

2448 [initials]

THE

19.

ELECTRICIAN

THE TECHNICAL NEWSPAPER OF THE ELECTRICAL INDUSTRY

SIEMENS

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No. 2



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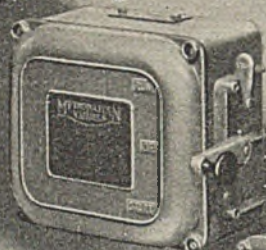
ESTABLISHED 1858

WOOLWICH, LONDON, S.E.18

TELEPHONE: WOOLWICH 2020

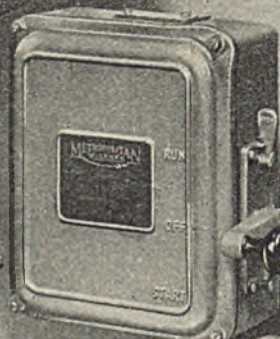
10 JANUARY, 1947
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A good line of AIR BREAK STARTERS



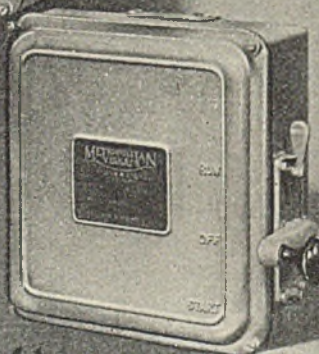
STAR DELTA

ASD. 11
up to 7½ hp.



STAR DELTA

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up to 12½ hp.



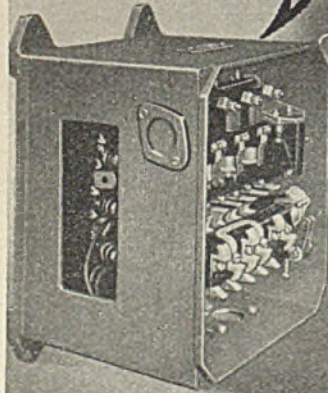
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ASD. 41
up to 25 hp.



AUTO
TRANSFORMER

The AAT. 41
up to 25 hp.



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CO. LTD.
ELECTRICAL
TRAFFORD PARK · MANCHESTER 17.



The well-known, wide range of Air-Break Starters made by Metropolitan-Vickers has now been extended by the addition of the Type AAT 41 Auto Transformer.

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H/A 502

Switch to **METROVICK** when daylight fades



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WITH A WORLD-WIDE REPUTATION

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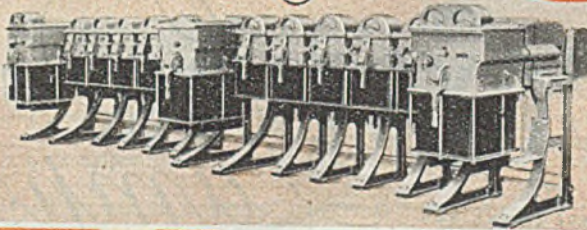


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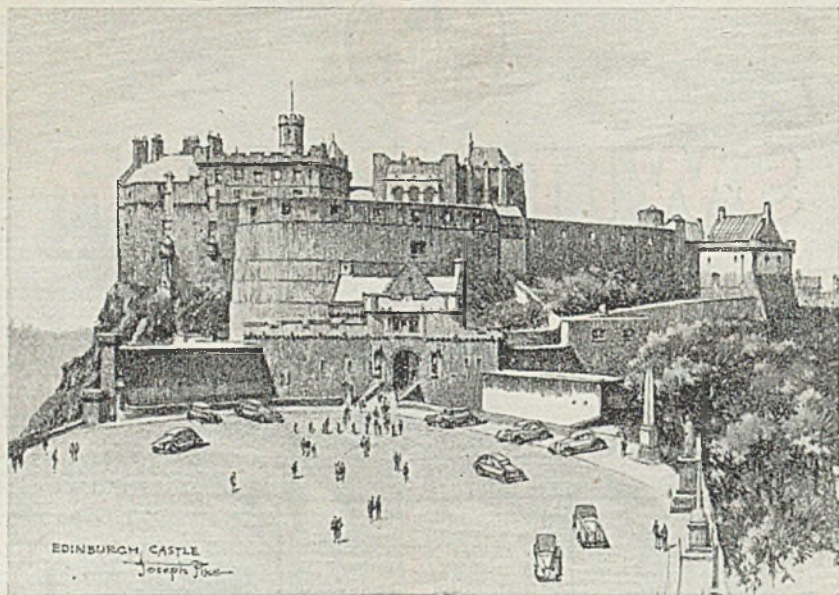
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THE BRITISH THOMSON-HOUSTON COMPANY LIMITED, WILLESDEN, ENGLAND.

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Landmarks of Britain

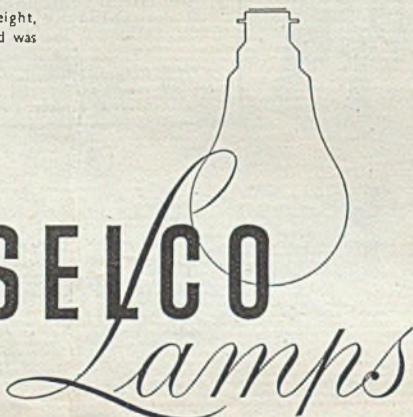


EDINBURGH CASTLE

The Castle stands on a precipitous height, dominating the capital city of Scotland, and was formerly the seat of the Scottish Kings

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Apart from a wood bush at the lower end for the entrance of the cable this box is composed entirely of moulded insulating material with five "knock-outs" provided in a spigoted cap for taking out the cable cores. Available in two sizes and suitable for a range of single to five core cables.

Write for particulars.

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Supply is improving!

It doesn't yet meet the demand—but we are doing all we can to hasten the happy day. There are many factors contributing to the continued shortage, but one by one we are overcoming them and narrowing the gap between order and delivery. *And production is not being achieved at the expense of quality.* In fact, J. & P. have now demobbed "War Emergency" and reinstated full C.M.A. standards—the standards that are acknowledged the world over as the buyer's surest guarantee of reliability.

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J & P are
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have always been
to the fore in the
manufacture of
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cables—
worth remembering!

JOHNSON & PHILLIPS LTD.

Electrical Engineers and Cable Makers since 1875

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The mark that means that "little more" in quality

Introducing

TOTALLY ENCLOSED · FAN COOLED

Fractional H.P. Motors



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SINGLE PHASE	from $\frac{1}{16}$ H.P.-1000 r.p.m. to $\frac{1}{2}$ H.P.-1500 r.p.m.
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VOLTAGES	200/210, 220/230, 240/250 & dual voltage 110-115/220-230
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Cogent

THE GENERAL ELECTRIC CO. LTD

Announces

that Electric Discharge Lamps
previously marketed under their
registered trade mark “**OSIRA**”
and electric lamps previously
marketed under their registered trade
mark “**OSGLIM**” will from
1st JANUARY, 1947

(except for existing stocks) be
marketed under their registered
trade mark —

The logo for Osram, featuring a large, stylized letter 'O' on the left. To the right of the 'O', the word 'sram' is written in a bold, sans-serif font. A thick, dark shadow or underline is cast beneath the entire 'Osram' text, extending to the right.

Announcement of The General Electric Co. Ltd., Magnet House, Kingsway, London, W.C.2



**EVERYTHING
YOU NEED**

This simple, compact service unit incorporates everything you need for the supply intake and control for domestic consumer's installations. The three main components, Supply Intake Chamber, Main Switch Chamber, and Consumers' Fuse Chamber, can be assembled in various formations to suit most requirements.

Write for details.

Complies with E.D.A.
Specification 1627.

HENLEY

CONSUMER'S SERVICE UNIT

W.T. HENLEY'S TELEGRAPH WORKS CO. LTD.

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CHANCERY 6822
GRAMS: HENLETEL, SMITH, LONDON

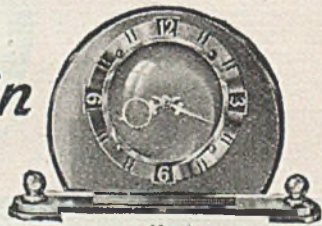


ERICSSON TELEPHONES LTD. 58, KINGSWAY, LONDON, W.C.2

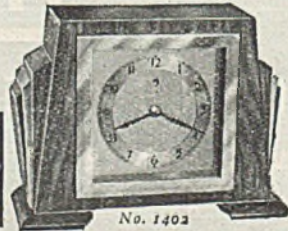
Tele.—HOL. 9336. Works Gwenton, Galls.

It's *TIME* for *TEMCO* again

NOT to the same extent as in the good old days of course, but supplies are improving; so by keeping in touch with your usual wholesaler you will occasionally be able to do some of your customers, and yourself, quite a good turn.



No. 630



No. 1402

TEMCO SYNCHRONOUS ELECTRIC
CLOCKS
The *CURRENT* way of telling the *TIME*

Products of TELEPHONE MANUFACTURING CO., LTD.

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RIPAULTS

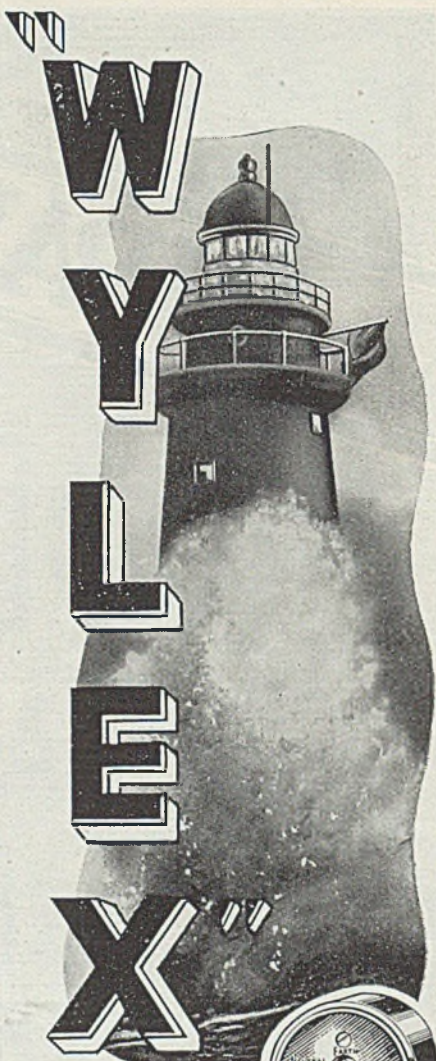
fine range of:-

**DOMESTIC
CABLES AND
FLEXIBLES** /

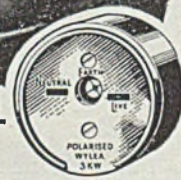
cables

Ripaults Ltd., Southbury Road, Enfield, Middlx.

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WYLEX



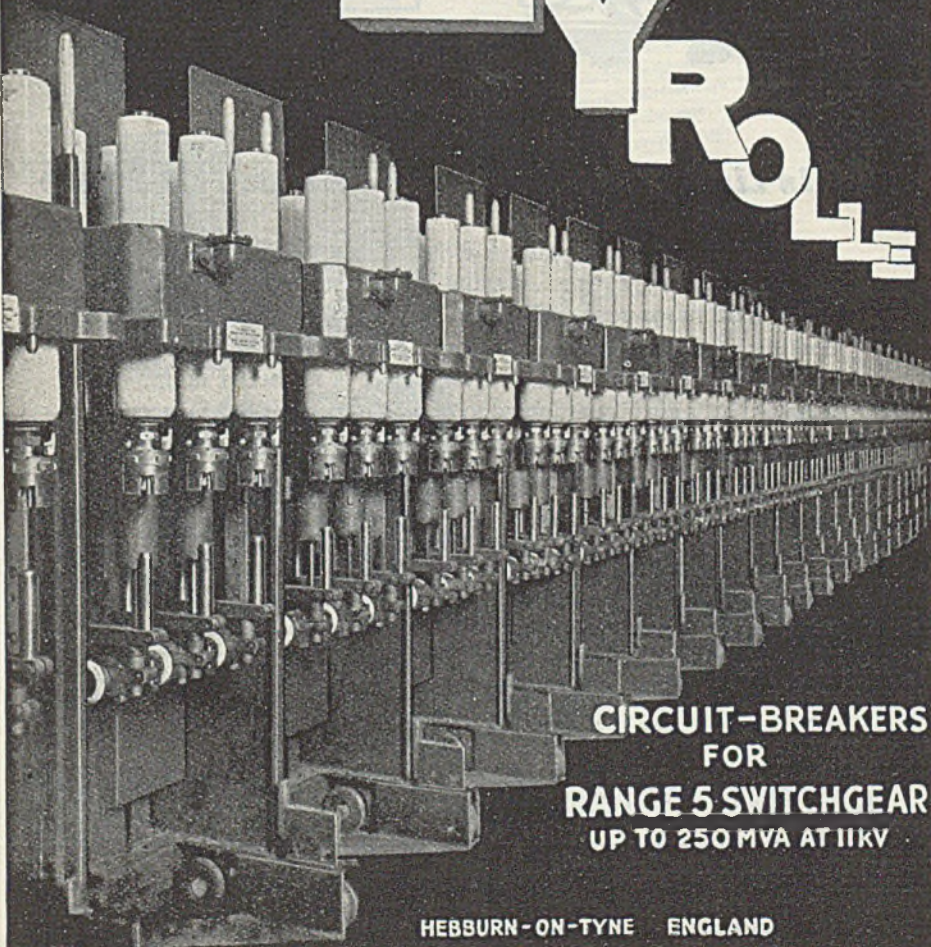
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 for
DEPENDABILITY

'Wylex must be good'

GEORGE H. SCHOLES & CO., LTD.
 Wylex Works, Wythenshawe
 MANCHESTER

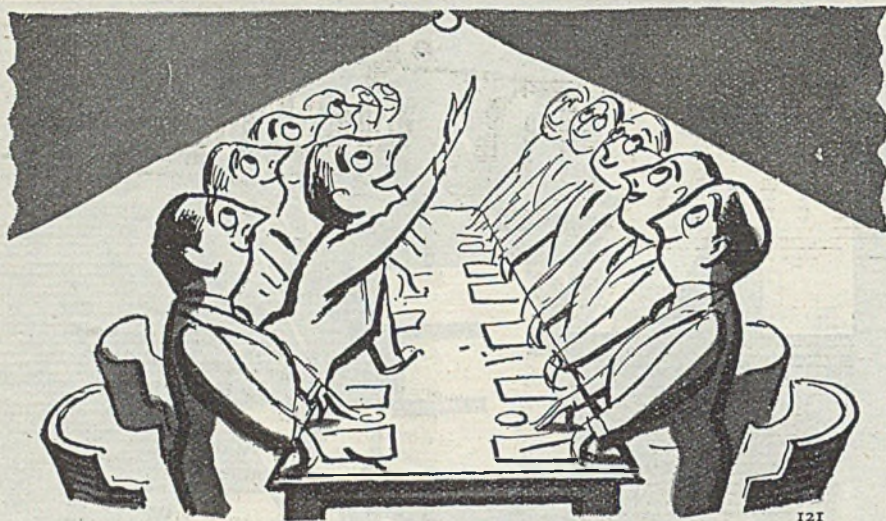
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A NEW LINE
by



**CIRCUIT-BREAKERS
FOR
RANGE 5 SWITCHGEAR
UP TO 250 MVA AT 11kV**

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Atlas lamps preside at many a Board meeting . . . throwing light on important decisions . . . staying bright when speeches get dull! More and more responsible people are choosing Atlas lamps because engineers, electricians and those who take the trouble to check up on light values know that there is no better lamp. Every Atlas lamp is guaranteed to be made to strict B.S.I. specification and is tested at each stage of manufacture. Write for terms today.

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Our lighting engineers will supply you with exactly the lighting you need, exactly where you need it. We design and supply modern fittings, using new materials boldly, yet

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for STAYING POWER



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The New KANGO S-TYPE HAMMER



The new "S" Type Kango Hammer has been introduced to fill an essential need for a light, handy, yet powerful hammer designed to stand up to hard and continuous work within its very useful capacity.

A most important feature of this new "S" type hammer is that owing to its light weight it can be used for all ceiling work where the much heavier hammers are outside the physical capabilities of the workman to operate, furthermore its use will, in the majority of cases, dispense with the elaborate staging that the work usually entails.

SPECIFICATION

Length	- -	19 inches
Weight	- -	12 lbs.
Number of blows		1,550 per min.

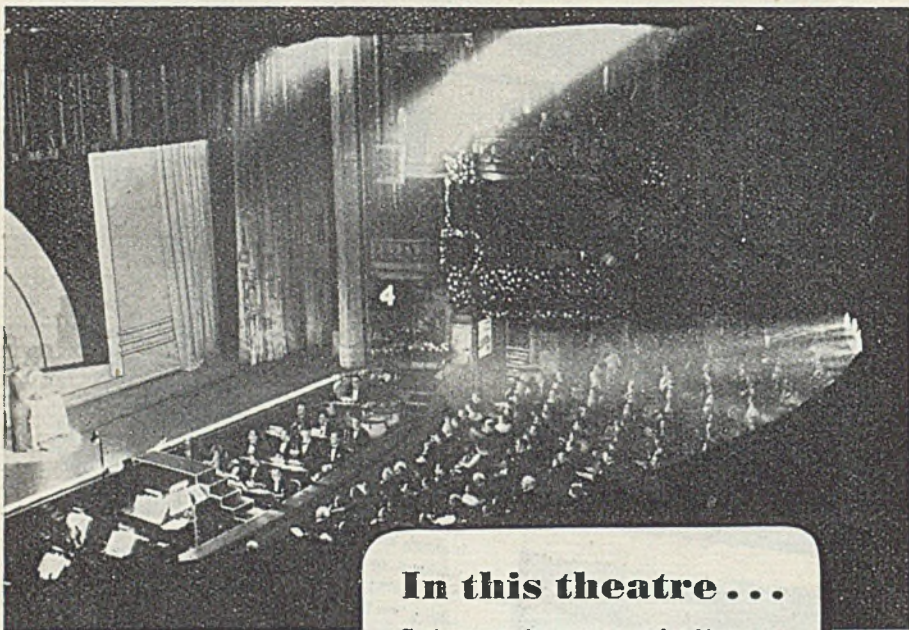
Drilling in Concrete, Depth 2".

No. 6 - 12 Secs.	No. 12 - 23 Secs.
No. 8 - 18 "	No. 14 - 26 "
No. 10 - 21 "	No. 16 - 30 "
	No. 18 - 32 Secs.

The current consumption of the "S" type is less than 360 watts.

For heavier work, either the Kango C or D type Hammers, of which we have good stocks, are recommended.

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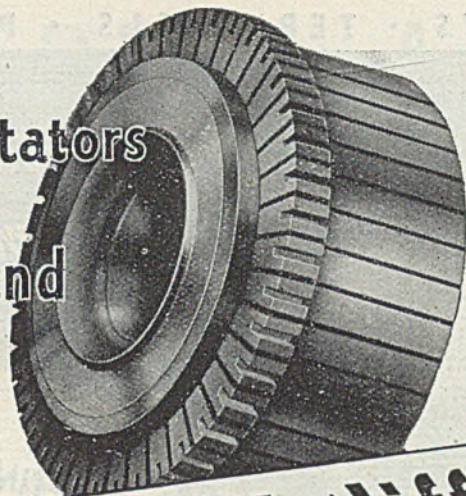
Ashtrays, Lipstick Cases, Flap-jacks, parts of a pair of Opera Glasses, special Containers for Make-up Cosmetics in the dressing rooms, and even materials for the scenic effects themselves, are but a few of the many things made by Wright, Bindley & Gell Ltd. They appreciate the approach already made to them by many firms anxious to obtain supplies and hope the situation will soon be easier.

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A commutator made by Watliff is expertly produced and gives no trouble in service.



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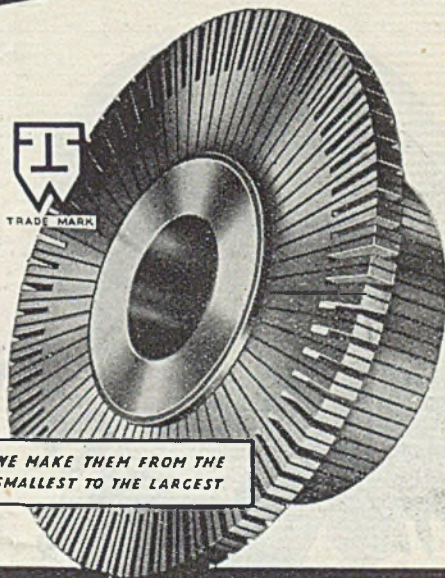
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We have been making commutators and slip rings for over 25 years and are confident that we know our business.



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COOKER DS CONTROL

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E 10

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*Lighter and More Compact, these Sturdy Tools
Speed Fabrication, Assembly and Installation*

Thor

**PORTABLE
ELECTRIC
TOOLS**

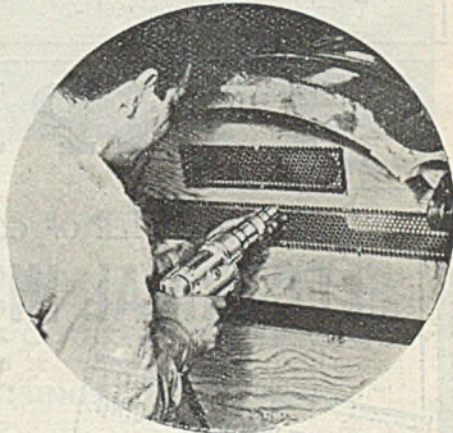
Smaller in size and lighter in weight for greater handling ease, Thor Electric Tools today have high-efficiency motors that provide more power-per-pound than ever before. Virtually impossible to stall, they make short work of tough jobs . . . and *stay on their job* day after day.

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AN AUTOMATIC ADJUSTABLE CLUTCH enables this Thor U16CP Screwdriver to drive screws to uniform tightness at top speed.

Thor

PORTABLE POWER

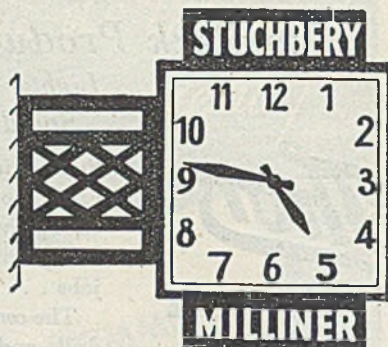
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FOR A.C. OR D.C. SUPPLY**



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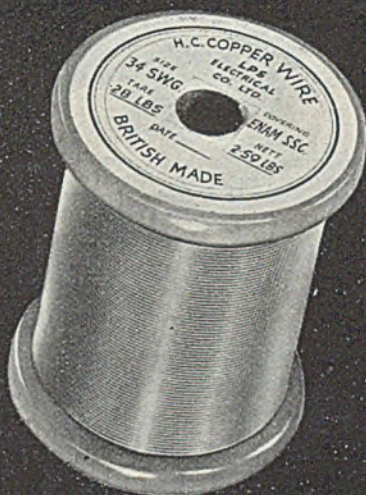
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Manufactured by,

ROTUNDA LIMITED

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Insulated
**WIRES
 AND
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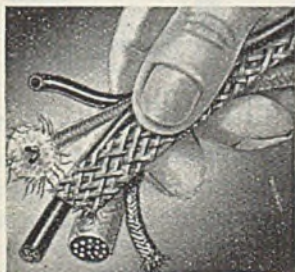


INSTRUMENT WIRES : STRANDS & BRAIDS

TELEPHONE & RADIO CORDS & CABLES

RESISTANCE WIRES : GLASS COVERED CONDUCTORS

4 P.V.C. TUBINGS



LPS *Electrical Co Ltd*

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TELEGRAMS : ENGINEYOR, PHONE, LONDON



Designed by engineers for engineers, the Solon electric soldering iron gives neater, cleaner, more efficient work in less time. The heating element is right inside the bit; giving constant heat at the point—where you want it. All internal connections housed at end of handle away from heat and easy to get at. Complete with 6 ft. of Henley 3-core flexible. Made for the following standard voltages—200/220, 230/250.

Model shown is a standard 125 watt round pencil bit Solon. Other sizes and types available.

Made in England.

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WORKS CO. LTD.
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SOLON
Electric
SOLDERING IRON FOR INDUSTRIAL USE

ZENITH

(Regd. Trade-Mark)

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(British Patent No. 439567)

PROVIDE THE MOST ECONOMIC METHOD FOR ACCURATE A.C. VOLTAGE AND CURRENT CONTROL

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you solve any
Resistance
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Resistances

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G97

10 JANUARY 1947

THE ELECTRICIAN



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Clem
electric iron

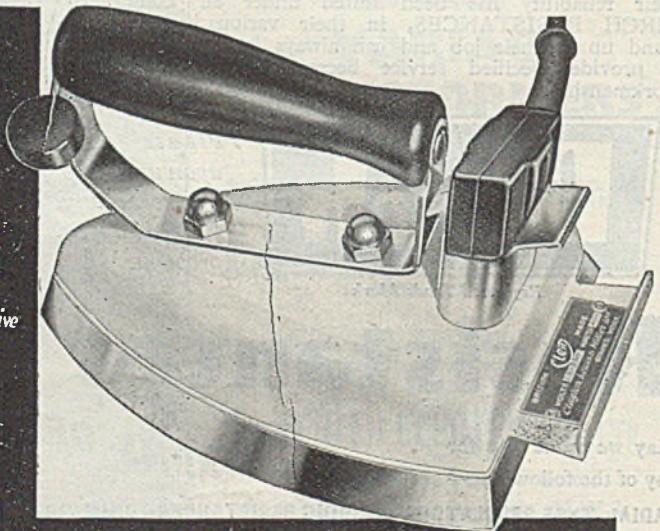
Sturdily built with heavily plated base, moulded handle, & cover, colour enamelled in various attractive shades or heavily nickel plated. Voltage as required 450 watts in each case.

Earth connector.

Approximate weight - 6lbs.

Retail selling
Price 30/-

Supplied through Factors only

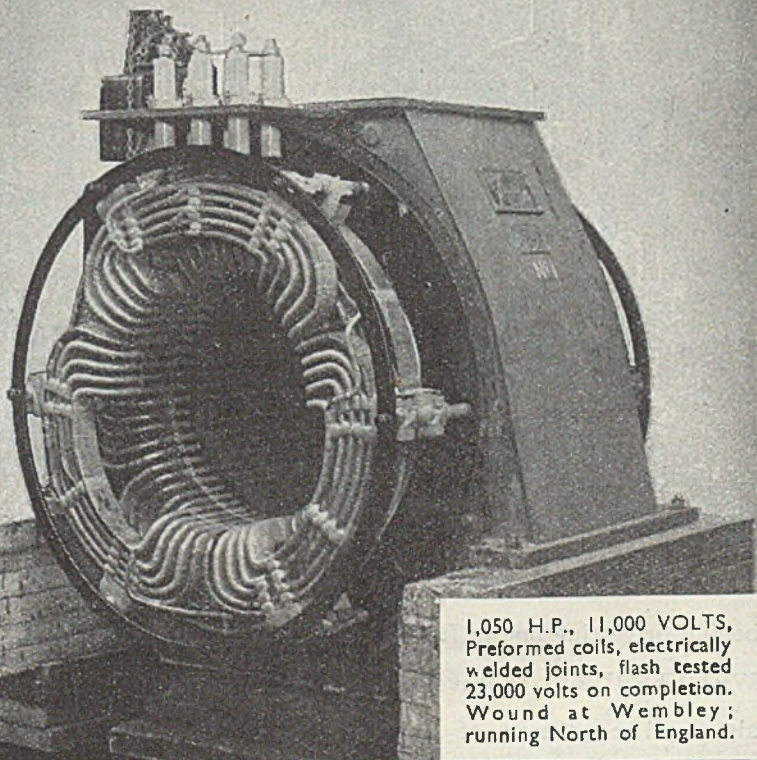


CLAYTON, LEWIS & MILLER, LTD.
CLEM WORKS, MANILLA RD., SOUTHBEND-ON-SEA

REPAIRING

REWINDING

RECONDITIONING



1,050 H.P., 11,000 VOLTS,
Preformed coils, electrically
welded joints, flash tested
23,000 volts on completion.
Wound at Wembley;
running North of England.

DYNAMO & MOTOR REPAIRS LTD.

Wembley Park Works
North End Road
Wembley, Mddx.

Wembley 3121

Phoenix Works
Soho Road
Birmingham

Northern 0898

Up to
the
minute-

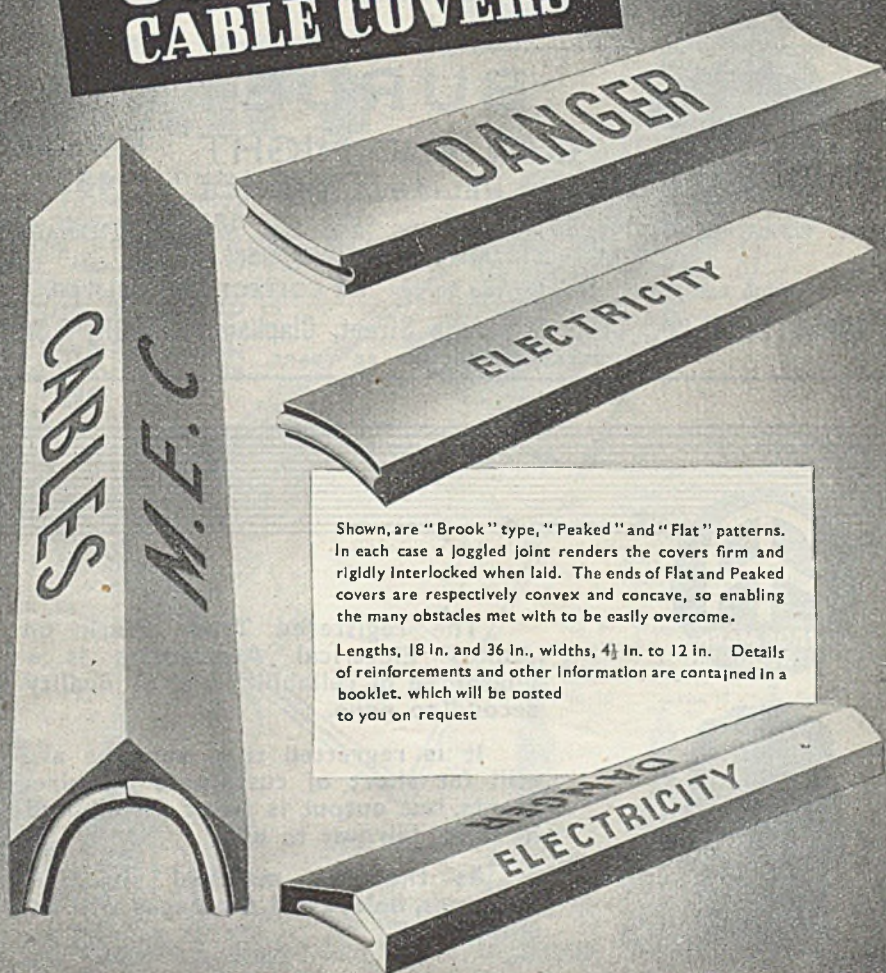


“BIG BEN” is always up to the minute, never falling a step behind or getting one in front. Unlike Big Ben, we at SANDERS—WEDNESBURY, endeavour to be always a step in front, but the abnormal conditions of today unfortunately will not permit us to keep pace with the demand for our products. Shortage of supplies, restrictions, etc. are gradually being overcome—meantime, modifications to existing ranges and entirely new designs are being planned to keep Sanders switchgear, fusegear, sockets, plugs etc., ‘up to the minute.’

WM. SANDERS & CO. (WEDNESBURY) LTD., WEDNESBURY, STAFFS.

VINCULUM

CONCRETE CABLE COVERS




Shown, are "Brook" type, "Peaked" and "Flat" patterns. In each case a joggled joint renders the covers firm and rigidly interlocked when laid. The ends of Flat and Peaked covers are respectively convex and concave, so enabling the many obstacles met with to be easily overcome.

Lengths, 18 in. and 36 in., widths, 4½ in. to 12 in. Details of reinforcements and other information are contained in a booklet, which will be posted to you on request.

TARMAC LTD. VINCULUM DEPT.
 ETTINGSHALL · WOLVERHAMPTON · TELEPHONE BILSTON 41101/8


MOTORS



from
STOCK

CITY ELECTRICAL
LONDON

EMERALD STREET, LONDON, W. C. 1. TELEPHONE HOLBORN 5722.



- DURATUBE
- DURASTRIP
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- DURATWINTAPE
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- DURATHREEFLEX
- DURATHREECABLE
- DURATWINCABLE
- DURATWINFLAT
- DURATHREEFLAT
- DURAWIRE
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Sole Manufacturers:
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BURDETTE

DAY AND NIGHT **MACaulay**
FOR RELIABLE SERVICE **4555**

WE REPAIR, REWIND, AND REDESIGN A.C. AND D.C. MOTORS, ALTERNATORS
 ROTARY CONVERTERS AND CONTROLLERS.

Nothing too Small. Nothing too Large. WE COLLECT AND DELIVER.

BURDETTE & CO., LTD., Stonhouse Street, Clapham, LONDON, S.W.4
 ESTABLISHED OVER 35 YEARS.




The registered Trade Mark on Ashley Electrical Accessories is a guarantee of reliability and of quality second to none.

It is regretted that supplies are still far short of customers' requirements, but output is being distributed in strict fairness to all.

As the raw material situation improves, delays and shortages will be eliminated.

ASHLEY ACCESSORIES LTD

MANUFACTURERS OF ELECTRICAL ACCESSORIES
 ULVERSTON · LANCASHIRE

Shockproof **NETTLE**

INSPECTION LAMPS

ALL PATTERNS COMPLY STRICTLY WITH HOME OFFICE REGULATIONS WITH REGARD TO PROTECTION AGAINST ELECTRIC SHOCK. NO NIPPING OF FLEXIBLE IS POSSIBLE AND NO EARTHING OF GUARD IS NECESSARY. CAN BE SUPPLIED WITH EDISON SCREW HOLDERS OR FOR THREE PIN LAMPS.

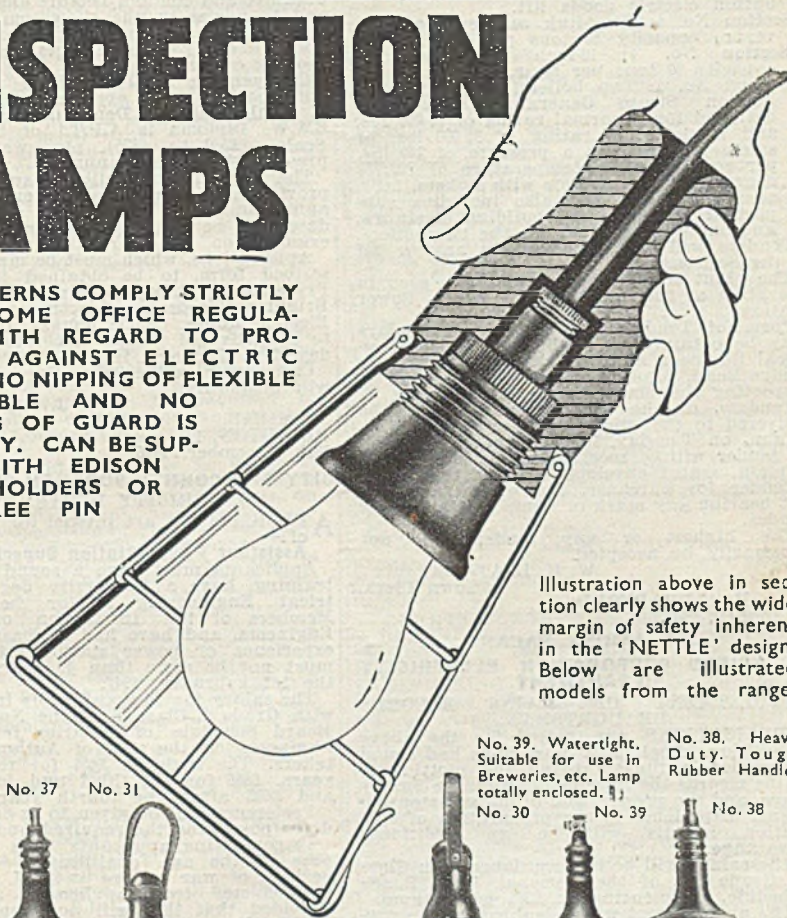


Illustration above in section clearly shows the wide margin of safety inherent in the 'NETTLE' design. Below are illustrated models from the range.

No. 33 Width 3 1/2 in. For use where space is restricted.

No. 37. All-insulated. For use near Switch-gear, Electric motors, etc.

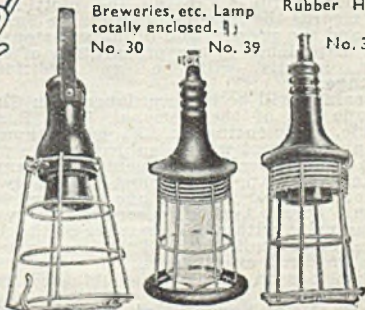
No. 39. Watertight. Suitable for use in Breweries, etc. Lamp totally enclosed. No. 30

No. 38. Heavy Duty. Tough Rubber Handle. No. 38



No. 31. Reflector Type.

No. 30. Standard Type. Construction as shown above.



VICTOR H. IDDON *Ltd.*

HARPER ROAD
WYTHENSHAW
MANCHESTER

MISCELLANEOUS ADVERTISEMENTS

TENDER

CITY OF BRADFORD.

BOILERS, ETC., FOR DISPOSAL.

THE Electricity Committee of the Bradford Corporation invite tenders for the purchase and removal of—

Section No. 1: Coal bunker, supporting steel-work, etc.

Section No. 2: 10-cwt. fully-automatic push-button electric goods lift.

Section No. 3: Drag-link scraper coal conveyor; capacity 50 tons per hour.

Section No. 4: 18-inch belt conveyor; capacity 70 tons per hour.

Section No. 5: Two boilers, made by Combustion Steam Generator, Ltd., each designed for a normal rating of 80 000 lbs. and a maximum rating of 96 000 lbs. of steam per hour, at a pressure of 240 lbs. per sq. in. and a temperature of 720/750 degrees Fahr.; complete with stokers, fans, auxiliaries, etc., and also including supporting steelwork and building steelwork, and one steel chimney for the two boilers. Tenders will be considered for any or all of the Sections.

The plant can, by appointment, be seen in operation at the Corporation's Valley Power Station.

Form of Tender and further particulars may be obtained on application to the Electrical Engineer and Manager, 45 to 53, Sun-bridge Road, Bradford, to whom all enquiries respecting the plant should be addressed.

Tenders, on the forms provided, must be delivered to the undersigned not later than 10 a.m. on Tuesday, 18th February, 1947, and no tender will be received unless enclosed in a plain, sealed envelope bearing the words "Tender for purchase, etc., of Boilers," but not bearing any mark or name indicating the sender.

The highest or any tender will not necessarily be accepted.

W. H. LEATHEN,

Town Clerk.

Town Hall, BRADFORD.

January, 1947.

SITUATIONS VACANT

SHEFFIELD CORPORATION ELECTRICITY DEPARTMENT.

APPOINTMENT OF MAINS RECORDS DRAUGHTSMAN.

APPLICATIONS are invited for the above position. Applicants must have had sound experience in the surveying and plotting of mains records, the revision of Ordnance Survey Maps, and the preparation of mains extension plans. Experience in the preparation of sub-station layouts will be an additional advantage.

The salary will be in accordance with Class M, Grade 10b, of the National Joint Board Schedule, commencing at £381 per annum.

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

Applications on forms to be obtained from the undersigned are to be returned to me not later than Monday, 3rd February, 1947, accompanied by copies of not more than three recent testimonials.

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

JOHN R. STRUTHERS,

General Manager and Engineer.

Commercial Street,
SHEFFIELD, 1.

SITUATIONS VACANT

BRIGHTON CORPORATION ELECTRICITY DEPARTMENT.

Electric House, Castle Square, Brighton, 1.

APPOINTMENT OF CHIEF DEMONSTRATOR.

APPLICATIONS are invited from candidates of good education and training for the position of Chief Demonstrator.

Candidates must hold either the Diploma or the Certificate for Electrical Housecraft of the E.A.W. They must be competent to organise and conduct Lecture Demonstrations and to advise in the showroom or on consumers' premises on the selection and use of domestic electrical appliances and commercial cooking apparatus.

Commencing salary will be according to qualifications and experience. The grading of a fully qualified Demonstrator holding the E.A.W. Diploma is A.P.T.1 of the National Scales (£530 to £375), plus war bonus, at present £48 2s. per annum.

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

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

Canvassing, either directly or indirectly, will disqualify.

J. G. DREW,

Town Clerk.

Town Hall,

BRIGHTON, 1.

30th December, 1946.

CITY AND COUNTY BOROUGH OF BELFAST. ELECTRICITY DEPARTMENT.

APPLICATIONS are invited for the position of—

Assistant Power Station Superintendent.

Applicants must have a sound engineering training, have a University degree in Electrical Engineering and/or be Corporate Members of the Institution of Electrical Engineers, and have had at least five years' experience of power station practice. They must not be more than 40 years of age on the 1st February, 1947.

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

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

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

Applications must be made on official forms, which can be obtained from the City Electrical Engineer and General Manager, Electricity Department, East Bridge Street, Belfast, and, with copies of not more than three recent testimonials, should reach the Town Clerk, City Hall, Belfast, not later than 4 p.m. on Friday, 24th January, 1947.

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

JOHN DUNLOP,

Town Clerk.

City Hall, BELFAST.

3rd January, 1947.

FIRST-CLASS Electrician wanted, used to installation work. Permanent post for right man. Apply—R. J. Kemp and Co. Ltd., Coalville, near Leicester.

SITUATIONS VACANT
BOROUGH OF GRAVESEND.
GENERATION SUPERINTENDENT.

APPPLICATIONS are invited from Corporate Members of the I.E.E. and/or Corporate Members of the I.Mech.E. for the above position. Membership of the Institute of Fuel will be a recommendation. The position is Class "F," Grade 3, carrying a salary of £640-£667 per annum, and the successful applicant will be required to contribute to the Council's Superannuation Scheme.

Applicants should preferably be under 45 years of age and have had a thorough training and a varied experience in the operation of steam raising and electrical generating plant in a Selected Power Station.

The Gravesend Selected Power Station has a capacity of 13 500 Kw's with steam at 200 lbs./sq. in., and generation at 6 600 v. A programme of modernisation is in hand and two shift running is usual.

Applications, giving details of training and past work and present position, together with copies of any testimonials, should be sent to the undersigned before Friday, 31st January, 1947.

G. V. HARRAP, A.M.I.E.E., A.I.Mech.E.,
 M.Inst.F.,
 General Manager and Engineer.

BOROUGH OF GRAVESEND.
DISTRIBUTION SUPERINTENDENT.

APPPLICATIONS are invited for the above position from Corporate Members of the I.E.E. The position is Class F, Grade 3, with a salary of £640-£667 per annum, and the successful applicant will be required to undergo a medical examination and participate in the Corporation's Superannuation Scheme.

Applicants should preferably be under 45 years of age, and must have had experience on E.H.V. and L.V. A.C. and D.C. mains, on rotary and rectifier plant, and on the construction and operation of Sub-stations, overhead lines and underground networks.

The Gravesend system handles about 50 million units per annum, and has 44 Sub-stations with another 12 Sub-stations under construction. The present maximum demand is approximately 14 000 Kw's and industrial loads comprise about half the consumption of electricity to the 16 000 consumers.

Applications giving details of training and past work and present position, together with copies of any testimonials, should be sent to the undersigned before Friday, 31st January, 1947.

G. V. HARRAP, A.M.I.E.E., M.Am.I.E.E.,
 M.I.B.A.E.,
 General Manager and Engineer.

CITY OF PLYMOUTH EDUCATION
COMMITTEE.

PLYMOUTH AND DEVONPORT TECHNICAL
COLLEGE.

Principal: A. R. Boeree, M.A., B.Sc. (Oxon),
 F.I.C.

APPPLICATIONS are invited for (a) the post of lecturer in Chemistry; (b) the post of lecturer to teach Electrical and/or Civil and Mechanical Engineering. A good honours degree of a British University and teaching and industrial experience are desirable. Salary will be paid according to the Burnham Technical Report. Further particulars and application form (which should be returned within two weeks of the appearance of this advertisement) may be had from

ANDREW SCOTLAND,
 Director of Education,
 Cobourg Street, Plymouth.

EXPERIENCED DRAUGHTSMEN required for electric cookers and water heating appliances. Applications to—South Wales Switchgear, Ltd., Blackwood, Mon.

SITUATIONS VACANT
WOLVERHAMPTON AND STAFFORDSHIRE
TECHNICAL COLLEGE.

Principal: W. E. Fisher, O.B.E., D.Sc.
APPPLICATIONS invited for appointment as Senior Assistant in Electrical Engineering. Salary £600 to £750 per annum with additions for recognised training. Applicants should be graduates with appropriate teaching and industrial experience. Research experience an advantage. Further particulars obtainable on application within 10 days of this advertisement from

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

20th December, 1946.

SOUTHEND-ON-SEA CORPORATION
ELECTRICITY DEPARTMENT.

APPPOINTMENT OF TESTING ENGINEER.
APPPLICATIONS are invited for the above appointment from Engineers under 35 years of age who possess the minimum qualification of Graduateship of the I.E.E. or the Higher National Certificate in Electrical Engineering. The successful applicant will be responsible to the Sub-stations Superintendent for testing protective gear, fault location, oil testing, etc.

The salary will be in accordance with Class F, grade 8A, of the N.J.B. Schedule, commencing at £413 per annum. (Re-classification to Class G is now under consideration and will be decided before the appointment is made.) The appointment will be subject to the Local Government Superannuation Act, 1937, and the person selected will be required to pass a medical examination.

Applications giving full details of training and experience, accompanied by copies of two recent testimonials and endorsed "Testing Engineer," to reach the Borough Electrical Engineer and Manager, Electric House, London Road, Southend-on-Sea, not later than 20th January, 1947.

Canvassing with disqualification.
 ARCHIBALD GLEN,
 Municipal Buildings, Town Clerk.
 SOUTHEND-ON-SEA.
 December, 1946.

COUNTY BOROUGH OF BLACKBURN.

APPPLICATIONS are invited from Corporate Members of the Institution of Electrical Engineers for the position of CHIEF ENGINEERING ASSISTANT in the Electricity Undertaking. The conditions of employment will be as prescribed by the National Joint Board, and the salary will be in accordance with Grade 2, Class H, at present £806 per annum. An additional sum will be paid to the person appointed at the discretion of the Council, as a temporary measure, in respect of extensions to the Power Station, which will extend over the next three years. The appointment will be subject to the provisions of the Local Government Superannuation Act, 1937.

Applicants must have had a sound training, possess good technical qualifications, and have a wide experience in the construction, maintenance and operation of the various sections of modern supply undertakings operating Selected Power Stations. Applications from engineers who have gained an extensive knowledge in the design and constructions of Power Stations will be specially considered.

Applications, stating full details of training, experience and qualifications, together with copies of three recent testimonials, to be delivered to R. H. HARRAL, Esq., M.I.E.E., Engineer and Manager, Electricity Offices, Jubilee Street, Blackburn, in an envelope endorsed "Chief Engineering Assistant," by 18th January, 1947.

CHAS. S. ROBINSON,
 Town Clerk.

MANOR ELECTRIC COMPANY

53, Victoria Street, London, S.W.1
Tel.: Abbey 1782

ELECTRICAL ENGINEERS

Manufacturers of
HOSPITAL FOOD TROLLEYS,
IMPREGNATING OVENS, Etc.

Also Apparatus to Customers' own specifications

immediate delivery!



TEXOLEX TUBES IN LAMINATED
FABRIC OR PAPER BASE

THE BUSHING CO. LTD.
HEBBURN-ON-TYNE

FRY'S

**ALCHO-RE
SOLDERING FLUX**

non-corrosive: for electrical work

Write for sample

FRY'S METAL FOUNDRIES LTD.,
Tandem Works, Merton Abbey, London, S.W.19

SITUATIONS VACANT

TRANSFORMER Technical Sales Engineer. Internal appointment, tendering and correspondence, static transformers and allied apparatus; conversant association requirement, Single man (25-30) suggested due housing difficulty; 5-day week, pension scheme. Particulars and salary required to HTC please.—British Electric Transformer Co., Ltd., Hayes, Middx. (Tel. Hayes 1954).

GENERAL Manager, with mechanical and electrical qualifications, required for responsible position by Engineering firm of National repute, West Riding of Yorkshire. Applicant should have Public School or University education and must previously have had complete executive responsibility for not less than 500/1 000 employees, and been in receipt of four figure remuneration. Apply in writing, with full particulars, in confidence, to Williamson, Butterfield and Roberts, Chartered Accountants, 2, Darley Street, Bradford.

JOINTERS required for work in Persia.— Suitable applicants would be placed on a year's contract with good salary and accommodation found.—Apply Box LDH. "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4.

NOTICES

G.  R.

By Order of the Minister of Supply.

BAINTON, NORTHAMPTONSHIRE,

10 Miles from Peterborough, 5 Miles from Stamford.

For Sale by Auction without reserve on 29th January, 1947, at 10 a.m.

PLANT, EQUIPMENT, and Miscellaneous Stores.

Including:—

Portable Forges, Saltbath Furnaces, Metal-electric Furnaces, Electric Air Dryers, Gas Boosters with Motors, Rotary Pumps, Washing Machines, Hydro Washing Plants, Screw Presses, Powder Mixing Machines, Painting Ovens, Vacuum Boilers, Etching Machines, Electric Cable and other electric and radio equipment, copper and steel wire, oil seals, a very large quantity of Nuts, Bolts, Rivets, Screws, and split pins, Paint, Rust Preventives and Varnish, Tarpaulins, Oilskins and Anti-Gas Clothing, small tools, and many other items too numerous to mention.

At the Ministry of Supply Depot, No. 91, Bainton, Northants.

Peterborough (L.N.E.) 10 Miles, Stamford (L.M.S.) 5 Miles, Tallington 2 Miles, Essendine 7 Miles.

On view Thursday and Friday, January 23rd and 24th, and on Monday and Tuesday, January 27th and 28th, 1947, from 11 a.m. to 4 p.m.

Admission by Catalogue only (price 1s.), obtainable from the Auctioneers, Messrs. Richardson, 15, Barn Hill, Stamford, Lines (Phone: Stamford 3315).

G.  R.

By Order of the Minister of Supply.

WITHOUT RESERVE.

ASHCHURCH, GLOS.

(Within 2 miles of Tewkesbury and 7 of Cheltenham.)

Sale by Auction of about 26 000 TYRES and wheel assemblies.

4 500 INNER TUBES.

2 000 GENERATING UNITS, Petrol and Diesel driven, from 110 to 125 volts, and from 5 to 30 kilowatts.

A LARGE QUANTITY OF MEDICAL EQUIPMENT, including Stretchers,

Bedside and other Tables. Enamel Instrument Tables, Stands, Chairs, etc. Miscellaneous RUBBER AND CANVAS HOSE and FITTINGS.

A very large, and varied, assortment of CARPENTER'S, BLACKSMITH'S, ENGINEER'S, and ELECTRICIAN'S TOOLS, stores, etc.

Auctioneers: BRUTON, KNOWLES AND CO.

in conjunction with GEORGE HONE.
SALE DAYS: TUESDAY, WEDNESDAY, THURSDAY and FRIDAY of each week.
JANUARY 28th, 29th, 30th, 31st.
FEBRUARY 4th, 5th, 6th, 7th, FEBRUARY 11th, 12th, 13th, 14th, 1947. at 11 o'clock punctually each day.
VIEW DAYS: THURSDAY, FRIDAY AND SATURDAY, January 23rd, 24th, 25th, and MONDAYS, JANUARY 27th, and FEBRUARY 3rd and 10th, 1947.
From 10 a.m. to 3 p.m., and on Sale Days from 9 a.m. to 10.30 a.m.

CATALOGUES, price 6d. each, may be had of the Auctioneers: Bruton, Knowles and Co., Albion Chambers, Gloucester (telephone Gloucester 2267), or George Hone, Tewkesbury (telephone Tewkesbury 10).

Admission will be by catalogue only.

FOR SALE

WE have for immediate disposal a large quantity of New Insulating Sleeving (mainly Vidaflex) in various sizes. Discounts up to 40 per cent. allowable off current prices for bulk purchases.—Thornley and Co., 82, Hoylelake Crescent, Ickenham, Middlesex.

D.C. Higgs Motors, one 15 h.p., with starter, £22 10s.; one 10 h.p., ditto, £15.—Ryland, 150, Moseley Road, Birmingham, 12.

D.C. Exhaust Fans: Keith Blackman, type S, 8 in. outlet, 15 h.p., 220 v.; Sturtevant No. 6, 10 in. outlet, 12 h.p., 220 v.; Sturtevant No. 6, 10 in. outlet, 10½ h.p., 220 v.; Sturtevant No. 3, 7 in. outlet, 4½ h.p., 220 v.; Keith Blackman, type S, 8 in. outlet, 6½ h.p., 440 v.—S. C. Bilsby, Crosswells Road, Langley Green, near Birmingham.

ONE 8-h.p. totally enclosed Vertical Fan Motor, Lancashire Dynamo make, for 200 v., 2-ph., 50 cys., at 950 r.p.m. with starter complete. Ex stock.—H. J. H. King and Co. Ltd., Newmarket Engineering Works, Nailsworth, Glos.

5 000 GOOD strong Crates, inside measurements 29 in. by 9½ in. by 2½ in., ½ in. thick, battened all round, at 1s. 9d. each, ex works.—L. Goldser and Sons, 14a, Rectorv Square, London, E.1 (Tel.: Stepney Green 2550).

600-w. and 750-w. Spiral Elements, large quantities ex stock, competitive prices, 5d. and 6d. each respectively.—Middlesex Electron Co. Ltd. (Molesey 3541).

SECTIONAL timber buildings.—Completely reconditioned and equal to new. Sizes: 6 ft. by 6 ft., 16 ft. by 8 ft., 20 ft. by 12 ft., 36 ft. by 17 ft., 52 ft. by 20 ft., 60 ft. by 16 ft., 6 in. Nissen types: 90 ft. by 30 ft., 95 ft. by 35 ft., and others. Suitable for offices, canteens, workshops, classrooms, hostels, and bungalows. No purchase licence required. Offered subject to being unsold.—D. McMaster and Co., Mount Bures Works, 21c, Bures, near Colchester, Essex. Tel.: Bures 351/2.

FREE Elements.—Good quality, pencil type. Wound nichrome wire, 9½ in., 1 kW., 48s. dozen; 500 lots, 3s. 7d. each; 1 000 lots, 3s. 6d. each; 5 000 lots, 3s. 3d. each, 8 in., 750 w., 42s. dozen; 500 lots, 3s. 1d. each; 1 000 lots, 3s.; 5 000 lots, 2s. 9d. Quotations for other sizes. Immediate delivery all sizes. Carriage paid 500 and over, otherwise 4s. 2d. per 100 extra. Samples 5s. each.—The Welleo General Supplies, Knebworth, Herts.

DOMESTIC Plant, 100-v. set, 54 cells, all good order. Inspection.—Henley House, Chelsham, Upper Warrlingham, Surrey.

SOCKETS

3 PIN, 5 AMP, SHUTTER
Available in good quantities

COMPACT BALLAST UNITS
including strikers

TENATHERAM SOIL HEATERS

FULL LIST ON REQUEST

J. RIVLIN

16/17, BRUNSWICK STREET, LEEDS, 2

Telephone 21515

Makers of Synthetic
RESIN PAPERS
(IMPREGNATED AND COATED)



SAMUEL JONES & CO. LTD

16-17 NEW BRIDGE STREET, E.C.4
PHONE: CENTRAL 6500

REWINDS

MOTORS, GENERATORS, TRANSFORMERS
ALL SIZES WITH THE MINIMUM DELAY

FOR EFFICIENT SERVICE WIRE

"PORTER," LINCOLN

**PENNEY & PORTER (1932) LTD.,
LINCOLN**

Grams: Porter.

Phone: 1706/7.

TRANSFORMERS & CHOKES

A FEW POPULAR SELECTIONS

T/56. Replacement mains transformer incorporating both 4v. and 6.3v. windings. 100 ma.	21/.
TS/7. Multi ratio output transformer, centre tapped.	5/.
TC/15. LF Choke. 420 ohms., 60 ma.	4/9

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ASK FOR TRADE LIST

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Rockman SOLDER GUNS

For all
Industrial
purposes



The Gun
with the
Guarantee

- Minimum Heat Loss
- Maximum Efficiency
- Perfect Balance — Effortless Operation
- Savings in Power and Labour

Rockman

ENGINEERING CO. LTD.

16-18, Russell Street, MANCHESTER, 1

FOR SALE

WE have for immediate disposal the following materials surplus to our requirements.—Black Oiled Silk, 12 in. sq. 394. Yellow Varnished Silk, 5 in. by .006 in. Black Varnished Silk, 1.13/16 in. by .006 in. Yellow Varnished Silk, 1.13/16 in. by .006 in. Varnished Silk Sq. 394, 1.15/16 in. by .006 in. Varnished Silk, 10 m/m by .0025 sq. 394. All the above are brand new and are offered at considerably less than market prices to clear.—Leightons (Contractors), Ltd., 10, Chandos Street, London, W.1. Tel.: Langham 3704.

“COLD NIGHTS.”—“Snug” new improved Electric Bed-Warmer; lasts a lifetime; no leaks, simple, safe and effective; complete with flex; thousands in use; sample carriage paid; price 16s. inc. P.T.—Wycomware Ltd., 39, Piccadilly, Manchester, 1.

HALF GROSS Arcoelectric Time Lag Switches One way 5 amp. S/Recessed less Blocks. Bakelite. Boxed and Sealed (New) 12s. each. Retail 18s. 9d. Two Table Model “Pira” Infra-Red Lamps, £5 15s. each. No Tax. 1 Floor Model (ditto), all 230/50 volts. A.C., £9 9s. New and guaranteed.—E. A. Porritt, 15 and 27, Wastdale Road, Forest Hill, S.E.23.

SWITCH BLOCKS.—Round I.W. and W.E. Swell finished in best quality hardwood. 3½ in. by ½ in., 48s. gross; 3 in. by ½ in., 45s. gross. 2½ per cent. discount. Carriage paid.—Eli Mfg. Co., Sansone Place, Worcester.

BUS-BARS, 1350. 12 ft. sections, 3-phase neutral Bus-Bar Chambers, complete with connectors. MERCURY VAPOUR LAMPS.—50 complete, as new, with chokes and condensers, 400-watt bulbs. DUAL FITTINGS WITH SHADES.—100 as new complete less chokes and condensers. FLUORESCENT LIGHTING.

—100 Twin 5 ft. Tube Fittings, complete with chokes and condensers, and tested, less tubes.—Apply: C. J. Rice, 137, Mayplace Road West, Rexheath, Kent. Phone: Rex. Heath 3282.

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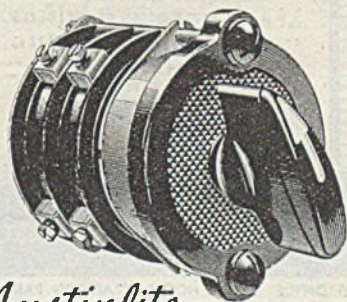
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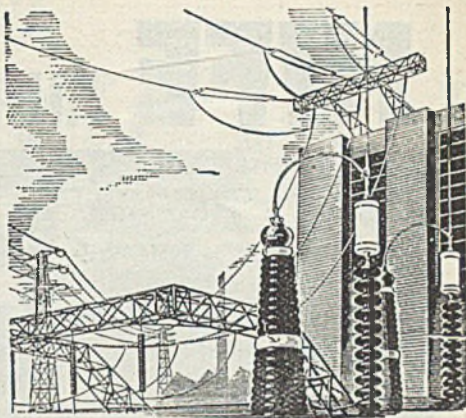
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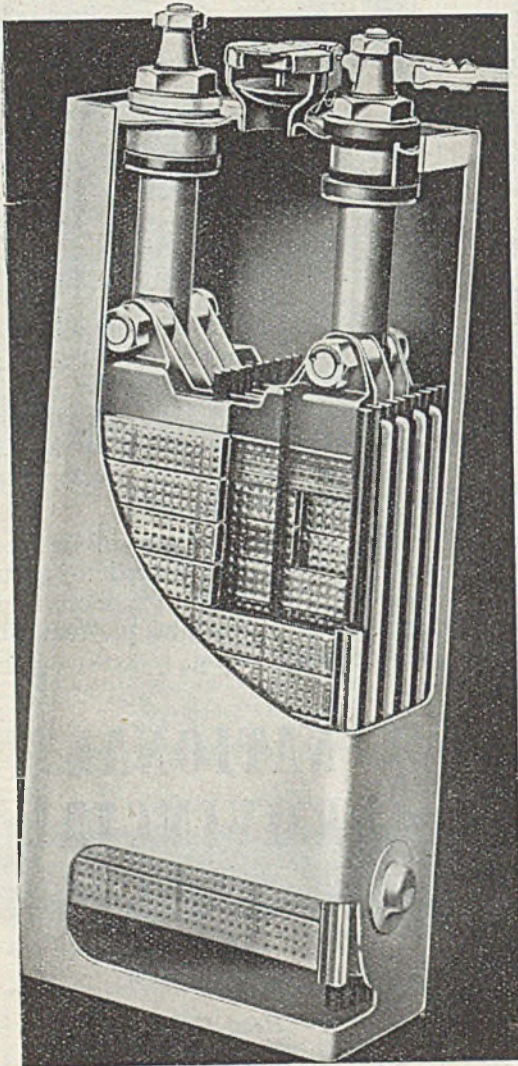
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Coal Chaos

WHATEVER the political opinion, there can be no one in the electricity supply industry who does not hope that the altered conditions in the coal industry will do something to bring about the production of more coal. The celebrations of the miners in attaining their alleged ambition of nationalisation of the coal-fields are at an end and the electricity supply industry, as one of the biggest consumers of coal, now looks for results. Various authorities have expressed alarm at the rate at which they are required to draw upon their stocks, many industrial organisations in and out of the electrical field are hard pressed to keep their works going, and with the cold spells which must be expected to occur up to the end of March to cause a rise in the electrical demand, the prospect is such that only an immediate response to the appeal for a bigger coal output will avoid disaster.

Last minute efforts to avert stoppages in industrial production are having to be made by rushing emergency supplies of coal hither and thither, all but a few basic industries are being compelled to reduce consumption by 5 or even 10 per cent., and a slowing down of the rate of production in the next months seems inevitable. In the circumstances, the histrionics staged in connection with the transfer of the mines to national ownership appear uncalled for, and with the country in so earnest a plight are suggestive of a lack of appreciation of the seriousness of the industrial position.

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In the week ended December 28 last—that is, a week during which the industrial load was appreciably lighter than usual—the amount of coal consumed in electrical generation increased by 38.3 per cent. compared with the corresponding week of the year before, representing 596 000 tons. Bearing in mind the published figures of recent coal output, this increase, which is by no means the lowest which may be anticipated, shows how great is the demand of the supply industry and how serious is the responsibility of the National Coal Board to see that the demand is satisfied before electricity generation, starved of its raw fuel, is unable to keep the wheels of industry turning.

Action Better than Words

IN their broadcast last week, members of the Coal Board spoke of their intention to mechanise the mines, to use electrical machinery, electric locomotion and the like, but before any of these things can come about, the equipment to make them possible must be made—and made, let it be understood, in those works which are at the moment being kept going only by hand to mouth supplies of both coal and power. If the Ministry of Fuel, the Coal Board and the miners themselves, mean what they say—actions are more convincing than words, and coal most convincing of all.

Protection of Installations

THE views expressed by "Supervisor" in this journal are invariably responsible for promoting discussion, and so provocative was his contribution to the issue dated September 6 last, that some of our friends in Australia have taken up the challenge. The reason for this ventilation of opinion is that "Supervisor" has in past issues championed the cause of earth leakage circuit breakers in preference to M.E.N., and he has not gone far before meeting views not altogether in agreement with his own. There was published in last week's issue a letter from Melbourne on the subject and this week publication is given to another statement, emanating from the same city. Our own position in the discussion is that of referee and so long as the exchange of views can be maintained, the sooner may a reasonable conclusion with re-

spect to the merits or demerits of M.E.N. or earth leakage trip be reached. Finality in the matter is perhaps too much to look for, but the various opinions are published in the hope that they may prove assisting to those trying to solve the protection problem and so that those committees engaged in investigating the position may have the benefit of overseas experience.

Schoolboys and Electricity

A PLEASANT change from thoughts of coal shortage and a break-away from the atmosphere of nationalisation problems, will be found at the Schoolboys' Exhibition now being held in London. Among the visitors this week were many who have long since changed their coloured caps for headgear more appropriate to their years, but who have not apparently lost their boyish inquisitiveness for wanting to see how things work; a curiosity which can be satisfied to overflowing at the Central Hall. The exhibition has been revived after a lapse of seven years and as might be expected electricity plays a major part in the items displayed, as for instance, the driver's cabin of a tube train, a model of a cable repair ship, demonstrations of transmitting photographs by radio and over wire, and so on. It is, however, a pity that the electrical industry as such, has not sponsored a stand of its own, as have the gas manufacturers. The amount of understanding displayed by the young visitors to the exhibition this week is indicative of the commonplace acceptance of things electrical by the rising generation and though at times embarrassing to their older and often less electrically-minded escorts, the enthusiasm displayed by our young friends is such that only the fullest answers to their questions will reduce them to silence—out of which, however, is soon born another query.

Technology Pays a Debt

FROM America come reports of a new aid to astronomical investigation which has permitted a "conquest of vast regions of cosmic space hitherto inaccessible to man" and the observation of stars only one-fifteenth as bright as any previously seen. This, it is claimed, has been achieved with a lead sulphide photo-conductive infra-red detector,

made at the North-Western University, which converts into electrical impulses the radiation from stars and other cosmic bodies otherwise invisible. Infra-red telescopes have already revealed the outlines of a distant nucleus, discovered deductively but previously shrouded behind stellar dust clouds, and the new cell, believed to be many times more sensitive than anything previously used, is likely to widen still further the boundaries of human knowledge. The development of infra-red detectors is a branch of science which received considerable impetus during the war, particularly in Germany, where the location of objects by reflected or radiated infra-red was second in importance only to radar methods. The complaint is often heard to-day that technology, using the discoveries of pure science, turns them only to destructive ends. In this instance, at least, war-time invention appears to have repaid the debt with a valuable contribution to peaceful research.

Catering and the Electrical Idea

BAKERS and caterers are often die-hard in their adherence to time honoured methods, and any indication of awakening interest in scientific development is, therefore, to be encouraged. Whilst bakers and their kind are willing in some instances to utilise electric power for activating mixers, whisks, dough dividers, etc., it is not always easy to convince them of the advantages of more extensive electrification. The current issue of "The Baker's National Association Review," however, carries an article and comment, in which the subject matter is related to unusual applications of electrical methods, and quite rightly stresses that the present difficulties of the supply industry are purely transient. It reminds the trade that electricity will exert a most powerful influence on future business. Bakers are advised that developments in food production of the past few years, which appear at present to be only in the experimental stage, may have widespread effects on the economics of the baking and catering industries when unlimited supplies of current are available. It would be interesting in the circumstances, to know the reactions of the baker-caterer trade to these applications

of science to food preparation, and inquiry might produce valuable information.

Atomic Energy Development

ON December 2, 1942, the first self-sustaining uranium pile became an established fact and the development of atomic energy took another step forward. The pile was built at Chicago and each year since some mild form of recognition of the occasion has taken place. Developments which led up to the success of the Chicago experiment were to some extent made known by speakers in this country last year, largely by Prof. M. L. OLIPHANT when delivering the Kelvin Lecture and by Dr. T. E. ALLIBONE when giving the Faraday Lecture, but we have received this week from the U.S.A. a communication which throws further light on the experiment. There is perhaps in the communication little detail which is new but some of the experiences which contributed to the success of the Chicago experiment make interesting reading. The information is based on a report of the United States War Department.

State Electricity Bill

FRIDAY, January 10, is likely to be remembered for all time by the electricity supply industry, for it is understood that there will made available to-day, the text of the Electricity Bill which will provide for the transfer of the industry in this country to national ownership. It will be remembered that in THE ELECTRICIAN of December 27, details of the First Reading of the Bill in dummy form were given, when it was also pointed out that the full Bill was scheduled for its Second Reading on January 21. The Bill will provide for the establishment of a British Electricity Authority and Area Electricity Boards, and for the exercise and performance by the Authority and Boards and the North of Scotland Hydro-Electric Board, of functions relating to the supply of electricity and certain other matters; for the transfer to the Authority or any such Board of properties, rights, obligations and liabilities of electricity undertakers and other bodies; and among other things to amend the law relating to the supply of electricity.

NEWS FROM FRANCE

FROM OUR PARIS CORRESPONDENT

NOW under construction at Chandoline, near Sion, Switzerland, is the Dixence hydro-electric plant, which is fed by a basin 43.6 sq. m. in area, and equipped with five 30 000 kW turbo-alternators. The falls utilised, which vary from 1 747 m. to 1 686 m. are believed to be the highest in the world. Retained by a barrage, the Dixence water creates a reservoir of 50 million cu. m. capacity. Annual generation is 200 million kWh, but is expected soon to increase to 240 millions, by the addition of new supplies carried by tunnel from the Dix Lake.

* * *

The Dixence barrage comprises a series of triangular cement buttresses with a maximum height of 87 m. Water flows at a maximum rate of 10.25 cu. m. a second, from the reservoir through a gallery dug in the left bank of the valley. This gallery, 11.6 km. long, leads to an intake from which a forced conduit starts. This conduit is a single welded pipe 2 m. in diameter, 15 mm. thick, and 400 m. long. A pressure tube joint divides it into two, each branch having a hand valve. From these two valves the forced conduits which feed the plant are led. The Chandoline plant is housed in a building about 25 m. wide and 100 m. long. The five main hydro-alternators are each driven by two Pelton wheels, and an auxiliary group of 5 000 kW, comprising a single Pelton wheel and alternator, supplies the interior services of the plant, and meets local needs. In normal times only four of the main sets function, the fifth being kept in reserve.

The alternators, running at 500 r.p.m., are three-phase, 37 500 kVA, 30 000 kW. Each is linked directly to a three-phase transformer. Three of the five main transformers have windings of 14 kV, 65 kV, and 135 kV. The auxiliary alternator also supplies a 10/65 kV transformer of 6 000 kVA rating.

* * *

Electricity restrictions already announced in France as a precautionary measure divide the country into two, cuts being envisaged in alternate sectors. While it is emphasised that the situation is a considerable improvement on last year, the public has been warned that economy is necessary, particularly as some thermal plants are undergoing maintenance and repair work.

* * *

The consumption for 1946 showed a

marked increase over the previous year. Demand in December reached a figure equal to 4 400 000 kW, compared with only 3 700 000 kW in 1945, and although much of the increase was due to industrial recovery, domestic needs accounted for a large proportion.

* * *

Following appeals to the public, daily consumption fell from 79 900 000 kWh in the 48th week of 1946 to 74 900 000 kWh in the 49th week. With the introduction of cuts, generation by thermal stations was reduced from 48 500 000 kWh to between 42 700 000 and 45 800 000 kWh, and coal stocks have been built up in the Paris region to ensure 17 days consumption compared with the former 10 days. 82 200 000 kWh were consumed on the coldest day so far in the Paris region.

* * *

Unless there are further difficulties, such as delays in coal deliveries, freezing, or breakdown in generating plants, it is considered that the present electricity supply can be assured until the end of February. Owing to lack of coal, certain industries have had to close down, and this has led to economy in consumption, which, together with the present restrictions, appear to answer the needs of the moment.

* * *

The Government have now decided on increases in charges for electricity, amounting to an average of 52.5 per cent. From this will be deducted the standard 5 per cent. cut in controlled prices, announced on January 2. The remaining increase, heavy as it is, it is pointed out, will help to finance essential maintenance work. Since few repairs were done during the war, and considerable new projects are planned, the work is likely to cost several milliards of francs.

* * *

A project for the urgent electrification of the Bastille railway has been placed before the Conseil General of the Seine. An earlier plan passed in 1941 was never put into effect, and the credit voted for that purpose is now largely insufficient. The plan includes the modernisation of material and the creation of intercommunications linking with the Metropolitan network.

Protection of Installations

There appeared in this journal of September 6, last year, an article by "Supervisor,"—whose ability to be provocative is well-known—dealing with the Multiple Earth Neutral System of protecting consumers' installations. In the last issue was published a letter on the subject from Mr. W. H. Connolly, engineer and manager, electricity supply department, State Electricity Commission of Victoria, and below is given a further contribution to the discussion.

* * *

The remarks which follow have as their author Mr. W. Thorn, also of the State Electricity Commission, and they are published in the hope that they may encourage readers to ventilate still more opinions on M.E.N. and other protective methods.

ON few subjects have more misleading statements been made than on the protection of consumers' installations as related to earthing. A typical example is the article headed "Installation Matters," by "Supervisor," published in THE ELECTRICIAN of September 6, 1946. Anyone reading this article would be justified in assuming that, in Victoria, the M.E.N. system had been found unsatisfactory and had been replaced by earth leakage circuit breaker protection. In actual fact, E.L.C.B. protection was adopted for all new installations in Victoria in 1936 and for all installations in 1938. Owing to difficulties experienced with this system, new regulations were brought into force in 1940, which provided for the use under prescribed conditions of all three systems of protection, namely: direct earthing, M.E.N. and E.L.C.B. As a result of these new regulations, E.L.C.B. protection has been virtually abandoned in favour of the M.E.N. system.

Admittedly, there is a serious theoretical objection to the use of the M.E.N. system in that, under certain conditions, and particularly if the neutral service conductor should be broken while any active conductor remains intact, the potential of exposed protected metal surfaces in an installation may be raised to a dangerous value to earth, even though no defect occurs within the installation itself. To engineers who have had no practical experience with the M.E.N. system, this appears to introduce such a risk as to condemn the system, but experience over many years and covering millions of installations has shown that the risk asso-

ciated with the use of the system is negligible.

The term "M.E.N. system" is used to cover systems which are installed in accordance with the conditions prescribed by recognised authorities, such as the National Electric Code, U.S.A.; the V.D.E. Regulations for Nullung, Germany; the State Electricity Commission Regulations, Victoria; and the Electrical Supply Regulations, New Zealand.

The M.E.N. system, or its equivalent, is operating satisfactorily in U.S.A., Canada, New Zealand, Victoria, Germany and Switzerland, to quote the best known examples, and so far as can be ascertained, there is not the slightest likelihood of the system being abandoned in any of the countries mentioned. There is no perfect system for the protection of consumers' installations, but by far the most widely used and satisfactory, is undoubtedly the M.E.N. system.

Many articles and books on the use of E.L.C.B. protection published in England have created the impression that such protection is widely used in Germany, and was introduced because M.E.N. had been found unsatisfactory. In actual fact, the V.E.D. rules in Germany provide for three systems of protection, namely: direct earthing (Erdung), M.E.N. (Nullung) and E.L.C.B. (Schutzschaltung). In 1938, under 5 per cent. of the consumers' installations were protected by E.L.C.B.'s in Germany, and the only reason that such form of protection was used at all, was that the conditions prescribed for the use of Nullung could not be economically met. Engineers of the R.W.E., the only large supply authority in Germany which used E.L.C.B. protection extensively, frankly admitted that Nullung was perfectly satisfactory, but in their particular case the conditions prescribed could not be met. The problem of selectivity had not been solved by the R.W.E. in 1938. It is also interesting to note that, in 1938, Nullung was recognised as standard for all new systems in Germany.

Earth leakage circuit breaker protection is used extensively by the Sydney County Council in New South Wales, where this system of protection was made compulsory in 1937 in the Council's area. Operation has been satisfactory. In Sydney, E.L.C.B.'s are used as a back-up protec-

tion to direct earthing, which, in general, and particularly in large installations, is reasonably satisfactory.

Earth leakage circuit breaker protection is theoretically superior to the M.E.N. system, but the problem of selectivity in large and multiple installations has never been satisfactorily solved, and its practical application should be confined to areas in which the prescribed conditions for M.E.N. cannot be met.

As previously mentioned, the danger from broken neutral conductors is always strongly stressed by those opposed to the M.E.N. system. It is considered that an investigation of New Zealand conditions should convince them that the dangers associated with broken neutrals can be grossly over-estimated. In New Zealand, the M.E.N. system has been compulsory since 1927, a large proportion of the services are overhead, and high winds are prevalent. Records are kept of all broken conductors and a very large number of broken neutrals is recorded annually. In 1936, over 8 000 broken conductors were recorded, of which, it is assumed, one-third would represent cases in which the neutral was broken and the phase conductor remained intact, the total number of con-

sumers for that year being approximately 356 000. In spite of this very high number of broken conductors, which represent over 23 000 consumers, the accidents caused by broken neutrals have been negligible, and the M.E.N. system is generally regarded as the best known system of protection.

American and Canadian experience is often dismissed by opponents of M.E.N. as of little value; nevertheless, over 35 million consumers are protected by M.E.N. The opinion of leading American engineers is that the best results are obtained by solidly bonding all available metal, such as neutral conductors, cable sheaths, supply authorities' earths, water mains and exposed or buried metal, in order to reduce the resistance to earth to as low a value as possible.

After a thorough investigation of the position in Germany, North America and New Zealand, in 1938 and 1939, and the experience of the State Electricity Commission of Victoria, the writer is satisfied that the M.E.N. system is the most satisfactory known system of protecting consumers' installations in urban and closely settled areas where a.c. distribution is used.

Electrical Statistics For November

THE twelfth Monthly Digest of Statistics for 1946 shows that the weekly average consumption of coal by authorised electricity undertakings increased from 513 000 tons in October to 594 000 tons in November. In November, 1945, the average consumption was 495 000 tons a week. Distributed stocks of coal held by undertakings fell from 2 280 000 tons in October to 2 138 000 tons in November. In November, 1945, the stocks amounted to 3 287 000 tons. Electricity generated in November last reached the total of 3 938 million kWh, compared with 3 733 million kWh in October and 3 463 million in November, 1945.

Deliveries of British-built arc-welding sets numbered 362, value £38 000, and resistance welding sets 16, value £38 000, in November last, as against 540 arc-welding sets, value £61 000, and 274 resistance welding sets, value £76 000, in October. The figures for November, 1945, were: 561 arc-welding sets, value £93 000; and 182 resistance welding sets, value £69 000, respectively.

During the July to September quarter, 1946, the production of electrical appliances, except kettles, was less than in the previous quarter, due, probably, to holidays. The totals were: Electric fires, 217.7 thousands, of which 190.2 thousands

were for the home civilian market; electric irons, 259.3 thousands, of which 192.9 thousands were for the home civilian market; vacuum cleaners, 51.8 thousands, of which 39.6 thousands were for the home civilian market; electric kettles, 50.4 thousands, of which 41.3 thousands were for the home market. The figures for the previous quarter were: Electric fires, 225.0 thousands, of which 199.9 thousands were for the home market; electric irons, 302.7 thousands, of which 241.7 thousands were for the home market; vacuum cleaners, 52.2 thousands, of which 42.9 thousands were for the home market; electric kettles, 48.2 thousands, of which 37.2 thousands were for the home domestic market.

The production of electrical appliances classed as building components during November was as follows: Cookers, 18.6 thousands; wash-boilers, 25.6 thousands; immersion water heaters, 40.8 thousands; meters, 136.0 thousands. In October the totals were: Cookers, 18.7 thousands; wash-boilers, 19.8 thousands; immersion water heaters, 41.5 thousands; meters, 127.2 thousands. For November, 1945, the figures were: Cookers, 7.9 thousands; wash-boilers, 6.7 thousands; immersion water heaters, 18.7 thousands; meters, 61.1 thousands.

INSIDE OF ELECTRICAL MACHINES

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

THIS, Part XIX of the series*, is devoted to the application of insulation to d.c. machines of sizes larger than fractional horse-power.

Electrical Conditions in Armatures.—

In order to understand why the insulation is disposed in the various ways to be de-

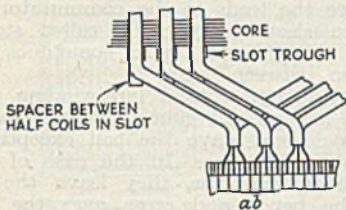


Fig. 1.—Armature connections—lap winding

scribed, some knowledge of the electrical conditions is necessary. The first point,

and a most important one, is that the passage of electric current along conductors causes them to heat up, and this heat must be dissipated. Insulation impedes the passage of heat away from the conductors, hence it is policy to keep the insulation as thin as possible, consistent with electrical safety.

Electrical safety is a condition which must be provided for as a long-term policy.

It not only means that a machine shall be insulated well enough to stand up to the high voltage tests at the manufacturers' works, but that it shall give unflinching ser-

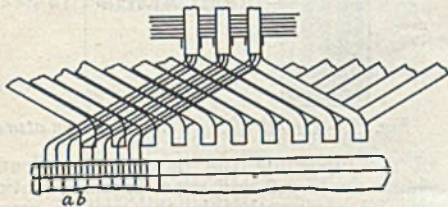


Fig. 2.—Armature connections—wave winding

vice for fifteen or twenty years; the two requirements necessitate entirely different treatment. For example, a machine insu-

lated just sufficiently to withstand the high voltage tests might give unflinching service for years if run in a clean power station or workshop. On the other hand, a traction motor or steel-mill motor, insulated with the same idea in mind, would probably break down in the course of a few weeks, due to moisture or metal dust penetrating the windings and providing the conditions for short-circuits or breakdowns to earth. In such cases the ideal of using as little insulation as possible cannot be attained. The windings must be completely encased with ample insulation, so that, for a given temperature rise, a larger machine may be necessary for a given output than would be required for normal industrial service.

The next point is one which few, excepting designers, seem to understand. In Fig. 1 is shown diagrammatically the com-

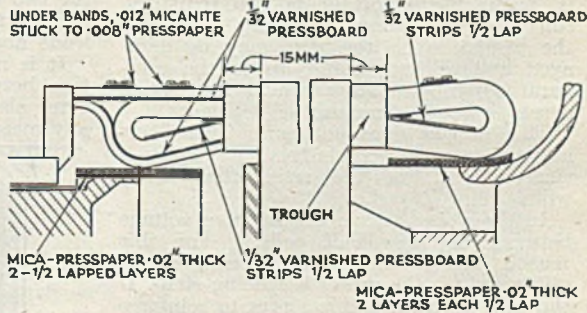


Fig. 3.—Disposition of insulation in armatures

mutator end of an armature winding in which there are three commutator segments per slot. In general, the voltage between adjacent segments is limited to seldom more than between 10 and 20 V. Thus, the voltage between the sides of the coils connected to a and b is only that between the adjacent segments a and b. Because the coils are taped overall, many people think that there is full voltage between them, and that additional insulation, such as a layer of mica or varnished cotton tape, ought to be added. It will be seen that this is a fallacy. The tape is chiefly employed in the end winding to keep the turns from becoming disarranged. In fact, if each coil is composed of taped strips as in Fig. 5 it is quite common for the separate strips to go independently to the commutator, without each slot group being taped together.

It may be advisable here to refer to armature coils of round wire. These coils

* Parts I, II, III, IV, V, VI, VII, VIII, IX, X, XI, XII, XIII, XIV, XV, XVI, XVII, XVIII, appeared in THE ELECTRICIAN of April 26, May 10, May 24, June 7, June 21, July 5, July 19, August 2, 16, 30, September 20, October 4, 18, November 1, 15, 29, and December 13, 27, 1946, respectively.

are invariably taped all over and such an operation inevitably results in the coils taking up a circular shape in cross-section. Before they can be inserted in their slots they have to be flattened along the sides. This generally causes some of the turns to alter their relative position. If the taped

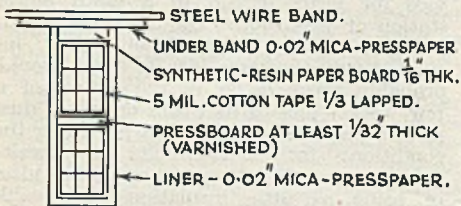


Fig. 4.—Slot insulation for medium-sized armature

group contains three sections, i.e., there are three independent coils, each of which will be connected to a pair of segments, it is possible to have wires coming together with the voltage between them equal to that across three segments. It is, therefore, important not to treat the coils roughly when flattening them, or the insulation on the wire may be damaged and will not stand up to the comparatively high voltage which may exist across several commutator segments.

This danger does not exist when rectangular or square conductors are employed since coils of this kind retain their shape while being taped.

In the slots there is the full line voltage between the two half coils. For this reason the insulation between them is reinforced by the use of a spacing strip. If the coils are taped, this serves to reinforce the covering on the conductors, in which case the strip may be only 20 or 30 mils thick. When taped strips are employed the overall taping is often dispensed with and the separating strip is made 40 or 60 mils thick. The separating strip should always be carried beyond the bends at the end of the slot portions of the coil since the electric strength of the taping is weakest at those points.

Consideration of Fig. 1 also shows that as the upper part of the coil progresses away from the bend towards the nose (i.e., the outer end), the voltage difference between it and the coils which cross beneath it becomes smaller. It is necessary to interpose insulation between the two layers where the voltage is high, and since such insulation must be kept in place, it is usual to make it extend from under the separating strip to the start of the radius at the nose, as shown in Fig. 3. It is not taken closer to the core because the space between the coils where they emerge from the slots up to the bends, is

kept open for ventilating and cooling. In any case it cannot be fixed closer to the core than the outer edges of the troughs.

The slot insulation is extended outside the slot for a distance of $\frac{3}{8}$ in. to $\frac{1}{2}$ in., depending upon the size of the machine. In large machines where finger strips are employed for preventing long core teeth from spreading longitudinally, the slot extension is made at least 1 in.

When coils have more than one turn per commutator segment, it is usual to reinforce the leads to the commutator with cotton sleeving, generally called stockinette. In addition, tape is sometimes interwoven between them.

Fig. 1 represents a lap winding. This does not present much difficulty as the leads do not leave the coil excepting at or near the nose. In the case of wave windings, however, they leave the coils at the bends and cross over the other coils as shown in Fig. 2. This results in high voltages being present between the leads and the coils—the case is somewhat analogous to that existing between the two layers of coils—and a solid barrier, as shown in Fig. 3 is interposed between leads and coils.

It is necessary to provide ample insulation between the coils and the armature core, also between the end windings and any metal in close proximity. The methods

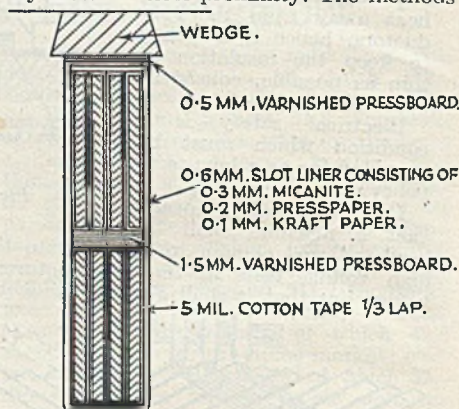


Fig. 5.—Detail of slot for large armatures

of accomplishing the latter are clearly shown in Fig. 3 and need no amplification beyond saying that in the smaller armatures the mica-presspaper may be replaced by a combination of presspaper and varnished cotton (empire) cloth, or two or more pieces of varnished presspaper.

Conductor and Slot Insulation.—Conductor and slot insulation vary greatly and a selection of the most general types will now be described. It should be understood that many of the applications

described in these articles are not the speciality of any one manufacturer but

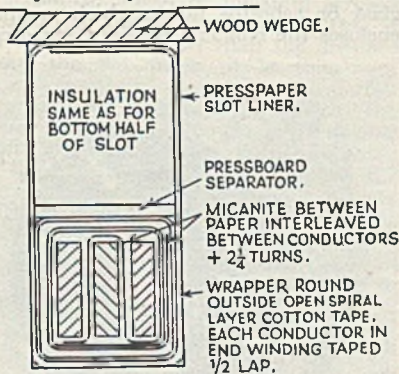


Fig. 6.—Mica-paper insulation

represent the general practice of the industry.

In Fig. 4 is shown a useful type of insulation. The coils may be wound with round wire or rectangular strip insulated with d.c.c., synthetic enamel, asbestos or double glass. If the slot liner is of mica-presspaper it may be regarded as Class B insulation. At present, synthetic enamel is applied only to round wires. When the coils are held in by steel wire bands it is advisable to maintain a reasonable creepage distance from the coils to the top of the slots by inserting a $\frac{1}{8}$ in. closing strip at the top, as shown.

The term "creepage distance" is rather ambiguous as applied to electrical machines. It is normally associated with

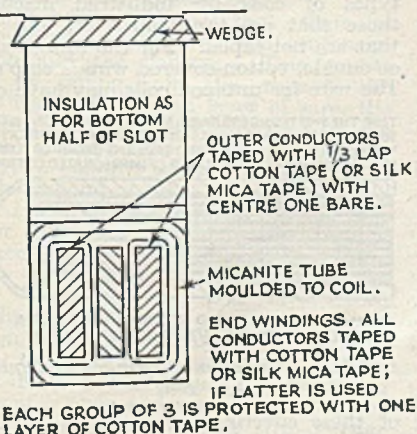


Fig. 7.—Moulded mica-paper insulation

the distance a current would have to travel to pass from a point of high potential to one of lower potential by creeping or flashing over the intervening surface. As an

example, may be cited the distance from the outer vertical surface of commutator segments across the mica-ite vee-ring extension to the metal clamp ring.

In machines, the term is also applied to the distance from points of weakness in an insulating covering to the nearest earthed part. Thus, referring to Fig. 4, since the coils are only taped with cotton tape and varnished, the electric stress between the conductors and the top of the armature teeth, especially during the high voltage test, might be great enough to puncture the tape if the coil were too near the top of the slot. It is for a similar reason that the slot troughs, or mica-ite tubes, if used, are extended beyond the slot, the length of the extension increasing with increased voltages.

The high voltage test is not the only time of danger. Machines invariably accumulate dirt on their windings as time

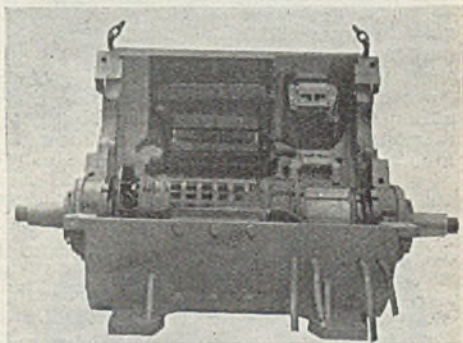


Fig. 8.—Motor for steel mills, 60 H.P., 250 V (English Electric Co., Ltd.)

passes. If this is metallic, or made up of carbon from the brushes, a path of comparatively low resistance is provided. Even dirt which does not contain these ingredients becomes partially conducting if a machine becomes damp due to "sweating" in damp weather.

When the coils are held in by wedges, as shown in Fig. 5, the liner is invariably folded over under the wedge. Since wedges are usually employed only in large machines, the insulation to earth is made reliable by the inclusion of mica, and the other alternatives given in Fig. 4 are not favoured. Mica-ite-presspaper liners of this type have an electric strength of 6 000 V, and at least 2 000 V is required to cause a breakdown between adjacent conductors.

The conductors shown in Fig. 6 are un-insulated copper strips, the insulation being provided by mica sandwiched between .002 in. kraft paper, a flexible mica sticking varnish being used. The

electric strength between conductors is in the region of 2 000 V and to earth about 9 000 V.

The arrangement depicted in Fig. 7 has an electric strength of about 2 000 V between conductors. If the tube is made of micafolium, the electric strength to earth will be in the region of 15 000 V for a wall thickness of 0.030 in. Micafolium consists of mica splittings stuck to kraft paper. If jap tissue or flexrope paper be used a greater proportion of mica can be incorporated and an electric strength of 20 000 V is quite usual.

There are other variations, but enough has been said to show how insulation may be applied to armature coils. One warning should be given. It is inadvisable to use tape, whether mica or varnished cotton, as the sole insulation to earth. With the few number of layers for which there is room there is a possibility of creepage between the overlaps leading to failure. A more impenetrable barrier, such as varnished pressboard of adequate thickness, or a couple of turns of mica-paper in sheet form, should be used.

Another point to be remembered is that although bare conductors may be permissible in the slots, e.g., as shown in Fig. 7, every one should be individually

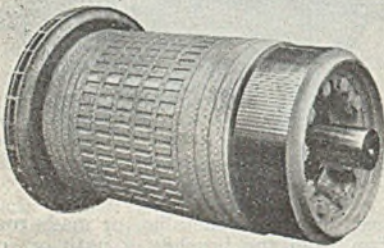


Fig. 9.—Railway motor armature, 328 H.P., insulated for 1 500 V (General Electric Co., Ltd.)

insulated in the end winding. It is found that the movement and bending which the end winding receives during winding, banding, and in service, results in shorts developing if every conductor is not insulated.

Mill Type and Traction Armatures.—

As already suggested these two types need protection against very adverse conditions. Of the two, traction machines experience the worst conditions because moisture is sprayed on to them from the wheels of the vehicles they drive, and these motors are seldom totally enclosed. The type of motor used in steel mills is illustrated in Fig. 8. It will be noticed that protection is provided against metal dust getting into the windings. Fig. 9 is reproduced

from a photograph of a traction armature; the protection is completed by a hood of glass or asbestos fabric which completely encloses the rear end winding and a cover-

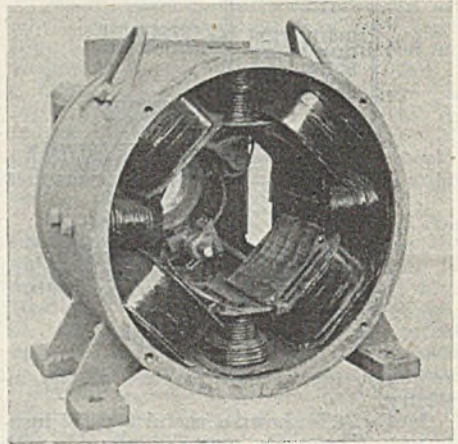


Fig. 10.—Typical industrial motor field assembly, employing untaped coils (General Electric Co., Ltd.)

ing of the same material protects the front end winding.

Glass Insulated Armatures.—The manufacture of these presents no serious trouble once the technique has been mastered. The special mica sticking and impregnating varnishes require higher temperatures and longer times for their curing.

Main Field and Interpole Coils for Industrial Machines.—There are two main types of coils for industrial machines; those that are taped all over, and those that are not taped. For the former single, or double, cotton-covered wire is employed. The wire for untaped coils may have either

TAPE THE END TURNS (TO GIVE A MINIMUM CREEPAGE DISTANCE TO EARTH OF AT LEAST 10MM.) AND LEADS WITH ONE LAYER OF VARNISHED COTTON TAPE; AND TAPE THE GROUP OF TURNS AND LEAD TOGETHER WITH ONE LAYER OF IMPREGNATED COTTON TAPE

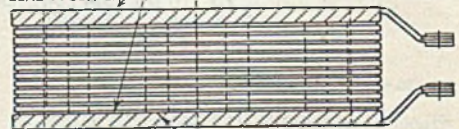


Fig. 11.—Insulation of strip-on-edge interpole coils

of these coverings or ordinary enamelled wire may be used.

Taped coils must be wound on formers, tapes being interleaved in the layers to hold the winding together. Flexible mica-nite washers, 0.030 in. thick, are placed at the top and bottom of the coil after it has been removed from the former. These

are cut larger than the coil faces so that they can be bent about $\frac{1}{4}$ in. down the outside to give ample creepage to earth.

A similar thickness of micanite is used for lining the inside of the coil. This is made about 1 in. longer than the distance between the flat faces, it is then cut down sufficiently at each corner to permit of $\frac{1}{4}$ in. being folded over on to the washers. Separate small pieces of flexible micanite are fitted in each corner to cover over the small gaps present where the centre micanite bends outward. A piece of 0.030 in. presspaper is fixed inside the coil as mechanical protection to the micanite. The whole coil is then taped all over with 7 mil cotton tape and impregnated in compound. Interpole coils may be insulated in the same manner.

A photograph of a field system with untaped coils is reproduced in Fig. 10. The main coils are wound with enamelled wire, and the interpole coils with d.c.c. The spools for both are made of pressboard, those for the enamelled wire coils being impregnated in varnish before any wire is wound on them. Those for the interpoles need not be varnished as the wound coils are impregnated in compound. Tapes are interleaved in the windings and taken over the flanges to keep them in position. Some tapes may be seen passing over the edges of the main coil flanges, but they are not discernible on the other coils. The flanges vary in thickness from 0.040 in. to 0.080 in. according to the size of the coils. The centres of the spools are formed of 0.060 in. pressboard. For machines having armatures of larger diameter than about 6 in., it is advantageous to support the insulation with a thin sheet-iron or brass spool.

It will be appreciated that there is necessarily a gap between the centre insulation and the flanges. This gap is sealed by taping $\frac{1}{4}$ in. dia. rope to the corner turns of the first layer of wire, the rope fitting into the angles formed by the junction of the centre and flanges. Alternatively, a suitable thickness of thin twine may be wound in the corners and well brushed with shellac varnish. If the coils are for very large machines, and wound with rectangular wire the necessary protection may be provided by taping the corner turns of the first layer with varnished cotton tape.

When the section of copper for interpole coils is too large for covering with cotton, means have to be found for employing bare copper strip and insulating the turns.

One method of insulating strip-on-edge coils is depicted in Fig. 11. Varnished pressboard troughs 0.030 in. thick are fitted to alternate turns. Alternatively, washers may be used between turns if preferred. These must be cut at one side

for inserting in the spiral. Since a cut may open and permit a short circuit between turns, it is usual to employ two washers, of, say, 0.015 in. thickness, inserted with the cuts on opposite sides of

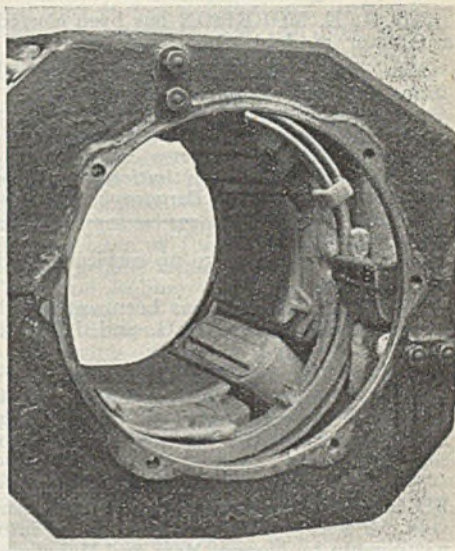


Fig. 12.—Field system of 328 H.P. railway motor, insulated for 1 500 V (General Electric Co., Ltd.)

the coil. The centre and flanges may be of pressboard as before.

Sometimes the coils are wound with the strip on the flat, in which case lengths of 8 or 10 mil varnished presspaper, cut a little wider than the copper, are fed in as the winding proceeds.

These forms of construction are applicable to all sizes of machine, including those having an output of many hundreds of horse-power or kilowatts. If Class B insulation is required, micanite and other suitable materials may be used in place of pressboard. A form of synthetic-resin board, built up of sheets of asbestos paper, makes a good material for coil flanges. Seven mil. asbestos paper impregnated in varnish is suitable for winding in between the turns of strip-on-the-flat coils.

Mil Type And Traction Field Coils.—All coils are completely enclosed in insulation. Often the wound coils are taped overall with cotton tape, brushed with synthetic resin varnish and bakelised before the overall insulation is added. This may consist of cloth-mica-tape, or the straight sides and ends may be wrapped with mica-foil and the corners taped with silk-mica tape overlapping on to the wraps. The outside tape may be

(continues on p. 136)

Electrical Personalities

SIR A. P. M. FLEMING left London Airport last week to attend the Indian Science Congress in Delhi.

MR. A. E. MORRISON has been elected a director of John Shaw and Sons, Ltd.

MR. B. G. HARRISON has resigned from the board of Crabtree Electrical Industries, Ltd.

MR. G. SUMNER, manager for nine years of the Burnley electricity showroom, is leaving to take up service abroad with N.A.A.F.I.

MR. N. M. NIVEN has been appointed an additional director of G. and J. Weir, Ltd.

MR. W. B. PARKINSON has been appointed meter and test superintendent of the Liverpool electricity undertaking in succession to Mr. Samuel Lowey, who retired recently.

MR. FREDERICK CAVENDISH WINFIELD, who has been a member of their staff for many years has been taken into partnership by Messrs. Merz and McLellan. Mr. Winfield will be at their Newcastle office normally.

MR. S. B. WARDER, who has been appointed assistant to the Chief Electrical



MR. S. B. WARDER

Engineer of the Southern Railway, obtained his technical education at the University of London. After serving an apprenticeship with Johnson and Phillips, Ltd., he gained further experience with Ferguson Pailin, Ltd., Manchester, and later as an engineer with the General Electric Co., Ltd., at Witton, Birmingham. In 1927 he went to the Swedish General Electric Co. (later Asea Electric, Ltd.), as an engineer in the export department, and became chief engineer and manager of that department. He joined the Southern Railway in March, 1936, as technical assistant to Mr. Alfred Raworth, then electrical engineer for new works, and dealt with all general matters. Mr. Warder was appointed new works assistant to the Chief Electrical Engineer in August, 1943, and as such, was one of the delegation of officers who recently visited North America to study Diesel-electric traction.

He is a member of the I.Mech.E. and the I.E.E.

MR. W.-O. HEYNE has resigned from the board of the Plessey Co., Ltd., and Mr. R. G. W. Attwood has been appointed in his place.

MR. B. I. METCALF, Mr. J. H. R. Nixon, Mr. P. C. Sharpe, Mr. D. C. A. E. Jessop, and Colonel H. T. Thornley have been appointed by the board

of the Brush Electrical Engineering Co., Ltd., as local directors.

MR. FRANK HAYTON, of Chester-le-Street, assistant area superintendent with the North-Eastern Electric Supply Co., Ltd., Newcastle-on-Tyne, has retired after 40 years with the company. He was formerly district engineer at Chester-le-Street.

MR. H. B. HOCKEN, manager of the Birmingham branch of the London Electric Wire Co. and Smiths, Ltd., has retired after nearly 45 years' service. He is succeeded by Mr. E. W. Darville

MR. W. E. WARRILOW, who celebrates his 70th birthday on January 15,

has retired after 53 years' association with the electrical industry, ten years in municipal supply and manufacturing and 43 in technical journalism. He has been a keen advocate of storage battery traction and large wind dynamos. On his retirement, Mr. Warrilow was the recipient from his colleagues at Odhams' of a silver tea and coffee service as a mark of their esteem and respect. He was for 40 years an Associate Member of the I.E.E., and in January, 1944, was transferred to full membership. Mr. Warrilow is now living at 24, Bath Hill Court, Bournemouth (telephone: Bournemouth 4810), where, in due course, he hopes to write his memoirs. His many friends will be able to continue meeting him at the luncheons of the Batti-Wallahs' Society, of which he has been a member for 35 years, at the Radio Club luncheons, and those many other electrical functions it is his intention to attend.



MR. W. E. WARRILOW

MR. H. HOOPER, hon. secretary of the I.E.E., South Midland Centre, has com-

pleted twenty-five years of service to the centre, and it has been decided to open a testimonial fund, contributions to which should be forwarded to the honorary treasurer, Mr. W. Clarke, c/o. Messrs. English Electric Co., 75, New Street, Birmingham, 2.

MR. L. A. WALKER, who has retired from the service of the General Electric Co., Ltd., established a record by having been a member of the staff for 57 years. He joined the company in 1889, and was employed on the repair of gas lighters. The head office was then in Queen Victoria Street, where he served, successively, in the bell, estimating and bought ledger departments. He was subsequently promoted to the



MR. L. A. WALKER

publicity organisation, where he has worked in an administrative capacity for the last 35 years. Mr. Leslie Gainage, vice-chairman and joint managing director, made presentations to Mr. Walker and three other members of the staff who have retired—Mr. W. B. Steggall, counter manager, and Mr. S. T. Gill, of the despatch department, who have each served the company for 50 years, and Mr. H. N. Castledine, of the export department, who had 36 years' service.

LORD BRABAZON OF TARA, president of the British Electrical Development Association, arrived at St. Moritz on January 4, and within 12 hours his enthusiasm for tobogganing, after eight years' denial, resulted in a tumble at "Shuttlecock Corner." It is reported that his toboggan made such a hole in the ice that all riding had to be abandoned for the rest of the day.

MR. F. C. SPRIGG has retired from the position of installation engineer to Wallasey Corporation, after 26 years' service, and employees of the electricity department presented him with a radio extension speaker. The gift was handed to Mr. Sprigg by Mr. B. T. Hawkins, the former borough electrical engineer.

MR. A. D. KENT, who was awarded an M.B.E. in the New Year Honours List, was throughout the war chief inspector and chief of the testing department of Marconi's Wireless Telegraph Co., Ltd., in which capacity he was responsible for the testing of installations for important Government contracts. Mr. Kent has been a member of the engineering staff of the Marconi Company for 35 years and was for

ten years honorary secretary of the Chelmsford Engineering Society, a position from which he resigned at the beginning of the present session.

MR. J. H. C. BROOKING has retired, after over 50 years of electrical engineering work. A Liverpool man, he first served as an apprentice on a sailing ship during a voyage around the world, and, after "swallowing the anchor," was re-apprenticed to the late Spagnoletti and Crookes in London. He studied at Finsbury Technical College and then became draughtsman to the Telegraph Manufacturing Co. He next joined W. T. Glover and Co., Ltd., as cable laying engineer and was engaged later at their works. He left to become general manager of the St. Helen's Cable and Rubber Co., with whom he invented and put on the market, in 1911, the C.T.S. type of cable. Subsequently, as managing director of the Croydon Cable Works, Ltd., he developed one of its products, Pernax, so usefully as to cause the junction of that company with B. I. Calender's Cables, Ltd., with whom he has been engaged as Pernax specialist during the last 10 years, and is still available to that firm for consultative work. Mr. Brooking is a member of the I.E.E., and his other interests have included founder membership of the Institution of the Rubber Industry (of which he was the first president) and the Association of Mining Electrical Engineers.

MR. E. MOCKETT, who has been appointed staff manager of Cable and Wireless, Ltd., joined the staff department in January, 1943, after 25 years' service with the company, chiefly at overseas stations. He was appointed assistant staff manager in April, 1944, and has been deputy staff manager since July, 1946. He is 44 years of age. Mr. N. C. Chapling, the new traffic manager, entered the traffic department of the Western Telegraph Co., in 1918, and has been joint deputy traffic manager since April, 1944. He was a member of the company's delegation at the International Telecommunications Conference in Cairo in 1938. Mr. Chapling is 43 years of age. Mr. G. H. Entwisle, appointed engineer-in-chief, has been joint deputy engineer-in-chief since the merger of cable and wireless companies in 1929. He joined the Marconi Company in 1910 and went to Glace Bay, Nova Scotia, to take charge of the steam plant at the station set up there to operate the first trans-atlantic wireless service to Clifden, Galway. He subsequently became chief communications engineer of the Marconi Company, a post which he held up to the time of the merger. Mr. Entwistle is 59. Mr. F. H. Lansbury, assistant secretary of the company since April, 1941, has now been made secre-

tary at the age of 46. Mr. H. A. S. Blankley, deputy contracts manager for the last nine years, has been appointed contracts manager. After 10 years' service abroad with the Western Telegraph Co., he joined the engineer-in-chief's department in 1922 and has been in the contracts department since the merger in 1929. He is 53 years of age.

MR. H. G. THOMAS, who has been chief accountant of Cable and Wireless, Ltd., since 1941, is to retain that position. Mr. J. Armstrong, chief engineer of the c.s. "Mirror," has been appointed superintendent marine engineer. He has been a member of the marine staff of the company for 24 years. Mr. C. A. Stradling, who has been deputy Press liaison officer since 1944, now becomes Press liaison officer, vice Rear-Admiral G. P. Thomson. For 15 months he was engineer and assistant manager for the company at Accra. After further service in London he served as assistant manager in Lagos, returning to London as supervisor and assistant superintendent. He was awarded the B.E.M. in June, 1943. Mr. H. J. Wilson is confirmed in the appointment of public relations officer, which he has held since 1944.

In addition to those published in our last issue, the following names of electrical interest appeared in the New Year's Honours List:—

O.B.E.: Dr. G. E. Bairsto, senior principal scientific officer, Ministry of Supply; Mr. P. J. Clarke, an Associate member of the I.E.E.; Mr. G. F. Craven, general manager and engineer, Halifax Corporation passenger transport department; Dr. D. D. Pratt, assistant director, D.S.I.R.

M.B.E. (Military Division): Major G. H. Hooper Collins, R.E.M.E., an associate member of the I.E.E. M.B.E.: Mr. A. W. Biddlecombe, assistant engineer, telephones development and maintenance department, G.P.O.; Mr. A. D. Kent, chief of testing department, Marconi's Wireless Telegraph Co., Ltd., Chelmsford, B.E.M.; Mr. E. Armstrong, head foreman electrician, Vickers-Armstrongs, Ltd., Newcastle-on-Tyne; Mr. J. S. Bradshaw, chief tester, Admiralty section test room, Evershed and Vignoles, Ltd., Chiswick; Mr. W. E. Judd, mechanic examiner, Inspectorate of Electrical and Mechanical Equipment, Ministry of Supply; Mr. C. Richardson, precision machinist, English Electric Co., Ltd., Preston; Mr. G. D. Seal, charge hand, Standard Telephones and Cables, Ltd., London; Mr. J. T. Simpson, stoker's assistant, Carville power station, North Eastern Electric Supply Co., Ltd.; Mr. A. F. Andrews, foreman, Ransomes, Sims and Jefferies, Ltd., Ipswich.


Obituary

MR. FRANK CLEGG, head of Clegg and Coupe, electrical installation contractors, of Molesworth Street, Rochdale, suddenly on December 31, aged 66 years.

MR. GEORGE HERBERT, one of the oldest engineers in the lighting industry on January 3, aged 76 years. For over thirty-five years and up to the time of

his death he was with the Benjamin Electric, Ltd., and for some years past he had devoted his time particularly to the requirements of Government departments. He was a member of the Illuminating Engineering Society since its early days and latterly became a Fellow of the society.

MR. LESLIE ARTHUR BOOTH, sales director of Enfield Cables, Ltd., at "St. Olave's," Staines, Middx., on January 6, aged 50 years.

Before joining the board of Enfield Cables, Ltd., in January, 1943, Mr. Booth was London manager for Johnson and Phillips, Ltd. He had also been in the contracts department of Crompton Parkinson, Ltd. He was an associate of the I.E.E. and a past chairman of the Association of Super-


MR. L. A. BOOTH

vising Electrical Engineers. Since the war Mr. Booth had accompanied Lord Forrester, managing director of the company, to South Africa, Australia, New Zealand, Malay, Egypt and India. The funeral service will be held at St. Peter's Church, Staines, at 2.30 p.m., to-day (Friday), and the interment will be in Staines Cemetery.

"Pre-Fab" Demand

FIGURES showing the m.d. in two estates of 97 and 78 M.O.W. temporary houses, supplied from separate substations, are contained in a report by Mr. C. H. A. Collyns, general manager of the Lothians Electric Power Co., quoted in the current "E.D.A. Bulletin."

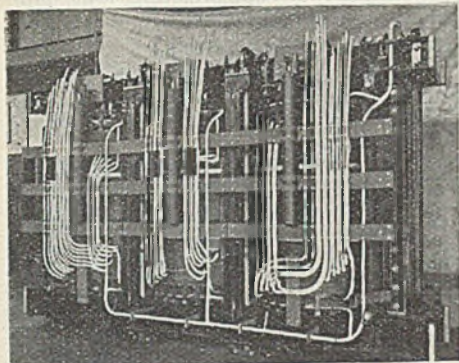
The houses are fitted with electric cooker, immersion heater, wash boiler and lighting and the figures, after allowing for diversity, indicate that, when only a few houses are connected, the average daily maximum demand is about 1.3 kW, whilst, after about 50 are connected up, the week-day average daily maximum demand falls to about 0.76 kW, and the Sunday peak rises to about 1.02 kW. These figures remained consistent from April to September.

The number of units consumed is interesting. On the company's advice, the majority of consumers have been very careful in the use of the immersion heater and the average units per day, in September, was 5.62, on the 97-house scheme and 5.88 on the other. The average all-in cost is about 1d. per unit.

Equipment and Appliances

Three-Phase 50 MVA Transformer

Further details are now available of the 50 MVA, 150/15.6 kV transformer recently shipped to France by the British Electric Transformer Co., Ltd., and described in *THE ELECTRICIAN* of January 3. The transformer is three-phase, 50 cycles, star/delta



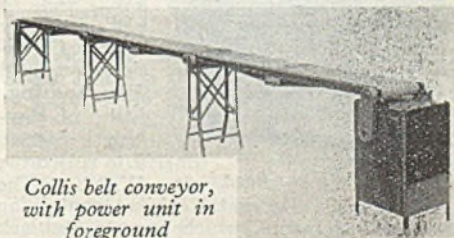
Core and coil structure, with 150 kV connections, are shown

connected, and fitted with a twin type "A" cooler unit. The cooling is ON/OFB, the artificial system being controlled thermostatically to come into operation at 50 per cent. load. Type "L.S." on-load tap-changing gear provides a voltage regulating range of 30 per cent. \pm 15 per cent. in twenty steps. The tap-changer operates on the 150 kV winding, and consists of a selector switch, two diverter switches and one auto-transformer per phase. The selector switch has two common bars, and two moving contacts, which connect the bars either to two adjacent taps, or to a single tap. Each bar is connected to one end of one of the two half windings of the auto-transformer. The other ends of the half winding are connected together by the two single-pole diverter switches. With both selector switch moving contacts on one tap, the auto-transformer serves as a non-inductive conductor. When a tap-change is made, one diverter switch opens and the half winding still in circuit serves as a choke coil. One moving contact can then travel to an adjacent tap, and the diverter switch be reclosed so that the auto-transformer is now bridging two tappings. It may be left in this position to provide a voltage change mid-way between that effected by a complete movement from one tapping to another. Such an arrangement reduces the number of tappings brought out from the main winding. For the next tap-change, the other diverter switch opens.

and the corresponding selector switch moving contact travels to the tapping already connected to the other moving contact. Both single pole diverter switches for each phase are enclosed together in one oil tank, and mounted under an auto-transformer tank fitted to the side of the main transformer. Each diverter is operated independently by side rods from the motor equipment located at one end of the line of switches. The motor for operating the tap changer is housed, with a magnetic brake, at one end of the transformer, and is controlled by reversible contactors. The 150 kV star-connected winding is designed to operate with the neutral solidly earthed. This factor permits the adoption of a form of winding with the line connection made at the vertical centre of the assembly by a heavily-insulated lead brought out through the wraps. Each phase of the high voltage winding consists of two separate sections wound in opposite directions, so as to give the same polarity at the centre of the limb. The two central ends are connected together, and the line connection attached thereto. Tapping leads are taken from the neutral end of each half winding and connected together in pairs. Thus, each phase of the 150 kV winding is, in fact, two separate windings connected in parallel. Such an arrangement allows a minimum of insulation at the two solidly earthed neutral ends of the assembly and permits a reduction in the overall height of the carcass. The high voltage winding is protected by a static ring, around the centre of the limb, connected to the bushing insulator. All the coils in both the 150 and 15.6 kV windings are manila-paper insulated, and all the major insulation is pressboard, oil-impregnated throughout, no varnish being used.

Unit Construction Belt Conveyor

An extensible conveyor belt system, made by J. Collis and Sons, Ltd., may be of interest to firms considering conver-



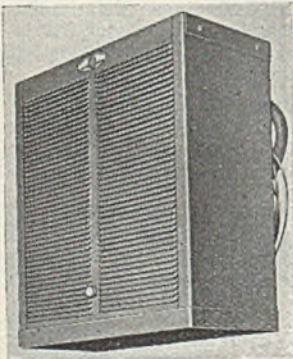
Collis belt conveyor, with power unit in foreground

sion to mass-production methods. The conveyor is composed of a number of endless belt units, each with belt tensioner

and belt drift correcter, stands, and one or more driving cabinets, according to the overall length. The driving cabinet and stands have cradles into which the belt unit drops, and the drive is passed from one unit to another by means of snap-on couplers. Each unit has a load capacity of 112 lb. and, as the makers point out, the total length of belting which can be driven from one power unit varies with the average weight conveyed, the speed and gradient. In general, one driving cabinet will suffice for an assembly 42 ft. in length. Belt travel is not limited to the horizontal, and one or more units may be inclined up or down, a maximum gradient of 1 in 4 being practicable for normal loads. All the units are synchronised at a standard speed of 50 ft. per minute, unless special accelerating or decelerating couplers are fitted; a reversing type of coupler can, however, be fitted to make belts travel in the reverse direction—as, for instance, when they feed an assembly point from both ends. The belt units themselves are of pressed steel, of inverted, flat-topped channel section, while the moving belt is normally of woven cotton. Skid plates, the use of which is optional, are provided to bridge the narrow gap between the separate units. The motive power may be provided by electric motor or internal combustion engine. In the electrically-driven models, the starter and speed reducer are enclosed within the driving cabinet. Power consumption at maximum loading is approximately 1 kW per 100 ft. length.

Industrial Space Heater

A simple and compact space-heater, applicable to the heating of isolated rooms, offices and workshops



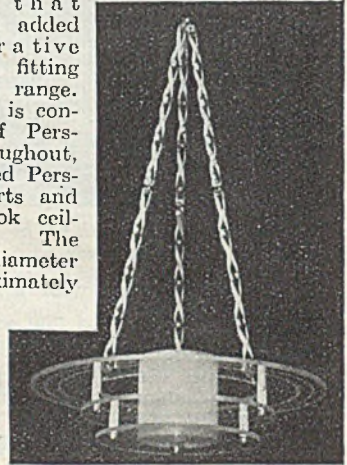
"A.C.E." air heater

The unit consists of a metal cabinet containing the heat elements, which operate at black heat, an electric fan, running at 1300 r.p.m., attached to the rear, and a front grill consisting of two 3 in. louvred sections, the louvres being arranged to give a down-

ward deflection to the warm air. The finish is green stove enamel. Among the advantages of the heater, the makers state, are that the motor is silent in running, the unit, measuring approximately 12 in. square and 12 in. deep, takes up little wall space, and maintenance is required only at infrequent intervals. It is normally supplied with manual control. A thermostat can be used, however, if required. The company is contemplating later production of a 6 kW model.

All-Perspex Ceiling Fitting

Although they have previously specialised in table lamps, the Exchange Electrical Co., of 41, Cheetham Hill Road, Manchester, 4, announce that they have added a decorative centre-light fitting to their range. The fitting is constructed of Perspex throughout, with twisted Perspex supports and a three-hook ceiling cup. The overall diameter is approximately



Perspex hanging ceiling fitting

18 in., and it is available in three colours: clear, pink, or peach.

Air-Cooled Welding Transformers

Mobility and stepless current regulation over a wide range are features of the "Breco" air-cooled welding transformer plants, made by Brentford Transformers, Ltd. A handwheel on the top of the steel casing lowers and raises a choke core and at the same time moves a current indicator on the side of the tank. Heavy and light welding currents are available by a quick change-over of two plugs, and six standard primary connections are provided for covering all normal a.c. supply voltages. The unit is fitted with draw handle and two 8 in. wheels. The reactance, the makers claim, is sufficient to maintain a stable arc under all welding conditions, and low power consumption and good thermal rating ensure satisfactory heavy duty performance. Of the three models available, the smallest has a range of 15 to 150 A, with a continuous hand-welding current of 100 A, while the largest works over 30-300 A.

The Chicago Pile

An Experiment in the Development of Atomic Energy

THE successful operation at Chicago, on December 2, 1942, of the first self-sustaining nuclear chain reactor was an event of outstanding significance in the development of atomic energy and the following is an account of the experiment and of the scientific work which preceded it.

The success of the experiment was due mainly to Mr. Enrico Fermi, who, born in Italy in 1901, had been working with uranium for many years. In 1934 he bombarded uranium with neutrons and produced what appeared to be both element 93 and also element 94. However, after closer examination it seemed that several other elements were present, but none could be fitted into the periodic table near uranium. Five years later it was realized that fission of the uranium had been caused and the unexplained elements belonged to the middle part of the periodic table.

Mr. Fermi was awarded the Nobel Prize in 1938 for his work on transuranic elements, and he and his family went to Sweden to receive it.

From Sweden he proceeded to London and thence to America, where he has remained ever since.

AN IMPLIED POSSIBILITY

Three years before the December 2 experiment, it had been discovered that when an atom of uranium was bombarded by neutrons, the uranium atom sometimes split, or fissioned, into two parts. Later, it had been found that when an atom of uranium fissioned, additional neutrons were emitted and became available for further reaction with other uranium atoms. These facts implied the possibility of a chain reaction, similar in certain respects to the reaction which is the source of the sun's energy. The facts further indicated that if a sufficient quantity of uranium could be brought together under the proper conditions, a self-sustaining chain reaction would result. This quantity of uranium necessary for a chain reaction under given conditions is known as the critical mass, or, as more commonly referred to, the "critical size" of the particular pile.

In 1938, two German scientists, Otto Hahn and Fritz Strassman, found barium in the residue material from an experiment in which they had bombarded uranium with neutrons from a radium-beryllium source. This discovery was of interest because of the difference in atomic mass

between the barium and the uranium. Previously, in residue material from similar experiments, elements other than uranium had been found, but they differed from the uranium by only one or two units of mass. The barium differed by approximately 98 units of mass, by which it appeared that the uranium atom when bombarded by a neutron had split into two different elements, each of approximately half the mass of the uranium.

Before publishing their work in the German physical journal "Naturwissenschaften," Hahn and Strassman communicated with Lise Meitner who, having fled the Nazi controlled Reich, was working with Neils Bohr in Copenhagen.

OBSERVATIONS ON BARIUM

Meitner immediately attempted to analyse mathematically the results of the experiment. She reasoned that the barium and the other residual elements were the result of a fission, or breaking, of the uranium atom. But when she added the atomic masses of the residual elements, she found this total was less than the atomic mass of uranium.

There was but one explanation, the uranium fissioned or split, forming two elements each of approximately half of its original mass, but not exactly half. Some of the mass of the uranium had disappeared. Meitner and her nephew O. R. Frisch, suggested that the mass which disappeared was converted into energy. According to the theories advanced in 1905 by Albert Einstein in which the relationship of mass to energy was stated by the equation $E=mc^2$ (energy is equal to mass times the square of the speed of light), this energy release would be of the order of 200 000 000 electron V for each atom fissioned.

Einstein himself, nearly 35 years before, had said this theory might be proved by further study of radioactive elements.

In 1939, Bohr arrived in the U.S.A., and after an exchange of information with Fermi, the idea of the possibility of a chain reaction began to crystallise.

Before the meeting was over, experimental confirmation of Meitner and Frisch's deduction was obtained from the Carnegie Institute of Washington, the Columbia, and the Johns Hopkins Laboratories, and the University of California. Later it was learned that similar confirmatory experiments had been made by Frisch and Meitner. Frederic Joliot-Curie, in France, too, confirmed the results and

published them in the January 30, 1939, issue of the French scientific journal, "Comptes Rendus."

On February 27, 1939, Walter Zinn and Leo Szilard, both working at Columbia University, began their experiments to find the number of neutrons emitted by the fissioning uranium. At the same time, Fermi, and his associates, H. L. Anderson and H. B. Hanstein, commenced investigation of the same problem. The results were published in the April edition of the "Physical Review," and showed that a chain reaction might be possible since the uranium emitted additional neutrons when it fissioned.

DISCOVERY OF PLUTONIUM

Further impetus to the work on a uranium reactor was given by the discovery of plutonium at Berkeley, California, in March, 1940. This element, unknown in nature, was formed by uranium-238 capturing a neutron, and thence undergoing two successive changes in atomic structure with the emission of beta particles. Plutonium, it was thought, might undergo fission as did the rare isotope of uranium, U-235.

Meanwhile, at Columbia, Fermi and his associates were working to determine operationally possible designs of a uranium chain reactor. Among other things, they had to find a suitable moderating material to slow down the neutrons, since uranium 235 is most readily fissioned by neutrons travelling at relatively low velocities. In July, 1941, experiments with uranium were started to obtain measurements of the reproduction factor ("K"), which was the key to the problem of a chain reaction. If this factor could be made sufficiently greater than 1, a chain reaction could be made to take place in a mass of material of practical dimensions. If it were less than 1, no chain reaction could occur.

Since impurities in the uranium and in the moderator would capture neutrons and make them unavailable for further reactions, and since neutrons would escape from the pile without encountering uranium atoms, it was not known whether a value for "K" greater than unity could ever be obtained.

One of the first things that had to be determined was how best to place the uranium in the reactor. Fermi and Szilard suggested placing the uranium in a matrix of the moderating material, thus forming a cubical lattice of uranium. This placement appeared to offer the best opportunity for a neutron to encounter a uranium atom. Of all the materials which possessed the proper moderating qualities, graphite was the only one which could be obtained in sufficient quantity of the desired degree of purity.

THE ELECTRICIAN

The study of graphite-uranium lattice reactors was started at Columbia in July, 1941, but after reorganisation of the entire uranium project in December, 1941, the chain reactor programme was concentrated at Chicago.

By July, 1942, measurements obtained from experimental piles had gone far enough to permit a choice of design for a test pile of critical size. At that time, the dies for the pressing of the uranium oxides were designed by Zinn and made. It was necessary to use uranium oxides because metallic uranium of the desired degree of purity did not exist.

Although the dies for the pressing of the uranium oxides were designed in July, additional measurements were necessary to obtain information about controlling the reaction, to revise estimates as to the final critical size of the pile, and to develop other data. Thirty experimental sub-critical piles were constructed before the final pile was completed.

Construction of the main pile started in November. The Chicago project gained momentum with machining of the graphite blocks, pressing of the uranium oxide pellets, and the design of instruments.

FINAL OBSERVATIONS

During the early afternoon of December 1, tests indicated that critical size was being approached and shortly after, the last layer was placed. In the pile were three sets of control rods. One set was automatic and could be controlled from a balcony. Another was an emergency safety rod, attached to one end of which was a rope running through the pile, weighted heavily on the opposite end. The rod was withdrawn from the pile and tied by rope to the balcony. The rope could be cut should anything unexpected happen, or in case the automatic safety rod failed. The third rod held the reaction in check until withdrawn the proper distance.

At 9.54 a.m. the electrically-operated control rod was withdrawn; shortly after 10 a.m. the emergency rod was pulled out and by afternoon it had been established that the reaction was self-sustaining.

The rod was replaced in the pile and the neutron counters slowed down, thus indicating that a self-sustaining nuclear reaction capable of control had been initiated.

The Council of the City and Guilds of London Institute have conferred the distinction of Fellow of the Institute (F.C.G.I.) upon Messrs. Harold Bishop, Loughnan St. L. Pendred, Charles E. R. Sams, Major Gen. Alexander W. Sproull, and Sir Bruce G. White.

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

Why are both a fuse and a circuit breaker sometimes used for the protection of an industrial electric motor?

A motor may be damaged either by a sustained overload lasting for half an hour or more or by a short-circuit or earth in the windings. The current in the former case may be only $1\frac{1}{2}$ to $1\frac{1}{2}$ times the full-

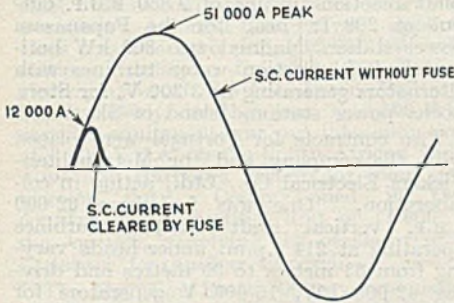


Fig. 1.—100 A fuse clearing 36 000 A (r.m.s.) current

load current but in the latter case it may, with modern conditions, amount to several thousand amperes (36 000 A r.m.s. for a short-circuit MVA of 25 at 400 V).

A high-rupturing-capacity fuse is a very cheap and convenient method of interrupting heavy short-circuit currents up to the highest values encountered in industrial practice; with the smaller sizes of fuse—up to about 200 A full-load rating—the current can be interrupted within $\frac{1}{4}$ cycle so that the short-circuit current does not have time to reach its peak value before being cut off; for instance, a 100 A fuse in a circuit with a short-circuit MVA of 25 will have broken the circuit by the time the current has reached about 12 000 A as shown in Fig. 1.

It is not practicable, however, to design a fuse which will operate reliably at currents only slightly above its normal full-load rating, for instance the above 100 A fuse could not be relied upon to clear an excess current of less than about 160 A. The ratio between the minimum fusing current and the normal full-load rated current is called the fusing factor and the above value of 1.6 is typical. A fuse will not, therefore, clear overload currents corresponding to less than about 50 per cent. overload and some other device is necessary.

An ordinary circuit breaker with an overcurrent release can, of course, be adjusted to trip quite reliably at as small an overcurrent as desired—it can also be designed to clear heavy fault currents but the time will be longer than that required with a fuse and it will not operate before the current has reached its peak value; also the cost depends on the maximum current which it has to clear under short-circuit conditions rather than on the normal full-load current.

When a fuse and a circuit breaker are placed in series the fuse will clear, almost instantaneously, any short-circuit current which may occur before the circuit breaker has had time to operate but the circuit breaker will clear any sustained overload current below the fusing current of the fuse. The circuit breaker is thus relieved of the heavy duty and can, therefore, be of fairly light and cheap construction, the total cost of the two items being less than that of a circuit breaker designed to interrupt the full fault current. The degree of protection offered by this arrangement is also greater since the fault is cleared before the current has reached its peak value thus relieving the switch itself and also the associated circuits of the high electromagnetic forces which would be set up by the peak current. It may be noted also that protection is afforded by the fuse when closing on to a fault.

For larger motors, where a fuse is not suitable, e.g., for power station auxiliary drives, the same principle is sometimes applied, two circuit breakers in series being used, one being given a high instantaneous setting to clear short circuits and the other being given a low setting with a time lag to clear sustained overloads—in some cases the second is arranged to give an alarm instead of tripping the circuit.

E. O. T.

The "Morbiham," the second motor-driven cargo liner built by Harland and Wolff, Ltd., at the Govan yard, is fitted with electrical winches throughout and her steering gear, refrigerating machinery, fans, etc., are electrically operated. Power for lighting and driving is supplied by three Diesel-driven generator sets, and a 27 B.H.P. Diesel engine drives an emergency dynamo and an air compressor. Electric welding was largely employed in the construction of the hull.

What Manufacturers are Doing—III

Generating Plant, Electric and Diesel-Electric Traction

MANY orders for steam turbo-alternator sets were added during 1946 to those already in production at the works of the English Electric Co., Ltd., at the beginning of the year. Those for home installations included a third 50 000 kW, 3 000 r.p.m. set with hydrogen cooled alternator for Birkenhead power station, a third 15 000 kW set for the Cornwall Electric Power Co., at Hayle, and two 20 000 kW units for the Peterborough Corporation.

Among overseas contracts were those for two 31 500 kW, 3 000 r.p.m. units and two further 6 250 kW pass-out sets, for the refineries of the Anglo-Iranian Oil Co. at Abadan and Haifa, respectively; two 30 000 kW, 3 000 r.p.m. units for Pretoria City Council; one of 4 000 kW for the Vryheid Coal and Iron Co., South Africa, and a 1 000 kW unit for the United Africa Co.; a third 15 000 kW unit for the Cawnpore Electric Supply Corporation; a 15 000 kW unit for the Government of Madras electricity department and one of 6 000 kW for the India stores department. As part of the complete electrification of a large cotton and jute mill in Madras, undertaken by the company, the manufacture of two 4 000 kW pass-out type turbo-alternator sets has been in progress for supplying power and process steam. Commissioned during the year were two fur-

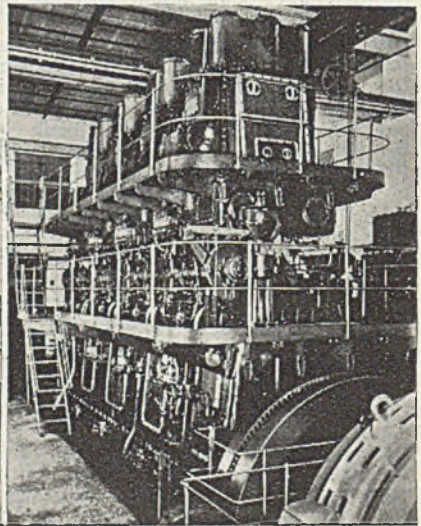
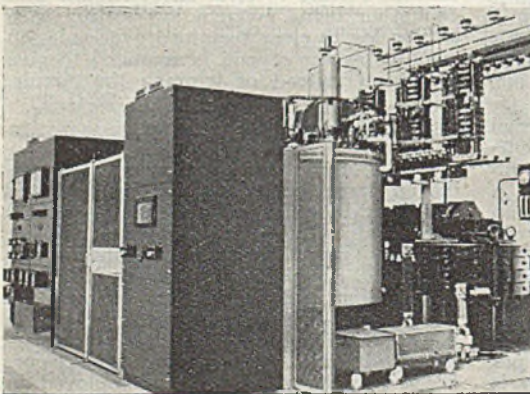
ther 25 000 kW pass-out type turbo-alternator units for the U.S.S.R.

In connection with hydro-electric development, contracts were received for the fifth and last generator to be installed in Waitaki power station, New Zealand, of 15 000 kW capacity, running at 125 r.p.m.; two units of the horizontal shaft reaction type, each of 5 000 kW capacity, for the Malakand power station, India; a vertical shaft reaction turbine of 9 850 B.H.P. output at 298 ft. head for the Papanasam power station, Madras; two 800 kW horizontal shaft reaction water turbines with alternators generating at 3 300 V, for Storr Lochs power station, Island of Skye.

Two contracts for Portugal were placed with the company and the Metropolitan-Vickers Electrical Co., Ltd., acting in collaboration. One was for three 62 000 B.H.P. vertical shaft reaction turbines operating at 214 r.p.m. under heads varying from 53 metres to 95 metres and driving 42 000 kW, 15 000 V generators for the Castelo do Bode station of Hidro-Electrica do Zezere of Lisbon, each turbine to be capable of an output of 73 000 B.H.P. The other contract has been placed by Hidro-Electrica do Cavado, for Vila Nova power station, for three horizontal shaft, four-jet, twin overhung impulse turbines, each developing 36 000 B.H.P. at the average head of 366 metres, and driving a

Below: Mercury-arc rectifier equipment, 2 500 kW, 3 000 V d.c., on the S. African Railways and Harbours system

Right: A 3,275 B.H.P. 8-cylinder, two-stroke "Fullagar" Diesel engine for Bernuda



25 500 kW, 11 000 V generator at 428 r.p.m.

A feature of the year's activities was the number of Diesel engines required for service overseas. In addition to one 8-cylinder, 3 275 v.h.p., "Fullagar" engine and alternator already in course of manufacture for the Bermuda Electric Light Power and Traction Co., a similar set was ordered by the company. The 750 r.p.m. "RK" range of Diesel engines are now available for industrial, traction and marine work in the naturally aspirated and turbo-pressure-charged form.

A large volume of orders were received for all classes of switchgear.

A substantial proportion of the large number of orders received for pumpless steel bulb mercury-arc rectifiers came from overseas. Amongst the railway applications was one involving a 12 000 kW substation installation for the 3 000 V d.c. electrification of the Sao Paulo Railway, Brazil. Early in the year a 2 500 kW rectifier equipment was put into operation at 3 000 V d.c. on the South African Railways and Harbours system for main line traction duty. Commissioned in this country was a rectifier unit of 11 000 V d.c. output, supplying the oscillator of a cyclotron for nuclear research.

The Egyptian State Railways entrusted the company with the supply of 19 Diesel-

electric five-coach trains, three Diesel-electric three-coach trains, and a two-coach royal train for the personal use of King Farouk; the Sao Paulo Railway, Brazil, placed a contract for the electrification of their line from Sao Paulo to Jundiaby; and the New Zealand Government Railways signed a 10-year contract with the company for the supply of electric multiple unit stock and electric locomotives, to meet an extensive electrification programme. The company is also to supply to the Great Indian Peninsular Railway 32 two-coach multiple-unit trains for their 1 500 V electrified system.

To meet the big demand for fractional h.p. motors, a special $\frac{1}{4}$ h.p. split-phase motor was introduced.

A substantial increase was shown in the output of fusegear. Deliveries for export increased by 70 per cent. A new range of cartridge fuse links for use in the E.D.A. house service cut-out is in production.

The year 1946 witnessed a change in direction of the marine activities of the company from Admiralty work to the construction of a variety of machinery for commercial use. On the merchant side, propulsion activities have been chiefly centred round Diesel-electric drive, of which the company manufactures both the Diesel engines and the electrical equipment.

Industrial Information

B.E.A.M.A. Price Adjustment Formulae

For purpose of calculating variations in (a) rates of pay, consequent on the reduction of the working week from 47 hours to 44 hours, the rate of pay for adult male labour at January 6, 1947, shall be deemed to be 110s.; (b) costs of material, the index figure for intermediate products last published by the Board of Trade on December 14, is 201.8, and is the figure for the month of November, 1946.

Physical Society's Exhibition

The Physical Society has planned to hold the thirty-first exhibition of scientific instruments and industrial apparatus from April 9 to 12 inclusive, instead of, as customary, this month, in the physics and chemistry departments of Imperial College, South Kensington, London, S.W.7. Tickets will be obtainable early in March from Fellows of the society, and from exhibiting firms.

Radio Equipment for Turkey

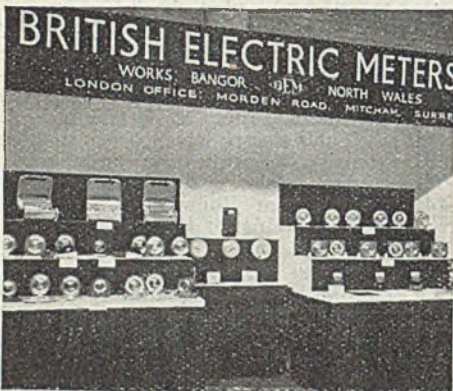
Standard Telephones and Cables, Ltd., have secured an important order from the Posts and Telegraphs Department of the

Turkish Administration for long distance radio telephone and telegraph communication equipment. The order provides for two major radio stations at Ankara and Istanbul, respectively, which will give facilities for telephone links with London and New York using the most modern systems and apparatus. The stations further provide for an extensive system of radio telegraphy operating from Turkey to Europe, America and the Near East. The value of the order approaches £400 000. It has been secured against competition from other firms, including American.

Avoiding Electricity Cuts

In connection with its campaign planned to persuade the public to use electricity only at "off-peak" periods and help to avoid "cuts" the E.D.A. has issued three leaflets explaining why this winter is the most critical that the electrical industry has had to face and advising the housewife and others how and when to use electric cookers, water heaters and heating appliances to the best advantage, and shift the domestic demand without inconvenience. Another leaflet entitled

"Electricity—Your Servant in Every Room," tells how many little things the



Part of the stand of British Electric Meters, Ltd., at the Welsh Industries Fair. Electric clocks, fires and service meters are the main products shown

electrical industry can provide to ease the burdens of house work, and to enhance the enjoyment of rest and recreation.

New Carlisle Factory Opened

A new factory has been opened in Junction Street, Carlisle, by Smith and Co., electrical engineers. The opening ceremony was performed by Mr. J. Henderson, M.P., and others present included Mr. A. C. Thirlie, city electrical engineer; Mr. A. R. Hill, chief electrical engineer, United Steel Co.; Mr. J. R. Potts, and Mr. E. Grierson, M.P. for Carlisle.

New Guard Posts for Westminster

The Tube Investments Group subsidiary, Gowshall, Ltd., have received an order for 600 electrically illuminated "Keep Left" guardposts designed according to the Report of the Departmental Committee on Traffic Signs and approved by the Ministry of Transport for erection in the City of Westminster. The new guardposts, which will be installed steadily, are 4 ft. high, both the upper and lower glass panels being illuminated. They are the result of development on the part of Tube Investments, Ltd., working with, among others, the public lighting engineers of the supply companies, and Central London Electricity, Ltd.

Exchange of German Information

Hundreds of thousands of important German scientific and technical documents have been uncovered by British and American investigators in their respective zones, and microfilm copies have been made. Under a new exchange arrangement representatives of each nation will be able

to select from each other's storehouse of reports the items which they find valuable. Copies will be obtained on an exchange basis. In London, the main processing centre for German documents is the Board of Trade, German Division (Documents Unit), which is located at Lansdowne House.

The "Queen Elizabeth's" Telephones

The telephone installation of the Cunard White Star liner "Queen Elizabeth," was designed by engineers of the General Electric Co., Ltd., working in close collaboration with the owners and builders. The installation consists of a manual switchboard, for three operators, telephones in all parts of the ship for either passenger or staff use, and provision for shore calls by land-line extension when the ship is in port and by radio link when at sea. The switchboard serves 610 lines and has a capacity for extension to 710 lines. Four hundred and seventy-two cabins are equipped with ivory Gecophones, each of which is fitted with a small plug to enable it to be connected to alternative sockets in the cabins to suit the convenience of passengers. There is a pantries-to-kitchen auxiliary telephone system. The switchboard, of which two panels of position "two" are shown in the illustration, is fitted athwart ship and is specially designed to help the operators in providing speedy connections for room service. All



Two panels of the G.E.C. 3-position switchboard on the "Queen Elizabeth"

lines, except the cabin lines, are designated in groups on the vertical stile strips, whilst the stile strips for the cabin lines indicate the deck and also the side of the

ship served. A system of colour coding groups of cabins still further facilitates service. Duplicate sets of twelve-cell batteries serve the switchboard, one set being in service whilst the other batteries are being charged by a motor generator

such shots must be fired electrically, in series.

Lighting a Blanket Mill

A new fluorescent lighting scheme has been put into operation at the blanket mills of Smith and Phillips, at Whitney. Part of the scheme is shown in the photograph reproduced on this page, which illustrates a weaving shop illuminated at night. There are some 70 looms over each of which is a Revo "Truflite" reflector with an Osram 80 W tubular fluorescent lamp. Each fitting is mounted 4 ft. 6 in. above the working plane, and the degree of illumination provided averages 30 l.p.f. (This reading was taken during the first 100 hours and may fall slightly.) The previous tungsten illumination varied in intensity from 5/15 l.p.f. To provide maximum reflection



New fluorescent lighting scheme in the weaving shop of a blanket mill

and distribution of light the walls of the shop are coloured cream and the ceilings white, and consequently there is no "tunnel" effect. The "Truflite" reflectors used throughout the installation, have all operating gear enclosed in the ends, and facilities for easy cleaning, relamping and removal, and were made by Revo Electric Co., Ltd., Tipton. The installation was planned and carried out by Hill, Upton and Co., Ltd., of Oxford.

E.D.A. Sales Conference

The British Electrical Development Association announces that the date of the next E.D.A. Sales Management Conference in London has been fixed for May 7, 8 and 9 this year.

Change of Address

Due to the increase in the activities of the Aluminium Development Association and the consequent expansion of the staff, it has been found necessary to move from 67, Brook Street, W.1., to 33, Grosvenor Street, London, W.1. (Telephone: Mayfair 7501.)

E.I.B.A. Northern Area Meeting

The annual general meeting of the Northern Counties Area of the Electrical Industries' Benevolent Association will be held on Thursday, January 23, at 3.30 p.m., at the Royal Station Hotel, Neville Street, Newcastle-upon-Tyne, 1, under the chairmanship of Mr. J. Clement.

Explosives in Mines

The Explosives in Coal Mines Order, 1946, amends Clause 6 (g) of the Explosives in Coal Mines Order, 1934. It provides that in stone drifts shots must be fired electrically, in series; simultaneous firing may now be adopted in any other part of the mine with the prior permission of the Chief Inspector of Mines, and all

such shots must be fired electrically, in series.

Lighting Equipment on Royal Train

During the war two new saloons for the use of the King and Queen were added to the L.M.S. Royal train. Built at the company's carriage works at Wolverton, both have air conditioning and temperature control equipment. Normally the lighting is supplied by generating plant consisting of two internal combustion engines direct coupled to two 35 kVA three-phase alternators delivering current at 250V, 50 cycles. A "Keopalite" emergency lighting set is provided on each saloon as a precaution against interruption of the main supply. The lighting supply is at 50 V through a transformer divided into three sections on the low voltage side, one of which is connected to a "Keopalite" equipment, which includes a 50 V Exide Ironclad emergency battery. A special feature of this equipment is the automatic contactor which functions in the event of interruption of the main supply, automatically and instantaneously switching over the lighting circuit from the main supply to the battery. The power brake car, which accommodates the

generating sets, has 50 V lighting also provided by a "Westat" reactor and a battery of 23 Exide Ironclad DCL4/F cells, the latter floating across the load and supplying current when the generators are at a standstill. Apart from lighting, the batteries supply current for the operation of a 25-line automatic telephone system, a buzzer call system for the staff, and loud speaking telephones for communication between the train guard and locomotive crew.

Electrical Orders from Turkey

The Turkish Government has placed with the Metropolitan-Vickers Electrical Co., Ltd., and other north-west firms orders for electrical switchgear and rolling stock to the value of £7 000 000.

New Factory Site

Raymond Electric, Ltd., have acquired a two-acre site on the Bromborough Port Industrial Estate, where they propose to build a radio factory likely to give employment to 275 persons.

Social News

The staff of Metway Electrical Industries, Ltd., King Street, Brighton, numbering some 150, were the guests of the directors at a dinner and dance at the Savoy Restaurant, Brighton, recently. They were welcomed by Mr. D. G. E. Barrie, managing director, who referred to the firm as the largest in the country in its own particular sphere of business. Mr. D. McEwan, general manager, replied. The toast of "The Visitors" was proposed by Mr. Still and acknowledged by Mr. W. Seymour.

Line Laying in Turkey

With ex-Service Humber four-wheel drive chassis, and bodies recovered from a dump, nine volunteers at the G.E.C. Telephone Works, Coventry, are building seven motor vans enabling the company to comply with the terms of a £500 000 order from Turkey for telephone equipment. This involves the laying of new lines over a wide area of wild country, and no transport is available. The first of the vans is now ready for despatch. Two teams of technicians will be sent to Turkey by air. They will spend from four to six months making preliminary investigations and will use these vehicles, which will also serve the installation engineers later.

Scientific Aids for War-Blinded

The thirty-first annual report of St. Dunstan's for the year ended March 31, 1946, states that there are 1 673 blinded survivors of the first world war living today, and as a result of the late war 666

young men and 20 young women have been added to the numbers. Some have lost one or more limbs, or hearing as well as sight. Inventions to help them range from simple devices such as the striking clock to an elaborate telephone switch-board which can be operated by hearing and with metal fingers. Unusual scientific research has been initiated to study the substitution of sight by other senses. The possibilities of a guiding device, which might be to the blind man what a pocket torch is to the seeing, and a machine which will read ordinary print in an understandable language, are among the subjects being studied and upon which some preliminary work has been done.

Polish Contract for Britain

The Automatic Telephone and Electric Co., Ltd., has signed its biggest post-war contract to supply Polish cities with telephone and electrical equipment, it was announced on Tuesday. The amount involved is about £600 000. The contract marks the renewal of the company's friendly relations with Poland. Before the war it held a large long-term contract for installing telephones in Polish cities.

B.S. for Lifting Tackle

We have received from the British Standards Institution a copy of their new B.S. Handbook No. 4 (price 12s. 6d. net, post free), embodying British standards for those portions of lifting tackle which suspend or carry a load and are in common use with a large variety of lifting appliances, from mammoth cranes to contractors' winches and from fibre rope to heavy chain slings. Statutory requirements under the Factory Acts are also included.

The "Henley Telegraph"

The winter issue of the "Henley Telegraph," published by the W. T. Henley's Telegraph Works Co., Ltd., contains details of appointments, retirements and other personal happenings, and accounts of educational, social, recreational and sports activities, and is accompanied by a supplement giving a record of 77 employees of the Henley organisation who sacrificed their lives in the late war.

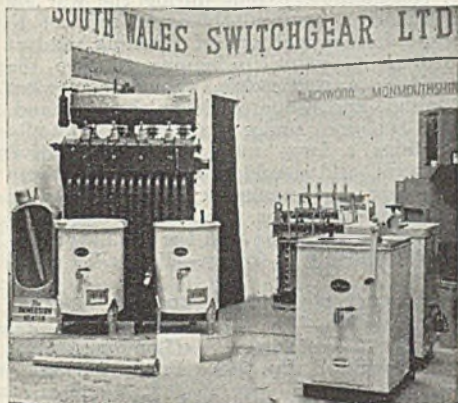
Heaton Works Journal

The Christmas number of the journal of C. A. Parsons and Co., Ltd., contains a number of particularly interesting features admirably illustrated. Technical articles include a paper by W. D. Horsley on "Turbo-alternator Rotor Coil Shrinkage," presented before the "Conference Internationale des Grand Réseaux Electriques in Paris in June; and "The use of Metals Under Stress at High Tempera-

tures," by J. M. Robertson. Under the heading "Work in Hand," details are given of important home and overseas orders received by the company.

Sale of Machine Tools

A two-days' auction sale of 600 machine tools will be held at the M.O.S. Depôt, Queens Road, Kilmarnock, Ayrshire, on



Part of the stand of South Wales Switchgear, Ltd., at the Welsh Industries Fair in London

Tuesday and Wednesday, January 28 and 29, commencing each day at 11 a.m. These machine tools are located in the above depôt and at the Portland Road depôt, Irvine, and may be viewed upon production of a catalogue, between 9.30 a.m. and 4.30 p.m., seven days prior to the sale.

I.M.E.A. New Address

The address of the Incorporated Municipal Electrical Association is now "Kingsway House," 103, Kingsway, London, W.C.2.

Adoption of Five-day Week

The works of the Jackson Electric Stove Co., Ltd., at Luton, will be closed on Saturdays owing to the adoption of the five-day week. The head office at 143, Sloane Street, London, S.W.1 (Telephone: Sloane 6248), will also be closed on Saturdays.

A.S.E.E. Lecture Meetings

The Association of Supervising Electrical Engineers announces that it has been found necessary to alter the dates of the January and February lecture-meetings. That arranged for Tuesday, January 21, will take place on Thursday, January 23, and the one planned for Tuesday, February 18, on Wednesday, February 19.

Trade Publications Received

Illustrated leaflets, D.F. 101 and D.F. 102, describing a new range of Aircon

fans for the ventilation of the home, office, and factory, issued by Air Conditioning and Engineering, Ltd., 3, Bayley Street, Tottenham Court Road, London, W.C.1.

New folders issued by the International Time Recording Co., Ltd., International Works, Beavor Lane, Hammersmith, London, W.6, describing their time recorders, electric time units and systems, and other products.

An illustrated booklet, published by Standard Telephones and Cables, Ltd., describing the studio equipment at Radio House, Copenhagen. The design of this broadcast equipment was the result of close co-operation between engineers of the Danish Broadcasting Administration and those of the Standard organisation.

A catalogue from the Coventry Gauge and Tool Co., Ltd., Coventry, giving details of their "Matrix" No. 33, bench thread grinder which is designed primarily to meet the needs of the manufacturer of small scientific instruments. It incorporates the multi-ribbed wheel principle and threads of any required form can be produced. The machines are supplied complete with all electrical equipment.

Schoolboys' Exhibition

After a forced interval of seven years, the Schoolboys' Own Exhibition returned to London, on January 4, when it was opened at the Central Hall, Westminster. The emphasis in this first post-war exhibition was largely on careers for boys leaving school, and various professional bodies, as well as the three fighting Services, had stands at which advice on entry and recruitment was available. On the stands representing the Services, there were several items of electrical interest, including the firing mechanism from a German magnetic mine, an Army tank wireless set and—in an exhibit illustrating the training of electrical apprentices at the boys' training depôt, Arborfield—a cathode-ray oscillograph, examples of instrument repair work, cable jointing and miscellaneous electrical components. A popular model was that of the driving cab of a London tube train, full-size, and among other exhibits in the railways section were a coloured-light signal, which could be operated by visitors, and a working model of a station escalator. A model boat, remotely controlled by short-wave radio, was an unusual feature of another stand, on which was, also, a teleprinter. One of the largest displays was that of Cable and Wireless, Ltd., who were giving working demonstrations of message transmission and radio picture telegraphy, and also showing an eight-foot long model of their new cable repair ship, the "Edward Wilshaw," now under construction.

Book Reviews

Engineering Radiography.—"Mechanical World" Monograph No. 26. (Manchester: Emmott and Co., Ltd.) Pp. 57, with 38 figs. Price 2s. 6d. net.

The application of radiographical methods to industry has been relatively slow to take root in this country, but it is becoming generally recognised, to-day, that X-rays, as a means of analysis and inspection, have a useful part to play in many kinds of manufacture. It seems certain, therefore, that an increasing number of engineers will, in the future, find themselves confronted with apparatus of which they know little, and for these the present volume will form a valuable primer. The author sketches the fundamental principles of X- and gamma radiations, describes the types of equipment most likely to be encountered, and then explains, in a most useful chapter, the methods of examination most suited to specific purposes. A short chapter on the special advantages of gamma-ray inspection follows, after which an introduction is given to the technique of crystal analysis. The safety precautions to be observed in conjunction with the work are emphasised, and the book ends with an illustrated chapter on "Applications." The book is not, and makes no claim to be, other than an introduction: as such, it is successful.

Questions and Answers on Alternating Current Work.—By E. MOLLOY. (London: George Newnes, Ltd.) Pp. 144. Price 5s. net.

The book contains about 300 questions divided into sections covering a.c. theory and calculations, power generation and measurement, transformers, rectifiers and converters, protective devices, lighting, motors, welding, a.c., heating and electronics. As the questions include such inquiries as "What is the usual frequency of an a.c. supply?" "Describe the principle of the three-phase commutator motor," and "Describe the principle and operation of the betatron," it will be realised that the range permits only superficial treatment. The answers vary in length from a few words to half a page or more, and all mathematics other than a little simple arithmetic are avoided. The over-simplification results, in some cases, in misleading statements as, for instance, when it is said that the three types of relay used in protective gear are directional, impedance and impedance-time relays. Fig. 32 shows a single-phase induction regulator but gives the vector

diagram appropriate to a three-phase unit and the captions for Figs. 47 and 48, illustrating balanced protective gear, have been interchanged. The "Question and Answer" method of training was used to a considerable extent during the war by the Forces, particularly as an adjunct to more formal methods of teaching, and it proved its value in helping to give the trainees a serviceable, though somewhat limited, knowledge of the subject in hand. The volume under review undoubtedly contains a large number of informative answers, and should prove useful to those who are just commencing evening class or other studies or who are starting practical work and who find the ordinary textbooks difficult to follow.—E. O. T.

Principles of Direct Current Electric Traction.—By D. W. HINDE and H. E. INGHAM. (London: George Newnes.) Pp. 248. Price 15s. net.

The recently published plans for the further electrification of the Southern Railway and work in progress on the railways in the eastern suburbs of London lend interest to the present volume. Although the book includes tramway and trolley-bus equipment, it is mainly devoted to railway work, and is the first publication to appear on this subject for a number of years. The title would perhaps have been more explicit had it been "The Practice of . . ." instead of "Principles of . . ." since, apart from an introductory chapter on the principle of the d.c. motor, the matter contained is largely descriptive of the plant in use. It covers motors, control gear, auxiliary equipment (brakes, lighting, etc.), rolling stock and collector gear, together with short chapters on Diesel-electric traction, testing and service maintenance and on the Metadyne equipments of the London Passenger Transport Board. The text is lucidly written and, apart from pure description, explains the functions of the various items dealt with and discusses clearly the relative merits of various alternatives where such exist. Most of the plant described is naturally of British manufacture, although such well-known items as the Buchli drive are also included. There are over 180 diagrams and photographs. The book gives an excellent outline of present British practice, and can be recommended to students of electric traction and also to railway and road transport engineers who are associated in any way with electrification projects.

Electricity Supply

Tottenham.—Wiring of flats, at a cost of £2 997, is to be carried out by direct labour.

Worthing.—As the deficit is now about £1 200 per annum, the Electricity Committee is to increase charges for hired apparatus. Kettles, originally supplied free, are to be charged at 1s. 6d. per quarter.

Hull.—An estimate of £80 000 for electricity and heating improvements in the schools has been approved. The Highways Committee is to instal sodium vapour lighting in Blackburn Road, at a cost of £2 556.

Liverpool.—Preparations are being made to close down the Formby power station, which has been used to supply the L.M.S. Liverpool-Southport-Ormskirk line. The supply is now being given by the Liverpool undertaking, which also feeds the Formby urban district. The distribution system is being modernised.

Stanhope (Co. Durham).—At the annual meeting of the Parish Council it was announced that plans for supplying electricity to many hamlets and districts were being held up through shortage of poles. Supplies will eventually be extended at Stanhope, Westgate, Rookhope, St. John's Chapel, Wearhead, Huntshieldsford, and Cowhill.

Tottenham.—The Health Committee is to purchase 208 refrigerators at a cost of £3 432 for council houses and proposes to charge each tenant for a period representing the "life" of the appliance. This is estimated at 10 years. To meet the cost of £16 10s. with interest at 2 per cent. within that period a weekly charge of 8½d. will suffice.

Colwyn Bay.—Tariffs have been amended as from the first reading of the meters after January 1, as follows: Colwyn Bay: all-in tariff reduced to 12½ per cent. on rateable value plus ⅔ of a penny per unit; lighting (prepayment) reduced from 5d. to 4¾d. per unit; power (prepayment) reduced from 1½d. to 1d. There are also reductions in Penrhyn Bay and Glan Conway.

Shoreditch.—The Town Council recently approved the carrying out of the first stage of the change-over of the l.t. system from d.c. to a.c., which will deal with about one-third of the supply area. The estimated cost of the work, which includes sub-station buildings and plant, e.h.t. and l.t. mains, meters and alterations to consumers' apparatus, is £355 000. Application is to be made to the Commissioners for sanction to borrow this sum.

Basingstoke.—The net profit of the electricity supply undertaking for the year was

£7 051, compared with a loss of £521 during the preceding year. This position was brought about as a result of the adjustment of tariffs, which became fully effective during the year, the percentage addition to the standard charges yielding additional income to the extent of £8 400. The units sold amounted to 11 675 864, a drop of 1 523 090 on the previous year.

Barnstaple.—Plans of the C.E.B. for the improvement of generating facilities in South-West England have taken a step forward with the surveying of suitable sites in the Barnstaple area. One site under consideration is alongside the tidal waters of the River Taw at Lower Ye'land, and trial borings of the marshy land are already being made. Apart from the prospect of a new station, it is stated that a new h.t. transmission line is to be erected between Barnstaple and Taunton. Work on the latter is expected to commence shortly.

Huddersfield.—Forthcoming developments will cost £212 000. This includes £161 790 for the installation of a second ring main for the strengthening of the distribution system, which will involve the building of a new switch house, the provision of sub-stations at Birkby and Dalton and the installation of an interconnector between the stations. The Council is to spend £20 000 for mains and services, £10 000 for 14 new power transformers and £18 508 for supplying electricity to 254 houses on the Fernside Avenue estate.

Middlesex.—Reporting to the Education Committee on the question of the installation of fluorescent lighting in schools, the Council Medical Officer stated that where such lighting was planned by experts, it was of great value to schools which were at present inadequately lighted or which were used at night. There appeared to be no evidence that it was in any way harmful on medical grounds. In schools and colleges used for evening classes it was considered that fluorescent lighting will be more economic, whereas in the normal secondary schools it is considered that tungsten filament lighting will involve less overall expense.

Hornsey.—Some interesting figures illustrating the growth of the undertaking are contained in the Chief Electrical Engineer's annual report. Over a period of ten years, the number of consumers has increased by 38.8 per cent., units sold by 71.7 per cent. and the total income of the undertaking by 96.6 per cent. The average price per unit sold, in the same period, rose from 2.02d. to 2.30d., an increase of 13.85 per cent. The average units per consumer rose from

650 to 804 (23.7 per cent.) and the average connected load per consumer from 1.28 kW to 1.93 kW (50.7 per cent.), while the ratio of connected to demand load increased by 48.3 per cent., from 3.31 to 1, in 1935, to 4.93 in the last financial year. This latter comparison is reflected in the undertaking load factor, which shows, over the ten years, an improvement from 23.6 to 29.8. Since the power station was bombed in November, 1944, all energy has been imported from the grid under an agreement with the London and Home Counties J.E.A. Units sold during the year 1945-46 were 23 323 069, of which 52.4 per cent. was supplied under the all-in tariff, and the total income amounted to £224 323. A gross profit of £60 838 and net surplus of £1 261 are recorded. Reserve and suspense accounts total £39 098, revenue balance £10 306 and reserve fund £53 660.

Douglas (I.O.M.).—On account of the increased cost of labour and material, the Electricity Committee has increased the payment to contractors for cooker wiring from 1s. 10d. to 2s. per ft. run.

Brighton.—Having received directions to proceed with the extensions at Southwick power station, the Electrical Engineer reports that he is now able to submit the following estimates, totalling £7 555 000: Building and civil works, £1 790 000; generating plant, £1 114 000; boiler plant, £2 880 000; coal and ash-handling plant, £175 000; circulating water system, £432 000; switchgear, £210 000; general electrical works, £200 000; other works, £67 000; and contingencies fees, etc., £687 000. The Engineer has discussed with the C.E.B. the most expeditious way of dealing with the large contracts, and it has been agreed that direct negotiations with single firms be carried out as follows: boiler plant, Babcock and Wilcox, Ltd.; turbo-alternators, Metropolitan Vickers Electrical Co., Ltd., with sub-contractors for the condensing and feed heating plant; main and auxiliary transformers, English Electric Co., Ltd.; chlorinating plant, Wallace and Tiernan, Ltd. For coal handling plant, ash and flue dust disposal plant, steam and feed pipes, and main inlet circulating water screens, competitive tenders are to be invited. This list is not yet complete, and excludes the main civil engineering and constructional work, for which it is proposed to compile a register of some six firms.

Ipswich.—A surplus of £10 040, compared with £11 486 in the previous year, is shown in the annual accounts of the electric supply department. Income from sale of electricity amounted to £424 711, from miscellaneous sources £35 646, and from installations and consumers' service, £28 549, making a total of £488 906.

Expenditure included working expenses of £376 619, installation and consumers' service of £26 570, and provision for income tax, interest, etc., and repayment of loan £75 677, making a total expenditure of £478 866. Units sold during the year amounted to 90 105 729, an increase of 3.7 per cent. on the previous year's total of 86 886 953, and the average price received per unit was 1.131d., against the previous year's average of 1.986d., the increase being due entirely to the coal excess charges following increased coal prices. There were no alterations in tariffs or rental charges during the year. The generating station was in operation for 40 per cent. of the hours of the year, a total of 38 916 500 units being generated, and the maximum demand was 22 410 kW. Load was shed on three occasions. In his statement, the chief engineer and manager, Mr. G. A. Vowles, says that much of the coal received under the global allocation scheme was unsuitable for the plant installed, and the year's consumption of coal, amounting to some 33 000 tons, was made up from over 30 different qualities. In addition to a quantity of coke, 450 tons of sawdust were burnt. Work on the construction of the new generating station at Cliff Quay was well advanced, and every effort was being made to adhere closely to the commissioning dates, which provided for 90 000 kW to be available for the winter of 1947-48 and 180 000 kW by the following winter. A long term extension to the 33 kV system was contemplated.

Electrical Machines:—Concluded from p. 119.

of asbestos or woven glass. The space inside these machines is generally very limited and the coils in consequence are usually given a final pressing in suitable moulds after all taping is finished. This accounts for the clean-cut appearance of such coils.

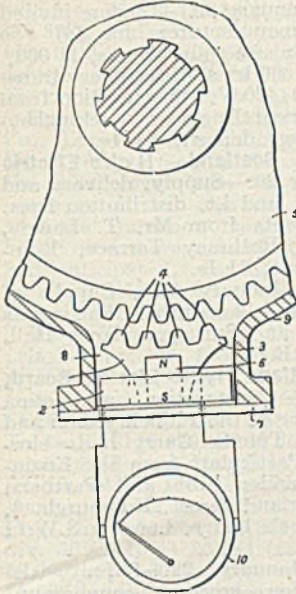
Fig. 12 is included for the purpose of showing the care taken to exclude dirt and moisture from every part of the winding. The connections entering the coils are so bulky because they are liberally coated with an insulating putty before being taped up. Some of the putty is squeezed out by the tape and helps to seal between the layers.

Acknowledgments.—With reference to Part XVIII in this series, published in *THE ELECTRICIAN* of December 27, the photograph of which Fig. 8 is a reproduction was supplied by the British Thomson-Houston Co., Ltd., and that from which the illustration in Fig. 10 was made was supplied by the General Electric Co., Ltd.

Electrical Inventions

Magnetic Speed Indicator

An electro-magnetic speed indicator is described, suitable for use on motors, aero-engines or any moving apparatus incorporating a toothed reduction gear.



The magnetic circuit consists partly of the gear wheel and partly of a pick-up device mounted on the base 7. The pick-up itself consists of a short magnetic core 1 carrying a winding 2 at one end and an enlarged pole-piece 3, at the other. The pole-piece is provided with four teeth 4 of the same pitch as those of the spur gear-wheel 5, with which the pick-up co-operates and which forms, for instance, part of the main reduction gear. The teeth 4 are disposed longitudinally along part of a cylindrical surface of appropriate radius. A short permanent magnet 6 polarises the core 1.

The indicating instrument may be of the moving-iron or moving-coil rectifier type, with a dial calibrated in r.p.m. It may be provided with an adjustment, such as a variable magnetic shunt in a moving coil-instrument, for compensation purposes.

General Electric Co., Ltd., and H. C. Turner and T. A. Rudge. Application date, September 15, 1944. No. 582 694.

Under-Water Arc-Welding

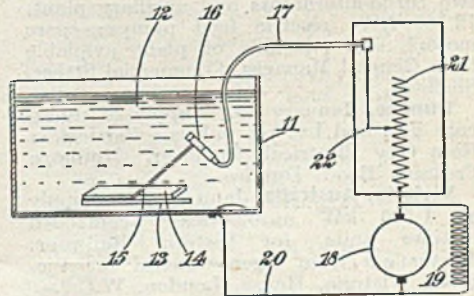
The specification points out that it is normal practice when arc-welding in air to employ a generator with a high open-circuit voltage and a steeply falling voltage characteristic, this property tending to secure arc stability. In welding under water, particularly salt water, it is stated, such a method has been found not entirely to meet the conditions, as the arc becomes much less stable than in air.

Increased stability, it is claimed, can be obtained by employing a generator with

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

an open-circuit voltage high enough to afford the maximum desired voltage at the arc, yet with a constant voltage characteristic. In series with the generator and the electrode is placed a resistance, so that at the maximum rate of current flow it will reduce the voltage at the arc to the working value. With this arrangement, any tendency of the current to fall off is immediately compensated by an increased arc voltage, whereas with previous methods, a delay existed.

In the application described, 11 represents a tank containing water 12 beneath the surface of which are two plates 13, 14 to be welded together. An electrode 15 is held in an insulated holder 16 and supplied through the cable 17 from the generator 18. This generator has a shunt field winding 19, and its voltage falls only slightly, therefore, as the load increases. One pole of the generator is connected by a line 20 to the tank 11 and the other pole (usually negative) is connected through a variable resistance 21 to the cable 17.



The generator is designed to have an output voltage on open-circuit of about 90-100 V and the resistance 21 is adjusted so that when the arc is taking its full current the voltage will fall between the generator and the electrode 15 to a value of about 25/35 V.

Under Water Welders and Repairers, Ltd., and R.H.F. Boot. Application date, April 12, 1944. No. 582 769.

Contracts Open

WE give below the latest information regarding contracts for which tenders are invited. In the case of overseas contracts, particulars are to be had from the Board of Trade, Millbank, London, S.W.1 (corner Horseferry Road), unless otherwise stated:—

Manchester, January 13.—Supply and delivery over 12 months ending January 31, 1948, of electric water heaters. Specification from Chief Engineer and Manager, Electricity Department, Town Hall, Manchester, 2; deposit, £1 ls.

Hastings, January 13.—Manufacture, supply and delivery of two 2 000 kVA Scott-connected transformers, and two switch kiosks. Specifications from Borough Electrical Engineer and Manager, 12 and 13, York Buildings, Hastings.

Kingston-upon-Thames, January 13.—Supply and delivery of self-interlocking type underground cable covers. Specification from Borough Electrical Engineer, 17, High Street, Kingston-upon-Thames.

Manchester, January 13.—Supply, delivery and erection, over period of two years, with option to terminate at end of first year, of 6.6 kV sub-station switchgear. Specification from Chief Engineer and Manager, Electricity Department, Town Hall, Manchester, 2.

Elland, January 14.—Electrical work in 50 permanent houses at Greetland. Particulars from Engineer and Surveyor, Council Offices, Elland; deposit, £2 2s.

Sheffield, January 15.—Tenders for purchase and removal of redundant plant from Neepsend power station, including two turbo-alternators and ancillary plant, 12 500 kW; electric feed pumps; spare motors, etc. Details of plant available from General Manager, Commercial Street, Sheffield, 1.

Dundee, January 15.—Supply of multi-core h.v. and l.v. p.i. cables. Particulars from City Electrical Engineer, Dudhope Crescent Road, Dundee.

Victoria, Australia, January 15.—Supply of 1 500 kW automatically controlled rectifier units, for Victoria Railways. Particulars from Agent-General for Victoria, Victoria House, London, W.C.2.

Newark, January 16.—Supply and delivery of p.i. and armoured cable, for electricity department. Particulars from Borough Electrical Engineer, Municipal Buildings, Baldertongate, Newark, Notts.

Newton-le-Willows, January 17.—Supply and delivery of two 11 kV switchboards. Particulars from Electrical Engineer, Electricity Offices, Old Town Hall, Newton-le-Willows, Lancs.

Burnley, January 20.—Supply and de-

livery of (a) e.h.t. cables; (b) transformers. Particulars from Borough Electrical Engineer, 43, Grimshaw Street, Burnley.

Kettering, January 20.—Tenders invited from British manufacturers for (a) two 400 kVA three-phase transformers, 11 000/420 V; (b) six 500 kVA, three-phase transformers, 11 000/420 V. Specification from Borough Electrical Engineer, Rockingham Road, Kettering; deposit, £1 ls.

North of Scotland Hydro-Electric Board, January 20.—Supply, delivery and erection of h.t. and l.t. distribution lines. Tender documents from Mr. T. Lawrie, Secretary, 16, Rothesay Terrace, Edinburgh, 3; deposit, £1 ls.

Camberwell, January 20.—Supply of electric lamps for 12 months. Particulars from Engineer and Surveyor, Town Hall, Camberwell, S.E.15.

North of Scotland Hydro-Electric Board, January 21.—Construction, completion and maintenance of the Pitlochry dam and power station, Tummel-Garry hydro-electric project. Particulars from the Engineers, Sir Alexander Gibb and Partners, 39, Northumberland Street, Edinburgh, 3, and Queen Anne's Lodge, London, S.W.1; deposit, £5.

Blackwell, January 22.—Supply, delivery, installation, erection, coupling-up, testing and setting to work of complete equipment of two electrical sewage pumping stations, each comprising duplicate vertical spindle pumps, float controlled. Specification from Mr. A. H. Elliott, Chartered Civil Engineer, Dale Close, 100, Chesterfield Road, South, Mansfield, Notts; deposit, £2 2s.

Salford, January 23.—Supply of kitchen equipment and electrically heated food conveyors, for Hope Hospital. Details from Secretary-Steward, Hope Hospital, Eccles Road, Salford, 6.

Wandsworth, January 29.—Installation of refrigeration apparatus at Wandsworth Mortuary. Specification from Borough Engineer, Municipal Buildings, Wandsworth High Street, London, S.W.18.

Portsmouth, January 30.—Supply, delivery and erection of three 1 500 kVA 11/6.3 kV transformers, connected delta/interstar for direct connection to existing 30 MW alternators for works auxiliary supplies. Particulars from Engineer and Manager, Electricity Undertaking, 111, High Street, Portsmouth; deposit, £1 ls.

Brighouse, January 31.—Supply and delivery of (a) two 11 kV switchboards; (b) one 300 kVA and one 600 kVA transformer. Specifications from Borough Electrical Engineer, Huddersfield Road, Brighouse, Yorks.

Company News

PERAK RIVER HYDRO-ELECTRIC POWER Co., LTD.—After deb. int. £24 745 (£28 210) and prov. for int. on deb. stk. advances £5 100 (£2 250), dirs.' fees £1 875 (£1 896), and exes. £4 752 (£4 513), net loss to July 31 £20 545 (£35 253), incrs. debit blee. brot. in from £70 935 to £91 480. Div. on 5% pref. in arrear since 1941.

ENGINEERING AND LIGHTING EQUIPMENT Co., LTD.—In a circular to shareholders, Mr. S. A. Marples (chairman), stated that the change-over from war-time trading to peace conditions was not yet completed and the transition period was proving longer and more difficult than the board had anticipated. In these circumstances, he added, the directors considered that no interim dividends should be paid.

MANN EGERTON AND Co., LTD.—Trdg. prft. to Sept. 30, £167 310 (£157 540), plus provs. not required £14 250 (nil), divs. from subsid. co. £11 113 (£5 625) and int. £1 861 (£1 439), mkg. £194 534 (£164 604). To taxn. £146 950 (£133 500), prov. defd. reprs. fixed assets £10 000 (same), deprecn. fixed assets £7 130 (£6 609), dirs.' fees £900 (same), leaving net prft. £29 554 (£13 595). Pref. div. absorbs £9 258 (£8 416), ord. div. 30% (15%) £5 864 (£2 665), gen. res. £5 000 (£2 500), div. equalisation res. £5 000 (nil), supplementary pensions £2 500 (nil), fwd. £26 754 (£24 822).

CROMPTON PARKINSON, LTD.—The new chairman, Mr. Albert Parkinson, speaking at the annual meeting, announced fresh rules governing the appointment of executive directors. It would no longer be necessary, he said, for an executive director to hold a share qualification, or for his appointment to be confirmed at the annual general meeting following his appointment to the board. Believing that in regard to certain of their products, the company could expect a continuing demand in excess of their pre-war capacity, they had acquired and were developing a factory at Doncaster. Steps had also been taken to secure permanent premises in London. In 1941, the Chairman said, they had acquired a business engaged in the manufacture and sale of electric vehicles, and they had maintained their position as the leading manufacturers. The partnership with the Austin Motor Co., Ltd., would, he thought, ensure the enhancement of this business to the benefit of the joint venture.

JOHN SHAW AND SONS, WOLVERHAMPTON, LTD.—Presiding at the annual meeting, the Chairman (Mr. R. P. Jenks) said that the net profit for the year was £30 382, making an available balance to the credit of profit and loss appropriation account of £47 912, out of which £20 000 had been transferred

to general reserve, raising that reserve to £60 000. The directors recommended that a dividend of 10%, less income tax, be declared and paid, leaving the balance of £18 700 to be carried forward. The whole of the shareholding in the Indian subsidiary, the Chairman added, had been disposed of on March 15, 1946, and the net surplus on realisation was £82 453, which had been added to capital reserve. The subsidiaries, he said, had full order books, and their output had only been limited by an inadequacy of labour and latterly by a general shortage of materials. Despite these difficulties, many of their standard ranges of products had been sent overseas, and had been favourably received. The trading results for the year were entirely satisfactory. Looking to the future, the Chairman said that not only did they require a sufficient labour force, but one which would accept in increasing measure its full responsibilities in producing, at an economic price, goods which would be required if this country were to maintain and increase its exports in the face of the inevitable competition which would develop once the urgent current demand was satisfied.

Metal Prices

	Monday, Price	January 6 Inc. Dec.
Copper—		
Best Selected (nom.)...per ton	£115 10 0	£19 0 0 —
Electro Wire bars	£117 0 0	£19 0 0 —
H.C. Wires, basis	£133 0 0	£20 15 0 —
Sheet	£158 10 0	£20 0 0 —
Bronze Electrical quality		
1% Tin		
Wire (Telephone) basis per ton	£154 15 0	£20 15 0 —
Brass (60/40)—		
Rod basis	1s. 0½d.	1½d. —
Wire	1s. 5d.	1½d. —
Iron and Steel—		
Pig Iron (E. Coast Hematite No. 1) ...per ton	£8 19 0	— —
Galvanised Steel Wire (Cable Armouring) basis 0.104 in.	£33 0 0	— —
Mild Steel Tape (Cable Armouring) basis 0.04 in.)	£21 15 0	— —
Lead Pig—		
English	£70 0 0	£13 10 0 —
Foreign and Colonial... ..	£71 10 0	£16 10 0 —
Tin—		
Ingot (minimum of 99.9% purity)	£384 0 0	— —
Wire, basis	per lb. 4s. 10½d.	— —
Aluminium Ingots ...per ton	£72 15 0	— —
Spelter	£70 0 0	£15 0 0 —
Mercury (spot)	per bott. £25 0 0	— —

Prices of galvanised steel wire and steel tape supplied by C.M.A. Other metal prices supplied by B.I. Callender & Co., Ltd. The latter prices are nominal only, and do not include any allowances for tariff charges.

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.

VOLTA ELECTRIC, LTD., London, E.C.—November 29, mortgage and charge, to National Provincial Bank, Ltd., securing all money due or to become due to the Bank; charged on two pieces of land known as Park Works, Stamford Baron, with machinery, fixtures, etc., also general charge (subject to etc.). *£10 000. December 10, 1945.

TRANSRECEIVERS, LTD., Surbiton, November 27, debenture to Lloyds Bank, Ltd., securing all moneys due or to become due to the Bank; general charge. *Nil. October 3, 1944.

BARLITE LAMPS, LTD., Blackpool.—Decem-

ber 5, £1 000 debenture to F. D. Parkinson, Blackpool; general charge.

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.

HILDREW, T. (male), 29, Coatsworth Road, Gateshead-on-Tyne, radio specialist. £11 5s. 10d. October 29.

SMITH'S BATTERY SERVICE (sued as a firm), 55, Walmersley Road, Bury, Lancs., electrician. £26 14s. 9d. October 29.

SMITH, J. AND CO. (a firm), Bridge Street, Cradley, Staffs., electrical engineers. £22 9s. 10d. October 7.

MARTINDALE, E. J. AND SON, (sued as a firm), 7, Doonlands Parade, Upper Brighton Road, Worthing, electrical dealers. £10 15s. 8d. October 28.

Coming Events

Friday, January 10 (To-day)

INSTITUTE OF PHYSICS.—Manchester. In the new Physics Theatre, the University. "Recent Developments of Calculating Machines in U.S.A.," Prof. D. R. Hartree. 7 p.m.

INSTITUTE OF PHYSICS.—Birmingham, Imperial Hotel. "Nature of the Electric Spark," Prof. J. M. Meek.

Saturday January 11

I.E.E.—London Students' Section. Visit to the B.B.C., Brookmans Park Station. 2.30 p.m.

Monday, January 13

I.E.E., N.E. CENTRE.—Newcastle-on-Tyne. "The Influence of Resistance Switching on the Design of High-Voltage Oil Circuit-Breakers," H. E. Cox and T. W. Wilcox. 6.15 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—Manchester. At 16, St. Mary's Parsonage. "Modern Electric Lifts," G. P. F. Newlands. 7 p.m.

Tuesday, January 14

I.E.E., SCOTTISH CENTRE.—Glasgow. In Societies' Room, Royal Technical College. "Fundamental Legislation for Electricity Supply to Consumers," W. Fennell. 6.15 p.m.

I.E.E., S. MIDLAND CENTRE.—Derby. Chairman's Address, C. F. Partridge.

I.E.E., N. MIDLAND CENTRE.—Leeds. "Silicon Carbide Non-Ohmic Resistors," F. Ashworth, W. Needham and R. W. Sillars. 6 p.m.

Wednesday, January 15

JUNIOR INSTITUTION OF ENGINEERS.—Birmingham. At the Grand Hotel. "Inspection," Presidential Address, Major-General A. W. Sproull. 7.30 p.m.

I.E.E.—London Students' Section. Visit to Johnson Matthey and Co., Ltd., Hatton Garden. 3.30 p.m.

I.E.E.—London. Radio Section. "Crystal Valves," D. Bleaney, J. W. Ryde and T. H. Kinman. 5.30 p.m.

EDINBURGH ELECTRICAL SOCIETY.—"Electronics," R. Brydon. 7.30 p.m.

ROYAL STATISTICAL SOCIETY.—Birmingham. At the Chamber of Commerce. "Statistical Definitions and Their Consequences," V. E. Gough. 6.30 p.m.

INSTITUTE OF WELDING.—West of Scotland Branch. "Industrial Radiography. With Special Reference to Welds," H. S. Tasker.

Thursday, January 16

I.E.E.—London. "Industrial Applications of Electronic Techniques," H. A. Thomas. 5.30 p.m.

I.E.E., Southern Centre.—Southampton. In the Physics Theatre, University College. "Hydro-Electric Developments in West Devon," F. E. Pitt. 6.30 p.m.

BRITISH INSTITUTE OF RADIOLOGY.—London. At the Reid-Knox Hall. "Cardiac Radiology," T. Holmes Sellors, Dr. D. Bedford and Dr. J. D. White. 5 p.m.

I.E.E., N. WESTERN CENTRE.—Manchester. Radio Group. "The Voltage Characteristics of Polythene Cables," R. Davis, A. E. W. Austen and Prof. Willis Jackson. 6 p.m.

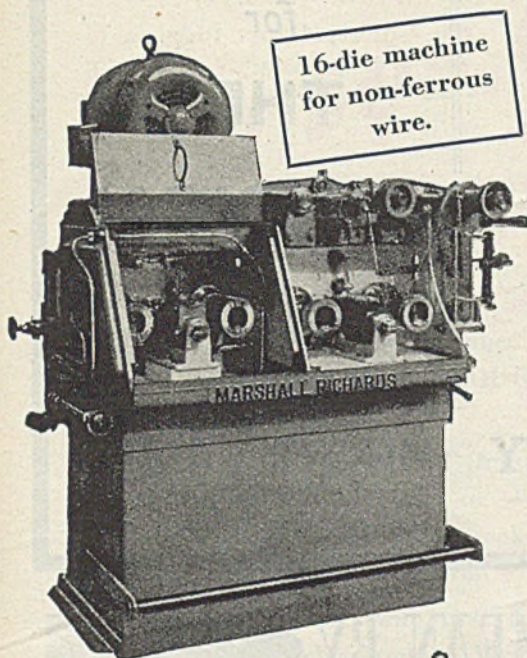
Friday, January 17

NORTHAMPTON POLYTECHNIC.—London. First of twelve lectures on "Television Practice." 7 p.m.

I.E.E., N. EASTERN STUDENTS' SECTION.—Newcastle-on-Tyne. Chairman's address, T. M. Ayres. 6.30 p.m.

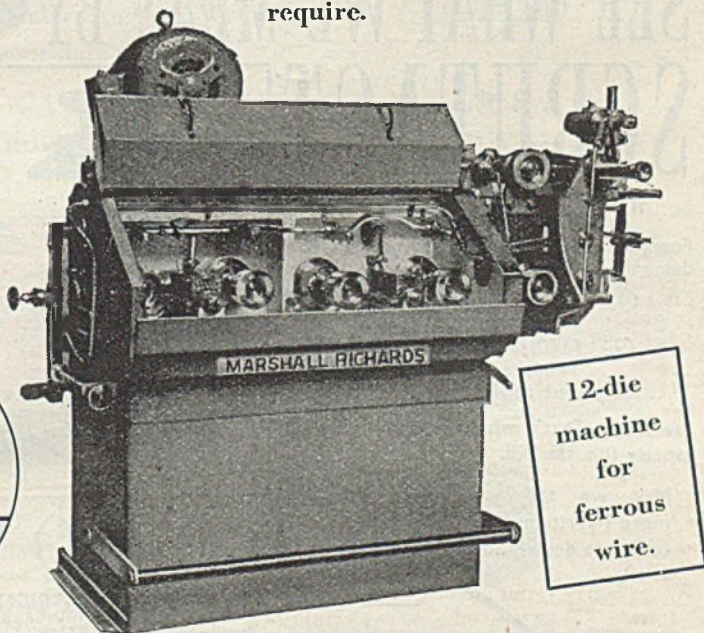
JUNIOR INSTITUTION OF ENGINEERS.—London. "Design Considerations for Draughtsmen in Connection With High Speed Rotative Machinery," J. M. Tebby. 6.30 p.m.

fine Wire drawing— *easy to some—a bugbear to others?*



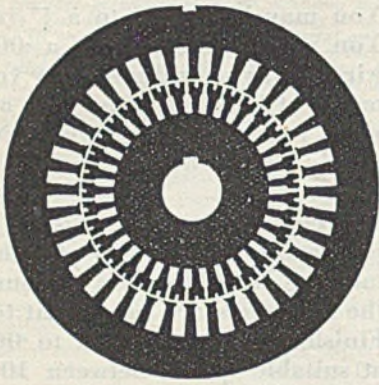
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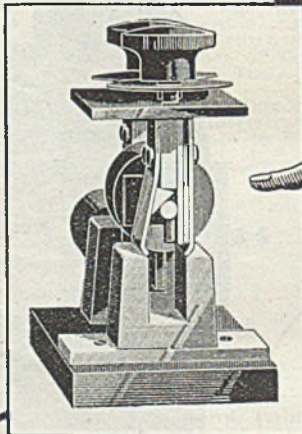
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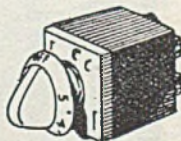
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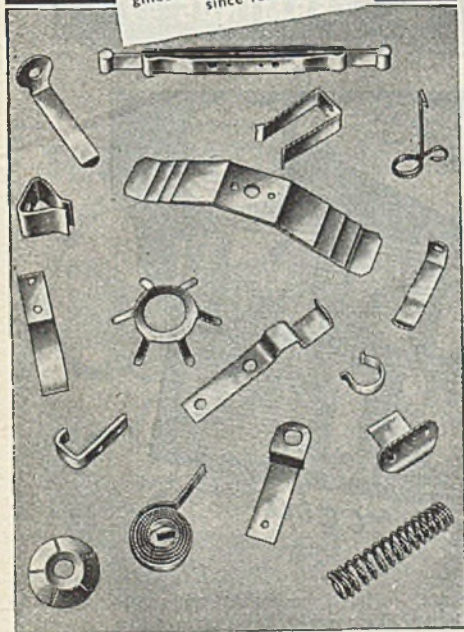
Telegrams: Hivoltcon, Phone, London.

Cables: Hivoltcon, London, Marconi International Code.

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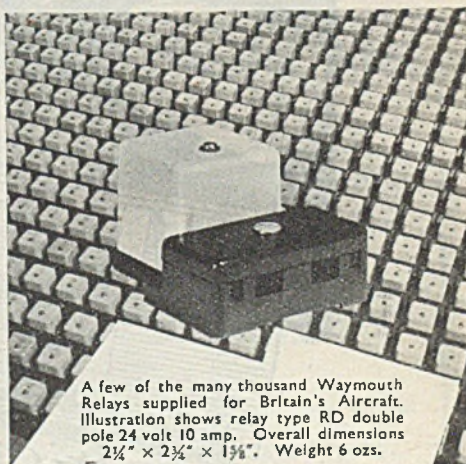
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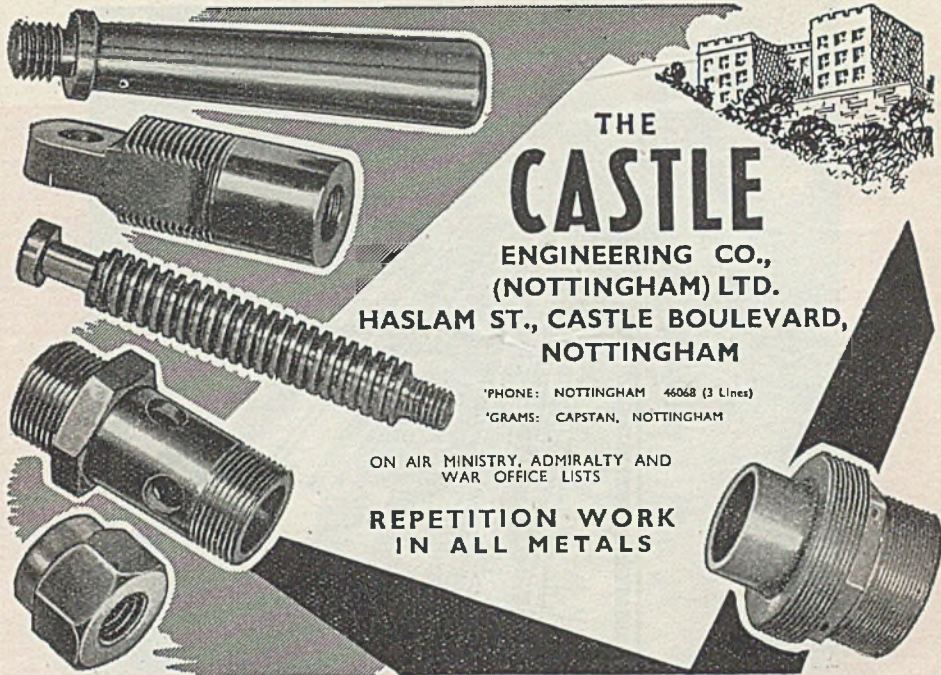


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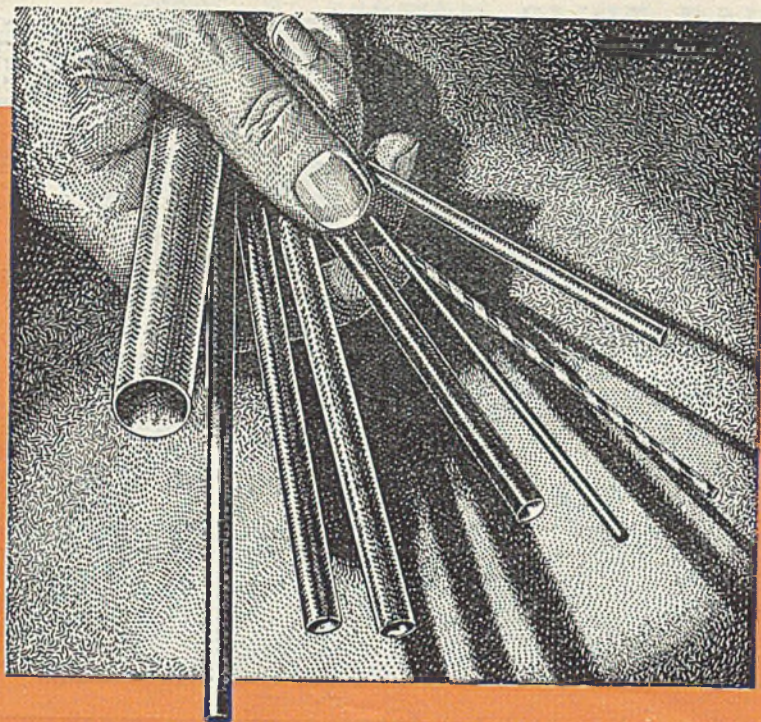
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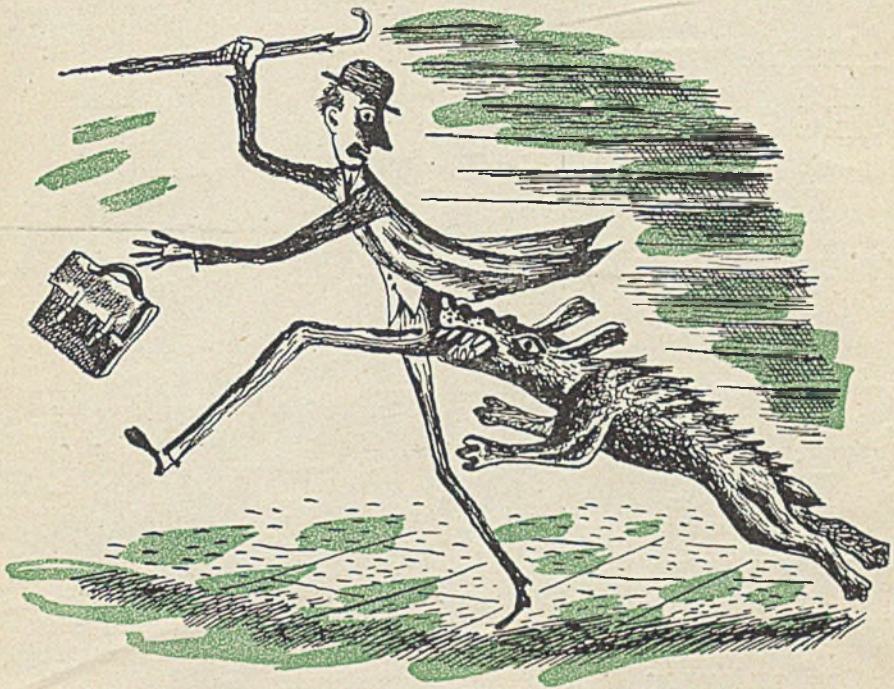
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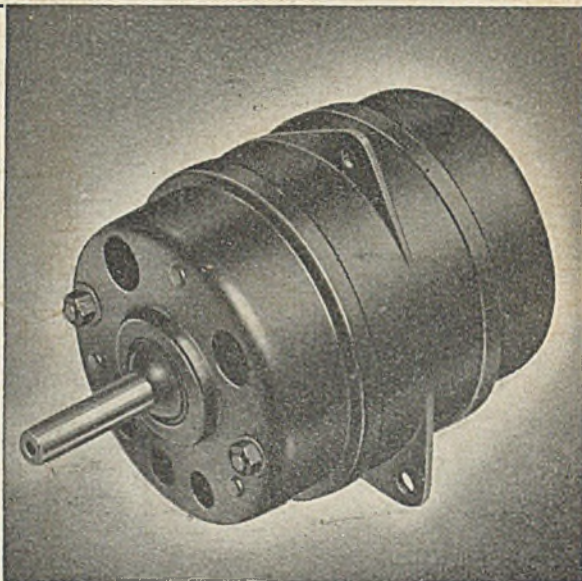
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