WAR DEPARTMENT TECHNICAL MANUAL

TM 11-2209

This manual supersedes TM 11-2209, 131B2 Printer Station Equipment for Army and Navy Installations, 10 May 1944.

TELETYPEWRITER

SET 131B2

WAR DEPARTMENT • FEBRUARY 1946

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WAR DEPARTMENT

WASHINGTON 25, D. C., 20 February 1946

TM 11-2209, Teletypewriter Set 131B2, is published for the information and guidance of all concerned.

[AG 300.7 (2 Nov 45)]

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Refer to FM 21-6 for explanation of distribution formula.

TECHNICAL MANUAL

TELETYPEWRITER REPEATER-MIXER AN/FGQ–1

TM 11–2209
CHANGES NO. 3

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *31 August 1955*

TM 11–2209, 20 February 1946, is changed as follows:

1.1. Forms and Records
(Added)

Note. This paragraph does not apply to the cryptographic equipment.

The following forms will be used for reporting unsatisfactory conditions of Army equipment:

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

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

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

d. Use other forms and records as authorized.

46. Relays

* * * * *

b. 255–A Type Relays.

* * * * *

(2) *Inspect* (*I*). Remove the relay * * * through the gap. If these two requirements are not met, the relay requires cleaning and readjustment according to **paragraphs 91 and 92.**

* * * * *

Section XIV.1. RELAY ASSEMBLY RE–121/UG
(Added)

67.1. Description of Relay Assembly RE–121/UG
(fig. 75.1, 75.5, and 75.6)

Relay Assembly RE–121/UG consists essentially of two, independent, 255–A type polar relays and associated control, filter, and rectifier circuits. A five-conductor, equipment interconnection cable assembly and an ac input cable are provided. A connection changing terminal board and a potentiometer control knob are mounted on the outside of the front panel. All of the electrical components are mounted on the back of the front panel and on an inner shelf. A box-shaped cover protects and completely incloses the internal parts. Louvers in the top of the cover provide ventilation.

67.2. Purpose and Use

Relay Assembly RE–121/UG is a line isolation and signal repeater unit for use specifically with Teletypewriter Repeater-Mixer AN/FGQ–1. It will receive polar signals from and send neutral signals to the AN/FGQ–1 and can be arranged to send and receive either neutral or polar signals over a two-wire line.

67.3. Packaging Data

For shipment, Relay Assembly RE–121/UG is placed in a close-fitting, corrugated fiberboard carton, which then is sealed. The carton then is sealed within a moisture-vaporproof barrier bag. The packaged unit is sealed within a second fiberboard carton. The dimensions, volume, and weight of the equipment packed for shipment and unpacked are given in the table that follows.

Relay Assembly RE–121/UG	Dimensions (in.)			Volume (cu ft)	Weight (lb)
	Height	Width	Depth		
Packed	10	8	7½	0. 34	5½
Unpacked	8	6½	5	. 15	5

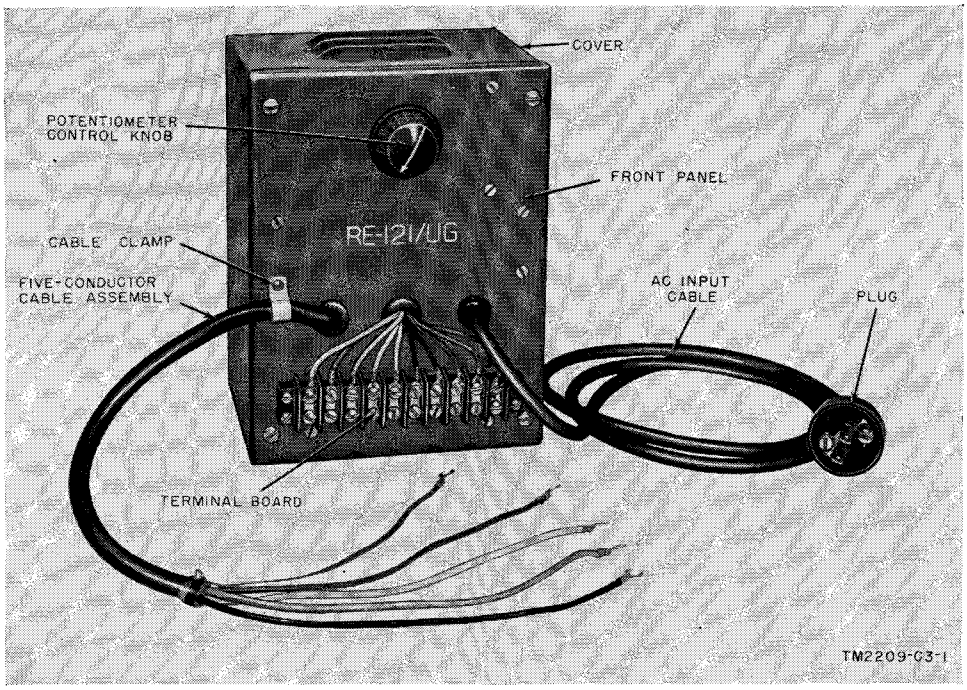


Figure 75.1 (Added). *Relay Assembly RE–121/UG.*

67.4. Unpacking and Checking

Be careful not to drop the relay assembly while it is being unpacked. Handle the unit carefully at all times.

a. Slit the sealing tape, open the carton, and remove the packaged equipment.

b. Open and remove the moisture-vaporproof barrier bag.

c. Slit the sealing tape, open the inner carton, and remove the equipment.

d. Examine the relay unit carefully. Be sure that it has not been damaged during shipment. If any damage is noted, fill out and forward DD Form 6 in accordance with the instructions in paragraph 1.1.

67.5. Connecting Relay Assembly RE–121/UG to Teletypewriter Repeater-Mixer AN/FGQ–1

(figs. 75.6 and 105)

The method of connecting Relay Assembly RE–121/UG to Teletypewriter Repeater-Mixer AN/FGQ–1 is the same for all types of operation. In the instructions that follow, all reference symbols that include the letter B indicate items mounted in the AN/FGQ–1.

a. Make the following changes in the AN/FGQ–1:

(1) Cut the shorting straps of resistors BO and BZ.

(2) Connect terminals B2 and B16 to terminal B14.

(3) Connect terminal B13 to terminal B3.

(4) Connect a milliammeter across terminals B18 to B19. Adjust the current to 30 milliamperes. To do this, if the current is too high, cut the straps across resistors BB and BC; if the current is too low, strap either resistor BB or BC. When the current is adjusted satisfactorily, disconnect the milliammeter.

(5) Strap terminal B18 to terminal B19.

b. Connect four of the five wires of the five-conductor cable assembly to terminal strip B of the AN/FGQ–1 repeater unit as follows:

(1) Connect the wire marked No. 15 to terminal B15.

(2) Connect the wire marked No. 1 to terminal B1.

(3) Connect the wire marked No. 13 to terminal B13.

(4) Connect the wire marked No. 21 to terminal B21. This grounds the RE–121/UG to the AN/FGQ–1.

c. Connect a milliammeter to the wire marked No. 4 and to terminal B4. Adjust the current to 60 milliamperes by adjusting resistors BV and BW. When the current is adjusted satisfactorily, disconnect the milliammeter and connect the wire marked No. 4 to terminal B4.

67.6. Connecting Relay Assembly Into a Two-Wire Line

(fig. 75.2)

a. Neutral, Half-Duplex Operation, Line Current Supplied by Distant Station (A, fig. 75.2). Make the following connections at the relay assembly terminal board:

(1) Connect the positive side of the line to terminal 5.
(2) Connect terminal 6 to terminal 7 with a jumper.
(3) Connect the negative side of the line to terminal 8.
(4) Insert the plug of the ac input cable into the convenience receptacle on the AN/FGQ–1.

b. Neutral, Half-Duplex Operation, Line Current Supplied by Local Station (B, fig. 75.2). When the line current is to be supplied by a separate rectifier placed near the relay assembly, make the following connections at the relay assembly terminal board:

(1) Connect the positive side of the rectifier output to terminal 5.
(2) Connect terminal 6 to terminal 7 with a jumper.
(3) Connect one line wire to terminal 8.
(4) Connect the other line wire to terminal 9.
(5) Connect the negative side of the rectifier output to terminal 10.
(6) Using the potentiometer, R14, adjust the current to 60 milliamperes.
(7) Insert the plug of the ac input cable into the convenience receptacle on the AN/FGQ–1.

c. Full-Duplex, Polar Send, Polar Receive, Line Current Supplied by Local Station (C, fig. 75.2). When the line current of the send circuit is to be supplied by a separate rectifier placed near the relay assembly, make the following connections at the relay assembly terminal board:

(1) Connect the positive side of the rectifier output to terminal 1 and connect terminal 1 to terminal 6 with jumper.
(2) Connect the negative side of the rectifier output to terminal 3 and connect terminal 3 to terminal 4 with jumper.
(3) Connect the ground side of the send line to terminal 2.
(4) Connect the send line to terminal 5.
(5) Connect the ground side of the receive line to terminal 7.
(6) Connect the receive line to terminal 10.
(7) Connect terminal 8 to terminal 9 with a jumper.
(8) Using the potentiometer, R14, adjust the current in the receive line to 20 milliamperes.
(9) The ac input cable is *not* used in this type of operation. *Do not plug it into the convenience receptacle of the AN/FGQ–1.*

67.7. Preventive Maintenance Services for Relay Assembly RE–121/UG

The tools and materials required to perform preventive maintenance on Relay Assembly RE–121/UG are listed in paragraph 53. Perform the preventive maintenance services described below at the same intervals that preventive maintenance is performed on the AN/FGQ–1.

a. Wipe dust and dirt from the outside of the relay assembly housing and the terminal board. Use a clean dry cloth or a soft brush.

b. Inspect all external wiring and electrical connections to see that the wire is in good condition and that the connections are clean and tight. Clean corroded contacts and tighten loose connections.

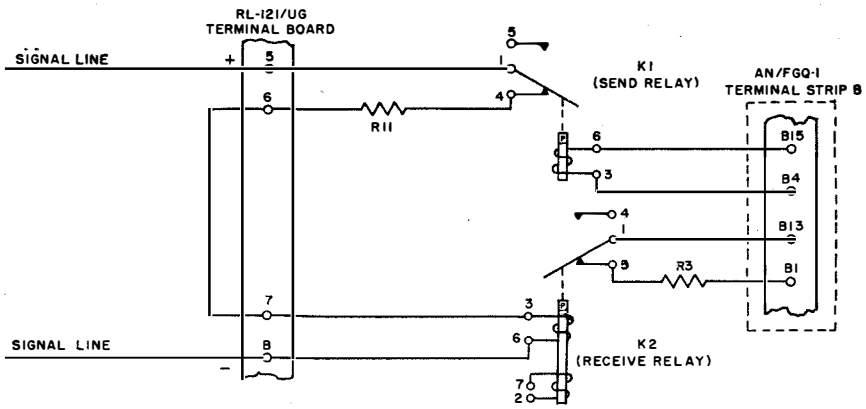
c. Perform the preventive maintenance operations described in paragraphs 44, 45, 46, 49, 50, and 51.

67.8. Theory of Operation

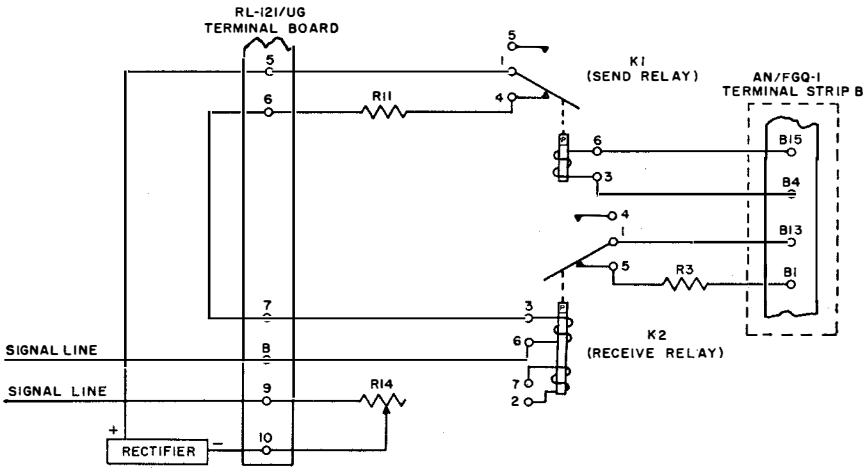
(figs. 75.2 and 75.3)

Relay Assembly RE–121/UG is a line isolation and repeater unit for Teletypewriter Repeater-Mixer AN/FGQ–1. The relay assembly functions in one of three ways, depending upon the connections made to its terminal board. Under each of the optional connection arrangements, the RE–121/UG receives *polar* signals from the AN/FGQ–1 in the line winding (3–6) of the send relay, K1, to control the send relay armature, which is in series with the signal line. The 7–2 winding of relay K1 is not used. The RE–121/UG receives signal line current in the line winding (3–6) of the receive relay, K2, to control the receive relay armature, which relays neutral signals to the receive circuit of the AN/FGQ–1. The three arrangements differ only in the type of operation used in the signal circuit between the RE–121/UG and the distant station, and in the location of the line current supply.

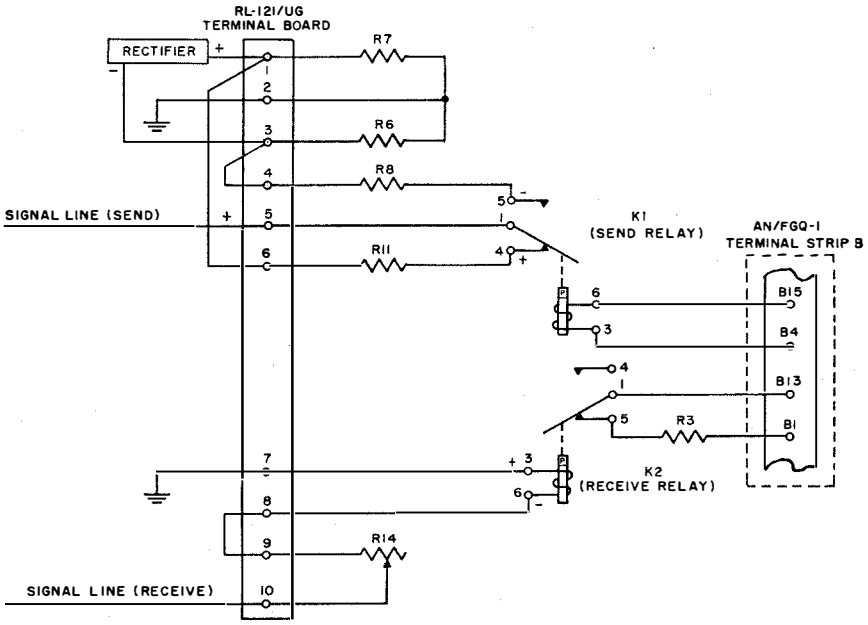
a. Neutral, Half-Duplex Operation, Line Current Supplied by Distant Station. When a local copy of all messages transmitted over the signal line is to



A. NEUTRAL, HALF-DUPLEX OPERATION, LINE CURRENT SUPPLIED BY DISTANT STATION



B. NEUTRAL, HALF-DUPLEX OPERATION, LINE CURRENT SUPPLIED BY LOCAL STATION



C. FULL-DUPLEX, POLAR SEND, POLAR RECEIVE OPERATION, LINE CURRENT SUPPLIED BY LOCAL STATION

TM2209-C3-2

Figure 75.2 (Added). *Relay Assembly RE–121/UG, partial schematic diagrams showing connections and circuits for three optional operation arrangements.*

be recorded and the distant station is to supply the line current, the RE–121/UG is connected as shown in A, figure 75.2. Operation of the relay assembly with this circuit arrangement is as follows:

(1) *Transmitting.* Current received in the form of polar signals (reversals of current) from the AN/FGQ–1 controls the armature of the send relay, K1, which, in turn, opens and closes the neutral signal circuit. The signal line circuit is closed when the armature of relay K1 is at contact 4, and is interrupted whenever the armature is at contact 5. Neutral signals are transmitted to the signal line.

(2) *Receiving.* Neutral signals, consisting of current and no-current impulses, are received in the line winding (3–6) of the receive relay, K2, from the signal circuit. Current through the line winding (marking impulses) causes the armature of the receive relay to move to contact 5 and to complete the receive circuit to the AN/FGQ–1. In the absence of current from the signal line circuit (spacing impulses), the bias winding (2–7) of relay K2, energized constantly from the AN/FGQ–1 with current approximately half the value of the signal line current, causes the armature of relay K2 to move to contact 4 and to open the receive circuit of the AN/FGQ–1.

b. Neutral, Half-Duplex Operation, Line Current Supplied by Local Station. When a local copy of all messages transmitted over the signal line is to be recorded and the local station is to supply the line current, the RE–121/UG is connected as shown in B, figure 75.2. Operation of the relay assembly with this circuit arrangement is the same as that described in *a* above, except for the location of the rectifier that supplies the line current. The signal circuit is traced from the negative side of the rectifier to terminal 10 of the relay assembly terminal board, through current limiting potentiometer R14, through terminal 9 of the relay assembly terminal board, to one side of the signal circuit. The circuit then continues through the distant equipment and returns through the opposite side of the signal circuit to terminal 8 of the relay assembly terminal board. The circuit then continues through the line winding (3–6) of the receive relay, K2, to terminal 7 of the terminal board, through a strap to terminal 6, through resistor R11, and then to the contacts of the send relay, K1, and terminal 5 of the terminal board, which is connected to the positive side of the rectifier.

c. Full-Duplex Operation, Polar Send, Polar Receive, Line Current Supplied by Local Station. When a local copy of transmitted messages is not required, the sending and receiving operations are carried on independently. In this type of operation, line current normally is supplied by the transmitting station. The RE–121/UG is connected as shown in C, figure 75.2, and the operation of the relay assembly with this circuit arrangement is as follows:

(1) *Transmitting.* Polar signals from the AN/FGQ–1 energize the line winding (3–6) of the send relay, K1, and control the armature of the send relay.

(*a*) If the armature of relay K1 is against contact 5, the path of negative battery from the rectifier is through terminal 3 of the relay assembly terminal board, through a strap to terminal 4, through resistor R8 to contact 5 and the armature (1) of relay K1, to terminal 5 of the relay assembly terminal board, and to the signal line. The signal goes to the receiver of the distant station and then to ground. The local ground connection of the relay assembly provides a path to terminal 2 of the relay assembly terminal board. The circuit continues through resistor R7 to terminal 1 of the relay assembly terminal board and to the positive side of the rectifier.

(*b*) If the armature of relay K1 is against contact 4, the path of negative battery from the rectifier is through terminal 3 of the relay assembly terminal board, through resistor R6 to terminal 2 of the terminal board. The signal then goes to ground at the local equipment, to the ground connection of the distant station, and through the line winding of the distant receiver. The circuit then continues through the send signal line to terminal 5 of the relay assembly terminal board, through the armature of relay K1, to contact 4, through resistor R11 to terminal 6 of the relay assembly terminal board, and

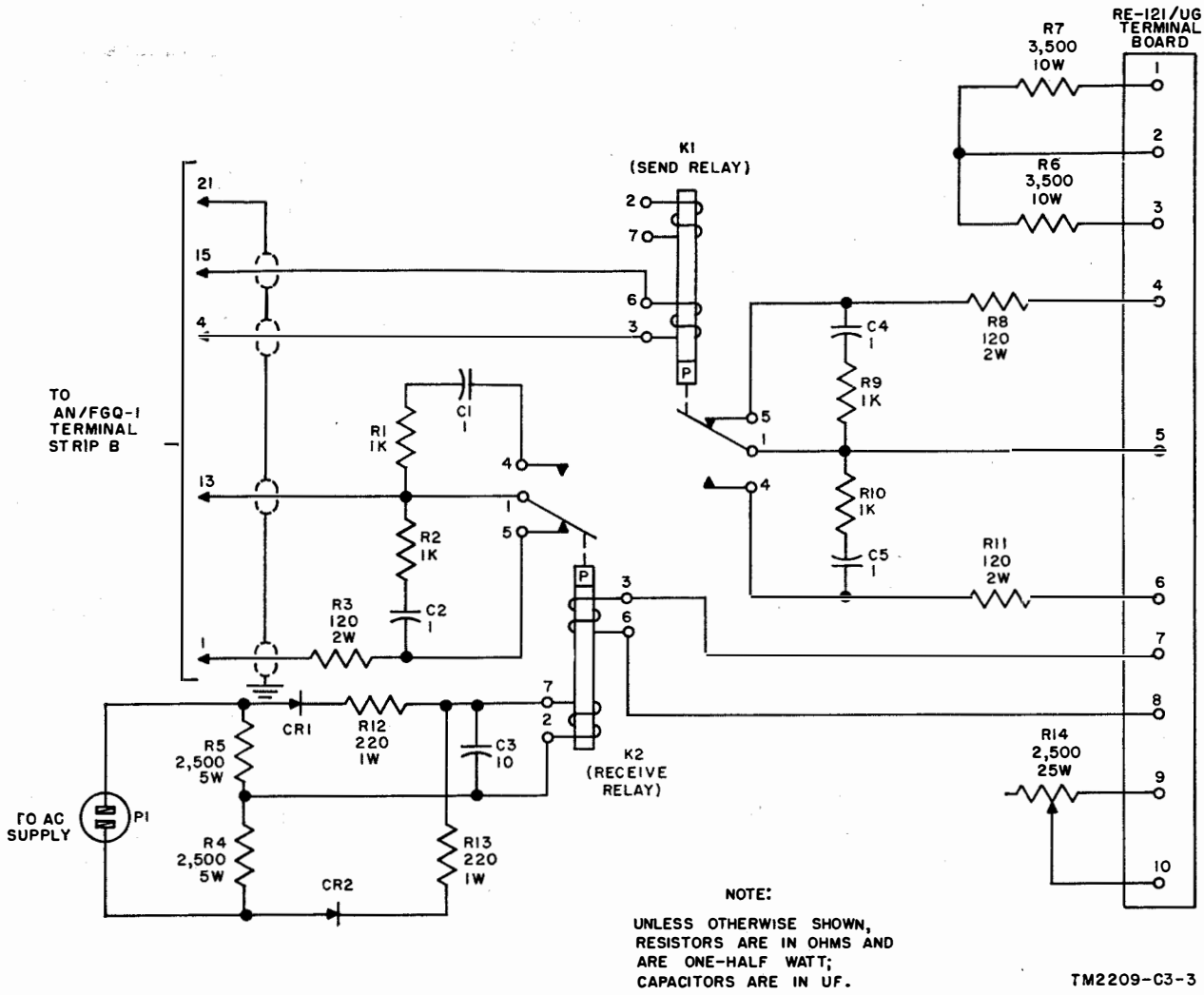


Figure 75.3 (Added). *Relay Assembly RE-121/UG, schematic diagram.*

then to terminal 1, which is connected to the positive side of the rectifier.

(2) *Receiving.* Polar signals received in K2 operate the K2 armature to relay neutral signals to the AN/FGQ–1. The K2 bias winding is not energized for this type of operation. The K2 line winding (3–6) and variable resistor R14 are placed in series with the receive circuit at terminals 7 and 10.

d. Bias Winding Circuit, Receive Relay K2. The bias winding of K2 is energized only when this relay is to operate with neutral signals. This circuit is energized when the plug, P1, (fig. 75.3) is connected to an ac power source. The ac is applied to a full-wave rectifier circuit that consists of rectifiers CR1 and CR2; resistors R4, R5, R12, and R13; and filter capacitor C3. The output of this rectifier circuit is connected to terminals 2 and 7 of the receive relay jack. Insertion of relay K2 into this jack places the bias winding across the output of the rectifier circuit.

67.9. Trouble Location and Repair

a. General. If the relay assembly fails to function satisfactorily, before looking further for the difficulty, be sure the trouble is not an incorrect, loose, or dirty connection.

(1) Check the connections at the relay assembly terminal board to be sure they are correct for the type of operation desired (par. 67.6).

(2) Remove the cover and check the internal connections and wiring.

b. Checking and Adjusting Relays. A check of the operation of the send and receive relays, K1

and K2, is a convenient way to locate many difficulties.

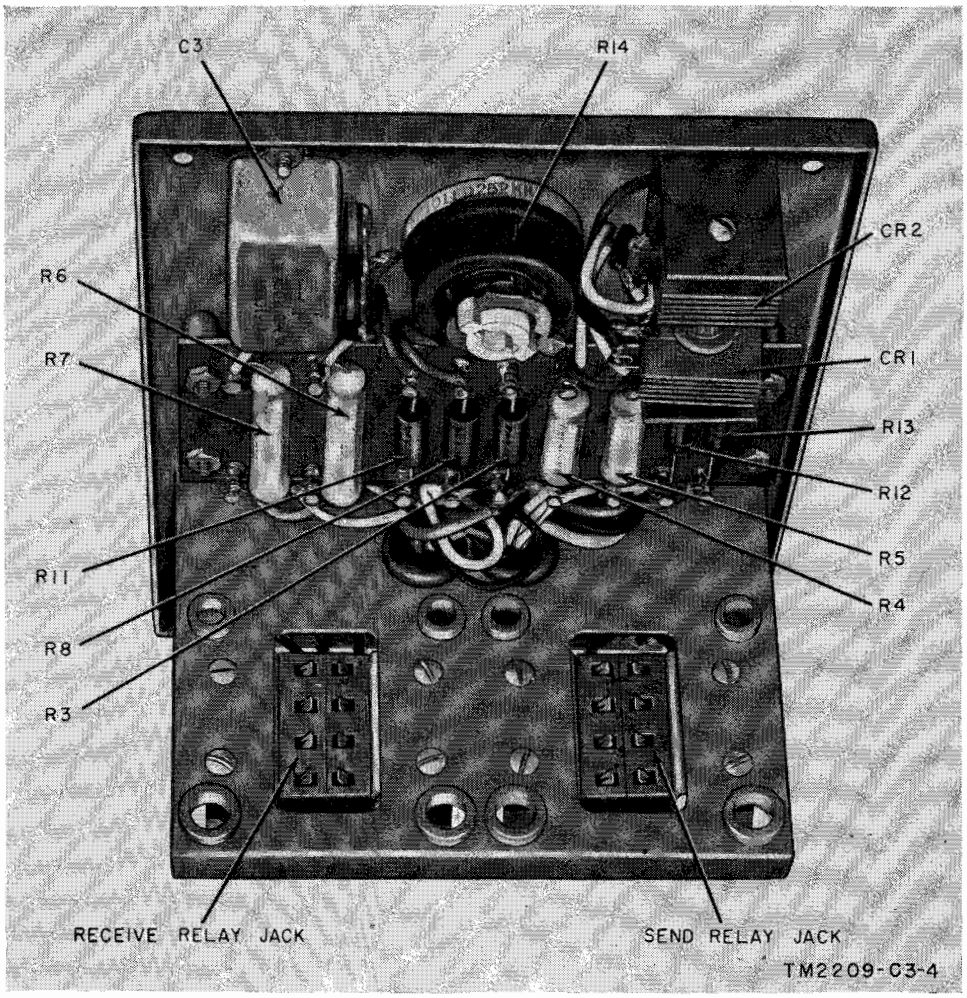
(1) If a relay is suspected to be the source of the difficulty, if possible, substitute (par. 67.9*b*) a relay known to be in good condition and adjustment.

(2) Check the suspected relay in accordance with the instructions in paragraph 46*b*. If the relay is found to be the cause of the difficulty, clean and adjust the relay in accordance with the instructions in paragraphs 91 and 92. *Do not adjust relays unless it is absolutely necessary.*

c. Other Trouble Location and Repair. The location of trouble in components other than the relays necessitates an analysis of the operation of the relay assembly and the interrelated circuits of the AN/FGQ–1.

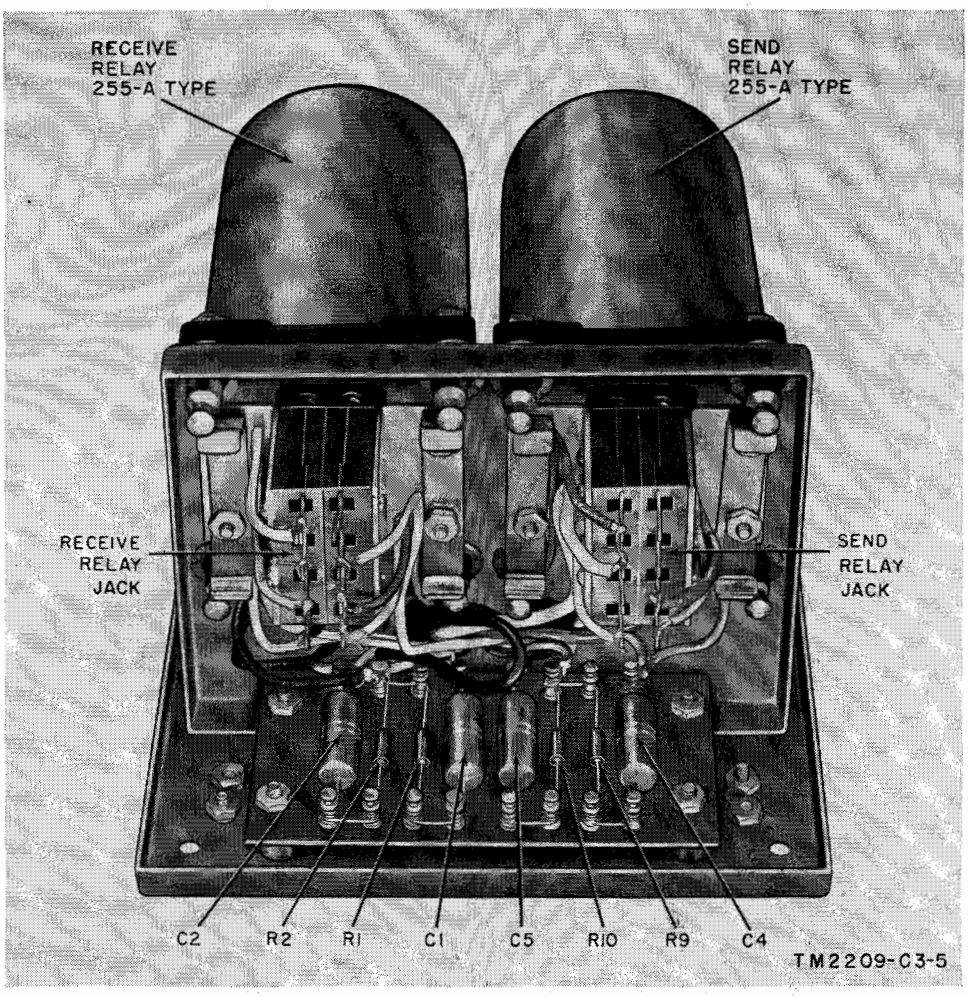
(1) When the trouble has been localized to a particular circuit, check each component of the circuit to determine the faulty component. Figures 75.4 and 75.5 show the location of components.

(2) Replace the faulty component with a new one (par. 67.10).



C3. Filter capacitor for output of rectifiers CR1 and CR2.
CR1. Selenium-type, half-wave rectifier.
CR2. Selenium-type, half-wave rectifier.
R3. Current limiting resistor in receive circuit.
R4. Voltage divider in rectifier input circuit.
R5. Voltage divider in rectifier input circuit.
R6. Voltage divider resistor.
R7. Voltage divider resistor.
R8. Current limiting resistor in send circuit.
R11. Current limiting resistor in send circuit.
R12. Filter resistor in rectifier output circuit.
R13. Filter resistor in rectifier output circuit.
R14. Potentiometer, adjustable current limiting resistor.

Figure 75.4 (Added). *Relay Assembly RE–121/UG, top view, cover and relays removed.*



C1. Capacitor, part of filter circuit for receive relay K2.
C2. Capacitor, part of filter circuit for receive relay K2.
C4. Capacitor, part of filter circuit for send relay K1.
C5. Capacitor, part of filter circuit for send relay K1.
K1. Send relay, 255–A type polar relay.
K2. Receive relay, 255–A type polar relay.
R1. Resistor, part of filter circuit for receive relay K2.
R2. Resistor, part of filter circuit for receive relay K2.
R9. Resistor, part of filter circuit for send relay K1.
R10. Resistor, part of filter circuit for send relay K1.

Figure 75.5 (Added). *Relay Assembly RE–121/UG, bottom view, cover removed.*

67.10. Removal and Replacement of Components

a. Cover. Take out the four large screws, one at each corner of the front panel, and pull the chassis out of the cover.

b. Relays. The relays plug into the equipment and can be removed without disconnecting any wires.

(1) To remove a relay, pull it out of its jack.

(2) To remove the dust cover from the relay, turn the cover counterclockwise and pull it forward.

(3) To reinstall a relay, plug it into the jack in the equipment.

c. All Other Components. To remove any of the other components of the relay assembly, unsolder the leads and remove the mounting screws. Tag the leads before detaching them to assure reconnecting them correctly. Mount the replacement part and solder the leads to the terminals. Be careful not to allow solder to drop into the equipment, especially on the plates of the rectifiers. Be sure to reconnect the leads to the correct points on the new part. Check the wiring and the color coding with figure 75.6.

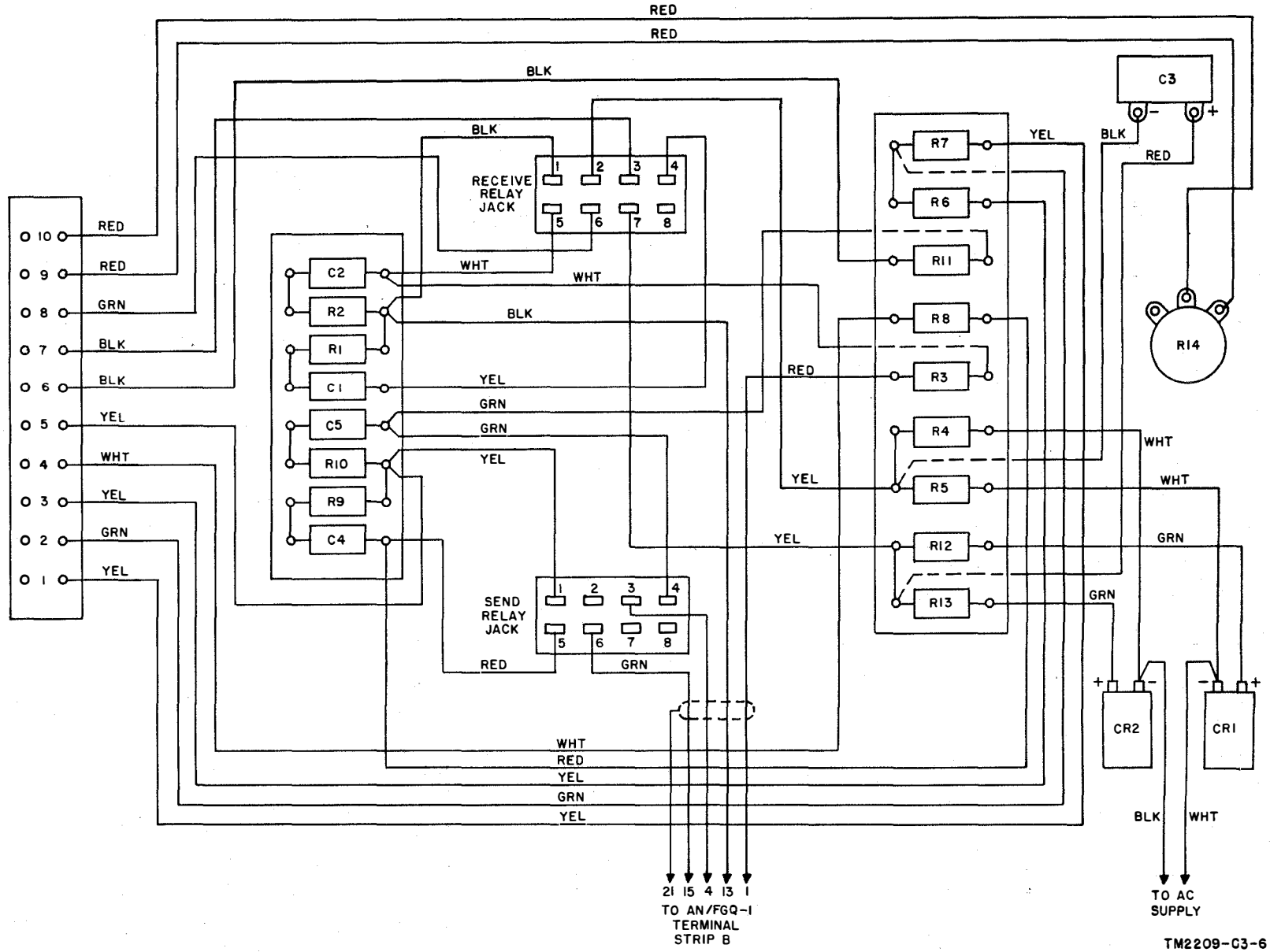


Figure 75.6 (Added). *Relay Assembly RE-121/UG, wiring diagram.*

PART FIVE

REPAIR INSTRUCTIONS

Note.* Failure or unsatisfactory performance of equipment will be reported on **DA Form 468 (Unsatisfactory Equipment Report) **(Army), or DD Form 535** (Unsatisfactory Report) **(Air Force)**.

* * * * *

69. Unsatisfactory Equipment Report

(Superseded)

a. When trouble with equipment used by the Department of the Army occurs more often than repair personnel consider to be normal, DA Form 468, Unsatisfactory Equipment Report, should be filled out and forwarded in accordance with the instructions in paragraph 1.1*b*.

b. When trouble with equipment used by the Department of the Air Force occurs more frequently than repair personnel consider to be normal, DD Form 535 should be filled out and forwarded in accordance with the instructions in paragraph 1.1*c*.

Figure 76 is rescinded.

* * * * *

91. Cleaning and Adjustment of 255–A Type Relays

a. General. If a relay * * * position for repairs. After inspection and cleaning, readjust the relay according to **the instructions in paragraph 92** if Test Set I–193–A is not available. If Test Set * * * in TM 11–2513.

* * * * *

c. Inspection of Relay Contacts. Inspect the relay * * * one is available. The replaced relay requires cleaning (***d* below**) and readjustment (**par. 92**). If the contacts * * * the other contact. If a gap wider than 0.005 inch is found, the relay requires cleaning (***d* below**) and readjustment (**par. 92**).

* * * * *

[AG 300.7 (30 Jun 55)]

BY ORDER OF THE SECRETARY OF THE ARMY:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

OFFICIAL:
JOHN A. KLEIN,
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The Adjutant General.

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Gen & Br Svc Sch (5)
SigC Sch (25)
Gen Depots (2) except Atlanta Gen Depot (0)
SigC Sec, Gen Depots (10)
SigC Depots (20)
POE (2)
OS Sup Agencies (2)
SigC Fld Maint Shops (3)
SigC Lab (5)
Mil Dist (1)
Units organized under following TOE's:
11–7R, Sig Co Inf Div (2)
11–16R, Hq & Hq Co, Sig Bn, Corps or Abn Corps (2).
11–57R, Armd Sig Co (2)
11–127R, Sig Rep Co (2)
11–128R, Sig Depot Co (2)
11–500R (AA–AE), Sig Svc Org (2).
11–557R, Abn Sig Co (2)
11–587R, Sig Base Maint Co (2)
11–592R, Hq & Hq Co, Sig Base Depot (2).
11–597R, Sig Base Depot Co (2)

NG: State AG (6); units—same as Active Army except allowance is one copy to each unit.
USAR: None.
For explanation of abbreviations used, see SR 320–50–1.

TAGO 1229A

U. S. GOVERNMENT PRINTING OFFICE: 1955

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C 1
TO 16-45-140

TECHNICAL MANUAL

TELETYPEWRITER REPEATER-MIXER AN/FGQ-1

CHANGES No. 1

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *10 August 1951*

TM 11-2209, 20 February 1946, is changed as follows:
The title of the manual is changed to read—

TELETYPEWRITER REPEATER-MIXER AN/FGQ-1

PART ONE

INTRODUCTION

Note (Added).—Teletypewriter Repeater-Mixer AN/FGQ-1, procured on Order Nos. 25817-Phila-49 and 21851-Phila-50, is essentially the same as the equipment covered in TM 11-2209. Whenever Teletypewriter Set 131B2 appears in the manual, change the nomenclature to Teletypewriter Repeater-Mixer AN/FGQ-1.

AGO 458A—Aug. 950968°—51

Figure 106. **Teletypewriter Repeater-Mixer AN/FGQ–1,** *repeater unit, circuit requirement table.*

APPARATUS		MECH. REQ.			CIRCUIT PREPARATION			TEST SET PREP.	SEE TEST NOTE NO.	DIRECT CURRENT FLOW REQ.					REMARKS
DESIG.	CODE	BSP FIG.	CONT. PRESS.	ARM. TRVL.	BLOCK OR INSULATE	TEST CLIP DATA				TEST WDG.	TEST FOR	AFTER SOAK MA	TEST MA	READJ. MA	
						CONN. BAT.	CONN. GRD.								
*			*		*			*		*			*		*
BK1	Y254	151/201	H	41	(BK)O	B(BK1)	T(BK1)	NGB	½		O	40		27	KEY
													28. 5		●PERATED
					(BK)O	B(BK1)	T(BK1)	NGB	½		R		1. 2	1. 6	TO (TEXT)
					(BK)O	**B(BK1)**	**T(BK1)**	**NGB**	½		**H**		4. 9	4. 6	POS.
*			*		*			*		*			*		*

APPENDIX II

IDENTIFICATION TABLE OF PARTS

(Superseded)

Note.—The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as a specific T/O&E, T/A, SIG 7&8, SIG 7–8–10, SIG 10, list of allowances of expendable material, or another authorized supply basis. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1.

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	TELETYPEWRITER REPEATER-MIXER AN/FGQ-1: 2-way TT repeater and mixer; cabinet of wood and steel construction; 30 5″ h x 26″ wd x 22″ d o/a; input 95 to 125/190 to 250 v, 25 to 60 cyc ac.	A teletypewriter secrecy system in which plain text messages are enciphered automatically before transmission and incoming messages in cipher are deciphered automatically and recorded in plain text.	4TW131-B2
	POWER SUPPLY GROUP		
	POWER SUPPLY: metallic disk type; output—120 v dc, .8 amp continuously, 1.2 amp dc intermittently: input—95 to 250 v. 25 to 60 cyc ac.	Supplies 120 volts d-c from a-c supply	3H4956-33
	CABLE ASSEMBLY, power: 2 #18 AWG stranded cond; 2′ lg excl term.	For d-c power connections to power unit	3EM2DH-1
	CABLE ASSEMBLY, power: 2 #16 AWG stranded copper cond; braided copper shield w/#16 AWG lead at ea end; 2′ lg excl term.		3E4036-24-5
	CABLE ASSEMBLY, power: 2 #16 AWG stranded copper cond; #36 AWG copper braid w/#16 AWG lead at ea end; 24″ lg excl term.		3E4036-24-6
	CABLE ASSEMBLY, power: 4 stranded tinned copper cond; 9′ lg excl 5 color-coded free leads.		3EM5G
	CABLE ASSEMBLY, power: 2 #18 AWG stranded cond; 2′ 6″ lg excl term.; Hubbell plug No. 7465 one end, other end bared and stripped.		3E7350.1-9.2
	CABLE ASSEMBLY, special purpose: 4 #22 AWG pr, 1 shielded cond; 2′ 6″ lg excl term.	Teletypewriter unit interconnection	3EM9C
	CABLE ASSEMBLY, special purpose: 4 #22 AWG pr, 1 shielded cond; 6′ lg excl term.	Same as above	3EM9D

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	POWER SUPPLY GROUP—Continued		
D	CONNECTOR, plug: 3 rectangular polarized female cont; straight type.	D-c power connection to power unit	6Z3150-6
A	CONNECTOR, plug: 4 flat polarized male cont; straight type.	Same as above	6Z1729
	CONNECTOR, plug: 4 rectangular polarized male cont; straight type.	For connection to transmitter-distributor unit.	2Z8639-2
	CONNECTOR, plug: 4 rectangular polarized female cont; straight type.	Same as above	2Z8639-17
	CONNECTOR, plug: 2 curved male twistlock cont; straight type.	For connection to repeater and mixing relay units.	
B, C	CONNECTOR, receptacle: 2 T-shaped polarized female cont one sec., 3 flat polarized female cont other sec.; straight type.	B—For motor power to crypto unit C—Convenience outlet.	6Z7809-21
A	CONNECTOR, receptacle: 4 rectangular polarized female cont; straight type.	For connection to power unit	6Z7783-4
	CONNECTOR, solderless: cap type; accommodates 5 #18 AWG wires.	For external connections in power circuit.	6Z3188
A, B, C	FILTER, low-pass: 10 kc cut-off	Electrical noise suppressor	6Z1892-1.10
	FOOT, mounting	Protects floor from scratches	6Z4016-50
	FUSE, plug: 3.2 amp	Protects relay P	3Z2603.13
	FUSEHOLDER: screw type; for single No. 3.2 Fustat.	Holds 3.2-ampere fuse	3Z3285-6.4
	INSULATOR, bushing: post shape; white porcelain; 1″ lg o/a; $1\frac{3}{16}$″ OD, $\frac{5}{16}$″ ID.	Insulates cable passage	3G1250-16.38
	LABEL: $3\frac{3}{4}$″ lg x $\frac{7}{8}$″ wd; inscribed BEFORE OPERATING READ TM 11-2209.	Warning label	6D16782
	LABEL: 6″ lg x $4\frac{3}{4}$″ wd	Circuit label	6D16782-1
	MOUNT, vibration: sq mtg; $2\frac{1}{4}$″ sq x 1″ thk o/a.	Mounts associated equipment	2Z8404-45
	MOUNT, vibration: sq mtg; $2\frac{1}{4}$″ sq x 1″ thk o/a.	Same as above	2Z8405-20
P	RELAY, armature: DPST, normally open; single wnd; operates 42 to 56 v dc, .055 amp, 1130 ohms; ins coil.	Input power relay from repeater circuit	2Z7589-96
	PLATE, retainer: cold rolled steel, cad pl; oval shape; 1″ lg x $\frac{1}{2}$″ wd x .024″ thk o/a.	Holds captive screws in place	4Z6684-1
	SCREW, captive: thumbscrew; knurled thumb head; cold rolled steel, cad pl; retainer ring.	Fastening screws	6L4768-24.8K
	TERMINAL, lug: ring type; .120″ wd x $\frac{5}{32}$″ d wire groove.	For terminal board ground connections	4E6399
	WASHER, flat: round; $\frac{7}{8}$″ ID, $1\frac{1}{2}$″ OD; $\frac{1}{32}$″ thk.		6L58034G

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	REPEATER UNIT GROUP		
A, C	BOARD, terminal: for tp relay rack wiring; 8 U-shaped solder lug term.; approx 1⅝″ lg x 13/16″ wd x ⅞″ h o/a.	For control panel connections	4E9955B
B	BOARD, terminal: general purpose; 21 brass nickel pl screw term.; 8½″ lg x ⅞″ wd x 3/32″ thk.	For teletypewriter connections	2Z9421.5
	BRACKET: used to mount WECo term. strip No. 203 or No. D-164205.	Holds terminal board	4Z2778
D, D1	CAPACITOR, fixed: paper dielectric; single sec.; 100,000 μμf min, 125,000 μμf max; 300 vdcw.	Spark-killer for contacts 1-4 of relay LS	3DA100-156
B, C, E, F G	CAPACITOR, fixed: paper dielectric; single sec.; 500,000 μμf min, 620,000 μμf max; 300 vdcw.	B—Spark-killer for contacts 1-5 of relay LR. C—Spark-killer for contacts 1-4 of relay LR. E—Spark-killer for contacts 1-4 of relay TR. F—Spark-killer for contacts 1-5 of relay TR. G—Spark-killer for contacts 1-4 of relay TS.	3DA500-80
A	CAPACITOR, fixed: paper dielectric; .5 μf +.125 μf; 200 vdcw; JAN type CP79A1HC504W.	Spark-killer for contacts 4-7 of relay BK	3DA500-485
J, J1, J2	CAPACITOR, fixed: paper dielectric; 4.36 μf max, 4.28 μf min; 200 vdcw.	Allows slow release of relay LB	3DB4E36
H	CAPACITOR, fixed: paper dielectric; 5 μf max, 4 μf min; 200 vdcw.	Filter from relay TS to teletypewriter magnets.	3DB5-90
	CONNECTOR, receptacle: 8 rectangular female cont slots; straight type.	For relay connections	4E318B
E	CONNECTOR, receptacle: 2 curved polarized female cont; straight type.	For connecting repeater-mixer relay unit	6Z7813-3
D	CONNECTOR, receptacle: 3 flat-blade polarized male cont; straight type.	For connection to power unit	6Z8367
	COVER: relay	Relay cover	4C3103-2
	COVER: relay	Same as above	4C3103-6
	COVER: relay; L-shaped; 1⅝″ lg x 1⅝″ wd x 1¼″ d o/a.	Covers top of relay	4Z3504-1
	FUSE, plug: .8 amp	Protects d-c input	3Z2598-1.1
	FUSEHOLDER: screw type; for single No. S 8/10 Fustat.	Holds .8-ampere fuse	3Z2876-6
	HOLDER, label	Holds circuit label	4TW264699
	LABEL: 10⅝″ lg x 8″ wd	Circuit label	6D16782-2
	LAMP, incandescent: tp swbd lamp; 48 v, .030 to .042 ampl T-2 clear bulb.	Indicator lamps	4C5492Y
	LENS, indicator light: red, opalescent; 3 5/64″ dia.	Indicator lamp lens	4C25040
	LENS, indicator light: amber, opalescent; 17/32″ dia.	Same as above	4C2504M

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	REPEATER UNIT GROUP—Con.		
CIPHER, BK, TEXT	LIGHT, indicator: w/o lens; for No. 2 type lamp.	CIPHER (amber)—Indicates cipher message condition. BK (red)—Indicates break in signal condition. TEXT (red)—Indicates test message condition.	4C5572
LR, LS, TR, TS	RELAY, armature: SPDT; 2 parallel wnd, 5 ma dc cur.; 2 inductive wnd, 136-ohm d-c resistance.	LR—Repeats signals to relay TX. LS—Repeats outgoing signals from relay TX. TR—Repeats signal from teletypewriter on polar basis. TS—Repeats signal to teletypewriter selector magnet.	4TRY30
LT	RELAY, armature: cont arrangement 1C; single wnd; 48 v dc; .003 amp oper. .001-amp release, 500 ohms; polarized; ins.	Prevents relay LS from opening line with power removed from station.	4C9139FM
RV	RELAY, armature: cont arrangement 1C; 2 wnd; 48 v dc; pri—.005-amp oper, .0012-amp release, 120 ohms dc; secd—.0039—amp oper, 480 ohms; polarized; ins.	Controls relays LB and LS	4C9139JC
LB	RELAY, armature: cont arrangement 1C; 2 parallel wnd; 48 v dc; ea .001-amp oper, 1915 ohms; polarized; ins.	Slow-release relay	4C9139JE.1
BK	RELAY, armature: cont arrangement 1C; 2 parallel wnd; 48 v dc; ea. .0022-amp oper, 95 ohms; polarized; ins.	Operates slow-release relay BK1	4C9139JS
CP, TX	RELAY, armature: cont arrangement pos #1 and #2—1A2C1D; single wnd; .0165 amp, 1775 ohms; inductive; ins.	CP—Repeats ciphered signal from relay TR to mixing relay circuit. TX—Repeats incoming and outgoing signals.	4C8920.1112
BK1	RELAY, armature: cont arrangement pos #1—2A2B, pos #2—1A2B; single wnd; .027-amp oper, .0016-amp release, 830 ohms; inductive; polarized.	Slow-release break relay	4C8939.254
BL	RESISTOR fixed: WW; 100 ohms ±1%; 5.1 w at 40° C ambient temp.	Current limiter together with resistors BF and BG, across contacts 1-4 of relay LS.	3Z6010.83
BT	RESISTOR, fixed: WW; 106 ohms ±1%; CT—47 ohms one sec., 59 ohms other sec.; 5.1 w max distributed or 5 w for either provided other sec. is used at .1 w or less.	Current limiter, winding 2-5 of relay BK	3Z6005J9
BO, BZ	RESISTOR, fixed: WW; 120 ohms ±5%; 5.1 w at 104° F max ambient temp.	BO—Current limiter, contact 5 of relay LS. BZ—current limiter, contact 4 of relay LS.	3Z6012-6
AC, AD	RESISTOR, fixed: WW; 120 ohms ±5%; 18 w at 275° C max continuous oper temp; JAN type RW33J121.	AC—Current limiter, positive battery to terminal B14 of connector B. AD—Current limiter, negative battery to terminal B13 of connector B.	3RW18034

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	REPEATER UNIT GROUP—Con.		
G, N, T	RESISTOR, fixed: WW; 265 ohms ±5%; 20 w.	G—Current limiter, teletypewriter magneto and contact 5 of relay CP. N—Current limiter, BREAK-BREAK RELEASE key to contact to teletypewriter keyboard control key. T—Current limiter, STA TEST key contact, contact 4 (bottom) of relay BK1, and teletypewriter sending contacts.	3Z6015-70
BV	RESISTOR, fixed: WW; 600 ohms ±5%; CT—200 ohms one sec., 400 ohms other sec.; 5.1 w max distributed or 5 w for either provided other sec. is used at .1 w or less.	Current limiter, winding 3–6 of relay LR	3Z6040-16
E, R, W	RESISTOR, fixed: WW; 600 ohms ±5%; 20 w.	E—Current limiter, winding 2–7 of relay RV. R—Current limiter, contact 3 of relay CP. W—Current limiter, winding of relay BK1.	3Z6060-58
BR	RESISTOR, fixed: WW; 620 ohms ±1% 5.1 w at 40° C ambient temp.	Part of spark-killer circuit for relay TS	3Z6062-4
U, V	RESISTOR, fixed: WW; 710 ohms ±5%; 18 w at 275° C max continuous oper temp; JAN type RW33J711.	U—Current limiter, STA TEST key contact and contact 4 of relay TX. V—Current limiter, contacts 1 and 4 of relay LR and contacts 4 and 6 of relay TX.	5RW23426.
BS	RESISTOR, fixed: WW; 750 ohms ±1%; 5.1 w at 104° F max ambient temp.	Part of spark-killer circuit for relay TS	3Z5818DR
BW	RESISTOR, fixed: WW; 900 ohms ±5%; CT—300 ohms one sec., 600 ohms other sec.; 5.1 w max distributed or 5 w for either provided other sec. is used at .1 w or less.	Current limiter, winding 3–6 of relay LR	3Z6060-46
S	RESISTOR, fixed: WW; 900 ohms ±5%; 18 w at 275° C max continuous oper temp; JAN type RW33J901.	Current limiter, negative battery to teletypewriter subset table circuit.	3RW24012
BP, BX	RESISTOR, fixed: WW on refractory core; 1600 ohms ±5%; 5.1 w at 40° C ambient temp.	BP—Part of spark-killer circuit for relay TS. BX—Current limiter for winding 2–7 of relay TS.	3Z6160-7
BY	RESISTOR, fixed: WW; 1600 ohms ±1%; 5.1 w at 40° C ambient temp.	Current limiter, winding 3–5 of relay LB	3Z6160-19
D, P, Z	RESISTOR, fixed: WW; 1600 ohms ±5%; 20 w.	D—Current limiter, winding 3–6 of relay RV and contact 3 of relay LB. P—Current limiter, contact 11 of relay CP. Z—Current limiter, winding of relay LT and contacts 5 and 8 of relay CP.	3Z6160-23
BB, BC	RESISTOR, fixed: WW on core of heat-resistant material; 2000 ohms ±5%; 5.1 w at 40° C ambient temp.	Current limiters, winding 2–7 of relay LR to terminal B18 of connector B.	3Z6200-55

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	REPEATER UNIT GROUP—Con.		
BE	RESISTOR, fixed: WW; 2000 ohms ±5%; CT—1000 ohms ea sec.; 5.1 w max distributed or 5 w for either provided other sec. is used at .1 w or less.	Part of spark-killer circuit for contacts 1–4 of relay LS.	3Z6200–187
J, M, Y	RESISTOR, fixed: WW; 2000 ohms ±5%; 16.2 w at 275° C max continuous oper temp; CT—100 ohms, 8.1 w ea sec.; JAN type RW33J202T.	J—Current limiter, contact 7 of relay BK, contact 11 of relay TX, and contact 2 of relay CP. M—Current limiter, break indicator. Y—Current limiter, contact 4 of relay LB, contact 7 of relay TX, contact 6 (top) of relay BK1, and winding of relay TX.	3RW26159
BK	RESISTOR, fixed: WW; 2300 ohms ±1%; CT—1150 ohms ea sec.; 5.1 w max distributed or 5 w for either provided other sec. is used at .1 w or less.	Current limiter, line to contact 1 of relay LS, contact 2 of relay BK1, and contact 5 of relay LT.	3Z6115–1
BA	RESISTOR, fixed: WW; 2500 ohms ±5%; 5.1 w at 40° C ambient temp.	Part of spark-killer circuit for contacts 47 of relay BK.	3Z6250–47.1
BD, BN	RESISTOR, fixed: WW; 3200 ohms ±5%; CT—1600 ohms ea sec.; 5.1 w max distributed or 5 w for either provided other sec. is used at .1 w or less.	BD—Part of spark-killer circuit for contacts 1–4 and 1–5 of relay LR. BN—Part of spark-killer circuit for contacts 1–4 and 1–5 of relay TR.	3Z6320–6
H, AA	RESISTOR, fixed: WW; 3300 ohms ±5%; 20 w.	H—Current limiter, winding 3–6 of relay TR and capacitors J, J1, and J2. AA—Current limiter, contact 1 (top) of relay BK1 and TEXT and CIPHER lamps.	3Z6330–25
A	RESISTOR, fixed: WW; 3500 ohms ±5%; 16.2 w at 275° C max continual oper temp; JAN type RW33J712T.	Voltage divider for common battery connection to bias coil of relay LR.	3RW27625
K, X	RESISTOR, fixed: WW, 4,000 ohms ±5%; 21.6 w at 275° max continuous oper temp; JAN type RW40F402T.	K—Current limiter, bias winding of relay LS. X—Current limiter, windings 3–4 of relay LB and 2–7 of relay TR.	3RW27941
L	RESISTOR, fixed: WW, 4,900 ohms ±5%; 20 w power dissipation at 120° F max continuous oper temp.	Current limiter winding of relay CT and winding 2–5 of relay BK.	3Z6490–3
BM	RESISTOR, fixed: WW; 6,600 ohms ±1%; CT—600 ohms, 1.5 w one sec., 6,000 ohms, 3.6 w other sec.	Current limiter, line to contact 1 of relay LS, contact 2 of relay BK1, and contact 5 of relay LT.	3Z6560–17
B, C, AB	RESISTOR, fixed: WW; 7,100 ohms ±5%; 16.2 w at 215° C max continuous oper temp; CT—3,550 ohms, 8.1 w ea sec.; JAN type RW33J712T.	B and C—Voltage divider for common battery connection to line winding of relay LS. AB—Voltage divider, terminal 1 of filter B.	3RW29426
F	RESISTOR, fixed: WW; 8,300 ohms ±5%; 20 w.	Current limiter, winding 1–8 of relay RV.	3Z6583
BG	RESISTOR, fixed: WW; 8,600 ohms ±5%; 5.1 w at 40° C ambient temp.	Current limiter, together with resistors BF and BL, across contacts 1–4 of relay LS.	3Z6586
BJ	RESISTOR, fixed: WW; 9,000 ohms ±5%; 5.1 w power dissipation.	Current limiter, line to contact 1 of relay LS, contact 2 of relay BK1, and contact 5 of relay LT.	3Z6590–7

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	REPEATER UNIT GROUP—Con.		
BU	RESISTOR, fixed: WW; 10,000 ohms ±5%; 5.1 w power dissipation.	Current limiter, winding 1–8 of relay RV.	3Z6610–125
BF, BH	RESISTOR, fixed: WW; 10,000 ohms ±1%; 5.1 w power dissipation.	BF—Current limiter, together with resistors BG and LB, across contacts 1–4 of relay LS. BH—Current limiter, line to contact 1 of relay LS, contact 2 of relay BK1, and contact 5 of relay LT.	3Z6610–124
	SPRING: flat type; 2¼″ lg x ⅜″ wd x ⅝″ h; U-shaped.	Retains type 225–A relay	4Z6891–8
	SUPPRESSOR, electrical noise: capacitor and coil type.	Electrical noise suppressor	3Z1892–5
A, B, C	SUPPRESSOR, electrical noise: capacitor and coil type.	Same as above	3Z1892–3.38
	SWITCH, lever: 2 pos nonlocking; cont arrangement pos #1—B2C, pos #2–1C and 1C.	BREAK—BREAK RELEASE key. In the BREAK position it creates a steady spacing condition on the line. In the BREAK—RELEASE position it re-releases or unlocks a break which has been received by the station.	4C5104.79BF
	SWITCH, lever: 3 pos locking; cont arrangement pos #1 and #2–2C.	CIPHER—LOCAL TEST—TEXT key. In the CIPHER position, it places the station in condition to send and receive enciphered messages. In the TEXT position, it places the station in condition to send and receive test messages. In the LOCAL TEST position, it places the station in condition to send copy locally from its keyboard or transmitter-distributor to its own typing unit.	4C5105.73A.3
	SWITCH, rotary: cont arrangment 4C	STA TEST KEY. In the TEST position, it places the station in condition to be tested locally. In the REG (regular) position, it places the station in condition for normal operation.	4C5102.72D.1
	TERMINAL, lug: angle type; for #15 AWG wire or smaller.	For connections to relays JE, FM, and JS.	3Z12075–12
	TERMINAL, lug: angle type; for #15 AWG wire or smaller.	For connection to resistor F	4E6427A
	TERMINAL, lug: spade type; for #18 AWG wire.	For connections to terminal board B	3Z12027–2
	MIXING RELAY UNIT GROUP		
	BOARD, terminal: for tp relay rack wiring; 8 U-shaped solder lug term.; approx 1⅝″ lg x 13/16″ wd x ⅞″ h o/a.	Connections to repeater unit	4E9955B
	BRACKET: used to mount WECo term. board No. 203 or No. D–164205.	For holding terminal board	4Z2778
A, B, C, D	CAPACITOR, fixed: paper dielectric; single sec.; 500,000 μμf min, 620 μμf max; 300 vdcw.	Spark suppressor	3DA500–80
	CONNECTOR, receptacle: 8 rectangular female cont slots; straight type.	For connections to relay R	4E318B

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	MIXING RELAY UNIT GROUP—Con.		
E	CONNECTOR, plug: 2 curved polarized male blades; straight type.	Mates with plug E in repeater unit	6Z1735.8
F	CONNECTOR, receptacle: 2 polarized female cont; straight type.	Mates with plug F in crypto unit	6Z7813-3
A	CONNECTOR, receptacle: 12 parallel flat blade polarized female cont; straight type.	Mates with plug A of crypto unit	2Z7403-3
	CONNECTOR, solderless: cap type; for 5 #18 AWG wires.	External connectors for power wires	6Z3188-2.
	FUSE, plug: .8 amp	Protects mixing relay unit	3Z2598-1.1
	FUSEHOLDER: screw type; for single No. S 8/10 Fustat.	Holds .8-ampere fuse	3Z2876-6
	HOLDER, label	Holds circuit label	4TW264699
	LABEL: 10″ lg x 8″ wd	Circuit label	6D16782-3
R, S, R1	RELAY, armature: SPDT; 2 parallel wnd, 5 ma dc min cur. ea wnd; 2 inductive wnd, 136-ohm d-c resistance ea wnd; ins; polarized.	R—Repeats signal from repeater unit to crypto unit. S—Repeats signal from crypto unit to repeater unit. R1—Sends positive pulses for each space to operate relay LB.	4TRY30
H, M, D, E, G, F, K, C.	RESISTOR, fixed: WW; 600 ohms ±5%; 20 w.	H—Controls current flow through LS and TS relays in repeater unit. M—Limits current flow to the stop pulse of crypto unit. D—With resistor A, controls current flow through bias winding of relay S. E—With resistors G and F, controls current flow through line winding of relay S. G—With resistor F, forms a potentiometer circuit. F—With resistor G, forms a potentiometer circuit. K—Furnishes negative battery for code pulses of crypto unit. C—Furnishes positive battery for code pulses of crypto unit.	3Z6060-58
AC, AD	RESISTOR, fixed: WW; 775 ohms ±5%; CT—387.5 ohms ea sec.: 5.1 max distributed or 5 w for either provided other sec. is used at .1 w or less.	AC—Current limiter, bias winding of relay R. AD—Current limiter, bias winding of relay R and line winding of relay S.	3Z6038G7
AA, AB	RESISTOR, fixed: WW; 3,200 ohms ±5%; CT—1,600 ohms ea sec.; 5.1 w max distributed or 5 w for either provided other sec. is used at .1 w or less.	AA—Current limiter in spark suppressor circuit of relay R. AB—Current limiter in spark suppressor circuit of relay S.	3Z6320-6
A, N	RESISTOR, fixed: WW; 7,100 ohms ±5%; 16.2 w.	A—Voltage divider for common battery connection to bias coil of relays. N—Voltage divider for common battery return to line winding of relay R1.	3RW29414
AE	RESISTOR, fixed: WW; 10,000 ohms ±1%; 5.1 w power dissipation.	Current limiter, bias winding of relay S	3Z6610-124
	SPRING: flat type; 2¼″ lg x ⅜″ wd x ⅝″ h.	Retains type 255-A relay.	
R, S	SUPPRESSOR, electrical noise: capacitor and coil type.	Spark-suppressing filter	3Z1892-5

Ref. symbol	Name of part and description	Function of part	Signal Corps stock No.
	MISCELLANEOUS ITEMS		
	BARE UNIT: for WECo No. 131B2 table.		4TW131-B2-1Z
	PANEL: steel, brown enamel finish; 22" lg x 21¼" wd x 1⁹⁄₁₀" thk o/a.	Rear cover panel	4Z6350-1
	PANEL: 2 compartment covers, 4 captive screws; steel, brown enamel finish; 20½" lg x 21¼" wd x 2½" thk o/a.	Holds crypto tapes	4Z6350-2

[(AG 300.7 (26 Jul 51)]

BY ORDER OF THE SECRETARY OF THE ARMY:

OFFICIAL:
WM. E. BERGIN
Major General, USA
The Adjutant General

J. LAWTON COLLINS
Chief of Staff, United States Army

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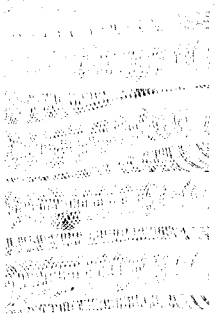
U. S. GOVERNMENT PRINTING OFFICE: 1951



TM 11–2209
C 6

TELETYPEWRITER, REPEATER-MIXER AN/FGQ–1, AN/FGQ–1A, AND RELAY ASSEMBLY RE–121/UG

CHANGE
No. 6

HEADQUARTERS,
DEPARTMENT OF THE ARMY
WASHINGTON D.C., *16 October 1963*

TM 11–2209, 20 February 1946, is changed as follows:

Note. The parenthetical reference to a previous change (example: "page 1 of C 2") indicates that pertinent material was published in that change.

Page 1. Delete paragraph 1.1 (page 1 of C 3 and C 4) and substitute:

1.1. Index of Publications

Refer to the latest issue of DA Pam 310–4 to determine whether there are new editions, changes, or additional publications pertaining to your equipment. Department of the Army Pamphlet No. 310–4 is an index of current technical manuals, technical bulletins, supply manuals (types 4, 6, 7, 8, and 9), supply bulletins, lubrication orders, and modification work orders that are available through publications supply channels. The index lists the individual parts (–10, –20, –35P, etc) and the latest changes to and revisions of each equipment publication.

Add paragraph 1.2 after paragraph 1.1.

1.2. Forms and Records

a. Reports of Maintenance and Unsatisfactory Equipment. Use equipment forms and records in accordance with instructions in TM 38–750.

b. Report of Damaged or Improper Shipment. Fill out and forward DD Form 6 (Report of Damaged or Improper Shipment) as prescribed in AR 700–58 (Army), NAVSANDA Publication 378 (Navy), and AFR 71–4 (Air Force).

c. Reporting of Equipment Manual Improvements. The direct reporting user by the individual of errors, omissions, and recommendations for improving this manual is authorized and encouraged. DA Form 2028 (Recommended changes to DA technical manual parts lists or supply manual 7, 8, or 9) will be used for reporting these improvements. This form will be completed in triplicate using pencil, pen, or typewriter. The original and one copy will be forwarded direct to: Commanding Officer, U. S. Army Electronics Material Support Agency, ATTN: SELMS–MP, Fort Monmouth, N. J. 07703. One information copy will be furnished to the individual's immediate supervisor (e.g., officer, noncommissioned officer, supervisor, etc.).

Page 57, section VIII. Make the following changes:

Change the title to: OPERATOR'S MAINTENANCE.

Delete paragraph 41 and substitute:

41. Scope of Operator's Maintenance

The maintenance duties assigned to the operator of Teletypewriter, Repeater-Mixers AN/FGQ–1 and AN/FGQ–1A and Relay Assembly RE–121/UG are listed below, together with a reference to the paragraph covering the specific maintenance function. The duties assigned do not require tools or test equipment other than those issued with the set.

a. Daily preventive maintenance checks and services (par. 43.1).

b. Cleaning (par. 43.2).

c. Replacement of indicator lamps (fig. 5).

Delete paragraph 42 and substitute:

42. Preventive Maintenance

Preventive maintenance is the systematic care, servicing, and inspection of equipment to prevent the occurrence of trouble, to reduce

downtime, and to assure that the equipment is serviceable.

a. Systematic Care. The procedures given in paragraphs 43 through 43.2 cover routine systematic care and cleaning essential to proper upkeep and operation of the equipment.

b. Preventive Maintenance Checks and Services. The preventive maintenance checks and services chart (par. 43.1) outlines functions to be performed at specific intervals. These checks and services are to maintain Army electronic equipment in a combat serviceable condition; that is, in good general (physical) condition and in good operating condition. To assist operators in maintaining combat serviceability, the chart indicates what to check, how to check, and what the normal conditions are. The *References* column lists the illustrations, paragraphs, or manuals that contain supplementary information. If the defect cannot be remedied by the operator, higher echelon maintenance or repair is required. Records and reports of these checks and services must be made in accordance with the requirements set forth in TM 38–750.

Page 58. Delete paragraph 43 and substitute:

43. Preventive Maintenance Checks and Services Periods

a. Preventive maintenance checks and services of the equipment are required daily.

b. Paragraph 43.1 specifies checks and services that must be accomplished daily under the conditions listed below.

(1) When the equipment is initially installed.
(2) When the equipment is reinstalled after removal for any reason.
(3) At least once each week if the equipment is maintained in a standby condition.

Add paragraphs 43.1 and 43.2 after paragraph 43.

43.1. Daily Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Teletypewriter, Repeater-Mixer AN/FGQ–1, AN/FGQ–1A and Relay Assembly RE–121/UG.	Check the Teletypewriter, Repeater-Mixer AN/FGQ–1, AN/FGQ–1A and Relay Assembly RE–121/UG including accessory items for completeness and satisfactory condition.	(App III.)
2	Exterior surfaces _____	Remove dirt, dust, grease, moisture, and fungus from all exposed surfaces. Inspect painted surfaces for bare spots, rust, and corrosion.	None.
3	Table-mounted equipments:	Inspect equipment mounted on top of table for secure mounting. Inspect rubber mounts for deterioration.	
4	Operational checks _____	Check the equipment for normal operation. While performing the operational checks, observe the operation of the CIPHER-LOCAL TEST-TEXT key, the BREAK-BREAK RELEASE key, and the universal connector switch for positive mechanical action. The keys and switches should be free of binding, scraping, and backlash. Check the CIPHER, TEXT, and BREAK indicator lamps for proper operation.	(Par. 40.)

43.2. Cleaning

The exterior surfaces of the AN/FGQ–1, AN/FGQ–1A and RE–121/UG should be clean and free of dirt, dust, grease and fungus.

a. Remove dust and loose dirt with a clean soft cloth.

Warning: **Cleaning compound is flammable and its fumes are toxic.. Provide adequate ventillation.** ***Do not*** **use near flames.**

b. Remove grease, fungus and ground-in dirt from the case; use a cloth dampened (not wet) with cleaning compound.

c. Clean panels and control knobs; use a soft clean cloth. If dirt is difficult to remove, dampen the cloth with water; use a mild soap if necessary.

d. Clean rust and corrosion from metal surfaces by lightly sanding them with fine sandpaper. Brush two thin coats of paint on the bare metal to protect it from further corrosion. Refer to applicable cleaning and refinishing practices specified in TM 9–213.

After paragraph 43.2 add:

Section VIII.1 ORGANIZATIONAL MAINTENANCE

43.3. Scope of Organizational Maintenance

a. This section contains instructions covering second echelon maintenance of the AN/FGQ–1, AN/FGQ–1A and RE–121/UG. It includes instructions for performing preventive and periodic maintenance services and repair functions to be accomplished by the organizational repairman. Refer to Appendix III for tools and test equipment and to paragraph 53 for materials required for organizational maintenance.

b. Second echelon maintenance of Teletypewriter Repeater-Mixer AN/FGQ–1, AN/FGQ–1A and Relay Assembly RE–121/UG includes:

(1) Weekly preventive maintenance checks and services (par. 43.6).
(2) Monthly preventive maintenance checks and services (par. 43.7).
(3) Initial adjustments (par. 29–33).
(4) Replacement of defective fuses (fig. 3, 8, 10, 69).
(5) Troubleshooting (par. 40).

43.4. Organizational Preventive Maintenance

a. Preventive maintenance is the systematic care, inspection, and servicing of equipment to maintain it in serviceable condition, prevent breakdowns, and assure maximum operational capability. Preventive maintenance is the responsibility of all echelons concerned with the equipment and includes inspection, testing, and repair or replacement of parts, subassemblies, or units that inspection and tests indicate would probably fail before the next scheduled periodic service. Preventive maintenance checks and services of the AN/FGQ–1, AN/FGQ–1A and RE–121/UG at the second echelon level are made at weekly and monthly intervals unless otherwise directed by the commanding officer. The maintenance services should be scheduled concurrently with the periodic service schedule of the carrying vehicle for all vehicular installations.

b. Maintenane forms and records to be used and maintained on this equipment are specified in TM 38–750. Paragraph 1.2 contains additional information concerning submission of specific forms.

43.5. Weekly and Monthly Maintenance

Perform the maintenance functions indicated in the weekly and monthly preventive maintenance checks and services charts (par. 43.6 and 43.7) on the AN/FGQ–1, AN/FGQ–1A and the RE–121/UG at the intervals specified and in the sequence listed. Whenever an abnormal condition or result is observed, take corrective action in occordance with the paragraph listed under references. All deficiencies and shortcomings will be recorded and those deficiencies not corrected during the preventive maintenance checks and services tests will be reported to higher echelon as specified in TM 38–750. Equipment which has deficiencies that cannot be corrected by second ehelon will be deadlined in accordance with TM 38–750. Equipment maintained in a standby (ready for immediate operation) condition must have monthly maintenance checks and services performed on it. Equipment in limited storage (requires service before operation) does not require monthly preventive maintenance.

Note. A month is defined as approximately 30 calendar days of 8-hour-per-day operation. For 16 hours a day operation, the monthly preventive maintenance checks and services will be performed at 15-day intervals. Adjustment of the maintenance interval must be made to compensate for any unusual operating conditions.

43.6. Weekly Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Interior surfaces _____	Inspect all interior surfaces of the table and exposed surface of the internally mounted units, power box, power unit (main and varistor), repeater unit, mixing relay unit, and control panel for general condition. Remove dirt, dust, grease, moisture, and fungus from all accessible areas and components.	None.
2	Wiring, cabling, cords, connections, and connectors:	Inspect all interior wiring, cabling, and cords for breaks; cut, frayed, or cracked insulation; strains, kinks, improper supports; and for loose or poor grounds. Inspect for poorly soldered, loose, and corroded connections. Inspect the interior and exterior of all connectors for general cleanliness and signs of corrosion; cracks and deterioration; loose and bent pins, and for proper fit and mounting.	None.
3	Fuses _____	Inspect all fuses (F1 through F7) for correct value, corrosion, proper fit, and electrical condition. Fuse — Location — Value (amp) F1, F2 — Mixing relay unit — .8 F3, F4 — Repeater unit — .8 F5 — Power unit — 1.6 F6 — Power unit — 10 F7 — Power box — 3.2	(Par. 52.)
4	Metal shield, grill, cases, and covers:	Inspect the following items for damage and proper fit. *a.* Metal shield surrounding interior of the table. *b.* Metal grill fastened to rear of table. *c.* Metal cases for the power box, power supply, control panel, Relay Assembly RE–121/UG, universal connector, and for all relays in the mixing relay unit, the repeater unit, and Relay Assembly RE–121/UG.	(Figs. 2, 3, 4, 6, 8, 10.)
5	Interior mountings _____	Inspect mountings of all units installed in the interior of the table for loose, missing, and damaged hardware.	(Par. 3.)
6	Terminal boards _____	Inspect the terminal boards in the repeater unit, the mixing relay unit, and Relay Assembly RE–121/UG for cracks, breaks, dirt, loose connections, and deterioration.	(Par. 49.)
7	Transformer and filter chokes.	Inspect the transformer and filter chokes in the power unit for loose mounting, evidences of overheating, and general condition.	(Par. 48.)

43.7. Monthly Preventive Maintenance Checks and Services Chart

Sequence No.	Item	Procedure	References
1	Publication _____	Check for the availability, completeness, and general condition of all current publications and Changes thereto.	DA Pam 310–4.
2	Modification work orders:	Check to see that all urgent MWO's have been applied and that all routine MWO's have been scheduled.	DA Pam 310–4.

Sequence No.	Item	Procedure	References
3	Spare parts	Check all spare parts for general condition, method of storage, overstocks, and shortages. Shortages must be on valid requisitions.	App III.
4	Relays	Inspect contacts of all relays (repeater unit (LR, LS, TR, and TS), mixing relay unit (R, R1, and S), Relay Assembly RE–121/UG (K1, and K2 for pitting, dirt, alignment, adjustment, corrosion, proper mechanical action, and loose or poor connections. Inspect relay armatures for positive mechanical action, spring, tension, adjustment, and alignment. Inspect relay coils for signs of overheating, frayed or broken insulation, and broken wires. Inspect relay mountings, sockets, and holding springs for tight and proper fit.	(Par. 46.)
5	Capacitors	Inspect all capacitors (power unit, repeater unit, mixing relay unit, Relay Assembly RE–121/UG) for leaky, bulging, and discolored cases; loose or corroded terminals and connections; and for loose mounting screws, studs, and brackets.	(Par. 44.)
6	Resistors	Inspect all resistors (power unit, repeater unit, mixing relay unit, Relay Assembly RE–121/UG) for blistering and discoloration, loose and corroded leads, and for loose mounting screws, studs and brackets.	(Par. 45.)
7	Key and switch contacts:	Inspect the contacts of the (BREAK-BREAK RELEASE key, CIPHER-LOCAL TEST-TEXT key and STA TEST key) for pitting, dirt, misalignment, and corrosion.	(Par. 47 and fig. 9.)

Page 61. Delete section IX.

Page 72. Delete paragraphs 65 and 67.7 (page 3 of C 3).

Page 73. PART FIVE (page 10 of C 3). Delete note below the heading. Delete paragraph 69.

Pages 74 and 75. Delete figure 76.

Page 104. Delete paragraph 95.

Page 123, appendix I. Make the following changes:

Delete the note below "REFERENCES." Delete paragraph 1 and substitute:

1. List of Pertinent Publications

DA Pam 310–4	Index of Technical Manuals, Technical Bulletins, Supply Bulletins, Lubrication Orders, and Modification Work Orders.
TM 9–213	Painting Instructions for Field Use.
TM 38–750	The Army Equipment Record System and Procedures.

Delete paragraphs 2 and 3.

Page 123. Delete paragraphs 4 through 9.

Page 123. Delete paragraph 10. Redesignate paragraphs 11 and 12 as 2 and 3, respectively.

By Order of the Secretary of the Army:

EARLE G. WHEELER,
General, United States Army,
Chief of Staff.

Official:

J. C. LAMBERT,
Major General, United States Army,
The Adjutant General.

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Svc Colleges (2)
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Sig Sec, GENDEP (5)
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Two copies each unit UNOINDC:
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  11–16
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  11–117
  11–155
  11–157
  11–500 (AA–AE) (4)
  11–557
  11–587
  11–592
  11–597
  32–500

NG: None.

USAR: None.

For explanation of abbreviations used, see AR 320–50.

☆ U. S. GOVERNMENT PRINTING OFFICE: 1963—700504

4TW131-B2

TECHNICAL MANUAL

TELETYPEWRITER REPEATER-MIXER AN/FGQ-1

TM 11-2209
CHANGES No. 2

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *5 April 1955*

TM 11-2209, 20 February 1946, is changed as follows:

PART FOUR

AUXILIARY EQUIPMENT

Section XII. DESCRIPTION OF UNIVERSAL CONNECTOR

Note. (Added) Universal Connector Kit MX-733/FGQ-1 is essentially the same as the universal connector covered in paragraphs 60 through 67. All information pertaining to this universal connector applies equally to Universal Connector Kit MX-733/FGQ-1 except as otherwise specified in this change.

* * * * *

63. Installation

a. Disconnect the cord associated with the switchbox from the receptacle box of the universal connector by loosening the seven terminal screws **(or six terminal screws on the MX-733/FGQ-1)** on the terminal block associated with the receptacle **box** and removing the spade terminals of the cord. Also, loosen the * * * the AN/FGQ-1 table.

Note. (Added) When Universal Connector Kit MX-733/FGQ-1 is received new, the switchbox cord is disconnected from the receptacle box.

* * * * *

c. Pass the **free** end of the switch cord downward through the square cord hole in the bottom of the table and **clamp** it under the cord clamp on the receptacle box. **Connect** the cord terminals to the terminal block on the receptacle box. **When the MX-733/FGQ-1 is being installed, connect the six conductors of the switchbox cord to terminal board E1 as follows:**

Wire color		*Terminal No.*
Black	to	**2**
White	to	**4**
Green	to	**5**
Yellow	to	**6**
Red	to	**7**
Blue	to	**8**

Figure 75. The reference designation "E1" is added just above the terminal board at the lower right-hand edge of the receptacle box diagram (labeled UNIVERSAL CONNECTOR). The terminals on this terminal board are numbered, beginning at the top terminal, as follows: 1, 2, 3, 4, 4, 5, 7, 2, 8, and 6. The letter "A" is added after the word "SOCKET" at the extreme upper left-hand corner of the receptacle box diagram and the reference designation "R1" is added next to the 600-ohm resistor adjacent to terminal 2 of this socket. The letter "B" is added after the word "SOCKET" at the center of the left-hand edge of the receptacle box diagram and the reference designation "R2" is added next to the 600-ohm resistor adjacent to terminal 2 of this socket. In the switchbox diagram at the lower right of the page, the reference designation "S1" is added next to switch A (left-hand side of the diagram) and the reference designation "S2" is added next to switch B (right-hand side of the diagram).

Figure 112. The value of capacitors C1 and C2 is changed from 450 microfarads to 500 microfarads.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Rescinded

[AG 300.7 (8 Mar 55)]
TAGO 4420A—April 310474°—55

By order of the Secretary of the Army:

M. B. RIDGWAY,
General, United States Army,
Chief of Staff.

Official:

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

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Corps (2)
Tng Div (2)
Ft & Cp (2)
Gen & Br Svc (5)
SigC Sch (25)
Gen Depots (2)
SigC Sec, Gen Depots (10)
SigC Depots (20)
POE (2)
OS Sup Agencies (2)
SigC Fld Maint Shops (3)
SigC Lab (5)
Mil Dist (1)
Units organized under following TOE's:
11–7, Sig Co Inf Div (2)
11–16A, Hq & Hq Co, Sig Bn, Corps or Abn Corps (2)
Units organized under following TOE's—Continued
11–57, Armd Sig Co (2)
11–127, Sig Rep Co (2)
11–128A, Sig Depot Co (2)
11–500A (AA through AE), Sig Svc Org (2)
11–557A, Abn Sig Co (2)
11–587A, Sig Base Maint Co (2)
11–592A, Hq & Hq Co, Sig Base Depot (2)
11–597A, Sig Base Depot Co (2)

NG: Same as Active Army except allowance is one copy to each unit.
USAR: None.
For explanation of abbreviations used, see SR 320–50–1.

U. S. GOVERNMENT PRINTING OFFICE: 1955

4TW131-B2

TECHNICAL MANUAL

TELETYPEWRITER REPEATER-MIXER AN/FGQ-1

TM 11-2209
CHANGES No. 2

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *5 April 1955*

TM 11-2209, 20 February 1946, is changed as follows:

PART FOUR

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Section XII. DESCRIPTION OF UNIVERSAL CONNECTOR

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* * * * *

63. Installation

a. Disconnect the cord associated with the switchbox from the receptacle box of the universal connector by loosening the seven terminal screws **(or six terminal screws on the MX-733/FGQ-1)** on the terminal block associated with the receptacle **box** and removing the spade terminals of the cord. Also, loosen the * * * the AN/FGQ-1 table.

Note. (Added) When Universal Connector Kit MX-733/FGQ-1 is received new, the switchbox cord is disconnected from the receptacle box.

* * * * *

c. Pass the **free** end of the switch cord downward through the square cord hole in the bottom of the table and **clamp** it under the cord clamp on the receptacle box. **Connect** the cord terminals to the terminal block on the receptacle box. **When the MX-733/FGQ-1 is being installed, connect the six conductors of the switchbox cord to terminal board E1 as follows:**

Wire color		*Terminal No.*
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Yellow	to	**6**
Red	to	**7**
Blue	to	**8**

Figure 75. The reference designation "E1" is added just above the terminal board at the lower right-hand edge of the receptacle box diagram (labeled UNIVERSAL CONNECTOR). The terminals on this terminal board are numbered, beginning at the top terminal, as follows: 1, 2, 3, 4, 4, 5, 7, 2, 8, and 6. The letter "A" is added after the word "SOCKET" at the extreme upper left-hand corner of the receptacle box diagram and the reference designation "R1" is added next to the 600-ohm resistor adjacent to terminal 2 of this socket. The letter "B" is added after the word "SOCKET" at the center of the left-hand edge of the receptacle box diagram and the reference designation "R2" is added next to the 600-ohm resistor adjacent to terminal 2 of this socket. In the switchbox diagram at the lower right of the page, the reference designation "S1" is added next to switch A (left-hand side of the diagram) and the reference designation "S2" is added next to switch B (right-hand side of the diagram).

Figure 112. The value of capacitors C1 and C2 is changed from 450 microfarads to 500 microfarads.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Rescinded

[AG 300.7 (8 Mar 55)]
TAGO 4420A—April 310474°—55

BY ORDER OF THE SECRETARY OF THE ARMY:

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General, United States Army,
Chief of Staff.

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Major General, United States Army,
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Units organized under following TOE's—Continued
11–57, Armd Sig Co (2)
11–127, Sig Rep Co (2)
11–128A, Sig Depot Co (2)
11–500A (AA through AE), Sig Svc Org (2)
11–557A, Abn Sig Co (2)
11–587A, Sig Base Maint Co (2)
11–592A, Hq & Hq Co, Sig Base Depot (2)
11–597A, Sig Base Depot Co (2)

NG: Same as Active Army except allowance is one copy to each unit.
USAR: None.
For explanation of abbreviations used, see SR 320–50–1.

TAGO 4420A

U. S. GOVERNMENT PRINTING OFFICE: 1955

DEPARTMENT OF THE ARMY TECHNICAL MANUAL
DEPARTMENT OF THE AIR FORCE TECHNICAL ORDER

TM 11–2209
TO 31W4–2FGQ1–1
***C 5**

TELETYPEWRITER, REPEATER-MIXER AN/FGQ-1, AN/FGQ-1A, AND RELAY ASSEMBLY RE-121/UG

TM 11–2209
TO 31W4–2FGQ1–1
Changes No. 5

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *13 January 1961*

TM 11–2209, 20 February 1946, is changed as follows:

Change title to read as above.

APPENDIX II
MAINTENANCE ALLOCATION

(Superseded)

1. General

a. This appendix assigns maintenance functions and repair operations to be performed by the lowest appropriate maintenance echelon.

b. Columns in the maintenance allocation chart are as follows:

(1) *Part or component.* This column shows only the nomenclature or standard item name. Additional descriptive data are included only where clarification is necessary to identify the part. Components and parts comprising a major end item are listed alphabetically. Assemblies and subassemblies are in alphabetical sequence with their components listed alphabetically immediately below the assembly listing.

(2) *Maintenance function.* This column indicates the various maintenance functions allocated to the echelon capable of performing the operations.

(a) Service. To clean, to preserve, and to replenish fuel and lubricants.

(b) Adjust. To regulate periodically to prevent malfunction.

(c) Inspect. To verify serviceability and to detect incipient electrical or mechanical failure by scrutiny.

(d) Test. To verify serviceability and to detect incipient electrical or mechanical failure by use of special equipment such as gages, meters, etc.

(e) Replace. To substitute serviceable assemblies, subassemblies, and parts for unserviceable components.

(f) Repair. To restore an item to serviceable condition through correction of a specific failure or unserviceable condition. This function includes but is not limited to, inspecting, cleaning, preserving, adjusting, replacing, welding, riveting, and straightening.

(g) Rebuild. To restore an item to a standard as near as possible to

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***These changes supersede so much of DA Supply Manuals SIG 7 & 8 AN/FGQ-1, 1 August 1958, including C 1, 12 May 1959; SIG 7 & 8 RE-121/UG, 27 June 1958; and SIG 7 & 8 PP-748/U, 16 September 1957, including C 1, 9 February 1960, as pertains to first echelon items herein.**

original or new condition in appearance, performance, and life expectancy. This is accomplished through the maintenance technique of complete disassembly of the item, inspection of all parts or components, repair or replacement of worn or unserviceable elements using original manufacturing tolerances and/or specifications and subsequent reassembly of the item.

(3) *1st, 2d, 3d, 4th, 5th echelon.* The X indicates the echelon responsible for performing that parciular maintenance operation, but does not necessarily indicate that repair parts will be stocked at that level. Echelons higher than the echelon marked by X are authorized to perform the indicated operation.

(4) *Tools required.* This column indicates codes assigned to each individual tool equipment, test equipment, and maintenance equipment referenced. The grouping of codes in this column of the maintenance allocation chart indicates the tool, test, and maintenance equipment required to perform the maintenance function.

(5) *Remarks.* Entries in this column will be utilized when necessary to clarify any of the data cited in the proceding columns.

c. Columns in the allocation of tools for maintenance functions are as follows:

(1) *Tools required for maintenance functions.* This column lists tools, test, and maintenance equipment required to perform the maintenance functions.

(2) *2d, 3d, 4th, 5th echelon.* A dagger indicates the echelons allocated the faculty.

(3) *Tool code.* This column lists the tool code assigned.

(4) *Remarks.* Entries in this column are used to clarify data in the other columns.

2. Maintenance by Using Organizations

When this equipment is used by signal service organizations organic to theater headquarters or communication zones to provide theater communications, those maintenance functions allocated up to and including fourth echelon are authorized to the organization operating this equipment.

3. Mounting Hardware

The basic entries of the maintenance allocation chart do not include mounting hardware such as screws, nuts, bolts, washers, brackets, clamps, etc.

Maintenance Allocation Chart

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH	(4) 2ND ECH	(5) 3RD ECH	(6) 4TH ECH	(7) 5TH ECH	(8) TOOLS REQUIRED	(9) REMARKS
TELETYPEWRITER, REPEATER-MIXER AN/FGQ-1; AN/FGQ-1A								
(Including Universal Connector Kit MX-733/FGQ-1	service	X						External parts
and Relay Assembly RE-121/UG)			X				6	Interior parts
	adjust		X				1, 2, 6	Initial Adjustments
				X			1, 2, 6, 7	All adjustments
	inspect	X						External parts
			X					Interior parts
	test		X				1, 2	Performs resistance, voltage and current measurements to determine condition of circuits. Performs operational tests to insure the interoperation of components.
					X		1 thru 7	Conducts all tests to insure equipment returned to user meets minimum mechanical visual, electrical and operational requirements
	rebuild					X	6, 7	
TABLE AND ACCESSORIES								
CABLES	replace			X			6	
CABLE ASSEMBLIES	replace			X			6	
	repair			X			6	
CONNECTORS	replace			X			6	
CORD ASSEMBLY	replace			X			6	
FEET, MOUNTING	replace			X			6	
FILTERS, LOW PASS	replace			X			6	
FUSE, PLUG	replace	X						
FUSEHOLDER	replace			X			6	
MOUNTS, VIBRATION	replace			X			6	
PLUG, TELEPHONE	replace			X			6	
RELAY, ARMATURE	replace			X			6	
SPLICE, CONDUCTORS	replace			X			6	
SWITCH, PUSH	replace			X			6	
TERMINAL, LUGS	replace			X			6	
WIRE, ELECTRICAL	replace			X			6	
REPEATER UNIT								
CAPACITORS, FIXED, PAPER DIELECTRIC	replace			X			6	
CONNECTORS, RECEPTACLE, ELECTRICAL	replace			X			6	
COVERS, ELECTRICAL RELAY	replace			X			6	

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH.	(4) 2ND ECH.	(5) 3RD ECH.	(6) 4TH ECH.	(7) 5TH ECH.	(8) TOOLS REQUIRED	(9) REMARKS
AN/FGQ-1; AN/FGQ-1A (Incl MX-733/FGQ-1 And RE-121/UG) (continued)								
FILTERS, BAND SUPPRESSION	replace			X			6	
FUSEHOLDERS	replace			X			6	
FUSES, PLUG	replace	X						
LAMPHOLDERS	replace			X			6	
LAMPS, INCANDESCENT	replace	X						
RELAYS, ARMATURE	replace			X			6	
RESISTORS	replace						6	
SWITCHES	replace			X			6	
TERMINAL LUGS	replace			X			6	
MIXING RELAY UNIT								
CABLE, POWER, ELECTRICAL	replace			X			6	
CAPACITORS, FIXED, PAPER DIELECTRIC	replace			X			6	
CONNECTORS	replace			X			6	
FILTERS, BAND SUPPRESSION	replace			X			6	
FUSEHOLDERS	replace			X			6	
FUSES, PLUG	replace	X						
RELAYS, ARMATURE	replace			X			6	
RESISTORS	replace			X			6	
SPLICE, CONDUCTORS	replace			X			6	
POWER SUPPLY PP-748/U	rebuild					X	6, 7	
CABLES, POWER ELECTRICAL	replace			X			6	
CAPACITORS, FIXED, ELECTROLYTIC	replace			X			6	
CLIP, ELECTRICAL	replace			X			6	
CONNECTORS	replace			X			6	
FUSES	replace	X						
REACTOR	replace			X			6	
RECTIFIERS, METALLIC	replace			X			6	
RESISTORS, FIXED, WIRE WOUND	replace			X			6	
SWITCH, SENSITIVE	replace			X			6	
TRANSFORMER, POWER STEP-DOWN AND STEP-UP	replace			X			6	

(1) PART OR COMPONENT	(2) MAINTENANCE FUNCTION	(3) 1ST ECH.	(4) 2ND ECH.	(5) 3RD ECH.	(6) 4TH ECH.	(7) 5TH ECH.	(8) TOOLS REQUIRED	(9) REMARKS
AN/FGQ-1; AN/FGQ-1A(Incl MX 733/FGQ-1 And RE-121/UG) (continued)								
UNIVERSAL CONNECTOR KIT MX 733/FGQ-1 (used with but not part of AN/FGQ-1)	service inspect test rebuild	X X	X			X	1 6, 7	Continuity
CABLES, POWER ELECTRICAL	replace			X			6	
CONNECTORS	replace			X			6	
GROMMETS	replace			X			6	
RESISTORS, FIXED, WIRE WOUND	replace			X			6	
SWITCHES, TOGGLE	replace			X			6	
TERMINAL BOARD	replace			X			6	
TERMINAL LUGS	replace			X			6	
RELAY ASSEMBLY RE-121/UG (Used with but not part of AN/FGQ-1)	rebuild					X	6, 7	
BUSHINGS	replace			X			6	
CABLE, POWER	replace			X			6	
CAPACITORS	replace			X			6	
CLAMP	replace			X			6	
CONNECTOR	replace			X			6	
GROMMET	replace			X			6	
KNOB	replace			X			6	
RECTIFIERS	replace			X			6	
RELAY, ARMATURE RE-163/G	replace		X					
RESISTORS	replace			X			6	
SOCKET, RELAY	replace			X			6	
TERMINAL BOARD	replace			X			6	
TERMINAL LUGS	replace			X			6	

(1) TOOLS REQUIRED FOR MAINTENANCE FUNCTIONS	(2) 1ST ECH	(3) 2ND ECH	(4) 3RD ECH	(5) 4TH ECH	(6) 5TH ECH	(7) TOOL CODE	(8) REMARKS
AN/FGQ-1; AN/FGQ-1A(Incl MX-733/FGQ-1 And RE-121/UG) (continued)							
MULTIMETER AN/URM-105		†	†	†	†	1	Replaces Multimeters TS-297/U and TS-352/U
SHUNT INSTRUMENT MULTIRANGE MX-1471/U		†	†	†	†	2	
TEST SET I-181				†	†	3	
TEST SET I-193				†	†	4	
VOLTMETER METER ME-304/U				†	†	5	
TOOL EQUIPMENT TE-50B		†	†	†	†	6	
TOOL EQUIPMENT TE-111			†	†	†	7	

APPENDIX III
BASIC ISSUE ITEMS
SECTION I INTRODUCTION

1. Scope

a. This appendix lists items supplied for initial operation and for running spares. The list includes tools, accessories, parts, and material issued as *part of* the major end item. The list includes all items authorized for basic operator maintenance of the equipment. End items of equipment are issued on the basis of allowances prescribed in the equipment authorization tables and other documents that are a basis for requisitioning.

b. Columns are as follows:

(1) *Source, maintenance, and recoverability code.* Not used.

(2) *Federal stock number.* This column lists the 11-digit Federal stock number.

(3) *Designation by model.* A dagger (†) indicates the model in which the part is used.

(4) *Description.* Nomenclature or the standard item name and brief identifying data for each item are listed in this column. When requisitioning, enter the nomenclature and description on the requisition.

(5) *Unit of issue.* The unit of issue is the supply term by which the individual item is counted for procurement, storage, requisitioning, allowances, and issue purposes.

(6) *Expendability.* Expendable items are indicated by the letter X; nonexpendable items are indicated by NX.

(7) *Quantity authorized.* Under "Items Comprising an Operable Equipment," the column lists the quantity of items supplied for the initial operation of the equipment. Under "Running Spares and Accessory Items," the quantities listed are those issued initially with the equipment as spare parts. The quantities are authorized to be kept on hand by the operator for maintenance of the equipment.

(8) *Illustrations.* The "Item No." column lists the Figure No. and the reference designations that appear on the part in the equipment. These same designations are also used on any illustrations of the equipment.

2. Critical Items

A zero slash (ø) in the "Description" column indicates items that are expected to fail during the first year or items that will make the equipment inoperative if they fail.

3. Comments or Suggestions

Any comments concerning omissions and discrepancies in this Change will be prepared on DA Form 2028 and forwarded direct to Commanding Officer, U. S. Army Signal Materiel Support Agency, ATTN: SIGMS–ML, Fort Monmouth, N. J.

SECTION II. FUNCTIONAL PARTS LIST

(1) SOURCE MAINTENANCE AND RECOVERABILITY CODE	(2) FEDERAL STOCK NUMBER	(3) DESIGNATION BY MODEL	(4) DESCRIPTION	(5) UNIT OF ISSUE	(6) EXPENDABILITY	(7) QUANTITY AUTHORIZED	(8) ILLUSTRATIONS FIGURE NO.	(9) ILLUSTRATIONS ITEM NO.
		1 2	ITEMS COMPRISING AN OPERABLE EQUIPMENT					
			TELETYPEWRITER, REPEATER-MIXER AN/FGQ-1; AN/FGQ-1A (INCLUDING UNIVERSAL CONNECTOR KIT MX-733/FGQ-1 AND RELAY ASSEMBLY RE-121/UG)					
			PART I					
			NOTE: Model Column 1 refers to AN/FGQ-1; Column 2 refers to AN/FGQ-1A.					
	5815-256-4067		TELETYPEWRITER REPEATER MIXER AN/FGQ-1; AN/FGQ-1A: f/secret transmission f/wire and radio cem; input 95 v to 125 v, 190 v to 250 v, 25 cyc to 60 cyc, ac	ea	NX			
	Ord thru AGC	† †	TECHNICAL MANUAL TM 11-2209	ea	X	2		
			GROUP 1 COMPONENT LIST					
	5995-160-0950	†	CABLE ASSEMBLY, POWER, ELECTRICAL: 2 cond No. 16 AWG; w/socket H.B. Jones part No. P-404-CCT; approx 2-1/2 ft lg	ea	X	1	2	M3AT-P
	5995-160-0951	†	CABLE ASSEMBLY, POWER, ELECTRICAL: 2 cond No. 16 AWG; w/socket H.B. Jones part No. S-404-CCT; approx 2-1/2 ft lg	ea	X	1	2	M3AT-S
	5995-161-8716	† †	CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL: 8 stranded No. 22 AWG, cond; 7 ft lg; SigC dwg No. SC-D-4689	ea	X	1	2	M9D
	5995-162-7091	† †	CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL: 8 stranded No. 22 AWG cond; 30 in lg; WECo No. M9C	ea	X	1	2	M9C
	5995-233-3383	†	CABLE ASSEMBLY, POWER, ELECTRICAL: cable MIL type CO-02MGF(2/18)0300; terminated w/plugs Hubbell part No. 7082 and No. 7251; approx 2 ft 3 in lg WECo part No. M2DH modified	ea	X	1	2	DC
	5995-542-6033	†	CABLE ASSEMBLY, SPECIAL PURPOSE ELECTRICAL: 2 stranded No. 16 AWG; 1 braided No.34 AWG; 2 ft 7-1/16 in lg; WECo part M3AT w/S-404-CCT Socket	ea	X	1	2	M3AT-S
	5995-542-6050	†	CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL: 2 stranded No. 16 AWG, 1 braided No.34 AWG; 2 ft 7-1/16 in lg; WECo part M3AT w/P-404-CCT Plug	ea	X	1	2	M3AT-P
	5995-542-6062	†	CABLE ASSEMBLY, SPECIAL PURPOSE, ELECTRICAL: 3 stranded No. 18 AWG, 1 braided No. 34 AWG; 2 ft 10-5/8 in lg; WECo part M4AB w/7055 Hubbell Cap	ea	X	1	2	DC

(1) SOURCE MAINTENANCE AND RECOVERABILITY CODE	(2) FEDERAL STOCK NUMBER	(3) DESIGNATION BY MODEL	(4) DESCRIPTION	(5) UNIT OF ISSUE	(6) EXPENDABILITY	(7) QUANTITY AUTHORIZED	(8) ILLUSTRATIONS FIGURE NO.	(9) ILLUSTRATIONS ITEM NO
		1 2	AN/FGQ-1; AN/FGQ-1A (Incl MX-733/FGQ-1 And RE-121/UG) (continued)					
	6145-191-3283	† †	CABLE, POWER, ELECTRICAL: 4 cond; MIL type CO-04LGF(4/18)SJO524	ft	X	11	2	M5G
	5815-643-0262	† †	POWER SUPPLY PP-748/U	ea	NX	1	2	POWER UNIT
	5945-188-5631	† †	RELAY, ARMATURE RE-163/G	ea	NX	7	2	255 RELAY
			GROUP 2 POWER SUPPLY PP-748/U					
	6130-351-6732		0 RECTIFIER ASSEMBLY, METALLIC: SigC dwg No. SM-D-169183	ea	X	1		
			PART II					
	5975-498-0562		UNIVERSAL CONNECTOR KIT MX-733/FGQ-1: Manual control; black wrinkle finsih; 7 in lg x 4-1/2 in w x 2-1/16 in h sw box; permits 2 "Crypto Units", 2 "SpTD Units" or 1 "Crypto Unit" and 1 "SpTD Unit" to be connected to Teletypewriter Repeater-Mixer AN/FGQ-1	ea	NX			
			NO OPERABLE EQUIPMENT PARTS					
			PART III					
	5945-384-8097		RELAY ASSEMBLY RE-121/UG: steel box 5-9/32 in w x 9-1/2 in h x 5-3/16 in d o/a; to send and receive †† signal	[illegible]	MX			
	5945-188-5631		RELAY, ARMATURE RE-163/G	ea	NX	2		

(1) SOURCE MAINTENANCE AND RECOVERABILITY CODE	(2) FEDERAL STOCK NUMBER	(3) DESIGNATION BY MODEL 1	2	(4) DESCRIPTION	(5) UNIT OF ISSUE	(6) EXPENDABILITY	(7) QUANTITY AUTHORIZED	(8) ILLUSTRATIONS FIGURE NO	(9) ILLUSTRATIONS ITEM NO
		1	2	AN/FGQ-1; AN/FGQ-1A (Incl MX-733/FGQ-1 And RE-121/UG) (continued)					
				RUNNING SPARES AND ACCESSORY ITEMS					
				TELETYPEWRITER, REPEATER-MIXER AN/FGQ-1; AN/FGQ-1A (INCLUDING UNIVERSAL CONNECTOR KIT MX-733/FGQ-1 AND RELAY ASSEMBLY RE-121/UG)					
				PART I TELETYPEWRITER REPEATER-MIXER AN/FGQ-1; AN/FGQ-1A					
				GROUP I TABLE, INCLUDING REPEATER AND MIXING RELAY UNITS					
	5920-228-4502	†	†	FUSE, PLUG: 0.8 amp Buss part No. S-8/10	ea	X	10		
	5920-243-4175	†	†	FUSE, PLUG: 3.2 amp Buss part No. S-3-2/10	ea	X	5		
	6240-132-5316	†	†	LAMP, INCANDESCENT: WECo part No. 53A	ea	X	2		
	5945-188-5631	†	†	RELAY, ARMATURE RE-163/G	ea	X	2		
				GROUP 2 POWER SUPPLY PP-743/U (Parts Common to AN/FGQ-1; AN/FGQ-1A)					
	5920-280-3160			FUSE, CARTRIDGE: 1.6 amp; MIL type F15G1R60B	ea	X	5		
	5920-280-9343			FUSE, CARTRIDGE: 10 amp, MIL type F15G10R0B	ea	X	3		

BY ORDER OF THE SECRETARIES OF THE ARMY AND THE AIR FORCE:

G. H. DECKER,
General, United States Army,
Chief of Staff.

Official:

R. V. LEE,
Major General, United States Army,
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11-117	11-597
11-155	

NG: None.

USAR: None.

For explanation of abbreviations used, see AR 320-50.

U. S. GOVERNMENT PRINTING OFFICE: 1961—570795/788

TELETYPEWRITER REPEATER-MIXER AN/FGQ–1

TM 11–2209
TO 31W4–2FGQ1–1
CHANGES No. 4

DEPARTMENTS OF THE ARMY
AND THE AIR FORCE
WASHINGTON 25, D. C., *7 August 1956*

TM 11–2209, 20 February 1946, is changed as follows:

Page 1, paragraph 1.1 (C3). Make the following changes:

a. In line 3, change "SR 745–45–5" to read: **AR 700–58.**

b. In line 3, change "Office of the Chief Signal Officer" to read: **Commanding General, Signal Corps Engineering Laboratories, Fort Monmouth, N. J.**

b. In line 4, change "SR 700–45–5" to read: **AR 700–38.**

c. In line 5, delete "SR 700–45–5 and."

Page 72, figure 75.2 (C3). Make the following changes:

Reverse the terminal designations 3 and 6 of send relay K1, in A, B, and C.

Reverse the terminal designations 4 and 5 of receive relay K2, in A, B, and C.

Page 72, paragraph 67.8 (C3). Make the following changes:

a(2). In line 7, change "5" to read: **4.**

In Line 12, change "from the AN/FGQ–1 with current approximately half the value of the signal line current" to read: **(provided that plug P1 is connected to a source of 110- to 120-volt ac power).**

In Line 16, change "4" to read: **5.**

c(2). After the second sentence, insert the following: (Plug P1 should be removed from the source of power).

Page 72, figure 75.3 (C3). Make the following changes:

Reverse the terminal designations 3 and 6 of send relay K1.

Reverse the terminal designations 4 and 5 of receive relay K2.

Position the armature of send relay K1 against the No. 4 contact or the relay.

Page 72, figure 75.6 (C3). Make the following changes:

Reverse the wires connected to terminals 4 and 5 of the receive relay jack.

Reverse the wires connected to terminals 3 and 6 of the send relay jack.

[AG 300.7 (27 Jul 56)]

By order of the Secretaries of the Army and the Air Force:

MAXWELL D. TAYLOR,
General, United States Army,
Chief of Staff.

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Distribution:

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CNGB (1)
ASA (3)
Tec Svc, DA (1) except CSIGO (30)
Tec Svc Bd (1)
Hq CONARC (5)
CONARC Bd (Incl ea Test Sec) (1)
Army AA Comd (2)
OS Maj Comd (5)
OS Base Comd (5)
Log Comd (5)
MDW (1)
Armies (5)
Corps (2)
Ft & Cp (2)
Sp Wpn Comd (2)
Army Cml Cen (4)
Gen & Br Svc Sch (5) except Sig Sch (25)
Gen Depots (2) except Atlanta Gen Depot (None)
Sig Sec, Gen Depots (10)
Sig Depots (17)
US Army Tng Cen (2)
POE (OS) (2)
Trans Terminal Comd (2)
Army Terminals (2)
OS Sup Agencies (2)
Army Elct PG (1)
Sig Fld Maint Shops (3)
Sig Lab (5)
ACS (3)
Mil Dist (1)
Engr Maint Cen (1)
Units organized under following TOE's:
11–7C, Sig Co, Inf Div (2)
11–16C, Hq & Hq Co, Sig Bn, Corps or Abn Corps (2)
11–57C, Armd Sig Co (2)
11–127R, Sig Rep Co (2)
11–128C, Sig Depot Co (2)
11–500R (AA–AE), Sig Svc Org (2)
11–557C, Abn Sig Co (2)
11–587R, Sig Base Maint Co (2)
11–592R, Hq & Hq Co, Sig Base Depot (2)
11–597R, Sig Base Depot Co (2)

NG: State AG (6); units—same as Active Army except allowance is one copy to each unit.
USAR: None.
For explanation of abbreviations used, see SR 320–50–1.

TAGO 727A

U. S. GOVERNMENT PRINTING OFFICE: 1956

WAR DEPARTMENT TECHNICAL MANUAL

TM 11-2209

This manual supersedes TM 11-2209, 131B2 Printer Station Equipment for Army and Navy Installations, 10 May 1944.

TELETYPEWRITER

SET 131B2

WAR DEPARTMENT • FEBRUARY 1946

RESTRICTED. *DISSEMINATION OF RESTRICTED MATTER.* No person is entitled solely by virtue of his grade or position to knowledge or possession of classified matter. Such matter is entrusted only to those individuals whose official duties require such knowledge or possession. (See also paragraph 23b, AR 380-5, 15 March 1944.)

United States Government Printing Office
Washington: 1946

WAR DEPARTMENT

WASHINGTON 25, D. C., 20 February 1946

TM 11-2209, Teletypewriter Set 131B2, is published for the information and guidance of all concerned.

[AG 300.7 (2 Nov 45)]

BY ORDER OF THE SECRETARY OF WAR:

OFFICIAL:

EDWARD F. WITSELL
Major General
The Adjutant General

DWIGHT D. EISENHOWER
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Refer to FM 21-6 for explanation of distribution formula.

CONTENTS

DESTRUCTION NOTICE

WHY — To prevent the enemy from using or salvaging this equipment for his benefit.

WHEN — When ordered by your commander.

HOW — 1. Smash — Use sledges, axes, handaxes, pickaxes, hammers, crowbars, heavy tools.

2. Cut — Use axes, handaxes, machetes.

3. Burn — Use gasoline, kerosene, oil, flame throwers, incendiary grenades.

4. Explosives — Use firearms, grenades, TNT.

5. Disposal — Bury in slit trenches, fox holes, other holes. Throw in streams. Scatter.

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT

WHAT — 1. Smash — Cabinets, tables, relays, resistors, capacitors, switches, nameplates and other identifying marks.

2. Cut — All wiring, cords and cables, relay and transformer windings.

3. Burn — Technical Manuals, diagrams, circuit labels.

4. Bend — Frameworks and panels.

5. Bury or scatter — Any or all of the above pieces after smashing, cutting, or breaking.

DESTROY EVERYTHING

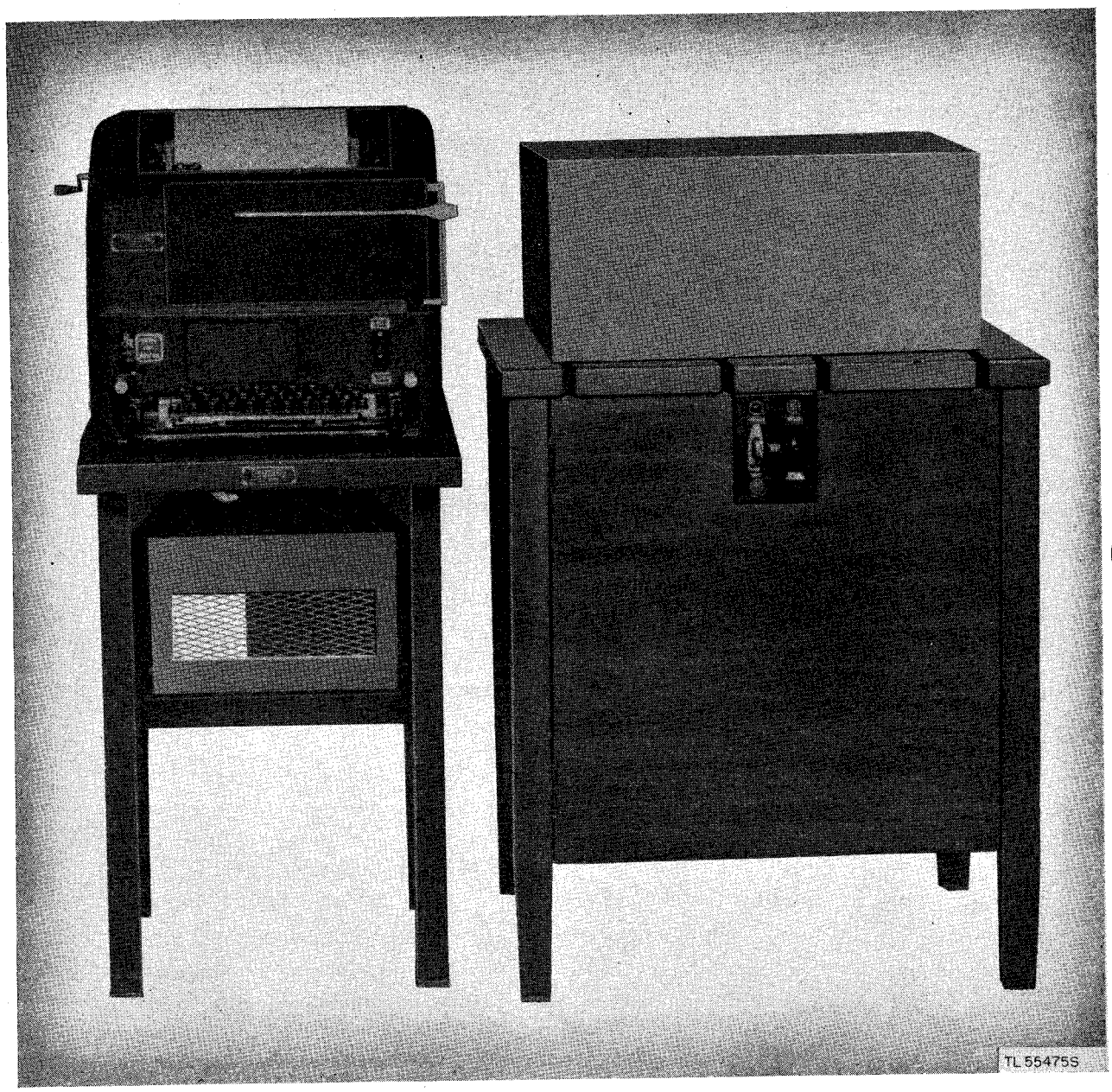


Figure 1. Typical AO, on-line station arrangement.

This manual supersedes TM 11-2209, 131B2 Printer Station Equipment for Army and Navy Installations, 10 May 1944.

PART ONE
INTRODUCTION

Section I. DESCRIPTION OF TELETYPEWRITER SET 131B2

1. General

a. Teletypewriter Set 131B2 is used in conjunction with other teletypewriter equipment to provide a teletypewriter secrecy system in which plain text messages may be automatically enciphered before transmission to a distant station. Incoming messages received in cipher are automatically deciphered and appear on the recording teletypewriter in plain text. These teletypewriter station arrangements are adaptable for general use over stable communication facilities either wire or radio or for local enciphering and deciphering arrangements known as off-line room circuits. An on-line station installation is shown in figure 1. Two types of cryptographic units may be used with the 131B2 set. These cryptographic units are not furnished as components of the Teletypewriter Set 131B2. One of these units which is contained in a black metal box and located on the table of the 131B2 set will be hereinafter referred to as the "crypto unit." The other unit is a special transmitter-distributor referred to as the "SpTD unit." The secrecy system operates on the basis of mixing the characters of a message pulse by pulse with coding combinations set up by the "crypto" or "SpTD unit." Enciphered messages are automatically deciphered by recombining the characters pulse by pulse by means of a "crpyto" or "SpTD unit." The arrangement is limited in use to the start-stop form of teletypewriter operation at a speed of 60 words or 368 operations per minute.

b. 131B2 station arrangements have been designed to operate under the same transmission conditions under which normal teletypewriter stations operate.

c. 131B2 station arrangements have been designed to provide service in place of teletypewriter stations where a secrecy system is required. They will operate directly on a line or line extension in combination with the various line units, repeater units, and telegraph terminals or in off-line circuits.

d. When 131B2 station arrangements are used with direct current for universal motors the primary source of power supply should be 105 to 125 volts direct current (d-c). When these arrangements are equipped with alternating-current (a-c) synchronous motors the primary source of power should be 95 to 125 volts, 60-cycle. When a-c series or universal motors are furnished, the primary source of power may be 25, 40, 50, or 60 cycles and the line voltages 95, 105, 115, 125, 190, 210, 230, or 250 volts.

Figure 2. Teletypewriter Set 131B2, over-all illustration.

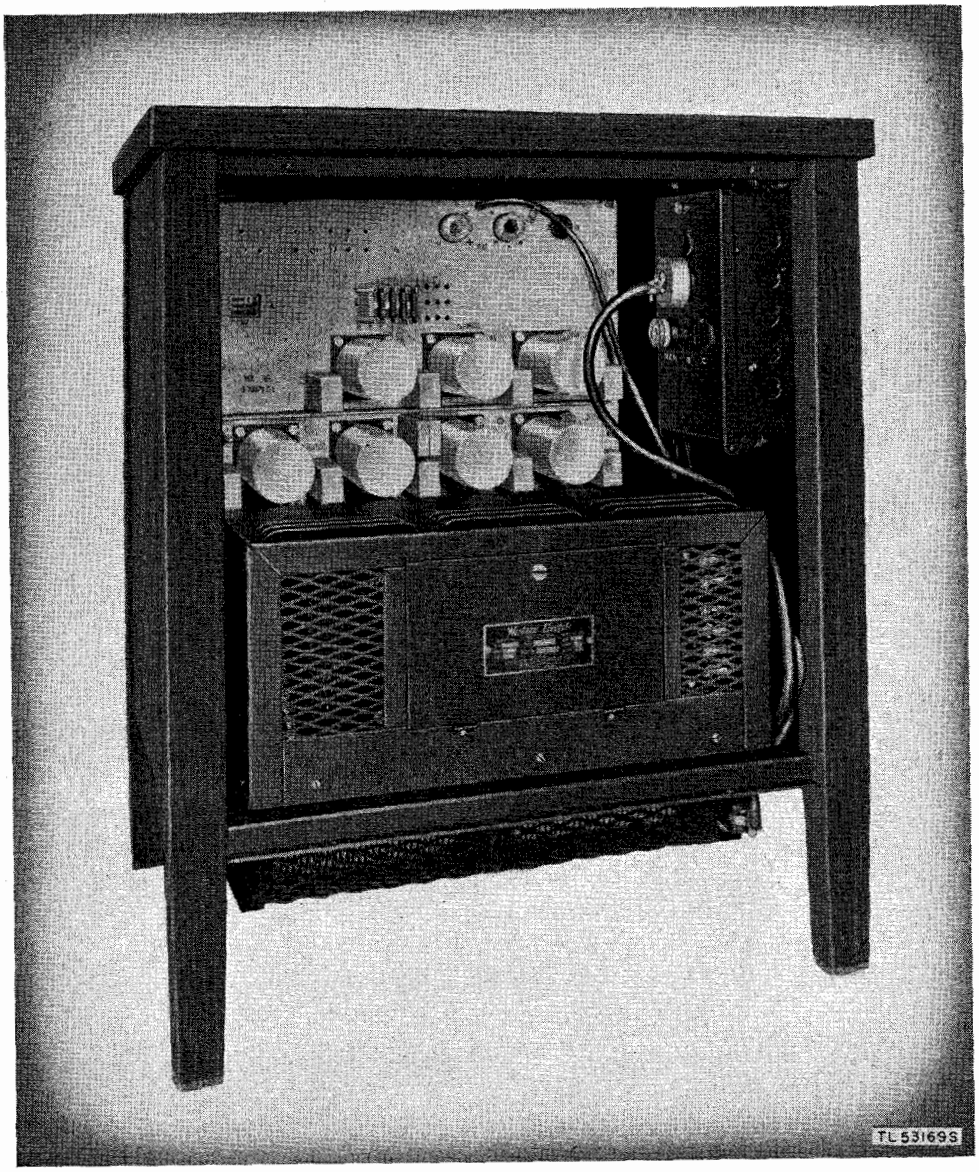


Figure 3. Teletypewriter Set 131B2, rear view, grill removed.

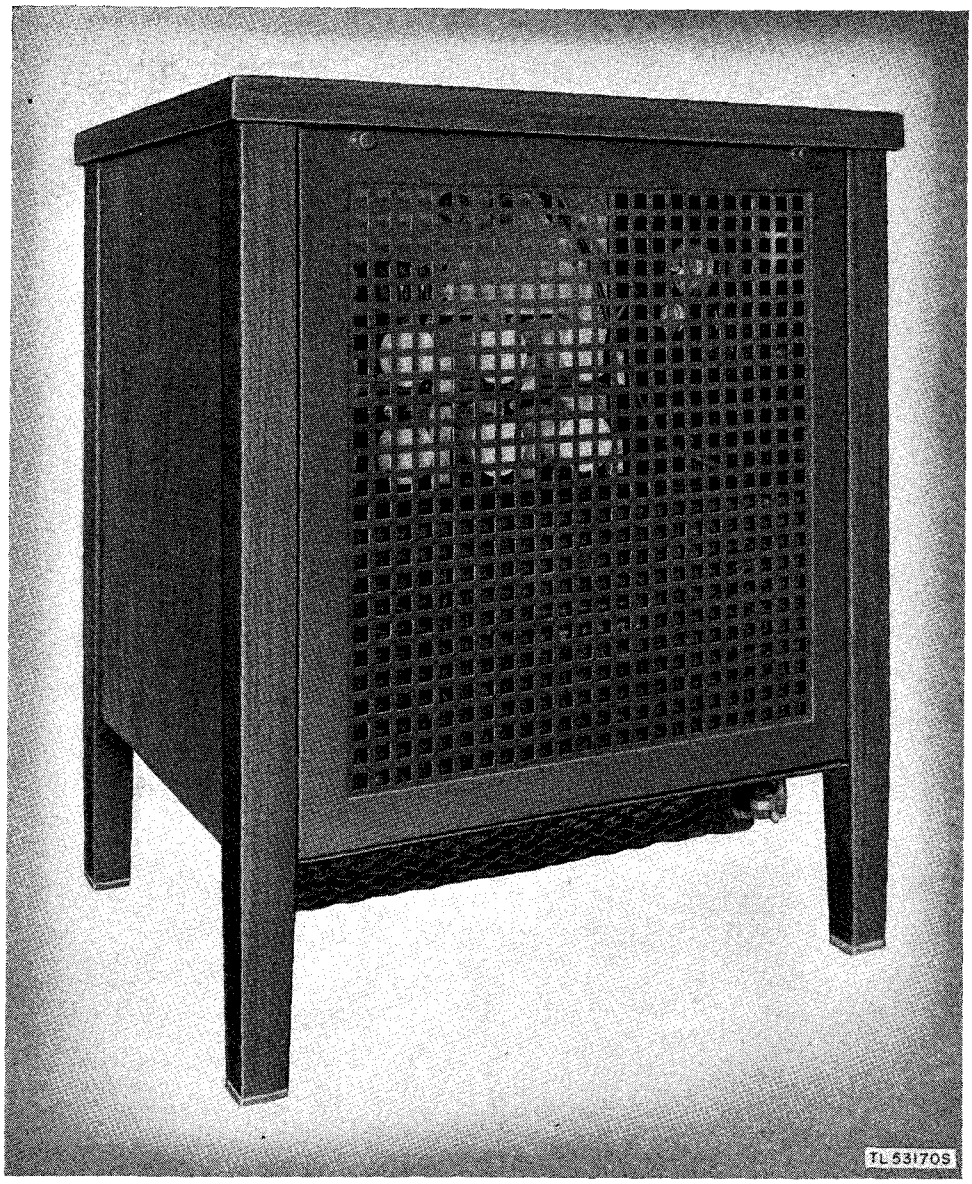


Figure 4. Teletypewriter Set 131B2, rear view, grill in place.

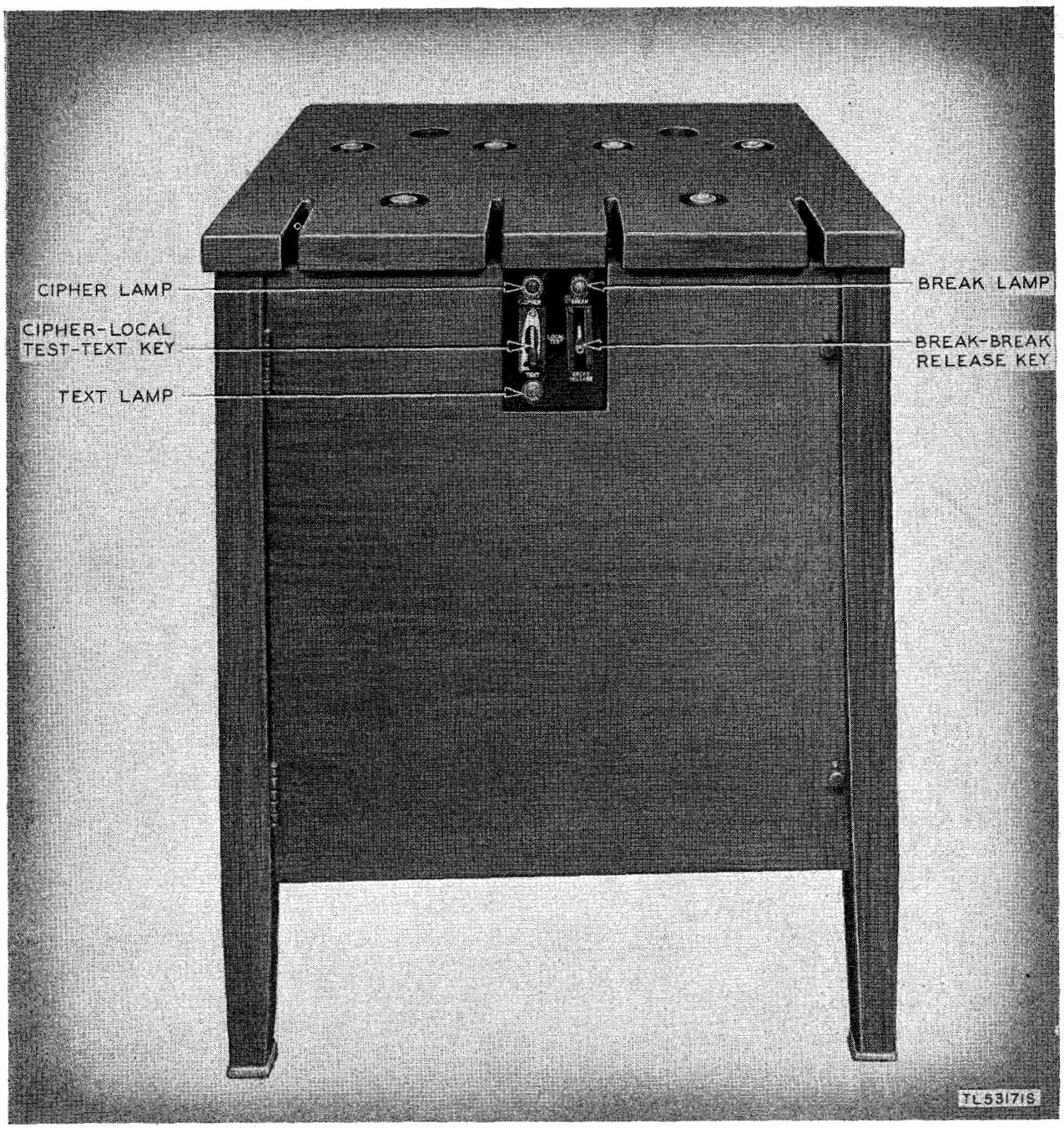


Figure 5. Teletypewriter Set 131B2, front view, door closed.

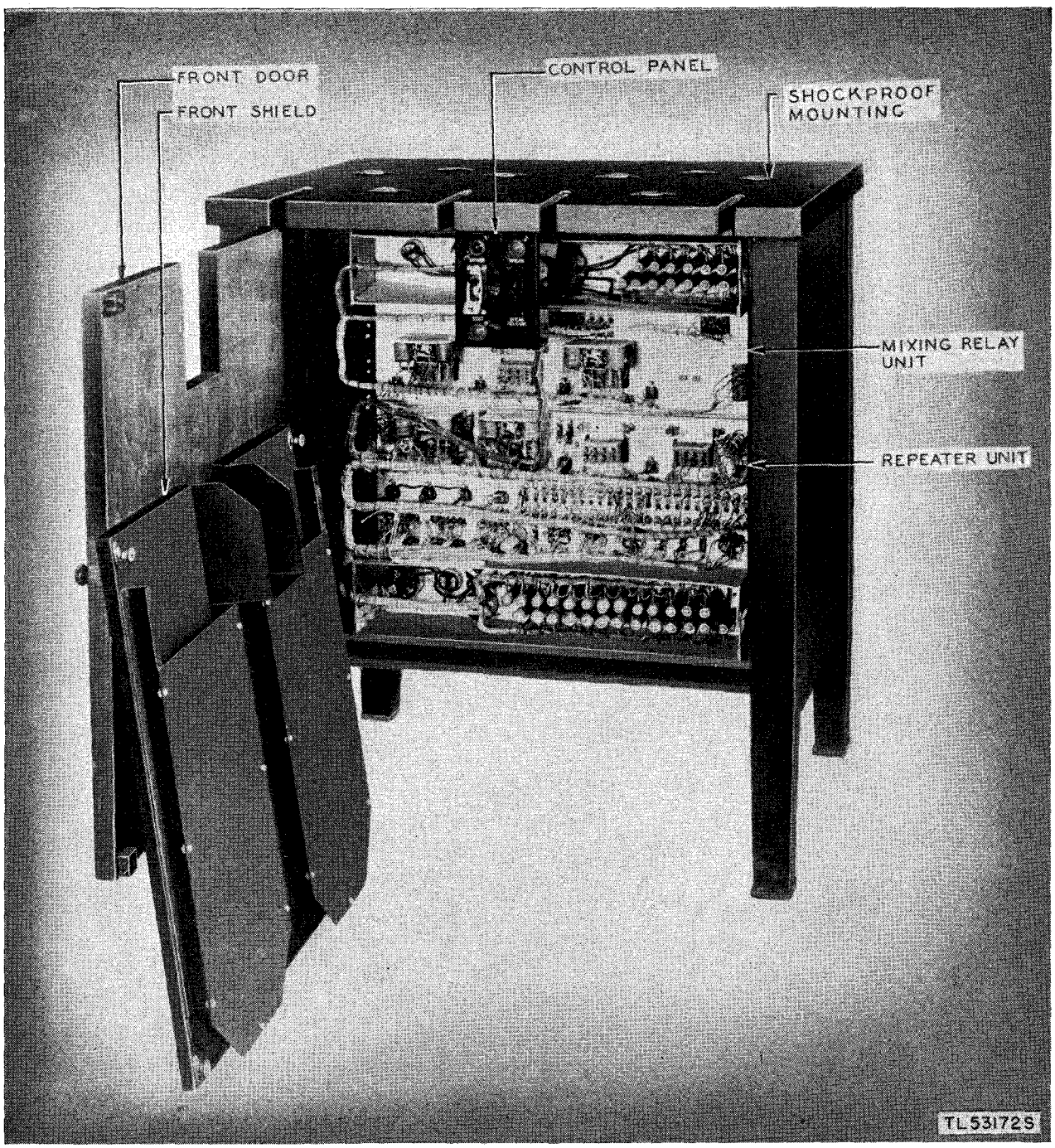


Figure 6. Teletypewriter Set 131B2, front view, door open and shield removed.

2. Table of Components

The items listed below in table I are the components of Teletypewriter Set 131B2. The data given below are for the equipment unpacked and ready for use.

Table I

Quantity	Component	Weight (pounds) each	Dimensions (inches)	Volume (cu ft) each
1	Teletypewriter Set 131B2	160	30½ x 26 x 22	10.1
1	D-c power cord			
1	M3AT–P cord with multiconductor plug			
1	M3AT–S cord with multiconductor socket			
1	M9C cord			
1	M9D cord			
1	M5G cable			
1	Heater lamp			
7	255-type relay	1.5	5¾ x 2¾ x 2¾	.009
1	Power unit (when a-c power is used).			
	Main unit	79	19½ x 7½ x 9⅛	.77
	Varistor unit	11	20¾ x 4¼ x 4⅛	.21

3. Physical Description of Teletypewriter Set 131B2

a. TABLE. (1) The table of Teletypewriter Set 131B2 is constructed of wood. It has a walnut finish and is 30½ inches high, 26 inches wide, and 22 inches deep. A serial number is stamped inside the table near the top of the right front leg. The inside of the table is shielded to reduce the radiation of text signals that might be picked up by nearby radio receivers. Part of this shield forms the bottom of the table. It contains mounting arrangements for the repeater unit and the mixing relay unit. A power box is provided as part of the table and is bolted to the side wall. Four clearance holes are provided in the top of the shield with four starting holes located immediately above those in the table top. They are used for mounting certain auxiliary equipment. Three mounting holes are located in the table top next to and to the left of the control panel and these are also used to mount auxiliary equipment.

(2) The power box contains a power relay for turning on the "crypto" or "SpTD unit" motor when the set is in the "cipher" condition, power filters to reduce the radiation of signals on the power lines, a terminal on the frame of the box for connecting ground leads, and a terminal block for connecting the primary power source and power leads to the teletypewriter. The cover of the power box (fig. 7) contains a 4-connector receptacle to receive the 4-connector plug of the power unit or the 4-connector plug of the cord which is used instead of the power unit when d-c primary power is used. The cover of the box also contains a 3-connector receptacle to receive the power cord of the "crypto" or "SpTD unit" and a 2-connector convenience receptacle which is connected across primary power at all times. This convenience receptacle may be used for a soldering iron, trouble lamp or the cord and plug of a heating lamp when this lamp is used. Caution should be exercised before using this convenience outlet for soldering irons or lamps so that the irons or lamps will not be destroyed by an a-c voltage supply that is higher in value than the rated voltage of the iron or lamps. A fustat mounting and a 3.2-ampere fustat are also provided on the cover of the power box and these protect the "crypto" or "SpTD unit" motor circuit. A squeeze-type cord connector is provided in one of the knockouts in the bottom of the power box to clamp the power cords entering the box.

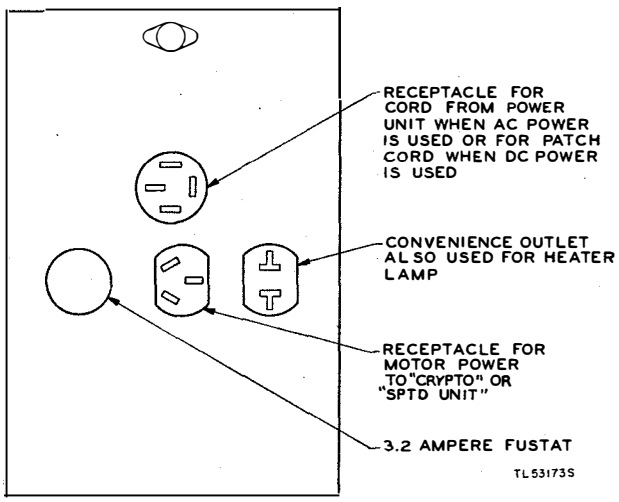


Figure 7. Power box cover.

(3) The metal bottom of the table forms a shelf inside the table on which the main part of the power unit mounts. Holes are provided in this shelf for mounting screws to mount the varistor unit under the table. A hole is provided in the bottom of the table, at the rear under the left-hand side looking from the front, to permit the power cords which connect to the power box to enter the table. The cord that connects the two parts of the power unit also passes through this hole. Two bushings, to provide for loop or line leads and cords from the teletypewriter set are provided in the bottom of the table under the position of the terminal strip to which these leads and cords connect. The rear of the table is inclosed with an easily removable metal grill which bonds with the table shield. A hinged wooden door is provided on the front of the table. This door completely incloses the front of the table except for the control panel on which control keys and lamps are mounted. On the most recent sets manufactured, a section of the door immediately to the left of the cut-out for the control panel is partially sawed through to provide for easily removing a piece of the door when certain auxiliary equipment is used. The control panel, which is part of the repeater unit, is mounted under the top of the table at the center of the front. Behind the door a removable metal plate, which bonds with the table shield and which shields the wiring of the units mounted in the table, is provided.

(4) The top of the table is provided with six shockproof mountings. The two front mountings and the two inner rear mountings are used to mount the "crypto unit." One front mounting and two rear mountings are used to mount the "SpTD unit." Two holes are provided toward the rear of the table top and the hole at the left looking from the front of the table is used to carry the cords of the "crypto" or "SpTD unit" into the table. The right-hand hole and the four slots in the front of the table top are not used in this application of the set.

b. Repeater Unit. The repeater unit (figs. 8 and 9) consists of a mounting plate 10½ inches high and 19 inches wide and a control panel 5½ inches high and 3¾ inches wide. The mounting plate mounts on the lower part of the mounting rack in the table and contains four polar relays, one **Y**-type relay, two **U**-type relays, connecting blocks for four 255-A type relays, resistors, capacitors, filters, connecting blocks, fuse mountings and fuses, power receptacles, and a key. The control panel which mounts on the front of the table contains two keys and three lamps as well as a cut-out covered by a cover plate. This cut-out is used to mount an auxiliary key when required.

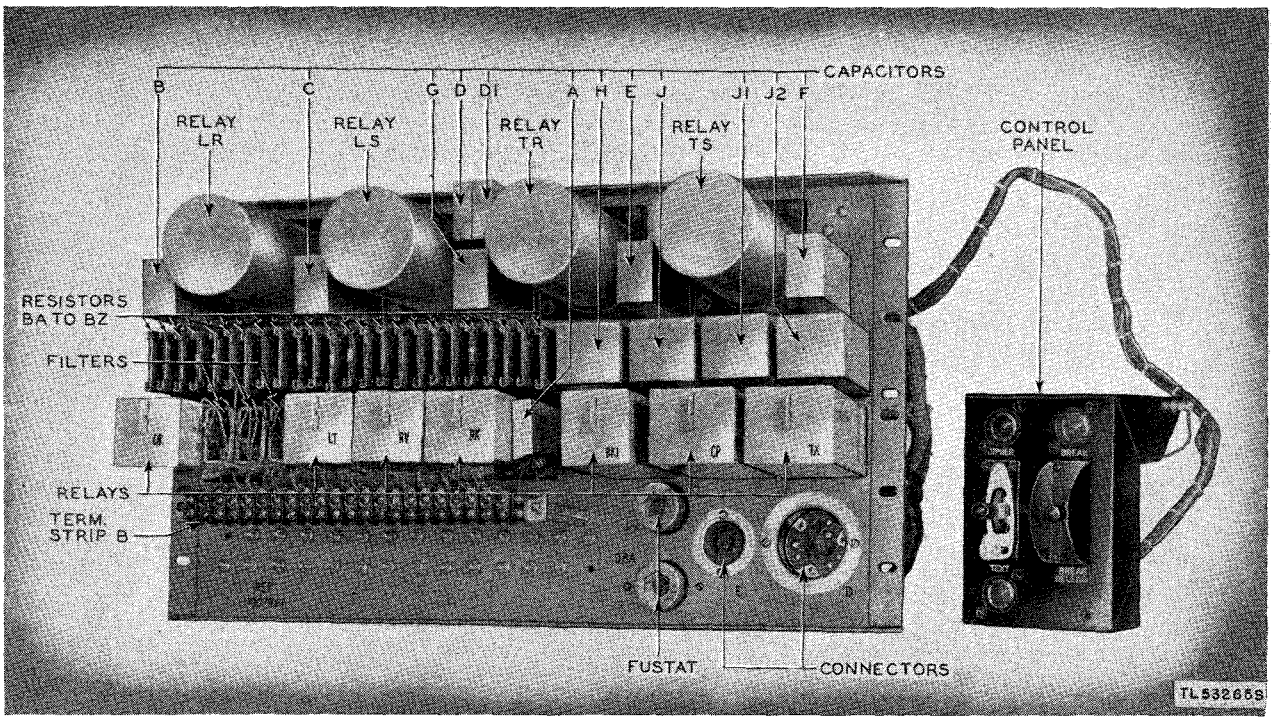


Figure 8. Front view of repeater unit panel.

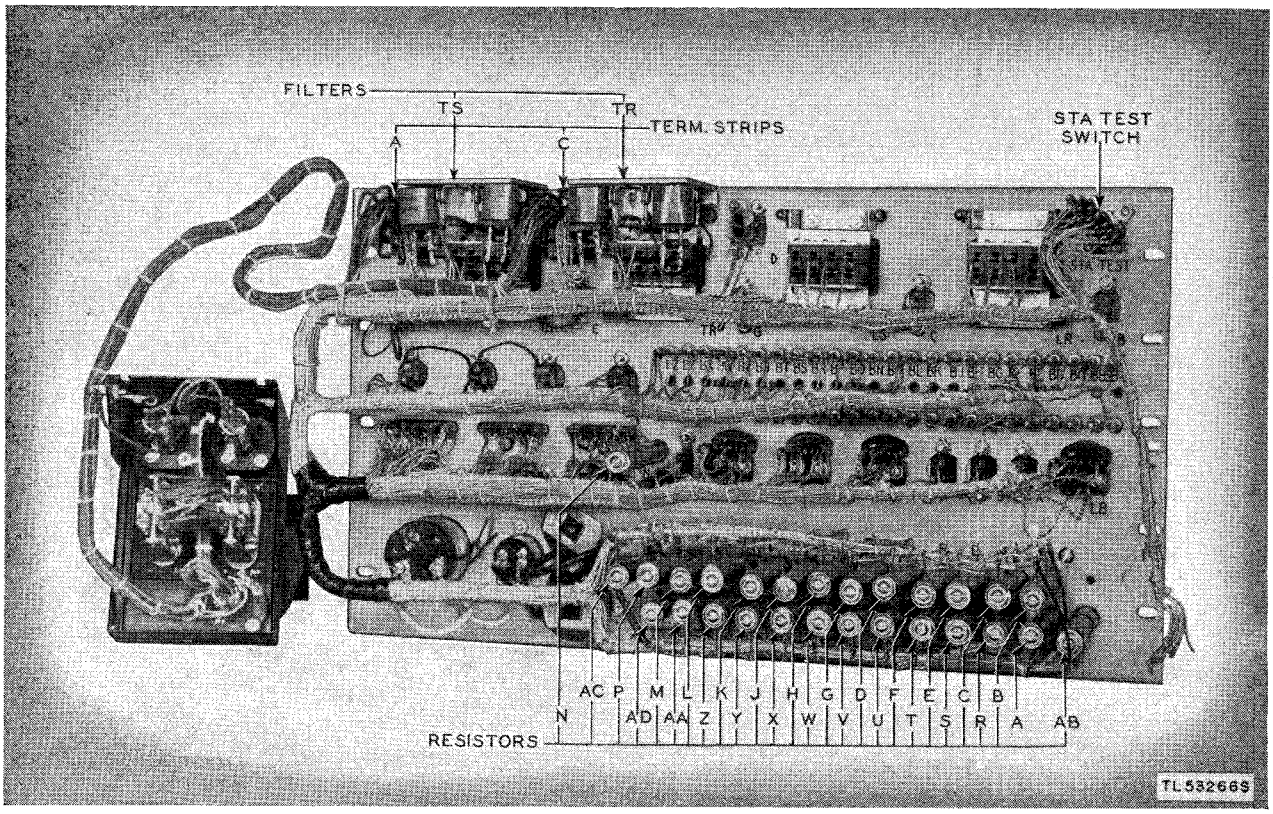


Figure 9. Rear view of repeater unit panel.

c. MIXING RELAY UNIT. The mixing relay unit (figs. 10 and 11) consists of a mounting plate 8¾ inches high and 19 inches wide which mounts in the table above the repeater unit. It contains three connecting blocks for 255–A type relays, capacitors, power resistors, fuse receptacles and fuses, a power cord and connector, terminal blocks, and a power receptacle to receive cords and plugs from the "crypto" or "SpTD unit."

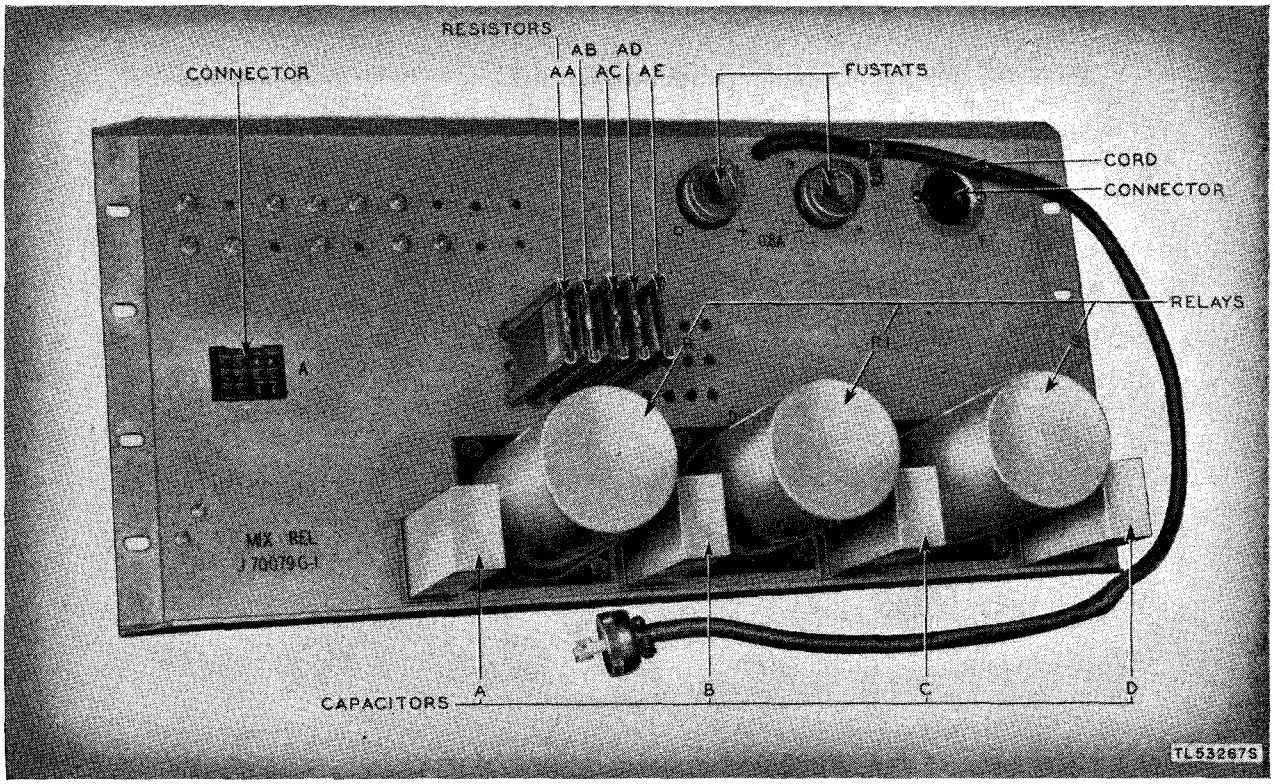


Figure 10. Front view of mixing relay unit panel.

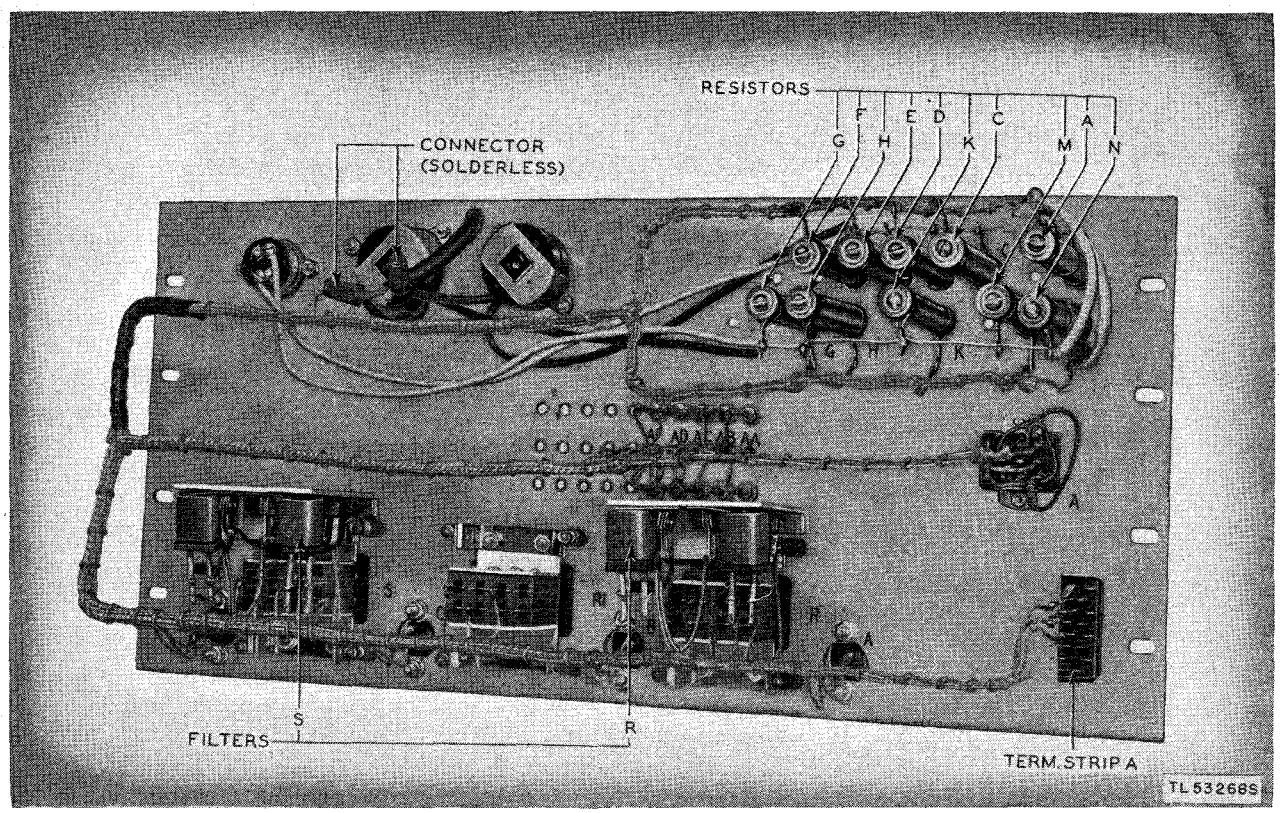


Figure 11. Rear view of mixing relay unit panel.

4. Cords and Cable

Five cords and one cable are provided with every Teletypewriter Set 131B2. These cords and cable are all that are required for normal services. The cords and cable are as follows:

a. D-c Power Cord. This cord has a 4-connector plug on one end and a three-connector socket on the other end. It is used when direct-current (d-c) primary power is used and connects the power box to the repeater unit.

b. M3AT–P Cord. This cord is 2 feet long with a multiconductor plug. This cord, which is shielded, carries the line connections of the transmitter-distributor of a 19-type teletypewriter set to the M3AT–S cord below.

c. M3AT–S Cord. This cord is 2 feet long with a multiconductor socket which connects to the teletypewriter base. It is a shielded cord and plugs into the M3AT–P cord mentioned above.

d. M9C Cord. This cord is 2 feet, 6 inches long. It is an 8-conductor shielded cord with the shield terminating as a lead on one end and as a connector on a multiconductor plug on the other end. It connects to the teletypewriter base and plugs into the M9D cord.

e. M9D Cord. This cord is 6 feet long. It is an 8-conductor shielded cord with the shield terminating as a conductor on one end and as a connector on a multiconductor socket on the other end. It connects to a terminal block on the set and plugs into the M9C cord mentioned above.

f. M5G Cable. This is a 4-conductor, 18-gauge, shielded power cable 9 feet long. The shield is brought out of each end as a conductor and the cable is used to connect the power circuits of the teletypewriter and the 131B2 set.

5. Heater Lamp

A 50-watt lamp, inclosed in a protective cage and attached to a cord on the other end of which is a combined plug and receptacle, is provided for use in tropical areas. This lamp, which may be laid on top of the power unit, is intended to keep the inside of the set dry and free from certain types of insects. The cord plugs into the convenience outlet in the power box on the table.

6. 255–A Type Relays

The 255–A relay is a demountable polar relay. Seven of these relays are used with each 131B2 set. They mount in the connecting blocks of the mixing relay and repeater units of the 131B2 set.

7. Power Unit

The power unit consists of two parts. One part is a varistor unit containing the stacks of selenium disks and the other part is the main unit containing the power transformer, capacitors, filters, fuses, cross-connection panels, and cords. The varistor unit mounts under the bottom of the 131B2 table by means of mounting screws and the main unit stands inside of the table on the bottom. A 4-conductor cord provided with a multiconductor socket is a part of the main unit and this socket connects to a plug which is part of the varistor unit. A 4-conductor cord with a 4-conductor plug is also a part of the main unit and this plugs into the 4-conductor outlet in the power box on the 131B2 table. A 3-conductor cord equipped with a 3-conductor receptacle is part of the main unit and this cord, which is connected to the d-c output of the unit, connects to a 3-conductor base on the repeater unit. The main unit contains a panel which mounts eight input-voltage taps, four frequency taps, and eight rectifier taps. This panel is covered by a door hinged to the outer case of the main unit. This door, upon being opened, operates a safety switch which opens the hot side of the primary power. The primary side of the power unit is fused by a 10-ampere fusetron and the secondary side is fused by a 1.6-ampere fusetron. These fusetrons are mounted on the panel containing the taps mentioned above.

8. General Functioning of Equipment

a. Repeater Unit. (1) The front and rear views of the repeater unit panel are shown in figures 8 and 9. The repeater unit is provided primarily to control the direction of transmission into or out of the set. By means of a reversing relay arrangement it directs incoming enciphered material to the mixing relay unit and "crypto" or "SpTD unit" for deciphering and directs the deciphered output to the receiving teletypewriter. When the station is sending, the repeater unit directs the plain text material from the teletypewriter to the mixing relay unit and "crypto" or "SpTD unit" and directs the enciphered output to the line. The repeater unit provides for sending a "break" to the line and for the reception and locking-in of a received "break" which automatically stops sending from the station and returns it to the "text" condition. Controls are provided to permit the transmission and reception of plain text as well as enciphered text at the will of the operator.

(2) A local test feature permitting the operator to send from the local keyboard or transmitter to the local typing unit is also provided and is so arranged that its use does not interfere with traffic between other stations on the same circuit. This feature is particularly useful when tape transmission is used and it is desired to prove the tape locally before transmission and is useful for test purposes. The repeater unit also includes a station test feature which provides a means of locally testing and lining up a complete station when no line is available or without interfering with the line if one is connected to the set. Visual signals are provided to indicate whether the station is in the "cipher" or "text" condition and whether a "break" is locked in the set.

(3) Terminals are provided on the terminal strip of the repeater unit for connecting local battery for polar sending as well as for limited uses outside the 131B2 set.

b. Mixing Relay Unit. The panel of the mixing relay unit is shown in figures 10 and 11. The mixing relay unit is provided to receive straight text or enciphered signals from the repeater unit, encipher or decipher these signals by means of the "crypto" or "SpTD unit," and send these enciphered or plain text signals back to the repeater unit for transmission to the line or to the teletypewriter.

c. Power Unit. A power unit (fig. 2) is required with 131B2 station arrangements when the primary power source is alternating current (ac). This power unit has the dual purpose of supplying d-c power for relay, magnet, and in some cases line operation, and of supplying the proper a-c voltage to operate the teletypewriter and "crypto" or "SpTD" unit motors when the input frequencies and voltages are 25, 40, 50, or 60 cycles and 95, 105, 115, 125, 190, 210, 230, or 250 volts.

d. Functioning of Keys, Switches, and Lamps. (1) *General.* A number of keys, lamps, and switches are provided as part of the station arrangements for the purpose of controlling and

supervising the operation and testing of the station. Some of the keys and the lamps are a part of the Teletypewriter Set 131B2 and some of the keys and the switches are a part of the teletypewriter.

(2) *Keys and lamps of Teletypewriter Set 131B2.* Two keys and three lamps are provided on the control panel of the 131B2 set for operating and supervisory purposes. (See fig. 5.) A key used for testing is provided inside of the set on the repeater unit panel.

(a) CIPHER-LOCAL TEST-TEXT key. This is a three-position lockin lever type key with an added mechanical lock in its extreme positions. It is located on the control panel of the 131B2 set. (See fig. 5.) When thrown to its CIPHER position, it places the station in condition to send and receive enciphered messages. When thrown to its TEXT position, it places the station in condition to send and receive text messages. In the normal or LOCAL TEST position, it places the station in condition to send copy locally from its own keyboard or transmitter-distributor to its own typing unit.

(b) BREAK-BREAK RELEASE key. This is a three-position nonlocking lever-type key located on the control panel of the 131B2 set. (See fig. 5.) When thrown to its BREAK position, it creates a steady spacing condition on the line. When thrown to its BREAK RELEASE position, it releases or unlocks a break which has been received by the station.

(c) CIPHER lamp. This is an amber or green lamp located above the CIPHER-LOCAL TEST-TEXT key on the control panel (fig. 5) and it is lighted when the station is in the cipher condition.

(d) TEXT lamp. This is a red lamp located below the CIPHER-LOCAL TEST-TEXT key on the control panel (fig. 5) and it is lighted when the station is in the text condition.

(e) BREAK lamp. This is a red lamp located above the BREAK-BREAK RELEASE key on the control panel (fig. 5) and it is lighted when a break has been received and locked into the station.

(f) STA TEST key. This is a two-position twist-type key located inside the table of the 131B2 set. (See fig. 9.) When in its TEST position, it places the station in condition to be tested locally. When in its REGULAR position, it places the station in condition for normal operation.

(3) *Keys and switches of teletypewriter set.* Certain control keys and power switches are provided as part of the teletypewriter and are used in operating the 131B2 set. These differ depending on the type of teletypewriter.

(a) KEYBOARD-KBD & TAPE-TAPE key. This key is used on 19-type teletypewriter sets. (See fig. 12.) It is a lever-type key extending through the cover of the 19-type teletypewriter. When the key is in the KEYBOARD position, the station will transmit from its keyboard and local copy of what is being transmitted from the keyboard will be printed. When the key is in its KBD & TAPE position, the station will transmit from its keyboard, prepare a perforated tape, and print local copy of the transmission at the same time. If under this condition the station is in the LOCAL TEST condition, the copy shows what is being perforated but no transmission on the line takes place. When the key is in its TAPE position, the station will transmit from its transmitter-distributor if it is turned on by its own start switch, local copy of the material being transmitted will be printed, and tape may be perforated. If the station is receiving and the key is operated to its TAPE position, operation of the keyboard will not interfere with the received copy.

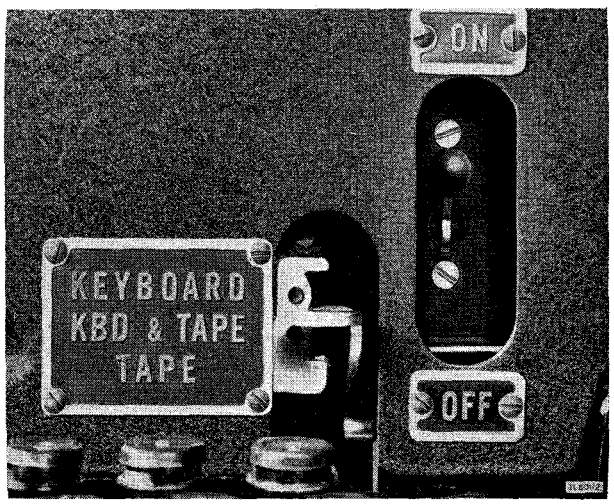


Figure 12. KEYBOARD-KBD & TAPE-TAPE key of 19-type teletypewriter.

(b) Power switches of teletypewriter. The wiring to the power switch of TG–7–A, TG–7–B, TG–37–B, TT–5/FG, TT–6/FG sets or in the teletypewriter of the other 15- and 19-type sets must be

modified so that the switch will control the power to the 131B2 set, the "crypto" or "SpTD unit" motor and the teletypewriter motor. In the usual 19-type set there are two other power switches independently controlling the motor of the transmitter-distributor and the rectifier unit of the set. These must be operated to permit automatic transmission and perforating.

(c) SEND-REC-BREAK key. This key on the various types of teletypewriter is not used with 131B2 stations and the wiring to it must be modified to remove it from the circuit.

9. Electrical Characteristics

a. LINES. The 131B2 station arrangements are connected to the various line units, line repeater units, and telegraph terminals by means of 0.020, 0.030, or 0.060 ampere lines which are similar to those used with other telegraph arrangements.

b. RADIO INDUCTION SUPPRESSION. Radio induction suppression is required for two reasons. One is to reduce the possible interference with nearby radio receivers and the other is to reduce the possibility of radio pick-up of text signals as radiated by the keyboard contacts, transmitter-distributor, wiring and relays. The relay apparatus and wiring of the 131B2 set is shielded by a steel shield in the table and the cords interconnecting the 131B2 set and teletypewriter are shielded and the leads to these cords filtered. Teletypewriters are normally equipped with shielded cords and with suppression filters to reduce the radiation from the sets.

c. POWER SUPPLIES. (1) The 131B2 station arrangement requires a source of d-c power for relay, magnet, and in some cases line operation; and a source of d-c or a-c power for the operation of the "crypto" or "SpTD unit" and teletypewriter motors. The dc for relay, magnet, and line operation should be 105 to 125 volts and the power drain at maximum load will be about 1 ampere. This dc may be supplied from a primary source of commercial or gas-engine direct current if the voltage is held within the limits mentioned above. Where a-c commercial or gas engine power is used, the direct current for relay, magnet, and line operation is supplied by the power unit.

(2) On stations where primary power is alternating current, the motor power for the "crypto" or "SpTD unit" and the teletypewriter is supplied through the transformer of the 131B2 power unit. The power for the perforator start magnet and end of line indicator must be supplied from REC 13 or REC 30 installed in association with the 19-type table. The motor for the transmitter on the 19-type table will receive its power directly from the primary power source or from the transformer of the REC 30 depending on the type of 19 table. The following lists the primary requirements:

(a) When direct current or universal motors on direct current are used, the primary power should be 105 to 125 volts dc and the power drain of the station, which will vary somewhat with the condition of the equipment, will be about as follows:

19-type station

At 105 volts—3.8 amps, 400 watts
At 125 volts—3.2 amps, 400 watts

15-type station

2.2 amps	230 watts
1.8 amps	230 watts

(b) When 60-cycle, a-c synchronous motors are used, the primary power should be 95- to 125-volt, 60-cycle power, and the power drain of the station, which will vary somewhat with the condition of the equipment, will be about as follows:

19-type station

At 95 volts—5.25 amps, 325 watts
At 115 volts—7.5 amps, 500 watts
At 125 volts—9.25 amps, 585 watts

15-type station

3.9 amps,	190 watts
4.9 amps,	260 watts
5.55 amps,	300 watts

(c) When a-c series or universal motors on alternating current are used, 25-, 40-, 50-, or 60-cycle, 95-, 105-, 115-, 125-, 190-, 210-, 230-, or 250-volt primary power may be used. In this case the power unit of the 131B2 set supplies power for the motor of the "crypto" or "SpTD unit," teletypewriter motor and d-c drain of the 131B2 set. In the case of the 19-type set the transmitter-distributor motor and d-c drain for the perforating set are supplied from the power unit of the 19-type set. The power drain for the power unit of the 131B2 set is about as follows:

Volts	25 cycles		40 cycles		50 cycles		60 cycles	
	Amps	Watts	Amps	Watts	Amps	Watts	Amps	Watts
95	3.00	265	3.00	270	3.40	300	3.55	315
105	2.90	265	2.70	270	3.05	300	3.15	315
115	2.65	265	2.45	270	2.90	300	2.90	315
125	2.50	265	2.25	270	2.60	300	2.65	315
190	1.80	265	1.50	270	1.75	300	1.75	315
210	1.70	265	1.35	270	1.55	300	1.60	315
230	1.60	265	1.25	270	1.40	300	1.50	315
250	1.50	265	1.20	270	1.35	300	1.40	315

Section II. APPLICATION

10. System Application

a. GENERAL. A common application of 131B2 station arrangement is shown in figure 13 which is a block diagram showing a type B (full-duplex) off-line arrangement at stations *A* and *B* which are interconnected by radio channels. At each station outgoing signals are from 15- or 19-type teletypewriter set through the upper 131B2 set of each station into the 133A1 or 133A2 set where they are converted to tape form by the typing reperforator of the 133 set. The tape signals may be either in text or enciphered. The tape is carried from the 133 set to the transmitter-distributor which sends the signal over the radio channel to the receiving station. The typing reperforator of each station receives the signals from the radio channel and prints and perforates the signals on tape. This tape is carried from the typing reperforator to the 133 set where the signals are sent by the transmitter-distributor through the 131B2 set to the 15-type teletypewriter. The two-way transmission between the upper 131B2 set and the 15- or 19-type teletypewriter set indicates that for outgoing transmission local copy is obtained with teletypewriter set by transmission of signals back to the teletypewriter set from the 131B2 set.

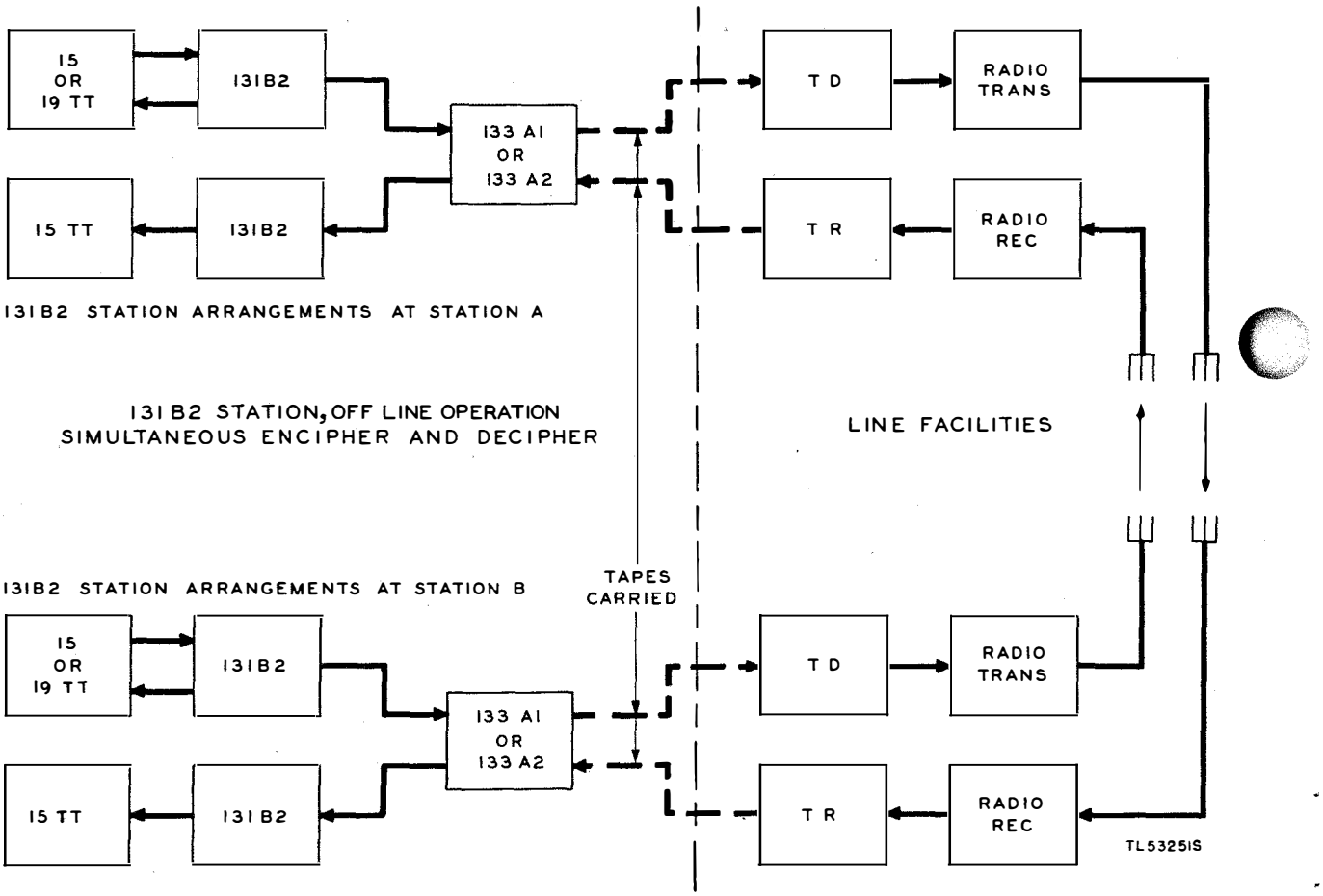


Figure 13. Teletypewriter Set 131B2, typical system application.

b. TELETYPEWRITER SETS. (1) The information covering the installation of the 131B2 set has been prepared specifically to cover the use of the following station teletypewriter facilities as a part of the 131B2 station arrangements.

19-type sets

TT–7/FG
TT–8/FG
Army Set on XRT–96 and XRT–107 Tables
Commercial 19 type set

15-type sets

TT–5/FG
TT–6/FG
TG–7–A
TG–7–B
TG–37–B

(2) Other teletypewriter sets may be used with 131B2 station arrangements provided the following requirements are met:

(a) Operate at a speed of 60 WPM (368 operations per minute).

(b) Operate start-stop on a 7.43 unit selecting code.

(c) Equipped with either pulling or holding selector magnets.

(d) The repeat space feature is removed.

(e) Equipped with the sending contacts and receiving magnet circuits separable.

11. Other Applications

a. The many applications of the 131B2 set are shown in figures 14 to 24 inclusive. These applications are divided into two general classifications known as on-line operation and off-line operation.

(1) On-line operation is used to define those applications in which the 131B2 set is directly connected to the transmission path to the distant station. (See figs. 14, 15, 16, 17, 18, 19, 20, 23, and 24.)

(2) Off-line operation is used to define those applications in which the 131B2 set is used locally to encipher and decipher messages received and sent by other apparatus to the distant station. (See figs. 21 and 22.)

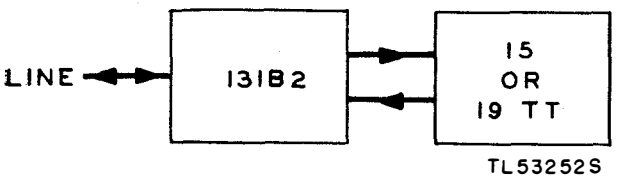


Figure 14. Type AO single (half-duplex), two-wire operation (without Line Unit BE-77-( ) or Repeater TG-30).

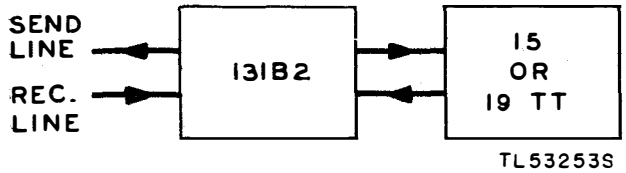


Figure 15. Type AO single (half-duplex), four-wire operation (without Line Unit BE-77-( ) or Repeater TG-30).

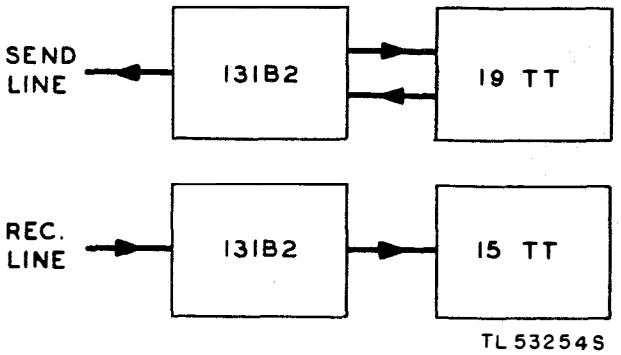


Figure 16. Full-duplex operation (without Line Unit BE-77-( ) or Repeater TG-30).

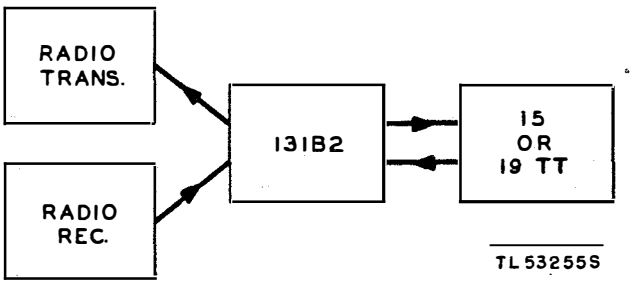


Figure 17. Single (half-duplex) operation on radio channels.

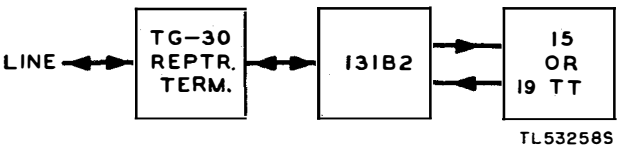


Figure 18. Type AO single (half-duplex) operation with Repeater TG-30 (Terminal).

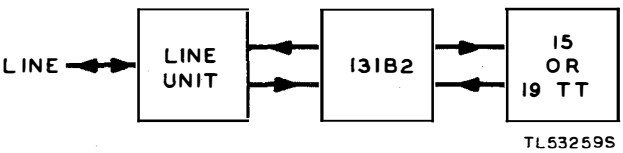


Figure 19. Type AO single (half-duplex) operation with Line Unit BE-77-( ).

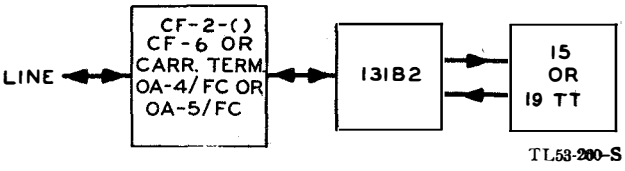


Figure 20. Type AO single (half-duplex) operation with Telegraph Terminal CF-2-( ) or CF-6, or Carrier Terminal OA-4/FC (X-61822A) or OA-5/FC (X-618225).

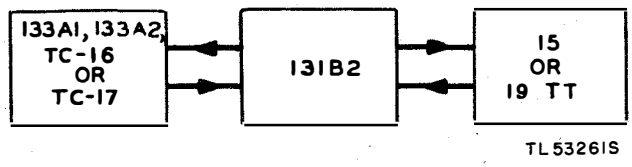


Figure 21. Types A, C, AA, and AC, off-line operation, alternate encipher and decipher.

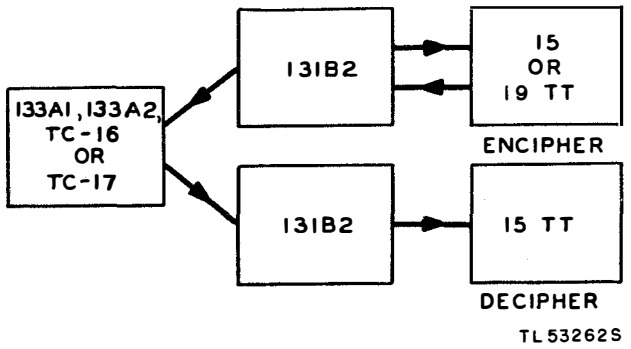


Figure 22. Types B, D, and BD, off-line operation, simultaneous encipher and decipher.

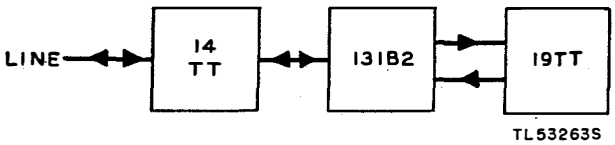


Figure 23. Type J, conference circuit, single (half-duplex), on-line two-wire operation.

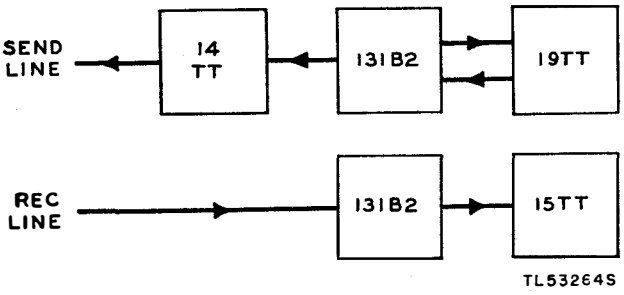


Figure 24. Type G, conference circuit, full-duplex operation.

b. Either the "crypto unit" or "SpTD unit" may be used on any of these applications and when auxiliary apparatus known as the "universal connector" is used two of either of these units or a combination of a "crypto unit" and an "SpTD unit" may be used on the same 131B2 set. If two units are used, only one may be operating at a given time but either may be used by operating a switch which is part of the universal connector. This universal connector is described in part four.

c. Certain of the most commonly used applications have been given alphabetical designations to provide an easy way of identifying them. The applications so designated are explained in the following list:

Type A. Off-line operation, alternate encipher and decipher using a "crypto unit." (See fig. 21.)

Type B. Off-line operation, simultaneous enciphering and deciphering using a single "crypto unit" on each of two 131B2 sets. (See fig. 22.)

Type C. Off-line operation, alternate encipher and decipher using an "SpTD unit." (See fig. 21.)

Type D. Off-line operation, simultaneous enciphering and deciphering using an "SpTD unit" on each of two 131B2 sets. (See fig. 22.)

Type G. On-line, full-duplex operation for conference circuits using an "SpTD unit." (See fig. 24.)

Type J. On-line, single (half-duplex) operation for conference circuits using a single "SpDT unit" on each of two 131B2 sets. (See fig. 23.)

Type AA. Off-line operation, alternate encipher and decipher using two "crypto units" on the 131B2 set. (See fig. 21.)

Type AC. Off-line operation, alternate encipher and decipher using one "crypto unit" and one "SpTD unit" on the 131B2 set. (See fig. 21.)

Type AO. On-line, single (half-duplex) operation, using a "crypto unit" on the 131B2 set. (See figs. 14 and 15.)

Type BD. Off-line operation, simultaneous enciphering and deciphering using one "crypto unit" and one "SpTD unit" on each of two 131B2 sets. (See fig. 22.)

Section III. UNPACKING, SETTING-UP, MOVING, AND REPACKING INSTRUCTIONS

12. Location of Equipment

Locate the 131B2 station arrangements in a room suitable for the operation of coding equipment. Place each equipment unit to allow adequate passageways and working space, with access to a power outlet of the proper type. Install the 131B2 set either to the left or right of the teletypewriter. The 131B2 set may be located against a wall, provided the front is turned forward so that the control panel is outward. It may prove more convenient to allow a space of 3 feet or more between the rear of the 131B2 set and the wall to avoid the necessity for moving the set forward to gain access to the rear for maintenance.

13. Unpacking

a. The following table gives the unit weights and volumes of the components of the 131B2 set crated for export shipment.

Table II. Weights and volume of 131B2 set crated for export shipment

Equipment	Quantity	Weight (pounds)	Volume (cu ft)
131B2 table including relays, cords, and Technical Manual.....	1	273	17.0
Power unit.....	1	135	3.9
Total.....		408	20.9

b. Use particular care when unpacking or handling the equipment because it may be damaged easily when not protected by the packing case. (See fig. 25.) The inner and outer cartons, foil-lined bag, packing case, and other packing materials should be preserved so that they may be used in repacking the equipment for further shipment. After removal from the equipment, store these materials in a convenient location where they will be protected.

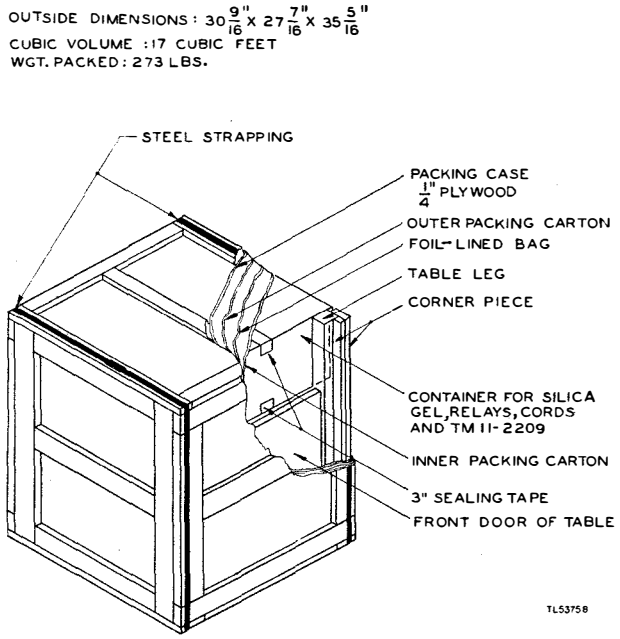


Figure 25. Teletypewriter Set 131B, method of packing for export shipment.

(1) Place the packing case as near the operating location as is convenient.

(2) Turn the packing case so that the side marked top is down. In this position the 131B2 table is upside down.

(3) Cut the steel straps.

(4) Remove the four nails that fasten the side now on top to the case, using a nail puller, and remove the top of the case. Prying the side off may result in damage to the equipment.

(5) Open and remove the upper surface of the outer packing carton.

(6) Cut the foil-lined bag down close to the packing case with a knife and remove its upper surface.

(7) Open and remove the upper surface of the inner packing carton.

(8) Remove the carton containing the relays, cords, Technical Manual and silica gel.

(9) Turn the table right side up and remove the packing case, outer packing carton, and foil-lined bag.

(10) Remove the inner packing carton from the table, cutting the carton with a knife along the four vertical corners, if necessary.

(11) Remove the four corner details which protect the table legs and remove the protective padding from the top of the table.

(12) If the power unit is to be used unpack it by opening its packing case in a similar manner.

14. Assembly

a. VARISTOR UNIT. If a-c power is used, mount the varistor unit of the power unit under the bottom of the 131B2 table by means of the two screws and nuts provided with the 131B2 set. Mount this unit with the end containing the multi-conductor plug near the hole located in the bottom of the table under the power box. If d-c power is used, connect the power cord between the power box and the repeater unit.

b. 255-A-TYPE RELAYS. Place the 255-A-type relays in their mounting jacks in the 131B2 set.

c. MAIN POWER UNIT. When the power unit is used, connect the main power unit to the table. It may be advisable to leave this unit on the floor instead of setting it inside of the table during the operating checks and adjustments.

d. FUSES. Install the correct size fustat, fusetron, or fuse in the teletypewriter base for the particular type of motor used.

e. "CRYPTO UNIT." Place the "crypto unit" on the 131B2 table as follows if only one cryptographic unit is used. If two units are used see part four.

(1) Place the "crypto unit" on the 131B2 table so that the two front feet fit into the two shockproof mountings on the front of the table and the two rear feet fit into the two inner shockproof mountings at the rear of the table. The cords of the "crypto unit" enter the table through the hole in its top located at the point where the cords leave the unit.

(2) If the shockproof mountings on the table top do not appear to be supporting most of the weight of the "crypto unit," the cups into which the feet fit may be raised by unscrewing the cups and placing one or more of the large washers that were used in mounting the "crypto unit" to the baseboard, between the cup and the rubber part of the mounting.

(3) Connect the three cords of the "crypto unit" to the 131B2 table by plugging them into the receptacles of the mixing relay unit panel and power box provided in the table.

(4) If the "crypto unit" is provided with a universal-type motor, operate the switch on the resistor unit appearing on the outside of the "crypto unit" cover on the left-hand side to the 50-and 60-cycle a-c position if the power supply is alternating current regardless of its frequency. Operate it to the d-c position only when direct current is used. The switch is operated to its 50- and 60-cycle a-c position when a-c power is used even if other frequencies are used, since the power unit provides the proper motor voltage for the various frequencies encountered.

f. "SPTD UNIT." Place the "SpTD unit" on the 131B2 table as follows if only one cryptographic unit is used. If two units are used refer to part four.

(1) Place the "SpTD unit" on the 131B2 table so that the three feet fit into either of two groups of three shockproof mountings. One group of mountings appears on the right and the other on the left of the table top. The cords of the "SpTD unit" enter the table through the hole in its top located at the point where the cords leave the unit.

(2) Connect the three cords of the "SpTD unit" to the 131B2 table by plugging them into the receptacles of the mixing relay unit panel and power box provided in the table.

15. Repacking for Local Movement

If it becomes necessary to use the 131B2 set at a new location which may be at some distance but does not require repacking for shipment proceed as follows:

a. Disconnect and remove the "crypto" or "SpTD unit" from the table top.

b. Disconnect the main power unit and remove it from the table.

c. Remove the polar relays from the table.

d. Pack the relays separately either in their original cartons or by wrapping them in suitable padding material.

e. Tie up the cords and fasten them inside the table and replace the rear grill.

f. Place the table and other component parts in a truck or other vehicle for transportation. Be careful not to scratch or mar the outer surface of the table.

16. Repacking for Export Shipment

a. 131B2 TABLE. Repack the 131B2 equipment utilizing the cartons, packing case, foil-lined bag, and other packing items in which it was originally packed.

(1) Remove the varistor unit and cords from the table.

(2) Remove the relays from the table and pack them in their original cartons.

(3) Repack the relays, cords, and Technical Manual in the carton originally furnished.

(4) With the table upright place the inner packing carton over the table after placing the protective padding on the table top.

(5) Place the foil-lined bag over the inner packing carton.

(6) Place the outer packing carton over the foil-lined bag.

(7) Place the packing case over the outer packing carton.

(8) Turn the table upside down.

(9) Insert the four corner details which protect the table legs and drive them in until they are flush with the ends of the legs.

(10) Place the carton containing the relays, cords and Technical Manual between the table legs.

(11) Restore the upper sides of the inner carton, foil-lined bag, outer carton and packing case, nailing on the upper side of the case securely.

b. Power Unit. Repack the two parts of the power unit in their original packing box. Make sure that the box is securely fastened.

PART TWO
OPERATING INSTRUCTIONS

Note. For information on destroying this equipment to prevent enemy use, see the Destruction Notice at the front of this manual.

Section IV. EQUIPMENT CONNECTIONS AND MECHANICAL ARRANGEMENTS

17. General

a. This section covers the procedures to be followed when installing a Teletypewriter Set 131B2. The work to be done has been divided into two parts in order to cover the many combinations of different teletypewriters and types of operation which may be used. These parts which are covered in detail are:

(1) Cord and power connections to the 131B2 set and the teletypewriter as well as the internal wiring and mechanical changes required in the teletypewriters.

(2) Line connections to the 131B2 set and internal wiring changes in the set.

b. Each station to be installed will require the work called for under some part of *a*(1) above depending on the teletypewriter used and some part of *a*(2) above depending on the type of operation or system in which the set is to be used.

c. Figure 26 is a schematic diagram showing the cord connections used when a 19-type set is used with a 131B2 set.

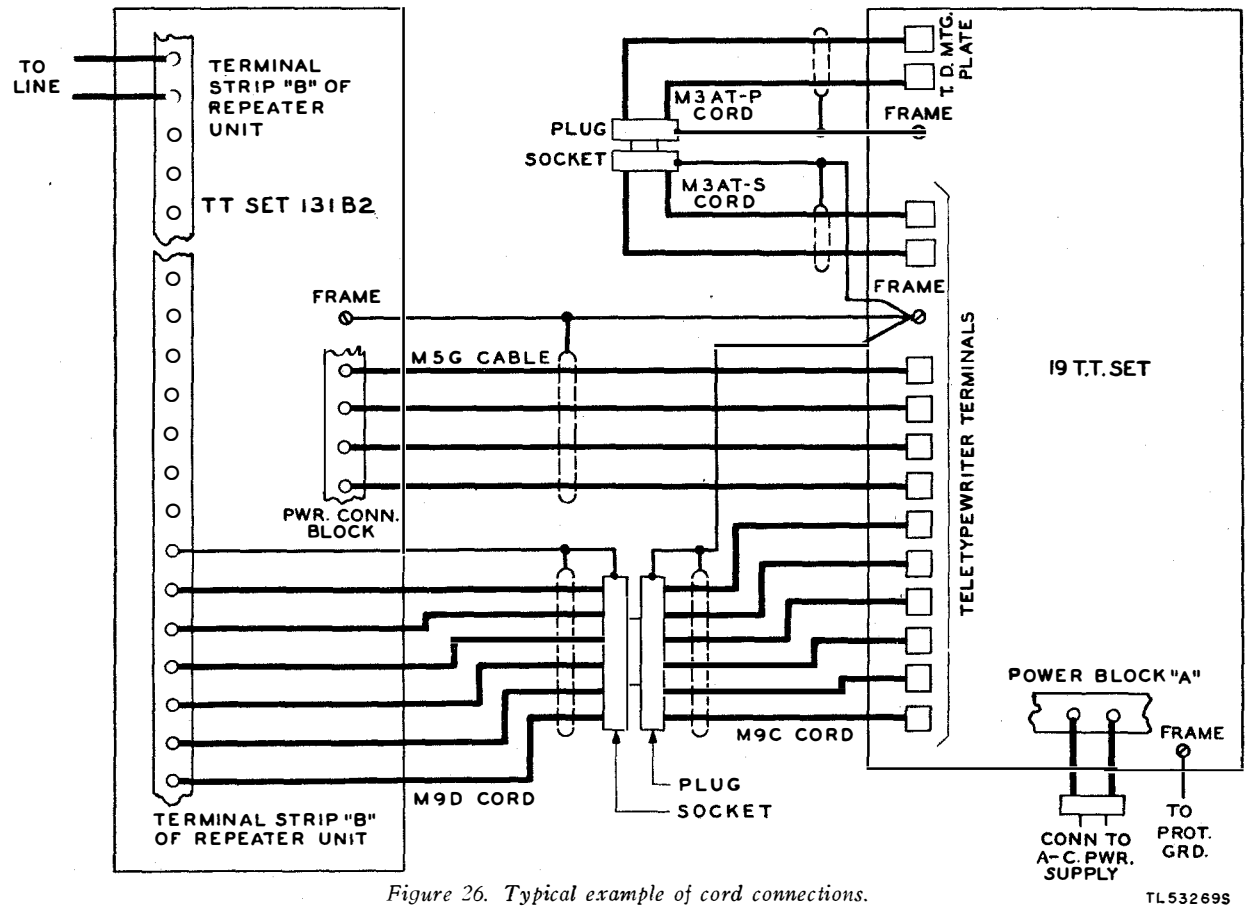


Figure 26. Typical example of cord connections.

18. Cord and Power Connections to 131B2 Set and Teletypewriter—Internal Wiring and Mechanical Changes in Teletypewriter

The connections between the 131B2 set and the teletypewriter, the connections between the teletypewriter and its table, the internal wiring changes in the teletypewriter, the power connections to the station, and the mechanical changes in the teletypewriter vary with the type of teletypewriter used. The method of installation for each of the different types of teletypewriters used is covered below. It is assumed in the following instructions that the teletypewriters used will be provided with standard wiring and mechanical arrangements.

a. TELETYPEWRITER TT-7/FG or TT-8/FG. (1) Remove the repeat space feature by removing the No. 83343 space rod and its No. 35–89 spring. The rod is removed by removing the No. 3599 nuts holding it to the space bar. (See TM 11–2216.)

(2) Make the connections and changes covered in figures 27, 28, 29, 30, 31, and 32.

b. TELETYPEWRITER TT–5/FG OR TT–6/FG. (1) Remove the repeat space feature by removing the No. 74604 space rod and its No. 35–89 spring. The rod is removed by removing the No. 3599 nuts holding it to the space bar. (See TM 11–2215.)

(2) Make the connections and changes covered in figures 31, 32, 33, and 35.

c. ARMY 19-TYPE SET USING XRT–96 AND XRT–107 TABLES. (1) Remove the repeat space feature by removing the No. 83343 space rod and its No. 35–89 spring. The rod is removed by removing No. 3599 nuts holding it to the space bar.

(2) Make connections and changes covered in figures 27, 29, 31, 32, 36, and 37.

d. COMMERCIAL, 19-TYPE SET.

Note. This set may only be used if provided with a-c series motors.

(1) Remove the repeat space feature by removing the No. 83343 space rod and its No. 35–89 spring. The rod is removed by removing the No. 3599 nuts holding it to the space rod.

(2) Make the connections and changes covered in figures 27, 31, 38, and 39.

e. PRINTER TG-7-A. (1) Remove the repeat space feature by removing No. 74604 space rod and its No. 35–89 spring. The rod is removed by removing the No. 3599 nuts holding it to the space rod. (See TM 11-352.)

(2) Make the connections and changes covered in figures 31, 33, 34, 35, and 40.

f. TELETYPEWRITERS TG–7–B AND TG–37–B. (1) Remove the repeat space feature by removing the No. 74604 space rod and its No. 35–89 spring. The rod is removed by removing the No. 3599 nuts holding it to the space rod. (See TM 11–352.)

(2) Make the connections and changes covered in figures 31, 35, 41, and 42.

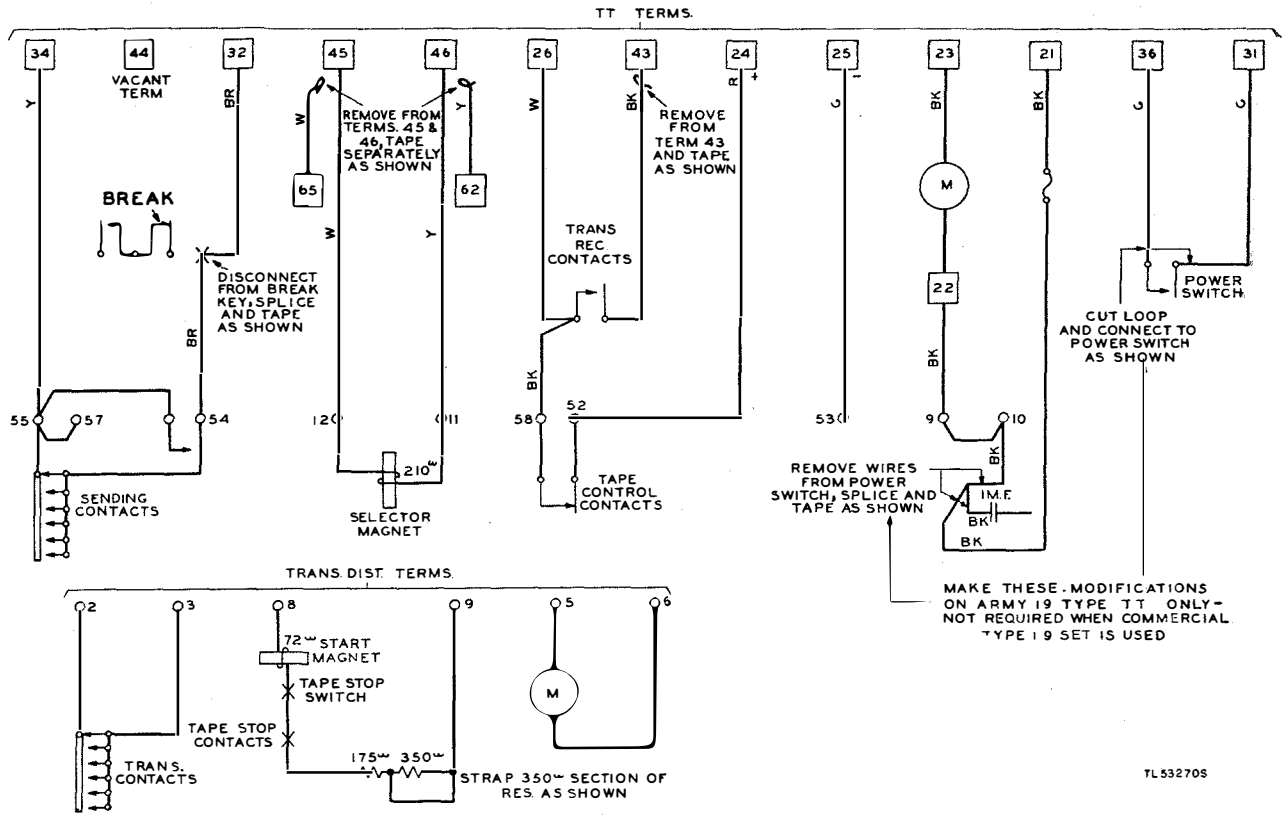


Figure 27. Internal wiring modifications of teletypewriters and transmitter-distributors used on TT–7/FG, TT–8/FG, 19-type set on XRT–96 and XRT–107 tables, and commercial 19-type set.

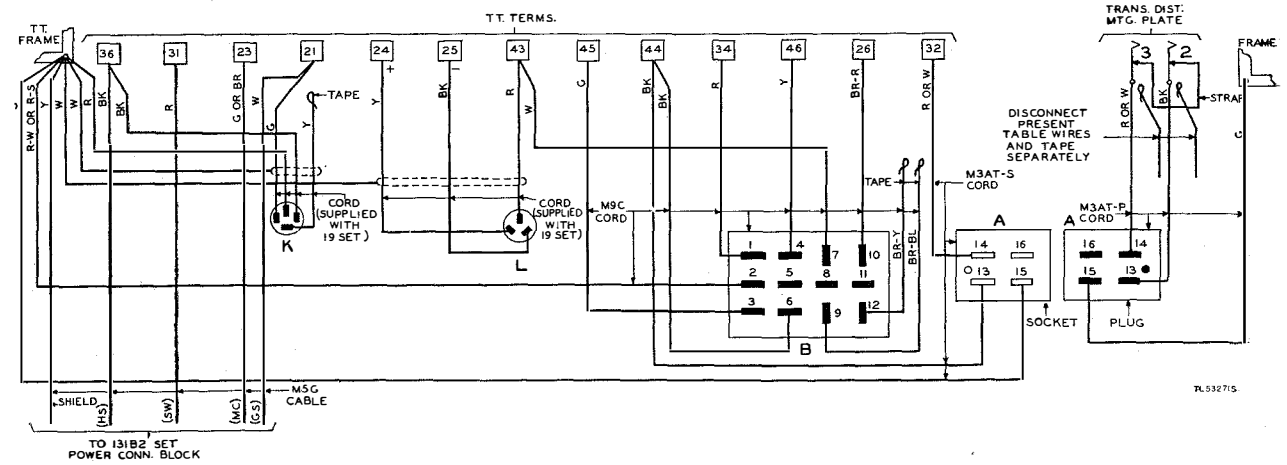


Figure 28. Cord connections to teletypewriter and transmitter-distributor of TT–7/FG or TT–8/FG.

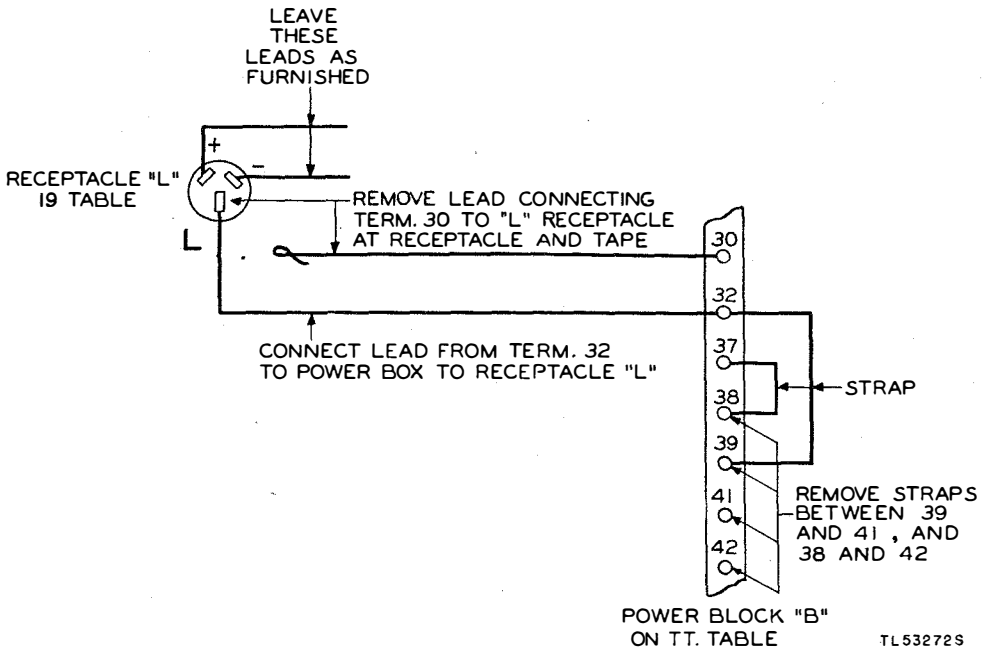


Figure 29. Wiring changes in d-c circuit of XRT–96, XRT–107 or XRT–116 table.

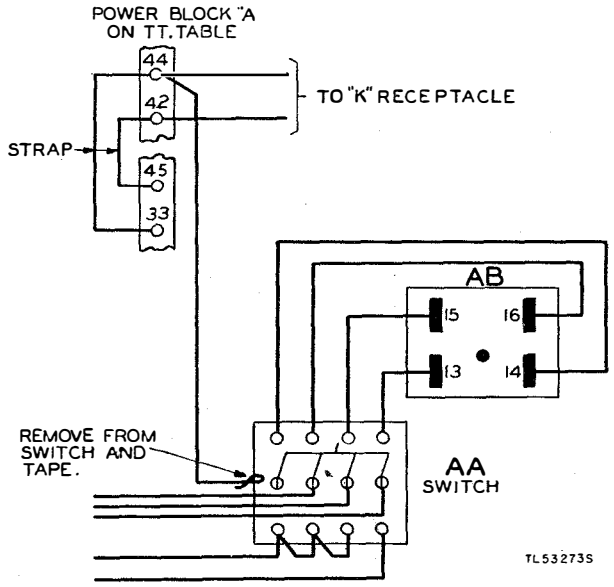


Figure 30. Wiring changes in a-c circuit of XRT–116 table.

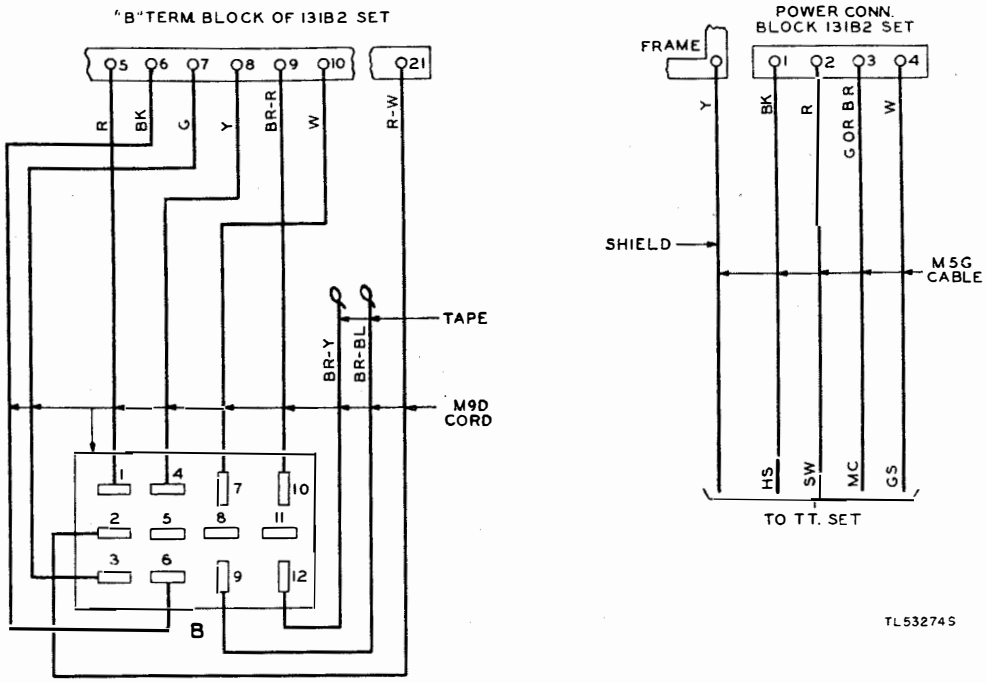


Figure 31. Cord connections to 131B2 set.

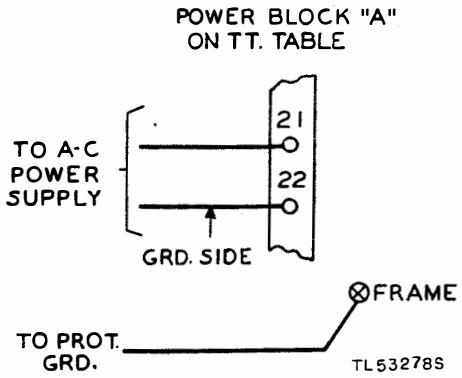


Figure 32. Primary power connections to 19-type set on XRT-96 or XRT-107 table, TT-7/FG and TT-8/FG.

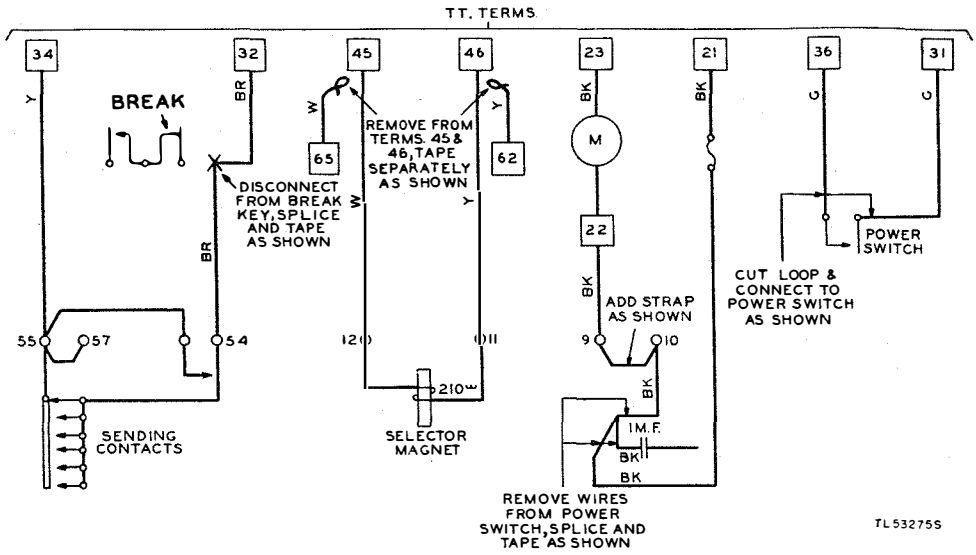


Figure 33. Internal wiring modifications of teletypewriters of TG-7-A, TT-5/FG, and TT-6/FG.

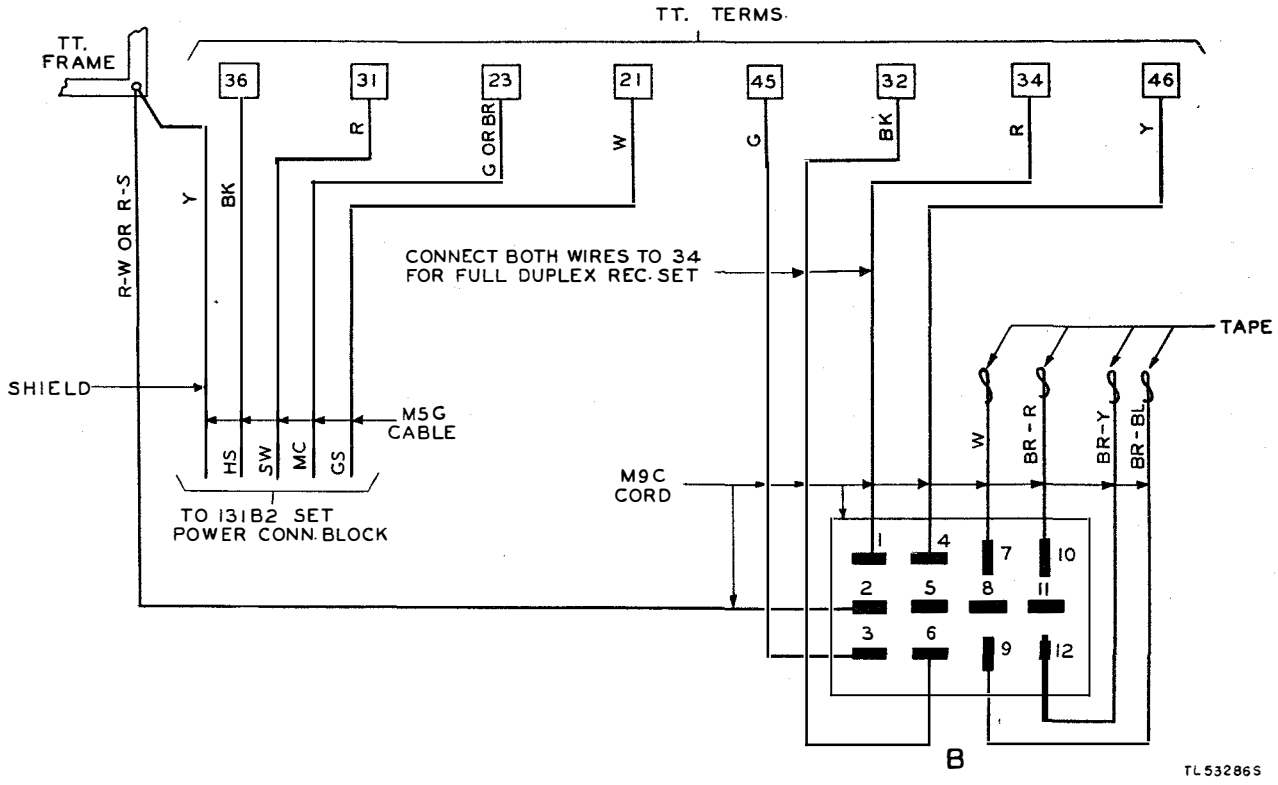


Figure 34. Cord connections to teletypewriters of TG-7-A, TT-5/FG, and TT-6/FG.

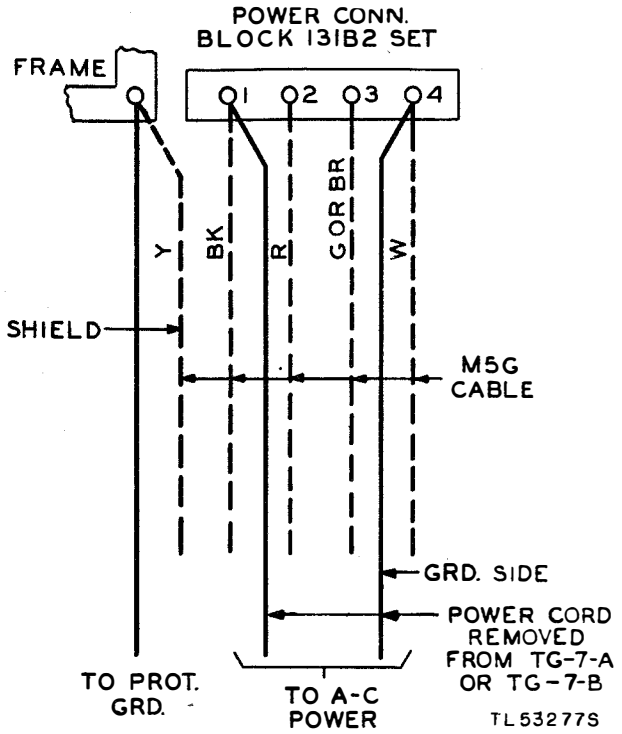


Figure 35. Power connections to 131B2 set when TG-7-A, TT-5/FG, or TT-6/FG is used.

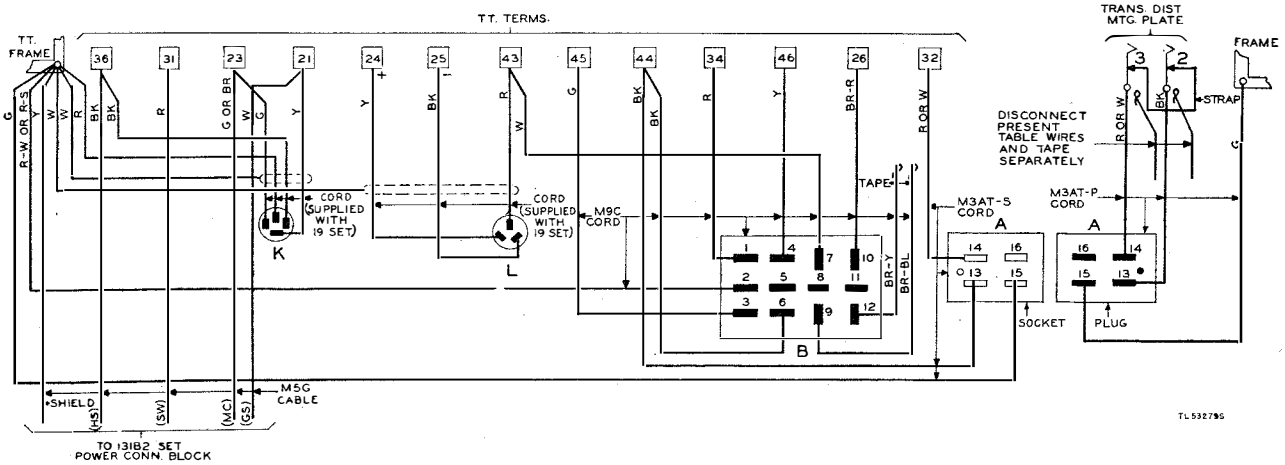


Figure 36. Cord connections to teletypewriter and transmitter-distributor of 19-type set on XRT-96 and XRT-107 tables.

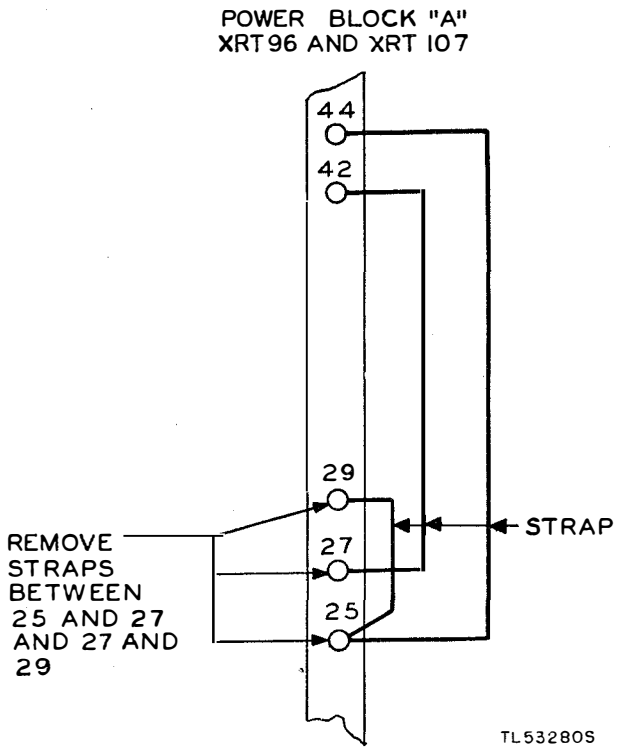


Figure 37. Wiring changes in a-c circuit of XRT-96 or XRT-107 tables.

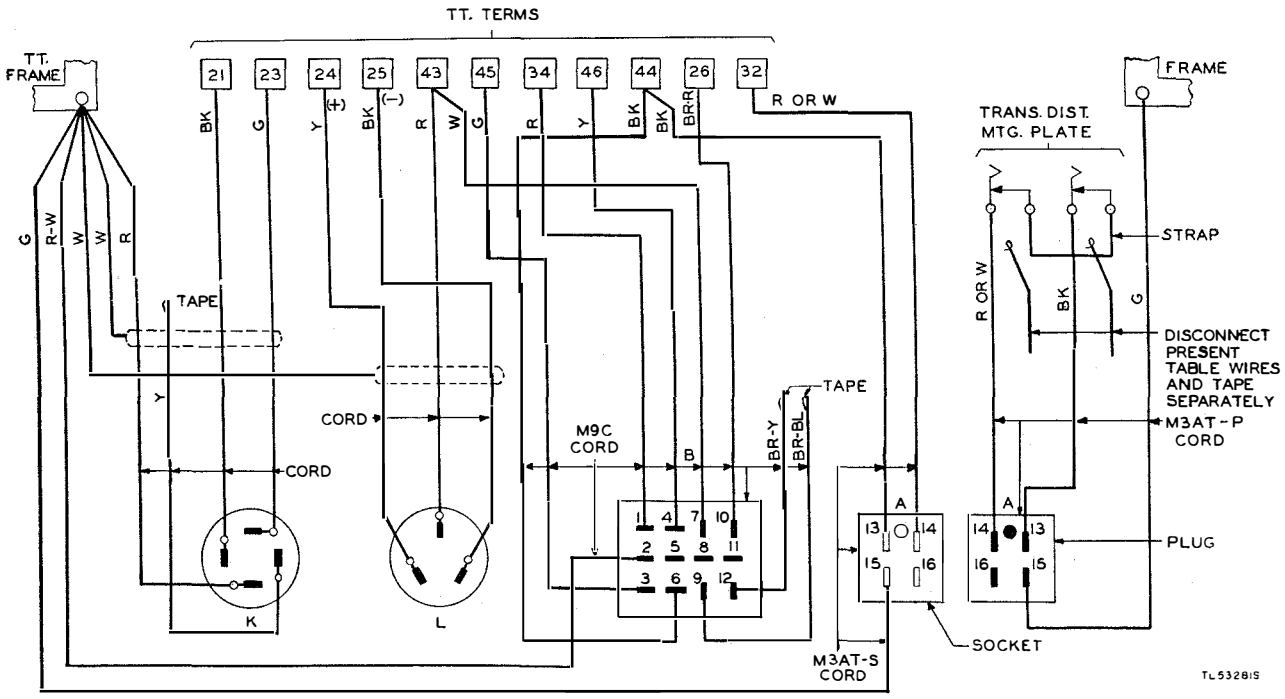


Figure 38. Cord connections to teletypewriter and transmitter-distributor of commercial 19-type set.

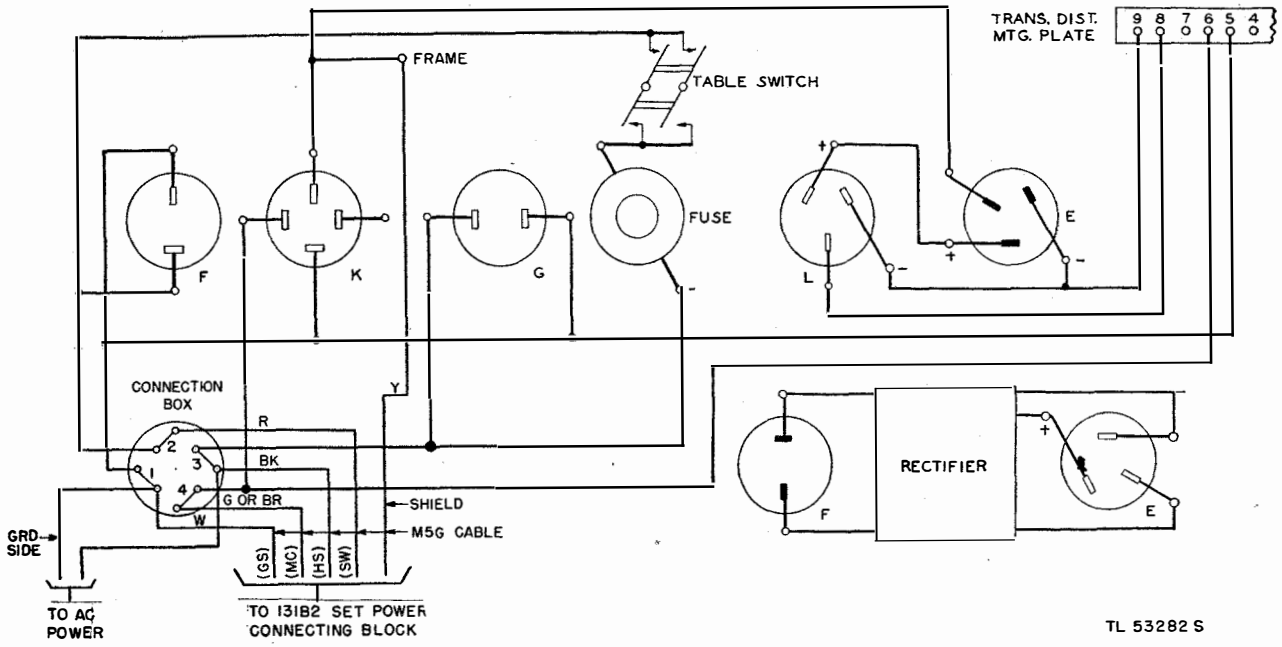


Figure 39. Wiring of table of commercial 19-type set.

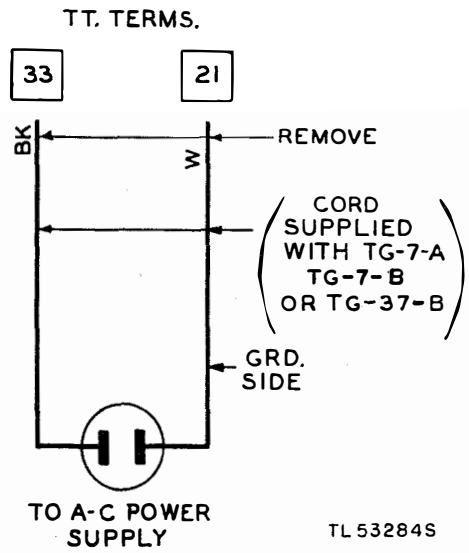


Figure 40. Power cord of Teletypewriter TG-7-A.

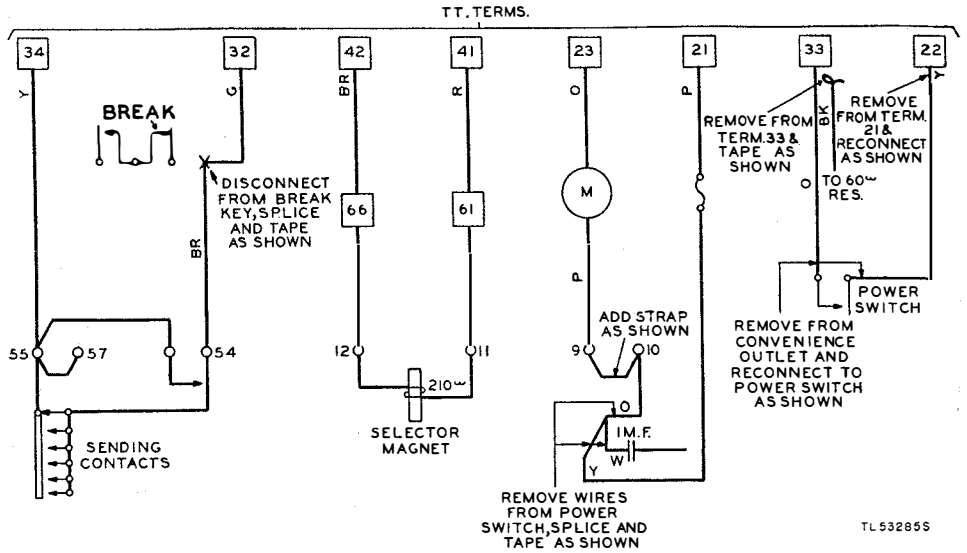


Figure 41. Internal wiring modifications of Teletypewriter TG-7-B or TG-37-B.

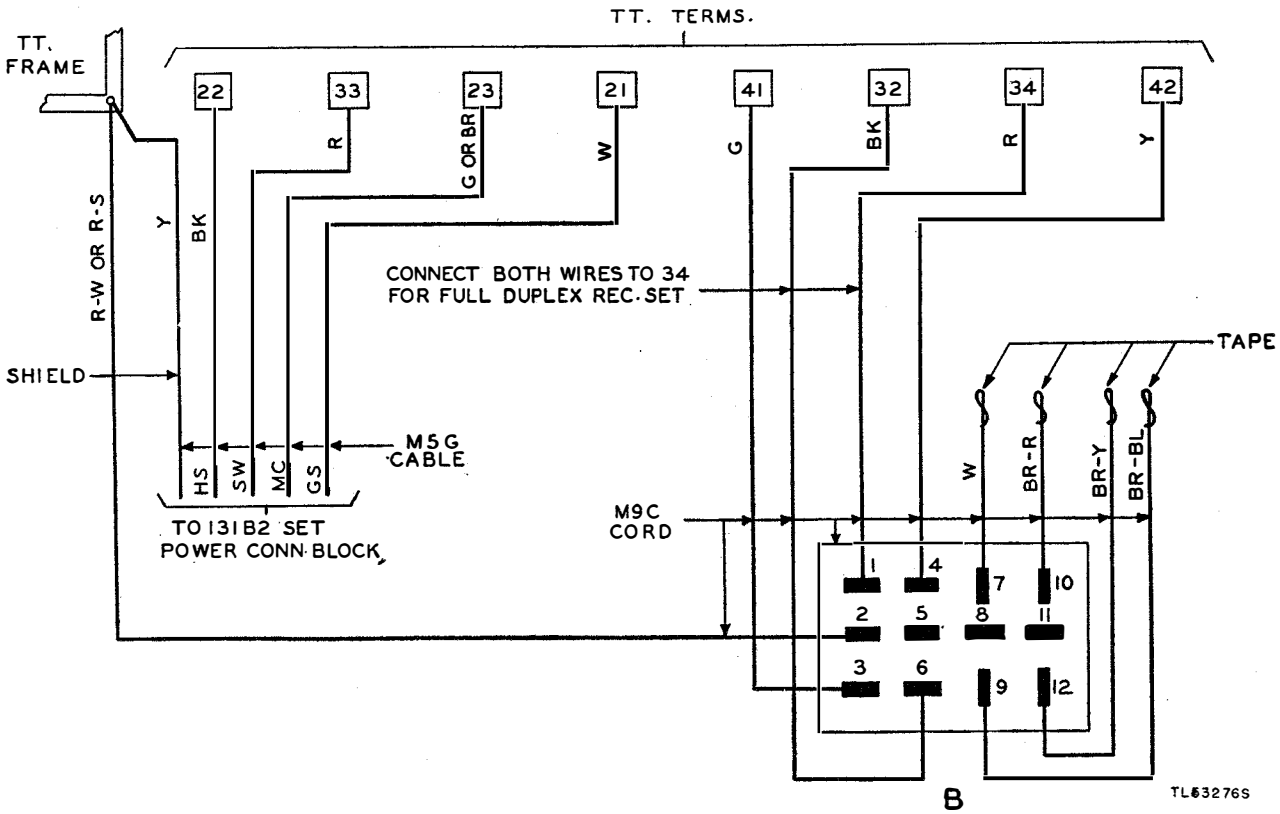


Figure 42. Cord connections to Teletypewriter TG-7-B or TG-37-B.

19. Line Connections and Internal Wiring Changes in 131B2 Set

a. The line connections to the set and the changes required in its internal wiring vary with the type of operation and the system in which it is to be used. The internal wiring changes are covered for the most part as wiring options which are shown in the schematic diagram (fig. 105) and in detail in the wiring diagram (fig. 109). The sets are provided by the manufacturer with options A, B, E, G, M, R, S, and T included as part of the wiring. The use of other options requires the removal of some or part of some of the options provided. In order to provide greater convenience in installing this equipment, the actual wiring changes or options that need to be used in the set are covered as items of work to be done under each of the operating conditions covered below. When the operating condition requires an option provided in the set as manufactured, the work items will call for a check of the wiring and if it is not present, the installer should make the required connections. The connections are covered in figures which are a part of this section and will be called for under each operating condition covered below. Under a number of operating conditions different line currents may be used which require that changes be made in the set to provide the proper biasing current for relays LR and BK. These changes are covered by options A, B, Z, X, and Y and the detailed work items to be performed to provide these options are covered in tables III, IV, and V.

b. If the 131B2 set has undergone local repair and contains other than standard wiring the installer may find it advisable to use the wiring options and the wiring diagram (fig. 109) instead of the work items listed under each heading following: A list of the wiring options for reference purposes is given under each heading.

20. Type AO–Single (Half-Duplex) Operation Without Line Unit BE–77–( ) or Repeater TG–30 (Terminal)

a. NEUTRAL TRANSMISSION ON 2-WIRE LINE (fig. 14). (1) Always use figure 43.

(2) Make changes to provide proper biasing current for relays LR and BK, according to tables III, IV, or V.

(3) Strap resistors BV and BW of repeater unit in order to provide proper values of line current and wave-shaping resistance for the line conditions encountered.

Note. The following work items provide the equivalent of wiring options E, G, R, T, and M.

(4) Check presence of R wire between 3-bottom of relay TX and 3-bottom of relay BK1.

(5) Check presence of R-G wire between 4-bottom of relay BK1 and 5 of terminal strip B.

(6) Check presence of R-G wire between top terminal of resistor BL and 2-bottom of relay BK1.

(7) Check presence of R-W between 1-bottom of relay BK1 and 3 of relay LT.

(8) Check presence of R-S wire between 2-bottom of relay TX and outside terminal of resistor T.

(9) Check presence of strap between upper terminal of capacitor D and upper terminal of capacitor D1.

(10) Check presence of strap between lower terminal of capacitor D and lower terminal of capacitor D1.

(11) Check presence of R wire between middle terminal of resistor BE and 5 of relay LT.

(12) Check presence of strap on terminals of resistor BZ.

b. SEPARATE SEND AND RECEIVE LINES (fig. 15). (1) *Neutral transmission. (a)* Always use figure 44 or 45.

(b) Make changes to provide proper biasing current for relays LR and BK, according to tables III, IV, or V.

(c) Strap resistors BV and BW of repeater unit in order to provide proper values of line current and wave-shaping resistance for the line conditions encountered.

Note. The following work items provide the equivalent of wiring options E, G, R, T, and N.

(d) Check presence of R wire between 3-bottom of relay TX and 3-bottom of relay BK1.

(e) Check presence of R-G wire between 4-bottom of relay BK1 and 5 of terminal strip B.

(f) Check presence of R-G wire between top terminal of resistor BL and 2-bottom of relay BK1.

(g) Check presence of R-W wire between 1-bottom of relay BK1 and 3 of relay LT.

(h) Remove R-S wire from 2-bottom of relay TX and tape.

(i) Strap 2-bottom and 3-bottom of relay TX.

(j) Check presence of strap between upper ter-

minal of capacitor D and upper terminal of capacitor D1.

(k) Check presence of strap between lower terminal of capacitor D and lower terminal of capacitor D1.

(l) Check presence of R wire between middle terminal of resistor BE and 5 of relay LT.

(m) Check presence of strap on terminals of resistor BZ.

(2) *Polar transmission. (a) When external sending battery is used.*

1. Use figure 46.
2. Remove strap from terminal of resistor BO (removal of wiring option T).
3. Remove strap from terminal of resistor BZ (removal of wiring option T).

(b) When battery is supplied from 131B2 set.

1. Use figure 47.
2. Check presence of strap on terminals of resistor BO (wiring option T).
3. Check presence of strap on terminals of resistor BZ (wiring option T).

(c) Under all conditions.

1. Strap out resistors BV and BW.

Note. The following work items provide the equivalent of wiring options E, H, and N.

2. Remove strap between middle and lower terminal of resistor BT.
3. Check presence of R-W wire between lower terminal of resistor BT and outer terminal of resistor L.
4. Check presence of wire between 3-bottom of relay TX and 3-bottom of relay BK1.
5. Check presence of R-G wire between 4-bottom of relay BK1 and 5 of terminal strip B.
6. Remove R-G wire from top terminal of resistor BL and tape.
7. Remove R-S wire from 2-bottom of relay TX and tape.
8. Strap 2-bottom and 3-bottom of relay TX.
9. Remove strap between top terminal of capacitor D and top terminal of capacitor D1.
10. Remove strap between bottom terminal of capacitor D and bottom terminal of capacitor D1.
11. Connect R-G-W wire to 6 of terminal block A and to top terminal of capacitor D1.
12. Connect R-G-W wire to top terminal of capacitor D1 and to 5 of relay LS.
13. Connect BR wire from bottom terminal of capacitor D1 to bottom terminal of resistor BE.
14. Check presence of R wire on middle terminal of resistor BE and move other end from 5 of relay LT to 2 of relay LT.
15. Remove R-S wire from 2 of relay BK and tape.
16. Remove strap between lower terminal of resistor BB and lower terminal of resistor BC.

21. Full-duplex With or Without 132A2 Set in Receiving Leg and Without Line Unit BE–77–( ) or Repeater TG–30 (Terminal) (figs. 16 and 18)

a. Sending Side of Circuit, Neutral Transmission. (1) Always use figures 48 or 49.

(2) Block relay BK1 of the repeater unit operated by using 508A armature blocking tool provided with equipment.

(3) Remove relay LR from repeater unit.

Note. The following work items provide the equivalent of wiring options B, J, R, N, and T.

(4) Remove strap between two lower terminals of resistor BT.

(5) Check presence of R-W wire between lower terminal of resistor BT and outer terminal of resistor L.

(6) Strap terminals 1 and 4 of mounting block of relay LR.

(7) Remove R-S wire from 2-bottom of relay TX and tape.

(8) Strap 2-bottom and 3-bottom of relay TX.

(9) Check presence of strap between upper terminal of capacitor D and upper terminal of capacitor D1.

(10) Check presence of strap between lower terminal of capacitor D and lower terminal of capacitor D1.

(11) Check presence of R wire between middle terminal of resistor BE and 5 of relay LT.

(12) Remove R-S wire from 2 of relay BK and tape.

(13) Check presence of strap on resistor BZ.

b. Sending Side of Circuit, Polar Transmission. (1) *When external sending battery is used.* *(a)* Use figure 50.

(b) Remove strap from terminals of resistor BO (removal of wiring option T).

(c) Remove strap from terminals of resistor BZ (removal of wiring option T).

(2) *When battery is supplied from the 131B2 set.* *(a)* Use figure 51.

(b) Check presence of strap on terminals of resistor BO (wiring option T).

(c) Check presence of strap on terminals of resistor BZ (wiring option T).

(3) *Under all conditions.* *(a)* Block relay BK1 of repeater unit operated by using 508A armature blocking tool provided with equipment.

(b) Remove relay LR from repeater unit.

Note. The following work items provide the equivalent of wiring options B, H, J, and N.

(c) Remove strap between lower terminals of resistor BT.

(d) Check presence of R-W wire between lower terminal of resistor BT and outer terminal of resistor L.

(e) Remove strap between top terminal of capacitor D and top terminal of capacitor D1.

(f) Remove strap between bottom terminal of capacitor D and bottom terminal of capacitor D1.

(g) Connect R-G-W wire to 6 of terminal block A and to top terminal of capacitor D1.

(h) Connect R-G-W wire to top terminal of capacitor D1 and to 5 of relay LS.

(i) Connect R-BR wire from bottom of capacitor D1 to bottom of resistor BE.

(j) Check presence of R wire on middle terminal of resistor BE and move other end from 5 of relay LT to 2 of relay LT.

(k) Remove R-S wire from 2-bottom of relay TX and tape.

(l) Strap 2-bottom and 3-bottom of relay TX.

(m) Remove R-S wire from 2 of relay BK and tape.

c. Receiving Side of Circuit With or Without a 132A2 Set, Neutral Transmission.

Note. Only a receiving teletypewriter is required for this condition.

(1) Always use figure 52.

(2) Make changes to provide proper biasing current for relays LR and BK, according to tables III, IV, and V.

(3) Strap resistors BV and BW of repeater unit in order to provide the proper values of line current and wave shaping resistance for the line conditions encountered or in same manner as resistors BV and BW in 132A2 set if it is used.

(4) Check presence of R-S wire between 2-bottom of relay TX and outside terminal of resistor T (wiring option M).

d. Receiving Side of Circuit With or Without a 132A2 Set, Polar Transmission. (1) Always use figure 53.

(2) Strap out resistors BV and BW.

Note. The following work items provide the equivalent of wiring options B and M.

(3) Check the presence of R-S wire between 2-bottom of relay TX and outside terminal of resistor T.

(4) Check presence of R-W wire between lower terminal of resistor BT and outer terminal of resistor L.

(5) Remove strap between middle and lower terminal of resistor BT.

(6) Remove R-S wire from 2 of relay BK and tape.

(7) Remove strap between lower terminal of resistor BB and lower terminal of resistor BC.

22. Single (Half-duplex) Operation on Radio Channels With or Without 132A2 Set (fig. 17)

a. Use figure 47.

b. Check presence of strap on terminals of resistor BO.

c. Check presence of strap on terminals of resistor BZ.

d. Strap out resistors BV and BW.

e. Remove strap between middle and lower terminal of resistor BT.

f. Check presence of R-W wire between lower terminal of resistor BT and outer terminal of resistor L.

g. Check presence of wire between 3-bottom of relay TX and 3-bottom of relay BK1.

h. Check presence of R-G wire between 4-bottom of relay BK1 and 5 of terminal strip B.

i. Remove R-G wire from top terminal of resistor BL and tape.

j. Remove R-S wire from 2-bottom of relay TX and tape.

k. Strap 2-bottom and 3-bottom of relay TX.

l. Remove strap between top terminal of capacitor D and top terminal of capacitor D1.

m. Remove strap between bottom terminal of capacitor D and bottom terminal of capacitor D1.

n. Connect R-G-W wire to 6 of terminal block A and to top terminal of capacitor D1.

o. Connect R-G-W wire to top terminal of capacitor D1 and to 5 of relay LS.

p. Connect R-BR wire from bottom terminal of capacitor D1 to bottom terminal of resistor BE.

q. Check presence of R wire on middle terminal or resistor BE and move other end from terminal 5 of relay LT to 2 of relay LT.

r. Remove R-S wire from terminal 2 of relay BK and tape.

s. Remove strap between lower terminal of resistor BB and lower terminal of resistor BC.

23. Operation With Repeater TG–30 (Terminal) (fig. 18)

a. Always use figure 54.

b. Remove straps from resistors BV and BW.

c. Set switch designated LOCAL on TG–30 unit to position 5.

d. Make connections to secure proper biasing current for relays LR and BK according to table IV.

Note. The following work items provide the equivalent of wiring options E, G, M, R, and T.

e. Check presence of R wire between 3-bottom of relay TX and 3-bottom of relay BK1.

f. Check presence of R-G wire between 4-bottom of relay BK1 and 5 of terminal strip B.

g. Check presence of R-G wire between top terminal of resistor BL and 2-bottom of relay BK1.

h. Check presence of R-W wire between 1-bottom of relay BK1 and 3 of relay LT.

i. Check presence of R-S wire between 2-bottom of relay TX and outside of terminal of resistor T.

j. Check presence of strap between upper terminal of capacitor D and upper terminal of capacitor D1.

k. Check presence of strap between lower terminal of capacitor D and lower terminal of capacitor D1.

l. Check presence of R wire between middle terminal of resistor BE and 5 of relay LT.

m. Check presence of strap on terminals of resistor BZ.

24. Operation With Line Unit BE–77–( ) and Telegraph Terminals CF–2–( ), CF–6, and Carrier Terminal OA–4/FC (X-61822A) or OA–5/FC (X-61822B) (figs. 19 and 20)

Note. When used over a loop from a CF–2–( ), CF–6, OA–4/FC, or OA–5/FC, the 131B2 set should operate from a Line Unit BE–77–( ) or Telegraph Repeater TG–30 (Terminal) and the installation should be made in accordance with that part of this paragraph covering the line units or the paragraph covering the TC–30 (Terminal). When used normally with Telegraph Terminal CF–2–( ), CF–6, or Carrier Terminal OA–4/FC or ORA–5/FC, that part of this paragraph covering the local use should be used.

a. When Line Unit BE-77 is used, use figure 55.

b. When Line Unit BE–77–A is used, use figure 56.

c. When either Line Unit BE–77 or BE–77–A is used, use it with line relay in circuit and connect the cord of the unit to power supply so that with the line side of the unit closed, the 131B2 set receive loop is marking.

d. When a CF–2–( ), CF–6, OA–4/FC or OA–5/FC terminal is used locally, use figure 59. Pole the CF–2–( ), CF–6, OA–4/FC, or OA–5/FC loop current so that the 131B2 set is marking when the loop is closed and operate the loop switch of CF–2–( ), CF–6, OA–4/FC or OA–5/FC to the NEUTRAL TO POS BATT, HALF-DX position.

e. Under all conditions proceed as follows:

(1) Make changes to provide proper biasing current for relays LR and BK, according to table III.

(2) Strap out resistors BV and BW of repeater unit.

Note. The following work items provide the equivalent of wiring options E, G, M, R, and T.

(3) Check presence of R wire between 3-bottom of relay TX and 3-bottom of relay BK1.

(4) Check presence of R-G wire between 4-bottom of relay BK1 and 5 of terminal strip B.

(5) Check presence of R-G wire between top terminal of resistor BL and 2-bottom of relay BK1.

(6) Check presence of R-W wire between 1-bottom of relay BK1 and 3 of relay LT.

(7) Check presence of R-S wire between 2-bottom of relay TX and outside terminal of resistor T.

(8) Check presence of strap between upper terminal of capacitor D and upper terminal of capacitor D1.

(9) Check presence of strap between lower terminal of capacitor D and lower terminal of capacitor D1.

(10) Check presence of R wire between middle terminal of resistor BE and 5 of relay LT.

(11) Check presence of strap on terminals of resistor BZ.

25. Off-line Operation With 133A1 Table or 133A2 Set

a. TYPES A, C, AA, AND AC, ALTERNATE ENCIPHER AND DECIPHER (fig. 21). (1) When used with a 133A1 table supplied with rectifier or a 133A2 set, use figure 58.

(2) When used with a 133A1 table without a rectifier, use figures 58 and 59.

(3) Make changes to provide proper biasing current to relays LR and BK, according to table III.

(4) Remove straps from resistors BV and BW.

Note. The following work items provide the equivalent of wiring options E, G, N, R, and T.

(5) Check presence of R wire between 3-bottom of relay TK and 3-bottom of relay BK1.

(6) Check presence of R-G wire between 4-bottom of relay BK1 and 5 of terminal strip B.

(7) Check presence of R-G wire between top terminal of resistor BL and 2-bottom of relay BK1.

(8) Check presence of R-W wire between 1-bottom of relay BK1 and 3 of relay LT.

(9) Remove R-S wire from 2-bottom of relay TX and tape.

(10) Strap 2-bottom to 3-bottom of relay TX.

(11) Check presence of strap between upper terminal of capacitor D and upper terminal of capacitor D1.

(12) Check presence of strap between lower terminal of capacitor D and lower terminal of capacitor D1.

(13) Check presence of R wire between middle terminal of resistor BE and 5 of relay LT.

(14) Check presence of strap on terminals of resistor BZ.

b. TYPES B, D, AND BD, SIMULTANEOUS ENCIPHER AND DECIPHER (fig. 22).

Note. Two 131B2 sets are required for this type of operation and the same wiring changes should be used on both as covered below. The steps in the installation procedure refer to both sets.

(1) When used with 133A1 table with a rectifer or a 133A2 set, use figure 60.

(2) When used with 133A1 table without a rectifier, use figures 59 and 60.

(3) Make changes to provide proper biasing current to relays LR and BK according to table III.

(4) Remove straps from resistors BV and BW.

Note. The following work items provide the equivalent of wiring options E, G, M, R, and T.

(5) Check presence of R wire between 3-bottom of relay TX and 3-bottom of relay BK1.

(6) Check presence of R-G wire between 4-bottom of relay BK1 and 5 of terminal strip B.

(7) Check presence of R-G wire between top terminal of resistor BL and 2-bottom of relay BK1.

(8) Check presence of R-W wire between 1-bottom of relay BK1 and 3 of relay LT.

(9) Check presence of R-S wire between 2-bottom of relay BK and outside terminal of resistor T.

(10) Check presence of strap between upper terminal of capacitor D and upper terminal of capacitor D1.

(11) Check presence of strap between lower terminal of capacitor D and lower terminal of capacitor D1.

(12) Check presence of R wire between middle terminal of resistor BE and 5 of relay LT.

(13) Check presence of strap on terminals of resistor BZ.

26. Conference Circuit Operation

Conference circuit operation requires the use of a 14-type teletypewriter for monitoring the material sent to the line. The information below covers single and full duplex neutral transmission using external line battery supply. If other types of installations are required, the paragraphs in this section covering them may be used if the line relay of the 14-type teletypewriter is put in series with the send line and if biasing current for this relay is applied from the 131B2 set as covered below. The information below also covers only the case where 0.060-ampere line current is used. If 0.020- or 0.030-ampere line current is used additional resistors of 8,000 ohms for 0.020-ampere and 4,000 ohms for 0.030-ampere operation will have to be added in series between terminals B15 of the 131B2 set and terminal 25 of the 14-type teletypewriter.

a. TYPE J, SINGLE (HALF-DUPLEX), NEUTRAL TRANSMISSION ON TWO-WIRE LINE (fig. 23). (1) Always use figure 61.

(2) Always use figure 59.

(3) Make changes to provide proper biasing current for relays LR and BK, according to table III.

Note. The following work items provide the equivalent of wiring options E, G, M, R, and T.

(4) Strap resistors BV and BW of repeater unit in order to provide the proper values of line current and wave-shaping resistance for the line conditions encountered.

(5) Check presence of R wire between 3-bottom of relay TX and 3-bottom of relay BK1.

(6) Check presence of R-G wire between 4-bottom of relay BK1 and 5 of terminal strip B.

(7) Check presence of R-G wire between top terminal of resistor BL and 2-bottom of relay BK1.

(8) Check presence of R-W wire between 1-bottom of relay BK1 and 3 of relay LT.

(9) Check presence of R-S wire between 2-bottom of relay TX and outside terminal of resistor T.

(10) Check presence of strap between upper terminal of capacitor D and upper terminal of capacitor D1.

(11) Check presence of strap between lower terminal of capacitor D and lower terminal of capacitor D1.

(12) Check presence of R wire between middle terminal of resistor BE and 5 of relay LT.

(13) Check presence of strap on terminals of resistor BZ.

b. TYPE G, FULL-DUPLEX NEUTRAL TRANSMISSION *(fig. 24).* (1) *Sending side of circuit. (a)* Always use figure 62.

(b) Always use figure 59.

(c) Block relay of BK1 repeater unit operated by using 508A armature blocking tool provided with equipment.

(d) Remove relay LR from repeater unit.

Note. The following work items provide the equivalent of wiring options J, N, R, and T.

(e) Remove strap between the lower terminals of resistor BT.

(f) Check presence of R-W wire between lower terminal of resistor BT and outer terminal of resistor L.

(g) Strap terminals 1 and 4 of mounting block of relay LR.

(h) Remove R-S wire from 2-bottom of relay TX and tape.

(i) Strap 2-bottom and 3-bottom of relay TX.

(j) Check presence of strap between upper terminal of capacitor D and upper terminal of capacitor D1.

(k) Check presence of strap between lower terminal of capacitor D and lower terminal of capacitor D1.

(l) Check presence of R wire between middle terminal of resistor BE and 5 of relay LT.

(m) Remove R-S wire from 2 of relay BK and tape.

(n) Check presence of strap on terminals of resistor BZ.

(2) *Receiving side of circuit.* Only a receiving teletypewriter is required for this condition.

(a) Always use figure 52.

(b) Make changes to provide proper biasing current for relays LR and BK, according to table III.

(c) Strap resistors BV and BW of repeater unit in order to provide the proper values of line current and wave-shaping resistance for the line conditions encountered.

(d) Check presence of R-S wire between 2-bottom of relay TX and outside terminal of resistor T (wiring option M).

27. Off-line Operation With Reperforator Teletypewriter TC–16 or TC–17

The TC–16 and TC–17 sets are furnished with their own power units for controlling motor power and providing direct current for local operation. The units should be set up in accordance with standard procedure with respect to the power supply. The line connections however, should be made as covered below. The line unit is not used in this case.

a. TYPES A, C, AA, AND AC, ALTERNATE ENCIPHER AND DECIPHER (fig. 21). (1) Always use figures 63 and 59.

(2) Make changes to provide proper biasing current for relays LR and BK, according to table III.

(3) Remove straps from resistors BV and BW.

Note. The following work items provide the equivalent of wiring options E, G, N, R, and T.

(4) Check presence of R wire between 3-bottom of relay TX and 3-bottom of relay BK1.

(5) Check presence of R-G wire between 4-bottom of relay BK1 and 5 of terminal strip B.

(6) Check presence of R-G wire between top terminal of resistor BL and 2-bottom of relay BK1.

(7) Check presence of R-W wire between 1-bottom of relay BK1 and 3 of relay LT.

(8) Remove R-S wire from 2-bottom of relay TX and tape.

(9) Strap 2-bottom to 3-bottom of relay TX.

(10) Check presence of strap between upper terminal of capacitor D and upper terminal of capacitor D1.

(11) Check presence of strap between lower terminal of capacitor D and lower terminal of capacitor D1.

(12) Check presence of R wire between middle terminal of resistor BE and 5 of relay LT.

(13) Check presence of strap on terminals of resistor BZ.

b. TYPES B, D, AND BD, SIMULTANEOUS ENCIPHER AND DECIPHER (fig. 22). Two 131B2 sets are required for this type of operation and the same wiring changes should be used on both as covered below. The steps in the installation procedure refer to both sets.

(1) Always use figure 64.

(2) Make changes to provide proper biasing current for relays LR and BK, according to table III.

(3) Remove straps from resistors BV and BW.

Note. The following work items provide the equivalent of wiring options E, G, M, R, and T.

(4) Check presence of R wire between 3-bottom of relay TX and 3-bottom of relay BK1.

(5) Check presence of R-G wire between 4-bottom of relay BK1 and 5 of terminal strip B.

(6) Check presence of R-G wire between top terminal of resistor BL and 2-bottom of relay BK1.

(7) Check presence of R-W wire between 1-bottom of relay BK1 and 3 of relay LT.

(8) Check presence of R-S wire between 2-bottom of relay TX and outside terminal of resistor T.

(9) Check presence of strap between upper terminal of capacitor D and upper terminal of capacitor D1.

(10) Check presence of strap between lower terminal of capacitor D and lower terminal of capacitor D1.

(11) Check presence of R wire between the middle of terminal resistor BE and 5 of relay LT.

(12) Check presence of strap on terminals of resistor BZ.

Table III. Connections to provide proper biasing current for 0.060 ampere line operation

Options—X wiring:

Option X is added and option B is removed.

Procedure:

Strap top terminal of resistor BB to top terminal of resistor BC.

Check that R-S wire connects terminal 2 of relay BK and outer terminal of resistor L.

Remove R-W wire from bottom terminal of resistor BT and tape.

Table IV. Connections to provide proper biasing current for 0.030 ampere line operation

Options—B, S, and Y wiring:

Options B and S are provided in the set as manufactured, option Y is added and option A is removed.

Procedure:

Strap terminals of resistor BC.

Check that lower terminal of resistor BC is strapped to lower terminal of resistor BB.

Check that R-S wire connects terminal 2 of relay BK to outer terminal of resistor L.

Check that R-W wire connects lower terminal of resistor BT to outer terminal of resistor L.

Remove strap between two lower terminals of resistor BT.

Table V. Connections to provide proper biasing current for 0.020 ampere line operation

Options—A, B, and S wiring:

Options A, B, and S are provided with the set as manufactured.

Procedure:

Check that two lower terminals of resistors BT are strapped.

Check that R-W wire connects lower terminal of resistor BT and outer terminal of resistor L.

Check that lower terminal of resistor BC is strapped to lower terminal of resistor BB.

Check that R-S wire between terminal 2 of relay BK and outer terminal of resistor L is present.

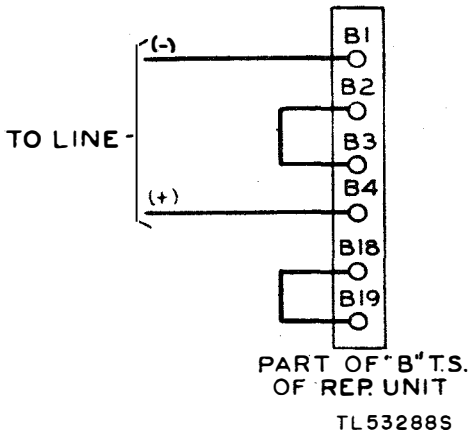
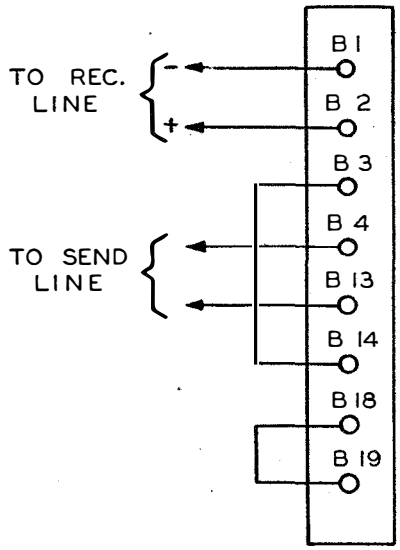


Figure 43. Type AO, single neutral transmission on two-wire line, external line battery.



TYPE AO, SINGLE NEUTRAL TRANSMISSION ON SEPARATE SEND AND RECEIVE LINES, SEND LINE BATTERY SUPPLIED FROM 131B2 SET

TL53967S

Figure 45. Type AO, single neutral transmission on separate send and receive lines, send line battery supplied from 131B2 Set.

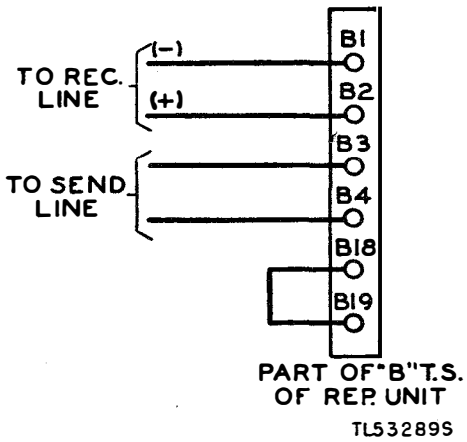


Figure 44. Type AO, single neutral transmission on separate send and receive lines, external line battery.

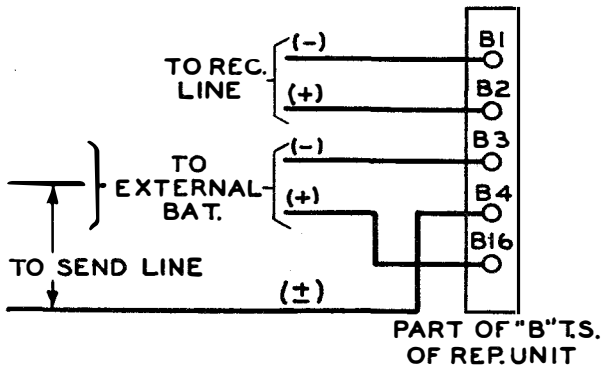


Figure 46. Single polar transmission, external line battery.

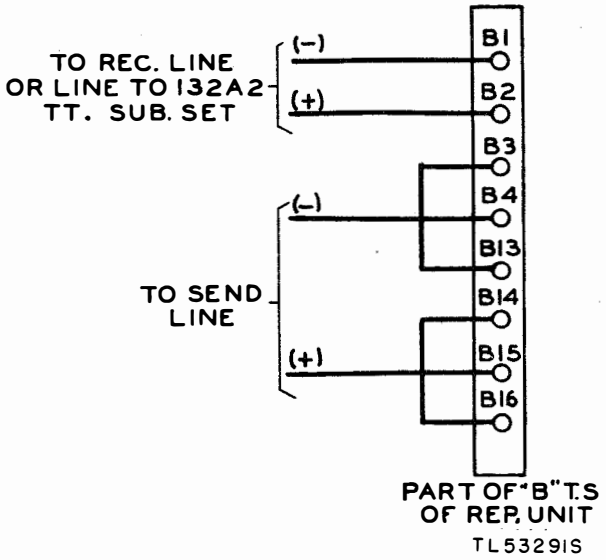


Figure 47. Single polar transmission, send line battery supplied from 131B2 set.

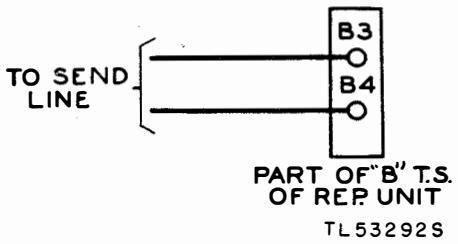


Figure 48. Sending side, full-duplex neutral transmission, external line battery.

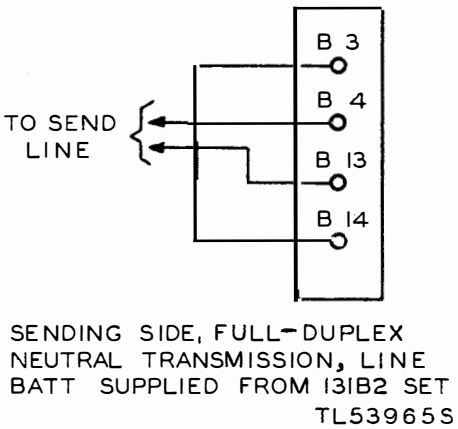


Figure 49. Sending side, full-duplex neutral transmission, line battery supplied from 131B2 set.

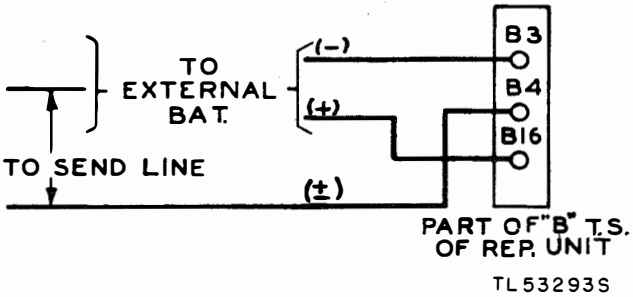


Figure 50. Sending side, full-duplex polar transmission, external line battery.

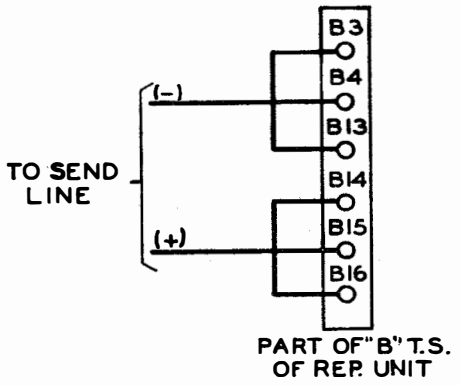


Figure 51. Sending side, full-duplex polar transmission, line battery supplied from 131B2 set.

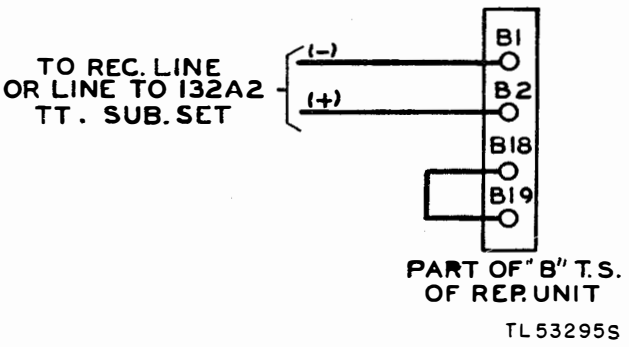


Figure 52. Receiving side, full-duplex neutral transmission, external line battery.

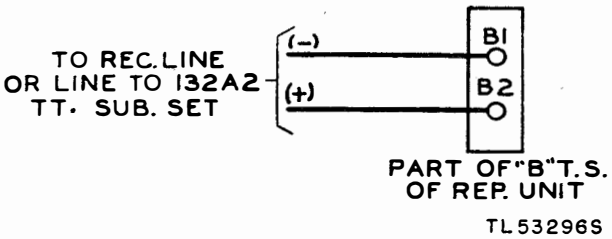


Figure 53. Receiving side, full-duplex polar transmission, external line battery.

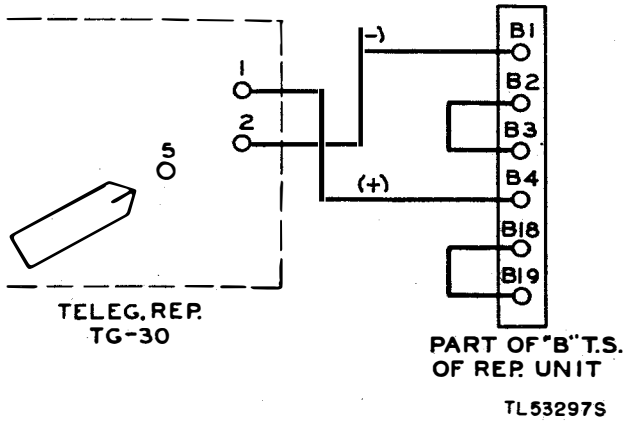


Figure 54. Type AO single neutral or polar transmission with Repeater TG-30 (Terminal), line battery from repeater.

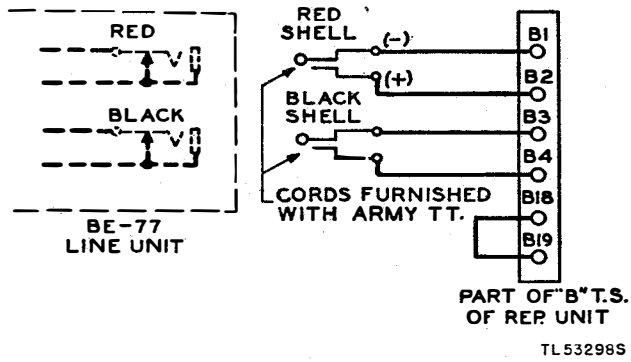


Figure 55. Type AO, single neutral transmission with Line Unit BE-77.

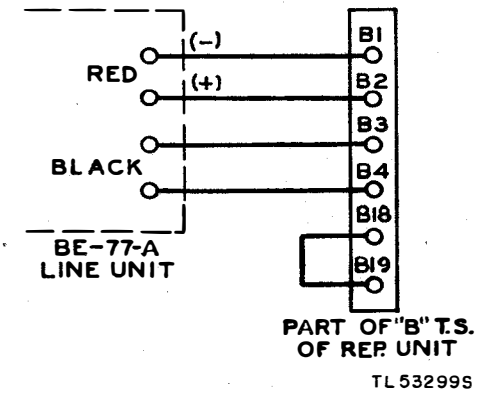


Figure 56. Type AO, single neutral transmission with Line Unit BE-77-A.

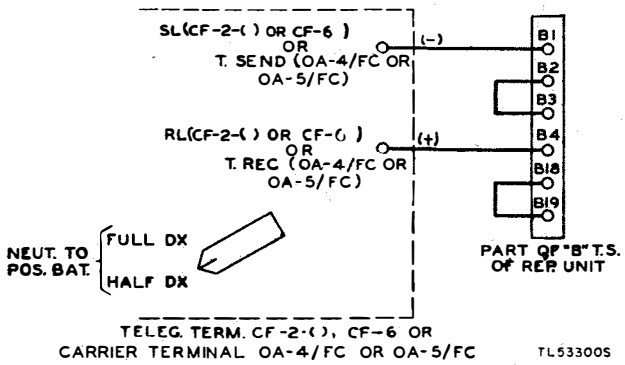


Figure 57. Type AO with Telegraph Terminal CF-2-( ) or CF-6, and Carrier Terminal OA-4/FC or OA-5/FC.

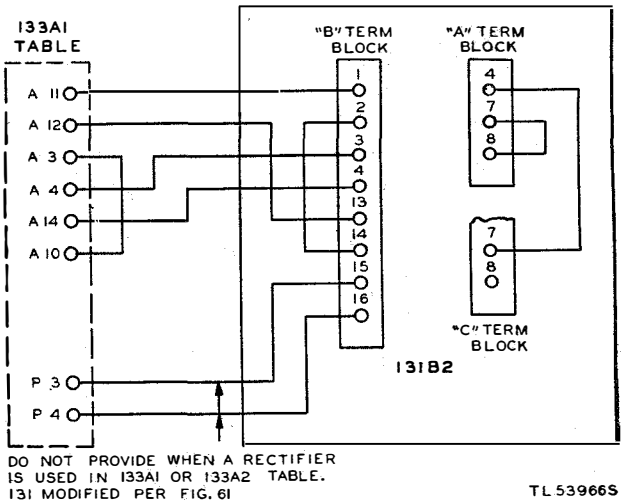


Figure 58. Types A, C, AA, and AC, off-line operation, alternate encipher and decipher with 133A1 table or 133A2 set.

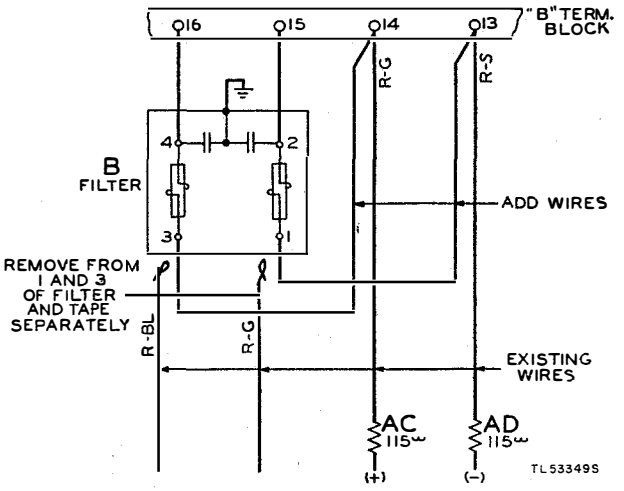


Figure 59. Modification of 131B2 set used with 133A1 table without a rectifier.

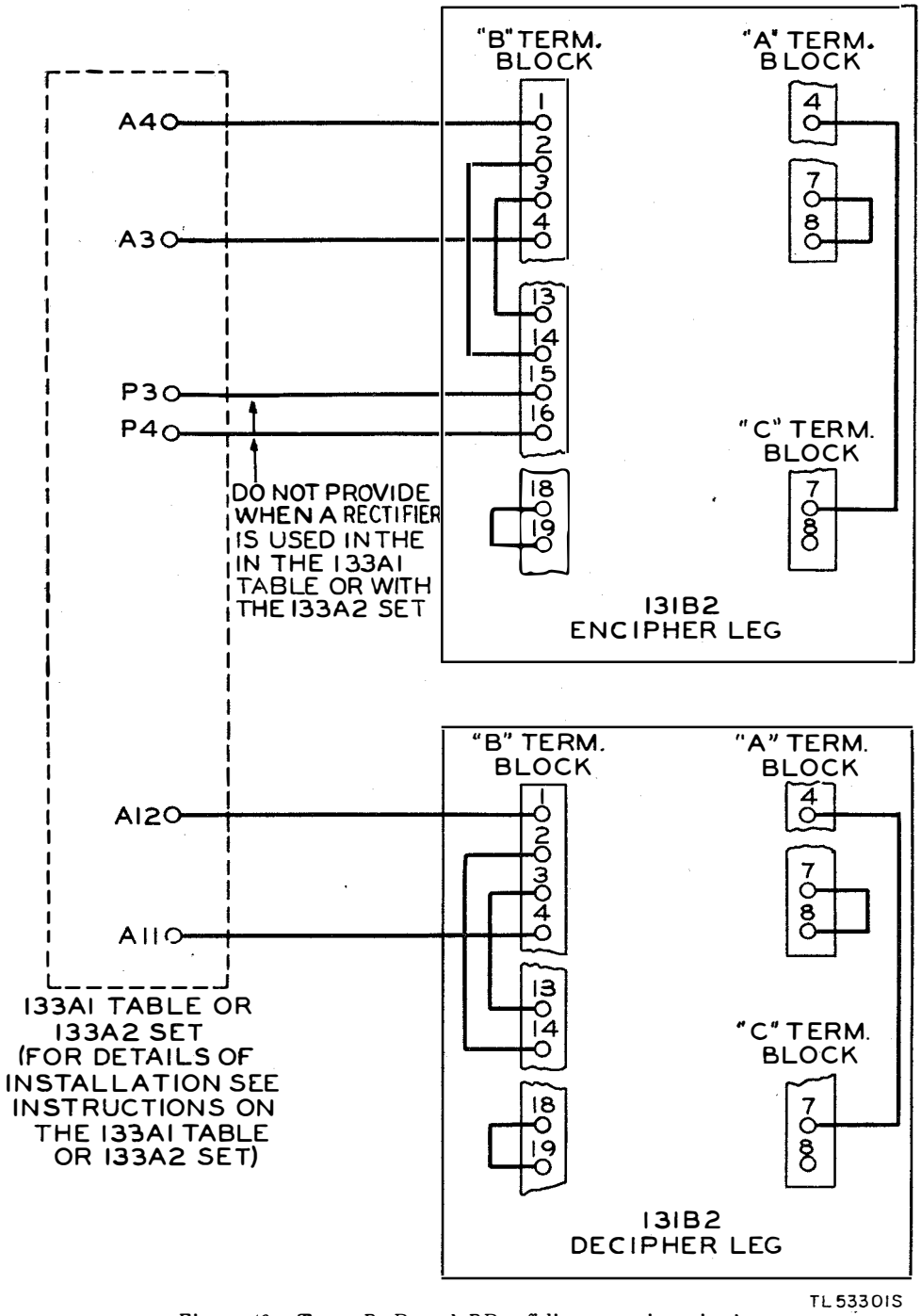


Figure 60. Types B, D, and BD, off-line operation, simultaneous encipher and decipher with 133A1 table or 133A2 set.

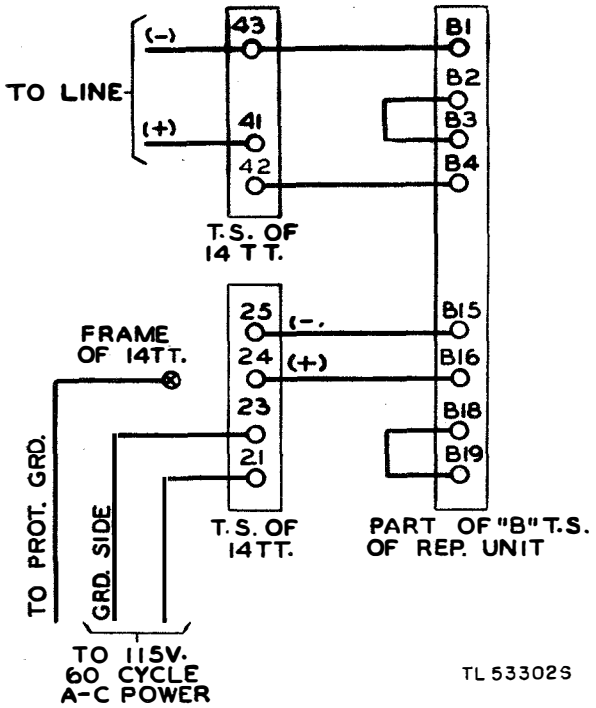


Figure 61. Type J, conference circuit operation, single (half-duplex) neutral transmission on two-wire line.

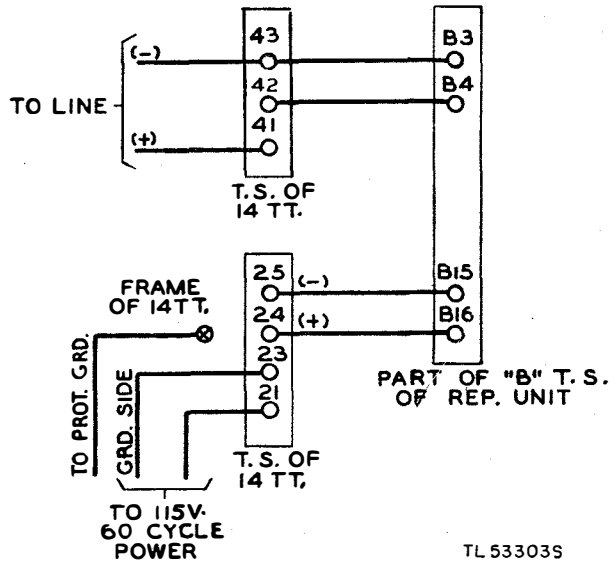


Figure 62. Type G, conference circuit operation, full-duplex neutral transmission, sending side.

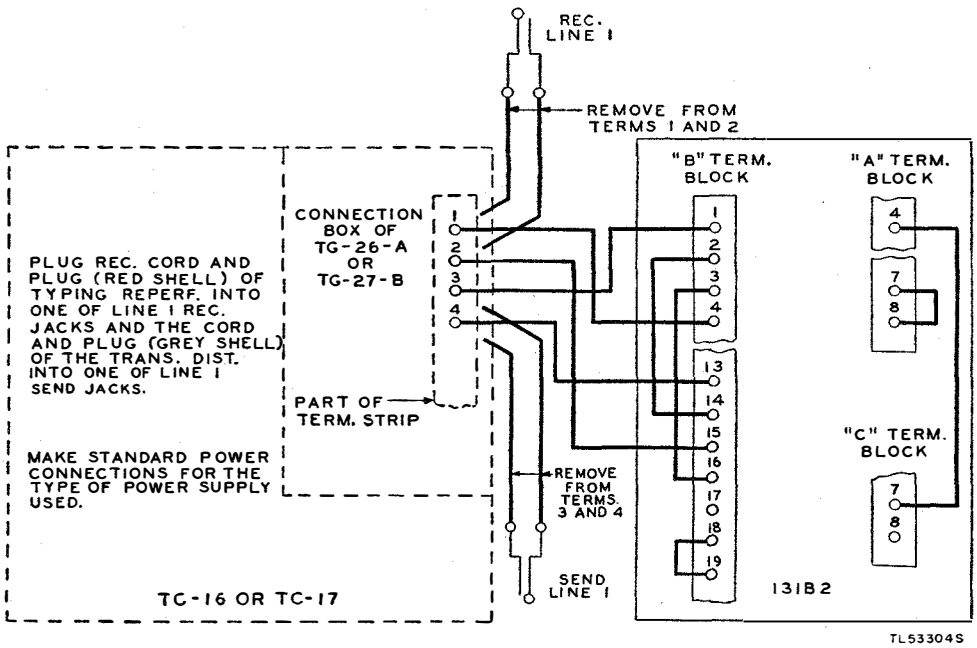


Figure 63. Types A, C, AA, and AC, off-line operation, alternate encipher and decipher with TC-16 or TC-17 sets.

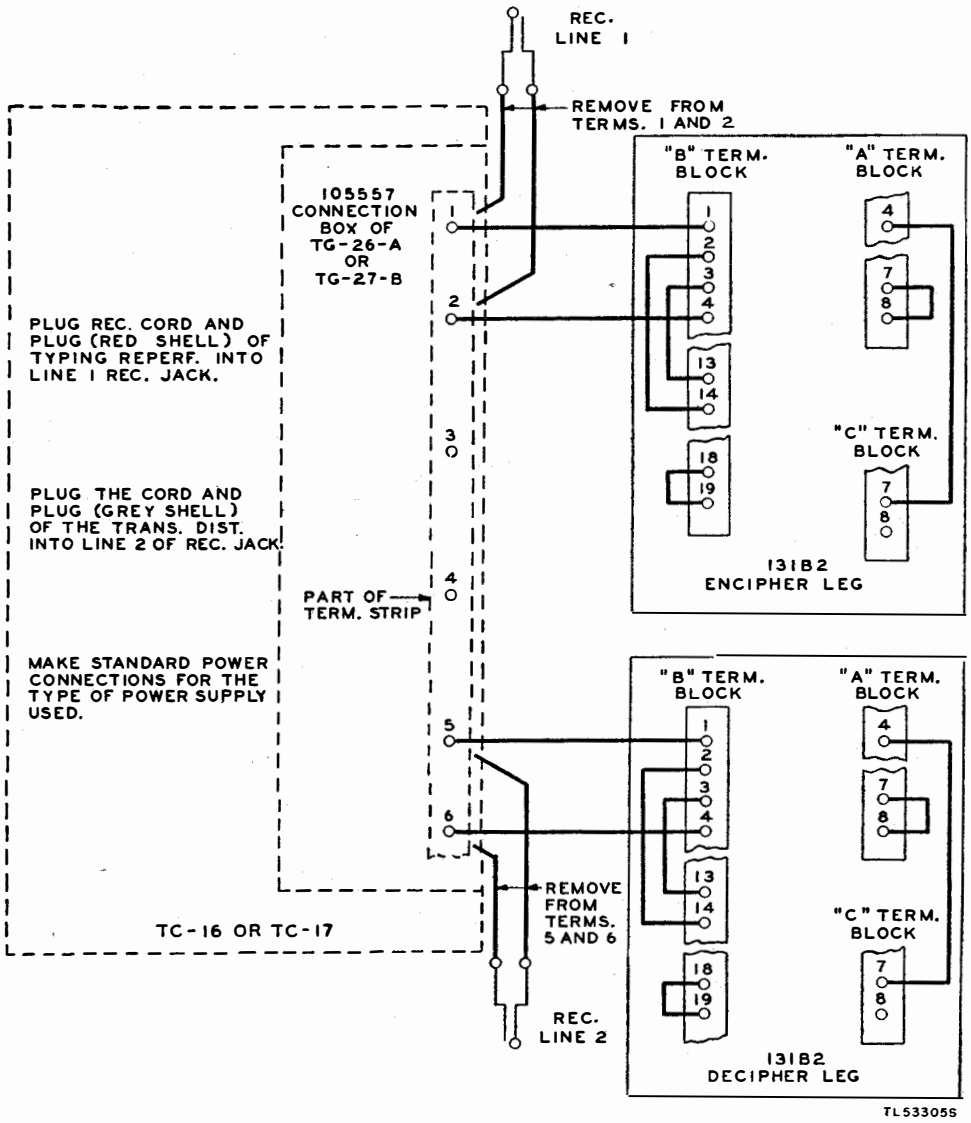


Figure 64. Types B, D, and BD, off-line operation, simultaneous encipher and decipher with TC–16 or TC–17 set.

Section V. OPERATING CHECKS AND ADJUSTMENTS

28. Equipment Checks

The 255–A type relay may be checked for electrical bias and operating sensitivity with Test Set I–193–A. (See TM 11–2513.) If this test set is not available, use the checks and inspections covered in section VIII.

29. System Line-up

Prior to placing the 131B2 station arrangement into regular operation it should be tested to meet the requirements specified in the tests listed in the following. Where the universal connector and two "crypto units" or one "crypto unit" and one "SpTD unit" are used, the items involving these units should be performed for each one.

30. Types AO, J, and Single (Half-duplex) Stations

a. These tests are applicable to installations made in accordance with paragraphs 20, 22, 23, 24, and 26*b*.

b. Prepare the station for testing as follows:

(1) Block relay BK1 operated, using the 508A armature blocking tool provided with the set.

(2) Throw the CIPHER-LOCAL TEST-TEXT lever to its LOCAL TEST position.

(3) Turn the STA TEST knob to the REG position.

c. Measure the orientation range of the teletypewriter on signals sent from its keyboard or in the case of a 19-type set from its keyboard and transmitter-distributor. The following should be transmitted if practicable: THE (sp) QUICK (sp) BROWN (sp) FOX (sp) JUMPED (sp) OVER (sp) A LAZY (sp) DOG (figs) ' (ltrs) S (sp) BACK (sp) (figs) 1234567890 (ltrs) (CR) (LF). If the use of this test sentence is not praccable, use any other sentence composed of miscellaneous characters or alternate R's and Y's.

d. The minimum orientation range requirements are "test—68" and "readjust—72." The former value should be used for checking and the latter whenever a readjustment has been made. Note the limit of the ranges obtained.

e. The limits of the orientation ranges on the 19-type set obtained from keyboard and transmister-distributor should be within ± 5 points of each other.

f. If the teletypewriter set fails to meet these requirements, follow the usual procedures for making it meet them.

g. Throw the CIPHER-LOCAL TEST-TEXT lever to its TEXT position. In this condition, the "crypto" or "SpTD unit" is not in the circuit.

h. Turn the STATION TEST knob to its TEST position.

i. Measure the orientation range of the teletypewriter on signals from its keyboard or in the case of a 19-type set from its transmitter-distributor. Use the signals as outlined in *c* above.

j. This range should be substantially the same as that obtained in *c* above with the limits of the range within 10 points of those obtained in *c* above.

k. If the station fails to meet these requirements, consider the following points:

(1) Check relays TR and TS for adjustment.

(2) Check the optional wiring in the repeater unit of the set for proper connections.

l. Set the range finder of the teletypewriter at the midpoint of the range obtained in *i* above.

m. Throw the CIPHER-LOCAL TEST-TEXT lever to its CIPHER position.

n. Remove one or more of the test elements from the "crypto unit" or remove the tape from the "SpTD unit" and depress the "tape-out" pin by placing a piece of paper over it and closing the gate. This paper must not extend over the sensing pins.

o. When a "crypto unit" is used, orient it as follows:

(1) Measure its receiving orientation range on signals sent from the keyboard of the teletypewriter or the transmitter-distributor when a 19-type set is used. The signals being used should be those covered in *c* above. This range is measured by the range scale and lever provided on the "crypto unit" and by observing the copy on the teletypewriter. The scale of the "crypto unit" is read at the right edge of the pointer provided on the unit, and in order to orient the unit, two screws to the rear of the distributor face have to be loosened.

(2) As zero bias signals are being used to measure this range, a mechanical lower limit of the range will be encountered in the large majority of cases. When this occurs, there should be a range of at least 50 points above this limit, and the range finder should be set 40 points below the upper limit. If a mechanical limit is not encountered, a total range of about 70 points or more should result. If this condition is encountered, set the range finder at the midpoint of the range. Tighten the screws that were loosened to move the range finder.

(3) If the orientation range requirements are not met, the following points should be considered:

(a) Check the clutch torque of the "crypto unit."

(b) Check the adjustment of the start magnet and latch.

(c) Check the condition and adjustment of the "crypto unit" distributor brushes and face.

(d) Check relays R, R1, and S in the mixing relay unit for adjustment.

(e) If a governed motor is used, check its speed.

p. When an "SpTD unit" is used, orient the face of the unit so that the brushes are fully on, but at the very edge of the trailing end of the rest segment ahead of the start segment, when the unit is in the stop position. In order to orient this face, three screws appearing on the face will have to be loosened. Tighten these screws after the orientation setting has been made.

q. With the station still in the "cipher" condition, and with one or more of the test elements removed

from the "crypto unit" or with the tape removed from the "SpTD unit" and with its "tape-out" pin depressed, test transmission from the "crypto" or "SpTD unit" by sending signals from the keyboard or transmitter-distributor in the case of a 19-type set and measure the orientation range of the teletypewriter. The signals used should be those covered in *c* above. The range should be substantially that found in *i* above with the limits of the range within 10 points of those obtained in *i* above.

r. If the station fails to meet these requirements, check the crypto unit or SpTD adjustments mentioned in (3) above.

s. Set the range finder of the teletypewriter at the midpoint of the range found in *i* above.

t. With satisfactory results in the above tests, the station can be assumed to be in good operating condition except for relay LB, relay LS, relay LR, relay LT, the break feature, and the paths through the "crypto" or "SpTD unit."

u. Relays LB, LR, LS, and LT should be carefully checked for correct adjustment.

v. To test the break feature of the station, open the loop to the station and with the station in the "cipher" condition, remove the block from relay BK1. The CIPHER lamp should go out, the TEXT and BREAK lamps should light, and it should be impossible to send signals from the keyboard or transmitter-distributor of the station.

w. When a station tested in the above manner is used in actual service, especially over relatively poor facilities, it may be necessary to change the orientation setting of the "crypto unit" and the teletypewriter set to obtain optimum operation with a distant station.

31. Types A, C, AA, and AC, Off-line Alternate Encipher and Decipher

a. These tests are applicable to installations made in accordance with paragraphs *25a* and *27a*.

b. Prepare the station for testing as follows:

(1) Throw the CIPHER-LOCAL TEST-TEXT lever to its LOCAL TEST position.

(2) Turn the STA TEST knob to the REG position.

c. Measure the orientation range of the teletypewriter on signals sent from its keyboard, or in the case of a 19-type set from its keyboard and transmitter-distributor. The following should be transmitted if practicable: THE (sp) QUICK (sp) BROWN (sp) FOX (sp) JUMPED (sp) OVER (sp) A (sp) LAZY (sp) DOG (figs) ' (ltrs) S (sp) BACK (sp) (figs) 1234567890 (ltrs) (CR) (LF). If the use of the test sentence is not practicable, use any other sentence composed of miscellaneous characters or alternate R's and Y's.

d. The minimum orientation range requirements are "test—68" and "readjust—72." The former value should be used for checking and the latter whenever a readjustment has been made. Note the limits of the ranges obtained.

e. The limits of the orientation ranges on the 19-type set obtained from keyboard and transmitter-distributor should be within ± 5 points of each other.

f. Set the range finder at the middle of the range.

g. If the teletypewriter set fails to meet the requirements, follow the usual procedures for making it meet them.

h. Throw the CIPHER-LOCAL TEST-TEXT lever to its TEXT position. In this condition, the "crypto" or "SpTD unit" is not in the circuit.

i. Measure the orientation range of the typing reperforator of the 133 table, TC–16 or TC–17 sets on signals from the keyboard of the teletypewriter or in the case of a 19-type set from the transmitter-distributor. Use the signals as outlined in *c* above.

j. This range should be "test—68" and "readjust —72."

k. If the station fails to meet these requirements, the following points should be considered:

(1) Check relays TR and TS for adjustment.

(2) Check the optional wiring in the repeater unit of the set for proper connections.

l. Measure the orientation range of the teletypewriter or 19-type set on signals sent from the transmitter-distributor of the 133 table, TC-16 or TC-17 sets. This range should be substantially the same as that obtained in *c* above.

m. Set the range finder of the teletypewriter at the midpoint of the range obtained in *i* above.

n. Throw the CIPHER-LOCAL TEST-TEXT lever to its CIPHER position.

o. Remove one or more of the test elements from the "crypto unit" or remove the tape from the "SpTD unit" and depress the "tape-out" pin by placing a piece of paper over it and closing the gate. This paper must not extend over the sensing pins.

p. When a "crypto unit" is used, orient it as follows:

(1) Measure its receiving orientation range on signals sent from the transmitter of the 133 table, TC–16, or TC–17 sets. The signals used should be those covered in *c* above. This range is measured by the range scale and lever provided on the "crypto unit" and by observing the copy on teletypewriter. The scale of the "crypto unit" is read at the right-hand edge of the pointer provided on the unit and in order to orient the unit, two screws to the rear of the distributor face must be loosened.

(2) As zero biased signals are being used to measure this range, the mechanical lower limit of the range will be encountered in a large majority of cases. When this occurs, there should be a range of at least 50 points above this limit, and the range finder should be set 40 points below the upper limit. If a mechanical limit is not encountered, a total range of about 70 points or more should result. If this condition is encountered, set the range finder at the midpoint of the range. Tighten the screws that were loosened to move the range finder.

(3) If the orientation range requirements are not met, consider the following points:

(a) Check the clutch torque of the "crypto unit."

(b) Check the adjustment of the start magnet and latch.

(c) Check the condition and adjustment of the "crypto unit" distributor brushes and face.

(d) Check relays R, R1, and S in the mixing relay unit for adjustment.

(e) If a governed motor is used, check its speed.

q. When an "SpTD unit" is used, orient the face of the unit so that the brushes are fully on but at the very edge of the trailing end of the rest segment ahead of the start segment when the unit is in the stop position. In order to orient this face, the three screws appearing on the face must be loosened. Tighten these screws after the orientation setting has been made.

r. With the station still in the "cipher" condition, and with one or more of the test elements removed or with no tape in the "SpTD unit" and with its "tape-out" pin depressed, test transmission from the "crypto" or "SpTD unit" by sending signals from the keyboard or transmitter-distributor in the case of a 19-type set and measure the orientation range of the typing reperforator of the 133 table, TC–16 or TC–17 sets. The signals used should be those covered in *c* above and the range should be substantially that found in *i* above.

s. If the station fails to meet these requirements, check the "crypto unit" adjustments mentioned in *p* (3) above or similar adjustments on the "SpTD unit."

t. Set the range finder of the typing reperforator at the midpoint of the range found in *i* above.

u. With satisfactory results in the above tests, the station can be assumed to be in good operating condition except for the paths through the "crypto unit" or "SpTD unit."

32. Type G and Full Duplex Operation

These tests apply to installations made in accordance with paragraphs 21 and 26*b*.

a. For neutral (open and close) operation, stations installed in accordance with paragraphs 21*a*, *c*, and 26*c* should be prepared for testing as follows:

(1) Remove the sending and receiving loops from the sending and receiving sets.

(2) Connect terminal B4 of the sending set to terminal B2 of the receiving set.

(3) Connect terminal B13 of the sending set to terminal B1 of the receiving set.

(4) Strap terminal B3 to terminal B14 of the sending set.

(5) Remove the straps, if any, on resistors BV and BW of the receiving set so that the total value of these resistors is in series with the receiving relay.

b. For polar operation, stations installed in accordance with paragraphs 21*b* and *d* should be prepared for testing as follows:

(1) Remove the sending and receiving loops from the sending and receiving sets.

(2) Strap B3 to B13 of the sending set.

(3) Strap B14 to B16 of the sending set.

(4) Connect B4 of the sending set to B1 of the receiving set.

(5) Connect B15 of the sending set to B2 of the receiving set.

c. After the stations have been prepared as covered in *a* and *b* above, they should be tested as follows:

d. Throw CIPHER-LOCAL TEST-TEXT lever to its LOCAL TEST position.

e. Measure the orientation range of the sending teletypewriter on signals sent from its keyboard or

in the case of the 19-type set from its keyboard and transmitter-distributor. The following should be transmitted if practicable: THE (sp) QUICK (sp) BROWN (sp) FOX (sp) JUMPED (sp) OVER (sp) A (sp) LAZY (sp) DOG (figs) ' (ltrs) S (sp) BACK (sp) (figs) 1234567890 (ltrs) (CR) (LF). If this test sentence is not practicable, use any other sentence composed of miscellaneous characters or alternate R's and Y's.

f. The minimum orientation range requirements are "test—68" and "readjust—72." The former value should be used for checking and the latter whenever a readjustment has been made. Set the range finder at the middle of this range.

g. The limits of the orientation ranges on a 19-type set obtained from keyboard and transmitter-distributor should be within ± 5 points of each other.

h. If the teletypewriter set fails to meet these requirements, follow the usual procedure for making it meet them.

i. Throw the CIPHER-LOCAL TEST-TEXT levers on both the sending and receiving sets to their TEXT positions.

j. Send the test sentence or equivalent covered in *e* above from the keyboard or transmitter-distributor of the sending station and measure the orientation range of the receiving set teletypewriter.

k. The minimum orientation range requirements are "test—68" and "readjust—72." The former value should be used for checking and the latter whenever a readjustment has been made. Set the range finder at the middle of this range.

l. If the station fails to meet this requirement, check the following points:

(1) Adjustments of selector mechanism of receiving set.

(2) Relays LR and TS of the receiving set.

(3) Relays LS and TR of the sending set.

(4 The optional wiring of the repeater units of both sets.

(5) If no copy is received, check relay LB of the receiving set and relay LT of the sending set.

m. Throw the CIPHER-LOCAL TEST-TEXT lever of the sending set to the CIPHER position.

n. Remove one or more of the test elements from the "crypto unit" or remove the tape from the "SpTD unit" of the sending set. Depress the "tape-out" pin of the "SpTD unit" by placing a piece of paper over it and closing the gate. This paper must not extend over the sensing pins.

o. Set the sending set "crypto unit" range finder so that the brushes line up with a line through the center of the brush arm shaft and top mounting screw of the distributor face when the unit is in the stop position. In order to make this setting, two screws to the rear of the distributor face must be loosened. Tighten these screws after the setting has been made. Set the "SpTD" range finder so that the brushes are fully on but at the very edge of the trailing end of the rest segment ahead of the start segment when the unit is in the stop position. In order to make this setting the three screws appearing on the face of the unit must be loosened. Tighten these screws after making the setting.

p. With the receiving set in the text condition, measure the orientation range of its teletypewriter on signals transmitted from the sending set. Use the test signals covered in *a*(5) above.

q. The orientation range should be almost the same as that measured in *j* above. Set the range finder at the middle of this range.

r. If the station fails to meet these requirements, the following points should be considered:

(1) Check the clutch torque of the "crypto" or "SpTD unit" on the sending set.

(2) Check the adjustment of the start magnet and latch of the "crypto" or "SpTD unit" on the sending set.

(3) Check the position and adjustment of the sending set "crypto" or "SpTD unit" distributor brushes and face.

(4) If a governed motor is used, check its speed.

(5) Check relays R, R1, and S of the mixing relay unit of the sending set for adjustment.

s. Throw the CIPHER-LOCAL TEST-TEXT lever of the receiving set to its CIPHER position.

t. Remove one or more of the test elements from the receiving set "crypto unit" or the tape from the "SpTD unit" and depress the "tape-out" pin by placing a piece of paper over it and closing the gate. This paper must not extend over the sensing pins.

u. When a "crypto unit" is used, proceed as follows:

(1) Test its receiving orientation range on signals sent from the transmitter of the sending set. The signals used should be those covered in *a*(5) above. This range is measured by the range scale

and lever provided on the "crypto unit" and by observing the copy on the teletypewriter. The scale of the "crypto unit" is read at the right-hand edge of the pointer provided on the unit and in order to orient the unit, two screws to the rear of the distributor face have to be loosened.

(2) As zero biased signals are being used to measure this range, the mechanical lower limit of the range will be encountered in a large majority of cases. When this occurs, there should be a range of at least 50 points above this limit, and the range finder should be set 40 points below the upper limit. If a mechanical limit is not encountered, a total range of about 70 points or more should result. If this condition is encountered, set the range finder at the midpoint of the range. Tighten the screws that were loosened to move the range finder.

(3) If the orientation range requirements are not met, consider the following points:

(a) Check the clutch torque of the "crypto unit."

(b) Check the adjustment of the start magnet and latch.

(c) Check the condition and adjustment of the "crypto unit" distributor brushes and face.

(d) Check relays R, R1, and S in the mixing relay unit of the receiving set for adjustment.

(e) If a governed motor is used, check its speed.

v. When an "SpTD unit" is used proceed as follows:

(1) Orient the face so that the brushes are fully on, but at the very edge of the trailing end of the rest segment ahead of the start segment, when the unit is in the stop position. In order to orient the face, the three screws appearing on the face must be loosened. Tighten these screws after the setting has been made.

(2) With both the sending and receiving sets in the CIPHER position measure the orientation range of the teletypewriter of the receiving set on signals sent from the keyboard or transmitter-distributor of the sending set. The signals used should be those covered in *e* above.

(3) The orientation range should be substantially that found in *j* above. Set the range finder at the middle of this range.

(4) If the set fails to meet this requirement the following points should be considered:

(a) Check the clutch torque of the "SpTD unit" on the receiving and sending sets.

(b) Check the adjustment of the start magnet and latch of the "SpTD unit" on the receiving and sending sets.

(c) Check the position and adjustment of the sending set "SpTD unit" distributor brushes and face on the receiving and sending sets.

(d) If a governed motor is used, check its speed.

(e) Check relays R, R1, and S of the mixing relay unit on the receiving and sending sets.

w. With the receiving set in the "cipher" position, throw the BREAK-BREAK RELEASE lever of the sending set to its BREAK position, and hold it there for about 2 seconds. The receiving set CIPHER LAMP should go out. The TEXT lamp and the BREAK lamp should light.

x. With satisfactory results on the above tests, the sending and receiving sides of the station can be assumed to be in good operating condition if the paths through the "crypto" or "SpTD unit" have been checked.

y. Reconnect the send and receive sets to the lines or loops.

z. When a station tested in the above manner is used in actual service, especially over relatively poor facilities, it may be necessary to change the orientation setting of the "crypto unit" and the teletypewriter sets to obtain optimum operation with a distant station.

33. Types B, D, and BD, Off-line Simultaneous Encipher and Decipher

a. GENERAL. These tests apply to installations made in accordance with paragraphs 25*b* and 27*b*.

b. ENCIPHERING SET. (1) Throw the CIPHER-LOCAL TEST-TEXT lever of the enciphering set to its LOCAL TEST position.

(2) Measure the orientation of the enciphering set teletypewriter on signals from its keyboard and in the case of the 19-type set from its keyboard and transmitter-distributor. The following should be transmitted if practicable: THE (sp) QUICK (sp) BROWN (sp) FOX (sp) JUMPED (sp) OVER (sp) A (sp) LAZY (sp) DOG (figs) ' (ltrs) S (sp) BACK (sp) (figs) 1234567890 (ltrs) (CR) (LF). If the use of this test sentence is not practicable, use any other sentence composed of miscellaneous characters or alternate R's and Y's.

(3) The minimum orientation range requirements are "test—68" and "readjust—72." The former value should be used for checking and the latter

whenever a readjustment has been made. Set the range finder at the middle of this range.

(4) The limits of the orientation ranges on the 19-type set, obtained from keyboard and transmitter-distributor, should be within ± 5 points of each other.

(5) If the teletypewriter set fails to meet these requirements, follow the usual procedure for making it meet them.

(6) Throw the CIPHER-LOCAL TEST-TEXT levers of both the sending and receiving sets to their TEXT positions.

(7) Send the test sentence or equivalent covered in *b*(2) above from the keyboard or transmitter-distributor of the enciphering leg and measure the orientation range of the typing reperforator of the 133 table, TC–16, or TC–17 sets.

(8) The minimum orientation range requirements are "test—68" and "readjust—72." The former value should be used for checking and the latter whenever a readjustment has been made. Set the range finder at the middle of this range.

(9) If the station fails to meet this requirement, check the following points:

(a) Adjustment of selector mechanism of the receiving typing reperforator.

(b) Relays LS and TR of the enciphering 131B2 set.

(c) The optional wiring of the repeater unit of the enciphering set.

(d) If no copy is received, check relay LT of the enciphering set.

(10) Throw CIPHER-LOCAL TEST-TEXT lever of the enciphering set to the CIPHER position.

(11) Remove one or more of the test elements from the "crypto unit" or remove the tape from the "SpTD unit" of the enciphering set. Depress the "tape-out" pin of the "SpTD unit" by placing a piece of paper over it and closing the gate. This paper must not extend over the sensing pins.

(12) Set the enciphering set "crypto unit" range finder so that the brushes align with a line through the center of the brush arm shaft and top mounting screw of the distributor face when the unit is in the stop position. In order to make this setting, loosen the two screws to the rear of the distributor face. Tighten them after the setting has been made. Set the "SpTD range" finder so that the brushes are fully on, but at the very edge of the trailing end of the rest segment ahead of the start segment, when the unit is in the stop position. In order to make this setting, loosen the three screws appearing on the face of the unit. Tighten them after making the setting.

(13) Measure the orientation range of the typing reperforator of the 133 table, TC–16 or TC–17 sets on signals transmitted from the enciphering set. Use the test signals covered in (2) above.

(14) The orientation range of the typing reperforator should be almost the same as that measured in (7) above. Set the range finder at the middle of this range.

(15) If the station fails to meet these requirements, consider the following points:

(a) Check the clutch torque of the "crypto" or "SpTD unit" on the enciphering set.

(b) Check the adjustment of the start magnet and latch of the "crypto" or "SpTD unit" on the enciphering set.

(c) Check the condition and adjustment of the enciphering set "crypto" or "SpTD unit" distributor brushes and face.

(d) If a governed motor is used, check its speed.

(e) Check relays R, R1, and S of the mixing relay unit for adjustment.

c. DECIPHERING SET. (1) Throw the CIPHER-LOCAL TEST-TEXT lever to its TEXT position.

(2) Measure the orientation range of the deciphering set teletypewriter on signals from the transmitter-distributor of the 133 table, TC–16, or TC–17 sets. The signals should be those used in *b*(2) above.

(3) The minimum orientation range requirements are "test—68" and "readjust—72." The former value should be used for checking and the latter whenever a readjustment has been made. Set the range finder at the middle of this range.

(4) If the teletypewriter set fails to meet these requirements, consider the following items:

(a) Follow the usual procedure for checking the teletypewriter.

(b) Check relays LR and TS of the repeater unit of the deciphering set.

(c) Check the optional wiring of the repeater unit of the deciphering set.

(d) If no copy is received check relay LB of the deciphering set.

(5) Throw the CIPHER-LOCAL TEST-TEXT lever to its CIPHER position.

(6) Remove one or more of the test elements from the "crypto unit" or remove the tape from the "SpTD unit" and depress the "tape-out" pin by placing a piece of paper over it and closing the gate. This paper must not extend over the sensing pins.

(7) When a "crypto unit" is used:

(a) Measure its orientation range on signals sent from the transmitter of the 133 table, TC–16, or TC–17 sets. The signals used should be those covered in *b*(2) above. This range is measured by the range scale and lever provided on the "crypto unit" and by observing the copy on the teletypewriter. The scale of the "crypto unit" is read at the right-hand edge of the pointer provided on the unit. To orient the unit, loosen the two screws to the rear of the distributor face.

(b) As zero biased signals are being used to measure this range, the mechanical lower limit of the range will be encountered in a large majority of cases. When this occurs, there should be a range of at least 50 points above this limit, and the range finder should be set 40 points below the upper limit. If a mechanical limit is not encountered, a total range of about 70 points or more should result. If this condition is encountered, set the range finder at the midpoint of the range. Tighten the screws that were loosened to move the range finder.

(c) If the orientation range requirements are not met, consider the following points:

1. Check the clutch torque of the "crypto unit."
2. Check the adjustment of the start magnet and latch.
3. Check the condition and adjustment of the "crypto unit" distributor brushes and face.
4. Check relays R, R1, and S in the mixing relay unit for adjustment.
5. If a governed motor is used, check its speed.

(8) When an "SpTD unit" is used: Orient the face so that the brushes are fully on, but at the very edge of the trailing end of the rest segment ahead of the start segment, when the unit is in the stop position. To orient the face, loosen the three screws appearing on the face. Tighten them after the setting has been made.

(9) With the set still in the CIPHER condition, measure the orientation range of the teletypewriter on signals sent from the transmitter-distributor of the 133 table, TC–16, or TC–17 sets. The signals used should be those covered in *b*(2) above.

(10) The orientation range should be substantially the same as that found in (2) above. Set the range finder at the middle of this range.

(11) If the set fails to meet this requirement, consider the following points:

(a) Check the clutch torque of the "SpTD unit" if used.

(b) Check the adjustment of the start magnet and latch of the "SpTD unit" if used.

(c) Check the position and adjustment of the "SpTD unit" distributor brushes and face, if used.

(d) If a governed motor is used, check its speed.

(e) Check relays R, R1, and S of the mixing relay unit for adjustment.

(12) With satisfactory results on the above tests, the enciphering and deciphering sets of the station can be assumed to be in good operating condition if the paths through the "crypto" or "SpTD unit" have been checked.

Section VI. SUMMARY OF PROCEDURE FOR PLACING EQUIPMENT AND SERVICE

34. Assembly of Equipment

Assemble the units of equipment on the 131B2 table in the following manner:

a. When an a-c source of power is to be used, assemble the varistor power unit under the table and interconnect the varistor and main power unit to the table and equipment. (See par. 14*a* and *c*.)

b. When d-c power is supplied, connect the power cord between the power box and repeater unit. (See par. 14*a*.)

c. Place the 255–A type relays in their connecting blocks inside the table. (See par. 14*b*.)

d. Install the correct size fustat, fusetron, or fuse in the teletypewriter base for the particular type of motor used. (See par. 14*d*.)

e. Assembly the "crypto" or "SpTD unit" on the table and make the necessary cord connections to the table equipment. (See par. 14*e* and *f*.)

35. Installation

Equipment connections and mechanical arrangements (pars. 18 through 27) are as follows:

a. Make the necessary changes in the mechanical arrangements and wiring of the teletypewriter.

b. Arrange the internal wiring of the 131B2 set for the particular type of operation desired.

c. Make the cord connections between the various units and the 131B2 set. Also connect the teletypewriter to the source of power. (See pars. 19 through 27.)

d. Complete the line connections to the 131B2 sets. (See pars. 19 through 27.)

36. Equipment Checks

Check the 255– type relays with the polar relay test set I–193–A. (See TM 11-2513.)

37. System Line-up (pars. 29 through 33)

a. Make local tests of the equipment in accordance with the prescribed procedures.

b. In case of failure to meet the requirement, make adjustments in the usual manner until the requirements are met.

c. Place the equipment in actual service and if necessary, because of abnormal circuit conditions such as excessive leakage, readjust the orientation of the "crypto unit" and the teletypewriter to obtain optimum operating margins in communicating with the distant station.

Section VII. ROUTINE CHECKS OF PERFORMANCE

38. Records

a. It is advisable at each station to maintain a record showing when each periodic test or line-up is made. This record should also show the settings of the orientation levers of the "crypto unit," teletypewriters and typing reperforators, the rectifier connections, the troubles found, and when and how they were cleared. Such records will indicate which equipment and circuits should be given the most attention and are also useful in locating conditions causing circuit failures.

b. Forms for recording such data may be improvised and should be made to cover transmission in both directions, results of over-all system lineup tests and operating adjustments. These forms may be designed to cover the results of a single day or several days if experience indicates that the number of adjustments permits such usage. Typical records of this type are shown in figures 65 and 66.

Date	Time	Reported by	Report	Disposition	Date	Time	Cleared by
21 Oct	1530	WMB	Will not transmit	Relay BK out of ADJ	21 Oct	1600	MHL
23 Oct	0923	EFW	Received bad copy	Relay RV out of ADJ	23 Oct	0945	MHL

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Figure 65. Trouble report.

Adjustable unit	Connections or Settings	
	22 Oct.	25 Oct.
Orientations:		
"crypto unit"	45	47
"SPTD unit"	--	--
19 set TT	56	54
T. R. 133 table	61	60
Power Unit:		
Freq.	60	60
Line voltage	115	115
Rect. taps	OM-4	OM-3

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Figure 66. Records of power rectifier connections and orientation settings.

39. Purpose and Use of Equipment Performance Check List

a. General. The equipment performance and check list (par. 40) will help the operator to determine whether the 131B2 set arrangements are functioning properly. The check list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the correction measures that the operator can take. Items 1 to 17 correspond to the initial line-up and are checked when the system is about to go into operation after having been shut down. Items 18 to 20 have to do with starting the motors and turning the power on. Items 21 to 26 are the daily checks that are made during operation and item 28 is the method of stopping the station.

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

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator will find 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 routine operational checks that can be made without turning the equipment in for repairs. A reference to part five indicates that the correction of the trouble cannot be effected during operation, and that trouble shooting by an experienced repairman is necessary. 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 maintain the set in operation as long as it is possible to do so.

40. Equipment Performance Check List for 131B2 Teletypewriter Station Arrangements

	Item No.	Item	Action or condition	Normal indication	Corrective measures
PREPARATORY	1	Power unit. (Power unit is used only when source of a-c power is utilized. When d-c power is furnished, omit item 1 and make connection shown for item 2.)	Main unit cord connected to varistor unit. A-c cord connected to receptacle in power box. Output cord connected to 3-conductor base on repeater unit. Check the 10 and 1.6 amp. fusetrons located in main unit.		
	2	Power cord. (See note above.)	Connected between the 4-terminal receptacle of the power box and the 3-conductor base on the repeater unit.		
	3	"Crypto" or "SpTD unit."	Three cords of "crypto" or "SpTD unit" connected to mixing relay unit and 3-conductor receptacle in power box. If "crypto unit" has universal motor throw switch on resistor unit to dc (if 4-c power is being used) and to 50- and 60-cycle if a-c power, regardless of frequency.		
	4	M3AT cords. (One M3AT–P cord and one M3AT–S used only when 19-type set is used.)	M3AT–P cord plug connected to socket of M3AT–S cord.		
	5	M9C and M9D cords.	M9C cord plug connected to socket of M9D cord.		
	6	Cord of mixing relay unit.	Connected to receptacle in repeater unit.		
	7	Tt cords. (These are used only on 19-type sets.)	Connected to receptacles in teletypewriter tables.		
	8	Power to set.	Connected to primary power. Check that power is present.		
	9	Fusing.	Check fuses and fustats in the 131B2 table and teletypewriter set.		
	10	Line.	Check line connections to 131B2 set.		

	Item No.	Item	Action or condition	Normal indication	Corrective measures
PREPARATORY	11	STA TEST key.	Key in REG position.		
	12	CIPHER-LOCAL TEST-TEXT key.	Key in TEXT position.		
	13	Start switch on transmitter-distributor of 19-type set when used.	Switch in STOP position.		
	14	KEYBOARD-KBD & TAPE-TAPE key of 19-type set.	Key in TAPE position.		
	15	Teletypewriter paper.	Teletypewriter provided with paper.		Insert new roll of paper.
	16	Teletypewriter ribbon.	Teletypewriter ribbon in good condition.	Copy shall be clearly legible.	Install new ribbon.
	17	Perforator tape (19-type set only).	Teletypewriter set provided with perforator tape.		Insert new roll of tape.
	18	Teletypewriter power switch.	Switch in ON position.	The TEXT lamp should light and the BREAK lamp should light for those setups where the "break" feature has not been eliminated.	See part five.
START	19	Rectifier power switch on 19-type set.	Throw switch and punch keyboard.	Set punches tape.	
	20	Transmitter distributor motor switch on 19-type set.	Throw switch to start motor of transmitter-distributor.	131B2 set arrangements ready for normal operation.	
	21	BREAK-BREAK RELEASE key. (Perform only on those setups where "break" feature has not been eliminated.)	Operate momentarily to BREAK RELEASE position.	Red BREAK lamp goes out.	Check line connections to station.
EQUIPMENT PERFORMANCE	22	Send Text.	Punch teletypewriter keyboard and in case of 19-type set put tape in transmitter - distributor and operate start switch to start.	Copy appears on teletypewriter and message is sent to line in text.	See part five.
	23	Receive text.	Have distant station send.	Text appears on teletypewriter.	
	24	Place station in Cipher condition.	CIPHER-LOCAL TEST-TEXT key in CIPHER position.	CIPHER lamp lights, TEXT lamp goes out, motor of "crypto unit" or "SpTD unit" starts.	Check cord connections between "crypto" or "SpTD units" and 131B2 set.

	Item No.	Item	Action or condition	Normal indication	Corrective measures
EQUIPMENT PERFORMANCE	25	Send cipher.	Punch keyboard and in case of 19-type set put tape in transmitter-distributor and operate start switch to Start position.	Copy appears on teletypewriter, "crypto unit" or "SpTD unit" operates and cipher copy goes on line.	See part five.
	26	Receive cipher.	Have distant station send.	Text appears on teletypewriter.	See part five.
	27	Send and receive a break.	While operating keyboard or sending from transmitter-distributor, operate BREAK-BREAK RELEASE key to BREAK position and hold it operated for about 2 seconds.	CIPHER lamp goes out, TEXT lamp lights, BREAK lamp lights, or transmitter-distributor stops and "crypto unit" or "SpTD unit" motor stops.	See part five.
STOP	28	*To Stop* operation of 131B2 set arrangements.	Power switch of teletypewriter in OFF position and in case of 19-type set transmitter-distributor and rectifier switches in OFF position.	All lamps except heater lamps go out. All motors stop.	

PART THREE

MAINTENANCE INSTRUCTIONS

Section VIII. PREVENTIVE MAINTENANCE TECHNIQUES

41. Meaning of Preventive Maintenance

Preventive maintenance is a systematic series of operations performed periodically on equipment in order to maintain top efficiency in performance, to minimize unwanted interruptions in service and to eliminate major break-downs. To appreciate the meaning of the term "preventive maintenance," it is necessary to distinguish between preventive maintenance and trouble shooting and repair. The primary function of preventive maintenance is to prevent break-downs and the consequent necessity of repair. The primary function of trouble shooting and repair is to locate and correct *existing* defects. The importance of preventive maintenance cannot be overemphasized. The usefulness of the entire system depends upon the equipment being ready to operate at peak efficiency when needed.

Note. The operations in section VIII are first and second echelon (organization operators and repairmen) maintenance. Some operations in section XI are higher echelon maintenance.

42. Description of Preventive Maintenance Techniques

a. GENERAL. Most of the electrical parts used in 131B2 set arrangements require routine preventive maintenance. Those requiring maintenance differ in the amount and kind required. Because maintenance techniques cannot be applied indiscriminately, definite and specific instructions are needed. This section of the manual contains this type of specific instructions and serves as a guide for personnel assigned to perform the six basic maintenance operations, namely, Feel, Inspect, Tighten, Clean, Adjust, and Lubricate. Throughout this manual the lettering system for the six operations will be as follows:

F—Feel
I—Inspect
T—Tighten
C—Clean
A—Adjust
L—Lubricate *

The first two operations establish the need for the other four. The selection of operations is based on a general knowledge of field requirements, namely, rapid changes in climatic conditions (such as heavy rains followed by blistering heat) or excessive dampness, snow, and ice tend to cause deterioration of exposed surfaces and parts.

b. FEEL (F). The feel operation is used to determine if electrical connections, transformers, filters, etc., are overheated. Feeling indicates the existence of some type of defect requiring correction. The maintenance man must become familiar with the normal operating temperatures of transformers, etc., in order to recognize signs of overheating.

Note. It is important that the feel operation be performed as soon as possible after the shut-down, and also before any other maintenance is done.

c. INSPECT (I). (1) *General.* Inspection is the most important preventive maintenance operation. If more than one man is available to do this work, choose the most observant for careful observations required to detect defects in the functioning of moving parts and any other abnormal conditions. To carry out the inspection operation most effectively, make every effort to become thoroughly familiar with normal operating conditions and to be able to recognize and identify abnormal conditions readily.

(2) *Inspection.* Inspection consists of carefully observing all parts in the equipment, noticing their color, placement, cleanliness, etc. Inspect for the following conditions:

(a) Overheating. Overheating is indicated by discoloration, blistering, or bulging of the part or surface of the container; leakage of insulating compounds; and oxidation of metal contact surfaces.

(b) Placement. By observing that all leads and cabling are in their original positions.

* The Lubricate operations are inapplicable to Teletypewriter Set 131B2. (See par. 55.)

(c) Cleanliness. By carefully examining all recesses in the units for accumulated dust, especially between connecting terminals. Parts, connections, and joints should be free of dust, corrosion, and other foreign matter. In tropical and high-humidity locations look for fungus growth and mildew.

(d) Tightness. By testing any connection or mounting which appears to be loose, by slightly pulling on the wire, or by feeling the lug or terminal screw.

d. TIGHTEN (T). Any movement of the equipment caused by transportation, by concussion from falling shells, or by vibration from moving machinery, may result in loose connections which are likely to impair the operation of the set. The importance of firm mountings and connections cannot be overemphasized. However, never tighten screws, bolts, and nuts unless it is known definitely that they are loose. Fittings that are tightened beyond the pressure for which they are designed will be damaged or broken. When tightening, always be certain to use the correct tool of the proper size.

e. CLEAN (C). When the schedule calls for a cleaning operation, it does not mean that every item which bears that identifying letter must be cleaned each time it is inspected. Clean parts only when inspection shows that it is necessary. The cleaning operation to be performed on each part is described in the paragraphs in this section covering the type of part.

Note. Gasoline will not be used as a cleaning fluid for any purpose. Solvent, Dry Cleaning, is available as a cleaning fluid through established supply channels. Oil, Fuel, Diesel, may be used for cleaning purposes when dry-cleaning solvent (SD) is not on hand. Carbon tetrachloride will be used as a cleaning fluid only in the following cases: where inflammable solvents cannot be used because of the fire hazard, and for cleaning electrical contacts including relay contacts, plugs, commutators, etc.

f. ADJUST (A). Adjustments are made only when necessary to restore normal operating conditions. Specific types of adjustment are described in paragraphs 85 through 88.

43. Preventive Maintenance on Classes of Parts

This section of the manual does not deal with each resistor, relay, or capacitor of the equipment. Rather it combines all the instructional material on the major classes of parts and devices.

44. Capacitors

a. INSPECT (I). (1) Inspect the terminals of the capacitors for corrosion and loose connections. The mountings should be carefully inspected for any loose mounting screws, studs, or brackets. Examine the leads for poor insulation and for evidence of dry rot. Cut away frayed strands on the insulation. If the wire is exposed, wrap it with friction tape. The terminals of the capacitors should not be cracked or broken.

(2) The case of each capacitor must be thoroughly inspected for leaks, bulges, and discoloration.

b. TIGHTEN (T). Tighten loose terminals, mountings, and connections on the capacitors.

c. CLEAN (C). Clean the case of the capacitor and any connections that are dirty or corroded. The capacitor cases and bushings can usually be cleaned with a dry cloth, but if the deposit of dirt is difficult to remove, moisten the cloth in Solvent, Dry Cleaning.

45. Resistors

a. INSPECT (I). Inspect the coating of vitreous resistors for signs of cracks and chipping, especially at the ends. Examine the bodies of all types of resistors for blistering, discoloration, and other indications of overheating. Also look for arc pits or craters. Inspect leads, and all other connections for corrosion, dust, looseness, and broken strands in the connecting wires. Check the security of all mountings.

b. TIGHTEN (T). Tighten resistor connections and mountings whenever they are loose. If a resistor is allowed to remain loose, vibration may break the connection or damage the body.

c. CLEAN (C). (1) The large vitreous enameled resistors must be kept clean to avoid flash-overs or leakage between terminals. They will ordinarily be wiped with a dry cloth. However, if the dirt deposit is unusually difficult to remove, use dry-cleaning solvent (SD).

(2) Resistors with discolored bodies cannot be cleaned. Discoloration is indicative of overloading at some time prior to inspection and is probably due to circuit trouble which requires analysis.

46. Relays

a. U-, Y-, AND 239-TYPE RELAYS. (1) *General.* Before applying preventive maintenance techniques

to relays of these types, determine whether the relay is *normal* or *abnormal*.

(a) A relay is considered *normal* if the—

1. Exterior is free from dirt or dust.
2. Contacts are not burned, pitted, or corroded.
3. Contacts are lined up and correctly spaced.
4. Contact springs are in good condition.
5. Moving parts travel freely and function satisfactorily.
6. Connections to the relay are tight.
7. Wire insulation is not frayed or torn.
8. Relay assembly is securely mounted.
9. Field coil shows no signs of overheating.

(b) A relay is considered *abnormal* if it *fails* to meet any of the nine requirements of a normal unit.

(2) *Inspect (I). (a)* Inspect the relay to detect abnormalities using the check list above. The relay can be inspected and cleaned and its contacts cleaned without being removed from the mounting or taken apart.

(b) Check the mechanical action of the relay to make certain that when the moving and stationary contacts come together, they make positive contact and are directly in line with each other. The armature should move freely, without binding or dragging. Do not damage or misalign the relay mechanism.

(3) *Tighten (T).* Tighten all loose connections and mounting screws but do not apply enough force to damage the screws or break the parts. Bend over springs or tangs so that the relay cover fits snugly.

(4) *Clean (C). (a)* Wipe the exterior of the relay and the cover with a dry or damp cloth. If it is very dirty clean it with a cloth or brush dipped in dry-cleaning solvent (SD). Wipe the surface with a dry cloth to remove the white deposit left by the solvent when it dries.

(b) Contacts will ordinarily not require cleaning. However, dust or dirt conditions may require that contacts be cleaned periodically as prescribed locally. When required, insert a No. 265C contact burnisher between the contacts and draw it through them while gently pressing the contacts together with the fingers. Contact metal will wear away at an excessive rate if the cleaning is careless. Recheck the operation of the relay, noting in particular the making of contacts.

b. 255–A TYPE RELAYS. (1) *General.* The 255–A type relay, inclosed in a dust cover, is designed to plug into the equipment making it unnecessary to disconnect any wires to replace the relay or take it out for inspection. To remove the relay cover, turn the cover in a counterclockwise direction and pull forward.

(2) *Inspect (I).* Remove the relay cover and inspect the relay contacts in a good light. If the contacts appear black or burned or have a sooty deposit, replace the relay with a spare, if one is available. Inspect also for gas absorber assemblies on the polar relays. The replaced relay requires cleaning and readjustment according to paragraph 87. If the contacts on examination do not appear black or burned, make a further check for contact build-ups. Hold the armature lightly against one contact and check that the 0.003-inch blade of the No. 74D gauge passes easily between the armature and the contact. Repeat for the other contact. Check that the contact gap is not too wide, by holding the armature lightly against one contact and observing that the 0.005-inch blade of the No. 74D gauge does not pass easily through the gap. If these two requirements are not met, the relay requires cleaning and readjustment according to paragraph 87.

(3) *Tighten (T).* Tighten all loose screws on the frame of the relay. Tighten the locknuts on four terminal block mounting posts. Tighten the locknuts on the relay terminals, using a 5/32-inch wrench, if available.

47. Keys and Switches

a. INSPECT (I). Inspect the mechanical action of each key or switch and look for signs of dirt or corrosion of all exposed elements. Examine the elements of the key or switch visually.

b. CLEAN (C). Clean the exterior surfaces of keys and switches with a stiff brush moistened with dry-cleaning solvent (SD) and polish with a piece of cloth. Clean corroded connections with #0000 sandpaper. Clean all key and switch contacts in the same way as relay contacts. When the contacts have deep pits caused by burning or arcing, use the burnishing tool to resurface them.

48. Transformers and Filter Chokes.

a. GENERAL. Almost without exception transformers and chokes must be replaced if defective, but preventive maintenance techniques give some amount of protection against failure at inopportune times.

b. FEEL. (F). Feel wax-impregnated transformers for signs of overheating; the surest sign of overheating is the presence of insulating compound on the outside of the seams of the case. Overheating is an indication of circuit trouble and requires a system analysis.

c. INSPECT (I). Inspect transformers and chokes for general cleanliness, clearance, and for tightness of connections, connecting lugs or terminals (brackets and rivets). Dust, dirt, or moisture between the terminals of high-voltage transformers or on chokes located at high-potential points in the circuit, may cause flash-overs.

d. TIGHTEN (T). (1) Tighten loose mounting screws or connections immediately.

(2) If it is necessary to move wires to tighten loose parts, note the position of the wires before they are unsoldered, tag them and restore them to their original places.

e. CLEAN (C). (1) Clean the cases of transformers and chokes with a dry cloth. In a few instances, it may be desirable to use dry-cleaning solvent to remove foreign matter.

(2) Corroded contacts or connections can be sandpapered and wiped clean.

(3) Clean corrosion from ground connections, and from resoldered connections.

49. Terminal Blocks

a. GENERAL. Terminal blocks are used as receiving, connecting, and distributing points for electrical circuits. Their construction is simple. They consist of a strip of insulation with screw-type connections mounted on it. Little preventive maintenance is needed on the terminal blocks especially if the equipment has not been moved. The following subparagraphs describe their care.

b. INSPECT (I). (1) Inspect the terminal blocks for cracks, breakage, dirt, and loose connections or mounting screws.

(2) Carefully examine the connections for mechanical defects, dirt, and corrosion.

c. TIGHTEN (T). Tighten loose screws, lugs, and mounting bolts. When tightening screws, be sure to select a screw driver of the correct size and do not exert too much pressure. Remove loose connections and clean them when they are dirty or corroded.

d. CLEAN (C). Clean the terminal blocks when they require it with a dry brush. When necessary, use a cloth moistened with dry-cleaning solvent. If a solvent is used, the block must be thoroughly wiped with a cloth and then brushed to remove lint.

50. Cords and Cables

a. GENERAL. The cords and cables are the life lines of the equipment. Observe the condition of the cords and cables closely.

b. INSPECT (I). (1) Inspect the cables for cracked or deteriorated insulation, frayed or cut insulation at the connecting and supporting points, and improper placement which places the cables or connections under strain. Watch for kinks and improper supports.

(2) If the frame of the equipment is grounded at a loose point, the loose connection nullifies protection for the operating personnel.

c. TIGHTEN (T). Tighten loose cable clamps, coupling rings, and cable connections.

d. CLEAN (C). Wipe dust and dirt from cords and cabling with a dry cloth or soft brush. Take care not to damage any soldered connections.

51. Multiple Connectors

a. GENERAL. All connecting plugs, receptacles, and sockets which are used to connect components by cords or cables are classed as multiple connectors, regardless of the number of pins in the connector.

b. INSPECT (I). Inspect the exterior and interior of all multiple connectors for general cleanliness and signs of corrosion, moisture, or fungus. Look for loose or bent pins. Examine all cable or cord wires at the point at which they connect to the separate pins. Check for broken strands of wire or poor insulation which might cause a short between pins.

c. TIGHTEN (T). Resolder any poor or loose connections.

d. CLEAN (C). Clean the exterior and interior of multiple connectors with a brush dipped in dry-cleaning solvent. Dry thoroughly with a clean, dry, lint-free cloth. Use #0000 sandpaper to remove corrosion from connectors and pins. Do not attempt to remove individual pins from the connectors.

52. Fuses

a. GENERAL. Fuses are small strips of metal with a low melting point contained in various types of mountings. They are inserted in series with an electrical circuit to open the circuit when the current exceeds a prescribed value. Being very rapid

in action, fuses protect equipment against overload and damage. Whenever a fuse is blown, make an attempt to discover the reason and to make corrections, before a new fuse is installed. The procedure for this type of trouble shooting is described in section XVII. The fuses used in this equipment are not reusable and, therefore, should be thrown away after they are blown. The small nonrenewable glass-cased fuses are mounted on some of the equipment panels and are removed by unscrewing and withdrawing the cap screws which hold them in place. When removed from a panel, a fuse and its holding cap screw can be separated by pulling them apart. Do *not* throw away the fuse cap holder. Fuse holder positions and fuses are marked individually as to current carrying capacity to match the right fuse to its circuit. Glass fuses are easily removable for inspection. The fuse ends and holding clips should be clean and tight to avoid arcing or burning.

b. INSPECT (I). Inspect the fuse caps for evidence of burning, charring, or corrosion. Inspect the fuse holding clips for dirt, loose connections, and amount of tension. Inspect the fuse ends for dirt and corrosion.

c. TIGHTEN (T). Tighten loose fuse clips and their connecting wires.

d. CLEAN (C). Clean all fuse ends and fuse clips, when necessary, with #0000 sandpaper and wipe with a dry cloth. If necessary, use a fine file to remove deep pits in the clips or fuse ends. If such treatment is used, finish this work with #0000 sandpaper to leave a smooth surface. As a final step, wipe the filed surface with a clean dry cloth.

53. Preventive Maintenance Tools and Materials

a. The following tools and materials will be needed in performing preventive maintenance:

Screwdriver KS-6854
Contact burnisher No. 265C
74D gauge
Clean lintless cloth
#0000 sandpaper
Cleaning brush
Solvent, Dry Cleaning.

b. Make sure that all tools and materials required are on hand before starting preventive maintenance operations.

Section IX. PREVENTIVE MAINTENANCE CHECK LIST

54. Preventive Maintenance Check List

The following check list is a summary of the preventive maintenance to be performed on the 131B2 set. The echelon column indicates which operations are first echelon maintenance and which operations are second echelon maintenance. Operations are indicated by the letters of the word FITCAL. For example, if the letters ITC appear in the "Operations" column, the item to be treated must be inspected (I), tightened (T), and cleaned (C).

Item No.	Operations	Item	When performed					Echelon
			Daily	Weekly	Monthly	Semi-annually	Yearly	
1	ITC	Resistors. (See par. 45.)				X		2d.
2	ITC	Relays. (See par. 46.)				X		2d.
3	IC	Keys and switches. (See par. 47.)				X		2d.
4	FITC	Transformers and chokes. (See par. 48.)				X		2d.
5	ITC	Terminal blocks. (See par. 49.)				X		2d.
6	ITC	Cords and cables. (See par. 50.)				X		2d.
7	ITC	Capacitors. (See par. 44.)				X		2d.
8	ITC	Multiple connectors. (See par. 51.)				X		2d.
9	ITC	Fuses. (See par. 52.)				X		2d.

F Feel — I Inspect — T Tighten — C Clean — A Adjust — L Lubricate

* Lubrication operations are inapplicable to Teletypewriter Set 131B2.

Section X. LUBRICATION

55. Lubrication

Note. No lubrication is required for Teletypewriter Set 131B2.

Section XI. MOISTUREPROOFING AND FUNGIPROOFING

56. General

When operated in tropical areas where temperature and relative humidity are extremely high, Signal Corps equipment requires special attention. These are some of the problems met:

a. Resistors, capacitors, coils, chokes, transformer windings, etc., fail because of the effects of fungus growth and excessive moisture.

b. Electrolytic action, often visible in the form of corrosion, takes place in resistors, coils, chokes, transformer windings, etc., causing eventual breakdown.

c. Hook-up wire insulation and cable insulation break down. Fungus growth accelerates deterioration.

d. Moisture forms electrical leakage paths on terminal boards and insulating strips, causing flashovers and crosstalk.

e. Moisture provides leakage paths between battery terminals.

57. Treatment

A moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection against fungus growth, insects, corrosion, salt spray, and moisture. The treatment involves the use of a moisture- and fungi-resistant varnish applied with a spray gun or brush. See TB SIG 13 for a detailed description of the varnish-spray method of moistureproofing and fungiproofing and the supplies and equipment required in this treatment.

Caution: Varnish spray may have poisonous effect if inhaled. To avoid inhaling spray, use respirator if available; otherwise fasten cheesecloth or other cloth material over nose and mouth. Never spray varnish or lacquer near an open flame. Do not smoke in a room where varnish or lacquer is being sprayed. The spray may be highly explosive.

58. Teletypewriter Set 131B2

a. PREPARATION. Make all repairs and adjustments necessary for proper operation of the equipment.

b. DISASSEMBLY.

Note. As the equipment is disassembled, replace all screws, bolts, and nuts that are removed immediately in their respective holes, thus preventing loss of screws or clogging of threads during treatment.

(1) *Removal of unit from cabinet. (a)* Disconnect the a-c input cable from the power source.

(b) Remove the rear panel after loosening the two captive screws SS1. (See fig. 72.)

(c) Remove the main power unit PU. (See fig. 70.)

(d) Remove the varistor unit RT (fig. 70) after removing the four screws which fasten it under the bottom of the cabinet.

(e) Remove the front shield by loosening the four captive screws SS2. (See fig. 68.)

(f) Remove the interconnecting cables and wires from socket S2 (fig. 67) and terminal board TB1 (fig. 70).

(2) *Back of cabinet* (fig. 67). *(a)* Remove the seven polar relays S, R, R1, LR, LS, TR, and TS from their sockets. (See fig. 67.)

(b) Remove the rubber-covered input cable A1. (See fig. 70.)

1. Disconnect the two solderless wire connectors located on the back of the mixing relay unit panel.
2. Loosen the cable clamp CL. (See fig. 67.)
3. Remove the plug from receptacle E (fig. 70) and pull the cable through the panel.

(c) Tighten all connecting screws on the terminal board TB1. (See fig. 70.)

(d) Open the front cover of the power box PB (fig. 67) by loosening captive screw SS3 (fig. 67).

(3) *Front of cabinet* (fig. 68). *(a)* Remove the friction tape from all cabling in the cabinet.

(b) Remove the lacing where practicable and separate the wires sufficiently for varnish penetration to insure proper lacquering and drying of the innermost wires of the cabling.

(4) *Main power unit.* *(a)* Remove the cover of the main power unit by removing the 10 screws around the bottom edge of the cover.

(b) Remove the two fuses F5 and F6. (See fig. 69.)

(c) Tighten all connecting screws on terminal boards TB2 and TB3. (See fig. 69.)

(5) *Varistor unit.* No disassembly is necessary as the selenium disk rectifier is not to be treated.

c. CLEANING. Clean all dirt, dust, rust, and fungus from the equipment to be processed. Clean all oil and grease from the surfaces to be varnished.

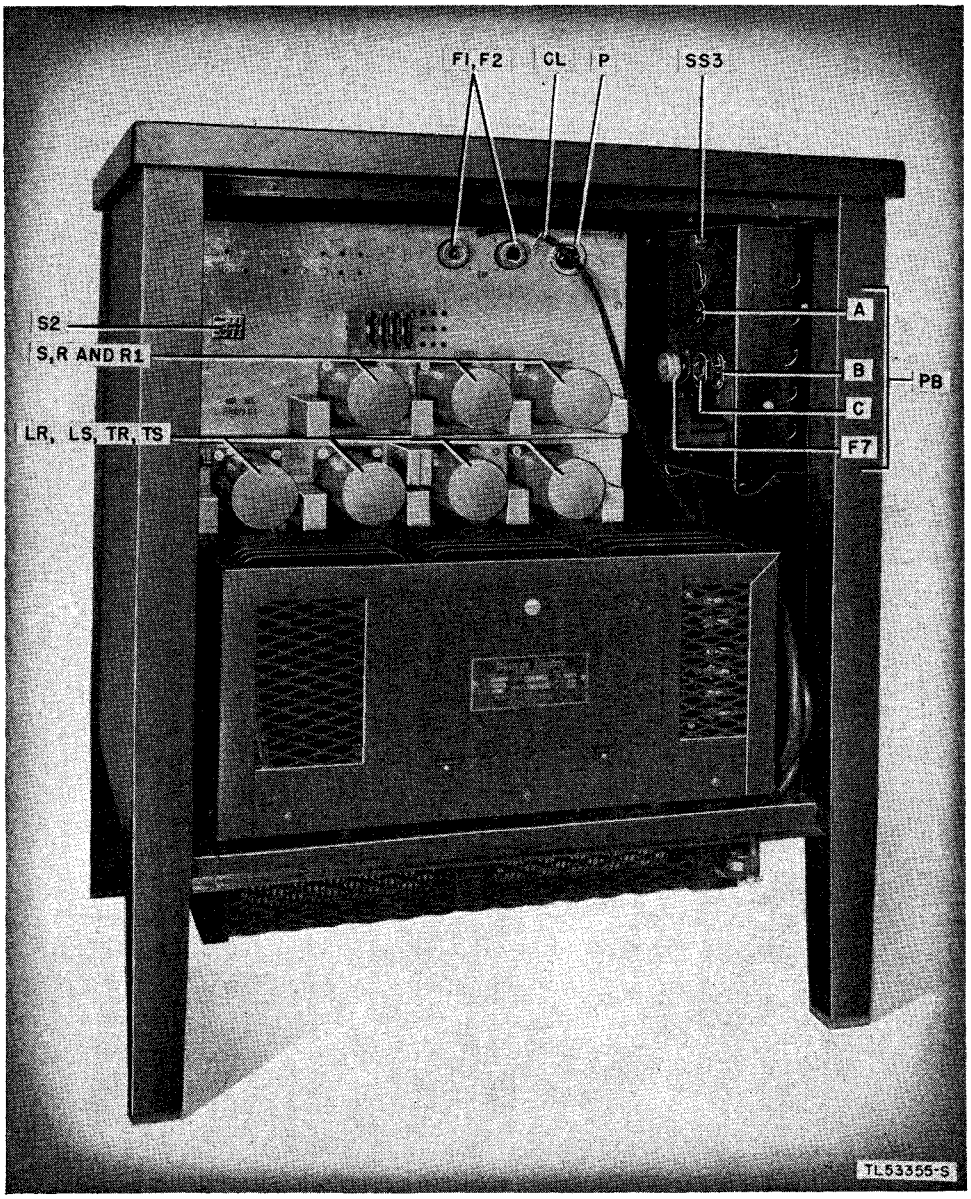

Figure 67. Back of cabinet, masked for moistureproofing and fungiproofing treatment.

d. MASKING. (1) *Back of cabinet. (a)* Mask the socket S2. (See fig. 67.)

(b) Mask the glass front of the fustats F1 and F2. (See fig. 67.)

(c) Mask the a-c receptacle P. (See fig. 67.)

(d) Mask the sockets where the seven polar relays S, R, R1, LR, LS, TR, and TS (fig. 67) have been removed.

(e) Mask the glass front of the fustats F3 and F4. (See fig. 70.)

(f) Mask the two receptacles D and E. (See fig. 70.)

(g) Mask the power relay located inside the power box.

(h) Mask the three receptacles A, B, and C (fig. 67) and the glass front of fustat F7 (fig. 67) on the front cover of the power box.

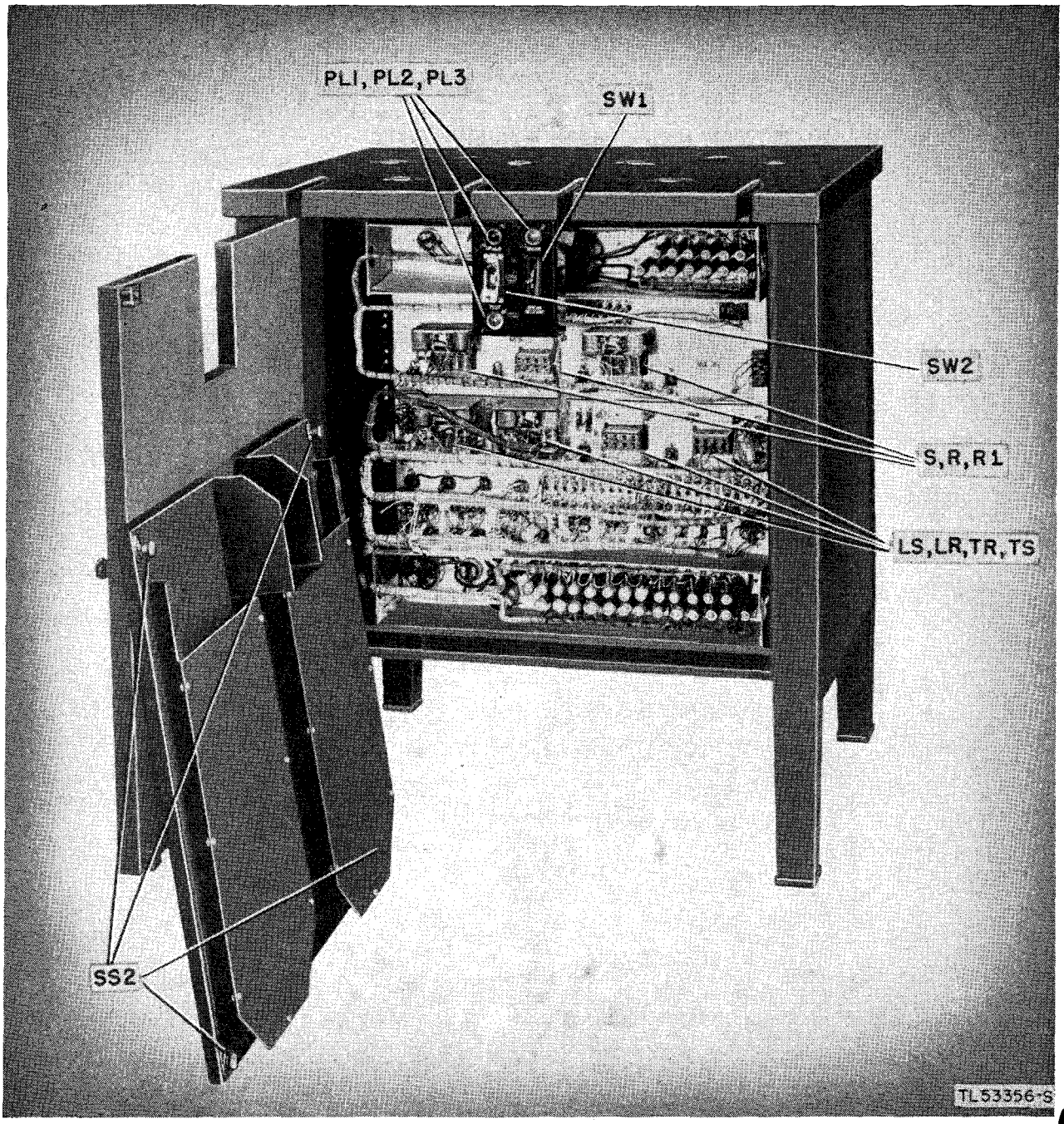

Figure 68. Front of cabinet, masked for moistureproofing and fungiproofing treatment.

(2) *Front of cabinet. (a)* Mask the wire where the solderless wire connectors were removed.

(b) Mask the opening around connectors of sockets for polar relays S, R, R1, LR, LS, TR, and TS. (See fig. 67.)

(c) Mask the three reflectors and sockets of the indicator lamps PL1, PL2, and PL3 (fig. 68) on the control panel.

(d) Completely mask switches SW1 and SW2 (fig. 68) on the control panel.

(3) *Main power unit. (a)* Mask the interlock switch SW3. (See fig. 71.)

(b) Mask the clips where fuses F5 and F6 (fig. 69) have been removed.

(c) Completely mask all rubber covered cable using paper masking tape.

(d) Mask cable connectors CN1, CN2, and CN3. (See fig. 70.)

e. DRYING. (1) If an oven will not accommodate the cabinet, it may be processed by placing heat lamps or elements directly inside the cabinet.

(2) The main power unit and cover may be processed by returning them to their original position inside the cabinet or by placing them inside an oven.

(3) Dry the equipment for 4 to 6 hours at a temperature of 140° F.

Caution: Do not exceed 140° F. If the impregnating compound in any part should begin to melt, decrease the temperature and increase the drying time by 1 hour for each 10° F. decrease in temperature.

f. VARNISHING. (1) Apply three coats of moistureproofing and fungiproofing varnish (Lacquer, Fungus-resistant spec No. 71–2202 (stock No. 6G1005.3), or equal). Allow each coat to air-dry for 15 or 20 minutes before applying the next coat.

(2) Apply varnish immediately after the equipment is dried. If varnish is not applied immediately, moisture condenses on the equipment. Varnish applied over the moisture peels off readily after the varnish has dried.

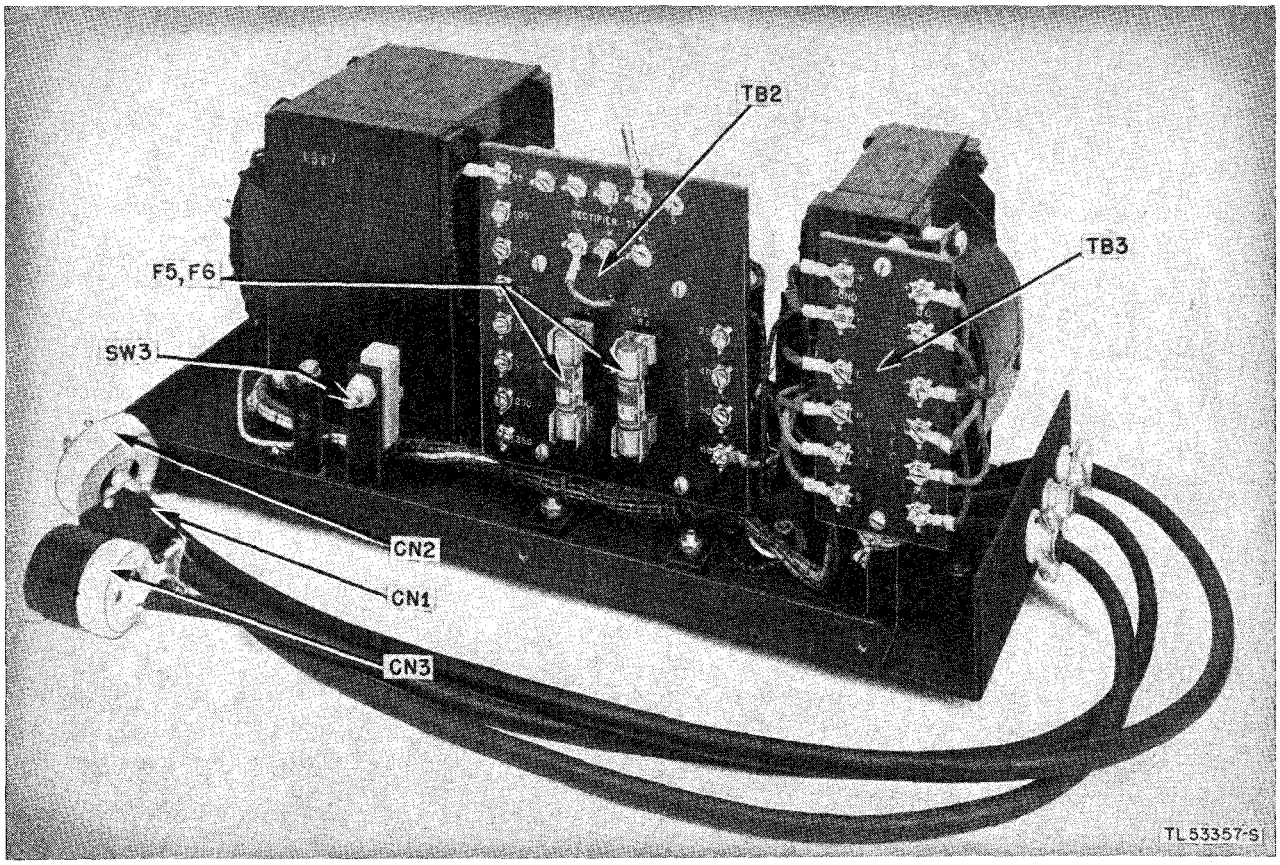

Figure 69. Rectifier, cover removed, front view, ready for moistureproofing and fungiproofing treatment.

(3) Spray the varnish on this equipment.

(4) Apply varnish to all units and surfaces except the outside of the cabinet and the selenium disk rectifier.

g. REASSEMBLY. (1) Remove all masking tape, being careful not to peel varnish from nearby areas.

(2) Replace all cables as neatly as possible.

(3) Reassemble the set and test its operation.

h. MARKING. Mark the letters MFP and the date of treatment near the top of the unit on the mixing relay chassis.

Example: MFP—15 Mar 45.

59. Moistureproofing and Fungiproofing After Repairs

If, during repair, the coating of protective varnish has been punctured or broken, and if complete treatment is not needed to reseal the equipment, apply a brush coat to the affected part. Be sure the break is completely sealed.

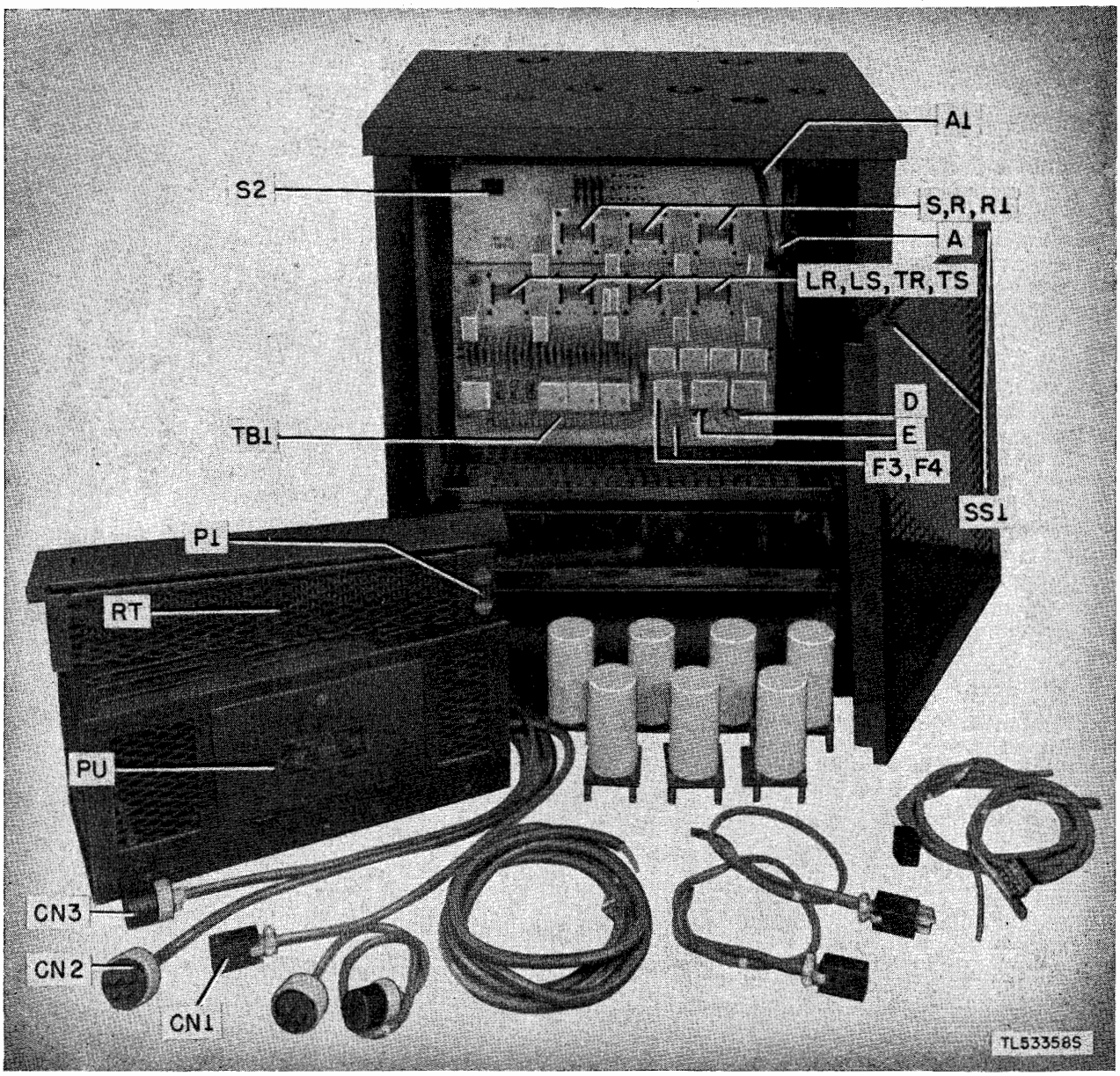

Figure 70. Units removed from cabinet for moistureproofing and fungiproofing treatment.

PART FOUR

AUXILIARY EQUIPMENT

Section XII. DESCRIPTION OF UNIVERSAL CONNECTOR

60. Purpose

The universal connector is auxiliary equipment to the Teletypewriter Set 131B2. It is provided to permit two "crypto units," two "SpTD units" or one "crypto" and one "SpTD unit" to be connected to a 131B2 set.

61. General

External connections to a "crypto" or "SpTD unit" are made through three plug-ended cords, which are connected to the unit. These three cords are patched to three receptacles in the 131B2 set when only one cryptographic unit is used. When two cryptographic units are connected simultaneously to the 131B2 set, three plug-ended cords associated with the universal connector are connected to the three receptacles of the 131B2 set and the three plug-ended cords of each cryptographic unit are connected to one of two sets of receptacles in the universal connector. Since only one unit may be used at a time the universal connector is equipped with a two-position switch, which permits operation with either cryptographic unit, as desired.

62. Physical Description of Universal Connector

a. The universal connector (figs. 71 and 72) consists of a receptacle box, a switch box connected to the receptacle box by a cable, three cords terminating in plugs, nine wood screws, and two cable clamps.

b. The receptacle box is mounted beneath the top and to the rear of the 131B2 table. (See fig. 73.) The outside dimensions of the receptacle box are approximately 6¼ by 4½ by 1½ inches. The upper 6¼ by 4½ inch side is open and the receptacle box

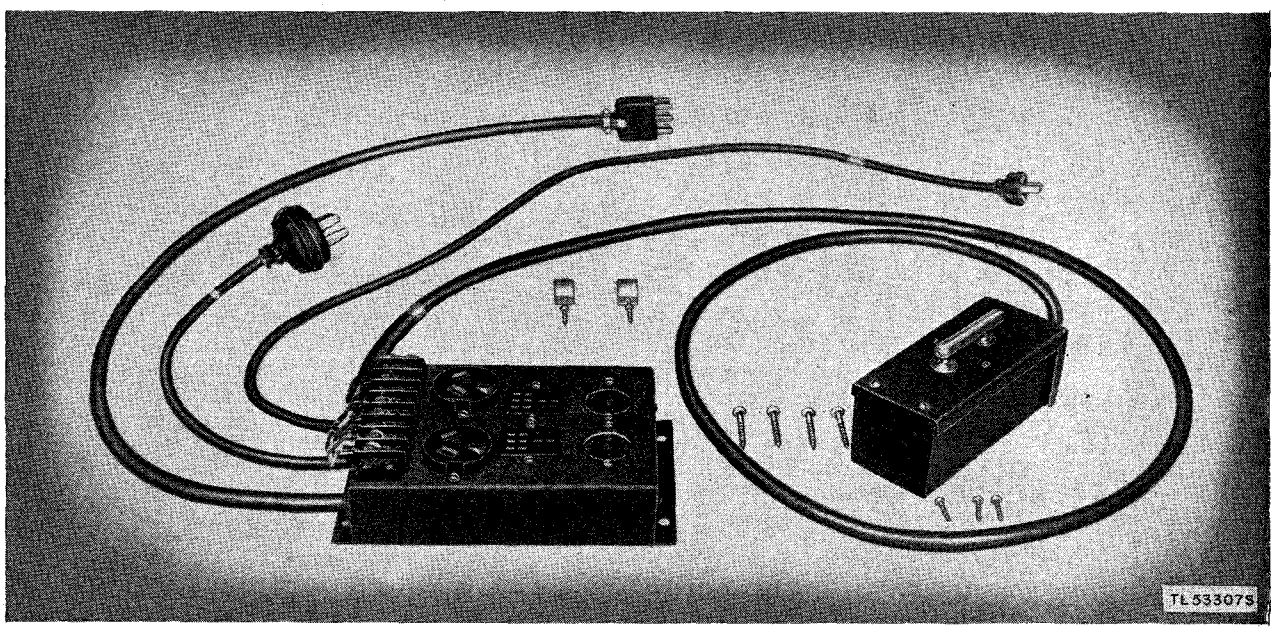

Figure 71. Universal connector—outside of receptacle box.

mounts with this open side against the metal shield which is beneath the table top. Two opposite sides of the receptacle box are flanged and each flange is drilled to accommodate two 10 by 1¼ roundhead wood screws, which fasten the box to the table top. These four mounting screws which are provided with the connector project through drillings in the shield beneath the table top. In some of the latest 131B2 sets, holes in the shield and starting holes in the under side of the table top are provided to be used in mounting the universal connector. The lower 6¼ by 4½ inch side of the receptacle is provided with two 12-terminal sockets, two 2-terminal d-c power sockets and two 3-terminal a-c power sockets. The sockets are divided into two groups designated *A* and *B*. Each group consists of a 12-terminal socket, a 2-terminal d-c power socket and a 3-terminal a-c power socket.

c. The receptacle box is connected to three cords which are equipped with plugs. It also contains a terminal strip to which is connected a cable, the other end of which terminates at the switchbox. The switchbox which houses a two-position switch is a rectangular metal box having external dimensions of approximately 2¼ by 5¼ by 2⅛ inches. The switchbox is mounted in an upright position under the front edge of the table (fig. 74) to which it is fastened by means of three 6 by ⅝ roundhead wood screws furnished with the connector (fig. 71). In some of the latest 131B2 sets manufactured, three starting holes are drilled under the front edge of the table top to facilitate starting the screws which mount the switchbox. In the latest 131B2 sets manufactured, saw slots are provided in the top of the front door in order to enable the present cut-out for the control panel to be easily enlarged to accommodate the switch in addition to the control panel. The switchbox cord is of sufficient length to extend from the receptacle box through the cord hole in the bottom of the table, then forward and upward along the inside surface of the left side of the table, where it is supported by means of a lower and upper cable clamp which are furnished with the connector. From the upper clamp the cord passes horizontally to the switchbox. Each of the cord clamps is held by means of a 6 by ⅝ roundhead wood screw furnished with the connector.

d. The three cords equipped with plugs are used to connect the universal connector to the 12-terminal socket located on the mixing relay unit panel, the 2-terminal d-c power socket on the mixing relay unit panel and the 3-terminal a-c power socket on the powerbox.

e. The wiring of the universal connector is so arranged that, when connected to a 131B2 set and two cryptographic units, operation of the switch to a position *A* starts the motor of the cryptographic unit plugged into the *A* receptacle of the connector,

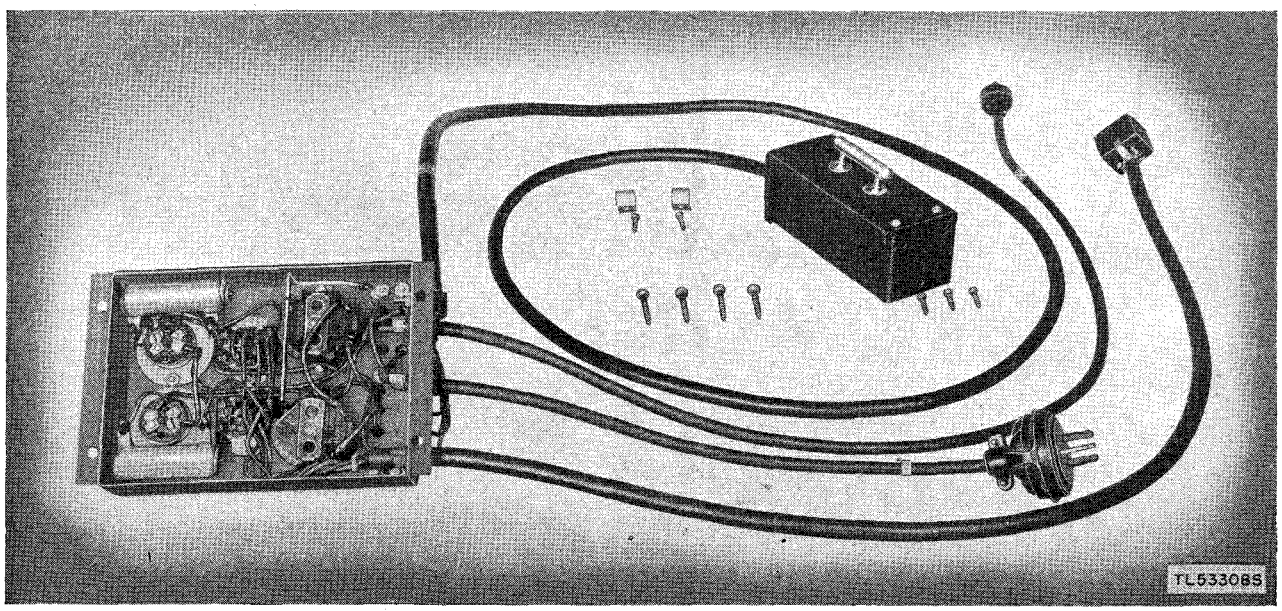

Figure 72. Universal connector—interior of receptacle box.

and permits the use of this unit. When the switch is thrown to position *B* the motor of the cryptographic unit, plugged into the *B* receptacle of the connector, starts and it may be used. Figure 75 is a functional diagram of the universal connector as used with the 131B2 set.

Section XIII. INSTALLATION AND OPERATION OF UNIVERSAL CONNECTOR

63. Installation

a. Disconnect the cord associated with the switchbox from the receptacle box of the universal connector by loosening the seven terminal screws on the terminal block associated with the receptacle and removing the spade terminals of the cord. Also, loosen the cord clamp which fastens the cord to the receptacle. Remove the rear grill, the front shield, the main part of the power unit, and the demountable relays from the 131B2 table.

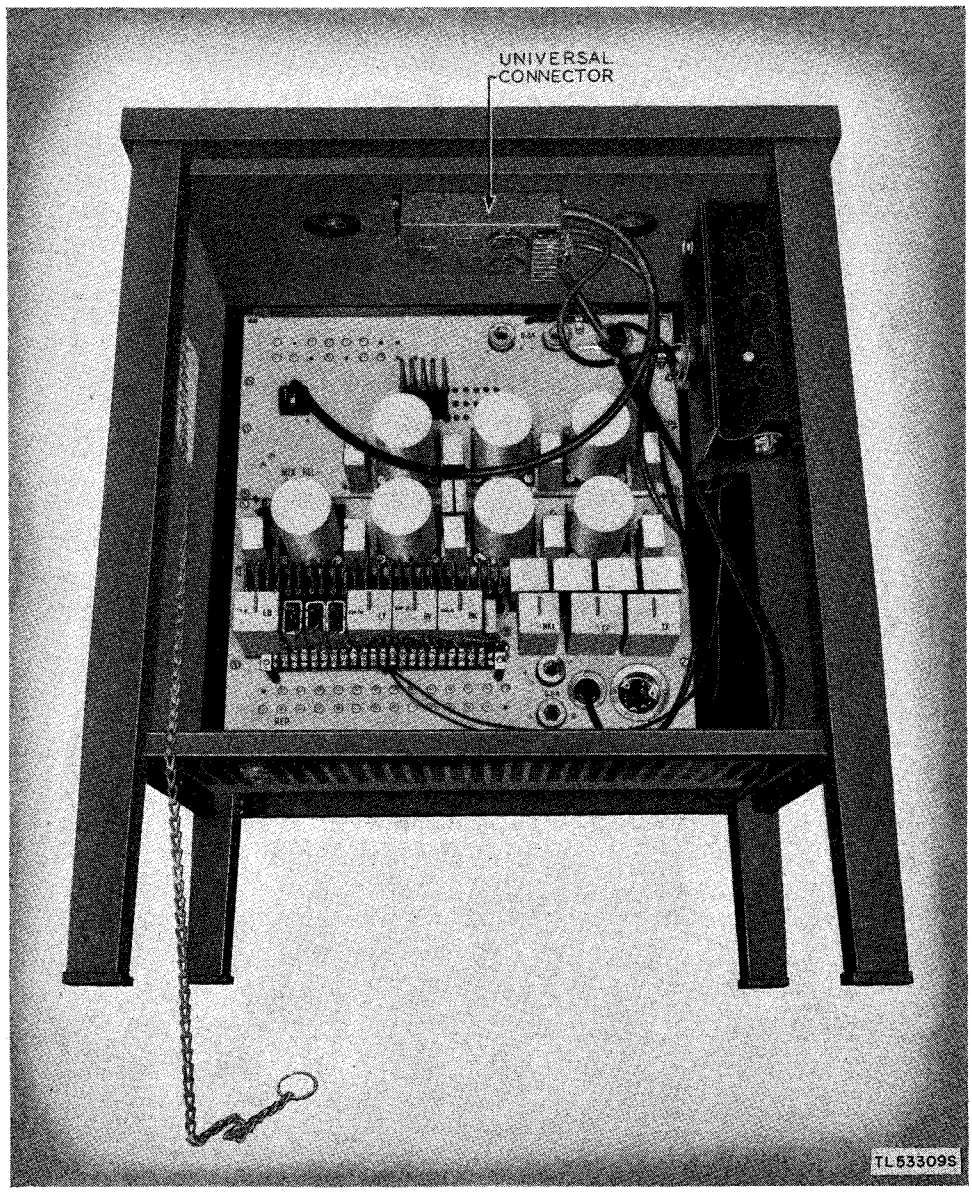

Figure 73. Teletypewriter Set 131B2—universal connector receptacle box mounted in table.

b. Fasten the receptacle box to the under side of the table top using the four 10 by 1¼ roundhead wood screws provided. The receptacle box should be mounted with the terminal block toward the power box in the 131B2 set.

c. Pass the end of the switch cord that was disconnected from the receptacle box in *a* above, downward through the square cord hole in the bottom of the table and reclamp it under the cord clamp on the receptacle box. Reconnect the seven cord terminals to the terminal block on the receptacle box.

d. Remove the front cover from the switchbox by removing the four screws. Mount the box beneath the front edge of the table by means of the three 6 by ⅝ roundhead wood screws provided. Replace the front cover on the switchbox and fasten it securely by means of its four screws.

e. Turn the table upright. Fasten the loose cord to the wood surface inside of the table door on the left-hand side using one cord clamp at the bottom and one at the top. The cord should be fastened as closely as possible to the mixing relay and repeater unit panels to avoid interference with the front shield.

64. Operation

a. Connect the three cords of each cryptographic unit to the universal connector, plugging the cords

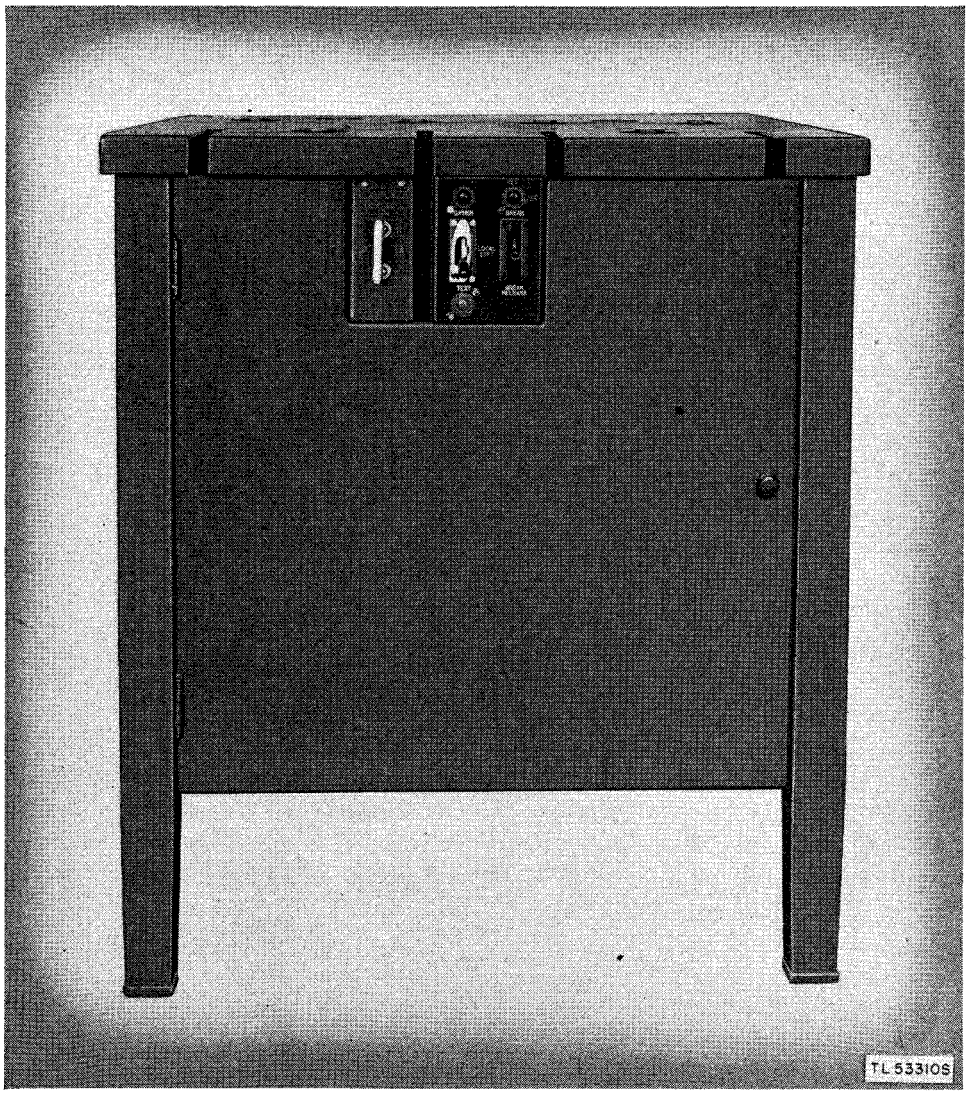

Figure 74. Teletypewriter Set 131B2, front view, universal connector switch box mounted in place.

of one unit to the *A* socket and those of the other unit to the *B* sockets of the receptacle box. The cords of each cryptographic unit should pass down into the table through the nearest round cord hole in the table top.

b. Connect the three plug-ended cords of the universal connector to the three sockets inside the table. The 12-terminal plug should be connected to the 12-terminal socket located on the mixing relay unit; the 2-terminal d-c power plug should be connected to the 2-terminal socket on the mixing relay unit and the 3-terminal a-c power plug should be connected to the 3-terminal socket on the power box of the 131B2 set.

c. Operate the switch to position *A* or *B* if it is desired to use the cryptographic unit which has been connected to the *A* or *B* sockets of the universal connector.

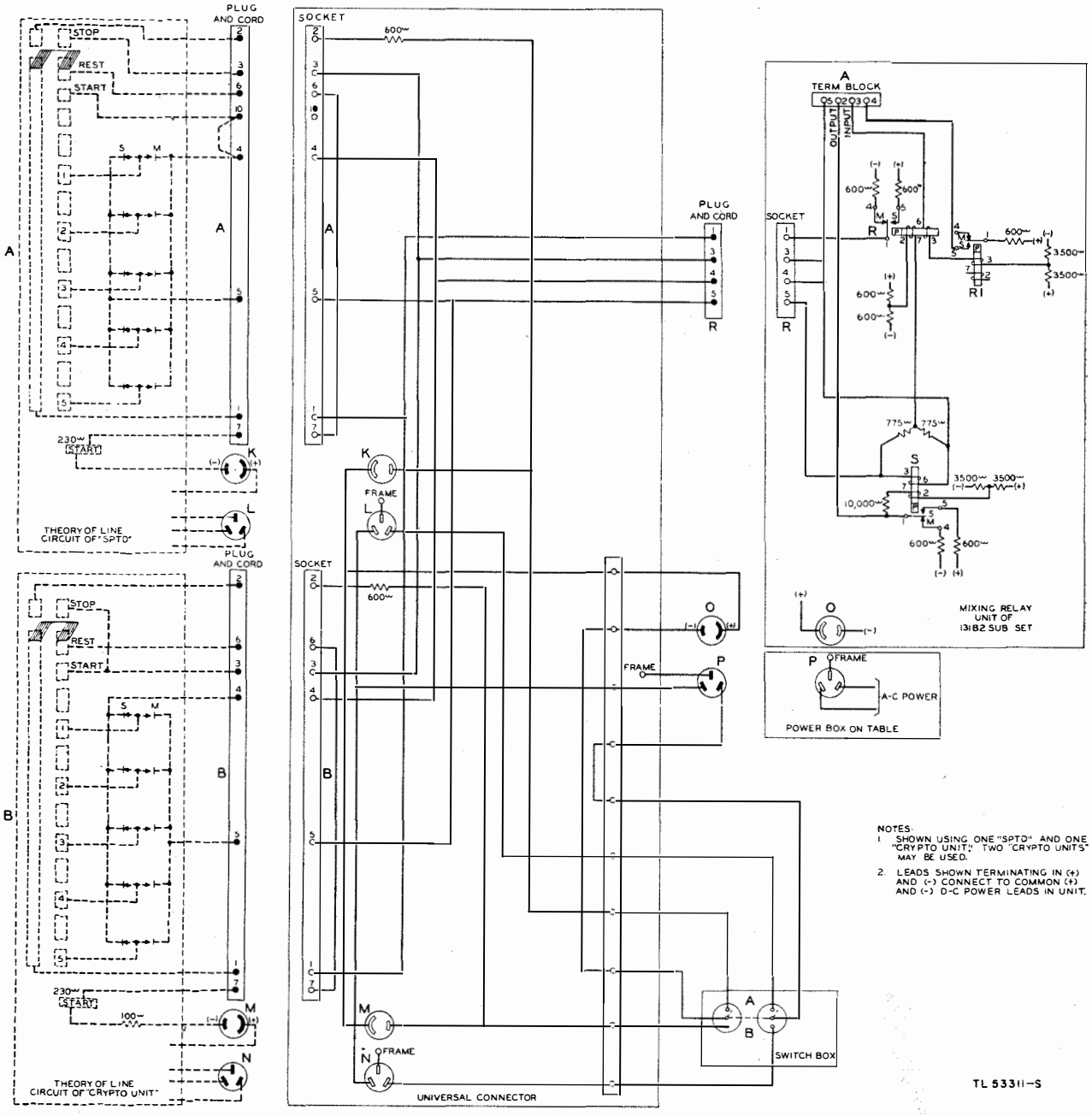

Figure 75. Functional diagram of universal connector used with 131B2 set.

65. Preventive Maintenance Check List

The following check list is a summary of the preventive maintenance to be performed on the universal connector. The echelon column indicates which operations are first echelon maintenance and which operations are second echelon maintenance.

Item No.	Operations	Item	When performed					Echelon
			Daily	Weekly	Monthly	Semi-annually	Yearly	
1	ITC	Resistors. (See par. 45.)				X		2d.
2	IC	Keys and switches. (See par. 47.)				X		2d.
3	ITC	Terminal blocks. (See par. 49.)				X		2d.
4	ITC	Cords and cables. (See par. 50.)				X		2d.

F Feel — I Inspect — T Tighten — C Clean — A Adjust — L* Lubricate

Section XIV. REPAIR INSTRUCTIONS FOR UNIVERSAL CONNECTOR

66. Trouble Location

Trouble in the universal connector may be caused by a failure of the switches in the switchbox, failure of the resistors, failure in the wiring and cords, and failure of the plugs and sockets to make good connection with associated plugs and sockets.

67. Repair Techniques

a. Trouble found in the switch contacts caused by burning or loss of continuity through the contacts cannot be remedied and the switches must be replaced.

b. The continuity of the resistors, wiring, and cords can be tested with an ohmmeter and the resistors replaced and the wiring and cords repaired or replaced as required.

c. Failure of the plugs and sockets to make good contact may be caused by bent prongs or broken or chipped connector bodies. Prongs may be bent back to their proper positions. Replace broken or badly chipped plugs and sockets.

d. If the universal connector has not caused trouble but is being repaired for reuse, careful inspection of the cords and wiring will indicate if repair or replacement is required. Cracks in insulation of cords or wiring, cracks or chips in connector bodies or resistors are indications of probable future trouble. Repair or replace them.

* Lubrication operations are inapplicable to Teletypewriter Set 131B2.

PART FIVE

REPAIR INSTRUCTIONS

* *Note.* Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Service Forces will be reported on WD AGO Form 468 (Unsatisfactory Equipment Report), by Army Air Forces, on WD AAF Form 54 (Unsatisfactory Report).

Section XV. GENERAL REPAIR PROCEDURE

68. Repair Techniques

a. GENERAL. A complete knowledge of the detailed functions of the various parts and circuits in the equipment and trouble locating procedures is necessary to perform satisfactory repairs. Keep service failures to a minimum by careful handling of the equipment during installation and operation and by being careful when making field repairs and adjustments. Do not disturb the wiring more than is necessary in testing or inspecting. If a soldering iron is used do not drop splashes of solder on apparatus parts or wiring terminals.

b. TROUBLE LOCATION. Trouble in a 131B2 station may be caused by the teletypewriter apparatus used at the station, the 131B2 set circuits, the cryptographic units, or the power unit. The station line-up procedures covered in paragraphs 29 through 33 are very useful in locating the part of the station that is in trouble. Use the line-up procedure applicable to the type of installation being worked on. If the station is not installed in any particular system but is being repaired or tested for reuse, use the line-up procedure for single (half-duplex) stations covered in paragraph 30. Trouble in a 131B2 station will usually be indicated by its failure to type any copy, to type correct copy, to pass its line-up tests, or to transmit good signals. Other troubles such as failure of lamps to light and failure of the "break" arrangements to function may also be encountered. Detailed procedures for locating troubles are described in section XVII.

c. WIRING DIAGRAMS. The detailed wiring information for the 131B2 set is covered in three wiring diagrams which are included as part of this manual. One of these diagrams (fig. 111) shows the wiring of the power circuit, another (fig. 109) shows the wiring of the repeater unit circuit and the third (fig. 110) shows the wiring of the mixing relay unit circuit. In these diagrams each piece of apparatus has the same marking as that stamped on the equipment, and the wiring terminals on each piece of apparatus are shown in its proper relative location as viewed from the wiring side. A wiring diagram (fig. 112) of the power unit is also included.

69. Unsatisfactory Equipment Report

a. When trouble in equipment used by the Army Ground Forces or Army Service Forces occurs more often than repair personnel feel is normal WD AGO Form 468 (Unsatisfactory Equipment Report) should be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D. C.

b. When trouble in equipment used by Army Air Forces occurs more often than repair personnel feel is normal, WD AAF Form 54 should be filled out and forwarded to the Commanding General, Air Technical Service Command, Wright Field, Dayton, Ohio, in accordance with AAF Regulation 15–54. If form is not available, prepare the data according to the sample form reproduced in figure 762.

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* This note does not apply to the cryptographic equipment.

WAR DEPARTMENT

UNSATISFACTORY EQUIPMENT REPORT

FOR	TECHNICAL SERVICE: Signal Corps — MATÉRIEL		DATE: 15 Apr 45
FROM	ORGANIZATION: 6th Signal Repair Co.		STATION: San Fransisco, Calif
TO	NEXT SUPERIOR HEADQUARTERS: Signal Officer, Sixth Army	STATION: A.P.O. 465 San Fransisco, Calif	TECHNICAL SERVICE: Signal Corps

COMPLETE MAJOR ITEM

NOMENCLATURE	TYPE	MODEL	
Teletypewriter Set 100BO			
MANUFACTURER	U. S. A. REG. No.	SERIAL No.	DATE RECEIVED
Blank Co.		502	1 Jan 45
EQUIPMENT WITH WHICH USED (*if applicable*)			

DEFECTIVE COMPONENT—DESCRIPTION AND CAUSE OF TROUBLE

PART No. Stock No.	TYPE	MANUFACTURER	DATE INSTALLED
3F87654.1	Switch Key	Blank Inc.	1 Feb 45

DESCRIPTION OF FAILURE AND PROBABLE CAUSE (*If additional space is required, use back of form*)

Intermittent failure due to break down of insulation between springs.

DATE OF INITIAL TROUBLE	TOTAL TIME INSTALLED			TOTAL PERIOD OF OPERATION BEFORE FAILURE					
	YEARS	MONTHS	DAYS	YEARS	MONTHS	DAYS	HOURS	MILES	ROUNDS
6 Mar 45		1	3			31			

BRIEF DESCRIPTION OF UNUSUAL SERVICE CONDITIONS AND ANY REMEDIAL ACTION TAKEN

Operating in tropics an average of 18 hours daily during this period. Cleaned and replaced bushing.

TRAINING OR SKILL OF USING PERSONNEL			RECOMMENDATIONS (*If additional space is required, use back of form*)
POOR	FAIR	GOOD	
		X	Improve design and material of insulator strip and bushing.

ORIGINATING OFFICER

TYPED NAME, GRADE, AND ORGANIZATION	SIGNATURE
R. W. BURNS, 2nd. Lt., 6th Signal Repair Co.	R. W. Burns.

FIRST ENDORSEMENT

TO CHIEF	TECHNICAL SERVICE	OFFICE	
NAME, GRADE, AND STATION		STATION	DATE

Instructions

1. It is imperative that the chief of technical service concerned be advised at the earliest practical moment of any constructional, design, or operational defect in matériel. This form is designed to facilitate such reports and to provide a uniform method of submitting the required data.
2. This form will be used for reporting manufacturing, design, or operational defects in matériel, petroleum fuels, lubricants, and preserving materials with a view to improving and correcting such defects, and for use in recommending modifications of matériel.
3. This form will not be used for reporting failures, isolated material defects or malfunctions of matériel resulting from fair-wear-and-tear or accidental damage nor for the replacement, repair or the issue of parts and equipment. It does not replace currently authorized operational or performance records.
4. Reports of malfunctions and accidents involving ammunition will continue to be submitted as directed in the manner described in AR 750-10 (change No. 3).
5. It will not be practicable or desirable in all cases to fill all blank spaces of the report. However, the report should be as complete as possible in order to expedite necessary corrective action. Additional pertinent information not provided for in the blank spaces should be submitted as inclosures to the form. Photographs, sketches, or other illustrative material are highly desirable.
6. When cases arise where it is necessary to communicate with a chief of service in order to assure safety to personnel, more expeditious means of communication are authorized. This form should be used to confirm reports made by more expeditious means.
7. This form will be made out in triplicate by using or service organization. Two copies will be forwarded direct to the technical service; one copy will be forwarded through command channels.
8. Necessity for using this form will be determined by the using or service troops.

W. D., A. G. O. Form No. 468
30 August 1944

This form supersedes W. D., A. G. O. Form No. 468, 1 December 1943, which may be used until existing stocks are exhausted.

TL 53312 S

U. S. GOVERNMENT PRINTING OFFICE 16—41560-1

① *WD AGO Form 486 (Unsatisfactory Equipment Report), sample form.*
Figure 76.

WAR DEPARTMENT
AAF Form No. 54
(Revised 2-18-43)

WAR DEPARTMENT
ARMY AIR FORCES

UNSATISFACTORY REPORT
(See AAF Reg. 15-54 for Information on Proper Use of this Form)

TO BE FILLED IN BY STATION	
STATION SERIAL No.	DATE SUBMITTED
45-1	27 Mar 45

LEAVE BLANK		
A. S. C. SERIAL No.	REFER TO	CLASS

STATION: APO 528, c/o PM, New York		ORGANIZATION: 58th AACS Grp. 116th AACS Sq.	
SUBJECT OF REPORT	Property Class—Name: Signal Corps Reperforator Transmitter OO-42-C	Manufacturer: Blank Corp.	AAF Order or Shipping No.
AIRCRAFT—Model & AAF Serial No.	ENGINE—Model & AAF Serial No.	UNIT OR ACCESSORY—Type, Model and Serial No.	

AIRCRAFT REPORTS ONLY	LAST D. I. R.—Depot	Date	Flying Time Since	Total Flying Time
ENGINE REPORTS ONLY	LAST OVERHAUL—Depot	Hours Since	Depots and Hours At Each Previous Overhaul	

PART						
Name: Spring retainer of punch block assembly			Part Drawing, Serial and Specification No.: 4T102791			
Time in Use	Quantity on Hand	Quantity Known Defective	No. Previous Failures	Manufacturer	Inspector's No. or Identification	
14 days	1	1	3	Blank Corp.		

Indicate by "X" Disposition of Exhibit	Photographed and Prints Enclosed	Held for Instructions	Sent Under Separate Cover	Sent In Attached Package	Repaired and Returned to Service	Disposed of (Explain Below.)	To Overhaul Facility (INITIALS)
					x		

GIVE COMPLETE DETAILS, PROBABLE CAUSES AND RECOMMENDATIONS BELOW:
(Use Only Applicable Spaces Above—Avoid Unnecessary Repetition)

EXPEDITE

1. DESCRIPTION OF UNSATISFACTORY CONDITION: The spring retainer is part of the punch block assembly of the U. S. Army Signal Corps OO-42-C. Shortly after these teletypewriters were installed, the spring retainer in three of the machines snapped at the end section. Two were rewelded and put back in service due to lack of spares. The third was too badly broken to repair.

2. PROBABLE CAUSES: Evidently too much strain is put on the arm section of this part especially the farther arm which is considerably smaller in width and thickness.

3. RECOMMENDATIONS: The spring retainer should be made of non-cast or a heavier metal. Spares should be provided with each set.

GEORGE R. DAVIS
Capt, Air Corps
Communications Officer

ROUTING SEND ORIGINAL AND TWO COPIES DIRECT TO COMMANDING GENERAL, HQ. AIR SERVICE COMMAND, PATTERSON FIELD, FAIRFIELD, OHIO.

☆ U. S. GOVERNMENT PRINTING OFFICE : 1943 16—34619-1

TL55966S

② *WD AAF Form 54 (Unsatisfactory Report), sample form.*
Figure 76—Continued.

Section XVI. DETAILED FUNCTIONING OF EQUIPMENT

70. General

a. The functioning of the 131B2 station may be readily followed by reference to figures 96, 97, 98, 99, 100, and 101. These figures cover the theory of operation of the station in so far as the transmission and control circuits are concerned. No attempt is made in these figures or in the following descriptive material to cover the power circuits or the mechanical functioning of the teletypewriter set or cryptographic units. The figures do not include spark-killers, radio induction suppression filters, fustats, teletypewriter motors, and other apparatus that does not enter into the theory of transmission and control. The function of the spark-killer is to reduce sparking and hence increase contact life. The function of the radio filters is to reduce the radiation from the set to nearby radio receiving equipment. The function of the fustats is to protect the wiring and apparatus against excessive currents. The function of the teletypewriter motors is to provide mechanical power to the moving machinery. The heating lamp, which is used in tropical locations, provides heat and light inside the table to prevent condensation of moisture and the entry of insects. This lamp may be left on at all times as it plugs into the convenience outlet, which is not under the control of the power switch of the station. The repeater unit, mixing relay unit, and power circuits are shown in greater detail in the schematic diagrams of figures 105, 107, and 108.

b. Three functional diagrams showing the power circuits of 131B2 stations using three different types of teletypewriter apparatus are covered in figures 102, 103, and 104.

c. In the material that follows, the most comprehensive type of 131B2 station (the single (half-duplex) station using neutral transmission) is covered in detail and the other types of stations are covered briefly with reference to the detailed description. Flow diagrams, which show the transmission paths through the relays and show which control relays are operated and which are released for different station conditions, are included with the description. These diagrams will help in understanding the circuit operation when too much detail is not required. The functional diagrams provide considerably greater detail including all the control circuits. Full details can be obtained by using the schematic diagrams. The headings designating the different types of operation are general and the description under each may cover a number of different types of stations.

71. Repeater Circuit Operation, Single (Half-duplex), Neutral Transmission

The repeater unit is provided to control and direct transmission of the station. By means of a reversing relay it directs incoming enciphered signals from the line to the mixing relay unit and directs the output of this unit (deciphered signals) to the teletypewriter. When the station is sending it directs the text signals from the teletypewriter to the mixing relay unit and directs the output of this unit (the enciphered signals) to the line. The repeater unit also provides for the reception and locking-in of a break signal and for the sending of a break signal. If a break signal of approximately 2 seconds is received while the station is sending, the transmission from the station will automatically stop and cannot be restarted until the break has been cleared by the operation of the BREAK-BREAK RELEASE key. If at the same time the station is in the "cipher" condition the reception of a break will automatically return the station to the text condition. In the text condition the mixing relay unit is removed from the circuit and signals received from the line are repeated directly to the teletypewriter, but no signals may be sent from the keyboard or the transmitter-distributor on the 19-type table because these units are locked by action of the BK1 relay. The CIPHER-LOCAL TEST-TEXT key which is a part of the repeater unit provides a means of arranging the station for cipher or text transmission or for local test. The STA TEST key provides a means for making a partial operating test of the station without the necessity of having a line connected to the station or without interfering with transmission on the line if it is connected.

72. Text Condition (figs. 77, 78, and 96)

a. Assume power is supplied to the station, current is flowing in the line, the CIPHER-LOCAL TEST-TEXT key lever is in the TEXT position, a break is not locked in the circuit and the STA TEST key is in its REG position. Relays LR and BK are held on their No. 4 contacts by the line current. Relay LT is held on its No. 2 contact by current

through its winding 1–4. Relay LS is held on its No. 4 contact by current from the midpoint of battery (a point midway between positive and negative of the d-c output of the power unit or d-c supply as determined by the midpoint of a potentiometer), through its winding 3–6, operated contacts of relay TX, contacts 1–4 of relay TR, the STA TEST key contacts, and other operated contacts of relay TX to negative battery (negative of the d-c output of the power unit or d-c supply). Relay BK1 is held operated by positive battery, through contacts 7–4 of relay BK, through operated contacts of the BK1 relay to negative battery. Relay TX is operated by negative battery through the winding of relay TX, back contacts of relay CP, contacts of CIPHER-LOCAL TEST-TEXT key to positive battery. The TEXT lamp is lighted by negative battery through the lamp and operated contacts of relay TX to positive battery. Relay TR is held on its contact No. 4 by positive battery through its winding 3–6, the sending contacts, or sending contacts and transmitter-distributor of the teletypewriter set to negative battery. Relay TS is operated to its No. 4 contact by a circuit from midpoint of battery through its winding 3–6, contacts of the STA TEST key, operated contacts of relay TX, contacts 1–4 of relay LR to negative battery. The teletypewriter selector magnet is energized to positive battery through the winding of the magnet contacts 1–4 of relay TS, contacts of the STA TEST key, operated contacts of relay TX to negative battery.

b. In these circuits there are a number of cases where polar relays are used with operating and bias windings. In these cases the bias winding of the relay tends to move the relay to its opposite contact against the influence of the operating winding. The current through the operating winding is, however, great enough to overcome the effect of the bias winding. When the operating winding is opened the relay will operate to the other contact. Relays BK, LR, and TR are used in this fashion and in the instructions that follow, their operation will be described on the basis of this paragraph.

c. Signals produced by the sending contacts or transmitter-distributor of the teletypewriter set consist of marking pulses of current and spacing pulses of no current. The marking signals operate relay TR to its No. 4 contact and the spacing signals permit its bias winding 2–7 to operate it to its No. 5 contact. Relay TR, therefore, follows the signals sent by the teletypewriter and repeats them on a polar basis to winding 3–6 of relay LS. Relay LS in turn repeats the signals to the line by opening and closing it at its No. 4 contact. In this manner the signals sent by the teletypewriter are sent to the line. Relay LR will follow the signals sent on the line as the circuit through its operate winding 3–6 will be opened and closed and its bias winding 2–7 will operate it to its spacing contact when the line is opened. Relay LR repeats the signals on a polar basis from its contacts to winding 3–6 of relay TS. Relay TS repeats the signals on an open and closed basis by means of its contacts 1–4, to the teletypewriter selector magnet which causes the teletypewriter to print a local copy of the material it is transmitting.

d. Incoming open and closed signals on the line operate relays BK and LR by opening and closing

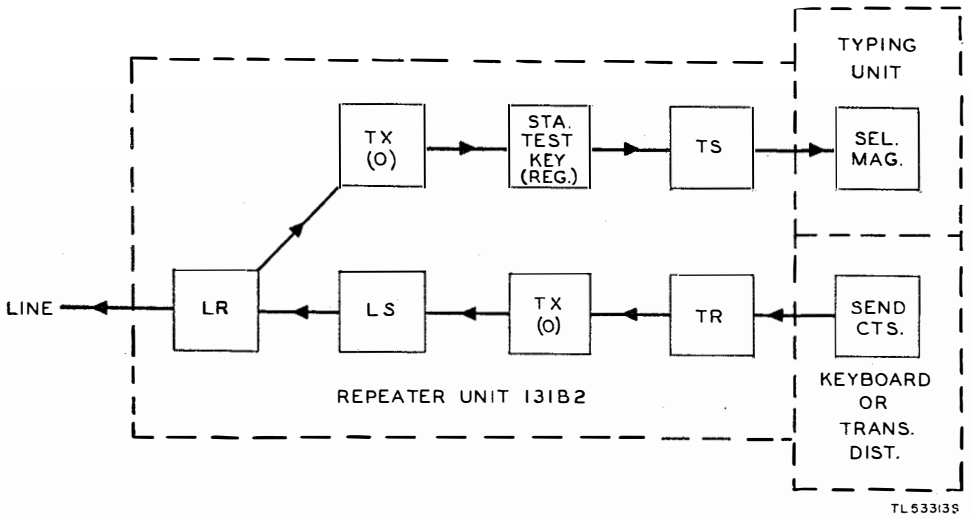


Figure 77. Flow diagram, single line operation, text condition, sending to line.

their operating windings. The bias windings of these relays operate them to their spacing contacts when their operating windings are open. Relay BK follows the incoming signals but relay BK1 is a slow-release relay and does not release when the 7–4 contacts of relay BK open during normal transmission. Relay LR repeats the signals on a polar basis to windings 3–6 of relay TS. Relay TS following relay LR repeats the signals to the teletypewriter selector magnet and the teletypewriter prints the incoming text message.

e. If a 2-second break (in this case an open line) is received, relay BK operates to its spacing contact and at its No. 4 contact opens the locking circuit of relay BK1. As this is an open of sufficient duration, relay BK1 releases. Relay BK1 will not reoperate when relay BK reoperates to its No. 4 contact and the break is locked in the unit. Release of relay BK1 lights the BREAK lamp and at the same time short-circuits the output of the sending contacts of the teletypewriter and the transmitter-distributor, which prevents signals from being transmitted. Relay BK1 upon releasing also opens a circuit to the transmitter-distributor stopmagnet, which releases and stops the transmitter-distributor. Another contact on relay BK1 short-circuits the contacts of Relay LS. When the nonlocking BREAK-BREAK RELEASE key lever is thrown momentarily to its RELEASE position, it operates relay BK1, which will lock operated through the No. 4 contact of relay BK and the operated contacts of BK1 relay. When in its RELEASE position, this key also opens the path to the transmitter-distributor stopmagnet and keeps it from starting until the key is returned to normal. The operation of relay BK1 extinguishes the BREAK lamp. A break may be sent from the station by throwing the BREAK-BREAK RELEASE lever to its BREAK position and holding it there about 2 seconds. This opens the line at the contacts of the key.

f. Relay LT, which is operated whenever power is applied to the set, short-circuits the contacts of relay LS when it releases thereby preventing the contacts of relay LS from opening the line when the power is removed from the station.

73. Cipher Condition (figs. 79, 80, 96, 100, and 101)

a. Assume now that the CIPHER-LOCAL TEST-TEXT key is thrown to CIPHER. Relay TX will release as its operating path is opened through this key. Relay CP will operate from contacts on the key. The TEXT lamp will be extinguished and the CIPHER lamp will light. The power relay on the table will operate and turn on the motor of the cryptographic unit.

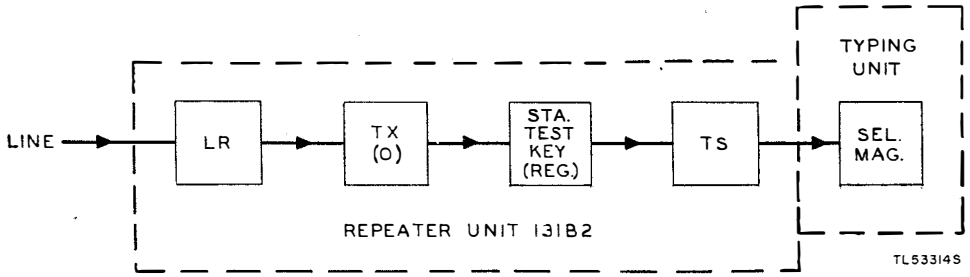


Figure 78. Flow diagram, single and two-line operation, text condition, receiving from line.

b. Signals sent from the teletypewriter will operate relay TR and at the same time operate the teletypewriter selector magnet making a local copy of the text being sent by the teletypewriter. On the first space signal, relay RV will operate to its No. 4 contact by current flowing from positive battery through its 2–7 winding, the 5–1 contacts of relay TR, operated contacts of relay CP and via lead A3 through the windings of relays R and R1 to midpoint of battery in the mixing relay unit. Relay RV will remain locked operated through its 4–9 contacts and contacts of relay CP now operated. Relay TS will also lock to its No. 4 contact by a circuit through its windings 2–7, contact No. 4 of relay RV, operated contacts of relay CP, contacts of the STA TEST key to battery. The signals received from the teletypewriter by relay TR will be repeated by this relay on a polar basis to the mixing relay unit through the contacts of relay CP over lead A3. These signals after being enciphered by the mixing

relay unit will be repeated on a polar basis over lead A2 back to relay LS of the repeater unit. Relay LS will repeat the enciphered signals to the line. The signals over lead A2 will also tend to operate relay TS through back contacts of relay TX. Relay TS will not operate, however, as it is held on its No. 4 contact by a greater current through its winding 2–7 as explained previously. When the signals are repeated by relay TR to the mixing relay unit they cause, as will be explained later in describing the mixing relay unit, a pulse of positive current for each spacing pulse to be sent back over lead A4 of the repeater unit. These pulses of positive current operate relay LB to its contact No. 3. Relay LB will stay on this contact between normal spacing pulses as it is made slow release because of the capacitors ahead of its winding 2–5. These capacitors are discharged each time a pulse positive battery comes over lead A4 and in between these pulses they are charged from current from negative battery flowing through winding 2–5 of relay LB. This current keeps relay LB operated to its No. 3 contact. Positive battery from contact No. 3 of relay LB through a back contact of relay TX to winding 2–7 of relay LR operates and holds relay LR on its contact No. 4, as it is the reverse of its normal bias current and prevents relay LR from following the signals that relay LS is sending to the line. It should be noted that, as explained above, a local copy was obtained directly from the teletypewriter and not from relays LR and TS, as is true when the station is sending text.

c. Incoming enciphered signals on the line operate relay LR whose bias winding is returned to normal shortly after sending from the station ceases because of the return of relay LB to its No. 4 contact under the influence of its bias spring when the capacitors are fully charged. Relay LR repeats the enciphered signals received on the line on a polar basis from its contacts, a back contact of relay TX, a contact of the STA TEST key, contacts 4–1 of relay TR, back contacts of relay CP, over lead A3 to the mixing relay unit. Relay RV operates to its No. 5 contact on the first space signal received because when relay LR moves to its contact No. 5 the current in winding 3–6 of relay RV overcomes the effect of locking winding 1–8. Relay RV will remain on its No. 5 contact under the influence of its bias spring. Negative battery through contacts 9–5 of relay RV will hold relays LB and LS on their No. 4 contacts. Relay BK also follows the

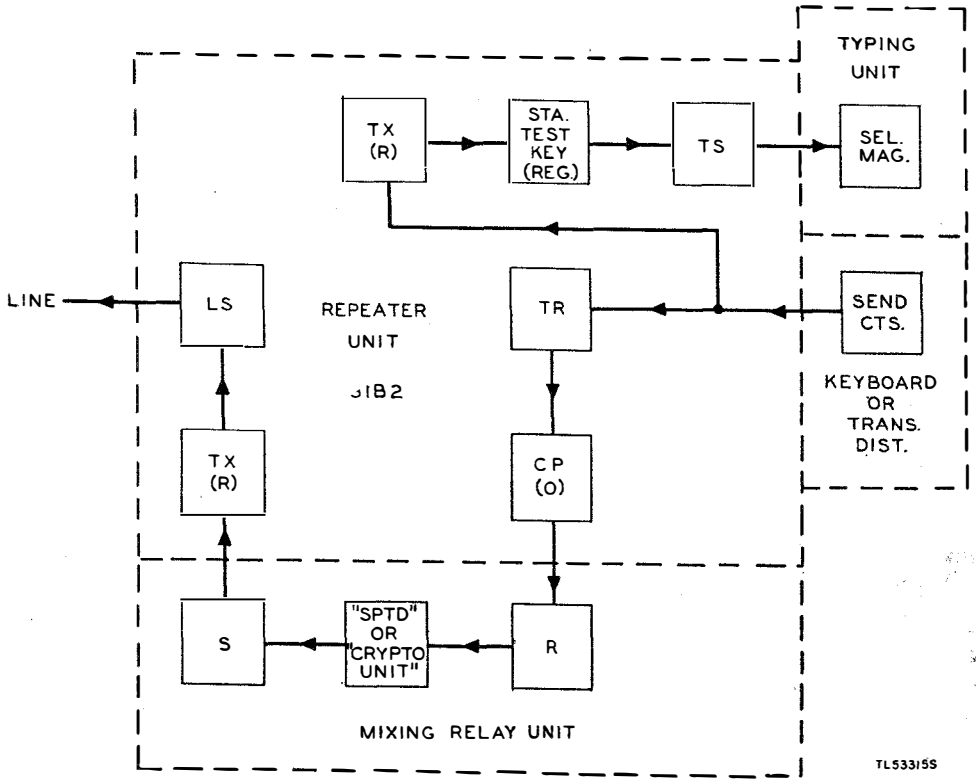


Figure 79. Flow diagram, cipher condition, sending to line.

incoming enciphered signals but relay BK1 holds operated as it is a slow-release relay. The enciphered signals repeated over lead A3 to the mixing relay unit are deciphered by it and the cryptographic unit, and the deciphered signals are repeated back on a polar basis to the repeater unit over lead A2. These signals operate relay TS which repeats them to the teletypewriter selector magnet and the teletypewriter prints the deciphered message. The signals over lead A2 also tend to operate relay LS but cannot do so as it is held on its No. 4 contact as explained above. Relay LB also tends to operate on pulses over lead A4 but cannot do so since it is held, as explained above.

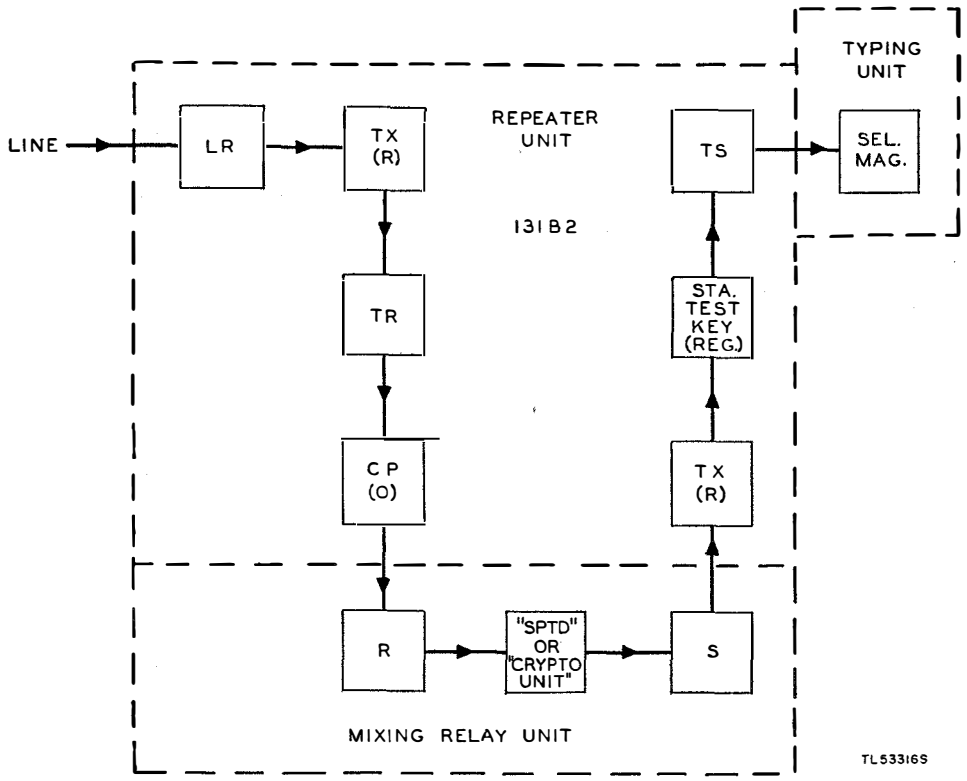


Figure 80. Flow diagram, cipher condition, receiving from line.

d. If a 2-second break is received with a set in the "cipher" condition relays BK and BK1 release as explained previously. Relay BK1 on releasing releases relay CP which in turn operates relay TX. This returns the station to the text condition. The BREAK lamp lights, the TEXT lamp lights, the CIPHER lamp goes out, the power relay in the table releases, stopping the motor on the cryptographic unit, the output of the sending contacts of the teletypewriter are shorted and the transmitter-distributor, if used, is stopped. No sending can take place, the station is in the TEXT condition and incoming signals in text will be recorded on the teletypewriter. Momentary operation of the BREAK-BREAK RELEASE key lever to its BREAK RELEASE position will return the station to the "cipher" condition by reoperating relay BK1, which operates relay CP. When the key is released to its normal position, the transmitter-distributor may send once more. This, of course, is only true if the CIPHER-LOCAL TEST-TEXT key has not been operated to its TEXT position before the break has been released.

e. A break may be sent from the station by throwing the BREAK-BREAK RELEASE lever to its BREAK position and holding it there for about 2 seconds. This will open the line and the break will be transmitted.

74. Local Test (fig. 81)

To test the teletypewriter locally or prove tape locally before transmission, operate the CIPHER-LOCAL TEST-TEXT key lever to its LOCAL

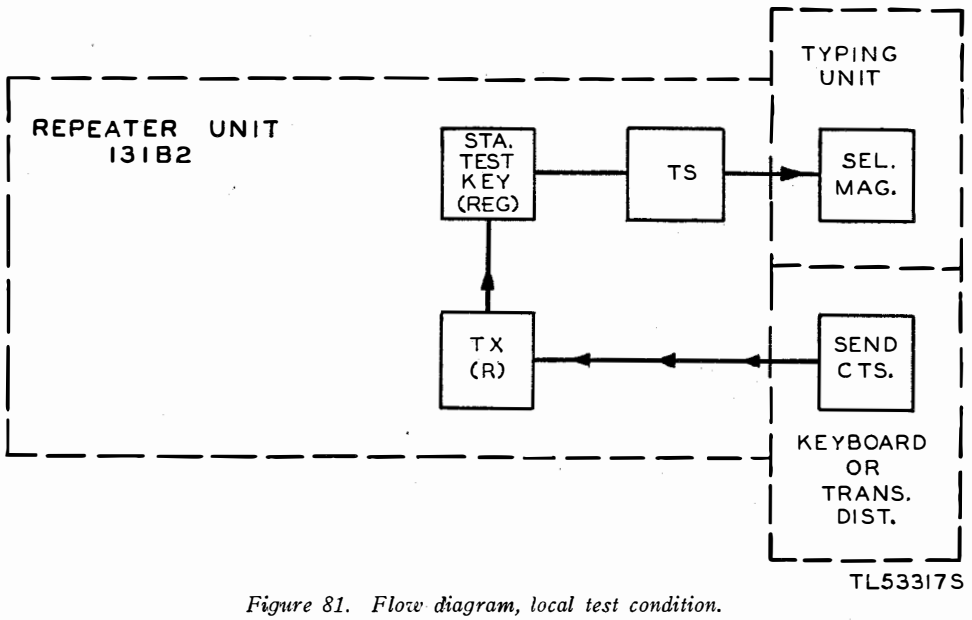


Figure 81. Flow diagram, local test condition.

TEST position. Relay BK1 is held operated so it will not release if the line is opened. Relay TX and CP are both released thereby opening the circuits through the armature of relay TR. Signals sent from the teletypewriter operate the teletypewriter magnet directly and are not repeated to the line by relay TR.

75. Station Test (figs. 82 and 83)

To test the station locally operate the STA TEST key to its TEST position. The station may be tested in either its text or "cipher" condition, depending on the position of the CIPHER-LOCAL TEST-TEXT key. In either case the operation of the STA TEST key to TEST holds relay LS operated so that signals will not be repeated to the line. The signals from the teletypewriter do not operate the teletypewriter selector magnet directly but operate only relay TR, which repeats them to relay TS either directly or through the mixing relay unit, depending on whether the station is in the text or cipher condition.

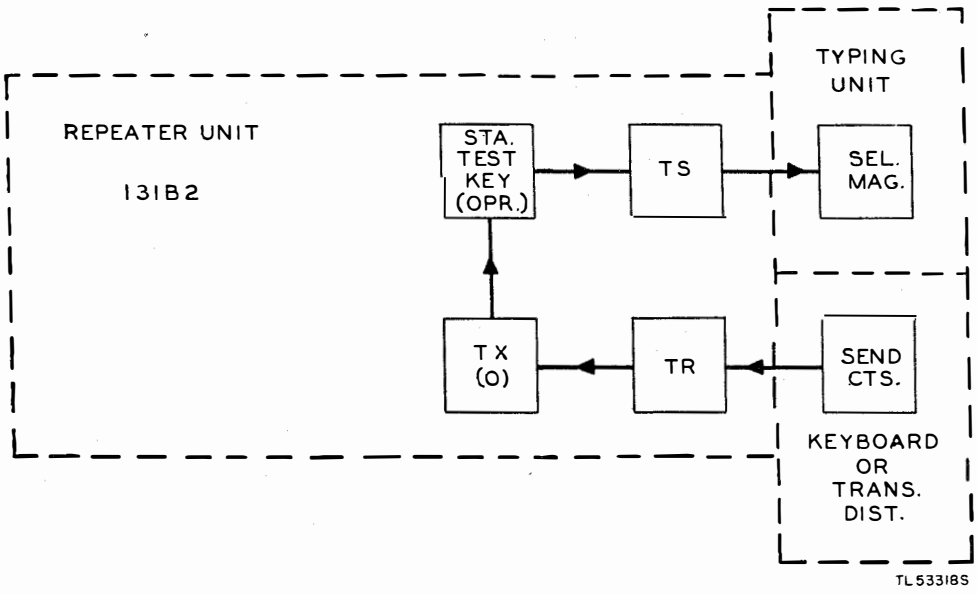


Figure 82. Flow diagram, station test and text condition.

76. Mixing Relay Circuit Operation (figs. 79, 80, 83, 100, and 101)

a. The mixing relay unit is provided to take text signals from the repeater unit and mix them with the combinations set up in the cryptographic units, and to repeat the enciphered signals back to the repeater unit for transmission to the line. It also takes enciphered incoming signals from the repeater unit, deciphers them with the cryptograph units and repeats them in text back to the repeater unit for reproduction on the teletypewriter. The mixing relay unit is shown with a "crypto unit" in figure 100 and with an "SpTD unit" in figure 101.

b. The dotted indications of the cryptographic units in figures 100 and 101, are not representative of the circuit details of these units but merely show the transmission and control circuit paths through them.

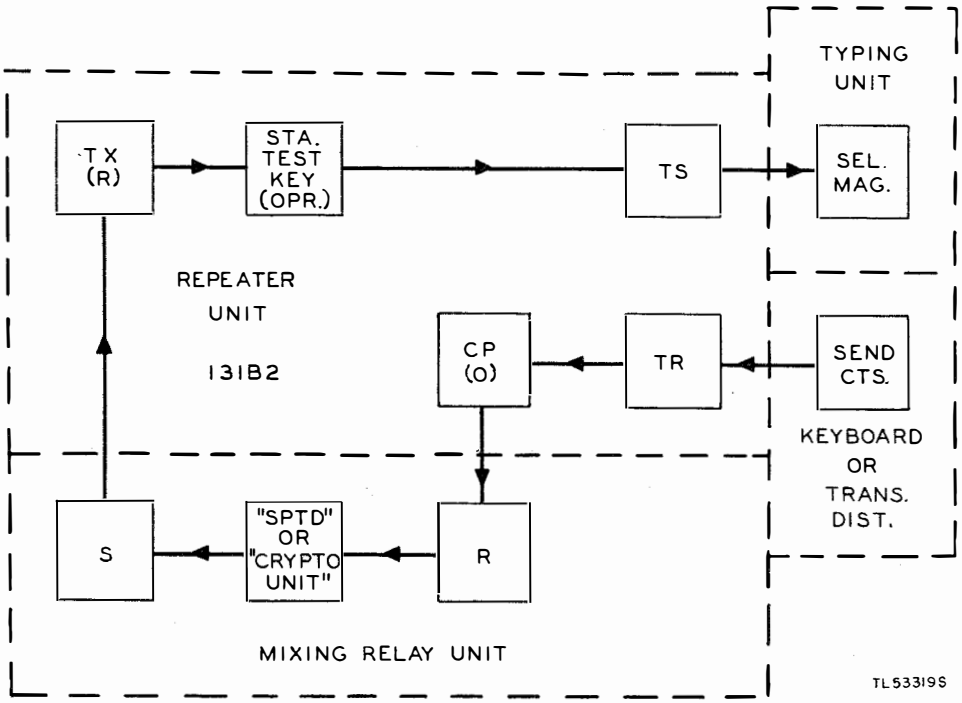


Figure 83. Flow diagram, station test and cipher condition.

c. Assume that power is applied to the 131B2 station arrangement and that the CIPHER-LOCAL TEST-TEXT key lever is thrown to the CIPHER position. As covered under repeater circuit operation the motor of the cryptographic unit will be running. Assume signals are being received over lead A3 from the repeater unit for enciphering or deciphering. Relay R will attempt to follow these signals and will do so, unless held by its locking winding 2–7. Relay R1 will follow these signals and send over lead A4 the positive battery pulses for each spacing signal to operate relay LB of the repeater unit as explained in the description of that circuit. On the first spacing signal or start pulse over lead A3, relay R will operate to its spacing or No. 5 contact since there is no current in its locking winding 2–7. This will energize the start magnet of the cryptographic unit from contact No. 5 of relay R over the common ring of the cryptographic unit distributor, the brushes of the unit, the rest segment to the magnet winding. The start magnet on energizing releases the shaft of the cryptographic unit and the brushes start to move. On reaching the start segment of the cryptographic unit the brushes place the positive battery from contact No. 5 of relay R on terminal 6 of relay S. They also lock relay R on its No. 5 contact through its locking winding 2–7. Relay S, which has been locked on its No. 4 contact by a previous stop pulse, will operate to its No. 5 contact. Relay S will lock on either of its contacts through its winding 2–7. This locking action is not great enough to prevent operation of the relay by current in its operating winding 3–6 but merely holds it in either position when there is no current in the operating winding. The operation of relay S to its No. 5 contact sends a spacing signal over lead A2 to the repeater unit.

d. As soon as the brush of the cryptographic unit leaves the start segment, relay R is unlocked but relay S remains on its spacing contact. The second pulse over lead A3 will position relay R which will connect either positive or negative battery to the brush. When the brush reaches segment 1 it will place this battery either on terminal 6 or terminal 3 of relay S, depending on the position of the contacts indicated as S and M in the cryptographic unit. Thus, depending on whether relay R is on its No. 4 or No. 5 contact and depending on the position of the contact connected to segment 1, relay S will operate to either its No. 4 or No. 5 contact and send over lead A2 the combination of the pulse as received by relay R and the mixing contact of the cryptographic unit. In this manner the No. 1 pulse of the character is enciphered or deciphered and sent back to the repeater unit.

e. The 2, 3, 4, and 5 pulses of the character are enciphered or deciphered in the same manner as described above. A rule may be stated for the operation of relay S as follows:

Contact of relay R	*"Crypto unit"*	*Contact of relay S*
M	M	S
S	S	S
M	S	M
S	M	M
Contact of relay R	***"SpTD unit"***	***Contact of relay S***
M	M	M
S	S	M
M	S	S
S	M	S

f. As the brush passes over the stop segment it places negative battery on terminal 6 of relay S and operates it to its No. 4 contact which sends a mark or stop pulse to the repeater unit. If no further signals are received by relay R no further operation takes place. Further characters are enciphered in the same manner as described above.

g. The combination set up on the S and M contacts of all "crypto units" on a circuit must be the same for each character to result in the deciphering of the messages. Likewise, the combination set up on the S and M contacts of all "SpTD units" on a circuit must be the same for each character although the combinations for the "SpTD units" are different from those of the "crypto units."

77. Single (Half-duplex) Polar Operation

a. Repeater Circuit Operation (figs. 84, 78, and 97). The repeater circuit operation of this type of service is very similar to that covered in paragraphs 71 through 75. The detailed operation will not be described here. The major differences in circuit operation between this type of service and that described in paragraphs 71 through 75 are that the station sends and receives over separate lines on a polar basis. This eliminates the bias winding on relays BK and LR and prevents relay LR from making the home copy in the text condition. The local copy is made by the teletyewriter sending contacts operating the selector magnet directly. Another difference is that relay LS sends polar signals to the sending line. The break in this case is also

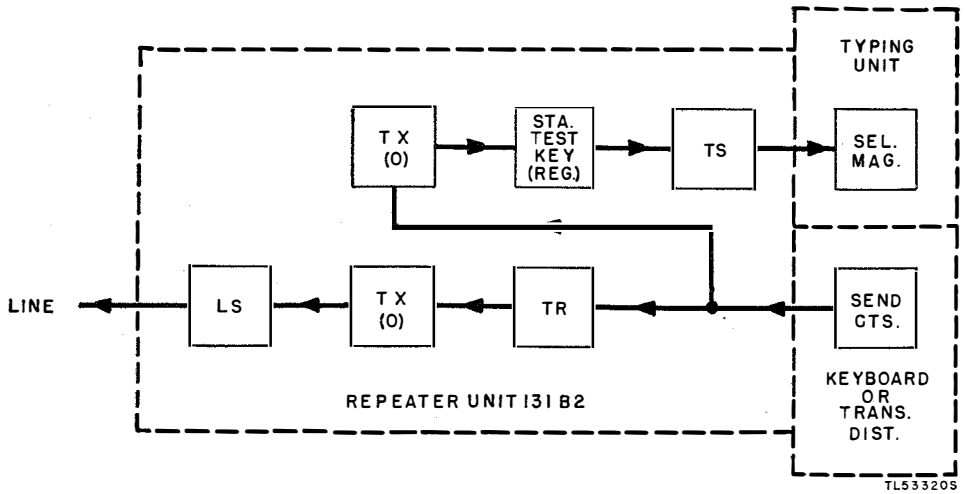


Figure 84. Flow diagram, two loop operation, text condition.

different in that spacing current is sent instead of an open.

b. MIXING RELAY CIRCUIT OPERATION. This is covered in paragraph 76.

78. Full-duplex Operation

a. GENERAL. In full-duplex operation a station sends and receives on separate 131B2 station arrangements. The sending and receiving may be on either a neutral or polar basis.

b. REPEATER CIRCUIT OPERATION—RECEIVING SIDE (figs. 78 and 98). In this case the teletypewriter and 131B2 set do not send signals and the receiving line operating either neutral or polar is connected to relays BK and LR only. Since no sending contacts are used in the teletypewriter they are replaced by a strap from terminal B5 to terminal B6. The operation of the parts of the circuit that are used is about the same as covered in paragraphs 71 through 75 for neutral transmission and 77 for polar transmission.

c. REPEATER CIRCUIT OPERATION—SENDING SIDE (figs. 84 and 99). In this case the station receives no signals and only the sending side of the circuit is required. Relay LR is removed and a strap replaces its contacts. Relay BK1 is blocked operated as relay BK is never energized. The transmission may be either on a neutral or polar basis and the operation of the parts of the circuit that are used is about the same as covered in paragraph 71 through 75 for neutral transmission and 77 for polar transmission.

d. MIXING RELAY CIRCUIT OPERATION. This is covered in paragraph 76.

79. Power Unit

a. GENERAL. The power unit acts as both a rectifier to supply d-c power for relay, magnet, lamp and, sometimes, line operation; and as an a-c voltage changer to supply proper operating voltage to the teletypewriter and "crypto" or "SpTD unit" motors if universal or a-c series motors are used. It will provide the 120 volt d-c and the proper a-c voltage for motor operation with input frequencies and voltages of 25, 40, 50, or 60 cycles and 95, 105, 115, 125, 190, 210, 230, or 250 volts. Figure 112 shows a wiring diagram of the power unit and figures 102, 103, and 104 are functional diagrams of the power circuits when different types of teletypewriters are used.

b. A-C INPUT. Input a-c is brought into the power unit over two of the four wires of the 4-conductor cord. The ground side of power is permanently connected to one end of the primary coil of the power transformer *T*. The other side of power which is controlled by the switch of the teletypewriter first goes through the safety switch on the door of the power unit, then through a 10-ampere fusetron and is finally connected to one of the voltage taps of the primary depending on the voltage of the power supply being used. The voltage taps are so arranged that this connection will provide the correct number of turns in the primary to produce approximately 164 volts in the secondary which feeds the rectifier portion of the unit.

c. A-C OUTPUT. The power for motor operation is provided at the proper voltage for the frequency encountered by means of four frequency taps on the primary of the transformer. In this case the primary acts as an auto-transformer and the voltage between the lead connected to the proper frequency tap and the ground side of power is used for motor operation. This voltage is controlled by both the voltage tap and frequency tap used and is supplied over a third lead in the 4-conductor cord.

d. FRAME GROUND. The fourth conductor in the 4-conductor cord terminates in the frame of the power unit and connects it to the frames of the 131B2 set, the teletypewriter, and ground for protective and shielding purposes.

e. D-C OUTPUT. The output of the secondary of transformer is applied to the varistor of the power unit for rectification over two of the four wires connecting the main part of the unit to the varistor. The voltage of the input to the varistor is regulated to produce the proper d-c output by means of eight taps on the secondary of the transformer. The rectifier is protected by a 1.6-ampere fusetron in one side of the secondary output. The varistor unit which consists of selenium disks connected as a full-wave rectifier, rectifies the ac and provides dc over the two remaining leads of the cord to the main unit. A filter consisting of a retard coil and two capacitors is provided on the output of the varistor to reduce the amount of ripple in the output. A 2,000-ohm resistor is provided across the d-c output to prevent the d-c voltage from rising sharply when the load is removed. The d-c output and frame ground appear on a 3-conductor cord leaving the unit.

Section XVII. TROUBLE LOCATION

80. Testing Equipment

Test Set I–181, Test Set I–193–A, and Test Set TS–190/U are test sets ordinarily used with Teletypewriter Set 131B2.

a. TEST SET I–181. This is a current-flow type relay adjusting set. The primary purpose of the current-flow test set is to measure and control the amount of current flow through the winding of a relay or similar electro-magnetic apparatus which is being tested or adjusted. Test Set I-181 also may be used as a d-c milliammeter over three meter scale ranges of 0 to 15 milliamperes, 0 to 75 milliamperes, and 0 to 150 milliamperes. TM 11–2036 gives detailed instructions for the use of this test set.

b. TEST SET I–193–A. This test set provides a means for testing and adjusting polar relays 255–A, D–163119A, and D–164816. It is a compact, portable unit assembled in a plywood carrying case with a hinged cover. The top of the panel of the unit is arranged with terminals, keys, jacks, and a meter. On the under side of the panel are located the associated resistors, capacitors, and filters. The unit may be removed from the carrying case by loosening four screws. When removed from the carrying case, the unit may be mounted on a relay rack, if required. At each end of the test set is a compartment. One compartment is for carrying three spare relays, either 255–A, D–164816, or D–163119A. Two of the three sections of the other compartment are used as locations for relays S1 and S2, which are part of the equipment of Test Set I–193–A; the third section is used as a location for a spare relay, either relay 255–A or D–163119A. Detailed information pertaining to Test Set I–193–A is given in TM 11–2513.

c. TEST SET TS–190/U. This test set is a telephone test receiver assembly with a switch-controlled resistance external to the receiver. It is designed for maintenance use with telephone and telegraph communications equipments, and includes a cord equipped with a test pick and with a spring socket chuck to which spring clips or other types of terminals may be affixed. The test receiver unit itself is of about 1,000-ohm resistance. The external resistance is of 50,000 ohms. The resistance is normally in series with the receiver element, but the resistance may be short-circuited by depressing a switch in the handle of the test pick. The resistance has two purposes: to protect the ear of the user against excessive clicks when probing for the presence of potentials in circuits, and to provide a high-impedance monitoring receiver so that it may be bridged across high-impedance circuits without appreciably affecting the circuit performance, or for bridging across circuit points without shunting down the current so much as to cause the release of the relays.

81. Technique of Trouble Location

Trouble in a 131B2 station may be located in any of the several elements making up the station arrangement. It will usually be indicated by the failure of the station to type any copy, to type correct copy, to pass its line-up tests or to transmit good signals. Other troubles such as failure of lamps to light and failure of the break arrangements to function may also be encountered. The station line-up procedures covered in paragraphs 29 through 33 are very useful in locating the part of the station that is in trouble. The line-up procedure applicable to the type of installation being worked on should be used. If the station is not installed in any particular system but is being repaired or tested for reuse, use the line-up procedure for single (half-duplex) stations as covered in paragraph 30. Tables VI, VII, VIII, and IX gives a comprehensive step-by-step method of locating trouble. These tables cover the different types of station installations and should be used accordingly. If, by using the tables, a trouble is localized in a certain part of the circuit such as the failure of a relay to function properly, the actual cause of the trouble may be relay adjustment or failure of the electrical path operating the relay. The continuity of the electrical paths may be checked by the use of an ohmmeter although care must be used to insure that parallel paths do not give an appearance of continuity where it does not exist. Before making any continuity checks with an ohmmeter be sure that all power is off the station. The functional diagrams (figs. 96 through 104) are very useful in checking the electrical paths under various station conditions.

82. Use of Diagrams and Charts

a. APPARATUS DESIGNATED. Wiring diagrams of the repeater unit, mixing relay unit and power circuit are figures 109, 110, and 111 respectively. In

these diagrams each piece of apparatus has the same designation as that stamped on the equipment and the wiring terminals of each piece of apparatus are shown in their proper relative locations as viewed from the wiring side. The diagrams shown in figures 109 and 110, use the airline system of showing connections. With this system each piece of apparatus is arbitrarily numbered and lines called "feed lines," representing the individual wires are carried a short distance and terminated at a common or base line running at right angles to the feed lines. These feed lines are marked with the color of the wire and have a number near the base line which is the same as the number of the piece of apparatus to which the other end of the wire connects. It is not necessary to trace a connection through the common or base line and no provision is made for doing so. By observing the color and identification number it is possible to move directly to the other end of the wire.

*Table VI. Trouble location single (half-duplex) stations, types AO and J**

Step No.	Condition of station	Indication of trouble	Detailed action to be taken
1.	Power on, station in text.	Tt motors do not run.	a. Check presence of primary power supply. b. Check power connections to and between tt and 131B2 set. c. Check fusetrons or fustats of tt apparatus. d. Check tt power switches. e. Check input fusetron (10 amp) of POWER UNIT. f. Check safety switch of POWER UNIT. g. Check that proper voltage and frequency taps of POWER UNIT are being used.
		Output voltage of POWER UNIT not within limits (120 ± 2 volts).	a. Check output fusetron (1.6 amps) of POWER UNIT. b. Check output taps of POWER UNIT.
2.	Station in local test, relay BK1 blocked operated, STA. TEST key in REG position.	Orientation range of tt from signals of own keyboard or transmitter-distributor less than 68 points. (See par. 30*c* and *d*.)	a. If tt is equipped with governed motors check motor speeds. b. Check adjustment of tt selector mechanism. c. Check that relay TS is on its No. 4 contact. d. Check other tt adjustments such as those of the keyboard and transmitter-distributor if used. e. Check optional wiring of 131B2 set.
3.	Station in station test and text, relay BK1 still blocked operated.	Orientation range of tt from signals of own keyboard or transmitter-distributor less than 68 points or limits of range more than 10 points different than step 2. (See par. 30*i* and *j*.)	a. Check adjustment and operation of relay TR (continuity of coils of filter is important). b. Check adjustment and operation of relay TS (continuity of coils of filter is important.) c. Check that relay RV is on its No. 4 contact. d. Check that relay LS remains on its No. 4 contact. e. Check that relay TX is operated. f. Check optional wiring of 131B2 set.
		TEXT lamp is not lighted.	a. Check for burned-out lamp. b. Check adjustment of relay TX.
4.	Station in test and cipher, relay BK1 still blocked operated.	Motor of "crypto unit" or "SpTD unit" does not start.	a. Check that power relay in power box of 131B2 set is operated. b. Check that relay CP is operated. c. Check fustat (3.2 amp) in power box of 131B2 set.

* See paragraph 30.

Table VI. Trouble location single (half-duplex) stations, types AO and J (continued)*

Step No.	Condition of station	Indication of trouble	Detailed action to be taken
		No copy or poor copy on tt from signals sent from own keyboard or transmitter-distributor with Test Element removed from "crypto unit" or tape removed and "tape-out" pin depressed on "SpTD unit." (See par. 30*n*, o, p.)	a. If governed motors are used on "cryto unit" or "SpTD unit" check motor speeds. b. Check clutch torque of "crypto unit" or "SpTD unit." c. Check adjustment of start magnet and latch of "crypto unit" or "SpTD unit." d. Check condition and adjustment of "crypto unit" or "SpTD unit" distributor face and brushes. e. Check operation and adjustment of relay R (continuity of coils of filter is important). f. Check operation and adjustment of relay RI. g. Check operation and adjustment of relay S (continuity of coils of filter is important).
		CIPHER lamp is not lighted.	a. Check for burned-out lamp. b. Check adjustment of relay CP.
5.	Station in regular and text, and connected to a line to local or distant station, relay BK1 unblocked.	Orientation range of tt from signals sent to station from a local or distant point less than 68 points or limits of range more than 10 points different than step 3.	a. Check operation and adjustment of relay LR. b. Check to see that relay RV is on its No. 5 contact. c. Check options used in 131B2 set.
		Signals sent from tt keyboard or transmitter-distributor to line show more than ± 5 percent distortion.	a. Check to see that relay LT is on its No. 2 contact. b. Check operation and adjustment of relay LS. c. Check to see that relay RV is on its No. 4 contact. d. Check to see that relay BK is operated to its No. 4 contact. e. Check that relay BK1 is operated.
6.	Station in regular and cipher, and connected to a line to a local or distant station, relay BK1 unblocked.	When signals are being sent from the tt keyboard or transmitter-distributor local copy is bad.	a. Check operation and adjustment of relay LB.
		When signals are being sent from tt keyboard or transmitter-distributor and the line is opened (break received) transmission stops.	a. Check that relay BK1 is released. b. Check operation and adjustment of relay BK.
		When line is opened (break received) BREAK lamp does not light and set does not change from cipher to text condition.	a. Check for burned-out lamp. b. Check to see that relay CP is released. c. Check to see that relay TX is operated.
		After line has been opened (break received) operation of BREAK-BREAK RELEASE key does not put out BREAK lamp and return set to CIPHER.	a. Check to see that relay BK1 is operated.

*Table VII. Trouble location alternate encipher and decipher room circuit, types A, C, AA, and AC**

Step No.	Condition of station	Indication of trouble	Detailed action to be taken
1.	Power on, station in text.	Tt motors do not run.	a. Check presence of primary power supply. b. Check power connections to and between tt and 131B2 set. c. Check fusetrons or fustats of tt apparatus. d. Check tt power switches. e. Check input fusetron (10 amp) of POWER UNIT. f. Check safety switch of POWER UNIT. g. Check that proper voltage and frequency taps of POWER UNIT are being used.
		Output voltage of POWER UNIT not within limits (120 ± 2 volts).	a. Check output fusetron (1.6 amp) of POWER UNIT. b. Check output taps of POWER UNIT.
2.	Station in regular, and local test.	Orientation range of tt from signal of own keyboard or transmitter-distributor less than 68 points. (See par. 31*c* and *d*.)	a. If tt is equipped with governed motors check motor speeds. b. Check adjustment of tt selector mechanism. c. Check that relay TS is on its No. 4 contact. d. Check other tt adjustments such as those of the keyboard and transmitter-distributor if used. e. Check optional wiring of 131B2 set.
3.	Station in regular and text.	Orientation range of typing reperforator of 133 table, TC-16, or TC-17 from signals of tt keyboard transmitter-distributor less than 68 points. (See par. 31*i*.)	a. Check adjustment of typing reperforator including motor speed. b. Check operation and adjustment of relay LS. c. Check operation and adjustment of relay TR (continuity of coils of filter is important). d. Check that relay RV is on its No. 4 contact. e. Check that relay TX is operated. f. Check optional wiring of 131B2 set. g. Check that relay LT is on its No. 2 contact.
		Orientation range of tt on signals sent from transmitter-distributor of 133 table, TC-16 or TC-17 is less than 68 points or limits or range are more than 10 points different than step 2. (See par. 31*l*.)	a. Check adjustment of transmitter-distributor on 133 table, TC-16 or TC-17. b. Check operation and adjustment of relay LS. c. Check operation and adjustment of relay TS (continuity of coils of filter is important). d. Check that relay RV is on its No. 5 contact.
		TEXT lamp is not lighted.	a. Check for burned-out lamp. b. Check adjustment of relay TX.
4.	Station in regular and cipher.	Motor of "crypto unit" of "SpTD unit" does not start.	a. Check that power relay in power box of 131B2 set is operated. b. Check that relay CP is operated. c. Check fustat (3.2 amp) in power box of 131B2 set is operated.

* See paragraph 31.

Table VII. Trouble location alternate encipher and decipher room circuit types A, C, AA, and AC (continued)*

Step No.	Condition of station	Indication of trouble	Detailed action to be taken
		No copy or poor copy on tt from signals sent from transmitter-distributor of 133 table, TC-16 or TC-17 with Test Element removed from "crypto unit" or tape removed and "tape-out" pin depressed on "SpTD unit." (See pars. 31*o, p, q.*)	a. If governed motors are used on "crypto unit" or "SpTD unit" check motor speed. b. Check clutch torque of "crypto unit" or "SpTD unit." c. Check adjustment of start magnet and latch of "crypto unit" or "SpTD unit." d. Check condition and adjustment of "crypto unit" or "SpTD unit" distributor face and brushes. e. Check operation and adjustment of relay R (continuity of coils of filters is important). f. Check operation and adjustment of relay R1. g. Check operation and adjustment of relay S (continuity of coils of filter is important).
		CIPHER lamp is not lighted.	a. Check for burned-out lamp. b. Check adjustment of relay CP.
		When signals are sent from tt keyboard or transmitter-distributor, local copy is bad.	a. Check operation and adjustment of relay LB.

Table VIII. Trouble location full duplex station sending set[1] and simultaneous encipher and decipher off line circuit, types B, D, and BD enciphering set[2]

Step No.	Condition of station	Indication of trouble	Detailed action to be taken
1.	Power on, station in text.	Tt motors do not run.	a. Check presence of primary power supply. b. Check power connections to and between tt and 131B2 set. c. Check fusetrons or fustats of tt apparatus. d. Check tt power switches. e. Check input fusetron (10 amp) of POWER UNIT. f. Check safety switch of POWER UNIT. g. Check that proper voltage and frequency taps of POWER UNIT are being used.
		Output voltage of POWER UNIT not within limits (120 ± 2 volts).	a. Check output fusetron (1.6 amp) of POWER UNIT. b. Check output taps of POWER UNIT.
2.	Station in Regular and Local Test.	Orientation range of tt from signals of own keyboard or transmitter-distributor less than 68 points. (See pars. 32*a*(5) and 33*b*(2).)	a. If tt is equipped with governed motors check motor speeds. b. Check adjustment of tt selector mechanism. c. Check other tt adjustments such as those of the keyboard and transmitter-distributor. d. Check optional wiring of 131B2 set.

* See paragraph 31.
[1] See paragraph 32.
[2] See paragraph 33*b*.

Table VIII. Trouble location full duplex station sending set[1] and simultaneous encipher and decipher off line Circuit types B, D, and BD, Enciphering set[2] (continued)

Step No.	Condition of station	Indication of trouble	Detailed action to be taken
3.	Station in regular text, and output of stations connected either to a receiving set in good operating condition, to a receiving tt, or to the typing reperforator of a 133 table, TC-16, or TC-17.	Orientation range of tt of receiving set, tt on output of station or typing reperforator of 133 table, TC-16 or TC-17 from signals sent from station tt keyboard or transmitter-distributor less than 68 points. (See pars. 32*a*(10) and 33*b*(7).)	a. Check that relay LT is on its No. 2 contact. b. Check operation and adjustment of relay LS. c. Check operation and adjustment of relay TR (continuity of coils of filter is important). d. Check that relay TX is operated. e. Check that relay BK1 is blocked operated. f. Check wiring options of 131B2 set.
		TEXT lamp is not lighted.	a. Check for burned out lamp. b. Check adjustment of relay TX.
4.	Station in regular and cipher.	Motor of "crypto unit" or "SpTD unit" does not start.	a. Check that power relay in power box of 131B2 set is operated. b. Check that relay CP is operated. c. Check fustat (3.2 amp) in power box of 131B2 set.
		When signals are sent from station tt keyboard or transmitter-distributor orientation range of tt of receiving set, tt on line or typing reperforator on 133 table TC-16, or TC-17 is less than 68 points or limits of range more than 10 points different than step 3.	a. If governed motors are used on "crypto unit" or "SpTD unit" check motor speeds. b. Check clutch torque of "crypto unit" or "SpTD unit." c. Check adjustment of start magnet and latch of "crypto unit" or "SpTD unit." d. Check condition and adjustment of "crypto unit" and "SpTD unit" distributor faces and brushes. e. Check operation and adjustment of relay R (continuity of coils of filters is important). f. Check operation and adjustment of relay S (continuity of coils of filters is important).
		CIPHER lamp is not lighted.	a. Check for burned out lamp. b. Check adjustment of relay CP.

Table IX. Trouble location full duplex station receiving set[1] and simultaneous encipher and decipher off line circuit, Types B, D, and BD deciphering set[2]

Step No.	Condition of station	Indication of trouble	Detailed action to be taken
1.	Power on, station in text.	Tt motors do not run.	a. Check presence of primary power supply. b. Check power connections to and between tt and 131B2 set. c. Check fusetrons or fustats of tt apparatus. d. Check tt power switches. e. Check input fusetron (10 amp.) of POWER UNIT. f. Check safety switch of POWER UNIT. g. Check that proper voltage and frequency taps of POWER UNIT are being used.

[1] See paragraph 32.
[2] See paragraph 33*c*.

Table IX. Trouble location full duplex station receiving set[1] and simultaneous encipher and decipher off line circuit, Types B, D, and BD deciphering set[2] (continued)

Step No.	Condition of station	Indication of trouble	Detailed action to be taken
		Output voltage of POWER UNIT not within limits (120 ± 2 volts).	a. Check output fusetron (1.6 amp.) of POWER UNIT. b. Check output taps of POWER UNIT.
2.	Station in regular and text, and input of station connected either to a sending set in good operating condition, to a transmitter-distributor, tt keyboard or to the transmitter-distributor of a 133 table, TC-16, or TC-17.	Orientation range of tt of receiving set from signals sent from sending set, transmitter-distributor, tt keyboard or transmitter-distributor of 133 table, TC-16, or TC-17 on input less than 68 points. (See pars. 32*a*(16) and 33*c*(2).)	a. If receiving set tt is equipped with a governed motor check its speed. b. Check operation and adjustment of relay LR. c. Check operation and adjustment of relay TS (continuity of coils of filters is important). d. Check that relay RV is on its No. 5 contact. e. Check that relay TX is operated. f. Check adjustment of tt selector mechanism. g. Check other adjustments of tt. h. Check optional wiring of 131B2 set.
3.	Station in regular and cipher.	Motor of "crypto unit" of "SpTD unit" does not start.	a. Check that power relay in power box of 131B2 set is operated. b. Check that relay CP is operated. c. Check fustat (3.2 amp.) in power box of 131B2 set.
		Orientation range of receiving set tt on signals sent from sending set, transmitter-distributor, tt keyboard on transmitter-distributor of 133 table, TC-16, or TC-17 on input less than 68 points or limits of range more than 10 points different than step 2. (See pars. 32*a*(20), (21), (22); 33*c*(7), (8), and (9).)	a. If governed motors are used on "crypto unit" or "SpTD unit" check motor speed. b. Check clutch torque of "crypto unit" or "SpTD unit." c. Check start magnet and latch of "crypto unit" or "SpTD unit." d. Check condition and adjustment of "crypto unit" or "SpTD unit" distributor faces and brushes. e. Check operation and adjustment of relay R (continuity of coils of filters is important). f. Check operation and adjustment of relay S (continuity of coils of filters is important). g. Check operation and adjustment of relay R1. h. Check that relay TR is on its No. 4 contact. i. Check that relay BK1 is operated. j. Check that relay LB is on its No. 4 contact. k. Check that relay RV is on its No. 5 contact. l. Check optional wiring of 131B2 set.
		CIPHER lamp is not lighted.	a. Check for burned out lamp. b. Check adjustment of relay CP.
		When loop is opened (break received) receiving set fails to return to text.[3]	a. Check that relay BK1 is released. b. Check operation and adjustment of relay BK. c. Check that relay CP is released. d. Check that relay TX is operated.
		When loop is opened (break received) BREAK lamp does not light.	a. Check for burned out lamp. b. Check adjustment of relay BK1.
		When BREAK-BREAK RELEASE key is operated to BREAK RELEASE and returned to normal the set fails to return to cipher.	a. Check that relay BK1 is operated.

[1] See paragraph 32.
[2] See paragraph 33*c*.
[3] Only applicable where break feature is used.

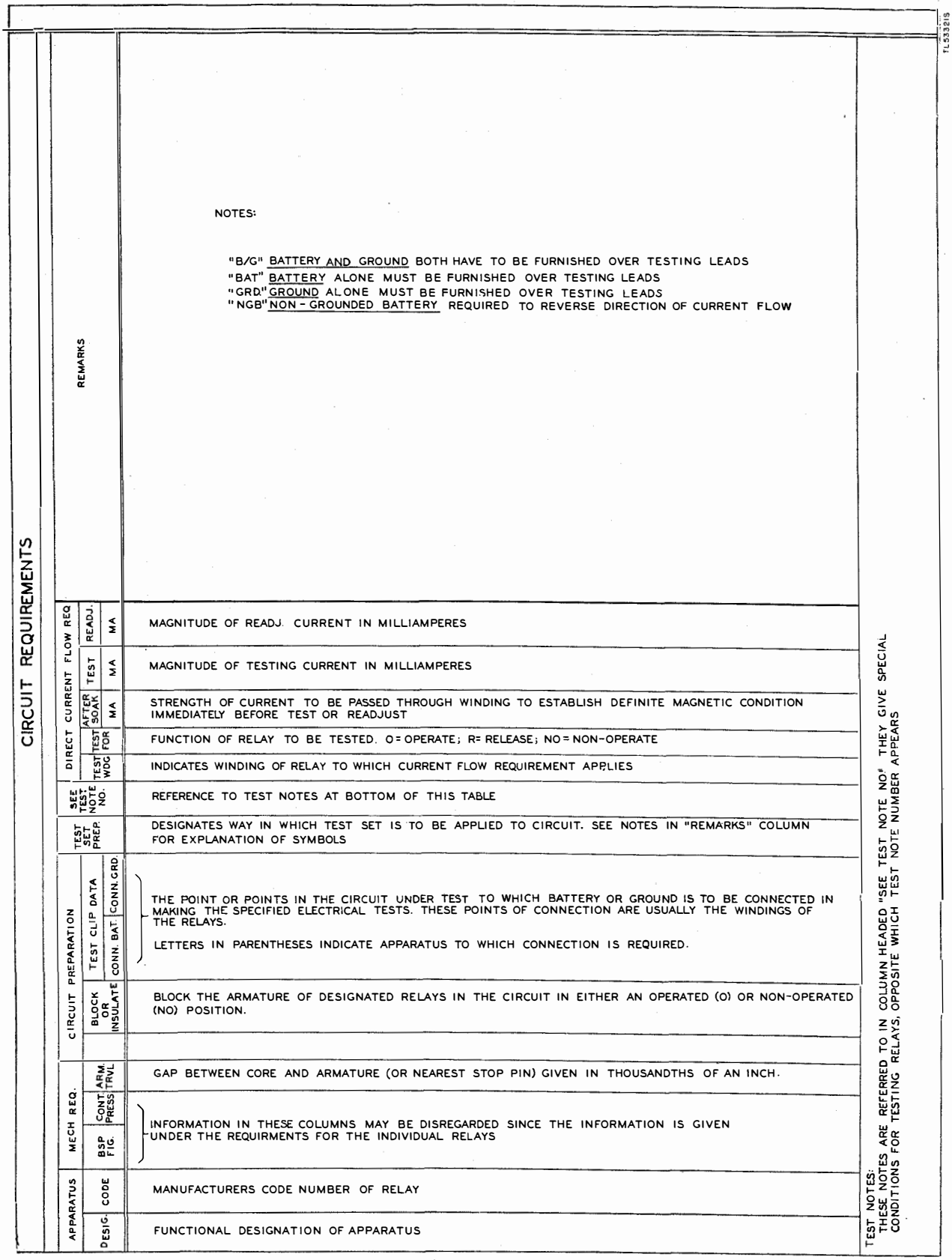


Figure 85. Explanation of circuit requirement table.

b. CIRCUIT REQUIREMENT TABLE. Figures 106 and 108 include circuit requirement tables which provide information for adjusting the relays. Figure 85 illustrates the headings of a typical circuit requirement table and explains the meaning of the usual entries in each column. The test clip data columns specify relay spring or winding terminals to which current flow test set connections are to be made. The numbering of the terminals of the U- and Y- and 239-type relays is explained in paragraph 83.

Section XVIII. REPAIRS

83. Maintenance of Relays

a. Relays are given designations which appear on the schematic, wiring, and functional diagrams, and these designations are stamped on the relays. The circuit requirement tables which form a part of the circuit schematic drawings show the designation of the relays in the first column and the code of the relay in the second column. In general, the first part of the code is the relay type such as U type, 239 type, etc.

b. FITCAL is applied to relays as explained in paragraph 46. The procedures and requirements covered herein are used when the relay fails to function properly in the circuit.

c. Relay maintenance involves cleaning of the relay parts and contacts, adjustment to meet mechanical requirements, and the further refinement of some of these adjustments, if necessary, to meet the electrical requirements. For the U-, Y-, and 239-type relays, the electrical requirements are shown in the circuit requirement table. An explanation of the information shown in the circuit requirement table is covered in paragraph 82*b*. In practically all cases electrical and mechanical requirements are specified under two headings: Test and Readjust. If a relay meets the test requirements it is satisfactory for service. If, however, on investigation it is found that certain of the test requirements which may affect the performance of the relay in the circuit are not met, adjust the relay to meet the readjust requirements. These requirements are more severe than the test requirements.

84. Winding and Spring Designations of U-, Y-, and 239-type Relays

a. The contact springs and winding terminals of U- and Y-type relays are numbered consecutively from right to left facing the terminal side of the relay. (See fig. 86.) The top and bottom spring assemblies of the relay are each numbered in this sequence. On the circuit schematic and wiring diagrams the top and bottom relay spring pile-ups are shown, respectively, above and below the relay core and winding convention. A relay winding terminal on the drawing is followed by the letter T or B to indicate whether it is aligned with the top or bottom spring terminal pile-ups.

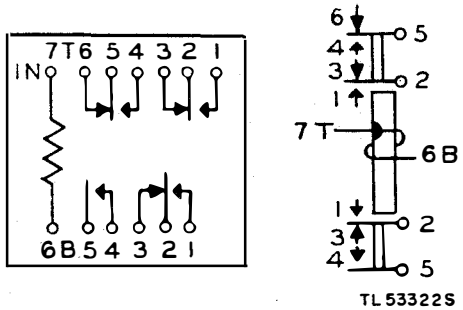


Figure 86. Winding and spring terminal arrangement, U- and Y- type relays, viewed from rear (terminal side).

b. The contact and winding terminals of 239-type relays are located in a single horizontal group numbered consecutively from right to left facing the terminal side of the relay as shown in figure 87.

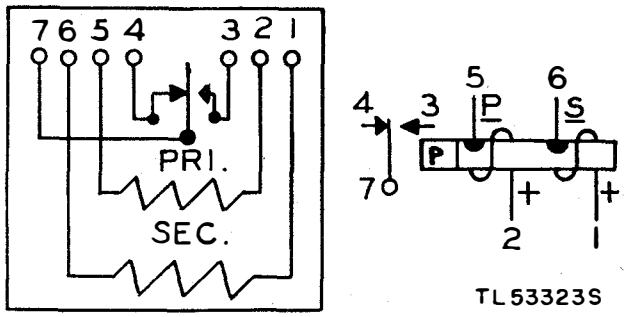


Figure 87. Winding and spring terminal arrangement, 239-type relays, viewed from rear (terminal side).

85. Cleaning Relays and Contacts, U-, Y-, and 239-type Relays

a. GENERAL. It is essential that relay parts and contacts be kept clean since failure of a circuit is often traced to particles of dirt or lint between contacts or to dirty parts of a relay. Covers are provided to reduce as far as possible the entry and accumulation of foreign materials to the working parts of relays. It is important that relay covers be kept in place except when necessary to remove

them for maintenance purposes. When covers are replaced on relays, replace them right side up as determined by the designations on the covers in order to avoid depositing dirt and lint from the bottom of the cover on the relay contacts and parts. When relays are cleaned, the inside of the cover should be wiped clean, using a lint-free cloth.

b. TESTING CONTACTS. If there is evidence that a relay contact is not properly closed, this condition may be checked for by bridging a test receiver (such as Test Set TS–190/U) across the springs of the contact through which current should be flowing. Absence of clicks or fluttering in the test receiver is evidence of a satisfactory contact. If the contact is unsatisfactory and on inspection it is found to be in mechanical adjustment, burnish it. (See *c* below.)

c. CONTACT BURNISHING. When necessary to clean the contacts, burnish them using a clean No. 266 blade of the No. 265C contact burnisher. It is very important to keep the blades of the contact burnisher and any thickness gauges which are used on the contacts clean. Wipe these off with a clean, dry cloth before placing them against each contact and frequently wipe them with a clean cloth dampened with dry-cleaning solvent (SD).

(1) In burnishing normally open contacts of a U- or Y-type relay, place the blade of the burnisher between the contacts and operate the relay manually to give a slight pressure against the blade of the burnisher. At the same time move the blade back and forth. The desired result is usually obtained by rubbing the burnisher between the contacts two or three times. In the case of normally closed contacts, the tensions of the springs themselves will usually furnish sufficient pressure against the burnisher. On springs having heavy tension, lift one of the springs away to insert the burnisher.

(2) To burnish contacts of the 239-type relay, back off the contact screws an equal amount and far enough to permit the flat blade of the No. 265C contact burnisher to enter easily between the armature and the contact. This will facilitate burnishing the contacts on the armature and contact screws at the proper angle. Insert a clean blade of the contact burnisher horizontally between the armature and the stationary contact. Hold the armature or flexible contact against the contact burnisher and proceed to burnish the contacts. While rubbing the contact burnisher back and forth take care to hold it parallel to the armature. Continue the operation until the contacts on both sides of the armature are cleaned as determined by visual inspection. Do not attempt to produce a convex surface on the stationary contact.

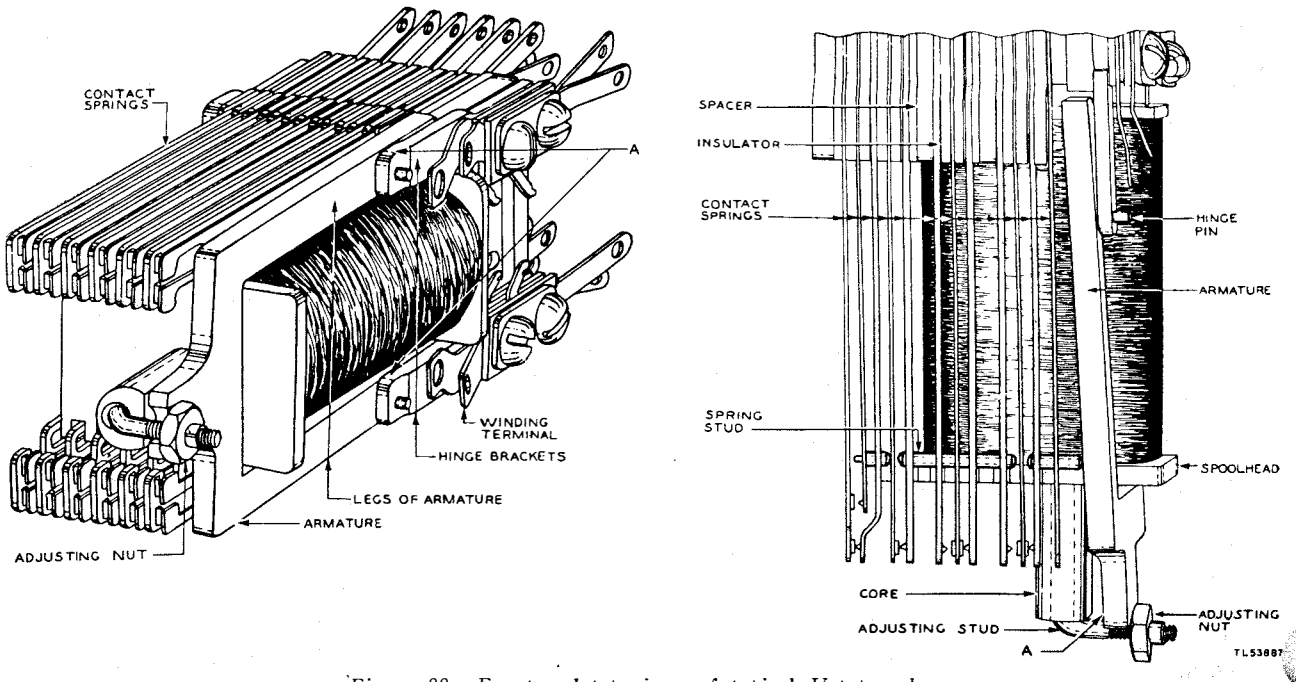


Figure 88. Front and top views of typical U-type relay.

86. Requirements for Relays BK1, CP, and TX

a. Relay BK1. Relay BK1 is a Y-type and relays CP and TX are U-type. The U- and Y-type relays are of the same general type and the same class of mechanical requirements and methods of adjustments apply to both. Figure 88 shows front and top views of a typical U-type relay.

b. Tools and Gauges. Tools and gauges, the use of which are referred to in the requirements for U- and Y-type relays in this paragraph are tabulated below. All codes are Western Electric Company codes, unless otherwise specified.

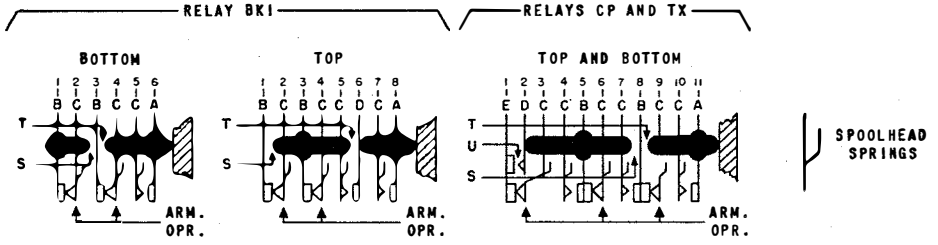
Tools	*Description*
No. 474A	3/16" by ¼" hexagonal closed end offset wrench.
No. 505A	Spring adjuster for thin (0.013 inch) springs
No. 507A (two required)	Spring adjuster for springs other than 0.013 inch springs.
No. 265C	Contact burnisher
Gauges	
No. 70H	0-30-gram gauge
No. 131A	Thickness gauges (consists of a nest of No. 132-type gauges).
Test sets	
Test Set I–181 (D–162269)	Current flow test set for testing and adjusting relays.

c. Spring Arrangements. The spring arrangements and spring tension requirements are shown in figure 89.

87. Adjustment of Relays BK1, CP, and TX

a. Armature Travel. The armature travel requirement is shown on the circuit requirement table. To adjust the armature travel insert the proper No. 132-type gauge between the armature and core with the long axis of the gauge parallel to the axis of the core. Turn the adjusting nut with the No. 474A wrench until friction is felt against the gauge.

b. Stud Gaps. Stud gaps labeled *T* (fig. 89)



SPRING TENSION REQUIREMENTS

	TENSION, GRAMS. TEST	READJUST
ALL SPRINGS SHALL BE TENSIONED TOWARD THE ARMATURE. APPLY THE GAUGE SO THAT ITS TIP ENGAGES BOTH PRONGS OF FORKED SPRINGS. ON SOLID SPRINGS APPLY THE TIP OF THE GAUGE JUST IN FRONT OF CONTACT. USE THE 70H GAUGE.		
TENSION OF SPRINGS MARKED ARM OPR IS MEASURED WITH THE ARMATURE IN THE OPERATED POSITION; TENSION OF ALL OTHER SPRINGS IS MEASURED WITH THE ARMATURE IN THE NONOPERATED POSITION.		
THE MINIMUM ARMATURE BACK TENSION MEASURED AS THE ARMATURE LEAVES ITS BACK STOP.	18	22
THE SPRINGS DESIGNATED A HAVE NO DEFINITE TENSION REQUIREMENT OTHER THAN THAT THE COMBINED PRESSURES OF THE TOP AND BOTTOM A SPRINGS (TOGETHER WITH THE D SPRING OF RELAY BK1) SHALL BE SUFFICIENT TO MEET THE ARMATURE BACK TENSION REQUIREMENTS ABOVE.		
MINIMUM TENSION OF D SPRINGS MEASURED AS THE SPRING LEAVES THE STUD.	5	6
MINIMUM TENSION OF B SPRINGS MEASURED AS THE CONTACTS BREAK.	18	20
MINIMUM TENSION OF C SPRINGS MEASURED AS THE SPRING TANG LEAVES THE SPOOLHEAD.	25	30
MINIMUM TENSION OF E SPRINGS MEASURED AS THE CONTACTS BREAK.	28	30

TL53326S

Figure 89. Spring adjustments and spring tension requirements.

should be a minimum of 0.006 inches. The stud gap labeled *S* should be a slight clearance.

c. CONTACT SEPARATION. The minimum separation between each pair of contacts normally opened or between each pair of contacts that are opened when the relay is electrically operated should be 0.005 inch except for the contact labeled *U* (fig. 89) which should be a minimum of 0.010 inch.

d. CONTACT MAKE. (1) Both contacts on the fork spring should make with their associated contacts with the relay in the electrically operated position for normally open contacts and in the unoperated position for normally closed contacts.

(2) All normally open contacts should make when the relay armature is *electrically* operated against a gauge of 0.008-inch thickness (No. 132A gauge) placed between the armature and the fork. These requirements are met if at least one of the two contacts of forked springs close or make.

Note. Stud gaps in *b* above insure that normally closed contacts close before the armature fully restores.

e. ADJUSTMENT OF SPRINGS. (1) Use the No. 505A spring adjuster for thin springs and the No. 507A spring adjuster for thick springs. To adjust the position of springs to meet the contact separation, stud gap, and contact make requirements, adjust the spring tangs resting against the spoolhead. To do this hold the spring with one No. 507A spring adjuster placed above the spring tang and adjust the tang to the right or left as required with another No. 507A adjuster. To adjust the tension of a spring, span the spring with the slotted end of the spring adjuster just back of the stud and slide the adjuster to the base of the spring. Adjust the springs to the right or left as required, exercising care not to disturb adjacent springs. All springs should be approximately straight but a slight bow is permissible if there is a clearance between adjacent springs in either the nonoperated or electrically-operated position of the relay armature.

(2) The relays should meet the specified electrical requirements. Connect a current flow test set (Test Set I–181) as indicated in the circuit requirement table and apply the current flow values specified therein. If the relay fails to meet requirements adjust as follows: To meet the operate requirement decrease the tension of moving springs toward the minimum. If the requirement cannot be met in this manner increase the stud gaps. To meet the release requirement increase the tension of the moving springs. In all cases, however, keep the tensions within the requirements specified in figure 89.

88. Requirements for Relays BK, LB, LT, and RV (239-type) (fig. 90)

a. These relays, with permanently magnetized pole pieces, with close spacing between the pole pieces and the armature, and with comparatively small contact travel and contact pressures, are particularly susceptible to trouble if foreign material is allowed to enter the relay. Small magnetic particles which are attracted to the pole pieces may result in a change in performance. For this reason, it is important that the relay cover cap should be adjusted as to provide a dustproof joint at the back end of the plate on the cover cap.

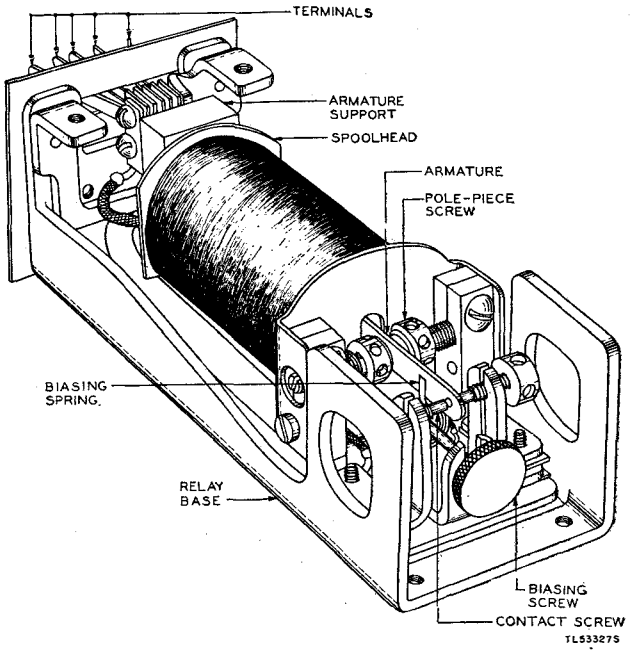


Figure 90. 239-type relay.

b. Relays LB, LT, and RV are in the unoperated position when the armature rests against the right-hand contact screw. The armature of relay BK tends to stand between the contacts when no current is flowing through the windings. When negative battery is connected to its No. 5 or No. 6 terminal the armature tends to move to the left-hand contact.

c. Tools and gauges, referred to in the requirements for 239-type relays in this paragraph are tabulated below. All codes are Western Electric Company codes unless otherwise specified.

Tools	*Description*
No. 340 (2 required)	Tool
No. 363	Spring adjuster
	KS–6320 orange stick
	3-inch cabinet screw driver
	6½-inch P-long-nose plier
	4-inch regular screw driver
No. 265C	Contact burnisher
Gauges	
No. 70D	50–0–50 gram gauge
No. 70F	10–0–10 gram gauge
No. 74D	Thickness gauge nest
No. 92D	Nonmagnetic offset thickness gauge
Test sets	
Test Set I–181 (D–162269)	Current flow test set for testing and adjusting relays.

89. Mechanical Adjustments for Relays BK, LB, LT, and RV (239-type)

a. Flexible Contact Spring Alignment (fig. 91). (1) The tips of the flexible contact springs should be approximately flat, bear upon each other at the top and bottom edges, and make a line contact for at least 25 percent of the distance across the 3/16-inch width. Gauge by eye.

(2) If the tips of the flexible contact springs do not rest against each other properly, back off the contact screws with the No. 340 tool and adjust the tips of the springs as required using the No. 363 spring adjuster. Reset the contact screws to meet contact travel requirements.

(3) Check to see that the flexible springs rest against each other in line with the armature with a pressure of 20 to 50 grams measured on one spring at the contact with the other spring held so that it cannot follow its mate. Use the No. 70D gauge to measure the tension and hold the other spring with the flat end of the KS–6320 orange stick. If necessary, back off the contact screws with the No. 340 tool and adjust the tension by applying the No. 363 spring adjuster to the spring as closely as practicable to the point where it is riveted to the armature. Adjust the spring toward or away from the other contact spring as required, at the same time keeping the contact springs in good alignment with the armature. Reset the contact screws to meet contact travel requirements.

b. Biasing-spring Position (fig. 92). (1) There should be a clearance between the armature and the coil portion of the biasing spring. Gauge by eye.

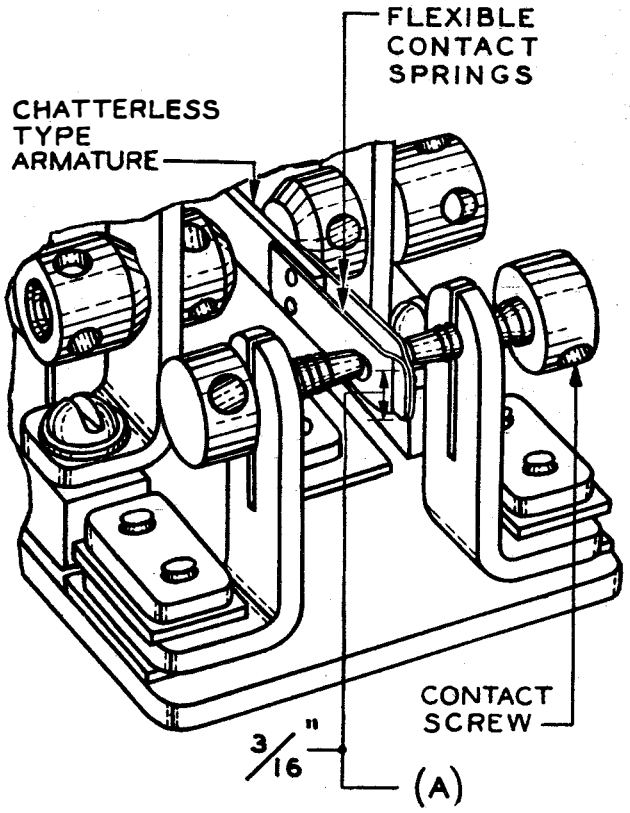


Figure 91. Flexible contact spring adjustment, 239-type relay.

(2) There should be a clearance between the coil portion of the biasing spring and the contact soldering lug. Gauge by eye.

(3) With the relay in the final adjustment the straight portion of the biasing spring should rest approximately flat against the armature. (See fig. 92.) This will be considered satisfactory if the top end of the straight portion rests against the armature and the clearance, if any, between the bottom edge of the armature and the straight portion of the biasing spring does not exceed 0.020 inch. Gauge by eye.

(4) If there is no clearance between the armature and the coil portion of the biasing spring remove the biasing-spring screw by pulling it out while turning it slightly back and forth. In this operation do not damage the biasing spring. Remove the biasing screw from the relay and reduce the size of the outer coil of the spring by grasping the spring between the thumb and forefinger and turning the biasing screw in a direction which will tighten the

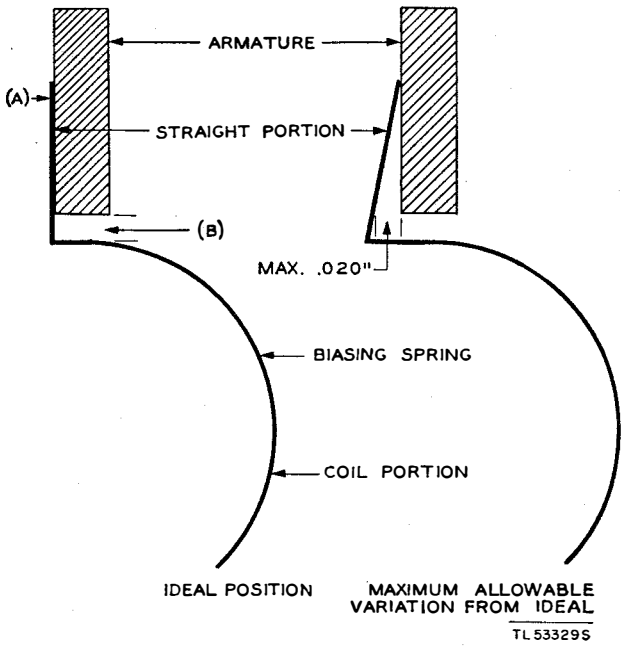


Figure 92. Allowable variation in biasing-spring position, 239-type relay.

spring on the biasing screw. Do not wind the spring more than necessary to reduce the diameter of the coil the required amount. Remount the biasing-screw assembly.

(5) If the biasing spring does not rest flat against the armature with the relay in adjustment remove the biasing screw from the relay, and adjust the flat portion of the biasing spring with the long-nose pliers. Remount the biasing-screw assembly.

(6) If the biasing spring is distorted to the extent that it cannot be satisfactorily adjusted, replace the biasing spring.

c. ARMATURE AND SPOOL CLEARANCE. (1) The armature should not touch the inside of the spool in any position which the armature may assume with the relay either operated or unoperated. Gauge by eye.

(2) If the armature does not clear the inside of the spool, correct by centering the armature vertically or horizontally as follows: Remove the relay from the mounting plate and remove the cover by removing the screws which hold it to the base, with the 3-inch cabinet screw driver. Note the difference in the length of the screws when they are removed so that they will be replaced in their proper position.

(3) If a biasing spring is provided, free the biasing spring from the armature by turning the biasing-spring adjusting screw in a counterclockwise direction.

(4) Using the No. 340 tool, back off the contact screws on each side sufficiently to give the armature free play between the pole-piece screws.

(5) Loosen the locknuts or clamping screws, if provided, and with the No. 340 tool back off the pole-piece screws as far as they will go. This is done to insure that the armature will assume its normal mechanical position. The normal mechanical position of the armature is approximately the central position with respect to the coil and the spool-head.

(6) To center the armature vertically first loosen the screws holding the armature to its support using the 3-inch cabinet screw driver. Then move the armature up or down as may be required to bring it into an approximate central position with respect to the coil, while noting that the contacts are still in alignment vertically.

(7) Firmly retighten all screws loosened in making this adjustment after the adjustment has been completed, and take care not to change the position of the coil or the armature. At the same time note that all screws which hold the contact brackets to the base of the relay are tight. If they are not, tighten them securely. When finally adjusted the armature should be approximately central with respect to the slot in the coil through which it protrudes and should not strike on any part of the spool.

(8) If the pole-piece screws appear dirty, clean them in accordance with the following procedures. Back off the pole-piece screws as far as possible from the armature using the No. 340 tool, to permit the insertion of the cleaning tool. Also, back off the contact screws until the armature will not touch either contact when the cleaning tool is inserted between the armature and either pole piece.

(9) If it is necessary to remove metallic particles from the pole pieces, clean them with a tool made out of a piece of thin stiff metal (preferably nonmagnetic) over which is wrapped a layer of friction tape with the stickier side toward the blade. Press, do not rub, the taped portion of the tool against the pole pieces and the armature so as to cause any particles that may be present to adhere to the tape. Do not rub the tape over the pole pieces as this tends to leave a residue from the tape on the pole pieces. Do not use the tape for more than one cleaning operation.

d. CONTACT ALIGNMENT (fig. 93). (1) Contacts should line up so that the point of contact falls wholly within the boundary of the opposing contact, except for opposing contacts having the same diameter in which case their centers should not be out of alignment more than 25 percent of the contact diameter. Gauge by eye.

(2) To align the contacts vertically remove the relay from the mounting plate and move the armature up or down.

(3) To align the contacts from front to rear, move the armature forward or backward, loosening the screws holding the armature to its support. Check related adjustment of armature in paragraphs 89c(1) and (2). If it is impossible to align the contacts in this manner, loosen the screws holding the contact screw bracket to the base of the relay using 3-inch cabinet screw driver. Then move the bracket until the contacts line up properly. In making this adjustment it is desirable to set the contact-screw brackets so that the contact screws strike the contacts on the armature as near the center as possible.

e. TIGHTNESS OF CONTACT AND BIASING SCREWS. (1) Contact and biasing screws should be sufficiently tight in their brackets to hold any adjusted position. Gauge by feel.

(2) If the contact and biasing screws are not sufficiently tight in the bracket remove the screw from the bracket and force the two parts of the bracket together sufficiently with the long-nose pliers to insure that the screw will hold any adjusted position, then replace the screw. Use the No. 340 tool to remove and replace the contact screws.

f. TIGHTNESS OF POLE-PIECE SCREWS. Pole-piece screws should be sufficiently tight in the pole piece to insure their holding any adjusted position unless locknuts or clamping screws are provided in which case the locknuts or clamping screws should be sufficiently tight to hold the pole-piece screws in any adjusted position. Gauge by feel. Do not tighten clamping screws with excessive pressure of the screw driver after adjustment of pole-piece screws as this may destroy the adjustment.

g. TOTAL CONTACT TRAVEL. (1) The total contact travel, that is, the distance which the armature, or the flexible contact springs in the case of chatterless armatures, travels in passing from a position against either contact screw to a position against the opposite contact screw, should be:

Relays BK, LT, RV	*Relay LB*
Min 0.003 inch	Min 0.003 inch
Max 0.005 inch	Max 0.004 inch

(2) Use the No. 74D gauge and check the travel with the armature resting against each contact screw. If there is a difference between the measured travel on opposite sides of the armature it is an indication that the contacts on the side of the armature having the smaller travel are pitted.

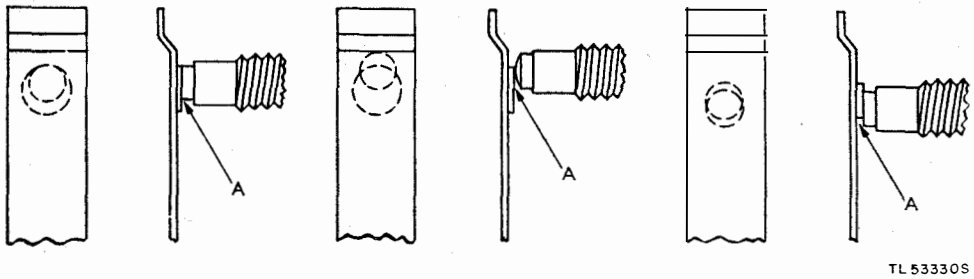


Figure 93. Contact alignment, 239-type relay.

(3) To adjust the contact travel, loosen the locknuts or clamping screws, if provided, and back off the pole-piece screws as far as possible. Use the 3-inch cabinet screw driver to loosen the clamping screws and the No. 340 tool on the locknuts and pole-piece screws. Back off each contact screw with the No. 340 tool so that it does not touch the armature. Advance one contact screw, until it just touches the armature and then back it off one-half the specified total contact travel. One-twelfth of a turn of the contact screw (approximately one-third the distance between hole centers in the head of the contact screw) corresponds to approximately 0.002-inch contact travel. Repeat this operation with the other contact screw. Check that with the armature in its normal mechanical position it does not make contact with either contact screw but stands approximately midway between the contact points. With the No. 74D gauge check that the total contact travel is within the specified limits. Then set the pole-piece screws as outlined in paragraph 88*f*.

h. MAGNETIC BALANCE, RELAYS LT AND RV. (1) The armature should stick magnetically to each contact in turn with approximately equal pressure within the limits specified below.

Sticking pressure	*Difference in pressure*
Min 1 gram	Max 3 grams

(2) To check for the requirement of this paragraph, turn back or otherwise disengage the biasing spring on relays so equipped from the armature. Apply the soak current and immediately apply the No. 70D or No. 70F gauge to the front end of the armature. Measure the pressure required to move the armature from its position against the contact. Apply the soak current in the opposite direction to that applied previously and after disconnecting the current measure the pressure required to move the armature from this contact. When more than one soak value is specified on the circuit requirement table, the soak value associated with the particular operate readjust requirement applying should be used.

i. MAGNETIC BALANCE, RELAY BK. With the current disconnected after the relay has been operated on the specified soak current, the armature should stand free of either contact when moved away manually from the contact to which it was operated. This condition should be met on each contact in turn.

j. MAGNETIC AIR GAP, RELAY LB. The magnetic air gap, that is, the clearance between the stop pins on the armature (or the armature itself when no stop pins are provided) and either pole-piece screw, with the armature against the opposite pole-piece screw, should be a maximum of 0.018 inch. Use the No. 92D gauge.

90. General Adjustments to Meet Electrical Requirements of Relays BK, LB, LT, and RV (239-type)

a. GENERAL. (1) The relay should meet the electrical requirements specified on the circuit requirement table. Relays not equipped with biasing springs should operate in both directions on current reversals.

(2) When adjusting relays which have soak requirements as part of the adjustment, apply the soak current associated with the operate, nonoperate, hold or release requirement before applying the requirement itself.

(3) If the relay fails to meet the electrical requirements specified in the circuit requirement table or fails to function properly in the circuit the magnetic air gap or the biasing spring, if provided, may require adjustment. When readjusting to meet the magnetic balance requirement it is desirable to keep the pressure with which the armature sticks to each contact as nearly equal as possible in order to facilitate meeting the electrical requirements.

(4) After each adjustment of the pole-piece screws tighten the locknuts or clamping screws, when provided, sufficiently to hold the pole-piece screws firmly in the adjusted position. Use the No. 340 tool to hold the screws in position and tighten the locknut with another No. 340 tool. In the case of relays equipped with clamping screws use the 3-inch cabinet screw driver to tighten the clamping screw. After the final adjustment is obtained, check that the electrical requirements are still met on both contacts of the relay. Replace the cover or cover cap, if equipped, and recheck to see that the electrical requirements are still met.

b. ADJUSTMENT OF RELAYS LT AND RV. These relays have solid armatures and use the biasing spring. Release the tension of the biasing spring against the armature by turning the biasing screw in a counterclockwise direction. Loosen the locknuts or clamping screws, if provided, and back off the pole-piece screws using the No. 340 tool. Note that the armature stands approximately midway between the contacts, and if necessary set the contact screws as outlined in paragraph 89*g*. Readjust the magnetic airgaps on each side by turning in the pole-piece screws gradually and equally, using the No. 340 tool until the armature, when moved over by hand, will just stick to each contact. Then apply the specified soak (or operate) current to the relay. Reverse the soak (or operate) current and then measure the pressure with which the armature sticks to the contact with the current disconnected. Again reverse the current and measure the pressure with the current disconnected. Note that the difference in pressure does not exceed the specified limit. If the pressure is not within the specified limits readjust the magnetic airgaps until the relay meets the magnetic balance requirement. Apply the electrical requirements and tension the biasing spring against the armature by turning the biasing screw in a clockwise direction until the relay meets the electrical requirement. If the electrical requirements cannot be met by turning the biasing screw it is an in-

dication that the sticking pressure is either too high or too low. In this case, turn back the biasing screw and reset the pole-piece screws slightly by turning in or backing off the screws with the No. 340 tool, taking care to maintain the magnetic balance. Then tension the biasing spring against the armature until the electrical requirements are met.

c. Adjustment of Relay LB. This relay has chatterless armature and uses the biasing spring. If the relay does not meet its electrical requirements increase or reduce the tension of the biasing spring against the armature. If the electrical requirements cannot be met by this means alone, release the tension of the biasing spring against the armature by turning the biasing screw in a counterclockwise direction. Loosen the locknuts or clamping screws, if provided, and back off the pole-piece screws using the No. 340 tool. Note that the armature stands approximately midway between the contacts and, if necessary, set the contact screws as outlined in paragraph 89*g*. Readjust the magnetic airgaps on each side by turning the pole-piece screws gradually and equally, using the No. 340 tool, until the armature, when moved by hand,will just hold to each contact. Again apply the electrical requirements and by means of the biasing screw, tension the biasing spring against the armature. If it is impossible to secure a satisfactory adjustment with the magnetic air gap as adjusted, back off or turn in the pole-piece screws gradually and equally until the relay meets the electrical requirements on both contacts. Check the magnetic air gap with the specified gauge. If the gauge cannot be inserted between the armature (or stop pin on the armature when provided) and either pole piece, or if it can be inserted with a snug fit, without forcing, the air gap is satisfactory. If the gauge is inserted, the armature (or stop pin on the armature when provided) should rest firmly against the pole piece on the opposite side. If the magnetic air gap is not satisfactory, reduce the gap until it is satisfactory and the electrical requirements are met. If the contact closure is not steady (chattering contacts) it is an indication that either the pressure between the flexible contact springs is excessive or insufficient or that the contacts are dirty. If necessary adjust the flexible springs as covered in paragraph 86*b*. If the contacts are dirty, they should be cleaned.

d. Adjustment of Relay BK. This relay has chatterless armature and does not use the biasing spring. If the relay fails to meet its electrical requirement or if the armature does not remain floating between the contacts when moved away from the contact against which it is resting readjust the magnetic air gap on each side. To do this loosen the lock nuts or clamping screws, if provided, and back off the pole-piece screws using the No. 340 tool. Note that the armature stands midway between the contacts. If necessary, set the contact screws as covered in paragraph 89*g*. Turn in first one pole piece and then the other, until the armature approaches the position where it will barely stay against the contact on the side to which the pole-piece screw is being adjusted. Back off the pole-piece screws slightly until the armature will stand equidistant between the contacts. Check the total contact travel by holding the armature over, so that it just makes contact with the contact screw. Take care that the flexible portion of the armature does not bend. Note that the relay meets its magnetic balance and electrical requirements on both contacts and that it operates properly on current reversal. Check the relay in circuit and if it does not function properly, repeat the adjustment.

91. Cleaning and Adjustment of 255–A type Relays

a. General. If a relay is found to be causing trouble or if preventive maintenence operations show that the relay should be cleaned or readjusted (par. 46) remove it from its operating position for repairs. After inspection and cleaning, readjust the relay according to *e* below if Test Set I–193–A is not available. If Test Set I–193–A is available follow the instruction in TM 11–2513.

b. List of Tools Required.

2 No. 340 Tool
1 No. 265C Contact burnisher
1 KS–2663 File
1 74D Thickness gauge
1 Orange stick
1 209 Shunt tool

c. Inspection of Relay Contacts. Inspect the relay contacts in a good light. If the contacts appear black or burned or have a sooty deposit, replace the relay with a spare, if one is available. The replaced relay requires cleaning and readjustment according to *d* and *e* below. If the contacts on examination do not appear black or burned, make a further check for contact build-ups by holding the arma-

ture lightly against one contact and checking if the 0.003-inch blade of the No. 74D gauge passes easily between the armature and the other contact. Repeat for the other contact gap. If the 0.003-inch blade passes easily through the contact gap, check that the contact gap is not too wide by holding the armature lightly against one contact and checking that the 0.005-inch blade of the No. 74D gauge does *not* pass through the gap easily. Repeat for the other contact. If a gap wider than 0.005 inch is found the relay requires cleaning and readjustment in accordance with *e* below.

d. CLEANING. When inspection indicates need for cleaning a 255–A type relay, back off the contact screws sufficiently to permit a KS-2663 file to enter easily between the contact and armature. Insert an orange stick between the contact springs. To avoid damage to the springs, avoid inserting the stick far enough to bend the springs. Insert a No. KS–2663 file parallel to the axis of the armature. The use of the orange stick and the file or burnisher are indicated in figure 94. The file should be used in the same manner as the burnisher shown in this figure.

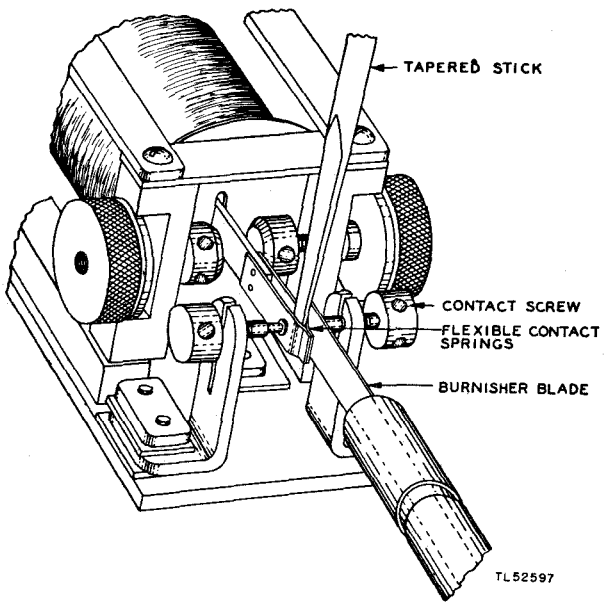


Figure 94. Use of orange stick, file or burnisher.

File the armature contact, being careful to move the file in and out parallel to the axis of the armature. The contacts of the armature are of moderately soft alloy. It is therefore necessary to avoid excessive filing so that no more material will be removed from the contacts than is absolutely necessary. Move the file several strokes and then examine the contacts to determine if the pit has been removed before again applying the file. After filing, burnish the contacts with burnisher No. 265C as shown in figure 88. Do not handle the burnisher with the fingers. Before using the burnisher blade, be sure to clean it with a clean lintless cloth moistened with dry-cleaning solvent (SD). Move the blade of the burnisher in and out parallel to the axis of the armature. If the relay armature or contacts have a sooty deposit add gas-adsorbing units to the side of the relay as indicated in figure 95. Clean the pole piece surfaces. Loosen the knurled tension nuts on the pole screws of the 255–A type relay with the fingers. Insert the blade of a screw driver per KS–6854 in the pole-screw slot and turn it counterclockwise to back off each pole screw as far as it will go. Remove any foreign material on the pole screws by pressing friction tape lightly against the pole screw. The friction tape can be applied conveniently if it is wrapped around the flattened end of an orange stick. Use friction tape only once and do not rub the pole screws with it. Clean the relay cover. Invert the relay cover and tap it to loosen dirt. Wipe the cover with a dry, lint-free cloth.

92. Readjustment of 255–A type Relays

a. ARMATURE. Turn both contact screws with the No. 340 tool in the direction which moves them away from the armature. Loosen the knurled tension nuts with the fingers and back off the pole screw on each side as far as they will go. Remove the armature and check that the armature is straight. The tips of the flexible contact springs shall be approximately flat, shall bear upon each other at the top and bottom edges and shall make at least a line contact for at least 25 percent of the distance across the $\frac{3}{16}$-inch width. Gauge by eye. If the tips of the flexible contact springs do not rest against each other properly, back off the contact screws with the No. 340 tool and adjust the tips of the springs as required, using the 363 spring adjuster. Reset the contact screws to meet contact travel requirements. (See par. 89*g*(1).) Check that the flexible springs rest against each other, in line with the armature, with a pressure of 20 to 50 grams measured on one spring at the contact with the other spring held so that it cannot follow its mate. Use the 70D gauge to measure the tension and hold the

other spring with the flat end of the KS–6320 orange stick. Replace the armature. Place the 209 shunt tool across the pole piece brackets directly in front of the pole pieces. Check that the armature is positioned in the center of the relay. Armature position may be adjusted by backing off slightly four screws, two armature block assembly screws on top and two assembly screws on the bottom of the relay. Check that the armature position has not changed. Check the position of the coil. The coil should be positioned so that the armature is equidistant from both sides of the coil. To position the coil, it is necessary to loosen two coil mounting screws on the bottom of the relay. Tighten all screws. Remove the 0.005-inch blade from the 74D thickness gauge and place it between the front ends of the flexible contact springs, using an ohmmeter connected between terminals No. 1, No. 3, and No. 4; turn up the contact screws until they just make contact with the armature. Remove the 0.005-inch thickness gauge. The armature now should have 0.005-inch travel and rest equidistant between the two contact screws. Armature travel limits may be checked by using the 0.003-inch and the 0.005-inch blades of the 74D gauge. Before using the blades, clean them with a clean, lint-free cloth moistened with dry-cleaning solvent (SD). Hold the armature lightly against one contact and check the contact gap. The 0.003-inch blade of the 74D gauge should pass easily between the armature and the contact and the 0.005-inch blade should pass through with pressure. Check the contact gap on the other contact.

b. Pole Screws. Advance the right-hand pole screw with a screw driver per KS-6854 until the pole screw nearly touches the armature. Hold the pole screw in position with a No. 340 tool and tighten the knurled tension nut with the fingers until a noticeable increase in force is required to turn the pole screw. Advance the right-hand pole screw further, using a No. 340 tool until the armature contact touches the left-hand contact screw and then back off the right-hand pole screw more than one-fourth turn but less than one-half turn. Advance the left-hand pole screw until it nearly touches the armature; then tighten the knurled tension nut slightly on the left-hand pole screw as described previously for the right-hand screw. Adjust the left-hand pole screw until the armature will float between the two contacts. Remove the shunt tool. The armature should hold to either contact screw when placed there and should float between the contact screws when placed there. If this condition is not met, refine adjustments of the pole screws.

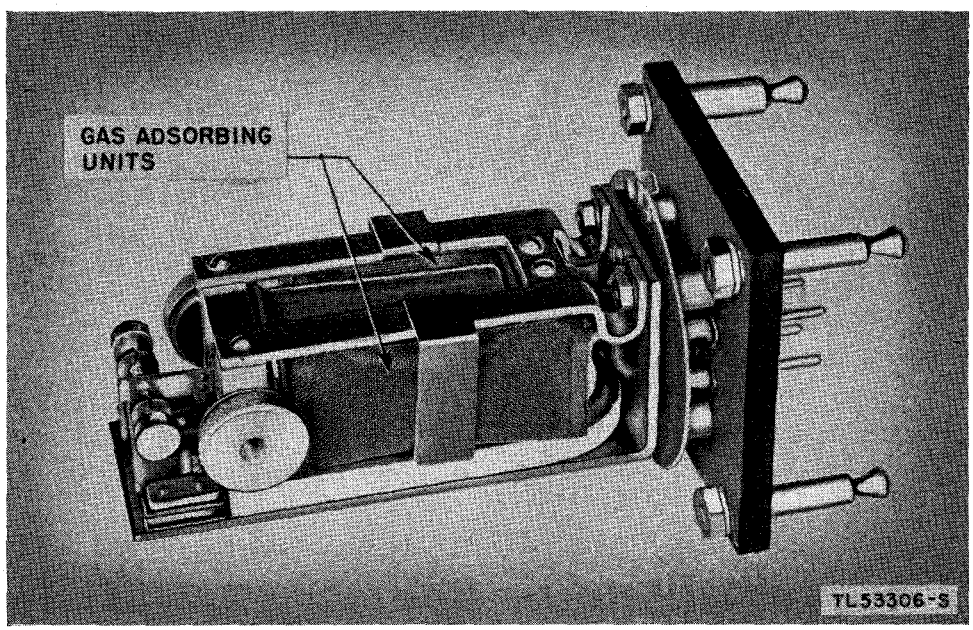


Figure 95. Relay with gas adsorbing units.

93. Requirements for Relay P

The electrical requirements for this relay are shown on the circuit requirement table of figure 108. The

contact pressure should be 18 grams, nominal. The contacts may be adjusted by changing the tension of the armature retractile spring or by carefully forming the flat springs which carry the contacts. The adjustment of the relay may be changed to make it operate on a lower voltage by changing the contact pressure, but these should not be less than the minimum given above. This may also be accomplished by adjusting the air gap. If the relay fails to release when the operating voltage is removed make a check for binding of the armature.

94. Maintenance of Power Unit (fig. 112)

a. Replace electrolytic capacitors C1 and C2 (fig. 112) with new ones about every 3½ years after date on capacitor. If the rectifier is not in use, operate it temporarily for ½ hour every 18 months to restore the film on the electrolytic capacitor plates. When this is impracticable, the same results can be obtained by connecting 100–130 volts dc for ½ hour in series with a 110–120-volt Mazda lamp across the rectifier output, + to terminal DC + and — to terminal DC—. An electrolytic capacitor if not connected to voltage for more than 18 months may be ruined.

b. If there is no output voltage the a-c input power may have been interrupted, the 10-ampere or 1.6-ampere fusetron may be blown, the safety switch on the door may be open or capacitory C1 or C2 may have failed because of shorting.

c. If the d-c output voltage is low the a-c input voltage may be low, the disks in the varistor unit may be aging or the unit may be operating under excessive load. A drop in output voltage due to aging of the disks may usually be offset by changing the rectifier taps. The maximum d-c output load should be 0.8 ampere.

d. If the d-c output voltage is high, the a-c input voltage may be high. If this high voltage occurs at no load resistor DC may be open.

e. If the d-c output voltage is erratic electrolytic capacitors C1 and C2 may be too old, there may be loose connections, probably at the capacitors or fuses or trouble may exist in connected circuits.

95. Painting and Refinishing

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

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

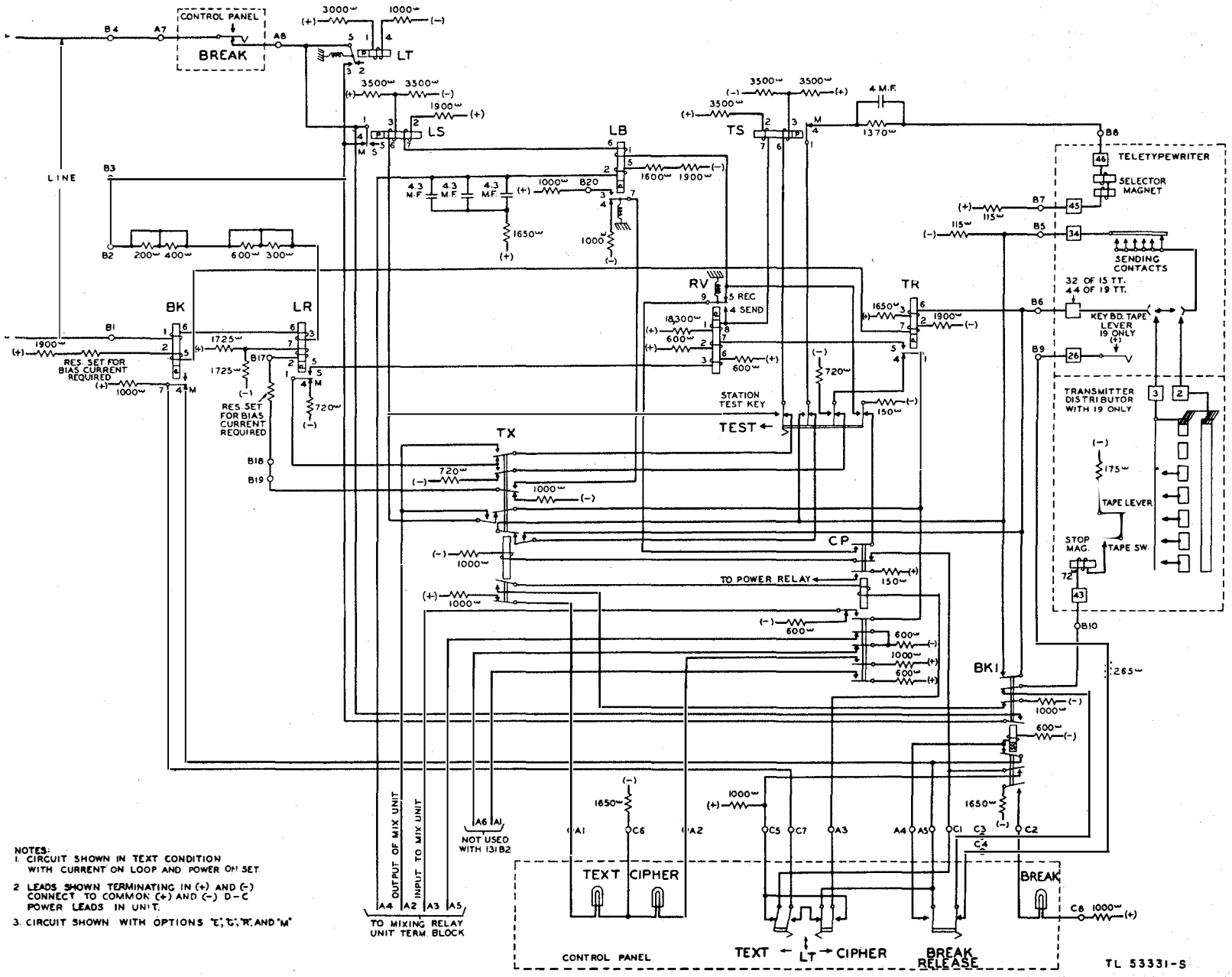


Figure 96. 131B2 set, repeater unit, functional diagram, single neutral transmission.

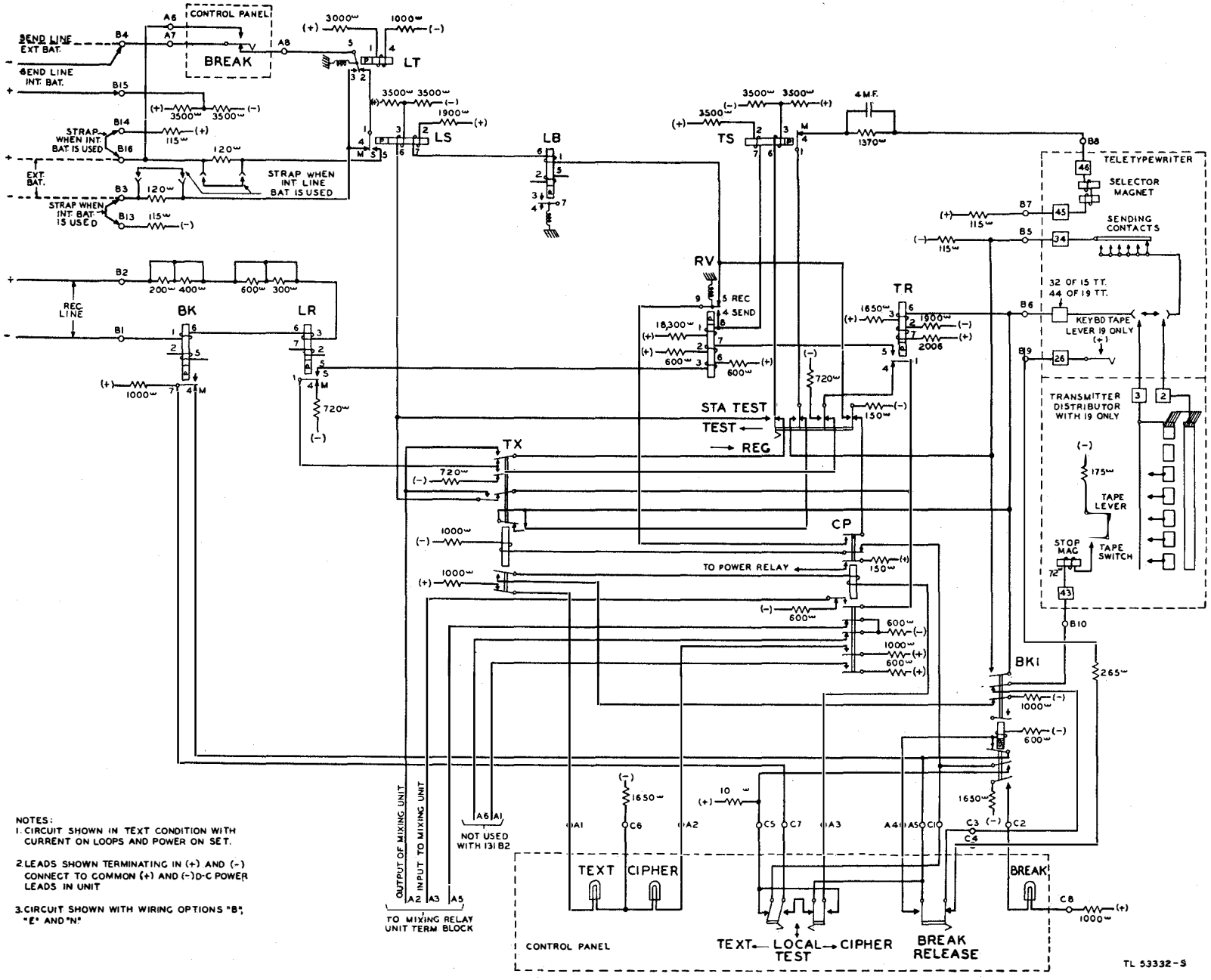


Figure 97. 131B2 set, repeater unit, functional diagram, single, separate send and receive lines, polar transmission.

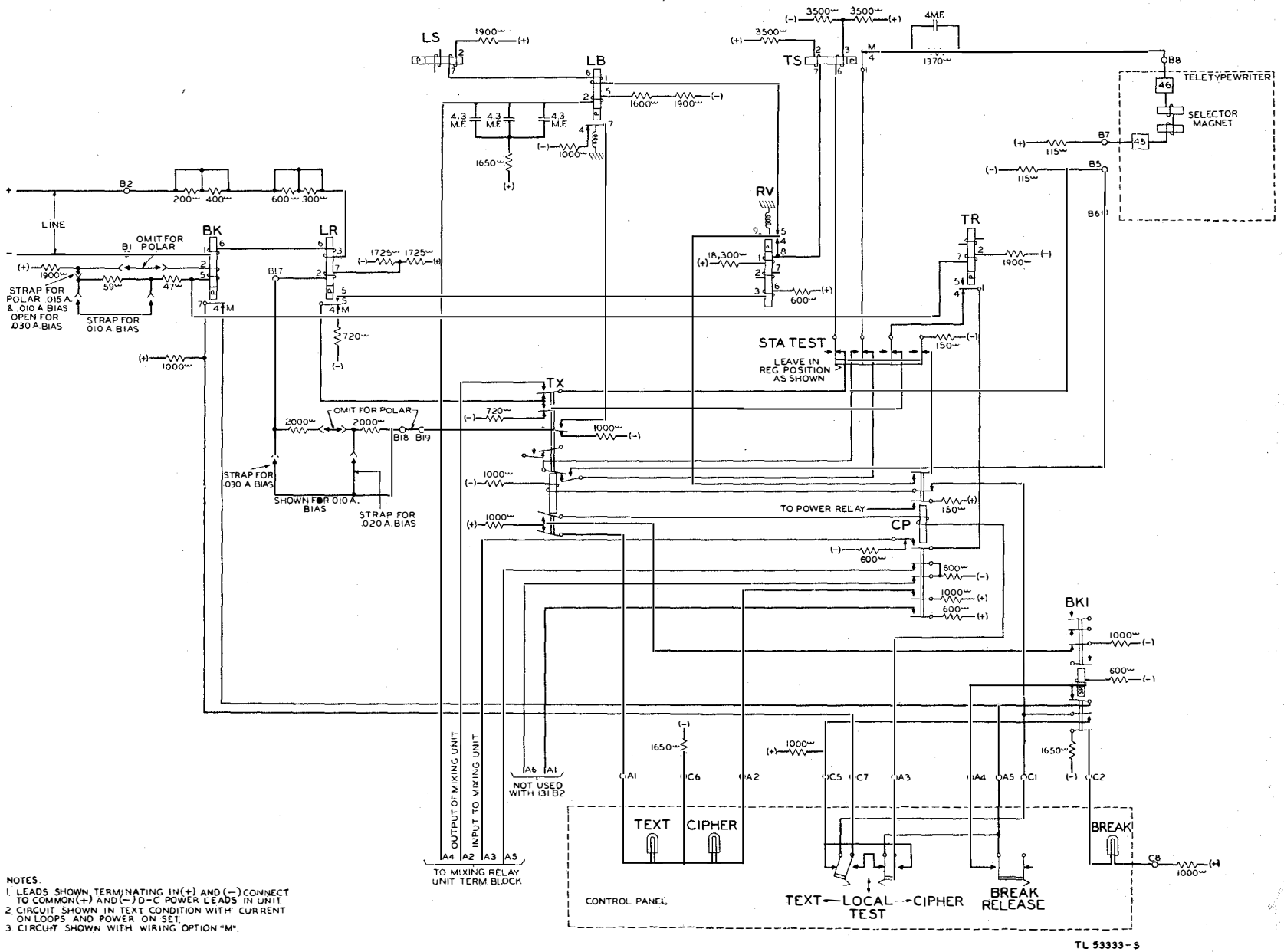


Figure 98. 131B2 set, repeater unit, functional diagram, receiving side, full duplex.

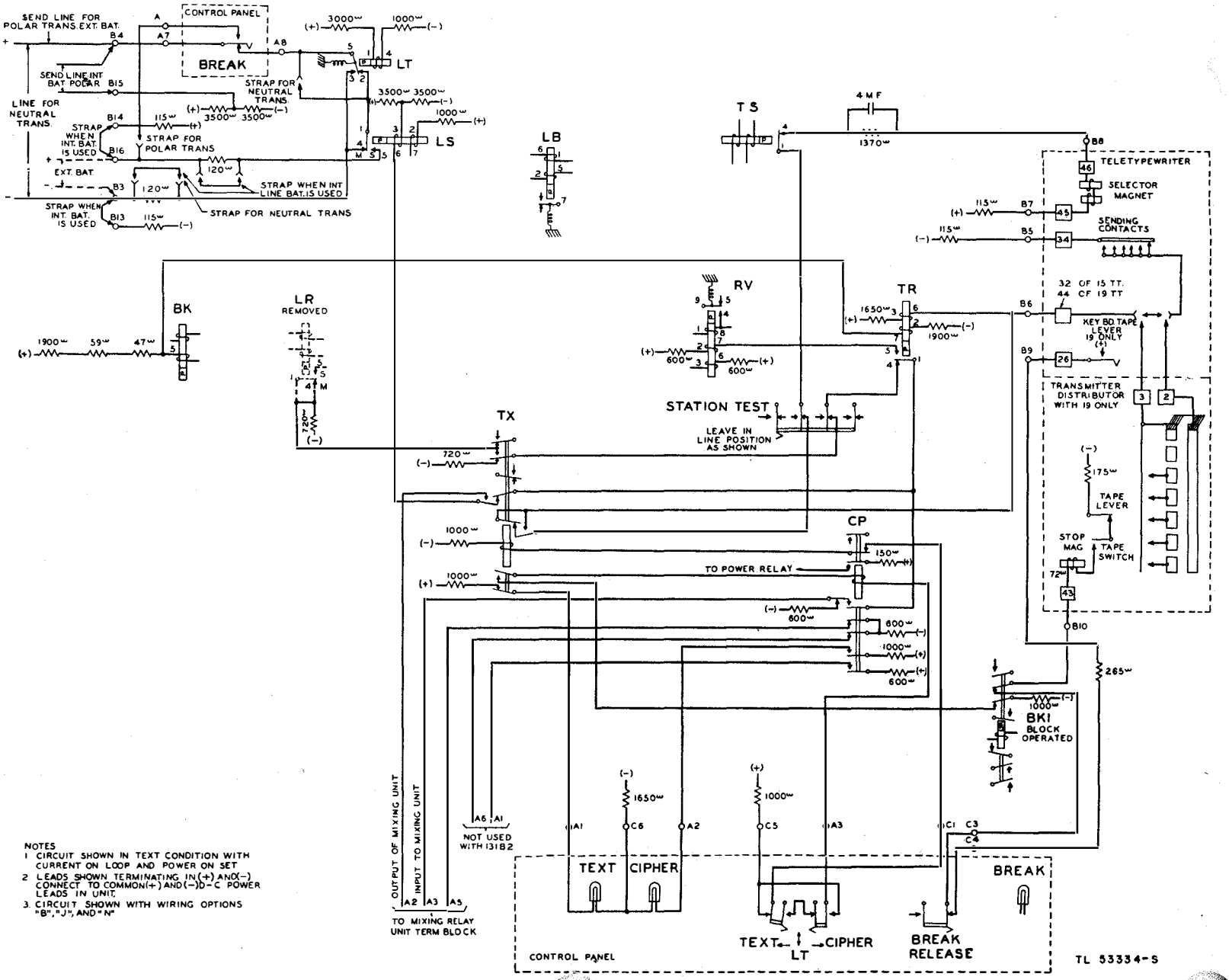


Figure 99. 131B2 set, repeater ... ctional diagram, sending side, full duplex.

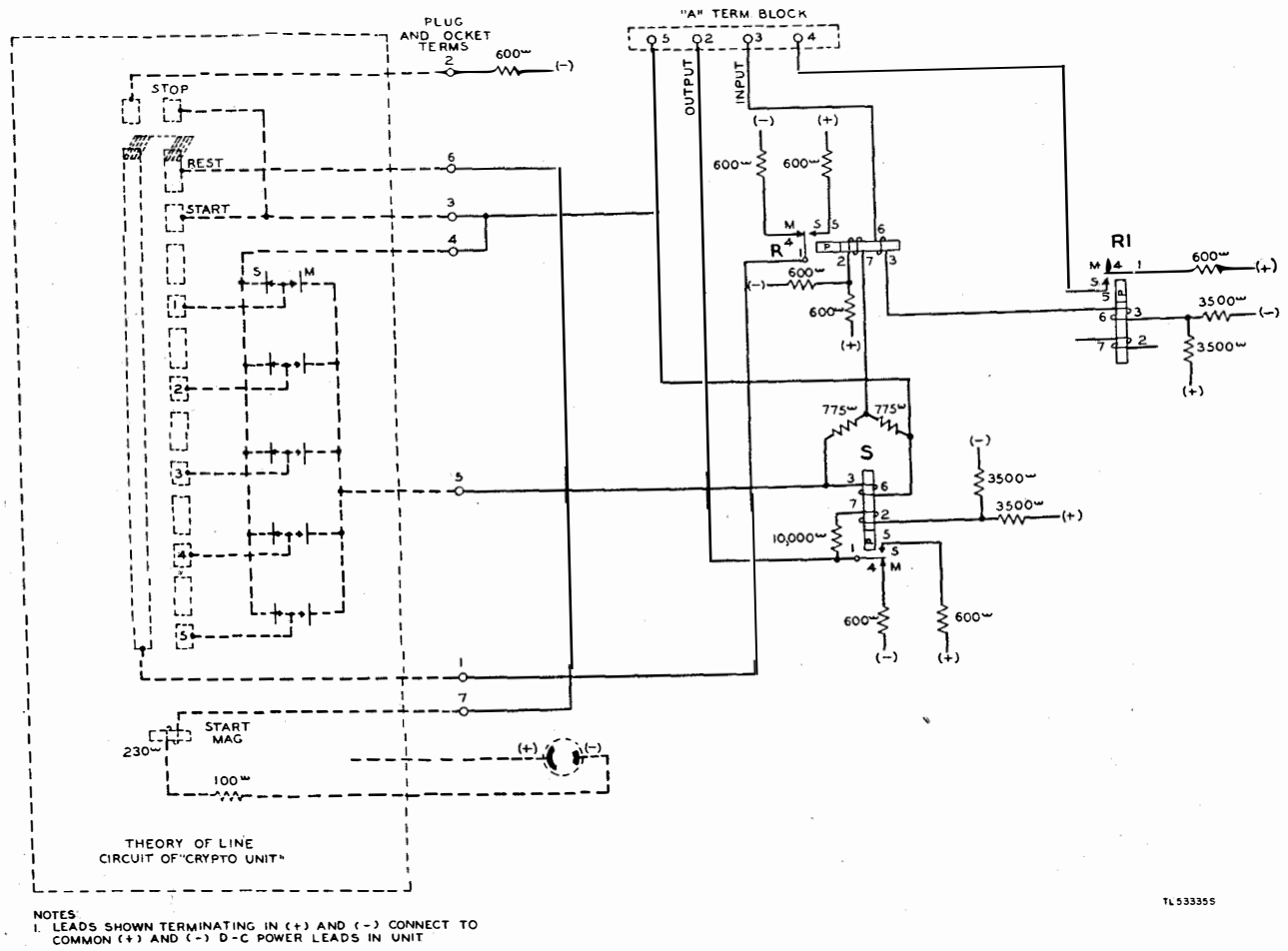


Figure 100. 131B2 set, mixing relay unit, functional diagram, using "crypto unit."

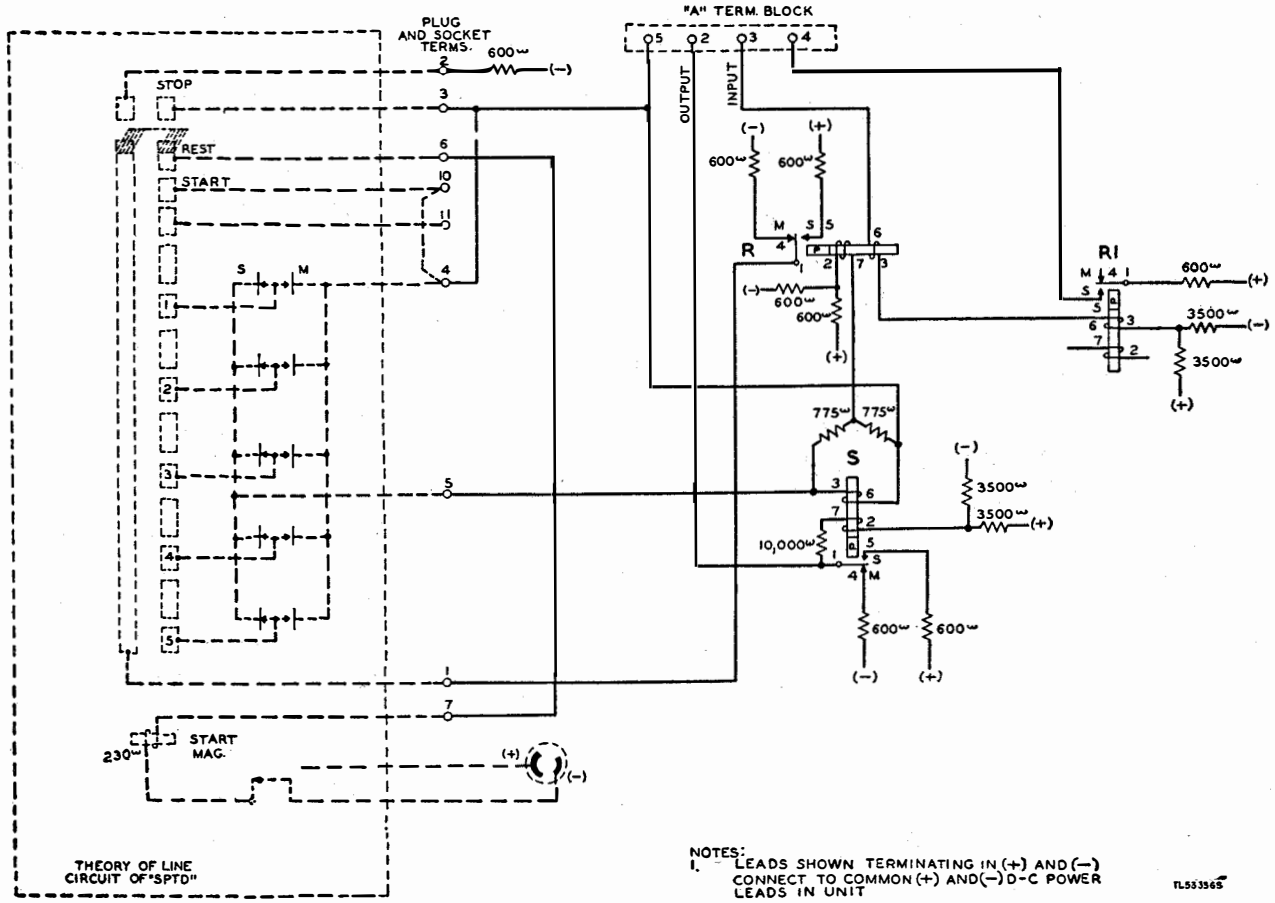


Figure 101. 131B2 set, mixing relay unit, functional diagram, using "SpTD unit."

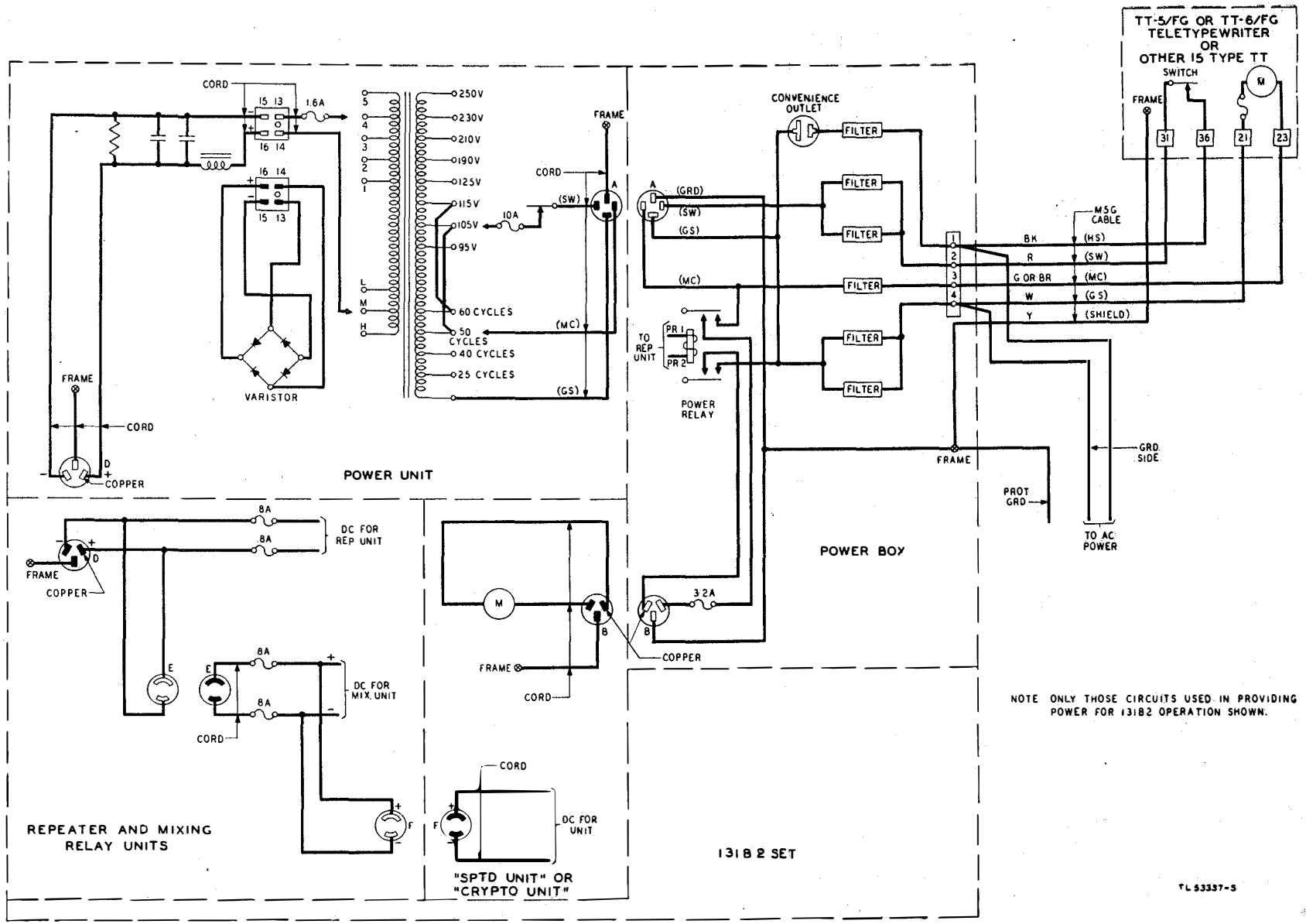
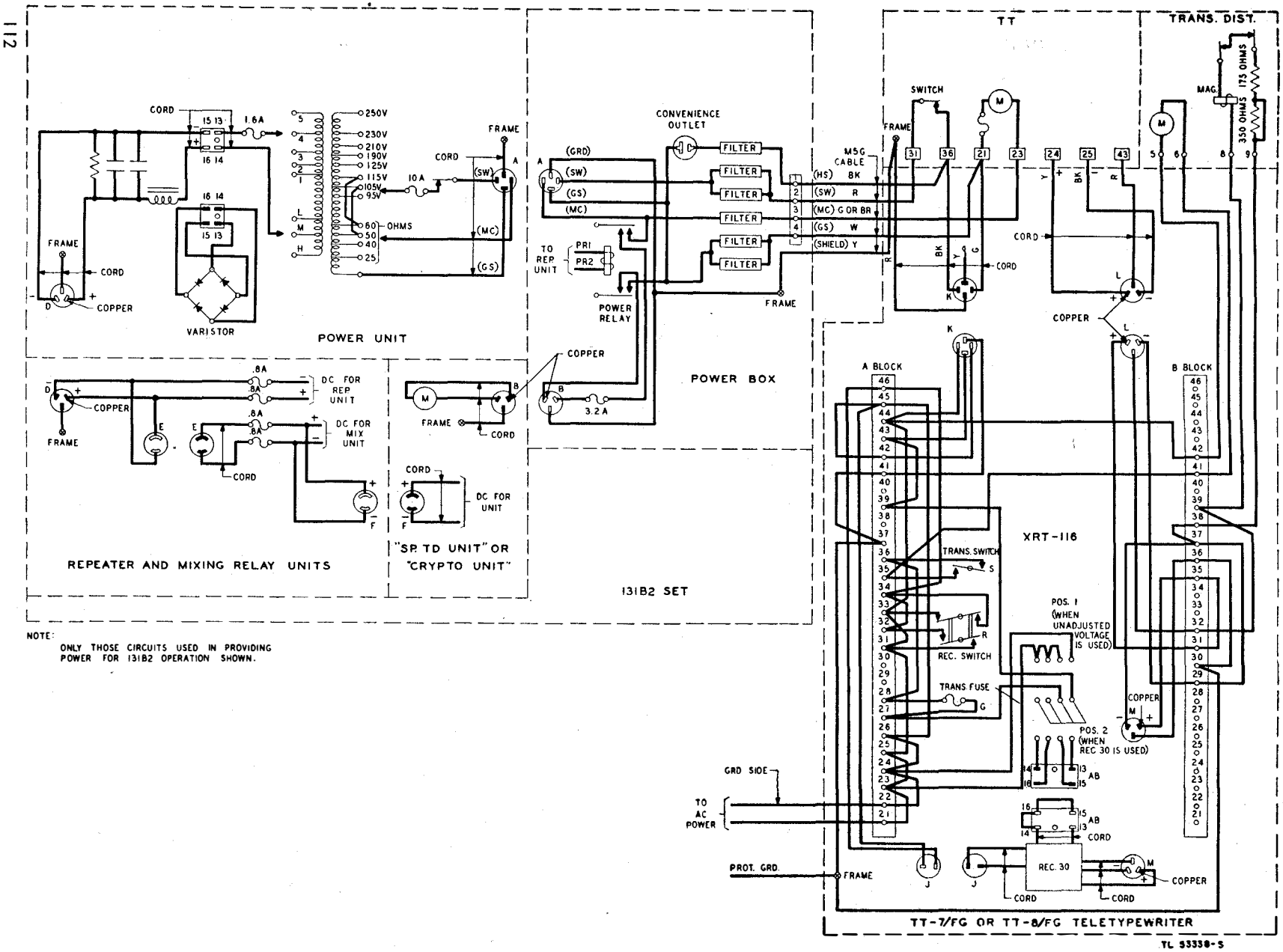
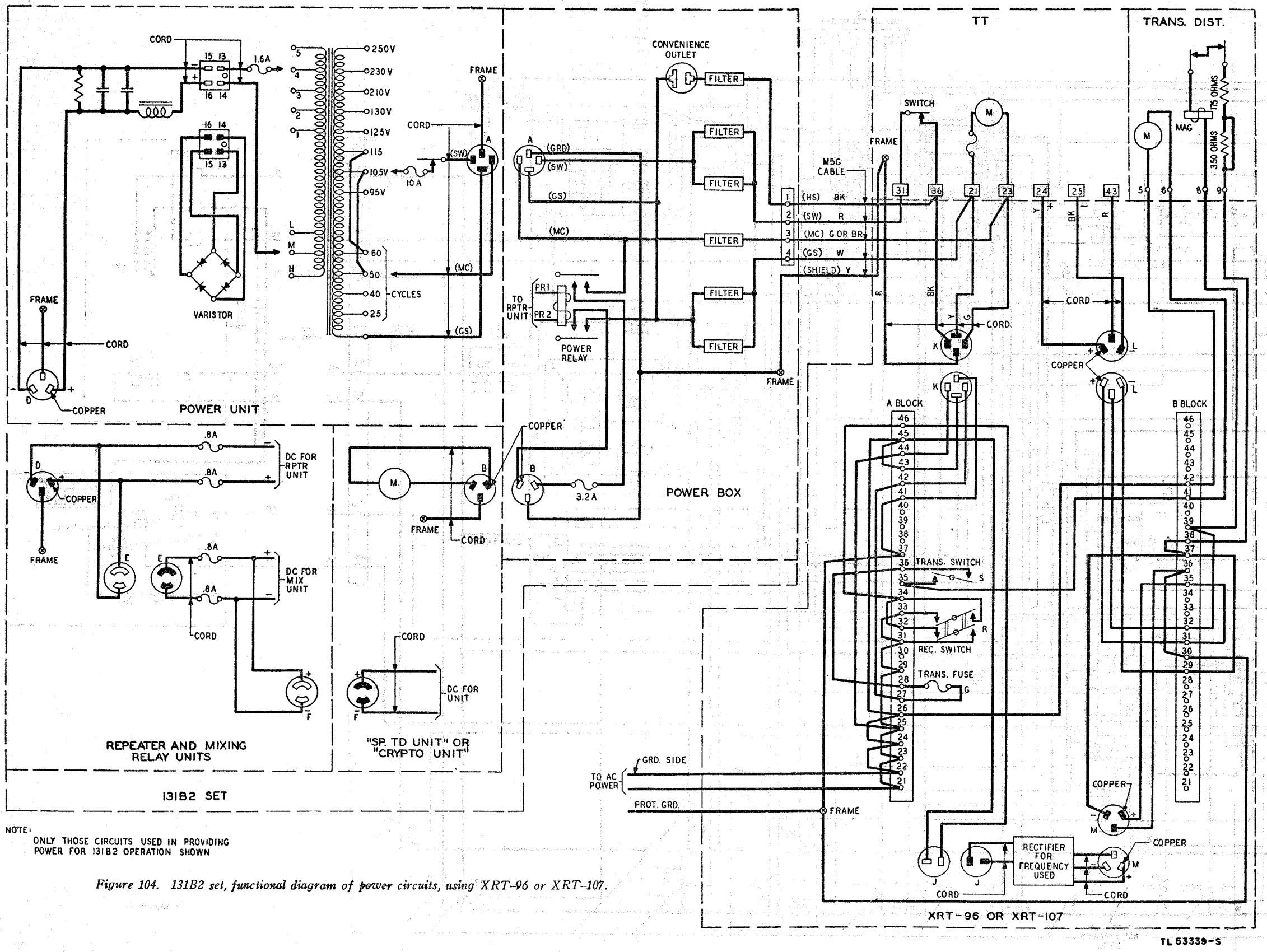


Figure 102. 131B2 set, functional diagram of power circuit, using TT-5/FG, TT-6/FG, or other 15-type set.



NOTE:
ONLY THOSE CIRCUITS USED IN PROVIDING POWER FOR 131B2 OPERATION SHOWN.

Figure 103. 131B2 set, functional diagram of power circuits, using TT-7/FG or TT-8/FG.



NOTE:
ONLY THOSE CIRCUITS USED IN PROVIDING POWER FOR 131B2 OPERATION SHOWN

Figure 104. 131B2 set, functional diagram of power circuits, using XRT-96 or XRT-107.

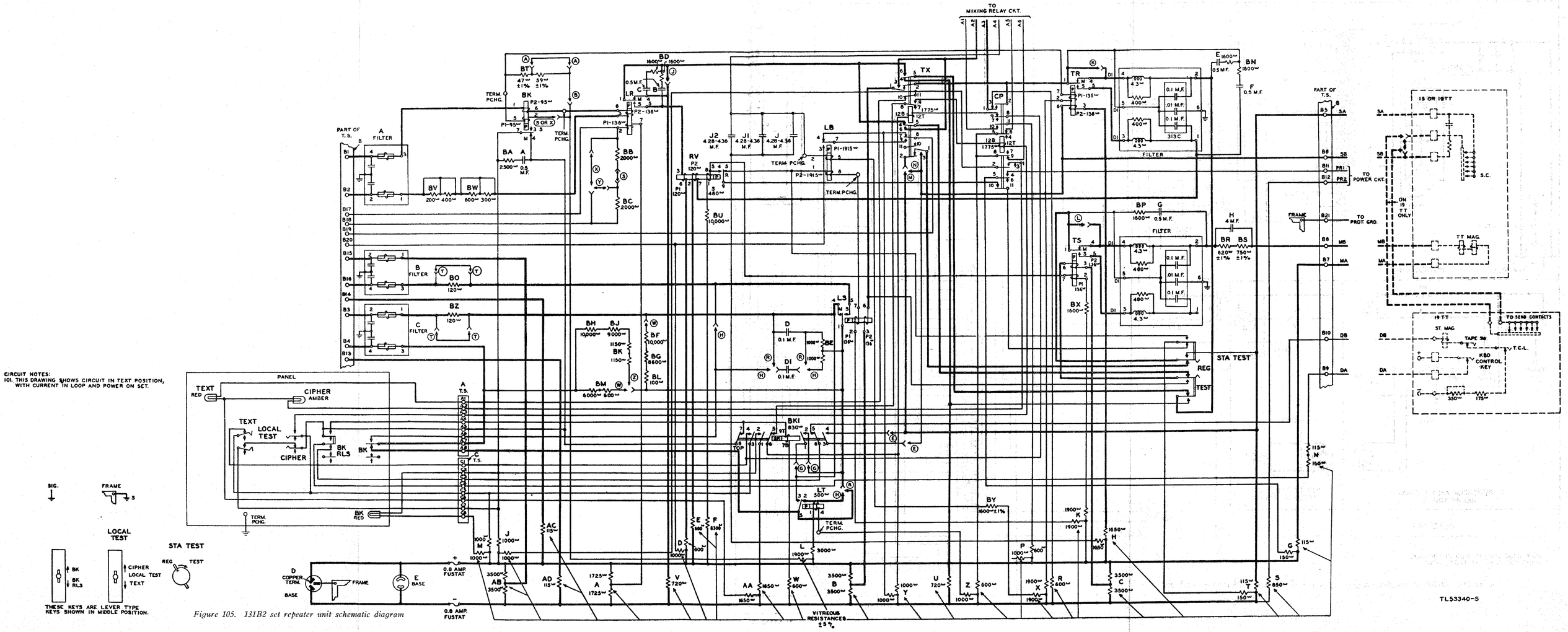


Figure 105. 131B2 set repeater unit schematic diagram

CIRCUIT REQUIREMENTS

APPARATUS DESIG.	APPARATUS CODE	MECH. REQ. BSP FIG.	MECH. REQ. CONT. PRESS.	MECH. REQ. ARM. TRVL.	CIRCUIT PREPARATION BLOCK OR INSULATE	CIRCUIT PREPARATION TEST CLIP DATA CONN. BAT.	CIRCUIT PREPARATION TEST CLIP DATA CONN. GRD.	TEST SET PREP.	SEE TEST NOTE NO.	DIRECT CURRENT FLOW REQ. TEST WDG.	DIRECT CURRENT FLOW REQ. TEST FOR	DIRECT CURRENT FLOW REQ. AFTER SOAK MA	DIRECT CURRENT FLOW REQ. TEST MA	DIRECT CURRENT FLOW REQ. READJ. MA	REMARKS	DWG. ISS. 3
RELAYS FIG. 1																
BK	239JS	13				5 (BK)	2 (BK)	NGB	1/2	P1	O	-40	2.3	2.2	REMOVE LEADS FROM TERM. PCHG. ASSOCIATED WITH 5 & 6 (BK)	
						6 (BK)	1 (BK)	NGB	1/2	P2	O	-40	2.3	2.2		
BK1	Y211	151/137	H	41	(BK)O	B (BK1)	T (BK1)	NGB	1/2		O	40	28	27	KEY OPERATED TO (TEXT) POS.	
					(BK)O	B (BK1)	T (BK1)	NGB	1/2		R		1.1	1.2		
CP	U1112	163/163	H	59	(TX)O	B (CP)	T (CP)	NGB	1/2		O		17.5	16.5		
LB	239JE	6		MIN. 3 MAX. 4		5 (LB)	2 (LB)	NGB	1/2	P1	O	-15	2.3	2.2	REMOVE LEADS FROM TERM. PCHG. ASSOCIATED WITH 2 & 6 (LB)	
						5 (LB)	2 (LB)	NGB	1/2	P1	R	15	1.1	1.2		
						6 (LB)	1 (LB)	NGB	1/2	P2	O	-15	2.3	2.2		
LT	239FM	3				4 (LT)	1 (LT)	NGB	1/2		O	-15	8.7	8.3	REMOVE LEAD FROM TERM. PCHG. ASSOCIATED WITH 4 (LT)	
						4 (LT)	1 (LT)	NGB	1/2		R	15	3.1	3.3		
Rv	239JC	3				6 (RV)	3 (RV)	NGB	1/2	P1	O	-50	5.3	5		
						6 (RV)	3 (RV)	NGB	1/2	P1	R	50	1.1	1.2	REMOVE (LR), (TR), & (TS) RELS.	
						7 (RV)	2 (RV)	NGB	1/2	P2	O	-50	5.3	5		
						7 (RV)	2 (RV)	NGB	1/2	P2	R	50	1.1	1.2		
						8 (RV)	1 (RV)	NGB	1/2	S	O		4.1	3.9		
TX	U1112	163/163	H	59	(CP)O	B (TX)	T (TX)	NGB	1/2				17.5	16.5		

TEST NOTES:

1. USE 45V. "B" BAT. FOR ALL TESTS CONNECTING NEG. TO THE BAT. TERM. AND POS. TO THE GRD. TERM. OF TEST SET I-181.
2. ALL POWER TO BE REMOVED FROM THE UNIT.

TI 533415

Figure 106. 131B2 set, repeater unit, circuit requirement table.

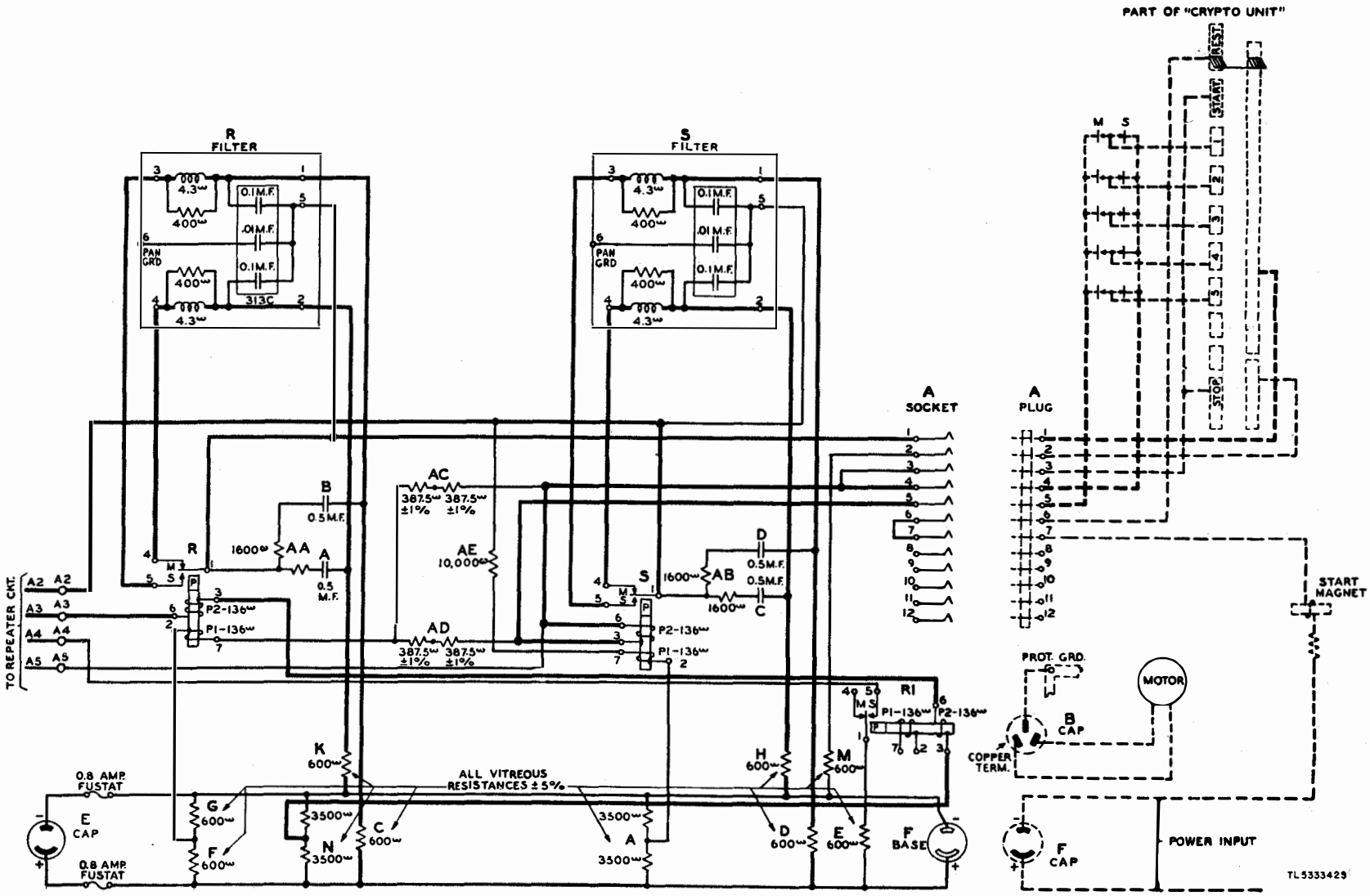
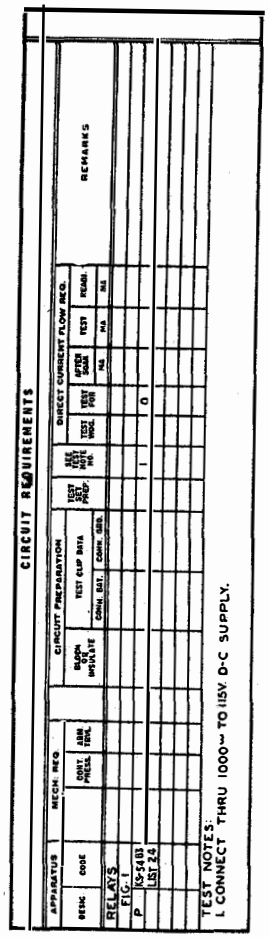


Figure 107. 131B2 set, mixing relay unit, schematic diagram.



CIRCUIT NOTES:

101. THE LETTERS ASSOCIATED WITH CAPS OR BASES INDICATE THAT CONNECTION SHOULD BE MADE TO RECEPTACLES OR CAPS HAVING SIMILAR LETTERS THESE LETTERS ARE NOT EQPT. DESIGNATIONS

102. PROVIDE FIGS. FOR POWER CONDITIONS AS FOLLOWS:

POWER SUPPLY	FIGURE	OPTION
A-C SUPPLY	1 & A	
115V. D-C POSITIVE GROUNDED	1 & B	X
115V. D-C UNGROUNDED OR NEGATIVE GROUNDED	1 & B	Y

FIG. A
SEE NOTES
101 & 102

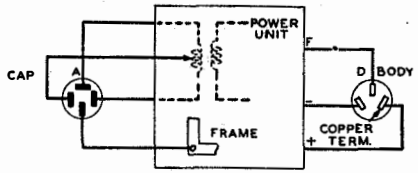


FIG. B
SEE NOTES
101 & 102

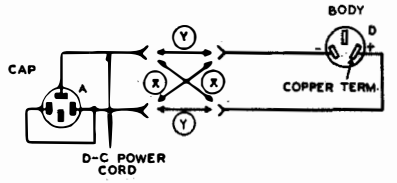


FIG. C
SEE NOTES
101 & 102

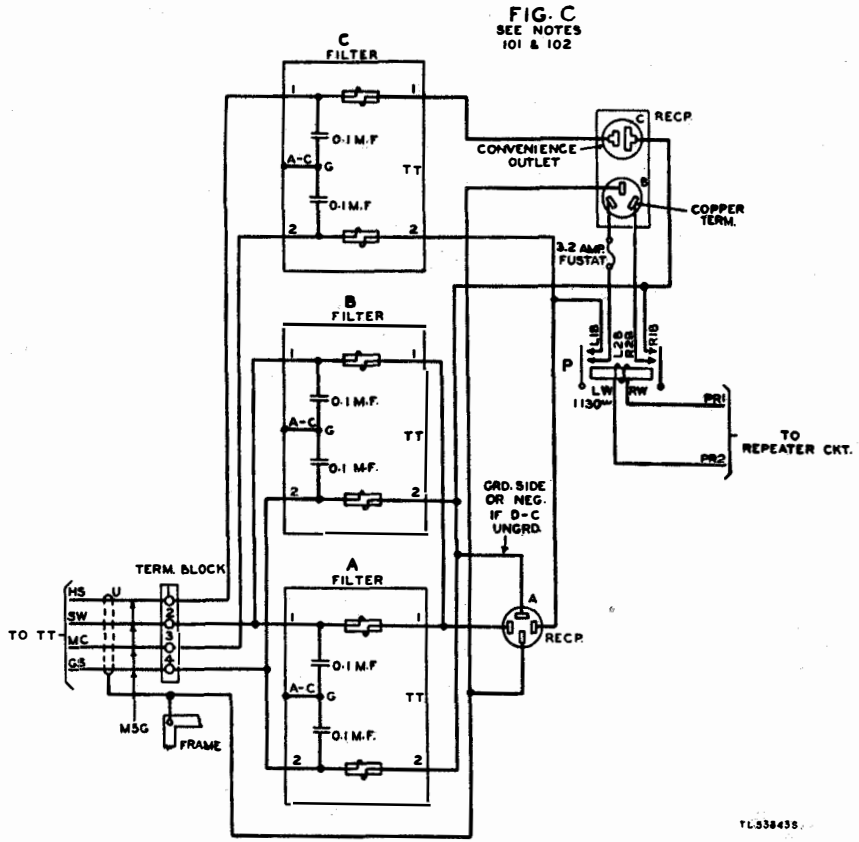


Figure 108. 131B2 set, power circuit, schematic diagram.

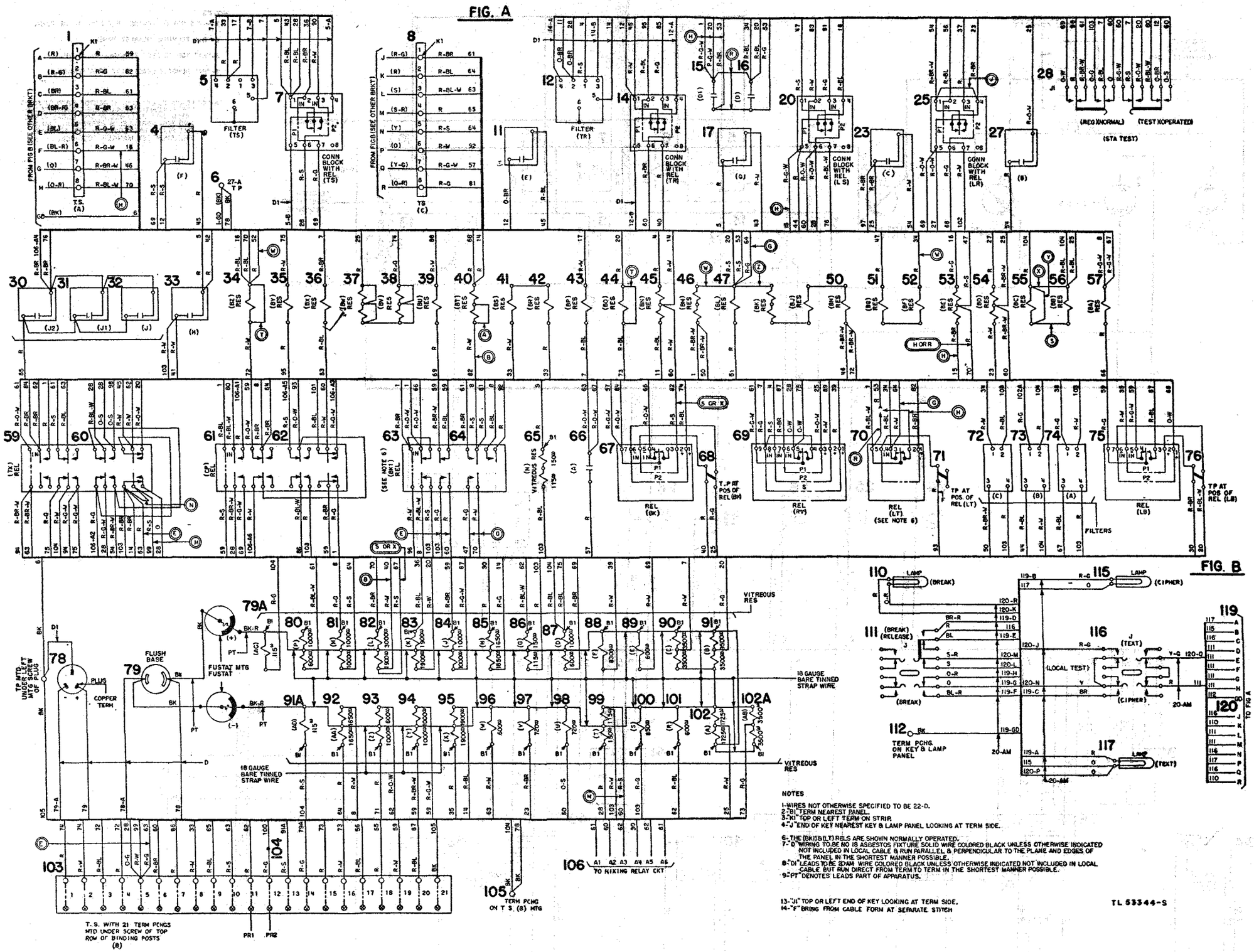


Figure 109. 131B2 set, repeater unit, wiring diagram.

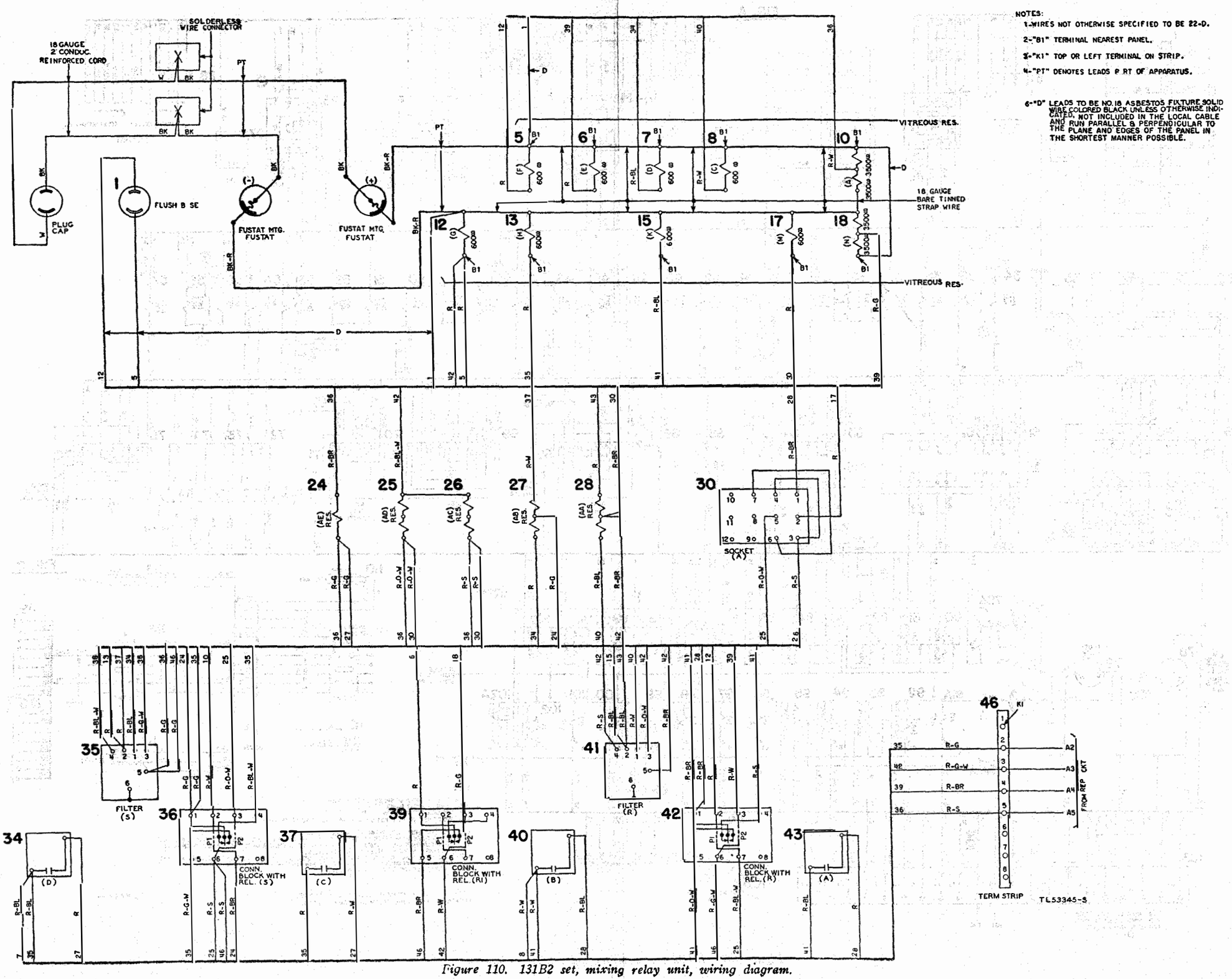
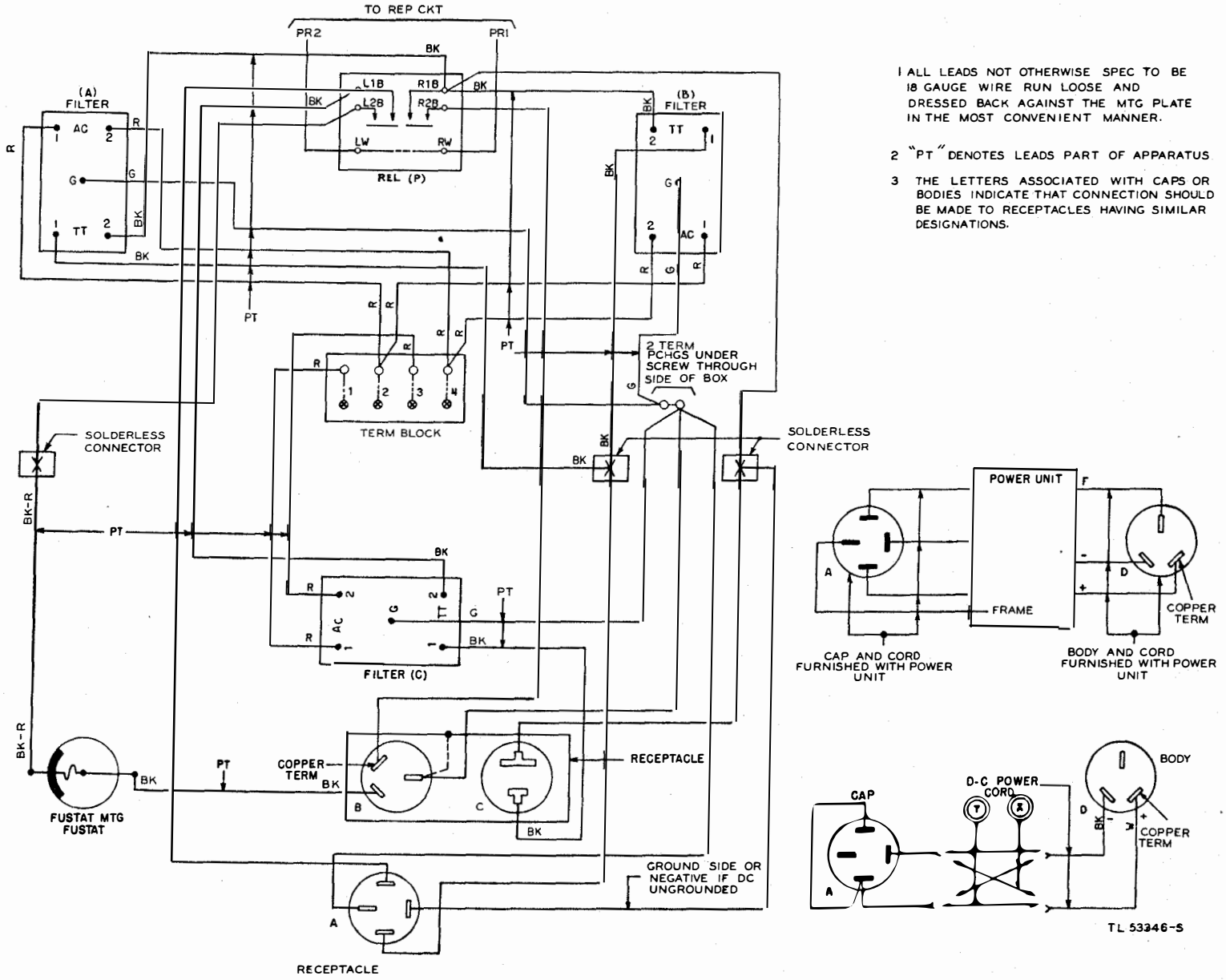


Figure 110. 131B2 set, mixing relay unit, wiring diagram.

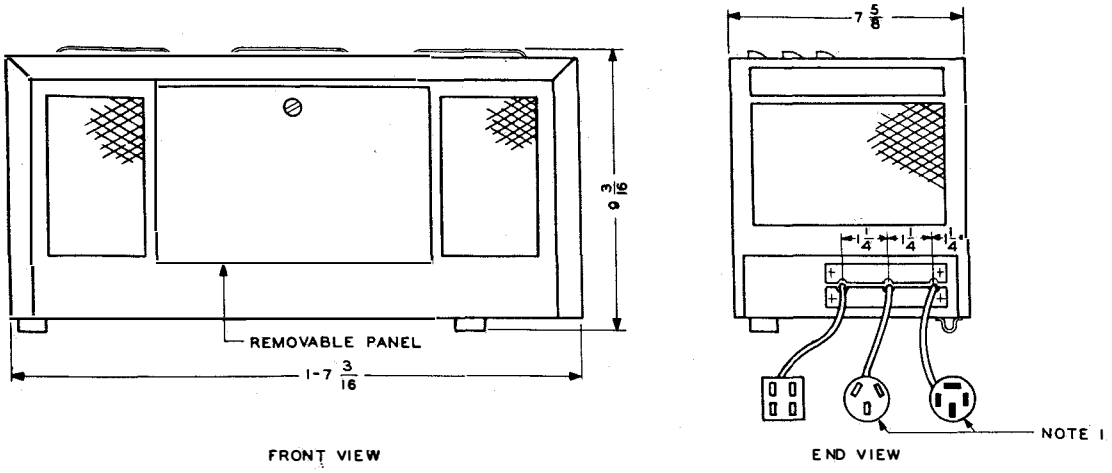


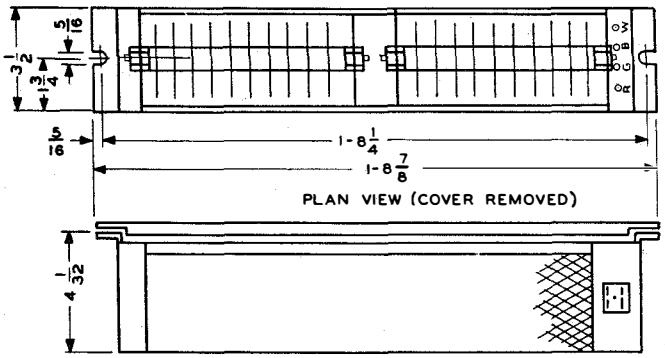
1 ALL LEADS NOT OTHERWISE SPEC TO BE 18 GAUGE WIRE RUN LOOSE AND DRESSED BACK AGAINST THE MTG PLATE IN THE MOST CONVENIENT MANNER.

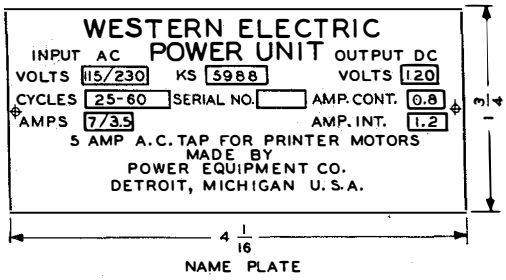
2 "PT" DENOTES LEADS PART OF APPARATUS

3 THE LETTERS ASSOCIATED WITH CAPS OR BODIES INDICATE THAT CONNECTION SHOULD BE MADE TO RECEPTACLES HAVING SIMILAR DESIGNATIONS.

Figure 111. 131B2 set, power circuit, wiring diagram.







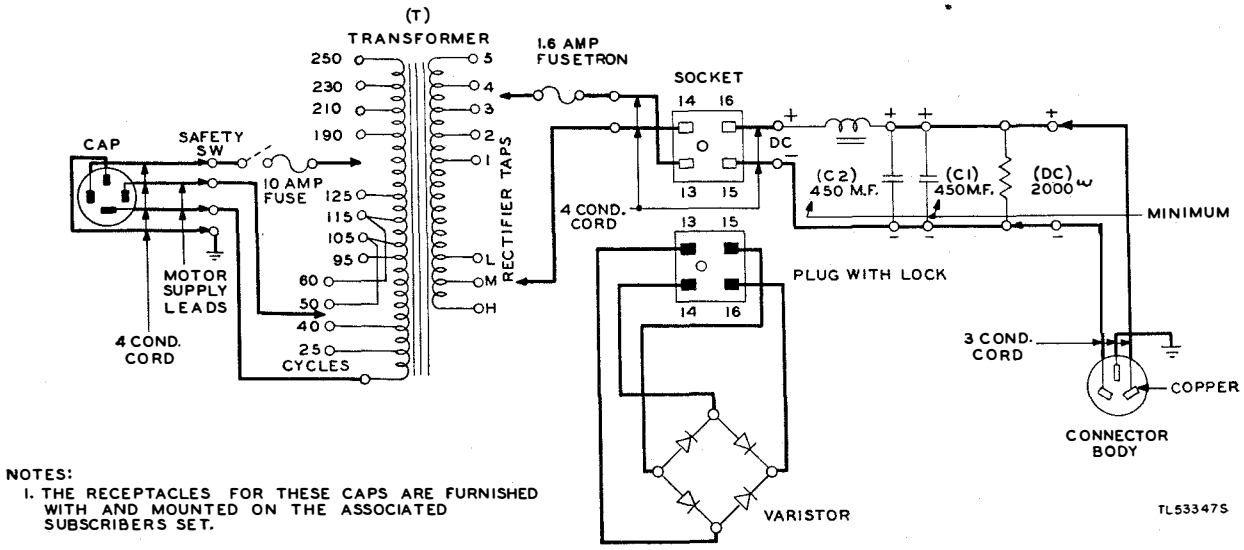


Figure 112. Power unit, disk-type rectifier, manual regulation.

APPENDIX I

REFERENCES

Note. For availability of items listed, check FM 21–6, and ASF Catalog SIG 2. Also see FM 21–6 for applicable Technical Bulletins, Supply Bulletins, Modification Work Orders, and Changes.

1. Army Regulations

AR 380–5 ..... Safeguarding Military Information.

2. Parts List

SIG 1 ..... Introduction to ASF Signal Supply Catalog.
SIG 3 ..... List of Items for Troop Issue.
SIG 4–1 ..... Allowances of Expendable Supplies.
SIG 4–2 ..... Allowances of Expendable Supplies for Schools, Training Centers, and Boards.
SIG 5 ..... Stock List of All Items.
SIG 6 ..... Sets and P & I Control List.
SIG 10 ..... Fixed Plant.
SIG 11–8 ..... Chests for Running Spares.
SIG 11–10 ..... Signal Corps Kit and Materials for Moisture and Fungi-Resistant Treatment.

3. Technical Manuals on Associated Equipment and Test Equipment

TM 11–351 ..... Telegraph Sets TG–5, TG–5–A, and TG–5–B.
TM 11–352 ..... Printer TG–7–A and Teletypewriters TG–7–B and TG–37–B.
TM 11–354 ..... Telegraph Printer Sets (Teletypewriter) EE–97 and EE–98; Teletypewriter Sets EE–97–A, EE–98–A, EE–102.
TM 11–355 ..... Telegraph Terminal CF–2–A (Carrier).
TM 11–355B ..... Telegraph Terminal CF–2–B (Carrier).
TM 11–356 ..... Radio Teletype Terminal Equipment AN/FGC1 or AN/FGC–1X.
TM 11–358 ..... Telegraph Central Office Set TC–3.
TM 11–359 ..... Line Unit BE–77, BE–77–A, and BE–77–B.
TM 11–2004 ..... Repeater Set TC–18 (Terminal, Telegraph).
TM 11–2005 ..... Repeater Set TC–19 (Intermediate).
TM 11–2009 ..... Telegraph Terminal CF–6 (Carrier).
TM 11–2029 ..... Preliminary Instructions, Voice-frequency Carrier Telegraph Packaged Equipment.
TM 11–2034 ..... Preliminary Instructions, D-C Telegraph Repeater Packaged Equipment.
TM 11–2036 ..... Test Set I–181.
TM 11–2201 ..... Reperforator Teletypewriter Sets TC–16 and TC–17.
TM 11–2203 ..... Teletypewriter Set AN/TGC–1.
TM 11–2210 ..... 132A2 Teletypewriter Subscriber Set and Associated Equipment.
TM 11–2211 ..... Instruction Book, 133A1 Teletypewriter Table and Associated Printer Apparatus.

TM 11–2214 ..... 133A2 Teletypewriter Subscriber Set and Associated Equipment.
TM 11–2215 ..... Teletypewriters TT–5/FG and TT–6/FG.
TM 11–2216 ..... Teletypewriters TT–7/FG and TT–8/FG.
TM 11–2220 ..... Reperforator Transmitters TG–26–A and TG–27–A.
TM 11–2221 ..... Receiving Transmitter Distributers Models 14AA, 14AB, 14AD, and 14ABM.
TM 11–2513 ..... Test Set I–193–A.

4. Painting, Preserving, and Lubrication

TB SIG 13 ..... Moistureproofing and Fungiproofing Signal Corps Equipment.

5. Shipping Instructions

U. S. Army spec No.
100–14A ..... Army-Navy General Specifications for Packaging and Packing for Overseas Shipment.

6. Decontamination

TM 3–220 ..... Decontamination.

7. Demolition

FM 5–25 ..... Explosives and Demolitions.

8. Camouflage

FM 5–20 ..... Camouflage, Basic Principles.

9. Other Technical Publications

FM 11–5 ..... Mission, Functions, and Signal Communication in General.
FM 11–22 ..... Signal Operations in the Corps and Army.
FM 24–5 ..... Signal Communication.
FM 24–8 ..... Combined Teletypewriter (Teleprinter) Procedure.
FM 24–14 ..... Teletypewriter Switching and Relay Procedures.
FM 24–20 ..... Field Wire Systems.
TB SIG 24 ..... Inspection Procedure for Repaired Electrical Indicating Instruments.
TB SIG 64 ..... Expedient Means of Determining Power-supply Frequency in the Field Using Teletypewriter Line Unit BE–77–A or BE–77–B.
TB SIG 66 ..... Winter Maintenance of Signal Equipment.
TB SIG 69 ..... Lubrication of Ground Signal Equipment.
TB SIG 72 ..... Tropical Maintenance of Ground Signal Equipment.
TB SIG 75 ..... Desert Maintenance of Ground Signal Equipment.
TB SIG 103 ..... Nomenclature Designations in Signal Corps Publications.
TM 11–353 ..... Installation and Maintenance of Telegraph Printer Equipment.
TM 11–369 ..... Spiral-Four Cable.
TM 11–430 ..... Batteries for Signal Communication, Except those pertaining to Aircraft.
TM 11–450 ..... Training of Signal Communication Personnel.
TM 11–455 ..... Radio Fundamentals.
TM 11–456 ..... Wire Telegraphy.
TM 11–469 ..... Communication Security.
TM 11–472 ..... Repair and Calibration of Electrical Measuring Instruments.

TM 11–486	Electrical Communication Systems Engineering.
TM 11–487	Electrical Communication Systems Equipment.
TM 11–498	Fundamentals of Telephony and Manual Telegraphy.
TM 11–755	Grounds, Grounding Procedure, and Protective Devices for Wire Communication Equipment.
TM 11–2001	Complete 100-mile Spiral—Four Carrier System.
TM 11–2253	Open Wire Construction for Fixed Plant Application.

10. Forms

WD AAF Form 54	Unsatisfactory Report.
WD AGO Form 468	Unsatisfactory Equipment Report.

11. Abbreviations

A	adjust
ac	alternating current
amp	ampere
&	and
BR	brown
X	by
C	clean
cond	conductor
dc	direct current
F	feel
fig.	figure
freq.	frequency
ft	foot
G	green
hex.	hexagonal
I	inspect
in.	inch
KBD	keyboard
L	lubricate
lb	pound
max	maximum
min	minimum
MFP	moistureproofed and fungiproofed
No.	number
#	number
par.	paragraph
R	red
REC	record
rect	rectifier
RH	roundhead
spec	specification
STA	station
subpar.	subparagraph
T	tighten
TR	transmitter-receiver
TT	teletypewriter
W	white
WD AGO	War Department, Adjutant General's Office

12. Glossary

The following glossary contains information in explanation of technical terms used in this manual.

Battery. The term battery normally is used when referring to a group of dry cells or storage cells. In telegraph communication it is common usage to refer to any d-c source used in production of telegraph signals as battery. Consequently this manual applies the term to the dc supplied by the rectifier.

Duplex system. A telegraph system which affords simultaneous independent operation in opposite directions over the same channel.

Full-duplex operation. Full-duplex operation of a telegraph system is simultaneous operation in both directions.

Half-duplex operation. Half-duplex operation of a telegraph system is operation of a duplex system arranged to permit operation in either direction at a time but not in both directions simultaneously.

Mark. In neutral operation, the closed circuit signal is referred to as a mark, and the open circuit signal is known as a space. In other than neutral operation, the term mark is applied to the circuit condition which will produce the same result in the terminal equipment that a mark signal produces in neutral operation. Similarly, the term space is applied to the circuit condition which will produce the same result in the terminal equipment that a space signal produces in neutral operation.

Neutral operation. Marking signals are formed

by current pulses of one polarity, either positive or negative, and spacing signals are formed by reducing the current to zero or nearly zero.

Neutral relay. A relay which operates in exactly the same way, regardless of the direction in which current flows through its windings.

On line operation. Those applications in which Teletypewriter Set 131B2 at one station is directly connected to the transmission path to a distant station.

Polar operation. A type of telegraph transmission in which marking signals are formed by current pulses of one polarity and spacing signals by current pulses of equal magnitude but of opposite polarity.

Polarential operation. A type of telegraph transmission in which signals are sent in one direction by reversing polarity of current and in the other by varying the magnitude of the current.

Polar relay. A relay, the armature of which is pulled to one contact when current flows in one direction through its windings, and to the other contact when current is reversed in direction.

Rectifier. A device for changing alternating current to direct current.

Room circuit operation. Those applications in which Teletypewriter Set 131B2 is used locally to encipher or decipher messages received or sent by other apparatus within the station to or from a distant station.

Space. See Mark.

Station. A teletypewriter and its associated equipment.

Thermistor. A resistor with a negative temperature coefficient whose resistance decreases rapidly when the temperature increases.

Two-path polar operation. A method of operation which uses polar operation on both the sending and receiving loops.

Varistor. A metallic type of rectifier.

APPENDIX II

MAINTENANCE PARTS

1. ASF Signal Supply Catalog Pamphlets

The following information was compiled on 22 May 1945. The appropriate pamphlets of the ASF Signal Supply Catalog for Teletypewriter Set 131B2 are:

Fixed Plant Maintenance List

SIG 10-867, Teletypewriter Subscriber Set 131B2.

SIG 10-862, Rectifier Unit KS-5988.

For an index of available catalog pamphlets, see the latest issue of ASF Signal Supply Catalog SIG 2.

Note. The following lists cover station stock maintenance parts.

2. Maintenance Parts for Teletypewriter Subscriber Set 131B2

Ref symbol	Signal Corps	Name
F1, F2, F3, F4. (See figs. 67 and 70.)	3Z2698-1	Fuse.
F7. (See fig. 67.)	3Z2603.13	Fuse.
PL1, PL2, PL3. (See fig. 68.)	4C5492Y	Lamp.
AC, AD	3Z6038G7	Resistor.
B, C, AB, A, N.	3Z6570-23	Resistor.
E, R, W, C, D, E, F, G, H, K, M.	3Z6060-58	Resistor.

3. Maintenance Parts for Rectifier Unit KS-5988

Ref symbol	Signal Corps	Name
F6 (See fig. 69.)	3Z1903-1.6	Fusetron.
F5 (See fig. 69.)	3Z2610.14	Fusetron.

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