GENERAL DESCRIPTION

640-LINE AND 1440-LINE

NO. 12 SWITCHBOARD

1. GENERAL

1.01 This section describes the No. 12 Switchboard arranged for a maximum of either 640 lines or 1440 lines.

1.02 The No. 12 switchboard central office equipment consists of the following principal units:

(a) A switchboard assembly of single-position two panel sections.

(b) A small double-sided floor supported distributing frame for the protectors and terminal strips required for the office.

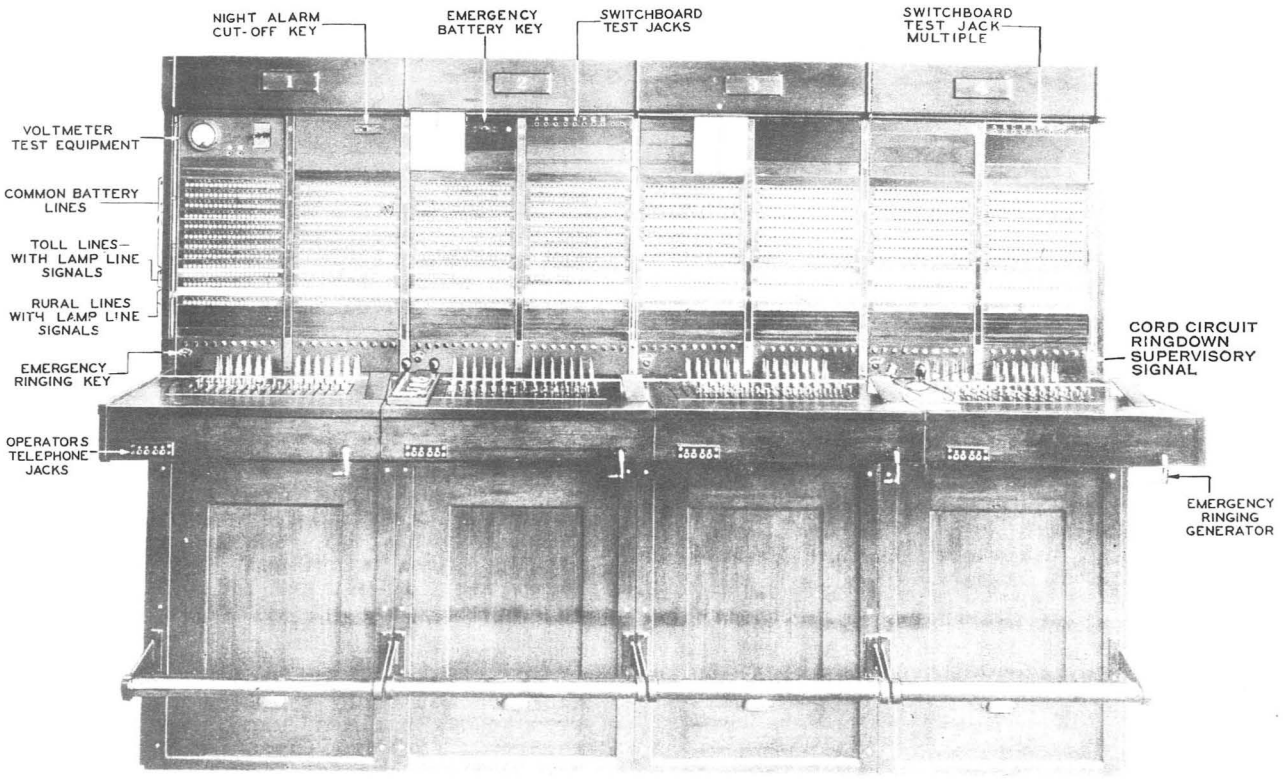
(c) A compact floor-supported power plant including a 23-cell battery, one or two Tungar rectifiers, and either a motor-driven magneto or a ringing machine.

(d) For the 1440-line switchboard, a floor-supported relay rack.

2. GENERAL EQUIPMENT AND CIRCUIT ARRANGEMENTS

Section Equipment

2.01 The No. 12 switchboard employs a two 12-inch panel single-position section, as illustrated by Fig. 1. This section serves for both local and toll service and for either the 640-line capacity or the 1440-line capacity. The woodwork of the section is finished in walnut and the key-shelf is faced with blank phenol fiber.



2.02 The switchboard is arranged for only one direction of growth, namely, from left to right.

2.03 The 640-line capacity equipment arrangement provides for a maximum of 640 common battery subscriber lines with designation strips and 120 magneto lines with drops. The latter circuits may be used interchangeably for rural subscriber lines, toll lines or ringdown trunks.

2.04 The 1440-line capacity equipment arrangement provides for a maximum of 1440 common battery subscriber lines without designation strips and 120 magneto lines with drops or 240 lines with line lamps. The magneto circuits may be used interchangeably for rural subscriber lines, toll lines or ringdown trunks. Busy lamps may be provided with the toll lines.

Keyshelf Equipment

2.05 The keyshelf is wired for 15 full-universal cords of which 13 (cords 3 to 15) are normally equipped. An additional cord at either end may be provided in some cases, making a total of 17 cords. The cord circuit keys may have either one or two levers.

2.06 Two positional lever type keys with red handles, one for "night alarm release" and "grouping," and the other for "monitoring" and "master ringing" are located in the middle of the keyshelf opposite the stile strip.

2.07 Additional items of equipment which may be provided are a calculagraph (in alternate positions) ticket pad holders, plate glass bulletin holders, a dial and a dial cord.

2.08 The operator's telephone set jacks and emergency hand generator crank are located at the left and right ends of the keyshelf lock rail, respectively.

Front Equipment

2.09 The arrangement of the front equipment in a typical switchboard is shown in Fig. 1.

2.10 The common battery subscriber lines, the magneto lines and most of the miscellaneous trunk circuits are multipled on a four panel basis.

2.11 Common battery subscriber line jacks are mounted 20 per strip, and when these are provided with designation strips 640 may be equipped. When common battery line jacks are not provided with designation strips, 1440 lines may be equipped. The jack mountings are unnumbered. When designation strips are provided the jack numbers are indicated on these strips. When designation strips are not provided, the number of the first and last jack in each strip is indicated by means of engravings on stile strip number plates. In this case, each group of one hundred line jacks is separated by a 1/16 inch holly strip.

2.12 Magneto lines, when equipped with drops, have their jacks mounted 10 per strip, a limit introduced by the drops which can mount only 10 per strip in a 12-inch panel. Three rows of these in each of the four panels permits the installation of 120. Magneto lines with lamp line signals have their jacks mounted 20 per strip, and the provision of three rows of these in each of the four panels allows a total of 240 circuits. They may be used as toll lines, ringdown trunks or rural lines. Toll lines may be equipped with busy lamps.

2.13 The lamp sockets for the cord circuit lamp ringdown supervisory signals are located in the piling block and in line with their associated cords. The emergency ringing key is also located in one of these piling blocks.

2.14 Either a voltmeter test panel mounted in the jack opening above the common battery multiple equipment or a local test cabinet No. 2 fastened to the left-hand end panel may be furnished. A switchboard test circuit having strip-mounted test jacks and an associated designation strip is provided. Additional appearances of these jacks may be provided and multipled on a 4-panel basis. The jacks are located at the top of the jack opening. The jack designations in some cases may be stamped on the crown moulding and the designation strip omitted when the full capacity of line equipment is provided.

2.15 The night alarm cut-off key may be mounted in a panel at the top of the multiple space. The emergency battery key and its associated guard lamp may also be located at the top of the jack field. In some cases these keys are mounted in the crown moulding.

Rear Equipment

2.16 In the rear equipment, in addition to the cord and telephone circuit apparatus the mounting plates are drilled for the apparatus of a 16th and 17th cord. A canvas cord protection panel is used in this section. The subscriber sets for the ringing fuse alarm and the supervisor's telephone circuit are located in the roof of the section.

2.17 The apparatus for the night alarm circuit is mounted on a unit, which includes not only the line fuses in addition to night alarm apparatus but also the apparatus for the fuse alarm circuit, and the resistances for the switchboard test circuit.

2.18 The resistances associated with toll line busy lamps, may be located in the rear of the section.

2.19 The emergency battery is located on the floor in the rear of the section, and the associated fuses are located on the rear equipment mounting details.

2.20 The varistors, where provided for subscriber line circuits, may be mounted in the rear of a switchboard position and cabled to the distributing frame for cross-connection to the lines. In some cases, the varistors are located on the M.D.F.

2.21 Miscellaneous trunk relay equipment may be located in the rear of any position. The supervisor's telephone circuit equipment may be located in the rear of a position.

3. DESCRIPTION OF CIRCUITS

Common Battery Line

3.01 The common battery line circuit consists of one or more cut-off jacks and lamp sockets with the line lamp in series with the line, as shown in Fig. 2. Multiple lamp sockets are furnished primarily to allow flexibility in assigning the answering jack. In general, only one line lamp may be furnished although two line lamps may be furnished on shorter loops.

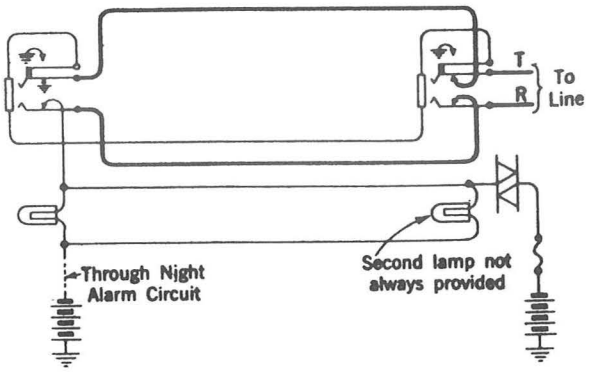


Fig. 2 - Common Battery Line Circuit.

3.02 The line jack is arranged to connect ground to its sleeve conductor when a plug is connected. The application of this ground not only makes all the associated multiple jacks test busy but also operates the sleeve relay of the cord as required for common battery talking and supervision.

3.03 Under certain conditions where subscriber lines are exposed to power circuits, the line lamps may be subject to overvoltages induced or conducted from the power circuits during electrical storms. To protect these lines, varistors may be provided and connected in parallel with the lamps as shown in Fig. 2. The varistor is a disc of silicon carbide mounted between two metal plates. Its resistance decreases rapidly as the voltage across it is increased and thereby the varistor tends to limit the voltage impressed across the line lamp.

Magneto Line with Line Drop

3.04 The magneto line circuit consists of one or more cut-off jacks and drop in series with the line as shown in Fig. 3. This circuit may be used as a rural or toll line or as a ringdown trunk.

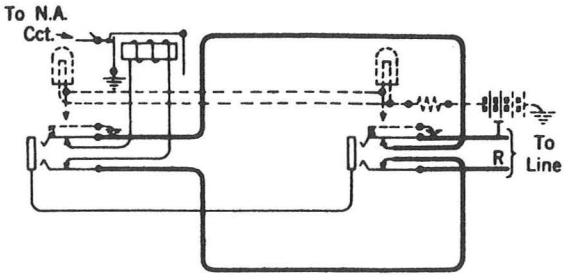


Fig. 3 - Magneto Line with Line Drop.

3.05 Magneto lines with drops may also be equipped with lamp busy signals when the lines are used as toll lines. An additional pair of make contacts on the jack lights the lamps when a plug is in the jack as shown by the dotted lines in Fig. 3. Resistances are employed in order to reduce the current supplied to the busy lamps for the two-fold purpose of minimizing jack contact deterioration and of providing suitable illumination.

Magneto Line with Line Lamp

3.06 Magneto lines employing lamp signals rather than drops may be provided for rural or toll lines and for ringdown trunks. See Fig. 4. Lamp busy signals may be provided when this circuit is used as a toll line. On a rural line if a subscriber calls another station on the same line, the line lamp is extinguished during the time the ringing current is being applied by the subscriber.

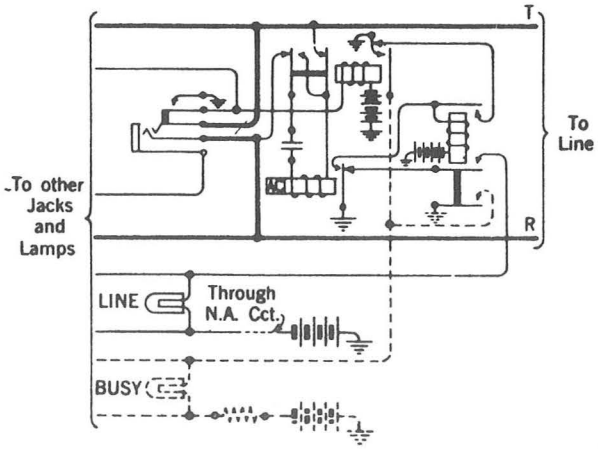


Fig. 4 - Magneto Line with Line Lamp.

Grounded Magneto Line

3.07 Where a magneto line is used as a grounded subscriber line, ground is connected to the tip side of the line at the M.D.F. and if the line is partly in a cable out from the office, the tip lead of the cable pair is usually grounded at the distant end of the cable to prevent excessive cross-talk. A repeating coil may also be included in a grounded line circuit to reduce the transmission losses when the circuit is connected to a metallic circuit. The repeating coil will usually be located in the central office but may be at the end of the cable pair where the grounded circuit enters the cable.

Universal Cords

3.08 In the universal cord circuit shown in Fig. 5, the answering and calling ends of the circuit are symmetrical except for the provision of a key in the front cord. The key is arranged for connecting the operator's telephone set when operated toward the switchboard, and for connecting ringing current to the front cord when the key is operated toward the operator. The ringing current is normally connected to the ring side of the line unless the associated master ringing key is also operated in which case ringing current is applied to the tip side of the line.

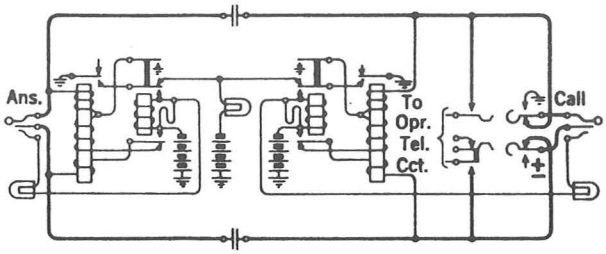


Fig. 5 - Universal Cord Circuit.

3.09 The cord circuit may be equipped with a two-lever key. This key is provided primarily to obtain ringing on the answering cord in connection with delayed toll calls. In addition ringing on the tip or ring of the calling cord is obtained without the use of a master key. When this key is provided the audible ringing feature is furnished.

3.10 The back and front cords are connected through two 2 m.f. condensers and are equipped with 48-volt bridged impedance talking battery for use on common battery connections. The supervisory relays are employed as battery supply relays as well as for common battery supervision and ringdown signaling. They have three windings, two of which are employed on common battery connections, whereas all three windings are connected in series on magneto lines. The additional winding for the ringdown condition adds turns to increase the sensitivity of the relay for ringdown operation.

3.11 The cord includes back and front sleeve relays which operate on common battery connections due to the ground on the sleeve conductor of the associated line jack. The operation of either of these relays connects battery and ground through two windings of the associated supervisory relay to the ring and tip conductors of the cord as shown in Fig. 6. On a connection to a magneto circuit the sleeve relay does not operate and accordingly the three windings of the associated supervisory relay are bridged across the cord to receive ringing signals from the subscriber or distant operator as shown in Fig. 7. In this case, the ringdown supervisory lamp will light only while ringing current is received.

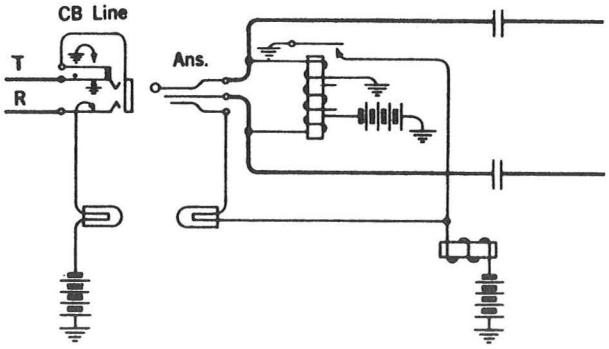


Fig. 6 - Cord Connected to Common Battery Line.

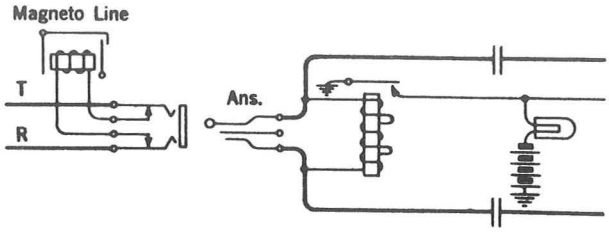


Fig. 7 - Cord Connected to Magneto Line.

Telephone Sets and Emergency Battery

3.12 The operator's telephone circuit shown in Fig. 8 includes facilities for positional monitoring and one-way grouping. The grouping is designed to make the cords on a position available to an adjacent operator at a higher numbered position. The telephone circuit provides a busy test potentiometer consisting of an 18000-ohm resistance to battery and a 6000-ohm resistance to ground. This arrangement places a potential of approximately 12 volts across a condenser wired in series with the busy test coil. When a busy common battery line (with ground on the sleeve) is tested the condenser is partially discharged and then recharged to about 12 volts. On a busy magneto line (with battery on the sleeve) the condenser is alternately charged and discharged from a voltage of 12 to 24.

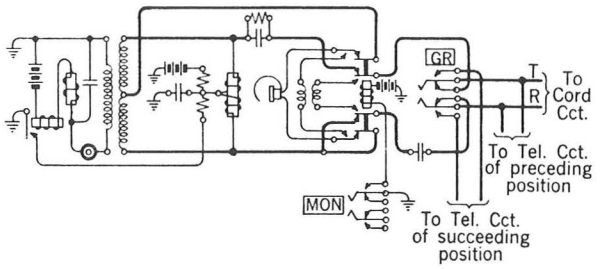


Fig. 8 - Operator's Telephone Circuit.

The volume of the busy test in both these cases is approximately the same.

3.13 An emergency talking battery of dry cells may be provided. It may also be used as a testing battery with either the voltmeter test circuit or the No. 2 local test cabinet. The emergency battery is connected to the operator's telephone circuit and to a cord circuit by the operation of the EMB key in the face of the board. While the key is operated, the associated lamp is lighted if the voltage of the central office battery is adequate.

3.14 A supervisor's telephone circuit may be provided. It is cross-connected to a spare subscriber line. This not only provides multiple appearances of the supervisor's circuit before regular operators for completing calls to the supervisor but also permits the supervisor to originate calls. The supervisor's circuit is equipped with a subscriber set for furnishing an audible indication when a call is waiting.

Trunks

3.15 The magneto line circuits described in 3.04, 3.05 and 3.06 may also be employed as two-way ringdown trunks between the No. 12 and another office. Other kinds of trunks may be provided for completing connections to and from tandem offices. These may be of the composite signaling, straightforward or call announcer type. Where the No. 12 office serves as the master office for a small step-by-step office, the trunks between the two offices are arranged to signal the operator when the trunk is selected and to enable the operator to call subscribers in the step-by-step office by means of the position dial and dial cord. Interposition trunks may be furnished for extending calls from any position to another position designated, for example, to handle delayed toll or information calls.

Toll Line Repeating Coils and Test Jacks

3.16 The toll line repeating coils and test jacks may be mounted on the main distributing frame or on the relay rack. Miscellaneous ground and short-circuit jacks are located near the jacks through which the toll lines are looped in order that the proper test conditions may be placed on the toll lines by means of patching cords as described in Part 6 - Maintenance Facilities.

Night Alarm

3.17 The night alarm circuit shown in Fig. 9 includes a Wheatstone bridge having two inductive arms and two non-inductive arms. A polarized relay is connected across the bridge so that, when a common battery subscriber originates a call, a relatively high initial current is connected in series with the polarized relay and the two non-inductive arms of the bridge. This initial surge of current causes the polarized relay to operate momentarily, in turn energizing an auxiliary relay which locks operated. Accordingly a night bell will sound until the auxiliary relay is released by operating the release key at any position. The night alarm also operates in the same way on the various trunks and toll lines equipped with lamp signals. The operation of rural or toll line or ringdown trunk drops will sound the night bell directly. The bell is silenced by the restoration of the drop. The positional release key is ineffective in this case.

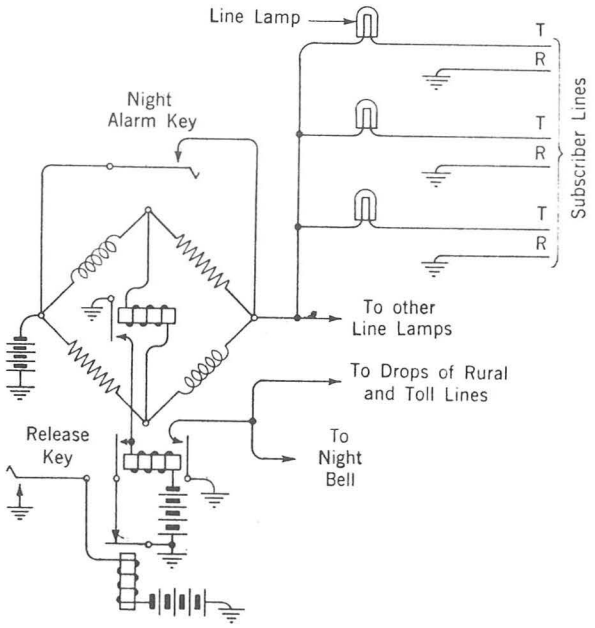


Fig. 9 - Night Alarm Circuit.

3.18 If more than 720 common battery lines are equipped, two night alarm circuits are furnished to avoid possible failures of the alarm circuit to operate, which otherwise might be experienced due to low overall line leakage resistance.

3.19 During the periods when the audible alarm on incoming calls is not re-

quired, the night alarm circuit can be cut off by operating the night alarm key which is located in the face of the switchboard.

Fuse Alarms

3.20 The 35-type fuses for the switchboard circuits are associated with a fuse alarm consisting of a buzzer. The buzzer sounds when any fuse operates, and will continue to sound until the operated fuse is removed. The alarm contacts of the ringing fuses are connected to a subscriber set.

4. MAIN DISTRIBUTING FRAME AND RELAY RACK

Main Distributing Frame

4.01 The No. 12 switchboard employs a small floor-supported "B" type main frame, which is 6 feet 2 inches high, the same as the height of the section. The capacity of the frame on the horizontal side is 10 shelves.

4.02 The main frame may be located either in line with or in the rear of and parallel to the switchboard depending upon building conditions. When the main frame is located to the rear of the switchboard, a cable rack is bridged between the switchboard and the main frame without any ceiling supports.

Protectors

4.03 The main frame verticals are arranged to accommodate 152 protectors each on 3/8-inch centers, a strip of 101 protectors being placed at the bottom of the verticals and a strip of 51 protectors at the top.

Terminal Strips

4.04 The horizontal side of the main frame is equipped with 6-1/2-inch terminal strips. The terminal strips for the common battery lines are located to correspond as nearly as possible to the associated equipment located in the face of the switchboard; that is, in the 640-line switchboard four terminal strips are mounted in a horizontal row, corresponding to the arrangement in the four switchboard panels. In the case of the 1440-line switchboard, this same arrangement is followed up to 720 lines, beyond which it is necessary to locate a second group of horizontal rows of four terminal strips to correspond to the arrangement of the upper portions of the switchboard panels.

4.05 The toll, rural and miscellaneous terminal strips are located on the top shelf above the common battery line terminal strips.

Relay Rack

4.06 With the larger boards certain features require more mounting space than is available in the section, and, for such cases a 23-inch floor-supported relay rack 7 feet in height is employed.

5. POWER PLANT

5.01 The power plant for the No. 12 office consists essentially of a 23-cell battery with either one or two Tungar rectifiers operating continuously and a small motor-driven magneto or a ringing machine. Audible ringing may be supplied when the ringing machine is used. A battery with a normal rating of 4 to 8 amperes or of 8 to 16 amperes is furnished. Under normal conditions the battery voltage will remain within the limits of 44 to 54 volts with extreme limits of 40 to 56 volts. Fig. 10 shows the front view of a complete power plant unit.

5.02 Fig. 11 shows the circuit of the power plant. The rectifier is controlled manually, being adjusted so that it will supply during the 24 hours of the day the average daily office load plus the losses of the battery. A voltmeter is provided for reading the voltage of the battery.

5.03 The battery control panel is equipped with battery and ringing fuses and ringing lamps for supplying a limited number of 48-volt battery and ringing feeders for PBX's. Where it is necessary to furnish 24-volt PBX supply, a battery of twelve cells may be employed. They are charged from the regular No. 12 central office power plant.

5.04 For the synchronous motor-driven calculagraphs a bell ringing transformer is used for the power supply where a regulated 110-volt 60-cycle supply is available. The transformer is mounted, in most cases, in the rear of the power board. Alarm circuits and fuses usually are not provided.

6. MAINTENANCE FACILITIES

6.01 When required, a testing circuit is provided for conducting various tests on the switchboard circuits and a voltmeter test circuit is furnished for testing lines and trunks. These testing circuits are described in some detail in Sections of Division A700. A local test cabinet No. 2 may be furnished in some cases instead of the voltmeter circuit. The description and method of operation of the local test cabinet are covered in sections of the F series.

6.02 Toll lines will usually be tested from the distant toll center. To assist in these tests, a test jack circuit is provided at the No. 12 office for setting up various testing conditions on the lines under test at the request of a tester in the distant office.

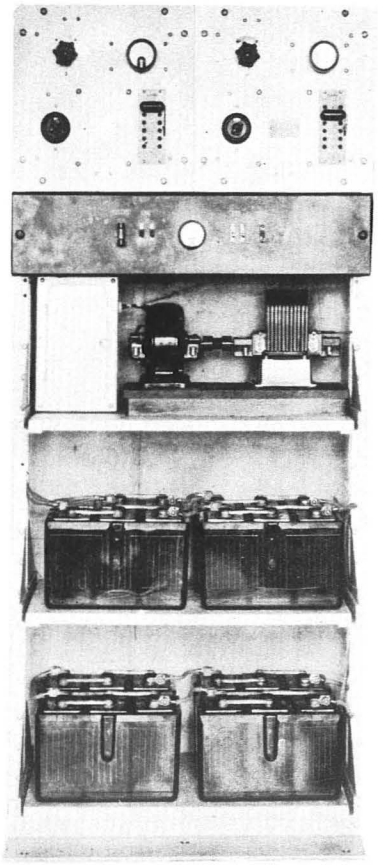


Fig. 10 - Power Plant.

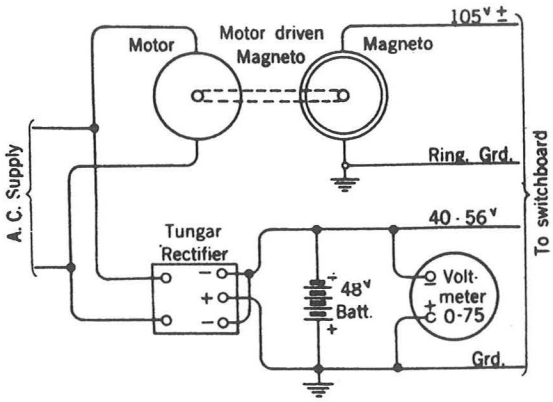


Fig. 11 - Power Circuit.

6.03 Where the toll line repeating coils are mounted on the M.D.F., test jacks, as shown in Fig. 12, are provided.

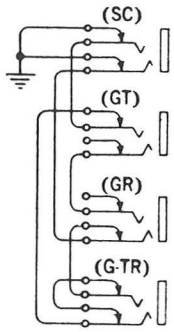


Fig. 12 - Toll Test Jacks on the M.D.F.

6.04 Connections between the toll lines and the test jacks are made by means of patching cords which may be arranged in such a manner as to produce any of the following conditions:

(a) Short of tip and ring.
(b) Ground on tip.
(c) Ground on ring.
(d) Ground on tip and ring.
(e) Connect any tip or ring to any other tip or ring.

6.05 Where the repeating coils are mounted on the relay rack, the toll testing facilities provided consist of four-jack toll line circuits and miscellaneous jack circuits. In addition, a talking and signaling circuit may be provided.

6.06 The repeating coils and jack circuits are arranged so that a toll line may be connected for testing by plugging into the "Line" jacks with a patching cord, the other end of which may be connected to other line jacks, to the talking circuit or to the miscellaneous ground jacks. Similarly the switchboard drop may be connected by inserting a patching cord into the "Drop" jacks, thus permitting patches between the "Line" and "Drop" jacks of various circuits for the purpose of interchanging line or drop facilities or for strapping out repeating coils temporarily for the purpose of making drop tests from the distant office or of making side circuits good in case of repeating coil failure.

7. CIRCUITS AND CIRCUIT DESCRIPTIONS

7.01 The circuits of the No. 12 switchboard are shown on the key sheet SD-15120-01. For any particular installation, a list of the drawings used is ordinarily provided. Detailed descriptions of the circuit operations will be found in the associated CD sheets.