THE
ELECTRICIAN

Vol. CXXXV. No. 3526. Friday, December 28, 1945. Sixpence
(Registered at the General Post Office. Entered as Second Class at the New York U.S.A. Post Office.)

MISCELLANEOUS ADVERTISEMENTS

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

SITUATIONS VACANT

YOUNG Man required for London area to act as Representative of Electrical Manufacturers. Will also be required to undertake other duties in connection with buying and office routine.—Write, stating age, experience and salary required, Box L.Q.O., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4.

ELECTRICIAN-WIREMEN for general electrical work; permanencies to suitable applicants, who should be Class "A" ex-Service men or otherwise exempt from Ministry of Labour Control.—J. W. Russell, Ltd., Electrical Contractors, 18, Queens Road, Watford.

FOR SALE

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

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

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

REBUILT MOTORS AND GENERATORS

LONG deliveries can often be avoided by purchasing rebuilt secondhand plant. We can redesign or replace surplus plant of any size.
SEND US YOUR ENQUIRIES.
OVER 1 000 RATINGS ACTUALLY IN STOCK HERE.
DYNAMO & MOTOR REPAIRS LTD.,
Wembley Park, Middlesex.
Telephone: Wembley 3121 (4 lines).
Also at Phœnix Works, Belgrave Terrace, Soho Road, Handsworth, Birmingham.
Telephone: Northern 0898.

BURDETTE & CO. LTD.
Stock
Reconditioned A.C. and D.C. Motors and Starters Equal to New.
STONHOUSE STREET, CLAPHAM, S.W.4.
Day and night service. MACaulay 4555.

WANTED

WANTED, Ball and Roller Bearings, also loose balls. Commissions arranged for introduction to transactions, Licensed Buyers. —W. Ball Ltd., Blackburn Road, Accrington. Tel. 2200.

REPAIRS

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

WORK WANTED AND OFFERED

WE will gladly undertake the making of component parts, etc., on our Lathes, Millers, Drills, etc.—London Electric Firm, Croydon. 'Phone: UPLands 4871.

PATENT AGENTS

MEWBURN, ELLIS & CO.,
PATENTS, DESIGNS AND TRADE MARKS,
70 & 72, Chancery Lane, London, W.C.2.
Grams: "Patent, London." 'Phone: Holborn 0437 (2 lines)
And at—NEWCASTLE: 3, St. Nicholas Buildings.

A. E. HILL,
Chartered Patent Agent,
27, Chancery Lane,
London, W.C.2.

BATTERY CHARGERS MODERNISED
Your old Charger made like new by specialists.
Conversion from valve to metal rectification.
Send for interesting leaflet R.D. on this Service.
RUNBAKEN ELECTRICAL PRODUCTS, MANCHESTER, 1

Portable FLASH TEST

All makers and dealers in electrical equipment, service engineers, and repairers need this portable Flash Tester.
Detects faults at 1,000 to 2,000 volts.
Send for interesting leaflet "All about Flash Testing."
RUNBAKEN·MANCHESTER·1

REWINDS
MOTORS, GENERATORS, TRANSFORMERS ALL SIZES WITH THE MINIMUM DELAY
FOR EFFICIENT SERVICE WIRE
"PORTER," LINCOLN
PRIORITY ORDERS ONLY UNTIL BETTER TIMES
PENNEY & PORTER (1932) LTD., LINCOLN
Grams: Porter. Phone: 1706/7.

THE ELECTRICIAN

Established 1861. *The Oldest Weekly Illustrated Journal of*

Electrical Engineering, Industry, Science and Finance

Bouverie House. 154, Fleet Street, London, E.C.4. Telegrams: "Electric, Fleet, London. Telephone: Central 3212 (Twelve Lines).

Midlands Office: Daimler House, Paradise Street, Birmingham. Telephone: Midland 0784.
Glasgow Office: 116, Hope Street, Glasgow, C.2. Telephone: Central 3970.

The Offices of THE ELECTRICIAN *are closed on Saturdays in accordance with the "Five-day Week" plan adopted by Benn Brothers, Ltd., and its associated publishing organisations. Until further notice the offices will be open between the hours of 9 a.m. and 5.30 p.m. from Monday to Friday.*

No. 3526. [No. 26 Vol. CXXXV] December 28, 1945 Annual Subscription 25s. Overseas 30s.

CHIEF CONTENTS IN THIS ISSUE

1945

WITH the end of 1945 will close a year, which in the final and complete downfall of our enemies, saw expression of all the engineering genius which the industry conceived during the war in support of our Fighting Services. During 1945, removal of censorship regulation permitted something of the gigantic efforts made by the industry to become known, while details of how the industry fared under the attacks of the Luftwaffe were also made public. Issues of THE ELECTRICIAN published during the year are rich in history which engineers of the future will find it hard to outstrip in interest.

The year has been crowded with events so important to the industry that an adequate review of all that has happened would, if attempted, result in a volume more massive than any that has gone before. Leaving past issues of THE ELECTRICIAN, therefore, to record the outstanding engineering achievements of the industry during the year, and giving our attention to the altered economic conditions, it will be remembered that last year was looked upon as one of preparation for the reconversion of our manufacturing capacity; as one of preparation for resuming once more efforts to expand the industry further. By the beginning of 1945, such preparations were well advanced in readiness for the anticipated end of the European war, but before many months had gone by it became apparent that many of the controls and regulations which beset the industry during the war were to continue, and most of its efforts to get back into its peace-time stride were to be frustrated.

The result of this has been that the industry has approached the road back by a route rougher and more rugged than it might have been, and is in consequence required to apply its initiative with energy no less exacting than during the war years. This, it is agreed, is gladly undertaken and is producing results which do the industry credit; in mentioning the fact, however, the difficulties put in the way by an officialdom which has the strangest way of giving practical expression to its intentions of assisting in the promotion of the trade of the country, should not be overlooked, and everything should be done to persuade our political leaders to keep their feet on the ground.

The end of the year finds the industry still divided in its opinions on such matters as plugs and sockets, ring mains and so on, though this is in no way hindering the application of electrical service to the grant-aided housing schemes which have become evident during the year. Another item which has engaged the attention

of the industry has been the Government's intention to nationalise electricity supply, and though this is now unlikely to materialise before the New Year, its prospect is hanging over the industry like a sword of Damocles. Progress in the extension of our generating capacity has been steady, and whereas the anticipated extensions at the beginning of the year were valued at £90 000 000, they now stand at £150 000 000 or more, indicating to some extent the demands which are likely to be made on the industry in the coming years.

Aftermath of War

IT may be said, in conclusion, that the year ending has permitted the industry to shed most of its war-time activities, and so far as returning to its more normal pursuits are concerned, has seen a commendable readiness to turn over to peace-time production. Before such readiness can give way to actual manufacture, however, the depleted ranks of man-power, and the replacement of over-age plant must be made good, while the materials position is another problem not easy of solution. What the industry has achieved so far has, in the circumstances, been truly remarkable, and the fact that during the first three-quarters of the year electrical exports were over £2 500 000 greater than in the corresponding period of 1938, shows to what extent the industry has recovered leeway lost during the war years.

Politicians, Please Note

DURING the last few months the supply industry has been subjected to all sorts of criticism at the hands of politicians, very little of which has borne investigation. In the circumstances we draw the attention of these critics to the following incident which took place five miles south of Reigate in Surrey, in the hope that they may yet learn that all is not chaos and inefficiency. It appears that during tree felling operations, one tree fouled the service lines to the houses nearby and cut off their supplies. One enterprising housewife telephoned the maintenance staff of the London J.E.A. at Dorking, 6 miles away, and explained the difficulty. Within 20 minutes a squad arrived, repaired the damage, found the distribution box a mile and a half away along a rough track—and restored the supply after a cut-off lasting not more than 35 minutes. Without claiming such incidents to be everyday happenings, the industry is always ready for them, always prepared to treat them with the same efficiency as at Dorking. Whether under a nationalisation policy such independence of action, whether such freedom to act without first filling up this or that form would be possible remains to be seen; meanwhile, however, the industry is setting an example which, —instead of being criticised by a group of individuals whose knowledge of the industry is limited to hearsay—should be held up to all other industries as one to follow.

I.E.E. Benevolent Fund

THOUGH the membership of the Institution of Electrical Engineers on September 30 last, was 27 550, subscribers to the institution's benevolent fund at that date numbered the surprisingly low total of 11 650, representing an average contribution per member of 4s. 11d. As Dr. P. DUNSHEATH, president I.E.E., has pointed out, there are many in the industry who by a freak of fortune, and very often through no fault of their own, suddenly find themselves bereft of means and in a state of anxiety hard to describe. If readers knew these people personally they would insist on helping; the claim made by the Benevolent Fund Committee, upon their generosity should thus, receive the same insistence. There are many among the membership of the institution who intending to contribute to the fund have not yet done so because of that very human failing of waiting until tomorrow, and this note is a reminder of the fact that the tomorrows of yesterday have now reached—to-day.

Electrocoating of Fabrics

A MODERN application of the physics experiment with a glass rod and a piece of silk, is the electrocoating of fabrics in such a way as to give the material attractive floral or other designs. The process is one whereby cloth fibres are passed through an electrostatic field, become charged, stand on end, and are repelled perpendicularly against an adhesive-coated "backing" fabric. The result is creation of either a new fabric or a design on the original material. The electrostatic field is set up by high-

voltage equipment and loose fibres, or flock, when conveyed on a belt through the field, receive a charge of the same polarity as an electrode at the base of the field. Because of the similar polarity, the fibres are repelled upwards with such force that they are hurled perpendicularly on to the adhesive-coated "backing" fabric, the ends of the fibres being buried in the adhesive. In making designed goods, the pattern is printed with adhesive on the "backing" fabric and when run through the electrostatic field, the fibres then cling only where the adhesive design appears. In final form, fibres resemble fine embroidery. Though the full field of application is virtually unexplored, applications conceived include the treatment of materials for women's dresses and blouses, scarfs, overcoats, window drapes, curtains, bedspreads, bath-mats, hosiery, hats, upholstering for furniture, rugs and carpeting.

I.E.I.C. Golden Jubilee

THIS is the Golden Jubilee year of the Institution of Engineers-in-Charge which was founded in 1895, though it did not receive its charter until some twenty-eight years later. When or how this event will be celebrated has not yet been decided though it seems doubtful whether anything will be done this year. It is probable that the practice of holding an annual dinner, interrupted by the war, will be resumed next year, but there is a strong desire among the members to acknowledge publicly in some suitable manner, before he leaves office, the services rendered by their war-time president, Sir ALEXANDER GIBB, who has held office for the last six years.

Swedish Railway Electrification

OWING to the shortage of copper during the war, the Swedish Railway Authorities were forced to substitute aluminium for copper in the return cables on a 51-mile extension of their electrified lines. Moreover, experiments were made with a view to replacing steel poles with units of concrete. Commenting on these measures, the authorities state, however, that the saving of material aimed at has proved problematical, and so far as costs were concerned the experiments gave negative results. The war put great demands on the Swedish State Railways. The heavily reduced motor road traffic, and, above all, the enormous transport of wood fuel, increased the volume of the goods traffic to record figures. If the railways had not been electrified to such a large extent as they were when the war broke out, it would not, it is stated, have been possible to handle the traffic owing to the shortage of coal. It might well be said, therefore, that the fact that Sweden was able to cope with her emergency situation as relatively satisfactorily as was the case, was due in no small measure to her electrified railways.

Turbine Developments in the U.S.A.

AMONG new turbine developments in the United States, may be mentioned improvements resulting from the application of new alloys capable of withstanding higher pressures and temperatures. In this connection information has reached us to the effect that turbines have recently been built which are designed to operate at 1 000°F. and at pressures up to 2 400 lb. per sq. in., the highest pressure ever used in an electric power generating station in the United States. One way adopted in the United States of getting higher efficiencies out of older machines is to superpose a new, high-pressure unit upon the original machine. The new turbine takes steam at high pressure and exhausts it into the old turbine at the pressure for which that machine was built. Thus, it is claimed, a great increase in power can be obtained from very little more coal. Still another way of improving efficiency is said to be to use mercury. This metal has a high boiling point, a relatively low pressure at high temperatures, and can absorb a great amount of heat. After it has passed through a mercury turbine, this extra heat is still sufficient to change the condensing water into steam, and this in turn can be used to run a companion steam turbine. The mercury turbines now in operation in the United States are said to indicate that mercury-steam plants can be built which will produce power for 10 to 15 per cent. less fuel than the best steam plants now in operation. At the time of writing, however, we are without details.

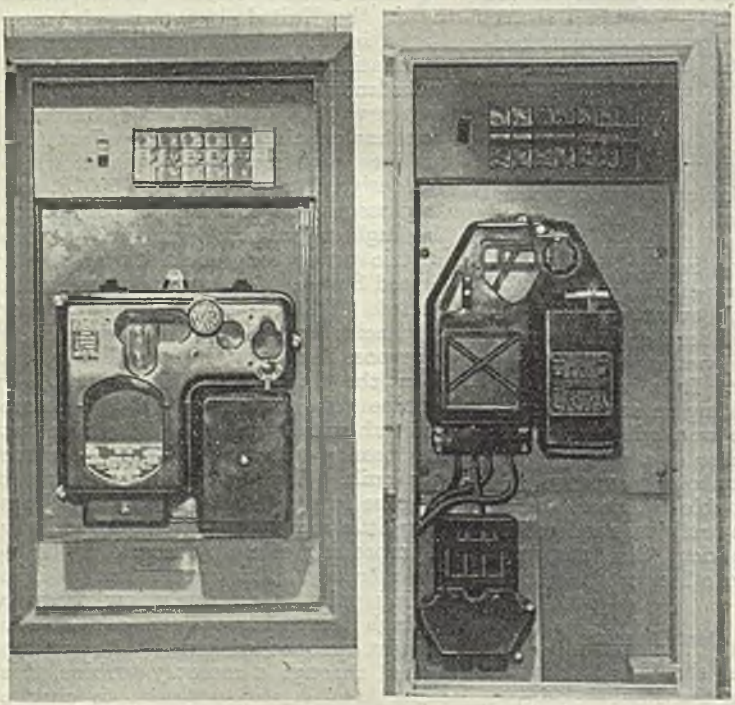
L.C.C. Housing Plans

Electrical Facilities to be Provided in First Year's Programme

THE first year's programme of the London County Council provides for the erection of a number of blocks of flats and cottages included in pre-war schemes that had to be deferred on the outbreak of hostilities. The Council have decided that these are to have planned kitchens arranged to give the amenities of the Portal bungalow, and half are to have electric equipment and half gas. All tenants, however, will have the choice of an electric or a gas cooker.

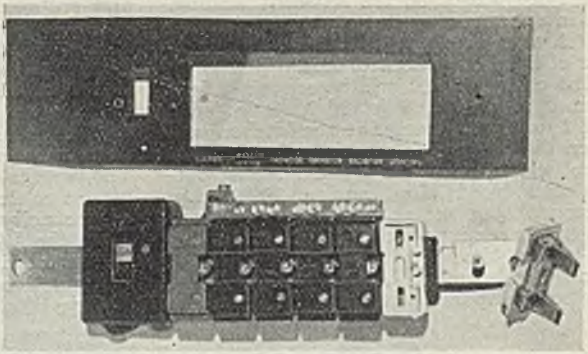
In the " all electric " dwellings the equipment will comprise a 20-gall. 2-heat water heater of the U.D.B. type to go under a removable draining board on one side of the sink, the top loading to provide a constant supply of hot water for ordinary domestic purposes, and the bottom element, operated by a foot switch, to increase the loading to heat the full capacity for the bath; an electric copper, or wash-boiler, to go under another draining board; and an electric cooker on the opposite side of kitchen. On the cooker switch panel there will be a 3kW fused plug and socket for an electric kettle, iron or other portable apparatus. Below the larder space will be provided for a refrigerator, but the Council are not supplying refrigerators as part of the equipment. Tenants can have them installed when they become available, if they so desire. A fitted dresser and ample cupboard accommodation are provided as part of the kitchen fittings.

As far as possible in each flat the bathroom will be next to the kitchen permitting a short length of piping from the water heater to the bath. There will be one lighting point and one 3kW fused plug and socket in each room. The socket outlets and plugs will be of the same pattern throughout each dwelling. In every kitchen, whether " all-electric " or gas, wiring will be taken to a cooker point, including a cooker control panel, with socket outlet, and to an additional general purpose socket outlet which will also serve the wash-copper. Similarly gas piping will be run to the cooker position and wash-copper position in all dwellings, and to other rooms where a flue is provided; the choice of service for cooking, washing, and space heating being one for the tenant to make. A gas multi-point water heater will be fitted in the non-" all-electric " flats, but cottages will have a back-of-the-fire boiler with an immersion heater in the storage tank for summer use. The bathrooms in the cottages will be upstairs.



The consumer's control unit shown on the left is the type to be used in blocks of flats. That on the right is designed for cottages and has provision for the service cable and fuse box. Each type will have a single door hinged at the side

The system of wiring to be employed will be V.I.R. cables in light gauge brazed or welded conduits with continuity lug-grip B.S.S. boxes to give a complete draw-in and out system. All conduit work will be concealed in the walls and ceilings, preformed chases being used wherever possible to avoid cutting away. In the block dwellings the conduit system will be "cast" in the concrete while the floors are being formed. A detailed description of this system of tubing and wiring, with details of fittings, etc., used, was given in a series of four articles which appeared in THE ELECTRICIAN,* commencing November 19, 1943.



The illustration shows the assembly of the 60A main switch and the cut-outs on a steel batten, with one of the cut-outs removed, and also the plastic covering panel

A new feature of these installations will be the provision of a consumer's control unit in each dwelling. These units, designed in the Chief Engineer's department, not only meet the need of the Council's own dwellings, but have been accepted by the Code of Practice Committee as satisfying the requirements for such a unit-set out in the No. 11 Post-War Building Studies report and now being considered as a British standard. The cases of the units, which are designed to fit standard brickwork dimensions, will be supplied to the builder, without the electrical gear at a very early stage in the erection of the dwellings, for building into the wall of either the hall or kitchen as the brickwork advances.

Two Combined Service Designs

There are two types of unit—one for cottages and one for blocks of flats. The case for the cottage type is of 16 s.w.g. welded sheet steel, and is 13 in. wide, 30 in. high and 5 in. deep. It will recess 4½ in. in the wall, leaving ½ in. for the plaster, thus finishing flush with the surface. It has to accommodate a prepayment meter, which may be as much as 7 in. in projection, and, therefore, additional space is provided by a door designed to give a 2 in. clearance inside. The door is so arranged that if the unit is placed in the kitchen, very little moisture in the way of steam can enter the cabinet. The case will be built-in 3 ft. or 3 ft. 6in. above the floor level, according to the type, so that the wiring, connecting-up and fixing of the meter can be done by a man standing on the floor. The resultant height of the meter will enable the housewife to insert coins without standing on anything or bending down. It is proposed that the main 60A double-pole switch of the microgap, or other approved type, shall be mounted in line with a 30A, and a reasonable number of 15 A s.p. cut-outs and neutral bar, on a steel batten, and provided with a plastic covering panel engraved with the circuit numbers; the complete assembly to be fixed in the top portion of the cabinet by two O.B.A. bolts. The various fuse-holders will have distinctive colours, the 30 A being green, those for the water heater, wash-boiler and socket outyellow. Originally it was intended to have h.r.c. fuses, but the matter was reconsidered, and it was later decided that a rewirable type of fuse would be used. The meter is mounted on a 16 s.w.g. steel plate held in position by four 2B.A. bolts. This panel can be removed for drilling a shape to suit any type of meter. The supply undertaker's service cable and fuse box is mounted on a sloping metal plate welded to the back and bottom of the case. Any make of moulded cable and fuse box can be used. On either side of the interior of the case is a cable duct ¾in. wide by 2 in. deep, through which will run the cables taken from the meter to the main switch, and also the circuit cables to the socket outlets. Knock-outs to take the conduits are provided at the bottom and top of the case, and there are stencilled instructions to the builder to leave a conduit chase above to the ceiling. In the bottom of the case there is also an aperture for the entry of the service cable.

The cabinet for the block dwellings will be 13½ in. wide, 24 in. high and 5 in. deep, and it differs from the cottage type

* These articles were contributed by Mr. R. Plummer, M.I.E.E., who is in charge of all electrical work for L.C.C. housing, under the chief engineer, Mr. Forbes Jackson.

in that there is no provision for a service cable and fuse box. The mains will be brought in from a common distribution box, or service board, on the adjacent landing. The interior arrangement of the meter, main switch and circuit fuses will be similar to that of the cottage control unit.

The cooker switch will be contained in a pressed steel box, 9 in. high, 3 in. wide and 2 in. deep, recessed in the kitchen wall when the building is erected. On the face panel will be mounted a 3 kW socket outlet with fused plug, and a 30 A d.p. microgap type switch for the cooker; and the only work involved will be the connecting-up and the screwing of the plate to the box. The entrance to the conduit below the control panel will be 2 ft. from the floor, and will have a smoth bore bush to take the flexible connection to the cooker.

For the new designs of blocks of flats and cottages under the post-war housing programme it is intended that the number of socket outlets recommended in the "Housing Manual" and a ring main system of wiring shall be installed. Water heating will be by solid fuel in a stove with a boiler at the back, augmented by an immersion heater in the storage tank. The tenants will have the choice of cooking by gas or electricity. Wash-boilers for gas or electricity will be provided.

On the Woodberry Down site at Stoke Newington it is proposed to erect blocks of flats five and eight stories high, and electric lifts will be installed.

Code of Lighting Practice

THE Codes of Practice Committee of the Ministry of Works have added two further chapters to their Code of Functional Requirements of Buildings, and these are published by the British Standards Institution. That of chief interest to the electrical industry is referred to as Chapter VII (F.) CP7, 1945, and deals with the provision of artificial lighting in houses, flats and schools only. It points out that artificial lighting should be considered as an integral part of the design of buildings, and the equipment and light sources should be installed at the time of construction, also that suitable lighting is that which gives freedom from glare, accords in colour with the surroundings, and provides good but not unduly sharp contrasts.

Amongst the factors which should receive consideration in the design of a lighting system are nature of occupancy, source output (lumens), luminous efficiency of fittings, distribution of light, dimensions of room, reflection factor of surroundings, and the mounting height. It is important that suitably placed plug points be provided for local lighting, besides properly located general lighting points.

Lighting installations in dwellings should be such as to give, on a horizontal plane at a height of 2 ft. 9 in. above the floor, the following values of illumination: For a working kitchen, etc., 6-10 f.c. from two separately controlled lamps, using for an area up to 80 sq. ft. one 60 W and one 40 W lamp; for an area of 80-120 sq. ft., one 75 W and one 40 W; and for an area more than 120 sq. ft., one 100 W and one 40 W. In the case of a living room, 10-15 f.c. should be used for reading, 15-25 f.c. for sewing, using for an area up to 120 sq. ft. two separately controlled 60 W lamps; a room of greater area than 120 sq. ft. two separately controlled 100 W lamps are recommended. Other recommendations are: bathroom, 6-10 f.c. with one 60 W lamp; bedroom, 4-6 f.c., using, where the position of the furniture can be defined, one bedhead lamp in a fixed position and one lamp in a position suitable for the dressing table; for general room lighting the same size lamps as for living rooms are recommended; lavatories, one 25 W lamp; staircase, one 40 W lamp arranged at or near the head of the stairs; communal stairs, corridors and balconies should have a minimum illumination of .5 f.c. at ground level.

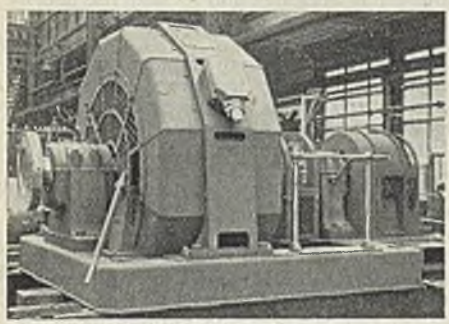
School lighting installations should receive the same consideration in their design as those for dwellings, with the added requirements such as adequate standard of illumination on work plane (books and chalk boards). The lighting should, too, be suitable not only for the hours of darkness, but for those periods when failing daylight necessitates lighting part of a room by artificial means; and adequate maintenance of the lighting equipment and decoration to minimise deterioration of the illumination is strongly recommended. In teaching rooms, no luminous part of a fitting used for general lighting should be less than 9 ft. above the floor level immediately below the fitting, and if mounted less than 16 ft. above floor level, the brightness for any angle of view between the horizontal and 45° below, should preferably be less than 3 candles per sq. in. each; in any case it should not exceed 5 candles per sq. in. The recommended minimum illumination in a working area at 2 ft. 9 in. above floor level for schools is, teaching rooms and laboratories 12 f.c., with a 50 to 100 per cent. increase of illumination over the demonstration area; gymnasiums, assembly halls, 8 f.c.; staff rooms, dormitories, 6 f.c., with additional local lighting; and corridors, cloakrooms, and lavatories, 3 f.c.

An appendix shows a chart for determining the size of electric lamps for fixed positions in living rooms.

Manufacturers' Activities in 1945

From War Production to Peace-Time Requirements

A REVIEW of the work carried out by Bruce Peebles and Co., Ltd., Edinburgh, during 1945 reveals that in the early part of the year emphasis continued to be on production devoted directly to war equipments. Many of the products were

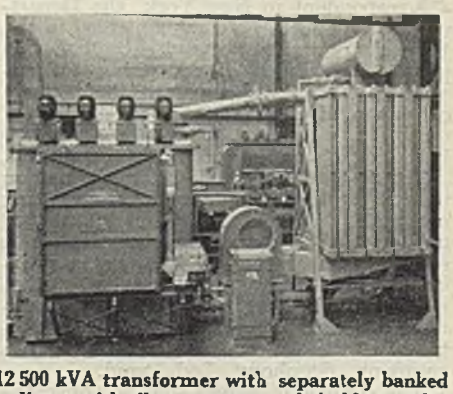


550 B.H.P. synchronous induction motor

electrical items of the kind to be expected from an organisation with such an extensive background of electrical plant manufacturing experience, and included large numbers of generators, motors and transformers for various naval and military services. For example, large reversible machines for ship propulsion; generators for power and lighting on various classes of naval vessels; vertical and horizontal shaft motors for shipboard requirements; special motor generators for use in connection with signals; and transformers for radio transmitters and other services. In addition to electrical plant, a great variety of work of a non-electrical nature was undertaken by the company to meet war demands There were, for instance, among other equipments, rocket projectors; tank parts and anti-tank weapons; searchlights; pontoons for the "Mulberry" harbour at Arromanches; devices for the anti-U-boat war, including the "Foxer" which was the antidote to the German "Gnat," or acoustic torpedo. In the transition period the company, while still concentrating on certain war contracts, made preparations to meet the vast demands of peace-time reconstruction and development, and by the end of the war was ready to play its part in the peace-time programme.

In the rotating electrical machinery shops there are definite indications of the extent of peace-time requirements for machines for generation, conversion and power application of electricity for developments held up during the war; for replacements of war-worn plant; and for the change-over to peace-time production in various factories; while the progressive expansion of mechanisation in coal mining created fresh demands for flameproof mining-type motors for operating coal face loaders, conveyors, haulages and pumps. The demands for alternators experienced in 1944 were maintained. Orders were received for numbers of small self-contained machines for coupling to internal combustion engines and for several geared steam turbine-driven alternators provided with air filters forming an integral part of the machine.

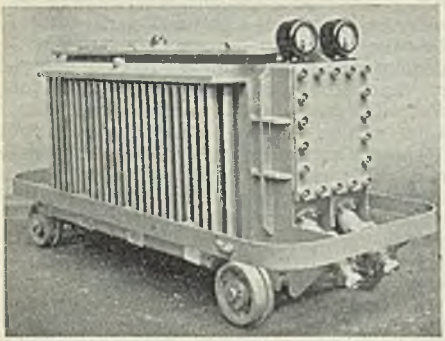
The increasing activities in the transformer shop reflects the progress made in the change-over to peace-time operations. Important extensions have been made to the large factory, for research and to meet advancements in technique which have been introduced by the company. Orders were received for large numbers of pole distribution transformers, in sizes of a few kVA upwards, and for large power transformers running into many thousands of kVA for voltages up to 132 kVA for various power supply authorities and industrial concerns throughout the country. Many orders were received from collieries for mining-type transformers, including mobile transformer sub-stations with flameproof switchgear. Recent developments in transformer engineering include transformer units with



12 500 kVA transformer with separately banked radiator, with oil conservator and air-blast cooler

combined in-phase and quadrature voltage control with tap-changing under load to give phase angle control, or to introduce a variable phase displacement in the line without disturbing the load. In this connection, an order of special interest from a public supply authority is for a 15 000

kVA 33/6.6 kV unit with in-phase and quadrature booster for phase angle control. Remote electrically-controlled " on-load " tap changers are provided on the in-phase and quadrature windings of the exciter



Mobile oil-immersed rectifier for battery charging in mines

transformer for plus or minus 10 per cent. voltage variation, independently controlled to give the phase angle variation required. The equipment is a duplicate of one previously supplied to the same authority and which has operated most successfully.

Orders received by the company for mercury arc rectifiers included equipments for public supply authorities and various industrial concerns. There has been an increasing demand for mobile oil immersed rectifiers for charging batteries on mine electric cars underground. The rectifier, which was developed by the company to meet the growing demand for battery charging equipment suitable for use underground, is a one-piece unit comprising a low height transformer and metal rectifier mounted in a common tank, and is complete with flameproof control gear. The construction provides for transport in low head-room workings and to take the shocks due to shunting or rough handling over bad roads.

Exports, which were reduced to meagre proportions during the war, continue to expand and quiet optimism is expressed respecting overseas demands for all classes of electrical plant for rehabilitation and new developments. Orders received by the company for export include four 1 500kW motor converters and a 1 000 kW rotary converter for electricity supply authorities in India; two 10 000 kVA transformers for an Indian iron and steel works; and impressive numbers of distribution transformers and electric motors for various industries also in India. An order for two 12 500 kVA transformers was received from South Africa, and other important orders are in hand for numbers of various sizes of transformers, motors and alternators for New Zealand, Australia and Canada.

British Television Devices

ACCORDING to a " The Times " correspondent in New York, the Department of Justice, in a complaint filed in the Federal Court, has accused several motion picture companies of conspiring to prevent the use in the western hemisphere of advanced British patented devices of television, so as to keep television from becoming a competitor in their industry.

The court was asked for an injunction restraining the defendants from executing contracts they had made for this alleged purpose. The Department of Justice is seeking further to free the patents involved, and to have the court declare that a cartel exists which violates the anti-trust laws and makes entire agreement between American concerns and a British company, Scophony, Ltd., void.

The complaint asserts that the outbreak of war made it impossible for the further development in England of two new television ideas, the Supersonic and Skiatron systems, controlled by Scophony, Ltd.; that because it could not transfer funds from England to continue in the United States work it had done there, the company sought American financing; and that this it secured from Paramount and Twentieth Century Fox interests, but on condition, it is alleged, that these companies or their subsidiaries involved, would not be under obligation to turn over rights under Scophony inventions to their competitors in the electronic field.

The complaint then describes an intricate financial arrangement which was executed in such a way, it is alleged, as to suppress the sale of television equipment, keep Scophony, Ltd., from competing with television concerns in the United States, and prevent the competitors of the American defendant companies " from employing the essential advances in the television art."

Defendants in the action are Paramount Pictures Inc.; its wholly owned subsidiary Television Productions Inc.; General Precision Equipment Corporation, alleged to be the largest shareholder in the Twentieth Century Fox Film Corporation; the Scophony Corporation of America, said to have been organised by Television Productions and General Precision in furtherance of the alleged conspiracy; Scophony, Ltd.; and three individuals.

The Physical Society

New Apparatus to be Seen at the Thirtieth Exhibition

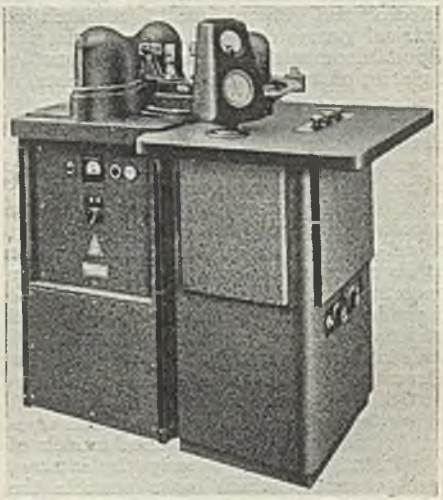
THE leading manufacturers of scientific instruments will be showing their latest products in the trade section of the thirtieth exhibition of scientific instruments and apparatus arranged by the Physical Society to be held at the Imperial College of Science and Technology, Imperial Institute Road, South Kensington, on January 1, 2, and 3. The hours of opening will be 2.30 to 9 p.m. on Tuesday, when Sir Stafford Cripps will be the opener, 4 to 9 p.m. on Wednesday, and 2.30 to 9 p.m. on Thursday. The research and educational section will contain contributions from research laboratories, and experiments of educational interest.

Particulars of some of the exhibits are given below:—

The display of Marconi's Wireless Telegraph Co., Ltd., will deal with the manufacture of high frequency crystals and magnetrons. The quartz crystal exhibit will give a simple story of the production of finished quartz plates associated with a historical survey of phenolic resin and polythene holders in various sizes and shapes together with the latest developments in evacuated glass bulb technique. Several measuring instruments will also be shown and the process of manufacture explained. In another case holder parts and completely assembled crystals will be shown, with one or two historical units belonging to the development of the latest evacuated glass envelope. The third section will consist of an exhibit of magnetrons in section, showing their design.

The industrial X-ray section of Philips Metalix (Philips Lamps, Ltd.) is exhibiting a new X-ray diffraction apparatus, type 41D, developed to meet the requirements of both university and industrial laboratories. The various components form an integral, self-contained unit. In the base of the cabinet is housed the h.t. generator (including the tube filament transformer), from which full-wave rectified h.t. is fed to the cathode of the X-ray tube; a circuit consisting of a centre earthed transformer and two oil-immersed rectifying valves being employed. The Philips X-ray spectrometer, also to be shown enables quantitative and qualitative analyses of crystalline and certain amorphous substances to be made by X-ray analysis. The makers state that under optimum conditions diffraction angles can be measured to within ± 0.03°. For certain applications, it has some advantage over conventional diffraction procedure which entails exposure and development of film besides measurements and computations.

Among the varied new exhibits to be seen on the stand of Ferranti, Ltd., will be an electrometer valve in the form of a double tetrode tube in which both tetrode sections draw their emission from a single filament and each section resembles the F.P. 54 in electrical characteristics; a new neon stro-



Philips' Geiger-counter X-ray spectrometer

boscopic lamp which takes a form similar to the straight fire bar element, and can be fitted into a reflector unit similar to the Ferranti electric radiators. This unit is then supplied by power pulses which are synchronised by a smaller lamp of the Neostron type at any frequency from 0 to 250 c.p.s. thus providing a powerful source of stroboscopic light; a control unit which can be used for the counting of moving objects up to 150 per minute by the interruption of a beam of light. This embodies the new K3 cold cathode triode—an exclusive Ferranti development—that made it possible to devise a photocell amplifier unusually simple in design and small in size. The device has various other applications. An automatic electronic device for obtaining spot-welds of accurately controlled duration up to 0.01 second; miniature hermetically sealed instruments to withstand the most severe tropical conditions; a new moving-iron instrument with very light movement; navigational instruments for aircraft; miniature relays in

sealed cases; an indicator of the electrostatic type, giving direct readings and voltages to earth up to 11 kV; a compact multi-range testing instrument for radio servicing and general electrical testing.

On Stand No. R20 members of the research laboratory staff of the British Thomson-Houston Co., Ltd., Rugby, will demonstrate the following:—A 100 W C.W. 10 CM. fixed tuned, water-cooled klystron, and a water jet model of reflection klystron action; a mechanical model illustrating klystron action; a mechanical model of electron motion in magnetrons; a remote cloud indicator, developed in collaboration with the Balloon Development Establishment and the Meteorological Office; recent research in electrical glasses and glass-metal seals, the exhibits demonstrating some characteristics of glasses of importance in the applications of glass in electrical engineering, with particular reference to vacuum devices; a colorimeter for fluorescent lamps, designed to meet the need for a rapid and sensitive method for measuring the colour appearance of low-pressure mercury-vapour fluorescent lamps (these are the first general-purpose lamps in which the designer has almost complete control over the colour appearance and radiation characteristics of his product); special uses of polythene and methods of manipulation; "butterfly" oscillators and absorption wave-meter; a differential thermometer for the measurement of the power output of magnetrons; new materials based on organic-silicon compounds (silicones); the sectioned models of magnetrons will show clearly the internal circuit elements which make possible the high-efficiency operation obtained in the centimetre wave-band; waveguide test bench (X-band), including local oscillator stabilised power supply unit; apparatus for measuring characteristics of iron under pulse conditions.

Measuring Carrier Noise

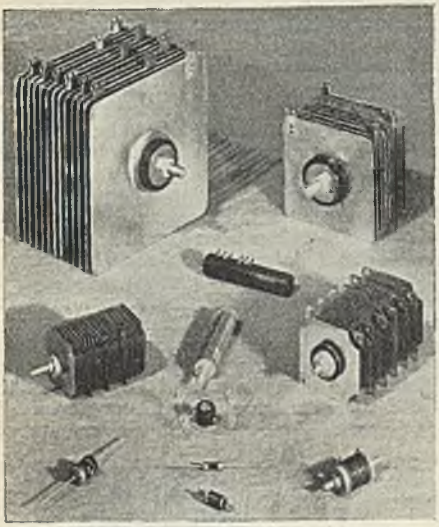
Over fifty items will be displayed on the stand of Standard Telephones and Cables, Ltd., including a spectrometer, a high-speed electric wave form analyser giving visual indication, in the form of a spectrum, of the individual components of a complex wave; a mains-operated coaxial transmission measuring set (74602) of new design for testing coaxial cable carrier telephone systems; a portable direct reading set designed for transmission and gain measurements on 24 channel carrier-on-cable systems over the frequency range, 1-150 kc/s; a self-contained and versatile portable equipment for measurements on voice frequency telephone circuits; a carrier noise measuring set (74105) for line noise surveys on open wire carrier telephone lines; a portable set of precision type designed for loss, level, and gain measurements on carrier-on-cable systems; various types of microphones; an instantaneous reading radio compass in the form of an automatic direction finder using Adcock aerials and a cathode-ray indicator; high frequency heating equipment with an output of 1 kW, suitable for dielectric heating of plastics, foodstuffs, etc.; a 5-gang miniature variable condenser incorporating novel features; a miniature rotary converter designed for obtaining various power supplies for aircraft radio equipments; a signal generator equipped with its own calibrator; a remote-controlled gearbox for obtaining alternative speeds of a driven shaft by remote control despite the shaft having close speed control; a Desynn trimmer, and an interesting range of valves and other components.

New Laboratory Instruments

Sangamo Weston, Ltd., will have on view among their laboratory standard instruments, representative types of a new series of 12-in. scale moving-coil and dynamometer instruments. Switches have been added for convenience in range-changing and to permit an increased number of self-contained ranges. The instruments are fitted with a knife-edge pointer, anti-parallax mirror and vernier type scale. They are also provided with a spirit-level, levelling feet, and a thermometer which indicates the true temperature of the movement and enables corrections to be made when extreme accuracy is necessary. None of the models shown in this section is yet in production. Sub-standard instruments comprise a range of 6-in. scale portable moving-coil, repulsion-moving-iron and dynamometer types. Other exhibits will be two new types of moving-coil relays, the latest type of Weston photographic exposure-meter, aircraft instruments, and various general moving-coil and moving-iron instruments ranging from miniature portable and panel-mounting types to large 6-in. scale switchboard models.

On stand No. 107 of the Record Electrical Co., Ltd., will be found the Shirley moisture meter, a quick and accurate means of measuring moisture regain in cotton, wool, rayon, flax, hemp, and other yarns by electrical means; an electro-magnetic thickness tester, which applies the principle of resistance variation with thickness of material; a universal multi-range ohmmeter, a modification of the standard cross-coil ohmmeter in which three ranges are provided; a street-lighting control equipment for obtaining any desired combination of street lighting, etc., by the use of a number of simple switching units; an earth leakage trip specially designed for protection of apparatus in

situations where effective earthing is impracticable; a remote torque indicator, consisting of a special coupling, in which the extension of a spring due to driving



A representative group of Westinghouse exhibits showing some miniature units

torque displaces a contact on a potentiometer resistance; a suspended-moving-coil instrument, in which the normal pivots and jewels are replaced by a special taut suspension of beryllium-copper strip; an alarm voltmeter incorporating a cold-cathode tube as a relay; and an exhibit showing three methods of opening out the portions of moving-coil instrument scales, without resorting to mechanical suppression.

Displayed by the British Rototherm Co., Ltd., will be a co-axial bi-metallic thermometer with electrical contact head, for industrial use where accurate control of temperature is required; a vertical bi-metallic thermometer resistant to heavy vibration; a pipe-line by-metallic thermometer; a by-metallic pocket thermometer; a laboratory thermometer, with a stainless steel stem and bi-metal element capable of an accuracy of 0.5 per cent. of the scale value; a thermometer for field ablution equipment; an aircraft auto-observer thermometer, in which the record of temperature is made photographically; a low-temperature aircraft thermometer, designed for high-altitude flying; an electrical temperature-indicator, an instrument of the ratiometer type for indicating aircraft engine-oil and radiator temperatures.

On the stand of Wild-Barfield Electric Furnaces, Ltd., there will be on view a Ferrant-Wild-Barfield self-contained h.f. dielectric generator and heating equipment, designed primarily for the pre-heating of plastic moulding materials; a Resilia pyrometer testing furnace, comprising a small vertical furnace accommodating special containers filled with pure materials with fixed and certified freezing points, which, together with any standard workshop potentiometer equipment, can be employed for checking the entire pyrometer installation; the Spekker steeloscope, a compact visual spectroscope for rapid routine qualitative analysis of alloy steels; the sensitive model Spekker photoelectric absorptiometer with the mirror spot galvanometer for metallurgical analysis of a quantitative nature in the ferrous, non-ferrous and light alloy fields.

The exhibits of the Westinghouse Brake and Signal Co., Ltd. will consist of "Westalite" and copper-oxide metal rectifier units and sets, constant potential a.c. and d.c. equipments, and static phase converters. Chief interest in the "Westalite" units will be in the improved double-voltage type. This operates at twice the reverse voltage per element with practically the same forward voltage drop, and a demonstration will be given to show the small size of the rectifier and its high efficiency. The reverse characteristic of the rectifier has a very sharp curvature at a critical voltage, the current varying as the twelfth power of the voltage, and use is made of this in voltage limiters. The improvements in copper-oxide units fall into the following three classes: (1) Miniaturisation, which has been applied to "Westcators"; (2) hermetic sealing to avoid the damaging effects of moisture; and (3) the lamination of graphite as a contact material to give an improvement in stability.

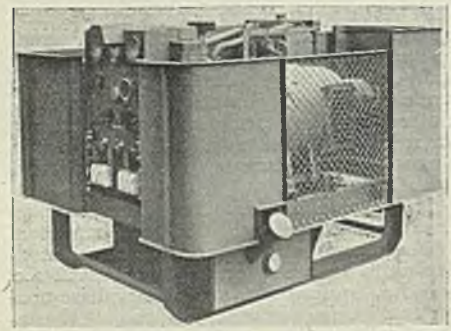
Voltage Regulators

The apparatus proposed to be exhibited by the Zenith Electric Co., Ltd., includes an automatic voltage regulator, and comprising a toroidal transformer providing a multiplicity of tappings, with a motor-controlled selector mechanism operated by a voltage sensitive relay; insulation testing equipment, incorporating features making for speed, safety and convenience in testing with voltages up to 3 000 V; alternative types of "Variac" voltage regulating transformers, incorporating the latest designs, ensuring smooth control, improved regulation independent of loading, silent operation, and provided with an improved form of calibrated dial; an example of the most recent design in phase shifting transformers with a double-ended vernier pointer; a small range of laboratory resistances illustrating the most recent features.

Equipment and Appliances

Screened Alternator Set—A High-Speed B.B. Contactor

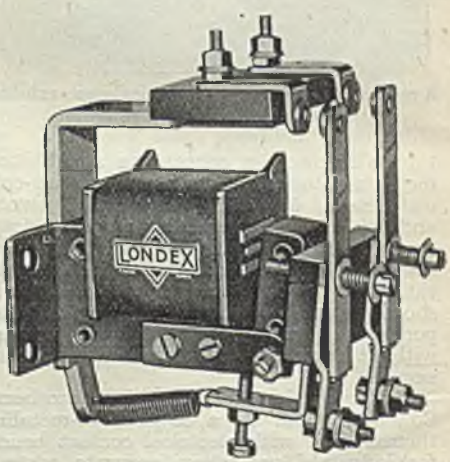
AMONG the alternator sets produced by Newage (Manchester), Ltd., 282, Bury New Road, Manchester, is a stationary generating set mounted on a skid type base-



A 22·5 kW skid-mounted alternator set with metal screens

frame, and powered by a Ford 30 H.P. eight-cylinder petrol engine to give an electrical output of 22½ kW, 400 V, three-phase, 4 wire, 50 cycles. The drive to the alternator is by means of five ⅞ in. vee ropes, the engine running at 1 850 r.p.m., to the alternator's 1 500. An instrument cluster attached to the centre panel gives immediate indication of oil pressure, water temperature and alternator r.p.m., a red line at 1 500 r.p.m. on the tachometer denotes synchronous speed. The tachometer is driven from the exciter shaft. A Crompton Parkinson rotating armature alternator, with overhung exciter, provides supply at 400 V, three-phase, 50 periods; a neutral link is available to give 230 V phase to neutral. The wiring from the alternator to the switchboard is carried in watertight flexible conduit. A dead front type metal-clad switchboard is provided for distribution and metering of the supply. An ammeter is provided in each phase, and one voltmeter is arranged with a selector switch, to check the voltage across each phase. Coloured tabs on each ammeter and outgoing terminal indicate the phase loading, the standard phase rotation being checked before despatch. A Metropolitan Vickers' type V.P. carbon pile automatic voltage regulator is mounted on the side of the switchboard, a switch being provided to give alternative hand control by means of the exciter field rheostat. Suitable Slydlok fuses give protection for panel lamp, voltmeter and ammeter; the control coil and ignition switch for the engine are included on the main switchboard. Two outgoing parallel circuits are provided with separate switches and fuses for each circuit, and an exciter field breaking switch with discharge resistance is mounted between the main switches. The complete switchboard and regulator is mounted on rubber and spring shock absorbers. Metal screens provide the necessary protection from rotating parts.

A high-speed ball-bearing contactor (type "BB") has been produced by Londex Ltd., of Anerley Works, 207, Anerley Road, London, S.E.20, for high speed welding, motor control and signalling. It is spring-controlled and can work in any position. The coil excitation is from 2-500 V a.c. or d.c.; the switching capacity is 10 A up to 400 V a.c. and 5 A up to 250 V d.c.; the contacts, up to four "make" or "break", or two change-over, are of

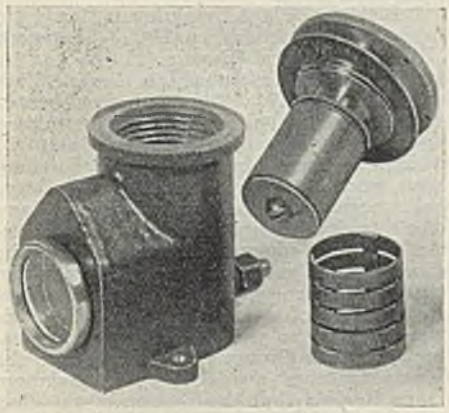


A high-speed ball-bearing contactor

heavy silver or tungsten. Several auxiliary contacts can be fitted (300 VA capacity). The contactors are supplied unmounted for fitting by means of four screws, or mounted on an insulated baseplate and fitted with a sheet metal dust cover, or cast iron casing.

The provision of a satisfactory lubrication system for modern machine tools is an essential requirement where mass production methods and precision work are involved. There are two essential requirements in the maintenance of an efficient lubricating system. The first is that the machine operator should have positive evidence that the oil is actually flowing and that no breakdown of the pump or other failure

of the lubrication system has taken place. The second is that the oil should be freed



Philips' Filtricator components

of all ferrous particles which are liable to cause excessive wear of the bearings, gears, etc. Philips magnetic filters cater especially for fine particles, and in addition to their existing magnetic filter equipment, Philips Industrial have developed a combined unit known as the "Filtricator," which both indicates oil flow and, and at the same time, eliminates from the oil the finest of magnetic particles. The "Filtricator" comprises a light alloy casing with a large diameter clear glass window in which the flow of oil can readily be seen, as the inside of the flow chamber is painted white. The vertical cylindrical part of the "Filtricator" contains one of the well-known Philips' magnetic filters, comprising a small "Ticonal" magnet of exceptional power surrounded by a mild steel cage containing air gaps in which even the smallest magnetic particles are caught. Access of oil is provided by a ½ in. gas nipple seen at the back of the "Filtricator"; the maximum capacity is about 50 gallons per hour. In order to remove any collected material it is only necessary to unscrew the cap and slide the cylindrical filter cage from the magnet, when it can easily be washed clean. The overall dimensions of the "Filtricator" are: 3 in. high by 2½ in. wide by 3 in. from back to front, and the weight is 1 lb.

Electrical Personalities

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

Mr. David Lionel Clarke, Belfast, first chairman Northern Ireland Road Transport Board, left estate in Gt. Britain and N. Ireland valued at £20 316.

Mr. G. T. Hall has been elected chairman of Wailes Dove Bitumastic, Ltd., in place of **Mr. H. A. Mackay,** who has resigned from the board. Mr. A. M. C. Bennett and Mr. H. K. Patterson have joined the board.

Mr. R. Brown, engineering general manager, has been appointed director and general manager of Scotts, Shipbuilding and Engineering Co., Ltd., on the retirement of Mr. K. E. Greig. **Mr. A. Alexander,** secretary, is also appointed a director.

The following changes are announced by Strand Electric Holdings: Mr. F. L. Blow, chairman (resigned); **Mr. J. D. H. Sheridan,** appointed chairman and joint managing director; Mr. S. E. Earnshaw, joint managing director; Mr. L. G. Applebee, additional director.

Thirty-five applications have been received for the post of borough electrical engineer and manager at Barnsley. **Major E. A. Barker,** the present holder of that office is about to retire.

Mr. B. Hallows Garside has been appointed managing director of the Britannic Electric Cable and Construction Co., Ltd., and of Hopkinson Motors and Electric Co., Ltd. The two companies are members of the Philco group. The appointments take effect from Jan. 1. Mr. Garside, for the past three years has been general manager of Crompton Parkinson, having served with that company for 18 years.

Mrs. Nora Wooster is visiting Czechoslovakia, at the invitation of the Society of Czechoslovakian Mathematicians and Physicists, and under the auspices of the British Council, to give a paper at a congress in Prague on "The use of X-ray Methods in the Metal Industry." She will also lecture for the British Council on "Industrial Diamonds," "Training X-ray Crystallographers for Industry" and allied subjects. Mrs. Wooster and her husband have a private X-ray laboratory in Cambridge (the Brooklyn Crystallographical Laboratory) for research and industrial consulting work. She has a special knowledge of the production of quartz oscillator plates and the use of industrial diamonds.

At the monthly meeting of the Birmingham Centre of the Illuminating Engineering Society on December 14 an interesting paper on "Mercury Vapour Projector Lamps" was presented by **Mr. H. K. Bourne.** The author first drew attention to the requirements of a light source for projection purposes, and after a brief out-

line of the types available and to come, went on to demonstrate their use in a practical way by showing many lantern slides using a mercury vapour lamp as the projection source. In addition, the actual working of a number of lamps was shown on the screen. Those who were photographers among the audience were particularly interested in Mr. Bourne's explanation of the use of mercury vapour lamps for photographic work. A spirited discussion followed.

The Edinburgh Chamber of Commerce, celebrating its 160th birthday, looked through the city for contemporaries and found some 40 firms with as long pedigrees. Among them were James Gray and Son, ironmongers and electricians, who, in 1899, took over the old-established business of Smiths and Company, 89, George Street, thus maintaining continuous trading from previous to 1770. The electrical department dates from about 1890, when the firm's own premises were lit by electricity before the public supply system was established. The business passed to the Douglas family in 1888, when Mr. Alexander Gray retired, leaving the firm to Mr. Robert Douglas, who died in 1912. The present control is in the hands of Councillor R. E. Douglas, who became managing director of the private company formed in 1925.

" Electrical Plant Breakdowns " was the subject of a lecture by **Mr. J. Ashmore** (British Electrical Repairs, Ltd.) to the members of the Birmingham Electric Club on December 17. He said that breakdowns could be divided broadly into two sections, namely: (a) electrical; and (b) mechanical, and emphasised that in diagnosis work the fundamentals must always be remembered, and particularly the laws of electricity and its effects. The mechanism of electro-magnetic forces and also the short circuit were demonstrated with the aid of lantern slides. Some interesting illustrations of mechanical fault diagnosis were shown as well as slides of typical breakdowns. Giving some insight into the repair facilities available, Mr. Ashmore made it clear that this section of the electrical industry had adequately kept pace with the demands on its service. Further slides depicted bomb damage to a Birmingham repair works, and a turbo-alternator sent to this country just after D-Day by the Forces in the field and repaired in the works rebuilt after the " blitz " damage.

Indian States Trade Delegation

AT a Press reception of the Indian States Trade Delegation held in London on December 19, Sir Stanley Reed, as chairman, extended a welcome to the delegation, and explained that a vast scheme of industrialisation in the Indian States was envisaged. The chief speaker was Mr. Magbool Mahmood, Director, Chancellor's Secretariat, Chamber of Princes, and secretary to the All-India States Post-War Reconstruction Committee, deputy leader of the delegation, the leader, Sirdar H. S. Malik, Prime Minister of Patiala, being now on his way back from the United States.

Mr. Mahmood said the Indian States they represented, roughly about one third of India, were prepared to place orders for all kinds of capital and consumer goods up to a collective value of £400 000 000 in connection with their development and industrialisation schemes, one of the main objects of which was to raise the standard of living in the Indian States. Besides goods, they required technical advice on industrial development and with this in mind, wished to arrange for the training of Indian technicians in Britain. The goods required, included electrical equipment and machine tools.

Most branches of British industry have received particulars of their requirements, through the F.B.I. and their respective trade organisations—in the case of the electrical industry, from the B.E.A.M.A. Already some firms engaged in the manufacture of electrical engineering equipment in Huddersfield, Gloucestershire, Birmingham, Hertfordshire and the Home Counties have had their inquiries placed before the interested States, and in some cases had received orders. Mr. Mahmood explained this was the first time such a delegation had been sent overseas by the Chamber of Princes, and they wished British engineering and other manufacturers to have first preference in supplying their needs.

Other members of the delegation include: Mr. E. Christesen, consulting engineer and industrialist, Nawanager State; Mr. K. D. Mahadik, Minister for Industries, Commerce and Communications, Gwaliar State; and Capt. Ohanda, Commerce Minister, Indore State. The last two mentioned members supplemented the remarks made by Mr. Mahmood, by speaking of the help given by the Indian States during the war in the supply of munitions. They wished to stress the fact that the delegation itself was not actually responsible for the placing of orders, but only in forwarding to the Indian States inquiries from interested manufacturers.

Electricity in Ships*

By A. C. HARDY, B.Sc., M.I.N.A.

REGARDING Diesel-electric drive, it is believed that the most important ship now under construction in this respect is the standard 12 000 ton 12 knot Anglo-Saxon tanker named last week. She is to be equipped with four Diesel-engined three-phase alternators supplying current at about 2 300 V to a 4 000 S.H.P. three-phase motor which at the normal ship's speed will run at about 110/115 r.p.m. The exhaust gases from three engines will be taken through a three furnace composite boiler to supply steam at sea. The electrically-driven cargo pump has three-phase motors on deck, totally-enclosed in a housing, which will operate at a voltage of about 800. It is reasonable to suppose that this ship should be regarded as the forerunner of many similar vessels, if the proves as successful as she promises to be.

Southern Railway Car Ferry

Another important, though smaller, Diesel-electric equipment now on order, is that for a car ferry for the Southern Railway's Lymington-Yarmouth (I.O.W.) service. She will accommodate 32 cars and 320 passengers. During the war there was delivered in Holland a pair of Diesel-electric grain elevators which had been ordered prior to the outbreak of war. These two last named ships, using d.c., are examples respectively, of the employment of electricity for manœuvrability reasons and for propulsive purposes as a secondary duty to the operating of the elevator machinery. In many respects the grain elevator is akin to the suction dredger. So far, in Great Britain no attempt has been made to apply Diesel-electricity on a big scale to this type of ship. In the United States, however, many installations of this kind have been made, invariably standard designs for ships constructed for operation by the United States Army Corps of Engineers.

On the other side of the Atlantic electricity is being employed, or has been, in a large number of important vessels. There is a three-screw Diesel-electric ice-breaker car ferry now under construction in Canada for the Prince Edward Island service. This promises to be interesting, because the main Diesel engines and the whole of the electrical gear, as well as the switchgear, are of Canadian manufacture. Canada, like the United States, is almost entirely electrically-minded for this type of ship, but something like a record has been created in the United States by the construction during the war of 4 Diesel-electric ice-breakers for the United States Coast Guards. They are among the highest-powered Diesel-electrically propelled ships in the world and have a length of 269 ft., a draught of 28 ft. and a displacement of nearly 6 000 tons. They have an electro-hydraulic system of heeling to " rock " the ship in ice. The power plant consists of 6 Fairbanks Morse opposed piston engines, each having a maximum output of 2 000 B.H.P., coupled to a 1 375 kW Westinghouse d.c. generator. The bow propeller is driven by a 3 300 S.H.P. motor and each of the two aft propellers by 5 000 S.H.P. motors. Current for the operation of auxiliaries is not generated by the main propelling units, but from 4 Fairbanks Morse 6-cylinder opposed piston engines coupled to generators. Each motor is controlled independently from a motor control board located on the platform level of the motor-room, or from one of three control stands arranged in the pilot house, or on the bridge wing. Power may be supplied to the starboard motor from one, two or three starboard generators and to the port motor from one, two or three port generators. Power may be supplied to the bow motor from either or both of the generators located in the forward engine-room. Excitation current to the propulsion motors and generators is provided by a local excitation motor-generator set on the platform level in each motor-room. Speed of the propulsion motors is controlled by connecting one, two or three propulsion generators in parallel to the motor armature and gradually raising the generator excitation to approximately 75 per cent. of maximum excitation, while the engines are running at a minimum speed and the motors are excited at a minimum value.

High Speed Control

Higher speeds are obtained by raising the engine speed gradually from minimum to maximum, while, at the same time, the generator excitation is increased from 75 per cent. to normal value. During this period the motor field is under the control of an automatic current regulator, which causes the motor to absorb approximately the maximum available engine output at any given speed and loading condition.

A technique is employed in the dredgers referred to above which has gained popularity in the United States in recent years. It is the use of standard high speed V-type General Motors Diesels, coupled to standard

*Continued from THE ELECTRICIAN, December 21, page 696.

generators. This drive has taken on the form of using two or four standard high speed small diameter motors, geared to the single propeller shaft. A group of four so-called ocean-going hopper dredgers uses two 12-cylinder General Motors Diesels on anti-vibration units, each coupled to two generators, one of which is used for propulsion and rated at 565 kW, 600 V d.c., whilst the other is a 310 kW, 240 V unit, separately excited and employed for driving the dredge pump motor. A similar technique to this was employed in connection with turbo-electric drive in two large sea-going dredgers constructed during and before the war years, for service in the tight compartment aft of the engine-room, struction the field control of both generators on each engine shaft allows very exact propeller and dredge pump motor speed control. The two shunt-wound 700 H.P. propelling motors are arranged in a watertight compartment aft of the engine-room and drive the propeller shafts at 190 r.p.m. through single reduction gears. The use of gearing in this case is undoubtedly due to lack of space in the vertical sense.

In the course of this general review of marine electrical development we come now to a discussion of the United States Army generator barges, which can generate enough electricity to supply a city of 60 000 inhabitants, and may, as a floating though non-self-propelling power plant, have considerable peace-time potentialities.

Power Generating Floats

It will be recalled that in the United States there has always been a tendency to favour floating power plants and that shortly after the last war a standard three-island United States Shipping Board cargo ship was taken over, fitted with boilers and a large turbo-generator, by means of which current could be fed, for example, to a distressed city. The type of bargo designed for the United States Army has a steel hull 175 ft. by 45 ft. by 11 ft., with an 8 ft. draught. She has a normal rated power output of her main power plant of 6 000 kVA, with an overload capacity of approximately 25 per cent. In addition, two auxiliaries may be cut in to permit an increase of 375 kVA. The main power plant comprises eight generator units arranged in two rows of four each, each unit consisting of a General Motors, two-cycle, 16-cylinder 1 000 H.P. Diesel direct-connected to a Westinghouse 750 kVA, three-phase, 60 cycles, 2 400 V, 720 r.p.m. generator. Each of the auxiliary generators comprises an 8-cylinder, 720 r.p.m., 230 H.P. Diesel direct-connected to a Westinghouse 150 kW three-phase, 60 cycle 240 V generator.

Another instance in which Diesel-electric power has been considerably used is in some special barracks ships, described as "virtually floating cities," air-conditioned throughout and complete with various facilities to make them comfortable living quarters in advanced fighting bases. Their equipment includes a 100 kW Diesel-generator set supplied by the General Motors Corporation. Diesel-electric power is also used in the series of concrete refrigerator barges employed to make ice cream and blocks of ice for the U.S. Army in the Pacific.

Flexibility of Electrification

In short, there seems to be little or no limit to the type of ship, class of installation and the range of opportunity for electric power plant. In some special ships marine requirements call for particular attention to design features. In others, perfectly standard power plants can be employed and adapted to their marine duties. Thus, from a manufacturing point of view the latter is probably the better of the two because it means a reduction in first cost and also superior maintenance.

Two further items are worth comment. I have suggested throughout these articles that marine electrical activity is mainly confined to the United States and to Great Britain. This is not completely correct if we recall that a passenger service is shortly to be started between Leningrad and British and United States ports. The first ship to sail in the resumed service will be the Vyascheslav Molotov, a turbo-electric ship of 7 500 tons gross built in 1940, fitted with Babcock and Wilcox boilers Stork (Dutch) turbines, and Asea electrical gear.

Admiralty Opinion

The other item, a useful note on which to end this review, recalls a question asked in the House of Commons some time ago as to whether the First Lord of the Admiralty had noted that approximately 900 naval auxiliary and merchant vessels built in the U.S.A. in 1942 were electrically driven, and whether this method of propulsion was being adopted to any extent in British shipyards. The First Lord's reply was to the effect that electric drive was not acceptable for the propulsion of major naval vessels, but that it was being adopted in merchant vessels building in the United Kingdom shipyards where production could be linked with fitting out facilities. How true this statement was is borne out by some of the examples which have been quoted above. How right the choice was, even though necessity governed it, is proved by the orders placed since the cessation of hostilities and other orders likely to be given to British shipyards and British marine electrical engineers in the near future.

Electricity in South Africa

Umniati Power Station—Plant Difficulties—Railway Electrification

THE new power station in the course of erection in the Midlands of Southern Rhodesia, at Umniati River, will be the biggest in the colony. The power station already working at Umniati is only a "pilot station," with an installed capacity of 8 750 kW. It is linked in parallel with the Gatooma power station, with an installed capacity of 2 000 kW., and before the end of 1945 will be linked in parallel with the Gwelo power station (installed capacity 4 500 kW.) by an 88 000 V line. If all goes well, the Electricity Supply Commission hopes to finish installing the first generating units at Umniati "B" by August 1, 1946. Each of these units will have a capacity of 10 000 kW, which means that they will be as big as any generating station in Southern Rhodesia. Their output, combined with that of the existing Umniati power station, will be so great that it is hoped to use the Gatooma and Gwelo stations simply as standby plant. Demands for power, however, have increased so rapidly that the Commission has found it necessary to order a 20 000 kW set for Umniati "B." It cannot hope to release plant from these stations for use elsewhere until this set is installed. The power station up to a peak load capacity of 20 000 kW will use cooling ponds, but when additional generating units are installed ferro-concrete cooling towers will be used. The design of Umniati "B" is similar to that of the four newest power stations in Great Britain and has been carried out entirely by the Commission's engineers. The plant is almost all situated on the same floor level, with no partition walls. Apart from the 60 per cent. or so of steel, which had to be obtained from the United States owing to the war, all the materials used were from either Great Britain or South Africa. The boilers, generation units and all the other equipment will be British.

Street Lighting in Cape Town

"Long overdue improvements in Cape Town's street lighting" are referred to in a report by the Electricity and Waterworks Committee, in which it is recommended that several of the main roads in Sea Point and the suburbs, be equipped with mercury vapour lamps, in place of the tungsten filament lamps at present in use. The municipality has in stock a number of mercury conversion units, and the purchase of 275 more, in addition to 600 mercury vapour lamps, at a cost of £3 650, will make it possible to improve the lighting in a fair number of the streets.

Two steam turbines built at Ljungstroem, Sweden, are being shipped to Durban; the Electricity Supply Commission has ordered four Swedish turbines for a power station near Viljoensdrift, in the Orange Free State, with a total capacity of over 100 000 kW.

Supplies in Rural Areas

The establishment by the Electricity Supply Commission of regional electricity supply schemes in certain rural areas has been urged by interested public bodies with the laudable objects of enabling the natural resources to be developed and attracting new industries, which are expected to be established now that the war is over. Such regional schemes, involving relatively small loads and lengthy transmission lines between supply points, are not, however, economically practicable at the present high prices of plant and materials, and must, therefore, be left in abeyance until conditions are more favourable. The fact that the Commission is required by statute to operate each of its undertakings as a separate and financially independent unit without incurring a loss, even in the initial stages of development, must, in the consideration by the Commission of new schemes of this nature, inevitably result in the adoption of a more cautious policy than the potential future development of such schemes might reasonably justify, if they were considered purely as business propositions. When the Railway Administration proceeds with the Cape main line electrification scheme, new possibilities will be opened up for electrical development in certain rural areas now remote from an economical source of supply.

In order to conserve stocks of steel during the war, and as suitable wooden poles were not available in certain areas, the Commission has been using reinforced concrete pylons in Natal. This is an original venture in South Africa for high voltage lines, although such pylons have proved satisfactory in other parts of the world.

When the supply of electricity was first made available to the town of Bethlehem in the Orange Free State it was contemplated that electrification of the railways would be extended to that town from Harrismith in the not distant future. A 88 kV line was consequently constructed beside the railway track, in pursuance of a policy then adopted for railway electrification. As the telephone lines, which are jointly owned by the Railway Administration and the General Post Office, follow the

same route, intense interference with telecommunication was experienced, due to the presence in the 88 kV circuit of harmonics originating mainly in the mercury arc rectifying equipment for railway traction supplies. Exhaustive tests, conducted jointly by the three parties concerned, led to the conclusion that the only solution to the problem was the physical separation of the lines, and, for reasons of accessibility to communication circuits, it was decided that it was more expedient to move the power line. War conditions stressed the urgency of proceeding with this work, in order that use could be made of this portion of the Post Office route as an alternative to the main trunk line between Pretoria, Johannesburg, and the coast. Eventually all 88 kV lines will be removed from their existing routes along the railway track. Investigations are also being conducted into the incidence of the lower order harmonics, with a view to finding ways and means of improving wave form in the whole of the Natal Central Undertaking system. The reconstruction of the line along a new route remote from communication circuits was started in September, 1944, and should be completed by the end of 1945.

Electrical News from Europe

Denmark.—The H. C. Oersted power station in Copenhagen has now been in operation for 25 years. Its present capacity is 122 000 kW, though its first generating set, installed in 1917, was of only 8 000 kW. This figure includes a Diesel-driven set of 15 000 kW, which at the time of its construction by the Danish firm Burmeister and Wain, in 1930-31, was the largest Diesel engine in the world.

Iceland.—The power station at Ljosifoss was increased in capacity during 1944 from 8 800 kW to 14 300 kW. The Laxfoss power station, which supplies the town of Akureyri, is also being extended, and a new station is under construction at Skeidsfoss. Reykjavik now enjoys a fully-developed hot-water and central-heating service fed from the island's volcanic springs; its equivalent capacity is 30 000 kW.

France.—France has planned to build twelve hydro-electric power stations on the middle course of the River Dordogne, with a total installed capacity of over 1 million kW and an annual output of some 2 million kWh. In the second half of 1944 four of the plants were reported to be in operation, but the short supply of building materials was then hampering further work. The largest of the plants under construction, the Aigle station, was not completed to schedule at the end of 1944, and there have still been no reports of its completion. The reservoir for this plant, which has been formed at the narrowest point of the Dordogne gorge, is sixteen miles long and will hold 200 million tons of water. The dam itself is 300 ft. high and nearly 1 000 ft. long; it is singular in that the overflow from the reservoir passes out directly over the centrally-situated generator house in two huge chutes. The four generators are each to be of 60 000 kVA.

Switzerland.—In 1944 the Bernische Kraftwerke, one of Switzerland's largest electricity-supply undertakings, sold 1 115 million kWh, as compared with 1 068 million in 1943. Small light and power consumers took 452 million kWh, the electro-chemical and electro-thermal industries 216 million, the railways 70 million, while sales to other Swiss companies and exports accounted for 330 and 46 million kWh respectively.

In mid-1944 there were in Switzerland 43 State-subsidised electric grass-driers with a connected load of 29 400 kW and four wholly private grass-driers of capacity 1 720 kW, as well as over 50 driers of capacity 10-50 kW (compared with the individual capacity of the larger driers of 300-1 200 kW). The 47 large plants consumed over 25 million kWh in 1943, and were thus in operation for only about 850 hours in the year. For this and other technical reasons the driers are something of an embarrassment to the electricity supply companies.

When the Zürich municipality's Albulawerk hydro-electric power station at Sils was built in the years 1906-9, it was fitted out with eight generators, each of 2 500 kVA. At that time demand for electricity did not so closely match supply as at present, and full advantage was not taken of the site's possibilities. The plant is now being rebuilt to produce 28 000 kVA from only two generator sets.

Zürich now owns or shares the following hydro-electric plants:—

Full Ownership.	Capacity, kW.	Average Annual Output, million kWh.
Albulawerk, Sils	22 000	140
Heidseewerk, Solis... ...	9 000	20
Lettenwerk, Zürich ...	750	5
Limmatwerk, Wettengen...	24 000	141
	55 750	305

Partial Ownership	share owned, %		
A.G. Kraftwerk Wäggital ...	50	52 000	68
Kraftwerk Oberhasli A.G.	16⅔	32 000	100

Small Arms Ammunition

Photo-Electric Device for Testing Fire Holes

IN all types of small arms ammunition the propellant charge is contained in a metal case, one end of which carries the bullet, while the other end is closed and embodies a recess in which a percussion cap is mounted. When the cap is struck the resulting flash is communicated to the propellant through small holes punched or drilled in the closed end of the case. In all the types of ammunition with which this article is concerned two such holes are provided.

Since the diameter of the fire-holes is small, of the order of 0.02 ins. to 0.05 ins., breakage of punches and drills is frequent, and such breakage is not easy to detect; hence a considerable proportion of cases contain one fire-hole only, and some cases contain none at all.

The effect of the absence of any fire-holes is, of course, that any automatic weapon to which the cartridge is fed jams and ceases to fire; similar jams may also occur when only one fire-hole is present,

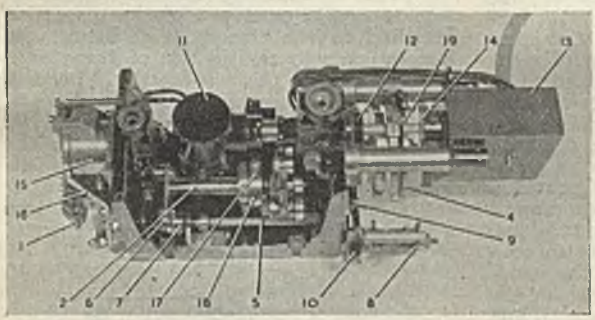


Fig. 1.—View from above, showing a case in the gauging position, and another case in the case fingers

due to slow ignition of the propellant. Such jams are serious enough when the weapon is accessible, but when it is mounted on the wing of an aircraft, and the stoppage cannot be cleared, the defective case may cost the pilot his life.

These considerations had led to the institution of a system of visual inspection of fire-holes, carried out two or even three times on each case. Such inspection was a very exacting task, and, in spite of the precautions taken, was not in fact entirely effective; experience had shown that, even with inspectors working on a penalty system, a proportion of one "one-hole" case accepted per ten thousand cases inspected was normal. Attention was therefore directed to the development of an automatic method of inspection, which should not be liable to errors and would enable the existing inspection staff to be released for other work.

Attempts had been made to detect the presence of fire-holes by applying air pressure to the inside of the case, and operating some pressure-responsive device by air flowing through the holes. Such a method involves mechanism for temporarily making air-tight connections to both ends of the case, which is not an entirely simple matter. Further, unless special precautions are taken, it does not differentiate between cases with one hole and those with two holes. There is also the possibility that particles of dirt and swarf may be blown into the fire-holes after the inspection mechanism has operated and accepted the case. The provision of a compressed air service may also be a difficulty. It is believed that these difficulties have now been overcome and that satisfactory pneumatic

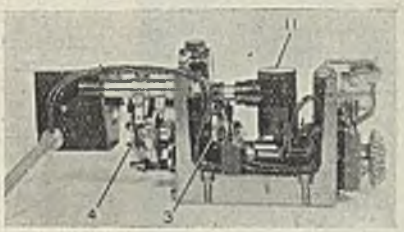


Fig. 2.—View from feed side

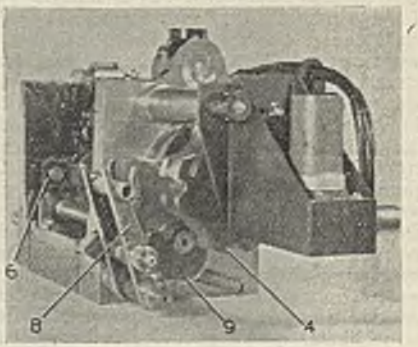


Fig. 3.—View from casewheel end, showing photo-cell housing with cover removed

* By R. S. Spilsbury, B.Sc.Eng. and A. Felton, B.Sc.Eng.; Electricity Division N.P.L.

gauges are available, but at the time of the development of the gauge described herein no success had been attained. It was therefore desired to develop an alternative method of testing, and the Electricity Division of the National Physical Laboratory was asked to consider the possibility of photo-electric inspection of fire-holes.

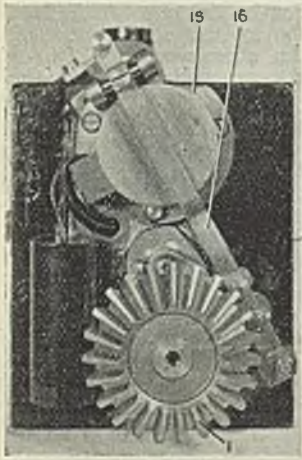


Fig. 4.—View of drive end showing electromagnet

One of the main conditions to be satisfied by any testing method is that it shall be adaptable to the existing gauging machines. The importance of this lies in the fact that the operation of picking up the cases and presenting them to an inspection device in the correct orientation is quite difficult to accomplish mechanically, and it is therefore most desirable that the fire-hole gauge should form part of a gauging machine which is already provided with a feeding system. This requirement imposes severe space and other limitations. It will accordingly be appropriate to consider at this point the design of the gauging machines at present in use, which are manufactured by Messrs. Thomas White and Son Ltd., of Paisley.

The White machine consists of a number of testing heads, usually about 9, driven by a common motor through bevel gears; one such head is shown in Figs. 1 to 4*. The bevel gear (1) is mounted on the main-shaft (2) and rotation of this shaft causes the operation of the intermittent motion (3), which drives the case-wheel (4). This motion is such that the case-wheel is at rest and definitely located during about ¾ of a revolution of the main-shaft, and turns through ¼ revolution during the remainder of the revolution of the main-shaft. Thus if a case is fed by a hopper mechanism into one of the four slots** of the case-wheel it will be carried to the uppermost position and held stationary there for a period of about ¾ second, since the main-shaft makes about 1 revolution per second. During this time a mechincal gauging device is brought by appropriate mechanism to bear on the case, and its indication is transmitted through links and levers to the trip-rod (5), which moves axially forward, that is towards the case-wheel end of the head by an amount depending on the size of the element gauged. Shortly after this, and before the case-wheel renews its motion, the detent (6), which was raised shortly after the case reached the gauging position, is caused to fall into contact with the limit-stop assembly (7), mounted on the trip-rod. The gauging device is then withdrawn (the case-wheel being still at rest) and the trip-rod is left locked in a position dependent on the particular part of the limit-stop assembly with which the detent engages, which is in turn dependent on the travel of the trip-rod while gauging was in progress, and hence on the size of the element gauged.

During the latter part of the process described the case-fingers (8) have been in the position shown in Fig 1. Soon after the conclusion of the trip-rod setting operation they are moved towards the case-wheel by a spring, the movement being controlled by the cam (9). According to the position of the trip-rod it is engaged by step 1, step 2, or step 3 of the piece (10) attached to the fingers, and hence the fingers come to rest in one of three positions relative to the case-wheel. After this selection has been made the case-wheel turns, and, according to the position of the fingers, delivers the case (a) between the fingers and the case-wheel, whence it falls into a drawer, or (b) into the fingers, or (c) beyond the fingers, whence it falls into a second drawer. The fingers then***

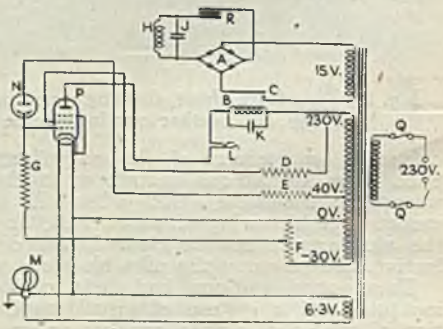


Fig. 5.—Diagram of electrical connections

move out from the case-wheel, and if the case lies in them, deliver it to the case-wheel of the next testing head as an accepted case. The cases which fall into the drawers are those for which the movement of the gauging device was too great or too small, i.e. those for which the dimension gauged was below or

above the limits for acceptance. Finally a new case comes to the gauging position, the detent (6) is raised, allowing the trip-rod to be fully retracted by its spring, and the cycle proceeds as before.

It will be clear from what has been said above that any fire-hole gauging device employed in conjunction with the White machine must incorporate most of the features of the mechanical gauge. For example the method of receipt of the case by the case-wheel, and delivery to the next machine by the fingers, has to be retained, and it is very desirable that the trip-rod should operate in the standard manner. Further, since the various heads are placed side by side without clearance, the whole mechanism, other than components requiring only electrical connections, must be contained between the two planes of which the sides of the head are parts. Other space limitations are imposed by a glass case in which the machines are enclosed. The N.P.L. fire-hole gauge was designed to comply with these conditions.

The gauge consists essentially of a light-projector, arranged to illuminate the head end of the case; a photo-emissive cell, which receives light through the fire-hole or fire-holes of the case; a single valve amplifier, which raises the output of the photo-cell to a suitable value; a relay, operated by the signal from the amplifier; and an electromagnet arranged to operate the trip-rod of the White head when this signal is of appropriate value.

The Optical System

The considerations already set out render any large or elaborate optical system inadmissible; further it is, from several points of view, undesirable to use light sources having a high power consumption. The system adopted is therefore a simple one, consisting of a 6 V 24 W automobile headlamp bulb, operated at approximately 5.8 V, and mounted in a small ventilated lamp-house (11). This lamp-house carries a lens tube containing two achromatic positive lenses each of 6.7 cm. focal length. The system is arranged to produce a defocussed image of the straight lamp filament on the head of the case. The image is arranged to have a diameter slightly larger than the spacing of the fire-holes, and is carefully centred on the case head. The lens tube is provided with an aperture-cap (12), the plane surface of which forms a continuation of the head guides which locate the case longitudinally in the machine.

For reasons of sensitivity and constancy a gas-filled caesium-type photo-emissive cell is employed, the particular cell being Philips type 3530 in early gauges, and cinema-television type G.S. 16 in later models. The cell is connected as indicated in Fig. 5 and is operated at a voltage of approximately 40 V, 50 cycles per second, a value well within the safe range. It is mounted in a metal housing (13) at the front of the machine, and receives light from the projector through the case fire-holes and an aperture cap (14), the plane surface of which forms a continuation of the case mouth guides. The aperture in this cap is slightly smaller than the mouth of the case. The spacing of the aperture-caps of the projector and photo-cell is such that the case has only a slight play between them; thus the photo-cell compartment is practically sealed against stray light, and the effect of room lighting is negligible.

The amplifier employs a single pentode (Mullard E.F. 50), mounted with the photo-cell, but in a separate ventilated compartment of the housing. The valve is coupled to the photo-cell by a 10 megohm resistance, and its anode current is of the order of 5 mA when the photo-cell receives light through two normal fire-holes. The supplies to the anode and auxiliary grid of the valve are at 230 V, 50 cycles per second.

The Amplifier

The control box which is mounted separately and connected to the gauge unit by a 10-core cable, in a flexible metallic conduit, contains the transformer, which furnishes all necessary supplies: a relay, the winding of which is in the valve anode circuit; a jack, to enable a milliammeter to be connected in the anode circuit; a variable potentiometer with a detachable control knob, regulating the grid bias voltage of the valve; a switch and fuses for the power supply; a selenium rectifier to furnish power for the operation of the electromagnet on the White machine; and various minor circuit components. The box is approximately 8½ ins. x 8½ ins. x 4½ ins. in size, and is mounted in a convenient place on the White machine frame.

The electromagnet (15) is mounted on the drive end of the White head, and consists of a mild steel pot carrying a winding of 22 ohms resistance, which is fed with rectified current at 12 V. The disc armature is attached to a pivoted lever (16),

---

* The photographs are of the head with the N.P.L. fire-hole gauge fitted, and do not show the mechanical gauging assembly.

** In Fig. 1 the top of the case-wheel turns towards the observer. The case is accordingly fed into the slot at the far side of the wheel.

*** The instant at which this movement starts is dependent on the position in which the fingers come to rest.

which has a return spring at the upper end. The lower end carries two adjustable dome-head screws, one of which acts against a facing on the machine frame and functions as a forward stop, while the other acts against the hardened plane end of the trip-rod. A similar screw, mounted on a bracket attached to the machine frame, acts as a back stop for the lever. In order to prevent undesired magnetic attractions, while keeping wear of the parts to a minimum, all three screws are made of hardened beryllium-copper. To obviate the possibility of sticking of the armature should the forward stop be set incorrectly, a brass dead stop is provided in the magnet gap which prevents the armature from touching the pole faces. An electrolytic condenser is shunted across the magnet winding, to by-pass the a.c. component of the rectified current and to act as a spark quench.

For reasons which will appear later it is not desirable that the electromagnet armature should always be operated when the photo-cell receives light. Accordingly the relay is connected to the electromagnet winding not directly, but through a pair of contacts (17), which are controlled by a cam (18) mounted on the mainshaft of the machine.

Photo-cell Protection

It is also undesirable that the photo-cell should be exposed to the full light of the projector when gaps occur in the succession of cases passing through the machine. Such gaps are due partly to the hopper feed mechanism, which does not pick up a case at every attempt, and, partly to rejection of cases by testing heads earlier in the sequence, and are not infrequent. For this reason a small steel shutter blade (19) is mounted in front of the photo-cell aperture, and is mechanically raised by the passage of each case, and allowed to fall by gravity as the case moves away from the gauging position. Thus the photo-cell aperture is always obscured except when a case is in position.

Since the lumen output of the lamp varies as about the 4th power of the applied voltage, excessive variations of voltage should be avoided. For this reason the gauge, which consumes only about 40 W, is supplied from a commercial voltage stabiliser, which is a static device embodying only condensers and transformers. With this device in circuit the rejection limit of the gauge is unaffected by variations of at least ± 15 per cent. in the mains voltage. The effect of large variations of frequency is more serious, but the changes met with on public supply have negligible results.

The operation of the N.P.L. gauge is as follows.

Suppose that a case having two clear fire-holes is fed into the case-wheel (4). At this point the shutter (19) covers the aperture of the photo-cell, and no light is therefore received from the projector (11). As the case enters the gauging position it opens the shutter mechanically, and when it comes to rest in the gauging position the photo-cell receives light through both fire-holes. This causes the photo-cell to pass current, and this current is amplified by the valve, and is sufficient to cause the relay in the control box to operate, and close its contacts. This relay prepares a circuit for the electromagnet, but the magnet is not energised, because the cam-operated contacts (17), which are in series with the magnet winding, are not yet closed. As the mainshaft of the unit continues to rotate the cam-operated contacts close; the electromagnet (15) then attracts its armature, which moves the trip-rod (5) of the White unit forward; the trip-rod detent (6) falls and locks the trip-rod in the forward position; the cam-operated contacts open and allow the electromagnet to release its armature; the case fingers (8) approach the case-wheel, and the trip-rod, owing to its forward position, engages the " accept " step of the stepped piece (10) attached to them; the case-wheel moves forward, and delivers the case to the fingers, which hand it on to the next gauging head. Finally the next case comes into the gauging position, the trip-rod detent is lifted, and, since the circuit of the electromagnet is still open at the cam-operated contacts, the trip-rod is returned to the fully-retracted position by its spring.

If, on the other hand, a case having one fire-hole only, or one correctly punched hole and one partially obstructed hole, is fed into the case-wheel, the amount of light received by the photo-cell is not sufficient to cause the relay to operate. The trip-rod therefore remains in its retracted position, and the fingers assume such a position that when the case leaves the case-wheel it falls beyond them into a drawer, and is rejected.

Operation of Gauge

It will be observed that the gauge classifies cases as having a satisfactory area of fire-holes, or not, and makes no attempt to subdivide satisfactory cases. Since unduly large holes, or the presence of four holes instead of two, will not cause irregular firing of the cartridge, no advantage is derived from segregating cases having these features, while the use of a simple accept-or-reject classification greatly reduces the complication and cost of the gauge. The one serious defect which could pass the gauge, namely absence of the entire base of the cap recess, would be detected by the mechanical head which

gauges the height of the cap anvil, and thus would lead to rejection of the case.

The degree of imperfection in the fire-holes which will cause rejection of a case is controllable by means of the potentiometer in the control box, which varies the grid bias of the amplifier valve. Essentially the adjustment consists in setting this potentiometer so that when a one-hole case is in position in the gauge the anode current of the valve is well below that necessary to close the relay, while with a good two-hole case in position the anode current is well above the closing current. The adjustment is, however, slightly complicated by the fact that the image of the filament projected on the case head is not perfectly uniform in brightness, so that the amount of light transmitted through the fire-holes varies to some extent if the case is rotated on its own axis. Since the orientation of the cases passing through the machine is random, it is necessary to allow for this effect, and the adjustment is as follows.

The special milliammeter provided is plugged into the jack in the control box and a case having only one fire-hole, of standard diameter, is placed in the case-wheel and carried to the gauging position. The case is then rotated by hand, in steps of about 1/10th revolution, and left in the position that gives the maximum reading on the milliammeter. By means of the detachable control knob the potentiometer is turned until the milliammeter reading has some standard value, usually about 1 milliampere. The one-hole case is then replaced by a case having two clear fire-holes of standard diameter, and this is rotated in steps until the position giving the minimum reading is reached. It is noted that this reading is equal to or greater than some standard value, usually about 4 mA. The closing current of the relay being about 2 mA, it will be seen that this adjustment ensures that a one-hole case can never be accepted, whatever its orientation, while a good two-hole case can never be rejected. The only effect of orientation is then that the minimum total area of fire-holes required to cause acceptance varies slightly according to the position of the case. Provided that the gauge is set in the manner described above, any case accepted by the gauge will be satisfactory in service.

Response of Photo-Cell Amplifier

It will be observed that a large margin exists between the responses of the photo-cell amplifier unit to one-hole and to two-hole cases. Thus the gauge is not sensitive to variations in the operating conditions, though precautions are, of course, taken to avoid such variations.

It will be clear from the introduction to this article that it is most important that the acceptance, due to any cause, of cases with no fire-holes or only one fire-hole, should be made practically impossible. Since the N.P.L. gauge will reject every case unless a positive signal travels completely through the chain of light-projector, photo-cell, amplifier, relay, contact-cam, electromagnet, and trip-rod, failure in any of the links in this chain will not lead to the acceptance of defective cases. Further, since the trip-rod should return to its retracted position after the acceptance of a good case the motion of this rod affords a continuous visual indication of the normal functioning of the gauge. Thus, should one of the few faults which could cause false acceptance occur—for example a failure of the grid-bias potentiometer such that the negative bias is removed from the valve grid and full anode current flows continuously—the absence of motion of the trip-rod would allow the defect to be detected at once.

Classification of Cases

It will also be observed that slight irregularities in the indexing action of the White head which might allow light to leak round the outside of the case, and similar light leaks due to the fact that the photo-cell shutter does not conform exactly to the contour of the outside of the case, cannot cause incorrect action of the trip-rod, since the circuit of the operating electromagnet is not completed until the case has been at rest in the gauging position for about 200 milliseconds. It is at this point, when all conditions have become stabilised, that classification of the case is carried out.

With regard to performance of service an N.P.L. fire-hole gauge was installed at a small arms ammunition factory on September 9, 1942. Up to December 11, 1942, the results were as follows:—

Hours of operation	1 217
Cases tested	2 656 500
Cases rejected:	
No holes	1
One hole	317
Two holes, partially filled with swarf or sawdust	6 333
Two holes, not fully punched ...	4 019

The mechanical adjustments of the gauge were checked after 2.6 million cases had passed through the machine, and were found to need no attention. As a result of this experience the gauge was put into production and some 180 instruments were made and installed during the war.

The work described above was carried out in the Electricity Division of the National Physical Laboratory on behalf of Director of Small Arms Ammunition, Ministry of Supply, by whose permission this article is published. The authors desire to acknowledge the assistance rendered by Mr. J. J. Hill in the development of the instrument.

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 is it so necessary to have load resistances quite free of reactance when such resistances are used for measuring the response curves of highly rated audio-frequency transformers?

When small audio-frequency transformers are tested for response over the specified frequency range it is comparatively easy to construct load and source resistances which are reactance-free over the frequency range of interest; such resistances can be made up of ceramic or carbon resistances in series and/or parallel from the available values to get exactly the effective resistance specified. Needless to say, this resistance should be measured, since the commercial values are available only in comparatively wide ranges of tolerances. The combination should also be of adequate proportions, so that the temperature rise does not change their resistance appreciably.

With increasing power there comes a stage when these small resistances are inadequate. For laboratory purposes it may be sufficient to stretch out lengths of Eureka wire on a frame, neutralising inductance in successive loops. Wire-wound vitreous resistances have far too great an angle, even 1 000 c/s., to permit their use up to 10 kc/s. The only way out is the use of resistance mats, nets, or grids, in which the resistance wires are woven with asbestos cord in such a proportion that the inductance effect is balanced against the capacitance effect to a fair degree of approximation. This was achieved in Ayrton and Mayther's gauze resistance half a century ago. A number of such mats can be mounted on terminals in a box, and used in series or parallel to achieve the desired resistance and wattage dissipation.

To notice the deleterious effect of resistance in such a load-resistance when testing an audio power-transformer, it is necessary to consider the equivalent circuit of the transformer. Taking one side of the circuit to be at earth potential, and that the transformer is changed into an actual transformer with unity turn-ratio followed by one with the actual turns-ratio but ideal in performance, we find that the mutual inductance appears as a shunt across the line, preceeded by the primary leakage and succeeded by the secondary leakage inductances. The secondary self-capacitance follows as a shunt before the ideal transformer with the correct turns-ratio and the terminating load. If the latter is inductive, it tends to neutralise the self-capacitance, and so alter the upper frequency of resonance in the transformer. Thus the upper end of the response curve is erroneous, not because (to a first approximation) the load takes any more or less power, which it does not, but, because all transformers have leakage inductance, the actual cut-off frequency is altered.

More serious is the effect of inductance in the source of power supplying the primary winding, because this adds to the leakage inductance and directly brings down the upper cut-off frequency of the transformer and so introduces an effective loss of response. The only way out is to apply the power through a " source " resistance, which is deliberately made non-inductive, keeping this voltage constant with a voltmeter across the line. The reactance of the real source is then immaterial. The disadvantage is then that at least twice the power rating of the transformer must be available.

L. E. C. H.

News in Brief

All-electric Houses.—At a recent meeting of the Luton T.C. it was decided that all future municipal houses would be all-electric.

Wireless Licence Record.—The number of wireless receiving licences in force in Great Britain and Northern Ireland has now reached the record total of 9 884 300.

Liverpool Trade Exhibition.—The electricity department had a stand in the recent trade exhibition at the Christmas cattle show. Refrigerators suitable for butchers' premises were shown.

Social Item.—The Blackburn electricity undertaking's sport and social club, suspended during the war, has resumed its activities under Mr. R. H. Harral, the electrical engineer and manager.

Radio Relay Service.—The Swindon Housing Committee has given permission to Swindon Radio Relay Exchange Ltd., to provide its relay service in prefabricated houses where so desired by the tenants.

Street Lighting Schemes.—The Wokingham (Berks) T.C. has signed a contract with the Engineering and Lighting Equipment Co., Ltd., for the installation of sodium street lighting. A scheme for the illumination of all Leicester streets by electricity has been approved by the Watch Committee. It will, it is understood, take five years to complete.

Power and Voltage Measurements

Demand for More Accurate Commercial Instruments

A PAPER on "Precision a.c./d.c. Comparator for Power and Voltage Measurements" by Mr. G. F. Shotter and Mr. H. D. Hawkes, was read and discussed at a meeting of the I.E.E. Measurements Section on December 14.

In recent years, stated the authors, there had been a marked increase in the demand for more accurate, commercial a.c. power-measuring instruments. The demand was due largely to changing industrial conditions brought about by legislation, although it already existed for the manufacturer whose a.c. standardising apparatus was only comparable in sensitivity and accuracy with that of the commercial apparatus he produced.

The paper gave a brief review of the sources of error common to dynamometer wattmeters, and emphasised some of the inherent errors which had been less publicised.

A new instrument for measurement of a.c. power and voltage by direct comparison with a standard d.c. potentiometer was described, the principle of operation being a null method based on the balancing of two torques.

A summary was given showing the errors inherent in the new instrument and those which had been eliminated by the method of measurement.

The stability of accuracy of the new instrument is maintained by self-standardisation, and means of checking the accuracy of the associated apparatus is made available.

Mr. R. S. J. Spilsbury (National Physical Laboratory) said this comparator was a complicated piece of apparatus and he did not regard the null method as being a very important feature of the instrument inherently, for it had certain drawbacks. Indeed, he was not very much in love with null methods. The inherent standardisation was really a form of calibration. The authors calibrated by means of another instrument to which they applied a reverse torque, and that was a very nice and simple way, but it had the rather bad drawback that it forced one, for practical reasons, to adopt a low range milliameter as the instrument which was calibrated. There were rather a lot of steps between the milliameter calibrated by this inherent standardisation method and the wattmeter finally used, and he felt it was necessary to cut some of these steps out. He showed some slides illustrating how this could be done, in preference to the authors' method, and gave a description of the method of calibration adopted at the N.P.L. Whilst the authors had eliminated practically all the troubles that could be eliminated fairly easily, there were still the more difficut errors to be deal with. Nevertheless, he regarded this instrument as a very fine one and a remarkable example of co-operation between a back-room boy and a front rank firm.

Mr. D. C. Gall (H. Tinsley and Co.) said the authors were only applying principles that had previously been applied in other instruments with a somewhat similar success. Dr. Drysdale had worked in this field with considerable success as far back as 1910, and his instrument had the advantage that it was astatic. The information given in the paper with regard to torque was rather meagre. The accuracy of the method depended on a knowledge of the impedance of the circuit, and as this was a copper circuit he did not see how one could expect an accuracy of 2 parts in 10 000. This was a reason why direct calibration under the conditions in which the instrument was to be used would be preferable. For routine testing, an instrument of this type would have considerable advantages if it could be simplified. A very similar system had been developed in which the balancing of the torque was carried out automatically. That seemed to him to be an advance in the techique of measurement, and had the advantage of avoiding some of the complications of the double adjustment. The automatic system could also be made astatic and thus avoid the use of magnetic screens, which must be a source of error.

Mr. L. B. S. Golds (Edmundsons Electricity Corporation) said he would have preferred to see this comparator made completely astatic without the necessity for using mumetal, which might be a source of nuisance. The beauty of this instrument was that it was self-checking with the exception of the voltage circuit resistances, and he suggested that these should be provided with tappings to give 1.25 V on the terminals with rated voltage on the resistances, so that they could be cross-checked against the volt box of the potentiometer. Referring to the application of the instrument, he said there might be some who would ask why have such an accurate instrument for meter testing. However, there were a number of undertakings with annual incomes from meters of £1 000 000 a year (his own undertaking was £7 000 000), which meant that with the ordinary wattmeter it was impossible to

guarantee the undertaking's revenue at nearer than £1 in £1 000 at the standard instrument. It might be argued that on the law of averages some meters would be fast and some slow, and, therefore, they would average out about the O.K. point. The fact was that the O.K. point was itself 1 part in 1 000 out, and it was here that the author's instrument was of the utmost value, as it was possible to improve the accuracy of the fundamental standard by five times, and stand a 50/50 chance of paying the whole cost of the instrument on even a small undertaking in one year. He suggested that the manufacturers should consider making this instrument in a portable astatic form to enable works or site tests to be made on lower power factors such as Petersen coil losses and insulation power factor. He was sure the instrument would, in time, have a wide field of application.

Mr. H. Easton (Ferranti, Ltd.), after referring to a number of deflectional instruments, as opposed to the authors' null method, called attention to the description in the appendices to the paper of the method used at the American Bureau of Standards by F. B. Silsbee. In this, a dynamometer instrument was used in which each coil consisted of two inter-mingled windings, one winding of which was supplied by the a.c. circuit to be measured, while the other winding of each coil was connected to a variable d.c. supply. This seemed to be the ideal arrangement because it did not depend on the torsion of a shaft connecting two elements trying to operate in opposite directions. He did not suggest the authors had adopted a wrong method, but he asked them to make sure they were using the best method for their particular case.

Mr. F. E. J. Ockenden (Everett, Edgcumbe and Co., Ltd.) said it was very refreshing to have an evening devoted to a paper dealing with an increase in the accuracy of commercial measurement, particularly when sponsored by two such authors. He also had been pleased to hear Dr. Drysdale's name mentioned because of the work he did in accurate measurement should be an inspiration to all measurement engineers. Indeed, a great deal of the ground covered in this paper had been covered by Dr. Drysdale. The results obtained by the authors were self-evident, and it was impossible to criticise the accuracy of the results produced. At the same time, he felt there were many points of criticism of the apparatus, about which there was a complexity and comparative massiveness, and the gist of his remarks was whether this was really worth while compared with what could be obtained with an astatic torsion head dynamometer instrument, of which he regarded Dr. Drysdale's instrument as the ideal. Indeed, he felt the paper did scant justice to the work of Dr. Drysdale. The great advantage of Dr. Drysdale's instrument was that it was astatic, and to avoid that the authors had adopted shielding, which had certain disadvantages and possibilities of error.

Dr. G. F. Tagg (English Electric Co., Ltd.) dealt with one or two small points of detail. He said he was a little worried about the correction for temperature, as, although the authors adopted an old idea used by Dr. Weston, there was the difference that whereas he measured the resistance of the whole of the circuit, the authors only measured part of it. How could it be certain that the part of the winding which they tapped off was at the same temperature as the whole of the instrument. He asked what part of the winding was tapped off.

Mr. W. L. Beck (Cambridge Instrument Co., Ltd.) called attention to a statement in the paper to the effect that with the use of magnetic material in the core of the wattmeter, an error on the a.c./d.c. changeover was unavoidable. That might be true, but the authors had given no proof of it nor any indication of its probable extent. He asked the authors for an approximate figure of the ohms per volt, and also enquired whether the instrument could be transported without clamping the moving coil.

Mr. F. Byrne, speaking from the user's point of view, also suggested that it would be an advantage if this instrument were astatic, to avoid the influence of stray fields, and added that a stabilising device was required for its successful operation. He asked if the authors were prepared to throw in a stabilising device as part of the instrument, at the same price, when it came on to the market.

Mr. Shotter, replying in part to the discussion, said he was always sorry for people who had to criticise an instrument which had been in use for six years as this one had, and which had passed all the N.P.L. tests in such a manner that practically no error could be found. Several speakers apparently had more faith in astatic instruments than he had, because his experience over many years had been that some of those instruments were not as astatic as they appeared to be unless the field was uniform. Whilst some people had objected to the complexity of the instrument, Mr. Ockenden apparently wanted it made more complicated. He did not know what the meter department would say to that. The instrument as it was at present did not present any difficulty in operation, as his colleagues would confirm. As to the use of a stabiliser, work was proceeding on one at the moment, and it would be the subject of another paper.

Electricity Supply

Bradford.—The Parks Committee has agreed to the provision of electricity to the pavilion in Bradford Moor Park, if the tenant will contribute 12½ per cent. of the cost. The General Purposes Committee is to replace a service lift in the old part of the Town Hall by an automatic lift at a cost of £1 003, and obtain a report as to the state of the two passenger lifts in the new portion of the Town Hall.

Llangollen.—The U.D.C. has approved a recommendation that sanction be obtained to the purchase of the assets of the Llangollen and District Electric Lighting Co. It was also decided to ask the local company to reduce its charges. One member stated that the charge in Llangollen was 7½d. per unit, while in Wrexham it was 4½d.; the charge for power in Llangollen was 3½d., with a sliding scale, compared with 1¾d. per unit in Wrexham.

Hove.—The Electricity Committee has considered the question of increasing the charges for hired apparatus. These were fixed at 10 per cent. of the capital costs per annum when the Council commenced to hire out appliances, but in 1936, in order to encourage this particular load, the charges were reduced by 25 per cent. to the present figures, and were not increased when war increases up to 20 per cent. were made in the charges for electricity. The Committee now recommends that the charges be increased by 20 per cent.

Rotherham.—At a meeting of the Electricity Committee, the Electrical Engineer reported that he had now procured a number of fixed charge prepayment collectors, which, subject to limitations in labour for fixing, were available to persons desiring an all-in tariff without the obligation to make reasonable use of electricity for heating, and/or cooking purposes. The Committee recommended that, with the addition of 2d. per week for the prepayment collectors and servicing, the all-in tariff, so far confined to tenants of council houses, be extended to all consumers requiring electricity for any purpose within the current capacity of the collector.

London and Home Counties J.E.A.—In submitting estimates of income and expenditure for 1946, at a recent meeting of the authority, Mr. T. H. Jones, chairman of the Finance Committee said that the new grid tariff under which the authority buys current from the Central Electricity Board, would lead to increased expenditure which could not be precisely estimated. It was not considered necessary, at present, to make any general increase of charges to the authority's consumers who would still receive current in 1946 at approximately the same average price per unit as that obtained in 1936. The capital expenditure during 1946 was estimated at £197 000.

Gairloch (Ross-shire) Distribution Scheme (No. 3).—The North of Scotland Hydro-Electric Board has published their distribution scheme for the Gairloch and Aultbea district in north-west Ross-shire. The scheme is planned to serve an area of 180 square miles round Loch Ewe and Loch Maree. With 52 miles of high voltage and 36 miles of low voltage distribution lines, it will make electricity available to over 95 per cent. of the total population of about 1 600 in the distribution area. The electricity will be generated at a power station on the River Kerry. The following places will be directly served by the distribution lines:—Obinan, Mellon Udrigle, Achagarve, Laide, Sand, First Coast, Second Coaet, Mellon Charles, Ormiscaig, Buailnaluib, Tighnafiline, Aultbee, Cove, Mellangaun, Inverasdale, Midtown Brae, Naust, Poolewe, Londubh, Melvaig, Aultgrishin, Aultanphadic, North Errasdale, Big Sand, Little Sand, Lonemore, Smithstown, Gairloch, Charlestown, Shieldaig, Badachro, Port Henderson, Opinan, and South Erradale.

Southampton.—In the report of the borough electrical engineer, Mr. W. G. Turner, for the year ended March 31, 1945, it is stated that the provisional financial result of the year's working was a net surplus of £21 548, compared with £6 905 for the previous year, an increase of £14 640. The total revenue from all sources was £663 501, as against £579 815, an increase of 14.43 per cent. This excludes the difference of £7 475 between the cost of electricity generated on behalf of and sold to the Board and the price for the purchase of electricity from the Board. The total units sold increased by 9.52 per cent. to 134 145 097 (122 490 155). The units sent out from the generating station totalled 156 060 000 (158 229 000), a decrease of 1.37 per cent. Of these units, 4.26 per cent. were exported to the Board for use in other areas. The number of consumers, exclusive of those of the two undertakers supplied in bulk, was 54 786, and the total connections 233 217 kW. The average revenue from the sale of electricity was 1.108d., as against 1.068d. for the previous year. The hired-wiring scheme was suspended at the outbreak of hostilities. Of the 18 617 installations provided since 1926, 44 were sold during the year, making a total of 359 sold. Of the 8 685 domestic wiring installations provided on hire terms since 1931, five were sold during the year, making a total of 19 sold.

Contracts Open

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

Tobermory T.C.—Electrical work in connection with the erection of 26 permanent houses. Applications to Mr. J. M. Spink, Town Clerk, Tobermory.

Tredegar U.D.C., December 29.—Supply and delivery of two 250 kVA, 11 kV, 400-230 V transformers and one 500 kVA, 11 kV, 400-230 V transformer. Specification from Mr. W. Davies, Bedwellty House, Tredegar. Mon.

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

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

Manchester City Council, December 31.—Supply, delivery and erection of 6.6 kV switchgear (feeds No. 4), Spec. No. 842, and one 20-ton weighbridge and frame, Spec. No. B.149. Specifications from Mr. R. A. S. Thwaites, Electricity Department, Town Hall, Manchester, 2; deposit, £1 1s.

Maesteg U.D.C., January 1.—Supplying and laying of l.t. mains, services and public lighting at the Caerau housing site, Specification from the Engineer and Manager, Electricity Department, 35, Commercial Street, Maesteg, Glam.

Aberdeen C.C., January 3.—Electrical work in connection with the erection of 60 permanent brick houses at Bankhead. Specification from the County Architect, County Buildings, 22, Union Terrace, Aberdeen.

Blackpool Electricity Department, January 3.—Supply and delivery of one control battery, one circuit-breaker closing battery, one circuit-breaker tripping battery, and high and low rate charging equipment. Specification from the Borough Electrical Engineer and Manager, Shannon Street, Blackpool.

Kettering Electricity Department, January 4.—Supply of two 300 kVA, ratio 6 600/420 V, two 300 kVA, ratio 11 000/420 V, and two 400 kVA, ratio 11 000/420 V, transformers (Spec. No. 101); 11 000 V and 6 600 V switchgear, and sheet steel kiosks (Spec. No. 102). Specifications from the Borough Electrical Engineer, Rockingham Road, Kettering.

Dundee T.C., January 9.—Supply of machine tool equipment to the Pre-Vocational School for the Engineering Industry, at Ann Street Works. Particulars from the City Quantity Surveyor, 21, City Square, Dundee.

Newcastle-upon-Tyne Transport and Electricity Department, January 14.—Supply, delivery and erection of one kW mercury arc rectifier equipment. Specification from Mr. H. C. Godsmark, Transport and Electricity Undertaking, Manors, Newcastle-upon-Tyne; deposit, £1 1s.

Rochdale Electricity Department, January 16.—Supply over 12 months of (a) a.c., single-phase, 5 A, and 25 A quarterly meters, and 5 A and 25 A prepayment meters; (b) 3-phase 6 000/400 V distribution transformers. Specification from W. G. Coates, Electric House, South Street, Rochdale; deposit £2 2s.

Edinburgh City Council, February 15.—Supply of 33 kV switchgear and accessories for Portobello power station. Specification (No. ED/GS. 190) from Messrs. Kennedy and Donkin, Alliance House, 12, Caxton Street, Westminster, S.W.1; deposit, £2 2s.

Overseas

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

Eire Electricity Supply Board, January 28.—Supply, delivery and erection of the hydro-electric generating plant at Cathaleen's Fall and Cliff stations on the River Erne. Particulars from the Chief Design Engineer, Electricity Supply Board, 26, Lower Fitzwilliam Street, Dublin, C.18, deposit, £5 5s.

Eire Electricity Supply Board, February 28.—Supply, delivery and erection of transformers and switchgear at the Cathaleen's Fall and Cliff Stations on the River Erne. Specifications from the Chief Design Engineer, Electricity Supply Board, 26, Lower Fitzwilliam Street, Dublin, C.18; deposit, £5 5s.

Industrial Information

Impregnated Gas Cushion Cables.—An illustrated booklet (No. 456) has been published by W. T. Henley's Telegraph Works Co., Ltd., giving details of the design, manufacture, methods of testing, jointing, and also a typical installation of their 132 kV impregnated gas-cushion cables.

Quality Control.—The British Standards Institution announce that B.S. 1 008—1943, "Guide for Quality Control and Control Chart Method of Analysing Data," has now been reprinted, and copies can be obtained, price 3s. 6d. each, from the publications department of the British Standards Institution, 28, Victoria Street, London, S.W.1.

Analysis of Iron, Steel and Ferro-alloys.—The United Steel Companies, Ltd., have published a third revised and enlarged edition of their book, "Standard Methods of Analysis of Iron, Steel and Ferro-alloys." Advantage has been taken of the progress made in chemical methods of analysis during the last few years to bring the text completely up to date. The new edition is confined, as formerly, to standard methods of chemical procedure in use in the laboratories of the constituent branches of the United Steel Companies, Ltd., and does not attempt to cover developments in technique which have been made with the application to ferrous analysis of physical methods such as the absorptiometer, the spectrograph and the polarograph. Copies, price 7s. 6d. net, may be obtained on application to the publications department, the United Steel Companies, Ltd., 17, Westbourne Road, Sheffield.

Electrical Machinery Traders. — This month's bulletin of the Association of Electrical Machinery Traders states that the rapid growth of the organisation had been a significant feature of the year's achievements. The following new members had been elected: British Electrical Repairs, Ltd., 8-10, Long Millgate, Manchester, 3; W. Hagg, 70, King Street, Norwich; and T. F. James, Ltd., Volta Works, Ings Road, Wakefield. In response to a request by Director-General of Machine Tool Control, the Council has nominated Messrs. T. A. Atkinson (Dynamo and Motor Repairs, Ltd.), H. F. K. Dearlove (Type, Wilson and Co., Ltd.), W. E. Lawton (Industrial Electrical Co., Ltd.), and H. Vernon (Thomas W. Ward, Ltd.) to sit on an advisory panel in connection with the disposal of Government-owned surpluses of industrial electrical equipment.

Modern Power Plant for Vestmanna.—Electricity, in all its applications, will soon be available to the 6 000 inhabitants of Vestmanna, a group of islands 30 miles south of Iceland. The decision of the community to substitute a full a.c. supply for the inadequate d.c. service previously in use is one of the indications of its modern outlook. British Oil Engines (Export), Ltd., of London, are the main contractors for the power station equipment, and the agents in Iceland responsible for the installation are O. H. Helgason and Co., whose director, Mr. Goodmundson, is now in Great Britain on a tour of inspection of the manufacturing methods of the power plant companies. The two engines comprising the power plant are by Mirrlees, Bickerton and Day, Ltd., of Stockport, and the generators, manufactured by the Brush Electrical Engineering Co., Ltd., of Loughborough, are generating a.c. at 6.6 kV. Waste heat recovery equipment is fitted to the plant to heat the water for the public swimming baths.

The Metropolitan-Vickers' Gazette.—In the issue for this quarter is a foreword by Mr. I. R. Cox, managing director, announcing that outstanding Metrovick achievements in research engineering and manufacture in the last six years will be described in future issues. The switch-over to peace products has been already largely completed. Mr. G. E. Kelly contributes an article on "Electric Drives for Oil Well Installations." Mr. J. F. Smee gives an abridged account of the principles of operation of a d.c. electrostatic generator. Mr. E. H. Hogg deals with atomic hydrogen welding; and there are also articles on "Colliery Practice—'Reid' Report," "Direct Current Supplies for the Collieries Underground," "A New Spot Welding Machine," and "A New Oil-break Starter for Squirrel-cage Motors."

Elmet Metals. — Compound Electro Metals, Ltd., of 42, Pall Mall, London, S.W.1, have issued a leaflet illustrating the use of their composite metals for high efficiency contact tips for electrical apparatus employed where conditions are severe and arduous, and similar metals and alloys evolved for electrical resistance welding, electrode tips, rollers, discs and die facings. The company announce that they have appointed Mr. C. J. Reeves, of 58, Walsall Road, Four Oaks, Sutton Coldfield, Birmingham (Telephone: Four Oaks 227) as their Midlands representative; and A. Johnson and Co. (London), Ltd., Royal Exchange Buildings, Glasgow, C.1 (Telephone: Glasgow Central 2251), as their representatives for Scotland and Northern Ireland.

Scientific Research.—Standard Telephones and Cables, Ltd., announce the formation of a central laboratory organisation to undertake long-term research and

development in the tele-communication, electronics and allied fields. The new laboratories, to be known as Standard Telecommunication Laboratories, Ltd., will be housed at Progress Way, Great Cambridge Road, Enfield, pending the erection of suitable permanent premises. They will have as their principal objective the intensification of research and development in all aspects of telephony, telegraphy, electronics, cables, radio, television, and so on, and the various divisions of the laboratory will be under the direction of well-known specialists in the different spheres.

Reinstatement of Service Men.—For the information and assistance of their men serving in the Forces, George Kent, Ltd., of Luton, Beds, have issued a booklet entitled "Reinstatement of Men Serving in the Forces." There is a foreword by Commander P. W. Kent, and the booklet goes on to describe how the war affected the firm's outlook and methods of production, and to indicate future policy. A summary is given of the company's productions covering every field of war activity between September, 1939, and November, 1944, followed by particulars of changes in executive personnel and a brief "Who's Who," notes on personal management, consultation, and joint production committees; anticipations regarding production; changes in works lay-out; social services; and details of the procedure for reinstatement.

Cooker Parts

STANDARDISATION, up to a point, is an essential feature in the electrical industry, if it is too rigid, it tends to stultify progress; it would, for instance, be undesirable to have a standard electric cooker or fire. There is, however, one direction in which there has been a certain lack of uniformity, namely in the interchangeability of the boiling plates and other wearing parts of the various makes of cookers and war-time maintenance was rendered doubly difficult on this account, coupled with the general shortage of supplies.

Realising the disadvantage of these conditions the Electric Cooking Committee has for some time had the matter under review, and the result of their deliberations is given in the specification just issued. Some progress in its adoption has already been made, as the special V-cooker, designed for the Ministry of Works temporary houses, already complies with all the provisions of the specification.

While pre-war cookers, which are all that manufacturers can supply at the moment, do not comply with the specification, because of the alterations to patterns and tools involved, the cooker manufacturers have, it is understood, agreed to adopt the specification in all their post-war designs, if required by supply authorities. In the circumstances the E.D.A. is looking to all such authorities to co-operate in securing general adoption by making compliance with the specification an essential requirement when purchasing post-war cookers.

The specification is concerned in the main with dimensions and in no way effects the performance factors likely to be developed.

COAL NATIONALISATION BILL

THE long title of the Coal Industry Nationalisation Bill which was published on December 21, is "to establish public ownership and control for the coal mining industry and certain allied activities, and purposes connected therewith." Details of the Bill do not, in the main, affect the electrical industry, except that with respect to the transfer of public ownership of various assets, these include power stations, etc., owned by colliery concerns. Such stations are not, we understand, within the jurisdiction of the Electricity Commissioners, though in some cases they offer public supply to the dwellings in the immediate neighbourhood of the collieries they are designed to serve.

Statistics as to the number of these non-statutory undertakings are not at the time of writing readily available, but the impression gained from research on the subject so far made, is that the number of stations which will be taken over is not large.

The Bill is a complicated one and will obviously require the most careful examination by colliery owners and their technical and legal advisers. The Mining Association which apparently had not seen the Bill until it was generally available last week would not comment upon it, except to say that with regard to the terms of reference to the tribunal which is to fix the compensation for certain assets, they had agreed these with the Minister of Fuel and Power.

Exhibition of Aero Engines.—In conjunction with the James Clayton lecture given by Air Commodore F. Whittle to the Manchester branch of the I.Mech.E., an exhibition of British aero engines was held at the aircraft factory of the Metropolitan-Vickers Electrical Co., Ltd., at Trafford Park, on December 13, 14 and 15. In the section for piston engines were seen the Armstrong-Siddeley Cheetah 25, Bristol Centaurus, Napier Sabre and Rolls-Royce Merlin 61, while in the section devoted to centrifugal jet propulsion engines was shown the famous Gloster E 28/29 jet propelled aircraft, Power Jets W.1, and W2/700 and the Rolls-Royce Derwent V engines.

Company News

GUY MOTORS, LTD.—Prelim. figs. give 7½% div. on 6% partic. pref., and 15% on ord. (both same).

PARA ELECTRIC RAILWAYS AND LIGHTING.—Net loss to Nov. 30, 1944, £6 868 (£38 024); debit blce. fwd. raised from £106 243 to £113 110.

UNIVERSAL GRINDING WHEEL CO., LTD.—Net pft. to Sept. 30 £73 646 (£66 820); 15% tax free (10%); res. £25 000 (same); fwd. £32 482 (£27 836).

PERNAMBUCO TRAMWAYS AND POWER.—Gross inc. 1944, £20 672 (£2 951). To deb. int., etc., £51 588 (£50 747), makg. loss £30 916 (£47 796), plus exchg. loss, etc., £6 496 (£47 434), increasg. debit blce. to £206 332.

SCOTTISH MOTOR TRACTION CO., LTD.—Pft. to Oct. 31 after deprecn. was £913 633 (£876 687), plus divs. and int. received £411 258 (£390 209). To taxn. £858 938 (£928 581). Div. on ord. 25% (13⅓%) tax free, £251 494 (£134 130).

S. SMITH AND SONS (ENGLAND), LTD.—Fin. div. 10½%, less tax on ord., mkg. 17½%, less tax (both same), for yr. ended Aug. 4. Distributn. on defd. cap. is to be 37½%, less tax (same). Prelim. figs. give net pft. at £116 568 (£103 579).

JOHN HOLROYD AND CO., LTD.—Pft. (after E.P.T. and defd. repairs) for yr. to Sept. 30, 1945, £55 798 (£59 493), to inc. tax £33 500 (£36 000), net pft. £22 298 (£23 493), fst. and fin. div. 20% less tax, £15 000 (same), fwd. £58 518 (£51 220).

WRIGHTS' ROPES, LTD.—Net pft. for yr. to Sept. 30, after £10 000 to conting. res., £35 046 (£30 365). To 5% pref. div. net £1 875 (same), 10% ord. net £10 000 (same), gen. res. £15 000 (same), staff pensions £5 000 (£3 000), fwd. £24 189 (£21 018).

GEO. TURTON PLATTS AND CO., LTD.—Pft. to Mar. 31, £38 403 (£33 938), plus £26 045 (£25 320) brot. in. To specl. dep. £2 500 (£7 500), deferd. repairs £12 000 (nil), contings. nil (£5 000). Fin. div. 12½% (10%), mkg. 20% (17½%), plus 10% (same) bonus, fwd. £27 527.

WOLVERHAMPTON DIE-CASTING CO., LTD.—After creditg. £3 356 (nil) taxn. res. not required, deductg. deprecn. £6 757 (£7 239), res. for inc.-tax £21 555 (£11 397), net pft. to June 30, £2 456 (£10 683). To pref. div. £1 770 net (same), fin. ord. div. 7½%, mkg. 12½% (same), fwd. £23 998 (£24 437).

WAILES DOVE BITUMASTIC CO., LTD.—After creditg. divs. from French associated co. £2 155 (nil), debitg. tax £54 671 (£43 485), defd. reprs. £2 625 (£204), deprecn. £3 726 (£3 028), and dirs.' fees, net pft. to Sept. 30, £21 083 (£21 221). Fin. div. 10%, mkg. 15% (same), prov. foreign debts £2 000 (nil), gen. res. £10 000 (£7 000), fwd. £10 883 (£10 925).

SPECIALLOID, LTD.—Trdg. pft. etc., to Mar. 31, £56 130 (£56 908). To fees, etc., £556 (£165), lvg. £55 574 (£56 743). Pref. div. £5 500, ord div. £10 600, fin. rate being 75% (same), mkg. 100% again. To taxn. £22 378 (£10 000), donatns. £5 257 (nil), off cap. incr. exes. nil (£4 284), to redemptn. prem. nil (£638), benevolent fund £2 500 (same), fwd. £36 826 (£22 656).

PERAK RIVER HYDRO-ELECTRIC POWER.—Accts. for yr. to July 31 show int. £1 469 (£1 427), trans. fees £147 (£69), mkg. £1 616 (£3,638, incldg. £2 142 pft. on sale of invests.); to admin. and gen. exes. £4 513 (same), dirs.' fees £1 896 (£2 500), deb. int. £30 460 (£31 510), net less £35 253 (£34 526), debit blce. fwd. £70 935 (£35 682). Div. on 5% pref. in arrear since Aug. 1, 1941.

WELLWORTHY PISTON RINGS.—Tradg. pft. for yr. ended July 31, 1945, £61 506 (£68 988), add other income £12 183 (£36), mkg. £73 690 (£69 024). To dirs.' fees £683 (£750), inc.-tax £38 593 (£38 054), deferrd. repairs res. £5 000 (same), genl. res. £5 000 (same), pref. div., incldg. additnl. cap. £3 123 (£2 400), fwd. £23 235 (£18 945). Combined trdg. pft. £85 281 (£81 824).

CRYSTALATE CO., LTD.—Pft. on tradg. to Sept. 30 £16 780 (£37 472), misc. receipts £1 261 (£804), trs. fees £186 (£211), divs. from Br. Homophone £10 200 gross (same), and tax credit £8 765 (nil), mkg. avail. pft. £37 192 (£48 687). To dirs.' fees £1 200 (same), deprecn. £2 568 (£2 802), tax res. and inc.-tax £11 600 (£33 300), tax credit £8 765—transferred to gen. res.—lvg. net pft. £13 059 (£11 385), fwd. £10 894.

LEWIS BERGER AND SONS, LTD.—Tradg. pft. for yr. to July 31 £200 841 (£226 112), plus divs. from subsids. £112 305 (£105 659), mkg. £313 146 (£331 771). Deduct dirs.' fees £5 000 (same), deprecn. £11 000 (same), tax £95 000 (£128 000), leavg. net pft. £202 146 (£187 771). To 7% pref. div. £28 000 (same), intm. 6% (same) on ord. £31 636, fin. 13% (same), £68 546, res. £75 000 (£50 000), fwd. £140 389 (£141 425).

BRETT'S STAMPING CO., LTD.—Tradg. pft. includg. est. E.P.T. refund and after prov. defd. repairs and taxn. £29 765 (£29 140 after E.P.T. and inc-tax). To deprecn. and spec. writing off £12 981 (£11 786), dirs.' fees £1 200 (same), war damage nil (£905), leavg. net pft. £15 584 (£15 249). Pref. div. absorbs £600 (same), intm. ord. div.

10% £3 000 (same), fin. ord. div. 15% £4 500 (same), mkg. 25% (same), to taxn. res. nil (£7 000), gen. res. £5 000 (nil), fwd. £14 620 (£12 136).

BUTLER MACHINE TOOL CO., LTD.—Tdg. pft. for yr. to Sept. 30, 1945, £71 367 (£84 128). Add divs., interest, etc., £2 373 (£2 420), fees £15 (£12). E.P.T. recoverable for yr. £15 500 (£3 000), mkg. £89 255 (£89 560), deduct exes., A.R.P., etc., £19 594 (£17 104), deprecn. £13 233 (£13 038), leavg. £56 428 (£59 418). Pref. div. £6 255 (same), ord. div. 12½% £25 000 (same), fwd. £18 987 (£17 674).

ASTON CONSTRUCTION CO., LTD.—Pft. on tradg., plus sundry rev. for yr. ended Sept. 30. £16 201 (£14 816), add portion of sales res. created in previous yr. no longer required £3 025 (nil). Deduct dirs.' fees £3 905 (same), deprecn. £1 665 (£1 852), leavn. gross pft. £13 656 (£9 060). To taxn. acct. £6 696 (£4 500). Pref. div., two yrs. to Sept. 30, 1945, £1 050 (nil), ord. div. 5% (£2 125 (nil), loss on investmt. in subsid. co. written off, nil (£1 925). Fwd. £24 155 (£20 370).

BRITISH ROLA, LTD.—Tradg. pft. and divs. to Mar. 31, £67 718 (£54 714). To dirs.' fees £400 (same). A.R.P. and employees' welfare £3 984 (£5 876), W.R.I. £479 (£958), off reinstallatn exes. £88 (£22 176), lvg. £62 767 (£45 304). To pref. div. £2 322 (same), ord. div. 15% £5 625 (same), pref. redemptn. £1 347 (£1 275), tax £53 500 (£34 300), defd. repairs nil (£2 000), fwd. £2 105 (£2 132).

CRYSTALATE, LTD.—The annual meeting was held in London on December 19. Sir Herbert E. Morgan, the chairman, said the net profit, after taxation had improved from £11 385 to £13 059. The combined liquid assets of the whole group stood at the substantial sum of £169 400. The plastic moulding capacity of the country could, when initial demands were met, be in excess of requirements. It seemed to him important that every care should be taken by the industry to avoid this position leading to a competitive policy which could easily prove unremunerative to the business as a whole. The orders in hand, were highly satisfactory, constituting a record.

PERAK RIVER HYDRO-ELECTRIC POWER CO., LTD.—The annual meeting was held in London on December 17, Mr. William Shearer, the chairman, presiding. In his statement circulated with the report and accounts the chairman said he was glad to be able to state that two of the company's representatives had already arrived in the concession area and are making, under military auspices, an inspection of their physical assets, and a complete survey of the position so far as their undertaking was concerned.

WILLIAM ASQUITH, LTD.—Trdg. pft. and sundry income, together with subsid. co., for period from Aug. 18, 1944, to Aug. 16 last £73 018 (£110 148). To deprecn. £17 442 (£15 738), dirs.' fees £4 000 (same), war dmge. £122 (£1 006), defd. reprs. nil (£6 100), taxn. less estimated E.P.T. recoverable £6 960, totals £21 000 (£61 000, E.P.T. £31 910, inc.-tax £29 090). Avail. blce. £28 358 (£21 123), pft. £27 490 (£26 196), brot. in. pref. div. absorbs, less tax, £6 622 (£6 731), ord. liv. £2 040 (same), prov. for redemptn. and int. on fundg. certs. £43 394 (int. £1 058), gen. res. nil (£10 000), fwd. £3 792.

TURNER AND NEWALL, LTD.—Fin. div. on ord. 8¾%, less tax, mkg. 12½% for yr. (same). Tradg. pft. for yr. ended Sept. 30, 1945, after providg. for contings., but before providg. for deprecn. mines amortisatn., dirs.' fees and taxatn., £3 795 889 (£4 161 838), a reduction of £365 949. Tradg. pft. of parent co., includg. divs. from subsids., £2 493 142 (£2 513 915). Deprecn. takes £225 681 (£215 716), dirs.' fees £1 907 (£2 154), and provision for tax, includg. subsids., £1 636 092 (£1 750 380), leavg. net pft. of £629 462 (£545 665).

COMING EVENTS

Friday, December 28 (To-day).

INSTITUTE OF WELDING, E. SCOTLAND BRANCH.—Edinburgh. "Non-Ferrous Welding," F. Clark. *7.30 p.m.*

Saturday, December 29.

INCORPORATED RADIO SOCIETY OF GREAT BRITAIN.—I.E.E., Savoy Place, London, W.C.2. "Radio-Location," Dr. R. L. Smith-Rose, preceded by annual general meeting. *2 p.m.*

Monday, December 31.

INSTITUTION OF ELECTRONICS.—Alliance Hall, 12, Caxton Street, London, S.W.1. Discussion, "The Nature and Uses of Atomic Energy," introduced by Dr. L. E. C. Hughes. *6 p.m.*

Wednesday, January 2.

INSTITUTE OF FUEL.—I.E.E., Savoy Place, London, W.C.2. "Waste Heat Boilers," Major W. Gregson. *6 p.m.*

I.E.E., SHEFFIELD STUDENTS' SECTION.—Central Library. "Permanent Magnets," F. Knight. *6.30 p.m.*

Thursday, January 3.

I.E.E., S. MID. CENTRE.—Birmingham. "Atomic Energy," Prof. M. L. Oliphant, F.R.S. *6 p.m.*

Friday, January 4.

ILLUMINATING ENGINEERING SOCIETY, BIRMINGHAM CENTRE.—Imperial Hotel. "The Physical Nature of Light," H. J. Cull. *6 p.m.*

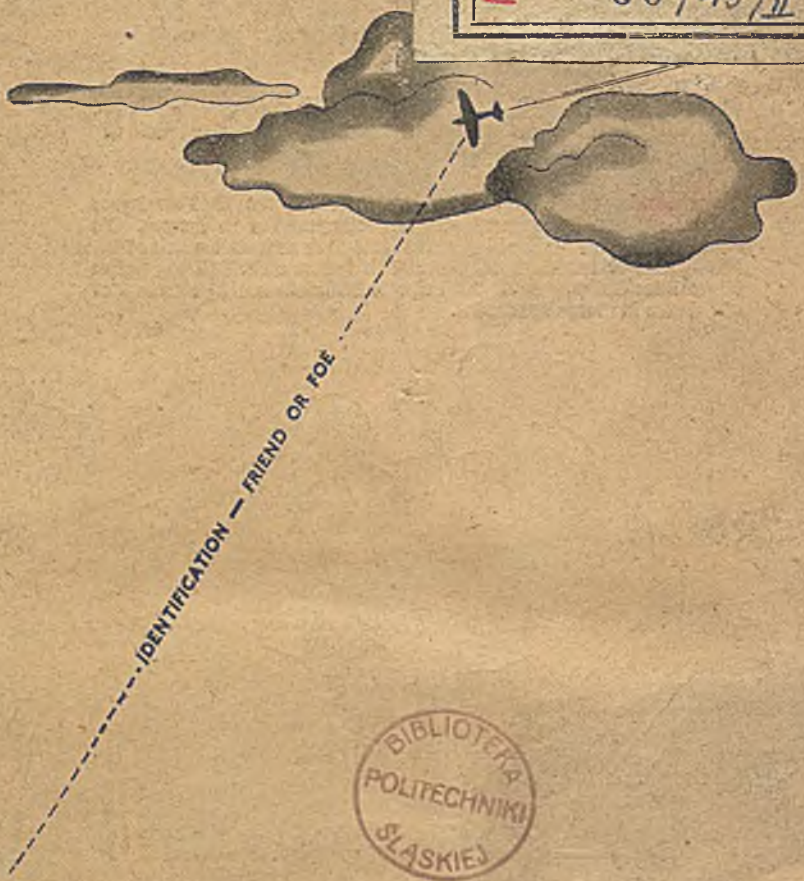
JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria Street, London, S.W.1. Discussion Groups. *6.30 p.m.*

Saturday, January 5.

N.E. COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS, STUDENTS' SECTION.—Visit to the Dunston power station of the North Eastern Electric Supply Co. Ltd.

JUNIOR INSTITUTION OF ENGINEERS, N.W. SECTION.—Manchester. "Ideas in Engineering," A. N. Haworth. *2.30 p.m.*

THE ELI



FRIEND or FOE? *From the beginning of the War Hoover Limited made the Power Unit Rotary Transformer of the telltale "echo" device which signalled "friend" automatically. Rotary electrical equipment of all types, including fractional h.p. motors, were made by Hoover Limited for a host of purposes during the war. The latter are available in peace, too, for those whose plans call for them. If you are interested, get into touch with us now.*

HOOVER LTD

Makers of the World's Best Cleaner

HOOVER LIMITED · PERIVALE · GREENFORD · MIDDLESEX

Printed in Great Britain by Straker Brothers Ltd., 194-200, Bishopsgate, E.C.2, and published by Benn Brothers, Ltd., at Bouverie House, 154, Fleet Street, London, E.C.4.—Friday, December 28, 1945.