

THE

ELECTRICIAN

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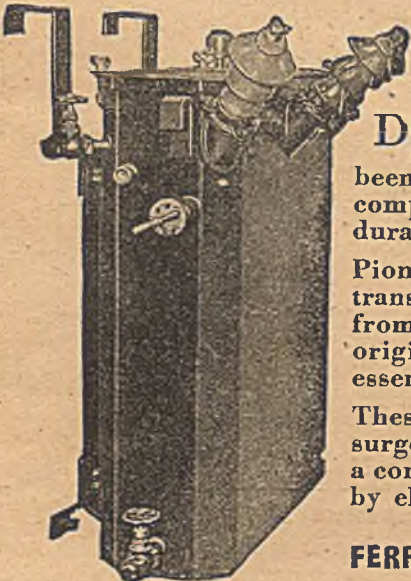
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DISTRIBUTION transformers of the type illustrated are quite trouble-free and have been operating for many years . . . giving complete satisfaction by their efficiency and durability.

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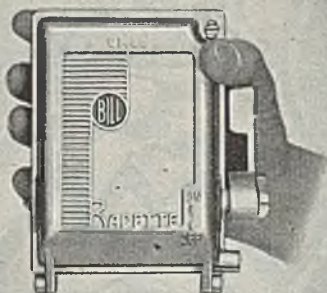



ELECTRICAL STEEL SHEETS
FOR TRANSFORMER AND DYNAMO WORK

ELECTRICAL STAMPINGS
OF ALL DESCRIPTIONS

SPECIAL ALLOY SHEET FOR MAGNETIC TEMPERATURE
COMPENSATION - HIGH FREQUENCY WORK - RELAYS

RICHARD THOMAS & BALDWINS LIMITED
WILDEN IRONWORKS, STOURPORT-ON-SEVERN, WORCS.



THE SMALLEST TRIPLE POLE SWITCHFUSE.
EMINENTLY SUITABLE FOR MACHINE TOOLS.
 RADETTE. 10 AMPERES, 500 VOLTS. CATALOGUE NO. Q1438.

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BILL SWITCHGEAR LTD
ASTON LANE, PERRY BARR
BIRMINGHAM · 20

MANCHESTER GLASGOW
BELFAST
BURTON-ON-TRENT



Like the hallmark on silver and the carat sign on pure gold, the Moffat crest, which is found on the door of every Moffat Electric Cooker and Electric Refrigerator, is a guarantee of the highest attainable quality in cooking and refrigeration equipment.

The crest was adopted by Moffats Limited to identify their products, symbolizing as it does the characteristics that give them leadership in their field—the crown to express REGAL QUALITY; the

elephant a symbol of LONG LIFE AND STRENGTH; the effortless leaping of the antelopes, typical of the SPEED IN OPERATION AND STREAMLINING IN DESIGN; and the beaver at the base of the shield signifies EFFICIENCY. The remaining intertwined letters represent the four senior members of the firm.

Truly a crest of quality—the mark of leadership in its own field, and a symbol known in all parts of the world.

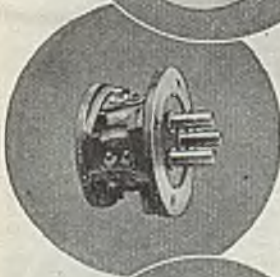
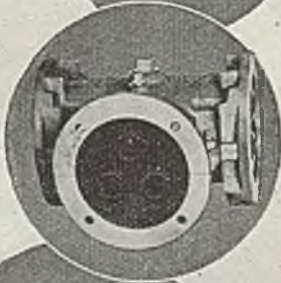
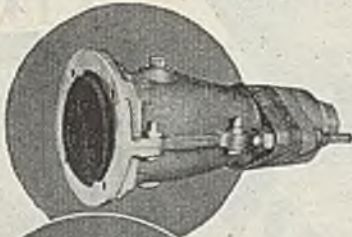
MOFFATS LIMITED

BLACKBURN LANCASHIRE

Makers of the Famous Moffat Electric Cookers & Refrigerators

"Sold the World over"

Every practical combination of cable coupling can be assembled from these units



B.I. Callender's Mining Type Coupling Boxes provide a means of making the cable system as readily transportable as the operating machinery.

Extensions, withdrawals and repairs can be effected with minimum expenditure of time and material.

Colliery electrical systems can be standardised in regard to cable lengths and sizes, with complete interchangeability of components.

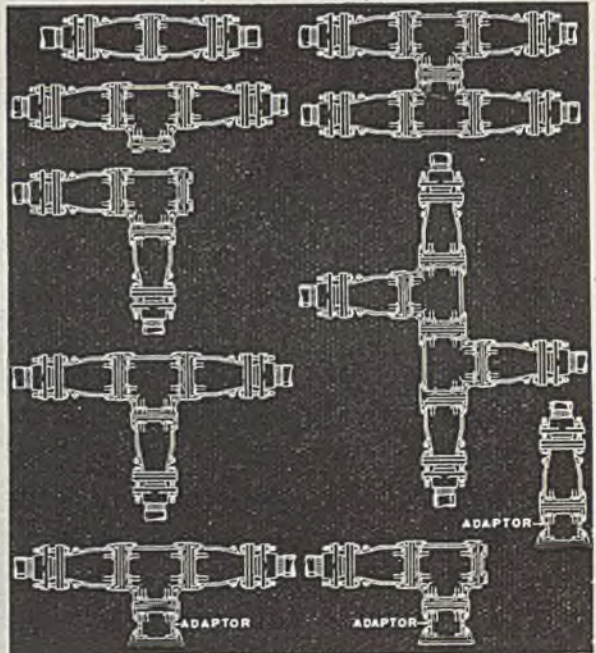
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For working pressures up to 660v. and 3,300v.

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The House of Copper Conductors for over 60 years

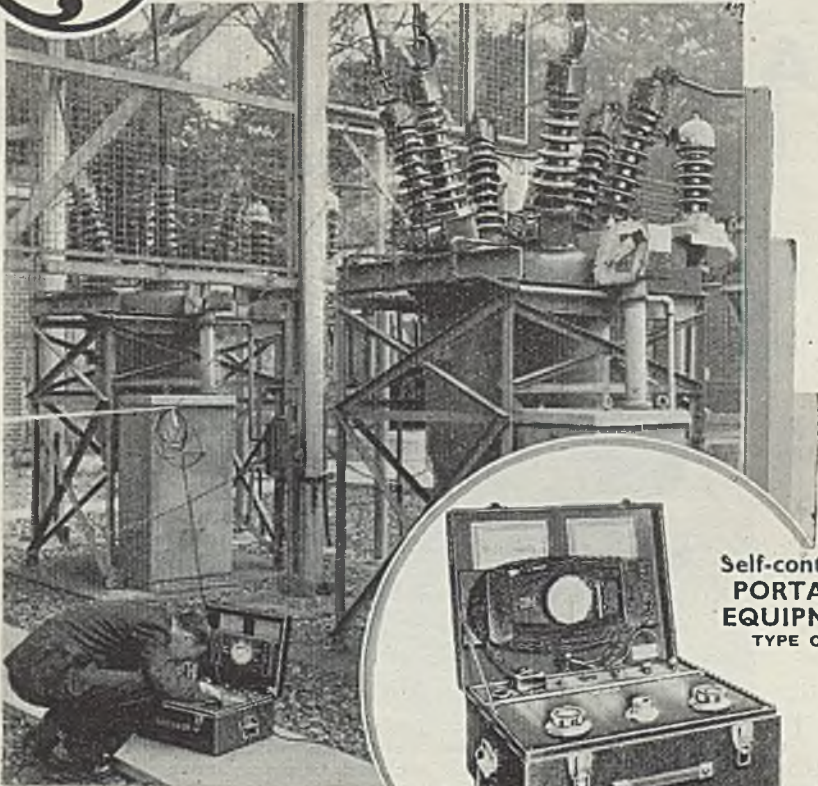
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(INCORPORATED IN THE LONDON ELECTRIC WIRE COMPANY & SMITHS, LIMITED)
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FORREST INSULATION TEST SET



For measuring high values of insulation resistance up to 40,000 megohms at Test Voltages up to 5 kv.

Also used in conjunction with BTH Oil Test Cell for testing of Insulating Oil.

Self-contained
PORTABLE
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Apply for
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Designed to facilitate routine testing of insulation for the detection of incipient breakdown, as recommended in Section 8 of "BRITISH STANDARD CODE OF PRACTICE" BS 1086/1942.

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THE BRITISH THOMSON-HOUSTON COMPANY LIMITED, WILLESDEN, ENGLAND.

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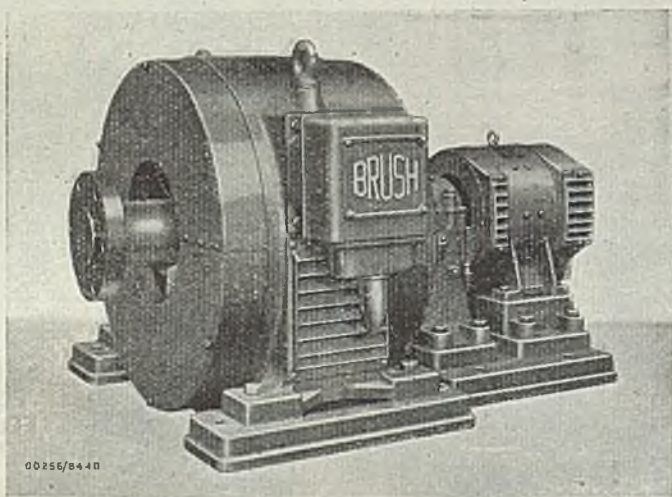
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Salient Pole

ALTERNATORS

25 K.V.A. to 2,500 K.V.A.

Pedestal Bearing Series



THE extensive experience which this Company possesses in the construction of plant for electric generation is embodied in the design and construction of "BRUSH" Alternators.

The outstanding features of these machines is the high efficiency of operation characterised by low internal losses.

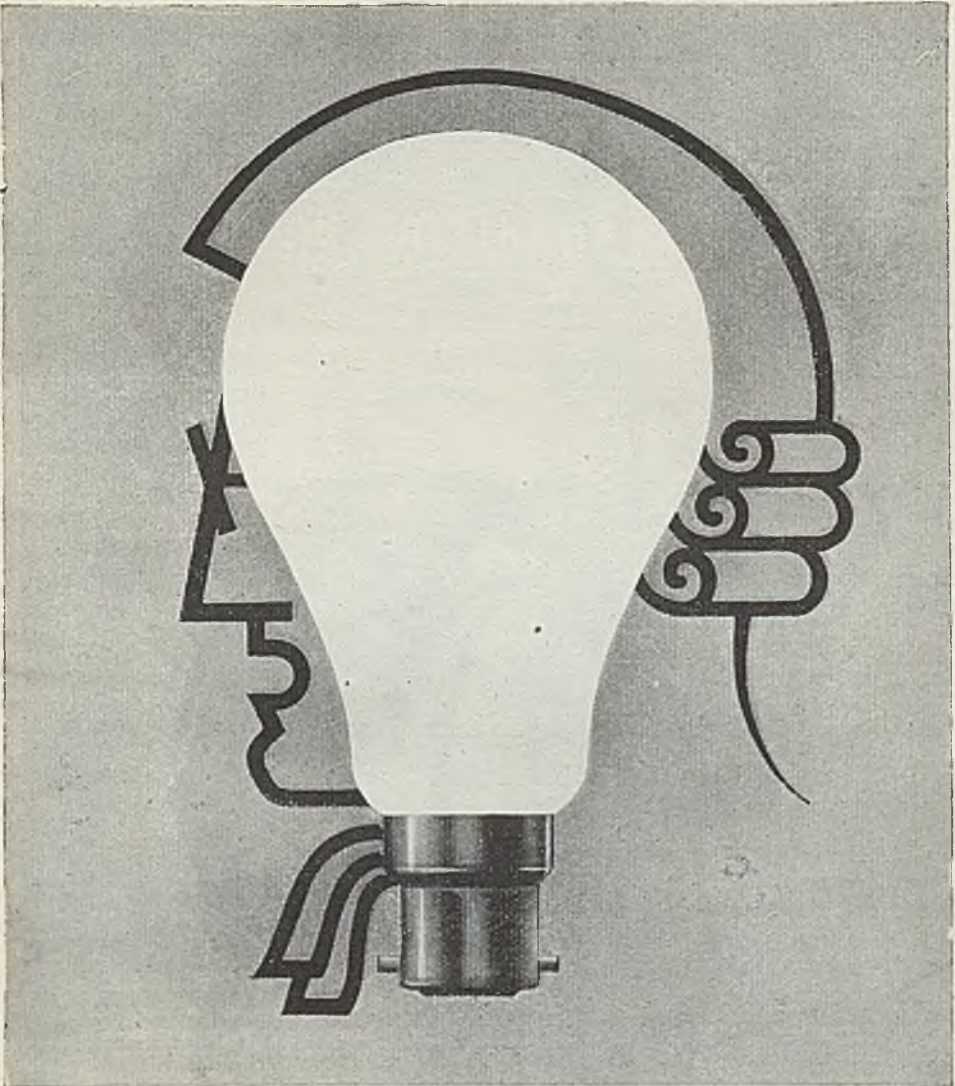
Many types of Alternators are available suited for drive by all classes of prime movers.

The important constructional features are set out in Publications EL/B. 226. Write for your copy to-day, mentioning the size of machine in which you are interested.

THE BRUSH ELECTRICAL ENGINEERING CO. LTD
LOUGHBOROUGH - ENGLAND

TURBO-GENERATORS, TRANSFORMERS, E.H.T. and M.T. SWITCHGEAR, A.C. and D.C. MOTORS and GENERATORS, BATTERY ELECTRIC VEHICLES and TRUCKS, TRACTION EQUIPMENT, BUS and COACH BODIES

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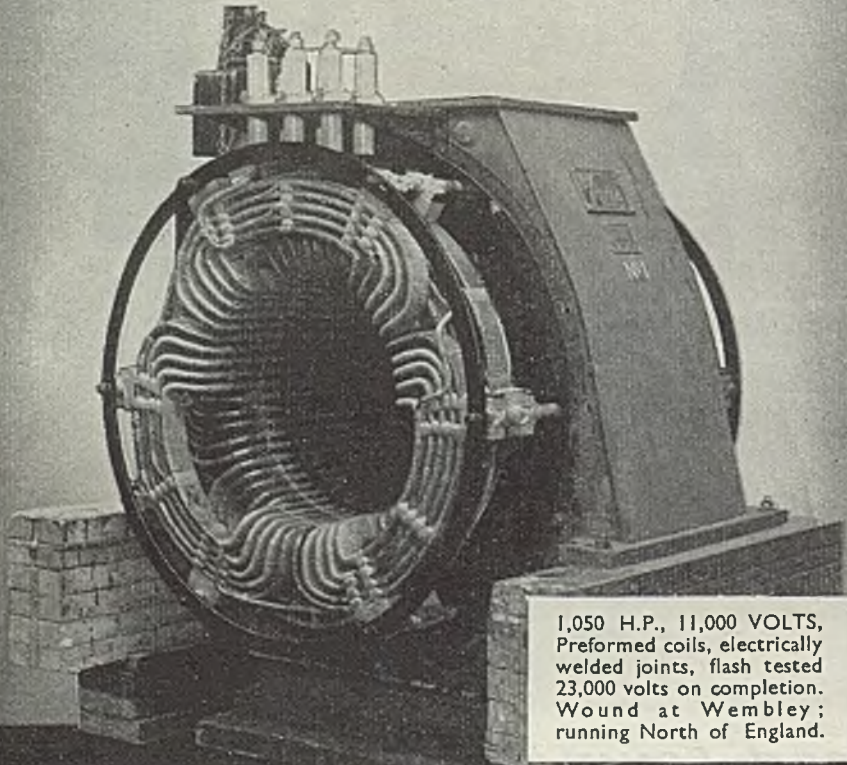
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Metrovick Cosmos Lamps: there is the best possible "case" for specifying them for all industrial, commercial and domestic lighting.

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REPAIRING REWINDING
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1,050 H.P., 11,000 VOLTS,
Preformed coils, electrically
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Wound at Wembley;
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The **BRITISH MADE**
PRESSBOARD INSULATION

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B. S. & W. WHITELEY LTD.
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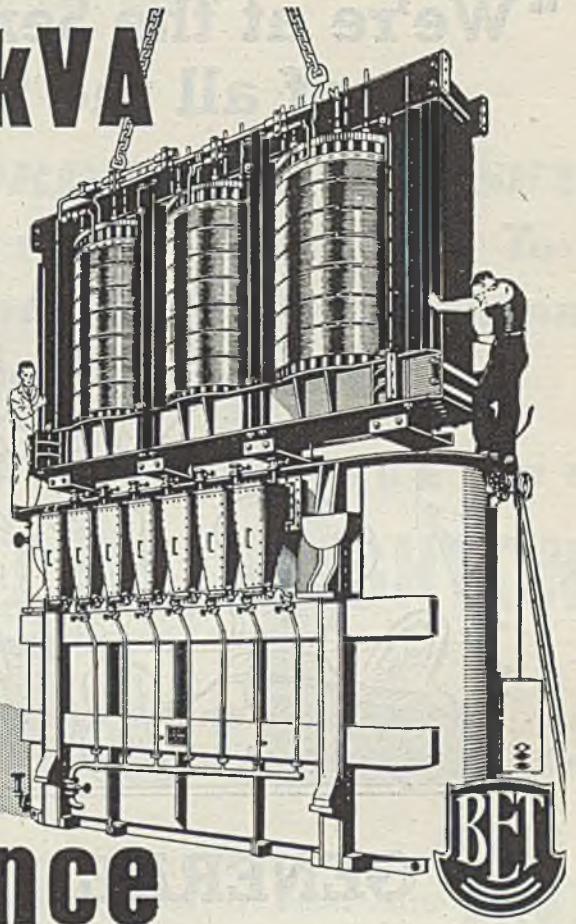
LONDON OFFICE: 104 HIGH HOLBORN, W.C.1
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Experience

This B.E.T. 62,500 kVA Transformer is going into its tank to give years of service. Its duty will be a responsible one but it goes out with the confidence of its makers. B.E.T. have specialised

in transformers for 47 years. There is nothing in transformer construction for which B.E.T. experience does not provide an answer. This experience is at your service.

The
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Company Limited

In association with CROMPTON PARKINSON LIMITED

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“We’re at the Service of all the Services” ...



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“Collaboration, complete, enthusiastic and unreserved—that’s what we aim at here,” says General Cable.

“Now that the fighting is over I’ll soon be allowed to tell you of the man-size task we’ve been tackling down here in Surrey. By then, too, we’ll be able to give the whole world the benefit of

the advances in production technique and cable efficiency achieved by our technical staff.

‘In the meantime if you have any present problems on which you’d like expert opinion or maybe even a spot of research or experiment, we’ll be glad to hear from you and give you all the assistance we can.’”

**THE GENERAL CABLE
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 the increasing demand for
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*where comprehensive stocks of
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THE LONDON ELECTRIC WIRE COMPANY AND SMITHS LIMITED



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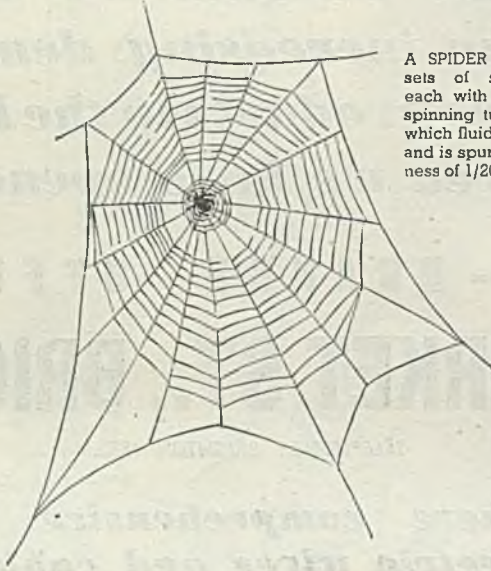


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A SPIDER has three sets of spinnerets, each with up to 100 spinning tubes, from which fluid silk issues and is spun to a thickness of $1/2000''$ or less

Fine Wires, insulated and covered, $8/100''$ to $1/1000''$, made and spun with all the latest and most modern machinery and materials, by a firm with a lifetime of experience in delicate textile coverings

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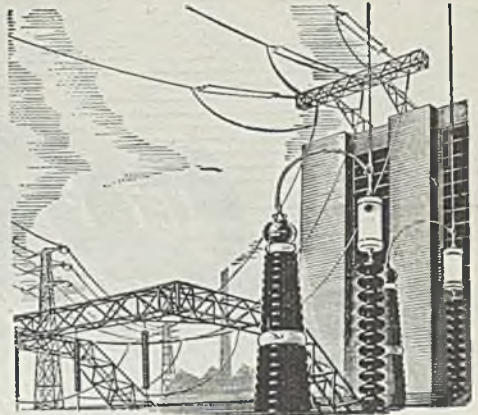
Varnished Cloths
IN SILKS AND CAMBRICS
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Guaranteed to B.S.1 Specification

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The rapid growth of the Electrical and allied industries has been encouraged and fostered by the financial services rendered by National Provincial Bank Limited whose interest in present and future developments continues to expand.

Principals of all types of business, large or small, are invited to discuss their plans in an atmosphere of mutual trust and goodwill—the pre-requisites of successful trading.

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**COTTON & PAPER COVERED
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PORTABLE ELECTRIC ARC WELDERS

A wide range of Engine Driven (gasoline or Diesel) Electric Arc Welding Plant is available including special lightweight models in both single and double-operator types up to 300 amps per operator.

ELECTRIC ARC SHOP WELDERS

Three models of these popular transformer oil-cooled sets are available, the "AGILE" with a current range of 30/130 amps suitable for either Arc or Carbon Welding: the "SENIOR II" 15-275 amps: and the "MAJOR" 30-400 amps.

ELECTRODES

An unusually complete range of Electrodes is available in all gauges for general purposes, shipbuilding and repair, constructional work, hard surfacing, rails, cast-iron bronze & tool steel.

OXY-ACETYLENE EQUIPMENT

PETBOW Oxy - Acetylene Welding Equipment includes a wide range of Wires and Rods including "PET-BRONZE" Rods which have great elasticity with the consequence that risk of contraction is largely eliminated. Special Fluxes can also be supplied.

WELDERS' EQUIPMENT & ACCESSORIES

The PETBOW range of Welders' Equipment has been specially designed to give maximum efficiency combined with greatest protection. It includes helmets and masks, cable, hammers, brushes, gauntlets, electrode holders, cable lugs, earth clamps, aprons and screen glasses.

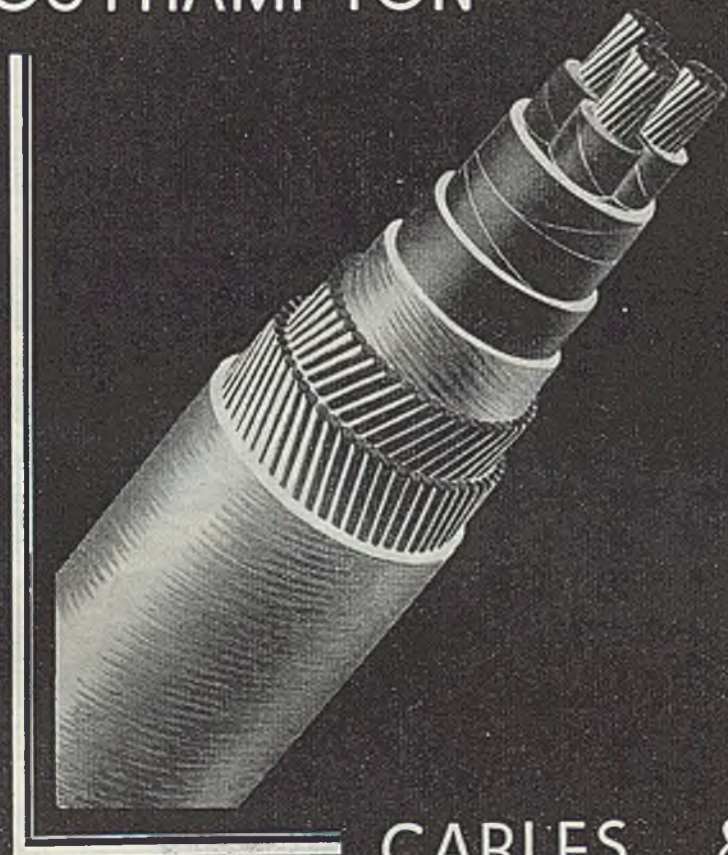
Fullest details of any or all PETBOW equipment gladly sent on request.

PETBOW ELECTRIC ARC
WELDING EQUIPMENT

PETBOW LTD Incorporating Agile Electrodes, Ltd., Power Electrode Co., Ltd., Weldrics (1922) Ltd.
STATION ESTATE, BALMORAL ROAD, WATFORD, HERTS. TELEPHONE: WATFORD 6037

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CABLES &
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BAKELITE LAMP HOLDERS

A wide range of Lamp holders can be supplied on priority. All are made to B.E.S.A. specifications. Illustrated is the Batten Type fitted with Porcelain or Bakelite interior.

Electrical Accessories

ASHLEY ACCESSORIES

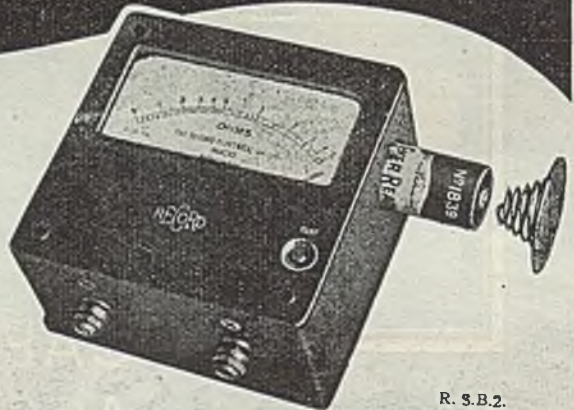
ULVERSTON • LANCS



Exact TEST results

CONTINUITY TEST SETS

This Record Instrument gives exact test results, unaffected by variation in the battery voltage.



R. S.B.2.

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THE RECORD ELECTRICAL CO. LTD.
BROADHEATH · ALTRINCHAM · CHESHIRE

'Phone: Altrincham 3221/2

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Use silica gel desiccators to dry the atmosphere in comparatively small spaces for the protection of instruments, meters and equipment.

Low temperatures frequently cause the dew point to be reached with consequent deposition of water on contacts, insulation, lense, etc., in instruments and equipment. This can be prevented with a breather or desiccator.

Fit silica gel breathers on transformers and other equipment where temperature changes cause breathing in and out of air.



Frederick & Perryman House

Silica gel

RECORD
DORSEY & BURNETT

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MISCELLANEOUS ADVERTISEMENTS

None of the situations advertised in these columns relates to a man between the ages of 18 and 50 inclusive, or a woman between the ages of 18 or 40 inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1945, or the vacancy is for employment excepted from the provisions of that Order.

SITUATIONS VACANT

AN Electricity Supply Authority in the Home Counties invites applications for the following vacancies:—

- (a) 6 Electricians for the maintenance and repair of domestic electrical apparatus on consumers' premises.
- (b) 1 Assistant Electrician for Works Maintenance—D.C. and overhead experience essential.
- (c) 4 Wiremen.
- (d) 2 Overhead Linesmen for H.T. line construction and maintenance.
- (e) 1 Plumber Joiner for 11 kV jointing.
- (f) 1 Electrician for Cooker Repair Shops and Factory maintenance.
- (g) 1 Tracer or Junior Draughtsman for Mains Records, etc.
- (h) 2 Meter Testers and Repairers.

District Rates will be paid. Applicants to indicate clearly the particular vacancy for which they are applying, and include the following information in their reply:—

Age.

Whether married or single.

Training and experience.

Last civilian employment and nature of work.

At present the Control of Engagement Order limits the age of Male Applicants to men under 18 years or over 51 years of age. Applicants who are thereby prevented from changing their employer may make an application, which will be retained for consideration when the restriction is removed.

Class A men on leave just discharged from the Forces may apply—irrespective of age—provided their period of leave has not expired.

Women under 18 years or over 41 years of age may apply for vacancies (a), (g) and (h).

This advertisement is published by permission of the Ministry of Labour and National Service.

Replies to Box L.Q.M., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4.

H.H.McL/MC.

OUTSIDE REPRESENTATIVE, capable and energetic, required by old-established manufacturing electrical engineers, to cover Yorkshire, Lincolnshire, Nottinghamshire. Resident in Leeds or Sheffield. Must have wide technical knowledge of electric power and distribution, and have connections amongst Supply Authorities and industrial organisations. Car owner preferred. Particulars of experience, with age and salary required, to Box L.Q.I., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4.

MANAGER, keen, competent man, required for servicing, estimating and supervising electrical wiring and installation work. London area.—Apply Box L.Q.J., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4.

EXECUTIVE required at once for London, W.9. district. Electrical and mechanical experience desired. Knowledge plastics an advantage.—Write, stating age and salary required, Box L.Q.L., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4.

SITUATIONS VACANT

BOROUGH OF LEYTON.

ELECTRICITY DEPARTMENT.

Appointment of Electrical Fitter.

APPPLICATIONS are invited for the position of Electrical Fitter. The rate of pay will be in accordance with the Schedule of the District Council (No. 10), London Area, Electricity Supply Industry, which at the present time is 2s. 0d. per hour plus War Bonus of 6d. per hour. Forty-seven hours will constitute a normal week's work.

Applicants should have had experience in the manufacture, erection and maintenance of E.I.T. switchgear.

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

Applications, in candidate's own handwriting, stating age, experience, position with regard to National Service, and when able to take up duties, accompanied by copies of two recent testimonials, to be sent to the Borough Electrical Engineer and Manager, Electricity Offices, Cathall Road, Leytonstone, E.11, not later than first post Monday, 24th December, 1945.

Canvassing in any form will be a disqualification. The Ministry of Labour and National Service have given permission under the Control of Engagement Order, 1945, for the advertising of this vacancy. (E.D.629a.)

D. J. OSBORNE,

Town Clerk.

Town Hall, Leyton, E.10.
23rd November, 1945.

ARMATURE WINDER, 5 to 50 h.p., A.C., D.C., Class A ex-Serviceman. Good employment conditions. Also Woman or Girl for similar but lighter work, and Boy to train.—Industrial Electrical Co. Ltd., Offord Street Works, London, N.1.

ELECTRICIAN FITTER. Experienced assembly and repair motors, 1 to 50 h.p. Good employment conditions. Class A ex-Serviceman, or otherwise exempt.—Industrial Electrical Co. Ltd., Offord Street Works, London, N.1.

CHIEF Engineer wanted. Important Gold Mining Corporation with Properties in West Africa have vacancy. Applicants must have good technical and practical engineering qualifications and have held similar post. State age, qualifications and experience, and apply Rhodes and Windeler, 33, Brazenose Street, Manchester, 2.

ELECTRICIANS and Assistants for installing and maintaining wiring installations. Suitable applicants can be placed in London or Provincial areas.—Apply Box L.Q.K., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4.

MACHINERY WANTED

A GENERATOR, 220-230 volts D.C., capable of giving 150 H.P. at 400 revs. per min. Approx. 110 K.W., 500 amps.—Denning & Co. (1937) Ltd., Crimchard Works, Chard.

PORTABLE self-stabilising engine-driven Single Operator Welding Plant capable of welding No. 6 gauge rods.—Denning & Co. (1937) Ltd., Crimchard Works, Chard.

TENDERS

ELECTRICITY SUPPLY BOARD, DUBLIN.
ERNE POWER DEVELOPMENT.

THE Electricity Supply Board invites Tenders for the supply, delivery and erection of:—**TRANSFORMERS AND SWITCHGEAR AT THE CATHALEEN'S FALL AND CLIFF STATIONS ON THE RIVER ERNE.**

Conditions of Tendering, Form of Tender, Conditions of Contract and Specification may be obtained by Contractors from the Chief Design Engineer, Electricity Supply Board, 26, Lower Fitzwilliam Street, Dublin, C.18, by application and on payment of a fee of five guineas, which will be refunded on receipt of a bona-fide tender. Additional copies may be purchased at a cost of one guinea per copy (non-returnable).

Tenders with all the relevant Documents enclosed in a sealed cover endorsed "Erne Power Development: Tender for Transformers and Switchgear," must be delivered to the undersigned not later than 12 o'clock noon on Thursday, the 28th February, 1946.

The Board does not bind itself to accept the lowest or any Tender.

PATRICK J. DEMPSEY,
Secretary.

28th November, 1945.
Electricity Supply Board,
60-62, Upper Mount Street,
Dublin, C.18.

CITY OF MANCHESTER.

THE Electricity Committee invites tenders for the supply and delivery of:—**6 TONS HARD FORGED HIGH CARBON STEEL BALLS, 1 1/2 IN. DIAMETER.**

Particulars and Form of Tender may be obtained from Mr. R. A. S. Thwaites, Chief Engineer and Manager, Electricity Department, Town Hall, Manchester, 2.

Tenders, addressed to the Chairman of the Electricity Committee, to be delivered not later than 10.0 o'clock a.m. on Friday, 7th December, 1945.

PHILIP B. DINGLE,
Town Clerk.

Town Hall, Manchester, 2,
26th November, 1945.

MISCELLANEOUS

TO OFFICE AND WORKS EXECUTIVES.—Please apply for our complete catalogue which is now available, together with 1946 Calendar (encl. 1d. stamp to comply), so that your records of Plant, Electrodes and Accessories manufactured are up to date.—Petbow Ltd., Watford, Herts.

REPAIRS

COOKERS.—We can give good deliveries of Sheet Metal Vitreous Enamelled Electric Cooker parts.—JOHN KING & SON (ENAMELLERS), Ltd., PYRO WORKS, WHITTINGTON MOOR, CHESTERFIELD. Phone: Chesterfield 5305.

PATENT AGENTS

MEWBURN, ELLIS & CO.,

PATENTS, DESIGNS AND TRADE MARKS,

70 & 72, Chancery Lane, London, W.C.2.

Grams: "Patent, London." Phone: Holborn 0437 (2 lines)

And at—NEWCASTLE: 3, St. Nicholas Buildings.

A. E. HILL,

Chartered Patent Agent,

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FOR SALE

SEARCHLIGHTS (sale or hire), Carbon Rods, Ebonite, Fibre Hightensite, Porcelain House-wiring and other Cleats, Reels and Knobs, Mirrors, Lenses, Lamp Lowering and Suspension Gear, T.R.S., lead and other Cables, Winches (hand), hundreds of thousands in use, etc.—London Electric Firm, Croydon.

LEATHER FINGER STALLS.—Made of Chrome Hide. Very strong and hard wearing. Length 3 in. Price 4s. per doz. Prompt delivery. Sample on application.—Willson Brothers, Industrial Clothing Manufacturers, Epsom, Surrey.

DRY CELLS.

OLD-ESTABLISHED firm now in production of all types of dry cells. D.R.3 speciality. Delivery ex works. Quotations by request. Contracts invited.—The Abies Battery Co., 117, Anerley Road, Anerley, S.E.20.

PACKING CASES, all sizes and descriptions, for Home and Export Trade; also S/h. Cardboard Cartons, all sizes.—L. Goldser & Sons, 14a, Rectory Square, London, E.1. Phone: Stepney Green 2550.

D.C. MOTORS, 1/2 and 3/4 h.p., voltages 25, 32, 50, 100/115 and 200/250. Suitable refrigerators, lathes, washing machines, etc. Unused motors, £7 15s. each; reconditioned, £5 15s. Other sizes available.—Johnson Engineering, 86, Great Portland Street, W.1. MUSEum 6373.

AGENCIES

MANUFACTURERS of Electric Domestic Appliances, Meter, Resistances, etc., desiring representation in Italy are invited to contact the Ufficio Commerciale Elettricit a' Industria, via Sant' Andrea, 6, Milan, Italy.

Portable FLASH TEST

All makers and dealers in electrical equipment, service engineers, and repairers need this portable Flash Tester.

Detects faults at 1,000 to 2,000 volts.

Send for interesting leaflet "All about Flash Testing."



RUNBAKEN · MANCHESTER · I

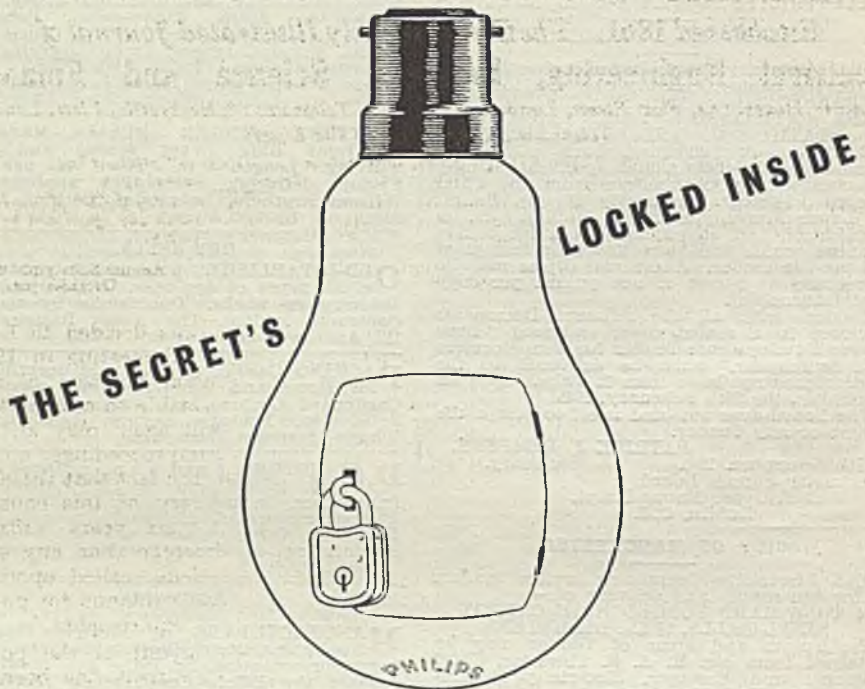
PRESS
TOOLS FOR
MICA & METALS

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H. J. COBB

AND SON,

35a, SOUTH PARK RD.
WIMBLEDON, S.W.19



A Philips Lamp may have the same appearance *outside* as any other lamp; but the secret of its success is the wonderful work *inside*.

Thanks to this, Philips Lamps are famous for their low consumption — they transform current economically into clear, bright light.

Sell

PHILIPS



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THE ELECTRICIAN



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week's meeting it was decided to hold, if possible, a sectional meeting in 1947, to discuss the general question of fuel economy, it is reasonable to assume that British interests will again play an appreciable part in the proceedings; an assumption based on the fact that the electricity supply industry of this country has during the last six years suffered more from fuel shortage than any elsewhere, while still being called upon to meet ever-increasing demands for power for war production requirements.

Since 1938 the layout of the power network of the Continent has been so changed, that reading the proceedings of the Vienna meeting conjures up a picture so strange in the light of more recent happenings that the details are both tragic and interesting. The 69 British delegates who attended the meeting were, for instance, welcomed by the then German Minister of Transport, Dr. J. DORPMULLER who, armed with the greetings of Field-Marshal GOERING and the Minister of Industry, HERR FUNK, sought to explain that by the rejoining of Austria and Germany, the waters of the Alps would be harnessed for the benefit of a united Germany; a condition formerly impossible owing to the "unhappy dismembering of the old State." A little over a year later those waters were being used for the generation of power to drive Germany's war machine, and seven years later, Field-Marshal GOERING and those of his brethren remaining are standing their trial at Nuremberg as war criminals.

What the future has in store for the World Power Conference remains to be seen, for at this stage no more is known than that the Council will meet in Paris next spring and there decide upon the

World Power

WHEN the International Executive Council of the World Power Conference met in London last week to discuss the post-war revival of their activities, they opened the way to a channel through which exchange of information with respect to electricity supply has been denied the industry since the last sectional meeting at Vienna in 1938.

It will be remembered that the conference was founded in this country in 1924, when the first plenary meeting was held at the Empire Exhibition, Wembley; the second plenary meeting was held in Berlin in 1930 and the third at Washington in 1936. At all these meetings and at a number of sectional meetings held in various capitals, British electrical engineering interests contributed a large number of valuable papers in response to the invitation of Sir HAROLD HARTLEY, the chairman of the British National Committee, and since at last

month and place for holding the sectional meeting in 1947. Before the war the conference published a statistical year book containing data on all sources of energy and giving both national resources and annual production, and among the decisions taken last week was one to resume publication as soon as possible. Another point which engaged the attention of the Council was concerned with atomic energy and its future significance over the whole range of power problems. The result of their deliberations was that a small committee is to be appointed to watch developments and to make recommendations to the International Executive as soon as it is practicable to have an effective discussion of the utilisation of such energy for industrial and domestic purposes. The machinery of the Conference is thus brought up to date with modern developments, and the industry will watch its working with considerable interest.

The Public and Street Lighting

WITHOUT in any way making capital out of the London gas strike, the absence of street lighting in the commercial areas served by the company affected, was in striking contrast to the office-building lighting in those same areas. As far as our observer could see there were hardly any offices which did not pour their electric light into the darkened streets, and those that did not were either closed for the night or were in darkness due to other causes. This simple observation brought home to many who had not before given thought to the subject, the general acceptance of electricity as the modern indoor illuminant and comments upon it by the man-in-the-street were not infrequent. Another point which seemed to record itself on the mind of the public was the mileage of London streets which are still lighted by gas, compared with the dormitory areas outside. These reactions to the difficulties which befell a section of the gas industry during the week-end indicate that the general public do not normally pay much attention to whether street lighting is by gas or electricity so long as the lighting is reasonably good, and nothing short of a major embarrassment to one or the other industry is able to excite their interest. This may be due to the patchwork arrangements brought about by

the absence of any national standard for street lighting acceptable to all local authorities, but it suggests too, a need for educating the public in the merits of good lighting generally, and the benefits which such lighting has to offer.

I.M.E.A. Jubilee Convention

ON the 18th of this month the Incorporated Municipal Electrical Association completed fifty years of its life, and the event will be duly celebrated at the first post-war convention, which is to be held at Blackpool from June 24 to 29 next year. As in pre-war years, there will be a full programme, including an exhibition to be organised by the E.D.A. Three papers will be read, and the names of the authors and the titles of these will be published in a month or so. Despite shortness of staff and the amount of work involved, the arrangements are well advanced, Mr. J. W. SIMPSON, secretary of the association, told a representative of THE ELECTRICIAN. He has been assured by the Blackpool authorities that there will be ample accommodation, but at the moment it appears likely that the members will have to stay at unlicensed private hotels, as the prospect of the large hotels being derequisitioned by the Government is somewhat remote. Lists of private hotels have been circulated among the members, and the Clifton Hotel has been reserved as the headquarters of the association. Every effort is being made to ensure that the jubilee convention will be notable in the history of the I.M.E.A.

Victory (Ex-Services) Club

THE attention of the industry is drawn to a fund being built up for the establishing of a Victory (Ex-Services) Club, which when completed will be a memorial to the fallen, a tribute to the living and a centre where welfare and advice bureaux, lounges, reading rooms, restaurant and sleeping accommodation will be provided for all those in the Armed Forces, who return to civil life. The club, which will be open to both men and women of the Armed Forces of the United Nations, will be situated in London, and until the proposed building can be erected a temporary centre will be founded for immediate use. The spirit behind the club was born of the close co-operation which existed between the Armed Forces and

Industry during the war, and each particular industry is in turn being asked to lend its support. On Tuesday, representatives of the electrical industry were addressed by Field Marshal Lord CHETWODE, Admiral of the Fleet, Lord CHATFIELD, Air-Vice Marshal Sir LEONARD SLATTER, Sir WALTER CITRINE and Sir HARRY RAILING, on their responsibility in the matter and readers are asked to turn to p. 600. It is understood that no special subscription list is being started for the electrical industry but each individual in it is invited to send a donation direct to the fund, to make the purpose of the fund known amongst his friends, while those who served in the 1914/18 war, remembering the difficulties which faced many of their friends years ago through the absence of a centre of the type proposed, are expected to be particularly understanding.

Radar and Cosmic Rays

EXPERIMENTS of special interest to physicists are being conducted in Manchester by Prof. P. M. S. BLACKETT and Prof. WILLIS JACKSON, with a view to locating showers of cosmic rays. Apparently, with the aid of radar equipment given by the Army to the Electrical Engineering Department of Manchester University, it is proposed to explore the ionosphere in the hope that the radiations may be reflected by showers of cosmic rays, thus permitting the showers to be located. Attempts have, it appears, already been made from the university building, but these are surrounded by houses, which are distracting. The calculations require measurements involving time periods of one-millionth of a second and local conditions are misleading. It is hoped to find a secluded country site, possibly in Cheshire, on which to pursue the experiments.

Safety in Mines

THE recent publicity accorded the subject of coal mining gives the 1944 report of the Safety in Mines Research Board a topicality not enjoyed by its predecessors, though none was less interesting. The current report deals for the most part with improvements in the safeguards against explosions and from the electrical point of view its chief interest is concerned with research work

on the flame-proofing of equipment, a short account of which is given in this issue. It may be remembered that there was published last year a review of electrical researches and testing carried out under the guidance of the Board, with regard to flame-proofing enclosure and intrinsic safety of electrical apparatus and circuits, and the present report gives further support to the views then expressed. With the prospect of the coal mining industry sooner or later stepping-up its output by mechanising its processes, the work of the Board is of particular importance in that those called upon to operate the equipment will, in many cases, know next to nothing about the equipment itself. In the circumstances, therefore, it is particularly pleasing to learn from the report that the Board is giving increased assistance to those responsible for training new entrants to the industry. In this connection a large assortment of films, slides, drawings, etc., is now being supplied and has received much commendation.

Sheffield Exhibition and Appliances

THE electrical exhibition which is being staged at Sheffield by the Electricity Department, in conjunction with the E.D.A., is attracting considerable interest and bears out the opinion often expressed in these columns that the public is more than anxious to adopt the all-electric idea in the home. The difficulties attaching to the availability of appliances, however, are aggravated by the fact that the grant-aided housing schemes are absorbing the majority of the output of manufacturers, leaving little or nothing of reputable make for purchase by the general public. This is obviously against the interests of the industry, but with labour and materials still matters of major concern, there is little that can be done save to once again beseech the responsible Government departments to take a more realist view of the circumstances. Given the opportunity, the electrical industry is fully capable of meeting both the needs of the housing programmes and the demands of the public where appliances are concerned, while the increased activity of the industry thus brought about would ensure the man-power being returned to civilian life by the Armed Forces being more readily absorbed.

Electricity Supply in Calcutta

From Our Own Correspondent

THE Governor of Bengal, Mr. R. G. Casey, announced at a Press conference in Calcutta, on November 9, that the Bengal Government have now satisfactorily concluded negotiations with the Calcutta Electric Supply Corporation for an agreement under which their complete undertaking will pass over to the Government at the earliest practicable date.

Under the agreement now reached, the Government will have a single option to purchase on January 1, 1950, or alternatively at intervals thereafter of 20 years, the whole undertaking covered by the corporation.

Licence Areas

The Calcutta Electric Supply Corporation supplies electricity under 14 separate licences, each licence dealing with a separate area, granted on various dates from 1907 to 1935. Its operations probably represent about 95 per cent. of the electrical enterprise of the Province. The areas to which the licences apply lie on both sides of the river Hoogly and are served by three inter-connected generating stations. All the licences include options of purchase by the Provincial Government, the earliest date on which the options can now be exercised being October, 1948, for five areas, October, 1958, for seven areas, February, 1970, for one area, and November 9, 1980 for one area.

Under the agreement now announced, the option to purchase on the various dates, specified in the 14 licences, are to be withdrawn and their place will be taken by a single option to purchase the whole undertaking on January 1, 1950, or alternatively at intervals thereafter of 20 years. The purchase price upon the exercise of the option of 1950 will be fair market value at the time of purchase plus 20 per cent. extra, together with a sum equivalent to one year's gross revenue received by the corporation in certain licence areas. If, however, the option to purchase is exercised in 1970 or subsequently, the purchase price will be the original cost of all lands, buildings, works, materials and plant, less depreciation at agreed specific rates.

These and other terms which the Governor announced were being embodied in an application by the Calcutta Electric Supply Corporation for a new consolidated licence replacing the existing 14 licences. The application would be published in the prescribed manner and objections, if any, received thereto, would be considered by the Government before the new consolidated licence is granted. The terms agreed upon between the Government and the

corporation were in that sense provisional, but the Government believed that they represented a satisfactory progress towards the solution of a very complicated problem of great public concern.

The Governor also announced that an agreement had been reached whereby the Calcutta Electric Supply Corporation would declare a policy for promoting Indianisation and submit a scheme before the granting of the licence, of training apprentices designed to fit officer posts.

In regard to raising additional capital by the corporation hereafter, it had been agreed that no future issue of capital should be made in England unless the prospectus was published in India and in England, applications invited in both countries, and allotments made pro rata according to applications received. The corporation might reserve such amount of any contemplated issue of capital not exceeding 25 per cent. as the corporation might decide, for offer in the first place exclusively to the stockholders of the corporation in such form as the directors might decide.

Replying to inquiries, the Governor explained that if the option was exercised, it was the idea of the Government to have a semi-autonomous non-political board to operate the enterprise for them. The undertaking would probably have to be bought by raising a loan. The Governor also stated that it was planned to link up the undertaking with the grid system for the whole Province.

South Indian Railway Electrification

There may be a considerable development in the near future in the electrification of the South Indian Railway system, said Mr. J. F. C. Reynolds, general manager of the South Indian Railways, outlining future developments at a conference held in Madras.

Mr. Reynolds expressed the view that with the electrification they had at present in the Madras suburban area, and with the near prospect of ample high tension current becoming available from the Pykara grid, the whole of the Madras-Villupuram section of the Railway, and the Arkonam branch line would be an ideal section to electrify.

A company has been registered in Madras with an authorised capital of five million rupees and issued capital of Rs2 000 000 for the purpose of manufacture and sale of all kinds of electronic and electrical goods, especially radios, refrigerators and fractional horse-power electric motors.

Timing a Meteor Aircraft

Systems Used for World Speed Record Flights at Herne Bay

TWO systems were employed for timing the speeds of the Meteor jet-propelled aircraft at Herne Bay this month when a world speed record, with an average of 606 m.p.h., was created by Group Captain H. J. Wilson, flying the Gloster Meteor IV Britannia. One was by a high-speed cine camera, used in conjunction with phonic-motor driven timing dials, and the other was by Type F24 single-shot aircraft cameras in conjunction with the chronograph recorder.

The timing systems used with both sets of photographic equipment are controlled in the same way as the ordinary domestic clock, i.e., by the frequency and not by the voltage of the supply. Obviously, therefore, this frequency must be very accurately controlled.

The National Physical Laboratory at Teddington, has as part of its standardisation equipment, a quartz crystal controlled oscillator operated at 100 000 cycles per second, which is stepped down in frequency by a series of multi-vibrator units for various requirements. The stability of this frequency is one part in a hundred million, which is equivalent to an error of one second in three years. For the purpose of the test the N.P.L. made available from this oscillator a signal at 200 cycles per second, this being the frequency required by the timing systems. This signal was sent to Herne Bay by two methods, namely:—

(A) By radio transmitter at the N.P.L. with receivers at Herne Bay; and
(B) by Post Office land line.

A Radio Shortcoming

The land line proved to be more reliable and was used, leaving the radio as a stand-by-system. Change over from "A" to "B" merely involved operating a switch in the master hut at Herne Bay. The signal from the master hut was transmitted by land-line to the two systems at the Reculver end of the course. Finally at both control sites, the signal was amplified to the level required by the timing apparatus. As a simple visual check, double beam oscilloscopes were permanently connected into the system and installed in each timing hut.

With the first-named timing system, the 200 cycles signal was amplified and used to drive a 200 cycles tuning fork kept in a constant temperature chamber. Pick-off coils were mounted on the other arm of the fork, and the signal from these coils was amplified and used to drive the Phonic motor mounted in the camera

base. (The function of the tuning fork is to carry over during short-term disturbances of the in-put signal). Since this procedure was followed at both ends of the course, both motors had to be running accurately in step, since these motors by their nature, must keep in step with the frequency, or stop altogether. Each unit was equipped with a set of engraved dials showing minutes, seconds, and 1/100ths of a second. The timing dials at both ends of the course were started simultaneously by a push button at one end of the course some minutes before being required.

Maximum Time Error

The N.P.L. has checked that the maximum error which can be introduced by these clutching systems is of the order of 1/500th of a second, the average being 1 000th of a second irrespective of the length of time the dials are running. The cine cameras which operate at approximately 150 frames per second, produce a permanent record of a series of positions of the moving object relative to a fixed siting pole simultaneously with the instantaneous time as indicated by the timing dials.

The following precautions were taken: (1) Before the aircraft appeared both sets of timing dials were set to zero and photographed while stationary; (2) at the end of the series of timed runs, the dials were simultaneously stopped and again photographed. To compute results, the film had to be processed and a series of consecutive pictures of the aircraft had to be plotted against the instantaneous dial readings. The precise instant at which the aircraft passed each siting post was then taken from the graph. The difference in the time readings on the films from either end of the course was the time taken to travel the three kilometres.

The over-all accuracy of the system, and this includes every conceivable source of error, is of the order of one part in 5 000, which is roughly equivalent to a tenth part of a mile an hour in 600.

In the second method two still picture aircraft cameras were employed, placed on the roofs of the huts directly over the cine cameras used in Method I. As the aircraft passed the post an observer released the shutter and took a photograph of the aircraft passing the post. Simultaneously a mark was made on a paper strip being fed through the chronograph recorder, fitted in the van at the Reculver end. Also marked on this paper by a special method were timing marks obtained from the standard frequency source earlier referred to.

There were two sets of timing marks showing 1/100th of seconds and tenths of seconds. By counting the number of tenths and hundreds between the marks for the cameras at the two ends of the course the time between the exposures was measured. This time was not necessarily the time for the aircraft to pass the measured three kilometres owing to the personal error of the operators of the cameras, but after processing the photographs this error in distance could be measured on the photograph pictures and the appropriate correction made. The correct speed was then calcu-

lated. When all this was done the result gave the speed of the aircraft to within 1 part in 5 000. This accuracy was borne out by comparisons which had been made by the two methods where the disagreement had never exceeded $\frac{1}{4}$ m/hr.

The final accurate answer which is in every way as accurate as that obtained by the first method, can only be obtained if the film has been processed, corrections and calculations made, checked and re-checked. This, in common with Method 1, may take five or six hours.

New Aid to Navigation

Radio Development of New Positioning Equipment

THE Decca Navigator Co., Ltd., of 1, Brixton Road, London, S.W.9, have developed an instrument for determining the exact geographical position in which radio signals, continuously emitted from three transmitting stations actuate a special form of radio receiver. The instrument has two dials, one red and one green, which give numerical readings, and the relation of these to a special chart gives an exact, and instantaneous geographical position.

Charts, covering the service area of the three transmitting stations, are gridded with a series of red and green lines which are all numbered, and when a position is required, it is merely necessary to read off the number indicated by the red meter and the number indicated by the green meter, then look for the correspondingly numbered red and green lines on the chart. The point of intersection of the two lines is the position required.

All operational and experimental work on the equipment up to August of this year was carried out with 2 kW portable transmitters operating on aerials with a height of 90 ft., and at the frequencies used the radiated power was approximately 14 W. With this equipment reliable operation was at all times experienced up to a range of 300 miles, and satisfactory tests were made over a period of ten days at a range of 550 miles. Last month, the same 2 kW transmitters were connected to 340 ft. aerial systems, and one experimental run has been made to 1 100 miles, showing accurate readings and ample signal strength at that distance. The company visualise setting up transmitting chains every 600 miles, which would ensure at all times, accuracies of the order of a few hundred yards. When this is not practicable higher power chains will be installed for long range work. The receiver can be switched from one chain to the next, but since it will be in range of at least two chains it would normally be switched to the one nearest its destination.

The navigator, as it has been called, operates on the principle of phase comparison of unmodulated low frequency signals emanating from synchronised transmitters. Understanding of the system is usually facilitated by an analogy in sound. If there is a sound source at a fixed position on an open field and a reflector of that sound some distance away, there are, in effect, two transmitters of sound which are synchronised. A person walking from one sound source towards the other passes through zones of high sound intensity and low sound intensity, depending on whether at a particular position the radiations of the two sources are aiding or neutralising each other (in phase or out of phase). If the person stops in a zone of maximum intensity, roughly half way between the two sound sources, and then turns so as to walk at right angles to the line connecting the two sources, and keeps himself in the high intensity zone, he will find that his path is approximately a straight line. If he now turns and goes through the minimum in-

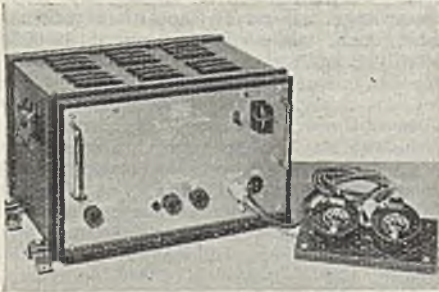


A portable model navigator

tensity zone into the next maximum intensity zone and walks along it, he will find he walks along a slightly curved path. Similarly, if he goes to the next maximum intensity zone and walks along it, the path

will be still more curved. If there is drawn, in plan, the various maximum intensity paths which the observer detects in this manner, it is found that there would be a series of hyperbolic lines; the distance between the lines (in between the stations) being equal to a half wavelength of the sound frequency.

When two synchronised radio transmitters are operated a fixed distance apart,



Navigator designed for marine use

a similar pattern of lines of constant phase difference is set up in space. If, therefore, the signals from each of the transmitters could be received separately and a phase meter applied to them, we could detect where we were in relation to any one pair of these lines. The phase meter would not, however, tell us between which pair of lines we were situated. In the Decca navigator, the two signals are received separately by using different frequencies, but in such a relationship that they can be multiplied to a common frequency, and the phase meter is equipped with a lane counting device, similar to that used on most types of consumption measuring instruments. The combination of phase meter and multiple counter continuously indicates position within the complete hyperbolic pattern.

The navigator is a continuously-operated system in which the hundreds, tens and units dials are set up to correspond with the position of an airport on the chart. From then on if the instrument is always switched on when the aircraft moves, these dials will, at all times indicate position (unless, of course, the aircraft goes outside range of the transmitters). Furthermore, either meter may be used as a "left-right" indicator to guide the aircraft along any red or green line. Where neither red nor green lines provide a direct route, the difference between the start and destination readings will indicate in what ratio the indicators should rotate.

The ground station installations for the proposed permanent chains will consist of a master crystal-controlled 4 kW transmitter

operating with an aerial system consisting of three 240-ft. masts in line roughly 300 ft. apart. The centre mast acting as a feeder for the flat top sections stretched between the masts. It is proposed to use three slave transmitters so as to give complete 360° coverage without dead spots, each slave consisting of a receiving and phase locking installation, situated some 200 yards from the transmitter aerial, which drives the transmitter proper. The operation of all the equipment will be automatic.

The navigator has been used operationally only by the Admiralty and models designed especially for use in ships guided the leading minesweepers and landing craft on D-day, the Admiralty Signals Establishment guaranteeing the navigational department a maximum error of 100 yards anywhere along the Normandy beach. This was, however, very conservative, the actual error being less than 20 yards.

The first aircraft model is being designed for operation at 80 V, 400 to 1 000 cycles, which is the supply fitted to certain service aircraft. The company are also producing a 24 V d.c. model.

R.P.U. Exhibition

On the outskirts of Bournemouth towards the end of 1941 there arose at West Howe a comparatively small group of buildings to be known as R.P.U. It has now been revealed that R.P.U. (Research Prototype Unit) was a branch of the Government Radar Research Establishment and there in the early days were made experimental models to assist the scientific staff in further research work, and the development of prototypes. The early equipment made there included special apparatus for the Western Desert, some parts of the now well-known Gee, G.C.I. and Eureka equipments and also test gear for centimetric research. In 1942 when there was evolved the radar apparatus known as the "Black Box," "Magic Eye," or officially, H2S, which produced in an aircraft an illuminated map of the ground over which the machine was flying, R.P.U. closed down its model shop activities, and was organised as a flexible production unit for the crash manufacture of urgently required new equipment.

Mainly to enable employees to see the purposes to which the many pieces of apparatus which they had made were put, an exhibition, with demonstrations, is being held at the R.P.U. West Howe, this week. Apparatus in various stages of development are displayed and one of the most interesting demonstrations is that showing the H2S in operation, picking out landmarks of the surrounding countryside.

Water Power in Sweden

Output Increased by 40 per cent. During the War

DURING the war years, 60 new power stations have been built in Sweden, several of them large units having a capacity of over 40 000 kW. The production of hydro-electric power increased from 9 054 million kWh in 1939 to 12 417 million kWh in 1944, or by about 40 per cent., and the total capacity of all water-power plant in the country amounts at present to about 2 500 000 kW. Further plant, with an aggregate capacity of about 600 000 kW, will have been completed towards the end of the 1940s, while preparatory works have been started on additional schemes comprising 350 000 kW.

Substitute for Coal

Due to the increasing supply of hydro-electric power, it has been possible to substitute electricity for large quantities of coal, for steam generation, heating, etc., and electric railway traction has also entailed a great saving of coal. The amount of energy utilised in 1944 was 10 573 million kWh (total production 12 417 million kWh.), as compared with 9 265 million kWh in 1943 and 7 943 million kWh in 1939. Of the 1944 consumption, 4 428 million kWh were accounted for by the big industries for engine power, etc., while the electro-chemical and thermo-electric industries consumed 1 891 million kWh. About 1 040 million kWh were used for railway and tramway traction, while the general consumption for domestic purposes and so on amounted to 2 017 million kWh. The relatively good supply of secondary power, i.e., power available at night-time and during non-working hours, made it possible to use 1 093 million kWh for electric steam-generation during 1944, which meant an increase of no less than 76 per cent. compared with 1943. The approximate value of the total deliveries of electric energy during the last year was about £26 530 000. It is estimated that the plant built during the war, including lake-regulation works, etc., have cost about £17 647 000, and the planned subsequent investments amount to about £3 530 000 a year.

During 1944 the first phase of the extensive Swedish water-power scheme drawn up for the emergency period of the war was concluded. The addition during that year amounted to 280 000 kW, corresponding to about 380 000 h.p. Plants for a further 46 000 kW will, it is estimated, be completed before the end of 1945. Among the new power-works to be completed within the next five years or so are Hjalta (120 000 kW), Forsmoforsen (75 000 kW),

and Nämforsen (46 000 kW), situated on the Angerman river, with the tributary Fax river, a water-system which has so far been very incompletely exploited. Three of the present stations on the Indal river, Järpströmmen, Krangede and Gammelänge, will receive one more generator-set each, while one station of 46 000 kW will be built at Skedvi on the Dalälven river and one of 34 000 kW on the Ljusnan river.

Among the works planned, the harnessing of the famous Harspranget waterfall in the Lule river is of special interest. The new station will have a capacity of 250 000 kW, making it Sweden's biggest power-plant. In recent years the huge task of regulating the Stora Lulevatten in Arctic Lapland, the well-lake of the Lule river, has been effected through the construction of the big Suorva Dam, creating a water storage with a maximum capacity of 113 000 million cu. ft. and a regulating height of 18 metres for the planned station, as well as for the existing Porjus plant; Sweden's third largest power station, with a capacity of 115 000 kW. It is estimated that the total Swedish water-power resources which can be economically exploited correspond to about 36 000 million kWh.

Gauge and Tool Makers' Exhibition.—

Benn Brothers, Ltd., publishers of THE ELECTRICIAN, will occupy stand No. 90 at the Gauge and Tool Makers' Exhibition which will be held at the New Hall, Vincent Square, London, from January 7 to 18. Other exhibitors include A. Shaw and Son, Waterloo Works, Waterloo Road, London, N.W.2; Buswell and Sweeney, Ltd., Metro Works, Bolton Street, Bordesley, Birmingham; Gay's (Hampton), Ltd., Oldfield Road, Hampton, Middx.; Richard Lloyd, Ltd., Steelhouse Works, Oliver Street, Birmingham; the Brooke Tool Manufacturing Co., Ltd., Warwick Road, Greet, Birmingham; the Horstmann Gear Co., Ltd., Newbridge Works, Bath; the Coventry Gauge and Tool Co., Ltd., Fletchamstead Highway, Coventry; Weir Precision Engineering, Ltd., Southall Road, Southampton; A. C. Wickman, Ltd., Banner Lane, Tile Hill, Coventry; the Pitter Gauge and Precision Tool Co., Ltd., 49, Kingston Road, Leatherhead; Surrey; Engineering Products, Ltd., Glenbrook Works, Littlers Close, Colliers Wood, London, S.W.; the Birmingham Tool and Gauge Co., Ltd., Soho Hill, Handsworth, Birmingham; and the National Physical Laboratory.

Notes on Plastics

By JAMES TAYLOR, B.Sc., F.R.I.C.

ALTHOUGH acrylic acid has been known for many years, it was only in 1935 that plastic materials derived from acrylic acid came on the market. Acrylic acid has the chemical formula $CH_2 : CH COOH$ and it will be noticed that it is not unlike a vinyl derivative in its structure as it contains the $CH_2 : CH$ linkage. It is a colourless liquid which boils at $141^\circ C.$ and can be made to polymerise to a solid by allowing it to stand under the influence of light or by heating it with a catalyst.

Similarly if acrylic acid is converted into methyl acrylate, this product also polymerises on exposure to light or by warming resulting in a transparent odourless solid. However, neither of these polymers is of great interest as a plastic material.

Methyl Methacrylate

The acrylic derivative which is of great interest to the plastic industry is methyl methacrylate and this compound can be polymerised to yield a glass clear product with very valuable properties.

Commercially the monomeric methyl methacrylate is produced by the action of methanol or methyl alcohol and sulphuric acid on acetone cyanhydrin. The acetone cyanhydrin is best made from acetone and hydrocyanic acid, both of which in turn come from coal. Poly methyl methacrylate is probably better known to readers under its trade name "Perspex," the product of Imperial Chemical Industries Ltd. Similar materials have been produced in the United States and Germany under the names Plexiglass and Leucite.

Polymethyl methacrylate is a clear transparent product, it is produced commercially in rods, sheets, etc., and also as a thermoplastic injection moulding powder. For purposes of comparison with the other products already discussed in this series, its main physical and electrical properties are:—

Specific gravity 1.3; tensile strength (lb. per sq. in.) 8 000; impact strength (lb. per in.) 0.25; volume resistivity (ohms cms.) 10^{15} ; dielectric strength (V per mil) 375; water absorption (24 hours) 0.3 per cent.

The cast sheet or rod material is available in two forms, plasticised and un-plasticised. Both forms are tough. At low temperature the tensile strength increases while the impact strength remains the same, hence its value for windows of aircraft where maintenance of physical properties at low temperatures is of prime importance. From the glazing point of view mention should be made that it will transmit about 92 per cent. of visible light and it is even more transparent to ultra

violet light than is glass. From the electrical point of view it is noteworthy that its electrical properties do not fall off appreciably, even on prolonged immersion in water. It is resistant to dilute acids, including accumulator acid, to strong caustic alkalis and to gases generally, including ozone and sulphur dioxide. Chlorine gas attacks it slightly, especially if the surface is moist. It is attacked and dissolved by many organic solvents including aromatic hydrocarbons, esters, ketones and chlorinated hydrocarbons. It is, however, unaffected by aliphatic hydrocarbons, hexane, octane, petroleum ether, transformer oil, glycol and glycerol.

Commercially it is produced in sheets from $\frac{1}{16}$ in. to $\frac{3}{8}$ in. thick, in sizes up to 54 in. by 48 in. in some thicknesses, and in block form from $\frac{1}{2}$ in. up to 2 in. thick in sizes up to 42 in. by 30 in. in the thinner material, and 30 in. by 30 in. in the thicker ones. By laminating, blocks up to $4\frac{1}{2}$ in. are also produced.

As a moulding powder it is produced in several grades and also as a powder for use in making up lacquers and dopes. Amongst the main electrical applications the moulding material are telephones, bell boxes, inspection cover plates, battery boxes and components, lighting fittings for ships and aircraft and various radio components. Telephones are made from it when they have to be used in countries where dryness of the atmosphere will cause cracks to develop in other types of plastics.

The sheet material can be cut, drilled, turned and milled.

By heating, it becomes soft and can be shaped over formers in much the same manner as was described under "celluloid" and "cellulose acetate." Sheets can be cemented together by using a cement consisting of methyl methacrylate dissolved in a volatile solvent. During the last year or so it has also been possible to mould it by heat.

Special grades are also produced from which lenses may be moulded or produced by cutting in the same way as glass lenses are produced. Polymethyl methacrylate also forms the basis of some of the newer plastic denture materials which have been used during the war to economise in rubber.

Polythene

Another plastic material which is manufactured from ethylene is polyethylene or polythene which consists simply of polymerised ethylene.

Polythene was developed in this country just before the outbreak of the war and its development in America was later.

The first work on its commercial development took place in 1936 and towards the end of 1938 the first ton was produced by a continuous process. In 1939 commercial production began. It was not until 1941 that the first commercial production took place in America.

Polythene is a wax like solid with a melting point of 110°-115°C., it is remarkably tough and possesses extraordinarily good electrical properties.

High Insulation Properties

For comparison purposes the usual table of specific mechanical and electrical properties is:—Specific gravity, 0.92; tensile strength, 1 500 lb. per sq. in.; impact strength, varies with quality but very high; volume resistivity, 10^{17} ohms. cms.; dielectric strength, 1 000 V per mil.; water absorption (7 days), nil.

As has been indicated above, these figures are given on the same basis as those of the other plastic materials in this series of articles purely to enable comparisons to be made. The electrical properties of polythene are so noteworthy and its applications so extensive to the electrical industry so that it is proposed to go into its electrical properties in some considerable detail.

Before doing so, however, it will be of interest to note some of its chemical properties. As is shown in the table above, polythene is extraordinarily resistant to water. This also applies to most inorganic chemical reagents. It is unaffected by 10 per cent. solutions of the ordinary mineral acids. 35 per cent. hydrochloric acid has no action in the cold and is only absorbed slightly at 100°C. 70 per cent. nitric acid has no action in the cold but oxidises it at 100°C. Even hydrofluoric acid is without action at temperatures up to 60°C. Strong caustic alkalis, hot or cold, are without any action. Chromic acid (i.e. chromium plating solution) does not affect it up to 40°C. It is resistant to fluorine but will absorb chlorine in the cold and reacts with chlorine at high temperatures. In view of its resistance to fluorine and hydrofluoric acid, it finds application in laboratory equipment for reactions involving these two substances.

Polythene is insoluble in water and is not wetted by it. Films of polythene give absolute protection against water and water vapour.

Polythene is insoluble in all organic liquids at temperatures below 60°C. but above this temperature it dissolves readily in hydro-carbons and halogenated hydro-carbons. This change from low solubility to ready solubility takes place rather sharply above 60°C. at temperatures which vary for the different solvents. Amongst the solvents for polythene at temperatures above 60°C. may be mentioned trichlore-

thylene, carbon tetrachloride, chlorobenzene, toluene, benzene and petroleum ether. Alcohols, esters, organic acids, phenols and nitro compounds dissolve polythene to a lesser degree.

Polythene is a thermo-plastic and can be moulded by compression, injection or extrusion. When extruded, better results are obtained by working with a mixture of polythene and polyisobutylene, about 7 to 1. The polyisobutylene acts as a plasticiser and makes the extrusion operation easier to control. This type of mixture is used in the manufacture of solid insulated and air-spaced high frequency cables where power loss is of importance. It is also used extensively in submarine cables where the customary lead sheath is sometimes dispensed with. As a moulding it is found in cable ends, high voltage bushings and condenser dielectrics.

Of all the electrical properties of polythene, that which has been studied most is the power factor and the reason for this has been that by far the greatest outlet for polythene up to the present has been in the construction of cables to be operated at very high frequencies.

The following figures for the power factor at different frequencies and at different temperatures have been quoted by E. Hunter and W. G. Oakes. (British Plastics, March, 1945, p. 95).

Power factor at 10 ³ c.p.s. at	20°C.	0.0001
" " " 10 ⁴ " "	20°C.	0.0002
" " " 10 ⁴ " "	20°C.	0.0003
" " " 2x10 ³ " "	-80°C.	0.0001
" " " " " "	-30°C.	0.0002
" " " " " "	-20°C.	0.00035
" " " " " "	-70°C.	0.0005

The effects of melting and consequent oxidation on the power factor of polythene are discussed in some detail in a paper by Messrs. Jackson and Forsyth read before the Radio Section of the Institution of Electrical Engineers on October 25, 1944. The effect of the addition of anti-oxidants is discussed in the same paper which gives the permittivity as 2.3 at 20°C., falling to about 2.15 at 100°C. independently of the frequency over the range 50 to 109 C.P.S.

Training in Illuminating Engineering.—The Northampton Polytechnic Institute is now initiating a course in illuminating engineering, specially adapted to meet the needs of those desiring to take the examination of the City and Guilds of London Institute. The course is to commence in the first week in December next. Students will attend for three evenings a week, and enrolments can take place up to November 30. Those interested should get in touch with Mr. H. S. Barlow (Tel. CLE. 1662), who will be responsible for the course.

Electricity in Mines

Progress Report on Research Work During 1944

THE Safety in Mines Research Board has published its twenty-third annual report (Stationery Office Is.) and after dealing with matters outside the direct electrical field, points out that problems concerning the safety of electrical apparatus,

A safety multi-shot magneto exploder has been designed and constructed.

The flame-proof qualities of the protective covers of electrical apparatus have hitherto been tested only at room temperature. When the apparatus is in use its temperature will rise and the possible effect of this on the "safe gap" has therefore been examined. An enclosure containing heating elements capable of raising their own temperature to 300°C. and that of the outer surface of the enclosure to 110°C. was tested. The safe gaps were determined with the most incendive mixture of methane and air within the enclosure, fired in the best position for causing the ignition of an external mixture, and with the most easily ignitable mixture of methane and air outside. Results obtained with the apparatus at room temperature are compared in Table 1 with results obtained when the heaters were used and giving rise to the temperatures mentioned.

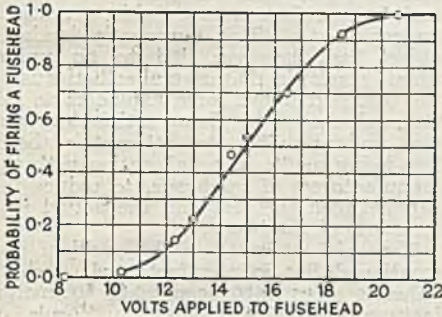


Fig. 1

which has received most attention during the past year, relate to flame-proof casings for high-power equipment and the intrinsic safety of low-power circuits, such as are used in signalling and shot-firing apparatus.

From these results, the statistical maximum safe gap in both series is calculated to be 0.052 in., showing that the heating had no effect on the safety of the enclosure.

Two details concerned with flame-proof casings have been cleared up during the past year. First, the safe gap between a case and its cover has been shown to be unaltered when the casing and its contents are heated, as occurs during use. Secondly, the "safe gap" is the same between flanges of a synthetic resin as between steel flanges, so long as the resin flanges have not become charred by the repeated passage of flame.

A question has been asked by manufacturers as to whether the flanges of flame-proof casings made of synthetic resins have a narrower safe gap than those with metal flanges. Comparative tests

TABLE 1.

Mixture within the enclosure: 9.5 per cent. methane-air.
Mixture outside the enclosure: 7.5 per cent. methane-air.

Ignition at Side of Casing Near Flange.

Gap, in.	No heating.		Enclosure heated.	
	Ignitions.	Non-Ignitions.	Ignitions.	Non-Ignitions.
0.055	0	20	0	20
0.056	1	19	1	19
0.057	1	19	2	18
0.058	7	13	—	—
0.059	9	11	9	11
0.060	10	10	—	—
0.061	15	5	13	7
0.062	18	2	—	—
0.063	19	1	19	1

The examination of the conditions necessary for intrinsic safety in low-power circuits has been carried a stage further by establishing the quantitative relationship between the effects of safety devices (condensers and resistances) on the minimum igniting currents in circuits of a wide range of inductance, at voltages of 25 and 60. It has been shown that, when the current in a circuit exceeds 1.0 A, condensers and resistances are practically useless as safety devices, for the increase in the minimum igniting current resulting from the use of a condenser or a resistance is negligibly small.

carried out in an 8-litre sphere gave 0.0445 in. as the safe gap with synthetic resin flanges, 0.044 in. with metal flanges. The difference is inappreciable. As these materials have very different thermal conductivities, it appears that the safety of the gap is not due to cooling of the flame by contact with the flanges. After 140 experiments the synthetic resin flanges had become charred enough to affect the safe gap. Attempts will be made to remedy this defect.

It follows that apparatus such as bells and relays must have high impedance and low current consumption for safety. Such bells and relays have the additional advantage that more of them can be used in parallel, fed from an approved source of power.

A series of experiments carried out for

the E.R.A. on the safe gaps of casings for industrial use have been completed by determinations made with mixtures of propane, butane, cyclohexane and butyl acetate individually with air.

The determination of the factors which govern the intrinsic safety of low-power electrical apparatus has been continued.

Two mishaps, in each of which a high-tension detonator used for shotfiring was fired by accidental contact with a plug-and-socket coupler of a drill, started a general examination of the firing characteristics of fuseheads. High tension fuseheads supplied commercially for testing single-shot h.t. exploders proved to have the same firing characteristics as the fuseheads in h.t. detonators. Random latches, each of 100 fuseheads, were subjected to chasen voltages for one second. The proportion of each batch which fired was recorded, with the results shown in Fig. 1.

The curve represents a Gaussian distribution with a 50 per cent. miss-fire voltage of 14.8 and a standard deviation of 2.4 V. From these figures there is a real but small chance of firing a detonator with a voltage as low as 7.0. This voltage can-

not exist between a coupler and earth in properly maintained equipment.

Low tension fuseheads supplied commercially for testing l.t. exploders proved to be less sensitive than the fuseheads in l.t. detonators. On inquiry of the manufacturers, it was learned that the fuseheads supplied for testing purposes were made slightly less sensitive than the least sensitive service fuseheads, with the object of not passing any exploder under test unless it was certain to fire a shot under somewhat unfavourable conditions underground. This apparently laudable object had, however, led to an unfortunate result, in that several collieries using the test had found some exploders to fail although they were giving satisfactory service underground. An attempt is therefore being made, in collaboration with the manufacturers of fuseheads, to reduce the gap between the test and the actual performance of fuseheads.

The chief difficulty in the problem just mentioned lies in the fact that, whilst valuable steps have been taken by manufacturers towards making fuseheads of identical properties, the problem is multiple and has not yet been solved.

Caroline Haslett Trust Fund

A representative gathering met at the headquarters of the Electrical Association for Women on Wednesday, on the occasion of the inauguration of the Caroline Haslett Trust for scholarships and travelling exhibitions in electrical housecraft, the speakers being Mrs. M. B. Jackson (chairman), Miss Ellen Wilkinson, M.P. (Minister of Education), and Mr. H. Hobson (chairman, Central Electricity Board). Equitable distribution is aimed at by the allocation of scholarships in colleges in London and South England, Scotland, Wales, the Midlands, and such other districts as the Committee may from time to time determine.

In her introductory remarks Mrs. Jackson said the Caroline Haslett Trust was launched in the association's 21st birthday year as the finest means of honouring the work of the director, Miss Haslett. Special thanks were due to Sir Andrew Duncan, first chairman of the Central Electricity Board, for his personal interest and encouragement. The leading electrical organisations—the financial sponsors of the scheme—are the Central Electricity Board, the British Electrical Development Association, manufacturers including the British Electrical and Allied Manufacturers' Association, the Cable Makers' Association, the Electric Lamp

Manufacturers' Association and the Electrical Contractors' Association.

Miss Ellen Wilkinson, a vice-president of the association, said that given right educational standards, Britain's women could find in electrical housecraft a means of great benefit to their homes, and a career both advantageous to themselves and to the nation's well-being.

The travelling exhibitions would enable electrical housecraft and economics generally to be seen against their true background of national and international well-being. Mr. H. Hobson said that the great expansion ahead of the electrical industry meant better housing, better communications, better health standards, better recreational facilities, and better amenities all round. In this great social progress there was need for increasing numbers of trained and educated women. The electrical industry, in financially sponsoring these scholarships in electrical housecraft indicated their belief in the necessity for preparing women adequately to make full use of all their potentialities. Miss C. Haslett, expressed her appreciation of this tribute.

During the course of the meeting it was announced that the electrical industry had guaranteed £2 000 a year to the Trust Fund, and in addition, the association's branches had raised £1 700 to date.

Small Two-Phase Motor

Development of Unit by Admiralty Compass Observatory

WE have received from the Admiralty Compass Observatory (Royal Naval Scientific Service) particulars of a two-phase induction motor developed in the Compass Department for use in applying torques for controlling the precession of the gyros of the Admiralty gyro transmission unit Mk. II. It was adopted as the follow-up motor of the Admiralty transmitting magnetic compass type III.

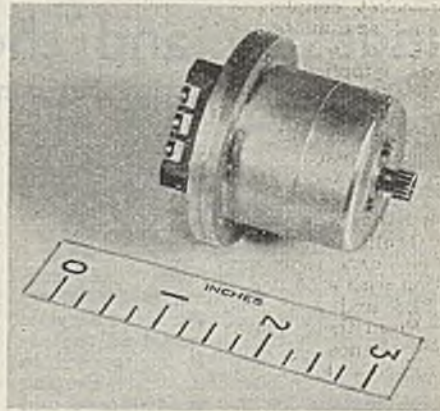
The illustration shows a complete motor which is totally enclosed and flange mounted, having an aluminium alloy shell and end shield. The stator leads are connected to an external terminal block secured to the end shield and the rotor is mounted in ball bearings, the shaft extension being arranged to project at either end. The weight of the complete motor is 5½ oz.

The stator core is built from radiometal laminations 0.010 in. thick secured by a brass or aluminium sleeve spun over at the ends. The assembled core is wound and impregnated and forms a readily replaceable unit which is held inside the shell by means of a flexible brass clamping ring secured by the end shield. The stator windings are of the double layer concentrated type, the individual coils being preformed and inserted in the 12-slot core to form a 2-phase 6-pole system.

The rotor is of squirrel-cage construction formed by copper strips secured in narrow slots in the laminations and soldered to copper end rings. Radiometal laminations and copper end rings are clamped on to

the rotor shaft by means of a nut and the 21 slots are skewed by one slot pitch to eliminate cogging. The shaft is made of stainless steel.

The deep, narrow rotor bars and open-ended slots assist in providing a relatively



Complete two-phase induction motor

flat speed-torque characteristic since at high slip frequencies the current in the bars is concentrated towards the outer edge, giving effectively greater rotor resistance at low rotor speeds.

For application, as a torque motor, the motor was required to operate on a supply

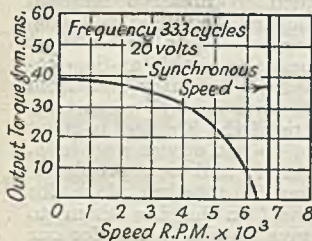


Fig. 1

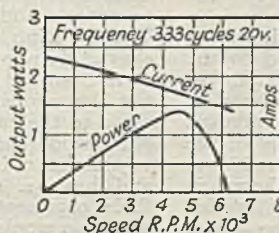


Fig. 2

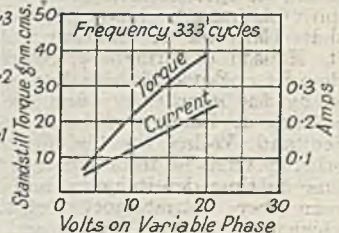


Fig. 3

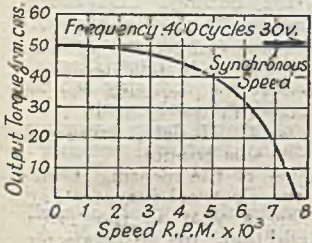


Fig. 4

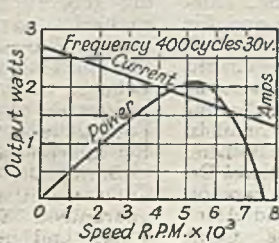


Fig. 5

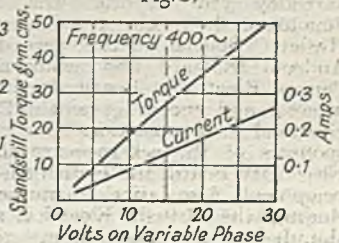


Fig. 6

of 333 cycles per second and works continuously under stand-still conditions. Under these latter the temperature rise at 20 V per phase is about 30°C.

For the second application, as a follow-up motor, the available supply was at a frequency of 400 cycles per second and one phase is constantly energised, while the second phase is supplied from the output of a valve amplifier in proportion to the misalignment of following. Under

these conditions a fixed phase voltage of 30 V gives a temperature rise of about 30°C. in normal operation.

The existing stator winding is of No. 36 s.w.g. nylon covered wire, and the use of smaller gauge wire would allow increase in applied voltage and proportional reduction in current requirements.

The accompanying curves show the general characteristics on 333 and 400 cycle supply and are self-explanatory.

Industry and the Armed Forces

Appeal to Electrical Personnel to Support Victory Club

IN order that industry may be able to pay tribute to the Armed Forces and to foster the spirit of co-operation which existed during the war, a fund has been started which has as its object the building of a Victory (Ex-Services) Club for the use and convenience of all ex-Service men and women of the allied nations. The suggested amount of the fund is £1 000 000 and the personnel of each industry is being invited in turn to assist in the attainment of that sum. It is proposed to build a club in London, with sleeping accommodation for 300 or 400 men and women, with lounges, reading and writing rooms, restaurant, and facilities for such social functions as dances.

The fund has the full support of all chiefs of the Armed Forces and on Tuesday, following a luncheon in London to representatives of the electrical industry, Field Marshal Lord Chetwode, president of the fund, explained that since the last war was an engineers' war, and in particular an electrical engineers' war, the spirit behind the club would be especially appreciated by the industry. Admiral of the Fleet, Lord Chatfield, referred to the close co-operation which had existed between the Royal Navy and the electrical industry for so many years, and pointed out that nowhere was the efficiency of the industry more respected than in the Navy. The industry in its turn had shown in many ways its recognition of the service which the Navy had done, and no better expression of that appreciation could be found than by supporting the fund. Air-Vice-Marshal Sir Leonard Slatter and Sir Walter Citrine also spoke, the latter pointing out that as it was due to the Armed Forces that the democratic movement which he represented remained in existence, industry would, in his view, fail in its duty if it did not support the fund.

Sir Harry Railing explained that the appeal was first launched at the Mansion House by the Lord Mayor of London, and was supported by Mr. Winston Churchill in addition to all the Service chiefs. The

committee responsible for promoting the fund, whilst appealing to every citizen individually for support, appealed as well to every industry, and on this occasion to the electrical industry. The Victory Club, as he understood it, was conceived as a national thanksgiving and a memorial to the spirit of brotherhood and comradeship that led us through six years of war to victory—a thanksgiving for the sacrifice and endurance of all our fighting men, and an attempt to preserve that spirit of comradeship, of thinking, feeling and working together that led us through those dark days. The home and fighting fronts, during the war had been one; industry and the services had acted in the closest co-operation. We were all determined to carry that spirit into the post-war world. With it we had won the war; and only by persevering in it could we win the peace. That was why our thanks for delivery should express themselves, not in monuments of stone, but in living memorials designed to preserve national teamwork and mutual helpfulness. The Victory Club was meant to foster that spirit. It was meant to enable ex-Service-men from all over the country and from the Dominions, to have a home when they came to the centre of the Empire, to meet old friends there, to get advice and help, to talk of old battles and new problems, and have a common meeting place for their organisations. In helping them to do so we would give thanks to God for our deliverance, and help to hand on to coming generations the heritage that alone enabled us to preserve our liberties and our national life—the spirit of pulling together, the spirit that to give was more blessed than to receive. As an industry which had sent some 100 000 men into the Forces, each and all should make a worthy contribution to such a national memorial of thanksgiving as would be a Victory Club.

Inquiries respecting the appeal, as well as donations, should be sent to Mr. M. A. Browning, 15, King Street, London, S.W.1.

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

Major W. Robinson, has rejoined the staff of the E.L.M.A. after serving with the Royal Engineers from the outbreak of war. He has spent most of the time in India and Burma, where his work included road making in the Arakan and base construction work in Akyab. He will be remembered in the industry for his activities in the Central England area before the war. He will be dealing largely with industrial lighting.



Major W. Robinson

Mr. W. S. Boone, has been appointed publicity manager to Johnson and Phillips, Ltd.

Mr. J. H. Mills has been appointed secretary and controller of Broadcast Relay Service.

Sir Robert Cary has been appointed a director of the Lancashire United Transport and Power Co., Ltd.

Councillor R. H. Scott has been elected chairman of Newcastle-on-Tyne Transport and Electricity Committee in succession to Alderman George Dixon.

Captain D. L. Sidney, late Hon. Artillery Coy. and 13/18 Royal Hussars (Queen Mary's Own) has resumed his pre-war appointment with Petbow, Ltd., Watford.

Mr. John G. Featherstone has been appointed director of the Fairfield Shipbuilding and Engineering Co., Ltd. He will continue to act as secretary.

Mr. Douglas Crabbe, power and maintenance engineer at Fort Dunlop, has been appointed chief engineer of the former bomber factory at Speke, Liverpool, recently acquired by Dunlop from Messrs. Rootes.

The D.F.C. has been awarded to **Flying Officer Frederick Fernley**, who in civil life was employed by Messrs. Murphy, electrical engineers, of Preston. He served his apprenticeship with E. Dewhurst, Ltd., at Mount Street works.

After 42 years with the North-Eastern Electric Supply Co., Ltd., **Mr. W. F. T. Pinkney**, assistant general manager, is to retire at the end of this year. During the war he served on the Newcastle-on-Tyne Advisory Committee on Fuel.

Major Stanley M. Mohr, managing director of the Micanite and Insulators Co.,

Ltd., has been elected president of the Institute of the Plastics Industry for the session 1945-1946. Major Mohr was chairman of the British Plastics Federation for five successive years, from 1939 until 1944.

The Mycalex Co., Ltd., of Ashcroft Road, Cirencester, Glos., announce that their three directors, who were in H.M. Forces, have now safely returned.

Mr. M. W. Ingram, who was a major in the Grenadier Guards is now taking over the post of managing director of the company.

Sympathy is extended to the relatives of **Mrs. Maude Matilda Marryat**, wife of the late Mr. Howard Marryat (founder and chairman of Marryat and Place, Ltd.), who died on November 21, in her 77th year.

Mr. F. A. Vaughan, a director of British Oil Engines (Export), Ltd., of London, has recently left England for a tour in the East, in connection with market developments of British oil engines overseas. He expects to remain in India for several months and to extend his tour to Burma, Ceylon and the Far East.

Lord Forrester, managing director of Enfield Cable Works, Ltd., and **Mr. L. A. Booth**, sales director of the company, have returned by air from their visit to South Africa in connection with export trade. They arrived at Hurn airport on Monday.

Southport Electricity Committee has recommended the promotion of **Mr. Douglas F. Grant**, station superintendent, to the position of deputy electrical engineer.

Miss Violet Markham, in a talk to the E.A.W. London branch on November 20, gave further details of the "National Institute of Homeworkers" outlined in the Markham/Hancock Report. In introducing her, Miss Caroline Haslett said that the association had made its contribution towards raising the status of the domestic worker in the Home Workers' Courses initiated in 1936; over 1 200 certificates had now been issued.

Mr. J. M. Shannon, of the Glasgow branch of the Simplex Electric Co., Ltd., has been appointed manager of that branch. He has been with the company for 18 years, and has just returned from six years' service in the R.E.M.E., having spent a considerable time overseas and been twice mentioned in despatches. **Mr. H. G. Barrett** remains manager for Scotland, responsible for the general direction of both the Glasgow and Edinburgh branches of the company.

As from November 1, **Mr. H. L. S. Heap** and **Mr. W. E. Hanson** have entered into partnership under the name of Heap

and Digby, to continue the practice of consulting and inspecting engineers previously carried on under the title of Heap and Digby Ltd.

Mr. W. H. Ashley, who for the last 14 years has been chief engineer of the Indian Radio and Cable Communications Co., Ltd., of Bombay, India, has relinquished this post and taken up an appointment with Marconi's Radio Telegraph Co., S.A.E., Cairo, Egypt.



Mr. W. H. Ashley

Replying to a question in the House of Commons on Tuesday, Mr. E. J. Williams, Minister of Information, said he had set up a television advisory committee consisting of representatives of the interested Government departments and the B.B.C. empowered to consult with representatives of the industry. The members include: Chairman, Mr. G. M. Garro-Jones; Col. Sir Stanley Angwin and Mr. H. Townsend, Post Office; Sir Edward Appleton; Mr. O. F. Brown, Department of Scientific and Industrial Research; Mr. W. J. Haley and Sir Noel Ashbridge, B.B.C.

Dr. James Greig has been appointed to the University Chair of Electrical Engineering tenable at King's College, from October 1. From 1926 to 1939 he was Lecturer in Electrical Engineering at the Birmingham University, and since then he has been head of the Engineering Department at the Northampton Polytechnic.

The forty-first illumination design course held by the E.L.M.A. at the Lighting Service Bureau, 2, Savoy Hill, London, opened on November 21 with an attend-

ance that reached 148. Many were men newly returned from the Forces. Mr. H. A. Lingard, chairman of the E.L.M.A. Council, opened the proceedings, and Mr. W. J. Jones, director of the E.L.M.A., gave the first lecture, taking for his subject "The New Outlook on Lighting."

In response to the request that contributions should be made to the funds of the Electrical Industries Benevolent Association, in lieu of floral tributes at the funeral of the late Mr. J. Y. Fletcher, a sum of over £500 has been received. Mr. Fletcher had been for many years honorary treasurer, one of the wardens, and a member of the Council, Court, and Finance Committee of the E.I.B.A., and was an ardent annual collector of funds and a generous personal contributor.

Miss M. L. V. Gayler gave a talk to members of the Women's Engineering Society on November 22. Miss Caroline Haslett, who introduced Miss Gayler from the chair, referred to the speaker's long experience of metallurgical research. Under the title of "My Job in the National Physical Laboratory," Miss Gayler was able to cover a great deal of ground by the use of lantern slides. She showed many graphs which plotted the reactions of various aluminium alloys under the age and hardness tests, and some interesting microscopic photographs of the change in structure of the metals undergoing such tests.

Many in the electrical industry throughout the country will be interested in the announcement that **Mr. John Vestey** has this week been appointed manager of THE ELECTRICIAN. Educated at Dame Alice Owen's School, Mr. Vestey spent the earlier years of his business life in the high-class shop-fitting and building construction field. Twelve years ago, however, he joined Benn Brothers Ltd., and thus followed in the footsteps of his father, Mr. Walter Vestey, who has long been a promi-



Opening of the 41st illumination design course held by the E.L.M.A. at the Lighting Service Bureau, Savoy Hill, London. At the table in the foreground, reading from left to right, are Mr. E. B. Sawyer, acting manager of the bureau, Mr. W. J. Jones, director of the E.L.M.A., Mr. H. A. Lingard, chairman of the E.L.M.A. Council and Mr. W. H. Williams, member of the E.L.M.A. Council

ment personality in the trade, and technical publishing world and who is also, with Messrs. Benn. Mr. John Vestey quickly showed his business qualities and gained promotion, becoming senior London representative of THE ELECTRICIAN. His five years' work in this position enabled him immediately war broke out to undertake additional responsibilities, and throughout the war period he has been acting manager of the journal. Now as full manager he takes up the position for which by his experience and work he is naturally fitted.

Mr. G. A. C. Thynne, late director West Devon Electric Supply Co., Ltd., and Bude Electric Supply Co., Ltd., left £138 589 (net £57 158). Duty, £16 404.

Sir John Anderson, chairman of the Advisory Committee on Atomic Energy, is to speak on "Research in Relation to Reconstruction" in Manchester on Thursday, December 6.

Mr. D. J. Sinclair, managing director of St. Helens Cable and Rubber Co., Ltd., chairman, British Insulated Cables (S.A.), Ltd., and director of Automatic Telephone and Electric Co., Ltd., British Insulated Cables, Ltd., Helsby Cables and the Midland Electric Corporation for Power Distribution, left £43 547 (net £38 321).

The President of the Board of Trade has appointed a committee under the chairmanship of Sir Clive Baillieu, president of the F.B.I., to frame detailed proposals for the formation of a British Institute of Management. Among the members of the committee are Miss Caroline Haslett, director, E.A.W.; Sir Archibald McKinstry, deputy chairman, Babcock and Wilcox, Ltd., and chairman, Industrial Management Research Association; and Mr. Henry Towers, general manager, Edmundsons Electricity Corporation, Ltd. Lord Forrester, managing director, Enfield Cable Works, Ltd., has also been invited to serve.

Mr. A. C. Hardy, who has contributed to THE ELECTRICIAN for many years on the subject of electricity in the shipping world, has now returned to his literary activities. Appointed to the Intelligence Division, Naval Staff, Admiralty, before the war, he joined in September, 1939, and served thereon until September, 1942. After this he was appointed Assistant Staff Constructor Officer to Lord Louis Mountbatten, who, at that time, was Chief of Combined Operations. During his period at the Admiralty, Mr. Hardy wrote and produced the first and, then only, handbook on Merchant Ship Recognition, which was widely used as a standard work in our own and the United States fleets and by the Air Forces of both nations. He also taught ship recognition to Coastal Command R.A.F., as well as in special Air Force advanced intelligence courses. At-

tended by officers of the United Nations throughout the later stages of the war. During his Combined Operations duties he flew to California, to convert U.S. Maritime Commission cargo ships to assault carriers. Thirteen of these ships were available on D-Day off the Normandy beaches. Later at Davisville, Rhode Island, he was concerned in association with the U.S. Navy with early experiments with the American box pontoon or naval landing equipment which subsequently, when built into rafts, was known as the Rhino pontoon. Mr. Hardy assisted Lord Louis Mountbatten as his technical adviser at the first Quebec Conference. Returning to the Admiralty late in 1943, he was associated with the preparation of the assault fleet for D-Day. After the German collapse he was attached to the Flag Officer Denmark, in connection with merchant ship repairs there, and then to the staff of the British Naval Commander-in-Chief, Germany, as assistant to the Command Constructor-Officer, and later was active in East Prussia and in Berlin as technical member of the Tripartite Naval Commission.

Obituary

Mr. John Oliver Pringle, retired electrical engineer, of Gosforth, Northumberland, aged 71 years.

Mr. John Edward Aldred, in New York, aged 83 years. He was for 24 years president and 32 years chairman of the board of the Shawining Water and Power Co., until his retirement in 1941. He was also connected for many years with the Pennsylvania Water and Power Corporation, and the Montreal Light Heat and Power Co.

Dr. F. W. Aston, F.R.S., at Cambridge on November 20, aged 68. He was one of the scientists engaged in the research which led to the discovery of "heavy water," a constituent in atomic bomb production, and had been chairman of the International Committee on Atoms since 1935. He achieved the first artificial separation of isotopes in 1913, having set out to separate the gases of neon by fractional diffusion. In 1919 Dr. Aston built a new positive ray apparatus, embodying his method of focusing capable of measuring atomic masses current to one part in a thousand and within a year he had measured the atomic masses and determined all the isotopes of all the permanent gases and most of the other elements which can be conveniently introduced into a gaseous discharge. By the end of 1920 some 92 elements had been successfully investigated. He built a new and improved mass-spectrograph in which the focusing of the rays was almost perfect and finally achieved a method of measurement of the desired accuracy.

Answers to Technical Questions

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

What factors govern the power factor of a mercury-arc rectifier?

The power factor on the primary side of a transformer supplying a rectifier can be regarded as being made up of two parts—a displacement factor $\cos \varphi$, arising from the phase displacement φ of the current relative to the voltage, and a

no phase displacement between the two. $\cos \varphi$ for this case will thus be unity; the wave shape is, however, not sinusoidal, i.e., it contains harmonics in addition to the fundamental component, so that $\cos \delta$ is less than unity.

Effect of Overlap—On account of the reactance of the transformer it is not possible for the current to rise and fall instantaneously to give the rectangular wave shape shown in (a)—it must rise gradually and fall gradually as shown in Fig. 1 (b). This means that just after the arc has transferred from anode 1 to anode 2, both anodes are carrying current simultaneously, i.e., the operation of one anode overlaps that of the next by a certain angle u , this being known as the angle of overlap. This angle depends on the load on the rectifier and may be 20° to 30° at full-load. It can be seen from the diagram that the centre-line of the anode current wave is now displaced from that of the secondary voltage by the angle φ . This phase displacement, in which the current lags behind the voltage, is reflected into the primary circuit of the transformer giving rise to a displacement factor in the supply.

It can be shown that the displacement φ , is approximately $\frac{2}{3}$ of the angle of overlap, u , so that $\cos \varphi = \cos(\frac{2}{3} u)$.

Effect of Grid Control—If the transfer of current from one anode to the next is delayed beyond the ordinary commutation point by means of grid control, the conditions are as shown in Fig. 1 (c). Neglecting the effect of overlap mentioned above it can be seen that there is again a displacement of the anode current wave to the right, the angle of displacement in this case being equal to the angle of delay in the transfer of current from anode to anode, i.e., $\varphi = \alpha$. Thus, in the grid controlled rectifier $\cos \varphi = \cos \alpha$. Reduction of the d.c. voltage by grid control is also proportional to $\cos \alpha$ and such a voltage variation is thus accompanied by a similar variation in displacement factor on the a.c. side. In addition to the above two effects, the transformer will take some lagging magnetising current which will add slightly to the above displacements.

Power Factor Improvement—Due to the displacement of the current wave from the voltage wave, the fundamental of the current wave can be resolved into two components, a power component in phase with the voltage and a reactive component

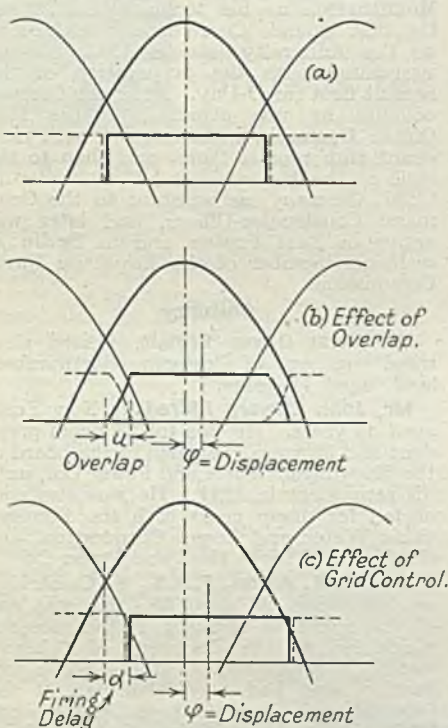


Fig. 1

distortion factor, $\cos \delta$, arising from the harmonics in the alternating current which are inevitable with all rectifier circuits. The power factor is given by—

$$\text{power factor} = \cos \varphi \cos \delta.$$

The anode currents and voltages of, for instance, a 3-anode rectifier are shown in Fig. 1. In diagram (a) it is assumed that each anode carries current for precisely $\frac{1}{3}$ of a cycle and that the inductance of the d.c. side is sufficient to keep the direct current absolutely constant. The anode current wave shape is thus rectangular as shown and it can be seen that its centre-line coincides with that of the corresponding anode voltage, i.e., there is

lagging by 90° . This lagging component can be neutralised by means of condensers connected on the primary side so that φ can be made zero and $\cos \varphi$ equal to unity. It is not practicable to neutralise or otherwise eliminate the harmonics in the current so that even though the displace-

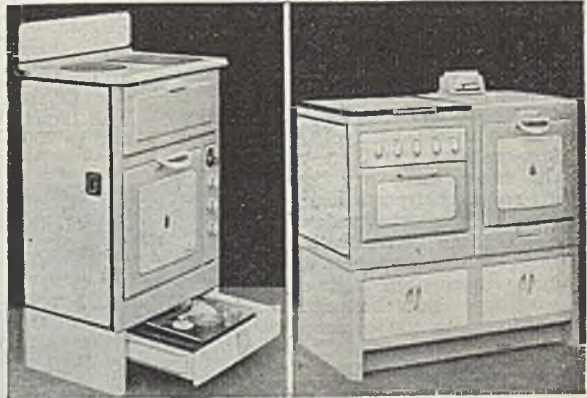
ment factor can be made unity the power factor cannot exceed $\cos \delta$, which, theoretically, is 0.955 for a rectifier with a 6-phase secondary and 0.988 for a rectifier with a 12-phase secondary.

E.O.T.

Equipment and Appliances

Television Pattern Generator—Plastic Electric Heater

Although minor modifications and constructional improvements have been embodied in the electric cookers now being produced by **Moffats, Ltd.**, the company have not made any radical changes in pre-war models. The photographs reproduced on this page show their medium upright cooker (model 42 Q), fitted with a step-in base, and the deluxe table top cooker (model 31 QG) similarly equipped. The bases in each case are all-steel, in a synthetic enamel finish to tone with the colour finish of the cookers. The drawers provide convenient accommodation for cooking utensils, etc. Each of the cookers has three hot plates, and one of these has a four-position switch giving three heats—high, medium and low. The oven has automatic heat control. The table top cooker has two grills and that beside the oven can be utilised for three purposes; for grilling at the top, for warming plates and dishes and for keeping food hot. The cookers will be obtainable in plain French grey, ivory, ivory and green, or ivory and black.



Moffat electric cookers fitted with step-in bases

existing television receivers. That handicap has been removed by the production by **E. K. Cole, Ltd.**, of Southend-on-Sea, of a compact, portable television pattern generator (type TSE/1) which provides facilities for testing the vision circuits, the audio circuits and the aerial system at any time when signals are not being radiated from a transmitter. It is hoped that the initial sets will be available by the end of the year at the price of approximately £10 10s. each, so that service engineers may be able to check and overhaul many existing receivers before the B.B.C. television broadcasts are resumed.

The unit is designed for use on mains of 200-250 V, 50 c.p.s. only, and the consumption is approximately 30 W. The frequency range covered is approximately 40 to 50 mc/s, and the output is of the order of 2 mV after a 10.1 attenuator. The pattern seen on the receiver when adjustments have been correctly carried out is a white screen with two black vertical bars and one horizontal grey bar.

The rigid plated chassis is housed in a cream metal case, $12\frac{1}{2}$ in. by 9 in. by 8 in., with louvres at the rear to ensure good

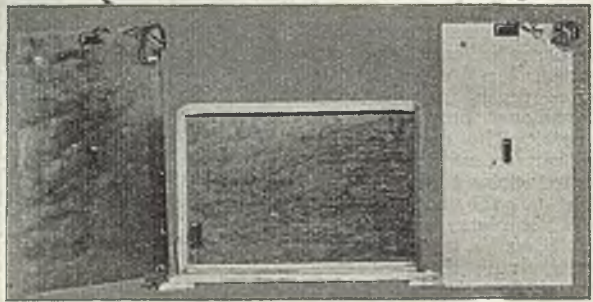


The Ekco Television pattern generator

ventilation. A carrying handle is attached to the top of the case, which has rubber feet. The aerial is supplied in two 6 in. sections, which can be screwed together. When not in use they are stowed away in clips on the case. One or both can be used for testing an aerial system. If the distance from the instrument to the aerial is less than 50 ft., only one 6-in. section would be required. For distances between 75 ft., and 100 ft. both rods would probably be needed. The radio frequency output sockets are arranged flush with the top of the carrying case. The 80 Ω cable output is a Carr fastener socket, into which the cable can be plugged. A double-pole toggle on/off switch is provided and there is a ruby pilot lamp indicator.

Low-temperature plastic electric heating panels are being manufactured by the **Yarworth Electric Panel Co.**, controlled by Reinforced Plastics, Ltd., of Queen's Road, Kingston-on-Thames, Surrey. For the home there are bed warmers, thermostatically controlled, giving, the makers claim, 70 hours' warmth for a penny; movable panels to go under a carpet, rug, or mat, in any room including the bathroom, or to be placed in an airing cupboard. This type of panel can be fitted to a light removable frame on a stand. These heaters can also be used in the form of mats for warming motor cars and railway carriages. One was demonstrated in the new coach that was on view at

Waterloo and Victoria Stations. The heating wires are interwoven in a fabric and the finished material is moulded and completely encased in insulating material, resulting in a thin, flat, light and flexible panel, which is non-inflammable, damp-proof, fool-proof and non-corrodible. The resistance wires not only fulfil their primary function of heating, but greatly increase the mechanical strength of the panel. The heating elements do not exceed "black heat" and the life of the panel is said to be practically everlasting. In the unlikely event of an element breaking there is no danger of fire or overheating, but only a reduction of the heating effect. Within limits, any size or shape of Yarworth heater panels can be produced. Panels 5 ft. by 2 ft. have been made, with a loading of 500 or 600 W; the rating could be up to 75 W per sq. ft. The convenient size for bed warming is 35 in. by 19 in. The panels can be used for voltages from 200 to 250 V.



Yarworth plastic electric heating panels

Mathematics for Industry

During the last six years mathematics have become increasingly harnessed to the needs of industry and research, and to assist in this connection the Department of Scientific and Industrial Research have set up a Mathematics Division in the National Physical Laboratory. Problems presented by the war, both in its operational and industrial aspects, required considerable use of mathematical analysis, and while the professional mathematician is satisfied with calculations expressed in terms of a formula, involving a number of variables, those who have to use the results in practice have often neither the time nor the ability to follow the arguments. It becomes necessary, therefore, either to compute the value of the formula for all likely values of the variables, or to invent a

mechanism which, by simply setting in accordance with these values, automatically and mechanically produces the answer. Of recent years, there has been considerable development in mechanical computing, using calculating machines, and it is to undertake this work for industrial concerns as well as Government departments that the Mathematics Division has been set up. The Division is at present organised in three sections dealing respectively with computing, statistics and the development of calculating machines. Mr. J. R. Womersley has been appointed superintendent. The staff will also be available for consultation in the field of applied mathematics, particularly on those aspects allied to industrial research, and the Division is now open for inquiries.

Large Scale Catering

By a Supply Engineer

DURING the Parliamentary debate on the Catering Bill two years ago, the late Minister of Labour emphasised that after the war the public would urgently need relaxation in the way of good holidays for which more efficient catering facilities must be provided. Recently, following the abrupt ending of lend-lease, the necessity of replenishing the country's much depleted stocks of foreign currency—especially American—has been particularly stressed in official circles. One proposal with this end in view, is to take full advantage of the attractions Britain now offers to Continental and American tourists. Here, the potentialities require no emphasis, but in the opinion of many, the standard of catering, hotel accommodation, travelling facilities and service generally, must be materially improved if full advantage of the position is to be taken.

Electrical Equipment Replacements

In view of the foregoing, it is not unreasonable to expect that a high degree of priority should be given to the rehabilitation of the catering industry generally, to the production of the apparatus required, a great deal of it electrical, and to the prompt derequisitioning of hotels, etc., employed for military purposes during the war. Unfortunately, hotels which have suffered the rigours of war-time occupation remain in a dilapidated condition with little apparent prospect of being restored in the immediate future, while average delivery of electric catering equipment is, at present, three to six months, nine months being not uncommon—this at a time when the demand has by no means assumed substantial proportions.

With the increased development of the school-meals service during the war, establishment of British restaurants and the revival of peace-time catering, the question might well be asked if the load potentialities in the future may not justify increased attention being paid to propaganda in this specialised field? Here, for instance, the E.D.A. might, with advantage, consider the introduction of a specialist section to deal with large scale catering, synonymous to the organisation now existing for space heating, public lighting and domestic development. Supply authorities in their turn could consider diverting some of the domestic sales staff now returning from the Services, to the development of this important load.

The development of large scale electric cooking has not proved unremunerative in the past, and for the reasons indicated,

the future potentialities may be considerable. Refrigeration and all motor-driven appliances—mixers, potato peelers, silver burnishers and similar equipment—have the field to themselves. Specialised apparatus, including automatic toasters, grills, coffee and milk urns, hot cupboards, food trolleys etc., often justify their installation on account of utility, cleanliness and convenience, the question of running costs not being the deciding factor. Where some experience has been gained, employment of electricity for roasting and baking is usually preferred, serious competition being generally encountered in the matter of steaming ovens, vegetable boilers and hot-plate work in which running costs go a long way in deciding the issue. From the electricity supply viewpoint, it is obvious that charges will, in some measure, have to keep in step with the rising cost of coal. Electric space heating engineers may, therefore, be in for a more difficult time in the immediate future, as in this field operating costs are often the deciding factor. As regards large scale catering, however, the question of running costs is not so closely associated with progress, moreover, the load—especially at holiday resorts—is often of the seasonal variety and therefore virtually off-peak. Full steam ahead in the immediate future as regards electric large scale catering is therefore clearly indicated.

In regard to the availability of specialised appliances—particularly automatic toasters, and to a lesser extent, grills and some types of milk bar equipment, such apparatus was, in pre-war days, imported in large quantities from America. The reason for this could, in some measure, be attributed to failure to produce in this country really competitive alternatives. As products of the American market in this connection may not be available for some time, opportunity now exists for enterprising manufacturers to study the requirements closely and produce more attractive and efficient designs than hitherto.

Blind Workers in Industry.—The annual report of the National Institute for the Blind states that more than 300 different operations in open industry have been found suitable for sightless people, and additions to the list are being made every month. When the war against Germany ended, nearly 2,000 blind men and women were working in factories, side by side with the seeing.

Measurement of Impulse Voltages

The Influence of Irradiation When Using Sphere Gaps

AT a meeting of the I.E.E. Measurements Section on November 23, Dr. J. M. Meek read a paper entitled "The Influence of Irradiation on the Measurement of Impulse Voltages with Sphere Gaps," a summary of which is as follows.

The impulse breakdown of short gaps between spheres is greatly affected by the amount of irradiation present, and recommendations are made in the British Standard "Rules for the Measurement of Voltage with Sphere-Gaps" that appropriate precautions should be taken when voltages of less than 50 kV (peak) are being measured. These precautions are generally considered to be unnecessary in the measurement of higher voltages, and, in most laboratories, no deliberate steps are taken to provide irradiation.

Measurements up to 400 kV

In a previous publication the author has shown that appreciable errors may be incurred if irradiation is not used with spheres of 6.25 cm. diameter in the measurement of voltages up to 100 kV (peak). Further measurements have now been made up to 400 kV (peak) with 1/5 and 1/50 impulse voltage waves, of positive and negative polarities, for spheres of 6.25 cm., 12.5 cm. and 25 cm. diameter. The present results confirm and extend the previous observations.

The irradiation provided by the ultraviolet illumination from the impulse generator spark-gaps has a marked influence on the behaviour of the sphere-gap, in the absence of other forms of irradiation, and consequently the position of the sphere-gap relative to the impulse generator is observed to affect the results. This factor does not appear to have been considered in other laboratories, and it may explain some of the differences between the results obtained by various investigators in the calibration of the sphere-gap with impulse voltages.

As it is not always convenient to illuminate the gap with the light from the impulse generator spark-gaps, the irradiation provided by the insertion of 0.5 mg. of radium in the high-voltage sphere has been examined and is found to give satisfactory results. Measurements of the impulse breakdown of the unirradiated sphere-gap show that there is a gradual transition from the voltage which causes breakdown for 10 per cent. of the applied impulses to that which causes 90 per cent. breakdown, whereas a sharply defined breakdown voltage is obtained when the gap is irradiated. The

mean breakdown voltage of the unirradiated gap exceeds that of the irradiated gap by an amount which varies with the gap length. For a 3 cm. gap between 12.5 cm. diameter spheres, breakdown of the unirradiated gap takes place at a mean voltage about 13 per cent. in excess of that for the irradiated gap. With a larger gap, for which a difference between the breakdown voltages for positive and negative impulses is recorded when one sphere is earthed, the difference is found to be largely influenced by irradiation. The mean breakdown voltage for an unirradiated gap of 9 cm. between 12.5 cm. diameter spheres is 20 per cent. higher than the irradiated value for a positive impulse, and 1.5 per cent. higher for a negative impulse. The negative impulse breakdown voltages agree closely with the corresponding values given in the B.S. 358 tables, whereas the voltages given in the tables for the positive impulse breakdown are intermediate between those obtained in the present experiments for the unirradiated and the irradiated gaps.

The results show that some revision of the standard rules for the use of sphere-gaps is necessary, and, in particular, that more definite recommendations should be made concerning irradiation. Further, it is evident that the influence of irradiation is an important factor to be considered in the breakdown of other forms of discharge gaps in which corona is not observed to precede breakdown. Also, the breakdown of discharge gaps on the wave-front may be expected to be governed largely by the amount of irradiation present, and, though this has been realised by many workers for short gaps, no consideration appears to have been given to irradiation in the measurement of wave-front breakdown for longer gaps.

Discussion

Mr. G. W. Bowdler (National Physical Laboratory) said that if the author's experience of unirradiated gaps was representative of other people's experience, he had made out a good case for the revision of the British standard specification for the measurements of the voltage of a sphere gap. However, he rather suspected that the author's experience was not representative of normal experience because, for one thing, the results given in the B.S.S.—which presumably represented the experience of a considerable number of other workers—were much closer to the values which Dr. Meek had obtained with

irradiation than those which had been obtained without irradiation. He also suspected that Dr. Meek had gone to extraordinary lengths to get rid of the normal sources of ionisation which might be expected in the neighbourhood of an impulse generator. Even with the precautions Dr. Meek had taken, his results showed there was a decreasing effect of irradiation with increased size of sphere, and extrapolating as far as one could do the author's results to larger spheres, it appeared probable that with a 500 mm. diameter sphere and over, the effect of irradiation was very small. A few experiments which he had carried out since the paper was available indicated that that was so.

Dr. W. Wilson (the General Electric Co., Ltd.) said the author's removal of the scatter in connection with the use of the sphere gap was very welcome, and he also supported the contention in the paper that B.S. 358 had been shown to be somewhat misleading and should be revised in the direction of making it more definite. With regard to the use of radium, he asked whether the author's use of $\frac{1}{2}$ mg. was an economic compromise. He supposed that lithium bromide was used, and asked what quantity of the salt would be employed to give $\frac{1}{2}$ mg. of radium and whether the salt was inserted inside the sphere in the vicinity of the gap and covered with something to keep it in position.

Dr. S. Whitehead (E.R.A.) said that as he had the honour or misfortune to be chairman of the International Electro-technical Commission sub-committee when the last I.E.C. standards were produced, he felt bound to say that for an ambitious project they had fared pretty well. Some attacks had been made which had not come to much, but a further attack on the very low voltage end might mature in the future. The author had already, in an earlier paper, criticised the impulse figures on the ground of inconsistency, which he himself could not then accept. The present paper made a much more serious but, at the same time, more constructive criticism of positive impulse values for spheres up to 50 cm. diameter and for certain spacings. Outside this, the author had to a large extent confirmed the I.E.C. standards and his opinions and results would also support the validity of the symmetrical or insulated gap results, since here the positive polarity would be immaterial. In a sense, continued Dr. Whitehead, he was not the proper person to deal with the standardisation side since the principles involved were the province of the Impulse Sub-Committee of which Dr. Allibone was chairman, and also chairman of the E.R.A. Committee which prepared B.S.358. How-

ever, he was convinced by the author's exposition that many of the discrepancies observed were due to variations in irradiation and that this factor must be controlled. Whilst agreeing with the author's basic propositions he was not prepared to admit all his explanations. For instance, the author's explanation of the change of sign of the polarity effect was rather unconvincing as to why there should be any change at all, while the hypothesis explaining why the negative polarity could be less than the positive, would seem also to explain that an avalanche was more easily propagated in a weak field than in a strong field—which he thought was hardly the intention.

Mr. F. S. Edwards (Metropolitan-Vickers Electrical Co., Ltd.), said that, having had a good deal to do with the calibration of sphere gaps, he found the paper rather chastening. The endeavour had been to find out all the variables that affected the results, and now Dr. Meek came along and said that something which was decisive had been missed out. It had been mentioned that the author's conditions were rather artificial, and it seemed that the air in London was more suited to a reliable calibration than the air in the North of England. It was a fact that results varied widely from place to place even in the same district. For this reason it seemed that whilst the earlier investigators were wrong, they were not so wrong as they might have been. The practical question was, what sort of specification should be put forward which would ensure that the results could be relied upon?

Mr. G. W. Carter (British Thomson-Houston Co., Ltd.), asked the author to expand his rather vague remarks about the region of the gap in which the appearance of an ion was effective, and put two questions arising out of the author's description of his impulse testing technique. First, he said, the assumption was made that the efficiency of the impulse generator was constant as a function of the circuit only and not of the voltage. Was this justified? Secondly, was it the author's experience that 10 impulses were sufficient to ensure consistent results in observations of sphere gaps?

Mr. F. J. Miranda (Ferguson Pailin, Ltd.), remarking that the irradiation of large gaps as well as small gaps had been studied before, said it might well be that insufficient screening of unirradiated gaps had affected the results. Great precautions must be taken to obtain effective screening. In some experiments he had carried out, a curtain, approximately 10 ft. by 8 ft. high, placed between the impulse generator set and a horizontal 6.25 cm. sphere gap proved insufficient, but the same curtain protecting the sphere gap on three sides

was effective in preventing irradiation. The author stated that the main object of the paper was to give qualitative rather than quantitative measurements, but the paper was full of figures, graphs and tables, and comparisons were made with the calibrations of B.S. 358. Therefore it was useful to discuss the validity of the results obtained. For instance, in one case a claim was made that the maximum error was of the order of 3 per cent., but apparently no account had been taken of personal errors. In any case a variation of ± 3 per cent. in the results obtained would in many cases cancel out some of the differences recorded. Also, in every case transition curves were drawn as straight lines, and he could not see any justification for this if the results were to be correctly interpreted. Percentage spark-over curves followed a probability law and could be obtained only by making a very large number of observations, particularly so at the lower and upper ends of the curves. The diagrams in the paper seemed to indicate an insufficient number of observations, and this view was supported by results obtained in his own case with the 6.25 cm. gap. With regard to the definition of breakdown voltage, the term "minimum" used by the author was misleading; it was not mentioned in B.S. 923, and its use should be discouraged. Finally, in agreeing with the author regarding the necessity for confirmation by other research workers on the effect of irradiation on sphere gaps, he said that care must be taken to ensure uniformity of technique and the elimination of as many variables as possible.

Dr. Meek, replying to the discussion, said he was not quite sure whether Mr. Bowdler regarded irradiation as necessary or otherwise. It rather appeared that he did not consider it essential to include the definition in the British standard. It was true that in the work described in the paper he had gone to the extreme in suppressing irradiation, although not as extreme as it might have been. As to the economics mentioned by Dr. Wilson, he had used $\frac{1}{2}$ mg. of radium, which cost about £6. It was contained in some salt form and could easily be installed in a normal sphere gap, and as there were expensive items in the total equipment, £6 was a small one. At the same time, he was not at all sure that $\frac{1}{2}$ mg. of radium was not too much, and one of the things he intended to do in the future was to ascertain the minimum amount of radium necessary for the particular sphere gap used. He thought the suggestion of a difference between the air in London and the air in Manchester rather a fiction. There might be slight differences, but not sufficient to explain any major differences in

the measurements. Incidentally, he mentioned that when he was in California he heard of differences in measurements which varied according to whether the wind came from the sea or the land side. The reason for that was that on the land side were certain mountains in which there was radioactivity from the soil and the influence of this was experienced in the laboratory when the wind came from that direction. He agreed that 10 impulses were not sufficient for non-irradiated measurements, but he felt that number was sufficient when measuring the breakdown of the irradiated gap.

Mr. S. H. Richards (chairman of the section) proposing a vote of thanks to the author, expressed regret that the attendance represented only about 5 per cent. of the membership of the section and said the importance of the paper justified a much larger attendance.

Correspondence

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

High Voltage Research

[TO THE EDITOR]

Sir,—With reference to the report on High Voltage Research on page 574 of THE ELECTRICIAN of November 23, may I point out that 20 capacitors of 20 microfarads each when connected in series, give a capacitance of 1 microfarad (namely $F \frac{1}{20 \times 20}$), and not 0.01 microfarad as stated in the article.

Yours faithfully,

London, W.4.

Z. M. RAHT.

THE HEAT PUMP

The British Electrical and Allied Industries Research Association, has issued Report Y/T7, under the title of "The Heat Pump for Space Heating. Critical Résumé of Published Information," which was prepared by Mr. D. V. Onslow. This publication is timely for considerable attention has been given during the past few years in the U.S.A. and in Switzerland to the possibilities offered by the heat pump, and the present résumé of published information has been prepared with a view to examining the economics of the system in its application to space heating, especially in view of the present high price of coal. One of the advantages of the system lies in its capacity to provide heating and cooling alternatively.

The report is supplemented by a bibliography of 88 references; its price is 4s.

News in Brief

Sanatorium X-ray Equipment.—The Durham C.C.'s estimates for next year include £3 000 for new X-ray plant and tomograph for the Holywood Hall Sanatorium.

Post Office News.—As a result of enemy action repair work was necessary to 1 700 cables, 4 000 joints, and 500 000 wires, between September, 1940, and September, 1941, in the London Telecommunications Region.

Tokio and Bangkok Wireless.—Cable and Wireless Ltd., announce that they have opened wireless telegraph circuits with Tokio (Government and ordinary Press traffic only) and Bangkok (all classes of traffic).

Preston Installation Schemes.—The Corporation has agreed upon free installation of tubing for wiring domestic appliances covered by simple hire in all new houses. Also, the E.D.A. service unit is to be installed, free of cost, in all post-war houses.

New Telephone Exchange.—A new telephone exchange to serve the western part of Aberdeen has been opened, 400 lines already working on the main exchange are to be transferred, and the change-over will make room for a similar number of new lines in the centre and north of the city.

Wireless Installation.—The Essex Health Committee is to instal a wireless system at the Wanstead County Hospital at a cost of £545. The Kent Health Committee has approved estimates for a wireless installation at Lenham hospital at £353; and fittings for an X-ray unit, £265, and wireless repairs, £140, at Chatham hospital.

L.C.C. Housing Equipment.—The L.C.C. has approved plans for a new type of block of flats. All such types will be provided with constant hot water from slow combustion stoves, and electric immersion heaters for supplying hot water in the summer; improved kitchen facilities with space for refrigerators; gas or electric coppers in place of solid fuel coppers; gas or electric fires in place of open fires in first bedrooms; and additional electric plug points.

Social Item.—Members of the sports club of Burco, Ltd., numbering nearly 500, recently spent an enjoyable evening at a victory dinner and dance. Mr. J. W. Carter, secretary, and Mr. Ernest Rogers, treasurer, were each presented with a wallet and writing case.

Eire Filament Lamp Quota.—The Eireann Government has fixed the quota for electric filament lamps which may be imported into Eire between December 10 and February 28 next, at 50 000.

Illuminating Engineering Society.—The annual dinner of the Birmingham Centre of the society is to be held at the Imperial Hotel on December 7, at 6 p.m. Owing to the limited accommodation available, early application for tickets is advisable.

New Eire Radio Station.—It is announced that the Eire Government has decided to erect a high-power short-wave radio station which it is hoped to have working by 1947.

Floodlighting to Aid Building.—It is announced that Mr. Frank Knight, of A. C. Knight and Sons, Birmingham, has originated a scheme whereby floodlighting will assist building employees to

carry on work for two hours after 4 p.m., instead of having to finish because of poor light. The scheme is being tried on the Eichelhurst Estate, Walmley.

War-time Telephones.—During the war more than 7 000 women helped with the work of telephone installation, and it is hoped that they will remain to assist the Post Office in clearing off the telephone waiting list.

Early Lighting for Workers.—The Maidenhead T.C. has decided that electric street lamps shall be lit in the early morning hours for the benefit of the travelling public.

All-electric Kitchen Exhibits.—An all-electric kitchen was featured in the exhibit of the electricity department at the Save to Buy Exhibition held at Macclesfield, recently, in connection with Thanksgiving Savings Week. An exhibition of model electric kitchens planned on lines suggested by the British Electrical Development Association, has been opened at Wallasey, by the Mayor.

Engineers' Conference.—An Engineers' Conference organised and sponsored by the Institution of Professional Civil Servants is to take place at Caxton Hall, London, S.W.1, on December 15 and 16. The conference will be opened by the Rt. Hon Ernest Bevin, at 2 p.m. The chairman on the opening day will be Miss C. Haslett, the subject being "Historical Development of Engineering." Speakers will include Dr. P. Dunsheath, Mr. J. Young, Mr. L. J. Edwards, M.P., Miss V. Holmes and Maj.-Gen. E. B. Rowcroft.

TWENTY-FIVE YEARS AGO

FROM THE ELECTRICIAN OF November 26, 1920: At the end of July there were 778 electricity supply works in Japan, with an aggregate capacity of 1 303 551 kW, and a total capital of 1 218 390 960 yen.

Water Power in the Highlands

Developments Over the Next-Ten-Year Period

IN a talk to the Edinburgh City Business Club on November 20, on the subject of "Hydro-Electric Development in the Highlands," Mr. A. E. McColl, Deputy Chairman and Chief Executive Officer of the North of Scotland Hydro-Electric Board, gave a brief outline of the history of the development of the water power resources of the Highlands, the setting up of the Board, its powers and obligations and made reference to the Loch Sloy and Tummel-Garry schemes and the export of power to the Lowlands to provide revenue to defray the financial losses on uneconomic distribution schemes in remote parts of the Highlands and in the islands.

By giving effect to these measures, he said, the Board would be able to sell electricity in the remote areas at tariffs which compared favourably with those charged by electricity undertakings operating in urban areas. The Board's policy would also provide for the giving of a supply without demanding from the consumer a capital contribution towards the cost of the overhead or underground cables erected or laid to give a supply to his premises, always provided he was within reasonable distance of the Board's main distributing cables. What was regarded as a reasonable distance obviously varied according to the type of consumer. A half-mile might be unreasonable in one case, whereas one mile might be reasonable in another. The Board's schemes of development provided for the distribution of electricity within approximately four years' time to 70 per cent. of the people in the remote areas. The remote areas meant the fringes of the North and North-West Coast and most of the islands, including Shetland and Orkney.

There was one further important potential consumer, i.e., the large consumer who might be attracted to the Highland area by virtue of the lower tariffs which would be available there from the development of cheap water-power energy. They hoped that the electro-chemical and electro-metallurgical industries might find a home in the north. It was true that their consumption of electricity was large in relation to the manpower which they employed, and for that reason many people condemned the attraction of industries of that type to the Highland area. It must be remembered, however, that their products were vital and necessary to the production of war material and for that reason alone, apart from any other consideration, they should be encouraged and fostered.

The Hydro-Electric Board had given recently an outline of their major water-power developments over the next 10-year period. This development covered the construction of 27 water-power stations, catering for the prospective demands of existing consumers and authorised electricity undertakings, new domestic consumers, and for the needs of the Central Electricity Board. In total, this represented a generating capacity of 811 000 kW, with an output of 2 250 million units per annum. Those constructional schemes would in their way represent a very substantial contribution to the problem of unemployment. Spread over a 10-year period, they would ensure continuous employment to several thousand workpeople, skilled, semi-skilled and rough labour, not counting the many who would be employed in the workshops which manufactured the mechanical and electrical machinery, underground and overhead cables, steel work, cement, and many other things which were required in connection with the construction of hydro-electric power stations, transmission lines and distribution schemes.

The cost of constructing a new steam electricity generating station to-day was about £35 per kW of plant installed. Some new stations were costing more. At that price per kW the fixed costs on capital alone were higher than the all-in cost of the Tummel-Garry hydro scheme. In fact the total cost of electricity from that scheme was about 30 per cent. less than the capital and fixed costs of the steam station, even if the steam station received its coal fuel or atomic fuel free of cost. Broadly, many other of the Board's hydro stations would occupy the same position relative to the cost of production at a steam station.

TELEVISION IN AMERICA

Speaking at a luncheon of the Radio Industries Club, in London, on Tuesday, Mr. L. H. Bedford, director of research of A. C. Cossor, Ltd., who has just returned from a visit to America, spoke on the state of television in the United States. His general conclusion was that, at the present time, America could not show pictures equal in merit to those we had in 1939. Her programme material could not compare with ours. At the same time, a good deal of research was going on, and where we had a technical staff of 10 on a line of development the United States had 150 or 200, with all the money they needed to carry on their work.

Electricity Supply

Swindon.—The Finance Committee is to instal fluorescent lighting in the Town Clerk's offices at a cost of £60.

Croydon.—Sodium street lamps are to be provided by the Highways Committee on the Ashburton estate at a cost of £1 400.

Power for Villages.—Electrical Distribution of Yorkshire Ltd., are to be asked to supply electricity to the villages in the Osgoldcross rural area which are still without power. They are East Hardwick, Cridling Stubbs, Burton Salmon, Birkin, Heck, Balne and Stapleton.

Bangor (North Wales).—The borough electrical engineer, Mr. F. O. Harber, has reported to his Committee that he has under consideration, the installation of equipment for the control of consumers' apparatus to reduce the peak and consequently the charges of the North Wales Power Co.

New Power Station.—Estimated to cost over £4 000 000, an electricity generating station is to be built at Westwood, Wigan. The cost will be borne by the Central Electricity Board. It will take 4½ years to build and equip the structure, the site of which is on the south side of the town near one of the deep water flashes.

Rothsay.—The North of Scotland Hydro-Electric Board, which is taking over the T.C. power station in May of next year, has installed new equipment in position against the transfer. A 450 kW Diesel generating plant, supplied by Mirrlees, Bickerton and Day, Ltd., has been officially started up by Provost Muir. It was, the Convener stated, the first plant to be installed by the Board, and although they regretted the change, they appreciated that it would mean cheaper electricity for the area in due course. The station will be operated ultimately in conjunction with the Board's Loch Striven hydro-electric station.

Glasgow.—In the report of Mr. G. Morgan, the general manager, for the year ended May 31, 1945, the net capital expenditure of the electricity undertaking is given as £10 440 753 as compared with £10 397 283 for the previous year, while the net revenue is stated at £452 341 (£476 802). The result of the year's working shows a surplus of £62 158, compared with £1 802 last year. The balance carried forward is £337 730 (£287 112). The total number of units generated was 672 656 500 (760 291 700), while the number sold totalled 668 406 453 (666 132 454). The total connections in kilowatts were 592 430 (577 670), and average cost per unit sold was .5439d. (.4782d.).

Douglas.—Mr. Bertram Kelly, borough electrical engineer, in a report on the operations of the undertaking in its twenty-first year, refers to the establishment of a joint board, comprising two members of the Electricity Board, three members of the Electricity Committee, and five represen-



One of the five all-electric kitchens to be seen at the Sheffield exhibition

tatives of the staff, set up to negotiate salary scales and the conditions of service for the technical staff of the electricity supply industry on the island. Total revenue was £165 221, and expenditure £114 104, leaving a gross profit of £51 117. Units sold totalled over twenty million—double the figure of 1939. Electricity generated amounted to 23 615 496 units, and bulk supplies to the Electricity Board for distribution outside Douglas accounted for 45.23 per cent. of the total. These units yielded an average price of 1.29 per cent. There were 6 600 consumers connected, units sold per consumer being 1 419 or 374 per head of population.

Valuation of Electricity Undertakings.—The Valuation Committee of the Leicestershire C.C. has considered a letter from the County Councils' Association stating that its War Emergency Committee has considered a letter from the Joint Committee of the Central Valuation Committee and the four associations of local authorities with reference to a revaluation of the Central Electricity Board's undertaking. The Joint Committee had recommended that Mr. H. P. Buckingham be appointed to make further valuations of the Board's undertaking based upon the 1943 accounts and the 1944 accounts at a fee of £2 500 and £1 000 respectively and the War Emergency Committee of the association recommended that subject to the division of Mr. Buckingham's fee on the basis

hitherto adopted the recommendation be adopted. The cost of those further valuations would be shared on the basis of the values apportioned to the respective areas of the county valuation committees. The Committee agreed to these proposals.

Sheffield.—An exhibition of electric kitchens was opened in Sheffield on November 12, by the Lord Mayor (Ald. C. W. Gascoigne, J.P.), in the presence of among others, Coun. J. W. Holland, J.P., chairman, Electricity Committee; Mr. J. R. Struthers, general manager of the electricity department; and Mr. V. W. Dale, general manager and secretary, E.D.A. The main feature of the exhibition is the four electric kitchens for the low-cost post-war home which have been constructed by the E.D.A. A fifth kitchen has been constructed by the electricity department, using Moffat all-steel kitchen equipment. In addition, ten display stands have been equipped with electrical appliances of all types by a variety of manufacturers, and a special water heating display has been arranged. Cookery demonstrations and film shows are given daily in a marquee specially arranged for this purpose. Considerable public interest has been shown in the exhibition, and in the first two weeks it has been visited by 55 000 people. Admission is free, but two days each week are set apart for complimentary ticket holders, tickets being available on application at the Corporation offices or show-rooms. On ticket-admission days attendances have averaged 700 per day, and a high percentage of inquiries from prospective users of electrical household appliances have been received. On other days attendances have varied between 5 000 and 10 000 per day, and although the percentage of inquiries received has been lower than for ticket admission days, a large number of interested inquiries have been received. Arrangements for the exhibition have been in the hands of Mr. A. Haddock.

Leyton.—In the annual report of the borough electrical engineer, Mr. A. E. Morgan, for the year ending March 31, 1945, the total sale of electricity is given at 37 491 516 units, representing an increase of 3 789 133 units on the previous year. The number of B.O.T. units purchased was 40 959 650, an increase of 3 233 900. Expenditure on electrical energy purchased shows an increase of £12 956. The average cost per unit purchased was .778d. compared with .773d. during the previous year. The cost of coal has risen by 4s. 8d. per ton. This has resulted in an additional expenditure of £7 646 over the previous year. Repair and maintenance costs are up by some 17 per cent. New apparatus is not available at present, and there will be a shortage for some time to come. The average cost

per unit sold for the year was 1.369d., while the average price received per unit sold was 1.568d. The total number of consumers at the end of the year was 27 278 showing a decrease of 1 062. For the period from June 15 (when the fly-bomb attacks started) to the end of the year, over 1 000 services were disconnected due to bomb damage. In the course of the year the Committee considered the need for simplification of domestic tariffs and introduced a new two-part domestic "all purpose" rate. A new development during the year was the supply to 100 "all-electric" emergency hutments at Whipps Cross. The gross profit for the year shows an increase of £6 676 (namely £66 452). On account of the provision for income tax the net profit is £15 467 (£17 155). After deducting revenue contributions to capital, and rate contribution, the revenue balance for the year is £9 501 (£10 989).

Reviewing the working of the undertaking since the outbreak of war in 1939, the reserve fund then amounted to £60 802, and the net revenue balance £49 473. With the advent of bombing and evacuation the sales of electricity dropped by 3 373 100 units to 30 710 000 and the number of consumers by 3 016 down to 26 076. From 1941 the sales of electricity increased steadily year by year until the previous record in 1939 was passed, and sales of units were still rising, although consumers were still 1 814 below the number in 1939. Although deficits were made in 1940 and 1941 the finances have improved year by year until at the end of the war period, the reserve fund is practically at its statutory maximum. It is pointed out that this financial position is to a certain extent artificial as war-time restrictions on maintenance and repairs have caused an accumulated liability which will have to be met in the future years, also the need to finance new capital expenditure has been practically nil.

Tin and its Uses.—Booklet No. 16, just published by the Tin Research Institute, describes a study of the use of very thin coatings of tin on steel as a pre-treatment before painting. It is suggested that this simple pre-treatment greatly increases the life of such products as motor car bodies, steel window frames, refrigerators, electric heaters and fires, water heaters, and many others. New processes for tinning cast iron without preliminary electroplating have solved a number of industrial problems. Attention is drawn to the publication of the first modern book on the tinsplate industry. "Tin and its Uses" may be obtained free of charge from the Tin Research Institute, Fraser Road, Greenford, Middlesex.

Industrial Information

Trading with the Enemy Act.—The Board of Trade announce that trading with the enemy controls have been removed in respect of British Far Eastern territories and the Philippines.

To Make Refrigerators.—The Grove Engineering Co., of Heaton Mersey, near Manchester, who have been engaged during the war on the manufacture of aircraft components, are to make domestic refrigerators, and they plan to employ 150 workers in a new factory at Barnoldswick, in Lancashire.

Dynamo and Motor Repairs.—Under the title of "Wheat from the Tares," Dynamo and Motor Repairs, Ltd., of North End Road, Wembley, have published an illustrated brochure dealing with the work of their repair specialists in reconditioning surplus used electrical plant, whether it be serviceable or defective; stocks of plant for sale or hire; installation and maintenance, and supply change-over work undertaken by the company.

Siemens' Magazine.—In the October/November number of the journal of the employees of Siemens Brothers and Co., Ltd., Woolwich, the narrative is concluded of Mr. A. W. Hearnden, one of the company's radio officers, who was radio officer-in-charge on the m.v. "Australind," when the ship was sunk by a German surface raider on August 19, 1941. He was wounded and taken prisoner and, after a voyage on the raider lasting 107 days, was interned at the Milag Nord Camp, where he spent nearly four years.

"B.T.H. Activities."—The current issue opens with illustrated notes on the important contribution to radar made by the British Thomson-Houston Co., Ltd., in research, development and manufacture. There are also articles on "New Flameproof Switchgear," by C. A. C. Hilyer (switchgear engineers' department); "Electrically Operated Excavators," by H. Sharp (industrial engineering department); "Trolleybus Braking," by J. H. Cansdale (traction department); and "New Design of a.c. Air-break High Voltage Contactor," by C. J. Sarjeant (control gear engineering department).

Survey of Industrial Research.—In the opinion of the F.B.I. Industrial Research Committee, British industry's research effort has been greatly under-estimated, and, with the object of establishing and publishing the facts of the scope of industrial research carried on in this country two questionnaires have been sent out. One is addressed to all manufacturing concerns that are carrying out research and development, and the second to all firms and organisations offering facilities to in-

dustry of an analytical, testing, consultant, research, or development nature.

British Council's Annual Report.—The report of the British Council for the financial year 1944-45, shows that the Council's expenditure during that period amounted to £2 336 140. Accompanying the report is an outline of the activities of the Science Department, including the engineering panel. This department was founded four years ago to make the British contribution to science better known abroad, and to promote mutual knowledge and understanding between scientists in Britain and other countries.

B.N.F.M.R.A. Silver Jubilee.—To mark the completion of 25 years of service to the non-ferrous metals industry as a co-operative research institution and metallurgical centre, the British Non-Ferrous Metals Research Association, has published a book dealing with its policy, organisation and work. Officially incorporated in January, 1920, the association started with a membership of eighteen and an annual income of less than £6 000. To-day the membership exceeds 370 companies and the annual income is approximately £50 000.

G.E.C. Journal.—In the current issue Dr. W. G. Thompson contributes an article on "A System of Graphical Representation for Arc-Converters"; Mr. F. B. Champness describes the plant installed by Fraser and Chalmers Engineering works at Horden Collieries for the recovery of iron pyrites; and other articles include "Fluorescent Lamps" by Mr. H. G. Jenkins; "Automatic Testing Equipment for Aircraft Wiring Systems" by Messrs. A. Forbes and H. Walrond; "Physical Conception and Calculation of Differential Leakage" by Mr. E. Friedlander and "Measurement of the Photometric Properties of the Upper Atmosphere" by Mr. J. M. Waldram.

Diesel Engine Users' Association.—The report of the Working Costs Committee on heavy-oil engine working costs for the year 1943-44 to be presented at the annual meeting of the association at Alliance Hall, Westminster, on December 13, deals with 52 stations compared with 55 in the previous year, the decrease being due to non-receipt of power returns from overseas, though there are two additions from home stations, one each from electricity and water undertakings. Tables show the average fuel consumption and its relation to the standard curve; lubricating oil consumption giving the rated B.H.P.H./gall.; the ratio of fuel to lubricating oil consumed; and the lubricating oil consumption, showing the average rated B.H.P.H. run per gall. Notes and

comments from members provide a useful addition.

Notes for Contractors.—Pending further consideration of the application made by the Electrical Trades' Union for a review of the existing wages structure of the industry the N.F.E.A. and the E.T.U. have agreed to a temporary increase of 2d. an hour to the Cost of Living (War) Addition to come into operation on the first pay day in December. As a result, the inclusive cost of living payments from that date until the second pay day in January next are to be: 8½d. an hour to labour over 21 years of age (journeymen electricians and adult assistants); 5½d. an hour to labour between 18 and 21 years of age; and 2½d. and hour to youths under 18 years of age.

At a meeting on October 10, the National Joint Industrial Council ratified the following "hub points" as alternative to the local council centre on the places named, for the purposes of the National Travelling Time Clause: Birmingham, Stevenson Place; Blackburn, Railway Station; Bristol, Tramway Centre; Coventry, Broadgate; Leicester, Clock Tower; Sheffield, Fitzalan Square. Calculations will be based on the "hub points" and not on the local council centres.

E.A.W. Mobile Canteen Service.—The E.A.W. Mobile Welfare Canteen Service, formed in 1940, has now closed down, after five years in which the sixteen canteens composing the fleet, operated all over the country. The personnel were all volunteers, and, dressed in the E.A.W. blue and silver uniform, covered thousands of miles in all weathers. The electrically-propelled canteen for which members subscribed was first used by the L.C.C. in feeding London's homeless, and was later presented to West Ham, where it was destroyed in the "blitz." Another canteen was used by a Home Guard detachment keeping watch on marshes round London. The service operated from a special headquarters department, but each canteen made its own arrangements with the local military authorities. The Sunderland canteen, which is entirely run by members of the local E.A.W. branch, is carrying on independently for another month. Now that the original need no longer exists, the canteens are being disposed of for other purposes. One, after use at the Leith docks, was recently presented by Ald. Mrs. Gregory, on behalf of the association to the Board of Trade, who handed it over to the Cambridgeshire Local Education Authority for work in connection with the Make-Do-and-Mend Campaign. Another has been given to the East Suffolk Federation of Women's In-

stitutes for use as a travelling van for educational and demonstration purposes in country districts. A third, loaned to the Central Board, for use by men engaged on line work, has now been presented outright.

Industries in War and Peace Exhibition.

—Among the exhibits being shown by the County of London Electric Supply Co., Ltd., at the exhibition of Streatham's industries in war and peace, is the aircraft multiple time recorder, with the aid of which one air-base is enabled to control up to 480 aircraft operating simultaneously from as many as 48 different air stations. It also warns the operator if any aircraft has failed to report at its specified time, so that immediate steps can be taken to locate the missing machine. In this way, it has assisted in saving many valuable lives. It is understood that the authorities propose to use the aircraft multiple time recorder in connection with centralised air traffic control. The whole of this equipment, and all the special jigs and tools necessary for the parts, were designed, developed and manufactured for the Air Ministry by the engineers of the company, in its own workshops. Another exhibit is the attenuator unit, Type 17, which is incorporated in the A.S.V. radar equipment that played a major part in defeating the U-boat. Also shown are "pulse" and "heater" transformer tanks, which are part of the radar equipment used by the R.A.F. An item of interest among the company's exhibits is a card showing a special job completed at short notice for D-Day operations. It is accompanied by a letter from Brigadier General Paul L. Williams, of the United States Army to Sir Robert Renwick, chairman of the company, and at that time Controller of Communications Equipment at the M.A.P., conveying his appreciation of the work carried out in this connection. The company's staff evolved methods for the emergency repair of the very critical co-axial receiver feeders between the aerial towers and the receivers on a number of the early radar chain stations around our coast, and they carried out this work in the field. They were also called upon to re-design the feeder system to obviate the unforeseeable difficulties which had arisen in the original design, and the company's various depots produced large quantities of the many types of fittings involved and provided engineers to train operatives and to supervise the erection of the new feeder system. The company's manufacturing activities resulted in the production of 885 423 different parts. The company has included a post-war section at the exhibition, demonstrating the part electricity will play in providing the home with the latest aids to efficiency and comfort.

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 Department of Overseas Trade, Millbank, London, S.W.1 (corner Horseferry Road), unless otherwise stated.

Milngavie B.C.—Electrical work in connection with the erection of 26 permanent houses on the Balvie Road site. Applications to Mr. F. A. B. Preston, 6, Buchanan Street, Milngavie; deposit, £1 ls.

Bedwellty U.D.C., December 1.—(1) Supplying and laying approximately 1 000 yards of 3 in. cast-iron main; (2) supplying and erecting 11 000 V switchgear, underground cables, and overhead lines. Particulars from the Electrical Engineer, Electricity Showrooms, High Street, Blackwood.

Southend D.C., December 3.—Supply and delivery of l.t. cable for 12 months commencing January 1, 1946. Specifications from Mr. A. C. Johnson, Electricity Works, London Road, Southend-on-Sea.

Batley T.C., December 4.—Supply of two lengths (approx. 500 yds. in all) of e.h.t. 11 000 V p.i. plain lead sheathed cable, served with fireproof covering. Specification from the Borough Electrical Engineer, Electricity Works, George Street, Batley.

North of Scotland Hydro-Electric Board (Distribution Scheme No. 1), December 10.—Supply, delivery and erection of h.t. and

i.t. distribution lines. Specification from Mr. T. Lawrie, 16, Rothesay Terrace, Edinburgh, 3; deposit, £2 2s.

Inverness B.C., December 12.—Supply of: (1) 6.6 kV switchgear kiosk complete with switchgear; (2) one 250 kVA kiosk sub-station; and (3) one 500 kVA distribution transformer. Specifications from Mr. N. B. Macarthur, Electricity Offices, Waterloo Place, Inverness; deposit, £1 ls.

Sutherland C.C., December 29.—Electrical work in connection with the construction of 60 houses in Golspie and Brora. Specification from Mr. E. W. Brannen, County Architect, Dornoch.

Sheffield Electricity Department, December 31.—Supply and delivery of two 600 kVA, 11/440 kV, 3-phase double wound self-cooled transformers. Specification from Mr. John R. Struthers, Commercial Street, Sheffield, 1; deposit, £2 2s.

Overseas

State Electricity Commission of Queensland, January 14. — Supply, delivery, erection, and setting to work of 7 500 kW and 750 kW steam turbo-alternators, accessories, and evaporating plant at Wide Bay Regional Electricity Board, Maryborough; Capricornia Regional Electricity Board, Rockhampton; and Townsville Regional Electricity Board. Tender forms from the Agent-General for Queensland, Queensland Government Offices, 409-410, Strand, London, W.C.2.

Book Reviews

The Story of the Atomic Bomb. By C. H. DOUGLAS CLARK, D.Sc. (London: Machinery Publishing Co., Ltd.) Pp. 52. 3s. 6d. net.

This little book which is illustrated with 22 figures, together with 7 photographs of famous scientists, gives a popular review of the principal discoveries which have led up to the production of atomic energy. Its author, who is a lecturer at Leeds University, has been interested in atomic and molecular structure for many years, and in the present volume he has attempted, with some success, to give in everyday language, a worthwhile appreciation of the development of atomic energy so that all may have a better understanding of the subject. In a postscript at the end of the volume the author expresses his personal views on the future application of atomic energy with certain conjectures on the use of the atomic bomb. The book offers both instructional and entertaining reading with the added attraction that it is likely to promote discussion among its readers when they meet.

High Vacuum Technique. By J. Yarwood, (London: Chapman & Hall). Pp. viii + 140. 12s. 6d. net.

The author, in this second revised edition, has included many new sections, but generally preserves the previous condensed treatment. The technique of high vacua has been developed over a long period of time, and many mistakes no doubt have been made in the past because of lack of information. The present author endeavours to tabulate considerable data and experience, so that manufactures and research involving evacuated apparatus can go forward with confidence in the light of accessible knowledge. It is not necessary to assess in detail the various sections, since these seem uniformly complete; one feature, however, is of considerable value, that is the section which deals with the relevant properties of materials which are well used in this field, with particular emphasis on sealing oils and cements and the various glasses, the surfaces to which they are applied. A bibliography of classical and modern references and patents is included.

In Parliament

The following are replies to recent questions in the House of Commons:—

Electrical Supplies.—Mr. Driberg asked the Minister of Fuel and Power if he was aware that electric power was supplied to R.A.F. stations and military establishments in remote rural areas, but that farms and dwelling-houses in such neighbourhoods were commonly without electricity; and if, as these establishments and camps became redundant, he would take steps to secure the electric plant and equipment that have been required hitherto for military purposes and use them for the speediest possible general electrification of the countryside. In reply, Mr. Shinwell said it had been arranged that Service Departments would notify the Electricity Commissioners of any cases where the local undertaking concerned did not wish to take them over. The Commissioners did everything possible to promote the use of this equipment for civilian purposes.

Electricity (Output).—In a written answer to Major Ramsey, Mr. Buchanan said that the total number of units, in millions, of electricity produced by public undertakings in Scotland, England and Wales, respectively, during the last complete year for which figures were available, namely, 1944, was Scotland 3 907, England (including Monmouth) 32 282, Wales 2 174. The estimated output of the schemes which the North of Scotland Hydro-Electric Board had in preparation was approximately

934 000 000 units, which was approximately equivalent to 24 per cent. of the Scottish, 3 per cent. of the English, and 43 per cent. of the Welsh output for 1944.

Electric Lighting Restrictions.—In a written answer to Mr. Naylor, who asked the Minister of Fuel and Power if his attention had been drawn to the excessive electric lighting in London amusement saloons at all hours of the day and evening; and if he would impose more effective restrictions on the present use of electric illumination, Mr. Shinwell said the whole question was engaging his careful attention, and he would not hesitate to ask for further statutory powers if necessary. He preferred, however, to rely as far as he could upon the voluntary co-operation of the public.

Gas and Electricity (Lanarkshire).—In reply to Mr. Timmins, Mr. Shinwell stated that comparisons of consumption of gas and electricity between the present and six months ago was of little value because of seasonal variations. However, the information available from gas and electricity undertakings indicated that compared with the corresponding period last year there had, in Lanarkshire, been a reduction in the industrial consumption of gas of about 25 per cent. and of about 12 per cent. in the consumption of electricity. He had no reliable information on the quantities of gas and electricity made by industrial firms in Lanarkshire for their own use.

Company News

AMERICAN TELEPHONE AND TELEGRAPH.—Reg. qtrly. \$2.25.

CANADA NORTHERN POWER.—Qtrly. 15 cts. on com. (same).

SOUTHERN CANADA POWER.—Qtrly. 20 cts. on com. (same).

J. H. FENNER AND CO., LTD.—Net pft. to June 30, £85 659.

TELEPHONE MANUFACTURING CO., LTD.—Intm. div. 2½% (same).

W. G. ALLEN AND SONS (TIPTON), LTD.—Intm. 2½%, less tax (same)

CHLORIDE ELECTRICAL STORAGE CO., LTD.—Intm. div. 5% (same) on "A" and "B" ord.

EAST-AFRICAN POWER AND LIGHTING.—Intm. divs. 3% on ord. (same), and 12% on new ord.

CARRIER ENGINEERING CO., LTD.—Pft. to June 30, £92 876 (£91 379). Ord. div. 25% (same).

HEPWORTH AND GRANDAGE LTD.—Fst. and fin. div. 15% (12½%), less tax, for yr. ended Sept. 30.

SUN ELECTRICAL CO., LTD.—Div. 2½% (same) for yr. ended Apr. 30, 1945. Pft. £18 195 (£17 856).

DICTOGRAPH TELEPHONES, LTD.—Fin. 7%, mkg. 11% (same). Net pft. to Aug. 31, £36 629 (£36 318).

LAKE AND ELLIOTT, LTD.—Fin. div. on ord. 15% (same), mkg. 20% (same), less tax, for yr. ended July 31.

BULLERS LTD.—Sec. intm. and fin. div. on ord. 5% (same), mkg. 7½% (same), less tax, for yr. ended July 31.

AERO ENGINES LTD.—Fst. and fin. div. on defd. 7½% (5%), less tax, for yr. ended Aug. 3. Pft. after tax, £23 082 (£17 478).

J. BROCKLEHOUSE AND CO., LTD.—Fin. div. on ord. 12½% (same), mkg. 20% (same), less tax, for yr. ended Sept. 30, payable Dec. 31.

HEENAN AND FROUDE LTD.—Fin. div. 5% (same), plus cash bonus 5% (same), mkg. 15% (same) for yr. to Aug. 31, 1945. Pft. £53 823 (£47 368).

ASSOCIATED EQUIPMENT LTD.—Fin. on

ord. 5%, tax free (same), again mkg. 7½%, tax free. Net pft. to Sept. 30 (subject to audit), £218 500 (£227 500).

JOSEPH LUCAS AND CO., LTD.—Total div. on ord. 15% (same), for yr. ended Aug. 7, with fin. 12% following 2½% intm. Pft. is returned at £319 270 (£289 426).

FAIRFIELD SHIPBUILDING AND ENGINEERING CO., LTD.—Pft. for yr. to June 30 after tax and deprecn. £100 388 (£95 975). To 5% "A" deb. int. £12 500 (same), div. 6% pref. £15 000 (same), contings. res. £50 000 (same), ord. div. 10% (same) £12 500, fwd. £68 521 (£58 133).

J. I. THORNYCROFT AND CO., LTD.—Fin. div. on ord. 12½% (8%), mkg. 17½% (13%) less tax, for yr. to July 31. Dirs. propose to trans. £50 000 (same) to gen. res., to provide £46 434 (nil) for deferd. repairs and to carry fwd. £101 707 (£110 718).

BUTLER MACHINE TOOL CO., LTD.—Fst. and fin. on ord. 12½%, less tax (same), payable Dec. 31. Net pft. for yr. to Sept. 30, 1945, (includg. E.P.T. recoverable £15 500, but after inc. tax on pfts.) £45 253 (£42 785 includg. E.P.T. recoverable £3 000 but after W.D.C. and inc. tax).

AERO ENGINES.—Pft. for yr. after deprecn. and E.P.T. £55 986 (£69 390), interest, dirs.' fees, war damage, insur., etc., takes £32 904 (£51 902), leav. net pft. £23 082 (£17 478). Available £55 165 (£40 677, includg. £13 677 tax overprovsn.) to res. £10 000 (nil). Divs. on ord. 7½% (5%), on defd. shs. 7½% (5%), fwd. £32 274 (£32 083).

CHADBURNS (LIVERPOOL).—Trdg. pft. to Mar. 31 £29 219 (£61 410), plus E.P.T. adjustmt. £38 900 (£5 500) and other income, mkg. £68 466 (£66 992). Deduct gen. exes. includg. reprs. and renewals £48 120 (£46 217), inc.-tax £7 500 (£8 000), deprecn. £4 455 (£4 454), dirs.' remun. £900 (same), leav. net pft. £7 491 (£7 421). Div. 6% and bonus 4% (both same), to gen. res. £3 000 (nil), fwd. £19 879 (£18 388).

ELECTRICAL AND MUSICAL INSTRUMENTS.—Accts. of group for yr. to June 30, show an expansion in tradg. pft., after providg. for deprecn. and obsolescence of £210 153 to £1 346 156. Interest from Gov. securities raises total pft. to £1 348 685 (£1 139 311). Taxatn. pd. and accrued absorbs £134 194 more at £706 207, while £337 637 (£323 254) is put to reserve for estimated inc. tax liability for 1946-47. £50 000 (nil) is written off patents rights acquired durg. yr. After allocatg. £64 790 (£56 127) to staff pensions and £4 349 (£5 893) for dirs.' fees, net pft. is £3 678 higher at £185 702. Div. on £460 000 6% cum. redeem. pref. requires £15 525 (£13 800) and ord. div. and bonus take £119 018 (£130 629). £268 902 (£253 360) fwd.

Company Meetings

AERIALITE, LTD.—The annual meeting was held at Stalybridge, on November 20. In the statement issued with the report and accounts, Mr. L. S. Hargreaves, chairman and managing director, said the company showed expanding and successful trading as before it was public, namely, from 1932. They were very fully booked with orders for post-war material, particularly connected with housing and the building trades, electrical appliance industries, telephone industries, railways, and similar works.

CRABTREE ELECTRICAL INDUSTRIES, LTD.—The annual meeting was held at Walsall on November 22, Dr. H. Schofield, the chairman, presiding. In the course of his address the chairman said the operating company had been very fortunate in finding itself among the few firms whose standard productions were in demand equally in war and peace and in consequence it had not been called upon to undergo drastic re-organisation. It would be correct to say that the slight drop in the trading profit this year was due to the cessation of special contracts and the switching over again to larger output of normal products. The company's war-time activities had been many and varied and they had contributed about 75 000 000 completely finished articles during the war.

Metal Prices

	Monday Price.	Nov. 26. Inc. Dec.
Copper—		
Best Selected (nom.) per ton	£60 10 0	— —
Electro Wirebars ...	£62 0 0	— —
H.C. Wires, basis ... per lb.	9½d.	— —
Sheet ...	11½d.	— —
Phosphor Bronze—		
Wire(Telephone)basis "	1s. 0½d.	—
Brass (80/40)—		
Rod, basis ...	—	—
Sheet " ...	—	—
Wire " ...	11d.	—
Iron and Steel—		
Pig Iron (E. Coast Hematite No.1)... per ton	£7 13 6	— —
Galvanised Steel Wire (Cable Armouring) basis 0.104 in. ...	£30 0 0	— —
Mild Steel Tape (Cable Armouring) basis 0.04 in. ...	£20 0 0	— —
Galvanised Steel Wire No. 8 S.W.G. ...	£28 0 0	— —
Lead Pig—		
English ...	£31 10 0	— —
Foreign or Colonial "	£30 0 0	— —
Tin—		
Ingot (minimum of 99.9% purity) ...	£303 10 0	— —
Wire, basis... per lb.	3s. 10d.	— —
Aluminium Ingots ... per ton	£85 0 0	— —
Speller... ..	£31 5 0	— —
Mercury (spot) Ware-house ... per bott.	£31 5 0	— —

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

Commercial Information

Mortgages and Charges

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

STAMFORD ELECTRICAL LTD., London, S.W.—Oct. 26, £2 000 charge and mort., to Norwich Union Life Insurance Soc.; charged on Glen Ashdale, Barnack Road, Stamford Baron, and a cap. redemption policy. *nil. Dec. 13, 1944.

MYCALEX CO., LTD. (formerly MYCALEX (PARENT) CO. LTD.), Cirencester, insulating material manufacturers.—Oct. 24, £15 000 deb., to Strand Nominees Ltd.; general charge. *— Jan. 12, 1945.

Notice to Creditors

LARNE ELECTRIC LIGHT AND POWER CO., LTD. (in Voluntary Liquidation).—Creditors of the above-named company are required on or before January 1, 1946, to send particulars of their debts and claims to L'estrang and Brett, Solicitors for Liquidator, 9, Chichester Street, Belfast.

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.

BEAUFORT RADIO SERVICE, 48, Vernon Grove, Odd Down, Bath, radio dealers. £37 19s. 4d. Aug. 14.

HOWELL, S. W. (male), 18, Harrison St., Holmes. Rotherham, maintenance electrician. £10 9s. 4d. Sept. 17

WILLIAMS, M. B. (male), 6, Well St., Holywell, Flint., radio engineer. £10 3s. Sept. 14.

THOMAS, W. H. (male), 47, Alltywerin Rd., Pontardawe, electrician. £30 13s. 2d. Aug. 22.

RADIO SERVICES, 48, Palmer Street, Victoria Street, London, S.W.1, radio dealers. £13 17s. 2d. Oct. 2.

WOOD, T. C. (male), 78, High Street, Aston, radio engineer. £15 1s. Oct. 1.

YOUNG, S. A. G. (male), 268, Broadway, Bexleyheath, radio dealer. £28 9s. 6d. Sept. 18.

Coming Events

Friday, November 30 (To-day).

I.E.E., S. MID. STUDENTS' SECTION.—Loughborough. "Air Blast Circuit Breakers," J. Humphries.

N.E. COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Newcastle-on-Tyne. "Electronics: Their Scope in Heavy Engineering," W. G. Thompson. 6 p.m.

Saturday, December 1.

I.E.E., N. MID. STUDENTS' SECTION.—Bradford. "Voltage Stabilisers; their Principle and Design," G. N. Patchett. 2.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS, N.W. SECTION.—Manchester. "The Application of Electric Motors and Control Gear," H. P. Pentelow. 2.30 p.m.

Monday, December 3.

I.E.E., S. MID. CENTRE.—James Watt Institute, Birmingham. "Factors Influencing the Design of Electric Lighting Installations for Building Interiors," R. O. Ackerley. 6 p.m.—**MERSEY AND N. WALES CENTRE.**—Liverpool. "Practical Aspects of Telephone Interference Arising from Power Systems," P. B. Frost and E. F. M. Gould. 6 p.m.

Wednesday, December 5.

I.E.E., RADIO SECTION.—London. W.C.2. "The Design and Use of Radio-Frequency Open-Wire Transmission Lines and Switchgear for Broadcasting Systems," F. C. McLean and F. D. Bolt. 5.30 p.m.

INSTITUTE OF WELDING, LEEDS BRANCH.—Technical College, Huddersfield. "Some Advantages and Dangers of Welding with

High Amperages and Heavy Deposits," J. M. Polson. 7 p.m.

Thursday, December 6.

I.E.E.—London, W.C.2. "The Operation of Large Turbo-Alternators to Reduce Rotor-Winding Deformation," R. H. Coates and B. C. Pyle. 5.30 p.m.

INSTITUTE OF WELDING, N.E. TEES-SIDE BRANCH.—Middlesbrough. "Welding of Plastics," Dr. J. H. Paterson. 7.15 p.m.

TOWN AND COUNTRY PLANNING ASSOCIATION.—23, King Street, Covent Garden, London, W.C.2. "Heating the Family Home," Mrs. Gillian Harrison. Buffet lunch, 12.45-1.15, followed by talk and discussion.

Friday, December 7.

INSTITUTE OF WELDING, S. LONDON BRANCH.—Borough Polytechnic, London, S.E.1. "Welding of Plastics," Drs. Hain and Zade. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria Street, S.W.1. Discussion groups. 6.30 p.m.

ILLUMINATING ENGINEERING SOCIETY, BIRMINGHAM CENTRE.—Imperial Hotel. Annual dinner. 6 p.m.

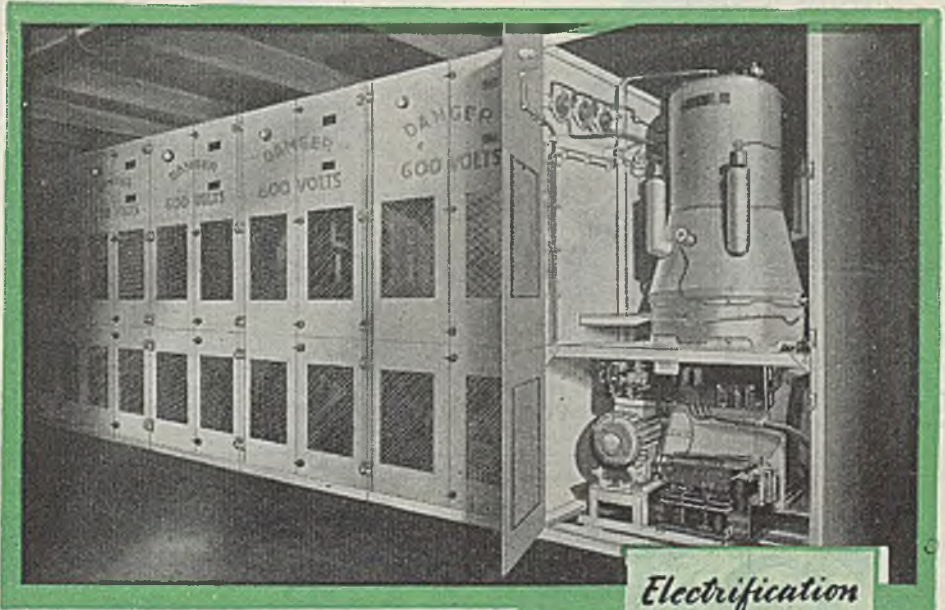
Saturday, December 8.

I.E.E., LONDON STUDENTS' CENTRE.—Porchester Hall, Bayswater. Informal dance. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria Street, S.W.1. Presentation of awards. Presidential address, "Atomic Energy," Sir G. P. Thomson, F.R.S. 3.30 p.m.

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Electrification Schemes

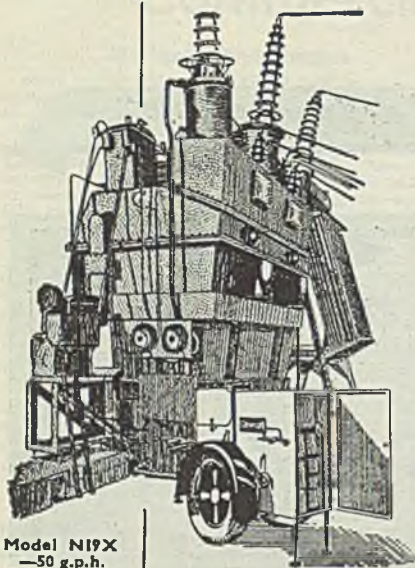
G.E.C. Electrification Schemes have been applied to all industries, including: Aircraft Factories; Chemical Works; Collieries; Food Factories; Gold Mines; Iron, Steel and Copper Works; Locomotive and Railway Carriage and Wagon Works; Motor Car Works; Ships and Shipyards; Textile Mills, etc., etc.

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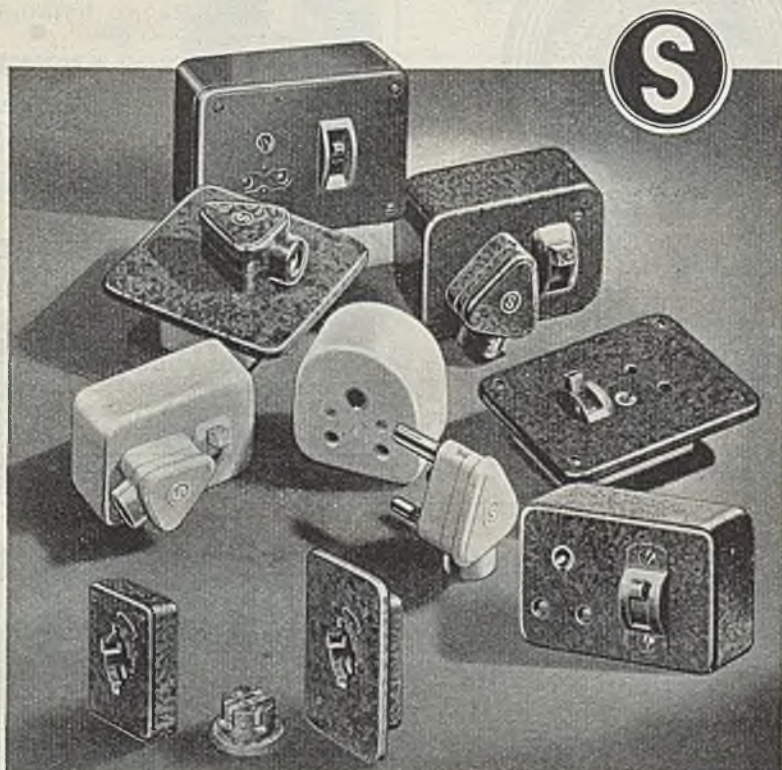
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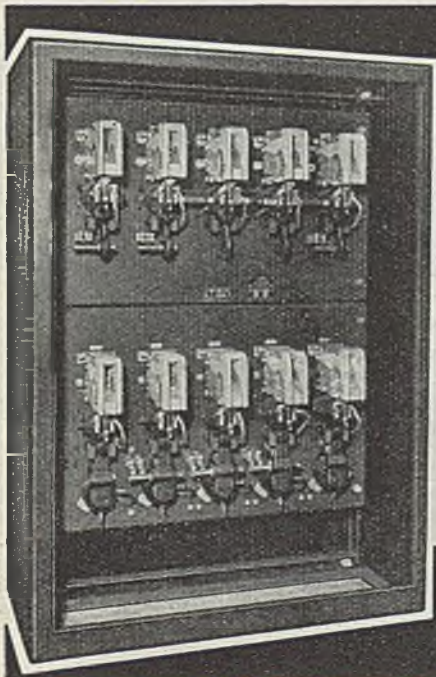
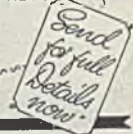
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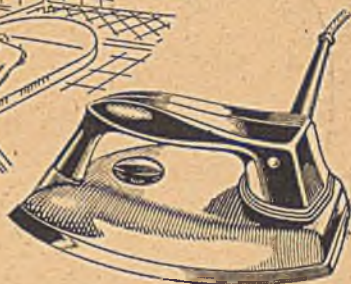
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