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WAR DEPARTMENT

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TECHNICAL MANUAL

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BIAS METER I-97-A

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TECHNICAL MANUAL
No. 11-2200

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Washington, 14 August, 1943

BIAS METER I-97-A

This technical manual published on order no. 4656-Phila-43 is furnished for the information and guidance of all concerned.

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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, or when you are in immediate danger of capture.

HOW —1. Smash — Use sledges, axes, hand-axes, pick-axes, hammers, crowbars, heavy tools, etc.

2. Cut — Use axes, hand-axes, machete, 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.

6. USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT—1. Smash—Meter, pushbutton, case, adapter plug, relay subbase.

2. Cut — Adapter Plug Cable and Power Cord, in several pieces.

3. Burn — Technical Manuals, Canvas Carrying Case CS-49-A.

4. Bury or Scatter — All pieces, after destroying them.

DESTROY EVERYTHING

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SECTION I—DESCRIPTION

1. General.

a. Bias Meter I-97-A is for measuring bias in teletypewriter signals and is used in connection with the adjustment of spring tension on Western Union 41-C type relays as used in Line Unit BE-77, a component part of Telegraph Printer Sets EE-97 and EE-98. Figure 1 shows an overall view of the bias meter.

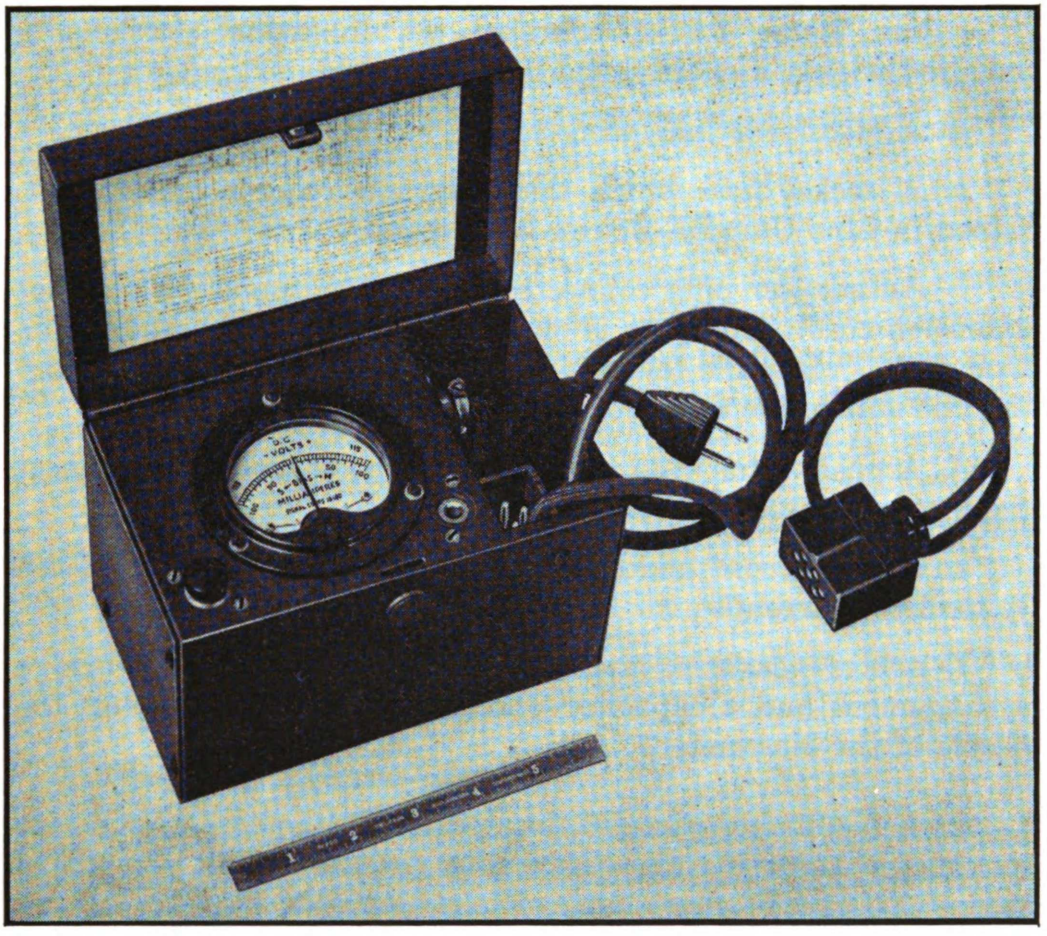


Fig. 1. Bias Meter I-97-A

b. Bias is a term denoting a lengthening or shortening of transmitted teletypewriter signal impulses by the electrical characteristics of the transmission line or the electrical or mechanical characteristics of the transmitter. When these characteristics lengthen each signal, it is said to have marking or positive bias. When these characteristics reduce the length of each signal, it is said to have spacing or negative bias. Bias can be largely com-

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pensated for in the receiving apparatus by changing the spring tension of the relay. Thus, if a line has marking bias, the spring tension of the relay can be increased so its contacts close a little later and open a little earlier for each signal, and the length of time the relay contacts are closed can usually be made the same as the length of time of a perfect signal.

2. Components.

Bias Meter I-97-A contains the following components mounted within a sheet metal case with a hinged cover:

a. A meter for indicating bias.

b. A socket into which the telegraph relay normally contained in Line Unit BE-77 can be plugged.

c. An adapter plug connected to the bias meter by a 3-foot extension cord. This plug is placed in the relay subbase of Line Unit BE-77 after the telegraph relay has been transferred from the line unit to the socket of Bias Meter I-97-A.

d. A pushbutton type key which can be depressed to connect the meter in circuit to read bias.

e. A power cord and plug for connection to a source of 115 volts direct current.

f. A bias measuring circuit consisting of resistors in a bridge arrangement and a capacitor and inductance for damping the needle of the bias meter.

g. A 0-400-ohm rheostat, located inside the case of the bias meter, for adjusting the measuring circuit so that the meter indicates correctly on a standard teletypewriter signal.

h. A jack into which the output of a teletype test distributor can be patched for checking the correctness of the rheostat setting, or into which any source of neutral teletypewriter signals may be patched for measuring the bias of such signals.

3. Size and Weight.

Bias Meter I-97-A is 7″ x 4½″ x 4⅞″ high, and weighs 6 pounds.

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SECTION II—INSTALLATION AND OPERATION

4. Installation.

Remove the bias meter from the canvas carrying Case CS-49-A and install it near Line Unit BE-77, so that the adapter cord of the bias meter will reach the relay subbase in the line unit and the power cord will reach a source of 115 volts direct current.

5. Power Supply.

Bias Meter I-97-A needs a source of 115 volts d-c power for its operation. This will normally be the same source of power used for Line Unit BE-77.

6. Preparation for Use.

a. Connect the power cord of Bias Meter I-97-A to a source of 115 volts direct current so that the meter needle deflects to the left when the pushbutton is depressed and no relay or plug is in the subbase of the bias meter. If the meter needle deflects to the right, withdraw the attachment plug from the power source, turn it 180°, and reinsert it.

b. Remove the Western Union 41-C relay from Line Unit BE-77 and insert the plug of the adapter cord assembly of the bias meter into the socket from which the relay was removed.

c. Insert the Western Union 41-C relay in the socket of Bias Meter I-97-A.

7. Operating Adjustments.

a. While the operator of the distant station sends "repeated space" signals by holding down his teletypewriter space bar, depress the pushbutton of the bias meter and watch the meter reading. If the meter needle goes to the right of the zero mark, it indicates that the received signals have a positive or marking bias, and the knob of the Western Union 41-C relay should be turned counterclockwise (to the left) until the meter needle vibrates around the zero position. If the reading was to the left of the zero point, indicating negative or spacing bias, reduce the armature spring tension of the relay by turning the adjusting knob of the relay clockwise (to the right) until the meter needle vibrates around the zero position.

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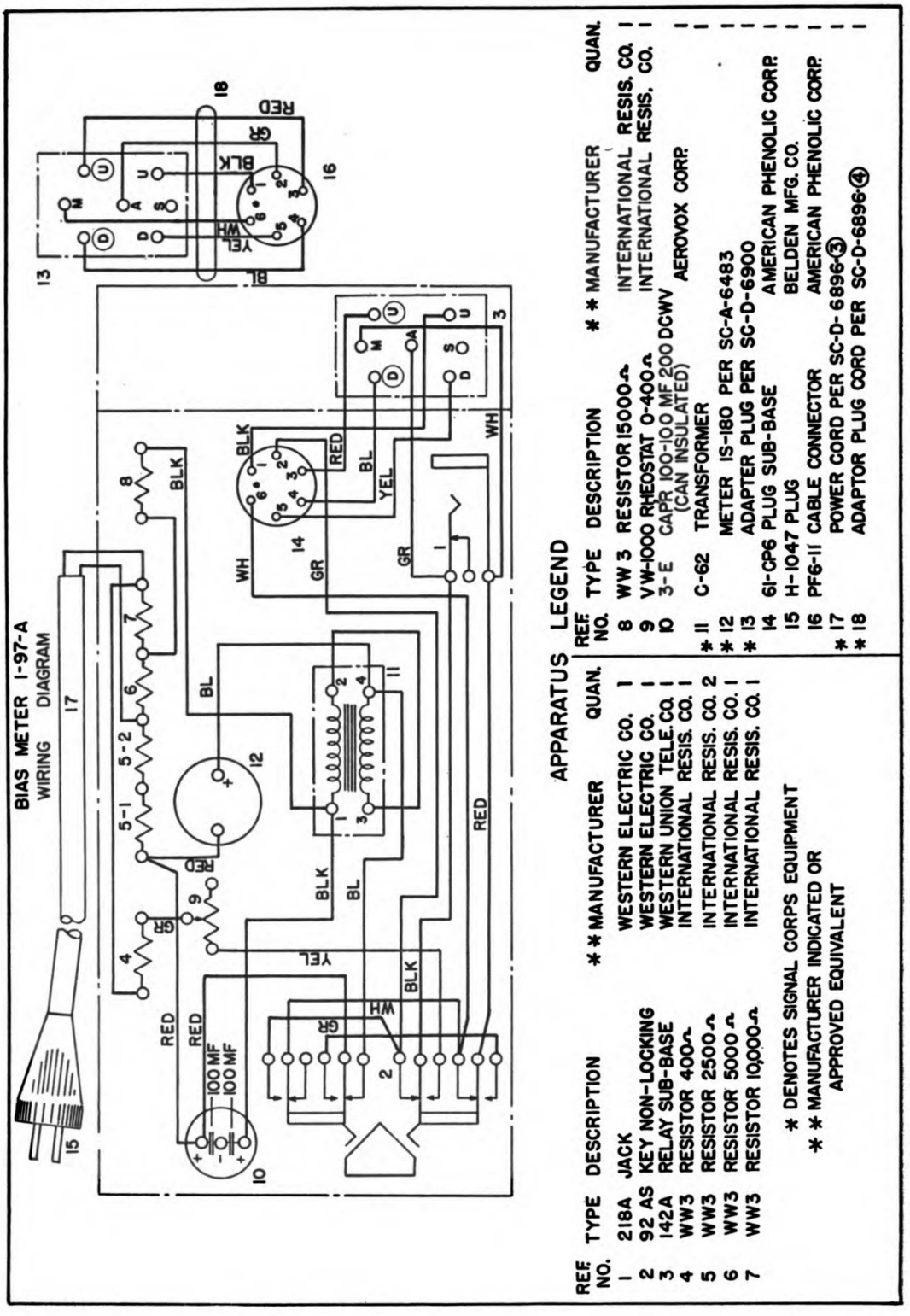


Fig. 2. General Circuit of Bias Meter I-97-A.

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b. It is usually necessary to adjust the knob of the relay for zero bias under the following conditions:

(1) When the equipment is first put into operation on a line.

(2) Whenever the line has been out of operation for more than a short time.

(3) Whenever the received messages show any errors.

(4) Whenever line characteristics change because of moisture or humidity.

c. Note that the bias meter is adjusted to read zero bias on a particular signal which is arbitrarily selected, and which is the signal for a space in the teletype transmission code. The fact that a space signal is used to check bias adjustments has nothing to do with "spacing" bias as read on the meter. Any signal can be used for measuring bias, as long as the bias meter is adjusted to read zero when a perfect signal of the character selected is received by the bias meter. The space signal is selected because it can be transmitted continuously and uniformly from a teletypewriter by holding down the space bar.

d. When working over long lines, it may not be possible to adjust the 41-C relay exactly to zero bias. However, it should be adjusted as closely to zero bias as possible. A small amount of needle vibration is always present when the meter is reading bias.

SECTION III—FUNCTIONING OF PARTS

8. General Circuit.

The general circuit of Bias Meter I-97-A is shown in Figure 2. The reference numbers shown are the same as those listed in the List of Maintenance Parts (see Par. 15).

9. Normal Operation.

The terminals of the relay subbase socket in the bias meter are connected in parallel with the terminals of the adapter plug when the pushbutton is unoperated. This causes the relay inserted in the socket in the bias meter to operate in the same way as though it were in its own socket in Line Unit BE-77. Power is

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supplied to the bias measuring network, but the meter is shorted out of the circuit, so that no indication is given. These connections are shown in Figure 3.

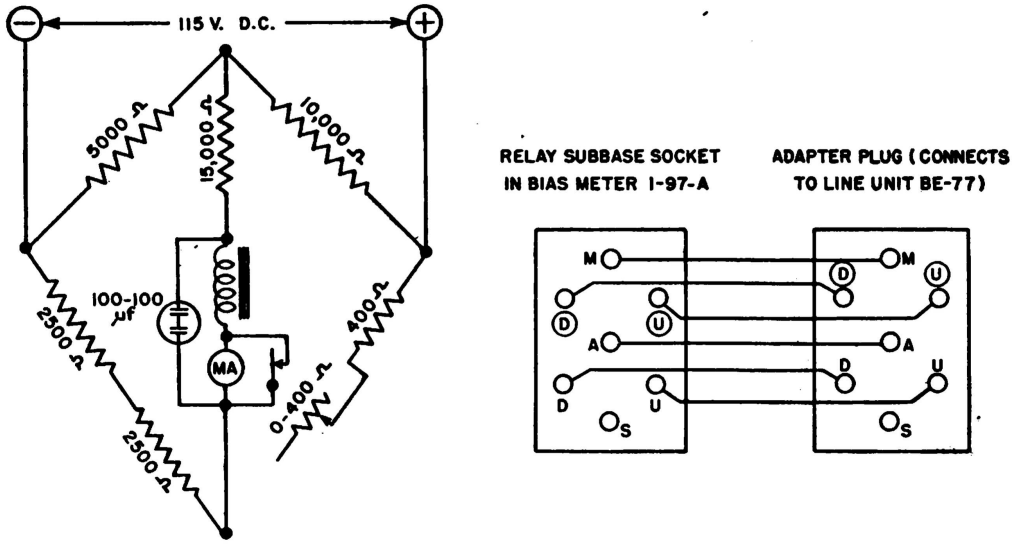


Fig. 3. Equivalent connections with pushbutton non-operated.

10. Bias Indication.

When the pushbutton is depressed, the short circuit around the meter is removed and the 400-ohm resistor and the 0-400-ohm rheostat are connected in series with the contacts of the relay to the proper points in the bias measuring circuit. With the button depressed, terminals A and M of the relay subbase socket are shorted together through the adapter plug and the pushbutton contacts, thereby keeping the selector magnet of the telegraph printer energized continuously and preventing it from "running open." These connections are shown in Figure 4.

11. Bias Measuring Circuit.

Looking at Figure 4, the circuit is of the Wheatstone-bridge type with two equal and two unequal bridge arms. The bridge arms are so proportioned (sized) that there is a reversal of current through the meter when the leg in which the relay contacts are located is opened and closed. The reversed currents are of such magnitudes that opening and closing of the relay contacts by repeated unbiased "space" signals will cause the meter to read zero. Any bias in the signals to the relay will vary the percentage

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of open-circuit to closed-circuit time of each signal, causing the meter to read to the right (indicating marking bias) or to the

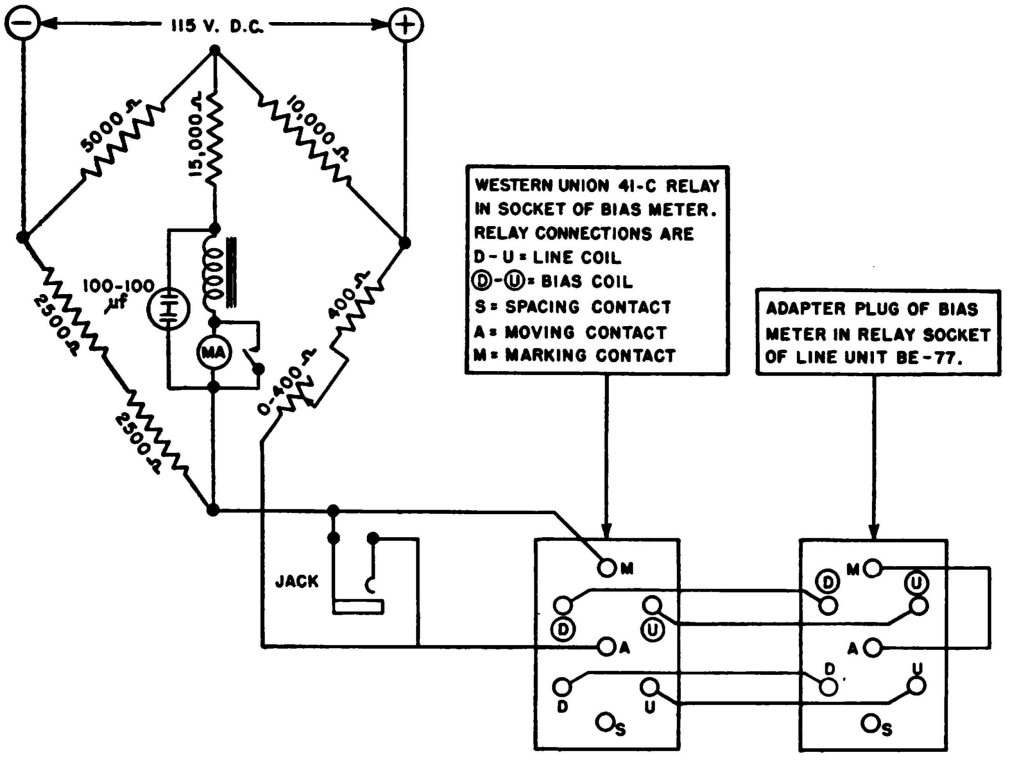


Fig. 4. Equivalent Connections for Reading Bias (Pushbutton depressed).

left (indicating spacing bias). The meter needle is damped by an inductance and shunt capacitor, making the meter easier to read by reducing the vibration of the needle.

12. Use of Jack.

The jack is provided in Bias Meter I-97-A for patching the output of a Test Distributor, Teletype 100-A, or other source of neutral type teletypewriter signals into the bias measuring circuit in place of the contacts of the relay. There should be no relay in the subbase of the bias meter when using the jack.

SECTION IV—MAINTENANCE

13. Servicing.

There will be little wear on any part of Bias Meter I-97-A. The relay, part of Line Unit BE-77, may possibly wear. Avoid

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attempts at repairs in the field. It is more satisfactory to have repairs made at the depot.

a. The meter used in the bias meter has a full-scale deflection of one milliampere and therefore is subject to damage if care in servicing is not taken. If a test set is used to check the wiring of the bias meter, disconnect one of the meter leads because the battery of the test set may pass sufficient current through the meter to damage it.

14. Zero Bias Adjustment.

An occasional check of the zero bias adjustment may be required and should be by a maintenance group with proper test equipment. Make the check by connecting a source of unbiased repeated "space" signals to the jack of the bias meter. The signals, which consist of marking pulse for the third and stop impulses and a spacing pulse for the start, first, second, fourth and fifth impulses, preferably should be from a brush-type distributor such as No. 100-A Teletypewriter Test Distributor or a 14-Type Transmitter-Distributor, manufactured by the Teletype Corporation. If the meter does not read zero while receiving the unbiased signals with the pushbutton depressed, readjust the 400-ohm rheostat located within the housing.

a. In order to make this adjustment, remove the sheet metal enclosure forming the sides and rear of the bias meter. Then remove the cap nut from the rheostat shaft and adjust the rheostat with a screwdriver until a zero reading is obtained under the conditions previously described. Replace the cap nut and tighten it securely. If the meter does not read zero when the pushbutton is not depressed, correct it with the zero adjusting screw on the face of the meter before adjusting the rheostat.

SECTION V—SUPPLEMENTARY DATA

15. Maintenance Parts.

All of the maintenance parts of Bias Meter I-97-A are shown in Figure 5. Descriptions, stock numbers, etc., are listed in the following pages. Each component has the same reference number in Figure 2 and Figure 5.

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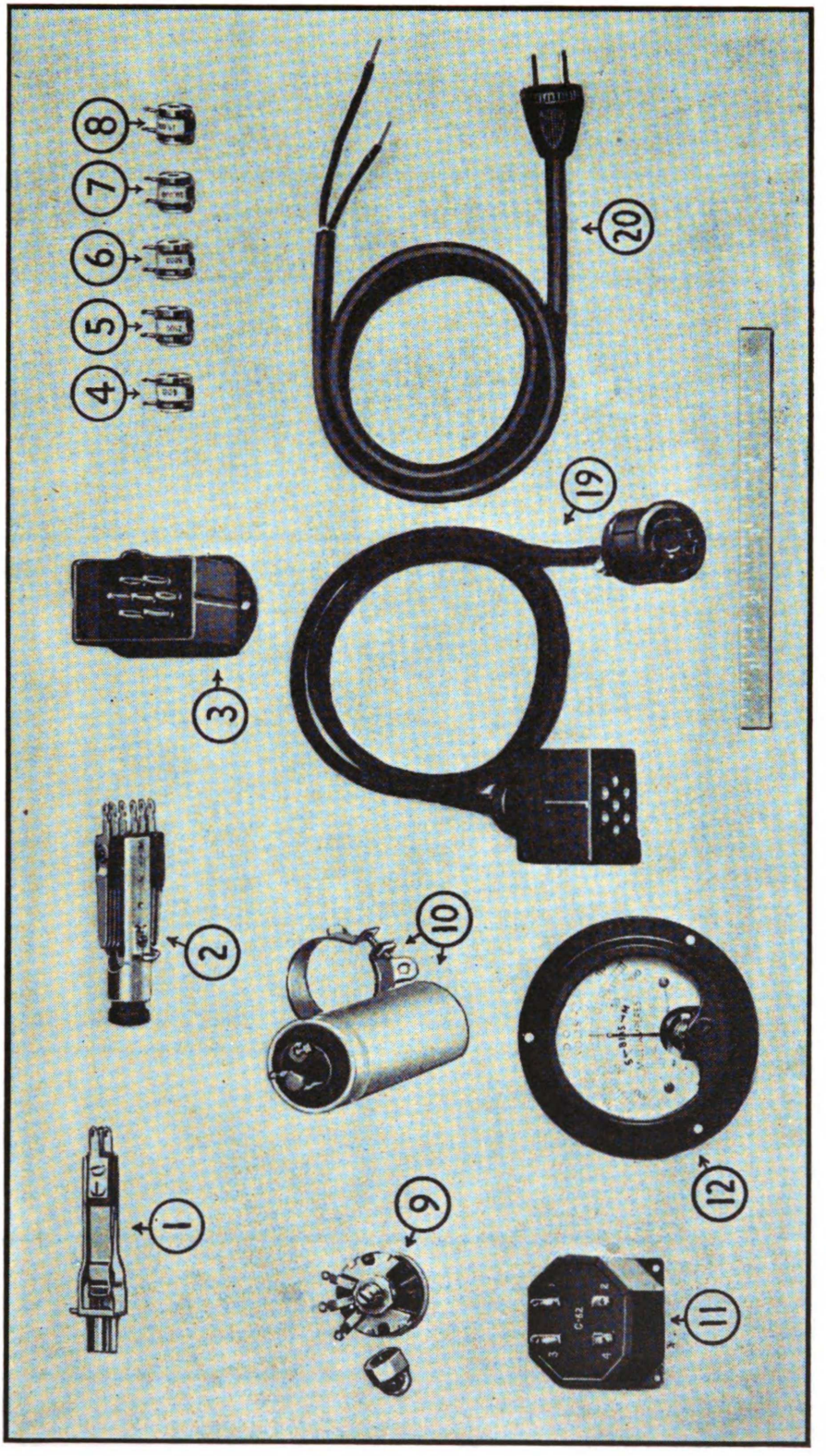


Fig. 5. Parts Identification I-97-A

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15. **LIST OF MAINTENANCE PARTS FOR BIAS METER I-97-A**

NOTE: Use the specified Signal Corps Stock Number when requisitioning items contained in the following list. To obtain an item not listed, requisition the next larger component listed containing the required part.

Total Quantity in Equip.	Ref. Symbol	Sig. Corps Stock No.	Name of Part and Description	Function	Mfr. Code	Contr's Dwg. or Part No.
		3F3397A	BIAS METER I-97-A	Used when adjusting spring tension on telegraph printer relays.		
1	1	2Z5524	Jack, single circuit, one normally closed contact, fits in $\frac{15}{32}$" hole, overall size $\frac{7}{8}$" x $\frac{9}{16}$" x 3½". W. E. Co. 218A.	Connects to plug.	WE	
1	2	4C5092AS	Key, pushbutton type, Western Electric 92AS, non-locking, fits in $\frac{43}{64}$" hole, 4 S.P.D.T. contacts, overall size $1\frac{1}{16}$" x $1\frac{5}{16}$" x 3½". W. E. Co. D121288.	Switches connections.	WE	
1	3	2Z7117.1	Relay Subbase, socket type, black molded phenolic, with 7 banana plugs molded in, for Western Union Telegraph Co. #41-C Relay, 2½" x $1\frac{9}{16}$" x 1⅞" high, with two .175" dia. mounting holes $2\frac{3}{16}$" apart. Western Union Telegraph Co. #142-A.	Holds relay.	AS	†SCD-6895-22
1	4	3Z6040-17	Resistor, fixed, precision, ceramic, $\frac{9}{16}$" dia. x $\frac{9}{16}$" long, .140" axial hole, with rigid soldering lugs ⅜" long, 400 ohms ±1%. IRC WW3.	Used in capacitor charging circuit.	IRC	

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2	5	3Z6250-33	Resistor, fixed, precision, ceramic, $\frac{9}{16}$" dia. x $\frac{9}{16}$" long, .140" axial hole, with rigid soldering lugs $\frac{3}{8}$" long, 2,500 ohms ±1%. IRC WW3.	Used in bias measuring network.	IRC
1	6	3Z6500-81	Resistor, fixed, precision, ceramic, $\frac{9}{16}$" dia. x $\frac{9}{16}$" long, .140" axial hole, with rigid soldering lugs $\frac{3}{8}$" long, 5,000 ohms ±1%. IRC WW3.	Used in bias measuring network.	IRC
1	7	3Z6610-80	Resistor, fixed, precision, ceramic, $\frac{9}{16}$" dia. x $\frac{9}{16}$" long, .140" axial hole, with rigid soldering lugs $\frac{3}{8}$" long, 10,000 ohms ±1%. IRC WW3.	Used in bias measuring network.	IRC
1	8	3Z6615-45	Resistor, fixed, precision, ceramic, $\frac{9}{16}$" dia. x $\frac{9}{16}$" long, .140" axial hole, with rigid soldering lugs $\frac{3}{8}$" long, 15,000 ohms ±1%. IRC WW3.	Used in bias measuring network.	IRC
1	9	2Z7292-400	Rheostat, wire wound, 0-400 ohms, 2 watts, no taper, enclosed, body 1¼" dia. x $\frac{9}{16}$" deep, bushing $\frac{3}{8}$"-32 x $\frac{3}{8}$" long, shaft ¼" dia. x ½" long, with screwdriver slot in end. Equipped with locknuts and acorn type capnut. IRC VW-1508.	Adjusts charging current.	IRC
1	10	3DB100-1	Capacitor, fixed, 100-100 mfd, 200 volt working, electrolytic, aluminum can, 1⅜" dia. x 4⅞" long, including three insulated terminals extending $\frac{3}{8}$" from insulated end of can. Black common negative insulated from can. With mounting ring having mounting holes $1\frac{13}{16}$" apart. Aerovox EP-N11.	Used in bias measuring circuit.	AC

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LIST OF MAINTENANCE PARTS FOR BIAS METER I-97-A (Cont'd.)

Total Quantity in Equip.	Ref. Symbol	Sig. Corps Stock No.	Name of Part and Description	Function	Mfr. Code	Contr's Dwg. or Part No.
1	11	2Z9662	Transformer C-62, AF, 1:1 ratio, 2" x 1⅝" x 2" high, 4 mounting holes .120" dia. on 1$\frac{11}{16}$" x 1$\frac{5}{16}$" centers. Ferranti C-62.	Choke	FE	
1	12	3F7380	Voltammeter IS-180, 1-0-1 ma., adjusted to 100 ohms ±½%, scale 100-0-100 ma. (used with external shunt) or 115-0-115 volts (used with external multiplier), D'Arsonval movement, flange 3½" dia., body 2¾" dia. x 1⅜" deep, round flush mounting, molded case, calibrated for $\frac{1}{16}$" steel panel. #10-32 terminal studs on back, ¾" long. Marion IS-180.	Indicates bias.	ME	†SCA-6483
1	19	3E4035-13	Adapter Plug and Cord Assembly, consists of Reference Nos. 13, 16 and 18 assembled together. (See Fig. 2.)	Connects Bias Meter to Relay socket.	AS	†SCD-6895
1	20	3E4059-6	Power Cord Assembly, 2-conductor #18 rubber-insulated, rubber jacketed cord, 36" long, with Belden H-1047 attachment plug. Other end has conductors separated 3" and skinned ½".	Connects to power supply.	AS	†SCD-6895

†Indicates Signal Corps drawing number.

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TABLE OF STANDARD NUTS, BOLTS, SCREWS AND WASHERS

Quantity	Description	Size	Length	Where Used
4	Rd. hd. mach. sc., steel, black	#2-56	1/8"	Nameplate
4	Bdg. hd. brass machine screw, black	#4-40	5/16"	Mount Transformer
3	Rd. hd. mach. sc., brass, black	#4-40	3/8"	Secure Meter
7	Steel lockwasher, nickel plated	#4		4 on transformer screws 3 on meter screws
3	Flat brass washer, small pattern	#4		With meter screws
4	Hex. brass nut, nickel plated	#4-40		With transformer screws
4	Rd hd. mach. sc., brass, nickel plated	#4-40	5/8"	Secure adapter cap to adapter body
9	Oval bdg. hd. steel machine screw, black paint finish	#6-32	1/4"	Secure box to Chassis
9	Rd hd. mach. sc., brass, nickel plated	#6-32	1/4"	4 on pushbutton 3 on jack 2 on relay sub-base
4	Rd hd. mach. sc., brass, nickel plated	#6-32	5/16"	2 on Cable Connector Socket 2 on Capacitor Mounting Ring
1	Bdg. hd. mach. sc., steel, parkerized	#6-32	3/8"	Secures Cable Clamp
1	Hex. nut, steel, parkerized	#6-32		On cable clamp screw
7	Hex. brass nut, nickel plated	#6-32		2 on Cable Connector Socket 2 on Capacitor Mounting Ring 3 on Resistor Assembly
3	Plain brass washer, nickel plated	#6		On Resistor Assembly

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TABLE OF STANDARD NUTS, BOLTS, SCREWS AND WASHERS (Cont'd.)

Quantity	Description	Size	Length	Where Used
7	Steel lockwasher, nickel plated	#6		1 on Cable Clamp Screw 2 on Resistor Assembly 2 on Cable Connector Socket 2 on Capacitor Mounting Ring
2	Brass rivet, button head	$\frac{3}{32}$"	¼"	Secure Catch to Cover
2	Steel lockwasher, nickel plated	#10		On Meter Connection Studs

MANUFACTURERS' NAMES AND ADDRESSES

Abbrev.	
AS	Automatic Signal Corporation, Regent Street, East Norwalk, Conn.
AC	Aerovox Corporation, New Bedford, Mass.
FE	Ferranti Electric, Inc., 30 Rockefeller Plaza, New York City
IRC	International Resistance Co., 401 North Broad Street, Philadelphia, Pa.
ME	Marion Electrical Instrument Co., Manchester, N. H.
WE	Western Electric Co., Inc., Kearney, N. J.

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