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TM 11-343

WAR DEPARTMENT TECHNICAL MANUAL

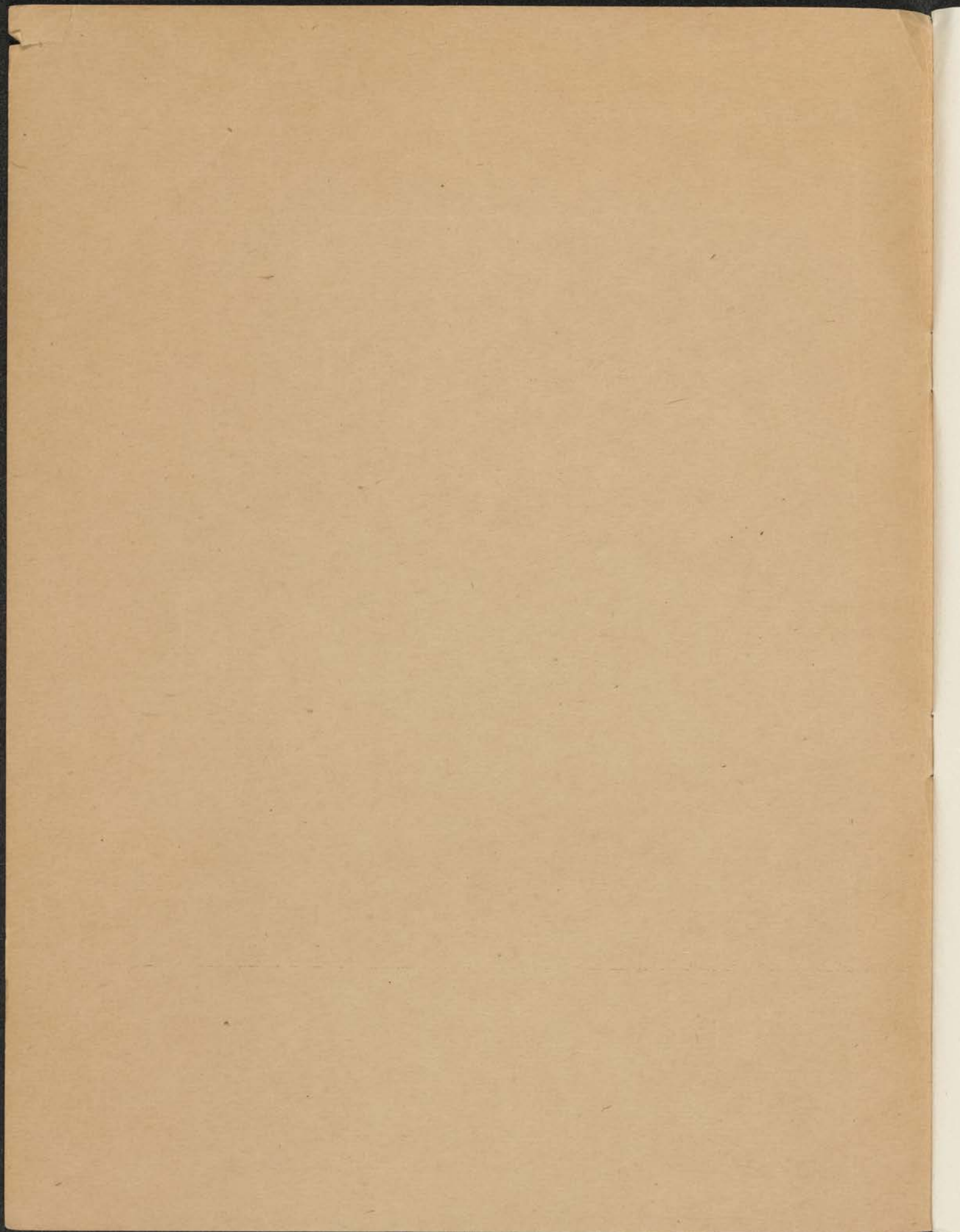
RELAY UNIT

BE-84-A

(TELETYPE TRUNK)

WAR DEPARTMENT • 8 APRIL 1944

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TM 11-343

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WAR DEPARTMENT

• 8 APRIL 1944

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TM 11-343, Relay Unit BE-84-A, (Teletype Trunk), is published for the information and guidance of all concerned.

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BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:

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

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(For explanation of symbols see FM 21-6.)

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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, hand axes, pickaxes, hammers, crowbars, heavy tools, etc.

2. Cut—Use axes, hand axes, machetes, etc.

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

4. Explosives—Use firearms, grenades, TNT, etc.

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—Cabinet, terminals, rheostat, key, switches, meter, rectifier, carrying case, relays, and all other electrical equipment.

2. Cut—All connecting cords and wires.

3. Burn—All wire, charts, circuit labels, instruction books, technical manuals.

4. Bury or scatter—Any or all of the above pieces after breaking.

DESTROY EVERYTHING

SAFETY NOTICE

IF IT BECOMES NECESSARY TO REMOVE THE UNIT FROM THE METAL CABINET, DISCONNECT THE POWER CORD FROM THE 115 VOLT A-C SUPPLY AND THE 115 VOLT D-C LEAD FROM KEY AND

LAMP UNIT TO SWITCHBOARD BD-100. CARE SHOULD BE EXERCISED TO AVOID TOUCHING TERMINALS WITH BARE HANDS WHILE TESTING. ALL TEST LEADS SHOULD BE INSULATED.

Section I

DESCRIPTION

1. Purpose

Relay Unit BE-84-A (Teletype Trunk), in combination with teletypewriter Switchboard BD-100 provides a means of establishing connections with a commercial teletypewriter exchange (TWX) in the continental United States. Relay Unit BE-84-A in operation with teletypewriter Switchboard BD-100 is shown in figure 1.

2. Application

The relay unit is located with the teletypewriter switchboard, and is designed primarily for use on Bell System line conductors. Relay Unit BE-84-A provides one circuit to a TWX switchboard. More than one relay unit may be used with a teletypewriter switchboard if required by the traffic load. An application schematic diagram, indicating the equipments involved in an over-all circuit between a teletypewriter switchboard and a TWX switchboard, is shown in figure 2.

3. Equipment Arrangement

The equipment is arranged as a portable unit and assembled in a compact metal cabinet, with the terminals, a rheostat, a key, switches, and a meter exposed on the top panel. The unit contains a built-in selenium-disk rectifier for supplying line voltage. A durable wooden carrying case equipped with shockproofing material serves as protection during transit. A key and lamp unit, supplied with wires for connecting to terminals in Switchboard BD-100 (fig. 5), is attached to Switchboard BD-100 during service periods. The key and lamp unit is permanently connected to Relay Unit BE-84-A by an 8-foot cord. Relay Unit BE-84-A, in its

carrying case, is shown in figure 3. It is supplied with a 10-foot cord for connecting to the a-c supply. The demountable polar relays are held in place by shockproof felt pads. (See fig. 5.)

4. Power

The 75-volt rectifier which supplies line battery requires 115-volt, 50-60 cycle alternating current to operate. This a-c power may be obtained from a commercial source or a gasoline engine-driven alternator. Approximately 60 watts from the a-c supply are required. The milliammeter associated with the bias measuring circuit is normally connected in series with a resistor across the d-c side of the rectifier to indicate the rectifier's output voltage. Power for the supervisory relays and the loop circuit of the relay unit is obtained from the 115-volt rectifier used with Switchboard BD-100. This power requirement is substantially the same as a station line circuit in the teletypewriter switchboard.

5. Major Components

The relay unit contains a polar relay telegraph repeater for the repetition of communication signals between the line facility and the teletypewriter switchboard; neutral supervisory relays and power relays; a bias measuring circuit used to adjust the current in the bias winding of the receiving relay; a rectifier for supplying direct current for the line conductors and bias winding of the receiving relay; a key and lamp unit for controlling the supervisory features of the relay unit. Also, apparatus is furnished so that service to the central office may be arranged on a 1-wire or 2-wire basis. In the case of 2-wire operation, one of the line conductors and

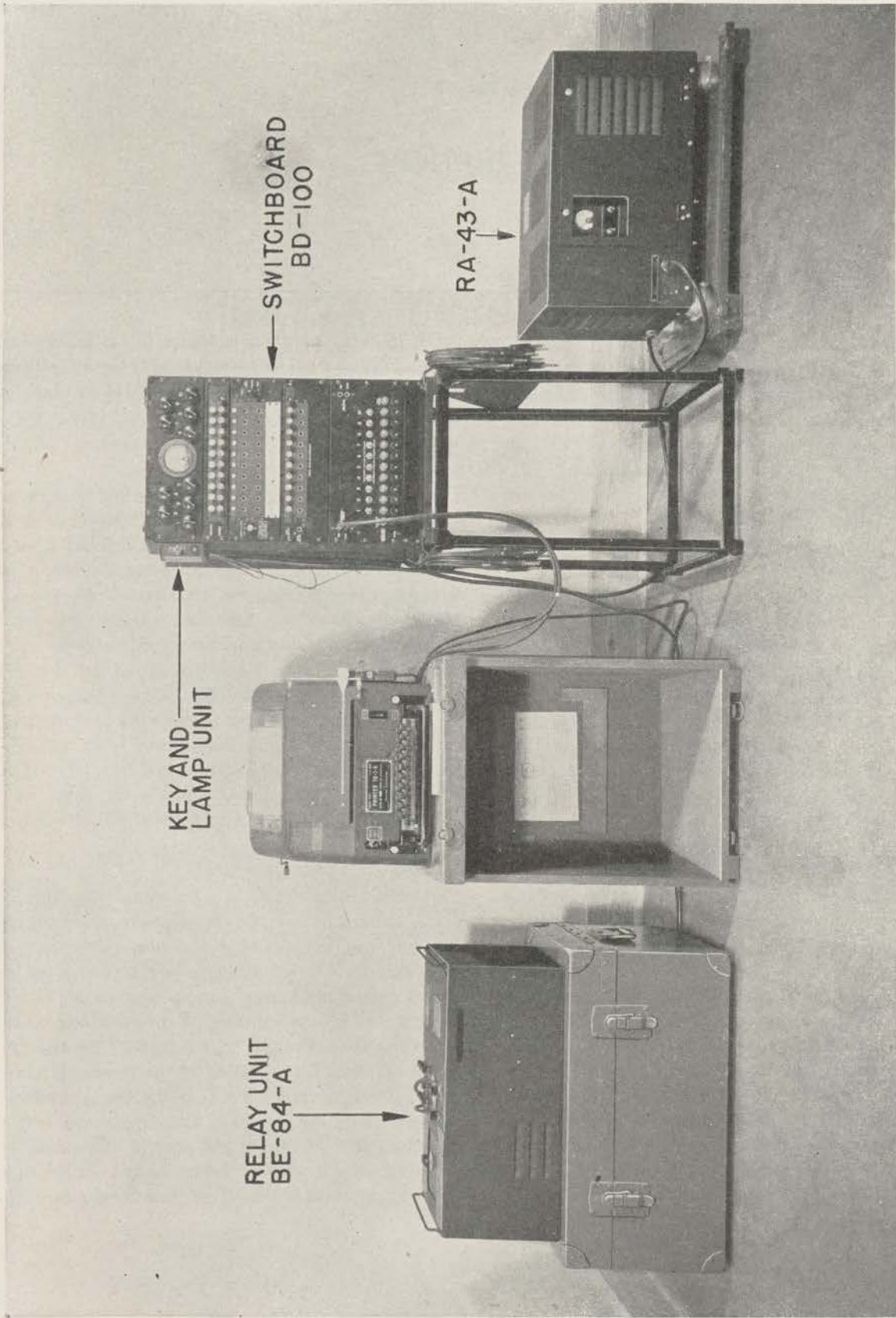
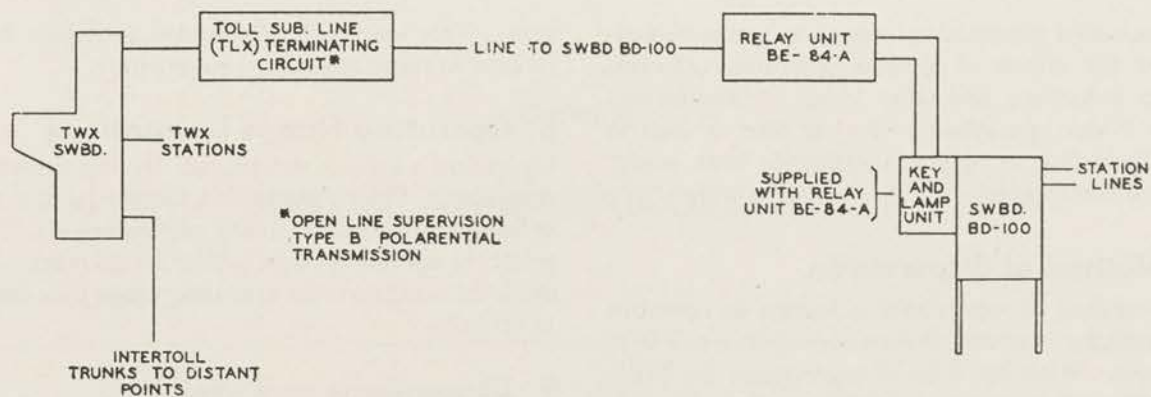


Figure 1. Relay Unit BE-84-A in operation with Switchboard BD-100.

TL-50016



TWX CENTRAL OFFICE

TL50019

SIGNAL CORPS SWITCHING CENTER

Figure 2. Application schematic diagram.

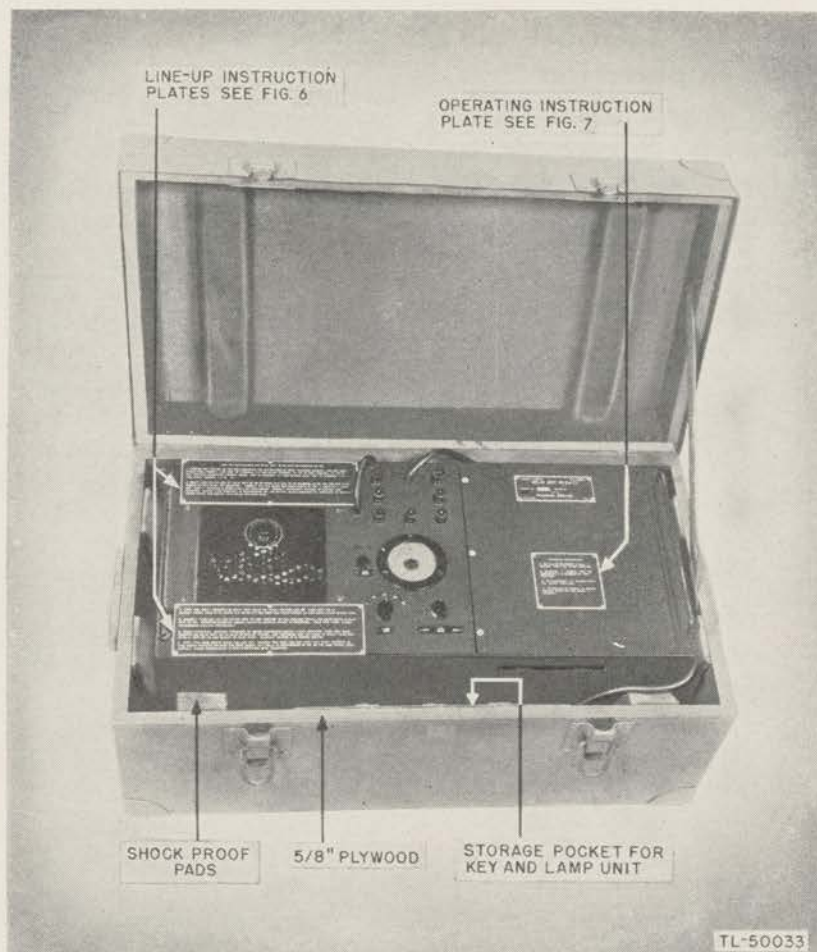


Figure 3. Relay Unit BE-84-A in carrying case.

its associated terminating apparatus serves to neutralize the effects of ground potentials, 25-cycle power induction, and other forms of interference. With 1-wire operation, a 60-cycle filter is used in the signal line to reduce interference from power lines of this frequency.

6. Method of Supervision

The method of supervision is known as open-line supervision. Current flows only while a call is in progress. With this form of supervision, the TWX switchboard operator calls by sending 20-cycle ringing current; the teletypewriter printer switchboard operator calls, recalls, and disconnects by using the TWX key in the key and lamp unit. When the TWX key is turned to ON, the normal marking current flows in the line; when it is OFF, no line current flows.

7. Radio Induction Suppression

The contacts of the polar relays and the a-c power cord are equipped with filters. Bypass condensers are connected to the line terminals of the relay

unit. This apparatus is provided to reduce interference to radio receiving equipment.

8. Operating Range Limitations

Operating range is determined by the telephone company. This is controlled largely by the type of line facility available in any particular area. Normally the operating range will be 20-25 miles. Under ideal conditions the operating range may extend to 80 miles.

9. Dimensions and Weights

The dimensions and weights of the relay unit and carrying case are as follows:

Component	Length (in.)	Height (in.)	Depth (in.)	Weight (lbs.)
Relay unit-----	24½	10	11½	87
Carrying case-----	28	13½	16	45
Total weight-----				132

Section II

INSTALLATION AND OPERATION

10. General

a. Communicate with the telephone company to determine whether the line conductors and the TWX switchboard terminating equipment are available. The line connections should be made in the TWX central office prior to lining up the relay

unit for service, since the lineup procedure requires cooperation with the TWX central office test board attendant.

b. To determine the connections to be made by cords and wires, refer to figures 4 and 5. The connections established to the relay unit are the line

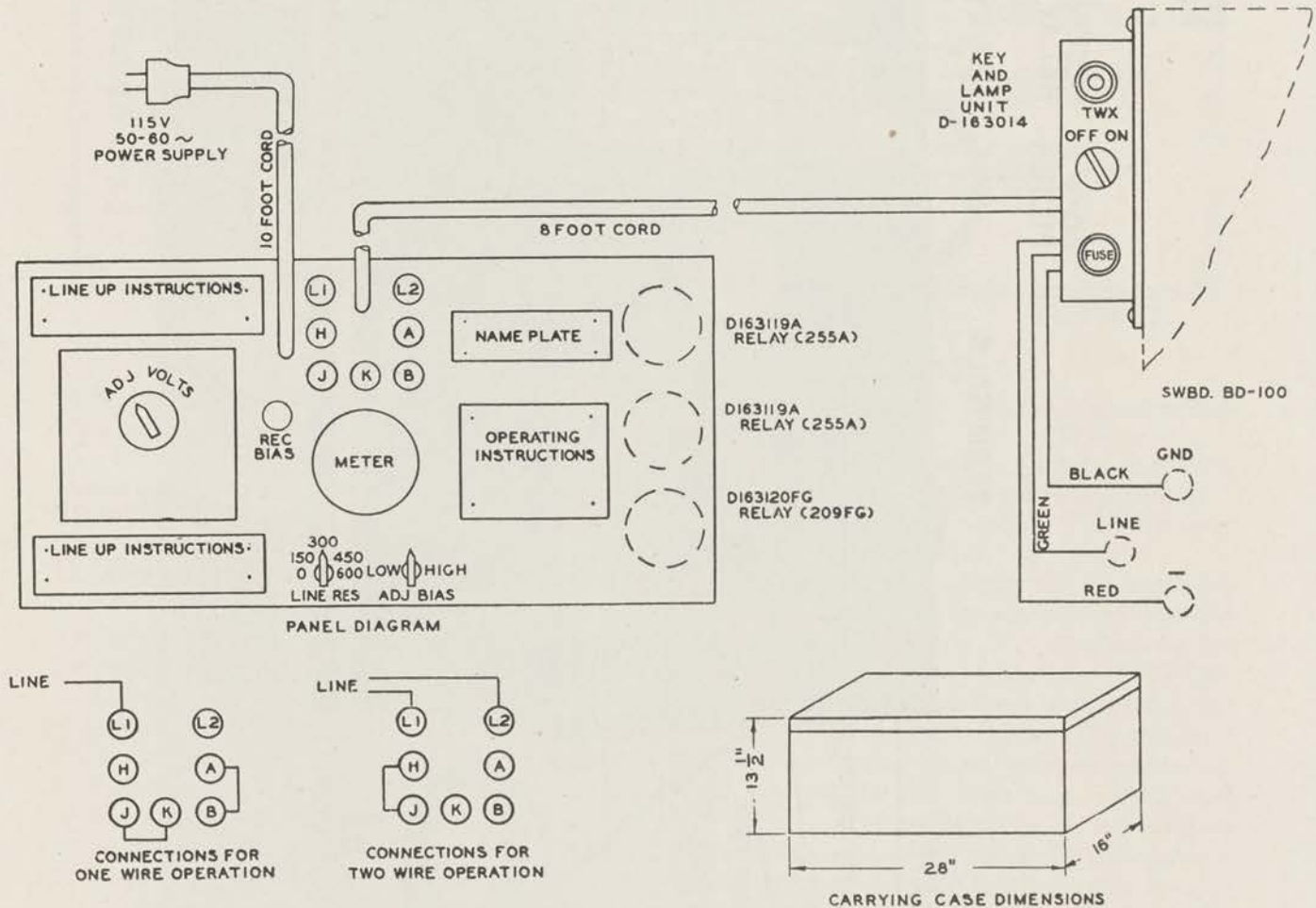
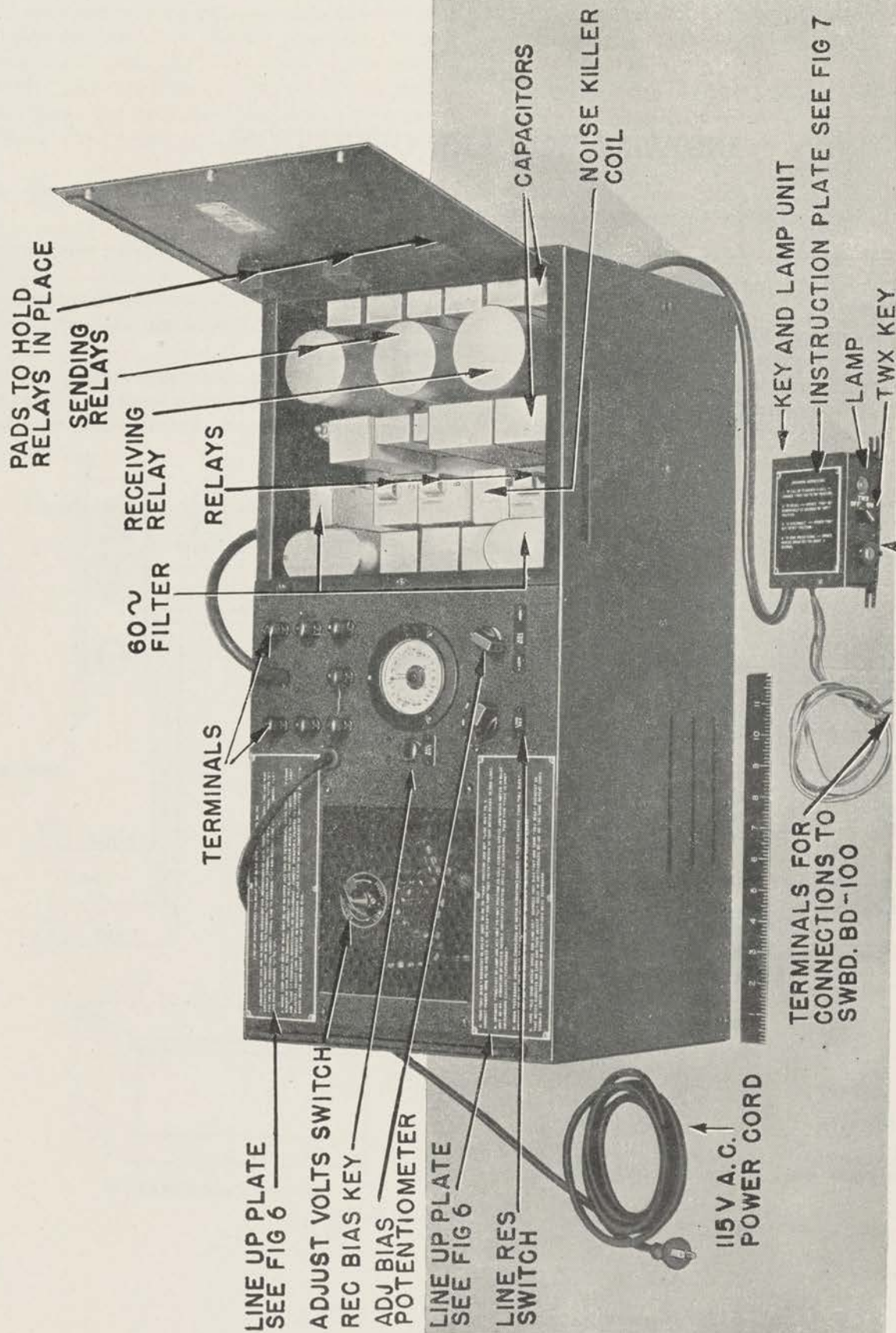


Figure 4. Cording and panel diagram.



TL-50017

115 V D.C. FUSE

Figure 5. Apparatus compartment door open.

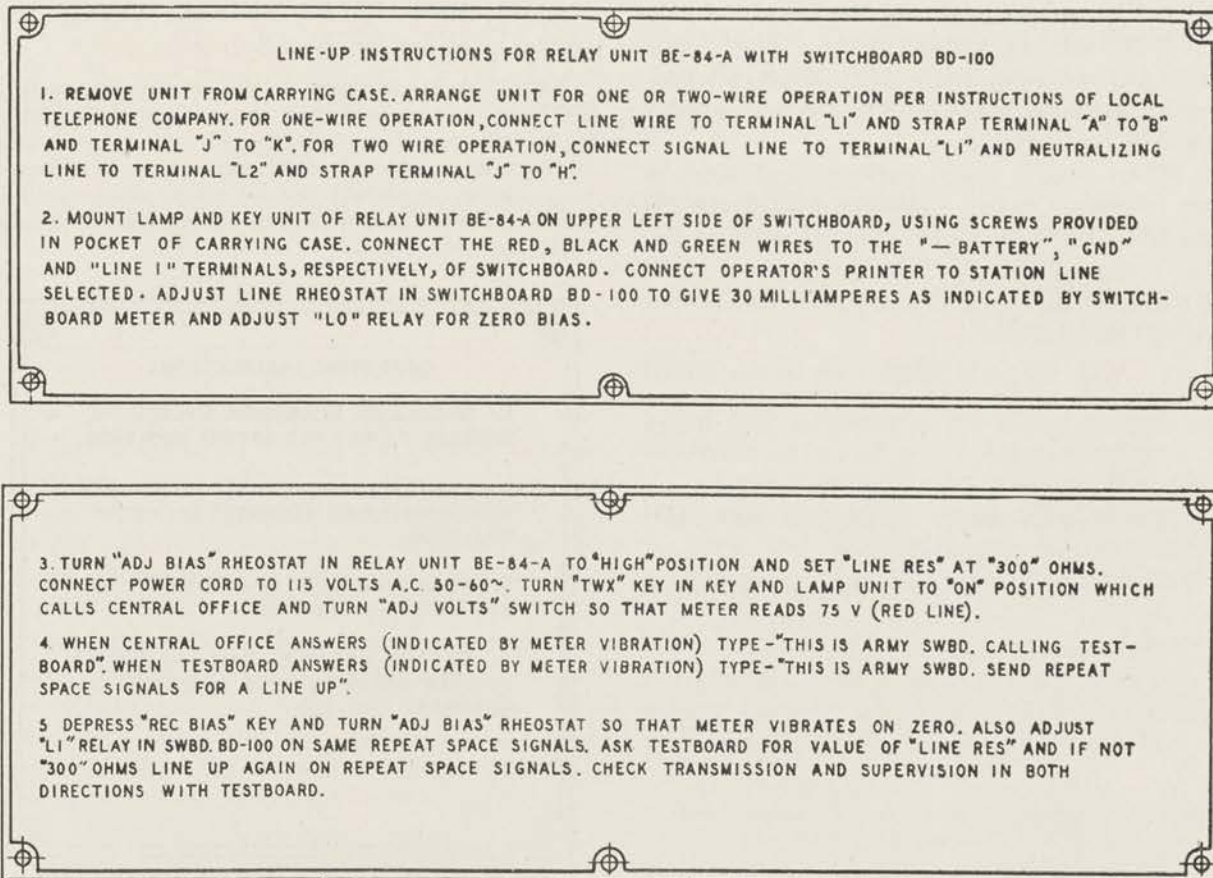


Figure 6. Facsimile of lineup instruction plates.

TL50021

or lines to the TWX central office and the power connection to a 115-volt, 50-60-cycle a-c supply. Also, local line, battery and ground connections are made from the key and lamp unit to Switchboard BD-100.

11. Preparation for Use and Lineup Procedure

The following lineup procedure is summarized on instruction plates attached to the relay unit. (A facsimile of these plates is shown in figure 6.)

a. Remove the relay unit from, and place it on the top of, the carrying case. As directed by the local telephone company, arrange the unit for 1-wire or 2-wire operation according to operating instructions. Refer to figure 4 for connections for 1-wire and 2-wire operation.

(1) *For 1-wire operation.* Connect signal line to terminal L2. Strap terminals A and B together,

and J and K together. (Do not strap terminals J and H.)

(2) *For 2-wire operation.* Connect signal line to terminal L1 and neutralizing line to terminal L2. Strap terminals J and H together. (Do not strap terminals A and B or J and K.)

b. Mount the key and lamp unit on upper left side of switchboard, using the screws found in pocket of carrying case. (See fig. 3.) Connect the red wire to the negative battery terminal,—BATTERY black wire to GND, and green wire to a LINE terminal in switchboard. Connect the operator's teletypewriter to the station line termination selected. Adjust the line rheostat in Switchboard BD-100 to give 30 milliamperes, as indicated by the switchboard meter, and adjust relay Lo for zero bias, using the switchboard-bias measuring circuit.

c. Turn the ADJ BIAS knob in Relay Unit BE-84-A to the HIGH position. Set LINE RES knob

to 300. Connect the power cord to a source of 115-volt, 50–60-cycle alternating current. Turn TWX knob in key and lamp unit to ON, which calls central office, and turn ADJ VOLTS knob so that meter reads 75 V (red line).

d. When central office answers (indicated by meter vibration), type: THIS IS ARMY SWBD CALLING TESTBOARD. When testboard answers (indicated by meter vibration), type: THIS IS ARMY SWBD. SEND REPEAT SPACE SIGNALS FOR LINEUP.

NOTE. With the ADJ BIAS knob in the HIGH position and the LINE RES knob at 300, signals can be transmitted to the TWX central office, even though signals cannot be received from the central office until the bias of the receiving relay has been adjusted.

e. Depress REC BIAS button and turn ADJ BIAS knob so that meter vibrates on zero. Then adjust relay Li in Switchboard BD-100 on same repeat space signals.

f. Ask testboard for value of LINE RES and if not 300 ohms readjust to the value given and line up again on repeat space signals. Check transmission and supervision in both directions with testboard.

NOTE. A current greater than 30 milliamperes in the loop line to Switchboard BD-100 tends to introduce *marking* bias and a current less than 30 milliamperes tends to introduce *spacing* bias. This current may be changed slightly on instructions of testboard attendant at TWX central office.

12. Operating Instructions

Operating instruction plates are attached to the relay unit and the key and lamp unit. A facsimile of the operating instruction plate is shown in figure 7.

a. **TO CALL, OR ANSWER A CALL.** Operate TWX key to ON and connect operator's teletypewriter to line in Switchboard BD-100 in normal manner.

b. **TO RECALL.** Operate TWX key momentarily (2 seconds) to OFF.

c. **TO DISCONNECT.** Operate TWX key to OFF. Disconnect line on Switchboard BD-100 in normal manner.

d. **TO SEND BREAK SIGNAL.** Operate the printer break key for about 3 seconds.

NOTE. A break signal in either direction over a TWX connection will light the associated line lamp in the teletypewriter switchboard. If a connection has been set up through the teletypewriter switchboard to a station, it should not be taken down until it has been determined that both parties wish to discontinue the connection.

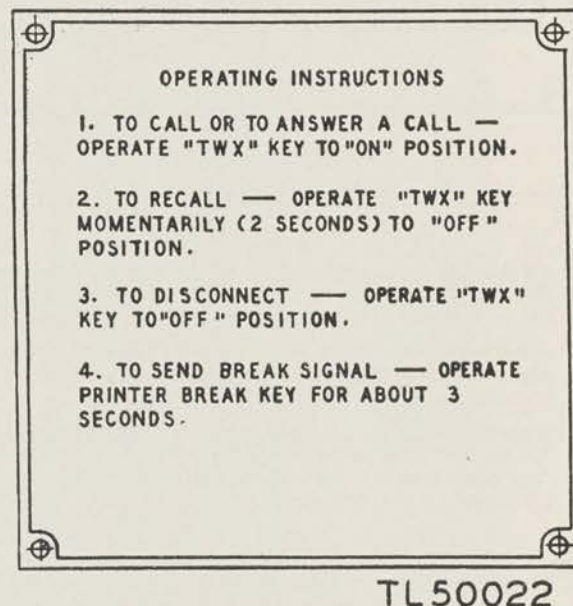


Figure 7. Operating instruction plate for key and lamp unit.

13. Adjustments to Maintain Service

The only adjustment required to maintain service is that of the rectifier voltage output in the case of an abnormal change in the a-c voltage supply after the initial lineup. The a-c voltage may vary plus and minus five volts without an appreciable effect on performance. Occasionally, and when abnormal a-c voltage changes occur while a TWX connection is up and no signals are being transmitted in either direction, check the reading of the meter and turn ADJ VOLTS knob as required to provide a meter reading of 75 V (red line). If a lineup check is desired, place a TWX call in the regular way and ask the operator for TESTBOARD.

Section III

FUNCTIONING OF PARTS

14. Transmission of Signals

Figure 8 shows an over-all transmission schematic diagram. The method of transmission (communication signaling on the line facility), is type B polar-entential, which is a d-c grounded-return system. This form of transmission requires no service adjustments to compensate for changes in the electrical characteristics of the line conductors caused by resistance-leakage or for grounded capacity variations resulting from wet and dry line conditions. Transmission is polar from the relay unit to the central office; differential from the central office to the relay unit. Sending relays S1 and S2 apply negative 75 volts to the line for *mark* and positive 75 volts for *space*. Thus, reversal in line current occurs when signals are sent from the relay unit because at the TWX central office the line terminates in ground at contact M of relay S via the line winding of the receiving relay and certain supervisory relays. At the central office, the sending relay applies ground for *mark* and positive 130 volts for *space*. When transmission is from the TWX central office, line current does not reverse and *space* current is approximately $2\frac{1}{2}$ times *mark* current. This *space* current flows as a result of approximately 205 volts (+130 volts at TWX office and -75 volts at relay unit) being applied to the line. The bias current of the receiving relay in the relay unit is always in a marking direction, and is approximately the average of *mark* and *space* currents sent from the central office. Thus the net effect on the armature of the receiving relay in the relay unit is polar. On installation the *marking* line current is adjusted between 20 and 30 milliamperes. The loop circuit connected to Switchboard BD-100 is a balanced (neutral) one adjusted for a current of 30 milliamperes. The receiving relay in the relay unit supplies ground to

the loop for *marking* and negative 115 volts for *spacing*.

15. Supervisory Circuit Operation

Refer to functional schematic diagram (fig. 9), and detail circuit schematic diagram. (See fig. 10.)

a. **INWARD CALL.** An inward call is a call from the TWX switchboard to the printer switchboard. The TWX operator connects a cord to the line jack of the TWX trunk and throws a ringing key lever which sends 20-cycle ringing current over the signal line. Relay D in the relay unit responds to this ringing current and in turn operates relay B. Relay B removes ground from the M contact of receiving relay R, which opens the loop to the switchboard, releasing relay Li, which in turn releases the signal relay. The release of the signal relay causes the switchboard associated LINE lamp to light. Subsequent ringing on the part of the TWX operator is ineffective because relay B is locked operated through the OFF contacts in the TWX key. The teletypewriter switchboard operator turns the TWX key in the key and lamp unit to ON and answers the call in the regular manner through the line termination in Switchboard BD-100. The turning of this TWX key lights the associated guard lamp, releases relay B, and supplies ground to operate relay A. The guard lamp remains lit as long as Relay Unit BE-84-A is energized. Relay A energizes the relay unit rectifier, which supplies marking negative potential at contact M of relay S1. During the marking condition the positive side of the rectifier is grounded at contact M of relay S2. Relay A also supplies ground to operate relay C, which removes the ringing relay D from the line and connects the signal line (also the neutralizing

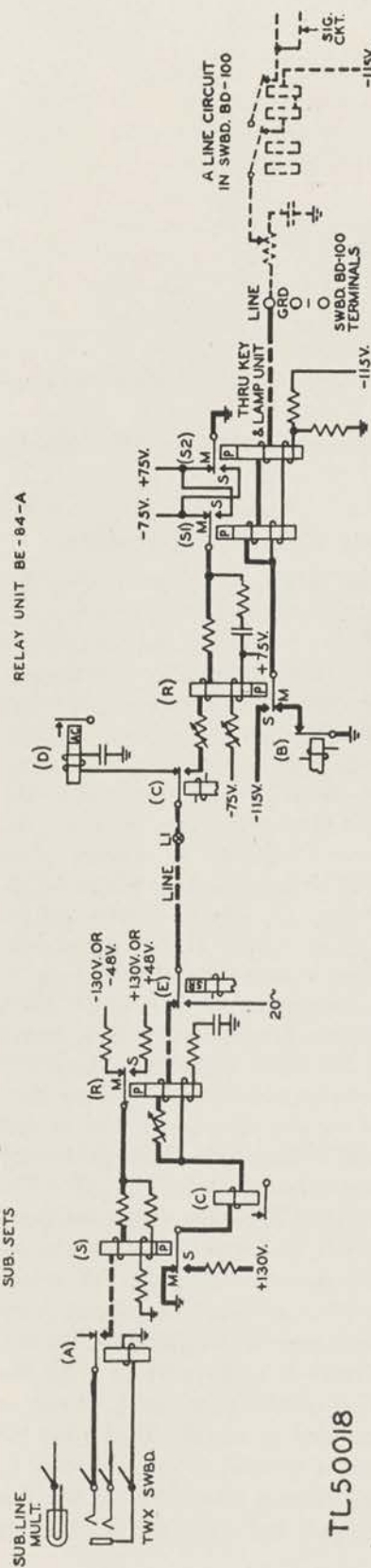


Figure 8. Over-all transmission schematic diagram.

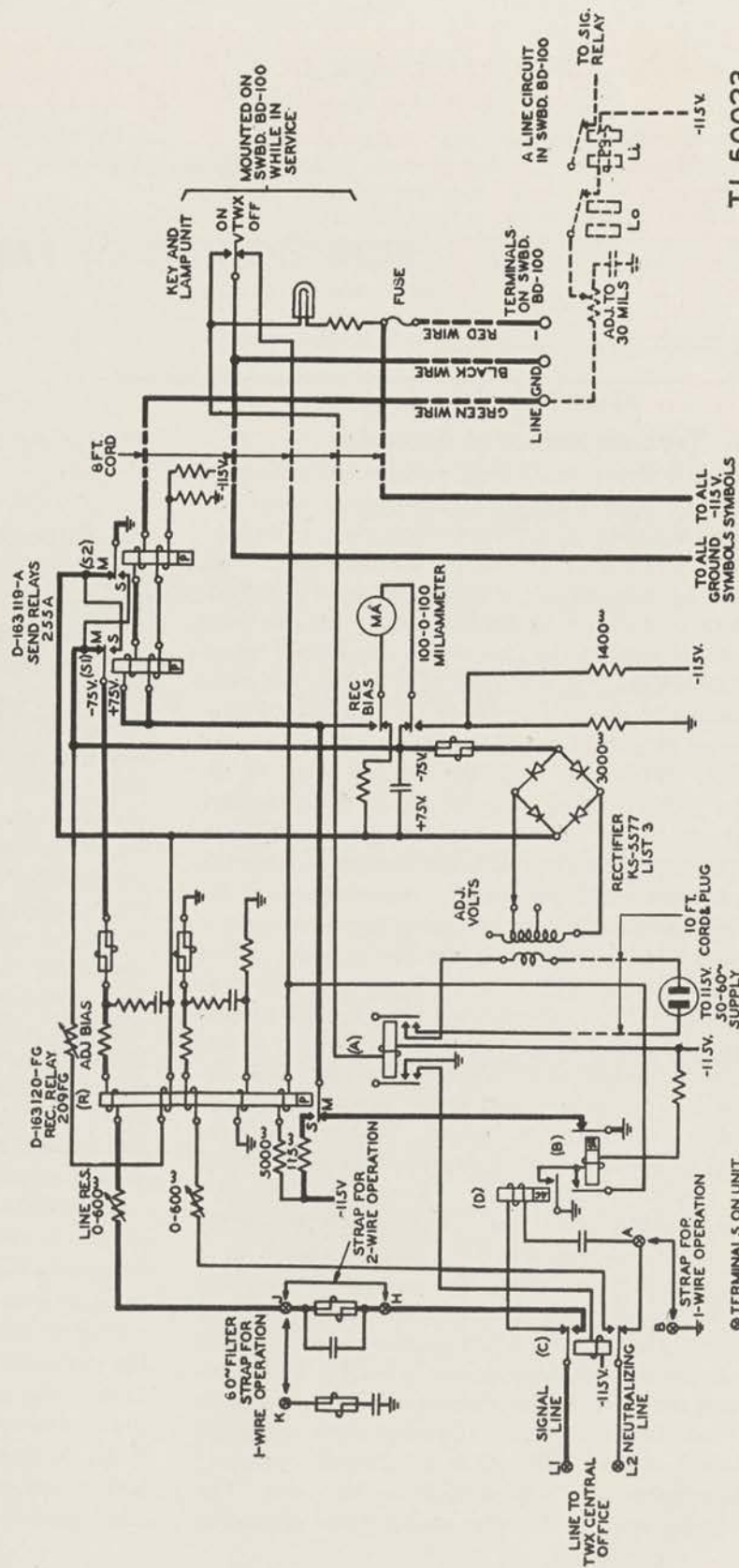


Figure 9. Functional schematic diagram.

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line if set is arranged for 2-wire operation) to the line windings of the receiving relay R, thereby closing the transmission path.

b. OUTWARD CALL. An outward call is a call from the teletypewriter switchboard to the TWX switchboard. The teletypewriter switchboard operator connects the teletypewriter in the normal manner to the TWX trunk line and turns the TWX key to ON, which operates relays A and C. As described in *a* above, this operation closes the a-c supply circuit to the relay unit rectifier and connects the line to the winding of relay R. The normal line current causes certain supervisory relays at the TWX office termination to light the LINE lamp, and the TWX operator answers, after connecting a cord to the LINE jack.

c. SUPERVISORY SIGNALS. (1) A recall signal to flash the TWX operator occurs when the teletypewriter switchboard operator turns the TWX key to OFF position for about 2 seconds. While the key is in OFF position the normal line current is removed, because relays A and C are released. When the key is again turned to ON the line battery is reapplied due to relays A and C reoperating. At this time the TWX operator receives a flashing supervisory lamp which is acted upon in a prescribed manner.

(2) A disconnect signal occurs when the TWX key is turned to OFF. As described in (1) above, this removes the normal line current, and, since the TWX key is *not* turned to ON again, the TWX operator receives a steadily lighted supervisory lamp.

(3) A communication break signal to interrupt the sending station occurs when the printer break key is held depressed. During this interval the send relays operate to their S contacts, and send a spacing transmission signal.

d. BIAS MEASURING CIRCUIT. When the REC BIAS button is depressed, the milliammeter (100-0-100) is removed from the normal connection on the output of the rectifier, and is connected to an unbalanced bridge circuit in a leak circuit from the armature of the receiving relay. This circuit provides a means of adjusting the bias winding current of the receiving relay on repeat space characters from the TWX central office, thus providing unbiased signal reception. The measuring circuit is designed so that the meter needle vibrates at 0 as an average, when the bias current is correctly adjusted. After this adjustment, unbiased signals will be transmitted to the receiving relay Li in the teletypewriter switchboard.

Figure 10. Schematic circuit diagram. (See back of manual.)

MAINTENANCE

16. Servicing

The necessary maintenance tools will be found in Tool Equipment TE-50.

17. Inspection and Preparation for Servicing

Turn the unit cover so it rests on its back, and remove screws holding bottom panel. (See fig. 11.) A circuit label showing wiring of apparatus will be found on the inside of the bottom panel. When the relay unit is resting on its back, the position of the apparatus corresponds to that in the circuit label. (See fig. 12 at back of manual.) The rectifier may be taken out of the cabinet by removing the four round-head screws on the top of the panel.

18. Adjustment of Polar Relays

a. GENERAL. The location of the polar relays is shown in figure 5. Relay Test Set 1-193-A or the relay test circuits of Telegraph Terminal CF-2-A (Carrier) or Telegraph Terminal CF-2-B (Carrier), if available, can be used to test relays S1 and S2 (255A). Polar relay test panels such as used by telephone companies can be used to test all polar relays in Relay Unit BE-84-A. The adjusting procedure described below is a mechanical method which will *not* result in adjustments as accurate as can be obtained by the use of the above means, but may be used in the field in an emergency. Reconditioning and adjustment by a telephone company is recommended for relays with pitted contacts, or poorly aligned armatures or winding spools. *No attempt* should be made to adjust the polar

relays while they are in their normal operating position.

b. ADJUSTING PROCEDURE. (1) Loosen the knurled tension nuts (255A, D-163119A) or pole-piece holding screws (209FG, D-163120FC) which clamp the pole-pieces, and turn pole-pieces as far away from the armature as possible.

(2) With an adjusting key (tommy tool) turn the screw contacts a few turns away from the armature.

(3) Clean contacts with carbon tetrachloride; then burnish contacts with contact burnisher. Insert a wedge-shaped stick (orange stick) between flexible contact springs while burnishing the armature contacts. *Do not use any type of file.*

(4) Remove all dirt (especially magnetic particles) from the face of the pole-pieces by contacting the pole faces lightly with a piece of friction tape.

(5) Check the alignment of the armature. It should be substantially in the center of the winding-spool slot. All assembly screws and nuts should be tight. Contacts should line up so that the point of contact for a screw contact is wholly within the boundary of the opposite armature contact.

(6) With pole-pieces and the screw contacts away from armature as in *b* (1) and (2) above, adjust the armature to have a total contact travel of 0.004 inch in the following manner: Turn each screw contact until there is a clearance of 0.002 inch between it and the corresponding armature contact. Use thickness gauges if available.

(7) Turn the pole-pieces toward the armature until there is a clearance of approximately $\frac{1}{16}$ inch, or slightly less. Clamp the pole-pieces to just permit turning.

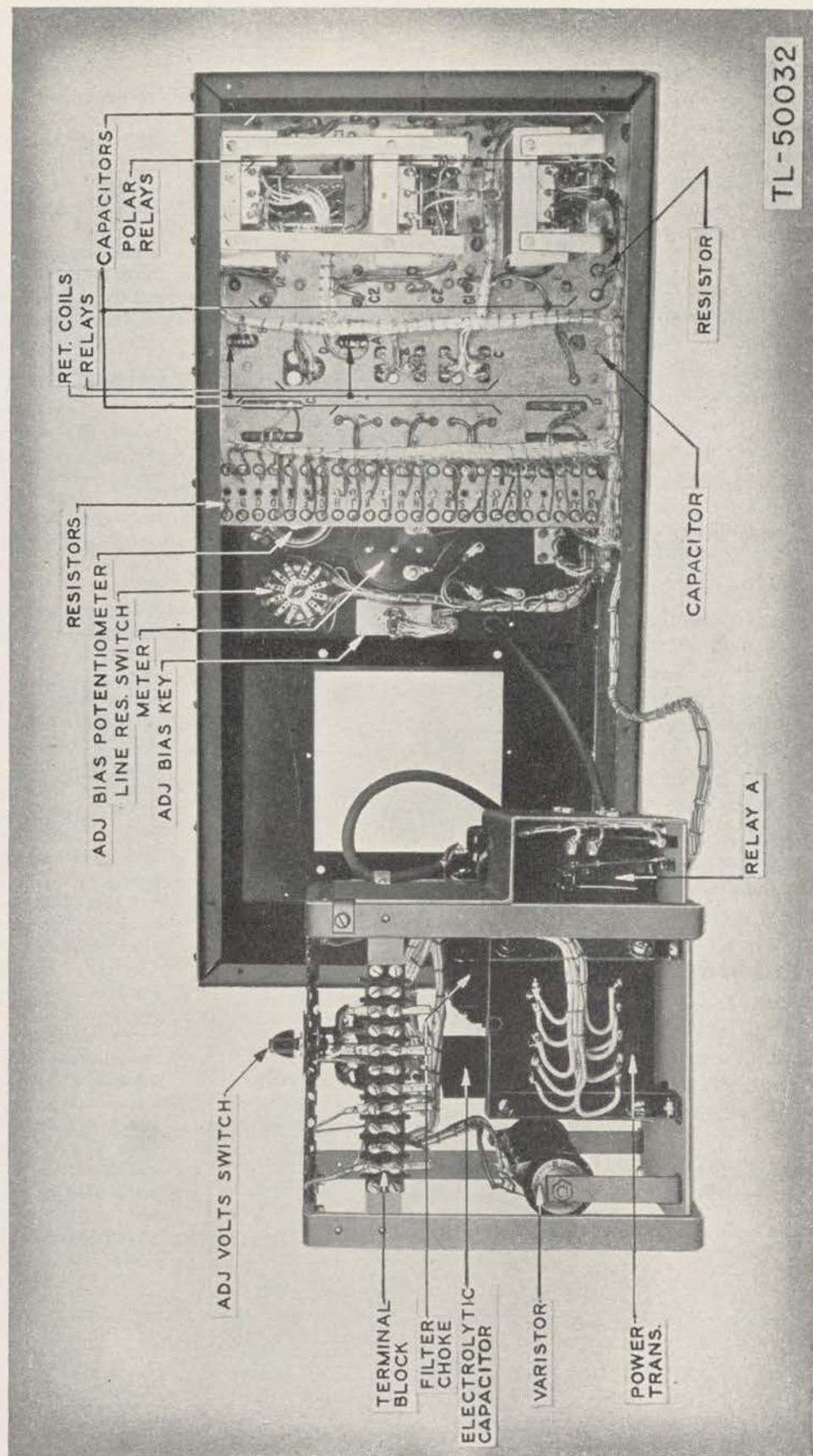


Figure 11. Wiring side of apparatus panel. Rectifier removed from unit.

Figure 12. Wiring of circuits. Circuit label. (See back of manual.)

(8) Hold the relay vertical, with the armature pointing upward. Gradually tip the relay to one side until the armature falls from the upper contact to the lower contact. Note the angle at which this occurs. It should take place before the relay has reached a horizontal position (90° from the vertical). Tip the relay to the opposite side and note the angle at which the armature falls to the lower contact. Then gradually turn the pole-piece screws in or out, a very slight amount at a time, until the armature will fall at about the same angle on each side, and at not less than 30° from the vertical. Also, the armature should stick on either contact when moved there by hand.

(9) Before putting the cover on the relay, tap it a few times and wipe the inside with a clean cloth.

19. Adjustment of Relays A, B, C, and D

a. **RELAY A.** Power relay A should be adjusted to operate in its normal operating circuit on 115-volt direct current, and it should release when the TWX key is at OFF position. Clean contacts with carbon tetrachloride; then burnish contacts with a contact burnisher. *Do not use any type of file.*

b. **RELAYS B, C, AND D.** Operating requirements for these relays are shown in the circuit requirements table in figure 10. Contact springs should be positioned to provide firm contacts in the front and back positions. Clean contacts with carbon tetrachloride; then burnish contacts with a contact burnisher. *Do not use any type of file.*

20. Replacing Fuses and Lamps

A fuse for the 115-volt d-c lead from Switchboard BD-100 is located on the face of the key and lamp unit. To replace, unscrew cap marked FUSE and pull out extractor post. Replace fuse. Replace lamp with tools supplied with Switchboard BD-100.

21. Procedure in Case of Relay Unit Failure

The following table is a list of troubles most likely to occur:

Nature of trouble

No voltmeter readings when TWX key is operated.

TWX lamp does not light when TWX key is operated.

Voltmeter reading is normal with TWX key operated, but TWX operator does not answer a call.

Lamp in Switchboard BD-100 does not light when TWX operator calls.

Errors occur on teletypewriter when sending after initial contact with TWX central office on first line-up.

Testboard attendant at TWX central office reports biased communication signals.

Errors occur on teletypewriters while receiving from TWX switchboard.

Probable cause and remedy

Power cord to a-c supply not connected. Relay A does not operate or contacts require cleaning if it does operate. Contacts in TWX key require burnishing. Red or black wire to Switchboard BD-100 disconnected. Fuse in key and lamp unit blown.

Lamp burned out. Contacts in TWX key require cleaning.

Line trouble. Check with portable voltmeter at terminal L1 to determine that relay unit is applying normal voltage to the line. Meter should read about 75 volts. This checks operation of relays A and C. Notify telephone company.

Switchboard lamp burned out. Relays D or B do not operate or contacts require cleaning. Disconnected leads to Switchboard BD-100. Check signal circuit in Switchboard BD-100.

Check and see that ADJ BIAS rheostat is in HIGH position and that LINE RES switch is set at 300 ohms.

Check bias adjustment of Lo relay in Switchboard BD-100. Readjust current (normally 30 milliamperes) in line to printer switchboard. Increasing current introduces marking bias and decreasing current introduces spacing bias.

Readjust voltage to 75 if required and request repeat space signal from TWX testboard. Check bias adjustment of receiving relay and printer switchboard relay L1 as covered in paragraph 11e.

Section V

SUPPLEMENTARY DATA

22. Replaceable Parts

a. GENERAL. The reference designations shown in the first column of table in *b* below correspond to the designation shown on the wiring of circuits. (See fig. 12.) These designations are also stamped on the apparatus or on the adjacent mounting as shown in figure 11.

b. TABLE OF REPLACEABLE PARTS—RELAY UNIT BE-84-A.

NOTE. The list of stock numbers is intended to supplement the Signal Supply Catalog until such time as the catalog is revised to include the stock numbers herein. Order replacement parts by stock number, name, and description.

Reference designation	Signal Corps stock No.	Name of part and description	Function	Manufacturer	Mfr. part No.
A, B, H, J, K, L1, L2.	3Z737-1	Binding post—hard rubber, screw cap.	Line connection and strapping.	Eby	42.
	3EPWP-32	Cord—rubber covered, 2-conductor, 18-gauge, 10' long.	115V a-c; power cord.	Simplex	18SJ or PWP-32.
	6Z1727	Plug cap—parallel blades, nonpolarized, armored.	Power cord plug	Hubbell	No. 7057.
		5-conductor microphone cable—five conductors, 20-gauge, outer rubber jacket.	Connects relay unit to key and lamp unit.	Belden	No. 8425.
L1, L2	3DA10-157.1	Capacitor—molded, silvered mica, low-loss, equipped with wire terminals. 10,000 $\mu\text{f} \pm .5\% \pm 1 \mu\text{f}$.	Radio suppression	W. E. Co.	402-B 10,000 μf .
H1, H2, G1, G2.	3DA500-81	Capacitor—assembly of 4 high-voltage, high-temperature paper units in parallel; in sealed metal can; working voltage 250V. 0.5 $\mu\text{f} \pm 15\%$ (Spl. 269A).	Spark killer	do.	D-163137.
R	3DB1.557	Capacitor—hermetically sealed, oil filled, wound paper in metal can; tested at 1,200V d-c 1. μf .	60-cycle filter	do.	D-161557.
P	3DA750	Capacitor—hermetically sealed, oil filled, wound paper in metal can; tested at 1,200V d-c 0.75 μf .	do.	do.	D-161556.
N, M	3DB1E5	Capacitor—hermetically sealed, oil filled, wound paper in metal can; tested at 1,200V d-c 1.5 μf .	do.	W. E. Co.	D-161558.
C1, D1	3DB1.136A	Capacitor—wax filled, hermetically sealed, paper; working voltage 250V d-c 1.5 $\mu\text{f} \pm 15\%$ (Spl. 229A).	Antikick circuit	do.	D-163136A.

Reference designation	Signal Corps stock No.	Name of part and description	Function	Manufacturer	Mfr. part No.
C2, D2	3DEB5.75	Capacitor—wax filled, hermetically sealed, paper; working voltage 650V d-c $0.5 \mu f \pm 15\%$ (Spl. 227A).	Antikick Circuit	W. E. Co.	D-163138.
E	3DB2-7	Capacitor—wax filled, hermetically sealed, paper; working voltage 250V d-c $2. \mu f \pm 15\%$ (Spl. 228A).	Ringling	do	D-163135.
F1, F2	3DB1.136C	Capacitor—wax filled, hermetically sealed, paper; working voltage 250V d-c $1. \mu f \pm 15\%$ (Spl. 229C).	Spark killer	do	D-163136C.
S1, S2	2Z5595-9	Connecting block—arranged to connect to relay and mount on mounting plate (Spl. 18B).	To connect relay S1 and S2.	do	D-162479B.
R		Connecting block—arranged to connect to relay and mount on mounting plate (Spl. 18A).	To connect relay R	do	D-162479A.
	3Z2587	Fuse—glass tube, automobile type, $\frac{1}{4}$ amp. 3AG.	115V d-c fuse	Littel or Buss.	1045 3AG- $\frac{1}{4}$
	3Z3275-1	Fuse extractor post—mounting for glass tube, automobile type fuse.	To mount fuse	do	1075 HKM.
A	3Z1892-1.3	Filter—two retardation coils and one capacitor assembled on a mounting bracket.	Radio suppression 115V a-c cord.	W. E. Co.	D-162943.
S1, S2, R	3Z1892	Filter—two retardation coils two resistances and one condenser assembled on a mounting bracket.	Radio suppression contacts of polar relays.	do	D-163011.
		Key and lamp unit—key, lamp socket, lamp, red cap, fuse, fuse extractor post, resistor and terminal block; all in metal box.	Controls supervision	do	D-163014.
TWX	4C5105.52A.1	Key—turn button, two transfer contacts (Spl. 552A).	To signal TWX switchboard.	do	D-161892A.
REC BIAS		Key—push button, two transfer contacts (Spl. 92A).	To engage milliammeter.	do	D-161905A.
		Knob—bar knob of insulating material.	For LINE RES switch and ADJ BIAS pot.	Centralab	K-120.
		Lamp socket—singly mounted, for 2 type lamp and 2 or 72 lamp cap (Spl. 47A).	To mount TWX guard lamp.	W. E. Co.	D-162043.
	4C2502H	Lamp cap (red)—plain red lamp cap for use with No. 12 or No. 13 lamp sockets.	To cover TWX guard lamp.	do	2H.
	4C5492-C	Lamp—tungsten filament, 36-volt switchboard lamp.	TWX guard lamp	do	C2.
		Milliammeter—flush type, shielded, plastic case scale 100-0-100 ma. d-c accuracy $\pm 2\%$.	D-c voltage of rectifier and bias measuring ckt.	do	D-162468.

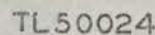
Reference designation	Signal Corps stock No.	Name of part and description	Function	Manufacturer	Mfr. part No.
ADJUST BIAS		Potentiometer—vitreous enamel, wire wound, ceramic body, 1,600w, $\frac{3}{8}$ " shaft extension.	Adjusts bias of receiving relay R.	W. E. Co.	KS-8852, List 4.
A. B.	3C1987-18E	Retard coil—closed core coils in metal case, electromagnetic shield (Spl. 307E).	Noise killer	W. E. Co.	D-161818E.
C, D.	3C1987-39E	Retard coil—shell-type coils in metal case, 2 windings, 44w each (Spl. 149E).	60-cycle filter	do	D-162039E.
		Rectifier—consists of transformer selenium disk varistor, retard coil, condenser-type filter, and switch to control voltage output. (Rated 0.2 ampere at 75 volts).	Supplies voltage for line and bias of relay R.	do	KS-5577, List 3.
A		Relay—two make contacts, 98-150V d-c, 4,600w, 0.040 amps.	Controls rectifier	do	KS-5483, List 27.
C		Relay—flat type, round core, twin contact, one transfer, single winding (Spl. U-823).	Connects repeater to line.	do	D-161984-823.
B.		Relay—flat type, round core, twin contact, double make and make before break, slow acting, single winding (Spl. U-567).	Open loop line to Switchboard BD-100. Adds delay.	do	D-161984-567.
D		Relay—single winding, transfer, flat type, dustproof cover, removable cap (Spl. J-51).	Ringling relay	do	D-161975-51.
S1, S2	2Z7585-18	Relay—polarized, reed-type permalloy armature, anti-chatter heavy contacts, 136w $\pm$ 10% (Spl. 255A).	Sending relay	do	D-163119-A.
R.		Relay—sensitive, polarized, primary windings, 185w each, secondary 115w (Spl. 209FG).	Receiving relay	do	D-163120-FG.
	4Z3504	Relay cover—individual cover with removable cap (Spl. U3).	For D-161984-823 and D-161984-567, relays.	W. E. Co.	D-162264-3.
	1B518.11	Wire—tinned copper, stranded, paper wrapped, rubber wall, glazed cotton braid, lacquered.	1115 V d-c lead to Switchboard BD-100.	Belden	"Ravine" 18GA Red.
	1B518.7	Wire—tinned copper, stranded, paper wrapped, rubber wall, glazed cotton braid, lacquered.	Line to Switchboard BD-100.	do	"Ravine" 18GA Green.
	1B518.34-1	Wire—tinned copper, stranded, paper wrapped, rubber wall, glazed cotton braid, lacquered.	Ground to Switchboard BD-100.	do	"Ravine" 18GA Black.
	3Z6250-47.1	Resistor—wire wound, cylindrical, ceramic.	Current limiter for TWX lamp.	I. R. C.	2,500 w, 4 watts, Type AB.

Reference designation	Signal Corps stock No.	Name of part and description	Function	Manufacturer	Mfr. part No.
AB.....	3Z650-61.....	Resistor—1,000w— 2,500w $\pm$ 5% (Spl. 19JS).	Current limiter for relay B.	W. E. Co.....	D-161700JS.
Z.....	3Z6115-1.1.....	Resistor—1,150w— 1,150w $\pm$ 1% (Spl. 19TL).	Current limiter in loop to Switchboard BD-100.	do.....	D-161700TL.
X.....	3Z6080-26.....	Resistor—600w— 800w $\pm$ 1% (Spl. 19SR).	Bias measuring circuit.	do.....	
U, V.....	3Z6502D4.....	Resistor—69.6w— 5,245w $\pm$ 1% (Spl. 19MS).	Bias winding relays S1, S2.	do.....	D-161700MS.
T.....	3Z6030-67.....	Resistor—150w— 300w $\pm$ 5% (Spl. 19DT).	Terminating resistor neutralizing line.	do.....	D-161700DT.
E, F, P, R.....	3Z6160-4.....	Resistor—1,600 w— 1,600 w $\pm$ 5% (Spl. 19JE).	Spark killers, polar relays.	do.....	D-161700JE.
L, M, N, K.....	3Z6015-41.....	Resistor—150w— 150w $\pm$ 1% (Spl. 19LB).	Series line resistor.	W. E. Co.....	D-161700LB.
H.....	3Z6133.....	Resistor—280w— 1330w $\pm$ 1% (Spl. 19DH).	Antikick current limiter.	do.....	D-161700DH.
G.....	3Z6440-1.....	Resistor—600w— 4400w $\pm$ 1% (Spl. 19RL).	Current limiter relay R hold ckt.	do.....	D-161700RC.
AA.....	3Z6095E5.....	Resistor—2,000w $\pm$ 1% (Spl. 18CR).	Current limiter for relay C.	do.....	D-161699CR.
Y.....	3Z6289H8.....	Resistor—2,898w $\pm$ 1% (Spl. 18EK).	Bias measuring circuit.	do.....	D-161699EK.
S.....	3Z6151.....	Resistor—1,510w $\pm$ 1% (Spl. 18DA).	Terminating resistor neutralizing line rectifier load.	do.....	D-161699EF.
D.....		Resistor—2,500w $\pm$ 5% (Spl. 18EF).		do.....	D-161699EF.
C.....	3Z6250-47.1.....	Resistor—800w $\pm$ 1% (Spl. 18GF).	Current limiter bias winding res. relay.	do.....	D-161699GF.
AB.....	3Z6050-112.....	Resistor—500w $\pm$ 1% (Spl. 18AP).	Current limiter for.....	do.....	D-161699AP.
W.....		Resistor—enameled porcelain type for high temperatures, 115w $\pm$ 5% (Spl. 59D).	Battery tap.....	do.....	D-162381D.
LINE RES.....	3Z9825-58.10.....	Switch—selector switch with bakelite insulation (non-shorting).	Control series line resistor.	Centralab.....	No. 1405.
	2Z9405.1.....	Terminal strip—5 double-screw terminals, mounted on insulating block.	Terminates leads to key and lamp unit.	Jones.....	5-141.
	2Z9402.44.....	Terminal strip—2 double-screw and soldering terminals mounted on insulating block.	Terminates a-c power cord.	do.....	2-141.

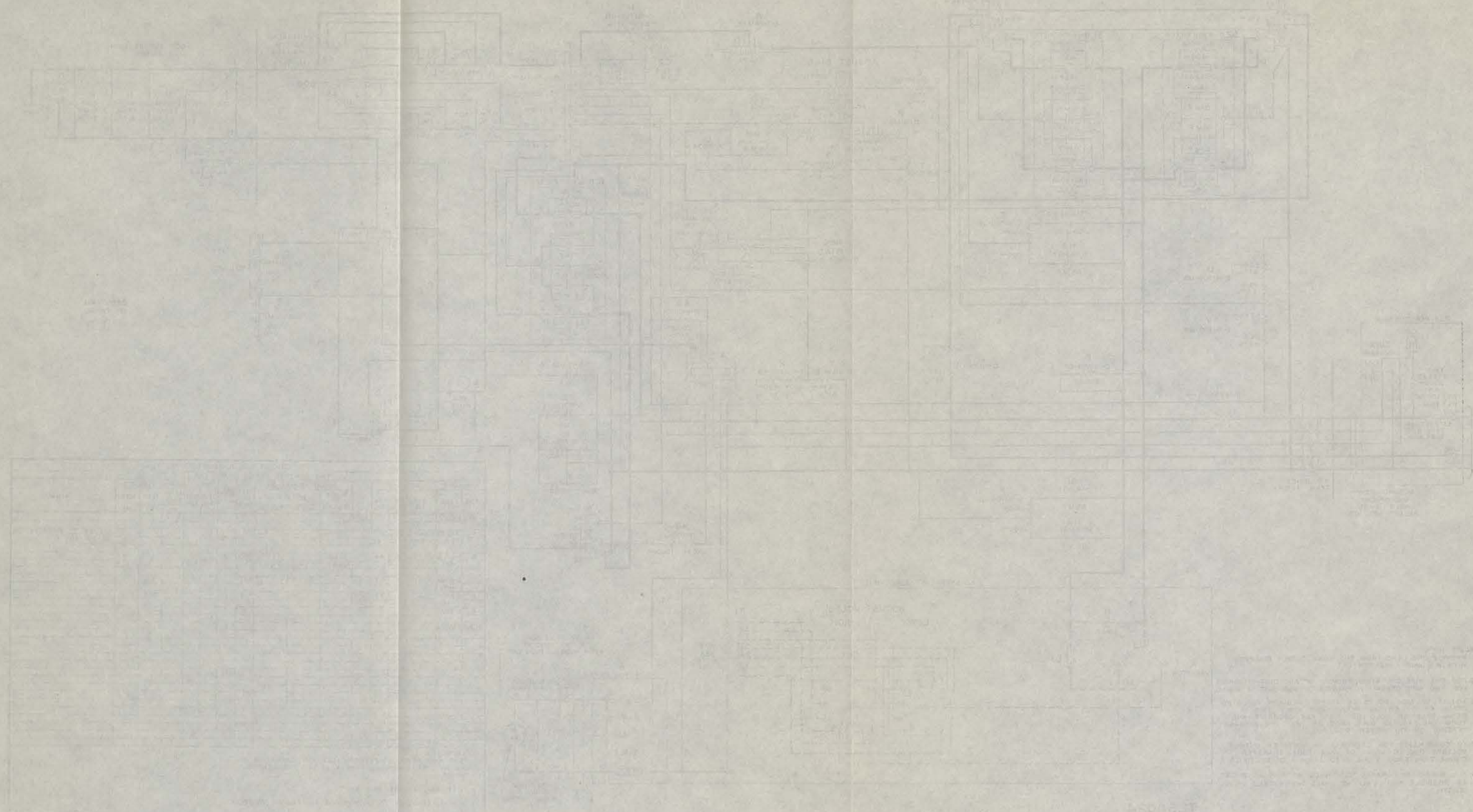
Reference designation	Signal Corps stock No.	Name of part and description	Function	Manufacturer	Mfr. part No.
-----	3Z12059-9----	Lock terminals—metal locking terminal with size 8 screw.	Lock binding screws---	S. L. W. C.--	2104-8.
-----	3Z12059-14----	Lock terminals—metal locking terminal with size 4 screw.	Lock ground connections for capacitors L1 and L2.	---do-----	2104-4.

23. List of Manufacturers

<i>Abbreviation in 22b.</i>	<i>Name</i>	<i>Address</i>
Belden	Belden Manufacturing Co.	Chicago, Ill.
Buss	Bussmann Manufacturing Co.	St. Louis, Mo.
Centralab	Centralab	Milwaukee, Wis.
Eby	H. H. Eby, Inc.	Philadelphia, Pa.
Hubbell	Harvey Hubbell, Inc.	Bridgeport, Conn.
I. R. C.	International Resistance Co.	Philadelphia, Pa.
Jones	H. B. Jones Co.	Chicago, Ill.
Littel	Littelfuse, Inc.	Chicago, Ill.
Simplex	Simplex Wire and Cable Co.	Boston, Mass.
S. L. W. C.	Shakeproof Lockwasher Co.	Chicago, Ill.
W. E. Co.	Western Electric Co.	New York, N. Y.



579317°—44 (Face p. 20) No. 1



1. The building is a two-story structure with a total area of 10,000 square feet. The ground floor is used for storage and the second floor for offices. The building is located on a corner lot and is surrounded by other commercial buildings. The building is owned by the City of New York and is used as a warehouse for the City's records. The building is in good condition and is well-maintained. The building is a good example of early 20th-century architecture.

KEY AND LAMP UNIT

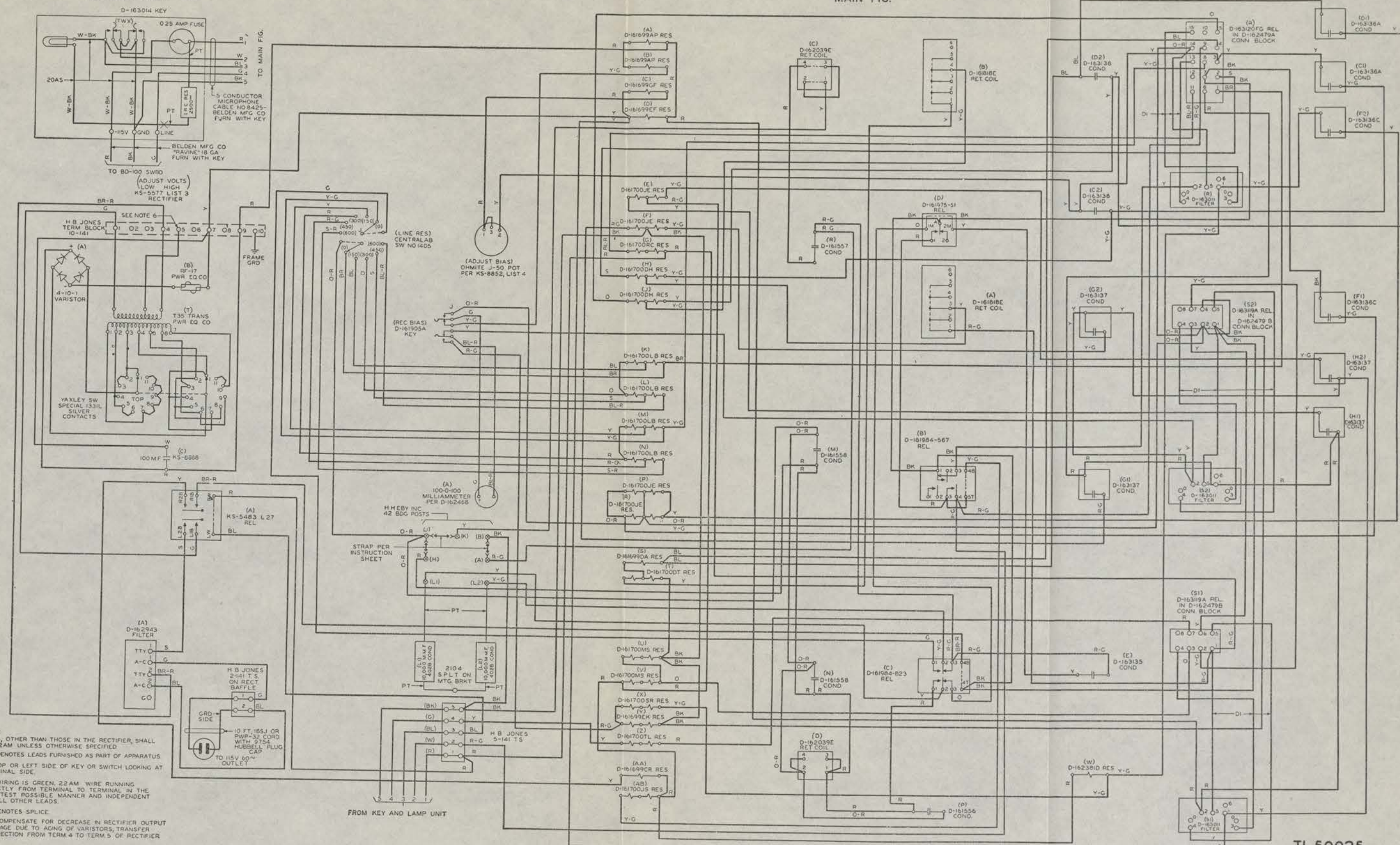
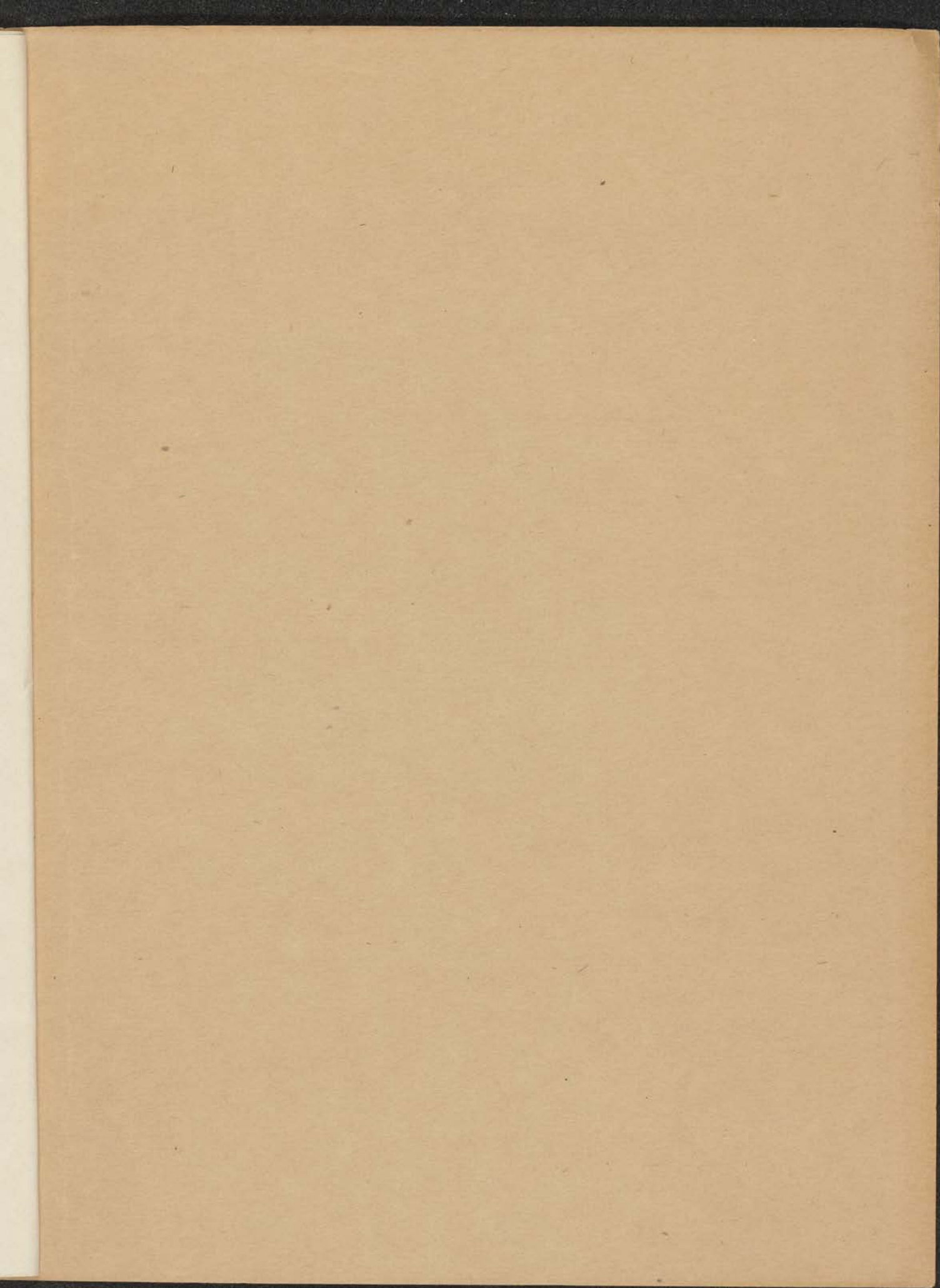


Figure 12. Wiring of circuits. Circuit label.

TL50025

579317°—44 (Face p. 20) No. 2



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