TELEPHONE DIAGRAMS

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POST OFFICE TELEGRAPHS.

CONNECTIONS
OF
TELEPHONIC APPARATUS
AND
CIRCUITS.

GENERAL POST OFFICE,
1909.

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1909.

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CONTENTS.

PART I.—COMMON BATTERY.

PART II.—COMMON BATTERY SIGNALLING.

PART III.—TRUNK CIRCUITS.

Wt. 24414. 17,650. 1/10. E. & S. a 2

PART IV.—HOUSE TELEPHONES.

PART V.—MISCELLANEOUS TELEPHONES AND CIRCUITS.

PART VI.—TABLES, AND LIST OF TELEPHONES STOCKED.

PART I.—COMMON BATTERY.

SECTION 1.

SUBSCRIBERS' APPARATUS ON DIRECT EXCHANGE CIRCUITS.

Plate 1.

C.B. Diagram No. 2.

Common Battery Wall Telephones.

Fig. 1.—Apparatus Schedule.

Telephone No. 1. The description includes Cord, Flexible, No. 222, and Receiver, Bell; Coil, Induction, No. 3 or 4; Bell, Magneto, 1,000 ohms; Condenser, metal-cased, 2 m.f.; Transmitter, C.B.; and 3 fixing screws and washers.

The 3-terminal type of the instrument is superseded by the 5-terminal patterns, but existing supplies of the former will be used up. *See* Fig. 4.

The instrument should be ordinarily fixed upon the wall with its lower edge 40 inches from the floor. If the subscriber desires it placed at some other height, his wish should be complied with. When the wall has to be plugged, care must be taken that no unnecessary damage is caused.

The wires may be led to the instrument, either from above or below, by way of the grooves in the back, through the holes below the terminals, and should be fixed below the lower nut of the terminal.

FIG. 2.—SUBSCRIBER'S SET WITH COIN COLLECTING BOX.

In addition to the items given under Fig. 1, the schedule includes:—

Box, Coin Collecting, Complete.

The description includes the Cash Box. The box should be fitted adjacent to the Telephone.

FIG. 3.—SUBSCRIBER'S SET WITH EXTENSION BELL.

The additional items in this case are:—

Bell, Magneto (1,000 ohms).
Switch, Tumbler, 3 ampères (bronzed).

The Tumbler Switch may be fitted adjacent either to the Wall Set or the Extension Bell in accordance with the desire of the subscriber.

FIG. 4.

Telephone No. 1 (Telephone, Wall, C.B.). The figure shows the wiring of the 5-terminal instrument, which has superseded the original C.B. Wall Set with 3 terminals shown in Fig. 1. *See also* Fig. 4, Plate 2, which shows the connections of the later form of Induction Coil fitted in C.B. sets.

Recent deliveries of this instrument are fitted with a detachable switch-hook (Hook, Receiver "F"), and the switch is arranged similarly to that shown in Plate 2, Fig. 5.

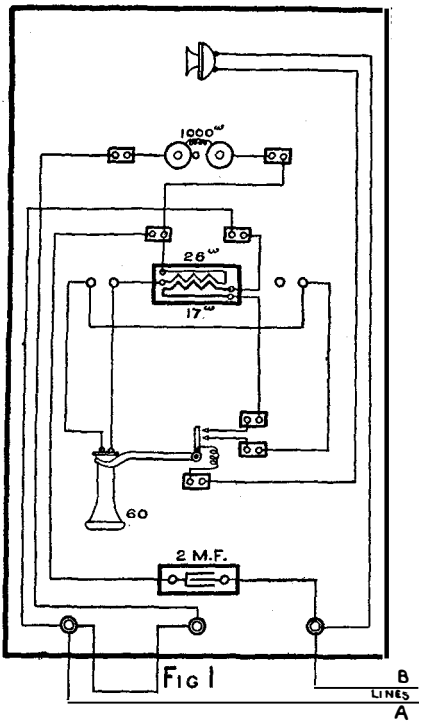


FIG 1

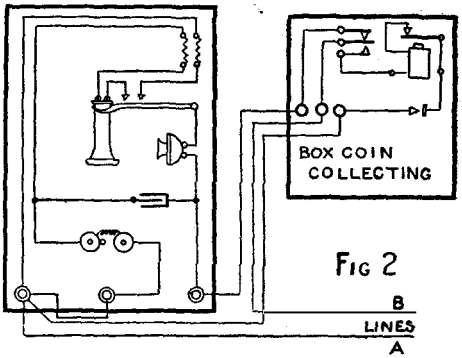


FIG 2

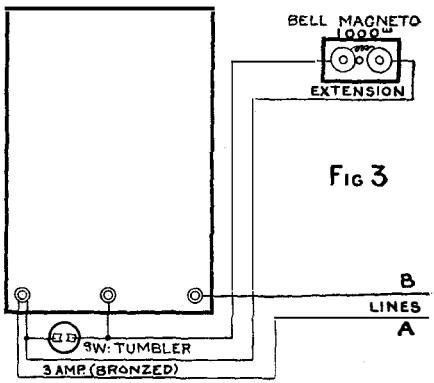


FIG 3

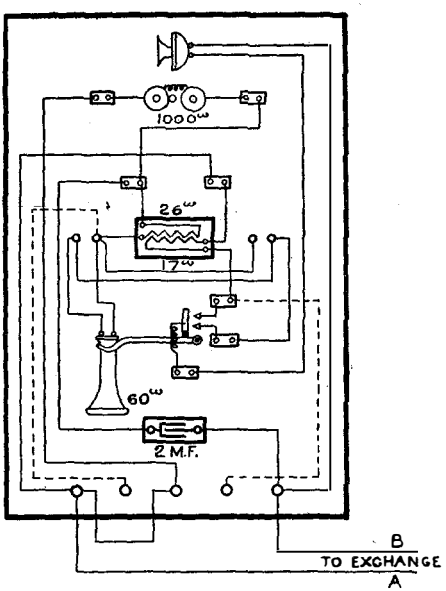


FIG. 4.

Plate 1.

Plate 2.

C.B. Diagram No. 1.

Common Battery Table Telephones.

Fig. 1.—Apparatus Schedule.

Telephone No 12. The description includes Cord, Flexible, No. 302; and Strip, Flexible Cord Connection, 4-terminal; Micro Telephone, C.B. (Telephone 38); and Cord, Flexible, No. 409.

This pattern of instrument is not now fitted on Exchange Circuits in competitive areas.

Bell Set No. 1 (Bell Set, Magneto, C.B.). The description includes Condenser, metal-cased, 2 m.f.; Induction Coil; and also screws for fixing. The internal connections are shown theoretically in this figure; for actual connections *see* Fig. 2. The Induction Coil fitted has two windings: Primary Coil 17 ohms, Secondary Coil 26 ohms. The resistance of the Bell, Magneto, is 1,000 ohms. A later pattern is fitted with a 500 ohms + 500 ohms Bell, the coils of which are joined in series, and an Induction Coil $\frac{26}{17}$ fitted with connecting plates and screws similarly to the primary battery Induction Coils. *See* Fig. 4.

Fig. 2.—Apparatus Schedule.

Telephone No. 2. The description includes Cords, Flexible, Nos. 222 (Receiver Cord) and 302; Receiver Bell; Strip, Flexible Cord Connection, 4-terminal; Transmitter, C.B.; and Label No. 43. *See also* Fig. 5.

Bell Set No. 1.

FIG. 3.—TABLE SET, WITH EXTENSION BELL.

The apparatus schedule is the same as either of the above, with the addition of:—

Bell, Magneto (1,000 ohms),

and

Switch, Tumbler, 3 ampères (bronzed).

FIG. 4.

Bell Set No. 1. In this Set the Induction Coil ("Coil Induction No. 4") is mounted on plates similarly to the primary battery Induction Coil. The small figure shows the method of winding the two coils; it will be observed that the magnetic effect will be in series if a current is sent through the coils from 2 to 1 and 3 to 4.

FIG. 5.

This figure shows the connections of Telephone No. 2 with a detachable switch hook. The description under Fig. 2 includes also 2 Cords, Flexible, No. 116 (Transmitter cord), in this case.

The Telephone should stand on the desk or table in a position indicated by the subscriber, and the Strip, Flexible Cord Connection, fixed to the ledge underneath the desk or table top in the vicinity of the telephone user's position.

The Bell Set, Magneto, C.B., should be fixed on the wall in the position desired by the subscriber, generally not less than 6 feet from the floor.

The Tumbler Switch may be fitted adjacent to either the Bell Set or the Extension Bell as required.

TELE., MICRO. C.B.

BELL SET, MAGNETO, C.B.

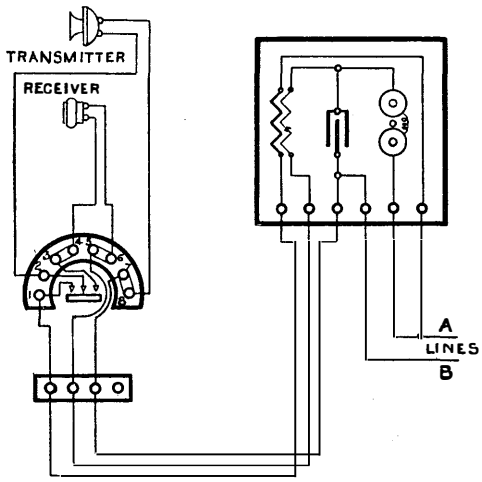


FIG. 1

TRANSMITTER, SOLID BACK, C.B.

BELL SET, MAGNETO, C.B.

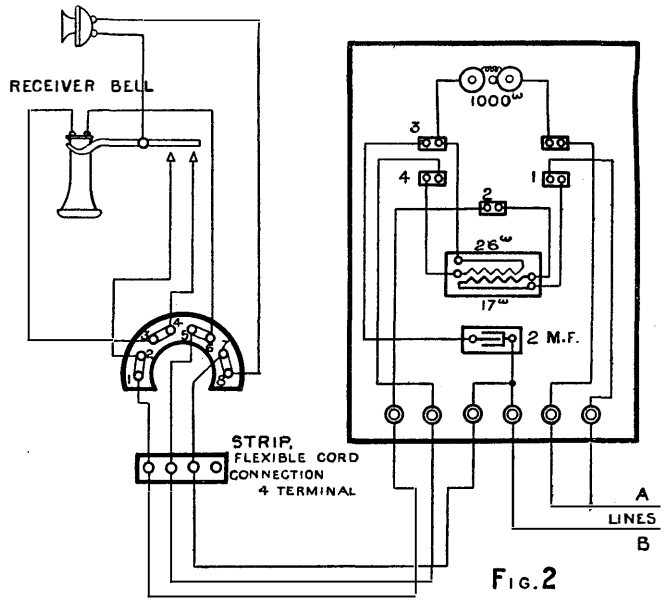


FIG. 2

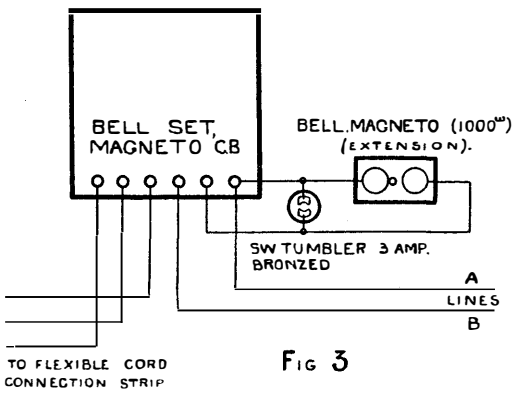


FIG 3

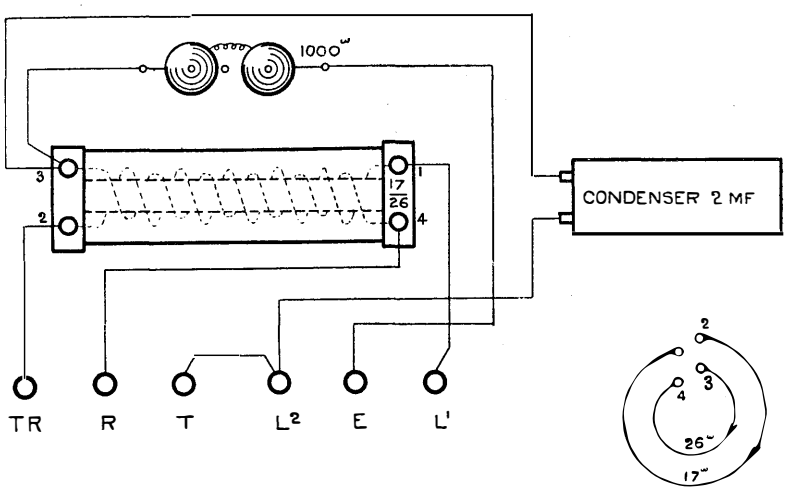


FIG. 4.

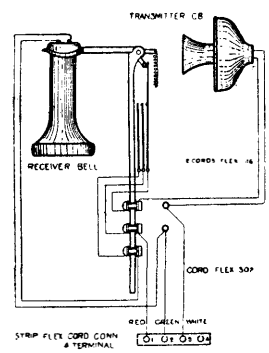


FIG. 5.

Plate 2.

Plate 3.

C.B. Diagram No. 30.

Connections of Subscriber's Circuit equipped with Wall Sockets and Plugs. Table Telephone.

In addition to the items required for an ordinary Table Set, shown in Fig. 2 of Plate 1, the following items are required :—

n Sockets, Wall, 4-hole.
n Bells, Magneto (1,000 ohms).
Plug, Wall, 4-pin.

The connection shown dotted between 2 and 4 of the plug has to be made locally.

TELE. TABLE TRANSR. TYPE C.B. BELL SET, MAGNETO C.B.

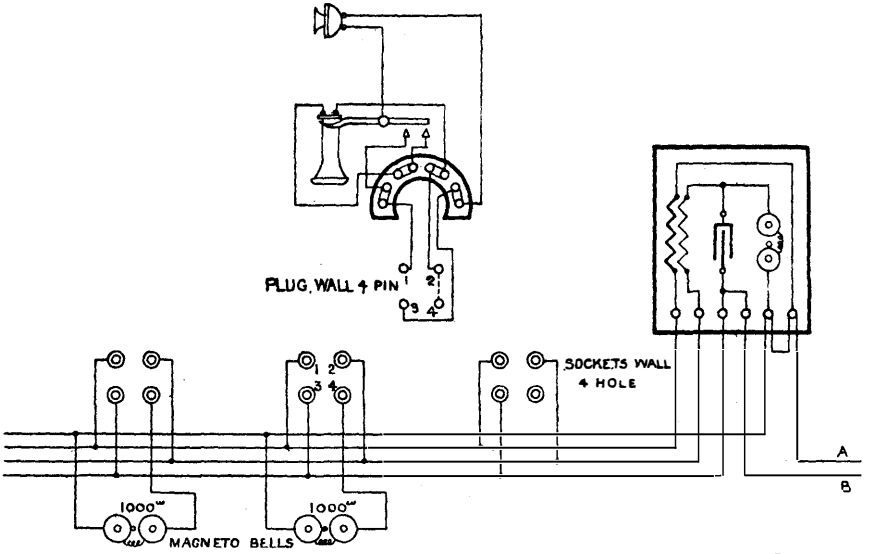


Plate 3.

SECTION 2.

SUBSCRIBERS' APPARATUS WITH SIMPLE EXTENSIONS.

Plate 4.

C.B. Diagram No. 3.

Connections of Subscriber's Circuit with Simple Extension. Table Telephone at each Point. Old Arrangement.

Apparatus Schedule.

Main Set.

Telephone No. 2.
Bell Set No. 1.
Press Button, "F."

Extension Set.

Telephone No. 2.
Bell, Trembler, Circular, 100 ohms.

The Press Button, "F," should be fitted on the table or desk, the Bell, Trembler, Circular, on the wall with the Armature in a vertical position, in positions agreed upon with the subscriber. For other fitting information, *see* page 5, Subscribers' Ordinary Circuit.

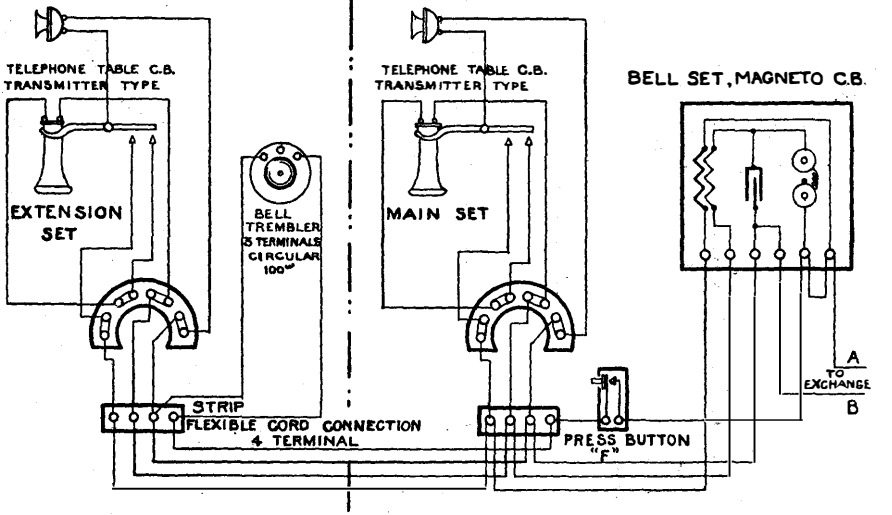

TELEPHONE TABLE C.B.
TRANSMITTER TYPE
EXTENSION
SET
BELL
TREMBLER
5 TERMINALS
CIRCULAR
100mm
TELEPHONE TABLE C.B.
TRANSMITTER TYPE
MAIN SET
BELL SET, MAGNETO C.B.
A
TO
EXCHANGE
B
STRIP
FLEXIBLE CORD CONNECTION
4 TERMINAL
PRESS BUTTON
"F"

Plate 4.

Plate 5.

C.B. Diagram No. 151.

CONNECTIONS OF SUBSCRIBER'S CIRCUIT WITH SIMPLE EXTENSION. TABLE TELEPHONE AT EACH POINT. NEW ARRANGEMENT.

APPARATUS SCHEDULE.

Main Set.

Telephone No. 10. The description includes, Cords, Flexible, Nos. 222 and 402; Strip, Flexible Cord Connection, 4-terminal; Transmitter, C.B.; and Receiver, Bell.
Bell Set No. 1.

Extension Set.

Telephone No. 2.
Bell, Trembler, Circular, 100 ohms.

The Press Button on the Main Set performs the same function as the Press Button, "F," in the old arrangement; *i.e.*, its depression completes the circuit of the Exchange Battery through the Trembler Bell at the Extension Set, thus giving a call at that point.

See Fig. 2, Plate 14, for original connections of Telephone, Table, C.B., with Press Button, Transmitter Type (now Telephone No. 10).

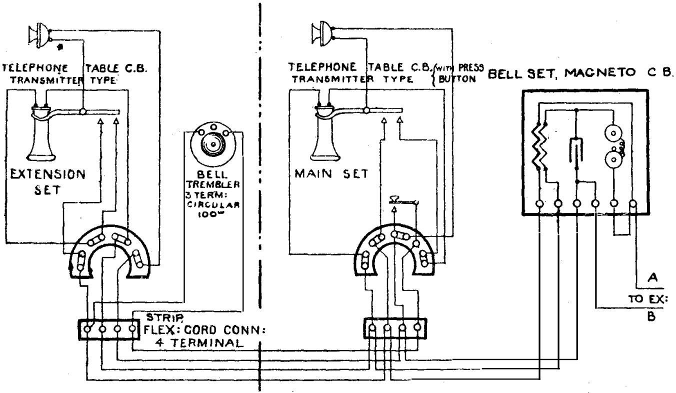

TELEPHONE TRANSMITTER
TABLE C.B. TYPE
EXTENSION SET
BELL TREMBLER 3 TERM: CIRCULAR 100ω
STRIP FLEX: CORD CONN: 4 TERMINAL
TELEPHONE TRANSMITTER
TABLE C.B. TYPE
(WITH PRESS BUTTON)
MAIN SET
BELL SET, MAGNETO C B.
A
TO EX:
B

Plate 5.

Plate 6.

C.B. Diagram No. 4.

Connections of Subscriber's Circuit with Simple Extension. Wall Telephone at each Point.

Apparatus Schedule.

Main Set.

Telephone No. 1 (3-terminal type shown).
Press Button, "F."

Extension Set.

Telephone No. 1 (3-terminal type shown).
Bell, Trembler, Circular, 100 ohms.

The Press Button, "F," should be fitted on the left side of the telephone desk, on a level with the Magneto Bell; the Trembler Bell at the Extension on the wall immediately above the instrument.

It should be observed that the two left-hand terminals of the Extension Set are not joined together as in the case of an ordinary Set, the Magneto Bell not being required at this point, all Exchange calls being received on the Magneto Bell at the Main Set.

See Plate 1 for internal connections of Sets.

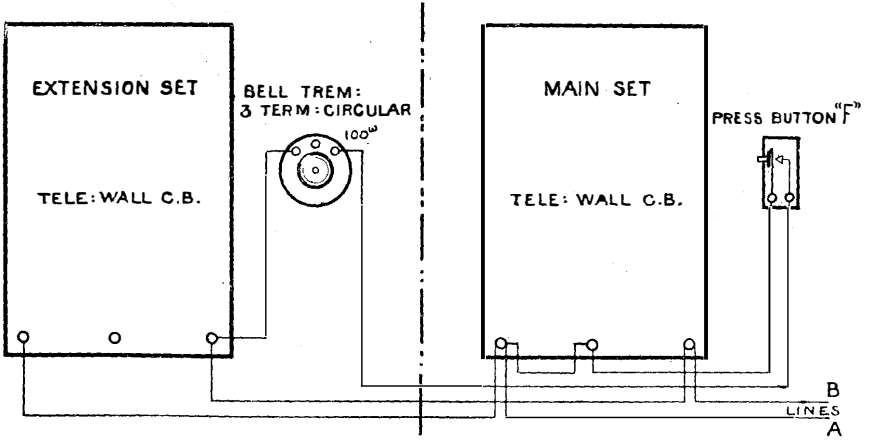

EXTENSION SET
TELE: WALL C.B.
BELL TREM:
3 TERM: CIRCULAR
100Ω
MAIN SET
TELE: WALL C.B.
PRESS BUTTON "F"
B
LINES
A

Plate 6.

Plate 7.

C.B. Diagram No. 5.

Connections of Subscriber's Circuit with Simple Extension. Wall Telephone at Main Set, and Table Telephone at Extension.

Apparatus Schedule.

Main Set.

Telephone No. 1.
Press Button, "F."

Extension Set.

Telephone No. 2.
Bell, Trembler, Circular, 100 ohms.

The Press Button should be fitted on the left side of the Main Set telephone desk, on a level with the Magneto Bell, and the Trembler Bell at the Extension Set on the wall in a position agreed upon with the subscriber.

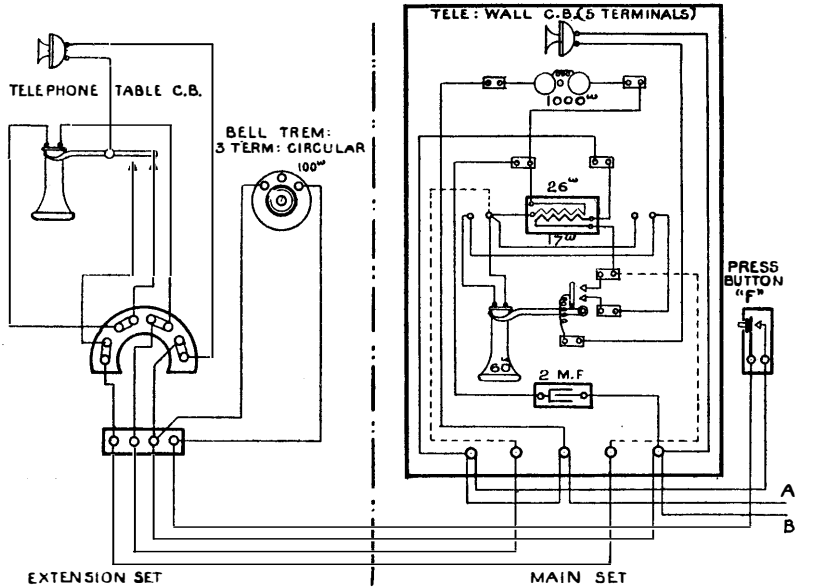

TELE: WALL C.B. (5 TERMINALS)
TELEPHONE TABLE C.B.
BELL TREM: 3 TERM: CIRCULAR
100ω
1000ω
26ω
17ω
PRESS BUTTON "F"
60
2 M.F
A
B
EXTENSION SET
MAIN SET

Plate 7.

Plate 8.

C.B. Diagram No. 6.

Connections of Subscriber's Circuit with Two Simple Extensions. Wall Telephone at Main Set, Table Telephones at Extensions.

Apparatus Schedule.

Main Set.

Telephone No. 1.
2 Press Buttons, "F" (One for each Extension).

Extension Sets 1 *and* 2.

Telephone No. 2.
Bell, Trembler, Circular, 100 ohms.

The Press Buttons, "F," should be fitted on the sides of the desk of the Main Set Telephone; No. 1, which calls Extension No. 1, on the right side, and No. 2, which calls Extension No. 2, on the left.

For internal connections of Main Set instrument, *see* Plate 1, Fig. 4.

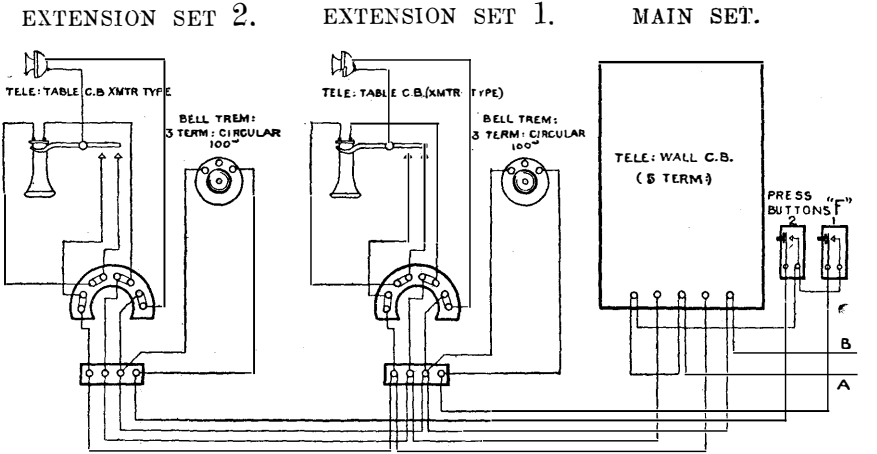

EXTENSION SET 2.
EXTENSION SET 1.
MAIN SET.
TELE: TABLE C.B XMTR TYPE
BELL TREM:
3 TERM: CIRCULAR
100Ω
TELE: TABLE C.B.(XMTR TYPE)
BELL TREM:
3 TERM: CIRCULAR
100Ω
TELE: WALL C.B.
(5 TERM.)
PRESS BUTTONS "F"
2
1
B
A

Plate 8.

Plate 9.

C.B. Diagram No. 7.

Connections of Subscriber's Circuit with Two Simple Extensions, Wall Telephone at Main Set and at Extension No. 1, Table Telephone at Extension No. 2.

Apparatus Schedule.

Main Set.

Telephone No. 1.
2 Press Buttons, " F " (One for each Extension).

Extension Set No. 1.

Telephone No. 1.
Bell, Trembler, Circular, 100 ohms.

Extension Set No. 2.

Telephone No. 2.
Bell, Trembler, Circular, 100 ohms.

See page 18 for position of Press Buttons, and Plate 1 for internal connections of Wall Telephones.

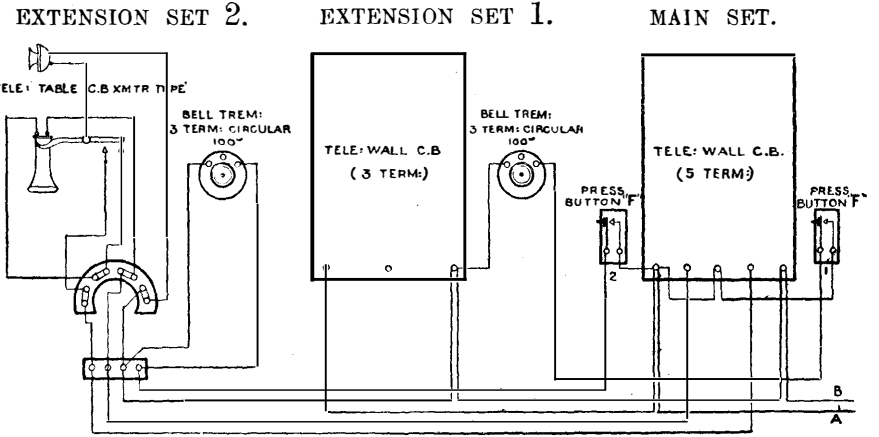

EXTENSION SET 2.
EXTENSION SET 1.
MAIN SET.
TELE: TABLE C.B XMTR TYPE
BELL TREM: 3 TERM: CIRCULAR 100~
TELE: WALL C.B (3 TERM:)
BELL TREM: 3 TERM: CIRCULAR 100~
TELE: WALL C.B. (5 TERM:)
PRESS BUTTON F
PRESS BUTTON F
2
1
B
A

Plate 9.

Plate 10.

C.B. Diagram No. 8.

Connections of Simple Extension Circuit with "Secrecy" Switch at Extension Set.

Apparatus Schedule.

Main Set.

Telephone No. 1 (3-terminal shown type).
Press Button, "F."

Extension Set.

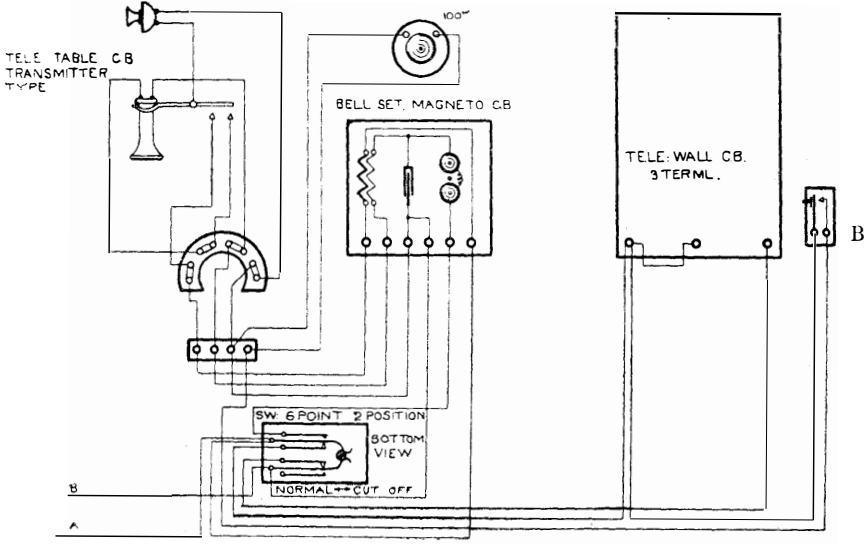
Telephone No. 2.
Bell Set No. 1.
Bell, Trembler, Circular, 100 ohms.
Switch, 6-point, 2-position.

The Switch should be fitted adjacent to the Extension Set in a position agreed upon with the subscriber.

Normally, the circuit is through to the Main Set for receiving calls, the Magneto Bell at the Extension instrument being out of circuit. When the "Secrecy" Switch is turned, the Main Set is entirely cut off from the Exchange, and the Bell at the Extension instrument is joined up, making that Set an ordinary "Terminal" instrument.

EXTENSION SET. BELL TREMBLER MAIN SET.

CIRCULAR.



PRESS BUTTON "F."

Plate 10.

SECTION 3.

SUBSCRIBERS' APPARATUS WITH ONE EXTENSION AND INTERCOMMUNICATION.

Plate 11.

C.B. Diagram 140A

CONNECTIONS OF SUBSCRIBER'S CIRCUIT WITH SIMPLE EXTENSION, GIVING INTERCOMMUNICATION, AND WITH OR WITHOUT SECRECY.

APPARATUS SCHEDULE.

Main Set.

Telephone No. 5.

In this, the more recent, type of Intermediate Telephone, an Intermediate Switch 4-way (Key, Type 2077) takes the place of the 3-way Switch in the older form, and the title includes also a Coil, Retardation, 400 ohms, Type 2010 F.

This arrangement permits of an additional "position" being utilised:—"Main Set through to Extension, Exchange held." *See* Plate 12 giving the theoretical connections of the circuit in the several positions of the Switch.

Extension Set.

Telephone No. 7.

The connections of the Switch and Links are shown as seen from the back of the Telephone.

For "Secrecy" the links should be connected between 1 and 2; for "Non-Secrecy" between 1 and 3.

Plate 13 gives the Table equivalent of the Main Set, and Plate 14 the Table equivalent of the Extension Set.

TELE. WALL, C.B.
INTERMEDIATE WITH GENR.

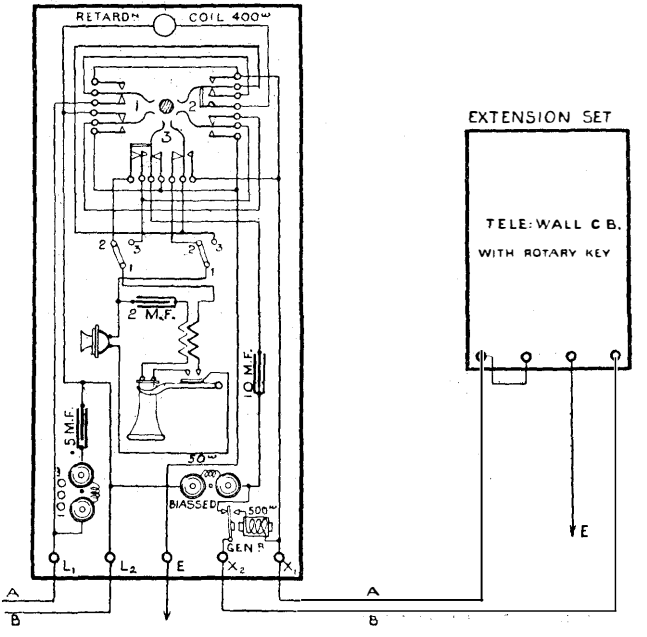


Plate 11

Plate 12.

C.B. Diagram No. 141.

THEORETICAL CONNECTIONS OF SUBSCRIBER'S CIRCUIT WITH SINGLE EXTENSION, GIVING INTERCOMMUNICATION, AND WITH OR WITHOUT SECRECY.

Fig. 1.—Switch in "Exchange" position. Lever Central—Main Set through to Exchange.

Fig. 2.—Switch in "Extension" position. Lever in 1—Main Set through to Extension Set.

Fig. 3.—Switch in "Main Set to Extension and Exchange held" position. Lever in 2.

Fig. 4.—Switch in "Extension Set through to Exchange" position. Lever in 3.

The Extension Set calls the Main Set by intermittently earthing the B line by means of the Rotary Key. This operates the Biassed Bell without indicating a signal at the Exchange. The Extension is called by generator.

FIG. 1.

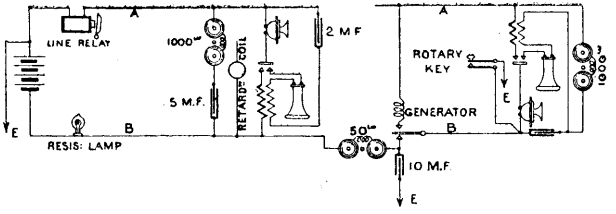


FIG. 2.

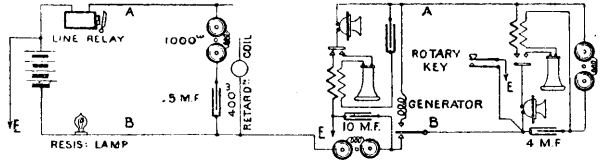


FIG. 3.

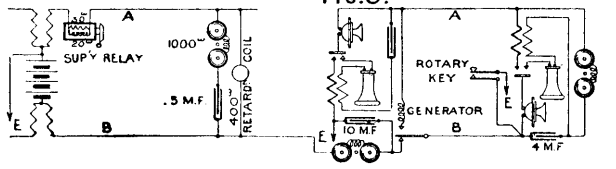


FIG. 4.

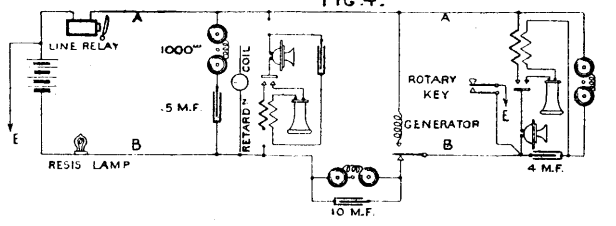


Plate 12.

Plate 13.

C.B. Diagram No. 174.

Connections of Subscriber's Circuit with Single Extension, giving Intercommunication, and With or Without Secrecy. Table Telephone at Main Set.

Apparatus Schedule.

Main Set.

Telephone No. 6. The description includes Cord, Flexible, No. 1202; Intermediate Switch (Key Type 2077); and Block, Flexible Cord Connection, 12-terminal. These instruments have now been fitted with a fixed C.B. Transmitter, Receiver Rest, and Receiver, Bell, "D," with Cord, Flexible, No. 222.

Bell Set No. 3 (Bell Set, Magneto, $\frac{2}{2}$ C.B.). The description includes 2 Bells, Magneto—one 1,000 ohms, the other 50 ohms (biassed); Coil, Retardation, 400 ohms, Type 2010 F; Coil, Induction, Type 2203; and 3 Condensers, metal-cased, ·5 m.f., 2 m.f., and 10 m.f.

See Plates 11, 12, and 14 for Extension Sets; and Plate 11 for the Wall Set equivalent of the above.

All connections are shown as if looking at the fronts of the sets, except the Key, which is shown as if seen from the back.

TELE. TABLE,
C.B. INTERMEDIATE, WITH GENR.

BELL SET,
MAGNETO $\frac{2}{2}$ C.B.

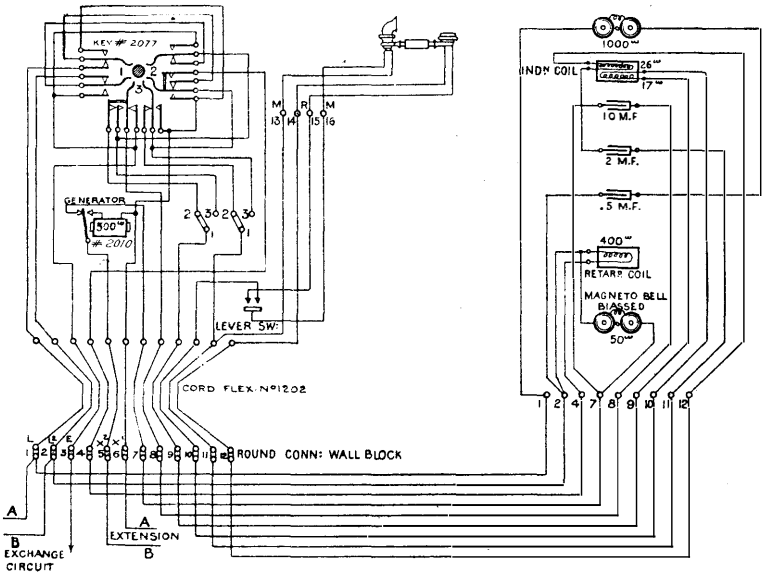


Plate 13.

Plate 13—*cont.*

Lever Central—Main Set through to Exchange.

Lever in Position 1—Main Set through to Extension.

Lever in Position 2—Main Set through to Extension and Exchange held.

Lever in Position 3—Extension Set through to Exchange.

For "Secrecy" the links should be connected between 1 and 2. For "Non-Secrecy" the links should be connected between 1 and 3.

See Plate 12 for theoretical conditions in the various positions of the Switch, and page 28 for the methods of calling. Lifting the Micro Telephone from the cradle in this instance calls the Exchange, when the Switch Lever is in the central position.

Plate 14.

C.B. Diagram No. 13.

Connections of Extension Set, giving Intercommunication with Main Set, With or Without Secrecy. Table Telephone at Extension.

Apparatus Schedule.

Telephone No. 10.
Bell Set No. 1.

This Table Set is the equivalent of the Wall Set, "Telephone No. 7" shown in Plates 11 and 12, the Press Button when pressed intermittently performing the same function as the Rotary Key in the case of the Wall Set.

Fig. 2 shows the original connections of the Press Button and the Telephone Base.

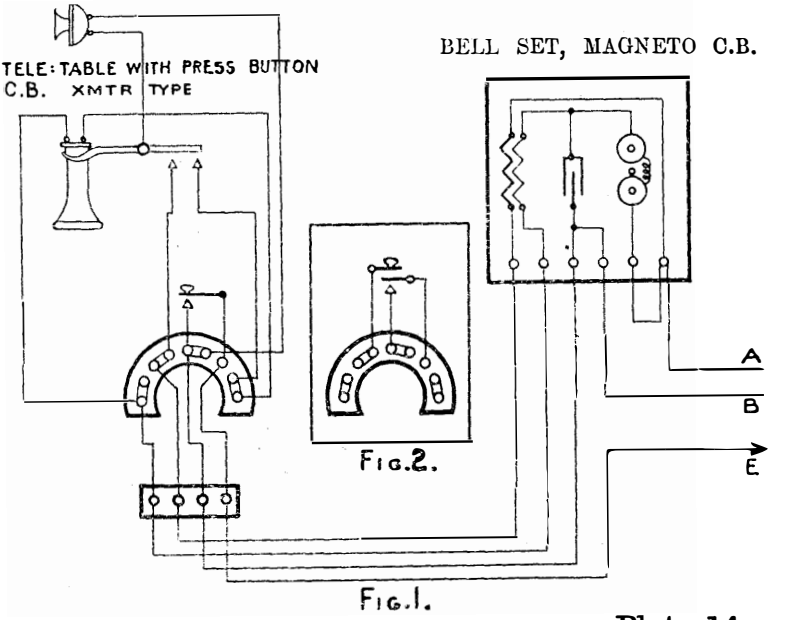

TELE: TABLE WITH PRESS BUTTON
C.B. XMTR TYPE
BELL SET, MAGNETO C.B.
A
B
E
Fig.2.
Fig.1.

Plate 14.

Plate 15.

C.B. Diagram No. 157.

Connections of Extension Set, giving Intercommunication with Main Set, With or Without Secrecy. Table Telephone with Wall Peg and Sockets.

Apparatus Schedule.

Telephone No. 10.
Bell Set No. 1.
Peg, Wall Socket, 7-connection.
n Sockets, Wall, 7-connection.
n Bells, Magneto, 1,000 ohms.

Connections at * to be made normally. When it is required that one Bell only should be in circuit at any time, the connections shown dotted should be made and the connection at * left disconnected.

See Plates 11 and 14 for ordinary Extension Sets.

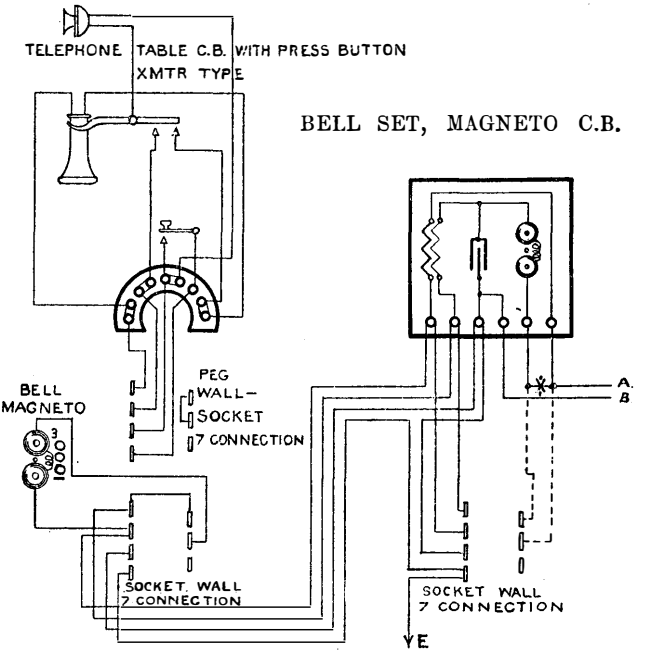

TELEPHONE
TABLE C.B. WITH PRESS BUTTON
XMTR TYPE
BELL SET, MAGNETO C.B.
S2
BELL
MAGNETO
PEG
WALL-
SOCKET
7 CONNECTION
A.
B
SOCKET WALL
7 CONNECTION
SOCKET WALL
7 CONNECTION
YE

Plate 15.

Plate 16.

Bell Set No. 4.

The plate shows the connections of the Intermediate C.B. Switching Set introduced in 1909 for use on a Subscriber's Circuit with one Extension, giving Intercommunication, with or without secrecy.

When the two pairs of terminals AA and BB are connected, as shown by the dotted lines, the intermediate station (at which an ordinary complete C.B. telephone set is fitted) is connected in bridge with the extension on the Exchange lines when springs " 2 " are operated. With the dotted connection removed, the intermediate station cannot overhear under the same conditions.

Speaking current for conversation between the intermediate and extension stations is provided by two dry cells which are connected to the terminals marked Z and C.

The Indicator is connected so as to afford an automatic clearing signal of a negative character, when the Extension clears to the Exchange.

See Plate 17 for the conditions in the various positions of the switch.

At the Extension an ordinary C.B. telephone is fitted with the addition of a generator for the purpose of calling the intermediate station.

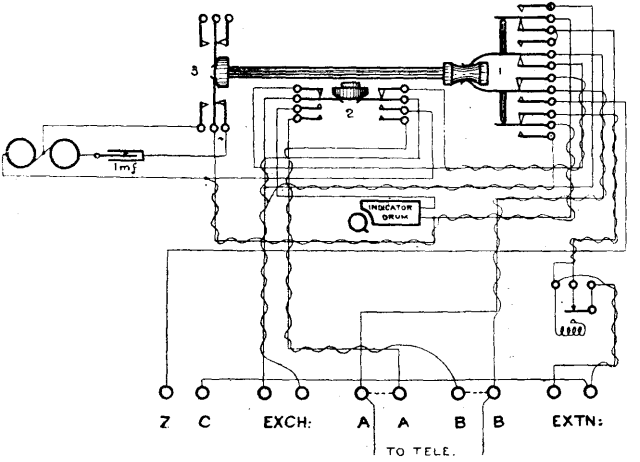


Plate 16.

Plate 17.

THEORETICAL CONNECTIONS OF SUBSCRIBER'S CIRCUIT WITH SINGLE EXTENSION, GIVING INTERCOMMUNICATION, WITH OR WITHOUT SECRECY, WHEN BELL SET No. 4 IS USED.

Fig. 1.—Switch in "Exchange" position. Lever central—Main Set through to Exchange; Extension on Extension Bell.

Fig. 2.—Switch in "Extension" position. Springs No. 1 operated—Main Set through to Extension; Exchange on Extension Bell. Local battery in series on the "Main to Extension" lines.

Fig. 3.—Switch in "Main Set to Extension and Exchange held" position. Springs Nos. 1 and 3 operated—Exchange held by one bell coil.

Fig. 4.—Switch in "Extension Set through to Exchange" position. Springs No. 2 operated—Drum Indicator on lines. Main Set in bridge on lines, if terminals AA and BB are connected; otherwise disconnected.

See Plate 16 for wiring of Switching Set.

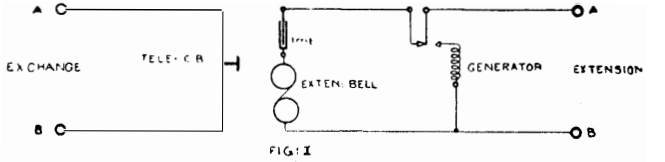


FIG: I

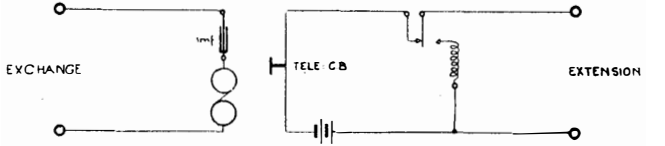


FIG: 2

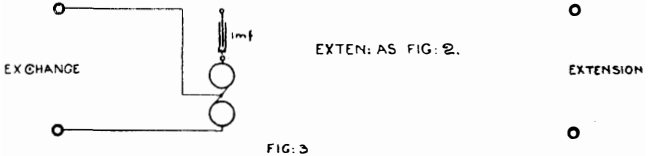


FIG: 3

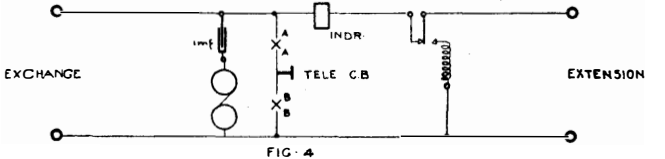


FIG: 4

Plate 17.

SECTION 4.

PRIVATE BRANCH EXCHANGES.

Plate 18.

C.B. Diagram No. 19.

Connections of Exchange Circuit: Communication with National Telephone Company's Extension Circuits, or with a Private Wire (N.T. Company's). P.O. Wall Telephone, Common Battery, Fixed.

Apparatus Schedule.

Instrument, Extension, C.B., No. 19. The description includes Case for Extension Instrument, C.B., No. 19; fitted with Coil, Retardation, Type 9A (80 + 80 ohms); Switch, 3-position, Drawing 926; 2 Condensers, metal-cased, 2 m.f.; and Switchspring, 5-point.

Calls from the P.O. Exchange are received on P.O. Telephone, and answered by turning Switch to "Exchange." If an Extension is wanted, the Switch is left in "Exchange" position, Receiver is replaced on hook, and the Extension is called by means of the National Company's instrument in the usual way.

When Extension subscriber replies, he is plugged through to Switchspring on this instrument and the Switch turned to "Extension." When the Extension subscriber clears, his Indicator drops and bell of P.O. Telephone rings. The pegs should then be withdrawn and the Switch restored to normal, the latter operation sending the clearing signal to the P.O. Exchange.

When an Extension subscriber desires to communicate with the P.O. Exchange, his line should be connected to the Switchspring on this instrument and the Switch turned to "Extension"; the P.O. Exchange will then be automatically called.

When the instrument is used in connection with a private wire circuit maintained by the N.T. Compa y where that is the only extension, teed connections should be taken from the private wire to the right hand terminals A, B. The operating is the same as before, except that no plugging through is necessary.

The position of the apparatus should be in accordance with the wishes of the subscriber.

INSTRUMENT, EXTENSION, C.B., NO. 19.

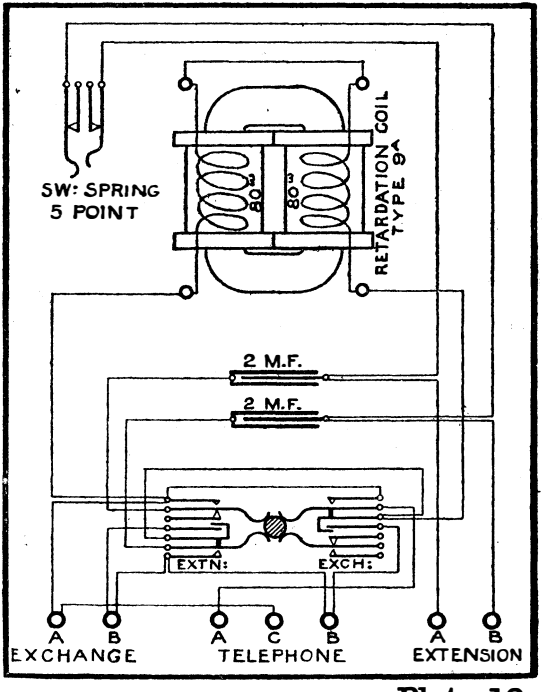


Plate 18.

Plate 19.

C.B. Diagram No. 20.

Connections of Exchange Circuit; Communication with National Telephone Company's Extension Circuits. N.T. Company's Telephone used for Speaking on all Circuits.

Apparatus Schedule.

Instrument, Extension, C.B., No. 20. The description includes Case for Extension Instrument, C.B., No. 20; fitted with Bell, Magneto, 1,000 ohms (unmounted); Coil, Retardation, Type 9A (80 + 80 ohms); Switch, 3-position, Drawing 926; 2 Condensers, metal-cased, 2 m.f.; and Switchspring, 5-point.

Calls from P.O. Exchange are received on the Magneto Bell, and answered by turning the Switch to "Exchange" position and inserting peg in Switchspring. If an Extension is wanted, Peg should be withdrawn and inserted in Switchspring of Extension asked for on N.T. Company's Switch. The Extension should then be called as usual from N.T. Company's Telephone and after replying should be connected to the Switchspring on this instrument.

Clearing Signal from Extension is received on the Magneto Bell, and the clearing signal to the Exchange is sent by restoring the Switch to normal.

Calls from the Extension are received on N.T. Company's Indicator. The Extension is

then pegged through to Switchspring on this instrument, and the Exchange is called by the action of turning Switch to "Exchange" position.

Clearing signal as before.

The movement of the 3-position Switch to the left should be blocked.

INSTRUMENT, EXTENSION, C.B., NO. 20.

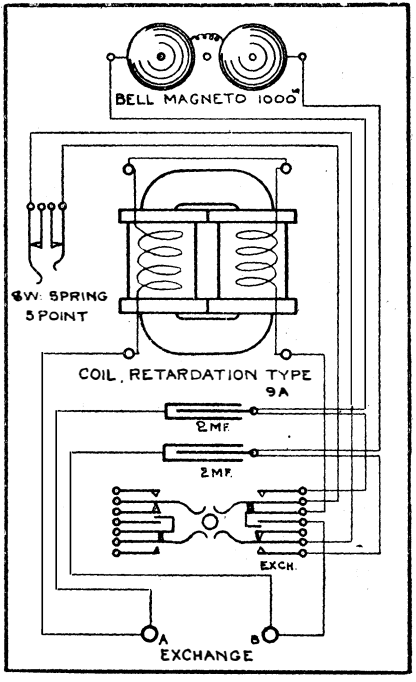


Plate 19.

Plate 20.

C.B. Diagram No. 21.

Connections for Long Extension Circuit, or for an Extension of a Branch Exchange Circuit.

Apparatus Schedule.

Instrument, Extension, C.B., No. 21. The description includes Case for Extension Instrument, C.B., No. 21; fitted with Bell, Trembler, Circular, 25 ohms; Coil, Retardation, Type 9A (80 + 80 ohms); 2 Condensers, metal-cased, 2 m.f.; Switchspring, 5, 8, and 5-point, $\frac{1+1+1}{3}$; Indicator, Drop, Tubular, 1,000 ohms, $\frac{2}{2}$, or Indicator, Non-polarised, "C," 500 + 500 ohms, $\frac{2}{2}$, Generator, Bracket, 3-terminal (Unmounted); Coil, Induction, $\frac{150}{1}$; and Suspender for Micro Telephone.

*Telephone No. 28 (with Hook).

Battery, Leclanché, Agglomerate, 2-block, 2-cell, No. 2.

Switch, 6-point, 2-position (*see* Notes).

The Exchange is automatically called by insertion of peg in the "Exchange" Switchspring; the Extension is called by Generator.

* Superseded by Telephone, Table, P.B., Transmitter Type, Complete (Telephone No. 4).

INSTRUMENT, EXTENSION, C.B., NO. 21.

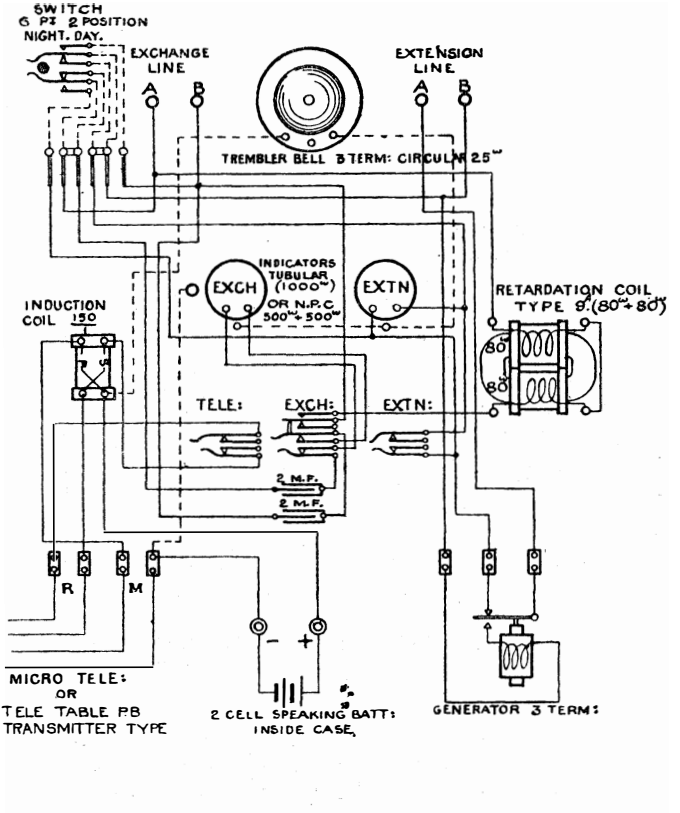


Plate 20.

Plate 20—*cont.*

At the Extension a Telephone, Table (or Wall), with Generator, is required, the Generator being used both for calling and clearing. The clearing signal to the Exchange is sent by withdrawing the peg from the "Exchange" Switchspring.

When it is desired to extend the Exchange Circuit to the Extension Station at night and the length of the line will permit this to be done satisfactorily, it is necessary to ask for "Instrument, Extension, C.B., No. 21, with Switch, 6-point, 2-position."

If it is necessary to add such a Switch locally to an instrument not previously equipped, a "Switch, 6-point, 2-position, engraved 'Night' and 'Day'" should be demanded. It should be fitted immediately over the aperture for the Indicators, and connected to the six screw tags (as shown by the dotted lines in the diagram), the connections shown between tags 2 and 3, and 4 and 5, being removed.

The wires must be taken round to the right-hand inside the case, and carefully cabled up so as to allow the hinged front to be freely opened.

Plate 21.

C.B. Diagram No. 134.

Wiring Diagram of Switchboards, Branch Exchange, C.B., $\frac{5}{10}$ and $\frac{10}{10}$, using Line Indicators for Calling and Clearing.

Apparatus Schedule.

Switchboard, Branch Exchange, C.B., $\frac{5}{10}$ or $\frac{10}{10}$. The description includes Transmitter, Solid-Back, C.B.; Cord, Flexible. No. 222; and Receiver, Bell, "D."

Switch, Tumbler, 3 ampères (bronzed).

Bell, Trembler, Small,
or,
Bell, Trembler, Circular, 25 ohms.
} If required.

Battery: 2 Cells, Dry, Y (for local bell circuit only).

This diagram shows the connections of the original $\frac{5}{10}$ and $\frac{10}{10}$ Switchboards, re-wired and brought into line with the principles adopted in the later forms of smaller sized Switchboards for Branch Exchanges. The Indicators, Type 34, formerly used for calling purposes only, now indicate both calling and clearing signals. This arrangement renders the use of clearing indicators

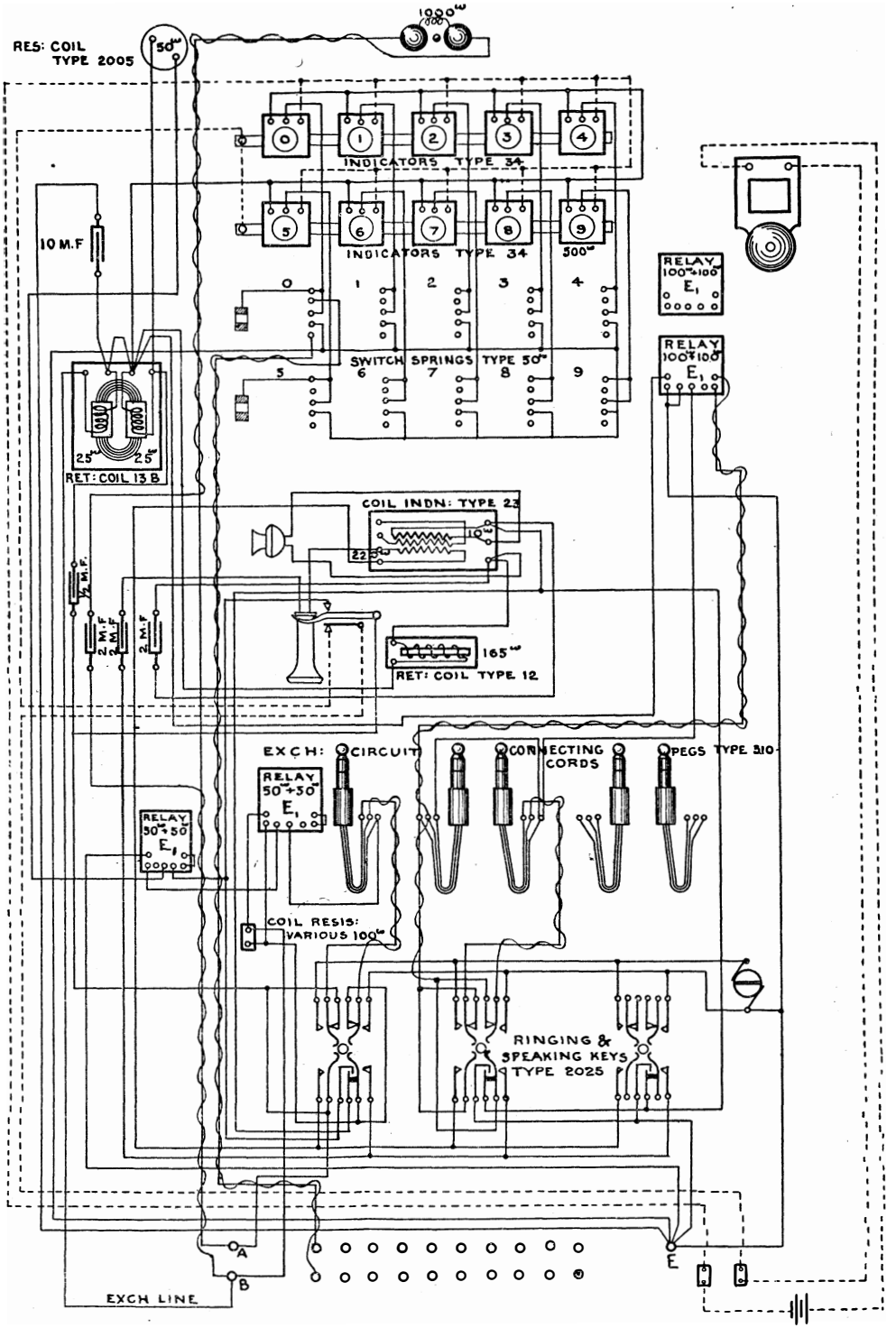

RES: COIL
TYPE 2005
50Ω
1000Ω
INDICATORS TYPE 34
INDICATORS TYPE 34
500Ω
10 M.F
RELAY
100Ω+100Ω
E1
RELAY
100Ω+100Ω
E1
SWITCH SPRINGS TYPE 50Ω
25Ω
25Ω
RET: COIL 13 B
COIL INDN: TYPE 23
22
½ M.F
2 M.F
2 M.F
2 M.F
165Ω
RET: COIL TYPE 12
EXCH: CIRCUIT
CONNECTING CORDS
PEGS TYPE 510
RELAY
50Ω+50Ω
E1
RELAY
50Ω+50Ω
E1
COIL RESIS:
VARIOUS 100Ω
RINGING &
SPEAKING KEYS
TYPE 2025
A
B
E
EXCH LINE

Plate 21.

on the B Cords unnecessary, and they have been accordingly cut-out.

The dotted connections show the local Bell Circuit where such is fitted. The Bell should be fitted off the Board in a position indicated by the subscriber; if a Switch, Tumbler, 3 ampères (bronzed), is used to control the Bell Circuit, it may be fitted on the Board.

Plate 22 shows the circuit arrangements on this Board.

Plate 22.

C.B. Diagram No. 133.

Subscriber's Installation when One Exchange Connection and Two to Ten Extensions Provided. Switchboards, Branch Exchange, C.B., $\frac{5}{10}$ and $\frac{10}{10}$. (Line Indicators Calling and Clearing.)

Circuit Arrangements.

The principles on which this board is worked are similar to those described on page 64, but owing to the fact that the arrangement had to be introduced on the boards originally supplied, which were wired and equipped in a somewhat different manner, the methods by which calling and clearing to the Exchange are effected differ from those of the later boards.

In this case the Exchange line terminates at the board on a peg. A Magneto Bell, 1,000 ohms, in series with a Condenser, metal-cased, 2 m.f., is permanently connected across the lines for the purpose of receiving calls from the Exchange. To call the Exchange, the operator pushes the Speaking and Ringing Key into the "speaking" position and at the same time raises the Receiver from the hook. This operation closes the circuit of the Exchange battery from the "A" line through the upper contact of the Receiver hook, the inner springs of the "speaking" Key, primary coil of Induction Coil, Transmitter, Retardation

EQUIPMENT AT EXTENSION POINT
CONSISTS OF ORDINARY WALL OR TABLE SET.

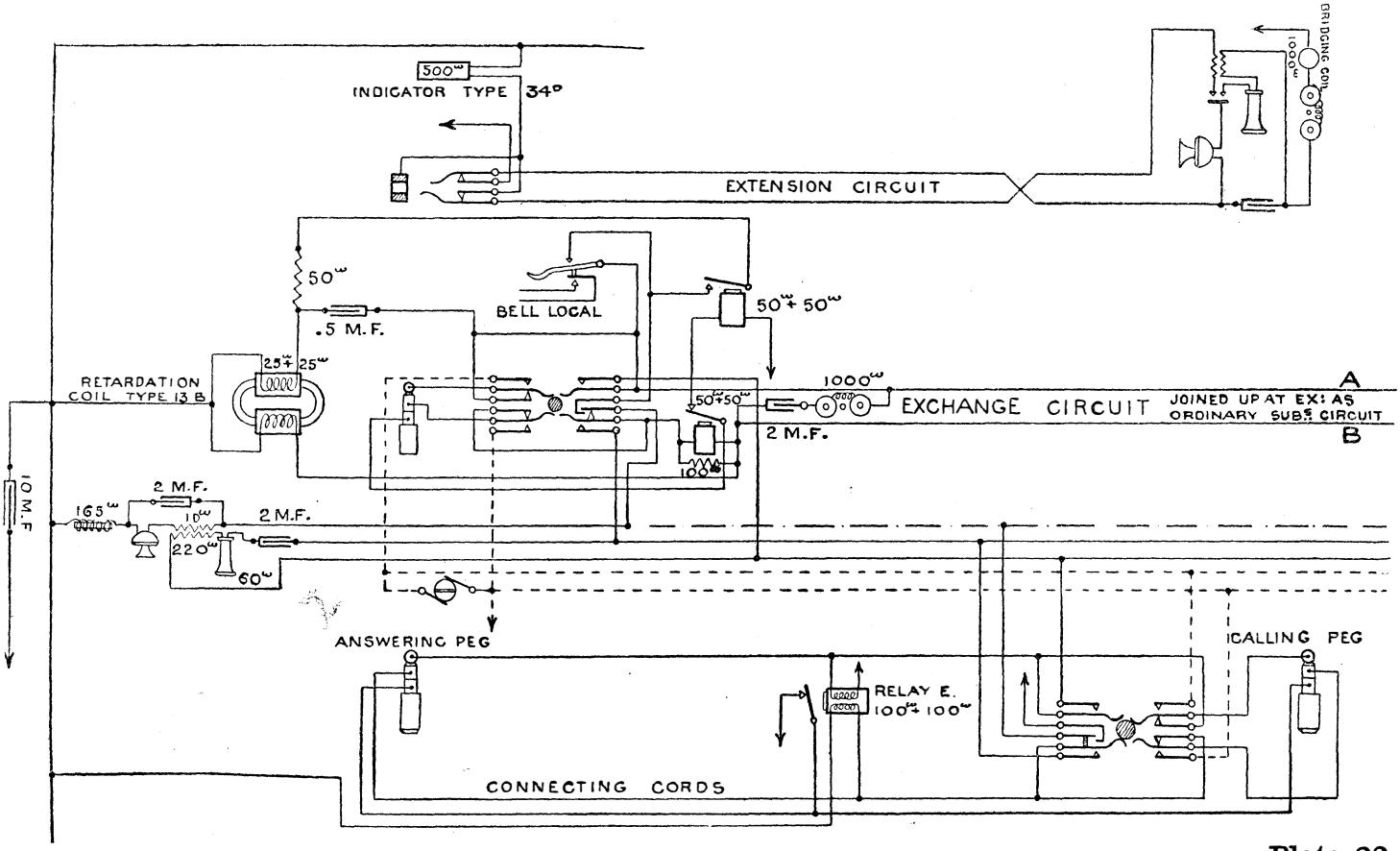


Plate 22.

Coil (165 ohms), and one half of the Retardation Coil (Type 13B), to the B line and negative pole of the battery.

If an Extension is required and independent communication between the board and the Extension not first considered necessary, the operator inserts the Exchange peg in the Switchspring associated with the Extension circuit, and throwing the Speaking and Ringing Key into the "ringing" position calls the Extension by Generator. The movement of the Key from "speaking" to "ringing" breaks the Exchange circuit that had been completed through the "speaking" side of the Key; but it will be observed that the insertion of the peg in the Switchspring had caused the upper of the two 50 + 50 ohm Relays (Type E 1) to be actuated by way of the third point on the peg and the bush of the Switchspring. The Exchange is thus "held" by the closing of a circuit from the A line through the Receiver hook and upper contact armature of the above Relay, 50-ohm Resistance Coil, Retardation Coil, Type 13B, to the B line. When the Extension replies by lifting the Receiver from the hook, this circuit is broken by the actuation of the lower 50 + 50 ohm Relay, and the condition then becomes that of an ordinary subscriber's circuit, the A and B Exchange lines on the peg being joined straight through to the Extension. The lower Relay, which is in series with the B line, is shunted by a non-inductive resistance of 100 ohms for speaking purposes.

If the operator considers it necessary to advise the Extension of the Exchange call, the Exchange peg should be inserted in a spare Extension Switchspring to hold the Exchange, and the Extension required called by means of an adjoining peg.

Plate 22—*cont.*

An Extension clears to the board—and also incidentally to the Exchange—by hanging up the Receiver, thereby breaking the main circuit, in which the lower E 1 Relay is placed. The movement of its armature to the upper contact closes the circuit of the Clearing Indicator (Type 34); from Earth on the upper E 1 Relay, armature of lower E 1 Relay, sleeve of peg, bush of Switch-spring, Indicator, distribution lead to the B line, and negative pole.

When an Extension calls the board by raising the Receiver, the calling circuit is completed from Earth on the inner A spring, the Extension A line, Extension Set, Extension B line, Indicator Type 34, to the Exchange B line as above.

Two Extensions are connected by means of a pair of pegs and cords, and in this respect the arrangement is similar to that of the later boards; viz., the distribution point at the middle of the large inductance (Retardation Coil, Type 13B), to which is connected one side of a 10 m.f. Condenser—the other side being earthed—is placed in a symmetrical position with regard to the A and B Exchange lines.

See Plate 21, for Wiring Diagram of board, and Plates 23 and 24 for connections of later types of Switchboards of this capacity.

Plate 23.

C.B. Diagram No. 149.

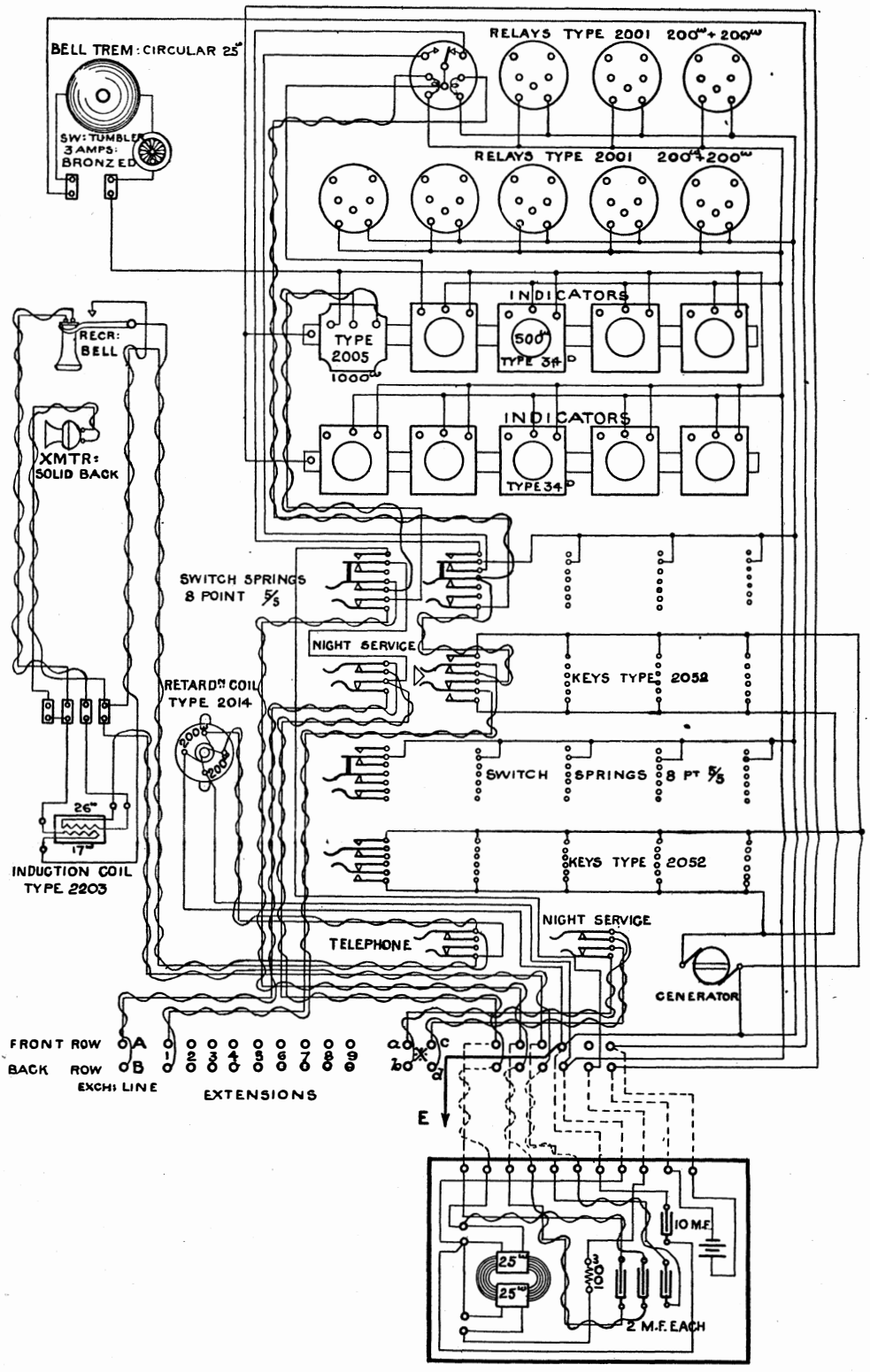
Wiring Diagram of Switchboards, Branch, Exchange, C.B., $\frac{1+4}{5}$ and $\frac{1+9}{10}$; and Case with Retardation Coil and Condensers, C.B. (1 + 4).

Apparatus Schedule.

Switchboard, Branch Exchange, C.B., $\frac{1+4}{5}$ or $\frac{1+9}{10}$. The description includes Transmitter, C.B.; Cord, Flexible, No. 222, and Receiver, Bell, "D." Two pairs of Pegs and Cords are issued with a $\frac{1+4}{5}$ board, and four pairs with a $\frac{1+9}{10}$ board.

Case with Retardation Coil and Condensers, C.B. (1 + 4). The description includes Coil, Retardation, Type 2013 or L 5, 25 + 25 ohms; Spool, Resistance, Type 2200, 100 ohms; and 4 Condensers, metal-cased (three 2-m.f., and one 10-m.f.).

Bell, Trembler, Circular, 25 ohms.



CASE WITH RETARDATION COIL AND CONDENSER C.B. (1 + 4).

Plate 23.

Switch, Tumbler, 3 ampères (bronzed).

Battery: 2 Cells, Dry, Y (for local bell circuit only).

The four tags at * and the corresponding Switchspring are to be used only when a Night Extension Service is required. When used, the line wires of the Extension requiring the Night Service should be connected to tags "a" and "b," while "c" and "d" should be connected to the ordinary tags of the Extension.

When a Night Service is wanted, a Label, No. 66, should be fitted on each of the Switchsprings so marked by means of two Brass Screws, No. 1, R.H., $\frac{3}{8}$-inch. When not wanted, Plugs, No. 1, Ebonite, should be inserted in the switch holes.

The Tumbler Switch controlling the local bell circuit should be fitted on the board, but the Trembler Bell should be fitted off the board in a position indicated by the subscriber.

See Plate 26, for diagram of circuit connections.

Plate 24.

C.B. Diagram No. 156.

WIRING DIAGRAM OF SWITCHBOARDS, BRANCH EXCHANGE, C.B. AND MAGNETO, $\frac{1+2+2}{5}$; AND CASE WITH RETARDATION COIL AND CONDENSERS, C.B. (1 + 6).

APPARATUS SCHEDULE.

Switchboard, Branch Exchange, C.B., and Magneto, $\frac{1+2+2}{5}$. The description includes Transmitter, C.B.; Cord, Flexible, No. 222; and Receiver, Bell, "D." Two pairs of Pegs and Cords are issued with each board.

Case with Retardation Coil and Condensers, C.B. (1 + 6). The title includes Coil, Retardation, Type 2013, 25 + 25 ohms; Spool, Resistance, Type 2200, 100 ohms; and 6 Condensers, metal-cased (five 2 m.f., and one 10 m.f.).

Bell, Trembler, Circular, 25 ohms.

Switch, Tumbler, 3 ampères (bronzed).

Battery: 2 Cells, Dry, Y (for local bell circuit only).

The four tags at * and the corresponding Switchspring are to be used only when a Night Extension Service is required. When used, the line wires of the Extension requiring the Night

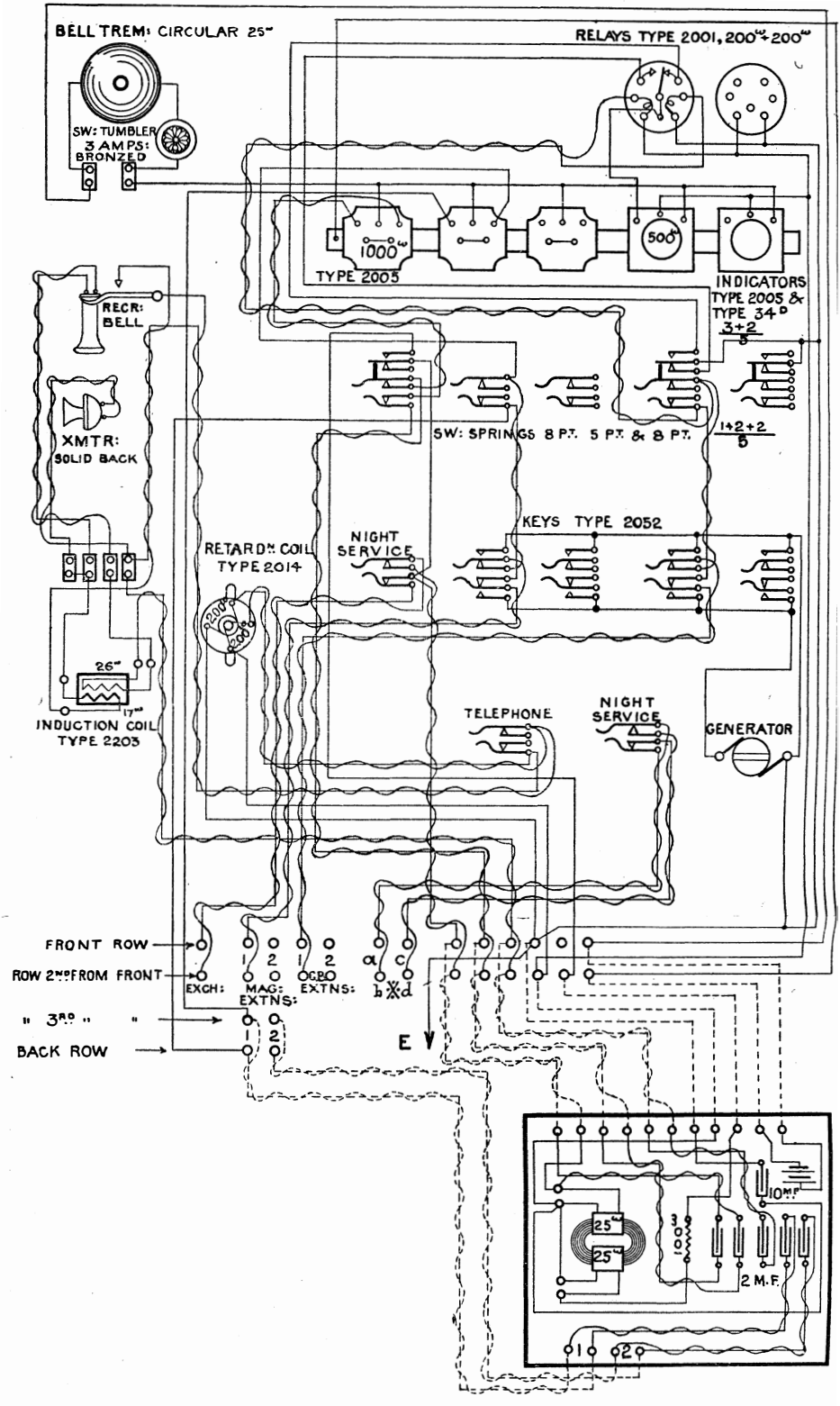


Plate 24.

CASE WITH RETARDATION COIL AND CONDENSERS C.B. (1+6).

Service should be connected to tags "a" and "b," while "c" and "d" should be connected to the ordinary tags of the Extension.

When a Night Service is wanted, a Label, No. 66, should be fitted on each of the Switch-springs so marked, by means of two Brass Screws, No. 1, R.H., $\frac{3}{8}$-inch. When not wanted, Plugs, No. 1, Ebonite, should be inserted in the switch holes.

The Tumbler Switch controlling the local bell circuit should be fitted on the board, but the Trembler Bell should be fitted off the board in a position indicated by the subscriber.

See Plate 26 for diagram of circuit connections.

Plate 25.

C.B. Diagram No. 155.

WIRING DIAGRAM OF SWITCHBOARD, BRANCH EXCHANGE, C.B. AND MAGNETO, $\frac{1+5+4}{10}$; AND CASE WITH RETARDATION COIL AND CONDENSERS, C.B. (1 + 8).

APPARATUS SCHEDULE.

Switchboard, Branch Exchange, C.B. and Magneto, $\frac{1+5+4}{10}$. The description includes Transmitter, C.B.; Cord, Flexible, No. 222, and Receiver, Bell, "D." Four pairs of Pegs and Cords are issued with each board.

Case with Retardation Coil and Condensers, C.B. (1 + 8). The title includes Coil, Retardation, Type 2013, 25 + 25 ohms; Spool, Resistance, Type 2200, 100 ohms; and 8 Condensers, metal-cased (seven 2 m.f., and one 10 m.f.).

Bell, Trembler, Circular, 25 ohms.

Switch, Tumbler, 3 ampères (bronzed).

Battery: 2 Cells, Dry, Y (for local bell circuit only).

The four tags at * and the corresponding Switchspring are to be used only when a Night Extension Service is required. When used, the line wires of the Extension requiring the Night

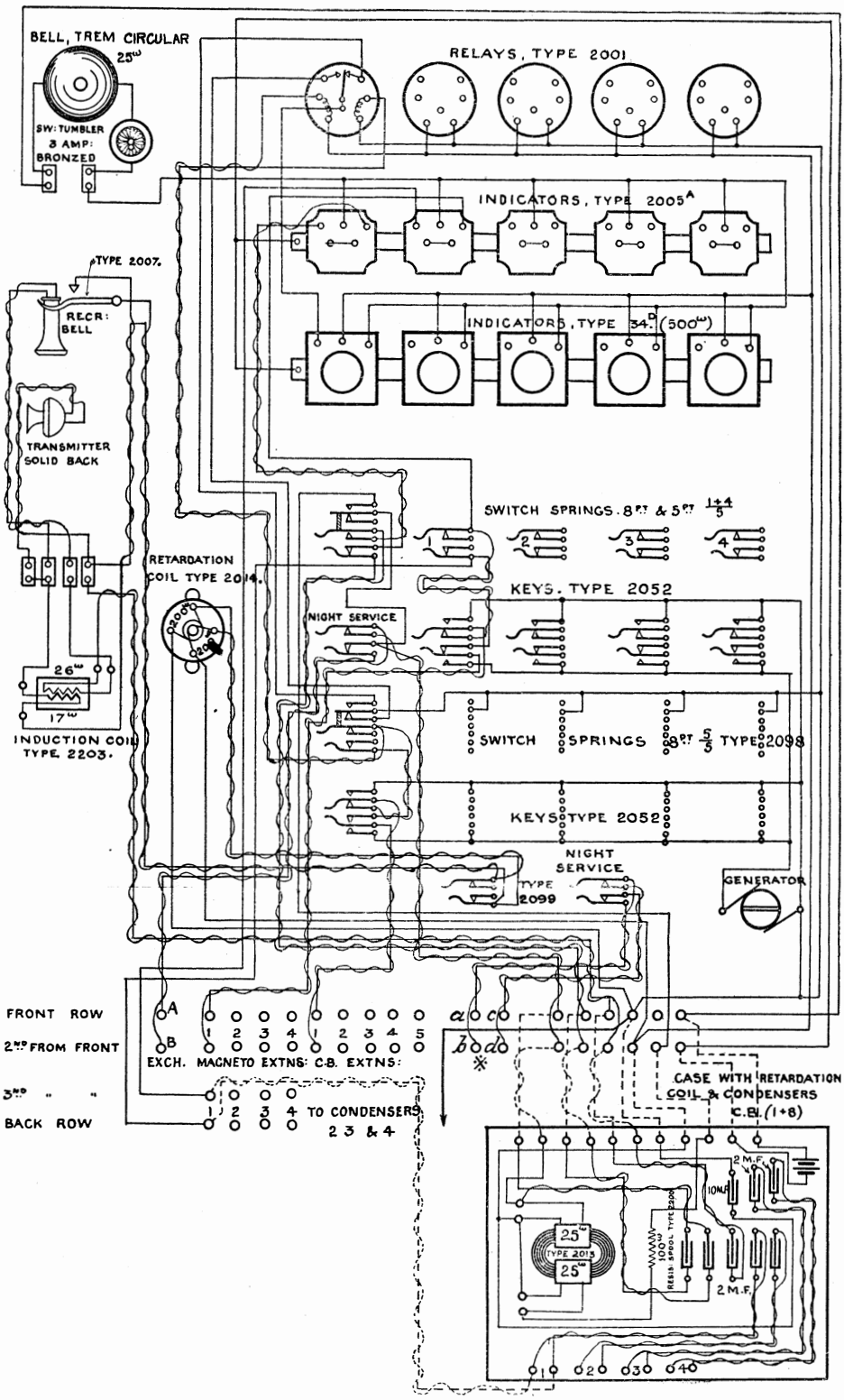

BELL, TREM CIRCULAR
25ω
SW: TUMBLER
3 AMP:
BRONZED
RELAYS, TYPE 2001
INDICATORS, TYPE 2005A
INDICATORS, TYPE 34B (500ω)
TYPE 2007
RECR: BELL
TRANSMITTER SOLID BACK
RETARDATION COIL TYPE 2014
SWITCH SPRINGS. 8PT & 5PT 1+4/5
KEYS. TYPE 2052
NIGHT SERVICE
26ω
17ω
INDUCTION COIL TYPE 2203.
SWITCH SPRINGS 8PT 5/5 TYPE 2098
KEYS TYPE 2052
NIGHT SERVICE TYPE 2099
GENERATOR
FRONT ROW
2ND FROM FRONT
3RD " "
BACK ROW
EXCH. MAGNETO EXTNS: C.B. EXTNS:
TO CONDENSERS 2 3 & 4
CASE WITH RETARDATION COIL & CONDENSERS
C.B. (1+8)
2 M.F.
10M.F.
25ω
TYPE 2015
25ω
100Ω
REELS SPOOL TYPE 2200
2 M.F.

Plate 25.

Service should be connected to tags "a" and "b," while "c" and "d" should be connected to the ordinary tags of the Extension.

When a Night Service is wanted, a Label, No. 66, should be fitted on each of the Switch-springs so marked by means of two Brass Screws, No. 1, R.H., $\frac{3}{8}$-inch. When not wanted, Plugs, No. 1, Ebonite, should be inserted in the switch holes.

The Tumbler Switch controlling the local bell circuit should be fitted on the board, but the Trembler Bell should be fitted off the board, in a position indicated by the subscriber.

See Plate 26 for diagram of circuit connections.

Plate 26.

C.B. Diagram No. 148.

CIRCUIT ARRANGEMENTS ON SWITCHBOARDS, BRANCH EXCHANGE, C.B., $\frac{1+4}{5}$ AND $\frac{1+9}{10}$, AND ON SWITCHBOARDS, BRANCH EXCHANGE, C.B. AND MAGNETO, $\frac{1+2+2}{5}$, $\frac{1+3+1}{5}$, AND $\frac{1+5+4}{10}$.

Night Extension Switchsprings, if required, are fitted at the points marked "x" on the upper portion of the diagram, which shows two Extension Circuits, the upper a Magneto Extension, and the lower a C.B. Extension. *See* separate diagrams for actual connections at Extensions; Plates 55 and 56 show the instruments fitted on Magneto Extensions, and Plate 27 the instruments on C.B. Extensions.

At the Exchange the lines are terminated in the ordinary manner, and calling and clearing signals from the board are indicated there like those of a simple subscriber's circuit. To the inner springs of the Exchange Switchspring a Non-polarised Indicator is connected, the A and B springs being joined through Condensers, metal-cased, 2 m.f., to the A and B lines respectively

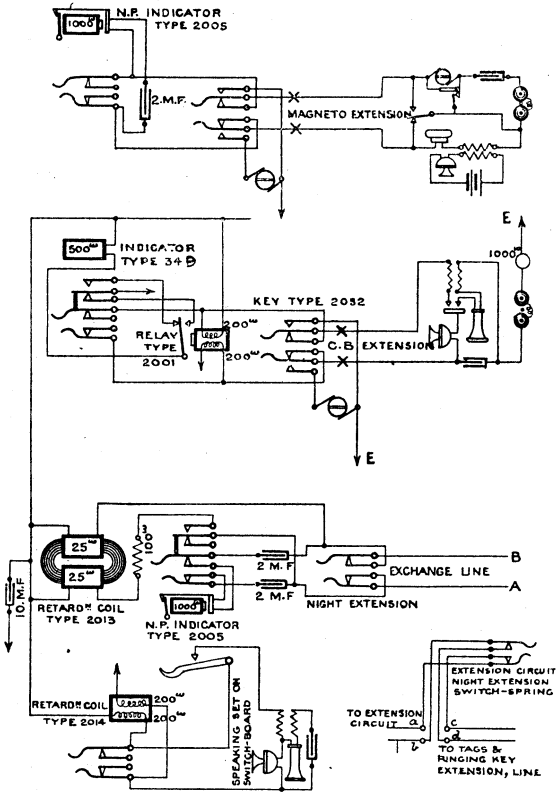

N.P. INDICATOR
TYPE 2005
1000
2 M.F.
MAGNETO EXTENSION
E
500
INDICATOR
TYPE 34 B
1000
KEY TYPE 2032
RELAY
TYPE
2001
200
200
C.B. EXTENSION
E
25
25
10 M.F.
RETARDN COIL
TYPE 2013
3
100
2 M.F
2 M.F
EXCHANGE LINE
B
A
NIGHT EXTENSION
1000
N.P. INDICATOR
TYPE 2005
RETARDN COIL
TYPE 2014
200
200
SPEAKING SET ON
SWITCH-BOARD
EXTENSION CIRCUIT
NIGHT EXTENSION
SWITCH-SPRING
TO EXTENSION
CIRCUIT
a
b
c
TO TAGS &
RINGING KEY
EXTENSION, LINE

Plate 26.

Plate 26—*cont.*

for speaking circuit purposes. When the Exchange operator calls by Generator, the shutter of the Indicator drops, thus indicating a call. The insertion of a peg in the Switchspring cuts out the Indicator, but throws across the lines by means of the upper springs a 100-ohms Resistance Spool (Type 2200) in series with a Retardation Coil of high inductance (Type 2013). At the centre point of this inductance is connected the power distribution lead between the Exchange line and the various Extension circuits, as well as one side of a Condenser, metal-cased, 10 m.f., the other side of which is earthed. The Retardation Coil and Resistance Spool joined across the Exchange lines "engage" the Exchange, and at the same time the distribution point is thrown into practically a symmetrical position with respect to the two Exchange wires.

A C.B. Extension calls the Board by raising the Receiver from the hook. This operation closes the circuit of the Common Battery through Earth on the positive pole, one coil of Relay, Type 2001, Extension A line, Extension Set, Extension B line, second coil of Relay, Type 2001, Distribution lead, one limb of Retardation Coil, Type 2013, to Exchange B line and negative pole. The armature of Relay, Type 2001, is attracted to the "marking" stop, which is connected to Earth through the inner and long springs of the Switchspring associated with the calling Extension, thus joining up a derived circuit in which is connected the calling and clearing Indicator (Type 34).

The insertion of a peg in the Switchspring breaks the derived circuit, and the armature of the Indicator resumes its normal position. Connections between the various circuits are made by means of simple 3-way pegs, and 2-way cords.

When both Extensions hang up their Receivers, the Relay circuits are disconnected, and the armatures fall back upon the "spacing" stops, closing the Indicator circuits, thus giving a clearing signal which disappears when the pegs are withdrawn.

The operator's Set is on the same principle as a C.B. Extension. The Relay, however, is replaced by a Retardation Coil of equal resistance (Type 2014), as no signalling apparatus is required. The Exchange is called by the insertion of a peg in the Exchange Switchspring, the other pair of the peg being inserted in the speaking Switchspring. A clearing signal is sent by withdrawing the peg from the Exchange Switchspring. The Receiver should be hung up when the clearing signal has been sent, and the peg withdrawn from the speaking Switchspring.

One side of the Generator mounted on the board is earthed, and both sides are teed to the outer springs of the Ringing Keys (Type 2052). The Extensions are called by Generator ; Magneto Extensions on the loop, and C.B. Extensions on the A line and Earth. A Magneto Extension calls and clears to the board by means of the Generator fitted in the set, the signals being received on the Non-polarised Indicator, 1,000 ohms, Type 2005, which is joined permanently across the lines.

When a Night Service is required, the Exchange Night Service Switchspring is joined to the Extension Night Service Switchspring by a pair of pegs and cords, the Extension circuit being joined up in the manner explained on page 68.

When fitted on Exchanges where B line feeding is not provided for, 8 Cells, Dry, Z, will be connected to the terminals to which the 10 m.f. Condenser is wired, and the tap to the centre of the Coil Ret. 2013 taken off locally.

Plate 27.

C.B. Diagram No. 152.

CONNECTIONS OF C.B. WALL AND TABLE TELEPHONES, WHEN USED UPON EXTENSION CIRCUITS FROM "SWITCHBOARDS, BRANCH EXCHANGE, C.B., $\frac{5}{10}$ $\frac{10}{10}$ $\frac{1+4}{5}$, and $\frac{1+9}{10}$," AND FROM "SWITCHBOARDS, BRANCH EXCHANGE, C.B. AND MAGNETO, $\frac{1+2+2}{5}$, $\frac{1+3+1}{5}$, AND $\frac{1+5+4}{10}$."

APPARATUS SCHEDULE.

Fig. 1.—*Wall Set.*

Telephone No. 1.

Coil, Bridging, 1,000 ohms, $\frac{1}{1}$.

Fig. 2.—*Table Set.*

Telephone No. 2.

Bell Set No. 1.

Coil, Bridging, 1,000 ohms, $\frac{1}{1}$.

The connections of the "A" and "B" lines are the reverse of those used when the Telephones are joined up upon direct subscribers' circuits.

When Wall Telephones are used, the Bridging Coils should be screwed underneath the projecting case containing the Magneto Bell. In the case of Table Telephones, the Bridging Coil should be screwed to the underside of the case containing the Magneto Bell and Induction Coil.

See Plates 55 and 56 for the connections of a Magneto Extension Set. No earth connection is required, however, as this circuit is called on the loop.

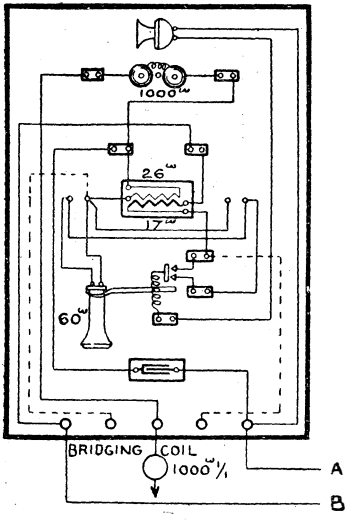


FIG: 1. WALL SET

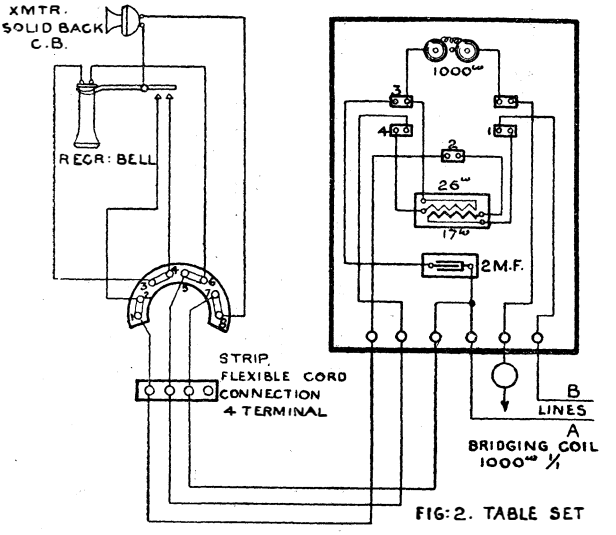


FIG: 2. TABLE SET

Plate 27.

Plate 28.

C.B. Diagram No. 17.

Wiring Diagram of Switchboards, Branch Exchange, C.B., $\frac{3+10}{25}$, $\frac{3+20}{25}$, $\frac{5+30}{60}$, and $\frac{5+50}{60}$.

Apparatus Schedule.

Switchboard, Branch Exchange, C.B., $\frac{3+10}{25}$, $\frac{3+20}{25}$, $\frac{5+30}{60}$, or $\frac{5+50}{60}$.

If a Night Bell is required, the following additional apparatus will be required :—

Bell, Trembler, Small.

New $\frac{3+10}{25}$ and $\frac{3+20}{25}$ Boards are fitted with 3 Exchange Circuits; $\frac{5+30}{60}$ and $\frac{5+50}{60}$ with 5 Exchange Circuits and an ultimate capacity of 10.

The number of Extension circuits fitted in each case is given by the second figure in the numerator of the fraction.

See Plate 29 for Circuit Arrangements.

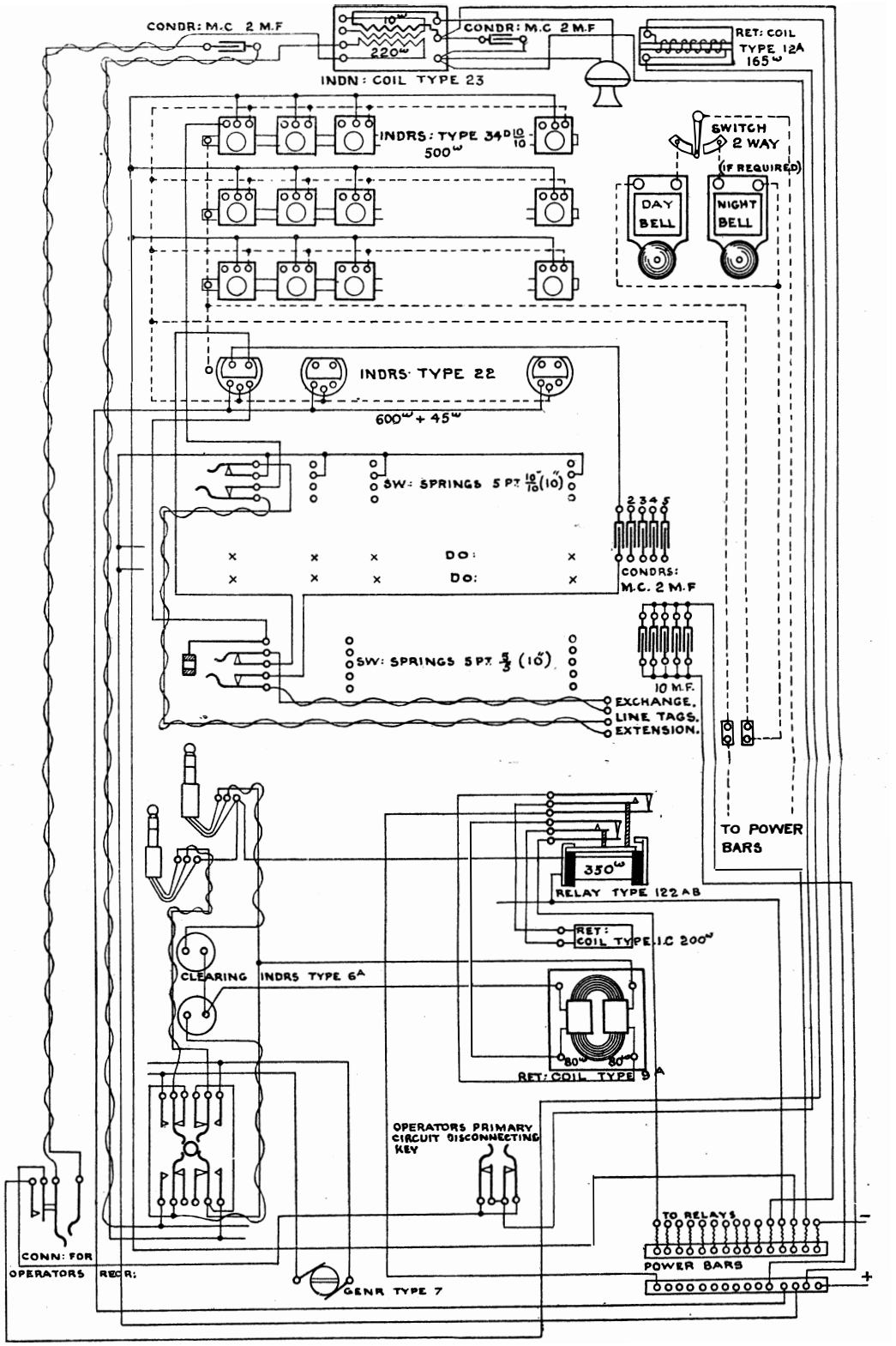

CONDR: M.C 2 M.F
10Ω
220Ω
CONDR: M.C 2 M.F
RET: COIL TYPE 12A 165Ω
INDN: COIL TYPE 23
INDRS: TYPE 34 D 10/10 500Ω
SWITCH 2 WAY (IF REQUIRED)
DAY BELL
NIGHT BELL
INDRS: TYPE 22
600Ω + 45Ω
SW: SPRINGS 5 PT 10"/10 (10")
DO:
DO:
2 3 4 5
CONDRS: M.C. 2 M.F
SW: SPRINGS 5 PT 5/3 (10")
10 M.F.
EXCHANGE.
LINE TAGS.
EXTENSION.
TO POWER BARS
350Ω
RELAY TYPE 122 AB
RET: COIL TYPE I.C 200Ω
CLEARING INDRS TYPE 6A
80Ω 80Ω
RET: COIL TYPE 9A
OPERATORS PRIMARY CIRCUIT DISCONNECTING KEY
TO RELAYS
POWER BARS
CONN: FOR OPERATORS RECR:
GENR TYPE 7
-
+

Plate 28.

Plate 29.

C.B. Diagram No. 16.

Circuit Arrangements on Switchboards, Branch Exchange, C.B., $\frac{3+10}{25}$, $\frac{3+20}{25}$, $\frac{5+30}{60}$, and $\frac{5+50}{60}$.

Fig. 1.—*Extension Circuit.*—Ordinary Wall, or Table, C.B. Sets are used at Extension points. Extension lines terminate on 5-point Switchsprings, the inner springs of which are connected (the B line through an Indicator, 500 ohms (Type 34)) to the Power Bars. An Extension calls the Board by lifting the Receiver from the hook, thus completing the circuit from the Power Bars through the Calling Indicator and Extension Lines and Set.

Fig. 2.—*Exchange Circuit.*—The Exchange lines are terminated at the Exchange in a similar manner to those of an ordinary subscriber, and calling signals are indicated and sent from there in the usual way. At the Board the lines are terminated on a 5-point Switchspring, the inner springs of which are connected through a Condenser, metal-cased, 2 m.f., to the line coil of a self-restoring Indicator (Indicator, Type 22). When the Board is called by Generator from the Exchange, the armature is attracted, and the projection of the shutter indicates the call.

ORDINARY WALL
OR TABLE SET.

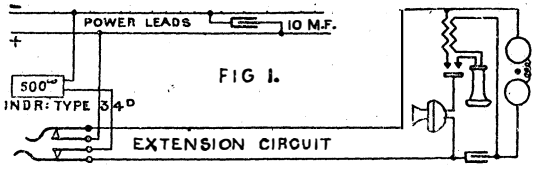


FIG 1.

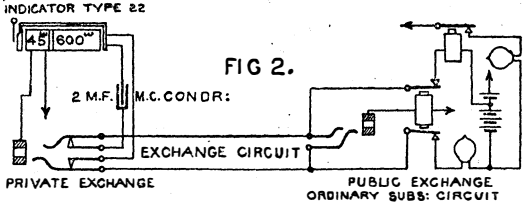


FIG 2.

FIG 3.

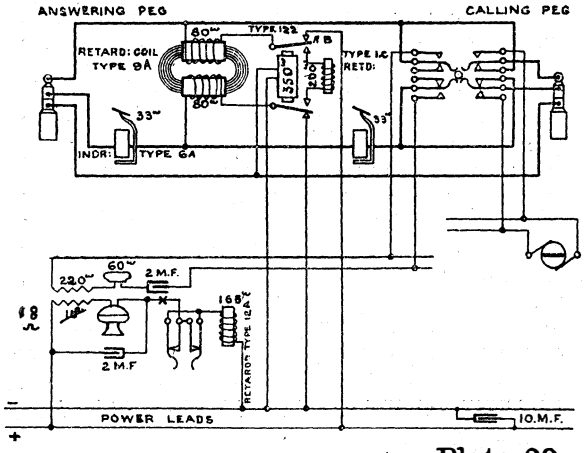


Plate 29.

Plate 29—*cont.*

Fig. 3.—*Cord Circuit.*—To call the Exchange the operator inserts the Calling Peg in the Switchspring associated with the Exchange line to be used. This operation closes the circuit of the restoring coil of Indicator, Type 22, from Earth through the bush of the Switchspring, the sleeve of the Peg, Relay, Type 122AB, to the Negative Power Lead. The current flowing in the circuit locks the Indicator, Type 22, and brings the double armature of the Relay in contact with the inner contacts, which are connected to the coil ends of the Retardation Coil, Type 9A, between which is now connected Retardation Coil, Type 1c. The Clearing Indicators (Type 6A) are permanently connected in the B Cord of each pair of Pegs and Cords, and since they are fitted in the speaking circuit, each Indicator Coil is shunted by a non-inductive resistance of 100 ohms. The Magnet coil is wound to 50 ohms, the joint resistance being thus approximately 33 ohms.

Extension Sets are called by Generator, which is teed across the outer springs of the "ringing" sides of the Speaking and Ringing Keys; they clear to the Board by hanging up the Receiver, thereby causing the discs of the Clearing Indicators (which show during speech) to disappear. The Board clears to the Exchange by withdrawing the peg from the Exchange line Switchspring.

When two Extensions are connected through to each other a current flows from the Positive Power Lead through the upper limb of Retardation Coil, Type 9A, to the Extension A lines, through both Extension Circuits in parallel to the B lines, and back through the Clearing Indicators and lower limb of Retardation Coil, Type 9A, to the Negative Power Lead. Speaking currents pass

between the Extensions when the potential equilibrium is disturbed by one of the Extensions altering the resistance of his circuit by speaking into the Transmitter.

The operator's Set is similar to that described on page 105, but in this instance a Key for the purpose of disconnecting the operator's primary circuit when necessary is mounted on the horizontal keyboard.

See Plate 28 for Wiring Diagram.

In recent deliveries the diagram of the operator's circuit shown in Plate 28 has been modified. On sizes up to $\frac{3+20}{25}$ no connector is fitted, the Bell Receiver being hung on a Switchhook. On larger sizes, a Connector, Type 48A, is fitted, and a Receiver, Headgear, connected to a Peg, 4-pin, Type 47, is used.

Plate 30.

C.B. Diagram No. 105.

WIRING DIAGRAM OF SWITCHBOARD, MAGNETO, $\frac{n + n'}{N}$, AND CASES, FOR CONDENSERS AND BATTERY.

These Switchboards are intended for use on C.B. Exchange circuits which are too long to permit of C.B. working on the Extension circuits, or when the Extension circuits are too long for C.B. working; also when the Exchange circuits are themselves Extensions from a C.B. private Branch Exchange, or when the circuits are of a mixed character and may include National Telephone Company's Exchange or private lines. For conditions of service in the last-mentioned condition, *see* Circular Memo. 9.2.03 "Intercommunication with Extension Lines, National Telephone Company," and Circular Memo. 26.3.03 "Private Wires on Switchboards which also accommodate Exchange circuits."

A second Switchspring is provided on each Exchange circuit for the purpose of joining it through to an Extension circuit for night service. It is fitted, as shown, beneath the ordinary line Switchspring, and replaces the Key, Type H 3 Oval (or its equivalent), used on Extension circuits. When night service is not required, the additional Switchspring should be plugged up by means of a Plug, No. 1, Ebonite.

"Cases for Condensers and Battery, n inches" accommodate 1 Coil, Retardation, Type 9A (80 + 80 ohms), and 2 Condensers, metal-cased, 2 m.f., for each Exchange circuit, and 1 Condenser, metal-cased, 2 m.f., for each Extension circuit to which an Exchange circuit is liable to be connected

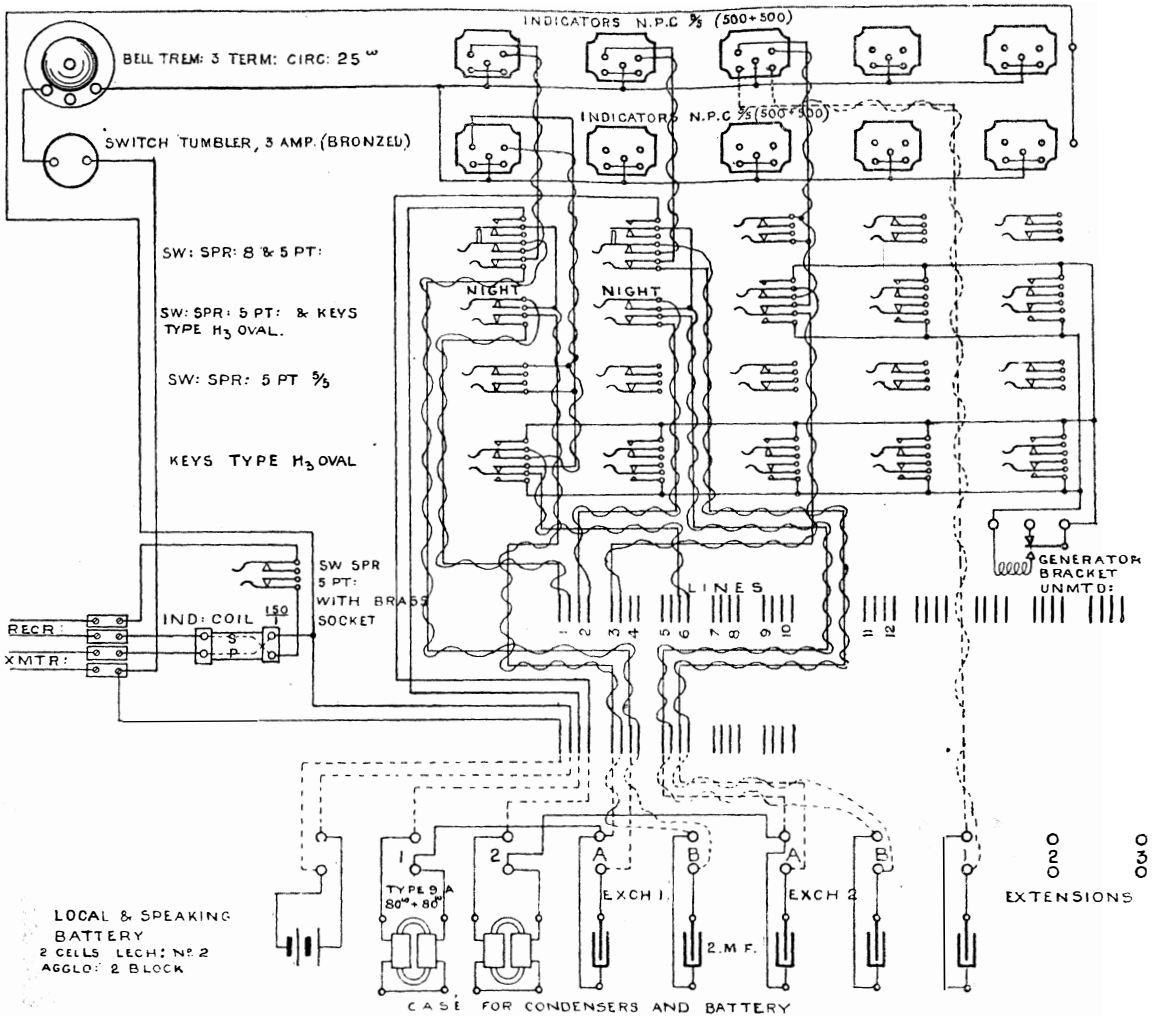

INDICATORS N.P.C 5/5 (500+500)
INDICATORS N.P.C 5/5 (500+500)
BELL TREM: 3 TERM: CIRC: 25 ω
SWITCH TUMBLER, 3 AMP. (BRONZED)
SW: SPR: 8 & 5 PT:
SW: SPR: 5 PT: & KEYS TYPE H3 OVAL.
SW: SPR: 5 PT 5/5
KEYS TYPE H3 OVAL
NIGHT
NIGHT
SW 5PR 5 PT: WITH BRASS SOCKET
IND: COIL
150
S
P
RECR:
XMTR:
LINES
1 2 3 4 5 6 7 8 9 10 11 12
GENERATOR BRACKET UNMTD:
LOCAL & SPEAKING BATTERY
2 CELLS LECH: No 2
AGGLO: 2 BLOCK
TYPE 9 A
80Ω + 80Ω
1
2
A
B
A
B
EXCH 1
EXCH 2
2.M.F.
1
EXTENSIONS
CASE FOR CONDENSERS AND BATTERY

Plate 30.

through for night service. The Case, which will also accommodate the speaking and local Battery, should be fitted with the interconnecting leads towards the wall if placed immediately beneath the Switchboard. The single Condensers necessary for each Extension circuit with night service should be wired direct to the corresponding Indicator, the wire which normally joins together the two lower terminals of the Indicator being removed.

At the Extension Offices "Telephones No. 16," or "Telephones No. 11," should be used, and in those cases where a night service is required a Condenser, metal-cased, 2 m.f., must be placed in series with the Magneto Bell.

The wiring between the tags on the Board and the apparatus in the Case must be done locally.

Normally, the Exchange lines are bridged by the Condensers in series with the Non-polarised Indicator "C." The Exchange calls the Board in the usual way by Generator, dropping the shutter of the Indicator.

To call the Exchange, a peg is inserted in the Exchange 8-point Switchspring; this operation cuts out the Indicator, which is connected to the inner springs of the Switchspring, and joins the Retardation Coil across the A and B lines, thereby completing the circuit of the Common Battery at the Exchange. The insertion of the other peg of the pair in the speaking Switchspring connects the secondary of the operator's Induction Coil and Receiver to the Exchange lines, through the 2 Condensers for speaking current purposes.

A clearing signal is sent to the Exchange by the withdrawal of the peg from the Exchange Switchspring.

Extensions call and clear to the Board by Generator, the signals actuating the Non-polarised Indicator associated with the circuit.

Plate 31.

C.B. Diagram No. 101.

Connections between P.O. Switchboards for Branch Exchanges and National Telephone Company's Exchange Circuits.

Fig. 1.—National Telephone Company's Circuits on $\frac{5}{10}$ and $\frac{10}{10}$ Switchboards, when the Company provide an Exchange Circuit only.

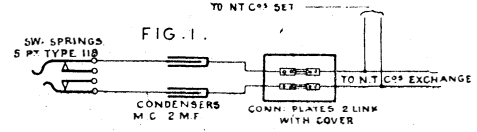
The Switchspring, 5-point, Type 118, should be fitted on P.O. Switchboard; the Connection Plates, 2-link, with Cover, at some convenient point for testing purposes only. These items together with two Condensers, metal-cased, 2 m.f. (one connected in each line as shown in the diagram), have to be provided by the P.O.

Fig. 2.—Connections of Junction Circuits between a $\frac{5}{10}$ or $\frac{10}{10}$ P.O. Switchboard and a National Telephone Company's Switchboard—the Boards being in the same room.

In addition to the position on the P.O. Switchboard, the Department has to provide the two Condensers, metal-cased, 2 m.f.

The National Extension's clearing signal is received on the Company's Board.

Fig. 3.—Connections of Junction Circuits between a $\frac{3+10}{25}$, $\frac{3+20}{25}$, $\frac{5+30}{60}$, or $\frac{5+50}{60}$


TO NT Cos SET
FIG. 1.
SW. SPRINGS 5 PY TYPE 118
TO N.T. Cos EXCHANGE
CONDENSERS M.C. 2 M.F.
CONN. PLATES 2 LINK WITH COVER

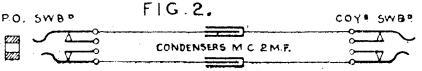


FIG. 2.
P.O. SWBD
COYS SWBD
CONDENSERS M.C. 2 M.F.

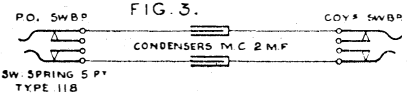
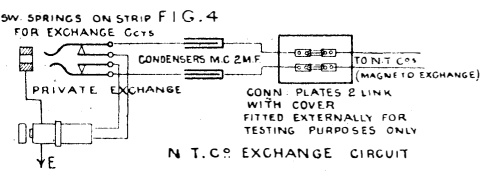


FIG. 3.
P.O. SWBD
COYS SWBD
CONDENSERS M.C. 2 M.F
SW. SPRING 5 PY TYPE 118


SW. SPRINGS ON STRIP FOR EXCHANGE Gcys
FIG. 4
CONDENSERS M.C. 2 M.F
TO N.T. Cos (MAGNETO EXCHANGE)
PRIVATE EXCHANGE
CONN. PLATES 2 LINK WITH COVER FITTED EXTERNALLY FOR TESTING PURPOSES ONLY
E
N T.Co EXCHANGE CIRCUIT

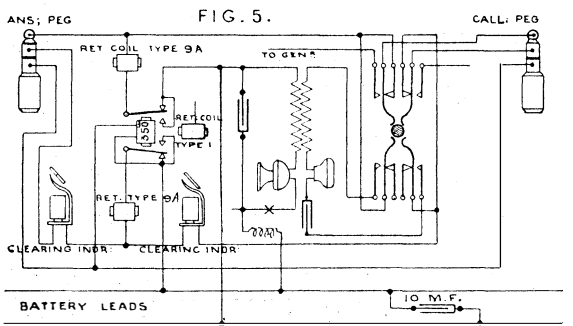


FIG. 5.
ANS; PEG
CALL; PEG
RET COIL TYPE 9A
TO GEN.S
RET. COIL TYPE 1
RET. TYPE 9A
CLEARING INDR.
CLEARING INDR.
BATTERY LEADS
10 M.F.

Plate 31.

Plate 31—*cont.*

P.O. Switchboard and a National Telephone Company's Switchboard—the Boards being in the same room.

In addition to the position on the P.O. Switchboard, the Department has to provide the 2 Condensers, metal-cased, 2 m.f.

When a P.O. Exchange Circuit is connected to a National Extension Circuit, the clearing signal from the latter is received on the National Board only. When the Switchboards are in different rooms special arrangements will be made for junction working.

Fig. 4.—Connection of National Telephone Company's Exchange Circuit (Magneto) when such is connected direct to a $\frac{3+10}{25}-\frac{5+50}{60}$ P.O. Switchboard.

The Company's lines after being brought through the Connection Plates, 2-link, with Cover, and Condensers, are terminated on a Switchspring fitted on the strip for Exchange Circuits, the inner springs of which are connected to the line coil of the Self-restoring Indicator associated with the Switchspring used. *See* Plate 29.

Fig. 5.—Special pair of Connecting Cords and Pegs when a National Exchange Circuit is terminated upon a $\frac{3+10}{25}-\frac{5+50}{60}$ Switchboard.

Connections between National Circuits and P.O. Extensions must be made by these Cords only.

It will be observed that the Coil, Retardation, Type 1, is cut out, and that the Connections of the Relay, Type 122AB, are altered.

Plate 32.

C.B. Diagram No. 90.

Connections of Extension Instrument C.B. 90.

For providing communication between C.B. Exchange Circuit and "A to A" Circuits on existing Private Telephone Switchboards. Each of the "A to A" Lines should be led through a Switchspring as shown.

Apparatus Schedule.

Instrument, Extension, C.B. 90. The title includes Case for Extension Instrument, C.B. 90; 2 Coils, Bridging, 250 ohms; 2 Condensers, metal-cased, 2 m.f.; 1 Indicator, N.P., 1,000 ohms; 1 Switchspring, 8-point, $\frac{1}{1}$, 6-inch; n Switch-springs, 5-point, $\frac{5}{5}$, 6-inch.

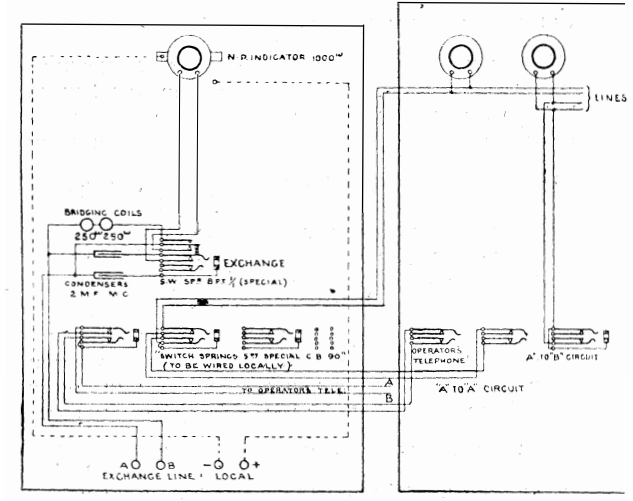
Fig. 1.—Connections of "A to A" Circuits when Main Switchboard is of old form.

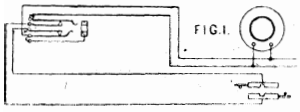
Fig. 2.—Connections of Pegs and Cords for use on Extension Instrument. Pegs, Circular, 3-way, Red; Cords, Flexible, No. 201. These Cords cannot be used on Main Switchboard.

"A to B" Circuits connected to Main Switch must not be joined to a Switchspring on the Extension Instrument.

INSTRUMENT EXTENSION
C.B. 90.

MAIN SWITCHBOARD.





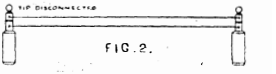


Plate 32.

Plate 33.

C.B. Diagram, No. 341.

Wiring Diagram of Switchboards, Cordless, $\frac{1+3}{4}$, $\frac{2+4}{6}$, and $\frac{3+7}{10}$.

Apparatus Schedule.

Switchboard, Branch Exchange, Cordless, C.B., $\frac{n+n'}{N}$. The description includes the operator's Induction Coil, Type 20, Mounted (similar to Type 2203), and Condenser, m.c., 2 m.f. It also includes a Buzzer, Type 90849, which is fitted in the local circuit of the calling Indicators.

Telephone No. 2.

The lower key of the combination associated with the operator's Telephone is utilised as a switch to cut off the local Buzzer when necessary.

On the $\frac{3+7}{10}$ board an extra row of keys is interpolated between the upper and lower rows shown in this diagram for the purpose of providing two additional connecting circuits. Each connecting circuit is equivalent to a pair of pegs and cords; on the $\frac{1+3}{4}$ two of these circuits are provided, on the $\frac{2+4}{6}$ three, and on the $\frac{3+7}{10}$ five. *See* Plate 34 for the circuit connections on this type of board.

The wiring shown dotted between the Coil, Induction, Mounted, and the Strip, Flexible Cord Connection, 4-terminal, has to be done locally.

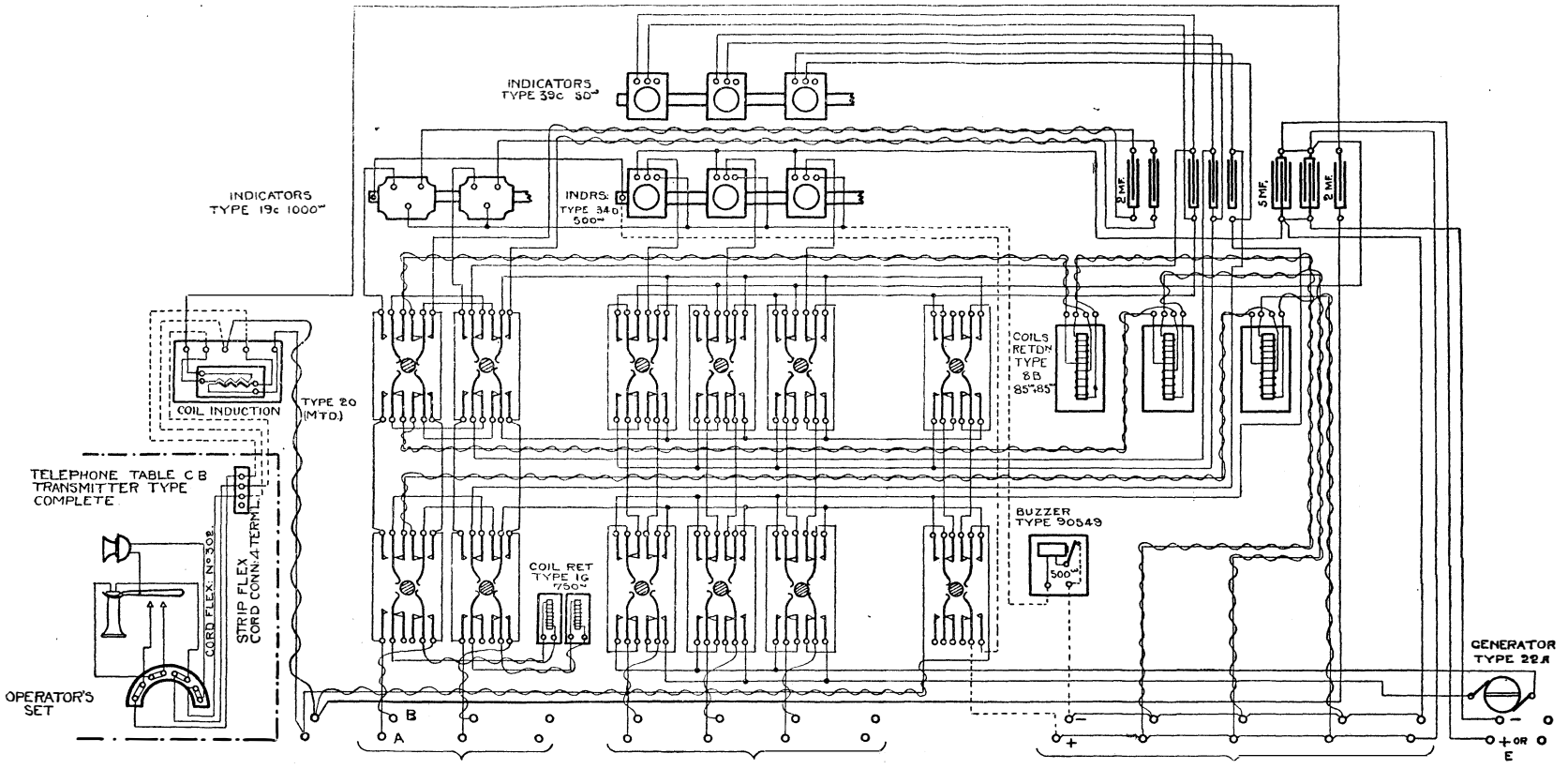

INDICATORS
TYPE 39c 50~
INDICATORS
TYPE 19c 1000~
INDRS.
TYPE 34c
500~
2 MF.
5 MF.
2 MF.
COIL INDUCTION
TYPE 20
(MTD)
TELEPHONE TABLE C B
TRANSMITTER TYPE
COMPLETE
CORD FLEX. N°308
STRIP FLEX
CORD CONN. 4 TERM.
OPERATOR'S
SET
COILS
RETDN
TYPE
8B
85~85~
BUZZER
TYPE 90549
500~
COIL RET
TYPE 16
750~
GENERATOR
TYPE 22A
B
A
EXCHANGE LINES.
EXTENSION LINES.
SEPARATE BATTERIES WHEN
REQUIRED.
POWER
LEADS.

Plate 33.

Plate 34.

C.B. Diagram No. 340.

Circuit Arrangements on Switchboards, Cordless, $\frac{1+3}{4}$, $\frac{2+4}{6}$, and $\frac{3+7}{10}$.

An Indicator and a pair of 3-position Keys, or 3 Keys in the case of the $\frac{3+7}{10}$ board, are associated with each line. The operator's Set is practically an Extension circuit without Indicator.

Fig. 1 shows how the various connecting circuits are wired to the Keys of the lines and operator's Set, so that they can be utilised for connecting any two lines together. It will be observed that when any one of the Exchange Keys is operated—except in the bottom position of the lowest Key—the leads from the Retardation Coils, through which the power leads, or battery, are connected, are cut off and the Exchange lines joined direct to the connecting circuit.

Fig. 2 represents the connections when an Exchange line is connected to an Extension.

Fig. 3 shows two Extensions connected together.

It will be seen that in both combinations the clearing signals are negative in character, *i.e.*, the signal shows during conversation, and disappears when the Receiver is hung upon the rest.

FIGURE 1.

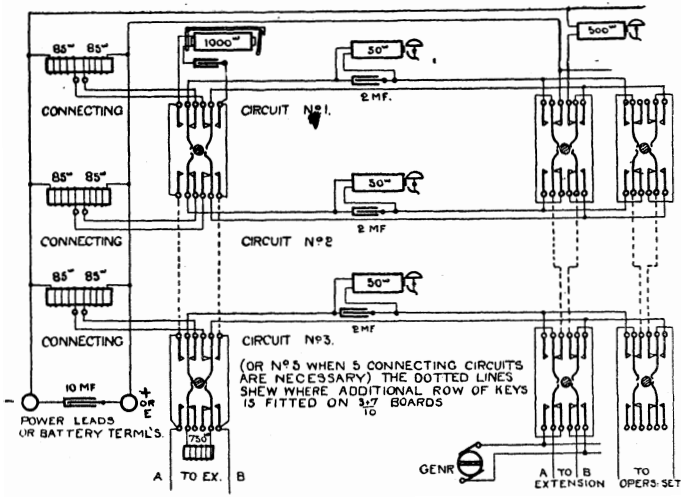


FIGURE 2

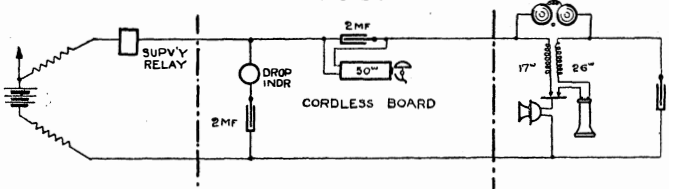


FIGURE 3

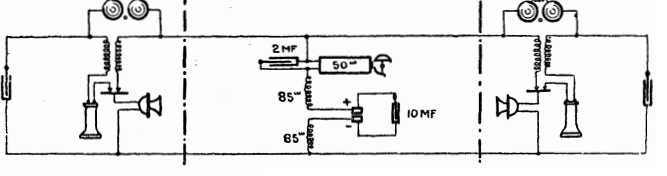


Plate 34.

SECTION 5.

PARTY LINE AND CALL OFFICE CIRCUITS.

Plate 35.

C.B. Diagram No. 135.

Party Lines; Connections of Subscribers' Instruments, when Telephones with Relays, Type 85, are used.

Apparatus Schedule.

Wall Sets.

Fig. 1.—Telephone No. 9. The description includes Cord, Flexible, No. 222; Bell, Magneto, 2,400 ohms; Relay, Type 85, 2,400 ohms; Coil, Induction, Type 2203; Condenser, metal-cased, 2 m.f.; Transmitter, C.B., and Receiver, Bell.

Box, Coin Collecting, Complete.

Table Sets.

Fig. 2.—Telephone No. 2.

Bell Set No. 2. The description includes Condenser, metal-cased, 2 m.f. The Bell and Relay are each 2,400 ohms; the Induction Coil is Type 2203; Primary, 17 ohms, Secondary, 26 ohms.

Box, Coin Collecting, Complete.

Two-Station Party Lines should be connected up as shown.

TELE. WALL C.B. PARTY LINE.

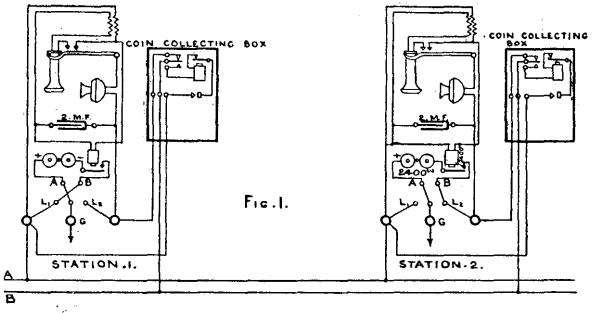


FIG. 1.

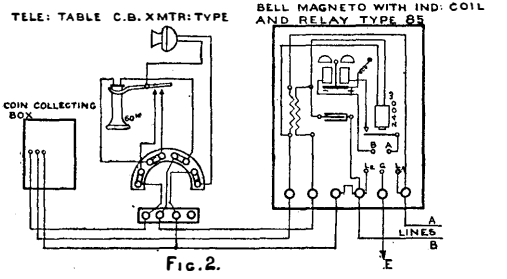


FIG. 2.

Plate 35.

Plate 35—*cont.*

On Ten-Station Party Lines, Stations 3, 5, 7, and 9, should be connected up as Station 1 shown in Fig. 1; Stations 4, 6, 8, and 10 as Station 2. When Table Sets are used the internal connections of the Bell, Magneto, with Induction Coil and Relay 85 should be:—

Station 1.—B to L_1, and A to G.
Station 2.—B to L_2 and A to G.

Subscribers' Exchange Numbers.

Stations 1, 3, 5, 7, and 9 will be given the circuit number with the addition of X1, X2, X3, X4, and X5 respectively.

Stations 2, 4, 6, 8, and 10 similarly have the circuit number with the addition of Y1, Y2, Y3, Y4, and Y5.

Ringing at Exchanges taking Two-Station Party Lines only.

The X subscriber (Station 1) is called in precisely the same way as an ordinary subscriber. The Y subscriber is called from the Subscribers' Board by turning the Party Line Key into position 1, and then ringing with the ordinary Key on the Cord Circuit. Y subscribers are called on the Junction Board by the Key marked "— to B Line" on the Junction diagram; this Key is engraved with the letter "Y."

Ringing at Exchanges taking Two and Ten-Station Party Lines.

On the Subscribers' Board X subscribers are called by ordinary ringing Keys, Y subscribers by

turning the Party Line Key into position 1 and then using ordinary Key.

On the Junction Board X subscribers are called by Keys marked "— to A line," and Y subscribers by Keys marked "— to B line." These Keys are engraved with the letters X and Y respectively.

In each case the number of rings given should agree with the figure following the prefix letter in the subscriber's number.

Four Party Lines.—These sets can also be used on 4-Party Lines. The wiring of the ringing circuits at all C.B. No. 1 Exchanges, except Central and City, is suitable for this type of circuit. The internal connections of the sets would be as follows:—

Station 1.—B to L_2 and A to G.
Station 2.—A to L_2 and B to G.
Station 3.—B to L_1 and A to G.
Station 4.—A to L_1 and B to G.

Station 1 is called by negative pulsations on the B line; Station 2 by positive pulsations on the B line; Station 3 by negative pulsations on the A line; Station 4 by positive pulsations on the A line. The second line is in each case connected to earth by the ringing key.

Plate 36.

C.B. Diagram No. 48.

Call Office Arrangements at Call Offices with One Circuit.

Apparatus Schedule.

Counter.

Telephone No. 1.
Switch, 6-terminal, 2-position.
Bell, Trembler, Circular, 100 ohms.
Coil, Resistance, various, 100 ohms.

Cabinet.

Telephone No. 1.

The lever of the Cabinet Telephone must be plugged up permanently.

The Counter Instrument is always in circuit. Switch in Position "1" (Normal position) cuts off Cabinet Instrument and Trembler Bell; in Position "2" Switch puts circuit through to Cabinet and connects Trembler Bell between "B" line and earth. When Caller is seated Bell and Earth Connection is cut off. All Fees are collected by Attendant.

Method of dealing with "Local" Calls.

Outwards.

Caller furnishes Attendant with particulars of Local Connection wanted, which Attendant passes

LEVER OF CABINET TELEPHONE MUST BE PLUGGED UP PERMANENTLY.

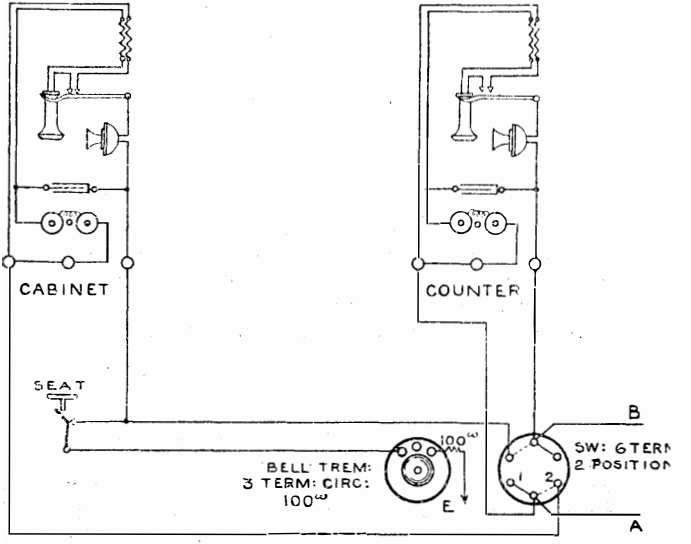


Plate 36.

Plate 36—*cont.*

to Exchange Operator, and directs Caller to enter Cabinet. Exchange Operator takes up control of call. Counter Attendant then turns Switch to Position "2," and replaces Telephone after hearing that Caller has entered circuit. When conversation terminates Caller replaces Receiver on hook and rises from seat; bell at Counter rings and Operator turns Switch to Position "1," thereby sending Clearing Signal.

Inward Calls.

Exchange rings in ordinary way, actuating bell of Counter Instrument. Attendant takes demand, directs Caller to Cabinet, and, when satisfied that latter has been entered and door closed, turns Switch to Position "2." Clearing effected as before.

Trunk Calls.

Caller communicates his requirement to Attendant. Latter records particulars, collects Fee, calls Local Exchange, is put through to Trunk Exchange, gives particulars to Record Operator, and then hangs up Receiver. When call matures Trunk Circuit is put through to Local Exchange on Junction Circuit, Junction Operator at Local Exchange rings up Call Office, actuating bell on Counter Telephone. Attendant replies, directs Caller to enter Cabinet, and, while doing so, *lets Receiver hang by means of cord without replacing it on hook* When Caller has entered Cabinet and closed the door Attendant turns the Switch to

Position "2" and listens on Telephone to hear that Caller has come in circuit. Attendant then hangs up instrument. Clearing effected as before.

If Fee to be returned, Exchange Operator requests Caller to leave Cabinet and ask Counter Attendant to speak on Telephone.

Plate 37.

C.B. Diagram No. 50.

Wiring Diagram of Wallboard for Call Office with Two or more Circuits.

Apparatus Schedule.

Wallboard, 33″ × 18″, wired to C.B. No. 50, and fitted with :—

1 Case, Switch and Indicator, $17\frac{1}{4}$″.

1 Indicator, Non-Polarised, 1,000 ohms, $\frac{n}{5}$.

1 Indicator, Non-Polarised, 100 ohms, $\frac{n}{5}$.

1 Switchspring, 8-point, $\frac{5}{5}$.

1 Switchspring, 5 and 8-point, $\frac{1+5}{6}$.

n Coils, Bridging, 500 ohms.
n Condensers, metal-cased, 2 m.f.
1 Strip, Cross Connection, 5 × 4.
1 Strip, Trembler Bell Connection, 4-plate.
1 Bell, Trembler, Circular, 25 ohms.

Battery, 3-cell, Leclanché, No. 1 C.Z.
n + 1 pairs Pegs, 201, Red, with 18″ Cord, Flexible.

Counter Telephone.

Telephone No. 1.

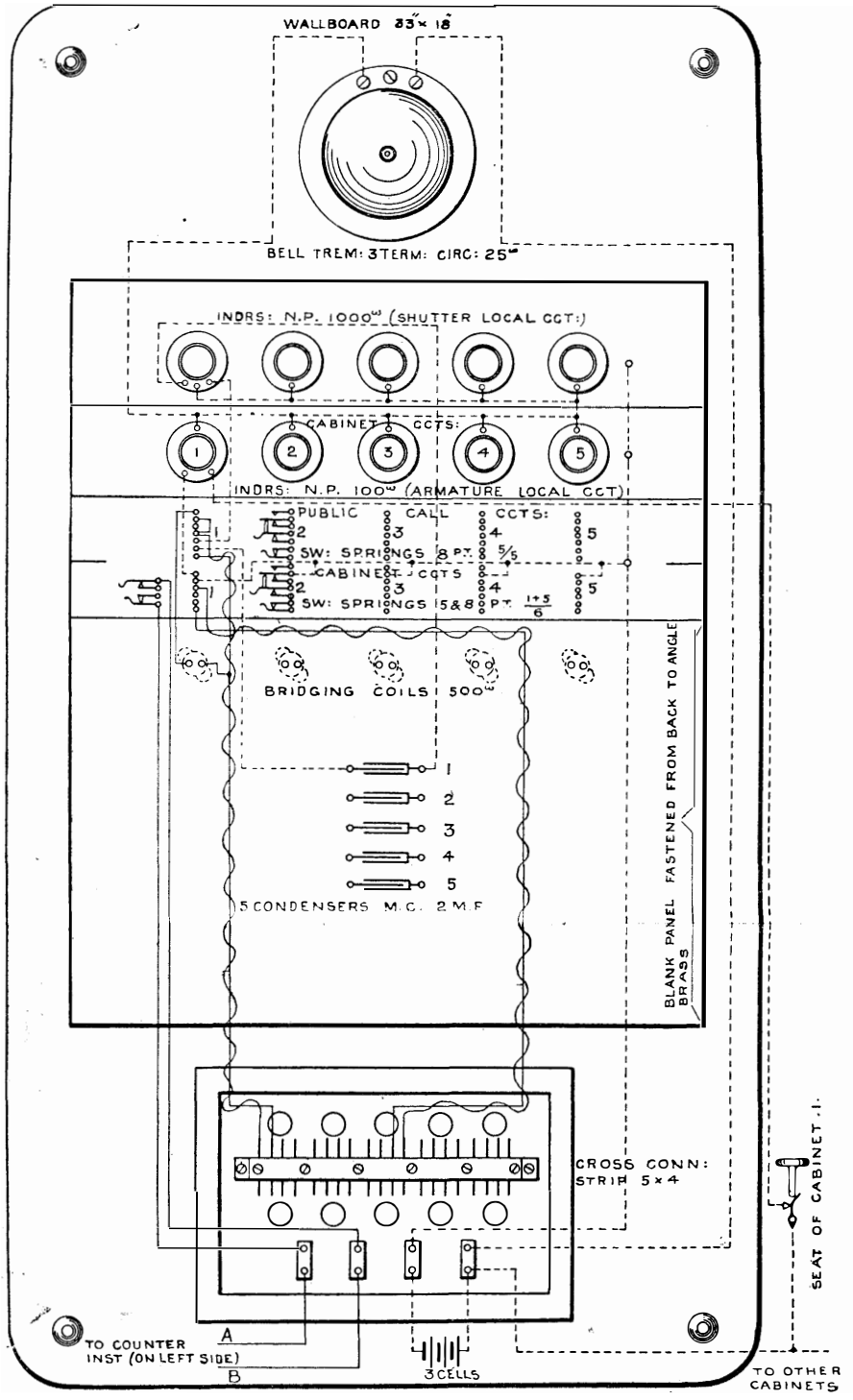

WALLBOARD 33" × 18"
BELL TREM: 3 TERM: CIRC: 25Ω
INDRS: N.P. 1000Ω (SHUTTER LOCAL CCT:)
CABINET CCTS:
1
2
3
4
5
INDRS: N.P. 100Ω (ARMATURE LOCAL CCT)
PUBLIC CALL CCTS:
SW: SPRINGS 8 PT. 5/5
CABINET CCTS
SW: SPRINGS 5&8 PT. 1+5/6
BRIDGING COILS 500Ω
1
2
3
4
5
5 CONDENSERS M.C. 2 M.F
BLANK PANEL FASTENED FROM BACK TO ANGLE BRASS
CROSS CONN: STRIP 5×4
SEAT OF CABINET 1.
TO COUNTER INST (ON LEFT SIDE)
A
B
3 CELLS
TO OTHER CABINETS

Plate 37.

For each Cabinet.

Telephone No. 1.

The various circuits terminate upon the Switch and Indicator Case, which is fixed in a position accessible only to the Counter Attendant who controls the service. Each Exchange Circuit terminates upon an 8-point Switchspring, and is normally bridged by means of a metal-cased Condenser, 2 m.f., and a Non-Polarised Indicator, 1,000 ohms. The normal condition is thus similar to that of an ordinary subscriber's circuit so far as the Exchange is concerned.

When a peg is inserted in a Switchspring the corresponding Indicator and Condenser are cut out of circuit, and a Bridging Coil (500 ohms) is automatically substituted. The function of the Bridging Coil is to prevent false Clearing Signals at the Exchange by maintaining the Clearing Relays there in their engaged condition while switching operations are in progress at the Call Office.

The Cabinet Circuits are terminated upon 8-point Switchsprings on the Switch and Indicator Case. The circuits of the corresponding Cabinet seats are also connected to these springs in such a way that when a peg is inserted into any Cabinet Switchspring the circuit of the seat is joined up through a Non-Polarised Indicator (100 ohms). When a seat is in its normal position and a peg is inserted into the corresponding Switchspring the Indicator is actuated and the bell rings.

The methods of operating are as follows:—

Local Calls, Outwards.

Caller furnishes Attendant with particulars of connection desired. Attendant collects Fee, selects a disengaged Circuit, connects it to Telephone by means of pegs and cord, passes particulars of call

Plate 37—*cont.*

to Exchange Operator, directs Caller to a disengaged Cabinet, and puts the Exchange Circuit through to that Cabinet by transferring the peg from the Counter Telephone Switchspring to the Cabinet Circuit Switchspring. If the connection at the Counter be put through before the Caller sits down, the Cabinet Circuit Indicator will be actuated, causing its shutter to drop and the bell to ring. The bell will cease ringing as soon as the Caller is seated, and the Indicator should then be restored to normal.

When the conversation terminates and the Caller rises, the Switch beneath the seat will be closed, actuating the Indicator and ringing the bell. The Attendant will then withdraw the pegs (thereby sending the Clearing Signal to the Exchange), and finally will restore the Indicator Shutter.

In the case of Local Outward Calls, it is essential that the Operator to whom the call is tendered by the Call Office Attendant should see it completed, in order that it may be possible to determine whether a Fee should or should not be returned.

Local Calls, Inwards.

The Exchange Operator calls in the usual way by Generator, actuating the Exchange Circuit Indicator, the shutter of which falls, closing the Bell Circuit. The Attendant in response replaces the Indicator Shutter, connects the circuit through to the Counter Telephone, ascertains the requirement, directs the Caller to a disengaged Cabinet, and connects the Cabinet selected to the Exchange Circuit by transferring the peg from the Counter

Instrument Switchspring to the Cabinet Circuit Switchspring.

Subsequent operations are similar to those in the preceding case.

Trunk Calls.

The Caller communicates his requirement to the Attendant, who records particulars, collects the Fee, calls the Local Exchange by connecting the Counter Telephone to an Exchange Circuit, asks for "Trunk," gives particulars to the Record Operator at the Trunk Exchange, then hangs up the Counter Receiver, and removes the pegs.

When the call matures the Trunk Circuit is put through to the Local Exchange on a Junction Circuit; the Junction Circuit Operator at the Local Exchange rings up the Call Office Attendant. The latter connects the Exchange Circuit to the Counter Telephone, restores the Indicator Shutter, ascertains demand, directs the Caller to a disengaged Cabinet, and connects the latter to the Exchange Circuit by transferring the peg from the Counter Telephone Switchspring to the Cabinet Circuit Switchspring.

Clearing is effected as before.

At the Exchange.

The connections of Public Call Office Circuits are effected similarly to those of ordinary subscribers' circuits.

Returning Fee.

In the event of a Fee having to be returned, the Exchange Operator must request the Caller to go to the Counter and ask the Attendant to speak.

SECTION 6.

EXCHANGE CONNECTIONS.

Plate 38

C.B. Diagram No. 70

Connections of Subscribers' and Cord Circuits at Central Exchange, London. Original Installation.

The diagram shows in skeleton form the connections of a subscriber's circuit, and also the cord circuits at the Central Exchange.

When the subscriber raises his Receiver from the hook, he closes the circuit of the 20 volts through his apparatus by means of his Transmitter, and the primary of his Induction Coil. A current consequently flows round the circuit and actuates the Line Relay. The closing of the contacts of the Line Relay completes the circuit of the Calling Lamp and Auxiliary Relay. A current then flows from the positive pole of the 24 volts to the tongue of the Line Relay, thence through the lower contact of the latter, the Calling Lamp, and 30-ohms coil of the Auxiliary, or Pilot, Relay, to the negative pole. The lower tongue of the Auxiliary Relay closes, allowing a current to flow through the 250-ohms coil of the Auxiliary Relay and the Auxiliary, or Pilot, Lamp (which are joined in multiple), by way of the Night Relay or the Switch across it. The Auxiliary Lamp glows and the armature of the 250-ohms coil closes upon its contact. The latter operation brings in the 0·38-ohms coil as a shunt upon the 30-ohms coil already mentioned. This reduces the resistance of the Calling Lamp Circuit, and increases the

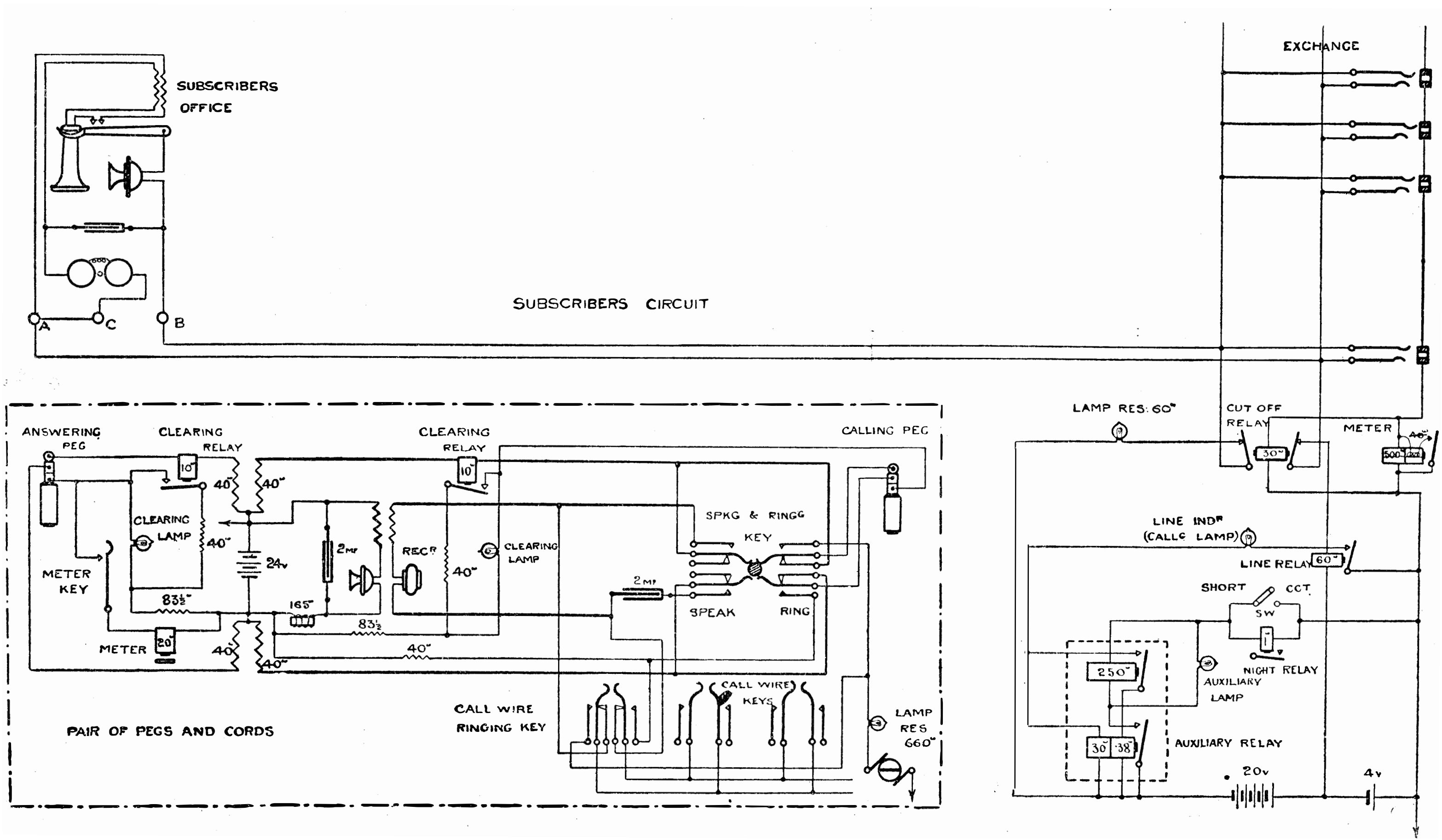

EXCHANGE
SUBSCRIBERS
OFFICE
A
C
B
SUBSCRIBERS CIRCUIT
ANSWERING PEG
CLEARING RELAY
10
40
40
CLEARING LAMP
40
24v
METER KEY
83½
METER
20
40
40
165
83½
40
2MF
RECR
40
CLEARING RELAY
10
CLEARING LAMP
SPKG & RINGG KEY
SPEAK
RING
2MF
CALLING PEG
CALL WIRE RINGING KEY
CALL WIRE KEYS
LAMP RES 660
PAIR OF PEGS AND CORDS
LAMP RES: 60
CUT OFF RELAY
30
METER
500
40
LINE INDR (CALLG LAMP)
LINE RELAY
60
SHORT CCT. SW
1
NIGHT RELAY
250
AUXILIARY LAMP
30
38
AUXILIARY RELAY
20v
4v

Plate 38.

voltage across the Lamp itself, causing it to glow (if not already in that condition), and thereby indicating the Call.

To answer the Call, the Exchange Operator inserts the Answering Peg of a pair in the Switchspring associated with it, and fitted immediately above the Calling Lamp. The tip of the peg makes contact with the A spring, the ring of the peg with the B spring, and the third point of the peg with the socket of the Switchspring. The last-mentioned connection completes a circuit from the positive pole of the battery through the Cut-off Relay and subscriber's meter in parallel, the socket of the Switchspring, third point of peg, Clearing Lamp, and 83½-ohms Resistance Spool to the negative pole. The Cut-off Relay is actuated (the current at this stage is, however, insufficient to operate the meter), the movement of the Relay armature breaks the battery circuit, but the contact of the tip and ring of the peg with the A and B springs, respectively, re-makes the circuit through the repeating coil shown between the Cords. The current now flowing out on the lines actuates the Clearing Relay, and the attraction of its armature throws a 40-ohms shunt across the Clearing Lamp, which remains darkened.

By throwing the Ringing and Speaking Key into the "speaking" position, the operator joins her Receiver, in series with the secondary of the Induction Coil and a 2-m.f. Condenser, across the Cords for the purpose of receiving the number of the required subscriber. This being done, and having first ascertained that the subscriber is not engaged by making the engaged test on the Switchspring of the multiple panel, she inserts the Calling Peg of the pair in the Switchspring, and throwing her Key into the "ringing" position connects the Generator to the lines. One side of

Plate 38—*cont.*

Plate 38a.

the Generator is earthed, and the other is connected through a Lamp Resistance to the top outer spring of the "ringing" Key. The top spring of the Key now makes contact with the spring connected to the tip of the Peg, and the current may be traced as going out on the A line, through the subscriber's Magneto Bell and 2-m.f. Condenser, back on the B line to the lower outer spring, through the 40-ohms resistance and the battery to Earth. The alternating currents cause the Bell to ring. When the required subscriber answers by lifting his Receiver, a current flows out on his lines and actuates the Clearing Relay on the Calling Side. The armature of the Relay throws a 40-ohms shunt across the Clearing Lamp, which is accordingly darkened. At the close of the conversation, the subscriber's Receivers are replaced on the hooks; the line circuits are thereby broken and the armatures of the Clearing Relays fall back, breaking the shunt circuits across the Clearing Lamps, which now glow. The operator thereupon depresses the Effective Meter Key on the answering side, and severs the connection by withdrawing the pegs from the Switchsprings. Should the operator be unable to complete the required connection the Ineffective Meter Key is depressed. It will be seen that by this operation the subscriber's meter is not actuated. *See* Plate 38A.

In certain recent Exchanges, the foregoing method of operating has been modified. At the "home" positions or "A" board, the outgoing junctions to other Exchanges and transfer circuits

Plate 38A shows the Cord Circuit at the Central Exchange; Plate 40 the Cord Circuit at Cardiff Exchange. The Cord Circuit at Hampstead and other London Exchanges are practically the same as that shown on Plate 38A; the Supervisory, or Clearing, Relays are wound to 20 ohms resistance, and shunted by a non-inductive resistance of 30 ohms for speaking purposes.

Plate 40.

C.B. Diagram No. 162.

Connections of Subscribers' Connecting Pegs and Cords at Cardiff Exchange.

The diagram shows the connections of the operators' pegs and cords circuits at Cardiff Exchange.

The main points of difference between these circuits and those shown on Plate 38, are the omission of the repeating coils between the Cords and the 24-volt battery; the increased resistance of the Clearing Relays, which are wound to 100 ohms in this case; and the introduction of the 2-microfarad Condensers shown connected across the Clearing Relays and Retardation Coils in the B Cords. The Retardation Coils are interpolated in the B Cords in order to maintain equal the resistances of the two halves of the circuit. Operators' speaking sets and clearing arrangements are practically identical with those given on Plate 38A.

For Subscribers' Circuit Connections, *see* Fig. 3, Plate 39.

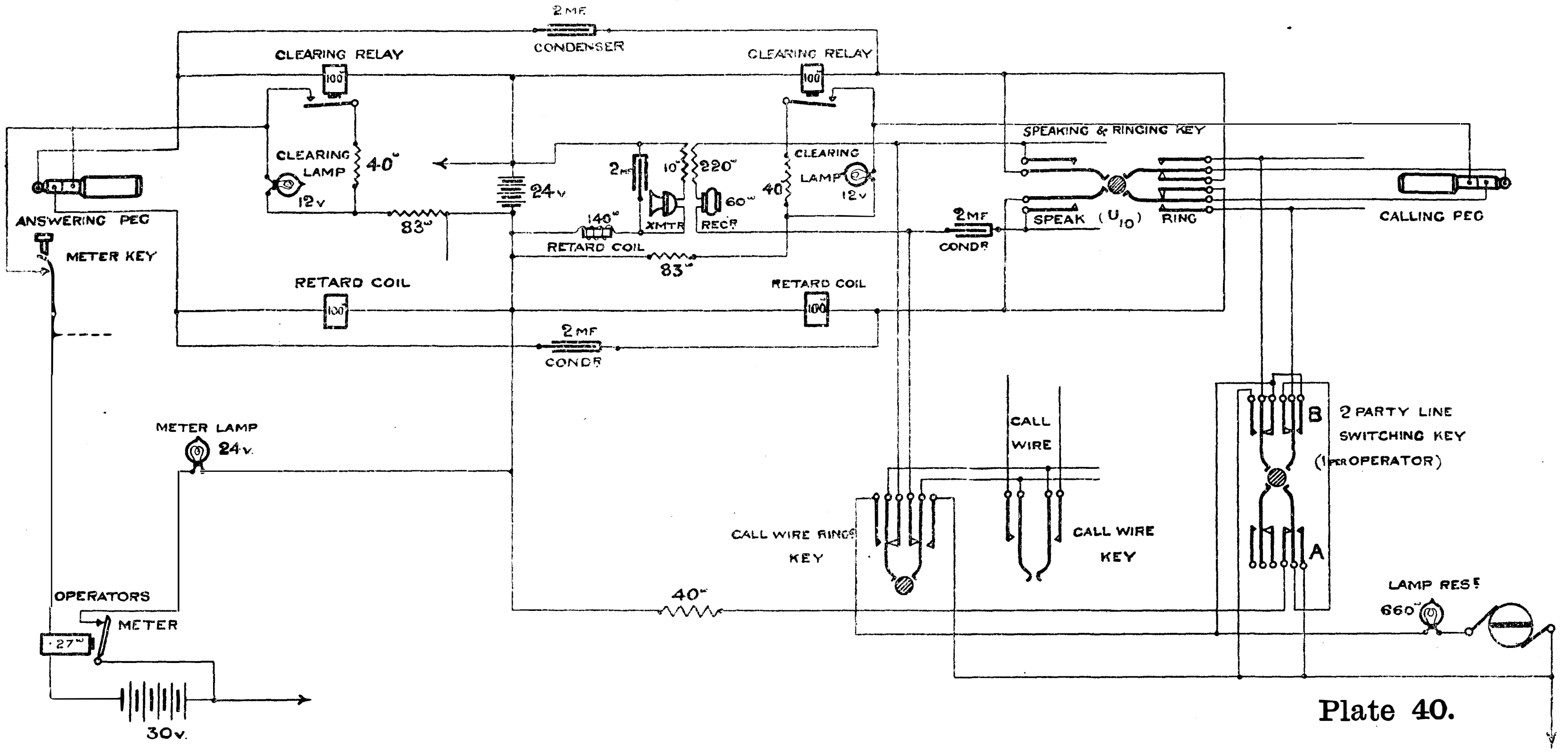

2 MF
CONDENSER
CLEARING RELAY
CLEARING RELAY
SPEAKING & RINGING KEY
CLEARING LAMP
40
24 v
2 MF
10
220
CLEARING LAMP
12 v
12 v
60
40
ANSWERING PEG
83
140
XMTR
RECR
2 MF
CONDR
SPEAK
(U_{10})
RING
CALLING PEG
METER KEY
RETARD COIL
83
RETARD COIL
RETARD COIL
100
100
2 MF
CONDR
METER LAMP
24 v.
CALL WIRE
B
2 PARTY LINE SWITCHING KEY (1 PER OPERATOR)
CALL WIRE RINGG KEY
CALL WIRE KEY
A
40
LAMP RESS
660
OPERATORS METER
·27
30 v.

Plate 40.

Plate 40A.

C.B. Diagram No. 525.

Subscribers' Line and Cord Circuits at Central Exchange, Glasgow.

The diagram shows in skeleton form the connections of the above circuits at the Central Exchange, Glasgow. It will be observed that the line relay is placed with one winding of 200 ohms in each line. At Exchanges on this system where B line feeding is required, the B line winding of the relay will be a non-inductive one. For a similar purpose the supervisory relays will have but one winding, viz., the one in the A conductor; in the B conductor a retardation coil of 200 ohms resistance and inductance equal to that of the relay will be fitted, so as to provide current for extension working.

The resistances in the various parts of the circuits have been arranged to suit the higher voltage used on this system. The supervisory lamps in the cord circuits are "36 volt" and are connected through the back contact of the supervisory relays to battery, the circuits being completed when the subscribers hang up their receivers, and the armatures of the supervisory relays fall back.

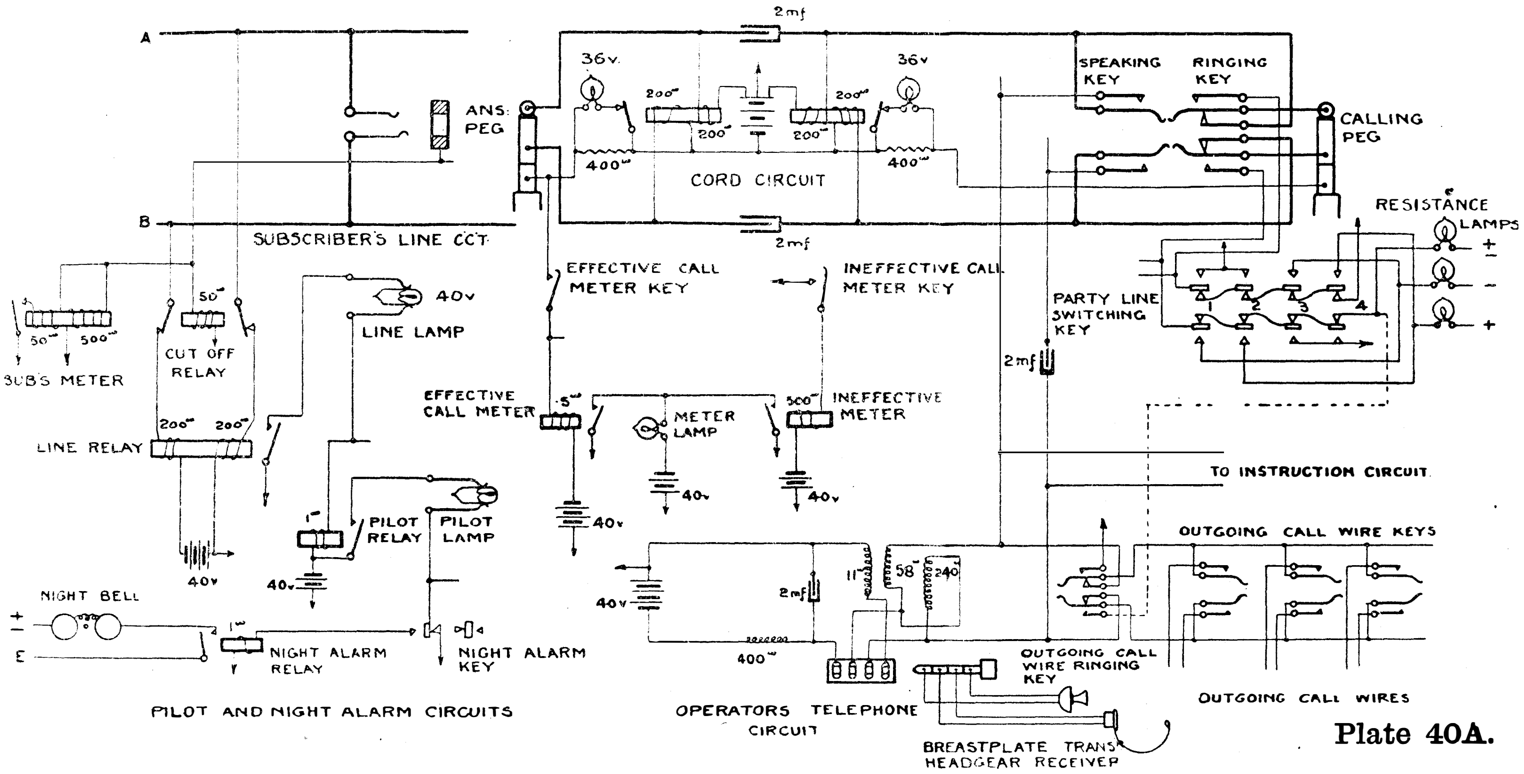

A
B
SUBSCRIBER'S LINE CCT
ANS. PEG
2mf
36v.
200
400
CORD CIRCUIT
36v
SPEAKING KEY
RINGING KEY
CALLING PEG
RESISTANCE LAMPS
PARTY LINE SWITCHING KEY
EFFECTIVE CALL METER KEY
INEFFECTIVE CALL METER KEY
50
500
SUB'S METER
CUT OFF RELAY
LINE LAMP
40v
LINE RELAY
EFFECTIVE CALL METER
METER LAMP
500
INEFFECTIVE METER
TO INSTRUCTION CIRCUIT
PILOT RELAY
PILOT LAMP
OUTGOING CALL WIRE KEYS
NIGHT BELL
E
NIGHT ALARM RELAY
NIGHT ALARM KEY
PILOT AND NIGHT ALARM CIRCUITS
11
58
240
400
OUTGOING CALL WIRE RINGING KEY
OUTGOING CALL WIRES
OPERATORS TELEPHONE CIRCUIT
BREASTPLATE TRANS
HEADGEAR RECEIVER

Plate 40A.

Plate 41.

C.B. Diagrams Nos. 243 and 246.

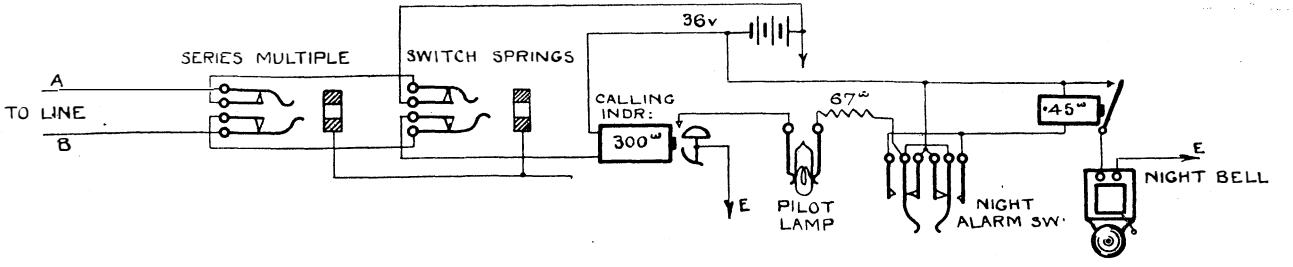
Connections of Subscribers' Circuits and Pegs and Cords Circuits at Minor C.B. Exchanges (No. 9 Switchboards).

Fig. 1.—Explanatory diagram of a Subscribers' Circuit. When the subscriber raises his Receiver, the Circuit from the Battery is closed through the Calling Indicator (Type 34, 300 ohms), in the local circuit of which is placed the Pilot Lamp.

Fig. 2.—Cord Circuit. Current is supplied to the speaking subscribers through the coils of the Supervisory Indicators, the armatures of which are attracted and the "eyeballs" show during the conversation. The 2-m.f. Condensers joined across the Indicators provide a direct path for the speaking currents between the subscribers. When the conversation is finished and the Receivers placed on the hooks, the circuits through the Indicators are broken and the Supervisory signals disappear.

Ordinary C.B. Telephones are fitted at subscribers' offices, but the arrangement does not provide for the installation of Branch Exchange Switchboards and Intercommunication sets on which the principle of B line current supply obtains.

FIG. 1.



ANSWERING PEG.

FIG. 2.

CALLING PEG.

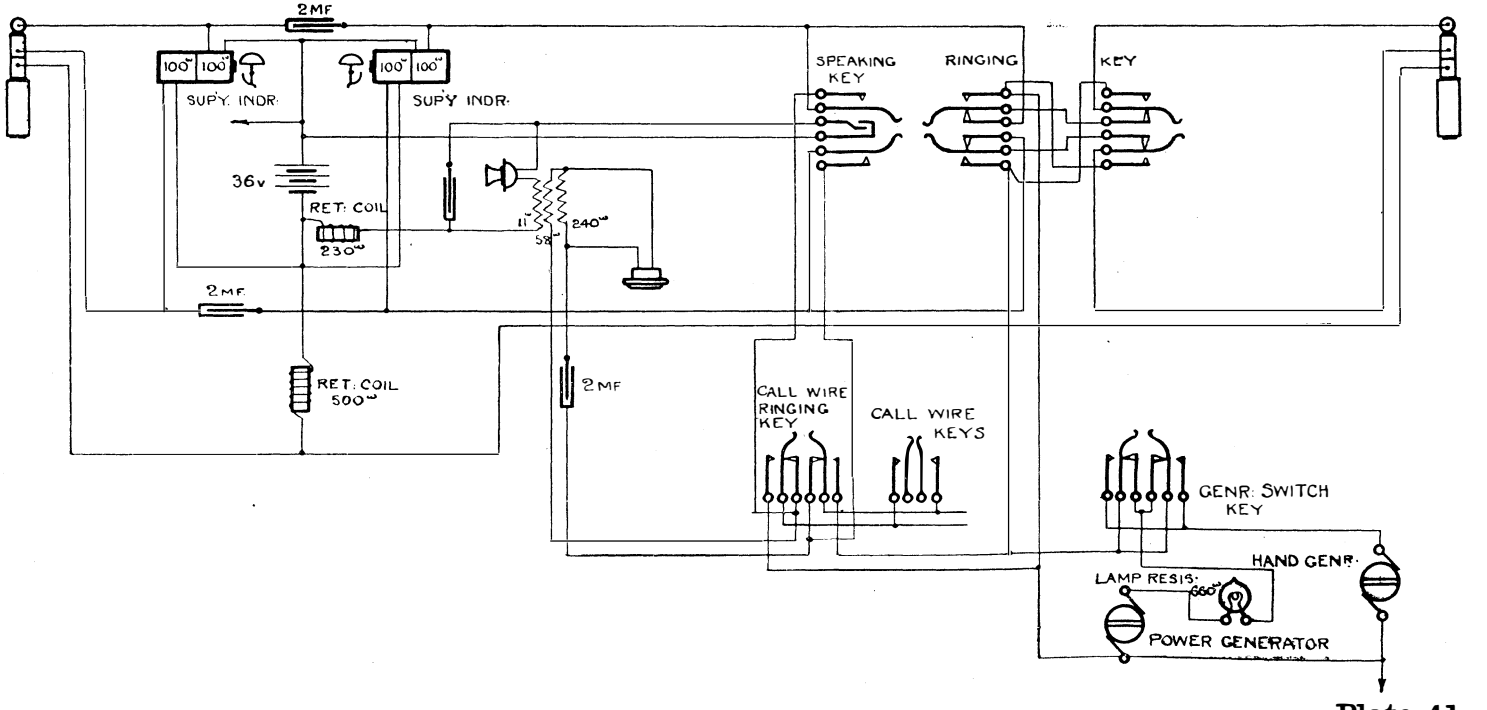


Plate 41.