TM 11-340

WAR DEPARTMENT

U. S. Dept of Army

TECHNICAL MANUAL

TELEPHONE CENTRAL OFFICE SET TC-2

October 19, 1942

U113
.2
TM11:340
1942

TECHNICAL MANUAL

TELEPHONE CENTRAL OFFICE SET TC-2

CHANGES No. 1 } 15 WAR DEPARTMENT, WASHINGTON 25, D. C., 12 November 1943.

TM 11-340, 19 October 1942, is changed as follows:

2. Description.

* * * * * * *

b. Cabinet BE-79 (main distributing frame) (fig. 2).—(1) *General.*—Cabinet BE-79 is * * * at the switchboard. **Twelve repeating coils C-161 are furnished as part of each cabinet BE-79. These coils are conveniently mounted on the line side of cabinet BE-79 to permit cross connection and cabling so that any repeating coil can be connected (between the central office side of the protectors and the switchboard cable terminals) into any incoming line as required to establish simplex or phantom circuits. (See par. 26*b*.)** Figure 2 shows repeating coils C-161 in place.

(2) *Equipment.*—Cabinet BE-79 is equipped as follows:

(*a*) *Line side.*—Protectors (protector blocks and heat coils) in two vertical **verticals** with 40 pairs per vertical. Total 80 pairs.

* * * * * * *

(*c*) *Coil rack* (Superseded).—Twelve coils C-161, mounted as shown in figure 2, are furnished as part of each cabinet BE-79.

* * * * * * *

[A. G. 300.7 (9 Nov 43).] (C 1, 12 Nov 43.)

4. Setting up and connecting equipment.

* * * * * * *

c. Cording diagram.

* * * * * * *

(2) Install the 24-volt * * * all power equipment. If the charging equipment causes objectionable noise on the telephone lines, **check for bad connections. If connections are satisfactory,** two banks of batteries will be required, one bank being charged while the other is in use. See paragraph 6 * * * RA-36-A, B, or C.

* * * * * * *

[A. G. 300.7 (9 Nov 43).] (C 1, 12 Nov 43.)

5. Switchboard operation.—The operation of the switchboard **follows standard Army practice.**

* * * * * * *

[A. G. 300.7 (9 Nov 43).] (C 1, 12 Nov 43.)

*The individual items in this change will be cut apart and pasted over the specific paragraphs or subparagraphs affected.

26. Cabinet BE-79.—The arrangement of * * * of the cabling. **Twelve repeating coils C-161 are furnished as part of each TC-2 mounted on the line side of cabinet BE-79 below the protectors as shown in figure 2.**

* * * * * * *

[A. G. 300.7 (9 Nov 43).] (C 1, 12 Nov 43.)

37. Maintenance.

* * * * * * *

b. Circuit breakers.—When a circuit breaker opens its circuit to **protect the equipment against damage as the result of excessive current flow,** the circuit breaker **must** not be re-closed until the cause of the excessive current has been determined and corrected. After the circuit * * * ON and OFF.

* * * * * * *

[A. G. 300.7 (9 Nov 43).] (C 1, 12 Nov 43.)

44. List of replaceable parts.

* * * * * * *

c. Cabinet BE-79, main distributing frame.

Ref. fig. No.	Ref. symbol	Stock No.	Name	Description	Function	Mfr.	Mfrs.' part No.	Signal Corps dwg. No.
	*	*	*	*	*		*	*
------	------	3C161	Coil C-161----	----------------	**To establish simplex and phantom circuits.**			
	*	*	*	*	*		*	*

* * * * * * *

[A. G. 300.7 (9 Nov 43).] (C 1, 12 Nov 43.)

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

U. S. GOVERNMENT PRINTING OFFICE: 1943

TECHNICAL MANUAL

TELEPHONE CENTRAL OFFICE SET TC-2

CHANGES }
No. 2 }

WAR DEPARTMENT,
WASHINGTON 25, D. C., 15 April 1944.

TM 11-340, 19 October 1942, is changed as follows:

APPENDIX (ADDED)

MOBILE FIELD INSTALLATION USING SHELTER HO-17-(&) OR HO-27-(&)

1. General.—*a.* This appendix contains a description of a method of installing the mobile Telephone Central Office Set TC-2, including one or two Switchboards BD-89 and Cabinets BE-79 (main distributing frame), in either Shelter HO-17-(&) or HO-27-(&).[1] The symbol (&) is used in this appendix to indicate all models of the equipment named. This method of mounting Telephone Central Office Set TC-2 is designed for use in fast-moving situations.

b. When Telephone Central Office Set TC-2 includes only one switchboard and main frame, the complete installation can be made in Shelter HO-17-(&) or HO-27-(&). If two switchboards and main frames are included, the installation requires a trailer, 1-ton, two-wheel, cargo, in addition to the shelter. In both cases, the shelter is mounted in the body of truck, 2½-ton, 6 x 6, cargo.

2. Lay-out of equipment.—*a.* The arrangement of the equipment in Shelter HO-27-(&) (or HO-17-(&)) for one or two switchboards and main frames is shown in figures 38 and 39, respectively.

b. Equipment which is fastened down is indicated by solid outlines; equipment not fastened down is indicated by dotted outlines.

c. Unfastened equipment must be removed from the shelter before the set is put into operation.

[1] Shelters HO-17-(&) and HO-27-(&) are identical, except that shielding is provided in the HO-17-(&) to reduce interference when the shelter is used to house a radio installation. Whenever available, Shelter HO-27-(&) should be used for the Telephone Central Office Set TC-2.

579701°—44—AGO 176

d. Cording for the electrical connections is shown as heavy solid lines. The cording is numbered and cross-referenced in the table at the bottom of the figure. The table also lists the description of the cording and its terminal points.

e. Dimensions are given for preferred locations of fastened equipment and for their points of connection to the shelter.

3. Fastening.—The equipment may be fastened to the shelter by lag screws, toggle bolts, or bolts and nuts. The lag screws are easiest to install and remove. Lag screws, bolts, or toggle bolts should have a body dimension of $\frac{5}{16}$ or $\frac{3}{8}$ inch.

4. Installation.—*a. Fastened equipment.*—The following procedure is used for fastening equipment to the shelter by either lag screws, bolts and nuts, or toggle bolts:

(1) *Use of lag screws* (preferred means).—(*a*) Drill close-fitting clearance holes in the bases of the equipment to be fastened down in the locations shown in figure 38 or 39. Use a brace and auger bit (wood) or a twist drill.

(*b*) Locate the equipment to be fastened down in the positions indicated in figure 38 or 39.

(*c*) Drill lead holes in the shelter floor, using the clearance holes previously drilled in the bases of the equipment as a guide. Use a hand drill or electric drill with a $\frac{3}{16}$-inch twist drill for $\frac{5}{16}$-inch lag screws, or a $\frac{1}{4}$-inch twist drill for $\frac{3}{8}$-inch lag screws.

(*d*) Install flat washers and lockwashers under the lag screw heads to provide additional bearing area and to prevent loosening. A sufficient number of spacing washers should be installed under the screw heads when required, so that the lag screws will project approximately $\frac{1}{4}$ to $\frac{3}{8}$ inch through the shelter floor. Insert the lag screws in the clearance holes in the equipment and screw into the lead holes in the shelter floor with a wrench. *Do not drive lag screws with a hammer.*

(2) *Use of bolts and nuts.*—(*a*) Arrange the equipment in the shelter in accordance with the dimensions shown in figure 38 or 39.

(*b*) Elevate the shelter or otherwise provide working space beneath the floor of the shelter. Take all necessary precautions to permit personnel to work beneath the shelter in safety.

(*c*) After elevating the shelter, recheck the location of the equipment to be certain that it has not moved. Relocate the equipment if necessary.

(*d*) Drill bolt clearance holes in the locations specified in figure 38 or 39. Use a twist drill for making these holes.

(*e*) Install sufficient flat washers under the bolt heads so that the bolts will not project below the bottom of the shelter skids; then insert the bolts in the clearance holes. Install flat washers, lock washers, and nuts. Tighten the nuts, using wrenches on both the nuts and the bolt heads.

(*f*) Lower the shelter to the ground or relocate it in the body of the truck.

(3) *Use of toggle bolts.*—(*a*) Arrange the equipment to be fastened in accordance with the dimensions shown in figure 38 or 39.

(*b*) Use a twist drill to drill clearance holes in the equipment and floor of the shelter, in the locations shown in figure 38 or 39.

(*c*) Insert the toggle bolts in the clearance holes. Install flat washers and lockwashers under the nuts and tighten the nuts with a wrench.

b. Cording.—(1) Install the cording in the locations shown in figure 38 or 39.

(2) Cut a hole in the rear-end wall of the shelter at the location shown in figure 38 or 39 to accommodate Cords CD-393 and CD-409. The dimensions of the hole should be the minimum size required for the cords.

(3) Cut a hole of the minimum size required in the locations shown in figures 38 or 39 to accommodate ground Cord CO-258.

(4) To make the shelter weatherproof and to keep light in, place canvas squares over the cord holes in the shelter rear-end wall. Fasten the squares by their top edges to the outside of the shelter wall.

c. Communication lines.—(1) Cut the holes for the communication lines in the shelter side wall in the locations shown in figure 38 or 39. Make the holes 3 inches in diameter and locate them above troop-seat height.

(2) Install a square of canvas over the communication-line hole at the top edge on the outside of the shelter wall to provide weatherproofing and lightproofing.

(3) At an operating point, bring the communication wires and cables through the hole and terminate them directly on the main distributing-frame terminal blocks.

d. Cabinet BE–70–(&) (wire chief's test set).—(1) When only one main distributing frame is included in the installation, construct a wooden shelf of the required size and install Cabinet BE–70–(&) on the shelter wall adjacent to Cabinet BE–79–(&). When two Cabinets BE–79 are included in the installation, shape two pieces of strap iron to form a cradle for suspending the Cabinet BE–70–(&) between the two main distributing frames at the operating point.

(2) When not in use, keep the Cabinet BE–70–(&) in Case CS–57 to protect against damage. If Case CS–57 interferes with the operation or maintenance of the central offices at operating points, it may be removed from the shelter.

e. Unfastened equipment.—When only one switchboard and main distributing frame is included in Telephone Central Office Set TC–2, locate the unfastened components in Shelter HO–17–(&) or HO–27–(&), as shown by the dotted outlines in figure 38. If two switchboards and main distributing frames are included in Telephone Central Office Set TC–2, a trailer, 1-ton, two-wheel, cargo, is required for the unfastened components. These components are located in the trailer in the positions shown in figure 40.

5. Material list.—The material required for mounting Telephone Central Office Set TC–2 in Shelter HO–17–(&) or HO–27–(&) is given in the following table. (Equivalent bolts and toggle bolts may be used (if available) instead of the lag screws listed.)

Signal Corps stock number	Name and description	Number required for—	
		1 switchboard and 1 main frame	2 switchboards and 2 main frames
3Z7700–17(&)	Shelter HO–17–(&)	1	1
or	or		
3Z7700–27(&)	Shelter HO–27–(&)	1	1
5B1006–3*	Screw, lag, G. I., 3/8″ x 3″	16	20
(*)	Screw, lag, G. I., 3/8″ x 2½″	4	8
(*)	Screw, lag, G. I., 3/8″ x 2¼″	6	6
5B20080	Washer PE–80, round, G. I	40	50
6L71006	Lockwasher, steel	28	36

*Lag screw 5/16 inch in diameter may be substituted.

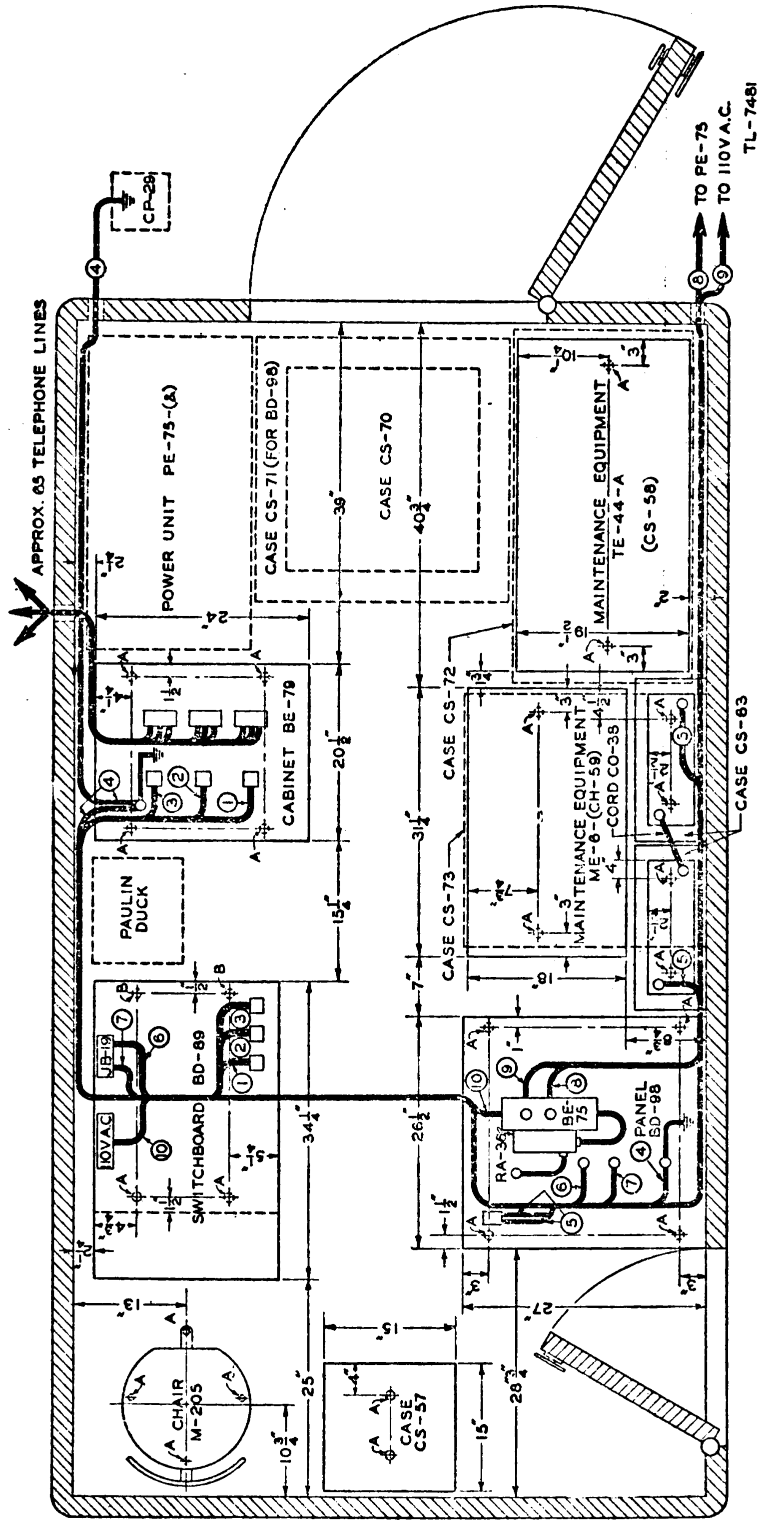


FIGURE 38.—Telephone Central Office Set TC-2, including one switchboard and one main distributing frame, mounted for operation in Shelter HO-17-(&) or HO-27-(&).

Key to figure 38.

WIRING IDENTIFICATION TABLE

Number on drawing	Description	Connects—
1, 2, 3	Cord CD-298 (part of BE-79)	BE-79 to BD-89
4	Cord CO-258	BE-79 to GP-29
4	Part of BD-98	BD-98 to BE-79
5	Cord CD-335	BB-46 to BD-98
6	Part of JB-19	BD-89 to BD-98
7	Part of JB-19	BD-89 to BD-98
8	Cord CD-409	PE-75 to BE-75
9	Cord CD-393	BE-75 to a-c power
10	Cord CD-395	BE-75 to BD-89

NOTES.—1. *A* and *B* designate locations of the equipment clearance holes and the shelter floor lead holes, used for holding the lag screws for fastening. Do not drill clearance holes in the shelter floor unless bolts or toggle bolts are to be used for fastening.
2. *B* designates clearance holes drilled in back-cover slots of Switchboard BD-89. The back cover should be notched at lower corners to clear lag screw heads.

Key to figure 39.

WIRING IDENTIFICATION TABLE

Number on drawing	Description	Connects—
1, 2, 3	Cord CD-298 (part of BE-79)	BE-79 to BD-89
11, 22, 33	Cord CD-298 (part of BE-79)	BE-79 to BD-89
4	Cord CO-258	BE-79 to GP-29
4A	Cord CO-259	BE-79 to BE-79
4B	Part of BD-98 (ground)	BE-98 to BE-79
5	Cord CD-335	BB-46 to BD-98
6	Part of JB-19	BD-89 to BD-98
7	Part of JB-19	BD-89 to BD-98
8	Cord CD-409	PE-75 to BE-75
9	Cord CD-393	BE-75 to a-c power
10	Cord CD-395	BE-75 to BD-89
10A	Cord CD-394 (a-c power)	BD-89 to BD-89

NOTES.—1. *A* and *B* designate locations of the equipment clearance holes and the shelter floor lead holes, used for holding the lag screws for fastening. Do not drill clearance holes in the shelter floor unless bolts or toggle bolts are to be used for fastening.
2. *B* designates clearance holes drilled in back-cover slots of Switchboard BD-89. The back cover should be notched at lower corners to clear lag screw heads.

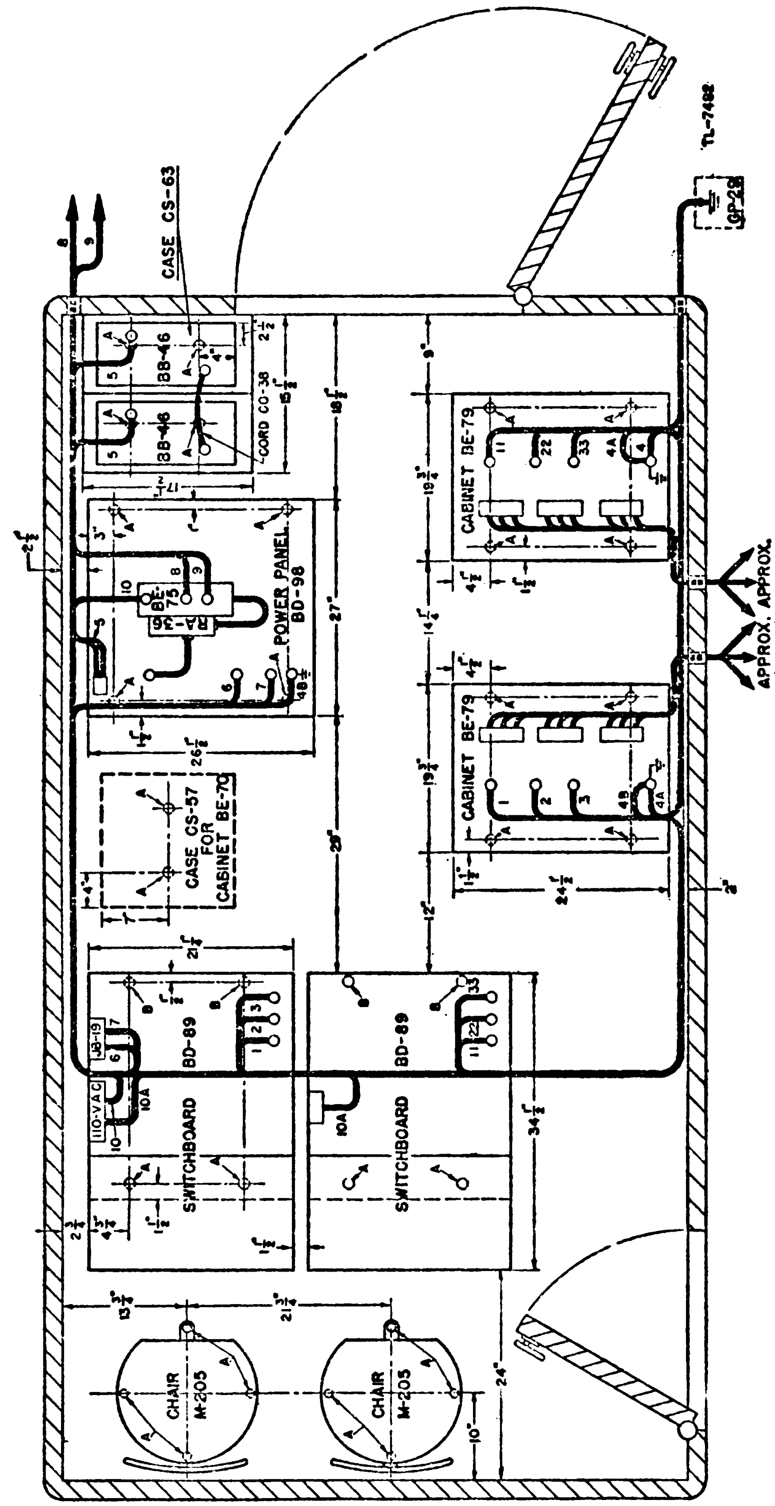


FIGURE 39.—Telephone Central Office Set TC-2, including two switchboards and two main distributing frames, mounted for operation in Shelter HO-17-(&) or HO-27-(&).

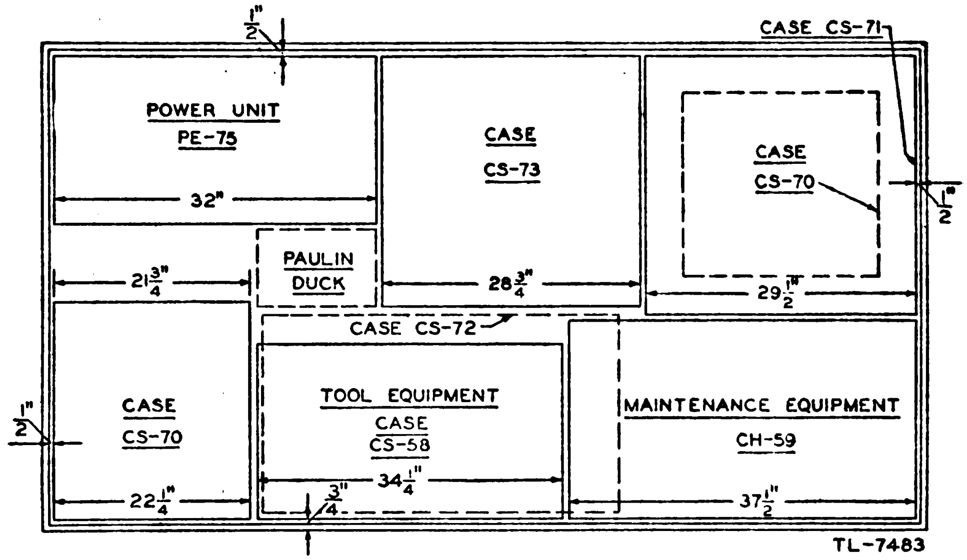


Figure 40.—Arrangement in trailer of unfastened equipment when two-position Telephone Central Office Set TC-2 is installed in Shelter HO-17.

[A. G. 300.7 (10 Mar 44).]

By order of the Secretary of War:

G. C. MARSHALL,
Chief of Staff.

Official:

J. A. ULIO,
Major General,
The Adjutant General.

Distribution:

Armies (2); Corps (2); Sv C (1); Depots (1); Def Comds (1); D (2); IBn 11 (2); IC 11 (10); Sig C Sch (50).

IBn 11: T/O 11-15, Sig Bn.

IC 11: T/O 11-88-S, Sig Co Opn Wire Armd; 11-267, Sig Co AAF; 11-217, Sig Co Avn; 11-287, Sig Co Dep Avn; 11-18; Field Opn Co, Sig Bn; 11-460-15, Sig Hqs Co, AWS Fi Comd; 11-107, Sig Dep Co; 11-127, Sig Rep Co; 11-327, Sig Port Sv Co; 11-587, Sig Base Maint Co.

For explanation of symbols see FM 21-6.

AGO 176

U. S. GOVERNMENT PRINTING OFFICE: 1944

TECHNICAL MANUAL
No. 11-340

WAR DEPARTMENT
WASHINGTON, OCTOBER 19, 1942.

TELEPHONE CENTRAL OFFICE SET TC-2

*This manual supersedes TM 11-340, November 1, 1941.

Section I

GENERAL

1. Use.—*a. General.*—Switching central, telephone central office set TC-2, is for use at an army corps or other headquarters which requires a telephone switchboard of the capacity of one or two switchboards BD-89-A as described in paragraph 2*a*. The total weight of the complete equipment is approximately 2,900 pounds.

b. Component parts.—

Quantity	Article	Approximate size	Approximate weight in pounds
2	Battery BB–46	15½"x 6½"x14–9/16"	97 each
1	Cabinet BE–70–B (wire chief's test set)	12" x 9"x18"	32
1	Cabinet BE–75 (a-c power distribution)	13½"x 4–5/8"x 9¾"	25
1	Cabinet BE–79 (main distributing frame)	26" x20"x41¾"	300
1	Case CS–57 (for BE–70–B)	15¼"x15¼"x22¾"	36
2	Case CS–63 (for BB–46)	20½"x 8–5/8"x20"	19 each
1	Case CS–70 (for M–205)	22½"x22½"x36"	67
1	Case CS–71 (for BD–98)	30" x28½"x29½"	110
1	Case CS–72 (for FM–31, HM–5, and 3 GP–29)	20" x10½"x39½"	50
1	Case CS–73 (for RA–36–A, B, or C, BE–75, and FM–30)	26¾"x28¾"x24¾"	63
1	Chair M–205	Packed in CS–70	22
1	Cord CD–335 (BB–46 to BD–98)	30' long	13
1	Cord CD–393 (a-c power to BE–75)	50' long	20
1	Cord CD–394 (a-c power; BD–89 to BD–89)	8' long	5
1	Cord CD–395 (BE–75 to BD–89–A)	30' long	10
1	Cord CD–409 (PE–75–A, B, or C to BE–75)	50' long	20
1	Cord CO–38 (BB–46 to BB–46)	1' long	1/16
1	Cord CO–258 (BE–79 to GP–29)	50' long	4
1	Cord CO–259 (ground lead, BE–79 to BE–79)	5' long	2
3	Ground rod GP–29	36" x 2¼" diameter	25 each
1	Hammer HM–5	36" long	12
2	Head and chest set HS–19	Packed in switchboard	1½ each
1	Junction box JB–19	10½"x 4"x 5¾" with 2—30' cables	17
1	Maintenance equipment ME–6 (CH–59)	39" x21"x30"	250
1	Panel BD–98 (power)	24½"x26"x26½"	145
2	Paulin, duck, type I, equipped with not less than 10 grommets with 5½' cotton tie ropes	12.3'x16'	55 each
1	Power unit PE–75–A, B, or C	25½"x24½"x32"	275
1	Rack FM–30 (for RA–36–A, B, or C and BE–75)	24" x16¾"x20¾"	50
1	Rack FM–31 (for BB–46)	16" x16" x 3"	7
1	Rectifier RA–36–A, B, or C	21" x16½"x20"	75
1	Switchboard BD–89–A	22½"x35½"x47¼"	400
1	Tool equipment TE–44–A	34¼"x18¾"x26¾"	50

2. Description.—*a. Switchboard BD–89–A* (fig. 1).—(1) *General.*—Switchboard BD–89–A is a complete, portable, single-position, two-panel, manually operated telephone switchboard for serving both magneto and common-battery lines, and is arranged for handling both types of local calls as well as originating and terminating trunk and tie-line traffic. Universal cord circuits are employed. Lamp signals are provided for the common-battery lines and the cord circuits. Drop signals are provided for the magneto lines, with magneto recall lamps associated with each cord. The line jacks are wired to a binding post panel at the rear of the switchboard which provides for connections with spade-terminal strips through rubber-jacketed cable to cabinet BE–79 (main distributing frame). Terminal facilities are provided for making connections to the exchange battery, ringing current, and grouping key circuit.

(2) *Circuits.*—Each switchboard contains the following circuits:

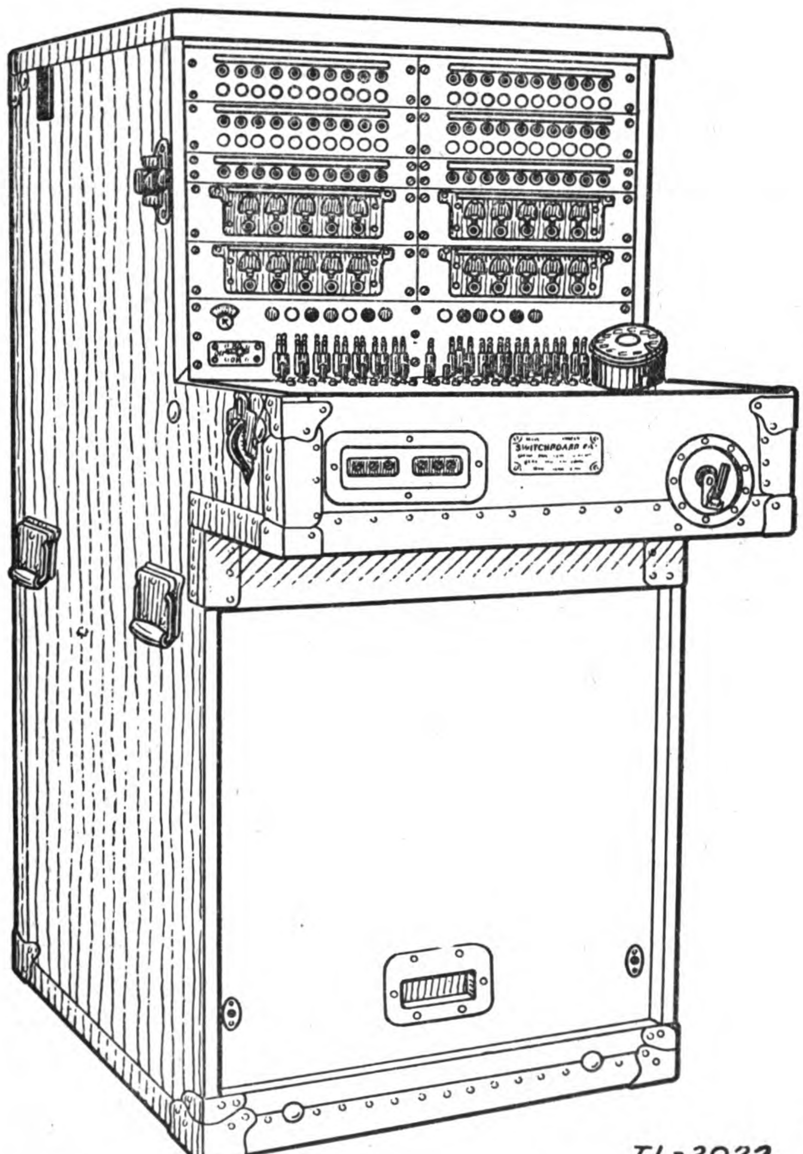
Quantity	Type of Circuit
1	Operator's telephone circuit with grouping key
13	Universal cord circuits
1	Ringing circuit
20	Line circuits, magneto (drop and jack)
37	Line circuits, common-battery (lamp and jack)
1	Trunk circuit, two-way to dial (automatic telephone central office)
1	Dial cord circuit
2	Trunk circuits, two-way to common-battery manual telephone central office
3	Line circuits, outgoing
2	Line circuits, through
1	Conference circuit (5 jacks)
1	Switchboard test circuit
1	Night alarm circuit
1	Fuse alarm circuit
1	Battery and ground circuit, 24 volts
1	Power and heating circuit

(3) *Jack numbering.*—The jack equipment on the face of switchboard BD–89–A is divided generally into two panels of five jack mounting strips each.

(*a*) *Magneto line jacks.*—The magneto line jacks and drop signals appear in the two bottom jack mounting strips in each panel, and are of the mechanically restored, combined jack and signal type, mounted five per strip. The lines are numbered consecutively from 0 to 19, starting from the lower jack strip in the left-hand panel. Jacks are numbered from left to right; thus the lines appearing in the bottom jack strips of the left-hand and right-hand panels are numbered from 0 to 4 and 5 to 9, respectively. Lines 10 to 19 appear in the second row of jack strips, counting from the bottom.

(*b*) *Third jack strip, left-hand panel.*—The first jack is the dial jack for the dial trunk (which appears in the fourth jack strip from the bottom, and immediately above the dial jack). The second and third jacks from the left-hand end are the *A* and *B* jacks, respectively, of the first through line circuit (par. 12). The fourth and fifth jacks are, respectively, jacks *A* and *B* of the second through line circuit. The last five jacks in this jack strip are the conference jacks *A*, *B*, *C*, *D*, and *E*, respectively (par. 18).

(*c*) *Third jack strip, right-hand panel.*—The first seven jacks, counting from the left of the jack strip, are the jacks of the switchboard test circuit (par. 19), *A, B, C, D, E, F,* and *G,* respectively. The three remaining jacks on the right-hand end of the jack strip are the jacks associated with outgoing line circuits (par. 11) 1 to 3, inclusive.



TL-3922

FIGURE 1.—Switchboard BD-89-A, front view, cover removed.

(*d*) *Fourth jack strip, left-hand panel.*—The first jack is the dial trunk answer jack (par. 13) and is numbered 0 (zero). The second and third jacks are the two manual trunk answer jacks (par. 14) and are numbered 1 and 2. The remaining seven jacks are common-battery line jacks (par. 10) and are numbered from 3 to 9, inclusive.

(*e*) *Fourth jack strip, right-hand panel.*—This jack strip contains the jacks associated with common-battery line circuits numbered 10 to 19, inclusive.

(*f*) *Fifth row of jack strips.*—Common-battery line circuits 20 to 29 appear in the jacks in the left-hand panel, and circuits 30 to 39 appear in the right-hand panel.

(4) *Case.*—The case of switchboard BD–89–A is of trunk type construction, making a separate packing case unnecessary for army transportation.

b. Cabinet BE–79 (*main distributing frame*) (fig. 2).—(1) *General.*—Cabinet BE–79 is a main distributing frame unit for use with one switchboard BD–89–A. It is equipped with protector blocks and heat coils which are connected to terminal strips. Binding posts TM–197 are provided for the incoming lines and for cross-connecting, so that all such connections can be made in the field without soldering. The connections from cabinet BE–79 to switchboard BD–89–A are made with rubber-jacketed cables (cord CD–298) equipped with binding post cable connectors (terminal strips) at the cabinet, and spade-terminal cable connectors (terminal strips) at the switchboard. Provision is made for mounting and cross-connecting repeating coils C–161 (not furnished as part of the TC–2). Figure 2 shows repeating coils C–161 in place.

(2) *Equipment.*—Cabinet BE–79 is equipped as follows:

(*a*) *Line side.*—Protectors (protector blocks and heat coils in two vertical with 40 pairs per vertical). Total 80 pairs.

(*b*) *Switchboard side.*—Terminals connected to switchboard. (Three verticals of 25 pairs per vertical.) Total 75 pairs.

(*c*) *Coil rack.*—Capacity for 12 coils C–161. These coils are not furnished as part of cabinet BE–79.

(3) *Terminal numbering.*—The cross-connecting terminals on the switchboard side of cabinet BE–79 are mounted in three verticals. The circuits appearing on each vertical are as follows:

(*a*) *Left-hand vertical.*—The 20 magneto line circuits appear on the top 20 pairs of binding posts and are numbered from 0 to 19, in descending order. The 10 terminals associated with through line circuit No. 1 appear immediately below the magneto line

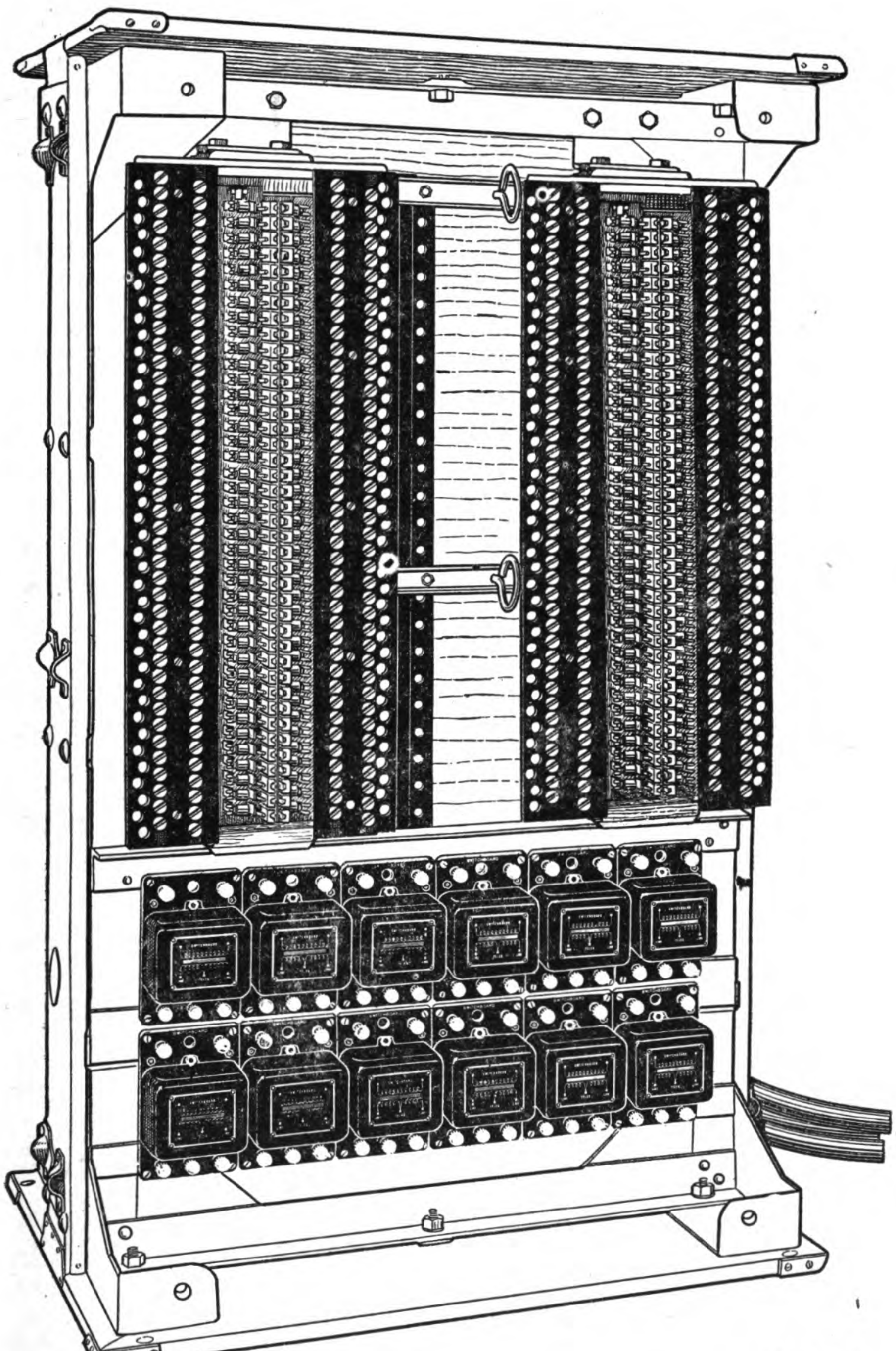


FIGURE 2.—Cabinet BE–79, line side, showing repeating coils in place.

terminals. The terminal designations of each binding post associated with the through line circuit are stenciled on the binding post panel opposite the corresponding binding post. See paragraph 4*g* for method of connecting the through line circuit.

(*b*) *Center vertical.*—The dial trunk appears on the top pair of binding posts and is numbered 0 (zero) and is stenciled DIAL. The two common-battery manual trunks appear on the second and third pairs of binding posts, and are not numbered, but are stenciled MANUAL. Common-battery line circuits from 3 to 19 inclusive appear in descending order immediately below the manual trunk binding posts, in positions 3 to 19. The binding posts for through line circuit No. 2 are immediately below the terminals for common-battery line circuit No. 19. The marking of the binding posts and connections are outlined in subparagraph (*a*) above.

(*c*) *Right-hand vertical.*—Common-battery line circuits numbered 20 to 39 appear on the top 20 pairs of binding posts in descending order. The binding posts for the three outgoing line circuits appear immediately below the common-battery line terminals. The proper designations for the through line terminals are stenciled on the terminal strip.

(4) *Ground terminal screw.*—The ground terminal screw is located in the center of the vertical portion of the bottom angle iron on the switchboard cable side of cabinet BE–79.

(5) *Case.*—The case of cabinet BE–79 is of trunk type construction, making a separate packing case unnecessary for army transportation.

c. Power equipment.—The power equipment consists of two batteries BB–46 for furnishing 24-volt d-c power to switchboard BD–89–A, one panel BD–98 (including ringing equipment) (fig. 3) for d-c power control, one rectifier RA–36–A, B, or C (fig. 4) for charging the storage batteries, one cabinet BE–75 for control of the a-c power distribution, and one power unit PE–75–A, B, or C (covered in TM 11–900 or TM 11–901) for supplying a-c power when such power is not available from an independent source. Flexible rubber-jacketed cables are included for interconnecting the several units of power equipment (see fig. 5). Cases are furnished for transportation of the equipment.

d. Rectifier RA–36–A, B, or C (fig. 4).—Rectifier RA–36–A, B, or C, supplied as part of the TC–2, is a full-wave, vacuum-tube rectifier, capable of charging storage batteries at a maximum rate of from 12 to 14 amperes. The rectifier has two charging circuits, each with a separate ammeter and control board. The left-hand circuit of the rectifier is controlled by the left-hand control board, and the right-hand circuit is similarly controlled by the right-hand control board. The control board for each circuit is equipped for making both coarse and fine adjustments in the charging rate. For

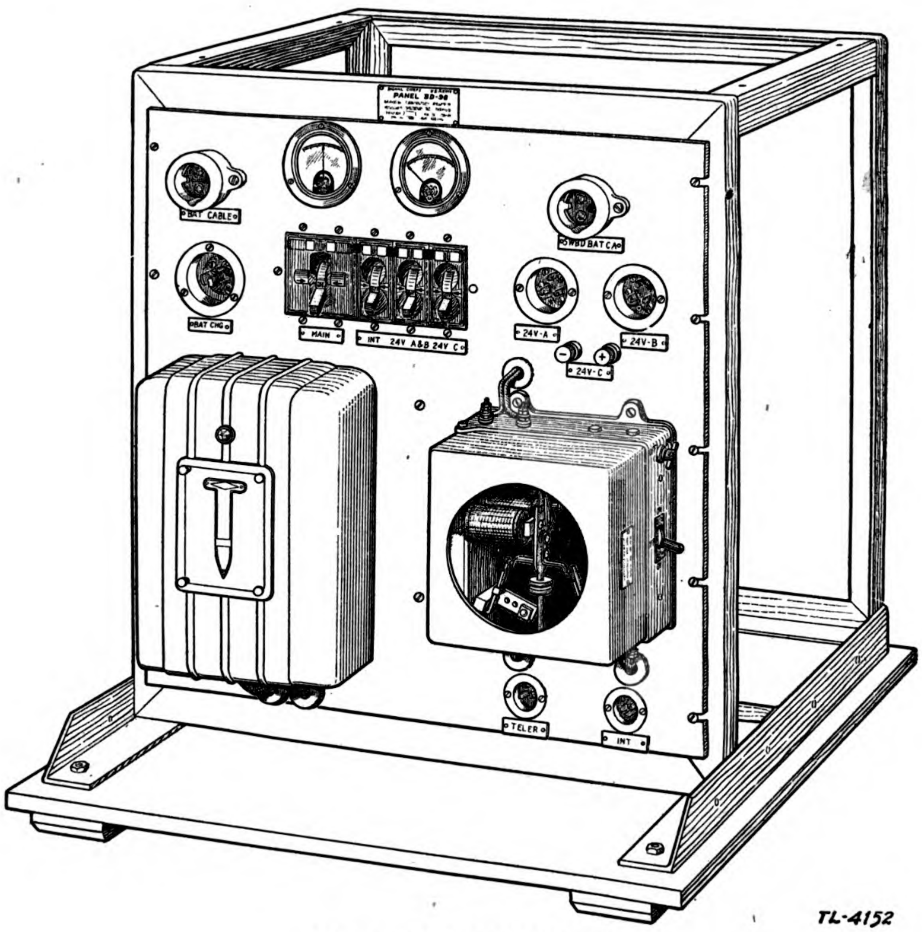


FIGURE 3.—Panel BD-98.

telephone service, the two rectifier circuits are connected together, in order that a full-wave output may be secured. The rectifier is designed to operate on alternating current line voltages of 105, 115, or 125 volts. The proper connection for any of the various alternating current line voltages is made on the primary terminal board, located behind the safety door and near the bottom of the front panel. The transformer is of the insulated type (separate windings for primary and secondary) in order that this rectifier may be suitable for charging telephone batteries where one terminal of the battery is connected to ground. It may be desirable to remove the rectifier tubes and pack them separately for transportation.

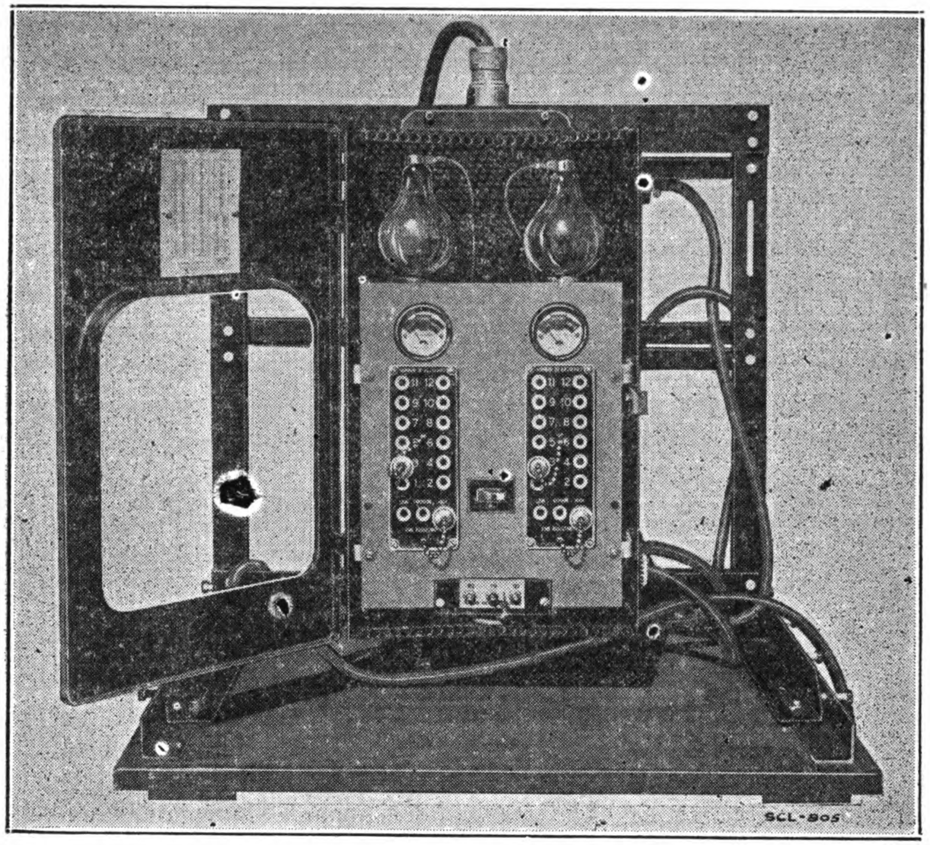


FIGURE 4.—Rectifier RA-36-A, B, or C.

e. Line test equipment.—Cabinet BE-70-B, furnished as a part of TC-2, is a wire chief's test cabinet which affords means of accurately locating practically all faults common to both magneto and common-battery telephone exchanges. Tests can be made in a simple manner for grounds, short circuits, crosses, opens (lack of continuity), bad joints, etc., without complicated mathematical calculations. The test cabinet is equipped with a Weston M24, flush type, 100,000-ohm voltmeter. A 30-volt battery is used for test purposes. Case CS-57 is supplied for transportation of cabinet BE-70-B. Cabinet BE-70-B is covered in detail in TM 11-345.

SECTION II

EMPLOYMENT

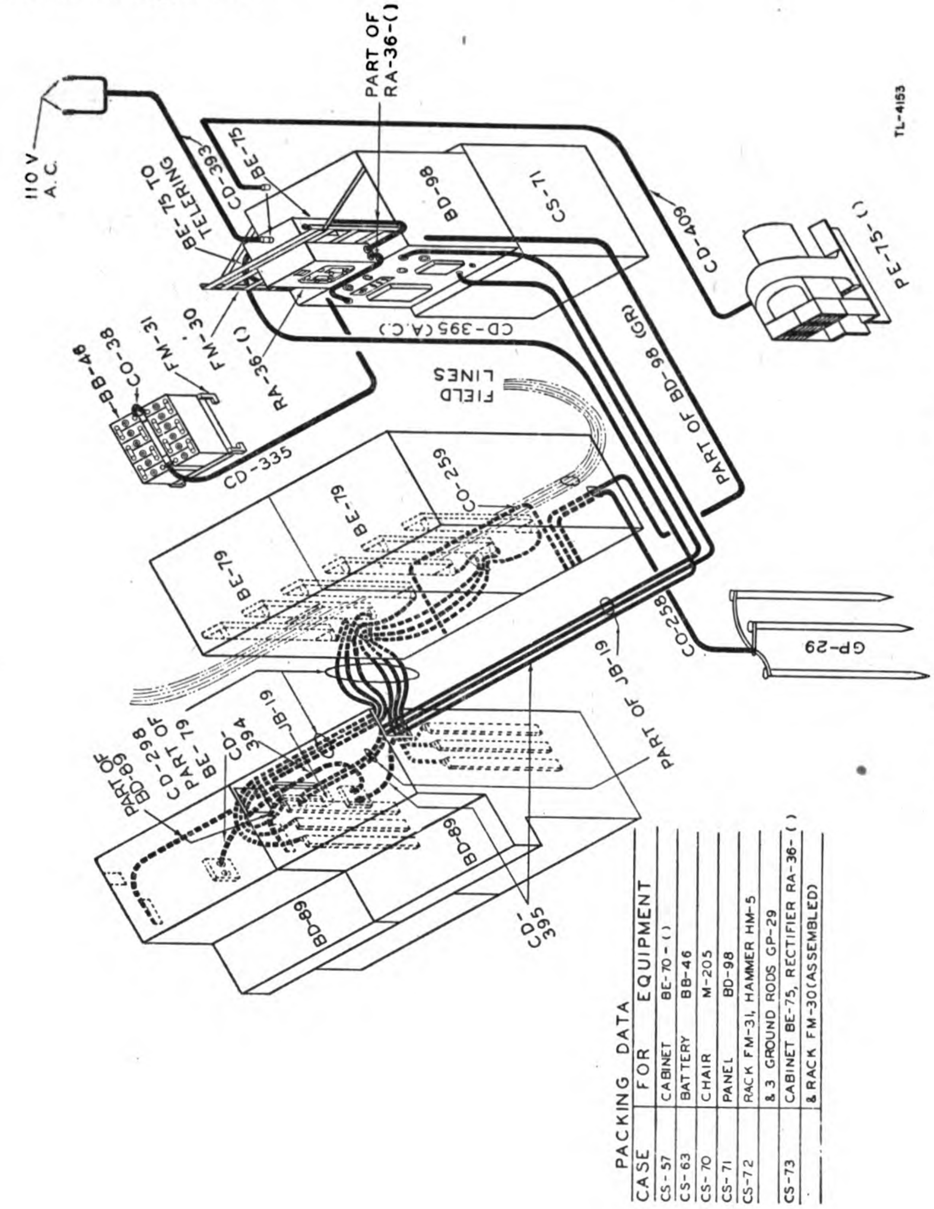
Paragraph

3. Equipment layout.—Before an installation is made, determine the general layout of the equipment, with due consideration given to local conditions. It is desirable to install the switchboard in a room away from the other equipment in order that the operation of the switchboard may be free from interruption and disturbance.

4. Setting up and connecting equipment.—*a.* Refer to figure 5 for cabling arrangement. Set the switchboard in the desired location and remove the front cover. Loosen the drop support mounting screws (at the extreme ends of the drop support strips) and raise the drop supports from the locking position to the service position, leaving the drops free to fall. Remove the panel underneath the keyshelf and remove the cord weights from the cord-weight support. Place the movable member of the cord-weight support back so that it will not interfere with the movement of the cords. Remove the rear panel and the top cover. Inspect the switchboard for damaged or loose parts.

b. Set cabinet BE–79 (main distributing frame) in the desired location within cabling distance of switchboard BD–89–A. Remove the two covers. Disconnect the spade-terminal cable connectors from the binding-post cable connectors to which they were fastened during transportation. Unstrap the cables and attach them to the switchboard. Cross-connect the lines from the binding-post panels at the right of the protectors to the binding posts on the cable side of the cabinet. The incoming lines should be connected to the binding posts located at the left of the protectors. Install protector blocks and heat coils, if not already in place.

c. Cording diagram.—(1) Figure 5, cording diagram, shows the necessary cord connections when two switchboards BD–89–A are used together. However, the same cording arrangement may be used when only one switchboard is required, by using only those cords and connections that apply to the right-hand switchboard shown in figure 5.



PACKING DATA		
CASE	FOR	EQUIPMENT
CS-57	CABINET	BE-70-( )
CS-63	BATTERY	BB-46
CS-70	CHAIR	M-205
CS-71	PANEL	BD-98
CS-72	RACK FM-31, HAMMER HM-5 & 3 GROUND RODS GP-29	
CS-73	CABINET BE-75, RECTIFIER RA-36-( ) & RACK FM-30 (ASSEMBLED)	

FIGURE 5.—Cording diagram, TC-2.

(2) Install the 24-volt battery group (2 batteries BB–46), power unit PE–75–A, B, or C, and panel BD–98 in the selected location. See figure 5 for method of assembling case CS–71, panel BD–98, and rack FM–30 (containing rectifier RA–36–A, B, or C, and cabinet BE–75) into one unit. Install the three ground rods GP–29. Connect cord CO–258 from cabinet BE–79 to ground rods GP–29, and the

ground lead (GR) from cabinet BE–79 to the ground terminal on panel BD–98. Connect cord CD–395 from switchboard BD–89–A to cabinet BE–75. Connect the switchboard battery cable and ringing cable from junction box JB–19 to panel BD–98. Connect the two batteries BB–46 in series with cord CO–38, and connect cord CD–335 from the two batteries BB–46 to panel BD–98. Plug the Telering power-ringer cord into cabinet BE–75 and cords from rectifier RA–36–A, B, or C to cabinet BE–75 and panel BD–98, respectively. Connect cabinet BE–75 to the 110-120-volt a-c power supply with cord CD–393, or if an independent source of a-c power is not available, connect panel BD–98 to power unit PE–75–A, B, or C with cord CD–409 after the power unit has been checked for proper operation (refer to TM 11–900 or TM 11–901 covering the power unit). Test the operation of all power equipment. If the charging equipment causes objectionable noise on the telephone lines, two banks of batteries will be required, one bank being charged while the other is in use. See paragraph 6 for operating instructions for rectifier RA–36–A, B, or C.

d. Insert fuses in the fuse mountings on the rear of switchboard BD–89–A, if not already in place. Plug in the operator's head and chest set HS–19. Test the operation of all circuits. See section III for detailed descriptions of the various circuits. Check line and trunk designation strips and make changes as required.

e. Install and test cabinet BE–70–B, wire chief's testing cabinet (see par. 7).

f. When a second switchboard BD–89–A and its associated cabinet BE–79 are required, install them as indicated in figure 5. Supply a-c power to the second switchboard BD–89–A from the first switchboard BD–89–A by means of cord CD–394. Connect the battery and ringing current cord of the second switchboard to junction box JB–19 of the first switchboard. Extend ground from the frame of the first cabinet BE–79 to the second cabinet BE–79 by means of cord CO–259.

g. If a through line circuit (par. 12) is desired, cross-connect the jacks as follows: Binding posts designated *T1*, *R1*, and *S* associated with jack *A* should be cross-connected to similarly designated binding posts associated with jack *B*. The *T* and *R* terminals of jack *A* are now associated with the *T* and *R* terminals of jack *B* through the cut-off springs of the respective jacks.

5. Switchboard operation.—The operation of the switchboard is characteristic of comparable commercial practice.

a. Incoming calls.—A drop signal indicates a call on a magneto line. A line lamp (located below the line jack) indicates a call on a common-battery line or trunk.

b. Answering calls.—To answer a call, insert the answering (back) plug in the jack associated with the signal, and operate the TALK-RING key (in front of, and in line with the plug being used) to the locking TALK position (away from the operator) to connect the operator to the circuit.

c. Outgoing calls.—(1) *Calls to station line.*—To call a station, insert the calling (front) plug in the desired party's line jack and operate the TALK-RING key to the non-locking RING position (toward the operator).

(2) *Trunk calls to dial exchange.*—To connect a telephone to a dial exchange for the purpose of making an outgoing call, proceed as follows: Insert the calling (front) cord plug in the LINE jack of the dial trunk. Wait for dial tone. When dial tone is heard, plug the dial cord plug into the DIAL jack and dial the desired number. Remove the dial cord plug at once and listen for the ringing tone.

(3) *Trunk calls to common-battery manual exchange.*—Connect the calling (front) cord plug to the manual trunk jack. The act of inserting the plug into the manual trunk jack signals the distant manual operator.

d. Supervision.—(1) *Common-battery circuits.*—Supervision on common-battery circuits is provided by a double row of lamp signals located on the keyshelf between the row of keys and the plugs. The lamp signals in the front row are associated with the front cords, and the lamps in the back row are associated with the back cords. To assist in identification of corresponding cords and lamps, the colors of the various lamp caps are the same color as their associated cords, alternate red, white, and green. Double supervision is thus provided. A lighted supervisory lamp indicates that either the calling or called party (depending on which lamp is lighted) has not answered or has disconnected. Intermittent up and down movement of the telephone receiver switchhook on a common-battery circuit causes the cord supervisory lamp to flash. Upon receiving such a flashing signal, the operator challenges on the line by operating the TALK key associated with the flashing lamp, and requests the wishes of the telephone user. Care must be used in supervising trunk calls to or from a manual common-battery exchange and in disconnecting promptly, since the operator at that exchange normally depends upon receiving a disconnect signal from the trunk to switchboard BD–89–A before completing disconnection in the manual central office.

(2) *Magneto circuits.*—Each magneto circuit supervisory lamp is located on the face of the board directly above the associated plugs. Ring-off or recall (the signal sent to the operator when either party operates his ringing generator after completion of a call) is indicated by a lighted lamp which remains lighted only during the ringing period. Upon observing a lighted recall lamp, the operator challenges on the line before taking down the cords to determine whether the signal means disconnect or recall.

e. Grouping key.—By operating the grouping key (engraved GR) on the keyshelf, the cords of this switchboard may be used by an operator at an adjacent switchboard during periods of light traffic, when it is not necessary that this switchboard position be attended.

f. Night alarm key.—The night alarm circuit may be disconnected by operating the night alarm key (engraved NA) on the face of the switchboard to the OFF position. Operate the night alarm release key (engraved NA RLS) on the keyshelf after each actuation of the night alarm circuit caused by the lighting of a common-battery line lamp, in order to release the alarm and prepare the circuit for the next signal.

g. Monitoring key.—To monitor (listen) on a circuit, first operate the monitoring key (engraved MON), and then operate the TALK key associated with the cord circuit used. The operator cannot talk on the line being monitored but can listen in to determine whether or not the line is in use. The monitoring key connects the operator's receiver across the line without introducing any perceptible loss in transmission.

h. Conference circuit.—The conference circuit is used to connect a number of lines together as follows: Insert an answering (rear) cord plug in the jack associated with the telephone of the person originating the conference. Then insert the associated calling (front) cord plug in a conference-circuit jack. The conference is completed by inserting the answering cord plugs in other jacks of the conference circuit and calling the desired telephones with the respective calling cords. Patching cords may also be used in conference connections under certain conditions (see par. 18*b*).

6. Rectifier RA–36–A, B, or C.—*a. Installation.*—Care should be exercised when removing rectifier RA–36–A, B, or C from case CS–73, to avoid damaging the equipment and meters. Mount the rectifier on frame FM–30 and fasten it securely. Before making any electrical connections, be sure that the a-c circuit to which the rectifier is to be connected agrees with the voltage and frequency stamped on the name plate. If there is any doubt about the voltage and frequency of a commercial source of a-c power, consult the local power company for information. Connect the movable primary lead (fig. 4) to the voltage tap, on the primary terminal board, that is nearest the value of the actual line voltage. Install the two rectifier tubes, if these have been packed separately, and attach the connecting leads with clips to the wires at the top of the tubes. The two rectifier tubes must be firmly screwed into their respective sockets.

b. Connections.—(1) Before connection is made to the storage batteries, turn the control switch to the OFF position and remove all four adjustment plugs, in order to prevent damage to the rectifier in case the two leads to the battery should accidentally become shorted prior to actual connection to the battery, and to avoid accidentally overloading the rectifier when the batteries are first connected.

(2) The two negative (−) leads have been connected together and wired through a cable to power panel BD–98. This cable is part of rectifier RA–36–A, B, or C.

(3) The positive (+) lead has been wired through a reactance, then through the cable to power panel BD–98. The reactance is used as a noise filter to prevent electrical noise from the rectifier from reaching the storage battery, and thence into the talking circuits.

c. Operation.—(1) In order to get the most efficient operation from the rectifier, place the coarse adjustment plugs in correspondingly numbered holes on the right and left control panels (fig. 4). Likewise place the fine adjustment plugs in correspondingly designated holes, LOW, MEDIUM, or HIGH.

(2) Initial settings of the coarse and fine plugs, when charging two batteries BB–46 in series, are as follows:

Coarse adjustment plugs in hole 4;
Fine adjustment plugs in hole marked LOW.

Turn the control switch to the ON position. The charging rate will be the sum of the two ammeter readings. If the charging rate is not high enough, turn the control switch to the OFF position and move both fine adjustment plugs to the MEDIUM position. Turn the rectifier on again. If the charging rate is still too low, the same procedure should be followed, and the fine adjustment plugs moved to the HIGH position. If still unable to obtain a charging rate as high as desired, again turn off the control switch and move the coarse adjustment plugs to the next higher numbered hole and the fine adjustment plugs to the LOW position and proceed as before. If the charging rate is too high, follow the reverse procedure, by moving the coarse adjustment plugs to the next lower numbered hole, and the fine adjustment plugs to the HIGH position. The fine adjustment plugs are then moved to the MEDIUM or LOW position as required.

Caution.—Always turn the control switch to the OFF position before making any adjustment to the rectifier, otherwise the tubes may be severely damaged.

(3) *Charging rate.*—Reference should be made to TM 11–430 for the proper charging rate for the various types of storage batteries encountered in the field. Other information relating to the care and use of storage batteries may be found in the same reference.

7. Cabinet BE–70–B.—The cabinet BE–70–B, wire chief's testing cabinet, may be mounted in any convenient location, either adjacent to the switchboard, or in the terminal room near the distributing frame. When the testing cabinet is located near the switchboard, connection may be made to the line to be tested by reaching across the face of the switchboard with the test cord from cabinet BE–70–B. When the testing cabinet is located near the main distributing frame, connections to the line to be tested may be made with a test shoe. The *T*, *R*, and *S* test cord terminals in cabinet BE–70–B may also be connected to the corresponding terminals of an outgoing line circuit, in order to provide means of testing lines from the switchboard, even though the testing cabinet may be located at some distance from the switchboard. Connection between the outgoing line circuit jack and the line jack of the circuit to be tested is made at the switchboard by means of a patching cord. The outgoing line circuit must be of the type that has no series or bridged line equipment, such as is shown in figure 10. Details of installation and method of operation of cabinet BE–70–B are covered in TM 11–345.

SECTION III

DETAILED FUNCTIONING OF PARTS

8. Switchboard BD–89–A.—The switchboard cabinet, framework, mounting plates, and miscellaneous mechanical details were designed for the mounting and assembly of standard telephone apparatus to form a telephone switchboard suitable for military use. Induction coil C–105, monitor coil C–278, jack JK–37, head and chest set HS–19, binding post TM–197, generator GN–41, and the terminal panel are of Signal Corps design and are used in other equipment. The remaining apparatus consists of standard commercial parts. See list of replaceable parts in paragraph 44.

a. Equipment layout.—The front equipment layout is shown in figure 1 and described in paragraph 2*a*(2). The rear equipment layout is shown in figure 6. The lower section of the switchboard is occupied by the cords, a rack upon which are mounted all cord circuit relays, capacitors, operator's telephone circuit apparatus, trunk circuit equipment, and switchboard fuses. All equipment associated with each individual circuit unit is mounted on individual mounting plates for ease in replacing complete units. The upper section of the switchboard is occupied by the jack and signal

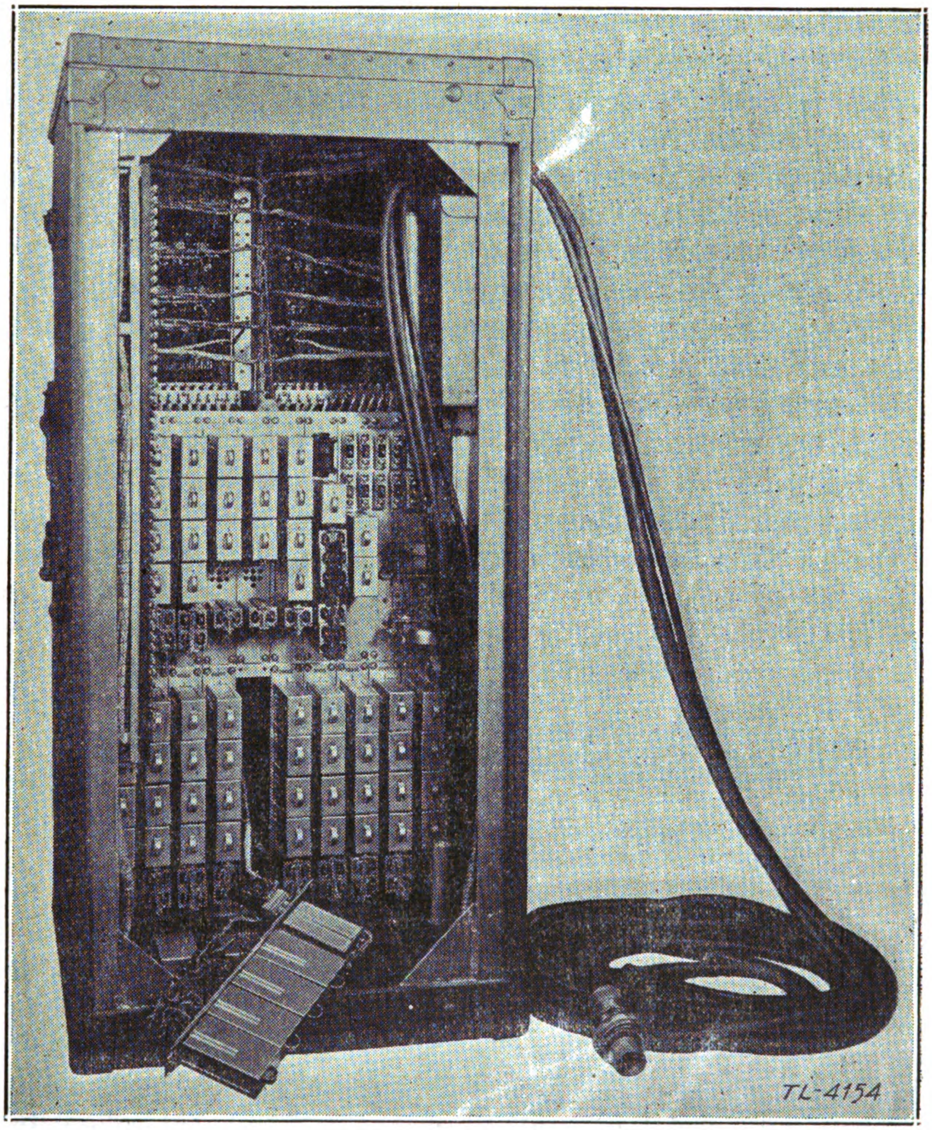


FIGURE 6.—Switchboard BD–89–A and junction box JB–19, rear view, cord circuit mounting plate removed.

equipment. The line binding post panel is mounted on the left-hand side of the switchboard, as viewed from the rear of the switchboard. The binding post panel may be unfastened from the supporting framework to provide access to the wiring side of the panel and to other apparatus. The binding post panel contains 150 binding posts in three vertical rows of 50 binding posts each. These binding posts are arranged to screw down on the spade-terminal strips attached to the cable which connects to cabinet BE-79. The binding post screws should be tightened only by means of a screw driver. The purpose of the binding post panel is to provide rapid means of connecting the line circuits to cabinet BE-79.

b. Tip, ring, and sleeve.—In subsequent discussions, frequent reference is made to the terms "tip," "ring," and "sleeve." This method of designating the three conductors (two line wires and one control wire) is derived from the plug used on a manual switchboard. One of the cord conductors is connected to the tip of the plug, a second conductor is connected to the ring of the plug, and the third conductor (control wire) is connected to the sleeve of the plug. This method of distinguishing between the various cord conductors has been applied to the line circuit. The tip of the plug makes contact with the short spring of the jack. This jack spring is designated as the tip spring, and the side of the line connected to the tip spring is designated as the tip side of the line, or tip conductor (fig. 7). The ring of the plug makes contact with a longer jack spring. This longer jack spring is designated the ring spring,

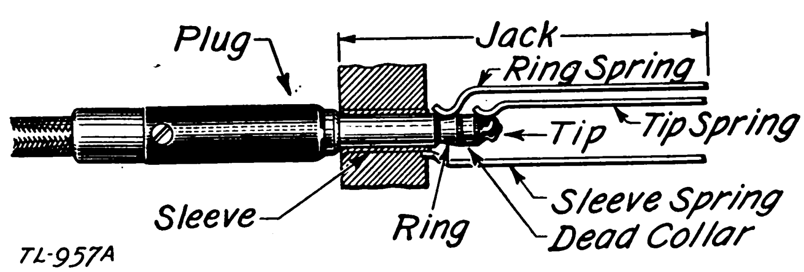


FIGURE 7.—Three-conductor plug and jack.

and the side of the line connected to the ring spring is known as the ring side of the line, or ring conductor. The sleeve of the plug makes contact with the sleeve of the jack. The control wire connected to the sleeve of the jack is designated as the sleeve wire, and is used only to assist in controlling the supervisory relays in the cord circuit.

c. Circuits.—The various circuits are designed for use in a 24-volt non-multiple switchboard. The relay adjustment data are given in paragraph 42. Detailed description of the various circuits appears in the following paragraphs 9 to 24 inclusive.

9. Magneto line circuit (fig. 8).—This circuit is for use with equipment that uses 16- to 20-cycle ringing current for signaling. Since direct current is not applied to the line through this circuit, it cannot be used with telephones or circuits which require an external source of transmitter current (common-battery telephones), or for telephones or circuits which require direct current for supervisory purposes. The application of ringing current from the line to the circuit causes the drop to fall. When a plug is inserted into the jack, the drop is mechanically restored and the winding of the drop is disconnected from the line at the cut-off contacts in the jack. Contacts are provided on the drop to supply ground to a night alarm circuit which provides, when desired, an audible signal when a drop falls. (See par. 20.) The magneto line circuit may be connected to the following types of equipment or circuits:

a. Signal Corps type local-battery (magneto) telephones such as telephone EE–3, EE–4, EE–5, EE–8, and EE–8–A.

b. Commercial type magneto telephones.

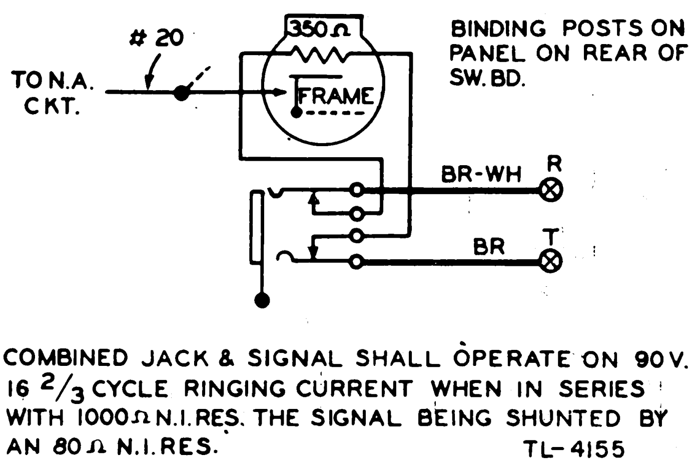


FIGURE 8.—Magneto line circuit.

c. Switchboards, as follows: Magneto line circuits in switchboards BD–14, BD–71, BD–72, BD–80, BD–89–A, BD–91, BD–96, and commercial magneto switchboards; line circuits equipped with ring-down relays and arranged for two-way ringing in commercial common-battery switchboards, switchboards BD-74 and BD-78. For two-way service connect this circuit to a circuit in the distant switchboard which is equipped with a drop or ring-down relay. For incoming service only at switchboard BD-89-A, connect this circuit to a jack circuit (such as shown in fig. 10) at the distant switchboard. This latter connection may also apply to interposition trunks when three or more switchboards BD-89-A, B, or C, are installed as one exchange.

10. Common-battery line circuit (fig. 9).—This circuit is for use with telephones and circuits that require an external source of transmitter current and which signal switchboard BD-89-A by closing a d-c path.

a. Connecting circuits.—The common-battery line circuit may be connected to the following types of equipment or circuits:

(1) Telephones EE-8 and EE-8-A (with screw switch turned to CB).

(2) Commercial common-battery telephones.

(3) Trunk circuits that are arranged at the distant switchboard for incoming a-c ringing signals and outgoing d-c signals.

b. Working limits.—(1) Maximum external circuit loop resistance, 300 ohms.

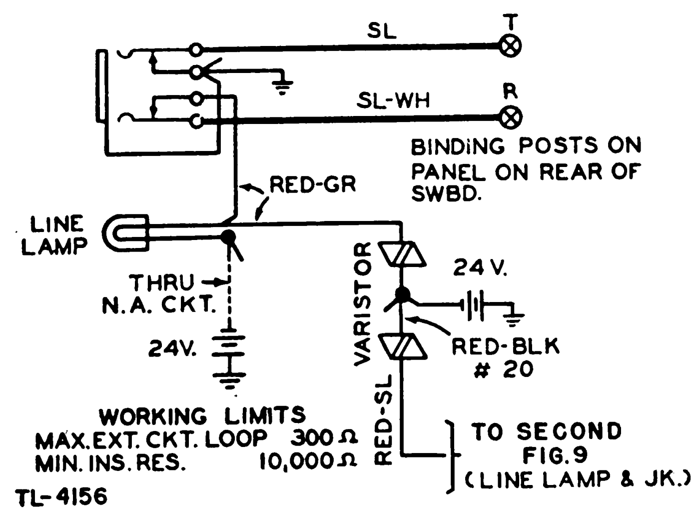


FIGURE 9.—Common-battery line circuit.

(2) Minimum insulation resistance, 10,000 ohms.

The maximum external circuit loop resistance includes the resistance of the conductors from the switchboard to the telephone, plus the internal resistance of that portion of the telephone circuit through which the line current flows.

c. Operation.—The operation of the common-battery line circuit is as follows: When a circuit is completed through a common-battery telephone, by removing the handset from the telephone switch (switchhook), current flows through the line lamp, which is in series with the line and the telephone, causing the lamp to light and signal the operator. The battery supply for the lamp may be furnished through the night alarm circuit to provide, if desired, for an audible as well as a visual signal to the switchboard operator. Insertion of a plug into the line jack disconnects the lamp and ground from the line. When the plug is removed from the line jack, the line lamp and ground are again connected to the line, and other calls may be received on the same line. To make an outgoing call, the operator inserts a calling plug into the jack, disconnecting the lamp and ground from the line. The distant equipment is signaled with ringing current applied from the cord circuit.

d. Varistor.—A varistor connected in multiple with the line lamp protects the lamp filament from being damaged by excessive voltages. The varistor is of the silicon-carbide-disk type containing 10 groups of disks, each group having two disks and three terminals. The center terminals of the 10 groups are connected together. One group provides protection for two lines. The varistor has a high resistance at an applied voltage of 24 volts and therefore does not materially affect the current through (or the lighting of) the lamp. However, if voltages higher than normal are induced in or connected across the line, the resistance of the varistor decreases and shunts most of the current in the line through the varistor rather than permitting it to flow through the lamp, thus preventing excessive currents from flowing through the lamp filament.

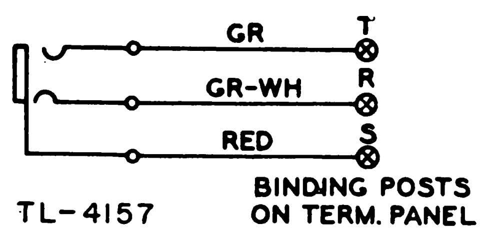


FIGURE 10.—Outgoing line circuit.

11. Outgoing line circuit (fig. 10).—This circuit may be used as the outgoing end of a one-way trunk to other switchboards or as an interposition trunk to another switchboard in the same group. The apparatus consists of a jack connected to the terminal strip. No signalling apparatus is associated with this circuit; hence it is not suitable for incoming calls. In the event that this circuit is to be associated with common-battery circuits, ground should be connected to the binding post designated *S* on the terminal panel.

12. Through line circuit (fig. 11).—This circuit is intended to be used for connecting two lines together to form a through line which normally is not to be used at switchboard BD-89-A. However, for test purposes the operator at this switchboard, by plugging a test cord into either of the cut-off jacks, may separate the two lines connected by this through line circuit. The operator may also use either of these two lines in the same manner as any other outgoing trunk circuits by plugging a cord into either of the cut-off jacks. Plugging into either jack disconnects the other jack and its line from the circuit. In the event that this circuit is to be used as an outgoing trunk circuit and is to be associated with common-battery circuits, ground should be connected to the binding posts designated *S* on the terminal panel. See paragraph 4*g* for method of connecting.

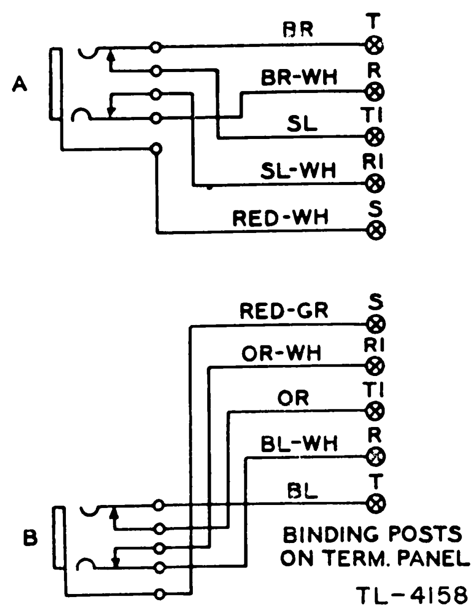


FIGURE 11.—Through line circuit.

13. Trunk circuit, two-way for connection to dial (automatic) telephone central office, and associated dial cord circuit (fig. 12).—This trunk circuit provides for two-way service between switchboard BD-89-A and a dial (automatic) central office. A dial cord circuit is provided for dialing on the trunk circuit. The trunk circuit should be connected to a telephone line circuit of a dial telephone central office. The trunk circuit may be connected in place of, or bridged across, any dial telephone.

a. Working limits.—(The working limit of the dial central office will usually be controlling.)

(1) Maximum external loop resistance, 750 ohms.

(2) Minimum insulation resistance, 15,000 ohms.

b. Functions.—(1) Provides for a ring-down signal and lights a lamp to signal the operator on incoming calls from the central office.

(2) Extinguishes the signal lamp, cuts off (trips) the ringing current, and closes a metallic bridge over the trunk when the operator answers.

(3) Extends supervision from the loop to the cord circuit if battery is reversed when the central office disconnects.

(4) Opens the loop to the central office and prepares the circuit for an incoming signal if the operator disconnects.

(5) Closes the trunk loop to the central office when the operator plugs into the trunk ANS jack.

(6) Provides for dialing over the trunk by means of the dial cord and the dial jack.

(7) Extends supervision from the loop to the cord circuit if battery is reversed on the trunk when the dial telephone is answered.

(8) Releases when the operator removes the plug from the ANS jack.

c. Detailed description of incoming calls.—(1) The application of alternating current to the distant end of the trunk operates relay *D* which in turn operates relay *C*. Relay *C* lights the ANS lamp, locks itself to ground at a spring of relay *B*, connects ground to the NA circuit to provide an audible signal, and prepares a low-resistance circuit for cutting off (tripping) automatic ringing, if it is used, at the central office. The completion of this low-resistance circuit is dependent upon the operation of relay *B*.

(2) When the operator answers, relay *B* operates from ground on a contact of the answering jack, completing the low-resistance circuit mentioned above as being prepared by relay *C*, disconnecting relay *D* from the trunk, preparing the circuit to relay *A*, and opening the circuit to relay *C*. The slow release feature of relay *C* keeps it operated long enough to cut off the ringing current at the

central office. When relay *C* releases, it extinguishes the ANS lamp, disconnects ground from the night alarm lead and opens the low-resistance circuit across the trunk which was established by relay *B*. The low-resistance winding of relay *A*, through the operation of relay *B*, is now energized in series with the line side of the repeating coil and trunk loop. This establishes a trunk-holding bridge for maintaining the central office equipment operated. Relay *A* is an electro-polarized relay. Hence, when the currents in its windings flow in opposite directions and produce opposing magnetic fields the relay will not operate, but when the currents in its windings flow in the same direction and produce magnetic fields aiding each other and the permanent magnetic field, the relay will operate. In this case, if the connections discussed below are properly made, the two windings aid each other, and relay *A* operates at this time and closes a loop to the cord circuit, causing the cord supervisory lamp to be extinguished.

(3) In order to provide for the correct operation of relay *A*, negative battery must be connected to the *T* lead, and positive battery to the *R* lead on incoming calls. This can be done by reversing the connector normals, or *T* and *R* of the connector multiple, at the dial central office distributing frame. The exact method used will depend upon the type of dial central office involved.

(4) If battery is reversed over the trunk, or if battery is disconnected from the trunk when the central office disconnects, relay *A* will release and open the loop to the cord circuit, causing the supervisory lamp to light. When the plug is removed from the answering jack, relay *B* releases, opening the trunk-holding circuit through the polarizing winding of relay *A*, allowing the central office equipment to release. The release of relay *B* also connects relay *D* and capacitor *C3* in series across the trunk to provide for another incoming signal.

d. Detailed description of outgoing calls.—(1) Insertion of a calling cord plug in the answering jack operates relay *B* from ground on a contact of the answering jack. This operation establishes a trunk-holding circuit through the line side of the repeating coil and the low-resistance winding of relay *A* in series across the trunk to seize the central office equipment. At this time negative battery is on the *R* lead and ground on the *T* lead. Relay *A* remains normal, allowing the cord supervisory lamp to light. The operator then inserts the dial cord in the dial jack, which disconnects the repeating coil and relay *A* from the trunk and closes a holding bridge for the trunk through the dial impulse springs. The operator dials the desired number, causing the switch train at the central office to complete the connection. After dialing is completed, the dial cord is removed from the dial jack, and the trunk is again held through the repeating coil and relay *A*.

(2) When the central office answers, battery is reversed over the trunk, causing relay *A* to operate and extinguish the cord supervisory lamp. When the central office disconnects, normal battery (that is, negative battery on the *R* lead and ground on the *T* lead) on the trunk causes relay *A* to release and light the cord supervisory lamp. When the operator removes the plug from the ANS jack, relay *B* releases, opens the trunk-holding bridge to allow the central office equipment to release, and connects relay *D* and capacitor *C3* across the trunk to prepare the circuit for incoming calls.

e. Supervision, special cases.—In a few isolated instances, the cord lamp supervision may appear to be faulty, whereas no trouble actually exists, either in the switchboard BD–89–A or in the connecting circuits. The cause and effect of the special conditions causing this apparently faulty supervision are outlined in detail following:

(1) *Outgoing calls, calling cord supervisory lamp remains lighted after called party answers.*—Failure to receive answering supervision on the calling cord may be encountered when calling certain commercial telephone company numbers, such as wire chief, information, repair service, and some other *official* telephone numbers. This condition is peculiar to certain commercial telephone company operating practices, and is made necessary due to the fact that some types of commercial equipment will not function properly with *reverse battery* supervision when calling these *official* numbers. Under such conditions it will be necessary for the operator to depend upon the answering cord lamp for supervision. In case supervision of the above type is encountered, and the call is not to any of the telephone numbers listed above, it is an indication of a trouble condition, either in the cord circuit, the trunk circuit, or the dial central office equipment.

(2) *Incoming and outgoing calls, supervisory lamp remains lighted at all times.*—A condition may be encountered where the supervisory lamp associated with the cord connected to the trunk jack may remain lighted at all times, including the time when a conversation is taking place. This condition will be encountered

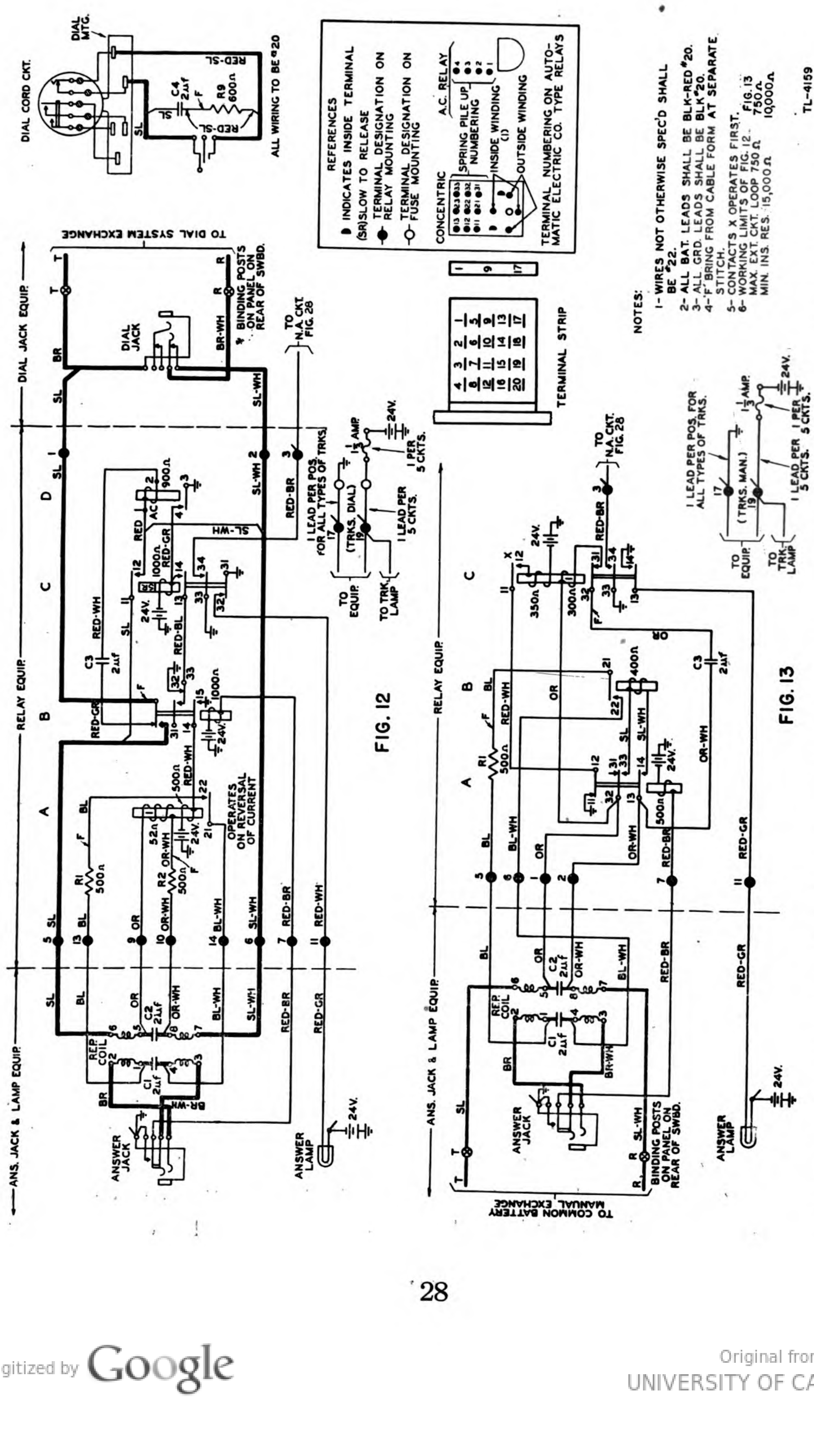


FIGURE 12.—Trunk circuit, two-way, for connection to dial system exchange, and associated dial cord circuit.

FIGURE 13.—Trunk circuit, incoming ring-down, outgoing automatic, for connection to common-battery manual exchange.

when the trunk to the dial central office is of such length that auxiliary long-trunk equipment is required at the dial central office. These auxiliary long-trunk circuits used at the dial central office are usually not designed to furnish *reverse battery* for supervisory purposes; consequently when such equipment is used on a dial trunk from switchboard BD-89-A, no supervision will be indicated by the cord lamp associated with the cord connected to the trunk jack. If it is desired that the supervisory lamp remain unlighted at all times rather than lighted, it is only necessary to reverse the trunk line connections at the terminals in cabinet BE-79. Should supervision of the above type be encountered and it is definitely known that there is no auxiliary long-trunk equipment in the dial central office, it is an indication of a trouble condition existing in some portion of the circuit.

14. Trunk circuit, two-way to manual common-battery telephone central office.—Figure 13 shows the trunk circuit used to provide two-way service between switchboard BD-89-A and a common-battery manual exchange. This circuit should be connected to a common-battery manual line circuit equipped with a line relay of approximately 2,000 ohms resistance at the distant switchboard. (This precludes connection to the common-battery line circuit of telephone central office set TC-1 if correct supervision is desired.) It may be connected in place of, or bridged across, any manual telephone which is connected to a common-battery manual switchboard.

a. Working limits.—The working limits of the manual common-battery central office will usually be controlling.

(1) Maximum external loop resistance, 750 ohms.

(2) Minimum insulation resistance, 10,000 ohms.

b. Functions.—(1) Provides for a ring-down signal and lights a lamp to signal the operator on incoming calls from the central office.

(2) Extinguishes the signal lamp and closes a metallic bridge over the trunk to cut off (trip) the ringing current and provide for supervision when the operator answers.

(3) Extends supervision from the loop to the cord circuit when the central office disconnects.

(4) Opens the loop to the central office and prepares the circuit for an incoming call when the operator disconnects.

(5) Closes the loop to signal the central office when the operator seizes the trunk.

(6) Releases and extends supervision to the central office when the operator disconnects.

c. Detailed description of incoming calls.—(1) On incoming calls, relay *C* operates from ringing current applied at the central office, locks itself to ground at a spring of relay *A*, lights the ANS lamp, and connects ground to the NA lead to provide for an audible signal. When the operator plugs into the ANS jack, relay *A* operates through the ground made at the jack. This opens the locking circuit to relay *C*, which releases, extinguishing the ANS lamp, and removing ground from the NA lead. Relay *A* also connects the winding of relay *B* in series with the line side of the repeating coil across the trunk to give answer supervision to the central office. Relay *B* operates at this time and connects a 500-ohm resistor *R1* in a loop to the cord circuit, causing the *A* relay in the cord circuit to operate and extinguish the cord-supervisory lamp in switchboard BD-89-A. Relay *B* operates in series with the battery-supply apparatus in the central office cord circuit, and releases in series with the line relay at the central office. For this purpose the resistances of the cord-circuit battery-supply apparatus and the line relay at the central office should be approximately 200 ohms and 2,000 ohms respectively. The value of 200 ohms resistance of the cord-circuit battery-supply apparatus is an average value. In actual practice the resistance of the cord-circuit battery-supply apparatus may vary considerably from the average value of 200 ohms, and is dependent upon the type of switchboard, and the service for which it is designed. The resistance of line relays may also vary somewhat from the average value of 2,000 ohms, stated above. Probably the most extreme case that will be encountered in actual practice will be on trunk circuits of such length that an auxiliary long-trunk circuit is required at the commercial central office end of the circuit. In such cases the resistance in series with the battery-supply apparatus, connected to the central office end of the trunk circuit may be as low as 125 ohms, instead of the 2,000-ohm line relay and 200-ohm (average) cord circuit. The trunk circuit of switchboard BD-89-A will still function properly under such conditions except that disconnect supervision will not be received and it will be necessary to depend upon supervision indicated by the cord connected to the local station.

(2) When the central office disconnects, the line relay at the central office is connected to the line, and the resistance in the

circuit to relay *B* is increased. Relay *B* releases and the cord supervisory lamp lights through the release of relay *A* in the cord circuit.

(3) When the plug is removed from the ANS jack, relay *A* releases and disconnects the winding of relay *B* from the trunk, thus opening the holding bridge and extending disconnect supervision to the central office.

d. Detailed description of outgoing calls.—(1) On outgoing calls when a plug is inserted in the trunk ANS jack, relay *A* operates and closes a metallic bridge across the trunk through the line side of the repeating coil and the winding of relay *B* in series. The line relay at the central office is in series with relay *B* and operates to signal the central office operator. Relay *B* does not operate at this time, and the loop to the cord circuit remains open, allowing the cord-circuit supervisory lamp to light. When the central office answers, the resistance in the circuit to relay *B* is decreased, causing relay *B* to operate, connecting a 500-ohm resistor in a loop to the cord circuit which extinguishes the cord-supervisory lamp through the operation of the cord circuit *A* relay.

(2) When the central office disconnects, the action is the same as described in subparagraph 14*c*(2), preceding.

(3) When the switchboard BD–89–A operator disconnects by removing the plug from the ANS jack, relay *A* releases and disconnects the winding of relay *B* from the trunk, thus opening the holding bridge and extending disconnect supervision to the central office.

e. An exception to the above operation will be encountered on trunk circuits of such length that an auxiliary long-trunk circuit is required at the central office. In such cases there is no change in resistance in the central office equipment when the central office operator disconnects. Therefore, the operator at switchboard BD–89–A must depend upon supervision from the answering-cord supervisory lamp on outgoing trunk calls and upon supervision from the calling-cord supervisory lamp on incoming calls. This condition will, in all probability, be encountered rather infrequently in actual practice.

15. Universal cord circuit (fig. 14).—This cord circuit is of the universal type; that is, it provides for connection between two common-battery lines, between two magneto lines, between a common-battery line and a magneto line, and between a magneto line and a common-battery line. Supervision on common-battery lines is indicated by cord supervisory lamps located on the keyshelf between the keys and plugs. Recall and disconnect signals on magneto lines are indicated by lamp signals located in the face of the switchboard below the magneto line signals (drops).

a. Working limits.—(1) *Common-battery line circuits.*—(*a*) Maximum external circuit loop resistance; for supervision, 1,200 ohms; for transmitter battery supply, 700 ohms.

(*b*) Minimum insulation resistance 5,000 ohms.

(2) *Magneto line circuits, using telephone EE–8 or EE–8–A.*—(*a*) Maximum external loop resistance, 15,000 ohms; minimum line insulation resistance, 30,000 ohms, or

(*b*) Maximum external loop, 7,000 ohms; minimum line insulation resistance, 1,000 ohms.

(3) *Dial and manual trunk circuits.*—When connected to these circuits, no cord-circuit working limits apply, since the working limits of the trunk circuits in BD–89–A apply.

b. Functions.—(1) Supplies transmitter battery to common-battery telephones.

(2) Provides means for supervising battery-operated trunk circuits and common-battery line circuits.

(3) Provides a non-locking lamp ring-off signal on magneto lines.

(4) Provides means for connecting the operator's telephone set to the cord circuit.

(5) Provides means for ringing on either the tip or ring of the calling cord.

c. Connection to magneto lines.—(1) *Incoming calls.*—When the plug of the answering cord is inserted in the jack of a magneto line circuit the *BS* relay does not operate, since the sleeve circuit of the line jack is open. Under this condition the three windings of the *A* relay are connected series-aiding and remain bridged across the tip and ring of the answering cord for ring-off supervision. The operator answers the call with the TALK key in the operated position.

(2) *Outgoing calls.*—When the plug of the calling cord is inserted into a jack of a magneto line circuit the *FS* relay does not operate since the sleeve circuit of the line jack is open. Under this condition the three windings of the *C* relay are connected series-aiding and remain bridged across the tip and ring of the calling cord for ring-off supervision. Upon the operation of the ringing key, ringing current is applied to the line. Except while ringing

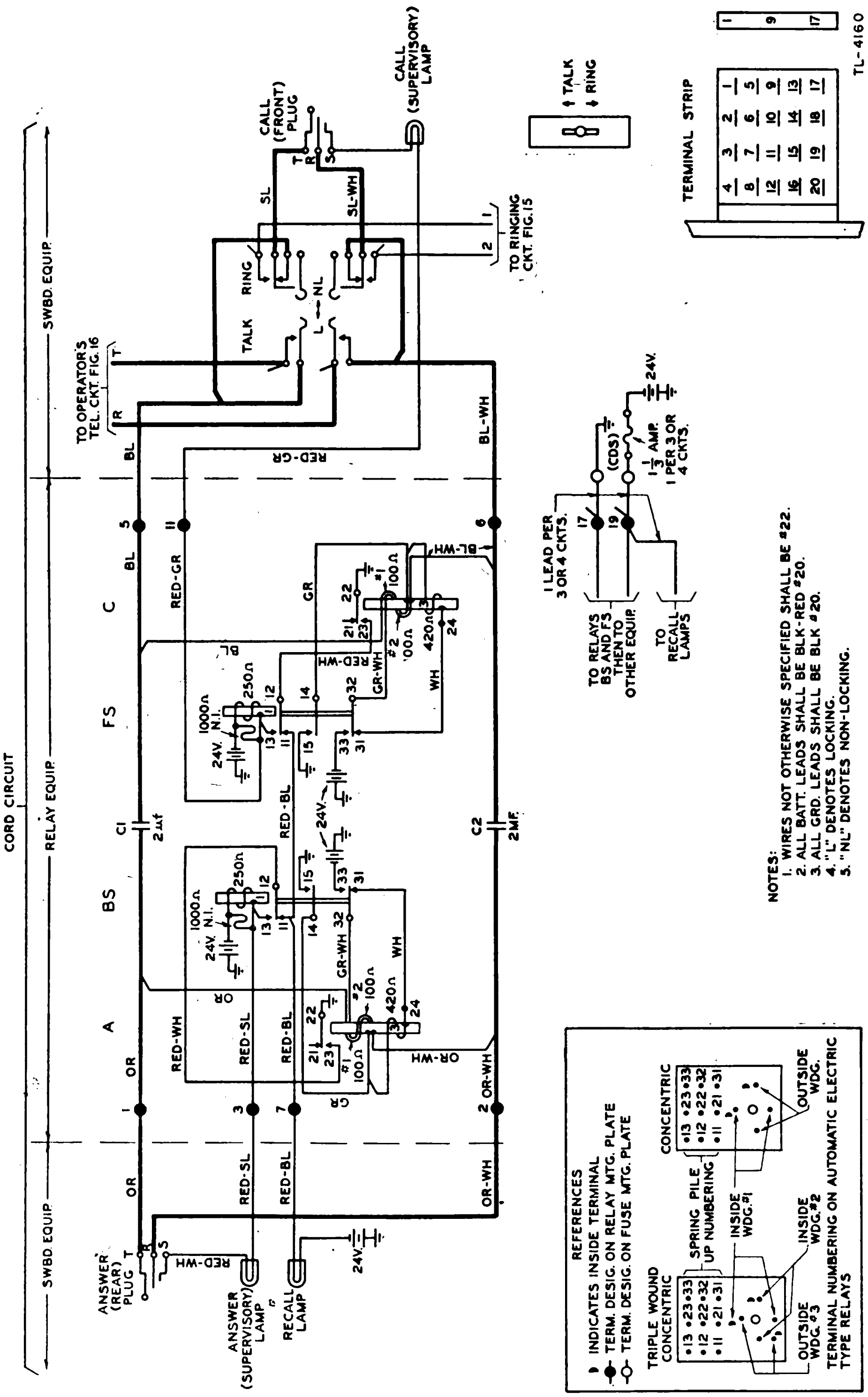


FIGURE 14.—Cord circuit.

on the line, the TALK key is operated so that the operator may know when the call is answered at the distant end of the line, since no supervision is obtained when the call is answered.

(3) *Completion of conversation.*—When a conversation is completed, ringing current should be applied to the line by either telephone user, in the case of line-to-line connection, or by the distant switchboard operator in the case of a switchboard-to-switchboard connection. Ringing current over the line associated with the answering cord will operate the *A* relay. Ringing current over the line associated with the calling cord will operate the *C* relay. Operation of either the *A* or *C* relay will cause the RECALL lamp to light and remain lighted as long as ringing current is being received over the line.

d. Connection to outgoing and through line circuits.—The operation is the same as for outgoing magneto line calls and for completion of such calls.

e. Connection to conference circuit.—When the plug of a cord is inserted in a conference circuit jack, the *BS* or *FS* relay does not operate because the jack circuit is open at the sleeve. Under this condition the three windings of the *A* or *C* relay are connected series-aiding and remain bridged across the tip and ring of the cord. In the normal use of the conference circuit the relays associated with the half of the cord circuit connected to the conference jack do not function.

f. Connection to common-battery lines.—(1) *Incoming calls.*—When the plug of the answering cord is inserted in the jack of a common-battery line in response to a call, the *BS* relay operates, due to the ground on the line jack sleeve, and the supervisory lamp associated with the answering cord lights momentarily. The operation of the *BS* relay connects ground and battery respectively, to the tip and ring of the cord through the No. 1 and No. 2 windings of the *A* relay, thus providing for transmitter and supervisory battery through the common-battery line circuit. In the event that the distant telephone is a telephone EE–8–A, separate transmitter battery is also provided at the telephone. The *A* relay operates since the circuit through its windings is completed at the distant telephone. The operation of the *A* relay short-circuits the supervisory lamp, thus extinguishing the lamp. The operator answers the call with the TALK key in the operated position.

(2) *Outgoing calls.*—When the plug of the calling cord is inserted in a common-battery line circuit jack, the *FS* relay operates and

the associated supervisory lamp lights in series with the *FS* relay. The operation of the *FS* relay connects ground and battery respectively to the tip and ring of the calling cord through the No. 1 and No. 2 windings of the *C* relay. Operation of the ringing key applies ringing current to the line. When the called telephone answers, the *C* relay operates and short-circuits the supervisory lamp, thus extinguishing the lamp.

(3) *Completion of conversation.*—When a conversation is completed, the parties hang up, and the circuit is broken at the switchhook or lever switch in the telephone, thus causing the *A* or *C* relay to release, which in turn causes the associated supervisory lamp to light. Removal of the plug from the jack releases the *BS* or *FS* relay and extinguishes the supervisory lamp, thereby restoring the circuit to normal.

g. Connection to dial and manual trunk circuits.—The operation of the cord circuit is the same as the operation of the circuit when it is connected to a common-battery line circuit except that the circuit through the windings of the *A* or *C* relay is completed in the trunk circuit switchboard equipment instead of through the distant telephone. Therefore no cord circuit working limits apply.

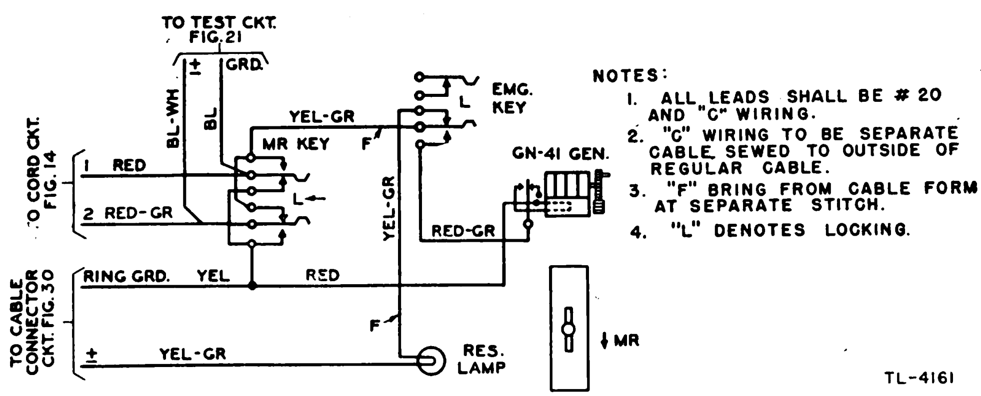


FIGURE 15.—Ringing circuit.

16. Ringing circuit (fig. 15).—The ringing circuit provides two-party selective ringing. Two-party selective ringing is used only on common-battery lines, and then only when it is desired to utilize party line service. The telephone instruments used for this type of service will be commercial type common-battery instruments with the bell circuit connected between ground and either the tip or ring of the line as desired. The master ringing key is the first

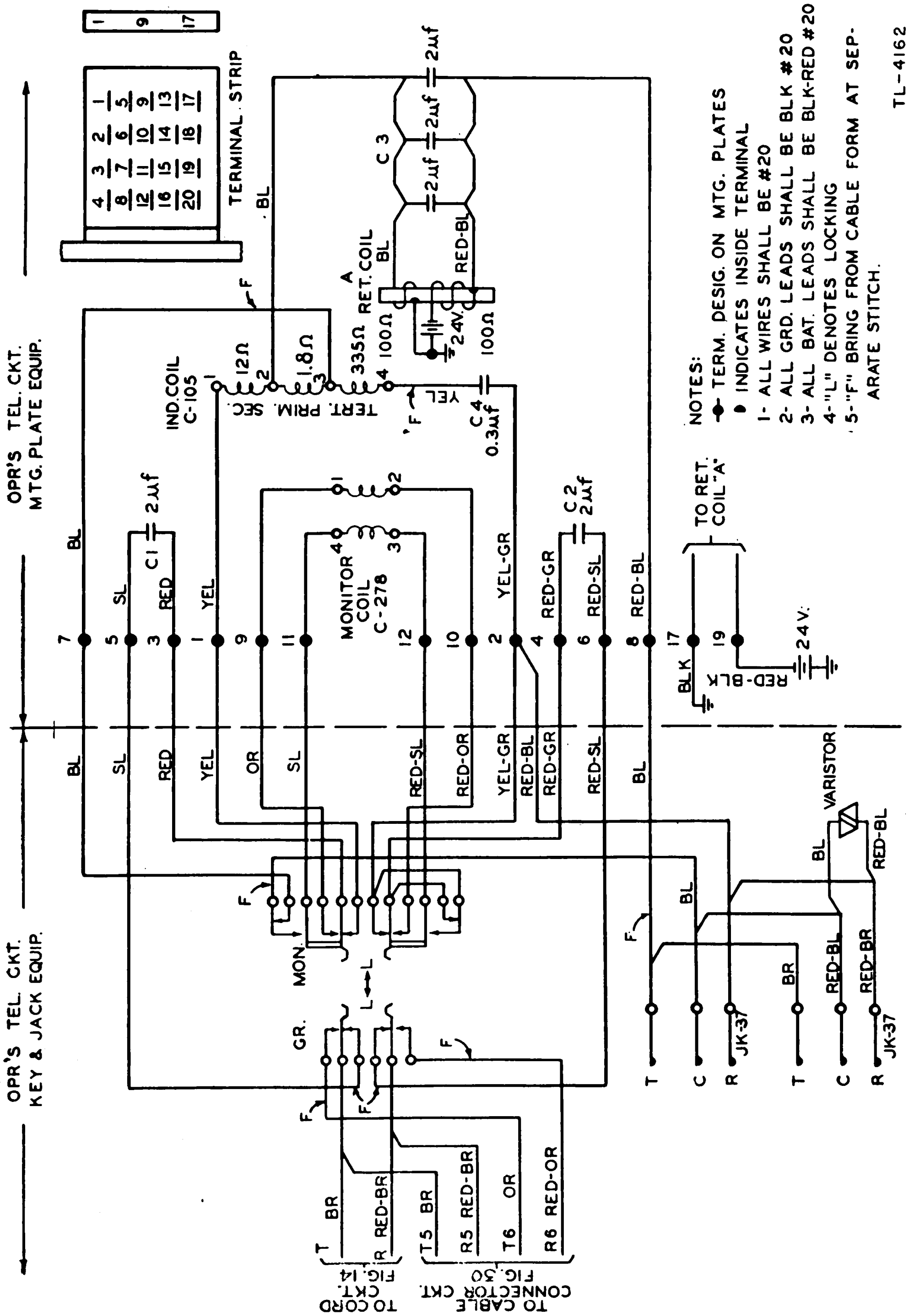


FIGURE 16.—Operator's telephone circuit.

key on the left-hand side of the keyshelf and is engraved MR. When the MR key is in the normal position, ringing current is applied to the ring side of the line with the tip side grounded. When the MR key is operated (handle inclined towards the operator) ringing current is applied to the tip side of the line with the ring side grounded. The terminals for connecting ringing power are located to the right of the cordshelf in the rear of the switchboard. A key designated EMG KEY on the schematic drawing (marked RINGING KEY-HAND on the switchboard), is used for switching on either power ringing or the hand generator. This key is located in the lower left-hand corner of the face of switchboard BD-89-A. The hand generator is a generator GN-41. A resistor lamp located above the cordshelf in the rear of the switchboard is connected in series with the power ringing circuit so that ringing on a short-circuited or grounded line will not interfere with ringing on another switchboard position using the same source of ringing power.

17. Operator's telephone circuit and grouping key circuit (figs. 16 and 17).—An antisidetone telephone circuit which includes induction coil C-105, and is equivalent to the circuit in telephone EE-8-A, is provided in switchboard BD-89-A. A varistor is bridged across the receiver terminals to reduce acoustic shock to the operator from excessive voltages across the receiver terminals. The varistor consists of an arrangement of copper oxide disks, the resistance of

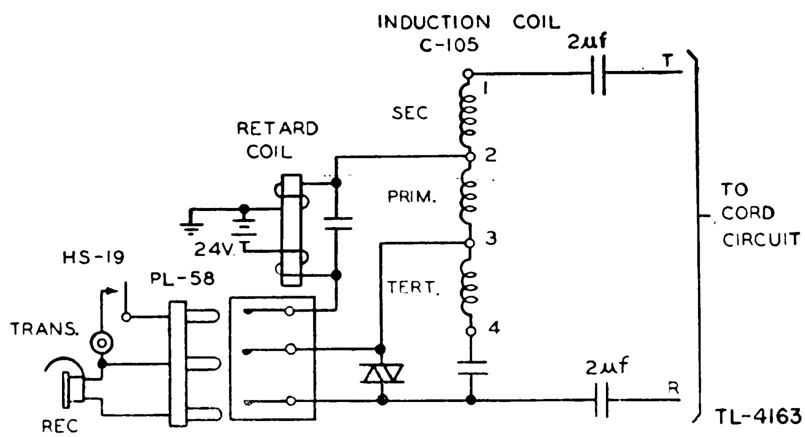


FIGURE 17.—Operator talking, functional diagram.

which decreases as the applied voltage increases. The operation of the monitoring key (engraved MON) and a cord circuit key connects the 1-2 winding of monitor coil C-278 in series with two

2-microfarad capacitors *C1* and *C2* across the cord circuit, which enables the operator to listen to the conversation without introducing any material transmission loss (fig. 18). A grouping key (figs. 16 and 19) is provided so that the cords of one switchboard BD-89-A may be used by the operator of an adjacent switchboard

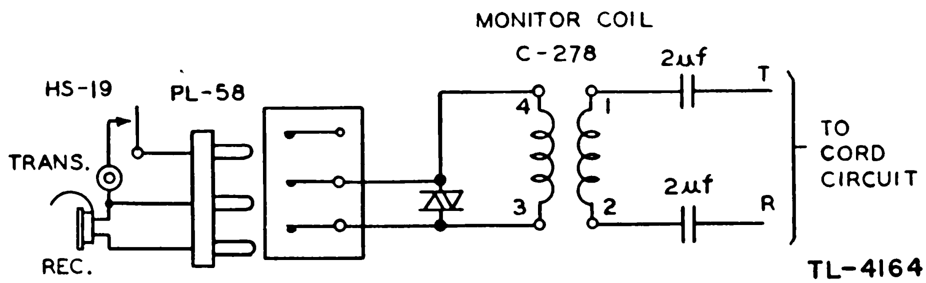


FIGURE 18.—Operator monitoring, functional diagram.

BD-89-A when the first switchboard is unattended. The grouping key is mounted on the keyshelf and is engraved GR. Head and chest sets HS-17-A, HS-19, and commercial types of head and

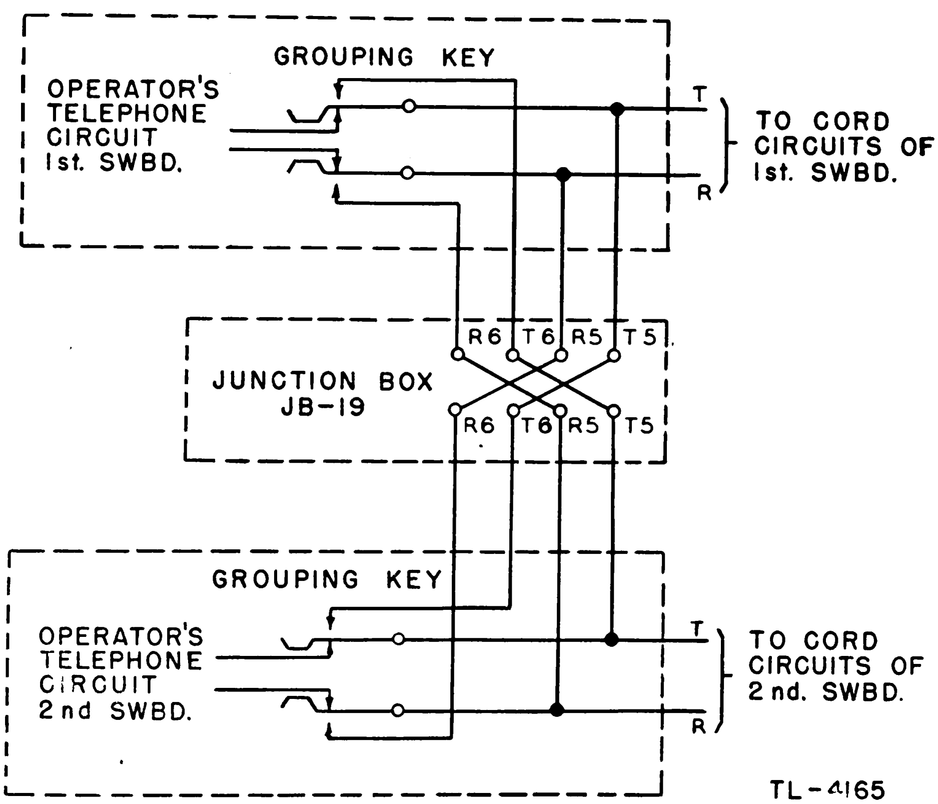


FIGURE 19.—Grouping circuit, functional diagram.

chest sets that are equipped with plug PL–58 may be connected to the operator's telephone circuit by plugging into either of the two jacks JK–37 mounted in the front of the keyshelf.

18. Conference jack circuit (fig. 20).—*a*. This circuit consists of five jacks connected in parallel to enable the operator to connect a number of lines together for a conference. Cord circuits or patching cords may be used for connecting the various lines to the conference circuit. For limitations on use of patching cords, see paragraph *b*, following.

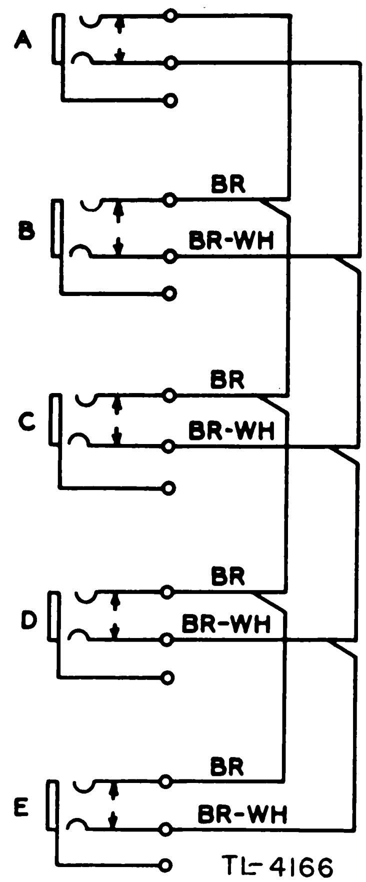


FIGURE 20.—Conference jack circuit.

b. The use of patching cords is desirable, whenever possible, in order to reduce the number of cord circuits required on a conference connection. However, on account of complications arising on common-battery connections due to battery-supply conditions, it will be necessary to use a cord circuit for each common-battery line connected to the conference. In the case of trunked connections and magneto lines, patching cords may be used. It must be remembered, however, that at least one cord circuit must be used in each conference for purposes of supervising the entire conference. Patching cords are not issued as a part of TC-2. See paragraph *c* following.

c. Patching cords.—Patching cords consist of two switchboard plugs connected by a piece of switchboard cordage of the desired length. If no standard patching cords are available they may be improvised out of two switchboard cords whose corresponding terminals are securely fastened together, and the two conductors insulated from each other. Patching cords may also be used to tie circuits through the switchboard in a semi-permanent manner, thereby avoiding the use of a cord circuit. In case this use is made of patching cords, it must be remembered that there is no supervision on the circuits so connected.

19. Switchboard test circuit (fig. 21).—This circuit is to be used in making routine tests of, and for locating trouble on the cord circuits, line circuits, trunk circuits, and the night alarm circuit. The tests are made by connecting the circuit under test to jacks in the switchboard test circuit either directly or by means of patching cords. The tests are made from the front of the switchboard. A visual or audible signal is provided for indicating the performance of the equipment under test. Before making the tests described below, the person making the tests must be familiar with paragraph 5, on operation of the switchboard.

a. Functions.—(1) To check the operation of the night alarm circuit.

(2) To test the lamps of common-battery line circuits.

(3) To apply an operation test to the drops of the magneto line circuits.

(4) To apply an operation test to the dial trunk circuit and the dial cord circuit.

(5) To apply an operation test to the manual trunk circuit.

(6) To test the cord circuits.

b. Detailed description of circuit operation.—(1) *General.*—If the circuit under test fails to operate as described, consult the detailed description of the particular circuit. Before readjusting any relays, the continuity of the circuit under consideration should be checked and tests made for other possible sources of trouble.

(2) *Testing the night alarm circuit.*—Test the night alarm circuit when tests on line and trunk circuits are made.

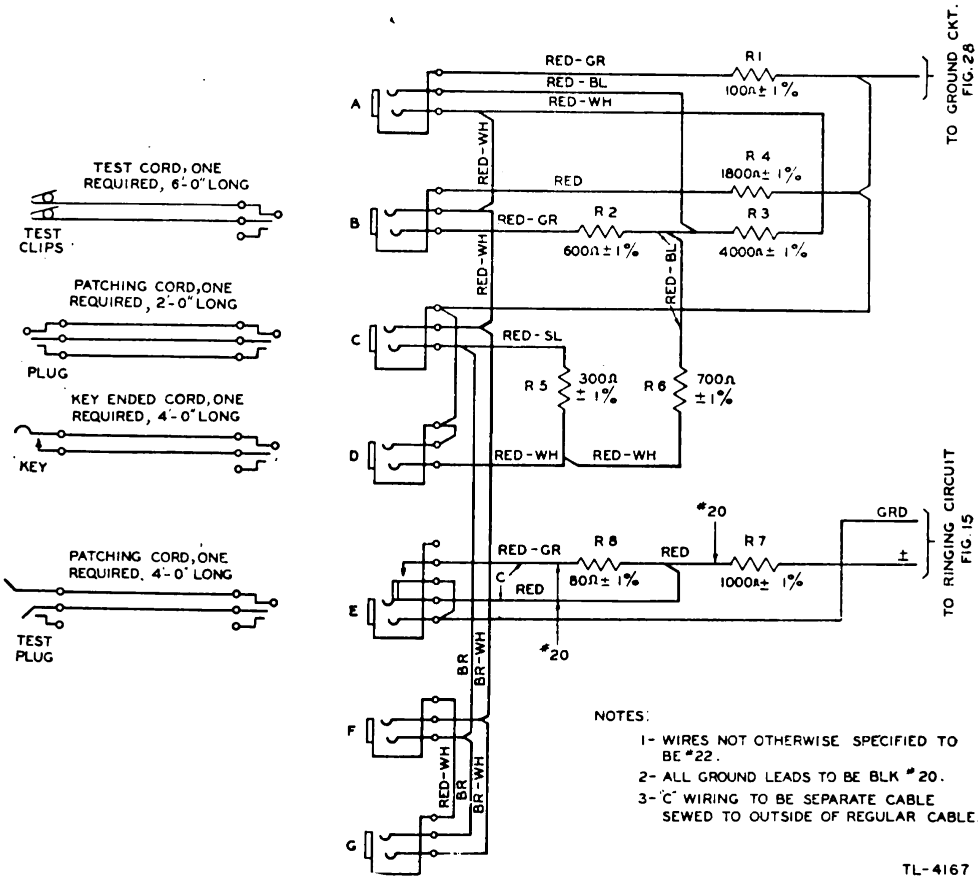


FIGURE 21.—Switchboard test circuit.

(3) *Testing the common-battery line lamps.*—Connect the key-ended test cord to the *D* jack. Connect one end of a double-ended patching cord to the *C* jack and partly insert the other end into a jack of the common-battery line circuit under test until the tip of the plug makes contact with the ring spring of the jack. Operate the key on the test cord to complete the circuit for lighting the lamp through resistance *R5*.

(4) *Testing magneto line circuit drops.*—If the magneto line circuit is connected to a line, remove the heat coils or open the circuit at the terminal strip to prevent ringing current from being applied to the line during the test. Insert the test plug in the line circuit jack (with the white line on the shell of the test plug held on the right-hand side) and insert the regular plug on the other

end of the test cord in the *E* jack. This associates the ringing circuit with the drop through the network of the test circuit. Check to see that operation of the ringing key on power ringing, or the hand generator and ringing key on hand ringing, causes the drop to fall. Replace heat coils or close the circuit at the terminal strip when the test is completed.

(5) *Testing the dial trunk and dial cord circuits* (fig. 22).—(*a*) Disconnect the dial trunk circuit by removing the heat coils, or open the circuit at the terminal strip.

(*b*) Insert in the *G* jack the plug of the test cord equipped with test clips. Attach the *T* and *R* test clips to the dial trunk circuit binding posts marked *T* and *R* respectively on the rear of the switchboard. Insert the calling (front) plug of any cord circuit into the *A* jack of the test circuit. The supervisory lamp of this cord should light.

(*c*) Apply ringing current to the cord in the *A* jack. The dial trunk lamp should light, and the audible signal of the night alarm should be heard if the night alarm release key is in the normal position.

(*d*) Insert the answering (rear) plug of any cord circuit in the answering jack of the dial trunk. This connection should extinguish the dial trunk lamp and the supervisory lamp of the cord connected to the *A* jack. The supervisory lamp of the cord connected to the answering jack of the dial trunk should be lighted under the above conditions.

(*e*) Remove the test cord plug from the *G* jack and insert it into the *B* jack. This connection reverses the current in the circuit, thereby causing the *A* relay in the trunk circuit to operate. (The *A* relay was previously held inoperative by the normal battery from the test circuit *G* jack.) This, in turn, causes the *A* relay in the cord circuit to operate, shorting out the supervisory lamp of the cord connected to the dial-trunk answering jack, causing the lamp to be extinguished.

(*f*) The cords should remain connected as above for testing the operation of the dial cord circuit. Insert the dial plug into the dial jack of the dial trunk circuit and operate the dial. The supervisory lamp of the cord connected to the *A* jack of the test circuit should flash in unison with the operation of the dial contacts through the alternate operation and release of the dial trunk circuit *A* relay.

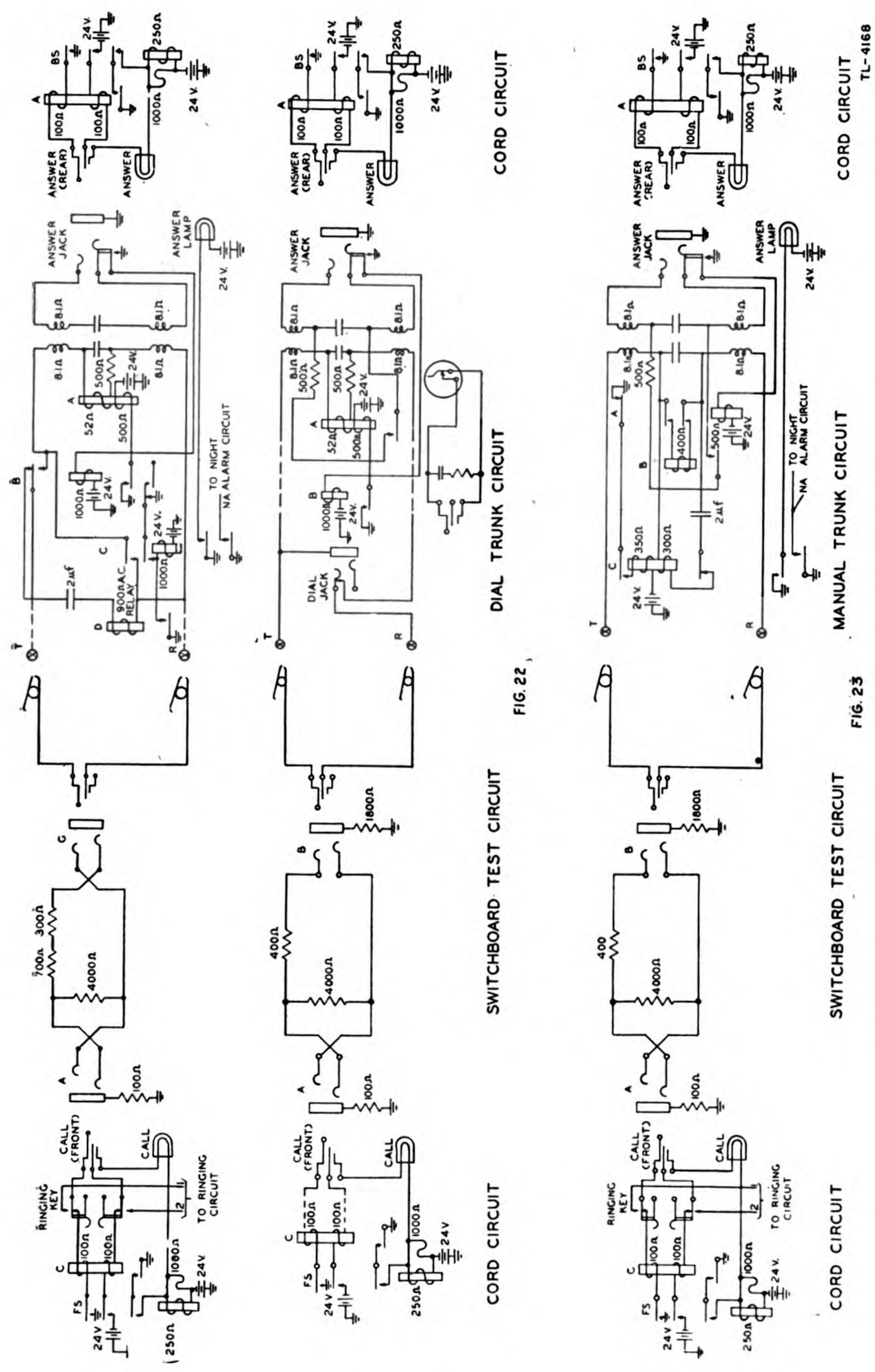


FIGURE 22.—Test of dial trunk circuit, functional diagram.
FIGURE 23.—Test of manual trunk circuit, functional diagram.

(*g*) Replace the heat coils or close the circuit at the terminal strip when the test is completed.

(6) *Testing the common-battery manual trunk circuits* (fig. 23). —(*a*) Disconnect the circuit by removing the heat coils, or open the circuit at the terminal strip.

(*b*) Insert into the *B* jack the plug of the test cord equipped with test clips. Attach the test clips to the manual trunk circuit binding posts marked *T* and *R* on the rear of the switchboard. Insert into the *A* jack a calling (front) plug of any cord circuit. The supervisory lamp of this cord should light from ground on the sleeve of the *A* jack.

(*c*) Apply ringing current to the cord in the *A* jack. The *C* relay of the trunk circuit should operate, locking itself up through ground on a contact of the trunk circuit *A* relay, lighting the manual trunk lamp and operating the audible signal of the night alarm circuit if the night alarm key is in the normal position.

(*d*) Insert an answering (rear) plug of any cord circuit into the manual trunk jack. This action operates the trunk circuit *A* relay from ground on one of the answer jack contacts. Operation of the *A* relay causes the release of the trunk circuit *C* relay, which in turn extinguishes the trunk answer lamp and stops the night alarm audible signal. Operation of the trunk circuit *A* relay also connects the winding of the trunk circuit *B* relay in series with the line windings of the repeating coil across the line, causing the *B* relay to operate from battery and ground supplied by the cord circuit connected to the *A* jack of the test circuit. Operation of the trunk circuit *B* relay connects a 500-ohm resistor across the line in a loop to the cord circuit, which results in the supervisory lamp of this cord being shunted out.

(*e*) Replace heat coils or close the circuit at the terminal strip when the test is completed.

(7) *Testing the universal cord circuits.*—The cord circuit lamps on the keyshelf are referred to as supervisory lamps. The cord circuit lamps on the switchboard face above the plugs are referred to as recall lamps. (Used only for disconnect or recall on magneto lines.)

(*a*) *Operate and release test of supervisory relays A and C* (fig. 24).—Insert the answering (rear) plug of the cord under test into the *C* jack and connect the test cord equipped with the key to the *F* jack. The supervisory lamp of the cord under test should light until the key is operated. Operation of the key completes a circuit through the *1* and *2* windings of the cord circuit *A* relay, which operates, shorting out the supervisory lamp and causing it to be extinguished. Operate the key momentarily to apply a "soak" current to the supervisory relay. Withdraw the plug of the key-ended cord from the *F* jack and insert into the *A* jack. Operate the key to apply an *operate* test current to the supervisory relay. Release the key to apply the *release* test current to the supervisory relay. If the lamp remains lighted after operation of the key, failure of the supervisory relay to operate on the *operate* test value is indicated. Failure of the supervisory lamp to light upon release of the key indicates failure of the supervisory relay to release on the *release* test current. Repeat this test with the calling (front) plug inserted into the *C* jack instead of the answering (rear) plug in order to test the *C* supervisory relay. Test all cord circuits in the same manner.

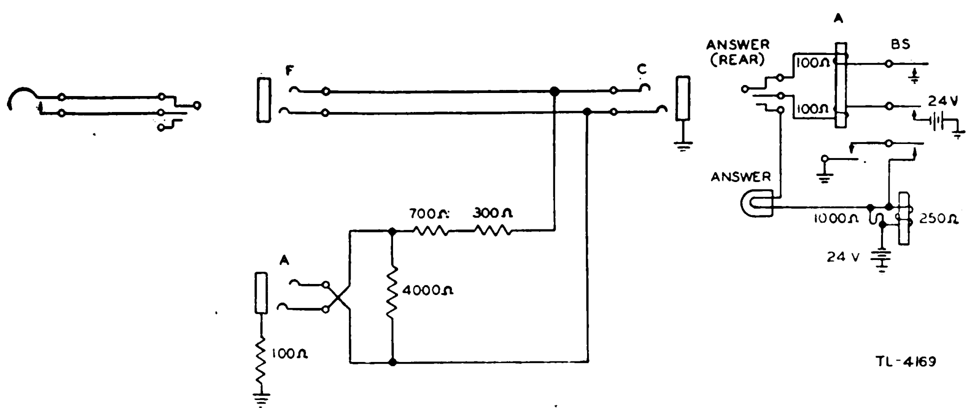


FIGURE 24.—Test of supervisory relays, functional diagram.

(*b*) *Ringing current operate test of the three windings of supervisory relays A and C, and ringing-key test* (fig. 25).—Insert either plug of a cord circuit into the *B* jack and the plug of a calling (front) cord of another cord circuit into the *F* jack. Apply ringing current to the cord in the *F* jack. The recall lamp of the cord connected to the *B* jack should light. The 1,800-ohm resistor connected to the sleeve of the *B* jack prevents either the *FS* or *BS* relay of the cord circuit from operating This is a test of the operation of the supervisory relay of the cord connected to the *B* jack and a test of the ringing key of the cord connected to the *F* jack. Repeat this test until all answering (rear) plugs and calling (front) plugs have been tested in the *B* jack, and all calling (front) plugs have been tested in the *F* jack.

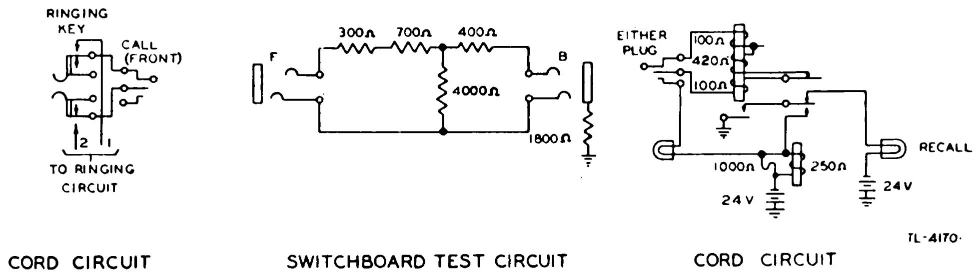


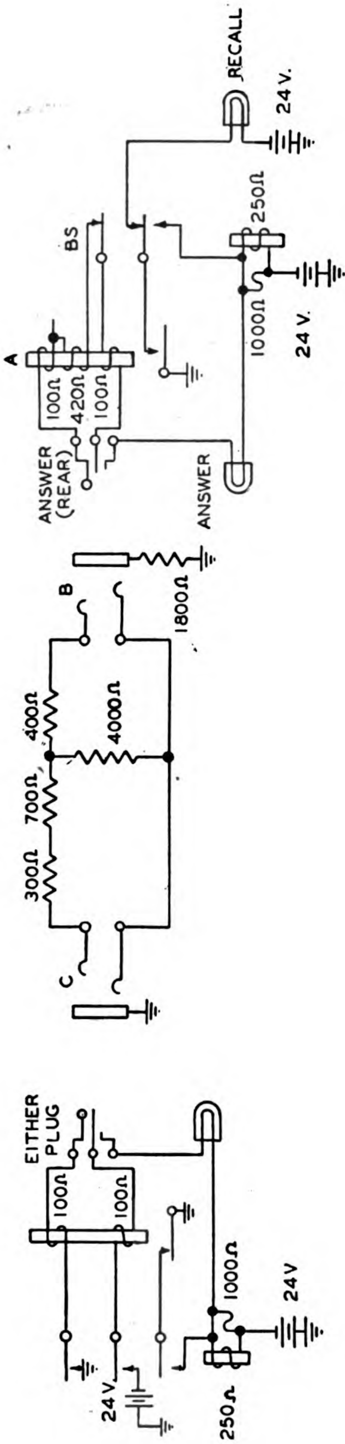
FIGURE 25.—Ringing test of supervisory relays, functional diagram.

c. Non-operate test of the sleeve relays BS and FS and direct-current operate test of the three windings of supervisory relays A and C (fig. 26).—Insert either plug of any cord circuit into the *C* jack, and insert into the *B* jack the answering (rear) plug of the cord under test. The recall lamp of the cord under test should light unless the lamp is defective. Failure of the recall lamp to light may indicate that the sleeve relay fails to meet its non-operate requirements or that the supervisory *A* relay does not meet the direct-current operate test with the three windings in series. Repeat this test with the calling (front) plug of the cord under test inserted into the *B* jack in order to test the *FS* and *C* relays. Test all cord circuits in the same manner.

(*d*) *Operate test of sleeve relays BS and FS* (fig. 27).—Insert either plug of any cord circuit into the *B* jack and insert into the *A* jack the answering (rear) plug of the cord under test. If the sleeve relay of the cord under test operates satisfactorily, the recall lamp of the cord connected to the *B* jack should light. Repeat this test with the calling (front) plug of the cord under test inserted into the *A* jack. Test all cord circuits in the same manner.

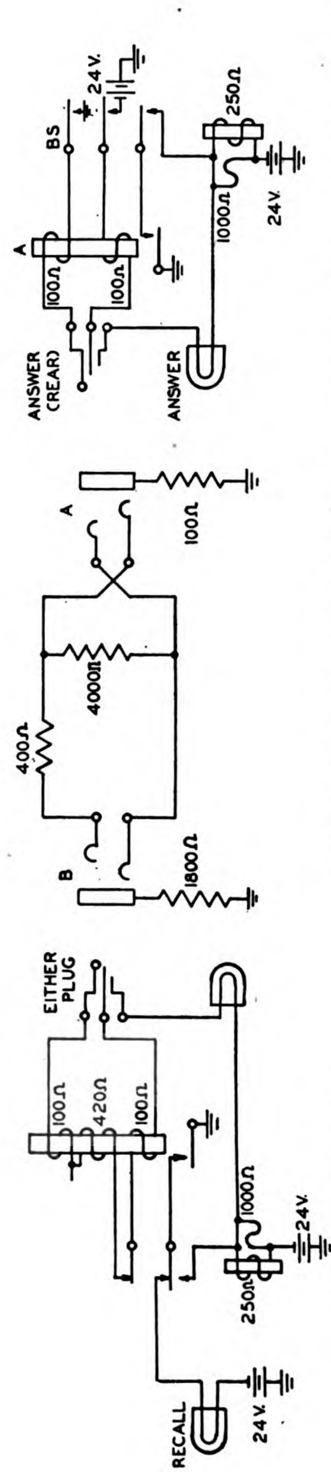
(*e*) *Test of talking keys.*—Insert the calling (front) plug of the cord under test in the *E* jack and operate the TALK key. The ringing current connected to the *E* jack should be heard in the operator's headset. If the power ringing machine is not operating the hand generator must be used to supply ringing current.

20. Night alarm circuit (fig. 28).—The use of series line circuits makes the use of a conventional night alarm circuit unsatisfactory. The combined leakage current of all the line lamps in series with their respective lines causes an appreciable amount of line lamp current to flow at all times even when all lamps are idle. This amount



ANY CORD CIRCUIT SWITCHBOARD TEST CIRCUIT CORD CIRCUIT UNDER TEST

FIG. 26



ANY CORD CIRCUIT SWITCHBOARD TEST CIRCUIT CORD CIRCUIT UNDER TEST

FIG. 27

TL-4171

FIGURE 26.—Test of sleeve and supervisory relays, functional diagram.
FIGURE 27.—Operate test of sleeve relays, functional diagram.

will vary as the insulation resistances of the lines vary. Therefore, it is not practical to adjust a relay in the conventional night alarm circuit to operate satisfactorily. The circuit used in switchboard BD–89–A operates on the increase in line lamp current caused by the lighting of a lamp.

a. Working limits of all common-battery line circuits.—(1) Maximum external circuit loop resistance, 300 ohms.

(2) Minimum combined line insulation resistance of all common-battery lines in parallel, 400 ohms.

b. Functions.—(1) Supplies battery to the series line lamps.

(2) Causes a steady audible signal to sound when a line lamp is lighted.

(3) Provides a means to release the audible signal.

(4) Causes an audible signal to sound when a trunk or magneto line is seized.

(5) Opens the alarm circuit and supplies direct battery to the series line lamps when the NA key is operated.

c. Line lamp signal.—(1) The battery connection to the line lamp common is connected through one side of an impulse transformer. The other side of the transformer is in series with the low-resistance winding of relay *A*. When a line lamp is lighted, the increase in current flowing through the low-resistance winding of the transformer induces an impulse in the high-resistance winding of the transformer, operating relay *A*. The high-resistance winding of relay *A* is permanently energized but does not have enough power to operate the relay. However, relay *A*, once operated, holds through its high-resistance winding and operates relay *B*. Relay *B* opens the circuit to the high-resistance winding of the transformer, connects direct battery to the line lamp common, shunting the low-resistance winding of the transformer, and closes the circuit to the night alarm bell to sound a steady audible signal. The shunt on the low-resistance winding of the transformer prevents cross-talk which might occur in the primary (low-resistance) winding of the transformer when two or more line lamps are lighted at the same time, since the primary winding is common to all line lamps.

(2) Operation of the NA RLS key opens the circuit to the high-resistance battery-fed winding of relay *A*, allowing relay *A* to release, which in turn releases relay *B*. When released, relay *B* opens the circuit to the night alarm bell, disconnects direct battery from the line lamp common, and closes the circuit to the high-resistance

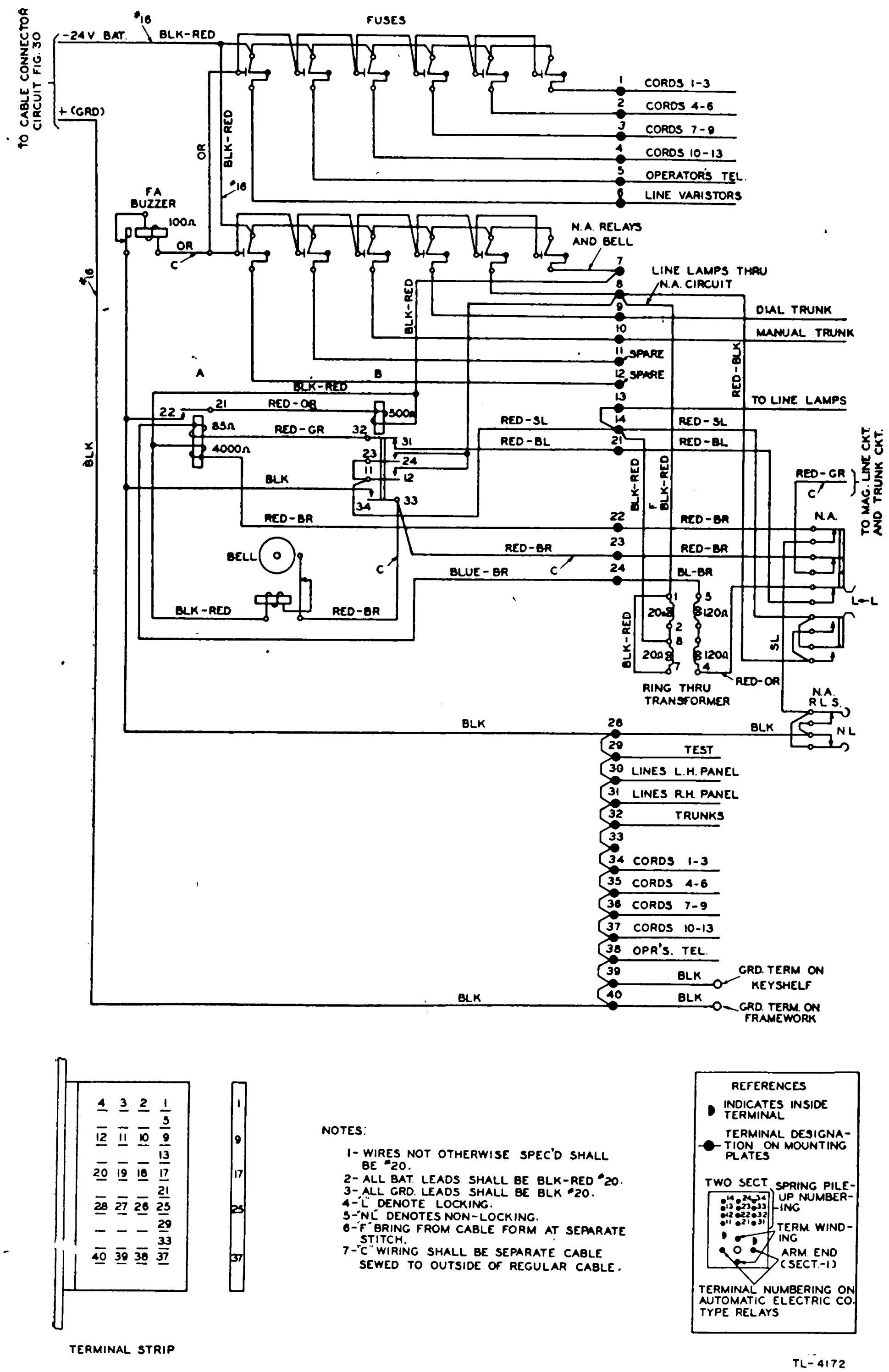


FIGURE 28.—Night alarm, fuse alarm, battery, and ground circuit.

winding of the transformer and the low-resistance winding of relay *A* in series. When the NA RLS key is restored, the circuit to the high-resistance winding of relay *A* is closed and the circuit is prepared for another signal.

(3) Operation of the NA key disconnects the bell from the magneto line and trunk circuits, opens the circuits to both windings of relay *A*, and connects direct battery to the line lamp common, shunting the low-resistance winding of the transformer. This prevents the operation of the night alarm bell when either line or trunk signals are received. Restoring the NA key again prepares the circuit for audible signals.

d. Magneto line and trunk signals.—When a magneto line or a trunk signal is received, direct ground is connected to the bell to sound an audible signal. The magneto line circuits and the trunk circuits are arranged to that the ground is removed when the operator answers, thus opening the circuit to the bell.

21. Fuse alarm circuit (fig. 28).—When a fuse blows, the alarm contact of the fuse connects battery to the alarm bar, causing the buzzer to operate and provide an audible alarm. The buzzer continues to operate until the blown fuse is removed.

22. Battery and ground circuit, 24 volts.—The 24-volt battery and ground circuit is shown in figure 28. The keyshelf ground terminal is located on the underside of the keyshelf at the left-hand side. The framework ground terminal is located on the iron framework between the two varistor groups.

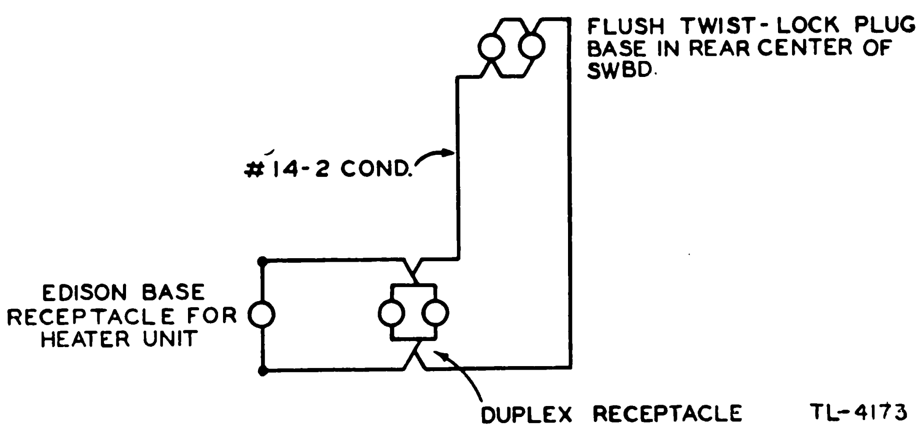


FIGURE 29.—Power and heating circuit, wiring diagram.

23. Power and heating circuit, 110-120 volts, alternating current (fig. 29).— This circuit includes two heating units for drying the switchboard and one outlet for soldering iron or extension lamp.

24. Cable connector circuit (fig. 30).—This circuit is utilized in extending leads from the battery and ground circuit, ringing circuit, and grouping key contacts, to junction box JB-19. In the event that a second switchboard BD-89-A is required, this circuit is used to extend the above mentioned leads from the terminal strip of the adjacent switchboard to junction box JB-19 mounted in this switchboard.

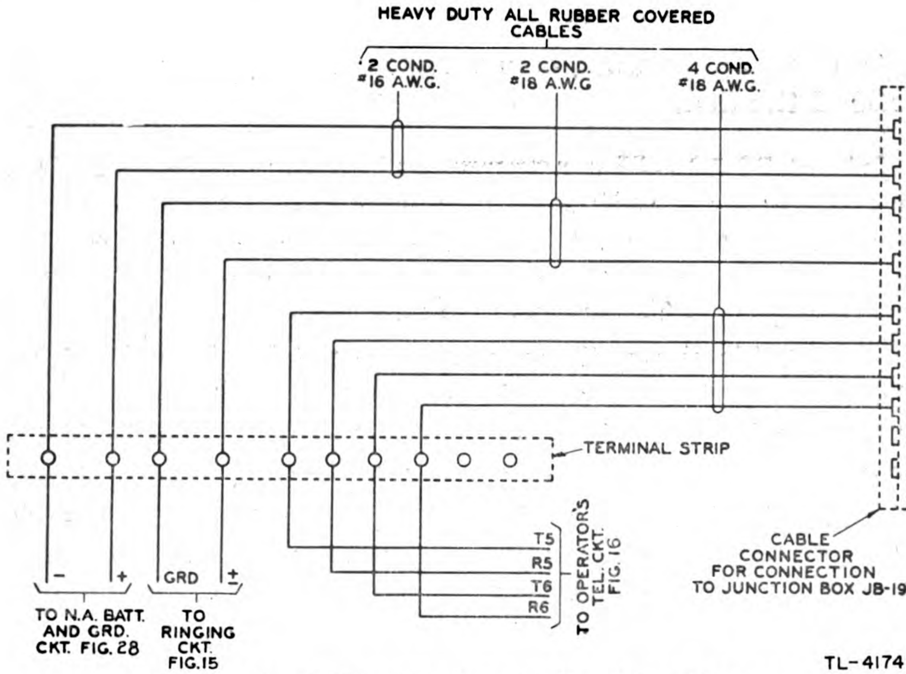


FIGURE 30.—Cable connector circuit, wiring diagram.

25. Working limits, general explanation.—The term "maximum external circuit loop" means that the sum of the resistances of all lines and equipment connected to the circuit in question should not exceed the values stated, in order to insure that the circuit functions properly. For example, the maximum external circuit loop of the common-battery line circuit (fig. 9) is 300 ohms. If the resistance of the line between the switchboard and the telephone does not exceed 200 ohms and the resistance of the connected telephone is 100 ohms, the sum is 300 ohms or just equal to the maximum resistance allowed. The resistance of the common-battery holding coil in an EE-8-A telephone is 100 ohms. In the above case, if the 300-ohm limit is greatly exceeded the line lamp may not burn sufficiently bright. This effect will be come increasingly noticeable as the storage battery approaches a state of discharge. Another example of the use of working limits is as follows: Circuits in two different switchboards are to be connected together. One switchboard circuit has a working limit of 750 ohms, and the other switchboard circuit has a working limit of 1,000 ohms. In this case the 750-ohm limit is controlling. In each case it is necessary to use the sum of the line resistance plus the internal resistance in the distant connecting circuit in determining whether or not the value of maximum external circuit loop resistance will be exceeded. In case it is not possible to meet the working limits with one pair of conductors, it will be necessary to use two pairs in parallel, connected tip to tip and ring to ring at each end of the line.

26. Cabinet BE–79.—The arrangement of apparatus is shown in figure 2. An opening with a sliding cover is provided for incoming line wires in the lower part (each side) of the cabinet. An opening with a sliding cover is also provided in each side of the cover on the switchboard side of the cabinet, for the cables to the switchboard. This allows the covers to be put in place after the installation of the cabling. Space is provided below the protectors for 12 repeating coils C–161 (not furnished as part of the TC–2).

a. Cabling and cable connectors.—The cabling between cabinet BE–79 and switchboard BD–89–A consists of three rubber-jacketed cables, each containing 25 pairs of braid-covered, latex-insulated, No. 22 AWG stranded conductors. The cables, exclusive of the cable connectors, are 21 feet in length. The cable connector at the cabinet BE–79 end of the cable consists of a strip of insulating material on which is mounted a row of 50 binding posts to which the cable conductors are soldered. These soldered connections are inclosed in a copper-alloy protecting cover. Binding posts TM–197 are the same as those used on the terminal panel of switchboard BD–89–A. The cable connectors at the switchboard end of the cable consist of strips of insulating material between which is mounted a row of 50 spade terminals of Signal Corps design. The spade terminals are mounted in such a manner that some movement is allowed in order that the spade terminals will be self-alining when connections are made to binding posts TM–197 on switchboard BD–89–A terminal panel. The cable conductors are soldered to spade terminals. The soldered connections are inclosed in a copper-alloy protecting cover.

b. Protectors and associated terminal strips.—Two vertical strips of protectors are mounted in cabinet BE–79. Each strip is equipped with 40 pairs of commercial high-potential protector blocks and heat coils. A terminal panel, equipped with 80 binding posts TM-197 for connecting the incoming lines, is mounted on the line side of the protectors. The central office side of the protectors is permanently wired to a terminal panel equipped with 80 binding posts from which the lines may be cross-connected to the repeating coils C-161 or to the cables to the switchboard.

27. Power equipment.—The power equipment included in the telephone central office set TC-2 is discussed in paragraphs 28 to 35, inclusive.

28. Storage battery.—*a.* The storage battery consists of two batteries BB-46 connected in series with cord CO-38. This provides a 24-volt, 75 ampere-hour, sealed type storage battery for furnishing direct current to switchboard BD-89-A. Cord CD-335 is provided for battery leads to panel BD-98. When in use, the battery is mounted on rack FM-31. Two cases CS-63 are furnished for transportation of batteries BB-46.

b. Rack FM-31, hammer HM-5, and three ground rods GP-29 are transported in case CS-72.

29. Power Panel.—For power control and distribution one cabinet BE-75 and one panel BD-98 are provided. These, along with associated equipment, are discussed in paragraphs 30 to 35, inclusive.

30. Cabinet BE-75.—This cabinet provides for protection, control, and distribution of 110-120-volt a-c power. When in use, cabinet BE-75 is mounted on a rack FM-30 with rectifier RA-36-A, B, or C. Cord CD-393 is furnished for connecting cabinet BE-75 to a local source of alternating current, and cord CD-395 is furnished to connect cabinet BE-75 to switchboard BD-89-A. When a second switchboard BD-89-A is installed, a-c power is connected from the first switchboard to the second by means of cord CD-394. When any circuit-breaker switch is closed, a-c power supply is connected to the correspondingly numbered socket. For transportation, cabinet BE-75 is packed in the case CS-73 with the rack FM-30 and the rectifier RA-36-A, B, or C. (See par. 35 for discussion of rectifier RA-36-A, B, or C.)

31. Panel BD-98 (figs. 30 and 31).—This panel contains a voltmeter and an ammeter for controlling the rate of charge of the storage batteries and is equipped with a Telering 20-cycle power ringer (see par. 32) which supplies ringing current when 60-cycle

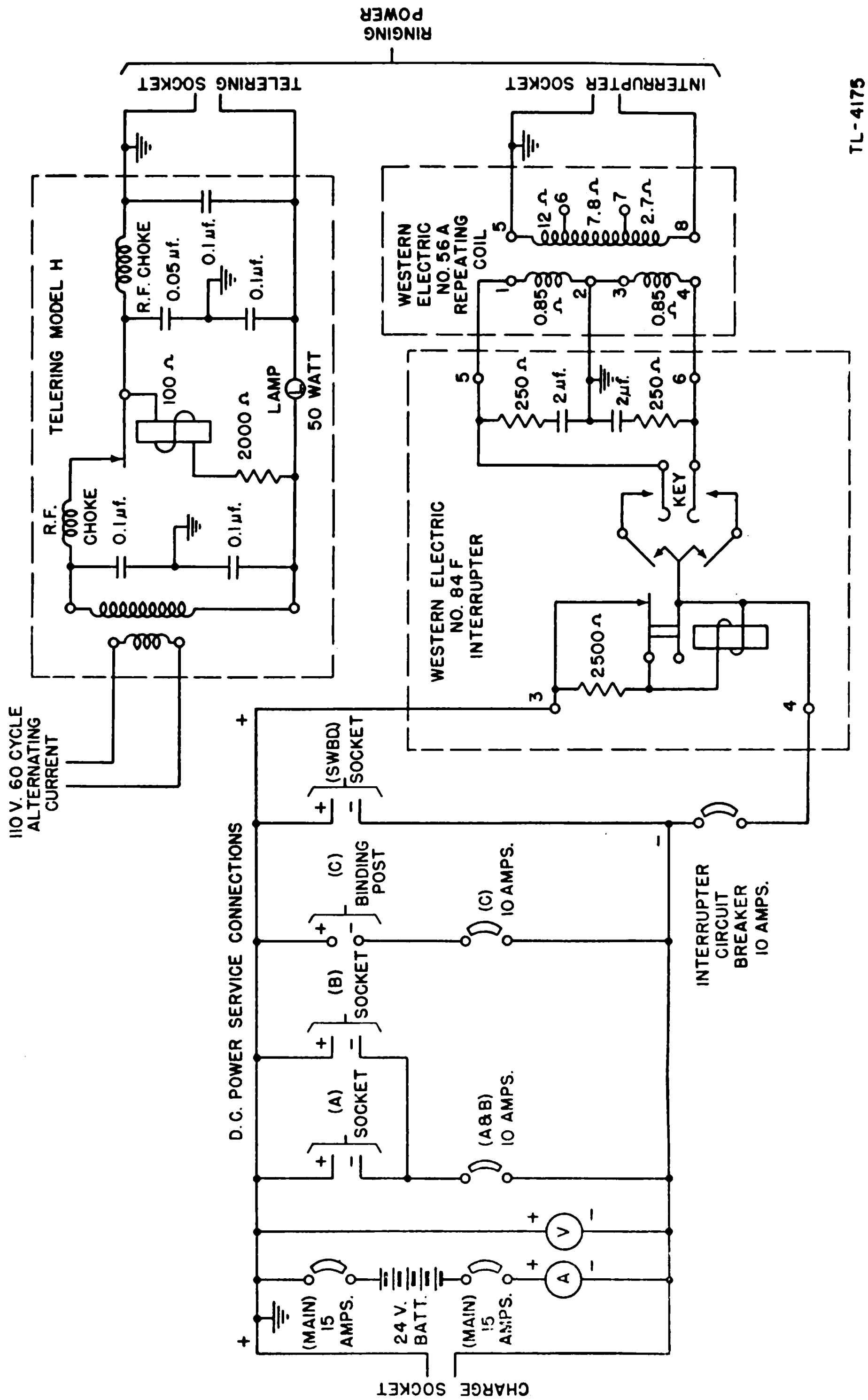


FIGURE 31.—Panel BD-98, schematic diagram.

alternating-current power is available, and an interrupter for providing ringing current from the battery power supply. The Telering 20-cycle power ringer is operated by plugging its power supply cord into a power outlet in cabinet BE-75 and closing the circuit-breaker switch corresponding to the power outlet selected. The interrupter (see par. 33) is started by the operation of the INT circuit-breaker switch on panel BD-98 and the interrupter circuit is completed by operating the rotating button-type key on the interrupter. Closing the *A* and *B* or the *C* circuit-breaker switches connects the 24-volt bus bars to the *A* and *B* sockets or to the *C* binding posts, respectively, which provide spare power terminals. The closing of the MAIN circuit-breaker switch connects the battery socket to the bus bars. A schematic diagram is shown in figure 31. Case CS-71 is furnished for transportation of panel BD-98.

32. Telering 20-cycle power ringer, Model H (figs. 31 and 32).—The Telering 20-cycle power ringer is a vibrating-reed type of frequency converter. It is designed to supply 20-cycle ringing current from a 110-volt, 60-cycle, a-c power supply. The reed vibrates between a contact screw and an electromagnet. The contact screw adjustment is set at the factory, and it is suggested that no change be made in the adjustment unless the reed vibrates in a surging manner, or there is sparking at the contact. If sparking occurs, it requires only the slightest turn on the contact screw, either inward or outward, to correct it. However, it is seldom that any change will be necessary. The adjustment of the Telering contact is practically opposite to that of other vibrating type power ringers, in that the contact gap in the Telering must be kept *as wide as possible*. Closing the contact gap does not increase the output, but instead will upset the adjustment, cause sparking, interfere with radio reception, and may prevent starting.

33. No. 84F interrupter (fig. 31).—*a*. The Western Electric Company 84F interrupter is a vibrating pole-changer type of ringer for converting direct current into alternating current for ringing. When the interrupter is properly adjusted, it is sparkless and noiseless in operation. When the machine is in constant use, daily inspection should be made to check for the following:

(1) Sparking at contacts.
(2) Noisy operation.
(3) Tendency of armature to stick to magneto (operating coils).
(4) Short circuits.

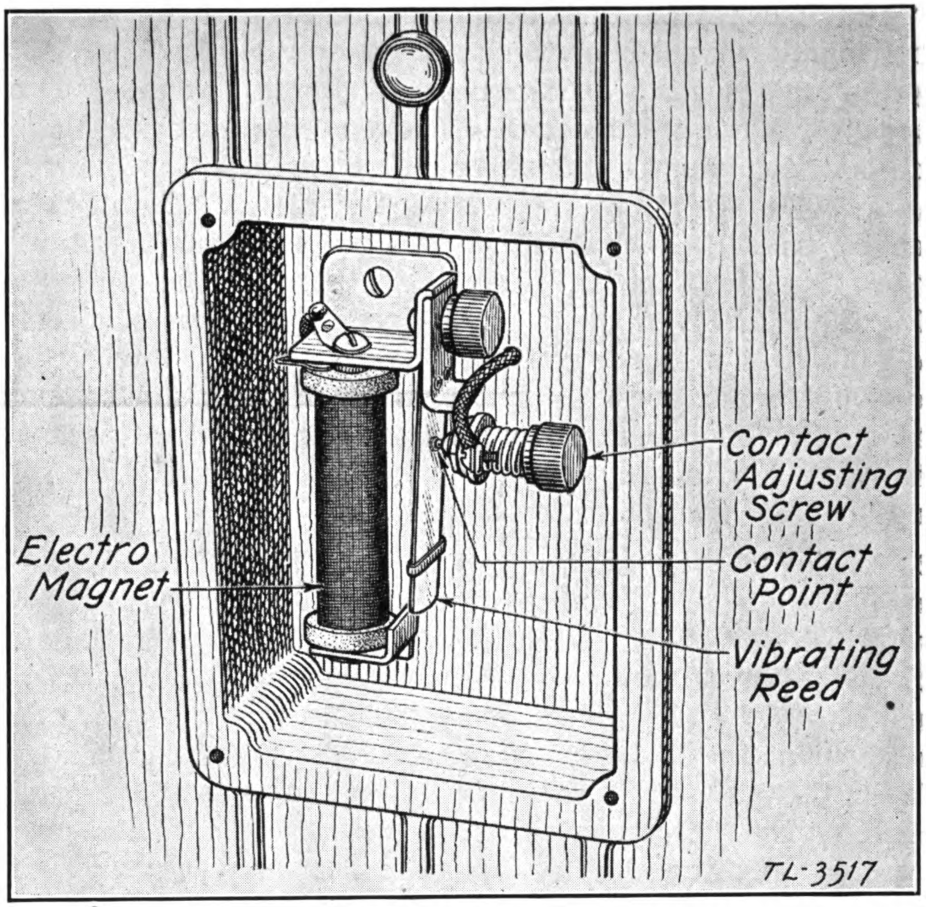


FIGURE 32.—Telering ringer, cover removed, showing vibrator assembly.

b. A weekly inspection of the condition of the contacts should also be made. If sparking occurs at the contacts in the operating magneto, they should be polished. If the ringing contacts spark, they should be polished. If polishing does not eliminate the sparking, the ringing springs should be readjusted. *Do not attempt to adjust the springs without disconnecting the ringing battery at the fuses.* If the armature can be made to lock by pushing it toward the magneto while the interrupter is in operation, the setscrew should be unscrewed slightly. If the adjustment of the ringing springs is affected by readjustment of the setscrew, a complete readjustment of the ringing springs should be made. The position of the weighting nut on the threaded screw at the end of the armature governs the frequency of vibration of the armature. The nut should be at approximately the center of the threaded portion of the screw. If the vibrating arm strikes the magnet, the operation of the interrupter will be noisy. To eliminate the noise from this source, all the ringing springs should be moved in such a manner that the vibrating arm will be farther away from the magnet. The interrupter should then be completely readjusted.

34. Power supply.—Telephone central office set TC-2 is equipped to operate from 110-120-volt, 60-cycle, a-c power. Power unit PE-75-A, B, or C is provided to serve as a source of local power, in case commercial 110-120-volt, 60-cycle, a-c power is not available. The power unit is furnished with a collapsible case for transportation. Refer to TM 11-900 or TM 11-901 as required for operating instructions for power unit PE-75-A, B, or C.

35. Rectifier RA-36-A, B, or C.—This rectifier is provided for charging batteries BB-46. It is designed to mount on rack FM-30 and to operate from 100-125-volt, 60-cycle, a-c power. The rectifier is of the full-wave type and is adjustable for charging a 24-volt storage battery at a rate of from 2 to 12 amperes. The rectifier is transported in case CS-73. For detailed information on the adjustment of the rectifier for varying the charging rate, consult the instructions outlined in paragraph 6*c*. Figure 33 shows the circuit diagram of the rectifier.

36. Line test equipment—Cabinet BE-70-B.—A cabinet BE-70-B (wire chief's testing cabinet) and its packing case, case CS-57, are furnished (see TM 11-345 for detailed functioning of parts). The cabinet is designed to make the following tests or operations on magneto and 24-volt common-battery telephone lines:

a. Talking to telephone user.
b. Talking on telephone trunks.
c. Talking on two call wires.
d. Ringing.
e. Continuity tests.
f. Tests for short circuits.
g. Tests for grounds.
h. Tests for crosses with lines carrying current.
i. Tests for crosses with other lines.
j. Location of crosses or grounds by means of a Wheatstone bridge (not furnished as part of telephone central office set TC-2).
k. Ballistic capacity tests.
l. Measuring test-battery voltage.

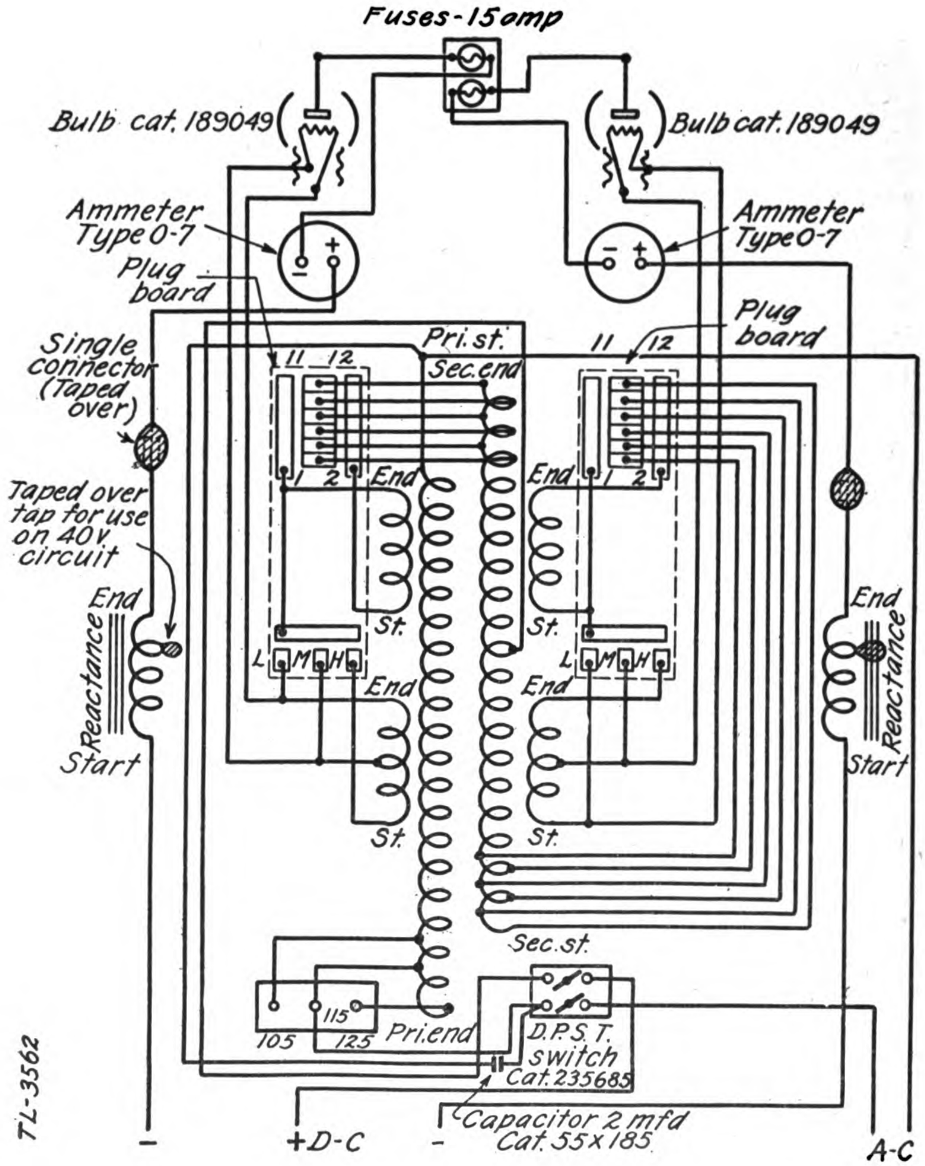


FIGURE 33.—Rectifier RA-36-A, B, or C, circuit diagram.

SECTION IV

SERVICING AND REPAIR

37. Maintenance.—*a. General.*—The greatest single factor in trouble-free operation is careful handling of the equipment while packing and unpacking, transporting, and installing. After the installation has been completed, all circuits, fuses, and protector blocks should be tested at least once each month, or more often where climatic conditions warrant.

b. Circuit breakers.—When a circuit breaker opens its circuit due to a flow of excessive current, the circuit breaker should not be re-closed until the cause of the excessive current has been determined and corrected. After the circuit breaker has tripped, the handle must be returned to the OFF position for resetting before the circuit breaker can be re-closed. The trip position can be readily recognized as a position midway between ON and OFF.

c. Working limits.—The loop resistance and insulation resistance of the lines connected to the switchboard should be maintained within the limits specified on the respective circuits. However, the loop resistance of common-battery lines may exceed the values specified on the drawings, provided the brightness of the switchboard lamp is satisfactory.

38. Alarm type fuses.—Inspection of an alarm type fuse will show that the fuse wire holds two springs under tension. In case a fuse is blown, the tension on the two springs is released and they assume different positions with respect to the body of the fuse. The front spring (with the glass bead) serves as a visual indication of the condition of the fuse, and the back spring serves to complete the fuse alarm circuit, thus giving an audible signal to indicate a blown fuse. Alarm type fuses must be properly installed in the fuse mounting in order that advantage may be taken of the alarm feature. The fuse must be so installed that the bent end of the alarm contact spring (back spring) will be directly over the alarm contact stud, or alarm bus bar, on the fuse mounting. If the fuse has been improperly installed, the alarm circuit will not be completed, and consequently no alarm will be received. However, the fuse will be blown under overload conditions, thereby protecting the equipment.

39. Storage Batteries.—The electrolyte in the storage batteries should be maintained at the proper level. The voltage of the battery should be as follows:

Not less than 22 volts.

Not more than 30 volts if batteries are charged during use.

Between 25.2 and 26.4 volts if the batteries are trickle-charged or *floated.*

Caution.—Violent *gassing* and a rise in temperature of the electrolyte are two indications of too high a charging current. Keep open flames, lighted cigarettes, and other burning articles away from the batteries at all times. Poor connections cause sparking and are therefore a very dangerous fire hazard. Do not change connections without turning off the MAIN circuit breaker on panel BD-98. The instructions for the care and use of the battery, outlined in TM 11-430, should be carefully followed.

40. Switchboard plugs, cleaning.—In order to maintain high-grade transmission through the cord circuits, clean all plugs as often as required to maintain brightness, using a light oil and cake rouge, or a paste type metal polish. The use of light oil and cake rouge is the preferable method of polishing plugs, as there is less tendency to use an abnormally large amount of polishing material. It is also easier to remove the unused portion of the polishing material from the plug upon completion of the polishing operation. Pour a few drops of light oil on the cake of rouge, thereby softening the rouge to such an extent that when the polishing rag is rubbed across the surface of the cake, a small amount of the rouge is transferred to the rag. Care must be taken when using either the rouge or paste type of polish to make sure that all surplus polishing material is thoroughly removed from the plug upon completion of the polishing operation.

41. Manufacturer's drawings.—*a. Relay terminal numbering.*—The manufacturer's drawings furnished with switchboard BD-89-A, and the figures used in this manual show sample diagrams of relay winding terminals and relay spring pile-up numbering as viewed from the rear or wiring side of the relay. The diagrams do not show the complete numbering scheme, but do show the general system. For example, in figure 14, cord circuit, relays BS and FS each have a set of make contacts with springs numbered *14* and *15*. The sample diagram showing the spring pile-up numbering does not show either of these springs. However, it will be found springs *14* and *15* on the relay are in the same vertical row of the spring pile-up as springs *11*, *12*, and *13*, and are immediately above them in numerical order. For this general type of relay of Automatic Electric Company manufacture, the following rule may prove helpful: The first digit of the spring number denotes the vertical row; for example *1* indicates the left-hand vertical row, *2* the middle row, and *3* the right-hand row, as viewed from the rear or wiring side. The second digit of the spring number indicates the vertical position of the spring as counted from the bottom of the spring pile-up. For example, spring No. 25 will appear in the center vertical row and will be the fifth spring from the bottom. Each small solid semi-circle, shown on both the schematic drawings and the terminal diagrams, denotes the terminal of the inner end of a relay winding. This terminal is usually connected to the ground or low-potential side of the connected circuit, while the battery or high-potential side of the circuit is connected to the unmarked or outside ending of the relay winding.

b. Color of wires.—The manufacturer's drawings and the figures in this manual show, in most cases, the color of the wire connected to the various terminals. In a few isolated cases it may be found that the color of the wire used in wiring the equipment does not correspond with the color shown on the drawings. If such conditions are encountered, it will be necessary to use care in checking the wiring, to see that the same color of wire is connected to the appropriate terminals, even though the color used differs from that specified on the drawings. An example of this condition has been located in some cord circuit relay units, which are wired as follows (reference fig. 14): A RED instead of a WHITE wire is used to make the connection between the inner terminal of winding No. 3 of the *A* relay and spring No. 31 of the *BS* relay. A like substitution has also been made, in some cases, between corresponding terminals of the *C* and *FS* relays.

42. Relay adjustment data.—Table I gives the necessary information for making mechanical and electrical adjustments on the various

TABLE I

CIRCUIT REQUIREMENTS

Apparatus designation 1	Mechanical requirements		Contact data		Circuit preparation	Test clip data		See note	Test set prep. 3	Direct current flow requirements				
	Arm. travel	Residual screw projection	Spring No.	Separation	Block 2	Conn. bat.	Conn. grd.			Test wdg.	Test for 4	After soak Amp.	Test Amp.	Readjust Amp.
Trunk circuit, dial, figure 12														
A	.020″	.0015″	21–22	.010″		Repeating Coil Terminal 5	Repeating Coil Terminal 8		B/G	52 ohm	O		.0397	.0365
									do		NO		.0293	.0327
B		.0015″	11–12	.015″			Jack Spring		G		O		.0153	.0135
			12–13	.010″			do		do		NO		.0105	.0118
			14–15	.010″										
			31–33	.016″										
			32–33	.010″										
C	.020″	.0015″	All	.010″	(B)O		Spring #4 Relay(D)		do		O		.0170	.0159
									do		NO		.0131	.0144
D	.025″		3–4	.015″		Spring #2 Relay (D)	Spring #1 Relay (D)		B/G		O		.0056	.0052
									do		NO		.0044	.0047
Trunk circuit, manual, figure 13														
A		.0015″	11–12	.015″			Jack Spring		G		O		.0169	.0153
			13–14	.010″			do		do		NO		.0121	.0126
			31–32	.015″										
			32–33	.010″										
B	.015″	.020″	21–22	.010″		Spring #14 Relay (A)	Spring #33 Relay (A)		B/G		O		.0169	.0157
									do		NO		.0129	.0137
									do		RLS		.0100	

Apparatus designation 1	Mechanical requirements		Contact data		Circuit preparation	Test clip data				Direct current flow requirements				
	Arm. travel	Residual screw projection	Spring No.	Separation	Block 2	Conn. bat.	Conn. grd.	See note	Test set prep. 3	Test wdg.	Test for 4	After soak Amp.	Test Amp.	Re-adjust Amp.
C	.034″	.0015″	11–12	.025″		Spring #31	Spring #32	5	do.	300	O.		.0314	.0286
			13–14	.010″		Relay (C)	Relay (A)	5	do.	ohm	NO.		.0232	.0256
			31–32	.015″			Spring #12	5, 6	G.	350	O.		.0169	.0154
			33–34	.010″			Relay (C)			ohm				
Cord circuit, figure 14														
A & C		.006″	21–22	.010″	(BS) or (FS)O			7	M [8]	1 & 2	O.	.069	.0137	.0130
			22–23	.006″	(BS) or (FS)O			7	M [8]	1 & 2	RLS.		.0076	.008
									M [8]	1, 2 & 3	O.		.0072	
BS & FS		.0015″	11–12	.015″			Spring #13		G.		O.		.033	.0297
			12–13	.010″			Relay (BS)		G.		NO.		.0242	.0263
			14–15	.010″			or (FS)							
			31–32	.015″										
			32–33	.010″										
Night alarm circuit, figure 28														
A	.020″	.0015″	21–22	.010″		Spring #32	Transformer	9	B/G.	85	O.		.0273	.0244
						Relay (B)	Terminal #5	9	B/G.	ohm	NO.		.0188	.0211
B		.0015″	11–12	.010″			Spring #21		G.		O.		.0170	.0153
			23–24	.010″			Relay (A)		G.		NO.		.0121	.0135
			31–32	.015″										
			32–33	.010″										

Note: 1 See parts list for Automatic Electric Company code numbers.
2 Letter to left of dash denotes relay to be blocked in the operated or nonoperated position as specified.
3 "B/G" denotes that test set is to supply battery and ground. "M" denotes metallic connection, battery and ground to be supplied by the circuit. "G" denotes that test set is to supply ground.
4 "O" denotes operation. "NO" denotes nonoperation. "RLS" denotes release.
5 Insulate springs #11 and #12 of relay (A).
6 Operation of spring #11 and #12 of relay (C) only.
7 Windings in series aiding. Block (BS)O when adjusting (A), and block (FS)O when adjusting (C).
8 Connect to terminals on cord-shelf, windings in series aiding.
9 Operate NA key to disconnect battery from 4,000-ohm winding.

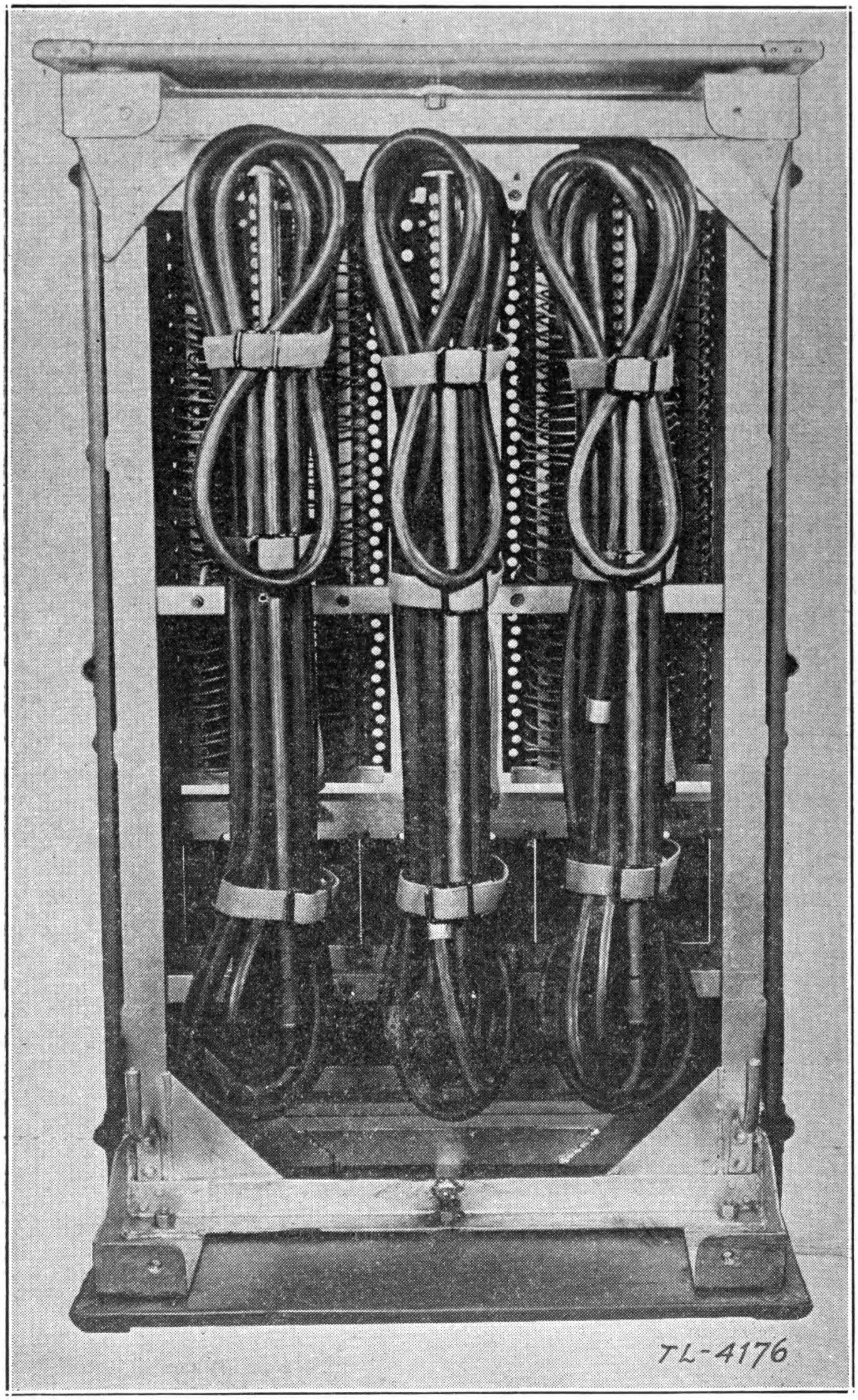


FIGURE 34.—Cabinet BE-79, cables secured for transportation.

relays. The necessary equipment for making these adjustments is not included as a part of TC–2; therefore, these adjustments should not be attempted in the field, but should be performed by signal repair companies or higher repair echelons.

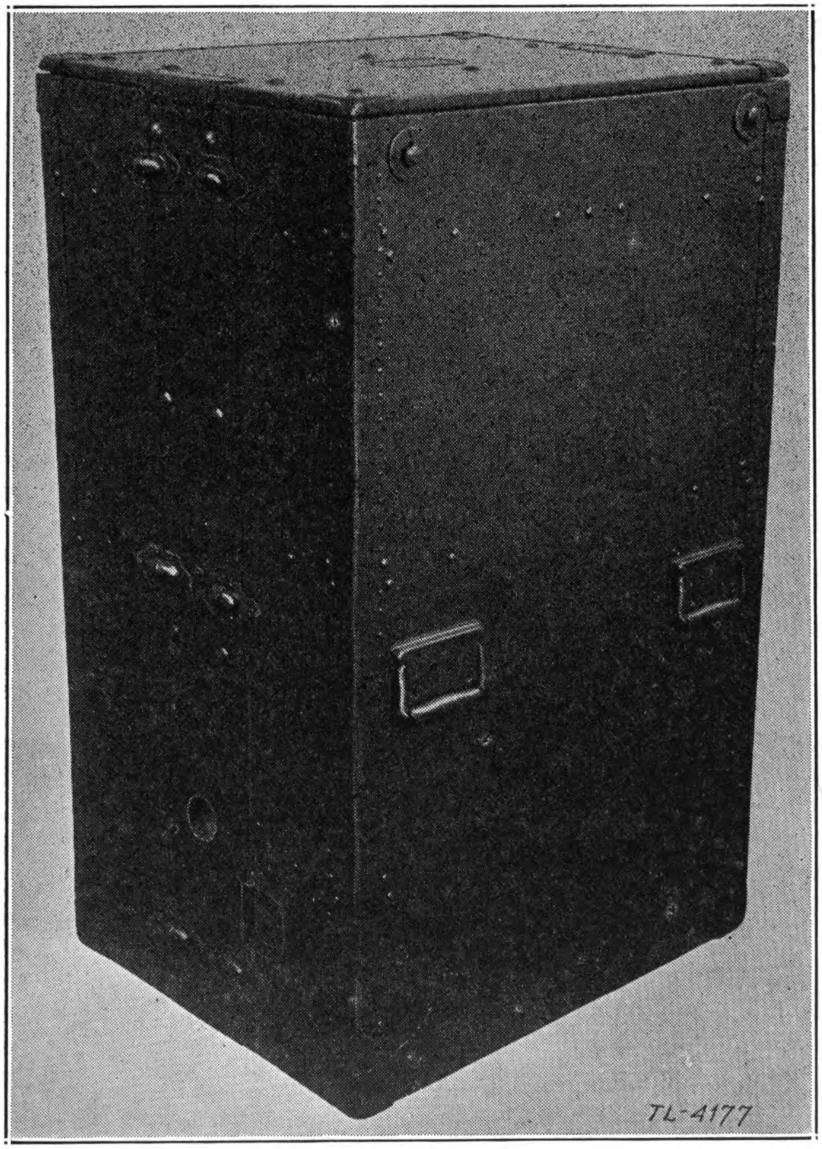


FIGURE 35.—Cabinet BE–79, ready for transportation.

43. Packing for army transportation.—Remove the spade-terminal strips from the switchboard BD–89–A and fasten them to the associated binding post terminals in cabinet BE–79. Coil up the cables and strap them in place as shown in figure 34. Fasten the cabinet covers in place as shown in figure 35. Pack the head and chest sets HS-19 in the compartment in the front cover of switchboard BD-89-A. Loosen the designation strip mounting screws (at the extreme ends of the strip) and lower the supports to fasten the drops in place. Tighten the screws sufficiently to hold the drops securely. Place the cord weights in the cord-weight support and fasten the support in place as shown in figure 36. Fasten all switch-

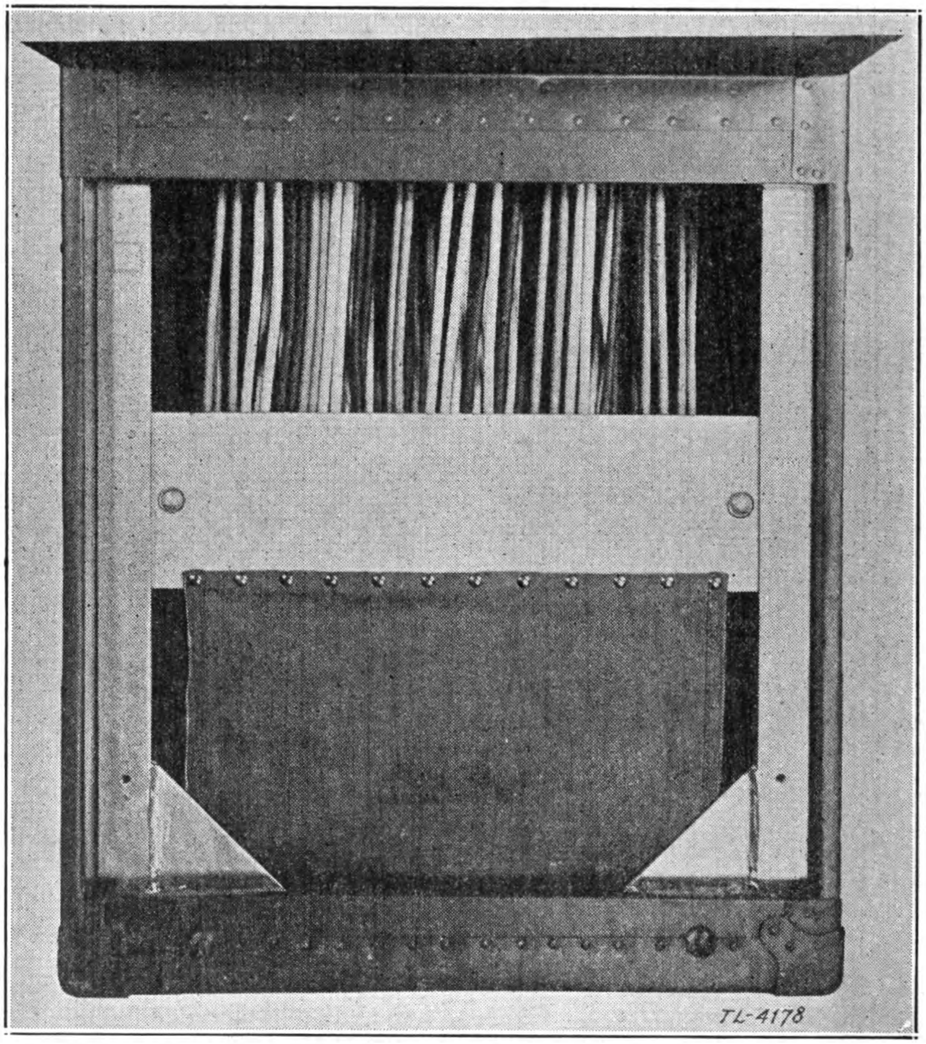


FIGURE 36.—Switchboard BD-89-A, front panel removed, showing cord weights secured for transportation.

board covers in place as shown in figure 37. Remove rack FM-30 containing rectifier RA-36-A, B, or C, and cabinet BE-75, and pack them, assembled, in case CS-73. Pack each battery BB-46 in one case CS-63. Pack rack FM-31, hammer HM-5, and three ground rods GP-29, in case CS-72. Pack cabinet BE-70-B (wire chief's test set) in case CS-57. Pack the operator's chair M-205 in case CS-70. Pack panel BE-98 in case CS-71. The packing case for power unit PE-75-A, B, or C, also provides room for cord CD-409.

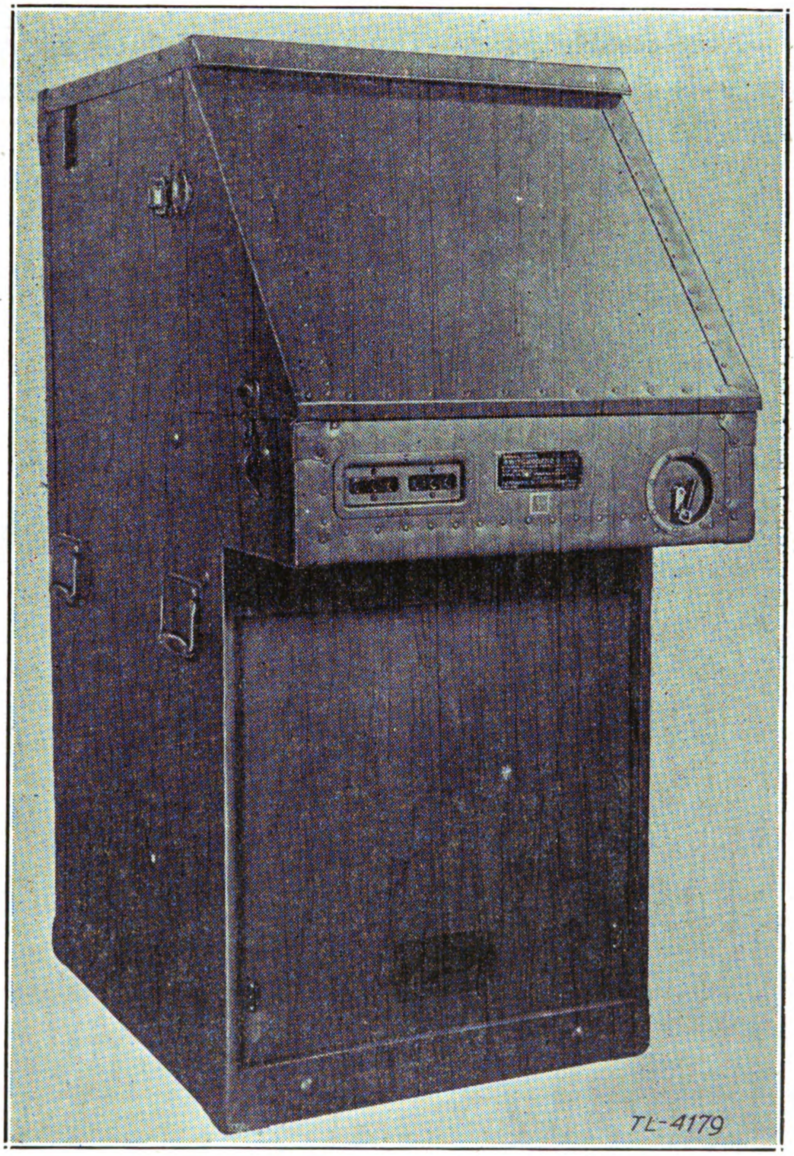


FIGURE 37.—Switchboard BD-89-A, ready for transportation

SECTION V

REPLACEABLE PARTS

44. List of replaceable parts.—The following list of major component parts is further expanded in succeeding subparagraphs dealing with the larger items of equipment.

a. Telephone central office set TC–2.

Stock No.	Name	Description	Function	Ref. par. No.
4C9989A	Switchboard BD–89–A		Switching central	44*b*
4E1179	Cabinet BE–79		Main distributing frame	44*c*
3H4098	Panel BD–98		Power panel	44*d*
4E1175	Cabinet BE–75		A–c power distribution	44*e*
4E2917	Junction box JB–19		Cable connections	44*f*
4B1279	Head and chest set HS–19		Operator's set	44*g*
3H4676( )	Rectifier RA–36–A, B		For charging BB–46	44*h*
	Maintenance equipment ME–6	In chest CH–59	For maintenance	44*i*
6R38044	Tool equipment TE–44–A	In chest CH–58	Provides tools	44*j*
3B46	Battery BB–46		Switchboard d–c power	
3F2405( )	Cabinet BE–70–B		Wire chief's testing cabinet	
3F2570	Case CS–57		For cabinet BE–70–B	
3B863	Case CS–63		For battery BB–46	
4C2905.1	Case CS–70		For chair M–205	
3H771	Case CS–71		For panel BD–98	
3B872	Case CS–72		For rack FM–31, hammer HM–5 and 3 ground rods GP–29	
3Z973	Case CS–73		For rectifier RA–36–( ), cabinet BE–75 and rack FM–30	
4C2905.1	Chair M–205		Operator's chair	
3E1335	Cord CD–335	30′ long	Battery cord	
3E1393	Cord CD–393	50′ long	Cabinet BE–75 to a–c power	
3E1394	Cord CD–394	8′ long	Switchboard BD–89–A to switchboard BD–89–A, a–c power	
3E1395	Cord CD–395	30′ long	Cabinet BE–75 to switchboard BD–89–A	
3E1409	Cord CD–409	50′ long	Power unit PE–75–( ) to cabinet BE–75	
3E2038	Cord CO–38	1′ long	Battery BB–46 to battery BB–46	
3E2258	Cord CO–258	50′ long	Ground cord	
3E2259	Cord CO–259	5′ long	Cabinet BE–79 to cabinet BE–79, ground cord	
3Z3329	Ground rod GP–29	Steel, 3′ x 2¼″ dia.		
6Q49005	Hammer HM–5	Sledge, 12–lb.		
3H4575( )	Power unit PE–75–A, B or C		Emergency a–c power	
4E6530	Rack FM–30		For rectifier RA–36–( ) and cabinet BE–75	
4E6531	Rack FM–31		For 2 batteries BB–46	
6Z7510–1	Paulin, duck	12.3′ x 16′	Equipment protection	

b. Switchboard BD-89-A.

Ref. fig. No.	Ref. symbol	Stock No.	Name	Description	Function	Mfr.	Mfr's. part No.	Signal Corps dwg. No.
8			Combined jack and signal	5 per strip	Magneto line jack and signal	W. E. Co.	31C	SC-D-6375
9			Jack		Line jack	do.	239B	Do.
9	LINE		Lamp	Switchboard	Line lamp	do.	B-2	Do.
9			Varistor	1/10 of 300-A	Line lamp protection	do.	300A	Do.
10			Jack		Outgoing line circuit	do.	238B	SC-D-6373
11	A, B		Jack		Through line circuit	do.	239B	Do.
12	C1, C2		Capacitor	2 μf	Bypass	A. E. Co.	D-68195-A	SC-F-3971 & SC-D-6377
12	C3		Capacitor	do.	Blocking	do.	do.	Do.
12	C4		Capacitor	do.	Contact protection	do.	do.	Do.
12			Coil	Repeating coil		do.	D-281686-A Type 2A	Do.
12			Dial			A. E. Co. or W. E. Co.	D-84760-A 5EB	Do. Do.
12	ANSWER		Jack		Answering jack	W. E. Co.	241B	Do.
12	DIAL		Jack		Dial jack	do.	239B	Do.
12	ANSWER		Lamp	Switchboard	Answering lamp	do.	A1	Do.
12			Plug	Switchboard	Dial cord	do.	310	Do.
12	A		Relay		Supervisory relay	A. E. Co.	H-66470-1	Do.
12	B		Relay		Sleeve relay	do.	H-66470-2	Do.
12	C		Relay		Ring-down locking relay	do.	H-66470-9	Do.
12	D		Relay		Ring-down relay	do.	H-60611-11	Do.
12	R1, R2		Resistor	500 ohms	Current limiting	do.	H-60611-19	Do.
12	R9		do.	600 ohms	Contact protection	do.	H-66470-101	Do.
13	C1, C2		Capacitor	2 μf	Bypass	A. E. Co.	D-68195-A	SC-F-3971 & SC-D-6377
13	C3		do.	do.	Blocking	do.	do.	Do.
13			Coil	Repeating coil		do.	D-281686-A Type 2A	Do.
13	ANSWER		Jack		Answering jack	W. E. Co.	241B	Do.
13	ANSWER		Lamp	Switchboard	Answering lamp	do.	A1	Do.
13	A		Relay		Sleeve relay	A. E. Co.	H-60611-24	Do.
13	B		do.		Supervisory relay	do.	H-60611-4	Do.
13	C		do.		Ring-down relay	do.	H-66470-10	Do.
13	R1		Resistor	500 ohms	Current limiting	do.	H-60611-19	Do.
14	C1, C2		Capacitor	2 μf	Blocking	do.	D-68195-A	SC-F-3972 & SC-D-6374
14	TALK-RING		Key		Talking and ringing	do.	D-321965	Do.
14	ANSWER, CALL		Lamp		Supervisory	W. E. Co.	E1	Do.

14	RE-CALL		Lamp		Ring-down supervisory	W. E. Co.	A1	Do.
14	ANSWER, CALL		Plug		Answering or calling plug	do	310	Do.
14	A, C		Relay		Answering or calling supervisory	A. E. Co.	H-66470-3	Do.
14	BS, FS		do		Back or front sleeve relay	do	H-66470-4	Do.
15		4B454	Crank GC-9					SC-D-4237
15		4B841	Generator GN-41		Hand generator			SC-D-6374
15	EMG		Key		Emergency	W. E. Co.	498F	Do.
15	MR		do		Master ringing	A. E. Co.	D-321005	Do.
15			Resistor lamp		Ballast lamp	W. E. Co.	12D or 8D	Do.
16	C1, C2		Capacitor	2 μf	Blocking	A. E. Co.	D-68195-A	SC-D-6375
16	C3		do	6 μf (three 2-μf in parallel)	Bypass	do	do	Do.
16	C4		do	0.5 μf	Blocking	do	D-68211-A	Do.
16		3C105	Coil C-105		Induction coil			
16			Coil C-278		Monitor coil			
16	A		Coil	Retardation coil	Battery supply	do	H-66470-5	Do.
16		4C4277	Jack JK-37					
16	GR-MON		Key		Grouping and monitoring	do	D-322147	Do.
16		4C9971/136	Varistor		Acoustic shock reduction	W. E. Co.	3-A	Do.
20	A-E		Jack		Conference cct	do	239B	SC-D-6373
21			Clip	Cord tip, for 2W6A cord	Test cord	do	59	SC-D-6376
21			Cord	Clip ended, 6′ long	do	do	2W6A	Do.
21			do	Key ended, 4′ long	do	A. E. Co.	H-66503 assembly #2	Do.
21			do	Patching, 2′ long	do	W. E. Co.	2P4A	Do.
21			do	Patching test, 4′ long	do	A. E. Co.	H-66503 assembly #1	Do.
21	A-D		Jack		Test jack	W. E. Co.	238B	Do.
21	E		Jack		do	do	241B	Do.
21	F-G		do		do	do	238B	Do.
21	KEY		Key	For A. E. Co. H-66503 assembly #2	Test cord	do	522A	SC-D-6376
21			Plug	For test cords	do	do	310	Do.
21	TEST PLUG		Plug, test	For A. E. Co. H-66503 assembly #1	do	do	257A	Do.
21	R1		Resistor	100 ohms ± 1%, 1-watt		A. E. Co.	H-66470-102	Do.
21	R2		do	400 ohms ± 1%, 1-watt		do	H-66470-104	Do.
21	R3		do	4000 ohms ± 1%, 1-watt		do	H-66470-105	Do.
21	R4		do	1800 ohms ± 1%, 1-watt		do	H-66470-103	Do
21	R5		do	300 ohms ± 1%, 1-watt		do	H-66470-106	Do.
21	R6		do	700 ohms ± 1%, 1-watt		do	H-66470-107	Do.
21	R7		Resistor	1000 ohms ± 1%, 20-watts		A. E. Co.	H-66470-108	SC-D-6376
21	R8		do	200 ohms ± 1%, 2-watts		do	H-66470-109	Do.
28	BELL		Bell		Night alarm	do	H-66470-8	SC-D-4264& SC-D-6378
28	FA		Buzzer		Fuse alarm	do	H-60611-14	Do.
28	A		Relay		Impulse relay	do	H-66470-7	Do.
28	B		do		Lockout relay	do	H-66470-6	Do.

Ref. fig. No.	Ref. symbol	Stock No.	Name	Description	Function	Mfr.	Mfr's. part No.	Signal Corps dwg. No.
28	NA		Key		Night alarm key	W. E. Co.	479DC	Do.
28	NA RLS		Key		Night alarm release key	A. E. Co.	D-322154	Do.
28	RING THRU		Transformer	Ring through transformer.	Impulse transformer	do.	D-282302-A	Do.
28		3Z2135A	Fuse	1$\frac{1}{3}$ amp., alarm type	Circuit protection	W. E. Co.	35A	Do.
30			Cable connector	Terminal strip and 3 rubber covered cables	Extends d-c and a-c switchboard power circuits to JB-19			SC-D-4258
			Adapter	Composition	Part of heating unit assembly	Graybar	KL	SC-D-4259
			Adapter, dial		Part of dial mounting	W. E. Co.	52B	SC-D-4251
		3E1298/1-1	Angle	Spade terminal	Cable connector			SC-D-4287
			Angle	Brass	Cable connector terminal strip			SC-D-4261
			Base, plug	Flush	Part of heating unit assembly	Graybar	8808	SC-D-4259
		3Z756	Binding post TM-197		Line and trunk binding posts			SC-D-4255
			Block, connecting		Dial mounting	W. E. Co.	25B	SC-D-4251
			Brace	Keyshelf brace	To hold keyshelf open	do.	11G	SC-D-4251
			Bracket	Cable bracket	Holds keyshelf form			Do.
			do.	Condenser mounting				SC-D-4248
			do.	Steel	Part of heating unit assembly			SC-D-4259
		4C2502L	Cap, lamp	Switchboard, green	Cord lamp cap	W. E. Co.	2L	SC-D-4251
		4C2502H	do.	Switchboard, red	do.	do.	2H	Do.
		4C2502AY	do.	Switchboard, white	do.	do.	2AY	Do.
		4C2504F	do.	Switchboard, green	Recall lamp cap	do.	4F	SC-D-4249
		4C2504D	do.	Switchboard, red	do.	do.	4D	Do
		4C2504A	do.	Switchboard, white	do.	do.	4A	Do.
			do.	do.	Line and trunk lamp caps	do.	12AY	Do.
			Clamp, cable	Phenolic, top section				SC-D-4262
			do.	Phenolic, bottom section				Do.
			Connector	Armored cable connector.		Graybar	2226-S	SC-D-4259
			Cord	5', green	Cord circuit	W. E. Co.	S3B	SC-D-4243
			do.	5', red	do.	do.	S3B	Do.
			do.	5', white	Cord circuit and dial cord circuit	do.	S3B	Do.
			Form.	Switchboard local cabling form				SC-D-4266
		4C3709	Fastener, cord		Cord terminal	do.	9	SC-D-4244
		4C4247B	Hook, cord	14 per strip		do.	7B	Do.
			Insulator	Phenolic	Generator base			SC-D-4247

			Mounting, dial		Dial mounting	W. E. Co.	34E	SC-D-4251
						A. E. Co.	D-78399-A	Do.
			Mounting, fuse	For alarm type fuses		W. E. Co.	12E	SC-D-4254
			Mounting	Steel	Support key mounting bars			SC-D-4251
			Nut, wing	5/16″, 18-thread				SC-D-4257
			Plate, apparatus	Phenolic, jack mounting	Through lines, conference circuit, test circuit, and outgoing lines			SC-D-4249
			Mounting, jack		For JK-37			SC-D-4239
			Plate, apparatus	Phenolic, jack and lamp mounting	Dial trunk, manual trunks, and common battery lines			SC-D-4249
			Plate, apparatus	Steel, magneto jack and signal mounting	Magneto lines			Do.
			Plate, designation	Nickel silver, engraved RINGING KEY-HAND				Do.
			Plate, floor	Steel	Capacitor mounting			SC-D-4248
			Plate, inside	Cover fastener				SC-D-4260
			Plate, outside	do				Do.
			Plate, mounting	Steel	Cord circuit equipment			SC-D-4254
			Plate, mounting	do	Dial trunk equipment			Do.
			Plate, mounting	do	Manual trunk equipment			Do.
			Plate, mounting	do	Operator's telephone circuit equipment			Do.
			Plate, mounting	do	Night alarm, fuse alarm, and protection equipment			Do.
			Plate	Phenolic	End of cord shelf			SC-D-4251
			Plate	do	Right end of key shelf			Do.
			Plate	do	Left end of keyshelf			Do.
			Plate	do	Line and trunk terminal strip			SC-D-4255
			Receptacle	Composition, two pole, plug	Part of heating unit assembly	Appleton	7685	SC-D-4259
			do	Porcelain, rectangular	do	do	7660	Do.
			Resistor	250-ohm, 60-watt	Heating unit	Ward-L	EB	Do.
			Rod	H.R. steel, 1/2″x19-3/16″ long	Part of cord guard assembly			SC-D-4256
			Seat, plug	Phenolic	Plug seat			SC-D-4251
			Sheet, duck	Cotton OD.	Part of cord guard assembly			SC-D-4256
			Socket, lamp	Switchboard	Recall lamps	W. E. Co.	34	SC-D-4249
			do	do	Line and trunk lamps	do	47A	Do.
			do	do	Cord circuit supervisory lamps	do	do	SC-D-4251

Ref. fig. No.	Ref. symbol	Stock No.	Name	Description	Function	Mfr.	Mfr's. part No.	Signal Corps dwg. No.
			do		For resistor lamp in ringing circuit	A. E. Co.	D-9480	SC-D-4241
			Spacer, key	Left end of keyshelf				SC-D-4251
			do	Right end of keyshelf				Do.
			Spacer	Steel, used with magneto line circuit mounting plates				SC-D-4249
			Strip, designation, plate	Brass	Designation strip plate and drop retainer			Do.
			Strip, designation	6½″	Magneto lines	W. E. Co.	8M	Do.
			Strip, designation	7½″	Trunk, common battery line, through line, outgoing line, conference circuit and test circuit designation strips.	do	8M	Do.
			Strip, terminal		Connecting block	W. E. Co.	171C	SC-D-4266
			Strip, terminal.	Phenolic	For use with cable connector			SC-D-4261
			Strip, top	do	Top jack space			SC-D-4249
			Support, cord weight	Duck, OD.	Cord weight support			SC-D-4257
			Terminal		Telephone a-c and d-c power terminals	do	18A	SC-D-4261
			Unilet	Steel	Heating unit assembly	Appleton	6625	SC-D-4259
			do	do	do	do	9001-E	Do.
			do	do	do	do	9200-LF	Do.
			Webbing	Cotton, OD, ½″ wide	Cable clamp.			SC-D-4251
		4C29100	Weight, cord	Flat, 8 to 11 oz.	Cord weight			SC-D-4243

c. Cabinet BE-79, main distributing frame.

Ref. fig. No.	Ref. symbol	Stock No.	Name	Description	Function	Mfr.	Mfr's. part No.	Signal Corps dwg. No.
		3E1298/1-1	Angle		Part of CD-298			SC-D-4287
		3Z756	Binding post TM -197		Cable connector, cross-connection, and line terminals			SC-D-4289
		4E926	Block	Protector block	Part of protector	W. E. Co.	26	
		4E927	do	do	do	do	27	
			Clamp		Terminal strip clamp			SC-D-4274
		(3C161)	(Coil C-161)		(Used with but not furnished as part of TC-2)			
		3C476A	Coil	Heat coil	Sneak current protection	do	76A	
		3E1298	Cord CD-298		Extends lines and trunks to BD-89-A			
			Post	Clamp post	Terminal strip clamp post			Do.
		4E5368A	Protector	Strip of 20	Line protection	do	1268A	SC-D-4273
			Ring	Distribution ring	Protection of cross-connection wires			
			Strip	Fanning strip, phenolic	Segregation of cross-connection wires			SC-D-4274
			do	Terminal, phenolic plate	For line and trunk binding posts			SC-D-4284
			do	do	For CD-298			Do.
			do	Phenolic, slotted	do			SC-D-4287
			do	Phenolic, cover	do			Do.

d. Panel BD-98.

Ref. fig. No.	Ref. symbol	Stock No.	Name	Description	Function	Mfr.	Mfr's. part No.	Signal Corps dwg. No.
33	MAIN		Circuit breaker	15-ampere, time delay curve D	Circuit breaker and switch	Heine-mann	0322-15	SC-D-5766
33	A & B, C, & INT		do	10-ampere, time delay curve D	do	do	0311-10	Do.
			Ammeter	20-0-20 amperes, d-c	Charge and discharge current	Weston	301	Do.
			Base	Midget, flush, male	Telering and interrupter output connection	Hubbell	7462	SC-D-4329
		3Z209	Binding post TM-109		D-c power, 24 V C terminals			Do.
			Block	Terminal, phenolic	For mounting d-c power bus bars			SC-D-4403
			Bus bar	Copper	D-c power bus bar			Do.
			Bushing	Phenolic, cord		Thomas	70L	SC-D-4329
			do	Phenolic	For binding post TM-109			Do.
			do	Phenolic, round	Part of Telering cord entrance bushing			Do.
			do	Phenolic, diamond shape	do			Do.
			Button	Plug	Closure plug, bottom of Telering	United	E-512	Do.
			Cap, plug		Telering a-c power plug	Hubbell	7238	Dc.
			Coil	Repeating	Ringing transformer	W. E. Co.	56A	Do.
			Cord assembly		Ground cord			SC-D-6370
			Insulator	Phenolic plate	Rear cover plate for d-c bus bar terminal strip			SC-D-4403
			Interrupter		D-c power ringer	W. E. Co.	84F	SC-D-5766
			Plug	3-wire, flush base, male	D-c power, (BAT CHG)	Hubbell	7327	SC-D-4329
			do	do	D-c power, (24V-A) or (24V-B)	do	7808	Do.
			Receptacle	Female	D-c power (BAT CABLE)	Crouse	BR-2302	Do.
			do	do	D-c power, (SWBD BAT CA)	do	do	Dc.
			Receptacle housing		D-c power, (BAT CABLE)	do	BRM-7302	Do.
			do		D-c power, (SWBD BAT CA)	do	do	Do.

			Ring, strain relief		Cord strain relief ring in Telering	Ericson		Do.
			Telering		A-c power ringer	Telkor	Model H (modified)	Do.
			Terminal block assembly		D-c power bus bar terminal			SC-D-4403
			Terminal	Copper tinned	Frame ground terminal	Stewart	311	SC-D-4326
		3Z10122	Terminal TM-122		Main circuit breaker			SC-D-4329
		3Z10126	Terminal TM-126		24V A & B, 24V C, and INT circuit breakers			Do.
		3Z10130	Terminal TM-130		Bus bar terminals			SC-D-4403
			Terminal	do.	24V C binding post terminals	Patton	992A	SC-D-4329
			Terminal	do.	Terminals on Ammeter, BAT CABLE receptacle, and SWBD BAT CA receptacle	do.	2050	Do.
			do.	do.	Voltmeter terminals	do.	2053	Do.
			Voltmeter	0-30 volts, d-c	D-c voltage	Weston	301	Do.

e. Cabinet BE-75, a-c power distribution.

Ref. fig. No.	Ref. symbol	Stock No.	Name	Description	Function	Mfr.	Mfr's. part No.	Signal Corps dwg. No.
	1 & 2; 3, 4, 5 & 6; 7 & 8		Circuit breaker	25-ampere, time delay curve D	A-c circuit protection	Heinemann	0322-25	SC-D-4386
			Outlet	Duplex outlet	Circuits 3 & 4, 5 & 6	Hubbell	9575	Do.
			Plug	Flush base, female	Circuits 1, 2, 7 & 8	do.	8809	Do.
			Receptacle		A-c power input	Crouse	BR-2302	Do.
			Rec. housing		do.	do.	BRM-7302	Do.

f. Junction box JB-19.

Ref. fig. No.	Ref. symbol	Stock No.	Name	Description	Function	Mfr.	Mfr's. part No.	Signal Corps dwg. No.
		3Z756	Binding post TM-197					SC-D-4289
			Cable	2-conductor, rubber No. 8 AWG, 30′ free length	24-volt, d-c power cable	G. E. Co.	60% Type S.	SC-D-4305
			do	2-conductor rubber, No. 16 AWG, 30′ free length	20-cycle a-c ringing power cable	do	do	Do.
			Connector body	10-ampere connector body	20-cycle a-c ringing power cable connector	Hubbell	KX-11382	Do.
			Partition	Phenolic	Separate cable connectors			Do.
			Plug		24-volt d-c power cable connector	Crouse	BP-8732-M3.	Do.
			Strip, terminal	do	For mounting TM-197			Do.

g. Head and chest set HS-19.

Ref. fig. No.	Ref. symbol	Stock No.	Name	Description	Function	Mfr.	Mfr's. part No.	Signal Corps dwg. No.
		4B418	Chest unit T-26, includes the following items (Stock number in parentheses):					
		(4Z6924)	Strap ST-24					
		(4Z6925)	Strap ST-25					
		(3Z8118)	Switch SW-118					
		3E333	Cord CC-333	6′, 3-conductor				
		3E337	Cord CC-337	20″, 2-conductor				
		4C4153BA	Headband					
		4C4153BA/1	Pad	Leather				
		4B2358	Plug PL-58					
		4B2522	Receiver R-22					

h. Rectifier RA-36-A, B, or C.

Ref. fig. No.	Ref. ymbo	Stock No.	Name	Description	Function	Mfr.	Mfr's. part No.	Signal Corps dwg. No.
			Ammeter	0-7 amperes	Measures current			
		3H606	Bulb		Rectifier	G. E. Co	189049	
			Capacitor	2 μf	A-c line filter	do	55X185	
		3Z2015	Fuse	15 ampere, plug	Output circuit protection			
			Fuse block			do	62965	
			Switch	Double pole, single throw, toggle switch	Control a-c and d-c circuits	do	235685	

i. Maintenance equipment ME–6.

Quantity	Stock No.	Name	Description	Mfr.	Mfr's. part No.	Signal Corps dwg. No.
20	3E1298/1–1	Angle	Spade terminal, cable connector			SC–D–4287
20	3Z756	Binding post TM–197				SC–D–4289
1	6Z3150–1	Body	Connector	Hubbell	7506	
25	6L604–2N	Bolt	Machine, square head, steel, ¼" x 2", 20 thread, nickeled			
25	6L605–2.5N	Bolt	Machine, square head, steel, 5/16" x 2½", 18 thread, nickeled			
25	6L606–2N	Bolt	Machine, square head, steel, 3/8" x 2", 16 thread, nickeled			
10	6Z1727	Cap		Hubbell	7057	
3	6Z1734.1	Cap, plug		do	7238	
1	6Q19059	Chest CH–59				
1	6Z3150	Connector		do	7224	
50 ft	3E1335/1	Cordage	Rubber covered, black, 2-conductor No. 8 AWG	G. E. Co.	60% Type S	
250 ft	3E1395/1	do	Rubber covered, black, 2-conductor No. 14 AWG	do	do	
1	3E1298	Cord CD–298				
6	6Z5009	Handle	Carrying box, spare for CS–57, CS–63, CS–71, CS–73, BE–79 and BD–89–A	Stanley	1216	
12 doz	6L3106–32.1	Nut	Brass, hex., No. 6–32, nickeled			
12 doz	6L3108–32.1	do	Brass, hex., No. 8–32, nickeled			
12 doz	6L3110–32.1	do	Brass, hex., No. 10–32, nickeled			
2 doz	6L3504–20.1	do	Brass, hex., ¼", 20 thread, nickeled			
2 doz	6L3505–18.1	do	Brass, hex., 5/16", 18 thread, nickeled			
2 doz	6L3506–16.1	do	Brass, hex., 3/8", 16 thread, nickeled			
1	6Z7564	Plug		Crouse	BP–8732–M3	
12 doz	6L3112–24.1	Nut	Brass, hex., No. 12–24, nickeled			
12 doz	6L6632–16.7	Screw	Machine, FHB, nickeled, No. 6–32, 1"			
12 doz	6L6832–24.7	do	Machine, FHB, nickeled, No. 8–32, 1½"			
12 doz	6L7032–24.7	do	Machine, FHB, nickeled, No. 10–32, 1½"			
12 doz	6L7224–32.7	do	Machine, FHB, nickeled, No. 12–24, 2"			
12 doz	6L8006–6.7	do	Wood, brass, flat head, ¾", No. 6, nickeled			
12 doz	6L8006–8.7	do	Wood, brass, flat head, 1", No. 6, nickeled			
12 doz	6L8008–6.7	do	Wood, brass, flat head, ¾", No. 8, nickeled			
12 doz	6L8008–8.7	do	Wood, brass, flat head, 1", No. 8, nickeled			
12 doz	6L8010–6.7	do	Wood, brass, flat head, ¾", No. 10, nickeled			
12 doz	6L8010–8.7	do	Wood, brass, flat head, 1", No. 10, nickeled			
12 doz	6L8010–12.7	do	Wood, brass, flat head, 1½", No. 10, nickeled			
10	6Z8363	Socket		Hubbell	3595	
1	6Q494	Tool	Assembling	do	3594	
1000 ft	1B122–1	Wire	Cross-connecting, No. 22 AWG, 2-conductor, black and red	Acorn		

j. Tool equipment TE-44.

Quantity	Stock No.	Name	Description	Mfr.	Mfrs. part No.	Signal Corps dwg. No.
24	6Q8110-18	Blade	Hacksaw, 10", 18 teeth per inch, flexible back			
1	6Q19058	Chest CH-58				
3	6Q38030-6	File	Flat, bastard, 6"			
3	6Q38030-10	do	Flat, bastard, 10"			
3	6Q38033-6	do	Flat, second cut, 6"			
3	6Q38033-10	do	Flat, second cut, 10"			
3	6Q38500-10	do	Round, bastard, 10"			
3	6Q38500-6	File TL-133				
1	6Q41000	Frame	Hacksaw, adjustable 8" to 12"			
1	6Q49716	Hammer	Machinist's, ball pein, 16-oz			
1	6Q50004	do	Riveting, cast steel, 4-oz			
1 pr.	3F4056/L1	Lead, test		Weston	D-70033-4	
1	6Z7496	Padlock MC-96 Type Ia				
1	6R4741-5A	Pliers	Spring adjusting	Klein	311	
1	6R40313	do	Heat coil	do	313	
1	6R4513	Pliers TL-13				
2	6R4603	Pliers TL-103				
1	6R4607	Pliers TL-107				
1	6R4625	Pliers TL-125				
1	6R4626	Pliers TL-126				
1	6R19100	Screwdriver set TL-128. Consists of the following quantity in parentheses:				
(1)	6R19030	Screw driver	Spiral ratchet	Yankee	30A	
(8)	6Q34900	Drill points	1/16" to 11/64" and chuck			
(1)	6Q29230	Countersink				
(1)	6R19011	Screw driver	Ratchet, 6" blade	Yankee	11-6	
(1)	6R19015	Screw driver	Ratchet, 3" blade	do	15-3	
1	6R24008	Shears	Tinner's hand snips, 8" over-all, 2" straight cut			
1	6R24617	Soldering iron TL-117				
1	6R24512H	Soldering iron	Size 1⅓, ¾ lb ,with handle			
1	6R24524H	Soldering iron	Size 3, 1⅓ lb, with handle			
1	6R24620	Soldering iron TL-120				
2	6R24641	Soldering iron holder		Vulcan	2100	
1	6R24617/1	Tip	For soldering iron TL-117			
1	6R24620/1	do	For soldering iron TL-120			
1	6R42167	Torch TL-130				
1	3F4056A/V1	Volt-ohmmeter	Type 3-B, 0-100,000 ohm, 0-300-600 v d-c	Weston	Model 564	
1	6R55004	Wrench	Adjustable, 4"	Crescent	A-14	
2	6R55006	Wrench TL-111				
1	6R55010	Wrench TL-112				

k. Switchboard plug cleaning material.—(Use with, but not included as a part of telephone central office set TC–2).

Quantity	Stock No.	Name	Description	Mfr.	Mfr's. part No.	Signal Corps dwg. No.
	6G1315	Oil, light	3-oz. can ("3 in 1")			
	6G1516	Polish, metal	Paste, 2-oz. can			
		Rouge	Cake, jeweler's			

45. Addresses of manufacturers.

Abbreviation	Name	Address
Acorn	Acorn Insulated Wire Co.	225 King St., Brooklyn, N. Y.
A.E.Co.	Automatic Electric Co.	1033 W. Van Buren St., Chicago, Ill.
Appleton	Appleton Electric Co.	1701-20 Wellington Ave., Chicago, Ill.
Crouse	Crouse Hinds Co.	Syracuse, N. Y.
Ericson	Ericson Manufacturing Co.	Cleveland, Ohio
G.E.Co.	General Electric Co.	Schenectady, N. Y.
Graybar	Graybar Electric Co.	New York, N. Y.
Heinemann	Heinemann Electric Co.	Trenton, N. J.
Hubbell	Harvey Hubbell, Inc.	Bridgeport, Conn.
Patton	Patton Macguyer Co.	Providence, R. I.
Stanley	The Stanley Works	New Britain, Conn.
Stewart	Stewart Stamping Corp.	New York, N. Y.
Telkor	Telkor, Inc.	Elyria, Ohio
Thomas	Thomas & Betts Co. Inc.	Elizabeth, N. J.
United	United-Carr Fastener Corp.	Cambridge, Mass.
Vulcan	Vulcan Electric Co.	Lynn, Mass.
Ward-L	Ward-Leonard Co.	Mount Vernon, N. Y.
W.E.Co.	Western Electric Co.	Kearny, N. J.
Weston	Weston Electrical Instrument Co.	Newark, N. J.

[A. G. 062.11 (4-29-42).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

J. A. ULIO,
Major General,
The Adjutant General.

DISTRIBUTION:

IBn 11 (2); IC 11 (10).
(For explanation of symbols see FM 21-6.)

753—Ft. Monmouth—10-26-42—7M