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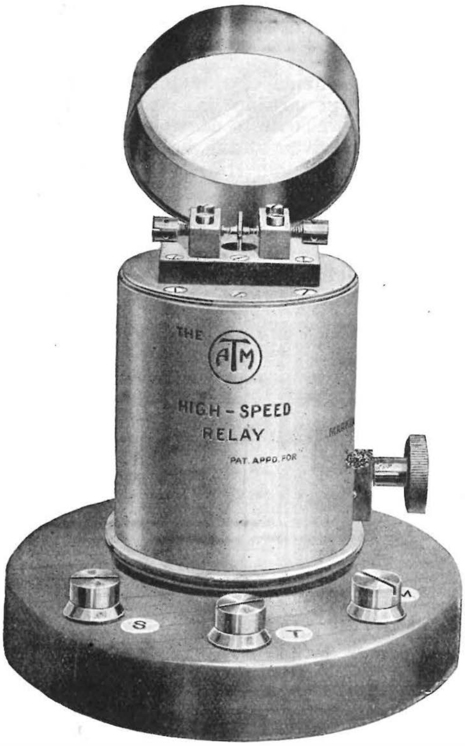
The A.T.M.

High-Speed Relay.



R. 337.

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The Post Office Electrical Engineers' Journal.

A QUARTERLY JOURNAL.

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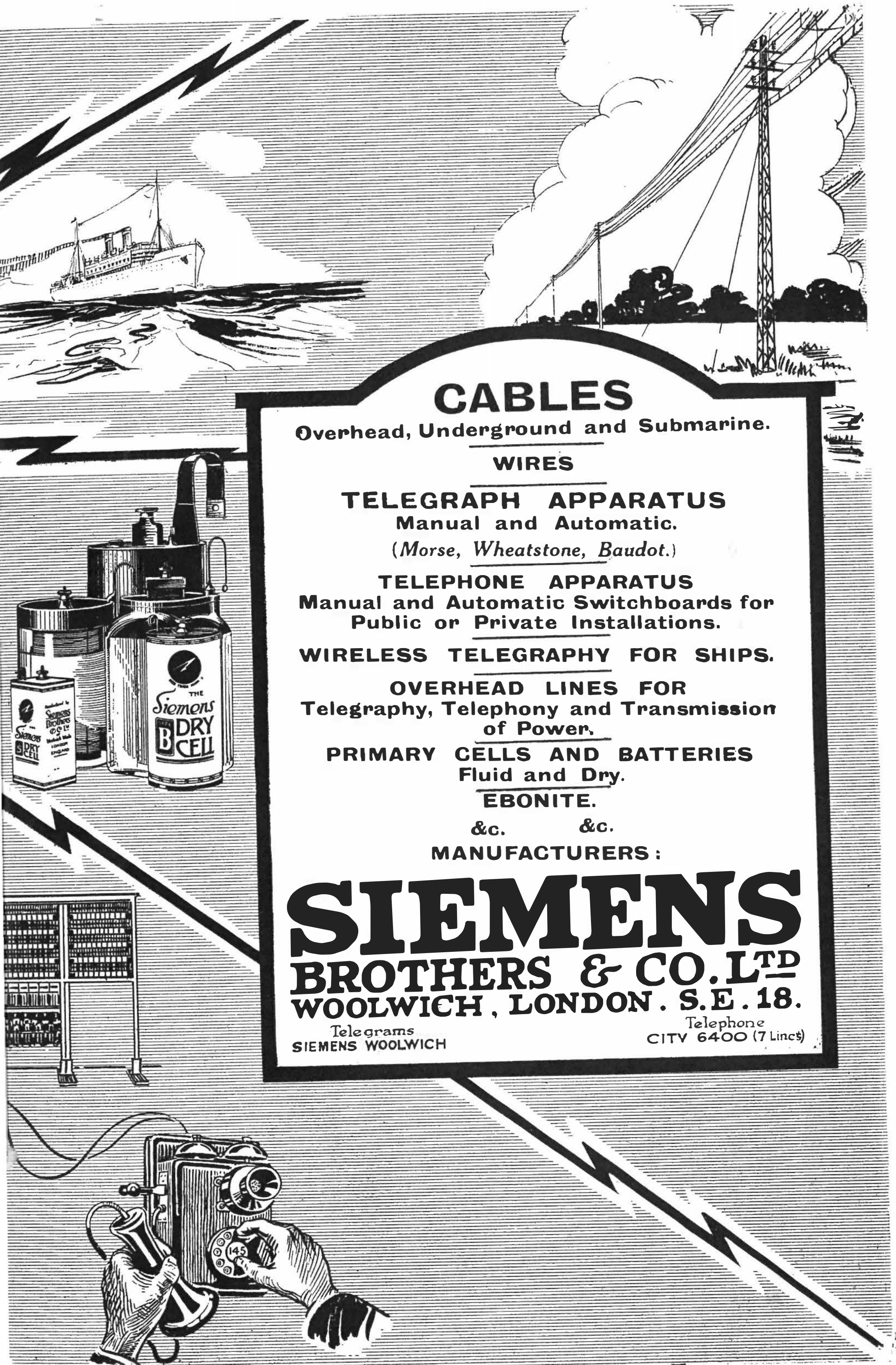
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LONDON TOLL EXCHANGE.

A new Exchange which will relieve the London Trunk Exchange of the short distance trunks has been opened at No. 11, Norwich Street, Fetter Lane, E.C. 4.

The equipment provided has been designed with the view of accelerating the services between London and the nearer provincial Exchanges, the designation "Toll" being given to distinguish it from the present "Trunk" Exchange. Common Battery Automatic signalling facilities are provided, but as subscribers lines will not be terminated in the exchange the cord circuit feed relays employed are more sensitive than those generally used in ordinary C.B. local exchanges, whereby signalling over long lines is facilitated.

The test apparatus and power plant are located on the ground floor.

The batteries consist of 2 sets of 11 L-type E.P.S. cells in wood lead-lined boxes, each of 1764 ampere-hours capacity, with 2 auxiliary batteries of 4 S-type cells in glass boxes of 293 ampere-hours each for signalling purposes.

Two charging motor-generators made by Messrs. Crompton & Co., Ltd., are driven from the 400-volt D.C. main. Each has an output of 260 amps at 26 volts. One ringer is driven from the 200-volt D.C. main, and one from the main battery.

The Test Desk consists of two positions and is similar to that provided in local C.B. exchanges. On the top of the desk, however, is fitted a cabinet consisting of 5 panels to accommodate 1000 test break jacks. These jacks are cabled to connectors on the M.D. Frame. By means of jumpering, selected lines may be led through the Test Desk *viâ* these break jacks, and facilities for readily testing the external or internal sections of any line subject to disturbances are thereby afforded from the desk. The main and intermediate distributing frames, relay, coils, and fuse racks follow the lines of ordinary local equipment.

The Switchroom is located on the third floor of the building. The Switchboard is of the No. 10 type, which permits the larger type of jacks and plugs to be utilised, and consists of 93 positions, 25 of which are in the gallery of the main Switchroom.

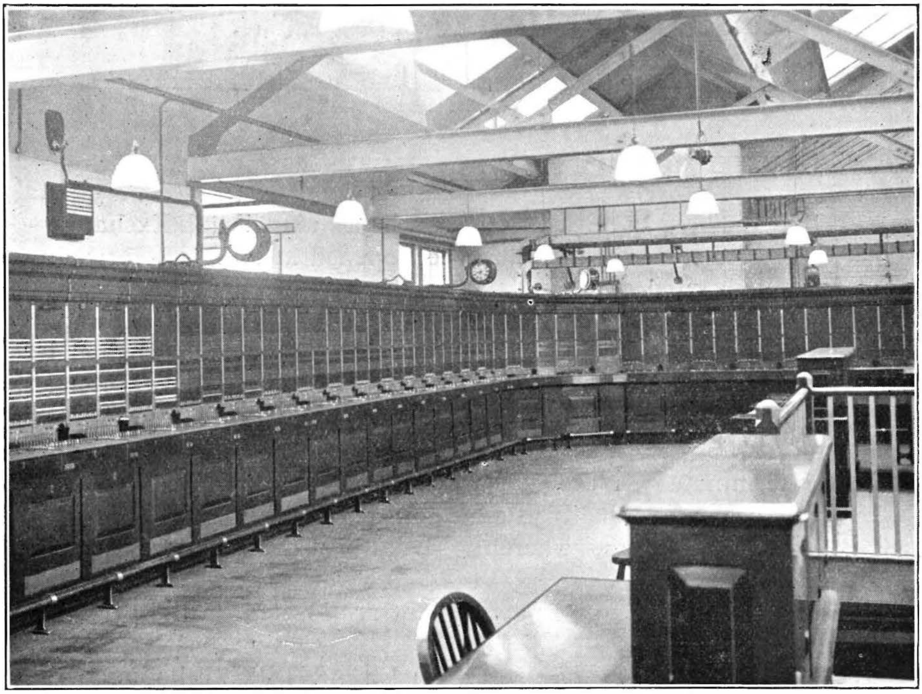


FIG. 1.—PART OF MAIN SWITCH ROOM. 25 SECTIONS ARE ON GALLERY ON RIGHT.

The position switching arrangements are divided into three groups:—

(1) Positions dealing with calls incoming from the London Trunk Exchange.

(2) Positions dealing with calls incoming from London local exchanges. These are termed "Control" positions.

(3) Positions dealing with calls incoming from the provincial exchanges in the London Toll area. These are termed "Incoming" positions.

(1) Lines incoming from the London Trunk Exchange will deal with traffic passing through both the London Trunk Exchange and the Toll Exchange. The traffic will circulate over groups of order wire junctions which terminate at the Toll Exchange on positions equipped similarly to incoming order wire " B " positions at local exchanges. Three positions, Nos. 1, 2, and 3, each equipped with 30 plug-ended junctions with interrupt jacks, will be allocated for this traffic, control being vested in the trunk exchange operator.

(2) Lines incoming from London local exchanges are terminated on lamps and jacks. The traffic over these lines will be controlled by the Toll Exchange Operator.

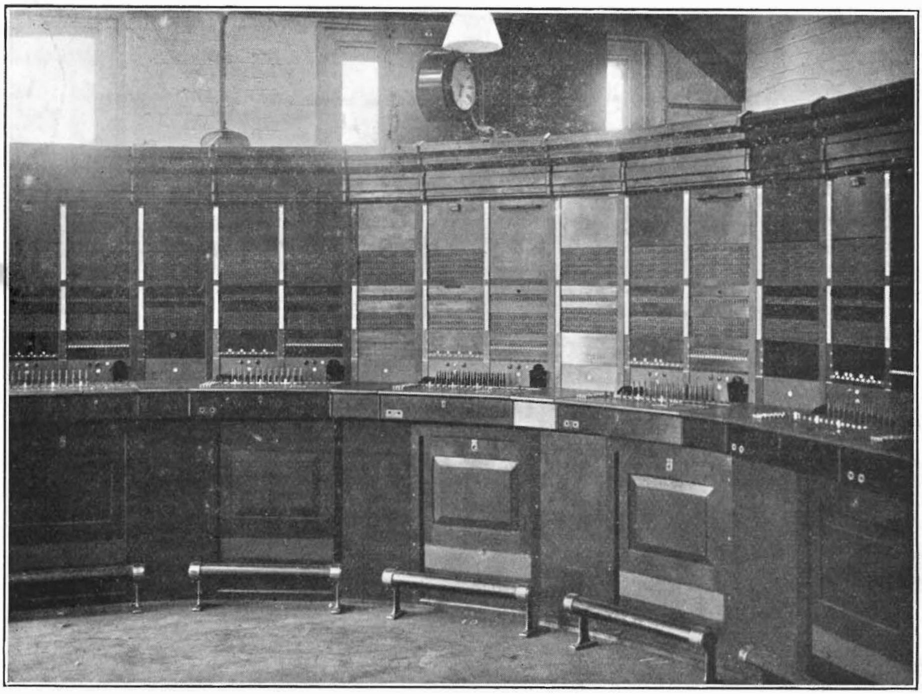


FIG. 2.—VIEW SHOWING MULTIPLE IN ANGLE SECTION.

Subscribers in the London Telephone Service area have been supplied with a list of Provincial Exchanges which will be obtained through the London Toll Exchange, and have been instructed to ask for " Toll " when desiring to make a call to any of these exchanges. The local " A " operator on demand for " Toll " will connect the subscriber to a disengaged Toll junction and the Toll Operator, after taking particulars of the required connection from the subscriber, will ticket and take control of the connection. Owing to traffic considerations through clearing from the distant provincial subscriber to the London "A" Operator will not be resorted to over these circuits.

(3) Lines incoming from the Provincial Toll Area will terminate on jacks and lamps similarly to those incoming from London local exchanges. Traffic over these lines will, however, be controlled at the originating provincial exchange, and the position on which they will be allocated at the Toll Exchange will be known as

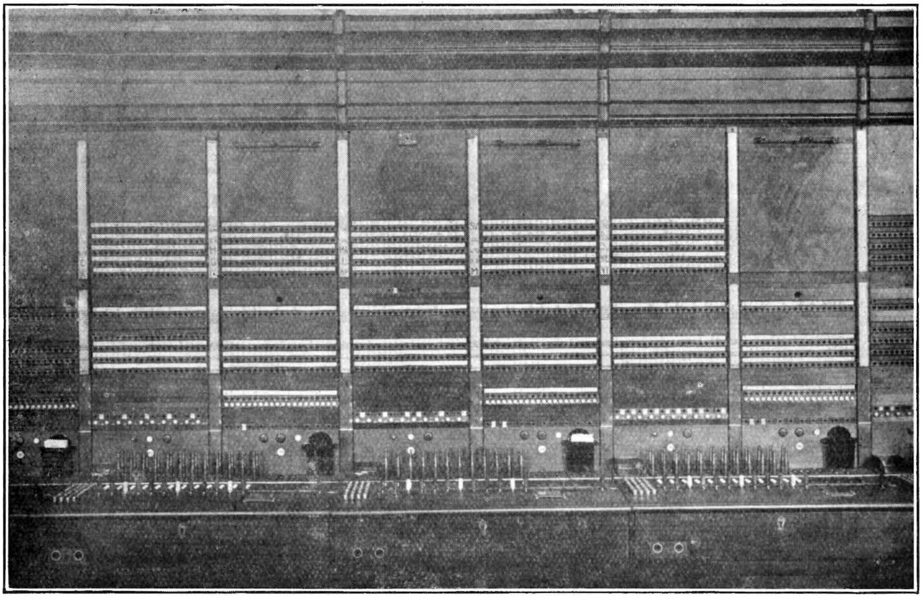


FIG. 3.—PART OF CONTROL POSITIONS. FRONT EQUIPMENT.

"Incoming" positions. Such positions will be equipped with through clearing cord circuits and no record of this traffic will be kept in the Toll Exchange.

As stated previously, positions Nos. 1—3, equipped with order wire junctions from the London Trunk Exchange, will be used for (*a*) Calls originating at provincial exchanges outside the London Toll Area for provincial exchanges served through the Toll Exchange, and (*b*) Calls from Exchanges connected to the London Toll Exchange for provincial exchanges served through the London Trunk Exchange. In the case of (*b*) particulars of the call will in the first instance be passed over a record circuit to the London Trunk Exchange and on maturity the call will be reversed. Each of these positions is equipped with 30 Incoming junctions (to diagram C.B. 1905) as shown in Fig. **6**.

Positions Nos. 4—63, forming the "Control" positions, are each fitted with 10 answering jacks and lamps for lines incoming from London local exchanges. For night and slack period working facilities are provided, by the throwing of a key fitted at the top of each panel, and common to 10 or 20 circuits, for groups of these lines to be concentrated on positions Nos. 4—23. The line connec-

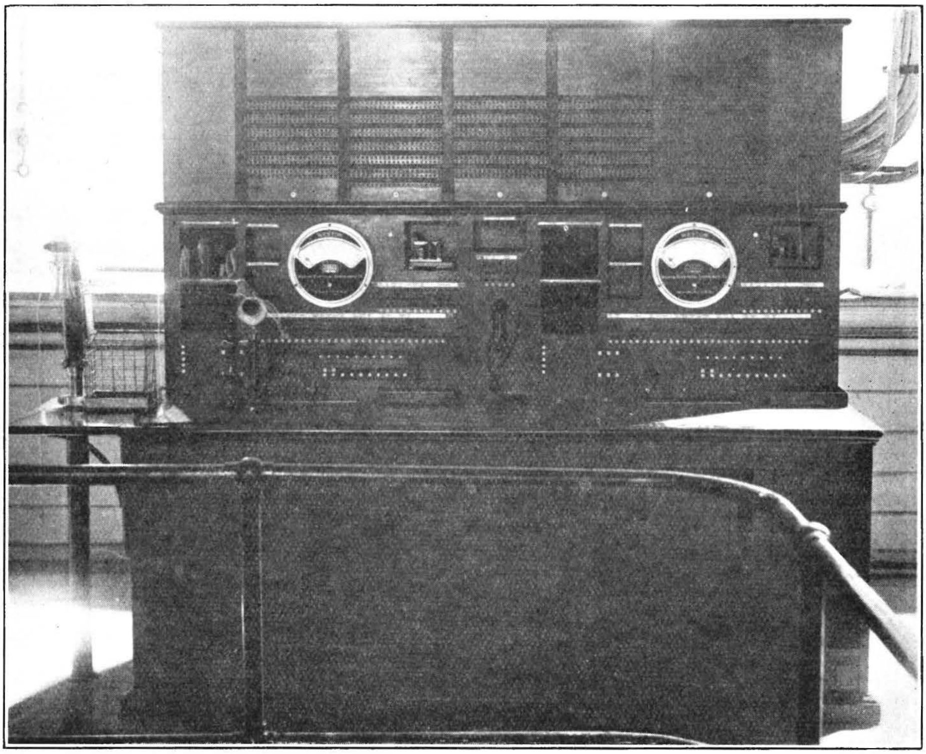
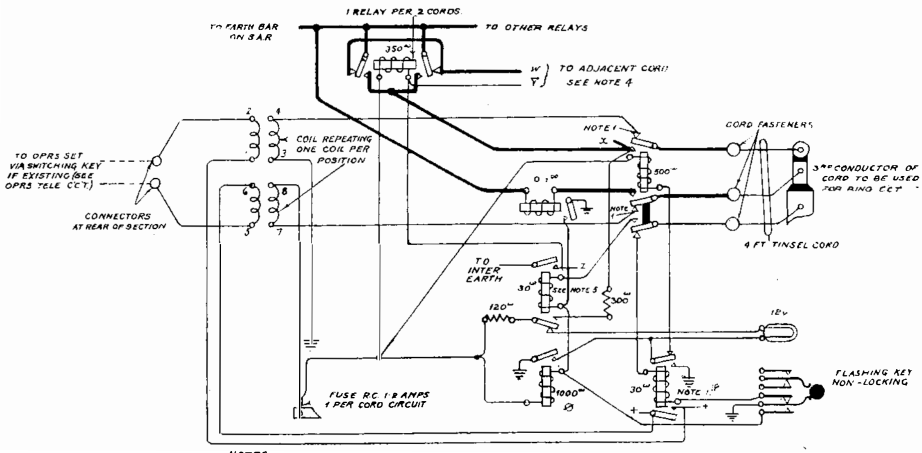


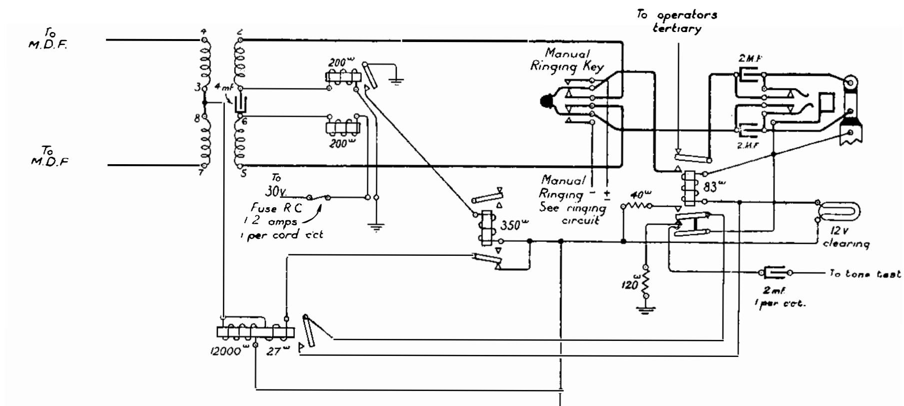
FIG. **4**.—TEST BOARD SHOWING TEST BREAK-JACKS ON TOP OF DESK.

tion for those circuits normally associated with the concentration positions is shown in Fig. **7** (C.B. 932), while those required to be terminated on these positions during the concentration period are shown in Figs. **8** and **9** and (C.B. 1090 and 1091 with 30^{ω} cut-off relays). Each position is equipped with 12 pairs of connecting cord circuits, those on positions Nos. 4—58 are wired to Fig. **10** (C.B. 933), while those on positions Nos. 59—63 are wired to Fig. **11** (C.B. 902 C). Those on position Nos. 59—63 are provided with control or through clearing facilities, the latter being required



NOTES -
1 COMMON TO RELAYS SERVING ADJACENT CORDS ON SAME POSITION.
2 THE INTERRUPT PLUG MUST BE INSERTED INTO THE CORD C'CT BREAK JACK BEFORE THE JUNC CORD CIRCUIT PLUG IS INSERTED INTO THE SUBSCRIBERS JACK THE CORD CIRCUIT SPEAKING KEY (WHERE IT EXISTS) MUST BE THROWN WHEN CHALLENGING
3 LINES SHOWN ▬▬ TO BE OF HEAVY GAUGE SEE SPEC "TYPES OF CABLE WIRE ETC"
4 WIRES W & Y TO BE CONNECTED TO POINTS X & Z RESPECTIVELY OF ADJACENT CORD
5 WILL NOT OPERATE OR RETAIN IN SERIES WITH RELAY Ø

FIG. 5.—INTERRUPT CORD CIRCUIT ON POSITIONS INCOMING FROM TRUNKS.



※ The tone connection is not req'd where only two trunk positions exist.
When provided, the tone leads are to be in a separate form or cable.

FIG. 6.—LINES INCOMING FROM LONDON TRUNK EXCHANGE.

in connection with the incoming lines which will be terminated on these positions during the concentration period.

Positions Nos. 64—93 are equipped for dealing with incoming traffic from provincial exchanges in the London Toll area, and are designated "Incoming" positions. Each position is equipped

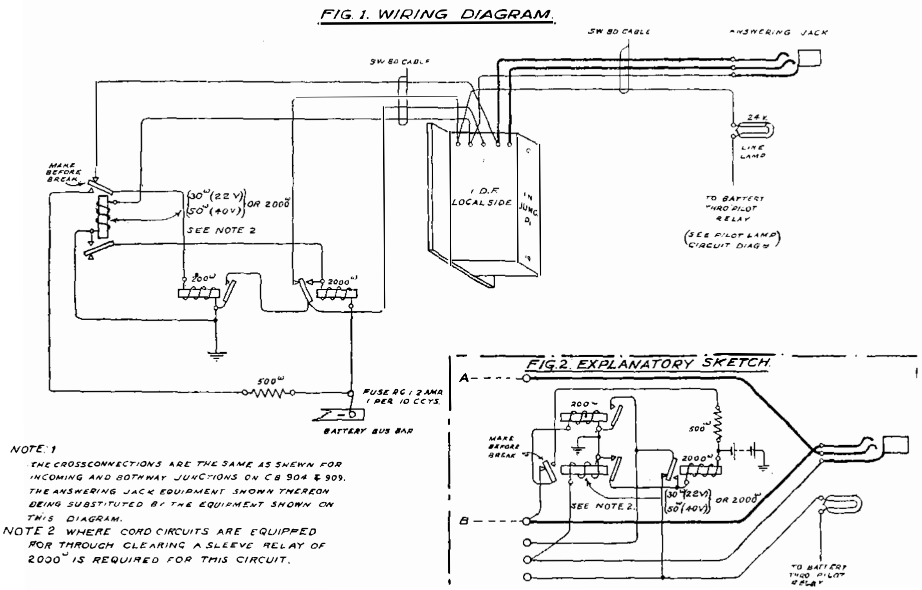


FIG. 7.—LINES INCOMING FROM LONDON LOCAL EXCHANGES.

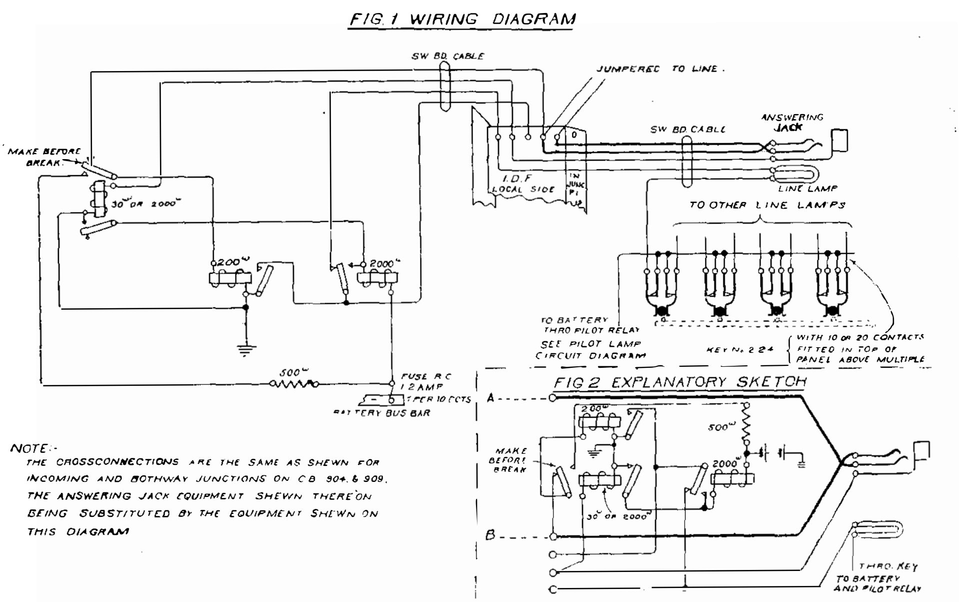


FIG. 8.—LINES INCOMING FROM LONDON LOCAL EX AND PROVINCIAL TOLL EXCHANGES WITH CONCENTRATION FACILITIES.

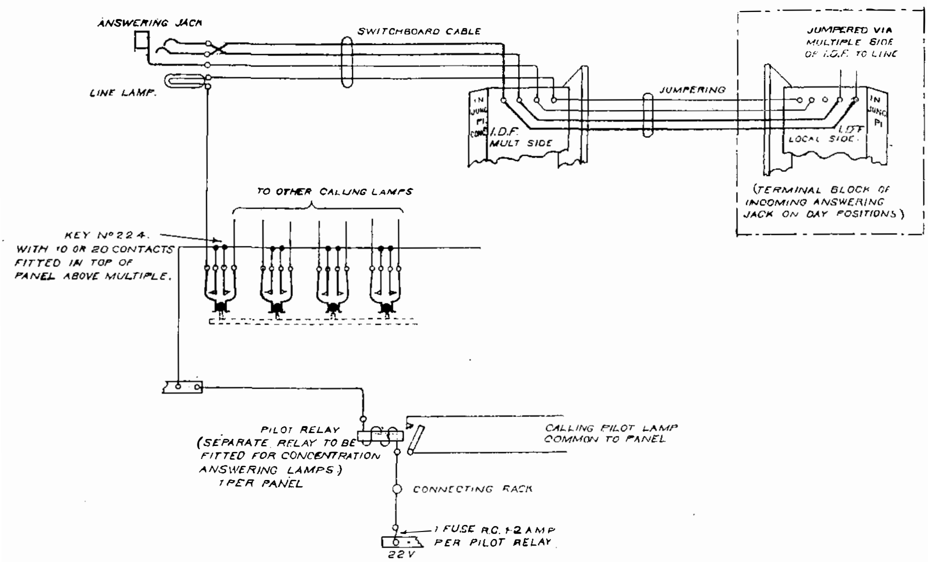


FIG. 9.—CONCENTRATION ANSWERING JACK ON CONCENTRATION POSITIONS.

with 20 answering jacks and lamps. For night working, arrangements are provided for concentrating all such incoming traffic on positions 59—68. The line circuit normally associated with these positions is similar to those on the control positions Nos. 4—23 excepting that the cut-off relay is wound to 2000ω. Similarly, those

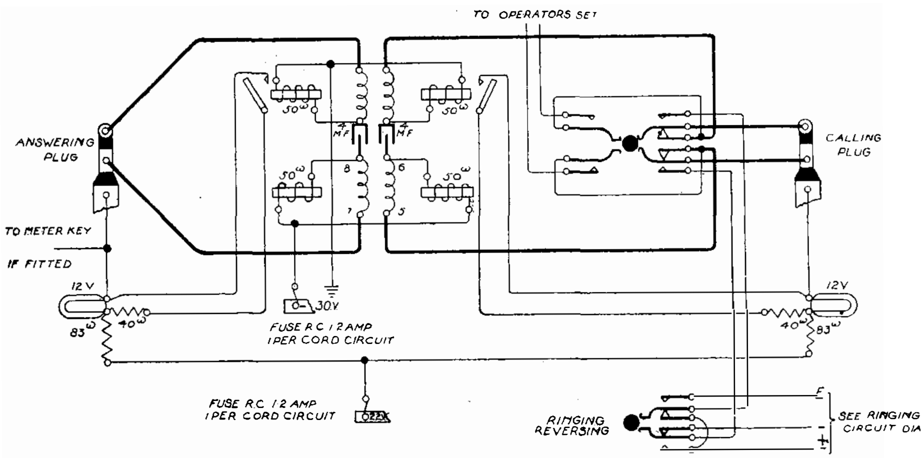


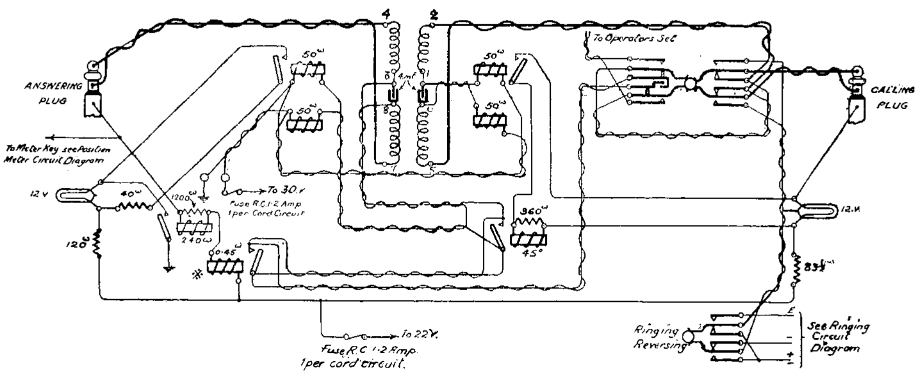
FIG. 10.—CORD CIRCUIT ON CONTROL POSITIONS.

The relays and retard coils are 200ω each. The ringing reversing key is not fitted.

to be concentrated follow Figs. **8** and **9** with 2000^{ω} cut-off relays. Seventeen through clearing cord circuits to Fig. **11** (C.B. 902) are provided on each of these positions.

The outgoing junctions consist of a six panel multiple which is continued throughout the exchange including the angle sections. It is divided into three groups and consists of 500 multiple jacks fitted in the upper portion of the multiple field for outgoing traffic to London local exchanges; 120 for Toll outgoing junction traffic fitted beneath, and 380 in the lower portion for outgoing Toll traffic fitted with group selective testing facilities. Fig. **12** refers.

Where four or more outgoing lines are provided to a provincial Toll exchange these lines are divided into groups of four, and with each group is associated a "group-engaged" test jack. The group-engaged test jack is fitted with a metal stud having a concave



Note 1 * This relay does not operate when the answering plug is inserted into an incoming junction jack.

FIG. **11**.—CORD CIRCUIT ON "INCOMING" POSITIONS.

The relays and retard coils are 200^{ω} each. The ringing reversing key is not fitted.

surface and is the 1st jack in each group of 5. Thus, in a group of 16 lines to any one provincial exchange, jacks No. 0, 5, 10 and 15 will be group-engaged test jacks.

In the event of all the toll lines connected to the four jacks immediately following a stud being in use, an engaged click will be received by the telephonist when the tip of a plug is applied to the stud. If all the lines in the group are not engaged the click will not be received, and as each jack in the group is provided with an individual engaged test each separate jack in the group is tested until a disengaged line is found. In the case of the test being received on the test stud, the operator makes similar tests in the group allocated to her for second choice. Fig. 12 refers. (C.B. 891).

Cord testing facilities are provided on each alternate position, and plugging-up lines to the test desk are equipped on the end positions in the main Switchroom. Test extension lines to the Test Desk are provided on a similar position in the gallery.

Out-of-order tones are provided for use in connection with faulty outgoing Toll and Signal Junctions, and lamp flashing interrupt facilities are arranged for on the positions incoming from Trunks. A group of 40 order wire keys is multipled throughout the exchange

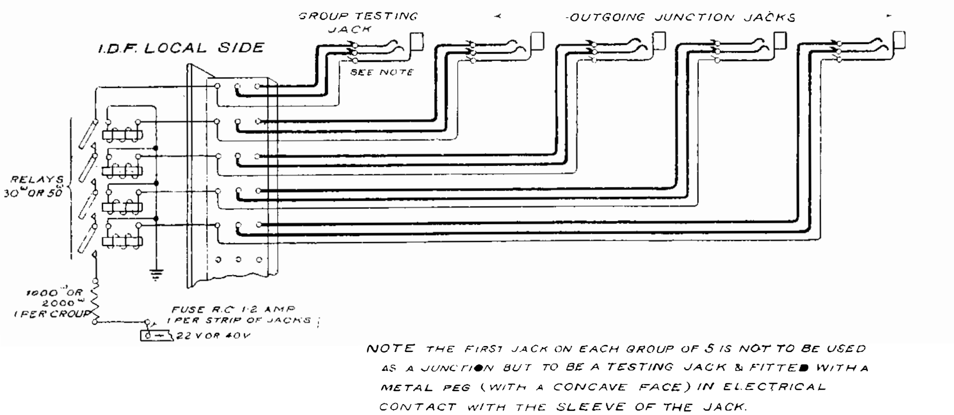


FIG. 12.—OUTGOING JUNCTION WITH "GROUP ENGAGED TEST."

and order wire ringing keys are provided for use when continuous listening is not in force.

The desk equipment consists of the following:—

1—One position desk for Traffic Superintendent.
1— ,, ,, ,, ,, Supervisor.
2—Four positions Information and Enquiry desk.

The whole switching equipment was manufactured and installed by Messrs. The Western Electric Co., who kindly furnished copies of the photos accompanying this description.

R.T.K.

MEASURED RATE SERVICE AT AUTOMATIC EXCHANGES ON 2-PARTY LINES.

Measured Rate Service on Party Lines under Manual conditions, presents difficulties, owing to the necessity for ticketing the calls. When an attempt is made to operate Party Lines on the Measured

Rate Service at Automatic Exchanges, the difficulties are, of course, increased, and it has generally been thought necessary to connect such lines to an operator's position for the completion of originated traffic. In such cases it has been customary to operate the incoming traffic automatically upon the "number-per-station" principle. In this country, with the introduction of the new rates, the only Party Service offered, apart from Rural Party Lines, is the 2-Party line, and it is felt that the case now presents such improved conditions as should permit of the practical solution of the Measured Rate Party Line problem so far as Automatic Exchanges are concerned.

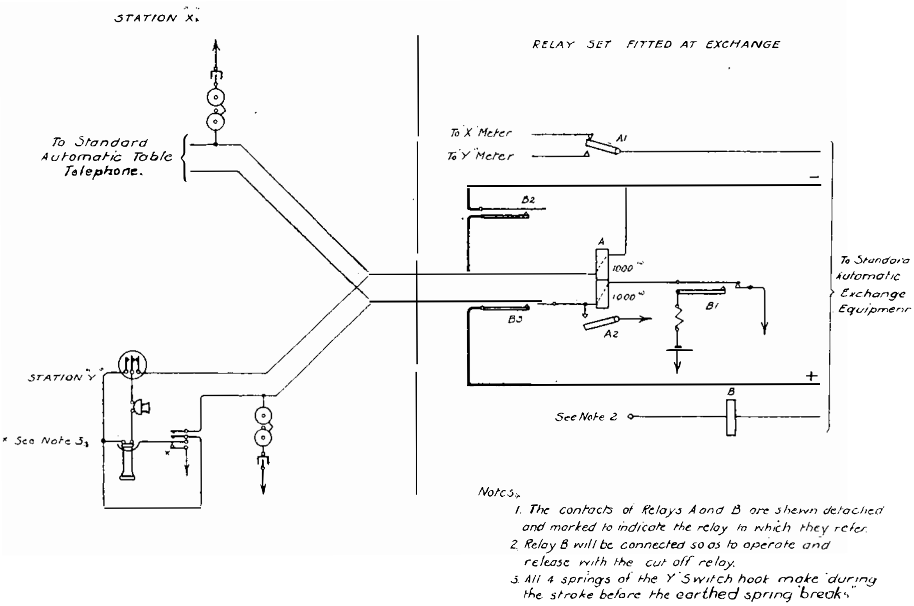
The first efforts at solution lay in the direction of the installation of a sub-station Meter at each Party Line subscriber's house or office, but the operation of this meter, however simple electrically and mechanically, involved modifying the conditions in the exchange plant in a way that proved troublesome. Further, the reading of sub-station meters is inconvenient and expensive and their maintenance is appreciable.

Efforts were, therefore, made to design a Party Line circuit suitable for all automatic systems, which would operate under the normal metering conditions of the exchange concerned and would register calls for each party on a meter individual to that party. Such a circuit is very desirable *because of its universal character* and also on account of its applicability to the severe conditions that follow multi-office working on an automatic basis. Experimental circuits are now on trial and promise well, and it is thought that some details may be of interest to the readers of this Journal.

It will be seen from the figure illustrating this article that a double-wound discriminating Relay is provided at the exchange. The directions of the current in each of the two windings of this relay (A) are such that they neutralise each other when a loop call is given by station "X," and the call then proceeds with the meter relating to station "X" left ready for the passage of a metering current when the call becomes effective. Calls originated by station "Y" earth-connect the negative line during the long-stroke movement of the Switch-hook contacts from the "normal" to the "operated" position, and this current *viâ* the Switch-hook earth connection passes through one winding of A and serves to operate that relay after which its local contacts earth-connect and so short-circuit the second winding. This operation of relay A substitutes the "Y" for the "X" Meter and the subsequent operation of the Subscriber's cut-off relay provides conditions that energise relay B; the latter then joins up the Earth-connected winding of A to battery, thereby providing a retaining circuit. When possible, Relay B is connected in *parallel* with the cut-off Relay, but when (as is the case in some Automatic systems) this is not practicable, B is operated *by* the cut-off Relay.

It will be seen that on both originated and incoming calls, B serves to cut the windings of relay A out of the transmission circuit during conversation.

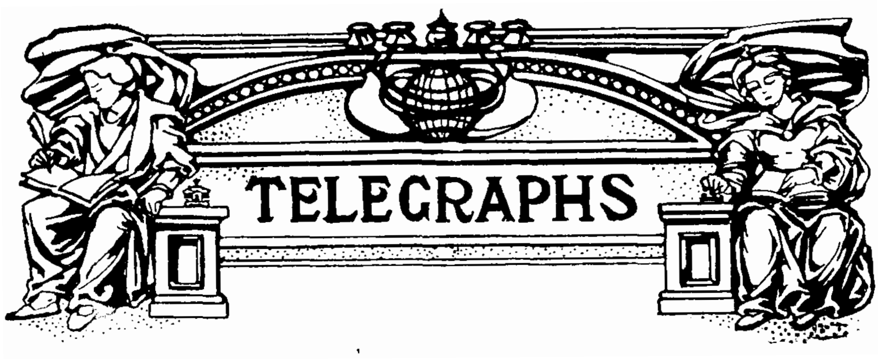
So far as the Exchange equipment is concerned, arrangements can be made to leave the existing cabling undisturbed, the circuits being jumpered at the I.D.F. to the special auxiliary relay sets described above. The meters proper to the two numbers allotted to the party stations will be used.



Special arrangements have been made hitherto to provide Reverse Ringing Units for "Y" party working, but the abandonment of the use of sub-station meters which contain polarised relays will render that course unnecessary. The ringing of the "Y" party Subscriber will be provided for by a cross connection on the Distribution Frame.

So far as the modifications to the standard instruments are concerned, it will be clear that no special steps need be taken for the "X" Station from which a "loop" calling signal is required. A simple modification to the Switch-hook springs of a standard telephone provides a telephone suitable for use at the "Y" Station.

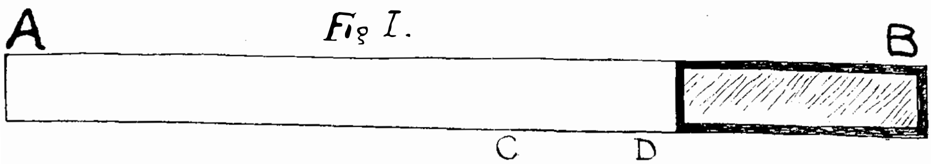
W. WHEELER

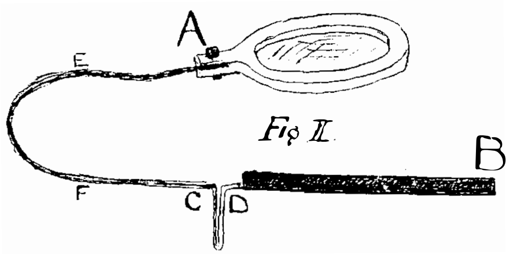


A COMBINED LENS AND MIRROR FOR OBSERVING RELAY CONTACTS.

J. G. WILSON.
Llanfairpwll Repeater Station.

MY experience of practical repeater working, extending over a period of many years, has shown the need for a simple and reliable device for examining and adjusting the contacts of the Standard Post Office Relay. With this view I have constructed a little





instrument, shown in Figs. **1** and **2**, from a strip of aluminium, AB, $4\frac{3}{4}''$ long, $\frac{11}{32}''$ wide and $\frac{1}{64}''$ thick. At one end a mirror, DB, $1\frac{5}{16}''$ long, $\frac{11}{32}''$ wide and $\frac{3}{64}''$ thick is fastened by gummed paper tape, which also prevents possible accidental short-circuits by the aluminium strip. The aluminium strip is then bent at CD to form a foot, so as to ensure that the mirror and lens occupy a correct position in regard to the contacts of the relay under examination. In order to adjust the focussing of the lens, holes are drilled at E and F, through which is passed a screw with an adjustable nut. The lens is mounted in an ebonite frame and clamped in position.

The photograph, Fig. 3, shows the instrument in position on a Post Office relay. The mirror reflects light on to the contacts and facilitates observation in adjusting the contact screws and in watching the working of the tongue of the relay; while the lens gives an appropriate magnification, leaving both hands entirely free for making adjustments.

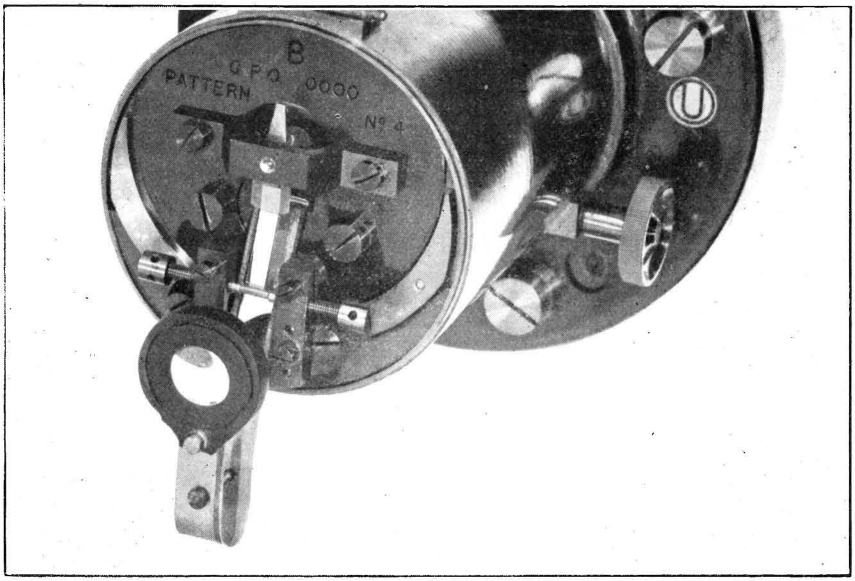


FIG. 3 —LENS AND MIRROR IN POSITION ON RELAY.

It has been found to be particularly useful in connection with the adjustment of the relays working the automatic switch, and has facilitated the rather delicate and somewhat difficult correct regulation of the neutral springs. Faults in working, caused by inequality in the resilience of the springs, or slight fouling of the contacts, are by its use more quickly detected and more easily removed.

WIRELESS

CAISTER WIRELESS STATION.

Caister Wireless Station was one of the first Marconi Wireless Coast Communication Stations and was erected originally in 1901. It was taken over by the Post Office when the Coast Communication Service was required in 1909. Its use for ship and shore work became unnecessary with the installation of North Foreland and Cullercoats Wireless stations, and it was decided after the war that it should be reconstructed for "point-to-point" working with the near Continental countries, such as Holland and Belgium.

A brief general description of the transmitting plant at the reconstructed station, which is now fitted with a Continuous Wave Wireless Transmitter of the Valve type, may be of interest to the readers of this Journal.

Aerial System. It was decided to leave the arrangement of the aerial system unaltered for the present. There are two masts of 150ft. and 80ft. in height respectively. These masts support an aerial of two 7/19 bronze wires 15ft. apart, the total length of the aerial being about 400ft. The capacity of the aerial is 1,300 $\mu\mu$F. and its inductance is 50 μH. The natural wave length of the aerial is therefore approximately 480 metres.

The continuous wave system necessitates a very high standard of aerial insulation, and this was improved by the substitution of the old aerial insulators by porcelain insulators (3ft. long) of the candle type and the fitting of a new porcelain leading-in insulator.

Power Plant. The electrical energy required is generated at the Wireless Station as no public supply is economically available. The prime mover is a 10 H.P. "Pelapone" oil engine, direct-coupled to a 5.K.W.C.C. generator which supplies current for charging a 176 ampere-hour secondary cell battery. The power supply to the Wireless Transmitter is obtained from a Motor-Alternator (driven from the battery) which delivers alternating current at 400 volts, 300 cycles, to the Wireless operating room where it is transformed up to 10,000 volts. The motor-alternator is fitted with a remote controlled starter which is operated by means of push buttons on the operating table in the Wireless room.

Wireless Transmitter. In accordance with modern practice the Continuous Wave system of transmission has been adopted and the High Frequency oscillatory aerial current is produced by means of a valve transmitter.

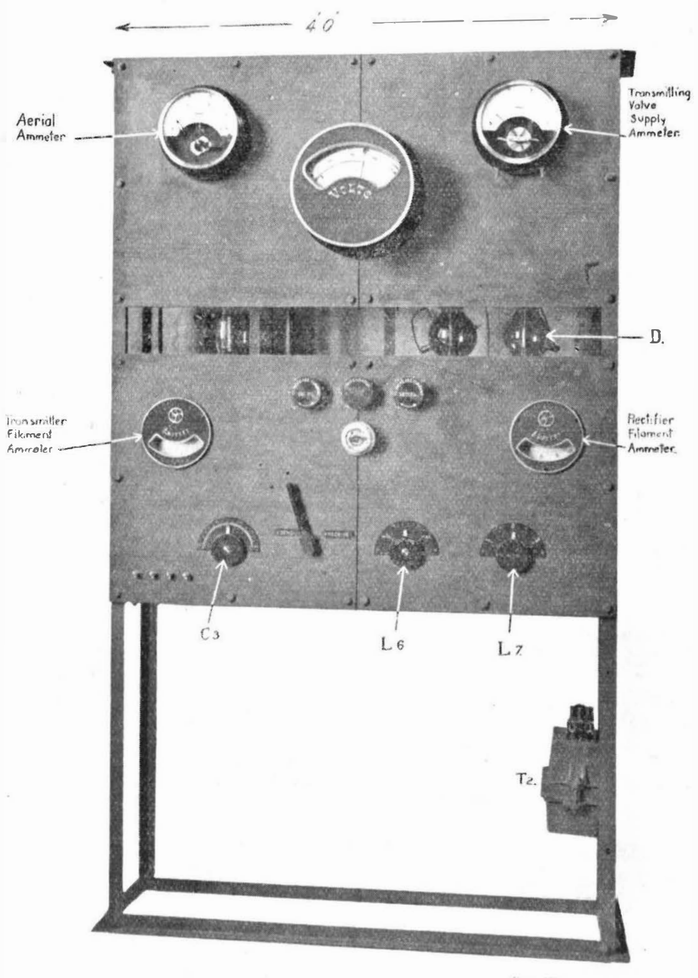


Fig. 1.

Figs. **1** and **2** are photographs of the front and back respectively of the valve panel. A skeleton diagram of the circuit arrangements is given in Fig. **3** and the wiring diagram of the panel is shown in Fig. **4**.

A High Tension Direct Current supply (in this case at 5,000 volts) is necessary for the operation of such a valve transmitter. The rectification of H.T.A.C. is a very convenient method of providing this D.C. power and has been adopted in this case.

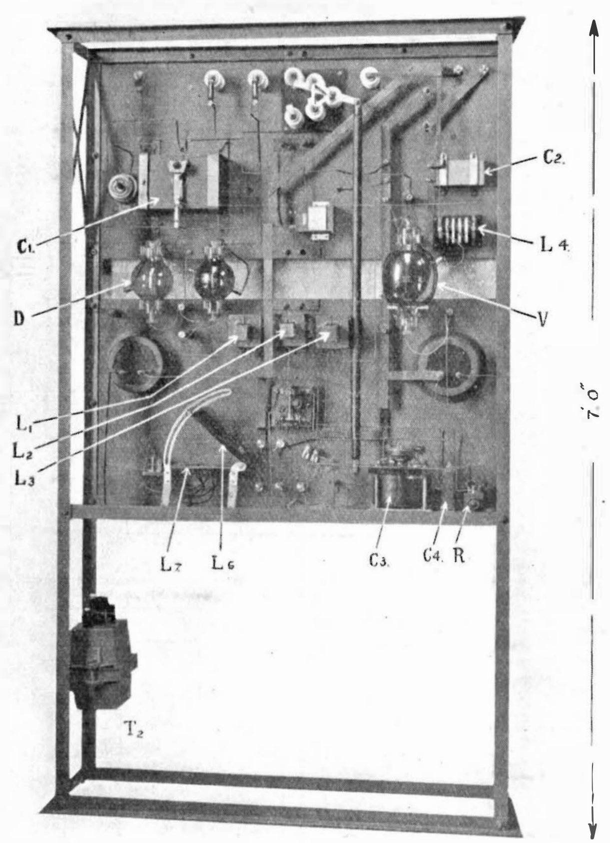
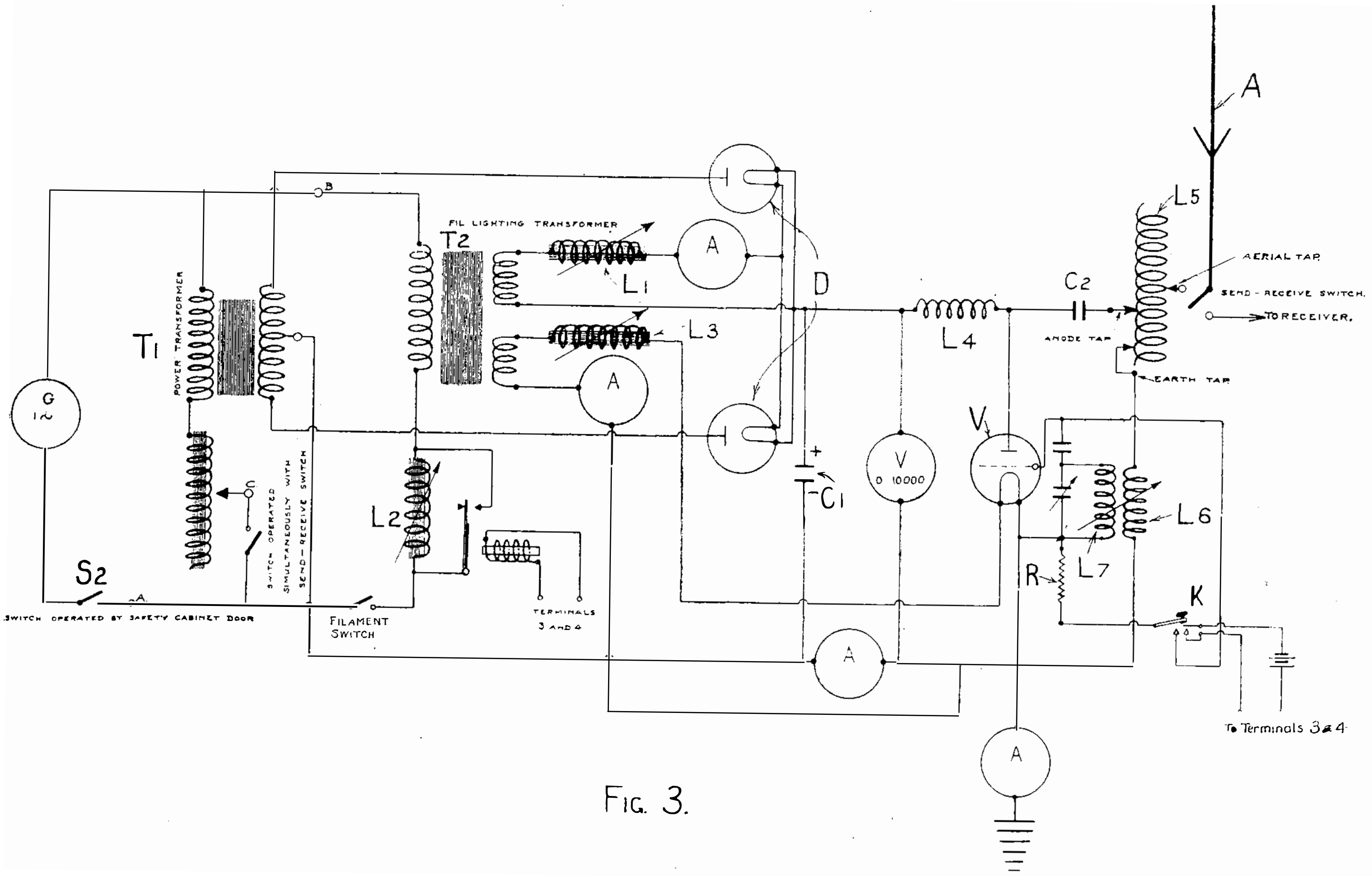


FIG. 2.

It will be seen from the figures that the complete set includes three valves, two of which are used as rectifiers and the third as an oscillator. All the filaments are heated by A.C. suitably transformed down from 400 volts supply by means of a special transformer (T_2) with two secondaries, that for the rectifiers being specially insulated to stand the high potential to which it is subjected. The filament brightness is regulated by the variable chokes (L_1 and L_3). A choke coil L_2 which is inserted in the primary



A
L5
AERIAL TAP
SEND - RECEIVE SWITCH.
TO RECEIVER.
C2
ANODE TAP
EARTH TAP
L4
D
FIL LIGHTING TRANSFORMER
T2
L1
L3
A
POWER TRANSFORMER
T1
G
B
C
L2
SWITCH OPERATED SIMULTANEOUSLY WITH SEND - RECEIVE SWITCH
S2
SWITCH OPERATED BY SAFETY CABINET DOOR
FILAMENT SWITCH
TERMINALS 3 AND 4
C1
V 0 10000
V
L6
L7
R
K
To Terminals 3 & 4

Fig. 3.

circuit of the filament lighting transformer is short-circuited when the Key is depressed to compensate, so far as the filament circuit is concerned, for the drop of alternator voltage on load.

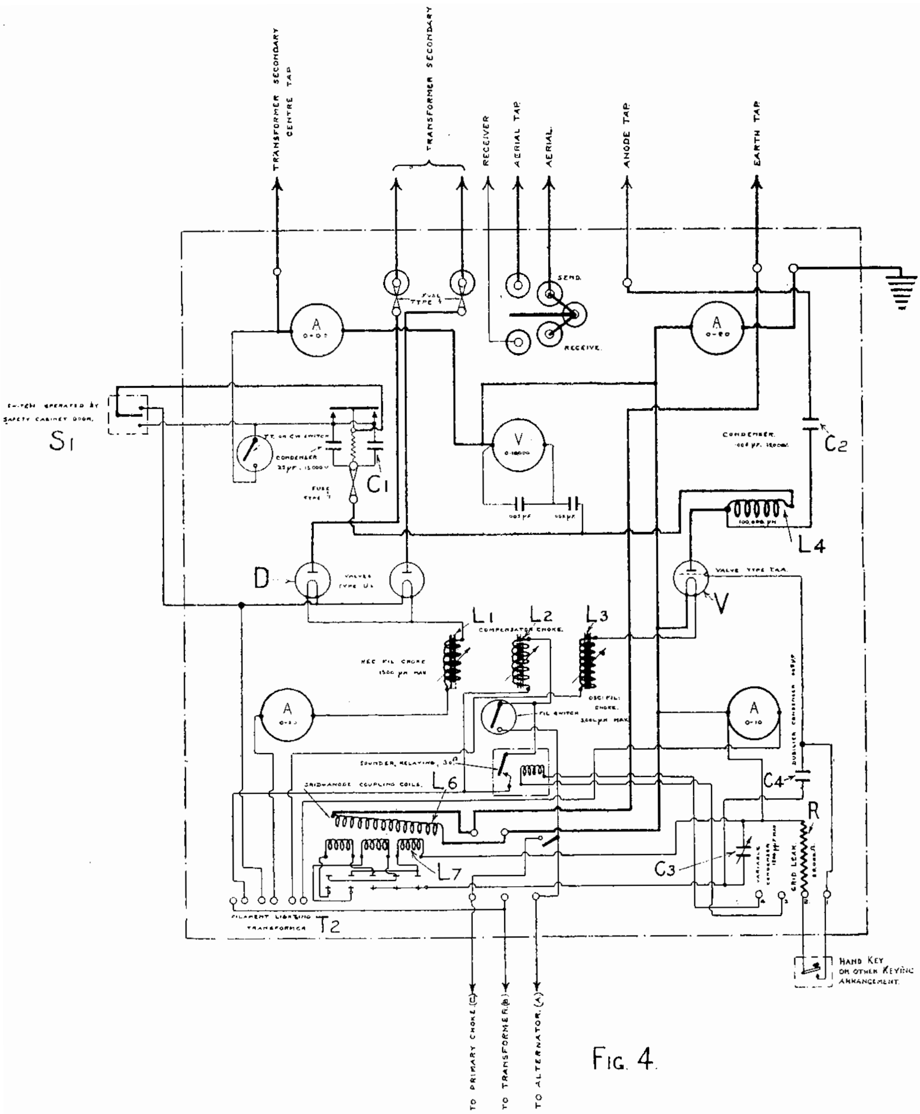


FIG. 4.

The rectifying apparatus consists of two diodes (D) and a smoothing condenser (C_1) of .25 μF capacity connected as shown in the diagram. It will be seen that in this arrangement the plates of the diodes are connected to the opposite ends of the secondary of the main transformer (T_1), and consequently become positive with reference to the centre point of this secondary in turn; owing to the rectifying properties of the diode, pulsations of current flow alternately through the diodes into the smoothing condenser C_1, one side of which is connected to both the filaments; the other side of the condenser is connected to the céntre point of the transformer secondary and the terminals of the condenser marked + and – can therefore be regarded as the source of D.C. power to the transmitter valve. An air core choke L_4 of large inductance is placed between this source of supply and the anode of the transmitting valve to confine the high frequency currents to the oscillating valve circuit.

The oscillating valve is a triode, capable of dissipating about 400 watts, and is used in connection with an oscillating circuit of the well-known type shown in Fig. **3**.

The main oscillating circuit consists of the aerial (A) and the aerial tuning inductance (L_5) and the coil L_6, which has a variable inductive coupling to coil L_7, which is in the grid circuit.

Fig. **5** is a photograph of the aerial tuning inductance. It consists of 150 turns of 243/40 stranded enamelled copper wire mounted on a framework of best quality paxolin. It has a total inductance of 3,000 μH, and suitable tapping points are led out to terminals as shown in the photograph.

It will be remembered that according to the well known principles of self-oscillation of the triode the oscillating circuit must be so designed that the periodic variation in anode voltage produced by the HF oscillating current is accompanied by a similar variation of grid voltage opposite in phase.

The variation of anode voltage is obtained in this case by means of a variable tapping from the anode to the aerial inductance *viâ* the blocking condenser (C_2), which is necessary to avoid the short-circuiting of the main supply. The variation of grid voltage is induced by the variable coupling between the coils L_6 and L_7, the exact phase relationship with the anode voltage variation being obtained by means of the variable condenser C_3. It is necessary to adjust carefully all these three variables, anode tap, grid coupling and grid condenser to obtain the best oscillating conditions at any particular wave-length.

In order that a valve transmitter should operate with the highest possible efficiency it is necessary that the mean grid voltage while oscillating should be negative relative to the filament to an extent dependent upon the characteristics of the valve in use. This is achieved by the use of the grid condenser (C_4) and the grid leak coil R (20,000 ohms).

The set is operated by means of a key (K) in the grid leak circuit, as shown in Fig. 3. When the key is released the grid becomes so highly negative relative to the filament that no flow of current through the plate circuit of the valve is possible and in consequence the oscillations cease. The depression of the Key provides a path (*viâ* the grid leak coil R) for this negative charge to leak away and the oscillations re-commence.

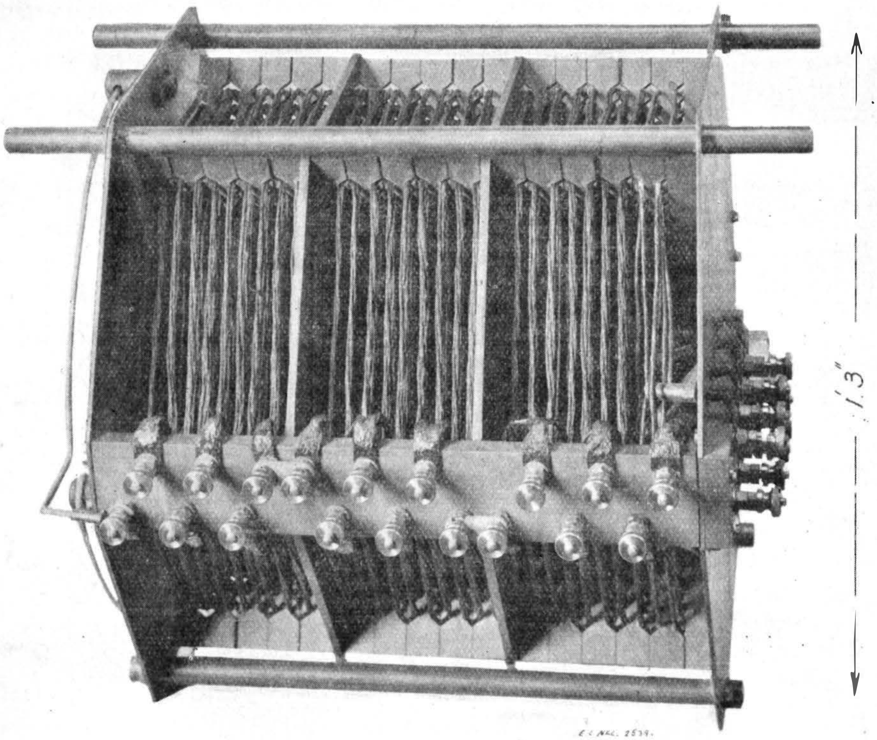


Fig. 5.

As the currents dealt with at the Key contacts are small control by a Wheatstone transmitter is possible, and this valve set has been operated up to speeds of 150 words per minute without difficulty over a distance of 400 miles.

The power delivered to the aerial by this transmitter at full load is about a Kilowatt, the aerial current varying from 7 to 12 amps according to the resistance of the aerial at the particular wavelength in use. It is hoped that alterations to the aerial and earth system which are contemplated will result in a considerable increase in the aerial current.

The efficiency of the valve oscillating circuit approximates to

75%, and the overall efficiency of the Wireless transmitter, including transformer, rectifiers and filament watts, is about 50%.

The valve panel forms one side of a H.T. enclosure in the wireless operating room; all H.T. apparatus and wiring is placed inside this enclosure, the door of which is provided with two safety devices (S_1 and S_2). The opening of the door breaks the main transformer primary circuit and also discharges the smoothing condenser. The panel is placed in such a position relative to the operating table and at such a height that all adjustments of the transmitter, as well as the operation of the send-receive switch, the control of the motor alternator and the adjustments of the receiver can be carried out by the operator from his normal working position.

The station was reopened on the 18th May for commercial service with Amsterdam and since that time has worked quite successfully. Working at hand speed for six days per week at 12 hours per day and as supplementary to the cable routes, the station transmitted a total of 12,091 messages between the date of opening (18th May) and the 31st July. This total gives an average of 16 transmitted messages per hour over the entire working period.

It is anticipated that in the near future the transmitter at Caister will be controlled from a receiving station in London, which will thus permit a high speed duplex service between London and Continental countries.

COMBINED WIRE AND WIRELESS TELEGRAPHY.

CONTINENTAL TRIALS OF MACHINE TELEGRAPHS ON WIRELESS SETS.

In our April issue we reported the results of the Central Telegraph Office—Stonehaven—Königswursterhausen trials and on page 151 of the present number a description is given of the Caister Station, which is now working as a commercial station to Amsterdam and on which Wheatstone has been tried successfully.

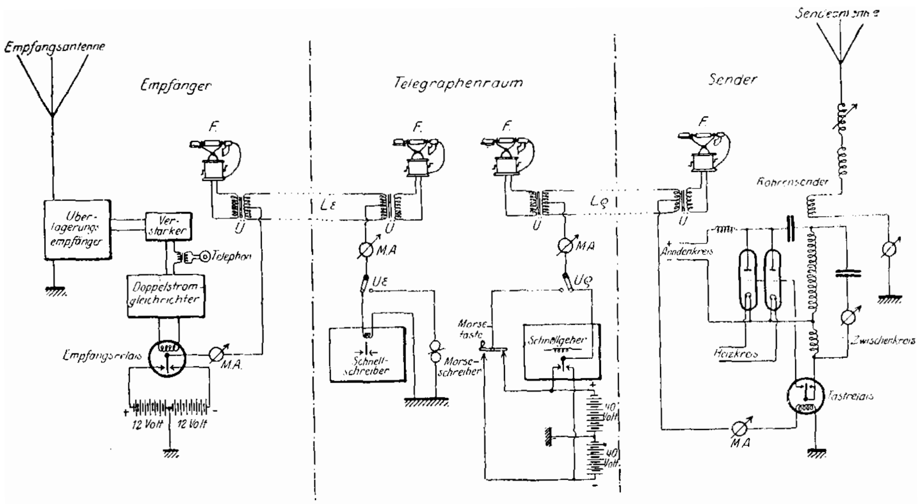
On the Continent of Europe the German and French telegraph administration have been experimenting on the same lines, and we have pleasure in publishing the results of their trials.

German Postal Telegraphs.

The following extract from the "Electrotechnische Zeitschrift," of the 7th July, communicated by Dr. Fritz Banneitz, Director of Telegraphs, summarises the position:—

Installation of the Apparatus.

The method of dividing the installation for Wireless high-speed telegraphy into three sections has proved itself advantageous. This method is shown in the Fig. The Wireless transmitter, the Wireless receiver and the Machine-telegraph apparatus are separated locally from one another. For the last mentioned the most suitable place is the instrument room of the telegraph office, and at times it would be useful if this were placed near the apparatus



GLOSSARY

Empfangsantenne—Receiving Antenna.
Uberlagerungs emfanger—Leak Receiver (Superposed).
Verstarker—Amplifier.
Doppelstrom-gleichrichter—Rectifier.
Empfangsrelais—Receiving relay.
Schnell-schreiber—Fast speed printer.
Morse-schreiber—Morse printer.
Morse-taste—Morse key.
Schnell-geber—Fast speed transmitter.
Anodenkreis—Anode (plate filament) circuit.
Heizkreis—Heating circuit.
Tastrelais—Key or sending relay.
Zwischenkreis—Intermediate circuit.
Rohrensender—Tube (thermionic) sender.

for wire connections between the same places. From the standpoint of technical operating this has the great advantage that telegrams can be dispatched either by wire or by wireless. This advantage is chiefly felt when the same high-speed telegraph system can be used for both wire connections and wireless.

The prepared punched slip can then be dealt with as the need arises by wire or by wireless.

In addition, a far-reaching adaptation of wireless to wire telegraphy can be reached and it can be utilised without further training of the available staff. It is advantageous to instal the transmitter in such a place where the erection of the masts for the antennæ and the installation of the machine plant can be well carried out. In the choice of a site for the receiving plant special care must be taken that it will be free from disturbance. Buildings in the neighbourhood of electric power plants and tramways are therefore not suitable.

A double-line (LS and LE) will be used for connecting the telegraph apparatus with the transmitter on the one side and with the receiver on the other. This double-line serves equally well for telephonic communication with the staff working the apparatus as for the transforming of the telegraph current. The telephone apparatus is joined to these double lines by intermediate connections of ring transformer, and the telegraph current is led over these lines in parallel. By means of the Switches US and UE, high-speed working or key working (Morse-key and Morse-writer) can be resorted to.

In order to transform the signals from the telegraph plant to the wireless plant and *vice versâ*, double current operating as in ordinary (wire) telegraphy is used.

Experiments with Wheatstone Machine Telegraphs.

The first experiments were carried out with Wheatstone machine telegraphs. This telegraph system was used as neither synchronism nor adjustments after disturbances were necessary.

Very good results were obtained in the use of this system, especially as the apparatus is not so sensitive in relation to the exactitude of the signals as is a type printing telegraph.

Extensive trials were carried out with Wheatstone telegraphs between Berlin and Konigsberg. The operating was quite successful. When great atmospheric disturbance did not exist and when reception was not interrupted by transmitters in the vicinity, it was possible to transmit messages at the rate of 300 letters per minute. At times it was possible to transmit at the rate of 500 letters per minute.

A further wireless connection between London and Berlin, with Wheatstone apparatus, has existed since the beginning of this year. A 5 K.W. valve transmitter was used in this case and was installed in the Chief Wireless Station at Königswursterhausen. The Wheatstone apparatus is installed in the Foreign Section of the Head Telegraph Office and the wireless receiving plant in Berliner Schloss. On the English side an Arc-transmitter situated at Stonehaven (Scotland) was used, which was operated from the London

Telegraph Office. This plant is in use daily from 3 p.m. to 8 p.m., and generally works at a speed of 300 letters per minute. The number of telegrams transmitted, however, does not yet correspond with the working speed on account of atmospheric disturbances and those caused by outside transmitters. During the five working-hours an average of 150 messages only is dealt with daily; on favourable days, however, an output of 300 messages can be reached.

Experiments with the Siemens and Halske High-speed Printing Telegraphs.

In Germany the Wheatstone machine telegraphs on land lines have been completely supplanted for economic operating reasons by the Siemens and Halske high-speed printing telegraphs. The advantages of the latter would seem to point to its adaptability for wireless telegraphy.

Exhaustive tests have been carried out in the laboratory which have given most favourable results. The fear that the unison of this system would be frequently interrupted has not been justified. The unison is maintained, even during long atmospheric disturbances and those caused by other transmitters. False letters only are caused. The synchronism is only lost when continued signals are received from the interrupting stations (long dashes, tuning), yet this can be restored within a few seconds after the interruption is finished. In practical operating it is so arranged that the transmitting station sends the correction signal alternately with the calling signal. It is then easy to find the other station after these signals and to bring in the receiver. A further convenient method of verifying the correct speed of the receiver is the use of reversals, *i.e.*, equal alternating marking and spacing signals, corresponding to the shortest marking and spacing signals used in transmission of ordinary telegrams. On the correct working of the relay the whole of the milliamperemeters of the apparatus must be at zero. If this be attained correct working will be assured. Small disturbances, *e.g.*, the quite small current impulses of an atmospheric discharge do not stop working but mutilate only a single letter. When, for example, the interruption is so strong that the messages are unreadable the receiving station which is receiving badly gives the "stop" signal, and both stations will give the correction signal until the interruption is over. The working speed is hereby limited only by the relay and the speed at which the printing apparatus will work.

The relays, including the grid-signal relay, would operate sufficiently safely with 2000 letters per minute. The Siemens high-speed telegraph can run at a maximum of 900 revs per minute (1 rev. = 1 letter). At this speed, however, the printing is not clear and the mechanical strain is too great. It is not usual to exceed 600 revs. The first experimental wireless plant was tested in a working trial with Siemens' high-speed apparatus between Berlin and Leipzig. The apparatus has been in use since the beginning of this year and works several hours a day at a working speed of 650 letters per minute. 150-200 messages on an average were previously dealt with.

These figures show the suitability of this system for wireless telegraphy when it is understood that the output with this system on a good wire connection is but little better.

Pendulum Telegraph, Hughes and Baudot Apparatus.

Tests were also carried out with Siemens and Halske's pendulum apparatus with regard to its suitability. This apparatus, a description of which has not yet been published, has sprung from the Siemens high-speed apparatus and is also a printing system. The chief difference is that the permanent synchronism of the latter is not necessary between transmitter and receiver, as after a signal is sent the apparatus is brought to a standstill. Each new signal releases the apparatus afresh.

During the time of transmission of a signal, however, synchronism between Transmitter and Receiver is necessary, and this is obtained by means of finely adjusted springs, which set the pendulum in motion. The great mechanical sensitiveness of this apparatus lead, however, to a certain amount of uncertainty of working. The maximum output is only small and amounts to 240 letters per minute. The impulses at this speed correspond, in regard to length, to the impulses of the Siemens high-speed apparatus at 700 revs. The pendulum apparatus can be readily used for wireless telegraphy, but its use is not recommended for the reasons stated above.

Trials were made with Hughes apparatus. This may be used, but it offers little advantage on account of its small output for wireless telegraphy.

The tests with Baudot apparatus are not yet completed. It can, however, be stated that this type of apparatus can be used, but it does not lend itself so readily to high-speed wireless telegraphy as does the Siemens high-speed apparatus.

We should not omit to mention the tests with the "Stille" Telegraphone and the Radiographone of the Telegraphone Company. With the Telegraphone the signals were magnetically fixed on a rapidly moving steel wire, and with the Radiophone they were scratched on a wax roller (phonograph dictaphone).

With a slow movement of the wires or the roller the signals can be heard. This apparatus, however, is not suitable for practical telegraph operating on account of the troublesome translation.

Further Developments of Wireless High-speed Telegraphy.

It will be recognised as a result of these tests that the highest possible safe operating must be obtained for the further development of wireless high-speed telegraphy.

The most sensitive part of the installation is still the receiver. This is markedly brought to our notice if the received signal-strength is small, so that we must operate with large amplification. The surest remedy against this is the use of sufficiently large transmitters which preponderate over the normal disturbances.

With the installation described above and a 1 K.W. Valve transmitter a distance of 300 km. can be sufficiently well operated by high-speed apparatus.

It is, however, to be expected that with improvements in the receiving apparatus the output of a wireless connection can be considerably increased.

Siemens' high-speed apparatus is generally used in the Government Wireless System, as it is superior to all other systems.

It is intended, at least in the large towns of Germany, to instal such high-speed wireless telegraph plants which may take over the traffic when the line communications are interrupted and which can relieve the lines at times of pressure.

French Administration Trials.

Use of Baudot Apparatus.

(*Extracted from an article in "Les Annales des Postes, Télégraphes and Téléphones" of June, 1921, by MM. Henri Abraham and René Planiol.*)

The fact that the equivalent of a land line repeater is necessary at the wireless stations for transforming the land line and wireless signals should be no more detrimental to such a service than to ordinary land line working. The use of the 5-unit code is not quite so convenient as Morse, since the wireless station is unable to check the passing signals, but it is found in practice at land line repeater stations that this facility is not a necessity; the resulting advantages due to the use of the 5-unit code far outweigh this small disadvantage. With the use of test slips which give (*a*) continuous reversals, then (*b*) a prearranged sequence of signals producing one or more Morse letters, the land line repeater is in a position to make all necessary adjustments. This method should equally suffice for the Wireless stations.

The experimental use of the Baudot system was made with a quadruple set at Paris, working over a land line to a small wireless station which sent out automatically C.W. signals to a wireless reception station at Nogent-le-Rotrou, some 120 km. distant, where the receiving apparatus actuated a Baudot printing telegraph set and at the same time sent on signals by wire to Paris in order that a close check could be kept on the accuracy of the working.

The first experiments were made from the Eiffel Tower over a short distance in the early part of 1920, and showed that the Baudot relay was suitable for automatically controlling the wireless transmission, as well as for responding to the reception of wireless signals, when they were suitably amplified. The speed of a Quadruple Baudot set is 33 cycles per second, which gives a printing speed of 120 words per minute.

Fig. 1 shows the general arrangement for the test.

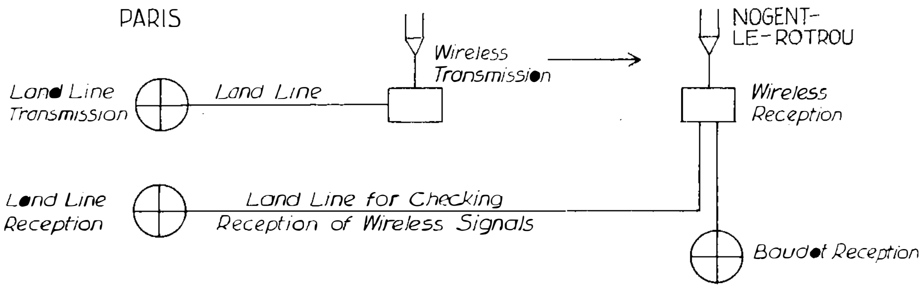


FIG. 1.

The automatic translation of signals from land-line to wireless and from wireless to land-line is an essential requirement for making wireless communication as rapid and as convenient as ordinary land-line working, and the above arrangement shows that this was carried out at both Paris and Nogent-le-Rotrou.

The aerial used at the Paris wireless station was a small one, not exceeding an effective height of 10 metres, while that at Nogent-le-Rotrou was a single loop of triangular shape carried by a mast 30 metres high, or, alternatively, a small frame aerial situated in the reception room. Both aerials gave satisfactory working.

Power for transmission was obtained from the town supply of 110 volts alternating, at a frequency of 42. It was passed through a transformer and a Cooper-Hewitt rectifier.

Connection was made to a valve transmitter, as shown in Fig. **2**. This circuit was coupled very weakly to the transmitting aerial.

In order not to interfere with neighbouring stations the wave-length used was 2,200 metres.

The Baudot relay at the transmitting wireless station received the signals from the land line and controlled the outgoing wireless signals by means of an auxiliary valve, the plate of which was connected to the aerial and the filament connected to earth, as shown in Fig. **3**.

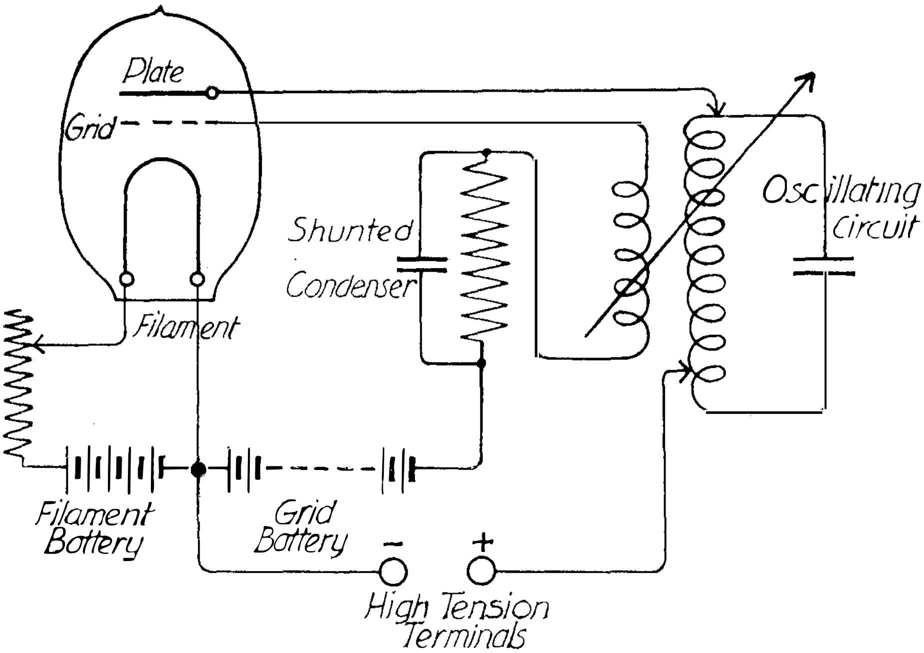


FIG. 2.

A check on the outgoing signals was obtained at the wireless transmitting station by using a small local oscillating circuit connected to a valve which worked a simple form of oscillograph.

The connections of the wireless receiving apparatus are shown in Fig. **4**. Two resonant circuits, primary and secondary, were utilised, each provided with a valve. This arrangement allowed very sharp tuning to be obtained and eliminated to a large extent the effect of atmospheric or other disturbances.

The terminals of the receiving set were connected to a high frequency amplifier with three lamps (Fig. **5**), two of which served as amplifiers and one as a detector. The latter furnished a con-

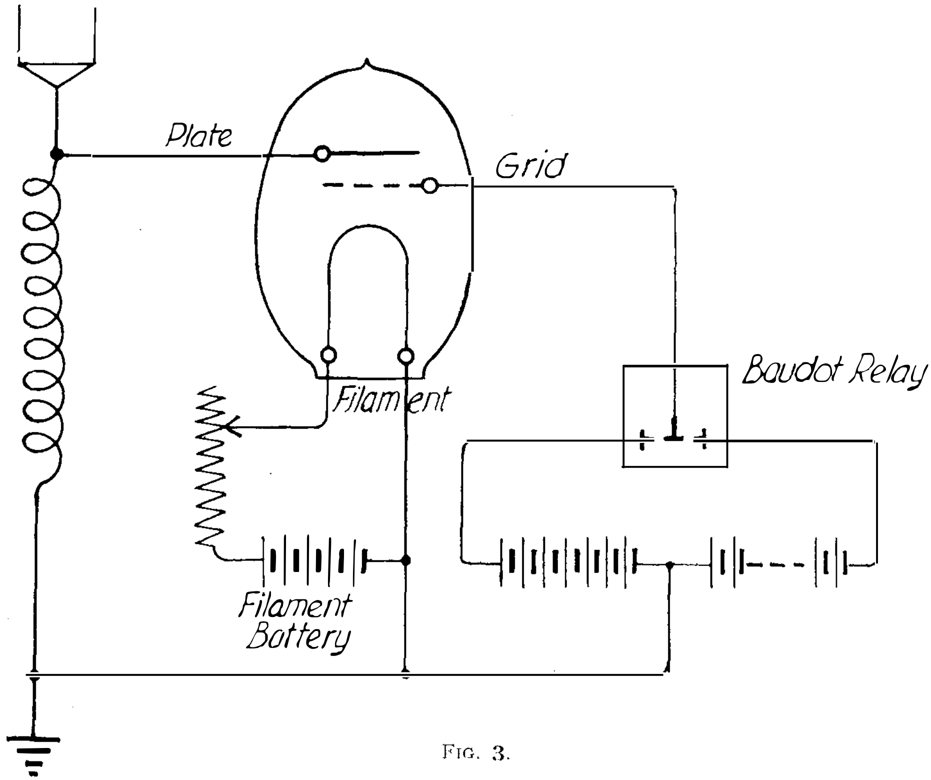


Plate
Grid
Filament
Baudot Relay
Filament Battery

FIG. 3.

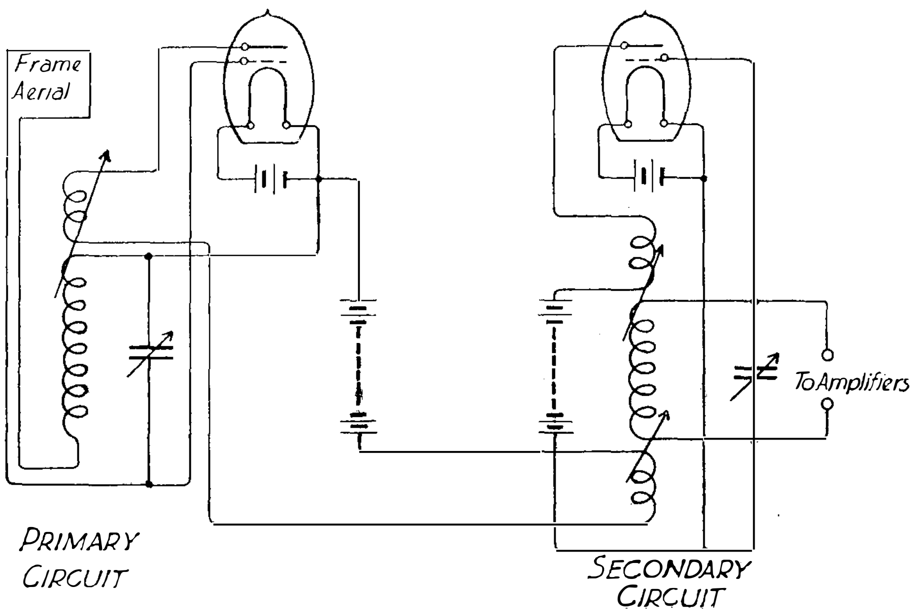

Frame Aerial
To Amplifiers
PRIMARY CIRCUIT
SECONDARY CIRCUIT

FIG. 4

tinuous current, the strength of which was reduced during the passage of a train of waves.

The high frequency amplifier is followed by a continuous current amplifier of four stages, arranged in a similar manner to that in Fig. **5**, but with the connecting condensers replaced by electromotive forces, which lower the potential of the grids to the immediate neighbourhood of that of the filaments. Blocking condensers are placed in the two amplifiers to avoid the spontaneous establishment of sustained oscillations in the circuits.

The usual protecting devices of inductance and capacity are provided to protect the amplifiers from re-actions by induction and from return waves arising from other apparatus.

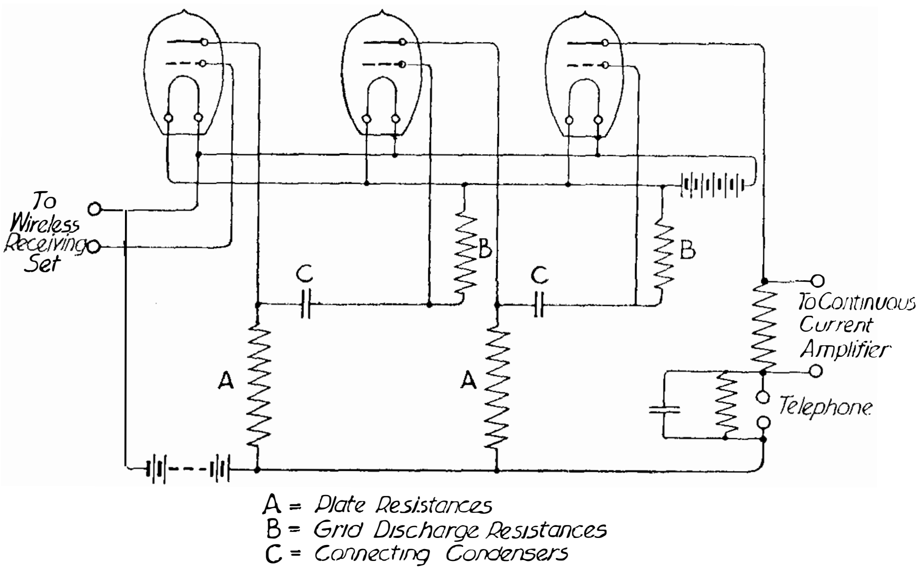


FIG. 5.

The adjustments of the set are made in two stages. Firstly, the primary and secondary circuits are brought into resonance with the waves to be received in order to obtain local oscillations of the same frequency. Secondly, the re-action coils are adjusted so that each oscillating circuit has a frequency in the immediate neighbourhood of the spontaneous establishment of sustained oscillations. The set is then ready for reception.

To obtain the most suitable value of the intensity of oscillations for reception, adjustments can be made on the re-action coils or on the coupling between the primary and secondary circuits, or better still on the number of amplifying lamps in use.

If, during these adjustments, it is desired to listen to the beats caused by the sustained waves and those of the local oscillator (heterodyne), a telephone can be placed at the end of the high frequency amplifier; but this arrangement is not so good as the check provided by the oscillograph already mentioned.

An oscillograph is placed at the end of the continuous current amplifier in series with the Baudot relay which works the printing apparatus. It is thus possible to observe the curves of the received signals at any instant, (*a*) to see the point at which disturbances are eliminated by adjustments of the resonance; (*b*) to see that the current is sufficient to work the Baudot relay without being excessively strong, and (*c*) to check any irregularities in transmission from the sending end. When the curves are correctly received it is an assurance that printed reception will be satisfactory.

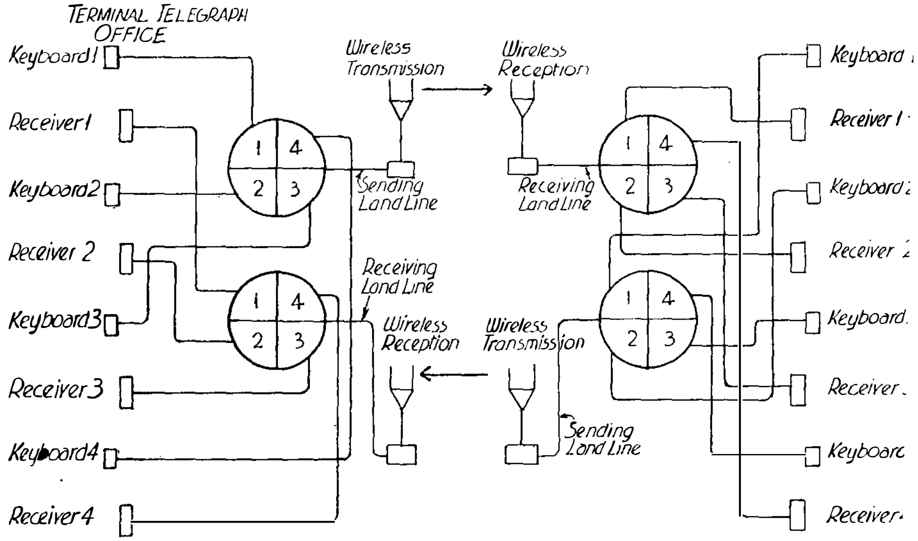


FIG. 6.

During the experiments it was noticeable that the unison of the two distributors was maintained even when printed reception was being disturbed by extraneous signals.

The results obtained indicate that sextuple working would be quite satisfactory, and the arrangement of the Baudot apparatus would be the equivalent to Duplex working or to 2-line Simplex working, *i.e.*, a quadruple set would have 4 sending channels and 4 receiving channels, as shown in Fig. 6.

Or the land line may be worked duplex to one of the pair of wireless stations on one side, with an extension to the other wireless station of the pair, as shown in Fig. 7.

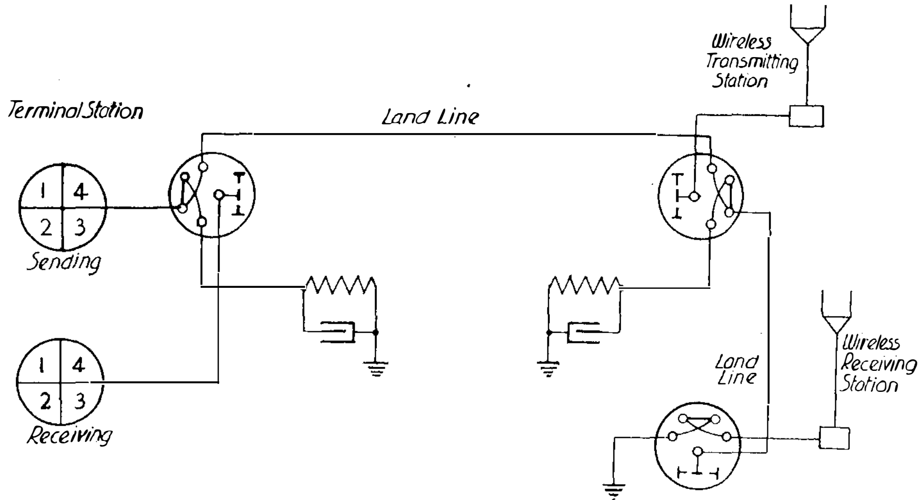
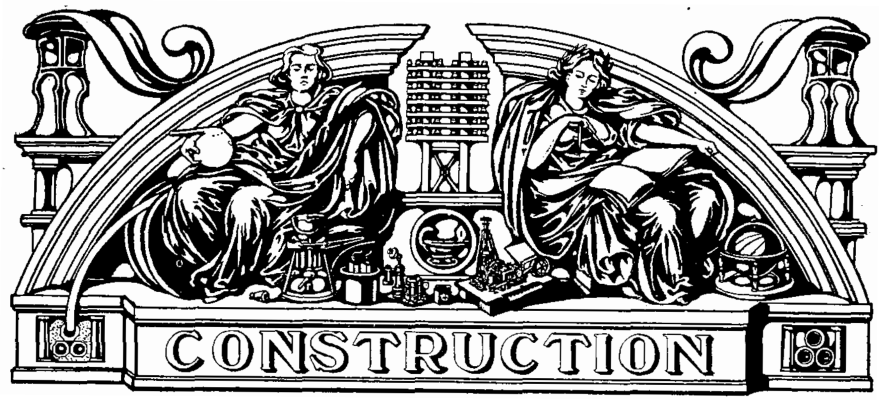


FIG. 7.

TELEGRAPH AND TELEPHONE PLANT IN THE UNITED KINGDOM.

MILEAGES AND TELEPHONE STATIONS FOR EACH ENGINEERING DISTRICT AS AT 30TH JUNE, 1921.

Telephone Stations.	Overhead Wires: Mileages.				Engineering District.	Underground Wires: Mileages.				Submarine (Land miles).
	Telegraph.	Trunk.	Exchange.	Spare.		Telegraph.	Trunk.	Exchange.	Spare.	
316,932	1,268	2,968	53,111	194	London	17,174	16,717	1,167,951	15,474	
46,635	6,136	15,946	41,789	2,631	S.E.	2,188	8,224	147,660	16,499	Telegraphs
39,258½	8,306	19,346	36,532	1,652	S.W.	12,218	1,618	73,607	1,509	18,281
31,489	14,809	27,838	33,375	4,019	E.	15,405	20,616	42,706	15,476	(Includes 3997
54,469	15,666	39,848	41,100	2,759	N. Mid.	7,273	13,237	93,223	51,912	Atlantic Cable,
42,124	11,187	24,686	45,019	4,781	S. Mid.	6,495	13,346	104,670	60,592	3667 Ex.D.U.S.)
35,017½	8,018	23,988	35,736	3,063	S. Wales	4,702	9,524	60,463	15,160	Trunks
51,730	12,415	20,678	34,166	5,929	N. Wales	11,529	16,315	93,303	10,504	1,497
94,210	4,732	16,149	43,903	3,321	S. Lancs.	9,610	31,571	228,773	30,755	
46,058½	9,321	25,052	34,796	2,186	N.E.	4,441	11,769	104,180	23,673	Exchanges
45,252½	6,972	27,023	38,198	1,643	N.W.	9,348	15,123	98,564	13,543	(Prov.)
30,422½	3,949	14,033	21,228	2,314	N.	3 119	4,750	51,206	6,281	380
31,536½	26,048	10,876	25,593	900	Ireland	840	100	51,873	487	
40,472½	11,908	18,874	27,933	2,638	Scot. E.	1,458	4,896	74,407	3,229	Spares
61,051½	10,736	20,984	39,860	474	Scot. W.	11,142	8,180	167,064	17,883	1,251
966,659	151,471	308,289	552,339	38,504	Total.	116,942	175,986	2,559,650	282,977	
982,023	152,294	302,986	555,133	39,295	Figures on 31st March, 1921.	116,210	167,923	2,495,482	218,385	



DESIGNING OF TELEPHONE NETWORKS.*

(Some minima problems which have connection with the question of the most economical designing of telephoning networks.)

By Prof. P. O. PEDERSEN, Fel. A.I.E.E., Fel. I.R.E.

A. INTRODUCTION.

THE smallest allowable diameter of a great many telephone wires, and especially subscribers wires, is determined by mechanical strength and other non-electrical considerations, while the most economical use of the material having regard only to the attenuation of the telephone current would give smaller diameters of the wire than used in practice.[1]

On the other hand the increasing use of cables and the rapid increase of the very expensive net of trunk and long-distance lines give the electrical requirements an increasing importance. The most economical design of a telephone net-work, having regard to the attenuation, is therefore a problem which is of some importance, and the telephone administrations which are up to date have already for several years been interested in this question.[2]

The requirements for minimum costs for a given attenuation can, however, be written in a more general form than, as far as I

* Extract from a paper published in the Danish journal "Ingeniören." (No. 34, 1920).

1 With regard to other conditions influencing the choice of wire sizes compare a paper of V. Clausen, "Ingeniören," No. 47, 1910 (Copenhagen), and J. G. Hill: Telephonic Transmission. London, 1920.

2 See V. Clausen; A. B. Hart and W. J. Hilyer, Trunk Telephone communication transmission Schemes, and the Design of Circuits. "Electrician," Vol. LXXI., p. 6, 1913; and J. G. Hill.

know, has been done heretofore. The following simple mathematical treatment may therefore have some interest, specially because the results in spite of their general character are very simple and easy to use. In order to obtain these simple results it has been necessary to use some approximations. However, these approximations will, with a possible exception to be mentioned in section B., not materially decrease the value of the results.

B. ASSUMPTIONS.

I. We neglect the terminal losses and the losses in the exchanges. The total attenuation constant is therefore:

$$B = \Sigma \alpha_s l_s, \qquad (I)$$

where α_s is the attenuation constant and l_s the length of one of the lines, and where the summation includes all the lines which make up the connecting circuit.

It is always possible to make correction for the losses in the exchanges by means of a corresponding reduction of the available total attenuation constant, but to correct for the terminal losses is more difficult. However, it is only when we neglect these losses that the mathematical treatment will be simple. A closer investigation shows also that in practice the reflection losses will only have a small effect on the *ratio* of the diameters of connected lines.

In common battery plants the resistance of the subscribers lines will affect the constant part of the microphone current. This effect is neglected, and this is—for common battery plants—no doubt the least satisfactory of the assumptions made.

To partly eliminate the effect of both above named assumptions we may choose the diameters of the subscribers wires and trunk lines more nearly equal than the minima conditions require.

II. We will put the attenuation constant

$$\alpha = \varphi(a), \qquad (II_1)$$

where a is the diameter of the wire in millimeters.

And the reciprocal function

$$a = \psi(\alpha). \qquad (II_2)$$

The attenuation constant α as a function of the primary constants of the line is, as is well known, given by

$$\alpha = \sqrt{\tfrac{1}{2}} \sqrt{\sqrt{(R^2+\omega^2L^2)(A^2+\omega^2C^2)} + RA - \omega^2LC.}$$

We will get the function φ when we express R, L, C, and A as functions of the wire diameter a. This leads in general to a complicated form of φ. We will, therefore, occasionally prefer to replace the exact expression for φ with simple approximation formulæ.

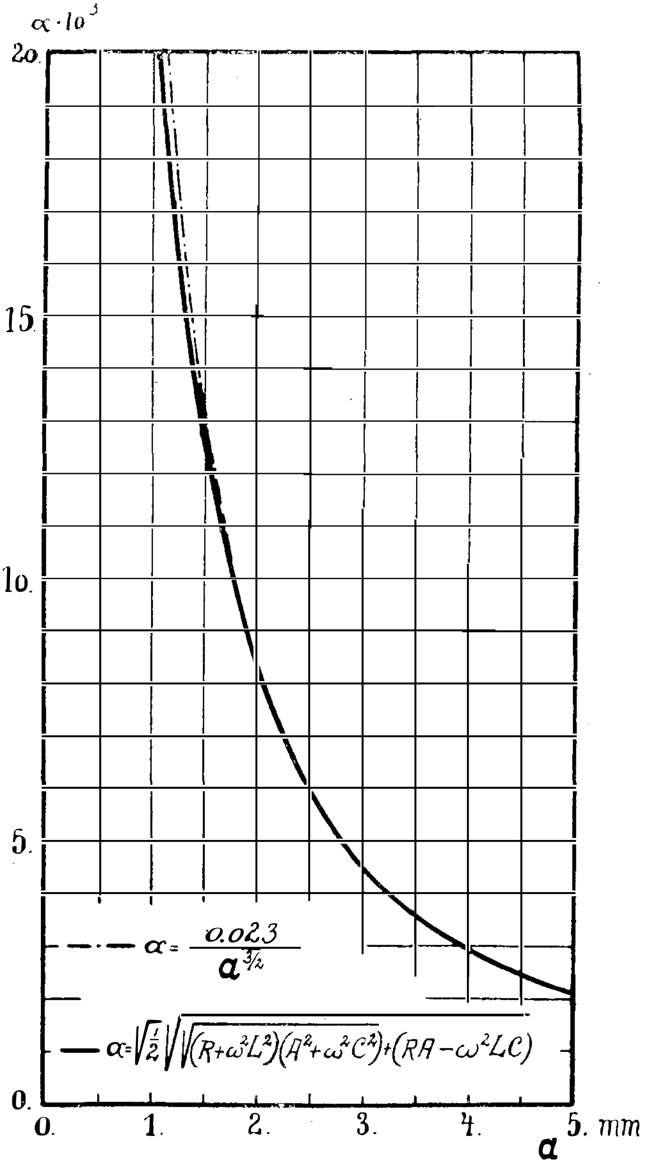


FIG. 1.—ATTENUATION CONSTANT FOR CABLES.
a: WIRE DIAMETER IN MILLIMETRES.

a. We will, in these cases, for paper-insulated lead cables, put

$$\alpha = \frac{b_1}{a} = \frac{0{\cdot}067}{a} \quad [a \text{ in mms}; \ \alpha \text{ per km}], \quad (II_3)$$

Where the value $b_1 = 0{\cdot}067$ corresponds to the following values of the primary constants:

$$R = \frac{44 \cdot 56}{a^2} \text{ ohms, } C = 0.04 \text{ mf, } A = 3 \cdot 10^{-6} \text{ mhos, and}$$

$$\omega = 2\pi n = 5000.$$

Fig. 1 shows the character of the approximation (II_3). For the small diameters the approximation is very good. For larger diameters it is not so good, but such large diameters are little used in practice.

b. For aerial lines (copper wires) we will put

$$\alpha = \frac{b_2}{a^{\frac{3}{2}}} = \frac{0.023}{a^{\frac{3}{2}}} \quad [a \text{ in mms; } \alpha \text{ per km}], \qquad (II_4)$$

where the value $b_2 = \cdot 023$ corresponds to a copper line with the following constants:

$$R = \frac{44 \cdot 56}{a^2} \text{ ohms,} \qquad L = 4\left(\log \frac{800}{a} + \frac{1}{4}\right) \cdot 10^{-4} \text{ H,}$$

$$C = \frac{10^{-6}}{36 \log \frac{800}{a}} + 5 \cdot 10^{-10} \text{F, } A = 2 \cdot 10^{-6} \text{ mhos, and } \omega = 5000.$$

Fig. 2 shows how the approximation (II_4) works out. It is seen that the approximation is quite good for the diameters used in practice.

In each specific case it is, of course, necessary to use the correct values of the constants b_1 and b_2.

III. We assume that the cost Q of a line can be written as follows:—

$$Q = P_0 + pla^2 = P_0 + qlG, \qquad (III_1)$$

where P_0, p, and q for each type of line are constants having different values for different type of lines. G is the weight of one kilometer of wire.

Equation (III_1) is not exact, but it is as a rule a good approximation within the range of wire diameters, which are of practical importance in the specific problem treated of. The constants P_0, p or q must naturally in each single case be determined by experience.

P_0 only affects that part of the total cost which is independent of the designing of the lines. The value of this constant has therefore no effect on the determination of the minima conditions. We will therefore here neglect P_0 and write:

$$Q = pla^2 = qlG. \qquad (III_2)$$

We put then the total cost Q_T equal to

$$Q_T = \Sigma Q_s, \qquad (III_3)$$

where the summation includes all the lines in the network.

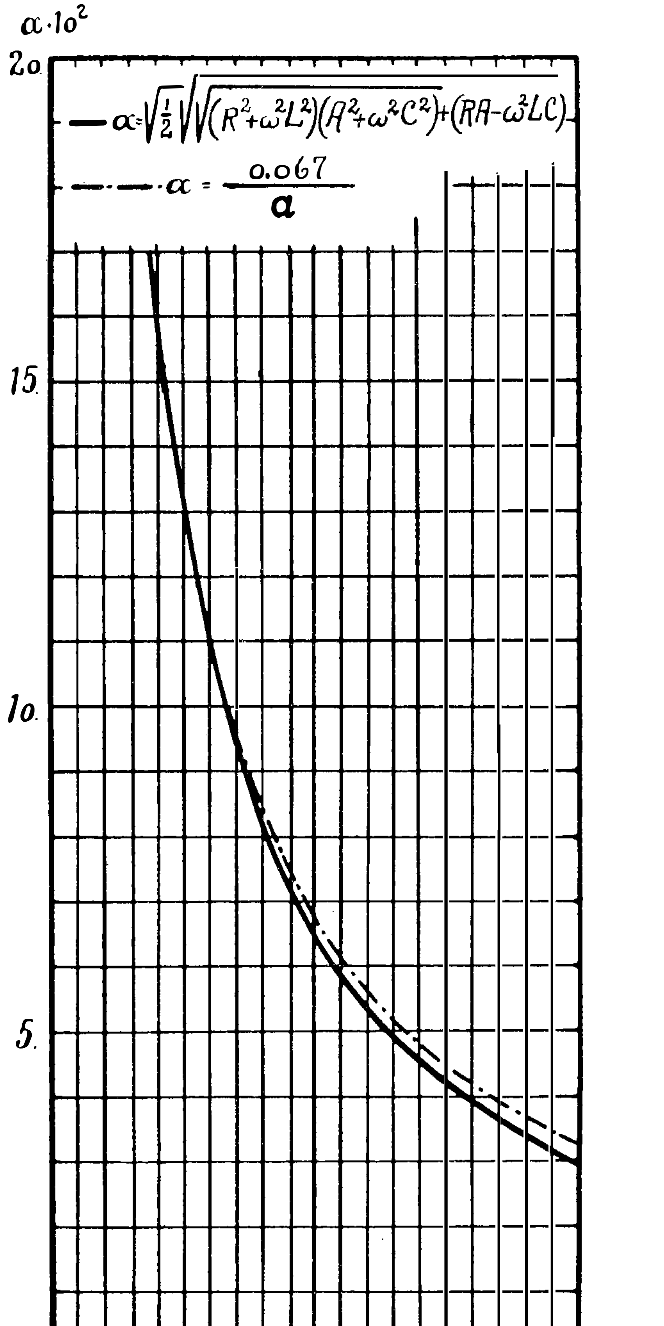


FIG. 2.—ATTENUATION CONSTANT FOR AERIAL CABLES.
a: WIRE DIAMETER IN MILLIMETRES.

C. THE MAIN PROBLEM AND ITS SOLUTION.

I.—A Single Exchange with ν sets of Trunk Lines.

We will first consider a single exchange C_1 from which n_1 subscribers lines originate (Fig. 3). The lengths of these lines are

$$l_{11}, l_{12}, l_{13}, \dots l_{1n_1};$$

greatest length l_{1m}; average length l_{10}. The diameters of these lines are respectively

$$a_{11}, a_{12}, a_{13}, \dots a_{1n_1}.$$

The cost constants respectively

$$p_{11}, p_{12}, p_{13}, \dots p_{1n_1}.$$

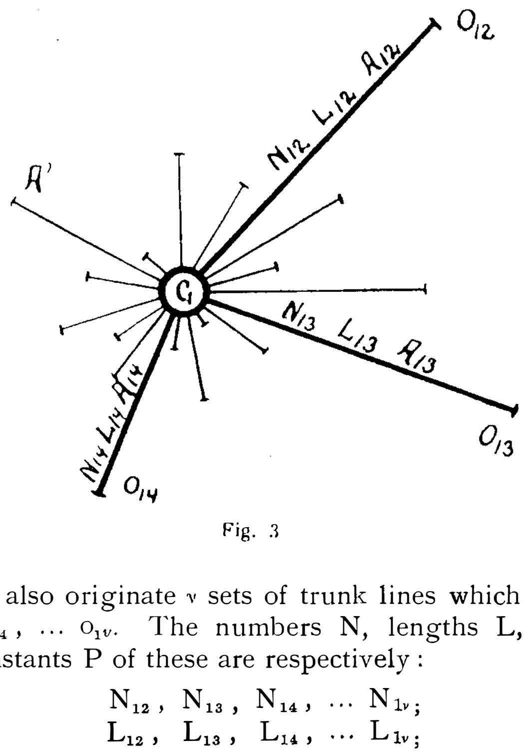


Fig. 3

From C_1 also originate ν sets of trunk lines which terminate in $o_{12}, o_{13}, o_{14}, \dots o_{1\nu}$. The numbers N, lengths L, diameter A and cost constants P of these are respectively:

$$N_{12}, N_{13}, N_{14}, \dots N_{1\nu};$$
$$L_{12}, L_{13}, L_{14}, \dots L_{1\nu};$$
$$A_{12}, A_{13}, A_{14}, \dots A_{1\nu};$$
$$P_{12}, P_{13}, P_{14}, \dots P_{1\nu}.$$

From an arbitrary subscriber to the terminal point o_{1s} the total attenuation B_{1s} must satisfy the relation

$$B_{1s} \leqq B_{1s}^{0}, \qquad (1)$$

where B_{1s} is the maximum attenuation constant from a subscriber to the point o_{1s}.

The minimum problem is how to design the network so that the ν relations (1) are satisfied and, at the same time, that

$$Q_r = \Sigma Q \qquad (2)$$

is a minimum, the summation including all the lines in the network.

We will treat the problem under the assumption that the subscriber lines either (1) all have the same total attenuation constant, or (2) all have the same diameter.

Assumption 1. All the subscriber lines have the same total attenuation constant B_0. The problem is then to determine B_0 so that Q_r will be a minimum.

Equations (II_1) and (II_2) give for the subscribers lines and trunk lines respectively:

$$\alpha_{1s} = \frac{B_0}{l_{1s}}, \qquad \alpha_{1s} = \varphi_a(a_{1s}), \qquad a_{1s} = \psi_a(\alpha_{1s}) = \psi_a\left(\frac{B_0}{l_{1s}}\right) \qquad (3)$$

and

$$\alpha'_{1r} = \frac{B^0_{1r} - B_0}{L_{1r}}, \qquad \alpha'_{1r} = \varphi_c(A_{1r}), \qquad A_{1r} = \psi_c(\alpha'_{1r}) = \psi_c\left(\frac{B^0_{1r} - B_0}{L_{1r}}\right). \qquad (4)$$

We have then

$$\left.\begin{aligned} Q_r &= \sum_{s=1}^{s=n_1} p_{1s} \cdot l_{1s} \cdot \left[\psi_a\left(\frac{B_0}{l_{1s}}\right)\right]^2 \\ &+ \sum_{r=1}^{r=\nu} P_{1r} \cdot N_{1r} \cdot L_{1r}\left[\psi_c\left(\frac{B^0_{1r} - B_0}{L_{1r}}\right)\right]^2. \end{aligned}\right\} \qquad (5)$$

Q_r is a minimum for $\frac{dQ_r}{dB_0} = 0$, and this equation gives

$$\left.\begin{aligned} &\sum_{s=1}^{s=n_1} p_{1s} \cdot \psi_a\left(\frac{B_0}{l_{1s}}\right)\psi'_a\left(\frac{B_0}{l_{1s}}\right) = \\ &\sum_{r=1}^{r=\nu} P_{1r} \cdot N_{1r} \cdot \psi_c\left(\frac{B^0_{1r} - B_0}{L_{1r}}\right)\psi'_c\left(\frac{B^0_{1r} - B_0}{L_{1r}}\right). \end{aligned}\right\} \qquad (6)$$

Using the formulæ (3) and (4) this equation can be written:

$$\sum_{s=1}^{s=n_1} p_{1s} \cdot a_{1s} \cdot \psi'_a(\varphi_a(a_{1s})) = \sum_{r=1}^{r=\nu} P_{1r} \cdot N_{1r} \cdot A_{1r} \cdot \psi'_c(\varphi_c(A_{1r}))\ldots \quad (A)$$

This relation is the only minimum condition in this case, because this equation in connection with the n_1 equations (3) and the ν equations (4) is sufficient to determine B_0 and the $(n_1 + \nu)$ diameters.

It is a characteristic of equation (A) that it is independent of the value of the given total attenuation constants B_{1r} and of the lengths of the lines. It contains only the number of the lines, their diameters, and cost constants. The minimum condition (A) is therefore very general.

Assumption 2.—If all the subscribers lines have the same diameter we get instead of (A) the following equations:

$$\left.\begin{aligned} \sum_{s=1}^{s=n_1} p_1 \frac{l_{1s}}{l_{1m}} a_1\psi'_a(\varphi_a(a_1)) &= p_1 n_1 \frac{l_{10}}{l_{1m}} a_1\psi'_a(\varphi_a(a_1)) \\ &= \sum_{r=1}^{r=\nu} P_{1r} \cdot N_{1r} \cdot A_{1r}\ \psi'_c(\varphi_c(A_{1r})). \end{aligned}\right\} \quad (A')$$

The equations obtained are correct for any form of the function φ. In the following table we have given the equations (A) and (A′) for certain simple forms of the function φ:—

II.—Several Exchanges interconnected by sets of Trunk Lines.

We are now able to give the minima conditions for several exchanges μ, which are inter-connected by trunk-lines. We will in this case get μ minimum equations, one for each exchange, and as many attenuation equations as there are trunk lines.

We will, therefore, have just enough equations to determine the diameters of the subscriber and trunk-lines. Hence there are no other minima conditions in this case.

MINIMUM EQUATION.

φ	Assumption 1.	Assumption 2.	Remarks.
$\alpha=\varphi_a(a)=\frac{b_a}{a^u}$. $\alpha=\varphi_c(A)=\frac{b_c}{A^u}$	$\sum_{s=1}^{s=n_1}\frac{p_{1s}}{b_a}a_{1s}^{2+u}=\sum_{r=1}^{r=v}\frac{P_{1r}}{b_c}N_{1r}\cdot A_{1r}^{2+v}\dots\ (A_1)$ or $\sum_{s=1}^{s=n_1}p_{1s}l_{1s}a_{1s}^2=\sum_{r=1}^{r=v}P_{1r}\cdot N_{1r}\cdot L_{1r}^1\cdot A_{1r}^2\dots\ (B)$	$\frac{p_1}{b_a}n_1\frac{l_{10}}{l_{1m}}\cdot a_1^{2+u}=\sum_{r=1}^{r=v}\frac{P_{1r}}{b_c}\cdot N_{1r}\cdot A_{1r}^{2+u}\cdots(A_1')$ or $p_1n_1l_{10}a_1^2=\sum_{r=1}^{r=v}P_{1r}\cdot N_{1r}\cdot L_{1r}^1\cdot A_{1r}^2\dots\ (B')$	$L_{1r}^1=B_0\frac{A_{1r}^u}{b_c}=\frac{b_a}{a_1^u}\cdot\frac{A_{1r}^u}{b_c}l_{1m}$ = "*equivalent length*" of a trunk line in the set r. Equations (B) and (B′) tell us that the minimum condition is: *The cost of all the subscribers' lines must be equal to the total cost of the equivalent lengths of all the trunk lines.*
$u=1$. (Cables)		$\frac{p_1}{b_a}n_1\frac{l_{10}}{l_{1m}}a_1^3=\sum_{r=1}^{r=v}\frac{P_{1r}}{b_c}N_{1r}\cdot A_{1r}^3\dots\ (A_1')$	
$u=\frac{3}{2}$. (Aerial lines)		$\frac{p_1}{b'_a}n_1\frac{l_{10}}{l_{1m}}a_1^{\frac{7}{2}}=\sum_{r=1}^{r=v}\frac{P_{1r}}{b'_c}N_{1r}\cdot A_{1r}^{\frac{7}{2}}\cdots(A_1'')$	
$u=1$ for subscr. lines $u=\frac{3}{2}$ for trunk lines		$\frac{p_1}{b_a}n_1\frac{l_{10}}{l_{1m}}a_1^3=\frac{2}{3}\sum_{r=1}^{r=v}\frac{P_{1r}}{b'_c}N_{1r}\cdot A_{1r}^{\frac{7}{2}}\dots\ (C')$	
$u=\frac{3}{2}$ for subscr. lines $u=1$ for trunk lines		$\frac{2}{3}\frac{p_1}{b'_a}n_1\frac{l_{10}}{l_{1m}}a_1^{\frac{7}{2}}=\sum_{r=1}^{r=v}\frac{P_{1r}}{b_c}N_{1r}\cdot A_{1r}^3\dots\ (C'')$	

III.—Two Classes of Lines from a Junction Point.

We have until now only spoken of subscriber and trunk lines, but the same minima conditions are correct for all junctions P, from which sets of lines are leaving, which can be divided into two classes, A and C, so that any connection through P is made over one of the lines of class A and one of class C.

If for instance n inter-urban lines with diameter a and ν sets of other lines (N_1 with diameter A_1 . . . . N_ν, A_ν) are leaving a junction P, so that the n lines form the class A and the ν sets of lines the class C, then we will have the following condition for a minimum of cost:

$$pna\,\psi'(\varphi(a)) = \sum_{r=1}^{r=\nu} P_r N_r A_r \psi'_c(\varphi_c(A_r)). \qquad \text{(D)}$$

If all the lines are cables then we can use the approximation formula (II_3); if besides we put $b_a = b_c$ and $P_r = P$ then (D) will be reduced to:

$$na^3 = \sum_{r=1}^{r=\nu} N_r A_r^3.$$

If further we assume that all A_r are equal in size, then we will have:

$$na^3 = A^3 \sum_{r=1}^{r=\nu} N_r = N \cdot A^3, \qquad \text{(D'')}$$

or

$$\frac{a}{A} = \sqrt[3]{\frac{N}{n}}, \qquad \text{(D''')}$$

where $N = \Sigma N_3$ is the total number of lines of class (C).

For aerial lines the equation corresponding to (D''') would be:

$$\frac{a}{A} = \sqrt[7]{\left(\frac{\Sigma N_r}{n}\right)^2} = \sqrt[7]{\left(\frac{N}{n}\right)^2}. \qquad \text{(E)}$$

D. *The solution of the problem when there are limitations with regard to the choice of the diameters of the wires* may be found in a similar way. The results for some of such cases are given in the original paper.

ROYAL TECHNICAL COLLEGE,
Copenhagen

THRUST BORING—CHANNEL SEA RIVER.

A NEW METHOD OF CONSTRUCTING UNDERGROUND PIPE LINES BY MEANS OF HYDRAULIC PRESSURE.

CONSIDERABLE difficulty is often experienced when the underground engineer has in the course of laying an underground route to negotiate a stream, canal, dock, railway or other obstacle, and any new method or process which will assist him in overcoming difficulties of this kind is always welcome.

During the War there were many instances in which pipes and cables had to be laid under roadway crossings, where it was not possible to stop the traffic and dig a trench in the ordinary way, and therefore it became necessary to adopt other means. In these cases a small handworked machine was used for pushing pipes under the surface of the road from a shaft on one side to a shaft on the other side of the roadway.

The Pilot or Driving Head used with this machine had a conical head which worked on a pivot centre, and by this means any tendency for the pilot to depart from the direction in which it was being thrust was compensated for, as the head—when straight—offered the point of the cone to the soil, and the pressure was equal over the whole of the surface of the cone, but as soon as it was turned from the straight the surface on the one side of the cone offered less resistance, while that on the other side offered greater resistance to the soil, resulting in a compensating turning movement in the opposite direction until the original direction was reached. See Figs. **1** and **2**.

The Mangnall-Irving Thrust Boring Machine, which has recently been used by the Department for thrusting nine 3½″ steel pipes under the Channel Sea River at Stratford, London, E., differs from machines previously in use, and it is proposed to give some details here of the apparatus.

(1) The "Gun," or Hydraulic Ram, Figs. **3** and **4**, consists of a steel cylinder and piston. The cylinder, which is approximately five feet long, is fitted in a substantial iron frame, and has two pins at the back end on which it can rotate when it is required to be brought into the vertical position for refilling purposes. See Figs. **4** and **5**.

(2) Two flexible tubes connect the back end of the cylinder to a petrol-driven pump and to a small water tank respectively. See Fig. **17**.

(3) A small 3-throw hydraulic pump driven by a 5 to 7-H.P.

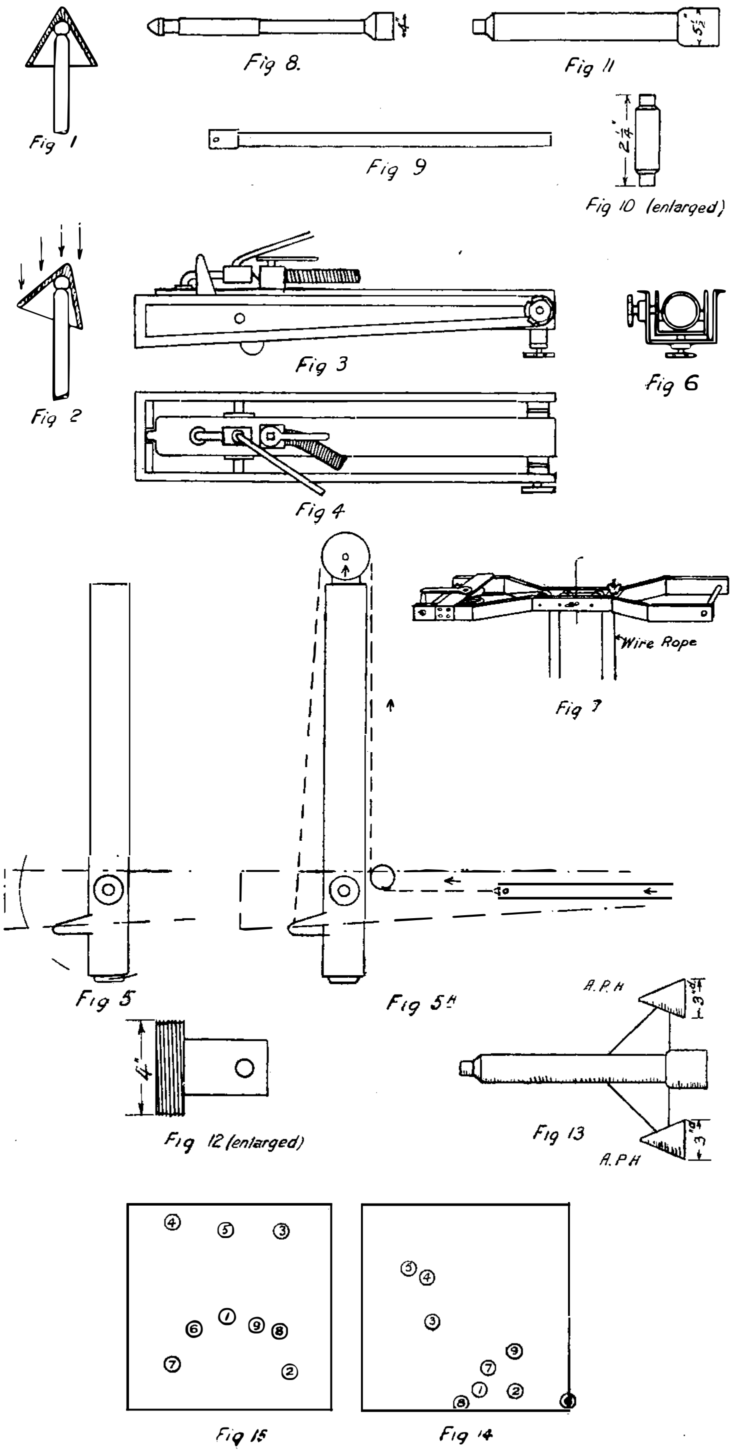


Fig 1
Fig 8.
Fig 11
Fig 9
Fig 10 (enlarged)
Fig 2
Fig 3
Fig 6
Fig 4
Wire Rope
Fig 7
Fig 5
Fig 5A
A.P.H
Fig 12 (enlarged)
Fig 13
A.P.H
Fig 15
Fig 14

FIGS. 1 TO 15.

petrol engine fitted on an iron frame, as shown in Fig. **16**, the petrol consumption being about $\frac{1}{3}$rd gallon for boring 150 feet.

(4) A water tank, approximately 2 ft. diameter by 2 ft. high.

(5) A set of steel rods and couplings.

(6) Various Pilots or Driving Heads.

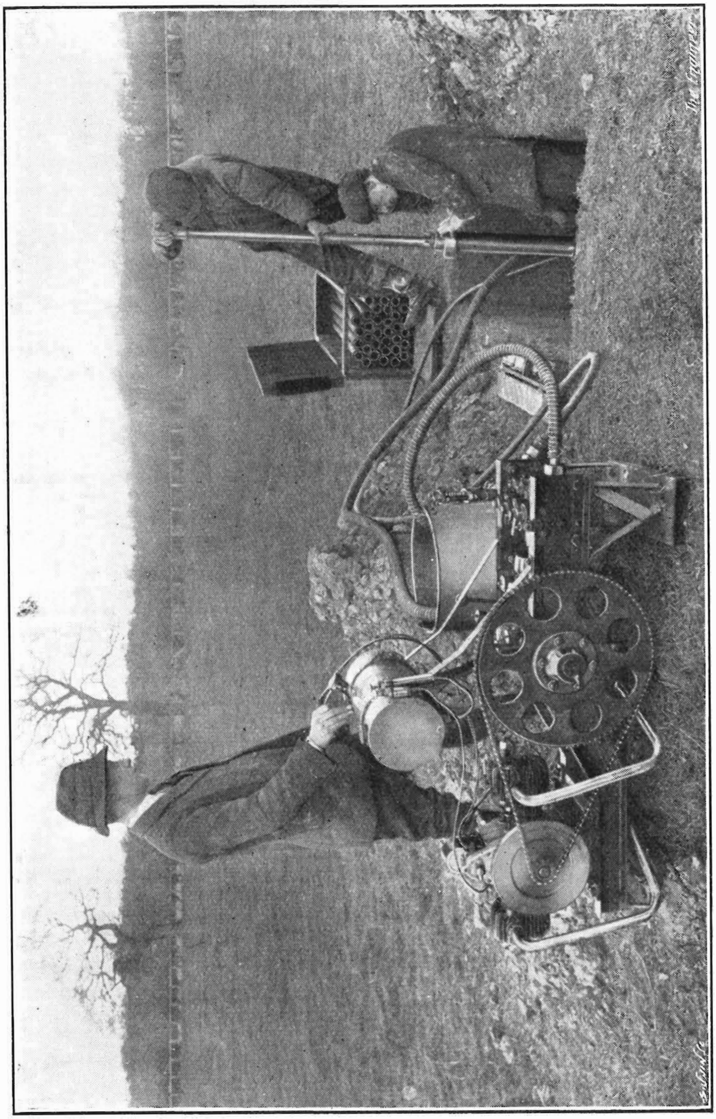


Fig. 16.

In thrust-boring, holes are made in the ground horizontally below the surface. There is no cutting action and consequently no spoil, the core being formed by the displacement and compression

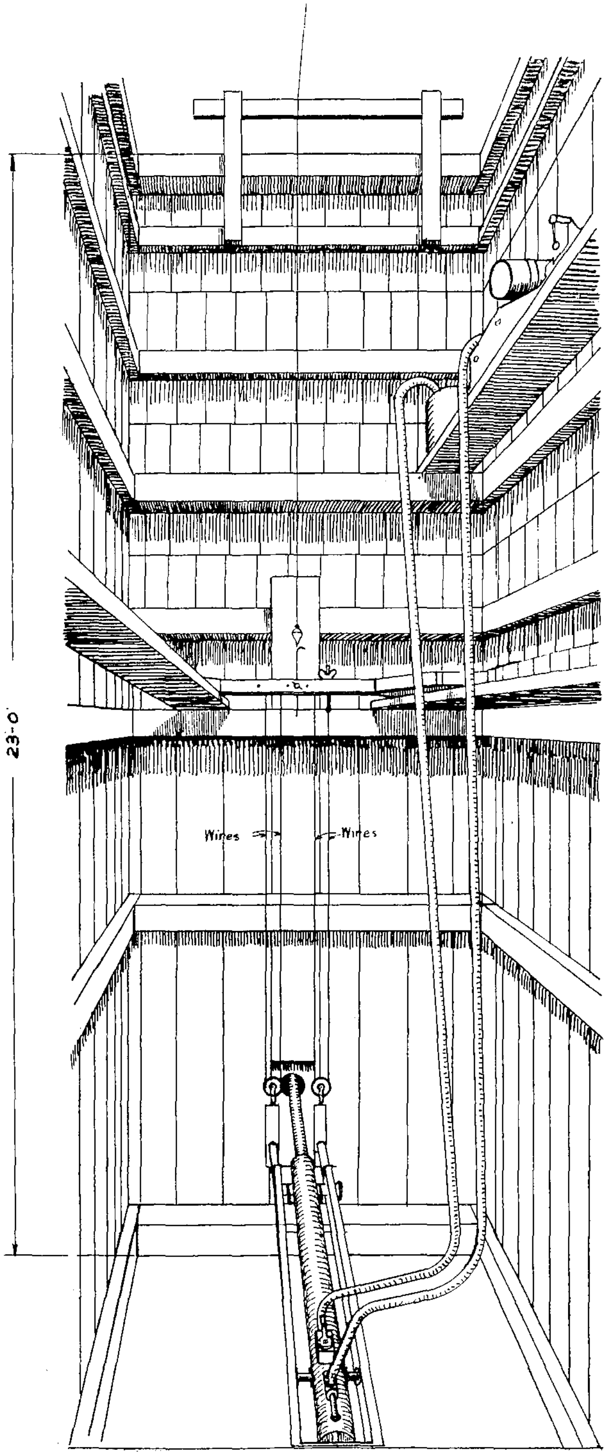


Fig. 17.

of the surrounding earth. The operation is limited to ground of a clay nature, but not necessarily pure clay. The hardest blue London clay can be thrust-bored, but chalk, sand, rock, etc., are not suitable.

Holes from 2″ to 12″ diameter can be made and even larger sizes where the depth of working and nature of ground permit. Normal

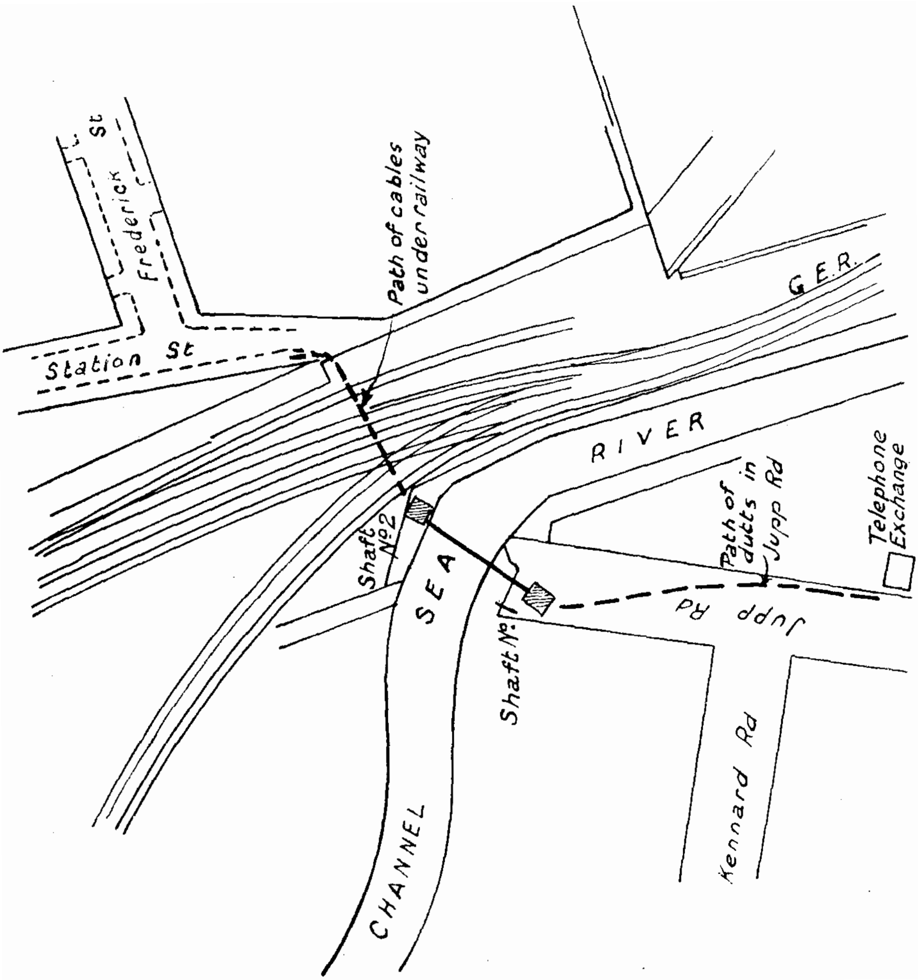


FIG. 18.

trench excavation for the laying of cables, pipes or the like is dispensed with and surface reinstatement costs are eliminated.

The whole of the apparatus can be seen in Fig. **17**. For moving the apparatus a light carriage is provided. This describes generally the apparatus that was used at Stratford.

Fig. **18** is a plan of the site of the work at the Channel Sea River. It will be seen that the pipes were thrust from a shaft (No. 1) at the end of Jupp Road to shaft (No. 2) on property belonging to the Great Eastern Railway Company. In sinking the shafts it was anticipated that water would be found, and arrangements were therefore made to meet this contingency. It will be seen from Fig. **19** that the first 13 ft. of depth was made-up ground: this was the minimum depth at which the top pipe could be placed in order to comply with the stipulations of the River Authorities requiring a clearance of 5′ below the bed of the river to permit of future dredging. Below this level, however, a 6 ft. stratum of water-logged ballast was met, which necessitated carrying the shafts to a lower level. In order to ascertain at what depth clay would be found a test was made by means of a 1″ iron barrel thrust through the ballast, and it was found on withdrawing this that the blue clay level was about 20 ft. The Geological Survey Office had reported that clay was to be found at 19 ft. in this area, and this proved to be correct. The sinking of the shaft was continued, and, owing to the amount of water present, it was necessary to resort to runners. The details of the timbering and the dimensions of the runners are shown in Fig. **17**. Pumps had to be kept going night and day in order to clear the large volume of water which found its way into the shaft from the ballast stratum.

On Tuesday, the 22nd February, the thrust-boring machine was lowered into the Jupp Road shaft and slung into position, levels were taken, and the level of the gun frame was regulated by the wires shown in Figs. **7** and **17**. The training of the gun on to the next shaft (No. 2) was now arranged by means of sights fixed up above the shafts. This gave the direction of the gun in a horizontal plane and plumb lines were dropped from the sighting line at the top of the shaft on to the centre line of the gun. It should be mentioned here that normally the supporting frame and sighting fittings, shown in Fig. **7**, are fixed above the ground. The vertical adjustment was then made by means of a clinometer. The adjusting screws are at the fore end of the gun and are shown in Fig. **6**. It will be seen that this end of the gun lies in a cradle, and that by means of vertical and horizontal screws a very fine adjustment is obtainable. The work of thrusting the pilot through the clay was now commenced. One of the runners was lifted so as to expose the clay face, the steel pilot (shown in Fig. **8**) was inserted in the machine, the pressure applied, and the pilot went forward into the clay. The head of this pilot is 2½ ins. in diameter and the shaft 2 ins. The gun was now raised to the vertical position, which is necessary for reloading, and one of the steel tubes, 4 ft. long, was inserted, the gun lowered, and the connection made between the pilot and the steel tube by means of a pin (shown in Figs. **9** and **10**); pressure was applied and the first of the steel coupling tubes was pressed forward into the earth. This process was repeated until the pilot reached shaft No. 2 and cut its way through by splintering the poling board. The pilot was then disconnected and the steel tubes were withdrawn by means of steel ropes working through sheaths, one of which was fitted to a ram on the gun and worked up and down in a vertical direction as shown in Fig. **5A**. The figure explains the movement and shows how by each thrust upwards of the sheath fitted in the bore of the gun the wire rope connected to the steel tubes pulls back one length at a time, it being necessary to stop and uncouple each rod as it is drawn into the shaft. This completed a hole 4 ins. in diameter, and the process of enlarging this to 5½ ins. diameter was now carried out by thrusting the auxiliary pilot (Fig. **11**) through the 4-in. hole. This was a repetition of the original boring, and when completed the hole had the appearance of a polished steel tube. The auxiliary pilot was now detached and a 3½ in. steel pipe (4 in. external diameter) 6 ft. long was connected to the pilot rods by means of a threaded disc (Fig. **12**). The pilot rods were now withdrawn and carried with them the first length of 3½ in. steel tube, which was ultimately to line the hole and form the conduit for one of the Department's cables. As one length of steel pipe was drawn into the earth the next length was screwed on to it, and this process continued until the steel pipe line was completed between the two shafts.

It should perhaps be mentioned here that after thrusting the first 4 ins. hole, a triple-headed pilot (shown in Fig. **13**) was thrust through to shaft No. 2 with a view to the two 3 in. holes formed by the auxiliary pilot heads APH being used for two further borings, one on each side of the original boring. The triple head, however, displaced an amount of clay at the face of shaft No. 2, which caused a considerable amount of inconvenience and extra friction when drawing in the next tube. This method of using the triple-head was therefore abandoned, and the remaining holes were each bored separately.

Owing to the amount of water entering the shafts and retarding the work only one pipe was drawn in per day.

Some difficulty was experienced with the timbering in order to expose the earth to admit of the pilot and thrust boring rods passing into the earth. This was overcome at the railway bank side by fitting extra walings and struts and removing others that covered the positions required. At the Jupp Road shaft it became necessary, owing to the large amount of water flowing in this hole, to restrict as much as possible the removal of timber from the face of the soil, and openings were therefore cut in the 9 in. × 3 in. deal runners. After thrusting three pipes from the Jupp Road shaft No. 1, it was decided to thrust the remaining pipes from shaft No. 2 towards Jupp Road, and in this case, after first piloting the hole with the 4 in. pilot, the second operation consisted of thrusting the auxiliary 5½ in. pilot forward with the 3½ in. steel tubes following, so that whereas the first pipes were drawn into the holes bored the second series was pushed in direct by the gun. The latter method considerably expedited the work.

Fig. **14** indicates the pipes at the face of shaft No. 1, and Fig. **15** shows the same pipes in position in shaft No. 2. The figures are both drawn looking from shaft No. 2 to shaft No. 1. It will be seen that some of the pipes have crossed each other, but considering that this was the first work of this nature that has been carried out

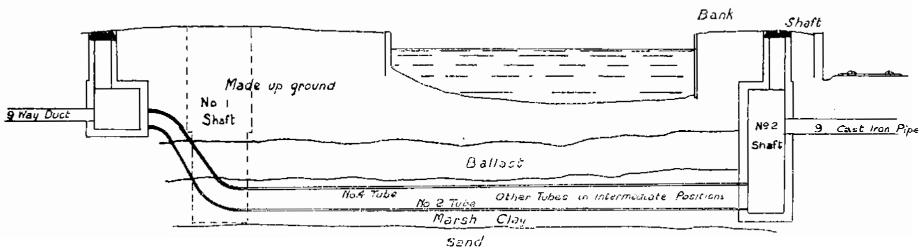


FIG. **19**.

the deviations are not very great, and as all the pipes come within the area allotted to them at the bottom of the shafts—which was restricted to approximately 5′ × 5′—the result may be considered fairly satisfactory. In no case did a pipe deviate so much from its course as to necessitate its abandonment. The pipes having been installed, the construction of the manholes was commenced. The manhole on the river bank on the railway Company's property was constructed, as shown in the diagram, with a 1 in. cement joint running through as a waterproofing course. The manhole in Jupp Road was constructed at the higher level in order to avoid as much as possible a large amount of water from this shaft, and the method adopted will be seen to consist of extending the steel tubes to the higher level by means of bends.

SECONDARY CELLS.
OIL LAYER ON ELECTROLYTE.

THE idea of placing a layer of oil on the surface of a volatile liquid in order to minimise evaporation troubles is not by any means new. It has been used time and again in connection with primary batteries, but has not been adopted extensively for several reasons, viz.:—the relatively short life of the primary battery elements, messiness, and the possibility of the formation of an explosive compound in the case of Leclanche cells unless a pure mineral oil free from unsaturated hydrocarbons be used.

With lead plate secondary cells, however, past difficulty with the use of oil has been due to the sulphuric acid, or the gases given off by the cell when on charge, decomposing the oil.

This difficulty has now been overcome by the use of a pure petroleum oil, and experimental trials have been sufficiently successful to warrant the decision to extend the use of the oil to all open-topped secondary cells in the Department's service.

The Specification for the oil, which is stocked as "Oil, insulating, No. 3," indicates that:

(1) It shall be free from acids, alkali, sulphur, moisture and dirt.
(2) Sp.G. at 60° F. of between .823 and .828.
(3) Flash point, by Abel close test, not lower than 240° F.
(4) Viscosity, by Redwood's viscometer, for 50 cubic cms. 62 to 72 seconds at 40° F.
(5) Loss by heating in open vessel, not more than 0.5% after 6 hours at 212° F.
(6) No more than a trace of precipated matter after passing a current of air at 30 cubic cms. per minute through 100 cubic cms. of the oil heated to 300° F. for three periods, each of 8 hours, on consecutive days.
(7) A specific resistance of 5 million megohms per cubic cm. at a pressure of 500—700 volts and at 60°—75° F.

Experimental trials with the oil on large telephone exchange batteries have shown that—

(1) Evaporation of electrolyte is reduced to a negligible amount.
(2) Hydrometer readings are more uniform and the instruments work more satisfactorily.
(3) There is an almost total absence of acid spray and noxious fumes.

(4) The oil protects the electrolyte from ammoniacal and other gases and minute solid matter from the atmosphere.

(5) Electric leakage between plate lugs and also corrosion of plate lugs are both reduced.

With regard to (1) it is estimated that there will be a saving of about 40,000 gallons of distilled water a year in connection with Post Office Batteries. With regard to (3), the effect of the oil is surprising, and will perhaps best be appreciated by stating the experience with two 50-volt 500-ampere-hour secondary batteries, one of which (Battery A) had a film of oil $\frac{1}{8}''$ thick on the surface of the electrolyte, and the other (Battery B) was untreated.

Both batteries were in the same room, which measured approximately 13′ × 12′ × 15′ high.

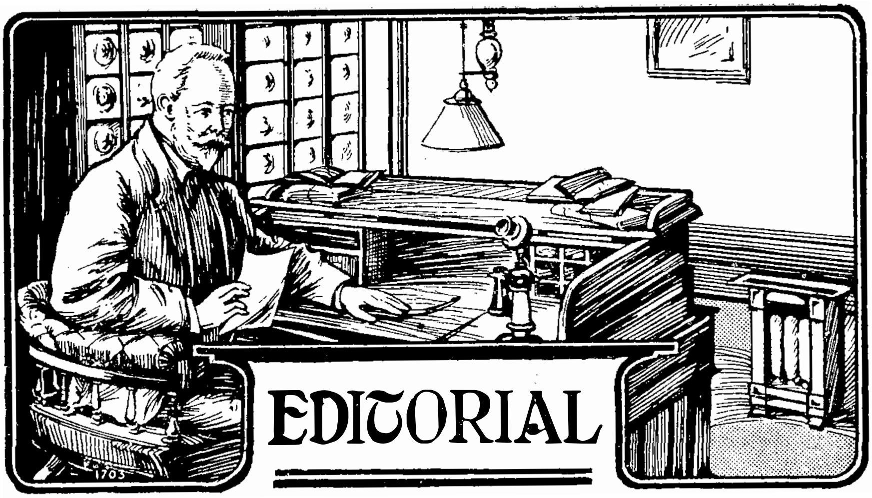
When Battery A was on charge and gassing well, no irritating acid fumes were observable in the atmosphere. Bubbles of hydrogen accumulated on the oil and gradually escaped into the air. Clean strips of iron, brass and german silver suspended immediately above the oil in one of the cells showed no appreciable sign of oxidation after a fortnight.

When Battery B was on charge and gassing, it was impossible to stay in the room on account of the strong fumes. Clean strips of the same kind of metals suspended in the same relative position as in the case of Battery A were heavily coated with ferric salts on the iron strip, and verdigris on the brass and german silver strips in three or four days.

The absence of the corrosive fumes when the oil is used will, it is anticipated, very materially ease the situation with regard to accommodation, special ventilation and the use of expensive acid resisting enamels.

Further experience is needed before a definite statement can be made, but it would appear that the only consideration in future will be to safeguard the cells from dirt falling into them.

J.G.L.



EDITORIAL NOTES AND COMMENTS.

In the course of the development of the science of electrical signalling without wires the two earlier systems of communication in general use, line telegraphy and telephony, at one time distinct and separate methods, and in many cases controlled and operated by different organisations, have become linked together more closely. Incidentally, this association of the two systems, assimilated as it were in a third by the trend of research and invention, affords an argument in favour of the unification of control, and provides the opportunity for the Administration to utilise the most efficient methods of each in a combination embodying all three. Morse key sending was the means ready at hand to transmit the train of waves sent out by the electric spark in the early days; ordinary telegraph methods were completed by connecting a relay or inker in the local circuit of the coherer. Later, the invention of the magnetic detector led to the use of the telephone receiver, but it was not until the late Mr. Duddell discovered the singing arc that the way was paved for the arrival of the wireless transmission of speech.

Just before the war the possibilities of the thermionic valve were beginning to be appreciated; its exploitation by all the belligerents during the years of conflict has bequeathed to the commercial engineer a piece of apparatus which is at once a high frequency alternator without friction, copper or iron losses, a receiver of energy without inductance and with no mechanical time-lag, and a distortionless and silent telephone repeater. The electrical industry in general has made marvellous progress in our own life-time, but we are beyond contradiction when we say that in no phase of the industry have events crowded themselves so closely as in that portion which deals with the transmission and reception of communications. Machine telegraphs, quadruple and sextuple duplex with printing on either a tape or a page is now every-day practice; machine switching in telephone exchanges has proved itself out, and its universal application is delayed only by the stringent economic position and not by its engineering difficulties; cable-loading, coil and continuous, has increased the distance over which communication is possible on cable routes; the use of carrier currents of frequencies beyond the audible has rendered possible the superposition of several telephone circuits on physical telegraph and telephone lines. In all these interesting developments the home Administration is playing its part. Several important experiments have been carried out successfully on the "wired-wireless" principle, and a London-Bristol trunk circuit is in commercial use. We hope to be able to describe this circuit in detail in the near future.

The following extracts from the "Electrical World," New York, explaining why Utility Rates in America are not dropping, so aptly describes the situation in this country that we cannot forebear from quoting them. "Public utilities are the only business whose operating sheets did not record payment of excess-profit taxes during the war." . . . "One reason that many people seem to forget is that utility rates did not advance comparably with commodity prices during the period when farmers, labourers, retailers, manufacturers and property owners' profits soared sky high. Utilities' earnings were anchored to earth by regulation. They were not permitted to earn profits of 100 per cent. and more all those years like other businesses were." . . . "Another reason is that during this period when utility earnings were not permitted to soar their operating costs steadily increased." . . . "People did not show a great concern about such small items as utility rates when they were being kept down while all other prices went up, but now when they are being raised 2 and 3 cents for street car rides and a small amount per month for gas and telephone services to meet higher operating costs, people who generally will be reasonable when they stop to think are persistently refusing to do so." If the term utilities be translated "public services" the above might well be circulated as a reply to our friends in Fleet Street.

The following item taken from the "Journal of Commerce" is headed "Private versus State Control," but the Sub-editor, who no doubt added the heading, omitted to mention that Sir William Slingo received all his training and spent over 40 years of his life in the service of the British Post Office. He is merely applying the methods of the British P.O. to an antiquated and somnolent administration :—

STRIKING CHANGES IN PERU.

British business methods are reported to be making most gratifying improvements in the Peruvian postal and telegraphic services.

Delays of from two or three days in the delivery of internal telegrams were common when on May Day Sir William Slingo, acting for the Marconi Company, took over these departments from the State. The staff, too, although nominally engaged on an 8-hour day, was found to be working ten or more hours a day, according to circumstances, without overtime or compensations.

So great has been the change that, on three successive days before the last mail left Lima, not a single telegram was left undelivered overnight in any part of the republic. The staff are also being given strictly eight hour " duties."

An amusing sidelight is thrown upon these reforms in a letter received recently in London by the manager of an engineering firm. Surprise and curiosity having been aroused by the delivery of English mails on the same morning as their arrival in port, an explanation was sought at the local Post Office. The reply, governed by the lady clerk's limited knowledge of English, was as follows : " Marconi no d——n good. Too much work."

" WIRED WIRELESS." A PROPHECY?

To the Editors, POST OFFICE ELECTRICAL ENGINEERS' JOURNAL.

Gentlemen,

I recently noticed the enclosed paragraph in a copy of Bond's book, so looked up the original source as a matter of interest. " The philosopher " has not even yet evolved an " insulationless wire " for sub-Atlantic communication!

Yours faithfully,

A. J. STUBBS.

In " Handbook of The Telegraph," by R. Bond, published in 1873, occurs the following :—

(The whole paragraph as quoted is an exercise in " punctuation "—the note of Interrogation in Morse code at the end!):

" Mr. Highton remarks that however difficult it is found in practice for man to transmit, artificially, currents of electricity from any kind of electric apparatus wholly immersed in water, yet Nature, in her sublime workings, finds no difficulty whatever in so doing. The philosopher is thus invited to careful study and deep investigation. The day may come when this mode of action in the animal kingdom will be better understood than it is now; and then, probably, will be discovered a means of constructing submarine telegraphs, without any insulation of the wires; and who shall say whether such a discovery would not satisfactorily solve the problem of communicating instantaneously between Great Britain and America . . — — . ."

This quotation is to be found on p. 22 of "The Electric Telegraph: Its History and Progress," by Edward Highton, Assoc. Inst. C.E., published by John Weale in 1852.

HEADQUARTERS NOTES.

EXCHANGE DEVELOPMENTS.

Orders have been placed for the following new Exchanges:—

Exchange.	Type.	No. of Lines.
Penarth	Manual C.B.	630
North Eastern Marine Engr. Co., P.B.A.	Automatic	100
Swansea	Automatic	3200
Sketty	Automatic	200

Orders have been placed for extending the Equipment at the following existing Exchanges:—

Exchange.	Type.	No. of Lines.
Jesmond	Manual C.B.	160
Norwich	Manual C.B.	300
Grimsby	Automatic	Extension of Manual Board.
Rusholme	Manual C.B.	620
Blackpool	Manual C.B.	340
Gt. Yarmouth	Manual C.B.	220

A description of the new London Toll Exchange appears elsewhere in this issue.

MR. A. L. DE LATTRE.

ASSISTANT ENGINEER-IN-CHIEF.

THE vacancy caused by the retirement of Mr. A. J. Stubbs on 31st July, 1921, has been filled by the appointment of Mr. A. L. De Lattre as second Assistant Engineer-in-Chief of the British Post Office.

Mr. De Lattre entered the Service at Birmingham in July, 1886, and was transferred to the office of the Superintending Engineer in that city in September, 1891. The district controlled from Birmingham at that time extended from London to Stockport and from Derby to the River Severn, and included most of the main telegraph

MR. A. L. DE LATTRE,
Assistant Engineer-in-Chief.

overhead lines between London and the North. The Headquarters staff consisted of Mr. F. E. Evans, the Superintending Engineer, and four clerks. Although telephonic development at that time was very slight, there was a persistent agitation for improved and extended services and the agreement for the transfer of long distance lines to the State was arrived at in 1893. In that year the ability and promise of Mr. De Lattre was recognised and he was promoted to the Engineer-in-Chief's Offie in May, where he immediately took up the duty of personal secretary to Mr. (later Sir John) Gavey, who at that time was completing preparations for the value of the

National Telephone Company's trunk line plant to be purchased by the State. The story of the inspection of every line throughout the country by Headquarters officers has been told by Mr. Leyshon in an earlier volume of this Journal, and it only remains to say that after completion of the inventory the party arrived at Headquarters with a mass of details which were subsequently summarised and valued, a task which fell very largely on the shoulders of Mr. De Lattre, who had accompanied the expedition throughout. He was thus early in his career brought into immediate contact with the financial questions relating to external plant, and obtained an intimate knowledge of the trunk telephone system, the development of which from 1893 has been his main responsibility up till to-day. In 1898 Mr. De Lattre took the first position in a competitive examination conducted by the Civil Service Commissioners and was appointed Technical Officer, 2nd Class, in October of that year.

A parliamentary committee, under the chairmanship of Mr. Hanbury, had about that time recommended that the Post Office should forthwith commence active telephonic operations in London and preparations were at once commenced for the inauguration of an up-to-date telephone system in the metropolis. On Mr. De Lattre's shoulders fell a large amount of the work and the financial and economical calculations connected therewith. The next five years were occupied in the strenuous work of laying the plant, and the bulk of the exchanges were opened in 1902. In 1903 Mr. De Lattre was transferred to Leeds as Assistant Superintending Engineer under the late Mr. Carr. Whilst at Leeds, he inaugurated locally what at that time were startling changes, namely, the systems of unit maintenance (1 April, 1904) and construction costs revised, and detailed hourly duties for each of the linemen. The information obtained in connection with the Cost Returns was years later of very great value in the arbitration proceedings in connection with the valuation of the local plant of the Telephone Company.

After slightly less than 4 years at Leeds, Mr. De Lattre was promoted to Headquarters and given charge of the Survey Section, which had been specially formed for dealing with the provision of line plant and valuations. The 1905 agreement to purchase the entire system of the National Telephone Company necessitated preparations for the arbitration proceedings which were necessary before the amount to be paid could be settled and Mr. De Lattre set about this work with characteristic enthusiasm and energy. The system of Unit Construction Costs inaugurated at Leeds was extended to the whole of the Kingdom, and figures relating to the life of various classes of line plant were compiled.

Arrangements had also been made for an inventory of the plant to be acquired by the State. The inventory, which occupied the labours of over 200 officers for 18 months and cost over £250,000, necessitated a large amount of organisation and co-ordination at Headquarters and involved a considerable amount of correspondence with the Company in settling the differences which arose between the staffs engaged relating to the extent and description of the plant scheduled. Concurrently with this work, preparations for the first legal proceedings which were in connection with the Postmaster General's objection to purchase certain portions of the plant were in hand and the whole of the details respecting the external plant fell on Mr. De Lattre's shoulders. The main arbitration proceedings lasted 74 days and the outstanding work of Mr. De Lattre was recognised in the reports by Sir John Simon, Solicitor General, Sir Robert Hunter, Solicitor to the Post Office, and the Engineer-in-Chief, Sir William Slingo.

During the War the staff in the Main Lines Section consisted of two Engineering officers and two clerks, and with this assistance Mr. De Lattre was responsible for a considerable amount of work in connection with the provision of the extensive network of emergency lines, the operations of the submarine cable fleet, which at one time included no less than 6 vessels, and in 1917 took over the work and staff of the Local Lines Section. Immediately after the Armistice the extensive programme of construction work which had been drawn up during the latter period of the war was commenced and the cost of the line plant to be provided and for which Mr. De Lattre was responsible to the Engineer-in-Chief, amounted to over £5,000,000.

We are sure that Mr. De Lattre's many friends in, and out of, the service will wish him the best of health and strength in the position he has been called upon to occupy.

RETIREMENT OF MESSRS. A. J. STUBBS AND A. MOIR.

PRESENTATION GATHERING.

THE Deputation Room in the G.P.O. North on the 13th July last was crowded to its utmost capacity with members of all grades of the staff to witness the presentation to Messrs. A. J. Stubbs and A. Moir, and to do them honour on the occasion of their retirement from the service. Among those present were Messrs. T. B. Johnson, J. E. Taylor, E. Gomersall, E. J. Eldridge, S. Plummer, J. M. G. Trezise, Greenham, Shackleton, Weaver, Stanhope, Price, Batchelor and Cook from the Districts and nearly all staff and assistant staff engineers and senior clerical officers at headquarters. Messrs. J. L. Robb and J. Newlands, late Controller C.T.O., represented the older brigade.

Sir William Noble, who made the presentation, explained that he had had no time to prepare a formal speech, but this was not without its advantage since he could speak as his heart dictated and not as a scribe. He eulogised the services rendered to the State and to the Department by the two gentlemen about to retire. Mr. Stubbs had served under seven Engineers-in-Chief and Mr. Moir was practically the father of the engineering service of the Post Office. In the name of the subscribers he presented Mr. Stubbs with five bicycles for the use of his family, a gramophone, and a silver casket containing cards bearing the signatures of the subscribers, and Mr. Moir with a gramophone from the Superintending Engineers and Staff Officers at headquarters.

In his reply Mr. Stubbs said he could not urge as an excuse that he had had no time to write up a speech. Indeed he had no desire to do so; one did not wish to compose an oration to be declaimed at his own funeral. He thanked everyone on behalf of himself, Mrs. Stubbs and family for their kindness and thoughtfulness. He had served the State to the best of his ability. To those remaining in the service he would say "work hard and play the game."

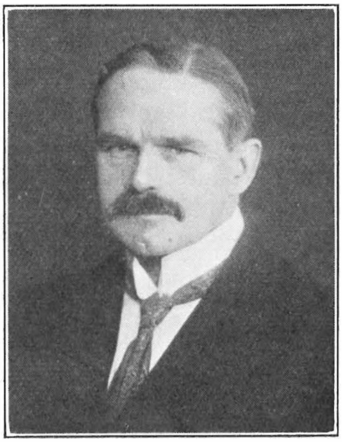
Mr. Moir recalled the fact that ever since he had occupied the chair at the Superintending Engineers' Committee meetings he had been supported whole heartedly by everyone, and he appreciated the present token of their regard as evidence of the good feeling that had always existed. His ambition had been to weld the two London Staffs, N.T. and P.O., into one harmonious whole, and to construct and maintain the telephone plant in the District so as to provide the public with the best service possible. They had succeeded in bringing down the number of faults per station per annum to 1.34.

Messrs. T. B. Johnson and J. Newlands also spoke in complimentary terms of the two guests, and a most successful gathering then terminated. When the Engineer-in-Chief was making the presentations the crowded audience broke forth into "For they are jolly good fellows;" the fervour of the singing indicated the regard in which the two recipients were held by the staff, although it disturbed unwontedly the quiet corridors of the G.P.O. North.

Mr. A. J. STUBBS.

ON the 31st of July last, Mr. A. J. Stubbs, the senior Assistant Engineer-in-Chief, severed his long connection with the Post Office

Engineering Department by retirement shortly after attaining the age of 60. With the exception of a short period of five years, May, 1902, to May, 1907, during which he held the position of Superintending Engineer in the Metropolitan North District, Mr. Stubbs' service was spent entirely in the Engineer-in-Chief's Headquarters office, and his retirement has severed the main link which, in the minds of many of us, remained in these later years to connect the present generation of Headquarters engineers with the group of brilliant men who, after the transfer of the telegraphs to the State, in 1870, laid the technical foundations which secured for the British Telegraph Service its long acknowledged reputation of the finest in



MR. A. J. STUBBS.

the world. The wonderful page of state service history which unfolded itself during Mr. Stubbs' career was charmingly portrayed by himself in a paper, "50 Years of State Telegraphs," which he read before the Telegraph and Telephone Society of London, in November, 1920. It was reproduced in that Society's Journal during December and January last, and will be fresh in the minds of most of our readers. He well described the story as one of "entrancing romance," and the only point that he does not make clear is that throughout the major part of it he was himself one of the most fruitful contributors to the striking progress he describes.

He entered the Engineer-in-Chief's office in 1880 as a 2nd Division Clerk, but his inventive genius and wonderful skill in mechanical draughtsmanship marked him out at once for a technical career. Edward Graves was his first Engineer-in-Chief, a shrewd and hard-headed business man of first-class capacity, who had no pretensions to being an engineer and who was content to leave the direction of technical matters in other hands—as well he might with Preece as his second in command and such henchmen as Gavey, Heaviside, Cooper, Kempe, Willmot, Eden, Hartnell and Stubbs at his disposal. When I came to the Engineer-in-Chief's office, early in 1894, Preece had just succeeded Graves, and I found the office saturated with the personality of Stubbs, who was then a "boy" of 33, with the reputation of perpetual youth which he has faithfully maintained all through. It was my duty to understudy him, and I remember that at the first interview I had with Preece about my duties he told me incidentally that Stubbs was worth his weight in gold. So I found him: a gentleman and in every sense a *man*. He always joked, he never preached, but he could not help raising the tone of his company by his mere presence.

In those days the reputation of the Engineer-in-Chief's office stood very high. Its circulars, diagrams, and memoranda carried, throughout the country, the full authority of plenary inspiration and were accepted as the edicts of men dowered with infallibility! The Headquarters technical staff then consisted of seven Technical Officers and three Engineers, packed together in the old, and now vanished, "Room 90," on the 2nd floor "bridgehead" of G.P.O. West, where each enjoyed about 4 ft. of desk space and his quota of the services of *one clerk!* These were the days of "direct action," speedy results, and conservation of energy. Into this little coterie of Olympians I entered with diffidence and trepidation, but I soon discovered that they kept their *halos* out of sight and that their most apparent unofficial characteristics were abundant bonhomie and capacity for fun. The degree of affectionate intimacy that speedily established itself, with Stubbs in particular, was to me a source of pride and pleasure which has continued undiminished. In this respect I am one of many, or rather I may say I am representative of the closer circle of his colleagues en masse. Mr. Stubbs himself will know if mean thoughts ever pass through his mind; I can only say that I have never heard a mean word pass his lips, nor heard of a mean action ascribed to him. We all know many who are clever at pushing the consequences of their mistakes upon other people, but Stubbs seemed almost to be on the outlook for opportunities of taking on his own shoulders responsibility for the shortcomings of others, sometimes with consequences far from pleasant to himself.

His contribution to the science and art of telegraphy cannot be expressed by a mere list of the many devices and items of apparatus which he has produced. His designs have been copied and adopted as standards all over the world, and scores of the beautiful drawings, turned out with such facility in his earlier days, are preserved in the

Engineer-in-Chief's archives, but even more important is the fact that he was largely instrumental in shaping the governing tradition of British telegraph design which many others have, more or less unconsciously, adopted and followed.

If he had remained a mechanical and electrical designer all his life he might have given this country an equally characteristic equipment of telephony; indeed, his work in the early days of Post Office telephones held the field for many years and is alive still. For the last 20 years the administrative work of our rapidly expanding department has claimed him increasingly, but all along I have fancied that his greatest zest appeared when some idea came to him that would give an opportunity of sending for a drawing board and getting out his set of instruments for an excursion back into his old domain.

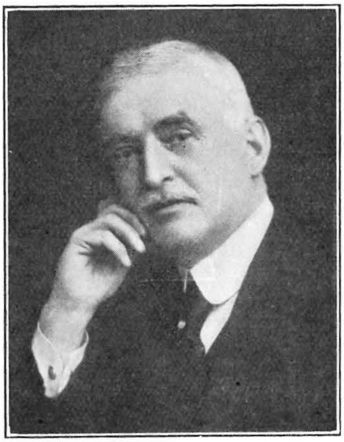
With his retirement there has passed from our daily official life a loyal colleague and a Christian gentleman *sans peur et sans reproche*.

T. F. PURVES.

Mr. A. MOIR, O.B.E.

Mr. Alexander Moir, Superintending Engineer of the London Engineering District, retired at the end of July last. He entered the service as a Telegraphist at Aberdeen in 1874 and joined the Engineering Department in 1878. During his official career he held appointments in Edinburgh, Bradford, Leeds, Newcastle-on-Tyne, Dublin and London. In 1903 he took charge of the Construction Section of the Engineer-in-Chief's Office which post he held for about 2½ years. At this time the methods of external construction were being revised. The Post Office was carrying out a large scheme for the provision of underground plant in London, and conduits, jointing chambers and cables of new types were being brought into use. The provision of long distance telegraph and telephone cables was also being carried out. Mr. Moir brought to bear on these matters a sound engineering knowledge combined with a national characteristic for obtaining the best value for money expended. He took measures to ensure standardisation and the general adoption of approved methods throughout the Kingdom. Mr. Moir has always declared that his experience in the Engineer-in-Chief's Office enabled him to gain a knowledge of men and methods at Headquarters which proved invaluable to him during his 15 years service as Superintending Engineer. During his service as Assistant Superintending Engineer in the Northern District and as Superintending Engineer in Ireland, and in the old South Metropolitan and South-Eastern Districts he accumulated experience which prepared him for the great responsibilities that devolved upon him as Superintending Engineer of the London Engineering District.

The London Engineering District as at present constituted was formed in 1912 out of the Central and South Metropolitan Districts and the National Telephone Company's transferred system in London. Mr. Moir's capacity for organisation stood him in good stead in forming a single homogeneous district from the mixed conditions as they existed prior to the reorganisation. The system then devised with its functional basis and clearly defined lines of responsibility has stood the test of time and its flexibility has enabled the staff of the District, which totals nearly 6,000, to be effectively handled under the changing conditions of both war and peace time. Mr. Moir always insisted on the need for close co-



MR. A. MOIR, O.B.E.

operation with other Departments and his practical application of this principle was a pleasing feature of the work of the District. He was also a believer in the advantages of round table conferences and made it a practice to preside at meetings of his Assistants at least once a fortnight, and of the fourteen Sectional Engineers at frequent intervals. The Sectional Engineers were in their turn encouraged to consult with their Inspectors in a similar manner from time to time. Much credit is due to Mr. Moir for the tactful way he handled the very difficult staff problems that arose as a consequence of combining two large bodies of men previously in opposing camps. The ex-Company's staff in London have always been pleased to bear testimony to the very fair treatment that they received at his hands, and it is largely because of his unbiased and consistent attitude in this matter that much of his success in governing the District must be attributed. The problems that arose in the London Engineering District during the war period and since might have proved too much for a less able man, but Mr. Moir, thanks to his unfailing energy and imperturbability was able to surmount all the difficulties and handed over the District to his successor with all the wheels running smoothly and the foundation stones of its future prosperity well and truly laid.

Mr. Moir was created an Officer of the British Empire in 1918 for services in London in connection with the war.

He served upon the Superintending Engineers' Committee from its formation in 1907 and has acted as Chairman since 1918.

At the Superintending Engineers' conferences, in the usefulness of which he was a strong believer, he always took a prominent part. With his retirement Sir William Noble remains the only representative in active service of those who were present at the first conference held in the Star and Garter Hotel at Richmond in 1907.

Whitley Committees on both the Engineering and Clerical sides were successfully launched in the London District during the latter period of Mr. Moir's service, and, as in all his dealings with the staff, he sought to hold the balance evenly between employer and employé. As a manager he believed in carrying devolution of responsibility to its furthest safe point. His watchwords were thoroughness and promptitude. He had no use whatever for methods which were dilatory, superficial or ineffectual.

Mr. Moir possessed many qualities which fitted him to fill the post of head of the Engineering District in the London Area. He had very high ideals for the Engineering Department and did valiant service in obtaining recognition of the importance of the work done by the Engineers. His dignified appearance added to his other qualities, always assured him an attentive hearing when conducting negotiations with other Departments, public bodies or members of the general public. He was always much in request as a speaker at public functions as he had the power of speaking both fluently and interestingly. When in an expansive mood he was a boon table companion and possessed a fund of interesting stories of men and things to draw upon. His interests outside business hours were principally of a literary character, but he kept himself in health on the bowling green.

Mr. Moir never lost an opportunity of acknowledging the help which he had received from the staff of the District. He leaves the service carrying with him the esteem and good wishes of the District and Headquarters staffs and also of the other Departments of the Post Office with which he was in constant touch.

G.F.G.

[We are indebted to the "Electrical Review" for the use of the blocks of Mr. Stubbs and Mr. Moir contained in the foregoing.—Eds. "P.O.E.E. Journal."]

LONDON DISTRICT NOTES.

TELEPHONE LINES AND STATIONS ADDED AND RECOVERED DURING THE THIRTEEN WEEKS ENDED JUNE 28TH, 1921.

	Exchange Lines.	Internal Extensions.	External Extensions.
Provided... ...	4053	5098	444
Recovered ...	4792	6053	565
Decrease... ...	739	955	121

The total figures for the District on August 23rd, 1921, were as follows:—

Direct Exchange Lines	158,329
Internal Extensions	146,580
External Extensions	10,153
Working Stations (Speaking Sets) ...	301,357

EXTERNAL CONSTRUCTION.

During the three months ended 31st July, 1921, the Telephone Exchange wire mileage showed an increase in underground of 28,197 miles and a decrease in open and aerial cable of 475 and 335 miles respectively, the nett increase for the period being 27,387 miles.

The Telephone Trunk wire mileage increased during this period by 9 miles open and 124 miles underground. There was a decrease in the wire in use for Public Telegraphs of 1 mile open and 144 miles underground. Pole line during this three months increased by 7 miles to 2,905 miles and pipe line by 44 miles to 3,976 miles.

The nett increase of underground cable was 108 miles, making a total to date of 7903 miles.

The total single wire mileage, exclusive of wires on Railways maintained by Companies, now stand at:—

Telegraphs	17,601
Telephone Exchange	1,229,051
Telephone Trunks	19,003
Spare wires	16,665

The following figures show the alterations to mileage during the three months ended 31st July, 1921.

Date.	ARIAL SINGLE WIRE.				UNDERGROUND SINGLE WIRE.			LINE.	
	Bare Wire.			In Cable.					
	Telegraphs.	Telephone Exchange.	Trunks.	Telephone Exchange.	Telegraphs.	Telephone Exchange.	Trunks.	Pole.	Pipe.
31st July, 1921 ..	565	26896	2189	25406	17036	1176749	16814	2905	3976
30th April, 1921	566	27371	2180	25741	17180	1148552	16690	2898	3932
Increase	—	—	9	—	—	28197	124	7	44
Decrease.. ..	1	475	—	335	144	—	—	—	—

INTERNAL CONSTRUCTION.

During the past three months extensions of the Ealing, Finchley, Lee Green, and Park Exchanges, carried out by the District Staff, and an extension of the New Cross Exchange, carried out by Messrs. The Western Electric Company, have together afforded accommodation for about 2,350 additional subscribers.

Two more relief Exchanges, known as Grosvenor and Minories, have been opened at South Audley Street, W. and Royal Mint Street, E., respectively, making the sixth and seventh relief exchanges installed by the London District Staff since the resumption of development activities in October, 1919. The equipment for both exchanges was supplied by Messrs. The Automatic Telephone Manufacturing Company and is of the C.B. Multiple No. 10 Type, being similar in arrangement to that installed at the Langham Relief Exchange, of which a full description appeared in the April issue of this Journal. The equipment at Grosvenor includes 24 "A" and 10 "B" positions and at Minories 35 "A" and 15 "B" positions, each Exchange having capacity for 2000 subscribers.

The new Toll Exchange in Norwich Street was brought into operation on August 27th. As a preliminary step 77 incoming circuits were connected. The remaining circuits were joined up at intervals, the final batch having been transferred on September 17th.

In addition to the new permanent Clerkenwell Exchange, which should be ready for opening about the end of October, Contractors are busy on the following important works:—

New Exchange:—Stratford. Extensions:—Avenue, East, Lee Green, Streatham, and Willesden Exchanges. Among other works, the District staff is engaged upon the installation of a temporary Exchange at Hendon, to be accommodated in an Army hut, and of extensions and alterations at the Hampstead, Kensington and North Exchanges.

The most important of the large Private Branch Exchanges in course of construction in the District is that being provided for the Ministry of Pensions at their new offices at Acton Vale, where a building is being erected which will have floor space of about 54,000 square yards. The left wing is already completed and accommodates a switchboard of the C.B. B.E. Multiple Type No. 9, with 10 positions, which will be equipped for 60 Exchanges, 10 Tie, and 520 extension lines. In this case a separate power plant will be provided within the building.

Central Telegraph Office.—A noteworthy extension of the British Baudot Duplex has been made in the last few weeks on lines between London and Amsterdam, which have been served for a period of about 12 years with Baudot quadruple simplex on two lines, having the four channels of one set for sending interleaved with the four channels of the other set for receiving. This arrangement was a marked improvement over the Duplex Hughes originally in use and more than doubled the previous output. The new installations consist of two Triple Duplex Baudot sets, giving six channels on each line, *i.e.*, three in each direction. Apart from increasing the number of channels by 50% the system has the great advantage of maintaining communication on one line when the other is stopped. With the quadruples traffic was often seriously disturbed when one line became interrupted, and on occasions a fault on one line meant the complete stoppage of both circuits, or a change to Hughes working.

The Triple Duplex sets are arranged in the standard P.O. form, with a switch for two-line simplex working should balance difficulties arise.

The working during the few weeks that the new sets have been in use has been most satisfactory. The apparatus at Amsterdam was supplied by the British Post Office, but was installed by the Dutch Administration.

There will shortly be a similar set installed for use between London and Brussels, which will complete the establishment of Triple Duplex Baudot working between London and Belgium, Holland, and France, leaving only the cables to Germany which up to the present have not been worked more than Double Duplex by the Postal Administrations.

The circuit to Belfast, mentioned in our last issue as being fitted with Murray high speed apparatus, is strictly speaking a Murray Duplex Multiplex fitted with Baudot receivers.

LOCAL CENTRE NOTES.

SOUTH WALES DISTRICT.

Promotion of Mr. R. McIlroy.

When it became known to the Staff in the South Wales District that Mr. McIlroy had been promoted to be Superintending Engineer of the London District, every member instinctively felt and said " What a loss we are experiencing."

During the twelve years Mr. McIlroy has been the Superintending Engineer in this District he has shown himself to be possessed of such exceptional qualities of heart and mind that everybody has been able to look up to him as a Chief with absolute reliance upon his justice and generosity. His outstanding abilities were constantly noticed and accepted as a sign of all-round efficiency. Before him there had been a line of men of outstanding ability making it difficult to follow. He succeeded in upholding and enhancing the dignity of the position. In every case he brought to bear clear thinking, keen perceptive faculties and quick decision. His alert and legalistic mind, clear and concise diction, keen insight and fairness, have won for him a great name. He never carries his heart on his sleeve, but behind that solid, quiet, apparently unemotional attitude, there is one of the most appreciative and generous natures. In every case all extenuating circumstances were carefully weighed and every attempt made to put himself in the other man's place with a view to see how the other man had thought, and, therefore, acted. A positive genius on Wayleave matters Mr. McIlroy cleared the clouds from many a dark case and won it. So that while we heartily and sincerely congratulate him upon his preferment, and wish for him good and gracious gifts, health, happiness and prosperity throughout his life, we feel very keenly his departure from our midst. It is said that a man with his face to the sun cannot see his own shadow. Mr. McIlroy has the sun of promotion shining on him now, but he cannot estimate, even approximately, the extent of the shadow which has been cast over us by his removal.

Every member of the Staff desired to show in a tangible form the great respect they have for Mr. McIlroy, but he, in this matter, as in all others, acts on a set principle and prefers to realise in his inner consciousness *the fact* that the Staff respect him and will always do so, not only as a superior officer, but also as a friend.

A farewell gathering in the form of a smoking concert was held on the 12th September, 1921, at the Whitehall Rooms, Park Hotel, Cardiff, under the chairmanship of Mr. C. J. Youngs. A most cordial and happy meeting took place, which comprised the District Office staff, members from the outside stations and representatives from the Surveyor's and Postmaster's staffs, the large number present being indicative of the high esteem in which Mr. McIlroy is held. An exceptionally fine programme was provided, chiefly by members of the District Office.

Speeches were made by officers representing the different grades of the Engineering Service congratulating Mr. McIlroy on his promotion and wishing for him health, happiness and success in his new position. Deep regret at his removal from the District was expressed on all sides. Mr. McIlroy received a great ovation, and in responding said with considerable feeling that he had been very happy during the twelve years he had been Superintending Engineer in the South Wales District and had made many friends. He appreciated to the full all the kind remarks that had been made by the various speakers and he pointed out that his guiding principle had been that of justice and fairness to one and all.

It was very much regretted that owing to illness Captain Crompton, O.B.E. (the new Superintending Engineer) was unable to be present.

SCOTLAND EAST DISTRICT.

A WELL attended meeting of the staff bade farewell to our esteemed Senior Assistant Superintending Engineer, Captain Crompton, O.B.E., on the 30th July, when he left on promotion to the Superintending Engineership of the South Wales District. The chair was taken by the Superintending Engineer, Mr. Taylor, and the meeting was graced by the presence of Mrs. Taylor, Mrs. Machugh, Mrs. Crompton and Mrs. Gilbert.

Among those who paid tributes of respect and good fellowship to Captain Crompton were General Price (The Secretary, Edinburgh), Mr. Mellersh (Surveyor, Scotland East District), Mr. Machugh (late Superintending Engineer, Scotland East District), Messrs. Creighton and Dawkes (Controllers, Postal and Telegraph, Edinburgh), Mr. Gilbert (Assistant Superintending Engineer), Messrs. Gillespie and Watson-Weatherburn (Engineers), Messrs. Ritchie, Gray and Stewart (Clerks), Mr. Pagan (Inspectors), and Mr. Burgher (Linemen). Mr. Wood, Telegraph Superintendent of the North British Railway, was unavoidably prevented from attending. Mr. Taylor joined in the appreciation and good wishes, and then presented a drawing-room clock, a watchguard, and a case of pipes to Captain Crompton and a pendant to Mrs. Crompton, both of whom responded suitably.

Our colleagues in the South Wales District are to be congratulated on their new Superintending Engineer.

INSTITUTION OF POST OFFICE ELECTRICAL ENGINEERS.

THE Council is pleased to announce that the Postmaster General has awarded Lt.-Col. A. C. Booth, M.I.E.E., the sum of £100 "in recognition of his invention and services in connection with improvements in Telegraph Working." This applies more particularly to the development of the Booth-Baudot Duplex, giving 6, 8, 10 or 12 channels per circuit in place of the 3, 4, 5 and 6 channels of the ordinary Baudot as used in France for some 40 years.

Lt.-Col. Booth has handed over this sum (£100) to be utilised at the discretion of the Council in Annual Awards for the best improvement in Telegraph Land-Line Apparatus, or Systems.

An annual award of £5 (to be known as "The Booth-Baudot

THE COUNCIL, I.P.O.E.E., SESSION 1920-21.

Front row: A. O. Gibbon, H. Kitchen, J. G. Hill, A. J. Stubbs (Chairman), J. G. Hines, S. C. Bartholomew, F. E. Mitton.

Back row: M. McMullen, A. W. Gardner, H. W. Senhenn, G. Bailey, T. Smerdon (Secretary), J. H. Hart, W. J. A. Payne, B. Miller.

Duplex Award") is therefore offered for the best improvement in Telegraph Land-Line Apparatus or Systems, to be governed by the following conditions:—

1. British Subjects only, employed by Public Telegraph Administrations throughout the world, will be eligible to compete for the Award.
2. Applications for the Award to be received between January 1st and March 31st of any year, such applications referring to improvements made, or suggested, during the twelve months prior to January 1st referred to above.
3. At the discretion of the Council of the Institution of Post Office Electrical Engineers an award may be withheld

in any year, if, in the opinion of the adjudicators appointed by the Council, after full consideration of the application received, no Award is warranted.

4. Applications for the Award, accompanied by full details of the improvement should be addressed to

The Secretary,
Institution of Post Office Electrical Engineers,
G.P.O. West,
London, E.C

BOOK REVIEWS.

"Dynamo and Motor Attendants and Their Machines." By Frank Broadbent, M.I.E.E. (S. Rentell & Co., Ltd. 4*s.* 6*d.*—10th Edition).

This is a book which should prove useful to many.

It sets out to provide a simple explanation of the theory of what, in the Post Office, is usually considered as "Power Plant" and also to provide sound advice for its proper maintenance.

The theory is well presented, a number of original analogies being used as well as those which we imbibed in our early days, and the amount of information given is sufficient to carry one beyond the little which is a dangerous thing.

The description of the operation of an accumulator may be cited as an instance. Without attempting to deal with elementary chemistry, the author gives a clear description of both the lead and iron-nickel battery in such a manner that the leading principles should be understood as quickly as one can read.

As regards the practical information, it is good to see that the author does not serve up a hash of trade catalogue advice, nor does he attempt to instruct in making repairs or adjustments which really necessitate the attentions of a large organisation. For instance, in dealing with an armature in which heating occurs due to eddy currents in the conductors or core, he very soundly states that "There is no remedy beyond complaining to the manufacturer." On the other hand, any small repair or remedy which can be readily applied is given its due amount of attention.

It should be mentioned that all the information is well illustrated with many photographs and diagrams, but there is a rather large number of misprints, *e.g.*, P. 153, where the following may be found:—"The *unction* of an auto-transformer," etc., etc.

It is, perhaps, unnecessary to remark that no reference to oil cooling is intended in this case!

Altogether a handy little book, which might well be found in use by those who have had a thorough engineering training as well as those who have not enjoyed this advantage so completely.

"Arithmetic of Telepraphy and Telephony." By Herbert and de Wardt. (Pitman. 5*s*. net).

Most of us will recollect Gunn's excellent little work, the "Arithmetic of Electricity and Magnetism" of years ago. The work before us is on similar lines and applies to the calculations involved in telegraphy and telephony. The examples are varied and well chosen, and any student who carefully works through the exercises given at the end of each chapter will find the time well spent and his knowledge tested and extended. It is a capital work and to be highly recommended for its clearness to elementary students of the subjects.

"Continuous Wave Wireless Telegraphy." Part I. By W. H. Eccles, D.Sc. (The Wireless Press Ltd. 25/- net).

The present volume is the first part of an exposition on Continuous Wave Wireless Telegraphy and deals with the fundamental principles of that subject. The book may conveniently be grouped into sections, the first dealing with electrostatics and electrodynamics, occupying about 80 pages; the second section of 159 pages deals with alternating current circuits and transformers; and the third section of 139 pages deals with the physical properties of thermionic tubes.

The mathematical treatment of high frequency alternating currents such as are employed in continuous wave wireless telegraphy is given in detail and in a very lucid manner.

The importance of the thermionic three-electrode tube in continuous wave wireless telegraphy, both for transmission and reception, is well known. The full and authoritative treatment of the mathematical and physical principles of thermionic tubes given by Dr. Eccles, constitutes a valuable addition to the extensive literature on this subject.

This volume does not deal with the practical applications of the various methods of installation and working of wireless stations, and appeals more to the student than to the experienced engineer who desires to become acquainted with existing practice.

The book is well arranged and well printed, and it is to be hoped that the second volume of the work will not be long delayed.

E. H. SHAUGHNESSY.

"Automatic Telephone Systems," Vol. 1; "Circuits and Apparatus as used in the Public Service," by William Aitken, M.I.E.E., A.Am.I.E.E. (Benn Bros. Ltd. 25s. net.)

The publication in this country of a work intended to cover the whole field of Automatic Telephony is an event of no little interest for British telephone men, and the writer is to be congratulated on the production of the first English book dealing with this important subject in anything like a comprehensive manner.

This volume is of peculiar interest to students and engineers in the Post Office, as the automatic systems described include all those in use in public exchanges in this country and others which may be installed in the near future.

One of the main difficulties to be overcome in producing a book concerned largely with the circuit operation of automatic systems is the preparation of clear circuit diagrams, on which the electrical changes can be followed without the need for continuous reference to the text. Any device is a distinct gain which minimises the frequency of the distracting process of picking up the last point reached in the diagram after each reference to the text, and *vice versâ*. To this end the author has adopted the scheme of numbering and describing the effect of each circuit change in the order in which it occurs. This number is marked on the diagram from end to end of the branch of the circuit affected by the change. Textual brevity is thereby attained. The descriptive term "bus routing" is used in the preface to define this method, since the numbers permit of the tracing of each branch circuit in the same way that the route of a bus is followed on the familiar bus maps of London.

Perhaps the expedient employed on these maps of clearly indicating the terminals of each route might have been included with advantage on the diagram or in the description. This would avoid the unnecessary process of tracing the circuit from the point at which it is completed to one of its terminals before tracing the complete circuit.

The book is divided into short self-contained sections instead of the usual chapters. This arrangement, although primarily designed to facilitate revision, has the advantage of breaking the monotony of long chapters.

After a few introductory sections on switch provision, trunking, the dial and the subscriber's telephone, the following automatic systems are described, viz., the Automatic Telephone Co.'s; Siemens Bros.'; Western Electric Co.'s Rotary; Lorimer; Relay Automatic Co.'s; Western Electric Co.'s Panel and the system of the Coventry Automatic Telephones Ltd. The first four systems are in use at Post Office exchanges, and the employment of the remainder is under consideration.

The descriptions of the systems are aided by photographs and drawings of representative apparatus and circuits, and for most of the systems the student will be piloted through all the circuits involved in the connection of one subscriber to another. The Western Electric Co.'s Panel system is explained in general terms and the sections devoted thereto will form an introduction to the study of this system, further details of which the author hopes to have available for Vol. 2.

In the description of the Western Electric Company's Rotary system, the principles of " continuous drive " systems generally and their application to this particular system are demonstrated with the aid of a series of strikingly clear diagrams showing the fundamental circuits.

The author, in the preface, is particularly severe on the " scrap or one feature diagram which eliminates the associated circuits and show the feature out of prospective." It is true that this method can be carried to extremes with consequent confusion. There are, however, certain fundamental features in any automatic system which can but be fixed in the mind by this method of representation. Such basic circuits as those for impulse receiving, transmission, engaged test and metering are particularly adapted for this method of treatment, and the author's criticism is rather vitiated by his successful employment of the " one feature " diagram in the case of this system.

The book is well bound and printed. The circuit diagrams are clear, with the exception of several of the through connection diagrams on which the employment of the " bus routing " device has resulted in congestion.

An error here and there in drawings and text is inevitable in a new work of this magnitude and intricacy, but there is none in the book to confuse the learned save perhaps those in Figs. 2 and 130. In the former, showing the trunking of a 100-line exchange, disengaged subscribers' lines are shown normally connected to common trunks. Fig. 130 shows a typical panel selector frame upside down.

The book is a notable addition to the literature of the subject, and the publication of the second volume will be awaited with interest.

R.L.B.

THE HUMOROUS SIDE OF A P.O. ENGINEER'S LIFE.

THERE are many incidents in an Engineer's life which are humorous and cheer him on his way, and the man without humour is like a kangaroo without a tail—lacking balance. Perhaps my funniest experience was in a Section to which I had only recently been attached and to whose members I was not known. It was necessary for me to visit a country post office—you know the type, garden with hollyhocks, phlox and all the old-world flowers, low building with overhanging roof, letter box built into wall as though apologising for its presence, and the " wire " sneaking in at the back of the building, like a thief—to inspect some work of leading-in one of the men was doing there, and as I approached the P.O. I found the Linemen—one of the " originals "—in conversation with a " gentleman of the road." I went up to them, but as they took not the slightest notice of my presence I did not " butt in," and the following is only a scrap of their conversation :—

G of the R: " Aye, I've spent many a half-day in the Black Bull at Roydonford when ah owt to hev been selling sewing-machines."

Lineman: " And I've spent many a day there when I owt to hev been on His Majesty's service. I expect t'Boss will be comin' to look at this job. Bye! them chaps hev a reight job on it, and really they don't kna what we are doin' half our time."

G of the R: " Well, I'll go and hev a pint at Brown Cow; tha'll be comin' up, I expect."

Lineman: " Ah'll come up now, I've finished." He went.

After examining the work I too went—not to the Brown Cow—but to his HQs. 2 miles away, and awaited his arrival. In two hours he walked in . . . glared at me . . . and vanished as though pursued by an evil spirit into an adjoining room, where the second man was working.

" Who's yon'd chap."

" That's 'A,' the new Engineer."

" Oh! ! ! ! He's been at Quxton and stood whilst I was talking to one of the sewing-machine men. I took him for a '*Bernard Shaw*' racing tout! "

It should be explained that I do not look official, my face is well . . . not my fortune, and I *had* a big check cap on that day.

* * * * * *

We, the Lineman and I, had done 7 good English miles, main line inspection, the road was hilly and dusty, the day scorching hot, and we had reached the stage when the wires danced to our every step. We were weary. The only place to obtain our midday snack was at the hostelry in the village. It was a " Dickens " place, with its three steps on the outside for " My Lady " to mount her horse, and its postage stamp windows.

The landlord had a comfortable rotundity and the best parlour was deliciously cool. Old sporting prints hung on the walls in company with " Reynard's Head " and copper bedpans. Cold beef, bread and sweets were available and were immediately forthcoming. We ate in silence, the first 10 minutes were like a sacrament, and I suppose we both wondered at the solemnity.

I was of the opinion that the Lineman thought it very unofficial for his chief to eat with him, and I supposed he was thinking that he would have enjoyed the meal much better had he been alone. "Will you have anything to drink, gentlemen?" he of the rotundity cheerfully exclaimed, and the gleam in the Lineman's eyes proved effectively to me the reason for his silence. He was missing his midday pint! Being teetotal, I said "No thanks," and then the Lineman with an appealing look in his eyes, turned to me and said in stammering tones "A pint, please," and then blushed. The landlord retired, the Lineman said "You aint T.T. are you, Sir?" "Yes."

"Sure you're joking, Sir, aint yer?" "No, why?"

"Well, when Brown and I saw you come into the Section with that big chap, Mr. Jones, you know, Sir, Brown said 'Bye, I bet that little 'un can shift pints, and that was meaning you, Sir, . . . and really, Sir, it's good beer here!"

The meal from this point was more cheerful.

* * * * * *

Larry was a good foreman and I always looked forward with interest to a visit to his gang. Always cheerful, fearful of no thing, and a ready wit.

"Good morning, Larry, all going well?"

"Yes, Sir, but that young gentleman you sent to the gang to 'learn things' is causing a little trouble. You see, Sir, he aint used to our ways and don't understand the King's English properly, and besides he's too touchy. For instance, only this morning he comes up to me, and se's:—

"Brawny has called me a —— fool."

"Well! Aint you a —— fool."

"No, I am not."

"Well go and tell Brawny so then."

"Oh, yes, he's too touchy, but I expect he will improve, Sir."

* * * * * *

One day I made a visit to a colleague in a neighbouring section, a kind of busman's holiday, you know, to see a friend of mine, a fine chap but with a slight impediment in his speech. He was not in when I reached his office, so I waited. In about 10 mins. he arrived full of fury.

"What's up?"

"You know the boss, well, I've just had a row with him, and whilst I do not mind being called a —— fool in my own office, I do object to being called it in a railway waiting room full of people!"

This he let off, like a "Ford" back-firing, and when he finished I laughed so heartily that it begun to dawn upon him, that carefully analysed, his remark was very funny and then he too laughed . . . and was saved. "Y."

STAFF CHANGES.

POST OFFICE ENGINEERING DEPARTMENT.

Retirements, etc.

Name.	Grade.	District.	Date.	Remarks.
Stubbs, A. J. ...	Asst. Engr.-in-Chief	E.-in-C.O.	31 : 7 : 21	Retired.
Moir, A., O.B.E	Superintending Engineer ...	London	31 : 7 : 21	Do.
Fraser, J.	Exect. Engineer	Scotland East	31 : 8 : 21	Do.
Gilpin, G. E. ...	1st Cl. Engineer	Northern	29 : 7 : 21	Do.
North, H.	2nd Cl. Clerk ...	E.-in-C.O.	21 : 8 : 21	Do.

Promotions, etc.

Name.	District.	From.	To.	Date.
De Lattre, A. L. ..	E.-in-C.O. (Line Sect.)	Staff Engineer	Asst. Engr-in-Chief	1 : 8 : 21
McIlroy, R.	South Wales	Superintending Engineer	Ldn. Superintending Engr.	1 : 8 : 21
Crompton, Capt. C , O.B.E.	Scotland East	Asst. Suptng. Engineer	Suptg. Engr. South Wales	1 : 8 : 21
Ivison, E. J.	E.-in-C.O. (Telephone Sec)	Asst. Staff Engineer	Staff Engineer (Telephone Sec)	1 : 8 : 21
Cowie, F. E. W. ...	Scotland East	Asst. Engineer	Execut. Engr.	1 : 9 : 21

Transfers.

Name.	Grade.	Transferred. From.	Transferred. To.	Date.
France, W. M. ...	Staff Engr.	E.-in-C.O. Telephone Sec.	E.-in-C.O. Line Section	1 : 8 : 21
Andrews, J. R. ...	Execut. Engr.	Eastern District Cambridge	Northern Dist. Newcastle.	1 : 8 : 21

COMMUNICATIONS.

All Remittances and Communications should be addressed to the Managing Editor, P.O.E.E. Journal, Engineer-in-Chief's Office, G.P.O. West, London, E.C.1.

Binding covers and copies of the Contents Index for Vol. 3 to 13 are available, and may be obtained from the local agents for 1*s.* 6*d.* and 3*d.* respectively. Subscribers can have their copies of Vol. 13 bound, with index included, at a cost of 3*s.* by sending the Journals to the local agents. Orders should indicate whether the original binding with black lettering, or the later pattern in gold, are required.

A supply of copies of the Station List of Engineering Officers, down to Assistant Engineers, is in stock, and may be obtained on demand, price 3*d.* each.

The Council of the Institution of Post Office Electrical Engineers has decided to raise the price of the Journal to 2*s.* (2*s.* 3*d.* post free) per copy. This price applies also to annual subscribers, the subscription being 9*s.* per annum, post free. All back numbers 2*s.* each. The Board of Editors is anxious to repurchase copies of the following parts: Vol. 1, Part 1; Vol. 5, Part 2; Vol. 6, Part 1; Vol. 7, Part 1; Vol. 9, Part 2; Vol. 12, all Parts. Two shillings each part will be paid for clean copies in good condition.

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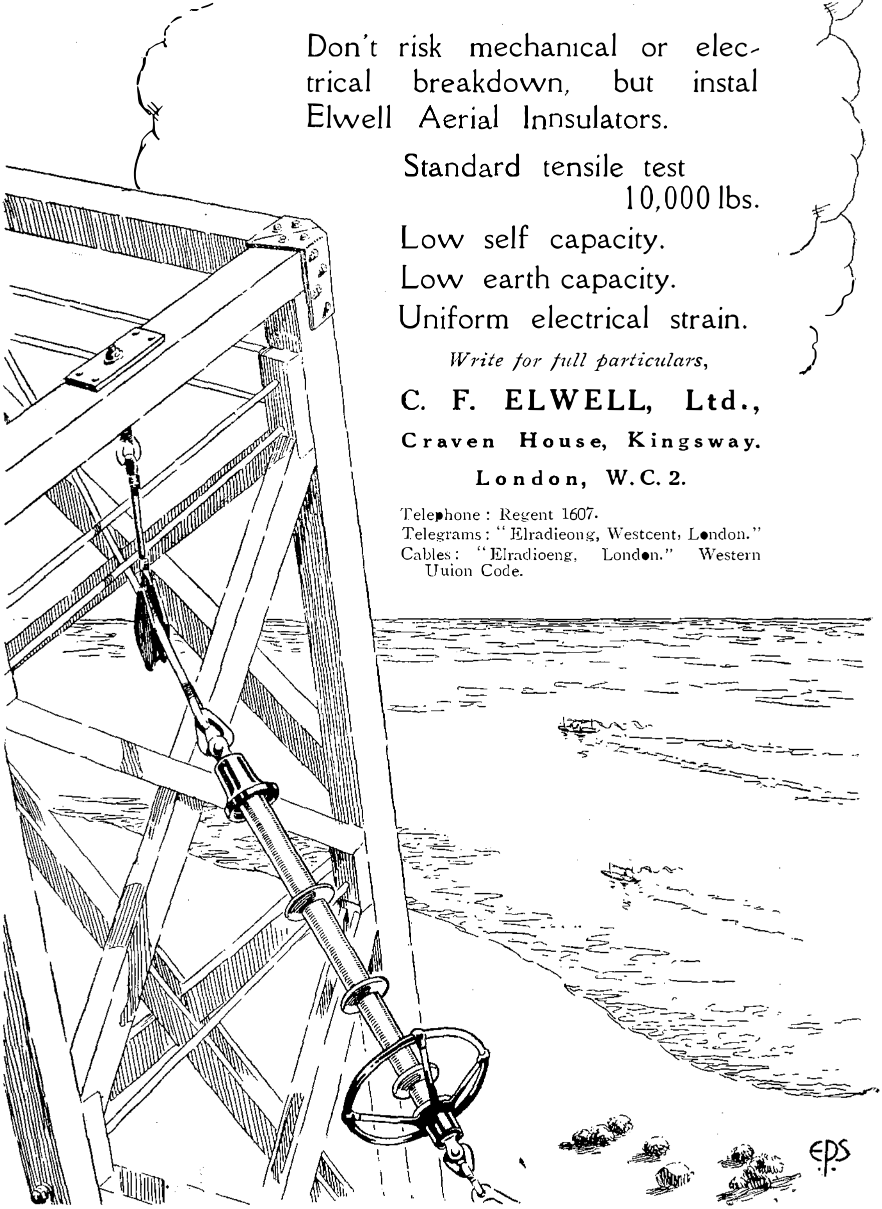
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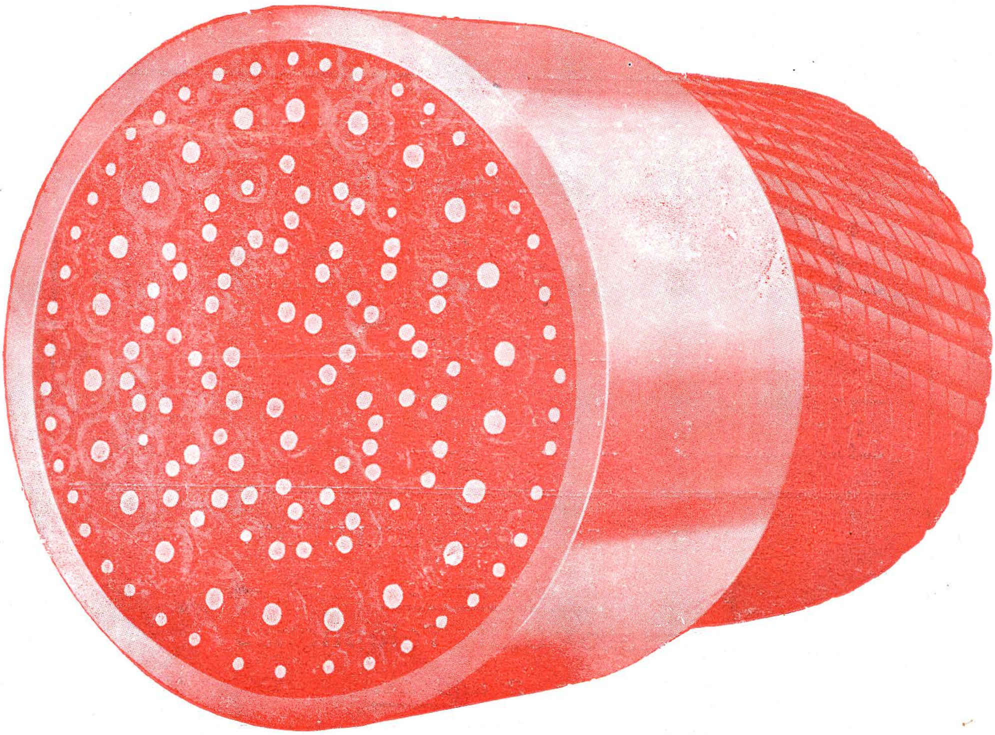

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