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Post Office Engineering Department

TECHNICAL PAMPHLETS FOR WORKMEN

Subject :
**Automatic Telephony:
Keysending "B" Positions.**

ENGINEER-IN-CHIEF'S OFFICE,
1928.

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(Continued on page iii of Cover.)

AUTOMATIC TELEPHONY: KEYSENDING "B" POSITIONS. (E. 3.)

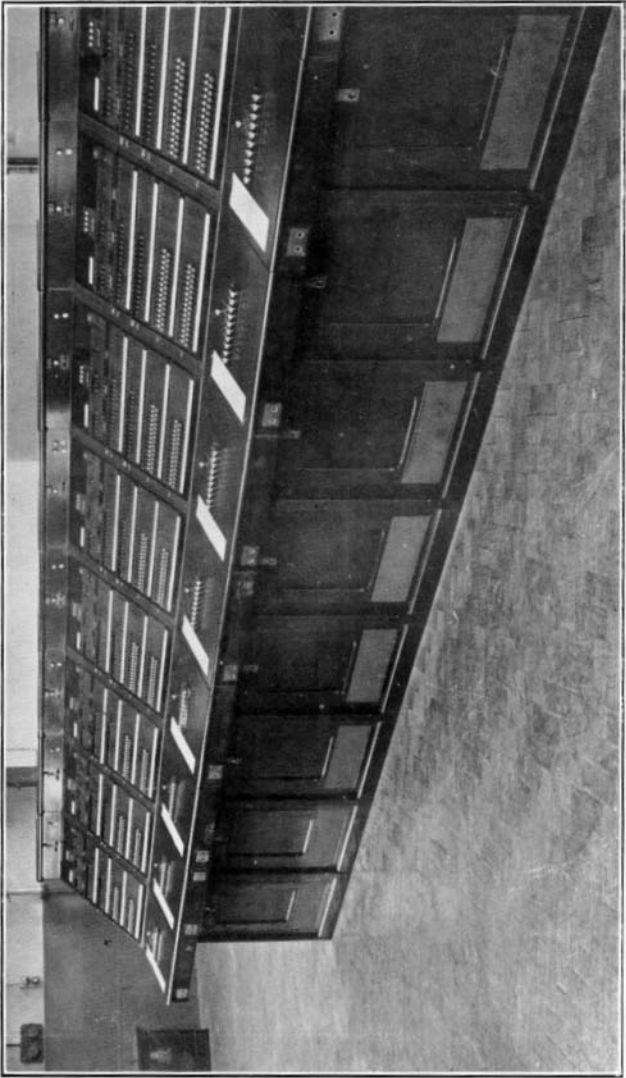
TABLE OF CONTENTS.

I.—GENERAL DESCRIPTION.

	PAGE
INTRODUCTORY NOTE	3
OPERATING PROCEDURE	5
KEYSENDING POSITION EQUIPMENT	6
APPARATUS	7
SUMMARY	8

II.—TECHNICAL DETAILS.

CIRCUIT SCHEME	11
SPECIAL CONDITIONS	19
GENERAL ARRANGEMENTS OF THE APPARATUS ...	21
ROUTINER	26



A SUITE OF KEYSENDING "B" POSITIONS.

AUTOMATIC TELEPHONY : KEYSENDING " B " POSITIONS.

I.—GENERAL DESCRIPTION.

Introductory Note.

In Pamphlet E1 (Automatic Telephony, Step by Step Systems) reference is made to " Cordless ' B ' " operating, and it is stated that " where there is a large amount of incoming traffic and where, for various reasons, dialling is impracticable, it is necessary to provide the operator with some more expeditious means of establishing connection than dialling from the manual board."

The incoming traffic referred to is, of course, that emanating from manual exchange subscribers who desire connection to automatic exchange subscribers.

Fig. 1 shows a typical keysending position, and it will be noticed that it differs considerably from the usual manual " B " position, inasmuch as there is an absence of plugs, cords and multiple jacks.

The capacity of a keysending " B " position is 5 order wires and 50 junctions. The junctions are operated on an order wire basis, and may be in small groups from various exchanges or a large group from one exchange. Therefore the number of these positions installed at an automatic exchange depends upon the amount of incoming traffic. It will be appreciated that where the demand for connection to an automatic exchange is small, it might be more economical to install " dialling-in " circuits from the manual exchanges.

The manipulation of a dial is appreciably slower than that of a digit key strip, Fig. 2. Whereas a dial must return to the normal position after each operation, an operator using a key strip depresses the keys in quick succession. The average time for dialling the digits 5555 is four seconds against approximately one second when using a digit key strip. Thus, where the traffic density to an automatic exchange is high, the keysending position provides a means of speedy operation.

The contents of this pamphlet deal in the main with 4-digit areas, but the explanations contained herein may also refer to mixed 4 and 5 digit areas.

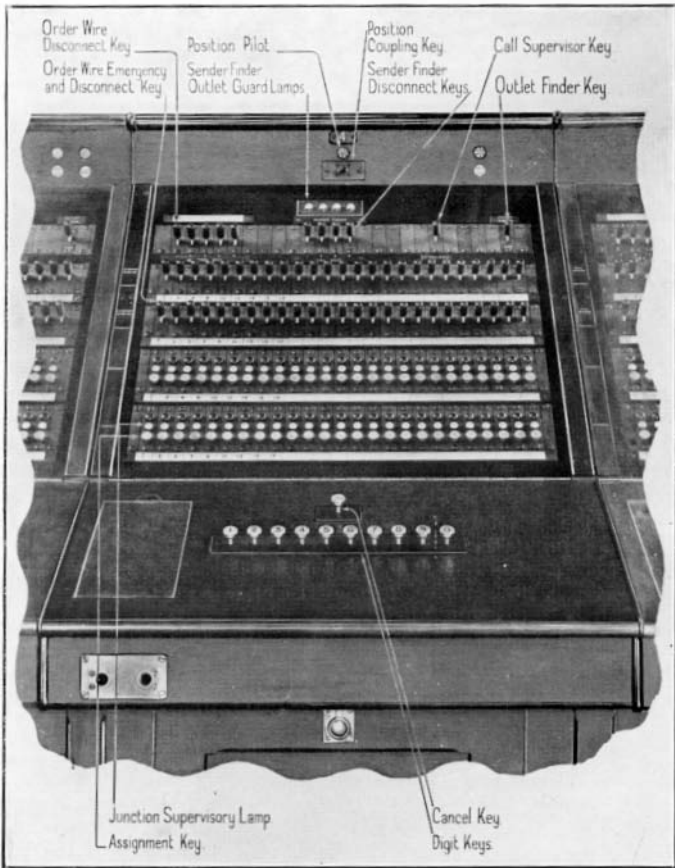


FIG. 1.



FIG. 2.



Manual Subscriber.

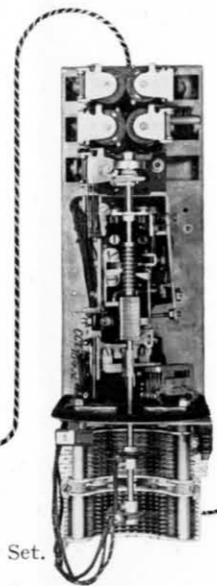


Manual Exchange.

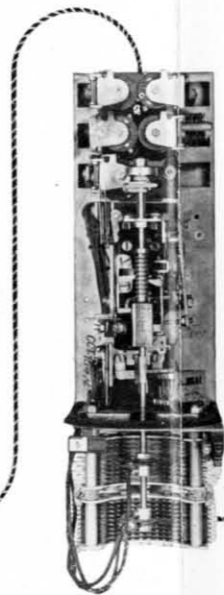


Keysending "B" Position,

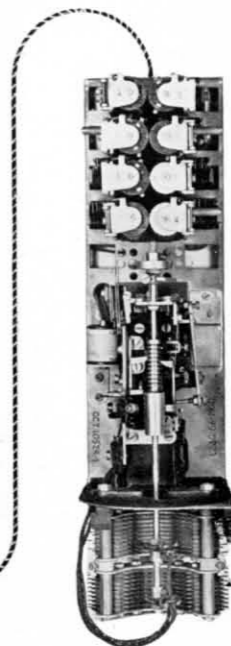
Trunk Relay Set.



1st Numerical Selector.



2nd Numerical Selector.



Final Selector.

AUTO EXCHANGE.



Automatic Subscriber.

FIG. 3.

Operating Procedure.

The "A" operator at the manual exchange, upon receiving a request from a subscriber for a connection to a subscriber served by an automatic exchange, depresses the appropriate order wire key. This puts the "A" operator in direct connection with the "B" operator at the automatic exchange, who verbally assigns a junction. The "B" operator depresses the "assignment key" corresponding to the allotted junction. The pressing of the assignment key causes the "junction finder" rotary line switch to hunt for and seize the assigned junction, and a "sender finder" rotary line switch to hunt for and seize a free sender. When a free sender is found, the lamp associated with the assigned junction will glow. The "B" operator now proceeds to "key-up" the call, *i.e.*, to depress the equivalent digit keys of the wanted number in correct sequence, *i.e.*, thousands, hundreds, tens and units. When the last digit (unit) has been received by the sender it immediately sends "Strowger" pulses to the numerical selectors. At the conclusion of sending, the sender disconnects itself, leaving the junction through to the required number.

Called Subscriber not Engaged.—If the called subscriber's line is free, he will be rung in the usual manner from the final selector, the ringing tone being heard by the calling subscriber.

Called Subscriber Answers.—When the called subscriber lifts the receiver the current is reversed over the junction by the operation of the final selector to give the "A" operator supervision of the call by means of the cord supervisory lamp.

Release of Call.—At the conclusion of the conversation the "A" operator receives a "clear" on the supervisory lamps and withdraws the plug from the junction jack. This releases the connection by opening the loop to the numerical and final selectors and the junction lamp on the keysender position will cease to glow.

Called Subscriber Engaged.—Should the called subscriber be engaged, standard "BUSY FLASH" conditions will be connected to the positive line from the final selector. This will cause the "A" operator's cord supervisory lamp to flash. The removal of the plug from the junction jack releases the connection as already described. "BUSY TONE" is also connected to the junction.

The junction lamp continues to glow whilst the call is in progress and until the "A" operator removes the plug from the outgoing junction jack. Fig. 3 is an illustration of a through connection.

Keysending Position Equipment.

Order Wire Disconnect Key.—The order wires terminating on the position are wired through “disconnect” keys. This arrangement permits the disconnection of a faulty order wire from the position.

Order Wire Emergency and Disconnect Key. 1 per Junction.—Each junction is wired through a key. When the key is thrown in one direction, the junction apparatus (described later) is disconnected and the junction joined through to the “B” operator’s telephone circuit, thus a faulty order wire can immediately be replaced by a junction by the operation of an “order wire disconnect” key and an “order wire emergency” key. By throwing the order wire emergency key in the opposite direction the junction apparatus only is disconnected. This is to allow a faulty junction to be disconnected from the position. The junction lamp glows under both conditions.

Calls incorrectly keyed up can be cancelled by operating the key to the junction disconnect position, thus releasing the relays concerned. The junction can then be reassigned by pressing the assignment key and the call again keyed up.

Cancel Key. 1 per Position.—A set up can also be cancelled if the operator depresses this key momentarily before the last digit is keyed up.

Sender Finder Disconnect Key.—As will be described later, rotary line switches are employed as sender finders. By throwing the appropriate sender finder disconnect key the sender finder and associated relay group is “busied.” The sender finder “outlet guard” lamp glows to indicate the condition.

Outlet Finder Key. 1 per Position.—A rotary line switch known as an “Outlet Finder” is provided to preselect a sender finder of which there are usually four. Each position is provided with a duplicate outlet finder and relay set for emergency use, but each set is used on alternate days. This is made possible by the above key.

Assignment Key. 1 per Junction.—This key when depressed, assigns the junction and sender finder circuits preparatory to keying up a call.

Digit Key Strip. 1 per Position.—Fig. 2 shows a digit key strip. The keys are of the press button type, which when depressed cause earthed impulses to be sent to a group of storage relays which store the numerals thus sent until the whole number, *i.e.*, four digits have been received. The

receipt of the last digit causes the sender to pulse out the stored number to the numerical selectors as already stated.

Junction Supervisory Lamp. 1 per Junction.—The lamp glows when an assignment key is depressed and a free sender has been found. It continues to glow after the sender has released and the “A” operator has picked up the junction and until the connection is released by the “A” operator.

This lamp also glows if an order wire emergency and disconnect key is thrown. If an “A” operator plugs into an unassigned junction the associated lamp flickers.

Sender Finder “Outlet Guard” Lamp.—When a free sender is found by the “sender finder” rotary line switch the associated “outlet guard” lamp glows on each of the positions concerned. By means of these lamps the operator ascertains if senders are available. If all “outlet guard” lamps on the position are glowing the “B” operator does not assign a junction upon receiving an application and informs the “A” operator that no lines are available.

Apparatus.

The apparatus used in connection with Keysending “B” working is in two parts, (a) that common to a position and (b) that individual to a junction circuit.

The apparatus is accommodated on racks situated in the apparatus room and is described below:—

Junction Relay Set.—As previously stated the “B” operator assigns a junction on receiving a request from an “A” operator. Each junction at the automatic exchange is associated with a relay set which, when the assignment key is depressed causes the sender finder rotary line switch to hunt for a free sender. It also connects the calling subscriber with the called subscriber’s line at the conclusion of sending and provides supervision to the “A” operator.

Sender Finder Rotary Line Switch and Relay Set.—Each position is equipped with four sender finders and associated relay sets. The rotary line switches are selected in rotation by the position “OUTLET FINDER,” a rotary line switch, the wipers of which are normally standing on a free sender finder and junction finder relay set. The sender finder relay set causes the sender finder to hunt for an idle sender, it then connects the sender to the digit keys via the outlet finder wipers. The relay set also causes the outlet finder to step to the next free sender finder when the sender has pulsed out the numerical digits for the prevailing call.

Junction Finder Rotary Line Switch and Relay Set.—There are four junction finders and relay sets to each position and these are associated with the sender finders so that when an assignment key is depressed, a junction finder hunts for the junction assigned. The relay set then connects the sender, when it is found by the sender finder, to the wires outgoing to the numerical selectors. The junction finder rotary line switch may have to hunt over 50 contacts in search of the assigned junction, therefore it is provided with a 50-point bank. This switch is of the double search type shown in Fig. 4.

The Sender.—When a sender is found by the sender finder, both junction and outlet guard lamps glow. This is an indication to the operator to commence keying up the call.

In depressing the digit keys, the operator causes relays in the sender storage group to become operated as explained later. The storage relays are in four groups, each group being connected in turn by the operation of a rotary line switch known as the DIGIT DISTRIBUTOR, which steps as each digit is received. When the four digits have been received, the SENDING rotary line switch in operating allows the stored digits to be sent out as “Strowger” pulses to the numerical selectors, the correct order of sending being maintained by the CONTROL rotary line switch. At the conclusion of sending, the sender apparatus is released.

A typical sender is illustrated in Fig. 5.

Summary.

The consecutive connections in a straight call are summarised below :—

- (1) The “ A ” operator quotes the required number to the “ B ” operator over the order wire.
- (2) The “ B ” operator assigns a junction and depresses the assignment key associated with the junction assigned.
- (3) The sender finder hunts for an idle sender and the junction finder hunts for the assigned junction.
- (4) The junction supervisory lamp glows when a free sender is found.
- (5) The outlet guard lamp glows.
- (6) The “ B ” operator commences to key-up the call on the digit keys.
- (7) The first digit key is depressed. The associated storage relays in the sender operate and lock up.
- (8) The first digit key is released. The digit distributor rotary line switch (DD) steps once and transfers the wires from the digit keys to the next storage group (2nd numerical).

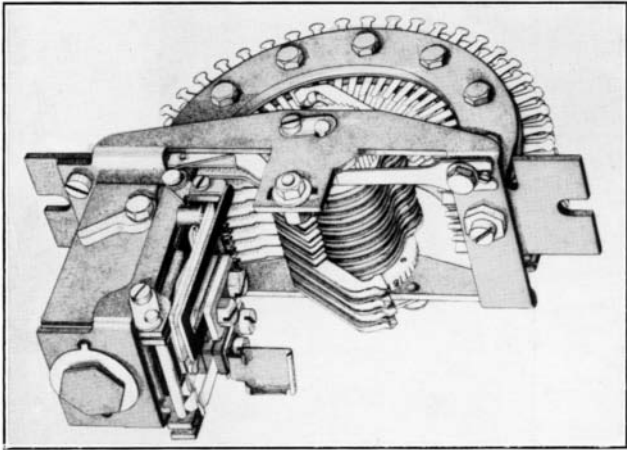
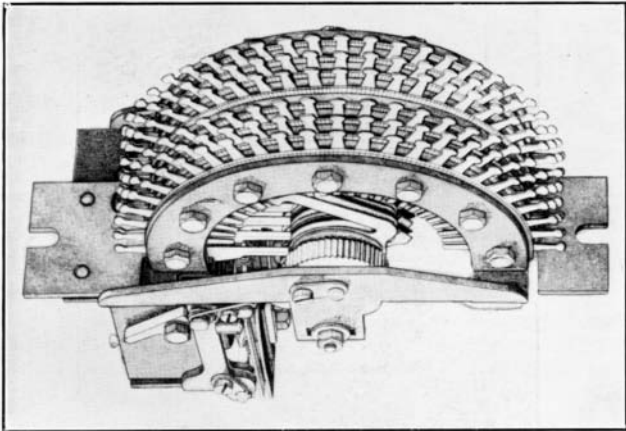


FIG. 4.



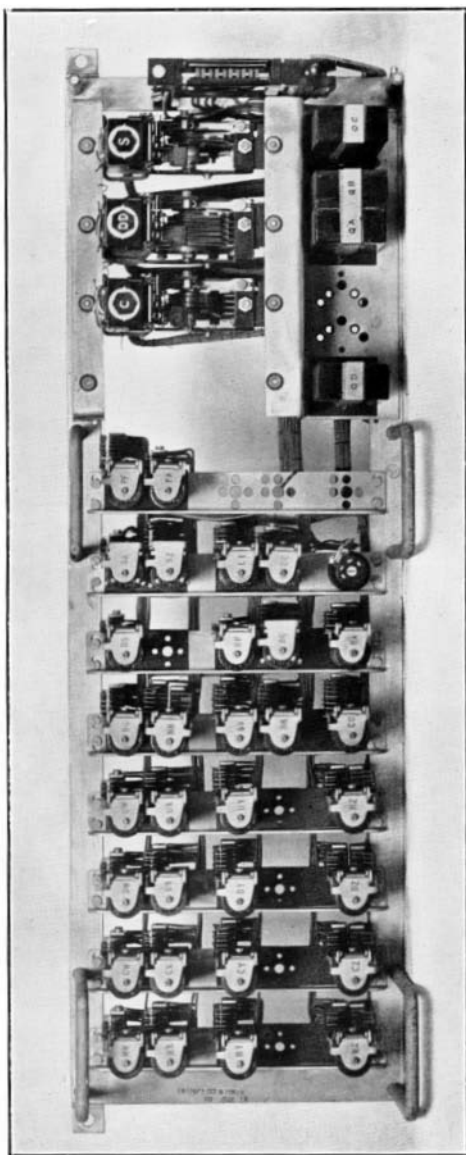


FIG. 5.

(9) The 2nd, 3rd and 4th digit operations are similar to the 1st digit operation.

(10) The DD steps after the 4th digit causing the sender finder and the position relay sets to complete the start-send condition.

(11) The Outlet Finder steps to a free sender finder relay group in preparation for the next call.

(12) The sending rotary line switch now steps at 10 impulses per second under the control of the motor impulse springs.

(13) Depending upon the number of steps taken, a corresponding number of "Strowger" impulses will be sent to the numerical selectors.

(14) The control rotary line switch steps at the end of the first train of impulses and the sender is now ready to send out the second train.

(15) The remaining numerical trains are sent in a similar manner. The control switch steps after each digit is sent out.

(16) When the last digit is sent, the control switch causes all relays to restore to normal. The distributor and control switches return to the home position.

(17) The outlet guard lamp is extinguished.

(18) The manual subscriber is joined through *via* the "A" position at the manual exchange and the junction relay set at the automatic exchange, to the wanted subscriber, who is being rung. Ringing tone is now transmitted to the calling subscriber.

(19) The junction supervisory lamp glows whilst the call is in progress.

(20) The junction, junction relay set and numerical selectors are released when the plug is withdrawn by the "Λ" operator upon receipt of the clearing signal.

(21) The junction supervisory lamp is extinguished.

Fig. 6 shows (a) the sequence of operation at the automatic exchange, and (b) the apparatus held during conversation.

II.—TECHNICAL DETAILS.

It is not the intention in this pamphlet to give full circuit details or complete circuit diagrams, but to deal briefly with circuits forming the basis of the scheme. It must therefore be understood that the diagrams given herewith are schematic only. Relays are shown in the non-operated position unless otherwise stated.

Circuit Scheme.

Assignment of a Junction.—The depression of an assignment key causes the junction finder and sender finder to rotate in search of a junction and a free sender respectively. The

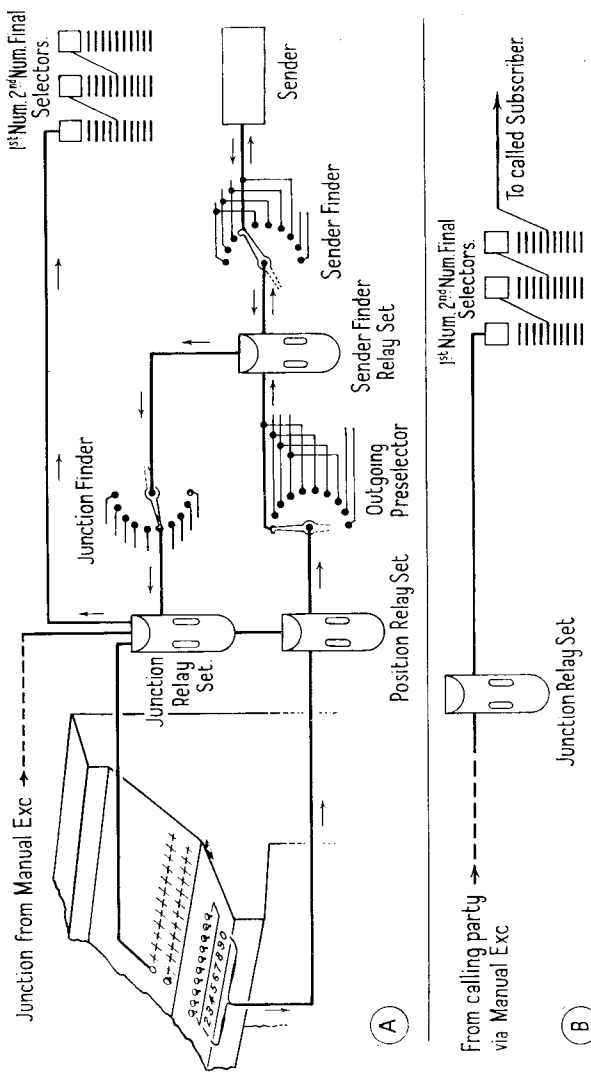


FIG. 6.

circuit arrangement is shown in Fig. 7. The operation of the assignment key causes relay AS to operate (Fig. 7A). Relay AS causes the operation of relays SJ and SF in the junction

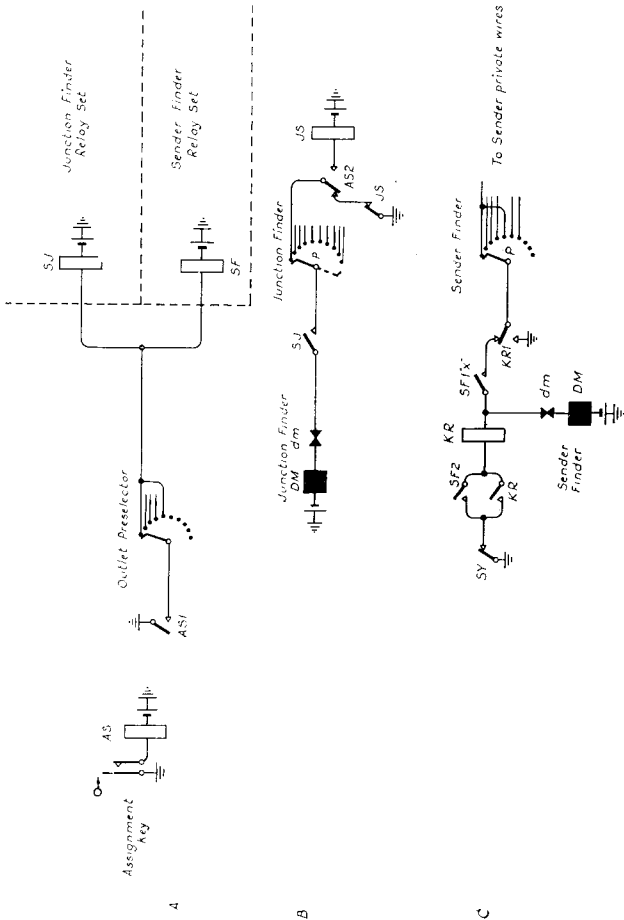


FIG. 7.

finder and sender finder relay sets respectively. The junction finder rotary line switch is a switch of the non-homing type and therefore may not be standing on the assigned junction. In this case the unassigned junction will have an earth on the

private wire because the associated relay (AS) is normal. As relay SJ of the assigned junction is operated a circuit is completed for the driving magnet (DM) of the junction finder rotary line switch as will be seen in Fig. 7B. The junction finder rotary line switch will halt upon arrival at the contacts of the assigned junction because relay AS is operated and contact AS 2 connects battery *via* relay JS in place of earth.

Simultaneously with the above operation, search for a free sender takes place. Relay SF operating, completes a circuit for the sender finder driving magnet (DM) *via* SF 1 "x" and KR 1 normal (Fig. 7C) to the private wipers of the sender finder rotary line switch, the bank contacts of which are connected to the private wires of a group of senders. Thus, if a sender is engaged, the earth on the private wire will cause the sender finder DM to operate. When a free sender is found, *i.e.*, a sender without an earth on the private wire the sender finder will stop. When this condition obtains, relay KR will operate, it having previously been shunted by an earth *via* SF 2. Relay KR will operate in series with the DM. The DM will not operate in series with relay KR. KR 1, extends an earth to the sender private wire, thus engaging it against other hunting switches.

Extending the Digit Keys to the Sender.—The operation of relay KR will result in the operation of relay KK. The operated contacts of KK extend the digit keys to the sender storage relay group *via* the outlet finder banks, the sender finder banks and the banks of the digit distributor, Fig. 8. The "Outlet Guard" lamp glows.

Keying up the Call.—According to the digit sent, the depression of the digit keys connects an earth to certain relays in the storage group as tabulated below. These relays operate and are locked.

Digit Key.	1st Numerical Group.	2nd Numerical Group.	3rd Numerical Group.	4th Numerical Group.
1	MW	CW	DW	UW
2	MX	CX	DX	UX
3	MW, MX	CW, CX	DW, DX	UW, UX
4	MY	CY	DY	UY
5	MZ	CZ	DZ	UZ
6	MW, MZ	CW, CZ	DW, DZ	UW, UZ
7	MX, MZ	CX, CZ	DX, DZ	UX, UZ
8	MW, MX, MZ	CW, CX, CZ	DW, DX, DZ	UW, UX, UZ
9	MY, MZ	CY, CZ	DY, DZ	UY, UZ
0	MX, MY	CX, CY	DX, DY	UX, UY

Upon the release of a digit key the digit distributor switch wipers step to the next group of storage relays. This is

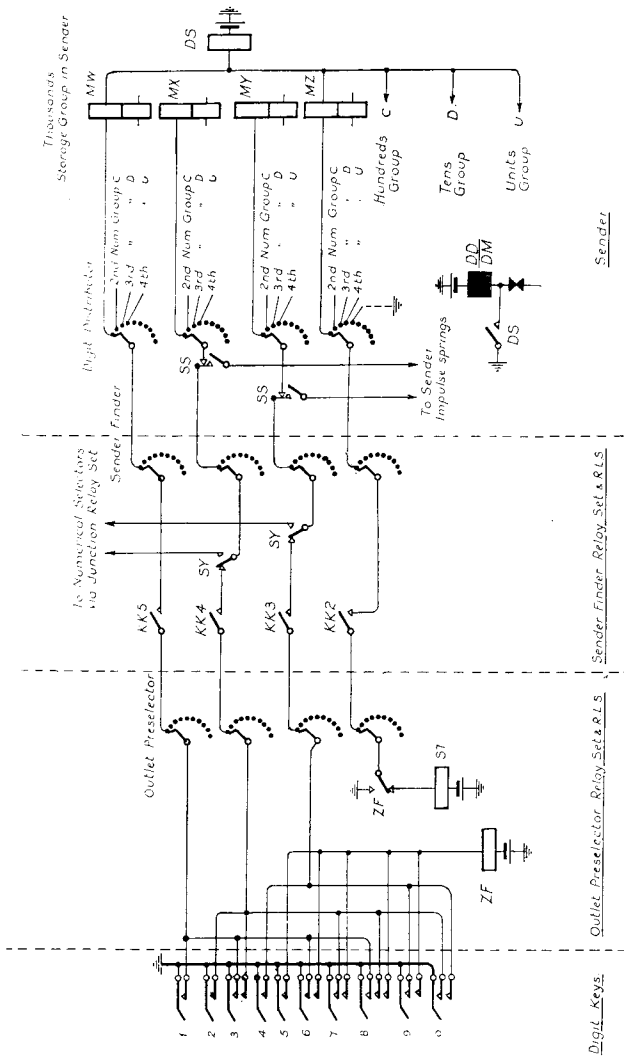


FIG. 8.

effected by the operation and release of relay DS, which is common to the 4 numerical groups, as shown in Fig. 8.

If, for example, an operator keys up the digits 2, 4, 5, 7 the following storage relays will be operated, for 2, MX; 4, CY; 5, DZ; 7, UX and UZ. The call is thus stored.

Automatic Start of Sender.—When the four digits have been stored, the digit distributor wipers will be in the 5th position, and from one bank an earth is returned to relay ST in the outlet finder relay group, Fig. 8; the result is to prepare the sending switch for operation. If the "A" operator has taken the assigned junction, sending commences at once, but otherwise the sending is delayed until the junction is taken up or the sender is cleared by a delayed timing arrangement to be described later.

Sending (Fig. 9).—At this stage, relays SY in the sender finder relay set, and SS in the sender group are operated, thus connecting the numerical selectors through to a pair of motor-driven impulse springs. The driving magnet of the sending rotary line switch is also connected to a similar pair of impulsing springs so that the sending switch falls into step. On the first step of the sending switch an earth is found on bank S 1, and relay SA operates, one contact of the relay removes the short-circuit previously existing across the pair of impulse springs extended to the selector, thus allowing impulses to be transmitted to the numerical selectors. The contacts of bank S 2 of the sending switch are wired to the storage group relay contacts which, as already stated, are operated according to the digits keyed up by the "B" operator. When the wipers of S 2 arrive at a contact on which the storage group relay contacts are operated, an earth exists which completes the circuit for relay SZ, the contacts of which in operating, short-circuit the impulse springs, thus preventing further impulses from passing out to the numerical selectors. The two pairs of impulse springs are synchronised, so that if the sender takes, for example, two steps before an earth is found on bank S 2, then two impulses will have been transmitted to the 1st numerical selector.

Relays SA and SZ, having operated, complete a circuit for the homing of the sending switch. When the wipers arrive at the "home" contact, relay SA falls away, and in turn releases relay SZ. Relay SA falling away first, maintains the shunt on the impulse springs. The control switch steps once and joins in the 2nd numerical group of storage relays. The sending switch again commences to rotate and the 2nd, 3rd and 4th digits are sent in succession, the circuit functioning for each digit as explained for the 1st digit. At

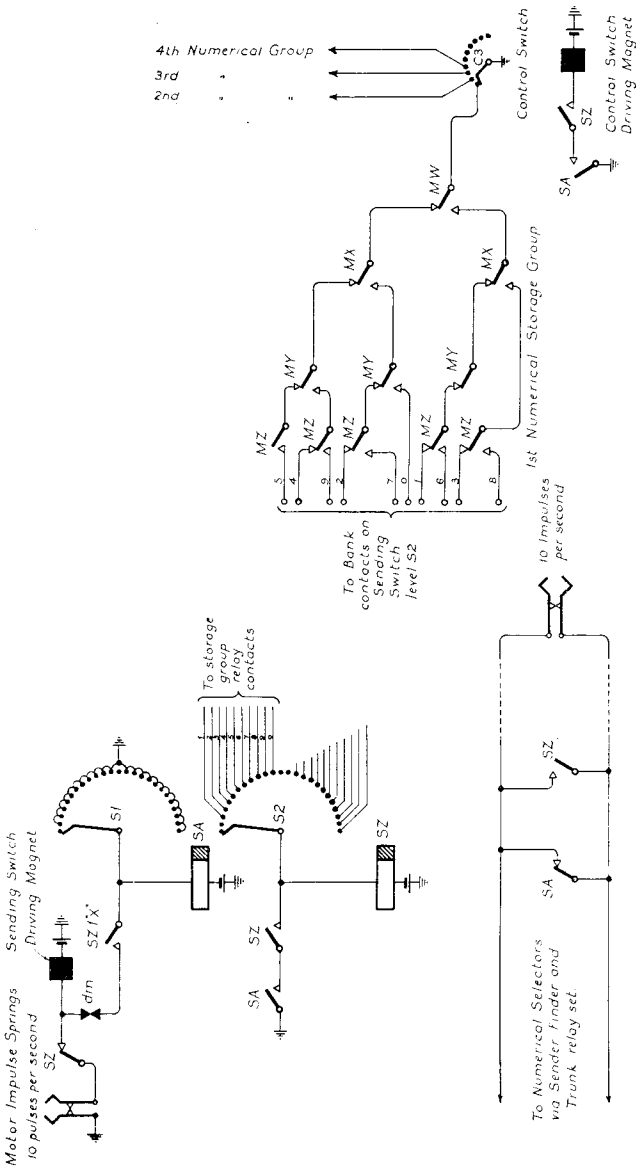


FIG. 9.

the conclusion of sending, the sender finder and junction finder apparatus is released and made free for further calls.

Switching Calling Subscriber through (Fig. 10).—The release of the junction finder apparatus releases the junction switching relay JS, which connects the calling subscriber, waiting on the manual junction, through to the final selector, and if the called subscriber is disengaged, ringing tone will be heard. The connection is maintained by the "A" operator, the plug in the outgoing junction jack supplying a battery to operate and hold relay L. This relay operates a relief relay LZ, one contact of which operates relay PS, which in turn earths the private wire to the numerical selectors, thus holding them engaged. Another contact of relay PS maintains the junction lamp circuit.

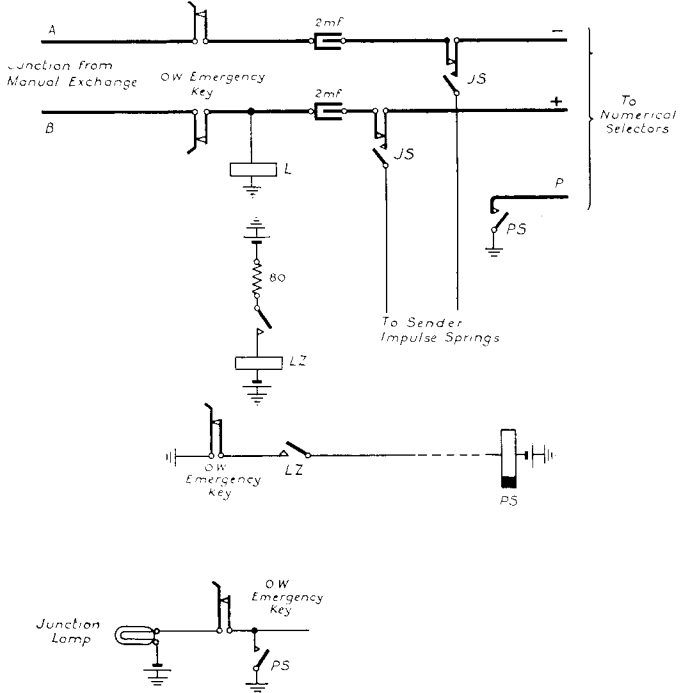


FIG. 10.

Called Subscriber Answers (Fig. 11).—When the called subscriber answers, the reversal of current, due to the

operation of the final selector relays, completes a circuit for relay I in the junction relay set *via* a contact of relay PS, operated, one winding of the shunt field relay D and a contact of relay L operated. Relay I completes the circuit for the second winding of the shunt field relay D. The relay therefore operates when the called subscriber answers and connects the coil LA to the A line. The "A" operator now has supervision over the call.

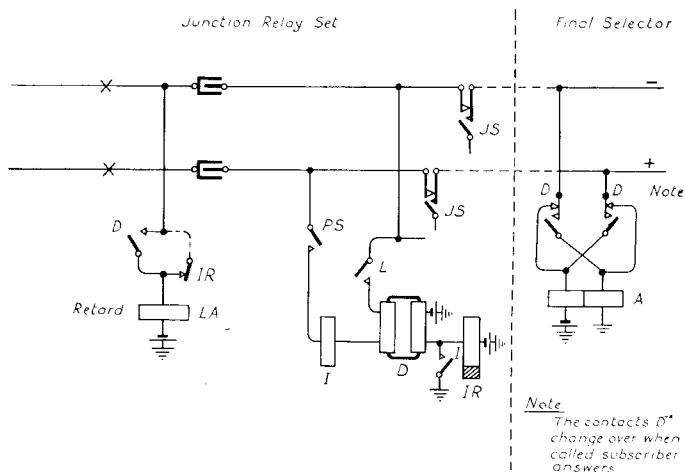


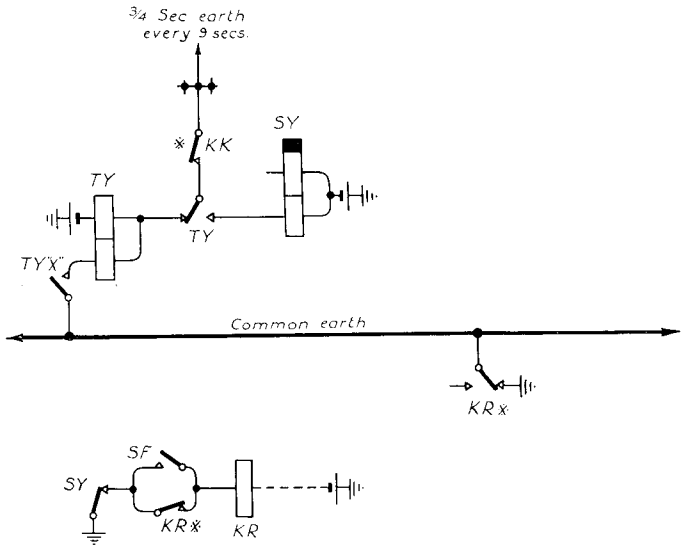
FIG. 11.

Called Subscriber Engaged.—In the event of the called subscriber being engaged, standard busy flash will be transmitted over the positive line from the final selector. Relay I in the junction relay set is shunted in synchronism with the flash condition, thus allowing relay IR to alternately operate and restore. The contact of IR alternately connects and disconnects coil LA with the A line (Fig. 11) to operate the cord circuit relays in the manual exchange for busy flash indication.

Special Conditions.

Clear Down Feature.—The sender and associated equipment are common apparatus and therefore must not be held engaged for long periods due to the existence of abnormal conditions. If the correct conditions for starting have not been set up within 9 to 18 seconds, the sender and associated apparatus is released.

It will be remembered that when a free sender is found, relay KK is operated. In Fig. 12 it will be seen that a contact of relay KK prepares a circuit for the time pulse relay TY. An earth of 0.75 seconds duration is connected to one winding of this relay every 9 seconds. Upon receipt of the first earth pulse, relay TY partially operates and closes its "x" contact. The second winding of this relay is now shunted by an earth. At the termination of this pulse, the shunt is removed and relay TY fully operates as its windings are then in series. The pulse circuit is connected to relay SY and upon receipt of the second pulse (9 seconds interval) relay SY fully operates and releases relay KR which in turn releases the common apparatus.



* Contacts shown operated.

FIG. 12.

Partial Set Up.—The time pulse circuit will operate under any of the following conditions:—

- (1) If a junction has been assigned.

(2) If, when a junction has been assigned and the digit keys operated, the "A" operator does not take up the junction within the specified time, or

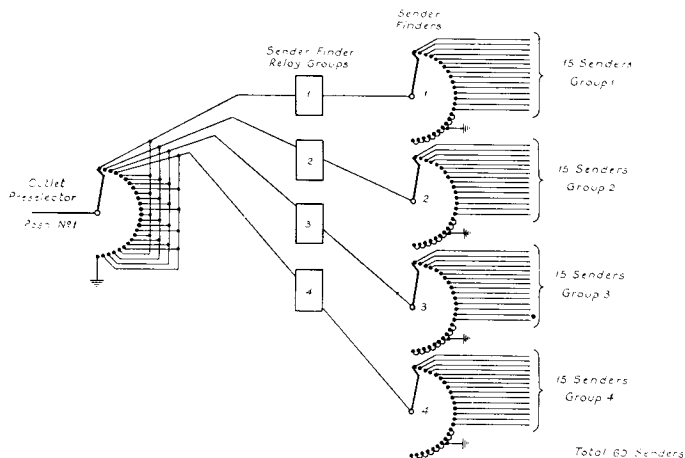
(3) If a junction has been assigned and taken up by the "A" operator, but the "B" operator has not operated all the digit keys.

In the latter case the call can be routed to a manual operator in the automatic exchange specially detailed to deal with calls of this character should this be desired. This facility is not generally adopted, however, the apparatus being automatically released as the result of the operation of the time pulse scheme.

General Arrangements of the Apparatus.

Grouping of Senders (Fig. 13).—The number of senders provided will depend upon the estimated incoming traffic and are divided into groups according to the local scheme.

As an example, assume that a large exchange with 40 keyending positions requires 60 senders to deal with the traffic, the senders would be divided into four groups of 15. Each position is equipped with four sender finders, so that, if each sender finder bank is connected to a separate group of



The outlets on Sender Finder N°1 are commoned to all N°1 Sender Finder banks of the remaining 39 positions and similarly for the other sender groups.

FIG. 13.

15 senders, the position will have access to the whole of the senders, further, if the 15 outlets of sender finders Nos. 1, 2, 3 and 4 of all the positions, are connected to the respective sender groups, then each position has access to the 60 senders.

As each sender finder in the example quoted requires only 15 outlets, the remaining 10 bank contacts are "busied" by connecting them to earth.

The Sender Rack (Fig. 14).—The number of senders mounted on a rack will depend upon the approved layout. In the illustration, 20 senders are mounted on each side of the rack. The senders "jack in" by the operation of a small lever thus allowing a sender to be disconnected without removing it from the rack. A sender can also be busied by operating the associated sender "Busy Key."

The Impulse Machine (Fig. 15).—The machine shown in the illustration is of the type fitted at the London "SLOANE" exchange. The motor is driven from a master machine. When the armature is revolving, an eccentric spindle causes a bakerlite rod to move to and fro. The projections on this rod make and break the spring sets at a standard speed of 10 impulses per second. This particular type of machine is provided with 20 sets of impulsing springs, two pairs of springs per set and therefore caters for 20 senders. The impulse machine, with dust cover, shown on the right-hand side of the rack in figure 14 serves the 10 senders on the right-hand side and also the 10 senders in the similar position on the opposite side of the rack. The remaining 20 senders (10 on each side of the rack) are served by the machine fitted on the other side.

As the senders on each side of the rack are in different groups it will be readily understood that should an impulse machine fail, a complete group of senders is not put out of action.

The Sender Finder and Outlet Preselector Rack (Fig. 16).—The sender finder and outlet preselector equipment for 10 positions is shown on the rack marked in the illustration " ' B ' Sender Outlets Positions 2-20."

The first two shelves of rotary switches are the 40 sender finders for the 10 positions, *i.e.*, four per position. The lower shelf of rotary switches are the outlet preselectors. There are 20 outlet preselectors, but only 10 position equipments on the rack, because the outlet preselectors are duplicated as an emergency precaution as previously indicated. The switches are mounted in pairs and are labelled "Odd and Even" and it is arranged to use them on alternate days.

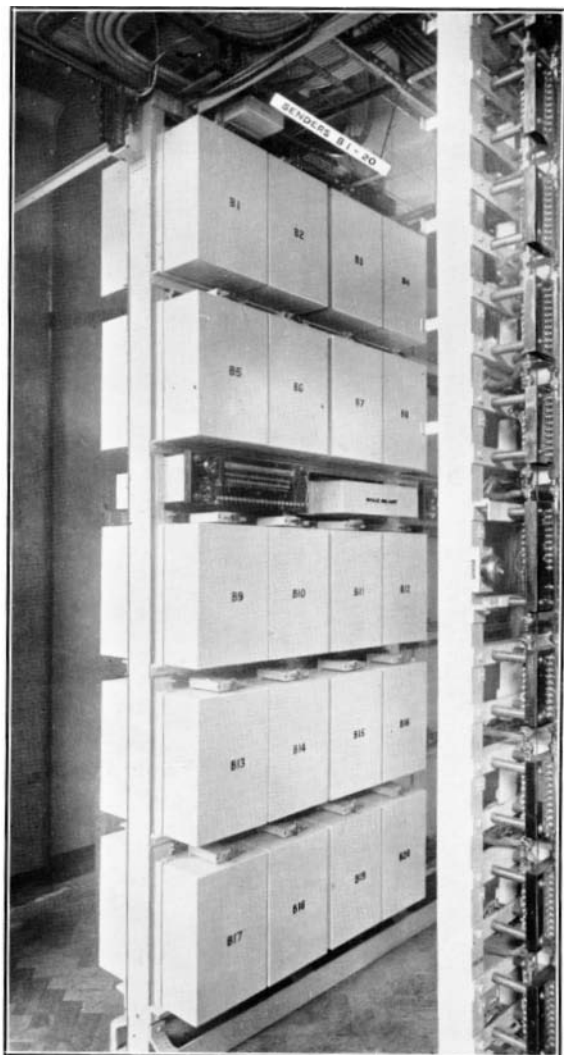


FIG. 14.

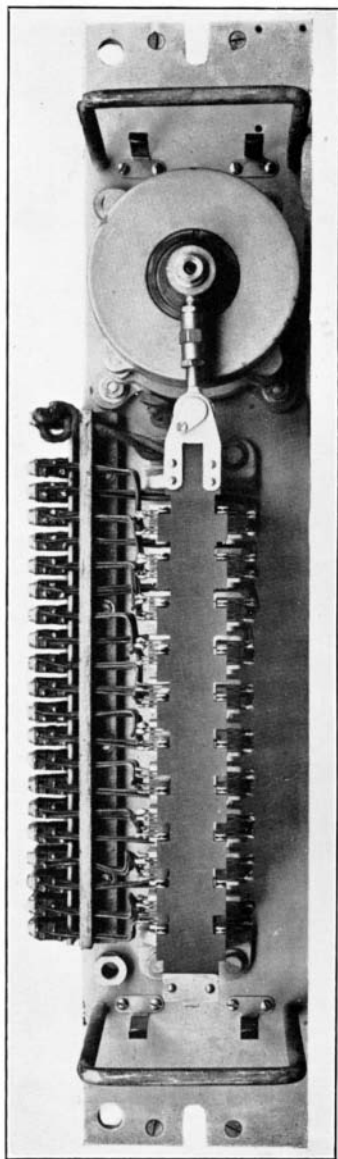


FIG. 15.

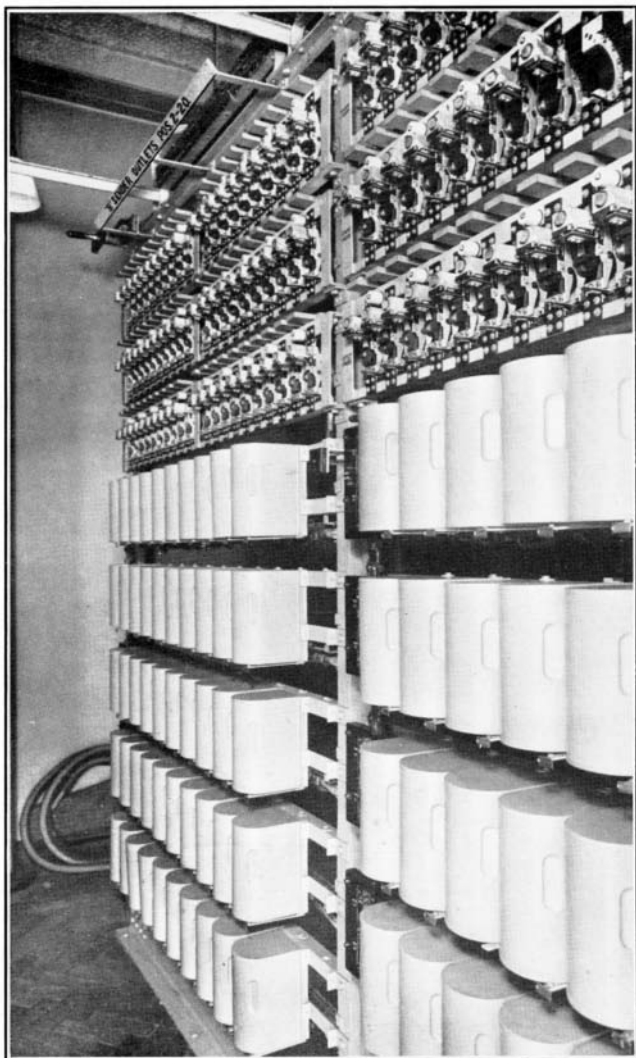


FIG. 16.

On the lower part of the rack are the relay sets for the sender finder and outlet preselector switches. The first shelf is typical of the remainder and reading from left to right the first four relay sets are those for the sender finder switches associated with position 2. The next two relay sets are the outlet preselector relays for positions 2 and 4 respectively and are followed by the sender finder relay sets for position 4.

The Junction Finder Rack (Fig. 17).—One rack provides accommodation for the junction finder equipment for two positions. The junction finder switches are mounted in the centre of the rack and 40 trunk relay sets per position are fitted above and below these switches. Where the full complement of 50 junctions per position is anticipated the additional rack space and wiring are provided.

Routiner.

The Sender Routiner (Fig. 18).—Permanent equipment is installed adjacent to the sender equipment in the apparatus room for the routine testing of senders.

The sender routiner is designed to perform the following functions:—

- (1) To automatically routine every sender in the exchange, or, if required to continuously routine any one sender.
- (2) To give a visual indication of the particular sender being routined.
- (3) To test the sender to ascertain whether it is busy before commencing the routine and if busy to delay the test for a predetermined period. If the sender is released within this period the routine proceeds. If the sender remains busy beyond this period an alarm is given.
- (4) To set up four or five digits, according to the numbering scheme of the area in which the exchange is situated, in simulation of a digit key set up.
- (5) To receive the digits from the sender under test and to display the digits on a visual indicator as they are received.
- (6) To test the duration of the pause between the first two digits sent out by the sender.
- (7) To test the correct clear down of the sender.
- (8) To test the forced start feature on mixed digit senders.
- (9) To give an alarm in the event of a fault and to stop the routine.
- (10) To hold the faulty sender engaged.
- (11) To give a visual indication of the nature of the faults indicated.
- (12) To test the operation of the sender where the call is only partially set up when this feature is required.

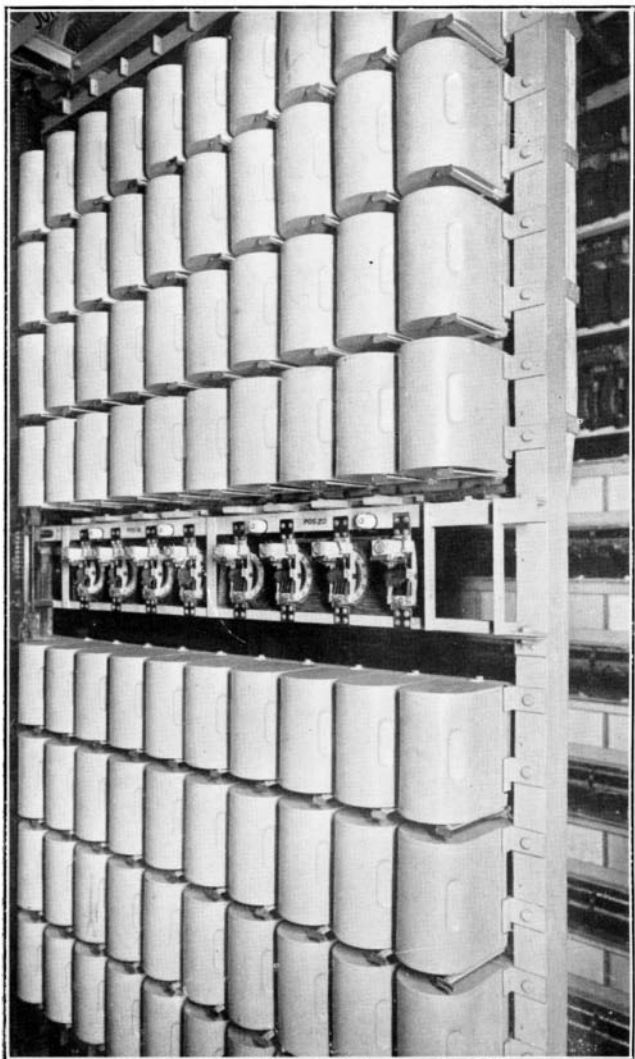


FIG. 17.

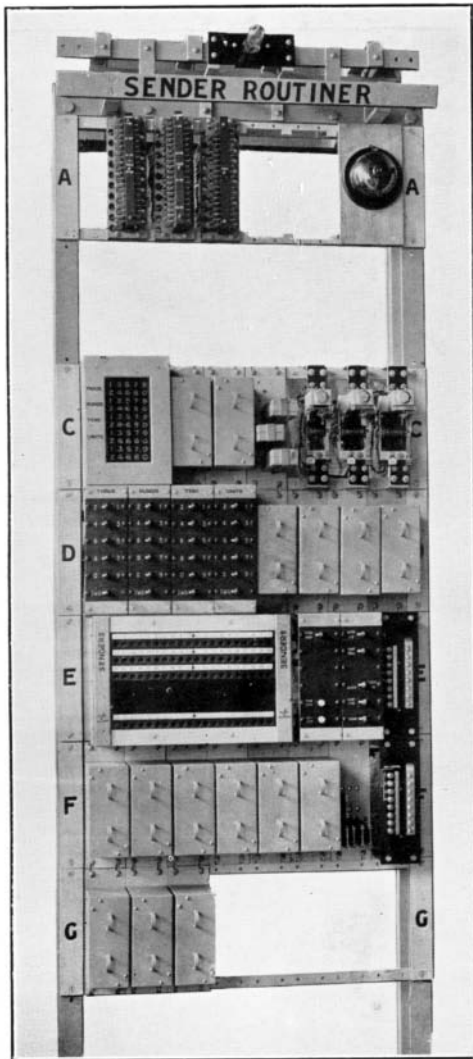


FIG. 10.

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(Continued).

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1. Subscribers' Apparatus C.B.
2. Subscribers' Apparatus C.B.S.
3. Subscribers' Apparatus Magneto.
4. Private Branch Exchange—C.B.
5. Private Branch Exchange—C.B. Multiple, No. 9.
6. Private Branch Exchange—Magneto.
7. House Telephones.
8. Wiring of Subscribers' Premises.

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1. Secondary Cells, Maintenance of.
2. Power Plant for Telegraph and Telephone Purposes.
3. Maintenance of Power Plant for Telegraph and Telephone Purposes.
4. Telegraph Battery Power Distribution Boards.

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1. Open Line Construction, Part I.
2. Open Line Construction, Part II.
3. Open Line Maintenance.
4. Underground Construction, Part I.
5. Underground Construction, Part II.
6. Underground Maintenance.
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