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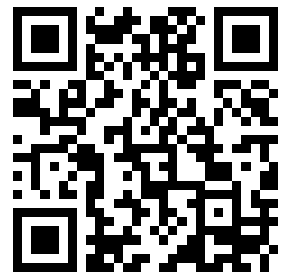

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DEPARTMENT OF THE ARMY TECHNICAL MANUAL

DIRECTION FINDER SET AN/SRD-11

DEPARTMENT OF THE ARMY • JUNE 1955

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WARNING

DANGEROUS VOLTAGES EXIST IN THIS EQUIPMENT

* * * * * * *

DON'T TAKE CHANCES!

EXTREMELY DANGEROUS VOLTAGES

EXIST IN THE FOLLOWING UNITS:

Dynamotor Power Supply 165-volt circuits

Input Power Line 110-volt circuits

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TECHNICAL MANUAL
No. 11-279

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *12 July 1955*

DIRECTION FINDER SET AN/SRD-11

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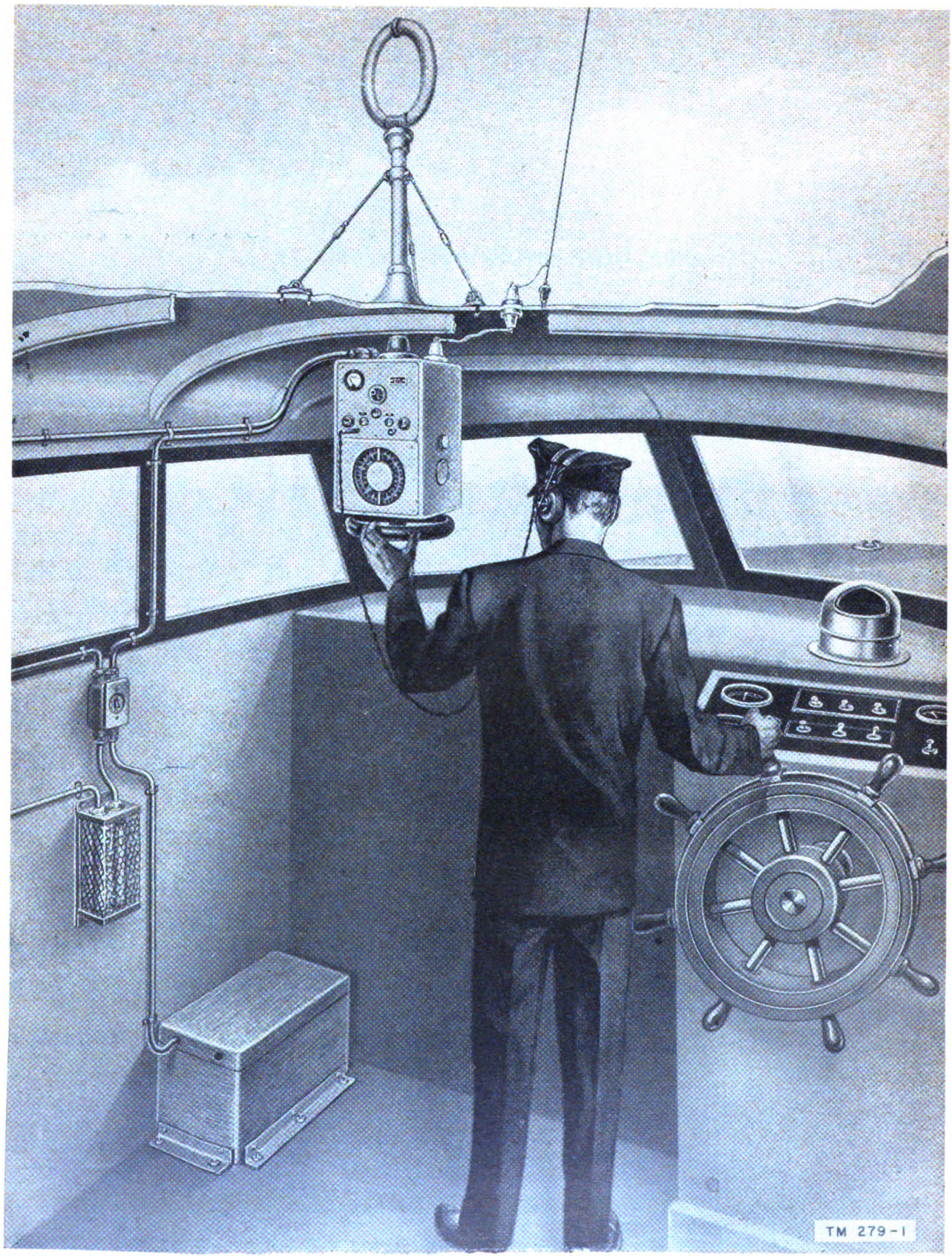

Figure 1. Direction Finder Set AN/SRD-11.

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CHAPTER 1

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for the installation, operation, maintenance, and repair of Direction Finder Set AN/SRD–11 (fig. 1). Maintenance may be carried out by following the instructions in chapters 4 and 6.

b. Forward comments on this publication directly to Commanding Officer, The Signal Corps Publications Agency, Fort Monmouth, New Jersey, ATTN: Standards Division.

2. Forms and Records

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

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

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. DA Form 11–238, Operator First Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 17).

d. DA Form 11–239, Second and Third Echelon Maintenance Check List for Signal Corps Equipment (Radio Communication, Direction Finding, Carrier, Radar), will be prepared in accordance with instructions on the back of the form (fig. 18).

e. Use other forms and records as authorized.

Section II. DESCRIPTION AND DATA

3. Purpose and Use

a. Direction Finder Set AN/SRD–11 is used as a navigational aid in fixing positions; checking wind, current, and tide drift at sea; and making landfalls on the coast in all kinds of weather. It operates in the low-frequency (280–520 kilocycles (kc)) radiobeacon band. Accurate radio bearing determinations can be made up to more than 100 miles from a radiobeacon station.

b. The equipment consists of a superheterodyne radio receiver, capable of receiving signals in the radiobeacon band of 280 to 520 kc, a directional antenna system, and a number of additional components. The operating components are shown in figure 2 and all the components are listed in paragraph 6.

4. Technical Characteristics

Frequency range	280 to 520 kc.
Receiver type	Superheterodyne.
Types of signals received	Cw, tone, and voice (A 0, A 1, A 2, and A 3 signals).
Number of tubes	9.
Intermediate frequency	115 kc.
Method of calibration	Signal generator and audio oscillator.
Calibration points:	
Audio	200, 600, 1,000, and 2,000 cps.
Radio	115, 280, 290, 300, 310, 400, and 500 kc.
Power input	6 volts dc, 4.6 amperes.
Power supply	6-volt, 150-ampere hour storage battery through dynamotor. Storage battery charged from power supply of vessel.
Antenna	18-inch circular loop, rotatable through 360° on a vertical axis.
Weight	161 lb.

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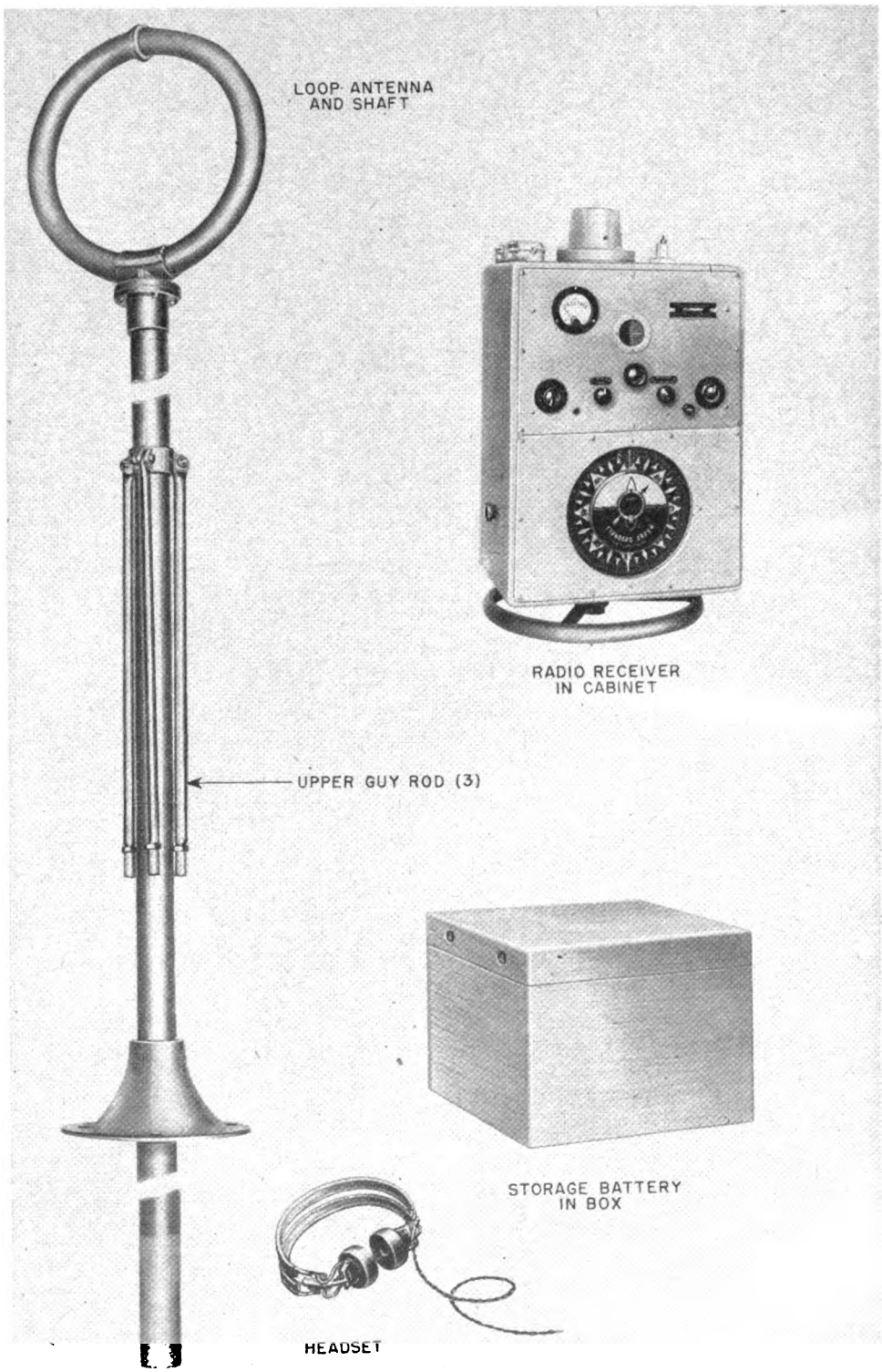

Figure 2. Direction Finder Set AN/SRD-11, operating components.

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5. Packaging Data

a. The components of Direction Finder Set AN/SRD–11 are packed for domestic shipment in four wooden cases. The size, weight, and volume of each case are indicated in the following chart.

Note. Items may be packaged in a manner different from that shown, depending on supply channel.

Case No.	Height (in.)	Width (in.)	Depth (in.)	Volume (cu ft)	Unit weight (lb)
1 of 4	18	30	18	6. 65	127
2 of 4	14½	126	21	21. 62	185
3 of 4	18	18½	16½	3. 18	70
4 of 4	13	26	11	2. 15	67
Total weight					449

b. The following list indicates the contents of each case. See the packing list attached to each case for exact contents.

Case dimensions (in.)	Contents	Notes
18 x 30 x 18	1 radio receiver cabinet	Includes radio receiver and tubes.
	1 set of running spares	Includes spare tubes, pilot lamp, dynamotor brushes, special wrench, and screwdriver.
	2 technical manuals.	
14½ x 126 x 21	1 loop antenna and shaft	Includes deck flange and guy rods.
18 x 18½ x 16½	1 installation material kit	Includes charging resistor, charging switch and box, and miscellaneous installation material.
	1 headphone with plug.	
	1 storage battery box.	
13 x 26 x 11	1 storage battery, 6-volt	Shipped dry-charged, electrolyte included.

6. Table of Components

(figs. 2 and 16)

Component	Required No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu ft)	Unit weight (lb)
Radio receiver cabinet	1	22	14	14	2. 49	90
Loop antenna and shaft	1	122	12	18	. 92	71
Storage battery	1	9¾	7⅜	13	. 54	53
Storage battery box	1	12¾	9	15	. 99	10
Charging resistor	1	3½	4¼	11⅜	. 09	5
Charging switch and box	1	2⅞	2¾	6	. 01	2
Headphones and plug	1					1

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

7. Description of Radio Receiver

a. The radio receiver (figs. 3 and 4) is a nine-tube superhetrodyne receiver, designed to receive radio-beacon signals within the range of 280 to 520 kc. The received chassis is mounted in the upper compartment of a gray wrinkle-finish, anodized aluminum alloy cabinet.

b. The lower compartment of the cabinet holds the dynamotor power supply, compass card and mechanical compensator assembly, compass card illumination control, gyro repeater motor and interlock relay.

c. The power and sense antenna connections are made through receptacles at the rear of the chassis. The loop antenna connections are made to collector rings located in the receiver. The loop antenna is connected directly, by means of a shaft, to a handwheel located underneath the cabinet.

8. Description of Dynamotor Power Supply

a. The dynamotor power supply shown in figure 33 is furnished with equipments bearing serial numbers 1 through 74; the unit shown in figure 35 is furnished with equipments bearing serial num-

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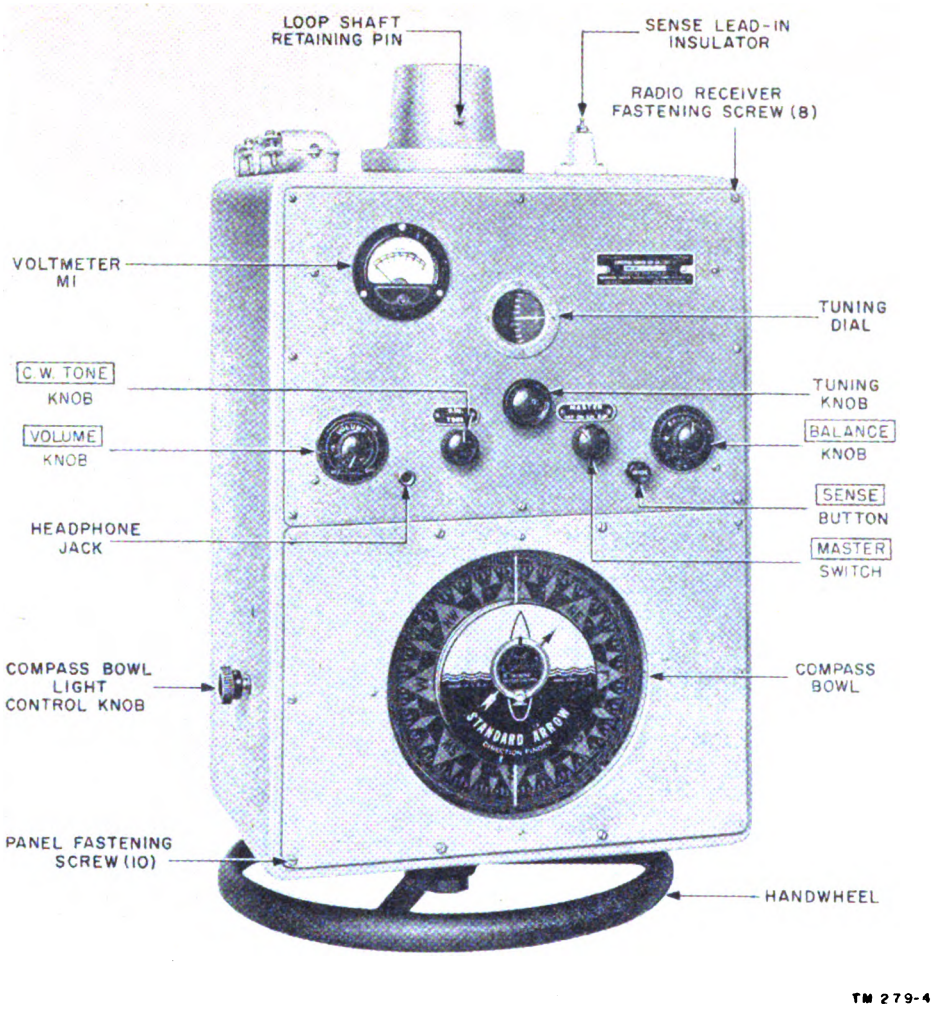

Figure 3. Radio receiver in cabinet, front view.

bers 75 through 137. The electrical performance of the two units is the same and the complete units are interchangeable mechanically and electrically. Different components in each unit, however, are used which are not interchangeable.

b. Each dynamotor power supply consists of a dynamotor and filter. The dynamotor operates from a 6-volt storage battery and furnishes plate voltage for the radio receiver. The plate voltage is effectively filtered. A filter is provided in the 6-volt supply, which furnishes heater voltage for the radio receiver.

9. Description of Interlock Relay

(fig. 5)

a. The interlock relay controls the 6-volt supply to the tube filaments and dynamotor. The wiring is such that it will close only when the antenna switch in the radio room of the ship is open. Thus, the direction finder will be inoperative when the radio transmitter of the ship is being used.

b. The same interlock relay is used with both dynamotor power supplies. When a dynamotor power supply is replaced, the interlock relay is transferred to the new power supply.

10. Description of Gyro Repeater Motor

(fig. 8)

The gyro repeater, a 70-volt direct-current (dc), step motor, is connected to the main gyrocompass of the ship and follows it. It is geared to the movable compass card so that this compass will show the same bearing as the main gyrocompass. A reset knob is provided for initially setting the compass card to conform to the main gyrocompass.

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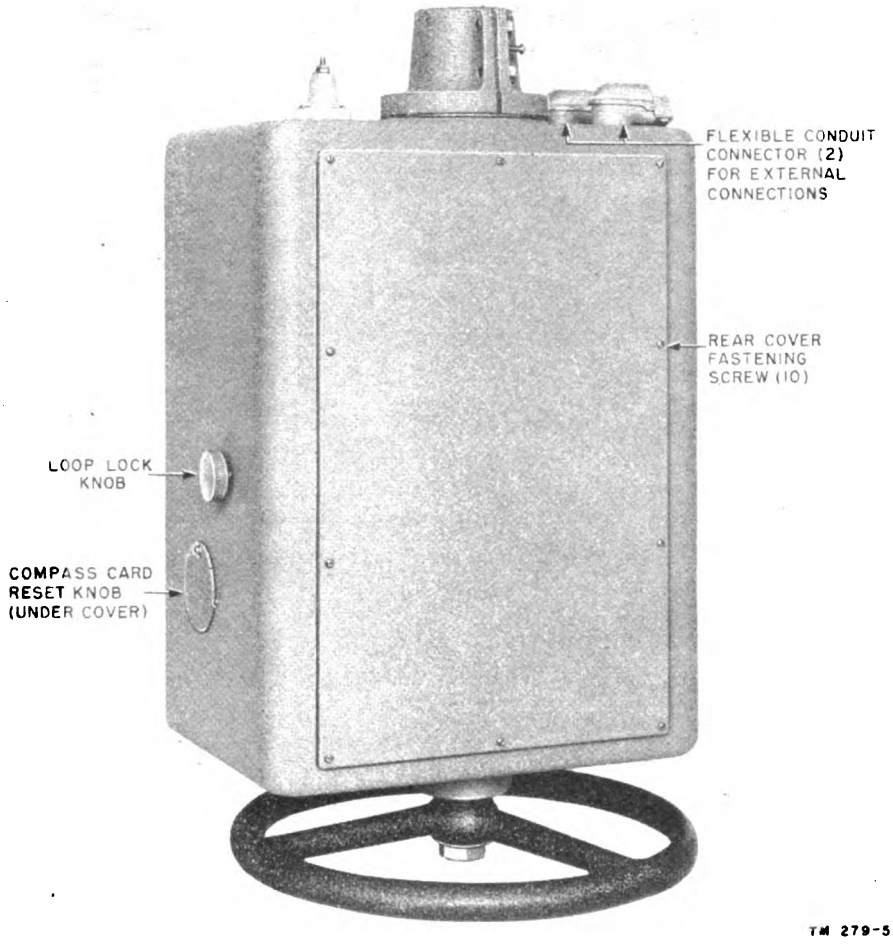

Figure 4. Radio receiver in cabinet, rear oblique view.

11. Compass Bowl and Mechanical Compensator Assembly (fig. 15)

The compass bowl and mechanical compensator assembly consist of a fixed azimuth scale, a movable compass card and azimuth scale, a pointer assembly, and a pointer compensator mechanism. Radio bearings, relative to the bow of the ship, are read from the fixed azimuth scale. True radio bearings are read from the movable compass card which is connected to the master compass of the ship. The pointer system is composed of a constant pointer which indicates loop position, a compensated pointer giving the true direction of the radio signal, and a sense pointer. The compensator mechanism corrects for bearing errors induced by the superstructure of the ship, and makes the compensated pointer indicate a true direction.

12. Description of Loop Antenna

a. The loop antenna (fig. 2) includes a circular loop, transmission line, and an inner shaft which is supported on roller bearings by an outer shaft. The loop and inner shaft rotate as a unit. Adjustable guy rods are provided for rigidity. The deck flange, also supplied, supports the unit at the deck and also provides a watertight fitting around the outer shaft which extends below deck to the radio cabinet.

b. The 18-inch loop has a continuous high Q winding of low-loss Litz wire inclosed in a waterproof, sweatproof, seamless 2-inch copper tube. The halves of the loop are insulated from each other at the top. The center-tapped winding connects to a three-connection terminal strip where connection is made to the transmission line.

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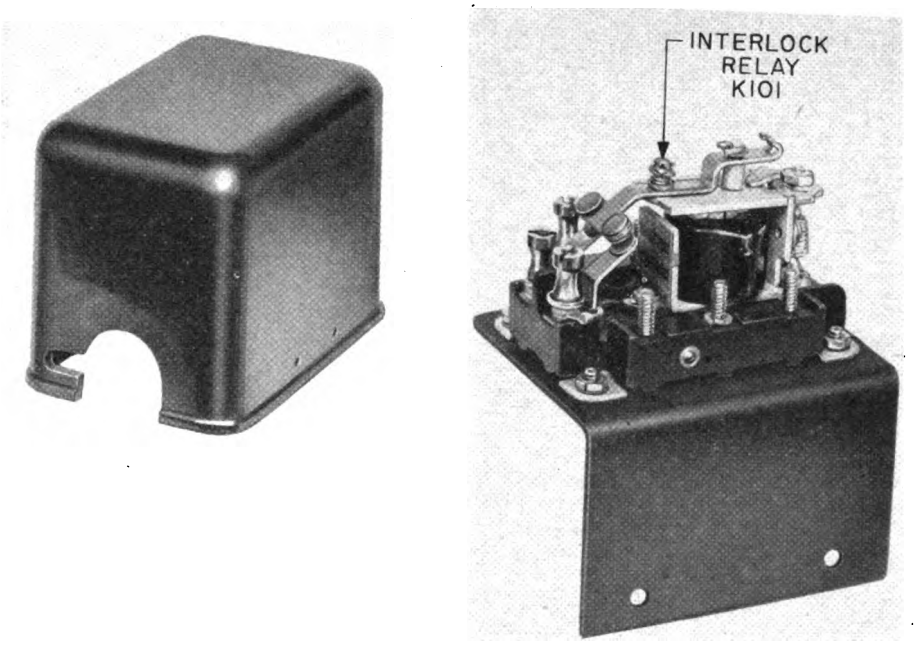

Figure 5. Interlock relay, cover off.

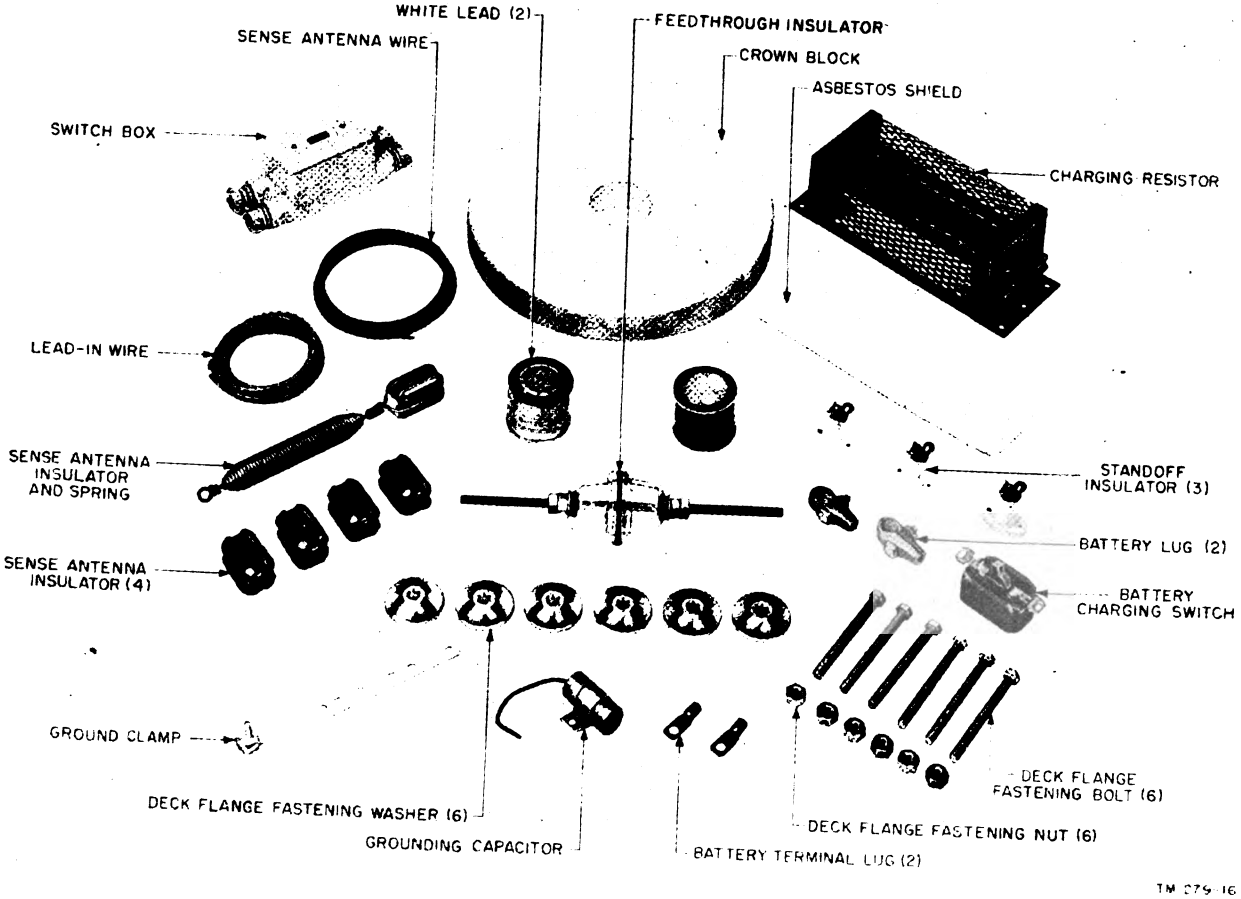

Figure 6. Installation kit.

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13. Description of Minor Components

a. A charging resistor and charging switch are supplied with the installation kit (fig. 6), so that the storage battery may be kept charged from the 115-volt dc power supply of the ship when the radio direction finder is not being used. The charging rate is approximately 2 amperes. The battery cannot be charged while the direction finder is in use.

b. The following items are supplied in the installation kit and listed in SIG 7 & 8 AN/SRD–11.

30 ft wire, sense antenna No. 12, 7/20 bare stranded phosphor bronze
10 ft. wire, lead-in, No. 12, 19/29 stranded copper, rubber and lacquered braid insulation
1 switch box, battery charging
1 insulator, strain and spring, sense antenna
1 capacitor, grounding, 1-microfarad (uf) 200 volt dc
3 insulators, standoff and clamp, sense antenna
2 terminal lugs, storage battery
1 resistor, battery charging
1 switch, battery charging
1 crown block, loop antenna installation
6 washers, deck flange fastening
2 white lead, ½-pound cans
6 bolts, deck flange fastening, ⅜–16 x 2 inch hexagonal head
1 ground clamp
4 insulators, sense antenna
1 insulator, feedthrough, sense antenna
2 terminal lugs
6 nuts, deck flange fastening, ⅜–16 hexagonal
1 shield, asbestos, charging resistor

14. Running Spares

A group of running spares is supplied with each direction finder set. Spares are provided for all normal expendable items, such as tubes, pilot lamps, and fuses. A list of running spares is shown below:

1 tube, electron, type 6SH7
1 tube, electron, type 6SA7
1 tube, electron, type 6SJ7
1 tube, electron, type 6C5
1 tube, electron, type 0C3
1 tube, electron, type 6SK7
1 lamp, incandescent, Mazda #47
1 set (2) generator brushes (high voltage)
1 set (2) generator brushes (low voltage)
1 headset
1 wrench, compensator adjusting
1 screw driver, special, for compensator adjusting

15. Additional Equipment Required

The material supplied is adequate to complete the average installation. In some instances, additional strain insulators and wire, similar to the sense antenna wire, may be required.

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CHAPTER 2

INSTALLATION

Section I. SERVICE UPON RECEIPT OF DIRECTION FINDER SET AN/SRD–11

16. Siting

(figs. 1, 9, and 10)

a. Select a location above deck for the loop that will permit the radio receiver cabinet to be fastened to the loop shaft which extends below the deck.

b. Locate the loop as close as possible to the center of the vessel.

Note. The deviation in one quadrant will then be practically the same as in the adjacent quadrant, except that one will be plus and the other minus.

c. Locate the loop as far as possible, at least 8 feet, from searchlights, binnacles, smokestacks, mast rigging, railings, electrical wires, whistle cords, pipes, rigging stays that have not been insulated, or other metallic objects.

Note. All stays and standing rigging in the vicinity of the loop, should be broken up with strain insulators wherever possible. When it is impossible to break up stays with insulators, both ends must be thoroughly bonded and grounded.

d. Locate the set at least 4 feet from the magnetic compass so that the slight magnetic effect of the metal components will not affect the compass.

e. Wherever possible, locate the instrument so that the observer faces forward when taking bearings. However, the most convenient location from an operating standpoint is suggested.

f. Plan the location so that the radio receiver cabinet may be raised to a height so that the compass card will be at the operator's eye level, and the rear of the cabinet at least 10 inches from the bulkhead.

Note. This rear clearance is required since the back panel is removable for adjustment, checking, and servicing, while clearance on the right is required for access to the gyro reset.

g. Mount the radio receiver cabinet case so that the compass card is visible for quick and accurate reading, and all operating controls are accessible.

Note. When the observer faces forward, the left and right sides of the movable compass card correspond to the left and right sides of the vessel, and are physically correct with the heading of the ship.

h. Select a well-ventilated location for the storage battery box, away from any heat generating devices. To prevent excessive voltage drop, locate the battery box so that the cable run from the battery to the radio receiver cabinet does not exceed 8 feet.

i. Select a suitable location for the resistor assembly and charging switch. A location with adequate ventilation and protection from spray should be provided for the resistor assembly. The charging switch should be located near the radio receiver cabinet so that it may be turned off when the direction finder set is used, and on for charging purposes, when the direction finder set is not in use.

j. For the sense antenna, a single vertical wire not over 30 feet long is required. It may be hung from a spring stay or signal stay, or run up on a flag halyard and hauled down as desired. A permanent sense antenna is preferred.

17. Uncrating and Unpacking New Equipment

a. General. The equipment is shipped in wooden domestic packing cases. When new equipment is received, select a location where the equipment may be unpacked without exposure to the elements, and which is convenient to the permanent installation of the equipment.

Caution: Be careful in uncrating, unpacking, and handling the equipment. It is easily damaged. If it becomes damaged or exposed, a complete overhauling might be required or the equipment may be rendered useless.

b. Step-by-Step Instructions for Uncrating and Unpacking Domestic Shipments.

(1) The serial number of the complete equipment and the order number for each complete equipment are stenciled on each packing case. Take care that all parts bearing the same serial number are installed as a unit.

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(2) Each packing case should be unpacked only as needed to avoid the possibility of damage or breakage. This is a precision instrument that requires careful handling.
(3) Place each packing case as near the operating position as convenient.
(4) Cut and remove the steel straps.
(5) Remove the nails from the cover with a nail puller and remove the cover of the packing case. Do not attempt to pry off the sides or the top or the equipment may be damaged.
(6) Remove the wooden cleats that hold the loop and radio receiver cabinet in their packing cases, and take each unit from its case.
(7) The storage battery is shipped dry-charged, acid being packed in the same case with the battery. Be careful in opening this case.

18. Installation of Loop Antenna and Shaft (fig. 7)

a. Drill a 2¾-inch hole through the deck at the selected loop location.

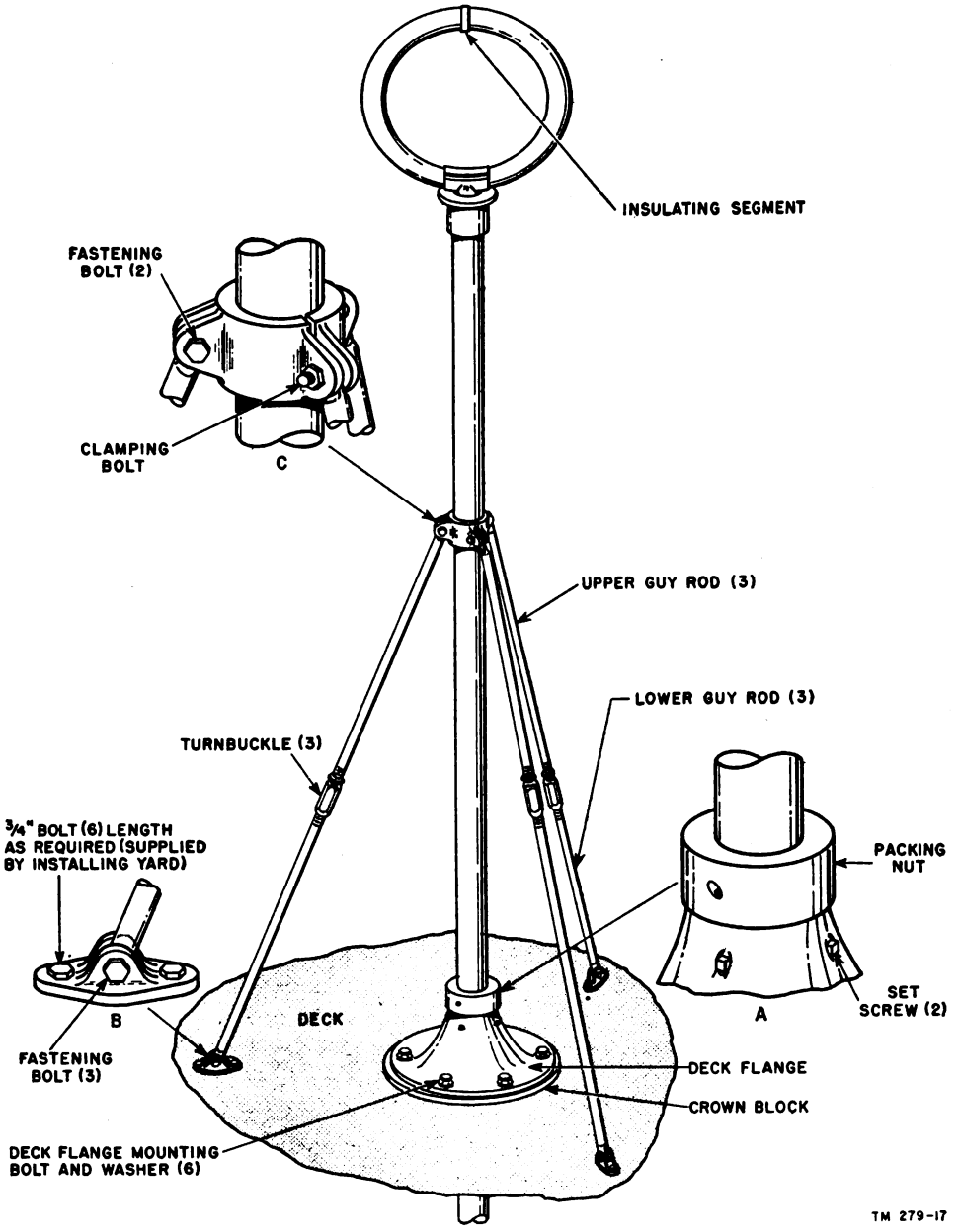

Figure 7. Installation of loop antenna.

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b. Center the crown block (fig. 6) over the hole and level it off.

Note. The bottom of the crown block should be fitted to the contour of the deck so that its top surface is exactly horizontal. The antenna shaft must be exactly vertical.

c. Remove the deck flange from the loop shaft, center it on top of the crown block and drill holes for the deck flange bolts through the crown block and the deck.

d. Place a white lead-coated gasket beneath the crown block, coat the bottom of the deck flange with white lead, and secure the flange and crown block to the deck with the flange bolts, washers, and nuts supplied. The washers go inside the cabin, with their flat surface against the cabin roof.

e. Check each wire of the transmission line with an ohmmeter for ground to the antenna shaft. One wire should show a direct ground and each of the other two wires should be free of grounds.

f. Loosen the packing nut and the setscrews in the deck flange.

g. Remove the protective tubing from the collector rings at the lower end of the shaft and carefully wrap the rings in clean cloth to prevent damage to the rings during the procedure described in *h* through *k* below.

h. Slide the shaft downward through the deck flange sufficiently so that the radio receiver cabinet may be fastened to the shaft. Tighten the packing nut and the setscrews to hold the shaft in position.

i. Secure the guy rod mounting feet to the deck (B, fig. 7) on the 18-inch radius from the center of the shaft and 120° apart. Use caulking compound and gaskets to make the assembly watertight.

j. Complete the guy rod assembly, but do not tighten the collar fastening bolts (C, fig. 7) until the radio receiver cabinet is positioned (par. 19*g*).

k. Use a waterproof canvas cover for the loop as additional protection from the weather when the direction finder set is not being used. It should tie snugly below the loop bearing.

19. Installation of Radio Receiver Cabinet (fig. 8)

a. Remove the radio receiver from its cabinet, after removing the eight panel fastening screws, store it temporarily in a safe place, and remove the rear cover.

b. Loosen the two loop shaft clamping bolts in the split flange on the top of the cabinet and tighten the flange expansion screw to allow insertion of the antenna shaft.

c. Slide the cabinet over the shaft and lift it up until the slotted coupling on the shaft fits into the mating part of the handwheel shaft with ⅛-inch clearance between the two shaft ends, and with the "0–0" markings on the two shaft ends alined for true fit.

d. Rotate the cabinet until the loop shaft retaining pin holes in the flange and those on the outer loop shaft of the antenna coincide (fig. 4). *Do not redrill or ream.*

e. Insert the loop shaft retaining pin (fig. 3) and drive into a snug fit only. The loop shaft retaining pin will project about one-fourth inch from the flange.

f. Loosen the flange expansion screw and tighten the two loop shaft clamping bolts (fig. 8), so that the split flange is securely tightened against the outer shaft of the antenna assembly.

g. Adjust the height of the cabinet so that the compass card is at eye level (approx. 53 in. above the deck), and the front of the cabinet is at right angles to the bow and stern, as follows:

(1) Loosen the packing nut and set screws in the deck flange, raise the cabinet and loop as required, and tighten the packing nut and one set screw temporarily.

(2) Spot the other set screw by drilling a hole one-sixteenth inch into the outer shaft. Be careful not to drill through the outer shaft. (If, however, the drill does penetrate, disassemble the outer shaft and clean thoroughly of metal chips before continuing the installation.)

(3) Tighten this set screw and repeat the procedure for the second set screw.

(4) Loosen the packing nut on the deck flange (A, fig. 7) and check the graphite cord packing for completeness. Then tighten the packing nut securely so that this gland (fitting) is watertight.

(5) Mount the shaft exactly vertical and tighten the guy rod collar fastening bolts. Adjust the guy rod turnbuckles (C, fig. 7) for equal tension.

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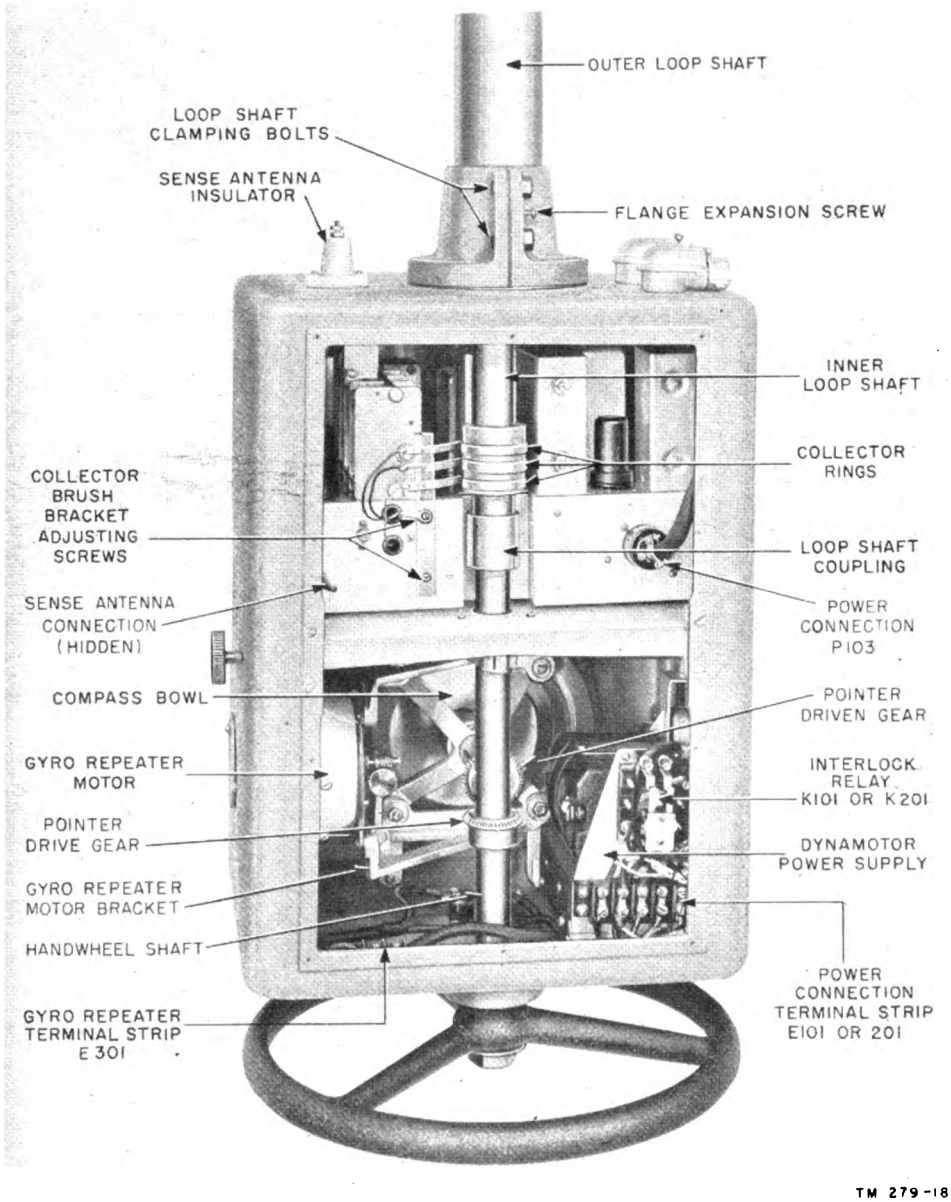

Figure 8. Radio receiver cabinet rear view, cover removed to show loop shaft.

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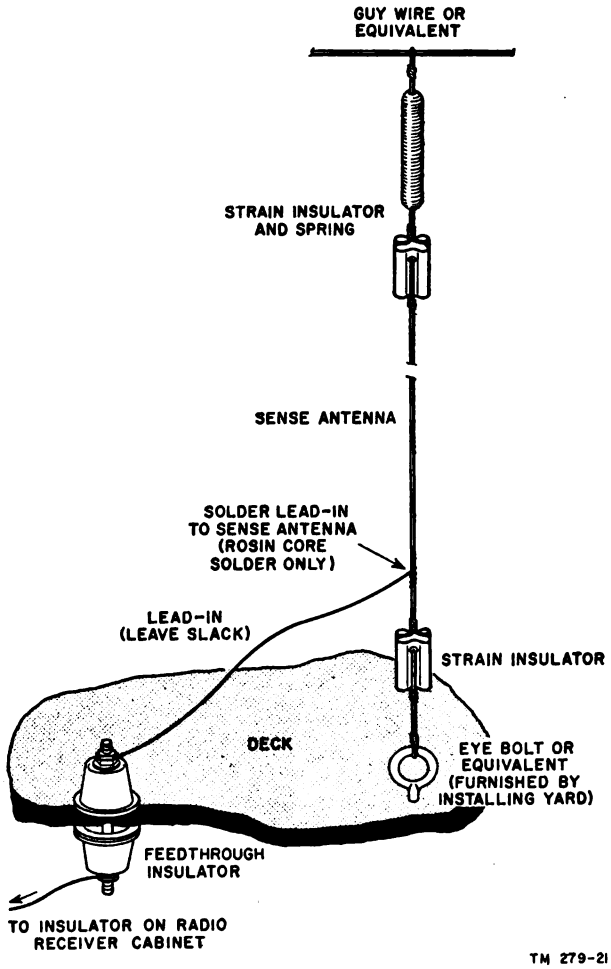

Figure 9. Sense antenna installation.

20. Installation of Battery Box

Fasten the battery box to the deck or to a shelf prepared for the purpose at the location selected using 2-inch brass angle, furnished by the installing yard. The box must be fastened securely so as not to be jarred loose during heavy weather.

21. Installation of Charging Resistor

Mount the charging resistor in a vertical position on a bulkhead with the asbestos shield (included in the installation material kit) between the resistor box and the bulkhead.

Caution: It is essential that there is sufficient ventilation to dissipate the heat generated, and also that the charging resistor is not subjected to spray or rain.

22. Installation of Charging Switch

a. Mount the charging switch box on a bulkhead near the radio receiver cabinet.

b. The location for this switch should not only be convenient for operation, but also for the running and connecting of the required cables.

c. Install the charging switch in the box. Make connections to the switch as shown in figure 11.

23. Installation of the Sense Antenna

(fig. 9)

a. Select a suitable location for the deck or feedthrough insulator which will allow a short lead-in, and where it can be sealed against leakage.

b. Drill a ¾-inch hole through the deck and assemble the deck insulator using caulking compound under the washers if necessary to insure a watertight fit.

c. Install a single vertical wire not over 30 feet long, and connect the lead into the sense antenna insulator on the receiver cabinet.

24. Connections

All connections should be made in accordance with figures 10 and 11, using the cables specified. Refer to figure 8 for the location of terminal strips.

25. Installation of Radio Receiver Chassis

a. Check to see that all tubes are firmly seated in their proper sockets (fig. 12).

b. Slide the chassis (fig. 30) into the upper compartment of the cabinet (fig. 3). Be careful not to bend the collector brushes.

c. Secure the chassis with the eight fastening screws.

d. Check the alinement of the collector brushes with the collector rings. If necessary, loosen the collector brush bracket adjusting screws (fig. 8), adjust as required, and retighten.

e. Plug the power cord into the receptacle on the rear of the chassis at the right.

f. Plug the sense antenna into the receptacle on the rear of the chassis at the left.

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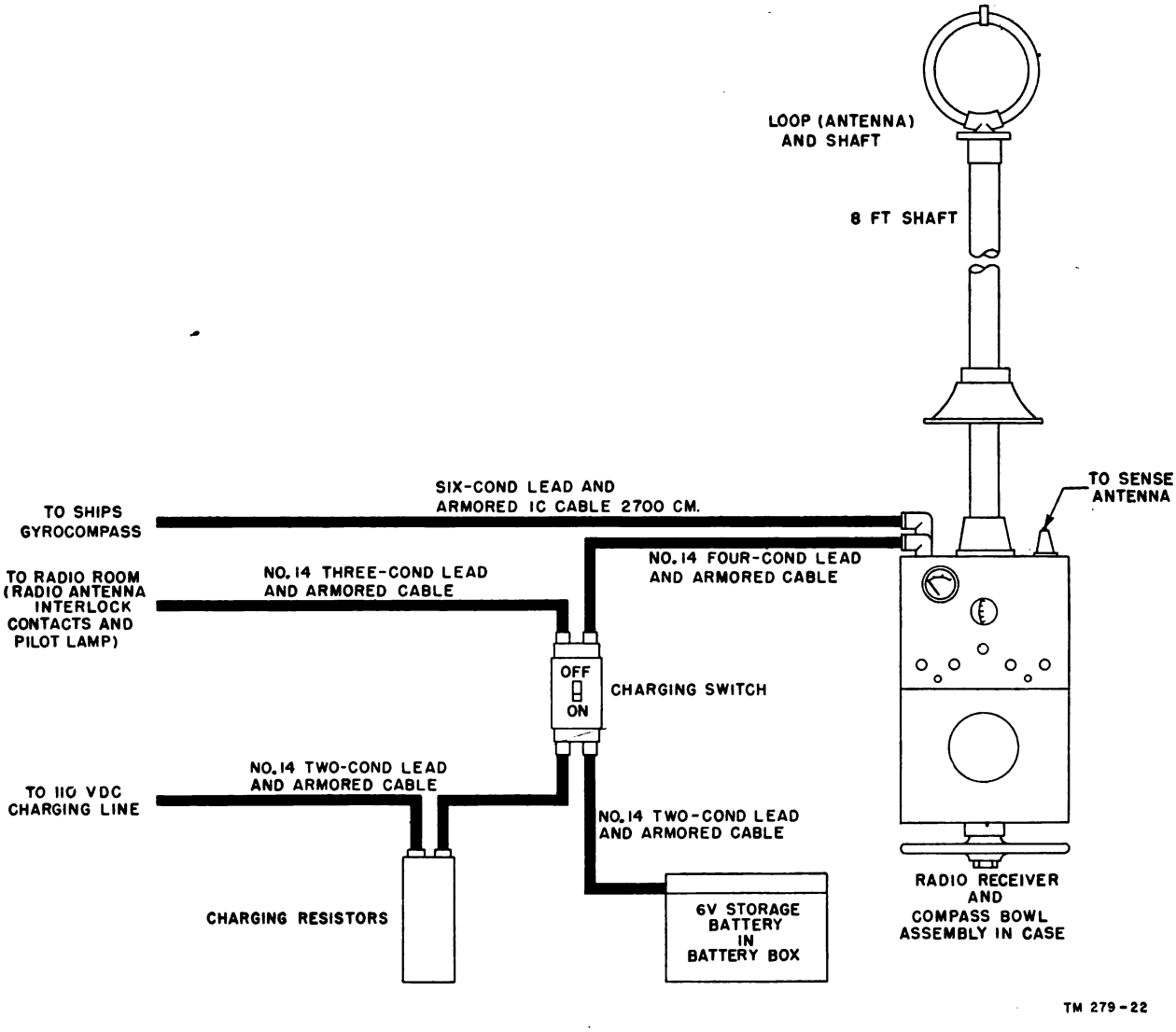

Figure 10. Direction Finder Set AN/SRD-11, cabling diagram.

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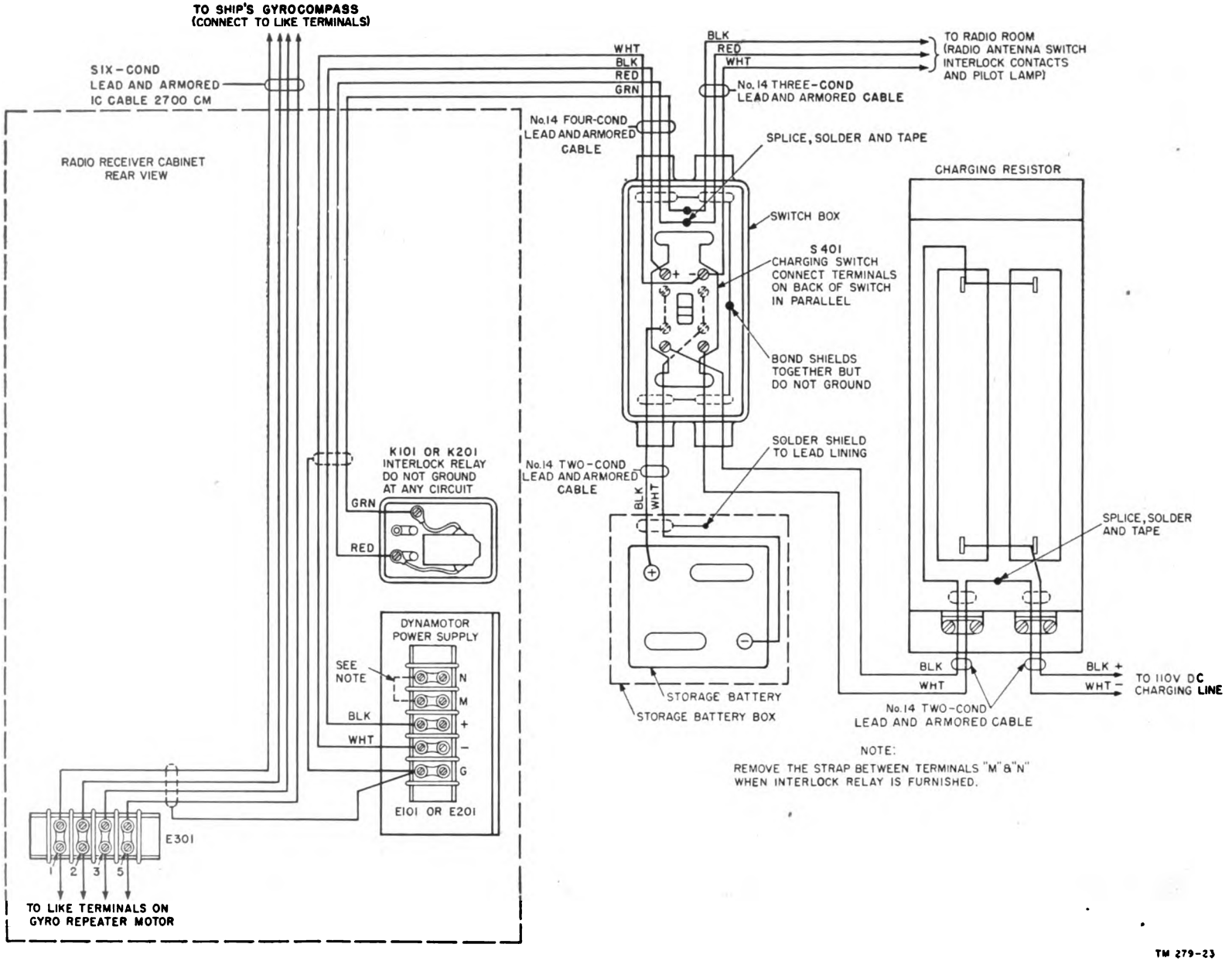

Figure 11. Direction Finder Set AN/SRD-11, connection diagram.

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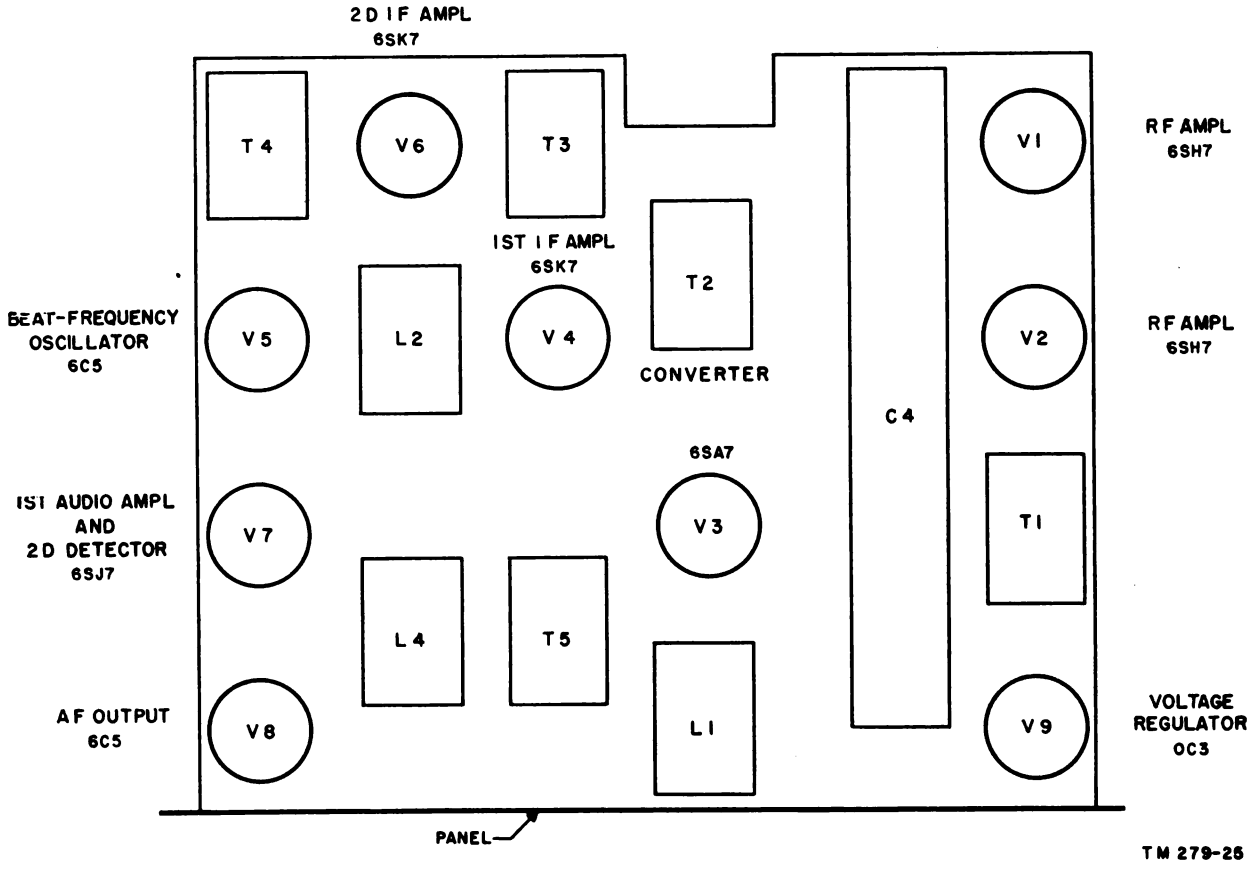

Figure 12. Radio receiver, tube location.

26. Service Upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 17 for uncrating and unpacking the equipment.

b. Check the used or reconditioned equipment for tags or other indications that pertain to changes in the wiring of the equipment. If any changes in wiring have been made, note the change in this manual preferably on the schematic diagram.

c. Check the operating controls for ease of rotation.

d. Check the operation of the dynamotor power supply.

e. Perform the installation and connection procedures given in paragraph 16 through 25.

f. Give the equipment an operational test (par. 50).

Section II. INITIAL ADJUSTMENT OF EQUIPMENT

27. Calibration

a. Calibration consists of taking radio bearings on a radiobeacon station, and comparing the radio bearings with visual bearings taken at the same time. The deviation of the radio bearings from the visual bearings is noted, and a mechanical compensator is adjusted to make the radio bearings agree with the visual or true bearings.

(1) Large bodies, such as the hull, cargo booms, lifeboats, davits or rigging, ballast, etc., tend to distort the front of the intercepted waves and change the angle of approach and thus the apparent bearing of the radiobeacon source. This effect is most pronounced when the bearing in 45° from *dead ahead* or *dead astern*. The deviation diminishes to 0 dead ahead and approaches or reaches 0 on the beam or dead astern.

(2) The deviation is not affected by the magnetism of the earth and does not vary as

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DIRECTION FINDER CALIBRATION DATA

1. Note Direction Finder value for each corresponding 10° interval. Record these values in Column "R".
2. Find difference between all values of T and R and record difference in "D".
3. Scan column "D" for maximum difference. This will determine maximum (±) value of the vertical lines. To assign (±) values proceed as follows: If maximum difference is within 8°, begin at zero and insert numbers 1, 2, 3, 4, etc., in ascending order in both directions, beginning at 0°. If maximum difference is less than 16°, insert numbers 2, 4, 6, 8, etc., in ascending order beginning at 0°.
4. Plot values of "D" on graph, using the Radio bearing "R" as the ordinates.
5. Obtain values for "C" from curve. Apply to Radio bearing at 10° intervals to give true bearing.

VESSEL

TYPE

OWNER

CAPTAIN

L.O.A.

BEAM _____

DRAFT FWD _____

AFT _____

BOOMS ☐ UP

☐ DOWN

D.F MODEL

SERIAL NO.

INSTALLED BY

DATE

PELORUS OBSERVER

RADIO OBSERVER

CHECKER

WEATHER

BEACON

TIME

DATE

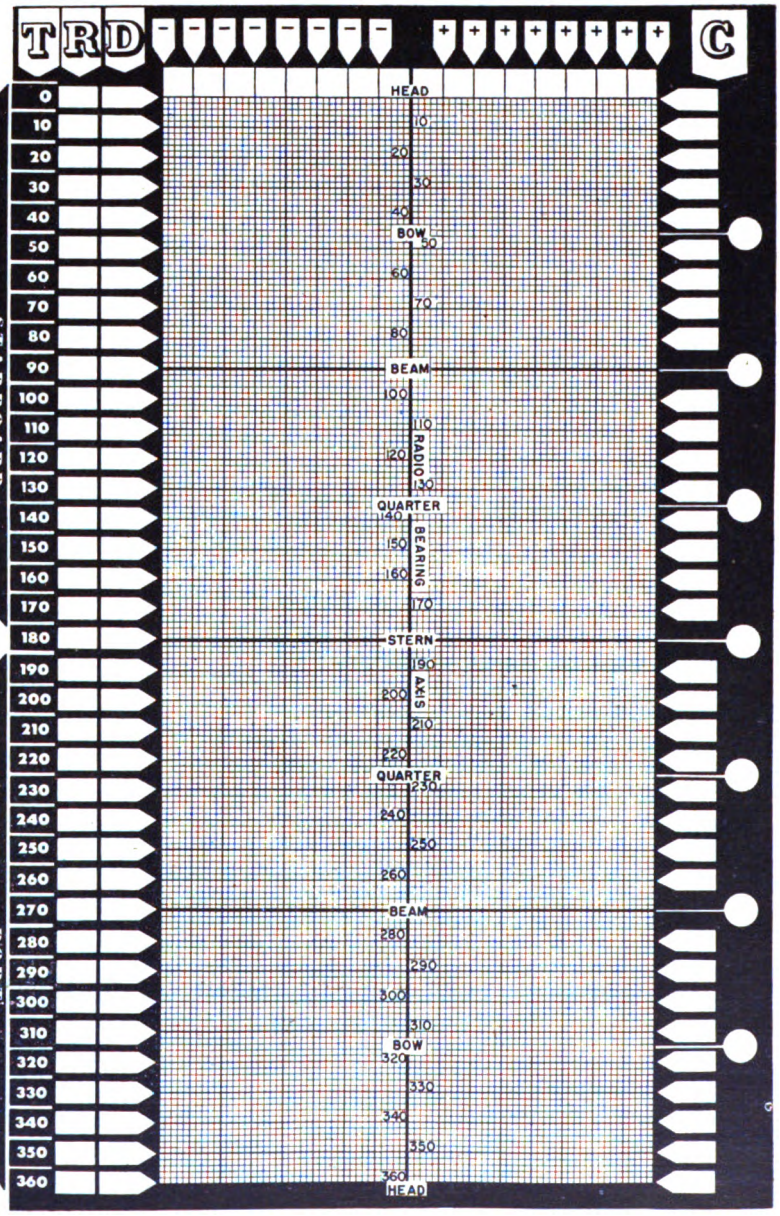
RADIO TRANSMITTER

YES ☐

NO ☐

MAKE _____

SIGNAL LETTERS



TM279-28

Figure 13. Calibration chart.

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long as the various elements of rigging and equipment are not moved, altered, or changed. Consequently, it has no relation to the compass course, but applies only to the angle between the keel of the ship and the observed line of bearing of the radiobeacon. The calibration procedure described below must be carried out carefully and accurately.

b. The vessel should take a position not closer than 4 or 5 miles to the radiobeacon station to reduce parallax between the direction finder and the pelorus. There should be no intervening land between the vessel and the station, since this condition could increase the deviation in the direction finder bearings.

Note. The pelorus is an instrument used to determine, visually, the azimuth or bearing between two points.

c. If the beacon is located on shore, the position of the ship should be such that the bearing of the beacon is as nearly as possible at right angles to the shore.

Note. Calibration requires two experienced observers; one for the pelorus and the other for the direction finder set. Calibration of the direction finder set should not be undertaken in rough weather or when visibility is poor. To accurately calibrate the direction finder set, the beacon must be visible and the vessel must be held steady on some heading for one-half minute or more to permit an accurate check between the direction finder and the pelorus bearings.

d. Set the sight pelorus on top of the pilot house on the flying bridge or in a suitable location near the position of the direction finder set. Mount the pelorus in a position where there is, as near as possible, clear visibility throughout 360°.

e. Line up the lubber's lines of the pelorus exactly with the keel of the vessel.

f. Make sure that the radio transmitter antenna of the ship, is open.

g. Set the sight pelorus to 0.

h. Set the movable compass card in the direction finder set at 0 by adjusting the compass reset knob (fig. 4), and start the direction finder set in accordance with paragraph 32.

i. Head the vessel toward the beacon station and when the mast of the beacon or tower is centered in the sights of the pelorus, take a bearing with the direction finder.

j. The black pointer should be exactly on the 0 lubber's line. If this is not the case, loosen the pointer fastening screws (fig. 15) and rotate the pointer so that it coincides exactly with the 0 line. Tighten the fastening screws securely.

k. Set the pelorus 10° to starboard.

l. Swing the vessel to port slowly and when the mast or tower of the beacon is centered in the pelorus sights, maintain that heading and take a bearing on the direction finder.

m. Record the direction finder bearing in column *R* of the calibration chart opposite the 10° pelorus bearing printed in column *T*. Record the deviation in column *D*.

Note. A calibration chart (fig. 13) is furnished with each instrument. The deviation (column *D*) is the number of degrees that must be added to or subtracted from the direction finder bearing to equal the true or pelorus bearing. For example, if the direction finder bearing is 35° when the pelorus setting is 40°, the deviation is +5. If the direction finder bearing is 137° when the pelorus setting is 130°, the deviation is —7. In general, the direction finder bearing is less than the pelorus setting in the starboard bow quadrant and greater in the starboard quarter quadrant.

n. Repeat the procedures outlined in *k*, *l*, and *m* above, through 360°.

o. Plot the direction finder set bearing and deviation according to the instructions on the chart, and draw a curve through all points.

Note. When the direction finder set is at the center of the vessel, the curve will approximate a sine wave as shown in figure 14. When the direction finder set is not at the center, the curve will be distorted. The curve should rise from 0° to 45° (broad on the starboard bow) and fall to near 0° at or near 90° (starboard beam), etc.

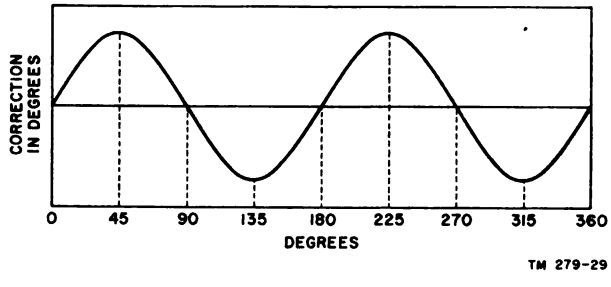

Figure 14. Ideal calibration curve.

p. At 10° intervals on the curve, read the correction in degrees and record on the chart in column *C*.

q. Transfer these corrections to a suitable card that may be displayed in the chart room or similar location.

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28. Mechanical Compensator Adjustment

(fig. 15)

Note. The mechanical compensator consists of a system of levers and a roller held in spring contact with one face of a continuous annular distortable brass band. Thirty-six adjusting screws spaced at 10° intervals are threaded into the brass band. Adjustment of these screws distorts this band and causes the compensated pointer (red at the top and white at the bottom) to lag or lead the constant pointer (black).

Note. Clockwise rotation of the screw adjusts for plus corrections (compensated pointer leads the constant pointer). Counterclockwise rotation adjusts for minus corrections (compensated pointer lags constant pointer).

Caution: Do not turn the screw more than two-fifths of a turn at a time. Do not move the black pointer while the screw driver is in position. Kinking of the mechanical compensator band will result if these precautions are not observed.

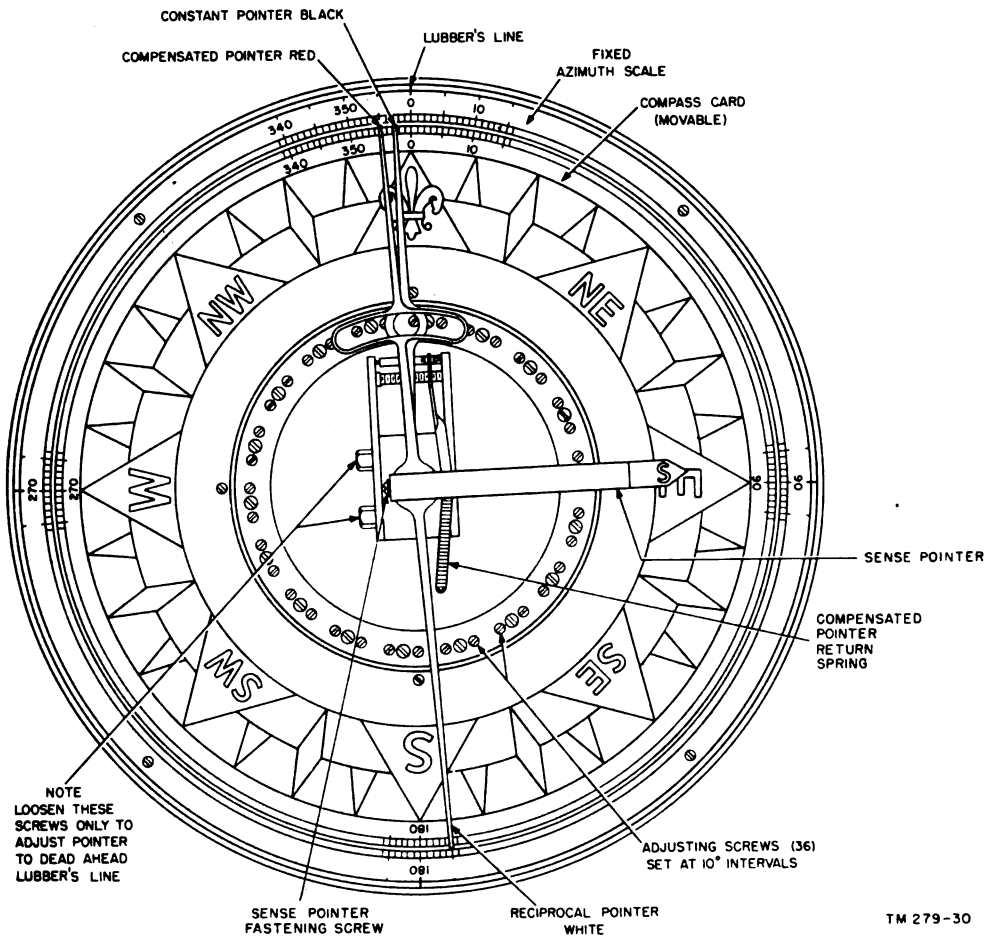

Figure 15. Compass bowl, pointer system and mechanical compensator.

a. Remove the compass bowl glass and holder.

b. Set the black pointer to 180°.

c. Insert the special screwdriver in the slot of the screw, visible through the hole in the black pointer, and turn the screw not more than two-fifths of a turn in a direction that will move the red pointer in the directon of the correction determined in paragraph 27.

d. Successively set the black pointer at 10° intervals either side of 180° and turn the screw so that the red pointer moves in the direction of the correction for that setting.

e. Make the complete circuit of all of the screws in the above order as many times as necessary to establish the proper correction at each 10° setting.

f. Finally, check each 10° setting to make sure that the difference between the red and black

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pointers, either plus or minus, is in accordance with the corrections determined in paragraph 27.

g. Replace the compass bowl glass and holder.

h. When the mechanical compensator has been adjusted as described above, the true direction finder bearing will be as shown on the compass card, by the compensated pointer, without further correction.

29. Synchronization of Movable Compass Card With Main Gyrocompass

Set the movable compass card in synchronism with the gyrocompass as follows:

a. Observe the heading of the gyrocompass.

b. Turn the gyro reset knob on the right side of the cabinet until the dummy compass card setting is exactly the same as that of the gyrocompass.

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CHAPTER 3

OPERATION

Section I. CONTROLS AND INSTRUMENTS

30. General

Haphazard operation or improper setting of the controls can cause damage to electronic equipment. For this reason, it is important to know the function of every control. The actual operation is discussed in paragraphs 32 through 34.

31. Direction Finder Set AN/SRD–11 Controls

(fig. 16)

The table shown on page 23 lists the controls of the radio receiver and indicates their functions.

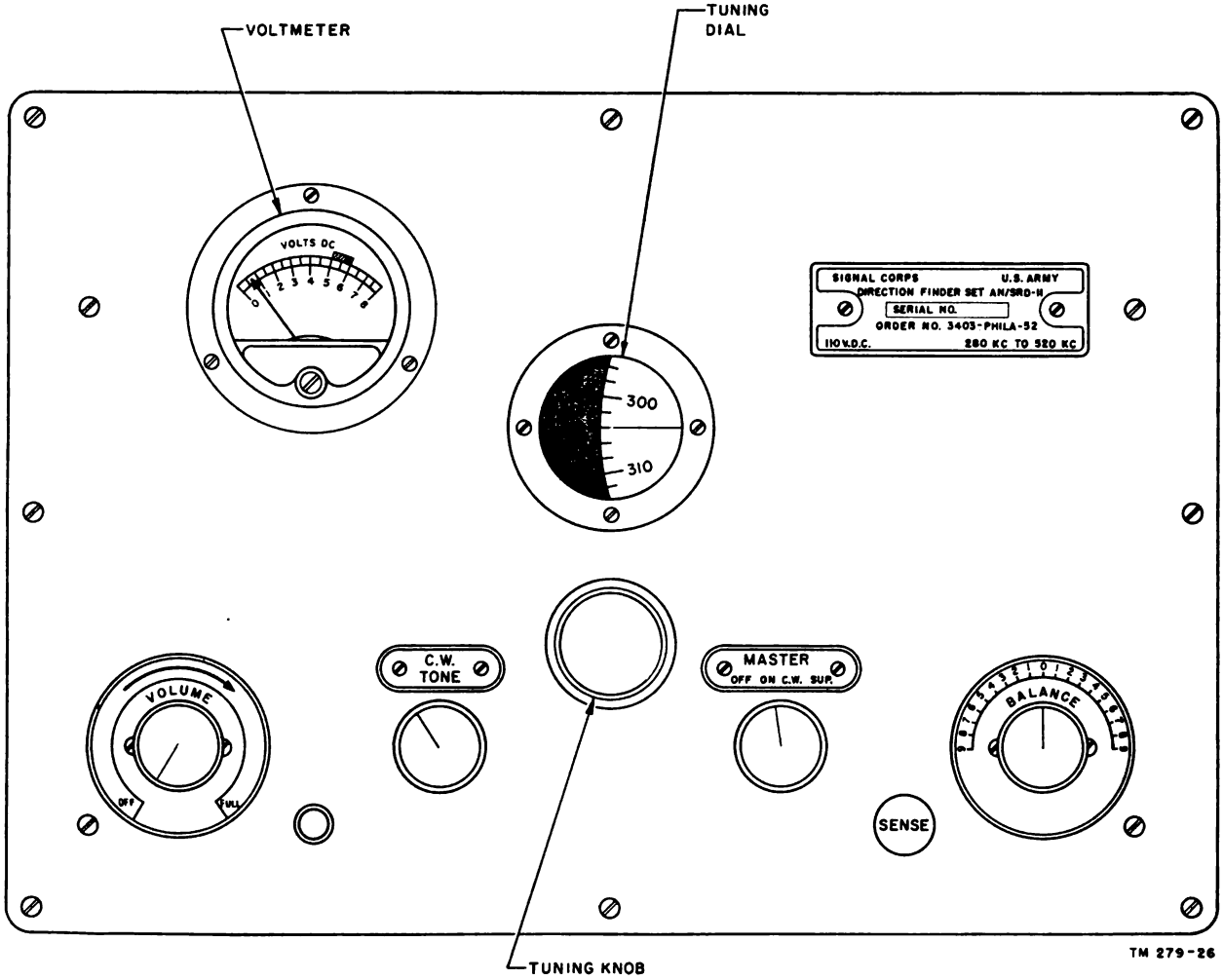

Figure 16. Radio receiver, front panel.

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Control	Function
MASTER switch	In OFF position, disconnects power from radio receiver, shorts loop terminals, and grounds sense antenna. In ON position, removes short circuit from loop and ground from sense antenna, and connects radio receiver to dc power source. In C. W. position, variable beat-frequency oscillator tone is superimposed on signal. In SUP. position, suppressor circuit is introduced to eliminate interference outside modulation frequency.
Tuning knob	Tunes receiver to desired radiobeacon station frequency as read on dial above knob.
Voltmeter	Indicates filament voltage.
VOLUME knob	Controls potentiometer that adjusts level of rf signal in receiver and thus signal level to headset.
BALANCE knob	Adjusts dual capacitor to cancel unwanted signals radiated from stays and rigging.
C. W. TONE knob	Adjusts frequency of beat-frequency oscillator.
SENSE button	Determines which of two bearings, 180° apart, is correct one.
Compass bowl light control (fig. 3).	Adjusts brilliancy of compass card pilot lights.
Loop lock knob (fig. 4).	Locks loop in any desired position and may be adjusted to act as drag in rough weather.

Section II. OPERATION UNDER USUAL CONDITIONS

32. Operating Procedure

a. Plug the headphones into the headphone jack.

b. Turn the CHARGE switch to the OFF position.

Note. In this position, the battery is connected to the instrument. In the ON position, the battery is connected to the charging line through the resistor assembly.

c. Set the MASTER switch to the ON position.

Note. With the interlock relay properly connected, a pilot lamp in the radio room lights when the MASTER switch is turned to ON. The radio operator then opens the radio transmitter antenna switch, closing the interlock contacts on this switch. These contacts complete the circuit to the operating winding of the interlock relay in the direction finder set. The contacts of the interlock relay close, power is connected to the direction finder set, and the compass bowl pilot lamps light. When the MASTER switch is turned to OFF, the pilot lamp in the radio room goes out as an automatic signal to the radio operator that the direction finder set is not in use.

d. Check the voltmeter reading. If the reading is less than 5 volts, a fully charged battery should be substituted for the one in use and the old battery should be placed on charge. Unsatisfactory operation will result if this is not done.

Note. Be sure that the voltmeter reads in the proper direction. The direction finder will not operate if the polarity of the battery is reversed.

e. Set the VOLUME knob for suitable headset level.

f. Set the BALANCE knob to 0.

g. Tune in a radiobeacon signal, using the tuning knob.

h. Rotate the loop with the handwheel until minimum signal (null) is heard in the headphones.

i. Adjust the BALANCE and VOLUME knobs as required to obtain a good clean null (minimum signal) as the loop is rotated.

j. If the radiobeacon signals are weak, turn the MASTER switch to C. W. and adjust the C. W. TONE knob to a moderately high pitch.

k. If static interferes, turn the MASTER switch to the SUP. position.

l. Continue to adjust the VOLUME, BALANCE, and C. W. TONE knobs as the loop is rotated, until the sharpest null is obtained.

m. Depress the SENSE button. Rotate the SENSE pointer marked S to the former position of the red pointer, and note the radiobeacon signal strength in the headphones.

n. Immediately rotate the sense pointer (fig. 15) exactly 180°. If the strongest signal is in the first position of the sense pointer, the true bearing is in that direction. If the strongest signal is in the second position, the bearing is in that direction.

o. Release the SENSE button and rotate the handwheel so that the red pointer is at the same point as the sense pointer was when the strongest signal was received.

p. Readjust, the BALANCE and VOLUME knobs, carefully rotating the loop to obtain the sharpest null.

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q. When the sharpest null has been obtained, the position of the red pointer on the compass card or azimuth ring is the true or relative bearing of the radiobeacon.

Note. The calibration procedure (par. 27) establishes the corrections required by the conditions existing on the vessel. The mechanical compensator is adjusted so that the red pointer gives, directly, the bearing of the radiobeacon.

r. Repeat the procedures outined in *g* through *q* above for the second radiobeacon signal.

s. Determine the correction required to convert the radiobeacon signal bearing to the Mercator bearing, and plot the resultant bearings on the navigational charts. The intersection of the two lines is the position of the vessel.

Note. All radio bearings are great circle bearings. When taken over distances exceeding 50 miles in the east or west quadrants, a correction must be applied in laying them down on the Mercator charts in common use. North and south bearings are on meridians of great circles and consequently require no correction. These corrections are shown in the chart below.

t. If, during the starting procedure, an abnormal result is obtained, refer to the equipment performance check list (par. 50).

u. The following chart is to be used for the conversion of radio bearings to Mercator bearings. *Do not confuse this chart with the calibration chart.*

Correction Chart for Conversion of Radio Bearings to Mercator Bearings

Difference of longitude (1° to 7.5°)

Mid. lat.	1°	1.5°	2°	2.5°	3°	3.5°	4°	4.5°	5°	5.5°	6°	6.5°	7°	7.5°
4	------	------	------	0. 1	0. 1	0. 1	0. 1	0. 2	0. 2	0. 2	0. 2	0. 2	0. 2	0. 3
5	0. 1	0. 1	0. 1	. 1	. 1	. 2	. 2	. 2	. 2	. 2	. 3	. 3	. 3	. 3
6	. 1	. 1	. 1	. 1	. 2	. 2	. 2	. 2	. 3	. 3	. 3	. 3	. 4	. 4
7	. 1	. 1	. 1	. 2	. 2	. 2	. 3	. 3	. 3	. 3	. 4	. 4	4	. 5
8	. 1	. 1	. 1	. 2	. 2	. 2	. 3	. 3	. 4	. 4	. 4	. 5	. 5	. 5
9	. 1	. 1	. 1	. 2	. 2	. 2	. 3	. 3	. 4	. 4	. 5	. 5	. 6	. 6
10	. 1	. 1	. 1	. 2	. 2	. 3	. 4	. 4	. 4	. 5	. 5	. 6	. 6	. 6
11	. 1	. 1	. 2	. 2	. 3	. 3	. 4	. 4	. 5	5	. 6	. 6	. 7	. 7
12	. 1	. 1	. 2	. 3	. 3	. 4	. 4	. 5	. 5	. 6	. 6	. 7	. 7	. 8
13	. 1	. 2	. 2	. 3	. 3	. 4	. 4	. 5	. 6	. 6	. 7	. 7	. 8	. 8
14	. 1	. 2	. 2	. 3	. 4	. 4	. 5	. 6	. 6	. 7	. 7	. 8	. 8	. 9
15	. 1	. 2	. 3	. 3	. 4	. 4	. 5	. 6	. 6	. 7	. 8	. 8	. 9	1. 0
16	. 1	. 2	. 3	. 4	. 4	. 5	6	. 6	. 7	. 8	. 8	. 9	1. 0	1. 0
17	. 2	. 2	. 3	. 4	. 4	. 5	. 6	6	. 7	. 8	. 9	1. 0	1. 0	1. 1
18	. 2	. 2	. 3	. 4	. 5	. 5	. 6	. 7	. 8	. 8	. 9	1. 0	1. 1	1. 2
19	. 2	. 2	. 3	. 4	. 5	. 6	. 6	. 7	. 8	. 9	1. 0	1. 1	1. 1	1. 2
20	. 2	. 2	. 3	. 4	. 5	. 6	. 7	. 8	. 8	. 9	1. 0	1. 1	1. 2	1. 3
21	. 2	. 3	. 4	. 5	. 5	. 6	. 7	. 8	. 9	1. 0	1. 1	1. 2	1. 2	1. 4
22	. 2	. 3	. 4	. 5	. 6	. 6	. 8	. 8	. 9	1. 0	1. 1	1. 2	1. 3	1. 4
23	. 2	. 3	. 4	. 5	. 6	. 7	. 8	. 9	1. 0	1. 1	1. 2	1. 3	1. 4	1. 5
24	. 2	. 3	. 4	. 5	. 6	. 7	. 8	. 9	1. 0	1. 1	1. 2	1. 3	1. 4	1. 5
25	. 2	. 3	. 4	. 5	. 6	. 7	. 8	1. 0	1. 1	1. 2	1. 3	1. 4	1. 5	1. 6
26	. 2	. 3	. 4	. 6	. 6	. 8	. 9	1. 0	1. 1	1. 2	1. 3	1. 4	1. 5	1. 6
27	. 2	. 3	. 4	. 6	. 7	. 8	. 9	1. 0	1. 1	1. 2	1. 4	1. 5	1. 6	1. 7
28	. 2	. 4	. 5	. 6	. 7	. 8	. 9	1. 1	1. 2	1. 3	1. 4	1. 5	1. 6	1. 8
29	. 2	. 4	. 5	. 6	. 7	. 8	1. 0	1. 1	1. 2	1. 3	1. 4	1. 6	1. 7	1. 8
30	. 2	. 4	. 5	. 6	. 8	. 9	1. 0	1. 1	1. 2	1. 4	1. 5	1. 6	1. 8	1. 9
31	. 2	. 4	. 5	. 6	. 8	. 9	1. 0	1. 2	1. 3	1. 4	1. 6	1. 7	1. 8	1. 9
32	. 3	. 4	. 5	. 7	. 8	. 9	1. 1	1. 2	1. 3	1. 4	1. 6	1. 7	1. 8	2. 0
33	. 3	. 4	. 6	. 7	. 8	1. 0	1. 1	1. 2	1. 4	1. 5	1. 6	1. 8	1. 9	2. 1
34	. 3	. 4	. 6	. 7	. 8	1. 0	1. 1	1. 2	1. 4	1. 5	1. 7	1. 8	2. 0	2. 1
35	. 3	. 4	. 6	. 7	. 9	1. 0	1. 2	1. 3	1. 4	1. 6	1. 7	1. 9	2. 0	2. 2
36	. 3	. 4	. 6	. 7	. 9	1. 0	1. 2	1. 3	1. 5	1. 6	1. 8	1. 9	2. 1	2. 2
37	. 3	. 4	. 6	. 8	. 9	1. 1	1. 2	1. 4	1. 5	1. 6	1. 8	2. 0	2. 1	2. 2
38	. 3	. 5	. 6	. 8	. 9	1. 1	1. 2	1. 4	1. 5	1. 7	1. 8	2. 0	2. 2	2. 3
39	. 3	. 5	. 6	. 8	1. 0	1. 1	1. 2	1. 4	1. 6	1. 7	1. 9	2. 1	2. 2	2. 4
40	. 3	. 5	. 6	. 8	1. 0	1. 1	1. 3	1. 4	1. 6	1. 8	1. 9	2. 1	2. 2	2. 4

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Correction Chart for Conversion of Radio Bearings to Mercator Bearings—Continued

Difference of longitude (1° to 7.5°)

Mid. lat.	1°	1.5°	2°	2.5°	3°	3.5°	4°	4.5°	5°	5.5°	6°	6.5°	7°	7.5°
41	0.3	0.5	0.6	0.8	1.0	1.2	1.3	1.5	1.6	1.8	2.0	2.1	2.3	2.5
42	.3	.5	.7	.8	1.0	1.2	1.3	1.5	1.7	1.8	2.0	2.2	2.3	2.5
43	.3	.5	.7	.8	1.0	1.2	1.4	1.5	1.7	1.9	2.1	2.2	2.4	2.6
44	.4	.5	.7	.9	1.1	1.2	1.4	1.6	1.7	1.9	2.1	2.2	2.4	2.6
45	.4	.5	.7	.9	1.1	1.2	1.4	1.6	1.8	2.0	2.1	2.3	2.5	2.6
46	.4	.5	.7	.9	1.1	1.3	1.4	1.6	1.8	2.0	2.2	2.3	2.5	2.7
47	.4	.6	.7	.9	1.1	1.3	1.5	1.7	1.8	2.0	2.2	2.4	2.6	2.8
48	.4	.6	.8	.9	1.1	1.3	1.5	1.7	1.8	2.1	2.2	2.4	2.6	2.8
49	.4	.6	.8	1.0	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.6	2.8
50	.4	.6	.8	1.0	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9
51	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0	2.1	2.3	2.5	2.7	2.9
52	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
53	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
54	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0	2.2	2.4	2.6	2.8	3.0
55	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.1	2.2	2.4	2.7	2.9	3.1
56	.4	.6	.8	1.0	1.2	1.4	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.1
57	.4	.6	.8	1.1	1.2	1.5	1.7	1.9	2.1	2.3	2.5	2.7	2.9	3.2
58	.4	.6	.8	1.1	1.3	1.5	1.7	1.9	2.1	2.3	2.6	2.8	3.0	3.2
59	.4	.6	.8	1.1	1.3	1.5	1.7	1.9	2.2	2.4	2.6	2.8	3.0	3.2
60	.4	.6	.9	1.1	1.3	1.5	1.7	2.0	2.2	2.4	2.6	2.8	3.0	3.2
61	.4	.7	.9	1.1	1.3	1.5	1.8	2.0	2.2	2.4	2.6	2.8	3.1	3.3
62	.4	.7	.9	1.1	1.3	1.5	1.8	2.0	2.2	2.4	2.6	2.9	3.1	3.3

Difference of longitude (8° to 14.5°)

Mid. lat.	8°	8.5°	9°	9.5°	10°	10.5°	11°	11.5°	12°	12.5°	13°	13.5°	14°	14.5°	Mid. lat.
4	0.3	0.3	0.3	0.3	0.3	0.4	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	4
5	.4	.4	.4	.4	.4	.5	.5	.5	.5	.6	.6	.6	.6	.6	5
6	.4	.5	.5	.5	.5	.6	.6	.6	.6	.7	.7	.7	.7	.8	6
7	.5	.5	.6	.6	.6	.6	.7	.7	.8	.8	.8	.8	.9	.9	7
8	.6	.6	.6	.7	.7	.7	.8	.8	.8	.9	.9	1.0	1.0	1.0	8
9	.6	.7	.7	.8	.8	.8	.9	.9	1.0	1.0	1.0	1.1	1.1	1.2	9
10	.7	.7	.8	.8	.9	.9	1.0	1.0	1.1	1.1	1.2	1.2	1.2	1.3	10
11	.8	.8	.8	.9	1.0	1.0	1.1	1.1	1.2	1.2	1.3	1.3	1.4	1.4	11
12	.8	.9	.9	1.0	1.0	1.1	1.2	1.2	1.3	1.3	1.4	1.4	1.5	1.5	12
13	.9	1.0	1.0	1.1	1.1	1.2	1.3	1.3	1.4	1.4	1.5	1.6	1.6	1.7	13
14	1.0	1.0	1.1	1.2	1.2	1.3	1.4	1.4	1.5	1.5	1.6	1.7	1.7	1.8	14
15	1.0	1.1	1.2	1.2	1.3	1.4	1.5	1.5	1.6	1.6	1.7	1.8	1.8	1.9	15
16	1.1	1.2	1.2	1.3	1.4	1.5	1.5	1.6	1.7	1.8	1.8	1.9	2.0	2.0	16
17	1.2	1.2	1.3	1.4	1.5	1.6	1.6	1.7	1.8	1.8	1.9	2.0	2.1	2.2	17
18	1.2	1.3	1.4	1.5	1.6	1.6	1.7	1.8	1.9	2.0	2.0	2.1	2.2	2.3	18
19	1.3	1.4	1.5	1.6	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.2	2.3	2.4	19
20	1.4	1.5	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.4	2.5	20
21	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.6	21
22	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	22
23	1.6	1.7	1.8	1.8	2.0	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	23
24	1.6	1.7	1.8	1.9	2.0	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9	3.0	24
25	1.7	1.8	1.9	2.0	2.1	2.2	2.4	2.5	2.6	2.7	2.8	2.9	3.0	3.1	25
26	1.8	1.9	2.0	2.1	2.2	2.3	2.4	2.6	2.7	2.8	2.9	3.0	3.1	3.1	26
27	1.8	1.9	2.1	2.2	2.3	2.4	2.5	2.6	2.8	2.9	3.0	3.1	3.2	3.4	27
28	1.9	2.0	2.1	2.2	2.4	2.5	2.6	2.7	2.9	3.0	3.1	3.2	3.4	3.5	28
29	1.9	2.1	2.2	2.3	2.4	2.6	2.7	2.8	3.0	3.1	3.2	3.3	3.4	3.6	29
30	2.0	2.1	2.2	2.4	2.5	2.7	2.8	2.9	3.0	3.2	3.3	3.4	3.6	3.7	30

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Correction Chart for Conversion of Radio Bearings to Mercator Bearings—Continued

Difference of longitude (8° to 14.5°)

Mid. lat.	8°	8.5°	9°	9.5°	10°	10.5°	11°	11.5°	12°	12.5°	13°	13.5°	14°	14.5°	Mid. lat.
31	2. 1	2. 2	2. 3	2. 5	2. 6	2. 7	2. 9	3. 0	3. 1	3. 3	3. 4	3. 5	3. 7	3. 8	31
32	2. 1	2. 2	2. 4	2. 5	2. 6	2. 8	3. 0	3. 1	3. 2	3. 4	3. 5	3. 6	3. 8	3. 9	32
33	2. 2	2. 3	2. 4	2. 6	2. 7	2. 9	3. 0	3. 2	3. 3	3. 4	3. 6	3. 8	3. 9	4. 0	33
34	2. 2	2. 4	2. 5	2. 6	2. 8	3. 0	3. 1	3. 3	3. 4	3. 6	3. 7	3. 8	4. 0	4. 1	34
35	2. 3	2. 4	2. 6	2. 7	2. 9	3. 1	3. 2	3. 3	3. 5	3. 6	3. 8	3. 9	4. 1	4. 3	35
36	2. 4	2. 5	2. 6	2. 8	2. 9	3. 1	3. 3	3. 4	3. 6	3. 7	3. 9	4. 1	4. 2	4. 3	36
37	2. 4	2. 6	2. 7	2. 9	3. 0	3. 2	3. 4	3. 5	3. 7	3. 8	4. 0	4. 1	4. 3	4. 5	37
38	2. 5	2. 6	2. 8	2. 9	3. 1	3. 3	3. 4	3. 6	3. 8	3. 9	4. 1	4. 2	4. 4	4. 6	38
39	2. 5	2. 7	2. 8	3. 0	3. 2	3. 3	3. 5	3. 7	3. 8	4. 0	4. 2	4. 3	4. 5	4. 6	39
40	2. 6	2. 7	2. 9	3. 1	3. 2	3. 4	3. 6	3. 8	3. 9	4. 1	4. 2	4. 4	4. 6	4. 8	40
41	2. 6	2. 8	3. 0	3. 1	3. 3	3. 5	3. 6	3. 8	4. 0	4. 2	4. 3	4. 5	4. 7	4. 8	41
42	2. 7	2. 8	3. 0	3. 2	3. 4	3. 6	3. 7	3. 9	4. 1	4. 2	4. 4	4. 6	4. 8	4. 9	42
43	2. 7	2. 9	3. 1	3. 2	3. 4	3. 6	3. 8	4. 0	4. 1	4. 3	4. 5	4. 7	4. 8	5. 0	43
44	2. 8	3. 0	3. 1	3. 3	3. 5	3. 7	3. 9	4. 0	4. 2	4. 4	4. 6	4. 8	5. 0	5. 1	44
45	2. 8	3. 0	3. 2	3. 4	3. 5	3. 7	3. 9	4. 1	4. 3	4. 5	4. 7	4. 8	5. 1	5. 2	45
46	2. 9	3. 1	3. 2	3. 4	3. 6	3. 8	4. 0	4. 2	4. 4	4. 6	4. 8	4. 9	5. 1	5. 3	46
47	2. 9	3. 1	3. 3	3. 5	3. 7	3. 9	4. 1	4. 2	4. 4	4. 6	4. 8	5. 0	5. 2	5. 4	47
48	3. 0	3. 2	3. 4	3. 5	3. 7	3. 9	4. 1	4. 3	4. 5	4. 7	4. 9	5. 1	5. 3	5. 5	48
49	3. 0	3. 2	3. 4	3. 6	3. 8	4. 0	4. 2	4. 4	4. 6	4. 8	5. 0	5. 2	5. 4	5. 6	49
50	3. 1	3. 2	3. 4	3. 6	3. 8	4. 1	4. 2	4. 5	4. 6	4. 8	5. 1	5. 3	5. 5	5. 7	50
51	3. 1	3. 3	3. 5	3. 7	3. 9	4. 1	4. 3	4. 5	4. 7	4. 9	5. 1	5. 3	5. 5	5. 8	51
52	3. 2	3. 4	3. 6	3. 8	4. 0	4. 2	4. 4	4. 6	4. 8	5. 0	5. 2	5. 4	5. 6	5. 8	52
53	3. 2	3. 4	3. 6	3. 8	4. 0	4. 2	4. 4	4. 6	4. 8	5. 1	5. 3	5. 4	5. 7	5. 9	53
54	3. 2	3. 4	3. 6	3. 8	4. 1	4. 3	4. 5	4. 7	4. 9	5. 1	5. 3	5. 6	5. 8	6. 0	54
55	3. 3	3. 5	3. 7	3. 9	4. 1	4. 4	4. 6	4. 8	5. 0	5. 2	5. 4	5. 6	5. 8	6. 1	55
56	3. 3	3. 5	3. 7	3. 9	4. 2	4. 4	4. 6	4. 8	5. 1	5. 2	5. 5	5. 7	5. 9	6. 1	56
57	3. 4	3. 6	3. 8	4. 0	4. 2	4. 5	4. 7	4. 9	5. 1	5. 3	5. 5	5. 8	6. 0	6. 2	57
58	3. 4	3. 6	3. 8	4. 0	4. 2	4. 5	4. 7	4. 9	5. 1	5. 4	5. 6	5. 8	6. 0	6. 3	58
59	3. 4	3. 6	3. 8	4. 1	4. 3	4. 6	4. 8	5. 0	5. 2	5. 4	5. 6	5. 9	6. 1	6. 3	59
60	3. 5	3. 7	3. 9	4. 1	4. 3	4. 6	4. 8	5. 0	5. 2	5. 5	5. 7	5. 9	6. 2	6. 4	60
61	3. 5	3. 8	4. 0	4. 2	4. 4	4. 6	4. 9	5. 1	5. 3	5. 5	5. 8	6. 0	6. 2	6. 5	61
62	3. 6	3. 8	4. 0	4. 2	4. 5	4. 7	4. 9	5. 1	5. 4	5. 6	5. 8	6. 1	6. 3	6. 5	62

(1) In the north latitudes when the ship is $\frac{\text{eastward}}{\text{westward}}$ of the station,

the correction is $\frac{\text{subtractive}}{\text{additive}}$.

(2) In the south latitudes when the ship is $\frac{\text{eastword}}{\text{westward}}$ of the station,

the correction is $\frac{\text{additive}}{\text{subtractive}}$.

Caution: The conversion chart corrects bearings only for the difference between a great circle track and a rhumb line and has no relation whatsoever with the errors due to deviation as given in the calibration curve or chart.

33. Antijamming Procedures

a. By applying jamming against direction finding equipment, enemy forces may make it difficult or impossible to obtain a correct bearing or a vessel's location. When a direction finder operator recognizes that his equipment is being jammed, his immediate superior should be informed of the fact. Under no conditions should operations cease. To obtain an accurate bearing through jamming, the following operating procedures should be used.

b. If it is impossible to obtain a sharp null caused by interference from a jamming station:

(1) Slowly adjust the tuning knob to each side of the frequency of the desired station to obtain a more accurate null.

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(2) If another radiobeacon station can be heard on a different frequency, switch operations to the new frequency.

c. If two or more jamming signals are coming in on the frequency of the radiobeacon station, the following procedure will aid in getting a true bearing on the desired signal:

(1) Tune to each of the jamming signals in turn, and get a bearing on each one. The bearing of the jamming signals will identify them for the next step.

(2) Tune to the radiobeacon station and take a trial bearing. If this bearing is the same as the bearing of one of the jamming stations, retune, with the MASTER switch on C. W. or SUP. position (par. 31), until a different bearing is obtained. *When a bearing is obtained which is different from the bearing readings taken on any of the jamming stations, it will be the desired bearing.*

34. Stopping Procedure

When the bearing has been obtained:

a. Turn the CHARGE switch to ON.

b. Turn the MASTER switch to OFF.

c. Set the BALANCE control to 0.

Section III. OPERATION UNDER UNUSUAL CONDITIONS

35. General

The operation of Direction Finder Set AN/SRD–11 may be difficult in regions where extreme cold, heat, humidity and moisture conditions, etc. prevail. In the following paragraphs, instructions are given on procedures for minimizing the effect of these unusual conditions.

36. Operation in Arctic Climates

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

a. Handle the equipment carefully.

b. Keep the equipment warm and dry. If the equipment is not in a heated inclosure, construct an insulated box for the radio receiver. Keep the filaments of the vacuum tubes lighted constantly, unless this overtaxes the power supply.

c. Wear a knitted woolen cap over the headphones when operating in an unheated inclosure with headphones that do not have rubber earpieces. Frequently, when headphones without rubber earpieces are worn, the edges of the ear may freeze without the operator being conscious of this condition. Never flex rubber earcaps since this action may render them useless. If water gets into the receivers or if moisture condenses within them, it may freeze and impede the movement of the diaphragm. When this happens, remove the bakelite cap and remove the ice and moisture from the receiver.

37. Operation in Tropical Climates

When operated in tropical climates, the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than that of the ambient air. To minimize this condition, place lighted electric bulbs under the radio receiver.

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CHAPTER 4

ORGANIZATIONAL MAINTENANCE

Section I. PREVENTIVE MAINTENANCE

38. Tools Used With Direction Finder Set AN/SRD–11

a. The tools supplied with the direction finder set are one compensator adjusting wrench and one compensator adjusting screwdriver.

b. Other tools necessary for the installation of the direction finder set will be normally found aboard ship.

39. Definiton of Preventive Maintenance

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

40. General Preventive Maintenance Techniques

a. Use No. 000 sandpaper to remove corrosion.

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

(1) If necessary, except for electrical contacts, moisten the cloth or brush with solvent, dry cleaning (SD); wipe the parts dry with a cloth.

(2) Clean electrical contacts with a cloth moistened with carbon tetrachloride, then wipe them dry with a dry cloth.

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

c. If available, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch.

d. For further information on preventive maintenance techniques, refer to TB SIG 178, Preventive Maintenance Guide for Radio Communications Equipment.

41. Use of Preventive Maintenance Forms (figs. 17 and 18)

The information in paragraph 42 is presented as a guide to the individual making an inspection of equipment in accordance with instructions on DA Forms 11–238 and 11–239. The decision as to which items on the forms are applicable to this equipment is a tactical decision to be made in the case of first echelon maintenance by the communication officer/chief or his designated representative, and in the case of second and third echelon maintenance, by the individual making the inspection. Instructions for the use of each form appear on the reverse side of the form.

42. Performing Preventive Maintenance

Caution: Tighten screws, bolts and nuts carefully. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

a. Exterior Items.

(1) Check for completeness and general condition of the direction finder. The components of the direction finder are listed in paragraph 6.

(2) Clean dirt and moisture from radio receiver case and loop antenna (fig. 2).

(3) Inspect seating of dial lamp I 1 (fig. 30) and compass bowl lamps, I 301 and I 302.

(4) Inspect controls for binding, scraping, excessive looseness, and positive action.

(5) Check the direction finder set for normal operation (par. 50).

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OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.
AN/SRD-11	

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

DAILY

NO.	ITEM	CONDITION S	M	T	W	T	F	S
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT *(receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories).* PAR. 42a (1)							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR. 42a (2)							
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 42a (3)							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR. 42a (4)							
6	CHECK FOR NORMAL OPERATION. PAR. 42a (5)							

WEEKLY

NO.	ITEM	CONDITION	NO.	ITEM	CONDITION
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR. 42a (6)		13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES. PAR. 42a (11)	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 42a (7)		14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR. 42a (8)		15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR. 42a (12)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS. PAR. 42a (9)		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.		17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 42a (10)		18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	

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

DA FORM 1 MAY 51 **11-238** REPLACES DA FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM279-31

Figure 17. DA Form 11-238.

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SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE: AN/SRD-11

EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X Adjustment, repair or replacement required; (1) Defect corrected.
NOTE: Strike out items not applicable.

NO.	ITEM	CONDITION
1	COMPLETENESS AND GENERAL CONDITION OF EQUIPMENT (*receiver, transmitter, carrying cases, wire and cable, microphones, tubes, spare parts, technical manuals and accessories*). PAR. 42a (1)	
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION.	
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS, PLUGS, TELEPHONES, CARRYING BAGS, COMPONENT PANELS. PAR. 42a (2)	
4	INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS. PAR. 42a (3)	
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, WORN OR CHIPPED GEARS, MISALIGNMENT, POSITIVE ACTION. PAR 42a (4)	
6	CHECK FOR NORMAL OPERATION. PAR. 42a (5)	
7	CLEAN AND TIGHTEN EXTERIOR OF COMPONENTS AND CASES, RACK MOUNTS, SHOCK MOUNTS, ANTENNA MOUNTS, COAXIAL TRANSMISSION LINES, WAVE GUIDES, AND CABLE CONNECTIONS. PAR. 42a (6)	
8	INSPECT CASES, MOUNTINGS, ANTENNAS, TOWERS, AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE. PAR. 42a (7)	
9	INSPECT CORD, CABLE, WIRE, AND SHOCK MOUNTS FOR CUTS, BREAKS, FRAYING, DETERIORATION, KINKS, AND STRAIN. PAR. 42a (8)	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, DAMAGED INSULATORS AND REFLECTORS.	
11	INSPECT CANVAS ITEMS, LEATHER, AND CABLING FOR MILDEW, TEARS, AND FRAYING.	
12	INSPECT FOR LOOSENESS OF ACCESSIBLE ITEMS: SWITCHES, KNOBS, JACKS, CONNECTORS, ELECTRICAL TRANSFORMERS, POWERSTATS, RELAYS, SELSYNS, MOTORS, BLOWERS, CAPACITORS, GENERATORS, AND PILOT LIGHT ASSEMBLIES. PAR. 42a (9)	
13	INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES. PAR. 42a (10)	
14	CLEAN AIR FILTERS, BRASS NAME PLATES, DIAL AND METER WINDOWS, JEWEL ASSEMBLIES.	
15	INSPECT METERS FOR DAMAGED GLASS AND CASES. PAR. 42a (11)	
16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHERPROOFING.	
17	CHECK ANTENNA GUY WIRES FOR LOOSENESS AND PROPER TENSION.	
18	CHECK TERMINAL BOX COVERS FOR CRACKS, LEAKS, DAMAGED GASKETS, DIRT AND GREASE.	
19	ELECTRON TUBES - INSPECT FOR LOOSE ENVELOPES, CAP CONNECTORS, CRACKED SOCKETS: INSUFFICIENT SOCKET SPRING TENSION; CLEAN DUST AND DIRT CAREFULLY; CHECK EMISSION OF RECEIVER TYPE TUBES. PAR. 42b (1)	
20	INSPECT FILM CUT-OUTS FOR LOOSE PARTS, DIRT, MISALIGNMENT AND CORROSION.	
21	INSPECT FIXED CAPACITORS FOR LEAKS, BULGES, AND DISCOLORATION. PAR. 42b (2)	
22	INSPECT RELAY AND CIRCUIT BREAKER ASSEMBLIES FOR LOOSE MOUNTINGS; BURNED, PITTED, CORRODED CONTACTS; MISALIGNMENT OF CONTACTS AND SPRINGS; INSUFFICIENT SPRING TENSION; BINDING OF PLUNGERS AND HINGE PARTS. PAR. 42b (3)	
23	INSPECT VARIABLE CAPACITORS FOR DIRT, MOISTURE, MISALIGNMENT OF PLATES, AND LOOSE MOUNTINGS. PAR 42b (4)	
24	INSPECT RESISTORS, BUSHINGS, AND INSULATORS, FOR CRACKS, CHIPPING, BLISTERING, DISCOLORATION AND MOISTURE. PAR. 42b (5)	
25	INSPECT TERMINALS OF LARGE FIXED CAPACITORS AND RESISTORS FOR CORROSION, DIRT AND LOOSE CONTACTS.	
26	CLEAN AND TIGHTEN SWITCHES, TERMINAL BLOCKS, BLOWERS, RELAY CASES, AND INTERIORS OF CHASSIS AND CABINETS NOT READILY ACCESSIBLE. PAR. 42b (6)	
27	INSPECT TERMINAL BLOCKS FOR LOOSE CONNECTIONS, CRACKS AND BREAKS.	
28	CHECK SETTINGS OF ADJUSTABLE RELAYS.	
29	LUBRICATE EQUIPMENT IN ACCORDANCE WITH APPLICABLE DEPARTMENT OF THE ARMY LUBRICATION ORDER.	
30	INSPECT GENERATORS, AMPLIDYNES, DYNAMOTORS, FOR BRUSH WEAR, SPRING TENSION, ARCING, AND FITTING OF COMMUTATOR. PAR. 42b (7)	
31	CLEAN AND TIGHTEN CONNECTIONS AND MOUNTINGS FOR TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS.	
32	INSPECT TRANSFORMERS, CHOKES, POTENTIOMETERS, AND RHEOSTATS FOR OVERHEATING AND OIL-LEAKAGE.	
33	BEFORE SHIPPING OR STORING - REMOVE BATTERIES.	
34	INSPECT CATHODE RAY TUBES FOR BURNT SCREEN SPOTS.	
35	INSPECT BATTERIES FOR SHORTS AND DEAD CELLS. PAR. 42b (8)	
36	INSPECT FOR LEAKING WATERPROOF GASKETS, WORN OR LOOSE PARTS. PAR. 42b (9)	
37	MOISTURE AND FUNGIPROOF. PAR. 42b (10)	
38	IF DEFICIENCIES NOTED ARE NOT CORRECTED DURING INSPECTION, INDICATE ACTION TAKEN FOR CORRECTION.	

DA 1 MAY 51 FORM 11-239 REPLACES DA FORM 419, 1 DEC 50, WHICH IS OBSOLETE. 16—64382-1

TM279-32

Figure 18. DA Form 11–239.

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(6) Check and tighten, where necessary, all mounting screws and bolts (fig. 7).

(7) Inspect all exposed metal surfaces of the radio receiver cabinet and loop antenna for rust and corrosion (fig. 2).

(8) Inspect all power cords and exposed wiring for breaks, deterioration, and loose connectors (fig. 10).

(9) Check the sense antenna for corrosion and damaged insulators.

(10) Inspect for looseness of accessible items such as dials, switch knobs, and lock nuts (fig. 3).

(11) Check condition of storage battery; specific gravity, corrosion, and terminal connections.

(12) Inspect meter, M1, for action, damaged glass or case (fig. 3).

Caution: Disconnect all power to the direction finder before performing the following operations. Upon completion, reconnect power and check for satisfactory operation of the direction finder.

b. Internal Items.

(1) Inspect tubes for signs of physical damage and insufficient spring tension on tube clamps. Test all tubes for normal emission.

(2) Inspect power supply filter capacitors C202, C203, and C205 for leaks or bulging (fig. 34).

(3) Inspect relay K101 for loose mounting, burned, pitted, or corroded contacts.

(4) Inspect variable capacitor C4 for dirt and loose mounting lugs (fig. 31).

(5) Inspect resistors and insulating bushings for cracks, discoloration, and chipping (fig. 31).

(6) Clean and tighten the detent of switch S1 (fig. 31).

(7) Inspect dynamotor, D1, for overheating and brush wear (figs. 33 and 35).

(8) Inspect the 6-volt battery for shorts and dead cells.

(9) Check the crown block gasket for leakage (fig. 7).

(10) Check moistureproof and fungiproof varnish for cracks and chipping.

Section II. LUBRICATION AND WEATHERPROOFING

43. Lubrication

The bevel gears in the radio receiver cabinet should have a thin coating of light grease once a year. No other lubrication is required for the direction finder.

44. Weatherproofing

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

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

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

45. Rustproofing and Painting

a. When the finish on the radio receiver cabinet or loop antenna has been badly scarred or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use No. 00 or No. 000 sandpaper to clean the surfaces down to the bare metal and obtain a bright smooth finish.

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

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

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Section III. TROUBLESHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

46. General

a. The troubleshooting and repair work that can be performed at the organizational maintenance level (operators and repairmen) is necessarily limited in scope by the tools, test equipment, and replacable parts issued. Accordingly, troubleshooting is based on the performance of the equipment and the use of the senses in determining such troubles as burned-out tubes, cracked insulators, etc.

b. Paragraphs 47 through 50 help to determine which components, such as the radio receiver or the dynamotor, is at fault, and in localizing the fault in that component to the defective stage or item, such as a tube.

47. Visual Inspection

a. Failure of this equipment to operate properly will usually be caused by one or more of the following faults.

(1) Improper connections to storage battery.
(2) Defective or discharged storage battery.
(3) Worn, broken, or disconnected headphone, power or sense antenna cord or plug.
(4) Relay contacts burned because of overloads.
(5) Wires broken because of excessive vibration.
(6) Defective tubes.

b. When failure is encountered and the cause is not immediately apparent, check as many of the above items as is practicable before starting a detailed examination of the component parts of the system. If possible, obtain information from the operator of the equipment regarding performance at the time trouble occurred.

c. Visually inspect the loop antenna for obvious abnormalities.

48. System Sectionalization of Trouble to Component

System sectionalization consists of determining if the trouble is in the radio receiver, loop antenna, dynamotor power supply, or storage battery.

a. Operate the direction finder set and observe its performance. Refer to the equipment performance check list (par. 50) for normal operating indications.

b. If the entire direction finder set is dead, the trouble probably is in the battery, charging switch, or power supply.

c. If the dynamotor in the power supply runs, the trouble is in the radio receiver or the loop antenna.

d. With the set turned on, and no signal in the headset from the loop antenna, depress the SENSE button. If signals are now heard in the headset, the trouble is in the loop antenna.

e. If, with the MASTER switch in the C.W. position and a beacon signal tuned in, no oscillator tone is heard in the headset, the trouble is in the beat-frequency oscillator circuit.

f. If one radio receiver exhibits unsatisfactory performance, such as excessive noise, howling or weak signals, replace it with a good receiver. If the trouble disappears, the replaced radio receiver is defective.

g. By the use of procedures similar to the simple checks given above the trouble can be isolated to a particular unit.

49. Troubleshooting by Using Equipment Performance Check List

a. General. The equipment performance check list (par. 50) will help the operator to locate trouble in the equipment. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances for correct operation, and the corrective measures the operator can take. *To use this list, follow the items in numerical sequence.*

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

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

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operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can make without turning in the equipment for repairs. A reference in the chart to paragraph 72*d* indicates that the trouble cannot be corrected during operation and that troubleshooting by an experienced repairman is necessary. If the direction finder set is completely inoperative or if the recommended corrective measures do not yield results, troubleshooting is necessary. However, if the tactical situation requires that bearings be taken, 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.

50. Equipment Performance Check List

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Antenna	Brushes on radio receiver chassis in contact with antenna slip rings.		
	2	Sense antenna	Sense antenna lead in plugged into jack on rear of chassis.		
	3	Headset	Headphone cord plugged into jack on radio receiver front panel.		
	4	Power cord	Plugged into receptacle at rear of radio receiver chassis.		
	5	CHARGE switch	Set at OFF position.		
	6	BALANCE knob	Set at 0.		
	7	Tuning knob	Set at frequency of nearest radiobeacon.		
	8	VOLUME knob	Set at maximum counterclockwise position.		
START	9	MASTER switch	Set at ON position	Voltmeter should read 5.6 to 6.2 and compass bowl dial lamp lights.	Check power cord. Check dynamotor power supply. Check storage battery.
				Rushing noise is heard in headset.	Check tubes in radio receiver. Check dynamotor power supply. Check headset and cord.
	10	Tuning knob	Tune in nearest radiobeacon.	Signal heard in headset	If signals are not heard or are weak, check antenna connections at collector rings at bottom of shaft, and brushes on radio receiver chassis. Check tubes.
EQUIPMENT PERFORMANCE	11	Phone jack			Check headphone cord plug and headset.
	12	VOLUME control	Tune in any station by rotating tuning knob, then rotate VOLUME knob in either direction.	Strength of signal increases or decreases.	Refer to paragraph 72.
	13	MASTER switch	Listen for beat note in headset. Rotate C. W. TONE knob in either direction.	Change in pitch of audio tone is noted.	Refer to paragraph 72.
	14	BALANCE knob	Rotate in either direction	Change in width of null should be noticed.	Refer to paragraph 72.

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	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	15	MASTER switch on SUP.	Listen to signal in headset.	Static and other interference should be eliminated as compared with previous settings of MASTER switch.	Refer to paragraph 72.
STOP	16	MASTER switch...	Turn to OFF position.....	Voltmeter reads 0 and compass bowl lamps go out. No noise or signals are heard in the headphones.	
	17	CHARGE switch...	Turn to ON position.....	Battery is charged from 110-volt dc line of the ship.	

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CHAPTER 5

THEORY

51. Direction Finding Fundamentals

a. Radio direction finding is concerned with determining the direction of arrival of a radio wave. Unlike an ordinary radio receiver, a radio direction finder indicates the direction in which a distant transmitter lies. Radio direction finders are used extensively as aids to navigation. A vessel, equipped with a direction finder and charts that show the location of radiobeacon stations in its vicinity, can always determine its position.

b. A basic radio direction finder consists of a sensitive radio receiver, a loop antenna for determining bearings of radio signals, and a sense antenna for determining the true direction (sense) of the received radio signal. The bearing determination is accomplished by the antenna system, the characteristics of which are described below.

c. When a loop antenna is at right angles to the bearing of a radiobeacon station whose signal it is receiving, a voltage is induced in each side or half of the loop. If the radio wave strikes both sides of the loop, simultaneously, the instantaneous voltage, at the output terminals of the loop, is zero, since the voltages in each half of the loop cancel. If, however, one edge or side of the loop is closer to the transmitting station than the other, it develops its voltage before the far side does. Since these two voltages are no longer developed at the same time (phase), the instantaneous sum is no longer zero. There is a resultant voltage at the loop antenna terminals whose amplitude is dependent on how much nearer one side of the loop is to the radiobeacon station than the other.

d. Therefore, if a loop antenna is rotated through 360°, there are two points of maximum signal and two points of minimum signal or nulls. The nulls are 180° apart (A, fig. 19) and occur when the loop is broadside to the radiobeacon station. Nulls rather than maximums are used in determining bearings because they give a sharper indication.

e. To determine which direction the signal is coming from, i. e., front or back of the loop, the voltage from the sense antenna is combined with the voltage from the loop antenna to give a heart-shaped (cardioid) pattern. Figure 19 shows the

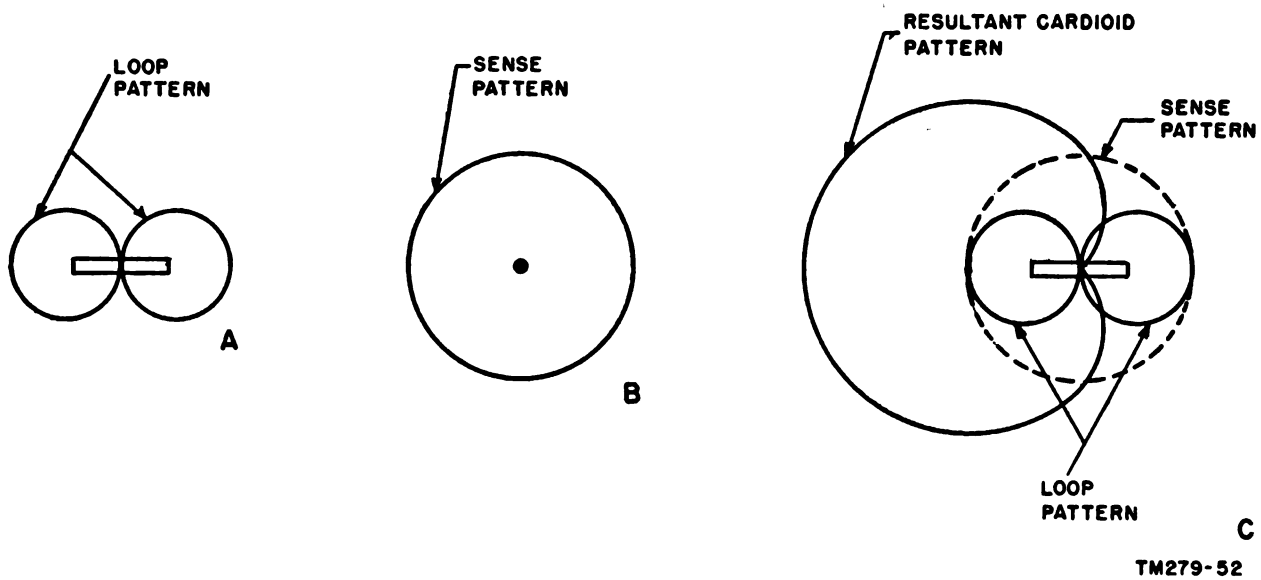

Figure 19. Direction finding antenna patterns.

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receiving pattern for the loop antenna, the sense antenna, and the resultant pattern when the two antennas are connected together.

f. When the loop antenna is rotated 360° during sensing, there is only one null and one maximum. One side or edge of the loop antenna will always be *hot* (indicating max. response), and the other side *cold* (indicating the null). The circuit is designed so that the same side of the loop antenna is always *hot* and the other side is always *cold.* It is then possible to determine the true direction (sense) of the received signal.

52. Block Diagram

(fig. 20)

Direction Finder Set AN/SRD–11 includes a superheterodyne radio receiver with a frequency range of 280 to 520 kc and a directional antenna system. The signal path is shown in figure 20. A complete schematic diagram is shown in figure 43.

a. Loop Antenna. The manually rotatable loop antenna, with its balanced loop and high impedance transmission line, is highly directional. Radio energy from the transmitting antenna of the radiobeacon station induces a voltage in the loop. The strength of this voltage depends on the position of the loop. This voltage is at a maximum when either edge of the loop points to the transmitting antenna and minimum when it is rotated 90°. The minimum voltage (null) position is the one used in taking bearings. This condition of signal in the headphones gives the more positive indication.

b. Sense Antenna. This single-wire vertical antenna has a nondirectional reception pattern. The voltage induced in it is combined with that induced in the loop in such a manner as to give a cardioid reception pattern (fig. 19) and thus show the true direction of the radiobeacon station. Signals from the radiobeacon station being received may strike the superstructure of the vessel and be reradiated at the loop antenna from a different angle. The sense antenna signal, when properly combined with the loop signal, will tend to cancel unwanted signals.

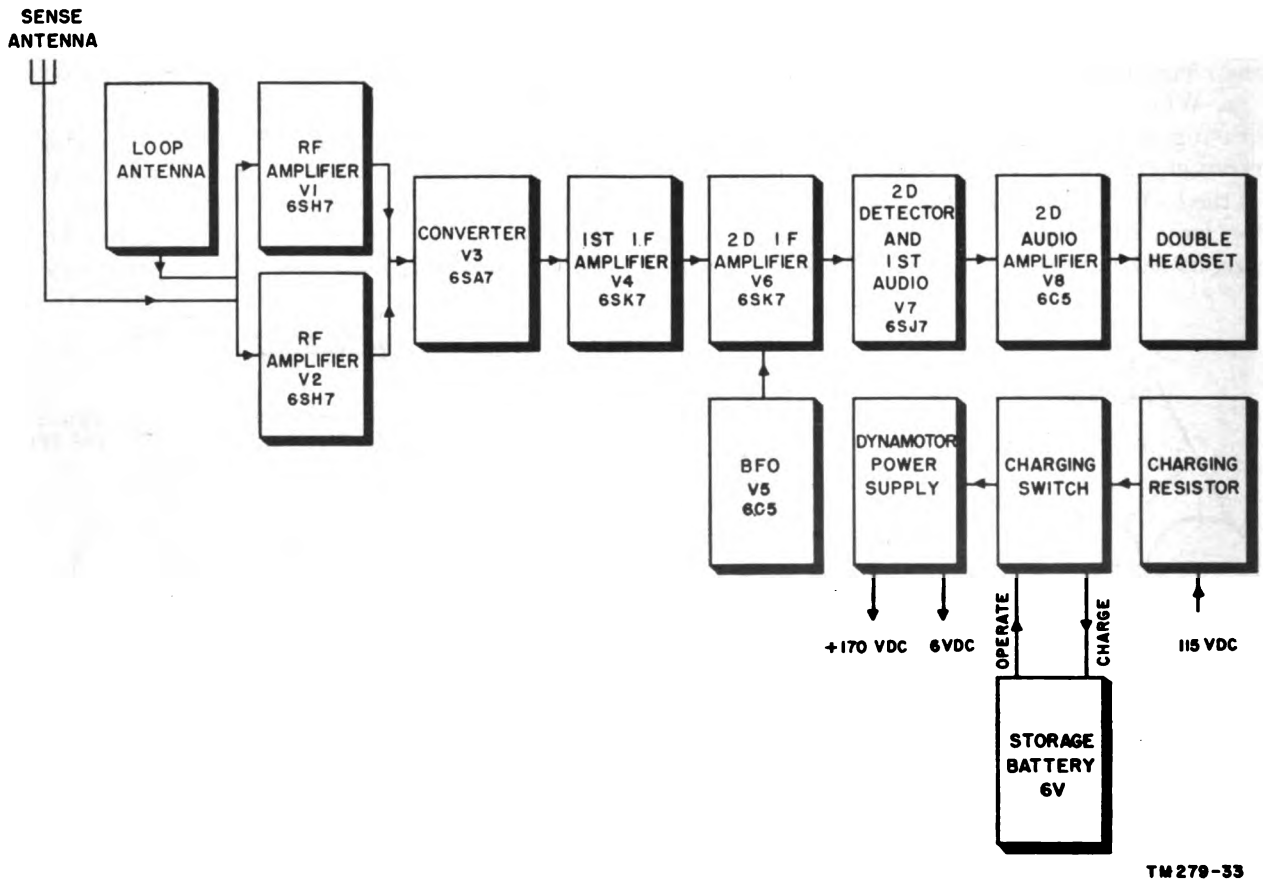

Figure 20. Direction Finder Set AN/SRD–11, block diagram.

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c. Rf Amplifier. The combined loop antenna and sense antenna signals are coupled to the push-pull radio-frequency (rf) amplifier, V1 and V2, and amplified and inductively coupled to the converter, V3.

d. Converter. The output signal from the push-pull (rf) amplifier, V1 and V2, is mixed with the signal from the local oscillator to form a difference signal of 115 kc which is amplified and inductively coupled to the first intermediate-frequency (if.) amplifier.

e. First If. Amplifier. This stage, V4, amplifies the intermediate frequency signal and increases selectivity. Its output is inductively coupled to the second if amplifier.

f. Beat-Frequency Oscillator. Tube V5 is an inductance-capacitance type oscillator that operates at 115 ±2 kc. It functions when the MASTER switch, S1, is in the C.W. or the SUP. position. A small portion of its output is impressed on the cathode of V6 to beat with the incoming if signal. This produces an audible beat note from radio signals and may increase the audibility of weak signals.

g. Second If. Amplifier. This stage, V6, amplifies the intermediate frequency (and beat-frequency oscillator signals when the beat-frequency oscillator is operating). Its output is inductively coupled to the second detector.

h. Second Detector and First Audio. Tube V7 is a combined detector and audio amplifier. It is resistance-coupled to the second audio amplifier.

i. Second Audio Amplifier. Tube V8 amplifies the incoming signal and inductively couples and matches the output to a 4,000-ohm load (at 1,000 cycles) at J2. The impedance of the headphones that plug into J2 is 4,000 ohms.

j. Power Supply. A dynamotor, operating from a 6-volt storage battery, supplies filtered plate voltage to the radio receiver.

53. Loop Antenna

(fig. 21)

a. The high impedance, balanced, center-tapped, circular loop has 38 turns of Litz wire. The three-wire high impedance transmission line of equally spaced parallel conductors connects the center tap of the loop to collector ring E3, and the ends to collector rings E1 and E5. Brushes E2 and E6 connect rings E1 and E5 to the radio receiver, while brush E4 grounds the center tap in the radio receiver.

b. The magnetic wave component of the transmitted radiobeacon signal cuts across the plane of the loop antenna, inducing a voltage in the loop antenna. The amplitude of this voltage is determined, primarily, by the position of the loop with respect to the incoming signal. If the plane of the loop is perpendicular to the incoming signal, equal voltages will be induced in each half of the loop at the same time (phase). The resultant sum voltage will be zero. If, however, either side or edge of the loop is more toward the radio-beacon station, the incoming signal will induce voltages which will be equal but not at the same time (phase). Thus, a resultant voltage of some value will remain to pass through the receiver and appear in the headset. The value of signal that appears in the headset will increase to a maximum when the loop is parallel to the direction of travel of the signal from a radiobeacon station, and decrease to a minimum (null) when the loop is at right angles to the direction of travel of the signal from the radiobeacon station.

c. MASTER switch S1, in the OFF position, short-circuits the loop antenna through brushes E2 and E6 to prevent possible loop damage from high-powered transmitters.

54. Sense Antenna

(fig. 21)

a. The sense antenna serves two purposes in direction finding:

(1) When taking bearings, it is connected in the circuit to reduce bearing errors by canceling secondary signals from the stays, rigging, etc., of a vessel.

(2) When determining the true direction of a radiobeacon signal, the voltage from the sense antenna is combined with the voltage from the loop. The mixing of the two signal voltages results in a cardioid receiving pattern which permits the 180° ambiguity of a bearing to be resolved.

b. When the loop antenna is perfectly balanced and at right angles to the incoming signal, the signal voltage at the output terminals of the loop is zero. However, if there is any metal in the vicinity of the loop, such as ventilators, rigging, stays, etc., a secondary signal is radiated from the metal to the loop. This makes it impossible to

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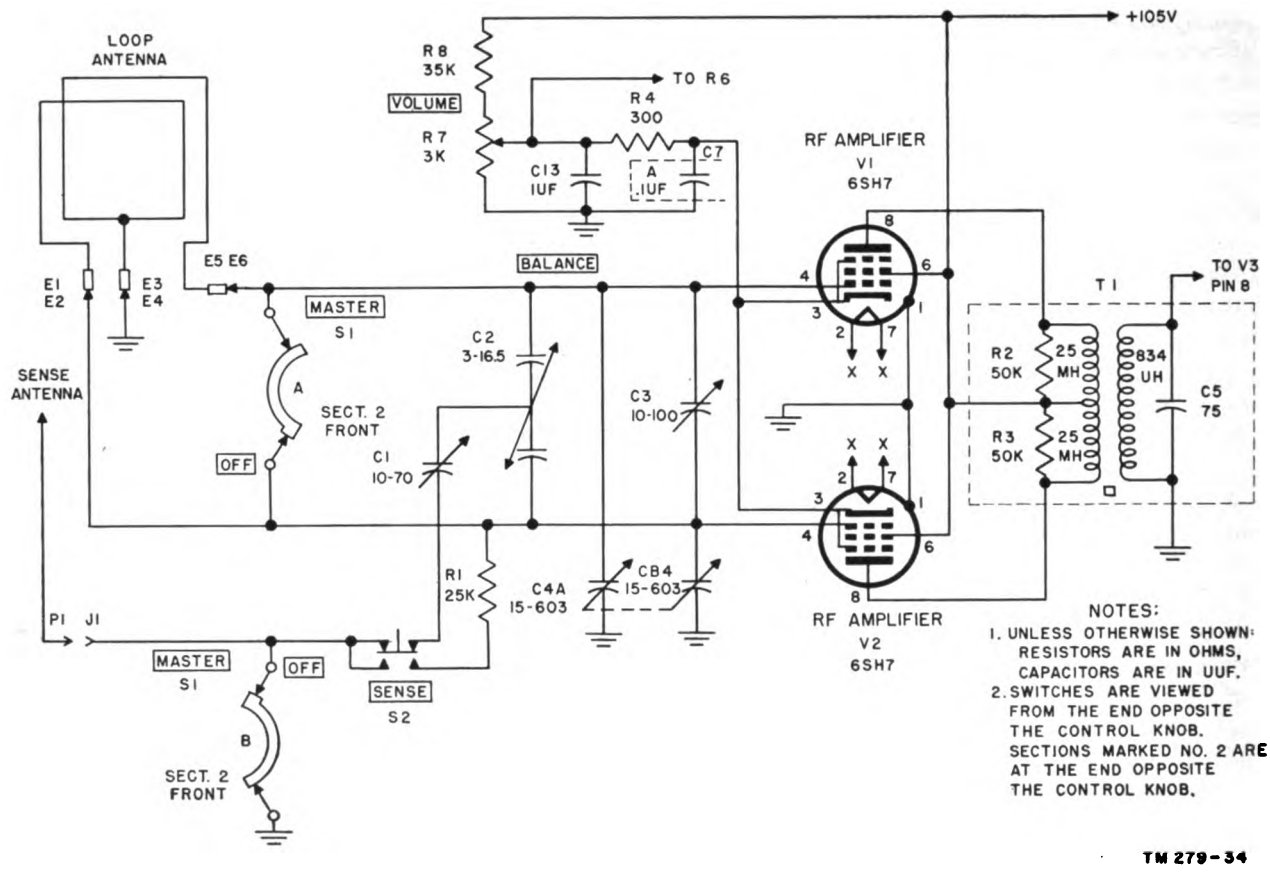

Figure 21. Radio receiver, functional diagram of rf amplifier.

secure a definite null. This secondary signal is also picked up by the sense antenna. The voltage, developed by the secondary signal in the sense antenna, is fed through a phasing network, which consists of C1 and BALANCE capacitor C2, to the rf stage. BALANCE capacitor C2 adjusts the phase of the secondary signal voltage from the sense antenna so that it cancels the secondary signal voltage from the loop antenna. The BALANCE capacitor must be adjusted for each position of the loop. When it is correctly adjusted, the bearing nulls will be clean and sharp.

c. When SENSE button S2 (fig. 28) is depressed, sense antenna voltage is applied to the grid of V2 and the corresponding end of the loop antenna winding through the phase correcting resistor, R1. Therefore, when one edge of the loop antenna is nearer the radiobeacon antenna, the signal will be louder than when the other edge of the loop (180° rotation) is nearer the radiobeacon antenna. The sense pointer is positioned so that it points to the radiobeacon when the signal is the louder.

55. Rf Stage, V1 and V2

(fig. 21)

a. The rf stage consists of the loop and sense antennas, and two type 6SH7 tubes, V1 and V2, connected in push-pull. Signal voltage from the loop antenna or loop-sense antenna combination is fed to the control grids of these tubes. After being amplified, the signal voltage is sent to the converter stage.

b. The MASTER switch, in the OFF position, shorts the loop wires together and grounds the sense antenna. This prevents damage to the direction finder set when the transmitter of the ship is operating. In all other positions of the MASTER switch, the ground is removed from the sense antenna, and the short is removed from the loop wires.

c. In the grid circuit, the loop antenna is tuned by C3, C4A, and C4B. Capacitors C4A and C4B are connected together as part of the four-gang tuning capacitor, C4. Capacitor, C1, is used to resonate the sense antenna to the rf stage, while C2 is used to adjust the phasing of the voltages

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from the loop and sense antennas to cancel the effects of signals radiated from the superstructure of the ship (par. 54*c*).

d. Bias for V1 and V2 is provided by R4, R7, and R8. Resistor R7 is variable and controls the gain of the rf stage, thus acting as the receiver VOLUME control. Capacitor C7A is the cathode bypass capacitor, and capacitor C13 is a decoupling capacitor.

e. Resistors R2 and R3 and capacitor C5 broaden the frequency response of T1.

f. Plate and screen voltages for the rf stage are taken from the dynamotor power supply. V9 maintains the output voltage at a constant value of 105-volt dc.

56. Converter Stage, V3
(fig. 22)

a. In the converter stage, the incoming rf signal is changed to a 115 kc if. signal. The signal from transformer T1 is combined with the output of the oscillator section of V3 to form their sum and difference frequencies. The plate circuit of V3 is tuned to the difference frequency which resembles the original received frequency in that it has identical amplitude variations. Tube V3 performs the functions of the mixer, oscillator, and amplifier.

b. The local oscillator in the receiver operates at a frequency 115 kc above the frequency being received. The frequency of oscillation is determined by the coil and capacitor combination located in L1 and by capacitors C4D and C8. Resistor R6 is the grid bias resistance, while R5 determines the oscillator grid current. Bias is also determined by the setting of R7, which simultaneously varies the gain of V1, V2, and V3. The oscillator is a Hartley circuit, and uses the plate, cathode, and control grid of the 6SA7 tube. The plate and cathode are also used by the amplifier section of the tube.

c. Mixing is accomplished by feeding the oscillator signal to the control grid of the 6SA7 tube (V3), and the received rf signal to the injector grid (grid 3). The resultant signals are amplified by normal tube action and appear in the plate circuit. The plate tank circuit (primary of T2) is tuned to 115 kc, so only that frequency will appear in the if. stage. Capacitor C7C is the screen-grid decoupling capacitor; C7B performs the same function for the control grid circuit. Plate and screen voltage are obtained from the 105–volt regulated supply.

57. First If. Stage, V4
(fig. 23)

a. The first if. stage amplifies the weak difference frequency signal present in the output circuit of the converter stage. Tube V4 amplifies the 115-kc signal and couples it into the second if. by means of the if. transformer T3.

b. The if. signal impressed on the grid of V4, is amplified and inductively coupled to V6 by permeability tuned transformer T3. Resistor

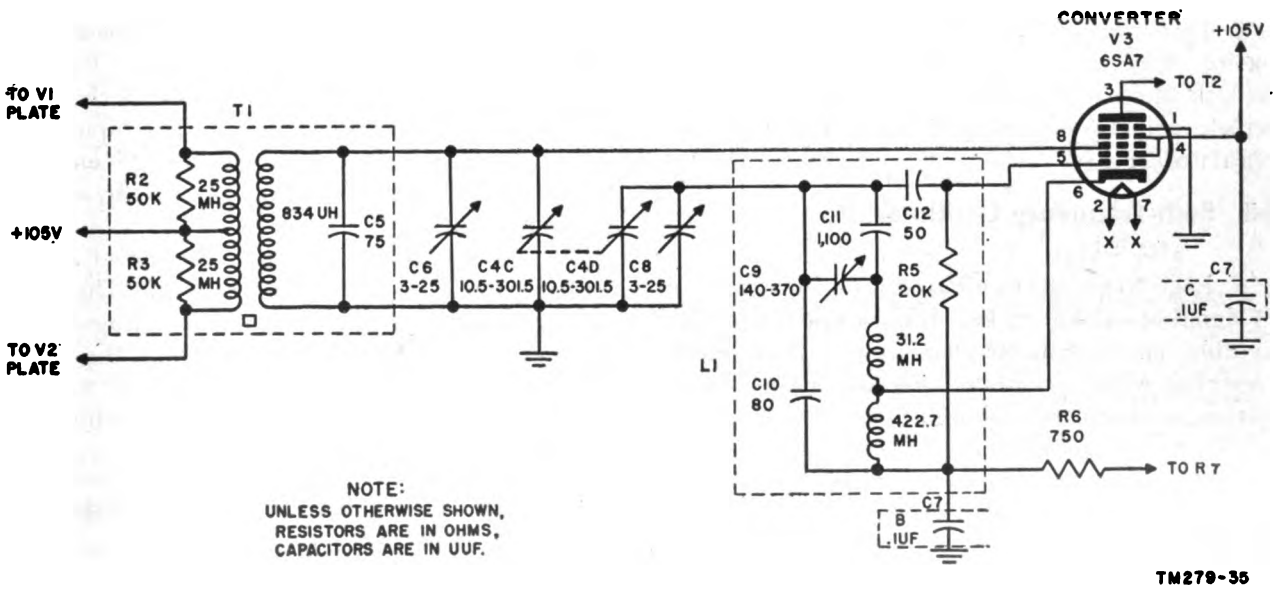

Figure 22. Radio receiver, functional diagram of converter.

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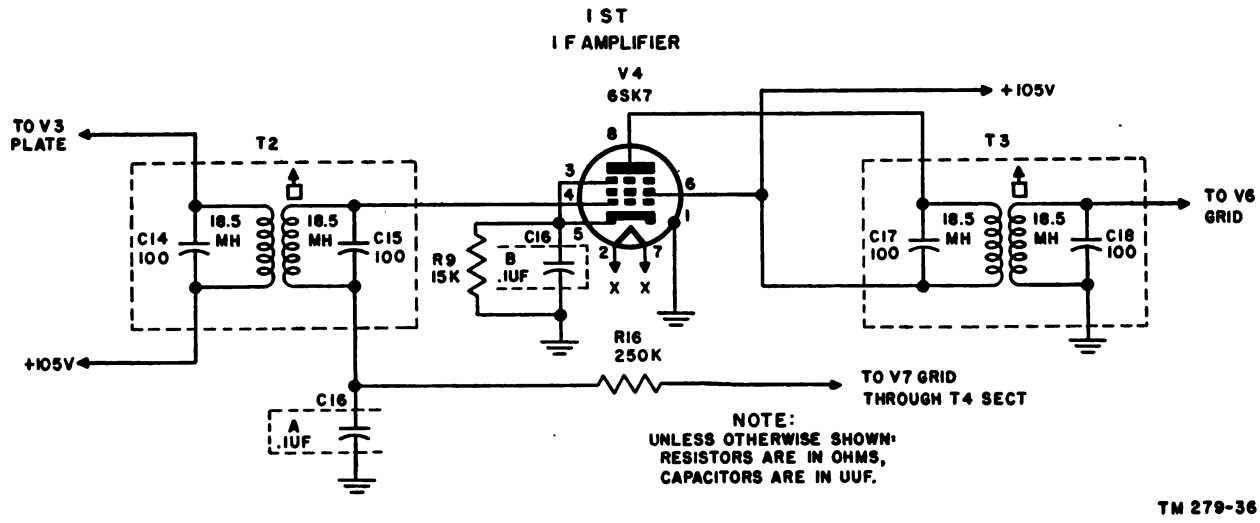

Figure 23. Radio receiver, functional diagram of first if. amplifier.

R9 is the cathode bias resistor; C16B is the cathode bypass capacitor.

c. Automatic-volume-control voltage is developed in the following manner. The grid return circuit of V4 and V7 are connected together through a decoupling filter that consists of C16A, C16C, and R16 and the grid bias on V4 is developed across R9 and R17. With normal signals, no grid current flows in V7; the grid bias of V4 is then the same as the cathode bias developed across R9, and the stage gain is maximum. If a strong incoming signal causes V7 to overload and draw grid current, an additional bias voltage is developed across R17 causing V4 to be biased more negatively and reducing the stage gain.

d. Transformer T3, with primary shunting capacitor C17 and secondary shunting capacitor C18, is permeability tuned to 115 kc. Plate and screen voltage is obtained from the 105-volt regulated supply.

58. Beat-Frequency Oscillator, V5

(fig. 24)

a. Beat-frequency oscillator V5 generates an rf signal of 115 kc ±2 kc. Its purpose is to make audible, unmodulated signals (cw). Also when receiving weak, modulated signals, the beat-frequency oscillator can be used to make the carrier of the radio signal audible. This makes it possible to get a precise bearing on a signal that would ordinarily not be usable. The tone of the signal in the headset is adjustable ±2 kc from the front panel of the receiver, by means of the C.W. TONE knob (C22). The beat-frequency oscillator operates when the MASTER switch is on either the C.W. or SUP. position.

b. The circuit is that of a conventional triode oscillator. The frequency of oscillation is determined by permeability tuned L2 and capacitors C20 and C22 (C.W. TONE). Resistor R13 is the cathode bias resistor, and C24 is the cathode bypass capacitor. Resistor R12 and capacitor C19 make up the grid bias network, and resistor R19 and capacitor C23 couple the oscillator output to second if. amplifier V6. Plate voltage is obtained from the 105-volt regulated supply.

59. Second If. Amplifier, V6

(fig. 24)

a. The second if. amplifier increases the amplitude of the signal from the first if. stage. Circuit selectivity also is improved by the use of the permeability tuned transformer, T4. The input and output circuits are tuned to 115 kc. From the second if. amplifier, the signal goes to the second detector circuit.

b. Cathode bias for the stage is developed across resistor, R15. Resistor R10 broadens the frequency response of T3. The output voltage from the beat-frequency oscillator is fed into the cathode circuit where it mixes with the if. signal. Plate and screen voltage for the circuit is obtained from the 105-volt regulated supply.

60. Second Detector and First Audio Stage, V7

(fig. 25)

a. In this circuit the if. signal is demodulated, and the remaining audio component is amplified

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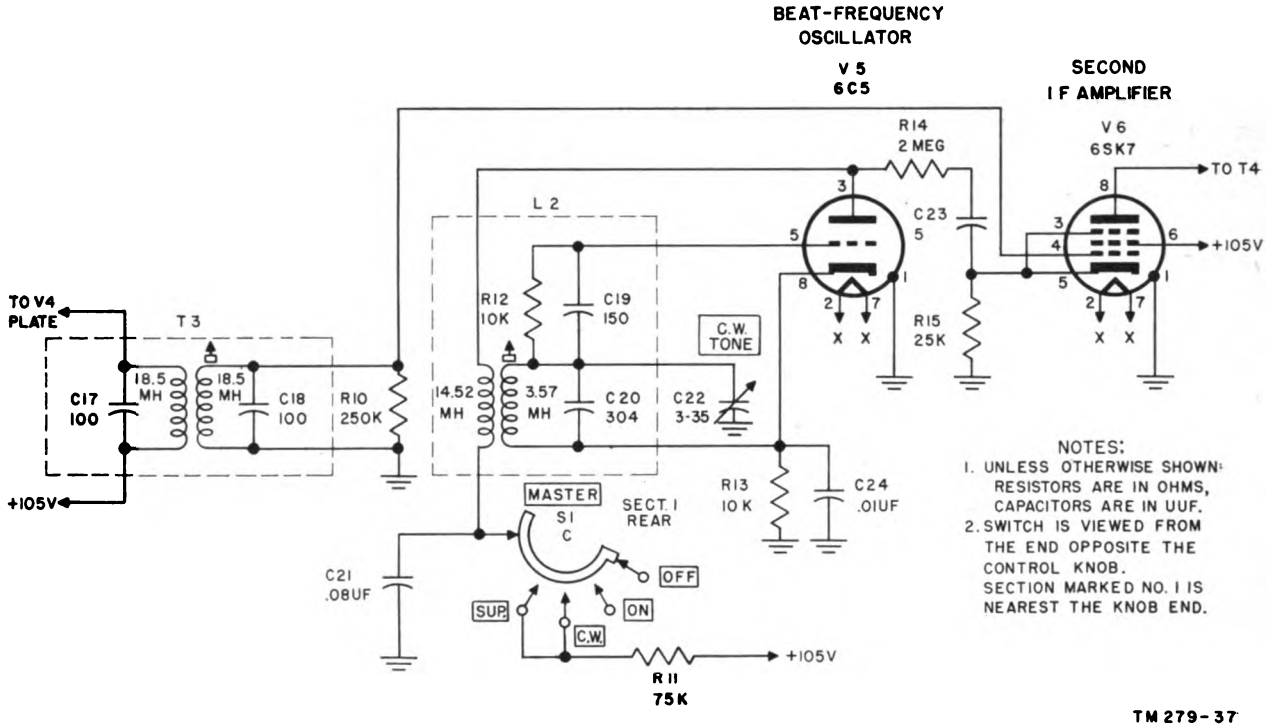

Figure 24. Radio receiver, functional diagram of beat-frequency oscillator and second if. amplifier.

and resistance is coupled to the second audio amplifier stage. Included in the circuit is a noise filter which has a resonant frequency of 750 cycles, and is placed in the circuit when the MASTER switch is in the SUP. position. With the MASTER switch in the SUP. position, the beat-frequency oscillator operates, causing an audio signal to appear in the headset. The noise filter bypasses all signals except those in a narrow band around 750 cycles per second (cps). By adjusting

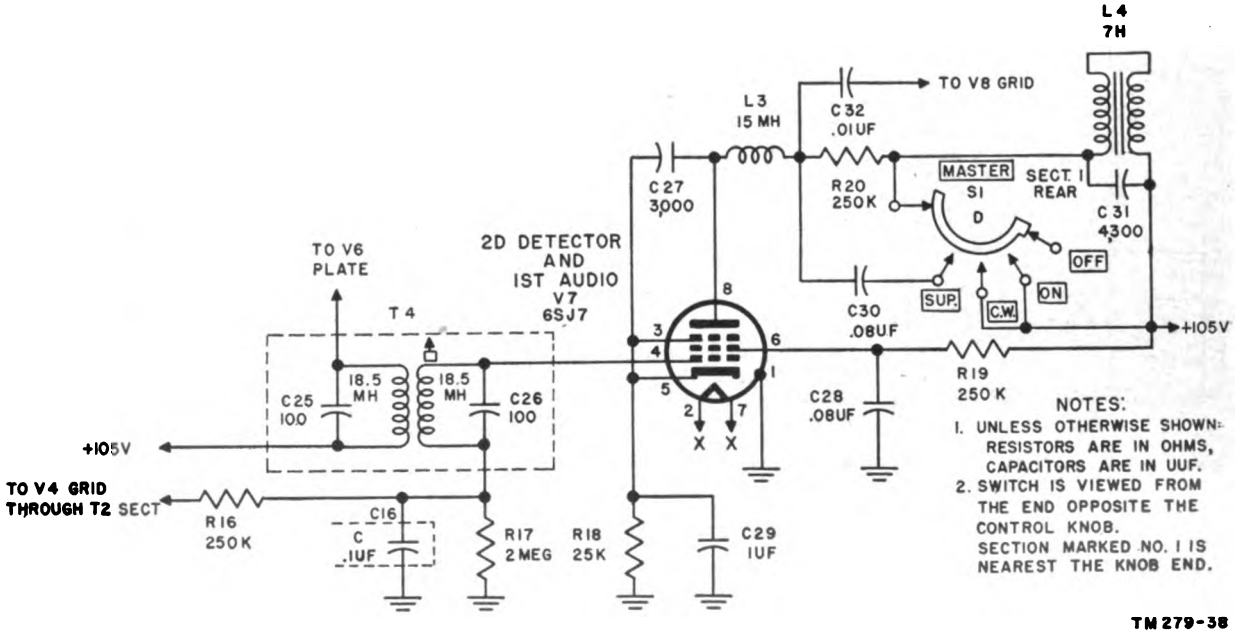

Figure 25. Radio receiver, functional diagram of second detector and first audio amplifier.

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the C.W. TONE knob (C22), the note is varied in frequency until a beat of 750 cps is heard. (At this point the signal in the headset will be loudest.) All static and interfering audio signals above and below 750 cycles will be attenuated, making it easier to secure a bearing on the signal.

b. Tube V7, type 6SJ7, is used as a combined detector and amplifier. Detection is accomplished in the grid circuit. Resistor R17 is the grid bias resistor, and R18 is the cathode bias resistor. Capacitor C29 is the cathode bypass capacitor. Capacitor C27 and choke L3 keep rf out of the audio stages. Resistor R19 and capacitor C28 decouple the screen-grid circuit. Resistor R20 is the plate load for every position of the MASTER switch except SUP. With the MASTER switch in the SUP. position, the plate load consists of R20, C30, C31, and L4. The noise filter circuit, C30, C31, and L4, is used when the MASTER switch is in the SUP. position.

c. At normal signal levels, no grid current flows, and the grid bias on V7 is the same as the cathode potential; the stage gain is now maximum. With high level input signals, V7 draws grid current through R17, causing the bias in V7 and V4 to become more negative. This lowers the gain of the two tubes and keeps the level of the signals, in the headset, fairly constant. Plate and screen voltages are obtained from the 105-volt regulated supply.

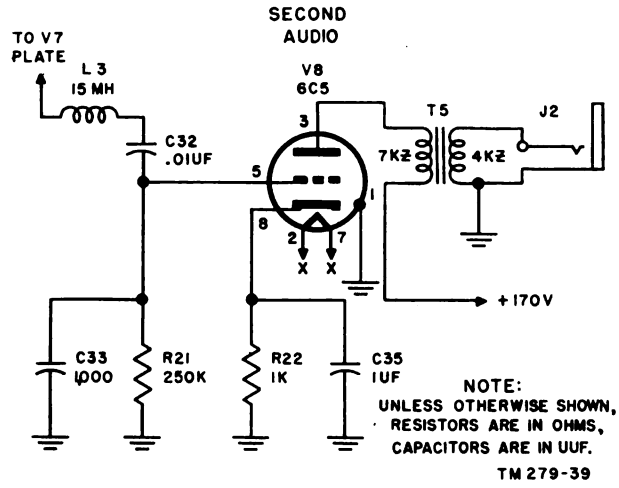

Figure 26. Radio receiver, functional diagram of second audio amplifier.

61. Second Audio Amplifier, V8

(fig. 26)

a. The second audio amplifier increases the level of the audio signal from the first audio amplifier and couples the output signal to a headset. A type 6C5 tube is used to amplify the signal sufficiently for headset reception. The circuit is a conventional triode amplifier that uses cathode bias. The values of cathode resistor (R22) and capacitor are chosen to give maximum audio gain at frequencies of 200 to 2,000 cps.

b. Capacitor C32 is the coupling capacitor between the first and second audio amplifiers. Capacitor C33 bypasses to ground any rf that may be in the grid circuit and at the same time lowers the high-frequency response of the audio amplifier. Capacitor C35 and resistor R22 are the cathode bias capacitor and resistor. The grid circuit is completed through R21 to ground. Plate voltage is obtained from the 170-volt output of the dynamotor.

62. Voltage Regulator, V9

(fig. 43)

a. The voltage regulator circuit consists of V9 and R23. The 170-volt output from the dynamotor is across V9 and R23 in series. The regulated output appears across V9. The voltage regulator, V9, maintains a constant 105-volt drop across its terminals. This voltage is kept constant within very close limits, keeping stage gain characteristics steady and minimizing oscillator drift. This enables accurate results to be obtained when taking bearings, and prevents damage, from excessive voltage, to components during the warmup period.

b. Tube V9 is gas-filled and conducts more current as the voltage impressed on it is increased, and less current when the voltage is decreased. Resistor R23 being in series with the tube will develop a voltage drop which will be proportional to the current through it. Therefore, although the voltage drop across the resistor may vary because of changes in the load or input voltage, the voltage across the regulator tube remains constant. Capacitor C34 filters any noise voltage developed by ionization of the gas within the tube.

63. Master Switch, S1

(fig. 27)

The four-position selector switch controls the functioning of the direction finder set as follows:

a. In the OFF position, all power is disconnected from the set, the loop antenna is short-circuited, and the sense antenna is grounded.

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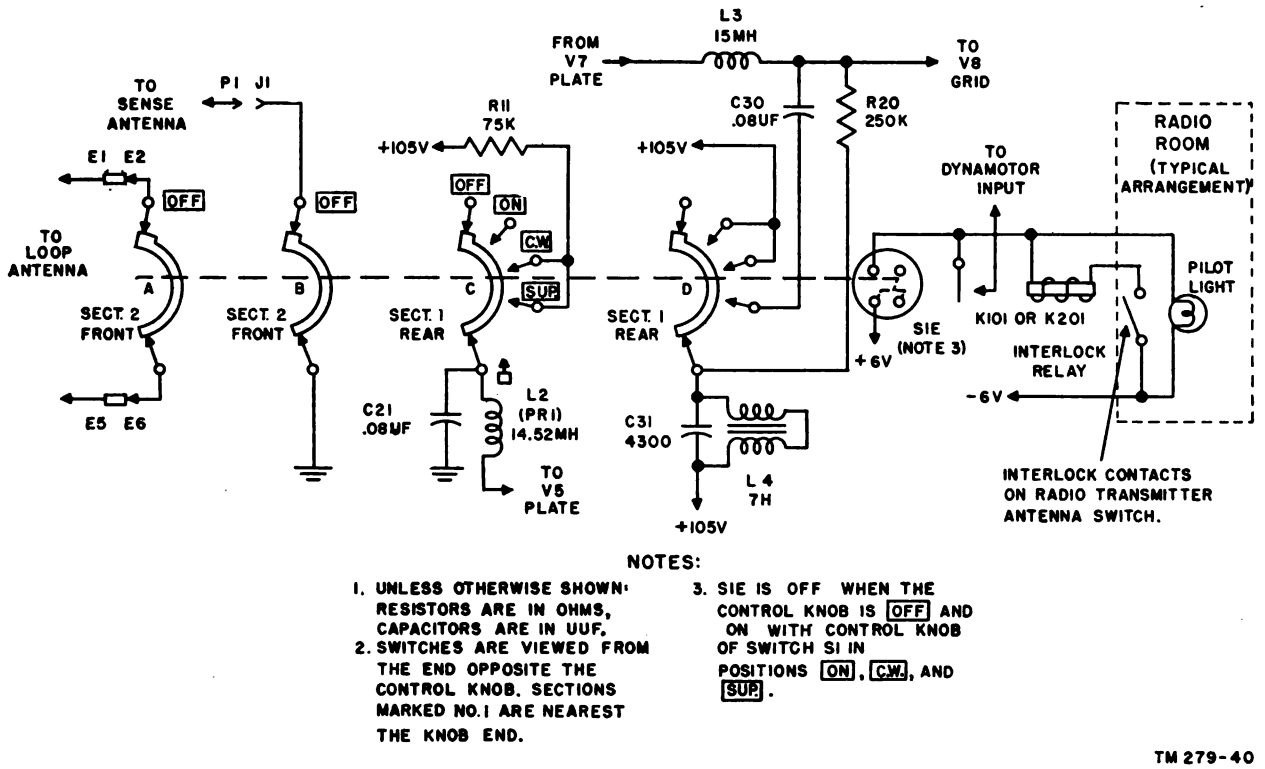

NOTES:

1. UNLESS OTHERWISE SHOWN: RESISTORS ARE IN OHMS, CAPACITORS ARE IN UUF.
2. SWITCHES ARE VIEWED FROM THE END OPPOSITE THE CONTROL KNOB. SECTIONS MARKED NO. 1 ARE NEAREST THE KNOB END.
3. SIE IS OFF WHEN THE CONTROL KNOB IS OFF AND ON WITH CONTROL KNOB OF SWITCH S1 IN POSITIONS ON, C.W., AND SUP.

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Figure 27. MASTER switch, S1, functional diagram.

b. In the ON position, the ground is removed from the sense antenna (S1B), the short circuit is removed from the loop antenna (S1A), and power is applied to the dynamotor power supply (S1E), and in turn to the radio receiver, when the radio transmitter antenna switch is open and its interlock contacts closed. Accurate radio bearings cannot be taken when the radio transmitter is operating. A typical circuit of these interlock contacts and a pilot lamp in the radio room is shown in figure 27. When the MASTER switch is in the ON position, the pilot lamp in the radio room lights as a signal to the radio operator that radio bearings are to be taken. The radio operator opens the radio transmitter antenna switch, and its interlock contacts close. These interlock contacts complete the interlock relay (K101); energizing circuit; the relay closes and voltage is applied to the dynamotor and to the heaters of the electron tubes in the radio receiver. The dynamotor power supply delivers plate voltage to the radio receiver.

c. In the C.W. position, beat-frequency oscillator V5 functions. Plate voltage is applied by S1C through the primary of L2.

d. In the SUP. position, band-pass filter L4 and C31 functions. Resistor R20 is shunted by C30 and the plate impedance is largely determined by this resonant filter with maximum gain at a frequency of 750 cps.

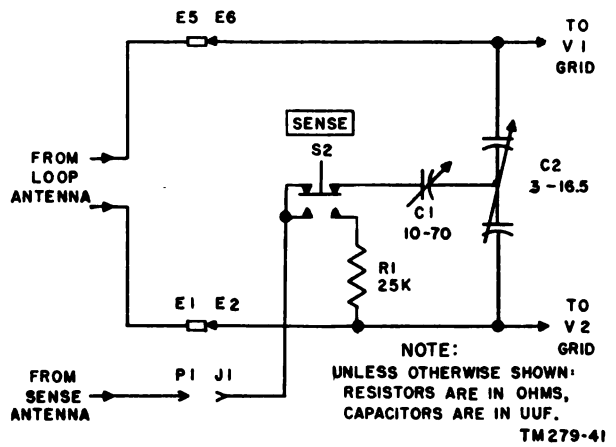

Figure 28. SENSE button S2, functional diagram.

64. SENSE Button, S2

(fig. 28)

This momentary push-button switch, when depressed, functions to determine the direction of the radiobeacon with respect to the vessel as follows: Depressing S2 applies the sense antenna signal to the grid of V2 and to the corresponding end of the

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loop antenna through the phase correcting resistor, R1. The signal will then be louder when one edge of the loop points toward the radiobeacon than when the loop is rotated 180° and the other edge of the loop points toward the radiobeacon. When the signal is the louder, the sense pointer will point to the radiobeacon.

65. Dynamotor Power Supply

(fig. 43)

The dynamotor power supply develops the plate and screen voltages for the operation of the direction finder set. The voltage developed by dynamotor D1 is filtered to remove all noise.

a. The dynamotor is a combination motor and generator that develops a high-voltage dc output from a low-voltage dc input. The armature of the dynamotor carries two sets of windings, each connected to a commutator at opposite ends of the shaft. A common field winding is used to provide the magnetic field for both the motor and generator. One armature winding, when energized by the 6-volt input source, produces the driving force to rotate the shaft. The other armature windings generates a high ac voltage when rotated in the magnetic field of the common field winding. This high ac voltage is changed to dc by the commutator connected to the armature windings.

b. The dc input to the dynamotor (direction finder set serial No. 1–74) is filtered by L101, C101, and C102, while the B+ output filter circuit consists of L102, L103, L104, C103, C104, C105, and C106.

c. In the dynamotor power supply (direction finder set serial No. 75–137), the dc input voltage is filtered by L203, C204, and C205. The B+ output voltage is filtered by L201, L202, C201, C202, and C203.

d. Power is applied to the dynamotor power supply as follows:

(1) Power from the mains of the ship is brought to CHARGE switch S401. With the switch at ON, the direction finder battery is charging. When the switch is in the OFF position, the battery is taken off charge and connected to the direction finder set. The direction finder set will not operate with the CHARGE switch in the ON position.

(2) With the CHARGE switch at OFF, battery voltage is applied to the power connection terminal strip located on the dynamotor power supply.

(3) With switch S1E closed (MASTER switch moved from the OFF position), the input circuit to the dynamotor is completed through S1E, then through the contacts of relay K101 (when radio transmitter interlock switch is closed), through noise filter L101, then through the motor part of D1 and back to the battery.

(4) Relay K101 is used in a protective circuit to prevent the direction finder set from being turned on while the radio transmitter of the ship is in operation. A three-wire cable, labeled "TO RADIO TRANSMITTER INTERLOCK SWITCH" on the main schematic diagram (fig. 43), connects to the radio operator's position. A pilot light, connected between the two upper wires of the cable, lights when the MASTER switch is moved from the OFF position. The radio operator then throws a switch which opens the circuit to the radio antenna and, at the same time, connects together the upper and lower wires of the three-wire cable. Relay K101 now closes and completes the input power circuit to the direction finder set, causing the dynamotor to start and the tube filaments, pilot lamp, and compass bowl lamps to light.

(5) When the protective circuit is not used, a jumper is placed across terminals M and N of the power connection terminal strip (fig. 36).

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CHAPTER 6

FIELD MAINTENANCE

Section I. TROUBLESHOOTING AT FIELD MAINTENANCE LEVEL

Warning: When servicing the direction finder set, be extremely careful because of the high voltages exposed. Always disconnect the power cable and discharge capacitors C34 and C36 (fig. 31) before doing any testing. With the high voltage off, potentials as great as 170 volts are still present in the set. Keep one hand in pocket when measuring socket voltages with the probe. When touching any parts observe all safety precautions.

66. Troubleshooting Procedures

The first step in servicing a defective set is to sectionalize the fault. Sectionalization means tracing the fault to the circuit responsible for the abnormal operation of the set. The second step is to localize the fault. Localization means tracing the fault to the defective component responsible for the abnormal condition. Some faults such as burned-out resistors, rf arcing, and shorted transformers can often be located by sight, smell, and hearing. The majority of faults, however, must be localized by checking voltage and resistance.

a. System Sectionalization. System sectionalization is discussed in paragraph 48.

b. Component Sectionalization and Localization. The tests below aid in isolating the source of trouble. To be effective, the procedure should be followed in the order given. Remember that servicing procedure should cause no further damage to the radio receiver. First, trouble should be localized to a single stage or circuit. Then the trouble may be isolated within that stage or circuit by appropriate voltage, resistance, and continuity measurements. The service procedure is summarized as follows:

(1) *Visual inspection.* The purpose of visual inspection (par. 47) is to locate any visible trouble. Through this inspection alone the repairman may frequently discover the trouble or determine the stage in which the trouble exists. This inspection is valuable in avoiding additional damage to the radio receiver which might occur through improper servicing methods and in forestalling future failures.

(2) *Power supply resistance measurements.* These measurements (par. 70) prevent further damage to the radio receiver from possible short circuits. Since this test gives an indication of the condition of the filter circuits, its function is more than preventive.

(3) *Operational test.* The operational test (par. 71) is important because it frequently indicates the general location of trouble. In many instances, the information gained will determine the existing nature of the fault. To use this information fully, all symptoms must be interpreted in relation to one another.

(4) *Troubleshooting chart.* The trouble symptoms listed in this chart (par. 72) will aid greatly in localizing trouble.

(5) *Signal substitution.* The principal advantage of the signal substitution method (par. 74) is that it usually enables the repairman to localize a trouble accurately and quickly to a given stage when the general location of the trouble is not immediately evident from the above tests.

(6) *Stage gain charts.* These charts (par. 78) can be used to localize hard-to-find troubles.

(7) *Intermittent trouble.* In all of these tests, the possibility of intermittent trouble should not be overlooked. If present, this type of trouble often may be made to appear by tapping or jarring the set. It is possible that the trouble is not in the radio receiver. It may be in the

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loop antenna or the power supply, or it may be caused by external conditions.

67. Troubleshooting Data

The material supplied in this manual will help in the rapid location of faults. Consult the following figure and paragraph references for location of parts, wiring and schematic diagrams.

a. Radio Reciever.

Fig. No.	Par. No.	Description
43	----	Direction Finder Set AN/SRD–11, schematic diagram.
29	----	Radio receiver, tube socket voltage and resistance chart.
30	----	Radio receiver, chassis, top view.
31	----	Radio receiver, chassis, bottom view.
42	----	Radio receiver, wiring diagram.
	73	Radio receiver, dc resistance of transformers and coils.

b. Power Supply.

Fig. No.	Description
32	Power supply, bottom view of filter (serial numbers 1–74).
34	Power supply, bottom view cover removed (serial numbers 75–137).
36	Power supply, wiring diagram (serial numbers 75–137).

68. Test Equipment Required for Troubleshooting

The test equipment required for troubleshooting Direction Finder Set AN/SRD–11 is listed below. The technical manuals associated with the test equipment are also listed.

Test equipment	Technical manual
Signal Generator AN/URM–25	TM 11–5551
Audio Oscillator TS–382A/U	TM 11–2684A
Electron Tube Test Set TV–2/U	TM 11–2661
Multimeter TS–352/U, or equal	TM 11–5527
Electronic Multimeter TS–505/U	TM 11–5511

69. General Precautions

When the radio receiver is serviced, observe the following precautions very carefully.

a. Be careful when the cover is removed; dangerous voltages are exposed.

b. Careless replacement of parts often makes new faults inevitable. Note the following points.

(1) Before a part is unsoldered, note the position of the leads. If the part, such as a transformer, has a number of connections, check each of the leads to it.

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

(3) Do not allow drops of solder to fall into the set since they may cause short circuits.

(4) A carelessly soldered connection may create a new fault. It is very important to make well-soldered joints since a poorly soldered joint is one of the most difficult faults to find.

(5) When a part is replaced in rf or if. circuits, it must be placed exactly as the original one was. A part which has the same electrical value but different physical size may cause trouble in high-frequency (hf) circuits. Give particular attention to proper grounds when replacing a part. Use the same ground as in the original wiring. Failure to observe these precautions may result in decreased gain or possibly in oscillation of the circuit.

(6) Do not disturb the adjustment of capacitor C3, C6, C8, C9, C14, C15, C17, C18, C22, C25, or C26.

70. Checking Filament and B+ Circuits for Shorts

Trouble within the radio receiver may often be detected by checking the resistance of the filament and high-voltage circuits before applying power to the set, thereby preventing damage to the power supply. Make the following checks before attempting to put the receiver in operation. Disconnect the power supply connector, P2, and remove all vacuum tubes and pilot lamps. Disconnect voltmeter M1. Set the MASTER switch to the OFF position.

a. The resistance between terminals 3 and 6 of J3 should be infinite, and the resistance from either pin 3 or 6 to pin 5 should be infinite. A resistance reading indicates a short circuit or ground in the heater, pilot lamp, or meter wiring,

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which must be corrected before power is applied to the receiver.

b. The resistance between pins 4 and 5 of J3 should be approximately 38,000 ohms (±10 percent). If the resistance is low or zero, first check R7 and R8. Also, if the resistance is low, check for a shorted bypass capacitor in one of the plate or screen circuits, a short in one of the filter capacitors, a short in the wiring of one of the plate or screen grid circuits, or leakage in one of the capacitors. Also check for a ground in one of the transformers or coils. To prevent possible damage to the power supply, correct all abnormal conditions before applying high voltage to the radio receiver.

71. Operational Test

a. If the radio receiver is connected to its associated components as in normal operation, check the equipment as described in the equipment performance check list (par. 50). This check list is important because it frequently indicates the general location of trouble. Also listen for crackling or buzzing noises which indicate high-voltage arcing. Check the receiver for smoke and the odor of burned or overheated parts. If the radio receiver is being checked apart from its associated antenna and power supply, the following procedures must be followed to make it ready for operation.

(1) Connect a 3,000-ohm, 1-watt resistor across antenna collector brushes E2 and E6.

(2) Turn the MASTER switch to OFF.

(3) To supply power for the vacuum tube heaters, provide a 6-volt storage battery (120-ampere hour capacity). Connect the positive side to pin 1 of J3 and the negative side to pin 6 of J3. Connect together pins 2 and 3 of J3 to complete the filament circuit through switch S1.

(4) To supply power for the plate and screen circuits, connect to pins 4 (+) and 5 (−) a power supply capable of delivering 170 volts dc at 100 milliamperes.

(5) Turn the MASTER switch to ON and allow the vacuum tubes to warm up for 1 minute.

(6) Listen for crackling or buzzing noises which indicate high-voltage arcing. Check the receiver for smoke and the odor of burned or overheated parts.

(7) Check items 9 through 15 of the equipment performance check list (par. 50). These items may indicate the general location of the trouble.

72. Troubleshooting Chart

The following chart is supplied as an aid in locating trouble in the radio receiver and associated power supply. This chart lists the symptoms that the radioman observes either visually or audibly while making a few simple tests. *The chart also indicates how to localize trouble quickly to the audio, if. or rf stage of the radio receiver.* The signal substitution test outlined in paragraphs 74 through 77 can then be used to supplement this procedure and to determine the defective stage. Once the trouble has been localized to a stage or circuit, a tube check and voltage and resistance measurement of this stage or circuit should ordinarily be sufficient to isolate the defective part. Normal voltage and resistance measurements are given in figure 29.

Symptom	Probable trouble	Correction
1. MASTER switch at ON position. Receiver fails to operate. Dial lamps do not light and voltmeter does not register.	*a.* Power cable not connected to receiver.	*a.* Connect power cable to receiver.
	b. CHARGE switch ON	*b.* Set CHARGE switch to OFF position.
	c. Interlock relay not operating	*c.* Check coil for open or ground, and contacts for proper closure.
	d. Storage battery not connected	*d.* Connect storage battery according to figure 11.
	e. Defect in power cable or wiring to interlock relay.	*e.* Check wiring for open or ground.
2. Receiver inoperative. Dial lamps light and voltmeter reads between 5.6 and 6.2 volts.	Failure of B+ supply	Measure voltage between pin 4 of J3 and and ground. Reading should be +170 volts. Check other B+ voltages according to figure 29.

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Symptom	Probable trouble	Correction
3. No noise or signal in headset with radiobeacon tuned in and VOLUME knob advanced.	*a.* Defect exists in audio-frequency (af) stages.	*a.* Use headphones with .1-μf capacitor in series with one lead and other lead to ground; check grid and plate circuits of successive audio stages to localize defective stage. (1) Test tube in this stage and, if necessary, make voltage and resistance measurements to locate defective part. (2) An alternate method is to use signal substitution in audio stages (par. 75).
	b. Faulty second detector stage	*b.* Check this stage by putting in a new tube, then make voltage and resistance measurements (fig. 29).
4. Af circuits satisfactory, but no receiver output is obtained when modulated 115 kc if signal is applied through a series capacitor to terminal 8 of V3.	Faulty if. stages	Use signal substitution in if. stages (par. 76) to locate defective stage. Test tube and make tube socket voltage and resistance tests.
5. Af and if. circuits satisfactory, but no receiver output when modulated rf signal (280 to 520 kc) is applied to E2 and E6 and receiver is tuned to signal.	*a.* Faulty rf stage	*a.* Use signal substitution in rf stage (par. 77) to locate faulty component. *b.* Test tubes and make tube socket voltage and resistance tests.
6. Am signals received, but no beat note obtained when MASTER switch is turned to C. W. Beat note heard when if. signal (115 kc) is applied to terminal 5 of V6.	Defective beat-frequency oscillator stage V5.	Test V5 and its tube socket resistance and voltages.
7. Reception weak. With no signal tuned in, tube rush not heard when VOLUME control turned to maximum.	*a.* Weak tubes. Low plate or screen voltage caused by shorted capacitor in plate or screen return circuit.	*a.* Check tubes, voltages, and resistances.
	b. Receiver not properly alined	*b.* Realign receiver.
8. Reception distorted	*a.* Open grid resistor or leaky capacitor in audio circuits.	*a.* Use headset with .1μf capacitor in series with one lead, to localize faulty stage. *b.* Check grid circuits.
9. Noisy and fading reception	*a.* Faulty VOLUME control	*a.* Check slider in VOLUME control and connections.
	b. Faulty antenna circuit	*b.* Check antenna installation for leakage paths to ground and also for loose connections.
	c. Faulty suppressor circuit	*c.* With MASTER switch on SUP. check noise. Check L4, C31 and R20.
	d. Faulty MASTER switch	*d.* Check all switch contacts for proper contact. Remove dirt. Also check associated wiring.
10. No nulls as loop antenna is rotated.	Faulty loop antenna circuit	Check loop antenna for open or short circuit.

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Symptom	Probable trouble	Correction
11. Objectionable hum in output	*a.* Shorted or open filter capacitors in receiver or power supply. *b.* Shorted turns in power supply chokes. *c.* Defective dynamotor	*a.* Check by connecting new equivalent capacitor for comparison. *b.* Check for shorted turns by measuring resistance of L1 through L5 (par. 73). *c.* Check commutators for open coils and dirt. (1) Commutators are checked by measuring resistance between adjacent segments. Resistance between all adjacent segments should be equal. If resistance is zero, winding is shorted. If resistance is higher than normal, winding is open. (2) Commutators are cleaned by holding piece of No. 000 sandpaper against segments and rotating armature. (3) Check brushes for wear and proper contact.
12. Intermittent noise	Defective tube, resistor, or capacitor.	With insulated prod, gently tap and slightly move all tubes, resistors, capacitors, and soldered connections to locate loose elements or loose connections to any component.
13. Oscillation (indicated by howl or whistle).	Defective tube, poor shielding, interstage coupling, or high resistance soldered chassis return.	Check tubes. Check shunt bypass capacitors by substituting capacitor of equal value.

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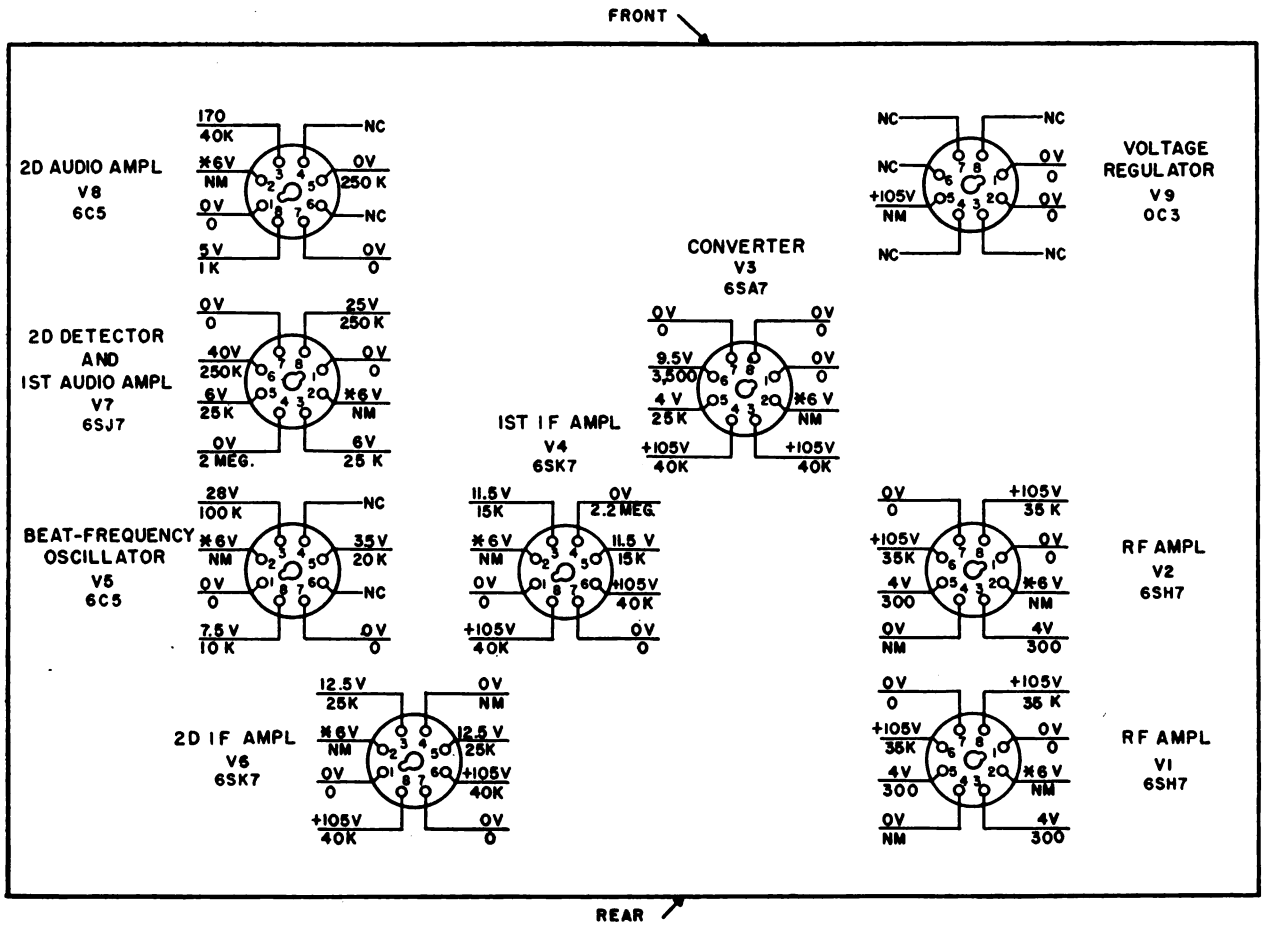

NOTES:

1. 6V DC INPUT.
2. MASTER SWITCH, S1, ON.
3. VOLUME CONTROL, R7, IN EXTREME CLOCKWISE POSITION.
4. VOLTAGES AND RESISTANCES MEASURED TO GROUND WITH 20,000 OHMS-PER-VOLT METER. USE HIGHER METER RANGES TO PREVENT CIRCUIT LOADING.
5. NM INDICATES NOT MEASURED.
6. NC INDICATES NO CONNECTION.
7. * INDICATES MEASUREMENT ACROSS FILAMENTS.

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Figure 29. Radio receiver, tube socket voltage and resistance diagram.

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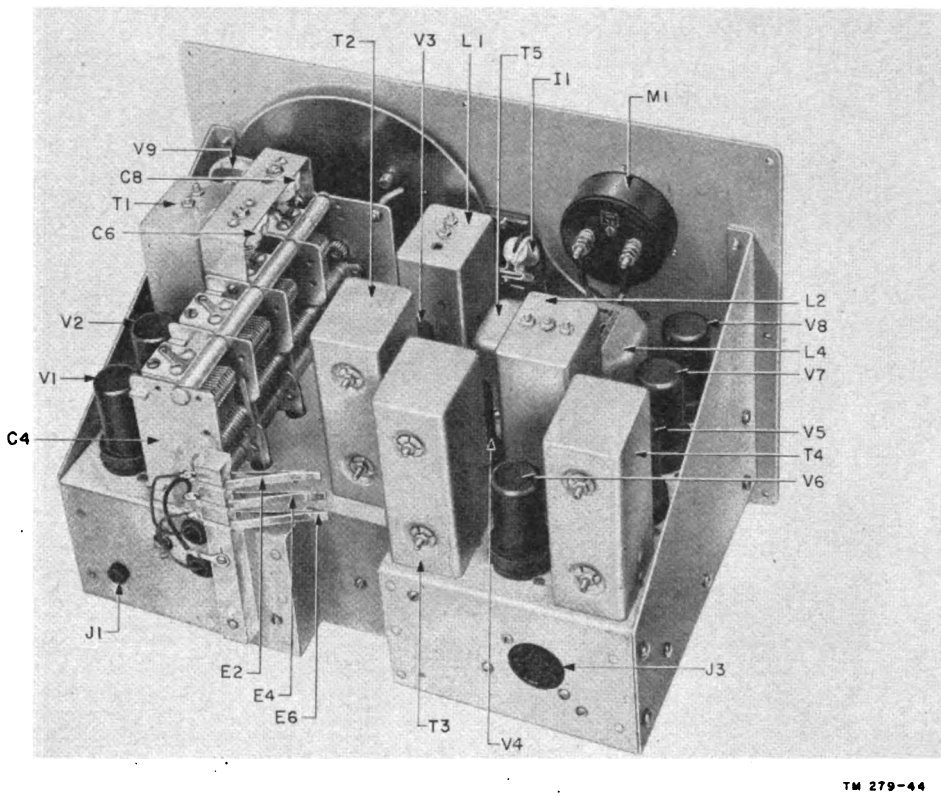

Figure 30. Radio receiver, top view of chassis.

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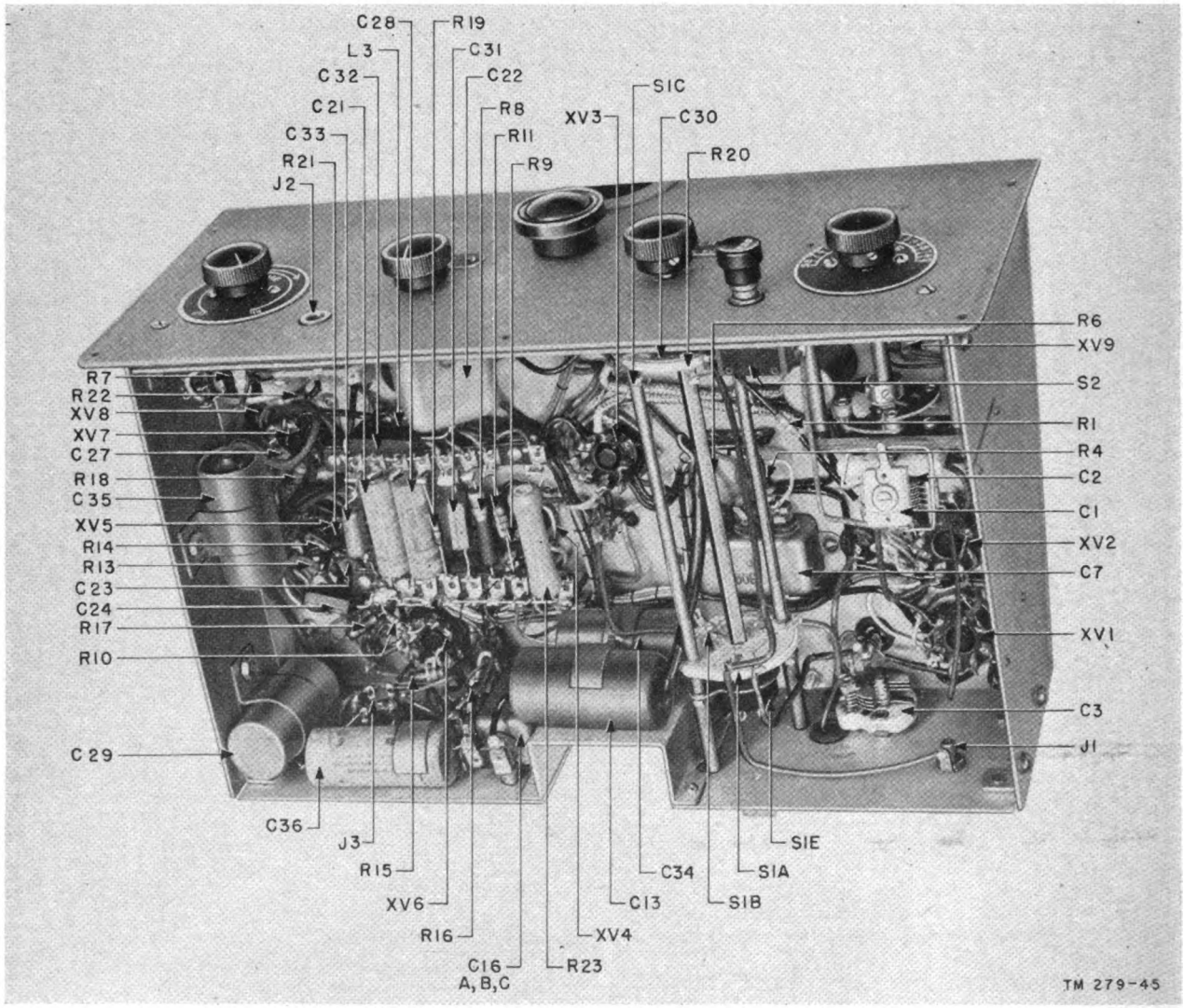

Figure 31. Radio receiver, bottom view of chassis.

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73. Dc Resistances of Transformers and Coils

The dc resistances of the transformers, windings, and coils in the receiver are listed below.

Transformer or coil	Between wires	Resistance (ohms)
T1	GRN and BLK	6
	BLU and RED or ORN	108
T2	GRN and BLK	40
	BLU and RED or ORN	40
T3	GRN and BLK	40
	BLU and RED or ORN	40
T4	GRN and BLK	40
	BLU and RED or ORN	40
T5	GRN and BLK	185
	BLU and RED	200
L1	GRN and BLK	(1)
	YEL and BLK	2
	YEL and WHT or ORN	(1)
	BLK and WHT or ORN	20,000
L2	GRN and BLK	10,000
	YEL and BLK	20
	BLU and ORN	120
L3	Two unmarked terminals	80
L4	Two unmarked terminals	780

[1] Infinity.

74. Signal Substitution

a. Signal substitution requires a source of audio, if., and rf signals. Rf Signal Generator AN/URM–25 is suitable for this purpose

b. In addition, a headset is necessary. The headset furnished with the radio direction finder set is satisfactory.

c. An analyzer and tube tester are also needed to isolate the defective part after the faulty stage has been indicated by signal substitution.

d. In the tests indicated in paragraphs 75, 76, and 77, ground one side of the signal generator to the receiver chassis and connect the other side through a capacitor (about .05 μf) to the receiver point as described.

e. Note the volume and listen for serious distortion from the headset at the various points in the signal substitution procedure. When working back from the output to the input stages, decrease the output of the signal generator as much as possible. If possible, compare with a receiver known to be in good condition.

f. Check the wiring and soldering in each stage during the procedure.

Caution: Do not damage the wiring by pushing it back and forth during inspection. Be careful not to damage the receiver in any other way.

g. Misalinement of one or more stages of the receiver will cause reduced output. Misalinement of L1 or L2 may prevent any output.

h. When trouble is sectionalized to a given stage, first test the tube, if such a test is indicated. Then measure voltages and finally measure resistances at the tube socket at that stage.

i. Trouble in a circuit or stage may not cause changes in voltage and resistance measurements at the tube socket. The instructions included in this paragraph are merely a guide and should suggest other procedures such as voltage and resistance measurements on individual parts.

j. Remove only one tube at a time when testing. Check the number of the tube, test the tube and if it is not defective, return it to its proper socket before another tube is removed.

k. At each step, it is assumed that all previous steps were completed satisfactorily. Isolate and clear any trouble located before proceeding with any succeeding steps.

75. Audio Amplifier Test

The purpose of this test is to localize any trouble in the af stages to the particular stage or component. An audio test tone of about 750 cycles and a headset are used for the af tests.

a. Terminal 3 of V8 (Plate of Second Af Output). Apply the test signal to terminal 3 of V8. Listen for the signal in the headset which is connected to the headphone jack. The volume will be very low. If no signal is heard, inspect the leads to transformer T5 and the headset connections.

b. Terminal 5 of V8 (Grid of Second Af Output). Place the test signal on terminal 5 of V8. Listen for an increased output in the headset. If no signal is heard, check resistor R21 and capacitor C33. Also check the plate supply voltage for V8.

c. Terminal 8 of V7 (Plate of First Af Output). Introduce the test signal at terminal 8 of V7 and listen for signal in the headset. If there is no signal, check L3 and C32 for an open circuit.

d. Terminal 4 of V7 (Grid of First Af Stage). Place the test signal at terminal 4 of V7. The output signal should be much louder than when it was applied to the plate terminal. If there is no signal or the signal is weak, test V7 and check the voltages at the socket terminals. Check the wiring and soldered connections.

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76. If. Tests

The if. tests check the operation of the if. stages and if any trouble does exist, the tests show the particular stage in which the trouble is occurring. An rf test signal of 115 kc, 30 percent modulated at 400 to 1,000 cycles, is applied through a series capacitor, where indicated.

a. Terminal 8 of V6 (Plate of Second If.). Apply the test signal to terminal 8 of V6 through the series capacitor. A signal should be heard in the headset. If no signal output is obtained, check T4, C25, C26, and R17 for opens or short circuits.

b. Terminal 4 of V6 (Grid of Second If.). Apply the same test if. signal through the series capacitor to terminal 4 of V6. The output signal should increase in volume. Test the tube and tube socket voltages and resistances.

c. Beat-Frequency Oscillator V5. With the test signal applied to terminal 4 of V6 and the MASTER swith to C.W., listen for the breat-frequency tone in the headset. Rotate the C.W. TONE control and listen for a change in the pitch of the beat note. If no tone is heard, check L2, C21, C22, C23, R14 and the voltages to V5.

d. Terminal 8 of V4 (Plate of First If.). Apply the same test signal through the series capacitor to terminal 8 of V4. If no signal is heard in the headset, check T3, C17, C18, and R10 for opens or short circuits.

e. Terminal 4 of V4 (Grid of First If.). Apply the test signal through the series capacitor to terminal 4 of V4. The output signal should increase in volume. If no output is obtained, test the tube and tube socket voltages and resistances.

f. Terminal 3 of V3 (Converter). Apply the test signal through a series capacitor to terminal 3 of mixer V3. A signal should be heard in the headset. If it is impossible to hear the signal, check V3, and make voltage and resistance measurements at the socket of V3.

77. Rf Tests

This test shows whether or not there is any trouble in the rf stage. An rf signal of 280 to 520 kc, 30 percent modulated at 400 to 1,000 kc, is used with a series capacitor.

a. Terminal 8 of V3 (Converter). Apply the test signal through a series capacitor to terminal 8 of V3. With the receiver tuned to the frequency of the test signal, the tone should be heard in the headset. If no tone is heard, check the tube and the tube socket voltages and resistances and associated elements. Also check L1 for open circuits or shorts, and the applied voltage.

b. Terminal 8 of V1 and V2 (Plates of Rf Amplifier). Apply the test signal through the series capacitor to terminal 8 of V1 and V2 in turn. If no signal is heard, check T1 and capacitors C4C, C6, and C5.

c. Terminal 4 of V1 and V2 (Grids of Rf Amplifier). Apply the test signal through the series capacitor to terminal 4 of V1 and V2 in turn. If no signal is heard in the headphones, check V1, V2, and the voltages and resistances at the socket terminals.

78. Stage Gain Charts

The stage gain charts given in this paragraph list the minimum and maximum input required at each of the rf and if. stages of the receiver to produce a signal output of 5 volts, at the secondary of T5, across an output load of 4,000 ohms. Use these charts as standards when troubleshooting to check the overall gain of the receiver and the gain of each rf or if. stage or group of stages. When the receiver output is low and the tubes are working satisfactorily, as indicated by a tube checker, localize the defective stage by checking signal-voltage level of each stage against the chart. To do this, use either the signal substitution or signal tracing method of troubleshooting. With the VOLUME control in extreme clockwise position, and the MASTER switch in ON position, make the following checks for the readings indicated in the charts below.

a. Radio Receiver, Rf Stages.

Signal generator frequency (kc)	Signal generator output connection: E2 (ground E6) or E6 (ground E2) — Signal generator output (microvolts)		Electric voltmeter reading (volts)
	Min.	Max.	
300	8	12	5
500	12	16	5

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b. Radio Receiver, If. Stages.

Signal generator frequency (kc)	Signal generator output connection	Signal generator output (microvolts)		Electronic voltmeter reading (volts)
		Min.	Max.	
115	V3, pin 8	70	150	5
115	V4, pin 4	4, 000	7, 500	5
115	V6, pin 4	85, 000		5
			100, 000	4

c. Radio Receiver, Audio Stages.

Audio oscillator frequency (cps)	Audio oscillator connection V7, pin 4 Audio oscillator output (volts)		Electronic voltmeter reading (volts)
	Min.	Max.	
200	0. 05	0. 1	5
600	. 05	. 1	5
1,000	. 1	. 15	5
1,500	. 1	. 18	5
2,000	. 15	. 2	5

Section II. REPAIRS

79. Replacement of Parts

Most of the parts in the radio receiver are readily accessible and are easily replaced if found to be faulty. If any of the switch wafers requires replacement, mark the wires connected to the switch carefully with tags or other devices to avoid misconnection when the new switch is installed. Follow this practice whenever replacement requires the disconnection of numerous wires. Specific instructions for the removal of certain parts of the direction finder set are given in *a* through *f* below.

a. Loop.

(1) Remove the four loop fastening bolts, below the flange at the upper end of the shaft assembly.

(2) Carefully raise the loop, unsolder the three color-coded loop wires from the circular Lucite terminal strip at the upper end of inner shaft and remove the loop. Be careful not to damage the gasket.

Caution: Careful unsoldering and resoldering of the loop wires is necessary because excessive heat may loosen the terminals in the Lucite terminal strip.

(3) With the replacement loop positioned above the shaft, solder the loop wires to the terminals on the Lucite terminal strip, carefully observing the color coding.

Note. The three terminals on the Lucite terminal strip are identified by a red, white, and black dot which corresponds to the color coding of the loop wires. If the loop wires are improperly connected, the sense will be reversed and the calibration changed.

(4) Secure the loop to the shaft assembly with bolts previously removed; be careful not to pinch the loop wires. The serial numbers on the loop and shaft flange must be in alinement.

b. Dynamotor Power Supply.

(1) *Serial numbers 1 through 74.*

(*a*) Remove the 10 rear cover fastening screws on the radio receiver cabinet and the rear cover.

(*b*) Remove the external connections from terminal strip E101 (fig. 8).

(*c*) Remove the four dynamotor power supply fastening screws (right side of the cabinet viewed from the rear) and remove the power supply.

(*d*) Remove the power supply cover fastening screws and the cover for access to the dynamotor and filter (fig. 33).

(*e*) Replace the power supply with the type furnished with serial numbers 75 through 137 according to (2) below.

Note. The two types of dynamotor power supplies furnished mount interchangeably and are interchangeable electrically. The interlock relay and the terminal strip are not included as part of the replacement units, but are transferred from the original unit to the replacing unit.

(*f*) Reconnect the external connections according to figure 11.

(*g*) Replace the rear cover on the radio receiver cabinet.

(2) *Serial numbers 75 through 137.*

(*a*) Remove the 10 rear cover fastening screws on the radio receiver cabinet and the rear cover.

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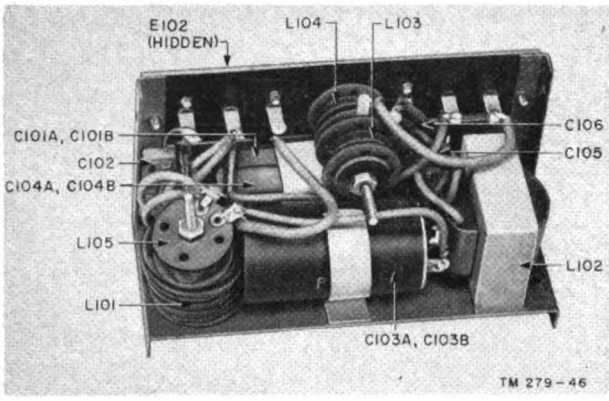

Figure 32. Dynamotor power supply, bottom view of filter, serial numbers 1 to 74 inclusive.

(*b*) Remove the external connections from terminal strip E201 (fig. 8).

(*c*) Remove the four dynamotor power supply fastening screws (right side of cabinet viewed from the rear) and remove the power supply.

(*d*) Remove the four support bracket mounting screws and the brackets for access to the filter.

Note. In view of the interconnections between E201 and the filter and dynamotor, handle the bracket on which E201 is mounted carefully (fig. 35).

(*e*) Remove the four filter cover fastening screws and the cover for access to the filter components.

(*f*) Transfer the interlock relay and terminal strip, with its cable form and plug, to the replacing power supply and make connections to the interlock relay and terminal strip according to figure 43.

(*g*) Mount the power supply and reconnect the external connections according to figure 36.

(*h*) Replace the rear cover on the radio receiver cabinet.

c. Gyro Repeater Motor.

(1) Remove the 10 rear cover fastening screws on the radio receiver cabinet and the cover.

(2) Open the compass reset knob cover (fig. 4) and remove the four wires from the gyro repeater motor terminal strip. Tag each wire.

(3) Remove the four gyro repeater motor bracket fastening nuts and the motor with its bracket.

(4) Remove the four gyro repeater motor mounting screws and remove the motor from the bracket.

(5) Position the replacement motor on the bracket with the worm gear and idler gear in mesh (fig. 38) and secure the motor to the bracket.

(6) Mount the gyro repeater motor and bracket on the studs and secure with the fastening nuts.

Note. The adjustable spring tension bracket (fig. 38) should be adjusted, as the gyro repeater motor is mounted, so that the compass card drive gear meshes correctly with the compass card driven gear (fig. 39).

(7) Loosen the bracket adjusting lock nut and turn the adjusting screw so that the compass card drive gear and the compass card driven gear are in mesh with slight backlash. Check by rotating the compass card reset knob and tighten the lock nut.

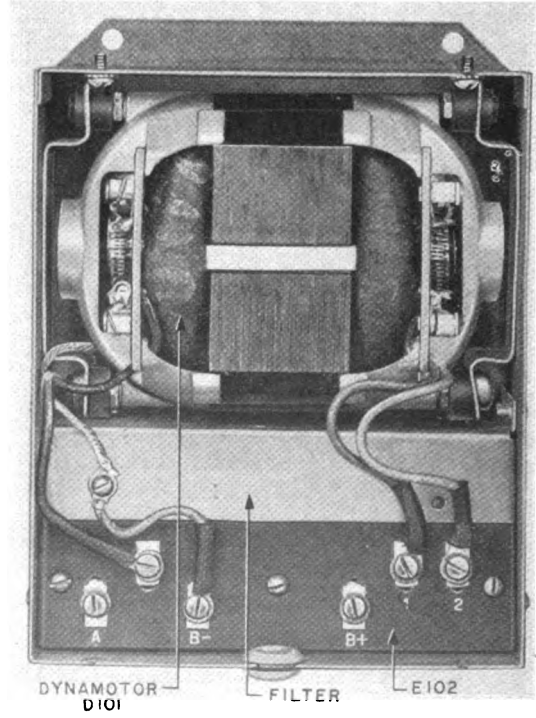

Figure 33. Dynamotor power supply, cover off, serial numbers 1 to 74 inclusive.

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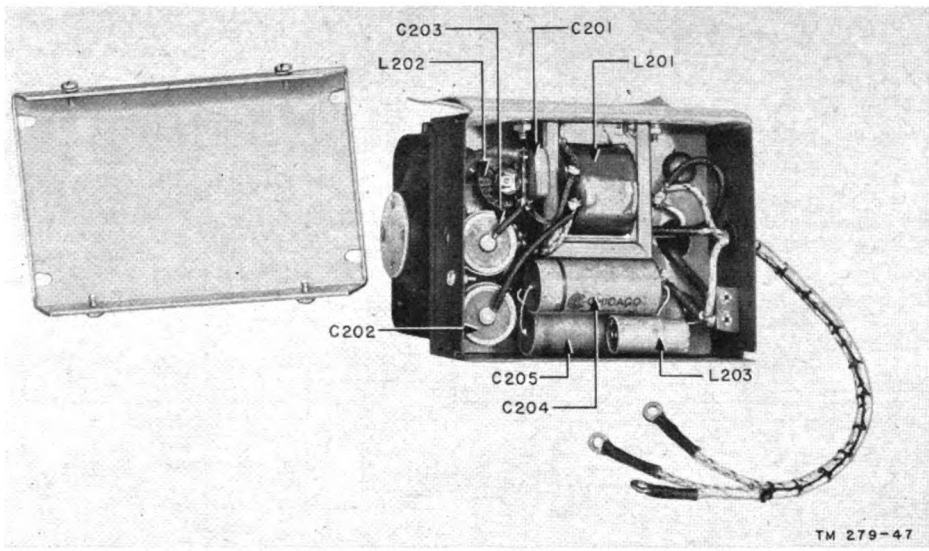

Figure 34. Dynamotor power supply, bottom view, cover removed, serial numbers 75 to 137 inclusive.

(8) Reconnect the four wires to the gyro repeater motor terminal strip and replace the rear cover on the radio receiver cabinet.

(9) Synchronize the movable compass card with the main gyrocompass according to paragraph 29.

d. Compass Bowl Pointer Assembly.

(1) Remove the 10 lower front cover fastening screws on the radio receiver cabinet (fig. 3) and the lower front cover.

(2) Remove the small sense pointer fastening screw (fig. 15) and the sense pointer.

(3) Remove the compensated pointer return spring.

(4) Remove the red and white compensated pointer.

(5) Remove the constant pointer fastening screw (visible when the compensated pointer is removed) and the constant pointer.

(6) Reassemble in reverse order.

e. Compass Bowl (Includes Pointer Assembly and Mechanical Compensator).

(1) Remove the 10 lower front cover fastening screws on the radio receiver cabinet (fig. 3) and the front cover.

(2) Remove the gyro repeater motor according to *c* above.

(3) Remove the four compass bowl bracket fastening screws from the rear of the cabinet.

(4) Move the compass bowl assembly carefully to disengage the two gears, tilt so that the two pilot lamp sockets may be removed from the bracket, and remove the compass bowl assembly from the cabinet.

(5) Reinstall the compass bowl assembly in reverse order and reinstall the gyro repeater motor according to *d* above.

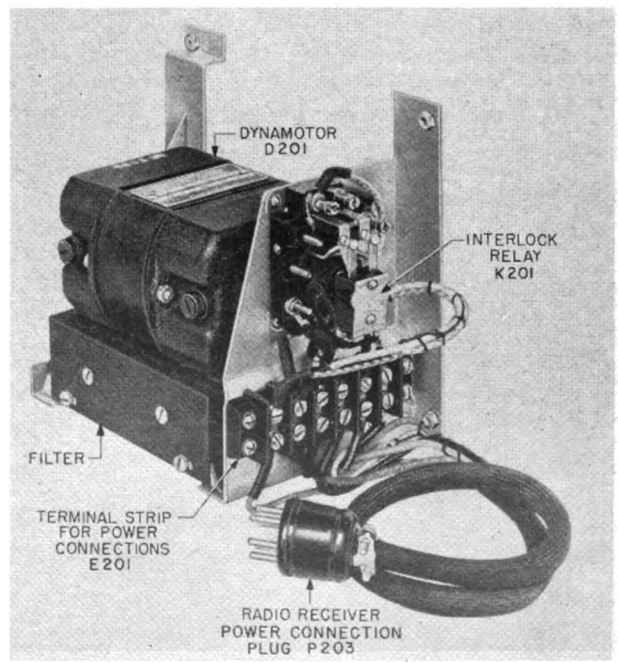

Figure 35. Dynamotor power supply, front view, serial numbers 75 to 137 inclusive.

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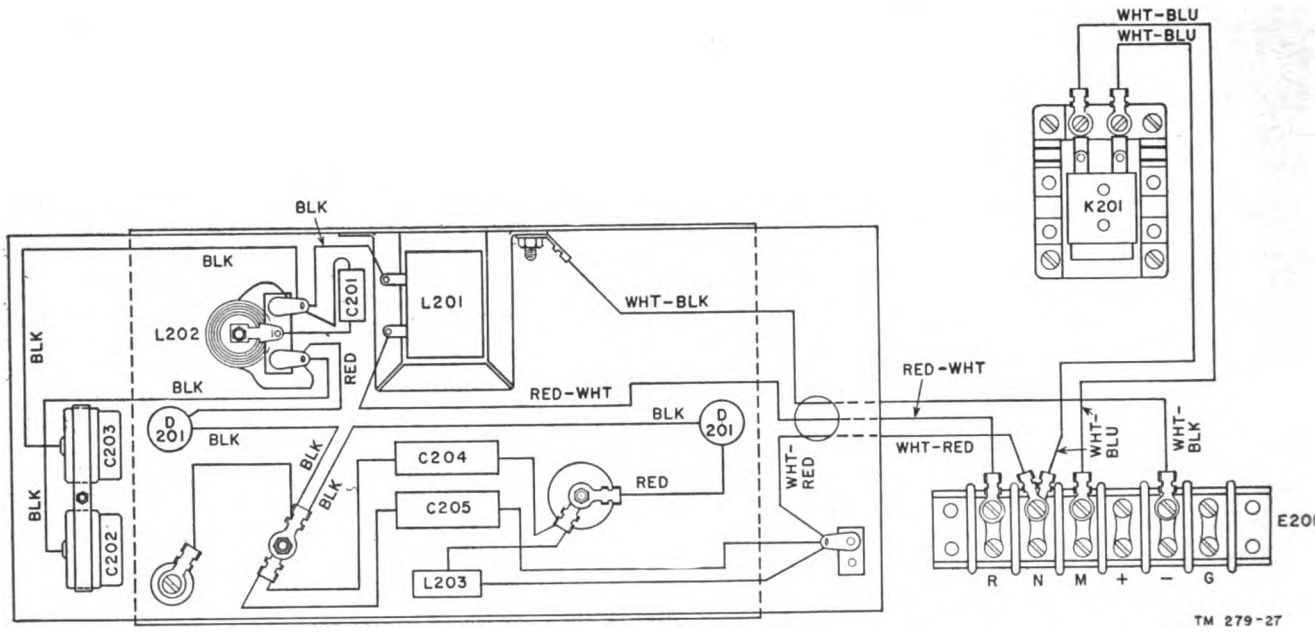

Figure 36. Dynamotor power supply, serial numbers 75 to 137, inclusive, wiring diagram.

f. Mechanical Compensator Assembly (fig. 15).

(1) Remove the compass bowl assembly according to *e* above.

(2) Set the constant pointer so that one of the mechanical compensator adjusting screws is visible through the hole in the pointer and hold this position.

(3) Starting nine adjusting screws either side of this position and progressing toward the center screw from alternate sides, turn each of the 19 screws two-fifths of a turn clockwise.

(4) Repeat the above procedure as many times as necessary, starting one screw nearer the center each time, until the distortable brass band is tight against the annular ring (in which the adjustable screws are held) at the point directly beneath the constant pointer.

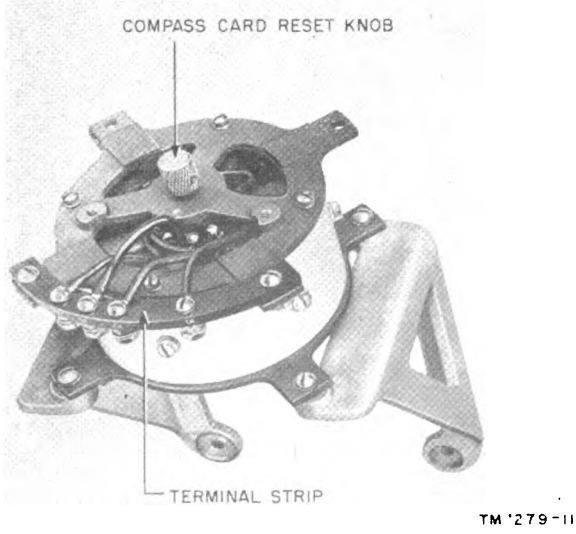

Figure 37. Gyro repeater motor, front view.

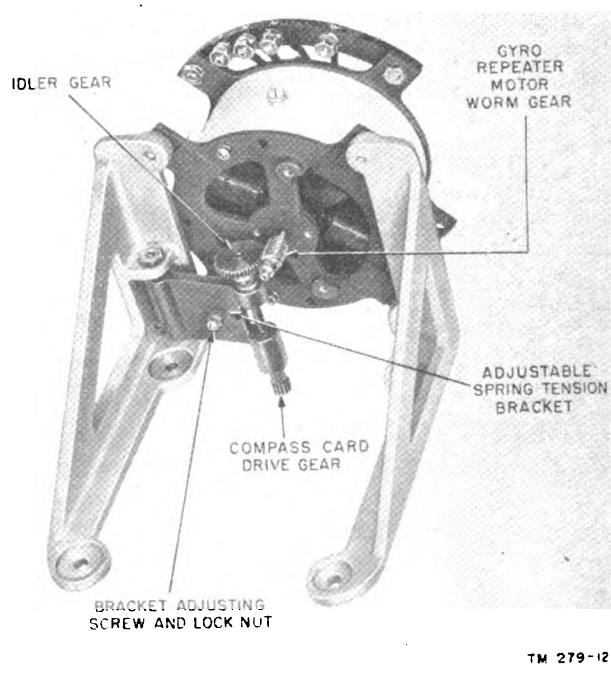

Figure 38. Gyro repeater motor, rear view.

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Note. This procedure is necessary to provide clearance for the removal of the compensator linkage assembly. Be careful not to damage the parts.

(5) Remove the compensator return spring and disengage the compensator lever from the compensated pointer.

(6) Remove the pointer assembly according to *d* above.

(7) Loosen the constant pointer adjusting nuts and remove the compensator linkage assembly.

(8) Remove the two pointer drive gear setscrews and the pointer drive gear.

(9) Unscrew the cylindrical nut at the end of the shaft from which the pointer drive gear was removed.

(10) Loosen the three set screws on the bracket adjacent to the cylindrical nut.

(11) Withdraw the mechanical compensator housing and shaft.

Note. Be sure not to change the position of the two ball bearings inside the bracket. The ball bearing retained by the three setscrews determines the position of the movable compass card, which should be flush with the fixed azimuth ring.

(12) Remove the three ball bearing retaining screws near the center of the compensator housing.

(13) Withdraw the compensator shaft from the compensator housing, tapping the end of the shaft with a rawhide hammer, if necessary, to free the ball bearing.

(14) Replace parts as necessary and assemble in reverse order, subject to the following.

(15) Initially the cylindrical nut should be fingertight and the three setscrews in the bracket should be loose.

(16) Set the constant pointer on the 0 lubber's line and rotate the compensator housing so that one of the mechanical compensator adjusting screws is centered in the hole in this pointer.

(17) Tighten the cylindrical nut securely and check the position of the movable compass card with respect to the fixed azimuth ring.

(18) Tighten the three setscrews.

(19) Before mounting the assembly in the radio receiver cabinet, make sure that the movable compass card and the pointer assembly rotate smoothly.

(20) Before meshing the pointer driven gear and the pointer drive gear (fig. 8), turn the loop so that it is exactly at right angles to the plane of the front of the cabinet. The constant pointer should be on the 0 lubber's line and the movable compass card 0 in alinement with the 0 lubber's line.

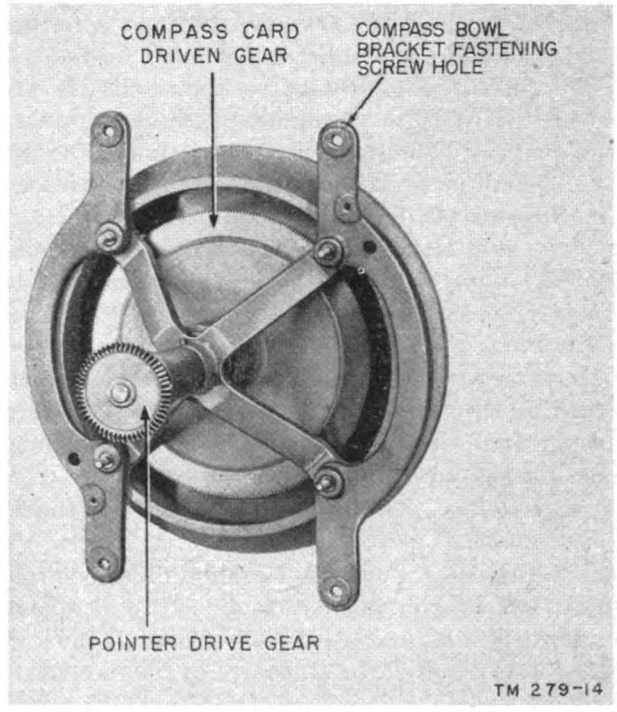

Figure 39. Compass bowl and mechanical compensator, rear view.

(21) Calibrate the instrument according to paragraph 27 and adjust the mechanical compensator according to paragraph 28.

80. Refinishing

Instructions for refinishing badly marred panels on exterior cabinets are given in TM 9-2851. When refinishing panels on a cabinet, make sure that all equipment tags, moisture and fungiproofing information, etc., are replaced.

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Section III. ALINEMENT PROCEDURES

81. Test Instruments Used for Alinement and Adjustment

a. Signal Generator. The signal generator should be an accurately calibrated instrument (such as RF Signal Generator AN/URM–25) producing rf signals with 30 percent modulation at 400 to 1,000 cps. In addition to 115 kc (the if. of the receiver), it should be capable of covering a range of from 280 to 520 kc, the tuning range of the receiver. The signal generator should have an output of at least 100,000 microvolts and an output impedance of approximately 100 ohms for best results when the rf and hf oscillator circuits are being alined. For if. alinement, these values are not critical. The frequency calibration of the signal generator is extremely important, because accurate receiver dial calibration depends on it.

b. Audio Oscillator. An accurate audio oscillator, having a range of not less than from 200 to 2,000 cps, such as Audio Oscillator TS–382A/U, is required.

c. Electronic Voltmeter. An accurate meter, such as Electronic Multimeter TS–505/U with a range of at least 10 volts is required for the alinement procedure.

d. Headset. The headset furnished with the set is adequate.

e. Alinement Tool. A suitable alinement tool (TL–207 or equivalent), such as an insulated screwdriver $\frac{3}{64}$-inch wide and .025-inch thick at the bit, is required for alinement of the receiver.

82. If. Alinement Procedure

a. Turn the MASTER switch to ON and let the receiver warm up for about 10 minutes before beginning adjustment.

b. Connect the electronic voltmeter across J2, and in parallel with a 4,000-ohm, 1-watt resistor.

c. To keep signals in the rf stage from interfering with the alinement procedure, ground pin 5 of V3.

d. Set the signal generator on exactly 115 kc (30 percent modulation at 400 to 1,000 cps) and connect one output lead to pin 8 of V3, and the other lead to the chassis.

e. Set the VOLUME control about three-quarters of the way clockwise and adjust the signal generator output until the voltmeter reads about 5 volts.

f. Adjust the tuning slugs on if. transformers T2, T3, and T4 until a peak reading is obtained on the voltmeter, and record the reading.

Caution: Carefully secure the slugs with the lock nut. They should not turn as the lock nut is tightened. If the slug turns as the lock nut is tightened, the circuit will no longer be at resonance as indicated by a decreased reading of the voltmeter.

g. Remove the ground from V3, terminal 5.

83. High-frequency Oscillator Alinement

a. Set the receiver tuning dial to 300 kc.

b. Set the signal generator on 300 kc (30 percent modulation at 400 to 1,000 cps), connect one output lead to pin 4 of V1, and the other lead to the chassis.

c. Adjust the signal generator output until the electronic voltmeter across the output (*b above*) reads about 5 volts with the VOLUME control set approximately three-quarters of the way clockwise.

d. With an insulated adjusting tool, adjust C9 (through the opening in the top of L1) until maximum output is obtained on the voltmeter.

e. Set the signal generator on 500 kc (same modulation) and the receiver tuning dial on 500 kc.

f. Adjust C8 until the maximum reading is obtained on the voltmeter.

g. With the same setting of the signal generator and receiver tuning dial, adjust C6 until maximum output is obtained on the voltmeter.

h. Repeat the procedures outlined in *c* through *g* above at 300 and 500 kc until maximum voltmeter readings are obtained at both frequencies.

Section IV. FINAL TESTING

84. General

This section is intended as a guide to be used in determining the quality of a repaired radio receiver. The minimum test requirements outlined in paragraphs 86 through 95, may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

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85. Test Equipment Required for Final Testing

The instruments needed for testing the repaired receiver are listed in *a* through *f* below.

a. Signal generator with metered output that covers a range of frequencies from 115 to 520 kc and capable of delivering a signal modulated 30 percent at 400 to 1,000 cps (Rf Signal Generator AN/URM–25).

b. Audio oscillator capable of covering a range of frequencies from 200 to 2,000 cps (Audio Oscillator TS–382A/U).

c. Electronic voltmeter with a range of not less than 10 volts (Electric Multimeter TS–505/U).

d. Spare radio receiver, used in the operational test, should be in good condition and should meet the minimum requirements given in paragraphs 86 through 95.

e. The headset furnished with the set.

f. A short lead with alligator clip attached to each end.

86. Beat-Frequency Oscillator Test

This test determines whether or not the beat-frequency oscillator is operating and whether or not the audio filter is in working order.

a. Connect the rf signal generator to E2 and the chassis.

b. Set the signal generator output frequency and the receiver tuning dial to 300 kc.

c. Set the C. W. TONE knob with the indicator up and down.

d. Set the MASTER switch on C.W.

e. Adjust the C.W. TONE knob and the tuning slug in L2 until a beat note is heard in the headset.

f. Turn the C.W. TONE knob clockwise. The frequency should increase.

g. Turn the C.W. TONE knob counterclockwise. The frequency should decrease.

h. Set the MASTER switch on SUP. and the C.W. TONE knob as in *e* above. The volume should be less than in *e* above.

87. Audio-Frequency Test

This test determines any signal loss in the detector or audio stages and gives an indication of the uniformity of amplification from 200 to 2,000 cps. The condition of the vacuum tubes, the detector plate filter capacitor and load resistor, the detector cathode resistor, and the audio cathode resistor will affect the signal output.

a. Set MASTER switch to the ON position.

b. Ground pin 5 of V3.

c. Connect an electronic voltmeter across the secondary of the output transformer in parallel with a 4,000-ohm, 1-watt resistor.

d. Set the audio oscillator on 200 cps, connect one output lead to pin 4 or V7, and the other to the chassis.

e. Adjust the audio oscillator output to give a reading of 5 volts on the electronic voltmeter and record the oscillator output level.

f. Keeping the output level from the audio oscillator constant, repeat the step outlined in *e* above at frequencies of 600, 1,000, 1,500, and 2,000 cps.

g. The output reading of the electronic voltmeter should not vary appreciably as the audio oscillator output frequency is varied from 600 to 2,000 cps.

88. First If. Sensitivity Test

This test gives an indication of the overall performance of the first and second if. stages. VOLUME control setting is not important.

a. Ground pin 5 of V3.

b. Set the rf signal generator on 115 kc (30 percent modulated signal at 400 to 1,000 cps), connect one output lead to pin 4 of V4, and the other to the chassis.

c. Adjust the generator output until the electronic voltmeter, across the output reads 5 volts, across a 4,000-ohm load, and record the signal generator output reading.

d. If the signal generator output reading is between 4,000 and 7,500 microvolts, the first and second if. sensitivity test is satisfactory. If the reading exceeds 7,500 microvolts, the test in the following paragraph should be made to determine which stage is faulty.

89. Second If. Amplifier Sensitivity Test

a. Ground pin 5 of V3.

b. Set the signal generator on 115 kc (30 percent modulation at 400 to 1,000 cps), connect one output lead to pin 4 of V6, and the other to the chassis.

c. Adjust the generator output until the reading on the voltmeter (connected across the output in parallel with a 4,000-ohm resistor) is 4 volts and record the signal generator output reading. If a signal generator output of 100,000 microvolts gives a reading of more than 4 volts on the vacuum-tube voltmeter, the second if. stage is satisfactory. If the reading is less than 4 volts, the fault may

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be caused by the vacuum tubes, an improperly tuned or defective if. transformer.

90. Oscillator and First If. Transformer Sensitivity Test

This test determines the amplification of V3 and V4 stages and the signal plus noise to noise power ratio. It is determined by measuring the output of the receiver when receiving a signal, and by comparing the output with modulation to the output without modulation. This ratio must be 100 to 1 as shown by the voltmeter reading of 5 volts, with the signal generator modulation on, and .5 volt with the signal generator modulation off.

a. Set the signal generator on 115 kc (30 percent modulated signal at 400 to 1,000 cps).

b. Ground pin 5 of V3.

c. Connect one signal generator output lead to pin 8 of V3, and the other to the chassis.

d. Set the VOLUME control initially in extreme clockwise position, then adjust the control and the signal generator output until the voltmeter reading, of the output, is 5 volts.

e. Turn off the modulation on the signal generator and adjust the VOLUME control until the electronic voltmeter reading is .5 volt.

f. Turn on the modulation of the signal generator and adjust the generator output until a 5-volt reading is obtained on the voltmeter.

g. Repeat the steps in *d*, *e*, and *f* above until the voltmeter reading is 5 volts with modulation on and .5 volts with modulation off with the same VOLUME control setting. If it is necessary to raise the generator output above 150 microvolts to obtain a 5-volt reading on the voltmeter, a defective 6SA7 converter tube, an improperly tuned T2, or a defective T2 is indicated.

91. Rf Sensitivity Test

This test determines the sensitivity of each half of the push-pull rf circuit and is important to secure good nulls when taking bearings.

a. Set the signal generator and the tuning dial on the receiver on 300 kc with the signal generator 30 percent modulated at 400 to 1,000 cps.

b. Apply one signal generator output lead to pin 4 of V1, and connect the other to the chassis.

c. Ground pin 4 of V2.

d. Set the VOLUME control initially in extreme clockwise position. Then adjust the control and the signal generator output until a 5-volt reading is obtained across the output with modulation, and .5 volt with no modulation (same setting of the VOLUME control).

e. Record the signal generator output necessary to give a 5-volt reading on the electronic voltmeter.

f. Set the signal generator and tuning dial on 500 kc (same modulation) and repeat the procedure in *d* and *e* above.

g. Transfer the ground from pin 4 of V2 to pin 4 of V1 and the signal generator connection from pin 4 of V1 to pin 4 of V2. Repeat the procedures outlined in *d* and *e* above.

h. To obtain a 5-volt reading on the voltmeter, the generator output should be 10 ±2 microvolts at 300 kc and about 14 ±2 microvolts at 500 kc for each input. If a higher signal generator output is required, V1 and V2 or R2 and R3 may not be matched or there may be excessive internal noise.

92. Direction Finder Set Sensitivity

The sensitivity of the direction finder set is determined by applying the signal generator output to a single turn of wire 2 feet from the loop, and by reading the signal generator output required to obtain a 5-volt receiver output. If the generator output exceeds 8 microvolts, a defective transmission line or loop is indicated and the test described in *a* through *g* below should be made.

a. Select a suitable area that will be free of all electrical noise. A totally shielded area is preferable.

b. Mount the loop and shaft assembly vertically so that the radio receiver may be connected to it in the regular way—that is, with the receiver brushes in proper contact with the collector rings at the lower end of the loop shaft.

c. Locate a single turn of wire, approximately 16 inches in diameter, 2 feet from, in line with (edge to edge), and parallel to the loop, and connect it to the signal generator output.

d. With the receiver connected to the loop, turn the MASTER switch ON and set the tuning dial in the receiver on 300 kc.

e. Turn on the signal generator (set on 300 kc, 30 percent modulation) and adjust C3 in the receiver for maximum reading of the voltmeter connected across the output. Adjust the VOLUME control and the generator output as required to obtain a suitable reading.

f. Turn off the signal generator and adjust the VOLUME control so that the voltmeter reading is .5 volt (noise level). Maintain this setting.

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g. Turn on the signal generator modulation (same setting) and adjust its output until the voltmeter reads 5 volts. The generator output should not exceed 8 microvolts. If the equipment fails to pass this test, follow the procedure in paragraph 93 to determine if the fault is in the loop or receiver.

93. Loop and Radio Receiver Sensitivity

The sensitivity of the loop alone and the radio receiver is determined in the same manner as in the previous paragraph, except that a capacitor, equivalent to the capacity of the transmission line, is connected across the receiver input. If the signal generator output exceeds 8 microvolts, a defective loop is indicated. If it is 8 microvolts or less, a defective transmission line is indicated.

a. Select a suitable area that will be free of all electrical noise. A totally shielded area is preferable. Remove the loop from the shaft and unsolder the transmission line (par. 79*d*).

b. Support the loop vertically close to the receiver and connect the black (or white) center tap wire to E4 and the other two wires to E2 and E6. Polarity is not important.

c. Connect a 30-micromicrofarad capacitor across E2 and E6.

d. Locate a single turn of wire, approximately 16 inches in diameter, 2 feet from, in line with, and parallel to the loop and connect it to the signal generator output.

e. Set the receiver MASTER switch to ON and the tuning dial to 300 kc.

f. Turn on the signal generator (set on 300 kc, 30 percent modulation). Adjust C3 in the receiver for maximum reading of the voltmeter connected across the output. Adjust the VOLUME control and the generator output as required to obtain a suitable reading.

Caution: When the radio receiver is reinstalled for normal operation, C3 must always be adjusted for maximum signal, as heard in the headset.

g. Turn the signal generator off and adjust the VOLUME control so that the voltmeter reads .5 volt (noise level). Maintain this setting.

h. Turn on the signal generator (same setting) and adjust its output until the voltmeter, across the output, reads 5 volts. The output should not exceed 8 microvolts.

94. Direction Finder Set Selectivity

Note. The overall bandwidth of the receiver, including the if amplifier, is determined by applying the signal generator output to a single turn of wire 2 feet from the loop, increasing the generator output, and reading the detuning required to obtain a constant receiver output.

a. Select a suitable area that will be free of all electrical noise. A totally shielded area is preferable.

b. Mount the loop and shaft assembly vertically so that the radio receiver may be connected to it in the regular way—that is, with the receiver brushes in proper contact with the collector rings at the lower end of the loop shaft.

c. Locate a single turn of wire, approximately 16 inches in diameter, 2 feet from, in line with, and parallel to the loop and connect to the signal generator output.

d. With the receiver connected to the loop, turn the MASTER switch ON and set the tuning dial on 300 kc.

e. With the signal generator off, adjust the VOLUME control in the receiver so that the voltmeter reads .5 volt (noise level). Maintain this setting.

f. Turn on the signal generator (set on 300 kc, 30 percent modulation) and adjust the output until the voltmeter reads 5 volts. The generator output should not exceed 8 microvolts.

g. Increase the signal generator output two times or 6 decibels.

h. Detune the signal generator one side of resonance until the voltmeter again reads 5 volts and record the generator frequency reading. This reading and the reading obtained according to the following paragraph should not be less than 299 kc nor greater than 301 kc.

i. Detune the generator the other side of resonance until the voltmeter again reads 5 volts and record the generator frequency reading.

j. Increase the generator output 10 times or 20 decibels, repeat *h* and *i* above, and record both generator frequency readings. These readings should not be less than 298 kc nor greater than 302 kc.

k. Increase the generator output 100 times or 40 decibels, repeat the procedures outlined in *h* and *i* above and record both generator frequency readings. These readings should not be less than 297 kc nor greater than 303 kc.

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l. Increase the generator output to 100,000 microvolts, repeat the procedures outlined in *h* and *i* above and record both generator frequency readings. These readings should not be less than 295.5 kc nor greater than 304.5 kc.

m. Determine the mean of all generator frequency readings. Subtract the mean reading from the maximum and the minimum reading from the mean to give the bandwidth in kc. The bandwidth should not be greater than ±4.5 kc,

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CHAPTER 7

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

95. Disassembly

a. To disassemble, reverse the installation instructions in paragraphs 17 through 25.

b. The storage battery should be handled carefully so that the electrolyte is not spilled and the case is not damaged.

96. Repacking for Shipment or Limited Storage

a. The exact procedure in repacking for shipment or limited storage depends on the material available and the conditions under which the equipment is to be shipped or stored. For repacking, reverse the instructions given in paragraph 16.

b. Whenever practicable, place a dehydrating agent such as silica gel inside the packing boxes. Protect the boxes with a waterproof paper barrier and seal the seams of the paper barrier with a waterproof sealing compound or tape. Pack the protected boxes in a padded wooden case, providing at least 3 inches of excelsior padding or some similar material between the paper barrier and the packing case.

c. In limited storage charge the storage battery periodically. A storage battery that is allowed to run down deteriorates rapidly and will become useless in a very short time.

d. For shipment, the battery is always packaged dry.

Section II. DEMOLITION OF MATERIEL TO PREVENT ENEMY USE

97. General

The demolition procedure outlined in paragraph 98 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished only on order from the commander.

98. Methods of Destruction

a. Smash. Smash the controls, tubes, coils, switches, capacitors, transformers, and headset; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

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

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

d. Bend. Bend the chassis, cabinet, and loop antenna.

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

f. Disposal. Throw all destroyed parts over the side of the vessel so that they will be scattered and not deposited in one spot.

g. Destroy. Destroy everything.

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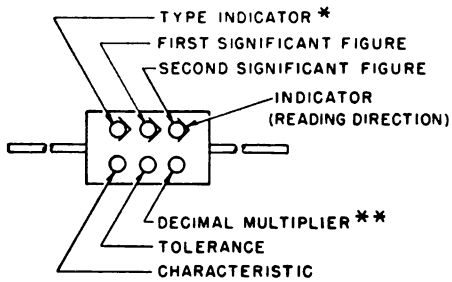
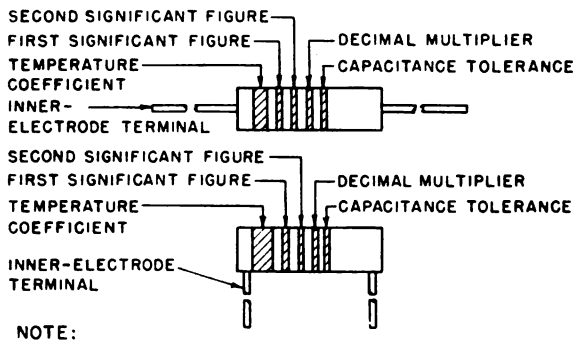
CAPACITOR COLOR CODE MARKING
(MIL-STD CAPACITORS)



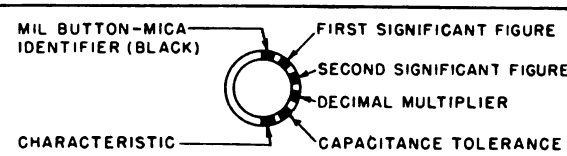
* BLACK DOT: MICA DIELECTRIC
SILVER DOT: PAPER DIELECTRIC
** INDICATES NUMBER OF ZEROS ON PAPER TYPE.

MICA (CM) AND PAPER (CN)

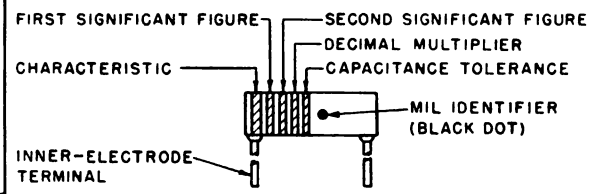


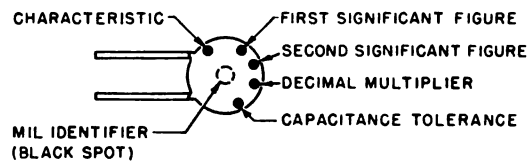
NOTE:
SPOTS MAY BE USED INSTEAD OF BANDS; TEMPERATURE COEFFICIENT MARKING IS LARGER.

CERAMIC-TEMPERATURE COMPENSATING (CC)



BUTTON-MICA (CB)





NOTES:
1. SPOTS MAY BE USED ON TUBULAR CAPACITORS; CHARACTERISTIC SPOT IS LARGER AND MIL IDENTIFIER IS ON SIDE DIAMETRICALLY OPPOSITE COLOR SPOTS.
2. MIL IDENTIFIER OF DISK TYPE IS ON REVERSE SIDE; CHARACTERISTIC SPOT IS LARGER OR SPACE BETWEEN CHARACTERISTIC AND TOLERANCE SPOTS IS THREE TIMES SPACE BETWEEN ADJACENT SPOTS.
3. TOLERANCE: YELLOW, +100%, -20%.

CERAMIC-GENERAL PURPOSE (CK)

CAPACITOR COLOR CODE

COLOR	SIG FIG.	MULTIPLIER		CHARACTERISTIC[1]				TOLERANCE [2]					TEMPERATURE COEFFICIENT (UUF/UF/°C)
		DECIMAL	NUMBER OF ZEROS	CM	CN	CB	CK	CM	CN	CB	CC		
											OVER 10UUF	10UUF OR LESS	CC
BLACK	0	1	NONE		A			20	20	20	20	2	ZERO
BROWN	1	10	1	B	E	B	W				1		-30
RED	2	100	2	C	H		X	2		2	2		-80
ORANGE	3	1,000	3	D	J	D			30				-150
YELLOW	4	10,000	4	E	P								-220
GREEN	5		5	F	R						5	0.5	-330
BLUE	6		6		S								-470
PURPLE (VIOLET)	7		7		T	W							-750
GRAY	8		8			X						0.25	+30
WHITE	9		9								10	1	-330(±500) [3]
GOLD		0.1						5		5			+100
SILVER		0.01						10	10	10			

1. LETTERS ARE IN TYPE DESIGNATIONS GIVEN IN MIL-C SPECIFICATIONS.
2. IN PERCENT, EXCEPT IN UUF FOR CC-TYPE CAPACITORS OF 10 UUF OR LESS.
3. INTENDED FOR USE IN CIRCUITS NOT REQUIRING COMPENSATION.

STD-CI

Figure 40. MIL-STD capacitor color codes.

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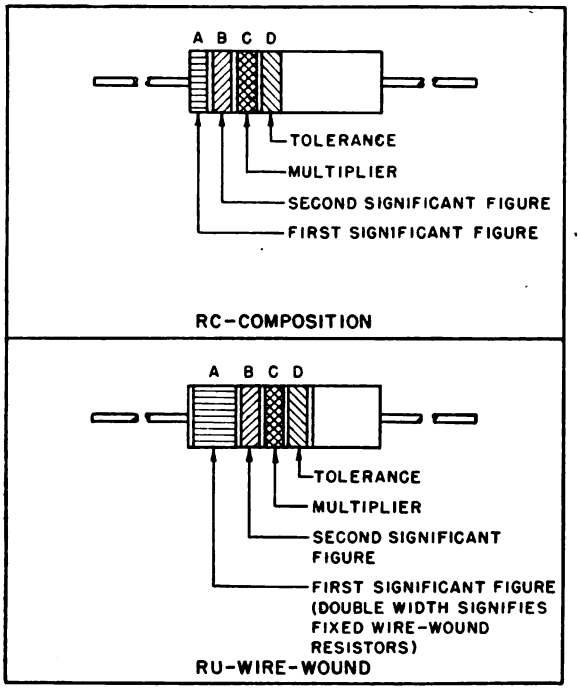
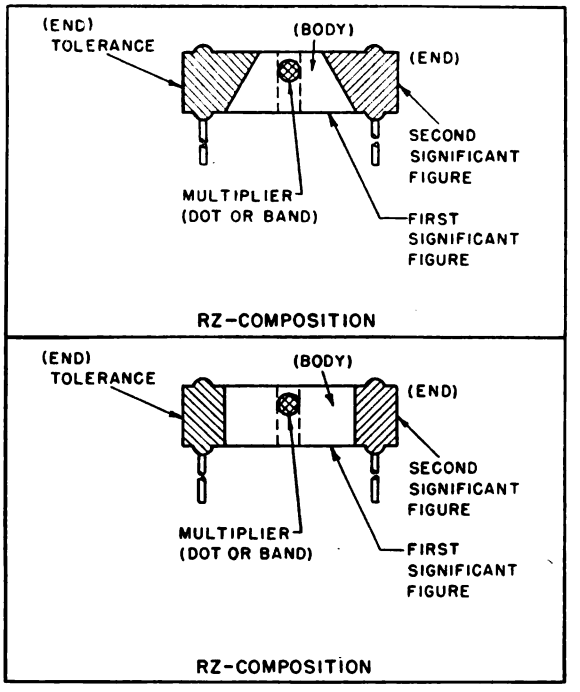
RESISTOR COLOR CODE MARKING
(MIL-STD RESISTORS)

AXIAL-LEAD RESISTORS (INSULATED)



RADIAL-LEAD RESISTORS (UNINSULATED)



RESISTOR COLOR CODE

BAND A OR BODY*		BAND B OR END*		BAND C OR DOT OR BAND*		BAND D OR END*	
COLOR	FIRST SIGNIFICANT FIGURE	COLOR	SECOND SIGNIFICANT FIGURE	COLOR	MULTIPLIER	COLOR	RESISTANCE TOLERANCE (PERCENT)
BLACK	0	BLACK	0	BLACK	1	BODY	± 20
BROWN	1	BROWN	1	BROWN	10	SILVER	± 10
RED	2	RED	2	RED	100	GOLD	± 5
ORANGE	3	ORANGE	3	ORANGE	1,000		
YELLOW	4	YELLOW	4	YELLOW	10,000		
GREEN	5	GREEN	5	GREEN	100,000		
BLUE	6	BLUE	6	BLUE	1,000,000		
PURPLE (VIOLET)	7	PURPLE (VIOLET)	7				
GRAY	8	GRAY	8	GOLD	0.1		
WHITE	9	WHITE	9	SILVER	0.01		

*FOR WIRE-WOUND-TYPE RESISTORS, BAND A SHALL BE DOUBLE-WIDTH. WHEN BODY COLOR IS THE SAME AS THE DOT (OR BAND) OR END COLOR, THE COLORS ARE DIFFERENTIATED BY SHADE, GLOSS, OR OTHER MEANS.

EXAMPLES (BAND MARKING):
10 OHMS ±20 PERCENT: BROWN BAND A; BLACK BAND B; BLACK BAND C; NO BAND D.
4.7 OHMS ±5 PERCENT: YELLOW BAND A; PURPLE BAND B; GOLD BAND C; GOLD BAND D.

EXAMPLES (BODY MARKING):
10 OHMS ±20 PERCENT: BROWN BODY; BLACK END; BLACK DOT OR BAND; BODY COLOR ON TOLERANCE END.
3,000 OHMS ±10 PERCENT: ORANGE BODY; BLACK END; RED DOT OR BAND; SILVER END.

STD-RI

Figure 41. MIL-STD resistor color codes.

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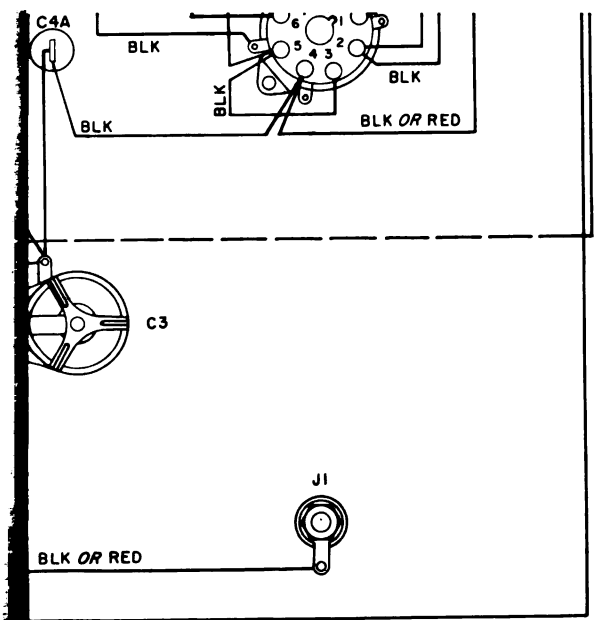

TM 279-50

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SigC Depots (20)
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SigC Lab (5)
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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–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: 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.

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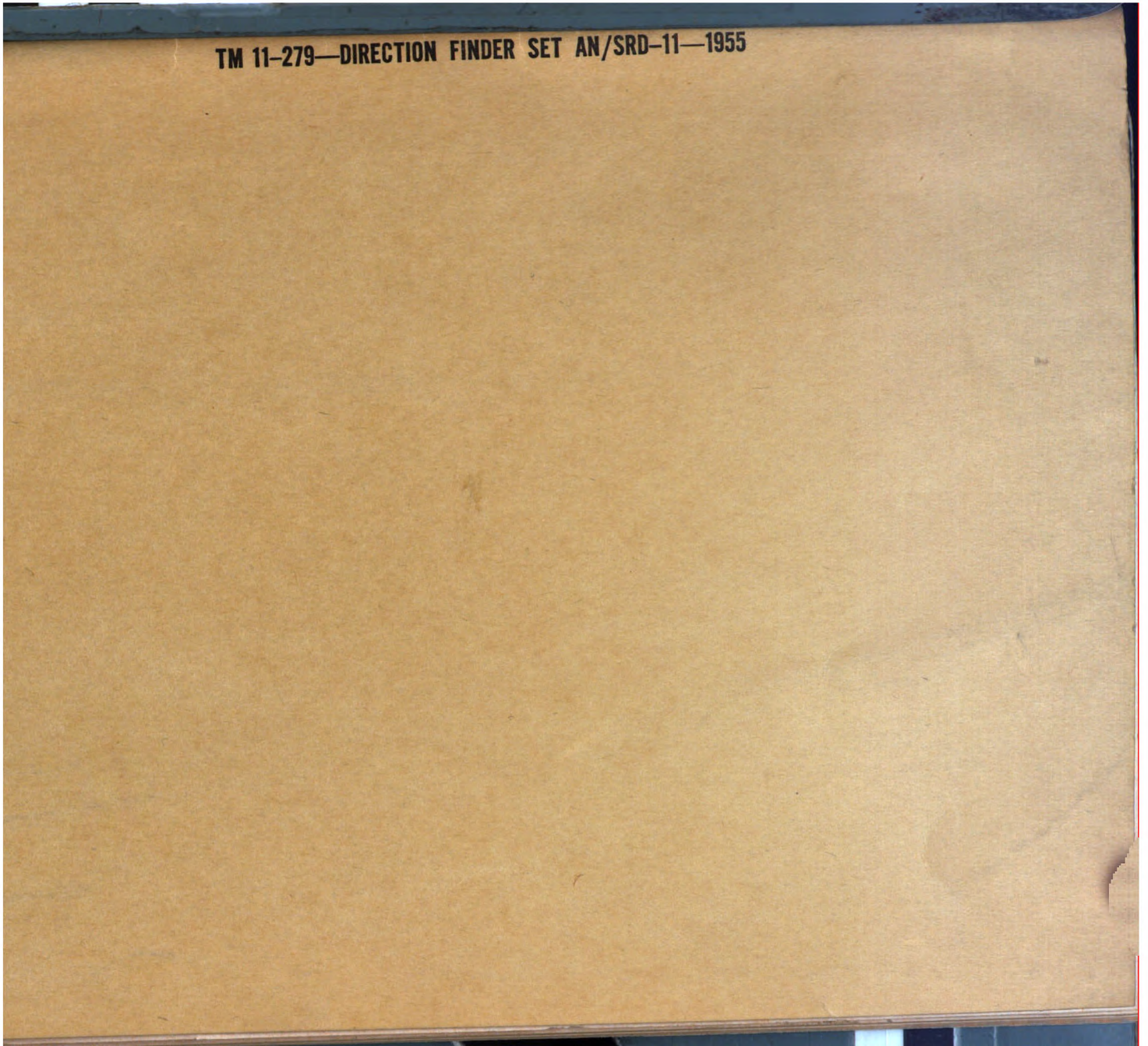

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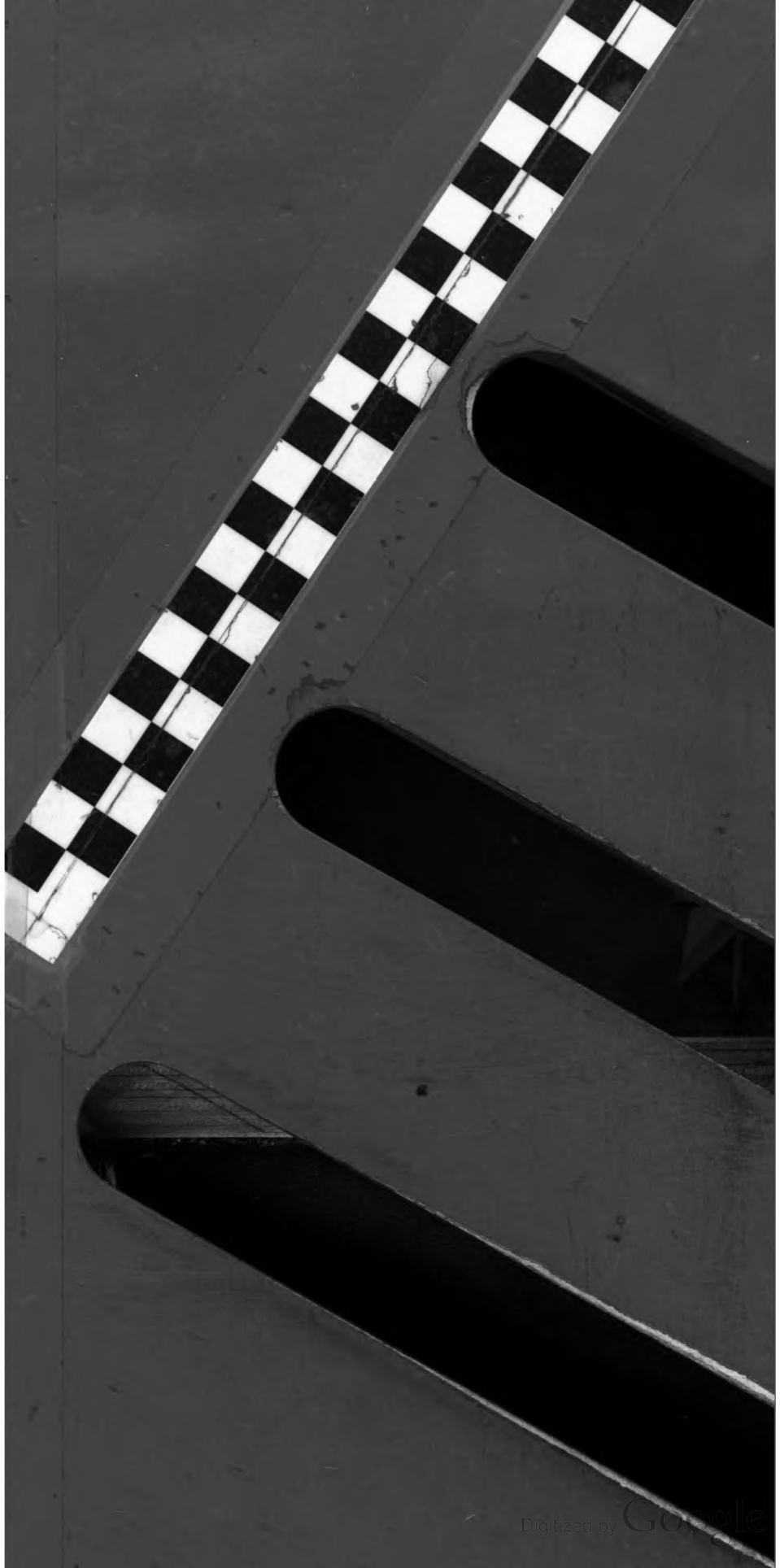
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