DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11-4134

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MANUAL TELEPHONE SWITCHBOARD SB-86/P

FIELD MAINTENANCE

DEPARTMENTS OF THE ARMY AND THE AIR FORCE

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TECHNICAL MANUAL
No. 11-4134

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THE AIR FORCE
WASHINGTON 25, D. C., *9 September 1955*

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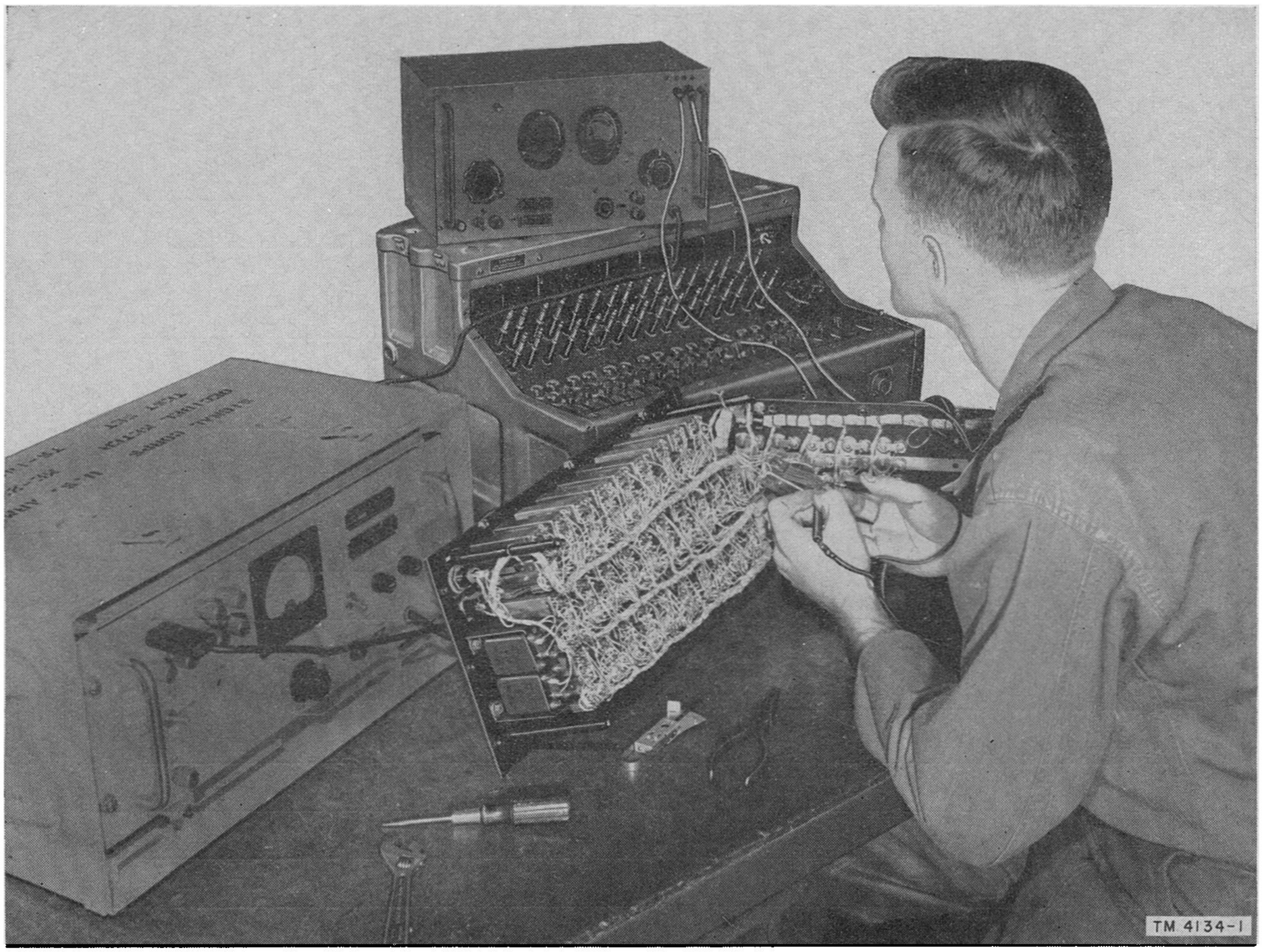

Figure 1. Testing components of Manual Telephone Switchboard SB–86/P.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual is published for the information and guidance of all concerned. It contains instructions for performing field maintenance on Manual Telephone Switchboard SB-86/P. TM 11-2134, Manual Telephone Switchboard SB-86/P, Installation and Operation, gives the operating, installation, and maintenance procedures for using organizations.

b. Comments on this publication should be forwarded directly to: Commanding Officer, The Signal Corps Publications Agency, Fort Monmouth, New Jersey, ATTN: Standards Branch.

2. Forms and Records

The following forms will be used for reporting unsatisfactory conditions of Army equipment and when performing preventive maintenance.

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745-45-5 (Army); Navy Shipping Guide, Article 1850-4 (Navy); and AFR 71-4 (Air Force).

b. DA Form 468, Unsatisfactory Equipment Report, will be filled out and forwarded to the Office of the Chief Signal Officer, as prescribed in SR 700-45-5.

c. DD Form 535, Unsatisfactory Report, will be filled out and forwarded to Commanding General, Air Materiel Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700-45-5 and AF TO 00-35D-54.

d. DA Form 11-247, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Telephone Switchboard), will be prepared in accordance with instructions on the back of the form (fig. 8).

e. Use other forms and records as authorized.

3. Common Names Used for Equipment Nomenclature

(fig. 3)

Nomenclatures and their common names are listed below.

Nomenclature	*Common name*
Switchboard Signal Assembly TA-207/P	Jack field section
Manual Telephone Switchboard Section SB-248/P	Keyshelf section
Cord Telephone Circuit TA-208/P	Cord pack
Operator's Telephone Circuit TA-220/P	Operator's pack
Handset-Headset H-91/U	Operator's telephone set
Power Supply PP-990/G	Power pack
Hand Ringing Generator G-42/PT	Hand generator

Section II. DESCRIPTION AND DATA

4. Purpose and Use

a. Manual Telephone Switchboard SB-86/P is a local battery field-type switchboard. It is used to interconnect up to 30 telephone lines. If additional equipment is available, up to 60 lines can be connected.

b. Local battery telephones are used with the SB-86/P. Each line circuit operates either as a magneto signaling line or as a common battery signaling line. With magneto signaling, ringing current from a hand generator on a telephone operates the signals on the switchboard. With common battery signaling, lifting the telephone handset from its cradle operates the signals on the switchboard.

5. Description

(figs. 2 and 3)

Manual Telephone Switchboard SB-86/P is a portable unit that can be packed into its outer cover assembly (fig. 2). Switchboard Signal Assembly TA-207/P terminates the incoming lines and Manual Telephone Switchboard Section SB-248/P interconnects the lines. Power Supply PP–990/G provides power for ringing the telephones and operating the switchboard signals. The components of the SB–86/P are shown in figure 3 and are described below.

a. Outer Cover Assembly. The outer cover assembly is a metal case that serves as a storage and carrying case for the SB–86/P (fig. 2). The bottom of the case can be used as the base for the keyshelf section (fig. 3) when the SB–86/P is set up for operation.

the keyshelf section by a plug-type connector on the back of the metal case. Two sets of controls are located on top of the metal case, one set for each cord circuit.

(2) The operator's pack contains all of the circuits for the operator's telephone. The controls, switches, and hand generator are located on top of the metal case that protects the circuits of the operator's pack.

c. Switchboard Signal Assembly TA–207/P.

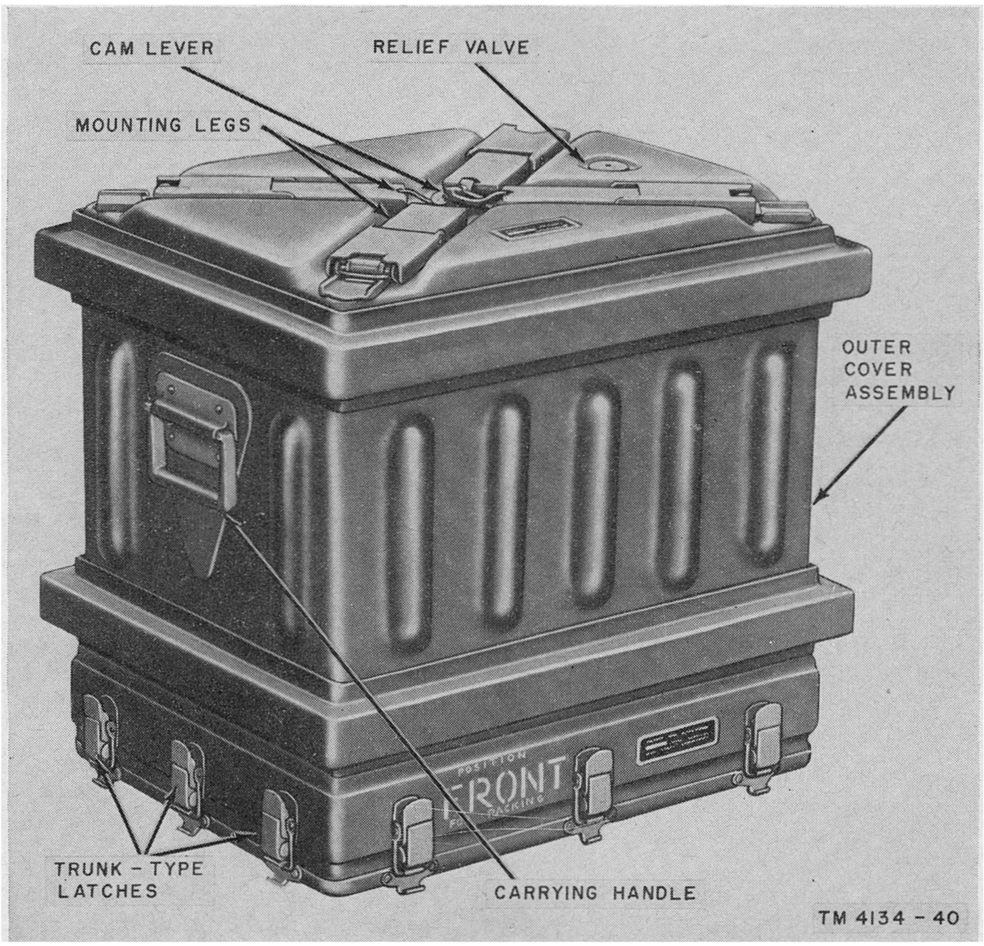

Figure 2. Manual Telephone Switchboard SB–86/P, assembled for transport.

b. Manual Telephone Switchboard Section SB–248/P. Manual Telephone Switchboard Section SB–248/P (keyshelf section) is a metal case containing eight Cord Telephone Circuits TA–208/P (cord packs) and one Operator's Telephone Circuit TA–220/P (operator's pack).

(1) The cord pack contains two complete cord circuits in a black metal case. It is connected to the multiple cable in the rear of

Switchboard Signal Assembly TA–207/P (jack field section) is a metal case containing 30 line circuits; it can be removed from the keyshelf section. The front panel contains the jacks, line signals, line selector switches, panel lamps, and designation strips. The rear panel contains the protectors and line binding posts for the incoming lines. A metal log plate mounted on top of the jack field section is held in place by two positioning rods.

d. Handset-Headset H–91/U. Handset-Headset H–91/U is the operator's telephone set supplied with this equipment. The unit has a headband and can be used as either a handset or a headset.

e. Power Supply PP–990/G. Power Supply PP-990/G (power pack) is a metal case containing switches, voltmeter, binding posts, and compartments for two banks of batteries. (The batteries are not supplied with the equipment.) The controls are protected from damage by a metal cover fitted with a rubber gasket.

f. Power Cords and Spare Parts.

(1) Two 6-foot power cords are provided with Manual Telephone Switchboard SB–86/P. One of these cords is a two-wire power cord; the other is a three-wire power cord. The cords are stored in the rear of the jack field section during shipment.

(2) A canvas roll containing spare parts is carried in a rear compartment in the jack field section. Extra fuses for the power pack are mounted on the underside of the power pack cover.

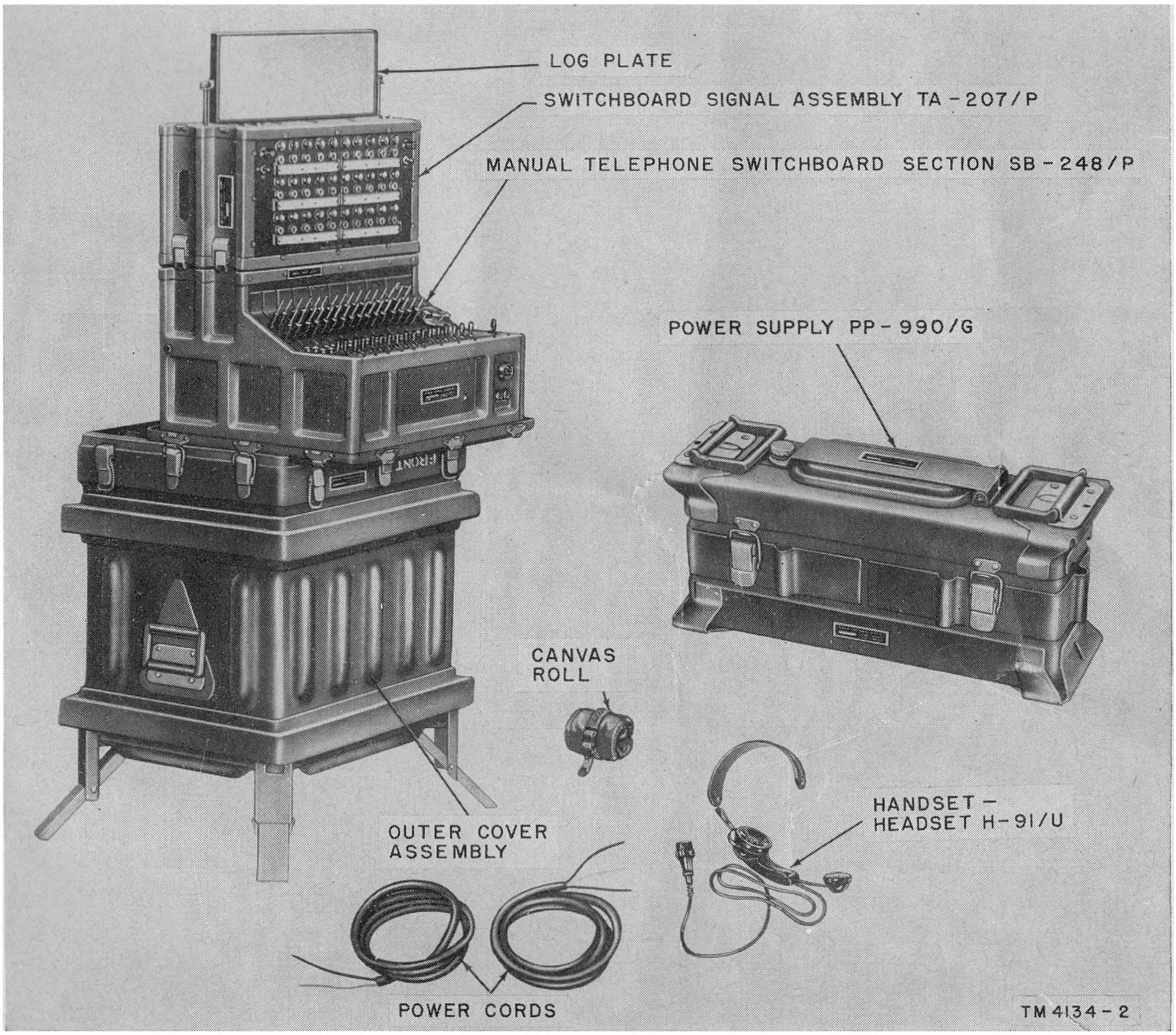

Figure 3. Manual Telephone Switchboard SB–86/P, components.

6. Technical Characteristics and Working Limits

a. The technical characteristics of the SB-86/P are listed below:

Lines served .... 30.
Telephone cord circuits .... 16.

Power requirements:

Common battery signaling ...... 20 to 26.5 volts dc (5 dry cells in power pack).
Magneto signaling .... 15 to 26.5 volts dc (5 dry cells in power pack).
Operator's telephone .... 3 volts dc (2 dry cells in operator's pack).
Night alarm and panel lamps ... 3 volts dc (2 dry cells in jack field section).

Ringing facilities:

Automatic ringing .... 20 cps vibrator in power pack.
Manual ringing .... Hand generator in operator's pack.

Protection .... 1 lightning arrester for each side of every line.

b. The working limits of the line are the greatest (maximum) loop resistance and the least (minimum) leakage resistance that a line can have and give efficient service. The working limits will vary with the type of signaling used. If the loop resistance of a line is too high or if the leakage resistance is too low, the line will not operate efficiently. Listed below are the working limits for different types of signaling.

Type of signaling	Working limits	
	Maximum loop (ohms)	Minimum leak (ohms)
Magneto signaling	5,000	10,000
Common battery signaling line	1,000	10,000
Common battery signaling trunk	2,000	10,000
Common battery signaling trunk (civilian)	1,000	10,000

7. Table of Components

(fig. 3)

Quantity	Component	Height (in.)	Width (in.)	Depth (in.)	Weight (lb)
1	Manual Telephone Switchboard Section SB-248/P, containing—	21	23½	18½	65
	1 Operator's Telephone Circuit TA-220/P	10	4	14½	6
	8 Cord Telephone Circuit TA-208/P	10	2	14½	4
1	Switchboard Signal Assembly TA-207/P	9¼	21	7⅛	31
1	Power Supply PP-990/G	10	21	7⅛	29 (less batteries)
1	Handset-Headset H-91/U				.4
1	Outer cover assembly	22	24	18¾	41
1	Log plate	6¼	21	⅝	2
1	Canvas roll (for spare parts)				1
1	Three-conductor cord	6 ft (long)			.7
1	Two-conductor cord	6 ft (long)			.5
1 set	Running spares (par. 5*f*(2).				

Note. This list is for general information only. See appropriate supply publications for information pertaining to the requisition of spare parts.

CHAPTER 2

THEORY

8. General

a. The SB–86/P provides switching facilities for 30 lines, numbered 1 through 30. Each line may be used as a magneto line, common battery signaling line, magneto trunk, or a common battery signaling trunk. Lines 29 and 30 may be used to connect the SB–86/P to a common battery telephone exchange.

b. The selection of different types of line and trunk operation is made by changing the setting on the line selector switch. The switch settings and the type of line or trunk used with the settings are shown in the chart below.

Line selector switch setting	Type of line or trunk
M	Magneto signaling line or trunk and civilian trunk.
C	Common battery signaling line.
T	Common battery signaling trunk.

c. The cord circuits of the SB–86/P do not provide transmission battery for the local telephone; therefore, only local battery or local battery talking and common battery signaling telephones can be used with it. The cord circuit is not described separately, but its functions are included in the description of the other circuits (*d* below). The cord circuit items are identified by reference symbol as described in *e* below.

d. Paragraphs 9 through 16 contain circuit descriptions of the line circuits, trunk circuits, and the power supply circuits. Figure 43 is the schematic diagram of one of the 30 identical line circuits. Figure 45 is the schematic diagram of the operator's telephone circuit and one of the 16 identical cord circuits. All of the circuit descriptions will refer to these two schematic diagrams. Figures 5, 6, and 7 are simplified schematics for use by personnel who have familiarized themselves with the circuit by using text and figures 43 and 45.

e. The chart below is provided to help the repairman to identify by reference symbol the component in which a part is located. For example the 0-hundred block includes any number from 0 through 99, the 100 block includes any number from 100 through 199, and so on.

Example: Assume that 236 is the numerical portion of a reference symbol. The number 236 lies within the 200 block assigned to the cord pack. Therefore, the part is located in the cord pack. The letter portion of the reference symbol is descriptive of the part; thus, R236 identifies a resistor in the cord pack; C236 identifies a capacitor which is also in the cord pack.

Component	Hundred block reserved for component
Jack field section	0-hundred block and 100 block.
Cord pack	200 block.
Operator's pack	300 block.
Operator's telephone set	400 block.
Power pack	600 block.
Miscellaneous parts (connectors, latches, gaskets, and grommets).	700 block.

Note. The 500 block is not used.

9. Magnetic Signal

(fig. 4)

The SB–86/P uses a magnetic signaling device instead of line and supervisory lamps or drops. The device is operated electrically and restored electrically. It consists of a two-winding electromagnet, a rotating black and white target, and a contact switch. The target is visible through a transparent plastic cap. The black portion of the target shows that the line or cord circuit is idle, and the white portion attracts the operator's attention. The contact switch is operated by the rotation of the target.

a. The device operates on the fundamental principle of magnetism that *like poles repel and unlike poles attract.* A permanent magnet is positioned inside the rotating target so that one of the two poles is always near the core of the electromagnet. Under specific circuit conditions (pars. 10 through 16), the electromagnet is polarized to repel the near end of the permanent magnet. This causes the target to rotate, thereby changing the signal from *white* to *black* or *black* to *white.*

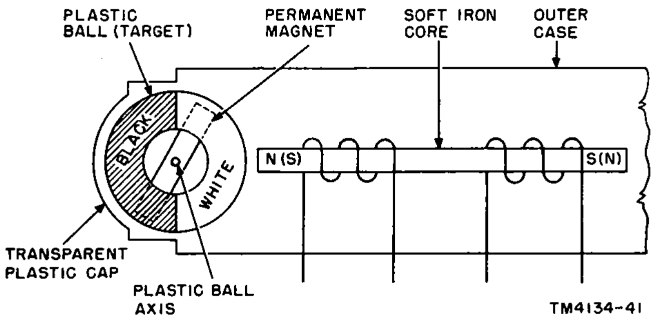

Figure 4. Magnetic signal device, schematic diagram.

b. The device operates on either alternating current (ac) or direct current (dc). The line selector switch setting determines whether the signal will operate on ac or dc. It also determines which of two circuit arrangements are used to operate the device on ac. One circuit arrangement places the windings in series with a half-wave crystal rectifier; the other places the winding directly across the ac signal. When the second arrangement is used, the signal switch contacts operate the instant the target rotates, opening the circuit. The circuit remains open until current is applied to the device to restore it through another circuit.

10. Magneto Line Circuit Description (Completing Calls between Field Telephones on Magneto Signaling Lines or Trunks)

(fig. 43)

a. Any of the line circuits 1 through 30 will operate as a magneto line when the corresponding line selector switch (S3 through S32) is in the M position. A call on a magneto line is originated by the telephone user operating the hand generator on his telephone. This causes ringing current to flow over the tip and ring of the line to the switchboard line circuit.

b. The current through the L1 side of the line flows through binding post E1, contacts 3 and 4 of line jack J1, and rectifier CR1. At CR1, the current is rectified and only positive half-cycle pulses pass through the rectifier. The rectified current flows through the 7–5 winding of line signal I 1, contacts 5 and 4 of line selector switch S3, current-limiting resistor R121, contacts 7 and 8 of jack J1, 4–2 winding of signal I 1, contacts 5 and 6 of line jack J1, binding post E92, and back over the L2 side of the line to the opposite terminal of the hand generator at the telephone.

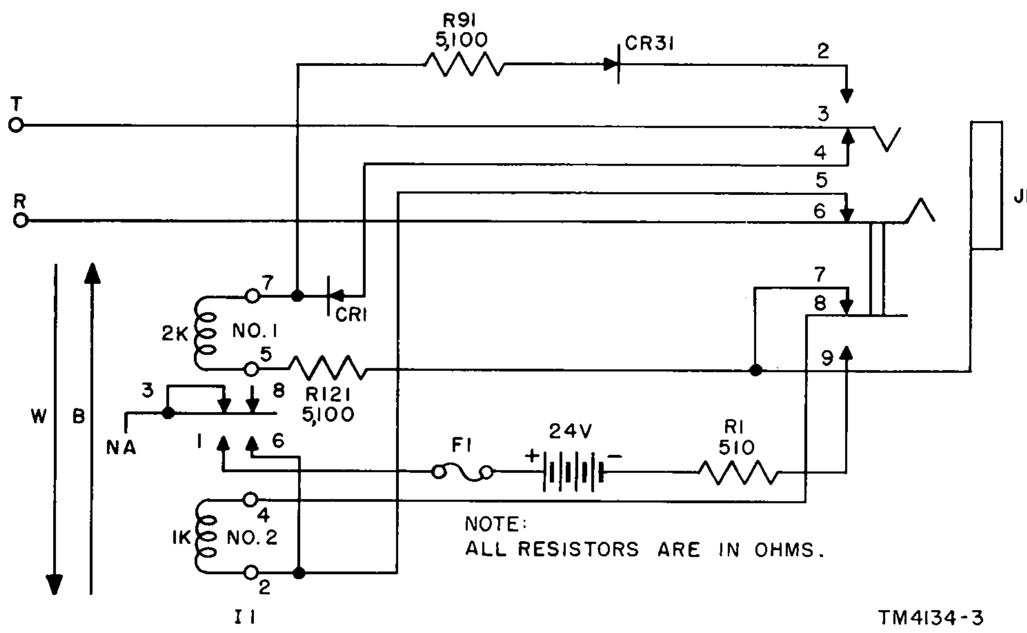

Figure 5. Magneto signaling line circuit, simplified schematic diagram.

c. The current flowing over the line and through the line circuit as described in *a* and *b* above, causes the line signal to operate from *black* to *white.*

d. With the plug of an answering cord in jack J1, dc flows from negative battery through terminal E122, current-limiting resistor R1, contacts 9 and 8 of jack J1, 4–2 winding of line signal I 1, contacts 11 and 10 of line selector switch S3, contacts 6, 3, and 1 of line signal I 1, terminal T9, and fuse F1 to positive battery through terminal E123. This energizes the coil of signal I 1 and causes it to restore to *black.* When signal I 1 restores, contact 3 breaks from 6 and 1, and opens the circuit.

e. The calling cord may be connected to a common battery signaling line, another magneto line, or a common battery signaling trunk without affecting any of the operations described in this section. The transmission path through the cord circuit is described in *f* below.

f. With the calling party connected with the called party and switch S202 restored to the neutral position, the talking path between the two field telephones through the SB–86/P is as follows: from the tip side of the line, through binding post E1, the tip of jack J1, the tip of plug P201, contacts 2 and 1 of stack B on switch S202, 1–2 winding of repeating coil T201, to blocking capacitor C201; from dc blocking capacitor C201 through terminal punching 1 on terminal block TB201, contacts 3 and 2 of stack E on switch S202, the ring of plug P201, the ring of jack J1, binding post E92, and over the ring side of the line to the field telephone. The talking current flowing through the 1–2 winding of repeating coil T201 induces a voltage in the 3–4 winding of the repeating coil. This establishes a circuit between the called telephone and the calling telephone. Voltage induced in the 3–4 winding of repeating coil T201 causes current to flow through the winding, out of terminal 3, to terminal 5 on I 203, through contacts 1 and 2 of stack C on switch S202, the tip of plug P203, the tip of the called party's jack, over the tip side of the line, the called party's telephone, back over the ring side of the line, the ring of the called party's jack, the ring of plug P203, contacts 2 and 3 of stack H on switch S202, terminal punching 2 of terminal block TB201, to dc blocking capacitor C203; from blocking capacitor C203 to terminal 4 of repeating coil T201, completing the circuit.

g. To ring forward over the line of the called party, switch S202 must be in the TALK LIST. position, and switch S301 must be in the RING FWD. position. The ringing current path is from terminal E308, through contacts 3 and 2 of stack H on switch S301, contacts 1 and 2 of stack H on switch S202, the ring of plug P203, the ring of the called party's line jack, over the ring side of the line, through the called party's telephone, over the tip side of the line, through the tip of the called party's line jack, the tip of plug P203, contacts 2 and 3 of stack C on switch S202, contacts 1 and 2 of stack B on switch S301, contacts 3 and 2 of stack G on switch S301, and out through terminal E307 to the ringing supply (par. 28*b* and *c*).

h. To ring back over the line of the calling party, switch S202 must be operated to the TALK LIST. position, switch S301 must be operated to the RING BACK position. The ringing current path is from terminal E308, through contacts 3 and 2 of stack D on switch S301, contacts 1 and 2 of stack E on switch S202, the ring of plug P201, the ring of the calling party's line jack, over the ring side of the line, through the calling party's telephone, over the tip side of the line, through the tip of the calling party's line jack, the tip of plug P201 (fig. 45), contacts 2 and 3 of stack B on switch S202, contacts 3 and 2 of stack C on switch S301, and out through terminal E307 to the ringing supply (par. 28*b* and *c*).

i. The talking path completed between a field telephone and the SB–86/P is as follows: With switch S202 in the TALK LIST. position, talking current flows from the field telephone over the tip side of the line, through binding post E1, the tip of jack J1, the tip of plug P201, contacts 2 and 3 of stack B on switch S202, AT binding posts of terminal strips J201 and J301, to contact 3 of stack C on switch S301, to capacitor C303; from capacitor C303 through contacts 1 and 2 of stack B on switch S301 to contact 3 of stack G on switch S301, the receiver of the operator's telephone set, operator's induction coil T301, to dc blocking capacitor C302; from blocking capacitor C302 through contact 1 of stack H on switch S301, to blocking capacitor C304; from blocking capacitor C304 through contacts 1 and 2 of stack D on switch S301, contacts 1 and 2 of stack E on switch S202, the ring of plug P201, the ring of jack J1, and binding post E92 to the ring side of the field telephone.

j. Talking paths for magneto trunks operate in the same manner.

k. To monitor a telephone call, switch S202 is operated to the TALK LIST. position. Talking current flows from one side of the telephone, over the tip side of the line, through binding post E1 (fig. 43), the tip of calling jack J1, the tip of plug P201, contacts 2 and 3 of stack B on switch S202 through the AT terminals of J201 and J301, to dc blocking capacitor C303; from capacitor C303 through the CT terminals of J201 and J301, contacts 3 and 2 of stack C on switch S202, the tip of plug P203, the tip of the called party's line jack, over the tip of the line, the called party's telephone; back over the ring side of the line, through the ring of the called party's jack, the ring of plug P203, contacts 2 and 1 of stack H on switch S202, contacts 2 and 1 of stack H on switch S301, to capacitor C304; from capacitor C304 through contacts 1 and 2 of stack D on switch S301, contacts 1 and 2 of stack E on switch S202, the ring of calling jack J1, binding post E92, over the ring side of the line, and through the calling party's telephone.

l. The operator's circuit is bridged across the circuit explained above and current flows through contacts 1 and 2 of stack B on switch S301, the receiver of the operator's telephone set, terminals 4 and 3 of operator's induction coil T301, to capacitor C302; from capacitor C302 to contact 1 of stack H on switch S301.

m. When the user of the magneto station rings off, the first half-cycle of ringing current in the direction that will cause signal I 201 to operate from *black* to *white*, flows through contact 3 (tip) of line jack J1 and the plug, contacts 2 and 1 of stack B on TALK LIST.-CONF. switch S202 (fig. 45), the 5–7 winding of supervisory signal I 201, the 2–4 winding of signal I 201, and contacts 3 and 2 of stack E on switch S202 to the ring of the plug through contact 6 on line jack J1, and back to the hand generator at the telephone. This first half-cycle causes supervisory signal I 201 to operate from *black* to *white.* To prevent signal I 201 from fluttering with the ac changes in current direction, a shunt circuit is connected as follows: When signal I 201 operates, contact 3 (on the target) makes with contacts 1 and 6 and connects resistor R217 in series with the 5–7 winding; contact 3 also closes a circuit that shunts the 5–7 winding. This shunt circuit is from the tip side of the line, through contact 2 of jack J1 (fig. 43), rectifier CR31, resistor R91, contacts 7 and 8 of switch S3, 7–5 winding of signal I 1, contacts 5 and 4 of switch S3, resistor R121, contact 2 of switch S3, the sleeve of jack J1, and the sleeve of plug P201 to contact 3 of signal I 201. When contact 3 makes with contacts 1 and 6, it also connects the 2–4 winding of signal I 201 to the sleeve instead of the tip of the line. This action places the 2–4 winding of signal I 201 in series with crystal rectifier CR31, which functions as a half-wave rectifier. The rectifier passes only the ac half-cycles that tend to keep the signal operated to *white*; it blocks the ac half-cycles that would cause the signal to operate to *black*.

n. With the plug removed from line jack J1 and restored to the plug seat, the circuit is from negative battery at terminal E301 (fig. 43) through coil L301, —24 binding post on terminal strips J301 and J201, terminal 4 on TB201, contacts 4–2 of plug seat switch S201 (which closes when the plug is in the plug seat), current-limiting resistor R213 to rectifier CR201 (which regulates the direction of current flow), terminal 1 of TB201, 4–2 winding of signal I 201, contacts 6 and 1 of signal I 201, rectifier CR205 (which regulates the direction of current flow), contact 2 of stack A on switch S202, through contacts 1 and 3 of plug seat switch S201, terminal 3 of TB201, +24 binding post on terminal strips J201 and J301, fuse F301, to positive battery of terminal E302. This causes signal I 201 to energize and restore to *black*, thereby opening its own restoring circuit through contacts 1 and 6 of signal I 201.

11. Common Battery Signaling Line Circuit Description

(figs. 43 and 45)

a. The common battery signaling line circuit functions as follows: With line selector switch S3 in the C position, a dc bridge is placed across the line by lifting the handset from the line switch (hookswitch). When the line switch operates, a circuit is completed from negative battery at terminal E122, through current-limiting resistor R31, contacts 9 and 8 of line selector switch S3, rectifier CR1 (which regulates the direction of current flow), contacts 4 and 3 of jack J1, over the tip side of the line to the telephone; back over the ring side of the line, through contacts 6 and 5 of jack J1, the 2–4 winding of line signal I 1, contacts 8 and 7 of jack J1, contacts 2 and 1 of switch S3, rectifier CR61, fuse F1, to positive battery on terminal E123. The line signal operates to *white*. When the target rotates, contact 3 makes with 1 and 6 to close a circuit through the 2,000-ohm bias 5–7 winding of signal I 1; however, the target remains on *white* as long as there is also current through the 1,000-ohm 2–4 winding.

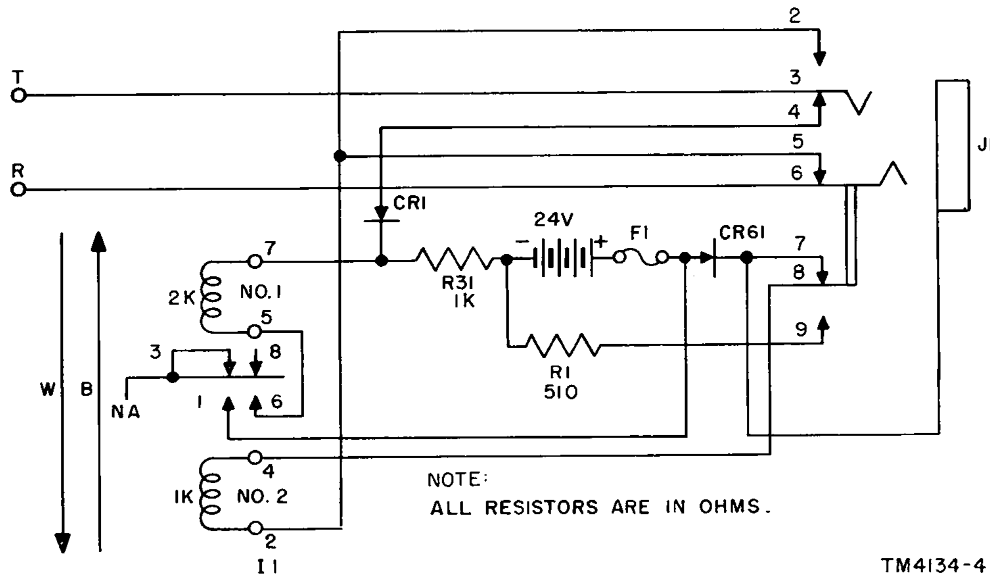

Figure 6. Common battery signaling line circuit, simplified schematic.

b. The current through the 2,000-ohm bias winding takes the following path: negative battery from terminal E122 through resistor R31, contacts 9 and 8 of line selector switch S3, 7–5 winding (2,000-ohm winding) of signal I 1, contacts 5 and 6 of line selector switch S3, and contacts 6, 3, and 1 (contact 3 is on the plastic ball target) of signal I 1 to positive battery terminal E123. If the line switch is restored before the operator answers, the current through the 2,000-ohm bias winding restores the signal to *black*. Intermittent operation of the line switch at the telephone causes line signal I 1 to flash *white* and *black*.

c. With plug P201 in line jack J1, the circuit is from negative battery at terminal E122 (fig. 43) through current-limiting resistor R1, contacts 9 and 8 of line jack J1, the 4–2 winding of line signal I 1, contacts 11 and 12 of line selector switch S3, and contacts 2 and 3 of jack J1 to the tip of plug P201 (fig. 45), contacts 2 and 3 of stack B on switch S202 (in the TALK LIST. position), through AT binding posts on J201, W701, and J301, contact 3 of stack C on switch S301, current-limiting resistor R303, rectifier CR303 (which regulates the direction of current flow), retardation coil L302, fuse F301, to positive battery through terminal E302. This causes line signal I 1 to operate from *white* to *black*.

d. After plug P203 has been inserted into the called party's jack and the called party has been signaled, switch S202 is restored to the neutral position.

e. With switch S202 restored to the neutral position, the supervisory signals are connected across the calling and called lines. The operation of the line switch at each of the telephones will control the respective supervisory signals. When the line switch of the calling party's telephone is operated, the circuit is from negative battery at terminal E122 of the line circuit, through resistor R1, contacts 9 and 8 of jack J1, 4–2 winding of signal I 1, contacts 11 and 12 of line selector switch S3, contacts 2 and 3 of jack J1 to the tip side of the line and plug, and then flows in two paths. The current in one path is through the tip of jack J1 and plug P201 (fig. 46), contacts 2 and 1 of stack B on switch S202, 5–7 winding of signal I 201, contacts 8 and 3 of signal I 201, the sleeve of plug P201, the sleeve of jack J1 (fig. 43), contacts 2 and 1 of line selector switch S3, rectifier CR61, and fuse F1, to positive battery on terminal E123. The other path is over the tip side of the line, through the telephone set, back over the ring side of the line to the ring of jack J1 and plug P201 (fig. 45); then through contacts 2 and 3 of stack E on switch S202, the 2–4 winding of signal I 201, contacts 6 and 3 of signal I 201, the sleeve of plug P201, the sleeve of jack J1 (fig. 43), contacts 2 and 1 of line selector switch S3, rectifier CR61, fuse F1, to positive battery at terminal E123. These parallel circuits cause opposing currents in the coils of supervisory signal I 201 and the signal remains *black*. The operation of the calling cord is the same as the answering cord.

f. With the handset replaced on the line switch of the calling party's telephone, the 2–4 winding of supervisory signal I 201 (fig. 45) is no longer energized, and the circuit is from negative battery at terminal E122 (fig. 43) in the line circuit, through resistor R1, contacts 9 and 8 of jack J1, 4–2 winding of line signal I 1, contacts 11 and 12 of line selector switch S3, and contacts 2 and 3 of jack J1, the tip of plug P201 (fig. 45), contacts 2 and 1 of stack B on switch S202, the 5–7 winding of signal I 201, contacts 8 and 3 of signal I 201, sleeve of plug P201, sleeve of jack J1 (fig. 43), contacts 2 and 1 of line selector switch S3, rectifier CR61, and fuse F1 to positive battery at terminal E123. This causes the answering supervisory signal to operate from *black* to *white*. Repeated operation of the telephone line switch causes the signal to flash from *black* to *white*. The operation of the calling supervisory signal is the same as the answering signal.

g. When a supervisory signal is in the *white* position, the operation of switch S202 to the TALK LIST. position causes the supervisory signal to restore from *white* to *black*. The circuit is from negative battery at terminal E301, through retardation coil L301, —24 binding post on J301, W701, J201, punching 4 on terminal board TB201, contacts 2 and 3 of stack D on switch S202, punching 2 on terminal board TB201, resistor R213, rectifier CR201, punching 1 on terminal board TB201, the 4–2 winding of signal I 201, contacts 6 and 3 of signal I 201, sleeve of jack J1, contacts 2 and 1 of switch S3 (fig. 43), rectifier CR61, and fuse F1 to positive battery on terminal E123.

h. When the call is completed, supervisory signal I 201 (fig. 45) operates to *white*. With the plug removed from the jack, and plug seat switch S201 restored, the circuit is from negative battery E301, L301, the —24 terminals of J301, P701, and J201, through contacts 4 and 2 of plug seat switch S201, resistor R213, rectifier CR201, the 4–2 winding of signal I 201, contacts 6 and 1 of signal I 201, rectifier CR205, contacts 1 and 3 of plug seat switch S201, terminal punching 3 on terminal block TB201, +24 binding post on J201, W701, and J301, and fuse F301 to positive battery on terminal E302. The supervisory signal restores to *black*. The operation of the calling cord is the same as the answering cord. The line and cord circuits are now normal.

i. The talking and ringing operation are the same for this circuit as for the magneto line operation.

12. Common Battery Signaling Trunk Circuit Description

(figs. 43 and 45)

a. Line selector switch S3 must be in position T, which closes contacts 2 and 3, and contact 11 operates to a neutral position. An outgoing call over the trunk circuit is originated by inserting a plug into the trunk jack. TALK LIST.-CONF. switch S202 must be in the TALK LIST. position and CONF. SUPV.-TRK SIG switch S302 must be operated to the TRK SIG position. Only the calling cord can be used to signal on a common battery signaling trunk. When the plug is inserted into the trunk jack, all elements in the local line circuit are disconnected from L1 and L2. The circuit is from negative battery at terminal E301 through retardation coil L301, contacts 3 and 2 of stack E on switch S302, contact 2 of stack H on switch S301, contacts

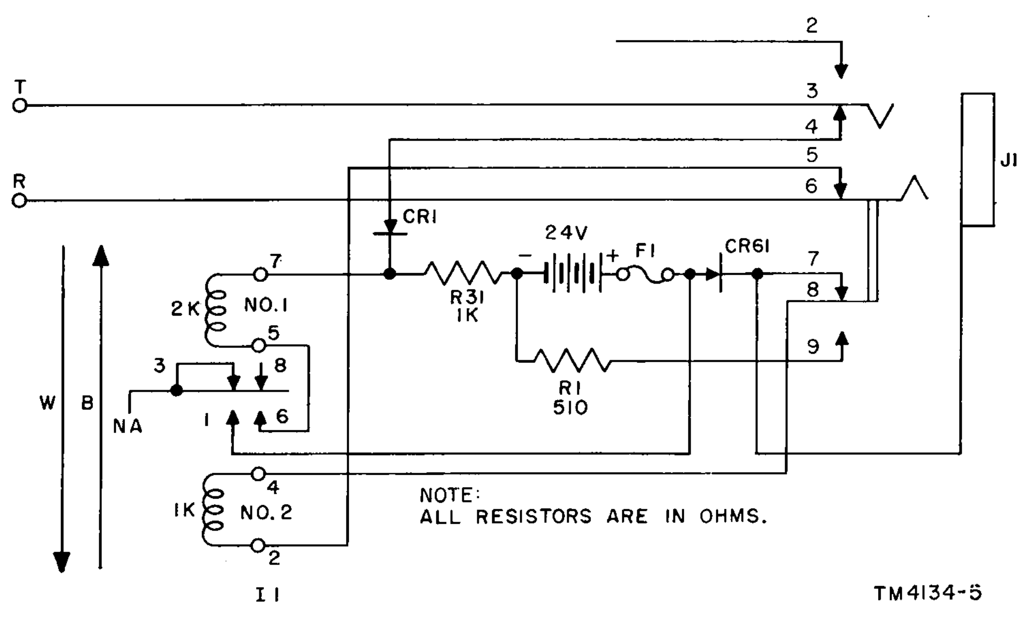

Figure 7. Common battery signaling trunk circuit, simplified schematic.

1 and 2 of stack H on switch S202, the ring of plug P203, and the ring of the jack of the trunk circuit to a distant switchboard. The circuit continues over the L2 side of the line, and through the following components of the distant switchboard: contacts 6 and 5 of jack J1, 4–2 winding of signal I 1, contacts 8 and 7 of jack J1, contacts 3 and 2 of switch S3, rectifier CR61, fuse F1, terminal E123, and the battery. From the negative battery terminal at the distant switchboard, the circuit is continued through terminal E122, resistor R31, contacts 9 and 8 of switch S3, contacts 4 and 3 of jack J1, over the L1 side of the line to the local (calling) switchboard. The circuit continues at the local (calling) switchboard through the tip of jack J1, the tip of plug P203, contacts 2 and 3 of stack C on switch S202, terminals CT on J201, W701, and J301, resistor R302, rectifier CR302, retardation coil L302, fuse F301, to positive battery through terminal E302. This circuit provides a path for current to operate the trunk signal at the distant switchboard. *The circuit voltage is increased because the batteries of both switchboards are arranged so that they are in series during the signaling period.*

b. With the plug of an answering cord in the trunk jack, the jack springs disconnect all of the circuit elements from L1 and L2. The supervisory signals at both ends of the trunk circuit remain *black*. The trunk signal at the distant switchboard operates from *white* to *black*.

c. With either the local or distant cord disconnected, the trunk jack springs at that switchboard restore and connect L1 through contacts 3 and 4 of jack J1, rectifier CR1, contacts 8 and 9 of switch S3, and resistor R31 to negative battery through terminal E122. The L2 side of the line is connected through contacts 6 and 5 of jack J1, 2–4 winding of signal I 1, contacts 8 and 7 of signal I 1, contacts 2 and 3 of switch S3, rectifier CR61, fuse F1, to positive battery through terminal E123. Current from negative battery on L1 flows over the line to the other switchboard (not yet disconnected), through the two windings of supervisory signal I 203 (of the distant switchboard), back on L2 to positive battery. The distant supervisory signal operates to *white* but the local trunk signal remains *black* since the current through the windings holds it in that position. If the calling operator reinserts the plug into a common battery signaling trunk circuit before the distant operator has removed the cord from a previous disconnect signal, the supervisory signal at the called end will remain *white* until the called operator disconnects. At that time, the trunk signal at the called end will operate to *white*, indicating a recall.

13. Civilian Trunk Circuit Description
(fig. 43)

The civilian trunk option is obtained by operating switch S1 (lines 29 and 30 only) to the ON position and the corresponding line selector switches to the M position. This places 50-ohm holding coil L1 across contacts 2 and 6 of jack J1. When the operator inserts the plug of a calling cord into jack J1, holding coil L1 bridges the line to operate the manual central office equipment. *There is no supervision from the manual central office.* In all other respects, the operation of the trunk circuit, when used with the civilian option is the same as described for magneto line circuits (par. 10).

14. Ringing Circuit Description
(fig. 45)

a. Ringing Forward with Vibrator Inverter. To ring on the calling cord using the vibrator inverter in the power pack, switch S202 must be operated to the TALK LIST. position and RING BACK-RING FWD. switch S301 must be operated to the RING FWD. position. This closes a circuit from positive battery on binding post E302 through fuse F301, to contact 2 of stack A on switch S301, through contacts 2 and 3 of stack E on switch S301, to contact 3 of stack A on switch S301, to binding post E304; this completes the dc supply circuit to the vibrator inverter and causes it to operate. Ringing current then is supplied to EXT. GEN. binding posts E307 and E308. From binding post E307, the ringing current flows through contacts 2 and 3 of stack G on switch S301, contacts 2 and 1 of stack B on switch S301, binding posts CT on terminal strips J301, W701, and J201, and contacts 2 and 3 of stack C on switch S202 to the tip of plug P203. The ringing current then flows through the tip of jack J1, out to the called telephone on the tip side of the line, through the telephone set and back to jack J1 on the ring side of the line. From the ring contact of jack J1 the ringing current flows through the ring of plug P203, contacts 2 and 1 of stack H on switch S202, binding posts CR on terminal strips J201, W701, and J301, contacts 2 and 3 of stack H on switch S301 to contact 3 of stack D on switch S301, and then to binding post E308. This causes the called party's telephone to ring.

b. Ringing Back With Vibrator Inverter. To ring on the answering cord, using the vibrator inverter in the power pack to supply ringing current, switch S202 must be operated to the TALK LIST. position and switch S301 must be operated to the RING BACK position. A circuit path from positive battery on binding post E302 through fuse F301, contacts 2 and 3 of stack A on switch S301 to binding post E304 completes the dc circuit to the vibrator inverter and causes it to operate. Ringing current is supplied to EXT. GEN. binding posts E307 and E308. From binding post E307, the ringing current flows to contact 2 of stack G on switch S301 through contacts 2 and 3 of stack C on switch S301, binding posts AT on terminal strips J301, W701, and J201, and contacts 3 and 2 of stack B on switch S202 to the tip of plug P201. The ringing current then flows through the tip contact of jack J1 (fig. 43) out on the tip side of the line, through the telephone set, and back on the ring side of the line to the ring contact of jack J1. From the ring contact of jack J1 the ringing current flows through the ring of plug P201 (fig. 45), contacts 2 and 1 of stack E on switch S202, binding posts AR on terminal strips J201, W701, and J301, and contacts 2 and 3 of stack D on switch S301, to binding post E308. This will cause the calling party's telephone to ring.

c. Ringing Forward With Hand Generator. To ring on the calling cord, using hand generator G301 as the ringing current source, switch S202 must be operated to the TALK LIST. position, switch S301 must be operated to the RING FWD. position and hand generator G301 must be turned. Ringing current flows from the float contact on generator G301 through contacts 3 and 2 of stack H on switch S301, to binding post CR on terminal strip J301. The ringing current then flows through the cord circuit to the telephone and back to binding post CT on terminal strip J301 over the same path as used for the ringing current for machine ringing (*a* above). From binding post CT on terminal strip J301 the ringing current flows through contacts 1 and 2 of stack B on switch S301, to contact 3 of stack G on switch S301, and back to the winding of generator G301. This will cause the called party's telephone to ring.

d. Ringing Back With Hand Generator. To ring on the answering cord, using hand generator G301 as the ringing current source, switch S202 must be operated to the TALK LIST. position, switch S301 must be operated to the RING BACK position, and hand generator G301 must be turned. Ringing current flows from the float contact of generator G301 to contact 3 of stack H on switch S301 and through contacts 3 and 2 on stack D of switch S301 to the AR binding post on terminal strip J301. The ringing current then flows through the cord circuit to the telephone and back to the AT binding post on terminal strip J301 over the same path as used for the ringing current from machine ringing (*b* above). From binding post AT on terminal strip J301, the ringing current flows to contact 3 of stack C on switch S301, through contacts 3 and 2 of stack B on switch S301, to contact 3 of stack G on switch S301, and back to the winding of hand generator G301. This will cause the calling party's telephone to ring.

15. Trunk Signaling Circuit Description
(fig. 45)

a. To signal the distant switchboard on a magneto trunk circuit, switch S202 must be operated to the TALK LIST. position and switch S301 must be operated to the RING FWD. position. This will connect ringing current to the trunk circuit over the circuit described in paragraph 14*a* if ringing current is supplied from the vibrator inverter or described in paragraph 14*c* if the hand ringing generator is used as the ringing current source.

b. To signal the distant switchboard on a common battery signaling trunk circuit, switch S202 must be in the TALK LIST. position and switch S302 must be operated to the TRK SIG position. The circuit is from negative battery on the —24 binding post on J301 through contacts 3 and 2 of stack E on switch S302, to contact 2 of stack H on switch S301, through binding post CR on terminal strips J301, W701, and J201, contacts 1 and 2 of stack H on switch S202, the ring of plug P203, the ring contact of jack J1, and out on the ring side of the trunk circuit. The circuit is continued through the distant switchboard operating the signal and back to the originating switchboard on the tip side of the trunk circuit, through the tip contact of jack J1, the tip of plug P203, contacts 2 and 3 of stack C on switch S202, binding post CT on terminal strips J201, W701, and J301, current-limiting resistor R302, rectifier CR302, retardation coil L302 which prevents voice currents from entering the battery, to the +24 binding post on terminal strip J301. This will cause the trunk signal at the distant switchboard to operate from *black* to *white*.

16. Conference Circuit Description
(fig. 45)

When a conference connection is required, switch S202 must be operated to the CONF. position on each cord circuit used to make the conference connection. When switch S202 is operated to the CONF. position, contacts 2 and 3 of the F stack on switch S202 connect the tip side of the cord circuit to binding post C1 on terminal strip J201, and contacts 2 and 3 of the G stack on switch S202 connect the ring side of the cord circuit to the C2 binding post on terminal strip J201. The C1 and C2 binding posts are common to all cord circuits. This bridges all of the cord circuits together when switch S202 is operated to the CONF. position. The operator can supervise the conference connection by operating switch S302 to the CONF. SUPV. position. This bridges the operator's telephone circuit across binding posts C1 and C2 on terminal strips J301, W701, and J201. The transmission circuit for the cord circuit is the same as described in paragraph 10*h*.

17. Night Alarm Circuit Description
(fig. 45)

Either visual or audible night alarm signals can be used on the SB–86/P, depending on the operation of switch S34, which is a three-position switch. When any *line* signal is operated to the *white* position, a circuit is completed to the night alarm circuit, depending on the position of N. A. switch S34 to either VIS or AUD position through contacts 1 and 3 on signal I 1. The circuit is from negative battery through buzzer I 33, switch S34, contacts 3 and 1 on signal I 1, and back to positive battery. This causes the buzzer to operate until the signal restores to *black* or switch S34 is operated to OFF. If N. A. switch S34 is in the VIS position, the illuminating lamps on the panel will be lighted.

18. Power Supply Circuit Description
(figs. 41 and 45)

a. Ringing Power Supply. When ringing power is required, RING FWD.-RING BACK switch is operated to either position. This connects positive battery through contacts 2 and 3 of stack A (or through contacts 2 and 3 of stack E) on switch S301, binding post E304, the ST. VIB. lead, binding post E606, fuse F602, to chassis ground in the power pack. This causes vibrator inverter G601 to operate because one side of it is connected to chassis ground and the other side is connected to negative battery. As dc is supplied to vibrator inverter G601 (fig. 41), a magnetic field is set up around the coil of G601 which moves the vibrating reed to the left. This opens the circuit through the vibrating reed to ground and causes dc to flow through resistor R601. With the resistor in the circuit, the magnetic field is reduced which allows the vibrating reed to return to normal. When the reed is moved to the left, negative battery flows through the 2–1 winding of transformer T601, and the reed contact to positive battery. When the reed is in the normal position, negative battery flows through the 2–3 winding of transformer T601, coil L602, and the reed contact to positive battery. This causes pulses of dc to flow in the primary winding of transformer T601 in alternating directions. A 20-cycle alternating voltage is induced in the secondary winding of transformer T601 and flows out through binding posts E607 and E608. Lamp I 601 is across the output binding posts and glows while the vibrator inverter is operating.

b. Battery Check Switch.

(1) The upper bank of batteries is checked by operating switch S601 to position 1. The circuit is from the negative terminal of the upper bank of batteries through S603, S602, S601, voltmeter M601, and switch S602 to the positive terminal on the upper bank of batteries.

(2) The lower bank of batteries is checked by operating switch S601 to position 2. The circuit is from the negative terminal of the lower bank of batteries through switch S601, voltmeter M601, and switch S602 to the positive terminal on the lower bank of batteries.

CHAPTER 3

PREVENTIVE MAINTENANCE

19. Definition of Preventive Maintenance

Preventive maintenance is work performed on equipment (usually when the equipment is not in use) to keep it in good working condition so that breakdowns and needless interruptions in service will be kept to a minimum. Preventive maintenance differs from troubleshooting and repair since its objective is to prevent certain troubles from occurring.

20. Preventive Maintenance Techniques

a. Use No. 0000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth, or a dry brush for cleaning.

(1) If necessary, except for electrical contacts, moisten the cloth or brush with Solvent, Dry Cleaning (SD); then wipe the parts dry with a cloth.

(2) Clean electrical contacts with a burnisher or a toothpick moistened with carbon tetrachloride. Never touch electrical contacts with the fingers.

Caution: Repeated contact of carbon tetrachloride with the skin or prolonged breathing of the fumes is dangerous. See that adequate ventilation is provided.

c. If available, dry compressed air at a line pressure not exceeding 60 pounds per square inch may be used to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result.

d. Use electrical tape to make temporary repairs to frayed, cut, or damaged insulation.

e. Tighten all loose assembly screws and mounting screws.

21. Use of Preventive Maintenance Form (fig. 8)

a. The decision as to which items on DA Form 11–247 are applicable to this equipment is a tactical decision to be made by the individual making the inspection.

b. Circled items in figure 8 are partially or totally applicable to Manual Telephone Switchboard SB–86/P. References in the ITEM column refer to paragraphs in text which contain additional maintenance information.

22. Performing Preventive Maintenance

The third echelon preventive maintenance inspection is normally scheduled at 3-month intervals; however, this schedule may be changed by the local commander. The following instructions should be used by the third echelon maintenance personnel when performing preventive maintenance.

a. Inspect the operator's telephone set for chips, cracked components, and frayed cord; replace all of the items found to be unserviceable (par. 35).

b. Inspect all of the switchboard cords for damaged insulation or fraying; repair the damaged insulation with electrical tape or replace the switchboard cord (par. 33*g*).

c. Inspect all of the switchboard plugs for cracked plug shells, bent tips, and damaged insulators between the plug conductors; replace all of the switchboard plugs found to be unserviceable (par. 33*h*).

d. Test the hand ringing generator by ringing on a line circuit which has a telephone set connected; if the telephone set does not ring, replace the hand ringing generator (par. 34*c*). *Do not lubricate the hand ringing generator.*

e. Remove the cord packs from the keyshelf section and remove the cover from the cord pack (par. 33).

(1) Inspect all of the switch contacts for pitting, wear, proper contact pressure, dirt, grease, and fungus. Clean the switch contacts with a burnishing tool or carbon tetrachloride.

(2) Inspect all wiring for frayed insulation, poor connections, and damaged moistureproofing-fungiproofing.

(3) Inspect all of the mounting screws for tightness. Tighten any screws found to be loose.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
TELEPHONE SWITCHBOARD

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.
MANUAL TELEPHONE SWITCHBOARD SB-86/P	

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (X) Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(switchboard, head and chest sets, straps, carrying cases).*		12	INSPECT FOR CHIPS, CRACKS, DAMAGE - SWITCHBOARD; HEAD AND CHEST SETS; PLUGS; GROUND ROD. PAR. 22 a AND b	
2	CLEAN DIRT, DUST, GREASE, GRIME, MOISTURE FROM OUTSIDE OF SWITCHBOARD; HEAD AND CHEST SETS; STRAPS; CARRYING CASES; BATTERIES.		13	CHECK SIGNAL DROPS TO WORK FREELY AND REMAIN LATCHED WHEN SWITCHBOARD IS JARRED.	
3	CLEAN RUST, CORROSION, FUNGUS, DIRT, MOISTURE FROM ALL EXTERNAL ELECTRICAL CONNECTIONS; TERMINALS AND BINDING POSTS; PLUGS AND JACKS.		14	INSPECT HAND GENERATOR FOR OUTPUT; FREE TURNING; PROPER LUBRICATION IN ACCORDANCE WITH LATEST APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER. PAR. 22d	
4	INSPECT CORDS AND CABLES FOR LOOSE TERMINALS; FRAYED, CUT OR DAMAGED INSULATION; MILDEW; MOISTURE.		15	INSPECT SWITCHBOARD UNITS FOR BINDING, WARPING, DIRT, DUST, GREASE, GRIME, CORROSION. PAR. 22 j	
5	TIGHTEN ALL LOOSE ASSEMBLY SCREWS AND APPARATUS MOUNTING SCREWS.		16	CLEAN GROUND-STRIP AIR-GAP.	
6	CHECK NIGHT ALARM BY ALLOWING ANY SIGNAL DROP TO FALL.		17	INSPECT ALL KEY CONTACTS FOR PITTING, WEAR, PROPER CONTACT, DIRT, GREASE, CORROSION, FUNGUS, OPERATIONS. PAR. 22 e(1) AND f(1)	
7	CHECK TO DETERMINE IF SIGNALS ARE RESTORED WHEN PLUG IS INSERTED IN JACK.		18	CLEAN INTERIOR AND APPARATUS, OF ALL DIRT, DUST, FUNGUS, GRIME. PAR. 22 e (1) AND f (1)	
8	INSPECT ALL LINE CIRCUITS FOR SATISFACTORY RING-DOWN AND TALK-UP OPERATION.		19	INSPECT INTERIOR ELECTRICAL CONNECTIONS FOR TIGHTNESS, MOISTURE, FUNGUS. PAR. 22 e (2) AND f (2)	
9	INSPECT ALL EXTERNAL CABLING AND WIRING FOR CORRECT POSITION; KINKS, STRAINS, SHARP BENDS.		20	INSPECT TELEGRAPH CIRCUITS FOR SATISFACTORY OPERATION BY SETTING UP AND OPERATING.	
10	INSPECT WRITING ON DESIGNATION STRIP FOR LEGIBILITY.		21	INSPECT SWITCHBOARD FOR PROPER SEASONAL MAINTENANCE WEATHERPROOFING, DUST PROOFING. PAR. 22e (2) AND f (2)	
11	INSPECT GROUND ROD FOR TIGHT CONNECTION, FIRM EMBEDDING; FRACTURES, BENDS, RUST.		22	INSPECT ALL CIRCUITS FOR PROPER OPERATION. PAR. 22k	

23 IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.

DA FORM 1 MAY 51 11-247 REPLACES DA FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM4134-26

Figure 8. DA Form 11-247.

f. Remove the operator's pack from the keyshelf section and remove the cover from the operator's pack (par. 34).

(1) Inspect all of the RING FWD.-RING BACK and TRK SIG-CONF. SUPV. switch contacts for pits, wear, proper contact, dirt, grease, and fungus. Clean the switch contacts with a burnishing tool or carbon tetrachloride.

(2) Inspect the wiring for frayed insulation, poorly soldered connections, and damaged moistureproofing-fungiproofing. Repair frayed insulation with electrical tape, resolder all poorly soldered connections, and reapply moistureproofing-fungiproofing.

(3) Check all mounting screws for tightness. Tighten all screws found to be loose.

g. Check each line circuit and cord circuit for proper operation by installing the batteries in the power pack, operator's pack, and the jack field section and connecting a test circuit to the line binding posts in the rear of the jack field section. Be sure to check for proper ringing, talking, and supervision on each of the circuits.

h. Inspect all of the mounting screws and binding posts on the jack field section for tightness, and check the binding posts for proper clamping of the wire. Tighten all loose mounting nuts and screws; replace all unserviceable binding posts.

i. Inspect the power pack for loose or damaged binding posts, damaged toggle switches, and damaged voltmeter; replace all of the components found to be unserviceable.

j. Inspect the exterior of each of the components for dust, dirt, mud, or corrosion; clean the components with a clean cloth moistened with solvent (SD), then wipe dry with a clean dry cloth.

k. Inspect the line signals, line jacks, designation strips, switches, and lamps on the jack field section for serviceability. If any of the components are found to be unserviceable, tag the component with the proper trouble indication, and turn the jack field section in for repair.

CHAPTER 4

TROUBLE SHOOTING

Section I. PREREPAIR PROCEDURES

23. Tools and Test Equipment

The following tools and test equipment are required for repair of the SB-86/P:

Tools or test equipment	Where used
Tool Equipment TE-49	General repair
Tool Equipment TE-111	General repair
Multimeter TS-352/U	Continuity testing and resistance measurements (par. 28*f*)
Test Set I-181	Current flow testing of magnetic signals

24. Cleaning and Inspecting SB-86/P

Note. Check the equipment for tags or other indications, put on the equipment by the using organization, which may indicate the trouble or fault in the SB-86/P or its components.

a. Inspecting. Make a visual inspection to determine the general condition of the equipment when it is received for repairs. Remove the jack field section chassis from the case, and remove the cord packs and the operator's pack from the keyshelf section. Remove the covers from the operator's pack and the cord packs and inspect the equipment as outlined below:

(1) Inspect all of the components for indications of burning.

(2) Inspect the wiring for broken leads, brittle or damaged insulation, and corrosion.

(3) Inspect all of the connections in each component for broken leads, broken lugs, and poorly soldered connections.

(4) Inspect the lamp and fuse holders for bent contacts, damaged covers, and corrosion.

(5) Check the operation of all switches. They should operate easily and have a positive action. Inspect for any corrosion, dirt, or foreign matter that might affect operation.

(6) Inspect for loose, damaged, or missing screws.

b. Cleaning.

(1) Clean the outside of the equipment with a clean, lint-free cloth.

(2) Remove dirt from the exterior of the equipment with a cloth moistened only with clear water. Dry the equipment before attempting any further cleaning.

(3) Use air pressure, if it is available, to blow out accumulated dust, dirt, sand, lumps of solder, and wire cuttings. Apply air so that dust is blown away from all switch contacts. If the air pressure is not available, brush the dust and dirt from the interior of the equipment with a soft bristle brush. Be careful not to damage equipment wiring. Use orange sticks or spudgers to dislodge caked dirt.

(4) Remove oil and grease with a cloth moistened with solvent (SD). Wipe dry with a clean cloth.

(5) Remove corrosion, fungus growth, and similar foreign material on the structural framework with No. 0000 sandpaper or a brush; clean with solvent (SD) when necessary.

25. Troubleshooting Data and Procedures

The first step in servicing defective equipment is to sectionalize the fault. Sectionalization means tracing the fault to the major component or circuit. The second step is to localize the fault. Localization means tracing the fault to the defective part. Some defective parts can be located by smell, sight, or hearing, such as burned-out lamps, fuses, relay coils, or shorted repeating coils, etc. The majority of faults must be localized, however, by checking the magnetic signal and switch contacts of these units in the component or circuit in question. Before troubleshooting, refer to the schematic and wiring diagrams of the component at fault. Become thoroughly familiar with the theory of operation and the physical layout of all the circuits associated with the faulty component. Refer to paragraph 45 for information concerning the adjustment of the magnetic line signals. Refer to the applicable illustrations to locate the parts indicated by symbols on the circuit schematic and wiring diagrams. The following schematic and wiring diagrams are used in troubleshooting:

Diagram	*Fig. No.*
Power pack, schematic diagram	41
Power pack, wiring diagram	42
Line circuit, schematic diagram	43
Line circuit, wiring diagram	44
Cord circuit and operator's telephone circuit, schematic diagram.	45
Cord circuit, wiring diagram	46
Operator's telephone circuit, wiring diagram	47

26. General Precautions

Whenever any component of Manual Telephone Switchboard SB–86/P is serviced, observe the following precautions:

a. Only competent repairmen supplied with suitable tools and equipment are authorized to service and repair this equipment. An inexperienced person attempting to make repairs may seriously damage the equipment and necessitate major repairs. Careless workmanship will cause new faults.

b. When removing and replacing defective parts and circuit elements, be careful not to damage wires or other parts by pulling or pushing them out of the way.

c. Before a part is unsoldered, note the position of the leads; if a part, such as a switch, has a number of connections, tag each lead as it is removed from the part.

d. Do not use more solder than is necessary to make a secure connection. Well-soldered joints are important since a poorly soldered joint is very difficult to locate.

e. Do not allow drops of solder to fall into the unit since they may cause short circuits.

f. When replacing a part, place the new part exactly as the original part was placed. Use leads of the same length as the original leads.

Section II. TESTING PROCEDURES

27. Preparation for Testing

Personnel setting up the SB–86/P so that it can be tested should familiarize themselves with the following instructions before attempting to install the various components. In general, the installation consists of placing the components in the correct operating positions, removing the covers to install the batteries, and then connecting the necessary wiring and cabling.

a. Assembling SB–86/P.

(1) Move the SB–86/P to the location where it is to be tested and repaired.

(2) Place the keyshelf and jack field sections on the open end of the cover (fig. 3) or on a convenient table or work bench.

(3) Open the rear door of the jack field section by unlocking the cam locks with a screw driver or a thin coin. Lift the door out of the hinged position and lay it on top of the switchboard to clear the rear of the jack field section.

(4) Open the rear door of the keyshelf section, lift it from the hinged position, and let it hang by the cord on each side of the door so that it will clear the rear of the keyshelf section.

(5) Remove the operator's telephone set from the canvas bag on the inside of the keyshelf section door.

b. Installing Batteries and Making Connections (fig. 9).

(1) Install ten Batteries BA–200/U in the battery compartments in the power pack. Remove all of the wax from the battery terminals.

(2) Install two Batteries BA–30 in the battery compartment located in the rear of the operator's pack.

(3) Install two Batteries BA–30 in the battery compartment located in the rear of the jack field section.

(4) If the power pack is not available, a Battery BA–2 may be installed in the battery compartment located in the rear of the jack field section. Position the battery so that the negative lead will reach the —24V binding post, and the positive lead will reach the +24V binding post.

(5) Connect two wires from the —24V and +24V binding posts on the jack field section to the corresponding binding posts on the operator's pack.

(6) Connect the two-wire rubber-covered cable from the RING SUP. binding posts on the power pack to the EXT. GEN. binding posts on the operator's pack.

(7) Connect the three-wire power cable as follows: connect the white wire from the —24V binding post on the power pack to the corresponding binding post on the op-

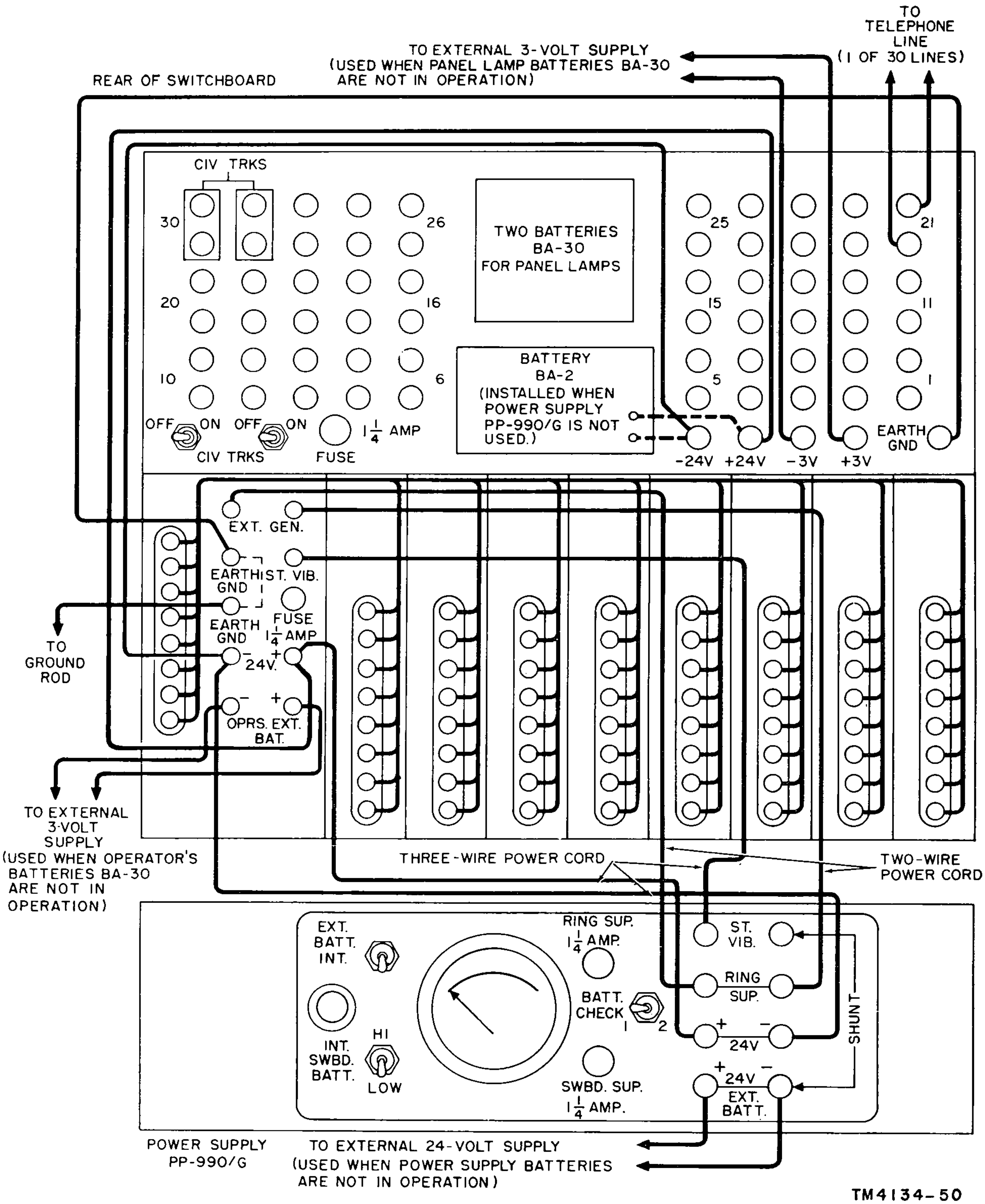

Figure 9. Manual Telephone Switchboard SB-86/P, cording diagram.

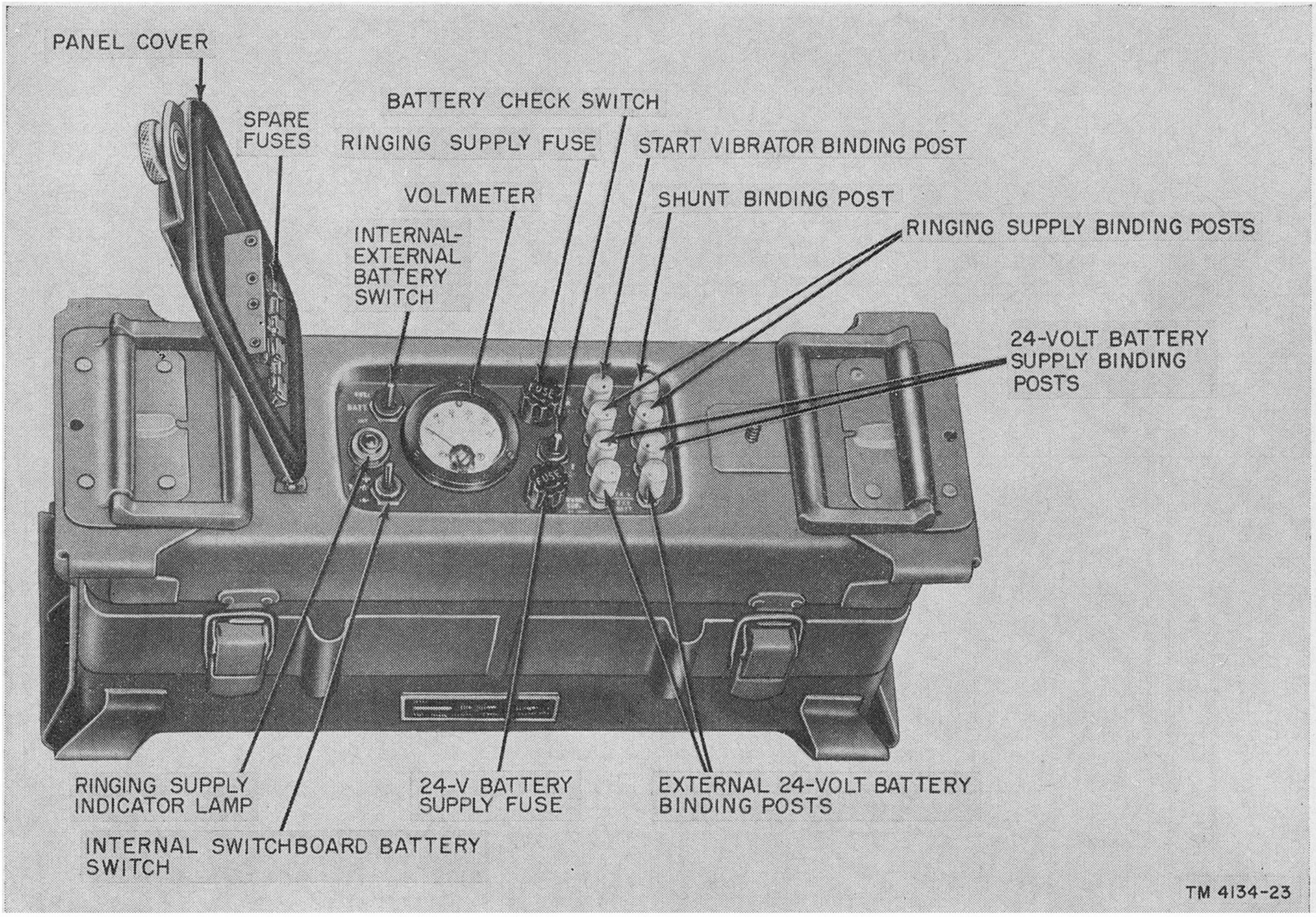

Figure 10. Power Supply PP-990/G, panel details.

erator's pack; connect the black wire from the +24V binding post on the power pack to the corresponding binding post on operator's pack; connect the red wire from the ST. VIB. binding post on the power pack to the ST. VIB. binding post on the operator's pack.

(8) If an external 24-volt battery source is used, connect one source to the EXT. BATT. binding posts on the power pack and operate the battery switch to the EXT. position. Disconnect the white wire from the binding posts at each end of the power cable, and connect a separate 24-volt battery source to the +24V and —24V binding posts on the operator's pack.

(9) Connect any test line and trunk circuits to the line binding posts located in the rear of the jack field section.

28. Operational Tests

Operational tests on this equipment must be conducted systematically to assure that each circuit is tested under all applicable types of operation. Test every line circuit with a cord circuit known to be in good working condition. Test every cord circuit by connecting field telephones to each of two pairs of binding posts and performing normal operational actions with each cord circuit between these telephones. Each test on each line circuit and on each cord circuit must be performed for all three positions of the associated line selector switches. When conducting the operational tests listed below, record *each* trouble found in *each* test and the number of the circuit. At the completion of *all* tests, locate and clear the trouble by using the troubleshooting chart (par. 29).

a. Battery Test (fig. 10). Test the voltage of each of the battery banks in the power pack by operating the BATT. CHECK switch to position 1 and then to position 2. The voltmeter should indicate between 20 and 26.5 volts in both positions. Operate the INT. SWBD. BATT. switch from LOW to HI with the BATT. CHECK switch in position 1; the voltage should be higher when the switch is operated to the HI position.

b. Ringing-current-source Indicator Test (fig. 10). Operate the ringing switch on the operator's pack to the RING FWD. and RING BACK positions. The neon lamp on the power pack should glow.

c. Magneto Line Test (figs. 11 and 12).

(1) Set the associated line selector switch to M.

(2) Operate the hand generator of the test telephone. The associated line signal should operate to white. Night alarm (N. A.) buzzer should sound if the N. A. switch is in AUD position or panel lamps will light if the N. A. switch is in the VIS position.

(3) Insert the answering plug (rear) into the calling party's jack (line signal should restore to *black*) and operate the associated TALK LIST.-CONF. switch to the TALK LIST. position. The operator and calling party should be able to talk (operator's TALK BATT. switch in ON position).

(4) Insert the calling plug (front) of the same cord circuit into the jack associated with the called party's line. Permit the TALK LIST.-CONF. switch to remain in the TALK LIST. position.

(5) Ring the called telephone by either of the methods listed below, but be sure both methods are used at some time during operational tests to test functioning of the ringing current sources.

(*a*) With Power Supply PP–990/G connected to the switchboard, operate the ring switch on the operator's pack to the RING FWD. position.

(*b*) With Power Supply PP–990/G *not* connected, operate the ring switch to the RING FWD. position and turn the crank of the hand ringing generator.

(6) Restore the TALK LIST.-CONF. switch to the normal position when the called party answers.

(7) To make a ring off check of the switchboard, proceed as follows:

(*a*) Operate the generator crank at either magneto station. The associated cord supervisory signal operates to *white*.

(*b*) When the plugs are returned to the plug seat, the supervisory signals should restore to *black*.

d. Common Battery Signaling Line Test.

(1) Set the field telephone circuit for common battery signaling.

(2) Set the line selector switch to the C position.

(3) Lift a handset on one of the test telephones. The associated line signal on the switchboard should operate to *white*. Night alarm operation is the same as described under magneto line test (*c*(2) above).

(4) Complete the call by performing the actions described in *c*(1) through (5) above.

(5) With the cords up, pushing down the line switch (hookswitch) on the station telephone should cause the associated supervisory signal to operate to *white*.

(6) When the plugs are pulled down and returned to the plug seat, the supervisory signals should restore to *black*.

e. Common Battery Signaling Trunk Test.

(1) Connect the SB–86/P being tested to a SB–86/P known to be in good condition. Each switchboard should have its own battery supply.

(2) Set the line selector switch to the T position.

(3) Insert the calling cord into the trunk jack at the switchboard and operate the switch of the cord pack to the TALK LIST. position.

(4) The trunk signal at the terminating switchboard (the one being tested) should operate to *white*. Since the terminating switchboard signal restores to *black* through its own contacts, either a flashing or steady white signal should be produced at the terminating switchboard by operation of the TALK LIST. switch at the originating switchboard.

(5) Plug an answering cord into the trunk jack associated with the trunk signal at the terminating switchboard. The trunk signal should restore to *black*.

(6) Either switchboard may be disconnected first. The cord pulled down first should cause the supervisory signal at the distant board to operate to *white*. Returning the cord to the plug seat on the switch-

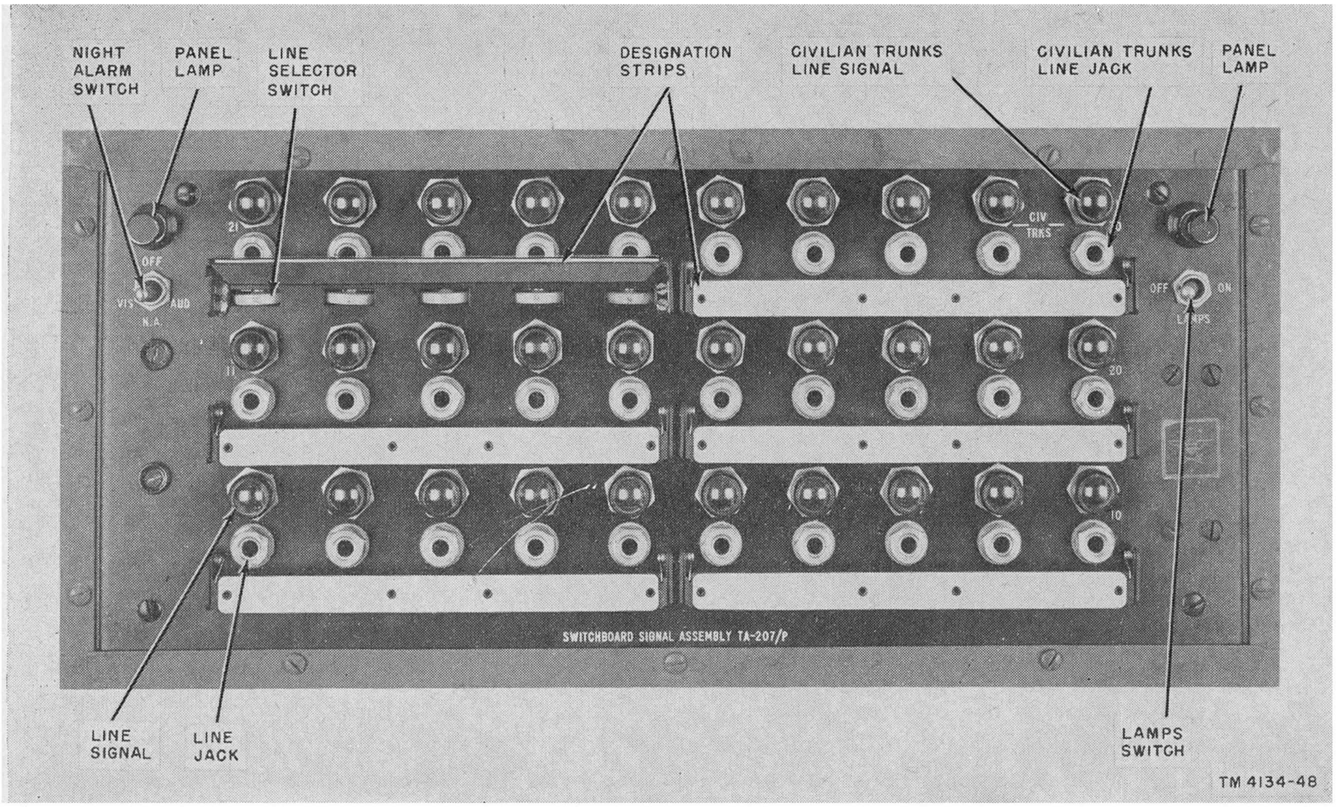

Figure 11. Jack field section, showing controls.

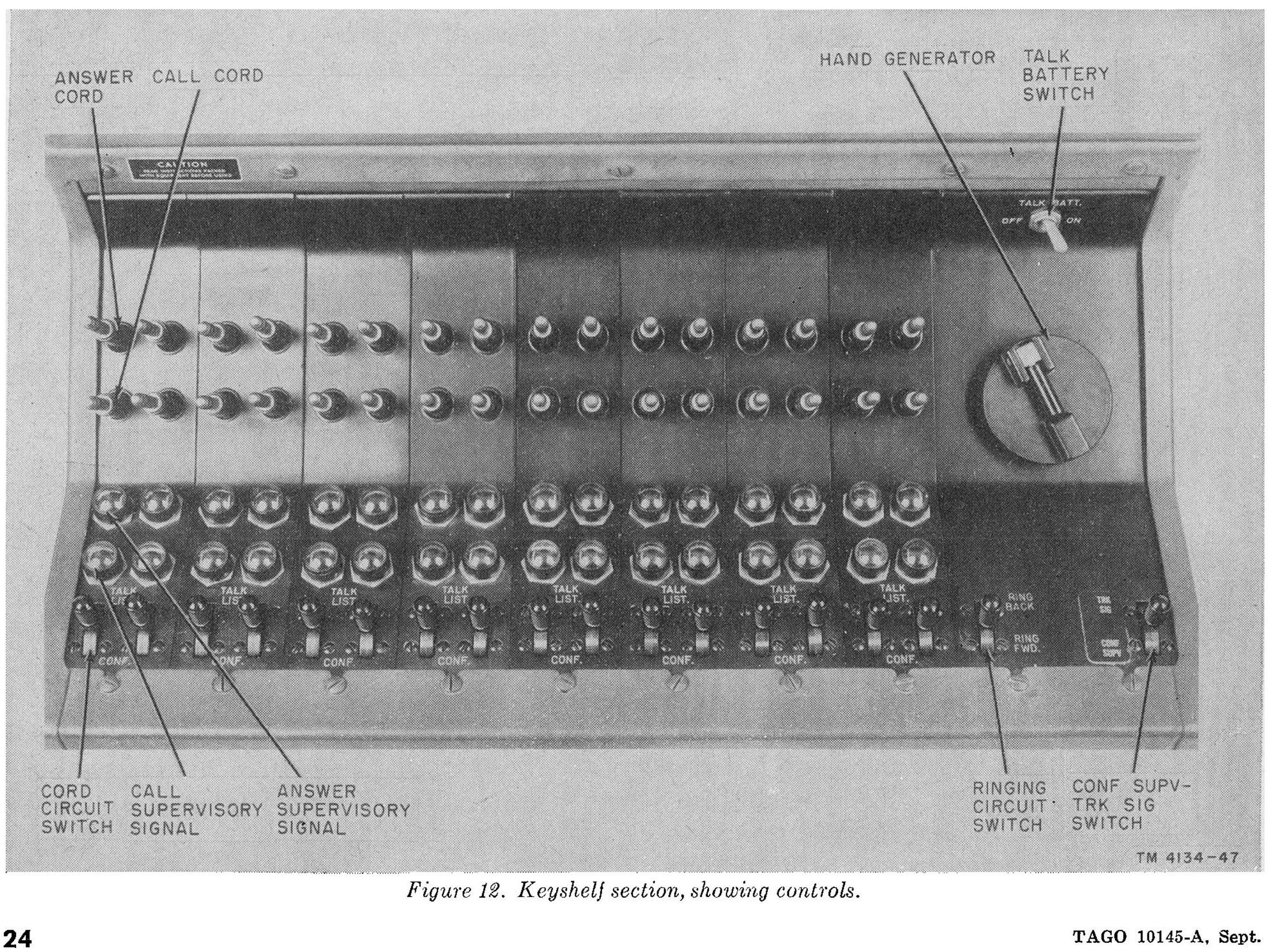

Figure 12. Keyshelf section, showing controls.

board that has the operated trunk supervisory signal should cause the signal to restore to *black*.

f. Civilian Trunk Option (Line 29 or 30 only).

(1) Test the resistance of the trunk circuit with a plug in the trunk jack and the CIV. TRKS. switch in the OFF position by connecting Multimeter TS–352/U, set in the ohms position, across the L1 and L2 binding posts. The circuit should test as an open circuit.

(2) Operate the CIV. TRKS. switch to the ON position and follow the procedure outline in (1) above. Multimeter TS–352/U should indicate approximately 50 ohms which is the resistance of coil L1.

Note. The signals are in the *black* position in the trunk tests.

29. Troubleshooting Chart

The troubleshooting chart is an aid in locating trouble in the equipment. The chart lists the symptoms that may be observed during operation or test, the probable trouble or troubles, and the procedures for correcting the defect. Once the trouble has been localized to a circuit, voltage and resistance measurements of the circuit will aid in determining the exact cause.

Symptom	Probable trouble	Correction
Common battery signaling line signal device (I 1 through I 30) does not operate to white on incoming signal.	*a.* Fuse F1 open.	*a.* Check and replace if necessary.
	b. Line selector switch (S3 through S32) may not be set correctly.	*b.* Set selector switch to position C.
	c. Jack (J1 through J30) defective.	*c.* Check and adjust or replace if necessary (par. 31).
	d. Rectifier (CR1 through CR30 or CR61 through CR90) defective.	*d.* Check and replace if necessary.
	e. Signal device (I 1 through I 30) defective.	*e.* Test windings (par. 58). Check mechanical operation (par. 56), and replace signal device (par. 31) if necessary. For replacement, *use* a signal device with *red band* around it.
	f. Line selector switch (S3 through S32) defective.	*f.* Check and adjust (par. 40), replace (par. 31) if necessary.
	g. Resistor (R151 through R180) shorted.	*g.* Check and replace if necessary.
Common battery signaling trunk signal device (I 1 through I 30) does not operate to white on incoming signal.	*a.* Line selector switch (S3 through S32) not set correctly.	*a.* Set switch in position **T**.
	b. Fuse F1 open.	*b.* Check and replace if necessary.
	c. Jack (J1 through J30) defective.	*c.* Check and adjust (par. 41), or replace (par. 34) if necessary.
	d. Line selector switch (S3 through S32) defective.	*d.* Check and adjust (par. 40), or replace (par. 31) if necessary.
	e. Rectifier (CR1 through CR30 and CR61 through CR90) defective.	*e.* Test and replace if necessary.
	f. Resistor (R31 through R60) defective.	*f.* Test and replace if necessary.
	g. Signal (I 1 through I 30) defective.	*g.* Test windings (par. 58). Check mechanical operation (par. 56), and replace signal device (par. 31) if necessary.
	h. Resistor (R151 through R180) defective.	*h.* Test and replace if necessary.
	i. Resistor R1 defective.	*i.* Test and replace if necessary.

Symptom	Probable trouble	Correction
Magneto line or trunk signal device (I 1 through I 30) does not operate to white on incoming signal.	*a.* Line selector switch (S3 through S32) may not be set correctly.	*a.* Set selector switch to position M.
	b. Protector (E31 through E60 and E62 through E91) grounded, shorting L1 and L2.	*b.* Check and clean or replace protectors if necessary.
	c. Jack (J1 through J30) defective.	*c.* Check and adjust (par. 41), or replace (par. 31) if necessary.
	d. Line selector switch (S3 through S32) defective.	*d.* Check and adjust (par. 40) or replace (par. 31) if necessary.
	e. Signal (I 1 through I 30) defective.	*e.* Test windings (par. 58). Check mechanical operation (par. 56) and replace (par. 31) if necessary.
	f. Rectifier (CR1 through CR30 and CR61 through CR90) defective.	*f.* Test and replace if necessary.
	g. Resistor (R121 through R150) defective.	*g.* Test and replace if necessary.
	h. Resistor (R151 through R180) defective.	*h.* Test and replace if necessary.
Common battery signaling line or trunk signal (I 1 through I 30) remains white after operator plugs into line jack.	*a.* Signal (I 1 through I 30) defective.	*a.* Test windings (par. 56). Check mechanical operation (par. 56) and replace (par. 31) if necessary.
	b. Line selector switch (S3 through S32) defective.	*b.* Check and adjust (par. 40) or replace (par. 31) if necessary.
	c. Jack (J1 through J30) defective.	*c.* Check and adjust (par. 41) or replace (par. 31) if necessary.
Panel lamps (I 31 and I 32) do not light when lamp switch is at ON or line signal operates with N. A. switch in VIS position.	*a.* Lamp battery (two Batteries BA-30) defective.	*a.* Test battery. Replace if necessary.
	b. Lamps I 31 and I 32 burned out.	*b.* Test lamps. Replace if necessary.
	c. Switches S33 and S34 defective.	*c.* Check switches. Replace (par. 32) if necessary.
Night alarm buzzer fails to operate. N. A. switch in AUD position.	*a.* Buzzer I 33 defective.	*a.* Check buzzer. Replace if necessary.
	b. Switch S34 defective.	*b.* Check switch. Replace if necessary.
	c. Line signal (I 1 through I 30) contacts defective.	*c.* Check signal for electrical and mechanical operation (par. 56). Replace (par. 31) if necessary.
Supervisory signals in a cord pack do not operate and restore properly.	*a.* Signals (I 201 through I 204) defective.	*a.* Check for electrical (par. 56) and mechanical operation and replace (par. 31) if necessary. Do not readjust the device.
	b. Defective TALK LIST.-CONF. switch in cord circuit.	*b.* Check TALK LIST.-CONF. switch for dirty contacts, continuity of circuits, and for poorly soldered connections.
	c. Resistor R1 defective.	*c.* Test and replace if necessary.
	d. Line selector switch defective.	*d.* Check and adjust (par. 40) or replace (par. 31) if necessary.
Operator cannot ring any station.	*a.* Hand ringing generator defective.	*a.* Test hand generator. Replace if necessary.
	b. Vibrator inverter defective.	*b.* Check and repair or replace (par. 38) if necessary.
	c. Ringing switch S301 in operator's pack defective.	*c.* Check and adjust or replace if necessary.
	d. Loose connections.	*d.* Check connections.
Operator cannot ring any station using a particular cord circuit.	*a.* Cord circuit switch out of adjustment.	*a.* Adjust the cord circuit switch (par. 42).
	b. Broken lead in multiple cable.	*b.* Test cable and repair broken lead.
	c. Open conductor in one of the switchboard cords.	*c.* Replace the switchboard cord (par. 33*g*).

Symptom	Probable trouble	Correction
Operator can ring stations on all but one line.	*a.* Jack (J1 through J30) associated with line defective. *b.* Protector grounded.	*a.* Check jack. Adjust (par. 41) or replace (par. 31) if necessary. *b.* Clean or replace protector.
Operator cannot transmit.	*a.* Operator's telephone set defective. *b.* Operator's battery worn out. *c.* Operator's induction coil defective.	*a.* Replace the operator's set with a set known to be in operating condition. *b.* Test battery in operator's pack and replace if necessary. *c.* Check and replace (par. 34) if necessary.
Operator cannot transmit through a particular cord circuit.	*a.* Defective TALK LIST.-CONF. switch. *b.* Loose connection at the TALK-LIST.-CONF. switch. *c.* Defective switchboard cord.	*a.* Check and readjust (par. 42) or replace (par. 33) the switch. *b.* Check all of the connections at the switch. *c.* Replace (par. 33) the switchboard cord.
Called and calling parties cannot transmit through a particular cord circuit.	*a.* Defective repeating coil in the cord circuit. *b.* Defective switchboard cord. *c.* Defective TALK LIST.-CONF. switch.	*a.* Replace (par. 33) the repeating coil. *b.* Check and replace (par. 33) the switchboard cord. *c.* Check and readjust (par. 42) or replace (par. 33) the switch.
Voltmeter M601 does not indicate (Power Supply PP-990/G).	*a.* Battery A or B worn out. *b.* BATT.-EXT.-INT. switch S602 defective. *c.* INT. SWBD. BATT. switch S603 defective. *d.* Voltmeter switch S601 defective. *e.* Voltmeter M601 damaged.	*a.* Check batteries. Replace if necessary. *b.* Check switch with an ohmmeter and replace the switch (par. 39) if necessary. *c.* Check switch with an ohmmeter and replace switch (par. 34) if necessary. *d.* Check switch with an ohmmeter and replace switch (par. 39) if necessary. *e.* Replace meter.
Lamp I 601 (Power Supply PP-990/G) does not glow when vibrator start circuit is closed.	*a.* Fuse F602 open. *b.* Lamp I 601 is defective. *c.* Transformer T601 shorted or open. *d.* Coils L601 and L602 open. *e.* Vibrator G601 defective. *f.* Capacitor C601 shorted. *g.* Resistor shorted. *h.* Switch S301 defective.	*a.* Check and replace if necessary. *b.* Check and replace if necessary. *c.* Check resistance values of transformer. Refer to paragraph 58. Replace (par. 38) if necessary. *d.* Check continuity of coils and replace (par. 38) if necessary. *e.* Replace (par. 38) vibrator. *f.* Check and replace if necessary. *g.* Check and replace if necessary. *h.* Check switch for positive action or dirty contacts and replace if necessary.
Civilian central office equipment not seized on lines 29 and 30 when operator plugs in.	*a.* Switches S1 and S2 not operated, or defective. *b.* Retardation coils L1 and L2 defective. *c.* Line jack J29 or J30 defective.	*a.* Check and replace if necessary. *b.* Test with an ohmmeter and replace (par. 32) if necessary. *c.* Check and adjust (par. 41) or replace (par. 31) if necessary.
Operator cannot supervise conference calls.	CONF. SUPV.-TRK SIG switch S302 defective.	Check switch. Adjust (par. 44) or replace (par. 34) if necessary.
Station user at field telephone cannot transmit or receive in a conference connection.	Defective TALK LIST.-CONF. switch S202 or S203.	Check switch. Adjust (par. 41) or replace (par. 33) if necessary.

CHAPTER 5

REPAIR AND REPLACEMENT OF PARTS

Section I. JACK FIELD SECTION

Note. All removal instructions in this chapter are presented in a simple step-by-step procedure. All repaired or new parts are installed by assembling parts in exactly the reverse sequence of the removal procedure.

30. Removal of Chassis from Case

(figs. 13 and 14)

When it is necessary to replace any of the internal parts of the jack field section, the chassis must be removed from the case. The step-by-step procedure outlined below must be followed to prevent damage to the wiring and the internal parts.

a. Remove the four mounting screws that hold the top mounting bracket to the rear panel of the chassis and the three mounting screws that hold the top mounting bracket to the case; remove the mounting bracket and rear door assembly from the case.

b. Remove the four mounting screws that hold the lower mounting bracket to the chassis and the three mounting screws that hold the lower mounting bracket to the case; remove the lower mounting bracket.

c. Slide a drift pin or large screw driver between the lower edge of the rear panel and the bottom of the case to wedge the chassis in position so that it will not bind the assembly screws on the front of the jack field section.

d. Remove the 12 assembly screws from the front of the case.

e. To remove the chassis from the case, follow the procedure outlined below.

(1) Slide the chassis to the rear of the case.

(2) Drop the rear panel far enough to permit the top of the rear panel to clear the lower edge of the top of the case. Slide the chassis out of the case as far as possible.

(3) Lift the rear of the chassis, keeping the top of the rear panel out of the case, until the bottom of the rear panel clears the case. Slide the chassis out of the case completely.

Caution: Do *not* force the chassis at any time when removing it from the case.

f. To expose the wiring terminals of the components mounted on the front and rear panels, the four assembly screws must be removed from the four supporting posts between the two panels. Unscrew each screw from the rear panel. Spread the two panels apart to expose the wiring side of each panel.

Note. To locate individual parts when doing the work described in paragraphs 31 and 32, compare the reference symbols on the applicable schematic diagrams with those in figures 15, 16, and 17.

31. Removal of Magnetic Signal Device and Line Jack and Line Selector Switch Assembly

(figs. 15–17)

The magnetic signal device (I 17, fig. 17) may be removed from the front panel separately or it may be removed with the associated line jack and line selector switch assembly (J17 and S19, fig. 17). If it is to be removed from the front panel with the line jack and line selector switch assembly, leave the wires connected. If the signal device and the line jack and line selector switch assembly are to be removed separately, disconnect all of the wires.

a. Removing Components as a Unit.

(1) Remove the plastic cap from the signal device.

(2) Remove the retaining nut from the signal device with a socket wrench of the proper size.

(3) Remove the retaining nut from the jack and line selector switch assembly with a socket wrench of the proper size.

(4) Slide the jack and line selector switch assembly and the magnetic signal device to the rear until the front of the components is clear of the front panel. Be careful not to damage the wiring. This will expose the components for adjustment or cleaning as required.

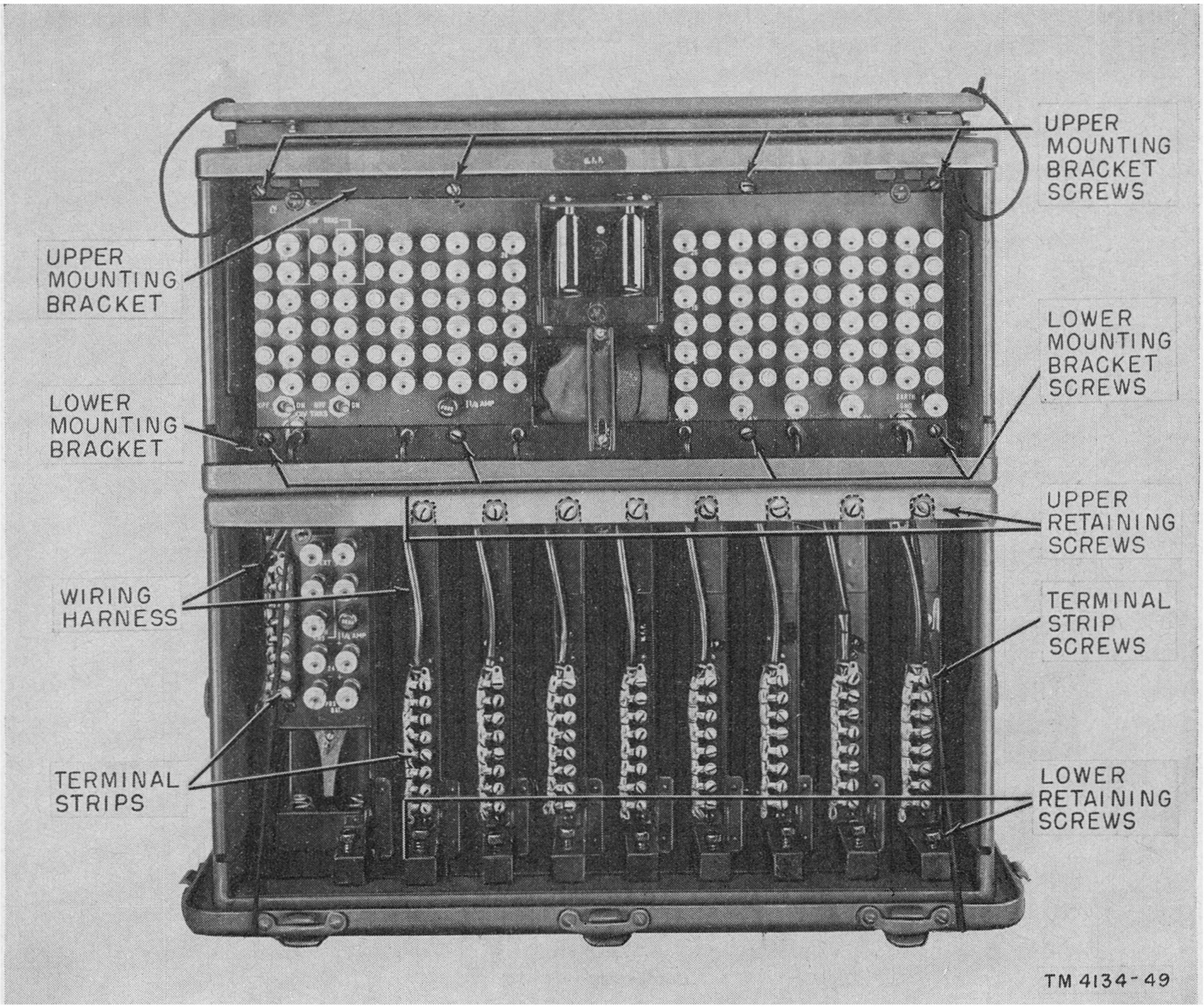

Figure 13. Jack field section and keyshelf section, rear view.

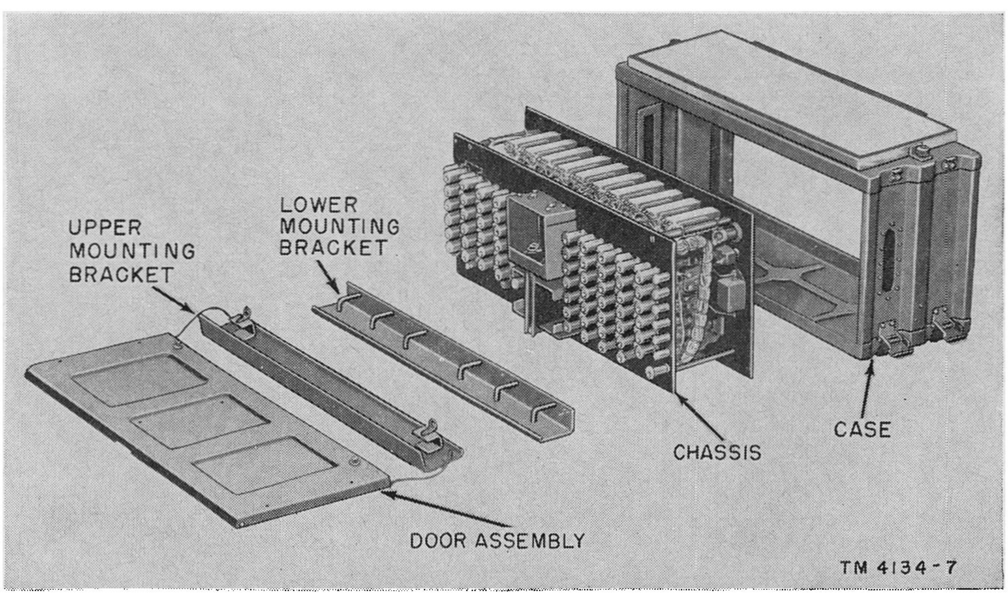

Figure 14. Jack field section, partially disassembled.

b. Removing Components Separately. When it is necessary to remove the component from the front panel completely, disconnect the wiring first and then follow the procedure given in *a* above. Be sure to tag each wire as it is disconnected from the terminal. Be sure to use a hot, well-tinned soldering iron to unsolder the leads.

32. Removal of Miscellaneous Components

(figs. 16 and 17)

a. Binding Posts.

(1) Remove the nut and solder lug from the binding post.

(2) Loosen the nut on the protector associated

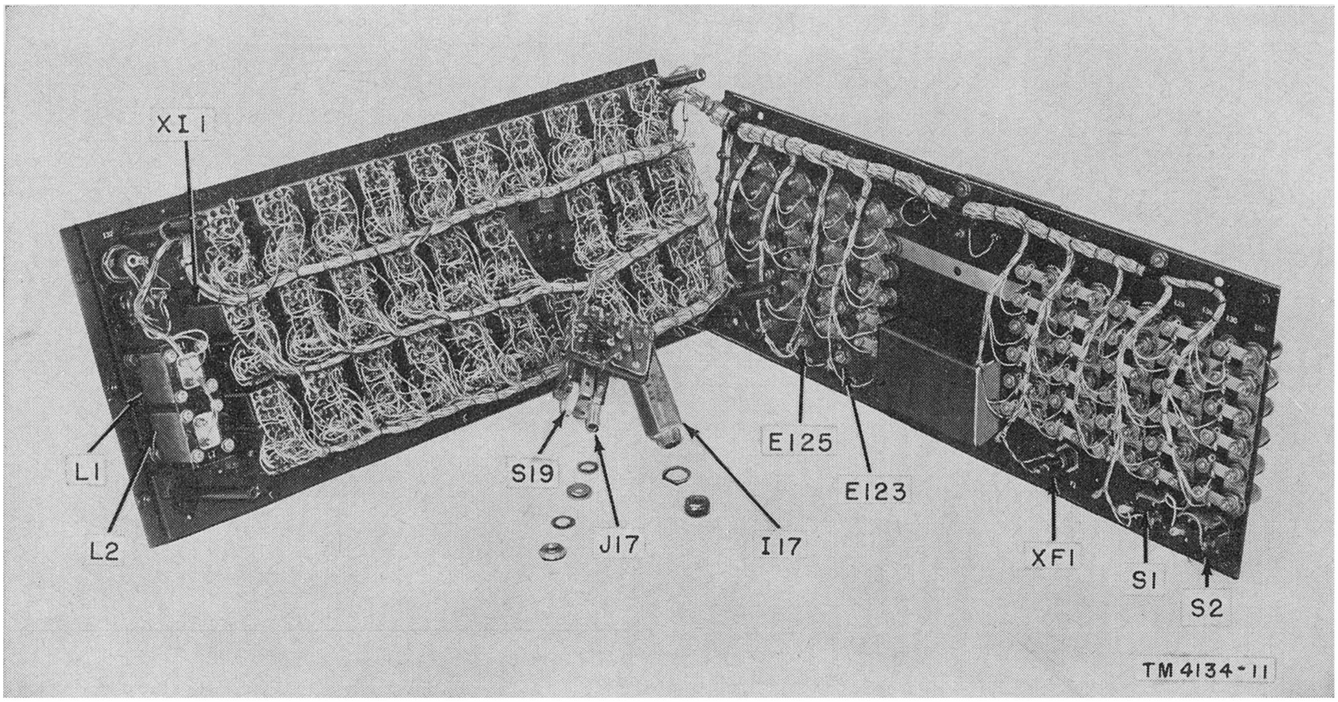

Figure 15. Line-jack-selector-switch assembly and magnetic signal device removed from jack field section, but not disconnected.

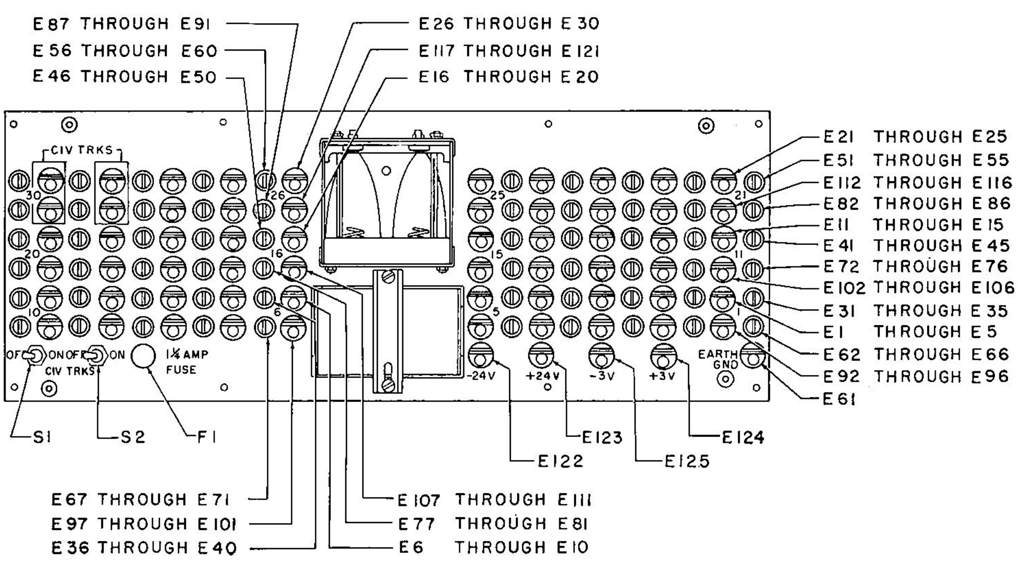

Figure 16. Jack field section, back panel showing reference symbols.

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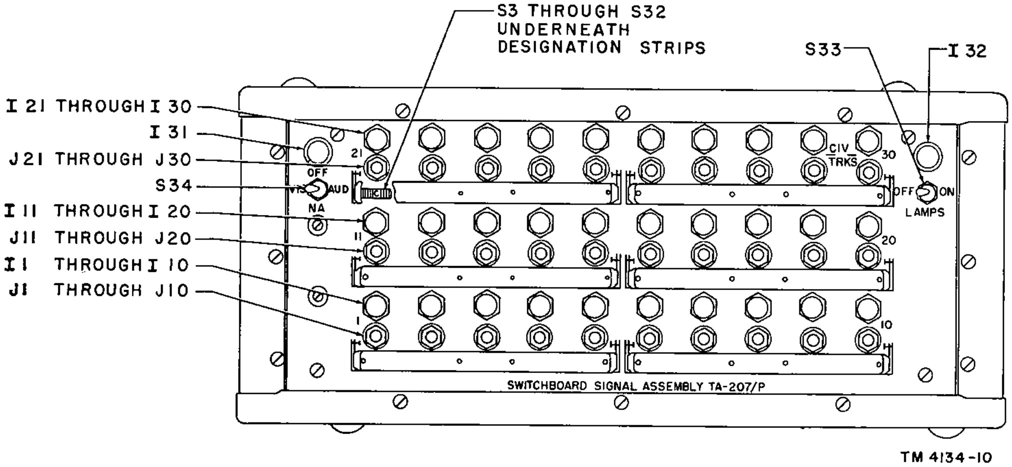


Figure 17. Jack field section, front panel showing reference symbols.

with the binding post being removed so that the bonding strap will clear the threaded end of the binding post stud.

(3) Remove the second nut, lockwasher, flat washer, and insulating washer from the rear of the binding post; slide the binding post out of the rear panel and remove the insulating shoulder bushing from the binding post.

b. Protector Mounting.

(1) Remove the bonding strap retaining nut and lockwasher from the protector stud.

(2) Loosen the assembly nut on the associated line binding post so that the bonding strap will clear the threaded end of the protector.

(3) Remove the large mounting nut and lockwasher from the rear of the protector, and slide the protector away from the panel.

c. Toggle Switches.

(1) Unsolder and tag the leads of the switch being replaced.

(2) Remove from the switch the mounting nut on the outer side of the panel.

(3) Slide the switch out of the panel toward the wiring side.

d. Fuse and Lamp Mountings.

(1) Unsolder and tag the leads of the mounting.

(2) Remove the mounting nut from the fuse mounting.

(3) Slide the mounting toward the outer side of the panel to remove it.

Section II. KEYSHELF SECTION

33. Removal and Disassembly of Cord Pack (figs. 18–22)

To remove the cord pack, loosen the cord pack mounting screw on the front of the cord pack and the mounting screws at the top and bottom of the cord pack in the rear. Loosen the screws in the terminal strip and slide the cord pack out of the keyshelf section.

a. Cover. To replace any of the internal parts of the cord pack, remove the *six* screws that hold the side cover in position and lift it from the cord pack. This exposes all of the internal parts. (The cover is on the right side. Do not remove the *eight* screws from the left side.)

b. Repeating Coils.

(1) Unscrew the four screws from the bottom of the cord pack and lift the repeating coil bracket and coils T201 and T202 from the cord pack.

(2) Unsolder and tag the wires connected to coil T201 and then remove the nuts from the mounting studs.

(3) Lift coil T201 from the mounting bracket.

(4) To remove coil T202, remove the mounting nuts from coil T201 and slide it out of the bracket so that coil T202 will clear the bracket. Then follow the instructions given in (1) through (3) above.

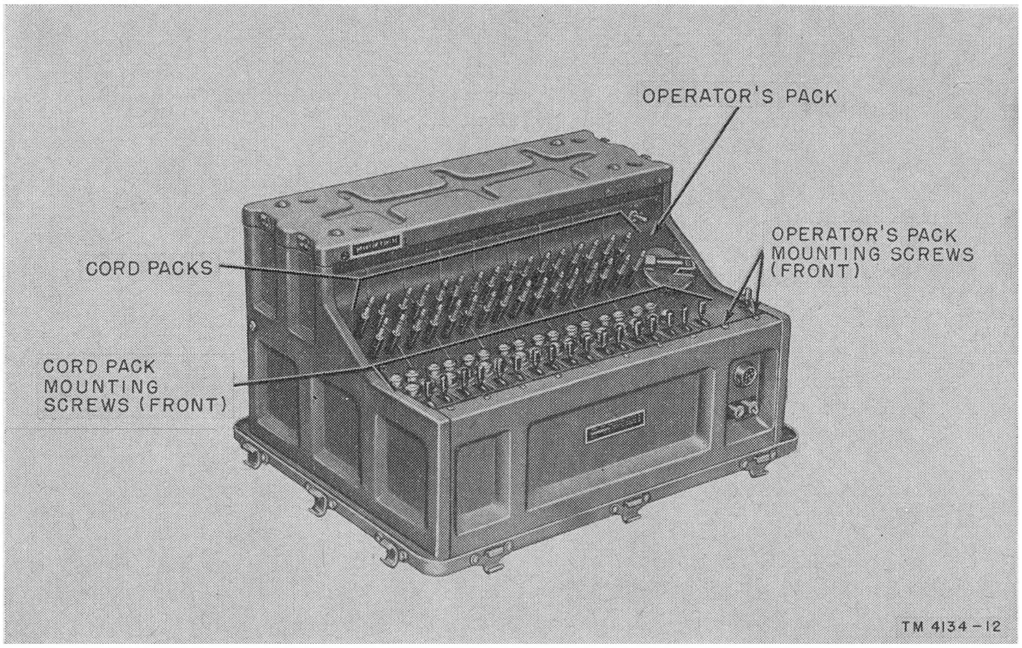


Figure 18. Keyshelf section.

c. Cord Circuit Switches.

(1) Remove the repeating coil bracket as outlined in *b*(1) above.

(2) Remove the handles from the switches.

(3) Remove the four screws from the top of the switch being removed from the cord pack.

(4) Slide the switch toward the bottom of the cord pack until the threaded portion of the switch handle clears the top of the cord pack.

(5) Lift the switch from the cord pack. There is slack enough in the cable form to the switch to permit removal.

(6) If it is necessary to remove the leads from the switch, be careful not to burn the insulation on adjacent terminals. Tag each lead.

d. Supervisory Signal.

(1) Remove the repeating coil bracket as outlined in *b*(1) above.

(2) Remove the lens cap and retaining nut from the top of the supervisory signal device being removed.

(3) Slide the signal device toward the bottom of the cord pack until the top of the signal device clears the top of the cord pack, and swing the signal device out of the cord pack so that the terminals are accessible.

(4) Unsolder the wires from the signal device. Tag each wire.

Caution: When replacing the signal device, mount the new one with the terminals positioned exactly as they were on the old signal device. This position minimizes magnetic interference from adjacent signals. Figure 34 shows the terminal arrangement of the magnetic signals.

e. Plug Seat Switch.

(1) Stand the cord pack up and remove the four screws that hold the cord reel assembly in position.

(2) Lift the terminal end of the cord reel assembly out of the cord pack and slide it toward the bottom of the cord pack. Do not remove the cord plugs; the length of the cords will permit removing the cord reel assembly from the cord pack completely.

(3) Pull up the four cord plugs through the top of the removed assembly far enough to clear the plug seat switch, and tie them together loosely so that they will not be retracted.

(4) Unsolder and tag the leads connected to the plug seat switch. Be careful not to burn the insulation on the adjacent wiring or the braided insulation on the four switchboard cords.

(5) Unscrew the two mounting nuts from the two screws that fasten the switch plate to the cord guide brackets and loosen, but do

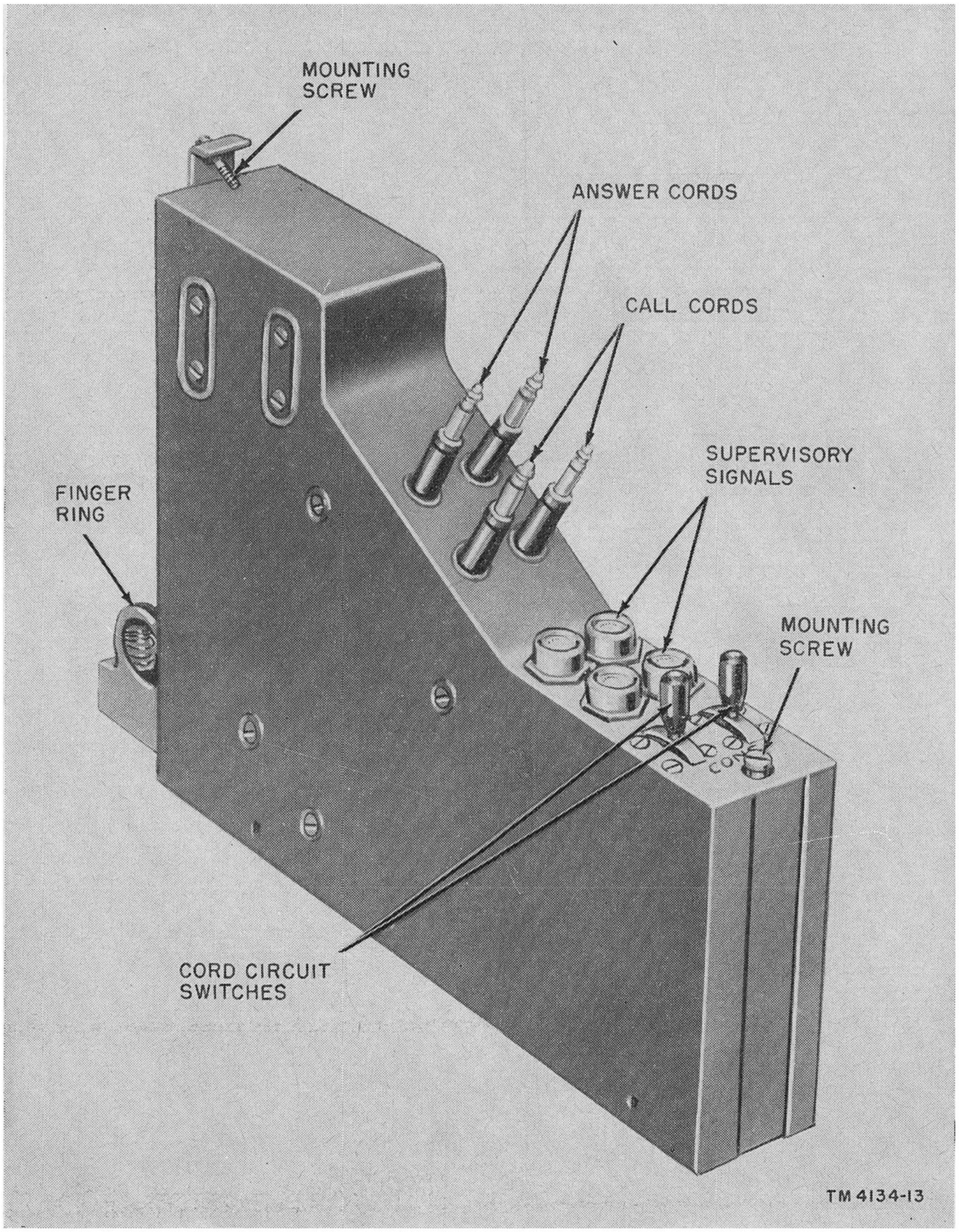


Figure 19. Cord pack removed from keyshelf section.

not remove, the screws that fasten the cord guide brackets to the cord reel mounting bracket.

(6) Slide the switch out of the cord guide bracket.

Caution: Be sure that the new switch is positioned properly because the contact arrangement is different for the calling cord than for the answering cord.

f. Cord Reel (fig. 23).

(1) Remove the reel cover retaining nut and lift the reel cover from the defective reel.

(2) Release the tension of the retracting springs by removing the rubber grommet from the reel mounting bracket and by allowing the reel to unwind *slowly*.

(3) Examine the reel carefully; note how it is mounted, the direction of rotation required to tension the retracting springs, and the side of the reel on which the wires project.

(4) Compare the replacement reel to the reel being replaced to determine how it is to be mounted.

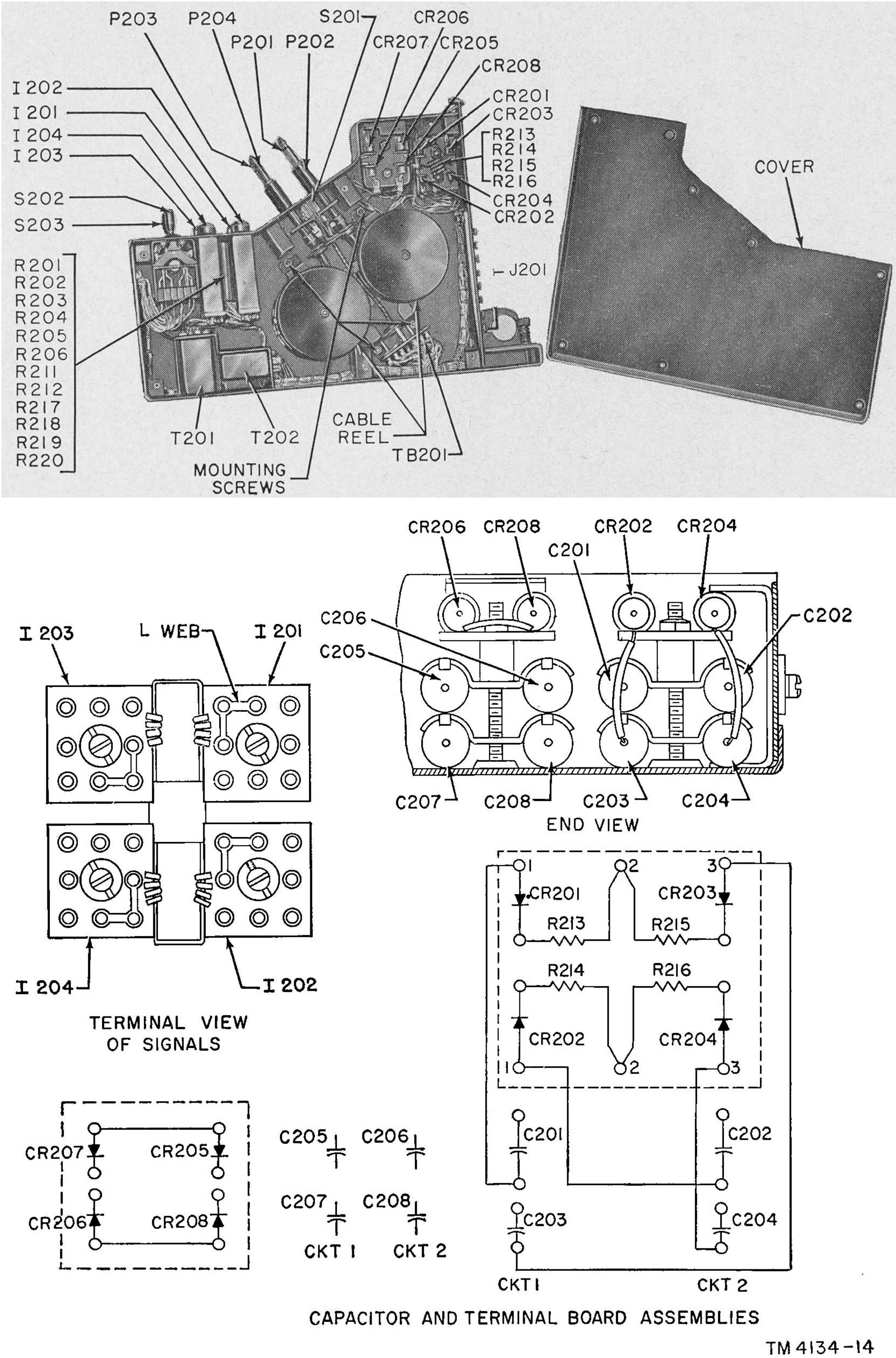


Figure 20. Cord pack with cover removed.

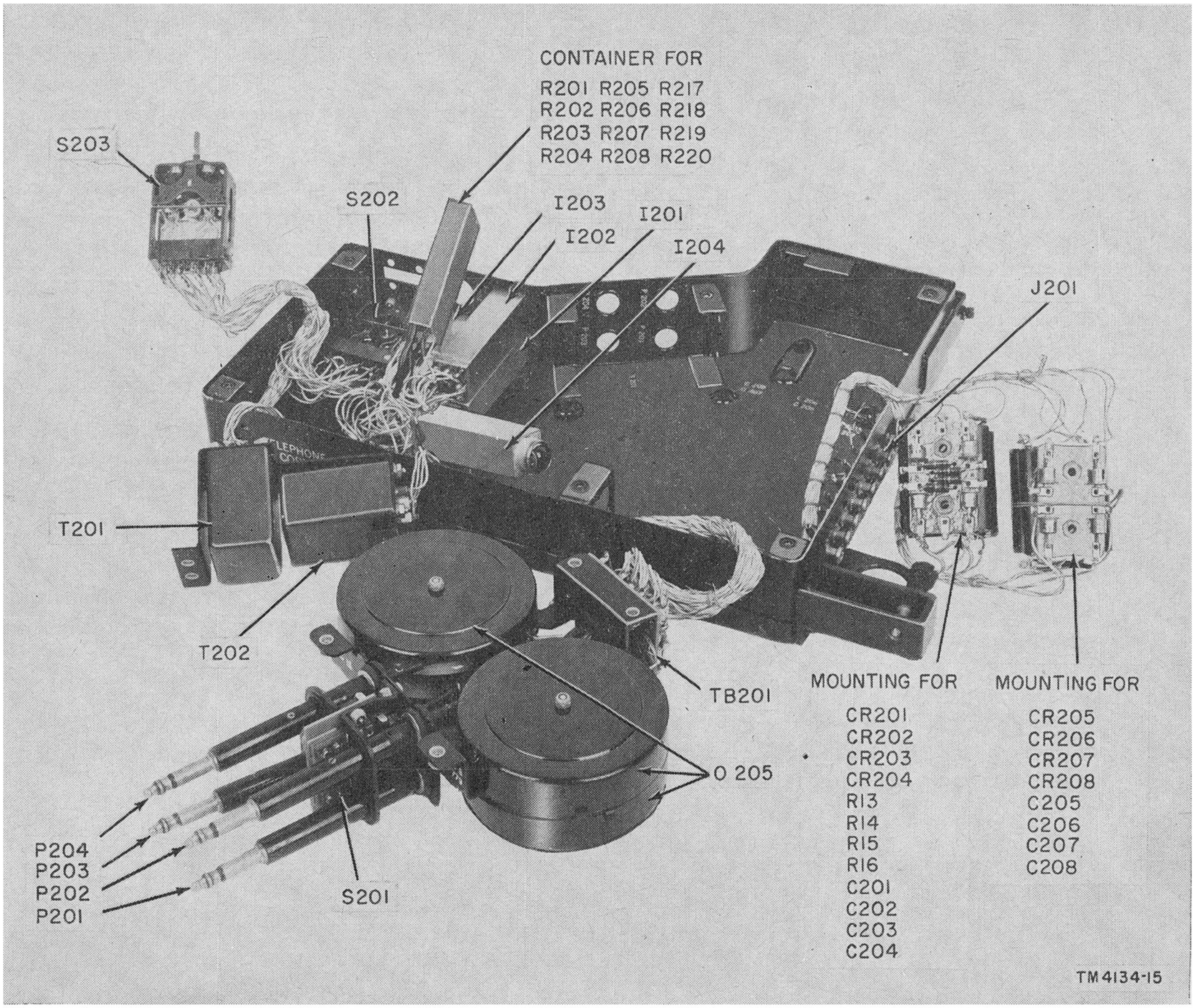


Figure 21. Cord pack, disassembled for repair.

(5) Clip the lead wires off the new reel on the side of the reel where they will not be required. The lead wires should be cut off as close as possible to the reel hub.

(6) Unsolder the lead wires of the defective reel from the terminal board. Be careful not to burn the adjacent wires or the terminal board.

(7) Lift the plastic bushing from the defective reel hub.

(8) Lift the defective reel from the three prongs that hold the reel hub stationary and discard it. Save the switchboard cord and plug if they are not damaged.

(9) Install the new reel on the three prongs and place the lead wires in the grooves in the two plastic bushings located between the reel and the reel mounting.

(10) Feed the lead wires through the reel mounting bracket, and connect them to the terminal board where the defective reel lead wires were disconnected.

(11) Replace the plastic bushing on the outside of the reel and be sure the reel is all of the way on the prongs.

(12) Retension the reel by wrapping the cord three times around the reel in the proper direction and then pulling it off to tighten the retracting springs.

(13) Hold the reel with one hand and wrap the entire length of the cord on the reel with the other hand.

(14) Insert the switchboard plug through the switchboard cord guide and replace the rubber grommet on the reel mounting bracket.

(15) Replace the reel cover and the reel cover retaining nut.

Caution: Be careful not to tighten the nuts or screws too tightly.

g. Switchboard Cord.

(1) Remove the reel cover retaining nut and lift the reel cover from the cord reel.

(2) Release the tension of the retracting spring by removing the rubber grommet from the reel mounting bracket and by allowing the reel to unwind *slowly.*

(3) Unwind the switchboard cord from the cord reel without retensioning the retracting spring.

(4) Remove the three reel assembly screws.

(5) Remove the plastic bushing and the outer reel flange from the reel hub.

(6) Remove the three cord connecting screws from the reel terminals and remove the cord from the reel. If the switchboard plug is not damaged, it should be saved.

(7) Install the new cord on the cord terminal and replace the cord connecting screws. *Be sure to check the leads to be sure they are connected to the correct terminals.*

(8) Replace the outer reel flange on the reel hub. Be sure it is properly *positioned* so that the cord terminals fit into the notches provided on the inside of the outer reel flange.

(9) Replace the reel assembly screws. Do not tighten the screws too much or the plastic threads in the reel will be stripped.

(10) Retension the reel by wrapping the cord around the reel three times and then pulling it off to tighten the retracting springs.

(11) Hold the tension on the reel with one hand, and wrap the cord on the reel with the other hand. Be sure that the cord is wrapped on the reel in the proper direction.

(12) Replace the cord in the cord guide and the rubber grommet.

(13) Replace the reel cover and reel cover retaining nut.

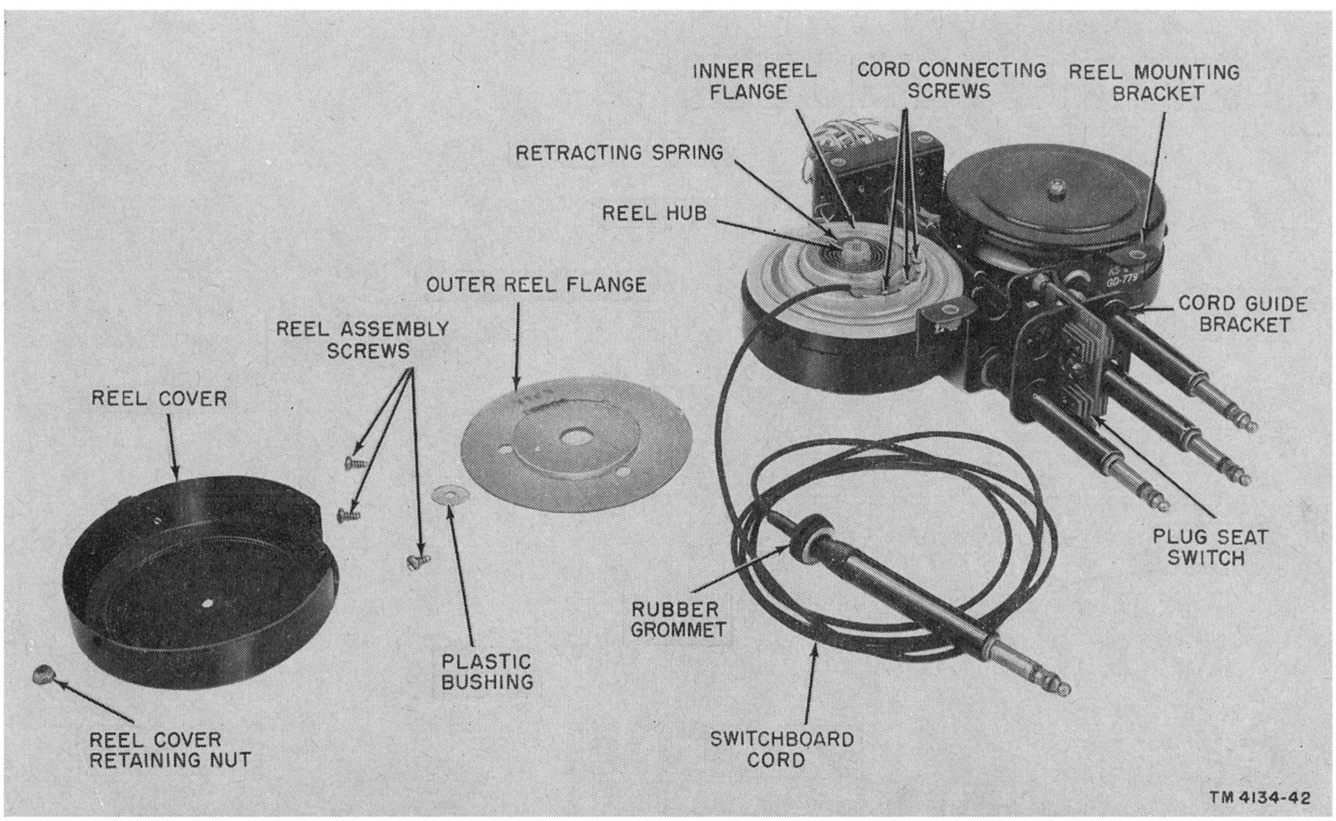


Figure 22. Switchboard cord removal.

h. Switchboard Plugs. A defective switchboard plug may be replaced without removing the cord pack from the keyshelf section or without removing the cord reel mounting bracket from the cord pack.

(1) Pull the cord about halfway off the reel and tie it around an adjacent plug. Do not pull the knot tight because the cord may be damaged.

(2) Remove the plug shell screw and the plug shell so that the plug terminal screws are exposed.

(3) Remove the terminal screws from the tip and ring of the plug and the terminal screw from the adapter.

(4) Hold the adapter and unscrew the rubber cord protector, and slide it up the cord.

(5) Hold the adapter and unscrew the *plug from the adapter.*

(6) Replace the defective plug with a new one.

(7) Fold the sleeve conductor into the groove of the adapter.

(8) Slide the cord conductors into the plug and screw the plug on the adapter. Be careful not to twist the tip and ring conductors when the plug is being screwed into place.

(9) Fasten the tip and ring cord terminals to their respective terminals in the plug. Be sure that the conductors are not shorted.

(10) Slide the rubber cord protector down and screw it on the adapter.

(11) Replace the plug shell and the plug shell screw.

(12) Untie the cord and allow it to be retracted.

i. Resistor, Capacitor, and Varistor Assemblies.

(1) Remove the two nuts and screws that hold the assembly containing the defective component in place.

(2) Lift the assembly from the cord pack and separate the components by spreading them apart.

(3) Unsolder the defective component and replace it with one known to be good. Do not burn the insulation on the conductor being unsoldered.

(4) Reassemble the assembly and replace it in the cord pack.

34. Operator's Pack

(figs. 23–27)

To remove the operator's pack from the keyshelf section, loosen the two mounting screws on the front of the operator's pack (fig. 18) and the two screws at the top and one at the bottom in the rear of the operator's pack. Loosen the screws in the terminal strip and slide the operator's pack out of the keyshelf section.

a. Cover. To replace any of the internal parts of the operator's pack, first remove the six screws that hold the cover in place and then lift the cover from the operator's pack. This exposes all of the internal parts.

Note. Manual Telephone Switchboard SB–86/P procured on Order No. 96–Phila–52 is equipped with Operator's Telephone Circuit TA–220/P which is electrically and physically interchangeable with Operator's Telephone Circuit TA–220/P provided with Manual Telephone Switchboard SB–86/P procured on Orders No. 1669–Phila–51 and 6505–Phila–51. However, the location of some of the parts has been changed slightly as shown in figure 25. The instructions for the repair and replacement of parts apply equally to both operator's packs.

b. Switches S301 and S302.

(1) Remove the switch handle and the four mounting screws from the defective switch.

(2) Lift the switch out of the pack so that the terminal and contacts are accessible.

(3) If necessary, unsolder and tag the wires connected to the switch.

(4) Replace the switch with one known to be good, and reassemble.

(5) Adjustment procedures for the switch are explained in paragraph 44.

c. Hand Ringing Generator G–42/PT.

(1) Remove the screw and washer from the center of the crank wheel, and lift the crank wheel of the main shaft.

(2) Unscrew the plain round nut that fastens the hand ringing generator in the operator's pack, and lift the generator from the operator's pack.

(3) Unsolder the three wires connected to the terminals on the hand ringing generator.

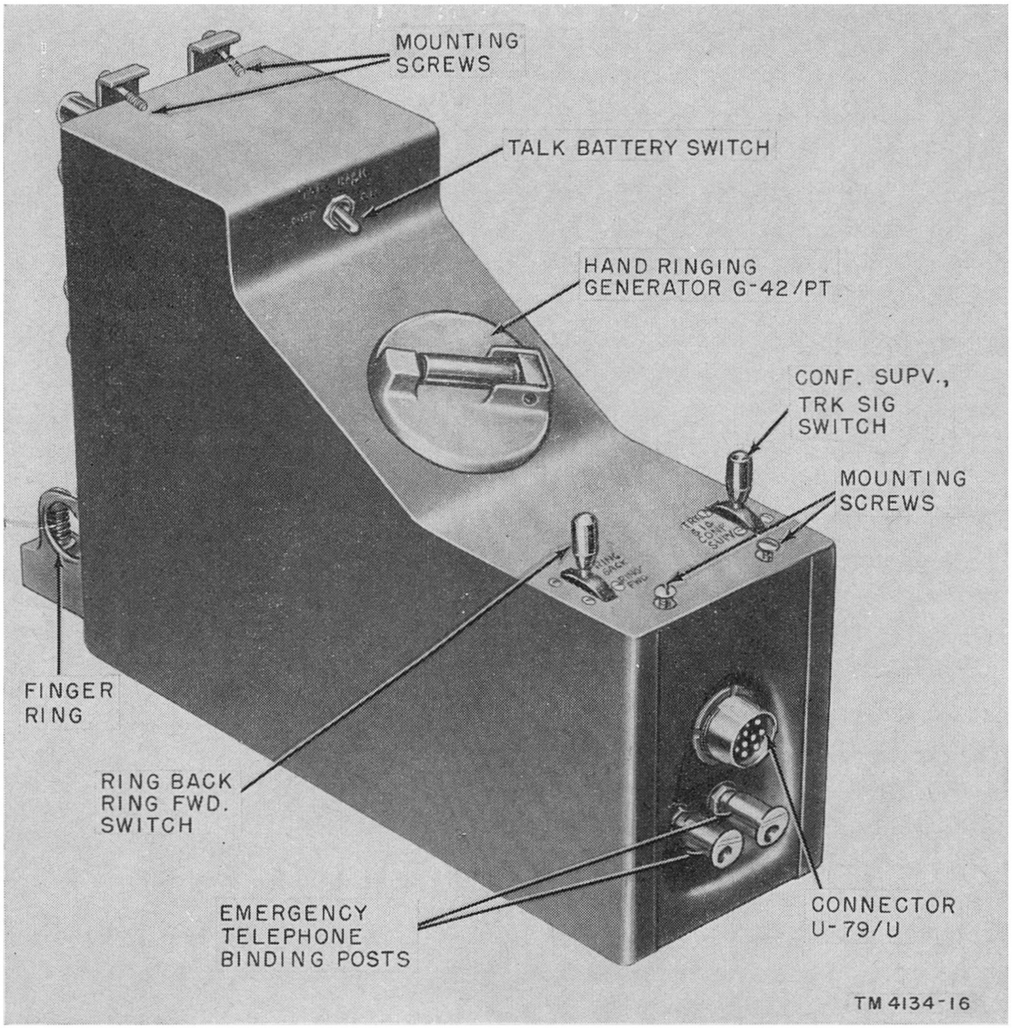


Figure 23. Operator's pack, removed from keyshelf section.

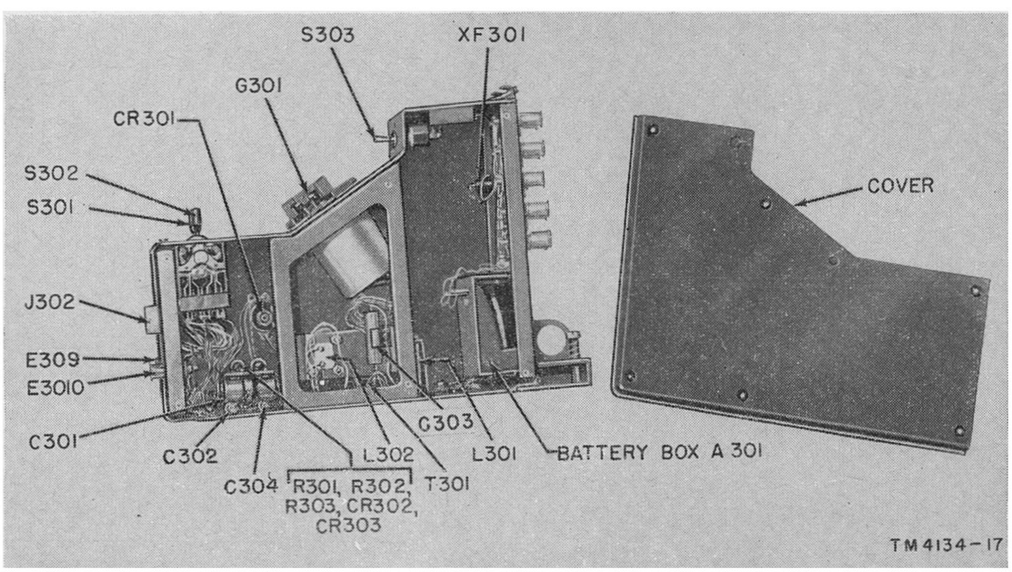


Figure 24. Operator's pack, cover removed (Orders No. 1669–Phila–51 and No. 6505–Phila–51 only).

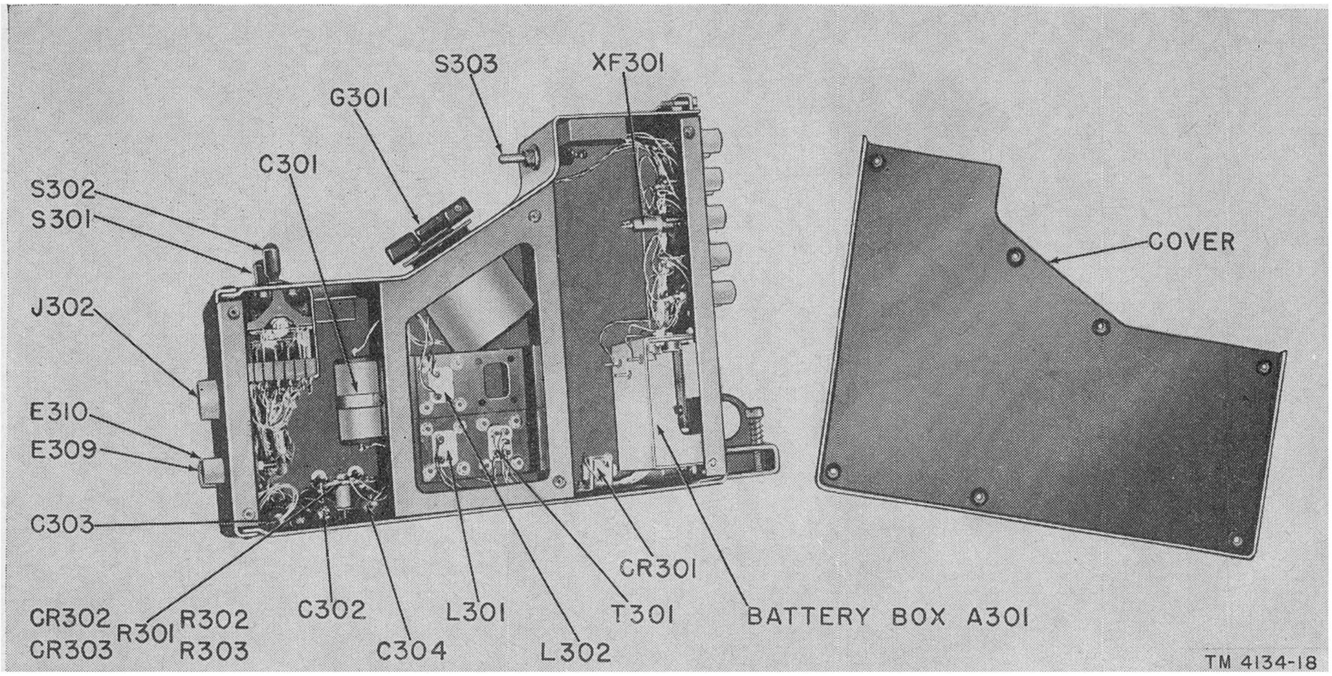


Figure 25. Operator's pack, cover removed (Order No. 96–Phila–52 only).

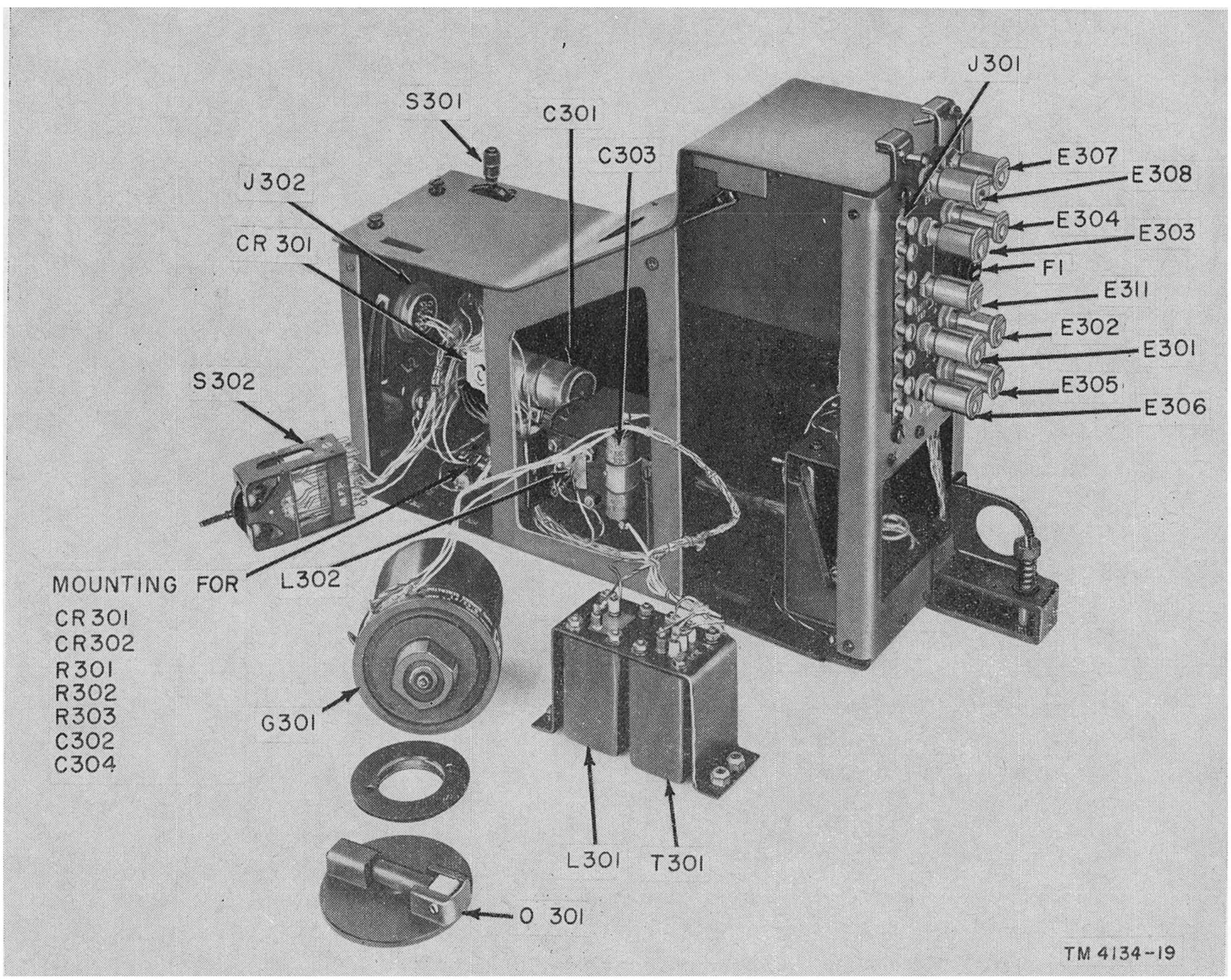


Figure 26. Operator's pack, disassembled for repair.

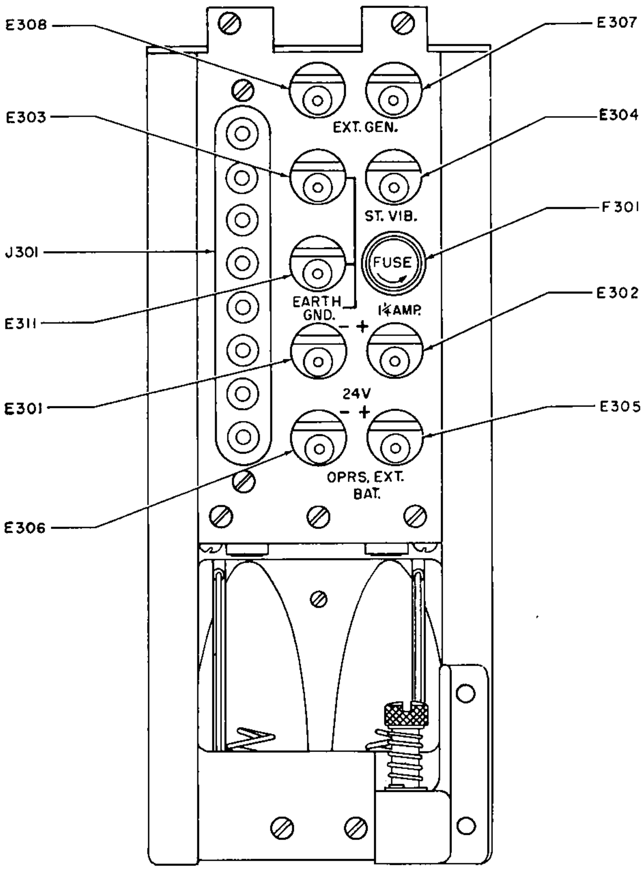


Figure 27. Operator's pack, rear panel.

(4) Replace the generator with one known to be serviceable, and reassemble the operator's pack.

d. Induction Coil T301 and Inductance Coil L301.

(1) Unscrew the four mounting screws from the bottom of the operator's pack that hold the coil mounting bracket in place.

(2) Lift the coil bracket and the coils out of the operator's pack so that the terminals and the coil mounting studs are accessible.

(3) Unsolder the wires connected to the defective coil.

(4) Remove the mounting nuts from the studs, remove the coil from the bracket, and replace it with a coil known to be in good condition.

e. Resistor, Capacitor, and Varistor Assembly.

(1) Unscrew the mounting screws and nut from the bottom of the pack.

(2) Lift the assembly from the operator's pack and separate the components.

(3) Carefully unsolder the defective component and replace it with a component known to be good.

(4) Reassemble the assembly and replace it in the operator's pack.

35. Operator's Telephone Set

(fig. 28)

a. Transmitter and Receiver Elements.

(1) Remove the cap from the defective telephone set.

(2) Remove the defective element from the operators telephone set handle.

(3) Place an element known to be good in the opening provided, and replace the cap. The transmitter element does not require positioning when it is placed in the operator's telephone set handle; however, the receiver element must be positioned so that it will fit all of the way into the opening.

b. Operator's Telephone Set Cord.

(1) Remove the three terminal cover retaining screws and the terminal cover from the operator's telephone set handle.

(2) Remove the four terminal screws that fasten the cord assembly to the operator's telephone set.

(3) Install a new cord, replace the terminal screws, and replace the terminal cover. Be sure that the wires with the proper colored insulation are connected to the proper terminals.

c. Operator's Telephone Set Plug.

(1) Unscrew the plug bushing and slide the strain relief spring and the plug bushing up the operator's telephone set cord.

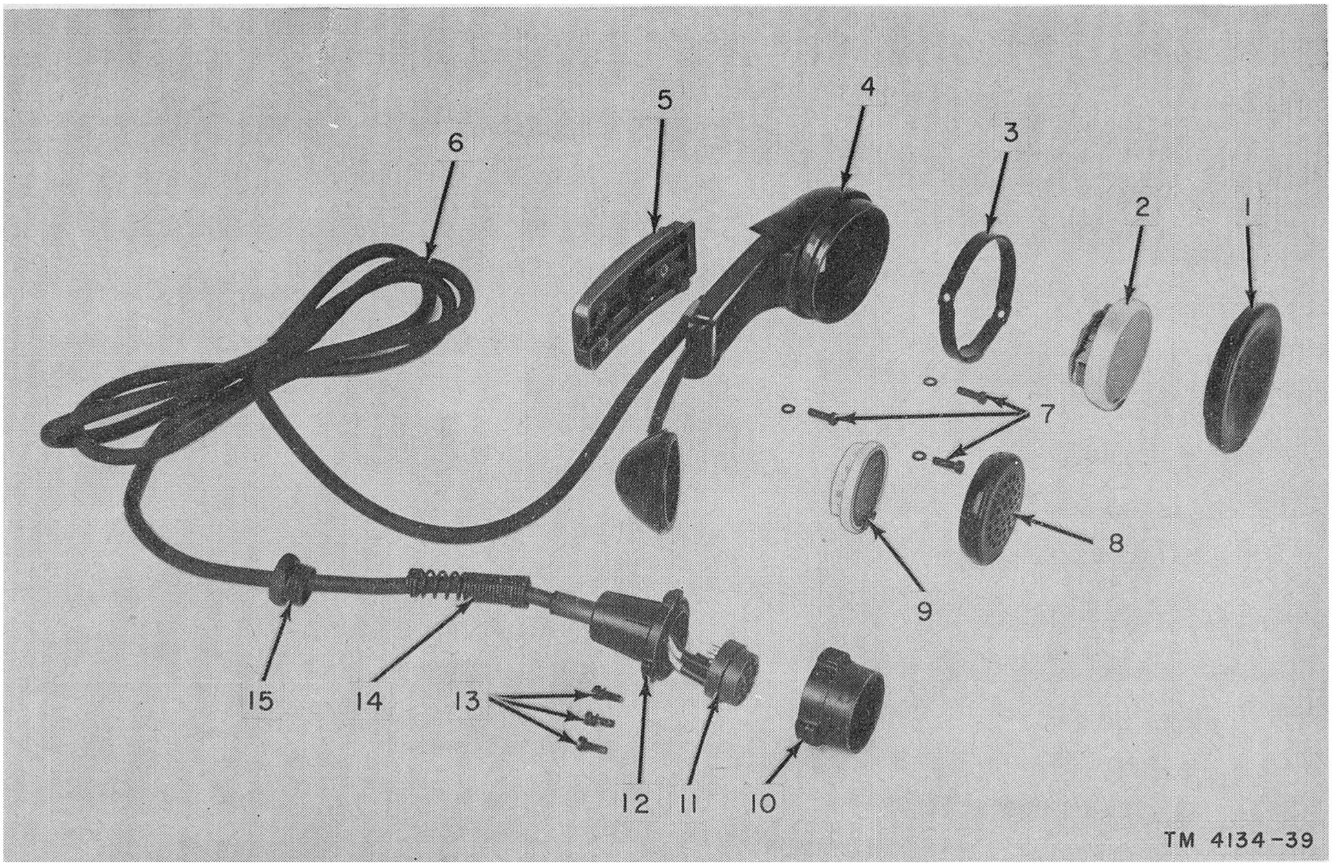
(2) Remove the three plug assembly screws, and remove the plug shell from the plug body.

(3) Lift the plug insert out of the plug body.

(4) Unsolder the four wires from the four terminals on the plug insert.

(5) Slide the plug body, strain relief spring, and plug bushing off the operator's telephone set cord.

(6) Select a serviceable plug connector and install it on the operator's telephone set cord. Be sure that the four wires in the operator's telephone set cord are connected to the proper terminals on the plug insert.



1 Receiver cap
2 Receiver element
3 Headband mounting ring
4 Shell
5 Terminal cover
6 Handset-headset cord
7 Terminal cover mounting screws
8 Transmitter cap
9 Transmitter element
10 Plug shell
11 Plug insert
12 Plug body
13 Plug assembly screws
14 Strain relief screws
15 Plug bushing

Figure 28. Operator's telephone set, exploded view.

36. Hand Ringing Generator
(figs. 29 and 30)

a. Remove the hand ringing generator from the operator's pack as explained in paragraph 33*c*.

b. Unscrew and remove the generator cover. Remove the cover gasket.

c. Unsolder and tag the five leads connected to the contact assembly (E1).

d. Unscrew the four contact assembly mounting screws and lift the contact assembly from the hand ringing generator.

e. Lift the switch button (H5) from the shank of the stud (H8).

f. Spread the weights on the switch subassembly (O 9) and unscrew the stud (H8). Lift both components from the hand ringing generator.

g. Unscrew and remove the two main assembly screws.

h. Lift the stator and the rotor off the front end plate. *Do not remove the rotor from the stator; the stator prevents demagnetization of the rotor.*

i. Remove the gear case (O 6) by screwing a main assembly screw into the front end plate and tap the head of the screw lightly until the

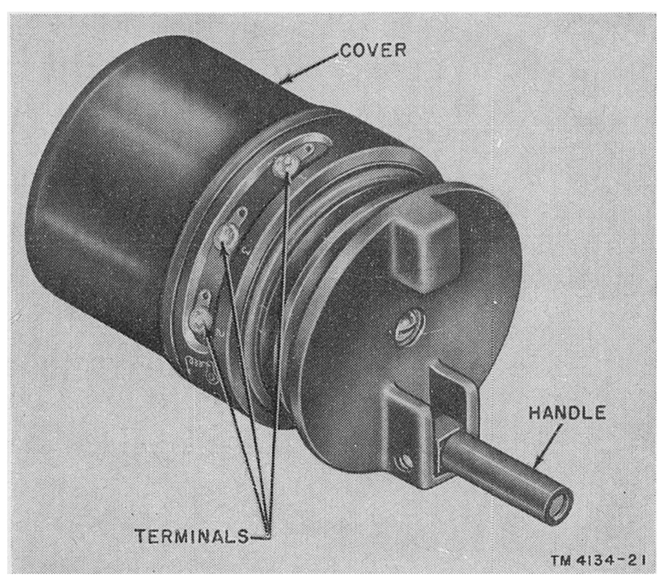
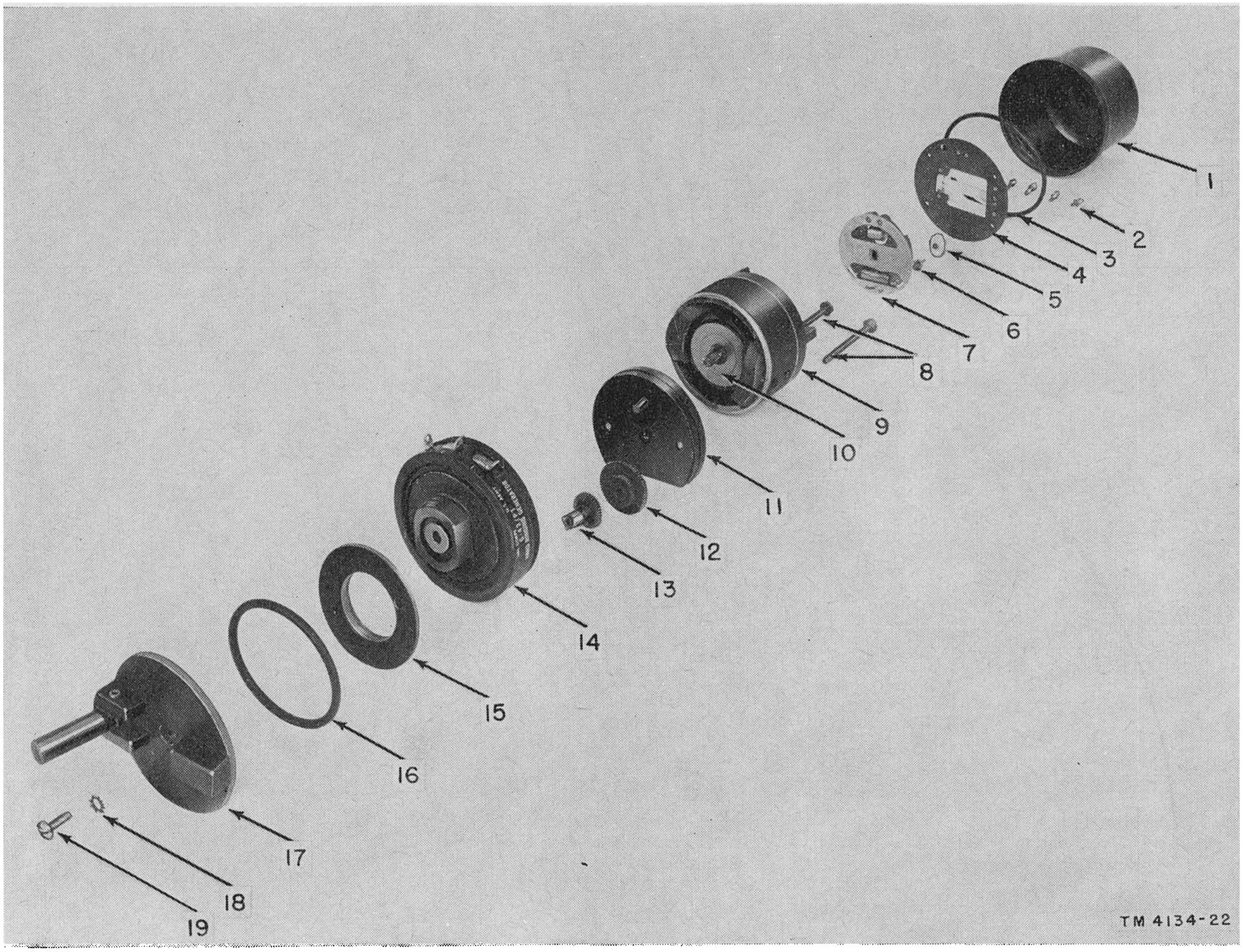


Figure 29. Hand Ringing Generator G-42/PT.



1 Cover	7 Switch subassembly (O 9)	14 End housing
2 Contact assembly mounting screws	8 Main assembly screws	15 Nut (H7)
3 Cover gasket (O 7)	9 Stator	16 Outer gasket (O 3)
4 Contact assembly (E1)	10 Rotor	17 Hand crank (O 1)
5 Switch button (H5)	11 Gear case (O 6)	18 Lockwasher
6 Stud (H8)	12 Gear assembly (O 4)	19 Hand crank mounting screws
	13 Spur gear (O 5)	

Figure 30. Hand Ringing Generator G–42/PT, exploded view.

gear case (O 6) comes loose from the front end plate.

j. Lift the gear assembly (O 4) from the stud on the inside of the gear case (O 6).

k. Remove the spur gear (O 5) from the front end plate by placing a small drift pin against the shaft on the outside of the front end plate and by pushing the spur gear and shaft out of the bearing.

l. Replace any of the parts of the hand ringing generator that are worn or damaged. Lubricate the gears with Grease, Aircraft and Instruments (GL), and reassemble the hand ringing generator.

Section III. POWER PACK

37. General

(fig. 31)

a. Unlatch the four trunk-type latches on the sides of the power pack and lift the chassis from the case.

b. Remove the batteries from the battery compartments.

c. Unscrew the two assembly screws from each end of the chassis and lift the top section from the chassis. This exposes all of the components for replacement.

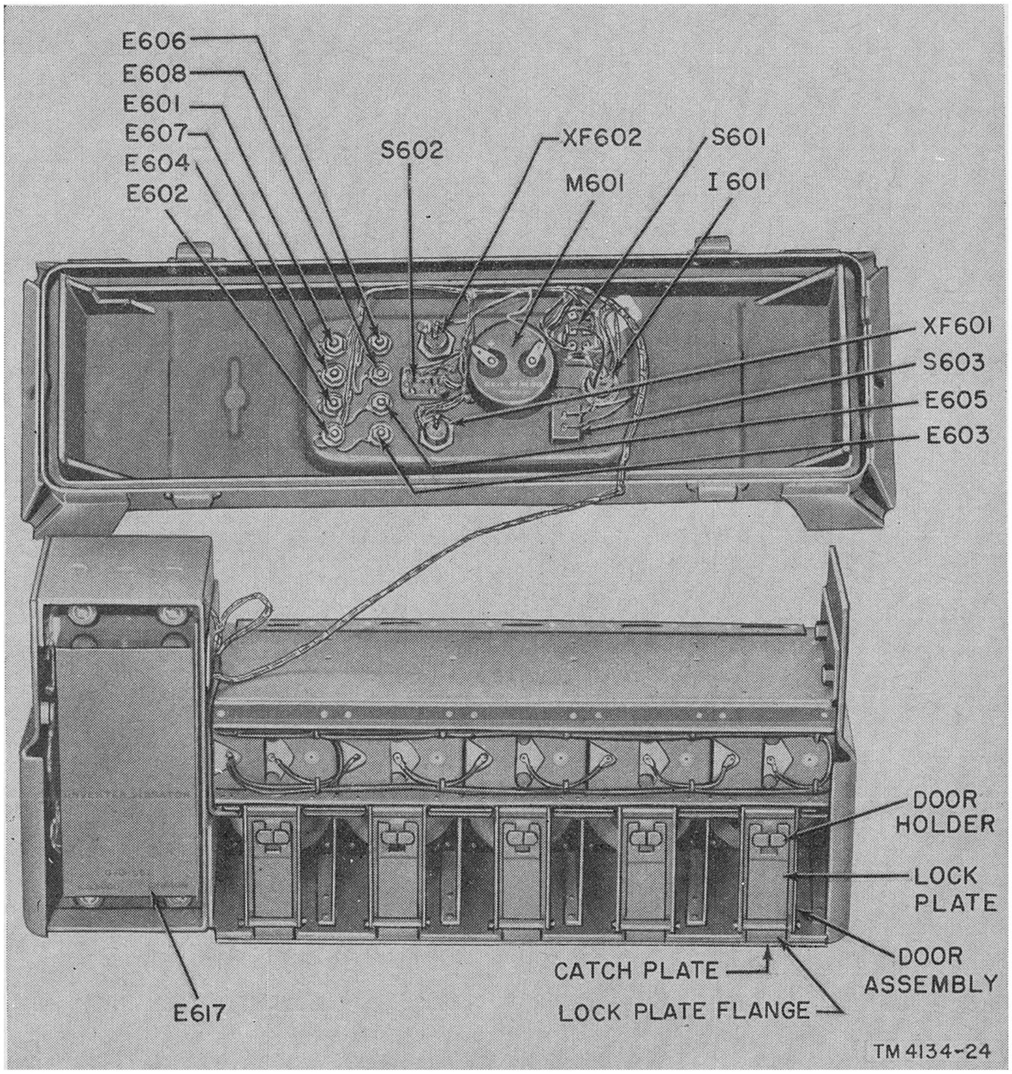


Figure 31. Power pack, top section removed.

38. Vibrator Inverter and Transformer

(fig. 32)

a. Unscrew the four screws that hold the vibrator inverter base plate on the chassis and lift out the vibrator inverter so that it is accessible for repair.

b. Remove the two screws from the cover of the vibrator inverter and lift off the cover of the unit.

c. Unsolder and tag all of the wires connected to the vibrator and remove the nuts from the four studs. Lift the vibrator from the base plate.

d. Replace the vibrator with one known to be serviceable.

39. Voltmeter, Switches, and Binding Posts

When the top section has been removed from the chassis, all of the terminals and mounting studs for the voltmeter, switches, and binding posts are accessible.

a. Disconnect and tag the leads connected to the damaged component.

b. Unscrew the mounting nut and lift the damaged component from the top section.

c. Replace the damaged component with one known to be serviceable and reassemble the power pack.

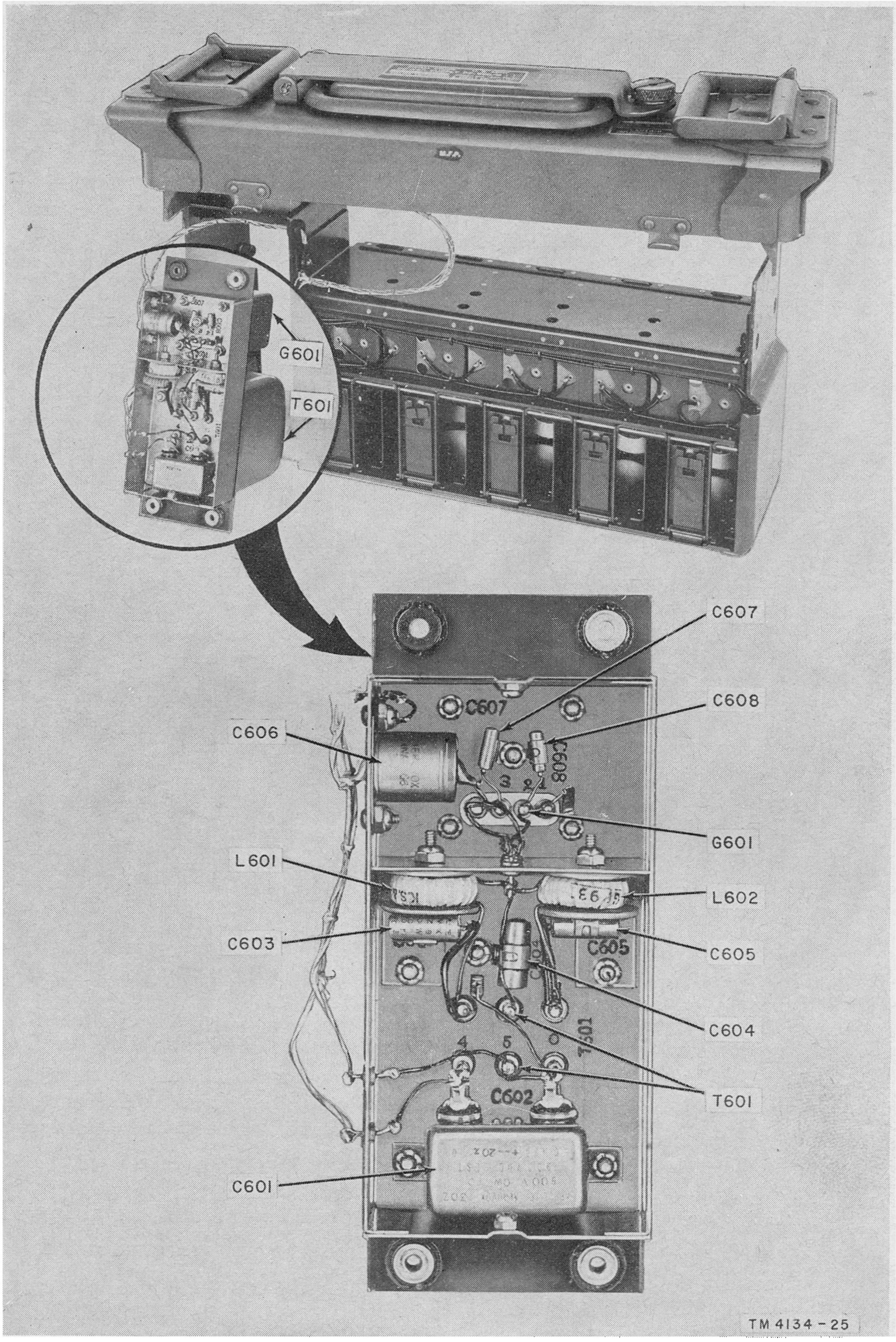


Figure 32. Power pack and vibrator inverter, disassembled for repair.

40. Line Selector Switch
(fig. 33)

The line selector switch must be removed from the jack field section before adjustments can be made. The minimum spring tension for the line selector switch is 30 grams. If the contacts do not meet this requirement when checked with a grams gage, they must be retensioned with a spring bender.

41. Line Jack Spring Adjustments
(fig. 34)

The line jack assembly must be removed from the jack field section and then must be removed from the line selector switch before the contacts can be adjusted. The minimum requirements that must be met during the test are listed below.

a. Tension springs G-H to press against the center post at all times.

b. The contact pressure between the contact springs A-B should be a minimum of 80 grams when the plug is not in the jack.

c. When a plug is being inserted into the jack, the contact springs G-D and A-B should open before the contact springs B-C make. The contact springs F-H should open before contacts F-I make.

42. Cord Circuit Switch Adjustment

The cord circuit switch (S202) must be removed from the cord pack before any adjustments are made. The minimum requirements that the contacts must meet are outlined below.

a. On contact stacks B, C, E, F, G, and H of switch S202 (designations on the wiring diagram, fig. 46), adjust the center spring to withstand 30 grams before the normally made contacts break. When the break occurs, there must be an .008-inch minimum air gap between the normally open contacts.

b. On contact stacks B, C, E, F, G, and H, adjust the springs so that when the switch is operated, the break contacts have an air gap of .008-inch minimum before the normally open contacts make. In the operated position, the contact pressure should be 30 grams minimum.

c. Contact stacks A and D are off-normal contacts operating when the normally open contacts stacks E, B, C, and H are closed. The contact pres-

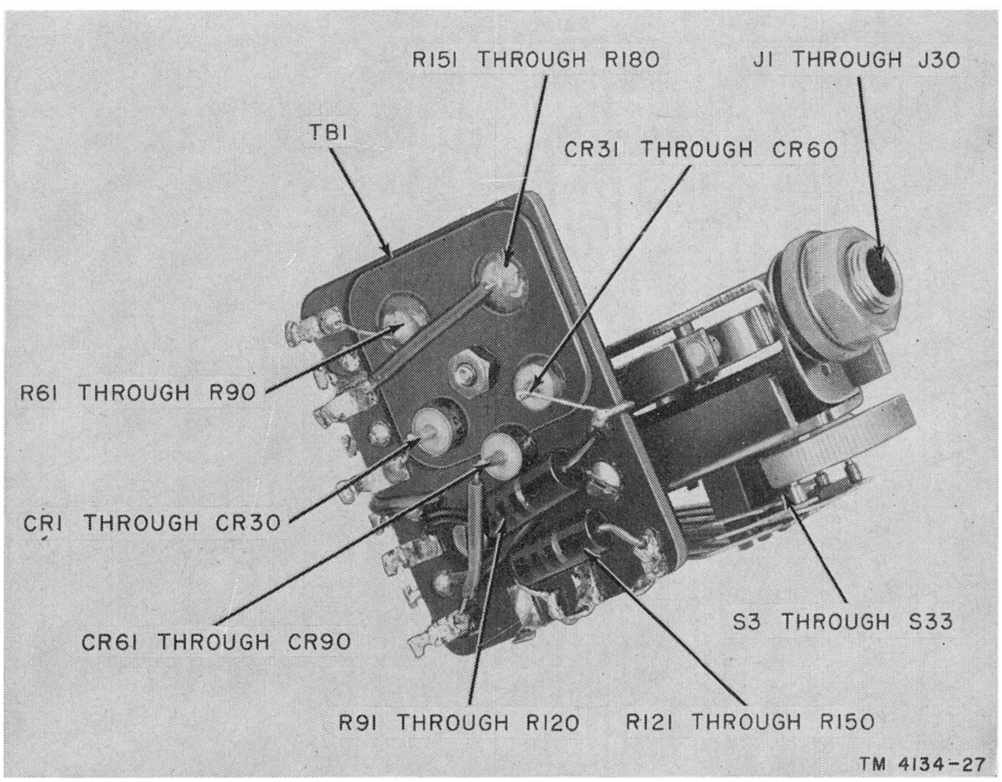


Figure 33. Line jack and line selector switch, removed from the jack field section.

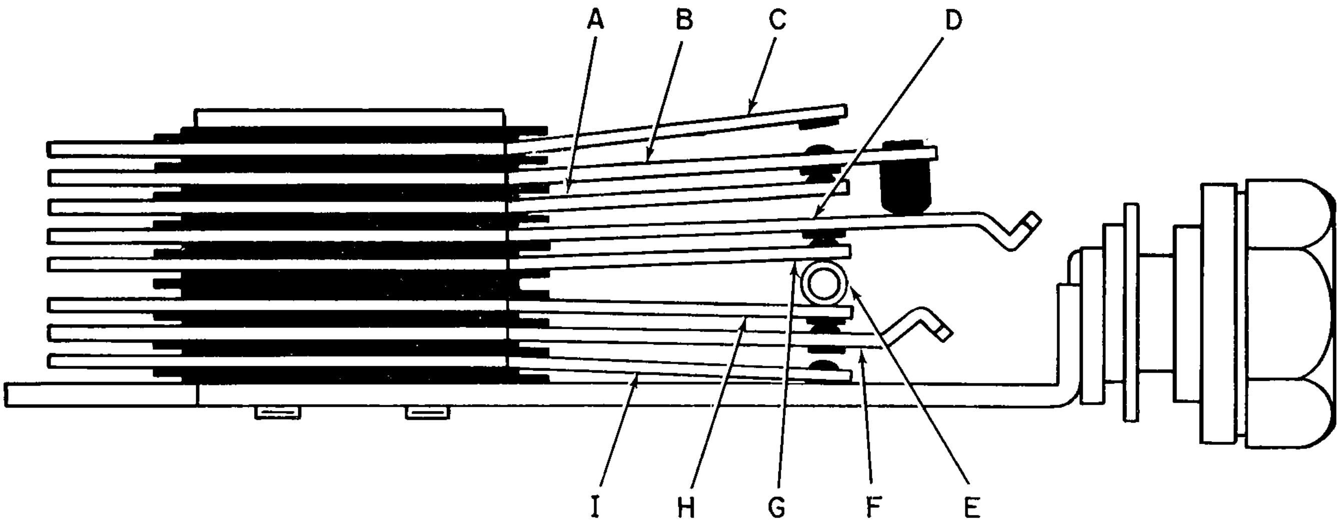


Figure 34. Line jack, showing contact arrangement.

sure requirements are the same as for comparable arrangements of contact stacks B, C, E, F, G, and H (*a* above). Be sure that the lever springs do not jam on the roller when the switch is operated after the contacts have been readjusted.

43. Plug Seat Switch
(fig. 35)

The plug seat switch must be removed from the plug guide before any adjustments can be made. The minimum requirements for the plug seat switch are listed below.

a. The roller and the contact clearance should meet the requirement illustrated on figure 36.

b. To open the contacts between contacts assemblies A1, A2, and B, the pressure should be 45 to 65 grams when the pressure is applied at right angles to switch plate E. Tension A1 and A2 to meet this requirement.

c. There should be perceptible contact follow after the contact assemblies C1, C2, and D make contact.

44. Ringing and Trunk Signaling Switch

The switches must be removed from the operator's pack before making the adjustments. Check the contact pressures and the air gap requirements by applying pressures and making measurements at points adjacent to the contacts. The minimum requirements for the switches are listed below.

a. On contact stacks A through H, adjust the center spring to withstand 30 grams before the nor-

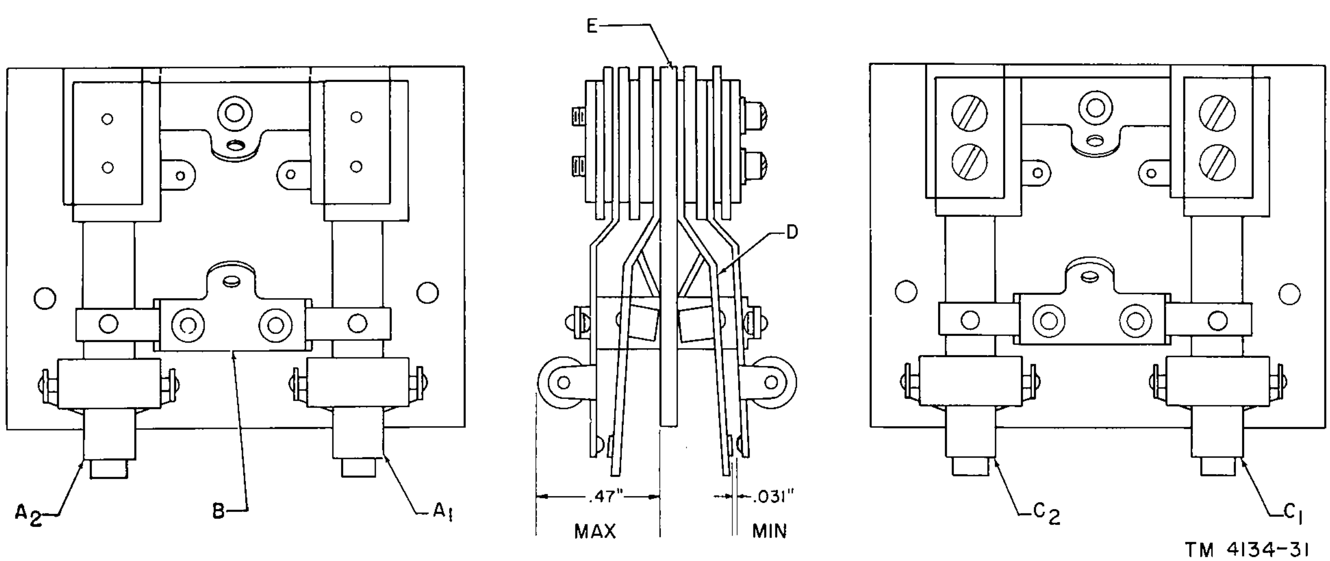


Figure 35. Plug seat switch, adjustment requirements.

TAGO 10145-A, Sept.

mally made contacts break. When the break occurs, there must be an .008-inch air gap between the normally open contacts and the center spring.

b. When the switch is operated, the break contacts must have an air gap of .008-inch minimum before the normally open contacts make.

45. Magnetic Line Signal Adjustment
(fig. 36)

The magnetic line signals may be readjusted while they are mounted in the jack field section. To test and readjust the line signals, follow the procedure outlined below.

a. Remove the glyptol seal from the adjusting screw on the back of the line signal with acetone.

b. Connect Test Set I–181 to terminals 5–7 and set the operate value on the test set for 5 milliamperes; adjust the second circuit in the test set for 4 milliamperes which is the nonoperate value. Use the nongrounded battery method explained in TM 11–2036, Test Sets I–181, I–181–A, and I–181–B.

c. If the line signal does not operate when the operate current is applied to the winding, loosen the locknut and turn the center screw clockwise until the signal operates.

d. If the signal operates on the nonoperate current, loosen the locknut and turn the adjusting screw counterclockwise until the signal does not operate on the nonoperate current. Repeat the operate test (*c* above).

e. Repeat the test with the test set connected to the 2–4 winding on the line signal.

f. After the signal has been adjusted, be sure the locknut is tight, and reseal the adjusting screw and the locknut with glyptol.

Caution: Do not turn the adjusting screw more than one-fourth turn in either direction when adjusting the line signal.

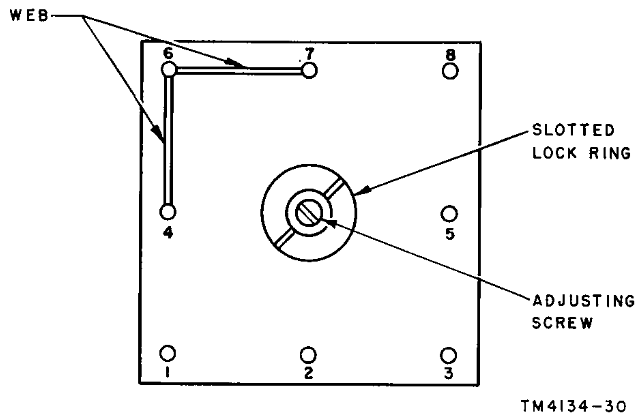


Figure 36. Magnetic line signal, showing adjusting screw.

CHAPTER 6

FINAL TESTING

46. General

This chapter is to be used as a guide in determining the quality of a repaired component. The minimum test requirements outlined in paragraphs 48 through 57 may be performed by maintenance personnel with adequate test equipment and necessary skills.

47. Test Equipment Required for Final Testing

The table below lists the test equipment required to perform the final tests for Manual Telephone Switchboard SB-86/P and gives a brief description of the equipment.

Test equipment	Description
Multimeter TS-352/U	Used as voltmeter and ammeter for tests on power pack.
Test Set I-142-(*)	Composite measuring instrument for measuring electrical characteristics of switchboard.
Test Set TS-140/PCM	Consists of Signal Generator SG-15/PCM and Decibel Meter ME-22/PCM, transmission measuring set.

48. Final Testing Manual Telephone Switchboard SB-86/P

The SB-86/P must be tested completely before it can be returned to the using organization. Paragraph 28 gives the detailed operational test for the SB-86/P. The final testing of the power pack is explained in paragraph 49; the cord pack insertion loss test is explained in paragraph 50; the efficiency tests for the transmitter are explained in paragraph 51; and the receiver is covered in paragraph 52.

49. Power Pack Tests

a. Test all of the toggle switches for ease of operation and positive action.

b. Test the voltmeter by checking the voltage of a battery known to be at full strength.

c. Check all of the binding posts by depressing and releasing them. The movement should be smooth and easy; however, the spring should be strong enough to retain the wire.

d. Test the vibrator by following the step-by-step procedure outlined below.

(1) Install new Batteries BA-200/U in the lower battery bank.

(2) Connect a 400-ohm resistor across the RING SUP. binding posts.

(3) Connect the ST. VIB. binding post to the +24-V binding post which will cause the vibrator to operate.

(4) Check the voltage output of the vibrator with Multimeter TS-352/U. The voltage output should be approximately 117 volts with a 30-volt dc input.

e. Check the exterior of the case for broken or missing parts.

f. Check the cover to be sure that the gasket is not damaged and that the knurled nut is not stripped or damaged.

50. Cord Pack Insertion Loss Test

(fig. 37)

a. Make this test with the cord pack installed in the keyshelf section.

b. Connect the output terminals of Signal Generator SG-15/PCM to the line terminals of a line circuit in the jack section which has been tested and is known to be serviceable.

c. Plug the answer cord of the cord circuit to be tested into the jack of the line circuit which is connected to the output of Signal Generator SG-15/PCM.

d. Connect the input terminals of Decibel Meter ME-22/PCM to the line terminals of a line circuit

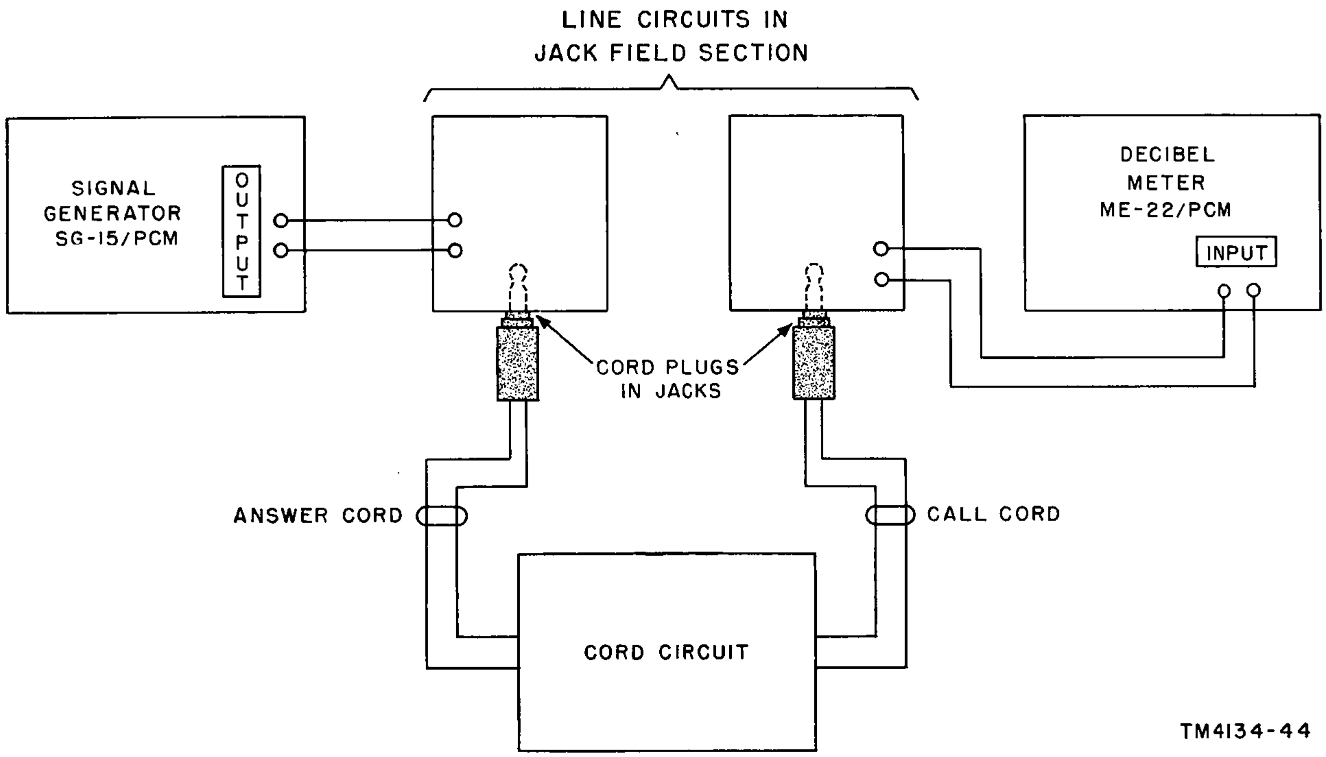


Figure 37. Cord pack insertion loss test, connection diagram.

in the jack field section which has been tested and is known to be serviceable.

e. Plug the call cord of the cord circuit to be tested into the jack of the line circuit which is connected to the input of Decibel Meter ME–22/PCM.

f. All batteries must be removed from the jack field section and the power pack must be disconnected from the operator's pack.

g. The cord circuit switch must be in the normal (unoperated) position and the switches on the operator's pack must *not* be operated.

h. Adjust the output control of Signal Generator SG–15/PCM to 0 decibel referred to 1 milliwatt in 600 ohms (dbm) at 1,000 cycles.

i. Decibel Meter ME–22/PCM will indicate the loss of the cord circuit under test which should not be more than 1.5 decibels (db).

51. Transmitting Test, Operator's Pack

(fig. 38)

a. Connect the output terminals of Signal Generator SG–15/PCM to the line terminals of a line circuit in the jack field section which has been tested and known to be serviceable. Insert the answer cord of a cord circuit into the jack.

b. Remove all dc sources from the equipment being tested, including the transmitter battery within the operator's pack.

c. Strap the two OPRS. EXT. BAT. binding posts with a piece of wire, and operate the TALK BAT. switch to the ON position.

d. Prepare a test cord by connecting a length of the cord, used for the operator's telephone set, to a spare Plug PU–77/U and then connect the plug to the receptacle on the front of the operator's pack. Strip the free ends of the conductors.

e. Operate the TALK LIST.-CONF. switch of the cord circuit being used to the TALK LIST. position.

f. Connect a resistor of approximately 300 ohms across the *receiver leads* of the test cord.

g. Connect the *transmitter leads* of the test cord to the input terminals of Decibel Meter ME–22/PCM.

h. Adjust the output control of Signal Generator SG–15/PCM to obtain a level of 0 dbm at 1,000 cycles per second (cps).

i. Decibel Meter ME–22/PCM now should indicate a loss of not more than 12.5 db.

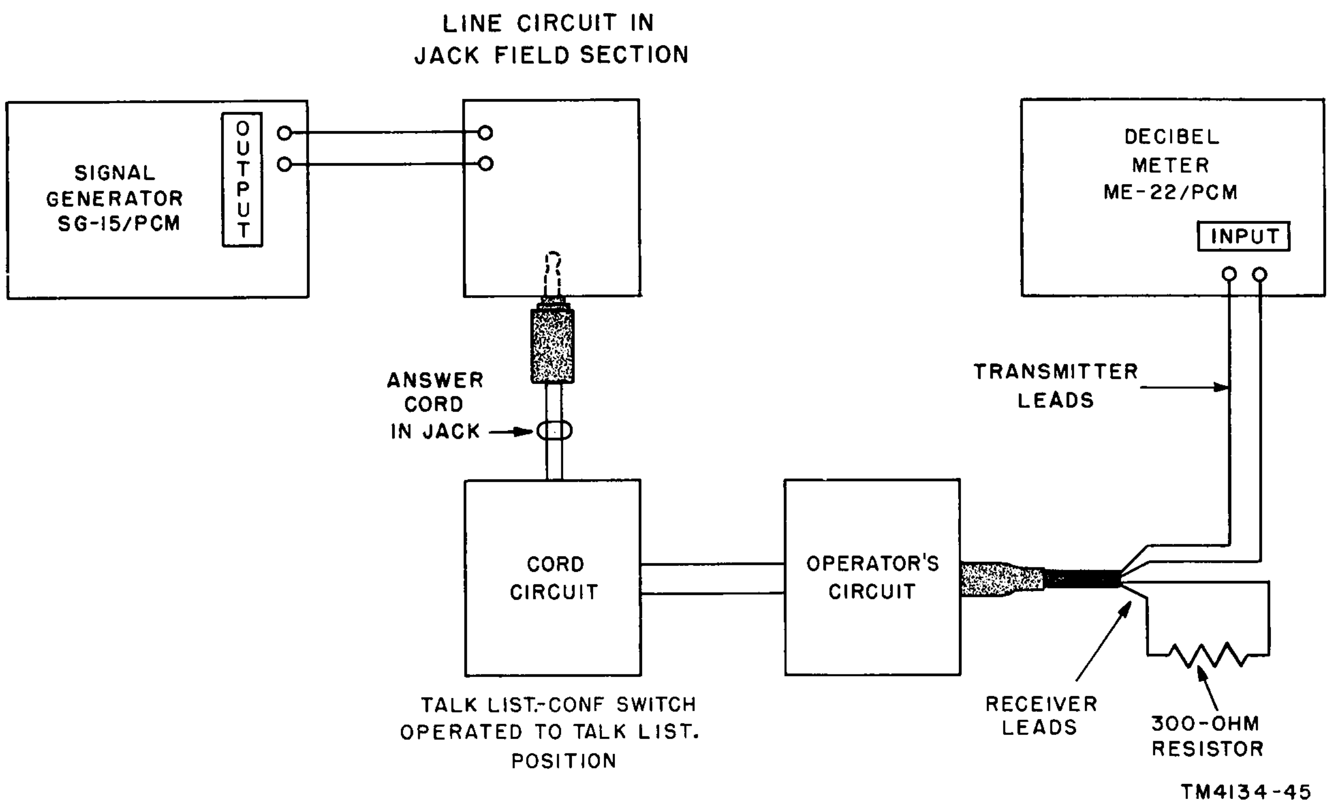


Figure 38. Operator's pack transmitting test, connection diagram.

52. Receiving Test, Operator's Pack
(fig. 39)

a. Repeat the steps outlined in paragraph 51*a* through *e.*

b. Connect a resistor of approximately 50 ohms across the *transmitter leads* of the test cord.

c. Connect the receiver leads of the test cord to the input terminals of Decibel Meter ME–22/PCM.

d. Adjust the output control of Signal Generator SG–15/PCM to obtain a level of 0 dbm at 1,000 cps.

e. Decibel Meter ME–22/PCM now should indicate a loss of not more than 11.0 db.

53. Efficiency Test of Operator's Telephone Set Transmitter

a. Make this test with Test Set I–142–(*) and in accordance with TM 11–2062, Test Set I–142 and Test Set I–142A (par. 26).

b. Make a test cord by connecting spare Receptacle U–79/U to a length of cord identical to that used on the operator's telephone set. Connect the transmitter leads of the test cord to the TRANSMITTER and COMMON test set clip terminals of Test Set I–142–(*). Connect the other end of the test cord transmitter leads to contacts C and D of the operator's telephone set cord plug.

c. Operate switch 1 to LBPE.

d. Operate switch 2 to RCT.

e. Set control D1 to position 2.

f. Set control D3 to position 4.

g. Prepare the microphone for testing by rotating it back and forth about its central axis and hold it in front of the sound source screen.

h. Operate switch 8 to TRANS.

i. Depress switch 9 and observe deflection on meter M1. It should be to the right of +2 db. If not, the microphone is defective.

54. Efficiency Test of Operator's Telephone Set Receiver

a. Make this test with Test Set I–142–(*) and in accordance with TM 11–2062.

b. Connect the receiver leads of the test cord (par. 53*b*) to the RECEIVER and COMMON test set clip terminals.

c. Operate switch 2 to RCT.

d. Set control D2 to position 2.

e. Set control D4 to position 6.

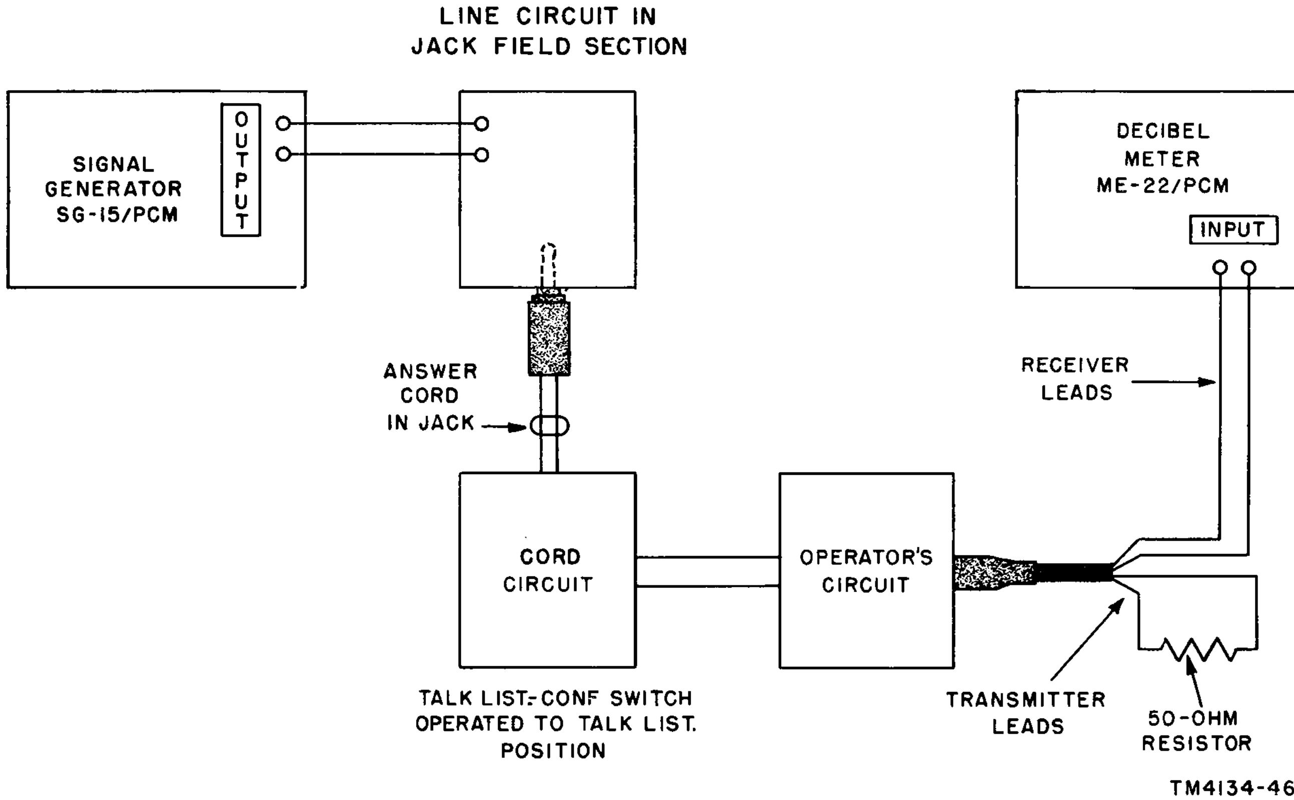


Figure 39. Operator's pack, receiving test, connection diagram.

f. Hold the receiver in front of the sound source. Position the cap in the center of the screen and flush against it.

g. Operate switch 8 to REC.

h. Depress switch 9 and observe the db scale reading on meter M1. Reading should be to the right of 0 db. If not, the receiver unit is defective.

55. Testing Hand Ringing Generator G–42/PT

Generator G–42/PT is tested by connecting its output to jack L1–L2 of Test Set I–142–(*) with the cord supplied with the test set. Details of the operation of the test set for this test are given in TM 11–2062. The most convenient connection to the generator output depends on the available assemblies.

a. If a complete switchboard is being tested, connect jack L1–L2 of Test Set I–142–(*) to the terminals of a line in the jack field section. Plug the calling cord of a cord circuit into the jack of this line and operate the cord circuit switch to TALK LIST. While holding the ringing switch of the operator's pack to RING FWD., operate the crank of the generator at approximately 200 revolutions per minute (rpm), and observe the reading of meter M1 of the test set.

b. If only the operator's pack and a cord pack are available, connect one to the other with a multiple cable. The output of generator G–42/PT may be measured at the tip and ring of the plug of a calling cord, as follows:

(1) Solder leads to the tip and ring of Jack JK–22 and connect the other end of these leads to the test cord of Test Set I–142–(*).

(2) Proceed as described in *a* above.

c. When only the operator's pack is available, connect the leads from L1–L2 of Test Set I–142–(*) directly to the CT and CR terminals at the back of the operator's pack. Complete the test as explained in *a* above.

d. For a generator not installed in the operator's pack, the leads from L1–L2 of Test Set I–142–(*) are connected to terminals 1 and 3 of the generator.

e. When testing with any method of interconnection (*a* through *d* above), operate Test Set I–142–(*) according to the instructions in TM 11–2062. Operation of the crank of the generator at approximately 200 rpm should produce a deflection on test set meter M1 of 0 db or higher. A lower reading indicates a defect in the generator or the switchboard circuits being used.

56. Testing Magnetic Signal Devices

(fig. 40)

This paragraph describes the method used to test the line and supervisory signaling devices by using a specially constructed test circuit. Subparagraph *a* below tells how to construct the *test circuit*; *b* below tells how to test the *line* signaling devices; and *c* below tells how to test the *supervisory* signaling devices.

a. Construction Test Circuit.

(1) Connect a 10,000-ohm resistor in parallel with a 1,000-ohm resistor which is series with a single-pole, single-throw switch, as shown in figure 40.

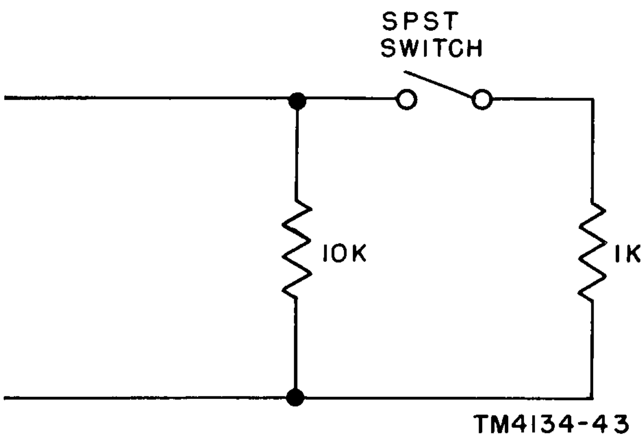


Figure 40. Magnetic signaling device test circuit.

(2) Connect a pair of test leads across the terminals of the 10,000-ohm resistor so that the test circuit can be connected to a line circuit.

b. Testing Line Signaling Devices.

(1) Install the batteries in the power pack and connect the power pack to the SB-86/P.

(2) Operate the switch on the test circuit to the off position.

(3) Connect the test leads from the test circuit to the binding posts of the first line circuit to be tested. The line signaling device should remain *black*.

(4) Operate the switch on the test circuit to the on position. The line signaling device should operate to *white*.

c. Testing Supervisory Signaling Devices.

(1) Connect the test leads to a line circuit on the SB-86/P.

(2) Operate the switch on the test circuit to the off position.

(3) Insert a cord into the jack of the test line circuit. The supervisory signaling device should remain *black*.

(4) Operate the switch on the test circuit to the on position. The supervisory signaling device should operate to *white*.

57. Testing Rectifiers

The rectifiers used in the SB-86/P are IN92 type and are all tested by the same procedure. The voltages and current values shown below are approximate.

a. The forward current when ½-volt dc is applied to the rectifier is 310 milliamperes. Connect a resistor, battery, and an ammeter in series with the rectifier to make this test.

b. The reverse current is 1.9 milliamperes when 200 volts are applied to the rectifier. Use the same procedure to check the rectifier in this direction as used in *a* above.

58. Coil Data

The table below lists the coils used in the SB-86/P, the dc resistance of each winding, and the location of each coil.

Coil	Location	Terminals	Dc resistance (ohms)
L1, L32	Jack field section	1–2	50
I 1 through	Magnetic signals	5–7	2K
I 30		2–4	1K
I 201 through	Cord pack	5–7	2K
I 204		2–4	1K
T201, T202	Cord pack	1–2	11.5
		3–4	13.5
L301, L302	Operator's pack	1–2	50
T301	Operator's pack	1–2	12
		3–4	33
		4–5	260
T601	Power pack	1–2	8.2
		2–3	8.2
		4–5	107

CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

59. Disassembly

The following instructions are supplied as a guide for preparing Manual Telephone Switchboard SB–86/P for transportation and storage.

a. Disconnect all test lines from the binding posts of the jack field section.

b. Disconnect all wires between the switchboard, power pack, and ground. Coil the two cables and place them behind the door of the jack field section.

c. See that all plugs are removed from jacks and are in place.

d. Store the operator's headset in the canvas bag on the back of the door of the keyshelf section and close the two doors in the rear of the switchboard. Make sure that the cam locks are locked correctly.

e. Remove the switchboard from its mounted position on top of the cover and place it on the ground.

f. Lift the power pack and place it inside the cover assembly so that the two lock rods fit into the threaded holes inside the cover. Insert the two lock rods (one on each end of the power pack) through the unit and screw them into the threaded holes.

g. Place the outer cover over the switchboard. (The word FRONT on the cover should be placed on the same side as the front of the keyshelf section.) Be sure that the cover is centered properly on the rubber gasket of the keyshelf case. Close the trunk-type latches that hold the cover to the lower portion of the switchboard. Fold the collapsible legs on top of the cover and secure them in place.

60. Repacking for Shipment or Limited Storage

a. The SB–86/P requires no further repacking for limited storage except for placing a package of desiccant on the keyshelf before closing the cover.

b. When repacking for shipment, inclose the SB–86/P in a wooden crate. Build the crate of heavy planks and line it with waterproof material. Place desiccant within the crate lining. Brace and cushion the equipment in the crate to prevent shifting during transit. Bind the crate with metal straps.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

61. General

Use the demolition procedures outlined in paragraph 62 to prevent the enemy from using or salvaging this equipment. Demolish the equipment only upon order of the commander.

Note. Before attempting to demolish the equipment, remove the cord and operator's packs from the keyshelf case, remove the chassis from the jack field section case, and remove the chassis from the power pack case.

62. Methods of Destruction

a. Smash. Smash the controls, lamps, coils, switches, binding posts, capacitors, resistors, and handsets; use sledges, axes, handaxes, pickaxes, crowbars, or heavy tools.

b. Cut. Cut cords, wiring, and cabling; use axes, handaxes, and machetes.

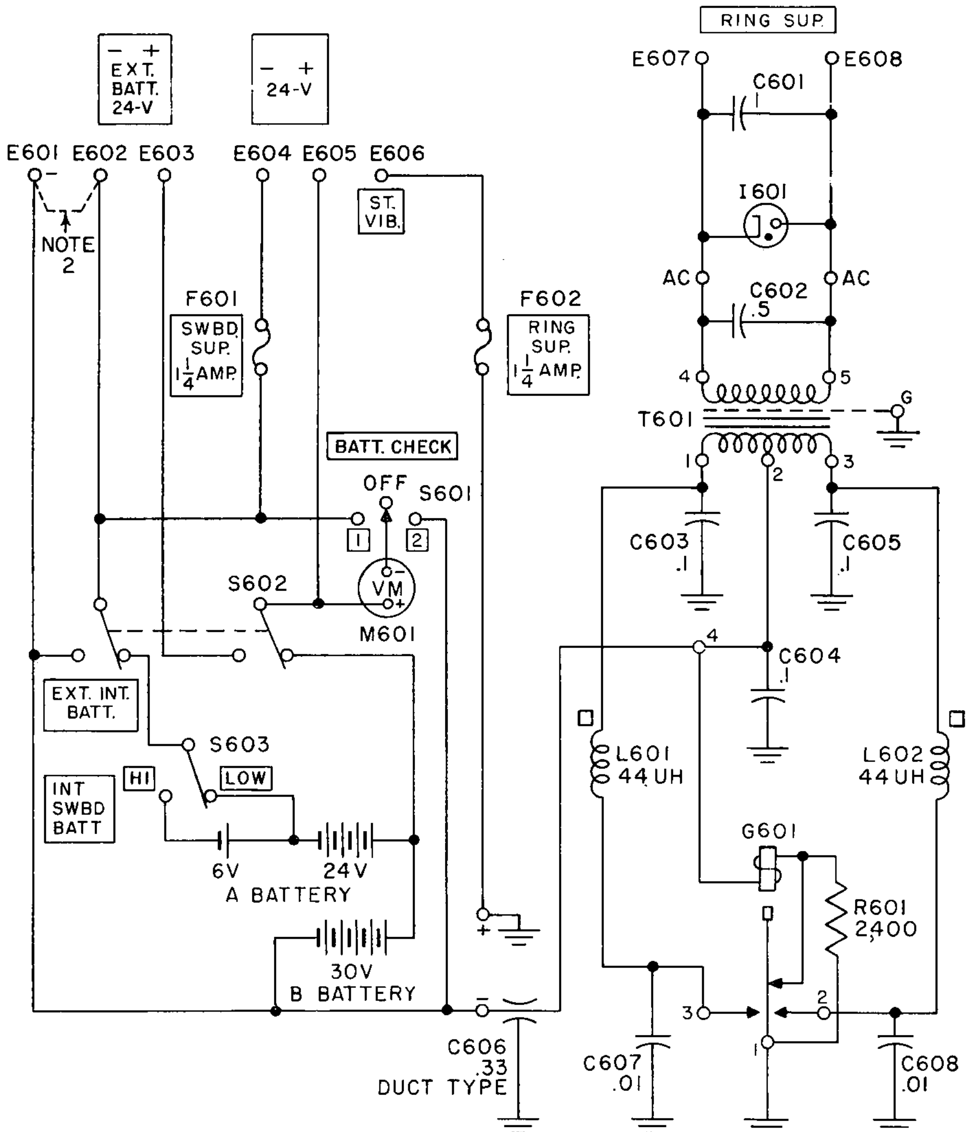
c. Burn. Burn cords, resistors, capacitors, coils, wiring, and technical manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend panel, chassis and all framework; use crowbars and other heavy tools.

e. Explosives. If explosives are necessary, use firearms, grenades, or TNT.

f. Disposal. Bury or scatter the destroyed parts in slit trenches, fox holes, or throw them into streams.

g. Destroy. Destroy everything.



NOTES:

1. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF.
2. PLACE JUMPER ACROSS BINDING POSTS TO MULTIPLE INTERNAL BATTERIES.
3. GROUNDS SHOWN ARE VIBRATOR INVERTER CHASSIS GROUNDS.
4. VIBRATOR INVERTER CHASSIS IS INSULATED FROM POWER SUPPLY CHASSIS.
5. A BATTERY (UPPER BATTERY GROUP) NORMALLY SUPPLIES THE SWITCHBOARD.
6. B BATTERY (LOWER BATTERY GROUP) NORMALLY SUPPLIES THE RINGING CONVERTER.
7.

VOLTAGE CHECK PROCEDURE			SWITCH POS	
REMOVE SHUNT WIRE	INT. BATT.	UPPER	INT.	1
		LOWER	INT.	2
	EXT. BATT.		EXT.	1 OR 2

TM4134-32

Figure 41. Power pack, schematic diagram.

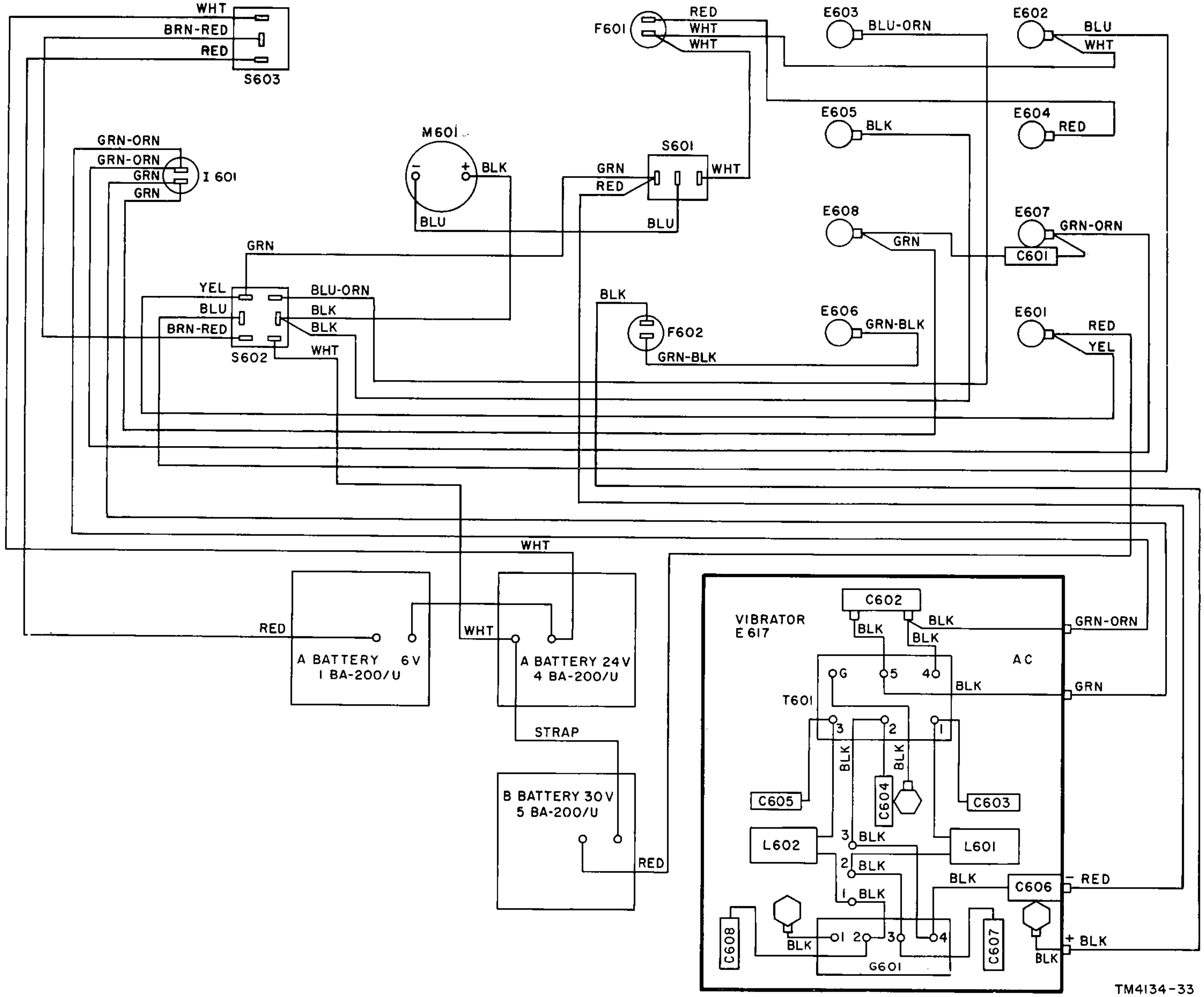
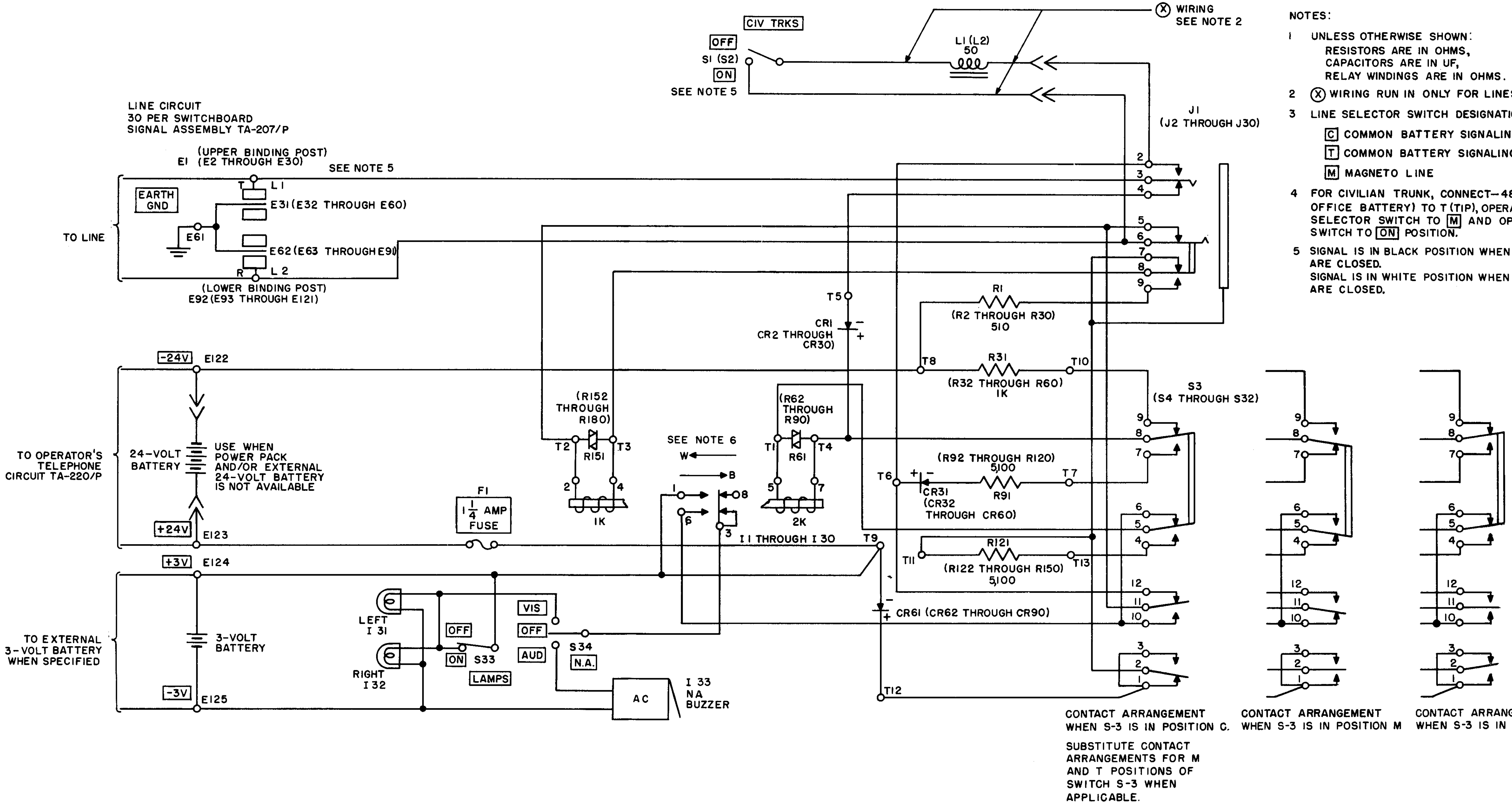


Figure 42. Power pack, wiring diagram.



NOTES:

1 UNLESS OTHERWISE SHOWN:
RESISTORS ARE IN OHMS,
CAPACITORS ARE IN UF,
RELAY WINDINGS ARE IN OHMS.

2 (X) WIRING RUN IN ONLY FOR LINES 29 AND 30.

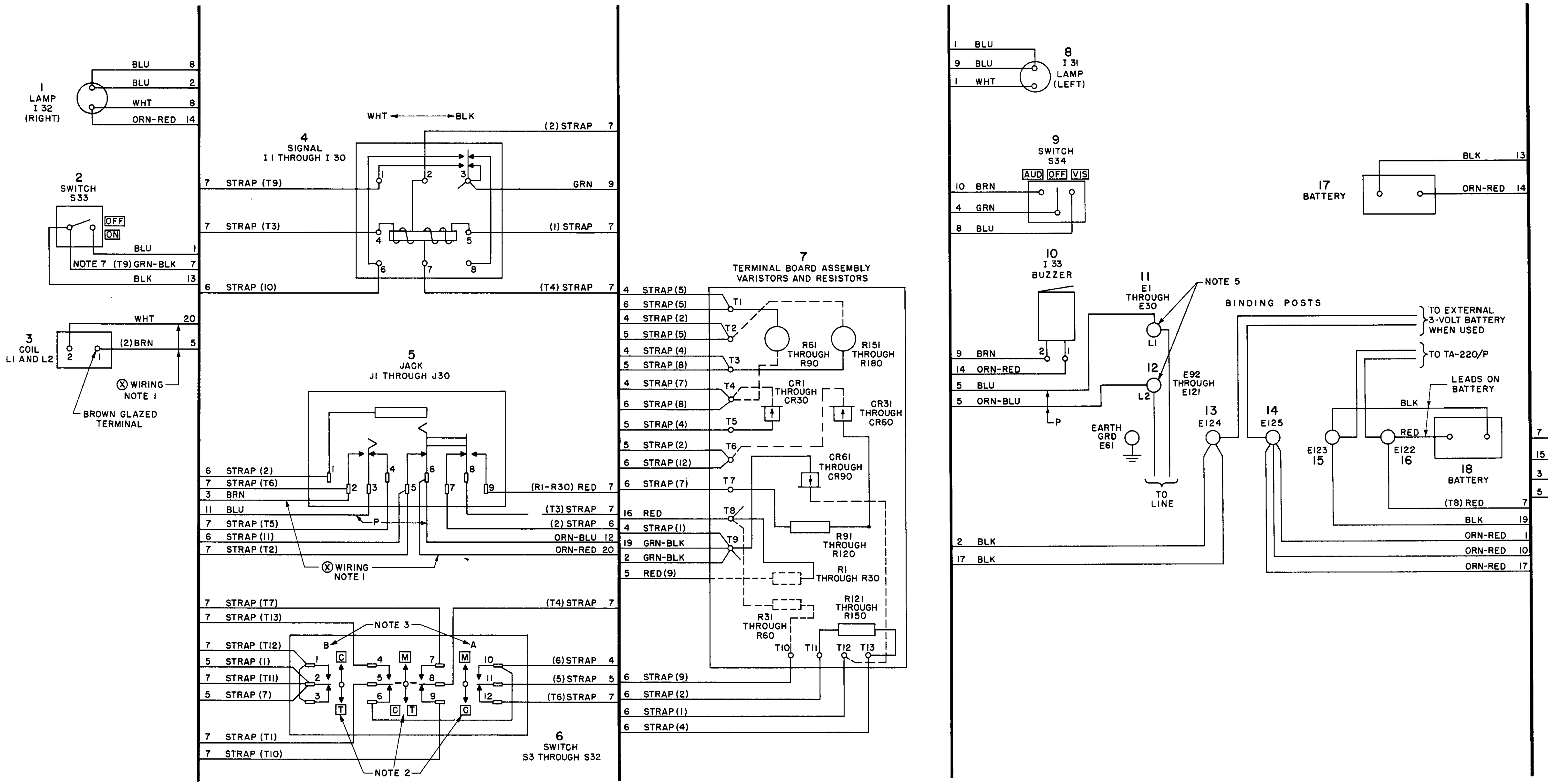
3 LINE SELECTOR SWITCH DESIGNATIONS:
[C] COMMON BATTERY SIGNALING LINE.
[T] COMMON BATTERY SIGNALING TRUNK.
[M] MAGNETO LINE

4 FOR CIVILIAN TRUNK, CONNECT—48V DC (CENTRAL OFFICE BATTERY) TO T (TIP), OPERATE LINE SELECTOR SWITCH TO [M] AND OPERATE [CIV TRKS] SWITCH TO [ON] POSITION.

5 SIGNAL IS IN BLACK POSITION WHEN CONTACTS 3 AND 8 ARE CLOSED.
SIGNAL IS IN WHITE POSITION WHEN CONTACTS 1 AND 6 ARE CLOSED.

Figure 43. Line circuit, schematic diagram.

584904 O - 61 (Face blank p. 56) No. 1



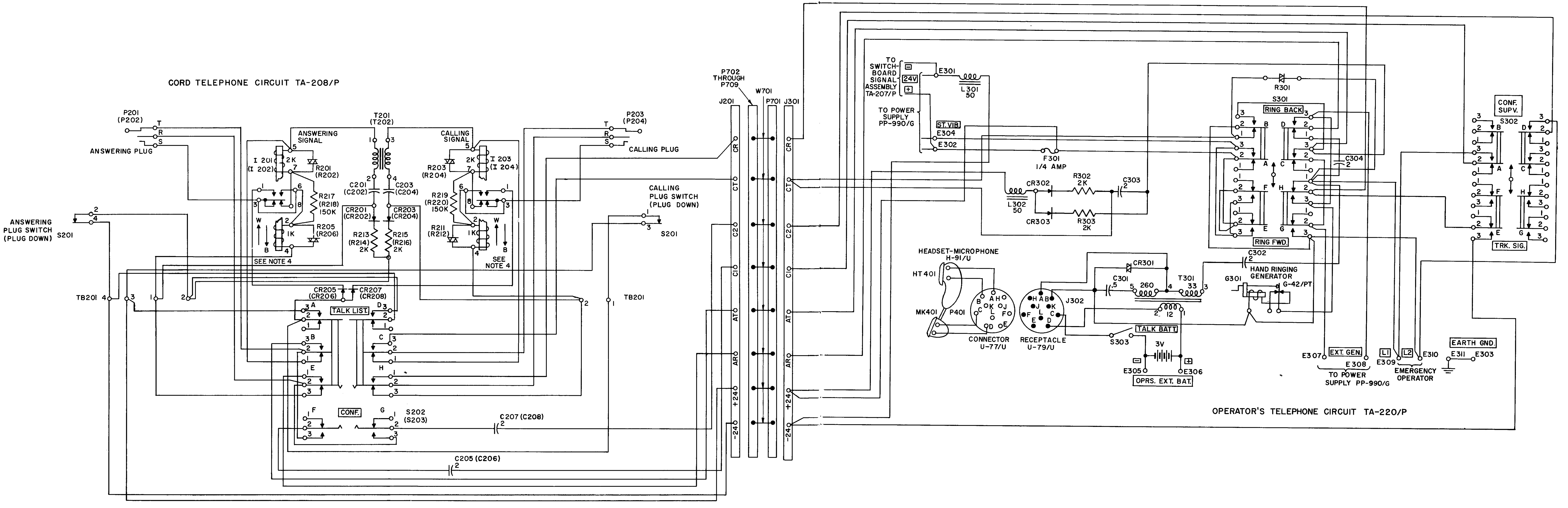
NOTES:

1. Ⓧ WIRING RUN IN ONLY FOR LINES 29 AND 30.
2. LINE SELECTOR SWITCH DESIGNATIONS:
   - C COMMON BATTERY SIGNALING LINE.
   - T COMMON BATTERY SIGNALING TRUNK.
   - M MAGNETO LINE.
3. SWINGER A TAKES A CENTER POSITION WHEN LINE SELECTOR SWITCH IS AT T.

   SWINGER B TAKES A CENTER POSITION WHEN LINE SELECTOR SWITCH IS AT M.
4. FOR CIVILIAN TRUNK, CONNECT THE NEGATIVE LINE FROM CENTRAL OFFICE TO L-1 BINDING POST, OPERATE LINE SELECTOR SWITCH TO M AND OPERATE CIV TRKS SWITCH TO ON POSITION.
5. PROTECTOR BLOCKS E31-E60 AND E62-E91 ARE MOUNTED ACROSS LINE TERMINALS L1 AND L2 RESPECTIVELY OF EACH LINE, WITH COMMON GROUND AT E61.
6. WIRING COLORS SHOWN ARE TRACERS ON A WHITE BASE.
7. ON SWITCHBOARD SIGNAL ASSEMBLY TA-207/P (SERIAL NUMBERS 1 THROUGH 200), THE WIRE SHOWN AS GRN-BLK ON LAMP SWITCH S33 IS SLATE COLORED.

Figure 44. Line circuit, wiring diagram.

584904 O - 61 (Face blank p. 56) No. 2



NOTES:
1. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS, CAPACITORS ARE IN UF, RELAY WINDINGS ARE IN OHMS.
2. RESISTOR SYMBOLS R207 THROUGH R210 HAVE BEEN DELETED DUE TO CHANGES IN THE EQUIPMENT.
3. THE CIRCUIT DESIGNATIONS IN PARENTHESES ARE FOR CIRCUIT NO.2.
4. SIGNAL IS IN BLACK POSITION WHEN CONTACTS 3 AND 8 ARE CLOSED. SIGNAL IS IN WHITE POSITION WHEN CONTACTS 1 AND 6 ARE CLOSED.

TM4134-36

Figure 45. Cord circuit and operator's telephone circuit, schematic diagram.

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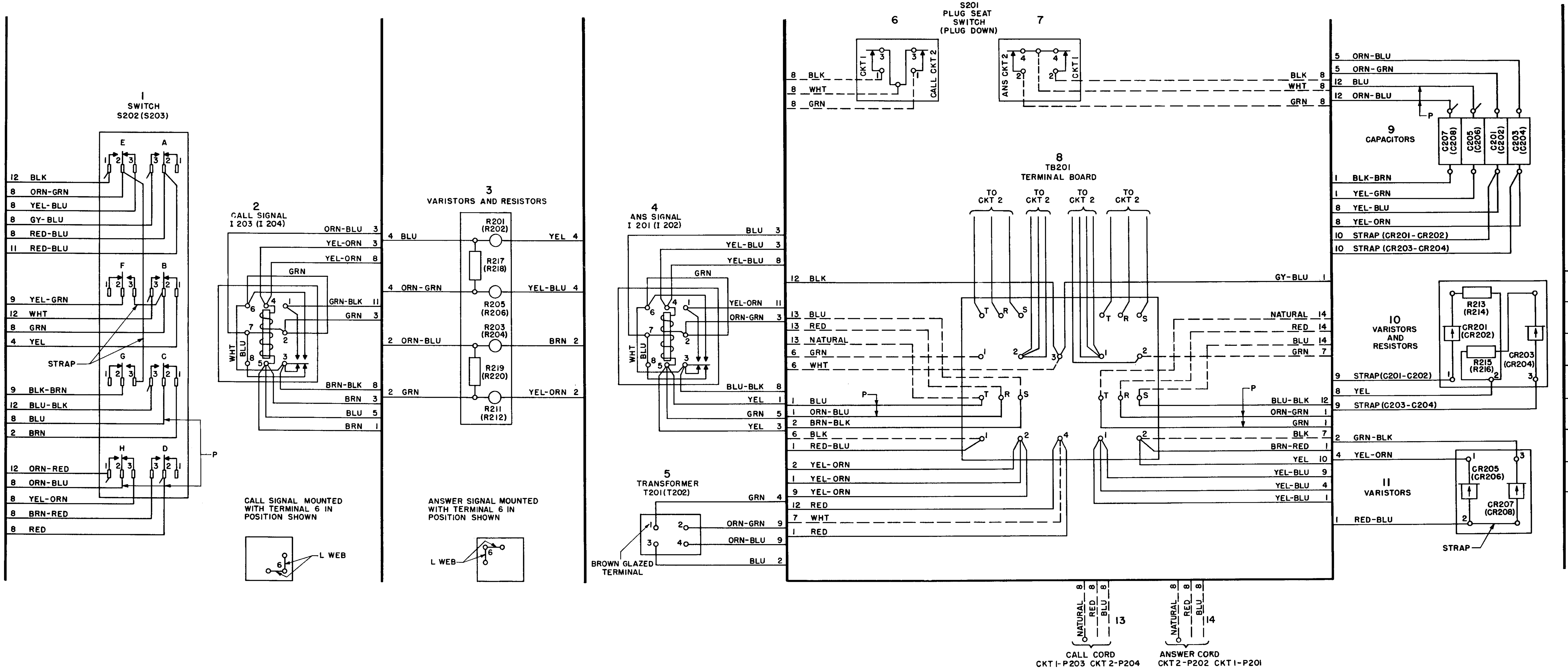
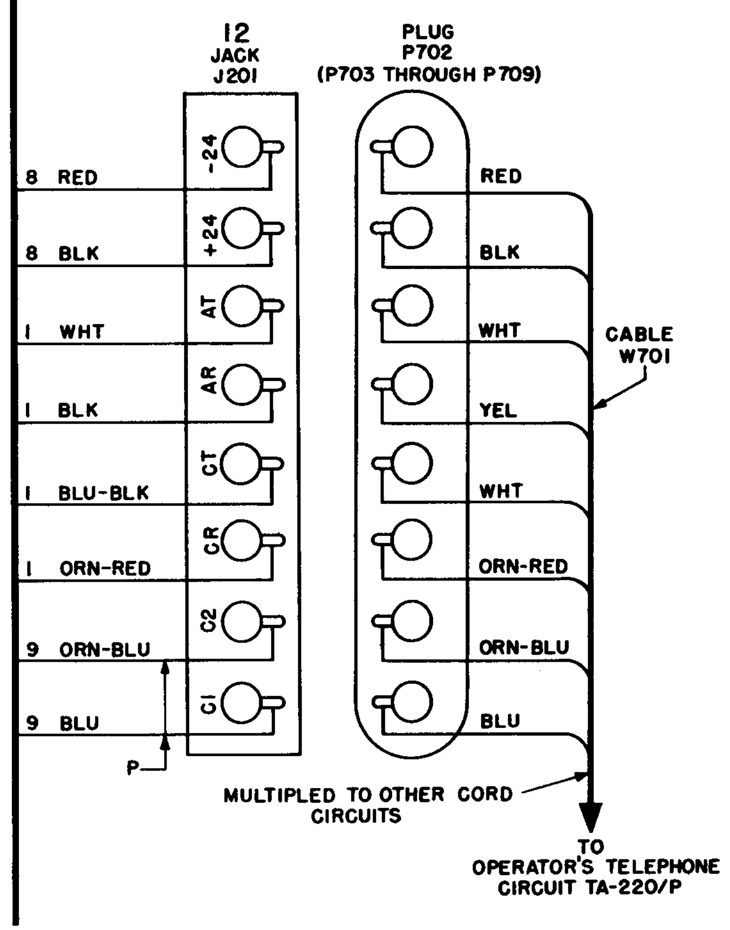
584804 O - 61 (Face blank p. 56) No. 4





NOTES:

1 WIRING COLORS SHOWN ARE TRACERS ON A WHITE BASE.

2 WIRING DIAGRAM SHOWN IS FOR ONE CORD CIRCUIT, REFERENCE SYMBOLS ARE SHOWN FOR TWO CIRCUITS WITH CIRCUIT 2 SYMBOLS IN PARENTHESES. EXAMPLE: R201-SYMBOL FOR RESISTOR IN CIRCUIT 1. (R202) SYMBOL FOR RESISTOR IN CIRCUIT 2.

3 WIRES SHOWN ____ ARE ON CABLE REEL ASSEMBLY.

4 TERMINAL BOARD TB-201 CONTAINS WIRING FOR TWO CORD CIRCUITS.

5 RESISTOR SYMBOLS R207 THROUGH R210 HAVE BEEN DELETED DUE TO CHANGES IN THE EQUIPMENT.

6 TERMINALS T,R,S, AND 1,2,3,4, FOR CORD CIRCUITS 1 AND 2 ARE LOCATED ON TERMINAL BOARD TB201 AS SHOWN BELOW.

TB201

CALLING	ANSWERING	
T R S / 1 2	T R S / 3 1 2	CKT 2
T R S / 1 2	T R S / 4 1 2	CKT 1

TM4134-37

Figure 46. Cord circuit, wiring diagram.

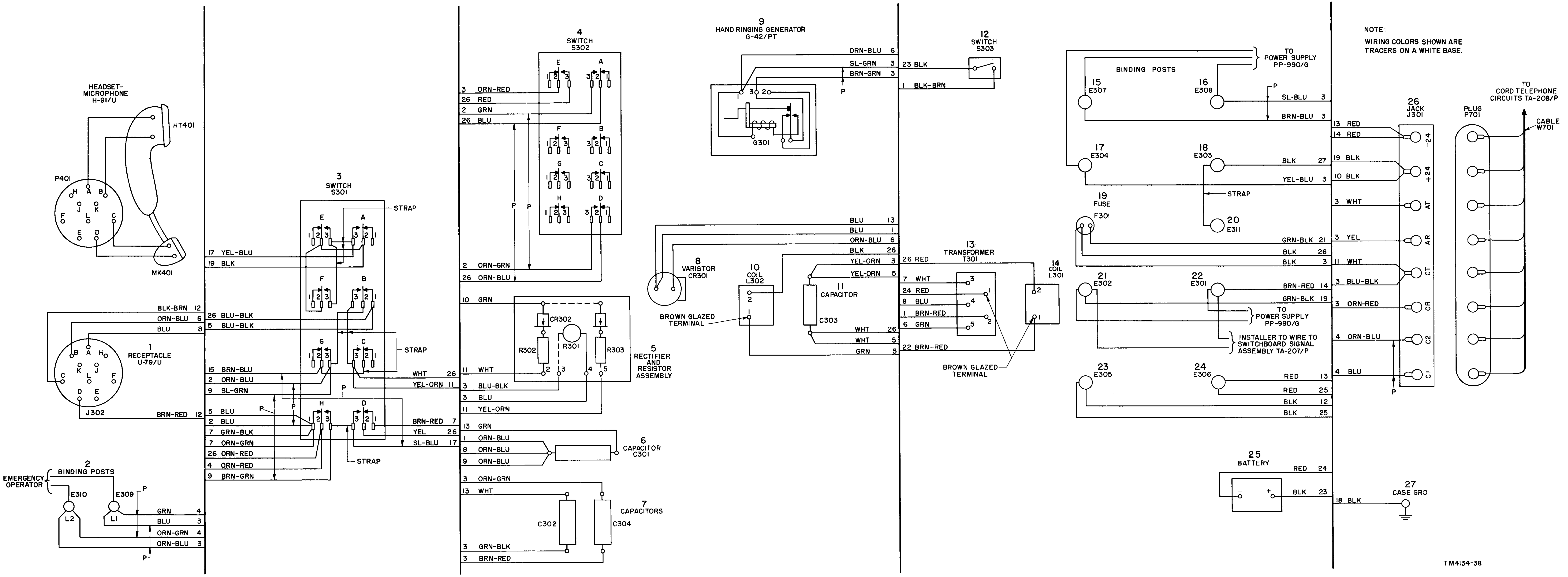


Figure 47. Operator's telephone circuit, wiring diagram.

584904 O - 61 (Face blank p. 56) No. 5

INDEX

[AG 412.42 (3 Aug 55)]

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USAR: None.

For explanation of abbreviations used, see SR 320–50–1.

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