THE
ELECTRICIAN

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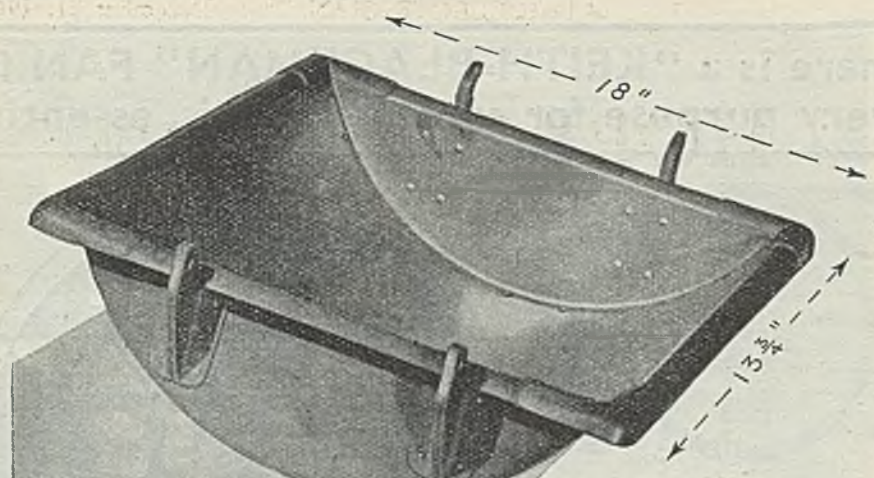

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None of the situations advertised in these columns relates to a man between the ages of 18 and 50 inclusive, or a woman between the ages of 18 or 40 inclusive, unless he or she is excepted from the provisions of the Control of Engagement Order, 1945,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

SITUATIONS VACANT

STEWARTRY OF KIRKCUDBRIGHT COUNTY COUNCIL.

Electricity Department.

APPOINTMENT OF JUNIOR MAINS ASSISTANT.

APPLICATIONS are invited for the above Post from suitably qualified Engineers, who have had previous experience of Mains work, preferably in a Rural Electricity Undertaking. Duties will include the survey and profiling for 11 kV Overhead lines, maintenance of Sub-stations and Switchgear, and generally acting as Assistant to the Mains Engineer.

Salary and conditions of appointment will be in accordance with the National Joint Board Schedule, the present salary being £268, rising to £279 per annum (Class D, Grade 9A).

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

Applications, stating age, and giving full particulars of training and experience, together with copies of testimonials, to be forwarded to the undersigned not later than 5th January, 1946.

This advertisement is issued with the consent of the Ministry of Labour and National Service.

A. L. BUSHNELL,
County Clerk.

County Offices, Kirkcudbright.
10th December, 1945.

EXPERIENCED Specialist Draughtsmen urgently required for Switchgear and Transformer Depts. of well-known Electrical Engineers, South-East London. Fullest details of experience must be given, together with age, salary required, and whether free to move.—Applications to Box L.Q.N., "THE ELECTRICIAN," 154, Fleet Street, London, E.C.4.

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CONTRACT No. 707.

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ELEVEN 600 kVA Double Wound Self-Cooled Generating Station Auxiliary Transformers.

Contractors desiring to submit tenders may obtain Specification and Form of Tender at this office on making a deposit of £2 2s. 0d., which sum will be refunded on receipt of a bona-fide tender.

To meet the convenience of Contractors, two copies of the Specification will be furnished; additional copies may be purchased at a cost of £1 1s. 0d. per copy.

Any person or firm sending in a tender will be required to comply with the Standing Orders of the Council relating to the "Prevention of Corruption" and to the standard rates of wages and proper hours and conditions of labour. A print of the Standing Orders may be obtained from the Department.

The tender and accompanying documents, filled up as directed, must be enclosed in the official envelope supplied with the Specifications, which shall not bear any name or mark indicating the sender, to be delivered to the Town Clerk, Town Hall, Sheffield, 1, not later than the first post on Monday, 28th January, 1946. Tenders received after the time stipulated herein will not be considered.

The Committee do not bind themselves to accept the lowest or any tender.

JOHN R. STRUTHERS,
General Manager and Engineer.

Commercial Street, Sheffield, 1.
December, 1945.

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THE ELECTRICIAN

Established 1861. *The Oldest Weekly Illustrated Journal of*

Electrical Engineering, Industry, Science and Finance

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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. 3525. [No. 25 Vol. CXXXV] December 21, 1945 Annual Subscription 25s. Overseas 30s.

CHIEF CONTENTS OF THIS ISSUE.

Busy Workshops

THERE reach us at this time of the year a number of details outlining some of the major activities of the electrical manufacturing industry throughout the previous twelve months, and while these indicate to some extent the progress of our export trade they give, in addition, some insight into the trend of development, into research and technical advancement. The peep into the sphere of electrical manufacturing which these details afford, is particularly interesting this year in that by it, it is possible to assess to some degree the progress being made in converting our manufacturing capacity from meeting the needs of war to those of peace, and to speculate upon the time which will be required before the industry will be able to reach the tempo of its pre-war production of consumer goods.

The impression gained from this information is that the industry is making commendable strides towards complete reconversion, though a number of large organisations are still committed to war contracts. These commitments, however, are not serious and were it possible for the industry to recruit more skilled labour, could from an overall output point of view be ignored.

There are passing through the electrical works up and down the country orders for large machines of every type and while there is a general shortage of equipment of all kinds, the greatest scarcity appears to be in such things as cookers, refrigerators, water heaters and portable appliances. This is no new condition, of course, but bearing in mind the number of houses which will sooner or later be ready for the installation of these equipments, the industry looks like being pressed unduly hard for many months to come. Some hold the view that this is good, but others suggest that with the industry wholly engaged in meeting the demands created by war-time scarcity, there can be little opportunity for the development of new designs with higher performance factors. In an attempt to catch up with the demand there are being applied, on the directions of the Ministry of Supply and insofar as the fittings of grant-aided houses are concerned, the mass-production methods made possible by standardisation, but while this policy may result in a higher production rate of this or that appliance, it is questionable whether this is in the best interests of the consumer.

The programme of extensions for our power stations is also responsible for a considerable amount of work passing through the shops and next year

promises to be one of increasing activity in all departments of electricity supply. Added to this there are, too, a large number of machines on order for overseas, and these coupled with home requirements suggest that the industry faces a future which will demand during the next few years a rate of output as high if not higher than that which obtained during the war.

Fuel Economy Advertisements

IT will be remembered that just a month ago we criticised the fuel economy advertising, now appearing in the national Press, as being inadequate in its explanation of the need for reduced electricity consumption. Since then we have received a further criticism of the advertisements and the complaint lodged at the door of the responsible Ministry seems equally justifiable. In this second instance, the makers of the Exide battery—whose letter is reproduced elsewhere in this issue—take the Ministry to task for saying that . . . "it is impossible to store electricity" . . . . when in fact the accumulator does just that thing. Everyone appreciates what the Ministry means in their warnings against probable electricity "cut-offs," but the way in which they express themselves is both inaccurate, misleading and untidy. The complaint which the accumulator makers lodge against the Ministry is reasonable enough and calls for some official answer if only to make the position clear to those members of the public who, in the event of an electricity cut-off in their area may find themselves enjoying the advantages of the emergency and peak load systems which the accumulator in certain circumstances makes possible.

Plugs and Sockets

ATTENTION was drawn last week to the fact that the plug and socket controversy, instead of being abated by the B.S.I. specification, is, if anything, more intense. Were it not for the extensive building programmes which must, sooner or later, commence in earnest, the position in which the installation trade finds itself would be bad enough, but with the trade facing an immediate future which promises to be the busiest in its history, the circumstances are even more serious. As things are, some local authorities—the only permitted builders for the time being—are ignoring the specification altogether and installing 13A plugs and sockets of the type described in these pages some time ago; others are continuing with their pre-war practice; while a few others are considering the adoption of the standard. As to the merits or otherwise of the B.S.I. specification, that is a matter for the industry and the user to decide, and in drawing their attention to the urgency of the matter it is, we feel, not out of place to remind them that the number of temporary dwellings being erected is already large. Many of the tenants of these will use electricity for purposes other than lighting for the first time, and if as a result of indecision with regard to plug and socket details their installations are to be as inadequate as were most pre-war domestic wiring services, they may do the industry irreparable harm, besides causing the new consumers considerable disappointment. The need for flexibility of installation is agreed by all parties as being the best solution for popularising electricity even further, while at the same time satisfying the most exacting consumer. That being so, settlement of the present controversy as to how this object can best be achieved is surely not beyond the reasoning power of the industry?

Electricity in Farm Buildings

APPRECIATION of the service which electricity has to offer the farmer is made by the committee which, appointed by the Minister of Agriculture in 1942, last week published its recommendations respecting farm buildings. The committee is in brief, in full support of the findings published in Study No. 11 on the subject of electrical installations, and the paragraphs which appear from time to time in the report regarding artificial lighting, show appreciation of the close relationship between farm buildings and electricity when determining the efficiency of those buildings. The committee is so understanding of the important part which electrical service can and will eventually play in the economics of farming that it reproduces in its report over six pages of quotations from the statements made in Study No. 11 respecting electrical installations, and if this were not enough, receives support from the Fire Manager

of the N.F.U. Insurance Society. The report, published as Study 17, is, of course, mainly concerned with buildings but there are within its pages many statements which, besides making interesting reading for the electrical industry, give encouragement and hope for the future.

Generation of Electricity

FOR the first time since the early twenties, the total electricity output for the United Kingdom is showing a decline. In the 11 months of 1945 up to the end of November the output was 33 601 million units, compared with 34 612 millions for the corresponding period of 1944—a decrease of 2.9 per cent. For November the figure was 3 463 million units, against 3 598 million for the same month last year, a drop of 3.7 per cent. This falling away is attributable to the change-over from war production to the more normal working conditions of peace, and relative slowness in reconversion. The slight set-back, though temporary, will in a way assist the supply industry to overhaul at least some of its plant and may in some quarters be welcomed. Incidentally, other supply news this week concerns the application by the Central Board to the Commissioners, for authority to increase their borrowing powers from £70 000 000 to £100 000 000, in order, we presume, to advance their £450 000 000 extension programme.

Home-made Lamp Standards

THE scarcity of such things as table and desk lamps has apparently resulted in a number of enterprising persons applying their energies to making their own and presenting them to their friends as Christmas presents. The idea is understandable to say the least, but since the finished articles in all the cases we have seen are likely to lead to trouble, if nothing more serious, we suggest that there be hung in electricity showrooms suitable warnings against the use of such appliances without their first being examined by a responsible wireman or showroom assistant. The ingenuity which can be displayed in adapting various domestic articles for use as table standard lamps is truly remarkable, while the ease with which lampholders can be wired up has apparently been taken by many who are unqualified to do the work, as an invitation to give expression to their inventive powers. While the flexibles are new, and the lampholders secure as to their fitting, these home-made lamp standards may be safe enough; with average use however, their design in most cases is such that sooner or later their users will be exposed to bare conductors—with results against which the public should be warned.

An Interesting Broadcast

THOSE who on Sunday heard in the Home Service broadcast the tribute which Sir HENRY TIZARD paid the late Lord RUTHERFORD, will have listened with more than average interest. The reason for this was that Sir HENRY not only spoke of the outstanding work associated with the name of Rutherford, but he contrived by means of records made exactly fourteen years ago, to allow the man to speak for himself on the subject of the nucleus. This treatment of his broadcast, puts Sir HENRY in a class deserving of further attention by the B.B.C. As to the talk itself, it was a masterly tribute in words which even the least scientifically-minded could understand, while at the same time holding the attention of those better acquainted with physics.

Christmas Greetings

WHEREAS this time last year we were looking forward with confidence to an early and victorious conclusion of the war, we can to-day contemplate a Christmas period free from the major anxieties which hostilities created. The industry can by comparison regard its future more in terms of peace-time expansion and for those who are fortunate enough to be able to take Monday as a holiday, the Christmas period will offer a brief respite from what has been for everybody in the industry a year of concentration of effort, first for war and latterly for reconversion. To all our readers, in and out of the industry, we send our greetings, coupling with them our best wishes for the New Year—a year which promises so much in the way of electrical development, expansion, and adoption of the electrical idea by other industries.

Nationalisation of French Supply

From Our Paris Correspondent

TWO stages are envisaged in the nationalisation of electricity to take place in France. There will first be a period during which there is a mobilisation and census of property to form a basis for a provisional estimate of compensation, and also an opportunity to create new organs for administration. The second period, which, it is expected, will come two years later, will consist of the expropriation of the existing companies, whose property will be taken over by the State. The latter will manage production and transport, while distribution will be through local collectives.

A Quasi-Monopoly

Up to the present, electricity interests formed one of the most powerful trusts in France, consisting of over 1 500 distributing companies, 350 producing companies, and about 100 dealing with transport. Ancillary production was undertaken by a further 1 000 companies. Actually, four large companies control the industry, namely, the C.P.D.E., the Nord-Lumiere, Energie Electrique du littoral Mediterranean, and Lyonnaise des Eaux. These companies constitute a quasi-monopoly which is naturally opposed to any transfer of property.

Opponents of the scheme are pointing out that the change-over will involve such a dislocation as to paralyse the economy of the country for a period. They have put forward a plan as a counter to that of the C.G.T. (French T.U.C.), in which they propose to concentrate on co-ordinating the work of the many power supply companies.

While assuring the State a voice in administration, the transfer of property would be invalidated on the grounds that compensation to be paid would create an impossible burden for the budget. The C.G.T. plan recommends the administration to be in the hands of a director-general and an administrative council comprising representatives of the State, producers and consumers.

Estimates show that government monopoly of electricity production should increase national production from 10 000 million kWh to 11 000 million kWh in thermal stations, and from 13 000 million kWh to 23 000 million kWh in hydro-electric plants. The national electricity service will consist of an administrative council of 15 members made up of five members representing the collective, five the producers, and five for the consumers. Members will be appointed to serve for six years, but will be liable to recall at any time for default. They are to be appointed from personnel free from any financial interest in the production, transport or distribution of electrical energy.

Barrages Almost Dry

Only a miracle or eight days of torrential rainfall can possibly restore the position of electricity supply in France to-day. The Massif Central barrages are almost dry, despite a heavy fall of rain some days ago, and production has fallen to as low as 2 600 000 kWh.

Production in this area, which used to be more than enough for local needs, is now falling so far short that current is having to be imported from thermal plants, thus aggravating the already serious coal shortage. Paris, which is normally supplied half by thermal and half by hydro-electrically produced current, is having to export thermal energy to other regions, and consumption of coal has increased by 60 000 tons a week, which is still not sufficient to cope with all demands. Paris reserves of coal have fallen to a three-days' supply, while in the north of France reserves are down to a two days' supply. The sudden severe cold weather has also increased domestic consumption.

Consumption Cuts

Drastic cuts in consumption have already started, as although production of electricity is up to 94 per cent. of its pre-war figure, an additional 20 000 tons of coal a day would be necessary to ease the position further. At least 30 milliard kWh a year would need to be made available to accelerate economic recovery, whereas only 23 milliard kWh are available at the present time.

Work in non-priority industries has been cut to three days a week, industries in one section working Monday, Wednesday and Friday, while the others work Tuesday, Thursday and Saturday. Domestic current has been cut systematically all over Paris for six half days a week, and all window lighting and publicity lighting are strictly forbidden. Shops, excepting chemists' and food stores, must close at 6 p.m., and reduce lighting after 5 p.m. This will last for fifteen days, and if, by then, the position has not improved, shops will be closed at 5 p.m. Cafe lighting and street lighting will be reduced to a minimum, and the metropolitan underground will close one hour earlier. Private consumers using over their allocation will be cut off completely.

Electromagnetic Pressure Recorder§§

By H. H. BAXTER, B.Sc.(Eng.), A.M.I.E.E.

ONE of the problems with which the Electrical Research Association has to deal is the measurement of the transient pressures set up during the operation of switch and fuse gear, and several methods of recording these have been tried during the past twenty years. These include

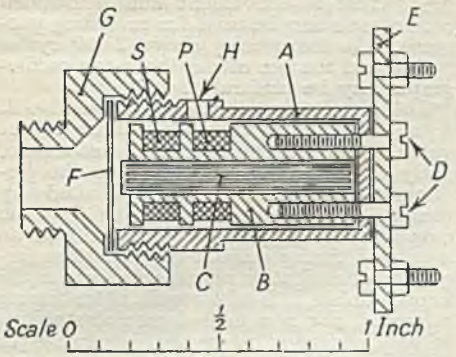


Fig. 1.—Sectional drawing of pressure unit

the carbon resistor, the Collins micro-indicator, the piezo-electric and the variable capacitor. The carbon resistor was abandoned, mainly because of an unstable zero and a high temperature co-efficient. The micro-indicator*, though extensively used, is limited to relatively low frequencies and is awkward to correlate with other measured quantities. The piezo-electric type† is good as regards frequency response and ease of correlation but electrical leakage renders static calibration impracticable. The capacitor type has been extensively used in switchgear researches, the change in capacity consequent upon the movement of a diaphragm causing a change in the response of a resonant circuit‡ and has been found reasonably satisfactory. A pressure recorder was, however, needed in connection with recent developments in fuse research. The existing recorder of the capacitor type was not available and as it is rather elaborate, its duplication was not convenient.

The electromagnetic pressure recorder described herein was therefore developed, the main problem being to produce a pressure actuated unit of sufficiently small dimensions. The internal dimensions of a representative cartridge fuse for domestic use may be taken as about 2 in. long by ½ in. diameter, the volume being about 0.4 cu. in. The additional volume due to the pressure unit must be small compared with this if it is not to modify unduly the pressure in the fuse; for the unit described, this is about 0.01 cu. in., and represents an increase in the internal volume of the fuse of less than 5 per cent.

In view of the complicated ancillary apparatus already needed for fuse testing, it was deemed desirable that the pressure recorder should be as simple as possible, relatively free from electrical interference and should not require frequent calibration. The present device conforms to those requirements.

The principle is not new, but certain features in the construction and use of the unit merit publication.

Several electromagnetic pressure units have been described in the past§, mostly consisting of a single coil, the inductance of which is varied by the movement of a diaphragm; as this inductance is usually inserted in one arm of a bridge circuit, a similar unit is inserted in an adjacent arm of the bridge for balancing purposes. The duplication of the pressure unit is a complication which has been avoided in this instance. This result has been achieved by using the voltage induced in a secondary coil, rather than by measuring the change in inductance of the primary winding; most of the secondary voltage, when there

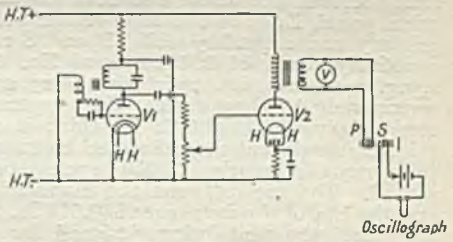


Fig. 2.—Circuit diagram of oscillator‡

is no mechanical pressure on the diaphragm, being suppressed by the method described in the next paragraph. The record obtained is in the form of a modulated high frequency wave, the change in amplitude being a

* Made by the Cambridge Instrument Co. Ltd.

† See E.R.A. report Ref. G/T 58 (THE ELECTRICIAN Vol. cxiii, p. 121, July 27, 1934.

‡ See E.R.A. Report Ref. G/T59 (Journal of Scientific Instruments, Vol. xiv, p. 173, May, 1937).

§ See for example, Pearce and Evans, J.I.E.E., Vol. 71, p. 714, Nov., 1932.

§§ Based on E.R.A. Report Ref. G/T 188.

measure of the pressure. The frequency of the supply to the unit must, therefore, be sufficiently high to give adequate delineation of rapid pressure fluctuations.

A sectional diagram of the pressure unit is shown in Fig. 1. A mild steel cylinder A, houses a close-fitting bobbin B, into

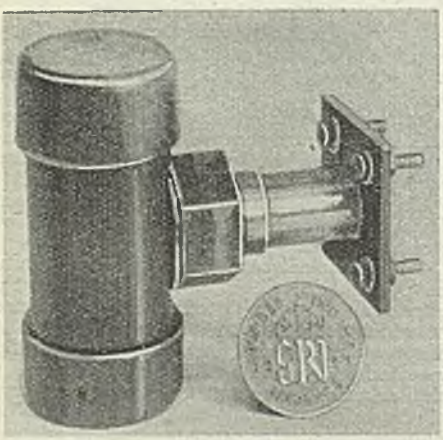


Fig. 3.—Pressure unit attached to a fuse

which are cemented a number of soft iron wires, C. When the cement is set the ends of the wires are machined at right angles to the axis of the bobbin, which is retained in the cylinder by the two fixing screws, D. These also hold the terminal panel, E. The bobbin is wound with primary and secondary coils, P and S respectively, each of 250 turns of No. 44 s.w.g. wire, the d.c. resistance being approximately 18 ohms each. The tempered steel diaphragm F, 0.0065 in. thick is of $\frac{1}{2}$ in. diameter and the calculated resonant frequency is nearly 20 000 cycles per second. The gap between the diaphragm and the end of the iron wires is 0.012 in. to 0.015 in., the unit being designed for a maximum pressure of 500 lb./sq. in. The hexagonal brass end, G, is suitably threaded for attachment to the apparatus under test. The hole H, into which is inserted a pin spanner when assembling the unit, serves as a pressure relief in the event of leakage past the diaphragm. A photograph of the unit attached to a fuse is shown in Fig. 3.

The unit is simple to use. A given and constant a.c. voltage is applied to the primary coil, which induces a voltage in the secondary coil; if pressure is applied to the diaphragm, causing it to move closer to the soft iron core, the secondary voltage will increase. With this particular unit the increase in secondary voltage is approximately 5 per cent. per 100 lb. per sq. in. so that a pressure of 500 lb./sq. in. gives a 25 per cent. increase in secondary voltage, the relative percentage increase being closely proportional to the pressure.

The percentage increase in secondary voltage is substantially independent of frequency, within reasonable limits of frequency fluctuation but it is important to maintain the primary voltage constant; this voltage is set by means of a voltmeter just before each test.

The unit may be operated at any convenient frequency between about 50 and 5 000 cycles per second; when the pressure takes several milli-seconds to reach its peak value a frequency of about 1 000 cycles per second is convenient and a Duddell oscillograph can be used for recording purposes. At frequencies above 2 000 cycles per second the use of a cathode-ray oscillograph may be preferable.

The circuit diagram is shown in Fig. 2. V_1 is the oscillator valve and V_2 the output valve. The h.t. supply unit is not shown.

By employing an output valve the frequency of oscillation is unaffected by changes in the output circuit so that the output from the pressure unit can also be used as a timing wave if desired. The frequency of oscillation need not be accurately known unless it is also required for timing purposes, nor is a high degree of stability in the oscillator necessary, a change in frequency of one or two per cent. causing no appreciable error.

At a frequency of 1 000 cycles per second, a voltage up to 8 V is applied to the primary coil of the pressure unit, the corresponding secondary voltage being about 3 V (r.m.s.) or 4.5 V (peak). When using a Duddell oscillograph the output from the secondary coil is rectified by a half-wave rectifier and opposed by a 4 V

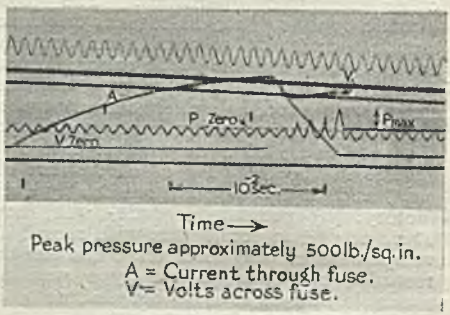


Fig. 4.—Typical pressure record

battery, so that only the peaks of the waves are recorded. By suppressing most of the standing current the oscillograph has only to deal with the increase in the current resulting from the movement of the diaphragm. A typical oscillogram|| is shown in Fig. 4. (Pressure calibration 1.5 mm. per 100 lb./sq. in.)

When using a cathode-ray oscillograph the secondary of the pressure unit is connected to a 70 to 1 ratio transformer (a

small microphone transformer with a Mu-metal core has been successfully used) giving about 200 V for operating the cathode-ray tube. Rectification and suppression of the standing voltage is unnecessary as the trace can be biased to one side of the screen, so that only the peaks of the waves appear. A pressure of 500 lb./sq. in. will then give an increase in voltage of some 50 V. Where a lower pressure range is to be recorded a thinner diaphragm may be used.

In conclusion it may be said that the miniature electro-magnetic pressure recorder described embodies high resonant frequency of diaphragm; freedom from electrical interference; is insensitive to small drifts in frequency; is stable and gives substantially linear calibration; gives ease of correlation with other data; and measures static and dynamic pressures.

The author is indebted to the Electrical Research Association for permission to publish this account.

‖ Due to the poor response of the oscillograph the standing current resembles a sine wave; actually it is a series of peaks.

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

Dubilier Condenser Co. (1925), Ltd., have appointed **Wing Commander Humfrey Andrewes,** late Chief Radar Officer, Base Air Forces, S. E. Asia Command, their laboratory manager. He has had a wide experience of radio, radar, and electronic engineering and will be responsible for all research and development in connection with the company's products.

Wing Cdr. H. Andrewes

Mr. J. C. Stewart has been appointed secretary of the Electrical Trades Commercial Travellers' Association in succession to Mr. C. E. R. Hickman, who resigned for business reasons.

Mr. S. A. Gaskell and **Mr. A. D. Mackenzie** have joined the board of Bruce Peebles and Co., Ltd.

The **Rt. Hon. Edward Leslie Burgin,** Minister of Transport, 1937 to 1940, left £79 042 (net £64 793). Duty £13 424.

Mr. John Dewhirst Mantle, chairman of A. A. Jones and Shipman, Ltd., left £90 122 (net personalty £58 523).

Southport Corporation Electricity Committee has appointed **Mr. D. F. Grant,** senior assistant, as deputy borough electrical engineer.

An electric blanket, an umbrella, a flowering plant and a bouquet, have been presented to **Mrs. H. W. Seymour,** former chairman of Blackburn branch of the Electrical Association for Women.

One of the members of a "Brains Trust," held on December 11, by the Preston Women Citizens' Association, was **Mr. G. A. Robertson,** the borough electrical engineer.

Miss Jasmine Bligh, one of the two original television announcers at the Alexandra Palace, Muswell Hill, is to return there when the service is resumed.

The North Eastern Marine Engineering Co. (1938), Ltd., announces that **Mr. George M. Smibert** has been made a director of the company. This appointment will relieve Mr. John Neill of certain of his duties at the Wallsend works.

Machynlleth Electricity Supply Company has appointed **Mr. I. W. Williams** as works manager. At present he holds an appointment under the North Wales Power Company at Pwllheli.

A special tribute was paid at a recent meeting of the Maidenhead Town Council to the work of **Mr. C. A. Britton,** borough electrical engineer, who was attending the meeting for the last time prior to taking up a new post in the Sudan.

Mr. E. S. Little has been appointed secretary of the British Thomson-Houston Co., Ltd. Mr. Little, who is a director of the company, will combine the duties of secretary with those of his existing position of comptroller.

Ald. J. D. Hinks, who has been chairman of Darlington Transport, Gas and Electricity Committee for six years, has been appointed chairman of the Northern area of the Municipal Transport Association.

Mr. Harry Williams, works manager of the Park Gate Iron and Steel Co., Ltd., Rotherham, who has been appointed director and general manager, began his career with the firm as an apprentice in the electrical department.

Mr. William Harrison, manager of the Birmingham branch of Cable and Wireless, Ltd., is retiring at the end of the year. In 1909 he opened the first cable office in that city for the Eastern Telegraph Company.

The new Associates in electrical engineering of the Royal Technical College, Glasgow, admitted at a meeting held in the

college on December 9, were F. J. Barclay (Bearsden), A. A. Dunn (Uddingston), B. J. F. Gerry (Glasgow), and D. C. Gilchrist (Rutherglen).

The Eccles Council has placed on record its appreciation of the services of **Mr. Frank Clark,** commercial superintendent of the electricity department, who is about to retire, having reached the age of 60. He has been in the service of the undertaking for 45 years.

Mr. L. F. Worthy, of the London Telecommunications Region, is retiring on December 31, after forty-three years' service in the engineering department of the National Telephone Co. and Post Office Engineering Department. He was External Area Engineer in charge of war damage repairs to telecommunications plant in the City area.

Mr. S. W. Fuller and **Mr. J. Russon,** the principals of Trustful Products, Ltd., were at one time associated with the lamp trade. Their organisation has now secured the services of Mr. E. Whittaker, Mr. D. McFarlane Edgar, and Mr. C. Clements, who are also known in the lamp trade. The address of the organisation is 100, St. Martin's Lane, London, W.C.2.

Mr. J. Eccles, Liverpool city electrical engineer, acted as host to a party of ten Belgian engineers (mechanical, metallurgical, mining and electrical), who visited Liverpool last week. One of the party, Mlle. Marcelle Yernaux, said she decided to take up electrical engineering as a career, because her father was an engineer, and she had always lived in an atmosphere of engineering.

Three members of the Swedish Directorate of Telegraphs are to visit London next month to study the British oversea system controlled by Cable and Wireless, Ltd., who operate a direct phototelegraph circuit with Stockholm. The party will comprise Mr. S. A. Gejer and Mr. K. J. T. Ekstrom, engineers of the Board of Swedish Telegraphs, and Mr. G. T. A. Widlund, superintendent of the Stockholm Radio Centre.

The Ministry of Fuel and Power exhibition, " Other People's Jobs " was opened in the Scottish Building Centre, Sauchiehall Street, Glasgow, on December 5, by the **Countess of Elgin,** and was attended by Lord Balfour, Regional Commissioner, and Sir Patrick Dollan, chairman of the Fuel Efficiency Committee. The exhibition includes examples of modern electrical domestic appliances. Advocating the use of modern equipment, the Countess said that under present solid fuel methods some five-sixths of the heat produced went up the chimney.

In recognition of efficient and long service, seven employees of R. Darbyshire, (Wholesale), Ltd., electrical and wireless engineers, Blackpool, were presented with ordinary shares in the company at a silver jubilee dinner and dance on December 5. Mrs. Darbyshire also handed savings certificates to four of the firm's ex-Servicemen. Mr. R. Darbyshire (managing director) said certificates were put aside for employees in the Services and distributed on their demobilisation. A sum of £185 was raised for the Electrical Industries' Benevolent Association.

Automotive Products Co., Ltd., Leamington Spa, announce that **Mr. F. Rowarth** has been appointed general sales manager to the associated companies (which include the Lockheed Hydraulic Brake Co., Ltd., Borg and Beck Co., Ltd., etc.). Mr. Rowarth is well known in the aircraft industry, and was chief engineer at the Air Ministry experimental stations at Martlesham Heath and Boscombe Down. During the war, he was in charge of one of the technical sections of the Ministry of Aircraft Production. He commenced his new duties December 10.

Obituary

Sir Alfred Robinson, at Bristol on December 16, aged 66 years. He had been South-West Regional Transport Commissioner since 1941, and Deputy Secretary, Ministry of Transport, from 1934 to 1940.

Mr. Percy Rosling, at Lower Bourne, Farnham, Surrey, on December 13. He was general manager of W. T. Henley's Telegraph Works Co., Ltd., and when he retired in March, 1932, he had been with the company just over 26 years. For a time he was Henley's manager in Australia. Mr. Rosling had been a member of the I.E.E. since its incorporation in 1900, when he transferred from membership of the Northern Society of Electrical Engineers. He had served as an ordinary member of the Council of the I.E.E. and was hon. treasurer some years ago. He was also interested in the Benevolent Fund.

Mr. John Taylor, inventor of the automatic sprinkler fire extinguisher and alarm, aged 84 years. Until his retirement three years ago, Mr. Taylor was joint managing director and vice-chairman of Mather and Platt, Ltd., of Manchester. A native of Bolton, he joined the Chemical Fire Engine Co., and afterwards became a partner in the firm of Dowson and Taylor, fire engineers, of Bolton. It was with this firm that he developed the automatic sprinkler incorporating a fire alarm bell, which has become standard throughout the world. When Mather and Platt became a limited company in 1889, they absorbed the firm of Dowson and Taylor, and Mr. Taylor became one of the directors of the new company, taking a special interest in the electrical side of the business.

Electricity in Ships

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

CONTINUING from the December 7 issue, the review of electricity in ships, much useful development was made on the British side with turbo-electric propulsion during the war. In the words of Sir Amos L. Ayre, who was at the time Director of Merchant Ship Building and Deputy Controller of Merchant Ship Building and Repair at the Admiralty, when the strain on the production of geared turbine installation became too great to allow for all demands to be met, resort was made to turbo-electric sets. These were fitted in a number of important ships, including some interesting heavy weight lifters, the kind of ship which is able to take complete pipe line installations, locomotives, dredgers and heavy war material in its holds and on its decks. A particular example of this type of ship had her machinery abaft the holds which had a total bale capacity of 496 050 cu. ft. She was a single screw ship in which turbo-alternator, propelling motor and control gear were manufactured by the General Electric Co., Ltd., and installed by J. and G. Kincaid and Co., well known as makers of marine steam and Diesel engines for a number of years. The turbine, of impulse multi-phase design was coupled straight to the alternator. The alternator and propelling motor were of three-phase two-pole type complete with air ventilation system and ventilating fans.

Motor Propulsion

The propelling motor was direct-coupled to a 17 in. diameter thrust shaft with a single thrust collar. The motor drove one four-bladed manganese bronze propeller 18 ft. in diameter with a developed surface of 121 sq. ft., and a pitch of about 13 ft. 11 in. The main turbine exhausted into a surface condenser underneath the turbine. A machinery control desk and propulsion cubicle was situated in a convenient position in the machinery space together with an excitation switchboard, a 26 kW excitation booster being attached to and driven from a 400 kW auxiliary steam turbo-generator which latter provided d.c. to the ship at 220 V. There were two Babcock and Wilcox boilers supplying steam at 460 lbs. per sq. in. with a steam temperature at the superheater outlet of 750° F. In addition to the 400 kW turbo-generator there were three electric generators of G.E.C. make, each direct-driven by a Harland B. and W. Diesel engine, each generator having an output of 180 kW, 220 V d.c. when running at 500 r.p.m., the generators being arranged in parallel.

The use of turbo-electric machinery in ships with their power plant aft reached a high phase of importance in certain large tankers completed before the end of the Japanese war and fitted with B.T-H. machinery and Babcock and Wilcox boilers. They could claim to be among the most powerful single screw ships afloat, with a loaded deadweight of 17 520 tons, a gross tonnage of 12 667 tons and an oil tank capacity (95 per cent. full) of 728 630 cu. ft. There was also bunkering for 2 130 tons of fuel oil. The designed speed on loaded trial was 17 knots.

Double Unit Propeller Shaft Motor

The propeller shaft was driven by a double unit synchronous type propeller motor operated by two turbo-alternator sets. The machinery was designed to develop 11 000 S.H.P. at maximum economy, but to be capable of maintaining 13 000 S.H.P. continuously—high power on a single screw for any type of machinery. The arrangement of the turbo-alternators and propeller motors was such that the advantages of a twin screw turbo-electric equipment were attained, but in a single screw vessel with, of course, the propulsion advantages of a large low-speed propeller. This was done by having two electrically independent half motors mounted together in the same frame and driving on the same shaft, each of the two sets of windings contributing half the total shaft horse power under full load conditions, though economical operation could be obtained by using one turbo-alternator and one half motor unit at about three-quarters of the maximum ship's speed.

Control was effected by lever-operated contactor control equipment. Steam conditions were 425 lbs. per sq. in. gauge pressure and 740° F. total temperature at the stop valve. When both alternators were running to supply power to drive the propeller shaft at speeds between 90 and 122 r.p.m. the maximum continuous rating of each of the two alternators was 5 000 kVA, 3 200 V, 4 150 r.p.m. With one alternator running, driving the propeller shaft at 90 r.p.m. or below, the maximum continuous rating of each alternator was 4 000 kVA, 2 460 V at 3 060 r.p.m. For the auxiliary electrical services there were two B.T-H. 560 kW, 220 V geared turbo-alternators with self-contained condensers. Steam was supplied by three Babcock and Wilcox water tube boilers, designed for a working pressure of 450 lbs. per sq. in. Superheaters capable of giving a steam temperature of 750° F. were incorporated in the boilers.

By way of contrast, the United States standard tankers of T2/SE/A1 type which will be found on many trade routes of the world in the next few years, are much smaller. They are in fact more in line with pre-war tanker practice as regards size, the turbo-electrically propelled ships mentioned above being very special and capable of working with the fleet at sea. As a sidelight on the productivity of American yards for this particular type, it may be mentioned that the Kaiser Co.'s Swan Island yard in California had early this year completed well over 100 single screw 14½ knots tankers of 16 560 tons dead-weight capacity since it laid its first keel, all having turbo-electric machinery built by the American General Electric Co., with Babcock and Wilcox boilers. The vessels were of single screw type with a single turbo-generator and two water-tube boilers arranged on an elevated flat above and abaft the main generator. This is an important example of the flexibility of electric drive. The main turbo-alternator is supplied with super-heated steam at a pressure of 450 lb. per sq. in. and a temperature of 730°F. from two oil-fired water tube boilers. The main alternator has a rating of 5 400 kVA, 2 370 V at 3 715 r.p.m. The main propulsion motor is an 80-pole synchronous induction unit rated at 6 000 to 6 600 s.h.p. at 90 to 93 r.p.m., 2 300/2 370 V, the excitation voltage being 120. The machine is designed for synchronising with the main generator at 15 cycles.

Engineering Personnel

Apropos of the mass production of such a large number of tankers on the Pacific coast, it is interesting to note that up to January of this year over 600 specialised tanker engineers had been graduated from the U.S. maritime service turbo-electric engineering school at Sausalito, California, the school taking licensed engineers nominated by shipping companies for a three weeks' course in advance training in turbo-electric propulsion. This is an interesting indication of the way in which specialised training is considered desirable and might perhaps prevent, if more widely adopted, unfortunate incidents such as that referred to in the last issue in connection with a Diesel-electric ship.

Critics of electric propulsion will instance this specialised training as an indication that the whole scheme is too complicated for an ordinary shipowner to adopt. At the worst training is an insurance premium, at the best it is an invitation to better economy and efficiency of operation.

The Westinghouse Co. has fitted turbo-electric drive into troopships constructed in U.S. West Coast shipyards. These are known as the B.D.I. ships in which the propulsion and auxiliary machinery and their accessories are situated amidships, the control equipment being on the second platform in two sections in the forward and aft machinery spaces. This provides a maximum efficiency for layout in that the machinery is situated directly above the deep tank permitting the weight of the machinery to be used to better advantage in ballasting and trimming. Propulsion equipment consists of two Westinghouse turbines of straight impulse type, each direct-coupled to a 2 500 kW, 2 210V, three-phase 82½ cycle, 4 950 r.p.m. maximum continuous rating Westinghouse generator.

Forward and Aft Engine Rooms

The forward engine room normally supplies power to rotate the starboard propeller, the port screw is normally driven from the aft engine room, this representing an interesting dividing up of the turbo-electric power plant, not normally seen in ships, but adopted in this case no doubt because of the duty of the vessel which under combat load conditions carries about 1 000 men, including ship's crew and officers and all equipment necessary.

These ships have a twin screw arrangement with automatic stability regulation, a Westinghouse development, and a device which in the form of a motor generator set controls excitation of the main generators, being responsive to load changes on the propulsion motors.

In general, the British turbo-electric ships now under construction are simpler in their layout, this being due to the fact that they are intended for peace-time duties. The large C.P.R. ships have a gross tonnage of about 10 000 tons, and are designed to carry 10 800 tons dead weight. They have six holds with large hatches and about 200 000 cu. ft. refrigerator space. Large ships though they are, it is interesting to note that they are of the single screw type.

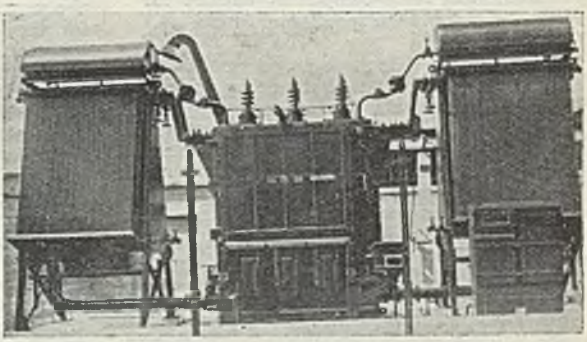
This is a feature of recent electrical practice, where confidence is shown in the system by the placing of so much power in one propulsion unit. Another interesting point about the C.P.R. ships is that the turbo-generators are supplied by C. A. Parsons and Co., Ltd., essentially a land firm. The designed horse-power of the ship is about 9 000, and it is expected that a sea speed of some 17 knots will be achieved. Steam is to be provided by two Johnson type oil-fired boilers, each of which is capable of providing sufficient power for propulsion and other auxiliary purposes. This does not represent the whole story of turbo-electric propulsion, but at least, is a representative cross-section through development.

(*To be concluded.*)

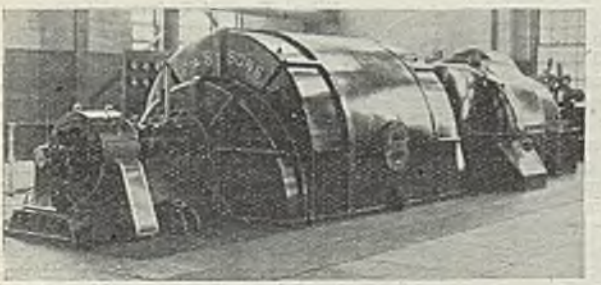
Manufacturers' Activities in 1945

Turbo-Alternators for Home and Overseas

MANY important orders for generating plant have been received by C. A. Parsons and Co., Ltd., during 1945, the majority of them being for alternators of the high voltage type generating at 33 000 V. For this country two 22 500 kW turbo-alternators have been ordered for the Valley Road power station, Bradford. The turbines for these sets will be of the two cylinder tandem type with a single ended low pressure cylinder operating at 3 000 r.p.m. One of the alternators will be of the high voltage type generating at 33 000 V. A 40 000 kW, 3 000 r.p.m. turbo-alternator, the third machine to be supplied is on order for the Earley power station, Reading, and here again the alternator will generate at 33 000 V. For the Hams Hall "B" power station three further machines have been ordered, each to develop an output of 53 500 kW. These machines will be similar to the three sets already installed. A 30 000 kW two cylinder tandem turbo-alternator is on order for the Prince of Wales power station, Rotherham. The trend towards higher rotational speeds for large output turbo-alternators is shown by the fact that in 1937, the company received an order for two 50 000 kW machines to operate at 3 000 r.p.m. for the Bunnerong power station, Australia, and recently a third machine has been installed. The turbines have three cylinders in tandem, and work with steam at 600 lb./ins. pressure, 825° F. temperature. The alternators generate at 11 000 V. This year the company received an order for the supply of a 50 000 kW, 3 000 r.p.m. turbo-alternator to be installed in the White Bay power station, Australia, and another 50 000 kW machine to operate at the same speed for Cossipore power station, India. The alternators for these two machines will be of the high voltage type generating at 33 000 V. For the Table Bay power station, South Africa, one further machine for an output of 40 000 kW at a speed of 3 000 r.p.m. and generating at 33 000 V, is under construction. Smaller sets which have been ordered for this country and abroad range in output up to 20 000 kW. These machines include a number of "pass-off" turbo-geared-alternators and straight condensing machines. Two turbo-blowers, each to deliver 50 000 cubic feet of free air per minute at a pressure of 25 lbs., have been ordered for a steel works in this country, and a turbo-compressor to deliver 10 000 cubic feet of free air per minute at a pressure of 100 lbs. has been ordered for a coal mining company in India. During the year, a 30 000 kW, 3 000 r.p.m. turbo-alternator, generating at 22 000 V, was set to work in the Newport "C" power station, Australia, and a 12 500 kW, 3 600 r.p.m. turbo-alternator in the power house at Halifax, Nova Scotia. Smaller machines put into commission include, a 1 250 kW geared turbo-alternator, and three 4 000 kW, 3 000 r.p.m. turbo-alternators, all installed in India.



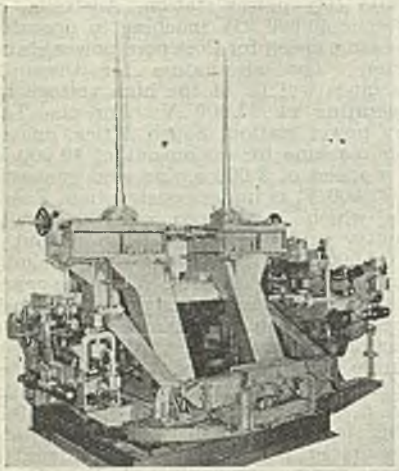
33 kV/6 600 V/20 00[illegible] kVA transformer in a N.W. England grid sub-station



16 000 kW 3 000 r.p.m. Parsons turbo-alternator in an industrial plant in Canada

The main propelling machinery required for the turbo-electric ship "Beaverdell" has been completed and was despatched to Greenock for assembly in the ship. The transport of the machinery presented no

difficulties with the exception of the main propulsion motor. Its height of 15 feet 6 inches precluded it being sent by rail, and



Additional three-component balance for R.A.F. high speed wind tunnel

for the same reason it could not be sent by road on account of its being too large to pass underneath bridges en route. The motor was, therefore, taken a short road journey to Newcastle Quayside, where it was loaded on to coaster and taken to Greenock by sea. The total height of the load when placed on the special road vehicle was 18 feet 6 inches, the length being 19 feet, and the width 16 ft. The weight of the load was 110 tons. The construction of the machinery for two other liners is proceeding, and an order for the supply of the propulsion machinery for a fourth liner has been received.

The transformer department have completed, during the past year, a number of large transformers, the most interesting unit being a 20 MVA, 3-phase transformer with voltage ratio of 33 000/6 600 installed in a C.E.B. sub-station in the Midlands. This unit is equipped with an on-load tap changer of a new design in which the diverter switches can be inspected and maintained without opening up the main tap changer tank. Phase separation of the diverter switches is achieved by the use of three small tanks which can easily be lowered, complete with oil, to expose the switches. Two separate " A " type oil coolers, complete with fans, are fitted to provide ON/OFB type cooling. The auxiliary wiring from the fans, gas actuated relays, and tap changer is carried out with " Pyrotenax " cable, run in ducts provided in the foundation block. All the cables terminate in a marshalling kiosk, which contains indicators for the oil and winding temperatures, also the motor control gear for the fans and on load tap changer. The main output of the department during the past twelve months, has consisted of small and medium sized transformers, large numbers of which have been completed, while there are still numerous orders in hand. One batch comprised 100 3-phase transformers of various sizes for France. An outstanding feature of the work undertaken has been the further development of the 3-phase (underground) mining type transformer. In this sphere, dimensions, particularly the width and height are limited, and whereas previously the largest units ordered had been in the region of 250 kVA, orders now being received are for 300 kVA, and the latest 400 kVA. To keep the overall dimensions of these larger transformers within the specified limits, which, incidentally, are the same as for the 250 kVA units, it has been necessary to utilise the 5-limb type of 3-phase core. A large number of rural type transformers and arc suppression coils also have been constructed during the year. A number of sets of control gear for the ancillary equipment used in conjunction with the larger transformers have been completed and a further 14 sets are now under construction in the panel section. These include junction boxes and marshalling kiosks for housing cooler motor controls and alarm equipment, and several wall-mounting panels for the automatic control of on-load tap changing equipment whereby the tap changers can be made to operate in any sequence. Recently a contract has been received covering the manufacture of two 45 MVA, 132/33 kV, 3-phase transformers for the C.E.B. These units are to be arranged for ON/OFB type cooling, and equipped with on-load tap changers suitable for remote electrical control.

Wind Tunnel Balance

At the optical works the additional three-component balance for the R.A.F. High Speed Wind Tunnel was completed and, after satisfactory tests, installed at Farnborough. This balance, forms part of the basic balance manufactured by the company and already in operation. By means of this apparatus measurements can now be made of all the forces acting on a model in the wind stream. A continuous indication of the forces appears on dials grouped in a control panel, and a photographic record is made to provide sets of simultaneous readings. Design and development work has been carried out during the year on Admiralty Radar equipment, which is the largest and most powerful of its type afloat.

Electrical Development in India

From Our Own Correspondent

THE Government of Mysore, it is reliably stated, have sanctioned the five-year scheme of post-war development of the Jog hydro-electric project in its second stage, estimated to cost Rs. 5 crores. The first stage of the project under construction, is expected to be finished by the end of 1946, its generating capacity being 48 000 kW. Provision has been made for installing additional generators, and the second stage of the project, when completed, is expected to generate an additional 72 000 kW, raising the total capacity to 120 000 kW.

Effects of War on Costs

An examination of the effects of the war on the finances of the Madras Government's electricity undertaking has shown an increase in the operation and maintenance expenditure, due mainly to the steep rise in the price of materials and some decrease in revenue.

The Government have, therefore, decided to levy a war-costs surcharge on all consumers served direct by the Madras electricity department (including bulk supply licences) at the rate of 10 per cent. in hydro-electric areas and 20 per cent. in thermal areas. The reason for fixing a higher rate of surcharge for thermal areas is that the increased expenditure on operation and maintenance over the normal expenditure, attributable to the war, is much heavier.

The 5 per cent. surcharge that is being levied by the Madras electricity department, at present on the high tension industrial consumers for recouping a portion of the A.R.P. works expenditure and the loss of revenue due to A.R.P. restrictions, will be withdrawn from the date on which the war-costs surcharge becomes leviable. The fuel surcharge now levied by the Madras electricity department in the Vizagapatam, Bezwada and Cocanada area will be inoperative for the duration of the levy of the war-costs surcharge.

To promote the healthy growth of electricity supply services and to standardise their rates, profits and reserves, the Labour Department of the Government of India has prepared a draft code of rules and regulations, which is to be scrutinised by a representative Advisory Board, as suggested by the Policy Committee on Electricity and Public Works. The Board will be constituted as follows: Mr. H. M. Mathews, Electrical Commissioner with the Government of India (chairman); Mr. D. L. Mazumdar, Joint-Secretary to the Government of India, Department of Labour; Mr. P. B. Advant, special officer (electricity grid), Bombay; Mr. K. V. Karantha, chief electrical inspector to the Government of Madras; and Mr. A. R. Colley, commercial manager, Calcutta E.S. Corporation.

Over Rs. 50 crores will be spent by Indian States on the installation of hydro-electric plants, says a Press note issued by the Chamber of Princes. Among the new schemes to be undertaken are the Jog Falls scheme in Mysore State, costing Rs. 408 lakhs; the Dhirangarh product by Gwalior, and a number of projects by the Eastern States Agency and Travancore, Hyderabad and Cochin.

The first hydro-electric scheme undertaken in India was that on the Cauvery river in Mysore State in 1902, for the supply of power to the gold fields at Kolar. The total amount spent by Mysore State on its hydro-electric works up to June 30, 1945, is estimated at Rs. 941 lakhs. The Kashmir Government has a plan which visualises the construction of a high head dam of about 700 feet high, forming a lake nearly 40 to 50 miles long, and utilising the water of the lake to supplement the flow of the river Jhelum during winter, the construction of a large power house, and the construction of a railway line from Jammu via Akhnur to the dam site at Dhirangarh.

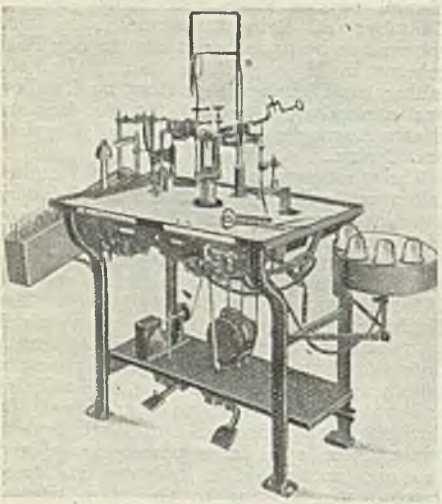
New Projects

Travancore has a project to increase the capacity of the Pallivasal station, and new generating sets are expected to be ready by the middle of 1946. The Tungabhadra project, which is being worked out by the Madras and Hyderabad Governments, when completed will, apart from the generation of hydro-electric power, irrigate the entire district of Raichur, bringing about 625 000 acres of land under cultivation. The project will cost approximately Rs. 20 crores. Among other important schemes which are proposed to be developed in the State are the Godavari project, the Jaldrug Falls project, and the Lower Kistna project. Gwalior has a scheme for erection of a dam on the Sind river at Nandan. It will be a combined irrigation and hydro-electric scheme, costing Rs. 7 crores. Jaipur is planning an hydro-electric scheme involving the construction of a dam across the river Banas at Charnoka-doh. Cochin proposes to generate energy from the falls of the Chalakudi river. Messrs. Birla Bros. have a scheme for using the Khandadhar Falls in Baonai State for generating hydro-electricity.

Electron Tube Design

By A. G. AREND.*

ALTHOUGH the subject of atom splitting and the power derived therefrom have aroused appreciable general interest recently, research has, it will be appreciated, been proceeding on all associated work for more than a generation. At



Representative arrangement of working bench of the inverted type for leading-in wires, automatic welding, adding inserts, sealing, etc.

much earlier times it was realised that information was lacking, but what it was could not then be clearly visualised. As an example, as far back as some 200 years ago, a certain knowledge of thermionic emission existed, when it was ascertained that the zone surrounding a hot body was a conductor of electricity, and which feature is to-day recognised as being due to electrons which are emitted into the adjacent space by the hot surface. In many respects there is a close association between the study of modern electronics and atom splitting, since although the former makes practical use of an enormous number of control systems, these are initially based on the knowledge of released electrons, while atom splitting goes a stage further and breaks up what was formerly known as the nucleus. At the present time, the behaviour of electrons which revolve about the central nucleus at enormous speeds is being put into service, or at least taken advantage of; but the secrets of the nucleus beyond the exterior have introduced a more formidable problem. Those who are already acquainted with even a classification of the different electron tubes as applied to various industries will be able to follow developments of sub-atomics with greater ease.

As all tubes without exception involve methods of producing electrons and control of their flow, the more intricate breaking-up of the interior, or nucleus, loses much of its otherwise apparent complexity, i.e. from the theoretical aspect. One of the best renowned scientists believed in the maxim " see it, and then study it," by which was meant that a study could frequently be simplified if a visual conception was at hand to make comparisons and help conclusions, instead of depending wholly on interpretations from written matter. Since cyclotrons and other high voltage generators for atom splitting are not at hand, the next best substitute, although perhaps an inferior one, is to examine the general set-up of electron tubes as these reveal how the exterior electrons, as arranged in atoms, behave under varying conditions. These function under the category of valves of too wide a variety to be entered into, since there are at least 10 different classifications. Some, however, are briefly described below.

Controlled Rectifiers

Controlled rectifiers; these include two varieties with thermionic cathode as the electron source, namely the thyratron and pliotron tubes, with gas (or vapour) and vacuum respectively, as the character of the controlled region. Two varieties with pool cathode, both with vapour controlled region, namely the grid-pool tube, and the ignitron. Another variety has a cold cathode and gas for the controlled region. Amplifier; this is similar to the thyratron and pliotron units. Oscillator, generator or inverter; these are again similar to the thyratron and pliotron, and include two cold cathode tubes (gas-filled), the glow tube, and the grid glow tube. Voltage regulator; these are similar to the gas filled glow tube and grid-glow tube. Wave-form analysis; two vacuum cathode-ray tubes, one using electrostatic control, and the other electro-magnetic control (thermionic cathode). Light detection measurement; here three varieties use a photo-electric cathode, namely the gas

* The views expressed by the author are entirely his own and are not necessarily endorsed by the Editor. They are published by reason of the interest and discussion they are likely to promote.

photo-tube, the vacuum photo-tube, and, and the vacuum arrangement with secondary multiplier. Radiant energy (principally light); two thermionic cathode and vacuum varieties, the X-ray tube, electron-ray tube, and the gas-filled, cold cathode strobotron arrangement.

The foregoing list incorporates the main electron tubes in service at the moment, and from which it will be gathered that the electron source principally utilised is that derived either from cathodes of the thermionic, pool, cold, or photo-electric varieties, and which are either vacuum, vapour, or gas-filled.

Principles Involved

As regards the principles involved, atoms are to-day known to comprise positive and negative particles of electricity, the proton or positive electron, and the negative simply as the electron, while neutrons and positrons are also present. These are arranged in different specific patterns with each atom. (In earlier years, atomic weights appeared in tables in most works on chemistry and physics as definite figures. To-day, these are known only to represent the average weights made up of what are termed lighter and heavier isotopes). The energy of electrons which move according to a known and defined pattern for each atom, derive their increased energy as a result of light or of heat. This can be accelerated within their orbits until some electrons dissipate into space, whereby even the speed of light may be approached. Probably the simplest example is that of hydrogen, around the proton of which the electron is quoted to have a velocity of some 75 miles per second.

The manner in which the different electrons revolve around their particular nucleus for each of the many individual elements need not be entered into, except to remark that this electron system varies in each instance, and is as yet not fully understood. Additional electrons have to be allowed for throughout the table of atomic weights, commencing with hydrogen at 1 to uranium which is usually quoted at 238, or the element of greatest atomic weight. In other words, more and still more electrons are available for rotation about the nucleus, commencing with hydrogen through each succeeding element throughout the scale to the final uranium. In the same manner, as two electrons neutralise the charge of two protons, so does this balancing process continue with all elements. Uranium, which has for long been the subject of the widest investigation in this respect has 184 protons and 92 electrons in its nucleus, and in its outer orbits 92 electrons, which again reveals how the balancing is established. When a solid conductor has electric current flowing through it, this has been accepted as the slow drift of free electrons in the conductor, but how this comes about is not yet fully confirmed. As it is, the earlier conception that electric current passed through a conductor with the speed of light is known to be in error, and that under normal conditions this flow of electrons is relatively slow. There appears to be a co-ordinated drift of free electrons from one atom to another when a voltage is applied to the ends of a conductor, and fortunately, the familiar hydraulic analogy is again of assistance in simplifying electron flow. As details of how closely this follows the activities of water in a pump and valve system have already appeared, this need not be repeated. The velocity of electrons through the circuit varies to an enormous degree, and with solid conductors carrying normal currents, the drift from the negative to positive end of the conductor has been figured out at only 0.01 in. per second, while this velocity only increases to 0.25 in. per second when the current density causes it to become red hot.

Electron movement, however, differs from this in a vacuum tube, and research investigators claim that such electrons have been observed moving at some 167 000 miles per second, and may even approach that of the velocity of light. A co-ordinated drift of an almost inconceivable number of electrons is required for even a small current flow, and in actual practice, emission by thermionic and photo-electric means, represent the principal methods of releasing electrons from atoms. In the first of these, the desired reaction is attained when the temperature of a solid has been sufficiently raised to cause electrons to fly into space, and in the second, the application of light causes the electrons to be released from a sensitised plate. An examination of different electron tube constructions will reveal how the cathodes comprise different direct-heated and indirect-heated wire varieties, and ribbon cathodes, and indirect-heated ribbon designs. The anodes are observed as simple plate, dome-shaped, cylindrical, inverted dome-shaped, rectangular, elliptical designs, and other types with fins. (The purpose of the fins is to increase the available heat-radiating surface.) This might indicate that despite the variety of shapes of wire or ribbon on the one hand, and plate or receptacle forms on the other, the work is really simple.

Materials Used

The fact that these tubes are either vacuum, vapour, or gas-filled, again does not suggest any complication, but it should be observed that the metals and com-

pounds utilised for these apparently similar parts amount to a considerable number, and most of them are from rarer elements. In this way, although current may be passed through in the normal manner (or light in the case of the photo-tubes) the emission can be of a very widely varying character. When electrons are released in a photo-electric tube, this is to-day known as photo-emission. Electron tubes without exception only permit current to flow through them in one direction from cathode to anode, and thus act in the capacity of check valves in a circuit.

Turning to the practical making of electron tubes, this belongs to a more or less specialised process, but the parts are sometimes purchased and assembled to specific designs only, while in the larger concerns, much of the fabrication of the rare metals is also carried out. These are acquired in the form of wire, ribbon, plate, and powder, together with oxides for coating purposes.

Tantalum occupies a prominent position in being one of the few really high melting point metals which can be easily fabricated. Molybdenum or graphite are more difficult to work. Tantalum contains no gas-pockets when properly treated, and hence during the later stage of the exhaust treatment there is no danger of the filament blowing-out, and internal and external bombarding may be performed without difficulty. All kinds of ribs, welded, and otherwise formed sections, are fabricated without any risk of cold-strain building-up. The direct heated filaments which have to operate at about 4 000° F. to emit a sufficiency of electrons, are largely made of wire or ribbon of tungsten. Tungsten-molybdenum alloy is used for heaters of the indirect type, where a spiral or thin sleeve encloses the actual direct-heated filament.

Filament Temperatures

This sleeve or spiral is frequently made of nickel alloy, and upon which a coating of electron-emitting material is applied. Although tungsten filaments require 4 000° F. for the desired emission of electrons, thorated tungsten operates at approximately 3 100° F.

This is because when thorium oxide is on the surface of the metal, some 90 times as many electrons per unit of surface area are emitted as from pure tungsten.

On the other hand, when coatings of oxides of cæsium, strontium, or barium, are applied to wire or ribbon of nichrome or other nickel alloy, electrons are freely emitted from the cathode at from 1 400° to 1 800° F.

Rhenium, which is claimed to be the metal of highest melting point has likewise been tried out for filaments, both alone, and in conjunction with tungsten.

The fabrication department includes a variety of machines for coiling, bending, perforating, stamping, welding, and otherwise working the wire, ribbon, and sheet of these rare metals, besides adding the coating materials. The final assembly of the vacuum, vapour, or gas-filled tube, with the filament, is done on a bench specially set-up with tools and equipment for the purpose. All tubes have an electron-collecting element in the form of a plate or anode, besides the electron-producing element.

Filament Heating

Electron emission which is useful does not take place from the heater, for the latter is only used to raise the coating to an electron-emitting temperature, while itself being insulated from the sleeve. For rapid heating, direct-heated filaments are preferred, as they heat quicker than indirect-heated types, but the latter are utilised for medium and large currents, as they can efficiently heat a much larger electron-emitting surface. The grids are likewise made from tantalum, tungsten, molybdenum, and alloys of tungsten and molybdenum, and nickel and manganese, and these control the current flow through the electron tube.

In conclusion, there are relatively few industries which cannot with advantage use electron tubes in one form or another, particularly in respect of actuating automatic continuous systems, whether of a mechanical or chemical order. The inonisation process which occurs, and the manner in which the atoms lose their electrons is a close approach to the more modern study of atom splitting which has recently been so widely publicised. Although the splitting of the nucleus of the atom usually involves more elaborate electrical equipment, and thereby falls within a slightly different field, the respective studies are too near one another not to be linked-up. Those desirous of keeping abreast with modern scientific achievements are recommended to keep in touch with all developments of electron tubes, for sooner or later it is expected that the power stored in atoms may be utilised industrially.

British Oil Engines for Turkey.—On behalf of the Turkish State Maritime Transport Purchasing Legation, Robert W. Hunt and Co., of London, have placed with British Oil Engines (Export), Ltd., an order for four marine propulsion engines by Mirrlees, Bickerton and Day, Ltd., of Stockport, aggregating 1 000 s.h.p.

Answers to Technical Questions

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

What is meant by the " 30° connection " as applied to directional protective relays?

The term is applied to certain directional types of relays, i.e., relays which operate

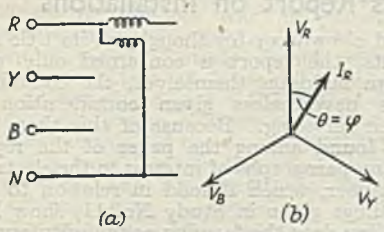


Fig. 1.—0° connection

when the current is in one direction but not when it is in the other direction. Since the direction of current through a relay must be determined relative to the voltage of the circuit a directional relay must have applied to it the circuit voltage as well as the current in the circuit. The torque on the relay disc (assuming it to be of the simple induction type, as it most usual) is given by—

Torque $= V \cdot I \cdot \cos\theta$ where θ is the phase angle between the voltage applied to the relay voltage coil and the current through its current coil.

Consider a relay connected as in Fig. 1 to a three-phase circuit. In practice instrument transformers would, of course, be interposed between the actual circuit and the relay coils to step the current and voltage down to suitable values. The voltage applied to the relay is V_R (Fig. 1b), and the current is I_R, so that the angle θ in the above expression for the torque is equal to φ the power factor angle of the main current. The torque for any power factor is thus given by the full curve of Fig. 2. Alternatively it may be said that the relay will operate if the current vector falls within the shaded semi-circle of Fig. 3, but not if it falls within the opposite semi-circle shown dotted.

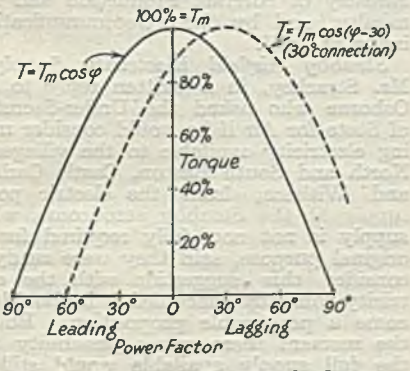


Fig. 2.—Torque on directional relay at various power factors

As, under fault conditions, the current will usually be lagging by nearly 90°, it can be seen that the torque on the relay will be small and may be insufficient to cause operation.

To overcome this difficulty and to ensure a good operating torque, even at 90° lagging power factor, the connections of Fig. 4 are used, the relay voltage coil being connected between the R and B phases. It can be seen from the vector diagram of Fig. 4b that the torque on the relay will be given by $T = T_m \cos(\varphi - 30)°$, i.e., maximum torque is obtained when the main circuit phase angle is 30° lagging. The torque for other power factors is given by the dotted curve of Fig. 2. Alternatively, it may again be said that the relay will operate when the current vector lies within the shaded semi-circle of Fig. 5.

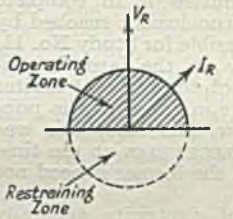


Fig. 3.—Operating zone for 0° connection

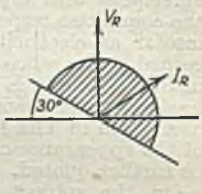


Fig. 5.—Operating zone for 30° connection

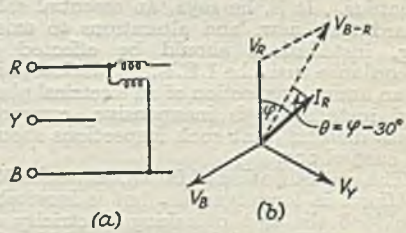


Fig. 4.—30° connection

It can also be seen from the vector diagram of Fig. 4b that if the power factor of the main circuit were unity, the relay

current would lead 30° ahead of the voltage V_{B-R} across the relay, and for this reason the term 30° connection is used for this arrangement.

A current lagging by 90° is well within the operating zone of the relay, and there is little danger of its failing to operate on any fault current likely to be met in practice. Currents leading by nearly 90° would, of course, not operate it, but such currents are not likely to occur under fault conditions, so that this is not a disadvantage.

E. O. T.

Electricity in Farm Buildings

Agricultural Committee Supports Report on Installations

THE committee which was in 1942 appointed by the Minister of Agriculture to consider and make recommendations regarding the layout, design and construction of farm buildings, has made known its findings in Post-War Study No. 17, obtainable from the Stationery Office, price 3s. The report, as might be expected, covers many points of interest to the electrical industry, chief among which is the fact that the committee is in complete agreement with the conclusions reached by the committee responsible for Study No. 11, insofar as electricity on the farm is concerned. The whole of the relevant matter in Study No. 11 is reproduced in the publication under review, and since this was dealt with in THE ELECTRICIAN at the time of the appearance of the former it need not be further quoted.

On the subject of electricity generally in its application to farming, the report quotes Mr. G. Stafford, fire manager of the N.F.U. Mutual Insurance Society, as stating that in many cases, whilst an original electrical installation on a farm may have been put in by a competent engineer, extensions and improvisations are the work of the amateur. It is, he says, an essential safeguard that new, and alterations to existing, installations should be effected in accordance with the I.E.E. regulations, and as an annual inspection of an electrical plant and installation is inexpensive, commonsense dictates that such inspections should be carried out.

The electrification of farms, contends Mr. Stafford, is long overdue, but is inevitable provided the cost of taking electricity on to the farm is made to come within the means of the farmer. With electrification, the internal combustion engine would not be needed except for distant elevator work; the electric motor would replace the steam engine for threshing work if the rickyard was not too distant from the steading; and the need to store inflammable oils and spirits to the present extent would not arise.

The report also makes strong recommendations in regard to the artificial lighting of farm buildings; low pressure boilers and comparable heaters for use in the dairy and elsewhere; for though, as its title suggests, the report is concerned only with farm buildings themselves, the committee has nevertheless given consideration to their servicing. Because of this there will be found among the pages of the report many paragraphs of interest to the electrical engineer, which if read in relation to the findings given in Study No. 11, show how willing does the farming community appear to be to adopt electrical methods, if and when the charges for such service are reasonably economic.

In Parliament

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

Telecommunication (Research and Development).—In a written reply to Mr. Cobb, the Assistant Postmaster-General said that the Post Office undertakes its own research and development. Research and development in the same field is also undertaken by other Government Departments, e.g., Department of Scientific and Industrial Research, Ministry of Supply, Ministry of Aircraft Production and Admiralty, and by the Telecommunications industry itself.

Strubby Airfield Electricity Supply.—Mr. Strachey, in a written reply to Mr. Osborne who asked the Under-Secretary of State for Air if he would consider making electricity available to the villages of North and South Reston, Castle Carlton, and Withern, from the electric power supply at the Strubby aerodrome, which supply is not now fully required for its original purpose, said they were ready to consider this suggestion with the electricity company concerned if it should become a practicable proposition. But at the moment there was a possibility that the full supply available would still be required for the airfield.

Hospital Lighting.—The Middlesex C.C. has arranged for the British Thomson-Houston Co., Ltd., to provide fluorescent street lighting in the roads of the Shenley Hospital at a cost of about £300.

The Engineer's Library

Fundamental Studies Necessary to Secure Improvements

AT a meeting of the A.S.E.E. on Tuesday, Mr. C. W. Marshall read a paper entitled "The Electrical Engineer and his Library," in the course of which it was pointed out that as nowadays, the possession of a university degree or equivalent certificate or diploma was an essential to promotion as an employee, and the objective of technical study should accordingly be to attain at least the standard of an engineering degree. His lecture was based on the course of study prescribed at Glasgow but this did not, in his view, differ materially from that used in other British universities. The pre-engineering technical subjects were mathematics, physics and chemistry, and with respect to mathematics the books recommended by the speaker were, he said, all published by Arnold, and written by S. N. Forrest. As to physics, this subject entered the province of the supervising engineer to a lesser extent than mathematics, but all should acquire some knowledge of sound and light, a good deal about heat and electricity. The old textbook by Ganot, which could still be picked up in second-hand book shops, was hard to beat as a basis, but of modern textbooks he recommended those on light, heat, electricity and magnetism by G. R. Noakes, and published by MacMillan.

Coming to chemistry Mr. Marshall suggested that E. J. Holmyard's "Inorganic Chemistry," and R. Hum's "Chemistry for Engineering Students" would enable them to do any calculations they were likely to encounter.

A.C. Engineering

Passing to engineering subjects, the author said he knew of no better textbooks for the non-electrical subjects than those written by MacQuorn Rankine about 70 years ago, and he recommended "The Steam Engine and Other Prime Movers" and "Civil Engineering." The electrical engineering book which he liked best was Jas. Barr's "D.C. Electrical Engineering." This had been brought up-to-date by Mr. Bolton of the Regent Street Polytechnic. Among the present-day textbooks on a.c. engineering, and the one which appealed most to him was "A.C. Electrical Engineering" by P. Kemp. It was preferable to base one's electrical engineering studies on alternating currents rather than on d.c.

The British Standard Specifications should form part of the library of all engineers. They would provide them with nomenclature, drawing symbols, and definitions which were accepted throughout the English-speaking world, and which merged into those of the International Electro-technical Commission. The B.S.S. for circuit-breakers provided all the information which was likely to be required by the user of switchgear, in brief but clear form. Those with a desire for intimate knowledge would derive much benefit from study of E.R.A. publications.

Hydrogen-Cooled Alternators

The study of large machines was recommended even though their everyday work was mainly concerned with small ones, as it indicated where the limits of size were decided by inherent properties of materials. The result of these limitations was that British designers had, so far, hesitated to go beyond an output of 60 000 kVA at 3 000 r.p.m. with air cooling. The Russians were said to have built at least one alternator with an output of 100 000 kVA at 3 000 r.p.m., and one of 125 000 kVA was under construction in America for use in France. These alternators were hydrogen cooled. American engineers claimed that over 4 million tons of coal had already been conserved by the use of hydrogen-cooled synchronous condensers and alternators in the U.S.A., so that their fundamental studies in physics had been productive of a great material harvest.

In general, electrical plant worked at such high efficiency that there was a danger of neglecting fundamental studies which were necessary to secure improvements.

Supervising engineers were probably more concerned with reliability of operation of plant than with any other matter. By far the most important factor in securing reliability was orderly and thorough maintenance. Books would not help much there, except perhaps in inspiring them to devise tests to determine when maintenance was necessary and justifiable, and in what degree it had been beneficial. There was, however, occasionally a mysterious type of trouble which gave rise to faults on electrical plant, and was attributed to "surges." An admirable account of the main facts relating to transient voltages could be found in the E.R.A. volume "Surge Phenomena."

The lesson to be learnt from that class of experience was that the more they knew about electrical measurements, the better able they would be to elucidate any mysterious over-voltage troubles.

Stresses in Transformer Windings

Discussion on Conditions Causing Breakdowns

At the meeting of the Transmission Section of the Institution of Electrical Engineers on December 12, Dr. E. Billig read a paper entitled ' Mechanical Stresses in Transformer Windings," an abstract of which was given last week.

The discussion which followed made it evident that the subject is of considerable interest to the industry, and the various remarks may be summed up as follows.

Mr. C. W. Marshall (Central Electricity Board) said he would like to attempt to put the matter of transformer winding trouble in its proper perspective. During the war faults on the grid system grew to many times the normal and some thousands of short circuits of varying severity were caused by enemy action and, to a considerable extent, by our own balloons and defensive measures. Grid supplies were never seriously interrupted due to failures of transformers, but a few failures occurred of the type described in the paper; not all transformers, however, were grid units. The C.E.B. took such a serious view of these short circuits that in the course of the next year or so it was hoped to inspect at the makers' works all the transformers which had been subjected to numerous short circuits, or at least to have type examinations to get an idea of where the trouble occurred. The transformers involved were, first, 132 kV units, which had occasionally failed mechanically after some electrical fault had occurred. There were also quite a number of failures on earthing transformers in the early days of grid operation because of the earthing resistances flashing over. Just recently, there had been a case of a 33 kV transformer which failed on short circuit. The nature of the faults had been failure of end rings. The author had given a warning against the use of Bakelised material, and imperfect clamping of the end rings had also been an occasional source of trouble. Unsatisfactory sizes of conductors had caused trouble in some cases, and a fourth cause of failure had been the shrinkage of the insulation. At one time the latter had been a serious source of trouble but with modern manufacture and technique no appreciable shrinkage should occur. From the supply side it would only be fair to improve the protective equipment on all items on the net-work to ensure that short circuits did not continue too long. Some of the secondary system protective equipment was too slow and primitive to give the apparatus a chance. He asked the author for a little more information as to the inter-relation between the thermal and mechanical effects.

Mr. D. P. Sayers (Birmingham Electricity Department) said it was probably true that the majority of faults on transformers were of an electrical nature, but faults also occurred on less frequent occasions where the disruptive effects were due to mechanical forces. After showing one or two slides illustrating this, he said the author had rightly called attention to the abnormal conditions resulting from electrical or mechanical faults in tap-changing gear, and most users had experienced a variety of such faults, nearly all of a comparatively trivial nature, such as oil leaking through bearings, mal-alignment of gear wheels, sticking contactors, defective clutches and brakes, faulty auxiliary switches, etc. Such faults frequently led to more serious troubles and supply interruptions. In one case, failure of the tap-change gear had resulted in serious damage to the main windings of a 15 000 kVA transformer. In this case, due probably to a combination of open circuit and earth faults on the tap-changing contactors whilst the transformer was under load, the distribution of flux was disturbed and extremely large circulating currents were induced in the longitudinal coil clamping bolts arranged between the clamping plates at the top and bottom of the coil stack. These bolts were of steel, about 1¼ ins. diameter, and enclosed in fairly close fitting Bakelite sleeves. The sleeves undoubtedly had an important effect on the occurrence, as they prevented free access of oil for cooling the bolts, but on the other hand they might have prevented a disastrous fire. The circulating currents were so large that several of these bolts melted in the middle. Subsequent work's tests proved that the melting of the bolts was in fact due to enormous circulating currents, and this was a striking demonstration of the dangers attendant upon any serious disturbance of the normal flux. Reference was made in the paper to the use of Bucholtz relays or similar devices in detecting internal faults. An interesting article appeared recently in the technical Press describing a new magnetic balance system, the principle of which was to instal dual winding current transformers at each side of the main transformer, connected in such a way that current in the relay winding was negligible with a healthy circuit, and restraint was exercised against the effect of tap unbalance during through faults. This appeared to be somewhat

novel and he asked for the author's comments on it. The main point emerging from the paper was summed up in item (b) of the conclusions: viz., "All methods of clamping which have been used up to the present effect a compromise between various factors, and none of them fully solves the problems arising out of shrinkage." All users of transformers would be interested to know whether other transformer designers were in agreement with this statement.

Mr. J. B. Hansell (Metropolitan Vickers Electrical Co., Ltd.), suggested that failures of large transformers on short circuit were very rare, and he knew of only one case. A great deal of the paper was devoted to what might be called secondary effects, i.e., the short circuiting of parts of the winding which might have been damaged by an original short circuit which did not cause breakdown. Therefore, it was a little difficult to know where to improve transformers because it was not always possible to find out where the original trouble had been. Nothing had been mentioned about any methods by which short circuit forces could actually be measured and he briefly described a method which he had used some years ago for measuring the short circuit forces on an experimental transformer. The author had pointed out that the short circuit forces depended on the rate of change of reactance with respect to the movement. If the winding was moved one inch, there would be a certain change in reactance, and the rate at which the reactance changed gave a good measure of the short circuit. Therefore, in the method he had mentioned he measured the change of reactance, and so was able to measure what the short circuit force was really going to be. This, of course, had to be done by the research department and appeared to him to be a very effective way of finding out what the force was going to be.

Mr. Leslie Smith (British Electric Transformer Co., Ltd.), remarked that whilst the author's arguments as to the trend of events were sound they were, in a number of cases, spoiled by considerable overstatement. In large transformers, particularly of the multi-winding type for system interconnection, the designer had to meet so many requirements—many of which, in the first approach, were incompatible with one another—that it was obvious that in a well balanced and reputable design, the hazards or trends in regard to forces were counterbalanced by quite adequate supporting area and strength of supports as part of the exercise of the designer's art. There was little mentioned in the paper which was not already well appreciated by skilled designers of large transformers, and over-statements concerning the trends could only give unnecessary concern to users when the hazards had already been adequately covered with a margin in the design.

Mr. R. H. Abell (Central Electricity Board) suggested that it might be worth while for users to give greater freedom to designers in regard to impedance. For a large transformer the usual figure specified was 10 per cent. but if that was increased to 15 per cent. it might be that a much better transformer could be produced from the point of view of short circuit forces. Greater freedom for the designer might also well be given in the matter of clamping. This might result in a better clamping structure or, indeed, in no clamping structure at all. In practice, users were often frightened to tighten up the clamping bolts although the clamping structure was said to be capable of adjustment. He also urged that greater attention should be given to the low voltage windings.

Mr. G. O. Castell (Hackbridge Cable and Construction Co., Ltd.) referring to the case mentioned by Mr. Sayers of a breakdown failure on a 15 000 kVA transformer where the tie-rods were melted, said that if, as apparently was the case, the actual fault was an open circuit on the tap switch so that the transformer was working in open delta with consequently no return path to the leakage flux, he felt that it might have been this which caused the failure.

Mr. E. T. Norris, chairman (Ferranti Ltd.) said that in considering the conclusions of the author it must be remembered that there were other characteristics of a transformer that also had to be considered. Therefore, it would be unfortunate if consulting engineers and purchasers of large transformers were to take any of the conclusions in the paper as they stood and insert them in specifications as prohibitions or stipulations. Nor would he like any one of the last three alternative tapping arrangements set out in Fig. 1, in the paper, to be inserted in a specification as the one to be adopted. The same comment applied to conclusion 1 of the paper. High pressure clamping was a very debatable point and there were other features also which called for a broader consideration before they should be considered a general stipulation or restriction. In the same way, in considering the photographs of breakdowns that had been shown, it was essential not to arrive at a conclusion as to the real cause without the most careful consideration. It was always difficult to determine what was the cause of the initial breakdown which led to the ultimate failure. Generally speaking, end clamps were strong enough and, as had been indicated in the discussion, the general position was satisfactory; it could be said that mechanical weakness was not a source of

defect in transformers to-day. He only knew of two instances of mechanical failure and in both of these the operating conditions were impossible. Therefore, he urged that all the conclusions in the paper should be considered as having particular reference to the mechanical strength of the transformer only.

The author in the course of his reply to the discussion, said it would be interesting to have details, in due course, of the systematic investigation of transformer failures indicated by Mr. Marshall. He agreed that faults on large transformers were rare and that was for the reason that the reactance of the supply system was fairly large as compared with the reactance of the transformer. The measurement referred to by Mr. Hansell was an indirect method and one of the E.R.A. publications had dealt with such a method. Whilst it might be true he had made some over-statements in the paper, as Mr. Smith had indicated, that was in order to draw attention to certain points which called for special care. As to the tightening of transformer clamps, it would be advisable if manufacturers gave users some instructions as to what should be done with adjustable clamps.

Mineral Insulation

Progress in its Application to Metal Sheathed Conductors

AT a meeting of the I.E.E. Installations Section on December 13, a paper on "Mineral-Insulated Metal-Sheathed Conductors," by Mr. F. W. Tomlinson and Mr. H. M. Wright, was read. Extracts from this were given in our last issue.

The paper recorded the progress made in the application of powdered mineral insulation to metal-sheathed conductors. It described manufacturing methods and the application of those products which have reached a commercial stage of development. Mineral-insulated copper-covered (m.i.c.c.) cable was dealt with at greater length, and it was thereby hoped that a solution to some cabling problems might be indicated.

Mr. E. Jacoby said that mineral insulated cable had received a considerable prominence since it was first installed in the Louvre, as illustrated in the paper, three or four years before the war, and it was becoming increasingly obvious that this type of cable might be used as an alternative to the older wiring systems. It would have been an advantage if a little more space had been given in the paper to the qualities and capabilities of the cable for use under normal wiring conditions. There was no indication that the cable had been manufactured for shields other than copper, and it would be interesting to know the degree to which it would stand up to various difficult conditions. The principal weaknesses were the terminations and the necessity to use glands. In the case of one particular make of mineral insulated cable, no fewer than 46 different sizes of cable were listed with 34 different diameters, and this involved a considerable number of glands and fittings. The result was that if only one of the fittings were missing on a job there would be considerable delay. So far as glands were concerned, he suggested the possibility of some chemical sealing in which the end of the cable could be dipped and form a sealing end by the actions of the compound used. If so, a great many of the troubles due to sealing would be avoided. Moreover, at present the terminations were made in conjunction with accessories made for ordinary conduit, but something better than this should be evolved. He also urged that the opportunity of this new development should be taken to size cables by current-carrying capacity instead of by strands per sq.in. This would allow of the number of sizes of cable to be reduced if the current-carrying capacities were on an electrical progression. There was no mention in the paper of test voltages, although reference was made to breakdown. What was the maximum surge capacity the cable would stand? As to cost, if the initial cost only was taken into account, this type of cable was as expensive as a first class conduit job using the very best type of material, but initial cost, of course, was not the only factor. Maintenance cost and ultimate life were very important, and it seemed from experience to date, that these were likely to be very satisfactory. More information was required with regard to the prefabricated units which had been mentioned; he felt that any system which necessitated units being returned to the works if anything went wrong, involved the possibility of delay. His judgment of the new cable, however, was that it was an extremely good system, but if it could be simplified in various directions it would be even better.

Mr. D. E. Bird said he had been responsible for using considerable quantities of this cable during the last seven or eight years in power station work, first on a small scale and later on a large scale, and it had been completely satisfactory in operation. It was now used for complete lighting, small power and pilot cable installations in power stations, and he had also used it for sub-station work. The chief

attractions of the cable were the ease of installation in awkward places, the small amount of room it took up, and its heat and fire resisting qualities. He showed slides illustrating its use for power station purposes and in connection with a coal conveyor, and suggested that the number of cables and fittings which had to be kept in stock could be very much reduced by selecting certain standard sizes for a job. In his case he had adopted one size of cable only for pilot connections, for instance, and other sizes had been adopted for power circuits. He disagreed with the suggestion to rate these cables on current-carrying capacity, but endorsed the plea for a simple sealing arrangement, although the present seal had been adequate. In one instance, where there were 20 000 seals, there had only been five failures in four years, but an easier method of sealing would be useful. He also thought that special fittings should be made for those cables instead of making use of conduit fittings.

Mr. W. S. Lovely also spoke highly of this cable in use, and said that whilst the sealing of the ends had been the chief source of worry, he thought in fairness it should be stated that the problem had been largely overcome by the use of the latest type of end seal. There was, however, need for a more suitable sealing compound, on which more nearly matched the filling of the cable. There were two forms of sealing compound now in use, both of which flowed below 100°C., and this limited the application of the cable for certain purposes. At present it was necessary to arrange matters so that there was a vertical entrance from below to a cable box. A cold pouring and non-setting type of compound was called for, something which could be poured or squeezed out of a tube into the end box to form a homogeneous connection with the filling in the end part of the cable. Speaking specially from the point of view of the use of this cable in connection with machine tools and in factories, he said there was always a large amount of oil about in such conditions in addition to considerable heat, and therefore a need existed for a cable which was simultaneously fireproof and oil resisting, and this class of cable seemed to fulfil those two conditions if the end connection problem was completely solved.

Mr. H. G. Gamble, who remarked he had used this cable for power station work, said he had also had experience of it for domestic electric cookers. Whilst it made a very fine job it was a little more expensive than other types of cable, but taking into account maintenance and life it had advantages. It would be necessary, however, to cheapen the glands and accessories, for he had found that with the ordinary wireman it took far too much time to assemble. Moreover, planning of installations for this cable must be much more accurate than with ordinary types of cable. The cutting of the lengths must be absolutely correct as it was not possible to have too much and then tuck it in. Moreover, the average operative did not like to have to work so accurately. Therefore, for a real comparison with ordinary wiring the cost would have to come down. He agreed with the need for a better compound for sealing. At the moment this was a long job. Further, a good deal of research was needed in connection with the heating elements of hot plates.

Mr. G. J. Maughfling asked for further details of the method of making the cable in which the magnesia was introduced by means of a hopper, through the centre of which the conductor wires were fed, the sheath being extruded round the point of exit from the hopper directly on to the magnesia. Referring to a statement in the paper that the authors had found that electrical methods provided the most convenient way of carrying out all the heating and annealing processes used in the manufacture of this type of cable, he said this conformed with cable makers' experience generally, but in this case it seemed that the heat was applied externally, and he thought it would be difficult to apply heat by way of the conductors if several quenching operations had to be performed on connections already made to the end of the embryo cable. If only it were not necessary to seal the ends of this type of cable against the ingress of water, the authors would have gone a long way towards producing the ideal they referred to.

Mr. G. F. Freeman said he had worked with Backer when he came to this country with his patent processes just over 20 years ago, and the processes described in the paper were, with very minor variations, the same as those which Backer initiated. He asked for a figure for the permutivity of magnesium oxide, and said he had a heating element in a nickel-chrome tube which was 19 years old and still serviceable. Admittedly the end connections were a trouble, particularly on d.c. supply, where electrolysis was more noticeable, than with a.c. He asked if the authors had tried any of the new sillicone products in his connection.

The Chairman (Mr. Forbes Jackson) asked for some information with regard to the use of this cable in houses, but nobody responded to the invitation.

Mr. D. B. McKenzie disagreed with the authors in their statement that cables designed specially for aircraft wiring, together with the necessary tubing or casing, were no lighter than mineral-insulated cables. As to the use of this type of cable for high frequency work, he said he would not consider it in preference to cables of the polythene type, and questioned whether it

would be competitive with polythene cables at high temperatures. He added that trouble had been experienced on aircraft due to corrosion being set up when mineral-insulated cables were in close proximity to other metals.

Mr. G. A. Cameron Brown thought there was something to be said for this new type of cable as a low temperature conductor for slow warming, and said that installations of this type were being watched. The possible drawback was the higher cost, which would always be a determining factor with farm installations.

Mr. J. G. Parker did not think the sealing of the ends of those cables was as bad as had been made out by many speakers. He had seen an ordinary competent electrician taught to seal the ends, and after making one or two joints he made satisfactory sealing ends. He asked if the cable had been tried without sealing the ends at all, and added that if experiments had been carried out he would like to know the results.

Mr. G. D. Clothier, deputising for Mr. Tomlinson (one of the authors, who is in the U.S.A.), replied to some of the points raised in the discussion. He expressed his satisfaction with the reception of the cable and the constructive criticisms that had been offered. Admittedly, he said, the seal was not ideal because it required special instructions, but work was in hand with the object of improving the seal. The use of silicone compounds was also being worked on, and the first tests had been most promising. He agreed with the criticism that too many components had to be used at present, which was due to the large number of sizes of sheath on the market. The makers thought it best, at first, to adapt this cable to existing conduit fittings rather than attempt to develop special fittings. That would be changed, as time went on, and he emphasised that a new technique had to be adopted in the use of the cable, which was not an easy thing to introduce. As to the effects of surges on those cables, he said that careful tests would have to be carried out with the aid of the oscillograph, but no very definite information was available at the moment. The suggestion that more planning was required with that cable tied up with the need of applying the new technique he had mentioned. He did not think supply authorities were yet in the frame of mind to accept the cable without end sealing.

Mr. Wright, who also briefly replied, said the statement that cables designed specially for aircraft wiring were no lighter than mineral-insulated cables was based on a statement by a well-known firm of aircraft manufacturers, who had expressed surprise, when the weights were compared, to find that this was so. No doubt Mr. McKenzie, in his disagreement with the statement in the paper on this point, was comparing an ordinary cable and not an equivalent fireproof cable used to run over an engine. No doubt there would be cases where p.v.c. cables could be used on aircraft without a casing, and then they would be lighter, but with equivalent protection he did not think they would be so.

Book Review

" Steel and its Practical Applications." By William Barr, and A. J. K. Honeyman. 2nd edition. Blackie's " Technique " Series. Pp. xii + 156. 8s. 6d. net.

The first edition of this book was one of the most useful and commonsense publications in not too technical language on the subject of steel, and of particular value to engineers of limited metallurgical experience.

Since the first publication in 1932, very considerable advances in the art of steel making and its uses have naturally occurred, and the second edition now available has been revised and rewritten to incorporate these advances, notably in connection with creep, precipitation hardening; spheroidising; isothermal treatment and S-curves; grain size; hardenability and the Jominy end-quench test; and the determination of critical ranges in heat treatment.

The title of the chapter devoted to case hardening has been wisely altered to " The Surface Hardening of Steel," and now includes cyanide treatment, nitriding, gas carburising, flame hardening and induction hardening, with some remarks on the fatigue strength of surface-hardened steels.

Considerable information is now included on the metallurgical aspects of welding and gas cutting in view of the rapid advances made in these processes in recent years, and the section on defects in steel and their detection has been considerably extended.

Altogether, this new edition may be taken as a very worthy successor to a valuable original publication, and it can be strongly recommended to busy engineers who have not time to delve too deeply into metallurgical subjects but to whom a general authoritative knowledge of the main aspects of the matter is nowadays an absolute essential to successful engineering practice.

BOOKS RECEIVED

Journal of the I.E.E. Vol. 92. Part I (General) No. 59 (November). (London: Spon). 5s. net.

" Raw Materials from the Sea." By E. F. Armstrong and L. M. Miall. (Leicester: Constructive Publications, Ltd.). Pp. xi + 164.

News in Brief

Illuminating Engineering Society.—A meeting of the Birmingham Centre of the Illuminating Engineering Society is to be held at the Imperial Hotel, Birmingham, on January 4, at 6 p.m., when Mr. H. J. Cull will speak on "The Physical Nature of Light."

"Thanks" Drive Donation.—British Insulated and Callenders Cables, Ltd., invested £5 000 in Huyton-with-Roby's £80 000 "Thanks" Drive.

Workshop Lighting.—The Bolton Watch Committee has decided to instal fluorescent lighting at the police garage workshops.

Shelter Thefts.—The Bootle Emergency Committee reported recently that 80 time switches, costing about £240, had been stolen from communal shelters.

Cathedral Floodlighting. — Liverpool cathedral tower was floodlit for the first time when the Royal Artillery memorial service was held there recently.

Empire Telecommunications.—A Royal Commission on the future of the Empire telecommunications system is proposed by Cable and Wireless, Ltd.

Refrigerator Vans for G.W.R.—Fifty refrigerator vans of a new type, for carrying fish, poultry, rabbits, soft fruit, and other highly perishable traffic, are to be built by the G.W.R. at Swindon.

Birmingham Electric Club.—A children's party, open to all members of the Club, and their families, is to be held at the Grand Hotel, Birmingham, on January 5, from 3 p.m. to 6 p.m. Tickets will be 5s. each.

Loudspeakers for Trams.—At a recent meeting of the Blackpool Transport Committee the Transport Manager sought the views of the Committee with regard to the installation of loud-speaker equipment in trams and buses, and he was authorised to so equip 12 tramcars and 12 buses.

Liffey Power Scheme.—It is announced that work on the Leixlip section of the Liffey will shortly start. This work is included in the general hydro-electric scheme of the Liffey to supplement power and lighting in Dublin and other areas within its ambit. Like the main scheme, it will come under the Poulaphouca reservoir of 5 000 acres in the Wicklow hills.

TWENTY-FIVE YEARS AGO

FROM THE ELECTRICIAN *of December 17, 1920: The half-yearly progress report on civil aviation states that the w.d.f. apparatus at Croydon airport has enabled aircraft to correct their course in thick weather, while the equipping of aircraft with wireless telephony has assisted navigation. Electric landing direction lighting is being installed, and tests with searchlights as a means of helping to locate aerodromes are being made.*

Advice to Farmers.—At a meeting of the Durham county branch of the National Farmers' Union, it was reported that the Union headquarters had appointed an electrical consultant to advise and assist members on the installation of electricity on farms.

Manchester Public Clocks.—The Finance Committee has voted £200 for the resumption of the lighting of public clocks. There are now 29 such clocks for which the Council accepts lighting responsibility.

Trolley-bus Contract. — The South Shields Corporation is to purchase another five trolley-buses at a cost of £2 870.

Street Lighting Schemes.—The Rawtenstall Electricity Committee is to provide street lighting at Dunnockshaw as soon as materials are available. The Warrington Highways Committee has decided upon electricity for street lighting on the new housing estates.

Electrification of Rural Areas.—At a meeting of the Dundee Branch of the National Farmers Union, a letter was read from the N.F.U. and Chamber of Agriculture for Scotland, stating that arrangements were in hand to hold a meeting, representative of all the electricity supply undertakings in Scotland, with a view to discussing a policy of rural electrification. There were 60 of these undertakings, but it was hoped to evolve a policy which would make supplies available on reasonable conditions, and at favourable rates.

Installation Before Occupation.—In his annual review the Mayor of Poplar recently referred to the acceptance by many authorities of the principle that electrical apparatus should be considered in the design and in the building of new property. The industry, he said, had always been handicapped because domestic apparatus had to be installed after occupation and not, as it should be, before completion. That meant that no longer would the tenant have to bear additional expenditure after moving in, for the whole of the costs of such apparatus would be included in the value of the house. The effect would be to reduce costs and bring the benefits of electricity to many thousands who previously were unable to afford it.

Toolmakers' Exhibition

Many Prospective Overseas Buyers Invited

ONE of the main objects of the first exhibition organised by the Gauge and Tool Makers' Association, to be held at the New Hall, Elverton Street, Vincent Square, London, from January 7 to 18 inclusive, is to stimulate export trade, and invitations have been sent to many thousands of actual and potential buyers of British precision tools and gauges. Another object is to give the general public an opportunity to see and learn something of the work and position of one of our key industries. The exhibition is to be opened by Mr. John Wilmot, M.P., Minister of Supply, at 11 a.m. on Monday, January 7, and for the remainder of the period it will be open daily from 10 a.m. to 8 p.m.

The area of the hall is 20 000 sq. ft., and accommodation has been provided for 90 stands of uniform size and design. The exhibits will include gauges and measuring equipment; jigs, fixtures and special tools; special purpose machines; press tools; moulds and dies; and diamond tools and gauges. Overseas visitors will have the assistance of an interpreter.

Established in 1942, the Gauge and Tool Makers' Association now has a membership of 200 firms in the industry, and it has paid particular attention to the importance of planning for the development of export trade.

A Pioneer Effort

In a foreword to the catalogue, the chairman of the association, Mr. F. W. Halliwell, points out that it is not only the first exhibition promoted by the gauge and toolmakers' industry, but it is also the first exhibition of a national character to be organised by any industry in this country since the end of the war. "It is, therefore," he states, "a pioneer effort entirely in keeping with the spirit of the industry, which by its nature must be in the van of progress."

Speaking at a Press conference at Claridges Hotel, London, on Tuesday, Mr. Halliwell, who was supported by the vice-chairman (Mr. H. S. Holden) and members of the Council, said that although relatively small, it was a highly skilled, highly specialised industry, and it had played a very important part in the production programmes during the war. It would make an equally important contribution to the country's reconversion and export programmes.

THE ELECTRICIAN will occupy stand No. 90, and we extend an invitation to readers to avail themselves of our services there. Arrangements have been made for a telephone to be installed, and the number will be Victoria 1577.

Correspondence

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

Fuel Economy Advertising

[TO THE EDITOR]

Sir,—With reference to the advertisement now appearing in the national Press, on behalf of the Ministry of Fuel and Power, while we agree with the principle which has inspired the advertisement, it seems to us extraordinary that when the Ministry is talking about "peak loads," it should be guilty of making the flat statement that ". . . . it is impossible to store electricity."

While it is appreciated that the storage of a sufficient quantity of electricity appreciably to relieve peak loads over the entire grid system is at present impracticable, at the same time a strong case can be made for large peak-load batteries in particular cases. It is well known in the industry that the borough of Heston and Isleworth has, to some extent eased its peak-load problems by installing a 460 V, 5 000 A-hour Chloride battery.

On the purely storage question, you are of course aware that, by law, cinemas and other places of entertainment must have an emergency lighting supply in case of an interruption of the mains supply. For this purpose, many storage batteries are in use.

It is also a fact that most hospitals have "stored electricity" standing-by to supply lighting current for the operating theatres in case the main supply is interrupted during a vital operation.

Again, a number of retail stores have found that it is in the public interest to have a stand-by supply of electricity from a storage battery available safely to clear their premises and, incidentally, to stop pilfering, during a temporary cessation of the mains supply.

In view of the above facts, we find it difficult to reconcile the Ministry's statement with our own experiences.—Yours faithfully,

W. FEARNLEY,
Exide Batteries Publicity Department.

Industrial Information

Change of Address.—John Fowler and Co. (Leeds), Ltd., announce that their London offices are now at Byron House, 7-9, St. James's Street, London, S.W.1. (Telephone: Whitehall 0484-5; telegrams: Steamplow, Piccy, London).

Ontario Trade Opening.—A manufacturers' representative who is about to establish himself in Toronto, wishes to secure the representation of United Kingdom manufacturers of household electrical appliances on a purchasing or consignment basis for the Province of Ontario (Ref. No. Z47820E, Department of Overseas Trade, 35, Old Queen Street, London, S.W.1).

Streamlined Kettle.—The Tetra Engineering Co., Ltd., Redhill Sreet, N.W.1, announce that they are going into production of domestic electrical appliances, which will include fires, irons, toasters, and, they claim, the first streamlined kettle. It is a three-pint kettle, with removable handle—to save shipping and storage space—quick-boiling, non-drip spout, 1 500 W element with easily re-set safety device, and is made either in chromium plated copper or aluminium dye-anodised in a wide range of colours.

A new electric kettle with streamlined effect

Geared Motor Units.—A new publication by the English Electric Co., Ltd. (DM/122) gives details of a.c. geared motor units for slow speed drives in which standard types of the company's motors are assembled with suitable reduction gears to form compact self-contained units. Outputs up to 15 H.P. are covered, and for each there is a choice of speeds from 20 to 500 r.p.m.

Electricity on the Faroe Islands.—In consequence of an electrical breakdown in Torshaven, the capital of the Faroe Islands, a Mirrlees engine, developing 300 B.H.P. at 600 r.p.m., coupled to a 200 kW generator, and complete with switchgear made by the Brush Electrical Engineering Co., Ltd. have been supplied by British Oil Engines (Export), Ltd., of London, replacing a Continental engine, the failure of which caused the breakdown.

All-Purpose Service Unit.—With reference to the new housing component known as the "All-Purpose Service Unit," the electrical features of which were described in our last issue, we are asked to confirm that this unit has been developed by the Building Component Producers' Association, in conjunction with the British Coal Utilisation Research Association. The former body are marketing the component, and all inquiries should be addressed to them at 31-33, High Holborn, London, W.C.1.

New Radio Factory for Dublin.—The production of radio sets by Sales, Masteradio (Ireland), Ltd., is expected to begin in January in the new factory which that firm has opened at 75, Lower Mount Street, Dublin. These premises are only temporary until a new factory can be built. Fifty hands will be employed, but it is hoped that when work has reached its peak, that number will be increased to 150. The new factory will be in charge of Mr. H. Burns, director.

Aluminium Alloys.—The increasing demand for quantity output of shaped components in aluminium and aluminium alloys has given rise to considerable developments in mechanical mass production methods. The latest Technical Information Bulletin No. 10, "Deep Drawing and Pressing of Aluminium Alloys," issued by the Aluminium Development Association, could not have appeared at a more favourable moment. It deals specifically with power press processes and the tools necessary to produce standardised products economically. The forty pages are illustrated with 32 photographs and diagrams of typical machines, tools and methods of production, together with a number of useful tables.

Allocation of Government Factories.—An additional 29 Government factories have been allocated by the Board of Trade to various firms for civilian production. They represent an area of over 7 million sq. ft., and will give employment eventually to about 35 000 people. Nearly all the larger Government factories have now been allocated, and the space so dealt with amounts to more than three-fifths of the total expected to become available. The Gramophone Co., Ltd., have been allocated a factory with an area of 158 800 sq. ft. at Treorchy, Wales, for the production of radio

and television equipment, gramophones and accessories, providing employment for 1 000 people. Rists Wires and Cables, Ltd., have been allotted a factory with an area of 394 266 sq.ft. at Newcastle-under-Lyme, where, it is estimated, 2 000 persons will be employed on the manufacture of commercial cables.

" Ulster To-day."—Under this title an illustrated handbook has been published by the Stationery Office for the Government of Northern Ireland. Its appeal is not only to the tourist seeking a romantic holiday, but also to the industrialist desiring to expand production and break new ground. Government grants and loans are available to industrialists in connection with the establishment of new undertakings and the extension of existing concerns likely to provide a substantial amount of additional employment. The booklet is free on application at the Ulster Office, 21, Cockspur Street, London, S.W.1.

Incendiary Bombs to Kettles.—Erinex Ltd., Flare, Northampton, announce that they have changed from the war production of incendiary bombs to the manufacture of electrical household appliances, which will be marketed under the brand name of " Cepco." The retail selling price of the company's universal electric kettle (immersion heater type) has been fixed at £2 18s. 1d., excluding purchase tax. The kettle is spun in heavy gauge aluminium, highly polished and designed on modern lines. It is fitted with a solid handle and black polished dielectric holder, the lid knob and feet (if required) also being of black dielectric. The element is 200-220 or 230-250 V, 1 200 W. These kettles, which will be on the market in January, are obtainable through wholesale channels only.

Joint Consultation in Industry. — Management and workers of the Philips group of radio and electrical companies have agreed to tackle peace-time problems in the spirit which permeated their factories during the war. Instead of only one joint-production committee with limited terms of reference, there will be a number of joint departmental committees qualified to deal speedily with most of the problems which arise at shop level. Difficult questions which cannot be settled on the spot will be referred to a central joint advisory council, which will also discuss matters of broad policy. Some of the subjects which will be covered by these committees are conditions of employment, welfare and recreation, safety, discipline, training, production, and national reconstruction.

Fuel Economy Review.—The current number of the review published by the Federation of British Industries contains an article on " Hydro-Electric Power Resources of the World," by Mr. Eric G. Saunders, who gives tables showing the water-power resources of the world by continents; the water-power potential and installed capacity by countries; large-scale hydro-electric power installations in 1941; and water-power potential and installed capacity in the British Isles in 1943; also the production of electricity in selected countries having hydro-electric installations. The author states that the world-installed water power may be expected to increase in the next 15 years by some 25 per cent., from an estimated 93 million H.P. to-day to 116 million H.P. Mr. Verdon O. Cutts, of the General Electric Co., Ltd., has contributed an article on " Recent Developments in Electric Furnaces," and particular reference is made to those of the resistance type.

Christmas Holiday Arrangements.—With reference to the Christmas holiday arrangements as recommended by the Government, the N.F.E.A. announce that in accordance with the national working rules, should such days be worked, the following provisions as to the payment of wages will apply :—Monday, December 24, bare time rates only; Christmas Day, all hours worked are payable at double time; Wednesday, December 26, all hours worked are payable at time-and-a-half; December 31, January 1 and 2, bare time rates only. Certain adjustments are necesary in those areas where the local working rules so determine. The following schedule names districts where the local working rules prescribe that time-and-a-half must be paid for all hours worked on the days named :—Thursday, December 27 : Derby, Leicester, Nottingham and Scarborough. Tuesday, January 1 : Certain towns in the North Eastern area, Scarborough, Manchester, Sheffield, and Salford. Should such days not be worked in undertakings not scheduled under an Essential Work Order, no wages are payable should the Government's recommendations be observed as holidays; in undertakings which are scheduled under an Essential Work Order, the following provisions apply :—(a) No wages are payable for any of the following days observed as holidays : Christmas Day or Boxing Day (National Working Rule, Clause 10(g); days which are local holidays in accordance with the local working rules being observed on the site in question; any days normally observed as holidays in the scheduled undertaking. (b) Should any days which do not come within the scope of the above paragraph be observed as holidays then no deduction can be made from the guaranteed working week, providing no work is available for specified persons who are available for and willing to work.

Electricity Supply

Bradford.—Additional supply to the Legram Mills is to be provided at a cost of £7 475.

Dartford.—The Electricity Committee is to extend mains to housing estates at a cost of £1 084.

South Shields.—The T.C. is to spend £900 laying cables in connection with the Dean Road electricity sub-station.

Hove.—The Electricity Committee is to increase the plant at Saxon Road sub-station at a cost of £1 000.

Wallasey.—The Electricity Committee is to purchase mechanical cable-laying plant at an estimated cost of £2 100.

Stanhope (Co. Durham).—The Parish Council is to extend electric street lighting as soon as circumstances allow.

Bournemouth.—The Education Committee is to obtain estimates for electric lighting improvements in all the departments of the municipal college.

Swindon.—The Electricity Committee has obtained sanction to borrow £3 690 for supply to housing sites, and is seeking sanction to borrow £5 992 for mains and services.

Glasgow. — The Gas Committee has arranged for the electricity department to instal cable, etc., in connection with machinery at the gas stores and workshops at a cost of £1 200.

Burton-on-Trent.—The Electricity Committee has arranged to provide supply to Derbyshire Gravel Aggregates, Ltd., at new works at Stanton-by-Bridge, and to various premises at Ticknall.

Hull.—Sanction to borrow £4 000 for coal plant, £64 756 for buildings, mains and plant, and £67 500 for consumers' electrical apparatus, has been obtained by the Electricity Committee.

Douglas (I.o.M.).—The Electricity Committee has informed the I.o.M. Electricity Board of its readiness to co-operate with respect to the supply of electricity to farms in the area of supply.

Torquay.—Supplies for public lighting are to be provided in the parishes of Kerswell, Ugborough and Ipplepen. The Corporation Electricity Committee is seeking sanction to borrow £2 500 for meters.

Walsall.—The Corporation, whose own electricity supply undertaking was started fifty years ago, is to make an offer of £140 000 for the undertaking of the Chasetown and District Electricity Co., Ltd.

Brighton.—The Electricity Committee has approved a scheme for street lighting on a trolley-bus route by utilising the trolley poles for the suspension of the street lighting lanterns, at a cost of £1 455.

Southport.—The Electricity Committee has agreed to the proposal of the Central Electricity Board to instal certain control gear at the power station in connection with proposed alterations to the grid supply at Ormskirk.

Bradford.—The Markets Committee has decided that the lighting charges at the John Street market be at the rate of 7d. per electric bulb, not exceeding 100 W for 12 hours consumption of current during each market period.

Liverpool. — The City Council has approved application being made for borrowing powers for £3 000 in respect of adaptations of unit factories Nos. 3 and 4 in Fleming Road, Speke, to be leased to G. P. Dennis, Ltd.

Exeter.—The Housing Committee has given permission to the Exeter Rediffusion Service to instal overhead wiring to temporary council houses as an experiment, on the understanding that the wiring will be removed if found unsatisfactory.

Fulham (London). — The Electricity Committee reports that the revised grid tariff will result in an increase in cost, but that this should not be more than 2 per cent. of the total cost of current purchased from the Central Electricity Board.

Southwark (London).—The Electricity Committee is to purchase cookers at a cost of £500, water-heaters at £600, and wash-boilers at £200, and is to extend mains to the Brandon Street estate at a cost of £250, and provide a.c. supply in Walworth Road at a cost of £2 000.

Wallasey.—The Electricity Committee has obtained sanction to borrow £15 206 for supply to housing estates, and is seeking sanction to borrow £11 000 for ripple control apparatus; and has approved a comprehensive development scheme at a total cost of £46 970.

Scarborough.—An electric cooker and hot-cupboard are to be installed by the electricity department, at the Town Hall, at a cost of £72. The Libraries Committee has asked the Electrical Engineer to submit an estimate for overhauling the electrical installation at the public library. The Electricity Committee has recommended that the present increase of 10 per cent. on all charges be replaced by a general increase of 15 per cent., and that the basic all-in tariff and flat rate of .5d. per unit be increased to .6d. per unit, and the mixed supply rate be increased by 5 per cent.

Cardiff.—Supply is to be provided to housing sites at Sweldon Farm at a cost of £1 733, and Caerau Farm at £3 086. The Electricity Committee has approved various

extensions at a cost of £4 722. The Highways Committee has approved a supplementary estimate of £11 850 for improved street lighting.

Wallasey.—The Corporation Electricity Committee recommends a new domestic tariff consisting of the present floor area charges plus 4d. per week fixed charge, together with a unit charge of ½d. per kWh, and a new business tariff for light and heat of £9 per kW of lighting demand plus 0.66d. per unit.

Reading.—Proposals for providing a supply of electricity to houses to be erected on their housing estate at Whitley have been approved by the Reading T.C., the scheme being estimated to cost £19 395. Application is to be made to the Electricity Commissioners for sanction to borrow this amount.

Electricity Statistics.—The official returns rendered to the Electricity Commissioners show that 3 463 million units of electricity were generated by authorised undertakers in Great Britain during November, 1945, as compared with the revised figure of 3 598 million units in the corresponding month of 1944, representing a decrease of 135 million units, or 3.7 per cent. During the eleven months of 1945 up to the end of November, the total amount of electricity generated by authorised undertakers was 33 601 million units as compared with the revised figure of 34 612 million units for 1944, representing a decrease of 1 011 million units or 2.9 per cent.

Increase in C.E.B. Borrowing Powers.—In the "London Gazette" on December 14, notice was given that application has been made to the Electricity Commissioners by the Central Board, for a Special Order, under the Acts of 1882 to 1936, for the purpose of authorising an increase in their borrowing powers under Section 27 of the Act, 1926. Copies of the draft Special Order may be obtained (1s. each) at the office of the Board, at Trafalgar Buildings, Charing Cross, S.W., and at Grid House, 168, Broomhill Drive, Glasgow, W.1. Any objections respecting the application must be made by registered letter addressed to the Secretary, Electricity Commission, Savoy Court, Strand, London, W.C.2, despatched on or before January 18, 1946; and a copy of any such objections must at the same time be forwarded to Mr. O. A. Sherrard, secretary of the Board.

Walsall Anniversary

AS soon as labour is available, it is intended to commence building a £5 000 000 generating station at Walsall, Staffs, similar to that at Ironbridge, or possibly an even larger station, the cost of which might be in the region of £8 000 000.

This announcement was made by Mr. C. Heathcock, chairman of the West Midlands J.E.A., when speaking at a dinner, on December 14, arranged by the Walsall Electricity Committee to celebrate the 50th anniversary of the undertaking.

Mr. Heathcock also spoke about the nationalisation of the supply industry and said he viewed with apprehension any attempt to force outside control on undertakings with long and faithful records. On the one hand was an efficient and still growing industry, while on the other was a national economy so disturbed that the whole standard of life was threatened. The proper procedure was to concentrate on putting those latter industries on their feet again, rather than endeavouring to apply an untried theory to a department in full and robust health. The only reasonable basis for interference was to show savings in charges to consumers. If there was to be any change in ownership and control, it was not unreasonable to suggest that electricity undertakings should again combine, and request that the interests of their consumers should be protected against charges that may be to their detriment. Such protection should be specific and incorporated in any Act to alter the control and ownership of the industry.

Sir William Walker, president of the I.M.E.A., criticised those councils which decided that in new housing districts half of the houses should have electricity and half gas. Local authorities, he said, had no right to select what medium a tenant should use for lighting, cooking or heating, but should allow free choice. Sir William deplored the discrimination against the electric supply industry in the cost of fuel. Constant research had enabled them to use grades of coal for which there had previously been no market and thus help the coal owners, yet the supply industry had been penalised by having to pay the largest percentage of the increase in the cost of coal.

The Mayor and Mayoress of Walsall (Coun. and Mrs. M. J. Kavanagh), and Ald. D. Cartwright (chairman of the Electricity Committee) received the 135 guests, including representatives of many Midland undertakings. During its 50 years' existence, the Walsall undertaking has increased the number of its consumers from 77 to 31 269, and the average price per unit has been reduced from 5.5d. to .94d.

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.

Bute C.C., December 27.—Electrical work in connection with 30 houses in the Arran district. Specification from Mr. A. Rennie, 20, Green Street, Saltcoats.

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.

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.

Company News

SILENTBLOC, LTD.—Intm. 12½% (same).

ELECTRIC FURNACE CO., LTD.—Intm. div. 3½% (same).

ANTI-ATTRITION METAL CO., LTD.—Fst. and fin. 15% (same).

ROTHERHAM FORGE AND ROLLING MILLS CO., LTD.—Intm. 5% on ord. (same).

LONDON ELECTRICAL AND GENERAL TRUST.—Intm. 2% (same), less tax, payable Jan. 1.

HYDRO-ELECTRIC SECURITIES CORPORATION.—Hlf.-yrly. div. on 5% "B" prefd., payable Feb. 1.

GOODYEAR TYRE AND RUBBER CO. (G.B.).—Third intm. div. on ord. 10%, less tax (fin. 5%, tax free), mkg. 16% (same), tax free.

EDWARD WOOD AND CO., LTD.—Net tradg. pft. £34 086 (£34 932). Div. 9% (same), to taxatn. £15 000 (£18 000), to defd. repairs £2 000 (£3 000), fwd. £23 520.

BRITISH ELECTRIC TRANSFORMER CO. LTD.—Net pft. to Sept. 30, after taxn. and deprecn. £29 674 (£24 569). To pref. div. £9 531 (same), fin. ord. div. 10%, mkg. 20% (15), fwd. £323 (£180).

MANN EGERTON AND CO., LTD.—Net pft. for yr. to Sept. 30, after dirs.' fees, deprecn. and taxn., £13 595 (£13 111). To ord. div. 15% (10), res. £2 500 (same), fwd., after prefd. div., £24 822 (£24 808).

CLEVELAND BRIDGE AND ENGINEERING.—Net pft. to Sept. 30, after tax, etc., £16 278 (£49 498), fin. ord. div. 3½%, mkg. 5%, tax free (4½%), fwd. £6 013 (£5 582), £36 000 transferred from tax provision to gen. res.

BROWN BAYLEY'S STEEL WORKS, LTD. Pft. to July 31, £131 717 (£136 077), fin. ord. div. 5%, mkg. 10%, tax free (13%), to gen. res. £50 000 (same) obsolescence res. £20 000 (same), fwd. £40 975 (£34 258).

JOHNSON AND PHILLIPS, LTD.—Co. are seeking permission to increase the borrowing power from the present limit of £1 000 000 to £1 600 000, and at an extra-ord. mtg., held on December 17, to consider the necessary resolution, it was carried unanimously.

AIRSCREW CO., LTD.—Pft. to Mar. 31, 1944, £71 754 (£62 363). To dirs.' fees £1 333 (£1 264), obsolescence £5 709 (£7 417), tax £35 527 (£40 508), pref. div. £3 000, fin. ord. div. 15%, mkg. 25% (same); gen. res. £15 000 (nil) fwd. £29 061 (£27 252).

CROMPTON PARKINSON, LTD.—Accordg. to prelim. statement pft. for yr. to Sept. 30 after tax and other charges, £434 283 (£432 099). The repeated distribution of 22½% is covered by earnings of just over 40% before the allocation of £5 000 to the benev. fund.

PETO SCOTT ELECTRICAL INSTRUMENTS.—Pft. to Mar. 31, £62 400 (£59 608), plus deb. int. excess provn. £340, mkg. £62 740. To inc.-tax, 1945-46, and E.P.T. £52 500 (£53 249), dfd. repairs £4 735 (nil), fst. and fin. div. 25%, less tax, £3 720 (same), fwd. £9 084 (£7 299).

SUN ELECTRICAL CO., LTD.—Tradg. pft., etc., to Apr. 30, £21 179 (£19 151), less deprecn., taxn., etc., lvg. net pft. £18 916 (£17 857). Pref. div. £9 375 (same), div. 2½% on ord. £2 333 (same), fees £1 500 (same), lease redemptn. £1 500 (same), inc. tax. res. £4 000 (£3 000), fwd. £2 112 (£1 905).

MARSHALL SONS AND CO., LTD.—Pft. to Sept. 30, £84 820 (£179 381). To tax £19 000 (£112 155), deprecn. £10 550 (£11 165), lvg. net pft. £55 270 (£56 061). To intm. div. 3¾% £9 375 (same), fin. 8¾% (10), mkg. 12½% (13¾) £21 875 (£25 625), to genl. res. £20 000 (same), fwd. £41 875 (£45 625).

R. HOOD HAGGIE AND SON, LTD.—After deprecn. res. allocation, dirs.' fees and amnt. written off leasehold prop., totallg. in all £16 800 (£17 000), net pft. to Oct. 31, £28 071 (£29 029). To pref. div. £2 000 (same), fin. ord. div. 7½%, mkg. 12½% (same), gen. res. £10 000 (same), fwd. £67 627 (£66 556).

MARCO REFRIGERATORS, LTD.—Trdg. pft. for yr. to Sept. 30, 1945, £38 289 (£33 641), to advertisg. £2 946 (£806), bank int. £800 (£238), dirs.' fees £900 (same), deprecn. £1 686 (£1 603), etc.; pft. £31 525 (£29 060), to tax provn. £27 745 (£25 597), first and fin. div., less tax, £2 625 (£1 313), fwd. £8 234 (£7,078).

D. NAPIER AND SON LTD.—Tradg. pft. after taxatn. to Sept. 30, £133 896 (£174 376). To dirs.' fees £750 (same), deprecn. £31 764 (£88 038); net pft. £101 382 (£85 588). Brot. in £278 061. To 7½% pref. div. £11 250 (same), 8% pref. div. £7 280 (same), ord. div. 7½%, less tax (same), £20 475; fwd. £340 438.

SOUTHERN BRAZIL ELECTRIC CO.—Report for 1944 shows gross income £56 400 (£78 449). Deduct int., etc., £42 908 (£36 484), leavg. £13 492 (£36 484). Add net exchge. gain £5 120 (£7 085), mkg. £18 612 (£43 569). To loss on investmt. in sub. co. liquidated £38 069 (nil), statutory res. nil (£1 820). Deficit fwd. £237 643 (£218 185).

MAX STONE, LTD.—Pfts. to June 30 £75 725 (£60 173). To amortisatn. of leases, etc., £5 269 (£5 190), dirs.' fees £750 (same), lvg. £69 706 (£54 233). To taxatn. £51 500 (£41 500), w.d.c. £57 (£573), to gen. res. £5 000 (same), pref. div. £3 600 (same), div. 15% (10), less

tax on ord., £6 750 (£4 500), fwd. £7 820 (£5 021).

HEPWORTH AND GRANDAGE LTD.—Tradg. pft. to Sept. 30 includg. invstmt. income, after chargg. all man. exes., deprecn., and E.P.T., £76 604 (£82 101). Deduct dirs.' fees £1 300 (same), inc.-tax £30 002 (£29 488) war dam. £477 (£1 691), leavg. net pft. £44 825 (£49 622). Div. 15% (12½%), res. £15 000 (£20 000), fwd. £17 319 (£18 244).

DICTOGRAPH TELEPHONES LTD.— Net trdg. pft. to Aug. 31, £35 148 (£35 313), div. and int. £1 481 (£1 005), mkg. £36 629 (£36 318). To dirs.' fees £996 (£1 100), war dam. £202 (£881), pensions £2 887 (£2 764), tax £16 614 (£16 096), lvg. net pft. £15 930 (£15 477). To intm. div. 4% £4 000 (same), fin. 7% (6%) £7 000 (£6 000), bonus nil (1%), mkg. 11% (same), to gen res. £5 000 (same), employees' fund £250 (same), fwd. £10 689 (£11 009).

Company Meetings

FERRANTI, LTD.—The annual meeting was held in London on December 6. In the statement circulated with the report and accounts, the chairman and managing director, Mr. V. Z. de Ferranti, said the company had covered a very wide field in its war-time activities, having an output of £30 000 000 divided into six principal categories—fuses, Radar and radio, fire-control apparatus, navigational instruments, electrical instruments and transformers. Nearly £3 000 000's worth of navigational instruments had been produced, two outstanding items being the distant reading compass and camera controls. Electrical instruments of many types had been in great demand for every kind of apparatus, particularly radio equipment, and had resulted in a turnover of £4 000 000. In common with others, the company had to face a difficult period of re-organisation, which they would appreciate when he said that only 10 per cent. of the turnover during the war was represented by normal products.

ASSOCIATED EQUIPMENT CO., LTD.—The annual meeting was held in London on December 10. In the course of his address the chairman, Mr. C. W. Reeve, said that the turnover for the year was the highest in the history of the company, but the rate of profit per unit on articles supplied against Government contracts was lower than in previous years. Sales to Government departments in the last five years had exceeded £20 000 000. The directors felt that in the matter of export, a very great deal of lip service was being paid by Ministers and various Government spokesmen, but that the company did not experience very much practical assistance from the same sources. They had no real priority for labour or materials for export.

ELECTRIC AND MUSICAL INDUSTRIES, LTD.—The annual meeting was held in London on December 13, Mr. Alfred Clark, the chairman, presiding. In the course of his statement circulated with the report and accounts, the chairman said that during the war the factories were completely transformed for their highly specialised work, and in view of the necessarily long period over which demobilisation must be spread, the reversion to peace-time production and expansion could not rapidly be achieved. The financial burden of the transition would also be a heavy one. In the past theirs was one of the greatest exporting companies of this country, and in that field, with its widespread connections, its volume of export business would depend largely upon the position of the home market. Their research in television and relative fields would be pursued intensively, and enable them to reap the fruits of their pioneering work before the war and of their new scientific discoveries during that period. During the year under review the company acquired a group of patents relating to a new application of science and engineering. This was a system closely allied to some branches of their work, and one which they hoped to develop for the British market as soon as they had completed their work of re-organisation.

Metal Prices

		Monday, Price.	Dec. 17, Inc.	Dec.
Copper—				
Best Selected (nom.)	per ton	£60 10 0	—	—
Electro Wirebars ...	„	£62 0 0	—	—
H.C. Wires, basis ...	per lb.	9 7/16d.	—	—
Sheet	„	11 7/16d.	—	—
Phosphor Bronze—				
Wire(Telephone)basis	„	1s. 0 7/16d.		—
Brass (60/40)—				
Rod, basis	„	—	—	—
Sheet „	„	—	—	—
Wire „	„	11d.	—	—
Iron and Steel—				
Pig Iron (E. Coast Hematite No. 1)...	per ton	£7 13 6	—	—
Galvanised Steel Wire (Cable Armouring) basis 0.104 in. ...	„	£30 0 0	—	—
Mild Steel Tape (Cable Armouring) basis 0.04 in. ...	„	£20 0 0	—	—
Galvanised Steel Wire No. 8 S.W.G. ...	„	£26 0 0	—	—
Lead Pig—				
English	„	£31 10 0	—	—
Foreign or Colonial	„	£30 0 0	—	—
Tin—				
Ingot (minimum of 99.9% purity) ...	„	£303 10 0	—	—
Wire, basis... ...	per lb.	3s. 10d.	—	—
Aluminium Ingots ...	per ton	£85 0 0	—	—
Spelter...	„	£31 5 0	—	—
Mercury (spot) Warehouse	per bott.	£31 5 0	—	—

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

Commercial Information

County Court Judgments

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

LAND, T. H. (male), 158, Chatsworth Road, Clapton, electrical retailer. £11 7s. Sept. 26.

LARKIN, Jno. E., 86, Uxendon Hill, Wembley, electrical maintenance engineer. £15 3s. Sept. 26.

STAR ELECTRICAL SERVICE, 163, Old Brompton Road, Earls Court, electrical, mechanical and sanitary engineers. £20 0s. 6d. Sept. 19.

ACTON BROS., Ashlett Road, Fawley, Hants, electricians. £29 18s. 3d. Oct. 2.

MANTLE, Jas., 75, Fallbarn Crescent, Rawtenstall, electrician. £17 8s. 4d. Oct. 24.

WRIGHT, Arthur H., 61, Prenton Place, Handbridge, Chester, electrician. £14 12s. 5d. Oct. 31.

HILL, Hy. R., Mount Pleasant Road, Exeter, electrical engineer. £58 17s. 4d. Sept. 19.

BLAKEBOROUGH, H. S. (male), 105, Harrow Road, Leytonstone, radio service engineer. £47 0s. 10d. Oct. 3.

BOYD, G. (male), 11, Oakleigh Close, Whetstone, Mddx., electrical engineer. £10 7s. 4d. Oct. 23.

CLAPTON RADIO AND ELECTRICAL SERVICE LTD., 142a, Upper Clapton Road, E.5. *£31 15s. Sept. 25.

HILLIER, Maurice (T/as Moreburns Radio), 486, Kingsland Road, E.8, radio dealer. £19 11s. 6d. Oct. 4.

FRENCH, Hy. E., Two Ball Lonnen, Fenham, Newcastle-on-Tyne, electrician. £14 9s. 8d. Oct. 24.

NICHOLSON'S RADIO, 95, Upper Bristol Road, Weston-super-Mare, radio enginers. £49 10s. Oct. 12.

FOTHERBY, L. R. (male), Millfields, Polegate, radio engineer. £11 10s. Oct. 24.

WOOD, Thomas C., 78, High Street, Aston, Birmingham, radio dealer. £25 8s. Oct. 9.

CORKER, Wm., 57, Beighton Road, Woodhouse, Sheffield, electrician. £17 16s. 10d. Oct. 12.

GROVES, J. R. (male), 191, Woodhouse Street, Leeds, 6, radio and electrical engr. £10 4s. Oct. 2.

DAVEY, Alfd., 9, Christchurch Road, Reading, electrician. £11 11s. 10d. Nov. 2.

Mortgages and Charges

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

BRUSH ELECTRICAL ENGINEERING CO., LTD., Loughborough.—Nov. 9 deb. by way of additional security to a deb. dated June 30, 1943, to Lloyds Bank Ltd., and Hambros Bank Ltd. securing all moneys due or to become due to the Banks; general charge (except ppties. mentioned in second schedule to charge). *£600 000. May 15, 1945.

NATIONAL ELECTRICAL SUPPLIES CO., LTD., London, W.—Nov. 19, charge, to National Bank Ltd., securing all moneys due or to become due to the Bank; charged on 89 and 91, Whitechapel, and 60 and 62, Victoria St., L'pool. *Nil. May 8, 1945.

BANNER ELECTRIC CO., LTD., London, W.C.—Nov. 21, charge, to Cheltenham and Gloucester Bldg. Soc. securing £3 600 and further advances; charged on Burford Ho., Burford St., Hoddesdon. *——. Mar. 14, 1944.

MODERN TELEPHONE CO., LTD., London, W.—Nov. 23, £10 000 debs.; general charge.

WRIGHT ELECTRIC MOTORS (HALIFAX), LTD. (formerly WRIGHT ELECTRIC POWER SPECIALITIES, LTD.).—Nov. 27, mort. and charge, to Midland Bank, Ltd., securing all moneys due or to become due to the Bank; charged on land, Century Works, Pellonla, Halifax, with machinery and fixtures, also general charge. *£750. May 1, 1945.

Satisfactions

WRIGHT ELECTRIC MOTORS (HALIFAX), LTD. (formerly WRIGHT (ELECTRIC POWER SPECIALITIES), LTD.).—Sat'n Nov. 21, of mort. reg. Sept. 10, 1929.

NORTH-EASTERN ELECTRIC SUPPLY CO., LTD., Newcastle-on-Tyne.—Sat'ns. Nov. 27, of deb. stock reg. Jan. 17, 1934, to the extent of £69 757, and of deb. stock reg. May 6, 1942, to the extent of £28 726.

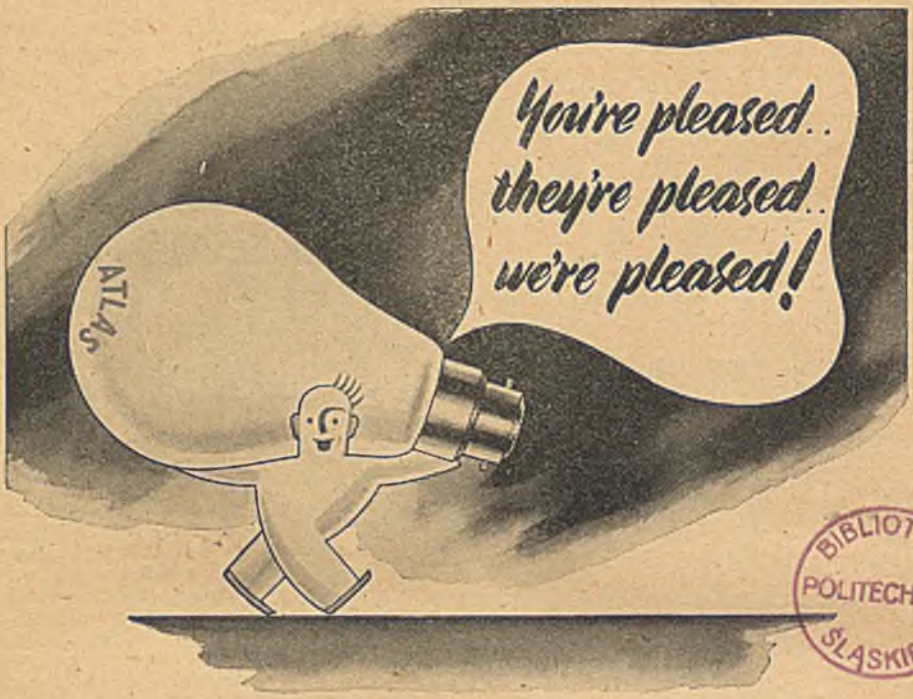
COMING EVENTS

Friday, December 28.

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.*



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Northern Branch: Stevenson Square, Manchester, 1. Phone: Central 3185
N.-E. Depot: 45, Sandhill, Newcastle-on-Tyne, 1. Phone: Newcastle 24068

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