DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11-2146

TO 16-30TCC7-15

MANUAL TELEPHONE CENTRAL OFFICE AN/TTC-7





DEPARTMENTS OF THE ARMY AND THE AIR FORCE

OCTOBER 1954

MANUAL TELEPHONE CENTRAL OFFICE AN/TTC–7

TM 11–2146
TO 31W1–2TCC7–11
CHANGES No. 1

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE
WASHINGTON 25, D. C., *11 January 1955*

TM 11–2146/TO 16–30 TCC7–15, 6 October 1954, is changed as follows:

CHAPTER 1

INTRODUCTION

Note. (Added) The basic manual covers Manual Telephone Switchboard SB–249/TTC, serial numbers 1 through 321, and Trunk Relay Telephone Circuit TA–226/TTC, serial numbers 1 through 107. Manual Telephone Switchboard SB–249/TTC, serial numbers 322 through 780, is similar to the switchboard described in the basic manual except for circuit modifications that permit dialing without the use of a special dial cord and that also permit ringing on the answer cords. Trunk Relay Telephone Circuit TA–226/TTC, serial numbers 108 through 260, is similar to the trunk relay case described in the basic manual except for circuit modifications that permit dialing without the use of a special dial cord. All information in the technical manual applies equally to Manual Telephone Switchboard SB–249/TTC, serial numbers 322 through 780, and Trunk Relay Telephone Circuit TA–226/TTC, serial numbers 108 through 260, unless otherwise indicated in this change. In this change, for purposes of simplicity, the serial numbers are used to identify the different models of SB–249/TTC and TA–226/TTC as shown below:

1 through 321 represents	Manual Telephone Switchboard SB–249/TTC serial numbers 1 through 321.	1 through 107 represents	Trunk Relay Telephone Circuit TA–226/TTC, serial numbers 1 through 107.
322 through 780 represents	Manual Telephone Switchboard SB–249/TTC serial numbers 322 through 780.	108 through 260 represents	Trunk Relay Telephone Circuit TA–226/TTC, serial numbers 108 through 260.

The phrase (1 through 321) is added to the headings and captions in the following places:

Paragraphs: 8*b*(2), 20*k*(4), 48*d*(1), 48*d*(3), 48*e*(1), 52*a*, 62*c*, and 62*d*.

Figures: 9, 36, 42, 44, 50, 52, 57, 63, 65, 66, 67, 79, 80, 81, and 109.

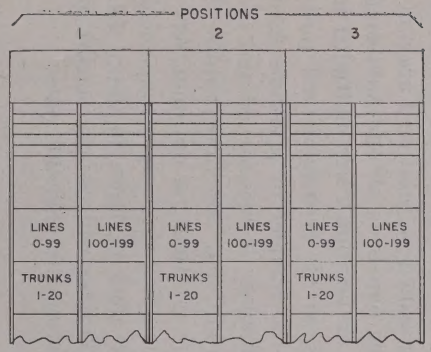
The phrase (1 through 107) is added to the captions in figures 49, 61, and 105.

4. System Application

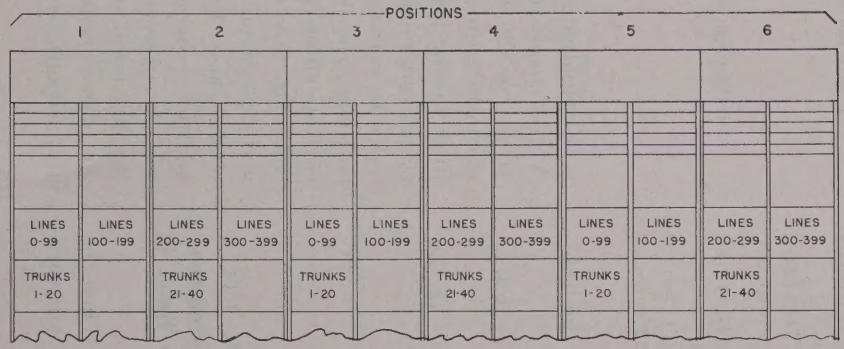
a. Two-Panel Multiple. Normally, the AN/TTC–7 * * * AN/TTC–7 are combined. **A suggested two-panel multiple arrangement for 200 lines is shown in figure 2.1.**

b. (Superseded) *Four-Panel Multiple.* When the number of lines exceeds 200, and further expansion is anticipated, a four-panel multiple should be used. A four-panel multiple will allow for the future growth of the exchange without changing the original installation. Expansion to a maximum of 1,000 lines can be achieved by adding switchboards and relay equipment. The panels on position 1 are multipled to corresponding panels on all odd-numbered positions; the panels on position 2 are multipled to corresponding panels on all even-numbered positions. In any case, the number of positions used will depend on the number of lines served and the traffic rate. Each additional 200 lines require 3 additional switchboard positions for optimum service. A suggested four-panel multiple arrangement for 400 lines and 800 lines is shown in figure 2.1. An office serving 1,000 lines will usually consist of 15 positions, or 3 positions for each 200 lines.

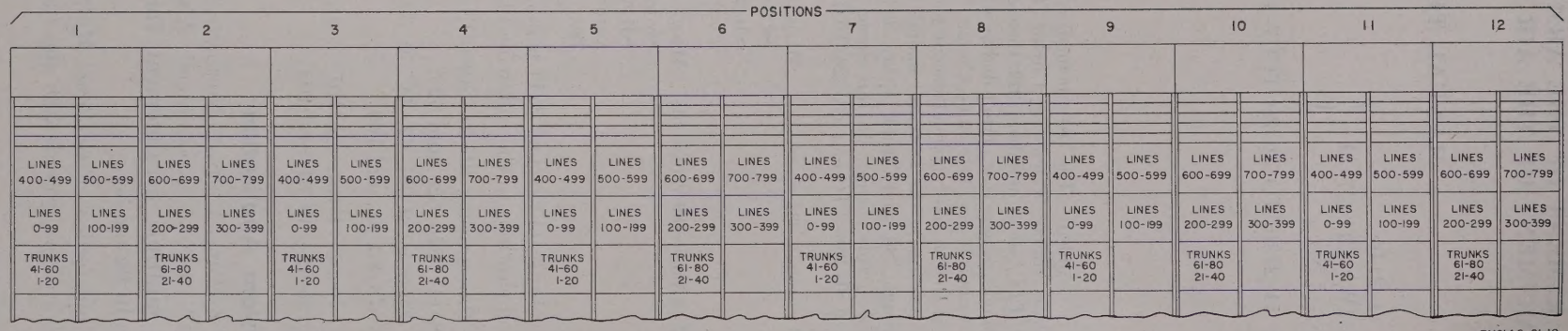
NOTE:
1. ONE AN/TTC-7 INCLUDES 3 SWITCHBOARD POSITIONS.
2. THE FACE EQUIPMENT OF ONE POSITION CAN ACCOMODATE ONLY 580 CIRCUITS.



A. TWO PANEL MULTIPLE 200-LINES 20-TRUNKS



B. FOUR PANEL MULTIPLE 400-LINES 40-TRUNKS



C. FOUR PANEL MULTIPLE 800-LINES 80-TRUNKS

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Figure 2.1. (Added) *Face equipment arrangement for two- and four-panel multiple.*

b.1. (Added) *Extending the Multiple.* When the number of switchboard positions required exceeds six, it is necessary to order additional cables (CX–2584/U) to extend the multiple.

(1) To determine the number of additional cables required, the following information is provided.

(*a*) Plug supervision trunk circuits are multipled in groups of 20 circuits.

(*b*) Three cables are required to multiple 1 group of 20 plug supervision trunk circuits for 1 extra appearance.

(*c*) Central office trunk circuits are multipled in groups of 10 circuits.

(*d*) One cable is required to multiple 1 group of 10 central office trunk circuits for 1 extra appearance.

(*e*) Line circuits are multipled in groups of 10 circuits.

(*f*) One cable is required to multiple 1 group of 10 line circuits for 1 extra appearance.

(*g*) All installations that involve more than six positions will be multipled on a four-panel basis.

(*h*) Fifty cables are provided with each central office for multipling purposes.

(2) Calculate the number of cables required for each type of circuit separately using the step-by-step procedure given below.

Note. If all the circuits of a particular type do not have the same number of appearances, each group of circuits that have the same number of appearances must be calculated separately.

(*a*) Divide the number of circuits to be multipled by the number of circuits per group to determine the number of groups to be multipled ((1)(*a*), (*c*), or (*e*) above).

(*b*) Multiply the number of groups by the number of cables required for each group ((1)(*b*), (*d*), or (*f*) above). This gives the number of cables needed for one extra appearance.

(*c*) Subtract one from the number of appearances that each group of circuits will have in the switchboard and multiply this figure by the number of cables needed for one extra appearance ((*b*) above). This gives the number of cables needed to multiple this group of circuits in the switchboard.

Note. All the circuits will not have the same number of appearances in a switchboard. In a nine-position switchboard, some circuits will have five appearances and others will have four appearances (fig. 2.1). This will happen whenever the switchboard has an odd number of positions. It is necessary to determine the number of appearances each group of circuits will have in the switchboard to make the calculation shown in (*c*) above.

(*d*) Add the number of cables required for each group of circuits to obtain the total number of cables required for multipling purposes.

(*e*) Subtract the total number of cables supplied with the central offices ((1)(*h*) above) from the total number of cables required for multipling purposes ((*d*) above) to obtain the number of additional cables required.

(3) The additional cables needed for multipling five central offices are calculated as shown in the following example.

(*a*) Number and type of circuits to be used:

60 plug supervision trunks (multipled for 8 appearances)
40 plug supervision trunks multipled for 7 appearances)
60 central office trunks (multipled for 8 appearances)
40 central office trunks (multipled for 7 appearances)
460 lines (multipled for 8 appearances)
500 lines (multipled for 7 appearances)

Note. The face equipment of each position cannot accommodate more than 580 circuits. Therefore, only 960 line circuits can be used in this typical telephone exchange.

(*b*) Calculate the number of cables required for each type of circuit by using the methods shown in (1) and (2) above.

1. Calculate the number of groups to be multipled (subpar. (2) (*a*) above).

60 plug supervision trunks ÷ 20 circuits = 3 groups
40 plug supervision trunks ÷ 20 circuits = 2 groups

60 central office trunks ÷ 10 circuits = 6 groups

40 central office trunks ÷ 10 circuits = 4 groups

460 lines ÷ 10 circuits = 46 groups

500 lines ÷ 10 circuits = 50 groups

2. Calculate the number of cables needed for one extra appearance (subpar. (2) (*b*) above).

3 plug supervision trunk groups × 3 cables = 9 cables

2 plug supervision trunk groups × 3 cables = 6 cables

6 central office trunk groups × 1 cable = 6 cables

4 central office trunk groups × 1 cable = 4 cables

46 line groups × 1 cable = 46 cables

50 line groups × 1 cable = 50 cables

3. Calculate the number of cables needed for multipling (subpar. (2) (*c*) above).

9 cables × (8 – 1) = 63 cables for 8 appearances of plug supervision trunk circuits

6 cables × (7 – 1) = 36 cables for 7 appearances of plug supervision trunk circuits

6 cables × (8 – 1) = 42 cables for 8 appearances of central office trunk circuits

4 cables × (7 – 1) = 24 cables for 7 appearances of central office trunk circuits

46 cables × (8 – 1) = 322 cables for 8 appearances of line circuits

50 cables × (7 – 1) = 300 cables for 7 appearances of line circuits

4. Calculate the total number of cables required (subpar. (2) (*d*) above).

The total number of cables required are:

63 + 36 + 42 + 24 + 322 + 300 = 787 cables

5. Calculate the number of additional cables required (subpar. (2) (*e*) above).

5 central offices × 50 cables = 250 cables

787 cables – 250 cables = 537 additional cables to be ordered

(5) The methods shown above can be used to calculate the additional number of multiple cables required for any size Manual Telephone Central Office AN/TTC–7.

* * * * *

5. Technical Characteristics

Lines served:

CB 100

CB–LB ..... 100 (may be used as ring-down magneto manual trunks)

* * * * *

Dial characteristics 8 to 12 pulses per second.

Note. (Added) The CB–LB line jacks that have associated designation strips should be used whenever the CB–LB line circuits are used for ring-down magneto manual trunks.

8. Description of Manual Telephone Switchboard SB–249/TTC

* * * * *

b. Interior (Front). Removal of the * * * and (2) below.

(1) Face equipment, ***1 through 321*** (figs. 5, 43, and 44) and ***322 through 780*** **(figs. 5, 43, and 44.1).** The face equipment * * * panels as follows:

(*a*) *Left panel.* The left panel * * * 100 CB–LB lines. **When needed, these circuits may be used without modification for ring-down magneto manual trunk circuits. On 1 through 321, the** bottom jack and lamp strip of the

lower group can be used to terminate 10 dial trunks or 20 manual trunks **(TA–226/TTC, 1 through 107).** If dial trunks * * * and lamp strip. **On 322 through 780, the bottom jack and lamp strip of the lower group is used to terminate 20 trunks (TA–226/TTC, 108 through 260). These circuits do not require an associated dial jack. When used as trunks to a dial exchange, the operator will dial through the calling cord inserted in the line jack.**

* * * * *

(3) (Added) *Key shelf equipment, 322 through 780* (figs. 4, 5, and 42.1). The key shelf equipment includes two rows of cord plugs, two rows of supervisory lamps, two rows of switches, and a dial.

(*a*) *Cord plugs.* On 322 through 780, the dial cord is omitted. Refer to figure 67.1 for the wiring diagram of the modified cord circuit.

(*b*) *Switches.* Fifteen sets of three-position, black-handled switches (two switches for each cord circuit) are mounted in two rows in the center of the hinged shelf directly in front of and in line with the supervisory lamps. The ring answer-dial switches are in the rear row; the ring call-talk switches are in the front row. These switches are nonlocking in the ring position and are locking in the talk or dial position. Grouping switch GRP and monitoring-master ringing switch MON–MR are located in the center of the group of switches. They are described in (2) (*c*) above. The white-handled operator's dial wipe-out switch at the extreme right is a two-position nonlocking switch.

Figures 4 and 5. The following note is added to each illustration:

NOTE. ON SERIAL NUMBERS 322 THROUGH 780 TWO ROWS OF CORD CIRCUIT SWITCHES AND A DIAL WIPE-OUT SWITCH ARE PROVIDED AND THE DIAL CORD IS OMITTED.

c. Interior (rear) (fig. 6.) The rear equipment * * * through (5) below.

(1) *Cable receptacle panels* (figs. 6 and 7). The cable receptacle * * * and (*b*) below.

* * * * *

(*b*) *Right cable receptacle panel.* A portion of * * * group is numbered 99–90. The two bottom DIAL TRKS receptacles **(1 through 321)** may be used to terminate another 20 CB–LB lines or manual trunks. **The two bottom DIAL TRKS receptacles (322 through 780) may be used to terminate 20 CB–LB lines, manual trunks, or dial trunks.** Therefore, the lower group of the right receptacle panel can be used to connect 80 CB–LB lines and 10 dial trunks **(1 through 321) or 20 dial trunks (322 through 780),** 80 CB–LB lines and 20 manual trunks, or 100 CB–LB lines. Refer to figures * * * or CB–LB receptacles.

* * * * *

(3) *Circuit plates,* ***1 through 321*** (figs. 6 and 36) ***and (322 through 780)*** **(figs. 6 and 36.1).** The six circuit plates are located at the bottom half of the rear of the switchboard. The top circuit plate **(1 through 321)** contains the relay equipment for the operator's circuit. **The top circuit plate (322 through 780) contains the relay equipment for the dial and operator's circuit.** The five circuit * * * covers in place. The operator's circuit plate and a cord circuit plate with covers removed are illustrated in figure 36 **(1 through 321) or figure 36.1 (322 through 780).** Each type of * * * and (*b*) below.

* * * * *

(*a.1*) (Added) *Dial and operator's circuit plate* (fig. 9.1). Located on the left portion of the dial and operator's circuit plate are the dial components, retard coil (RE), relays dial (DL) and cutoff (CO), and capacitors (C1 and C2); located on the right portion are the components of the operator's circuit described in (*a*) above. Refer to figure 63.1 for the wiring diagram of the dial and operator's circuit plate.

* * * * *

(4) *Power supply and grouping receptacle panel, **1 through 321*** (figs. 6 and 36) ***and 322 through 780*** **(figs. 6 and 36.1).** The metal panel * * * distributing circuit panel.

* * * * *

12. Description of Trunk Relay Telephone Circuit TA–226/TTC

(figs. 20 and 21)

* * * * *

b. Interior (figs. 20 and 21). The interior equipment of the trunk relay case is described in 1 and 2 below:

(1) *Front* (fig. 20). The front relay gate frame **(1 through 107)** is provided with five circuit plates, one MDF cable receptacle, and two switchboard cable receptacles. **The front relay gate frame (108 through 260) is the same except there is only one switchboard cable receptacle.** The five circuit * * * 10 trunk circuits. The following is a detailed description of a trunk circuit plate, the cable receptacles, and the vertical mounting panel:

(*a*) *Trunk circuit plate* (fig. 22). The trunk circuit * * * circuit No. 1. Refer to figure 61 **(1 through 107) or figure 61.1 (108 through 260)** for the wiring diagram of a trunk circuit. At the rear * * * plate component wiring. Refer to figure 105 **(1 through 107) or figure 105.1 (108 through 260)** for the wiring diagram of the terminal board of a trunk circuit plate.

(b) *Front cable receptacles* (fig. 20). At the upper * * * three cable receptacles. **On 1 through 107, the** upper receptacle is the MDF receptacle and is marked MDF H 1–20. The middle receptacle * * * jack receptacle D. **On 108 through 260, there are only two cable receptacles: MDF cable receptacle marked MDF H 1–20 and switchboard cable receptacle marked LINE F 1–10.**

* * * * *

(2) *Rear, **1 through 107*** (fig. 21). The rear relay * * * NA binding posts.

(3) (Added) *Rear, **108 through 260*** (fig. 21). The rear equipment is the same as explained in (2) above except the DIAL G 11–20 switchboard cable receptacle is omitted.

Figure 20. The following note is added:

NOTE. ON SERIAL NUMBERS 108 THROUGH 260 ODD-NUMBERED CIRCUITS ARE MOUNTED ON THE FRONT CIRCUIT PLATES AND SWITCHBOARD CABLE RECEPTACLE D (DIAL 1–10) IS OMITTED.

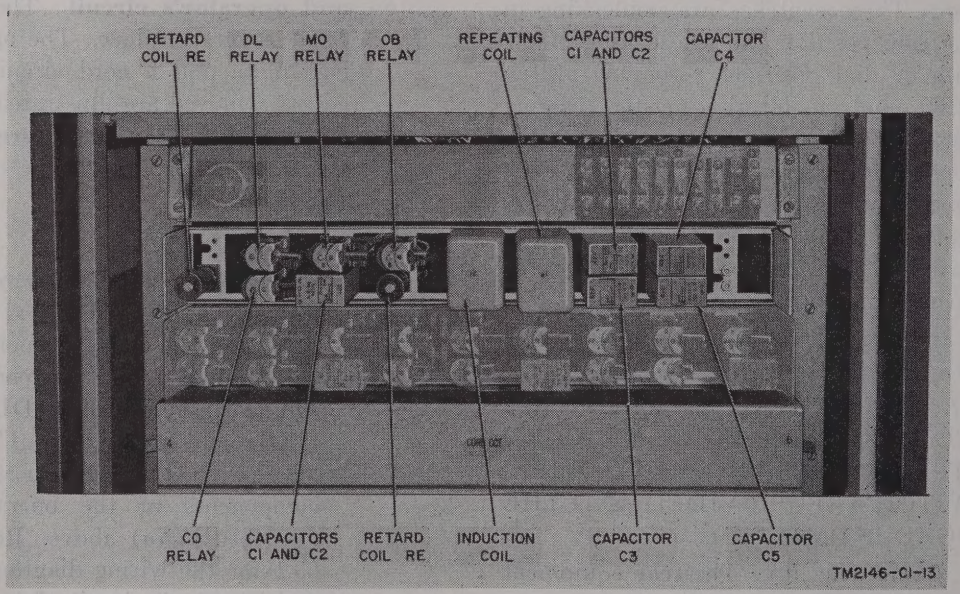


Figure 9.1. (Added) *Manual Telephone Switchboard SB–249/TTC (322 through 780), dial and operator's circuit plate.*

Figure 21. The following note is added:

NOTE. ON SERIAL NUMBERS 108 THROUGH 260 EVEN-NUMBERED CIRCUITS ARE MOUNTED ON THE REAR CIRCUIT PLATES AND SWITCHBOARD CABLE RECEPTACLE H (DIAL 11–20) IS OMITTED.

20. Connections

(fig. 33)

* * * * *

j. Connections Between Trunk Relay Case (fig. 20) *and Switchboard Position 1* (fig. 7). These two components * * * applicable trunk connection.

(1) *Manual* ***and/or dial*** *trunk operation (20 manual trunks).*

* * * * *

k. Multiple Connections Between Switchboard Positions 1 and 2 (fig. 35). Switchboard position 1 * * * 52-pin connector plug.

* * * * *

(3) *Multipling manual* ***and/or dial*** *trunks.*

* * * * *

24. Controls and Their Uses

* * * * *

c. Manual Telephone Switchboard SB–249/TTC ***(1 through 321).***

Item	Figure	Function
* *	*	* *
Front supervisory lamp--	42, 44	**Lights until called party answers; lights** when called party disconnects.
* *	*	* *

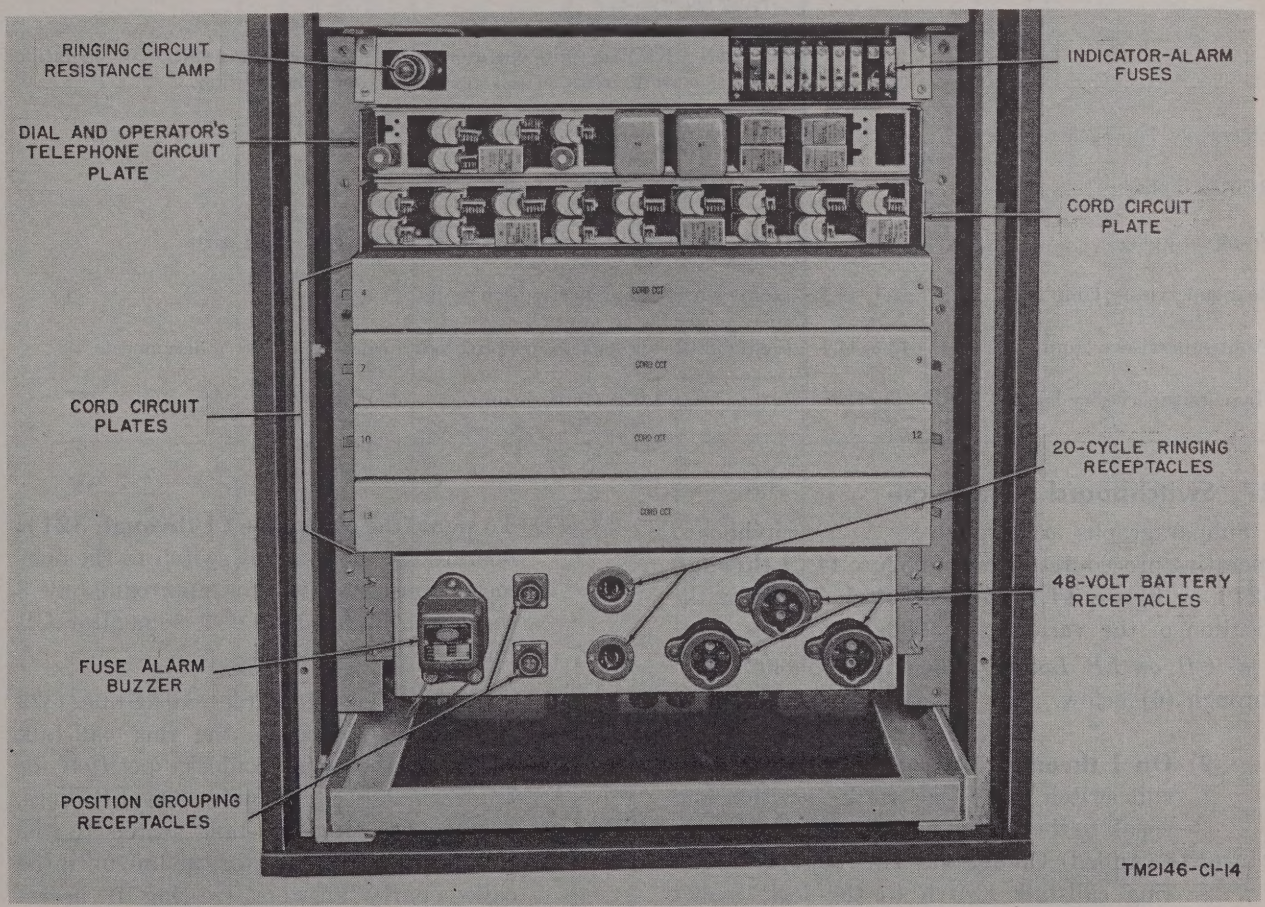


Figure 36.1. (Added) *Power and grouping cord receptacle panel for SB–249/TTC (322 through 780).*

c.1. (Added) *Manual Telephone Switchboard SB–249/TTC* ***(322 through 780).***

Item	Figure	Function
Ring call-talk switch	42.1, 44.1	Talk (lock): permits operator to talk during progress of call.
		Ring call (nonlock): permits operator to ring through call cord.
Ring answer-dial switch	42.1, 44.1	Dial (lock): permits operator to dial through call cord.
		Ring (nonlock): permits operator to ring through answer cord.
Position grouping switch	42.1, 44.1	Permits operator to vacate position by transferring cord circuits to other remaining positions.
MON-MR (monitoring and master ringing switch).	42.1	MON (nonlock): permits operator to monitor a call.
		MR (lock): permits operator to ring party line telephone.
Dial wipe-out switch	42.1, 44.1	Permits operator to correct an error in dialing.
Dial	42.1, 44 1	Permits operator to control the equipment in the dial exchange.
RINGING KEY-HAND switch	43, 44.1	HAND: permits operator to ring called station manually by turning crank on hand generator.
		RINGING KEY: permits operator to ring called or calling station by operation of either cord circuit switch to the ring (nonlock) position.
Emergency hand generator	44.1	Provides an emergency source of ringing current.
Rear cord plug	42.1, 44.1	Used to answer incoming calls.
Front cord plug	42.1	Used to connect calling party and/or operator to called party.
Rear supervisory lamp	42.1, 44.1	Lights when calling party disconnects.
Front supervisory lamp	42.1, 44.1	Lights until called party answers; lights when called party disconnects.
Magneto supervisory lamp	43, 44.1	Lights when LB party rings off.

27. Switchboard Operation

Subparagraphs *a* through * * * switchboard operating procedures. Refer to figure 44 **(1 through 321) or figure 44.1 (322 through 780)** for the location of the various switchboard controls.

a. CB or LB Lines. When a telephone * * * through (6) below.

* * * * *

(2) **On 1 through 321, operate** the cord circuit switch to its lock (talk) position and speak to the calling party.

(2.1) (Added) On 322 through 780, operate the ring call-talk switch to the lock (talk) position and speak to the calling party.

* * * * *

(4) To signal the called line **(1 through 321),** operate the cord circuit switch to the nonlock (ring) position for approximately 3 seconds. On LB lines * * * monitor CB lines.

(4.1) (Added) To signal the called line (322 through 780), operate the ring call-talk switch to the ring (nonlock) position for approximately 3 seconds. On LB lines, operate the ring call-talk switch to the talk position and monitor the line until the called party answers (re-ring if necessary). On CB lines, the call supervisory

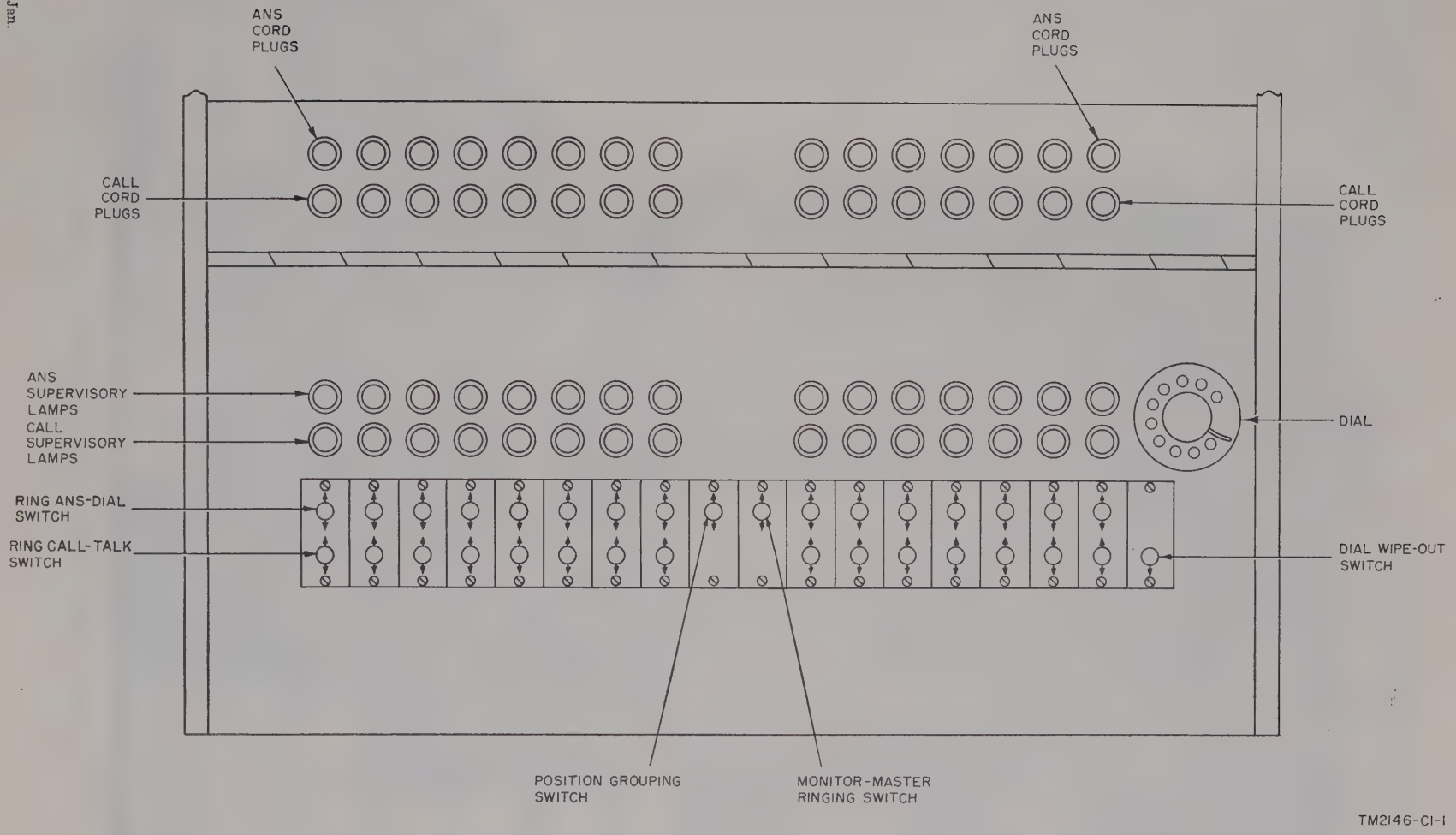


Figure 42.1 (Added) *Manual Telephone Switchboard SB–249/TTC (322 through 730) shelf controls.*

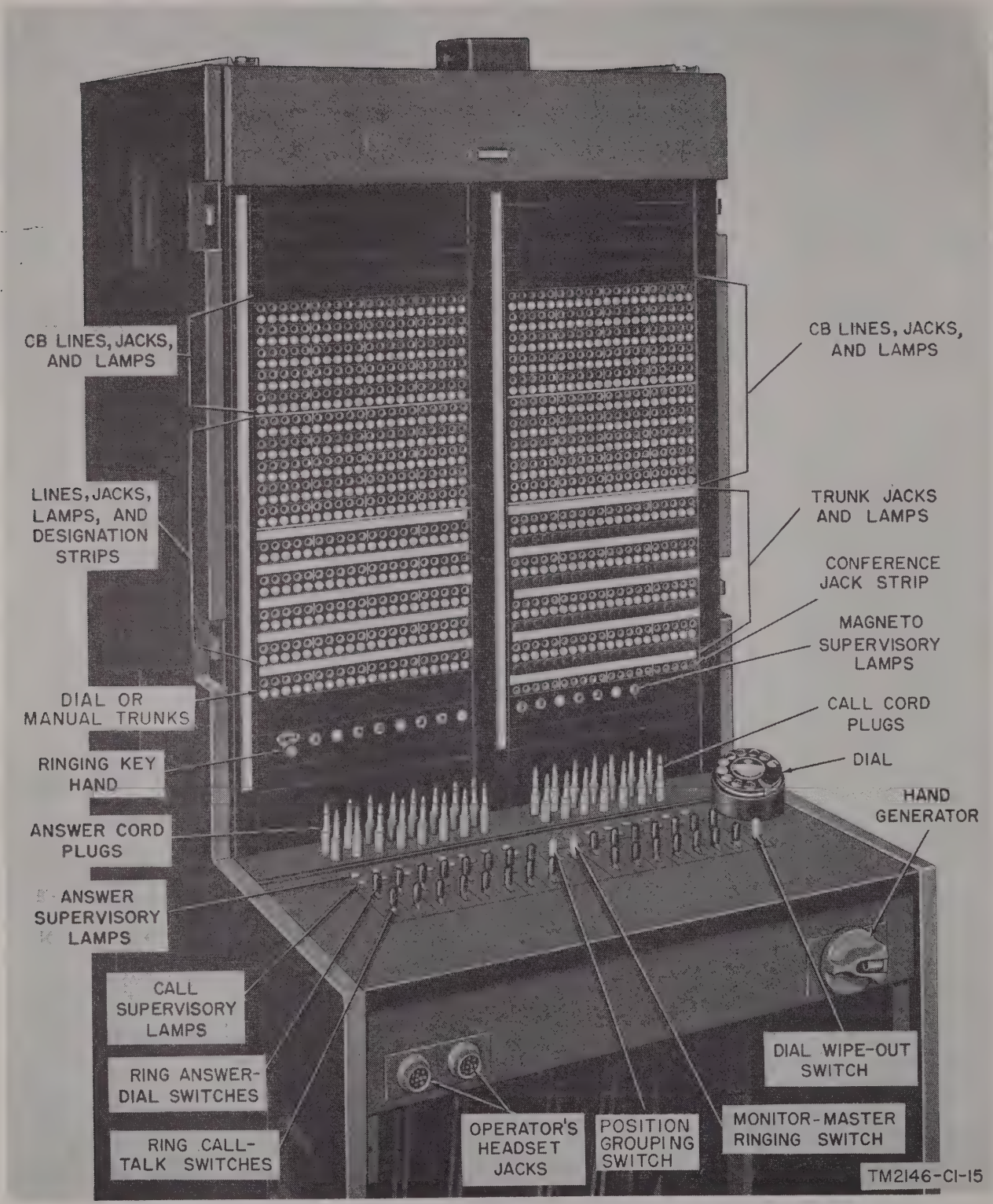


Figure 44.1. (Added) *Manual Telephone Switchboard SB-249/TTC (322 through 780) controls.*

lamp will be extinguished when the called party answers. It is not necessary to monitor on CB lines.

* * * * *

c. Trunk Calls (Outgoing). Subparagraph (1) below * * * dial trunk calls.

(1) To extend a call to another manual central office **(1 through 321),** make the busy test outlined in *a*(3) above. To signal the * * * and (6) above.

(1.1) (Added) To extend a call (322 through 780) to another manual office, proceed as described in (1) above except the operator operates the ring call-talk switch.

(2) To extend a call to a dial central office **(1 through 321),** make the busy test outlined in *a*(3) above. Dial tone should * * * local telephone user.

(2.1) (Added) To extend a call to a dial central office (322 through 780), make the busy test outlined in *a*(3) above. After making the busy test, insert the call cord into the trunk jack and operate the ring answer-dial switch to the dial position. The ring call-talk switch may be left in the talk position. When dial tone is heard, dial the desired number. If an error is made in dialing, momentarily operate the dial wipe-out switch; this releases the dial central office equipment and dial tone will be heard again. Upon completion of dialing, restore the ring answer-dial switch to normal and monitor the line with the ring call-talk switch in the talk position until the called party answers because there is no supervision on the call cord from the dial central office. Restore the ring call-talk switch to normal after the called party has answered. The disconnect supervisory signal will be provided on the answering cord only.

* * * * *

f. Emergency Ringing. If the ringing * * * the hand generator. To do this, first operate the RINGING KEY-HAND switch (figs. **43,** 44, **and 44.1**) to the HAND position. Then operate the * * * approximately 3 seconds.

* * * * *

46. Equipment Performance Checklist

Note. (Added) Items 12, 15, 16, 17, 21, 22, 24, 25, 27, and 28 apply only to 1 through 321; items 12.1, 15.1, 16.1, 21.1, 21.2, 28.1, and 31.1 apply only to 322 through 780.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
	*	* *	*	*	* *
EQUIPMENT PERFORMANCE	12.1	Ring call-talk switch.	Operate to talk (lock) position.	Operator connected with calling party.	Replace headset. Clean or adjust contacts of cord circuit switch. Clean cord plug.
	*	* *	*	*	* *
	15.1	Ring call-talk switch.	Operate to ring (non-lock) position.	Called telephone is signaled.	Check contacts of switch.
	*	* *	*	*	* *
	16.1	Ring call-talk switch.	Operate to talk (lock) position.	Called party answers. Front supervisory lamp is extinguished (CB lines only).	See paragraph 64, item 16.
	*	* *	*	*	* *
	21.1	Ring answer-dial switch.	Operate to dial (lock) position.	Dial tone heard in headset.	Check contacts of switch.
	21.2	Ring answer-dial switch.	Operate to ring (non-lock) position.	Called telephone is signaled.	Check contacts of switch.
	27.1	Ring call-talk switch.	Operate to ring (non-lock) position.		
	*	* *	*	*	* *
	28.1	Ring call-talk switch.	Operate to talk (lock) position.	Distant operator answers.	Replace headset. Check switch for dirty or faulty contacts.
	*	* *	*	*	* *
	31.1	Dial wipe-out switch.	Operate switch.	Dial tone is heard.	Check switch contacts.
	*	* *	*	*	* *

47. General Circuit Functions

The general functioning * * * through *g* below.

* * * * *

c. Manual or Dial Trunk Circuit, ***1 through 107*** (figs. 22 and 49) ***and 108 through 260*** **(figs. 22 and 49.1).** This type of * * * is 10,000 ohms.

* * * * *

f. Universal Cord Circuit, ***1 through 321*** (figs. 10 and 52) ***and 322 through 780*** **(figs. 10 and 52.1).** The cord circuit * * * a local-battery line.

* * * * *

48. CB Line Circuit

(fig. 47)

* * * * *

b. Operator Answers Incoming Call. To answer an incoming call, the operator at the switchboard inserts the answer (rear) cord into the associated line jack and operates the cord circuit switch **(1 through 321) or the ring call-talk switch (322 through 780)** to the talk (lock) position. The contacts of * * * jack to ground.

* * * * *

(1) *Relay CO operates.* Contacts 26–27 of relay CO connect ground to the sleeve of the line jack to operate relay RS in the universal cord circuit (fig. 52 **or 52.1**). Relay RS operates * * * LR to release.

* * * * *

c. Transmitting, Telephone User and Operator. The transmission path from the telephone user to the operator is from the telephone via T and R through the MDF case, through the T and R of the line jack (fig. 47), through the T and R of the answer cord, to capacitors C2 and C1, through contacts of the cord circuit (fig. 52 **or 52.1**) through contacts of the GRP switch, through contacts 2–1 and 22–21 of relay MO, to the 1–2 winding of the induction coil (fig. 51).

d. Operator Extends Call. To extend the * * * jack to ground.

* * * * *

(1.1) (Added) *Relay CO operates (322 through 780).* When relay CO operates, the circuit operation is identical to that described in (1) above except contacts 26–27 complete the circuit to the call supervisory lamp and relay FS as follows: ground at contact 26 through contact 27, to the sleeve of the line jack, through the sleeve of the call cord (fig. 52.1), contacts of the ring answer-dial switch, call supervisory lamp, A–C winding and B–D winding of relay FS (parallel connection), to negative battery.

* * * * *

(3.1) (Added) *Called party answers (322 through 780).* When the called party answers, relay FB (fig. 52.1) operates as follows: negative battery at closed contacts 8–7 of relay FS, through the D–B winding of relay FB, break contacts of the ring call-talk switch, break contacts of the ring answer-dial switch, R of the call cord, R of the line jack out on the R side of the line; through the telephone, back on the T side of the line, T of the line jack, T of the call cord, break contacts of the ring answer-dial switch, break contacts of the ring call-talk switch, C–A winding of relay FB, and through closed contacts 2–1 of relay FS to ground.

(4) *Relay FB operated.* When relay FB * * * relay CO (fig. 47). **Operation of relay FB also completes a holding circuit for relay FS as follows: ground through closed contacts 4–5 of relay FB, made contacts 4–5 of relay FS, and through winding A–C of relay FS to negative battery.**

e. Talking, CP Party to CB Party. Battery for transmitting (fig. 52 **or 52.1**) is supplied to the party on the answer cord through contacts 1–2 and 7–8 of relay RS. Battery for transmitting * * * of relay FS.

* * * * *

(1.1) (Added) *Party to party transmission path (322 through 780).* The party to party transmission path is from the calling telephone, over the T of the line, T of the line jack, T of the answer cord, contacts of the ring answer-dial switch, capacitor C2, contacts of the ring call-talk switch, contacts of the ring answer-dial switch, R of the call cord, R of the line jack, and out on R of the line to the called telephone; then back on the T of the line,

T of the line jack, T of the call cord, contacts of the ring answer-dial switch, contacts of the ring call-talk switch capacitor C1, R of the answer cord, R of the line jack, and out on R of the line to the calling telephone.

* * * * *

49. CB–LB Line Circuit
(fig. 48)

Note. (Added) This circuit may be used as a ring-down magneto manual trunk where required. The ring-down magneto manual trunk circuit operation is described in paragraph 49.1.

This circuit has * * * through *f* below.

* * * * *

b. Operator Answers Incoming Call. Refer to paragraph * * * does not apply. **The operation of relay CO opens the operating circuit of relay LR through contacts 21–22 and 25–26. Contacts 23–24 remove the lock-up ground from the winding of relay LR, causing it to release.**

* * * * *

f. Either Party Hangs Up. To *ring off* * * * FB (fig. 52). Relays RB and FB operate relay RU as discussed in paragraph **52*d*(5).**

49.1. Ring-Down Magneto Manual Trunk Circuit (LB Line Circuit)
(Added)

The CB–LB line circuit may be used as a ring-down magneto manual trunk circuit when its toggle switch is operated to the LB position. The circuit operation of the ring-down magneto manual trunk circuit is identical to the circuit operation of the LB line circuit described in paragraph 49 with the exceptions given below.

a. To signal the distant operator, the operator at the AN/TTC–7 inserts the call cord into the CB–LB line jack being used as a ring-down magneto manual trunk and operates the ring call-talk switch. The circuit operation is described in paragraph 49*d*.

b. The distant operator signals the operator at the AN/TTC–7 in the same manner as described in *a* above. The ring-down magneto manual trunk circuit will then function as described in 49*a*.

c. Transmission battery for a call between central offices is supplied by the operator's telephone and position grouping circuit (par. 51).

d. Disconnect supervision is provided by the distant operator *ringing off*. The circuit operation is described in paragraph 49*f*.

Figure 48. CB–LB line circuit, ***magneto manual trunk circuit,*** *schematic diagram.*

50. Common Battery Manual or Dial Trunk Circuit (1 through 107)
(fig. 49)

This circuit provides * * * to the AN/TTC–7.

* * * * *

50.1. Manual or Dial Trunk Circuit (108 Through 260)
(fig. 49.1)
(Added)

This circuit provides a two-way trunk between the AN/TTC–7 and a dial or manual telephone exchange.

a. Incoming Call. Ringing current from the distant central office is applied to the T side of the line, through break contacts 25 and 26 of relay CO, break contacts 3 and 4 of relay LR, a–c winding of relay LR, 100,000-ohm thermistor to capacitor C1; from capacitor C1 through the 6–8 winding of the repeating coil, break contacts 5 and 4 of relay DL, out over the R side of the line to the distant central office. The ringing current partially operates relay LR (make contacts 1 and 2 only).

(1) *Relay LR operates.* Closing of make contacts 1 and 2 of relay LR completes a circuit to fully operate and hold relay LR over the following path: negative battery through the D–B winding of relay LR, make contacts 2 and 1 of relay LR, break contacts 23 and 24 of relay CO to ground. Operation of relay LR completes or prepares the following circuits:

(*a*) Contacts 9 and 10 of relay LR complete the night alarm circuit when the NA switch is operated to the ON position.

(*b*) Contacts 7 and 8 of relay LR complete a resistance negative battery path to the sleeve of the line jack for busy test purposes.

(*c*) Contacts 5 and 6 of relay LR complete a circuit to light the incoming line lamp.

(2) *Line lamp lights.* The circuit for lighting the incoming line lamp is from negative

battery through make contacts 6 and 5 of relay LR, through the line lamp, to ground.

b. Operator Answers Incoming Call. To answer an incoming call, the operator at the switchboard inserts the answer (rear) cord into the associated line jack and operates the ring call-talk switch to the talk position. The contacts of the line jack complete the operating circuit for relay CO as follows: negative battery through the C–D winding of relay CO, through contacts of the line jack to ground.

(1) *Relay CO operates.* When relay CO operates, contacts 23 and 24 of relay CO break, opening the holding circuit to relay LR. Also, operation of relay CO closes the T and R loop from the MDF through the 5–8 winding of the repeating coil, maintaining a holding connection to the central office. Contacts 21 and 22 close but have no function on incoming calls.

(2) *Relay LR restores.* When relay LR restores, contacts 5 and 6 open, removing battery from the lamp and extinguishing the lamp. Also, contacts 7 and 8 open to disconnect the busy test potential from the sleeve of the jack, and contacts 9 and 10 open the night alarm circuit.

c. Transmission, Operator and Distant Exchange. The transmission path from the distant exchange is over the T of the line (fig. 49.1) through the 5–7 winding of the repeating coil, make contacts 26 and 27 of relay CO, 6–8 winding of the repeating coil, break contacts 5 and 4 of relay DL, out over the R side of the line to the distant exchange. The transmission path to the operator is from terminal 1 of the repeating coil, through break contacts 2 and 1 of relay DL, T of the line jack, T of the answer cord (fig. 52.1), contacts of the ring answer-dial switch, capacitor C2, contacts of the ring call-talk switch, contacts of the GRP switch (fig. 51), capacitor C1, and contacts 22 and 21 of relay MO, to terminal 2 of the induction coil; through the induction coil to terminal 1, C2–R1 network, contacts 1 and 2 of relay MO, contacts of the GRP switch, contacts of the ring call-talk switch, capacitor C1 (fig. 52.1), R of the answer cord, R of the line jack (fig. 49.1), to terminal 4 of the repeating coil. The repeating coil inductively couples the transmission path between the operator and the distant exchange.

d. Operator Extends Call. To extend the call to a CB line, refer to paragraph 48*d*. To extend the call to an LB line, refer to paragraph 49*d*. To extend a call to a manual or dial exchange, refer to *e* below.

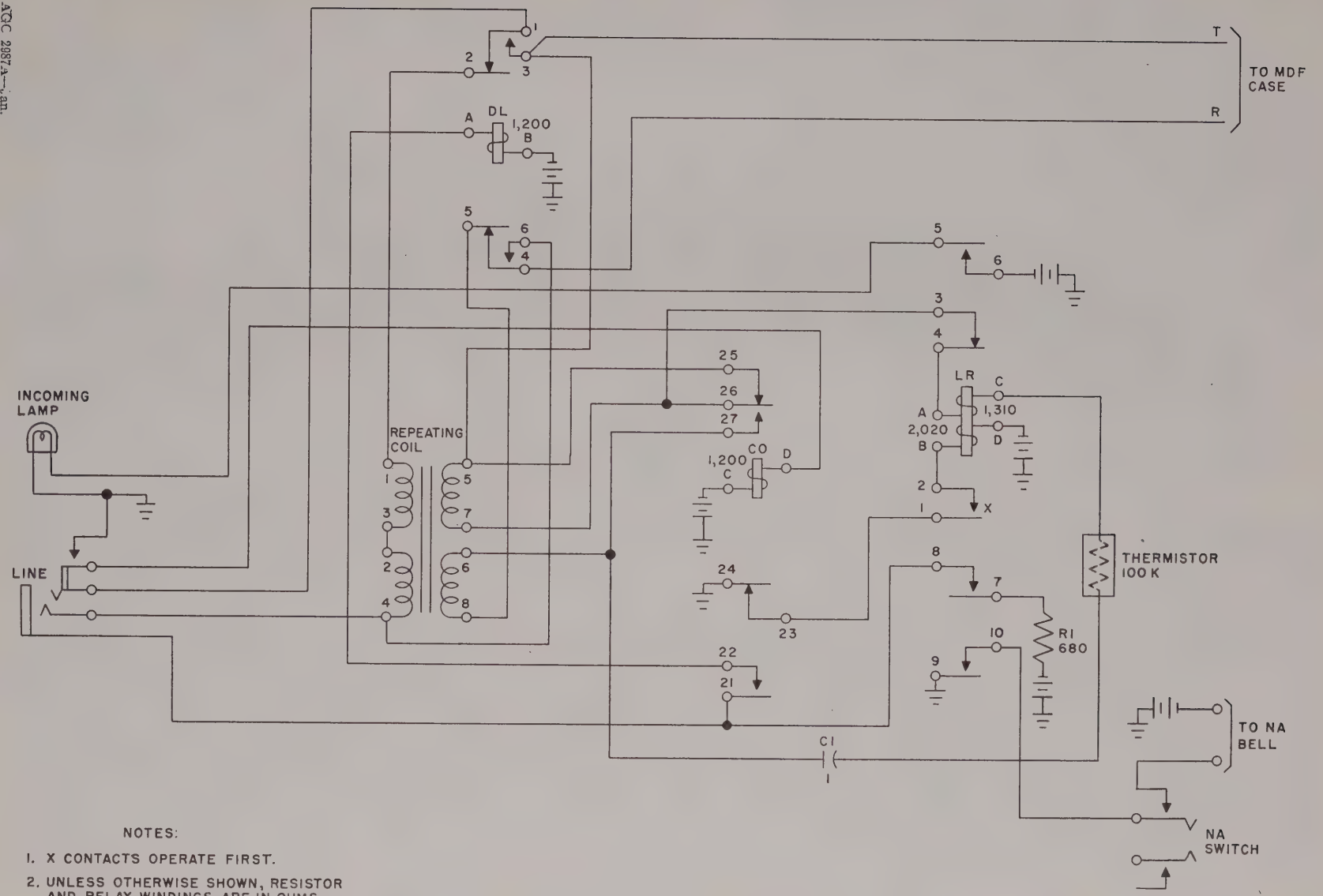
e. Operator Extends Call to Distant Exchange.

(1) *Manual exchange.* To signal a distant manual exchange, the operator inserts the call cord into a trunk circuit jack and operates the ring call-talk switch of the cord circuit to the talk position. The path for signaling the distant exchange is the same as the path used for transmission to the distant exchange described in *c* above.

(2) *Dial exchange.* To signal a distant dial exchange, the operator inserts the call cord into the trunk jack and operates the ring answer-dial switch to the dial position. The ring call-talk switch may be left in the talk position while dialing. Dial tone will be heard from the distant exchange, informing the operator that the dial equipment is ready to receive dial pulses. When the dial is moved off-normal (fig. 50.1), the off-normal springs operate, completing a circuit for relay DL from negative battery the C–A winding of relay DL, and the closed contacts of the dial to ground.

(*a*) *Relay DL operates* (fig. 50.1). When relay DL operates, contacts 5 and 6 close and apply ground to the DS lead, causing the trunk circuit to transfer the T and R loop of the seized equipment to the control of the dial impulse springs. Closing of contacts 1 and 2 short circuits the RE coil to establish a low resistance dialing path. Closing of contacts 3 and 4 completes the circuit for relay CO from negative battery through the C–A winding of relay CO, and contacts 4 and 3 of relay DL to ground.

(*b*) *Relay CO operates.* When relay CO operates, its contacts 1–2 and 3–4 open, opening the T and R leads to the talk switch. This removes the operator from the connection and prevents the operator from hearing loud clicks while dialing. The impulse springs open and close the dialing loop, transmitting the dial impulses to the distant office. After the



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Figure 49.1. (Added) *Manual or dial trunk circuit (108 through 260), schematic diagram.*

impulses have been transmitted, the off-normal springs restore, removing ground from relay DL.

(*c*) *Relay DL restores.* When relay DL restores, contacts 1 and 2 open, removing the short circuit from the RE coil. The RE coil remains bridged across the DT and DR leads to hold the equipment in the distant exchange. Contacts 3 and 4 open, removing ground from relay CO which restores. Contacts 5 and 6 open; removing ground from the DS lead causing relay DL in the trunk circuit to restore and reconnect the repeating coil across the trunk.

(*d*) *Relay CO restores.* When relay CO restores, its contacts 1–2 and 3–4 close and reconnect the operator's circuit, establishing the talking circuit between the operator and the called party. Relay CO remains operated a few milliseconds because of its slow release characteristics to prevent loud clicks from being heard by the operator.

Note. Each digit dialed will cause the circuit to function as described in (*a*) through (*d*) above.

(*e*) *Dial wipe-out switch.* If the operator makes an error in dialing, operation of the dial wipe-out switch through its X contacts completes an alternate circuit to hold relay DL operated from negative battery through the C–A winding of relay DL, the X contacts of the dial wipe-out switch, to ground. The operation of the Y break contacts then opens the dialing loop, releasing the equipment in the dial central office. When the wipe-out switch is restored to normal, the Y contacts make before the X contacts break, reclosing the loop and reseizing the equipment in the dial central office. The X contacts restore, opening the circuit to relay DL; the circuit is returned to the control of the dial, and the proper number may be redialed.

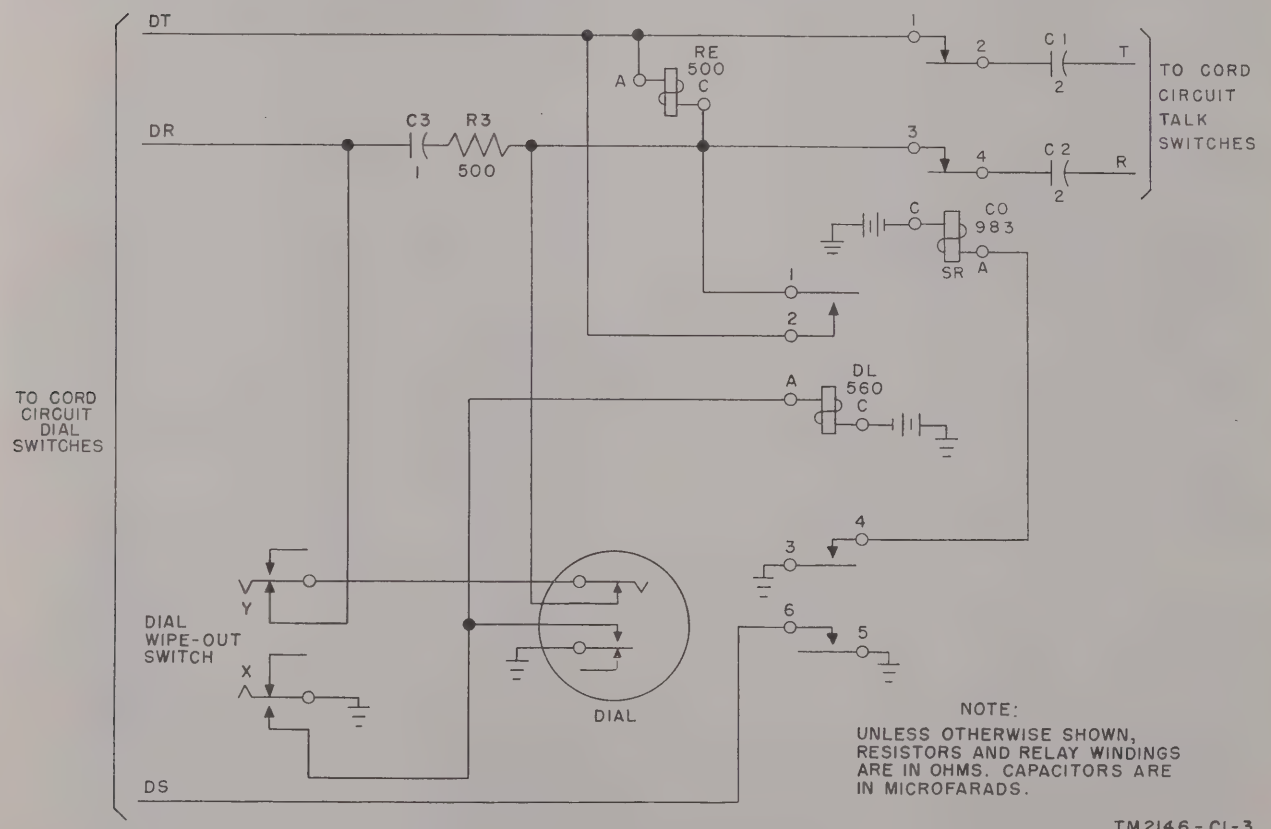


Figure 50.1. (Added) *Dial circuit (322 through 780), schematic diagram.*

52. Universal Cord Circuit
(fig. 52 **or 52.1**)

The circuit operation * * * universal cord circuit. The universal cord circuit **(1 through 321)** includes a cord circuit switch, a recall relay (RU) and lamp, an answering cord with its RS and RB relays, and a calling cord with its FS and FB relays. **The universal cord circuit (322 through 780) includes a ring call-talk switch, a ring answer-dial switch, a recall relay (RU) and lamp, an answering cord with its RS and RB relays, and a calling cord with its FS and FB relays.**

* * * * *

a.1. (Added) *Cord Circuit Switches (322 through 780).*

(1) *Ring call-talk switch.* When the switch is operated to the talk position, it bridges the T and R of the operator's telephone circuit to the T and R of the cord circuit. When the switch is operated to the ring call position, it completes the path from the ringing circuit to the call cord.

(2) *Ring answer-dial switch.* When the switch is operated to the dial position, it provides a dialing circuit for the call cord. When the switch is operated to the ring answer position, it completes the path from the ringing circuit to the answer cord.

* * * * *

*d. Relay Operation **(1 through 321).*** The operate path * * * are listed below.

Note. (Added) Relay operation (322 through 780) is identical with that described below except the operate paths include the contacts of the ring answer-dial switch and/or the ring call-talk switch.

* * * * *

62. Trouble Locating Procedures, Manual and Dial Trunks
(figs. 49 **or 49.1,** 61 **or 61.1**)

Be sure that * * * each symptom below.

a. Manual or Dial Central Office Cannot Signal Operator.

* * * * *

(2) *Trouble between trunk relay case and MDF.*

* * * * *

(*c*) At the trunk relay case, connect a test receiver across contacts 24 and 25 of relay CO **(1 through 107) or contacts 26 and 27 or relay CO (108 through 260).**

* * * * *

(*e*) If the tone is not heard, connect the receiver across contacts 1 and 3 of relay DL **(1 through 107) or contacts 3 and 5 of relay DL (108 through 260).** If the tone * * * the repeating coil.

* * * * *

b. *Operator Cannot Signal Manual Central Office.*

(1) *Trouble sectionalization.*

* * * * *

(*e*) If relay CO operates, connect a test receiver across contacts 1 and 2 of relay DL **(1 through 107) or contacts 3 and 5 of relay DL (108 through 260),** and instruct the man at the switchboard to operate the cord circuit switch to the ring position. If tone is * * * ((3) below).

(2) *Trouble between trunk relay case and MDF.*

(*a*) At the trunk * * * and ring again. If tone is not heard, the trouble lies in dirty or defective contacts 3 and 4 of relay DL **(1 through 107) or contacts 4 and 5 of relay DL (108 through 260),** dirty or defective MDF receptacle contacts, a defective cable or in the involved interior wiring.

* * * * *

c.1. (Added) *Operator Cannot Seize Dial Central Office (322 through 780).*

(1) Insert the call cord into the trunk jack and operate the ring answer-dial switch to the dial position.

(2) If dial tone is not heard, connect the test receiver to terminals A and C of retard coil RE (fig. 50.1). If dial tone is heard in the test receiver, the trouble lies in the winding of the retard coil, dirty contacts 1 and 2 or 3 and 4 of relay CO, or defective capacitor C1 or C2. If dial tone is not heard in the test receiver, the trouble lies in the contacts of the dial or dial wipeout switch.

(3) If relay CO operates correctly, connect a test receiver across contacts 26 and 27 of

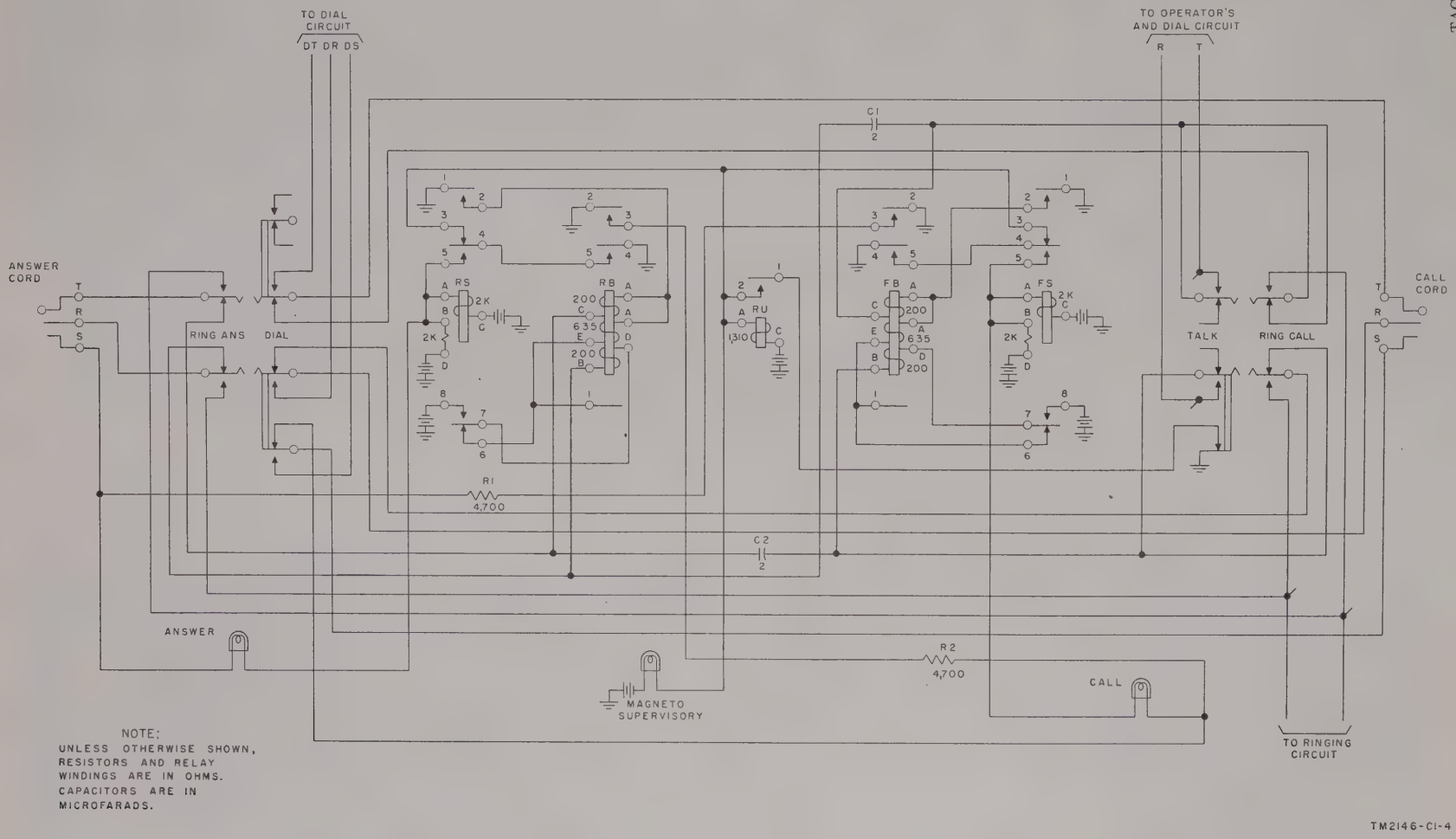


Figure 52.1. (Added) *Universal cord circuit (322 through 780), schematic diagram.*

relay CO (fig. 49.1). If dial tone is heard from the central office, the trouble lies in contacts 26 and 27 of relay CO.

(4) If dial tone is not heard, connect the receiver across contacts 3 and 5 of relay DL (fig. 49.1). If dial tone is heard, the trouble lies in the secondary winding of the repeating coil.

(5) If dial tone is not heard, connect the receiver across the correct T and R contacts on the rear of the plug connected to the trunk relay case MDF receptacle. If dial tone is heard, the trouble lies in contacts 4 and 5 of relay DL (fig. 49.1), in the receptacle contacts, or in the interior wiring.

(6) If dial tone is not heard, proceed to the MDF and connect the receiver across the correct T and R contacts at the rear of the cable plug. If dial tone is heard, the cable between the trunk relay case and the MDF is defective. If dial tone is not heard, the trouble lies in the MDF receptacle, the connections at the T and R binding posts, or the associated interior wiring.

* * * * *

e. (Added) *Operator Cannot Step Automatic Equipment at Dial Central Office (322 through 780).*

(1) Insert the call cord into the jack of the trunk in trouble and operate the ring answer-dial switch to the dial position.

(2) If relay D1 of the dial circuit (fig. 50.1) does not operate when the dial is turned off-normal, the fault lies in the winding of relay DL or the contacts of the dial.

(3) If relay DL of the dial circuit does operate, the fault lies in the pulsing contacts of the dial, or contacts 5 and 6 of relay DL in the dial circuit.

(4) If relay DL of the trunk circuit is not operated, the fault lies in the winding of relay DL, dirty contacts 21 and 22 of relay CO, or the S lead between the switchboard and the trunk case.

(5) If relay DL of the trunk circuit is operated, the fault lies in the contacts of relay DL, or the dial mechanism.

f. (Added) *Operator Hears Clicks in Ear (322 through 780).*

(1) If relay CO of the dial circuit is not operated, the fault lies in the winding of relay DL of the dial circuit, contacts 3 and 4 of relay DL of the dial circuit, or the winding of relay CO of the dial circuit.

(2) If relay CO of the dial circuit is operated, the fault lies in contacts 1 and 2 or 3 and 4 of relay CO of the dial circuit.

64. Troubleshooting Chart

Symptom	Probable trouble	Corrections
* *	* *	* *
3. Incoming trunk signal lamps fail to light.	*a.* Faulty incoming connections at line side of MDF.	*a.* Reconnect incoming trunk line.
* *	* * *	* *
	e. Dirty or defective contacts 21 and 22 of relay CO **(1 through 107).**	*e.* Clean or adjust contacts.
	e.1. (Added) **Dirty or defective contacts 23 and 24 of Relay CO (108 through 260).**	*e.1.* **Clean or adjust contacts.**
* *	* * *	* *
5. Operator cannot seize dial central office (no dial tone).	*a.* Faulty connections or binding posts at MDF.	*a.* Check * * * posts.
* *	* * *	* *
	b. Faulty contacts 3 and 4 of relay DL **(1 through 107).**	*b.* Clean or adjust contacts.
	b.1. (Added) **Faulty contacts 4 and 5 of relay DL (108 through 260).**	*b.1.* **Clean or adjust contacts.**
	c. Faulty contacts 24 and 25 of relay CO **(1 through 107).**	*c.* Clean or adjust contacts.
	c.1. (Added) **Faulty contacts 26 and 27 of relay CO (108 through 260).**	*c.1.* **Clean or adjust contacts.**
* *	* * *	* *

Symptom	Probable trouble	Corrections
	k. (Added) **Defective retard coil RE (322 through 780).**	*k.* **Replace retard coil.**
	l. (Added) **Defective dial mechanism.**	*l.* **Replace dial.**
	m. **Dirty contacts of dial wipe-out switch (322 through 780).**	*m.* **Clean or adjust contacts.**
6. Operator * * * office.	*a.* Faulty dial jack or dial contacts.	*a.* Clean or repair contacts.
* *	* * *	* *
	c. (Added) **Faulty winding of relay DL (322 through 780).**	*c.* **Replace relay DL.**
	d. (Added) **Dirty contacts of dial wipe-out switch (322 through 780).**	*d.* **Clean or adjust contacts.**
7. Operator cannot signal manual central office.	*a.* Faulty contacts 24 and 25 of relay CO **(1 through 107).**	*a.* Clean or adjust contacts.
	a.1. (Added) **Faulty contacts 26 and 27 of relay CO (108 through 260).**	*a.1.* **Clean or adjust contacts.**
	b. Faulty contacts 3 and 4 of relay DL **(1 through 107).**	*b.* Clean or adjust contacts.
	b.1. (Added) **Faulty contacts 4 and 5 of relay DL (108 through 260).**	*b.1.* **Clean or adjust contacts.**
* *	* * *	* *
22. (Added) **Operator hears clicks in ear (322 through 780 only).**	*a.* **Faulty winding of relay DL.**	*a.* **Replace relay DL.**
	b. **Dirty contacts of relay DL.**	*b.* **Clean or adjust contacts.**
	c. **Faulty winding of relay CO.**	*c.* **Replace relay CO.**
	d. **Dirty contacts of relay CO.**	*d.* **Clean or adjust contacts.**
23. (Added) Operator cannot wipe-out number dialed **(322 through 780 only).**	*a.* **Dirty contacts of dial wipe-out switch.**	*a.* **Clean or adjust contacts.**

69. Relay Adjustment Tables

* * * * *

b. Relay Adjustment Tables. The following (1) through **(6)** give the electrical requirements for relays used in the AN/TCC–7.

* * * * *

(3) *Trunk circuit,* ***1 through 107*** (fig. 49).

* * * * *

(3.1) Added) *Trunk circuit,* ***108 through 260*** (fig. 49.1).

Relay	Block or insulate	Test set lead	Test point	Test winding	Test for	Readjust ma	Test ma	Remarks
DL	DL(1,3)	Pos bat.	CO(22)	A–B	O	18	20	
					NO	10	9	
CO	CO(26,27)	Pos bat.	CO(D)	C–D	O	21	23	
					NO	17	15.5	
LR	LR(5,6)	Pos bat.	LR(2)	B–D	O	8.2	8.7	X contacts only.
					NO	6.7	6.2	X contacts only.
					O	16	17.5	Battery on contact 6.
					NO	13	11.5	

* * * * * * *

(6) (Added) *Dial circuit, 322 through 780* (fig. 50.1).

Relay	Block or insulate	Test set lead	Test point	Test winding	Test for	Readjust ma	Test ma	Remarks
DL	CO(NO) DL (5,6)	Pos bat.	DL(A)	A–C	O	10	11	
					NO	6.5	6	
CO		Pos bat.	DL(4)	A–C	O	12.5	13.5	
					NO	11	10	

73. Cord Circuit Switches

To replace a defective cord circuit switch, follow the instructions given below.

a. Raise the switchboard key shelf to the position shown in figure 57 **or 57.1.**

* * * * *

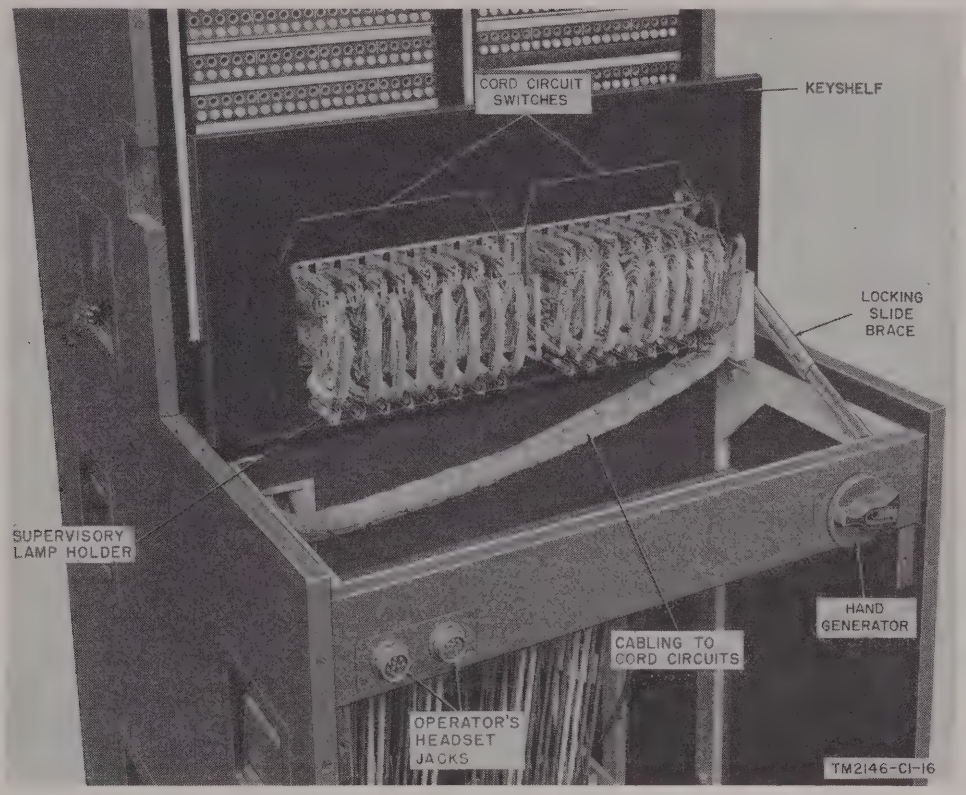
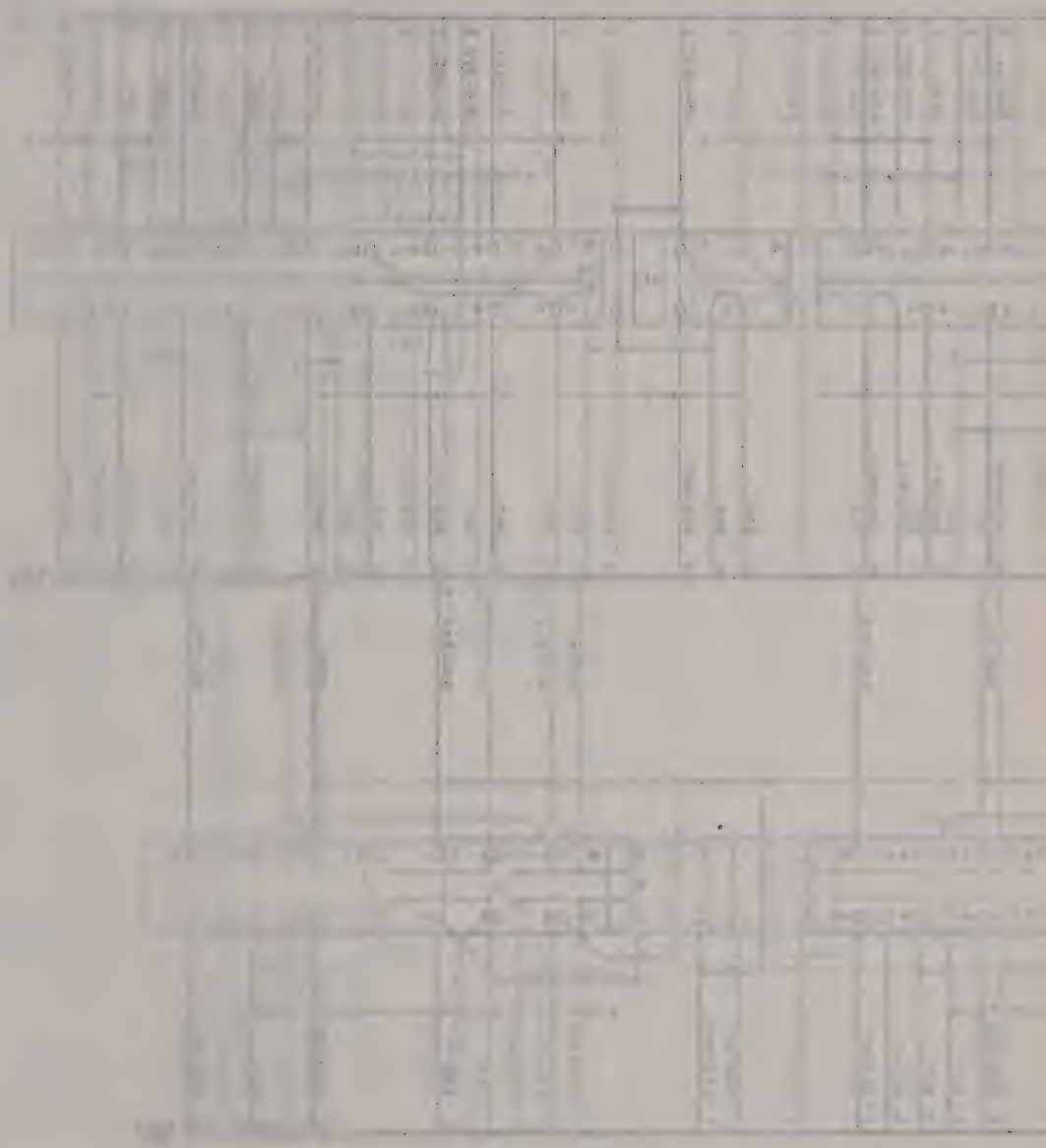


Figure 57.1. (Added) *Switchboard showing underside of key shelf (322 through 780).*



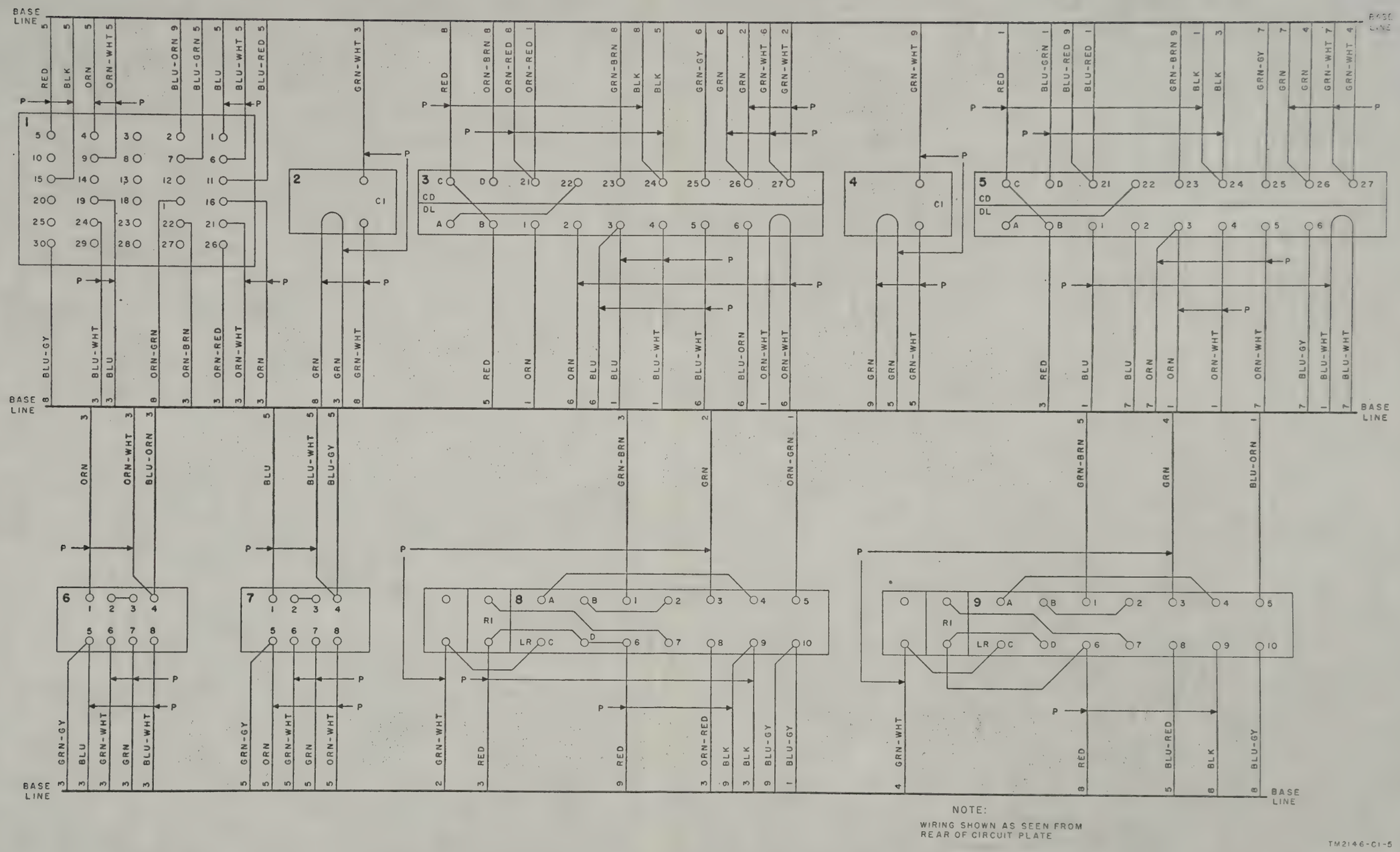


Figure 61.1. (Added) *Trunk Relay Telephone Circuit TA-226/TTC (108 through 260), trunk circuit plate, wiring diagram.*



BASE LINE
GRN-WHT 4
GY-WHT 5
ORN-WHT 17
BRN-WHT 19
BLU-WHT 3
WHT 3
RED 6
RED 8
BLU-ORN 1
BLK 6
BLU-BRN 23
BLU-GRN 1
7
26 25 24 23 22 21 C
MO
6 5 4 3 2 1 A
8
6 5 4 3 A
DL
2 1 C
P
4 GRN
5 GY
17 ORN
19 BRN
3 BLU
3 BLU-ORN
1 BLU-GRN
23 ORN
1 ORN
1 BRN
23 BRN
7 RED
BASE LINE
BLU 1
BLU 23
ORN 24
ORN 8
BLU 22
RED 6
RED 1
22
C1
C2
23
1 2 C
CO
3 4 A
24
RE
A C
1 BLU-WHT
23 BLU-WHT
8 BRN
24 BRN
22 BLU-WHT
8 BLU-BRN
23 ORN
23 BRN
BASE LINE

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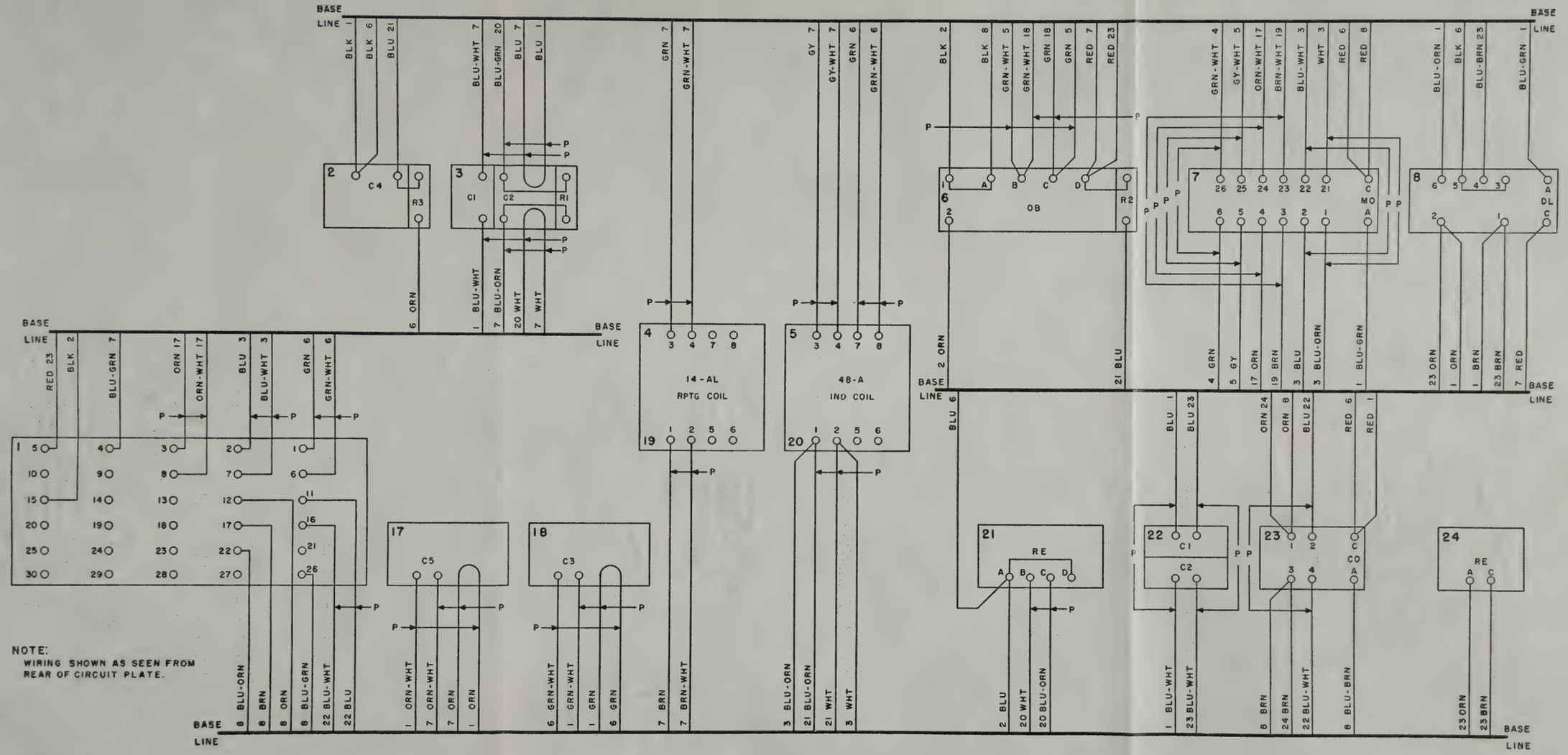
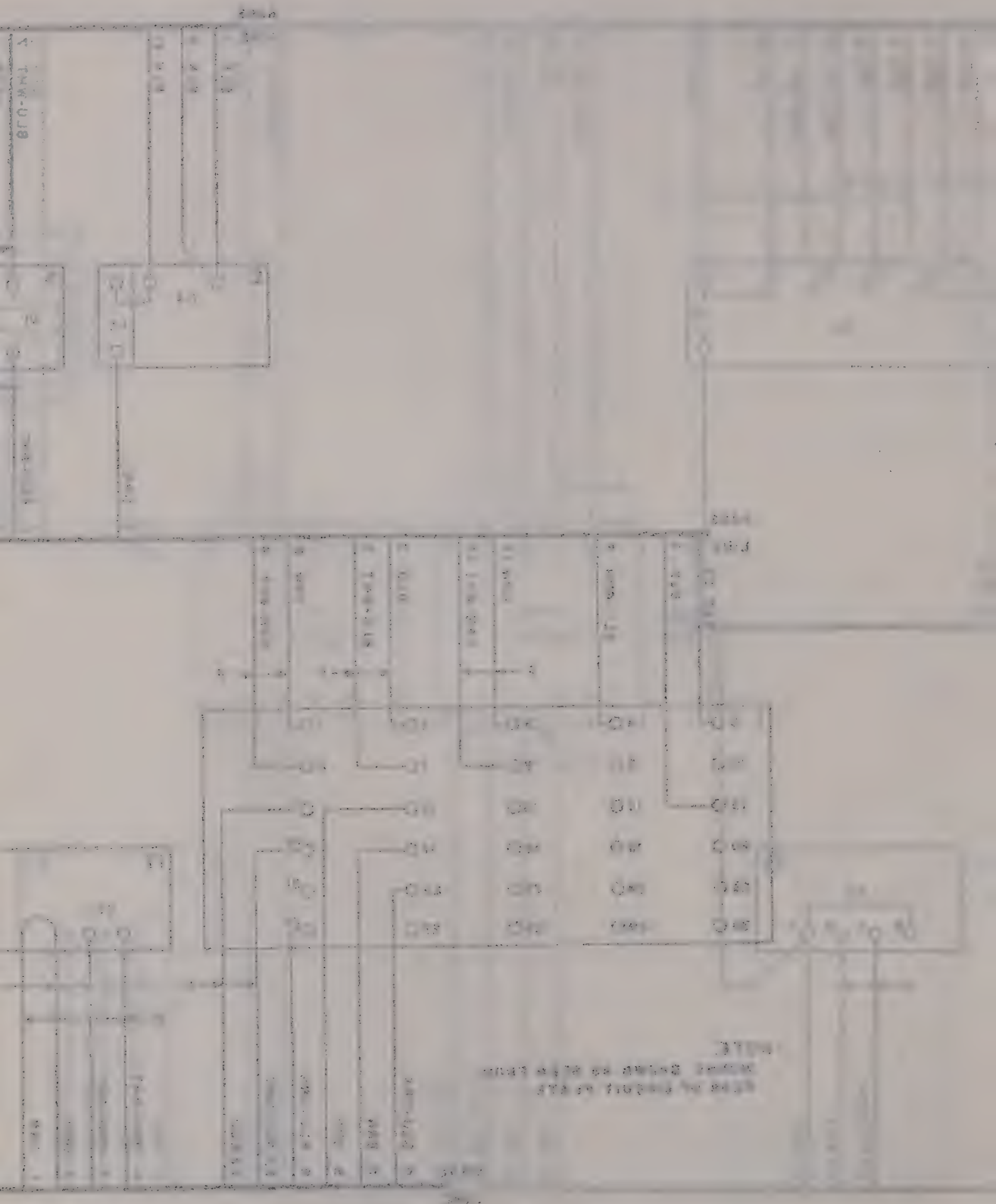


Figure 63.1. (Added) *Manual Telephone Switchboard SB-249/TTC (322 through 780), dial and operator's circuit plate, wiring diagram.*

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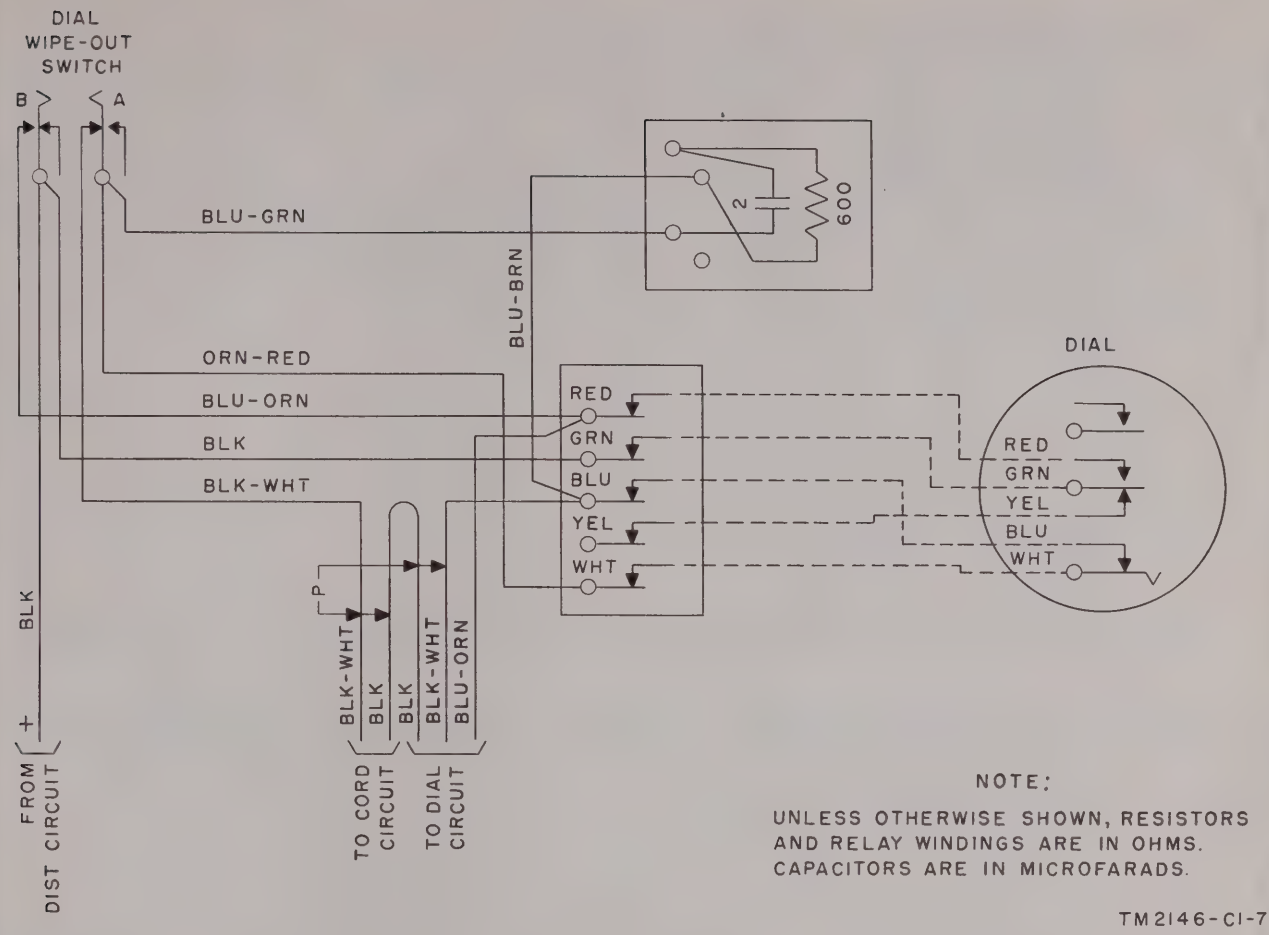


Figure 65.1. (Added) *Manual Telephone Switchboard SB–249/TTC (322 through 780), switchboard dial circuit, wiring diagram.*

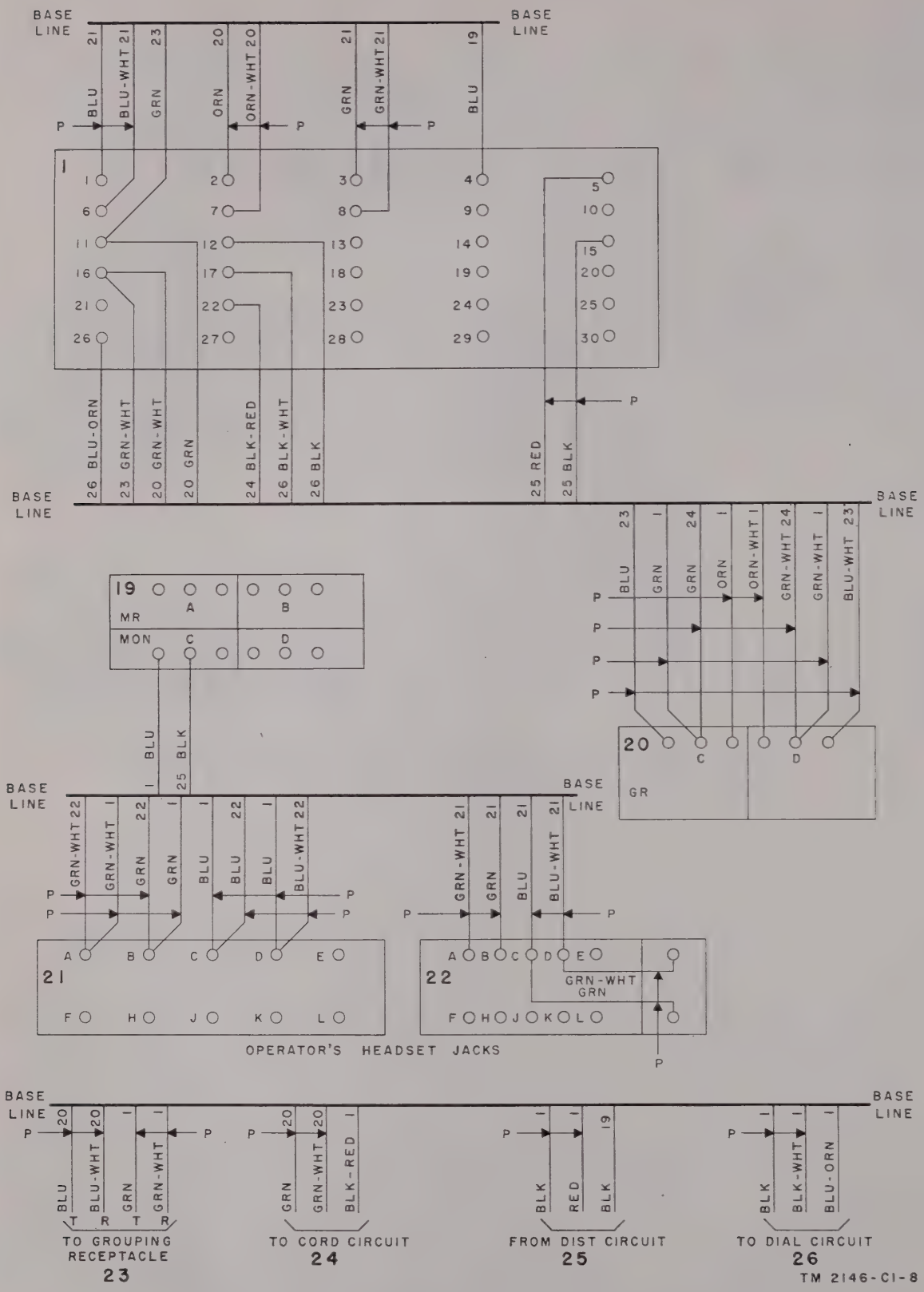
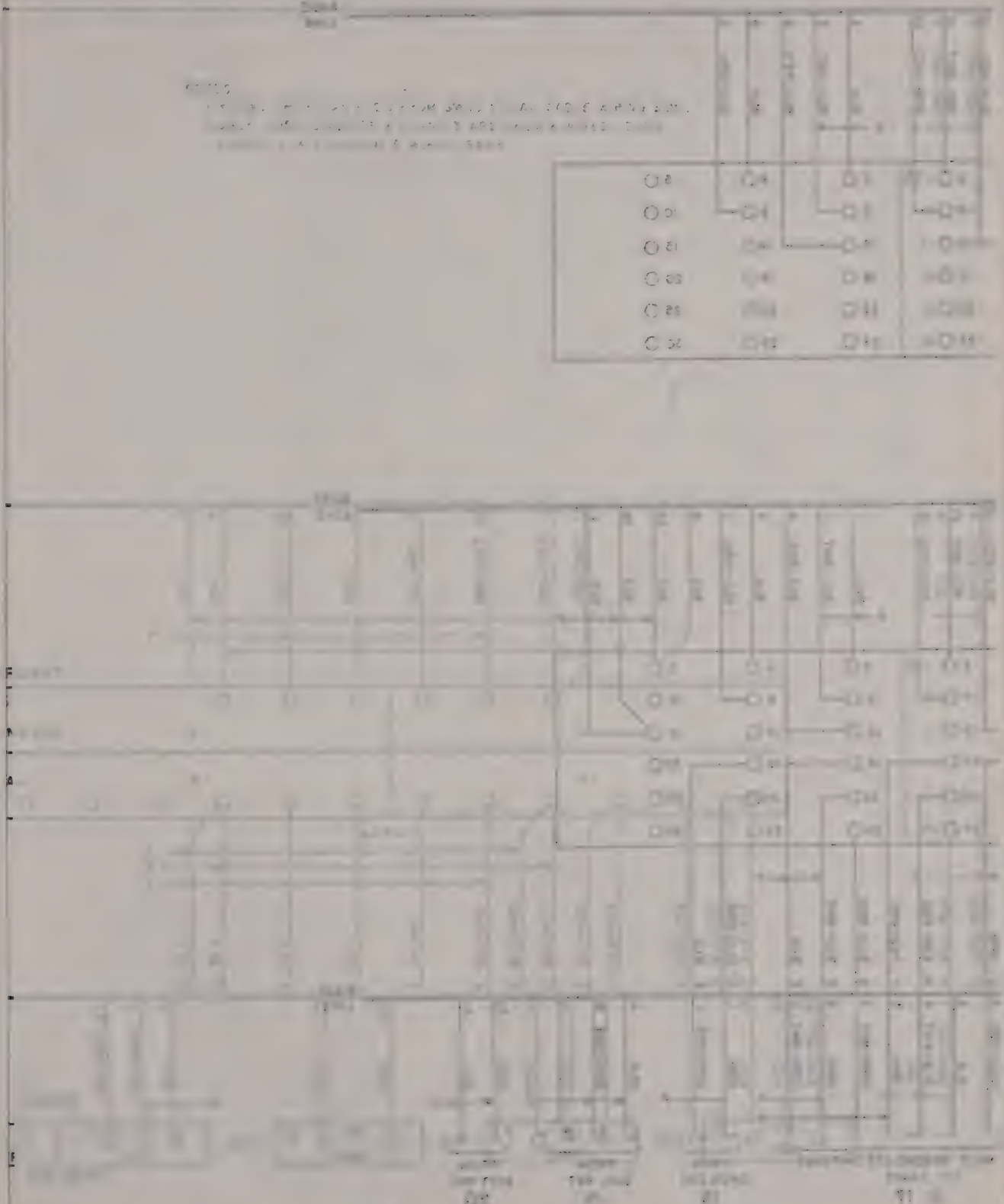


Figure 66.1. (Added) *Manual Telephone Switchboard SB-249/TTC (322 through 780), operator's and grouping circuit, wiring diagram.*



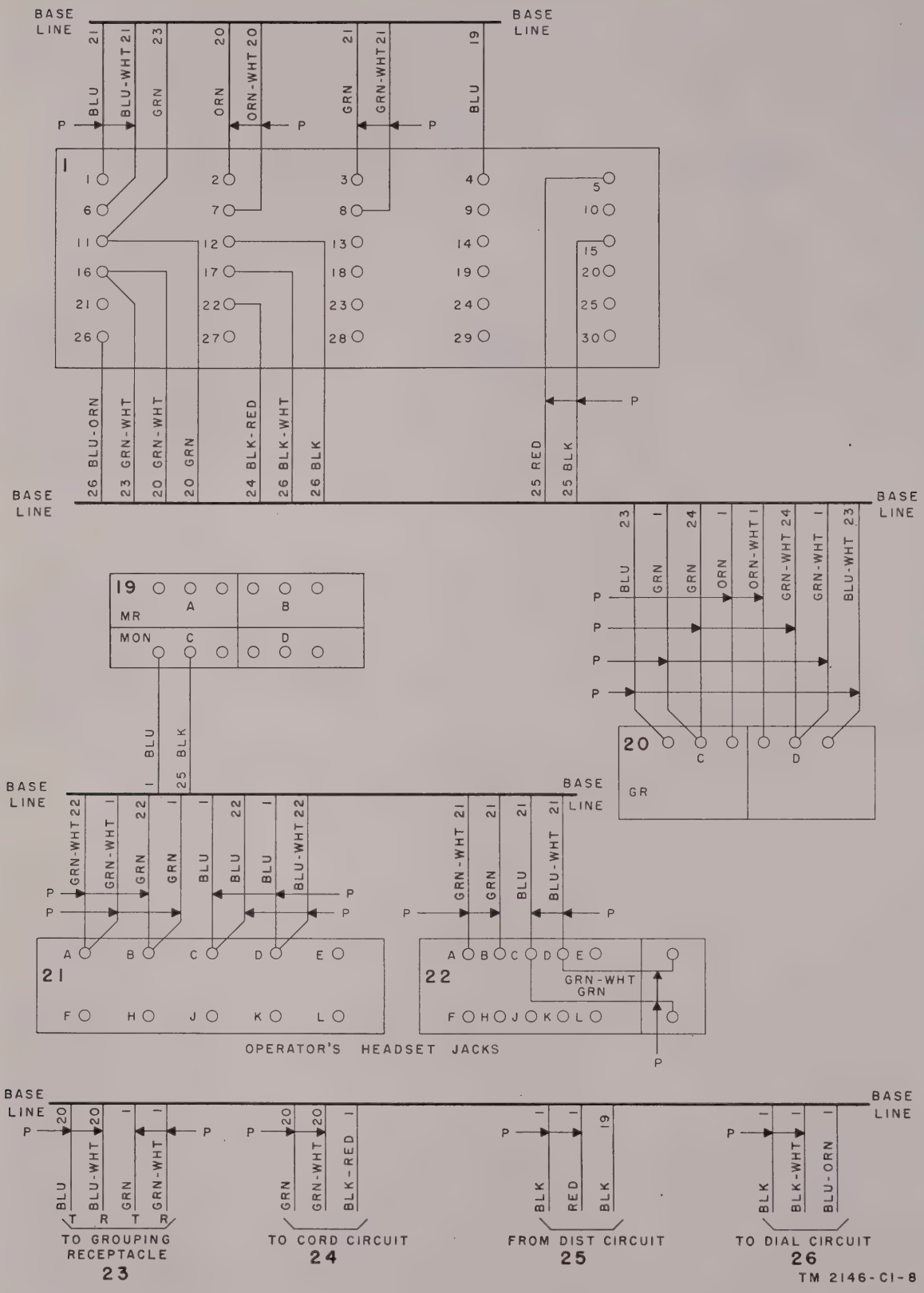


Figure 66.1. (Added) *Manual Telephone Switchboard SB–249/TTC (322 through 780), operator's and grouping circuit, wiring diagram.*

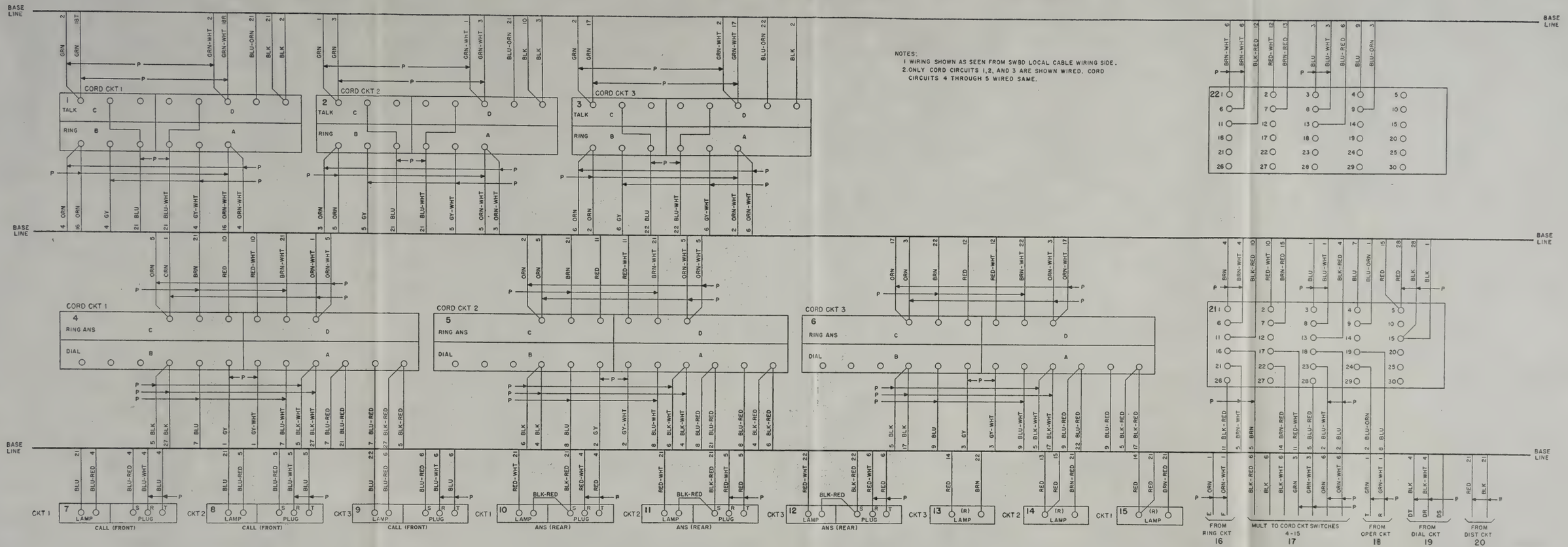
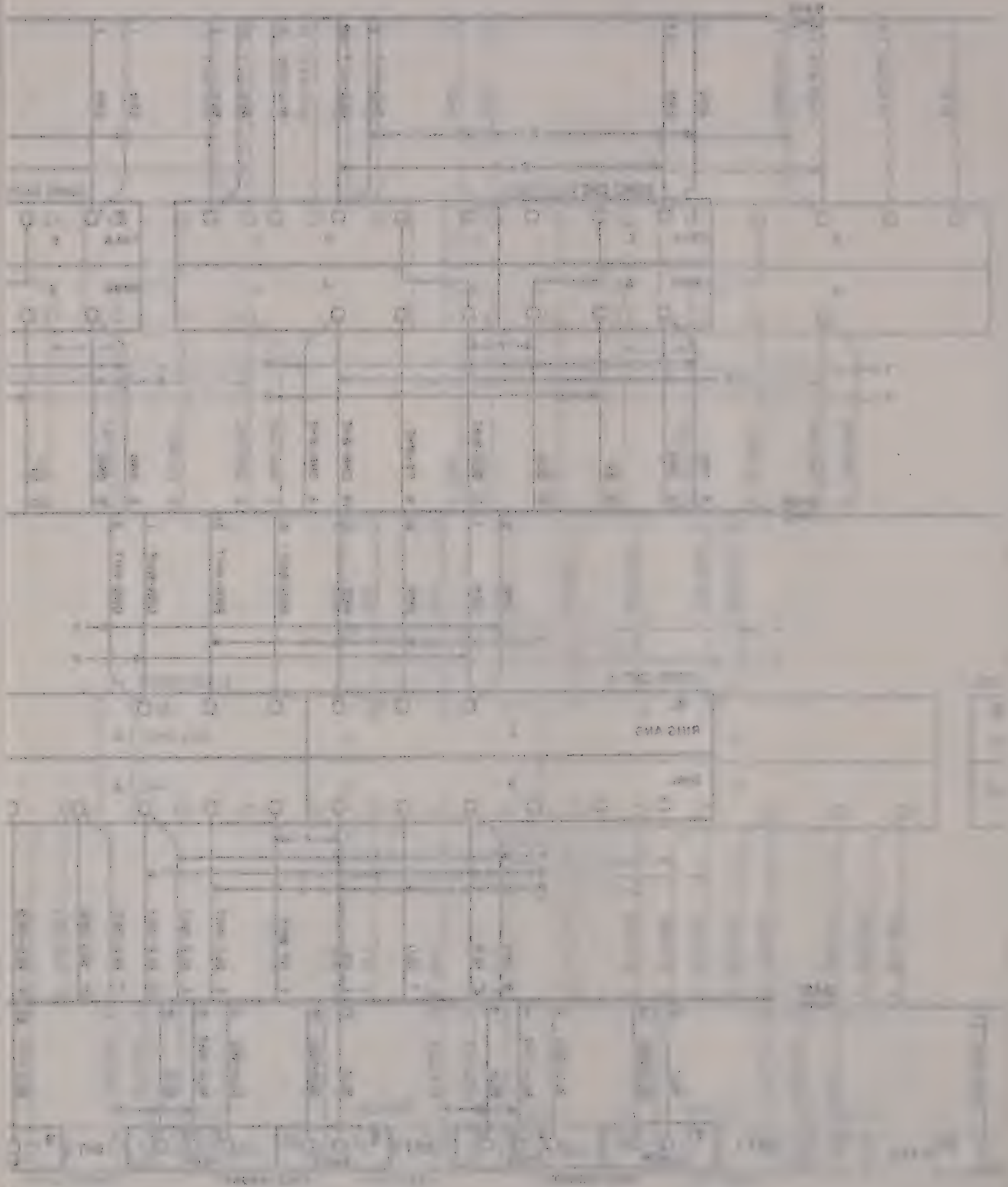
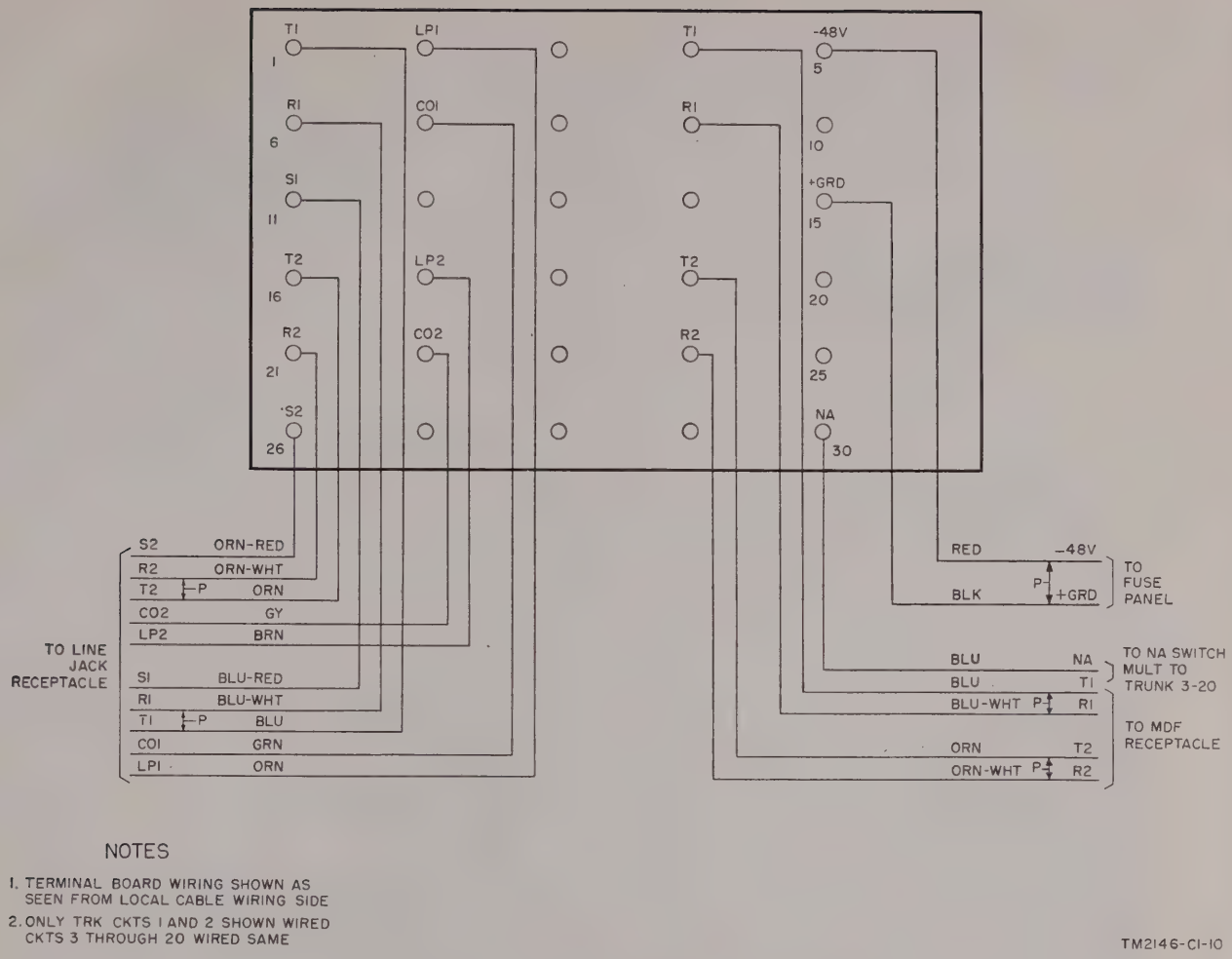


Figure 67.1. (Added) *Manual Telephone Switchboard SB-249/TTC (322 through 780), universal cord circuit, wiring diagram.*





NOTES

1. TERMINAL BOARD WIRING SHOWN AS SEEN FROM LOCAL CABLE WIRING SIDE
2. ONLY TRK CKTS 1 AND 2 SHOWN WIRED CKTS 3 THROUGH 20 WIRED SAME

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Figure 105.1. (Added) *Trunk Relay Telephone Circuit TA-226/TTC (108 through 260), trunk circuit plate terminal board, wiring diagram.*

[AG 413.44 (9 Dec. 54)]

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General, United States Army,
Chief of Staff.

Official:
JOHN A. KLEIN,
Major General, United States Army,
The Adjutant General.

N. F. TWINING,
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11–597A, Sig Base Depot Co (2)

NG: None.
USAR: None.
Unless otherwise noted, distribution applies to CONUS and overseas.
For explanation of abbreviations used, see SR 320–50–1.

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TECHNICAL MANUAL
No. 11-2146
TECHNICAL ORDER
No. 16-30TCC7-15

DEPARTMENTS OF THE ARMY AND
THE AIR FORCE
WASHINGTON 25, D. C., 6 October 1954

MANUAL TELEPHONE CENTRAL OFFICE AN/TTC-7

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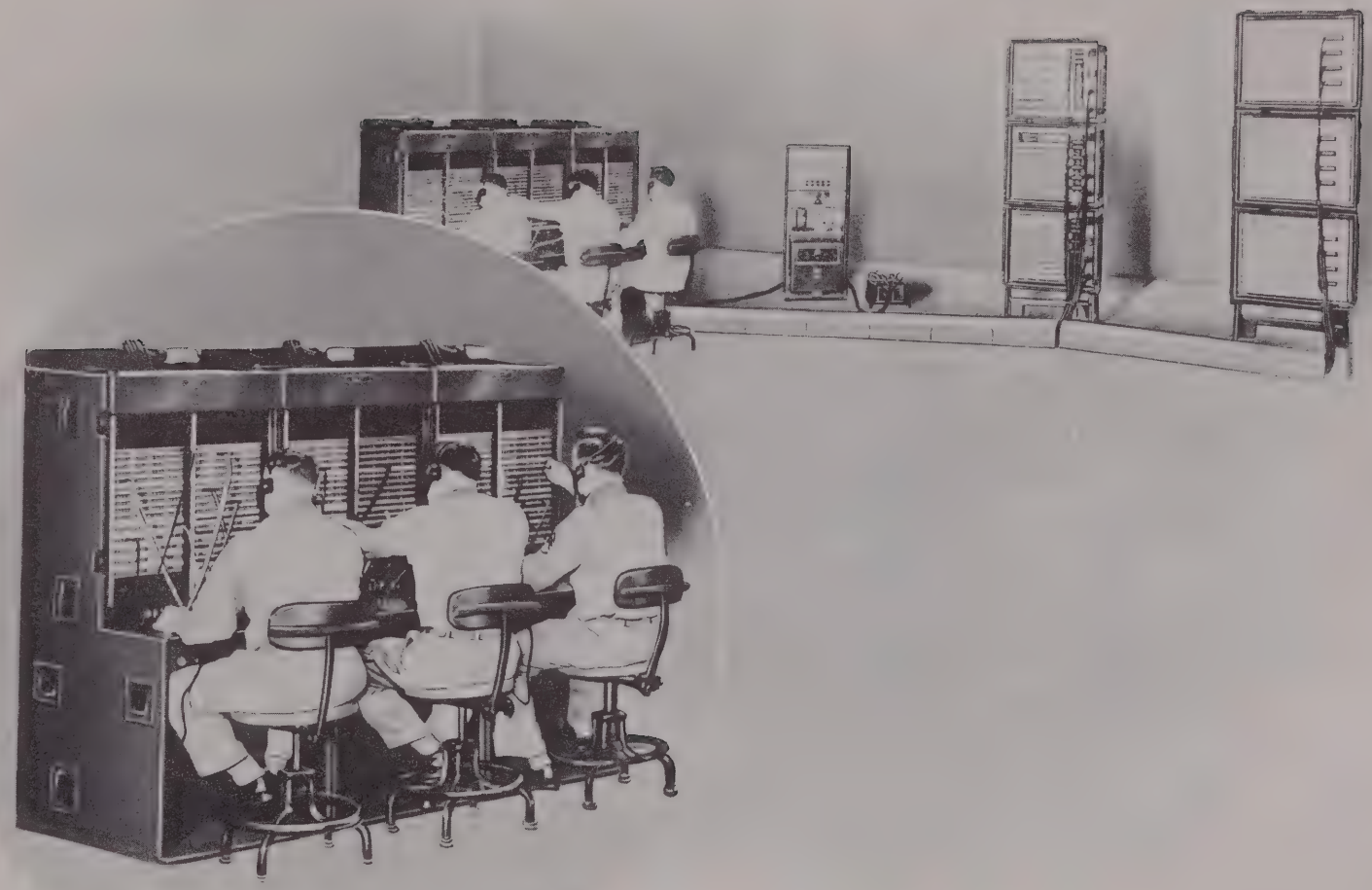
WARNING

HIGH VOLTAGE

is used as the incoming power supply
to this equipment.

DEATH ON CONTACT

may result if operating personnel fail
to observe safety precautions.



TM 2146-1

Figure 1. Manual Telephone Central Office AN/TTC-7, operational view.

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. These instructions are published for the information and guidance of the personnel to whom this equipment is issued. They contain information covering the description, installation, operation, and maintenance of Manual Telephone Central Office AN/TTC–7.

b. A list of nomenclature assignments for the AN/TTC–7 is given below. A common usage name is indicated after each major component.

Nomenclature	*Common name*
Manual Telephone Central Office AN/TTC–7	Central Office
Manual Telephone Switchboard SB-249/TTC	Switchboard
Line Relay Telephone Circuit TA-224/TTC	CB line relay case
Line Relay Telephone Circuit TA-223/TTC	CB-LB line relay case
Trunk Relay Telephone Circuit TA-226/TTC	Trunk relay case
Telephone Main Distributing Frame TA-257/TTC	Main distributing frame or MDF
Panel BD-132-A	Power board

Note. Basic nomenclature followed by ( ) is used to indicate all models of an item of equipment.

2. Forms and Records

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

a. DD Form 6, Report of Damaged or Improper Shipment, will be filled out and forwarded as prescribed in SR 745–45–4 (Army) Navy Shipping Guide, Article 1850–4, 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 Material Command, Wright-Patterson Air Force Base, Dayton, Ohio, as prescribed in SR 700–45–5 and AFR 65–26.

d. DA Form 11–242, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Telephone Central Office Set), will be prepared in accordance with instructions on the back of the form (fig. 45).

e. DA Form 11–243, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Telephone Central Office Set), will be prepared in accordance with instructions on the back of the form (fig. 46).

f. Use other forms and records as authorized.

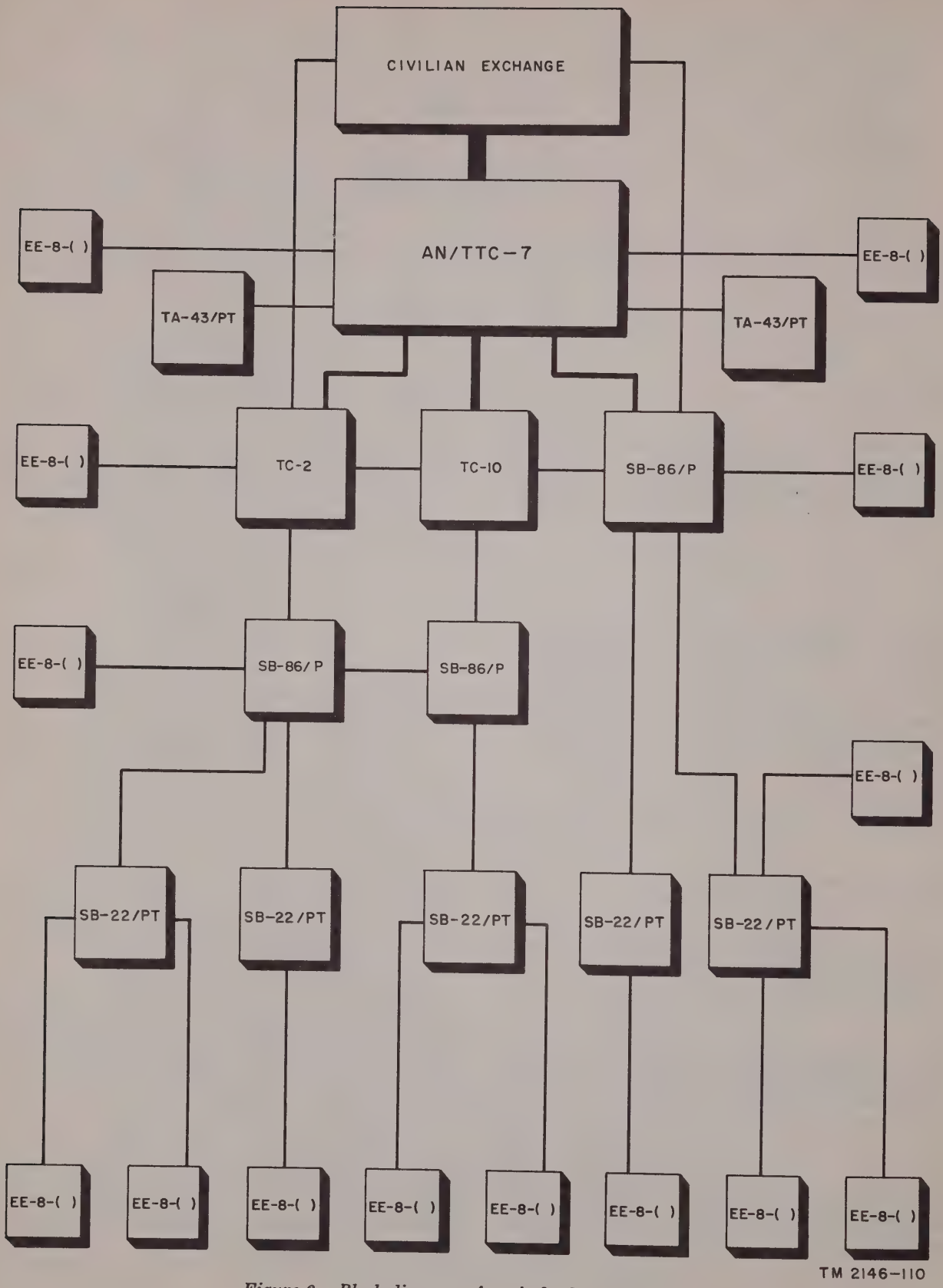


Figure 2. Block diagram of typical telephone system.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

Manual Telephone Central Office AN/TTC–7 (fig. 1) is a complete transportable telephone exchange. It is designed for use at any headquarters requiring telephone facilities. The AN/TTC–7 can be installed and put into operation rapidly, and can be dismantled and moved in a relatively short time.

a. Three common battery switchboard positions and relay equipment for 200 lines and 20 trunks, with the necessary power equipment, are provided for an initial installation. This equipment, which is displayed on a two-panel multiple basis, is covered in detail in this manual.

b. Each switchboard position is equipped with 15 cord circuits. This permits 45 simultaneous calls.

c. The face equipment of each switchboard position is factory-wired to accommodate 500 lines and 80 trunks. The extra facilities in the face equipment are provided for the normal growth and expansion of the exchange. For each 200-line addition, three more switchboard positions are required. If more than 400 lines are to be accommodated, the multiple should be planned on a four panel basis. On this four panel basis, the exchange can be expanded to accommodate 1,000 lines and 160 trunks. Additional cables will be required whenever 2 or more Central Offices AN/TTC–7 are combined.

Note. The bottom group on the right panel of each position is reserved for the future addition of trunk circuits that are not supplied with the central office. The bottom group on the left panel of each position consists of common battery-local battery (CB–LB) line jacks equipped with designation strips. The manual or dial trunk circuits provided at this time will terminate in this group.

4. System Application

a. Two-panel Multiple. Normally, the AN/TTC–7 serves 200 common battery (CB) or CB–LB lines and 20 trunks. The lines are displayed on a two-panel basis; each panel is multipled to corresponding panels on the other two switchboard positions. When the number of lines served exceeds 200, but is less than 400, the two-panel multiple may still be used with three additional positions. In this way, a six-position, two-panel multiple can accommodate 400 lines. Since additional cables (CX–2584/U (8 feet long)) are needed for this arrangement, it is advisable to use the four-panel multiple whenever two or more Central Offices AN/TTC–7 are combined.

b. Four-panel Multiple. When the number of lines exceeds 400, a four-panel multiple should be used. In a four-panel multiple, the line and trunk units are connected to positions 1 and 2. The panels on position 1 are then multipled to corresponding panels on all the odd-numbered positions in the exchange; the panels on position 2 are multipled to corresponding panels on all the even-numbered positions. In any case, the number of positions used in the exchange will depend on the number of lines served and the traffic rate. Each additional 200 lines requires three additional switchboard positions for optimum service; an office serving 1,000 lines will usually consist of 15 positions, or three positions for each 200 lines.

c. Trunking. The lines that terminate in the AN/TTC–7 are equipped with local or common battery telephones. A typical trunking diagram is illustrated in figure 2.

5. Technical Characteristics

Lines served	200
Trunks served	20
Operation	Common battery and local battery.
Protection	1 lightning arrestor for each line (located on MDF).
Power source requirements	110 volts ac and 48 volts dc.
Maximum CB line loop resistance	1,500 ohms.
Minimum CB line leakage resistance	10,000 ohms.
Maximum LB line loop resistance	3,500 ohms.

Minimum LB line leakage resistance..... 10,000 ohms.
Maximum trunk loop resistance..... 1,500 ohms.
Minimum trunk line leakage resistance..... 10,000 ohms.
Ringing..... 20 cycle ac at 90 volts.
Operating battery voltage limits..... 44 to 54 volts dc.
Dial characteristics..... 8 to 12 pulses per second.

6. Packaging Data

When packaged for shipment, the various components of Manual Telephone Central Office AN/TTC–7 are inclosed in wooden crates. The quantity, dimensions, volume, weight, and contents of each crate are listed in the table below. In some instances, as indicated in the table, a number of components are placed together in a single case before insertion into a wooden shipping crate. In other instances, a single component, such as Panel BD–132–A or Line Relay Telephone Circuit TA–223/TTC, is crated individually. Refer to paragraph 18 for detailed information concerning packaging and unpacking instructions.

No. of crates	Contents per crate	Height (in.)	Width (in.)	Depth (in.)	Volume (cu ft)	Weight (lb)
3	1 Manual Telephone Switchboard SB-249/TTC	47 1/8	92 3/4	44 3/4	113	1,280
3	1 Telephone Main Distributing Frame TA-257/TTC	21 7/16	38	31 5/8	15.3	237
1	1 Line Relay Telephone Circuit TA-223/TTC	21 7/16	38	31 5/8	15.3	348
1	1 Line Relay Telephone Circuit TA-224/TTC	21 7/16	38	31 5/8	15.3	302
1	1 Trunk Relay Telephone Circuit TA-226/TTC	21 7/16	38	31 5/8	15.3	290
1	1 Panel BD-132-A	32 7/8	75 3/4	44 3/4	64.5	880
4	1 Battery BB-46	18 3/8	21 7/8	10 1/2	2.5	130
3	3 Electrolyte 1-gallon bottles, for Battery BB-46	17 1/4	25 1/8	8 1/4	2.1	85
1	1 Chest Set CH-58 containing: 1 Tool Equipment TE-44	20 1/4	38	34 3/4	17.5	378
1	3 Stand Bases MT-1132/TT and 1 truck (dolly)	18	45 7/8	29 1/4	14.0	158
3	2 Duck Tarpaulins (16′ x 12.3′)	17	29	12 3/4	3.3	75
1	4 Cases CS-63 (for Battery BB-46)	22 7/8	47	22 7/8	14.4	148
3	1 Chair Case CY-1490/T containing: 1 Chair M-205-A	24 3/8	27 7/8	25 3/4	9.7	117
1	1 Cable Assembly Case CY-1498/T	23 1/8	81 1/8	27 1/8	30.0	421
1	1 Cable Assembly Case CY-1498/T	23 1/8	81 1/8	27 1/8	30.0	650
1	1 Accessories Case CY-1499/T containing: 8 Cable Cover CW-323/T 8 Cable Cover CW-324/T	19 1/2	56	17 1/8	10.8	161
1	1 Accessories Case CY-1500/T containing: 1 Rack FM-31 1 Hammer HM-5 1 Handle, Hammer HM-5 1 Night Alarm Bell 3 Ground Rods MX-148-G 1 Transformer TF-11 6 Message Registers 60 Trouble caps 1 Frame FM-65 9 Headset-Microphone H-91/U 300 Covers, telephone jack 1 Wire WD-15/U (1000′) 18 Sleeves, key 1 Set, running spares 1 Set, special tools 2 Portfolios (drawings & descriptions)	23 1/8	81 1/8	27 1/8	30.0	467

7. Table of Components

Quantity required	Component	Height (in.)	Width (in.)	Depth (in.)	Volume (cu ft)	Weight (lb)
3	Manual Telephone Switchboard SB-249/TTC	72	26 3/16	36 1/2	40	850
3	Telephone Main Distributing Frame TA-257/TTC	26 5/8	31 5/16	17	8	150
1	Line Relay Telephone Circuit TA-223/TTC	26 5/8	31 5/16	17	8	275
1	Line Relay Telephone Circuit TA-224/TTC	26 5/8	31 5/16	17	8	230
1	Trunk Relay Telephone Circuit TA-226/TTC	26 5/8	31 5/16	17	8	215
3	Stand Base MT-1132/TT	16 5/8	28 13/16	25		19
1	Panel BD-132-A	58	26	18	20	625
4	Case CS-63 (for batteries)	20	20 3/16	8 3/4	2.75	19
1	Transformer TS-11 and Frame FM-65	6 5/32	12 5/32	6 3/4		70
8	Cable Cover CW-323/T	6	24	8		3
8	Cable Cover CW-324/T	6	24	8 1/8		3
3	Ground Rods MX-148/G	72	3/4			10
3	Chair M-205-A	34	18	18		25
1	Truck dolly		22	15 1/2	1.66	26
4	Battery BB-46	15	18	8		97
1	Rack FM-31 (for Battery BB-46)	3	16	15 1/2		7
6	Duck Tarpaulin		192	144		28
1	Hammer HM-5	34	8	2 1/4		14
1	Handle, Hammer HM-5	34				3
6	Register, message	1 5/8	1 5/8	1 5/8		2
1	Wire W-15/U (1000')					7
60	Trouble caps (plug)	1 1/8	.305			6
9	Headset-Microphone H-91/U					1
300	Telephone jack cover	1/2	7/32			18
1	Night alarm bell	6 1/2	2 1/2	1 7/16		1 1/2
1	Tool Equipment TE-44	21	32 1/2	19		50
1	Set of .102 cables as follows:					
32	Telephone Cable Assembly CX-2584/U, (50' lg)					9
46	Telephone Cable Assembly CX-2584/U, (8' lg)					3
1	Cord CD-393, (50' lg)					8
1	Cord CD-409, (50' lg)					8
2	Cord CD-413, (5' lg)					1
1	Cable, (50' lg 110 v)					18
3	Cable, (50' lg 48 v)					18
3	Cable, (4' lg 48 v)					3
1	Cord CD-784, (30' lg)					6
3	Cable, (4' lg grouping)					1
1	Cable, (50' lg ringing)					4
3	Cable, (4' lg ringing)					1
1	Cord CD-258A, (50' lg)					3
1	Cord CD-414, (48' lg)					8
3	Cord CD-38, (1' lg)					1/4

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

8. Description of Manual Telephone Switchboard SB–249/TTC

a. Exterior (fig. 3). The switchboard exterior is a plywood, trunk-type, olive-drab case. The case forms the protective covering for the switchboard. Figure 3 illustrates the front and left side of the switchboard, with its top and front covers latched in place. Not shown in the illustration is the back cover, which protects the equipment located in the rear of the switchboard. Removal of the back cover exposes the cable and cord receptacles and relay equipment. The back cover is held in place by means of mounting screws. With the covers of the manual switchboard in place (fig. 3) no further packing is necessary for transportation or storage. Carrying handles on each side of the switchboard enable a crew of four to six men to carry the switchboard.

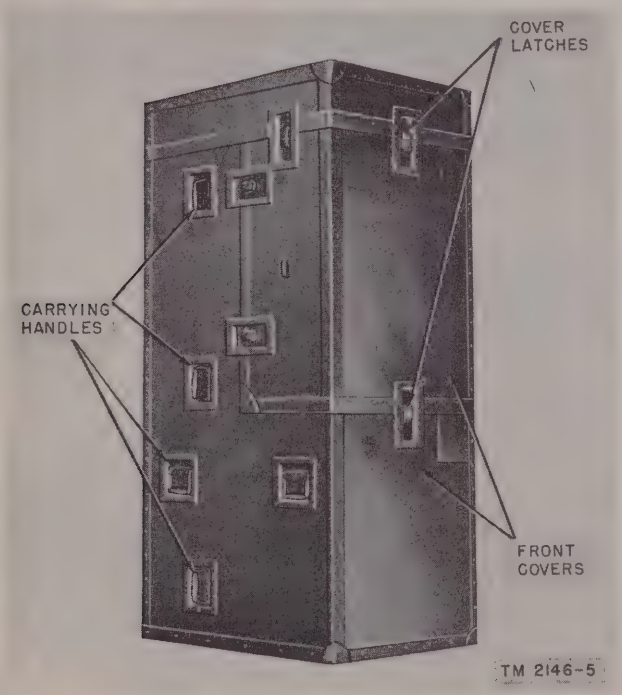


Figure 3. Manual Telephone Switchboard SB-249/TTC, covers in place.

b. Interior (front). Removal of the top and front covers provides access to the switchboard face equipment, key shelf, and cords (figs. 4 and 5) Removal of the back cover provides access to the cable and cord receptacle panels, (fig. 6) and the relay circuit plate equipment. A detailed description of the interior front equipment of the switchboard is given in subparagraphs (1) and (2) below.

(1) *Face equipment* (figs. 5, 43, and 44). The face equipment is located on the upper half of the front of the switchboard. The face equipment is divided into two panels as follows:

(*a*) *Left panel.* The left panel of the face equipment (fig. 43) consists of an upper, a middle, and a lower group of jack and lamp strips. The upper group contains five jack and five lamp strips that provide the termination of facilities for 100 common-battery (CB) lines. Refer to figure 76 for the wiring diagram of a CB line jack and lamp strip. The middle group contains five jack and five lamp strips which provide the termination facilities for either common battery or local battery (CB–LB) lines. Figure 76 is the wiring diagram for a CB–LB line jack and lamp strip. The lower group contains five designation strips, five jack strips, and five lamp strips which provide termination facilities for 100 CB–LB lines. The bottom jack and lamp strip of the lower group can be used to terminate 10 dial trunks or 20 manual trunks. If dial trunks are used with this central office, the jack at the extreme left of the bottom jack strip will be the line jack for dial trunk No. 1, with its associated lamp directly below. The next jack to the right of the line jack for dial trunk No. 1 will be the dial jack for dial trunk No. 1. The third jack to the right is the line jack for dial trunk No. 2, and the fourth is the dial jack for dial trunk No. 2, etc. Figure 76 is the wiring diagram for the dial trunk line jack and lamp strip. Figure 79 is the wiring diagram for the dial trunk, dial jack, and lamp strip.

(*b*) *Right panel.* The right panel of the face equipment consists of an upper, a middle, and a lower group of jack and lamp strips. The upper and middle groups each contain five jack and five lamp strips which provide the termination facilities for 200 CB lines. Refer to figure 76 for the wiring diagram of a CB line jack and lamp strip. The bottom

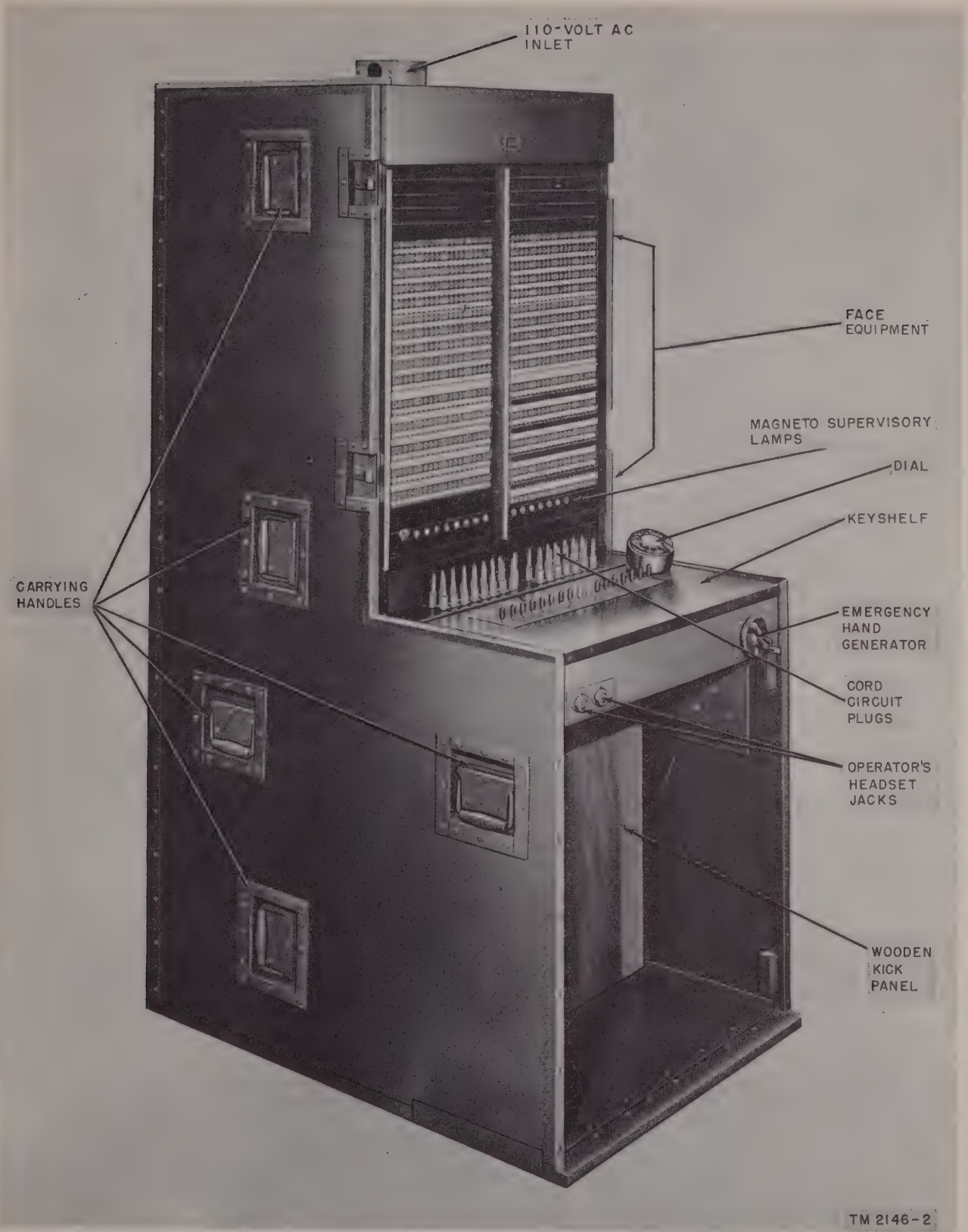


Figure 4. Manual Telephone Switchboard SB-249/TTC, three-quarter view.

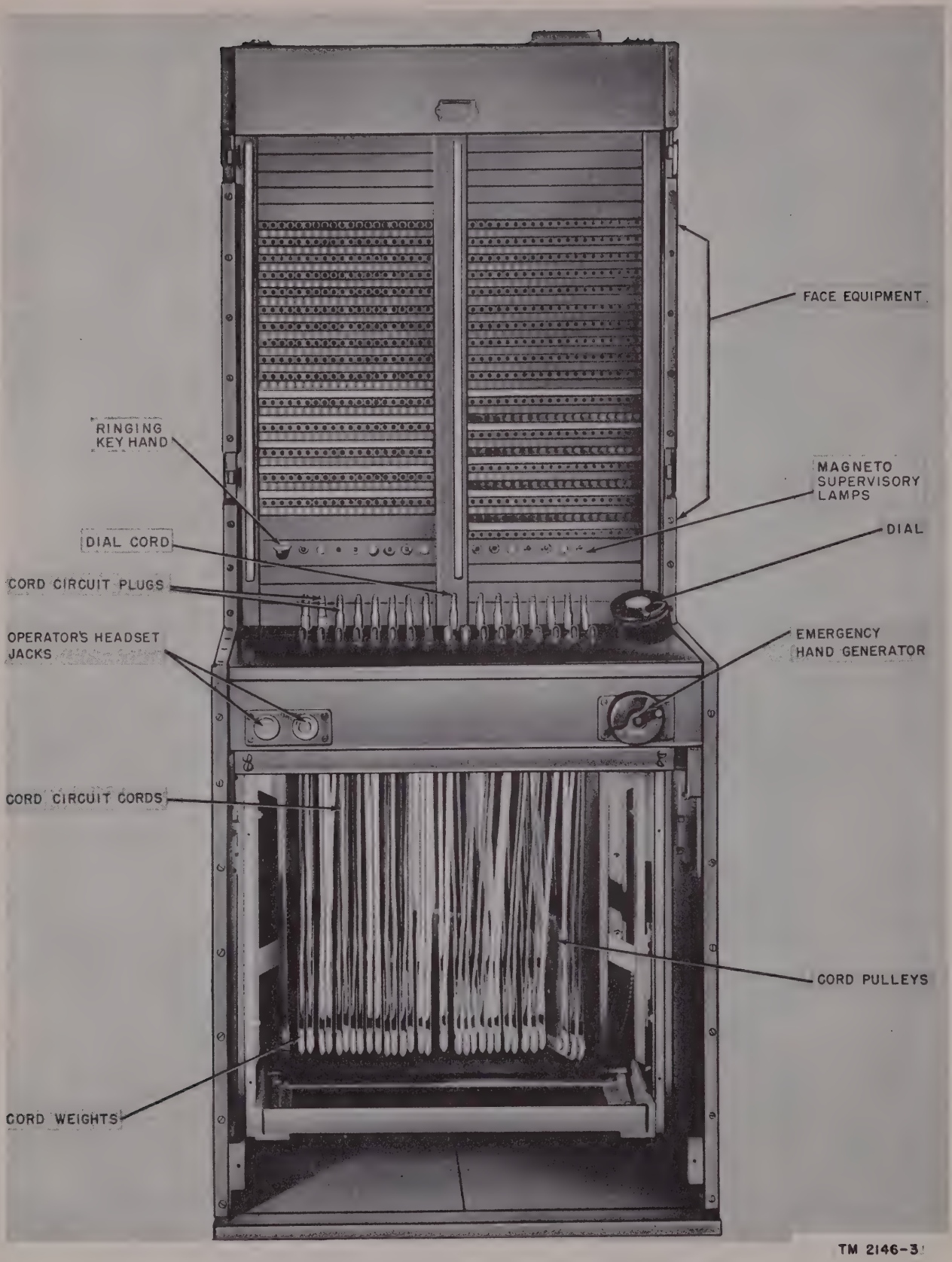


Figure 5. Manual Telephone Switchboard SB-249/TTC, front view.

group is the trunk group reserved for the addition of plug supervision type trunks. This group contains four strips of push-button *call-back* switches, four line jack strips, four incoming signal lamp strips, and four *pin-point* idle lamp designation strips which provide the termination facilities for the future incorporation of special plug supervision type trunks that are not yet provided with this central office. Refer to figure 74 for the wiring diagram of a trunk idle lamp and switch strip and to figure 75 for a trunk jack and lamp strip. Below the trunk group is a designation strip and one strip of 20 jacks. This is the jack appearance of the conference circuit. The jack at the extreme right of this strip is the *recall* jack. Figures 73 and 77 are the wiring diagrams for the conference circuit jack strip and *recall* jack.

(*c*) *Magneto supervisory lamp panels* (figs. 4, 5, and 43). Located directly below the lower group of jack and lamp strips of the left panel of the face equipment is a row of eight magneto supervisory lamps. At the extreme left of this row of lamps is mounted an emergency ringing switch that is marked RINGING KEY HAND and is used in conjunction with the emergency hand generator. Directly below the trunk group of the right panel is located a row of seven magneto supervisory lamps. Each of the 15 magneto supervisory lamps is associated with a cord circuit and is used to provide the operator with a supervisory indication on LB lines.

(2) *Key shelf equipment* (figs. 4, 5, 42, and 44). The key shelf equipment includes two rows of cord plugs, two rows of supervisory lamps, a row of switches, and a dial. This equipment is described in subparagraphs (*a*) through (*d*) below:

(*a*) *Cord plugs*. The two rows of cord plugs are mounted on the stationary portion of the key shelf nearest the face equipment panel. Each set of front and rear plugs provides the termination for the associated cord circuit cords which are connected to the cord circuit relay equipment. Refer to figure 67 for the wiring diagram of the cord circuit. The rear cords are used to answer incoming calls. The associated front cords are used to extend the calls to other lines or trunks which terminate on the switchboard face equipment. A dial plug, which is part of the dial cord, is located between the two groups of cord plugs. The dial cord is connected to the dial on the extreme right of the hinged shelf. The dial plug enables the operator to dial on any dial trunk that terminates on the switchboard face equipment. Refer to figure 65 for the wiring diagram of the dial cord circuit.

(*b*) *Supervisory lamps*. Two rows of supervisory lamps are mounted on the back edge of the hinged portion of the shelf. The lamp caps of the supervisory lamps are of the same color as the associated rear and front cords. This aids the operator in identifying the supervisory lamp indications with the associated cord circuit cord.

(*c*) *Switches*. A row of 17 lever switches is located approximately in the center of the hinged shelf and is mounted directly in front of the two rows of supervisory lamps. Fifteen three-position cord circuit (talk-ring) switches (numbered 1 through 15 and equipped with black handles) are in line with the cord supervisory lamps. These switches are nonlocking in the rear (ring) position and locking in the front (talk) position. Between cord circuit switches No. 8 and 9 are two switches equipped with red handles. The switch on the left, marked GRP (grouping), is a two-position locking switch. When operated, it transfers the cord circuits to the operator's circuit in the adjacent switchboard position. Refer to figure 66 for the wiring diagram of the grouping circuit. The switch on the right,

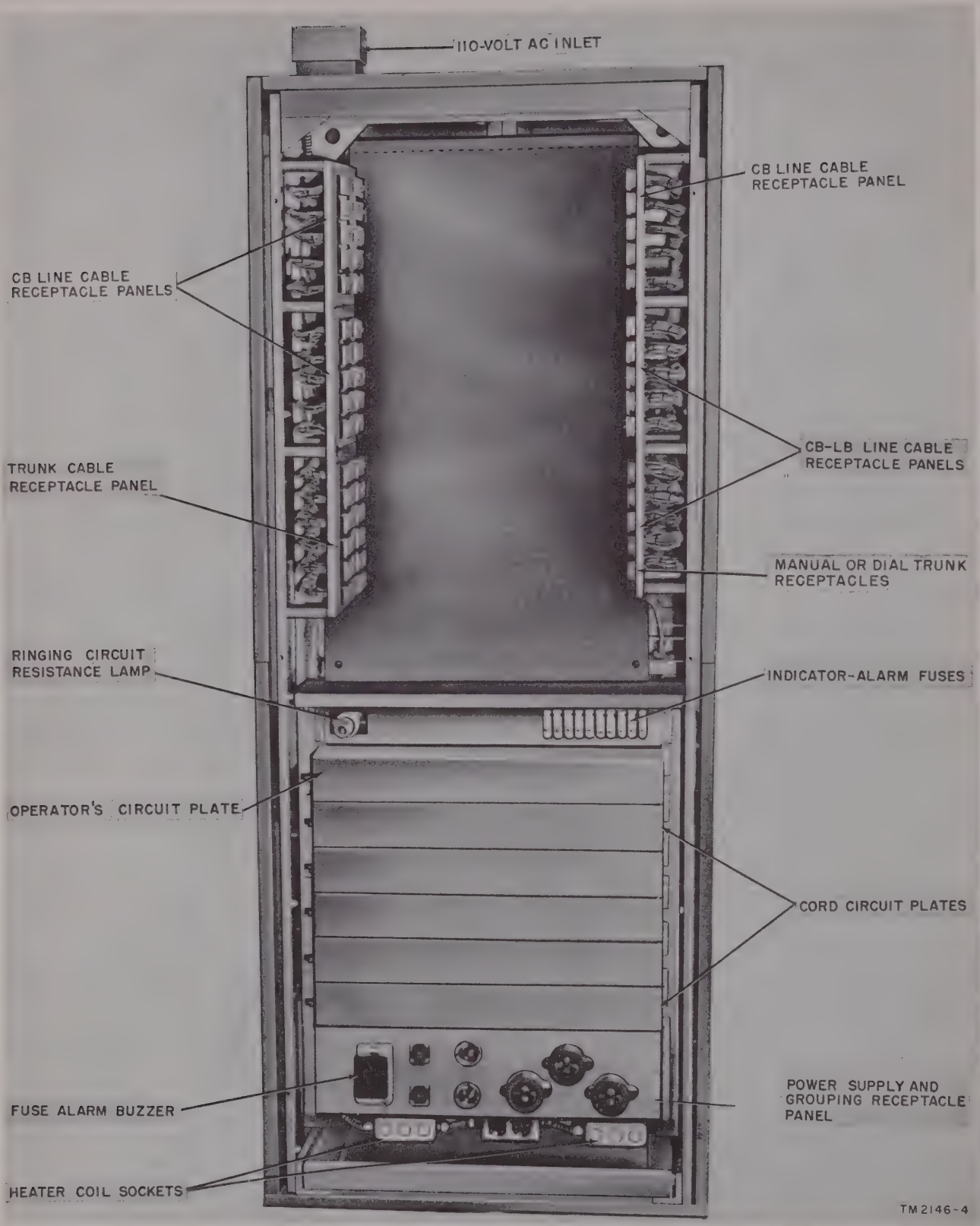


Figure 6. Manual Telephone Switchboard SB-249/TTC, rear view.

marked MON MR, is a three-position switch, nonlocking in the MON (monitoring) position and locking in the master ringing (MR) position. The MON position permits the operator to monitor any cord circuit, provided an associated cord circuit switch is in the front (talk) position. The MR position reverses the polarity of the ringing supply in order to ring two parties on one line. The hinged shelf (fig. 57) is held in the upright position by means of the locking slide brace. To lower the key shelf, the lock catch of the brace must be lifted ¼ inch; this allows the slide brace to retract.

(*d*) *Shelf apron.* The shelf apron is used to mount the emergency hand generator and two operator's headset jacks (fig. 44). The hand generator is located at the extreme right of the shelf apron. The folding hand crank of the generator extends through the shelf apron. Located on the extreme left of the shelf apron are the two multi-pin headset jacks, either of which may be used by the operator to connect the headset transmitter and receiver to the operator's telephone circuit. The space from the shelf apron to the floor of the switchboard allows room for the operator's legs. A wooden, kick panel is mounted below the shelf (fig. 4). Removal of the wooden, kick panel provides access to the cord circuit cords, pulleys, and weights (fig. 5).

c. Interior (rear) (fig. 6). The rear equipment includes: the left and right cable receptacle panels, the canvas curtain that covers the face equipment wiring, a resistance lamp and a row of indicator-alarm type fuses, the relay frame which supports six circuit plates, a metal panel for mounting the fuse alarm (FA) buzzer, the various power supply and grouping cord receptacles, and the heater coil sockets. This equipment is described in detail in subparagraphs (1) through (5) below.

(1) *Cable receptacle panels* (figs. 6 and 7). The cable receptacle panels are mounted approximately 3 inches from, and parallel to, the sides of the interior surface of the switchboard by means of standoff pillars. Each cable receptacle panel is divided into three groups of cable receptacles: the upper, middle, and lower groups. Except for the lower (trunk) group, which contains 12 cable receptacles, each group contains 10 cable receptacles. Each cable receptacle has 52 connector pins which terminate the wiring from one-half of a jack and lamp strip (10 lines) on the face equipment. A detailed description of the left and right cable receptacle panels is given in subparagraphs (*a*) and (*b*) below.

(*a*) *Left cable receptacle panel* (figs. 6, 7, and 8). The upper group of 10 cable receptacles is marked CB LINES. The lower left receptacle of this group is numbered 09-00, and the upper right receptacle is numbered 99-90. Refer to figures 68 and 69 for the wiring diagrams. The middle group of 10 cable receptacles is also marked CB LINES. The numbering and wiring of the receptacles of this group are identical with those of the upper group. The lower group of 12 receptacles (fig. 8) terminates the wiring from the trunk face equipment. The receptacles (numbered in groups of 10) 10-1 through 80-71 terminate the wiring from the jacks and lamps as described in subparagraph (1) above and are wired as illustrated in figures 70 and 71. The IDLE LP & KEY receptacles (numbered in groups of 20) 20-1 through 80-61 terminate the wiring from the idle lamps and switches. Figure 72 illustrates the wiring of the idle lamp and key receptacles.

(*b*) *Right cable receptacle panel.* A portion of the right receptacle panel is illustrated in figures 6 and 7. The upper group of 10 receptacles is marked CB LINES. The lower left receptacle of this group is numbered 09-00 and the upper right receptacle is numbered 99-90. Refer to figure 68 for the wiring diagram of a CB line cable receptacle. The middle group of 10 receptacles of

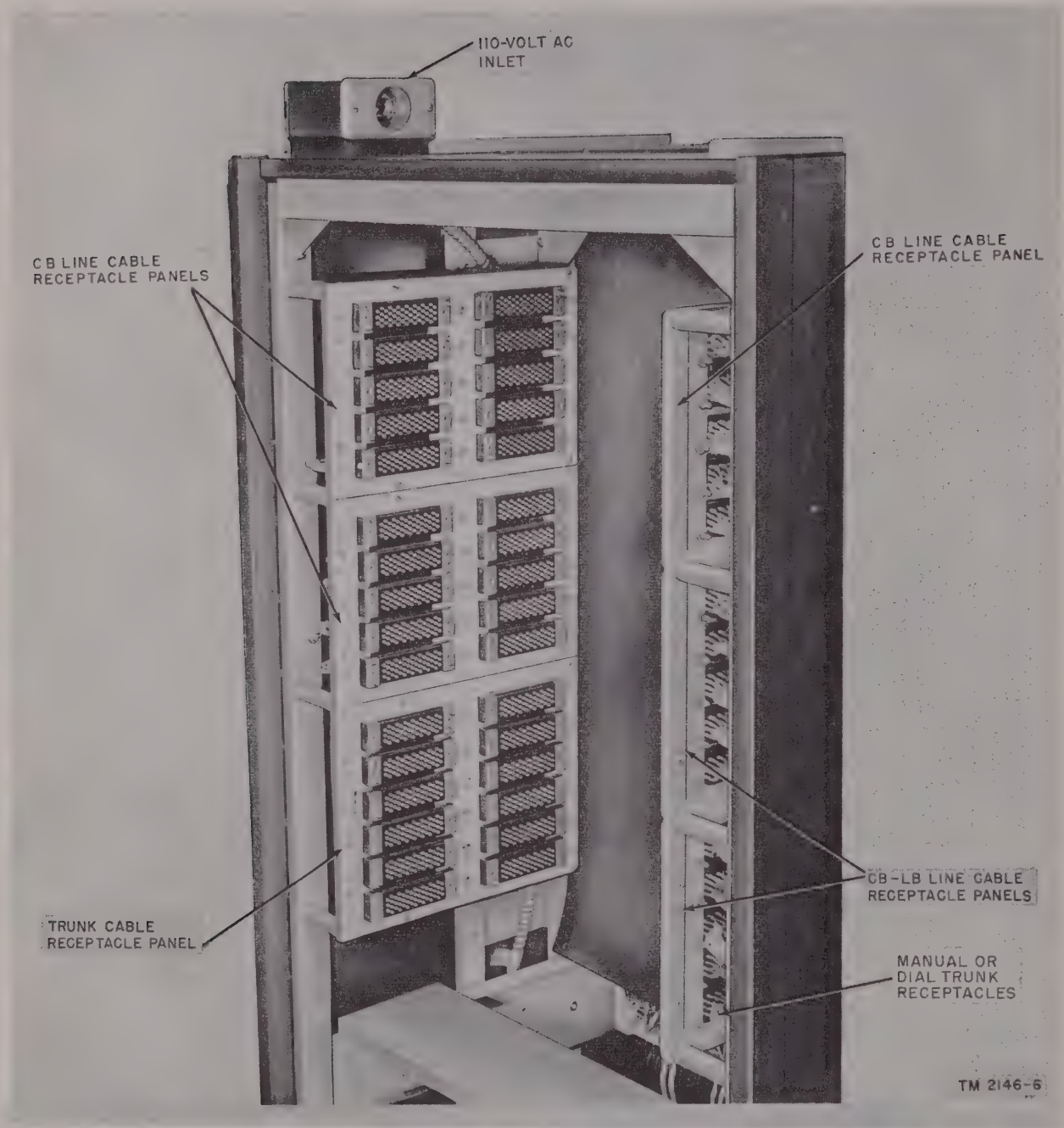


Figure 7. Manual Telephone Switchboard SB-249/TTC, cable receptacle panel.

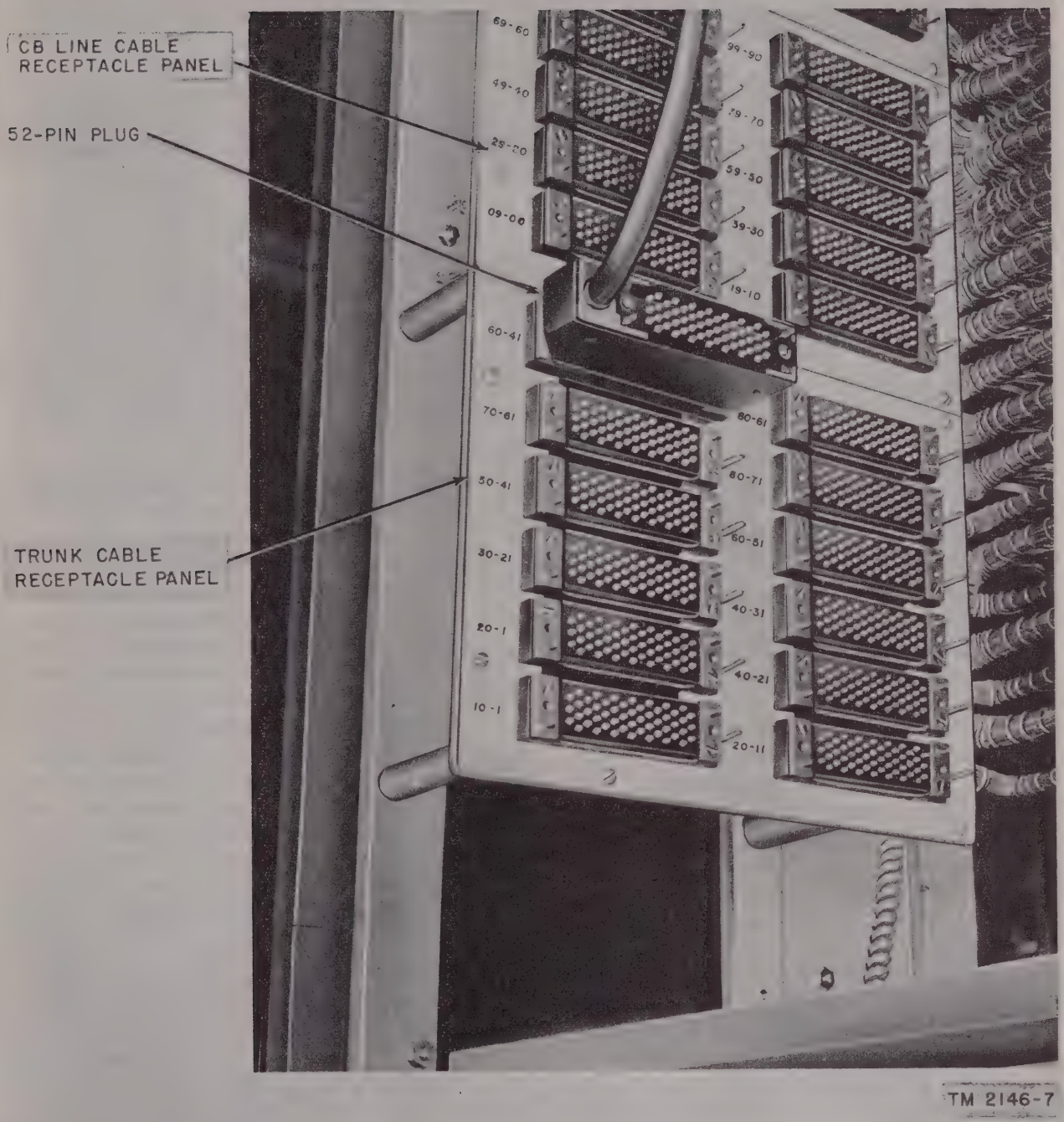


Figure 8. Manual Telephone Switchboard SB-249/TTC, 52-pin plug connected to cable receptacle.

the right panel is marked CB-LB LINES. Each receptacle of this group is numbered and wired the same as those for the CB LINES group above. The lower group of 10 cable receptacles is marked DIAL TRKS and CB-LB LINES. The two bottom receptacles of this group provide the cable connections for 10 dial trunks or 20 manual trunks or 20 CB-LB lines. The bottom left cable receptacle marked DIAL TRKS 19-01 provides the cable connections to the 10 line jacks and 10 lamps. The bottom right cable receptacle marked DIAL TRKS 18-00 provides cable connections to the dial jacks. The cable receptacle directly above the receptacle marked DIAL TRKS 19-01 is the CB-LB lines receptacle numbered 29-20. The upper right receptacle of this group is numbered 99-90. The two bottom DIAL TRKS receptacles may be used to terminate another 20 CB-LB lines or manual trunks. Therefore, the lower group of the right receptacle panel can be used to connect 80 CB-LB lines and 10 dial trunks, 80 CB-LB lines and 20 manual trunks, or 100 CB-LB lines. Refer to figures 80 and 81 for wiring diagrams of the dial trunk cable receptacles. Figures 68 and 69 are the wiring diagrams for either CB or CB-LB receptacles.

(2) *Fuse panel* (figs. 6 and 36). Mounted directly below the cable receptacles is a row of 10 indicator-alarm type fuses which provide overload protection for the relay equipment of the cord circuits and the operator's telephone circuit. To the left of the fuses is mounted a resistance lamp and socket. The lamp provides overload protection for the ringing circuit. Refer to figure 64 for the ringing circuit diagram.

(3) *Circuit plates* (figs. 6 and 36). The six circuit plates are located at the bottom half of the rear of the switchboard. The top circuit plate contains the relay equipment for the operator's circuit. The five circuit plates below the top circuit plate contain the relay equipment for 15 cord circuits. Each cord circuit plate contains the relay equipment for three cord circuits. Figure 6 illustrates the circuit plates with their dust covers in place. The operator's circuit plate and a cord circuit plate with covers removed are illustrated in figure 36. Each type of circuit plate is described in further detail in subparagraphs (*a*) and (*b*) below:

(*a*) *Operator's circuit plate* (fig. 9). Located from left to right on the circuit plate are relays monitoring (MO) and operator's battery (OB), the retard coil (RE), the induction coil, the repeating coil, and four capacitors. Refer to figure 63 for the wiring diagram of the operator's circuit plate.

(*b*) *Cord circuit plate.* An illustration of a cord circuit plate with its cover removed is shown in figure 10. The relay equipment for cord circuit No. 1, located at the left of the circuit plate, consists of the following relays: front bridge (FB), rear bridge (RB), back or rear sleeve (RS), ring-up or recall (RU), and front sleeve (FS). A metal can containing two capacitors is mounted under relay FS. The relay equipment for cord circuit No. 2 is located in the center of the circuit plate, and the relay equipment for cord circuit No. 3 is located at the right end of the circuit plate. Refer to figure 62 for the wiring diagram of a cord circuit plate.

(4) *Power supply and grouping receptacle panel* (figs. 6 and 36). The metal panel upon which are mounted the power supply and grouping receptacles, and a fuse alarm (FA) buzzer is located below the relay circuit plates. At the left of the panel is located the fuse alarm buzzer (marked FA), which gives an audible alarm of a blown fuse condition in any of the switchboard circuits. Two four-pin male receptacles marked GRP IN and GRP OUT are located directly to the right of the FA buzzer and are used to connect the grouping cords between switchboard

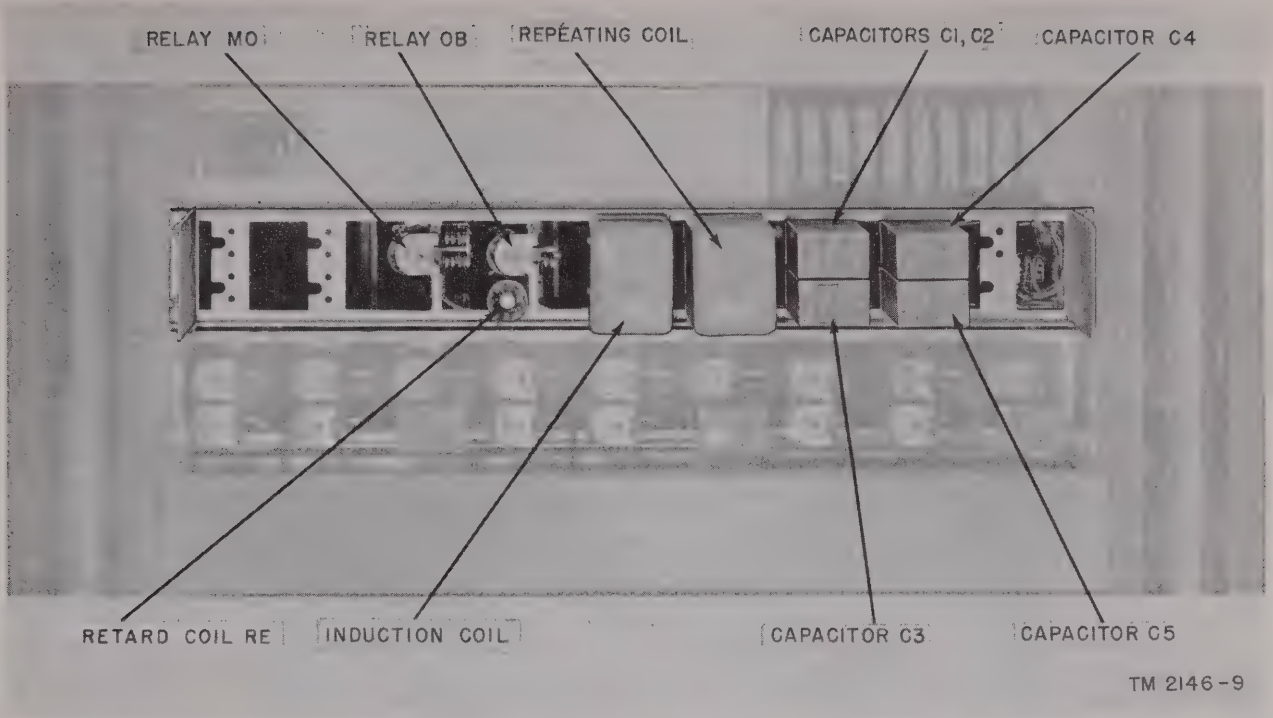


Figure 9. Manual Telephone Switchboard SB-249/TTC, operator's telephone circuit plate.

positions. Located approximately in the center of this panel are two receptacles marked 20∩ which are used to connect the switchboard 20-cycle ringing supply cords between switchboards and to the ringing current supply source. At the right of the panel are located three polarized receptacles marked 48V which provide the inlet and outlet facilities for the 48-volt battery cords. Refer to figure 78 for the wiring diagram of the power supply distributing circuit panel.

(5) *Heater coils and utility outlet box* (fig. 6). The heater sockets which mount the heater coils and the utility outlet box are located on the switchboard floor, approximately 1 foot in from the outer bottom

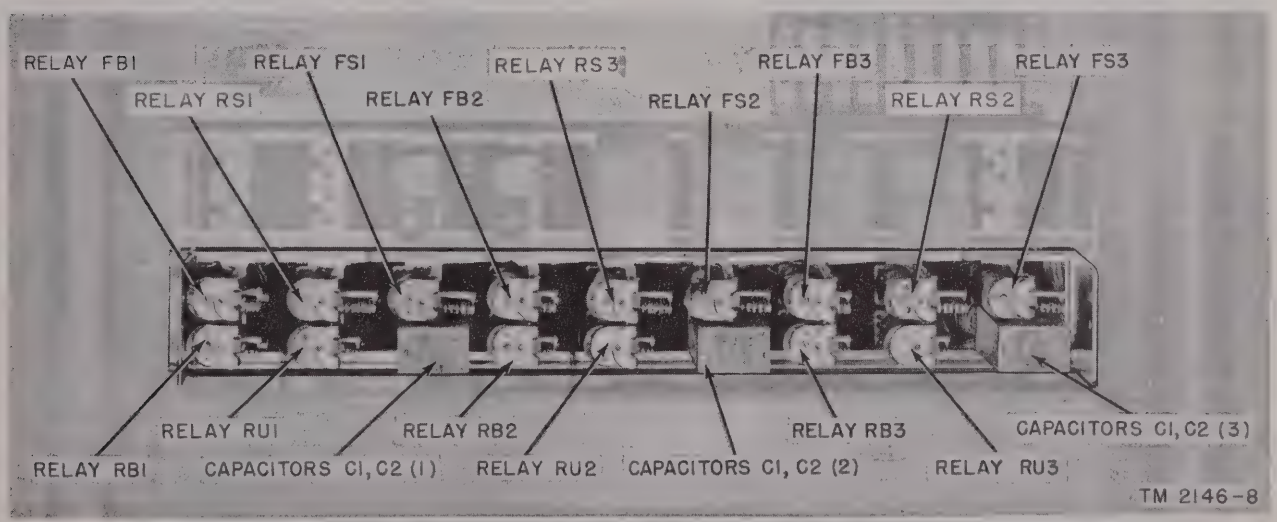


Figure 10. Manual Telephone Switchboard SB-249/TTC, universal cord circuit plate.

edge of the switchboard (fig. 6). The heater coils are not shown in the illustration because they are mounted behind the power supply receptacle panel and obscured from view. The heater coils and utility outlet are connected to the 110-volt ac inlet box (on the top of the switchboard) by means of a cable which is clamped on the left side of the switchboard inner surface. The utility box at the bottom of the switchboard provides a 110-volt ac outlet for the soldering iron or trouble lamp. The heater coils keep the switchboard interior equipment dry.

d. Switchboard Top (fig. 6). The top cover is removed to permit entry of the switchboard interconnecting cables.

9. Description of Telephone Main Distributing Frame TA–257/TTC

(figs. 11 and 12).

a. Exterior. The main distributing frame exterior is an olive-drab plywood trunk-type case. The MDF case is provided with front and rear covers that are held in place against the body of the plywood case by means of eight cover latches. A rubber gasket, mounted on the inner edge of the cover, seals the interior equipment of the MDF case from moisture, dust, and dirt when the covers are latched in place. Carrying handles, one on each side of the case, enable two men to carry it any required distance. The MDF case with its covers in place is shown in figure 13.

b. Interior (figs. 11 and 12). The MDF case has a steel frame upon which are hinge-mounted two zinc-plated steel plates. The two plates are secured with bolts and are situated back-to-back to form the front and rear MDF equipment mounting surfaces. The front plate is marked SWBD SIDE, and the rear plate is marked LINE SIDE. A detailed description of the two sides of the MDF case is given in subparagraph (1) and (2) below.

(1) *Switchboard side* (fig. 11). On the SWBD SIDE of the MDF case are two groups of binding post terminals. Each group contains 200 binding posts. The two groups of binding posts are divided into a left and a right group. The left group contains 20 horizontal rows of binding posts, each row containing five pairs of binding posts. Each pair is internally wired to corresponding pairs on the LINE SIDE of the MDF. The pair of binding posts at the extreme left of the top row of the left group is marked T 00 R and the pair at the extreme right of this row is marked T 04 R. Thus, the numbering of the pairs of binding posts is in consecutive order from left to right. The pair of binding posts at the left of the bottom row of the left group is marked T 95 R, and the pair at the right of this row is marked T 99 R. The numbering and the appearance of the right group are identical with those of the left group. Refer to figure 83 for the wiring diagram of the binding post groups. To the right of the right group of binding posts are located four 52-contact cable receptacles. The top receptacle is marked 00-24 and provides the connector terminations for the first five rows of binding posts of the left group. The second cable receptacle from the top is marked 25-49 and terminates the sixth through the tenth rows of binding posts of the left group. The third receptacle down from the top is numbered 50-74 and terminates the eleventh through the fifteenth rows of binding posts of the left group. The bottom receptacle is numbered 75-99 and terminates the sixteenth through the twentieth rows of binding posts of the left group. Refer to figure 84 for the wiring diagram of MDF cable receptacle 00-24. Located at the upper left corner of the SWBD SIDE of the MDF is a steel handle bar. The handle is used to swing the SWBD SIDE mounting plate away from the MDF frame to gain access to the internal wiring. A row of 10 steel jumper rings is located above the two groups of binding posts, and another row of 10 jumper rings is located below the binding posts. A single jumper ring is located in the middle at the left edge of the mounting plate, and another single ring is mounted between the two middle cable receptacles.

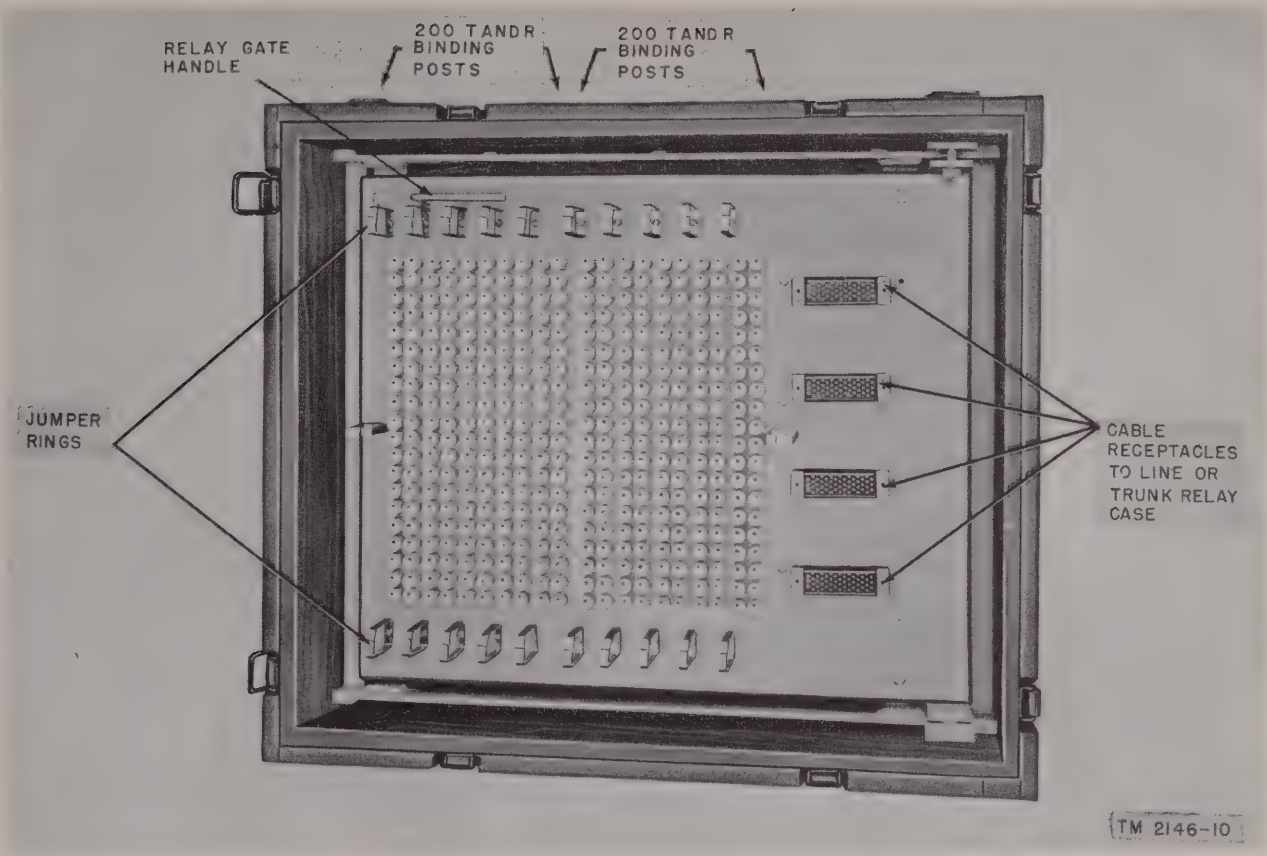


Figure 11. Telephone Main Distributing Frame TA-257/TTC, switchboard side.

(2) *Line side* (fig. 12). The equipment that is located on the LINE SIDE of the MDF case includes a single group of 200 binding post terminals and 200 cartridge-type protectors. This group contains 10 horizontal rows of binding posts, each row consisting of 20 binding posts. A cartridge-type protector is located directly below and to the right of each binding post in this group. Each row of binding posts contains 10 pairs of posts. Each pair of binding posts provides the connector terminations for the T and R leads of an incoming line. The binding post pair located at the upper left corner of the group is marked T 00 R. The bottom left pair of the group is marked T 09 R. The extreme upper right corner pair of binding posts is marked T 90 R, and the extreme lower right corner pair is marked T 99 R. Refer to figure 82 for the wiring diagram of the line side of the MDF. A steel handle bar is located at the upper left corner of the LINE SIDE mounting surface. The handle is used to swing the LINE SIDE mounting plate away from the MDF body frame to gain access to the internal wiring. A row of steel jumper rings is mounted above the top row of binding posts, and another row is located below the bottom row of posts. A single jumper ring is located in the middle of the left edge of the mounting plate, and another single ring is located in the middle of the right edge. A wing-nut ground terminal, located at the lower right corner of the LINE SIDE, is used to ground the MDF.

10. Description of Line Relay Telephone Circuit TA–224/TTC

a. Exterior (fig. 13). The exterior of Line Relay Telephone Circuit TA–224/TTC (CB line relay case) is the same as the exterior of the MDF (par. 9*a*). The schematic diagram of a CB line relay cir-

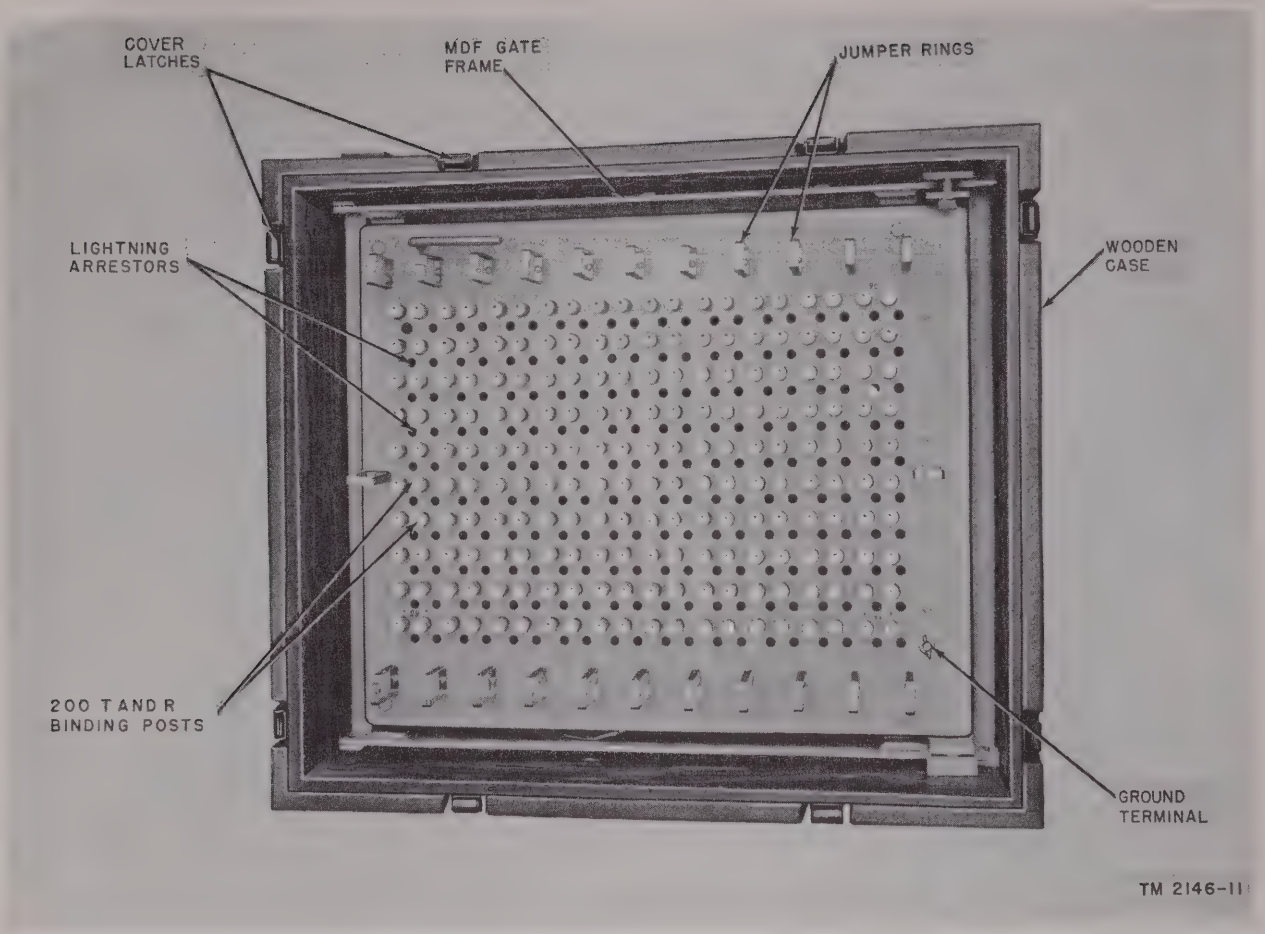


Figure 12. Telephone Main Distributing Frame TA-257/TTC, line side.

cuit is riveted to the back of one of the covers. One carrying handle on each side of the case enables two men to carry this component. No additional packaging is necessary for the transportation of this component when the front and rear covers are latched in place. The CB line relay case with its covers in place is illustrated in figure 13,

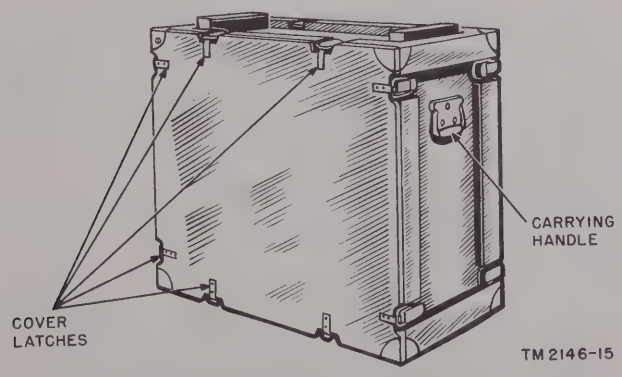


Figure 13. Line Relay Telephone Circuit TA-224/TTC, with covers in place.

b. Interior (figs. 14 and 15). The interior equipment of the case includes a rectangular steel frame which provides a mounting support for the front and rear relay gates and front and rear vertical steel panels and associated components. A detailed description of the front and rear equipment is given in subparagraphs (1) and (2) below.

(1) *Front equipment* (fig. 14). The front equipment of the CB line relay case includes a square steel relay gate frame that is hinged to the case frame and supported by mounting bolts. The relay gate frame provides a mounting for 10 relay circuit plates. At the right of the relay circuit plates is a vertical row of seven cable connector receptacles. A vertical, steel mounting panel, approximately 3 inches wide, is bolted to the top and bottom of the stationary relay gate frame. It is located at the right of the frame. Mounted on this panel are a group of five indicator-

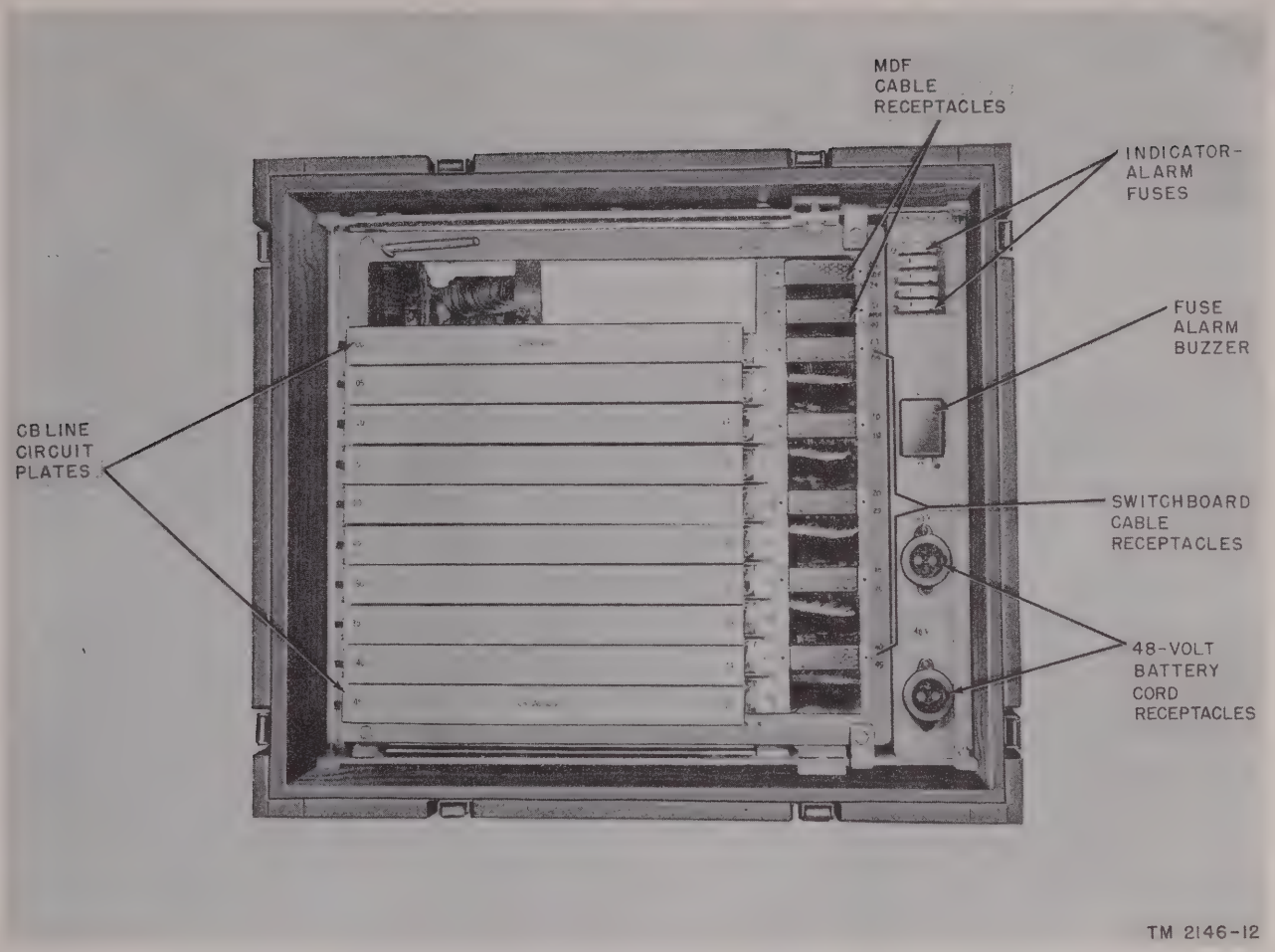


Figure 14. Line Relay Telephone Circuit TA-224/TTC, front view.

alarm type fuses, a fuse alarm buzzer (FA), and two female 48-volt battery cord receptacles, marked 48V. The front relay gate equipment is described in further detail in subparagraphs (*a*), (*b*), and (*c*) below.

(*a*) *CB line circuit plates* (fig. 14). The 10 circuit plates contain the relay equipment for 50 CB lines. Each circuit plate contains the line and cutoff relays for five CB line circuits. The front surface of the top circuit plate cover is marked CB LINE CCTS 00-04. The second circuit plate from the top is numbered 05-09. The numbering of the remaining eight circuit plates is in consecutive order. The bottom circuit plate cover is marked CB LINE CCTS 45-49. Figure 16 illustrates a CB line circuit plate. From left to right on the circuit plate frame are mounted a row of five twin-type relays. The twin relay at the left of this row is marked CO 1 and LR 1. The twin relay at the right of the row of relays is marked CO 5 and LR 5. A terminal board mounted on the back of the circuit plate is used to interconnect the cable receptacle to the relays. Refer to figure 59 for the wiring diagram of a CB line circuit plate and to figure 86 for the wiring diagram of the terminal board of a CB line circuit plate.

(*b*) *Cable receptacles* (fig. 14). The two top cable receptacles (MDF 00-24 and MDF 25-49) provide the inlet connections to the front circuit plates. Figure 85 is the wiring diagram for MDF re-

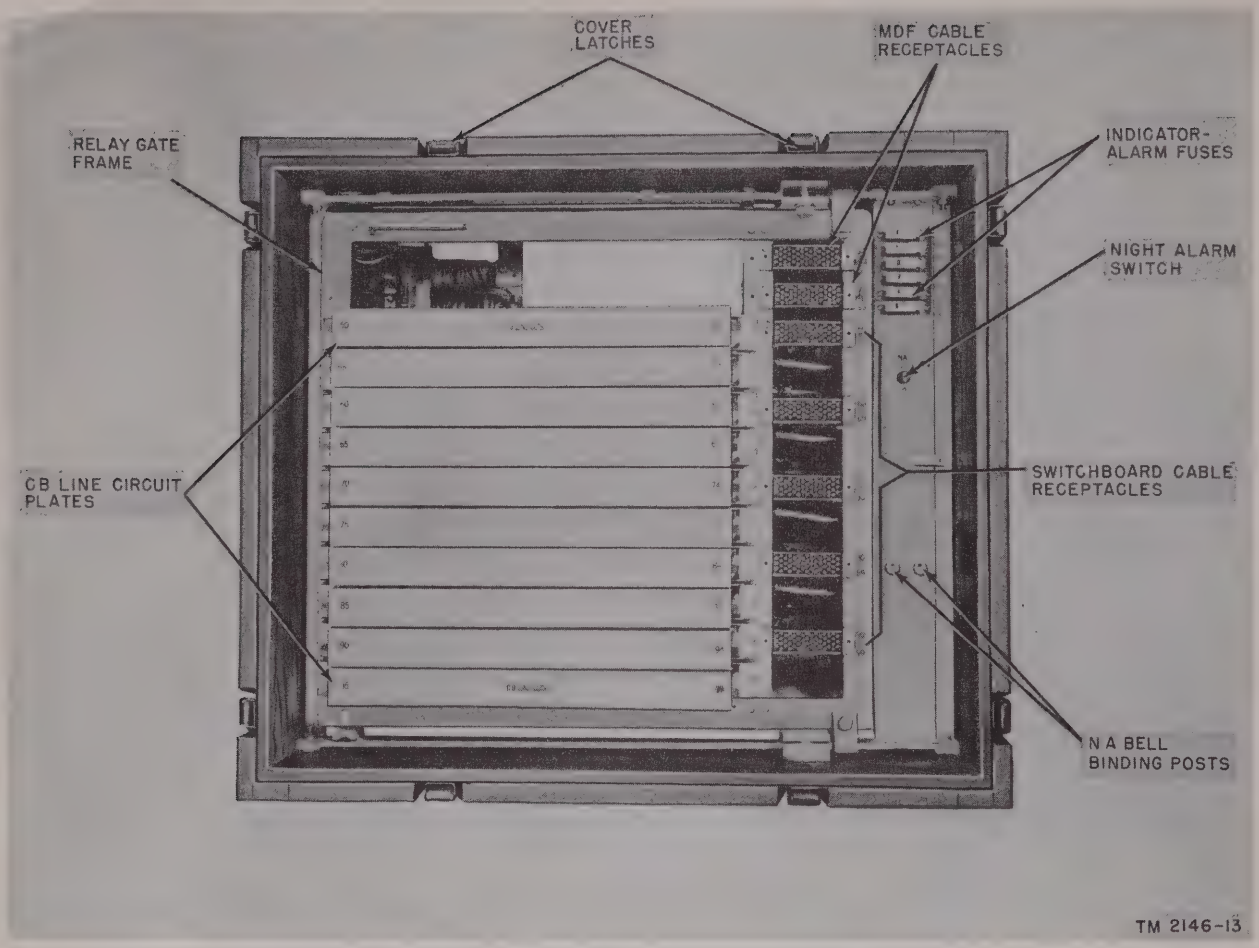


Figure 15. Line Relay Telephone Circuit TA-224/TTC, rear view.

ceptacle 00-24. The third switchboard cable receptacle from the top (00-09) provides the outlet connections from the two upper circuit plates that are numbered 00-04 and 05-09. The remaining four receptacles (10-19, 20-29, 30-39, and 40-49) provide the outlet connections for circuit plates 10-14 through 45-59. Refer to figure 87 for the wiring diagram of line circuit receptacle 00-09.

(*c*) *Vertical panel equipment* (fig. 14). The two 48-volt battery cord receptacles located at the bottom of the vertical panel provide the inlet and outlet facilities for the 48-volt battery supply. Refer to figure 88 for the wiring diagram of the battery receptacles of the CB line relay case. Directly above the two 48-volt cord receptacles is mounted the fuse alarm buzzer. Refer to figure 93 for the wiring diagram of the fuse alarm buzzer. Each replaceable indicator-alarm type fuse provides current overload protection for 10 CB line relay circuits. The top fuse is marked 00-09 and the bottom fuse is marked 40-49. Refer to figure 90 for the wiring diagram of the fuse circuits for lines 00-49.

(2) *Rear equipment* (fig. 15). The appearance of the rear equipment of the CB line relay case is identical with the front equipment in subparagraph (1) above with the following exceptions: The circuit plate numbering includes CB line circuits 50 through 99. The vertical row of switchboard receptacles to the right of

the circuit plates are numbered in accordance with the 10 circuit plates with which they are associated. The top two receptacles are marked MDF 50-74 and MDF 75-99. The five switchboard cable receptacles are numbered 50-59 through 90-99. The vertical mounting panel contains, from top to bottom, a group of six indicator-alarm type fuses, a night alarm switch, and two night alarm bell binding posts. The bottom fuse of the fuse group provides overload protection for the night alarm circuit. The remaining five fuses provide overload protection for CB line circuits 50 through 99. Refer to figure 89 for the wiring diagram of the NA binding post circuit. Figure 91 is the wiring diagram of the fuse circuit for CB lines 50-99, and figure 92 is the wiring diagram of the NA switch.

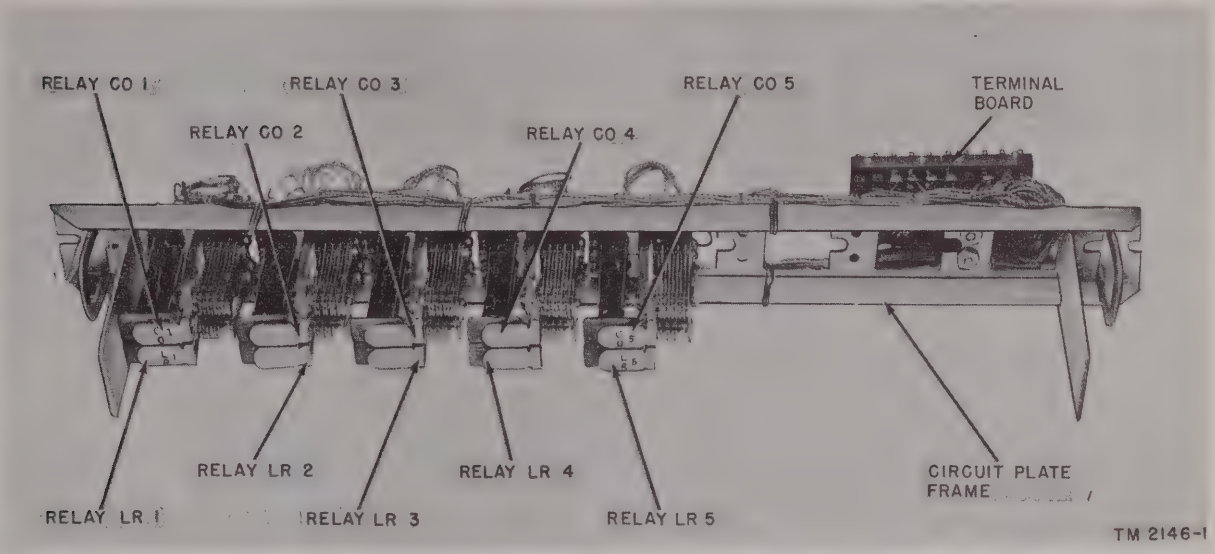


Figure 16. Line Relay Telephone Circuit TA-224/TTC, CB line circuit plate.

11. Description of Line Relay Telephone Circuit TA–223/TTC

a. Exterior (fig. 13). The exterior of Line Relay Telephone Circuit TA–223/TTC (CB-LB line relay case) is the same as the exterior of the MDF (par. 9*a* and fig. 13). The schematic diagram of a CB-LB line relay circuit is riveted to the back of one of the corners.

b. Interior (figs. 17 and 18). The interior equipment is gate-mounted and is similar to the CB line relay equipment described in paragraph 10*b*, with the following exceptions:

(1) *Front* (fig. 17). A metal panel mounted above the 10 circuit plates provides a mounting for 50 three-position toggle switches. The toggle switches are arranged in four horizontal rows. Each toggle switch is associated with a CB-LB line circuit and is used to convert the line circuit to either CB or LB operation, as required. The left switch of the top row is marked LB-CB 00, and the right switch of the top row is marked 12. The left switch of the bottom row is marked 37, and the right switch of this row is marked LB-CB 49. The numbering of the CB-LB line circuits is the same as that described for the CB line circuits (par. 10*b*). Refer to figure 96 for the wiring diagram of the CB-LB line circuit toggle switches. Subparagraphs (*a*), (*b*), and (*c*) below describe a CB-LB circuit plate, the MDF and switchboard cable receptacles, and the vertical panel.

(*a*) *CB-LB line circuit plate* (fig. 19). The 10 circuit plates are used to mount the relays and associated equipment for 50 CB-LB line circuits. Each circuit plate

contains the line and cutoff relays, capacitors, and rectifiers for five LB line circuits. The twin relay at the left is marked CO 1 and LR 1, and the twin relay at the right is marked CO 5 and LR 5. Mounted behind each twin relay is a selenium rectifier. To the right of the relays are three metal capacitor cases. Each case contains two capacitors except the right case, which contains one capacitor. The left capacitor case is marked C-1(1) and C-1(2), the middle case is marked C-1(3) and C-1(4), and the right case is marked C-1(5). Each capacitor is associated with a correspondingly numbered twin-relay, toggle switch, and rectifier to complete one CB-LB line circuit. Refer to figure 60 for the wiring diagram of a CB-LB line circuit plate. Mounted behind the capacitor cases is a terminal board that interconnects the cable receptacle wiring to the circuit plate wiring. Refer to figure 94 for the wiring diagram of a CB-LB line circuit plate terminal board.

(*b*) *Cable receptacles* (fig. 17). The cable receptacles on the CB-LB line relay case are the same as the cable receptacles described in paragraph 10*b*(1)(*b*). Refer to figure 95 for the wiring diagram of the switchboard cable receptacle of CB-LB line circuits 00-09 and to figure 97 for the MDF receptacle of CB-LB lines 00-24.

(*c*) *Vertical panel equipment* (fig. 17). The vertical panel equipment at the front of the CB-LB line relay case is the same as the vertical panel equipment described in paragraph 10*b*(1)(*c*). Refer to figure 98 for the wiring diagram of the 48-volt battery receptacles. Figure 99 is the wiring diagram for the FA buzzer, and figure 102 is the wiring diagram of the fuse panel for CB-LB lines 00-49.

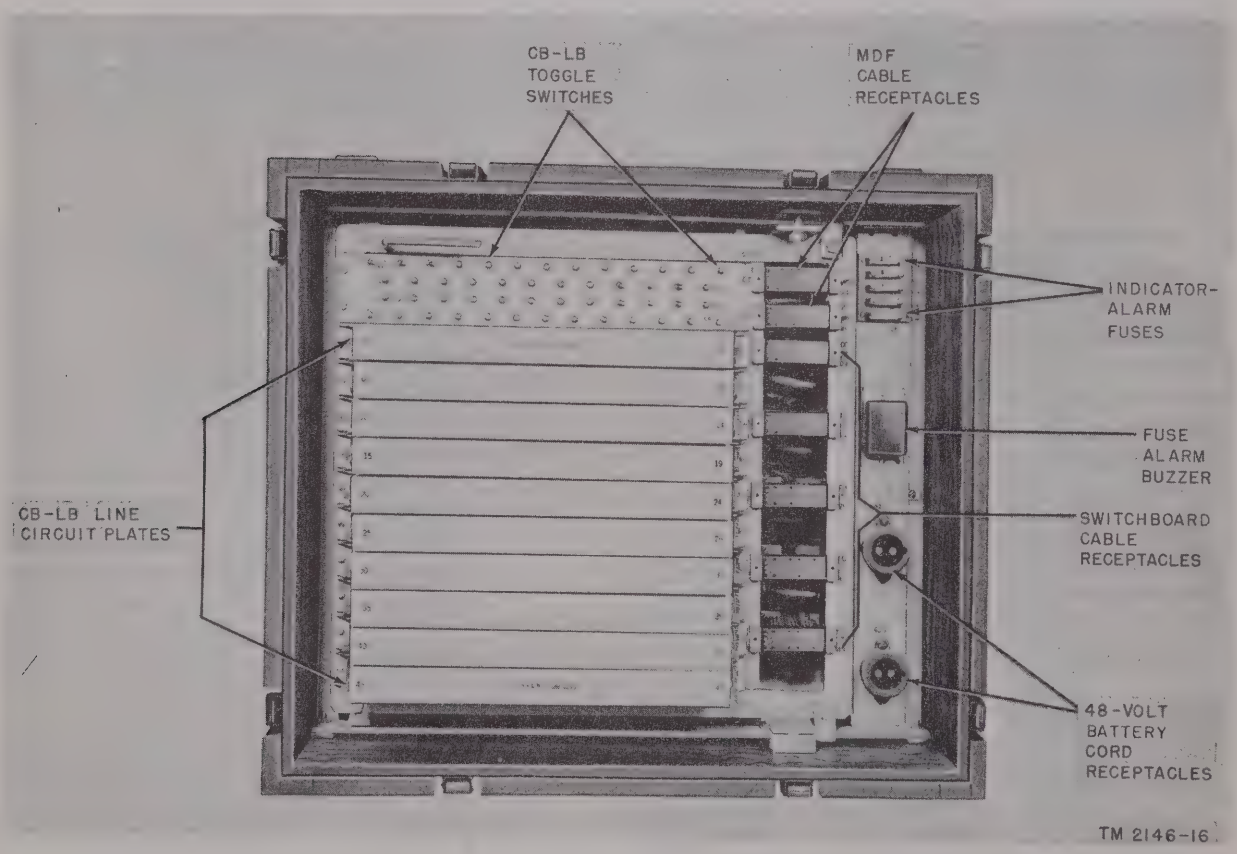


Figure 17. Line Relay Telephone Circuit TA-223/TTC, front view.

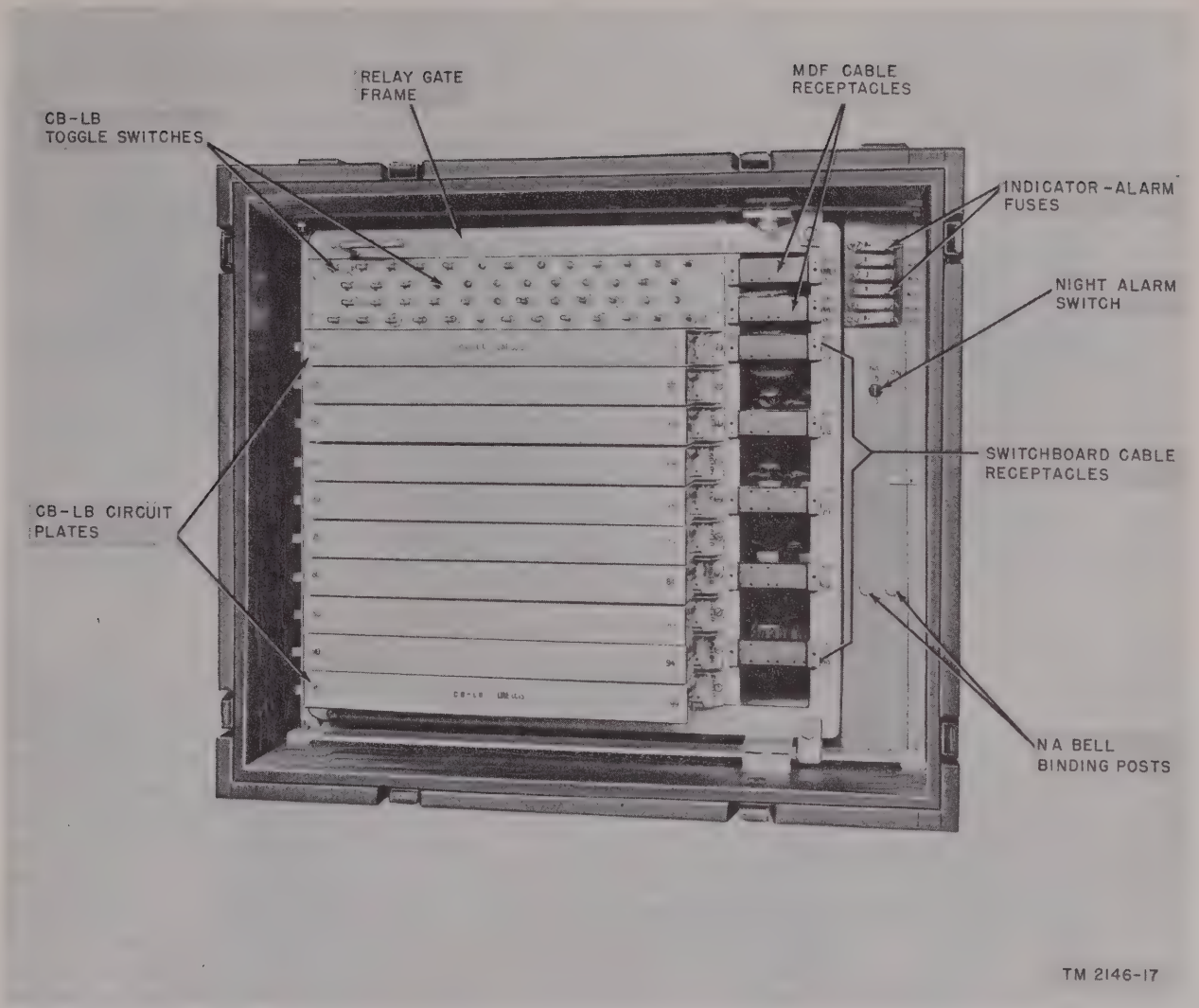


Figure 18. Line Relay Telephone Circuit TA-223/TTC, rear view.

(2) *Rear* (fig. 18). The rear equipment of the CB-LB line relay case is the same as the front equipment except for the numbering of the toggle switches, the circuit plate covers, and the MDF and switchboard cable receptacles. The rear vertical panel is the same as the rear vertical panel described in paragraph 10*b*(2). The switch located at the upper left corner of the toggle switch panel is marked LB-CB 50, and the switch located at the lower right corner is marked LB-CB 99. The circuit plate numbering is 50 through 99. The two upper MDF cable receptacles are marked MDF 50-74 and MDF 75-99. The five switchboard cable receptacles are numbered from 50 through 99. Refer to figure 100 for the wiring diagram of the NA binding posts and to figure 101 for the wiring diagram of the NA switch. Figure 103 is the wiring diagram of the fuse panel of CB-LB lines 50-99.

12. Description of Trunk Relay Telephone Circuit TA–226/TTC

(figs. 20 and 21).

a. Exterior (fig. 13). The exterior of Trunk Relay Telephone Circuit TA–226/TTC (trunk relay case) is the same as the exterior of the MDF (par. 9*a* and fig. 13). The schematic diagram of a trunk circuit is riveted to the back of one of the covers.

b. Interior (figs. 20 and 21). The interior equip-

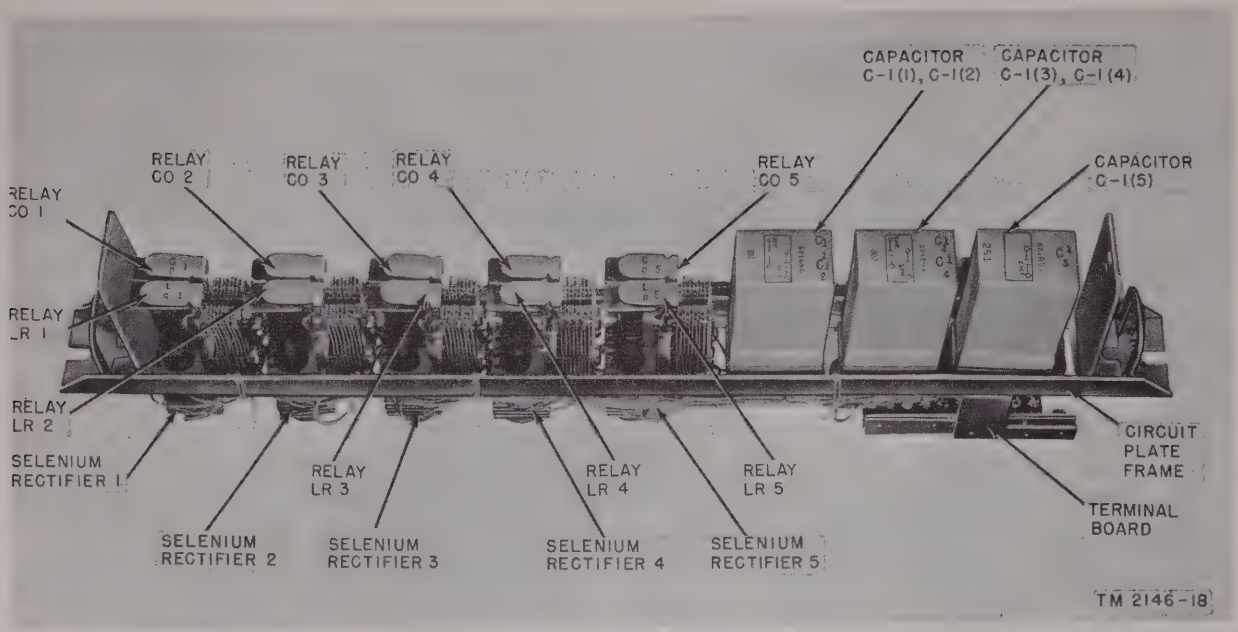


Figure 19. Line Relay Telephone Circuit TA-223/TTC, CB-LB line circuit plate.

ment of the trunk relay case is described in subparagraphs (1) and (2) below:

(1) *Front* (fig. 20). The front relay gate frame is provided with five circuit plates, one MDF cable receptacle, and two switchboard cable receptacles. The five circuit plates contain the relays and associated equipment for 10 trunk circuits. The following is a detailed description of a trunk circuit plate, the three cable receptacles, and the vertical mounting panel:

(*a*) *Trunk circuit plate* (fig. 22). The trunk circuit plate provides a mounting for the components of two trunk circuits. Trunk circuit No. 1 consists of a repeating coil (RC 1), one twin-type relay (CO 1 and DL 1), one single relay (LR 1), and a capacitor (C-1 1). The components for trunk circuit No. 2 are the same as those for circuit No. 1. Refer to figure 61 for the wiring diagram of a trunk circuit. At the rear of the circuit plate is a terminal board that interconnects the cable receptacle wiring to the circuit plate component wiring. Refer to figure 105 for the wiring diagram of the terminal board of a trunk circuit plate.

(*b*) *Front cable receptacles* (fig. 20). At the upper right corner of the relay gate frame are three cable receptacles. The upper receptacle is the MDF receptacle and is marked MDF H 1-20. The middle receptacle is a switchboard cable receptacle and is marked LINE F 1-10. The bottom receptacle is a switchboard receptacle and is marked DIAL D 1-10. Refer to figure 104 for the wiring diagram of MDF receptacle H. Figure 106 is the wiring diagram for trunk jack receptacle F, and figure 109 is the wiring diagram for dial jack receptacle D.

(*c*) *Front vertical mounting plate* (fig. 20). To the right of the front relay gate frame is a vertical mounting plate. At the top of the plate are five indicator-alarm type fuses. Each fuse provides current overload protection for two trunk circuits. Below the fuses is the trunk relay case fuse alarm buzzer FA. Two 48-volt battery cord receptacles are located below the FA buzzer. Refer to figure 107 for the wiring diagram of the fuse panel for trunk circuits 1-10. Figure 111 is the wiring diagram of the FA buzzer, and figure 113 is the wiring

diagram of the 48-volt battery receptacles.

(2) *Rear* (fig. 21). The rear relay gate frame supports five circuit plates and two switchboard cable receptacles. The five circuit plates contain the relays and associated equipment for 10 trunk circuits. The upper switchboard cable receptacle is marked LINE E 11-20, and the lower switchboard cable receptacle is marked DIAL G 11-20. The wiring diagram of receptacle E is figure 106, and the wiring diagram of receptacle G is figure 109. To the right of the relay gate frame is the vertical mounting plate. At the top of the mounting plate are six indicator-alarm type fuses. The bottom fuse is marked NA and provides overload protection for the night alarm circuit. The five fuses above the NA fuse each provide current overload protection for two trunk circuits. Refer to figure 108 for the wiring diagram of the fuse panel for trunk circuits 11-20. Below the fuse panel is the night alarm switch (NA). Refer to figure 110 for the wiring diagram of the NA switch. Below the NA switch are two binding posts that provide the connections to the external night alarm circuit. Refer to figure 112 for the wiring diagram of the NA binding posts.

13. Panel BD–132–A

(figs. 24 and 25).

Panel BD-132-A provides the 48-volt battery supply, the ringing and emergency ringing power supply, the battery charging rectifier, and the 110-volt ac outlet necessary for the operation of the central office. The voltmeter, ammeter, and circuit

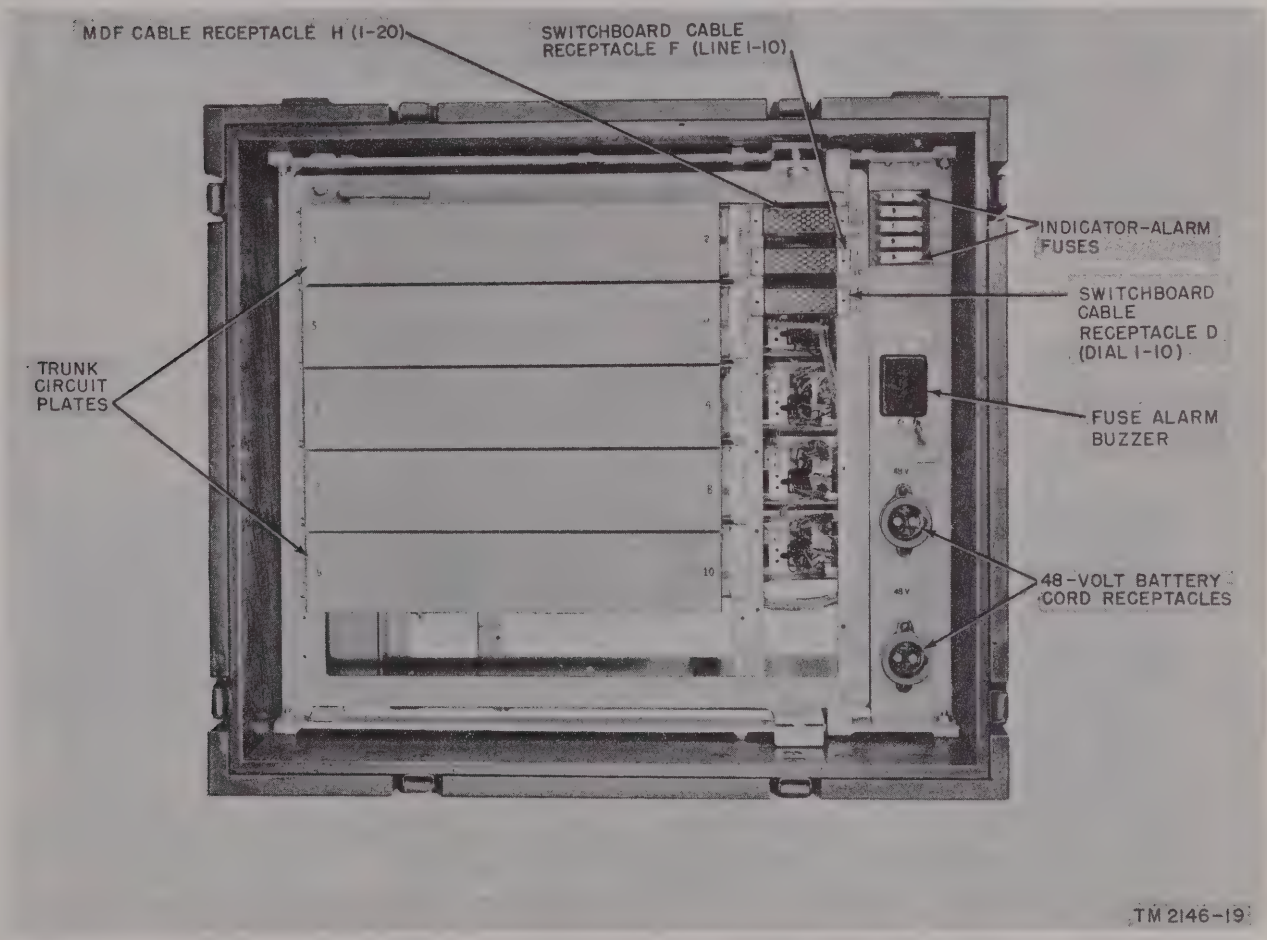


Figure 20. Trunk Relay Telephone Circuit TA-226/TTC, front view.

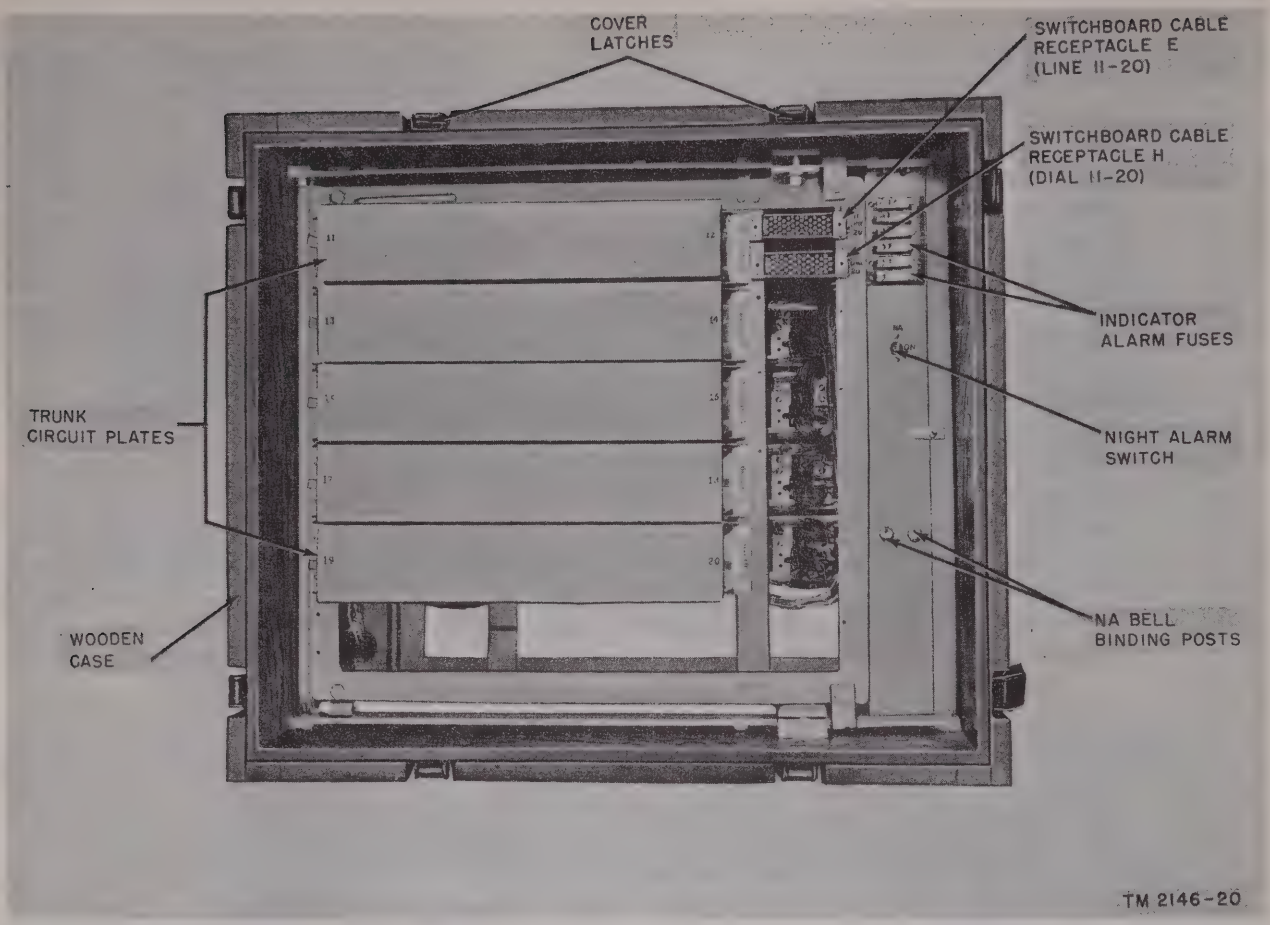


Figure 21. Trunk Relay Telephone Circuit TA-226/TTC, rear view.

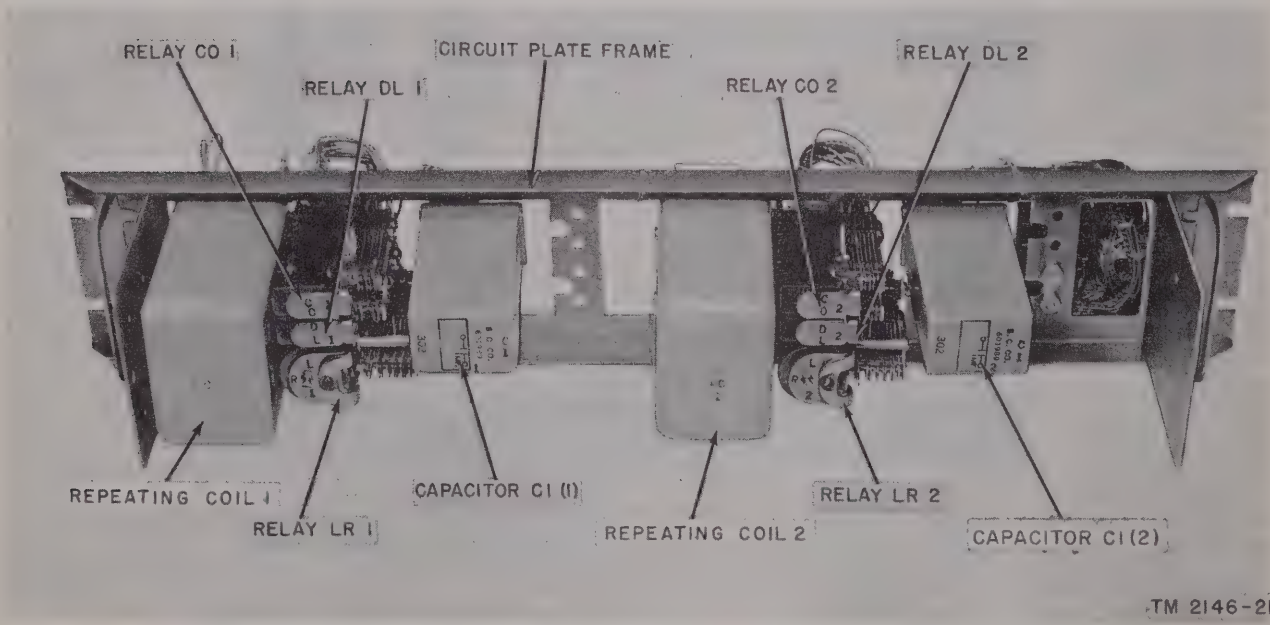


Figure 22. Trunk Relay Telephone Circuit TA-226/TTC, trunk circuit plate.

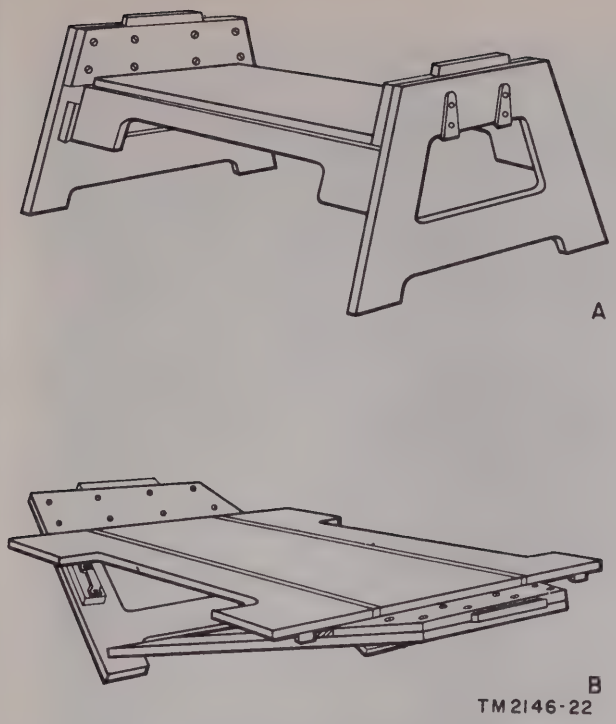


Figure 23. Stand Base MT-1132/TT, assembled and folded views.

breaker equipment are mounted on the top panel. The Telering, the emergency ringing supply rotary converter, the fuse panel, and the retardation coil are mounted on the center of the frame. The rectifier is mounted on the bottom of the frame. At the upper rear of Panel BD-132-A is the cord connector panel which mounts the necessary power receptacles. A detailed description of Panel BD-132-A, with operating and maintenance instructions, is given in TM 11-2064, Panels BD-132 and BD-132-A.

14. Cable Assembly Set

(fig. 34).

The cable assembly set includes all the cords and cables necessary to interconnect the components of the AN/TTC–7. Refer to paragraph 20*b* and figure 34 for information concerning the physical appearance, length, quantity, and function of each cable or cord supplied.

15. Description of Minor Components

Subparagraphs *a* through *q* below describe the minor components of the AN/TTC–7.

a. Transformer TF-11. Transformer TF-11 is provided to step down 230 volts ac to 115 volts ac, which is the normal operating voltage of Panel BD-132-A. The transformer is fitted with input and output receptacles marked INPUT 230 V and OUTPUT 115 V. See TM 11-2064 for further information.

b. Frame FM-65. Frame FM-65 is a steel frame that is used to mount Transformer TF-11.

c. Cable Covers CW-323/T and CW-324/T (fig. 26). The cable covers are U-shaped aluminum troughs. Holes have been drilled along the mounting edges so that the covers can be fastened to the floor. Sixteen cable covers are supplied with the AN/TTC–7.

d. Ground Rods MX-148-G. Three 6-foot steel ground rods are provided for grounding the equipment. Each rod is fitted with a screw-type connector.

e. Chair M-205-A. Three adjustable operator's chairs are provided with the AN/TTC–7.

f. Truck. The truck is an angle frame equipped with four swivel-type wheels. It is used to move components of the AN/TTC–7.

g. Batteries BB-46. Four 6-cell, 12-volt, lead-acid storage batteries are supplied with the AN/TTC–7. Electrolyte for the batteries is packaged separately. Four cases (CS-63) are provided to house the batteries when in use or in transit. A wooden block attached to the top of the battery case (CS-63) covers is intended to prevent the batteries from being placed in an inverted position.

Note. The batteries are shipped dry. Refer to TM 9–2857, Storage Batteries Lead Acid Type.

h. Rack FM-31. Rack FM-31 is a steel frame provided for mounting Batteries BB-46.

i. Duck Tarpaulin. Six canvas duck paulins, each approximately 16 feet long and 12 feet wide, are supplied to serve as a protective covering for the equipment while in storage or transit.

j. Message Register. The message register is a mechanical peg-count meter which is hand operated by means of a push button. Six message registers are provided with the equipment.

k. Wire WD-15/U. The wire (1,000 feet) is used for miscellaneous purposes, such as installing jumper wires at the MDF cases and connecting the night alarm bell.

l. Trouble Caps. Sixty black fiber tubes are provided to designate cord circuits in trouble. They fit over the cord circuit plugs.

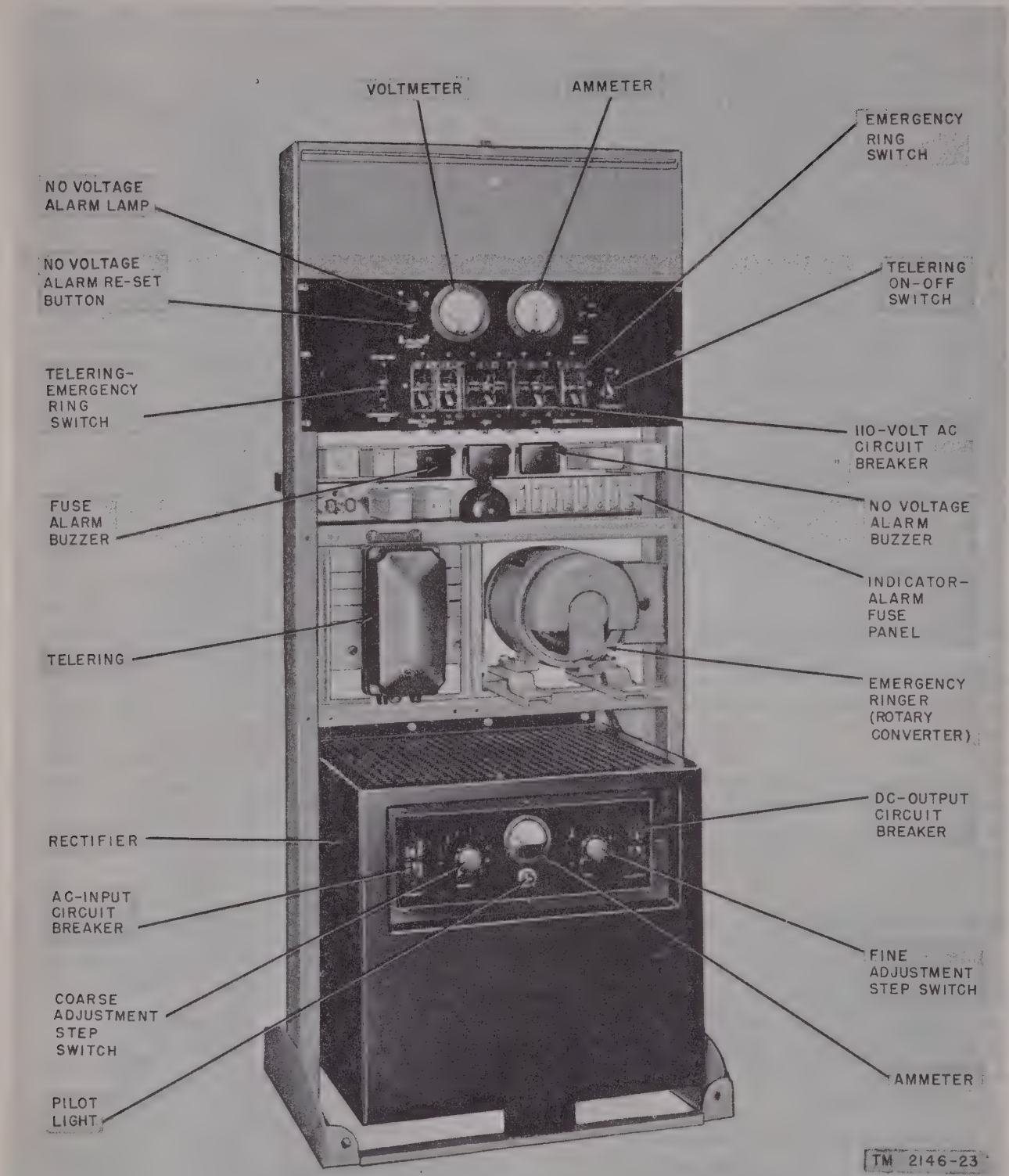


Figure 24. Panel BD-132-A, front view.

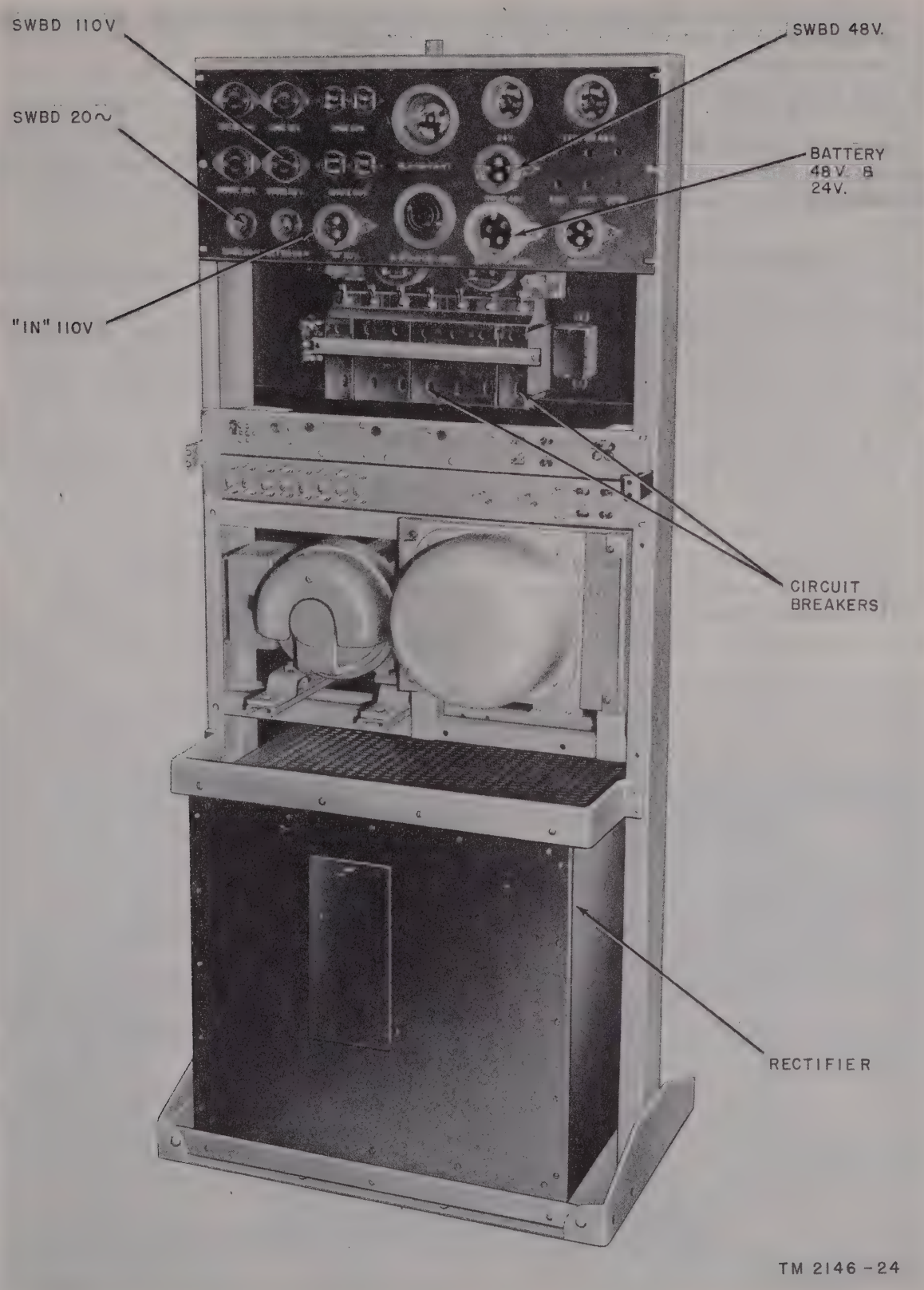


Figure 25. Panel BD-132-A, rear view.

m. Cover, Telephone Jack. A number of brass plugs are supplied which can be inserted into all unused jacks on the switchboard panels. Included are 60 with white facing, 210 with black facing, and 30 with yellow facing.

n. Headset-Microphone H-91/U. The H-91/U includes the operator's receiver and transmitter and the connecting cord and plug. Nine sets are provided.

o. Night Alarm Bell. The night alarm bell marked NA gives an audible signal of an incoming call. The night alarm bell is packed as a separate component and can be mounted where desired.

p. Stand Base MT-1132/TT (fig. 23). Stand Base MT-1132/TT is a folding, plywood, sawhorse style mounting stand. Three are provided with the AN/TTC–7 to support the line relay cases, the trunk relay case, and the MDF cases.

q. Chest CH-58. Chest CH-58 is a steel chest that houses Tool Equipment TE-44.

r. Tool Equipment TE-44. Tool Equipment TE-44 includes the installation and maintenance tools for the manual central office.

s. Cable Assembly Case CY-1498/T. Two cases CY-1498/T are provided to house the cable assemblies.

t. Accessories Case CY-1499/T. One case CY-1499/T is provided to house the cable covers.

u. Accessories Case CY-1500/T. One case CY-1500/T is provided to house miscellaneous items such as running spares, special tools, and manufacturer's drawings.

16. Running Spares

The following is a list of running spares for the AN/TTC–7:

Quantity	ITEM
102	Fuses, indicator alarm, 1⅓-ampere.
5	Fuses, FU–50.
3	Fuses, alarm, 3-ampere.
2	Lamps, 36-volt.
1	Lamp, telering, 50-watt, 115-volt.
10	Lamps, supervisory, 6-volt.
1	Lamp, resistance (generator)
202	Lamps, incoming signal, 48-volt.
1	Lamp (rectifier).
68	Lamp caps, incoming signal.
2	Lamp caps, supervisory, red.
2	Lamp caps, supervisory, white.
2	Lamp caps, supervisory, green.
60	Arrestors, lightning, MDF.

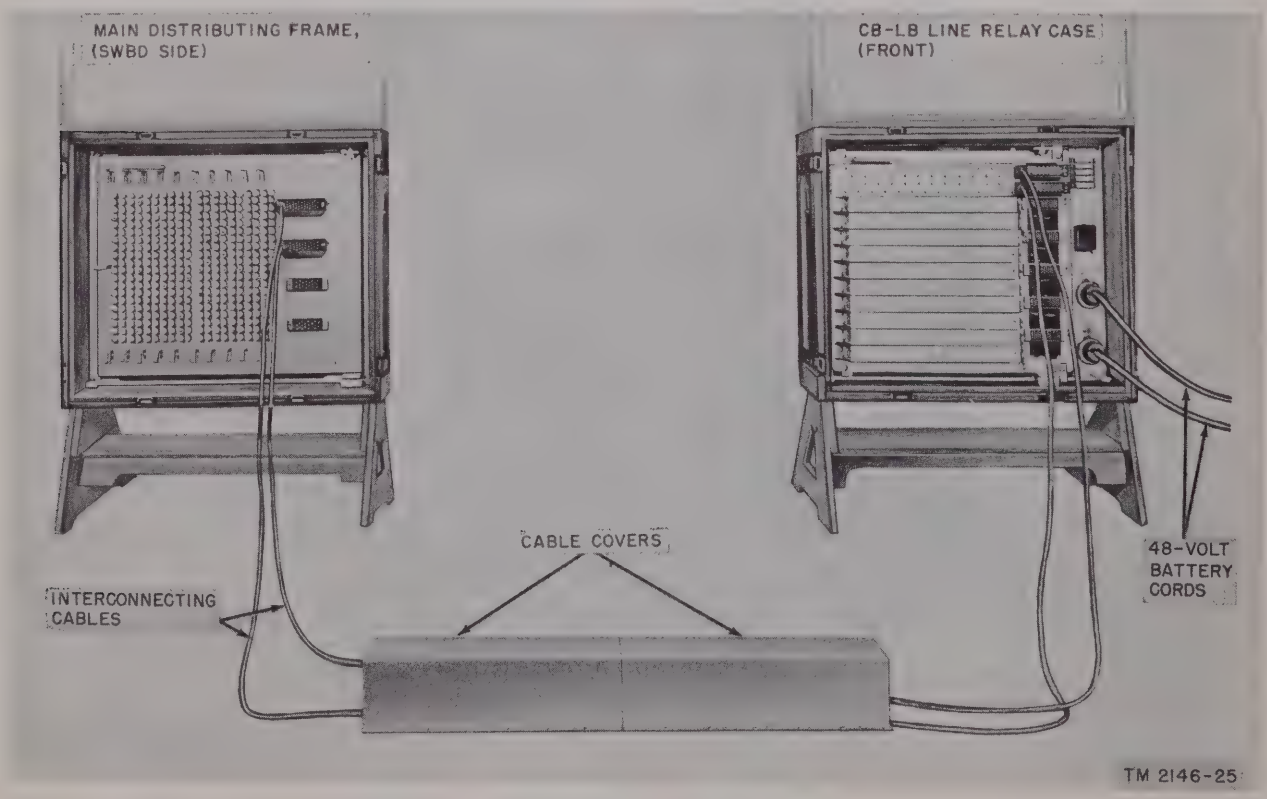


Figure 26. Telephone Main Distributing Frame TA-257/TTC and Line Relay Telephone Circuit TA-223/TTC, using two cable cover troughs.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF EQUIPMENT

17. Siting

Manual Telephone Central Office AN/TTC–7 can be installed in any location where adequate shelter is provided for the equipment and the operating personnel. Choose areas that are free from excessive amounts of dust or moisture. If possible, the site should accommodate heating facilities to keep the equipment warm and dry during cold weather. Once the installation site for the AN/TTC–7 has been chosen, determine individual sites for the location of each of its components. The distance between the switchboard and the line and trunk relay case should not exceed 40 feet. The distance between the line and trunk relay case and the MDF should not exceed 40 feet. The switchboard positions must be as close together as possible to permit intercabling with 8-foot cables. Panel BD–132–A should be located within 35 feet of the switchboard positions and within 40 feet of the 110-volt ac (alternating current) supply source.

18. Uncrating, Unpacking, and Checking New Equipment

a. General. For shipment, components of the AN/TTC–7 are packaged in wooden crates, the dimensions and volume of which are listed in paragraph 6. To identify the contents of any particular wooden crate, refer to paragraph 6. Follow the instructions in sub-paragraphs *b* through *g* below to uncrate and unpack new equipment.

b. Manual Telephone Switchboard SB–249/TTC and Panel BD–132–A (fig. 27). Each of the three Manual Telephone Switchboards SB–249/TTC are packaged identically for shipment. Panel BD–132–A is packaged in the same manner as the switchboards. To remove the component from its wooden crate, proceed as outlined in subparagraphs (1) through (6) below.

(1) Cut the metal straps and remove the top and sides of the crate with a suitable prying tool.

(2) Open the waterproof barrier.

(3) Remove the top filler that covers the component.

(4) Cut the metal straps that lash the component to the pallet.

(5) Using at least four men, grasp the component by its carrying handles and lift it clear of the pallet, leaving the pallet bolted to the skid.

(6) Place the component in an upright position, and unlatch and remove its covers. Visually inspect the component for scratched or marred surfaces, loose wiring, broken switches, and for defective, loose, or damaged parts.

c. CB and CB–LB Line Relay Cases, Trunk Relay Case, and MDF (fig. 28). These components are packaged identically and placed in individual wooden shipping crates. To unpack these components, proceed as outlined in subparagraphs (1) through (7) below.

(1) Cut the metal straps of the crate, and remove the top of the crate with a suitable tool.

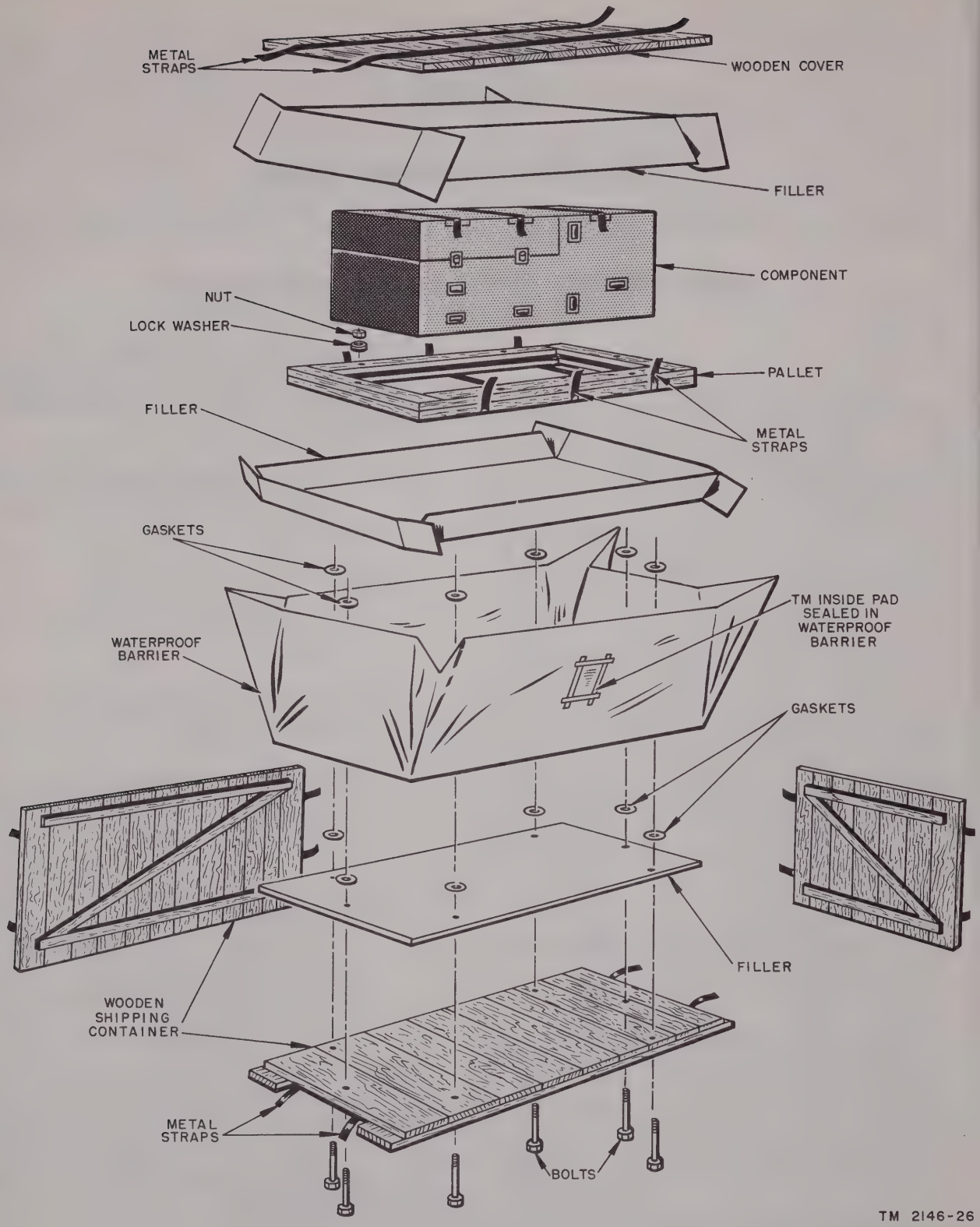


Figure 27. Manual Telephone Switchboard SB-249/TTC, and Panel BD-132-A, packing and packaging diagram.

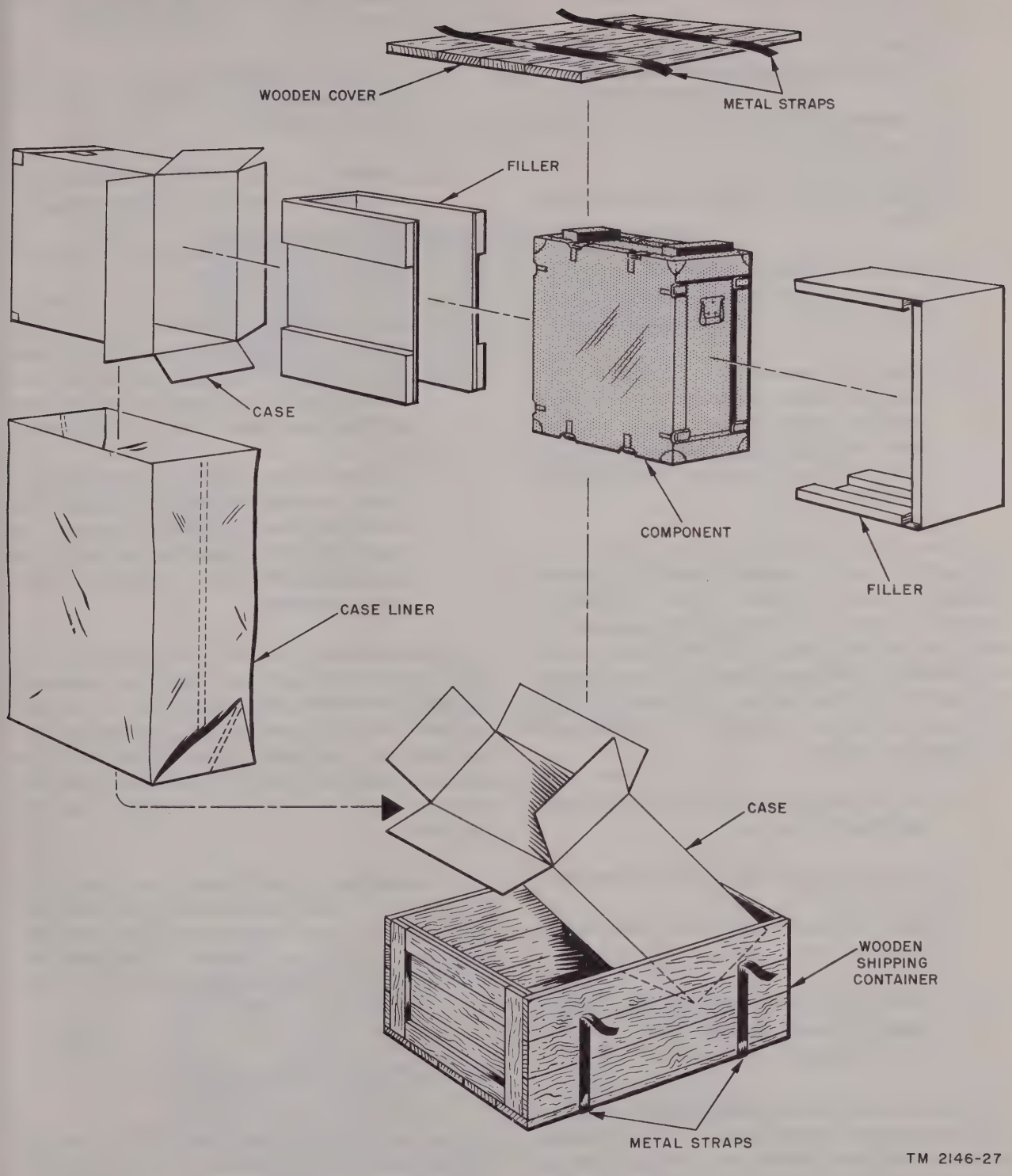


Figure 28. Line Relay Telephone Circuit TA-223/TTC, Line Relay Telephone Circuit TA-224/TTC, Trunk Relay Telephone Circuit TA-226/TTC, and Telephone Main Distributing Frame TA-257/TTC, packing and packaging diagram.

(2) Carefully lift the outer case out of the crate.

(3) Open the outer case, and slide it up and off the waterproofed inner case.

(4) Remove the vaporproof barrier from the inner case.

(5) Open the inner case and remove the top filler.

(6) Lift the component from the inner case by means of the carrying handles located on the end of the component.

(7) Place the component in an upright position, and unlatch and remove its front and rear covers. Visually check for broken binding posts, scratched or marred surfaces, loose parts, and damaged apparatus.

d. Case CS–63, Chest Set CH–58, Chair Case CY–1490/T, Cable Assembly Case CY–1498/T, Accessories Cases CY–1499/T, and CY–1500/T (fig. 29). The cases are prepared for shipment by being padded with suitable fillers, placed within water-resistant fiberboard boxes, and then packed into wooden shipping crates. To unpack any of the cases, proceed as outlined in subparagraphs (1) through (4) below.

(1) Cut the metal straps of the wooden crate, and remove the top.

(2) Carefully lift the carton out of the crate.

(3) Open the top of the carton and remove the fillers which surround the case.

(4) Grasp the case by means of the carrying handles located on each of its ends, and lift the case from the carton.

e. Batteries BB–46, and Bottled Electrolyte (fig. 30). For shipment, each Battery BB–46 is placed within a fiberboard carton and covered with a frame to protect the battery terminals against possible shock or damage. Each of the three 1-gallon bottles of electrolyte furnished for the batteries is packed in a fiberboard carton with the necessary fillers. Three cartons are placed in a wooden shipping crate. To remove the batteries or the electrolyte from their crates, proceed as outlined in subparagraphs (1) through (4) below.

(1) To unpack Batteries BB–46, cut the metal straps of the wooden crate and remove the top.

(2) Remove the fillers on the top and sides of the carton, and lift out the carton.

(3) Open the carton, remove the frame, and lift out the batteries.

(4) To remove a bottle of electrolyte from its wooden shipping container, cut the straps of the wooden crate and remove the top. Then open the top of the carton, remove the fillers, and carefully lift out the bottle.

Caution: The battery electrolyte contained in these bottles is a sulphuric-acid water solution of sufficient strength to harm the skin or clothing. Be careful in handling these bottles to prevent breakage or spillage.

f. Base Stands MT–1132/TT and Truck (fig. 31). Three base stands and one truck are packaged together in one wooden shipping crate. To unpack the base stands and truck from their wooden shipping crate, cut the metal straps around the crate and remove the top. Lift out the cased component, open the case, and remove the fillers and the component.

g. Tarpaulins. For shipment, two tarpaulins are tied and inserted into a case liner and then placed in a wooden shipping crate. To unpack the tarpaulins, cut the metal straps of the crate, remove the top, open the case liner, and lift out the tarpaulins.

19. Installation of Equipment

Personnel installing the AN/TTC–7 should familiarize themselves with the following detailed instructions before attempting to install the various components. In general, installation consists of placing the components in the correct operating positions and then removing their various covers in order to install and connect the necessary wir-

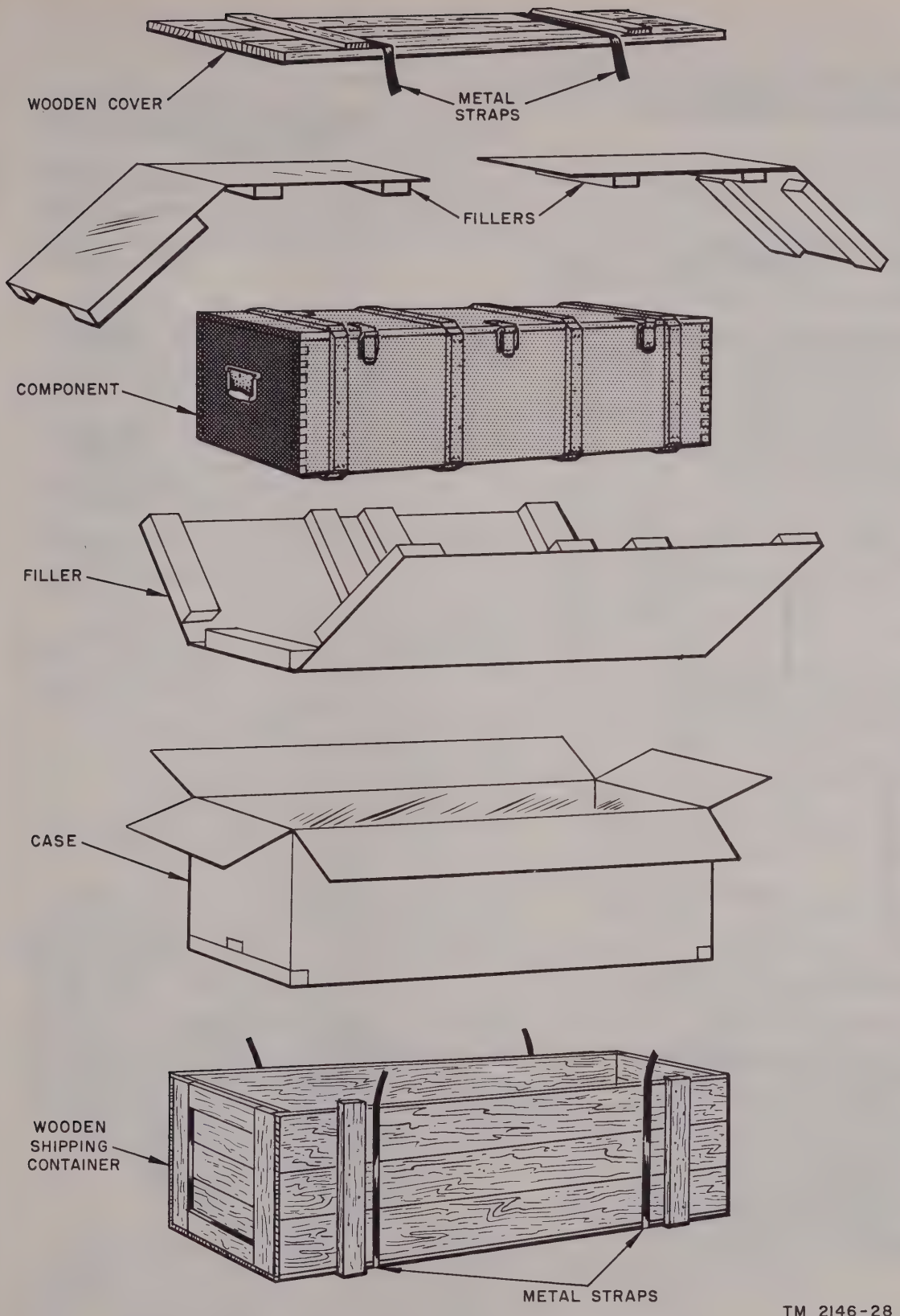


Figure 29. Case CS-63, Chair Case CY-1490/T, Cable Assembly Case CY-1498/T, Accessories Case CY-1499/T, Accessories Case CY-1500/T, and Chest Set CH-58, packing and packaging diagram.

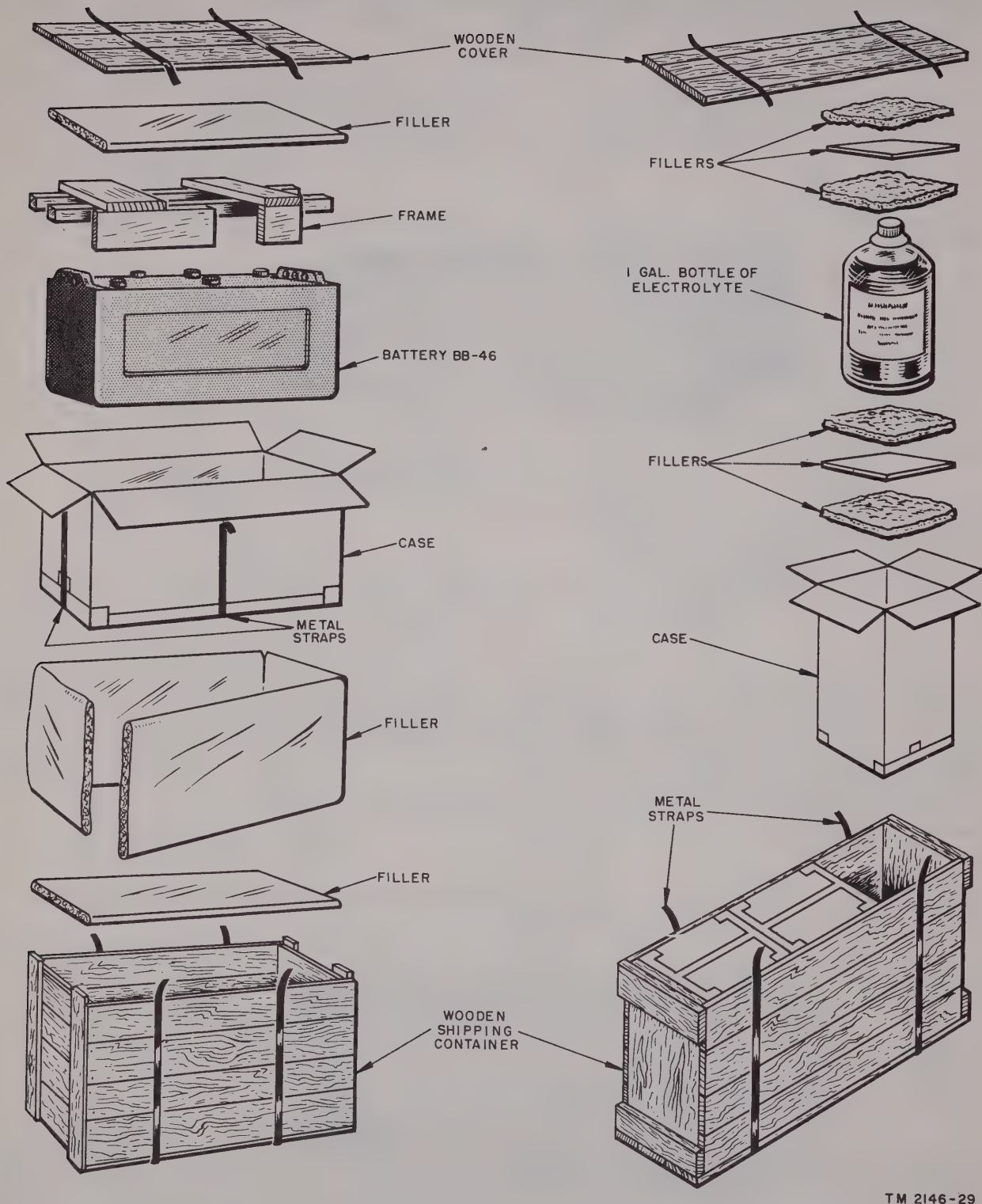


Figure 30. Batteries BB-46 and electrolyte, packing and packaging diagram.

ing and cabling (par. 20). Use the truck provided to move the heavier components into place.

a. Installation of Manual Telephone Switchboards SB–249/TTC (fig. 4). After the three switchboard positions have been uncrated and unpacked according to the instructions given in paragraph 18, proceed with the step-by-step installation procedures outlined in subparagraphs (1) through (6) below.

(1) Move one of the three switchboard positions to the site selected. If the switchboard is in an upright position before moving, grasp the carrying handles and slowly tilt the switchboard over on its back. Then lift the switchboard by the carrying handles and carry it to the selected site.

(2) Place the switchboard in its upright operating position.

(3) Unlatch and remove the top and front covers of the switchboard position. Store the covers in a convenient, safe place.

(4) Remove the rear cover by removing the securing screws. It is necessary to remove the rear cover in order to gain access to the interior of the switchboard. The rear cover is replaced after cabling procedures have been completed.

(5) Lift one of the remaining two switchboard positions and place it flush against the first position. Remove the front, top, and rear covers.

(6) Place the third switchboard position flush against the second position. Remove the front, top, and rear covers. The three-position switchboard is now ready for cabling (par. 20); do not proceed with the cabling until all the other components have been installed.

b. Installation of Base Stands MT–1132/TT (fig. 23). The three base stands furnished with the AN/TTC–7 are used to support the trunk relay case, line relay cases, or MDF cases. To prepare base stands for use, unfold them and lock their legs securely into place by means of the locking brackets which are attached to the under side of the board. Position the base stands at the place selected for the installation of the line and trunk relay cases and the main distributing frames.

c. Installation of Telephone Main Distributing Frames TA–257/TTC (fig. 11). Installation of the three main distributing frames supplied with the AN/TTC–7 consists of placing the main distributing frames on a base stand, one on top of the other, within 40 feet of the relay cases. When in place, unlatch and remove the front and rear covers of each MDF. Store the covers in an accessible place. The main distributing frames are now ready to be cabled to the relay cases and to be wired to the incoming lines (par. 20).

d. Installation of Line Relay Telephone Circuit TA–223/TTC Line Relay Telephone Circuit TA–224/TTC, and Trunk Relay Telephone Circuit TA–226/TTC (figs. 14, 17, and 20). The trunk and line relay cases must be installed within 40 feet of the switchboard positions. Follow the instructions outlined in subparagraphs (1) through (4) below to install the trunk relay case or either line relay case.

(1) Lift the case by its carrying handles and carry it to the site selected.

(2) Place the case on a base stand.

(3) Unlatch and remove the front and rear covers. Store them in an accessible place.

(4) Repeat the above steps for each of the two remaining cases. Place the two remaining cases on top of the first case. The line and trunk relay cases are now ready for cabling (par. 20).

e. Installation of Panel BD–132–A (fig. 24). Place this unit on the truck and roll it into position. Because of the length of the interconnecting cables and cords, this component must be installed within 35 feet of the installed switchboard positions. When in place, in its upright operating position, unlatch and remove its front and rear covers and store them with the covers of the other components of the AN/TTC–7. Cable as instructed in paragraph 20.

f. Installation of Batteries BB–46. Batteries BB–46 are shipped dry and uncharged. Electrolyte

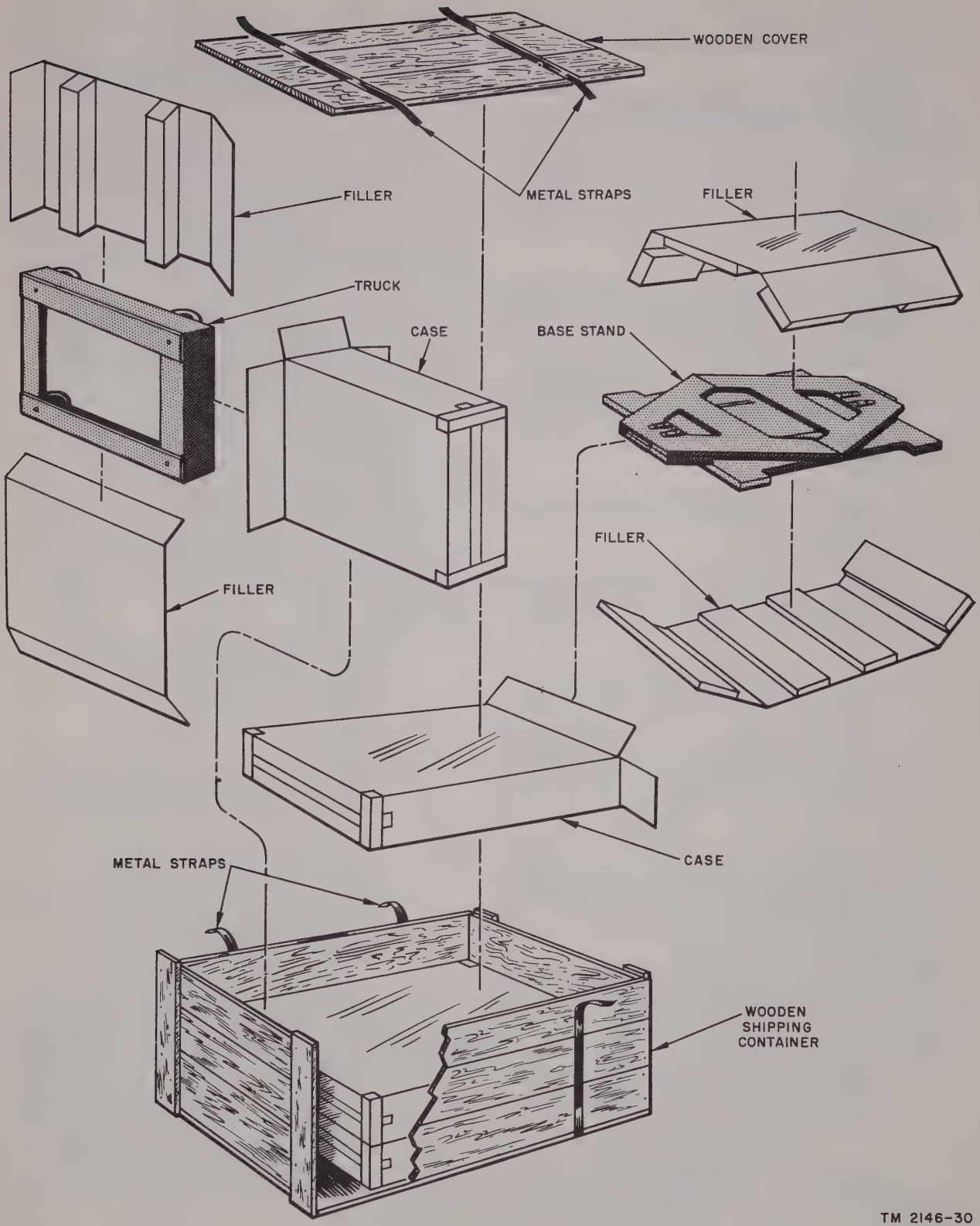


Figure 31. Base Stands MT-1132/TT and truck, packing and packaging diagram.

necessary for their operation is supplied separately. Before being put into use, these batteries must be filled with electrolyte and charged in strict accordance with instructions supplied with the battery. The four batteries and cases should be installed on Rack FM–31 within 25 feet of Panel BD–132–A. After the batteries have been filled and charged, they may be transported in their cases provided they are kept in an upright position to prevent spilling the electrolyte.

g. Installation of Cables and Cords. All the cables and cords necessary for the installation of the AN/TTC–7 are contained in Cable Assembly Cases CY–1498/T. Each cord or cable has a specific function; the functions (connections) of each cable and cord are listed in paragraph 20. Figures 32 and 34 illustrate the various receptacles and plugs used by each cable or cord. Figure 34 also lists the lengths of the cables and cords for identification purposes during installation. Install each cable or cord in accordance with the connection procedures outlined in paragraph 20.

h. Installation of Night Alarm (NA) Bell. The night alarm bell may be installed in any location. Make the connections as outlined in paragraph 20.

20. Connections
(fig. 33).

a. Cabling Block Diagram Figure 33 illustrates the cabling layout for the AN/TTC–7. Each line between components represents one individual cable. The numbers above each cable identify the lines the cable serves.

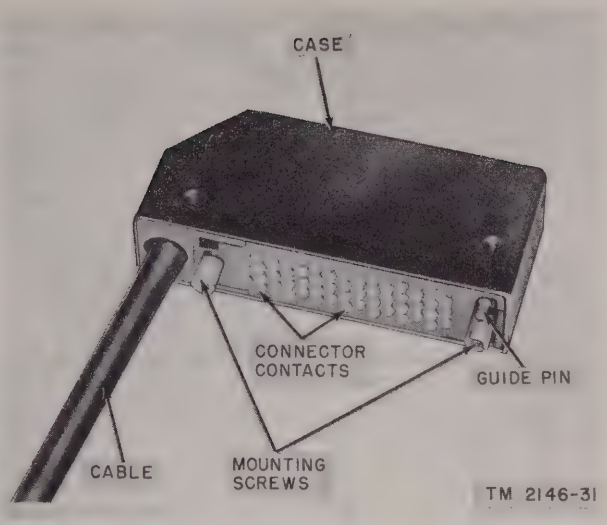


Figure 32. 52-pin cable plug, rear view.

b. Table of Cables and Cords. The table below lists the necessary cables and cords supplied with the AN/TTC–7. This table lists the quantity, marking, and length of each cable or cord. Also listed are the cable identifying letters which correspond to the sketches (fig. 34). To identify any cable or cord, refer to the lettered sketch (fig. 34) which corresponds to the letter listed in the left hand column of the table.

Sketch in fig. 34	Quantity	Nomenclature	Connection function	Length (ft)
A	32	Telephone Cable Assembly CX–2584/U	Line and trunk relay cases to main distributing frames and line and trunk relay cases to switchboard	50
B	46	Telephone Cable Assembly CX–2584/U	Switchboard to switchboard	8
C	1	Cord CD–393	110-volt supply to Panel BD–132–A	50
D	1	Cord CD–409	220-volt generator to Transformer TF–11	50
E	2	Cord CD–413	110-volts, switchboard to switchboard	5
F	1	Cable	48-volts, Panel BD–132–A to switchboard	50
F	3	Cable	48-volts, switchboard to switchboard	4
F	3	Cable	48-volts, switchboard to line and trunk relay cases	50
G	1	Cord CD–784	48-volts, battery to Panel BD–132–A	30
H	1	Cable	20-cycle ringing, Panel BD–132–A to switchboard	50
H	3	Cable	20-cycle ringing, switchboard to switchboard	4
I	3	Cable	Grouping, switchboard to switchboard	4
J	1	Cord CD–258A	Grounding, MDF to ground rods	50
K	1	Cord CD–414	110-volts, Panel BD–132–A to switchboard	48
L	3	Cord CD–38	Strapping between batteries	1

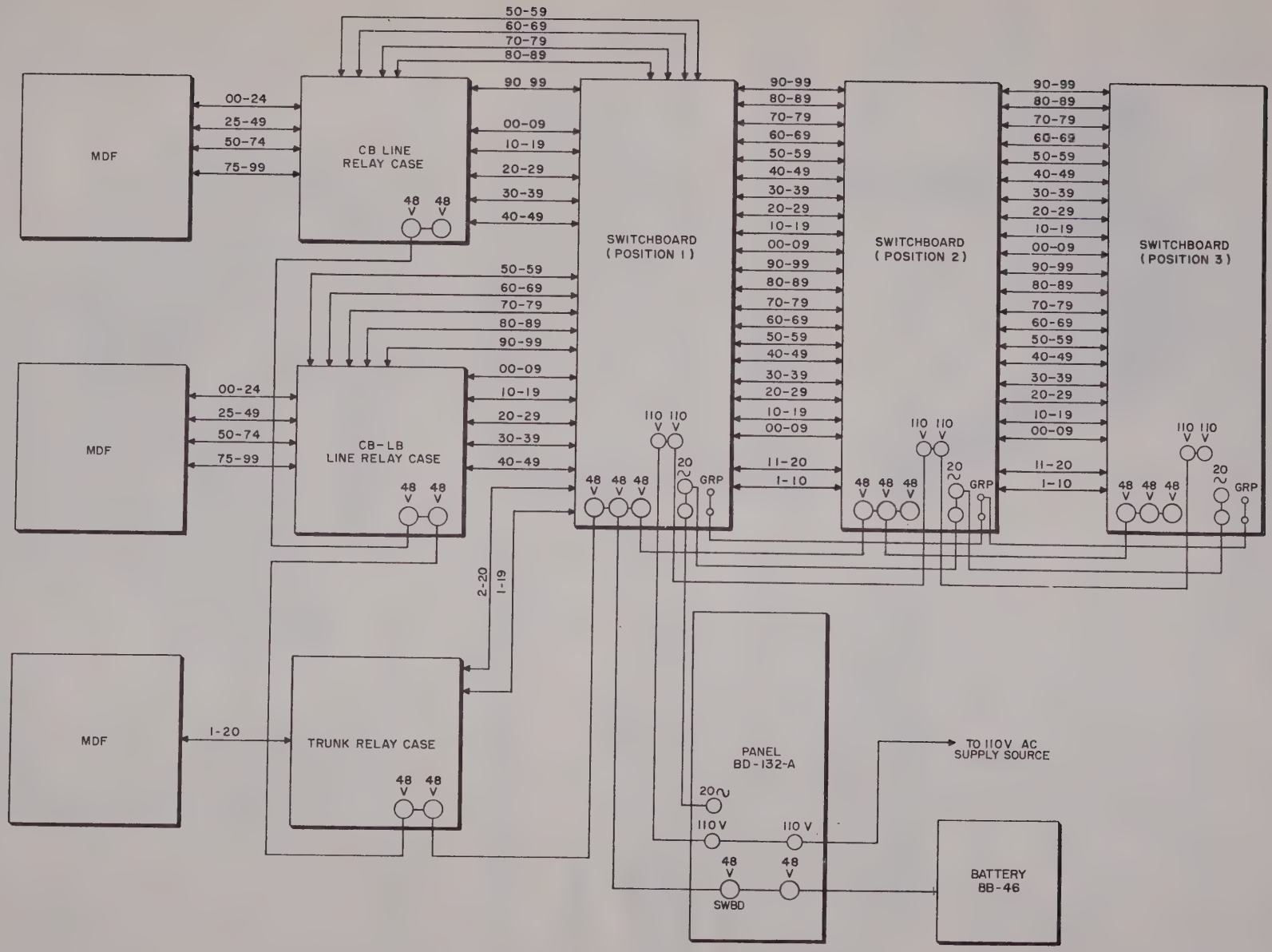


Figure 33. Manual Telephone Central Office AN/TTC-7, cabling block diagram.

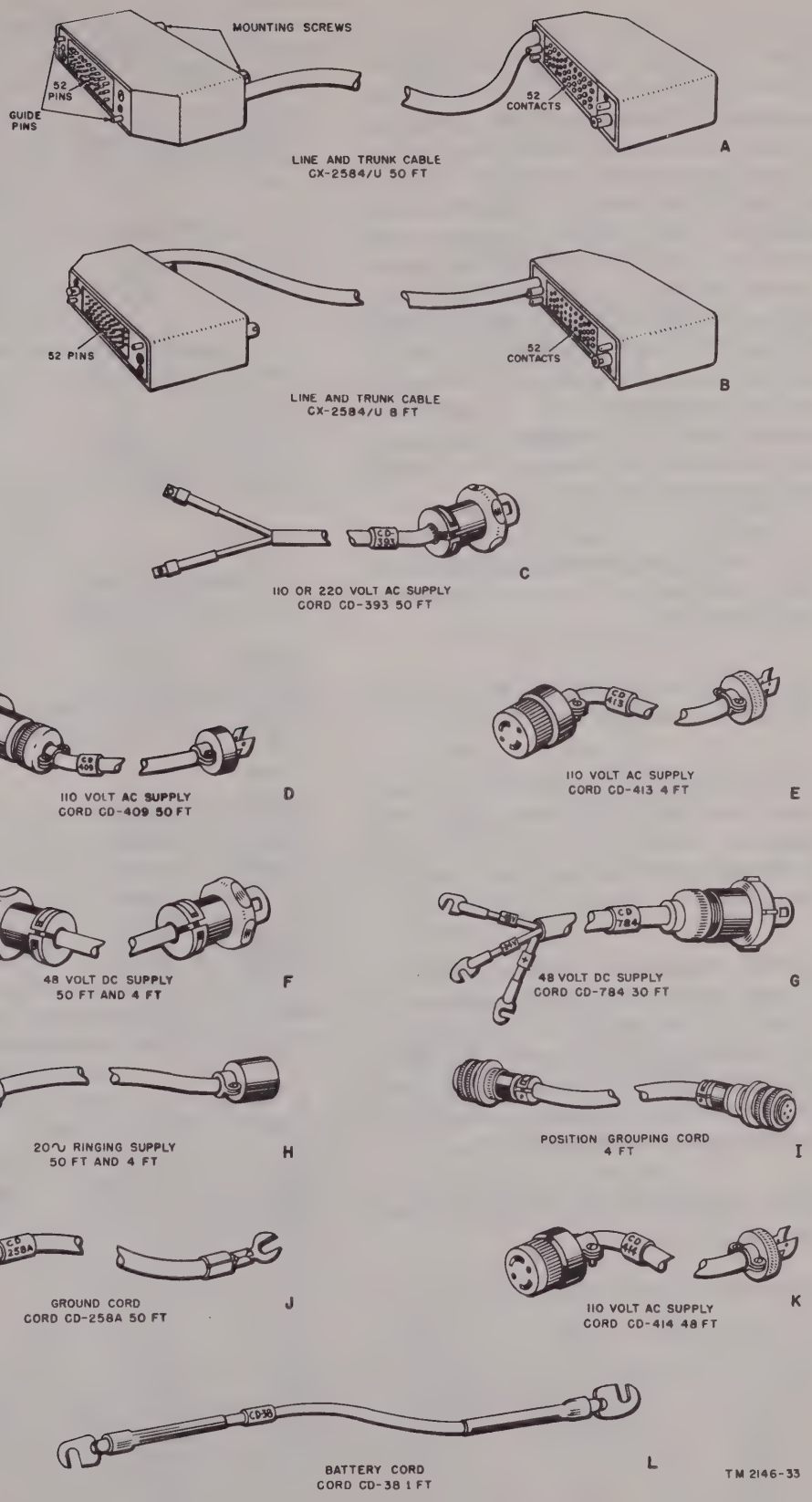


Figure 34. Manual Telephone Central Office AN/TTC-7, cable assembly set.

c. 52-pin Connector Plugs (Telephone Cable Assembly CX–2584/U) (fig. 32). Sketches A and B (fig. 34) illustrate the type of cable used for connections between switchboard positions, trunk and line relay cases, and main distributing frames. The ends of each cable are equipped with a 52-pin connector plug. When installed, each pin on the 52-pin connector makes electrical contact with corresponding pins located on the cable receptacles mounted on the various components. Each 52-pin connector plug is furnished with two mounting screws which serve to secure the plug to its associated receptacle. Figure 114 shows the wiring diagram of a 52-pin connector plug. To connect a 52-pin connector plug to its associated 52-contact cable receptacle, follow the instructions in subparagraphs (1) through (3) below.

(1) Hold the 52-pin connector plug in one hand, and position it against the associated receptacle.

(2) Tighten the screws located on the rear of the 52-pin connector plug (fig. 32).

(3) When connected to its associated receptacle, the 52-pin connector plug will appear as shown in figure 8. Figure 26 illustrates typical connections of two 50-foot cables.

d. Connection Procedures. Subparagraphs *e* through *w* give the necessary information for cabling between the components of the AN/TTC–7. The instructions given below are in a definite sequence in accordance with the component being cabled. When the cabling instructions are understood, any component can be cabled first.

e. Connections Between the MDF (fig. 11) *and CB Line Case* (fig. 14).

From MDF cable receptacle	To CB line case cable receptacle	Type of cable	Cable length (ft)
00-24	00-24	CX–2584/U A, (fig. 34)	50
25-49	25-49	”	”
50-74	50-74	”	”
75-99	75-99	”	”

f. Connections Between the MDF (fig. 11) *and CB–LB Line Case* (fig. 17).

From MDF cable receptacle	To CB line case cable receptacle	Type of cable	Cable length (ft)
00-24	00-24	CX–2584/U (A, fig. 34)	50
25-49	25-49	”	”
50-74	50-74	”	”
75-99	75-99	”	”

g. Connections Between the MDF (fig. 11) *and Trunk Relay Case* (fig. 20).

From MDF cable receptacle	To trunk relay case cable receptacle	Type of cable	Cable length (ft)
00-24	HMDF 1-20	CX–2584/U (A, fig. 34)	50

h. Connections Between CB Line Case (fig. 14) *and Switchboard Position 1* (fig. 7).

From CB line case cable receptacle	To switchboard position 1, cable receptacle	Type of cable	Cable length (ft)
00-09	09-00	CX–2584/U (A, fig. 34)	50
10-19	19-10	”	”
20-29	29-20	”	”
30-39	39-30	”	”
40-49	49-40	”	”
50-59	59-50	”	”
60-69	69-60	”	”
70-79	79-70	”	”
80-89	89-80	”	”
90-99	99-90	”	”

Note. The connections to switchboard position 1 can be made to either of the three groups of CB line receptacles.

i. Connections Between CB–LB Line Case (fig. 17) *and Switchboard Position 1* (fig. 7).

From CB–LB line case cable receptacle	To switchboard position 1, cable receptacle	Type of cable	Cable length (ft)
00-09	09-00	CX–2584/U (A, fig. 34)	50
10-19	19-10	”	”
20-29	29-20	”	”
30-39	39-30	”	”
40-49	49-40	”	”
50-59	59-50	”	”
60-69	69-60	”	”
70-79	79-70	”	”
80-89	89-80	”	”
90-99	99-90	”	”

Note. The connections to switchboard position 1 can be made to either of the two groups of CB–LB line receptacles.

j. Connections Between Trunk Relay Case (fig. 20) *and Switchboard Position 1* (fig. 7). These two components can be interconnected in one of two ways, depending on the type of trunk operation desired. The two different types of trunk connections are listed in subparagraphs (1) and (2) below. Use the applicable trunk connection.

(1) *Manual trunk operation (20 manual trunks).*

From trunk relay case cable receptacle	To switchboard position 1, cable receptacle	Type of cable	Cable length (ft)
F line 1-10	18-00	CX-2584/U (A, fig. 34)	50
E line 11-20	19-01	"	50

(2) *Dial trunk operation (10 dial trunks).*

From trunk relay case cable receptacle	To switchboard position 1, cable receptacle	Type of cable	Cable length (ft)
D 1-10	18-00	CX-2584/U (A, fig. 34)	50
H 1-10	19-01	"	50

Note. The switchboard receptacles marked 18-00 and 19-01 are the bottom receptacles at the right rear of the switchboard.

k. Multiple Connections Between Switchboard Positions 1 and 2 (fig. 35). Switchboard position 1 and switchboard position 2 are connected so that both switchboard positions have access to the same lines and trunks. Follow the instructions given in subparagraphs (1) through (4) below to interconnect the two positions. Refer to figure 35 for an illustration of how the 52-pin connector plug appears when it is connected to the rear of another 52-pin connector plug.

(1) *Multipling CB lines.*

From switchboard position 1	To switchboard position 2	Number of cables needed	Type of cable	Cable length (ft)
Lines 99-00	Lines 99-00	10 (1 cable for 10 lines)	CX-2584/U (B fig. 34)	8

(2) *Multipling CB–LB lines.*

From switchboard position 1	To switchboard position 2	Number of cables needed	Type of cable	Cable length (ft)
Lines 99-00	Lines 99-00	10 (1 cable for 10 lines)	CX–2584/U (B, fig. 34)	8

(3) *Multipling manual trunks.*

From switchboard position 1	To switchboard position 2	Number of cables needed	Type of cable	Cable length (ft)
18-00	18-00	1	CX–2584/U (B, fig. 34)	8
19-01	19-01	1	"	"

(4) *Multipling dial trunks.*

From switchboard position 1, cable receptacle	To switchboard position 2, cable receptacle	Number of cables needed	Type of cable	Cable length (ft)
18-00	18-00	1	CX–2584/U (B, fig. 34)	8
19-01	19-01	1	"	"

l. Multipling Switchboard Positions. To multiple switchboard position 2 to switchboard position 3, follow the procedure outlined in subparagraph *k*.

m. Grouping Connections Between Positions.

From switchboard	To switchboard	Type of cable	Cable length (ft)
Position 1, GRP OUT	Position 2, GRP IN	I, fig. 34	4
Position 2, GRP OUT	Position 3, GRP IN	"	"

n. Ringing Supply Connections Between Positions.

From switchboard	To switchboard	Type of cable	Cable length (ft)
Position 1, lower receptacle marked 20∩	Position 2, upper receptacle marked 20∩	H, fig. 34	4
Position 2, lower receptacle marked 20∩	Position 3, upper receptacle marked 20∩	"	"

o. AC Connections Between Positions, 110-volt.

From switchboard	To switchboard	Type of cable	Cable length (ft)
Position 1, top	Position 2, top	CD–413 (E fig. 34)	5
Position 2, top	Position 3, top	"	"

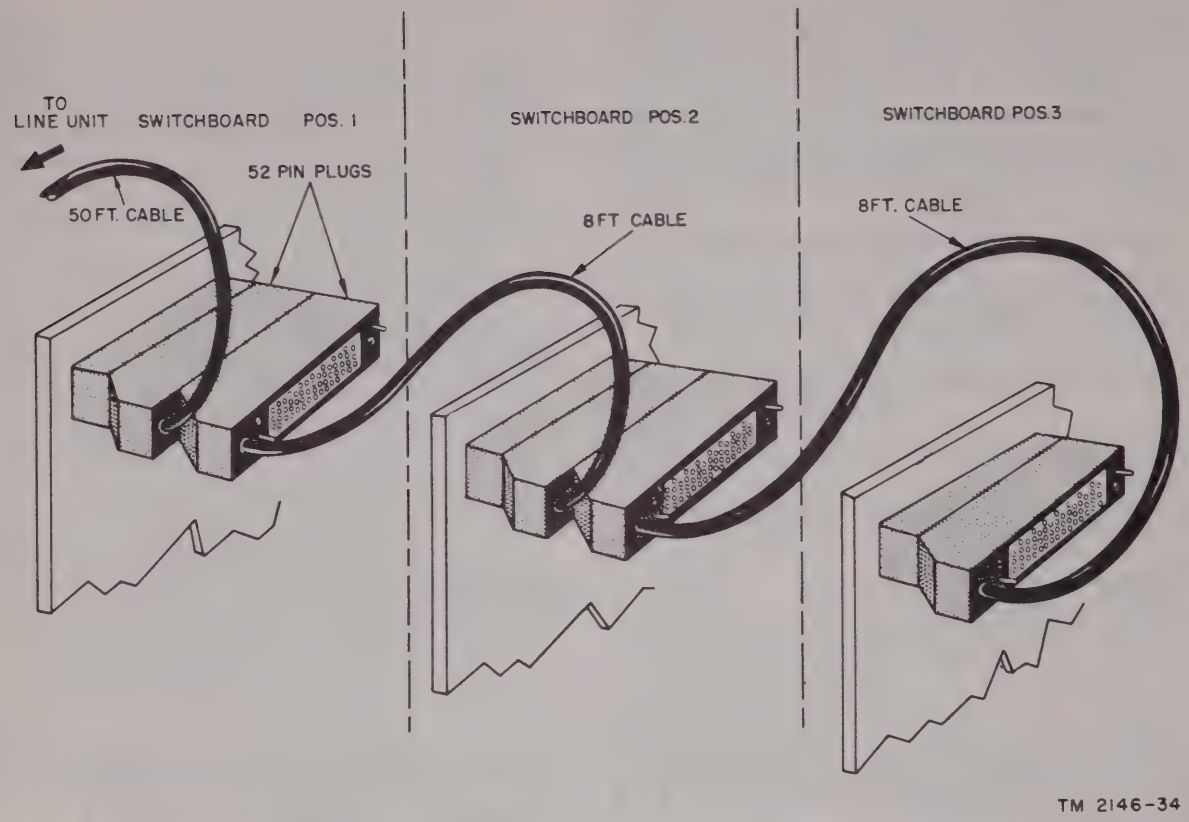


Figure 35. Manual Telephone Switchboard SB-249/TTC, method of multipling 8-foot cables.

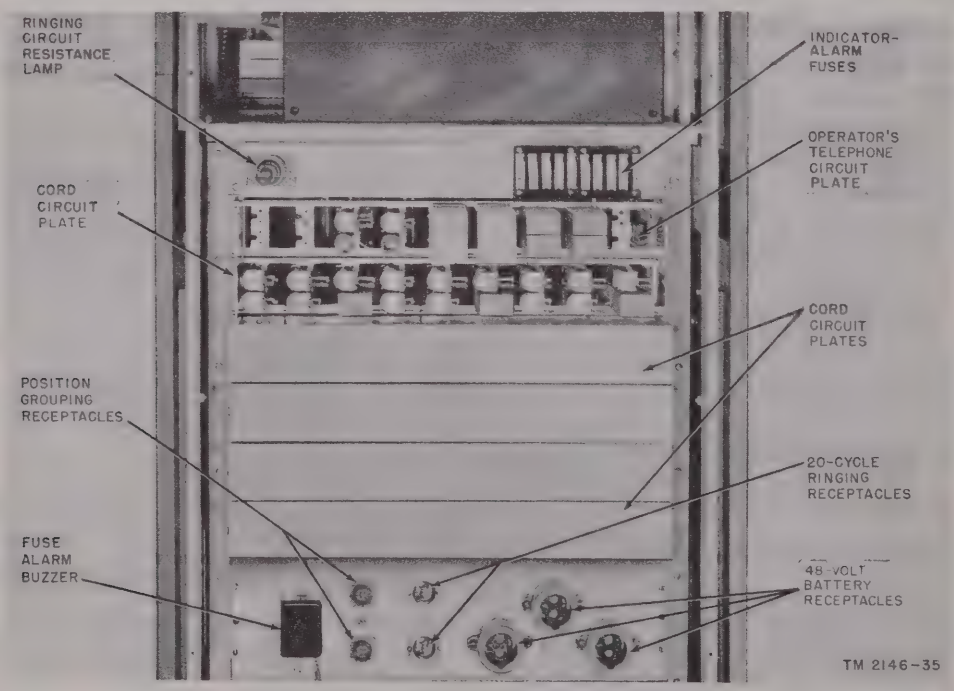


Figure 36. Power and grouping cord receptacle panel for SB-249/TTC.

p. Cord Connections, 48-volt. Figure 36 shows the location of the 48-volt receptacle on the switchboard positions.

From	To	Type of cable	Cable length (ft)
Left receptacle (48V) of position 1.	Right receptacle (48V) of position 2.	F, fig. 34	4
Left receptacle (48V) of position 2.	Right receptacle (48V) of position 3.	"	4
Right receptacle (48V) of position 1.	Bottom receptacle (48V) trunk relay case	"	50
Top receptacle (48V) trunk relay case	Bottom receptacle (48V) CB-LB line case	"	4
Top receptacle (48V) CB-LB line case	Bottom receptacle (48V) CB line case	"	4

q. Connections to Panel BD-132-A.

From rear of Panel BD-132-A	To switchboard position 1	Type of cable	Cable length (ft)
Receptacle marked SWBD 20Ω	Upper receptacle marked 20Ω	H, figure 34.	50
Receptacle marked SWBD 110V	Top of position 110V receptacle	Cord CD 414 (k, fig. 34)	48
Receptacle marked SWBD 48V.	Rear middle receptacle marked 48V.	F, figure 34.	50

r. Connections Between Panel BD-132-A and Power Source. Panel BD-132-A can be operated from a power supply of either 110 or 220 volts ac. For operation from a 110-volt ac supply, use the procedure given in subparagraph (1) below. For operation from a 220-volt ac supply, use the procedure in subparagraph (2) below.

(1) Ac supply source (Cord CD-393), 110-volt.

(*a*) Use one 50-foot cord (C, fig. 34) marked CD-393 for this connection.

(*b*) Connect the male plug of the cord to the receptacle marked IN 110V, located on the receptacle panel at the rear of Panel BD-132-A.

(*c*) Connect the opposite double end of the 50-foot cord to the 110-volt ac supply source.

Caution: Before connecting to the 110-volt ac supply source, make certain that the 110V circuit breaker on the front control panel of Panel BD-132-A is in the OFF position.

(2) Ac supply source, 220-volt.

(*a*) Use one 50-foot cord (D, fig. 34) marked CD-409 to connect Panel BD-132-A to Transformer TF-11.

1. Connect the large male plug of the 50-foot cord to the receptacle marked IN 110V located on the rear of Panel BD-132-A.

2. Connect the small plug at the opposite end of the 50-foot cord to the receptacle marked OUTPUT 115V located on Transformer TF-11.

(*b*) Use one 50-foot cord (C, fig. 34) marked CD-393 to connect Transformer TF-11 to the 220-volt ac supply source.

1. Connect the plug of the 50-foot cord to the receptacle marked INPUT 230V located on Transformer TF-11.

2. Connect the opposite ends of the 50-foot cord to the 220-volt ac source.

s. Connections Between Panel BD-132-A and Batteries BB-46.

(1) Connect the male plug of one 30-foot Cord CD-784 (G, fig. 34) to the receptacle marked BATT 48V & 24V at the rear of Panel BD-132-A (fig. 25).

Caution: Before connecting cord CD-784 to Battery BB-46, make certain that the 48V circuit breaker on the control panel of Panel BD-132-A is in the OFF position.

(2) Strap the terminals of the four batteries of Battery BB-46 in series; use the

three 1-foot Cords CD–38 (L, fig. 34).

(3) Connect the lug lead marked −48V (CD–784) to the negative terminal (−) of Battery BB–46.

(4) Connect the lug lead marked +' (CD–784) to the positive terminal (+) of Battery BB–46.

t. Ground Cords and Ground Rods.

(1) *Ground Rods.* Select a suitable spot to place the ground rods within 50 feet of the main distributing frames. Space them approximately 10 feet apart and drive them into the earth; use Hammer HM–5.

(2) Ground connections between Panel BD–132–A and MDF.

(*a*) Use Cord CD–783.

(*b*) Connect one end of Cord CD–783 to the frame of Panel BD–132–A.

(*c*) Connect the opposite end to the wing nut terminal marked GRD on the trunk relay case MDF.

(3) *Ground connections between MDF and Ground Rods MX–148/G.*

(*a*) Use Cord CD–258A (J, fig. 34).

(*b*) Connect one end of Cord CD–258A to the GRD terminal on the trunk relay case MDF.

(*c*) Connect the opposite end to one of the ground rods.

(*d*) Strap the ground rods together using two11-foot lengths of wire, No. 14 or larger.

(4) *Ground strapping between main distributing frames.*

(*a*) Connect the necessary length of No. 14 wire between the GRD terminals of the two line relay case main distributing frames.

(*b*) Connect another length of No. 14 wire from these two main distributing frames to the GRD terminal of the trunk relay case MDF.

u. Connection of Night Alarm. To install the night alarm bell, follow the instructions given below.

(1) Use the wire provided on the wire spool.

(2) Connect the three pairs of night alarm binding posts located on the trunk and line relay cases in parallel. Do this as follows:

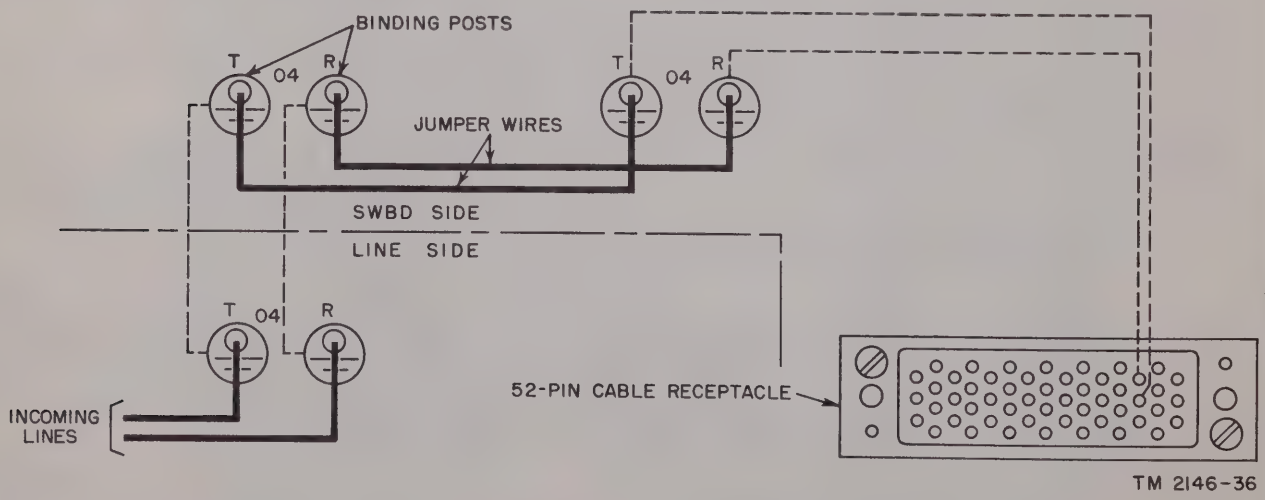


Figure 37. Telephone Main Distributing Frame TA-257/TTC, connections for one line.

(*a*) Select the trunk or line relay case most convenient to begin with, and connect the free ends of the wire on the wire spool to the night alarm binding post on the selected case, one wire per binding post. Hold the bare wire ends in one hand and press against the binding posts (one at a time) with the thumb of the free hand; insert the bare ends of the twisted pair into the slots on the binding posts. Release the binding posts.

(*b*) Run a sufficient amount of wire from the spool to connect to the binding posts located on the nearest, or most convenient, trunk or line relay case. Cut and strip the wires, and insert the ends into the slots of the night alarm binding posts as outlined in subparagraph (*a*) above.

(*c*) Run the wire from the spool until a sufficient amount of it is obtained to connect to the remaining line or trunk relay case. Insert these wire ends into the slot of the NA binding post on the remaining unit. Be sure that the binding posts on all three line or trunk relay cases are connected in parallel.

(*d*) Determine the length of wire needed to extend between the night alarm bell and any one of the three line or trunk relay cases. Cut the length of wire from the spool, and attach the two leads of one end to the two night alarm binding posts on any one of the three cases, one wire per binding post. Attach the other end of the twisted pair to the two terminals on the night alarm bell, one wire per terminal.

v. Connection of Incoming Lines. Figure 37 illustrates the manner of connecting a telephone line to a T and R binding post pair at the line side of the MDF. The connection of this line through to the cable receptacle is accomplished by installing jumper wires between associated T and R binding posts at the switchboard side of the MDF as illustrated in figure 37. Figure 38 illustrates a typical manner of connecting ten incoming lines to T and R binding posts at the line side.

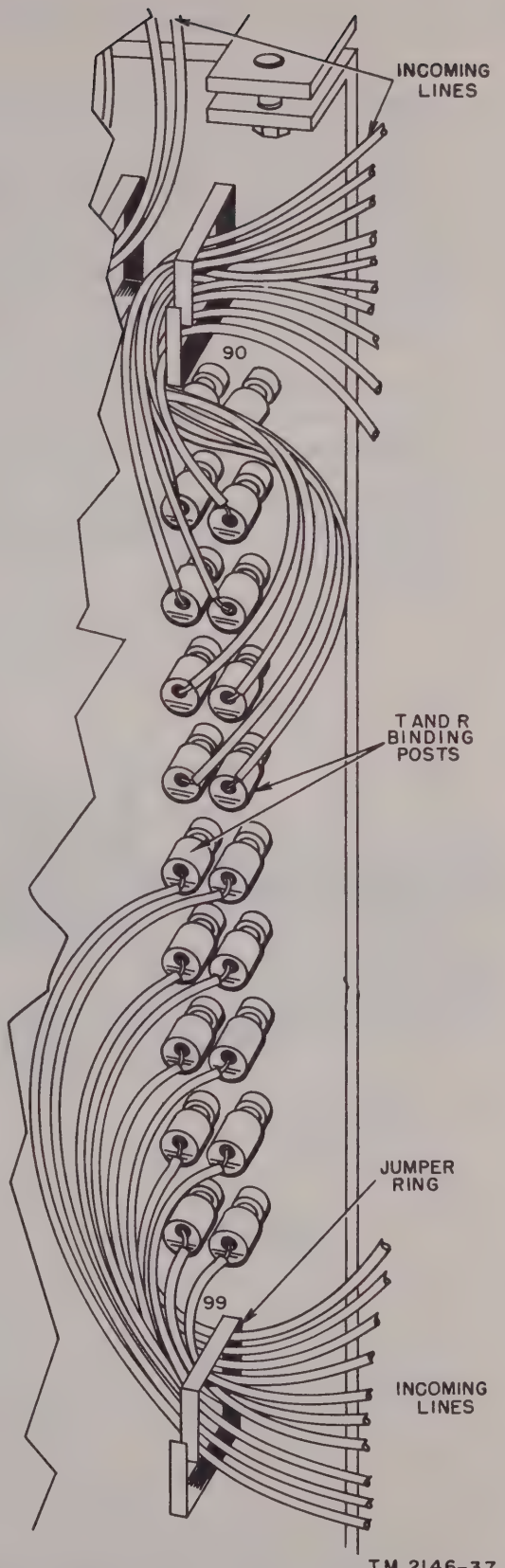


Figure 38. Telephone Main Distributing Frame TA-257/TTC, method of installing incoming lines at the line side.

The procedure in connecting the lines is as follows:

(1) Select a line T and R pair and strip the insulation back from the ends approximately ¾ inch.

(2) Starting with binding posts marked T 00 R at the upper left-hand corner of the line side, press the binding posts firmly. This opens the connector jaws in the binding posts so that the line wires will slip in.

(3) Insert the ends of each lead into the hole on the face of the associated T and R binding post and release the pressure.

(4) The leads will be held connected to the binding posts by a gripping action in the posts.

(5) Follow the same procedure with the remaining line pairs in numerical order.

w. Line Distribution. Figure 39 illustrates the manner of installing the line distribution jumper wires between T and R binding posts on the switchboard side of an MDF. Install the jumper wires as follows:

(1) Use the wire provided on the wire spool.

(2) Cut the necessary lengths of wire required, depending on the number of lines connected.

(3) Note the T and R binding post designation of a connected line on the line side and connect one end of the jumper wire pair to the corresponding designated T

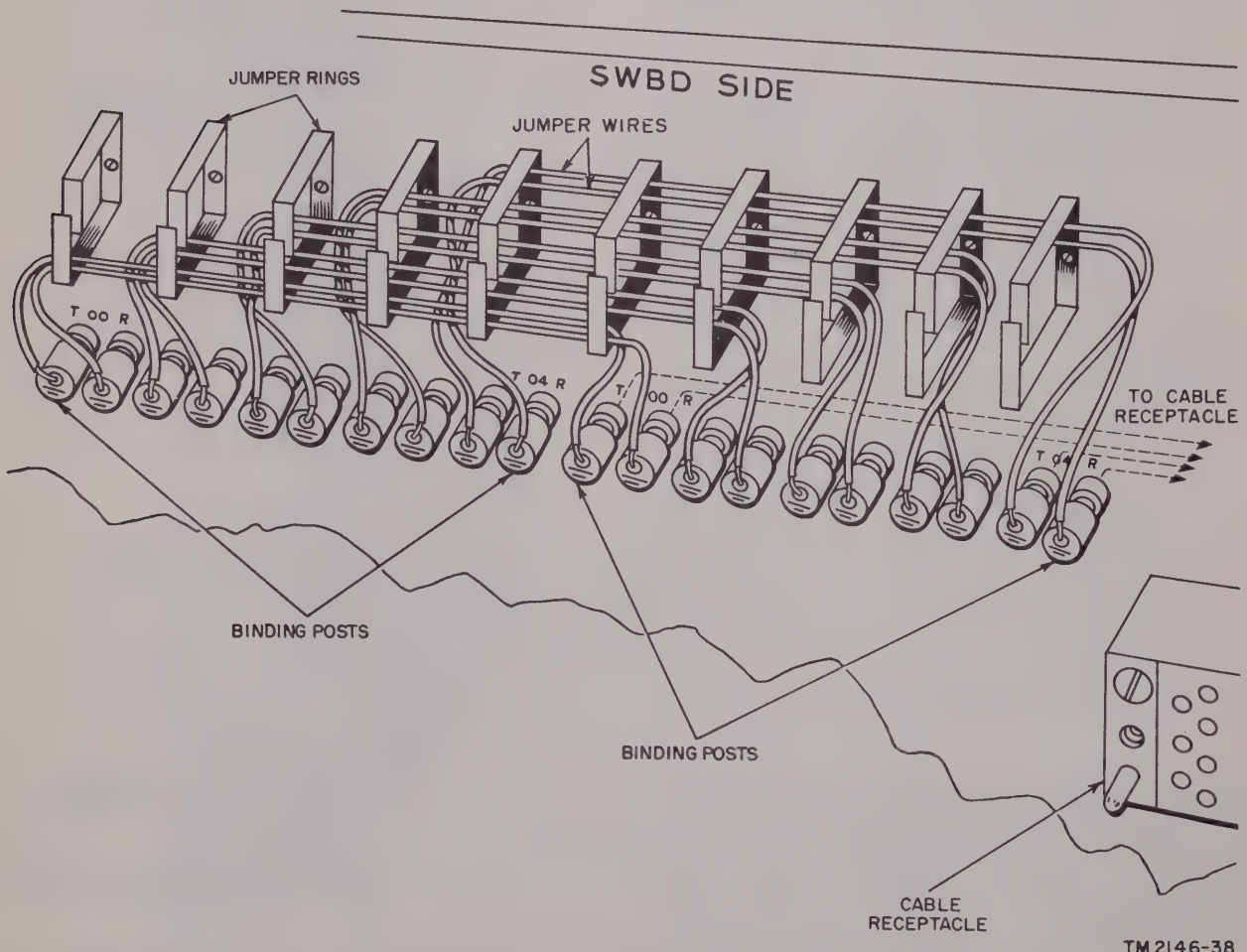


Figure 39. Telephone Main Distributing Frame TA-257/TTC, method of installing jumper wires for line distribution at the switchboard side.

and R binding posts in the left group of 200 binding posts on the switchboard side.

(4) Fit the jumper wire into the jumper rings (fig. 39) and connect the opposite end to the correspondingly numbered T and R binding posts in the right group of 200 binding posts.

(5) Follow the same procedure to distribute the remaining lines.

21. Fuses

Location	Circuit	Quantity	Rating (amp)
Telephone Switchboard, SB–249/TTC	Operator's telephone	1	1⅓
	Cord	5	1⅓
Trunk Relay Telephone circuit TA–226/TTC	Night alarm	1	1⅓
	Trunk	10	1⅓
Line Relay Telephone circuit TA–224/TTC	Night alarm	1	1⅓
	CB line	10	1⅓
Line Relay Telephone circuit TA–223/TTC	Night alarm	1	1⅓
	CB-LB line	10	1⅓

22. Service Upon Receipt of Used or Reconditioned Equipment

a. Upon receipt of used or reconditioned equipment, check all component surfaces for nicks or scratches. Check all operating controls, such as switches and knobs, for ease of operation. Be sure that all interconnecting cables are furnished with the equipment and that they are free from frayed insulation or defective plugs. Check the interior wiring of all wired components for possible shorts or broken connections.

b. Uncrate and unpack the equipment as specified in paragraph 18. Install the equipment as instructed in paragraphs 19 and 20 and observe the equipment in operation. This is the best means of checking used or reconditioned equipment. Equipment faults will be revealed more precisely under actual operating conditions.

Section II. CONTROLS AND INSTRUMENTS

23. General

To insure accuracy and speed of operation, each attendant should become familiar with the operating features and location of the various items of equipment used in operating the AN/TTC–7. The charts in paragraph 24 list the controls and instruments, figure references, and functions.

24. Controls and their Uses

a. Panel BD–132–A (figs. 24 and 40).

Item	Function
110V circuit breaker.	Circuit breaker for incoming 115-volt ac supply.
48V circuit breaker.	Circuit breaker for 48-volt dc supply.
TELERING-EMERGENCY RING switch	Telering-emergency ringer changeover switch.
EMERGENCY RING circuit breaker.	Circuit breaker to emergency ringer (rotary converter).
NO VOLTAGE ALARM switch.	No voltage alarm cutoff pushbutton switch stops the ringing of the no voltage alarm and extinguishes indicator lamp.
FA buzzer.	Indicates blown fuse.
ON-OFF TELERING switch.	Used to turn Telering on and off.
Voltmeter	Indicates dc voltage supply.
Ammeter	Indicates charge or discharge rate of battery–BB–46.

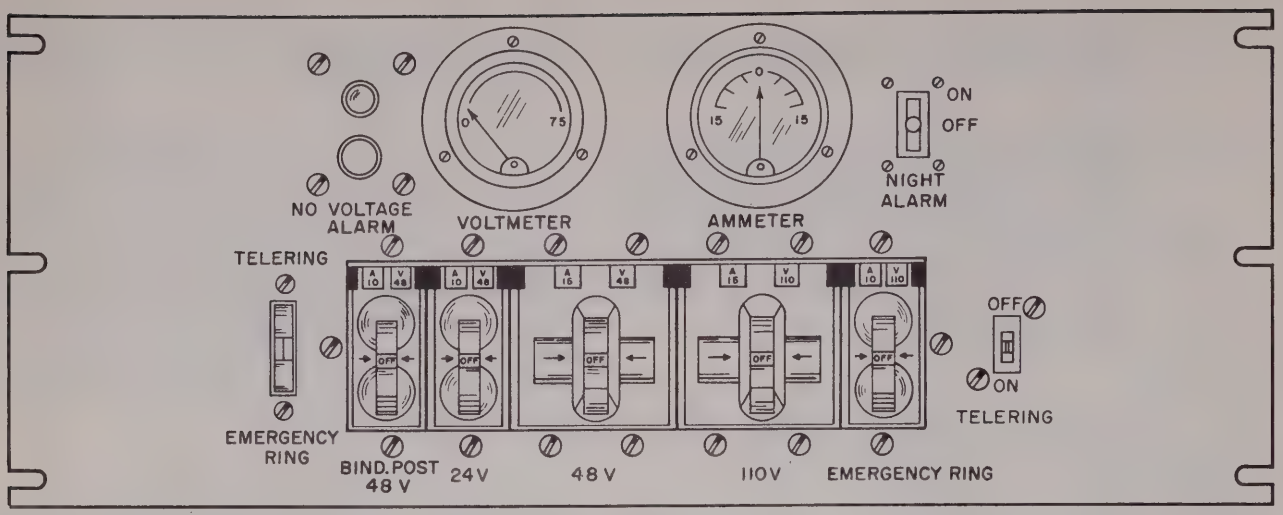


Figure 40. Panel BD-132-A, control panel.

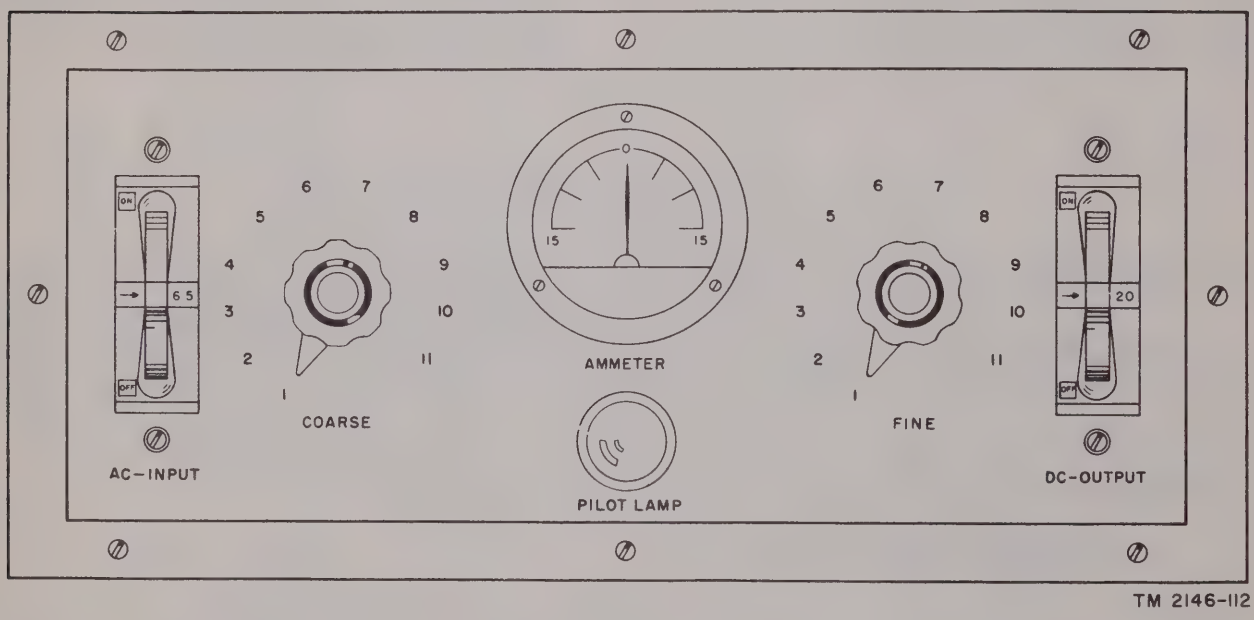


Figure 41. Rectifier control panel.

b. Rectifier Control Panel (figs. 24 and 41).

Item	Function
AC-INPUT circuit breaker	Circuit breaker for 110-volt ac supply.
DC-OUTPUT circuit breaker	Circuit breaker for rectifier dc output.
COARSE adjustment control switch	Charging rate coarse adjustment step switch. Varies charging rate to battery.
FINE adjustment control switch	Charging rate fine adjustment step switch. Varies charging rate to battery.
Ammeter	Indicates charging rate to battery.

c. Manual Telephone Switchboard SB-249/TTC.

Item	Figure	Function
Cord circuit switch	42, 44	Lock (talk): Permits operator to talk during progress of call. Non lock (ring): Permits operator to ring called telephone.
Position grouping switch	42, 44	Permits operator to vacate position by transferring cord circuits to other remaining positions.
MON-MR (monitor and master ringing switch)	42, 44	MON (nonlock): Permits operator to monitor a call by disconnecting transmitter from T and R loop. Operator's receiver remains across loop. MR (lock): Permits operator to ring party line telephone.
Dial	42	Permits operator to control equipment in dial exchange.
RINGING KEY-HAND switch	43, 44.	HAND: Permits operator to ring called station manually (in case of ringing failure at BD-132-A) by turning crank of hand generator. RINGING KEY: Permits operator to ring called station by operation of cord circuit switch to ring (non-lock) position only, utilizing ringing source.
Emergency hand generator	44	Provides an emergency source of ringing current.
Rear cord plug	42, 44	Used to answer incoming call.
Front cord plug	42, 44	Used to ring called party, and to connect calling party and operator (if necessary) to called party.
Rear supervisory lamp	42, 44	Lights when calling party disconnects.
Front supervisory lamp	42, 44	Lights when called party disconnects.
Magneto supervisory lamp	43, 44	Lights when LB party rings off.

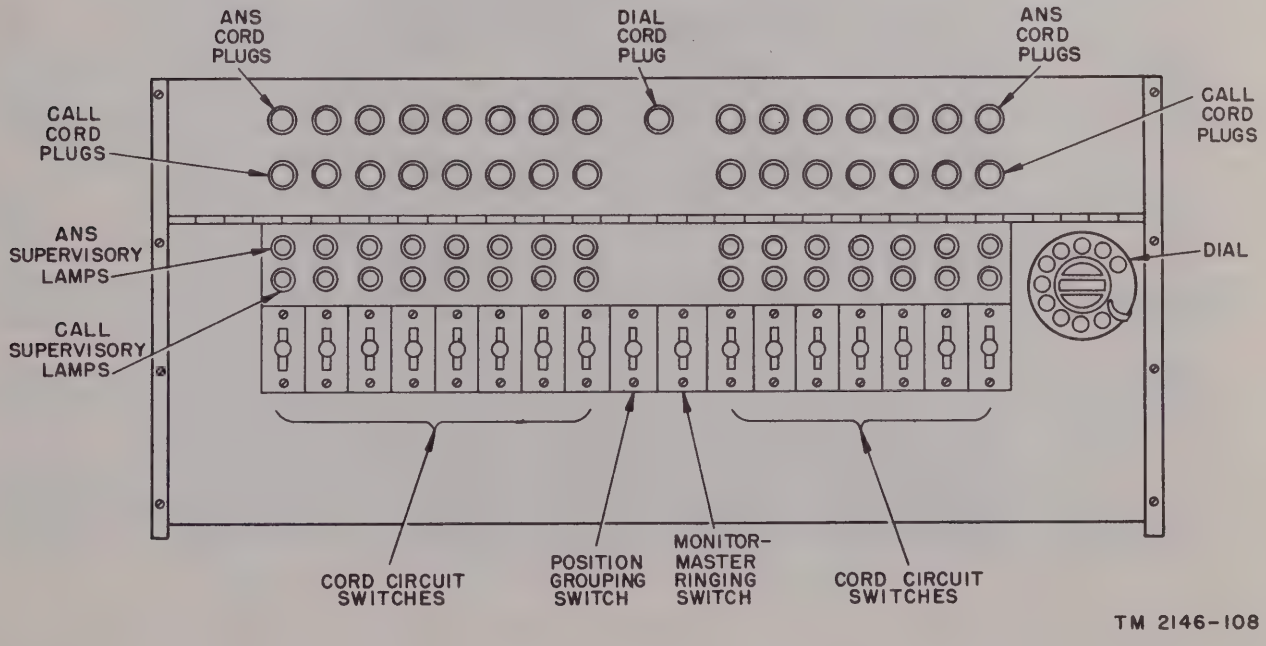


Figure 42. Manual Telephone Switchboard SB-249/TTC, shelf controls.

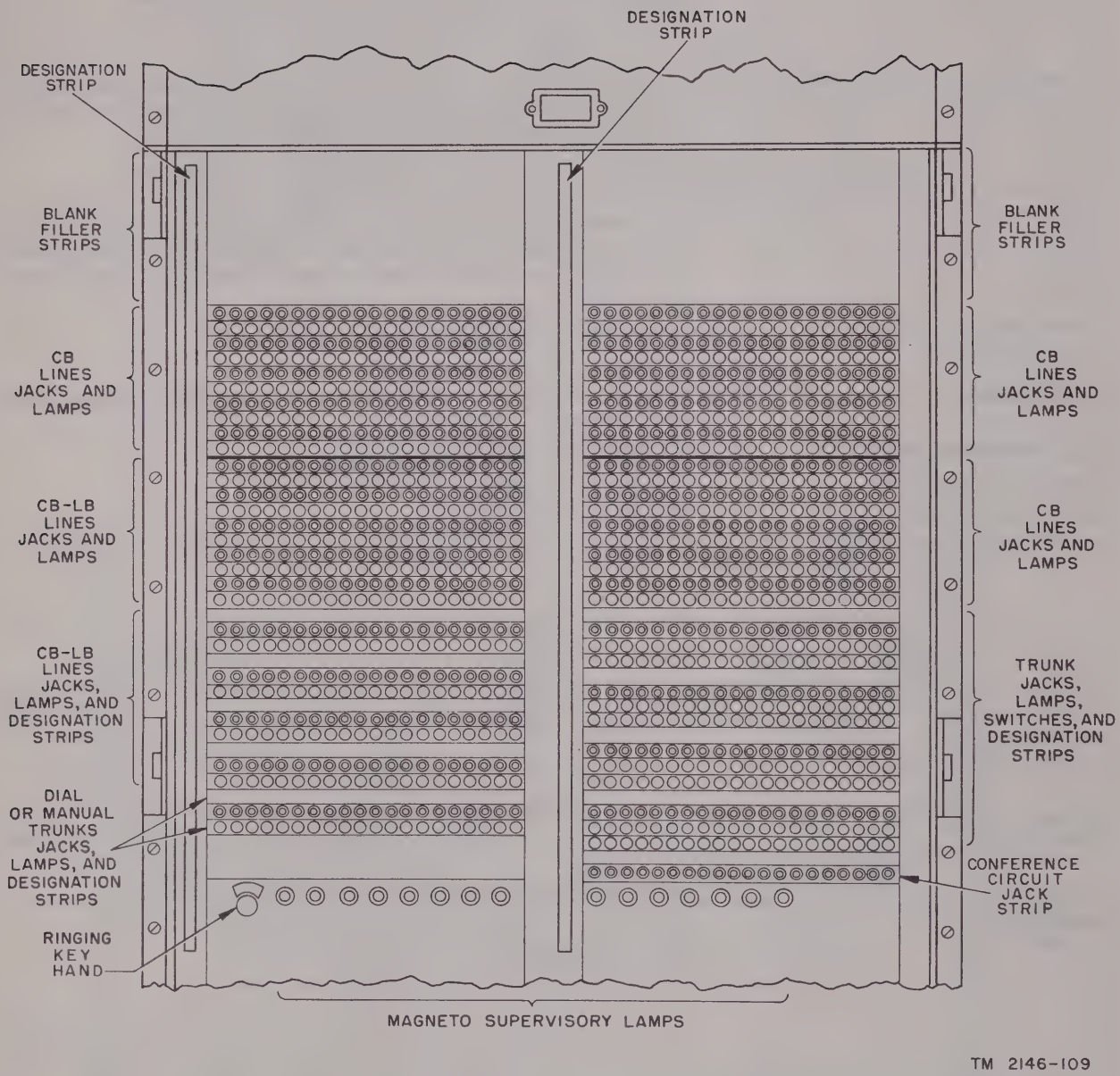


Figure 43. Manual Telephone Switchboard SB-249/TTC, face equipment.

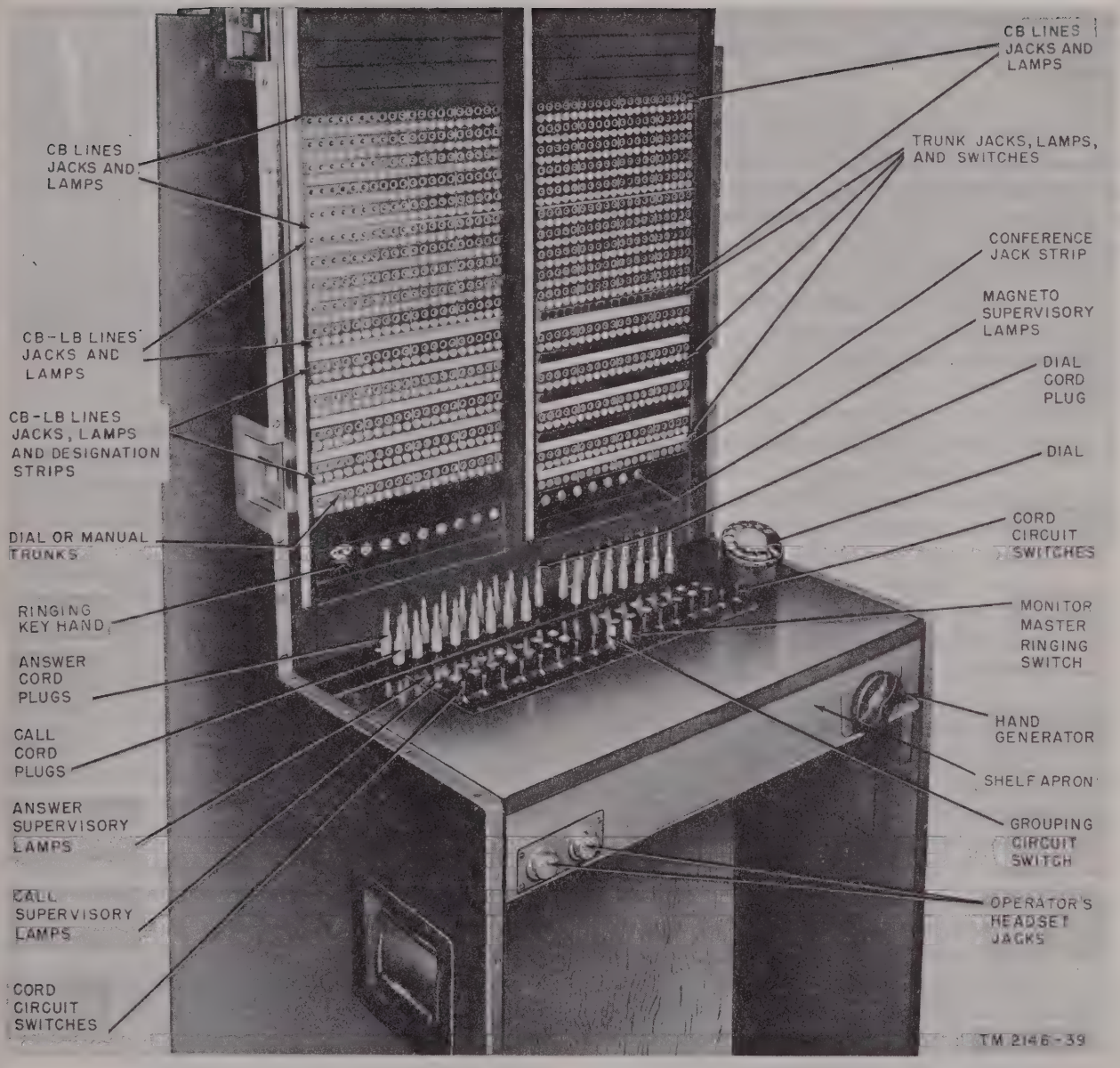


Figure 44. Manual Telephone Switchboard SB-249/TTC, controls.

Section III. OPERATION UNDER USUAL CONDITIONS

25. Preliminary Starting Procedures

a. Be sure that all circuit breakers on Panel BD-132-A are in their OFF positions.

b. Rotate the COARSE and FINE step switches on the rectifier to their full counterclockwise positions.

c. Check to see if the voltmeters and ammeters on the top of Panel BD–132–A and on the rectifier read zero. If not, adjust the pointers by turning the adjustment screw on each meter face until they read zero.

d. Before starting the equipment, be sure that the instructions in subparagraphs (1) through (11) below concerning Battery BB–46 have been followed.

(1) The battery is shipped with the plates in a dry-charged condition without electrolyte in the cells. The electrolyte is diluted sulphuric acid of 1.270 specific gravity and is supplied with the batteries. Battery BB–46 has a normal charging rate of 5 amperes. The discharge rate is 15 amperes for 5 hours to 42 volts.

(2) Remove the vent plugs and discard the paper disks from the cover holes. Fill each cell with electrolyte to a height even with the protector on top of the separators. Allow the battery to stand 4 hours. If the level has fallen, add more electrolyte.

(3) Install the vent plugs, then connect the positive lead of the charging circuit to the positive (marked POS, painted red) terminal of the battery. Connect the negative lead of the charging circuit to the negative (marked NEG, painted black) terminal of the battery.

(4) Charge the battery at 5 amperes until four consecutive hourly readings show no rise in specific gravity and voltage. If the charge rate is maintained at 5 amperes, the charging time will be at least 18 hours; lower rates will increase the time. If the temperature exceeds 110° F, reduce the charging rate.

(5) After completion of the charge, the specific gravity should be between 1.270 and 1.290, corrected to 80° F. The electrolyte level should be $\frac{3}{8}$ inch above the protector located over the separators. Before placing the battery in service, wash off any electrolyte that may have been spilled.

(6) When the battery discharges, the specific gravity lowers. When the specific gravity drops to 1.160 or when the voltage drops to 42 volts, the battery should be recharged.

(7) Stop the recharge when the specific gravity and voltage will rise no higher during a 1-hour period when charging at 5 amperes.

(8) When charging, do not bring an exposed flame near the battery. If the temperature exceeds 110° F, stop the charge temporarily.

(9) While in use, distilled water must be added to the battery to maintain electrolyte level above the separators. Add the water when starting the charge.

(10) Keep the outside surface of the battery dry and clean by washing it with soda and water.

(11) If the battery is not in use, it should be charged each month to prevent deterioration.

26. Starting Procedure

a. Battery Charging Equipment.

(1) Operate the 110V circuit breaker on the power board to the ON position.

(2) Operate the AC-INPUT circuit breaker on the rectifier to ON.

(3) Operate the DC–OUTPUT circuit breaker on the rectifier to ON.

(4) The correct charging rate to Battery BB–46 should be 5 amperes. Adjust the charging rate by turning the COARSE step switch to give a charging rate as close as possible to the 5 ampere value.

(5) If necessary, turn the FINE step switch until a closer value to the 5 ampere charging rate is indicated on the ammeter.

b. Switchboard Power Supply.

(1) Operate the 48V circuit breaker on the power board to the ON position. The voltmeter should indicate approximately 50 volts.

(2) Operate the TELERING switch to the ON position. A soft buzzing sound will emanate from the telering unit, which indicates proper operation.

(3) Operate the TELERING-EMERGENCY RING switch to the TELERING position. This provides ringing current to the switchboard. If the NO VOLTAGE ALARM lamp lights and the buzzer sounds, the telering is not operating properly. In this case, connect the emergency ringing converter as follows:

(*a*) Operate the TELERING switch to OFF.

(*b*) Operate the TELERING-EMERGENCY RING switch to the EMERGENCY RING position.

(*c*) Operate the EMERGENCY RING circuit breaker to the ON position. This starts the rotary converter, the ringing output of which is fed to the switchboard ringing circuit. The NO VOLTAGE ALARM lamp will remain lighted and the buzzer will stop.

c. Night Alarm. If operation of the NA bell is required, operate the NA-ON switches on the line and trunk relay cases to their ON positions. The NA-ON switch is a twist-lock type switch, and is in the ON position when the arrow points toward ON.

27. Switchboard Operation

Subparagraphs *a* through *g* below describe the switchboard operating procedures. Refer to figure 44 for the location of the various switchboard controls.

a. CB or LB lines. When a telephone user originates a call from a CB or LB telephone, a line lamp on the face equipment of the switchboard will light and the NA bell will ring (if the NA switch is in the ON position). To answer the call, follow the procedure outlined in subparagraphs (1) through (6) below.

(1) Insert the rear (ANS) cord plug into the jack above the lighted lamp. The lamp will be extinguished and the bell will stop ringing.

(2) Operate the cord circuit switch to its lock (talk) position and speak to the calling party.

(3) To extend the call to a CB or LB line, touch the tip of the front (call) cord plug to the sleeve of the line jack to be called. If a click is heard in the Operator's receiver, the line is busy. If no click is heard, insert the plug into the jack.

(*a*) The call supervisory lamp will light if a CB line is being called.

(*b*) The call supervisory lamp will not light if a LB line is being called.

(4) To signal the called line, operate the cord circuit switch to the nonlock (ring) position for approximately 3 seconds. On LB lines, operate the cord circuit switch to the talk position and monitor the line until the called party answers (re-ring if necessary). On CB lines, the call supervisory lamp will be extinguished when the called party answers. It is not necessary to monitor CB lines.

(5) The call or answer supervisory lamp will light to indicate that a CB line telephone user has disconnected. The magneto supervisory lamp will light to indicate that an LB line telephone user has rung off.

Note. A flashing call or answer supervisory lamp indicates that a CB line telephone user wants to contact the operator. It is necessary to monitor (challenge) all LB line calls to determine if the telephone user wants to contact the operator.

(6) After receiving the disconnect signals described in subparagraph (5) above, the operator will disconnect (take down the cords).

b. Trunk calls (incoming). The procedure for completing incoming trunk calls is the same as the procedure described in subparagraph *a* above.

c. Trunk calls (outgoing). Subparagraph (1) below describes outgoing manual trunk calls. Subparagraph (2) below describes outgoing dial trunk calls.

(1) To extend a call to another manual central office, make the busy test outlined in subparagraph *a*(3) above. To signal the distant office, momentarily operate the cord circuit switch to the ring position (it is not necessary to ring more than once) and wait for the distant operator to answer. After the distant operator answers, and has been given the necessary information, restore the cord circuit switch. The disconnect supervision is the same as that described for LB calls in subparagraph *a*(5) and (6) above.

(2) To extend a call to a dial central office, make the busy test outlined in subparagraph *a*(3) above. Dial tone should be heard in the operator's receiver. Insert the dial cord into the associated dial jack, and dial the desired number. When dialing is completed, remove the dial cord from the dial jack and restore the cord circuit switch. There is no disconnect supervision from the dial central office. The operator will be guided by the supervisory signal from the local telephone user.

d. Monitoring and Master Ringing. Subparagraph (1) below describes the procedure for monitoring lines and trunks. Subparagraph (2) below describes the procedure for party line ringing.

(1) To monitor a call, operate the MON–MR switch to the MON (nonlock) position, and then operate the associated cord circuit switch to the talk (lock) position. This permits the operator to monitor without disturbing the conversation.

(2) When two telephones are on one line, one telephone is signalled as described in subparagraphs *a*(4) above. To signal the other telephone operate the MON–MR switch to the MR (lock) position and then operate the associated cord circuit switch to the ring (nonlock) position.

e. Position grouping. Operate the GRP switch of a position when an operator vacates a position. This groups the cords of the vacated position to the operator of the adjacent attended position. Restore the GRP switch when the operator returns.

f. Emergency Ringing. If the ringing current from the telering and rotary converter on Panel BD–132–A fails, use the hand generator. To do this, first operate the RINGING KEY-HAND switch (fig. 44) to the HAND position. Then operate the cord circuit switch to the ring (nonlock) position and turn the crank of the hand generator for approximately 3 seconds.

g. Conference Calls. The conference circuit consists of 19 jacks (fig. 44) which are used to connect a group of telephone lines for a conference call. Subparagraphs (1) and (2) below describe conference call procedure.

(1) Insert an answer (rear) cord in the jack of the party originating the conference call. Insert the associated call (front) cord in a conference circuit jack.

(2) Insert answer cords in other conference jacks, and use the associated call cords to call the desired telephone lines.

28. Stopping Procedure

a. Operate the 48V circuit breaker on the power board to the OFF position.

b. Rotate the COARSE and FINE controls on the rectifier to their maximum counterclockwise positions.

c. Operate the DC-OUTPUT circuit breaker on the rectifier to the OFF position.

d. Operate the AC-INPUT circuit breaker on the rectifier to the OFF position.

e. Operate the TELERING switch on the power board to the OFF position.

f. Operate the 110V circuit breaker on the power board to the OFF position.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

29. General

Operation of Manual Telephone Central Office AN/TTC–7 may be difficult in regions where extreme cold, heat, humidity, moisture, and sand conditions prevail. Paragraphs 30 through 32 provide instructions for minimizing the effects of these conditions.

30. Operation in Arctic Climates

Subzero temperatures and climatic conditions associated with cold weather affect the efficient operation of this equipment. Instructions and precautions for operation under such adverse conditions follow:

a. Handle the equipment carefully.

b. Keep the equipment warm and dry, if possible, and in shelter.

c. Keep a protective cover over the transmitter when operating the equipment in a cold room or in the open air. This will minimize the effects of frost gathering in the transmitter, which causes adverse talking characteristics.

d. Keep a knitted woolen cap over the receiver and headband. Water freezing in the receiver may impede the action of the diaphragm. Keep the receiver as dry as possible.

e. Variations in temperature may cause condensation to gather on various parts of the equipment, which may freeze and cause damage to such items as binding posts, switches, jacks, and relays. If the situation permits, keep temperature variations at a minimum.

31. Operation in Tropical Climates

When operated in tropical climates, the central office may be installed below ground or in swampy areas where moist conditions are very acute. High relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment is considerably lower than that of the ambient air. Try to minimize the effect of this condition as much as possible.

32. Operation in Desert Climates

a. In desert climates where sand, dust and wind prevail, keep the equipment as free from dust and grit as possible. Install all component covers when the equipment is not in use.

b. Never tie power cords, or other wiring connections, to either the inside or the outside of tents. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

c. Make frequent preventive maintenance checks.

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

33. Tools and Materials Supplied with Equipment

Tool Equipment TE-44 is supplied with the equipment. The tools contained in Tool Equipment TE-44 are listed in Department of the Army Supply Catalog SIG-6-TE-44. Tool Equipment TE-73 is used but not supplied with the AN/TTC–7. The tools contained in Tool Equipment TE-73 are listed in Department of the Army Supply Catalog SIG-6-TE-73. The test equipments used but not supplied with the AN/TTC–7 are as follows: Test Set I-181 , Test Set TS-26/TSM, and Test Set TS-190/U. The materials used with the AN/TTC–7 are contained in Tool Equipment TE-44.

34. Special Tools and Materials Issued for Equipment

The special tools and materials supplied with the AN/TTC–7 are listed in the chart below. The chart lists the quantity and description of tools or materials supplied.

Quantity	Description
2	Lamp cap extractor (St-Carl No. 70)
2	Lamp extractor (St-Carl No. 553A)
2	Jack sleeve tool (St-Carl No. 69)
2	Spring adjustment tool (St-Carl No. 7)
2	Screw driver (St-Carl No. 42)
4	Piloted screw driver
2	Screw driver and socket wrench (St-Carl No. 24)
2	Spring adjustment tool (St-Carl No. 65)
2	Spring adjustment tool (St-Carl No. 66)
2	Spring adjustment tool (St-Carl No. 268)
2	Adjustment tool (St-Carl No. 72)
2	Long flat nose pliers (St-Carl No. 311-5-½)
2	Set of thickness gages (St-Carl No. 77)
2	Gram gage (St-Carl No. 68B)
2	Tool for removing pushers and stops (St-Carl No. 73)
2	Tool for removing pushers and stops (St-Carl No. 74)
2	Glyptol cement
2	Armature and backstop adjustment tool (St-Carl No. 78)
2	Contact burnisher and blades
2	Jack fastener wrench and screw driver

Section II. PREVENTIVE MAINTENANCE SERVICES

35. 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 trouble shooting and repair since its object is to prevent certain troubles from occurring.

36. General 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 brush with Solvent

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
TELEPHONE CENTRAL OFFICE SET

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.
MANUAL TELEPHONE CENTRAL OFFICE AN/TTC-7	

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

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
(1)	INSPECT SET FOR PRESENCE OF ALL COMPONENTS - SWITCHBOARD, CABINETS, HEAD AND CHEST SET, FRAMES, RACKS, PANELS, POWER UNIT, RECTIFIER, CONVERTER, MICROPHONE, CORDS, CABLES, MISCELLANEOUS ACCESSORIES AND RUNNING SPARE PARTS. PAR. 7							
(2)	CLEAN OUTSIDE SURFACES OF COMPONENTS OF DIRT, DUST, OIL, GRIME, RUST, CORROSION, FUNGUS. PAR. 38a(1)							
(3)	TIGHTEN ALL LOOSE ASSEMBLY SCREWS, EXTERIOR APPARATUS MOUNTING SCREWS, FASTENINGS, SUPPORTS, BRACKETS. PAR. 38a (2)							
(4)	CHECK ALL VISIBLE ELECTRICAL CONNECTIONS, TERMINALS, BINDING POSTS, FOR PROPER CONTACT, FIRMNESS OF SEATING, BENT BINDING POSTS, RUST, CORROSION. PAR. 38a(3)							
(5)	TIGHTEN ALL LOOSE VISIBLE TERMINALS, CABLES, AND BINDING POSTS UNTIL THEY ARE SNUG. PAR. 38a (4)							
(6)	INSPECT GROUND RODS FOR TIGHT CONNECTIONS, FRACTURES, BENDS, RUST, FIRMLY EMBEDDED. PAR. 38a(5)							
(7)	CHECK ALL MARKINGS AND DESIGNATION STRIPS FOR LEGIBILITY. PAR. 38a(6)							
8	CHECK SIGNAL DROPS TO SEE THAT THEY WORK FREELY; DO NOT DROP WHEN SWITCHBOARD IS JARRED.							
9	CHECK NIGHT ALARM BY ALLOWING A DROP TO FALL.							
10	CHECK SIGNALS TO SEE THAT DROPS ARE RESTORED WHEN PLUG IS INSERTED IN JACK, WHERE APPLICABLE.							
(11)	CHECK ALL LINE CIRCUITS FOR SATISFACTORY RING AND TALK OPERATION. PAR. 38a (7)							
(12)	CHECK CHARGING RATE OF BATTERIES FOR THE PROPER VALUE OF CURRENT FOR THE EQUIPMENT INVOLVED. PAR. 38a (14)							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
(13)	INSPECT OUTSIDE SURFACES OF COMPONENTS FOR LOOSE OR MISSING SCREWS, CRACKS, CHIPPED PAINT, RUST, GOUGES, CORROSION, BROKEN GLASS. PAR. 38b (1)		(17)	CHECK PLUGS FOR CHIPS, CRACKS, TARNISH, ROUGHNESS, SNUG FIT AND GOOD CONTACT. PAR. 38b (5)	
(14)	INSPECT ALL VISIBLE CORDS, CABLES AND WIRING FOR SECURELY FASTENED TERMINALS, BROKEN CONDUCTORS, DAMAGED INSULATION, MILDEW, FUNGUS, KINKS, STRAINS, SHARP BENDS, CORRECT POSITIONS. PAR. 38b(5)		(18)	CLEAN PLUGS OF TARNISH, GREASE, DUST, GRIME, OIL. PAR. 38b(5)	
(15)	CLEAN ALL VISIBLE CORDS, CABLING AND WIRING OF DIRT, DUST, GRIME, OIL, FUNGUS, MILDEW. PAR. 38b (5)		(19)	INSPECT STORAGE BATTERIES FOR WATER LEVEL, SPECIFIC GRAVITY, CRACKED CASE, CORROSION AT POSTS, DIRT, LOOSE CONNECTIONS. PAR. 38b (8)	
(16)	CLEAN ALL VISIBLE ELECTRICAL CONNECTIONS, TERMINALS, BINDING POSTS, OF DIRT, DUST, GREASE, GRIME AND CORROSION. PAR. 38b (6)		(20)	CHECK ALL SWITCHES AND KEYS FOR POSITIVE ACTION AND GOOD CONTACT. PAR. 38a (9)	
			21	INSPECT TO SEE THAT RECTIFIER HAS BEEN LOCATED WELL AWAY FROM BATTERY FUMES.	

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

DA FORM 1 MAY 51 11-242 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 2146-113

Figure 45. DA Form 11-242.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT
TELEPHONE CENTRAL OFFICE SET

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: MANUAL TELEPHONE CENTRAL OFFICE AN/TTC-7

EQUIPMENT SERIAL NO.

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

NO.	ITEM	CONDITION
1	INSPECT SET FOR PRESENCE OF ALL COMPONENTS - SWITCHBOARD, CABINETS, HEAD AND CHEST SET, FRAMES, RACKS, PANELS, POWER UNIT, RECTIFIER, CONVERTER, MICROPHONE, CORDS, CABLES, MISCELLANEOUS ACCESSORIES AND RUNNING SPARE PARTS. PAR. 7	
2	CLEAN OUTSIDE SURFACES OF COMPONENTS OF DIRT, DUST, OIL, GRIME, RUST, CORROSION, FUNGUS. PAR. 38a (1)	
3	TIGHTEN ALL LOOSE ASSEMBLY SCREWS, EXTERIOR APPARATUS MOUNTING SCREWS, FASTENINGS, SUPPORTS, BRACKETS. PAR. 38a (2)	
4	CHECK ALL VISIBLE ELECTRICAL CONNECTIONS, TERMINALS, BINDING POSTS, FOR PROPER CONTACT, FIRMNESS OF SEATING, BENT BINDING POSTS, RUST, CORROSION. PAR. 38a (3)	
5	TIGHTEN ALL LOOSE VISIBLE TERMINALS, CABLES, AND BINDING POSTS UNTIL THEY ARE SNUG. PAR. 38a (4)	
6	INSPECT GROUND RODS FOR TIGHT CONNECTIONS, FRACTURES, BENDS, RUST, FIRMLY EMBEDDED. PAR. 38a (5)	
7	CHECK ALL MARKINGS AND DESIGNATION STRIPS FOR LEGIBILITY. PAR. 38a (6)	
8	CHECK SIGNAL DROPS TO SEE THAT THEY WORK FREELY; DO NOT DROP WHEN SWITCHBOARD IS JARRED.	
9	CHECK NIGHT ALARM BY ALLOWING A DROP TO FALL.	
10	CHECK SIGNALS TO SEE THAT DROPS ARE RESTORED WHEN PLUG IS INSERTED IN JACK, WHERE APPLICABLE.	
11	CHECK ALL LINE CIRCUITS FOR SATISFACTORY RING AND TALK OPERATION. PAR. 38a (7)	
12	CHECK CHARGING RATE OF BATTERIES FOR THE PROPER VALUE OF CURRENT FOR THE EQUIPMENT INVOLVED. PAR. 38a (14)	
13	INSPECT OUTSIDE SURFACES OF COMPONENTS FOR LOOSE OR MISSING SCREWS, CRACKS, CHIPPED PAINT, RUST, GOUGES, CORROSION, BROKEN GLASS. PAR. 38b (1)	
14	INSPECT ALL VISIBLE CORDS, CABLES AND WIRING FOR SECURELY FASTENED TERMINALS, BROKEN CONDUCTORS, DAMAGED INSULATION, MILDEW, FUNGUS, KINKS, STRAINS, SHARP BENDS, CORRECT POSITIONS. PAR. 38b (5)	
15	CLEAN ALL VISIBLE CORDS, CABLING AND WIRING OF DIRT, DUST, GRIME, OIL, FUNGUS, MILDEW. PAR. 38b (5)	
16	CLEAN ALL VISIBLE ELECTRICAL CONNECTIONS, TERMINALS, BINDING POSTS, OF DIRT, DUST, GREASE, GRIME AND CORROSION. PAR. 38b (6)	
17	CHECK PLUGS FOR CHIPS, CRACKS, TARNISH, ROUGHNESS, SNUG FIT AND GOOD CONTACT. PAR. 38b (5)	
18	CLEAN PLUGS OF TARNISH, GREASE, DUST, GRIME, OIL. PAR. 38b (5)	
19	INSPECT STORAGE BATTERIES FOR WATER LEVEL, SPECIFIC GRAVITY, CRACKED CASE, CORROSION AT POSTS, DIRT, LOOSE CONNECTIONS. PAR. 38b (8)	
20	CHECK ALL SWITCHES AND KEYS FOR POSITIVE ACTION AND GOOD CONTACT. PAR. 38a (9)	
21	INSPECT TO SEE THAT RECTIFIER HAS BEEN LOCATED WELL AWAY FROM BATTERY FUMES.	
22	INSPECT PROTECTOR BLOCKS AND FUSES FOR CRACKS, CHIPS, CRUMBLING, GREASE, GRIME, DUST, OIL, CORROSION, TARNISH. PAR. 38c (2)	
23	CLEAN INTERIOR APPARATUS AND THE SMALL CREVICES BETWEEN THE PROTECTOR BLOCKS OF DUST, DIRT, GREASE, GRIME, OIL. PAR. 38b (6)	
24	TIGHTEN ALL LOOSE SCREWS AND FASTENINGS USED TO MOUNT INTERIOR APPARATUS. PAR. 38c (4)	
25	ADJUST SIGNAL SHUTTER LATCHES SO THAT SHUTTERS DO NOT FALL WHEN SWITCHBOARD IS JARRED.	
26	INSPECT HAND GENERATOR FOR FREE TURNING, SUFFICIENT OUTPUT TO RING TELEPHONE. PAR. 38a (13)	
27	CLEAN HAND GENERATOR OF DIRT, DUST, GREASE, EXCESS OIL. PAR. 38a (13)	
28	INSPECT TELEGRAPH CIRCUITS FOR SATISFACTORY OPERATION BY SETTING UP AND OPERATING.	
29	REMOVE DRY BATTERIES BEFORE STORING.	
30	INSPECT SWITCH AND KEY MECHANISMS FOR PITTING, WEAR, PROPER CONTACT, DIRT, GREASE, CORROSION, FUNGUS, AND PROPER OPERATION. PAR. 38c (4)	
31	INSPECT INTERIOR ELECTRICAL CONNECTIONS FOR TIGHTNESS, MOISTURE, OIL, GREASE, FUNGUS. PAR. 38c (5)	
32	OPERATE SET AND CHECK FOR OVERHEATING, SATISFACTORY OVERALL OPERATION OF SET. PAR. 38a (7)	
33	LUBRICATE AS SPECIFIED IN LATEST DEPARTMENT OF THE ARMY LUBRICATION ORDER.	
34	INSPECT MOISTURE AND FUNGIPROOFING FOR GENERAL CONDITION. PAR. 38c (7)	
35	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION	

DA FORM 1 MAY 51 11-243 REPLACES DA AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM2146-114

Figure 46. DA Form 11-243.

Dry Cleaning (SD), then wipe the parts dry with a clean cloth.

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

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

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

d. For further information on preventive maintenance techniques, refer to TB SIG 123 Preventive Maintenance Practices for Ground Signal Equipment.

e. Refer to paragraphs 65 through 72 for information concerning the adjustment and repair of relays.

37. Use of Preventive Maintenance Forms

(figs. 45 and 46).

a. The decision as to which items on DA Form 11-242 and 11-243 are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative, and in the case of second or third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

b. Circled items in figures 45 and 46 are partially or totally applicable to the AN/TTC–7. References in the ITEM column refer to paragraphs in text which contain additional maintenance information.

38. Performing Preventive Maintenance

Subparagraphs *a* through *c* below are a suggested schedule of preventive maintenance on the AN/TTC–7. The operations indicated should be performed by organizational personnel at the intervals indicated, unless these intervals are changed by the local commander.

Caution: Screws, bolts, and nuts should not be tightened beyond the pressure for which they are designed or they will be damaged or broken.

a. Daily.

(1) Remove dust, dirt, grease, and moisture from the exterior of the switchboard.

(2) Inspect and tighten all mounting bolts and screws of removable equipment.

(3) Inspect the binding post type terminals for loose or bent binding posts, dirt, and corrosion.

(4) Examine the cord sockets for foreign matter. Be sure the plugs seat properly.

(5) Inspect ground rods to see that connections have been made properly. Check to see that ground rods are imbedded firmly.

(6) Check the panel markings and the marking on the switchboard designation strip for legibility.

(7) Check all line and trunk circuits for satisfactory ring and talk operations.

(8) Inspect the dials for free action of the finger wheel, for bent finger stop, or for defaced number plates.

(9) Inspect the switches for smooth operation and positive action.

(10) Be sure all lamps light. Inspect lamp caps for possible defects.

(11) Lift the cords as far as possible and check for free travel and free-running cord weights. Clean the cord jackets if they are dirty.

(12) Observe whether the night alarm operates properly. If the alarm is in operation, the night alarm bell should ring with each incoming call (if the NA switch is in the ON position).

(13) Check the hand generators by signaling a telephone from each switchboard position. Lift up the switch shelf and inspect the generator for dust, dirt, grease, or excess oil. Clean it when necessary.

(14) Inspect the charging rate of the rectifier for overcharging or undercharging current to Battery BB-46. Adjust the coarse and fine control knobs to the charging current desired (maximum 12 amperes).

(15) Check the telering on Panel BD-132-A for proper operation. See TB SIG 203 Installation, Adjustment, and Maintenance of Interrupter PE-250 and Static Ringing Generators TA-248/TT and TA-248A/TT for information.

b. Weekly.

(1) Inspect the outside surfaces of all components for loose or missing screws, cracks, chipped paint, rust gouges, corrosion, or broken glass.

(2) Clean the jack sleeves with carbon tetrachloride. Wrap a clean cloth around an orange stick and dampen the cloth with the solution. Rotate the cloth in the jack sleeve; be careful not to contact the jack springs. Wipe the sleeve with a dry cloth.

(3) Remove dust from the interior of the switchboards with a soft brush. Check for a loose or burned out ringing resistance lamp.

(4) Inspect the operator's telephone for loose connections, dust, dirt, and corrosion.

(5) Inspect all interconnecting cables and cords for loose plugs, and corroded or bent contact pins. Remove the dirt, grease, and grime with a damp cloth.

(6) Check all MDF binding posts, and cable and cord receptacles for dirt and corrosion. Clean corroded metal contacts and parts with a clean cloth moistened with the cleaning solvent.

(7) Check the output of the emergency ringing machine by placing an ac voltmeter across the output terminals with the EMERGENCY RING switch operated to the ON position. If the output is below 90 volts, check for sparking at the brushes.

(8) Check the storage batteries (Battery BB-46) for water level, specific gravity, a cracked case, and corrosion at posts. Refer to paragraph 25*d* for information regarding water level and specific gravity. Remove corrosion at the posts with a wire brush, and clean them thoroughly with water. After cleaning, apply vaseline to prevent corrosion.

(9) Check panel markings for legibility. Remove any dirt or grease that may render the panel markings or designation strips unreadable.

c. Monthly.

(1) Clean the cord plugs with a rouge polish until the contact surfaces are bright and clean. Be sure to remove all traces of rouge after cleaning. Inspect the cord plugs for cracked or chipped shells or insulators; if they are damaged, replace them.

(2) Inspect the indicator-alarm type fuses for dirt, dust, and corrosion. Examine carefully, fuses that may have blown and do not make contact with the alarm bus bar.

(3) Remove the switchboard and line and trunk relay case circuit plate covers. Inspect the relays for dirt and dust. Examine the relay contacts for pitting and positioning. Inspect pusher clearance for rubbing and binding. Clean the dirty contacts with a contact burnisher. Check the residual screws for tightness.

(4) Inspect the switches for mounting tightness and secure wiring. Tighten the mounting and reconnect the wiring, if necessary.

(5) Inspect all cable receptacles for loose mountings and connections, and for

cracked or broken parts. Tighten loose mountings for connections, and replace cracked receptacles.

(6) Inspect the local cables for damaged insulation and proper clearance. Dress the wiring and repair the damaged insulation with electrical tape.

(7) Inspect moisture-fungiproofing for general condition. Whenever a loose connection is soldered or a break in the protective coating is found, it should be moisture-fungiproofed. Apply the varnish with a small brush.

Section III. WEATHERPROOFING AND LUBRICATION

39. Weatherproofing

a. General. Signal Corps equipment, when operated under severe climatic conditions such as prevail in tropical, arctic, and desert regions, requires special treatment and maintenance. Fungus growth, insects, dust, corrosion, salt spray, excessive moisture, and extreme temperatures are harmful to most materials in telephone equipment.

b. Tropical Maintenance. A special moisture-proofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. This treatment is explained fully in TB SIG 13 Moistureproofing and Fungiproofing Signal Corps Equipment, and TB SIG 72 Tropical Maintenance of Signal Corps Equipment.

c. Winter Maintenance. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained fully in TB SIG 66 Winter Maintenance of Signal Equipment and TB SIG 219 Operation of Signal Equipment at Low Temperatures.

d. Desert Maintenance. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained fully in TB SIG 75 Desert Maintenance of Ground Signal Equipment.

40. Lubrication

The only component of the AN/TTC–7 which requires lubrication is the emergency ringer on Panel BD-132-A. Refer to TM 11-2064 for the lubrication instructions on the emergency ringer. The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69 Lubrication of Ground Signal Equipment. Observe all precautions outlined in TB SIG 69 and pay strict attention to all lubrication orders when operating equipment under conditions of extreme cold or heat.

41. Rustproofing and Painting

a. Remove rust or corrosion from bare component surfaces by sanding them with No. 000 or No. 0000 sandpaper. Clean surfaces down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles frequently enter the case and cause harmful shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases, it may be necessary to use solvent (SD) to loosen the rust, and to use sandpaper to complete the preparation for painting. Paint used will be authorize d and consistent with existing regulations.

Section IV. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

42. General

The trouble shooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) are limited in scope by the tools, test equipment, replacement parts issued, and by the existing tactical situation. Accordingly, trouble shooting is based on the per-

formance of the equipment and the use of the senses in determining such troubles as broken leads, burned-out lamps, etc. Paragraphs 43 through 46 will help in determining a faulty component. If the procedures outlined do not yield results, refer to Section I in Chapter 5 which contains trouble-shooting repair procedures, most of which can be performed by organizational personnel having the necessary skills.

43. Visual Inspection

Subparagraphs *a* through *f* below list the faults which usually can be detected by the senses, and which can be corrected by personnel of the using organization.

a. Signal Lamps. When an incoming signal lamp *at one position only* fails to light, replace the lamp as directed in paragraph 74.

b. Fuses. The sounding of a fuse alarm (FA) buzzer indicates that a fuse has blown on the component on which the buzzer is located. Locate the blown fuse by visually checking the fuses on the fuse panel; the blown fuse will be indicated by a projecting glass bead. Replace the fuse. If the fuse blows again, the circuits should be checked by qualified organizational repairmen.

c. Night Alarm Bell. If the night alarm bell fails to sound on incoming calls, check the NA switches at the line and trunk relay cases to be sure that they are in the ON position. If the night alarm bell still does not sound, check the NA binding post connections and the NA wires between the line and trunk relay cases and the night alarm bell. If this procedure yields no results, the bell itself probably is defective.

d. Operator's Headset. If reception by the operator is weak or erratic, or if it is reported by telephone users that the operator's voice is weak, replace the operator's headset. If this yields no results, the procedures outlined in the trouble-shooting chart (par. 64, item 9) should be performed by qualified personnel.

e. Cord Plugs and Cords. Dirty, worn, or bent cord plugs can be detected visually and should be cleaned or replaced immediately. Cords which are frayed also should be replaced, as the leads within the insulation are subject to shorts or breaks.

f. Jack Sleeves. Jack sleeves which are badly worn will seat cord plugs loosely; such sleeves can be detected by the operator during insertion of a plug into a jack. Replace the sleeve as instructed in paragraph 75.

44. System Sectionalization

For the AN/TTC–7, system sectionalization consists of determining in which component the trouble lies (CB line relay case, CB-LB line relay case, trunk relay case, switchboards, or power panel). Certain indications of equipment performance can be interpreted by organizational personnel as the fault of a single component only. If any of the symptoms described below exist, follow the instructions given to correct the fault. However, if the fault cannot be corrected by the measure given, or if the symptom is not listed below, follow the instructions given in Section I of Chapter 5 to isolate or clear the trouble. The latter instructions should be followed by qualified personnel only.

a. If all the lamps on the switchboard are extinguished and all circuits are dead, check for a tripped 48-volt or 110-volt circuit breaker on Panel BD-132-A. If either circuit breaker is tripped, operate it to the ON position. If this yields no results, check the external power supply source. (Refer to TM 11-2064 for trouble shooting instructions for Panel BD-132-A.)

b. If none of the telephones served by the AN/TTC–7 can be signaled, check the TELE-RING-EMERGENCY RING switch at Panel BD-132-A to be sure it is in the TELERING position. Be sure the TELERING ON-OFF switch is in the ON position. If these switches are operated properly, check the telering unit on Panel BD-132-A. Correct operation of the telering is indicated by a soft buzzing noise in the unit. If the telering unit is silent, check the cartridge fuses located at the bottom of the unit. Replace them if they are blown.

c. Refer to the equipment performance checklist (par. 46) for further information concerning corrective measures for abnormal symptoms of the equipment.

45. Trouble Shooting (Using Equipment Performance Checklist)

a. General. The equipment performance checklist (par. 46) will help to locate trouble in the

equipment. The list gives the item to be checked, the normal indications and the tolerances of correct operation, and the corrective measures that can be taken by the operator. *To use this list, follow the items in numerical sequence.*

b. Action or Condition. For some items, the information given in the *Action or condition* column consists of various switch and control settings under which the item is to be checked. For other items, it represents an action that must be taken to check the normal indication given in the *Normal indications* column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should perceive when he checks the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those which the operator can make without turning in the equipment for repairs. If the set is completely inoperative or if the recommended corrective measures do not yield results, trouble shooting is necessary. However, if the tactical situation requires that communication be maintained, and if the set is not completely inoperative, the operator must keep the set in operation as long as it is possible to do so.

46. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	All circuit breakers and switches on Panel BD-132-A.	Operate to OFF positions.	No power.	Check switches.
	2	Cords and cables.	All cords and cables connected as described in paragraph 20.		
START	3	110V circuit breaker.	Operate to ON position.	Heater resistors in switchboards hot.	Check 110-volt cable connection.
	4	AC-INPUT circuit breaker on the rectifier.	Operate to ON position.	Pilot light glows.	Check cable connections.
	5	DC-OUTPUT circuit breaker on the rectifier.	Operate to ON position.	Ammeter needle of rectifier should deflect.	Check for blown fuse.
	6	COARSE step switch of the rectifier.	Rotate in clockwise direction.	Ammeter shows charging rate to Battery BB-46.	Check cord connections.
	7	FINE step switch of rectifier.	Rotate in clockwise direction.	Ammeter shows charging rate.	
	8	48V circuit breaker.	Operate to ON position.	Voltmeter indicates approximately 50 volts. Ammeter deflects.	 Check cord connections.
	9	TELERING ON-OFF switch. TELERING—EMERGENCY-RING switch.	Operate to ON position. Operate to TELERING position.	Low buzzing sound from telering.	Check for blown cartridge fuses at bottom of telering unit.
EQUIPMENT PERFORMANCE	10	Operator's headset.	Plug headset into operator's jack.	Sidetone.	Check operator's jack. Replace headrest.
	11	Incoming signal lamp.	Insert rear (answer) cord into line jack.	Lamp is extinguished.	Clean or adjust line jack contacts.
	12	Cord circuit switch.	Operate to talk (lock) position.	Operator connected with calling party.	Replace headset. Clean or adjust contacts of cord circuit switch. Clean cord plug.
	13	Front (call) cord plug.	Touch tip of plug to sleeve of line jack of party to be called.	If line is busy, a click is heard. No click is heard if line is not busy.	
	14	Front cord plug.	Insert plug into jack of called party.	Front supervisory lamp lights (when connected to a CB line).	Replace lamp. Clean metallic parts of plug.

46. Equipment Performance Checklist (contd.)

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	15	Cord circuit switch.	Operate to ring (non-lock) position.		
	16	Cord circuit switch.	Operate to talk (lock) position.	Called party answers. Front supervisory lamp is extinguished (CB lines only).	See paragraph 64, item 16.
	17	Cord circuit switch.	Restore to normal position.	Front and rear supervisory lamps are extinguished (CB lines only).	
	18	Front or rear supervisory lamp (CB lines). Magneto supervisory lamp (LB lines).	Calling and called party disconnect.	Lamps light.	Replace lamp.
	19	Front and rear cord.	Remove from line jacks.	Supervisory lamp is extinguished on CB lines.	
	20	Front cord plug (on calls to dial office).	Insert into line jack of dial trunk.		
	21	Cord circuit switch.	Operate to lock position.	Dial tone heard in headset.	Clean metallic parts of plug. Replace headset.
	22	Dial cord plug.	Insert into dial jack of trunk.	Dial tone is not heard in headset.	Check dial trunk circuit.
	23	Dial.	Dialing of number.		
	24	Dial cord plug.	Remove from dial jack after dialing.	Ring back tone or busy signal heard in headset.	Check dial mechanism for defects. Clean metallic parts of dial plug.
	25	Cord circuit switch.	Operate to normal position.		
	26	Front cord plug (on calls to manual central office).	Insert into line jack of a manual trunk.		
	27	Cord circuit switch.	Operate to ring (non-lock) position.		
	28	Cord circuit switch.	Operate to talk (lock) position.	Distant operator answers.	Replace headset. Check switch for dirty or faulty contacts.
	29	RINGING KEY-HAND switch.	Operate to RINGING KEY position.	Allows telephones or offices to be signaled by operation of cord circuit switch only.	
	30	RINGING KEY-HAND.	Operate to HAND position.	Allows telephones or offices to be signaled by emergency hand generator.	
	31	Emergency hand generator.	Operate with RINGING KEY-HAND switch in the HAND position.	Signals called party with cord circuit switch operated to the ring (non-lock) position.	Check contacts of RINGING KEY-HAND, master ring, and cord circuit switches. Clean metallic parts of plug of front cord.
STOP	32	48V circuit breaker.	Operate to OFF position.	Voltmeter pointer drops to zero.	
	33	110V circuit breaker.	Operate to OFF position.	Buzzing from telering ceases. Ammeters on Panel BD-132-A and rectifier indicate zero.	

CHAPTER 4

THEORY

47. General Circuit Functions

The general functioning and operating limits of the circuits of the AN/TTC–7 are described in subparagraphs *a* through *g* below.

a. CB Line Circuit (figs. 15 and 47). This circuit provides means for interconnecting a common-battery telephone to a jack on the switchboard panel. It contains the relay equipment that gives the operator a visual and audible signal of an incoming call. This circuit is designed to operate on a power supply of 44 to 54 volts dc with a maximum line loop resistance of 1,500 ohms and a minimum line leakage resistance of 10,000 ohms.

b. CB-LB Line Circuit (figs. 19 and 48). This circuit provides means for connecting a common-battery or local-battery telephone to a jack on the switchboard panel. CB or LB operation is selected by means of a toggle switch. Relays provide the operator with a visual and audible alarm of an incoming call. With this circuit operating on a local-battery line, the maximum line loop resistance is 3,500 ohms and the minimum line leakage resistance is 10,000 ohms.

c. Manual or Dial Trunk Circuit (figs. 22 and 49). This type of circuit provides a two-way connection from a jack on the switchboard panel to a distant dial or manual central office. The circuit contains the relay equipment that lights the incoming lamp and rings the audible alarm when it is actuated by ringing current from the distant office. Trunk circuits are designed to operate normally with a power supply of 44 to 54 volts dc. The maximum line loop resistance is 1,500 ohms and the minimum line leakage resistance is 10,000 ohms.

d. Night Alarm Circuit. A set of contacts on a relay in each line circuit and trunk circuit closes when a party calls the switchboard operator. This rings the night alarm bell, which gives the operator an audible signal of the incoming call.

e. Operator's Telephone and Position Grouping Circuit (figs. 9 and 51). This circuit provides a connection from the operator's telephone headset to the cord circuits. It contains the relay equipment that provides monitoring and busy test facilities and includes a switch located between the operator's telephone circuit and cord circuit connections. Operation of this switch transfers the cord circuits to an adjacent operator's telephone circuit.

f. Universal Cord Circuit (figs. 10 and 52). The cord circuit includes an answer cord and a call cord. These two cords provide the means by which the operator manually connects the line of the calling party to the line of the called party. Each cord circuit contains the relay equipment that supplies power to the common-battery lines. An answer and call supervisory lamp gives the operator a visual indication when either party disconnects. The cord circuit also contains a relay that operates the recall signal lamp when either cord circuit plug is connected to a local-battery line.

g. Fuse Alarm Circuit. Each circuit or series of circuits are fused by means of alarm-indicating type fuses. When an overload condition occurs that exceeds the current capacity of the fuse element, the wire element melts and allows a metal spring to drop against an electrical contact. This completes a circuit through the fuse alarm buzzer which gives the operating personnel an audible indication of a blown fuse. Thus, if the fuse alarm buzzer mounted on the common-battery line case sounds, it indicates that a fuse has blown in that particular relay case.

48. CB Line Circuit

(fig. 47).

a. Incoming Call. When a telephone user originates a call, relay LR operates to signal the operator at the switchboard. The operate path of relay LR is negative battery, through the B-A winding of relay LR, through contacts 22-21 of relay CO, out on the R side of the line, through the telephone, back on the T side of the line, through contacts 25-26 of relay CO to ground (positive battery).

(1) *Relay LR operates.* Relay LR closes its *make* contacts to complete the visual and audible signaling paths. Contacts 1-2 complete the circuit to light the incoming lamp. Contacts 5-6 complete the circuit to the NA bell.

(2) *Night alarm bell.* The night alarm bell rings only if the NA switch is operated to the ON position. The night alarm is normally used during night operation or during light load periods.

b. Operator Answers Incoming Call. To answer an incoming call, the operator at the switchboard inserts the answer (rear) cord into the associated line jack and operates the cord circuit switch to the talk (lock) position. The contacts of the line jack complete the operating circuit for relay CO as follows: Negative battery through the D-C winding of relay CO, through contacts of the line jack to ground.

(1) *Relay CO operates.* Contacts 26-27 of relay CO connect ground to the sleeve of the line jack to operate relay RS in the universal cord circuit (fig. 52). Relay RS operates relay RB. Relay RB supplies transmission battery to the telephone user. Contacts 21-22 and 25-26 of relay CO open the dc circuit to relay LR; this causes relay LR to release.

(2) *Relay LR releases.* When relay LR releases, its *make* contacts 1-2 and 5-6 open the circuit to the visual and audible signaling components.

c. Transmitting, Telephone User and Operator. The transmission path from the telephone user to the operator is from the telephone, via T and R through the MDF case, through the T and R of the line jack (fig. 47), through the T and R of the answer cord, to capacitors C2 and C1, through contacts of the cord circuit switch (fig. 52), through contacts of the GRP switch, through contacts 2-1 and 22-21 of relay MO, to the 1-2 winding of the induction coil (fig. 51).

d. Operator Extends Call. To extend the call, the operator inserts the associated call cord into the line jack of the line to be called. Ground at the line jack contacts causes relay CO to operate from negative battery through the D-C winding of relay CO, through contacts of the line jack to ground.

(1) *Relay CO operates.* When relay CO operates, contacts 21-22 and 25-26 operate to disconnect battery and ground from the line and open the operate circuit to relay LR. Contacts 26-27 complete the circuit to the call supervisory lamp and relay FS as follows: Ground at contact 26 through contact 27, to the sleeve of the line jack, through the sleeve of the call cord (fig. 52), through the call supervisory lamp, through the A-C winding of relay FS to negative battery. Relay FS, in operating, prepares an operating circuit for relay FB, supplies transmission battery to the called party, prepares its own lock-up circuit, and prepares a circuit that will shunt the call supervisory lamp.

(2) *Ringing.* To signal the called telephone, the operator operates the cord circuit switch to the ring (nonlock) position. This completes the ringing circuit to send 20-cycle ac out on the line.

(3) *Called party answers.* When the called party answers, relay FB (fig. 52) operates as follows: Negative battery at *made* contacts 8-7 of relay FS, through the D-B winding of relay FB, through break contacts of the cord circuit switch, through the R of the call cord, through the R of the line jack out on the R side of the line, through the telephone, back on the T side of the line, through the T of

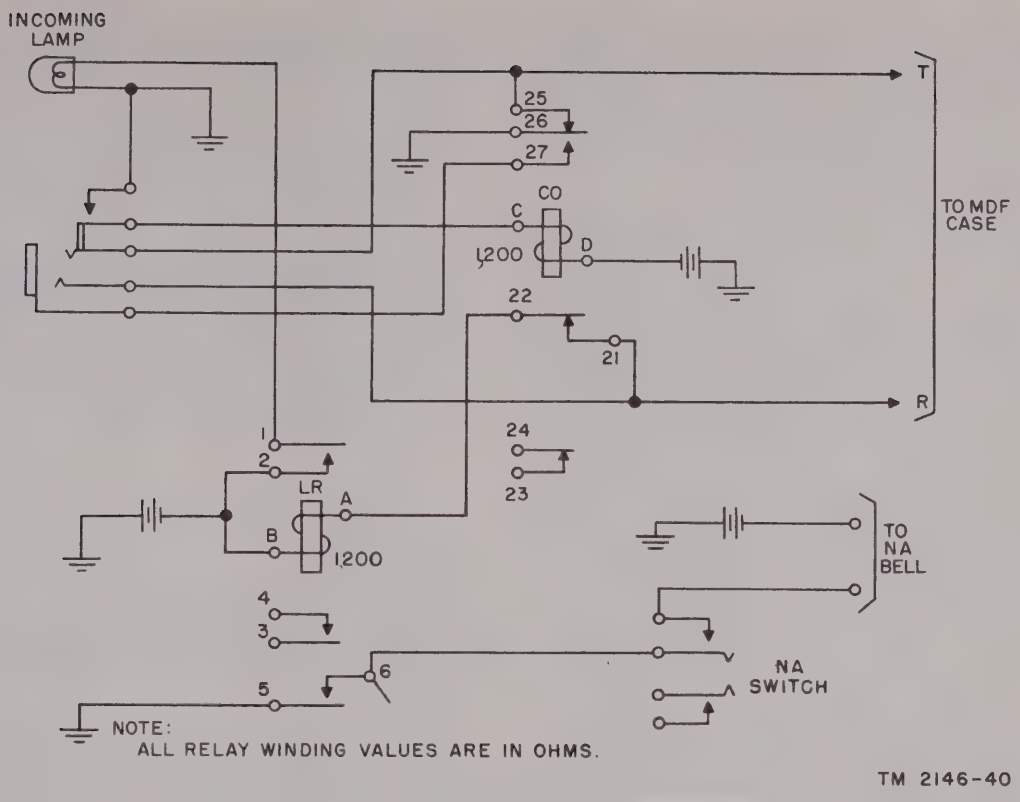


Figure 47. CB line circuit, schematic diagram.

the line jack, through the T of the call cord, through break contacts of the cord circuit switch, through the C-A winding of relay FB, through closed contacts 2-1 of relay FS to ground.

(4) *Relay FB operated.* When relay FB operates, it completes the path to shunt the call supervisory lamp as follows: Ground at contact 4, through contact 5, through contacts 4-5 of relay FS, to one side of the call supervisory lamp. The other side of the call supervisory lamp is grounded at contacts 26-27 of relay CO (fig. 47).

e. Talking, CB Party to CB Party. Battery for transmitting (fig. 52) is supplied to the party on the answer cord through contacts 1-2 and 7-8 of relay RS. Battery for transmitting is supplied to the party on the call cord through contacts 1-2 and 7-8 of relay FS.

(1) *Party to party transmission path.* The party to party transmission path is from the telephone, out on the T and R of the line, through the T and R of the line jack, through T and R of the answer cord, to capacitors C2 and C1, through contacts of the cord circuit switch, through T and R of the call cord, through T and R of the line jack, out on the T and R of the line to the telephone.

(2) *Either party hangs up.* When the party on the answer cord hangs up, relay RB in the universal cord circuit releases and removes the shunt from the answer supervisory lamp. This lights the answer supervisory lamp. When the party on the call cord hangs up, relay FB in the universal cord circuit releases to remove the shunt from the call supervisory lamp. This allows the call supervisory lamp to light.

49. CB-LB Line Circuit (fig. 48).

This circuit has a switching arrangement whereby the circuit can be adapted for use on CB or LB

equipment. For CB operation, operate the toggle switch to the CB position. For LB operation, operate the toggle switch to the LB position. The theory for CB operation is covered in paragraph 48. The theory for LB operation is described in subparagraphs *a* through *f* below.

a. Incoming Call (LB). To signal the operator at the AN/TTC–7, the LB telephone user must operate the hand generator (magneto). The magneto generates an ac voltage that is changed to dc by the rectifier in the CB-LB line circuit for operation of relay LR. During one-half cycle, current flows from the generator at the telephone, out on the T side of the line, through contacts 25-26 of relay CO, to ground, through the battery, through the rectifier, to capacitor C1 through contacts 22-21 of relay CO out on the R side of the line and back to the generator at the LB telephone. The next half-cycle of current flows from the generator, out on the R side of the line, through contacts 21-22 of relay CO, to capacitor C1, through the A-B winding of relay LR, through the battery, to ground, through contacts 26-25 of relay CO, out on the T side of the line, to the generator at the LB telephone. This half-cycle of current flow energizes relay LR. The succeeding cycles of current flow follow the same paths until relay LR operates.

(1) *Relay LR operates.* When relay LR operates, its 3-4 contacts shunt the ac from the generator and complete the lock-up path for relay LR as follows: Ground through contacts 24-23 of relay CO, through contacts 4-3 of relay LR, through the toggle switch, through the A-B winding of relay LR to negative battery. Contacts 1-2 and 5-6 of relay LR perform the same functions as described in paragraph 48*a*(1).

(2) *Night alarm bell.* Refer to paragraph 48*a*(2).

b. Operator Answers Incoming Call. Refer to paragraph 48*b* and 48*b*(2); subparagraph 48*b*(1) does not apply.

c. Transmitting, Telephone User and Operator. Refer to paragraph 48*c*. The LB telephone has its own battery for transmitting purposes.

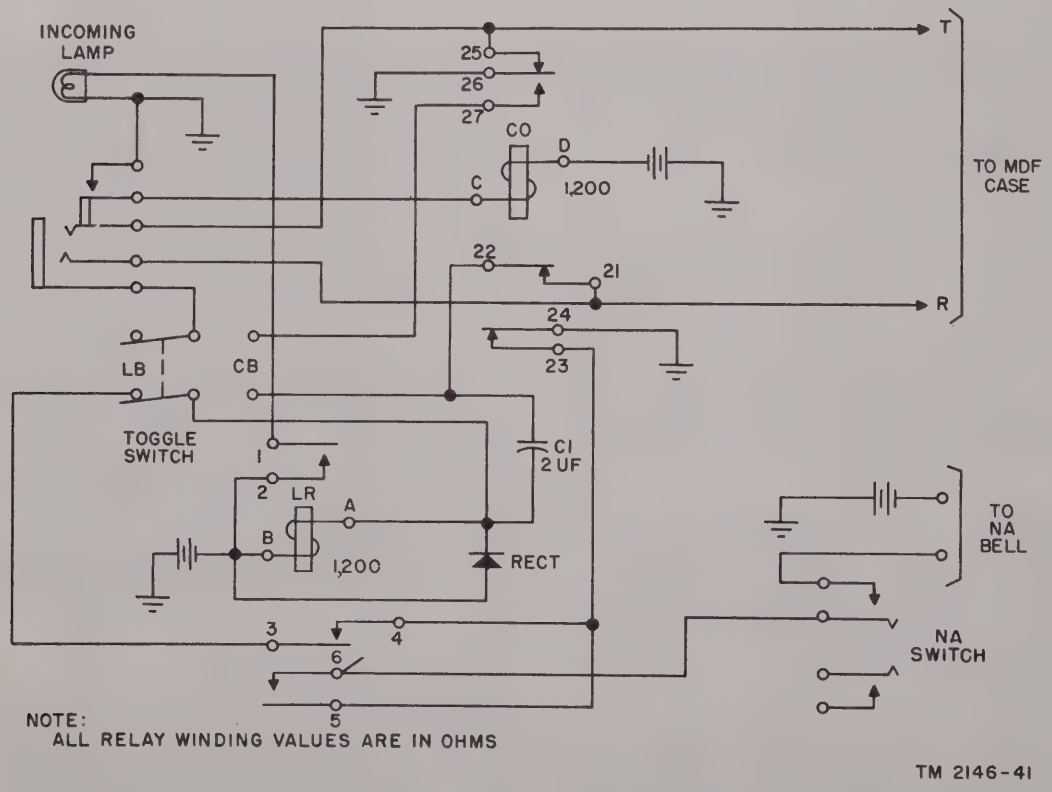


Figure 48. CB-LB Line Circuit, schematic diagram.

d. Operator Extends Call. To extend the call, the operator inserts the associated call cord into the jack of the line circuit to be called. Ground at the line jack operates relay CO as follows: Negative battery through the D-C winding of relay CO through *made* contacts of the line jack to ground.

(1) *Relay CO operates.* When relay CO operates, contacts 21-22 and 23-24 disconnect capacitor C1 from the R side of the line and open the operate and lock-up circuit to relay LR. Contacts 25-26 disconnect ground from the T side of the line.

(2) *Ringing.* Refer to paragraph 48*d*(2).

(3) *Called party answers.* The operator must monitor the called party's line until the called party answers (there is no cord supervisory signal on LB calls). When the called party answers, the operator restores the cord circuit switch to the normal position.

e. Talking, LB Party to LB Party. LB telephones do not require battery from the switchboard for transmission. The LB telephone has its own battery for transmission purposes. Refer to paragraph 48*e*(1) for the party to party transmission path.

f. Either Party Hangs Up. To *ring off* when either LB telephone conversation is completed, operate the hand generator associated with the LB telephone. Operation of the hand generator supplies ac current for operation of relay RB or FB (fig. 52). Relays RB and FB operate relay RU as discussed in paragraph 51*e*(5).

50. Manual or Dial Trunk Circuit (fig. 49).

This circuit provides facilities for interconnecting distant *dial* or *manual* telephone exchanges to the AN/TTC–7.

a. Incoming Call. Ringing current from a distant exchange signals the operator at the switchboard as follows: Ringing current on the T side of the line, through the MDF case at the AN/TTC–7, through contacts 3-4 of relay DL, through contacts 23-24 of relay CO, through contacts 3-4 of relay LR, through the A-C winding of relay LR, through the thermistor to capacitor C1, through the 6-8 winding of repeating coil RC1, via the R side of the line to the MDF case, out on the R side of the line to the distant exchange. This ringing current partially operates relay LR (contacts 1-2 only).

Note. The purpose of the thermistor is to guard against false calls. The thermistor has a high resistance to low voltage. When ringing current flows through the thermistor, its internal resistance decreases rapidly, thereby allowing more current to flow through it.

(1) *Relay LR operates.* After the 1-2 contacts of relay LR close, relay LR will operate fully from negative battery through the D-B winding, through contacts 2-1 of relay LR, through contacts 21-22 of relay CO to ground.

(2) *Relay LR contacts.* Contacts 7-8 of relay LR complete a resistance negative battery path to the sleeve of the line jack for busy test purposes. Negative battery on contact 6, through contact 5, through the incoming lamp to ground, lights the incoming lamp to signal the operator. Ground on contact 9, through contact 10 through the NA switch (when operated) through the NA bell to negative battery, operates the NA bell to signal the operator. Contacts 3-4 open the circuit to the A-C winding of relay LR.

b. Operator Answers Incoming Call. Refer to paragraph 48*b*.

(1) *Relay CO operates.* Contacts 24-25 of relay CO short circuit the A-C winding of relay LR, the thermistor, and capacitor C1. They also complete a transmission path through repeating coil RC1. Contacts 21-22 open the circuit to relay LR, which causes it to release.

(2) *Relay LR releases.* When relay LR releases, its *make* contacts 5-6 and 9-10 open the circuit to the visual and audible signaling components. Contacts 1-2 open the lock-up circuit of relay LR. Contacts 7-8 open to disconnect the original busy

test potential from the sleeve of the jack (busy test potential is now supplied by the cord circuit sleeve).

c. Transmitting, Operator and Distant Exchange. The transmission path from the distant exchange is as follows: From the distant exchange on the T side of the line to the trunk circuit (fig. 49) through contacts 3-4 of relay DL, through the 5-7 winding of repeating coil RC1, through contacts 24-25 of relay CO, through the 6-8 winding of repeating coil RC1, out on the R side of the line to the distant exchange. The transmission path to the operator is from terminal 1 of the repeating coil RC1 (fig. 49) to the T of the line jack, through the T of the answer cord (fig. 52), to capacitor C2, through contacts of the cord circuit switch, through contacts of the GRP switch (fig. 51), through the 2-1 contacts of relay MO, to the C2-R1 network, to terminal 1 of the induction coil, through the induction coil to terminal 2 through contacts 21-22 of relay MO, to capacitor C1, through contacts of GRP switch, through contacts of the cord circuit switch (fig. 52), to capacitor C1, through the R of the answer cord, to the R of the line jack (fig. 49), to terminal 4 of repeating coil RC1. Repeating Coil RC1 inductively couples the transmission path between the operator and the distant exchange.

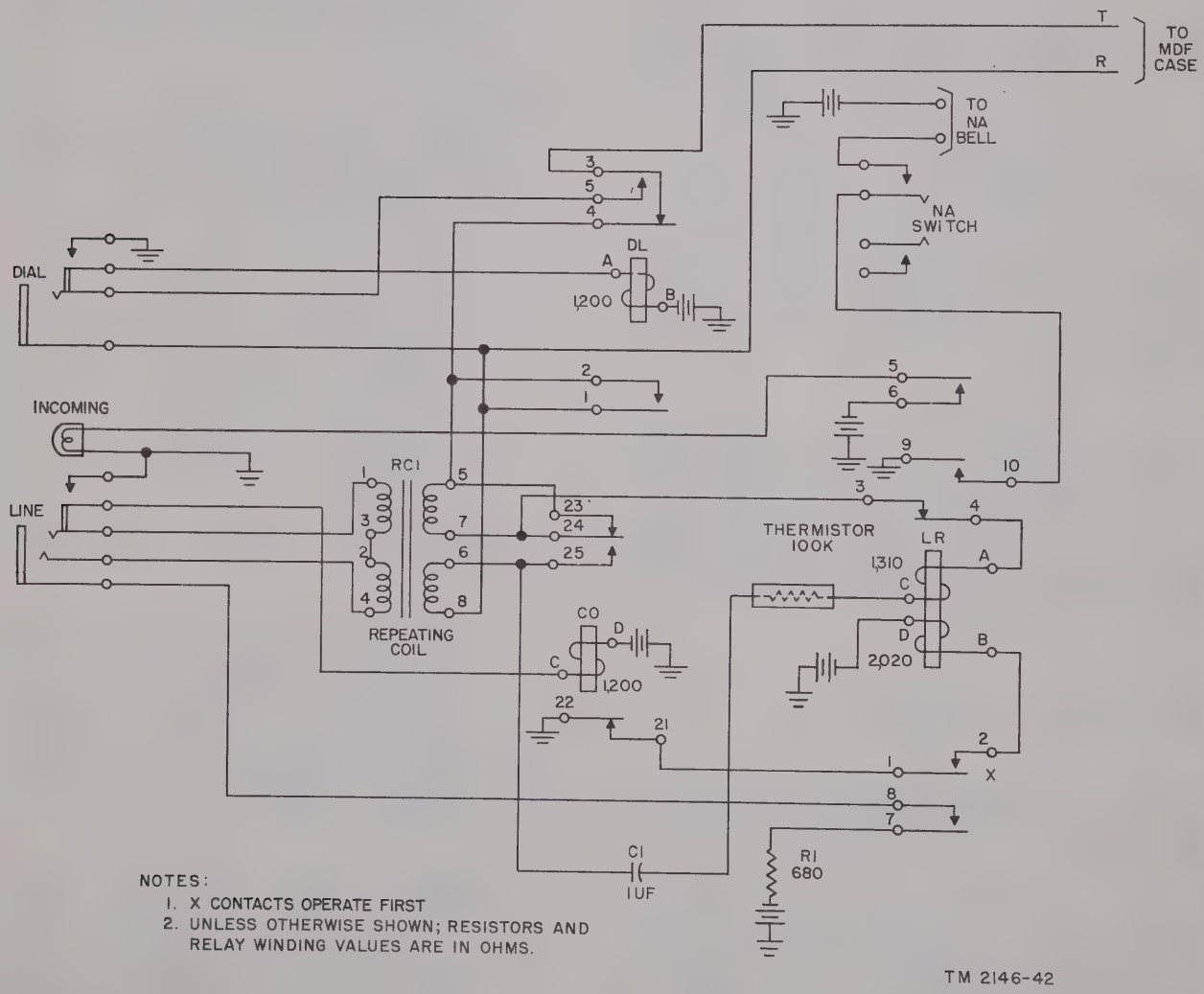


Figure 49. Manual or Dial Trunk Circuit, schematic diagram.

d. Operator Extends Call. To extend the call to a CB line, refer to paragraph 48*b*. To extend the call to an LB line, refer to paragraph 49*d*. To extend a call to a *manual* or *dial* exchange, refer to subparagraph *e* below.

e. Operator Extends Call to Distant Exchange. To signal a distant manual exchange, the operator inserts the call cord into a trunk circuit jack and operates the cord circuit switch to the talk position. The path to signal the distant exchange is similar to the path used for transmission described in subparagraph *c* above. The transmission path for this call is the same as described in subparagraph *c* above. To signal a distant dial exchange, the operator inserts the call cord into the trunk jack, and dial tone will be heard from the distant exchange informing the operator that the dial equipment is ready to receive dial pulses. The operator may now insert the *dial* cord into the *dial* jack of the associated trunk.

(1) *Operator inserts dial plug into dial jack.* When the operator inserts the *dial* cord into the *dial* jack, relay DL operates from negative battery through the B-A winding of relay DL, through the closed contacts of the *dial* jack to ground.

(2) *Relay DL operates.* Contacts 1-2 of relay DL close to short out the 5-7 and 6-8 winding or repeating coil RC1. Contacts 3-5 make to connect the T and R from the distant dial exchange to the operators dial (fig. 50). The operator can now dial a set of digits to select the telephone number desired. The switching equipment at the distant exchange supplies the ringing current needed to ring the called telephone. When the called party answers, transmission battery will be supplied by the distant exchange.

(3) *Transmitting, distant exchange to distant exchange.* The transmission path from the distant exchange on the answer cord to the distant exchange on the call cord is as follows: T and R from the distant exchange through contacts of relay DL (fig. 49), to the 5-8 winding of repeating coil RC1. By induction to the 1-4 winding of repeating coil RC1, through the T and R of the line jack, through the T and R of the answer cord (fig. 52), to capacitors C2 and C1, through the cord circuit switch, through the T and R of the call cord to the T and R of the line jack (fig. 49), to the 1-4 winding of repeating coil RC1 (by induction), to the 5-8 winding of repeating coil RC1, through contacts of relay DL, out on the T and R to the distant exchange.

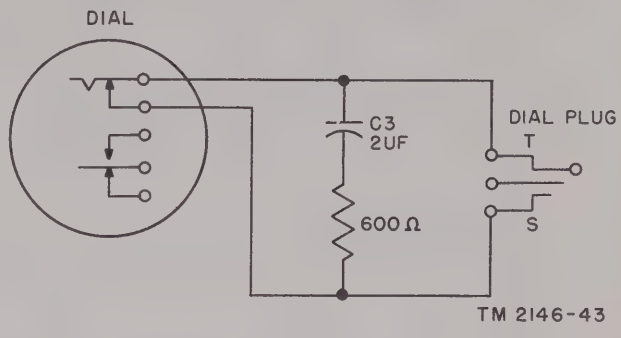


Figure 50. Dial Circuit, schematic diagram.

51. Operator's Telephone and Position Grouping Circuit

(fig. 51).

a. Transmitting and Receiving. The transmission path from the 1-2 winding of the induction coil in the operator's telephone circuit is described in paragraph 48*c*. This paragraph describes the theory of the primary circuit of the operator's telephone circuit. When the operator inserts the plug of the telephone set into the jack of the switchboard, relay OB operates from negative battery through the D-B winding of relay OB, through the transmitter, through the C-A winding of relay OB to ground. Relay OB, in operating, allows current to flow from negative battery, through resistors R2 and R3, through contacts 1-2 of relay OB to ground. The current flowing through resistors R2 and R3 develops a busy test potential (subpar. *e* below) at the junction of R2 and R3.

(1) *Transmitting.* Current for transmitting is supplied to the transmitter from negative battery, through the D-B winding of relay OB, through the transmitter, through the C-A winding of relay OB to ground. When the operator speaks into the transmitter, the resistance of the transmitter varies and causes a change in

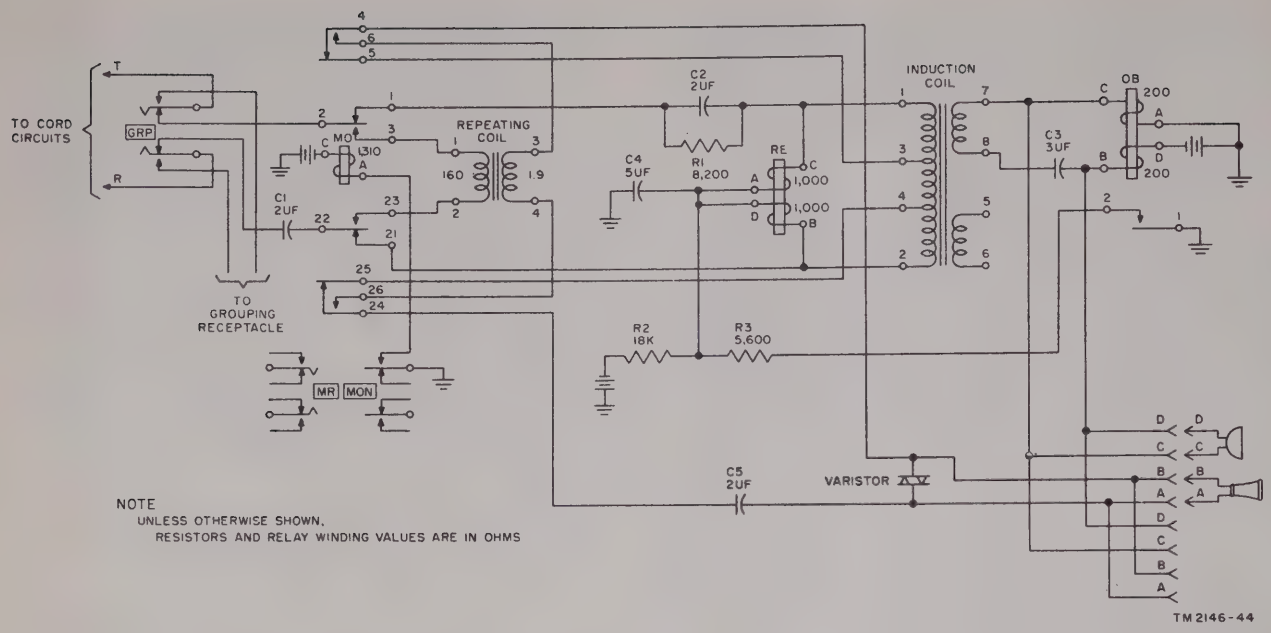


Figure 51. Operator's Telephone and Grouping Circuit, schematic diagram.

current flow through the transmitter and the 7-8 winding of the induction coil and capacitor C3. Current flowing through the 7-8 winding of the induction coil induces a voltage in the 1-2 winding of the induction coil that causes current to flow out on the telephone line as described in paragraph 48*c*.

(2) *Receiving.* The transmitting current from a distant telephone to the 1-2 winding of the induction coil (fig. 51) is described in paragraph 48*c*. The current from the 1-2 winding of the induction coil to the operator's receiver is from terminal 1 of the induction coil, through the induction coil to terminal 3, through contacts 5-4 of relay MO, through the receiver to capacitor C5, through contacts 24-25 of relay MO, to terminal 4 of the induction coil, through the induction coil to terminal 2.

b. Monitoring. To monitor a call that is in progress, the operator must first operate the MON-MR switch to the MON position and then operate the cord circuit switch to the talk position.

(1) *MON-MR switch in MON position.* Operation of the MON-MR switch to the MON position allows relay MO to operate from negative battery through the C-A winding of relay MO to ground at the contacts of the MON-MR switch.

(2) *Relay MO operates.* Contacts 4-6 and 24-26 of relay MO connect the 3-4 winding of the repeating coil to the operator's receiver. Contacts 2-3 and 22-23 of relay MO connect the 1-2 winding of the repeating coil to the T and R of the GRP switch.

(3) *Cord circuit switch in talk position.* Operation of the cord circuit switch to the talk position completes the T and R connections from the GRP switch to the T and R of the cord circuit.

c. Varistor. The varistor is a protective device connected across the operator's receiver. It offers a high resistance to normal voice voltages and a low resistance to high voltage surges. The varistor prevents acoustic shock (loud clicks) from reaching the operator's receiver by shunting the high voltage surges from the operator's receiver.

d. Grouping. When it is necessary to have one operator operate two or more switchboard positions, the grouping GRP switches of the unattended switchboard positions are operated to the

lock position. Operation of the GRP switches transfers the cord circuits of the unattended switchboard positions to the operator's telephone circuit at the attended position. This allows the operator to use the cord circuits of all positions.

e. Busy Test. To make a busy test, the operator at the switchboard must first operate the cord circuit switch to the talk position and then touch the tip of the associated cord to the sleeve of the jack being tested. If the jack under test is busy (has battery or ground on it), the operator hears a click in the receiver.

(1) *Battery on the sleeve.* When a jack has battery on the sleeve, the momentary current flow that produces the click in the operator's receiver is as follows: Battery on the sleeve to the T of the cord, through contacts of the cord circuit switch, through contacts of the GRP switch, through contacts 2-1 of relay MO to the C2-R1 network, through the 1-3 winding of the induction coil, through contacts 5-4 of relay MO, through the operator's receiver to capacitor C5, through contacts 24-25 of relay MO through the 4-2 winding of the induction coil, through the B-D winding of retard coil RE to capacitor C4 and resistor R3 to ground.

(2) *Ground on the sleeve.* When the jack sleeve is grounded, the current that produces the click heard by the operator flows from negative battery through resistor R2, through the same circuit components as described in subparagraph (1) above, to ground at the jack sleeve.

52. Universal Cord Circuit (fig. 52).

The circuit operation of the universal cord circuit has been covered in portions as it applied to the interconnection of the line and trunk circuits in paragraphs 48 through 51. This paragraph will cover the functions of the components of the universal cord circuit. The universal cord circuit includes a cord circuit switch, a recall relay (RU) and lamp, an answering cord with its RS and RB relays, and a calling cord with its FS and FB relays.

a. Cord Circuit Switch. When the cord circuit switch is operated to the talk position, it bridges the T and R of the operator's telephone circuit to the T and R of either or both cords. When the cord circuit switch is in the ring position, it completes the path from the ringing circuit to the call cord only.

b. Relay RU. The recall relay (RU) controls the lighting of the magneto supervisory lamps for supervision on LB calls.

c. Cord Components. The functions of the components associated with the answer cord are identical with those associated with the call cord.

(1) *Relays RS and FS.* Relay RS of the answer cord and relay FS of the call cord are supervisory relays. These relays operate if the answer or call cord are inserted into jacks having ground on the sleeve of the jack. The contacts of relays RS and FS supply battery to telephone circuits that require transmission battery from a central office (such as CB telephones) and prepare circuits for lighting the supervisory lamps and for operating relays RB and FB.

(2) *Relays RB and FB.* Relay RB of the answer cord and FB of the call cord are bridging relays. These relays operate when relays RS and FS have operated, or when an LB telephone is ringing off. The contacts of these relays control the *operate* circuits for the supervisory lamps.

(3) *Supervisory lamps.* When lighted the supervisory lamps are visual indication to the operator that the called or calling telephone users have completed their calls or have not yet begun their conversations.

(4) *Capacitors.* Capacitors C1 and C2 are used to complete the transmission path between the answer and call cords.

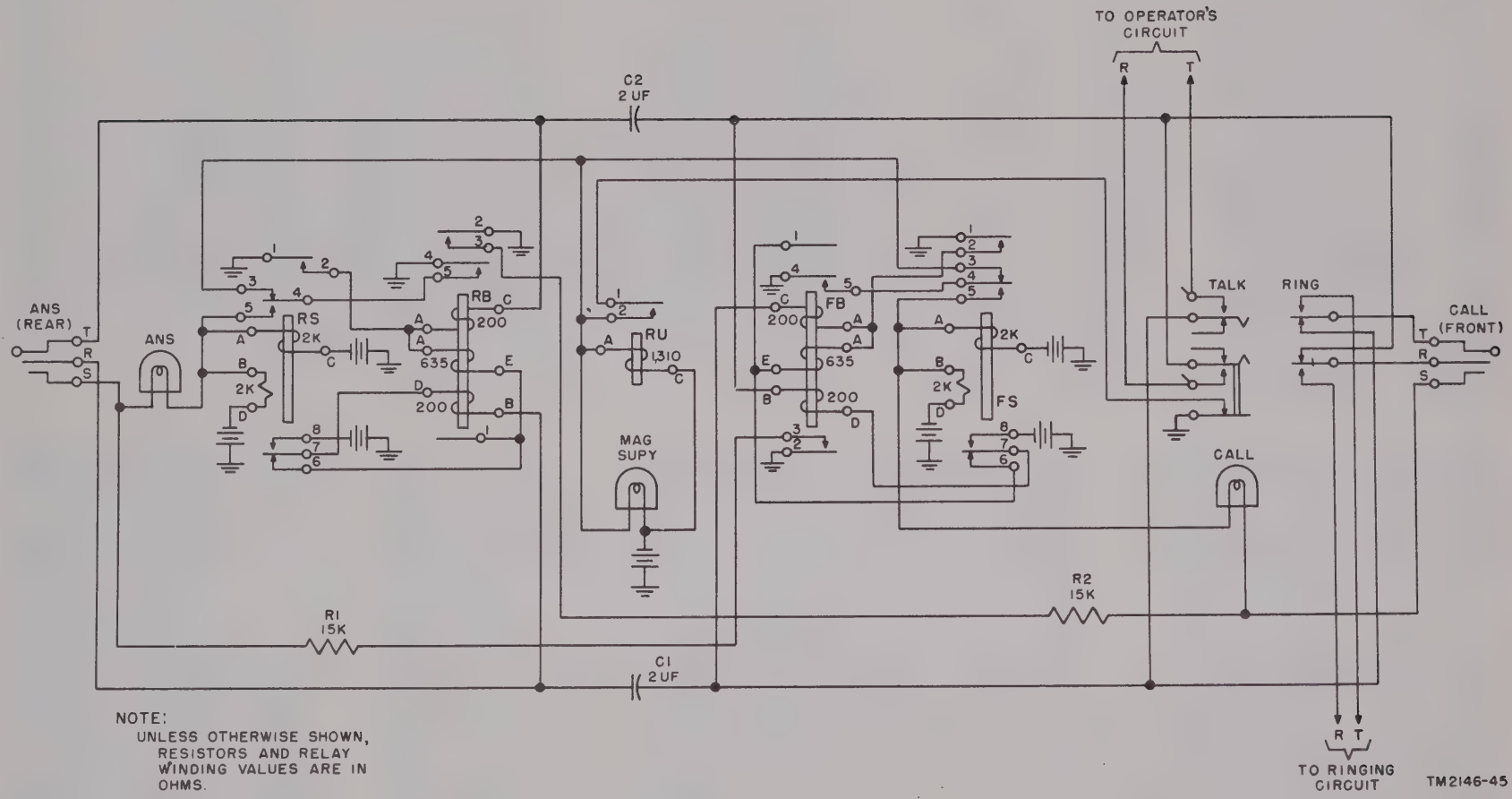


Figure 52. Universal cord circuit.

(5) *Resistors.* Resistors R1 and R2 limit the current flow and dim the answer and call supervisory lamps when the answer and call cords are connected to plug supervision type trunks.

d. Relay Operation. The operate path for relays RS, RB, FS and FB, and the function of the contacts of these relays are listed below.

(1) *Relay RS.* The operate path for relay RS is from negative battery through its C-A winding, through the answer lamp, through the sleeve of the cord, to ground at the sleeve of the line jack. Contacts 7-8 and 1-2 supply transmission battery when required, and supply battery and ground for operation of relay RB when required. Contacts 4-5 prepare the circuit for shunting the answer lamp. When relay RS is not operated, contacts 6-7 complete the connection between the A-E and D-B windings of relay RB (this connection is necessary for recall purposes on LB telephone calls). Contacts 3-4 prepare an operate circuit for relay RU (only if relay RB operates because of LB recall purposes).

(2) *Relay RB.* The operate path for relay RB is from negative battery at contact 8 of relay RS, through contact 7, through the D-B winding of relay RB, out on the R side of the line, back on the T side of the line, through the C-A winding of relay RB, through contacts 2-1 of relay RS to ground. Contacts 4-5 of relay RB supply the ground that shunts the answer lamp. Contacts 2-3 of relay RB extend resistance ground to the sleeve of the call cord for dimming the supervisory lamp when the answer cord is inserted into the jack of a plug supervision type trunk.

(3) *Relay FS.* The operate path for relay FS is from negative battery through its C-A winding, through the call lamp, through the sleeve of the cord, to ground at the sleeve of the line jack. Contacts 7-8 and 1-2 supply transmission battery when required, and supply battery and ground for operation of relay FB when required. Contacts 4-5 prepare the circuit for shunting the call lamp. When relay FS is not operated, contacts 6-7 complete the connection between the A-E and D-B windings of relay FB (this connection is necessary for recall purposes on LB calls). Contacts 3-4 prepare an operate circuit for relay RU (only if relay FB operates because of LB recall purposes).

(4) *Relay FB.* The operate path for relay FB is from negative battery at contact 8 of relay FS, through contact 7, through the D-B winding of relay FB, out on the R side of the line, back on the T side of the line, through the C-A winding of relay FB, through contacts 2-1 of relay FS to ground. Contacts 4-5 of relay FB supply the ground that shunts the call lamp. Contacts 2-3 of relay FB extend resistance ground to the sleeve of the call cord for dimming the supervisory lamp when the call cord is inserted into the jack of a plug supervision type trunk.

(5) *Relay RU.* Relay RU operates only on recall supervision from LB telephones. If the recall is on the answer cord, relay RU operates from negative battery through its C-A winding, through contacts 3-4 of relay RS, through contacts 5-4 of relay RB to ground. If the recall is on the call cord relay RU operates from negative battery through its C-A winding, through contacts 3-4 of relay FS, through contacts 5-4 of relay FB to ground. When relay RU operates, its 1-2 contacts *make* to extend ground from the contacts of the cord circuit switch to relay RU for lock-up purposes. The magneto supervisory lamp is in parallel with relay RU and will remain lighted. When the operator operates the cord circuit switch to the talk position to challenge the call, contacts of the cord circuit switch break to open the circuit to relay RU and the magneto supervisory lamp; this causes relay RU to release and the magneto supervisory lamp to be extinguished.

53. Ringing Circuit
(fig. 53).

a. The ringing circuit connects the telering on Panel BD-132-A to the T and R leads of the call

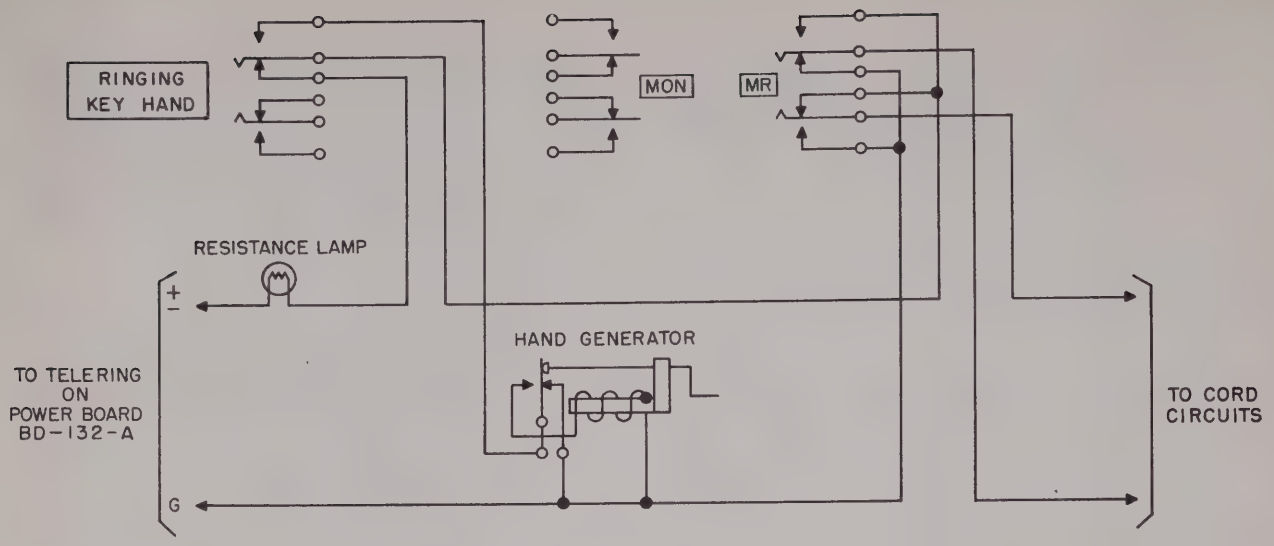


Figure 53. Ringing circuit, schematic diagram.

cord of the cord circuit when a cord circuit switch is operated to the ring position. The resistance lamp is in the circuit for protection against an overload condition. With the RINGING KEY-HAND switch in the RINGING KEY, or normal, position, the MON-MR switch in its normal position, and the cord circuit switch in the ring position, ringing current flows to the called party's telephone bell as follows: From the ± terminal of the telering at Panel BD-132-A, through the resistance lamp, through normal contacts of the MON-MR switch to the R lead of the call cord, through the operated contacts of the cord circuit switch, through the distant telephone bell to the T lead of the call cord through made contacts of the cord circuit switch, through normal contacts of the MON-MR switch to the G lead at the telering.

b. Operation of the RINGING KEY-HAND switch to the HAND position disconnects the telering and resistance lamp from the ringing circuit and connects the emergency hand generator across the ringing circuit. With the cord circuit switch operated to the ring position and the hand generator operated, ringing current for signaling is the same as described in subparagraph *a* above.

c. When two telephones are connected to a line, the bell of one is connected from the R lead to ground and the bell of the other is connected from the T lead to ground. With the MON-MR switch in the normal position and the cord circuit switch operated to the ring position, the G lead of the ringing circuit is connected to the T lead of the line and the ± lead is connected to the R lead, which causes the R telephone bell to ring. With the MON-MR switch operated to the lock position, the G lead of the ringing circuit is connected to the R lead of the line and the ± lead is connected to the T lead, which causes the T telephone bell to ring. Telephones that are bridged across the line T and R leads are signaled with the MON-MR switch in either position.

54. Fuse Alarm Circuit

(fig. 54).

Normal operating current flows through the fuse-element. When an overload condition occurs, such as a short circuit, the current carrying capabilities of the fuse element are exceeded and the element melts; this causes a spring to make contact with the alarm bar which is connected through the FA buzzer to ground. Current flows through make contacts of the fuse and through the FA buzzer to ground; this completes the fuse alarm circuit and causes the fuse alarm buzzer to sound.

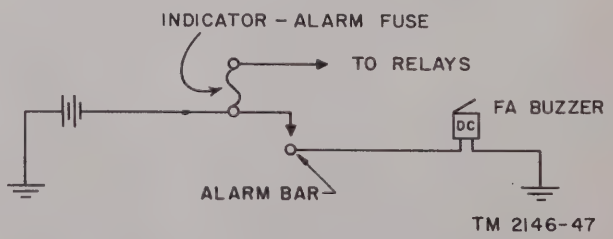


Figure 54. Fuse alarm circuit, schematic diagram.

55. Panel BD-132-A

Panel BD-132-A is the power supply panel for the AN/TTC-7. Refer to TM 11-2064 for detailed circuit theory of all circuits contained in Panel BD-132-A.

CHAPTER 5

FIELD MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field maintenance of Manual Telephone Central Office AN/TTC-7. The amount of repair that can be performed by units having field maintenance responsibility is limited only by the tools and test equipment available, and by the skill of the repairman.

Section I. TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

56. Tools, Materials, and Test Equipment Required for Field Maintenance

Tool Equipment TE-49
Tool Equipment TE-111
Tool Equipment TE-112
Moisture and Fungus Proofing Equipment MK-2/GSM
Test Set I-181-( )
Test Set TS-140/PCM
Test Set I-142

57. Trouble-shooting Procedures

The first step in servicing defective equipment is to sectionalize the fault. Sectionalizing 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 faults 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 relay contacts of those relays in the component or circuit in question.

58. Trouble-shooting Data

Before trouble shooting, refer to the schematics and wiring diagrams (figs. 59 through 114) 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 the applicable illustrations to locate the parts indicated by symbols on the circuit schematics and wiring diagrams. Refer to paragraphs 65 through 72 for information concerning relay adjustments.

59. Trouble-shooting Precautions

Whenever any component of Manual Telephone Central Office AN/TTC-7 is serviced, observe the following precautions.

a. Before a part is unsoldered, note the position of the leads. If the part, such as a relay, has a number of connections, tag each lead.

b. Be careful not to damage other leads by pulling or pushing them out of the way.

c. Do not allow drops of solder to fall onto other parts since they may cause short circuits.

d. A carelessly soldered connection may create a new fault. It is important to make well-soldered joints because a poorly soldered joint may be difficult to locate when trouble shooting.

60. Trouble Locating Procedures (figs. 47 and 59)

After it has been determined that the CB line trouble does not exist in the outside plant, follow the instructions given for the correct symptom below to isolate the trouble to a particular part or circuit element.

a. Telephone User Cannot Signal Switchboard.

(1) *Trouble sectionalization.* Determine to which CB line circuit the out-of-service

telephone is connected. At the CB line case (figs. 14 and 15), locate the circuit plate on which the above line circuit is mounted (fig. 16). Place a man at the switchboard positions, and manually operate relay LR. If the incoming lamps at the switchboards light, the trouble lies between the CB line case and the MDF (subpar. (3) below); if the incoming lamps fail to light, the trouble lies between the switchboards and the CB line case (subpar. (2) below).

(2) *Trouble between CB line case and switchboard.* If the incoming lamps fail to light, clean the contacts of relays LR and CO and repeat the procedure outlined in subparagraph (1) above. If the lamps still fail to light, wait until a light traffic period occurs, disconnect the proper cable between the CB line case and the switchboard, clean and inspect the corresponding receptacles, and connect a new cable between the two components. Do this as quickly as possible to minimize the time the 10 associated CB lines will be out of service. If changing the cable yields no results, check the circuit wiring at the switchboard and at the CB line case.

(3) *Trouble between CB line case and MDF.* If the incoming lamps light, restore the relay, and short the T and R contacts at the rear of the plug at the CB line case. If the incoming lamps light again, the trouble lies in the MDF or the interconnecting cable. Check the binding post connections and interior wiring at the MDF. If the incoming lamps do not light, the trouble lies in the CB line case. Check the coil of relay LR, clean the contacts of relays LR and CO, and again short out the T and R contacts. If the incoming lamps still do not light, clean the MDF receptacle contacts of the CB line case and check the circuit wiring.

b. Operator Cannot Signal CB Telephone.

(1) *Trouble sectionalization.*

(*a*) Place a man at the switchboard positions. Insert a call cord into the jack of the line in trouble.

(*b*) At the CB (or CB-LB) line case, locate the MDF cable receptacle in which the line is located.

(*c*) Connect a test receiver across the correct T and R contacts located at the rear of the MDF cable receptacle plug.

(*d*) Signal the man at the switchboard to operate the cord circuit switch to the ring position.

(*e*) If ringing tone is heard, the trouble lies between the CB (or CB-LB) line case MDF cable receptacle and the MDF (subpar. (2) below); if the tone is not heard, the trouble lies between the switchboard and the CB (or CB-LB) line case (subpar. (3) below).

(2) *Trouble between CB (or CB-LB) line case and MDF.*

(*a*) At the MDF (fig. 11), connect the receiver across the correct T and R contacts located at the rear of the cable plug.

(*b*) Repeat the instructions given in subparagraph (1) (*d*) above.

(*c*) If the tone is not heard, the cable between the CB (or CB-LB) line case and the MDF is faulty. Wait until a period of light traffic occurs, and quickly replace the cable.

(*d*) If the tone is heard, connect the receiver across the correct T and R binding posts on the line side of the MDF, and repeat ringing. If the tone is heard, the fault lies in the outside plant line; if the tone is not heard, the fault lies at the MDF.

Check MDF connections and interior wiring.

(3) *Trouble between switchboard and CB (or CB-LB) line case.*

(*a*) At the CB line case, locate the CB line circuit of the line in trouble.

(*b*) Instruct the man at the switchboard to withdraw and insert the call plug several times.

(*c*) Observe the action of relay CO. If relay CO does not operate, check the coil. If the coil is not defective, ground the correct CO terminal located at the rear of the plug connected to the switchboard cable receptacle. If relay CO operates, the trouble lies in the switchboard cable CO lead, in the CO lead at the switchboard, or in the jack contacts of the line.

(*d*) If relay CO operates when inserting the call plug into the jack, connect the receiver across contacts 25 and 21 of relay CO, and signal the man at the switchboard to ring again.

(*e*) If the tone is heard, the fault lies in the T and R leads between contacts 25 and 21 of relay CO and the MDF cable receptacle.

(*f*) If the tone is not heard, connect the receiver across the correct T and R contacts at the back of the plug connected to the CB (or CB-LB) line case switchboard cable receptacle and ring again.

(*g*) If the tone is heard, the trouble lies between the CB (or CB-LB) line case switchboard receptacle and contacts 25 and 21 of relay CO.

(*h*) If the tone is not heard, proceed to the rear of the first switchboard position. Connect the receiver across the correct T and R contacts located on the rear of the plug connected to the switchboard receptacle and ring again.

(*i*) If the tone is heard, the cable between the switchboard position and the CB line case is defective. Replace the cable only during light traffic.

(*j*) If the tone is not heard, check the switchboard jack contacts.

61. Trouble Locating Procedures, LB Lines (figs. 48 and 60)

Before attempting to trouble shoot LB lines, be sure that the trouble does not lie in the outside plant connections. After it has been determined that the trouble is within the central office, proceed to sectionalize the trouble by following the instructions given for the correct symptom below.

a. Telephone User Cannot Signal Switchboard.

(1) *Trouble sectionalization.* At the CB-LB line case (figs. 17 and 18), check the toggle switch of the line in trouble to make sure it is in the LB position. If not, operate it to the LB position, contact the telephone user, and direct the latter to again attempt to signal the switchboard. If this yields no results, proceed as follows.

(*a*) At the CB-LB line case, locate the line circuit in trouble.

(*b*) Place a man at the switchboard, and manually operate relay LR.

(*c*) If the incoming lamps at the switchboard light, the trouble lies between the CB-LB line case and the MDF (subpar. (2) below); if the incoming lamps fail to light, the trouble lies between the switchboards and the CB-LB line case (subpar. (3) below). If, upon being manually released, relay LR restores, the trouble lies in dirty contacts 23 and 24 of

relay CO, dirty contacts 3 and 4 of relay LR, faulty contacts on the CB-LB switch, or an open winding of relay LR. Any of these faults will prevent relay LR from establishing its own holding circuit, and thus, during signaling from the magneto-telephone, will allow the incoming lamp at the switchboards to light only momentarily.

(2) *Trouble between CB-LB line case and MDF.*

(*a*) Restore relay LR by manually operating relay CO.

(*b*) At the line side of the MDF, connect 20-cycle ringing current to the T and R binding posts of the line in trouble.

(*c*) Connect a test receiver across contacts 22 and 25 of relay CO. If ringing tone is heard, the fault lies in capacitor C1, the rectifier across the A-B terminals of relay LR, the coil of relay LR, or the involved interior wiring.

Warning: The failure of selenium rectifiers can result in the liberation of poisonous fumes and the deposit of poisonous selenium compounds. If a rectifier burns out or arcs over, the odor will be strong. Provide adequate ventilation immediately. *Avoid inhaling the fumes and do not handle the damaged rectifier until it has cooled.*

(*d*) If the tone is not heard, connect the receiver across the correct T and R contacts on the rear of the cable plug connected to the CB-LB line case MDF receptacle. If the tone is heard, the fault lies in dirty or defective contacts of relay CO, dirty or defective MDF receptacle contacts, or the involved interior wiring.

(*e*) If the tone is not heard, proceed to the MDF, and connect the receiver across the T and R contacts located on the rear of the 50-foot cable plug. If the tone is heard, the cable is faulty, and should be replaced only during a period of light traffic. If the tone is not heard, the trouble lies in the cable plug, the MDF receptacle, the T and R binding post connections at the MDF, or the involved interior wiring.

(3) *Trouble between CB-LB line case and switchboard.*

(*a*) Restore relay LR by manually operating relay CO.

(*b*) Clean the contacts of relay LR, and again manually operate relay LR.

(*c*) If the incoming lamps at the switchboard fail to light, perform the cable replacing procedure outlined in paragraph 60*a*(2) above. If changing the cable yields no results, check the involved shelf wiring of the switchboard and the CB-LB line case.

b. Operator Cannot Signal LB Telephone. Refer to paragraph 60*b*. Follow the instructions given therein to isolate trouble when an LB telephone cannot be signaled.

62. Trouble Locating Procedures, Manual and Dial Trunks

(figs. 49 and 61)

Be sure that the trouble does not exist in the outside plant trunks before attempting the trouble-shooting procedures outlined for each symptom below.

a. Manual or Dial Central Office Cannot Signal Operator.

(1) *Trouble sectionalization.*

(*a*) Place a man at the switchboard positions.

(*b*) At the trunk relay case (figs. 20 and 21), locate the trunk circuit in trouble, and manually operate relay LR.

(*c*) If the incoming trunk lamps at the switchboard light, the trouble lies between the trunk relay case and the MDF (subpar. (2) below); if the lamps fail to light, the trouble lies between the trunk relay case and the switchboard (subpar. (3) below). If, after being manually released, relay LR restores, the trouble lies in dirty contacts 21 and 22 of relay CO, dirty contacts 1 and 2 of relay LR, or in a defective B-D winding coil of relay LR. Any of these faults will prevent relay LR from establishing its own holding circuit, and thus will allow the incoming trunk lamps at the switchboards to light only momentarily.

(2) *Trouble between trunk relay case and MDF.*

(*a*) Restore relay LR by manually operating relay CO.

(*b*) At the line side of the MDF, connect a 20-cycle ringing current to the T and R binding posts of the trunk in trouble.

(*c*) At the trunk relay case, connect a test receiver across contacts 24 and 25 of relay CO.

(*d*) If ringing tone is heard, the trouble lies in the thermistor, capacitor C1, defective or dirty contacts 3 and 4 of relay LR, or an open C-A coil of relay LR.

(*e*) If the tone is not heard, connect the receiver across contacts 1 and 3 of relay DL. If the tone is heard, the trouble lies in the 5-7 or 6-8 winding of the repeating coil.

(*f*) If the tone is not heard, connect the receiver across the correct T and R contacts on the rear of the cable plug connected to the MDF receptacle of the trunk relay case. If tone is heard, the trouble lies in dirty or defective MDF receptacle contacts or defective interior wiring.

(*g*) If tone is not heard, proceed to the MDF, and connect the receiver across the correct T and R contacts on the rear of the plug connected to the MDF receptacle. If tone is heard, the cable between the MDF and the trunk relay case is defective, and should be replaced as directed in paragraph 60*a*(2) above.

(*h*) If tone is not heard, the trouble lies in the binding post connections at the MDF, in dirty or defective receptacle contacts, or in the involved interior wiring.

(3) *Trouble between trunk relay case and switchboard.*

(*a*) Restore relay LR by manually operating relay CO.

(*b*) Clean contacts 5 and 6 of relay LR, and again manually operate relay LR.

(*c*) If the incoming lamps at the switchboard fail to light, perform the cable replacing procedure outlined in paragraph 60*a*(2) above. If changing the cable or cleaning the receptacle contacts yields no results, check the involved shelf wiring of the switchboard and the trunk relay case.

b. Operator Cannot Signal Manual Central Office.

(1) *Trouble sectionalization.*

(*a*) Place a man at the switchboard.

(*b*) At the trunk relay case, locate relay CO of the trunk circuit in trouble.

(*c*) Instruct the man at the switchboard to insert a call plug into the proper trunk jack.

(*d*) Observe the action of relay CO. If relay CO does not operate, the trouble lies in the coil of relay CO, in the CO lead between the switchboard and the trunk case, or in the jack contacts of the trunk in question.

(*e*) If relay CO operates, connect a test receiver across contacts 1 and 2 of relay DL, and instruct the man at the switchboard to operate the cord circuit switch to the ring position. If tone is heard, the trouble lies between the trunk relay case and the MDF (subpar. (2) below); if tone is not heard, the trouble lies between the switchboard and the trunk relay case (subpar. (3) below).

(2) *Trouble between trunk relay case and MDF.*

(*a*) At the trunk relay case, connect the test receiver across the correct T and R contacts at the rear of the plug connected to the MDF receptacle, and ring again. If tone is not heard, the trouble lies in dirty or defective contacts 3 and 4 of relay DL, dirty or defective MDF receptacle contacts, a defective cable, or in the involved interior wiring.

(*b*) If tone is heard, proceed to the MDF, connect the receiver across the correct T and R contacts at the rear of the cable plug, and ring again.

(*c*) If tone is not heard, the cable between the trunk case and the MDF is defective. If tone is heard, the trouble lies in the MDF receptacle, the connections and the T and R binding posts, or in the associated interior wiring.

(3) *Trouble between switchboard and trunk relay case.*

(*a*) Connect the receiver across terminals 5 and 8 of the repeating coil, and ring again. If tone is heard, the trouble lies in contacts 24 and 25 of relay CO.

(*b*) If tone is not heard, connect the receiver across terminals 1 and 4 of the repeating coil, and ring again. If tone is heard, the trouble lies in the coil.

(*c*) If tone is not heard, the trouble lies in the cable, in the corresponding receptacles, in the jack, or in the involved interior wiring.

c. Operator Cannot Seize Dial Central Office.

(1) Repeat the procedure outlined in subparagraph *b* (1) (*a*), (*b*), (*c*), and (*d*) above.

(2) If relay CO operates correctly, connect a test receiver across contacts 24 and 25 of relay CO. If dial tone is heard from the central office, the trouble lies in contacts 24 and 25 of relay CO.

(3) If dial tone is not heard, connect the receiver across contacts 1 and 2 of relay DL. If dial tone is heard, the trouble lies in the secondary winding of the repeating coil.

(4) If dial tone is not heard, connect the receiver across the correct T and R contacts on the rear of the plug connected to the trunk relay case MDF receptacle. If dial tone is heard, the trouble lies in contacts 3 and 4 of relay DL, in the receptacle contacts, or in the involved interior winding.

(5) If dial tone is not heard, proceed to the MDF, and connect the receiver across the correct T and R contacts at the rear of the plug. If dial tone is heard, the cable between the trunk relay case and the MDF is defective. If dial tone is not heard, the trouble lies in the MDF receptacle, the connections at the T and R binding posts, or the associated interior wiring.

d. Operator Cannot Step Automatic Equipment at Dial Central Office.

(1) Insert the dial plug into the dial jack of the trunk in trouble.

(2) At the trunk relay case, locate relay DL of the trunk circuit in trouble.

(3) If relay DL is not operated, the fault lies in the winding of relay DL, the DL lead between the trunk relay case and the switchboard, or the contacts of the dial jack.

(4) If relay DL is operated, the fault lies in the contacts of relay DL, the T and S leads between the switchboard and the trunk relay case, the dial plug or jack, or the dial mechanism.

63. Trouble Locating Procedures, Operator's Telephone Circuit

(figs. 51 and 63)

a. Operator Cannot Transmit.

(1) Be sure that the trouble is not in the operator's headset.

(2) At the rear of the switchboard, locate the induction coil in the operator's telephone circuit. Place a test receiver across terminals 1 and 2 of the induction coil.

(3) Instruct the operator to talk into the transmitter.

(4) If voice currents are not heard in the test receiver, the trouble lies in the induction coil, the winding of relay OB, the operator's headset jacks, or the associated wiring.

(5) If voice currents are heard, place the receiver across contacts 1 and 21 of relay MO. If voice currents are not heard, the trouble lies in the C-2 R-1 network.

(6) If voice currents are heard, place the receiver across terminals A-2 and A-7 of the operator's telephone circuit plate terminal block. Be sure the MON-MR switch is not operated. If voice currents are not heard, the trouble lies in contacts 1-2 or 21-22 of relay MO or in capacitor C1. If voice currents are heard, the trouble lies in the contacts of the cord circuit switch.

b. Operator Cannot Receive.

(1) Repeat the procedure outlined in subparagraph *a* above.

(2) If the above procedure yields no results, the trouble lies in contacts 4-5, 24-25 of relay MO, the varistor, or the receiver jack contacts.

64. Trouble-shooting Chart

Symptom	Probable trouble	Corrections
1. Incoming signal lamp at one position only fails to light.	*a.* Defective lamp.	*a.* Replace lamp.
2. Incoming CB (or LB) signal lamps fail to light.	*a.* Faulty incoming connections at line side of MDF.	*a.* Reconnect incoming line.
	b. Faulty jumper connections at switchboard side of MDF.	*b.* Arrange wires correctly.
	c. Defective binding posts on line or switchboard side of MDF.	*c.* Replace binding posts.
	d. Dirty or defective contacts of relay CO.	*d.* Clean or adjust contacts.
	e. Dirty or defective contacts of relay LR.	*e.* Clean or adjust contacts.
	f. Defective coil of relay LR.	*f.* Replace coil.
	g. Dirty receptacle contacts at CB (or CB-LB) line case and MDF.	*g.* Clean contacts.

64. Trouble-shooting Chart (cont.)

Symptom	Probable trouble	Corrections
	h. Defective cable between CB (or CB-LB) line case and MDF.	*h.* Replace cable.
	i. Dirty receptacle contacts at switchboard or CB (or CB-LB) line case.	*i.* Clean contacts.
	j. Defective cable between CB (or CB-LB) line case and switchboard.	*j.* Replace cable.
3. Incoming trunk signal lamps fail to light.	*a.* Faulty incoming connections at line side of MDF.	*a.* Reconnect incoming trunk line.
	b. Faulty jumper connections at switchboard side of MDF.	*b.* Arrange wires correctly.
	c. Defective binding posts on line or switchboard side of MDF.	*c.* Replace binding posts.
	d. Dirty or defective contacts 3 and 4 of relay DL.	*d.* Clean or adjust contacts.
	e. Dirty or defective contacts 21 and 22 of relay CO.	*e.* Clean or adjust contacts.
	f. Dirty or defective contacts of relay LR.	*f.* Clean or adjust contacts.
	g. Faulty thermistor.	*g.* Replace thermistor.
	h. Open coil winding of relay LR.	*h.* Replace coil.
	i. Open capacitor C1.	*i.* Replace capacitor.
	j. Open winding 5-7 or 6-8 of repeating coil.	*j.* Replace coil.
	k. Dirty receptacle contacts at trunk case or MDF.	*k.* Clean contacts.
	l. Defective cable between trunk case and MDF.	*l.* Replace cable.
	m. Dirty receptacle contacts at switchboard or trunk.	*m.* Clean contacts.
	n. Defective cable between trunk relay case and switchboard.	*n.* Replace cable.
4. Operator cannot signal CB (or CB-LB) telephone.	*a.* Faulty connections at line side of MDF.	*a.* Reconnect incoming line.
	b. Faulty jumper connections at switchboard side of MDF.	*b.* Arrange wires correctly.
	c. Defective binding posts on line or switchboard side of MDF.	*c.* Replace binding posts.
	d. Dirty CB (or CB-LB) line jack contacts.	*d.* Clean contacts.
	e. Open coil of relay CO.	*e.* Replace coil.
	f. Dirty receptacle contacts on CB (or CB-LB) line case or MDF.	*f.* Clean contacts.
	g. Defective cable between CB (or CB-LB) line case and MDF.	*g.* Replace cable.
	h. Dirty receptacle contacts at switchboard or CB (or CB-LB) line case.	*h.* Clean contacts.
	i. Defective cable between CB (or CB-LB) line case and switchboard.	*i.* Replace cable.
5. Operator cannot seize dial central office equipment (no dial tone).	*a.* Faulty connections or binding posts at MDF.	*a.* Check connections; replace defective binding posts.
	b. Faulty contacts 3 and 4 of relay DL.	*b.* Clean or adjust contacts.
	c. Faulty contacts 24 and 25 of relay CO.	*c.* Clean or adjust contacts.
	d. Open coil winding of relay CO.	*d.* Replace coil.
	e. Open winding 5-7 or 6-8 of repeating coil.	*e.* Replace coil.
	f. Faulty trunk jack contacts.	*f.* Clean or repair contacts.

Symptom	Probable trouble	Corrections
	g. Dirty receptacle contacts at trunk case or MDF.	*g.* Clean contacts.
	h. Defective cable between trunk case and MDF.	*h.* Replace cable.
	i. Dirty receptacle contacts at switchboard or trunk relay case.	*i.* Clean contacts.
	j. Defective cable between switchboard and trunk relay case.	*j.* Replace cable.
6. Operator cannot step automatic equipment at dial central office.	*a.* Faulty dial jack or dial contacts.	*a.* Clean or repair contacts.
	b. Defective dial mechanism.	*b.* Replace dial.
7. Operator cannot signal manual central office.	*a.* Faulty contacts 24 and 25 of relay CO.	*a.* Clean or adjust contacts.
	b. Faulty contacts 3 and 4 of relay DL.	*b.* Clean or adjust contacts.
	c. Open coil of relay CO.	*c.* Replace coil.
	d. Faulty repeating coil.	*d.* Replace coil.
	e. Faulty contacts on trunk jack.	*e.* Clean or adjust contacts.
	f. Dirty receptacle contacts at switchboard or trunk case.	*f.* Clean contacts.
	g. Faulty cable between switchboard and trunk case.	*g.* Replace cable.
	h. See items 5, *g* and *h*.	
8. Weak transmission or reception.	*a.* Defective operator's headset.	*a.* Replace headset.
	b. Faulty headset jacks.	*b.* Clean or adjust jacks.
	c. Faulty cord circuit plug.	*c.* Replace plug.
	d. Faulty binding post connections at MDF.	*d.* Check connections.
	e. Faulty contacts on relays in T and R loop.	*e.* Clean or adjust contacts.
	f. Faulty switch contacts on switches in T and R loop.	*f.* Clean or adjust contacts.
	g. Faulty cables or receptacle contacts in T and R loop.	*g.* Replace cables; clean receptacle contacts.
	h. Intermittent short in capacitor in T and R loop.	*h.* Replace capacitor.
9. Operator cannot transmit or receive when answer cord is inserted into jack of CB telephone line with cord circuit switch in talk position.	*a.* Faulty operator's headset.	*a.* Replace headset.
	b. Faulty headset jacks.	*b.* Clean or adjust jacks.
	c. Faulty cord plug.	*c.* Replace plug.
	d. Faulty CB line jack contacts.	*d.* Repair contacts.
	e. Faulty contacts of relay MO.	*e.* Clean or adjust contacts.
	f. Faulty contacts on GRP switch.	*f.* Clean or adjust contacts.
	g. Faulty contacts on cord circuit switch.	*g.* Clean or adjust contacts.
	h. Faulty induction coil in operator's telephone circuit.	*h.* Replace coil.
	i. Open capacitor C1 or C2 in operator's telephone circuit.	*i.* Replace capacitor.
	j. Refer to item 4, *a* through *i*.	
10. Operator can transmit but cannot receive.	*a.* Faulty receiver in operator's headset.	*a.* Replace headset.
	b. Faulty operator's headset jack contacts.	*b.* Clean or adjust jacks.
	c. Dirty or defective contacts 5-6 or 24-25, or relay MO.	*c.* Clean or adjust contacts.
	d. Open capacitor C5 in operator's telephone circuit.	*d.* Replace capacitor.
	e. Faulty varistor in operator's telephone circuit.	*e.* Replace varistor.

64. Trouble-shooting Chart (contd.)

Symptom	Probable trouble	Corrections
11. Operator can receive but cannot transmit.	*a.* Faulty transmitter in operator's headset.	*a.* Replace headset.
	b. Faulty operator's headset jack contacts.	*b.* Clean or adjust contacts.
	c. Open capacitor C3 in operator's telephone circuit.	*c.* Replace capacitor.
	d. Open coil winding of relay OB.	*d.* Replace coil.
	e. Faulty winding 7-8 of induction coil.	*e.* Replace coil.
12. Incoming signal lamps light, but night alarm bell does not ring on incoming call with NA switch operated to ON position.	*a.* Faulty connections between associated line or trunk case and NA bell.	*a.* Check connections.
	b. Faulty contacts on NA switch.	*b.* Clean or adjust contacts.
	c. Faulty NA bell.	*c.* Replace bell.
	d. Faulty contacts of relay LR or CO in associated line or trunk circuits.	*d.* Clean or adjust contacts.
13. Operator cannot monitor call when MON MR switch is operated to MON position.	*a.* Faulty contacts of relay MO.	*a.* Clean or adjust contacts.
	b. Faulty contacts of MON-MR switch.	*b.* Clean or adjust contacts.
	c. Open coil winding of relay MO.	*c.* Replace coil.
	d. Faulty repeating coil in operator's telephone circuit.	*d.* Replace coil.
14. Unable to group switchboard position cord circuits with GRP switches operated.	*a.* Faulty or incorrectly installed grouping cords.	*a.* Replace or install cords correctly.
	b. Faulty contacts of GRP switch.	*b.* Clean or adjust contacts.
15. Call supervisory lamp fails to light when call plug is inserted into CB line jack.	*a.* Faulty lamp.	*a.* Replace lamp.
	b. Faulty cord circuit plug.	*b.* Replace plug.
	c. Faulty contacts of relay CO.	*c.* Clean or adjust contacts.
	d. Open coil of relay CO.	*d.* Replace coil.
	e. Faulty contacts on CB line jack.	*e.* Clean or adjust contacts.
	f. Dirty receptacle contacts at switchboard or CB line case.	*f.* Clean contacts.
	g. Faulty cable between switchboard and CB line case.	*g.* Replace cable.
16. Call supervisory lamp does not extinguish when called party answers.	*a.* Faulty contacts 4-5 of relay FB.	*a.* Clean or adjust contacts.
	b. Faulty contacts 4-5 of relay FS.	*b.* Clean or adjust contacts.
17. Answer supervisory lamp does not extinguish when answer plug is inserted into jack of calling line.	*a.* Faulty contacts 4-5 of relay RB.	*a.* Clean or adjust contacts.
	b. Faulty contacts 4-5 of relay FS.	*b.* Clean or adjust contacts.
18. Magneto supervisory lamp does not light when calling LB telephone rings off.	*a.* Faulty magneto supervisory lamp.	*a.* Replace lamp.
	b. Faulty contacts 4-5 of relay RB.	*b.* Clean or adjust contacts.
	c. Faulty contacts 3-4 of relay RS.	*c.* Clean or adjust contacts.
19. Magneto supervisory lamp lights momentarily when LB telephone rings off.	*a.* Faulty contacts 1-2 of relay RU.	*a.* Clean or adjust contacts.
	b. Faulty contacts of cord circuit switch.	*b.* Clean or adjust contacts.
	c. Open coil of relay RU.	*c.* Replace coil.
20. Magneto supervisory lamp does not light when called LB telephone rings off.	*a.* Faulty magneto supervisory lamp.	*a.* Replace lamp.
	b. Faulty contacts 4-5 of relay FB.	*b.* Clean or adjust contacts.
	c. Faulty contacts 3-4 of relay FS.	*c.* Clean or adjust contacts.
21. Operator cannot signal party line with MON-MR switch operated to MR position.	*a.* Faulty contacts of MON-MR switch.	*a.* Clean or adjust contacts.

Section II. RELAY ADJUSTMENT

65. General Information

Relays used in Manual Telephone Central Office AN/TTC-7 do not require frequent adjustment. However, continual use over a long period of time, contact wear, loss of spring tension and other factors make adjustment of relays necessary to restore them to maximum operating efficiency. Adjustment consists mainly of bending contact springs and armature levers by means of spring benders and armature adjustment tools. Refer to paragraph 34 for tools and gages used to check and adjust relays. Refer to the relay adjustment tables (par. 69*b*) for each circuit to obtain the operating requirement for each relay. These tables specify the test and readjust requirements. Determine if a relay needs adjustment by checking it against the specified test values. If the relay does not meet the test requirements, adjust the relay to meet the readjust requirements.

Note. Never adjust a relay unless it is certain that the relay does not meet the test requirements.

66. Definitions of Relay Adjusting Terms

a. Electrical.

(1) *Operate.* When current is connected to the relay winding, the armature moves sufficiently to cause all normally closed contacts to break and all normally open contacts to make, reliably. The armature residual screw must touch the core.

(2) *Nonoperate.* When current is connected to the relay winding, the armature does not move sufficiently to cause any open contacts to make or to reduce the pressure on normally closed contacts to cause an unreliable connection.

(3) *Hold.* After the relay has operated and the current is reduced abruptly, the armature residual screw should not leave the core to cause an unreliable connection between closed contacts or to close any open contacts.

(4) *Release.* The armature moves from the core sufficiently to break contacts that have been closed and make, reliably, contacts that have been open.

(5) *Soak.* The application of a comparatively heavy or *soak* current immediately before the application of the operate, hold, or release values.

b. Mechanical.

(1) *Contact make.* Distance contacts move after they have been made.

(2) *Airline.* Distance between the end of the frame and the inner surface of the armature when the relay is electrically operated (*C* type relay only).

(3) *Residual projection also operated air-gap.* Distance between the face of the relay core and the inner surface of the armature with the relay electrically operated and the residual screw touching the core.

(4) *Contact gaging.* Measuring the position of the armature with respect to the core when contacts make or break. The measurement is made with a thickness gage of specified value, inserted between armature and core.

(5) *Spring combination* (fig. 56). Entire pile-up or set of contact springs of a relay.

(6) *X combination.* The set of contact springs in a spring pile-up which operate first. The letter X when it is used always precedes A or C.

(7) *Armature travel or stroke.* Distance between the core and the armature residual screw, or the nearest point on the armature itself with the relay in its normal or unoperated position.

67. Contact Numbering and Winding Locations

(fig. 55)

a. On *A* and *C* type relay pile-ups, two series of numbers are used to designate spring and contact numbering. Viewed from the rear, with the pile-up on top, the right spring combination numbering begins with the spring or contact nearest the frame, and continues upward. The spring or contact nearest the frame is designated as No. 21 of the 21 to 40 series. On the left spring combination of *A* and *C* type relays, the spring or contact nearest the frame is designated as No. 1 of the 1 to 20 series. The series continue upward to the last spring or contact, which will be located farthest from the frame.

b. Coil windings on the *A* type relay are designated by the letters A through D when the coil is viewed from the rear, with the pile-up on top, counting from left to right. The windings begin on A and B and end on C and D. A single coil relay is usually equipped with only the A and C terminals. The coil is wound so that the winding begins on A and ends on C. When three windings are used, the ends of the tertiary windings are brought out to flexible leads and connected as required. They are designated as E and F, the winding begins on E and terminates on F.

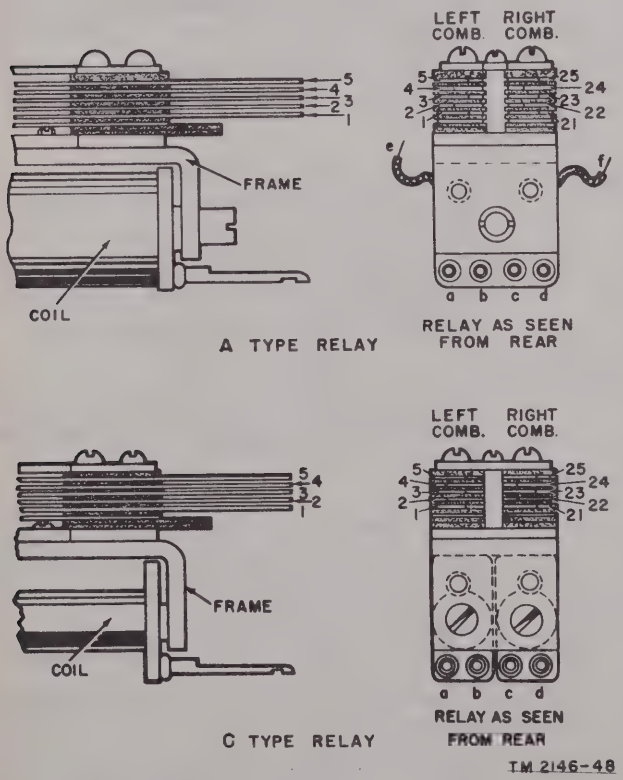


Figure 55. Coil and contact designations on A and C type relays.

c. Coil windings on the *C* type relays are designated by the letters A through D when the coil is viewed from the rear, with the pile-up on top, counting from left to right. The coils for the *C* type relay are wound so that the windings begin on A and C and end on B and D. The A-B coil operates the 1-19 spring combination assembly, and the C-D coil operates the 21-40 spring combination assembly.

68. Relay and Contact Cleaning

a. General.

(1) Failure of a circuit may be caused by dirt, corrosion, or lint on the contacts or other parts of a relay. Covers are provided on the equipment to reduce the accumulation of foreign materials on the working parts of relays. Keep the covers in place except when necessary to remove them to test or adjust the equipment. When relays are cleaned, wipe the inside of the cover with a lint-free cloth before replacing it.

(2) Clean the armatures and cores by inserting a clean piece of bond paper between the armature and core. Press the armature toward the core to apply a slight pressure between the paper and the part being cleaned. Then withdraw the paper. Repeat this operation several times, using a clean spot on the paper, until dirt is no longer deposited on the paper.

b. Contact Wear.

(1) Pitted or built-up contacts on relays do not prove that the contacts are useless. Do not replace relays because of contact erosion unless the contact is worn down to the base metal to which

the contact is welded. In the case of twin contacts, one contact of each mating pair may be worn nearly to the base metal before the apparatus requires replacement. When necessary, recondition contacts which are not excessively worn by removing build-ups and cleaning pits.

(2) Build-ups and pits on relay contacts result from the action of electric current as the relay makes and breaks contact. Sharp-pointed or excessive build-ups may result in the mechanical locking of the contacts in the operated or closed position. Remove build-ups with a burnisher, or replace the relay.

c. Cleaning Nonpitted Contacts.

(1) Contacts that fail in service may normally be cleaned with a contact burnisher to remove any foreign material. Clean the blade of the burnisher before and after using by wiping it with a clean, dry cloth. When burnishing normally open contacts of a relay, place the blade of the burnisher flat between the contacts and press them together with an orange stick, or operate the relay by hand. At the same time, move the blade back and forth. Rubbing the burnisher blade between the contacts two or three times is usually sufficient. When burnishing normally closed contacts, the tension of the springs themselves usually furnish sufficient pressure against the burnisher blade. On springs with heavy tension, lift one of the springs away or operate the relay by hand to insert the burnisher blade.

(2) When unable to clear contact troubles by burnishing only, clean and flush the contacts with carbon tetrachloride. Dip the flat end of a clean toothpick about 1/2 inch into the carbon tetrachloride. Deposit the liquid on the contacts (held slightly separated) without rubbing. Dip the flat end of another toothpick in the carbon tetrachloride and again deposit the liquid on the contacts without rubbing. This flushes away the dirt loosened by the first application. Keep the carbon tetrachloride away from the relay spoolheads and insulators. Allow the liquid on the contacts to evaporate. When the contacts are *thoroughly dry,* burnish them as outlined in subparagraph (1) above to insure that no deposit or residue from the solution, or any foreign matter, remains on the contacts. After burnishing, check to see that the requirements for contact make and contact separation are still met. Repeated burnishing tends to increase the contact separation and to reduce the contact make. If necessary, adjust the relay as specified on the adjustment sheet.

d. Cleaning Pitted Contacts.

(1) Burnish the contacts to be cleaned with the flat blade of the contact burnisher. Do not attempt to remove a pit from a contact, but burnish only enough to clean the flat, contact surface around the pit.

(2) Burnish the pit with the wire burnisher. Place the ball point of the burnisher in the pit. If the pit is small, rotate the barrel of the tool between the thumb and forefinger, and at the same time apply a slight pressure on the tool against the contact. Repeat the operation with the burnisher held at various angles until the entire surface of the pit has been cleaned. After cleaning the pit, burnish again, using the flat blade of the burnisher. When the burnishing is completed, check the contact make and separation requirements.

69. Relay Adjustment Tables

a. General. A relay adjustment table is provided below for each circuit in the AN/TTC-7. Each table contains information pertinent to relay testing procedures when using a current-flow test set. Listed in subparagraphs (1)

through (9) below are the column headings of the tables and their use.

(1) *Relay.* This column designates the particular relay in the circuit.

(2) *Block or insulate.* This column designates those relay contacts which must be insulated from each other before tests. The number within parentheses indicates the contacts which must be insulated; the relay designation outside the parentheses indicates the relay on which the contacts are located.

(3) *Test set lead.* This column indicates which lead of the current-flow test set is to be used for the test.

(4) *Test point.* This column indicates at which point the test set lead is to be applied. The number within parentheses indicates the terminal or contact; the relay designation outside the parentheses indicates the relay on which the terminals or contacts are located.

(5) *Test winding.* This column designates the winding through which current flows during test.

(6) *Test for.* Two designations are given in this column: O (operate) and NO (nonoperate). Each designation is accompanied by current values in the *Readjust ma* (milliamperes) and *Test ma* columns. When the indicated values of current for O is flowing through the relay during test, the relay must operate; when the indicated value of current for NO is flowing through the relay, the relay must not operate. R designates the release current of the relay.

(7) *Readjust ma.* This column indicates the value of current to which the relay must be adjusted if it fails to meet the current requirements listed in the *Test ma* column.

(8) *Test ma.* This column gives the current value at which the relay should operate or not operate. If the relay meets the current requirements in this column, no further adjustment is necessary. If the relay fails to meet these requirements, it must be adjusted in accordance with the values listed in the *Readjust* ma column.

(9) *Remarks.* This column gives the remarks pertinent to testing the relay.

b. Relay Adjustment Tables. The following subparagraphs (1) through (5) give the electrical requirements for relays used in the AN/TTC-7.

(1) *CB line circuit* (fig. 47).

Relay	Block or insulate	Test set lead	Test point	Test winding	Test for	Readjust ma	Test ma	Remarks
CO		Pos bat	CO(c)	C-D	O	28	30	
					NO	22	20	
LR	LR(1, 2)	Pos bat	CO(22)	A-B	O	14	15	
					NO	11	10	Battery on contact 2.

(2) *CB-LB line circuit* (fig. 48).

Relay	Block or insulate	Test set lead	Test point	Test winding	Test for	Readjust ma	Test ma	Remarks
CO		Pos bat	CO(c)	C-D	O	28	30	
					NO	22	20	
LR	LR(1, 2)	Pos bat	LR(A)	A-B	O	14	15	Remove wires from terminal A of relay LR before test. Battery on contact 2.
						11	10	

(3) *Trunk circuit* (fig. 49).

Relay	Block or insulate	Test set lead	Test point	Test winding	Test for	Readjust ma	Test ma	Remarks
DL	DL(1, 2)	Pos bat	DL(A)	A-B	O	14	15	
					NO	11	9.5	
CO	CO(24, 25)	Pos bat	CO(D)	C-D	O	20	22	
					NO	16.5	15	
LR	CO(21, 22) LR(5, 6)	Pos bat	LR(2)	B-D	O	8.2	8.7	X contacts only
					NO	6.7	6.2	X contacts only
					O	16	17.5	Battery on contact 6
					NO	13	11.5	

(4) *Operator's telephone circuit* (fig. 51).

Relay	Block or insulate	Test set lead	Test point	Test winding	Test for	Readjust ma	Test ma	Remarks
MO		Pos bat	MO(A)	A-C	O	18	20	
					NO	13	11.5	
OB	See	See		A-C				
	remarks	remarks	OB(C,B)	B-D	O	12	13	Disconnect operator's headset before test. Test both windings in series.
					NO	10	9	

(5) *Cord circuit* (fig. 52).

Relay	Block or insulate	Test set lead	Test point	Test winding	Test for	Readjust ma	Test ma	Remarks
RS		Pos bat	RS(5)	A-C	O	29	30.8	Battery on RS (8)
					NO	26	24	
	RS(3, 4)	Pos bat	RB(C)					
RB	RB(2, 3)	Neg bat	RS(2)	A-C	O	35	39	
					NO	29	25	
					R	13	12	
RU		Pos bat	RU(A)	A-C	O	6	6.5	Disconnect wires from A terminal of relay RU before test.
					NO	5	4.5	
	FS(3, 4)	Pos bat	FB(C)					
FB	FB(2, 3)	Neg bat	FS(2)	A-C	O	35	39	
					NO	29	25	
					R	13	12	
FS		Pos bat	FS(5)	A-C	O	29	30.8	
					NO	26	24	
					R	19	18	

70. Relay Testing and Adjusting Procedures

a. Adjust relays only when necessary and in accordance with the following routines:

(1) Inspect the relay for loose or bent parts, mechanical defects, contact alinement, and clearance from other relays. There must be a minimum of

1/32 of an inch clearance between relays. Inspect the mounting screws for tightness. Observe the alinement of mating contacts. The maximum allowable deviation is approximately one-third of the contact diameter (not to exceed 40 percent) judged visually.

(2) Check the residual air gap. The purpose of the residual air gap is to prevent the residual magnetism in the core from holding the armature operated after the current is cut off. The residual air gap for all relays in the AN/TTC-7 is .004 inch, with the exception of relays RS, RB, FB, and FS. The residual air gap for relays RS and FS is .014 inch; the residual air gap for relays RB and FB is .006 inch.

(3) Check the spring gaging. This is a measurement of the movement of the armature or movable contact springs in relation to the stationary or make and break contact springs. Spring gaging requirements are measured between the armature residual screw and the core, with the armature held operated, while observing whether the contacts being gaged make or break. Heavy springs are pre-formed to exert pressure against the spring stop. Light springs are pre-formed to exert pressure against back contacts or against the spring pusher. If springs are badly bent, it is advisable to remove the pusher and stop from the spring pile-up before attempting to restore the spring to its pre-formed shape.

(4) Check the electrical operating requirements. A current-flow test set is used to test the operate and nonoperate current values listed on the applicable relay adjustment table (par. 69). Test the relay with the test current also specified on the adjustment table. If the relay meets these electrical requirements, and if its mechanical adjustment is correct, the relay should function properly in the circuit. If the relay does not operate properly on the test values, readjust it to meet the readjust values specified. Additional adjustments are sometimes specified in the REMARKS column, and should be noted before testing or adjusting any relay.

b. Readjust the relays that fail to meet the current flow or mechanical requirements. Minor variations from specified values are to be expected and are not cause for readjustment.

71. Adjustments and Requirements for A Type Relays

a. General. Visually inspect the relay. Be sure the coil core nut is tight, the armature pivot edge is clean, and the pushers and stops are correctly positioned in the spring combinations. After the completion of the mechanical adjustments outlined in this paragraph, check the electrical operation of the relay according to the requirements specified on the applicable relay adjustment table. If relays fail to meet TEST values, readjust them. If necessary, tension the force springs until *operate* and *nonoperate* requirements are met.

b. Residual Screw Setting. The setting of the residual screw on relays equipped with adjustable residual screws is specified in paragraph 70*a*(2). This is an adjustment of the projection of the residual screw, and controls the amount of space between the core and the armature when the relay is electrically operated. Follow the steps given below to adjust the residual screw setting.

(1) Loosen the locking nut. Refer to paragraph 70*a*(2) to determine the setting of the residual.

(2) Operate the armature by hand. Insert the correct thickness gage between the armature and the core. Hold the thickness gage parallel to the pivot edge, on the opposite side of the residual screw.

(3) Check the fit of the thickness gage. The gage should fit snugly between the armature and core. For instance, if a residual projection is specified as .008

inch, a gage .007 inch should fit loosely between the armature and core, and a .009 inch gage should fit tightly. For residual projections specified as .010 inch and smaller, a gage .001 inch smaller than the specified projection must be loose, and a gage .001 inch larger than the specified projection must be tight when inserted. For residual projections specified as .011 inch or larger, a gage .002 inch smaller than the specified projection must be loose, and a gage .002 inch larger than the specified projection must be tight when inserted.

(4) Set the residual screw to the correct setting and tighten the locking nut. Reinspect the residual projection after tightening the locking nut.

(5) For relays which have release time or release or hold current requirements, the residual setting may be varied from that specified to obtain the desired characteristics, but there must always be a perceptible residual gap and contact pressure must be maintained.

(6) Relays equipped with nonadjustable welded-type residuals require no residual adjustment. All that is necessary for correct residual operation is that a .002 inch gage be loose when inserted between the armature and core of such relays.

(7) For *A* type relays having short lever ratio armatures, adjust the residual screw setting as outlined in subparagraphs (1) through (5) above. Check the armature pivot position as follows:

(*a*) With the relay electrically operated, the clearance between the armature and the end of the frame should not be less than .003 inch, nor more than one-half the value of the residual screw projection plus .003 inch.

(*b*) Check the face of the armature. It should be approximately parallel to the end of the frame.

(*c*) If the armature pivot must be readjusted, set the residual at zero and insert a .003-inch gage between the end of the frame and the armature. Operate the armature and then tighten the pivot mounting screw.

c. Spring Gaging for A, B, C, D, K, and X Combinations (fig. 56). The values of spring gaging shown below differ for each type of spring combination. Relays must meet the specified values. Relays may be adjusted to the specified values by turning the armature adjusting support screw and inserting the specified thickness gages until the correct values are obtained. (The thickness gage must just cover the residual projection.) This will normally be the only adjustment necessary to compensate for ordinary wear. However, if the armature adjusting support screw is turned in too far, it will be necessary to remove the armature and support and reduce the angle of the armature to seat the screw properly after adjustment is completed. Follow the instructions given below to check spring gaging.

(1) To check all make contacts, except those of make-before-break or X combinations, insert a .004-inch gage (or the equivalent values in a combination of smaller thickness gages) between the armature and core, and electrically operate the relay. The make contacts must make. Insert a .006-inch gage and operate the relay electrically. The make contacts must *not* make. If necessary, adjust the armature adjusting screw until the above values are obtained. Combinations greater than six steps (more than six hooks on the pusher) must make on a .005-inch gage but must not make on a .007-inch gage.

(2) To check all break contacts, except those of make-before-break or X combinations, insert a .008-inch gage between the armature and core, and electrically operate the relay. Under these conditions, the break contacts must

break. If necessary, adjust the break contact gaging as follows: Place the spring adjusting tool on the spring at the insulator and bend in the direction necessary to increase or decrease the tension. Then realine the spring by working the tool from the insulator toward the pusher. Check the break contact pressure with a gram gage. There must be a minimum contact pressure of 25 grams and a maximum of 40 grams per pair of twin contacts.

(3) The make of make-before-break D combinations must make when a .010-inch gage is inserted between the armature and core and the relay is electrically operated. There must be a minimum contact pressure of 20 grams and a maximum of 40 grams per pair of twin contacts.

(4) The make of make-before-break K combinations must make when a .009-inch gage is inserted between the armature and core. There must be a minimum contact pressure of 25 grams and a maximum of 40 grams per pair of twin contacts.

(5) On relays having only A (make) combinations, adjust the armature backstop so that a .008-inch gage will enter freely between the residual and core, but a .012-inch gage will not enter freely. Bend the backstop as required. The armature backstop must strike the retainer spring and not the frame.

(6) Contact gaging for relays having X combinations is as follows:

(*a*) All the spring combinations except the X combinations should be adjusted as described in subparagraphs (1) and (2) above. Adjust the pusher stops so that they hold the spring pushers in the normal nonoperated positions.

(*b*) The make contacts of XA and XC combinations should make when a .020-inch gage is inserted between armature and core and the relay is electrically operated. The make contacts must not make when the .020-inch gage is replaced by a .023-inch gage inserted in a similar manner. There should be a minimum contact pressure of 20-grams when the regular combination spring pushers touch the armature.

(*c*) For XA combinations only, adjust the armature backstop to a normal contact gap of .008 inch. With the relay unoperated, the pusher of the XA spring should rest against the armature with approximately 10-grams pressure. This pressure may be adjusted, as necessary, to meet the electrical operating requirements of the X combination. However, the minimum pressure must be sufficient to restore the armature fully against the backstop.

(*d*) For XC combinations only, the break contacts must open fully before the make contacts close. Judged visually, there should be a minimum .010-inch follow of the break contacts. Adjust the break contacts, if necessary, to a minimum contact pressure of 20 grams. Adjust the backstop to obtain a minimum clearance of .005 inch between the underside of the pusher and the armature, with the armature resting against the stop. The pusher may rest on the armature provided that the requirements outlined in this subparagraph are met.

d. Armature Backstop Adjustment. The backstop of all relays, except those having X contacts or limited travel, must be adjusted for perceptible clearance between the underside of the break contact springs and their pusher, but the clearance must not exceed .007 inch. To adjust the armature backstop, insert the projection of the spring adjusting tool between the frame and backstop and bend the backstop until the correct values are obtained.

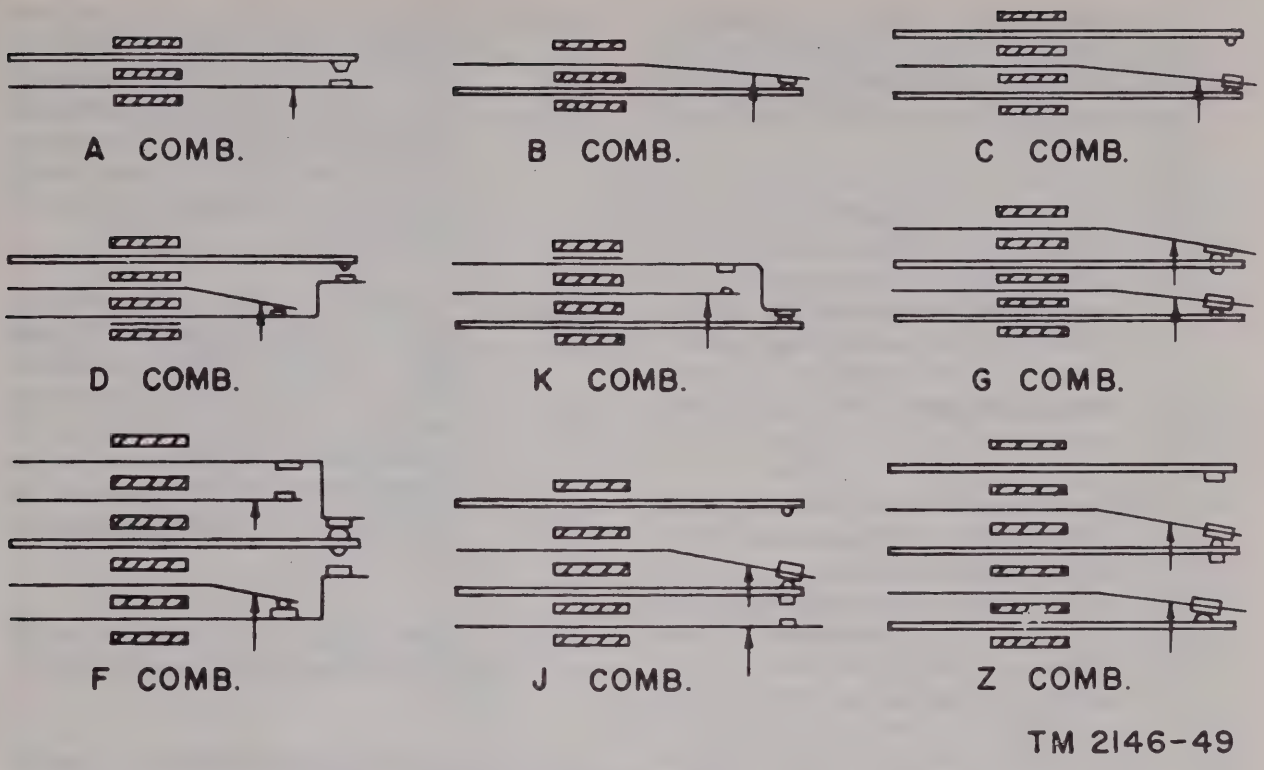


Figure 56. Pileup combinations used on A and C type relays.

72. Adjustments and Requirements for C Type Relays

a. Armature Position. Inspect the position of the armatures on the frame. If the armatures have been moved, position them correctly so that they operate without binding against the frame, and so that there is a .003-inch air gap between the armature and the frame. Tighten the retainer screws after adjustment is completed.

b. Residual Projection. Inspect the residual projections and, if necessary, readjust them as outlined in paragraph 71*b*.

c. Contact Gaging. The armature position at which the contacts make and break may be determined by means of standard thickness gages inserted between the armature and core. The end of the gage must cover the residual projection, and the relay must be electrically operated when performing this check. If necessary, adjust the make contact gaging by slightly bending the armature with the armature and back stop adjusting tool. Adjust the break contact gaging to the proper values as specified in paragraph 71*c*(2). Be careful not to damage the spring stop during this adjustment. Adjust make and break contact gaging to the values given below.

(1) Contact gaging for relays having standard lever ratio armatures with the bearing pin in the front position must be adjusted as follows:

(*a*) All make contacts, except those of make-before-break or X combinations, must make when a .005-inch gage is inserted between armature and core and the relay is electrically operated. The make contacts must not make when a .005-inch gage is replaced by a .008-inch gage inserted in a similar manner.

(*b*) All break contacts except those of make-before-break or X combinations, must break when a .010-inch gage is inserted but must not break when a .012-inch gage is inserted between the armature and core when

the relay is electrically operated. There must be a minimum contact pressure of 25 grams and a maximum of 40 grams per pair of twin contacts.

(*c*) The make of D combinations must make when a .013-inch gage is inserted between armature and core and the relay is electrically operated. There must be a minimum contact pressure of 20 grams and a maximum of 40 grams per pair of twin contacts.

(*d*) The make of K combinations must make when a .011-inch gage is inserted between armature and core and the relay is electrically operated. There must be a minimum contact pressure of 25 grams and a maximum of 40 grams per pair of twin contacts.

(2) Contact gaging for relays having slow-release or short-lever ratio armatures with the bearing pin in the rear position must be adjusted as follows:

(*a*) All make contacts, except those of make-before-break or X combinations, must make when a .009-inch gage is inserted between armature and core with the relay electrically operated. The make contacts must not make when a .009-inch gage is replaced by a .012-inch gage inserted in a similar manner.

(*b*) All *break* contacts, except those of make-before-break or X combinations, must break when a .016-inch gage is inserted between armature and core with the relay electrically operated. The break contacts must not break when the .016-inch gage is replaced by a .018-inch gage inserted in a similar manner. There must be a minimum contact pressure of 25 grams and a maximum of 40 grams per pair of twin contacts.

(*c*) The *make* contacts of D combinations must make when a .020-inch gage is inserted between armature and core with the relay electrically operated. There must be a minimum contact pressure of 20 grams and a maximum of 40 grams per pair of twin contacts.

(*d*) The make contacts of K combinations must make when a .017-inch gage is inserted between armature and core with the relay electrically operated. The break contacts of K combinations must have a minimum contact pressure of 25 grams and a maximum of 40 grams per pair of twin contacts.

(3) Contact gaging for relays having X combinations should be adjusted as follows:

(*a*) All the spring combinations except the X combinations should be adjusted as described in subparagraphs (1) and (2) above. Adjust pusher stops so that they hold the spring pushers in their normal, non-operated positions.

(*b*) The make contacts of XA and XC combinations should make when a .026-inch gage is inserted between armature and core and the relay is electrically operated. The make contacts must not make when the .026-gage is replaced by a .031-inch gage inserted in a similar manner. There should be a minimum make contact pressure of 20-grams when the regular combination spring pushers are touching the armature.

(*c*) For XA combinations only, adjust the armature backstop to a normal contact gap of .008 inch. With the relay unoperated, the pusher of the XA spring should rest against the armature with approximately 20-grams pressure. This pressure may be adjusted, as necessary, to meet

the electrical operating requirements of the X combination. However, the minimum pressure must be sufficient to restore the armature fully against the backstop.

(*d*) For XC combinations only, the break contacts must open fully before the make contacts close. Judged visually, there should be a minimum .010-inch follow of the break contacts. Adjust the break contacts, if necessary, to a minimum of 20-grams contact pressure. Adjust the backstop to obtain a minimum clearance of .005 inch between the underside of the pusher and the armature, with the armature resting against the stop. The pusher may rest on the armature provided that the requirements outlined in this subparagraph are met.

Note. The contacts of each pair of twin contacts must make or break within .003 inch of each other.

d. Armature Backstop Adjustment. Adjust the armature backstop, if necessary, by bending it with an armature and backstop adjusting tool until the correct position is obtained. Use the gage values given below to adjust the armature backstop on the following types of relays:

(1) *Standard lever ratio armatures.* Adjust the armature backstop to permit a .011-inch gage to enter freely between the residual screw and the core. A .015-inch gage inserted in a similar manner will bind.

(2) *All other relays except X contact relays.* Adjust the armature backstop with the relay armatures in the nonoperated position. The clearance between the underside of the break contact springs and their pusher must not exceed .006 inch. The springs may touch the pushers provided that the contact pressures specified are met.

e. Electrical Operation. After all mechanical adjustments are completed, check the electrical operation of the relay according to the readjust requirements specified on the relay adjustment tables. Adjust the tension of the force springs to meet the operate and nonoperate requirements.

Section III. REPLACEMENT OF PARTS

73. Cord Circuit Switches

To replace a defective cord circuit switch, follow the instructions given below.

a. Raise the switchboard key shelf to the position shown in figure 57.

b. Tag all wires connected to the defective switch.

c. Unsolder all wires connected to the defective switch.

d. Remove the mounting screws and lift the defective switch from the key shelf.

e. Insert a new switch on the key shelf, replace the mounting screws, and resolder the tagged wires to the correct terminals of the switch. Remove the tags from the resoldered wires.

74. Lamps

Replace defective lamps as follows.

a. To remove the lamp cap, insert the lamp cap extractor over the metal shell of the lamp cap and pull steadily away from the switchboard face.

b. To remove the lamp, slide the lamp extractor over the defective lamp; depress the handle of the lamp extractor and pull steadily.

c. Insert a new lamp into the socket and replace the lamp cap by hand.

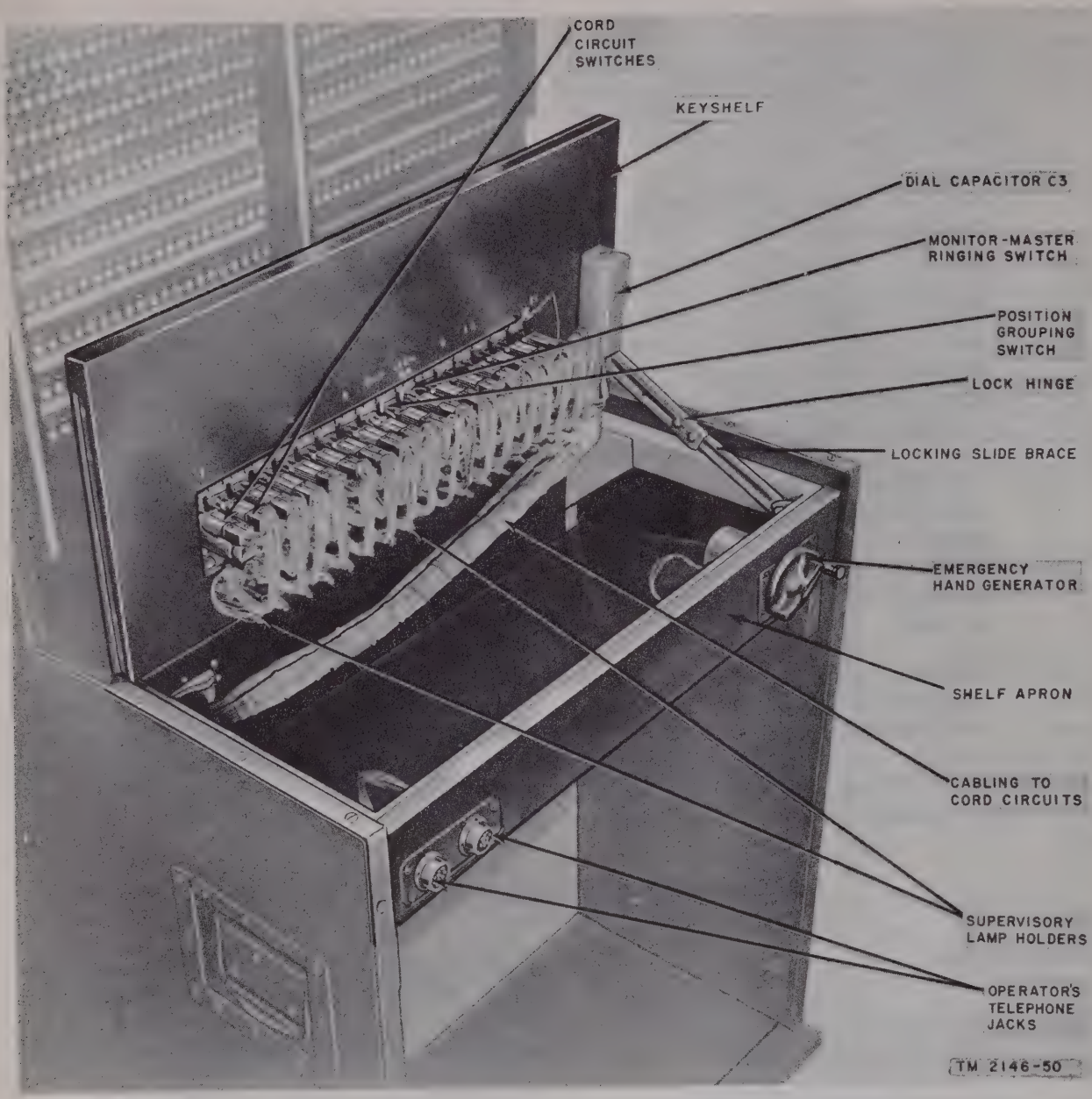


Figure 57. Switchboard showing underside of key shelf.

75. Jack Sleeves

Manual Telephone Switchboards SB-249/TTC are equipped with jack strips that have removable jack sleeves. A worn or damaged jack sleeve may be replaced by the use of the jack sleeve remover (fig. 58) as follows:

a. Hold the tool by its body and turn the rod counterclockwise until the diameter of the chuck is decreased sufficiently to permit insertion of the chuck end into the jack sleeve to be replaced.

b. Insert the chuck end of the tool into the jack sleeve as far as the shoulder of the chuck permits. Then turn the rod in a clockwise direction until the chuck is seated firmly in the sleeve of the jack.

c. Turn the body of the tool in a counterclockwise direction until the threaded end of the jack sleeve is disengaged from the jack strip.

d. Free the jack sleeve from the tool by turning the rod counterclockwise.

e. Place a new jack sleeve on the chuck and turn the rod in a clockwise direction until the sleeve fits tightly on the chuck.

f. Insert the sleeve into the jack opening as far as possible and turn the body of the tool in a clockwise direction until the threaded end of the new sleeve is seated firmly.

g. Turn the rod counterclockwise until the tool is loose and can be removed from the jack sleeve.

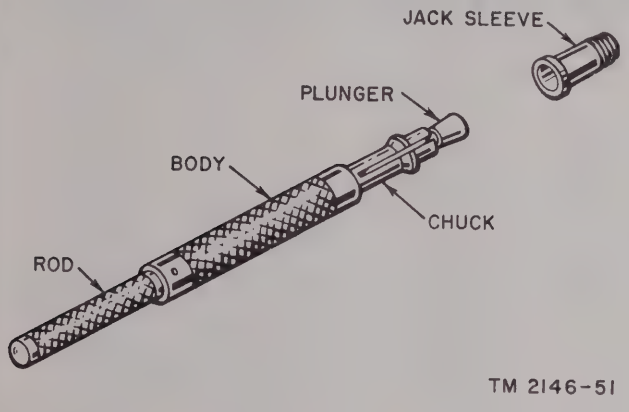


Figure 58. Jack sleeve remover.

76. Relays

a. Identify the circuit plate on which the relay to be replaced is located. Remove its cover.

b. Remove the four screws (two located on each end of the circuit plate) that attach the circuit plate to the mounting frame. (Refer to subparagraph *h* below if circuit plate is mounted on a line or trunk relay case.)

c. Slowly pull the circuit plate about an inch away from the component; be careful not to damage the wiring which connects the rear of the circuit plate to the component.

d. Locate the end of the circuit plate where the wiring is brought out and connected to the terminal board. Hold this end in place (about 1 inch away from the frame), and slowly swing the opposite end of the circuit plate away from the frame until the rear wiring of the circuit plate is accessible. Secure the circuit plate in this position.

e. Tag and unsolder all the leads connected to the relay to be replaced.

f. Remove the mounting screws that attach the relay to the circuit plate, and remove the relay.

g. Place a new relay into position on the circuit plate, replace the relay mounting screws, resolder the leads to the relay, remove the tags from the resoldered leads, and position the circuit plate correctly against its mounting. Replace the four screws which attach the circuit plate to the mounting frame, and replace the circuit plate cover.

h. If the circuit plate is located on a line or trunk relay case, removal of the circuit plate is not required. When the relay gate is opened the wiring side of the relays are exposed.

77. Binding Posts

To replace a binding post terminal on an MDF, proceed as follows:

a. Open the MDF gate to expose the wiring at the back of the gate.

b. Locate the defective binding post solder terminal at the back of the gate.

c. Unbolt the soldering lug that is connected to the terminal.

d. Using a wrench, unbolt the mounting nut that holds the binding post to the gate frame.

e. Remove the insulating washer from the shank.

f. Remove the binding post from the frame.

g. Replace the binding post with a new one. Follow the procedure outlined in subparagraphs *a* through *e* above in reverse order.

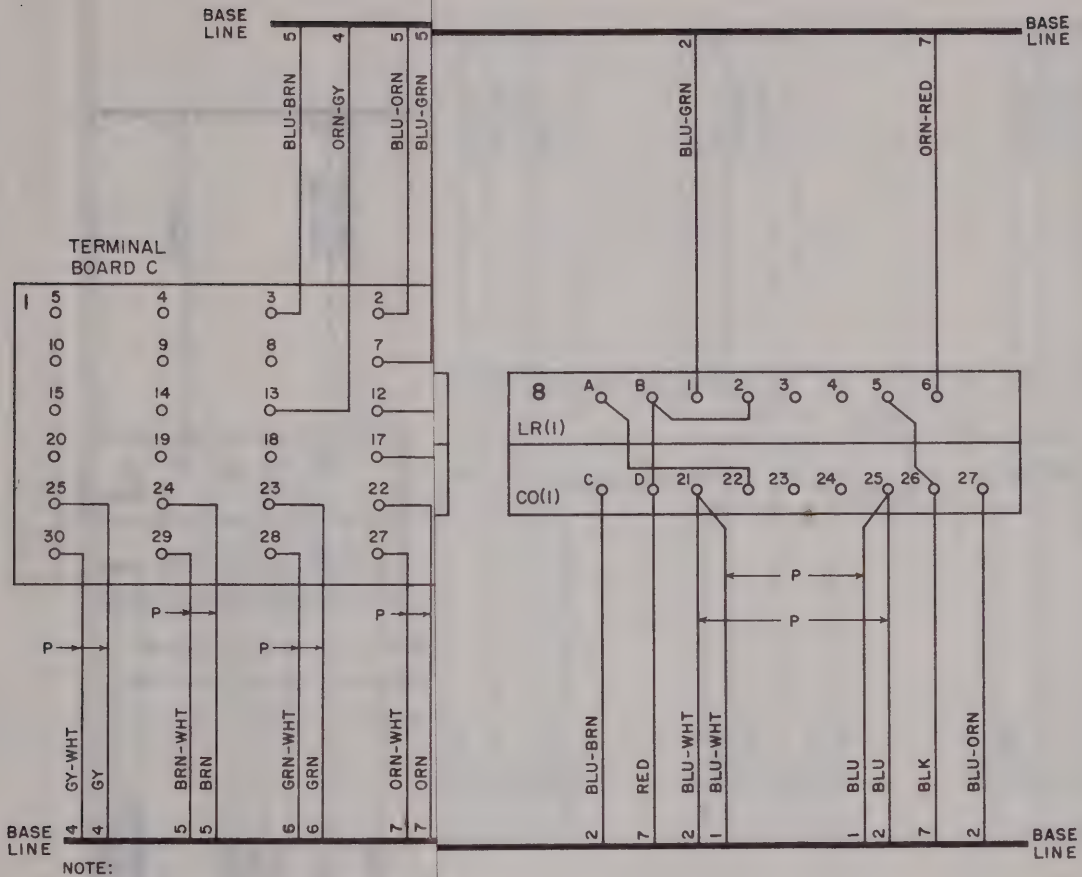
Section IV. FINAL TESTING

78. General

This section is to be used as a guide in determining the quality of a repaired component. The minimum test requirements outlined in paragraph 79 below may be performed by maintenance personnel who possess the adequate test equipment and the necessary skills.

79. Final Testing Procedures

Final testing procedures vary according to the type of repair or adjustment performed. If a relay has been repaired, adjust it to meet the current requirements listed on the applicable relay adjustment sheet. If a group of connections has been resoldered, make a continuity test of each connection. Be sure all wiring connections are in accordance with the applicable wiring diagrams given in this instruction book. The best procedure for final testing is to observe the equipment under actual operation after the repair or adjustment has been performed. Use the equipment performance checklist (par. 46) as an operational guide. Under these conditions, faulty repair or adjustment will be revealed.



NOTE:
WIRING SHOWN AS SEEN FROM REAR O

TM 2146 - 52

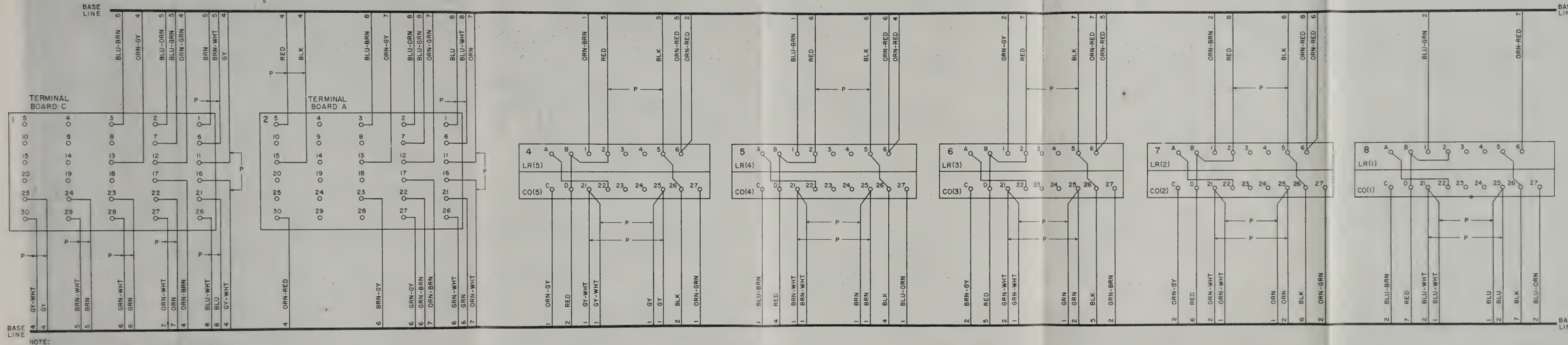
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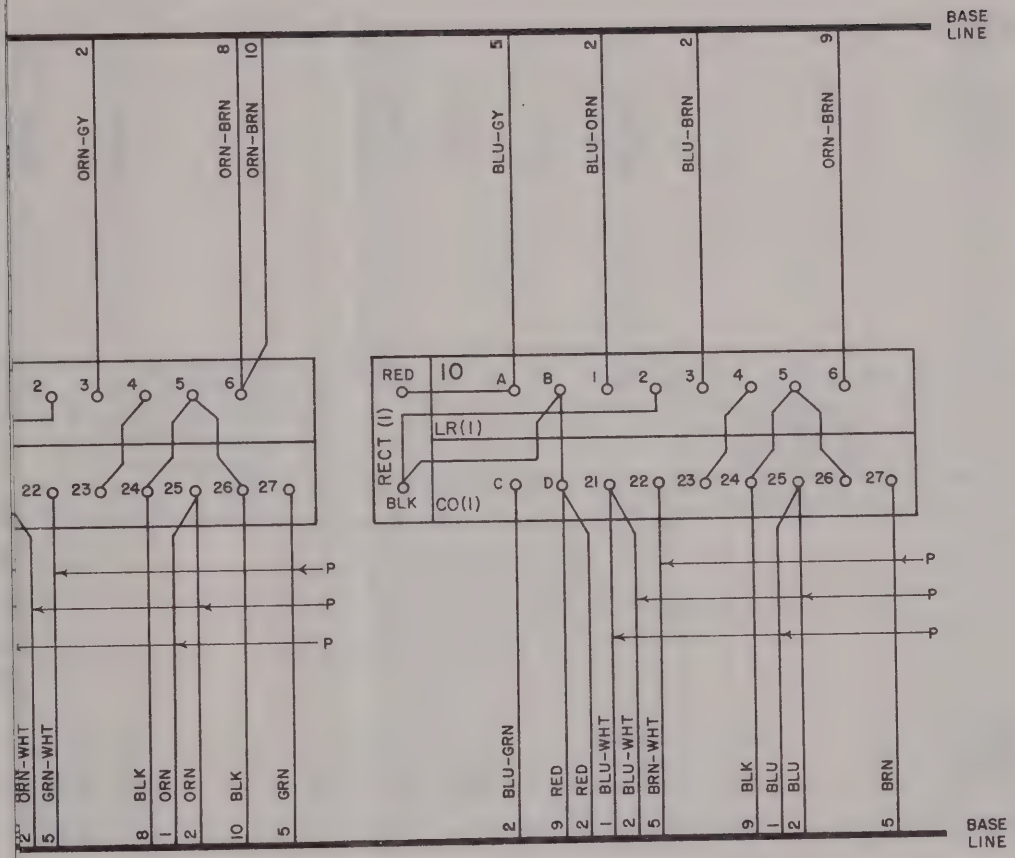
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NOTE:
WIRING SHOWN AS SEEN FROM REAR OF CIRCUIT PLATE.

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Figure 59. Line Relay Telephone Circuit TA-224/TTC, CB line circuit plate, wiring diagram.


BASE LINE
ORN-GY 2
ORN-BRN 8
ORN-BRN 10
BLU-GY 5
BLU-ORN 2
BLU-BRN 2
ORN-BRN 9
RED
10
A
B
1
2
3
4
5
6
RECT (1)
LR(1)
BLK
CO(1)
C
D
21
22
23
24
25
26
27
P
ORN-WHT 2
GRN-WHT 5
BLK 8
ORN 1
ORN 2
BLK 10
GRN 5
BLU-GRN 2
RED 9
RED 2
BLU-WHT 1
BLU-WHT 2
BRN-WHT 5
BLK 9
BLU 1
BLU 2
BRN 5
BASE LINE

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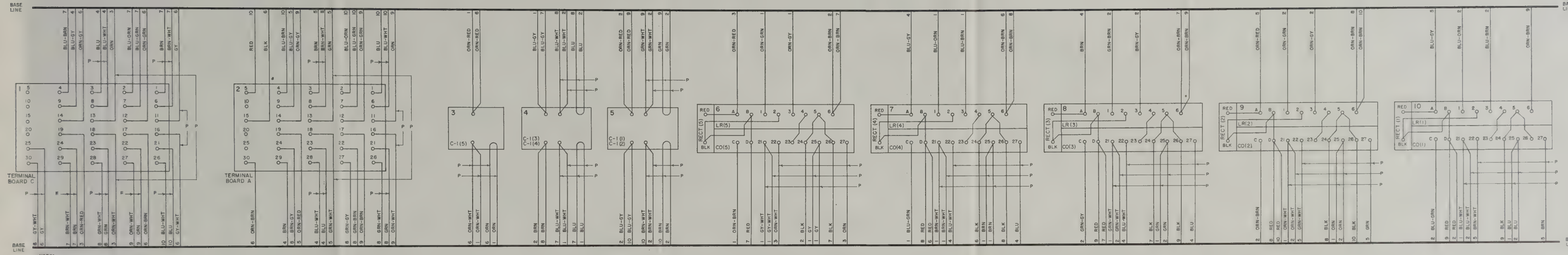
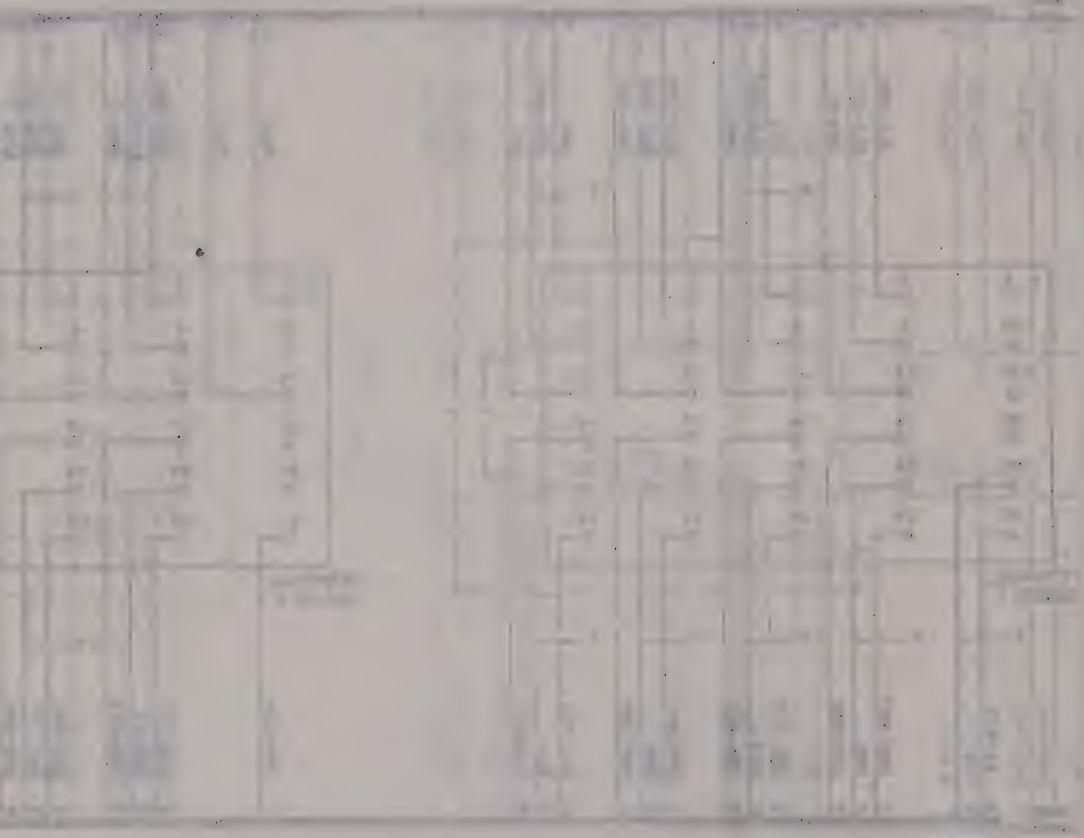
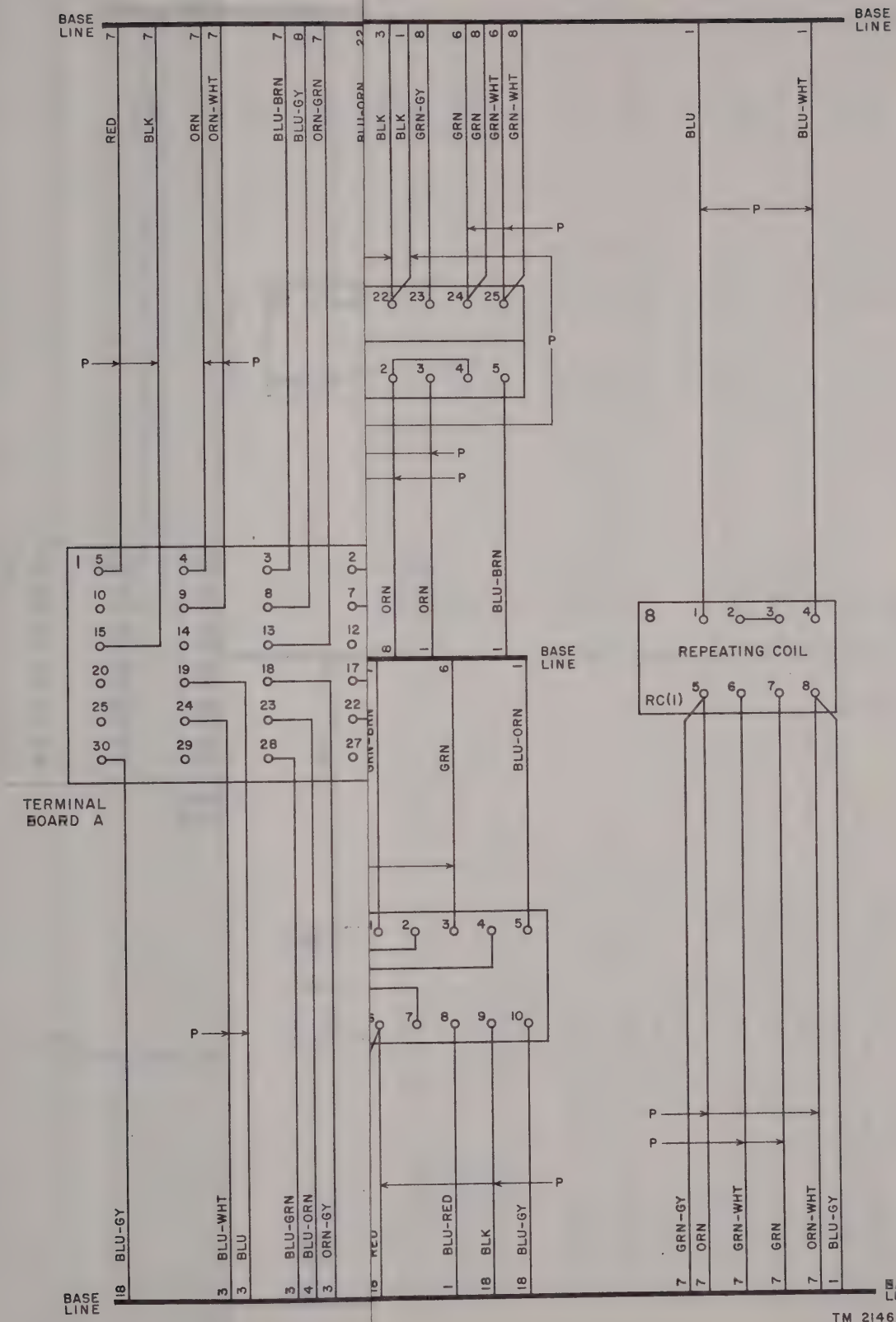


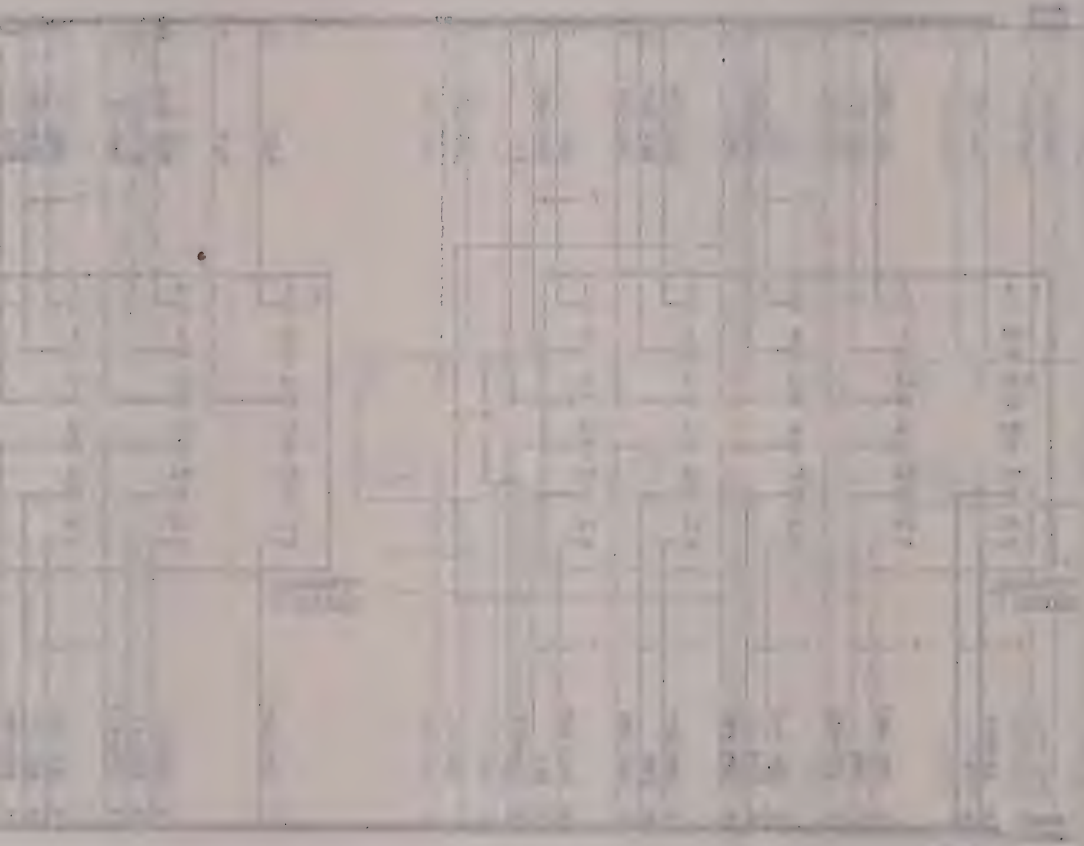
Figure 60. Line Relay Telephone Circuit TA-223/TTC, CB-LB line circuit plate, wiring diagram.

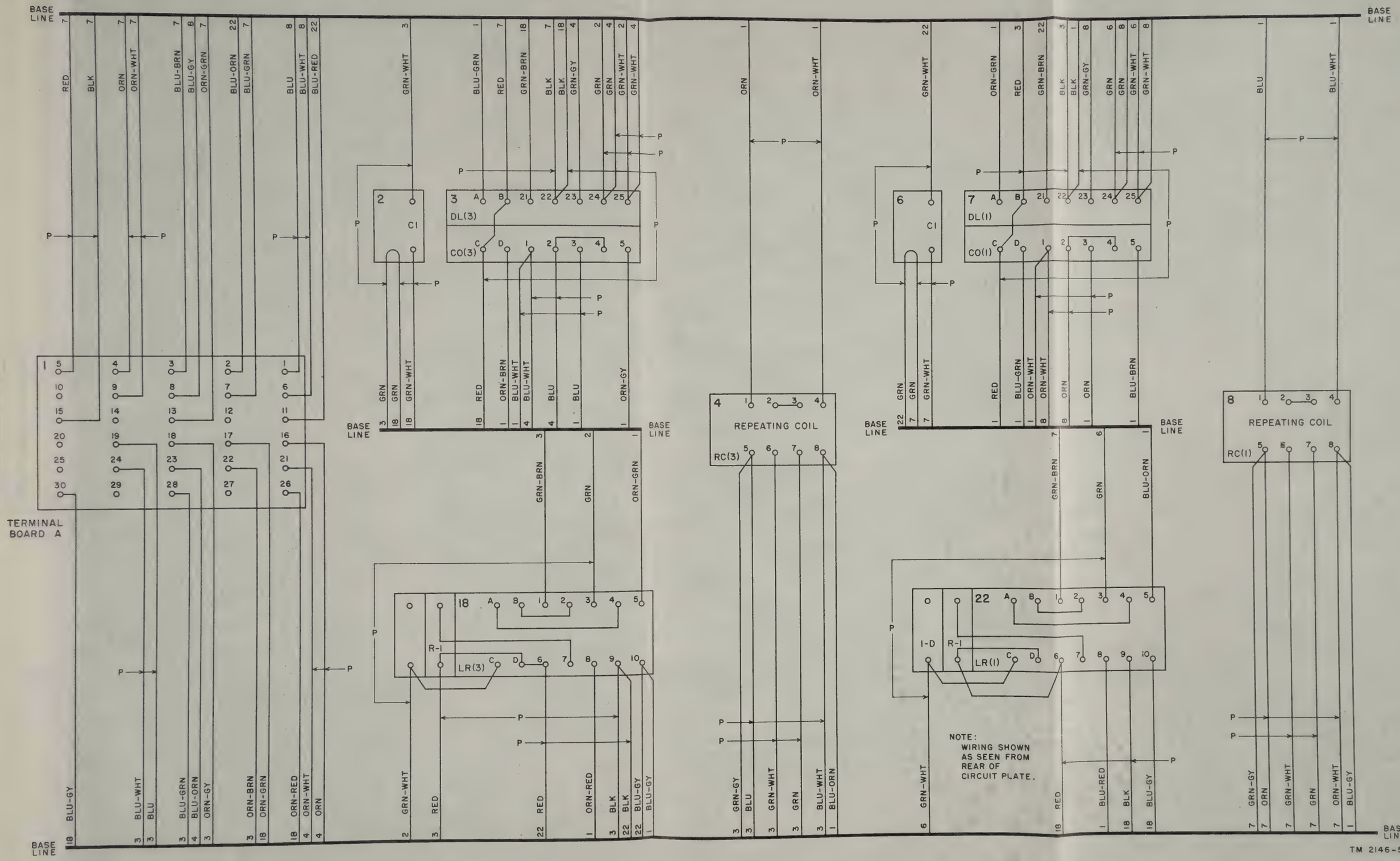
TM 2146-53




BASE LINE
BASE LINE
RED
BLK
ORN
ORN-WHT
BLU-BRN
BLU-GY
ORN-GRN
BLU-ORN
BLK
BLK
GRN-GY
GRN
GRN
GRN-WHT
GRN-WHT
BLU
BLU-WHT
P
22
23
24
25
2
3
4
5
ORN
ORN
BLU-BRN
BASE LINE
GRN
BLU-ORN
REPEATING COIL
RC(1)
TERMINAL BOARD A
BLU-GY
BLU-WHT
BLU
BLU-GRN
BLU-ORN
ORN-GY
BLU-RED
BLK
BLU-GY
GRN-GY
ORN
GRN-WHT
GRN
ORN-WHT
BLU-GY
BASE LINE
BASE LINE

TM 2146-54

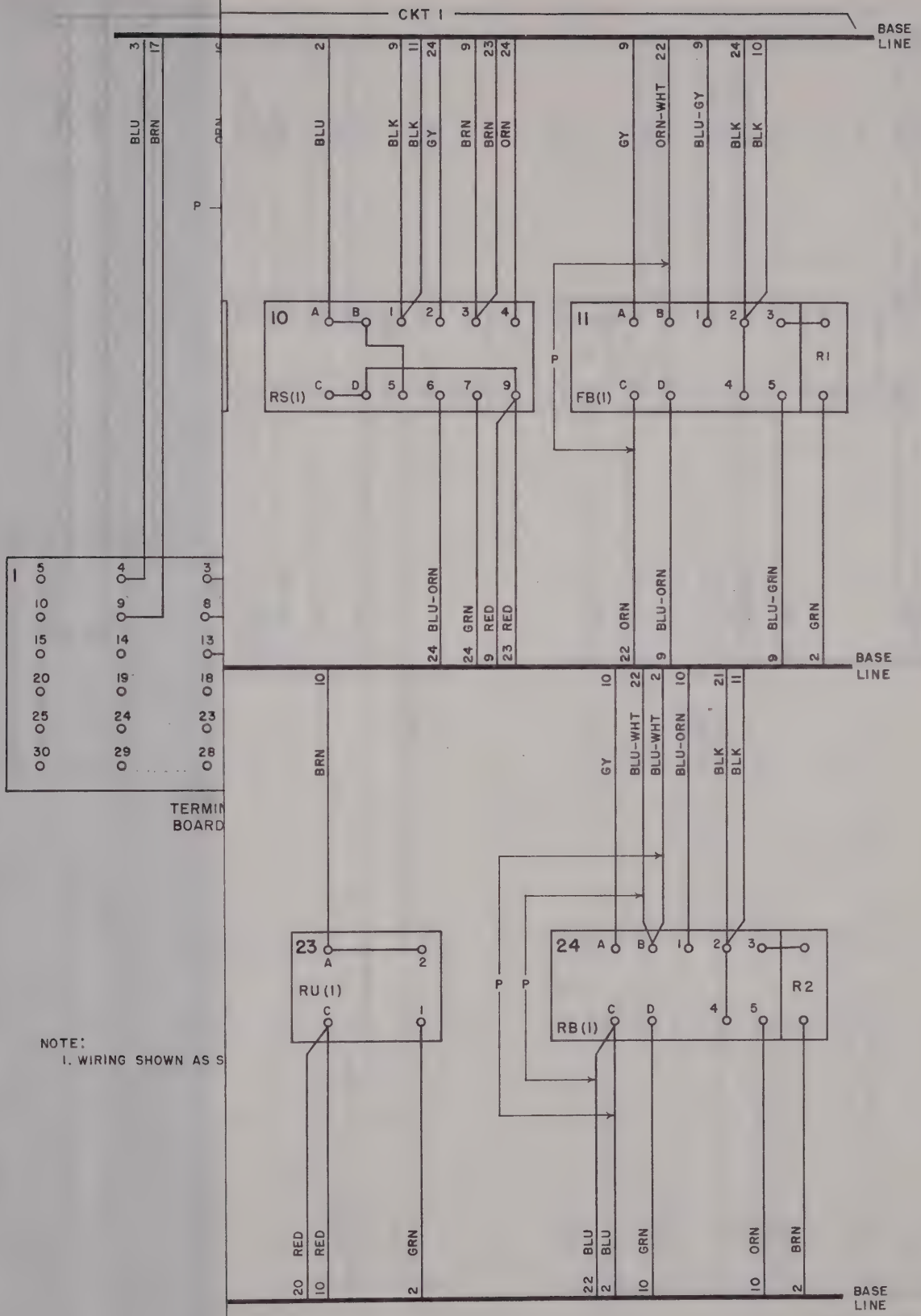




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Figure 61. Trunk Relay Telephone Circuit TA-226/TTC, trunk circuit plate, wiring diagram.





NOTE:
1. WIRING SHOWN AS S

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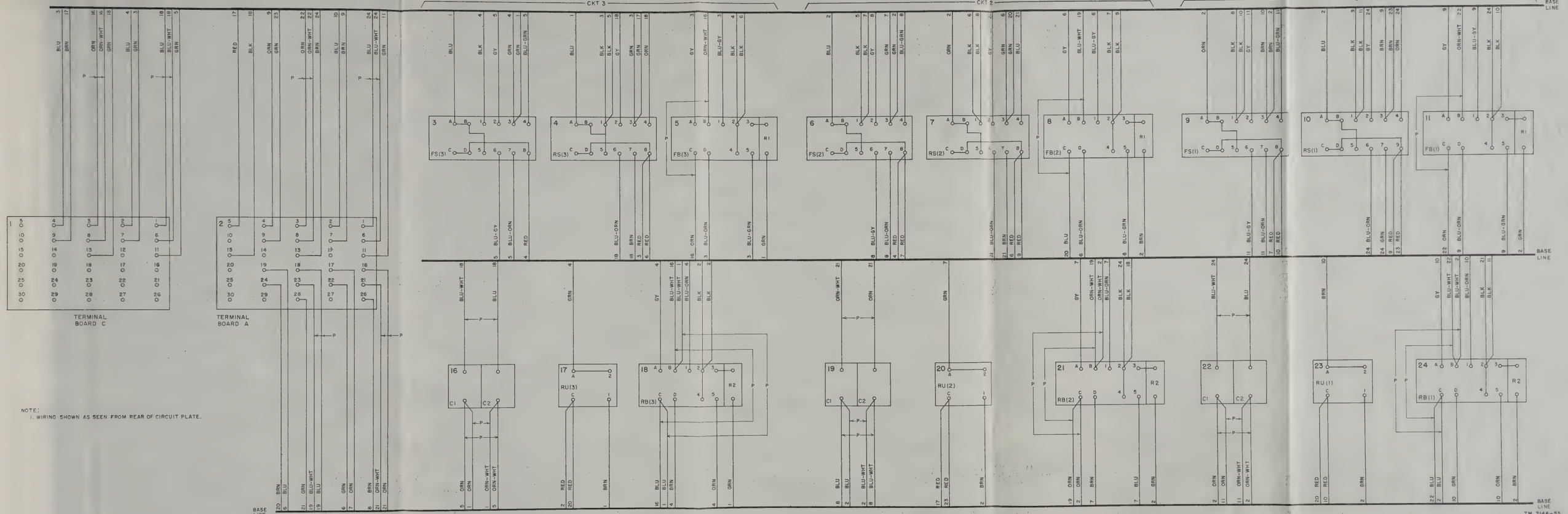
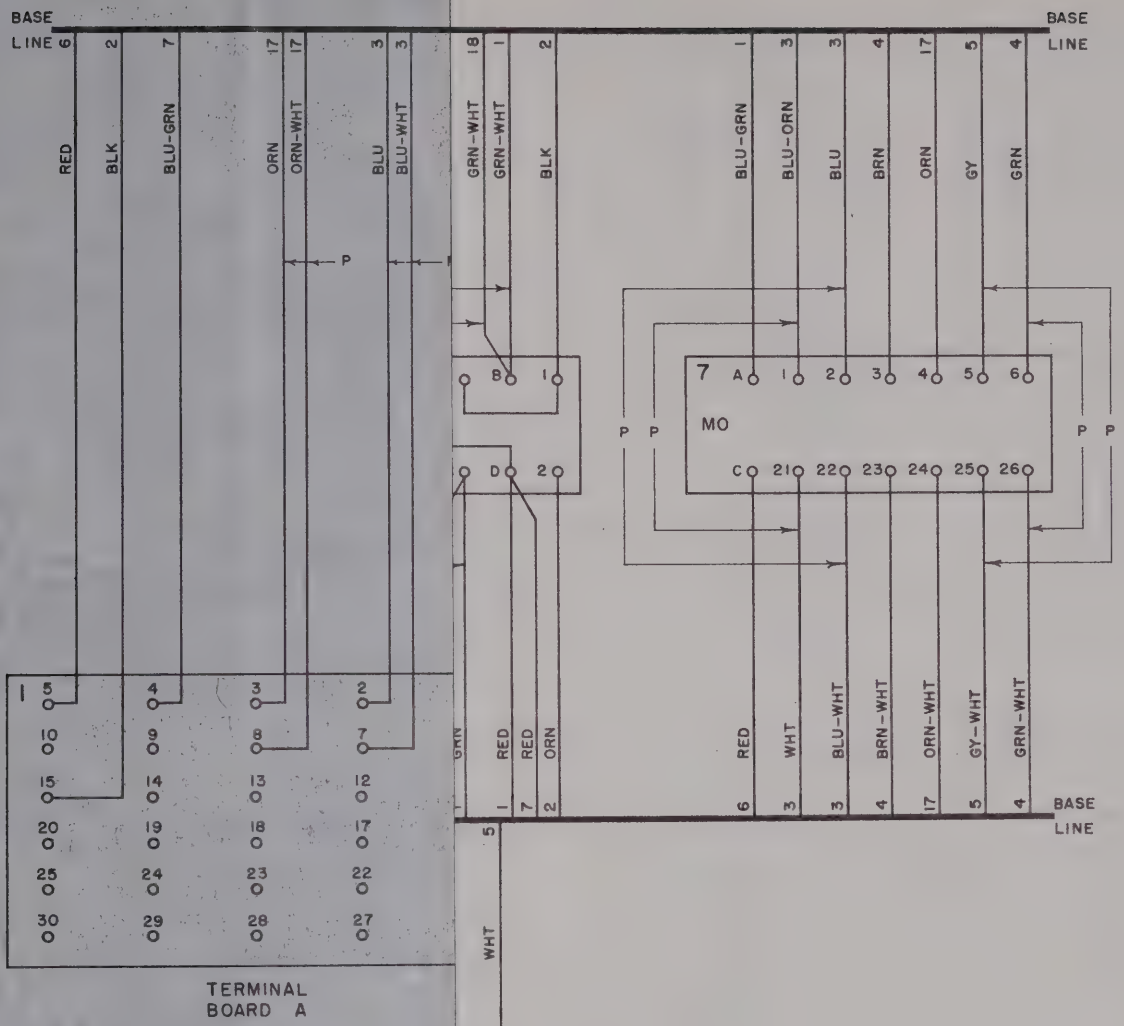
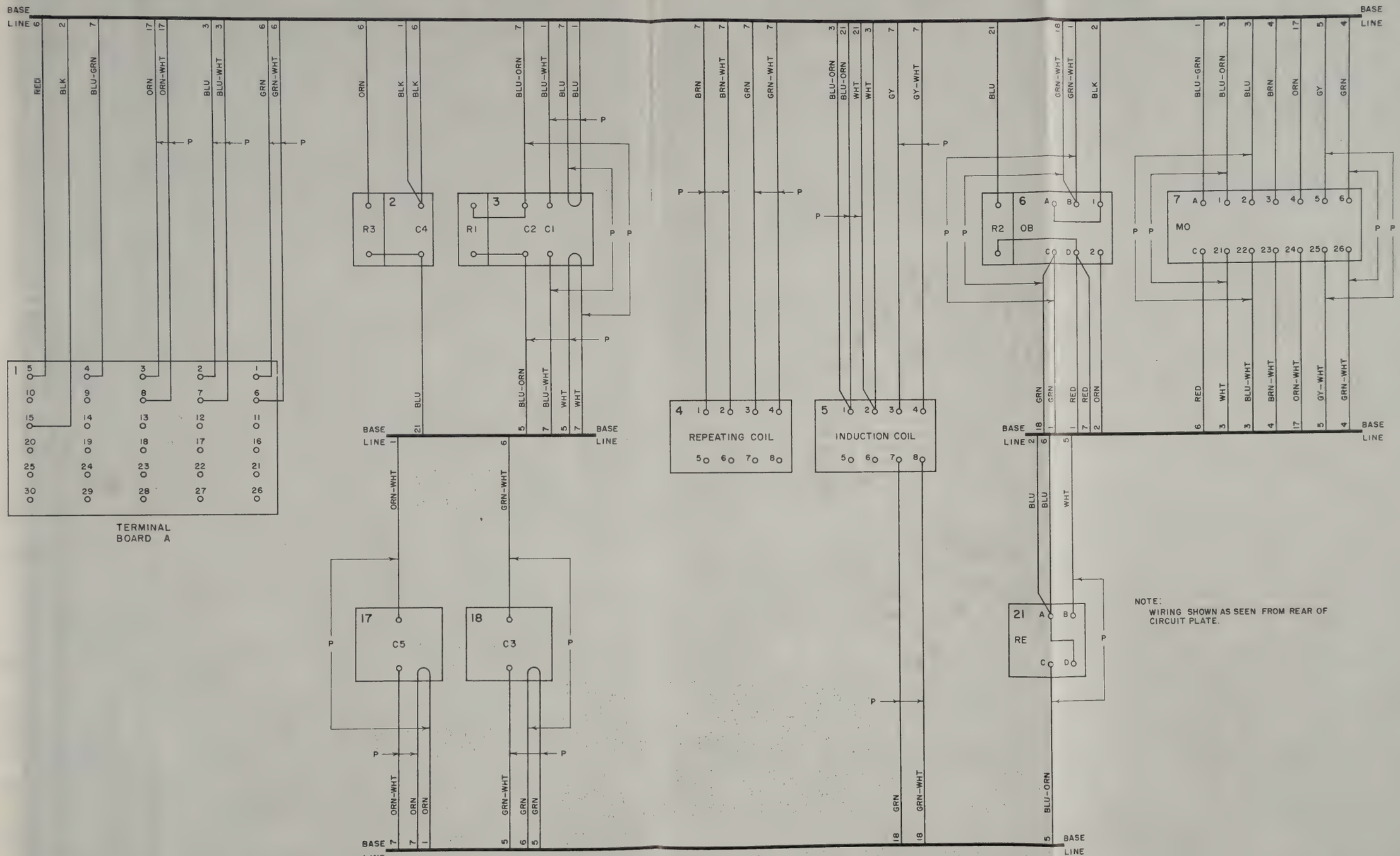


Figure 62. Manual Telephone Switchboard SB-249/TTC, cord circuit plate, wiring diagram.



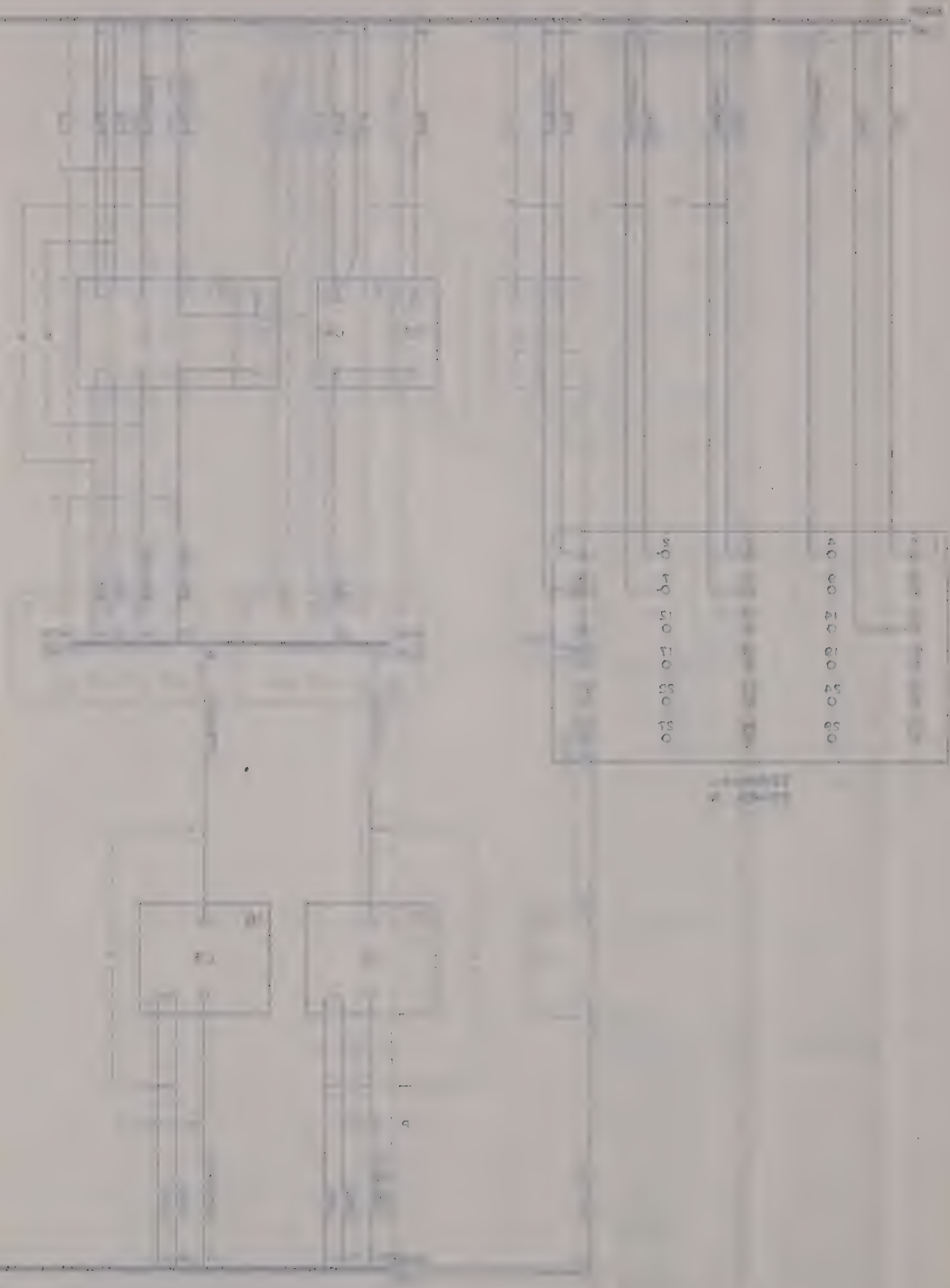
NOTE:
WIRING SHOWN AS SEEN FROM REAR OF CIRCUIT PLATE.

TERMINAL
BOARD A



TM 2146-56

Figure 63. Manual Telephone Switchboard SB-249/TTC, operator's telephone circuit plate, wiring diagram.



CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

80. Disassembly

Disassemble the equipment as follows:

a. Disconnect and unplug all cables and cords and remove the outside lines from the binding posts on the main distributing frames.

b. Coil the cables and cords neatly and pack them in the wooden boxes (Cable Assembly Case CY-1498/T).

c. Replace the covers on the switchboards and Panel BD-132-A, and latch them securely.

d. Replace the front and back covers of the MDF case and the line and trunk relay cases, and latch them securely in place.

e. Remove the cases from the base stands and fold up the base stands.

f. Place all the accessory equipment, such as the operator's headsets and message registers, in the wooden box (Accessories Case CY-1499/T).

g. Place the three operator's chairs in the three wooden boxes (Chair Case CY-1490/T).

h. Place the covers on the four battery cases (Case CS-63) and latch them securely.

81. Repacking for Shipment or Limited Storage

The AN/TTC-7 needs no further packing for shipment or limited storage. When in transit or in storage, cover the components with the duck tarpaulins provided for protection against the weather, dust, and dirt.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

82. General

The demolition procedure outlined in paragraph 83 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only upon order of the commander.

83. Methods of Destruction

a. Smash. Smash switches, controls, capacitors, and transformers; use sledges, axes, pickaxes, hammers, crowbars, or other heavy tools.

b. Cut. Cut all cords, cables, and wiring; use axes, handaxes, or machetes.

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

d. Bend. Bend panels and cabinets.

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

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

g. Destroy. Destroy everything.

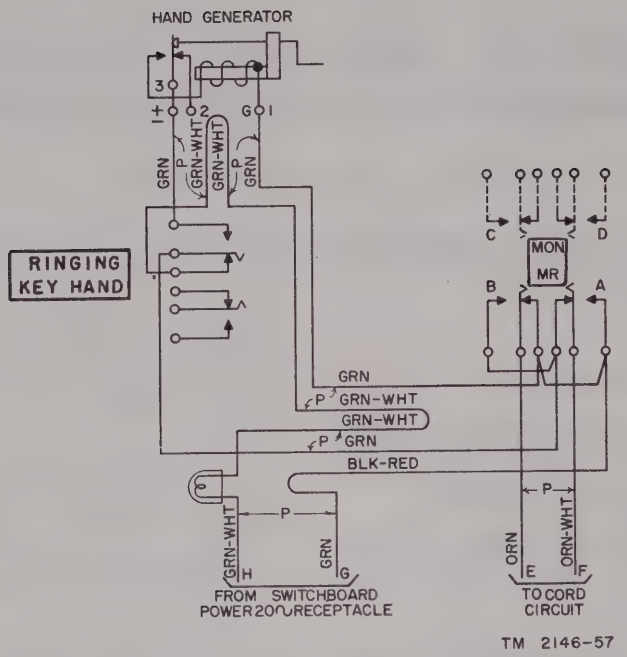


Figure 64. Manual Telephone Switchboard SB-249/TTC, ringing circuit, wiring diagram.

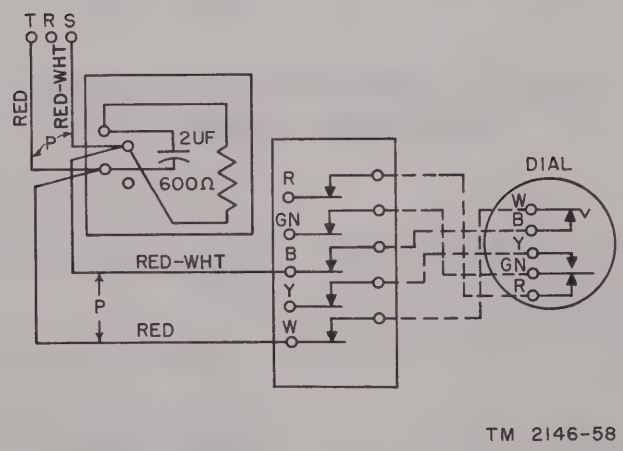


Figure 65. Manual Telephone Switchboard SB-249/TTC, dial cord circuit, switchboard, wiring diagram.

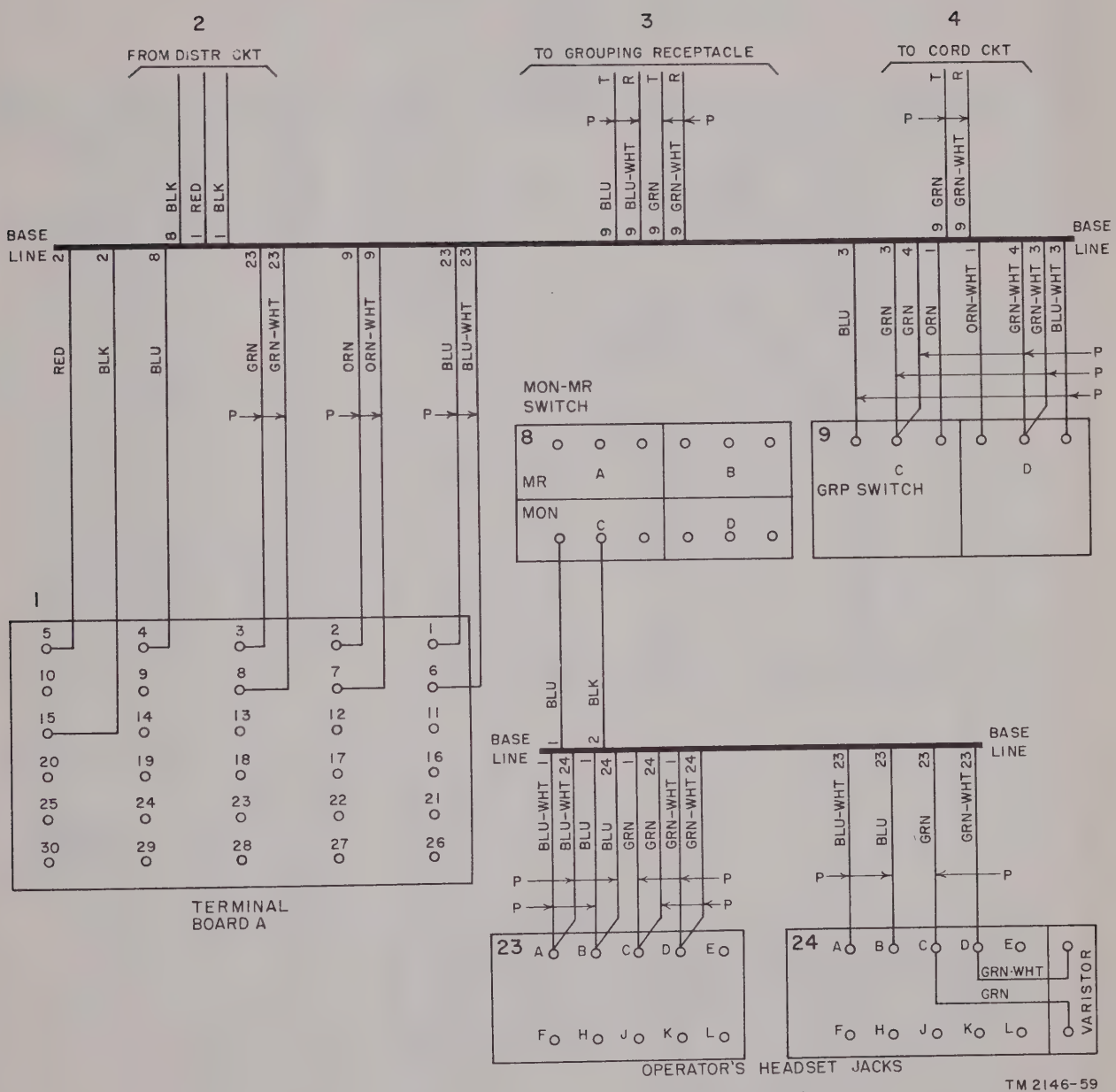
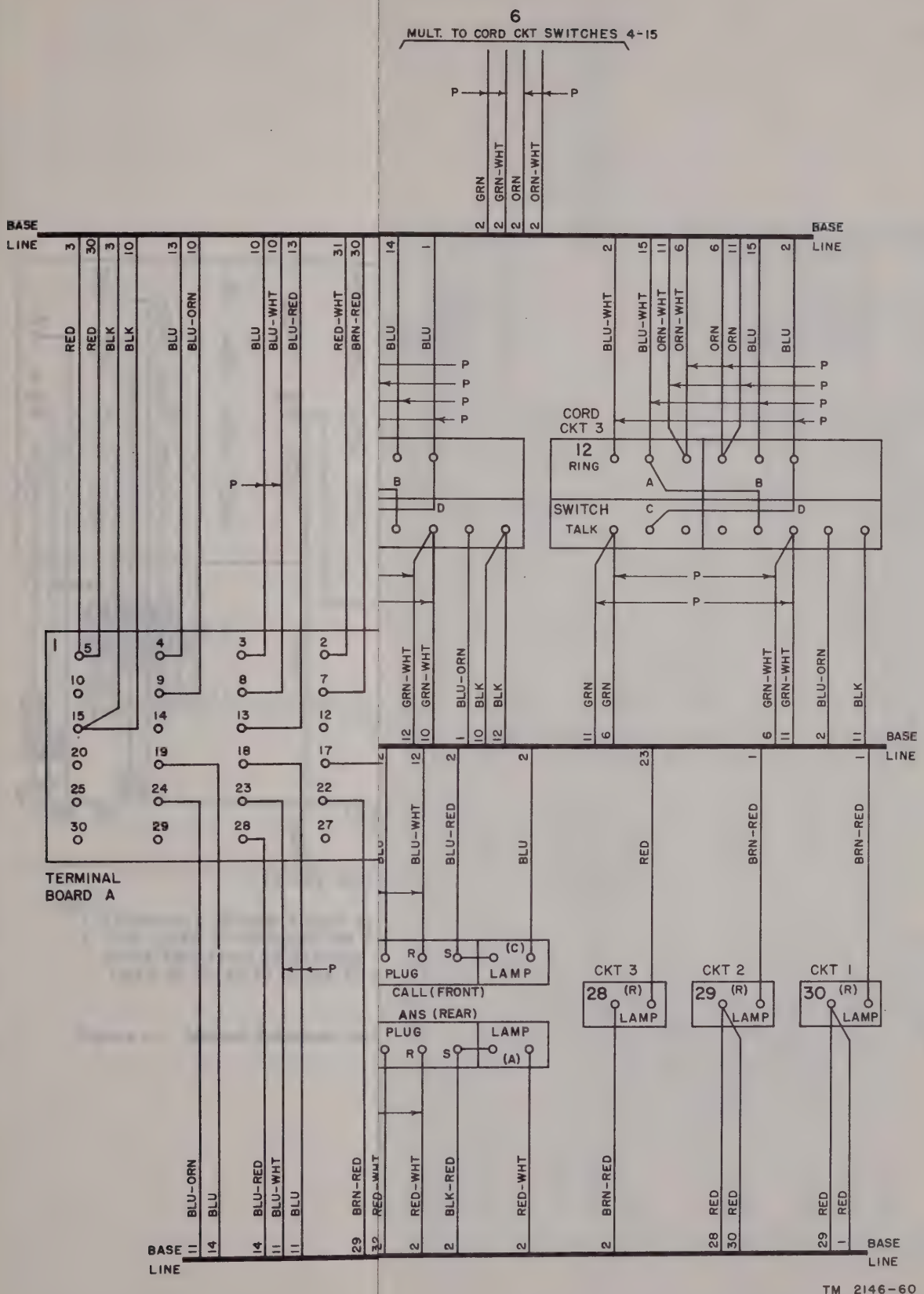


Figure 66. Manual Telephone Switchboard SB-249/TTC, operator's and grouping circuit, wiring diagram.


6
MULT. TO CORD CKT SWITCHES 4-15
GRN
GRN-WHT
ORN
ORN-WHT
BASE LINE
CORD CKT 3
12 RING
SWITCH
TALK
TERMINAL BOARD A
PLUG
CALL (FRONT)
ANS (REAR)
LAMP
CKT 3
CKT 2
CKT 1
28 (R) LAMP
29 (R) LAMP
30 (R) LAMP
TM 2146-60

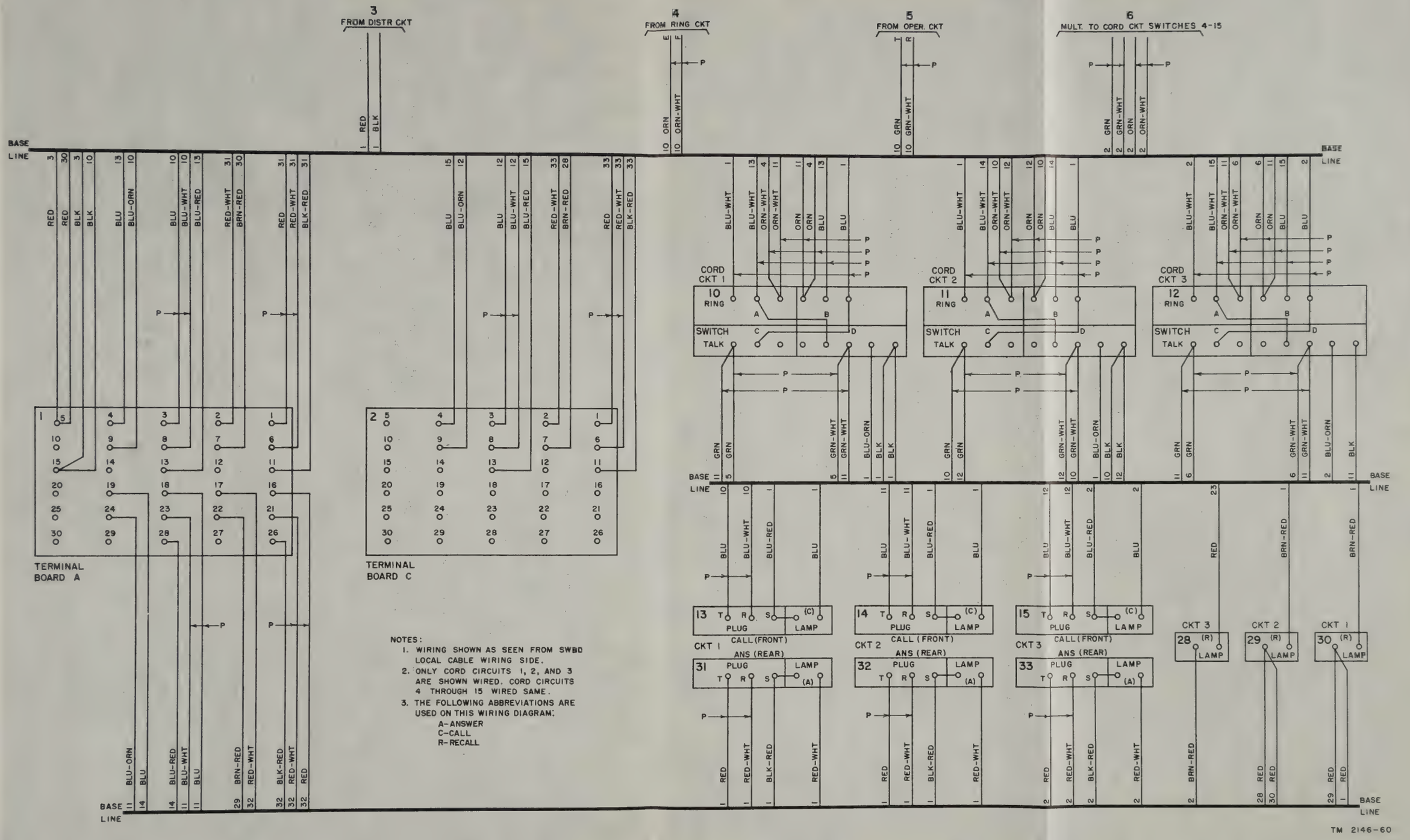
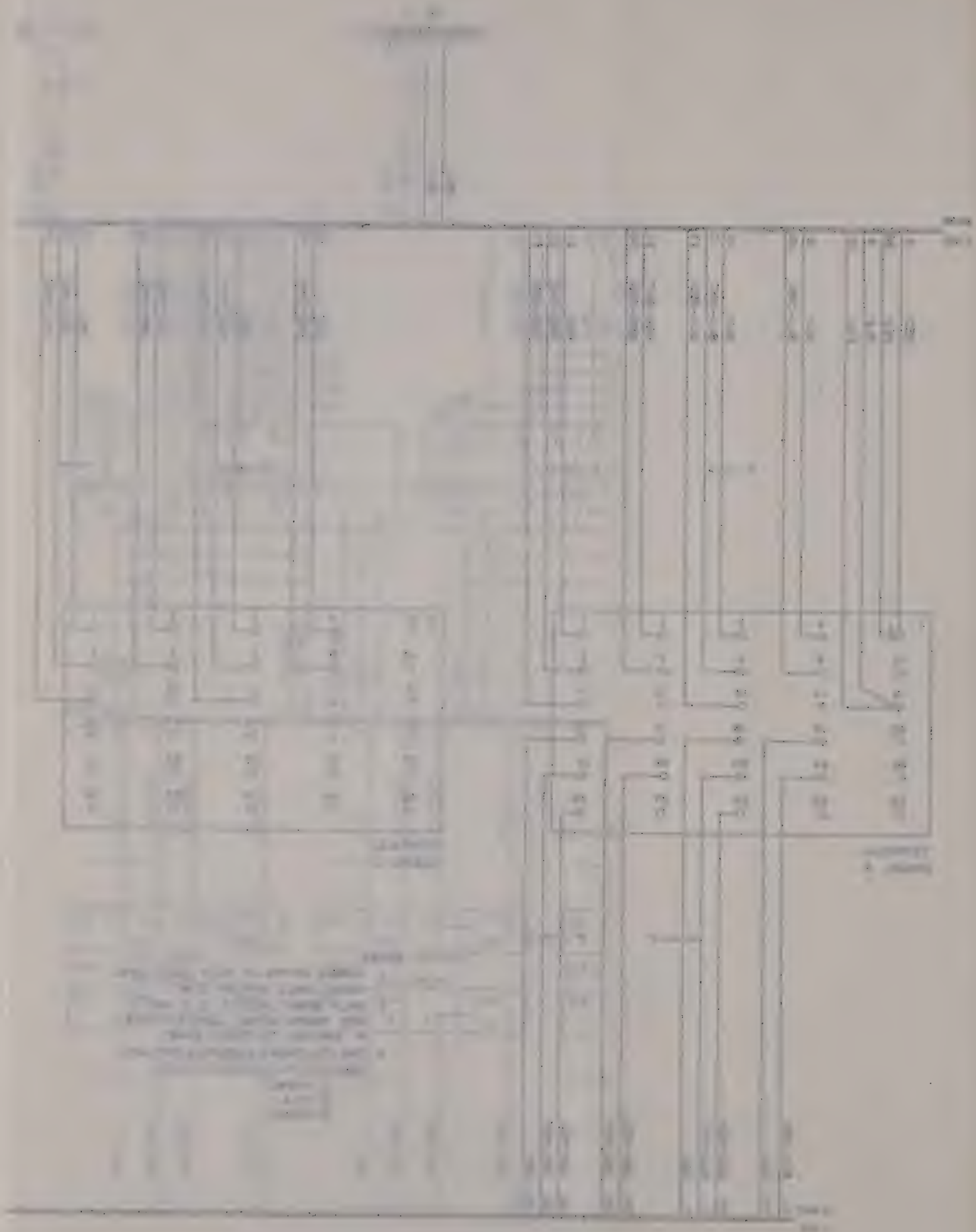
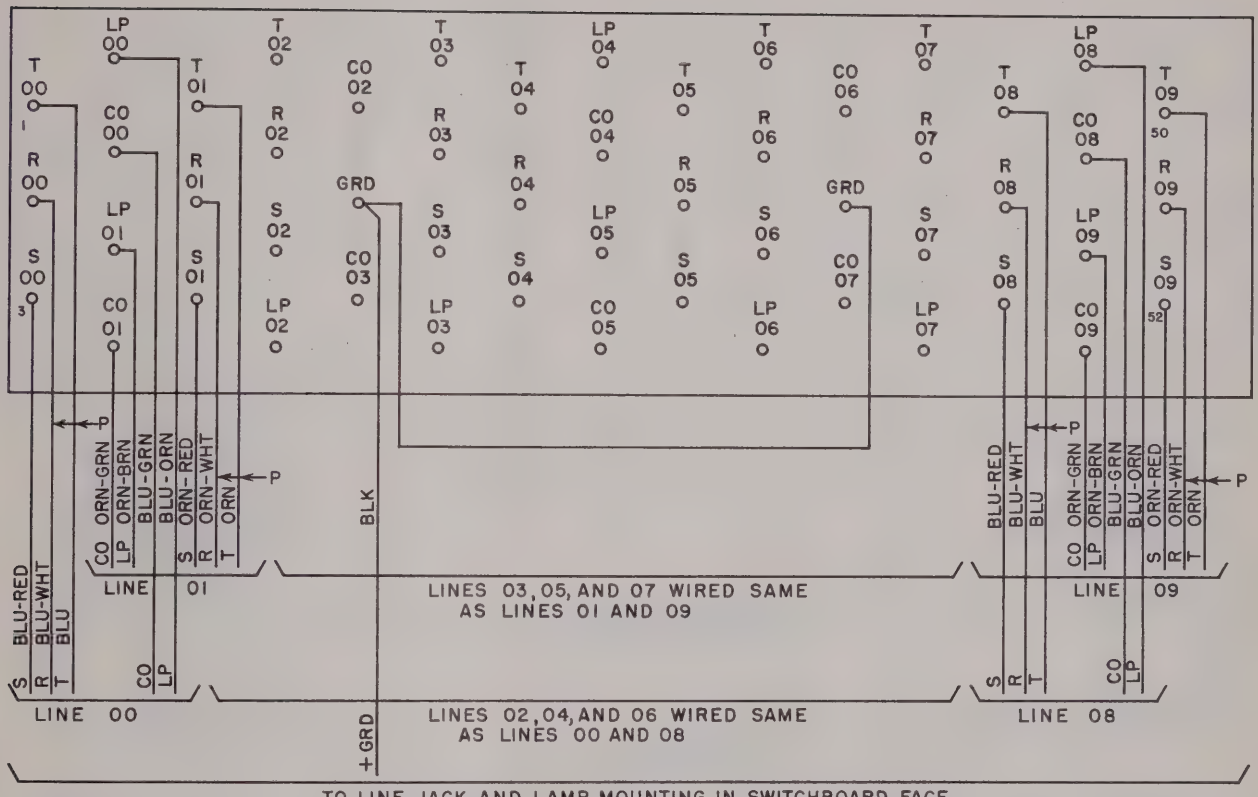


Figure 67. Manual Telephone Switchboard SB-249/TTC, universal cord circuit, wiring diagram.



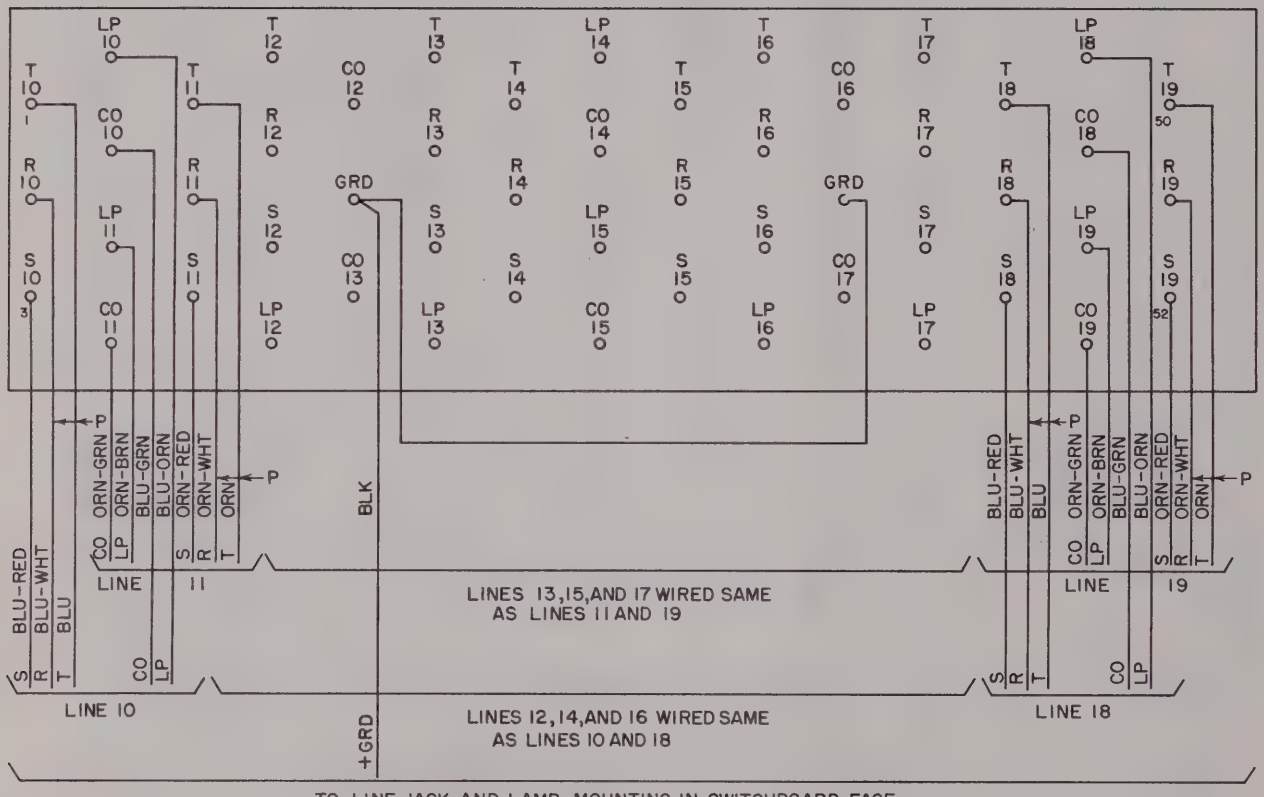


NOTES:

1. RECEPTACLE WIRING SHOWN AS SEEN FROM WIRING SIDE.
2. ONLY LINES 00 THROUGH 09 ARE SHOWN WIRED.
   OTHER RECEPTACLES SERVING
   LINES 20-29, 40-49, 60-69, 80-89 WIRED SAME.

TM 2146-61

Figure 68. Manual Telephone Switchboard SB-249/TTC, line receptacle (00-09), wiring diagram.

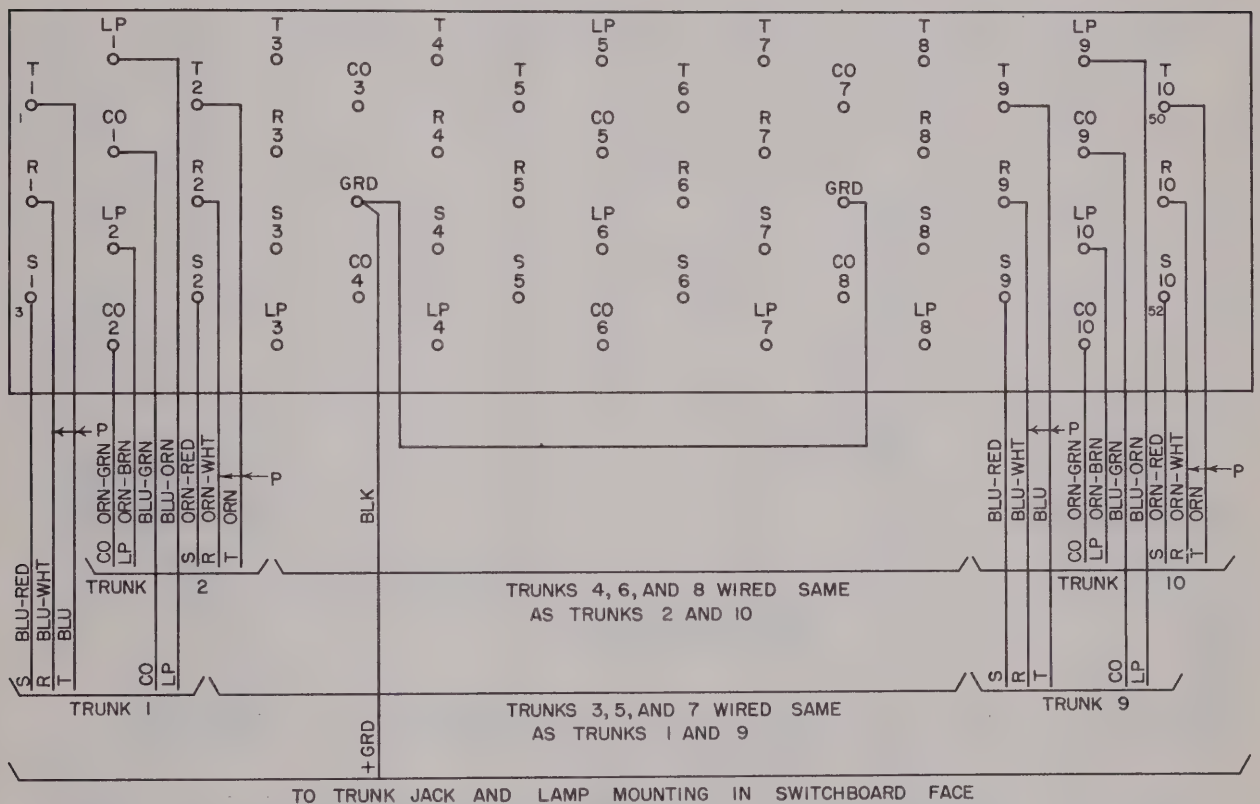


NOTES:

1. RECEPTACLE WIRING SHOWN AS SEEN FROM WIRING SIDE.
2. ONLY LINES 10 THROUGH 19 ARE SHOWN WIRED. OTHER RECEPTACLES SERVING LINES 30-39, 50-59, 70-79, 90-99 WIRED SAME.

TM 2146-62

Figure 69. Manual Telephone Switchboard SB-249/TTC, line receptacle (10-19), wiring diagram.

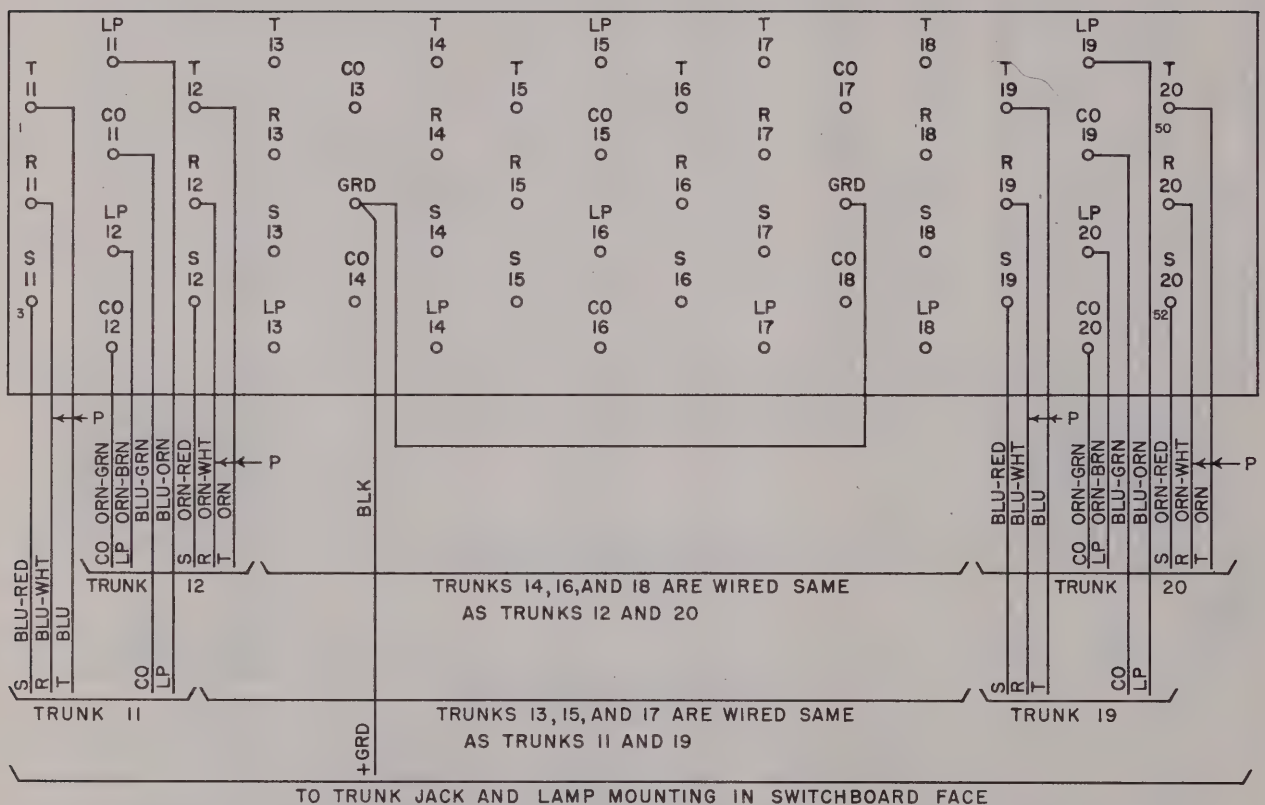


NOTES:

1. RECEPTACLE WIRING SHOWN AS SEEN FROM WIRING SIDE.
2. ONLY TRUNKS 1 THROUGH 10 ARE SHOWN WIRED. TRUNKS 21–30, 41–50, AND 61–70 WIRED SAME.

TM 2146-63

Figure 70. Manual Telephone Switchboard SB-249/TTC, trunk receptacle (1-10), wiring diagram.

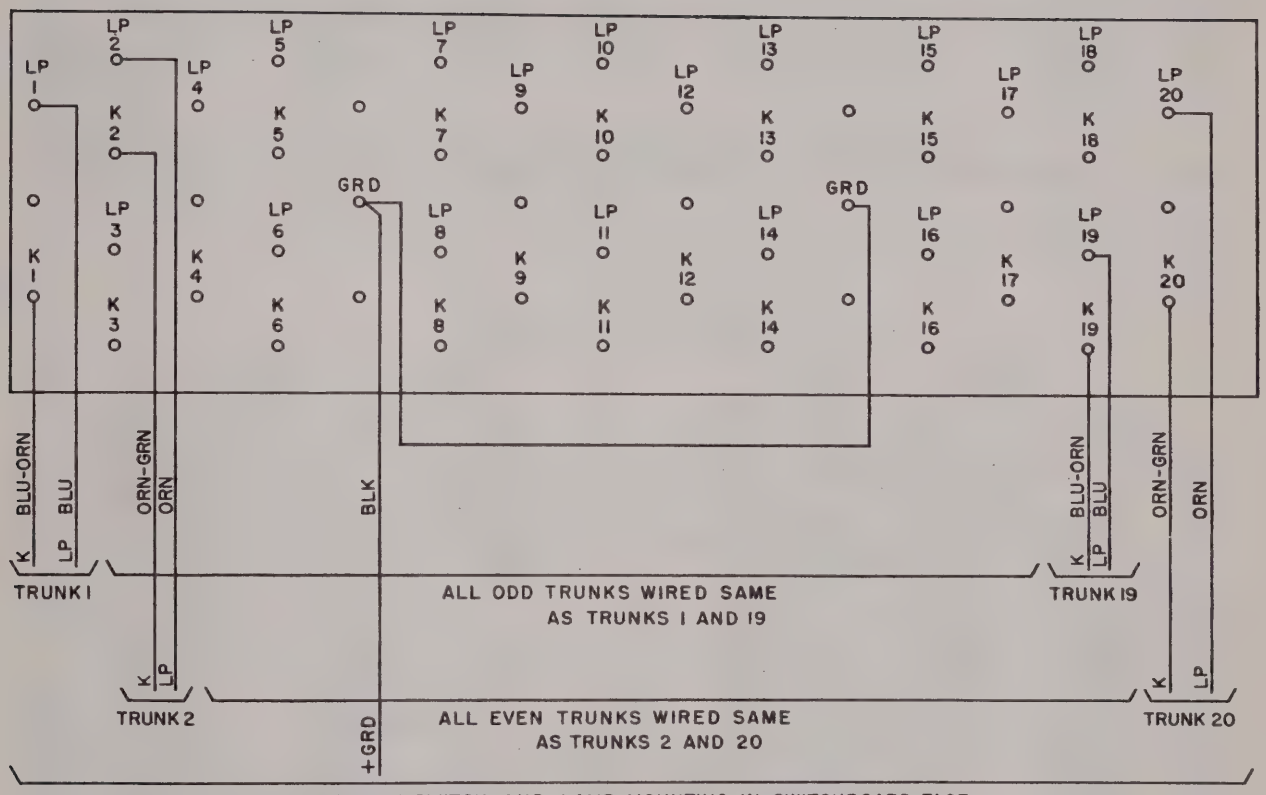


NOTES:

1. RECEPTACLE WIRING SHOWN AS SEEN FROM WIRING SIDE.
2. ONLY TRUNKS 11 THROUGH 20 ARE SHOWN WIRED. TRUNKS 31-40, 51-60, AND 71-80 WIRED SAME.

TM 2146-64

Figure 71. Manual Telephone Switchboard SB-249/TTC, trunk receptacle (11-20), wiring diagram.



NOTES:

1. RECEPTACLE WIRING SHOWN AS SEEN FROM WIRING SIDE.
2. ONLY TRUNKS 1 THROUGH 20 ARE SHOWN WIRED.
   TRUNKS 21 THROUGH 80 WIRED SAME.

TM 2146-65

Figure 72. Manual Telephone Switchboard SB-249/TTC, idle lamp and key receptacle, wiring diagram.

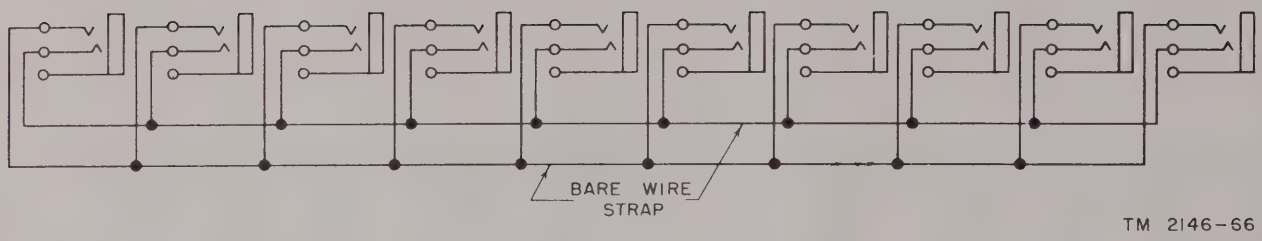


Figure 73. Manual Telephone Switchboard SB-249/TTC, jack mounting and conference circuit, wiring diagram.

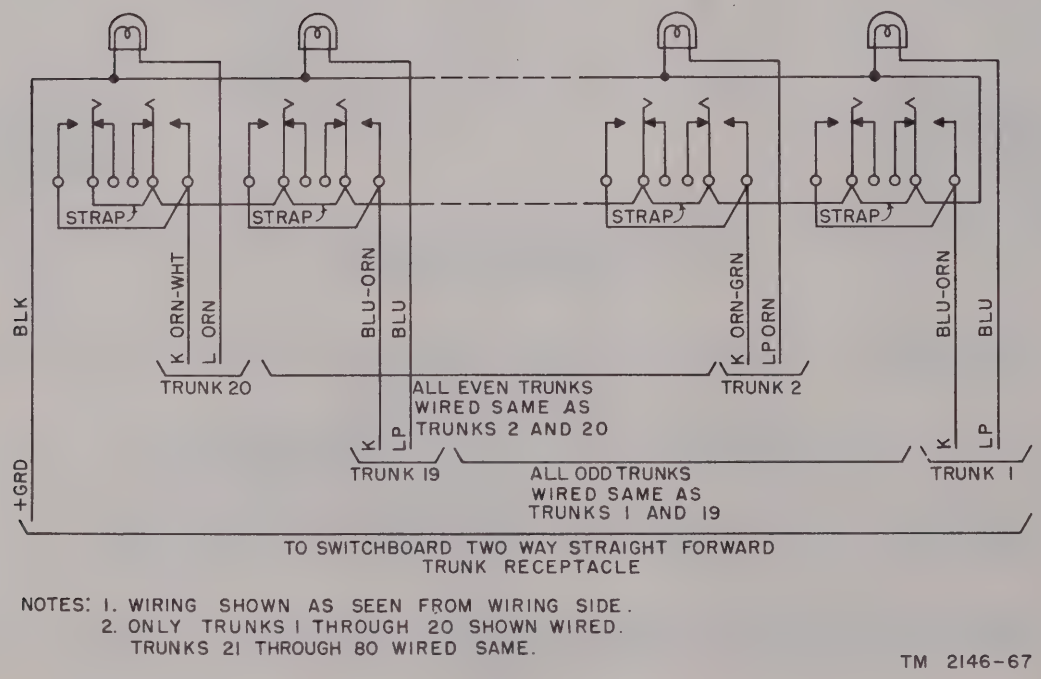
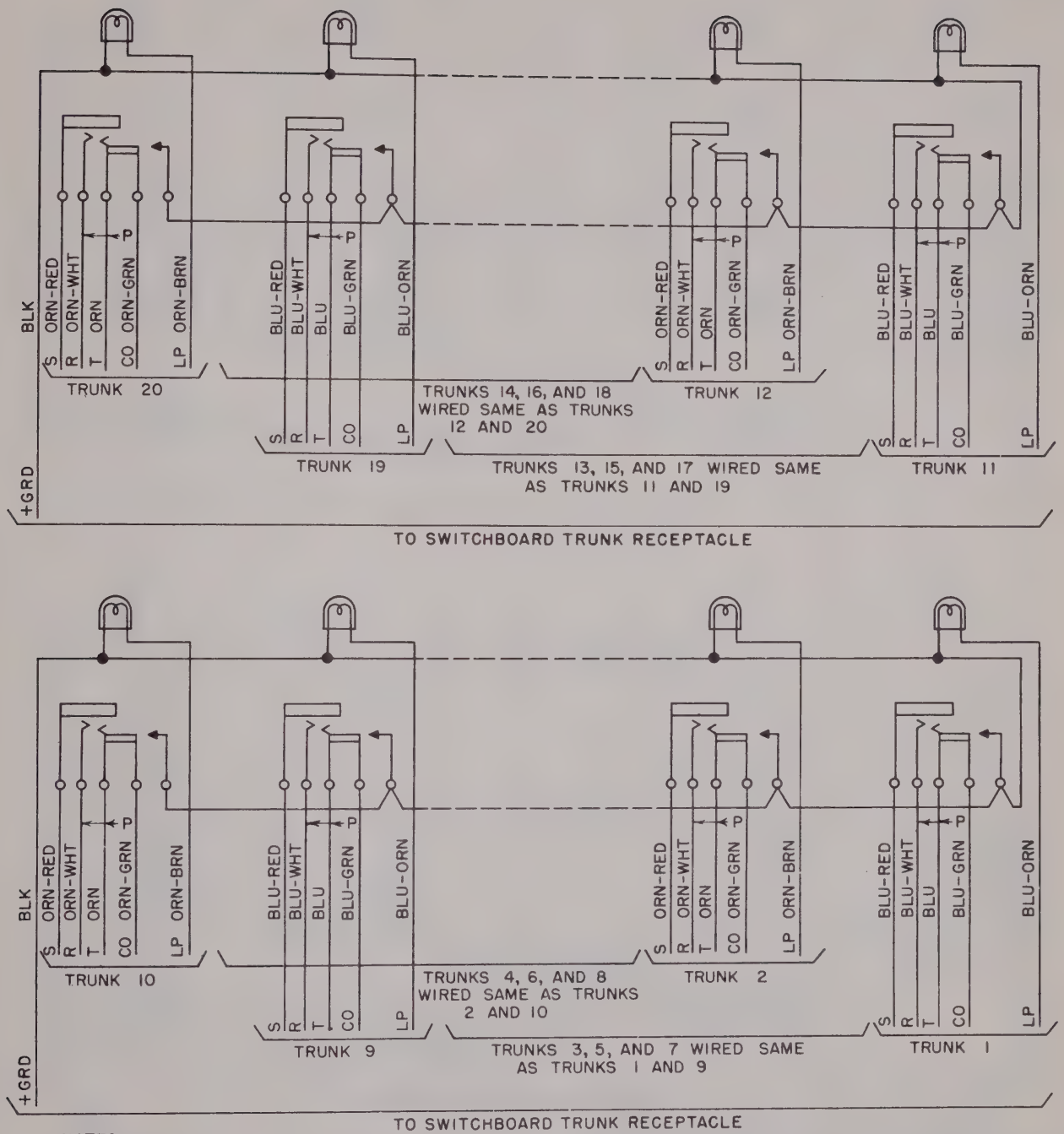


Figure 74. Manual Telephone Switchboard SB-249/TTC, plug supervision trunk switch and lamp mounting, wiring diagram.

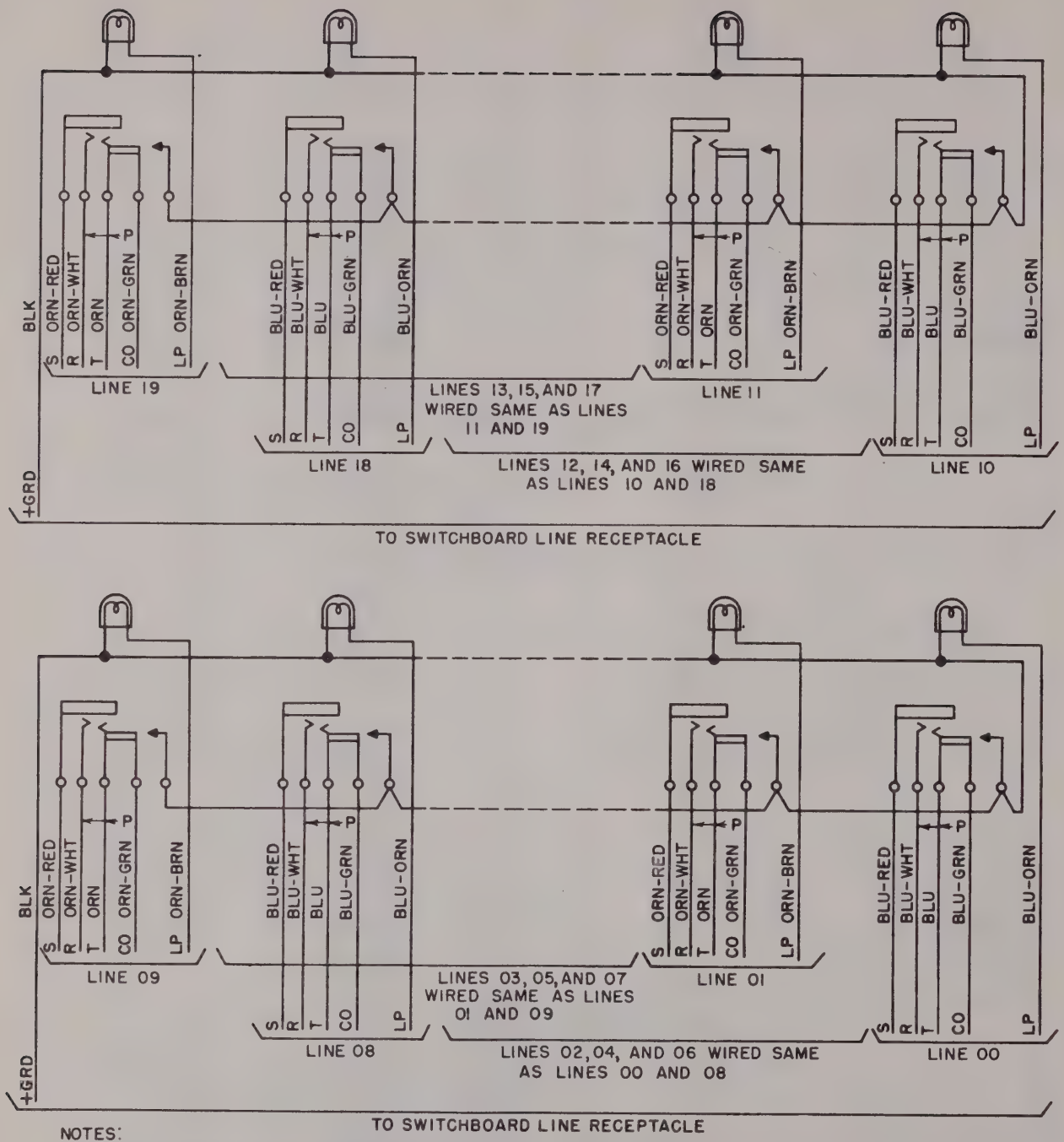


NOTES:

1. WIRING SHOWN AS SEEN FROM WIRING SIDE.
2. ONLY TRUNKS 1 THROUGH 20 SHOWN WIRED. TRUNKS 21 THROUGH 80 WIRED SAME.

TM 2146-68

Figure 75. Manual Telephone Switchboard SB-249/TTC, plug supervision trunk jack and lamp mounting, wiring diagram.



NOTES:

1. WIRING SHOWN AS SEEN FROM WIRING SIDE.
2. ONLY LINES 00 THROUGH 19 SHOWN WIRED. LINES 20 THROUGH 99 WIRED SAME.

TM 2146-6°

Figure 76. Manual Telephone Switchboard SB-249/TTC, line jack and lamp mounting, wiring diagram.

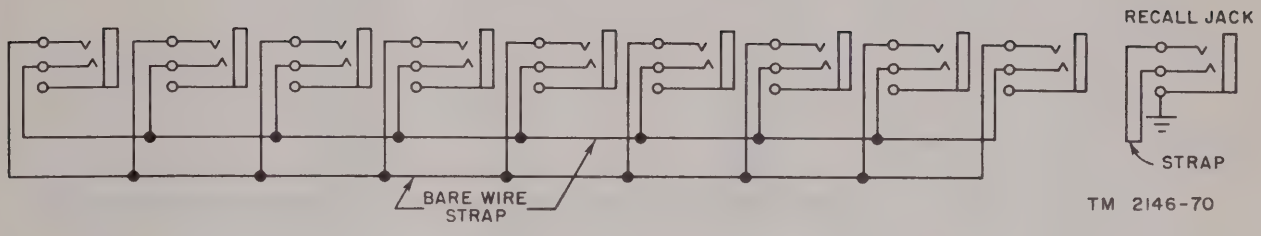


Figure 77. Manual Telephone Switchboard SB-249/TTC, conference circuit and recall jack, wiring diagram.

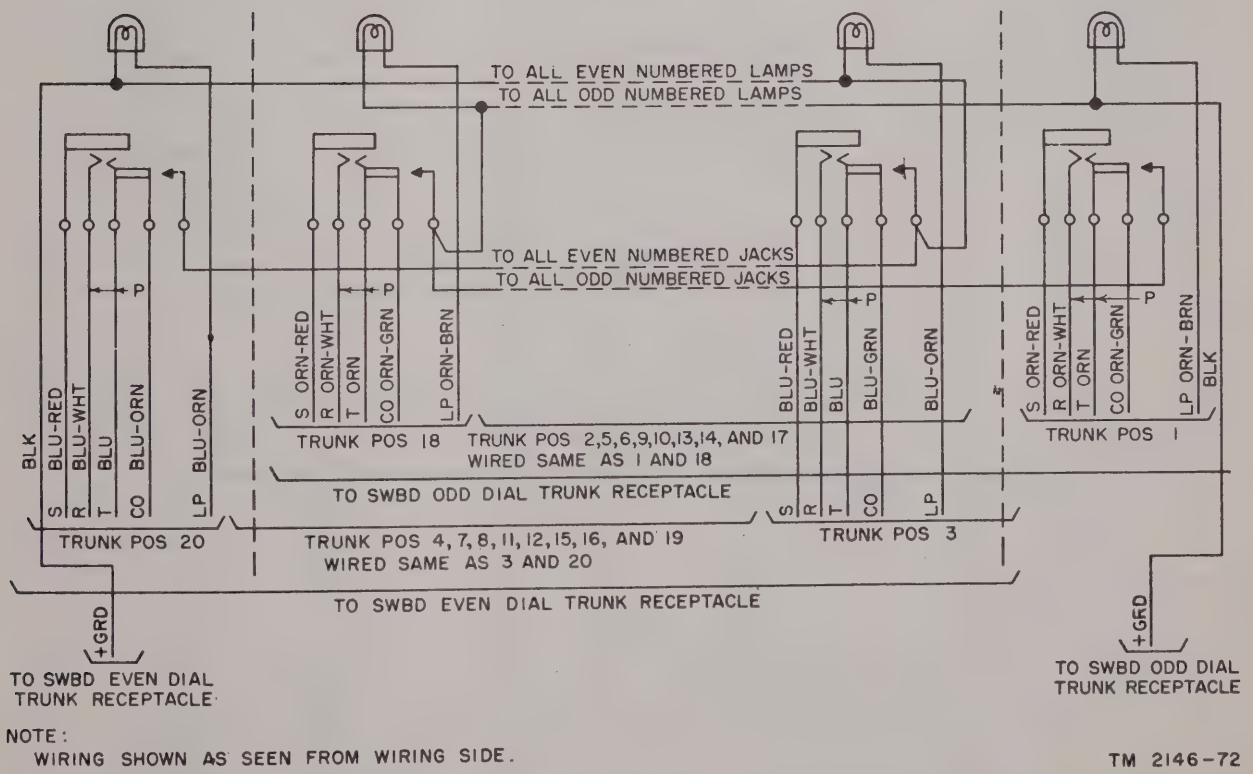


Figure 79. Manual Telephone Switchboard SB-249/TTC, dial trunk jack and lamp mounting, wiring diagram.

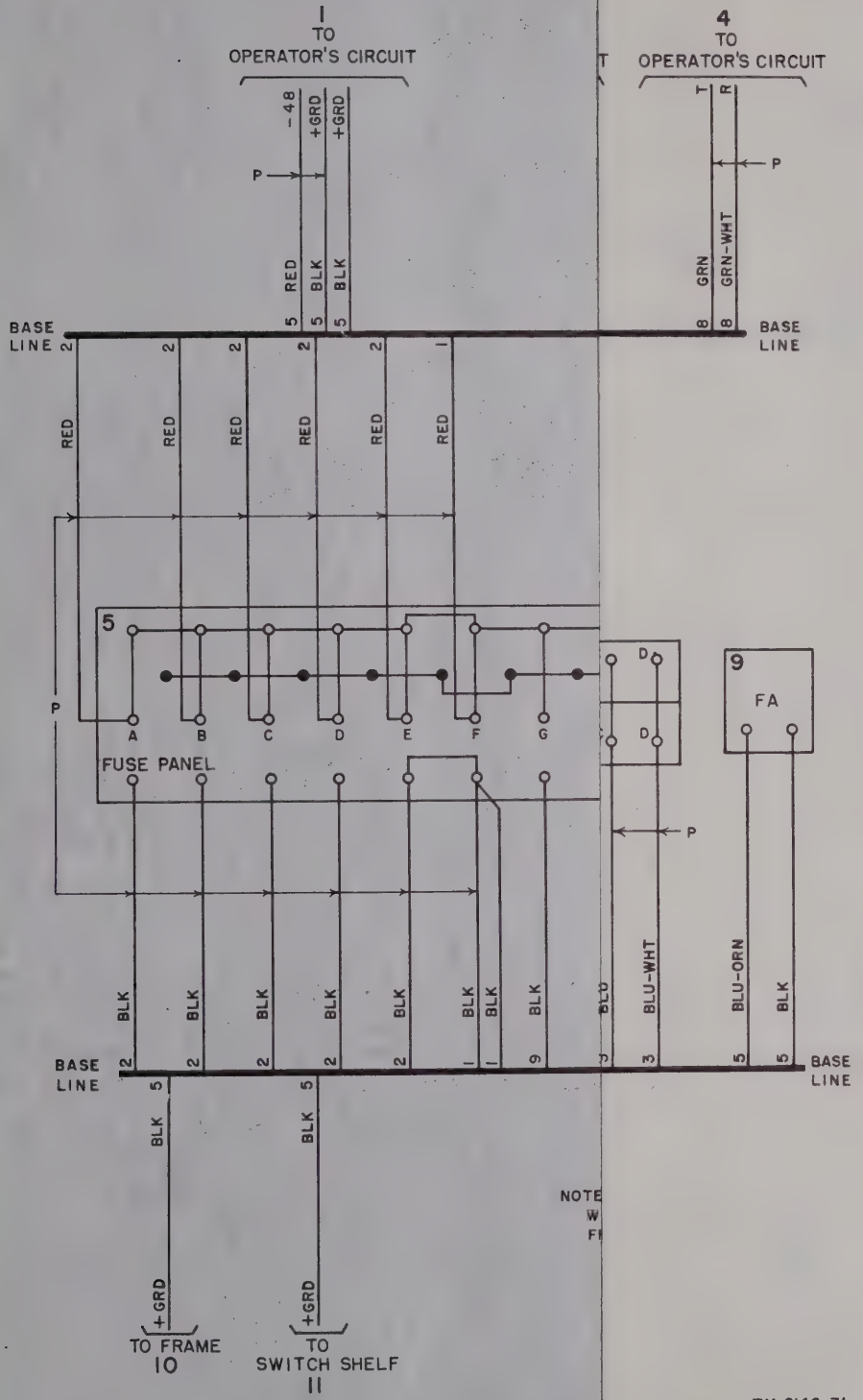


Figure 78. Manual Telepho

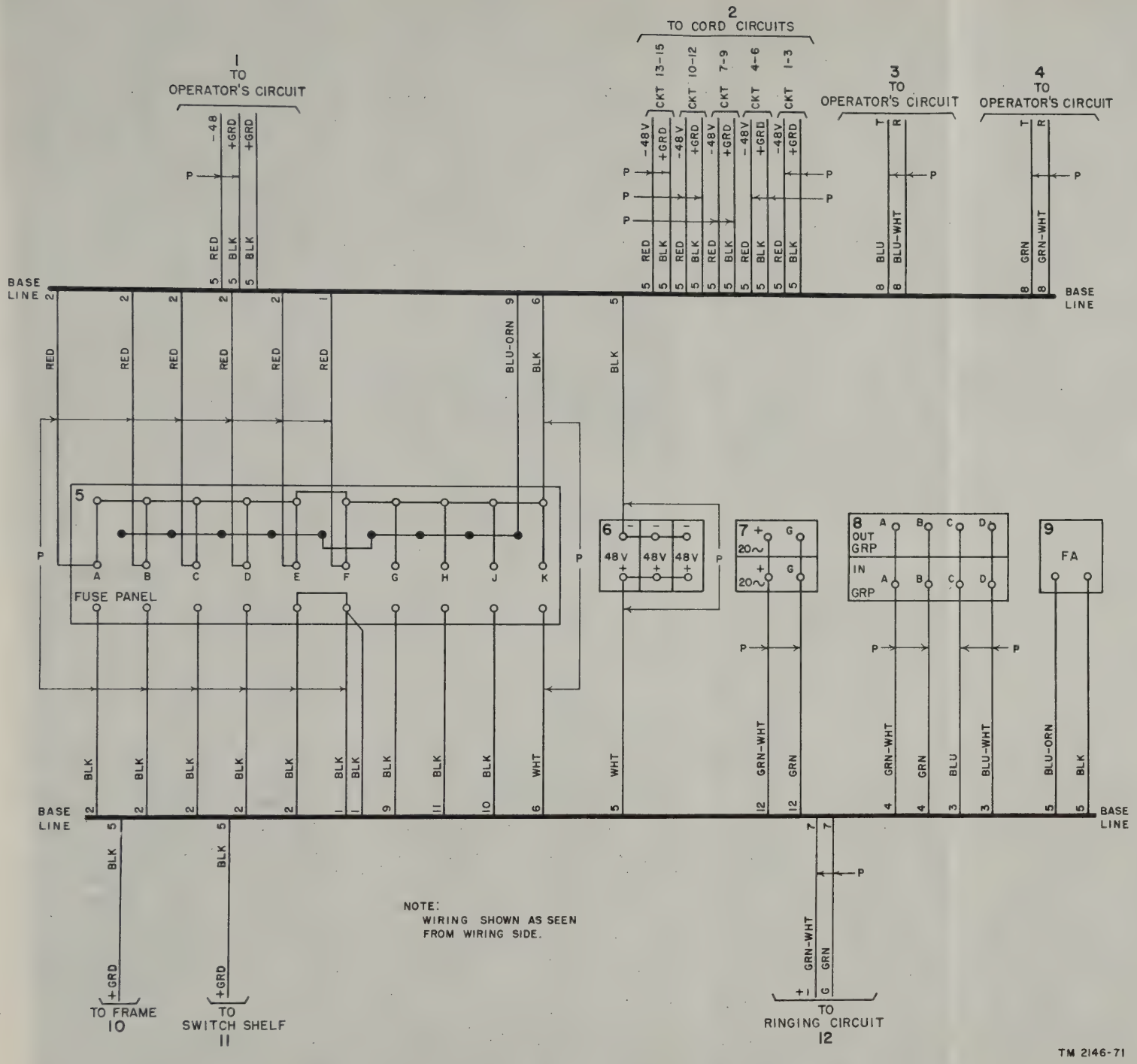
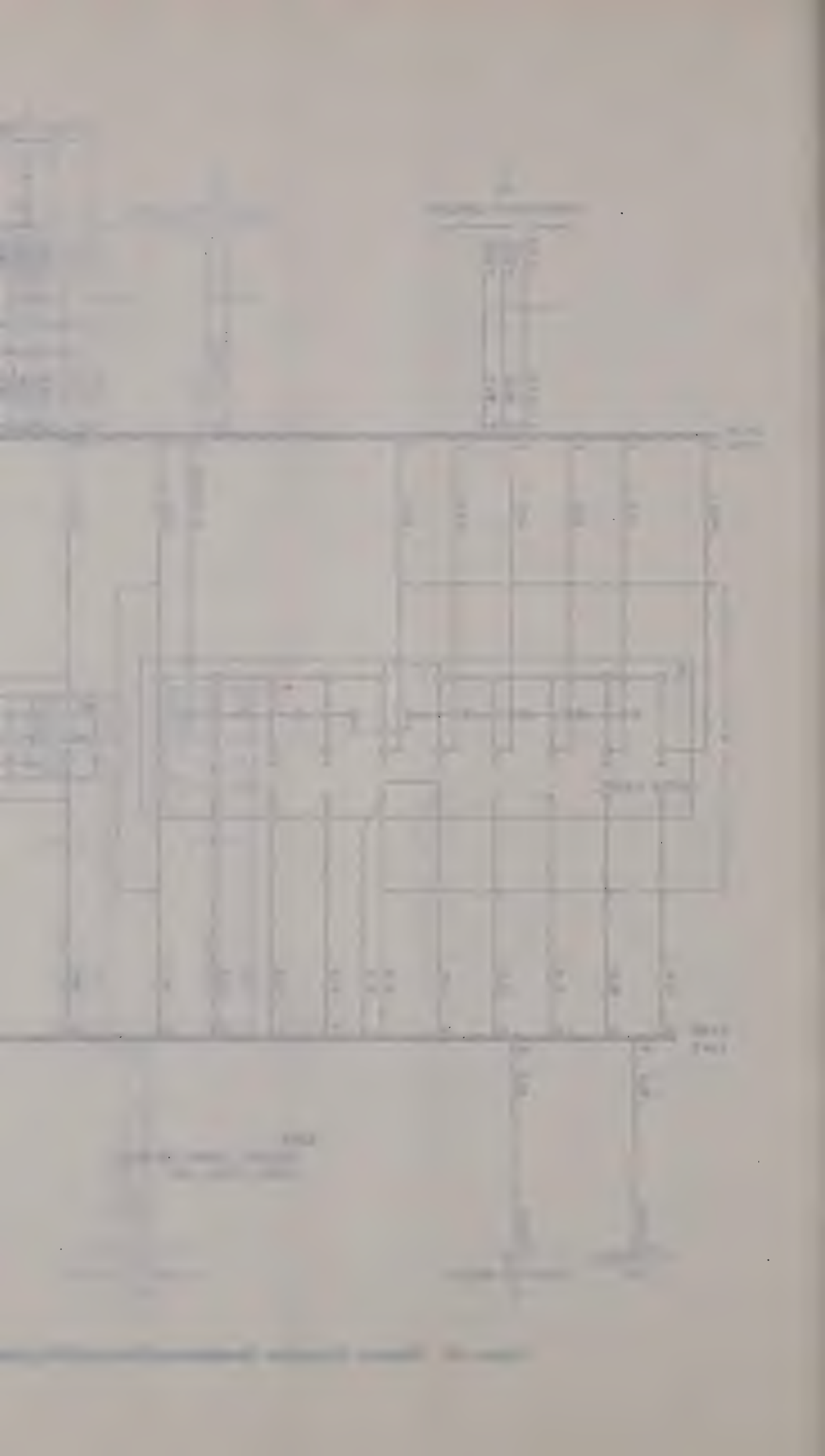
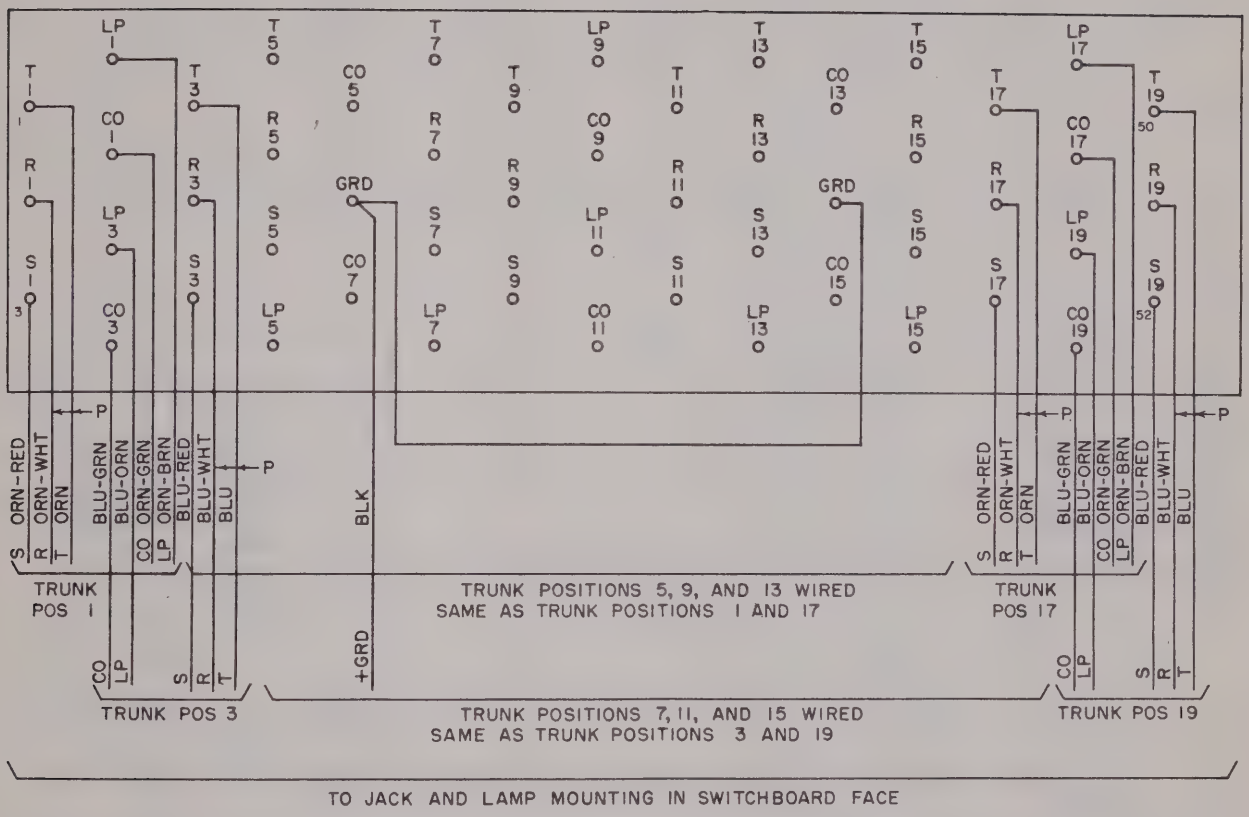


Figure 78. Manual Telephone Switchboard SB-249/TTC, distributing circuit, wiring diagram.



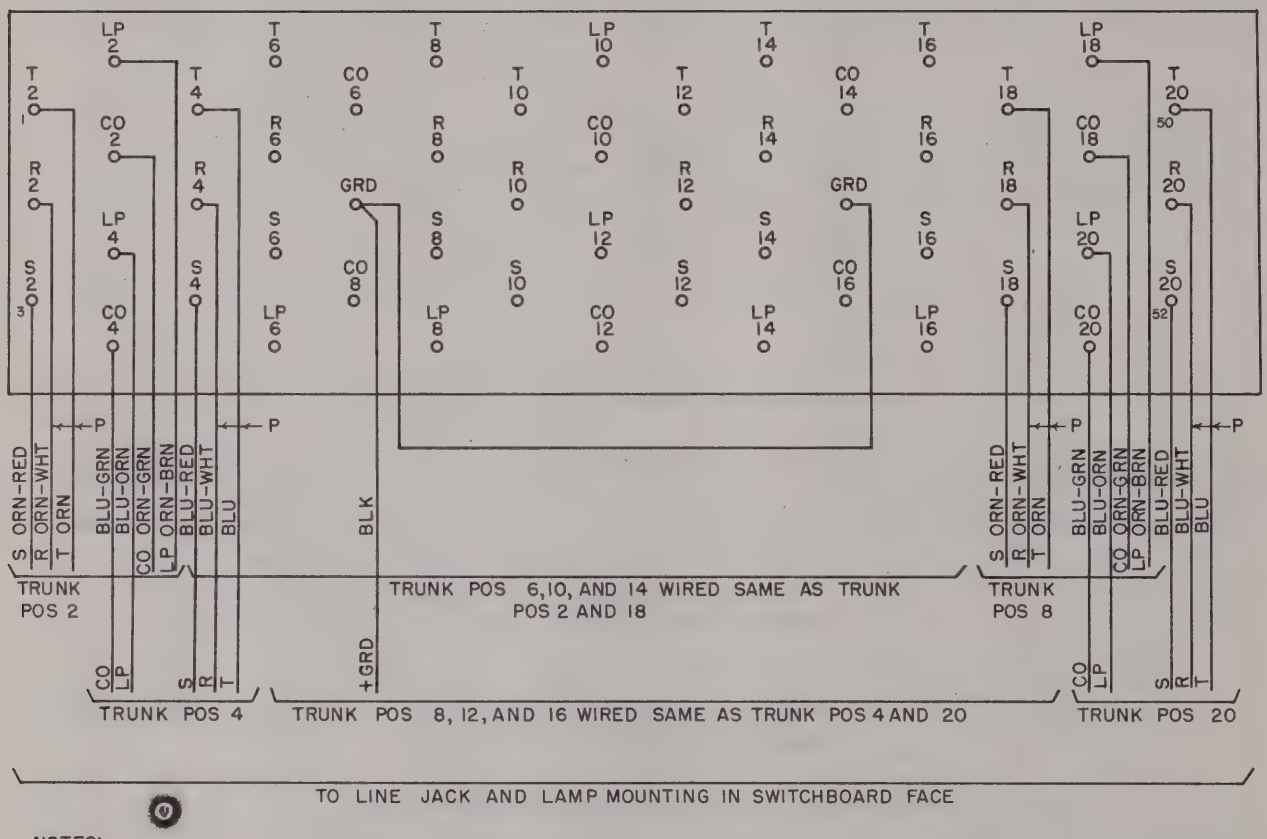


NOTES:

1. RECEPTACLE WIRING SHOWN AS SEEN FROM WIRING SIDE.
2. ONLY ODD TRUNKS 1 THROUGH 19 ARE SHOWN WIRED.

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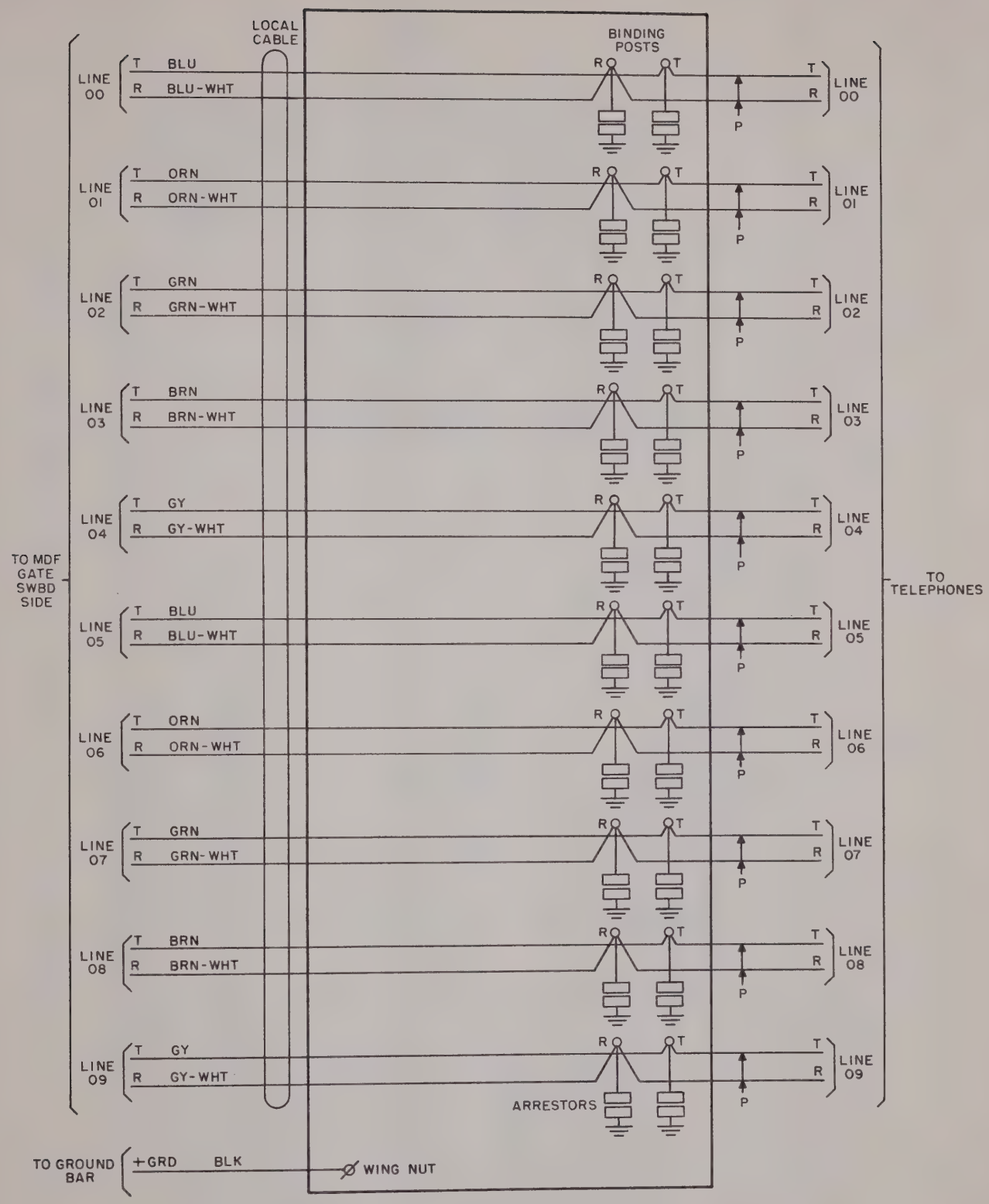
Figure 80. Manual Telephone Switchboard SB-249/TTC, dial trunk receptacle, odd trunk, wiring diagram.



NOTES:
1. RECEPTACLE WIRING SHOWN AS SEEN FROM WIRING SIDE.
2. ONLY EVEN TRUNKS 2 THROUGH 20 ARE SHOWN WIRED.

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Figure 81. Manual Telephone Switchboard SB-249/TTC, dial trunk receptacle, even trunk, wiring diagram.



NOTES:

1. WIRING SHOWN AS SEEN FROM LOCAL CABLE WIRING SIDE.
2. ONLY LINES 00 THROUGH 09 SHOWN WIRED. LINES 10 THROUGH 99 WIRED SAME.

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Figure 82. Telephone Main Distributing Frame TA-257/TTC, line side, wiring diagram.

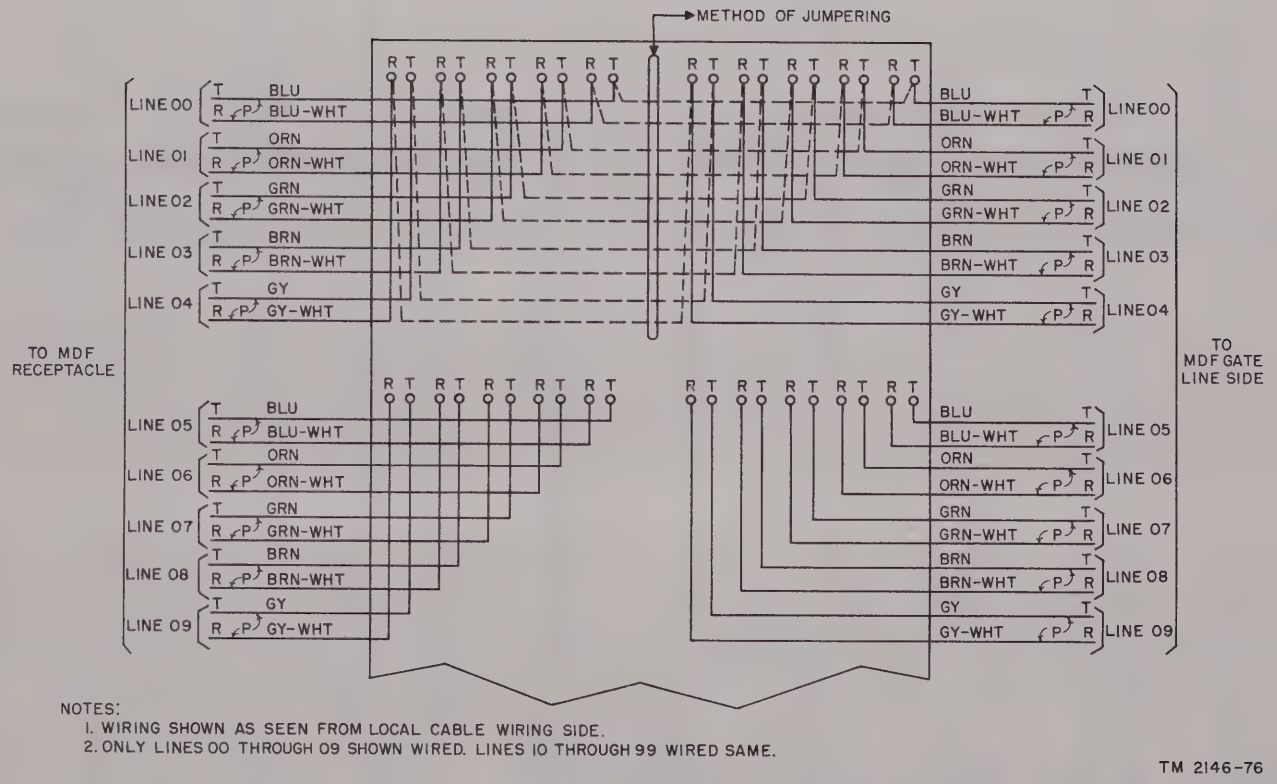


Figure 83. Telephone Main Distributing Frame TA-257/TTC, switchboard side, wiring diagram.

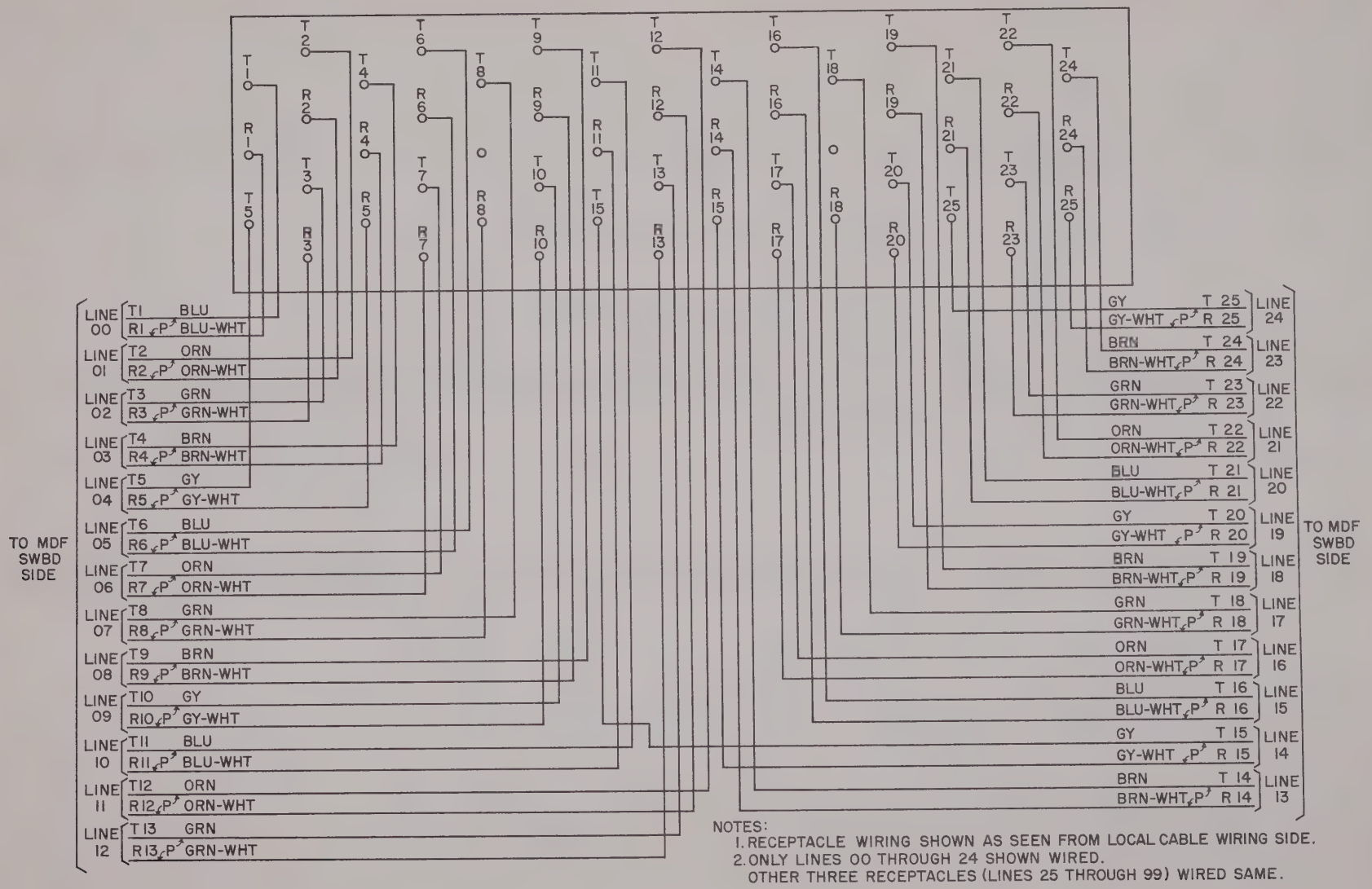


Figure 84. Telephone Main Distributing Frame TA-257/TTC, receptacle, wiring diagram.

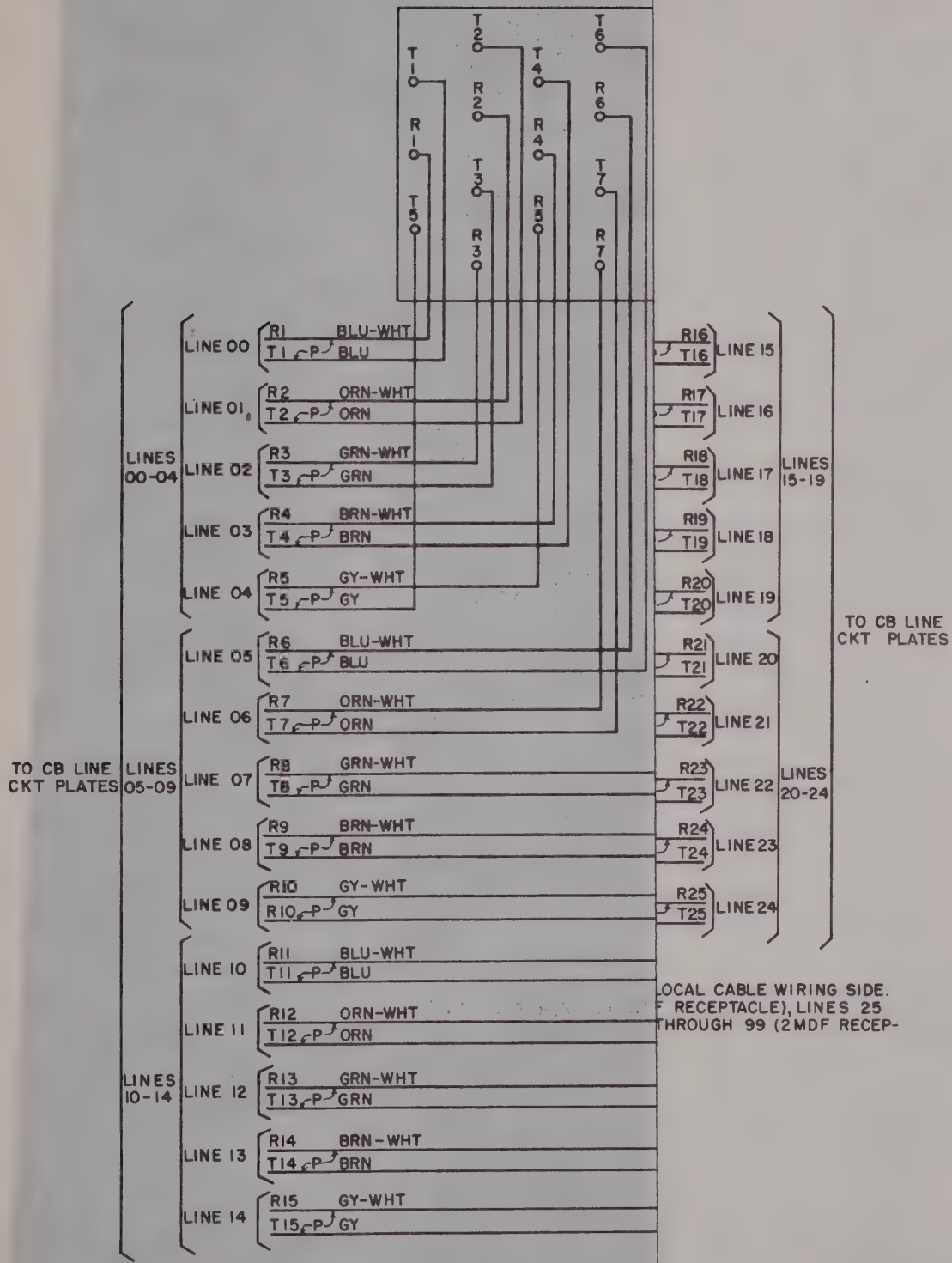
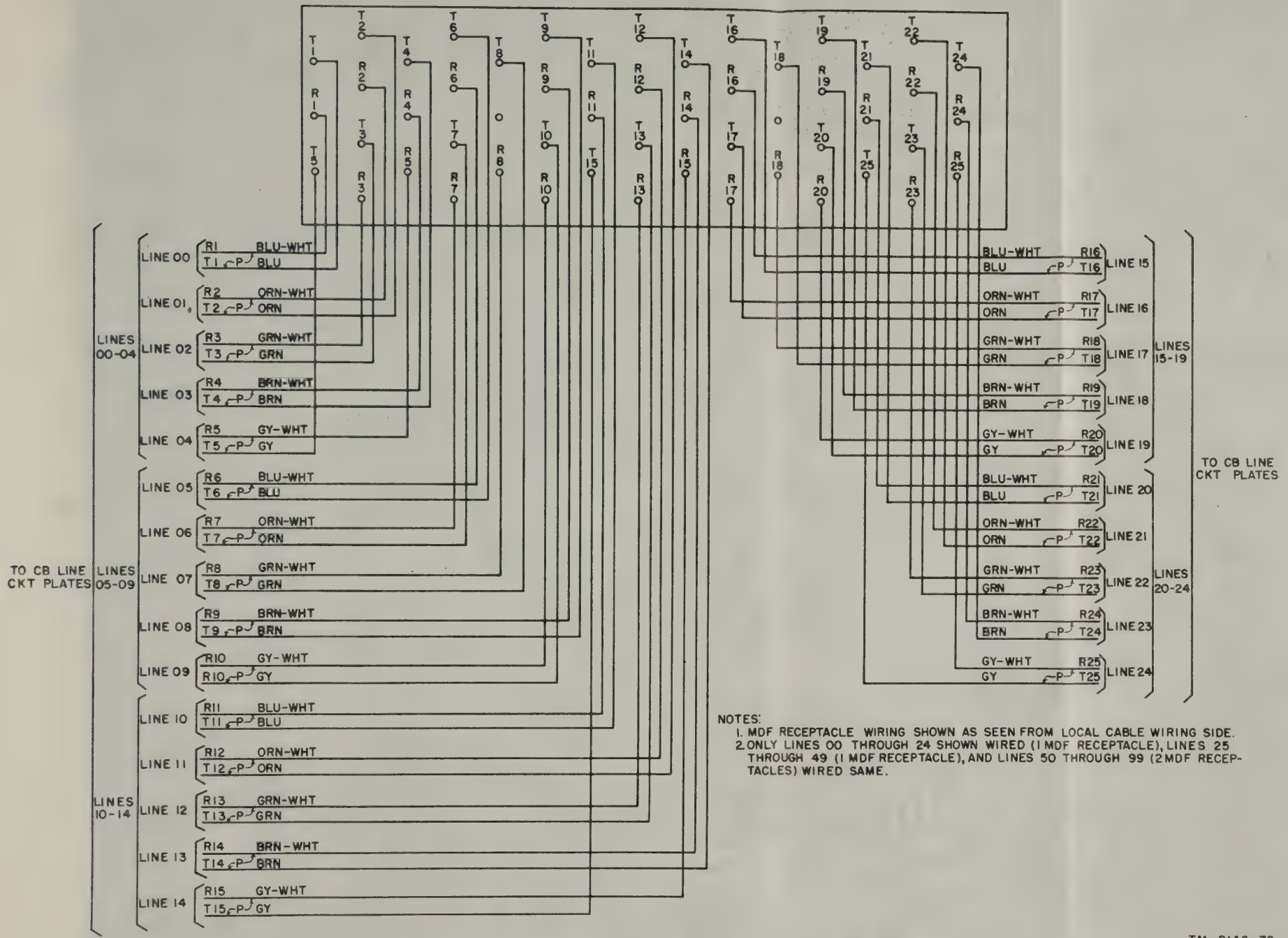


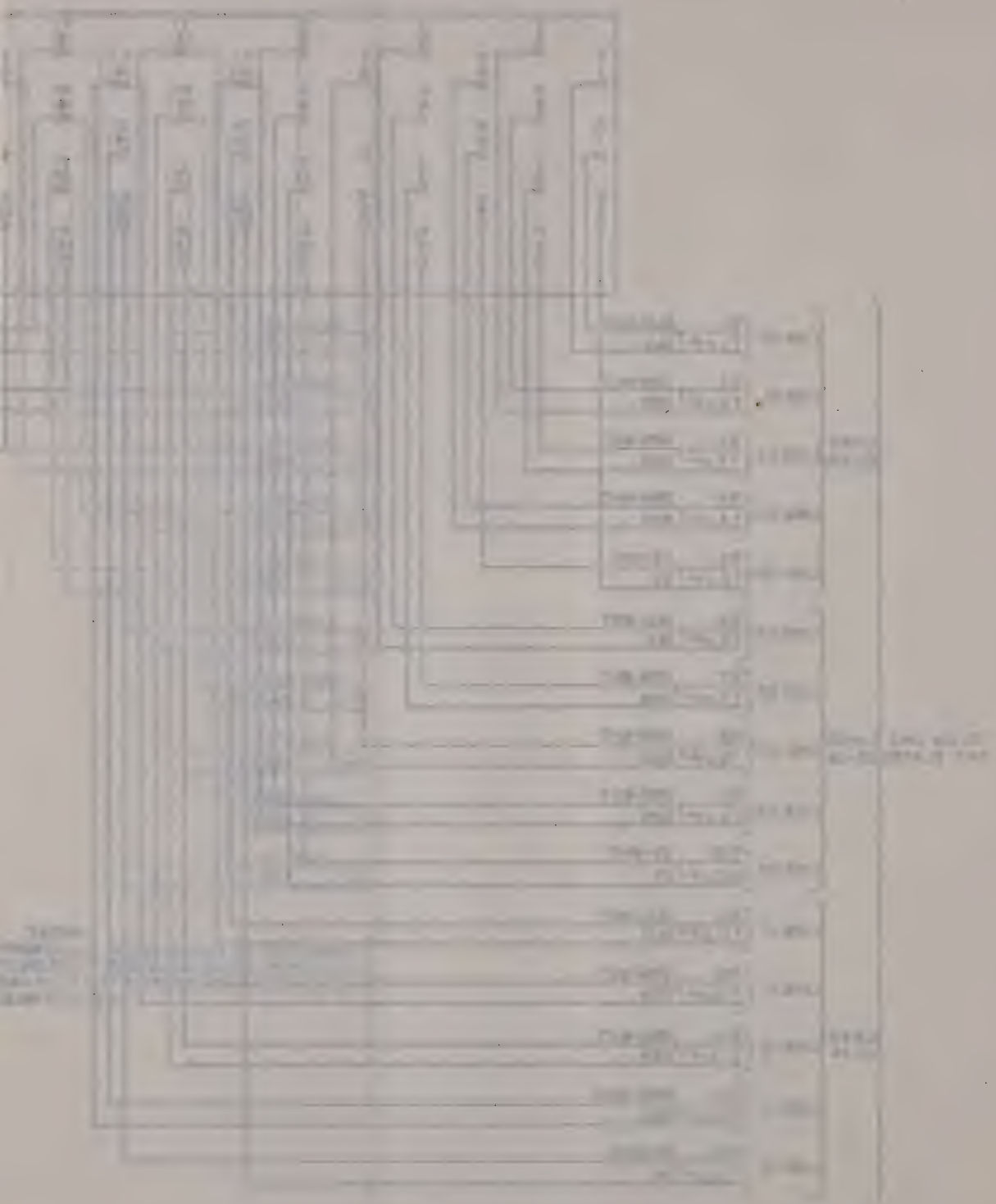
Figure 85. Line Rel



NOTES:
1. MDF RECEPTACLE WIRING SHOWN AS SEEN FROM LOCAL CABLE WIRING SIDE.
2. ONLY LINES 00 THROUGH 24 SHOWN WIRED (1 MDF RECEPTACLE), LINES 25 THROUGH 49 (1 MDF RECEPTACLE), AND LINES 50 THROUGH 99 (2 MDF RECEPTACLES) WIRED SAME.

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Figure 85. Line Relay Telephone Circuit TA-224/TTC, MDF receptacle, wiring diagram.



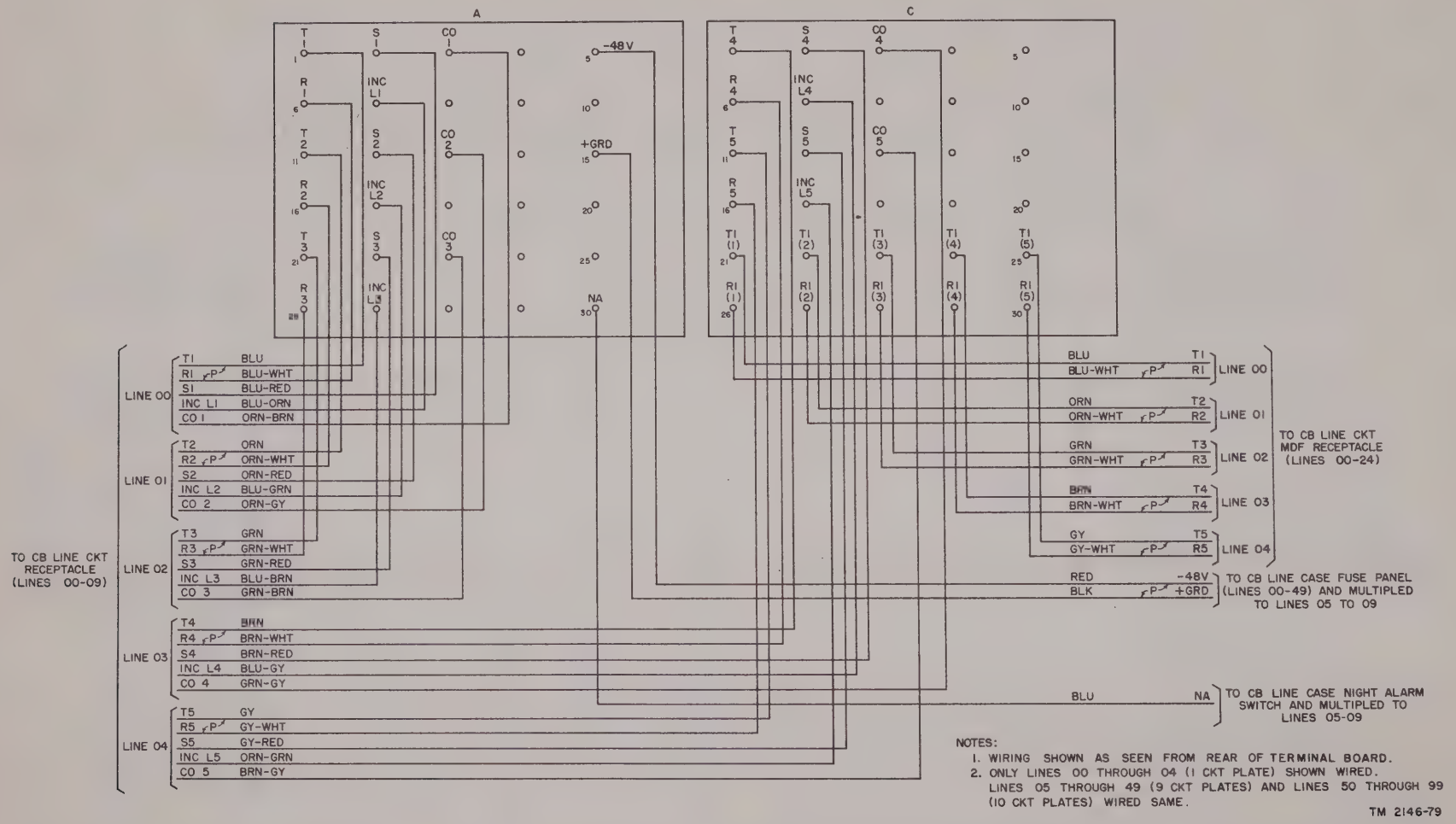


Figure 86. Line Relay Telephone Circuit TA-224/TTC, CB line circuit plate terminal board, wiring diagram.

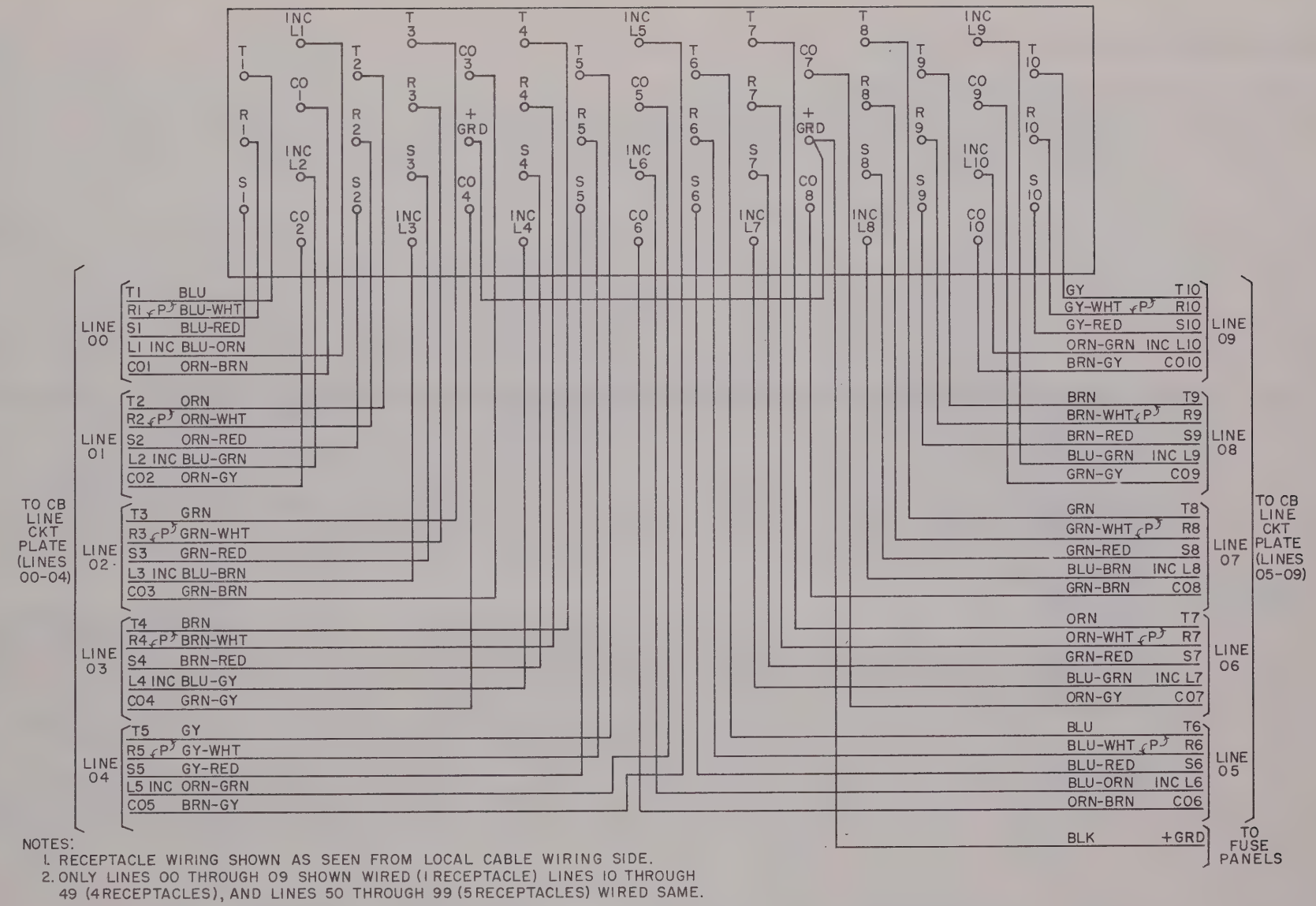


Figure 87. Line Relay Telephone Circuit TA-224/TTC, line circuit receptacle, wiring diagram.

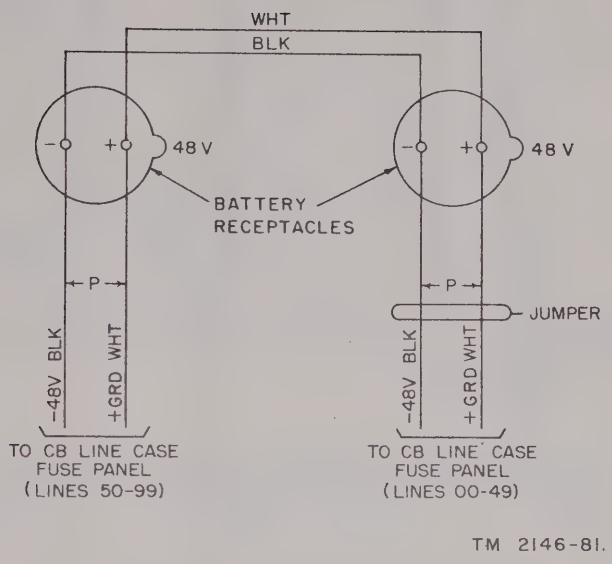


Figure 88. Line Relay Telephone Circuit TA-224/TTC, battery and ground receptacle, wiring diagram.



Figure 89. Line Relay Telephone Circuit TA-224/TTC, NA binding post, wiring diagram.

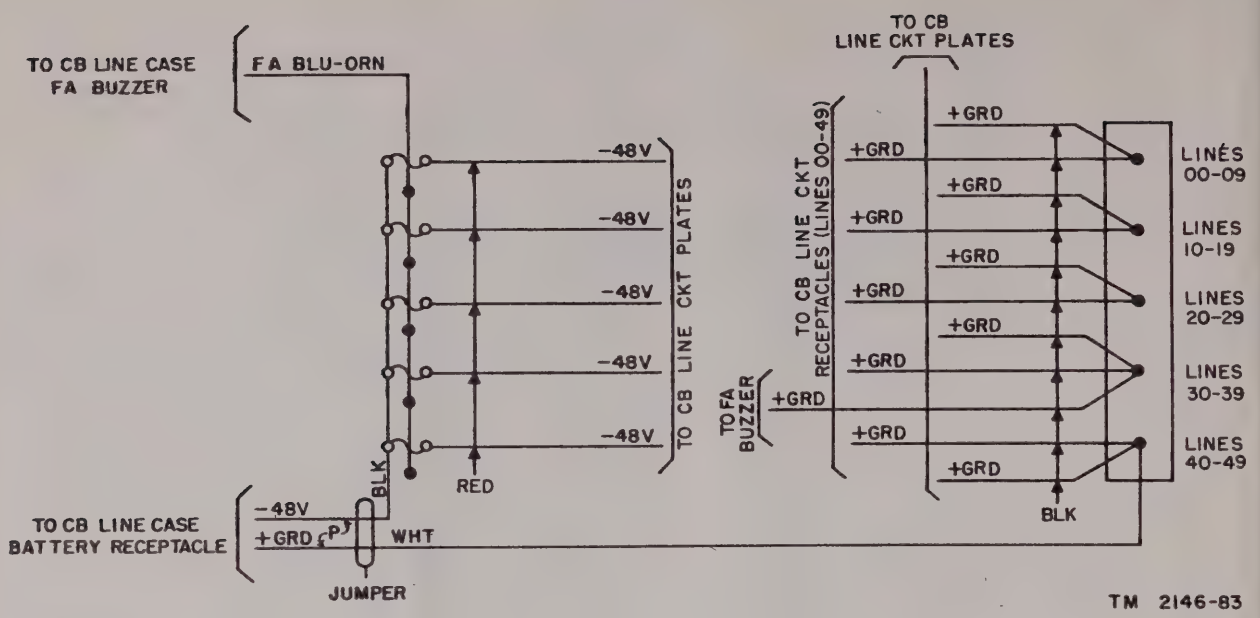


Figure 90. Line Relay Telephone Circuit TA-224/TTC, fuse panel, lines 00-49, wiring diagram.

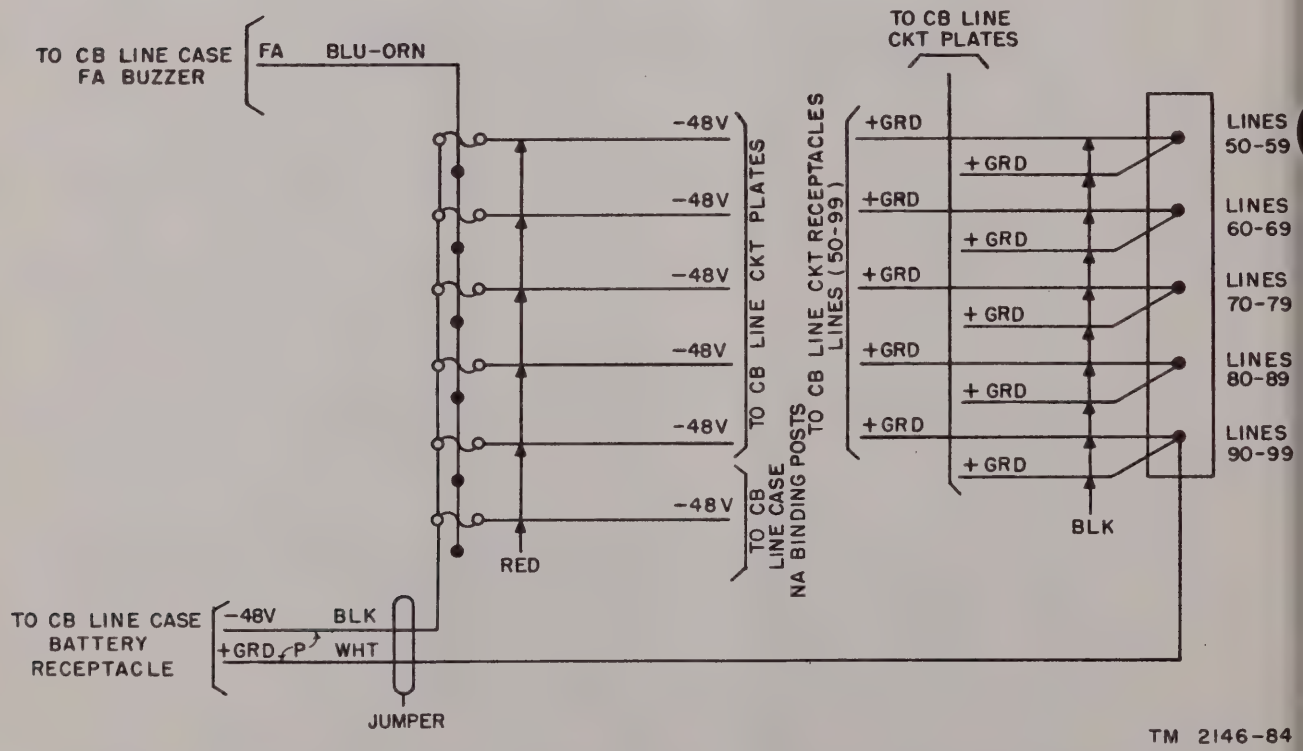


Figure 91. Line Relay Telephone Circuit TA-224/TTC, fuse panel, lines 50-99, wiring diagram.

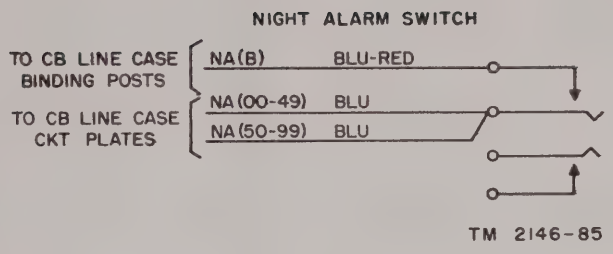


Figure 92. Line Relay Telephone Circuit TA-224/TTC, NA switch, wiring diagram.

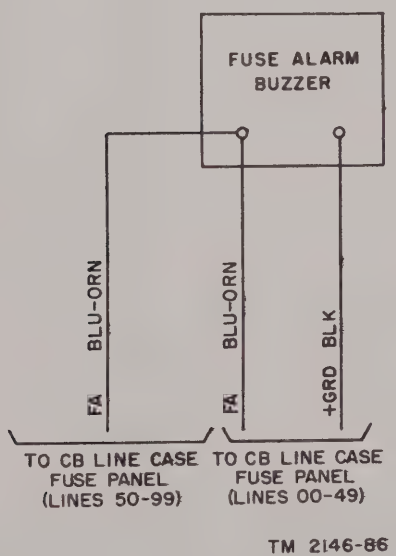
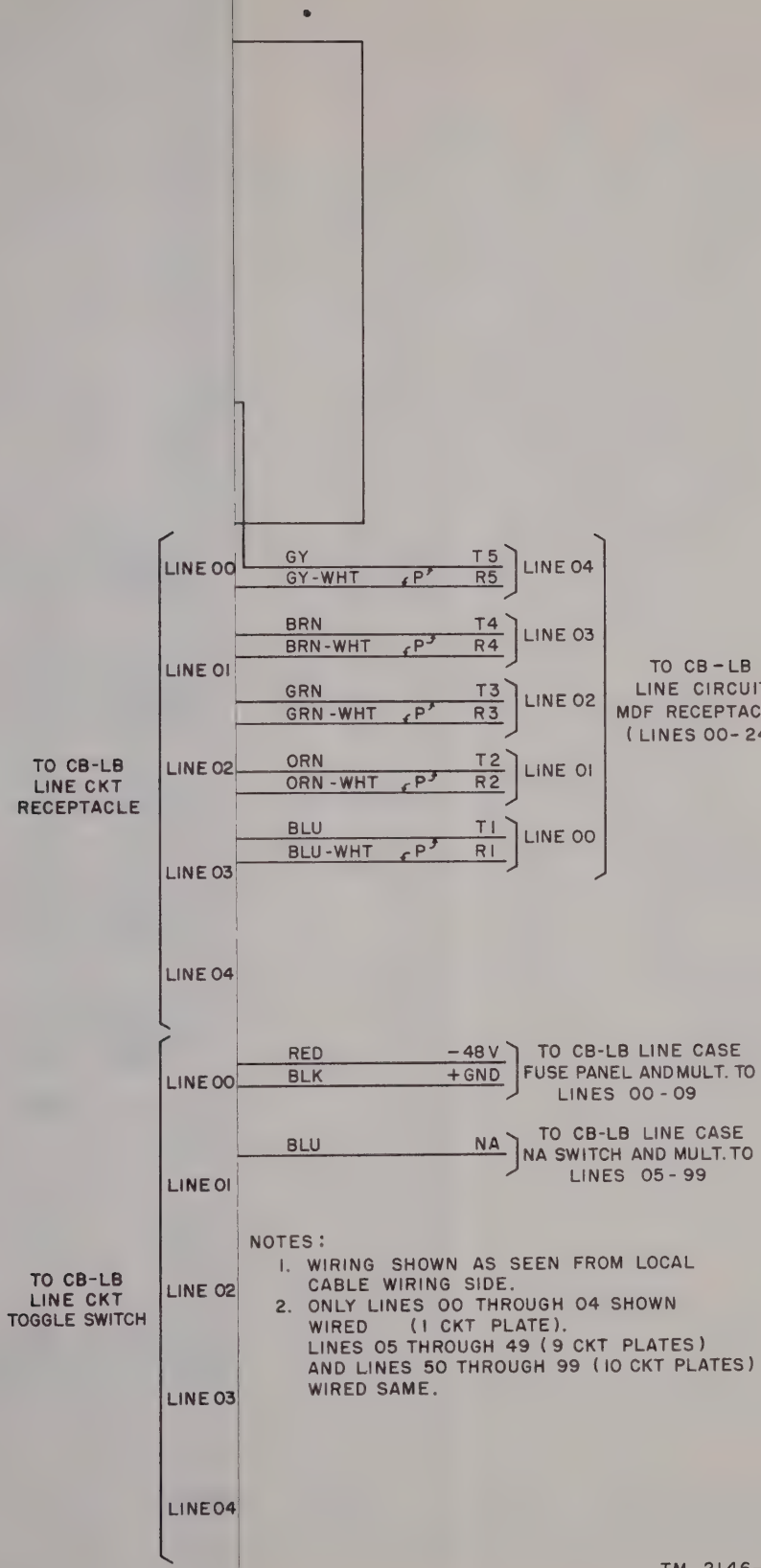


Figure 93. Line Relay Telephone Circuit TA-224/TTC, FA buzzer, wiring diagram.



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agram.

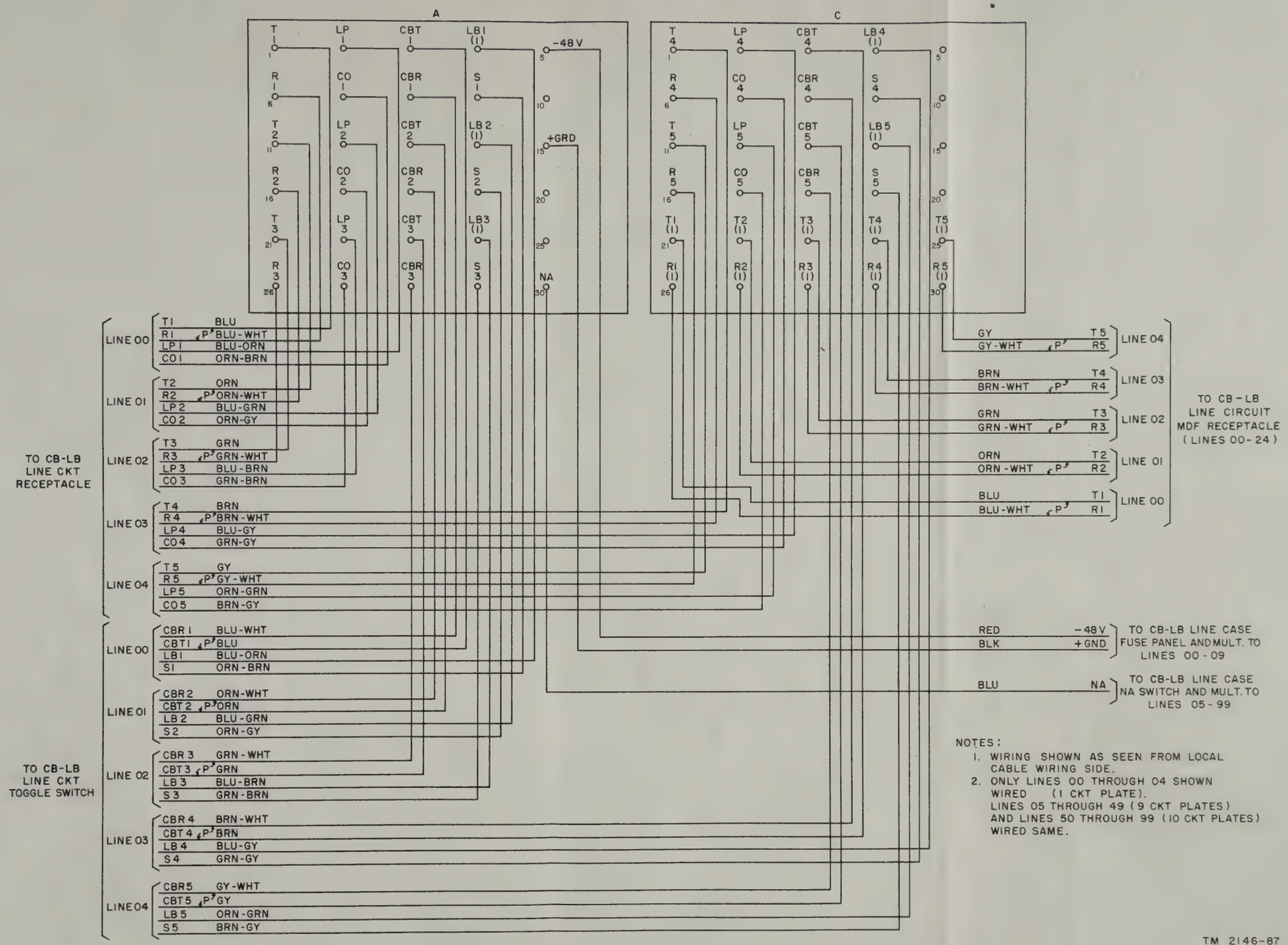
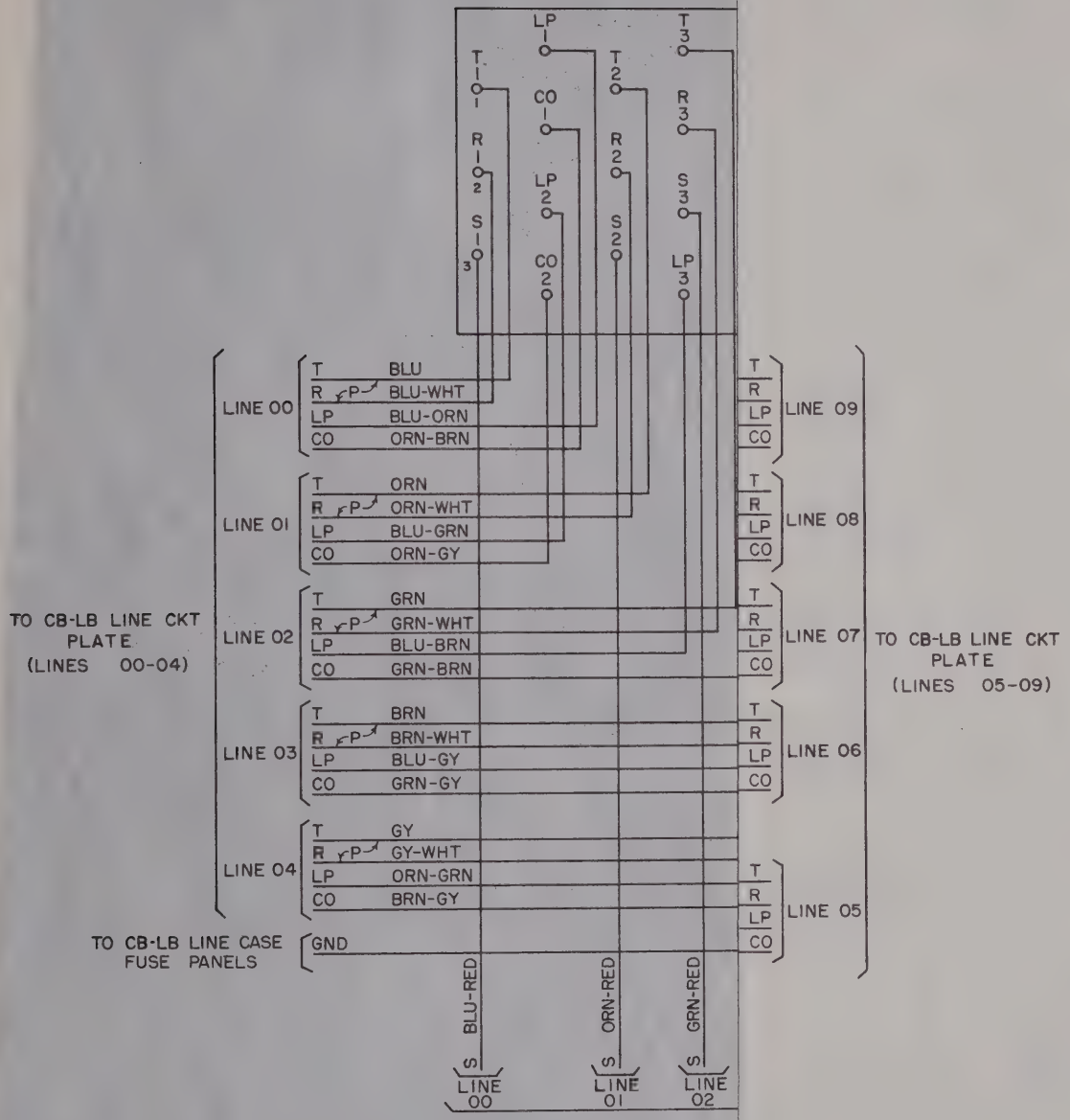


Figure 94. Line Relay Telephone Circuit TA-223/TTC, CB-LB line circuit plate terminal board, wiring diagram.



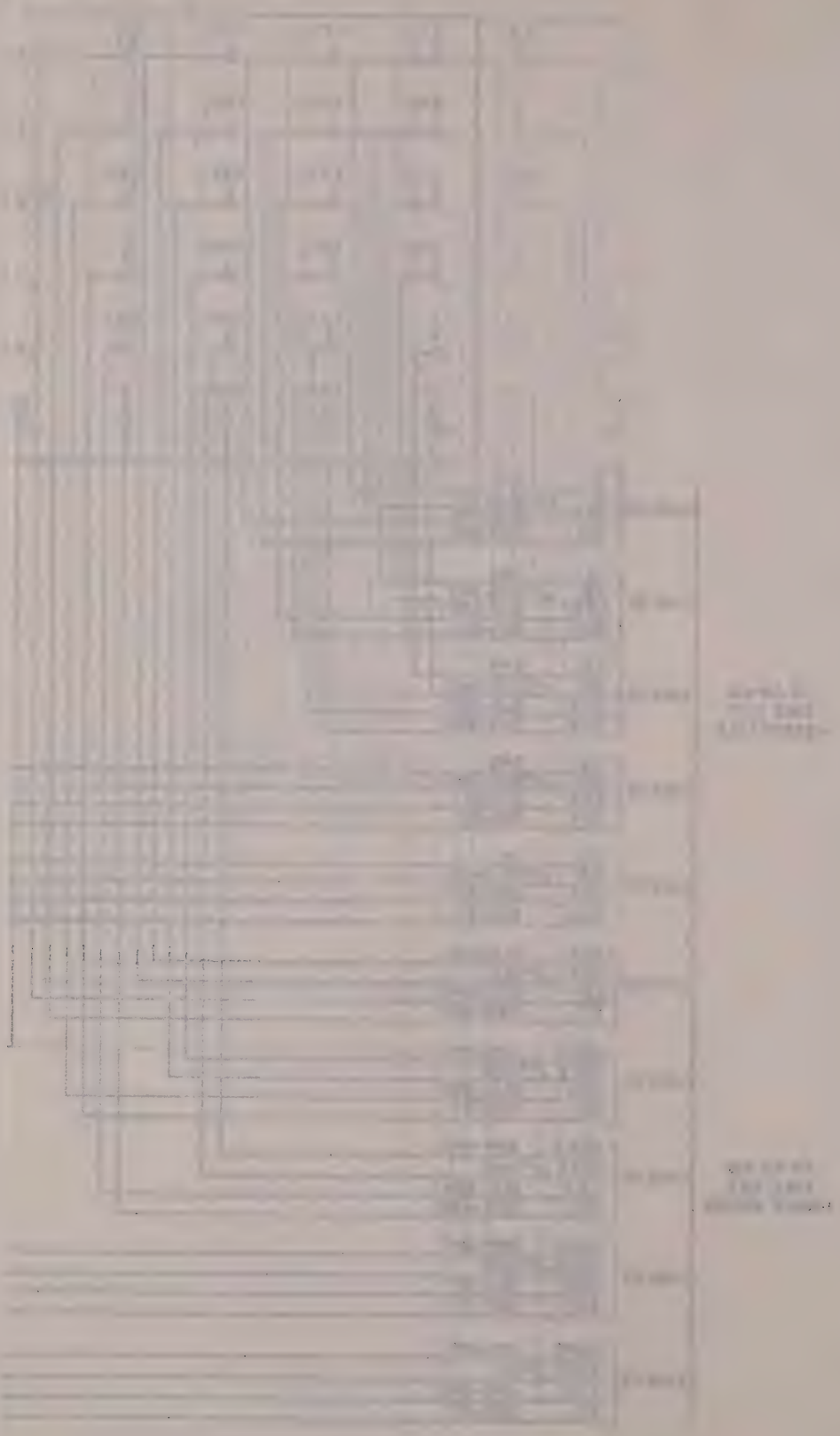


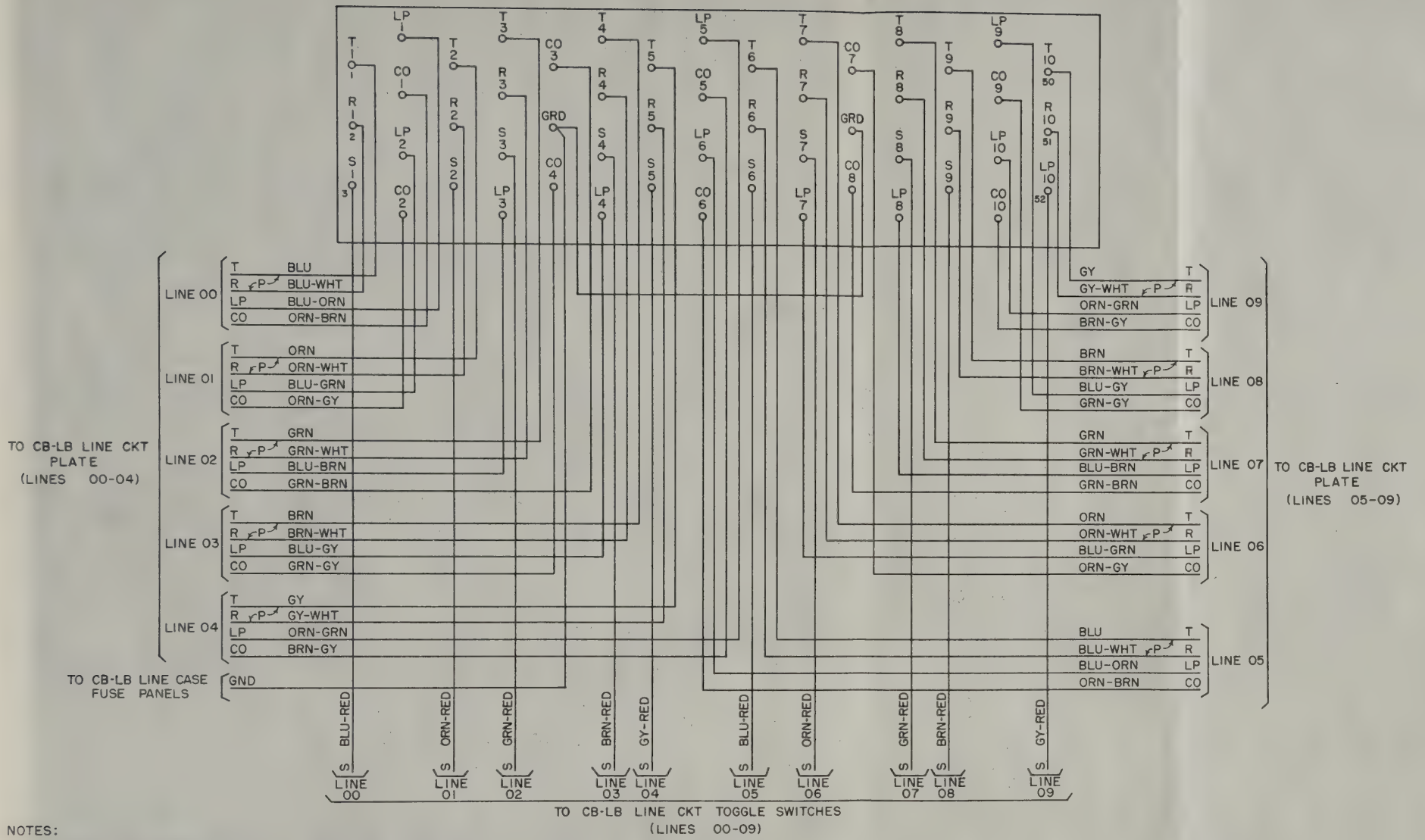
NOTES:

1. RECEPTACLE WIRING SHOWN AS SEEN FROM LOCAL CABLE WIRI
2. ONLY LINES 00 THROUGH 09 SHOWN WIRED (1 RECEPTACLE). 10 THROUGH 49 (4 RECEPTACLES) AND LINES 50 THROUGH 9 (5 RECEPTACLES) WIRED SAME.

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Figure 95. Line Relay T



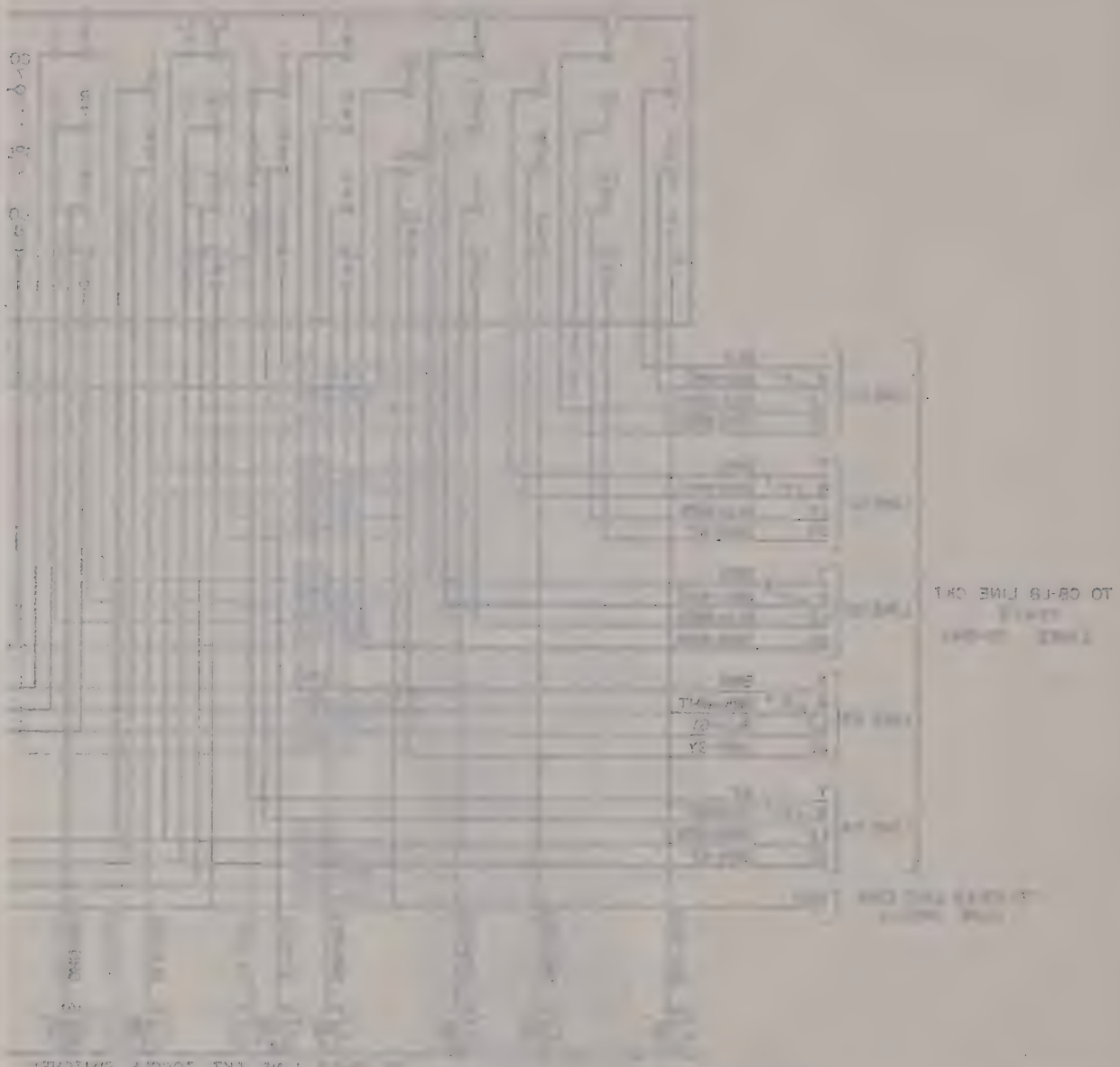


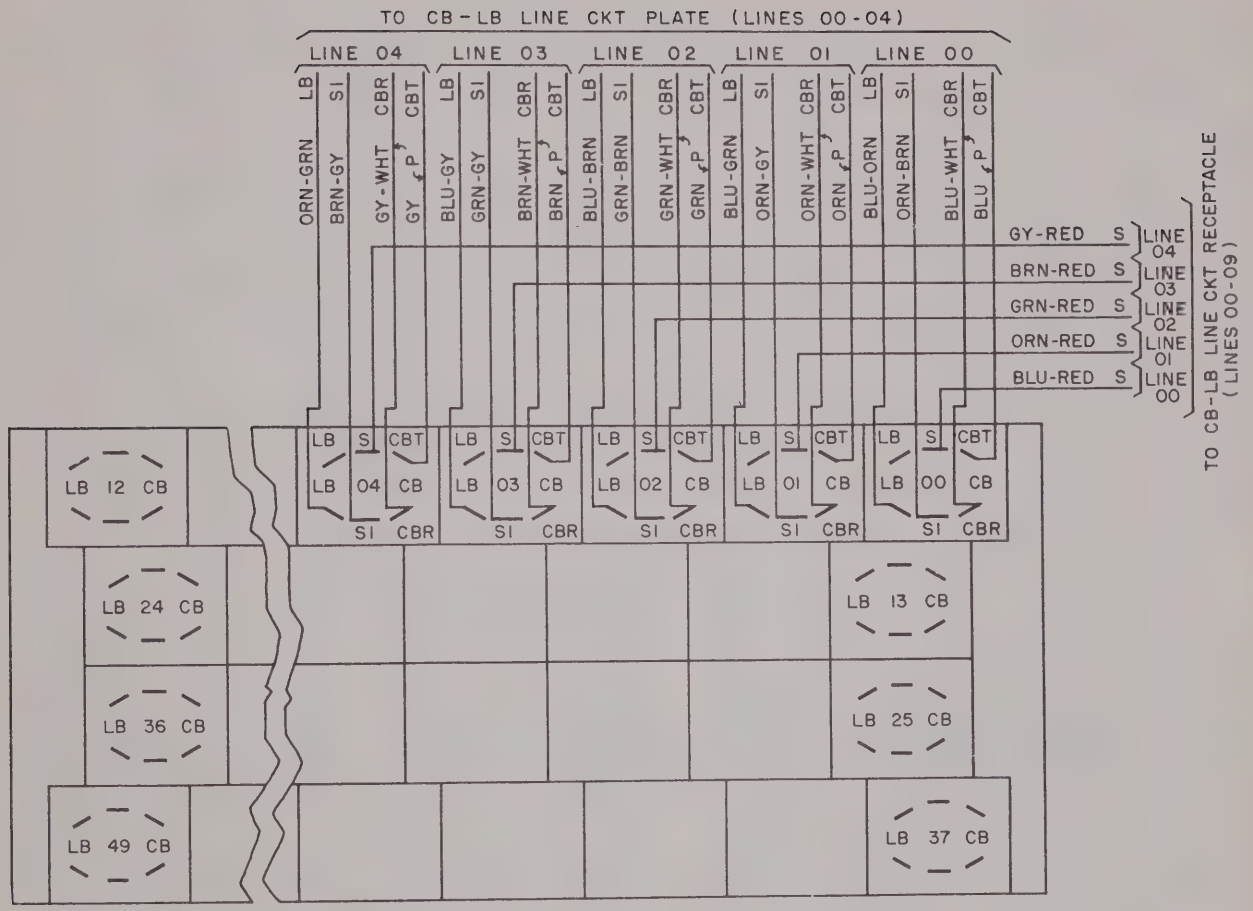
NOTES:

1. RECEPTACLE WIRING SHOWN AS SEEN FROM LOCAL CABLE WIRING SIDE
2. ONLY LINES 00 THROUGH 09 SHOWN WIRED (1 RECEPTACLE). LINES 10 THROUGH 49 (4 RECEPTACLES) AND LINES 50 THROUGH 99 (5 RECEPTACLES) WIRED SAME.

TM 2146-88

Figure 95. Line Relay Telephone Circuit TA-223/TTC, CB-LB line circuit receptacle, wiring diagram.



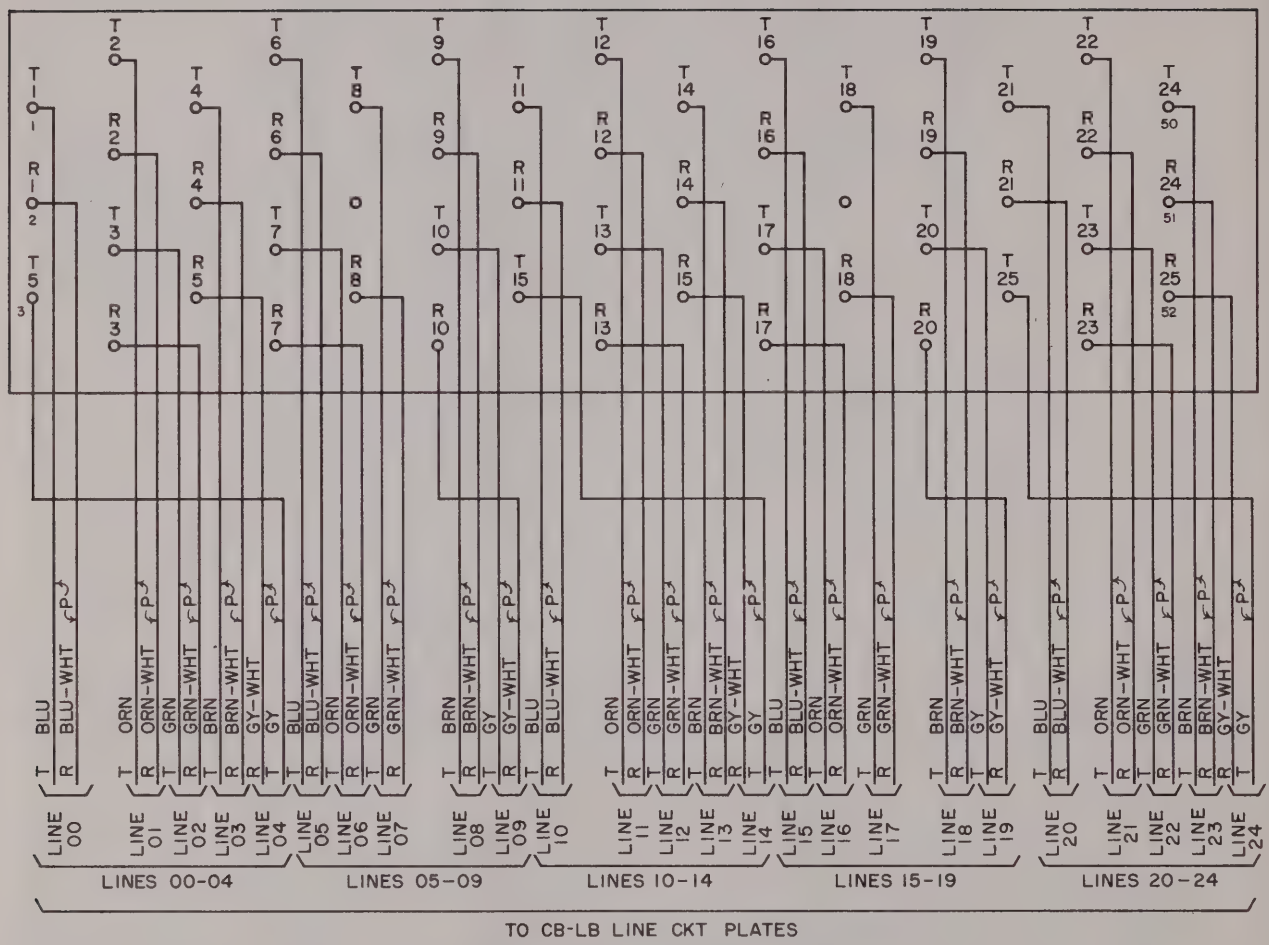


NOTES:

1. WIRING SHOWN AS SEEN FROM WIRING SIDE.
2. ONLY LINES 00 THROUGH 04 SHOWN WIRED (POSITIONS 1 AND 2). LINES 05 THROUGH 49 AND LINES 50 THROUGH 99 WIRED SAME.

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Figure 96. Line Relay Telephone Circuit TA-223/TTC, CB-LB line circuit toggle switches, wiring diagram.



NOTES:

1. RECEPTACLE WIRING SHOWN AS SEEN FROM LOCAL CABLE WIRING SIDE.
2. ONLY LINES 00 THROUGH 24 (1 RECEPTACLE) SHOWN WIRED.
   LINES 25 THROUGH 99 (3 RECEPTACLES) WIRED SAME.

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Figure 97. Line Relay Telephone Circuit TA-223/TTC, MDF receptacle, wiring diagram.

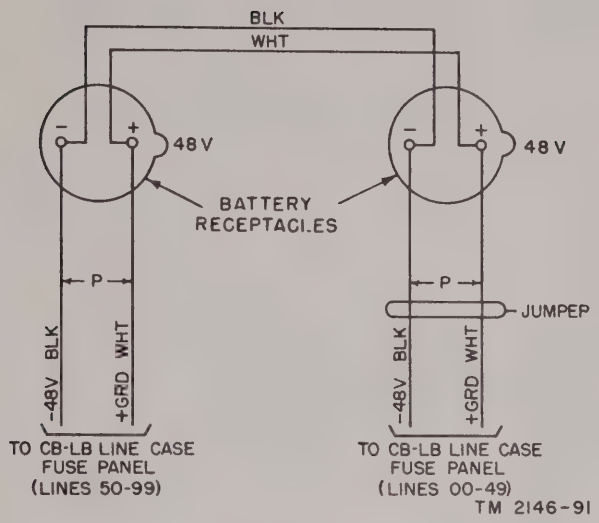


Figure 98. Line Relay Telephone Circuit TA-223/TTC, battery and ground receptacles, wiring diagram.

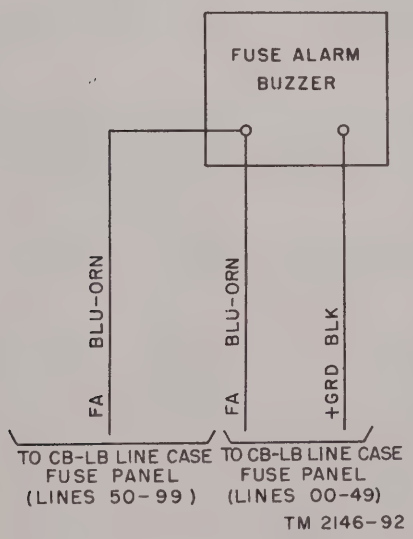


Figure 99. Line Relay Telephone Circuit TA-223/TTC, FA buzzer, wiring diagram.

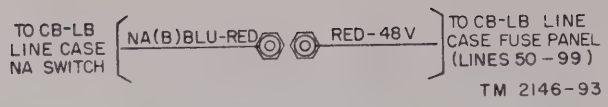


Figure 100. Line Relay Telephone Circuit TA-223/TTC, NA binding post, wiring diagram.

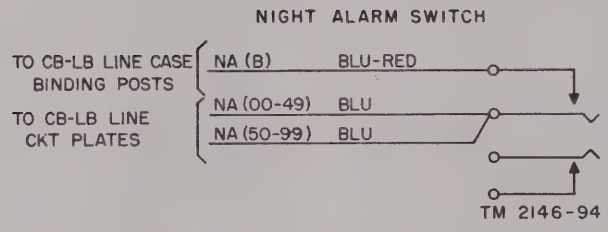


Figure 101. Line Relay Telephone Circuit TA-223/TTC, NA switch, wiring diagram.

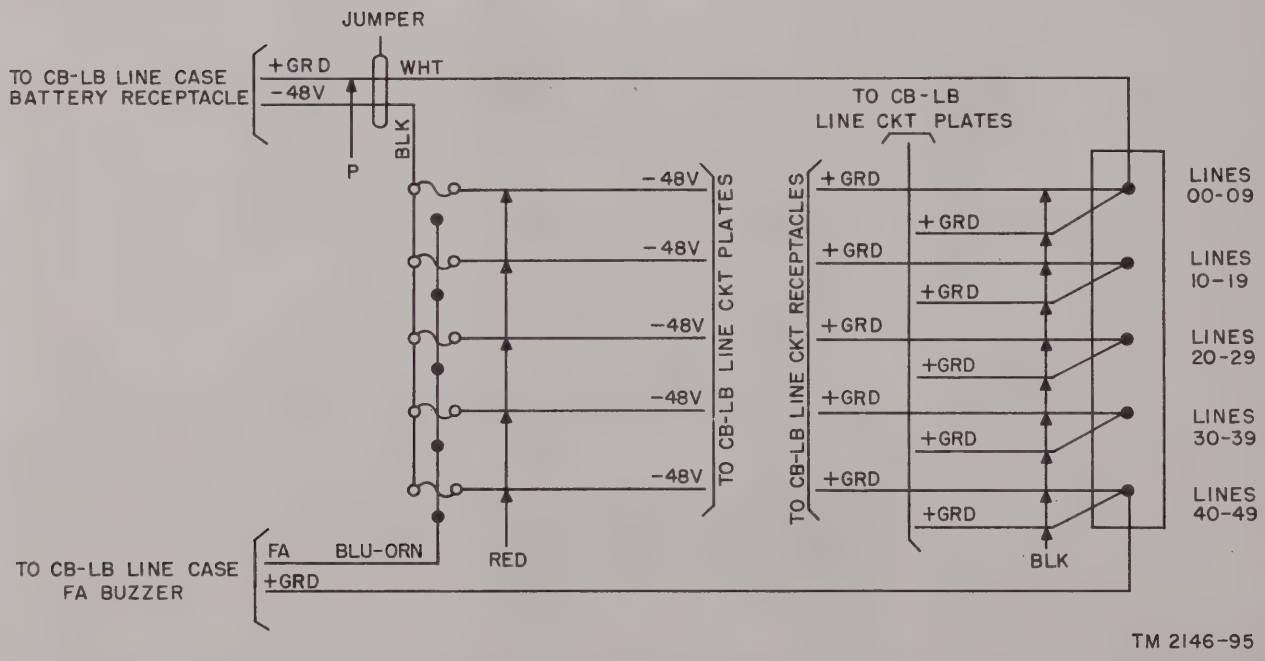


Figure 102. Line Relay Telephone Circuit TA-223/TTC, fuse panel, lines 00-49, wiring diagram.

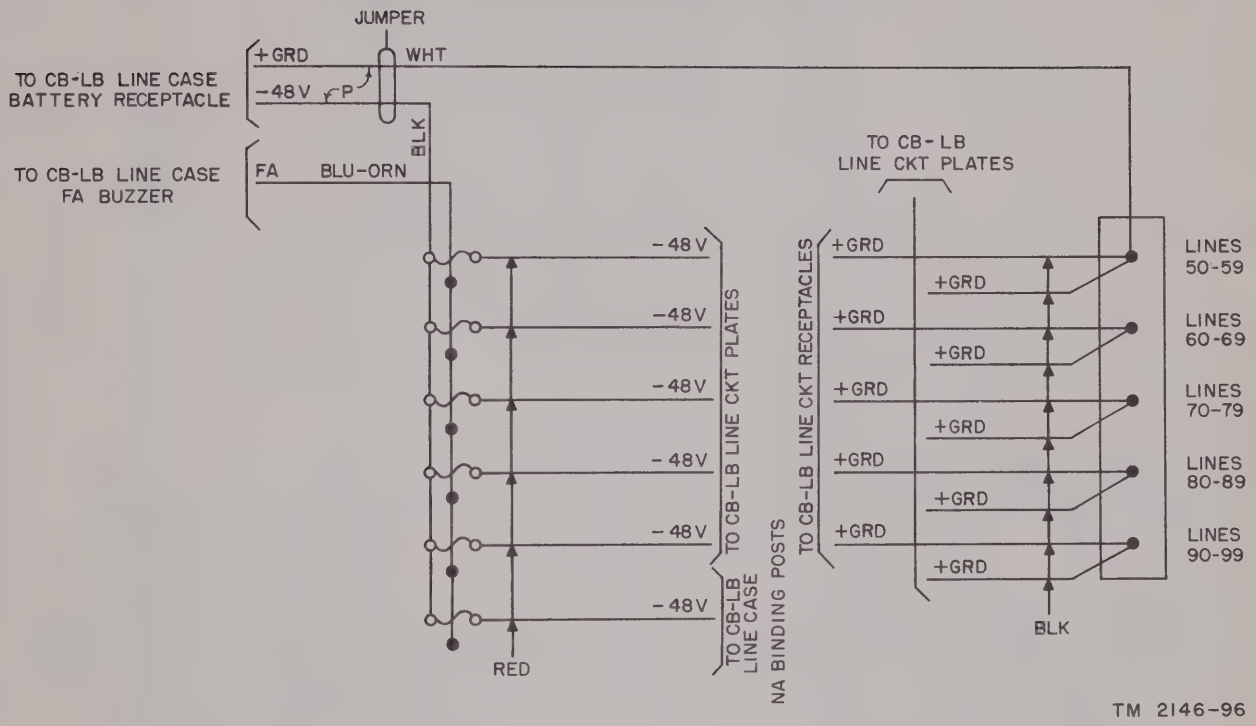


Figure 103. Line Relay Telephone Circuit TA-223/TTC, fuse panel, lines 50-99, wiring diagram.

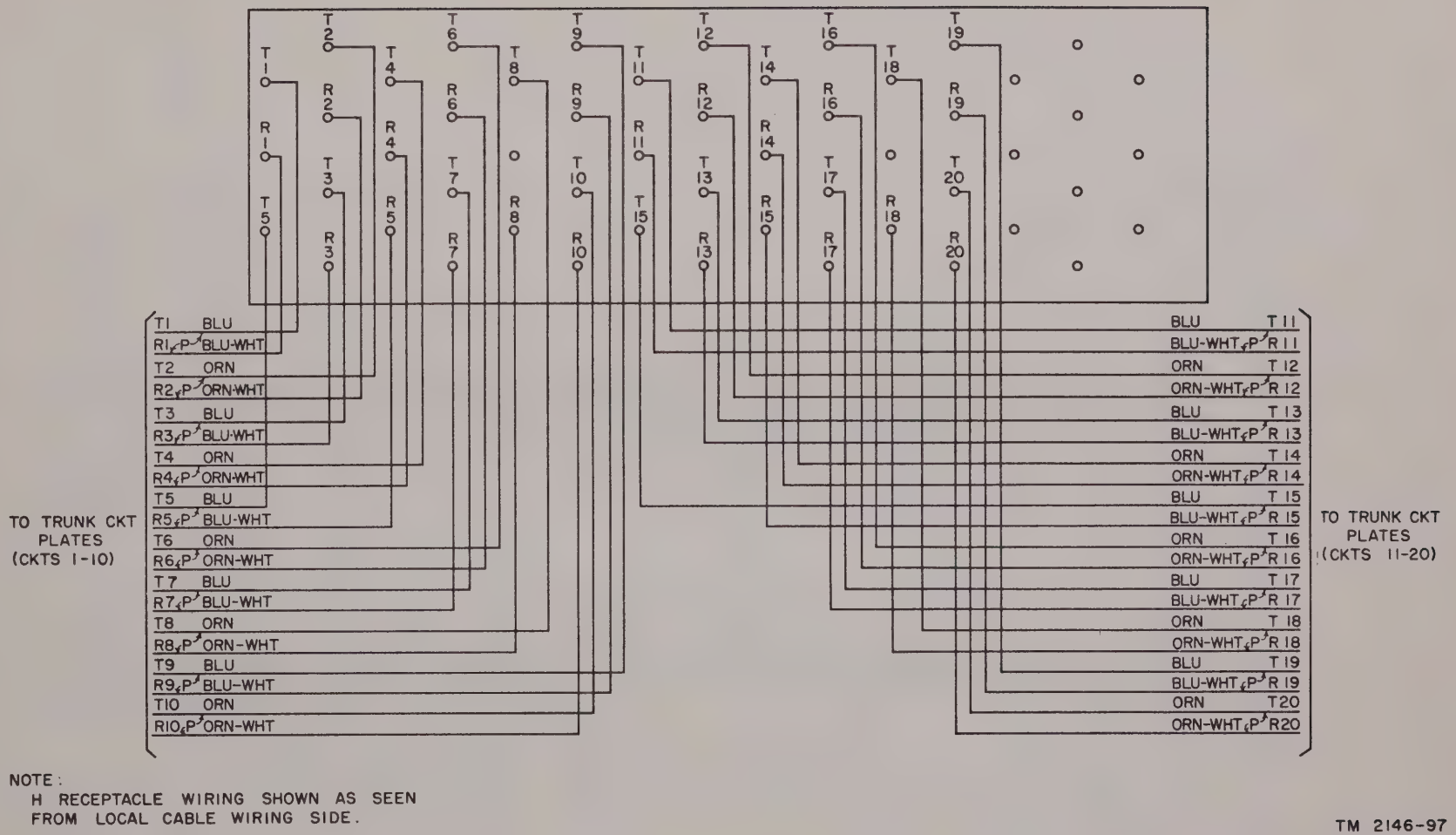


Figure 104. Trunk Relay Telephone Circuit TA-226/TTC, MDF receptacle H, wiring diagram.

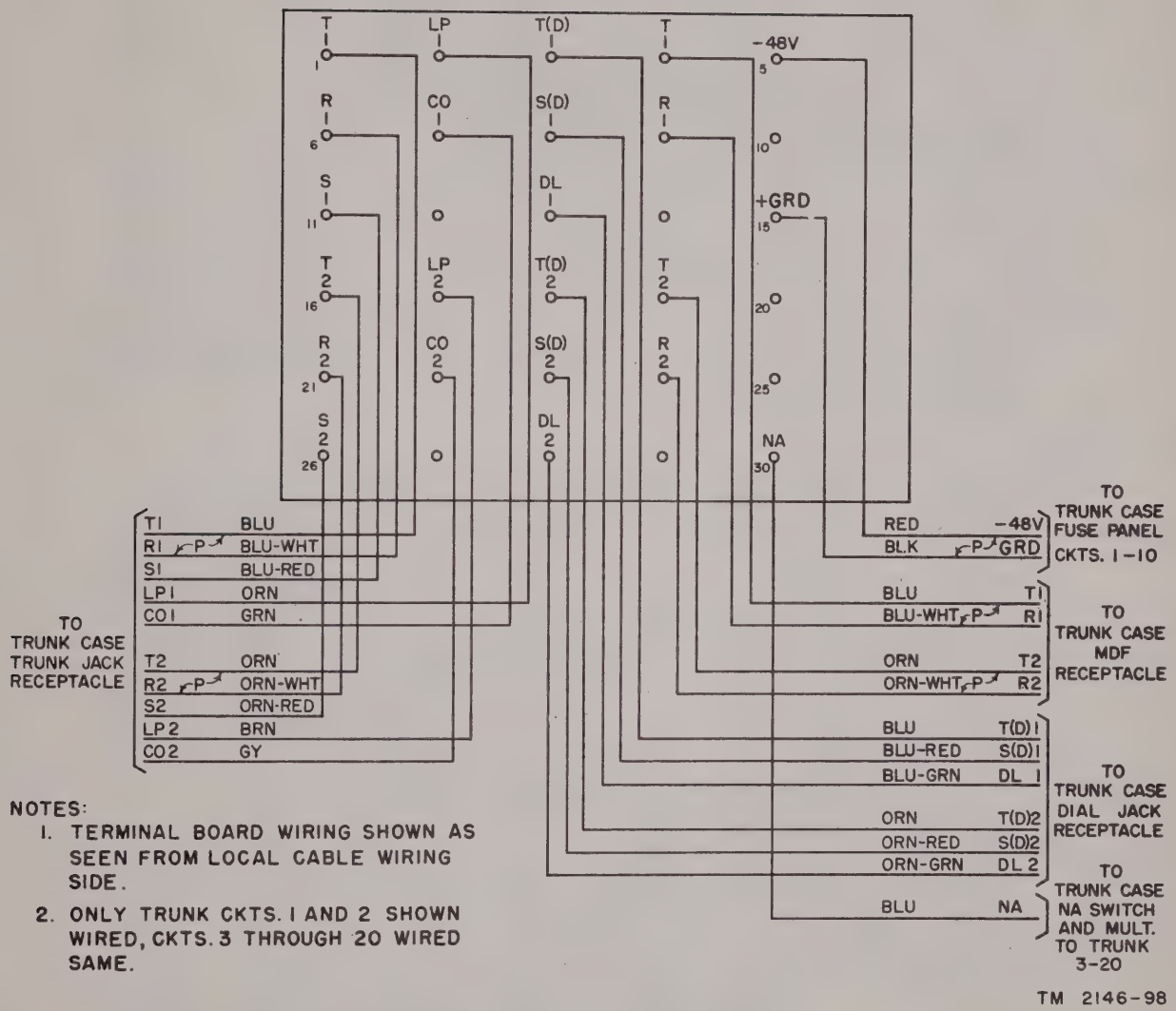


Figure 105. Trunk Relay Telephone Circuit TA-226/TTC, trunk circuit plate terminal board, wiring diagram.

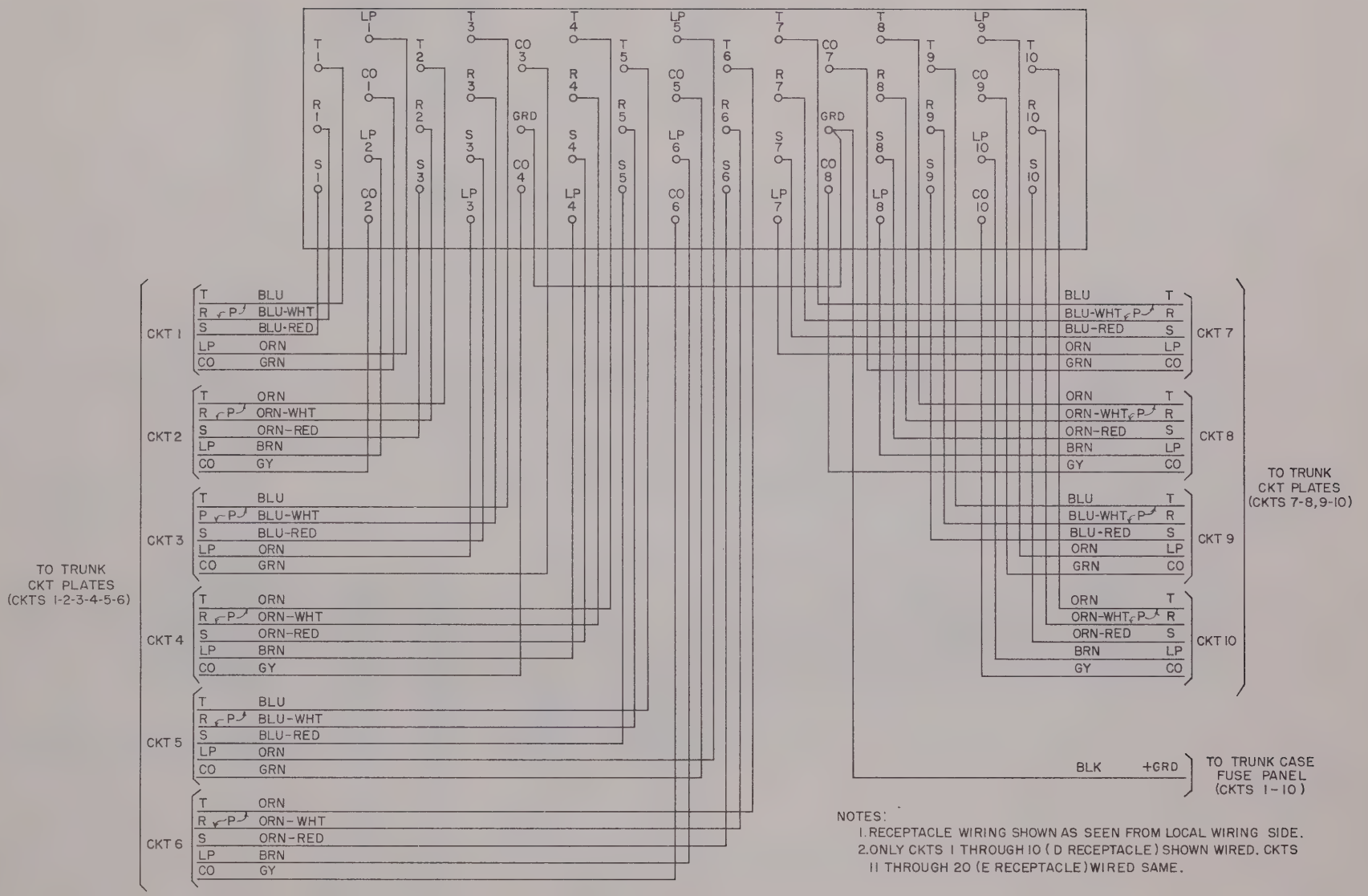


Figure 106. Trunk Relay Telephone Circuit TA-226/TTC, trunk jack receptacle, wiring diagram.

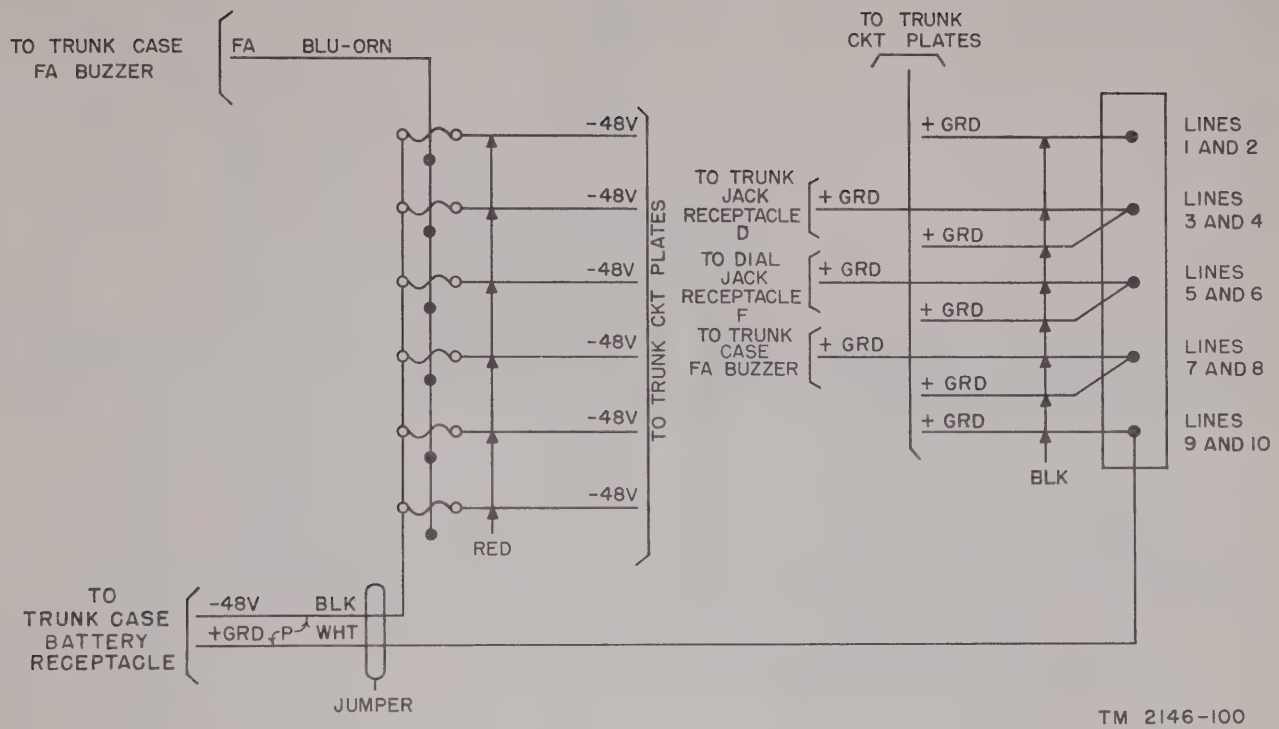


Figure 107. Trunk Relay Telephone Circuit TA-226/TTC, fuse panel, circuits 1-10, wiring diagram.

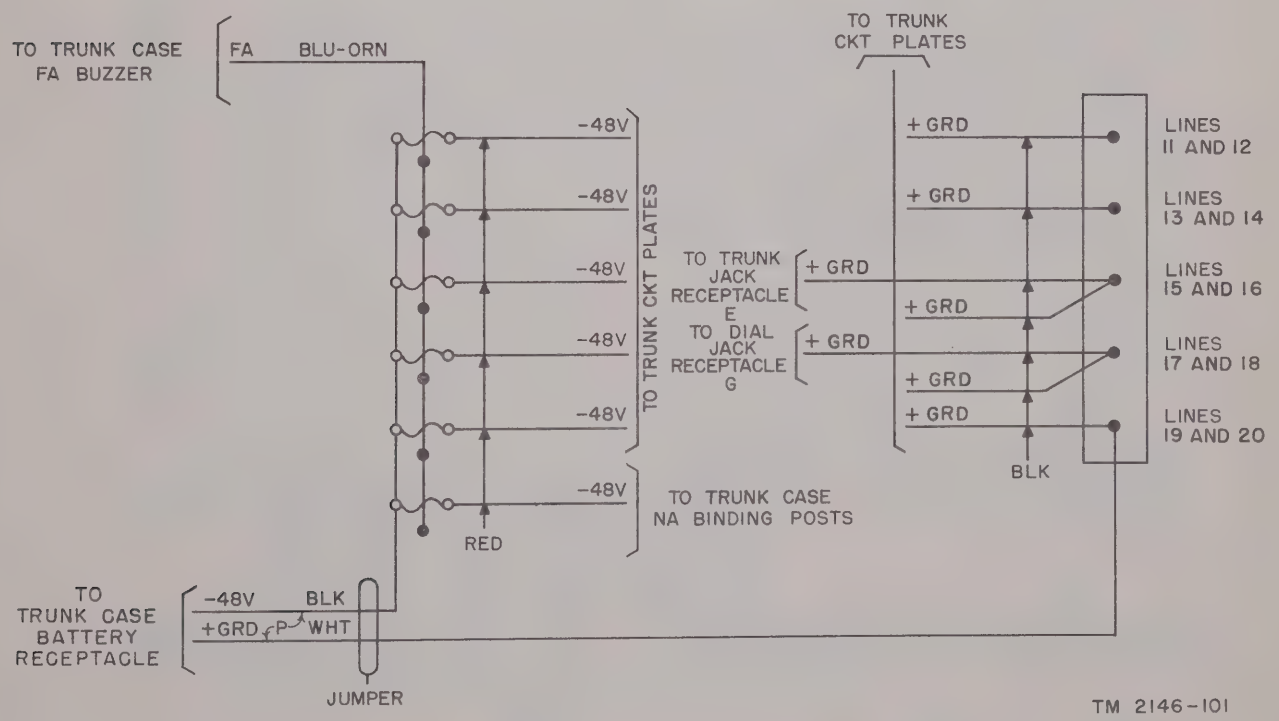


Figure 108. Trunk Relay Telephone Circuit TA-226/TTC, fuse panel, circuits 11-20, wiring diagram.

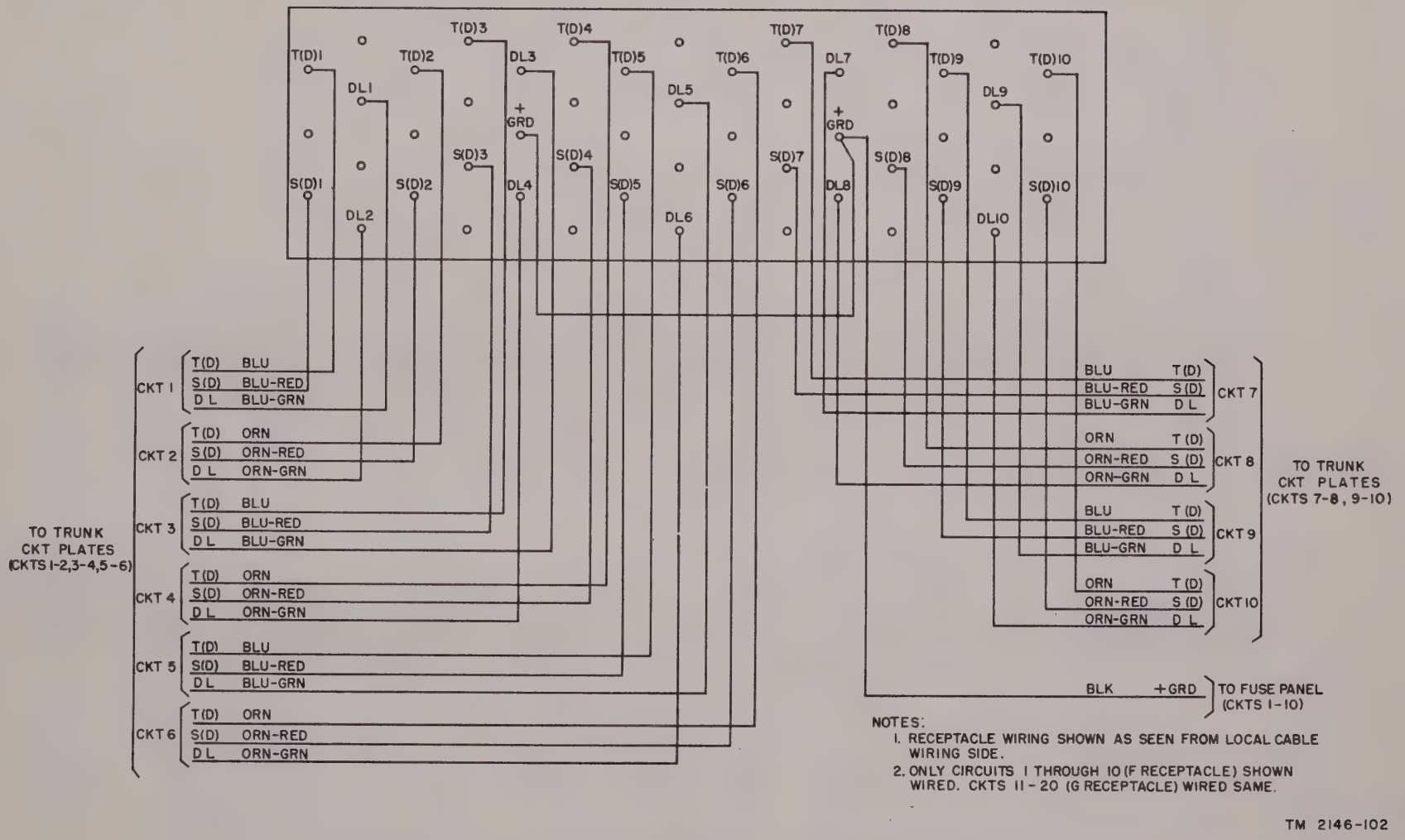


Figure 109. Trunk Relay Telephone Circuit TA-226/TTC, dial jack receptacle, wiring diagram.

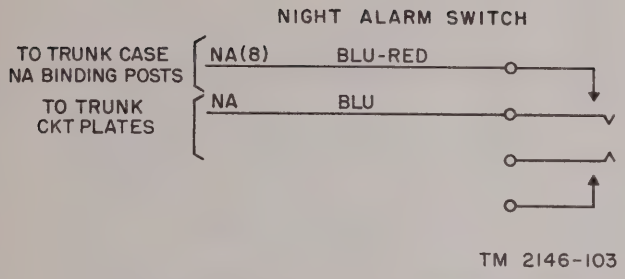


Figure 110. Trunk Relay Telephone Circuit TA-226/TTC, NA switch, wiring diagram.

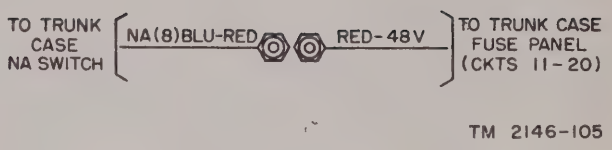


Figure 112. Trunk Relay Telephone Circuit TA-226/TTC, NA binding post, wiring diagram.

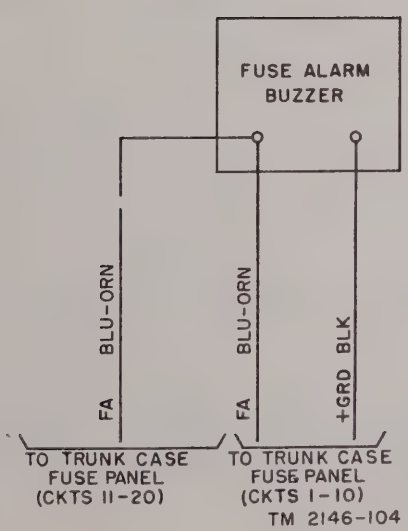


Figure 111. Trunk Relay Telephone Circuit TA-226/TTC, FA buzzer, wiring diagram.

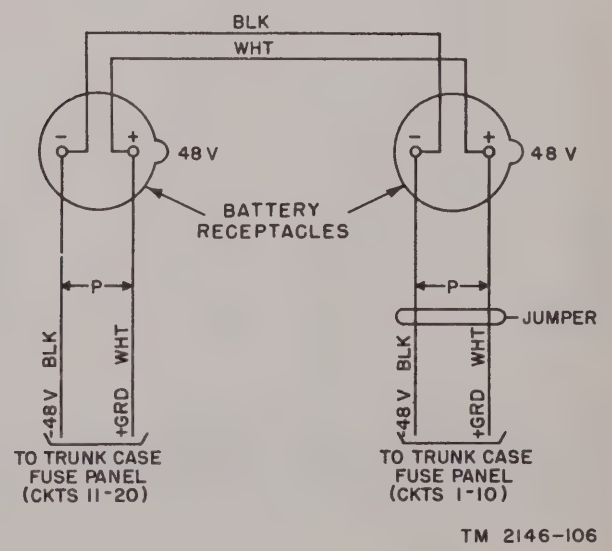
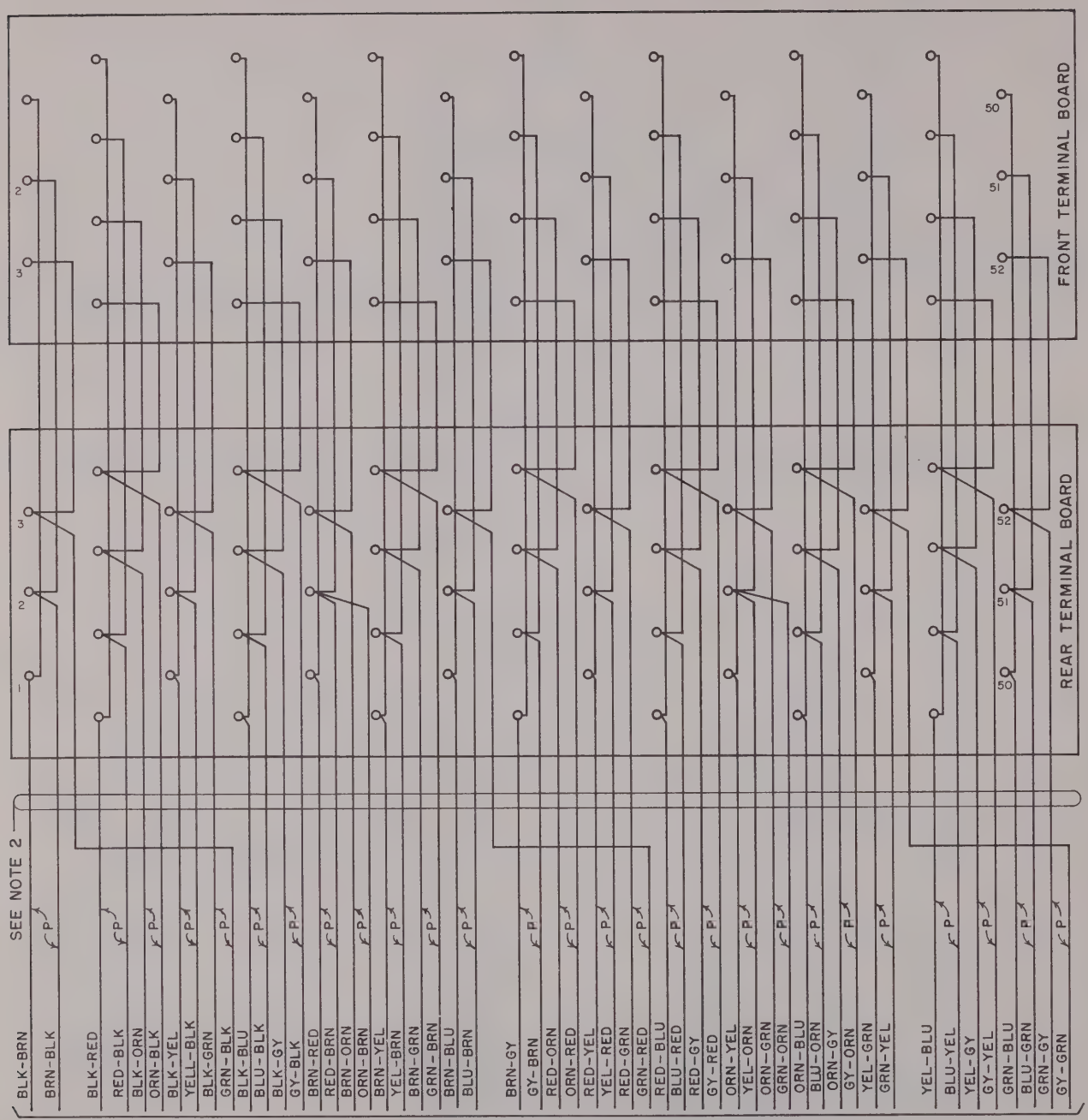


Figure 113. Trunk Relay Telephone Circuit TA-226/TTC, battery and ground receptacles, wiring diagram.



NOTES:
1. WIRING SHOWN AS SEEN FROM WIRING SIDE.
2. CABLE (27 PAIR).

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Figure 114. Manual Telephone Central Office AN/TTC-7, 52-pin connector plug, wiring diagram.

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