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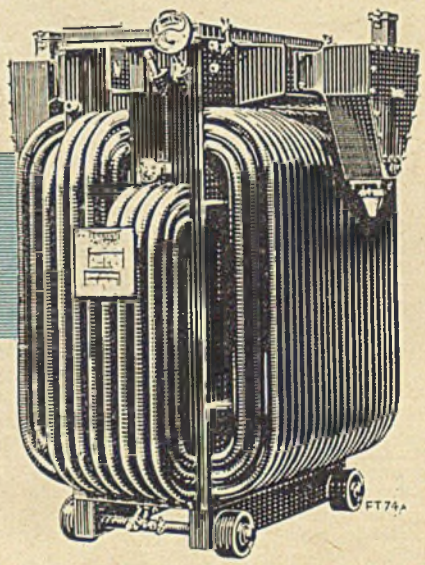
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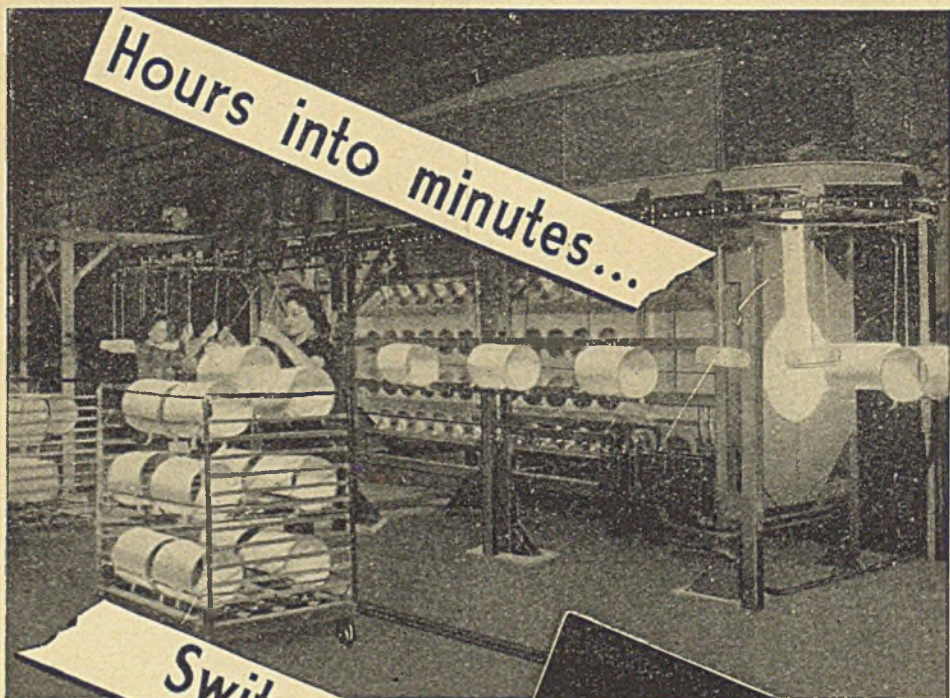
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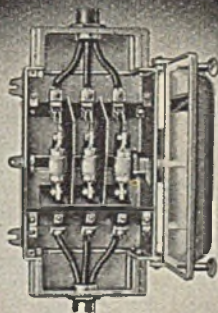
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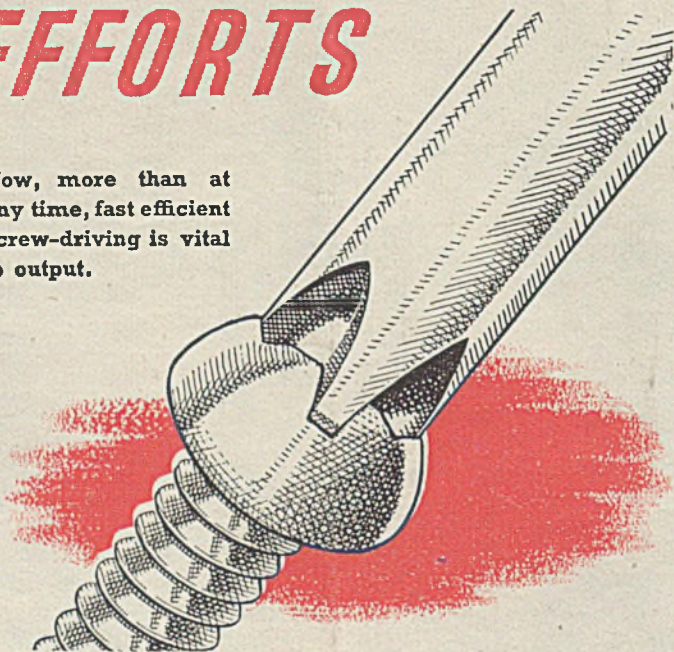
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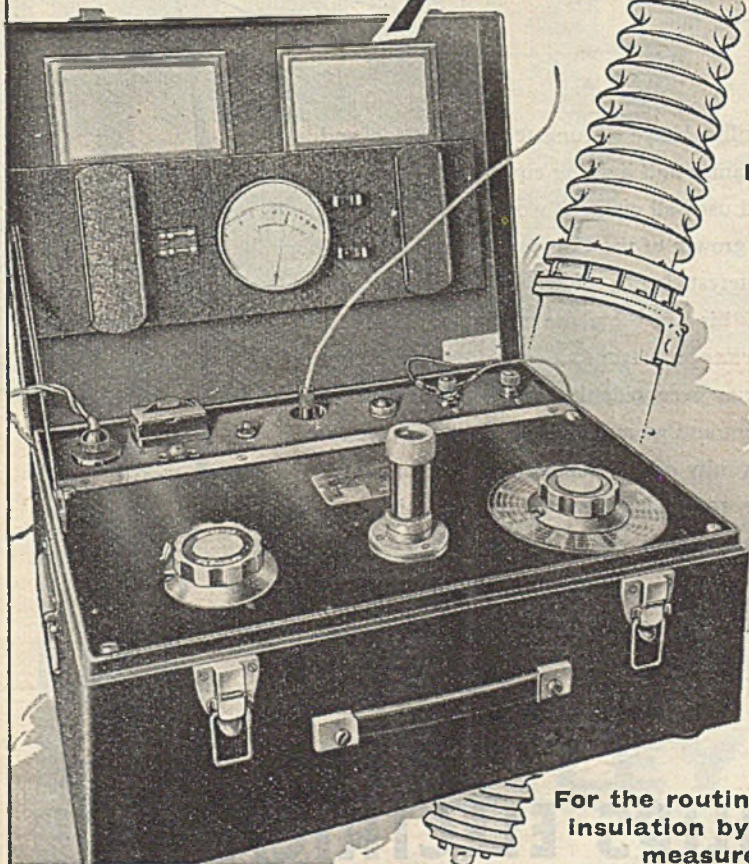
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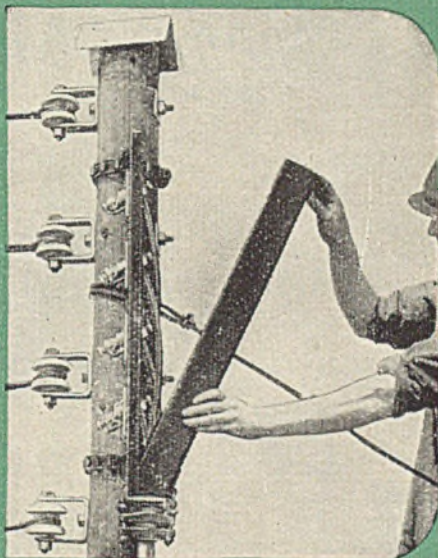
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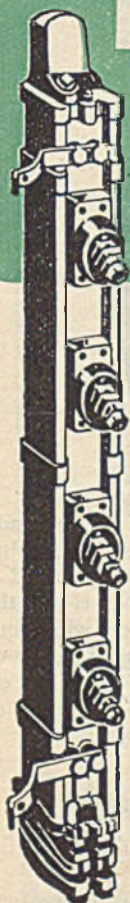
(P.296A)

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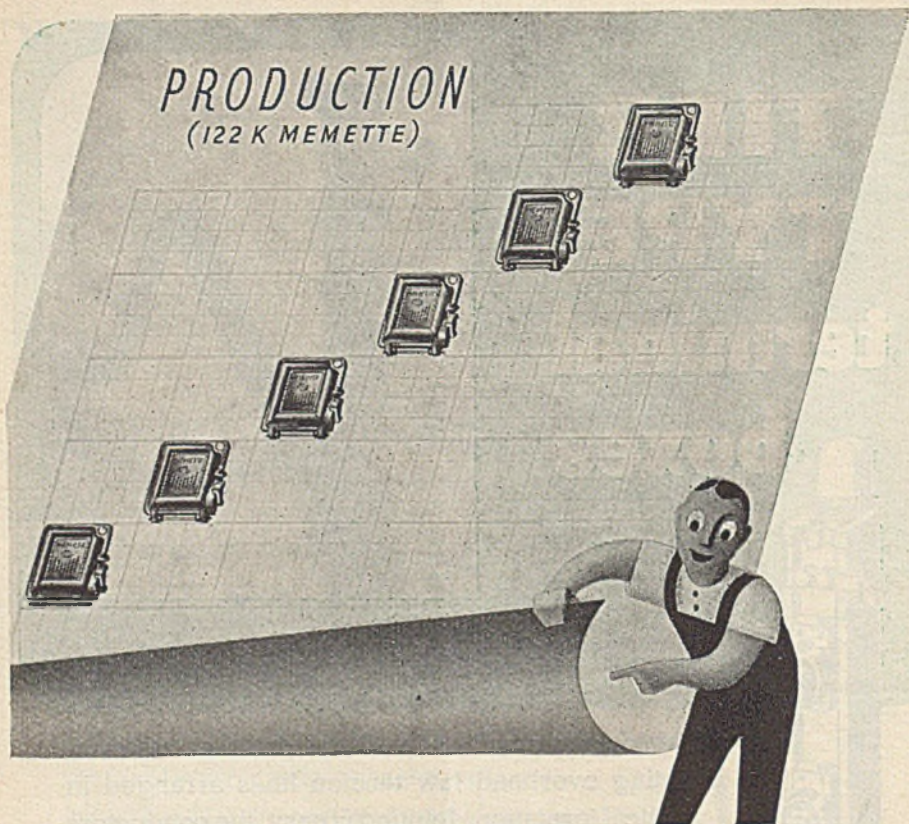
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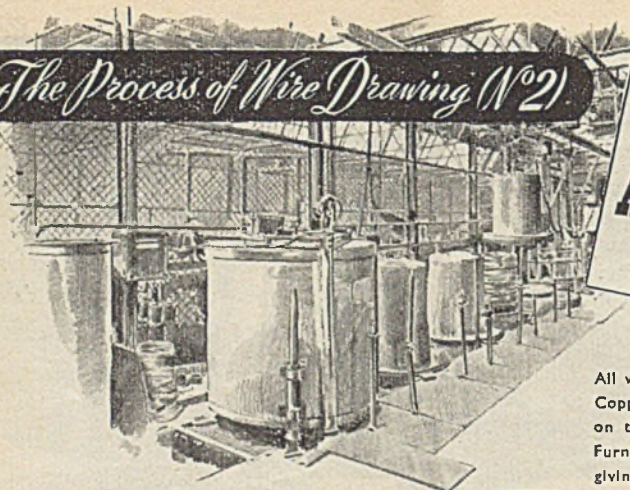
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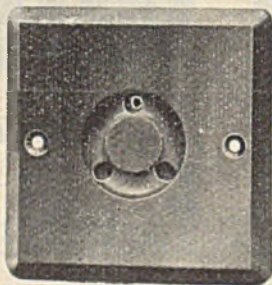
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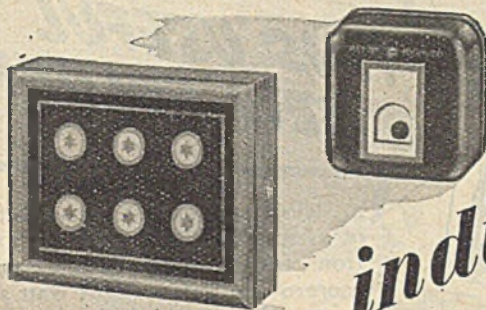
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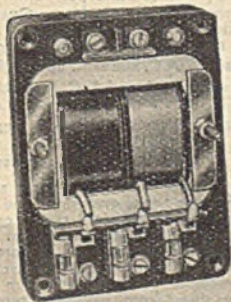


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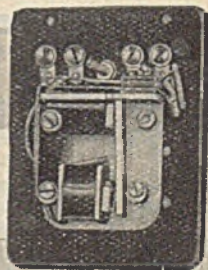
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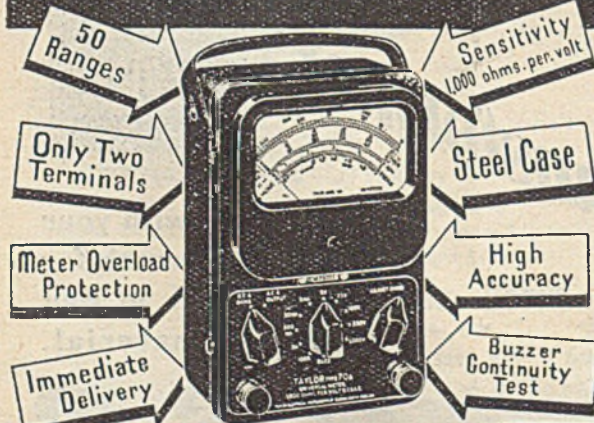


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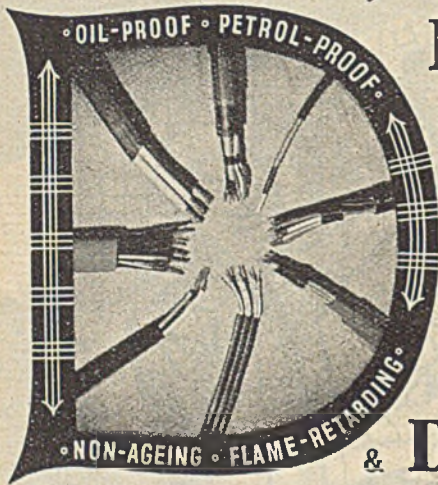
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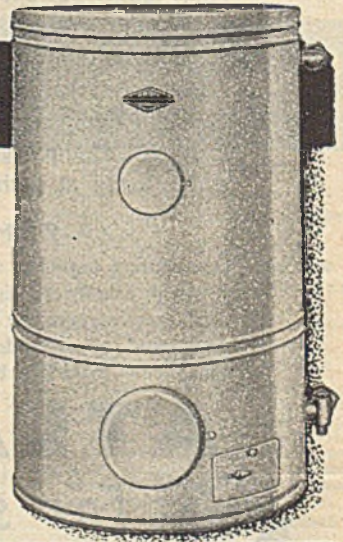
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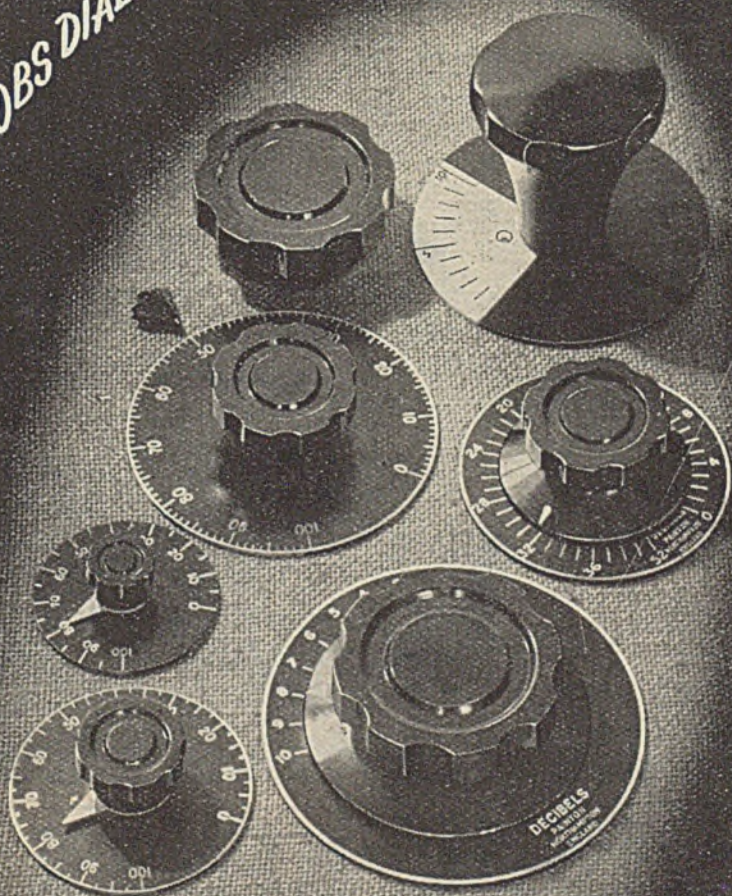
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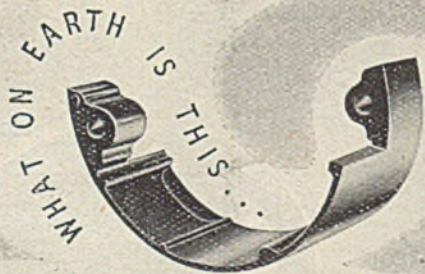
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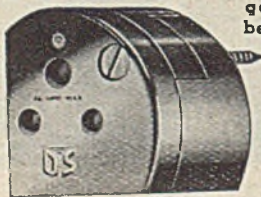
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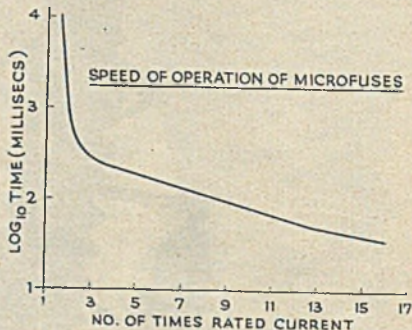
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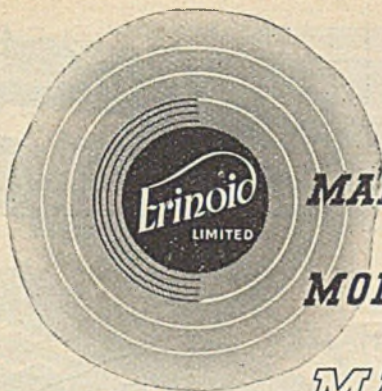
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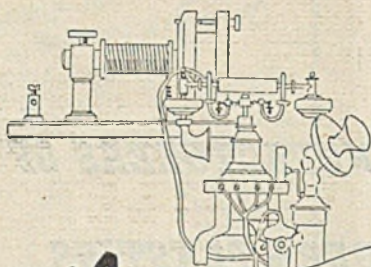
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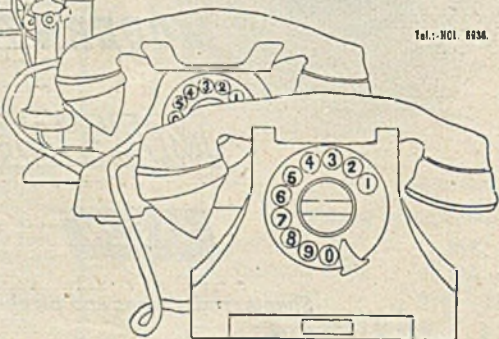


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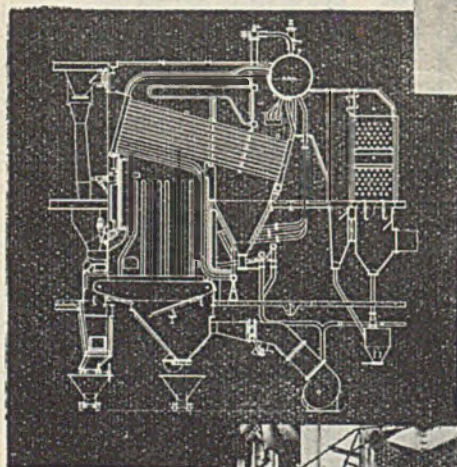
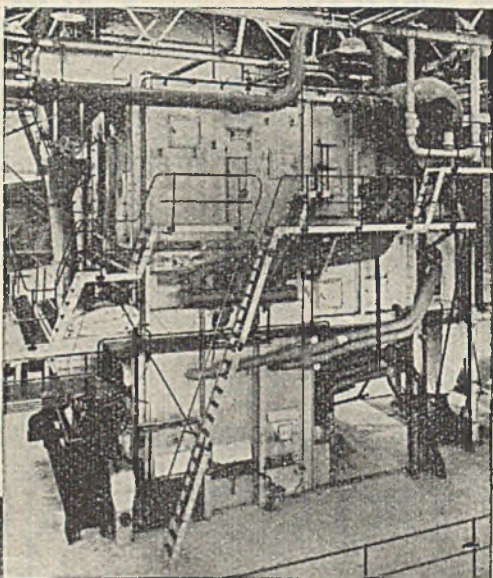
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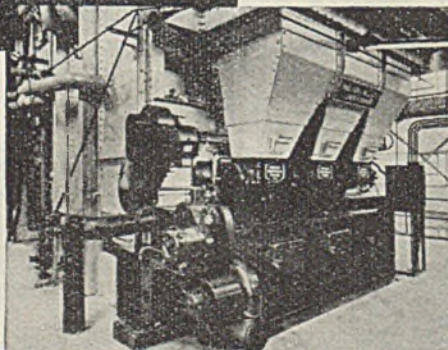
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29 AUGUST 1947

Vol CXXXIX No. 9

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British Association

THIS week saw the opening of the first normal meeting of the British Association since 1938, for at Dundee on Wednesday Sir HENRY DALE delivered his Presidential Address in circumstances promising not only a full programme lasting until September 3, but likely to dispel, at least, some of the loose thinking now so fashionable where scientific research is concerned.

In opening the proceedings, the President said that it was certain that the scientific activities of peace had never witnessed anything like the intimate collaboration of British and American physicists and engineers which finally played so important a part in winning the war. Born of that collaboration and the purpose for which it came about, however, is a fear that scientists and engineers may find it difficult to shake off quickly the spend-thrift habit in research—the policy of trading for quick returns—which six years of war experience may so easily have fostered and may even have made congenial.

In this connection Sir HENRY DALE expressed a hope that men with the creative ability that science now needs for the resumption of its normal progress in peace—whose influence and example are needed for the inspiration of those who will follow—will not too readily assume, or too easily be persuaded, that their best service to science can still be rendered by planning and organising, or by bringing scientific ideas to bear upon policy. Under conditions now to be faced, the building up of scientific capital of fundamental knowledge should have a

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prior claim over its practical exploitation and over any cultivation of its political influence.

Atomic Research

On the subject of atomic research, Sir HENRY pointed out on Wednesday that though the scientific basis for its prediction was available before the 1939 war, nothing but war could have brought about, in so few years, an effort on the scale needed to convert the release of atomic energy by a chain-reaction from theory to practical reality. The world might have had to wait many decades of unbroken peace to reach a point of such possibilities, but though war accelerated the arrival of this opportunity for science, in doing so it compromised the peaceful enjoyment of it by the threat of its further abuse in war. Science, then, finds itself facing a situation in which hope and frustration contend; the need to make the world safe, and the delay of agreement on the means of doing so, clog wheels which should even now be turning freely for the enrichment of knowledge and of human life.

Electricity Coal Stocks

THE distribution of coal stocks during July were such that by the end of the month, the supply industry held sufficient for five winter weeks' consumption compared with 2.7 weeks at the end of July last year. This figure is roughly a little over a half-a-week improvement on the June return which was in fact equal to 4.4 weeks' coal stock. On the face of things this build-up is encouraging, but when reviewing the position, account must be taken of the fact that the rate of coal consumption by the supply industry, due to the increased demand for electricity, is in the ascendant. During the five-week period July 12 to August 9, for example, the consumption of coal at power stations amounted to 1 972 000 tons, whereas during the same period last year the figure was 1 945 300, an increase on average of 5 340 tons per week.

Fuel Prospects

THE above figures with respect to both coal stocks and consumption, when taken as a basis upon which to review future prospects must be coupled with the figures given last week by Mr. HERBERT MORRISON at a Press confer-

ence on the general economic conditions of the country. These were to the effect that at August 16, the output of coal was 121 400 000 tons, or just over one week behind the target. But bearing in mind the fact that the objective of 200 000 000 tons, is generally regarded by industry as being at least 20 000 000 tons short of requirements, the estimate of just over one week behind the target is for all practical purposes even shorter of the mark. There is about the official appreciation of the coal position, an absence of realism which is hard to understand, for even if the target figure of 200 000 000 tons is reached there is still the chance of a coal shortage. If too, there is a cold spell in the winter severe enough to seriously interfere with transport and deliveries, that shortage will be aggravated. Again, it is only a month since Mr. MORRISON warned industry of the dearth of wagons for transporting coal and other goods, and the risk that next winter there may be a certain measure of slowing down in our basic activity as a result of it. In these circumstances, the fact that the supply industry is holding coal stocks equal to five weeks' winter consumption, and that the total output of coal is only over a week behind what the Government think it ought to be, is a poor guarantee that we shall not run into coal trouble in the months of January and February next year, if not earlier.

The New Electricity Authority

THE constituent membership of the newly-appointed British Electricity Authority should receive the general approval of the supply industry, and particularly of the I.M.E.A., whose president (Mr. J. ECCLES) and immediate past president (Mr. J. S. PICKLES) have been invited to become chairmen-designate of area boards and to serve on the Authority, and another past president (Ald. Sir WILLIAM WALKER) has been appointed a member. From the company side of the industry have been selected Lt.-Col. E. H. E. WOODWARD, as one of the four members, and Mr. H. J. RANDALL, as chairman-designate of the London Area Board. The latter may be expected to champion the cause of the E.D.A., being a member of the Council of that body and last year's chairman. Dame CAROLINE

HASLETT, who, by individual effort, has done more than anyone to further electrical development in the home, has the well-merited distinction of being the first lady member of the Authority. In her, domestic and industrial consumers will have a capable and influential advocate of their interests. The employees will have direct representation through Mr. E. W. BUSSEY, general secretary of the E.T.U.

Scottish Interests Served

NO immediate change in the membership of the North of Scotland Hydro-Electric Board, which, on the appointed day, becomes solely responsible for the generation, transmission and distribution of electricity in the whole of the North of Scotland district, is required or contemplated under the Electricity Act, apart from the disappearance of the representative of the C.E.B. whose functions are transferred to the B.E.A.; but on the appointed day the Secretary of State for Scotland and the Minister of Fuel and Power will have to appoint one additional member and may appoint up to five additional members. The Chairman of the North of Scotland Board will serve, *ex officio*, as a member of the B.E.A. in order to assist in the proper integration of the work of the two bodies, and Scottish interests will be further represented on the British Electricity Authority by Mr. J. S. PICKLES, chairman-designate of the Scottish South-West Area Board. There will also be a South-East Area Board in Scotland, and Mr. J. ECCLES, chairman-designate of the Merseyside and N. Wales Area Board, who was formerly engineer and manager of the Edinburgh electricity undertaking, will bring to the B.E.A. first-hand knowledge of the electricity industry in South-East Scotland.

Load Spreading

THE scheme for spreading the industrial electricity load, details of which were given in our last issue, is to be followed, about the middle of next month, by an announcement regarding the domestic electricity position and plans to meet it. This was mentioned by Sir GUY NOTTBOWER, deputy secretary of the Ministry of Fuel and Power, at a conference in London on Friday. So far as he knew, he said, there would not be any compulsory restriction of the use of electricity

next winter. It was emphasised that the whole object of staggering the demand with the aim of reducing the maximum industrial load by one-third of that recorded last winter was to avoid loss of production. What is asked for is not a reduction in the amount of electricity consumed, but an alteration in the time of day in which it is consumed. Staggering plans are now being worked out by the Regional Boards for Industry, who have a complicated and difficult job. Even if the staggering plans are reasonably or completely successful there will be still an appreciable danger of load shedding at certain periods during the winter, but it is hoped that many of the worst disadvantages and difficulties which occurred in the load shedding plan last winter will be avoided. Sir JOHN KENNEDY, of the Electricity Commission, said they were not afraid of the coal position for next winter; the output of electricity would be dependent purely upon the availability of generating plant. New plant was being brought into commission at the rate of from 800 to 900 thousand kW a year and that rate was rising. From this winter onwards there would be a gradual reduction in the extent of the power crisis and they hoped that in two or three years time it would be gone altogether and there would be reasonably free use of electricity.

Overseas Trade

THE figures of Britain's exports for July, which had the maximum number of working days this year, were the best achieved since the war, showing an increase of four per cent. over those of the previous best month. On the other hand, imports amounted to the highest monthly figure recorded since January, 1920. Electrical exports continued the upward trend at an accelerated pace, the June total being exceeded by £1 725 200, and the aggregate for July of last year by £2 638 028. Imports rose from £257 406 in June to £561 627 in July, the increase being mainly due to purchases of electrical machinery and furnace carbons. Our best customers continued to be the Dominions and Colonies, particularly what was then British India, and also the Union of South Africa, and nearly every country, except the U.S.A., made considerable purchases, showing that there is a world-wide demand for British electrical goods.

Portrait—Lord Citrine

The subject of this week's pen-portrait is the first Chairman of the British Electricity Authority appointed last week by the Minister of Fuel and Power to take over, on Vesting Day, responsibility for the generation and transmission of electricity for the whole of Great Britain, except for the area which remains within the scheme administered by the North of Scotland Hydro-Electric Board.

Lord Citrine's association with the industry commenced over forty years ago when he became an apprentice-electrician in Liverpool, and it was strengthened when his activities as a prominent officer of the Electrical Trades' Union, brought him into more intimate contact with those engaged in the



generation and distribution of electricity, until his energies were diverted into wider channels. Even then he retained a link with and an interest in the industry, and now, when one of his dreams has come true with nationalisation, he will play a major part in the direction and control of its future development.

APPPOINTED Chairman of the British Electricity Authority on the eve of his sixtieth birthday, Lord Citrine has been a national figure for many years. Before taking up the duties of Chairman of the Organising Committee for the Electricity Industry, he was a member of the National Coal Board (Manpower and Welfare Department), and Chairman of the Miners' Welfare Commission, to which he was appointed last year. He was general secretary of the British Trades Union Congress from 1926 to 1946, President of the International Federation of Trade Unions from 1928 to 1945, and of the World Federation of Trade Unions from 1945 to 1946.

Lord Citrine was created a K.B.E. in 1935, appointed a member of the Privy Council in 1940 and was created Baron Citrine of Wembley in 1946, on his retirement from the office of general secretary of the T.U.C.

Born in Liverpool in 1887, Walter McLennan Citrine entered the electrical trade at the age of sixteen and soon became prominent in the Electrical Trades Union; he still retains his membership as an electrician in the skilled section. He was made Mersey district secretary in 1914, and in 1920 was appointed assistant general secretary of the E.T.U. From 1917 to 1920 he also acted as president and, subsequently, as secretary of the Federation of Engineering and Shipbuilding Trades, Mersey District. He took part in the formation of the National Joint Industrial Council for the Electricity Supply Industry and was a

member of No. 3 North-Western Area Council.

Other bodies on which he has served include the Royal Commission on the West Indies (1938), the Executive Committee of the Red Cross, the Economic Advisory Council (1930-33), the Treasury Consultative Council, the Nuffield Trust for the Forces of the Crown, the Court of Governors of the London School of Economics, the National Production Advisory Council, the Reconstruction Joint Advisory Council and the National Joint Advisory Council to the Ministry of Labour.

Lord Citrine was chairman of the Committee on Regional Boards (Munitions Production) in 1942, and before the last war he was an adviser to the Government at the Ottawa Conference of 1932, and an industrial adviser at the World Monetary and Economic Conference in 1933. He was also a director of the "Daily Herald" for 18 years, serving as vice-chairman for eight years, and a Visiting Fellow of Nuffield College. He is a trustee of the Imperial Relations Trust; he serves on the Cinematograph Films Council; is a vice-president of the National Safety First Council and a Fellow of the Royal Statistical Society.

Publications of which Lord Citrine is the author comprise "A.B.C. of Chairmanship," "I Search for Truth in Russia" (1936 and 1938), "My Finnish Diary," "My American Diary" (1941), "The Trade Union Movement of Great Britain," "British Trade Unions" (1942), and "Labour and the Community."

British Electricity Authority

Members, with Chairmen-Designate of Area Boards

WITHIN week of the passing of the Electricity Act, the Minister of Fuel and Power announced that he had made the following appointments to the British

LT.-COL. E. H. E. WOODWARD, director and general manager, North Eastern Electric Supply Co., Ltd.

Mr. T. JOHNSON (ex-officio) as chairman



MR. J. HACKING

Electricity Authority, which will be responsible for the administration of the nationalised supply industry:

Chairman: LORD CITRINE, who is the subject of this week's portrait on page 602.

Deputy Chairman: SIR HENRY SELF, 57, Permanent Secretary to the Ministry of Civil Aviation until last month. Mr. J. HACKING, 59, chief engineer to the Central Electricity Board.

Members:

MR. E. W. BUSSEY, 55, general secretary to the Electrical Trades Union.

DAME CAROLINE HASLETT, Comp. I.E.E., adviser to the Ministry of Labour on women's training and director, E.A.W.

ALD. SIR WILLIAM WALKER, past president of the I.M.E.A.; chairman of the National Joint Industrial Council and National Joint Board for the Electricity Supply Industry.



MR. E. W. BUSSEY



DAME C. HASLETT

of the North of Scotland Hydro-Electric Board.

The following have been invited to be chairmen-designate of the area boards stated, and in that capacity to serve on the British Electricity Authority as soon as the area boards concerned have been constituted.

Merseyside and North Wales: Mr. J. ECCLES, city electrical engineer, Liverpool, and president of the I.M.E.A.

Midland: ALD. W. LEWIS, vice-chairman, West Midlands J.E.A.

South-west Scotland: MR. J. S. PICKLES, county electrical engineer, Dumfries, and immediate past president, I.M.E.A.

London: MR. H. J. RANDALL, past-chairman, E.D.A. Council; chairman, London Electric Supply Association; managing director, City of London Electric Lighting Co., Ltd.



SIR W. WALKER



LT.-COL. WOODWARD



MR. J. ECCLES



MR. J. S. PICKLES



MR. H. J. RANDALL

Scottish Enterprise

Attractive Electrical Products Exhibited at Edinburgh

THE outstanding impression made by the "Enterprise Scotland 1947" Exhibition, which was opened by the Duke of Gloucester in Edinburgh on Monday, is that Scotland has benefited considerably by the introduction of new industries, many of the products shown being from firms located on the industrial estates. Apart from these, however, the displays of native firms, include some admirable work deriving from post-war developments. The object of the exhibition is essentially to emphasise excellence of craftsmanship and design rather than to give a comprehensive display of the output of any particular industries. There is, consequently, an absence of products which might have been shown for their novelty or usefulness, but which failed in the opinion of the selection panels to achieve the desired level of quality and finish.

NEW DEVELOPMENTS

Electrical goods are to be found mainly in the domestic appliances section, throughout the furnished rooms, and in the radio section. The shipbuilding and scientific instrument sections also have a variety of interesting exhibits, one being the self-calculating open-circuit locator of Mu-Tron, Ltd., which can be employed for the location of defects in long trailing cables such as are used in coal mines. Kelvin, Bottomley and Baird, Ltd., are showing a galvanic sizing tester, an electrical barograph, and tubal insufflation apparatus; Ferranti, Ltd., have, among other products, a responder type marker buoy; the Lumsden Lamp Co., sunlamps and infra-red lamps. The new unit telephoto receiver of Telephoto Co., Ltd., made by Barr and Stroud, Ltd., is also on view. Another Scottish industry represented in this section is that of cinematograph projection equipment. The Simplex Ampro range of silent and sound 16 mm. equipment, with the necessary electrical units, made by Kelvin, Bottomley and Baird, Ltd. indicates an important post-war expansion.

The development of the radio manufacturing industry in Scotland is illustrated in the domestic section. Allander Radio, Ltd., show a 5-valve all-wave super-het, in a mirror glass cabinet with a wrought iron base. E. K. Cole display their Radiotime A33, and a car radio receiver; Philips Hamilton Works, Ltd., their model 209U, an attractive miniature receiver; Vidor, Ltd., have a miniature; and Atkins Robertson and Whiteford, Ltd., a radio

electrogram, loud speakers and other units.

Among the domestic electric equipment are selected clocks by Smith's English Clocks, Ltd., who have fitted a novel example in the board room of a suite of furnished rooms, in which the numerals are represented by small thistles. British Made Electrics, Ltd., show a 1½ gal. thermal storage heater, and British National Electric, Ltd., a variety of products such as electric fires, and tubular heaters. British Vacuum Cleaner and Engineering Co., Ltd., demonstrate a model cleaner, as do Vactric, Ltd., who have, in addition, a floor polisher finished in cream plastic enamel. Electric irons of attractive designs are displayed by the Carron Co., and also by Philip Woolfson, Ltd. E. K. Cole, Ltd., display examples of "warm white" and "daylight" fluorescent lighting equipment from their new Scottish factory. Robert Maclaren and Co., Ltd., exhibit a selection of thermostats; and Scottish Heat and Vacuum Ltd., a 2½ kW automatic circulator as well as immersion heaters, while the Scottish refrigeration equipment industry is represented by L. Sterne and Co., Ltd., with a 4 cu. ft. Sternette model. The bulk of the products in all these sections is available for home and export trade.

A radiogram by Wylie and Lochhead, Ltd., featured in the luxury furnished living room, is finished in delicate lilac/purple to harmonise with the suite. In this room too, an interesting three-branch wrought iron lamp standard by Thos. Bogie and Son, strikes new ground. In the library a novel use has been made of an overhead track to allow a lamp (a wire-framed, fabric-covered sphere) to be railed to any section of the bookcase or over the working desk.

ELECTRICAL EXHIBITORS

Among manufacturers whose goods have been selected for display are the following.—Scientific instruments: Barr and Stroud, Ltd., Dent and Co. and Johnson, Ltd., Ferranti, Ltd., Kelvin, Bottomley and Baird, Ltd., Lumsden Lamp Co., Aeroplastics, Ltd. Electrical appliances: British Made Electrics, Ltd., British National Electrics, Ltd., E. K. Cole, Ltd., Ekco Ensign Electric, Ltd., J. and G. Coughtrie, Ltd., Robert Maclaren and Co., Ltd., Scottish Heat and Vacuum, Ltd. Domestic appliances: Acme Wringers, Ltd., British Vacuum Cleaner and Engineering Co., Ltd., Carron Co., the Falkirk Iron Co., Ltd., James Howden and Co., Ltd., Lane and Girvan, Ltd., Napier Brothers, L. Sterne and Co., Ltd., Vactric, Ltd. Radio: E. K. Cole, Ltd., Philips Hamilton Works, Ltd., Vidor, Ltd. Clocks: Smiths English Clocks, Ltd.

THREE-PHASE INDUCTION MOTORS

VIEWS ON STARTING, REVERSAL AND ELECTRICAL BRAKING

by S. A. VINCZE, Dipl. Ing., A.M.I.E.E.

Continued from p. 543

The following pages deal with the mechanical, electrical and thermal phenomena which arise during the starting, reversing and electrical braking of three-phase induction motors, especially with the direct-across-line starting, the star-delta starting, starting with stator starter, starting with auto-transformer-starter, the Kusa starting, and with starting with rotor starter. Different braking methods, e.g., the braking by direct current, braking at super- and sub-synchronous speed, the counter current braking and braking methods by changing the number of poles are discussed, without any claim being made to have covered the whole subject. An experimental-graphical method for the determination of torque-speed curves of motors is given.

4. *The graphical computation of the acceleration at starting.*—The graphical determination of the acceleration curves of a centrifugal pump driven by special squirrel cage type motors is carried out in Figs. 4, 5 and 6, for the case of direct across line starting and for star delta starting. The construction follows the method shown in Fig. 3. The torque and the speed are given as a percentage of their rated values and the curves shown in the upper right-hand-side field of the co-ordinate system are the free torques, viz. the difference of the motor torque and of the existing load-torque. A small part of the load torque is also plotted. Started direct across line the motor will accelerate along the curve ω_{Δ}/t .

Started with a star delta starter the motor will accelerate when connected in star along the line O-A. Could the switching over into delta be accomplished within an infinitesimal time, the acceleration would be completed along the line A-C. However, the switching over requires a finite time; therefore the speed falls back under the effect of the load torque along the curve A-B and the motor attains its final speed when connected in delta along the curve B-D. It will be seen that the major part of the total time of acceleration is required during the motor's run in the star connection. When starting with a star delta starter the motor should not be switched into delta before it has reached about 90 per cent. of its full speed.

Figs. 5 and 6 show the starting currents for star delta starting also. It is easily understood that the smallest current peak after switching over occurs if the motor is allowed to reach its highest speed attainable in star connection, and is switched over into delta only when this has been accomplished. A premature and/or too slow switching over of the motor results in current peaks, similar to those obtained with direct across line starting.

Some authorities suggest that even higher current peaks may result.¹² Since the motor

accelerates more slowly when the pressure is below its rated value (the torque of an induction motor is proportional to the square of the pressure) it should be switched over into delta later, if pressure is below, and sooner, if it is above, its rated value. Therefore it is appropriate to use automatic star delta starters which are independent of the operator's skill. An unskilful switching over might result in undesirable current peaks, possibly in the opening of the circuit breaker.

5. *The slip and the torque.*—The starting torque of a three-phase induction motor depends chiefly upon the resistance of its rotor. Since slip is proportional to the rotor resistance, a conclusion may be drawn regarding magnitude of the starting torque from the magnitude of the slip. Smaller motors always have a greater slip, and consequently a comparatively higher starting torque than larger motors, and the increase of rotor resistance (in order to increase the starting torque) is limited by the heating, the slip and the efficiency of the motor.

During acceleration, the torque of the motor increases first up to its maximum value, the so-called pull out torque, and decreases to a value determined by the load torque.

During the acceleration the motor exerts a torque and draws a current from the

Output kW	Minimum starting torque per cent.	Synchronous speed, r.p.m.	Maximum starting current peak, per cent.	
			3 000	600
0.125 to 1.1	200	640	560	—
1.1 " 4	160	720	640	—
4 " 15	125	720	640	500
15 " 50	100	800	720	560
50 " 100	100	800	720	640

network, independent of the magnitude of the load torque. The latter influences the starting time only. The DIN-VDE specify the starting torque and the starting

current of three-phase squirrel cage type motors started direct across line, as shown in Table 1.

The actual values of the starting current are generally lower than those given in Table 1 for ordinary squirrel cage type motors, and much lower with special squirrel cage type motors.

6. Usual methods of starting three-phase induction motors.—The aim of all starting

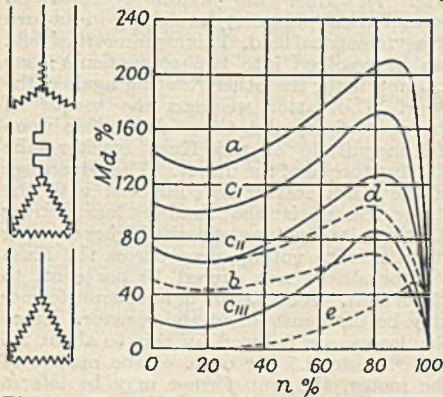


Fig. 7.—Connections and torque of a 5.5 kW, 220V, 970 r.p.m. eddy current type squirrel cage motor: (a) the torque as a function of the speed when the motor is connected in delta; (b) as (a) but motor connected in star; (c_I—c_{III}) as (a) but motor connected in delta with "Kusa" resistances of different magnitude; (d) as (a) with an auto-transformer instead of the resistance; (e) the torque of an acid "thermisilid" pump when its slide valve is closed

methods is to minimise the starting current peaks with simultaneous increase or decrease of the starting torque. The most frequently used starting methods for squirrel cage motors, including special type squirrel cage motors, are the following:

A. Direct-across-line starting.—The motor will be switched directly on to the line by means of a simple three pole switch preferably of the contactor type. The starting torque and the starting current are generally as shown in Table 1 and Fig. 1. The only disadvantage of this starting method is the comparatively high current peak at the first instant of starting. However, in most cases the effect of this current peak is negligible.

B. Star delta starting.—The normally delta connected stator will be connected into star at starting. Both the starting current and the starting torque amount to one third of their respective values with delta connection.

This simple and practical method is not generally used with motors wound for pressures higher than 3 000 V, because the turns in the stator winding would require to be unduly high in number.

Star - delta - resistor starting is a

crossing between the star-delta and the stator starter. Its characteristics can be derived accordingly. On the first step the motor will yield the same starting torque and draw the same starting current as with the conventional star-delta starter. On the second step the current will increase (depending on the value of resistor R) without increasing the torque; on the third step both current and torque will increase, depending again on the value of R, finally step 4 will give the full torque corresponding to the delta connection.

The advantage of the method as compared with the star-delta starting is that the current will never be interrupted between steps, its disadvantage, the added complication.

"Reinforced" star-delta starting.—In this method of starting the midpoint of each stator-phase has to be brought out to the terminal block of the motor, requiring 9 terminals instead of the usual 6.

This starting method will give 90 per cent. of the rated torque in star position at 270 per cent. of the rated current, i.e., both starting torque and starting current will amount to about $\frac{1}{2}$ of that obtained with direct across line starting.

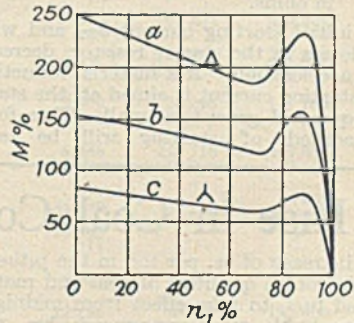


Fig. 8.—Torque-speed curves of a double squirrel cage type motor. Both torque and speed are represented as a percentage of their rated values; (a) motor connected in delta; (b) motor connected in "Kusa"; (c) motor connected in star

C. The auto-transformer starter.—With this method—depending upon the desired torque—50 per cent. to 70 per cent. of the rated pressure will be given to the motor at starting. The starting torque decreases proportionately with the square of the pressure; the starting current decreases proportionately with the pressure on the motor side and proportionately with the square of the pressure on the network side, e.g. when starting at 60 per cent. of the rated pressure, both the network side starting current and the starting torque amount

to 36 per cent. of their respective values with direct across line starting.

D. *The stator starter.*—In order to reduce the starting current materially, a comparatively large resistance—required by the heavy phase lag of the starting current—must be connected in the stator circuit. The starting current decreases proportionately with the pressure, whereas the starting torque decreases proportionately with the square of the pressure; e.g. if a reduction of the starting current to one third of its value with direct across line starting is desired, the starting torque decreases to one ninth of its value with direct across line starting. The starter resistance may be computed by the following formula :

$$R_{ST} = \sqrt{\left(\frac{U_1}{J_{ST}}\right)^2 - X^2} - R \dots\dots\dots(1)$$

where

R_{ST} = The required starter resistance per phase, in ohms.

U_1 = The voltage on one phase of the motor, in volts.

J_{ST} = The starting current per phase, in amperes.

X = The reactance of one motor phase at standstill, in ohms.

R = The resistance of one motor phase, in ohms.

The initial starting current J_{ST} and with it the losses in the starter resistor decrease during acceleration. If a material reduction of the starting current is aimed at, the starting torque will grow too small. Therefore, this method of starting will be used

only if the motor starts with no load, accelerates small masses only and if the star delta or the auto-transformer starting is for some reason not practicable. By substituting a choke coil for the resistor, the starting losses can be minimised.

E. *The Kusa starter.*—Related to the stator starter is the so-termed Kusa starter.¹⁰ Two stator phases are connected directly to the network, the third with a resistor (Fig. 7). Thus the motor receives an asymmetrical pressure, developing in its turn an asymmetrical field. This asymmetrical field can be resolved into two components; one rotating with, the other rotating against the rotor. The latter weakens the torque of the main field, and thus—depending upon the magnitude of the Kusa resistor—the starting torque of the motor. The advantage of the Kusa starter as compared with the stator starter is the smaller loss during starting; its disadvantage, the higher starting current. The voltage drop across the Kusa resistor should not exceed 10 per cent. to 25 per cent. A choke coil or auto-transformer may be used instead of the resistor. Since the losses are reduced by this to about 2.5 per cent. to 0.5 per cent. of the output of the motor, the transformer may be left in the circuit permanently. Figs. 7 and 8 show the comparative torques of double squirrel cage and eddy current type three-phase induction motors with Kusa starting.

F. *Rotor starter.*—In the case of wound rotors, rotor resistors located in or outside the motor allow of extensive control of both starting current and starting torque.

(To be continued)

Rise in Coal Costs—Effect on Tariffs

AN increase of 4s. per ton in the pithead price of all qualities of coal and manufactured fuel, to take effect from midnight on August 31, was announced by the National Coal Board on Monday. At the same time, it was announced that, as from October 1, there would be a further increase in the delivered and f.o.b. prices of coal in consequence of the increase in railway freight rates on that date. The average increase for coal class traffic on the railways resulting from the higher freight rates will be 1s. 9d. per ton.

Speaking on Tuesday of the degree to which these new charges would effect electricity tariffs, an official of the Ministry of Fuel and Power stated that the matter was now under consideration, and an early announcement was expected. Central Electricity Board tariffs to distributing undertakings are already automatically adjusted by operation of the coal clause in their agreements, which allows for an increase of .0007d. for each penny by which

the running costs exceed a basic figure of 38s. per ton. The full effect of the increase may not, however, be passed on by all undertakings, which will review their financial position before deciding any changes in tariffs. In cases where coal clause agreements exist between distributors and large consumers there will be an automatic price increase.

According to the C.E.B. report for 1946, the cost of coal was responsible for an advance in the cost of generation per unit of 137 per cent. above 1938—from 20s. 3d. per ton to 45s. 3d. per ton.

Mr. J. R. Struthers, general manager and engineer of the Sheffield undertaking, expressed the view on Tuesday that "large increases" in the price of electricity would have to be borne by consumers. The increased coal and freight charges would mean an additional annual expenditure to his undertaking of £182 379.

Electrical Overseas Trade

Export Figures for July Show Substantial Rise

ELECTRICAL manufactured goods exported in July reached the total of £7 543 178, an increase of £1 725 200 over the June aggregate. The figures for the corresponding month last year were £4 962 127, and the monthly average in 1938 was £1 839 196. The value of electrical imports in July was £561 627, as against £257 406 in June, £426 193 in July last year, and the 1938 monthly average of £310 117. For the seven months ended July 31 the value of electrical goods sent overseas was £40 287 392, compared with £28 024 706 for the first seven months of last year, and £12 955 557 for seven-twelfths of 1938. Imports decreased from £2 656 575 for the first seven months of 1946 to £1 725 257 up to July 31 this year.

In volume, the July exports in every

group exceeded those for June, and were well in advance of the monthly average of 1938. The number of domestic radio sets shipped rose from 206 533 in June to 244 853 in July. The monthly average for 1938 was 7 053 sets. The number of electronic valves sent to overseas buyers increased from 2 035 288 in June to 2 464 457 in July (1938 average was 183 826); electric bulbs and discharge lamps, from 15 765 569 to 18 637 172 (1 638 099 in 1938); generators, from 11 600 tons to 13 783 tons (858 tons in 1938); motors, 6 764 tons to 8 069 tons (927 tons in 1938); other electrical machinery, from 13 821 tons to 16 922 tons (1 935 tons in 1938); vacuum cleaners and parts, from 1 400 tons to 1 940 tons (55 tons in 1938); welding machinery, 1 341 tons to 1 638 tons; welding electrodes, from 2 221 to 4 316 tons.

	IMPORTS			EXPORTS		
	Monthly average 1938	Month ended July 31 1946	1947	Monthly average 1938	Month ended July 31 1946	1947
	£	£	£	£	£	£
Submarine cables	—	—	—	17 289	66 286	103 392
Other telegraph and telephone wires and cables	—	—	—	71 803	373 758	268 404
Electric cables, wires, &c.—						
Rubber insulated	{ 31 246	2 608	6 006	117 533	267 230	512 621
With other insulation				153 256	480 357	520 758
Radio and television transmitters (and radar) equipment	—	—	3 889	28 296	141 769	128 004
Radio receiving sets	10 148	7 699	698	36 755	339 894	446 730
Radio long distance telegraph and telephone equipment	9 243	1 248	6 248	242 716	449 052	655 366
Other descriptions	47 870	316 503	28 430	57 848	103 106	221 412
Transmitting and industrial valves	{ 10 893	8 469	41 149	41 272	18 335	29 419
Other valves					81 359	114 745
Electric furnace carbons... ..	4 054	6 718	110 545	—	—	—
Other electric carbons	2 301	6 333	211	—	—	—
Electric bulbs and discharge lamps	10 265	80	3 895	49 440	132 290	131 363
Other lamps, lighting appliances and fittings	38 662	911	12 141	48 565	192 480	316 330
Batteries and/or cells, primary... ..	3 549	16	5 385	13 572	39 748	54 596
Accumulators	—	—	—	48 647	153 452	240 029
Parts and accessories	—	—	—	—	60 506	38 848
Heating apparatus and elements	—	—	—	14 064	52 999	100 657
Other heating equipment	—	—	—	16 600	48 757	150 588
Commercial electrical instruments and parts	32 057	9 471	16 149	15 878	49 147	101 541
House service meters	—	—	—	15 791	49 690	87 288
All other descriptions of instruments	—	—	—	9 612	44 729	104 363
Electro-medical apparatus	—	—	—	3 038	28 028	34 142
X-ray apparatus, vacuum tubes and parts	9 734	23 406	34 499	4 881	83 229	90 438
Insulating cloth and tapes	—	—	—	7 038	49 408	48 059
Other insulating materials	—	—	—	12 305	63 614	84 741
Other articles	52 980	11 071	27 373	108 083	297 159	367 368
Generators and parts	—	—	—	157 150	288 080	636 101
Motors and parts	26 033	5 484	8 826	145 045	269 752	410 142
Other electrical machinery	14 455	3 000	252 394	355 663	438 800	942 166
Vacuum cleaners and parts	—	—	—	26 662	99 532	368 903
Other portable appliances	24 627	3 925	2 841	10 394	49 574	25 205
Welding machinery (including electrodes) other than tube making	—	19 251	5 953	—	149 907	209 459
Total	310 117	426 193	561 627	1 839 196	4 962 127	7 543 178

Book Reviews

Principles of Electrical Engineering. (Pp. 563+532 figs., price 40s. net) and **Test Papers and Solutions on Electrical Engineering.** (Pp. 312+363 figs., price 25s. net.) By T. F. WALL, D.Sc., D.Eng., M.I.E.E. (London: Geo. Newnes, Ltd.)

Prepared mainly to meet the requirements of the A.M.I.E.E. and B.Sc. (Eng.) examinations, these two books represent a distinguished addition to the standard works on electrical engineering. However different may be the outlooks of the radio technician and the power station engineer, they have at least a common bond in fundamental theory, and Dr. Wall, as he explains in his preface, has been at pains to place emphasis on the identity of principles, relating to both heavy-current and light-current engineering. Consequently, much of the book is concerned with purely theoretical considerations. If the heavy-current specialist feels that rotating machinery in general is scantily treated, the electronic engineer can equally claim that the thermionic valve is almost entirely ignored. Students in both fields, nevertheless, who have studied the book, and worked with the author through the numerous examples given, will find few difficulties, when the time comes for specialisation, in formulating for themselves the necessary explanations.

After an interesting historical review of the fundamental and technical units, the book opens with an account of the modern structure of the atom, in which Planck's constant and the Einstein mass-energy equation are used, and so passes naturally to conductors and insulators, providing, in so doing, a lucid account of dielectric breakdown. The subject matter from this point follows a conventional course through electrostatics, magnetism, electromagnetism, alternating currents, oscillatory circuits and electromagnetic radiation. A bald recital of chapter headings, however, does much less than justice to the author's very able selection of material. The chapter on capacitance, for example, contains an excellent introduction to modern high-tension cable technique, and later sections of the book deal exhaustively with surges on transmission lines, skin effect and non-sinusoidal waveforms. On networks the treatment is thorough, and Kirchoff's law, Thévenin's theorem, determinants and the star-mesh transformation are employed in the solution of problems. Graphical methods of solving those problems which do not readily lend themselves to mathematical treatment are described in another chapter.

There may be some surprise at the author's use of German capital letters to denote vector quantities. In making a clear typographical distinction between complex and real numbers they are certainly effective, but even supposing the student is familiar with the Gothic alphabet, he will have some difficulty in employing the characters in his own working of examples. At the end of the book, there is a collection of about 200 questions, arranged in the form of test papers on each chapter. The answers appear in the companion volume, where they are worked out in detail and supported by much additional data, of which a description of a 132 kV condenser bushing is a typical example. Finally, a word should be said of the high standard of production and the clarity of the diagrams in the two books. In both respects, they are above the present-day average and, with few exceptions, the diagrams are placed on the same pages as the relevant verbal matter. Dr. Wall's work will be received with gratitude by instructors and advanced students alike, and is likely to remain in use for many years.

The Cathode-Ray Tube Handbook. By S. K. LEWER, B.Sc. (London: Sir Isaac Pitman.) Pp. 103, with 36 figs. Price 6s. net.

There is no need to-day to emphasise the value of the cathode-ray oscillograph as a measuring instrument. Within the last decade, its applications have extended from a limited rôle in research laboratories until there is at present scarcely a single industry in which it cannot to advantage be employed. While the basic principles on which the tube itself is designed are now fairly widely known, there will be many whose daily work involves the manipulation of an oscillograph who are a little uncertain of what lies "inside the box." To those, and especially to the service-man or inspector who can follow a circuit diagram, this book (of which this is a second and revised edition) can be recommended. It begins with a simple account of the nature of the electron beam and fluorescent screen, explains, with the help of simplified circuits, the various methods—magnetic and electrostatic—of producing a time-base deflection, and touches briefly on some of the tasks which the c.r.o. can perform. Mr. Lewer's book is a sound primer, and a short bibliography, which is included, will be useful to those who wish to study further.

• Electrical Personalities •

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

MR. S. F. PHILPOTT has been appointed chief electrical engineer to S. Wolf and Co., Ltd., of Hanger Lane, Ealing, London, manufacturers of portable electric tools.



MR. H. WALTON, district mains engineer with the Carlisle electricity department, has been appointed mains superintendent in the Kirkcaldy electricity department.

MR. S. F. PHILPOTT BAILEY has been appointed to the board of Radio and Television Trust.

MR. GEORGE BARROW has retired from the board of the Revo Electric Co. Ltd.

MR. J. HEYS, of Farquhar and Heys, won the Albert Worden trophy in Blackburn Chamber of Trade's annual bowling fixture, on August 14.

MR. FRANCIS G. W. TREE of Glasgow has been appointed by Thorn Electrical Industries, Ltd., as their lighting engineer for Scotland. In an extensive experience of some 30 years, Mr. Tree has held executive positions in the electrical supply industry and has been responsible for important lighting installations. He has contributed to the technical and general Press articles on good lighting and other electrical matters.

MR. T. B. NUTTER, who has been borough electrical engineer at Burnley for five years, and associated with the electricity department there over 40 years, entered into retirement on superannuation on August 22. A Burnley man, he studied at Mechanics' Institute classes and joined the electricity department on leaving school.

MR. HAROLD BISHOP, controller (engineering), B.B.C., since 1943; Major-Gen. Alexander W. Sproull, Director General of Armaments Production, Ministry of Supply; and Sir Bruce White, a director of the Antrim Electricity Distribution Co., Ltd., and of the National Electric Construc-

tion Co., Ltd., were among the recently-elected Fellows of the City and Guilds of London Institute, who received the Diplomas of Fellowship at the annual meeting of the institute.

SIR JOHNSTONE WRIGHT, chairman, Central Electricity Board, is to head the British delegation to the Fuel Economy Conference of the World Power Conference to be held at The Hague from September 2 to 10, and Mr. J. Eccles, president of the I.M.E.A., will be chairman of Section A.5, which will discuss "Production: Electric Energy." Others attending the conference include Prof. J. D. Cockcroft, F.R.S. (Director, Atomic Energy Research Establishment, Harwell); Dame Caroline Haslett (Director, E.A.W.); Mr. Henry Nimmo (Electricity Commissioner); and Mr. I. V. Robinson (B.E.A.M.A.).

MR. J. W. BEAUCHAMP, the first director of the British Electrical Development Association, commercial manager of the Central Electricity Board, and, at one time, deputy engineer at Sheffield, left £7 101 (n.p. £6 897).

Obituary

MR. WILLIAM GARDNER, chairman of the Morecambe Electricity Committee for nearly 20 years, on August 18, aged 75 years.

MR. A. SOUTHWORTH, chief engineer of the General Electric Co.'s engineering works, Witton, on August 20, aged 47 years. Mr. Southworth was appointed chief engineer in September, 1945, in succession to the late Dr. M. L. Kahn. He was educated at Liverpool University and held the degree of B.Eng. He was apprenticed with Dick Kerr and Co., and after serving in the 1914-18 war, he returned to that company as a designer, specialising in traction. He joined the General Electric Co., Ltd., in 1936 as chief of traction motor design department. During the war he was engaged exclusively on secret development work in connection with large searchlights, radar and fire control problems. Since his appointment as chief engineer, Mr. Southworth had devoted his attention to design of large alternators. He had just returned from a visit to the U.S.A. in the course of which he had inspected modern installations and up-to-date generating stations.

Electricity in South Africa

From Our Own Correspondent

THE Minister of Economic Development, in moving the second reading of the Electricity Amendment Bill in the House of Assembly, said the purpose of the Bill was to provide for the Electricity Supply Commission to arrange for the supply of electricity in the areas where it could not be supplied on a profitable basis. There were several areas, particularly in the country regions, whose development would be materially assisted by the supply of electricity. Under the Bill the Minister would be empowered to require the Electricity Supply Commission to investigate the supply of electricity in any area and advise the Minister of the cost. The Minister could then determine whether electricity should be supplied to any such area and authorise the Commission accordingly. The Bill also authorised the Minister to empower the Commission to charge lower prices than those determined in the principal Act, where the normal charge was considered to be beyond the reach of consumers in any area, or to have the effect of retarding development.

Presiding at the annual meeting of Cable and Wireless of South Africa, Ltd., Mr. G. E. D. Orpen said that further progress in the negotiations with the Union Government was expected after the return to South Africa of the Postmaster-General, who was in Europe to attend an International Postal Conference in Paris. As a result of the nationalisation of Cable and Wireless, of London, the majority shareholding in the South African company, Mr. Orpen added, became the property of the British Government.

The Union Government's offer for the whole of the company's undertaking was based on the position shown in the 1945 balance sheet. Counter-proposals were submitted after a careful valuation of the assets by a sub-committee of the directors in December, 1946, and were followed by verbal negotiations. Discussions had also taken place about the future of the company's staff, who felt that they should be absorbed into the public service, but so far no assurances on this point had been received from the Government. It was not yet certain whether the cable and wireless service would become a department of the Post Office or whether it would be operated separately by a public utility corporation.

Realising the necessity to augment the output of their power station in view of

the steady growth of the town and a consequent increase in the use of electricity, municipal officials at Windhoek, South-West Africa, placed an order for new generating plant shortly before the outbreak of the war, but the conditions made delivery impossible. During the war years the European population of Windhoek increased from 4 000 to over 7 000, and the necessity for an extension to the town's electricity undertaking became a matter of such urgency that the Council again placed an order for new a.c. plant early in 1944. Three boilers are now being erected on site, and it is hoped that the new extension will be put into commission before the end of this year.

During its first year of production the incandescent lamp factory being established in Port Elizabeth will only manufacture lamps which are in general use. When more specialised machinery can be imported, a number of more specialised types will be made. Later tubular fluorescent lamps may also be manufactured.

It is considered possible in many electrical circles in South Africa that within the next 15 years some £300 000 000 will be invested in generating plant and it is not unlikely that a similar or greater sum will be invested in transmission and distribution equipment. This estimate takes no account of investment in plant, equipment and appliances which will utilise the output of the industry.

A deep telephone cable tunnel, believed to be the longest in Europe, was constructed by the Post Office during the war, from the Holborn telephone exchange, near Kingsway, to Faraday Building, Queen Victoria Street. Completed in 1943 at a cost of nearly £200 000, it holds 50 000 telephone wires, and was constructed to protect vital telecommunications essential in the war. At a depth of 100 ft. below the surface, the telephone cables were reasonably safe from any form of bombing. Water-tight bulkheads with doors are fitted to ensure the safety of the staff in the event of a large water-main burst near the head of the shaft. The Holborn tunnel is the outcome of a general policy to put trunk, toll and junction cables underground. It holds 62 cables and is capable of holding 50 more of maximum size.

Engineering and Marine Exhibition

THE OLYMPIA EXHIBITS REVIEWED

The opening at Olympia yesterday of the Engineering and Marine Exhibition marked the resumption of what was in pre-war years an important event in the engineering world and which, to judge from the interest shown on the opening day, continues to attract much attention among engineers and buyers from home and overseas. The first exhibition took place in 1906 and, apart from interruptions during the two wars, it has since been held biennially. With a separate section devoted, as usual, to the welding and foundry trades, the display this year occupies 200 000 sq. ft. of floor space—an increase of 50 per cent. over the best previous figure. The exhibition, which is under the presidency of Lord Dudley Gordon, will be open from 11 a.m. to 9 p.m. until September 13. While it is not possible to describe the stands of all the 450 exhibitors represented, the selection below will give an impression of the wide range of apparatus, ranging from small hand tools to heavy power station equipment, which may be seen.

Acrostyle, Ltd.

A range of modern spraying equipment of both portable and stationary types, with spray booths and accessories, are shown, a particular feature being several models of spray gun. The air compressors are of capacities up to 40 cu. ft. per minute.

A.E.W., Ltd.

The exhibit consists of electric furnaces and a range of accessories. Basic design features on which the standard furnaces, suitable for temperatures up to 1 000° C., are constructed, are large area easily renewable elements with free heat radiation, protected refractory element channels allowing free expansion without mechanical strain, and a high degree of heat insulation. Pyrometers and automatic temperature controllers are shown among the auxiliary equipment, as are small circuit-breakers for single-phase currents up to 15 A. There are also examples of low temperature electric industrial ovens.

A.I. Electric Welding Machines, Ltd.

New models of up-to-date general purpose flash-butt welding sets, together with a high-speed automatic flash-butt welder for metal window production, capable of speeds up to eight welds per minute, are shown on this stand in the welding section. Also on view are recent developments in aluminium alloy

flash-butt welding. A range of spot welders includes a new model with intensified pressure. Information is available on the stand as to heavy-duty flash-butt welding and rail welding plant.

Alfa-Laval Co., Ltd.

Oil-refining technique, in which this company specialises, is represented by power station equipments for the purification of lubricating and insulating oils, centrifugal separators, and a range of lubricating and fuel oil purifiers for motor and turbine propelled vessels. Special centrifugals for mineral oil, vegetable and other oils and a number of food products, as well as De Laval "Parawash" equipment, are also to be seen.

W. H. Allen, Sons and Co., Ltd.

The largest exhibit on this stand is a 250 kW marine auxiliary Diesel-engine generating set, comprising a five-cylinder 410 r.p.m. 365 B.H.P. engine, direct-coupled to a d.c. generator. This set is representative of a range made for power outputs of up to 400 kW. The d.c. generator is of the open single - pedestal bearing type with drip canopy, frame and bearings being split on the centre line to facilitate erection and dismantling. With individual readily adjustable brushes and a magnet system designed to have easily removable field and interpole wind-

As at previous exhibitions, there will be a number of official visits by parties representing trade and technical associations. Those of interest to the electrical world include: Faraday Society, August 29; Association of Supervising Electrical Engineers, August 30; British Electrical and Allied Manufacturers' Association, September 2; Association of Public Lighting Engineers, September 4; British Electrical and Allied Industries Research Association, September 5; Electrical Power Engineers' Association, September 6; Illuminating Engineering Society, September 9; Cable Makers' Association and Institution of Electrical Engineers, September 11; British Electrical Development Association, September 12; and Electrical Association for Women, September 13.

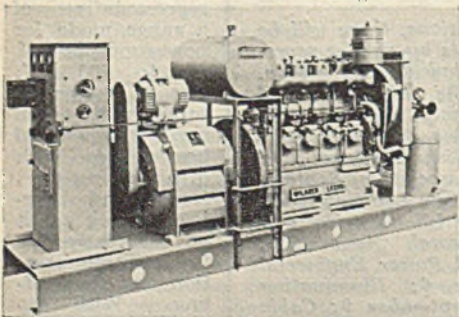
ings, the machine is compound wound with series windings on the negative side of the armature. Steam-driven generating sets shown include an 80 kW back-pressure turbo-generator and two steam engine sets of 10 kW and 90 kW power outputs. The company's products in the field of pumps are represented by large and small models, and another interesting exhibit is a 67 h.p. enclosed-ventilated drip-proof marine type d.c. compressor motor, complete with pillar type automatic starting panel of the multiple contactor type. Another electrical exhibit is an open-switchboard multiple contactor starting panel for use with a 150 h.p. refrigeration compressor on board ship.

Ardente Acoustic Laboratories, Ltd.

Some of the varied ways in which sound-amplification is made to meet modern marine communication needs are demonstrated. The equipment shown includes a loud-hailer, by means of which messages can be passed between ships at up to a mile apart, a "master communicator" equipment and the "Sonamarino" system, the latter providing both a complete ship's broadcast service and an entertainment loudspeaker system. A recent introduction is the "Diverphone," giving two-way communication without headphones between diver-to-diver and diver-to-surface, while for office use on shore there is a loudspeaker "intercomm." available for up to 30-channel working.

Associated British Oil Engines, Ltd.

The chief exhibit is a Diesel-electric generating set, driven by a McLaren "MR4" four cylinder, totally enclosed high speed airless injection engine rated at 88 B.H.P. at 1000 r.p.m., direct coupled to a Brush 55 kW 400/230 V, three-phase alternator. The alternator, direct-coupled exciter and shunt field regulator with Brush switchgear are



A 55 kW A.B.O.E.—Brush Diesel-electric set mounted on a combined bedplate. Materials were allocated by the Ministry of Supply in March this year for the manu-

facture of 1500 of these sets. The first deliveries of completed machines, of which the example shown is representative, were made last week.

Automotive Products Co., Ltd.

Sectioned valves, pumps, slave cylinders and hydraulic motors, with various sample applications, are shown, and there are some examples of contactless remote indication instruments. Among the boiler-house auxiliaries are soot blowers, provided with hydraulic automatic sequence controllers, dampers and fan vane controls. The makers also show follow-up valves and various servo mechanisms.

Axia Fans, Ltd.

A range of high efficiency axial flow fans and other equipment developed for marine requirements includes a 35 in. diameter trunion type for ventilation of

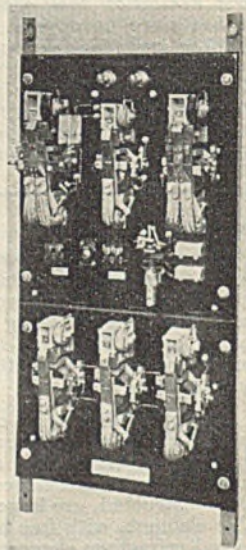
machinery and cargo spaces, and which incorporates a new device for improving the accessibility of the motor and for reversing air flow without any loss of efficiency. Another exhibit is a combined ventilating and heating unit for accommodation on shipboard.

British Electrical and Allied Manufacturers' Association

In the welding section of the exhibition, the manufacturers of arc welding electrodes, plant and resistance welding machines who belong to the association have a joint stand, on which charts and graphs indicate the growth of the welding industry during the past decade. Photographs illustrate applications of electric welding to various industries.

British Insulated Callender's Cables, Ltd

Working demonstrations are being held during the exhibition of resistance welding machines manufactured by this company. These include an air-operated spot welder of 50 kVA rating, a pedal-operated, bench-



A W. H. Allen open switchboard marine contactor panel

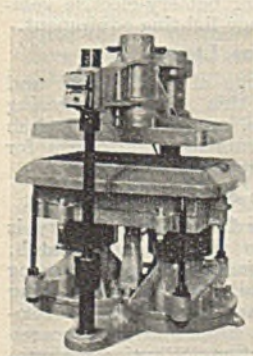
mounted spot welder rated at 0.75 kVA and a flash butt welder for steel strip work. A 30 kVA three-head resistance rivet heater is also on view. Another mechanical exhibit is a 240 V d.c. magnetic moulding machine, which is to be seen producing moulds for automobile castings from moulding bosses 17 in. \times 13 in. \times 3½ in. to 5 in. deep. The machine on view, the smallest of the range manufactured, is controlled through-out by push-button, and draws a momentary current of 38 A, this being supplied at Olympia from a three-phase mercury arc rectifier. The design is such, it is pointed out, that the operator can concentrate on mould production and does not spend time stripping the finished mould. An advantage arising from the elimination of hydraulic power is low maintenance cost, since pipe lines, etc., are unnecessary. The machine is suitable for single or double-sided pattern plate work and can be equipped to permit the use of boxes of nearly every shape. Special types of ships' wiring cables shown include a new varnished cambrie-insulated p.c.p. (poly-chloroprene) sheathed taped and braided cable, r.f. cables and waveguides, and high voltage transmission cables of all types.

British Rototherm Co., Ltd.

A comprehensive range of bi-metallic dial thermometers and temperature gauges for determining the temperature of Diesel exhaust gases and cooling water and oil systems may be seen. Various types of industrial thermometer, suitable for temperatures from minus 100° F. to 1 000° F., are also shown.

British Thomson-Houston Co., Ltd.

A particularly interesting feature of this stand is a model of a gas-turbine alternator set now under construction for a petroleum company, for whom it is to be installed in



B.I. Callender's magnetic moulding machine

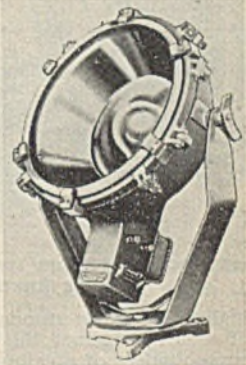
Whittle engine which in a Gloster aircraft in 1941 made the first successful jet-pro-

pelled flight. A selection of photographs illustrates varieties of ships' lighting and the exhibits include lighting fittings for harbour installations, floodlighting and public and private rooms. Various forms of electro-magnetic couplings and reduction gears for shipping use are interestingly depicted.

British Vacuum Cleaner & Eng. Co., Ltd.

The vacuum cleaners made by this company, of which examples are shown, range from the 1/3 H.P. "turbinet" to a 10 H.P. model for industrial use. In addition, they

market a separate portable primary container or wet interceptor, mounted on wheels for wet cleaning operations. Fixed suction cleaning installations, of which details are available on the stand, are also manufactured.



The B.T.-H. Mazdalux "3" floodlight

The associated company, the Magneta Time Co., Ltd., specialises, as is well known, in electrical timing equipment, and master clocks, slave clocks and time recorders are represented. They also exhibit loudspeakers, amplifiers, signal generators, microphones and rack assemblies comprising radio sets and gramophones.

Buck and Hickman, Ltd.

Both oxy-acetylene, electric arc and resistance welding equipment are represented on this stand in the welding section. The electric apparatus includes motor-generator and transformer welders, spot welding machines and various electrodes and accessories.

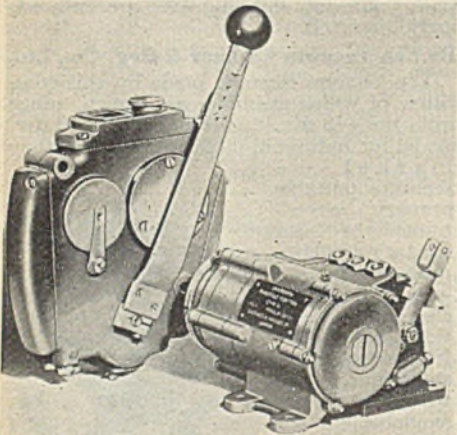
Burgess Products Co., Ltd.

The products shown on this stand range from air silencers suitable for the air intakes of engines or compressors to micro-switches. Precision limit switches which can be operated by 4/1 000 ounce/in. of energy and which are claimed to be vibration-proof, are also shown. Other products displayed include air filters, sound-absorption pads, a hand-vibratory engraving tool for 50 cycles supply and various plastic mouldings for the electrical and allied trades.

Cable Makers' Association

The display on this stand includes specimens of a wide range of wires and cables

which have been developed, as the result of many years' vigorous experimental and research work, to meet the exacting conditions of marine service, and which are widely accepted as representing the



An Evershed position controller, adapted for engine throttle control

highest available standards of quality and of security against the possibly disastrous consequences of any breakdown. The display includes enlarged photographs of several famous vessels on which C.M.A. cables have been installed.

Chance-Londex, Ltd.

During the war, these two companies manufactured a number of navigational buoys, etc., for the Admiralty, and one type, which is meeting with increasing peace-time uses, is shown in its component parts. It is an accumulator-lighted buoy, embodying a simple electric flasher, adjustable to give any specified "on-off" signal, and with a photo-electric "night-day" switch which prolongs the unattended run of the batteries. The lantern on top of the equipment is fitted with a special filament lamp mounted inside a lens. Amongst other exhibits are Chance optical devices and several Londex relays.

Chloride Electrical Storage Co., Ltd.

The emphasis on this stand has been placed on the marine uses of "Exide" batteries, and types suitable for engine-starting and lighting on both large and small vessels and h.t. and l.t. batteries for ships' wireless transmitting systems are shown. The "Keopalite" emergency panel, which may be used either for emergency lighting or steering purposes, may be seen.

Charles Churchill and Co., Ltd.

Maintenance and service equipment for marine engines is shown. The tools include

revolving centres, counterbores, knurling tools, screw extractors and presses, and there are also various types of measuring equipment.

E. K. Cole and Co. Ltd.

An entirely new heating product—"Thermotubes"—is shown. These are tubular heaters constructed of 2 in. dia. heavy gauge seamless steel tubing, with an element consisting of a nickel-chrome coil on a non-ceramic former, operating at black heat. They are supplied in various shapes and in banks or singly, and those exhibited are: double bank 3 ft., four bank 3 ft. and double bank 4 ft. tubes. A series of "Thermovent" space heaters are also on the stand, those shown including 2 kW inset marine models, a 2 kW steel-cased industrial model of the floor-standing type and a 1 kW floor-standing domestic convector in a black plastics case, with anodised aluminium grille and a luminous effect. Sectional models illustrate the principle of convection employed. The whole stand is illuminated by Ekco-Ensign fluorescent lighting, and the radio products of the company are represented by a portable radio for use in small pleasure craft.

D. P. Battery Co., Ltd.

Of particular interest are some of the special exhibits of "Kathode" batteries, which include one unit of a 110-cell emergency lighting battery for liners, and high-performance batteries for starting the Diesel engines of passenger and shunting locomotives. In a cell which may be seen sectioned, the glass-wool separators are exposed to view, and a number of castings and completed plates are shown. The other batteries include types suitable for docks, harbour installations and power stations, traction batteries for battery-electric vehicles and an emergency lighting equipment.

Davis and Timmins, Ltd.

From a wide range of small parts and accessories made, this firm is showing metal-thread screws, nuts, washers, switch and lampholder terminals and inserts for plastics and small repetition parts.

Dept. of Scientific & Indus. Research

One stand in the Grand Hall Gallery is devoted entirely to engineering research, and the various organisations participating are the Parsons and Marine Engineering Turbine Research and Development Association, the British Shipbuilding Research Association, the National Physical Laboratory, the Fuel Research Station, the Motor Industry Research Association, the British Internal Combustion Engineering Research Association, the British Iron and Steel Research Association, the British Cast Iron Research Association, the British Non-

Ferrous Metals Research Association and the British Welding Research Association. Each association is demonstrating some of the apparatus used in their researches.

Dorman and Smith, Ltd.

The company's exhibits cover a wide field. A marine-type flat back switchboard with Dorman "XL" circuit breakers and "F" type switches is one of the largest products shown, and there are also a totally enclosed circuit breaker, distribution fuseboards and consumers' distribution units. The smaller products include lighting fittings, switch fuses, brass-cased connectors with plugs, handlamps and a series of Dorman cartridge and rewirable fuses.

Drayton Regulator & Instrument Co., Ltd.

Of interest are a series of automatic temperature and pressure regulators, operated variously by air, water or electricity. The stand also features recorders and indicators, and examples are shown of steam traps, sight glasses, strainers, metal bellows and thermostat systems.

English Electric Co., Ltd.

The company is exhibiting in both the engineering and welding sections. Three Diesel engines, one incorporated in a 200 kW marine auxiliary generating set and another of a type used in Dieselelectric locomotives, are shown, and models and photographs depict the company's activities in other engineering fields. The welding exhibits include an a.c. arc welding equipment incorporating the H.F. ioniser unit and a.c. and d.c. models of their stud-welding gear.

Evershed and Vignoles, Ltd.

Indicative of the growing importance of position controllers and servo mechanisms are two new devices on this stand. The Evershed position controller consists of hand-operated transmitters connected by wires to one or more distant receivers or slave units. Any movement of the transmitter causes a proportional movement of the slave units, which develop sufficient power to operate engine throttle levers, valves, etc. The system functions over distances varying from a few yards to a quarter of a mile. The servo mechanisms displayed are of the MU2 type, and consist of an initiating transmitter controlling alternative motor units, with a stated accuracy of one part in 1 500. With additional components, this ratio can be raised to one part in 50 000. Another new product is an electronic repeater—for remote indication of various quantities—and the stand displays the established range of testing instruments.

Fry's Metal Foundries, Ltd.

Specimens of soldered articles illustrate the types of joints most suitable for different manufacturing processes, and the stand

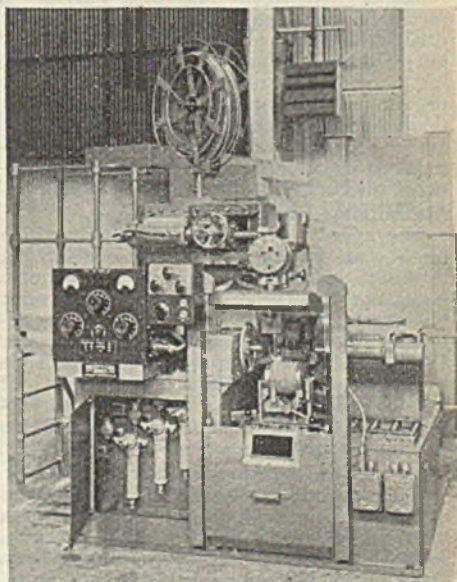
displays the many solders, pastes and fluxes made by this company. Two comparatively recent materials, "Fryolux" solder paint and "Four-Scored" solder wire, are suggested for use in mass-production soldering and tinning, where they are said to reduce the need for complicated and expensive machinery.

E. Green and Son, Ltd.

Green's economisers have now been used for waste-heat recovery for more than 100 years, and the progress made in this field is exemplified by a working model of a 650 lb. per sq. in. type with cast-iron tubes with integral cast-iron gills. Another type, with cast-iron gills shrunk on steel tubes, is designed for working pressures up to 4 000 lb. per sq. in. Also shown are cast-iron air heaters of a type now being ordered for many power station extensions, and oval tube type air heaters for use in industrial plants. Specimens of mild steel insulated casing for enclosing economisers and air heaters in place of brickwork are exhibited.

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

This stand has been arranged to indicate the variety of metal products, ranging from high-pressure autoclaves to perforated metals for sifting and grading, which the company makes. The "Harco Tapergil" gilled tube, displayed in a number of diameters and pitch of gills, is a recent departure giving an efficiency of heat transfer, it



An automatic arc-welding equipment, shown by the Metropolitan-Vickers Electrical Co., Ltd.

is stated, approximately 25 per cent. greater than that of a crimped gill tube.

Hilmor, Ltd.

A comprehensive display of tube bending machinery includes portable and bench fixtures of interest to the electrical trades, and power-operated universal and mandrel benders for general engineering purposes.

Lea Recorder Co., Ltd.

The instruments selected for display include recorders for the measurement of feed water supplies, effluent, etc., and various forms of coal meter, for measuring the quantity of fuel supplies to chain-grate stokers and other forms of automatic stoker.

London Electric Firm, Ltd.

The products on this stand are mainly concerned with outdoor lighting of various types, and include searchlights, arc lamps, precision worm geared winches, several sizes of self-sustaining winches, and lighting suspension gear. A span wire suspension system complete with lamp lowering equipment is shown, and there are contact suspension gears for external and interior lighting.

Mek-Elek Engineering, Ltd.

The importance of correctly positioned local lighting in machine shops and draughting offices is now generally recognised, and the industrial lighting units on this stand are adaptable to various purposes. A feature of the design is the epicyclic geared joint in the fitting, which permits a wide range of adjustment and also provides a means of taking cab-tyre cable through the fitting without alteration of the cable length during movement of the lamp. The lamps made are suitable for mains voltages or low voltage supplies and are made for floor, bench, wall or ceiling fittings, as well as with special fittings for direct attachment to machinery. One model has a sub-proof housing enclosing the lamp holder.

Metallizing Equipment Co., Ltd.

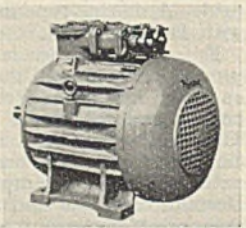
The speed and convenience with which metal can be applied to non-conductors, forming controlled deposits of known resistance, by the metal spraying process, has resulted in the installation of metallizing equipment in many production lines. Using the same equipment, it is possible to apply metal coatings for purposes of resistance to corrosion, for electrical screening, or to form aerials. The uses of Metco equipment are being demonstrated.

Metropolitan-Vickers Electrical Co., Ltd.

The company is making a special feature of the "Seascan" radar equipment, a development of the war-time P.P.I. system which is finding increasing use on merchant ships. The set comprises five main units, the console, aerial, transmitter, motor-generator and the control panel. The console, containing the cathode-ray tube indicator unit, is normally housed in the wheelhouse for use by the ship's officers.

The set is arranged for selective operation on any one of four ranges to suit navigation in congested waterways and long range landfalls. On a stand in the welding section, the company displays examples of their

arc welding resistance welding and atomic hydrogen welding plant, and in many cases the equipment may be seen in operation. A new addition is the "Thermac" welding transformer, features of which, it is stated, are its



A Newman flameproof fan-cooled motor

ease of operation and robust construction, together with freedom from the vibration effects often associated with this type of equipment. Among the larger exhibits is an automatic arc welding equipment. This machine uses electrode in continuous coils and is suitable for such applications as the automatic welding of all-steel railway wagons, pipework, etc. The equipment consists essentially of a welding head, control gear and a reel of electrode. Contactor gear controlling the automatic features—such as speed of rotation and welding speed—is housed in a separately mounted sheet steel cubicle. The resistance welding sets range from a 2.5 kW bench mounting foot-operated model for the lamp or valve industry to a 400 kVA roller spot welder for aluminium or light alloys, the latter machine being complete with "Ignitron" control cubicle and capable of 144 spot welds per minute. Electric brazing equipment may also be seen, and the smaller exhibits include the "Metroflux" magnetic crack detectors for the examination and location of faults in welded joints.

Murex Welding Processes, Ltd.

A 300 A motor-generator welding set, complete on a trolley, is one of the recent introductions of the company appearing on this stand. Fitted with a remote control regulator, which provides automatic adjustment of welding current, the operator having only to short-circuit the electrode holder to the work to vary the current supply, this new welder is claimed to reduce welding time and generally result in better joints. When performing the adjustment, a long "dash" short-circuit reduces the current, and a "dot and dash" contact raises it. A transformer welding set is also shown, and there are many forms of welding electrodes.

New Insulation Co., Ltd.

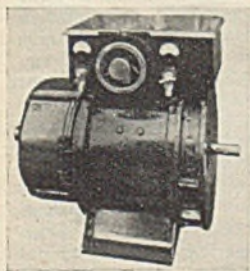
Typical machinery components fabricated from "Perinali," a laminated wood product, are displayed. Amongst the properties of this material, which is vacuum impregnated and densified, are high insulation resistance, good strength/weight ratio, dimensional stability and moisture resistance. It may be used for insulating components, circuit-breaker lift rods and operating links, transformer end rings and on H.V. overhead transmission lines.

Newman Industries, Ltd.

Industrial and fractional H.P. motors of many types are shown. In the industrial range is a totally enclosed fan-cooled squirrel cage machine, a typical double-cage, high torque motor and a totally-enclosed high efficiency loom motor. The F.H.P. motors include split-phase, capacitor start, and other types for various methods of mounting. All these are totally enclosed and have powers ranging from $\frac{1}{16}$ to $\frac{3}{4}$ H.P. Direct-on-line, direct-on-reversing contactor type and fully automatic star-delta starters are also exhibited. An interesting special exhibit is a Newman alternator and an oil-burner motor. The Newman electric fused steel chain cable is also available for inspection.

Nife Batteries, Ltd.

With their special advantages of small size, lightness, freedom from corrosive fumes and ability to discharge without damage at heavy rates, nickel-cadmium batteries are suitable for many special marine applications, and the manufacturer has illustrated some of the possible uses on the stand. These alkaline cells, which may be recharged in as little as three hours, if necessary, are sufficiently robust to withstand considerable vibration and hard usage, and may be tilted to an angle of 45° without spilling. Typical crates of cells are shown, as are a number of lamps for portable lighting.



A standard Reyrolle 300A welding generator

is a 25 kVA pole-mounting single-phase transformer for rural distribution, and

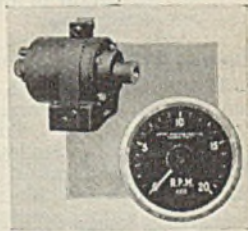
C. A. Parsons and Co., Ltd

A $\frac{1}{16}$ th scale model of a 50000 kW, 3000 r.p.m. turbo-alternator, complete with surface condensing plant, may be seen, accompanied by an illuminated sectional drawing which shows the construction of the machine. Another exhibit

there are several photographs and other models.

Philips Industrial (Philips Lamps, Ltd.)

In the welding section, the company shows a representative selection of products, one of which is a new capacity storage spot welding machine. Its special features are accurate control of welding heat and electrode pressure control to ensure a quick forging action. When operating, the spot welder is isolated from the supply, energy stored in capacitors being used for the welding cycle. There are several other spot welders, and also some transformer welding plants.



A Smith's 4 in. revolution indicator and generator

Pyrotenax, Ltd.

The company's mineral-insulated, metal-clad medium voltage cables are a familiar feature in power stations and many industrial installations and a typical selection is shown. This fireproof cable is made solely from copper and a magnesia insulant, these components giving it a high degree of freedom from ageing and deterioration.

Rawlplug Co., Ltd.

The demonstrations arranged depict the various applications of the company's fixing devices for light and heavy work, while amongst the tools shown are electrical and mechanical percussion hammers, drills and electric soldering irons.

Rediffusion, Ltd.

Two main fields of the company's activities are covered in this exhibit—radio communication equipment for marine purposes and industrial radio-frequency heaters. A replica cabin for a medium-sized ship is equipped with a versatile 100 W transmitter, radio direction finder and other devices, and there is a trawler cabin, with 50 W transmitter and a ships' public address equipment. On the engineering side of the stand, induction and dielectric heating and plastics welding sets are shown, the smallest equipment made in each class being utilised for demonstration purposes.

A. Reyrolle and Co., Ltd.

On its stand, the company is emphasising welding equipment, although a type "HH" metal-clad switch and fuse distribution panel is also shown. One of

their newest products is a single-operator welding generator rated at 300 A. The voltage has a drooping characteristic in relation to current and is rapid in recovery. Features of the design are a snap-action rotary current selector and a concentrically mounted fine regulator giving continuous regulation of welding current over the complete range.

Joseph Sankey and Sons, Ltd.

Electrical steels, both in sheet and made-up forms, are shown. The well-known types made by this company are "Crystalloy," "Stalloy" and "Lohys" brands, and a series of slotted laminations in these materials for motors and generators from F.H.P. sizes to heavy industrial machines may be seen. In addition, there are laminations for fire-control instruments and a series of stampings for the radio and television industries and for fluorescent lighting chokes.

Smith's Industrial Instruments, Ltd.

A number of working exhibits add interest to this display. Prominence is given to A.T. magnetic indicators in a variety of sizes and adapted to many forms of speed indication. One is a hand tachometer giving a direct reading in

r.p.m. and another is an electric revolution indicator, working with a generator at the driving end and a separate indicator situated where it may be wanted. Another interesting working exhibits shows the Smith's "Desynn" remote indication instruments.

Stream-Line Filters, Ltd.

Filters designed for the upgrading of insulating oils from transformers and circuit-breakers, arranged as fixed, semi-portable or fully mobile units, and reconditioning filters for lubricating oils are among the special products displayed. An oily water separator prevents pollution of sea and rivers by oily waste.

Henry Wiggin and Co., Ltd.

For many years this firm has specialised in the manufacture of a wide range of alloys, and examples of materials, showing the forms in which they are available and some possible uses, are displayed on the stand. The electrical resistance materials shown are marketed under the names "Brightray," "Glowray" and "Ferry"; the other alloys shown have, as their special properties, high corrosion resistance, high strength or good performance at high temperatures.

ELECTRICITY COMMISSION LOAN SANCTIONS

AMOUNTS SANCTIONED FOR THE PERIOD FROM APRIL 1, 1944, TO JUNE 30, 1947

(A) PUBLIC AUTHORITIES (EXCLUDING CENTRAL ELECTRICITY BOARD)

ITEM	PERIOD			Three Months ended 30 June 1947
	1944-45	1945-46	1946-47	
Purchase of property ...	£ 13 907	£ 124 165	£ 322 556	£ 25 836
Buildings (generation purposes) ...	6 711 285	10 710 085	6 799 906	2 990 052
Buildings (distribution purposes) ...	42 734	789 258	1 618 303	191 424
Plant (generation purposes) ...	20 323 383	19 077 935	19 239 336	10 237 770
Plant (distribution purposes) ...	593 327	2 381 948	4 854 982	3 614 363
Mains and services ...	491 422	3 667 759	8 299 475	2 371 854
Meters and instruments ...	31 249	246 418	679 128	334 420
Wiring installations ...	1 107	16 009	80 017	210 635
Apparatus ...	24 034	245 500	594 788	161 624
Other purposes ...	105 370	393 298	1 490 103	—
Total ...	28 337 818	37 652 375	43 978 594	20 164 978

(B) CENTRAL ELECTRICITY BOARD

	£	£	£	£
Purchase of property ...	—	—	—	—
Buildings (distribution purposes) ...	200 000	—	—	—
Plant (distribution) ...	230 000	—	—	—
Mains ...	400 000	—	—	—
Civil Defence ...	100 000	100 000	—	—
Generating stations ...	1 075 000	—	—	—
Other purposes ...	20 000	—	—	—
Total ...	2 025 000	100 000	—	—

(C) TOTAL AMOUNTS SANCTIONED DURING EACH QUARTER

	£	£	£	£
April 1-June 30 ...	1 067 578	16 792 980	8 816 821	20 164 978
July 1-Sept. 30 ...	5 801 894	4 035 003	18 414 206	—
Oct. 1-Dec. 31 ...	8 070 946	10 337 392	8 231 878	—
Jan. 1-Mar. 31 ...	15 422 400	6 587 000	8 515 689	—
Grand total ...	30 362 818	37 752 375	43 978 594	—

Industrial Information

Steel Tubes and Tubulars

The B.S.I. has issued a new standard for steel tubes and tubulars, B.S. 1387, which supersedes the pre-war B.S. 789 and the war emergency B.S. 789A. It has been prepared to meet the needs of post-war industry and it differs from the earlier standards in respect of the three classes of tube which are included. Copies can be obtained from the Publications Sales Department, 24, Victoria Street, London, S.W.1, price 2s. 6d. post free.

Homecraft Training for Servicewomen

During the summer the E.A.W., 35, Grosvenor Place, London, S.W.1, has been continuing the courses of homecraft training for service-women. At Regent Street special courses were arranged for groups from the W.R.N.S. and the W.A.T.S. Starting on July 25 and continuing to September 5, weekly courses are arranged for parties from the W.A.A.F. in the London area. Practical instruction is given in cookery, laundry, meter reading and the general use of domestic electric appliances. This is one means by which E.A.W. work is related to the Ministry of Education Circular 117.

L.N.E.R. Manchester District Control

The L.N.E.R. Manchester district control office, evacuated to Godley during the war, has returned to the London Road station. Entirely new and up-to-date equipment, supplied and fitted by Standard Telephone and Cables, Ltd., has been installed in the control room, to which more than one hundred signal boxes and other key operating points in Lancashire, Cheshire, the West Riding and North Wales are connected. Thirty-one special telephone circuits, sixteen of which are external and fifteen for inter-communication, are in use. Twenty-three miles of wire were used in fixing the installation. Every feature of the new system has been designed to facilitate efficient execution of control work. Fluorescent lighting has been installed throughout. The area covered by the control is divided into sections and a special control room lay-out has been adopted whereby section controllers are seated in front of specialists responsible for such matters as enginemens' relief, guards' relief and locomotive power. Above each section controller's desk there is an illuminated board showing the complete diagrammatic arrangement of his section. As train movements take place these are plotted on the boards by means of coloured tokens. A fully flexible intercommunication system is embodied. The telephone system is for

the most part automatic. The entire installation is run on electrical power taken direct from mains supply, but there is provided an emergency battery reserve sufficient to operate for forty-eight hours in the event of a mains breakdown.

Milk Tests with "Daylight" Lamps

The Leeds laboratory staff of the National Milk Testing Service found that



Milk testing with Metrovick fluorescent tubular lamps

the variable nature of the daylight available was unsatisfactory for the resazurin test in which light plays an important part. Metrovick illuminating engineers were consulted and they installed "daylight" fluorescent tubular lighting throughout the laboratory. This has been entirely successful. The test requires the addition of a small quantity of resazurin to a sample of milk in a test tube, subjecting it to incubation at blood heat and then comparing it side by side with an untreated milk sample in a specially-designed comparator. Contaminated milk samples take on different colourings as a result of the bacterial growth and to detect the actual degree of colourisation it is essential that the comparator be held so that a good source of natural or artificial daylight falls directly on to the test tubes.

Illumination Design Course

An illumination design course for the Central England area has been arranged by the E.L.M.A. Lighting Service Bureau, to be held at the electricity supply show-rooms, Paradise Street, Birmingham, from September 22 to 25. There will be an official opening by the Lord Mayor of Birmingham, Ald. A. F. Bradbeer, at 9.30 a.m. on the Monday, followed by

introductory remarks by Mr. F. W. Lawton, chief engineer and manager of the city electricity undertaking. It is the first course for the electrical industry to be held in the Birmingham area since the end of the war and has resulted directly from the appointment by the Bureau of Mr. F. Jamieson to that area. Applications for reservations should be made to the Bureau at 2, Savoy Hill, London, W.C.2.

Apprenticeship Scheme

Negotiations regarding the introduction of an indentured apprenticeship scheme for the electrical contracting industry as a whole are on the point of completion, and the scheme will come into operation as from the third pay day in October next. It will comprise an industrial agreement, applicable to all apprentices becoming indentured after that date.

Diamond Dies for Wire Drawing

In 1944 the British Standards Institution issued British Standard 1168 relating to non-reinforced diamond dies for wire drawing. The B.S.I. has now issued a companion specification, B.S. 1393: 1947, for reinforced diamond dies. The specification relates to reinforced dies with bores up to 0.06 in. diameter. It indicates the desirable characteristics of the stone and defines the appropriate minimum wall thicknesses and minimum weights for various bores. Provision is made for three grades of finish

of the hole: its dimensional accuracy is prescribed, and notes are included on methods of examining and measuring the bores. Copies can be obtained from the Publication Sales Department, 24, Victoria Street, London, S.W.1, price 2s. 6d.

New Sales Arrangement

Erinex, Ltd., of Fiore, Northamptonshire, announce that as from August 12 H. H. Linton and Co., Ltd., 34, Osnaburgh Street, Euston Road, London, N.W.1, are appointed sole distributors for Great Britain of the company's "Erinex" and "Cepeo" products.

Condenser Manufacture in Scotland

By the end of November the Telegraph Condenser Co., Ltd., expect to be in full production with the manufacture of condensers at their new factory, known as Whiteside Works, at Bathgate, Scotland. By the end of August, they plan to have occupied, and commenced work in, half of the site. The buildings will occupy approximately 100 000 sq. ft., and it is anticipated that full employment will be given to about 1 000 people, mostly females. The scope of the Scottish factory will be limited to the manufacture of paper condensers.

Lighting the "Queen Mary"

Originally responsible for the design and manufacture of a large part of the lighting installation in the public rooms and cabins of the "Queen Mary," the General Electric Co., Ltd., had the task of reinstating several hundred fittings on board during the re-fitting of the liner recently. All fittings, including those which had been in use all the time, were overhauled—there were some 7 000 Roanoid fittings alone. All lampholders, numbering tens of thousands, were dismantled, cleaned and rewired; all reflectors, totalling over 7 000 pieces, were stove enamelled again. Some of the reflectors in the public rooms comprised many pieces, and each had to be numbered so that everything went back correctly. Thousands of feet of metalwork were cleaned and relacquered. One of the chief difficulties was the replacement and matching of broken glassware. The lighting fittings were not the G.E.C.'s only contribution to the reconditioning of the ship. For many months men from



G.E.C. lighting scheme for the first-class restaurant on the "Queen Mary"

the company's Coventry works were on board overhauling the telephone system. The main switchboard was completely stripped and rewired, and every 'phone was taken away to Coventry and overhauled or replaced.

Ship's Fluorescent Lighting

The t.s.s. "Corinthic," a 15 000-ton passenger-carrying refrigerated meat ship, is one of the first ocean going ships to be equipped with fluorescent lighting as an integral part of the architectural design.

Lighting engineers from the ship lighting department of the British Thomson-Houston Co., Ltd., planned the lighting and designed the fittings, working in close collaboration with the architects. The a.c. supply for the fluorescent lamps is derived from two 220 V 600 cycle 4.5 kVA motor alternators of B.T.H. design and manufacture, operated from the ship's normal d.c. supply. The main lighting in the dining saloon comes from fourteen Mazda 80 W 5 ft. "warm-white" fluorescent lamps mounted in recesses in the deckhead, in the form of indirect cornice lighting. There are four over the centre of the room, and five over each of the out-board areas. The recesses are designed to conceal the lamps from direct view while reflecting a high proportion of their light. Eight special bulkhead bracket fittings, finished in matt silver, and with tinted sandblasted glass, each accommodating two Mazda 60 W tungsten lamps, supplement the light from the main fluorescent installation. In the forward lounge sixteen fluorescent lamps have been mounted in recesses in the deckhead. The bulkhead brackets for the tungsten lamps are finished in matt silver, the tinted sandblasted glass, as in all similar fittings, being mounted in channel-felting to prevent "chattering."

Radar Sets for Merchant Ships

Marine Instruments, Ltd., announce that the Kelvin-Hughes merchant ship radar equipment is now operating in the "Bergenske Dampskibsselskab," s.s. "Jupiter" and the G.W.R.'s s.s. "St. David." This set has been specially designed to meet the requirements of merchant vessels and is on view at the Engineering and Marine Exhibition at Olympia.

Contractors at Cricket

A cricket match between the West Yorkshire and the Huddersfield branches

of the Electrical Contractors' Association, played on the Lascelles Hall ground, Huddersfield, on Wednesday, August 20, in perfect weather, resulted in a victory for the West Yorks. branch, who scored 140 for three wickets. Huddersfield made 60 for eight wickets.

Works Extensions

During the last two years C. A. Parsons and Co., Ltd., have been carrying out a big reconstruction programme at their Heaton works. The various operational



Planned fluorescent lighting in the forward lounge of the t.s.s. "Corinthic"

shops have been re-arranged to give a more efficient service to the main shops, and a large number of modern machine tools have been installed. The insulation shop, tool room, blacksmiths' shop and apprentices' training school have been rehoused and work is proceeding on the modernisation of the foundry, the moving of the light machine shop to new quarters and the construction of a new heavy erecting bay. This latter building will be 315 ft. long, 60 ft. wide and 74 ft. high, and will have 200-ton cranes and lighter cranes. Provision is being made for the bay to be extended to 600 ft. in length. The company has recently acquired land, adjacent to Heaton works, on which it is proposed to build two new bays, each 360 ft. long and 60 ft. wide, for a core plate shop and a mirror shop, and two further bays, each 300 ft. long and 60 ft. wide, for housing materials. When these buildings are completed and the departments concerned moved from the Heaton works, it will enable other departments to be re-housed and extensions to be made. The company export half their output of turbo-generating plant, and will be enabled to increase production.

Electricity Supply

Clitheroe.—Inquiries as to the availability of station sites are, it is understood, being made by the Central Electricity Board.

Richmond (Yorks).—The Electricity Committee is to hold a special meeting on October 27 to commemorate the 21st birthday of the electricity undertaking.

Sheffield.—In a report covering the period from March, 1939, to March, 1947, the city lighting engineer, Mr. J. F. Colquhoun, gives an account of the activities of the lighting department during and since the war. Among the major tasks undertaken by the department was the installation of 25 000 "star-lighting" fittings in 1940 and the subsequent change-over to "moon-lighting" in September, 1944, the latter task being completed in three weeks. The report claims that when full street-lighting was permitted in July, 1945, Sheffield was the first city in the country to resume a peace-time standard, with 12 000 electric and 13 000 gas lamps, covering an area of 666 sq. miles, put into operation in one night. In an analysis of lighting costs, it is shown that, compared with a pre-war cost of 4.54d. per candle for all forms of street-lighting, the cost rose to £3 12s. per candle when "star-lighting" was in force.

Barrow.—The electricity department is investigating the hydraulic resources of the Furness area. There are three schemes, the first introducing a power station on the River Leven to give an output of 26 000 000 units per year; second, a modification of the existing hydraulic station at Coniston by the erection of two power stations, giving an output of 6 000 000 units per year; and the third, to gather the waters of the Upper Esk into two impounding reservoirs and pipe this water through a power station into a third reservoir on the Upper Duddon to the west of Seathwaite Tarn. The flood waters of Seathwaite Tarn would pass through another power station. The outlet of the new reservoir on the Upper Duddon would be piped through a third power station into another reservoir on the Duddon, from which water would be piped through a fourth power station on the Lower Duddon, near Ulpha. Possible output from this third scheme is estimated at 100 000 000 units a year, making a total for the three schemes of 132 000 000 units. Saving on coal is estimated to be equivalent to 100 000 tons per year. Seven new power stations would be involved in the

three schemes. Mr. J. E. Shepherd, borough electrical engineer, has also stated that the electricity department has been asked by the Electricity Commissioners to investigate the use of the docks at Barrow, together with the purchase of the necessary land, for the erection of a new generating station for the Central Board. The scheme envisages the installation of a 60 000 kW plant at the outset.

Supply Legislation

WITH the passing into law of the Electricity Act, 1947, considerable modifications and adaptations are made to the existing legislation governing electricity supply. According to the Fourth Schedule of the Act, six previous Acts are repealed entirely, while ten other Acts, dealing in whole or part with supply matters, are subject to amendments. Under the title of "The Electricity Supply Statutes, as adapted and modified by the Electricity Act, 1947," Mr. Norman Elliott, general manager of the London and Home Counties Joint Electricity Authority, has compiled a book in which the following statutes, which remain in force in amended form as a result of the 1947 Act, are brought up to date: The Electric Lighting Acts of 1882, 1888 and 1909; the Electric Lighting (Clauses) Act, 1899; the Electric (Supply) Acts of 1919, 1922 and 1926; and the Electricity Supply (Meters) Act, 1936. The Hydro-Electric Development (Scotland) Act, 1943, is not included. In addition, Mr. Elliott has prepared an exhaustive index, by means of which reference to the relevant clauses on specific points may readily be made. In order to facilitate binding into one volume with the Electricity Supply Regulations, 1937, and the new Act, the book has the same format as the official documents. Together, the three documents represent the whole of the current electricity supply legislation relating to Great Britain—apart from those Acts relating specifically to the North of Scotland Hydro-Electric area. The book, which was prepared initially for the guidance of members of the L. and H.C. J.E.A., is now made generally available, and may be obtained from the Clerk's Office, London and Home Counties J.E.A., 5-6, Lancaster Place, London, W.C.2, price 10s., post free. Undertaking staffs and all who will administer the supply industry after Vesting Day will find it of great assistance.

Contracts Open

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

Halifax, September 1.—Manufacture, delivery and putting into service of two 20 MVA, 33/6.6 kV type O.N. main transformers and two earthing/auxiliary transformers. Specification from Borough Electrical Engineer and Manager, 19/23, Northgate, Halifax; deposit, £1 ls.

Sheffield, September 2.—Supply and delivery of three-phase double-wound self-cooled generating station auxiliary transformers, as follows: ten 600 kVA, 11 400/440 V; two 600 kVA, 11 400/3 000 V; one 5 000 kVA, 33/11.3 kV. Specification from General Manager and Engineer, Commercial Street, Sheffield, 1; deposit, £2 2s.

Keighley, September 6.—Supply and delivery of three-phase transformers:—three 250 kVA, 11 000/6 600/420 V; four 400 kVA, 11 000/6 600/420 V; six 800 kVA, 11 000/6 600/420 V. Specification from Engineer and Manager, Electricity Offices, Coney Lane, Keighley.

Crayford, September 8.—Supply and fixing of fluorescent lighting in four offices at the Town Hall, together with alterations to existing wiring as necessary. Specification from Engineer and Surveyor, Town Hall, Crayford.

Stoke-on-Trent, September 10.—Manufacture, supply, delivery and erection of four 15 000 kVA, 33/6.6 kV, three-phase, 50 cycles outdoor static transformers, complete with "on-load" tap changers and control panels. Specification from General Manager, Electricity Department, 31, Kingsway, Stoke-on-Trent; deposit, £2 (in notes).

Birkenhead, September 15.—Supply, delivery and erection of one 80 kW mercury arc rectifier equipment for d.c. output 460/230 V, three-wire, to operate from 415/240 V three-phase supply. Specification from Borough Electrical Engineer, Craven Street, Birkenhead.

Newark-on-Trent, September 19.—Supply and delivery of: (a) p.i.c. cable; (b) two 300 kVA distribution transformers. Specification from Borough Electrical Engineer, Municipal Buildings, Balderton-gate, Newark.

Middlesbrough, September 19.—Supply and delivery, over two years, of: (a) 250 kVA, three-phase, 11 kV, indoor transformer; (b) 500 kVA, three-phase,

11 kV, indoor transformer; (c) coil and compound-filled, metal-clad circuit-breaker and oil-break isolators, suitable for use on 11 kV system; (d) sub-station type distribution feeder panels. Specifications from Borough Electrical Engineer, Corporation Electricity Works, Snowdon Road, Middlesbrough.

Weymouth and Melcombe Regis, September 27.—Supply and delivery of transformers. Specification from Borough Electrical Engineer and Manager, Electric House, Westham Road, Weymouth.

Portsmouth, September 30.—Supply, delivery and erection of:—(a) one (alternatively two) 15 MVA, 33/11 kV, type O.N. transformer; (b) four 5 MVA, 33/11 kV, type O.N. transformers; (c) one earthing transformer; (d) seven liquid type neutral earthing resistors. Specifications from Engineer and Manager, Portsmouth Electricity Service, 111, High Street, Portsmouth.

Scotland.—Supply, delivery and erection, for North of Scotland Hydro-Electric Board, of approximately 50 miles of 132 kV steel tower transmission lines. Tender documents from the Engineers, Messrs. Kennedy and Donkin, 32, Alva Street, Edinburgh, 2; deposit, £5.

Iraq.—Supply of 12 slow or medium speed Diesel-driven generating sets, 440/500 V, d.c., compound-wound, rating about 100 kW, to suit engine builders' standard design. Specification from Crown Agents for the Colonies, Ref. W/Iraq 7750, 4, Millbank, London, S.W.1.

Electric arc-welding was used extensively, externally and internally, in order to expedite the work of refitting the "Queen Mary" in the dry dock at Southampton. London Welding Co., Ltd., of London and Eastleigh, alone, used 19 Murex portable welding sets. Some were located on the sides of the dock and fitted with long welding leads in order to give the welders as much access to various parts of the ship as possible, without the need to disconnect, shift and reconnect the plant to the supply mains. The total length of cable used was upward of four miles. Welding on the superstructure was employed for bulkheads, alterations and extensions of cabins, fixtures in the engine rooms and on the stern, the construction of the projection room and for hundreds of other jobs. The "Vodex" type of electrode, suitable for welding in all positions with the same current strength, was used exclusively by the welding sub-contractors.

Company News

GREENWOOD AND BATLEY, LTD.—At the annual meeting, Col. H. A. Wickham, chairman, pointed out that the demand for the company's products showed no tendency to decline. Practically all departments were fully employed. In view of their extensive commitments, they were finding it necessary to quote somewhat long deliveries for many of their manufactures, and regretted that this sometimes caused disappointment. It was, however, unavoidable in the present difficult circumstances and simply reflected the demand for their goods. It had always been their practice to endeavour to ensure that designs were at least equal to, if not in advance of, those of their competitors abroad. For this reason they had on number of occasions lately arranged for senior members of the staff to visit foreign countries where machines such as they supplied were in operation.

BRITISH TIMKEN, LTD.—Speaking at the annual meeting, the chairman, Mr. M. V. B. Dewar, said that work and turnover were running at the highest rate in the company's history. Referring to the crisis conditions, the Chairman said that the gradual strangulation of industry and individual initiative by bureaucracy was clear to see all over the country, and the extra effort involved in trying, in spite of restrictions, to maintain and increase production was very great. The following example was quoted: steel was in short supply and it was thought that they might help the bearing industry if they could import special alloy steels from the United States. Their associated company in America agreed to make some steel available. Under a system of private enterprise, this order could have been placed in two to three days; under the system of bureaucracy prevailing to-day, it took two to three months, thereby losing one month's supply; and even then some "jack-in-office" took it upon himself to alter the specification of the steel without any reference to the company, and it was only through direct communication with their American associates and private enterprise that they discovered it in time.

REVO ELECTRIC CO., LTD.—Presiding at the ordinary general meeting at Dudley recently, the Chairman, Mr. Bertram Silcock, told shareholders that new production shops and foundries of approximately 40 000 sq. ft. were now equipped and in full production on high priority products and housing fittings. In addition, complete new mechanised plant in-

corporating improved stoving apparatus capable of handling many thousand units per week for the processing and finishing of fluorescent lighting equipment had been installed and was in operation. The demand on the fittings section had increased during the year, and new and important developments had taken place in the field of fluorescent lighting equipment. An entirely new technique in the design of street lighting lanterns embodying fluorescent lighting tubes had been developed and was gaining favour with street lighting authorities. In the switchgear section there were new types of 11t. units, and the works were producing for the home and export markets. The company had also introduced a stream-line electric cooker, an immersion heater type kettle, a thermostatically controlled iron and several new fires for export.

Company Meeting

Telephone Manufacturing Co. Change-Over Difficulties

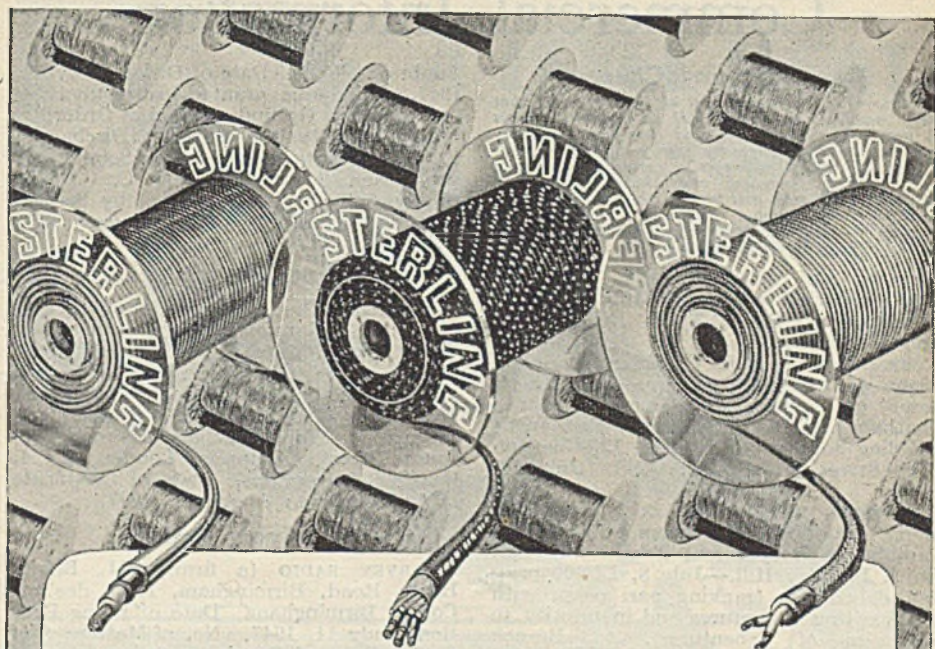
The 17th annual general meeting of the Telephone Manufacturing Company, Limited, was held in London on August 25, Mr. Fred T. Jackson, O.B.E., Comp. I.E.E., chairman and managing director, presiding.

The Chairman, in the course of his speech, said:

The gross profit on trading is £134 896, and in comparison with that of the preceding year of £410 559, shows a reduction of £275 663. This reflects in part the cancellation of contracts following on the cessation of the war and the change-over to civilian requirements. The total distributable balance is £266 577. An interim dividend of 2½ per cent. has already been paid and a final dividend of 6½ per cent. is proposed.

The change-over from war work presented us with difficulties which could not be foreseen as they arose from national policy created by the Government, and were altogether outside our control. The material supply position has been, and still is, one that causes very great anxiety, and during the present shortage it can only be dealt with by a system of priorities. There is far too much material being used in non-essential manufacture to the detriment of the country's effort in export and home trade. We are up against problems over which we have no control, and our only hope is that the Government will recognise its mistakes and allow private enterprise unfettered freedom. Given this freedom, your company is in a good position. We have a good order book amounting to over £1 800 000 at June 30, 1947. I would say that our prospects over the next few years are excellent, especially if the supply of raw materials becomes more plentiful. It is of interest to note that we are represented in 62 countries.

The report was adopted.



1826

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Commercial Information

Mortgages and Charges

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

TYLER AND FREEMAN, LTD., London, W.C., electrical engineers.—July 4, £4 000 debenture, to R. G. Tyler, Broxbourne; general charge.

MEC-ELECTRIC, LTD., Chatham, manufacturers of wireless receivers.—July 7, by order on terms, £3 000 mortgage, to Chatham and District Reliance Permanent Building Society; charged on 12, Cheriton High Street, Folkestone. *Nil. July 19, 1946.

CAMPBELL ENGINEERING CO., LTD. (formerly Campbell Conveyors, Ltd., and Campbell Conveyor and Engineering Co., Ltd.), Bromley Hill.—July 8, £4 500 prior lien debentures (ranking pari passu with two existing debentures and in priority to a series of debentures), to Branch Nominees, Ltd.; general charge. *£2 500 debentures. March 30, 1942.

Adjudication

GIBSON, Walter, residing at 23, Battledean Road, Highbury, London, described in the Receiving Order as W. Gibson (male), carrying on business as W. Gibson and Co., 1A, Battledean Road, Highbury, and 2D, Holloway Road, Highbury, London, builder, decorator and electrical engineer. Court: High Court of Justice. Date of Order: August 16, 1947. Date of Filing Petition: July 4, 1947.

LANGTON, Ronald Henry Alfred, 61, Heathfield Court, Chiswick, W.4, Middlesex, radio engineer. Court: Brentford. Date of Order: August 12, 1947. Date of Filing Petition: June 12, 1947.

Intended Dividend

PEACOCK, Cyril, 93, Lowther Street, and 51, Gillygate, York, electrical engineer. Court: York. Last Day for Receiving Proofs: September 3, 1947. Name of Trustee and Address: John Stanley Snowball, Lantern Tower Chambers, Coppergate, York.

Orders Made

BLAKE, Frederick Charles Stanley (described in the Receiving Order as F. C. Blake (Male), 6, Berkeley Road, Tunbridge Wells, Kent, wireless dealer, and lately carrying on business at 19, Vale Road, Tunbridge Wells, Kent. Court:

Tunbridge Wells. Date of Order: July 17, 1947. Discharge granted, suspended for two months. Grounds named in Order for refusing an absolute Order of Discharge: Proofs of Facts mentioned in Section 26, sub-section 3 (A., B. and C.), Bankruptcy Act, 1914, as amended by Section I of the Bankruptcy (Amendment) Act, 1926.

Appointment of Trustee

WILLIAMS, Thomas Richard Emlyn, Flat 17, Russell Mansions, 144, Southampton Row, W.C.1, lately trading as Radio Corner, at 138, Gray's Inn Road, Holborn, W.C.1, radio engineer. Court: High Court of Justice. Trustee's Name, Address and description: Albert Edgar Attwood, 90, Queen Street, Cheapside, London, E.C.4, Certified Accountant. Date of Certificate of Appointment: August 18, 1947.

Receiving Order

HARVEY RADIO (a firm), 211, Balsall Heath Road, Birmingham, radio dealers. Court: Birmingham. Date of Filing Petition: July 11, 1947. No. of Matter: 8 of 1947. Date of Receiving Order: August 14, 1947. No. of Receiving Order: 9 of 1947. Creditor's Petition: Act of Bankruptcy proved in Creditor's Petition—Section I-I (G.), Bankruptcy Act, 1914.

Metal Prices

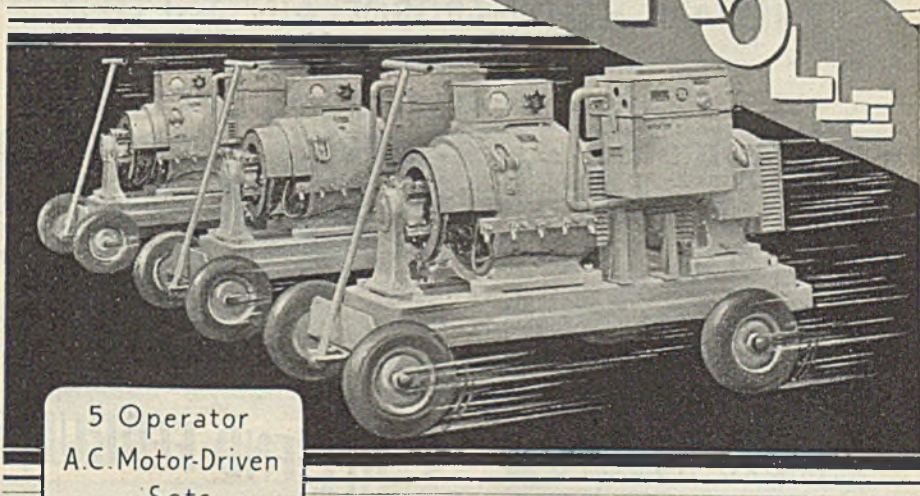
	Monday, Price	Inc.	August 25 Dec.
Copper—			
Best Selected per ton	£130 10 0	—	—
Electro Wire bars	£132 0 0	—	—
H.C. Wires, basis	£149 10 0	—	—
Sheet	£173 10 0	—	—
Bronze Electrical quality			
1% Tin—			
Wire (Telephone) basis per ton	£172 5 0	—	—
Brass (80/40)—			
Rod basis per lb.	1s. 1½d.	—	—
Wire	1s. 6½d.	—	—
Iron and Steel—			
Pig Iron (E. Coast Hematite No. 1) per ton	£8 19 0	—	—
Galvanised Steel Wire (Cable Armouring) basis 0.104 in.	£34 5 0	—	—
Mild Steel Tape (Cable Armouring) basis 0.04 in.	£21 15 0	—	—
Lead Pig—			
English	£91 10 0	—	—
Foreign or Colonial	£90 0 0	—	—
Tin—			
Ingot (minimum of 99.9% purity)	£412 10 0	—	—
Wire, basis per lb.	5s. 6½d.	—	—
Aluminium Ingots per ton	£80 0 0	—	—
Spelter	£70 0 0	—	—
Mercury (spot) per bott.	£16 0 0	—	—
(ex. warehouse)			

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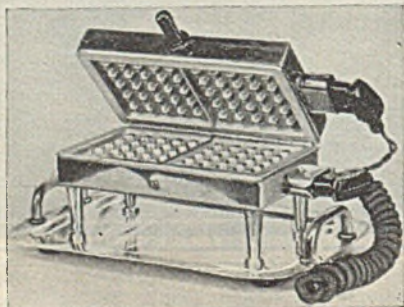
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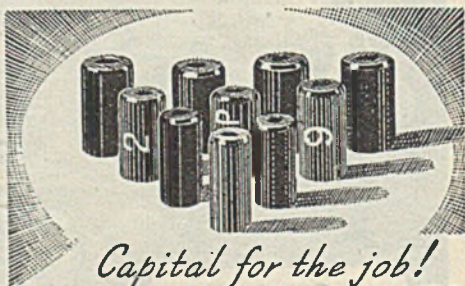
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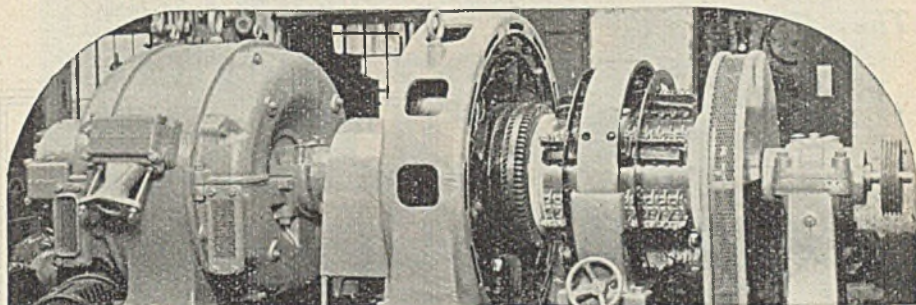
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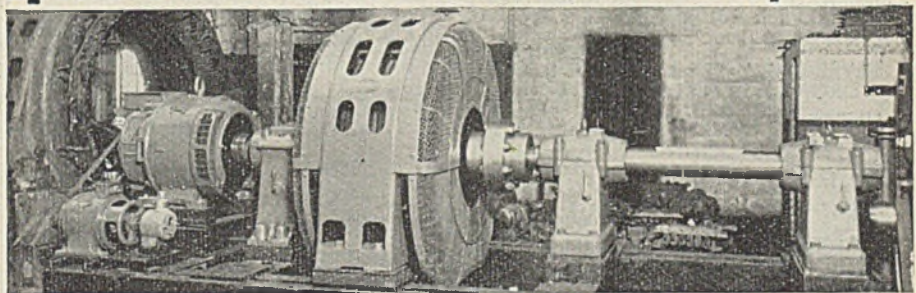
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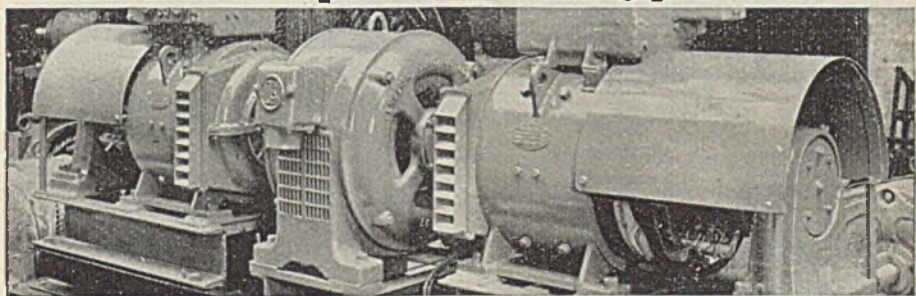
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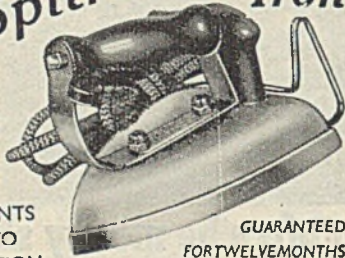
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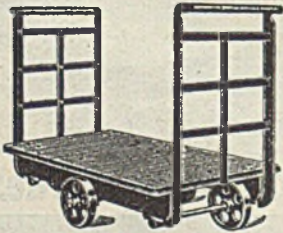
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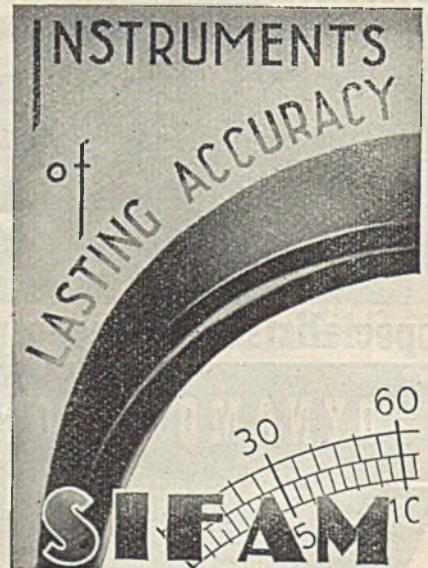
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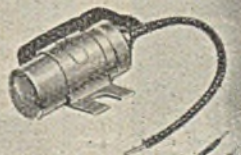
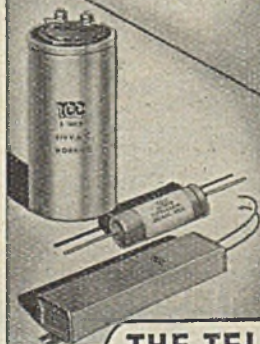
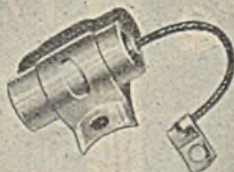
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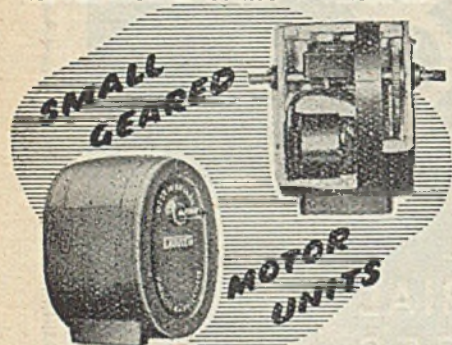
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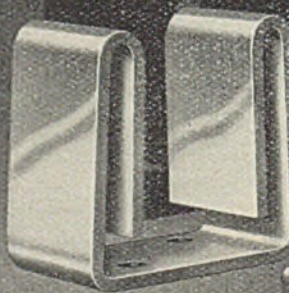
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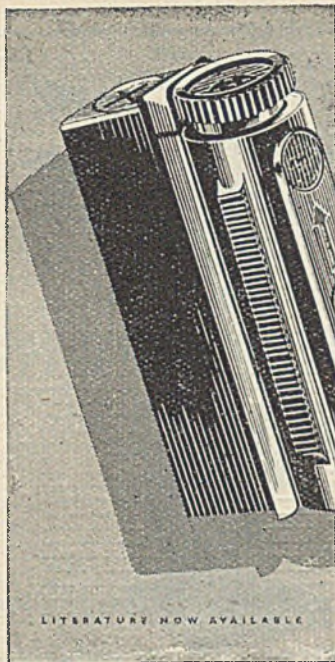
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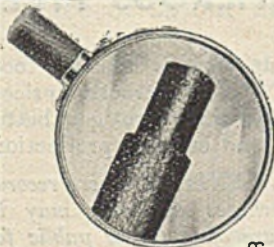
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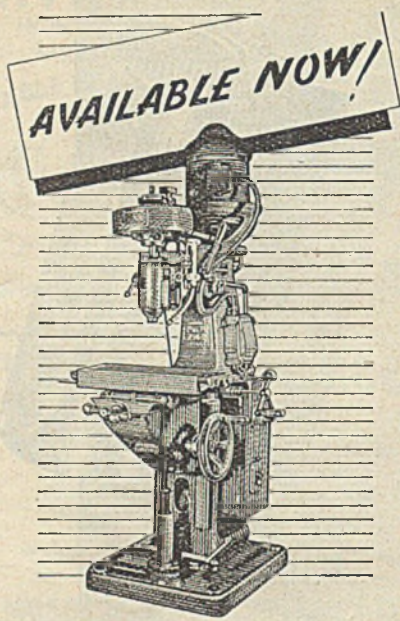


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Applicants should have had experience in the construction and maintenance of 11 K.V. and L.T. overhead lines and services.

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Applications, stating age, qualifications and experience, and endorsed "Overhead Lineman," giving names and addresses of not more than three persons to whom reference may be made, must be sent to the District Manager of the Authority, 56, South Street, Dorking, so as to reach him by not later than the 12th September, 1947.

Canvassing, directly or indirectly, will be a disqualification.

A. L. BURNELL,

Clerk to the Authority.

5-6, Lancaster Place,
STRAND, W.C.2.
August, 1947.

(105)

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ELECTRIC SUPPLY DEPARTMENT.

Chief Technical Engineer.

APPPLICATIONS are invited for the appointment of **CHIEF TECHNICAL ENGINEER** in the Electric Supply Department.

Applicants must have had a sound engineering training, hold a University degree in engineering and be Corporate Members of The Institution of Electrical Engineers and/or The Institution of Mechanical Engineers.

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The appointment will be subject to the Local Government Superannuation Act, 1937, and to the Standing Orders of the City Council, and will be determinable by three calendar months in writing on either side.

Applications on the appropriate forms, which may be obtained from the City Electrical Engineer, 24, Hatton Garden, Liverpool 3, must be accompanied by a covering letter in the candidate's own handwriting, together with a copy of three recent testimonials, and must be enclosed in a sealed envelope endorsed "Chief Technical Engineer," and forwarded so as to reach the undersigned not later than the first post on September 20th, 1947.

Candidates serving in H.M. Forces abroad need not complete the official form of application, but may submit direct applications within the date specified, giving particulars of age, education, qualifications and experience, and three names as references; the number of the applicant's release group and probable date of release should also be stated.

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THOMAS ALKER,

Town Clerk.

2/8/47.

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(54B)

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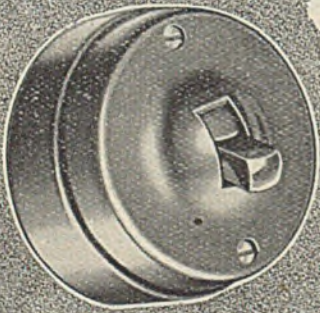
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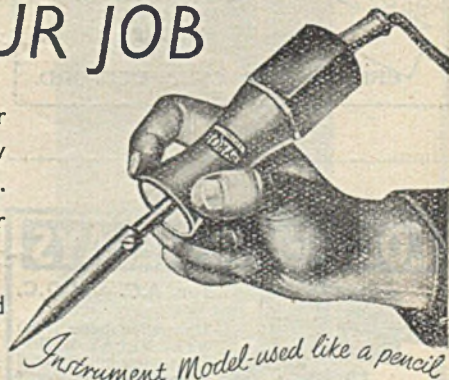
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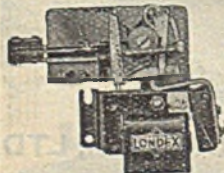
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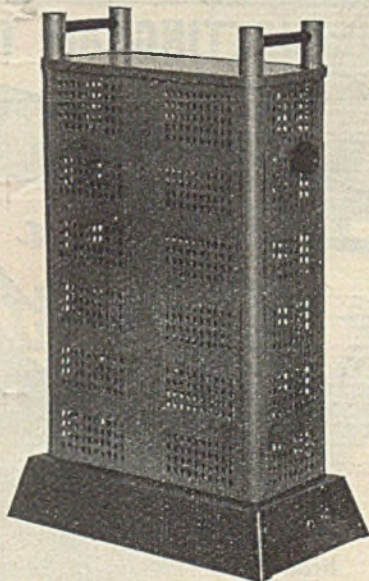
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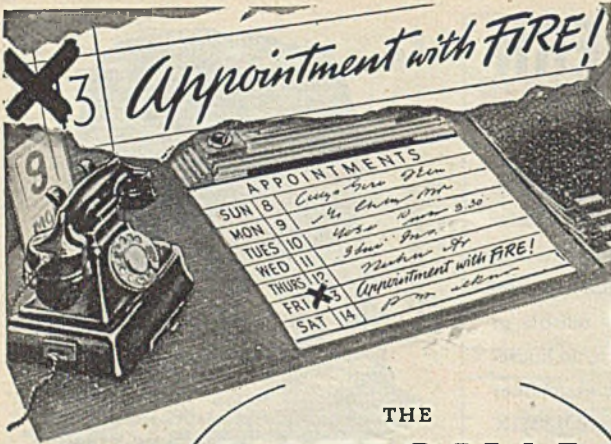
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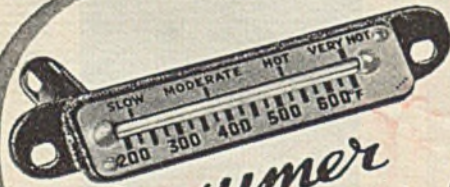
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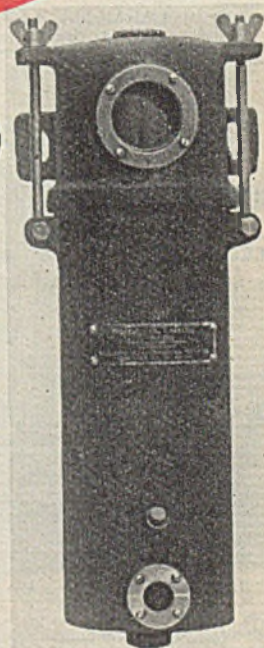
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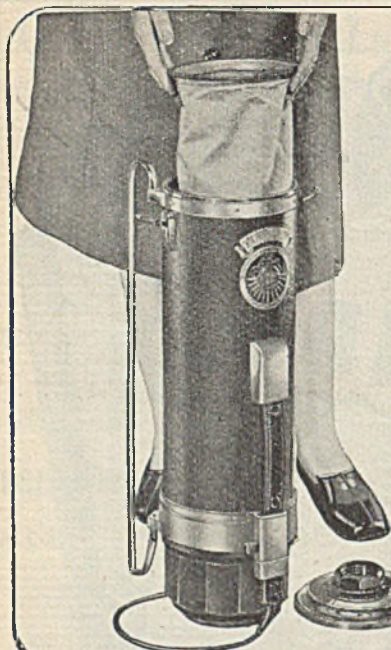
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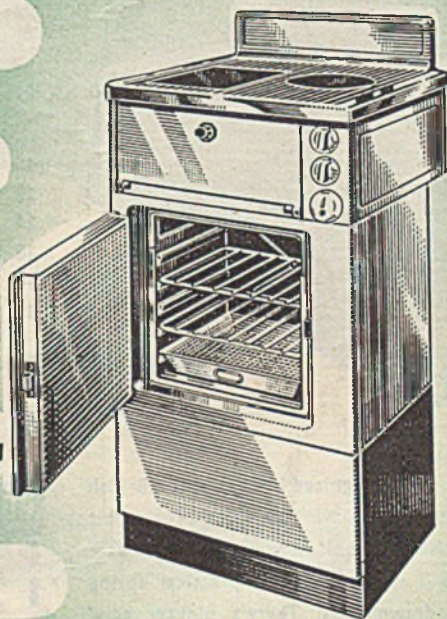
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THE ELECTRICIAN

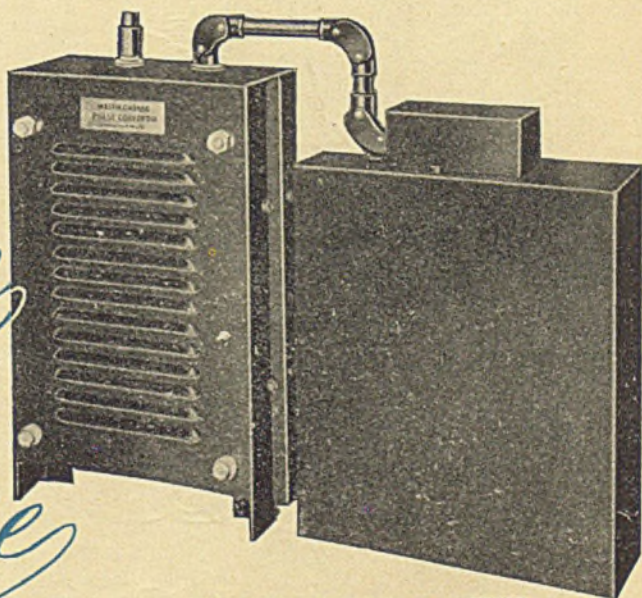
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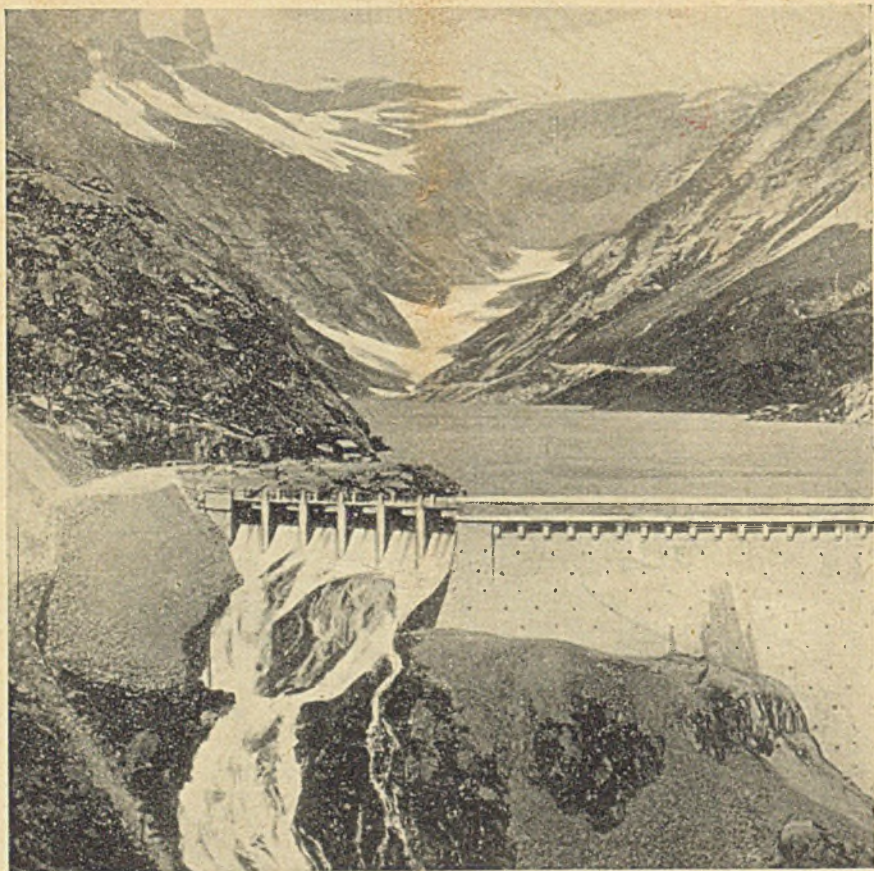


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