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Post Office Engineering Department

TECHNICAL PAMPHLETS FOR WORKMEN

Subject:

Private Branch Exchange, C.B. Multiple No. 9.

ENGINEER-IN-CHIEF'S OFFICE,
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PRIVATE BRANCH EXCHANGE.

C.B. MULTIPLE No. 9.

(F. 5).

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PRIVATE BRANCH EXCHANGE.

C.B. MULTIPLE No. 9.

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PRIVATE BRANCH EXCHANGE. C.B. MULTIPLE No. 9.

DESCRIPTION AND LAY-OUT OF PLANT.

This type of switchboard is designed for use at large private branch exchanges. The main advantages of C.B. working are obtained with a maximum of simplicity. The boards are made in one position sections, and lined up to form a continuous switchboard and multiple field. A cable turning section is fitted at the commencement of the line of boards, and at the end section an end panel usually suffices. If the number of sections renders it necessary owing to the quantity of cables, a cable turning section may also be used at the last section.

In the multiple, two panels per section are provided. There are no local jacks as usually understood, all calls being answered from the multiple. No I.D.F. is provided, and it is necessary, therefore, to arrange the calling signals initially in a suitable manner for the traffic needs. The calling signals are fitted above the jack multiple, the usual arrangement of the switchboard face equipment being as follows :—

Lowest in the Jack Panels are the extension line jacks in strips of 20, multipled every fourth panel. Above these are the exchange line jacks in strips of 10, multipled similary. Fitted above the jacks are the extension calling signals (eye-balls) in strips of 20. Finally, above these, are the exchange line calling indicators (self-restoring) in strips of 10.

The calling equipment is usually arranged so that jack multiples occur on the same section as the calling signals. Cables are run from the main frame to the first multiple jacks, thence jack to jack, and are terminated on tags at the rear of the last or last two sections. The calling equipments are cabled to tags on their respective sections. The tags are connected together by cable according to the traffic requirements, in blocks of strips of calling signals. Individual line jumpering is not provided for owing to no separate answering jacks being fitted. For tie lines and private wires exchange line jacks and calling equipments are generally utilised. On the keyboard, capacity exists for 17 sets of cord circuits. Equipment for 12 is usually provided with speaking and ringing keys and ringback keys, 3-way plugs being used. Fitted one per position are also position switching keys and generator switching keys. Provision is made on the keyboard for 2 supervisory signals per cord circuit. The cord circuit relays, retardation coils, condensers, etc., are fitted in the rear of the sections. Extra equipment for long lines, tie lines,

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private wires, etc., if necessary, is fitted on a separate relay rack. Main frame provision is made as required, one or more frames being fitted.

CORD CIRCUIT.

A skeleton cord circuit is shown in Fig. 1. The retardation coil D is employed to supply current to both plugs for speaking purposes. The circuit as shown is used for extension to extension connections. When an Exchange connection is involved the battery is substituted by a bridging coil of 200ω resistance. The speaking current is then supplied over the exchange line from the main exchange operator's cord circuit.

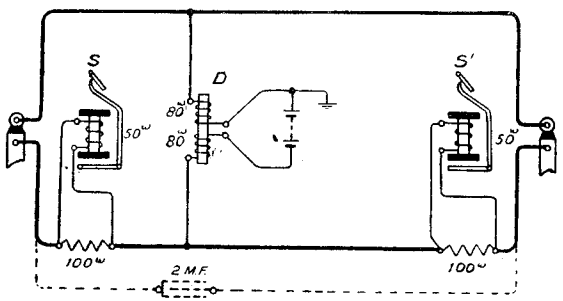


Fig. 1.

Diagram N.941 in the Loose Leaf series shows the full theoretical cord circuit. The requirements catered for are:—

(*a*) Supply of speaking current for extension to extension connections.

(*b*) Disconnecting cord circuit battery when exchange connection is involved.

(*c*) Clearing signals for supervision.

(*d*) Restoring the line calling signal on operator answering call.

(*e*) Provision of engaged test on lines connected.

(*f*) Ringing for both plugs and operator "listening in."

The action of the circuit is as follows:—

(*a*) It will be seen from diagram N.941 that when the sleeve relay is not actuated, battery is connected to the cord circuit *via* windings of the retardation coil and tongues and outers of the sleeve relay. This is the extension to extension condition. The energising of the sleeve relay depends upon a circuit obtaining *via* the line jack bush. On an extension line the jack bush is not connected to earth in any way (*see* Loose Leaf Diagram N.943).

(*b*) Referring to Loose Leaf Diagram N.942 it will be seen that when a plug is inserted, the exchange line jack bush is connected to earth *viâ* the restoring coil of the exchange line indicator. In this case the cord circuit sleeve relay is energised, *viz.*, from negative, *winding of relay*, plug sleeve, jack bush, 100ω restoring coil of Exchange line indicator, to earth. The relay operates, thereby connecting its moving springs to the 200ω bridging coil. These springs of the relay are connected to tip and ring of both plugs *viâ* the double wound retardation coil. The condition will now be that, across the cord circuit is the retardation coil with the 200ω bridging coil in its centre as shown in Fig 2.

(*c*) The supervisory signals are marked S and S¹. Each is of 50ω resistance, bridged by a non-inductive resistance of 100ω for transmission purposes. In later supplies of these switchboards a condenser is connected, as shown by the dotted lines across the supervisory signals the coils of which are then wound to 33 ohms, and the non-inductive shunts are omitted. For extension to extension connections the cord circuit relay, as already mentioned, is not actuated. Considering Signal S for such a connection it will

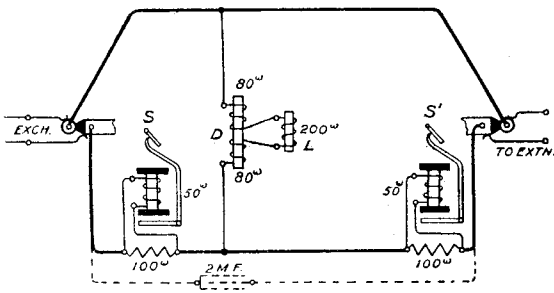


Fig. 2.

be seen that it will be actuated if a circuit is closed *viâ* the plug tip and ring. This condition would obtain during a connection (with extension receiver lifted), *viz.*, from negative, outer and moving spring of sleeve relay, one winding of retardation coil, *S Signal*, ringback key, plug ring, extension telephone, plug tip, ringback key, second winding of retardation coil, the other moving and outer spring of the sleeve relay, positive. The signal is, therefore, controlled by the extension telephone. The operation of supervisory signal S¹ is similar.

Whereas for extension to extension working, separate supervision for each plug is given, it is quite different when an exchange connection is involved. For this condition a clearing signal is only

available on the cord connected to the extension. As already described, the cord circuit relay operates for an exchange connection. The supervisory circuit is then as Fig. 2.

The current is now obtained from the main exchange, and S^1 (Fig. 2.) will be controlled by the extension, but S will be actuated until the plug is withdrawn. This is due to the fact that current is always on the exchange lines, *i.e.*, either from the main exchange cord circuit or calling equipment.

These supervisory signals are in effect negative signals. When actuated, the armature raises a disc, which thereby becomes visible to the operator. When an extension " hangs up," the disc falls back. This effect is the reverse of that given by, say, a C.B. exchange with lamp supervision, where the lamp dims during connection and glows on subscriber replacing receiver.

(*d*) The insertion of an answering plug into an exchange line jack will restore the shutter or flap of the calling indicator. The restoring of the exchange line calling indicator is effected by the negative battery connected to the plug sleeve, obtaining a circuit to earth *viâ* the restoring winding of the indicator. The precise action is given under the description of the exchange line circuit. In the case of an extension line the insertion of an answering plug will disconnect the eyeball circuit by the breaking of the contacts between the inner and outer jack springs. (*see* Loose Leaf Diagrams N.942 and N.943).

(*e*) Line jacks are "engaged" by connection of negative to the jack bushes. This is effected on a plug being inserted, as described later under " Extension line circuit."

The circuit conditions when the operator taps or tests a multiple jack, are explained in the description of the operator's telephone circuit.

(*f*) It will be seen from the diagram that the actuation of the ringing key or the ringback key will connect generator to the calling or answering plug respectively. The actuating of the speaking key will " bridge in " the operator's telephone.

Modifications for working to Automatic Exchanges.—When these switchboards are required to work to automatic exchanges, the following alterations are made:—

(*a*) On cord circuits, the tip side of the retardation coil connections is transferred to the long spring of the " dial and ring back " keys (*see* Loose Leaf Diagram No. N.1057).

(*b*) On the telephone circuit, a dial is fitted and the connections are altered as shown in Loose Leaf Diagram No. N.1058.

(*c*) On the ringing circuit, the ringing change-over key is replaced by a double throw key and connected as shown in Loose Leaf Diagram N.946.

The dial is in the operator's circuit and to dial a number, the speaking key of the cord circuit connected to an exchange line must be thrown. In this condition, the operator's telephone is in parallel with the calling extension and the cord circuit loop. When dialling, these must be disconnected by throwing the ring-back key which is labelled " Dial and Ring Back." A double throw ringing change-over key known as the " Power Ring Back Key " is provided so that ringing current shall not be sent out to the calling extension whilst dialling.

As the dial and ring-back keys are arranged to disconnect the loops from the cord circuit, it is necessary that the speaking key should be thrown whilst ringing back, the exchange line being held by the loop on the operator's telephone. To ring back by power, the power ring-back key must also be operated.

A dial is fitted on each extension requiring direct night service to the main exchange, and if auxiliary equipment is fitted on such extensions, a break jack for use on night connections is inserted in the line.

Night Extension Arrangements.—Loose Leaf Diagram N.941. Night extension keys are shown at the bottom of the diagram. When the switchboard is left without operators at night, etc., it is usually arranged that some or all of the exchange lines are connected to certain extensions for night working. Certain cord circuits are selected for this purpose. The straps are cut away from the tags shown (adjacent to the night extension keys) and the tags are wired to night extension keys in the manner illustrated in the diagram. The night extension keys are usually fitted on the Cable Turning section. It will be seen that when the key is operated, the sleeve relay circuit is broken. The circuit from the two windings of the retardation coil is also broken at the key. The cord circuit is therefore a simple loop with the two supervisory signals in series, and an extension connected through to the exchange is, for all practical purposes, a direct exchange line. In the " day " position of the night switching keys (all contacts made) the cord circuit is normal.

EXTENSION LINE CIRCUIT.

Loose Leaf Diagram N.943 shows the circuit connections of an Extension Line Circuit. The calling signal is of the eyeball type. On the extension receiver being lifted, the calling signal is actuated *viâ* negative of battery, eyeball winding, jack springs, B line, extension telephone, A line, jack springs, earth. On the operator answering, the eyeball circuit is broken by the answering plug breaking the contacts between the inner and outer jack springs. The engagement of the line multiple is effected on the insertion of a plug into a jack. The jacks are of the 7-point type with an auxiliary spring and contact, the latter being common to a strip of jacks.

All auxiliary springs for one extension are in parallel and normally rest on, and are in contact with, their jack bushes. Negative is connected to the contact. With a plug in a jack the auxiliary spring of that jack is pressed against the contact, thereby connecting negative to the rest of the springs of the extension multiple, and thence to the jack bushes. A 200^{w} resistance spool (one per group of 20 lines) is shown in the circuit of the engaged test battery. This resistance prevents excessive current passing, and reduces the voltage sufficiently to provide a reasonable " click " in the receiver when the operator is tapping the line.

EXCHANGE LINE CIRCUIT.

Loose Leaf Diagram N.942 shows the circuit connections. The calling signal is of the drop indicator type, responsive to generator ringing current. In addition to its 1,000^{w} coil it possesses a restoring coil of 100^{w}, the function of which is automatically to restore the indicator flap on a plug being inserted in the jack. The extra contacts on the jack are used for this purpose. To call the Private Branch Exchange the main exchange operator applies "generator" current to the line. The calling indicator is actuated *viz.*, *A* line, jack springs, 1,000^{w} winding of indicator, condenser, thence *viâ* the jack to *B* line. The indicator flap being released, falls forward and presses the light outer shutter upward.

The insertion of a plug into a jack closes the auxiliary contacts, thereby energising the restoring coil, thus restoring the indicator flap and shutter. The restoring circuit is as follows. Negative (from plug sleeve, Diagram N.941), jack bush, contact, 100^{w} winding of indicator, earth. The 1,000^{w} coil of the indicator is disconnected on the breaking of the inner spring contacts of the jack. The main exchange is called by the insertion of a plug into a jack. Being a C.B. main exchange its line calling signal is actuated by a loop. The loop is given from the Private Branch Exchange cord circuit (*see* Fig. 2).

The engaged test circuit is similar to that of an extension line and is described under that heading.

The 2 m.f. condenser is necessary, to prevent the operation of the line relay at the main exchange, through the 1,000^{w} indicator coil.

SHORT PRIVATE WIRE OR TIE LINE.

The circuit generally used for this is shown in Loose Leaf Diagrams N.948, Sheet 1 (Wiring), and N.949 (Explanatory). The operation of this circuit is best explained by tracing in detail the operation of an incoming call. The calling signal is given by generator ringing *viâ* line, jumper, top springs of 160^{w} relay, jumper, 2 m.f. condenser, 1,000^{w} indicator coil, jumper, bottom springs of 160^{w} relay, jumper and line. The answering of the call by the insertion of a plug connects battery *viâ* sleeve relay in the cord

circuit to the bush of the multiple jack; current flows thence *viâ* top auxiliary jack springs, jumper, tongue and back contact of 30^w relay (No. 32c) and coil of $1{,}000^w + 1{,}000^w$ relay to earth. This relay ($2{,}000^w$) is operated but owing to its high resistance the cord circuit sleeve relay (160^w) is not. The circuit for the restoration of the indicator is completed from battery *viâ* the coil of 160^w relay, contacts of $1{,}000^w + 1{,}000^w$ relay, jumper, and 100^w indicator coil to earth. The 160^w relay is operated and disconnects the lines from the indicator circuit and connects them to the multiple.

The plug having been inserted in the jack and the 160^w relay operated current flows from battery *viâ* 80^w retard (*see* cord circuit diagram N.941), 33^w supervisory signal, ring of plug, long spring of jack, jumper, coil of $30^w + 70^w$ relay, bottom springs of 160^w relay to line, and from line *viâ* top springs of 160^w relay, jumper, short spring of multiple jack, tip of plug and 80^w retard to earth. Until the clear is given from the distant end the supervisory signal and the $30^w + 70^w$ relay are thus retained in the operated position.

The effective connection between the private wire or tie line and the public exchange is prevented in the following manner. Assume the second plug of a pair to be inserted into an exchange line jack when the first plug is connected to a private wire or tie line with the circuit in the foregoing condition. Current will flow from battery *viâ* coil of 30^w relay (No. 32c), contact and tongue of $30^w + 70^w$ relay, jumper, auxiliary spring and bush of P.W. jack, sleeve of one cord, sleeve of other cord. bush of exchange line jack (N.942) to earth *viâ* 100^w coil of exchange line indicator. In the private wire or tie line circuit the 30^w relay (No. 32c), will be actuated and will retain *viâ* its own tongue and contact independently of any subsequent release of the $30^w + 70^w$ relay; at the same time it will disconnect the $1{,}000^w + 1{,}000^w$ relay which will be released and will in turn disconnect and release the 160^w relay. The release of the 160^w relay will disconnect the lines from the talking circuit and transfer them to the calling circuit thus rendering impossible any conversion over the connection.

LONG PRIVATE WIRE OR TIE LINE.

The standard circuit for this is shown in Loose Leaf Diagrams N.948, Sheet 2 (Wiring), and N.949 (Explanatory). Again considering the operation of an incoming call, the operation of the calling signal, its restoration and the transfer of the lines from the calling circuit are the same as on short lines.

The talking condition is as follows. The plug having been inserted into the jack and the 160^w relay operated, current flows from battery *viâ* 50^w retard, coil 8-7 of repeater, bottom spring and contact of 160^w relay and jumper to line, from line *viâ* top spring

of 160ω relay, coil 4-3 of repeater and 50ω relay to earth. Until the clear is given from the distant end the 50ω relay is retained in the operated position; this relay connects the 30ω relay (No. 39A) across terminals 1 and 6 of the repeater and provides a path for the operation of the supervisory signal in the cord circuit by current from battery *viâ* 80ω retard (N.941), 33ω supervisory signal, ring of plug long spring of jack, jumper, coil 5-6 of repeater 30ω, relay (No. 39A), contacts of 50ω relay, coil 1-2 of repeater, jumper, short spring of jack, tip of plug and 80ω retard to earth. The supervisory signal and 30ω relay (No. 39A) are thus controlled by the condition at the distant end of the line.

Effective connection between long private wires or tie lines and the public exchange is in a similar manner to that on short lines, the 30ω relay (No. 39A) in the former case performing the same functions as the 30ω + 70ω relay in the latter.

PRIVATE LINE (*Exchange connection prohibited*).

Loose Leaf Diagram N.944 shows a circuit that has been used in certain cases. The calling signal and engaged circuits are similar to those of the extension lines. The circuit is further arranged, however, to render effective connection to the exchange lines impossible whilst allowing connections between private lines and extensions. For this, the 30ω relay and the extra jack contacts are necessary. Should the operator connect a private line to an exchange line the 30ω relay is energised, *viz.*, negative battery *relay winding*, extra contacts to jack bush (contacts make with plug in jack), thence *viâ* plug sleeves (*see* Loose Leaf Diagram N.941) to exchange line jack bush, exchange line indicator, restoring coil, to earth.

Fig. 3 illustrates this condition.

Relay P, when energised, disconnects the private line entirely, thus making an effective connection between the private line and the exchange lines impossible.

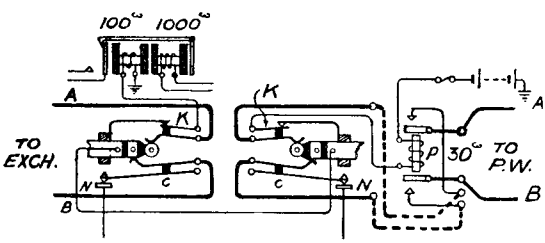


Fig. 3.

The connection of a private line to an extension is permitted by this circuit. Relay P will actuate only if a circuit to earth is obtained *viâ* the plug sleeves, and it will be seen from Loose Leaf Diagram N.946 that no path to earth exists on an extension jack bush.

TIE LINES.

Tie Lines are lines between two Private Branch Exchanges. Loose Leaf Diagram N.945 shows an arrangement that has been used in some cases. Provision is made in this case for calling by generator and prohibition against an exchange connection. The circuit action is as follows:—

On the distant operator " ringing," generator current is received which actuates the calling indicator. The circuit is *viâ* the line to repeating coil winding; a current is induced in the second repeating coil winding (the condenser shunts the 60ω relay for alternating currents), which passes *viâ* 30ω relay contacts to jacks and indicator. On the operator plugging in, the 60ω relay is energised from the cord circuit battery (Fig. 1) *viâ* contacts of 30ω relay, winding of repeating coil, and 60ω *relay*. The contacts of the latter close, completing a circuit for the restoring winding of the calling indicator, *viz.*, negative battery 150ω resistance, contacts of 60ω relay, *restoring winding* of indicator to earth. The cord circuit is now through to the tie line with the repeating coil interposed, the 30ω relay not being actuated. The condenser shunts the 60ω relay winding for speech currents. The 30ω relay will actuate and disconnect the tie line if a connection is made to an exchange line. This action has already been described for Diagram N.944. The 150ω resistance coil limits the current in the restoring circuit, thereby ensuring the action of the 30ω relay. The engagement of the line is similar to that of an exchange line. The additional equipment is usually fitted on a separate relay rack and jumpered in the manner shown.

OPERATOR'S TELEPHONE CIRCUIT.

Loose Leaf Diagram N.947 shows the details of this circuit. Connection to the battery bus bars is made for the transmitter circuit through a retardation coil of 165ω with a condenser connected as shown. The retardation coil suitably reduces the current for the transmitter. The impedance of the retardation coil will prevent high frequency current variations from traversing its winding, incidentally thus preventing overhearing from other circuits *viâ* the battery bus bars. The condenser completes a local circuit, *i.e.*, transmitter, primary windings of induction coil and condenser, for the high frequency currents due to speech. The combination of the condenser and retardation coil, therefore, is to give, in some measure, the effect of a separate battery for each operator's transmitter. The two primary windings of the induction coil, each of 18ω,

are joined up in parallel; the induction coil has also two secondary windings, each of 130ω. A non-inductive coil of 360ω is also in the circuit, the receiver being connected as shown in the diagram. The object of the 360ω coil arranged in the circuit in this manner is to eliminate, or at least to minimise, "side tone." "Side tone" is the reproduction of the operator's own voice in the receiver, which would occur were the receiver merely in series or parallel with a secondary winding. The receiver, as arranged in the diagram, is in a position in the circuit equivalent to that of a galvanometer in a Wheatstone bridge, the exchange or extension line and telephone resistance (averaged at 360ω) forming one arm. (Fig. 4 shows the effect, which is similar to a balanced Wheatstone bridge, the receiver being approximately balanced against currents induced in the secondary windings). The condenser in the secondary circuit prevents direct current passing from the cord circuit through the operator's receiver. The switching key is used to allow an operator to take adjoining positions during slack periods. The actuation of the key throws the position speaking key leads to the operator's set on the previous position.

Engaged test.—Fig. 5 shows the circuit when the operator is tapping a jack for the engaged condition. The condenser has a potential difference between its two coatings equal to that across the cord circuit. The plug tip is connected to the positive side of the battery. When the tip of the plug is tapped against the bush of the jack (which is negative if line engaged), the condenser poten-

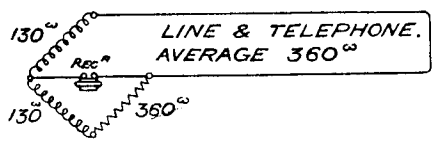


Fig. 4.

tial difference is varied. The ensuing current causes a click in the receiver, thus indicating to the operator that the line is engaged. No sound is heard in the receiver when a *disengaged* jack is tapped.

RINGING DISTRIBUTION.

Power ringing from the main exchange is generally available for a P.B.X. large enough to warrant a switchboard of this type. Hand generators, one per position, are fitted. Loose Leaf Diagram N.946 shows the arrangement. The generator switching key is fitted

(one per position) to bring the hand generator into use should the power ringing fail. The power ringing is wired direct from the main frame protective apparatus to the lamp (300ω resistance) and terminal on the first position, thence to succeeding positions. A resistance lamp is fitted for each position. The lamp is in the " live" side of the ringing leads. The object of the lamps is to prevent the short-circuiting of the common ringing supply should an operator ring on a line which is short-circuiting or earthing.

Night Alarm.—The night alarm circuit is shown in Loose Leaf Diagram N.946. The power tags referred to in the diagram are on the various sections. They are wired to the local contacts of the extension eyeball signals and exchange line indicators. The 200ω bridging coil reduces the voltage for the trembling bell and combined with the 2 m.f. condenser in parallel prevents disturbance on the power lead when the bell is ringing.

POWER DISTRIBUTION.

Special instructions are issued in connection with the grouping and arrangement of power leads. A.P.D. of not less than 16 volts is necessary at the Private Branch Exchange during the period of the busiest traffic.

The power leads are wired from the protectors to the bus bars of a fuse mounting fitted on the cable turning section at the

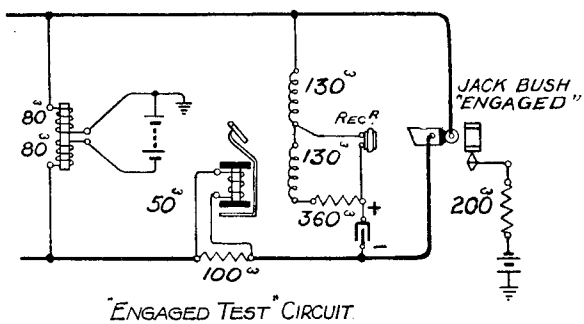


Fig. 5.

commencement of the switchboard. Additional fuse mountings are fitted on each section, and the positive and negative bus bars of each of these are cabled to the bus bars of the fuse mounting on the cable turning section. These cables are " looped in " to the

fuse mountings to prevent interruption to the remainder should one be disturbed for any reason. On the sections, the fuses are generally as follows :—

1 fuse per cord circuit.
1 ,, per section for extension equipment.
1 ,, per group of exchange line or tie line equipment.
1 ,, per operator's telephone.

A 10 m.f. condenser is fitted across the bus bars on the first fuse mounting. This condenser has a " smoothing " effect on the variations in the P.D. of the bus bars and so reduces the liability to cross-talk.

LONG EXTENSION EQUIPMENT.

Special provision is necessary for extensions having conductor resistances above certain values. Generally, the partial failure of calling and supervisory signals would occur in these cases. In addition, owing to the type of cord circuit, too great a difference in the resistance of any two circuits connected would result in the one of least resistance taking more than its share of the current from the cord circuit battery. This would rob the higher resistance circuit of current, resulting in poor speaking efficiency. The circuit to be used and the conditions in which it is necessary are shown in Loose Leaf Diagram N.938, Fig. 1. The unit shown is fitted on the special apparatus rack and is cabled or jumpered to the M.F. so as to interpose the apparatus in the line circuit. On the Private Branch Exchange side the ordinary extension equipment is used. Calling by the extension is as follows. The 1,000$^{\omega}$ + 1,000$^{\omega}$ relay is energised on receiver being lifted, *viz.*, negative 1,000$^{\omega}$ *winding of relay*, winding 7-8 of repeating coil, *B* line, telephone, *A* line, winding 2-4 of repeating coil, thence *viâ* second winding of the 1,000$^{\omega}$ + 1,000$^{\omega}$ relay to earth. The relay contacts close, thereby " shunting " the 2 m.f. condenser by means of the 40$^{\omega}$ spool. The eyeball circuit of the private branch exchange is now completed *viâ* the repeater coil winding 1-2, 40 spool, and repeater coil winding 5-6. On the extension " hanging up " a disconnection is given to the cord circuit by the relay armature falling back. The high resistance relay will actuate through any reasonable line resistance, and so far as the private branch exchange is concerned, the effect of a low resistance line is given.

The alternating generator current employed in calling the extension, rings through the repeating coil, with no effect on the 1,000$^{\omega}$ + 1,000$^{\omega}$ relay owing to the presence of the 4 m.f. condenser.

UNIT, AUXILIARY APPARATUS N°18.

FOR LONG EXTENSIONS & LONG PRIVATE WIRES ON A.T.& C.B. BRANCH EXCHANGE: DOUBLE CORD SWITCHBOARDS.

EXPLANATORY DIAGRAM.

N.938[A]

C.B. 962[H]

SUPERSEDES N.939 & N.940

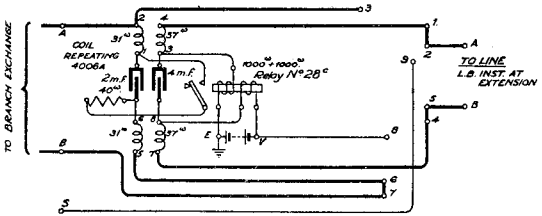


FIG.1. AS ISSUED & USED FOR EXTENSIONS.

On switchboards with hand restored indicators:-
With Relays N°119A in extension c&ts for clearing-on extns. over 50Ω
With Indicators N°600A in cord c&ts for clearing-on extns.over 50Ω
With Indicators N°600c in cord c&ts for clearing-on extns.over 100Ω
On switchboards with self restoring indicators:-
With Indicators N°600A in cord c&ts for clearing-on extns. over 100Ω
Indicators N°600c in cord c&ts for clearing on extns. over 150Ω
N.B. Where the total res. under Exch., to Exth. condition permits of C.B. speaking see Fig.3.

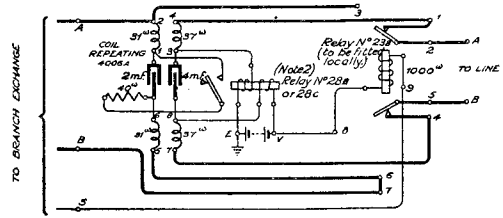


Fig.2. As modified for PRIVATE WIRES exceeding the limits quoted in Fig.1 on switchboards with hand restored indicators to prevent intercommunication with main exchange.

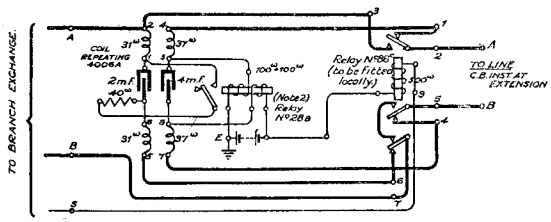
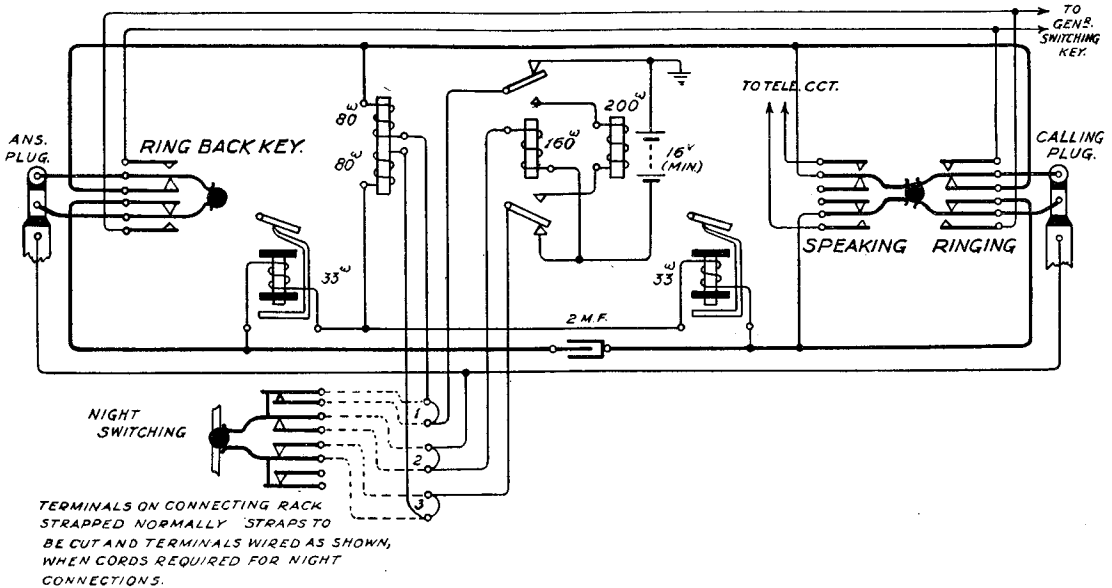


FIG.3. As modified for EXTENSIONS on switchboards with hand restored indicators, to cut out long line equipment on exchange connections when transmission requirements permit the use of C.B. telephones in such conditions.

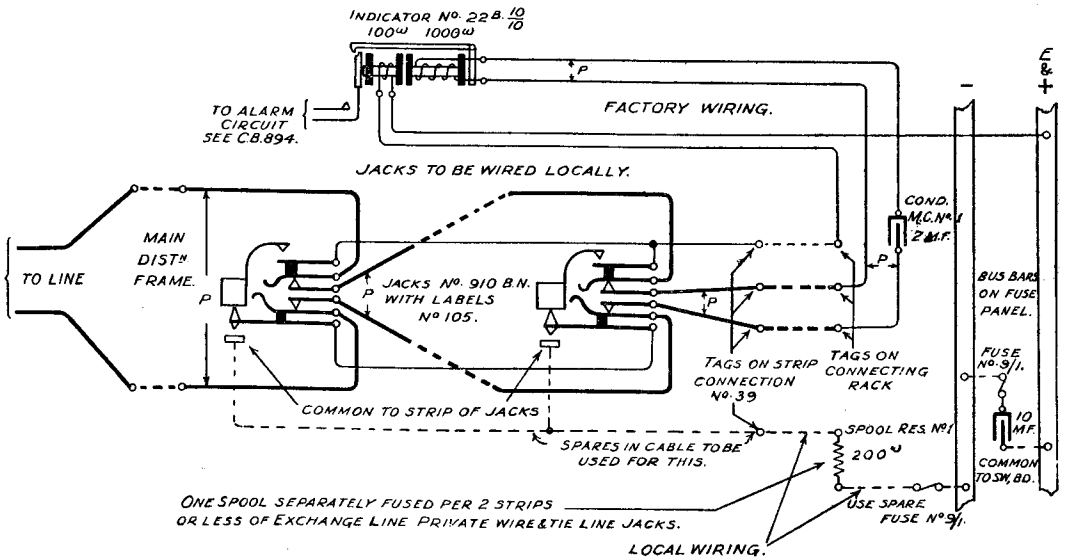
GENERAL NOTES.

1. Relays 28[a] and 28[c] do not operate with ringing current under these conditions.
2. The 1000Ω-1000Ω relay supplied with the unit is to be replaced locally by a 100Ω-100Ω relay when transmission requirements permit the use of a C.B. telephone at the out station.
3. Figs.2 & 3 are not applicable to switchboards with self restoring indicators.
4. The capacity between repeater terminals 1 & 6 cannot be increased beyond 2m.f. without risk of prematurely tripping machine ringing at the main exchange on night connections.
5. If necessary to provide for efficient ringing through these units Four-magnet generators will be provided at the P.B.X.
6. It is intended that the unit be mounted vertically on a wall or other suitable support.
7. For termination of private wires on N°9. Multiple Switchboards see separate diagram.

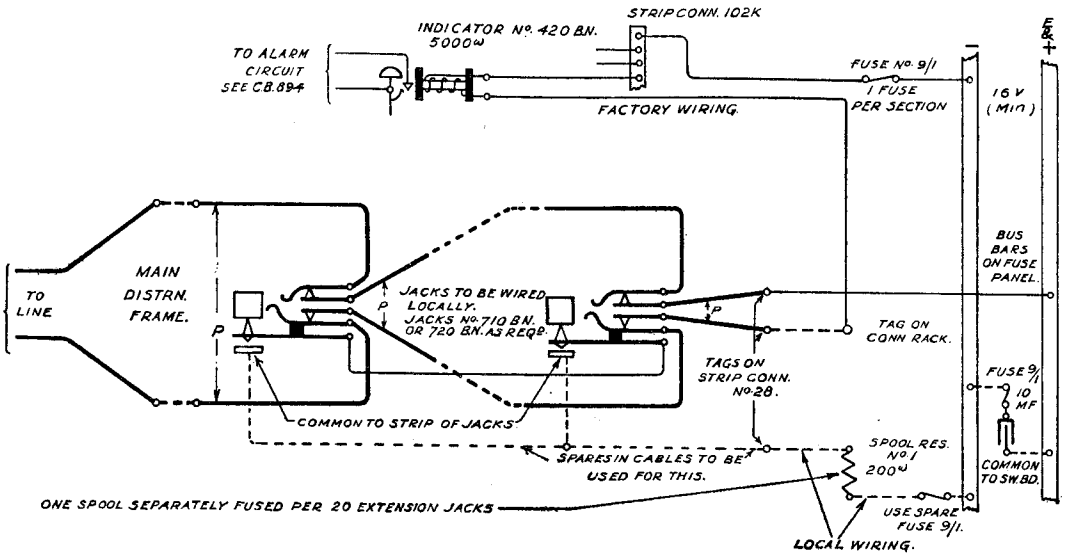
N. 941A
C.B.1218. 26.11.19.



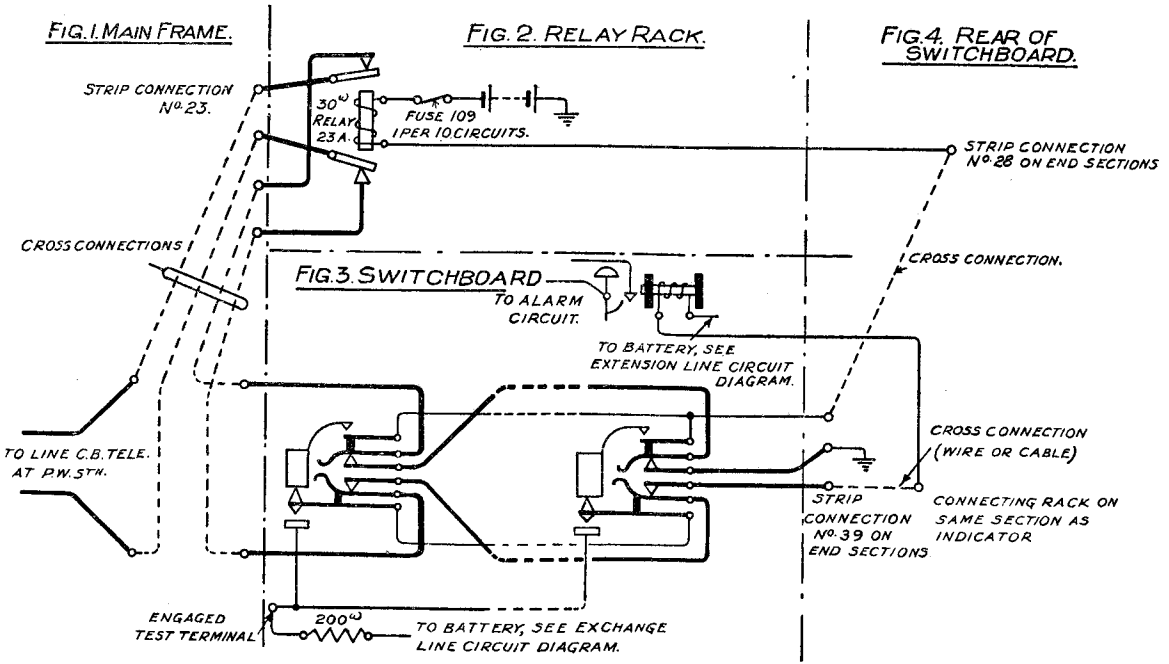
N. 942A 22.11.19
C.B. 919A



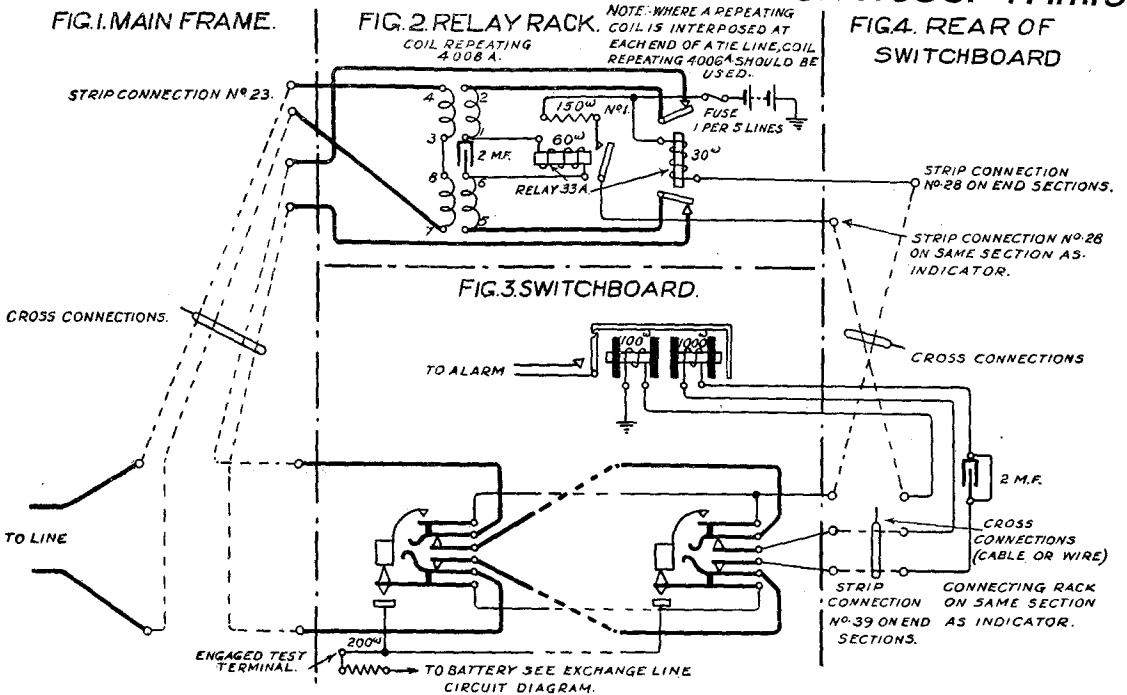
N. 943[B] 24.11.19
C.B. 920[C]



N. 944
C.B. 1031. 19.11.19



N. 945
C.B. 1030. 17.11.19



N.946[C]

C.B. 894[D] 24.9.14

FIG.1. NIGHT ALARM CIRCUIT.
(TO BE FITTED LOCALLY).

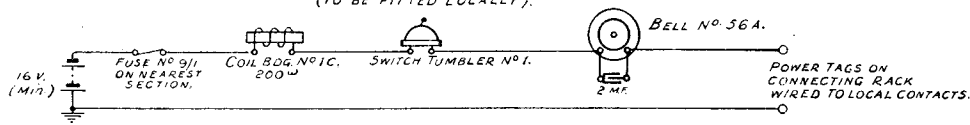


FIG. 2 RINGING CIRCUIT.

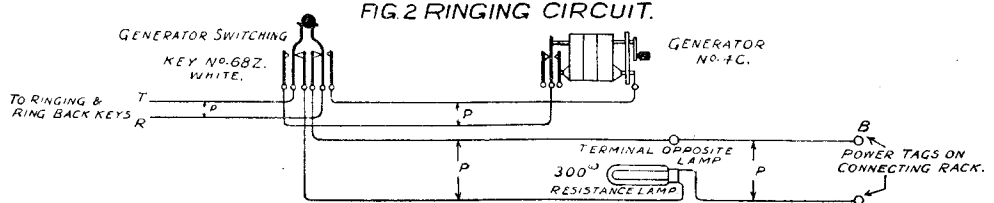
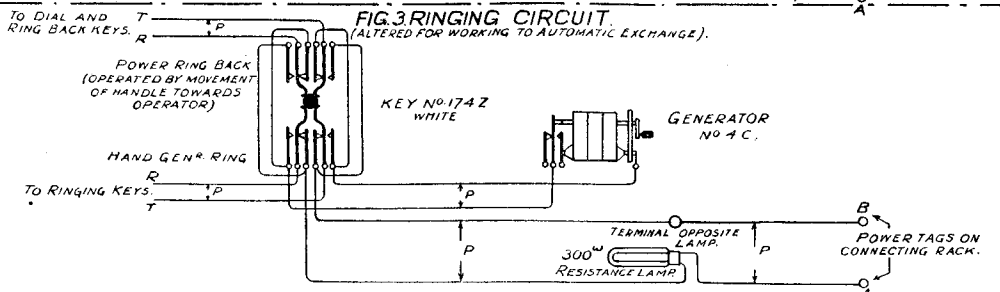
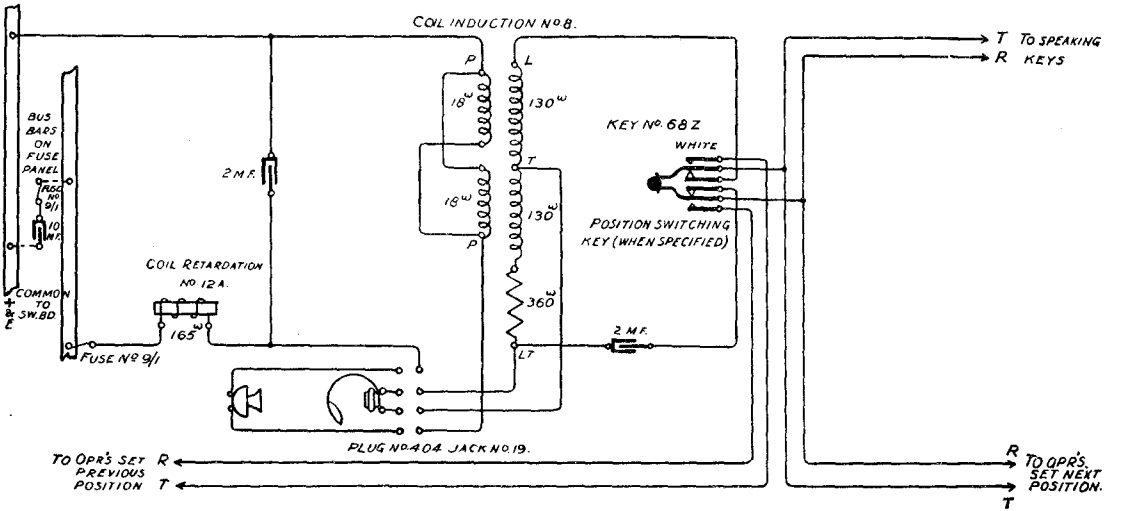


FIG. 3. RINGING CIRCUIT.
(ALTERED FOR WORKING TO AUTOMATIC EXCHANGE).



N. 947^{C} 19.2.23
C.B. 918^{F}



(SHEET 1.)

N. 948

C.B.1248. 20.11.23

FIG. 3. CROSS CONNECTIONS ON MAIN FRAME.

FIG. 1. REGULAR EXCHANGE LINE EQUIPMENT.

FIG. 4. CROSS CONNECTIONS AT REAR OF SECTIONS.

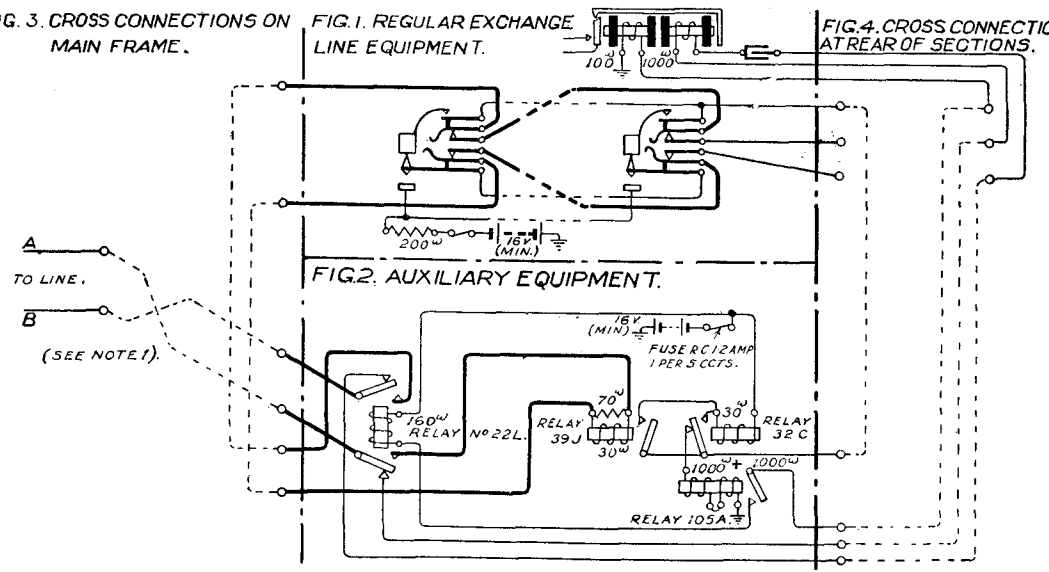


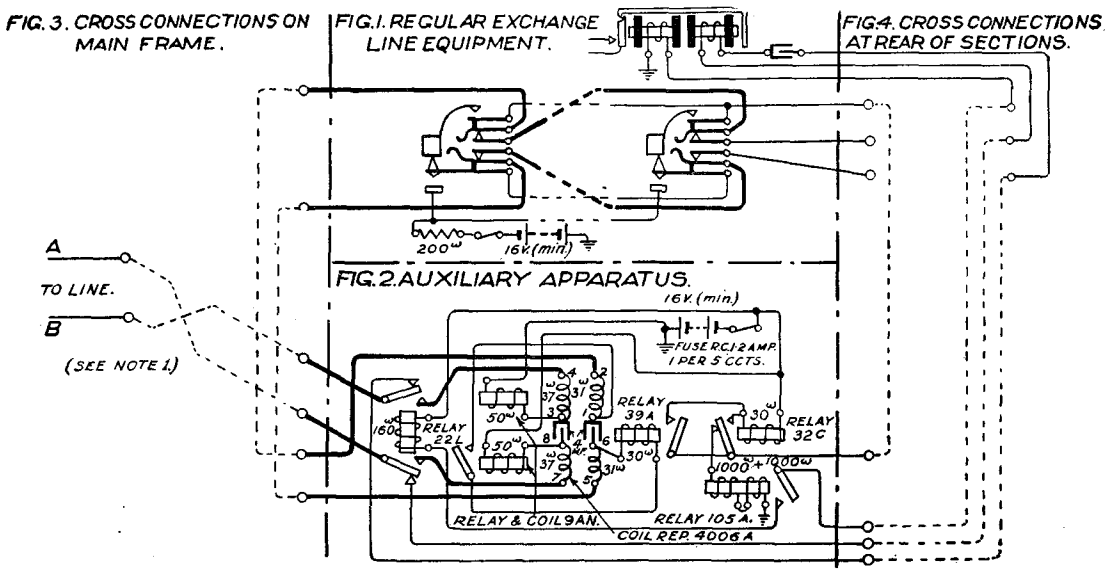
FIG. 2. AUXILIARY EQUIPMENT.

NOTE 1. REVERSAL TO BE MADE AT ONE END OF TIE LINE ONLY, & IF NECESSARY SPOOLS RESISTANCE Nº. 1 OF EQUAL VALUE TO BE INSERTED IN EACH LINE TO BRING RESISTANCE WITHIN THE LIMITS SPECª ON C.B.1250 (Nº. 949).

(SHEET 2.)

N. 948

C.B.1249[A] 20.11.23



NOTE 1. REVERSAL TO BE MADE AT ONE END OF TIE LINE ONLY.

N. 949[A]

C.B.1250[B] 30.11.23

SUPERSEDES FOR NEW WORK FIGS. 1 & 3 OF C.B[1] 1003 AND FIGS. 6 & 7 OF C.B. 1072.

FIG. 1. LONG LINES:- FOR WIRING SEE C.B.1249 (N.948).

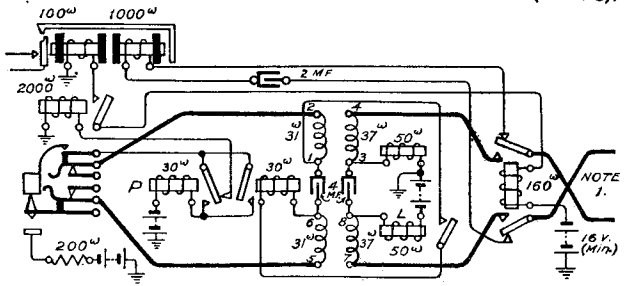
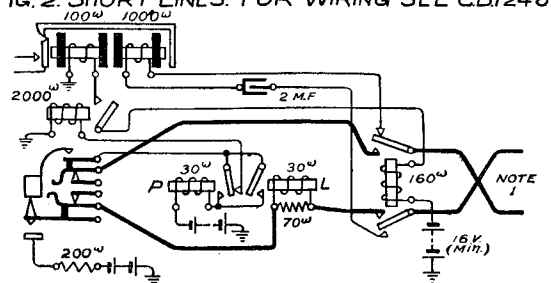


FIG. 2. SHORT LINES:- FOR WIRING SEE C.B.1248 (N.948).



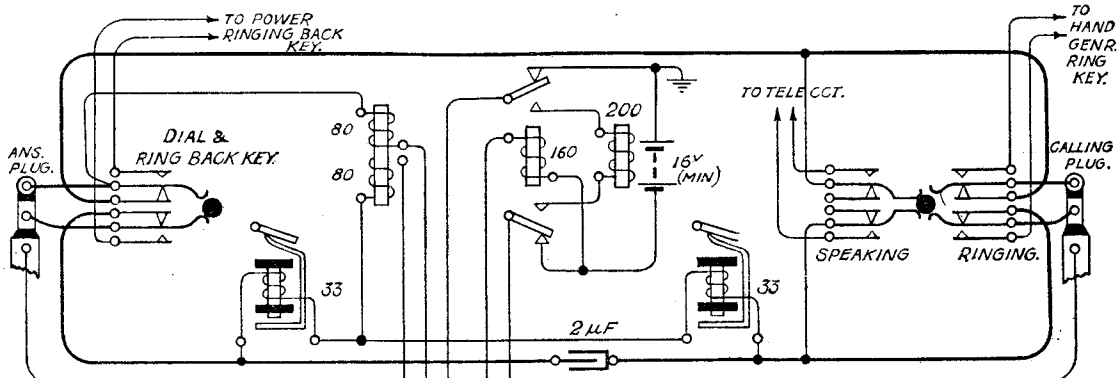
SWITCHBOARD B.E. C.B. MULTIPLE No 9. N.1057

CORD CIRCUIT. A.T.785 10.4.23.

CIRCUIT DIAGRAM.

WIRED FOR WORKING TO AUTOMATIC EXCHANGES.

FOR WIRING DIAGRAM SEE A.T. 740.



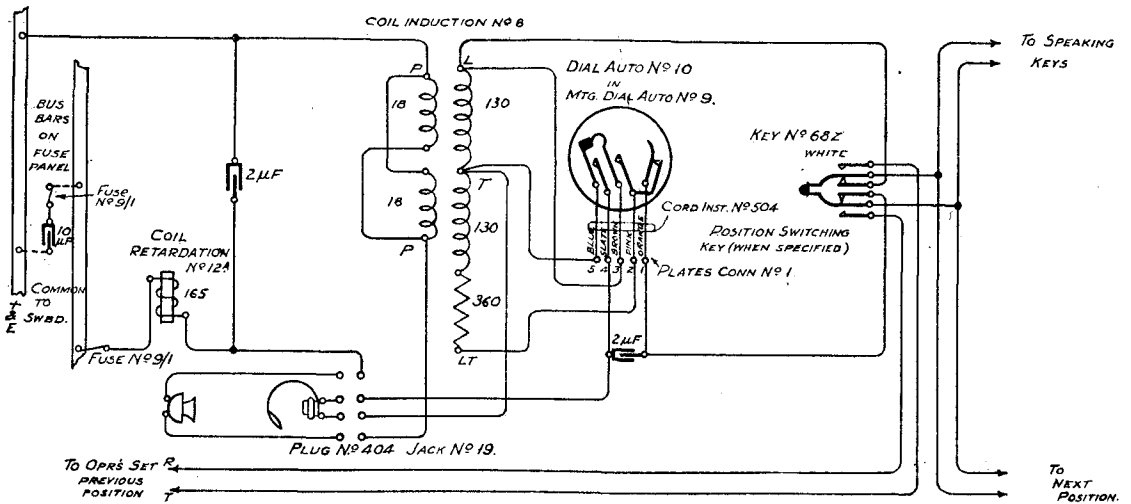
TERMINALS ON CONNECTING RACK STRAPPED NORMALLY STRAPS TO BE CUT AND TERMINALS WIRED AS SHOWN, WHEN CORDS REQUIRED FOR NIGHT CONNECTIONS.

SWITCHBOARD B.E C.B.

MULTIPLE No. 9,

OPERATORS CIRCUIT MODIFIED FOR WORKING TO AUTOMATIC EXCHANGE.

N 1058 19,9,25.
AT 741B



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Technical Pamphlets for Workmen

(Continued).

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2. Automatic Telephony. Coder Call Indicator (C.C.I.) Working.
3. Automatic Telephony. Keysending "B" positions.

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3. Subscribers' Apparatus, Magneto.
4. Private Branch Exchange—C.B.
5. Private Branch Exchange—C.B. Multiple, No. 9.
6. Private Branch Exchange—Magneto.
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8. Wiring of Subscribers' Premises.

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3. Maintenance of Power Plant for Telegraph and Telephone Purposes.
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2. Open Line Construction, Part II.
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