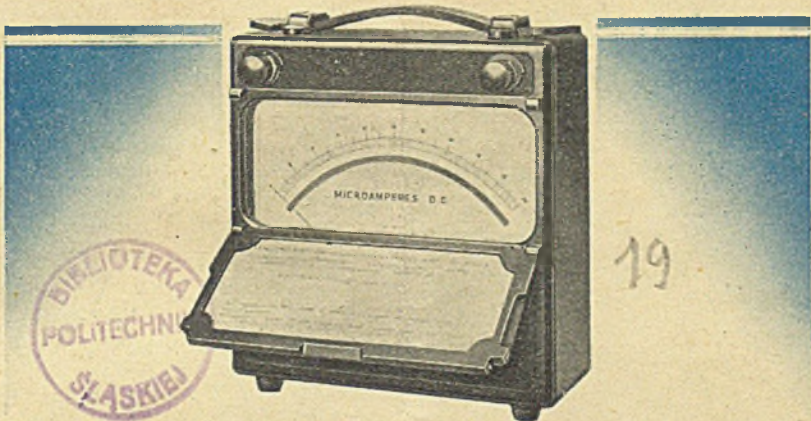


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ELECTRICIAN

THE TECHNICAL NEWSPAPER OF THE ELECTRICAL INDUSTRY



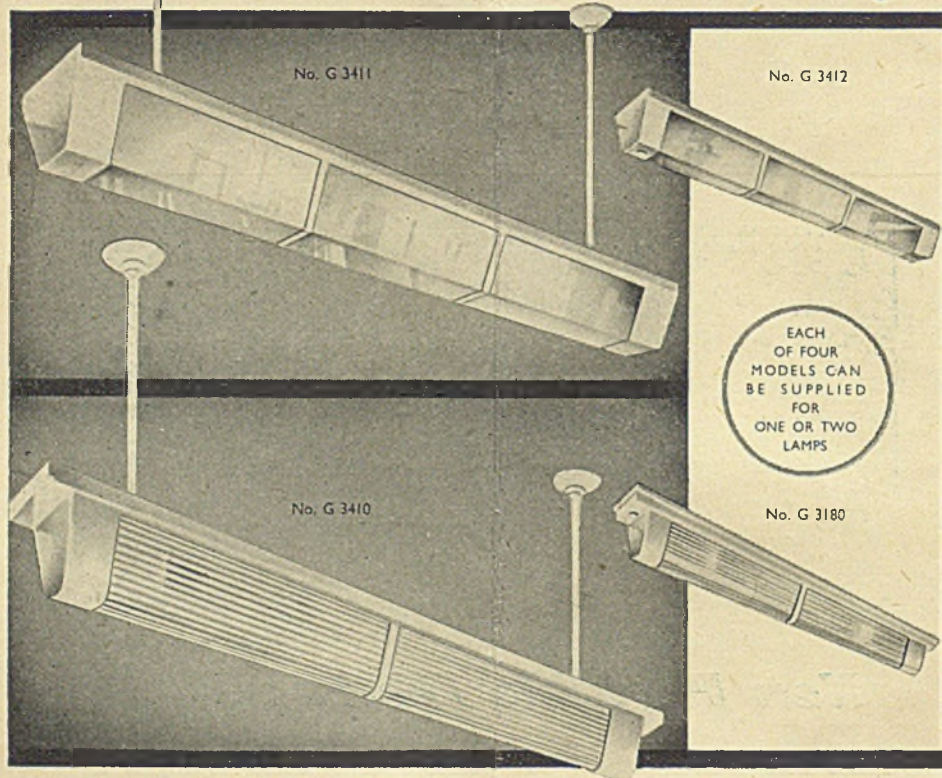
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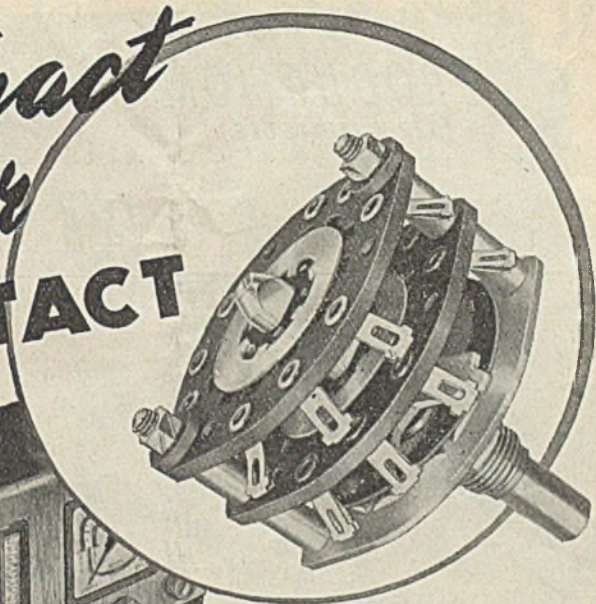
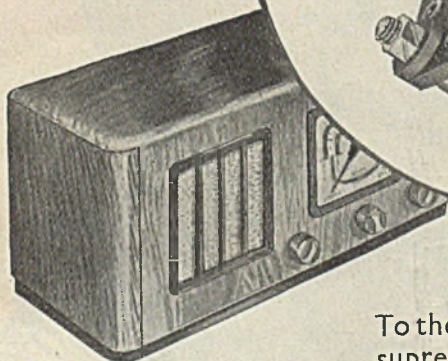
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The fittings illustrated have control gear built in for easy access, the pendants being arranged to provide some ceiling illumination. Illustrated leaflet on request.

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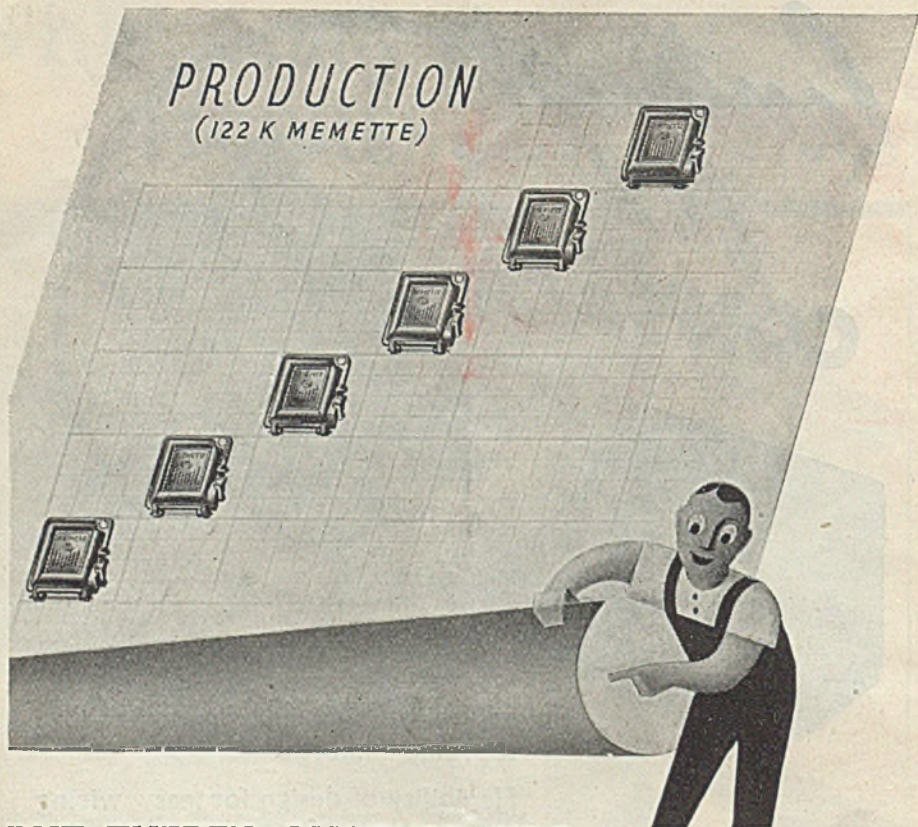
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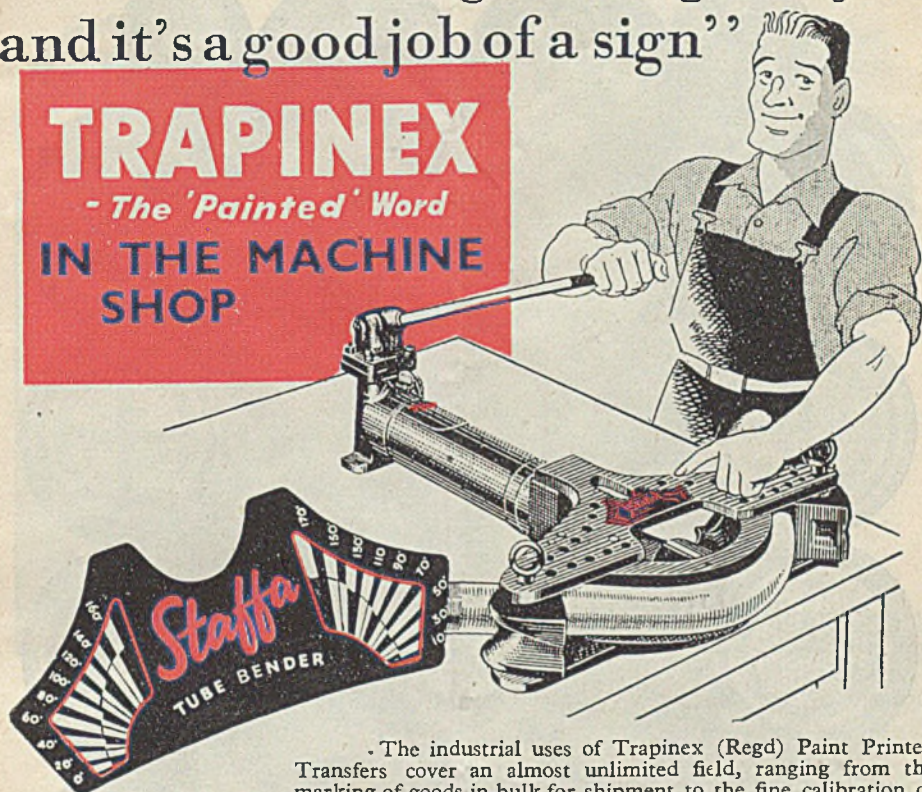
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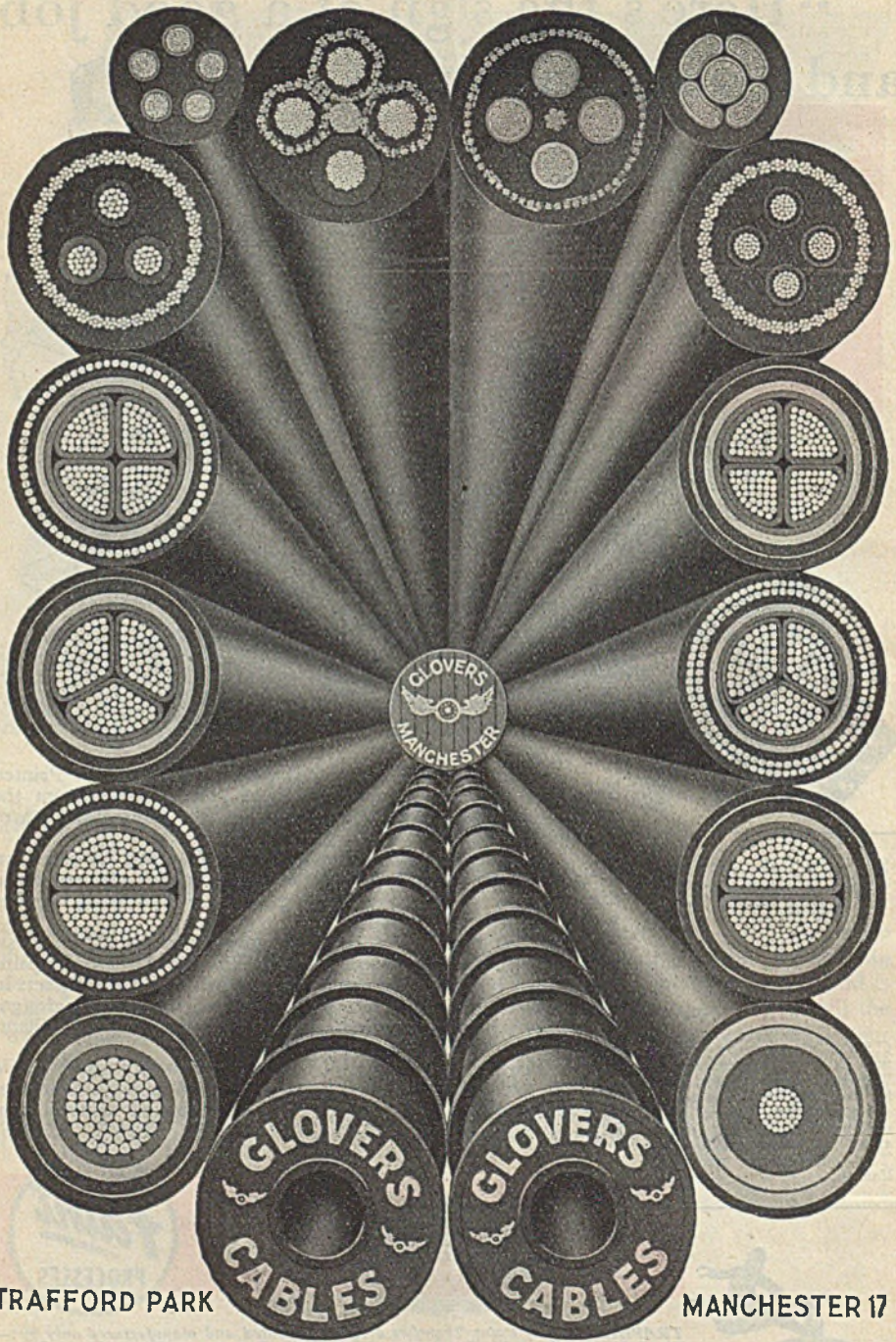
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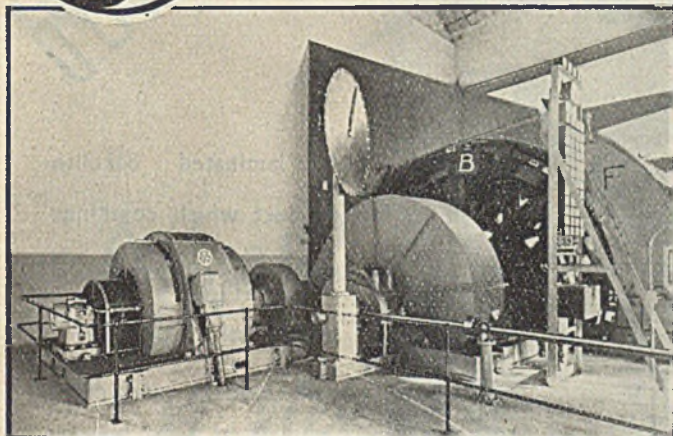


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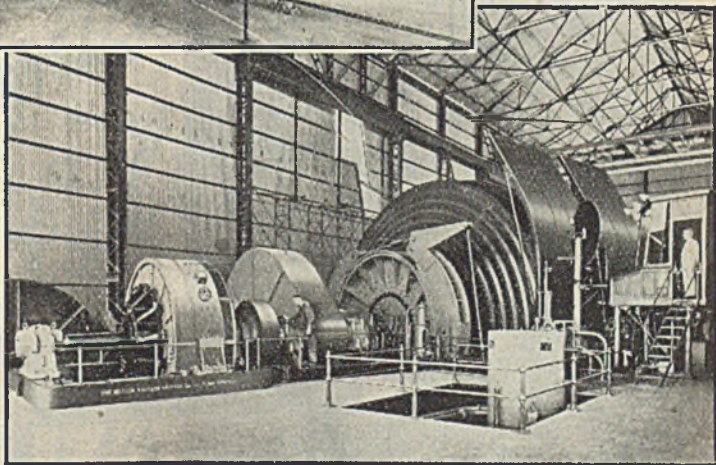
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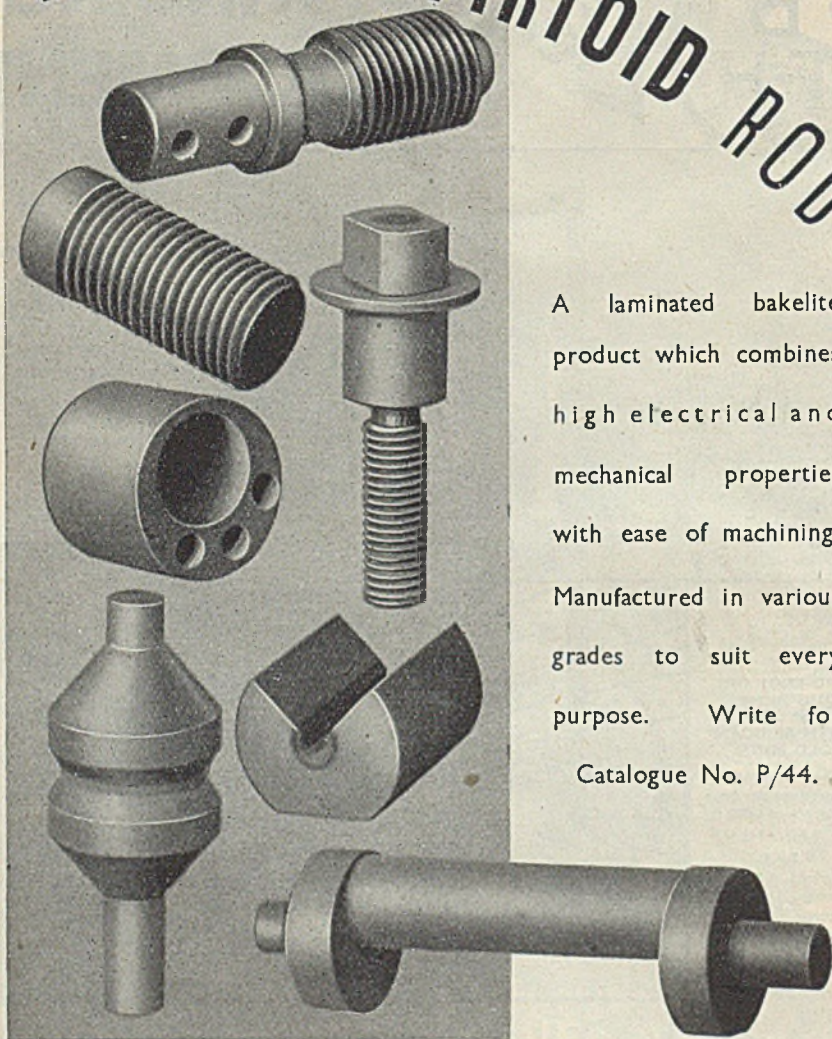
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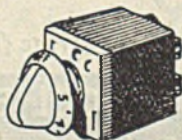
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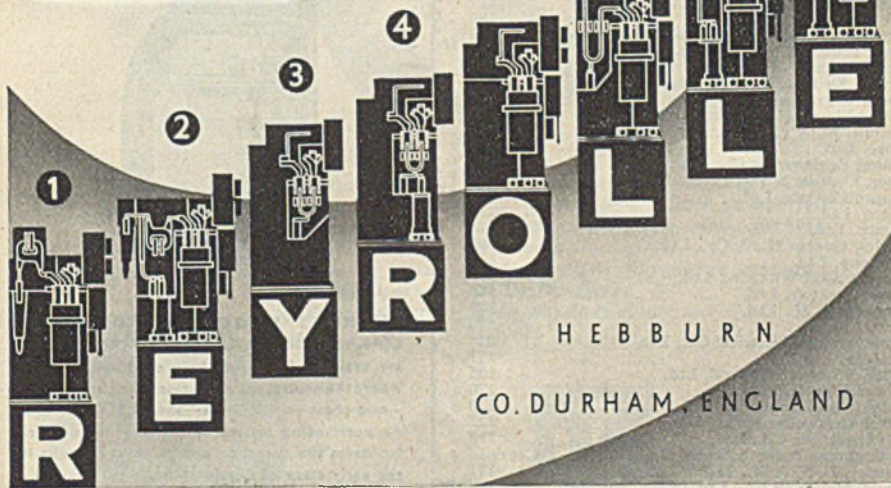
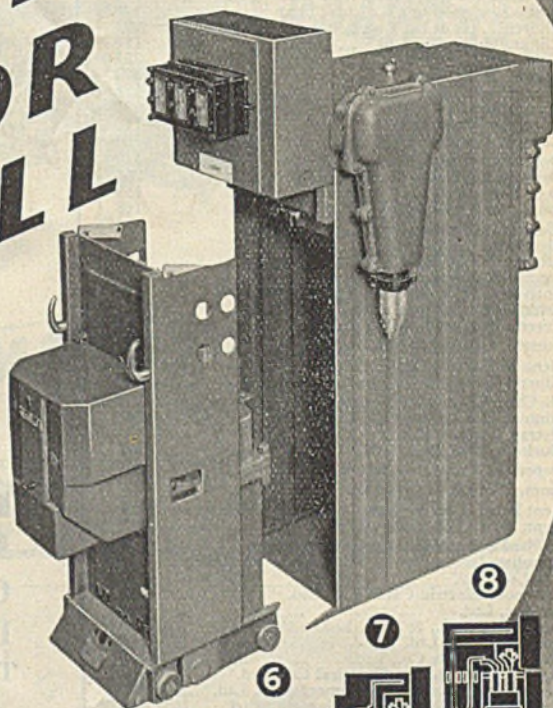
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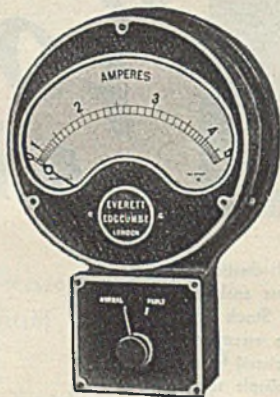


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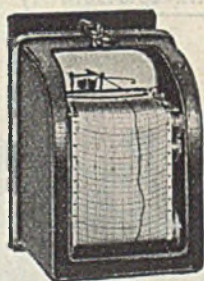
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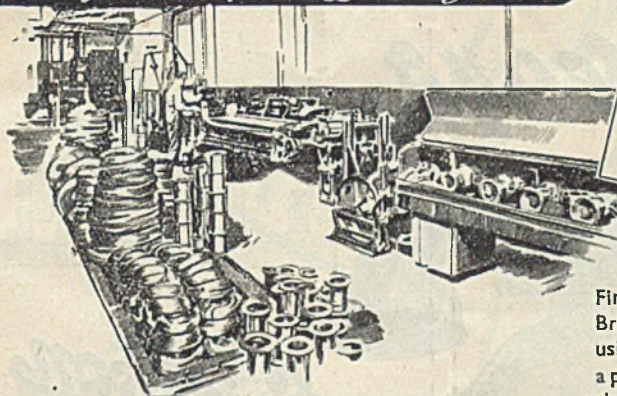


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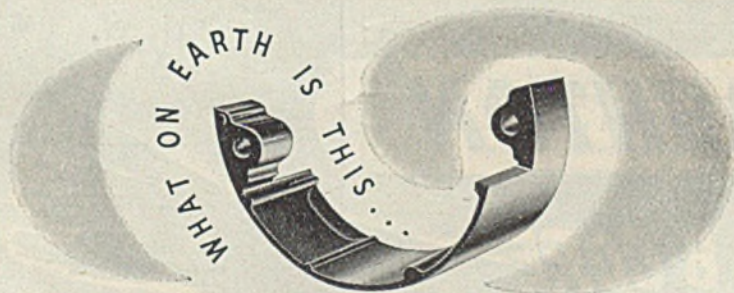
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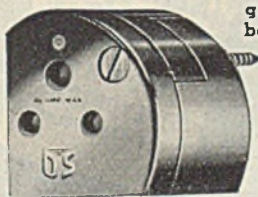
E32.



The rather rummy looking object above is one section of the new DS skirt for surface mounting the DS conduit box type socket. The other section is an absolute twin, and they get together as shown below.

This enables the skirt to be fixed after the wiring has been completed and means greater ease for the wireman.

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AND SOCKET

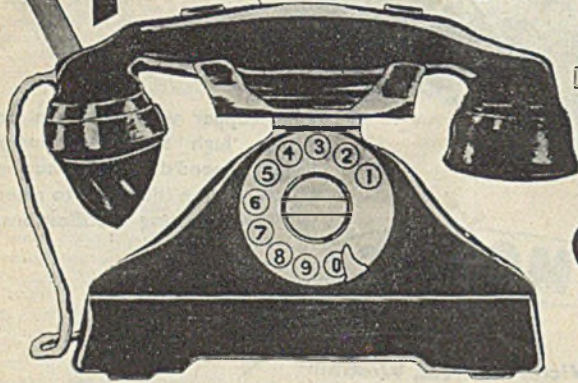
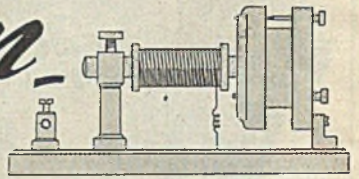
Announcement of DS Plugs Ltd., Manchester - London - Glasgow.

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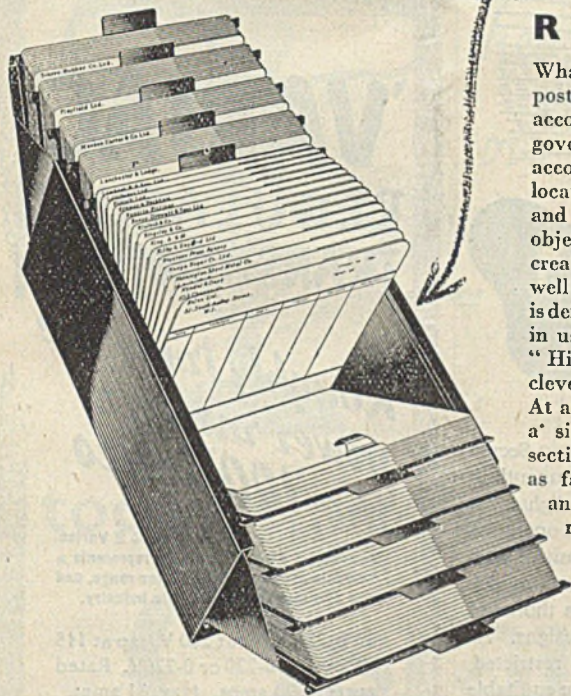
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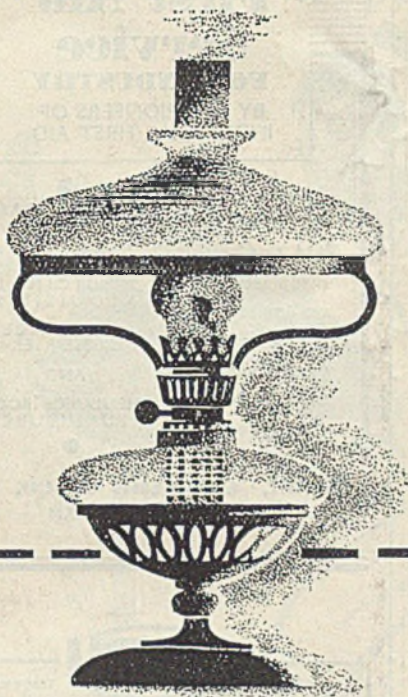
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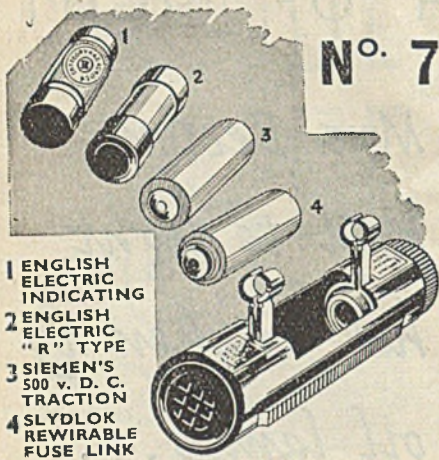
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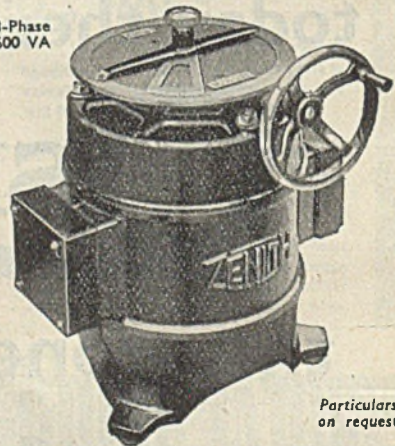
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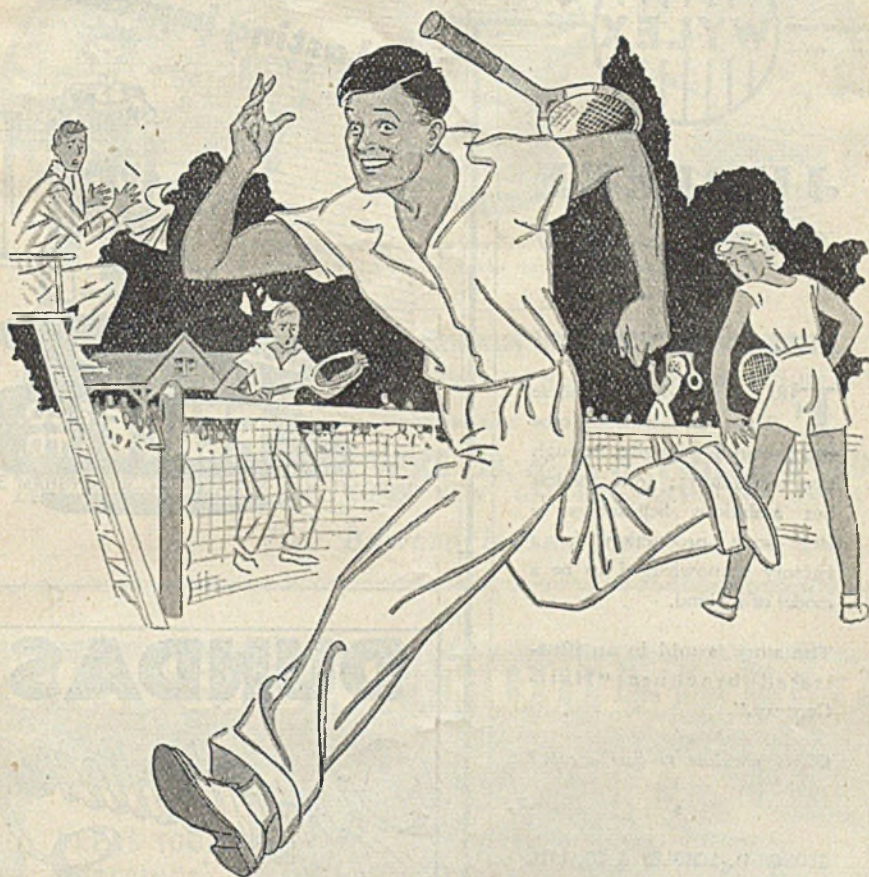
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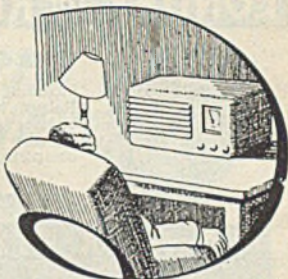
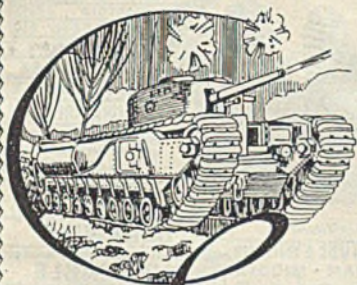
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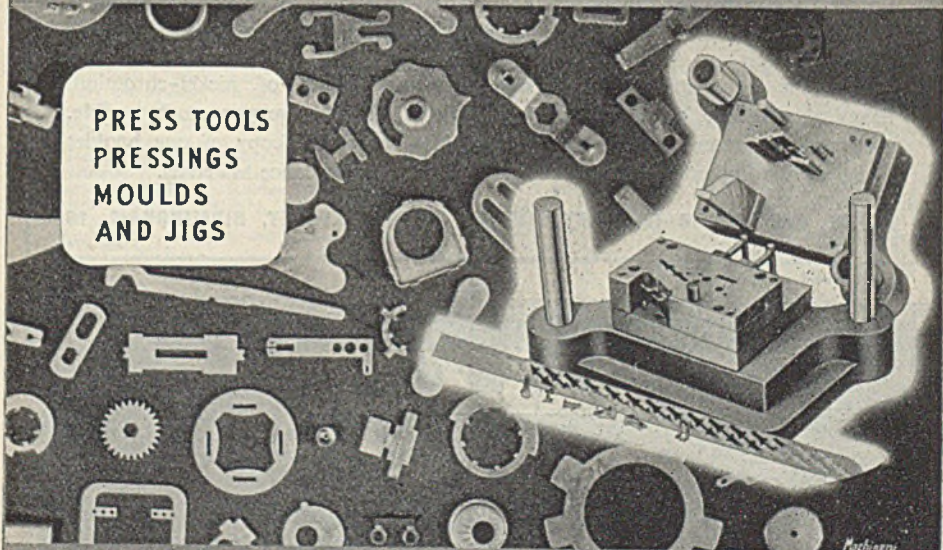
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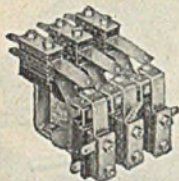
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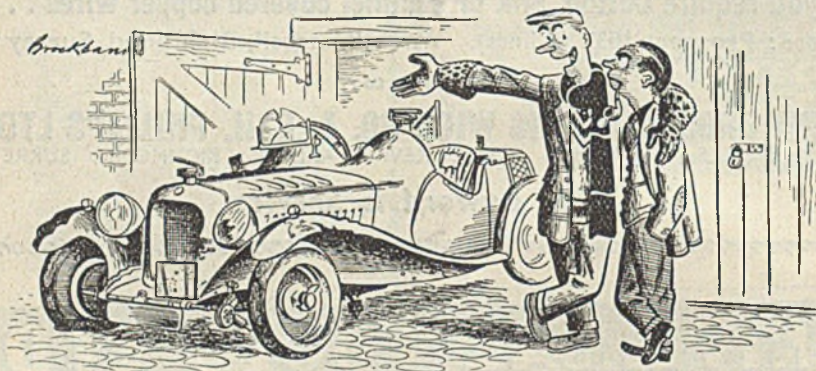
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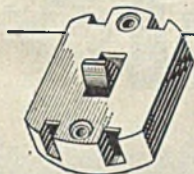
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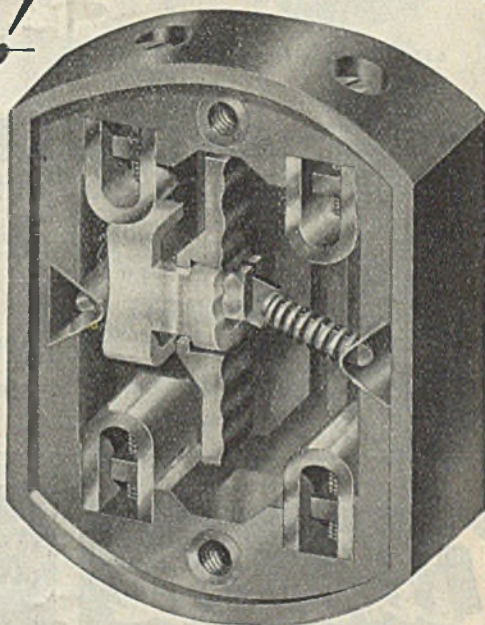
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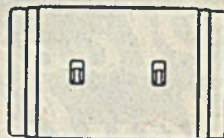
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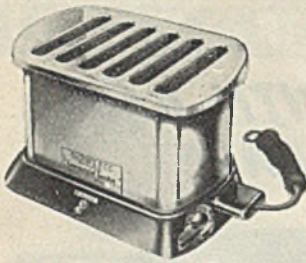
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Hi-Craft SWITCH

5-AMP. A.C



HI-CRAFT ELECTRICAL PRODUCTS LTD.
25 Manchester Square, London, W.1. Tel: Welbeck 7941



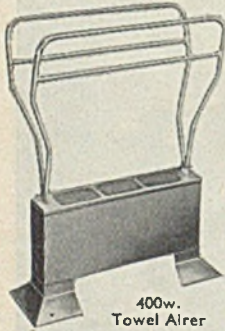
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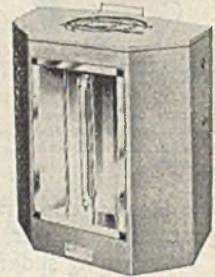
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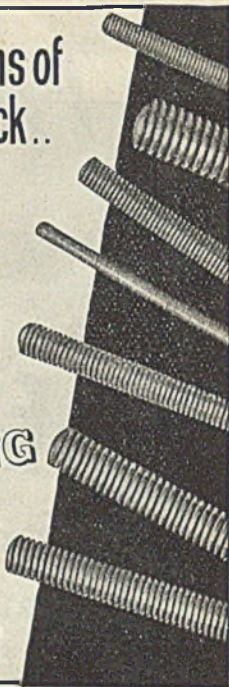
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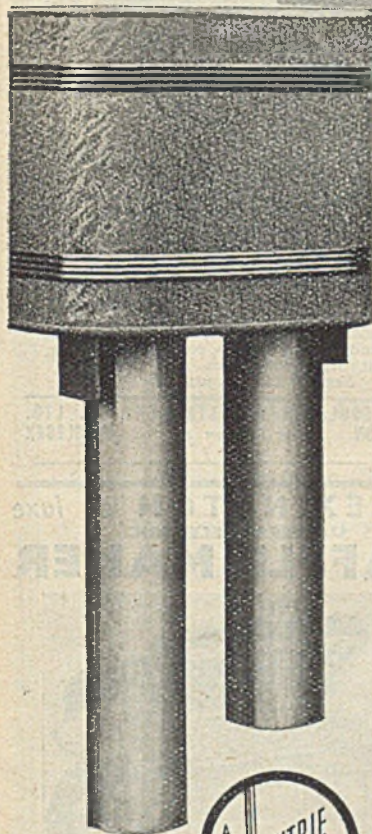
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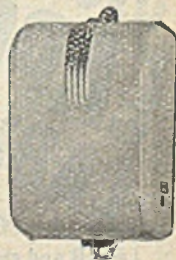
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You don't require extra flux when you use Ersin Multicore Solder. It contains 3 cores of super-active non-corrosive Ersin Flux. Ensures rapid melting and flux continuity, thus speeding up soldering operations and eliminating waste, with freedom from dry or H.R. joints. Sound joints can readily be made on oxidised surfaces.

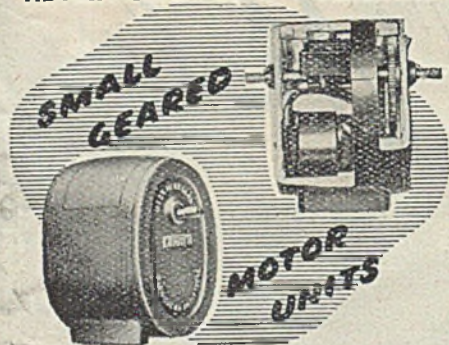


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Unidirectional or reversing, with or without self-switching, 100/110 or 200/250 volts A.C.

FINAL SHAFT SPEEDS:

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For: Operating valves, dampers or rheostats, cinema projectors, rotating screens, illuminated signs, small working models, Geneva movements for drum-type switches, rocking baths, work movement, soldering and welding fixtures, continuous turning, feed of light strip under process.

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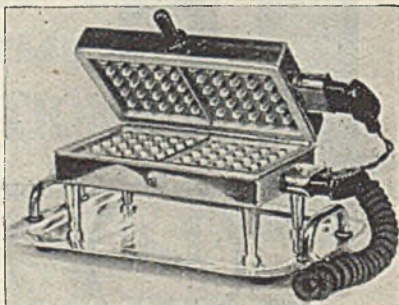
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LATED and sheathed with P.V.C.

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The LEXINGTON de luxe UNIVERSAL ELECTRIC WAFFLE MAKER



The first post-war British Waffle Machine

Designed to supply the popular domestic demand; also for use in the catering trade in Home and Export markets.

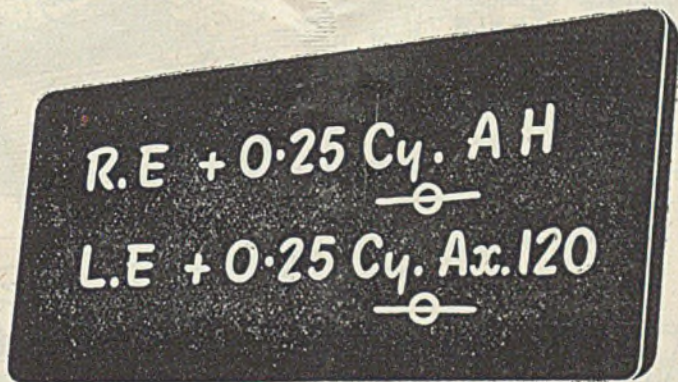
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A.C./D.C. 200-250v, also 100-110v models available. Load only 900 watts. Guaranteed 6 months.

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To the optician this prescription is as clear as the lenses it specifies. To the electrician it means nothing.

The modern specialist cannot hope to master the secrets of another's trade. He has enough to do in keeping abreast of developments in his own profession. If his eyes give trouble he seeks an oculist; when he needs medical aid he goes to a doctor; for legal advice he engages a solicitor . . . for expert opinions on topical problems of every kind he relies on

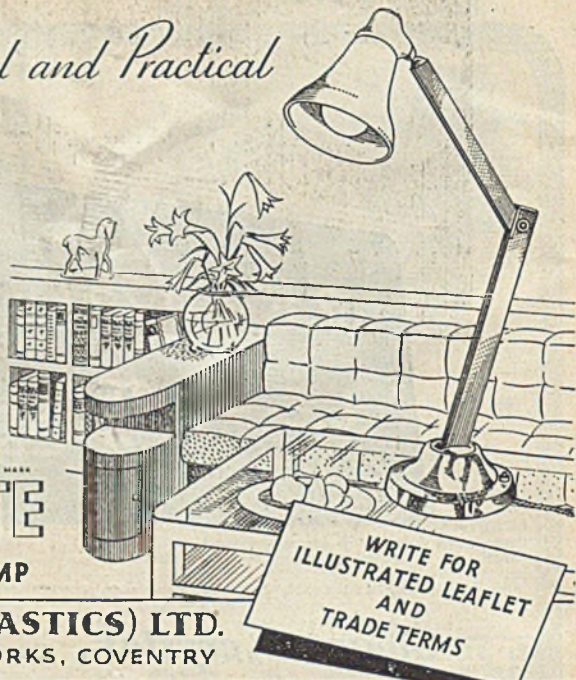
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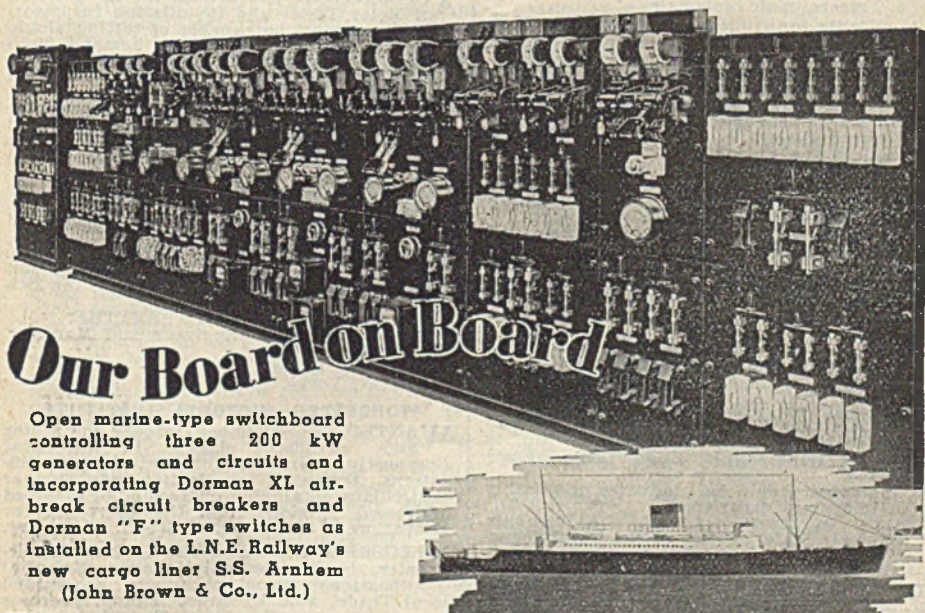


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Open marine-type switchboard controlling three 200 kW generators and circuits and incorporating Dorman XL air-break circuit breakers and Dorman "F" type switches as installed on the L.N.E. Railway's new cargo liner S.S. Arnhem (John Brown & Co., Ltd.)

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CLASSIFIED ADVERTISEMENTS

SITUATIONS VACANT

SPENBOROUGH URBAN DISTRICT COUNCIL. ELECTRICITY DEPARTMENT.

Electrician-Wireman.

APPLICATIONS are invited for the position of Electrician-Wireman in the above Department.

Applicants must have had experience in the repair of appliances and the wiring of installations.

Wages and working conditions in accordance with N.J.I.C. No. 2 District Section "B." Present rate 29.25d. per hour for a 47-hour week.

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

Applications, stating age, experience and present position, together with copies of not more than two testimonials, to be forwarded to Mr. Norman Ashton, A.M.I.E.E., Engineer and Manager, Electricity Department, 24, Market Street, Cleckheaton, and delivered not later than Monday, August 4th, 1947.

D. COUPE,

Clerk of the Council.

Town Hall,
Cleckheaton, YORKS.
14th July, 1947.

THE Central Electricity Board have vacancies on their permanent Staff for:—

1. Senior Draughtsmen.
2. Junior Draughtsmen
3. Tracers (male or female).

Applicants for (1) must have had considerable experience in one or more of the following:—

- (a) Electrical layout of H.T. Sub-stations.
- (b) Brick buildings.
- (c) Steel and R.I.C. structures.
- (d) R.I.C. foundations.

and should state experience (if any) in taking off and billing quantities.

Applicants for (2) should have similar experience but not so extensive.

Commencing salaries will be not less than A.E.S.D. rates (London area).

Applicants must state age and give full details of education, qualifications and experience and submit their applications to the Chief Engineer, Central Electricity Board, Trafalgar Buildings, 1, Charing Cross, London, S.W.1, by Monday, the 28th July, 1947.

THE POLYTECHNIC,

309, Regent Street, W.1.

SCHOOL OF ENGINEERING.

REQUIRED for September next, a FULL-TIME LECTURER AND DEMONSTRATOR in TELECOMMUNICATIONS SUBJECTS up to Higher National Diploma and B.Sc. (Eng.) standard.

Candidates should be graduates, preferably with industrial experience.

Salary in accordance with the Burnham (Technical) Scale, subject to the usual deduction of 5 per cent. for superannuation.

Further particulars and form of application, which should be returned within two weeks of the date of this advertisement, may be obtained by sending a stamped addressed foolscap envelope to the undersigned.

J. C. JONES,

Director of Education.

SITUATIONS VACANT

CORPORATION OF KIRKCALDY. ELECTRICITY DEPARTMENT.

APPLICATIONS are invited for the position of Mains Superintendent from Chartered Electrical Engineers, not exceeding 45 years of age, who have held a responsible position in the distribution department of an electricity supply undertaking. Applicants should have considerable experience in the design, construction, commissioning and maintenance of E.H.T. and L.T. distribution systems including sub-stations, be able to prepare estimates and specifications for this work, and have a sound knowledge of modern methods of street lighting by electricity. The salary and conditions of service will be in accordance with the N.J.B. Agreement, Class E, Grade 3 (at present £619/633 per annum), and the selected candidate will be required to pass a medical examination. Applications endorsed "Mains Superintendent," stating age, qualifications, training and experience, along with copies of not more than three recent testimonials, should be in the hands of the undersigned not later than 31st July, 1947.

JOHN H. McLUSKY,

Town Clerk.

SKIPTON URBAN DISTRICT COUNCIL. ELECTRICITY DEPARTMENT.

Appointment of Meter Tester and Installation Inspector.

APPLICATIONS are invited for the position of Meter Tester and Installation Inspector. Applicants must be capable of testing single phase meters and maximum demand indicators, and also must be acquainted with regulations governing all types of electrical installations.

Wages and conditions will be in accordance with the National Joint Industrial Council for the Electricity Supply Industry (Zone "B"), at present 2s. 7½d. per hour for 47-hour week.

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

Applications, stating age and qualifications, should be forwarded to the undersigned not later than the first post on Tuesday, the 29th July, 1947.

W. V. SMYTHE,

Engineer and Manager.

Electricity Offices,
79, Caroline Square,
SKIPTON, Yorks.

WORCESTER VICTORIA INSTITUTE.

WANTED for September, teacher for senior and advanced classes in Electrical Engineering. Graduate or equivalent qualifications. Forms of application and further particulars obtainable on receipt of stamped addressed envelope from the Secretary for Education, 4, Copenhagen Street, Worcester.

ELECTRICIAN.—Leading Birmingham Wholesale requires General Manager. Essential qualifications; good organiser, acquainted local Trade, able to direct buying, previous executive exper. Large staff and turnover exists. Good remuneration and permanency.—Full details, Box L.F.P., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4.

SITUATIONS VACANT

STOKE-ON-TRENT CORPORATION.
ELECTRICITY DEPARTMENT.

Meter Testers (2), Grade 1.

APPLICATIONS are invited for the appointment of two qualified Meter Testers. Applicants must be capable of testing single-phase, polyphase, and D.C. meters and also maximum demand indicators, and indicating and recording instruments.

The wages and conditions will be in accordance with the Agreement of the National Joint Industrial Council for the Electricity Supply Industry; wages at present £5 17s. 6d. gross per week of forty-seven hours. The appointments will be subject to the provisions of the local Superannuation Act, 1937, and the successful candidates will be required to pass a medical examination.

Application form and further details may be obtained from the General Manager, Electricity Department, 31, Kingsway, Stoke-on-Trent. Completed applications should be returned in the envelope provided so as to be received not later than Friday, 1st August, 1947.

HARRY TAYLOR, Town Clerk.
Town Hall, STOKE-ON-TRENT.

LINCOLN CORPORATION.
ELECTRICITY DEPARTMENT.

Assistant Meter Superintendent

APPLICATIONS are invited for the position of Assistant Meter Superintendent in a Class "A" Polyphase Meter Testing Department. Applicants should have a sound technical training and be fully conversant with the maintenance of all types of Meters and Instruments. The conditions of employment will be in accordance with the National Joint Board Agreement, and the salary will be grade 8a, Class "G," at present £437 per annum.

The successful candidate will be required to pass a medical examination, and the appointment will be subject to the Local Government Superannuation Act, 1937. Applications should be forwarded to the undersigned, and should be received not later than Wednesday, the 6th August, 1947.

F. NEWBY,
Engineer and Manager,
Electricity Department,
Brayford Side North,
LINCOLN.

H.M. COLONIAL SERVICE.

APPLICATIONS are invited for the post of Lecturer in Electrical Engineering, Technical Institute, Lagos, Nigeria. Candidates should have appropriate degree qualifications or an equivalent standard qualification of a professional body. Previous teaching experience is desirable.

The teaching of Electrical Engineering is a new departure for the Institute, and at first the standard of work attained by students will not be high. The successful candidate will be in complete charge of this Section of the Institute. He will be required to organise courses of instruction and to teach Day and Evening students.

Salary £660-£1300 according to qualifications and experience.

The post is pensionable. Terms of service include free quarters, free passages for officer and wife on appointment and on leave, outfit allowance of £60 on first appointment, free medical attention and home leave on full pay after eighteen months tour at rate of seven days for each month of resident service. Income tax is payable at low West African rates only.

Applicants should write at once to the Director of Recruitment (Colonial Service), 15, Victoria Street, London, S.W.1, stating age, professional qualifications and experience.

SITUATIONS VACANT

UNIVERSITY OF BIRMINGHAM.

FACULTY OF SCIENCE.

APPLICATIONS are invited for the post of Lecturer in Electrical Engineering (Grade 11a) at a salary of £750-£850 p.a. The appointment will date from 1st October, 1947. The qualifications required should include those necessary to teach the principles of Electrical Machines.

Three copies of applications, with the names of three referees, should be sent to the undersigned not later than 12th August, 1947, from whom further particulars may be obtained.

C. G. BURTON,
Secretary.
The University,
Edmund Street,
BIRMINGHAM, 3,
July, 1947.

ARMATURE winding Charge-hand required for repair shop, to control female labour on small Armature and Stator winding. Applicant must have experience of A.C. and D.C. winding.—The Midland Electric Installation Co. Ltd., Cyprus Works, Upper Villiers Street, Wolverhampton.

EXPERIENCED Industrial Lighting Engineer required for London area. Excellent prospects for the right type of man. Apply, giving full particulars, to—Veritys Ltd., 66, Quay Street, Manchester, 3.

SITUATION WANTED

YOUNG man, 27 years of age, energetic, single, and willing to travel anywhere in the world, wishes employment. Have spent several years in the tropics and remained healthy. Ex-R.A.F.; wide electrical experience, but will take any suitable employment, preferably in the tropics or travelling in the tropics.—Box L.F.O., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4.

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

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INSULATORS: Suitable for overhead service cables. Bakelite, brass inserts; screwed P.O. thread for pin mounting; vertical type with drip groove, 5½ in. high, 3½ in. dia. Large quantities available; sample 2s. per return. Discount on quantities.

WOOD SWITCH BLOCKS: 3½ in. round and square, 6 in. by 3 in. by ½ in.; 9 in. by 3 in. by ½ in. and 6 in. by 6 in. by 1 in. White Enamelled and Walnut Finish from 6s. 6d. to 6s. 3d. per dozen respectively. Discount on quantities and for natural finish.

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

CERAMIC Rods, suitable 110-250v., 750-1000w., 9 in. to 10½ in., ½ in. dia. Different threads, in each lot 5 000. Also complete 80/20 N.C. Wire.—Sole Agent, Richard Voss, 6, Merton Way, Hillingdon, Middx.

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5 000 YARDS 3-core C.M.A. circ. Glace Cotton Flex, 9/012 and 16/012, and quantity of twin-core, 10 cwt. 24G. Nickel-Chrome Resistance Wire, 65/15% by Fox and Concordia. 5 Tons 4-hard commercial purity aluminium strip (Brit. and Northern Alu. Cos.) in original coils, 13 1/2 in. wide by 22 S.W.G. 2 Tons 3 in. dia. 3-hard aluminium rod. 2 Tons 3 in. dia. duraluminium rod.—Please enquire Whyte-Leaf Machine Tools Ltd., 107, Albert Road, S. Norwood, S.E.25. ADDISCOMBE 6055/6/7.

50 1 h.p. NEW "ENGLISH ELECTRIC" Motors, 230/50 Volts: Single Phase: Cont. Rating. Price £8 10s. Cash with order. Delivery immediate. Carriage 2s. 6d.—Stark, 215, London Road, Mitcham.

15 AMP. SWITCHPLUGS.—Three pin surface metalclad complete with plug tops. Post free, 17s. 6d. each. Reduction for quantities. 47s. each in dozens. 16s. each in gross lots. Cash with order only.—Pruden and Pope, 38, Church Road, Upper Norwood, S.E.19. Tel.: LIVINGSTONE 1426. Get our reduced Summer Prices for PENCIL type electric elements.

EXHAUST Fans, 200/250 v., 50 cycles, single-ph., 1 200 r.p.m., totally enclosed induction; 8 in. diameter blades, £3 5s. 6d. each; 10 in. diameter, £3 15s. 6d.—Johnson Engineering, 319, Kennington Road, S.E.11. REL. 1412/3.

CONDENSERS, H.V. Transformers (all types), Relays, Junctions, etc., and wide range and quantities of Electrical Accessories and equipments, All New.—M.M.C., 206/210, Bishopsgate, London, E.C.2.

40 HUGH Scott Forge Blowers, 110 volts D.C., approx. 3 h.p. Motor and blower mounted as one unit. As new.—Hurst Electrical Industries Ltd., 75a, Well Street, E.9. Tel. Amhurst 4166.

ONE—100 KW. Generator, I.D.C., 220 v., 450 r.p.m. compound, sleeve bearings, screen protected, with switchboard comprising voltmeter, ammeter, circuit breaker, regulator. Guaranteed first-class condition. Available immediately. One—12 h.p. motor, Laurence Scott, 500/750 r.p.m. 220v. D.C. complete with starter and field regulator. Reconditioned. Ex stock.—Electronover Co. Ltd., 3, Retreat Close, Kenton. WORDSWORTH 4928.

SOCKETS and PLUGS (heavy industrial type).—250v., 15 amps. Three pin plugs, 2 pole and earth, with T.R.S. Gland and screwed ring. Sockets, 2 pole and earth, flange mounting, threaded to match plug. Complete with chained socket cover. New and unused. Price 13s. 6d. per unit, delivered.—Cox and Danks, Ltd., Plant and Machinery Department, London; Faggs Road, Feltham, Middx. Manchester: Frederick Road, Pendleton.

JACK PORTER, LTD., Bargains.—New small guaranteed D.C. Motor GENERATORS, dual windings, laminated fields, car radio type. 6 volt input, 230 volts, 50 milliamps output, 17s. 6d. Super 12 volt models, for mobile amplifiers, 250 volts, 120 milliamps, 19s. 6d. Vibrator Packs, 6 volts "Masteradio" and "Philco," 100 to 120 volts, 15 milliamps, guaranteed working and complete, 15s. Cash with order.—Jack Porter, Ltd. (Radio), College Street, Worcester. Phone 2442.

DYNAMO & MOTOR REPAIRS LTD.,

Wembley Park, Middlesex.

Telephone: Wembley 3121 (4 lines).

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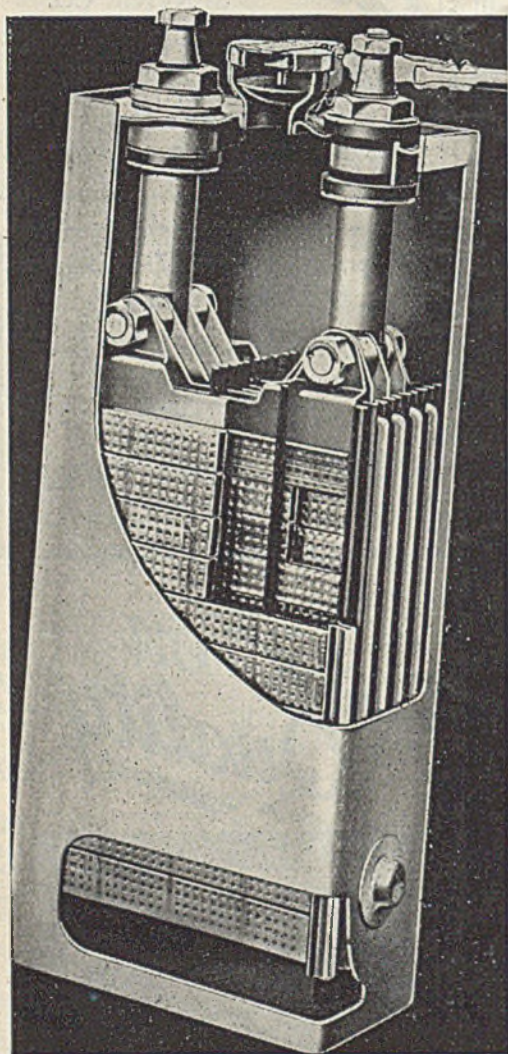
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Practical Training

THE publication this week of the report of the Joint Committee of the B.E.A.M.A., the Radio Industry Council and the I.E.E. which has been considering the question of practical training as applied to professional electrical engineers, should do much to ensure adequate recruitment in the industry for the next few years.

There is an insistent demand for an increase in the number of trained electrical engineers capable of filling responsible positions in industry, and though the output of the universities meets the need to some extent, not all graduates are regarded as being sufficiently conversant with practical engineering. The methods of half a century ago, when training was based more upon practical experience than upon academic courses, have given way to scholarship and college apprenticeship schemes as a result of the higher technical standards made necessary by engineering progress, but it has long been felt in the industry that something of a return, at least in part, to the old training methods would be a desirable addition.

Many of the larger manufacturing concerns with educational departments of their own, offer facilities for graduates and others to pursue a course of practical engineering on the lines suggested, but since such firms are relatively few, the Joint Committee was set the task of recommending how the position could be improved.

It will be recalled that the I.E.E. has already published two reports on the



subject of technical education and the training of engineers, and that published this week is concerned with including in the curricula a broad practical training. This, it is pointed out, would be possible by the provision of two types of professional apprenticeship, one of two years for apprentices who obtain their technical education as internal students, and another of four years for those who follow part-time courses.

Pre-Graduate Apprenticeship

IN the case of the two-year apprenticeship scheme suggested by the Joint Committee on Practical Training, it is recommended that the first year of the apprenticeship be served immediately on leaving school and before starting a main course of technical education, while the four-year scheme is designed on the same lines for those whose circumstances require them to follow a part-time course of technical study. The Committee offer no opinion as to which of the schemes is the better, in that the choice must be governed by domestic considerations of finance, time and so on, but both types of apprentice are badly required in the industry and both would have equal opportunity for advancement to positions of senior responsibility. The two-year scheme has the advantage that the year spent in pre-graduate training would permit of an apprentice being able to form an opinion upon his liking of engineering and if need be, allow a change in vocation before too many of his early years have gone by or before he enters upon more serious study. Space will not allow of more than an abstract of the report to be published in this issue, but it is urged that the industry study in detail the particulars we give, for there appear to be in the Committee's recommendations, means whereby the intake of much needed technical man-power in the industry can be substantially increased.

Deferment of National Service

IN view of the publication this week of the report of the Joint Committee which has been considering the practical training of professional electrical engineers, a new edition of the conditions attaching to the deferment from

military service of apprentices and students taking full-time courses in certain technical colleges, warrants careful study. The I.E.E. has considered these conditions in all their aspects and has sent us a statement based on a memorandum by the Ministry of Labour. In brief, deferment beyond the age of eighteen may be granted under certain conditions to student-apprentices in, and other students of, engineering to enable them to complete a course of preparation, extending over a period of not more than five years, designed to fit them for employment in a professional grade—but application for deferment must be made on form N.S.294, obtainable from the local office of the Ministry and be supported by the applicant's employer. The I.E.E. document is 5900/78 and its details should be studied with care.

Nationalisation and Cables

SPEAKING at Henley's annual meeting last week, Sir MONTAGUE HUGHMAN, chairman, expressed the hope that when the electricity supply industry passed to State-ownership cable manufacturers would be allowed to work as at present. Nationalisation might have far reaching effects on his company, he said, as there might be one authority acting as buyer for the bulk of the company's home production. On controls, Sir MONTAGUE declared that he believed the Government's intention was to remove these as supplies became more plentiful, but on the subject of coal, he expressed the view that it was one of the major tragedies of modern times that we had got to the point where the Government had to ask certain users of coal to revert to oil-burning if possible. If this country were not to fall to a second or third class power, ample coal by some means or other must be brought up, not only for home consumption, but for export. The oil importers had enough work on their hands to supply special needs, and it was a terrible thing to realise that in reverting from coal to oil, as many firms were compelled to do, we were increasing our imports. There was, continued Sir MONTAGUE, nothing in his remarks to be read politically, but he thought it was imperative for the safety of our future that the coal underground in abundance,

should be brought to the surface in sufficient quantities for home use and for export.

Load Staggering

ATTENTION was drawn in THE ELECTRICIAN last week to the urgency of devising some means of flattening the national peak loads next winter, in order to save load shedding even more serious to industry than was that experienced last winter. As if in answer to our appeal the Government are now considering the possibilities of staggering industrial working hours. In last week's issue also, we suggested that the seriousness of the generating plant position was not sufficiently appreciated, and confirmation of this point of view is given by the fact that the Government are finding it necessary to consider what action can be taken against firms which refuse to co-operate in regional arrangements. What industry generally, seems unable to realise, is that unless there is some arrangement whereby the demand on the national generating plant capacity is kept to within a given maximum, blocks of industrial areas all over the country will be denied electricity supply whether those areas like it or not. Without that limitation on demand the generating capacity of the whole country would be dangerously overloaded, and the national plant put into jeopardy. With the co-operation of industry and its willingness to stagger working hours, however, these conditions would be avoided, and load shedding, if not eliminated altogether, would certainly be less serious.

The Fused Plug

THE publication by the B.S.I. of the specification with respect to the 13-A fused plug and shuttered socket will have brought to a conclusion a certain amount of the controversy which has permeated the industry over a number of years, but it will not eliminate it altogether. That this is so is shown by the remarks of "Supervisor" in this issue, who draws attention to some of the confusion which still exists and must remain while there is a multiplicity of plug and socket connectors of various ratings and types. Many of the housing schemes being carried out, many of the block dwellings being built are to be

wired with accessories conforming to the old specification on the one hand and with accessories designed in anticipation of the new specification on the other. In these circumstances accessories designed both to the old as well as the new specification will have to be made, and with the shortage of material and labour prevailing, the supply position may worsen. That the new specification will, in time, take precedence over the old, is not at issue, but since manufacture to its design is at present likely to be difficult where materials are concerned, it is suggested that the new plug and socket may not be altogether welcome at this stage.

For American Consumption

MEMBERS of the Edison Electric Institute were recently addressed by Brigadier General WADE H. HAYES on the subject of nationalisation of the electricity supply industry, in such a way that though few would perhaps find fault with the generalities expressed, the overall picture was one of gloom. One of the difficulties with such addresses is that when they are given in the U.S.A., there are few in that country intimate enough with supply conditions obtaining here, to be able to separate opinion from fact. Whether one agrees with nationalisation or whether one does not, it must be understood in the U.S.A., as it is here, that the technical enthusiasm which has made the British supply industry an example even to America, is in no way related to politics and is not likely to be checked by them. The lead which the British supply industry has established over its counterparts in other countries is based upon engineering experience the world over, and though in the future the administration of the industry may be different, its technical framework, the high qualifications of its personnel, its pioneering spirit and ability to overcome operational problems—of which the supply industry in the U.S.A. can, on account of its geographical position in relation to the late war zones and its adequate coal and plant supplies have only read—will remain the same. The supply industry of this country has abounding confidence in itself and the future, and intends to make further progress under nationalisation or any other administration.

Portrait—Mr. E. T. Norris



FINDING mental relaxation in music and in piano playing, Mr. E. T. Norris, chief engineer of the Transformer Department of Ferranti, Ltd., has in other mood made many outstanding contributions to electrical engineering, while he maintains his physical fitness in winter by cross-country running, and by sailing and playing tennis in summer.

Educated at Yarmouth College, Great Yarmouth, of which his father was headmaster, E. T. Norris, after passing London University matriculation, gained an open scholarship at Finsbury Technical College, where he completed a two years' course in electrical engineering. His early practical training was with the British Westinghouse Co., Ltd., from 1915 to 1917, and while there he attended the Manchester College of Technology and obtained the associate-ship. He served with the R.E. Signals from 1917 to 1919, and on being demobilised took the position of transformer designer with the Metropolitan-Vickers Electrical Co., Ltd.

In the following year he went to Ferranti, Ltd., as chief assistant transformer designer, and within two years became chief transformer designer and had completed the design of the first 500 000 V

transformer to be built in this country, to be followed three years later by apparatus producing, for the first time in Great Britain, 1 000 000 V r.m.s. In 1928 he designed the first British 1 000 000 V testing equipment, forerunner of the building of four 1 000 000 V and three 500 000 V h.v. laboratories in this country. The largest power transformer built for the C.E.B.—one of 75 000 kVA—was designed by him in 1929, with a 50 000 kVA self-cooled rating, the biggest of its type in the world. Later work included a 80 000 kVA power transformer—another world record at the time. He then began work on the invention and design of the moving coil voltage regulator. During the war large numbers of these regulators were supplied to the Services.

In 1927 Mr. Norris was made responsible for the direction of the development of the technique of h.v. surge production and recording, followed progressively by the direction of research and development associated with the automatic control of industrial processes, h.v. electrostatic precipitation and radio frequency industrial heating. Other developments were his invention and design of the Astatic voltage relay in 1934, and the invention and design for the Air Ministry of high-speed voltage regulators for short-wave radio transmission, which he commenced in 1936.

Mr. Norris is a member of the I.E.E. and its Council, and was Chairman of the Transmission Section for 1945-6 and is this year Chairman of the North-Western Centre. He is also a member of the "Mechanicals" and of a number of committees of the E.R.A. and the B.S.I., and a fellow of the American I.E.E. For some years he was a part-time lecturer at the Manchester College of Technology. He is the author of eight papers and addresses read before the I.E.E., of one paper for the American I.E.E., and of over 200 papers and articles published by the British and foreign technical Press. Over forty contributions have appeared in *THE ELECTRICIAN*.

He was a British delegate to the International Electrical-Technical Conference at Paris in 1932, Prague, 1934, The Hague, 1935, Paris, 1937, and Torquay in 1938; and he was a member of the International H.T. Conference in Paris from 1929 to 1939 and last year.

Married in 1925, Mr. Norris has three sons, the eldest of whom has just commenced farming.

MODERN SUPERTENSION CABLES

by C. C. BARNES, A.M.I.E.E., A.I.I.A

Part I of this series reviews briefly, standard designs of screened type power cables for voltages up to 66 kV. Subsequent articles will deal with the various cable designs developed to suppress ionisation and permit the use of high maximum electric stress in order to reduce the insulation thickness and minimise cable weights and dimensions.

THE steady demand for progressively larger blocks of power due to the increased mechanisation of industry and the application of electricity to railways, mines, factories and the domestic sphere coupled with the use of buried cables for many purposes where overhead transmission lines were hitherto used, have resulted in the development of insulated cables capable of operating at progressively greater voltages.

B.S. 480:1942 (Paper Insulated Cables for Electricity Supply) provides design data for belted, screened, and S.L. (separate lead) type cables for voltages up to and including 22 kV working pressure, but at the present time there is no British standard available for higher voltage cables. The term "supertension" is applied to voltages above 22 kV, and the following notes review briefly the various types of such cables available.

Belted type cables, as used for 22 kV and lower voltages, have proved to be unsuitable for 33 kV operation, since the three-phase field is distributed in an irregular manner over core insulation, belt insulation and worming material in the interstices between the cores, due to the lack of uniformity possible when the insulation is applied partly on the cores and partly over the assembled cores, after they have been wormed into approximately circular section by means of jute or paper packing in the spaces between the cores.

Thus in the belted cable the direction of the lines of electric stress is continually changed in accordance with the voltage distribution on the conductors, so that at any instant they are parallel to some surfaces of the paper layers, or have components in that direction (tangential stresses).

The electric strength of the laminated cable dielectric along the layers (i.e. tangential to the paper tapes) is only approximately ten per cent. of the radial electric strength, and the effect of this pronounced tangential stress is to produce local discharges, known as ionisation, thereby adding to the copper losses a further source of power loss, which in time tends to form

carbonised paths in the dielectric which may eventually lead to breakdown of the cable.

Another form of ionisation is due to voids^{1*}, or gas pockets within the dielectric resulting from imperfect impregnation, bending of the cable during processing and installation, varying load cycles, or overheating of the cables. Owing to their lower permittivity the stress in these voids, or pockets, is three or four times greater than in the surrounding dielectric, so that the breakdown strength of cable showing such voids is greatly reduced.

The maximum electric working stress used for early designs of power cables was less than 20 kV/cm., well below the breakdown strength of any air occlusions in the insulation. Such cables were satisfactory for voltages up to 11 kV but resulted in bulky and expensive cables for greater service voltages, consequently it became necessary to increase the maximum stress, which was raised to about 30 kV/cm. and later to the order of 40 kV/cm. for 33 kV cables.

Modern supertension cables (see Fig. 1) are invariably of the "screened" type in which each individual conductor and its enveloping paper insulation is surrounded by an earthed electrostatic screen comprising metallised paper or thin copper tape so that the lines of stress are radial. The screened or "H" type construction which was patented by Hochstadter in 1914 results in the voltage gradient being confined to the paper insulation on the cores, and in maintaining a uniformly radial stress in the cores, thereby avoiding tangential stresses.

The screened type cable is available in three forms:—

1. *Single Core Screened Type*, used on installations where armouring is not required, e.g. power station cabling or where the conductor section is such that a three-core cable would be inconveniently heavy. When three single cables forming a three-phase circuit are buried in the ground they are normally installed in triangular formation (apex upwards) and bound together at regular intervals; in other applications they are supported on cleats.

2. *H.S.L. Type*.—In these the paper-

* The final article of this series will provide a detailed bibliography.

insulated cores are screened and individually lead-covered and taped; the three cores are then laid up, the assembly being wormed into circular section with compound jute roves, armoured and served overall. H.S.L. type cables may be steel-tape armoured, as the interstices between the cores can be employed for housing reinforcing strands in order to provide longitudinal strength, but the usual practice in this country is to use wire-armoured multicore screened type cables. The separate lead sheaths of the "H.S.L." type cable results in induced sheath currents, but the resulting losses are small and this form of construction is very convenient for jointing and terminating.

3. "H" Type Cable.—In common with the "screened type" cables already mentioned the conductors in the "H" type cable are insulated with the full thickness of insulation required between core and earth itself and screened, the cores are then twisted together to form a three-core (phase) cable. This cable has no belt insulation and the interstices between the cores are filled with paper pads, the assembly is then bound together with a cotton tape having copper wires in the weave, in order to maintain electrical contact between the electrostatic screens and the lead sheath which is earthed. The "H" type construction gives the smallest overall diameter for a given copper section, but is not always so convenient to terminate and joint. There is little to choose between the performance of the "H" and

"H.S.L." types, and the choice is usually a matter of individual preference.

Current British and American maximum conductor temperature-limits for screened type cables for the voltage range 33 kV to 69 kV are compared in Table 1, Table 2 gives design data for standard 33 and 66 kV single core paper insulated cables made in this country, and comparative data from the relative American specification are included*.

Several standard American copper sections have been omitted in Table 2 in order to make the comparison between the two ranges of copper conductors as simple as possible. An important difference in these two sets of standards is the American practice of reducing the dielectric wall with increasing conductor size, whereas the British standards have a steadily increasing thickness of paper insulation on the larger copper conductors.

The corresponding British practice for 33 kV three-core "H" and "H.S.L." type cables is to apply a radial thickness for dielectric of 0.325 in. for the normal range of conductor sections.

The data relative to British designs are representative of cable-makers' practice during the past fifteen years, but to-day manufacturing experience and long-term investigation into high voltage phenomena has reached the stage at which these dielectric thicknesses can safely be reduced.

Modern 33 kV screened cables are therefore designed on a maximum electric stress

TABLE I
Maximum Conductor Temperatures for Screened Type Cables

Single core	British practice Permissible temperature rise (°C.)			Maximum permissible core temperature (°C.)		Single core	American practice Permissible temperature rise (°C.)		Max. permissible core temp. (°C.) In ducts or in air	
	Laid direct	In air	In ducts	Laid direct or in air	In ducts		In ducts	In air		
Single core 33 kV and 66 kV oval conductors	50	40	35	65	50	35 kV (phase-phase)	50	30	70	
Single core 33 kV and 66 kV round conductors	45	35	35	60	50	46 kV (phase-phase)	43	23	63	
						69 kV (phase-phase)	40	20	60	
Multicore	Laid direct	In air	Armoured	Unarmoured	Laid direct or in air and armoured cables in ducts	Unarmoured cables in ducts	Multicore	In ducts	In air	In ducts or in air
Multicore 33 kV	50	40	50	35	65	50	35 kV (phase-phase)	50	30	70
33 kV HSL (separate lead type)	45	35	45	—	60	—	46 kV (phase-phase)	43	23	63

British practice is based on an (assumed) ground temperature of 15° C. and normal ambient air temperature of 25° C. The three main installation methods are:—

1. Laid direct in the ground.
2. Run in free air.
3. Pulled into ducts.

American practice allows for an (assumed) ground temperature of 20° C and normal ambient air temperature of 40° C. The two main installation methods are:—

1. Pulled into ducts.
2. Run in free air.

of about 40 kV/cm. resulting in a radial thickness of 0.315 in. for a three core cable of 0.10 sq. in. copper section.

On the basis of maximum stress and utilising dielectric radials as quoted above there is no justification for increasing the dielectric wall with increasing conductor

ing except for very small copper sections (e.g., 0.06 sq. in. and smaller sizes).

Where it is essential that single-core cables of larger copper section are wire armoured, various types of non-magnetic armouring materials are available*, but these materials make the cable expensive and the advice of the cable-maker should always be obtained when this problem arises.

For 66 kV, and particularly for higher voltages, the mass impregnated and screened type cable tends to become uneconomical, and special cables have been developed which permit a higher maximum stress and consequently a reduced thickness of insulation.

When it is realised that the instantaneous breakdown value of the impregnated paper used for the conductor insulation is in the neighbourhood of 400 kV/cm. and the long time breakdown value about 160 kV/cm., it is clear that the screened type construction results in very inefficient utilisation of the insulating medium for the higher operating voltages.



Examples of some solid type paper insulated screened cables

section, and the minimum recommended thickness for the larger copper sections is 0.280 in. radial.

Corresponding dielectric wall thickness for single core 33 kV, screened type cable is 0.335 for 0.1 sq. in. copper section tapering down to 0.30 in. for the larger copper sections. When using maximum stress as a basis for computing the dielectric thickness no correction is normally made for the effect of stranding, furthermore the same dielectric thicknesses are used for both circular and oval conductor cables.

Above 33 kV, the weight of three-conductor screened cables tends to become excessive and they have to be made in relatively short lengths and then wound on drums having large diameter centres; 66 kV screened cables are usually single core mainly because they can be manufactured and handled in longer lengths than the three-conductor cable, thereby minimising joints.

Except for very short runs of single-core cables the installation is bonded at both ends, which introduces sheath losses on a.c. systems, and such installations are not protected with the normal ferrous armour-

Appointments Bureau

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TABLE 2
Thickness of Dielectric and Lead Sheath for Single Core Cables
Centre Point Earthed Only (Grounded Neutral)

Nominal area of conductor (sq. in.)	British practice*		Area of conductor		American practice†		
	33 kV	66 kV	Circular miles	sq. in.	27 kV	33 kV	69 kV
0.06	0.40/0.10	—	105 500	— 0.0828	0.315/0.090	0.395/0.090	—
0.10	0.40/0.10	—	133 100	— 0.1045	0.305/0.090	0.385/0.090	—
0.15	0.40/0.10	0.65/0.14	211 600	— 0.1661	0.285/0.090	0.355/0.100	—
0.20	0.40/0.11	0.65/0.14	250 000	— 0.1962	0.275/0.090	0.350/0.100	—
0.25	0.40/0.11	0.65/0.14	350 000	— 0.2747	0.275/0.100	0.345/0.100	0.650/0.120
0.30	0.40/0.11	0.65/0.15	400 000	— 0.314	0.275/0.100	0.345/0.100	0.650/0.120
0.40	0.40/0.11	0.65/0.15	500 000	— 0.3925	0.275/0.100	0.345/0.105	0.650/0.120
0.50	0.45/0.12	0.65/0.15	600 000	— 0.471	0.275/0.100	0.345/0.105	0.650/0.125
0.60	0.47/0.13	—	800 000	— 0.628	0.275/0.105	0.345/0.110	0.650/0.125
0.75	0.50/0.14	—	1 000 000	— 0.785	0.275/0.105	0.345/0.110	0.650/0.125

* Thicknesses are minimum values.

† Thicknesses are average values and minimum thicknesses must not be less than 90% of the values specified above.

13A Fused Plug and Socket

Requirements of New B.S. Specification 1363

STANDARDISATION of the new 13 A fused plug and socket outlet took place, at the beginning of the month, with the publication of British Standard Specification 1363:1947, "for two-pole and earthing-pin fused plugs and shuttered socket outlets for circuits up to 250 V." It will be remembered that the Ministry of Works Report on "Electrical Installations" (Post-War Building Studies, No. 11), stated that the recommendation for ring circuits necessitated the introduction of a 13 A fused plug. Subsequently, the recommendations were considered by various committees, including the I.E.E. Wiring Regulations Committee, and the final conclusion, of which the present specification is the result, was that a new type of "all-purpose" 3 kW fused plug and shuttered socket outlet should be standardised for domestic purposes.

The new specification points out that B.S. 196:1930 (two-pin plugs and sockets with earthing connections) and B.S. 546:1934 (two pole and earthing pin plugs and sockets for 2, 5, 15 and 30 A) remain in force for extensions to existing installations, or where a 30 A rating is required.

After a definition of terms, in which it is stated that plug pins shall be of rectangular cross-section, the specification begins by requiring that no part of a current-carrying plug pin shall be less than 0.312 in. from the periphery of the face of the plug, while, among other precautions against accidental contact by the user, is the stipulation that when the plug is withdrawn the current-carrying socket contacts are automatically screened by shutters not operated solely by insertion of the current-carrying pins. The earthing pin must make and break contact with its socket before and after, respectively, the current-carrying pins make and break with their socket contacts.

The fuse link (to B.S. 1362) is to be contained within the body of the plug, and mounted between the line terminal and the corresponding pin in such a way that it cannot be displaced when the plug is in use. Similarly, the plug is to be strong enough not to fracture in the event of the link bursting in service.

Details are then given of the construction of pins and terminals within the plug, and it is required that insulating barriers, forming an integral part of the plug, shall be provided to separate metal at different potentials, including bared flexible conductors within the plug. The flexible cord,

which must be gripped effectively—a later paragraph specifies a test for the effectiveness of the grip—must enter on the opposite side to the earth pin, and between the current-carrying pins. A finger grip or other suitable means must be provided for inserting or withdrawing the plug without stressing the cord, and the plug must be designed to discourage gripping at the point of entry of the cord.

Regarding materials, the specification requires that ferrous metal parts shall be rust-proof, while the base and cover of plug and the socket outlet plate and shutter must be of tough non-ignitable insulating material and the socket outlet base of a vitrified ceramic.

In the socket outlet, the contacts must be self-adjusting, and the means for producing contact pressure are to be associated with each contact independently. Means are to be provided for earthing the socket-contact to the outlet box automatically, and the holes in the socket plate are to be chamfered at their front edges to facilitate pin insertion.

Detailing type tests, the specification requires that the plugs and sockets shall break a current of 17 A in an a.c. non-inductive circuit, this test being performed by withdrawing the plug at a speed of 6 in/sec. ten times at intervals of 30 secs. Temperature rise on any terminal must not exceed 35° C. after sufficient time has elapsed for the temperature to become steady. The withdrawal pull of a plug from a socket outlet must be not less than 1½ lb. and not more than 8 lb.

Three sampling tests are also specified. The first concerns minimum withdrawal pull from an individual socket outlet (not less than 8 oz.), or alternatively, the maximum voltage-drop between an individual contact and the corresponding pin, measured from terminal to terminal, shall be 12 millivolts at 13 A. Each plug and outlet must, also, pass an insulation resistance test of at least 100 megohms, measured at not less than 500 V d.c., while the a.c. flash-over test must be passed at not less than 2 000 V, 50 cycles. Both the latter tests are to be applied between line and neutral terminals and between terminals and other parts insulated from them.

Plugs must be marked with the word "fused" on the outside of the cover, so that it is always visible when the plug is in engagement with the outlet. Sockets must be marked with their current rating of 13 A.

DOMESTIC WIRING PROBLEMS

by "SUPERVISOR"

In the article below are discussed some of the reactions to the standardising of plugs and sockets, followed by a short critical review of the 13-A fused plug and shuttered socket dealt with in the now-published B.S.S. 1363. Details of the new specification are given on the preceding page.

FURTHER to my notes last month regarding the construction of the new standard plug and socket, many installation engineers appear to be concerned and worried about what is the future position—will the new standard be the only one to be taken into account for all new domestic installations, or will it be permissible to continue to instal plugs and sockets to B.S.S. 546, and if so, what becomes of standardisation? The writer has taken part in several discussions on the point, which had at best to be mere expressions of opinion, for official or semi-official pronouncements made no contribution towards a solution.

Going back to the start of the business, the Appendix to Post-War Building Studies No. 11, Electrical Installations, para. 1, simply states that consideration had been given to the provision of a standard "all-purpose" socket-outlet and plug for domestic purposes. Nothing whatever is said as to the desirability or otherwise of this new standard completely superseding existing standard socket-outlets and plugs, but it seems difficult to imagine that the Committee were thinking merely of just another socket-outlet, to be tacked on to the list of existing types.

It is important to note the word "domestic" in the Committee's report, as it is being argued in some quarters that the new standard is unsuitable for industrial purposes. Clearly, the new standard was never contemplated as suitable for use in such installations, although many will probably find their way there. It would seem, therefore, that the existing range will be continued, if only for industrial use, and it must be agreed that the standardisation problem is less acute in that direction than it is in the domestic sphere.

The March, 1946, Supplement to the I.E.E. Regulations makes it clear that although the new 13-A socket-outlet and plug is permissible on ring circuits and under certain other conditions, it is also permissible to continue to instal socket-outlets and plugs under the existing standards and under existing regulations. It is, of course, possible that some amendment may be made now that the officially-approved standard is available.

Some slight lifting of the curtain may be discerned in the draft of the British Standard Code of Practice, Electrical Installations (General), in its reference to socket-outlets. Para. 305, Arrangement of Final sub-circuits (c), says—"Socket outlets in domestic premises should be of the fused plug type of 13-A rating and these may be served by a ring circuit having a conductor of cross-sectional area of not less than 0.0045 sq. in., the circuit being protected by a fuse on the consumer's supply control unit or distribution fuseboard, both ends of the ring being brought into the fuse terminals. But every appliance served from such outlets should be protected by a suitable fuse incorporated in the plug."

The remaining sub-clauses make no reference to any other type or size of socket-outlet, from which it may be concluded that the compilers had no intention of using anything else in the domestic installation than the new 13-A rated socket-outlet. Whether or not the final approved draft is issued in the same form remains to be seen, as no doubt some pressure will be brought to bear.

It will be noted that in the above-quoted sub-clause, no definite reference is made to the capacity of the fuses to be inserted into the plug, or even if there are to be any rated differently from the 13-A socket. The final sentence refers to a "suitable" fuse, and here opinions are likely to differ. One manufacturer claims "The New Standard Domestic Gauge," with plugs fused to 3, 7 or 13-A as required, but we shall have to wait and see the fuse performances of these plugs, and under what standard they are constructed, before any really serious comment can be made.

However, a preliminary and purely personal view may be advanced here, based upon extended use with existing types of 13-A socket-outlets with fused plugs, and which have fuses rated at 3 and 13-A. It is found in practice that the 3-A fuse is never used, reliance upon the 13-A fuse being complete, and, so far, perfectly justified. In seeking the reasons for the disuse of the smaller fuse the following points were elicited, and which are apparently so widely agreed that the

makers of the socket-outlet are now discontinuing the supply of the 3-A fuse.

One of the main reasons advanced for the discard of the 3-A fuse is that, when two sizes are supplied the consumer is liable to use the smaller fuse for a 2 or 3 kW radiator, and wonder why the fuse blows. Obviously, when he finds out, he uses nothing but 13-A fuses from then on, as he can hardly be expected to appreciate the finer academic points behind the provision of the smaller size of fuse. Further, in practice, domestic appliances do not become overloaded; faults are either in the connecting flex' or the appliance, and are almost invariably short-circuits. Closer protection than that provided by means of an efficient 13-A fuse is, therefore, unnecessary.

The point is then raised—what about electric clocks and other very small current-consuming appliances? Assuming that a clock takes 5 W and is protected by means of a 3-A fuse blowing at 4½-A, it is still 200 times overloaded before the fuse blows. There would appear to be equivalent protection with a 13-A fuse which blows in 0.0006 second, in fact considerably enhanced protection over common practice which permits the consumer to rewire a fuse with any handy material.

Provided, therefore, that a fuse with a really satisfactory performance is incorporated in the new domestic standard, the writer suggests the use of one size only, in order to avoid further consumer-confusion and to increase the degree of standardisation.

The many advantages of a standard can be vitiated if the consumer still has three fuse sizes to plague him, and however desirable such close protection may be when rewirable fuses are used, there can be no real practical necessity for it with modern enclosed fuses to the standard desired, and which are available.

THE NEW STANDARD

Since the above notes were written, B.S.S. No. 1363/1947, dealing with fused plugs and shuttered socket-outlets for general domestic use and similar purposes, has been published. This lengthy and thorough publication deserves close attention, but it will be considered here only in so far as it answers the queries in the above paragraphs.

The new specification does not supersede Nos. 196/1930 and 546/1934, and plugs and sockets to these standards are to remain available. The enclosed fuses are, however, to what is, to the present writer, a new standard, No. 1362, and will be of all ratings up to 13-A. Otherwise there are no unexpected details and we shall have to await availability before the necessary practical tests can be made, and

upon the results of which alone the adoption of the new standard will rest.

SOME OBJECTIONS

As might be expected from previous notes, however, the present writer detects certain objections to the new standard, but these will be only briefly mentioned. The first is, having to take the plug to pieces to get at the fuse, and having to use a screwdriver for this purpose. Then there is the possibility of bridging the fuse-clips with something other than the approved cartridge fuse, and with the consumer actually handling the fuse-holder on short-circuit this may be a serious matter.

The plate and plug appear to be about the same size as the existing B.S.S. 546 15-A plug, which is usually considered to be unduly clumsy for domestic work. This was to be expected, however, with the incorporation of the fuse within the plug, and is unavoidable. Another objection is that the new standard socket-outlet requires a special iron or steel box, as it will fit none of the existing range, and only a contractor can fully understand just what that means. The present specification covers only unswitched sockets, and we have to wait still longer for a combined switch-socket-outlet.

Apart from these points which arise from a perusal of the specification, there seem to be other difficulties ahead. For instance, it may be 18 months or a couple of years before socket-outlets to the new standard are available in the quantities required for housing drives, and what are we to do about ring-main circuits in the interim? It would seem from the thorough specification that the new job is going to be quite expensive—one manufacturer has estimated the net trade cost as 15s. each—but this of the future.

Apart from these pessimistic utterances, however, the present writer will attempt to approach the matter of adoption of the new standard with an unjaundiced eye and unbiassed mind, and find out what the new socket-outlet can do on the job, which is, after all, the main consideration. The equipment that was used to test other types is still available, and will be used for the new pattern.

The Parliamentary Secretary to the Ministry of Fuel and Power has stated that during 1946 there was a net transfer of power from Scotland to England of 47 million units. The maximum power transfer was 146 000 kW from Scotland to England (which occurred from 9 to 9.30 a.m. on March 14) and 80 000 kW from England to Scotland (from 10.30 to 11 p.m. on December 30).

PRACTICAL TRAINING of ENGINEERS

RECOMMENDATIONS FOR PRE-GRADUATE WORKS EXPERIENCE

IT will be remembered that the I.E.E. published in April, 1943, a report entitled "Education and Training of Engineers,"* which reviewed existing systems and suggested a number of proposals for improvement, while a second report dealing with part-time further education was published later.*

THE JOINT COMMITTEE

In October, 1945, there was convened at the instigation of the I.E.E. a Joint Committee on Practical Training in the Electrical Engineering Industry, consisting of representatives of the B.E.A.M.A., the Radio Industry Council, and the I.E.E., to review the existing methods of practical training in the industry with special reference to those who desire to become professional engineers and technicians; to enumerate the essential features of schemes of practical training and the steps which should be taken to encourage the adoption and application of these schemes; and to prepare recommendations.

The Committee was made up of:

Sir Arthur P. M. Fleming, Mr. H. J. Allcock, Mr. D. A. Bell, Mr. J. E. Calverley, Brig. F. T. Chapman, Mr. W. N. C. Clinch, Mr. Kenneth R. Evans, Mr. T. E. Goldup, Mr. S. E. Goodall, Mr. C. Grad, Mr. D. B. Hoscason, Prof. Willis Jackson, Principal J. C. Jones, Capt. J. Legg, Mr. F. R. Livock, Mr. N. C. Stamford, Mr. S. Austen Stigant, Dr. R. C. G. Williams (later resigned), with Mr. M. W. Humphrey Davies as technical officer and Mr. W. K. Brasher as secretary.

The report, which was published on Monday, contains recommendations for the provision of two types of professional apprenticeship, one of two years for apprentices who obtain their technical education by full-time study and another of four years for those who follow part-time courses. A good secondary education is necessary for entry to either scheme. The apprenticeships are intended to provide only the general practical training that is necessary and those who have completed the courses should subsequently be given functional and specialised training in the branch of work upon which they are employed. The report also contains proposals concerning courses of study which should be provided for apprentices and refers to social and other activities organised by the apprentices themselves. Although the schemes of training may appear ambitious to many of the smaller firms, all but the smallest concerns should be able to devise satisfactory schemes of

training provided they can secure the co-operation of other engineering firms.

After reviewing the branches of industry in which professional electrical engineers are employed, the report points out that problems seldom present themselves in industry in terms which suggest their own solution, and the engineer must be sure that he obtains a complete statement of his problem. He must then seek much of the data for its solution and ensure that this is practicable. Textbooks and published tables of data will not usually provide the required information, which will be peculiar to the materials and methods that are or may be used in the branch of the industry concerned or are available to a particular firm or organisation. If he is to be qualified to solve such problems in a practical manner the professional engineer must be thoroughly acquainted both with the techniques and processes which find common application, and with those directly relevant to his particular branch. It is not necessary that he should himself be skilled in the detailed performance of these processes, but it is essential that he should understand their potentialities and limitations. Such an understanding can be acquired only by direct association with the processes and with those who perform them, and its development is the primary object of the systems of practical training discussed in the report. This training can generally best be obtained in a manufacturing organisation.

TWO AND FOUR YEAR SCHEMES

Appropriate schemes for obtaining such practical training are outlined in the report. The first is a two-year scheme called a graduate apprenticeship and intended for those who take a full-time course of technical education; for most candidates it would be preferable for the first year of the apprenticeship to be served immediately the candidate leaves school and before he starts his main course of technical education. This preliminary year may be called a pre-graduate apprenticeship. A second and four-year scheme called student apprenticeship is designed for those who propose to follow a concurrent course of part-time technical education. A third type of apprenticeship is possible in which the apprentice spends alternate periods in the factory and at a college. Such schemes are a compromise between the graduate and student apprenticeships, but whatever form a scheme takes, at least twelve months of graduate apprenticeship should, the Committee state,

* THE ELECTRICIAN, May 14, 1943; † THE ELECTRICIAN January 12, 1945

be served after the educational course has been completed.

The main object of a course of practical training is to familiarise the apprentice with: (a) The materials, tools, equipment and craft skill available in modern industry; (b) the techniques and organisation involved in designing, developing, manufacturing, installing and operating engineering equipment; (c) the outlook of the men he will be called upon to control, in one way or another, during his subsequent professional career.

LEARNING FACTS ABOUT INDUSTRY

At the beginning of his training the apprentice's acquaintance with the organisation and scope of the electrical engineering profession is likely to be very limited and such ideas as may have formed in his mind regarding his future career are likely to undergo considerable change as his training and experience develop. Careful observation of the progress of each apprentice is, therefore, essential at every stage of training so that a suitable appointment may be made at the end of apprenticeship. Independent responsibility begins with this initial appointment and although the junior engineer is then no longer under the direct supervision of the training department, continued observation of his progress is none the less desirable.

Schemes of practical training for graduate, pre-graduate and student apprentices are detailed in the report and each scheme may be divided into basic mechanical training, basic electrical training, and office training. The period of basic mechanical training, which occupies nearly half the course, gives the apprentice an acquaintance with workshop methods and processes and with factory organisation. The second period gives him opportunities for widening his knowledge of the properties of materials used in electrical engineering and of the various methods employed in assembling and testing electrical equipment. The final period gives him an introduction to the office work connected with production and design as well as opportunities for indicating his functional ability. Only the larger departments of an industrial concern can accommodate more than two or three apprentices at a time and it will be necessary to utilise a range of alternative departments for most sections of the course. This means that some aspects of the general training must be focused on the problems connected with particular products, but this specialisation must not be too narrow.

The complete course of training suggested by the Committee for those who obtain their technical education by full-time study is planned to last 104 weeks,

divided as follows: (a) Basic mechanical training, 44 weeks; (b) basic electrical training, 36 weeks; (c) office training, 24 weeks.

Pre-graduate apprentices should complete as much as possible of their basic mechanical training during their pre-university year, leaving those portions of the course which need fundamental electrical knowledge until they have graduated. As they should be released for part-time study on one day each week during the college year, it might be desirable as compensation to increase the length of the period of basic mechanical training to 52 weeks. The course has been drawn up on the assumption that at least part of the summer vacations during the university period will be devoted to further practical training.

The complete course of training for those who obtain their technical education by part-time study during their apprenticeship should last 208 weeks. The course outlined is modelled on the same principles as the course for graduate apprentices, but it is possible to cover more departments and to spend longer periods in each. The first two years are devoted mainly to basic mechanical training, the third to basic electrical training and the last to office training.

OPERATIONAL TRAINING

In the operation and maintenance of electrical equipment the Committee point out that there are large organisations organisation, it will generally be desirable supply of electricity, the operation of systems of electric traction and the provision of telecommunication facilities by radio, line and cable. Apprenticeships can be provided for entrance to operating concerns, wholly with an operating concern, wholly with a manufacturer, or by means of a combined apprenticeship with both. Those who have completed such apprenticeships will be suitable for initial appointments as junior engineers but, as in the other schemes, further functional training will be necessary and their work should be varied from time to time so that they may obtain a wider experience in operating techniques. While a few operating organisations may be able to provide training for graduate apprentices within the organisation it will generally be desirable for a part of the training to be obtained in a manufacturer's works. It will not usually be practicable for an operating organisation to accept pre-graduate apprentices as that part of the training which is given requires more technical knowledge than such an apprentice would possess.

A graduate apprenticeship scheme to be served mainly with an operating concern

is outlined in the report and provides for a total of 36 weeks with a manufacturer and 68 weeks with an operating organisation. Schemes for the training of student apprentices can be developed on similar lines.

CRAFTSMEN APPRENTICES

Among those apprenticed as craftsmen there will be some who show promise in their technical education, and provision should be made for selecting the best of these for transfer to student apprenticeships. Such transfers should be made as soon as possible after the apprentice reaches the age of 18 years.

There are many small firms who, either because of the small number of their employees or because of the limited range of work available, should not provide schemes of training for graduate and student apprentices. Such firms should concentrate on apprenticeships for craftsmen, giving apprentices of suitable ability a wider training which may ultimately fit them for employment as technicians.

An organised course of study should be associated with every scheme of practical training. Apprentices should be encouraged to develop the habit of collecting technical information for themselves from reference books and journals, and a technical library and reading room should be available for their use in the works or elsewhere. They should be required to attend regular courses provided in the works during working hours, and day and evening courses at technical colleges.

TECHNICAL COLLEGE COURSES

Student apprentices should be released from work on one day a week throughout their apprenticeship to attend courses at technical colleges in order that they may prepare for the Ordinary and Higher National Certificates in Electrical Engineering. They should in addition be required to attend on one evening a week during the session. Pre-graduate apprentices should also be granted part-time day release in order that they may continue their preparation for university entry.

By the end of his apprenticeship the apprentice will have acquired a general knowledge of the problems connected with the manufacture and operation of electrical apparatus and a deeper insight into the design and manufacture of some particular type of equipment. His formal training completed, he will be anxious to obtain a post involving responsibility and both he and his employers will have formed opinions as to the type of work most suited to his interests and abilities. He will be wise if, for a considerable time, he regards his employment as a continuation of his training and he should seize every oppor-

tunity for broadening his practical experience and extending his scientific, technical and commercial knowledge. Only through assiduous and constant attention to these matters will he prepare himself effectively for the senior positions which lie ahead. A few weeks before he commences his office training the apprentice should have been interviewed and advised by one or more senior members of the company who are professional electrical engineers. Such an interview affords opportunity for discussing the remainder of his course of training and for helping him to formulate his own ideas for his future on lines that are likely to lead to his advancement.

Copies of the report, "The Practical Training of Professional Electrical Engineers," are obtainable from the I.E.E., price 1s., post free.

Visit to Stourport

MEMBERS of the Cheltenham Electricity Committee recently visited the Wores. and Staffs Power Co.'s generating station at Stourport, where the 525 000 lb. per hour boiler illustrated in our last issue is being installed as part of the C.E.B. extension programme. They were accompanied by their borough electrical engineer, Mr. R. W. Steele, and were the guests of Mr. D. H. Kendon, general manager of the company.

In the course of a speech, in which he reviewed the extensive rural electrification work carried out by the company, Mr. Kendon said that the area covered by the Stourport station was about 45 acres. Coal arrived partly by rail and partly by canal, the amount of fuel consumed giving employment to 2 000 miners. Fifty five-ton lorry loads of ash had to be disposed of each day.

Over £3 000 000 had been spent on the existing station, and with the first stage of the new extension the sum would be over £5 000 000. The station at present paid over half the rates of the town of Stourport. Although the new buildings were well advanced, Mr. Kenyon explained that visitors would not see much in the way of machinery. The first part of the new station would contain one 60 000 kW, 3 000 r.p.m., hydrogen-cooled set, generating at 11 kV, although switching would be at 66 kV. It would be supplied with steam from one boiler at a pressure of 1 250 lbs. per sq. in. and a temperature of 950° F. The boiler drum would weigh 60 tons, be 36 ft. long, 6 ft. in diameter, and 5 in. thick.

The visitors were conducted round the station by Mr. H. North, power station engineer, and members of his staff.

Electrical Personalities

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

MR. J. A. WALTERS has been appointed manager of the carbon department of the General Electric Co., Ltd., in succession to Mr. T. Settle, who retired on March 31. Mr. Walters graduated in Chemistry at King's College, London, and after a short time with the South Metropolitan Gas Co. and the Anglo-Scottish Beet Sugar Corporation, joined the staff of the G.E.C. research laboratories in 1928. In 1937 he joined the head office staff of the company under Mr. Settle on the technical side of the carbon department.



MR. J. A. WALTERS

MR. W. R. VERNON SMITH and Mr. C. H. Davy have been appointed directors of Babcock and Wilcox, Ltd.

MR. R. F. HATTO, sales director of S. Wolf and Co., Ltd., has just returned from a successful business trip which took him to the Union of South Africa, Northern and Southern Rhodesia and Kenya. Mr. Hatto expresses the opinion that these long term markets deserve more attention than is being paid to them at present by British manufacturers. This is particularly so in the Union where sellers' market conditions show signs of changing. He emphasises the importance to manufacturers in this country of checking the credentials and business activities of any prospective agent or buyer, and in this connection, he states that the help given to him by the Trade Commissioners in the countries concerned was invaluable; he strongly advises obtaining their opinion before making any business arrangements.



MR. R. F. HATTO

MR. CYRIL C. SCOTT, managing director of Flinders Wholesale Ltd., has been

appointed a director of Electrical Components Ltd., of which the former is a subsidiary.

MR. JOHN WALSH, chairman of the Blackburn branch of the E.C.A., and Mr. James Heys, hon. sec., have been presented with silver cigarette caskets by the members, in appreciation of the services to the branch during the war period.

MR. E. E. HOADLEY, borough electrical engineer, Maidstone, on July 10 escorted the Duchess of Kent round the



MR. E. E. HOADLEY with the DUCHESS OF KENT at [the Kent Agricultural Show

stand of the British Electrical Development Association when she visited the Kent County Agricultural Society's show at Maidstone.

MR. W. L. BARBER, chairman of the Midland Electric Manufacturing Co., Ltd., presided at a sales conference at the company's works, attended by the firm's representatives from all parts of the United Kingdom. We reproduce opposite a photograph of a group, taken during the conference, included in which is Mr. James Thornell, the company's Australian representative, who is at present visiting the works.

Mr. W. C. S. PHILLIPS, after 28 years as head of the Department of Electrical Engineering and Physics at the Borough Polytechnic, is retiring at the end of

August. Mr. Phillips was educated at King Edward's Grammar School, Birmingham, and proceeded from there to Mason University College, Birmingham, where he remained for five years and held the Major Rowlinson Scholarship and a Staffs County Council Scholarship. Whilst working for his degree under the direction of Prof. J. H. Poynting, F.R.S., he was encouraged to take up research work in which he has shown a keen interest throughout his career. After obtaining his degree in physics, he continued to take courses in electrical engineering and became a lecturer at the Derby Technical College. In 1907 he returned to Birmingham as a lecturer at the Central Technical College. In 1914 a new wing was opened at the Stoke-on-Trent Technical College especially for electrical engineering work as applied to mining and pottery, and Mr. Phillips was appointed to start the department and to arrange for its equipment. He continued there until 1916 when he joined the Aeronautical Inspection Department. At the conclusion of the 1914-18 war, Mr. Phillips was selected to become head of the Department of Electrical Engineering and Physics at the Borough Polytechnic. Members of the staff yesterday (Thursday) made him a presentation.

MR. J. G. CURTIS has succeeded Mr. D. J. W. Harvey as engineer and manager of Kirkcaldy electricity department.

SIR ALEXANDER ROGER, chairman, and the directors of B.I. Callender's Cables, Ltd., entertained the staff of the Erith Works at a dinner and dance in the Paramount Salon de Danse, London, on July 9. With the exception of Mr. Charles Pipkin, who was unable to attend, all the directors of the company were present. In a short speech of welcome, Sir Alexander said it was intended to hold similar friendly functions at every factory in the group. One of the difficulties in big

business was in getting people in different factories and branches to meet together; it was the board's intention to overcome this if possible. They had already tried to do this with the shareholders and met with



SIR ALEXANDER ROGER, MR. E. F. SARGENT, and MR. H. HILL at the B. I. Callender's Erith Works Social

enormous success when 500 turned up at the company's annual general meeting to be shown round the Prescott factory. Shareholders, staff and workers should, he said, get to know each other, and although it was a big job the board were going to try and do it. Sir Alexander referred to the retirement of Mr. H. Hill, Erith works manager, next year.

MR. H. E. TAYLER, managing director of the British General Electric Co., Ltd., New Zealand, was host, and Mr. and the Hon. Mrs. Leslie Gamage were guests, at a luncheon party given on July 4 by the G.E.C. overseas staff now on visit to this country. Mr. Leslie Gamage, in thanking his hosts, said that the gathering was exceptional as it was representative of the G.E.C. all over the world. Exports had increased in spite of difficulties, but we



Group taken at the Sales Conference of the Midland Electrical Manufacturing Co. Ltd.

had not yet reached the target. He encouraged all overseas members to co-operate in reaching the goal. The Hon. Mrs. Leslie Gamage expressed her appre-



MR. L. C. GAMAGE addressing members of the G.E.C. overseas staff. THE HON. MRS. GAMAGE is on the right

ciation of the kindness she had received and the friends she had made on her overseas visits with her husband, and hoped at some future date to visit them again.

MR. DOUGLAS S. PARRY has joined the staff of A. Reyrolle and Co., Ltd., and will shortly take up his duties as district manager in Northern Ireland.

MR. J. A. HARLE has been appointed Professor of Electrical Engineering in the

University of Alberta, Edmonton, Canada, and is sailing early in August to take up his appointment on September 1. He served his time with C. A. Parsons and Co., Ltd., and studied at Armstrong (now King's) College under the late Prof. W. M. Thornton, graduating with distinction in 1919. He was appointed Lecturer in Electrical Engineering at Arm-



MR. J. A. HARLE

strong College in the same year, and during the three years he was there he lectured to many students who had returned from the 1914-18 war. In 1922 the late Mr. Clothier invited him to join the technical and research department of A. Reyrolle and Co., Ltd., and he took over the headship of the department in 1937 when he succeeded Mr. B. H. Leeson. Mr. Harle served as chairman of the North-Eastern Centre of the I.E.E. during the session 1944-45, and he has been the institution's area member for the Education and Training Advisory Service for returned Service members. He has taken part in

the work of the E.R.A., the B.E.A.M.A., and I.E.C. Committees, being keenly interested in insulation and circuit-breaking problems, both from the research and from the standardisation points of view.

Some 2 000 employees and their friends attended the 13th annual sports and gala of the Victoria Works Athletic Club on the Johnson and Phillips sports ground at Kidbrooke on July 12. A Championship Cup presented by J. Stone and Co., Ltd., to be competed for annually by local firms, was won appropriately by Stones Athletic and Social Club. Competing firms were Harveys Sports, U.G.B. Sports, Stones Athletic, Telcon Sports, Metrogas and Victoria Works Athletic Club. Of the individual competitors, Miss G. Harvey, Miss M. Davison, Mr. S. G. Wood and Mr. A. F. Kemp were outstanding winners. The Inter-Departmental Challenge Shield (presented by the management of Johnson and Phillips Ltd.) was won by the Employment and Welfare Department with a clear majority of 10 points. At the close of the evening, the prizes were presented by Mrs. G. Leslie Wates, wife of the chairman and joint-managing director of the company.

MR. S. S. BAGSHAW, of the B.T.H. Co., Rugby, who produces the B.T.H. Operatic and Dramatic Society shows, has recently received the Long Service Medal from the National Operatic and Dramatic Association for 25 years' continuous service to Dramatic Art. The B.T.H. Operatic and Dramatic Society are now going into rehearsal for "Rebecca" for production in the week commencing October 6 at the Co-operative Hall, Rugby.

MR. VICTOR C. H. CREER, has been appointed general manager of the B.T.H. lamp and lighting sales department.

Mr. Creer, who was born in Australia, has had experience on the London Stock Exchange and was an executive in the film industry for many years. On the outbreak of war, Mr. Creer became an administrative officer in the Ministry of Economic Warfare, and was afterwards transferred to the Air Ministry. He later



MR. V. C. H. CREER

became well-known to many executives in the lamp industry as Deputy Director of Lamp Production at the Ministry of Aircraft Production. He joined the lamp and lighting department of the B.T.H. Co., in October, 1945, as assistant to Mr. H. A. Lingard.

The Public Works Exhibition

Some Recent Street Lighting Developments

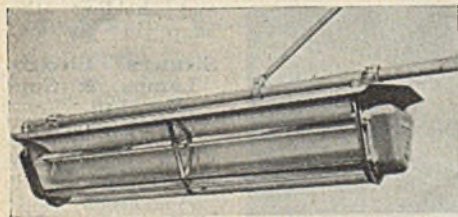
THE Prime Minister, Mr. C. R. Attlee, will open the eleventh Public Works, Roads and Transport Congress at Olympia on July 21. The Minister of Health, Mr. Aneurin Bevan, will take the chair as president of the Congress. Thereafter, the proceedings will continue until July 26.

The first to be held for ten years, the 1947 Congress will, it is expected, attract considerable attention, and over 1 000 delegates have been appointed by local authorities to attend. Some 20 papers on various aspects of public works are to be delivered, of which that to be presented by Mr. N. Boydell under the auspices of the Association of Public Lighting Engineers will be of interest to the electrical world. It is entitled "The Development and Trend of Street-Lighting by Electricity," and the conference which will follow will be under the chairmanship of Mr. W. N. C. Clinch, president of the A.P.L.E.

The exhibition, which is to be open to the public from 10.30 a.m. to 6.30 p.m. daily (admission 2s.), will be supported by 130 manufacturers. Short descriptions of some of the electrical and allied products which will be on show are given below.

Automatic Telephone & Electric Co., Ltd.

The general title "A.T.M. Automatic Electric Signalling Systems," will cover four sections featuring a number of products. In the one concerned with traffic signals, a large pictorial diagram will demonstrate



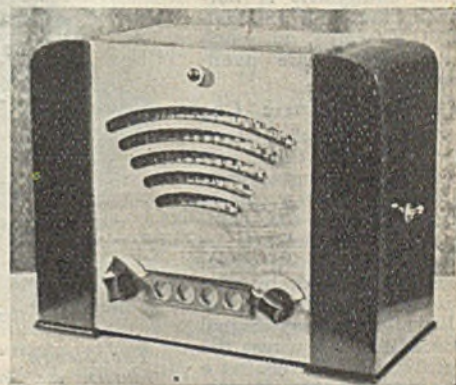
The B.T.H. "Mazdalux" fluorescent street-lighting lantern

the various phases of traffic movement at the complicated "Bank Complex" intersection in London—the most recent "Electromatic" vehicle-actuated signal installation. In another an illuminated map showing the location of important electric installations throughout the country and, operated by a standard "Rythmatic" control panel and relays, will illustrate the effectiveness of the equipment. A third section will deal with the company's equipment for remote

control, indication and metering, and in a fourth will be demonstrated the A.T.M. closed circuit system for fire alarms and ambulance calls.

British Thomson-Houston Co., Ltd.

The equipment to be displayed reflects the great advances made in lighting technique during recent years. Mazdalux lan-



The master set of the Fleming "Descaphone" apparatus

terns to accommodate many types of street-lighting lamp are to be exhibited, including the fluorescent three-lamp lantern; a new range of sixteen side entry lanterns; a horizontal enclosed lantern designed for standard 250 W or 400 W Mazda mercury vapour lamp, with controlled cut-off; new "Rural" and "Parish" lanterns; a new area floodlighting unit, the Mazdalux "10," for illuminating marshalling yards, dockyards, car parks and all kinds of outdoor working areas. Examples from a new range of fittings for use with 40 and 80 W fluorescent lamps are to be shown. One is designed to resist the corrosive action of most acid and other fumes found in factories and laboratories.

R. G. Dixon and Co., Ltd.

A complete range of power-driven floor maintenance equipment, for cleaning, waxing and polishing all types of floors, and for shampooing carpets, will be shown and demonstrated. There are senior and junior models of these machines. The "Columbus" combined floor polisher, vacuum cleaner and floor scrubber, manufactured by the associate company, Rollnick and Gordon, Ltd., will also be on view.

Fleming Electrical Corp., Ltd.

The time to be saved in an office by the use of an efficient inter-communication system will be stressed at this company's exhibit, where their mains-operated "Descaphone" is to be shown. The complete equipment, which gives two-way facilities at the touch of a "speak-listen" switch, consists of a master set with four satellites, the main set being provided with a selector switch for calling individual departments or for a simultaneous broadcast to all four. The equipment is normally made for a.c. 200-250 V mains, although d.c. models are available.

General Electric Co., Ltd.

Street lighting and road signalling equipment have been chosen to represent the company's products. An "Autoflex" road signal exhibit, staged by the Siemens and General Electric Railway Signal Co., Ltd., will stress the protection given to pedestrians by "cross now" signals and pedestrian push buttons. A pneumatic road vehicle detector and contact box (normally located in the roadway) is mounted to show the operation when a vehicle passes over the detector, a simple unidirectional feature ensuring that only vehicles travelling towards the junction record their presence. An improved speed timer will also be on show, in which a normal triode has been substituted for the customary discharge tube. Among the street lighting fixtures will be the new lanterns for use with 40 and 80 W fluorescent lamps, together with other lanterns for side and main road lighting. An interesting new main road model is a die cast light-alloy sodium lantern which is a new version of the G.E.C. diffractor lantern.

G. A. Harvey and Co. (London), Ltd.

From their range of perforated metal products, the company are to show various patterns for sifting and grading coal, ash,

etc., as well as special artistic grills for radiator covers and ventilators. Woven wire cloth and wire screens will also be seen, and there will be a number of metal tool cabinets, storage bins and staff lockers.

Rawlplug Co., Ltd.

Many of the fixing devices made by this company will need no introduction to readers. Special exhibits, however, will demonstrate the fixing of tram rails with "Rawlbolts," and the attachment of equipment to irregular surfaces by means of "Rawlbolts," with ferrules on studding. A new fixing device of special application when the reverse side of a wall is inaccessible is the "H" toggle, consisting of a metal member suspended on a bolt.

Scemco, Ltd.

The "Flite-Weight" fluorescent trough lighting fitting, a new product for 80 W fluorescent tubes has an open top to allow light to illuminate the area above the fitting. By the extensive use of

aluminium the gross weight has been reduced by 10 lb. from the standard weight of 24 lb. A "Hi-Craft" ballast unit is placed on the top of the fitting and aluminium sleeves serve the dual purpose of covering the lamp holders and holding the lamp in position.

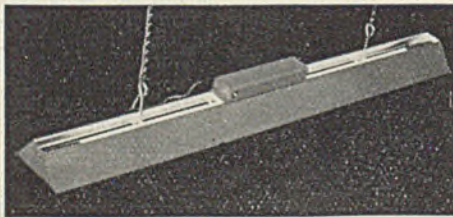
Siemens Electric Lamps & Supplies, Ltd.

Three lanterns which are to be shown for Group "A" street lighting are the "Weston-Sieray" side-entry bowl refractor lantern, de-

signed for 250 or 400 W "Sieray" MA/V lamps, the "Dilux" lantern incorporating a new prismatic glass dish refractor recently designed by the Holophane Co., and the "Halton-Sieray," a bowl refractor type normally suitable for 250 or 400 W medium pressure mercury discharge lamps. By adding an internal refractor it is possible to use this latter model with tungsten filament lamps.



The Siemens "Halton-Sieray" lantern for mercury-discharge lamps

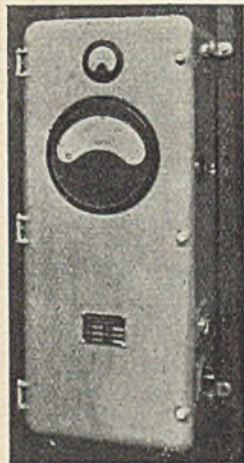


The "Flite-Weight" 5 ft. fluorescent fitting, by Scemco, Ltd.

Equipment and Appliances

Electronic Voltage Regulator

In conjunction with Mr. S. Pearson, Brookhirst Switchgear, Ltd., have developed a new automatic electronic voltage regulator. The apparatus can be used for voltage regulation and stabilisation of d.c. and a.c. generators, frequency stabilisation of a.c. alternators, speed control and stabilisation of d.c. motors and Ward Leonard drives, and stabilisation of a main d.c. supply. There are, of course, several other industrial applications. The sensitivity of this regulator is



Brookhirst voltage regulator

claimed to be within ± 0.1 per cent. under steady load. No auxiliary supplies are required for operation, and starting and control arrangements are simple. Only one thermionic valve of standard design is employed, and this, as a result of its light loading, should have a long life. A number of these regulators are already installed, providing, in some instances, regulation to within ± 0.03 per cent.

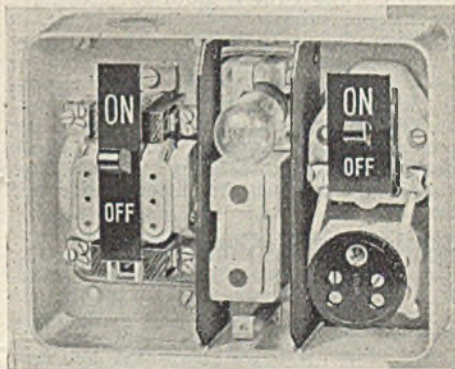
Photographic Flash Tube

High speed flash photography is being increasingly used as a method of examining the behaviour of fast-moving objects. During the war, the Mullard Wireless Service Co., Ltd., designed a flash tube, known as the "Arditron," for the photographic examination of projectiles in flight. The company has now introduced an improved version, the type LSD. 2, which should have many useful applications in industrial research. In principle, tubes of this nature consist of a gas-filled envelope containing anode, cathode and an auxiliary triggering electrode. A capacitor is allowed to charge to high voltage, of the order of 7 500 to 10 000 V, and is then discharged through the tube by means of a subsidiary spark applied to the third electrode. With, for example, an operating potential of 7 500 V and a capacitance of $3\mu\text{F}$, a one micro-second flash corresponds to an instantaneous power

dissipation of about 100 MW. The resulting light emission from the tube will provide effective photographic illumination over an extended area at a distance of 12 ft. for exposures at lens apertures not greater than F8. Higher tube loadings at lower voltages will give adequate illumination at distances up to 30 ft. at similar apertures. The light distribution, apart from some falling off towards the red regions, is said to be substantially uniform over the visible spectrum. In the LSD. 2 tube, which, in view of the high instantaneous loading is suitable only for single flash working, an envelope of boro-silicate glass contains a copper rod cathode, a copper rod anode and a copper ring electrode which acts as the trigger or grid, the latter requiring an oscillatory transient of about 3 000 V to start the main discharge. The anode-cathode spacing is some 30 mm., and the gas filling is mainly argon at atmospheric pressure. Potassium-activated electrodes ensure a low work function and a tube life of some thousands of flashes. Although there is an unavoidable time delay in the firing circuit and in the tube itself, this remains consistent under given conditions, and can thus be allowed for in the photographic arrangements. Photographic work, the makers point out, would normally be done in relative darkness with an open lens.

Cooker Control Unit

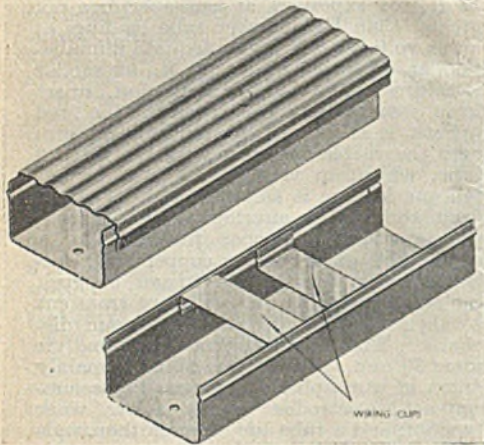
Close attention has been paid to outside appearance in a cooker control unit, the "Sandella," made by Wm. Sanders and Co. (Wednesbury), Ltd., of Falcon Elec-



The "Sandella" cooker control unit with covers removed. A separate easily removed cover fits over the centre section

trical Works, Wednesbury, Staffs. It has a lightweight die-cast case of a zinc base

alloy, finished in cream enamel, and shaped with rounded corners to facilitate cleaning. Inside, the unit has two switches, for cooker and electric kettle, or other portable appliance. The cooker switch is a recently introduced Sanders d.p. toggle type, of 30 A rating and incor-



Two sections of the new channel conduit showing (top) a length with the capping sprung into position and (bottom) the wiring clips fitted in alternative positions

porating arc-damping, heat-dissipating ceramic shields over the moving contacts. The main terminals are situated at the top, with outgoing terminals at the bottom. Auxiliary terminals are provided for the subsidiary wiring. The sub-circuit is not controlled by the main switch, but consists of a 5 A socket, wired in conjunction with a 15 A s.p. toggle switch, protected by a single rewirable fuse. Both switches have mechanical indicators, the main circuit, in addition, being furnished with a pygmy lamp indicator. Access to the lamp or fuse for replacement purposes is by removing a small panel in the front of the unit, accidental contact with live parts being prevented by insulated screens which divide the unit into three sections. Two earthing terminals are fitted inside the case.

Steel Channel Conduits

A conduit system, designed, it is stated, as a result of many years experience in the equipment of industrial buildings, is a development of Richard Crittall and Co., Ltd., which is to be marketed by their newly-formed subsidiary, Channel Conduits, Ltd. The new "Channel Conduit" system, which is said to provide simple installations with low cost, coupled with flexibility and adaptability, consists of rectangular section conduit made in 12 ft. lengths from 16, 18 and 20 s.w.g. steel

in six sizes, ranging from 1 by $\frac{1}{2}$ in. to $\frac{1}{2}$ by 3 in. A full range of fittings for each size, comprising tees, elbows, angles and various types of connectors, is also made. The covering and covers for the lengths of conduit and accessories are sprung on, so that the spring grip keeps the covers in position without the use of screws on nuts and bolts; removal is rapid for inspections, alterations or additions to the layout, a special tool being provided for the purpose. Where a new installation is required to meet an existing layout with metal tube conduits, a special adaptor for connecting the old and new conduits is available. Earthing arrangements are claimed to comply with I.E.E. Regulations and are incorporated in the means of connecting lengths of conduit together and the lengths of conduit to the fittings. An earth plate fitted to each connector or fitting is provided with two pointed grub screws which, when tightened down, form a strong mechanical joint and an efficient earth. The finish complies with B.S.I. Spec. 774-15 for protection of ducting and is a matt black conductor which will take paint of any colour; it is non-corrosive and is applied by a high temperature process which penetrates into the pores of the metal.

Hydro-Board Stock Issue

THE North of Scotland Hydro-Electric Board made its first issue of stock to the public, amounting to £5 000 000 at 2½ per cent., yesterday (Thursday). Announcing the issue in a written reply last week, Mr. Dalton, Chancellor of the Exchequer, stated: "The North of Scotland Hydro-Electric Board has made good progress with its programme of development and construction, on which £2 650 000 has already been spent and commitments of £11 750 000 have been incurred. The time has now come for the Board to make its first issue of stock, in order to fund the bank advances and to cover the further capital expenditure that will mature in the near future. The Board has behind it the credit of the State, and its stock will be guaranteed by the Treasury. The issue, which will be offered to the public, will be for £5 000 000 of 2½ per cent. North of Scotland Electricity Stock, 1967-72, at par. The issue will be open to the public throughout Great Britain, but special facilities will be provided through the Scottish banks for subscriptions from Scottish investors, who will wish to take this opportunity to acquire a stake in this important contribution to the prosperity of Scotland." The Board's area of operation will be considerably increased as a result of the Electricity Bill.

Electricity Supply

St. Marylebone.—The Borough Council is to spend £8 000 on electricity meters.

Bedford.—It is recommended that because of inconvenience to consumers during the first quarter of the year, a special discount of 15 per cent. should be allowed in respect of electricity consumed during that period.

St. Helens.—Negotiations are proceeding for the erection of a new power station near the town. The Electricity Commissioners will shortly be asked to approve plans of the proposed station, which is to receive its coal supplies direct from a neighbouring colliery.

Swansea.—New ash conveyor plant at the Tir John power station will cost £13 650, and additional works necessary are estimated to cost a further £9 750. The supply and installation of the apparatus will be carried out by the John Thompson Conveyor Co., Ltd.

Darlington.—A clause in the Corporation's scheme for the hiring of electrical apparatus, giving the hirer the option to purchase, is to be deleted from future agreements. The Town Council has approved increases in electricity charges from the present 15 per cent. war increase to 33½ per cent.

Glasgow.—The Clyde Navigation Trust is considering a ten-year scheme for improvements at Prince's Dock, which will include the provision of cables, electric capstans and cranes, at an estimated cost of £193 550. New hydraulic pumps and electrical equipment will also be installed at the graving docks, at an estimated cost of £48 350.

Fulham.—The television set which the Borough Council proposes to sell through the electricity showrooms will now cost approximately £100 (less purchase tax) it is reported, and not between £60 and £70, as was first expected. Assuming purchase tax to be £28, the Council has fixed hire-purchase terms for the sets, production of which will shortly commence, at an initial payment of £25, and subsequently £3 per month for three years.

Egypt.—The adjudication on tenders in respect of the Aswan hydro-electric project has now been published. Swedish firms are to supply five main turbines, two main generators and main transformers at a total cost of nearly £E. 2 000 000 f.o.b. Swiss firms will supply two main and two supplementary turbines and five main and two supplementary generators at a total cost

of nearly £E. 2 100 000 ex-factory. A. Reyrolle and Co., Ltd., of Hebburn-on-Tyne, are to supply switchgear to the value of £E. 732 110. Specifications for pipes and cranes have been withdrawn for later tenders.

Norway.—A 178 000 kW hydro-electric station, on which 850 workers are at present employed, is under construction at Mär, near Rjukan, Central Norway, and is expected to begin operation during autumn, 1948. A 600 ft. hall in which the generating and transformer plant are being housed is being hollowed out inside a mountain, and there will be a layer of at least 200 ft. of rock as a protective ceiling over the station which, it is claimed, will provide safety even under atomic-bomb attack. Apart from this hall, tunnels up to ten miles in length are being drilled for the water supply. Altogether, about 1 200 000 tons of rock will have to be removed. One-third of the output of the station, which is designed for an average load of 125 000 kW, is to be reserved for the industrial plant of Norsk Hydro at Rjukan, whilst the remainder will be at the disposal of the Norwegian Government for other purposes.

New Power Station Buildings.—Building and civil engineering work to the value of £75 000 000 will be carried out on electric power stations during the next two years. Site work is in operation, states the Ministry of Works, on 63 building projects to house plant capable of generating over 5 260 000 kW. Site work for 13 further projects (to provide 1 205 000 kW) will start shortly. A further programme covering the next two years is at present being drawn up. Instructions have been issued to all Ministry of Works Regional Officers to ensure a continuous supply of cement, bricks and other materials to the sites. Arrangements have been made through the Cement Makers' Federation for cement orders for these projects to have first call on deliveries, both direct and through merchants. An Interdepartmental Committee, on which are represented the Electricity Commission, Central Electricity Board and the North of Scotland Hydro-Electric Board, sits under the chairmanship of a Ministry of Works official. Its terms of reference are to speed up the supply of labour and civil engineering resources required in connection with the provision of generating capacity. Working Parties have been appointed in England and Scotland to resolve the day-to-day problems.

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

How is the tuning of an arc suppression coil carried out?

To ensure that an arc suppression coil shall completely suppress the capacitance fault current due to an earth fault on

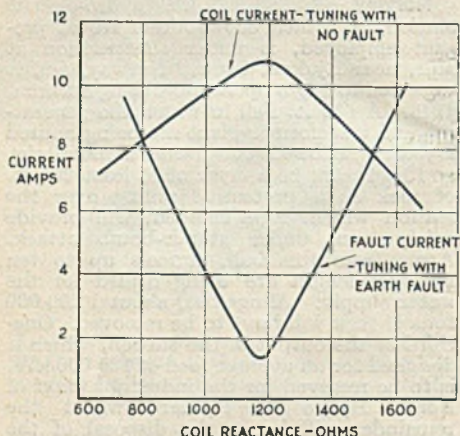


Fig. 1—Tuning curves for arc suppression coil

an isolated-neutral power system, the inductance of the coil must be of such a value as to resonate with the capacitance formed by the capacitance to neutral of the three phases in parallel, *i.e.*,

$$\omega L = \frac{1}{3 \omega C}$$

It is difficult to calculate the capacitance accurately as it depends to some extent on weather conditions, the sag of the wires and even on the growth or otherwise of crops beneath the line. Final adjustment of the value of inductance must, therefore, usually be made on site after the coil is installed, the process being known as "tuning" the coil. Two methods are available, as it can be done with or without a fault on the system.

(i) *Tuning with an earth fault on one phase.*—If an earth fault is put on one phase the coil will be correctly tuned when the inductance is adjusted to make the fault current a minimum; if there were no losses in the coil or the lines, the minimum current would be zero, but this is, of course, never attained in practice and a current of 3 or 4 amperes is common on systems up to 33 kV. A curve showing the relation between fault current

and coil reactance for a typical case is shown in Fig. 1.

(ii) *Tuning with no fault.*—If the capacitances to neutral of the three phases are not exactly equal the isolated neutral point of the system will not be at exactly earth potential, *i.e.*, there will be a potential between the neutral point and earth. This potential, which may, in practice, be as much as 5 per cent. of the normal phase voltage, is applied to a circuit consisting of the arc-suppression coil in series with the three capacitances to neutral in parallel, *i.e.*, to a series resonant circuit. In such a circuit the current is limited only by the resistance and will have a high value. Tuning, *i.e.*, adjustment to true series-resonance condition, is, therefore, carried out by adjusting the coil reactance until the current in the coil is a maximum. A typical tuning curve of this type is shown in Fig. 1. If the unbalance of the capacitances is not sufficient to produce sufficient current some artificial unbalance can be introduced, for instance by disconnecting a length of one phase of the line.

Accuracy of Tuning.—The coil is usually only adjustable in steps of 3 to 5 per cent., so the absolute accuracy is not possible. It is not, however, necessary, since on an 11 kV system a coil can be 10-20 per cent. out of tune and still be effective in suppressing faults; on higher voltage systems, however, greater accuracy is desirable.

E.O.T.

Nickel Fellowships

The Institute of Metals, the Iron and Steel Institute, the Institution of Mining and Metallurgy, the Institute of British Foundrymen and the Institution of Metallurgists, it is announced, have accepted the invitation of the Mond Nickel Co., Ltd., in awarding annually for the next fifteen years a number of fellowships to be known as the "Mond Nickel Fellowships." The company offered to make available over a number of years the sum of £50 000 for the purpose. The main object of the fellowships is to assist persons capable of appreciating and applying the results of research, rather than to encourage research itself.

ELECTRICAL UNITS

N.P.L. ANNOUNCES CHANGES TO TAKE EFFECT NEXT YEAR

IN accordance with decisions taken by the International Committee of Weights and Measures at their meeting in Paris in October, 1946, the system of electrical units employed at the National Physical Laboratory will be changed on January 1 next. The units at present in use are the "international" units based on certain material standards. From January 1, the units employed will be those derived from the centimeter, gramme and second, i.e., the so-called "absolute" units. The effects of this change may be seen from the following table:—

One international ohm	= 1.00049	" absolute "	ohms
One " volt	= 1.00034	"	volts
One " ampere	= 0.99985	"	ampere
One " watt	= 1.00019	"	watts
One " henry	= 1.00049	"	henries
One " farad	= 0.99951	"	farad

The factors given in the table apply to the mean international units; that is to say, to the mean values of the international units as realised at the various national laboratories.

After January 1 apparatus submitted to the laboratory with a view to the issue of a N.P.L. certificate of examination will be regarded as acceptable if its errors fall within the specified limits when the values are expressed in either international or absolute units, provided that it was manufactured before January 1, 1949, and is marked accordingly. Apparatus manufactured after that date and any apparatus not marked with the date of manufacture, will be acceptable only if its errors fall within the specified limits when the values are expressed in absolute units.

NEW CANDLE UNIT

Following the decision of the International Committee, the N.P.L. will also, on and after January 1, express all photometric values in terms of units based on the "new candle." This unit of luminous intensity is of such a magnitude that the brightness of a full (or cavity) radiator (black body) at the temperature of solidification of platinum is 60 new candles per sq. cm. The new lumen is the luminous flux radiated within unit solid angle by a uniform source having a luminous intensity of one new candle. The new unit of illumination will be one new lumen per unit area. One new lumen per sq. ft. will also be called one new foot-candle and one new lumen per sq. metre one new lux. The new unit of brightness will be one new candle per unit area, and,

alternatively, one new foot-lambert. The latter unit is defined as the brightness of a perfectly diffusing surface of 100 per cent. reflexion factor when its illumination is one new lumen per sq. ft.

When differences of colour are involved in the determination of any magnitude in terms of these units, the evaluation will be in accordance with that which would be obtained by an observer having the relative luminosity curve (curve connecting eye sensitivity with wavelength) adopted by the International Commission on Illumination 1924 and later by the International Committee of Weights and Measures.

IMPORTANT BUT SMALL DIFFERENCES

The differences between the new units and those in use hitherto are small. The present units, based on the "international candle," were introduced on April 1, 1909, in Great Britain, France and the U.S.A., and were adopted in 1921 by the International Commission on Illumination. Nevertheless, Germany and some Central European countries continued to use units based on the Hefner candle (about 0.9 international candle). The international candle was not based on any primary standard; it was derived from the units defined in terms of the old flame standards and was maintained by means of carbon and tungsten filament electric lamps. Further, the values of the unit at different colour temperatures did not exactly agree, when compared on the basis of the international relative luminosity curve adopted in 1924.

The magnitude of the new unit has been so chosen that it will introduce only very small changes (less than 0.5 per cent.) in the values of luminous intensity assigned to lamps operating at a colour temperature of about 2 360°K. For lamps at considerably higher colour temperatures, e.g., ordinary gas-filled electric lamps at normal efficiencies, the values expressed in terms of the new candle will be several per cent. lower than those expressed in international candles. At the colour temperature of the primary standard (2 046°K), values in terms of the new candle are about 1.7 per cent. higher than those in terms of the international candle.

On account of this alteration in the basis of which sources of light of different colours are compared, it is impossible to give a factor for converting values in international candles to value in new candles.

Industrial Information

Annual Outing

Metway Electrical Industries Ltd., announce that their offices and works will be closed on July 19 for the annual staff outing. This will take the form of a motor trip to Windsor for lunch, and then by boat to Hampton Court.

Lamp Contracts

The L.N.E.R., King's Cross, has placed a contract for Cosmos and Metrovick electric lamps for a further period of twelve months, ending April 30, 1948, with the Metropolitan-Vickers Electrical Co., Ltd.

Thorn Electrical Industries Ltd. announce that their tender for the supply of Atlas lamps until March 31, 1948, has been accepted by the Metropolitan Borough of Islington.

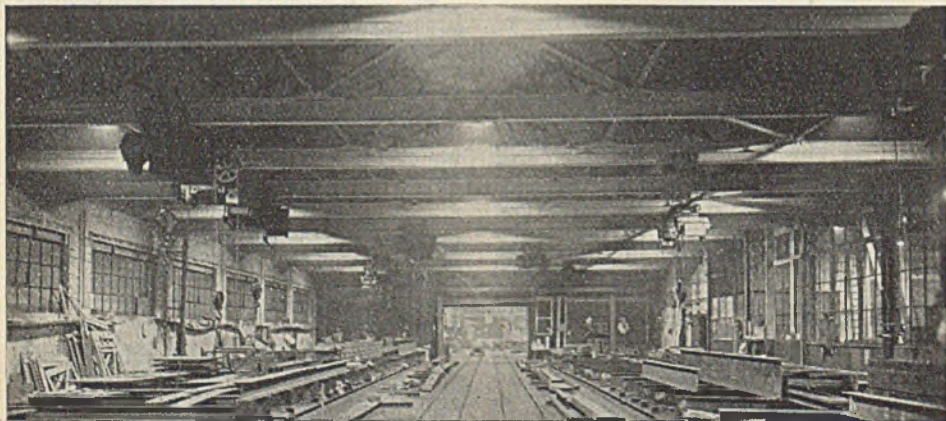
Courses in Illuminating Engineering

Two courses in illuminating engineering have been arranged to take place in London during the period September, 1947, to May, 1948, one at the Northampton Polytechnic on Wednesday afternoons and evenings, the other at the Borough Polytechnic on Thursday afternoons and evenings. The courses will prepare candidates for the City and Guilds of London Institute intermediate examination in illuminating engineering, passing of which is one of the essential qualifications for those desiring to be placed on the I.E.S. Register of Lighting Engineers. Those wishing to enter their names for either of these courses should communicate with the polytechnic concerned. A course has also been

arranged at the Central Technical College, Birmingham to commence in September this year and other courses are in prospect at Cardiff, Leeds, Liverpool and Manchester; further details are available from the Illuminating Engineering Society, 32, Victoria Street, London, S.W.1.

Steel Works Lighting

While preparations were going on for D-day, the Metropolitan-Vickers Electrical Co., Ltd., undertook the re-lighting of the works of Redpath, Brown and Company Ltd. To-day when the need for steel sections for building reconstruction is as urgent as was that for war material, the installation is enabling the same efficient output to be maintained. 400 W and 250 W mercury discharge lamps are used throughout for general lighting, and special Metrovick type SFT low voltage safety units are used on the batteries of drills. These units comprise 400/440 V 50 V 45 VA transformers with low voltage lighting 3-arm fittings, housing 40 W lamps screwed on the arms of the drills. Specially balanced cable arrangements are made for the bracket arm to be swung round with the drill head. In two of the drilling bays 80-400 W mercury discharge lamps mounted at a height of 33 ft. give a general illumination of 7/8 lumens per foot² over the working area. In the fitters' shop 250 W mercury discharge lamps in skirted dispersive reflectors, mounted 16 ft. 6 ins. are arranged to give complete cut-off to enable the operatives to see clearly the marking on the steel plates for drilling and other purposes. The illumination in this



Metrovick lighting in the platers' shed at the works of Redpath Brown & Co., Ltd.

shop is 8/10 lumens per foot² on the working plane. For the fittings shop, electricians' and joiners' shops 250 W discharge lamps are used in skirted dispersive reflectors, mounted 16 ft. 6 ins. above the working plane, providing 11/12 lumens per foot². The wiring was carried out by S. Dickinson Ltd., Fountain Street, Manchester.

Herts. Agricultural Show

The Hertfordshire Show is being held this year at North Mymms Park on July 24, and the Northmet Company has arranged a comprehensive exhibit of electrical appliances for the farm, the market garden and the home. Manufacturers supporting the exhibit will include:—

Freck. A. Pullen & Co., L. F. King, Nazcing, Keith Blackman, Ltd., Electrocut, Ltd., Rheostatic Co., Ltd., General Electric Co., Ltd., Clifford & Snell, Ltd., Chase Protected Cultivation, Ltd., Tarpen Engineering Co., Ltd., Geo. Monro, Ltd., Heatrae, Ltd., W. L. Holland, Ltd., Christy & Norris, Ltd., Lipton Products, Ltd., Byron Farm Machinery, Ltd., Herbert Morris, Ltd., Loading Devices, Ltd., Ferranti, Ltd., Geo. W. King, Ltd., Curfew Appliances, Ltd., Mc. and B. Heat Control, Ltd., Cope and Cope, Ltd., Brecknell, Munro & Rogers, Ltd., John Steel, Broadwall Engineering Co., Ltd., Pulsometer Engineering Co., Ltd., Thomas & Son (Worcester), Ltd., Pressed Steel Co., Ltd., Gascoignes (Reading), Ltd., J. W. Woolley & Co., Ltd., Cocks & Sons, Tomlinson (Electric Vehicles), Ltd., S. Wolf & Co., Ltd., Eutalloy, & Welding Processes, Ltd., Banner Electric Co., Ltd., Stenor, Ltd., Marconi Instruments, Ltd., Alldays & Onions, Ltd., Belling & Co., Ltd., English Electric Co., Ltd., Jackson Electric Stove Co., Ltd., Moffat, Ltd., Revs. Electric Co., Ltd., Aidas Electric, Ltd., Simplex Electric Co., Ltd., Universal Boilers & Eng. Co., Ltd., Wilkins & Mitchell, Hotpoint Electric Appliance Co., Ltd., Hurley Machine Co. (Eng.), Ltd., Electrolux, Ltd., Frigidaire, Ltd., Hoover, Ltd., Morphy Richards, Ltd.

"Civils" Conversazione

At the first post-war conversazione of the Institution of Civil Engineers, held at the Institution building in Great George Street, Westminster, on Thursday evening, July 10, there was shown a small but varied exhibition of scientific and general engineering interest. A water model demonstrated the principles on which the ventilating system of the new House of Commons debating chamber is being designed, and another showed how, by electro-chemical action, appreciable hardening could be produced in London clay when aluminium anodes are used to pass a current through the soil. A radio link was shown, with which, using a modulated carrier, the strain on a structure could be measured at some remote point where it was difficult to set up apparatus, and a working model built by the Road Research Laboratory demonstrated how, by means of electro-osmotic action, the construction of foundations in river silts could be facilitated by causing a water movement with an electric current. Among the many distinguished guests present at the conversazione, who were received by the

President, Sir William Halcrow, were the President of the I.E.E., Mr. V. Z. de Ferranti, Sir Henry Dale, Sir Charles Darwin, Sir Henry Self, and Prof. R. V. Southwell.

Domestic Appliances for Hospitals

The "Hospitals Domestic Aids" Exhibition, opened by the Minister of Health at the Empire Tea Bureau, Regent Street, on Monday afternoon, has been organised by the Electrical Development Association in conjunction with the British Gas Council in order to demonstrate to hospital authorities the benefits which modern appliances can provide. The electrical exhibits, of which there are more than 70, range from the more usual small household accessories, such as percolators and toasters, to large dish-washing machines, automatic bread-slicers, floor scrubbers and electrically heated food trolleys. Ovens for hospital kitchens and other equipment required for the cooking of meals for patients and staff are not displayed, for reasons of space, but the selection which has been made provides a clear impression of the advantages arising from the use of modern automatic equipment in many aspects of hospital domestic routine. The exhibition will remain open until August 2.

The manufacturers who have contributed exhibits to the electrical section are: Ajax Domestic Appliance Co., Ltd.; Aidas Electric, Ltd.; G. F. E. Bartlett and Son, Ltd.; Belling and Co., Ltd.; Bendix Home Appliances, Ltd.; Berkel and Parnall Co., Ltd.; British Vacuum Cleaner and Engineering Co., Ltd.; Burco, Ltd.; Campbell Engineering Co., Ltd.; E. K. Cole, Ltd.; John Compton Organ Co., Ltd.; Crypto, Ltd.; Dowsing Co. (Electrical Manufacturers), Ltd.; R. G. Dixon and Co., Ltd.; Electrolux, Ltd.; Frigidaire, Ltd.; Gardiner and Gulland, Ltd.; General Electric Co., Ltd.; J. Glover and Sons, Ltd.; Gramophone Co., Ltd.; Hague and McKenzie, Ltd.; L. G. Hawkins and Co., Ltd.; Hobart Manufacturing Co., Ltd.; Hoover, Ltd.; Hotpoint Electrical Appliance Co., Ltd.; Jackson Electric Stove Co., Ltd.; Jones Sewing Machine Co., Ltd.; Lightfoot Refrigeration Co., Ltd.; Mabbott and Co., Ltd.; Metcalf Ideal Products, Ltd.; Morphy Richards, Ltd.; Premier Electric Heaters, Ltd.; Rediffusion, Ltd.; S.J.L.R. Electric, Ltd.; Simplex Electric Co., Ltd.; Steel and Co., Ltd.; Sterling Engineering Co., Ltd.; Jas. Stott and Co. (Engineers), Ltd.; B. and P. Swift, Ltd.; Vent-Axia, Ltd.

Marconi Jubilee Brochure

To commemorate the fiftieth year of the establishment of the company, Marconi's Wireless Telegraph Co. have prepared a handsome and attractively illustrated brochure which reviews the history of the company to the present day. It describes the scientific background—Clerk Maxwell's prediction of electro-magnetic waves in 1867 and Hertz's experimental proof of their existence—which led Guglielmo Marconi

working at his home in Bologna, to begin experiments. In 1895, he succeeded not only in getting waves to travel across space, but in employing successions of waves broken into groups to convey intelligible messages. The book makes it clear that the fact that nearly all the important early experimental wireless work was undertaken in this country must be credited to the inventor's mother, of Scottish and Irish ancestry, who herself made arrangements for Marconi to meet Sir William Preece, then Chief Engineer of the G.P.O. Photographs of some of the original apparatus and early broadcasting stations help to give a remarkably interesting survey of the growth of an industry which, in only 50 years, has progressed from very modest beginnings to radar, television and the remote control of aircraft.

Electrical Machinery Traders

New members elected by the Committee of the Association of Electrical Machinery Traders are the British Electric Co., A. Cooksley and Co., Ltd., J. E. Fowler, and Hackett and Son.

Annual Holidays

Clayton, Lewis and Miller, Ltd., announce that their factory will be closed for the summer holiday from July 25 to August 5.

The Phoenix Telephone & Electric Works Ltd. announce that their works and offices will be closed for the annual holiday from 5.30 p.m., Friday, July 25, until 8 a.m., Tuesday, August 5. Goods cannot be accepted or despatched during the period.

The summer holiday break will operate among the various establishments forming the Philips Group during the under-mentioned periods: Mitcham Works, July 28 to August 5; Blackburn Works, July 19 to 26; Hamilton Works, Lanarkshire, radio transmission equipment, Balham, and Philips Industrial, Brixton, July 19 to 26. The service department and stores at Waddon, Surrey, will not close.

Tensor Analysis

One of the newest of the mathematical approaches now available to the engineer for the predetermination of performance of machines and structures is that known as tensor analysis. Johnson and Phillips, Ltd., announce the issue of a brochure, publication TF 14, entitled "The Direct Setting-up of $Z_{\alpha\beta}$ for Closed-Mesh Networks from the Network Diagram," which shows the application of tensor methods to the study of static network impedances considered, from a specified reference frame. A companion brochure (TF 15) will be issued later in the year on the Direct Setting-up of $Y^{\alpha\beta}$ for Junction

Networks. A small supply is still available of publication TF 13, "The Impedances of Multiple-Winding Transformers," in which tensor methods are employed in the study of the self and mutual impedances of transformers. The brochures are reprints of articles by the company's technical advisor, Mr. S. Austen Stigant, which appeared originally in the B.E.A.M.A. Journal. Applications for copies, which will be provided free of charge, should be made to the company at Victoria Way, Charlton, London, S.E.7.

Contract Price Adjustment Formulæ

The B.E.A.M.A. announce that for purposes of calculating variations in: (a) "Rates of Pay"—the rate of pay for adult male labour at July 12, 1947, shall be deemed to be 110s.; (b) "Costs of Material"—the index figure for Intermediate products last published by the Board of Trade on July 12 is 221.4 and is the figure for the month of June, 1947.

E.I.B.A. Report

THE annual report of the council of the Electrical Industries Benevolent Association, prepared by the secretary, Mr. H. Senior Fothergill, for presentation at the annual general meeting on July 24, stresses the value of the personal element introduced by the association into its charitable work, which, it considers, may often have more far-reaching results than the giving of a money grant alone. Many letters expressing appreciation are quoted in support.

During the year the number of cases dealt with was 253 (an increase of 25 per cent. on 1945), a figure which, taking into account families and other dependents, resulted in 465 men, women and children being assisted, of whom 142 were widows. Of this number, 85 cases involving 192 people were newly reported during the year, whereas the new cases in 1945 numbered 66. All but five of the 253 cases dealt with involved money payments on the part of the association, and the amount paid out in grants, pensions and allowances amounted to £16 134, a record figure in E.I.B.A. history and an increase of £3 983 on 1945.

This expansion in the association's work is ascribed partly to the growing awareness of the benefits available to people in distress in the industry, and partly to "the alarming number of men who are breaking down with arthritis and other nervous complaints, and of men and women who are being overcome with tuberculosis," a legacy, it is thought, of the war period. A contributory factor was the large number of people on fixed income who, the report states, are in real poverty as a result of increased living costs.

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:—

Dundee, July 21.—Supply, delivery and erection of automatic CO₂ fire extinguishing equipment for 33 kV sub-station at Clepington. Specification from Town Clerk, City Chambers, Dundee.

Bridgnorth, July 26.—Electrical installation in 18 houses at Sydney Cottage site. Specification from Town Clerk, College House, Bridgnorth.

Hornsey, July 28.—Provision of all labour and materials for electrical installation in 116 flats at North Hill, Highgate. Specification from Chief Electrical Engineer and Manager, Electricity Showrooms, Crouch End, N.8.

Accrington, July 31.—Tenders invited for purchase of: 2 000 kW B.T.H. Curtis turbo-alternator, three-phase, 50 cycles, 6.6 kV, 3 000 r.p.m., with Cole Marchant condensing plant. Further particulars from Borough Electrical Engineer, Corporation Electricity Works, Hyndburn Road, Accrington.

Hazel Grove (Cheshire), July 31.—Supply and delivery to Hazel Grove and Bramhall U.D.C. of two 750 kVA trans-

formers with externally operated off-load tap changing gear. Specification from Chief Electrical Engineer and Manager, Electricity Offices, Chapel Street, Hazel Grove, Cheshire; deposit, £1 ls.

Newport, July 31.—Manufacture, supply and installation of 3 kV main and pilot cables, by companies fully experienced in laying of submarine cables. Specifications from Electrical Engineer and Manager, Electric House, Dock Street, Newport, Mon.; deposit, £1 ls.

Dundee, August 13.—Supply of multi-core h.v. and l.v. p.i. cables. Particulars from City Electrical Engineer, Corporation Electricity Department, Dudhope Crescent Road, Dundee.

Halifax, August 18.—Manufacture, delivery, laying and jointing of 33 kV underground cables and manufacture, delivery and erection of 33 kV metal-clad switchgear and control panels, etc. Specifications from Borough Electrical Engineer and Manager, 19/23, Northgate, Halifax; deposit, £1 ls.

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

In Parliament

Load Shedding.—It was intimated by the Parliamentary Secretary to the Ministry of Fuel and Power that a statement indicating the progress made in dealing with the problem of load-shedding would be made very shortly, probably in the course of next week.

National Hearing Aids.—Replying to Sir E. Graham-Little, Mr. Herbert Morrison said that information about the new national hearing aid, including particulars of performance tests carried out by the National Physical Laboratory, would be given in the report of the Electro-Acoustic Committee of the Medical Research Council. This was now in the Press and would be issued by H.M. Stationery Office in due course.

Toasters and Shavers.—Mr. Shawcross asked the Minister of Supply whether he would take steps to secure the manufacture of automatic electric toasters and razors in the United Kingdom, or allow their importation from the U.S.A. or Switzerland. Mr. Wilmot answered that as these articles could not be regarded as

an urgent need, any substantial importation from hard currency sources was out of the question at the present time. Since they would, however, be much in demand in the future, a number of licences to manufacture had been issued, and they were pressing manufacturers to develop their production, mainly at present for the purposes of export.

Electrical Steel.—The Minister of Supply was asked by Mr. Skinnard whether, in view of the difficulty experienced by small industrial units in obtaining a fair proportion of the available supplies of electrical sheet steel used in the manufacture of telecommunications equipment for export, he would apply controls similar to those imposed on the distribution of mild steel sheet. Mr. Wilmot replied that arrangements for the distribution of electrical sheet were at present being reviewed. While the present shortage continued, priority must be given to programmes directly contributing to the expansion of fuel and power resources, and supplies to other users had, therefore, to be restricted.

Company News

HICK, HARGREAVES AND CO., LTD.—Net prft. for yr. ended March 31, £52 741, and net £53 464 as previously announced.

TELEGRAPH CONSTRUCTION AND MAINTENANCE CO., LTD.—Int. div. of 5% actual (1s. per share) less inc.-tax, has been declared for yr. endg. December 31, 1946.

STREAM-LINE FILTERS, LTD.—Net trdg. prft. for yr. endg. December 31, 1946, £39 269 (£52 385). To dirs.' fees £1 050 (£878), deprecn. £1 440 (£866), taxn. £20 000 (£35 831), prft. subj. to dirs.' addtl. remuneration £16 779 (£10 430). To gen. res. £4 000 (same), int. div. 5% less tax, £2 750, and prpsd. fin. div. 10% less tax, £5 500, mkg. £8 250 (£7 000); fwd. £18 988 (£15 471). Current liabs. £141 829 (£110 504) and current assets £212 067 (£273 912).

ORIENTAL TELEPHONE AND ELECTRIC CO., LTD.—The report states that owing to delay in receipt of audited returns from Singapore it will not be possible to complete accounts for 1946 in time for submission to the meeting on July 29. The Chairman will move that the meeting be adjourned. It is proposed to convert the issued ordinary shares into £1 units and also to amend articles.

BRITISH TIMKEN, LTD.—Consolidated trdg. prfts. for yr. 1946, £329 164 (£207 697). Deprecn. absorbs £115 288 (£29 817), incl. £65 270 of special nature. Allocn. for taxn. £102 278 (£87 235), and div. of parent coy. maintained at 15%; after placing £30 000 (£31 519) to gen. res., carry-fwd. £151 788 (£117 458). Current assets £1 559 753 and current liabs. and provns. £1 025 841. At annual meeting to be held on July 21, a resolution will be put to increase the limit upon borrowing powers of directors to £600 000.

GARRARD ENGINEERING AND MANUFACTURING CO., LTD.—Speaking at the annual meeting, Mr. H. V. Slade (chairman) said the year under review had proved a very difficult one. The company now had a programme in hand and facilities available to meet the requirements of both the home and export trade, and the present order book was the largest in the company's history, but shortages of materials prevented them from meeting demands. New products had received close attention, the Chairman said, but because of the heavy demand for their standard products and the difficulty in obtaining materials, these had been held in abeyance for the time being.

CAWNPORE ELECTRIC SUPPLY CORP., LTD.—A recent adjudicator's award in respect of a strike of employees for higher wages would, if enforced, result in employees

receiving 50 per cent. of the value of all the Corporation's reserve funds, declared the chairman, Mr. K. A. Scott-Moncrieff, at a shareholders' meeting in London. He stated that the company had not been able to agree to claims put forward by the workers and the Government had then appointed an adjudicator. A few days ago an award, which was confirmed by the Government, was declared. Legal opinion on the award was being sought, and the board intended to take all possible steps for its revocation.

ISLE OF THANET ELECTRIC SUPPLY CO., LTD.—Delay in obtaining a rating assessment is held responsible for the late presentation of the company's accounts for the year ending December 31, 1946, states a circular to stockholders. It is explained that the rating authorities appealed for a revision in respect of the period April 1 to December 31, 1946, of the rating assessment on the electricity undertaking previously owned by the company, and despite urgent requests from the company and the local authorities for the matter to be dealt with promptly, very little progress has apparently been made. The company is now advised that a draft revised rating valuation may be available for consideration in August next. Until the new assessment is agreed, the accounts for the year cannot be completed, neither can the purchase price payable by the Margate, Broadstairs and District Electricity Board be ascertained. The directors state that the rating question is the only matter outstanding, and give financial results for the year subject to adjustment (if any) of local rates. These show that revenue for the year totalled £173 052 (as against £108 635 for 1945), less expenses £100 490 (£57 566), leaving a surplus of £72 562 (£51 069). After deducting allocations to sinking funds, debenture stock interest and interest on sinking funds, totalling £23 272 (£23 057) and adding interest received £554 (£917), profit for the year, subject to rates adjustment, is £49 844 (£28 929).

SOUTHERN AREAS ELECTRIC CORP., LTD.—The chairman, Viscount Elibank, presided at the recent annual meeting. In the course of his speech, which dealt largely with the position of the company under the Electricity Bill, he said that their policy had been to develop their manufacturing subsidiaries in view of the threatened severance of the electricity supply interests. In Mawdsley's, Ltd., of Dursley, they had an efficient electrical manufacturing works, and Gillott Electro-Steam Cookers, Ltd., was also being developed, although shortage of materials and the national fuel

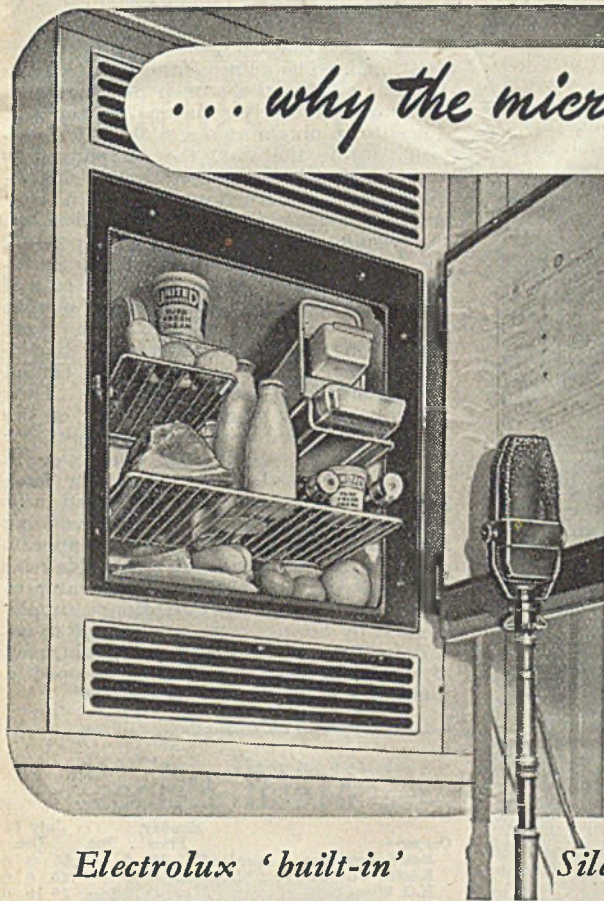
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economy campaign were proving to be retarding factors. A third subsidiary, P.A.M., Ltd., had been engaged until the end of the war solely on contracts for the Admiralty, but efforts to obtain new business were bearing fruit, and there seemed every prospect of the works being fully occupied shortly on the production of various types of precision mechanical equipments. New Day Electrics, Ltd., another subsidiary, was in the early stages of developing prototypes of electrical accessories for which, in time, there should be an increasing demand. They had also formed a new company, under the name of Mono-Cam, Ltd., for the sale and servicing of a new type of pump. Other projects had been under consideration, the Chairman said, but action had been deferred until they could see more clearly the effect of the passing of the Electricity Bill.

BROADCAST RELAY SERVICE, LTD.—Speaking at the annual general meeting, the new Chairman (Mr. J. S. Wills) said that shareholders would doubtless be aware of his connection with the British Electric Traction Co., Ltd., which had recently increased its holding in their company. They had not, however, secured control, and he wished to make it clear that Broadcast Relay had not become a subsidiary of any other company or group. It retained its independence, and would continue to be developed solely on its own merits. After saying that many thousands of new subscribers had recently been connected to their Rediffusion networks, Mr. Wills stated that, although he was confident that the company's licenses would be extended beyond the present expiry date of December 31, 1949, no decision on the matter had yet been reached. The factory at Wandsworth was busily engaged in developing a valuable export market for radio-heating and communication equipment. In their overseas business, they were entering upon a period of rapid expansion, and their first broadcast station overseas—Radio Trinidad—would be operating within a few weeks. The Chairman ended his speech by listing some of the technical advantages which, he said, were enjoyed by subscribers to the company's relay services.

LISBON ELECTRIC TRAMWAYS, LTD.—In his statement to shareholders, Sir Alexander Roger (chairman) spoke of shortages of materials, and said that delays in delivery of supplies, some of which were ordered in 1945, had prevented improvement and expansion of the Lisbon transport services on the scale planned. The continuing increase in the general travelling public was producing a traffic congestion problem in Lisbon which was very perplexing, and the company had, meanwhile, presented to

the authorities a five-year expansion programme involving an expenditure of approximately £1 000 000.

BRAZILIAN TRACTION, LIGHT AND POWER CO., LTD.—The President (Mr. Henry Borden) said at the annual meeting, held in Toronto recently, that as a result of difficulty in obtaining materials and equipment during the war, the company was now faced with the necessity of undertaking new construction work on a very large scale. More than 100 000 applications for telephones could not be met pending the receipt and installation of the necessary equipment, and the estimated cost of the expansion programme over the next few years was \$160 000 000. To assist in carrying out an extensive new hydro-electric programme, a well-known United States firm had been engaged. They would undertake the greater part of the Paraiba-Pirai water diversion project for the Rio power supply, the completion of which was scheduled for 1950. At the Serra plant, a new 91 000 h.p. unit had now come into service. Some concern was being felt, the President revealed, at the appearance of fissures or cracks in the hillside near the penstocks which carried the water to Serra. Geological investigations supplemented by borings were being made to ascertain the exact nature of the terrain, part of an old landslide which had developed in times past and then come to rest.

Metal Prices

	Monday, Price	Inc.	July 14 Dec.
Copper—			
Best Selected (nom.)...per ton	£130 10 0	—	£5 0 0
Electro Wire bars ... "	£132 0 0	—	£5 0 0
H.C. Wires, basis ... "	£149 0 0	—	£5 10 0
Sheet "	£173 10 0	—	£5 0 0
Brass Electrical quality			
1% Tin—			
Wire (Telephone) basis per ton	£172 5 0	—	£5 10 0
Brass (60/40)—			
Rod basis per lb.	1s. 2d.	—	½d
Wire "	1s. 6½d.	—	¾d
Iron and Steel—			
Pig Iron (E. Coast Hematite No. 1) ... per ton	£8 19 0	—	—
Galvanised Steel Wire (Cable Armouring) basis 0.104 in. ... "	£34 5 0	—	—
Mild Steel Tape (Cable Armouring) basis 0.04 in. "	£21 15 0	—	—
Lead Pig—			
English "	£91 10 0	—	—
Foreign and Colonial... "	£90 0 0	—	—
Tin—			
Ingot (minimum of 99.9% purity) "	£412 10 0	—	—
Wire, basis per lb.	5s. 6½d.	—	—
Aluminium Ingots per ton	£80 0 0	—	—
Spelter "	£70 0 0	—	—
Mercury (spot) per bott.	£17 3 6	—	—

Prices of galvanised steel wire and steel tape supplied by C.M.A. Other metal prices supplied by E.L. Callender's Cables, Ltd. The latter prices are nominal only, and do not include any allowances for tariff charges.

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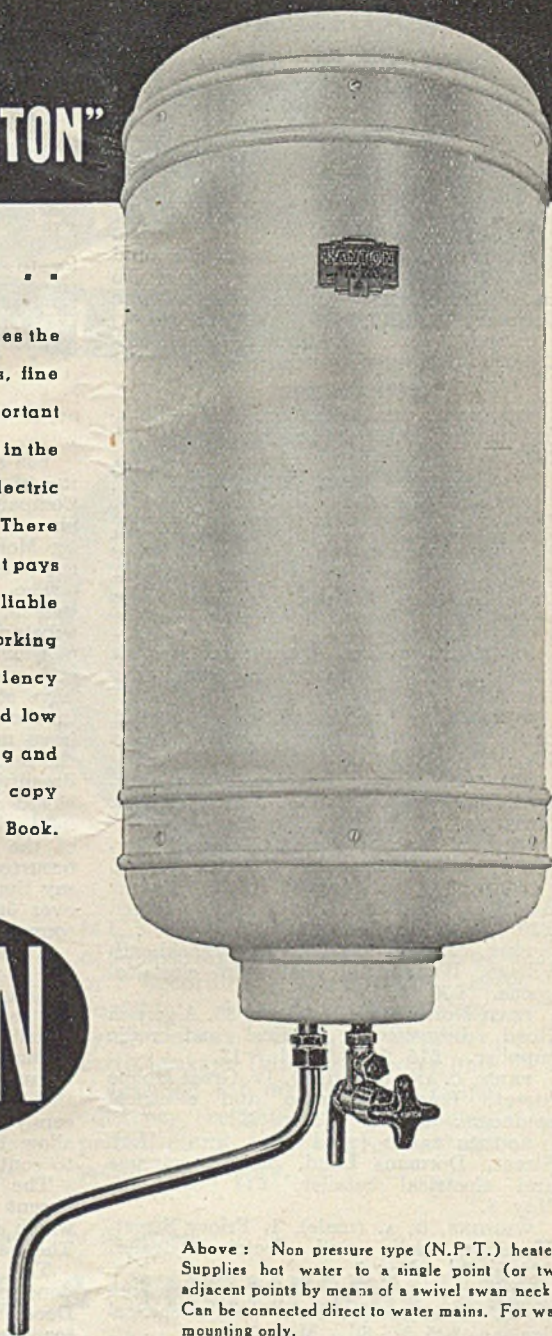
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Commercial Information

Mortgages and Charges

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

CHADDERTON RADIO AND TELEVISION CO., LTD.—June 9, £530 debenture, to H. H. Speight, Rochdale, general charge. *Nil. February 14, 1947.

TEMCO, LTD., Lydbrook.—June 10, £20 000 debentures; general charge.

Satisfaction

VENT-AXIA, LTD., London, S.W.—Satisfaction June 11, £4 000, registered April 29, 1938.

County Court Judgments

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

J. J. RADIO AND ELECTRICAL SERVICE (firm), Old Hill, Falmouth, radio and electrical dealers. £12 2s. 11d. May 6.

BUXTON, H. (male), 86, High Street, South Normanton, Derby, radio dealer. 18s. 10d. April 21.

BRUNWIN, Grant, Ness Road, Shoeburyness, Essex, radio retailer, trading as G.B. Services. £10 8s. 5d. May 9.

MODERN RADIO (firm), Thorpe Bay, Essex, radio dealers. £17 5s. 11d. May 8.

JONES, C. A. (male), 362, Tunnel Avenue, London, S.E.10, radio dealer. £29 11s. May 1.

PEAT, M. F. (male), 28, Blackheath Village, Blackheath, dealer in electrical goods. £56 8s. 11d. May 7.

PEAT, Norman F., Top Flat, 86, Algernon Road, Lewisham, electrical and radio supplier. £15 2s. 8d. May 13.

PRICE, C. AND CO. (firm), 12, Great Holme Street, Leicester, radio and electrical engineers. £14 13s. April 29.

ROGERS RADIO (sued as a firm), High Street, Dormans Land, Surrey, wireless and electrical retailer. £14 8s. 11d. May 8.

WIGGINS, G. A. (male), 1, Priory Street, Hastings, radio and electrical dealer. £19 5s. 9d. May 5.

ASQUITH, — (male), 7 and 8, Foreshore Road, Scarborough, radio and electrical dealer. £25 5s. 8d. May 2.

LOTHIAN, T. (male), 45, Cold Bath Road, Harrogate, radio dealer. £16 12s. 7d. May 8.

BRAY'S RADIO SERVICE (sued as a firm), 20, Stockton Street, West Hartlepool, electrical dealers. £22 0s. 5d. April 23.

TAYLOR, J. H. (male), 29, Watson Road, Clacton-on-Sea, Essex, electrical engineer. £20 14s. 10d. April 22.

TAYLOR, J. H. (male), 29, Watson Road, Clacton-on-Sea, Essex, radio dealer. £19 9s. 11d. April 24.

Company Meeting

W. T. Henley's Telegraph Works

Increase in Turnover

The sixty-eighth ordinary general meeting of W. T. Henley's Telegraph Works Company, Limited, was held at the Dorchester Hotel, London, W.1, on July 11, Sir Montague Hughman (chairman of the company) presiding.

The Chairman, in the course of his speech, said: I am pleased to report a substantial increase in our turnover, some of which is accounted for by the rise in the cost of materials, but undoubtedly, we have seen signs of recovery, as the figures in the balance sheet indicate. Still, we have many problems to face to-day, and the setback which we received during those dreadful winter weeks when we were closed down for want of fuel, power and light will ever stand in my memory as one of the most disastrous and unpleasant occurrences in my lifetime. I am glad to say that our exports overseas amounted to over 36 per cent. of our total business, compared with 27 per cent. in 1945.

At home we have to face the fact that the electric supply industry is about to be nationalised, and we are, by the nature of our business, very much interested in the distribution side of the industry. This change may have far-reaching effects, as we may have one authority the buyer for the bulk of our home production. I sincerely trust that this new authority will allow the cable manufacturing companies to continue the fine work they are doing.

The balance on trading account of the parent company amounts to £633 482, which is £50 653 greater than last year. The balance brought forward is £393 219.

The directors recommend a final dividend of 10 per cent. for the year ended December 31, 1946, making 15 per cent. for the year. They also recommend a cash bonus of 5 per cent., leaving to be carried forward £413 822.

The report was adopted.

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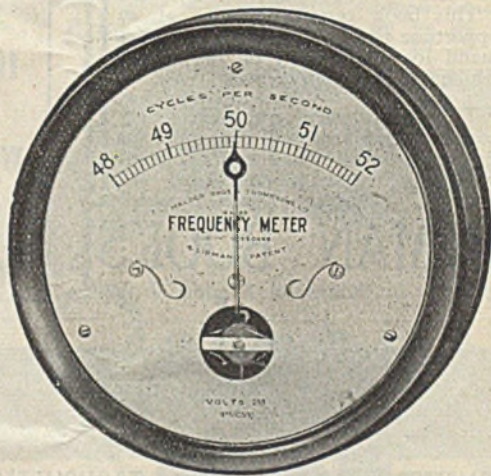
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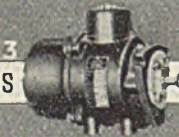


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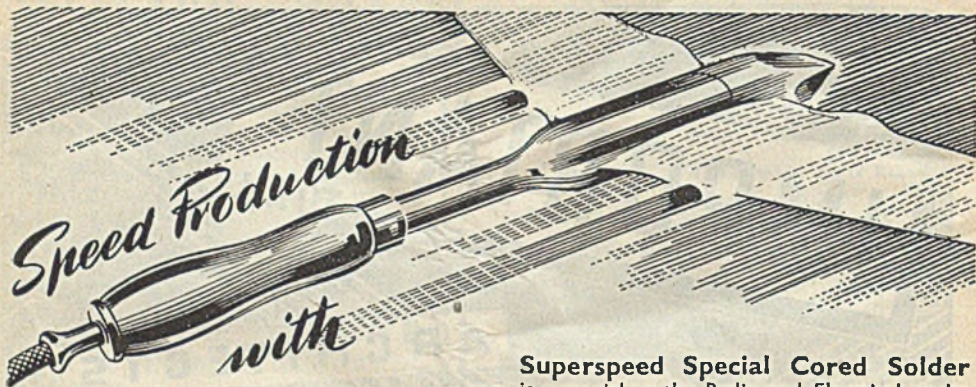
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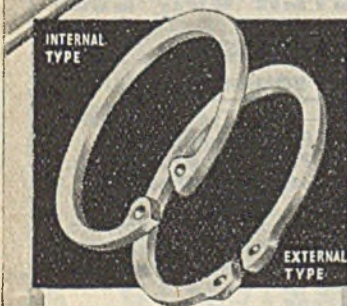


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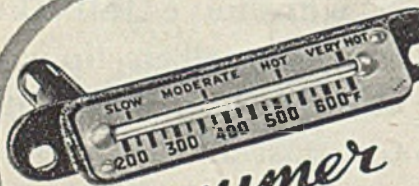
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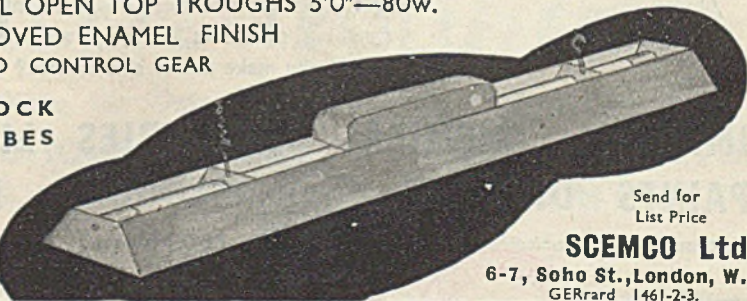
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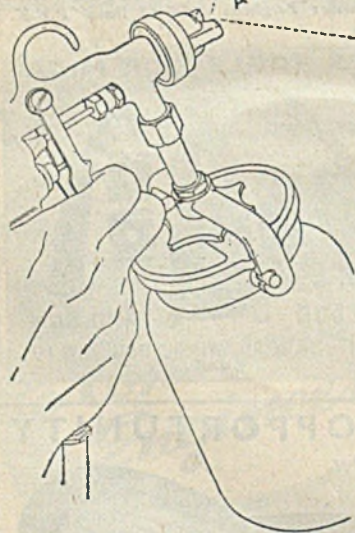
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OUT OF THE SPRAY GUN comes the paint or lacquer which will decide the final finish of the product: its appearance, its durability—and in many cases, its reputation.

Because the finish is so important a factor, I.C.I. Paints Division maintain a Technical Service Station where the industrial paint user can see for himself how best results may be achieved with existing finishes, and learn the possibilities of new finishes and finishing processes as they are developed. Could you make use of this service?

IMPERIAL CHEMICAL INDUSTRIES LIMITED
PAINTS DIVISION



SLOUGH, BUCKS

(successors to Nobel Chemical Finishes Ltd.)

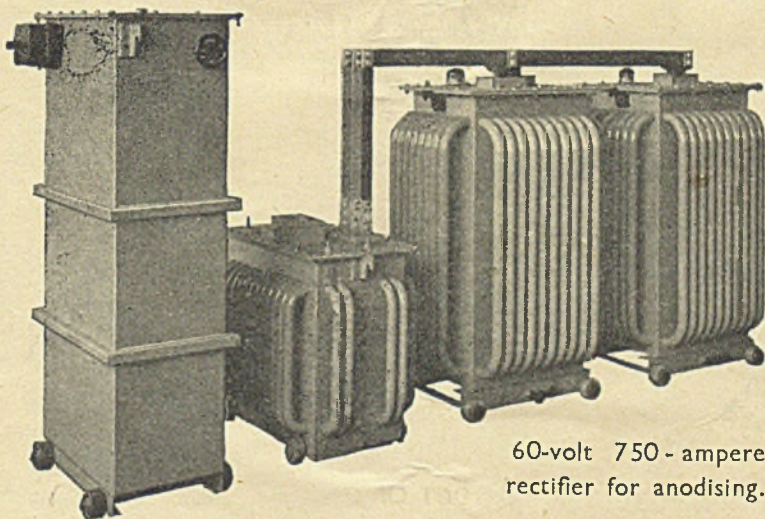
Telephone: Slough 23851

D.1.739



Power

for
chromic-acid anodising
&
allied processes



60-volt 750-ampere
rectifier for anodising.

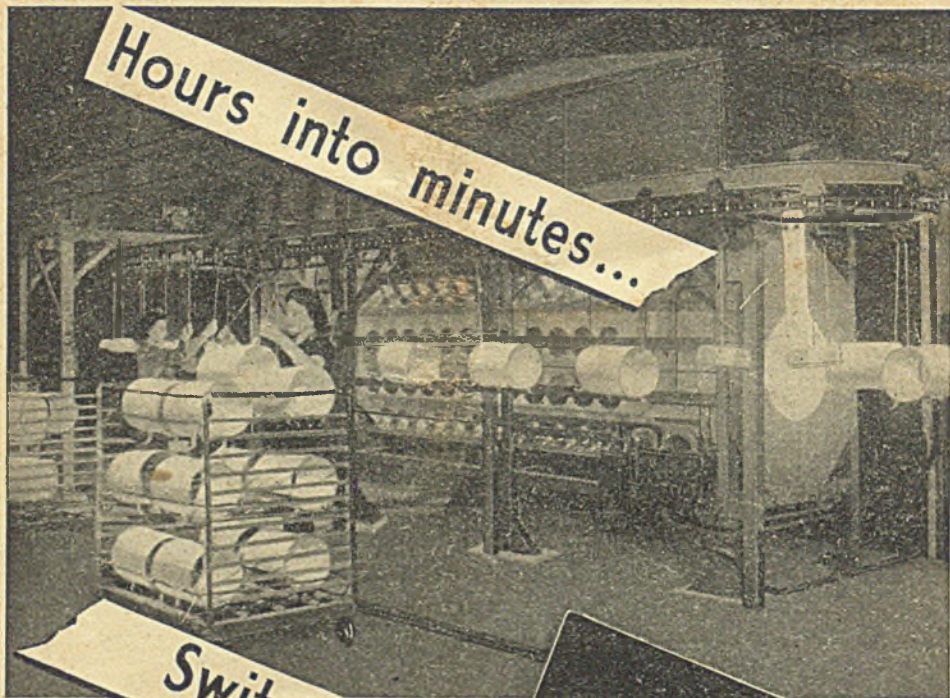
Overall efficiency of 85-90% from A.C. mains to bath

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Write for Data Sheet No. 44 to Dept. E.
WESTINGHOUSE BRAKE & SIGNAL CO. LTD.,
82, York Way, King's Cross, London, N.1

Hours into minutes...



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INFRA-RED**

PAINT STOVING

A Metrovick Electric Infra Red oven stoving paint on outer cases of water heaters, ranging from 1½ to 30 gallons capacity, in 5-6 minutes.

The plant is equipped with 96 Metrovick Infra Red lamps, having a total loading of 24 kW.

In addition to its ability to reduce vital production time this oven requires a floor space of only 12ft. x 4ft. x 11ft. high.

Metrovick equipments are readily adaptable to various production and factory requirements.

Executives are invited to visit our London Demonstration Department

*Photograph by courtesy of
Messrs. Johnson & Phillips Ltd.*



S/1701

METROPOLITAN-VICKERS ELECTRICAL CO. LTD · NUMBER ONE KINGSWAY · LONDON · W.C.2