICITY DEPARTMENT.

Senior Sales Assistants.

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Applicants, who must be not more than 40 years of age at the time of the appointment, must hold the Electricity Development Association Domestic Electricity Salesmanship Certificate, and should have had experience in an Electricity Supply Authority showroom, sale and hire of all types of Domestic Electrical Apparatus. Sound knowledge of the principles of electric cooking, water-heating, refrigeration, and illumination required, and experience of practical installation work an advantage.

Showroom Assistants.

Applications are invited from young persons over 18 years of age for the appointment of 4 SHOWROOM ASSISTANTS at a salary commencing at £200 per annum rising by annual increments of £15 to £250, plus bonus of £48 5s. per annum for females, or £60 per annum for males.

Applicants must have had a good general education, have a knowledge of salesmanship, and be capable of dealing promptly and efficiently with enquiries in the Showroom. Accuracy with figures, clear handwriting, tactful and courteous personality essential.

The above appointments will be subject to the Council's conditions of service applicable to such appointments, and to the provisions of the Local Government Superannuation Act, 1937, and the successful candidates will be required to satisfy the Council's Medical Officer of Health as to their medical fitness. It will be a condition of employment that the successful candidates must be members of a Trade Union.

Applications in the candidate's own handwriting, stating age, qualifications, experience, particulars as to membership of a Trade Union, and when able to take up duties, accompanied by copies of not more than three recent testimonials, to be sent to the Borough Electrical Engineer and Manager, Electricity Offices, Cathall Road, Leytonstone, E.11, not later than first post Monday, 2nd December, 1946. Canvassing in any form will be a disqualification.

Town Hall,

Town Clerk,

D. J. OSBORNE,

LEYTON, E.10.
8th November, 1946.

**WOLVERHAMPTON AND STAFFORDSHIRE
TECHNICAL COLLEGE.**

**MECHANICAL AND ELECTRICAL
ENGINEERING DEPARTMENT.**

Senior Assistant.—Burnham Salary Scale for Senior Assistants £600 to £750 per annum by annual increments of £25, with addition for time spent in approved study and/or training (maximum addition £45 for five years).

Post of Responsibility.—Salary £580 to £605 per annum by annual increments of £15; addition for approved study or training as above; previous teaching and industrial experience taken into account in fixing commencing salary. Particulars and Forms of Application from

F. IONSDALE MILLS,
Clerk to the Governors,
Education Offices, North Street,
Wolverhampton.

SITUATIONS VACANT

CITY OF LINCOLN.

ELECTRICITY DEPARTMENT.

MAINS ASSISTANT required, with experience of H.T. and L.T. networks. Must have good knowledge of mains records.

Salary in accordance with N.J.B. Scale, Class "G," Grade (6a), commencing £437 per annum.

Applications, together with copies of two testimonials, to be submitted to the undersigned not later than the 30th November, 1946.

F. NEWFAY, M.I.E.E.,
Engineer and Manager.

Electricity Department,
Brayford Side North,
LINCOLN.

5th November, 1946.

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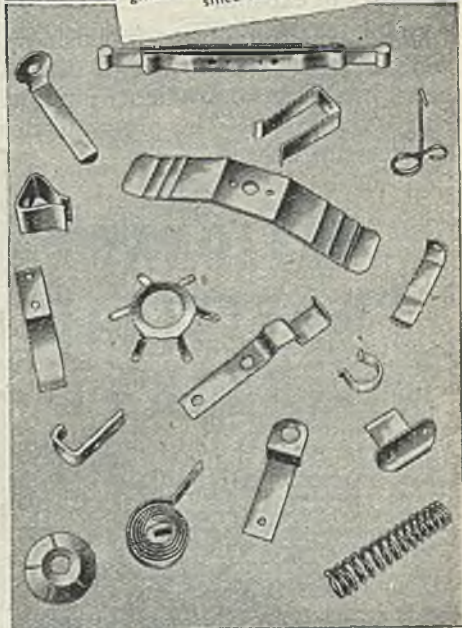
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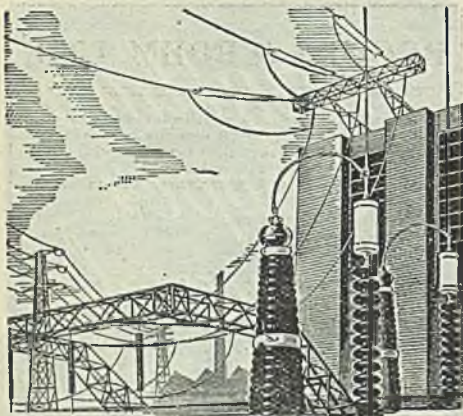


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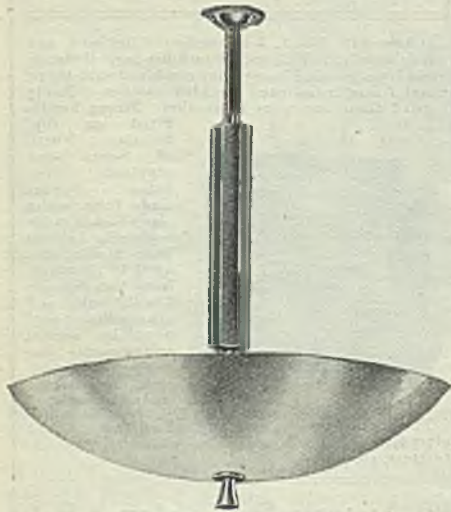
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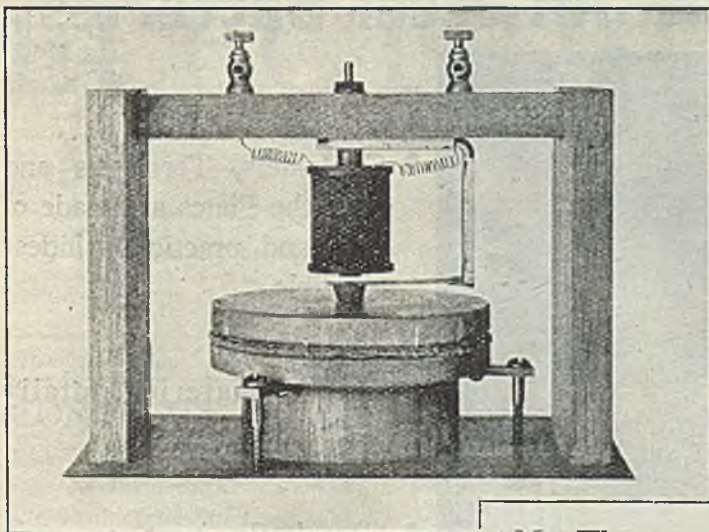
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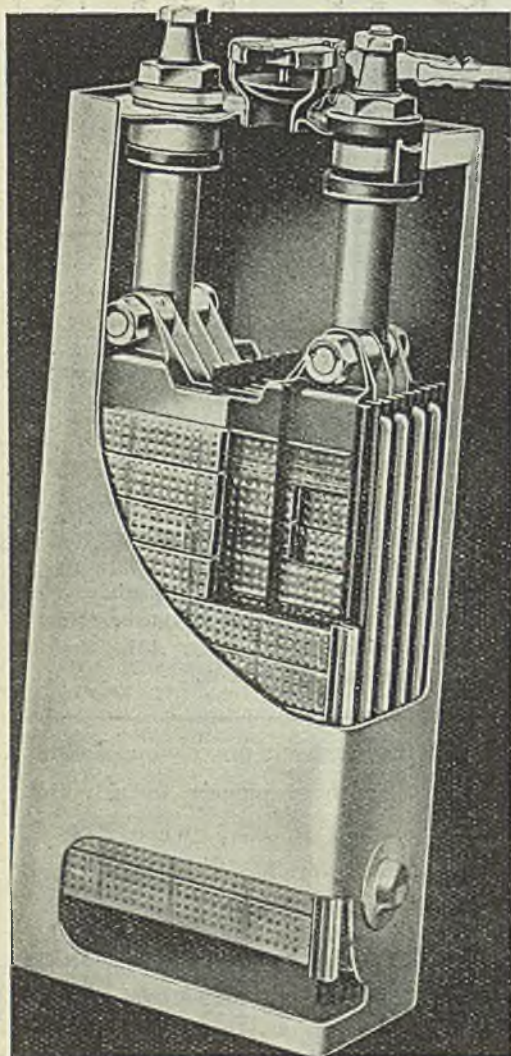
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Exhibitions and Trade

THE opens at Glasgow to-day, Friday, an exhibition which, though by no means confined to electrical interests, nevertheless includes much for which the industry is responsible. We refer to the Technical Exhibition—the largest of its kind to be held in this country for seven years—which will remain open at the Kelvin Hall until November 27.

This support by an industry which is generally admitted to be over-busy, is lent to the exhibition for the simple reason that the promoters of the display hope by their efforts to further export trade, to assist production with lessened man-power, and to attract to Glasgow many useful visitors from overseas.

The industry has already indicated its recognition of the fact that much of its export trade is in capital goods, and any national effort designed to promote overseas sales in consumer goods, be they industrial or domestic, must, therefore, be welcomed and its results followed with interest. The electrical industry has, from an export point of view, to face a future in which competition will be keener than it was before the war, and in which the handicaps of raw materials shortages, shorter working weeks and so on, will have to be overcome. Once the present demand of war-time creation is satisfied, the industry will have to sell in a market where quality of product is likely to prove more attractive than price, and in a

market in many cases already competed for by local industries born during the war years. That being so, any in the industry who believe that the present opportunities will remain for all time, should bear in mind the fact that at the moment, the heavy side of the industry in making good the stagnation and wastage of the war period, is now carrying most of the burden and must, sooner or later, shed most of its responsibility on to the industrial and domestic side of our manufacturing capacity. When that time comes the seeds planted at such exhibitions as that now being held at Glasgow will bring valuable reward.

The Plastics Exhibition

ONE of the noteworthy effects of the war was the stimulation of intensive investigation into the possibilities of plastics materials. When rubber became scarce, the insistent demands of the Services for increasing quantities of radar and radio equipment resulted in the production of dielectric substances that caused something of a stir in the cable-making industry. Although in itself of outstanding importance, this was only one phase in the general expansion of the plastics industry, and the first post-war exhibition of its products, organised in conjunction with the British Plastics Federation, which opened in London, on November 7, is a revelation of what has been achieved and the many uses to which the new materials are being put. Apart from giving the public an opportunity of learning something of the growth of the industry and its achievements, the exhibition serves the useful purpose of placing plastics in correct perspective in relation to other materials, showing that while plastics, with their distinctive properties, have advantages not possessed by other materials for many applications, they also have their limitations.

The Ace and the Jet-Plane

SINCE the publication in our last issue of the development of the British "Ace," which has been described as an electronic automatic computing engine, further information has been given by the N.P.L. of its capabilities and possible further development. It will operate with 5 000 radio valves as compared with the 17 000 required by the Eniac

and yet will do more than the more cumbersome American machine. By the speed of its calculations the "Ace" will be able to determine the momentum of the airflow around aircraft at velocities greater than that of sound, which experts in aerodynamics would otherwise have little hope of obtaining, and this may facilitate the construction of jet 'planes capable of speeds vastly greater than at present thought possible. The implications of the "Ace," which is making one field of human activity a thousand times faster, are so vast that it is not possible at the present time to foretell how far their effects will be felt. Dr. A. M. TURING, who conceived the idea, foresees the time, possibly in 30 years, when it will be as easy to "ask" the machine a question as to ask a man. Prof. D. HARTREE has hastened to correct any false impression that may have arisen in the public mind from the use of the label "electronic brain," in that he thinks that the machine will always require a great deal of thought on the part of the operator, and any notion that the "Ace" could ever be a complete substitute for the human mind is to be rightly discounted.

Circuit Breakers

THE ordinary meeting of the I.E.E. last week was distinguished by the fact that its programme included two highly interesting papers dealing with circuit-breakers. The first was concerned with the extinction of arcs in air-blast breakers and the second dealt with the influence of resistance switching on the design of high voltage oil circuit-breakers. Both papers were obtainable in advance of the meeting and it was therefore anticipated that there would be a lively discussion. No attempt was made to match one form of switchgear against the other, for such an attempt might quite reasonably have provoked a discussion rich in loyalty to one side or the other rather than one which might be of interest to the whole meeting. As it was, the discussion proved as valuable as the papers, and included many items of information which added to the success of the meeting. From the report of the proceedings given in this issue, it will be appreciated that the subject of circuit breakers in general is one which is engaging the attention

of the industry, not only in a technical sense but also from the point of view of economics. The experience of the supply industry of this country during the war, when all sorts of abnormal conditions were imposed upon the circuit breakers installed, shows that the claim for reliability is more than upheld. This experience, shared by no other country among the Allied Nations, places the British manufacturer in a class by himself and in a position to offer plant, the performance of which cannot be challenged.

Oil Burning Statistics

FROM an engineering point of view, progress of the conversion scheme at Neasden, details of which were given in our last issue, will be watched with a good deal of interest, for while the present coal position remains a handicap upon our boiler availability, the possibilities presented by oil firing in substitution of pulverised fuel must be borne in mind by the whole supply industry. Points upon which the supply engineer would no doubt be glad to be better informed are concerned with economics, both with respect to capital expenditure and running costs where stations bigger in capacity than Neasden are concerned. These details are at the moment not readily available, but since the London Passenger Transport Board have been willing to make known their experiences so far, it may well be that the Neasden conversion may prove a useful guide in the future.

Coal Outlook

OF all British industrial problems, coal is perhaps the most serious. There will be proportionate relief, therefore, that the latest figures issued by the Ministry of Fuel show a more favourable position than was generally feared. Two factors stand out sharply, a marked improvement in output per man-shift and a rapid growth in consumption. The question is, whether in fact the upward trend in coal winning will be maintained and whether it will be sufficient to meet the increased demands made by the rising consumption? While output in September and October rose by 3.4 and 4.1 per cent. respectively, consumption rose by 4.4 and 4.8 per cent., reflecting, incidentally, the scale on which peace-time

industry is getting back into its stride. The Ministry's figures indicate that there may be this winter a gap of between 2 and 5 million tons. The hope contained within the output figures is that if the present upward trend is maintained during the rest of the winter, the prospective gap would be covered. This, at least, has the merit of relating the future to a rising curve instead of a declining one, and that is something.

Nothing "For Export Only"

THE pre-war Ideal Home Exhibition was a valuable medium for spreading the gospel of domestic electrification, and though the possibilities of staging electrical exhibits and demonstrations on the same lavish scale are to-day fewer, the industry will welcome the fact that the exhibition is to be held again from March 4 to 29 next, in its old setting at Olympia. Homes, whether ideal or not, are to-day not easy to furnish, neither can there be added to existing appointments without some delay, those many portable and other domestic electrical appliances which mean so much in comfort and convenience. For this reason the exhibition will be doubly welcome, for not only will it be possible for the public to see and inspect many of the things they have for so long been unable to obtain, but everything in the exhibition will be purchasable, in that nothing will be "for export only." This does not mean, of course, that the exhibition will result in increased supplies, but that unlike the conditions obtaining in many other exhibitions so far held, the goods on view will also be on sale.

The Nationalisation Bill

THE nationalisation of electricity supply was foreshadowed in the KING'S Speech opening the new session of Parliament on Tuesday, as a further part of a concerted plan for the co-ordination of the fuel and power industries. No indication has so far been made as to when the Bill is likely to be presented, though it is believed to be already in an advanced state. The Opposition, it is understood, will demand that a public inquiry be held before the Government embarks upon its nationalisation programme, indicating thereby that the passage of the Bill will be a stormy one. Details are so far a closely-guarded secret.

Glasgow Technical Exhibition

Details of Electrical Equipment and Appliances

THE Technical Exhibition, which is to be opened by the Lord Provost of Glasgow, Sir Hector McNeil, at Kelvin Hall, Glasgow, to-day, and will conclude on November 27, is the largest of its kind held in Scotland for seven years. There are over 70 exhibitors, many of whom are showing new electrical instruments, appliances and equipment. The exhibition will be open daily from 10 a.m. to 8 p.m., except on the last day when it will close at 6 p.m. Brief descriptions of electrical products to be seen on the stands and the names of the makers are given below.

Allander Industries, Ltd., are showing for home and overseas markets, radio receivers, one of which is housed in a prototype aluminium cabinet designed for tropical conditions; a radio-gramophone in a wooden cabinet, with Garrard self-changing record mechanism and pick-up, for eight records of 10 in. and 8 in. diameter is another exhibit.

Atkins, Robertson and Whitefield, Ltd., as sole Scottish agents of Rediffusion, Ltd., for Redifon r.f. heating equipment, are demonstrating the use of this process for industrial purposes. They are also showing a new transportable a.c. gramophone; a four-valve amplifier for the reproduction of gramophone records, or for use with a microphone or home cinematograph equipment; and a Torrisdale boudoir speaker in Perspex.

The British Rotherm Co., Ltd., are displaying a comprehensive range of bi-metallic dial thermometers for cooking and water-heating systems, heavy and light industrial models, together with domestic types. The company are also introducing a new pocket thermometer with head and stem of stainless steel and a 1 in. dial, and a range of 0/200° F.

The Horstmann Gear Co., Ltd., have on their stand time switches for industrial and domestic purposes. Some are hand wound and others synchronous driven. The synchronous motors are of the self-starting 200 r.p.m. type. A new and interesting electric wind movement has

been evolved. In addition to a wide range of screw and plain plug and ring gauges, a new type of screw calliper gauge, eliminating all shearing action, is exhibited.

The British Vacuum Cleaner and Engineering Co., Ltd.,

are showing a range of portable industrial vacuum cleaners, from 1 H.P. to 8 H.P., designed to operate in the minimum of space available. A new feature is the perfection of a wet filter for collecting sludge from machine sumps, suds from carpet

cleaning, water from floors, etc. Also on the stand are to be seen a fixed plant for a central installation, comprising an air exhauster, driven by electric or other motor, and a dust filter with detachable dust-container.

J. Brockhouse and Co., Ltd., hope to have, in addition to the exhibits on their stand, a mobile demonstrator unit, in the vicinity of Kelvin Hall, which will show the Meldrums Neverjam underfeed stoker in use in conjunction with a Ruston and Hornsby vertical Thermax boiler. On the stand may be seen, among other things, the Meldrums new sprinkler stoker and High-field condensing heater; and the Brockhouse selfstoke gravity feed boiler.

The Bryterlyte Electrical Co. (Glasgow), Ltd., are showing a complete kitchen unit, the latest products of a number of manufacturers of electric domestic appliances, as well as radio sets, electric light fittings and shades, and an interesting display of electric cables.

Clyde Blowers, Ltd.—The exhibits of this company consist of soot blower equipment for all types of steam generators with manual and power operating units. The Lectramek (electro-mechanical) operating unit consists of a three-phase squirrel cage motor driving a mechanical reverse gear, the speed being reduced through worm and worm gear. Self-contained, the unit is applied to the soot blower by connecting horizontal or vertical shafts. In this way a motor that does not reverse is used to transmit through gears the necessary reversing motion to give the required reciprocating movement to the soot blowers. Each operating unit is provided with a

AN INVITATION

Benn Brothers, Ltd., proprietors of THE ELECTRICIAN, are exhibiting their trade and technical journals and other publications on Stand DD. Readers are cordially invited to visit the Stand and to make full use of the services available there.

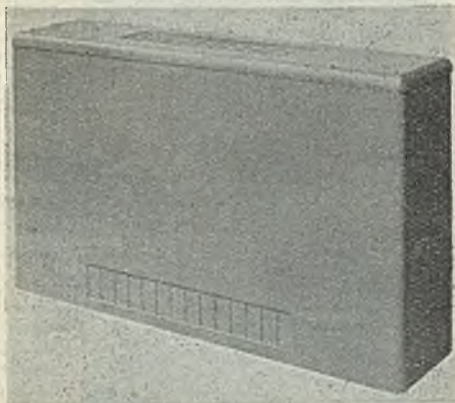
rotary limit switch which stops the soot blower always at "full off" position, after making three strokes in each direction.

The British Trane Co., Ltd., are exhibiting a Vectair 3 kW electric floor-standing convector heater and 1½ kW inset convector heater of the same type. A Univectair electric industrial heating unit, and a special assembly of extended surface heating and cooling coils; a new floor-standing space cooler for use in office buildings, hospitals, and so on, are also displayed. The cooling coils and air-circulating systems are housed within the cabinet shown in the illustration.

Electro-Platers, Ltd., have on view specimens showing the use of hard chromium and heavy deposits of nickel, such as the reclamation of worn and over-machined parts, and as a method of surface hardening and the reduction of friction. Examples are given of various types of deposited metals and their more common uses from the points of view of decoration, corrosion resistance, electrical properties, etc.

The Flextol Engineering Co., Ltd., are exhibiting and demonstrating flexible shaft equipment. A new addition to this range is the rotary filing and light grinding machine, incorporating a universal electric motor developing .45 H.P., and a two-speed gear box giving final speeds of 1 500 and 11 000 r.p.m., as desired.

Fusarc, Ltd., have as their main exhibit a marine deck welder which is a fully automatic arc-welding plant, primarily

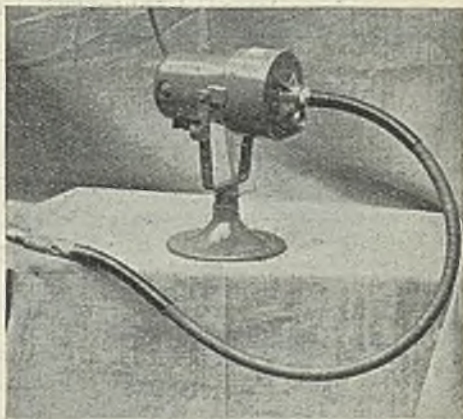


New floor type space cooler for office buildings, and hospitals—(The British Trane Co., Ltd.)

designed for the butt welding of deck plating, tank tops, etc., in ship construction. There are also displayed coils of the newly-developed mesh-wound continuous electrode and sample welding joints.

Hoover, Ltd., are exhibiting, among

their vacuum cleaners, a model designed for the larger type of home; their standard size cleaner; the Junior, and the Dustette. The company's range of F.H.P.



Two-speed rotary filing and light grinding machine—(The Flextol Engineering Co., Ltd.)

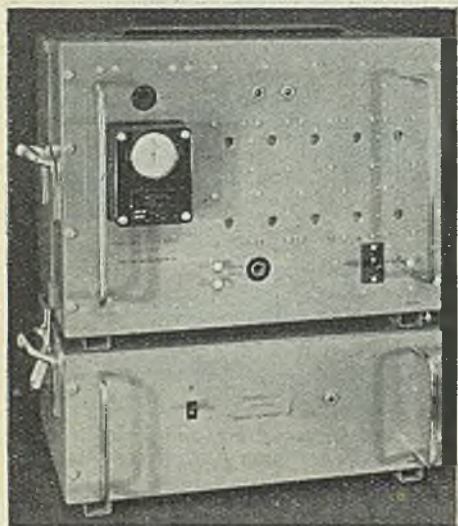
motors (squirrel cage induction type), also on view, covers ¼ to ½ H.P. Enclosure is of the protected ventilated type, and either solid cast foot or resilient cradle mounting is available.

Land, Speight and Co., Ltd. have in operation at their stand an automatic telephone exchange, a stroboscope installation and other test equipment. The exchange is by Ericsson Telephones, Ltd. There is also a display featuring the make-up of miniature and switch-board models, and a multi-range test set by Measuring Instruments (Pullin), Ltd. Other exhibits include transformers up to 300 kVA, and a 11.5 kVA variable voltage transformer with exposed construction, by Gresham Transformers, Ltd.; Telcon paper and cambrie insulated cables, h.f. co-axial cables and plastic products; and Dawes electronic test equipment.

The Magneta Time Co., Ltd. (subsidiary of the British Vacuum Cleaner and Engineering Co., Ltd.), are displaying a range of synchronous electric clocks from desk types to large outside advertising units, pendulum type master clocks, various types of electric instruments, public address sound and loudspeaker telephone systems.

Marconi Instruments, Ltd., are displaying a variety of instruments employed in connection with communications and a number for industrial applications. The latter include a meter for the rapid measurement of the percentage of water in cereals and a portable battery-operated meter which, it is claimed, instantaneously

measures the moisture content of wood. A plating-thickness meter determines the thickness of non-magnetic plating or paint applied to ferrous metals. Another useful



The chronoscope for measuring time intervals (Marconi Instruments, Ltd.)

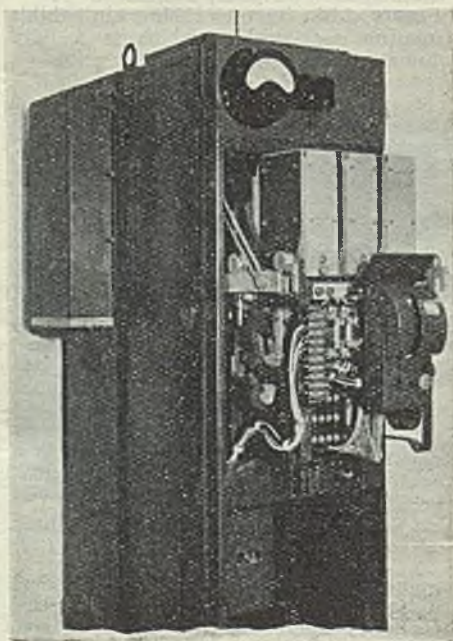
instrument on the stand is a chronoscope which measures time intervals of one millisecond and upwards, where the starting and stopping time of the interval can be represented by an electric function. There are also a conductivity recorder for the determination and recording of electrolytic conductivity; an electrical impulse counter, and a large scale indicator for pH or other measurements.

Midland Industries, Ltd., include in their exhibits Mindus electrically heated tubular towel rails, and electric convector heaters of low consumption, suitable for children's bedrooms, and also for heating garages, greenhouses and storerooms.

Naval Ordnance Inspection Department.—Exhibited on this stand are examples of various precision gauges designed and manufactured at the Gauge Factory, Sheffield. The Bragg Laboratory is staging demonstrations of the application of some modern physico-chemical methods to the analysis of ferrous and non-ferrous metals by means of the Spekker photo-electric absorptiometer and the Hilger "Pholec" photo-electric spectro-photometer, showing their mode of operation and their application to the micro-analysis of ferrous alloys. Other demonstrations show the Tinsley recording polarograph with the accessories used in some of its applications to the analysis of ferrous and non-ferrous alloys.

A. Reyrolle and Co., Ltd., are exhibiting

one of their 1200 A medium-voltage air-insulated horizontal draw-out metal-enclosed switchgear panels with air-break circuit-breaker which is typical of a range with normal current ratings up to 2400 A and with breaking capacity ratings of 25 MVA and 37.5 MVA at 400 V and 600 V respectively. This is a new development with a variety of uses in controlling power station auxiliaries and heavy current circuits in industrial plants and in substations. The dynamic balancer to balance induction-relay discs is demonstrated. This machine, by means of reflected light, indicates instantly where material must be removed from the disc and the amount, to produce perfect balance. Another exhibit is the Reymez pedestal wash-basin providing an instant supply of hot water from a 2½ gal. storage tank contained in the pedestal. Heat is provided by a thermostatically-controlled immersion heater which can have one of four alternative ratings to suit the frequency of use of the basin. Also to be seen on the stand are a cross-section through a domestic hot water cylinder showing the means of attaching the company's immersion heater by means of a special g.and-plate for this service, and a house-service unit to the E.D.A. specification No. 1627, while a new range of domestic plugs and sockets of 3 kW rating is exhibited on a display



A 660V 1200A solenoid operated air-break switchgear panel, with front cover removed (A Reyrolle and Co., Ltd.)

board with different types of flush-mounting and surface-mounting wall sockets. These are of the two-pole and earth pin pattern with a replaceable cartridge fuse pin in the plug.

Sunvic Controls, Ltd., display adjustable thermostats with a sensitivity of $\pm 1/4^\circ$ C. at temperatures up to 300° C., and $\pm 1/10^\circ$ C. at temperatures up to 150° C. An electronic relay with a control circuit, which requires only a few micro-watts, and will control an output of 2 kW is also exhibited. A proportioning head for a Toluene regulator to maintain control within a few milli-degrees in conjunction with standard Toluene regulators is shown, together with glass-sealed thermostats; these measure 2.5 in. by .125 in. by .5 in. and are fitted contacts, which, it is claimed, cannot oxidise. They are recommended for blankets, wax baths, glue pots, soil heating, fire alarms, etc.,

and will control 1 A a.c. or d.c. There are also other temperature controllers and recorders, energy regulators, and so on.

Vacticr, Ltd.—On this company's stand may be seen models of their cylinder type vacuum cleaner, Junior upright vacuum cleaner, and the Vacticr floor polisher. The first-named has been designed to equip the housewife with a complete outfit for home cleaning. The Junior is claimed to incorporate all the advances in cleaner design made during the war years. The floor polisher has three brushes, two revolving clockwise and the third anti-clockwise, mounted in a triangular base giving easy access to corners.

Charles Weston and Co., Ltd., are featuring oil seals, consisting of metal cases with chrome leather, sealing washers, and metal cases with synthetic rubber sealing washers which might have electrical applications in relation to equipment using oil.

Exhibition of Plastic Products

THE history of the plastics industry, its achievements up to the present day and possible future developments are outlined in an interesting and colourful exhibition, sponsored by the "Daily Graphic" in association with the British Plastics' Federation, which opened at Dorland Hall, Lower Regent Street, London, on November 7, and will close on November 27. The main object is to place plastics before the public in a true perspective in relation to other materials.

In the entrance hall the history of the industry from the time of the ancient Egyptians, who produced the first plastic from beeswax and resin two thousand years ago, to the pioneers of the industry as it is known to-day, is illustrated. The second section is concerned with the derivation of the raw materials of plastics from natural substances, while in the third, thirty different types of plastics materials are displayed, together with the finished products, and briefly described. Another section demonstrates the practical advantages of plastic articles and their immunity to corrosion and the effects of spilt fluids. Perspex and other products are effectively employed in admirably planned lighting arrangements, particularly in the Rainbow Room, where walls, ceiling and floor have been utilised to show to advantage the wide choice of colours afforded by plastics to the designer. Graded cables and wires covered with P.V.C. in distinctive shades form part of the scheme of decoration.

In an arcade of shop windows a large assortment of products illustrates the extent to which plastics are used in the

manufacture of electrical equipment and radio receivers. These include domestic meter covers, accumulator cases, lamp stands and shades, vacuum cleaners, radio cabinets, convection space heaters, electric clock and instrument cases, plugs and sockets, and so on.

A moulding press and a plastic welding machine are demonstrated.

Among the manufacturers whose products are represented are the following:—

I.C.I. Ltd.; Thermo-Plastics, Ltd.; Punfold and Barstow (Mouldings), Ltd.; Ebonestos Industries, Ltd.; the Graving Manufacturing Co., Ltd.; Insulators, Ltd.; Crystalate, Ltd.; United Ebonite and Lorival, Ltd.; Evered and Co., Ltd.; J. F. Kenure, Ltd.; De La Rue Plastics, Ltd.; General Accessories, Ltd.; E. K. Cole, Ltd.; the Streetley Manufacturing Co., Ltd.; the Viscose Development Co., Ltd.; F. A. Hughes and Co., Ltd.; Wembley Resinoids, Ltd.; Hoover, Ltd.; Artistic Enterprises, Ltd.; Waite and Son, Ltd.; the General Electric Co., Ltd.; Kent Mouldings, Ltd.; P. Lambda; Ferranti, Ltd.; Utilex, Ltd.; Ply Glass, Ltd.; Bakelite, Ltd.

A sub-committee of the Ekeo Social and Sports Club has been formed to produce a pantomime to be staged in the works canteen at Southend-on-Sea, early in 1947. Already talent spotters have been busy and plenty of comedy and charm has been found behind the factory benches and office desks. No outside "stars" are being invited to play parts, and, based on one of the traditional pantomime stories, the script will be produced on the premises. "Coupons permitting, we will make our own costumes and scenery, too," say the sub-committee. "We would rather be able to claim that this is all our own work."

Electrical Personalities

MR. J. CLAYTON has been appointed a director of Broadcast Relay Service in place of Sir Herbert B. Grotrian.

MR. H. L. OURA, whose portrait appears on this page, has been appointed by



MR. H. L. OURA

E. K. Cole, Ltd., to take charge of their western development interest at Malmesbury, Wiltshire. Brief biographical details were given in our issue of October 25.

COUN. J. MAYO, electrical engineer, has been elected Deputy Mayor of Tynemouth.

ALD. EDEN JOHNSTON, chairman of Sunderland Electricity Committee, has been elected Deputy Mayor of the borough.

MR. C. LACY-HUBERT, joint managing director, and Mr. E. G. Plucknett, general sales manager, Creeda division, of the Tube Investments subsidiary, Simplex Electric Co., Ltd., are visiting the United States and Canada on a business mission.

LT.-COLONEL NORMAN ELLIOTT, general manager and chief engineer of the London and Home Counties Joint Electricity Authority, will be the guest of honour at the luncheon of the Battis-Wallahs' Society at the Connaught Rooms,

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.

London, on November 28. He will speak on "Electricity in the Service of the 21st Army Group," telling of some extraordinary improvisations made for supplying electricity to the areas liberated by the advancing armies in Europe. Messrs. H. A. Crabtree, James Nelson, and H. R. Allen have been elected members of the society.

MR. A. W. BUNN, whose portrait is reproduced in this column and as was announced in our issue of Nov. 8, has been appointed to the new post of sales promotion manager of Hoover, Ltd. Previously he was manager of the London and West Branch of the company.

MR. A. G. FORGAN, power station superintendent in the York electricity department, has resigned, reports the City Electricity Committee.

ALD. J. L. DIRKIN, J.P., who was elected Mayor of Lancaster on November 9, has been chairman of the Electricity Committee for 11 years. He is a member



MR. A. W. BUNN



Group taken at the first annual competition held at Witton by the G.E.C. Divisions of the St. John Ambulance Brigade. The HON. MRS. LESLIE GAMAGE, who presented the trophies to the Witton B and Witton Nursing Divisions is seen with MR. J. J. GRACIE, president, with officials and teams

of the District Joint Board, District Joint Industrial Council and Joint Committee for North-West England, and also of the Council of the Incorporated Municipal Electrical Association.

LT.-COLONEL S. E. MONKHOUSE has retired from the position of managing director of the North-Eastern Electric

London, W., but pending the acquisition of suitable premises, they and their staff will operate from 24, Gillingham Street, S.W.1. Ewbank and Partners, Ltd., have signed an agreement with Edmundsons to do for them all that they have done in the past as officials of the corporation. Thus they retain the closest possible association with the corporation, and continuity of service is secured. Mr. Thomas E. Boothby, formerly deputy chief engineer to the corporation; Mr. Donald E. Bird, electrical engineer; Mr. Samuel N. Chew, project engineer; and Mr. William Kitson, generation engineer, are Mr. Ewbank's fellow directors in the new company.

MR. J. J. GRACIE and Dr. C. C. Garrard, joint general managers of the works, were present at a farewell party given to mark the retirement of five members of the senior staff of the Witton Engineering Works of the General Electric Co., Ltd., recently. The retiring members were Messrs. P. F. Harris, E. S. Fry, S. Allen, H. W. Richardson and W.



Farewell party to G.E.C. staff members at Witton. The photograph shows MR. J. J. GRACIE (centre) and DR. C. C. GARRARD (seated, left), joint general managers of the works. (Left to right, standing) Messrs. P. F. HARRIS, E. S. FRY and S. ALLEN; (seated second from left) H. W. RICHARDSON and (second from right) W. LEWTHWAITE

Supply Co., Ltd., and thus terminated his executive activities with the company after having been on the staff for 42 years. He remains on the board of directors. Colonel Monkhouse has not only taken a prominent part in the Nesco's organisation, but for many years has been actively engaged in outside circles affecting the electricity supply industry generally. On Friday, November 8, the staff of the Nesco presented to Colonel Monkhouse an antique table bearing an inscription recording the event, a salver made of old Newcastle silver, and a cut-glass decanter. Replying to Lieut.-Colonel Woodward, general manager, and a director of the company, who made the presentation at a gathering of the staff, Colonel Monkhouse paid warm tribute to the support he had received from all departments during the time he held the chief executive office.

MR. BERNARD WAINWRIGHT, an employee at Blackburn Meadows electricity station, Sheffield, has been awarded the B.E.M. for gallant conduct.

MR. CHARLES H. P. EW BANK, chief engineer of Edmundsons Electricity Corporation, Ltd., and four of the departmental heads who have served under him at Edmundsons' have retired from their positions to set up in business on their own account as Ewbank and Partners, Ltd., engineering consultants. Their registered offices are at 109, Jermyn Street,

Lewthwaite. They are seen in the photograph reproduced on this page.

MR. ALAN P. GOOD has been appointed managing director of the Brush Electrical Co., Ltd., in place of Mr. F. S. Mitman, who has resigned.

Obituary

MR. FREDERICK TWITCHETT, northern area manager at Newcastle-on-Tyne for the Splendor Lamp Co., Ltd.

MR. CHARLES RODGERS, deputy director of the British Electrical and Allied Manufacturers' Association, on November 5. Mr. Rodgers was born in 1875 at Wath-on-Dearne, Yorkshire, and was educated at the Firth College, Sheffield, and the Sheffield Technical School (later the University of Sheffield). He was an 1851 Exhibition Science Scholar at the City and Guilds' Engineering College, 1894-96, gaining the degrees of B.Sc. (London) and B.Eng. (Sheffield). He completed his education in



MR. C. RODGERS

the Zurich Polytechnic and then, following practical training at Zurich, he joined Siemens Brothers' Dynamo Works, Ltd., at Woolwich and Stafford, with whom he served as chief a.c. machinery designer. Later he was transferred to the head office in London, to deal with administration and publicity matters. He then went to the English Electric Co., Ltd., in London and was in charge of various classes of technical and commercial and administrative work. In 1908 he began his long and fruitful connection with electrical standardisation, as a member of the Engineering Standards' Committee, which in 1919 became the British Engineering Standards' Association (to-day the British Standards' Institution), and also of the International Electro-Technical Commission. In 1919 he was awarded the O.B.E. for his work for the Admiralty during the 1914-18 war. Mr. Rodgers joined the B.E.A.M.A. in 1921 as secretary and was appointed Deputy Director in 1935. He was due to retire on December 31 this year. He took an active part with the late D. N. Dunlop in the

formation of the World Power Conference, and was honorary secretary of the British National Committee of that organisation from its inception until his death. He had served at various times on the Councils of the I.E.E., the B.S.I., the E.D.A., the Science Museum, and the E.R.A. of which he was chairman in 1942 and 1943. The funeral took place on Saturday, the interment being preceded by a service at Watford Parish Church. Among those present were: Mr. V. Z. de Ferranti, president of the I.E.E.; Sir Harold Hartley, F.R.S., chairman, International Executive Council and British National Committee, World Power Conference; Sir Clifford Paterson, director, the General Electric Co., Ltd.; Mr. S. Whitehead, director, the E.R.A.; Mrs. Allen, representing Miss Caroline Haslett and the E.A.W.; Mr. C. H. Gray, secretary, International Executive Council, World Power Conference; Mr. B. H. Leeson, director of the B.E.A.M.A.; Mr. V. Watlington, late director of the B.E.A.M.A., and members of the staff of the association.

New Hostel for Apprentices

A NEW hostel provided by Crompton Parkinson, Ltd., at Chelmsford, for apprentices and pupils being trained under their well-known scheme, designed to give a thorough knowledge of electrical engineering practice and theory, was opened on Saturday, November 2, by the Mayoress of Chelmsford, Councillor Mrs. H. M. Hodge.

Known as "Phoenix House," in the London Road, the hostel adjoins, at the rear, the grounds of the social centre. The accommodation consists of a spacious dining room, lounge and study rooms, and sleeping quarters for thirty. Games and hobby rooms are being provided in buildings in the gardens.

After an inspection of the building, the guests took tea with the Mayor and Mayoress. Mr. T. H. Windibank, the works director, who presided, expressed the company's appreciation of the great assistance rendered by the Mayor and Mayoress in obtaining much of the equipment and furnishings, and of the interest they had taken in the establishment of the project.

The Mayoress, addressing the apprentices, urged them to take every advantage of the study facilities which the house offered and said the conditions for preparation for examinations were a vast improvement upon the chilly surroundings of the lodger's bedroom, that was so often the lot of the student.

Mr. J. C. P. Anderson, president of the

Apprentices' Association, expressed on behalf of the association, thanks to the company for their generous provision. For more than 60 years, he said, apprentices had trained in those works, and many more had achieved great success in the industry. That beautiful hostel would make history as the inspiration to even greater successes.

The Mayor, in a talk to the boys, spoke of youthful aspirations and of the fearless regulation of one's conduct on the first principles of truth and justice.

I.E.E. London Students

ABOUT 100 members of the I.E.E. London Students' Section and their friends, attended a "Brains Trust" meeting on Tuesday, November 5, when five prominent members of the institution, Sir Clifford Paterson, Mr. J. R. Beard, Mr. H. W. Grimmitt, Mr. P. V. Hunter and Mr. H. L. Kirke, gave instructive replies to the questions submitted to them.

As to whether there was sufficient application to industrial uses of the fruits of electrical research, it was suggested that the present was the time for sorting out ideas, and a lapse of time before these could be put into effect was inevitable. The need for greater co-operation between users and manufacturers in connection with new schemes was emphasised.

INSIDE OF ELECTRICAL MACHINES

by R. H. ROBINSON, B.Eng., A.M.I.E.E.

IN this article, Part XV of the series*, is continued the study of the impregnation of windings, particularly field coils; there is also a note on "greening." Baking ovens and temperature recorders are discussed, as also is a conveyor method employing radiant heat.

Treatment of Field Coils.—Different treatments are used depending upon the type of wire and size of coil. Coils wound with ordinary enamelled wire should not be soaked in varnish. If they are taped over they may be dried out and then given a quick dip in varnish so that it does not penetrate into the winding, but thoroughly saturates the tape. On the other hand, coils of synthetic enamelled wire may be soaked if desired, provided the varnish has not a methylated spirit solvent or one composed of a mixture of xylol and butanol. If in doubt about the effect of the solvent it is better to give a quick dip. In cases where coils have to be bent to the curvature of the shell, as often happens in table fans and fractional horse-power machines, it is advisable not to soak them.

Enamelled wire coils wound on spools and not taped all over, need only be brushed on the outside layer with a pigmented enamel such as grey heat resisting enamel, followed when dry, with a coat of black finishing varnish.

Small coils of silk or rayon-covered wire are often impregnated in ordinary insulating varnishes. If they have to fit the curvature of a shell it is best to bake them after fitting in position.

For cotton-covered wire coils, immersion in varnish after drying out may be employed. Since ordinary varnishes will not dry inside coils for a very long time, and may ooze out in service, oil modified synthetic varnishes which will harden by polymerisation should be used.

Without doubt the best treatment for cotton-covered wire coils, provided their radial thickness is not too great to permit of thorough penetration, is vacuum impregnation in bitumen. Certain aspects of this problem were discussed in the Part XIII of this series, and it is only necessary now to describe the actual process.

A diagrammatic arrangement is shown in Fig. 1. The compound is held in the heated storage tank in which it is kept molten, and is agitated by a revolving paddle. Coils are put in the impregnating

chamber. This is heated and is connected to a vacuum and pressure pump. A vacuum of not less than 28 in. is applied for at least two hours, after which bitumen is allowed to flood the impregnating chamber. The valve between the two sections is then closed and an air pressure of at least 80 lbs./sq. in. is applied above the bitumen to force it into the coils. At the end of the pressure period, usually one-half to one hour, the valve is opened and the compound is forced back into the storage tank by the compressed air. The air pressure is then removed and the coils allowed to drain for a period before opening up the impregnator.

In impregnating plants the compound is often kept fluid for weeks together. Under

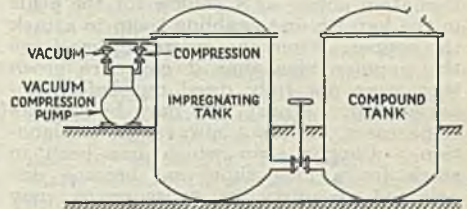


Fig. 1.—Compound impregnating plant

these conditions, some of the lighter fractions are driven off, and the dropping point rises. If this happens, too much compound may cling to the windings of untaped coils and give trouble by slowly creeping when the coils are hot in service. In the case of taped coils, the penetration may be insufficient. To avoid these troubles it is customary to check the dropping point at regular intervals and add fluxing oil to the compound to reduce the dropping point to normal. Fluxing oil is very dark in colour and is generally obtained from the refinery where the compound is made.

If the coils are too large for thorough penetration by bitumen it is usual to brush them with varnish layer by layer during winding. The grey pigmented heat-resisting varnish was much in favour before the advent of the oil modified synthetic varnishes. The latter are now being used for this purpose. Coils of rectangular or square strip are generally treated in this way because bitumen does not penetrate such coils in a satisfactory manner.

When a cotton-covered or taped strip series winding is wound on the top of an

* Parts I, I, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XIII, XIV, appeared in THE ELECTRICIAN of April 26, May 10, May 24, June 7, June 21, July 5, July 19, August 2, 16, 30, September 20, October 4, October 18, and November 1, respectively.

enamelled shunt coil, it is usual to brush this winding with varnish, since it is not advisable to impregnate enamelled wire in bitumen.

Finally, there are coils of glass insulated wire. These are invariably varnished with a suitable synthetic varnish. If of a suitable size for penetration by immersion this process is employed. Alternatively, the coils are brushed with varnish during winding.

Application of Finishing Varnishes.—It is customary to apply these varnishes immediately the parts are removed from the stove at the end of the final bake. Small and medium sized windings may be dipped in the varnish; larger ones are sprayed. In general these varnishes will dry on the hot windings without any need for further stoving.

Greening.—Coils which have been impregnated in a light coloured varnish sometimes exhibit a green colour after baking. The general opinion about this phenomenon is that it is due to moisture in the insulation acting as a vehicle for the acids in the varnish and enabling them to attack the copper. From this reasoning has come the popular idea that if coils are green they were not fully dried out before impregnation. Whilst this may be true in some cases, it is not always the explanation. Copper strip which has been in stock for a long time and become discoloured or dirty in consequence may exhibit greening after being taped with cotton tape, thoroughly dried out, and impregnated.

The subject of greening is too complex to discuss here and we have merely referred to it because we wish to deal with its practical aspect. Careful tests have shown that the copper salts which produce the green colour are insulators. The corrosion of which greening is indicative may cause open circuits in very fine wire coils, wire of say 0.124 in. diameter (30 swg) or smaller, but there is no evidence of it being responsible for failures in other cases.

Whilst regular greening

should be avoided, we see no reason to worry if an occasional batch of coils show slight greening. This phenomenon is not seen when black impregnating varnishes are used. Since these are made with the same types of oils there is no reason why the action should not occur. The probability is that the black colour masks the green.

Baking Ovens.—Baking ovens vary in size considerably. In a small shop in which fractional horse-power parts are wound they may be only the size of a domestic oven. In a large works they may be as much as 20 ft. cube.

For the smaller stoves electric heating with thermostatic control is quite general. Large stoves may be heated by hot air. This has the advantage of supplying plenty of oxygen for the setting of the varnish. Another method, frequently used in large factories where process steam is available, is by circulating the steam through suitably disposed pipes. The pipes are usually arranged in groups under the floor, which may consist of iron grating, and also in banks reaching part way up the walls.

Whatever may be the system of heating, it is most essential that adequate ventilation is provided. Fresh air should enter at the bottom and pass over the source of heat. Dampers are generally provided in the outlet at the top. Often these are closed down when an oven has just been loaded, so as to raise the temperature of the parts quickly. They should be so constructed that ventilation can never completely cease if a neglectful attendant forgets to open them fully at the appropriate time, although there may still be insufficient air for proper drying and oxidation.

In a small shop, where the responsible person may take a personal interest in all the work, an easily read thermometer may suffice for temperature recording. However, in large works, where ovens are frequently opened during the day, and probably kept closed all night, a recording thermometer is invariably installed

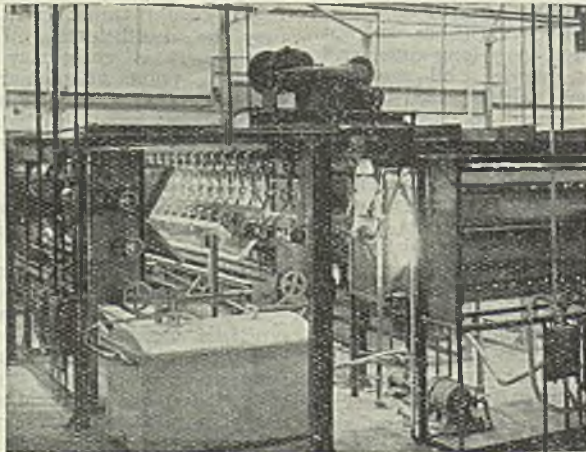


Fig. 2.—Pre-arying and baking with radiant heat. (The Sterling Varnish Co., Ltd.)

on each oven. One with a seven-day recording chart is much better than one with a daily chart. The former enables an executive to see how the ovens are being used; a daily chart is mostly changed early in the day and may never show anything of interest at the time of the executive's itinerary.

Large stoves may vary in temperature at different points and a recorder, or thermometer, will only record the temperature in the vicinity in which its bulb is located. It should be placed in a position of average temperature, if possible. Experience will indicate what temperature should be recorded to ensure proper baking of all parts put into the stove.

Pre-drying.—Pre-drying should be done at not less than 100° C. (212° F.), to ensure that practically all free moisture is driven off. It is usually done at 105-110° C. The time taken depends upon the articles being treated. Coils such as those for armatures, etc., which have not much heat capacity, or much material on them for retaining moisture, may be dry and ready for varnishing in a couple of hours.

The pre-drying of fractional horsepower windings requires at least four hours. Larger windings may require twelve hours or more. For long drying times it is customary to load the stoves as windings become available and leave them all night with full heat on the stoves. Whilst this may result in some windings being pre-dried much longer than others, it does ensure that those put in last receive an adequate drying time.

Baking Impregnated-Windings.—As in the case of pre-drying, factory routine governs this problem to a large extent. Thus, if pre-drying has been done during the night, impregnating may be done early in the day shift and the baking completed during the day. In general it may be said that the aim is to ensure that windings receive not less than the minimum baking necessary, and often a longer baking. Increasing the baking time by a few hours, provided the temperature is not greatly in excess of that recommended by the varnish makers, does not do any harm.

Increasing Oven Temperatures.—The advent of synthetic varnishes has introduced the problem of increased baking temperatures. If a higher steam pressure is available or the stoves are electrically heated, the increased temperature may be obtained without much trouble. We would emphasise that a synthetic varnish which requires to be stoved at 135° C. will not be satisfactory when stoved at say 110° C., even if the time be doubled. It may set hard and the windings may

show a good insulation resistance shortly after cooling down. When in service, however, it will be found almost impossible to maintain a good insulation resistance during damp weather.

It is uneconomic to attempt to increase the temperature of steam heated ovens by adding other forms of heating such as placing a few electric heaters in the space. The steam pipes will remain at their own natural temperature and therefore extract much of the added heat.

Other methods of Pre-drying and Baking.—When large numbers of small windings are being handled, pre-drying and the baking of the varnish may be done by passing current through them. Such a method requires skilled supervision to ensure over-heating does not take place.

Another method that is increasing in favour is the use of radiant heat. In this case the parts are drawn between banks of radiant heat lamps, or elements, by a conveyor chain. Fig. 2 is reproduced from a photograph of such a plant. This system is very useful for articles produced in daily large numbers, such as vacuum cleaner armatures and field coils, and stators.

The plant consists of three lots of radiant heat units, each unit comprising a number of banks of lamps arranged to form a tunnel. The three lots may be in line, or, as in Fig. 2, arranged to form three sides of a square. Circular discs are fitted to each end of the armature shafts so that as they are dragged along rails they rotate at approximately 1 r.p.m. Suitable fittings are attached to stators to ensure rotation.

In the first unit pre-drying takes place. Between this and the second tunnel, the parts roll through a shallow tank of varnish, then make two rotations in air before entering the second tunnel. A second roll through varnish, followed by two more revolutions in air occurs before the parts enter the third tunnel, in which they are finally baked. The whole process, pre-drying, double varnishing and baking takes 1½ hours. The same treatment carried out by ordinary methods would require a day and night.

Whilst such a plant may be used for parts having different heat capacities, it is not advisable to put through in mixed batches if their heat capacity varies greatly. It is better to treat each different class separately.

Large machines, such as turbo-alternators, are generally dried out by running them on short circuit. The excitation and speed are kept low so that approximately full temperature is attained slowly. If the machines have a closed ventilating system arrangements are made for a gradual change of air during the run.

(To be continued.)

Electrical Control of Machinery

Causes and Prevention of Common Industrial Accidents

IN his paper on "Electrical Control of Dangerous Machinery and Processes," read before the I.E.E. Installations Section on November 14, Mr. W. Fordham Cooper, a member of the Factory Department of the Ministry of Labour and National Service, began by saying that a considerable number of mechanical accidents in recent years arose from defective or unsuitable electrical control equipment.

In enunciating a number of general safety principles which could be applied, he thought the most important was that of "failing for safety," in which a machine would be stopped if any safety device failed or special conditions occurred which would make the process dangerous. A different application of the same principle arose in the use of warning lights. Generally speaking, the provision of a red danger light was insufficient, and a red and green light representing danger and safety respectively were preferable.

In most cases, Mr. Cooper said, he preferred to rely on mechanical features whenever possible. Mechanical interlocking had been brought to a fine art by the manufacturers of electrical switch- and control-gear.

MOST FREQUENT CAUSES

Most of the accident risks considered could be classified in the following categories:—

(a) Inadvertent starting of machinery, which might endanger the life or limbs of those working on the machine;

(b) failure of machines to stop when they should do so, due, for example, to inefficient brakes or lack of suitable over-running gear;

(c) excessive speed and over-driving, which might cause the bursting of grinding wheels or mechanical damage;

(d) unauthorised access to danger areas;

(f) failure or inadequacy of electrical safety devices.

Mr. Cooper then proceeded to give examples of accidents which had occurred from the above causes. Referring to the positioning of isolating switches, he said that although in the Factory Department's Regulations, the exact location of the switch was not specified, the number of machines starting unexpectedly to-day, particularly with push-button control, made the provision of convenient isolating switches essential.

In preventing access to dangerous en-

losures, the provision of key interlocks helped to avert accidents. Although an earth bar was commonly interlinked with gate or door locks so that the earth could not be removed until the door was shut and locked, it had been found on a number of occasions that the mechanism was unsound.

In the electrical supply industry, the use of the permit-to-work system on live gear was fairly widely adopted, and similar arrangements were used in some chemical works. It was important that the permit and instructions should be very clearly worded and thoroughly understood by all concerned.

PUSH-BUTTON DANGERS

In the course of a detailed survey of the troubles likely to be encountered with common types of control gear, the author drew attention to the dangers of sticking push-buttons, which might be brought about by the presence of dirt and oil, and to the importance, where several operators might be working on a large machine, of ensuring that only the operator who stopped a machine should be able to restart it. Standard electrical control gear could also advantageously be applied to steam-driven plant.

A number of accidents, including some on automatic lifts, had been caused through bad design of the control circuits. Some improvements to conventional circuits were suggested, and Mr. Cooper went on to say that in some large control diagrams circuits were cross-connected in such a way that it was extremely difficult to determine what would be the result of the failure or wrong operation of a component. The remedy was to segregate circuits wherever possible, and it was helpful to supply each individual circuit with a low voltage, with a high impedance earth-leakage relay between the circuit and earth.

In conclusion, after describing some of the troubles which might arise from deterioration in the springs, etc., of limit switches, and drawing attention to the importance of efficient braking and over-speed preventors, Mr. Cooper briefly mentioned electronic control, saying that little industrial data was so far available. Some electronic circuits had recently shown an altogether unwise exuberance, and where life and limb and extremely valuable plant were at risk, sound connections, the segregation of circuits and earth-leakage protection should be applied, even in the face of strong opposition from radio enthusiasts.

Circuit Breakers

I.E.E. Discussion on Air-Blast and Oil-Break Units

THE meeting of the I.E.E., on November 7, opened with an appeal by Mr. E. Leete, hon. treasurer, who gave a brief outline of the scheme for building the Chesters Estate by the Committee of the Benevolent Fund—a brochure concerning which has already been sent to all members. The appeal is made for a £50 000 Fund, which is the amount estimated to be required to carry through the scheme.

Addressing the audience, Mr. Leete, deputy chairman of the Benevolent Fund, announced that "The Chesters" had been given to the Fund by Mr. C. W. Speirs, a member of nearly 50 years standing, and that members had already subscribed, or promised, about £10 000 towards the cost of building suitable small houses on the site. The estate, at New Malden, Surrey, consists of some eight acres of land and a house. It was hoped that building would soon begin on this very fitting and living war memorial. As the "Homes Fund" grew, and as land became available, the memorial would be developed on a national scale.

Messrs. A. Allan and D. Amer, then read their paper, "The Extinction of Arcs in Air-blast Circuit-breakers,"* following which Messrs. H. E. Cox and T. W. Wilcox,† delivered their address on "The Performance of High Voltage Oil Circuit-breakers, Incorporating Resistance Switching."

The first paper dealt with the development of air-blast circuit-breakers, and described investigations of the many factors affecting their performance. Particular attention was paid to aerodynamic design. The development of the air turbulator and its application in commercial 66 kV and 132 kV circuit-breakers were described, and the data tabulated were derived from an analysis of results of short-circuit tests extending over many years. Copies of the paper were available in advance of the meeting and below is given an abstract of the discussion.

The second paper reviewed the improvement obtained in the performance of side-vented explosion pots when they are shunted by resistors. First, it was shown that the rating of explosion pots is determined by two critical regions, one of which determines the maximum voltage rating, whilst the other determines the maximum breaking-current rating. The effect of resistors on these critical regions

was first described and then illustrated by actual test results. Secondly, it was shown that the resistors shunting the pots can also be used to give even voltage distribution over several pots in series. The application of resistors in practice was illustrated by the description of a 132 kV oil circuit-breaker rated at 2 500 MVA. The effect of the resistors when breaking small currents in inductive and capacitive circuits was discussed in detail, and the paper went on with the validity of testing separately one pole of a three-phase separate-tank breaker, having two breaks per pole, by applying the full three-phase output of the test plant, the third terminal being obtained by bringing out through the tank wall a connection from the moving cross-bar.

In conclusion, actual performances were illustrated by test results obtained on one pole of a three-phase, 132 kV, 2 500 MVA breaker. Copies of the second paper, like the first, were obtainable before the date of the meeting.

Before the discussion opened, the President remarked that it was quite fortuitous that the two papers were read on the same evening; it had not been found possible to have them presented at separate meetings. There was no desire that there should be a debate on the relative merits of the two types of breakers dealt with.

MR. J. HACKING (C.E.B.), discussing both papers from the point of view of the buyer and user, said that it seemed to him that a landmark had been reached in the development of h.v. switching. He thought Messrs. Cox and Wilcox had put forward a convincing justification for the use of resistors on oil circuit-breakers. As regards air-blast circuit-breakers, there were five manufacturers in the country who were able to supply these for 2 500 MVA. and products of all of them were in operation or manufacture. An examination of the two types of circuit-breaker showed there was not much difference in performance. As to the relative cost, if one took into account the housing for the current transformer, the air-blast circuit-breaker was inherently more expensive; it was, however, necessary to have regard to the probable development of each type. It must be admitted that the air-blast breaker seemed to have certain advantages which might lead ultimately to its superiority over the oil circuit-breaker; it was by no means unlikely that later developments would result in economies in

* A Reyrolle and Co., Ltd. † British Thomson-Houston Co., Ltd.

cost, so that the disadvantage as against the oil circuit-breaker in that respect would disappear.

MR. F. C. WINFIELD (Messrs. Merz and McLellan) thought that fire risk in the oil circuit-breaker had been over-played, for in 20 years he did not think there had been a single failure on 132 kV circuits in this country, due to this cause. Personally, he considered the fire risk non-existent in 132 kV practice, as had been shown by service experience; yet that, in his view, was the only present objection to the tank type breaker. It was agreed that the air-blast breaker could be designed to do everything the oil circuit-breaker could perform, but the difficulty was in the designing of the auxiliary equipment. The air-blast breaker required high pressure air at from 250 to 1 000 lb., and it was a fact that there had been trouble with air at 250 lb. pressure. It was difficult to keep the air lines and valves tight and this had a reaction on the compressors and caused greater cost in maintenance. If the two types were to be compared at present it would be necessary to compare the tank type, the maintenance of which was well appreciated, with the relatively new air-blast breaker, concerning the maintenance of which not a great deal was known.

MR. C. H. FLURSCHEIM (Metropolitan Vickers Electrical Co., Ltd.) showed lantern slides of two new types of multi-break breakers, both of which it was claimed were capable of providing high-speed reclosure. Both designs had twin interrupters and were said to quadruple the speed of the conventional tank breaker.

MR. D. P. SAYERS (Birmingham electricity department), commenting on the statement by Mr. Hacking that there was little difference in performance between the oil breaker and the air-blast breaker, said it would be useful to have a simple common statement as to the effective duration of arcing and break time for the two types. At present it seemed that the authors were trying to keep engineers guessing by using different methods of definition in the two papers. The air-blast breaker appealed to the supply engineer, but the simplicity of the breaker proper was offset by the complexity of the pneumatic system. There was a complex valve system even at 250 lb. pressure, and it was not certain that all the valves would remain tight, or would not stick, after the breaker had been in service for several years under all-weather conditions. Some information about the valves and seatings from those who had had these breakers in service would be welcome. It was stated that the three phases of a three-phase breaker were not mechanically coupled, and this raised the question

whether pneumatic coupling between phases was really reliable. In the case of a generator switch, if the breaker failed to clear the three phases, the generator would be wrecked in a short time. In the paper by Messrs. Cox and Wilcox, it was stated that the cost of construction was overwhelmingly in favour of the dead-tank oil circuit-breaker. This might be true, but were the authors considering intrinsic cost or the purchase price which the user had to pay? The cost of a 2½ MVA air-blast breaker was in the neighbourhood of £11 000 to £15 000 and he asked if there was any good prospect of the price dropping when more breakers were produced and a greater number was available, so that the heavy cost of research and development could be spread more widely. In the case of the Birmingham 132 kV scheme, the cost of breakers was a serious item and it was desired to extend the use of air-break isolators. With multi-break air-blast breakers, each break carried approximately an equal share of duty, but in the case of oil circuit-breakers there was an unequal distribution of the voltage transient across the not unless shunt resistors were used. The chief value of the paper by Messrs. Cox and Wilcox was that the fitting of shunted pots offered the prospect of increasing the effective rating of many ordinary oil tank breakers now in use, at a comparatively cheap figure.

MR. H. TRENCHAM (B.T.H. Co.) dealt with circuit breaking and unit testing. In regard to the former he entered a strong plea for discarding the term "severity" of the circuit. He believed it was originally introduced by the E.R.A., as a comprehensive term, but he would like it limited to matters which were not clear, instead of embracing all factors involved in circuit interruption. The papers indicated that switchgear manufacturers could produce good circuit-breakers, and they had produced them the hard way. The idea had presented itself to him, however, that there was a good deal in these papers which was not yet fully comprehended. It was possible to mention many things in this connection, but one point was that whatever manufacturers were able to achieve, there was still a vast amount of knowledge which they would like to have from the point of view of research, but which they themselves had not the time to obtain. In the circumstances he suggested to the E.R.A. that there was a wide field still unexplored. Unit testing was only justifiable in special cases, and Messrs. Allan and Amer had indicated that they did not fully support the contention that such testing was necessary.

MR. L. GOSLAND (E.R.A.) discussed the problem of the switching out of cables and recalled that Dr. Brazier had pointed out

in a paper before the institution that surge strength was becoming the predominant factor in the design of cables, and that switching transients accounted for a great deal of the requirements as regards surge strength. A whole paper could be devoted to the dead tank type of oil circuit-breaker. As regards the air-blast breaker, he had been seeking the ideal form of nozzle. Messrs. Allan and Amer stated that it was necessary to pay considerable attention to aerodynamic design and that the nozzle could be made independent of back pressure. He presumed they referred to the Laval type, and therefore one would expect that all nozzles would be of the same kind. But that was not so, and he asked whether Messrs. Allan and Amer thought that that form of nozzle had a series effect on the performance of the air-blast breaker. The claim was made in their paper that the performance of the air-blast breaker was predictable but there was some doubt about that having regard to the data produced in America.

MR. M. HAMMARLAND (Sweden) referred to research work on the air-blast circuit-breaker with which he had been associated in Sweden for some years and said that although there were many points of interest in the methods which Messrs. Allan and Amer had used, care should be taken before applying them to breakers in general. The aerodynamics introduced factors of greater importance than the authors had indicated. He called attention to the fact that the curve in the paper expressing the rate of recovery of voltage and current was not clear. In Swedish experiments they had found an upper limit of interruption of current for a given rate of rise of the striking voltage, and the rate of rise of recovery voltage and current was not constant as was to be inferred from the curve in the paper. Referring to the paper by Messrs. Cox and Wilcox, he asked whether in their curves they had plotted arc variation against breaking current.

MR. J. A. HARLE (A. Reyrolle and Co., Ltd.) said he thought it was regrettable that these two papers had been taken together and he was pleased that the President had made it clear that it had not been the intention to discuss the relative merits of the air-blast circuit-breaker and the oil circuit-breaker. Most large manufacturers would supply either or both, according to the requirements. Whilst the high blast oil contact, which was used by the American Westinghouse Co., was all right, it had an effect upon the characteristics of the breaker in another way from that put forward, because a resistance was used across the high blast contacts. He indicated by means of a lantern slide another method by which the performance could be improved, and suggested that the

side-vented explosion pot with switching resistor shown in Fig. 7 of Messrs. Cox and Wilcox paper had limitations. He claimed that any new design of breaker should be proved for its capabilities for breaking low inductive circuits and switching out the capacity current.

DR. W. B. WHITNEY (E.R.A.) said he was interested in both these papers because they indicated the fruition of ideas put forward 15 or 20 years ago. For instance, in the paper on air-blast breakers there was a curve (Fig. 11) which showed the value of short gaps, and how the performance improved up to a certain point as the gap decreased. As long ago as 1927, the importance of short gaps in air-blast breakers was stressed by the E.R.A. MR. J. S. CLIFF (G.E.C.), speaking on the paper by Messrs. Cox and Wilcox, emphasised the importance of maintaining the highest possible pressure in the pot, because this ensured the greatest effectiveness. At the same time, as the authors pointed out, there was a limit to the strength of the pot in practical design. He referred to experiments which he had carried out in this connection and said that the curves in Fig. 4 of the paper were generally confirmed. Referring to Fig. 5 of the same paper, he said it indicated that the resistance made very little difference to a current above 72 A, and asked whether, therefore, the resistance was necessary, or whether there was some other factor introduced.

MR. AMER, replying to some of the points raised, said if he was asked to join in a discussion of the oil circuit-breaker versus the air-blast circuit-breaker he would not know which side he would be on. The paper by Mr. Allan and himself dealt with researches on the air-blast circuit-breaker which they had carried out and which they thought would be of interest. The difficulties with air-blast switchgear were primarily in connection with the mechanical complexity of the auxiliaries, and notwithstanding what had been said, he could only say that the view of Mr. Allan and himself was that the air-blast breaker would become simpler as time went on.

MR. WILCOX, also replying, said that it was not the intention of his firm to drop the air-blast circuit-breaker, for the simple reason that if the economics of the current transformer situation changed, then the whole problem would alter. He agreed that the fire risk with the oil circuit-breaker was a bogey and it was one which he thought engineers had fought long enough. There must be a lot of information available and it was time this was handed over to an actuary who would probably give a quantitative answer as to the oil fire risk.

Book Reviews

Installation and Care of Electrical Power Plant. (Mechanical World Monograph No. 23). By ENGINEER-IN-CHARGE. (Manchester: Emmott and Co., Ltd.) Pp. 133. Price 3s. 6d. net.

If there is a serious fault in this excellent little book it is that it does not do itself justice in its title. It will be apparent to the reader who glances at the first chapter, on the speed and torque characteristics of electric motors, that the author has by no means confined himself to installation and care, but has, within the admittedly severe limitations imposed by a non-mathematical treatment, successfully covered a wider field. The book, in fact, touches on almost the entire range of conventional motor and switchgear equipment likely to be encountered in the modern factory, gives brief explanations of their functions and method of working, and sums up the more elementary precautions to be observed for efficient and safe operation. Those whose work involves the maintenance of a variety of small motors, etc., will find the chapters on starting gear, with their numerous diagrams of internal connections, to be particularly valuable, and those whose knowledge of circuit theory extends deeper will still find, in the book, a handy work of reference. Since this monograph will almost certainly have a long and useful life, it seems worth pointing out that subsequent editions would be much improved if some effort were made to place the diagrams, particularly in the early chapters, on the same pages as their related text. In only one place does clarity of expression break down, and that is in the explanation of power factor. The mechanical analogy would have been better omitted.

Marconi: A War Record. By George Godwin. (London: Chatto and Windus.) Pp. 127. Price 10s. 6d. net.

The history of the telecommunications side of the British war effort is not, on the whole, one in which names stand out. Most technical advances in the radio field were the result of corporate efforts, and for this reason, Mr. Godwin's book may be regarded as more than the story of the Marconi company. So complete was the integration between the service research departments and the major manufacturers that the story of one company must be, to a large extent, that of the entire industry. And, since some aspect of electronics appeared at all levels in all the fighting services, it is, in miniature, the story of the war itself. The Marconi organisation

has for a long time been associated in the public mind with transmitters and, aptly, the book opens with an account of the hurried fitting of a mobile link for use with the original B.E.F. in France. Dividing the war into its main phases, the author describes the contributions of the company first to the Battle of France, then to the Battle of Britain, when radar, in the form of the Chain Home, G.C.I. and G.L. equipments, made its first full-dress appearance. The author effectively recaptures the sense of urgency which all associated with wartime telecommunications will remember, and he describes how tasks which were previously regarded as specialist laboratory jobs were eventually put on a mass-production basis.

Electrical Industries Ball

THE annual ball in aid of the Electrical Industries' Benevolent Association, held at Grosvenor House, London, on November 8, was one of the most successful in the history of the association. The attendance, which had been limited by the accommodation available, numbered nearly 600. The visitors were received by the president of the association, Mr. Walter Rigg, who, in a short speech later, extended a warm welcome to everyone, commended the excellent work of the E.I.B.A. and appealed for generous support. There was a popular programme of dances to the music of Debroy Somers and his band, with an interval for a cabaret by Charlie Chester, Helen Hill (accompanied by Frank Wilcox at the piano) and the Dehl Trio. Buffet supper was served. Prizes were awarded to the holders of programmes with lucky numbers, who were: Major A. Young, Mr. E. J. Vidler and Mr. N. Stone (electric fires, presented by Berry's Electric, Ltd., the English Electric Co., Ltd., and Ferranti, Ltd.); Mr. F. C. Lucas and Mr. J. C. Briggs (vacuum cleaners, given by the Hotpoint Electric Appliance Co., Ltd., and the British Vacuum Cleaner and Engineering Co., Ltd.); Mr. S. Ferguson (a wireless set, given by the General Electric Co., Ltd.); and Mr. E. J. Jarvis, borough electrical engineer, Kingston-on-Thames (an electric blanket, given by H. J. Baldwin and Co., Ltd.).

Mr. L. C. Penwill, chairman of the Court, announced that the sale of programmes produced £103 10s. 9d., and the penny collection £52 12s. 7d.

The proceeds of the ball amounted to over £400.

Answers to Technical Questions

We produce below the answers to a selection of questions which have been sent to us by readers. The co-operation of students and others in making this feature one of general interest is invited

What means are available for obtaining larger domestic television images than is provided by the ordinary cathode-ray tube?

It is unlikely that commercial television images greater than about 12 in. wide can be obtained from conventional television cathode-ray tubes; the only way out

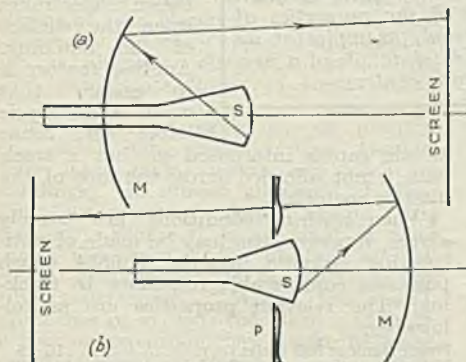


Fig. 1

seems the magnification of small cathode-ray tube images to the dimensions required, or a mechanical scanning system along the lines of the Scophony system, using a modulated light. The cathode-ray tube projection systems are likely to use the Schmidt camera principle, rather than a normal projection lens, because of the heavy loss of light in the latter, which has to consist of a considerable number of components, each of which absorbs light and scatters light at the interfaces. Moreover, the geometry of the optical system must entail a severe loss, unless the diameter of the lens is comparable with the image being magnified, thereby increasing the cost considerably, even if made of plastic components.

The two ways of using mirrors are as indicated. In Fig. 1(a), M , a spherical mirror focusses light from the inside of the cathode-ray tube screen S on to a distant screen. Clearly the shaping of S is critical, for M is also to be a specified shape (which may prove difficult) in order to get a flat image on the screen. Apart from this the light passes through the conical part of the cathode-ray tube and consequently this must be moulded or ground to an accurate specified optical shape, within limits dictated by the tolerances necessary in other parts of the system.

In (b) the light from the outside image on the phosphor S is collected by a spherical mirror M , and focussed on to a distant screen through a correcting lens plate P ; here the shape S must be specified within very close limits in order that after reflection from M and deviation by P the image comes to a sharp focus over a large area of screen, say 24 in. wide for the present 405-line scanning. Grinding or moulding to one wave-length of yellow light might be sufficient to meet the present definition requirements, coupled with the modern technique of making M and P from plastic material without heat or strain, and so permitting images, say 24 in. wide, to be achieved and to anticipate a considerable increase in the number of scanning lines in the picture.

In a few years time, once the public has grasped the value of projection television, such systems with a small cathode-ray tube will probably be a serious rival to the present large cathode-ray tube.

L. E. C. H.

Radio Industry Council

A report of the first year's work of the Technical Directive Board of the Radio Industry Council states that meetings with the representatives of the Inter-Service Components Technical Committee, which later was transformed into the Radio Components Standardisation Committee, has proved their value as a permanent institution. The Board was able to further the work which is being done on the standardisation of valves, by co-ordinating the technical views of the radio industry on that subject. Standardisation of radio apparatus in matters affecting the user has also received attention from the B.S.I. and the Board, acting in concert; and future progress has been ensured by a full representation of the radio industry on the relevant committees of the B.S.I. Close relations have been maintained with the I.E.E. in regard to the proposed regulations for the electrical equipment of ships, and in the preparation of codes of practice dealing with radio interference. The Board has been able satisfactorily to clear up the question in relation to shipborne radar of the official view as to the best wave-length for general purpose navigation and to eliminate doubts on the efficiency of the 3 cm. system.

PLASTICS IN ELECTRICAL INDUSTRY

by T. J. FIELDING, O.B.E., A.M.I.E.E.

EVERYDAY electrical components moulded in Bakelite materials, such as lamp-holders, meter boxes, switch-plates and the like, are produced from standard general purpose materials which provide good all-round mechanical and electrical properties in the finished moulding. It is important to realise, however, that these properties are capable of variation by the moulding material manufacturer.

Large numbers of grades of moulding materials now existing have been developed to meet requirements demanding emphasis on one or more particular property. The electrical properties of a typical general purpose Bakelite moulding material (type X.20) are as follows:—

Power factor at 800 cycles (%)	...	...	10-40
Volume resistivity at 20° C (Megohms/cm ²)	...	...	10 ¹⁰ -10 ¹⁴
Surface resistivity at 20° C (Megohms/cm ²)	...	...	10 ¹⁰ -10 ¹⁴
(a) Freshly moulded	...	...	10 ¹⁰ -10 ¹⁴
(b) After 24 hours in water	...	...	10 ¹⁰ -10 ¹⁴
Electric strength at 90° C (V/mil)	...	...	300-150
Electric strength at 20° C (V/mil)	...	...	150-250
Water absorption (mgms)	...	...	110-150
Specific inductive capacity	...	...	6.5-9.0

It has been found possible to improve these electrical properties while retaining the basic characteristics of the materials in other directions. By changes in resin formulation, X.20 HD, as the material is known, affords mouldings having a better power factor (3.0 to 4.0), improved volume and surface resistivity, while the electric strength at 20° C (V/mil) is raised to 300-350. There is a similar proportionate increase in the electric strength at 90° C.

A special low loss material which is used in many radio applications for switches, etc., is produced as X.5337. This has a mineral filler and its electrical properties are as follows:—

Power factor at 800 cycles (%)	...	...	3.0-4.0
Volume resistivity at 20° C (Megohms/cm ²)	...	...	10 ¹⁰ -10 ¹⁴
Surface resistivity at 20° C (Megohms/cm ²)	...	...	10 ¹⁰ -10 ¹⁴
(a) Freshly moulded	...	...	10 ¹⁰ -10 ¹⁴
(b) After 24 hours in water	...	...	10 ¹⁰ -10 ¹⁴
Electric strength at 90° C (V/mil)	...	...	250-350
Electric strength at 20° C (V/mil)	...	...	300-350
Water absorption (mgms)	...	...	30-50
Specific inductive capacity	...	...	5.0-5.5

For automobile ignition systems a grade of material has been developed (X.11049) which has higher resistance to tracking than normal grades. As is well known, a conducting path or track may be formed across an electrical insulation surface under adverse conditions. "Tracking" usually occurs under wet or very damp conditions

or in circumstances where, although damp may not be present, a spark is drawn across the surface of the insulation thus tending to carbonise it. Prevention of tracking in practice is largely a question of the correct design of the component. It is

important, for example, to ensure that moisture cannot collect between electrodes upon the surface of the moulding. Another feature is to ensure that when sparking is liable to occur

an air gap is interposed so that a track path is not afforded across the face of the plastics material.

When tracking conditions are usually severe, however, use may be made of anti-tracking Bakelite material X.5524 which possesses considerable resistance to tracking. The relevant properties are as follows:—

Power factor at 800 cycles (%)	...	...	10-25
Volume resistivity at 20° C (Megohms/cm ²)	...	...	10 ¹⁰ -10 ¹⁴
Surface resistivity at 20° C (Megohms/cm ²)	...	...	10 ¹⁰ -10 ¹⁴
(a) Freshly moulded	...	...	10 ¹⁰ -10 ¹⁴
(b) After 24 hours in water	...	...	10 ¹⁰ -10 ¹⁴
Electric strength at 90° C (V/mil)	...	...	100-150
Electric strength at 20° C (V/mil)	...	...	200-300
Water absorption (mgms)	...	...	60-90
Specific inductive capacity	...	...	8-12

The designer of the components which are to be moulded has many factors to bear in mind not immediately related to the problem of providing electrical insulation. The mechanical strength and dimensional stability of the component are obviously capable of influencing the electrical insulation over a given period of time. The right material is therefore one providing the correct balance between the various desirable properties and this balance can most frequently best be reached by discussion between the designer and technical experts of the moulding material manufacturer. For example, a component may be used in a position where it is exposed to mechanical shock and an impact strength higher than that afforded by general purpose materials is considered necessary. This can be achieved, but probably at the cost of some reduction in electrical properties. To take two actual materials, the impact strength of Bakelite general purpose material grade X.20 is 0.13-0.17 ft. lbs. and shock resisting grade X.5566/3 has an impact strength of 0.9-1.3 ft. lbs. The electrical properties of the shock resistant material, although

still adequate for most purposes, show an appreciable drop in comparison with those of the general purpose grades as will be noted from the table below:—

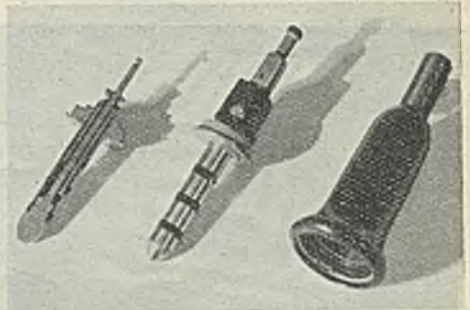
Power factor at 800 cycles (%)	...	...	30-50
Volume resistivity at 20° C (Megohms/cm ³)	...	...	10 ⁴ -10 ⁶
Surface resistivity at 20° C (Megohms/cm ²)	...	...	10 ⁷ -10 ⁹
(a) Freshly moulded	...	...	10 ⁷ -10 ⁸
(b) After 24 hours in water	...	...	10 ⁸ -10 ⁹
Electric strength at 90° C (V/mil)	...	...	20-50
Electric strength at 20° C (V/mil)	...	...	125-175
Water absorption (mgms)	...	...	250-350
Specific inductive capacity	...	...	7-10

Another property which the moulding material manufacturer may be required to impart to his product is heat resistance, which, in fact, can be achieved without sacrifice of good electrical properties. This is necessary for many types of applications such as plugs for electric irons, kettles, coffee percolators, bases of toast racks, etc.

The differential expansion of plastics and metal can cause serious trouble where large metal inserts are used in mouldings. In almost all types of electrical components metal inserts are necessary. Where these are small in relation to the mass of the plastics, normal general purpose grades of material are quite satisfactory. Where the metal approaches or exceeds the plastics in mass its greater expansion may crack the component of which it is part. Special crack resistant materials have been developed by Bakelite, Ltd., which impart a slight flexibility to the finished moulding which is sufficient to absorb the effects of a greater expansion of the metal. The degree of flexibility is very slight and is not comparable with that of rubber or celluloid.

Battery tops and many types of elec-

trical gear used either in contact or close proximity to chemicals make use of acid and alkali resistant grades of Bakelite material. Resistance to chemicals is by no means a straightforward property and many different grades of material



Illustrating a plug produced by the Telegraph Manufacturing Co., which relies for its insulation on Bakelite materials. The insulation is moulded in position

exist so that a decision on the correct material to adopt is one demanding close collaboration with the moulding material manufacturer.

At the other extreme in the field of electrical insulation are Bakelite moulding materials which have been specifically designed to be partial electrical conductors. These incorporate graphite to provide a useful leakage path and a typical example of their use are the moulded filling trays in Ordnance factories where avoidance of static charges and the consequent possibility of sparking is of paramount importance. Another use is for the production of moulded lightning arrestors for the telephone industry.

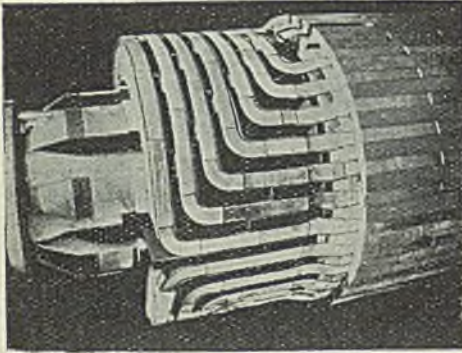
Applications of Laminated Materials.—The applications of Bakelite laminated in the electrical industry are extremely widespread. The material is seldom, if ever, chosen for any outstanding individual property. Considered individually, almost all its properties, insulation resistance, water resistance, tensile strength, crushing strength and so on, can be bettered by other materials, but for all round insulating properties combined with good mechanical strength it is not easily bettered. The thicknesses in which the material is used vary from 1/64 in. to 4½ in. The thinner grades find wide application in the telephone



A view of the Bakelite Ltd., chemical control laboratory at Birmingham

industry for the insulation of relay sets and telephone selector banks; thicker grades of $\frac{1}{4}$ in. and upwards are adopted for relay coil cheeks, switchboard panels and the like.

In the construction of turbo-alternators, generators, motors, transformers and



Partly finished rotor shaft for a Parsons turbo-alternator, employing Bakelite laminated and impregnated materials is important but unobtrusive. The completed equipment generally gives no indication, since none is visible, of the considerable quantities of Bakelite material used in its construction; neither is it possible to produce for illustrative purposes suitable components, since these are usually in the form of cut pieces, blocks, wedges, etc., which in themselves are merely pieces of laminated material.

similar heavy electrical equipment produced by C. A. Parsons and Co., Ltd., the part played by Bakelite laminated and impregnated materials is important but unobtrusive. The completed equipment generally gives no indication, since none is visible, of the considerable quantities of Bakelite material used in its construction; neither is it possible to produce for illustrative purposes suitable components, since these are usually in the form of cut pieces, blocks, wedges, etc., which in themselves are merely pieces of laminated material.

Although used chiefly for their insulating properties, full advantage is taken of various other factors such as ease of fabrication, heat stability and resistance to corrosion.

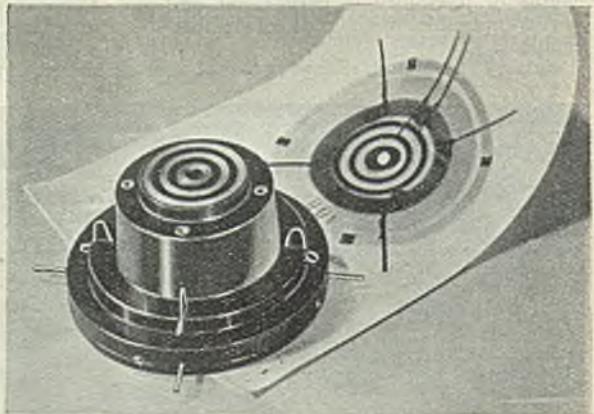
One of the illustrations shows a partly finished rotor shaft on which can be seen some typical laminated packing blocks and wedges. At each end of this rotor, and not easily visible, is an insulating ring of $\frac{3}{4}$ in. thick fabric laminated. This is bolted into position before the rotor slots are machined, being milled integrally with the rotor since standard machining practice gives results on the laminated equally as satisfactory as those on the steel shaft. Furthermore the Bakelite material is not affected by the coolant

necessary on the steel and after drying-out still retains its insulating properties.

The slot wedges are also machined from fabric-base material. On stator rings the coils are wound on bobbins built up from Bakelite impregnated cloth, and both paper and fabric materials are used for winding packings.

Further applications include bed-plate insulation on turbo-alternators and generators. This insulates the housing from the main body of the machine and the weight upon it is often very considerable, calling for a material of high mechanical strength and which is not affected by the hot oil that may be thrown out by the machine. All holding-down bolts are also insulated with laminated bushes and washers, while laminated tubes are used to insulate cable leads and Bakelite laminated sheet provides the terminal boards and instrument panels.

Anti-Tracking Sheet Material.—Urea plastics have a higher resistance to tracking than phenolic materials and advantage has been taken of this fact in the development of special grades of Bakelite laminated which have a surface of urea with a phenolic base. This development combines the best of both worlds in that the superior mechanical strength of the phenolic material, its better water absorption figures and its dimensional stability are retained and confer these properties on the sheet as a whole, while the outstanding advantage of urea from the



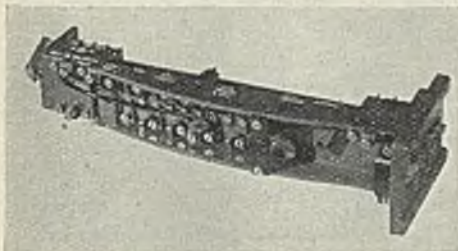
The slip-rings and silver connecting wires in this potentiometer base are an integral part of the moulding, as the X-ray photograph shows

tracking viewpoint is also obtained. For those concerned with precautions taken in the past with phenolic materials to overcome the tracking bogey, the advance that this integral urea facing represents

over earlier methods will be obvious. The urea facing has been successfully applied both to paper base and fabric base materials and laboratory tests as well as practical experience indicate the superiority of this phenol/urea sheet over either type individually for anti-tracking applications.

Another interesting combination of materials is represented by the production of rubber or neoprene faced Bakelite laminated. One outstanding example of the use of this material is for the manufacture of electrolytic condensers. Here the central electrode is in need of support and therefore requires the rigidity of Bakelite laminated. On the other hand to form an effective seal the condenser manufacturers' method is to spin over the ends of the aluminium tube, so pinning the cap. A far better and more effective seal was obtained by providing the rubber surface which this combination material affords. There are other applications for this development in the telephone industry.

An interesting feature of the rubber-faced laminated is that the two are joined together during the process of manufacture of the Bakelite laminated. This results in a far better adhesion



Air Ministry radio frequency switch moulded in Bakelite low loss material

than would be obtained by applying a rubber sheet to a surface of the laminated. Any type of rubber, natural or synthetic, can be combined with selected grades of Bakelite laminated.

During the war, the results of ten years' research into the development of a grade of Bakelite laminated which could be pressed in the same way as metal were brought to a successful conclusion. The principal applications during the war were for mechanical purposes such as the production of container fairings, airchutes and the like, where the light weight and strength of the material were the predominant factors. There have been many interesting electrical developments of this grade of Bakelite laminated (F.11141/1) among which is the fuse board shield now being used in

prefabricated houses. This laminated material can be pressed to simple shapes without elaborate equipment and by using simple forming tools of metal or wood, while the electrical properties of the finished products are comparable with those of normal grades of Bakelite lami-



Armatures for Hoover vacuum cleaner motors being dipped in Bakelite varnish

nated fabric materials. Other applications of this "post-forming" material, as it is known, include insulation for bus-bars, etc., and channel fittings of all types.

It has been noted earlier that Bakelite laminated is seldom adopted for any one property but for its combination of properties. If there were to be any exception to this statement, possibly one grade—E.5089/1—would hold the day on its water absorption figures, which are remarkably low. Its outstanding characteristics are its extreme water resistance with excellent electrical properties which are maintained under humid or tropical conditions. The tables below give the principal electrical properties of the

ELECTRICAL PROPERTIES OF E.5089/1	
Insulation resistance after 24 hours immersion in water (megohms) (minimum) ...	10,000
Power factor at 800 cycles (%) ...	2.0
Electric strength at 90° C (V/mil) ...	400
Electric strength at 20° C (V/mil) ...	500
Breakdown along laminae at 90° C (minimum) ...	25 K.V.
Specific inductive capacity ...	4.5

Moisture absorption—		Maximum absorption
Thickness		(mgms)
inch		
.016	...	7
.031	...	7
.062	...	7
.125	...	8
.188	...	9
.250	...	11
.375	...	13
.500	...	14

materials, together with the water absorption figures. Also, by the standards of any phenolic laminated sheet, the power factor of this material is extremely low.

In many of the applications of Bakelite laminated in the electrical industry its machining qualities rival its electrical properties in importance. Particularly in the telephone and radio branches of the industry, where there are innumerable small punched components, the ability of the material to punch cleanly to an intricate design is of outstanding importance. In many other applications the mechanical strength and the electrical properties go hand in hand.

Bakelite Resins, Varnishes and Cements.

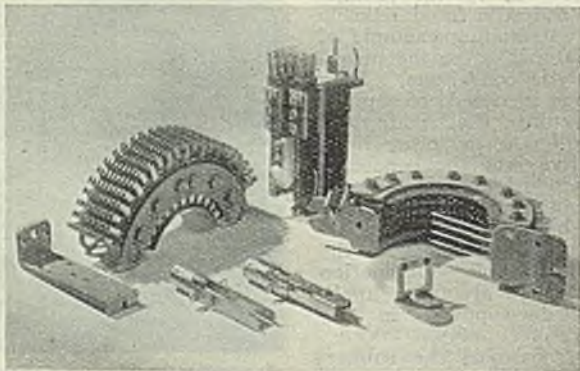
—Insulating varnishes were one of the earliest examples of the application of Bakelite products to the electrical industry and their use dates back over a period exceeding 30 years. The initial Bakelite resin resulting from the reaction of phenol and formaldehyde is dissolved in suitable solvents and used as the impregnant for armatures, field coils and electrical windings of all types. Cements are also produced based on Bakelite resin, which are used extensively throughout the radio valve and electric lamp branches of the industry for fixing the metal or plastics caps to the glass bulb.

For these and similar purposes the cement is used, naturally, entirely for its adhesive properties and succeeds in uniting glass and metal with a tenacity greatly exceeding the adhesion obtained with cements based on plasters of various types. For this lamp capping operation the Bakelite cements are supplied as a powder, are mixed by the user to the required consistency with methylated spirits and used on standard lamp capping machines. On the heated capping machines the paste cement is extruded as a ribbon which is inserted between the metal cap and the glass bulb, and sets with great rapidity.

In powder form Bakelite resin is supplied to manufacturers of high frequency coils for use in the production of iron dust cores. The powdered resin and iron powder are thoroughly mixed together and then cold moulded at a pressure of between 20 and 40 tons per sq. in. to the required form. These mouldings are then baked to

“cure out” the resin, causing it to become insoluble and infusible. The advantages of this method of coil production in reducing hysteresis loss while retaining a high inductance, will at once be apparent.

Other applications for Bakelite cements of various types include adhesives for loud speaker assemblies, manufacture of fuses, etc.



Bakelite laminated punchings provide the insulation in these telephone selectors and relays

Future Developments.

—The brief outline that has been given of existing uses of Bakelite plastics does indicate the diversity of their employment in the electrical industry, while in an important part of the components field they have gained a pre-eminent

position. This has not been achieved merely by adopting plastics as a substitute for other materials; in most instances they have won their place on their merits by the possession of a combination of properties not available in any other class of materials. Predictions on future progress serve little purpose. Research and development on the improvement of Bakelite plastics are constantly proceeding. As the materials are improved so the field of their application will continue to widen. Building is now proceeding on the erection of a new factory for Bakelite, Ltd., on a 38-acre site at Aycliffe, Co. Durham. Production at the new works will be devoted to increasing the output of phenolics and to the manufacture of vinyl compounds and urea materials, both of which have an important contribution to make to the electrical industry.

(Other articles dealing with plastics in the electrical industry appeared in THE ELECTRICIAN of Aug. 16, 23, 30, Sept. 6, Nov. 1 and 8.)

Further reports containing scientific and technical intelligence from German industry and now on sale at the Stationery Office include: B.I.O.S. 767, Accumulator Manufacture in Germany (3s. 6d.); F.I.A.T. 617, The Electrical and Technical Ceramic Industry in Germany (13s.); and B.I.O.S. 411, Miscellaneous Electrical Factories in the British and American Zones (3s. 6d.).

High Voltage Technique

The Testing of Gas-Cushion Underground Cables

THE paper on "The Development of the Gas-Cushion Cable System for the Highest Voltages," which Mr. T. R. P. Harrison* read before the I.E.E. Transmission Section on November 13, began with a review of high tension underground cable development in this country. Many miles of cable, for 132 kV and lower voltages, were now operating satisfactorily. At 33 kV, large quantities of both screened and unscreened lead-sheath cables, embodying belted construction principles, had given satisfactory service, but three-cored construction for 66 kV and 132 kV on the same basis would produce unwieldy, if not impracticable, designs. Further, in these solid cables, service operation might produce a vacuous condition. If vacuous spaces were formed in the dielectric, gaseous ionisation would result when the situation in the spaces and the degree of vacuum obtained were favourable.

The two methods which had been developed to overcome these disadvantages were oil-filled cables and those using a compressed inert gas to ensure that at all temperatures the pressure in any spaces forming in the cable would be such that gaseous ionisation was not possible. In the gas-cushion cable, the gas was introduced inside the lead sheath and in contact with the dielectric.

Mr. Harrison next described the manufacture of gas-cushion cables, stressing the importance of avoiding impurities in the materials used and of obtaining a mechanically balanced construction. The aim was to obtain the lowest possible dielectric power factor in order to reduce losses to a minimum.

Turning to testing procedure, Mr. Harrison said that, whereas routine and type tests could to an extent be standardised, design tests were continually subject to alteration as more became known of the service conditions.

The long-time stability test was, perhaps, the most popular, since it was intended to give an indication of the performance of any cable system in service. This test involved the application of voltage and loading current simultaneously over a long period, at least six months, and during this time frequent measurements were made of the characteristics of the various parts present in the miniature system.

Positive suppression of gaseous ionisation permitted the adoption of a working maximum stress of the order of twice that

present in a solid cable. The result was a reduced thickness of dielectric for the same operating voltage. In addition, because of the reduced effect of heat cycles on the reinforced cable, it was permissible to increase the operating temperature to a value of 80° C. The combination of the two factors created more onerous conditions for a given dielectric, and for voltages of 132 kV and above the question of thermal stability became of vital importance. The important point in thermal stability testing was not the actual value of the dielectric power factor at the operating temperature, but its rate of change with temperature at that temperature. This rate of change was largely dependent on the power factor/temperature characteristic of the impregnating compound.

The limitations of the above tests could be overcome to a great extent by a combination which might lead to the ultimate destruction of the test sample. The test

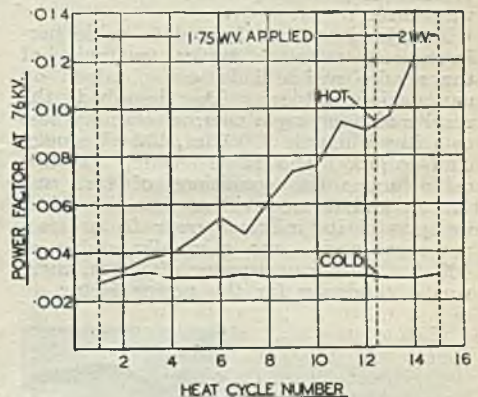


Fig. 1

system was subjected to a rising over-voltage in steps, with simultaneous application of current-heating cycles to any desired value equal to, or greater than, the rated load. The voltage was held at each step for a fixed time, and the test was continued until stable conditions were obtained at sufficiently high values of the applied voltage and current, or until failure of the sample occurred.

Power factor/voltage measurements applied to the complete samples gave an average value of the power factor of a large quantity of dielectric, and it was as yet impossible to measure the power factor at a weak spot on any sample. One method

* W. T. Henley's Telegraph Works Co., Ltd.

of obtaining further information in this direction was to locate the "hot spot" before breakdown (an easy matter from thermocouple readings) and to terminate the test before breakdown occurred.

Apart from breakdown resulting from increase of severity of test conditions, breakdowns occurred in service, and the ensuing post-mortems were made extremely difficult owing to the fact that severe burning occurred with the high fault current.

Troubles due to lightning had been experienced, and much information in this direction had been obtained as a result of work carried out by various investigators. It might be expected that as more became known of the behaviour of equipment under impulse conditions, impulse-voltage testing would be specified by purchasers. Such tests would be "withstand" tests, and could be of value only if successive impulses were inspected or recorded by means of a cathode-ray oscillograph and were all identical traces. In addition, information was required on the impulse strength of cable systems. It was usual in these cases to apply impulses to the sample, the peak value being increased in steps until breakdown was revealed, visually or photographically, by change of waveform.

Mr. Harrison then turned to cable performance, and gave typical examples of the results which had been obtained on gas-cushion cables. He described the results of applying a thermal stability test to a 20 yd. length of 0.3 in., 132 kV single-core cable. The rated loading for this cable under the conditions of test was 420 A, and it was evident that the cable, in spite of its inferior power factor/temperature curve, was thermally stable at 460 A. At the next value of 480 A, there was a tendency for the power factor to



become constant, indicating possible thermal stability at this loading, but on a further increase to 500 A, instability resulted. The development of a hot spot was clear from the values of maximum and average reinforcement temperatures. During this test, the voltage and current were maintained continuously.

The advantage of an accelerated stability test could be demonstrated by reference to tests taken on two 132 kV single-core samples similar in all respects, except that one cable had the strand deliberately con-

taminated during manufacture. In Fig. 1, which referred to the sample with the specially contaminated strand, heat-treatment caused the hot power factor to rise rapidly, so that ultimate thermal breakdown occurred. Investigation showed that the effect was caused by interaction of the contaminating agent with the normal im-

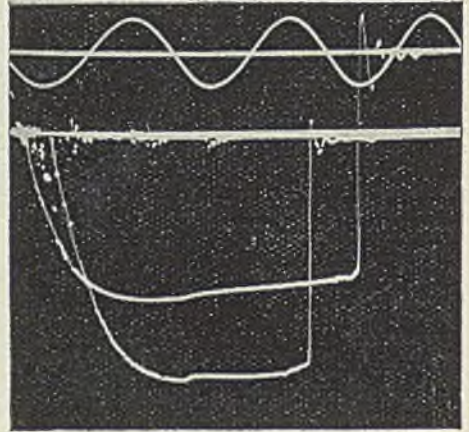


Fig. 3

pregnating compound in the innermost highly stressed layers of the dielectric. The effect was not apparent on the cold power factor measurements. With the normal sample having an untreated strand, a stable condition was apparent at the end of the period at twice the working voltage.

Although ionisation was absent in the gas-cushion cable under certain conditions, it was possible for such ionisation to occur on a breakdown test provided the stress at any point was at a sufficiently high value. The result was "tree burning" of the dielectric, and this was much more intense than that which occurred in solid cable, as could be seen from Fig. 2.

Next, Mr. Harrison turned to impulse testing, and said that the impulse breakdown of the cable had a somewhat different appearance from that obtained at 50 c.p.s. When true cable puncture occurred, the effect seen on the oscillograph was that the voltage fell to zero immediately, as shown in Fig. 3. Impulse breakdown might, however, follow a long path from conductor to sheath, in which case the voltage might remain quite high.

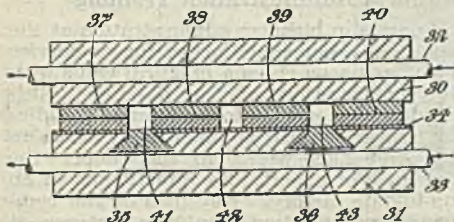
After a brief description of the methods used in testing cable accessories, Mr. Harrison concluded with a review of future possibilities. With the probable advent of 264 kV cables, he said, intensive development was needed to show how materials such as polythene and polystyrene, which had good power factors at high temperatures, could best be used.

Electrical Inventions

Electrodes for Dielectric Heating

Difficulties have been experienced in the high frequency welding of a number of thin pieces of thermoplastic material by electrical breakdown, which is liable to occur across the air spaces left between adjacent pieces of plastic. By attaching to one of the electrodes a sheet of dielectric material—such as polystyrene—which thus becomes interposed between the electrodes and the work-pieces, this disadvantage, it is claimed, may be overcome.

The additional dielectric (34), which should be thinner than the work-pieces themselves (37-40), may be cast on the face of the electrode (31) and subsequently machined to the correct thickness, or



attached by dovetailed grooves (35,36). Water-pipes (32,33) may be used for cooling purposes.

This arrangement, by increasing the voltage which may be used at a comparatively low frequency, with less risk of breakdown in the air spaces (41-43), permits more rapid welding of the sheets of plastic material.

G. Haim and H. P. Zade. Application date, February 7, 1944. No. 581 181.

Timing of Spot Welds

In apparatus suitable for the spot-welding of aluminium and other light alloys, the current impulse is normally derived from a condenser which is charged from the source of supply and then discharged through a circuit of which the electric resistance is low and the thermal conductivity high. The discharge usually takes place through the primary winding of a transformer, the secondary of which is connected to the spot-welding electrodes.

Since the strength of the weld is very susceptible to variations in the energy input, it is of primary importance that the energy stored in the condenser should be accurately controlled. This energy, being a function of the capacity multiplied by the square of the voltage, is most closely dependent upon voltage fluctuations.

The invention provides a method of controlling the voltage within close limits, by means of a discharge device which is

We give on this page abstracts of some recent electrical patents, which are prepared with the permission of the Controller of H.M. Stationery Office. These abstracts are written from the viewpoint of general interest and do not attempt to define the scope of the inventions, nor indicate in which features the novelty lies. Complete specifications may be obtained from the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each inland or 1s. 1d. each abroad.

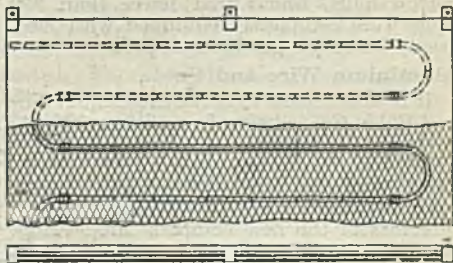
responsive to the condenser voltage. The device initiates and interrupts the discharge at pre-determined points on the charge/discharge curve.

English Electric Co., Ltd., G. Chadwick and J. E. Salthouse. Application date, January 19, 1944. No. 580 854.

Low Temperature Heating Panels

Improvements are described to the type of building heating system in which the heat is diffused principally by radiation at a comparatively low temperature from the surfaces of walls, ceilings or floors, the heat being supplied by electric heating elements in the form of long, continuously insulated wires distributed over the area from which radiation is to take place.

The element in this invention is held in place in a series of straight and curved metal channel members connected together to form a continuous holder. Sheets of metal lathing are fixed to the backs of the channel members. The members them-



selves, which may be of either U or rectangular cross-section, provide mechanical protection for the heating element and also give stiffness to the metal lathing. The lathing facilitates the keying of plaster or other heat conducting material in place, provides a good heat distributing surface and also a simple means of installing the heating element.

Electric Panels, Ltd., W. N. Mann and O. W. Minshull. Application date, July 19, 1944. No. 580 709.

Industrial Information

Mill Managers at Power Station

The Blackburn electricity works at Whitebirk were inspected recently by members of the Blackburn Mill Managers' Association. The visit was arranged for the purpose of securing the co-operation of all works managers in economical electricity consumption. Under the direction of Mr. J. B. Ashworth (sales and development engineer) the visitors were shown over the generating station, including the new extension, by special guides.

International Standardisation

A conference of representatives of the national standards bodies of 25 nations met in London recently, and as a result of long and friendly discussion, a draft constitution and by-laws for a new international organisation was unanimously agreed upon. The object of the International Organisation for Standardisation, or I.S.O., as the new body is to be known in its abbreviated title, is to facilitate the co-ordination and unification of the industrial standards of the different countries.

Electricity in Cotton Mills

Chairmen of many electricity committees and chief engineers of electricity supply undertakings in the north-west, held an area conference at Preston recently. Mr. R. H. Harral (chief electrical engineer and manager, Blackburn undertaking) reported that the North-west Area Textile Subcommittee, in their recent survey of 1 391 cotton mills, found that fewer than 350 mills were completely equipped with electricity and 670 partly equipped.

Aluminium Wire and Cable

It is understood that the Aluminium Wire and Cable Co. is being formed as a private company with an authorised capital of £500 000. The promoters are: the British Aluminium Co., Hawker Siddeley Aircraft Co., and Tube Investments. Proposed directors of the new company are:—Hon. Geoffrey Cunliffe and Mr. G. J. S. Boex (both directors of British Aluminium Company), Sir Frank Spriggs and Mr. H. Burroughes (both directors of the Hawker Siddeley Aircraft Co.), Mr. E. Austyn Reynolds (a director of Tube Investments) and Mr. A. J. S. Aston (a director of Reynolds Rolling Mills, a subsidiary of Tube Investments).

Old Cromptonian Association

At the recent annual general meeting of the Old Cromptonian Association, it was announced that Sir James Swinburne, F.R.S., had resigned the presidency of

the association, and was succeeded by the Earl of Mount Edgcumbe. It was decided that as from that meeting the name would be changed to "The Cromptonian Association," to include Crompton Parkin-son personnel who would not have been eligible for membership under the traditional rules. There is no intention of changing the essential character of the association which has for so many years formed a bond between past and present members of the company's staff. At the dinner following the meeting, a precedent was established by the presence of distinguished visitors as guests of the association.

Business Administration Training

Courses in business administration at the Southend Municipal College for ex-Service men have been given a practical value with the co-operation of E. K. Cole, Ltd. Students are able to follow up their studies in modern industrial practice by visits to the large Ekco works to see, under the guidance of experts, the functioning of an up-to-date factory. Key men of the company's organisation also give lectures at the college on their specialist subjects.

Contract Price Adjustment Formulae

The usual B.E.A.M.A. notice states that for purpose of calculating variations in (a) "Rates of Pay," the rate of pay for adult male labour at November 9 shall be deemed to 103s.; (b) "Costs of Materials," the index figure for intermediate products last published by the Board of Trade on November 9 is 199.9 and is the figure for the month of October, 1946.

E.A.W. Branch Officers' Conference

The third branch officers' conference held by the E.A.W., opened at Grange-over-Sands, Lancashire, on Tuesday, November 12, and will conclude to-day (Friday). The delegates have met in special session and in informal discussion groups with the object relating branch activities to the expanding policy of the association.

Cheerful Rationing

The cards issued by the E.A.W., 35, Grosvenor Place, London, for October and November, contain a number of new recipes for attractive dishes to bring variety into the daily diet. There are also several useful household hints.

Silicon Organic Compounds

Kautex (Plastics), Ltd., announce the formation of a completely new organisa-

tion called Silicon (Organic) Developments, Ltd., and that for further simplification of the organisation, all previous activities of the Kex products side of Kautex (Plastics) Ltd., have been taken over by Silicon (Organic) Developments, Ltd., and will be conducted from their Cavendish Place offices (Telephone: Langham 1373). Kautex (Plastics), Ltd., remain at Elstree, Herts.

Manchester Showroom Opened

The first showroom established by Hoover, Ltd., in Manchester, was opened at 40, Deansgate on November 7, by Mr. F. H. Bunn, director and general sales manager of the company. The guests were Hoover dealers in Manchester, and Mr. Bunn said that the advent of the showroom did not mean that the company would start selling cleaners direct to the public; the object of the showroom was to provide a centre where the public and the trade could come for help and guidance. Introducing members of the staff, Mr. Bunn said the showroom was suggested by Mr. W. M. Tribute, advertising and publicity manager of the company and oldest employee. The manager is Mr. H. Potts, who will be assisted by Miss P. Hinchcliffe.

Westinghouse Domestic Appliances

The Westinghouse Brake and Signal Co., Ltd., 82, York Way, King's Cross, London, W.1, ask us to announce that they are not the manufacturers of "Westinghouse" refrigerators, electric irons and other domestic electrical appliances. The official agents handling spare parts and service for these devices are Electrical and Refrigeration Services, Ltd., 40, Upper Richmond Road, London, S.W.15.

Manchester Consumers

The attainment of 200 000 consumers by Manchester electricity department was marked, when, on November 8, Alderman Sir William Walker, J.P., invited Mrs. A. R. White, of Wythenshawe, wife of the 200 000th consumer, to accept a set of aluminium saucepans as a souvenir. In the department's first decade progress was slow, and only reached 4 500 consumers; the second decade saw the consumers' list topping the 12 000 mark, but by 1923 the number barely exceeded 27 000. The 100 000 mark was reached at the end of the fourth decade, a period which marked the beginning of the scheme of wiring in existing premises on "hire-

purchase" terms, and the applications reached the record figure of 20 583 new connections in 1937. Since the beginning of 1945, an upward flow of new consumers has resulted in the 200 000 mark being reached in the 54th year of the department's history.

Lamp Contracts

Thorn Electrical Industries, Ltd., announce that their contract for the supply of Atlas electric lamps to the L.M.S. Railway has been extended for a further period from October 1, and also that their tender



Group taken during the opening ceremony at the new showrooms of Hoover, Ltd., at Deansgate Manchester. The guests were local dealers

for the supply of Atlas electric lamps to the Education Department of the Hertfordshire County Council has been accepted for the period ending April 26, 1947.

British Export Exhibition

The claim that they can take orders and deliver the goods is made by the firms showing their products at the British Export Exhibition, organised by Leon Goodman Displays, Ltd., at the London Exhibition Centre, New Coventry Street, W. 1, which was opened on Tuesday, November 12, and will close at 1 p.m. on Saturday, November 23. Exhibitors of electrical appliances and equipment include:—

Maranda Electric Productions (a room service grillette and hot plate and other domestic electric appliances); Simon Sales, Ltd. (recording equipment and accessories, transformers, etc.); O'Connor Electrical Industries, Ltd. (decorative fluorescent and other electric lamp fittings, and an attractive big-sized electric hotplate); Emmarel Distributors, Ltd. (a useful heater-cooker); Quick Supply, Ltd. (electric fire and radio receiver); Audix (British Binoculars), Ltd. (electronic equipment and sound apparatus); Flexitol Engineering Co., Ltd. (flexible shaft and power-driven screw-driving and nut-setting equipment, grinding, cutting and polishing tools); Compronex, Ltd. (deaf aid appliances by S. G. Brown, Ltd.; hair dryers by Fraction H.P. Motors, Ltd.; and a spot welding machine by Hirst Electronic Developments, Ltd.); Rowé Bros. and Co. (Export), Ltd.

(electric convection heaters, electric vegetable peelers, etc.); Elson, Ltd. (electric fires and appliances).

New Plastics Company

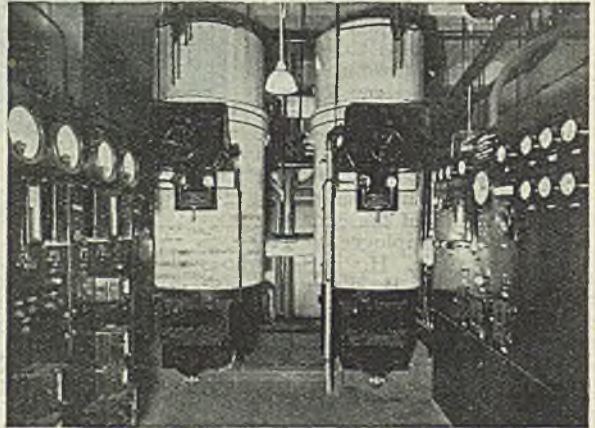
The directors of Thomas De La Rue and Co., Ltd., announce that negotiations are proceeding for the formation of a new company, to be called National Plastics Limited, to acquire and amalgamate the undertakings of De La Rue Plastics, Ltd., and Moulded Products, Ltd. It is intended that Thomas De La Rue and Co., Ltd., shall have a substantial interest in the new company and that the members of the present board of De La Rue Plastics, Ltd.,

shall join the board of the new company under the chairmanship of Mr. B. C. Westall. Mr. W. J. Merfield, the chairman of Moulded Products, Ltd., will join the board of the new company as deputy chairman. Mr. H. P. Bridge, the managing director of De La Rue Plastics, Ltd., and Mr. H. W. F. Ireland, the managing director of Moulded Products Ltd., have agreed to serve as joint managing directors of the new company. A further announcement is to be made in due course. In the meantime De La Rue Plastics, Ltd., and Moulded Products Ltd., will continue to carry on their respective businesses.

Heating at the Bodleian Library

THE electrical thermal storage equipment installed for warming the Bodleian Library new building at Oxford, referred to in our issue of November 1, and some of the old buildings consists essentially of two 1200 kW, 11 000 V electrode water heaters, three water storage cylinders having a combined capacity of approximately 70 000 gal., the necessary circulating pumps, automatic control gear and main motor-operated switchgear. The interconnections and valves are such as to allow either one or both of the electrode water heaters to be in service with one, two or all of the storage cylinders. The electrode water heaters are of the vertical type, totally enclosed and metalclad in boiler plate steel, and have all their live parts within earthed metal. Load regulation is obtained from full load to about 30 per cent. full load by porcelain controller tubes moving over fixed electrodes in the base of the shell. The controller tubes enclose the electrodes and are supported on a carriage mechanism, which is raised or lowered by a reversible electric motor operating through gearing. Fully automatic control within 1 per cent. of any pre-selected load is provided by relays. Load control and operation are entirely electrical and the general scheme of control is such as to ensure correct sequence of operations and adequate protection under all conditions. Normal switching is done at minimum load, but in emergency the plant is shut down instantly, irrespective of what the load may be. The supply of heat to the storage cylinders is under the control

of self-resetting thermostats in the cylinders and motor-driven valves fitted one in



Electrode boilers and control equipment at the Bodleian Library new building at Oxford

the primary flow pipe to each cylinder. The h.v. supply is taken from the mains, an electrically-operated time switch limiting the supply to the off-peak period in accordance with the requirements of the electricity authority. The water in the cylinders is stored at high temperature and is passed to the circulating system of the building through a thermostatically controlled automatic mixing valve, which maintains a preselected flow temperature. In addition, an automatic outside air thermostat adjusts the building flow temperature in accordance with any variation in the outside air temperature. The electrode water heaters, control board and main high-voltage switchgear were supplied and installed by A. Reyrolle and Co., Ltd., acting as sub-contractors to the heating engineers, G. N. Haden and Sons, Ltd., and F. G. Alden, Ltd.

Electricity Supply

Glasgow.—The Electricity Commissioners' sanction is being sought to the installation at Pinkston power station of a new 25 000 kW turbo-alternator.

Stockton-on-Tees.—The B.B.C.'s plans for a transmitting station at Two Mile Houses have been approved by the R.D.C.

Battersea.—The remaining obsolete vulcanised bitumen distributors in the area will be replaced by 4-core p.i. lead-sheathed and armoured cable, at a cost of £11 330. The Electricity Committee is to provide supply to the Hibbert Street area, which is being developed by the L.C.C., at £17 724.

Tyneside.—Local shipyards and engineering works have been informed of the dates and times when supplies are likely to be cut off by order of the C.E.B. Under present arrangements cuts are expected every 10 or 12 days between now and March. Newcastle-on-Tyne City Council, which runs both trams and trolley-buses, has informed the C.E.B. and the Ministry of Fuel that cuts in supplies will cause chaos in traffic conditions.

Yorkshire.—The Yorkshire Electric Power Co. have announced their decision to reduce charges for electricity supplied under agreements which provide for their present standard variation of charges with the cost of coal. The reduction will be made effective from January 1, this year, for supplies being given at that date, and from the date of commencement of supply for those commencing at a later date.

Oxford.—It was reported at a meeting of the City Council that a loss of about £30 000 on the electricity undertaking would in future years be more than covered by increased charges which had been authorised. People in the vicinity of Challow Station, G.W.R., which is partly in Childrey and partly in West Challow parishes, have agreed to invoke the Act of 1889 to demand a supply of electricity. It is estimated that a supply will cost cottages £5 to £6 for installation, and about £5 a year for supply of current.

London.—The London Power Co., Ltd. has applied to the Electricity Commissioners for consent to the establishment of the following main transmission lines: Four three-core 22 000 V, .25 sq. in. cables, at an estimated cost of £115 000, for bulk supply to the Bethnal Green Corporation; two three-core, 22 000 V, .25 sq. in. cables, from Crutched Friars to John Street, at an estimated cost of £56 000; and one three-core, .4 sq. in.,

66 000 V cable, from Battersea generating station to Gypsy Corner, Acton, at an estimated cost of £160 000, for reinforcing bulk supply to the Metropolitan Company's system.

Birkenhead.—A total of 2 922 street gas lamps will eventually be converted to electric lighting. The electrical engineer has been asked to submit an estimate of the total cost of conversion, including the provision of ripple control, in order that a programme of work can be prepared. The tender of Babcock and Wilcox, Ltd., for four boiler units and ancillary plant, and for two boiler units and ancillary plant, for the Birkenhead power station, has been accepted, at a total cost of £2 545 780. The Electricity Committee has reported the necessity of six new sub-stations and has recommended application being made to the Electricity Commissioners for sanction to borrow £34 835.

Oldham.—The net profit for the year, shown in the annual accounts of the electricity undertaking, was £46 921 5s. 9d. The revenue from electricity supply was £539 786 0s. 5d., and from rental of appliances, etc., £5 434 17s. 11d. The total of units generated during the year was 109 980 600, and units exported amounted to 15 642 155, while imports came to 34 805 000. Of the total sales of 112 432 492 units, 75 141 234 were for power and 1 103 820 for the traction load. The maximum load registered was 41 819 kW, and there were, at the end of the financial year, 57 533 consumers. Reviewing the year's work, the Chief Engineer said that the use of unsuitable fuel had added considerably to normal repair and maintenance work. The equipment in a number of sub-stations had been enlarged, renewed or overhauled, and additional feeder pillars had been erected at several points.

Liverpool.—The year's trading results, as given in the City Electrical Engineer's annual report, show that the maximum load supplied from the Clarence Dock and Lister Drive stations during the year was 305 440 kW (302 350 kW in the previous year), while the maximum load of the undertaking was 201 150 kW (188 550 kW). Units sent out during the year totalled 1 238 481 720 (1 288 260 350), of which 650 574 482 were sold within the undertaking and 478 468 200 were exported to the Central Electricity Board. The total income for the year was £3 177 276 (£3 041 058) and the surplus £79 318 (£40 109). The average price received per unit sold was 1.079d. The installation of two 350 000 lb./hr. boilers at Clarence Dock is

approaching completion, one of the boilers being ready for operation in January, 1946. New developments include main transmission lines from Clarence Dock to supply the central city load and other additional feeders. The 33 kV supply to the L.M.S. railway has been completed and is now in operation.

Bradford.—The report of the Electricity Committee for the year ending October, 1946, shows a net profit of £40 387, against a net deficiency of £8 731 in the previous year. The total number of units sold was 213 587 487, a decrease of 2 907 292, or 1.34 per cent. A drop in industrial units sold is accounted for by reduction of output and return to normal hours in the engineering trade, whilst an increase in

domestic units of 9 678 305 is due to the shortage of solid fuel and the use of electricity for heating, cooking and water heating. Traction sales fell by 894 366 units, while consumption for public lighting increased by 916 193. The total income from the sale of electricity was £1 045 383, and the income derived from an increase of 5 per cent. on the domestic and heating tariffs, which became operative on October 1, 1945, was £9 300. The average price per unit sold was 1.175d., compared with 1.123d. in the previous financial year. The cost per unit during the year was 1.255d., an increase of 0.025d. on 1944-45. Fuel consumption at the Valley power station was 181 487 tons, or 1.463 lb. per unit generated, an improvement of 8 per cent.

In Parliament

Nationalisation of Supply.—Referring, in his Speech at the Opening of Parliament, to forthcoming nationalisation measures, the King said: "A Bill will be submitted to you to bring into national ownership the electricity supply industry as a further part of a concerted plan for the co-ordination of the fuel and power industries."

Rural Supplies.—Asked by Mr. Granville when it was intended to extend the supply of electricity to cottages and farms in Suffolk without any cost to the users, Mr. Shinwell replied that he had no authority to vary the statutory powers of electricity undertakers to make a capital charge for a connection. This and cognate matters would be dealt with when the electricity supply industry was nationalised.

Fuel Conference.—The Minister of Fuel and Power was asked by Mr. Janner whether he would consider issuing a White Paper setting out what were the principal lessons learned at the recent Scientific Conference on Fuel Economy organised by his Department, together with an indication of what action was to be taken in each case to implement such of the lessons as had been approved by him. Mr. Shinwell replied that he had already arranged for the proceedings to be published. All the papers and recommendations were being exhaustively studied by the Fuel Efficiency Committee, as well as by his Department, and would in due course be published, or publicised, in the manner best designed to secure practical results. The action to be taken on the recommendations must necessarily be continuing action, much of it over a long period, and it would be impracticable, at any rate until there had been much more

time for detailed examination of the proceedings, to indicate exactly what action was being, or would be, taken over so wide a field.

Fuel Oil Subsidy.—Replying to Sir Patrick Hannon, who asked the Minister of Fuel and Power when the details of the subsidy scheme of £1 per ton on fuel oil used in this country would be made available; and if the Petroleum Board had yet completed the plan for rebate to large consumers, Mr. Shinwell said that details of the subsidy were published on or about October 1, the date from which the subsidy became payable. At the same time, it was announced that the normal peace-time system of zonal pricing of black oils, and of the granting of quantity rebates to all consumers buying more than 100 tons of oil per annum, was being introduced. He would not go so far as to say that the functions of the Petroleum Board were in the hands of his Ministry, but there was very close liaison between the two parties.

Materials for Electrification.—Lieut.-Commander Joynson-Hicks asked the Minister of Fuel and Power in how many cases the provision of new electricity supply schemes was now being held up through lack of materials; and how many people were consequently being deprived of a supply of electricity. Mr. Shinwell replied that the information was not available, and could only be obtained by asking 570 electricity undertakings to submit detailed returns. He did not think he was justified in imposing this burden on the undertakings, but, even if he did obtain the information, he was not sure that it would be of much value.

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:—

Keith, November 16.—Electrical work in 14 houses at South Cuthill site. Specification from Burgh Surveyor, Balloch Road, Keith, Banffshire; deposit, £1.

Birmingham, November 18.—Supply of ventilating system at Anti-Tuberculosis Centre, 151, Great Charles Street. Particulars from Engineer and Surveyor, Council House, Birmingham. Deposit, £2 2s.

Formby, November 18.—Supply and delivery of one 2 500 kVA transformer. Specification from Electrical Engineer, Council Offices, Formby.

Dublin, November 18.—Supply of street lighting control equipment for the sending of control signals by means of audio frequency impulses superimposed on normal supply over Dublin supply network. Area of control will comprise three 10 kV sub-station areas of the Board's networks, and will require approximately 445 relays. Particulars from City Engineer's Department, 28, Castle Street, Dublin.

N. Scotland Hydro-Electric Board.—Supply, delivery and erection of a 132 kV transmission line. Copies of tender documents from Messrs. Kennedy and Donkin, 32, Alva Street, Edinburgh, 2. Deposit, £1 1s.

Metropolitan Water Board.—Supply of an electric motor and starter, 25 H.P., 200-220 V, 1 450 r.p.m., vertical spindle drive or suitable for adaptation to vertical spindle drive, new or second-hand. Particulars to Clerk of the Metropolitan Water Board, New River Head, Rosebery Avenue, London, E.C.1.

Hepton, November 19.—Supply and erection of two electrically driven pumping sets, each of 200 gall./min. capacity; one electrically driven pumping set of 100 gall./min. capacity, both sets automatically controlled, together with pipework, valves, etc. Particulars from the Consulting Engineer, A. Brooksbank, 14, The Exchange, Bradford, Yorks. Deposit, £2 2s.

Abertillery, November 21.—Supply, delivery, construction and erection of sheet steel kiosks and equipment, e.h.t. and l.t. underground cables and l.t. service cables, in connection with the Council's housing site at Penrhiw, Bryn Ithel, Llanhilleth.

Particulars from Electrical Engineer and Manager, 40, Somerset Street, Abertillery. Deposit, £2 2s.

Barking, November 22.—Supply, delivery and erection of 6.6 kV switchgear. Particulars from Borough Electrical Engineer, Ripple Road, Barking.

Edinburgh, November 22.—Supply of electricity supply meters, during year beginning May 29, 1947. Specification from Engineer's and Manager's Office, Dewar Place, Edinburgh, 3.

Wallasey, November 23.—Supply and installation of 500 A, three-phase, meter testing set. Specification from Borough Electrical Engineer, Wallasey Road, Wallasey.

Littleborough, November 25.—Supply and delivery of one 350 kVA transformer, e.h.t. and l.t. underground cables, e.h.t. and l.t. switchgear. Particulars from Electrical Engineer and Manager, Council Offices, Littleborough.

N.W. Midlands J.E.A., November 25.—Supply of outdoor type static transformers. Particulars from Chief Engineer and Manager, York Chambers, Kingsway, Stoke-on-Trent.

Birmingham, November 25.—Delivery of following domestic electrical apparatus as required during period of 12 months from date of contract: Kettles, aluminium saucepans, cookers, wash-boilers, water circulators, storage water heaters, cooker control units, circulator control panels. Specifications from Chief Engineer and Manager, Electric Supply Department, 14, Dale End, Birmingham, 4.

Gairloch, November 25.—Supply, delivery and erection of h.t. and l.t. distribution lines for North of Scotland Hydro-Electric Board. Tender documents from the Engineers, Messrs. Strain and Robertson, 154, West George Street, Glasgow, C.2. Deposit, £1 1s.

Glasgow, November 26.—Supply of five electric vehicles. Particulars from General Manager, Corporation Electricity Department, 75, Waterloo Street, Glasgow, C.2.

Woolwich, November 27.—Supply of electricity meters, h.v. and m.v. cables and transformers during year beginning January 1, 1947. Specifications from Borough Electrical Engineer, Electric House, Powis Street, Woolwich, S.E.18.

Epsom and Ewell December 16.—Supply, delivery and erection of (a) one 500 kVA three-phase transformer, and (b) one ten-pole 11 kV 150 MVA truck type switchboard. Specifications from Town Clerk, Town Hall, The Parade, Epsom, Surrey. Deposit, £1.

Company News

NORTH WESTERN OF URUGUAY RAILWAY, LTD.—Gross receipts to June 30, £66 419 (£67 138), less wkg. exes. £57 842 (£68 218), lvg. net receipts. £8 577 (net loss £1 080), plus other inc. £2 502 (£1 503). To int. on 2nd deb. £5 268 (£5 097), bridge tolls guarantee £6 803 (£5 465), tax £3 836 (£992), lvg. debit £4 828 (£11 131), increasing deficiency to £130 576

PARA ELECTRIC RAILWAYS AND LIGHTING CO., LTD.—Gross rev. to Nov. 30, 1945, £218 713 (£221 856). To exes. £242 939 (£239 373), lvg. wkg. loss £24 226 (£17 517). To Ldn. exes. £2 542 (£2 656), dirs.' fees £1 120 (£1 086), less exch. £189, sundry rev. £248, lvg. net loss £27 451 (£6 868), increasg. debit b/c. to £140 561 (£113 110).

ELECTRICAL COMPONENTS, LTD.—Income for yr. to June 30, £46 064 (£12 230). To deprecn. £1 631 (£558), dirs.' fees £150 (nil), war damage nil (£15), lvg. net prft. £44 283 (£11 657). To cost of inc. of cap. and reorg. scheme £272, tax £35 655 (£6 083), res. £1 403 (nil), fwd. £10 308 (£3 855). As announced in prospectus iss. last May, no div. has been declared. At mtg. to-day resolutns. will be submitted to inc. cap. to £250 000.

JOHNSON AND PHILLIPS, LTD.—Letters of rights have been sent out by the directors for the issue to shareholders of 200 000 £1 shares at 65s. each, in the proportion of one for every four held on October 19. The new shares rank for all dividends declared after allotment. Subscription lists will be closed on November 18. The issue is to finance part of the expenditure on fixed assets and partly to replace bankers' loans.

FALK STADELMANN AND Co., LTD.—Prft. to March 31, after admin. charges, deprecn. and mort. h'old. props., £158 875 (£121 063). Written off goodwill and trade marks £5 000 (£2 945), to staff pensions £7 512 (£7 315), res. for taxn. £52 359 (£26 468), leavg. £94 003 (£84 335). Add prft. on sale of secs. £1 019 (£1 852) and res. for sub-contracts no longer reqd. £13 000. Div. on pref. takes £31 500, res. for contingencies £10 000 (nil). Div. 10% on ord. (same); to staff pension and benevolent fund £3 000 (nil); fwd. £53 303 (£47 531).

FERRANTI, LTD.—Tradg. prft., after prov. for taxn. but includg. estimated E.P.T. repayable £225 000 (nil), to June 30, was £116 079 (£150 988). Deprecn. absorbs £35 000 (£39 830), dirs.' fees £4 072 (£4 153), res. defrd. reprs. nil (£10 173), war damage nil (£1 154), leavg. net prft. £77 007 (£95 678). To pref. div. £18 375, less tax (£17 500). Ord.

div. 6%, tax free (same), gen. res. £40 000 (£72 817), contin. res. nil (£5 000), fwd. £59 464 (£58 832). Stock and work in progress £1 179 252 (£1 711 722), debtors £901 074 (£2 276 549), cash £3 401 (£5 052), bank overdraft £688 615 (£2 356 037), creditors, inclgd. tax prov. £630 073 (£873 979). Net current assets are shown at £714 609 (£708 091). Consd. prft. and loss acct. shows net prft. £98 170 (£115 342), and b/c. sheet gives current assets £2 421 365 (£4 256 933), agst. current liab. and provns. £1 542 876 (£3 382 977). Reserves and surplus £904 295 (£623 265).

PETO SCOTT ELECTRICAL INSTRUMENTS, LTD.—The chairman, Mr. Campbell Jones, presided at the eighteenth ordinary general meeting recently. In the course of his speech, he said that the directors had always visualised that larger and more up-to-date factory premises would eventually be required by the company, and during the last year an opportunity had occurred to take up modern factory accommodation at Weybridge. They, therefore, decided to go into these premises and co-ordinate the laying down of plant, equipping and organising of a new works in the same year as the transition was taking place of the company's production from war to peace activities. If these factors were taken into consideration, the trading profits for this year of £41 310, which compared with a record profit earned last year of £62 400, could not be considered unsatisfactory. The directors felt that the benefits of the up-to-date production unit at Weybridge would be apparent in due course.

ATLAS ELECTRIC AND GENERAL TRUST, LTD.—In the course of his speech at the annual meeting, Mr. D. M. Touche, the chairman, said that their tramway undertaking in Montevideo had carried nearly 165 million passengers during the year. The company continued to render this great service to the public of Montevideo without receiving any return upon its investment for the seventeenth year in succession. To work for service and not for profit was no new experience for them and, indeed, they were quite in the fashion. The gross receipts of the undertaking increased by 278 441 pesos during the year, whereas the operating costs increased by only 202 930 pesos. The net operating revenue improved from 211 109 pesos to 278 701 pesos, and the operating profit had gone to reduce the debit balance carried forward from previous years, which now stood at 481 663 pesos. After referring to the "cheap money" policy of the

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British Government, Mr. Touche said that it might be a good idea for a fresh Cohen Committee to inquire into the long overdue clarification of the national accounts.

CARRIER ENGINEERING Co., LTD.—Speaking at the annual meeting, the chairman (Mr. S. L. Gordon) said that in their tenth year as a public company their turnover had been a record, being approximately 50 per cent. higher than last year. They were fully occupied in their marine air-conditioning department and had contracts with the Admiralty and the mercantile marine, which represented a substantial volume of business to be carried out during the next few years. They had recently played a part in the reconditioning of the "Queen Elizabeth," and were now engaged in similar work for the "Queen Mary." In view of the position in the building industry to-day, the directors considered it was likely to be many years before the building air-conditioning business made a substantial contribution to earnings. The company had, therefore, developed entirely new equipment applicable to a broader field of industry than they had previously served.

JERUSALEM ELECTRIC AND PUBLIC SERVICE CORP LTD.—Addressing the

ordinary general meeting, Mr. William Shearer, the chairman, said that abnormal conditions prevailing in Palestine, coupled with difficulties in the supply, transport and erection of plant, had given considerable anxiety during and since the close of the year under review. The number of units sold during the year was 17 millions odd, as compared with 15½ millions in the previous year, an increase of some 12 per cent. Notwithstanding the restriction of supply found necessary from time to time through shortage of plant, the number of consumers increased and there was a waiting list. The first of the new 2 000 kW generating sets, ordered in March, 1944, went into commercial operation in July this year, while the erection of the second of these sets, ordered in May, 1945, was now taking place. One could see no slackening in the demand for electricity, the Chairman continued, and orders had been placed for two more generating sets of 2 000 kW each, but delivery could not be obtained before 1948, due to the heavy demand on manufacturers for electrical plant generally. Payment for this new plant and the complementary additions to the distribution system would in due course involve the provision of fresh capital.

Coming Events

Friday, November 15 (To-day)

I.E.E., N.E. CENTRE, STUDENTS' SECTION.—Newcastle-on-Tyne. "Carrier Wave Telephony." F. Moon. 6.30 p.m.

Saturday, November 16

I.E.E., LONDON STUDENTS' SECTION.—Visit to Willesden power station. 3 p.m.

I.E.E., N.E. CENTRE, TEES-SIDE SUB-CENTRE.—Middlesbrough. Visit to Darlington power station, 3 p.m.

Sunday, November 17

BRITISH KINEMATOGRAPH SOCIETY.—London. "Arc Lamp Conversion Equipment," J. C. Milne. 11 a.m.

Monday, November 18

I.E.E., LONDON STUDENTS' SECTION.—"The Trend of Modern Telecommunication," A. H. Mumford.

BIRMINGHAM ELECTRIC CLUB.—Birmingham. "The German Electric Supply System, 1933-1946," G. R. Peterson.

Tuesday, November 19

ASSOCIATION OF SUPERVISING ELECTRICAL ENGINEERS.—London. "Notes on Present-day Cable Practice," J. R. Harding. Joint meeting with the Institution of Engineers-in-Charge. 6.15 p.m.

Wednesday, November 20

I.E.E., LONDON STUDENTS' SECTION.—Visit to Standard Telephones and Cables, Ltd., New Southgate. 2.30 p.m.

I.E.E., S. MIDLANDS STUDENTS' SECTION.—Loughborough. "Lightning Protection of

High Voltage Systems," J. Mitchell (repetition). 7 p.m.

I.E.E.—London.—Radio Section. "The Voltage Characteristics of Polythene Cables," R. Davis, A. E. W. Austen, Prof. Willis Jackson. 5.30 p.m.

I.E.E., N.E. CENTRE.—Newcastle-on-Tyne. Radio and Measurements Group. "Theory of Servo Systems," A. L. Whiteley. 6.15 p.m.

BRITISH INSTITUTION OF RADIO ENGINEERS. SCOTTISH SECTION.—Heriot-Watt College, Edinburgh. "Development of Wire Broadcasting." P. Adorian. 6.30 p.m.

Thursday, November 21

I.E.E.—London. "The Development and Design of Colonial Telecommunication Systems and Plant," "The General Planning and Organisation of Colonial Telecommunication Systems," C. Lawton and V. H. Winson. 5.30 p.m.


I.E.E. N. WESTERN CENTRE.—Manchester. Radio Group. "A Method of Transmitting Sound on the Vision-Carrier of a Television System," D. I. Lawson, A. V. Lord and S. R. Kharbanda. 6 p.m.

Friday, November 22


I.E.E.—London. Measurements Section. "The Design of an Ellipsoid Voltmeter for the Precision Measurement of High Alternating Voltages," and "Calibration of Uniform-Field Spark-Gaps for High Voltage Measurement at Power Frequencies," F. M. Bruce. 5.30 p.m.

ELECTRICAL ENGINEERING SOCIETY.—London. Visit to Central Electricity Board Central Control Room, Southwark. 7 p.m.

ILLUMINATING ENGINEERING SOCIETY.—Birmingham. "Lighting for Photography," G. A. Jones.



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Commercial Information

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.

HEMMINGWAY, Thos., 29, John Street, Boldon Colliery, Durham, electrician. £10 10s. 4d. September 10.

LAWSON, E. (male), 1 and 8, Northam Road, Six Dials, Southampton, radio dealer. £32 4s. 4d. August 22.

ORMEROD, W. E. (male), 421a, Oxford Road, Manchester, electrical dealer. £12. September 19.

SWARBRICK, Jno. Stanislaus, Church Street, Garstang, Lancs., radio and electrical engineer. £61 5s. 10d. September 12.

NEWBERY, Robert Sidney and NEWBERY, Kathleen Queenie (wife), 59, Wilford Road, Nottingham, radio engineer. £14. September 4.

FLYNN, Jno. T., 20, Brighton Road, Croydon, radio engineer. £107 5s. 3d. September 9.

MORGAN, William Leslie Dean, Gleads Moss, Lower Withington, Cheshire, small-holder and electrical engineer. £16 8s. August 7.

WRIGHT, Arthur Henry, 61, Prenton Place, Chester, electrician. £16 16s. August 15.

STEVENS, Arthur Frederick, 11, Buxton Road, Chingford, Essex, electrical engineer. £22 14s. 4d. July 22.

HUTCHINS, K. C. (male), 8, Irby Road, Ashton Gate, Bristol, 3, electrician. £84 19s. 9d. July 16.

HESSE, C. M. (male), Main Road, Biggin Hill, Kent, electrical engineer. £17 17s. 6d. August 12.

Satisfaction

BROADCAST RELAY SERVICE (MALTA), LTD., London, S.W.—Satisfaction. September 25, of debentures registered October 14, 1935.

Application for Discharge

HOWARTH, George, 36, Union Street, Bury, Lancs., radio engineer. Hearing, 10.30 a.m., December 4, 1946, at The Court House, Mawdsley Street, Bolton.

Orders for Discharge

NEALE, Norman Ray Bastable, 22, Hewlett Road, Cheltenham, Gloucs., wireless

dealer. Court: Cheltenham. Bankrupt's discharge ordered suspended for one month, and that he be discharged as from October 24, 1946.

JOHNSON, Stanley, residing at 52, Hartley Street, Mexborough, Yorks., and carrying on business at 12, Swinton Road, Mexborough, Yorks., wireless and bicycle dealer. Court: Sheffield. Bankrupt's discharge ordered suspended for one month, and that he be discharged as from November 3, 1946.

MOORE, Harry H. (junr.), The Lindens, West Cliff Gardens, Bournemouth, electrical engineer. May 20, 1940. Discharged subject to consent to judgment for £50. Note.—£50 paid to Official Receiver in lieu of entering judgment.

Intended Dividend

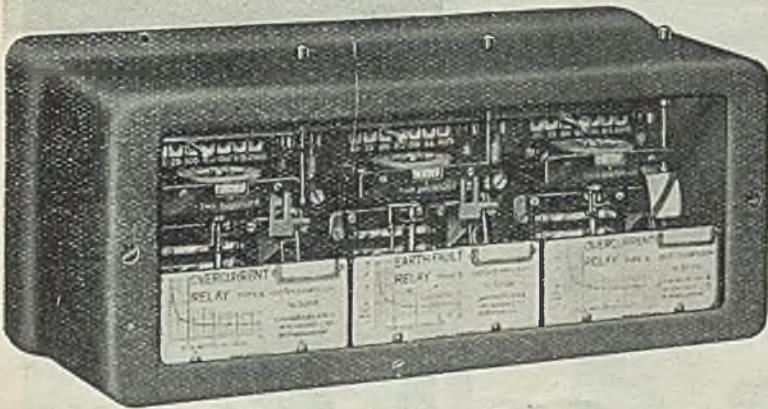
COUPE, George Francis, residing at 7, Carrington Road, Stockport, Chester, and carrying on business at 2, Spring Gardens, Stockport, Chester, electrical engineer. Last date for receiving proofs, November 20, 1946. Trustee, Milward, P.M., 20, Byrom Street, Manchester, Official Receiver.

Metal Prices

	Monday, Price	November 11 Inc. Dec.
Copper—		
Best Selected (nom.)...per ton	£82 10 0	— —
Electro Wire bars ... "	£84 0 0	— —
H.O. Wires, basis ... "	£86 15 0	— —
Sheet	£124 10 0	— —
Bronze Electrical quality		
1% Tin—		
Wire (Telephone) basis per ton	£118 10 0	—
Brass (60/40)—		
Rod basis	9½d.	— —
Wire	11, 1½d.	— —
Iron and Steel—		
Pig Iron (E. Coast Hematite No. 1) ...per ton	£8 19 0	— —
Galvanised Steel Wire (Cable Armouring) basis 0.104 in.	£32 10 0	— —
Mild Steel Tape (Cable Armouring) basis 0.04 in.)	£21 15 0	— —
Lead Pig—		
English	£56 10 0	— —
Foreign and Colonial... ..	£55 0 0	— —
Tin—		
Ingot (minimum of 99.9% purity)	£384 0 0	—
Wire, basis	per lb. 4s. 10½d.	—
Aluminium Ingots ...per ton	£72 15 0	— —
Spelter	£50 0 0	— —
Mercury (spot)	per bott. £31 5 0	— —

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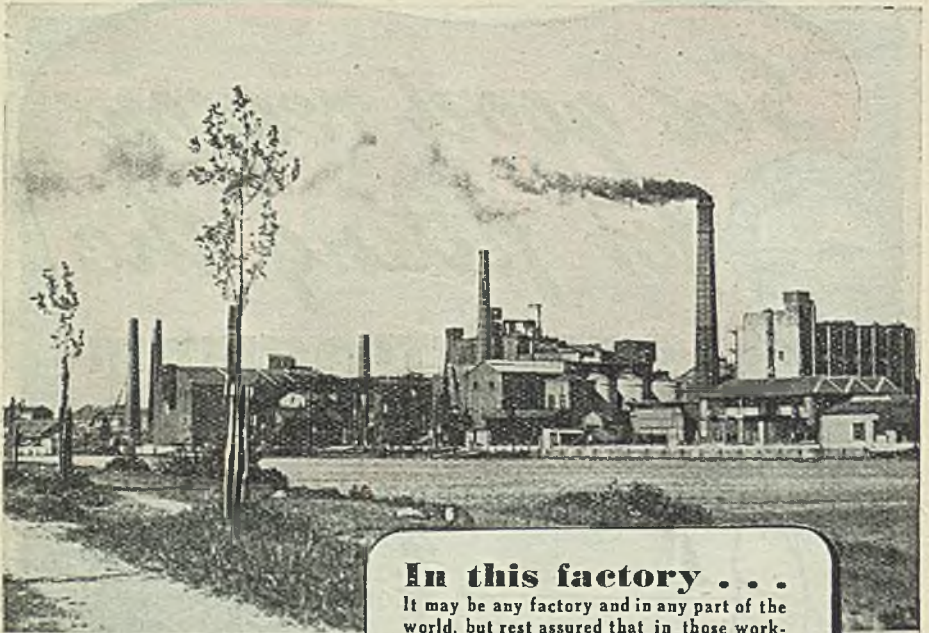
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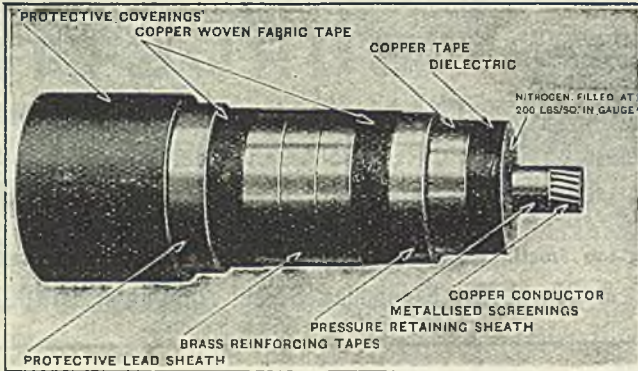
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Background to Achievement



Transport

IN the equipment of main line and suburban electrified railways, both overseas and in this country, including the unique "Tube" system of London, BTH has for over 50 years been in the forefront of invention and development. This applies not only to the motors driving the trains, and to the elaborate controlling devices, but also to the sub-stations which provide the motive power. On the lighting side, Mazda lamps of a myriad types and sizes are used on all British railway and road transport systems.

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