

Modern Developments in Phonogram and Telephone-Telegram Working

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INTRODUCTION.

THE modernizing of the purely telegraph side of telegraph plant has already been dealt with in an article appearing in a previous issue of this Journal¹ and a summary of the work undertaken as a result of the recommendations of the "Simon "

report has also been given.² It remains for details of the developments in the use of telephone aids to telegraph working to be set forth.

As there appears to be some dubiety as to the distinction between Phonogram and Telephone-Telegram working, it may be as well to commence by defining the two methods.

¹ "Telegraph Instrument Rooms." R. P. Smith and F. T. Cattell. P.O.E.E.J. Vol. 23, page 257.

² "Modernizing the Telegraph Service." A. O. Gibbon, M.I.E.E. P.O.E.E.J. Vol. 25, page 105.

- (a) Phonogram working provides for verbal dictation of telegrams between Post Offices subscribers' premises.
- (b) Telephone-Telegram working provides for verbal dictation of telegrams from one Post Office to another.

Method (b) is being extended with a view to the conversion to telephone working of all short distance Morse circuits of low traffic capacity, such as are now terminated on telegraph concentrators, and in London, on the Metropolitan Switch at C.T.O.

The received messages both phonogram and telephone-telegram are type-written direct from verbal dictation over the circuits at all Head Offices and at the larger out offices.

DESIGN.

The switchboard equipment which has been adopted as standard to meet phonogram and telephone-telegram requirements in large Telegraph Offices is of uniform design. In general, the switchboards used for one type of working are segregated from those used for the other, and different circuit arrangements are adopted to meet the varying requirements of the two schemes.

Any individual installation is built up into suites whose length is dependent on the traffic requirements and room lay-out. Each suite consists of desk elements which, when assembled, form a double-sided table. Each double table is assembled round a centrally-disposed V-belt conveyor. The conveyor is accessible to operators on both sides of the table and is used to convey received messages to the circulation point for distribution to the appropriate telegraph circuit. Fig. 1 shows an end view of a



FIG. 1.—END VIEW OF A TYPICAL TELEPHONE-TELEGRAM SUITE, SHOWING V-BELT CONVEYOR.



FIG. 2.—GENERAL VIEW OF A TELEPHONE-TELEGRAM SUITE.

typical telephone-telegram suite complete with belt conveyor. At a height of six inches above the conveyor is the switchboard multiple field. This is arranged to allow access to the multiple jacks by operators sitting on both sides of the table, but the width is kept down to that required for one-sided access by a design which is equivalent to two single-sided switchboards mounted one above the other, the jack field on one side being on the lower half of the panel and on the other side on the upper half of the panel. On each side, the spare panel space gives access to the wiring of the jack field appearing on the opposite side and also provides a field for the display of traffic notices and instructions. A 5-panel multiple is adopted, each operator's position occupying a space of $2\frac{1}{2}$ panels. A general view of the equipment forming a telephone-telegram suite is shown in Fig. 2.

A supervisor's desk, similar to that fitted in C.B. manual exchanges, is generally provided.

One operator's position is usually adapted for use as an enquiry desk.

A separate enclosure is provided for the I.D.F., relay racks, and auxiliary apparatus, such as flashing equipment, amplifiers, etc., that may be required.

The main components from which installations are built up consist of the switchboards, the desks (forming the table top), the cord boxes, and the auxiliary apparatus units.

The switchboards are known as Switchboards, Phonogram, Nos. 5 and 6 and consist of 2-panel units and 5-panel units respectively. They are used in combination to make up any required number of panels on both phonogram and telephone-telegram installations. At the end of each suite, the switchboard elements are closed by cable turning sections. The practice is to cable the installations from overhead, using switchboard cable from the I.D.F. and relay racks.

The desks are fibre-covered and differ in respect of the key circuit wiring in the two types of equip-

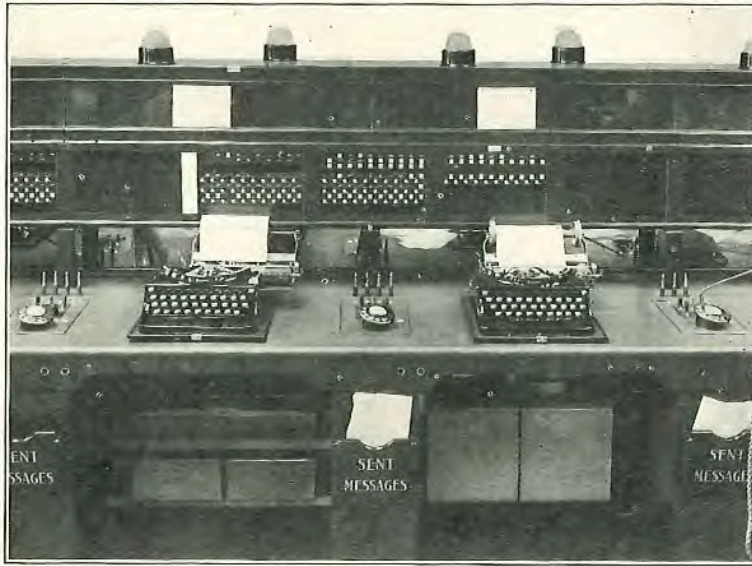


FIG. 3.—TWO POSITIONS OF TELEPHONE-TELEGRAM EQUIPMENT.

ment. The phonogram desks are known under the title "Desks, Pair, T.L.1414" and the telephone-telegram desks as "Desks, Pair, T.L.1601." The desks which are used to finish a suite are special fittings. These end desks have been given the titles "Desk, End Set, T.L.1414," which is used for phonogram purposes, and "Desk, End Set, T.L.1601," which applies to telephone-telegram equipment. The cord boxes, which are part of the desks, incorporate the cord tags and cabling to the keys and connexion strips. The height of the desk top above the floor has been fixed at 2 feet, 3 inches to allow of typewriters being used by the operators.

All the cord circuit apparatus not appearing on the keyshelf is incorporated, together with the operator's circuit apparatus, in an auxiliary apparatus unit. The units are arranged for jacking in, and are thus quickly interchangeable. They are mounted on ironwork fitted along the suit below the belt conveyor. "Unit, A.A., No. 74" incorporates the phonogram equipment and "Unit, A.A., No. 80" the telephone-telegram equipment.

Two positions of telephone-telegram equipment are shown in Fig. 3.

FACILITIES.

The following facilities are available in the case of both phonogram and telephone-telegram equipments.

Incoming circuits and the incoming ends of bothway circuits are ancillared

over one or more suites as required, and means of switching out all the appearances of the calling signals on each suite are provided. Calls which remain unanswered after a predetermined interval are marked by the steady glow of the calling lamp changing to a rapid flash.

A complete multiple of all outgoing circuits is normally made accessible to each operator.

The central position on each suite is equipped with special calling equipment and an additional operator's circuit, so that the assistant supervisor patrolling the suite may be called into circuit and speak by means of a hand set.

In some installations each operator handling incoming traffic can associate a valve amplifier with her head set. The amplifier is brought in circuit with the receiver when the operator throws a key and the volume is

adjusted by a potentiometer until the incoming speech is at a level suited to the operator concerned. In more recent installations, a volume control consisting of 1,000-ohm adjustable resistance is connected in series with a receiver of high efficiency, known as "Receiver, Headgear, No. 9A." The additional efficiency provided by these receivers enables the use of amplifiers to be avoided.

Transmitter cut-out facilities are provided.

Two pairs of cords are available to each operator. This provision is made to enable an operator to extend a caller to the Supervisor or to the Enquiry Desk and then proceed with her work of receiving

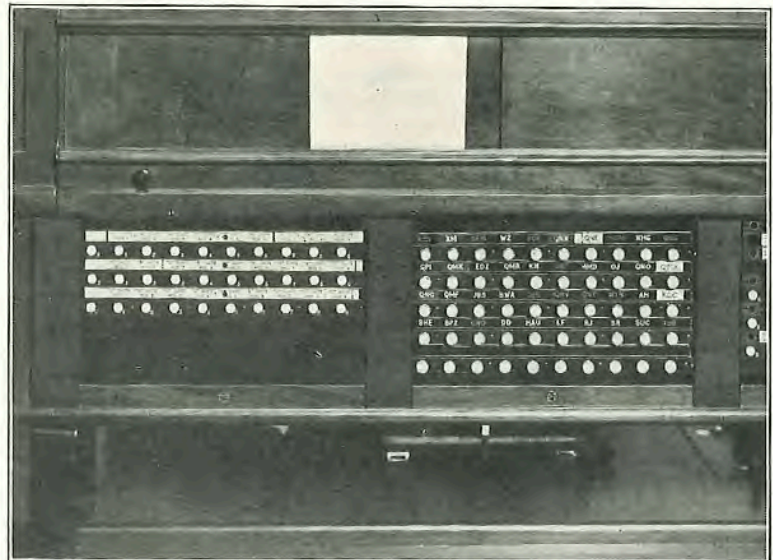


FIG. 4.—TELEPHONE-TELEGRAM DISTRIBUTION PANEL.

or dictating telegrams with the remaining cord circuit.

The supervisor's desk is equipped with a listening cord. Listening-in taps from all the operators' positions are brought out to jacks on the panel before the supervisor. Arrangements are provided which enable the supervisor to switch a 20 db. loss between her telephone and that of any operator, so that the efficiency of the operator's instrument can be estimated from a speaking test. Such tests are carried out daily.

Dialling or ringing may be applied to the calling cord by means of a change-over key.

An audible night alarm can be switched in circuit on the calling signals when required.

Certain additional facilities are provided on the telephone-telegram suites to assist in the distribution of traffic.

One panel of the multiple is equipped as a distribution panel. On this panel appears

- (a) A field of lamps, one lamp connected to each telephone-telegram position and labelled with the position number.
- (b) A field of press buttons each labelled with the designation of a telephone-telegram circuit.

A picture of the distribution panel on a typical telephone-telegram installation is shown in Fig. 4.

When a telegram for dictation to an office connected to the telephone-telegram suite reaches the distribution point adjacent to the distribution panel, the attendant depresses the circuit button labelled with the code of the office concerned and examines the lamp field. If a position lamp glows coincident with the pressing of a button, the circuit in question is being used by the operator at that position. Delay in transmission is thus avoided, as the attendant is able to pass the telegram to the operator in communication with the distant office. On the top of the switchboard above each telephone-telegram operator's position, a dome-shaped lamp fitting is fixed (see Fig. 3). The fitting contains two lamps, one green and one red. When a position is unstaffed there is no glow in the dome. If an operator has her instrument in circuit at a position but is not connected by a cord to any line, the dome displays a red light. The red light is changed to green immediately one of the four cords appearing before the operator is inserted in the line jack of a telephone-telegram out office. The attendant is thus able to locate operators not actually handling the traffic at any moment and to hand to such operators messages for offices which gave no glow on the distribution panel (indicating that the circuit was not in use) when the circuit button was depressed. The green glow changes to red on the position at the instant when the attendant depresses the circuit button. This momentary change from green to red serves two purposes (a) it indicates to the operator that a message is coming along for the circuit to which she is connected and (b) it assists the attendant in locating the required position.

CIRCUITS.

The phonogram cord circuit is shown in Fig. 5. The circuit employs Stone system transmission and the associated lamp supervision. Speaking current is not normally supplied from the cord circuit since

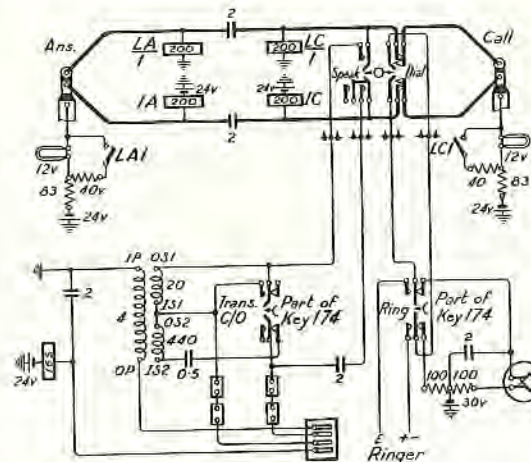


FIG. 5.—24-VOLT PHONOGRAM CORD CIRCUIT AND OPERATOR'S CIRCUIT.

only connexions to exchanges are concerned. The resistance of the feed coils is determined by signalling conditions and the transmission loss in the impedance bridge. A value of 200 ohms resistance for the feeding coils is used irrespective of the voltage of the installation. The extra springs fitted on the speaking key are used when amplifiers are fitted and these close the filament circuit when the key is in the speaking position. This provides against the wastage of filament current which otherwise results when an operator leaves her amplifier key thrown after the completion of a call. The dial and ring key is arranged so that dialling is normal to the calling cord, ringing being applied when both the dial and changeover keys are thrown. Battery dialling into automatic exchanges is adopted as standard practice.

The operator's circuit, which is also shown on Fig. 5, is basically the same as that used on standard C.B. switchboards. An 0.5 microfarad condenser is connected in circuit, as shown, to reduce the effect of side tone, an important point when amplifiers are used. The combination of "Coil, Induction, No. 16" with the 0.5 microfarad condenser in the circuit gives the following efficiencies for the operator's circuit as compared with a standard C.B. circuit.

Sending	2.6 db. better.
Receiving	2.0 db. better.

The circuit used to give amplification of speech is shown in Fig. 6. A gain of 13 db. can be obtained with the potentiometer at maximum. It will be seen that the amplifier is connected in circuit between the induction coil secondary and the operator's receiver. The output transformer is designed to match the valve impedance to that of the operator's receiver.

wire from the exchange to operate relay L. Contact L₁ provides a path for relay LL *via* contact LO₁. Contact LL₁ closes the night alarm circuit; contact LL₂ closes a circuit for relay LLR; contact LL₃ closes a circuit giving 1-second earth pulses to relay T. Contacts LLR_{1, 2} and 3 close the ancillary lamp circuits. Contact LLR₄ prepares a circuit for relay FA. Contact T₁ closes the stepping magnet circuit once per second and the uniselector wipers rotate at the rate of one step per second so long as relay LL remains operated. When the wiper associated with relay FA reaches an earthed bank contact, relay FA operates and locks over its FA₁ contact *via* contact LO₁ normal, to contact L₁ operated, and earth. Contact FA₂ prepares a circuit for relay FL which is completed 15 seconds after relay FA has locked out. Relay FL then operates and locks over contact FL₁, contact LO₁ normal, and L₁ operated, to earth. Contact FL₂ makes the circuit of relay LLR, and hence the lamp glow, depend on the position of contacts B₂ and C₂ of the common flash relays. Contact FL₃ starts the flashing train of relays A, B and C which continue to operate and release in that order and cause the ancillary appearance to flash. The facility given is an indication whether any calling subscriber

has been waiting for a period somewhere between 15 and 30 seconds, *i.e.*, in excess of 15 seconds but not more than 30 seconds for his call to be answered. This marginal period applies to all callers, whether one or more are calling together, and whatever position the uniselector stopped on last. It will be noticed that homing is provided over contacts 32 to 50 on the 50-point uniselector.

The telephone-telegram cord circuit, distribution panel and position lamp circuit, are shown on Fig. 8. The Stone system of transmission is again employed, but to provide for speaking current to the C.B. telephones used on some of the shorter out-office circuits, the feed coils are of 50 ohms resistance in 24-volt installations. Ringing is normal to the calling cord, but a dial switching key is provided so that dialling may be substituted for ringing when required. Considering the conditions which exist when the left-hand or answering plug is inserted in a circuit jack, when the plug meets the looped line condition from a calling telephone, relay LA operates. The supervisory lamp circuit is broken at contact LA₁. Relays HA and HB are operated over the sleeve circuit to earth *via* a 30-ohm resistance. Relay HAA is operated *via* contact HA₁, and relay HBB *via* contact HB₁. Contact HAA₁ prepares the path for the clearing lamp current. A path is pre-

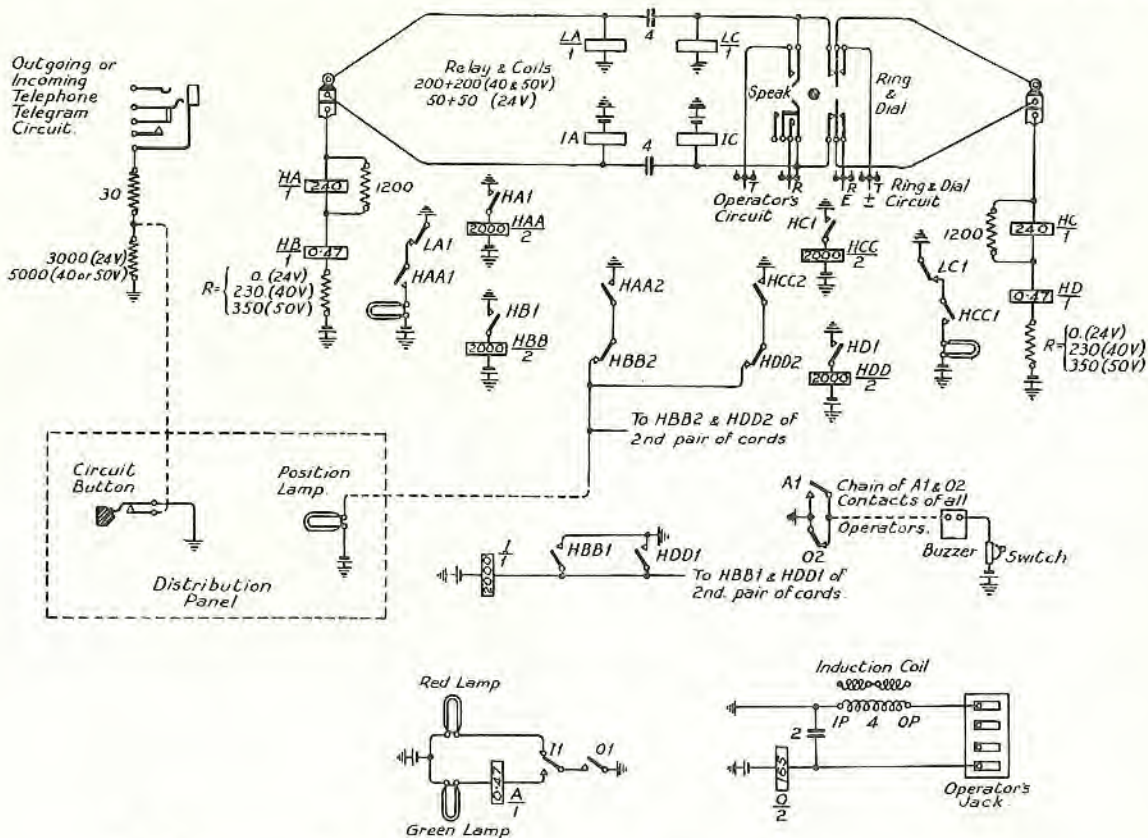


FIG. 8.—TELEPHONE-TELEGRAM CORD CIRCUIT SHOWING CONNEXIONS TO DISTRIBUTION PANEL.

pared *via* contact HAA2 for the lighting of the position lamp on the distribution panel. This path is held open at contact HBB2, at present operated. Relay I is operated *via* contact HBB1 to earth. The operator's instrument, being in the instrument jack, closes a circuit for the operation of relay O which replaces the retardation coil feed usually appearing in the C.B. operator's circuit. The green position lamp is lit *via* contacts I1 and O1. If now the circuit button associated with the circuit connected is depressed, a resistance of 3,000 ohms, assuming 24-volt working, is inserted in the sleeve circuit. This causes the release of relay HB, but not of relay HA. Relay HBB releases, and at contact HBB2 closes the circuit to the position lamp which now glows. Contact HBB1 releasing causes relay I to release, and changes over contact I1 from the green to the red lamp circuit. Release of the button restores the green lamp glow and extinguishes the position lamp. A similar sequence of events occurs when the calling cord is used. By means of a chain of contacts A1 and O2, a circuit is provided through positions which are closed down over resting O2 contacts, and through positions which are busy over operated A1 contacts, to an alarm buzzer on the supervisor's desk. When this alarm operates, it indicates to the

supervisor that all available staff are fully occupied with traffic and she may then consider it necessary to open a few more positions to meet the traffic load.

The circuit adopted to give loop calling with delayed call flash on telephone-telegram circuits from Post Offices is shown in Fig. 9. The line relay L is connected between earth and the B-wire, and battery is fed through a 200-ohm resistance to the A-wire. This is done in preference to the reverse arrangement, *i.e.*, battery to relay and earth to resistance, to prevent the calling signal from being permanently locked out should an earth fault develop on the line during a call. Considering an incoming call, a loop is applied to the line from the distant telephone, battery flows round the loop operating relay L, relay G operates over contact L1, a 100-ohm resistance and battery. Relay LL operates over contacts LO1 normal, L1 and 100-ohm resistance to battery. Contact G1 breaks the circuit of relay K to guard against the possible breakdown of the loop at K1 and K2 should a plug inadvertently be inserted in an outgoing jack. Contact G2 puts an engaged test potential on the bush of the outgoing jack. Contact LL1 closes the night alarm circuit. Contact LL2 closes the circuit for relay LLR. Contact LL3 closes the circuit to relay T which operates at 6-second

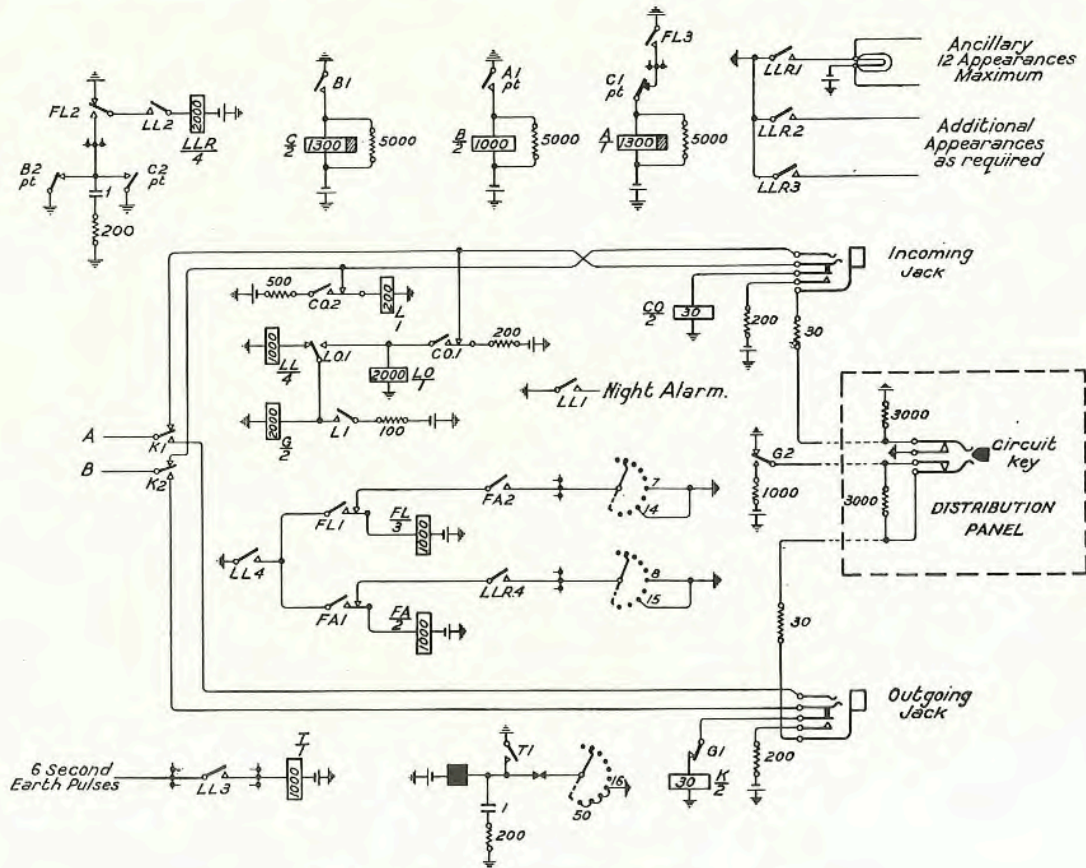
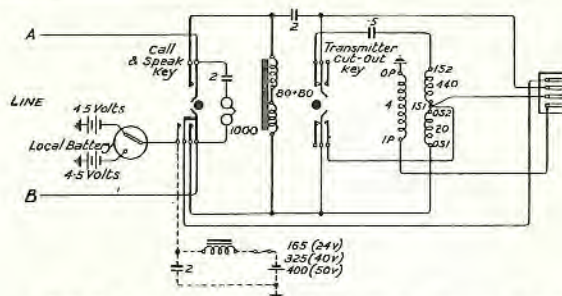


FIG. 9.—BOTHWAY TELEPHONE-TELEGRAM CIRCUIT.

intervals from a master clock, and, at contact T₁, operates the stepping mechanism of the uniselector which rotates at a corresponding speed. Contact LL₄ prepares a path for the subsequent lock-out of relays FA and FL. From this point onwards, the operation of the flashing circuit follows the lines already described for the phonogram bothway circuit. The marginal period during which the calling glow is changed to a flash is from 45 to 90 seconds in this case. The function of the distribution panel circuit key will be apparent from the details given above when dealing with the telephone-telegram cord circuit.

Telephone-telegram circuits which terminate at the distant end on exchanges are connected to battery calling or generator calling equipment as required. In these circumstances, the distribution panel feature is not included since the exchange circuit used for the connexion gives no indication as to the office connected at the exchange end of the circuit.

Out stations may be equipped with C.B. or L.B. telephones of pedestal or microtelephone pattern, or with the circuit shown in Fig. 10. Double headgear receivers of light-weight pattern are generally used in conjunction with pedestal telephones with the circuit of Fig. 10. The circuit shown provides for loop calling, but an equivalent circuit providing for generator calling is available. Typewriter reception



Note. The dotted connexions apply where a secondary cell source is available

FIG. 10.—TELEPHONE-TELEGRAM OUT-OFFICE OPERATOR'S CIRCUIT WITH LOOP CALLING.

is in use at the larger out offices and in some cases amplifiers are fitted.

Phonogram and telephone-telegram circuits terminating at C.B. exchanges are connected to subscriber's calling equipment modified to accord with junction signalling practice. At automatic exchanges, incoming circuits terminate on dialling-in relay-sets and 1st selectors. Outgoing circuits from automatic exchanges are connected via the 90 and 95 levels to relay-sets which give C.B. junction conditions towards phonograms and provide metering, ringing tone, holding and guard against following-on calls on the automatic side.

Telegraph and Telephone Plant in the United Kingdom.

TELEPHONES AND WIRE MILEAGES. THE PROPERTY OF AND MAINTAINED BY THE POST OFFICE IN EACH ENGINEERING DISTRICT AS AT 31ST DEC., 1932.

No. of Telephones owned and maintained by the Post Office.	Overhead Wire Mileages.				Engineering District.	Underground Wire Mileages.			
	Telegraph.	Trunk.	Exchange.	Spare.		Telegraph.	Trunk.	Exchange.	Spare.
786,236	708	8,936	41,942	3,016	London.	43,527	182,919	3,495,382	146,606
94,494	1,943	20,083	43,791	4,964	S. Eastern.	4,123	50,404	347,433	41,344
109,584	4,236	36,985	65,986	3,925	S. Western.	23,681	29,896	275,746	65,220
74,438	4,718	40,150	63,503	8,360	Eastern.	19,595	54,289	156,524	46,393
120,516	7,212	52,131	52,039	6,031	N. Midland.	32,083	131,582	324,091	70,257
95,695	4,088	32,632	62,626	2,646	S. Midland.	16,144	46,571	282,098	76,505
67,696	3,419	30,849	52,393	5,379	S. Wales.	6,741	40,838	164,593	52,332
131,859	6,540	30,096	54,694	5,522	N. Wales.	16,850	61,410	409,279	117,741
178,269	897	12,126	24,587	5,598	S. Lancs.	13,644	117,365	623,973	78,331
111,292	5,188	30,734	36,871	6,969	N. Eastern.	19,686	73,680	321,888	48,239
74,608	4,228	23,454	25,735	4,359	N. Western.	6,203	46,447	237,248	56,239
57,014	2,124	17,201	21,137	4,113	Northern.	10,667	35,311	181,972	37,536
27,971	3,403	11,164	11,530	813	Ireland N.	369	4,217	64,492	6,481
80,936	4,699	32,782	38,736	2,232	Scotland E.	9,374	35,994	176,602	39,432
103,518	5,525	24,204	30,212	1,971	Scotland W.	9,001	43,232	256,277	33,431
2,114,126	58,928	403,527	625,782	65,898	Total	231,688	954,155	7,317,598	916,087
2,095,327	59,163	400,395	617,589	62,082	Figures as at 30 Sept., 1932.	231,167	925,239	7,212,399	934,946