Superseded File

INSTRUCTION BOOK
FOR
ANTENNA AT-339/PRC
AND
ANTENNA AT-340/PRC

Cover, pg. 3

Phoenix Electronics Incorporated

PREPARED FOR

THE SIGNAL CORPS

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ANTENNA AT-339/PRC AND ANTENNA AT-340/PRC

TM1094-1

Figure 1. Antenna in use.

This instruction book will be replaced by TM 11-1094 which, when published will be listed in Department of the Army Pamphlet No. 310-4.

CHAPTER I

INTRODUCTION

Section I. GENERAL

1. Scope

a. This manual contains instructions for the installation, operation, maintenance, and repair of Antenna AT-339/PRC and Antenna AT-340/PRC (fig. 1).

b. Throughout this manual, references to *antenna, homing antenna,* or *loop antenna* indicate either Antenna AT-339/PRC or Antenna AT-340/PRC.

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

2. Forms and Records

a. Unsatisfactory Equipment Reports.

(1) 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.

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

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

c. Preventive Maintenance Forms.

(1) 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. 9).

(2) 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. 10).

Section II. DESCRIPTION AND DATA

3. Purpose and Use
(fig. 2)

a. Antenna AT-339/PRC when used with Radio Set AN/PRC-10 or Radio Set AN/PRC-6 comprises an effective homing device that permits the radio operator to find the direction of a transmitter tuned to the frequency of the radio set and to proceed in that direction. Antenna AT-340/PRC can similarly be used with Radio Set AN/PRC-8 or Radio Set AN/PRC-9. Highly accurate bearings generally are not required for homing; therefore, an azimuth scale is not provided. When desired, approximate azimuth readings can be obtained by sighting a pocket compass in the direction of the indicated bearing.

b. Handset Clip MX-1367/U provides a means to attach the handset of the radio set to the operator's helmet to free both hands. This enables the operator to manipulate the controls of the antenna with one hand while holding the antenna in his other hand.

c. Bag CW-258/PRC can be used to carry or store either Antenna AT-339/PRC or Antenna AT-340/PRC.

d. Antenna AT-339/PRC can be used in place of Antenna AT-249/GRD.

e. Antenna AT-339/PRC can also be used with all sets of the standardized series containing Receiver Transmitter RT-68/GRC, and AT-340/PRC can be used with all sets containing Receiver Transmitter RT-66/GRC and Receiver Transmitter RT-67/GRC.

4. Technical Characteristics

a. Antenna AT-339/PRC.

Frequency range .... Continuously tunable from 38 to 55.4 mc.

Type of antenna	Unshielded loop.
Provision for sensing	Built-in SENSE-NORMAL switch.
Output control	Five position pi-network type attenuator providing 0, 5, 15, 25 and 35 db attenuation.

b. Antenna AT-340/PRC.

Frequency range	Continuously tunable from 20 to 39 mc.
Type of antenna	Unshielded loop.
Provision for sensing	Built-in SENSE-NORMAL switch.
Output control	Five position pi-network type attenuator providing 0, 5, 15, 25 and 35 db attenuation.

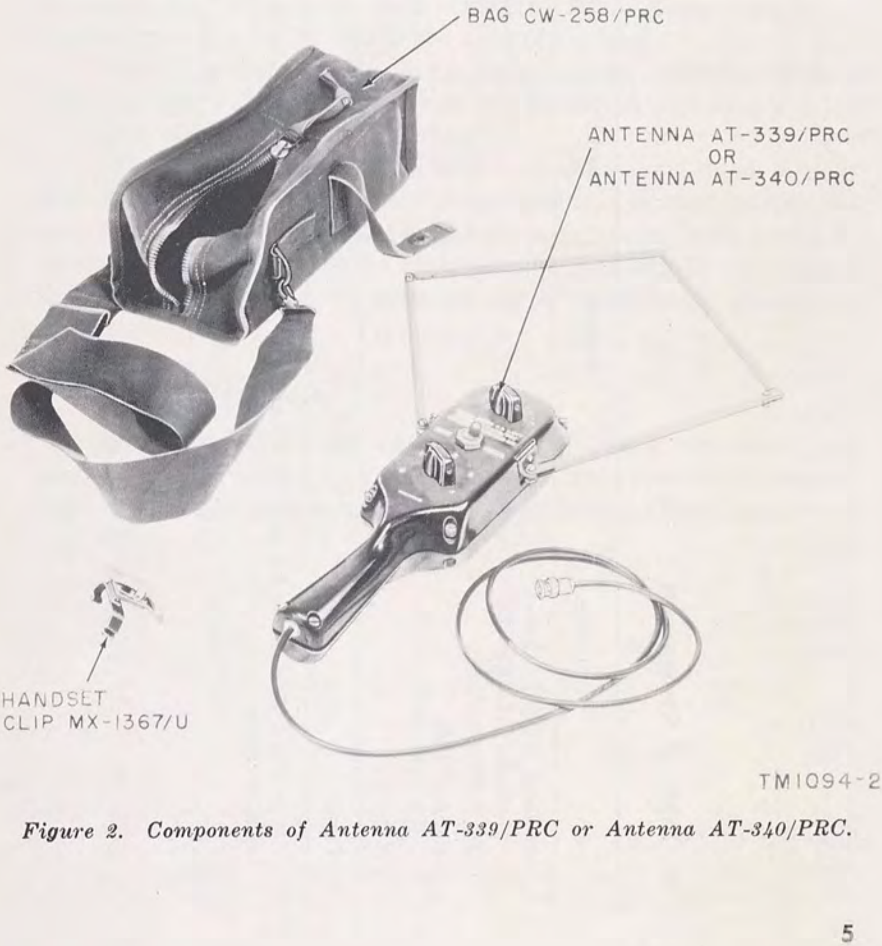

Figure 2. Components of Antenna AT-339/PRC or Antenna AT-340/PRC.

5. Table of Components

Components	Required No.	Width (in.)	Depth (in.)	Height (in.)	Volume (cu ft)	Unit weight (lb)
Antenna AT-339/PRC or Antenna AT-340/PRC (loop folded)	1	5	3¼	13	.14	2½
Bag CW-258/PRC	1	5½	4½	14	.19	1½
Handset Clip MX-1367/U	1	2	1⅝	2⅜	.00128	⅛
Manual	2	5⅞	⅛	9⅛	.004	¾
Total					.34	4⅞

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

6. Description of Antennas AT-339/PRC and AT-340/PRC

Antennas AT-339/PRC and AT-340/PRC are very similar (par. 4) with respect to component parts. They each consist of an unshielded loop, a tuning control, a SENSE-NORMAL switch, an attenuator control, a cable assembly, a case, a handset clip, and a bag (fig. 2).

a. Loop. The loop is a diamond-shaped frame constructed of a $\frac{3}{8}$-inch diameter aluminum rod. The loop (fig. 5) is collapsible when not in use. The loop is tuned to the operating frequency by means of the tuning control on the case.

b. Cable Assembly. The cable assembly consists of 5 feet of Radio Frequency Cable RG-58C/U and connectors Radio Frequency Plugs UG-88/U and UG-89/U. Radio Frequency Plug UG-89/U is connected directly into the attenuator and the UG-88/U is connected to the radio set with which the antenna is used.

c. Case. The antenna case is a waterproof inclosure made of hard weather-resistant plastic. It incloses and protects the transformer, capacitor, switch, and attenuator. The lower part of the case forms a handle by which the antenna is held.

d. Bag. Bag CW-258/PRC is a heavy canvas container used to hold and carry the antenna when not in use. A shoulder strap is provided with snap hook fastenings.

e. Clip. Handset Clip MX-1367/U is a spring-loaded clip designed to be snapped onto the handset and to a helmet for the purpose of holding the handset against the ear, freeing both hands for handling the loop and radio receiver. The clip can be swiveled so that the handset may be adjusted for a comfortable position of the mouthpiece.

7. Differences in Models

Antennas AT-339/PRC and AT-340/PRC are electrically and mechanically similar; they differ only in their operating frequencies and in the components which determine those frequencies (fig. 13).

Figure 3. Siting Radio Set AN/PRC-6 with Antenna AT-339/PRC.

CHAPTER 2

INSTALLATION AND OPERATION

Section I. SERVICE UPON RECEIPT OF ANTENNA AT-339/PRC OR AT-340/PRC

8. Siting

Antennas AT-339/PRC and AT-340/PRC, when used with the proper radio sets, are most successful over unobstructed paths. For this reason, equipments used as homing devices should be placed in locations free from intervening obstacles such as hills, reinforced concrete structures, steel buildings, bridges, or other obstructions. These obstacles block or deflect the signals from the homing station and make homing difficult or impossible. The equipment should not be near telephone and power lines. The best sites are high locations that give a clear view of the surrounding terrain. Figure 3 illustrates typical good and poor locations for the operation of this equipment.

9. Unpacking
(fig. 4)

a. Packaging Data.

(1) Each interior package contains one Antenna AT-339/PRC, or AT-340/PRC, one Bag CW-258/PRC, one Handset Clip MX-1367/U, and two manuals. Each component is individually cushioned and wrapped, then placed in moisture-vaporproof containers and sealed.

(2) When packaged for export shipment, Antenna AT-339/-PRC is wrapped in wadding, packed with desiccant, inclosed within a moisture-vaporproof barrier, and placed in Bag CW-258/PRC. The bag is placed in a waterproof container. This package measures 15½ inches long, 6 inches wide, and 6 inches deep, and weighs approximately 6 pounds. Twenty of these boxes are placed in a wooden export crate. The crate is approximately 35 inches long, 25 inches wide, and 17 inches deep. Its volume is 8.9 cubic feet; and its weight is approximately 150 pounds.

b. Removing Contents. Equipment may be shipped in oversea packing cases or in domestic packing cases. Uncrating instructions are given below.

Caution: Be careful when uncrating, unpacking, and handling the equipment; it is easily damaged. If it becomes damaged, a complete overhaul might be required or the equipment might be rendered useless.

(1) Cut and fold back the steel straps.

(2) Remove the nails with a nail puller. Remove the top and one side of the packing case.

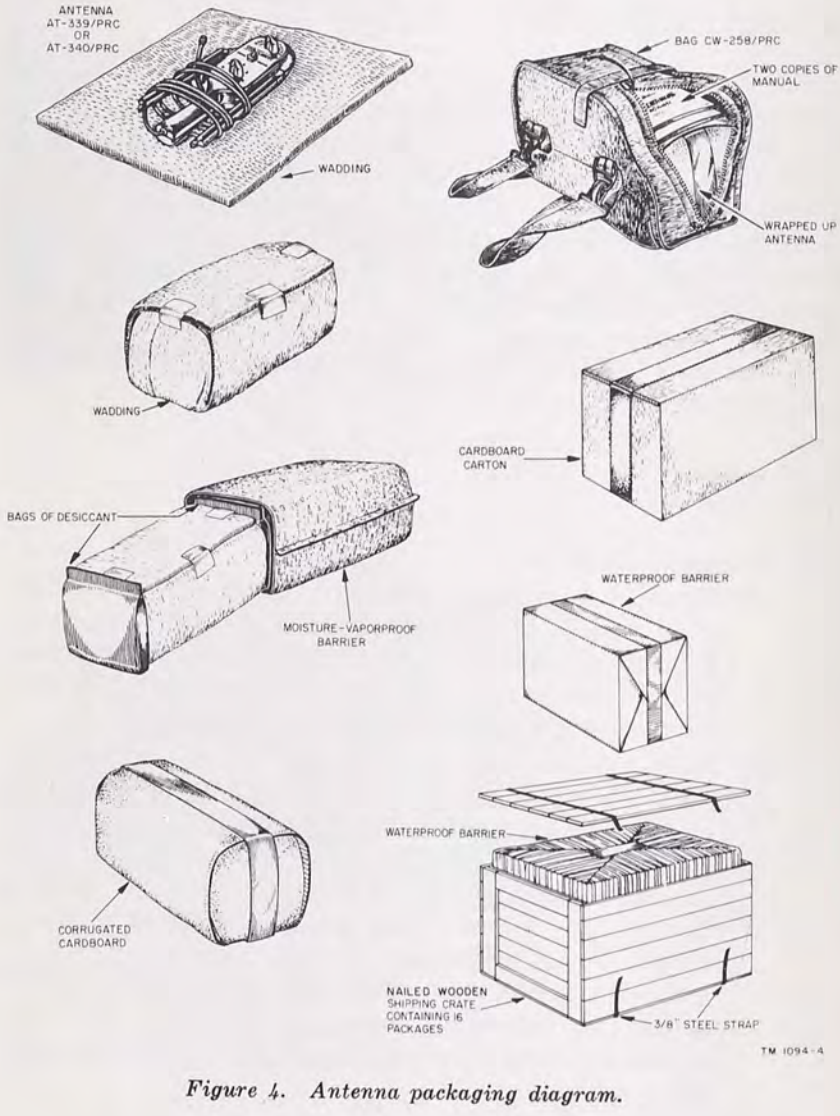

Figure 4. Antenna packaging diagram.

(3) Remove the waterproof barrier.

(4) Remove as many of the sets as required and store the remainder.

c. Checking.

(1) Remove the equipment from its inner case and inspect for possible shipping damage.

(2) Check the contents of the packing case against the master packing slip.

10. Installing Antenna AT-339/PRC or AT-340/PRC (fig. 5, 6, and 7)

a. Remove the equipment from the carrying bag.

b. Erect the collapsed loop antenna by extending the two arms as far as they will go. Fit the two sections together to complete the *diamond* form as shown in figure 7.

c. Connect the plug at the end of the transmisison line to the AUX ANT jack of Radio Set AN/PRC-8, -9, or -10 or to the loop antenna connection of Radio Set AN/PRC-6. Connect it to the loop antenna connector.

d. Attach Handset Clip MX-1367/U to the handset.

e. When Antenna AT-339/PRC is used with Radio Set AN/PRC-6, the whip antenna should be removed.

f. When used with Receiver Transmitter RT-66/GRC, RT-67/GRC or RT-68/GRC, use ANT connector.

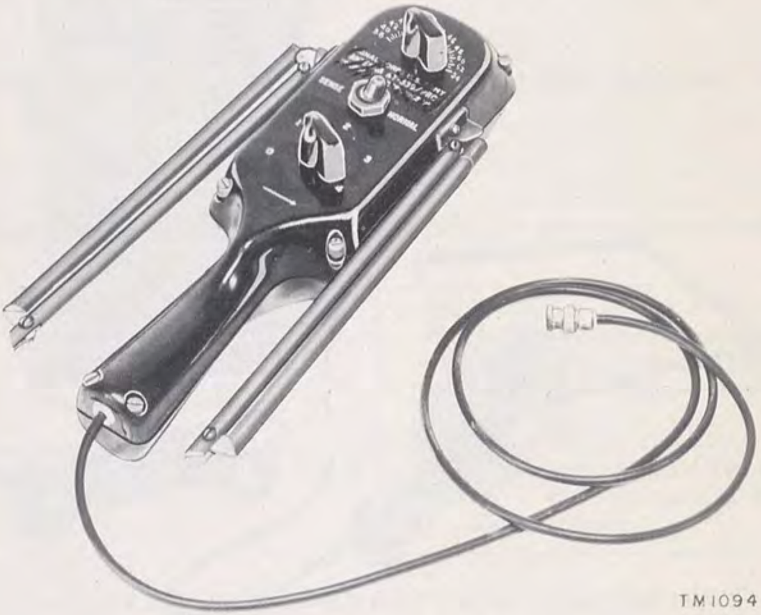

Figure 5. Antenna folded up.

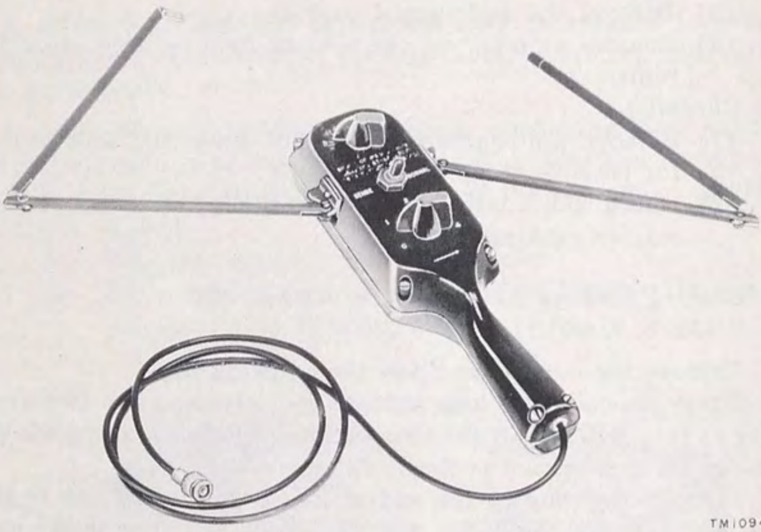

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Figure 6. Assembly of antenna.

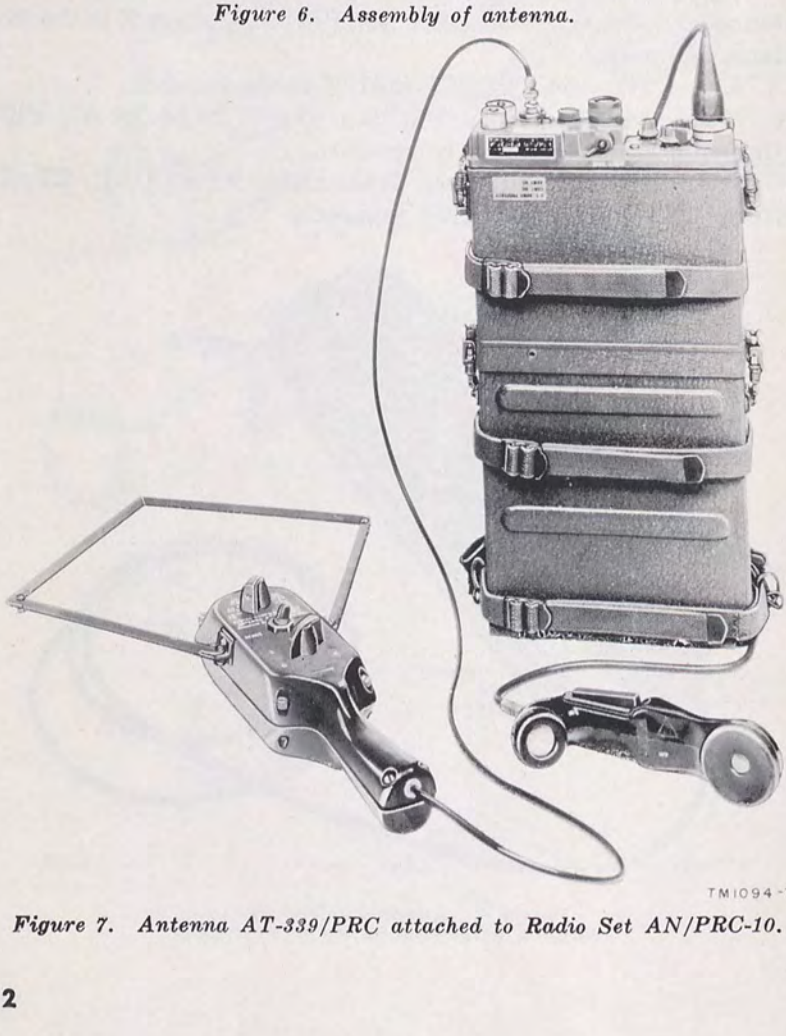

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Figure 7. Antenna AT-339/PRC attached to Radio Set AN/PRC-10.

11. Service upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 9 for uncrating, unpacking, and checking 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 the 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 joints of the loop for tightness. If loose, turn the screw that joins the segments until the joint has firm and smooth operation. This is necessary for good connection. Do not jam the screw so that excessive force is necessary to move elements.

e. Perform the installation procedure given in paragraph 10.

Section II. CONTROLS AND INSTRUMENTS

12. General

Do not force the operating controls because this may damage the antenna. The actual operation of the equipment is explained in paragraphs 14 and 15. Antennas AT-339/PRC and AT-340/PRC are receiving antennas, and may be damaged if used for transmitting.

13. Antenna Controls

The following chart lists the controls and their functions (fig. 8).

Control	Function
Frequency control calibrated in mc	Controls the operating frequency of the antenna.
SENSE-NORMAL switch	In the NORMAL position, a signal will give two bearings in opposite directions. In the SENSE position, bearings are obtained in only one direction.
Attenuator control marked 0, 1, 2, 3, 4	Decrease strength of signal fed to receiver as the attenuator is set to a higher number.

Note. In SENSE position, arrow points toward transmitting station.

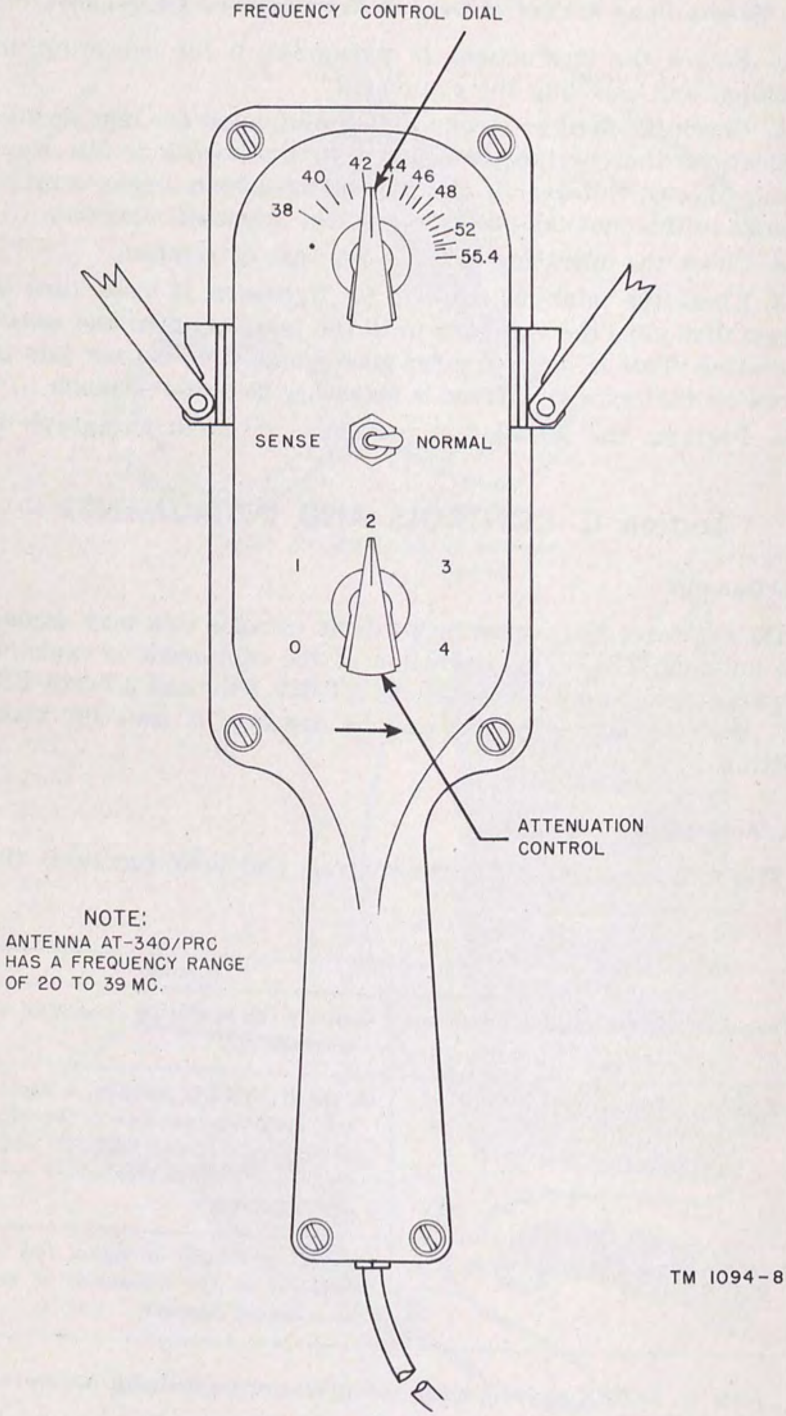

Figure 8. Antenna AT-339/PRC, controls, A.

Section III. OPERATION UNDER USUAL CONDITIONS

14. Direction Finding with Modulated Carrier

It is recommended that a minimum of 8 hours of training in the use of the antennas be completed before an operator is assigned field use of this equipment. Direction finding can be performed by using either modulated carrier or unmodulated carrier. Both techniques are described for Antennas AT-339/PRC and AT-340/PRC in paragraphs 14 and 15.

a. Maximum Signal. The term *maximum position* or *maximum* is used to define the position in which the antenna is oriented when the greatest signal response (loudest signal) is obtained. This occurs when the edge of the loop is pointing toward the transmitting station. When the SENSE-NORMAL switch is in the NORMAL position, signals of equal maximum intensity are obtained when either edge of the loop is pointed toward the transmitter. When the SENSE-NORMAL switch is in the SENSE position, a greater response is obtained from one edge than from the other.

b. Null. The term *null position* or *null* is used to define the position in which the antenna is oriented when minimum or no signal response is obtained. This occurs when either flat side of the loop faces toward the transmitting station. The two nulls are defined properly when the SENSE-NORMAL switch is in the NORMAL position. *Do not attempt to use null operation when this switch is in the SENSE position because a false null indication may be received.*

c. Transmitter Signal Modulation. The transmitting operator can give a long count or speak in a continuous tone at a constant level to provide the necessary signal modulation.

d. Tuning and Initially Locating Signal.

(1) Check to see that the SENSE-NORMAL switch is in the NORMAL position.

(2) Turn the volume control on the receiver to maximum.

(3) Set the attenuator switch to position 0.

(4) Set the tuning knob as close as possible to the desired operating frequency.

(5) Hold the antenna straight up and down with the handle slightly above eye level.

(6) Rotate the antenna until a signal is received. Adjust the tuning control for maximum response.

(7) For greater accuracy, tuning to a weak signal is preferred. If the received signal is too high in value, reduce it by advancing the attenuator to a higher number.

e. Null Location.

(1) Hold the antenna straight up and down and turn it by means of wrist motion.

(2) As the antenna is turned, two positions are found at which the received signal output of the receiver earphone falls off or disappears entirely. These points are the *nulls*. They occur ½ revolution apart when the plane of the loop is broadside to the direction from which the signal is coming.

f. Sensing. Because there are two nulls, the null indication alone does not provide sufficient information for the operator to determine whether the transmitting source is in front of, or behind the loop. Therefore, to find the actual direction to the transmitting source, it is necessary to determine the sense of the bearing. The sensing procedure is as follows:

(1) Throw the SENSE-NORMAL switch to the SENSE position holding the antenna on one of the nulls. (The antenna should be broadside to the signal source.)

(2) Rotate the loop ¼ turn in one direction and note the strength of the received signal. The signal should be louder.

(3) Rotate the loop ½ turn from this last position and again note the strength of the received signal. Compare the signal strength now with the other signal.

(4) Orient the loop in the position that produced the strongest received signal. The arrow on the case (fig. 5) will now point in the direction of the transmitter.

(5) When the direction of the signal is determined, throw the SENSE-NORMAL switch back to NORMAL and use the null for homing operation, since it gives a sharper and more accurate bearing indication than the maximum position. In the presence of a strong signal, the null will be quite narrow and rotation of a few degrees will result in sharp variations of the received signal. On a weaker signal, the width of the null may increase to 30° or 40°. The center of this null area is the correct bearing.

Caution: The SENSE-NORMAL switch should be in the SENSE position only when sensing. As soon as sense has been determined, throw the switch back to NORMAL and proceed toward the target transmitter by keeping the loop in the null position.

g. Attenuation.

(1) Very strong signals may have a tendency to obscure the null and sense indications. In general, such signals will only be found close to the transmitter. However, if the

transmitter cannot be seen and a very strong signal tends to obscure the bearings, advance the attenuator switch to position 1, 2, 3, or 4 as necessary, to reduce the received signal strength to the point where the null becomes clear. When the attenuator is used, it is generally not necessary to retune the antenna after switching to the various positions. However, if the nulls seem very broad or are not evident, readjust the tuning control for maximum signal with the attenuator switch in the position in which it is to be used.

(2) Positions 1, 2, 3, and 4 provide increasing and marked differences in attenuation. The position of least attenuation that will permit sense and bearing determination should be used. Operation in attenuator position 4 is not required except in the immedate vicinity of the transmitting station (100 to 200 yards). Accurate sense indication may be difficult to obtain in this position but this should not present any operating difficulties, since the general direction of travel has been previously established and the null bearing indication should be sufficient to permit finding the transmitter.

h. Homing. To home on a signal, or to find the transmitting station, do the following:

(1) Find the null and take a bearing.

(2) Determine the sense.

(3) Proceed in the direction indicated by the arrow on the loop frame when the loop is in the maximum response sense position.

(4) After the proper sense has been obtained and the SENSE-NORMAL switch returned to NORMAL, the loop must be turned back to the broadside position and the null again obtained. If the null is particularly broad, rotate the loop back and forth a few times. Select the center of the null and proceed on a line through the center of this null until the transmitting station is reached.

(5) As the transmitter is approached, successive bearings can be taken with increased accuracy because of the narrowing null area which results from increasing signal strength.

15. Direction Finding with Unmodulated Carrier

a. Maximum Carrier Signal. The term *maximum carrier signal* is used to define the position in which the antenna is oriented when the greatest signal response (maximum quieting action of carrier over noise) is obtained. This occurs when the edge of the loop is pointing toward the transmitting station. When the SENSE-NORMAL switch is in the NORMAL position, signals of equal *maximum quieting* action are obtained when either edge of the loop is pointed toward the transmitter. When the SENSE-NORMAL switch is in the SENSE position, greater quieting is obtained from one edge than from the other.

b. Null. The term *null position* or *null* is used to define the position in which the antenna is oriented when *minimum quieting* (maximum noise) action is obtained. The null (minimum quieting) occurs when either flat side of the loop faces toward the transmitting station. The two nulls are defined properly when the SENSE-NORMAL switch is in the NORMAL position. *Do not attempt to use null operation when this switch is in the SENSE position because a false null indication may be received.*

c. Unmodulated Carrier. When direction-finding operation is required, the operator asks the transmitting station for a definite period of unmodulated carrier operation. The transmitting station turns its carrier on the air for that period. No buzzer, audio oscillator, or speech is required. The carrier itself provides the information for direction finding.

d. Tuning and Initially Locating Signal. This procedure is the same as with a modulated carrier except for the following difference in (6) of paragraph 14*d*: Rotate the antenna about a vertical axis until a signal is received. Adjust the tuning control for maximum response (maximum quieting on station).

e. Null Location.

(1) Rotate the antenna around a vertical axis by means of wrist motion.

(2) As the antenna is rotated, two positions are found at which the *quieting action* of the carrier weakens to the point that full background noise is heard. These are the null positions. They occur ½ revolution apart when the plane of the loop is broadside to the direction from which the signal is coming.

f. Sensing. Because there are two nulls, the null indication alone does not provide sufficient information for the operator to determine whether the transmitting source is in front of, or behind the loop. Therefore, to find the actual direction to the transmitting source, it is necessary to determine the sense of the bearing. The procedure is the same as with a modulated carrier except for the following differences in (2), (3), (4) and (5) of paragraph 14 *f*:

(1) Rotate the loop ¼ turn in one direction and note the strength of the signal. The *quieting action* should be much greater.

(2) Rotate the loop ½ turn from this last position and again note the strength of the received signal. Compare the maximum carrier signal now with the signal before.

(3) Orient the loop in the position that produces the stronger carrier signal (maximum quieting). The arrow on the loop frame now points in the direction of the transmitter. Follow the directions in (4) below to sharpen further the direction desired.

(4) When the general direction of the signal has been determined, throw the SENSE-NORMAL switch back to the NORMAL position. Use the null for homing operation, since it gives a sharper and more accurate bearing indication than the maximum quieting positions. In the presence of a strong signal, the null is quite narrow, and rotation of a few degrees results in sharp variations of the received signal. On a weaker signal, the width of the null may increase 30° or 40°. The center of this null area is the correct bearing.

g. Attenuation. The procedure is the same as with a modulated carrier except for the following differences in (1) and (3) in paragraph 14*g*.

(1) Very strong signals may have a tendency to obscure the null and sense direction. In general, such signals are found close to the transmitter. However, if the transmitter cannot be seen and a very strong signal tends to obscure the bearings, advance the attenuator switch to position 1, 2, 3, or 4 as necessary to reduce the received signal to the point where there is a maximum difference between strong and weak signals, thus positively identifying the stronger (maximum quieting) as the true sense direction.

(2) Positions 1, 2, 3, and 4 provide increasing and marked differences in attenuation. Use the position of attenuation which shows the greatest difference in quieting when using the antenna with first one corner of the diamond pointed toward the transmitter and then the other corner. Listen for the difference in quieting, not for complete silence. Operation in attenuator position 4 is not required except in the immediate vicinity of the transmitting station (100 to 200 yards). Accurate sense indications may be difficult to obtain in this position, but this should not present any operating difficulties, because the general direction of travel has been previously established and the null bearing indication should be sufficient to permit finding the transmitter.

16. Operating Hints

a. When finding a null, hold the loop in a vertical position with the handle at eye level. When sensing, hold the loop as high as possible. In both cases, the plane of the loop should be vertical. It is not necessary to hold the loop high continuously, particularly when following a well defined null, but frequent checks should be made to assure the correct path of travel.

b. It is possible that a signal has been bent or reflected, but using the loop as instructed will lead the operator to the source. In wooded areas, there may be localities known as blind spots when the signal becomes very weak or dies away. When such occurs, follow the predetermined course for a short distance or seek any relatively open spot and take a bearing.

c. Do not take bearings near natural or man-made obstacles if open areas are available. Do not locate under power or telephone lines, or near fences, railroad tracks, cliffs, or buildings. This may distort the wave path and may cause false bearings.

d. Always tune for maximum signal on each operating frequency and recheck the tuning whenever in doubt or when using the attenuator unit.

e. To facilitate collapsing the loop, gently tap the loop arms at the hinge joints to loosen the tension on the apex connection.

f. Handset Clip MX-1367/U is supplied with each antenna to allow freedom of both hands. The clip holds the handset in position at the ear by clipping to the helmet.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

17. Operation in Arctic Climates

No special adjustments are necessary on Antenna AT-339/PRC or AT-340/PRC for operation under conditions of extreme cold. Before folding or unfolding the loop, be sure that no ice has formed at the joints which would cause damage if the loop is forced.

18. Operation in Tropical Climates

Humid areas may cause excessive corrosion of the component parts. Check frequently and apply corrective measures (par. 27*b*).

19. Operation in Desert Climates

The main problem which arises with equipment in desert areas is the large amount of sand, dust, or dirt that enters the moving parts of radio equipment. Keep the antenna case tightly closed at all times to keep dust and dirt from the tuning capacitor and attenuator. Before folding or unfolding the loop, be sure the joints are free from sand which would cause excessive wear if not removed.

CHAPTER 3

ORGANIZATION MAINTENANCE

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

20. Tools and Materials Supplied with Antennas AT-339/PRC or AT-340/PRC

No tools or materials are supplied with this equipment. However, since either Antenna AT-339/PRC or Antenna AT-340/PRC is used as auxiliary equipment with a radio set, the tools and materials supplied with the radio set may be used when necessary.

21. Tools Required for Maintenance of Antennas

Tool Equipment TE-41 is necessary for maintenance of the antennas.

Section II. PREVENTIVE MAINTENANCE SERVICES

22. Definition of Preventive Maintenance

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

23. General Preventive Maintenance Techniques

a. Use #000 sandpaper to remove corrosion.

b. Use a clean, dry, lint-free cloth or a dry brush for cleaning all parts (including electrical contacts). If necessary, moisten the cloth or brush with Cleaning Compound (Federal stock No. 7930-395-9542) and wipe the parts dry with a cloth.

Warning: Prolonged breathing of Cleaning Compound fumes is dangerous. Make sure adequate ventilation is provided. Cleaning Compound is flammable; do not use near flame.

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

24. Use of Preventive Maintenance Forms (fig. 9 and 10)

a. Instructions for the use of DA Forms 11-238 and 11-239 appear on the reverse side thereof.

b. References in the ITEM column are to paragraphs that contain additional detailed information.

c. Items lined out do not apply to the antennas.

OPERATOR FIRST ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE ANTENNA AT-339/PRC | EQUIPMENT SERIAL NO.

LEGEND FOR MARKING CONDITIONS: ✓ Satisfactory; X 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 5							
2	LOCATION AND INSTALLATION SUITABLE FOR NORMAL OPERATION. PAR 8 AND 10							
3	CLEAN DIRT AND MOISTURE FROM ANTENNA, ~~MICROPHONE, HEADSETS, CHESTSETS, KEYS, JACKS,~~ PLUGS, ~~TELEPHONES,~~ CARRYING BAGS, COMPONENT PANELS. PAR 25 b							
4	~~INSPECT SEATING OF READILY ACCESSIBLE "PLUCK-OUT" ITEMS: TUBES, LAMPS, CRYSTALS, FUSES, CONNECTORS, VIBRATORS, PLUG-IN COILS AND RESISTORS.~~							
5	INSPECT CONTROLS FOR BINDING, SCRAPING, EXCESSIVE LOOSENESS, ~~WORN OR CHIPPED GEARS, MISALIGNMENT,~~ POSITIVE ACTION. PAR 25							
6	CHECK FOR NORMAL OPERATION. PAR 25 g							

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 25		13	~~INSPECT STORAGE BATTERIES FOR DIRT, LOOSE TERMINALS, ELECTROLYTE LEVEL AND SPECIFIC GRAVITY, AND DAMAGED CASES.~~	
8	INSPECT CASES, ~~MOUNTINGS,~~ ANTENNAS, ~~TOWERS,~~ AND EXPOSED METAL SURFACES, FOR RUST, CORROSION, AND MOISTURE.		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 25		15	~~INSPECT METERS FOR DAMAGED GLASS AND CASES.~~	
10	INSPECT ANTENNA FOR ECCENTRICITIES, CORROSION, LOOSE FIT, ~~DAMAGED INSULATORS AND REFLECTORS.~~ PAR 25 e		16	INSPECT SHELTERS AND COVERS FOR ADEQUACY OF WEATHER-PROOFING. PAR 27	
11	INSPECT CANVAS ITEMS, ~~LEATHER,~~ AND CABLING FOR MILDEW, TEARS, AND FRAYING. PAR 25 f		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.~~		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 AGO FORM 419, 1 DEC 50, WHICH IS OBSOLETE.

TM 1094-9

Figure 9. DA Form 11-238.

SECOND AND THIRD ECHELON MAINTENANCE CHECK LIST FOR SIGNAL CORPS EQUIPMENT

RADIO COMMUNICATION, DIRECTION FINDING, CARRIER, RADAR

INSTRUCTIONS: See other side

EQUIPMENT NOMENCLATURE	EQUIPMENT SERIAL NO.
ANTENNA AT-339/PRC	

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

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

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

TM1094-10

Figure 10. DA Form 11-239.

25. Performing First Echelon Maintenance

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

a. Check for completeness and general condition of the equipment (par. 5).

b. Remove dirt and moisture from the loop, case, bag, and cable assembly (par. 23).

c. Inspect the tuning control, switch, and attenuator for binding, scraping, and excessive looseness.

d. Tighten the screws on the case.

e. Inspect the loop for bent arms, and inspect joints and the plug-in connection of the loop for dirt, corrosion, excessive looseness, binding, and for good electrical connection.

f. Inspect the canvas bag for mildew, cuts, fraying, and proper operation of the zipper.

g. Check the antenna for normal operation (par. 14).

26. Performing Second Echelon Maintenance

Caution: The secondary winding of the coupling transformer has been very carefully balanced at the factory and fastened in the proper position. If the form on which the secondary is wound is moved even a few hundredths of an inch, the homing antenna will not operate properly and will have to be rebalanced under laboratory conditions in a doubly shielded screened room. Also avoid moving any of the leads of the transformer or the tuning capacitor, since the balance may be affected.

a. Carefully remove any dirt or moisture from inside the case. Do not use compressed air to remove dirt or dust around the transformer or capacitors.

b. Inspect the gasket for signs of leakage.

c. Inspect the canvas carrying bag for mildew, tears, and fraying.

d. Inspect for looseness of the NORMAL-SENSE switch, the knob on the tuning control, and the attenuator control.

27. Weatherproofing

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

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 fully 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 total operational failure of equipment in extremely low temperatures are fully explained in TB SIG 66, Winter Maintenance of Signal Equipment and TB SIG 219, Operation of Signal Equipment at Low Temperatures.

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

Section III. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

Caution: Read the caution notice in paragraph 26 before performing any maintenance on the interior of the case of either Antenna AT-339/PRC or Antenna AT-340/PRC.

28. General

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

b. Paragraphs 29 through 31 help in determining which of the parts of the antenna are at fault.

29. Visual Inspection

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

(1) Loose or dirty loop joints.

(2) Cut, broken, or shorted cable.

(3) Worn, broken, or loose connectors on cable.

(4) Internal wires broken or disconnected because of vibration.

b. When failure is encountered and the cause is not apparent, check as many of the above items as is practical before starting a detailed examination of the parts of the homing antenna.

c. Visually inspect the entire antenna for obvious abnormalities.

30. Trouble Shooting by Using Equipment Performance Check List

a. General. The equipment performance check list (par. 31) 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 of correct operation, and the corrective measures the operator can take.

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

c. Normal Indications. The normal indications listed include the visible and audible signs which the operator should look for when checking the items. If the indications are not normal, the operator should apply the recommended corrective measures.

d. Corrective Measures. The corrective measures listed are those the operator can make without turning in the equipment for repairs. A reference in the chart to paragraph 40 indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is necessary. If the homing antenna is inoperative or if the recommended corrective measures do not yield results, trouble shooting is necessary.

31. Equipment Performance Check List

Note. In the following chart it is assumed that the radio set being used with the antenna is known to be in good operating condition.

31. Equipment Performance Check List (cont)

Item No.	Item	Action or condition	Normal indications	Corrective measures
1	Antenna	Pick up signal and rotate antenna with SENSE-NORMAL switch at NORMAL.	Two distinct signal nulls ½ revolution apart and two broad maximums ½ revolution apart.	Change location to get away from obstacles. If this does not correct trouble, refer to paragraph 40.
2	Antenna	Repeat item 1 above with SENSE-NORMAL switch at SENSE.	One broad null and one broad maximum ½ turn apart.	See item 1 above.
3	Frequency control.	Position antenna edgewise to pick up signal and rotate frequency control through its range.	Signal strength should be maximum when frequency control indicates the frequency of the signal and should fall off on either side of this point. The control should not cause any noise in the receiver while it is being rotated.	Refer to paragraph 40.
4	Attenuator control.	Position antenna edgewise to pick up signal with attenuator control at 0, then rotate it to positions 1, 2, 3, and 4.	Received signal strength should decrease with each advance in the attenuator control setting.	Refer to paragraph 40.

CHAPTER 4

THEORY

32. Antenna Theory

a. General. During transmission, a radio-frequency (r-f) current in a conductor produces an electromagnetic field which is radiated into space. This field consists of an electric and a magnetic field at right angles to each other. The plane parallel to the mutually perpendicular lines of electric and magnetic flux is called the wave front. The wave travels in a direction at right angles to the wave front.

b. Receiving Antennas.

(1) If the radiated electromagnetic field cuts a conductor, a voltage will be induced in that conductor. The resulting current varies in accordance with the variations of the electromagnetic field. Thus, a variation of the current in a radiating antenna causes a similar varying current in a conductor at a distant location. Any intelligence being produced as current in a transmitting antenna, will be reproduced as current in any receiving antenna.

(2) Antennas receive more energy in certain positions than they do in other positions. This directivity is due to the fact that the received energy depends upon the amount of the radiated field which is cut by the antenna. A horizontal dipole antenna will receive maximum energy when it is broadside to the plane of the wave front, since maximum interception occurs in this position. A vertical dipole antenna will have constant reception, because the amount of the radio field it will intercept remains constant regardless of the direction of the signal. Typical field strength patterns as viewed from above for vertical and horizontal dipole antennas are illustrated in A and B, figure 11.

33. Direction-finder Antennas

a. General. The half-wave antenna possesses bidirectional characteristics; therefore it is possible to use this antenna with certain modifications to determine the direction from which a radio signal is being received. This can be accomplished by rotating a horizontal antenna, keeping it parallel to the ground and observing the changes in received signal strength. The radiation pattern in A, figure 11, shows the directional pattern produced by a horizontal half-wave antenna. This pattern shows maximum and minimum sensitivity in two directions. In order to take a reasonably accurate bearing on the direction of a received signal it is necessary to have a unidirectional antenna, or one which has a maximum sensitivity in one direction. It is also necessary for the antenna to have relatively sharp maximum (or minimum) response points with fairly large differences in sensitivity existing between the maximums and minimums. A special antenna known as the loop antenna with a sensing circuit has these characteristics and is suitable for direction-finder usage.

b. Loop Antennas. A loop antenna consists of a large diameter coil and produces a directional response pattern similar to a figure eight, containing two broad maximums and two relatively sharp minimums or nulls (C, fig. 11). This pattern is oriented with the loop so that maximum response is obtained when either of the edges of the loop is pointed toward the transmitter, and minimum response is obtained when the plane of the loop is broadside to the transmitter. The points of minimum response (the nulls) are used to indicate direction, because they are more sharply defined than the points of maximum response and therefore make it easier to take an accurate bearing.

(1) Refer to A, figure 12. The radiated wave front is seen striking the front (left side, marked L) edge of the loop in the normal position with the arrow in the center of the loop pointing toward the transmitter. Note that the wave front hits the rear edge (right side, marked R) just a little later. The instantaneous peak voltage of the radiated wave striking the two edges of the loop has the same amplitude. There is a slight phase difference because of the spread of time between striking the edges. This is shown in the form of vectors in B, figure 12, with EL representing the induced voltage in the half of the loop first intercepting the wave front as a reference point at zero vector degrees. Because of the size of the loop and the frenquency used, the phase difference between sides of the loop is approximately 30°. ER, the induced voltage in the second half of the loop, is shown with the same amplitude as EL, but 30° behind. Note that while EL and ER appear to be going in almost the same direction, when considered as part of the loop,

they buck each other. Picture the vertical lines EL and ER as traveling around the loop in the direction of their arrows. It will readily be seen that they oppose each other. To obtain the resultant voltage, ER must be subtracted from EL. This is done by reversing ER 180°, drawing the parallelogram of forces, and arriving at ES as shown. The secondary of transformer T1 is wound in phase with the primary; therefore both right-hand ends of the coils in A, figure 12, are positive at the same moment. ES is the resultant voltage in the loop and appears across the secondary by transformer action.

(2) Refer to A, figure 12. The voltage ES can be considered a generator voltage, which drives current through the secondary coil and resistor which represents the attenuator in the loop antenna. At the operating frequency, the reactance of the secondary coil is approximately six times that of resistor R (in the position of least attenuation). As a result, secondary current I lags ES by approximately 80° as shown in C, figure 12. The voltage Er across resistor R is in phase with secondary current I. The voltage Ei across the secondary leads I by 90°. Another way of looking at the vectors is as follows: the generator voltage ES, less the counter-electromotive force developed by Ei, is equal to Er. The subtraction, shown in dotted lines in C, figure 12, uses reversed vectors Ei as the subtracted element and yields Er. The output voltage going to the receiver is taken from across resistor R. Thus, Er is the loop voltage actually delivered to the set when the loop is in its simple form.

(3) Refer to D, figure 12. The loop has been reversed. The arrow in the center of the loop points away from the transmitter. The wave front now strikes the right edge of the loop before the left, inducing the voltage shown as vector ER in E, figure 12. EL is developed approximately 30° later. As indicated in (1) above, ER must be subtracted from EL. This is done by reversing ER 180°, drawing the parallelogram of forces, and arriving at ES^1 as shown. By the same reasoning as brought out in (2) above, the resistive output (loop voltage) actually delivered to the set is Er^1 as in F, figure 12. This amplitude is the same as Er but reversed in direction. This is in keeping with the pattern shown in C, figure 11. Thus, either edge of the loop facing the transmitter will give maximum voltage indication. Each edge of the loop has a phase opposite to the other. Because the receiver

responds the same to either phase of voltage, at the same amplitude, the loop in its simplest form gives the same result when aimed toward the transmitter and away from the transmitter. When it is broadside to the transmitter, equal voltages of opposite phase are induced in each half of the antenna which cancel each other to give the nulls. The figure 8 pattern shows the response of the antenna from all directions.

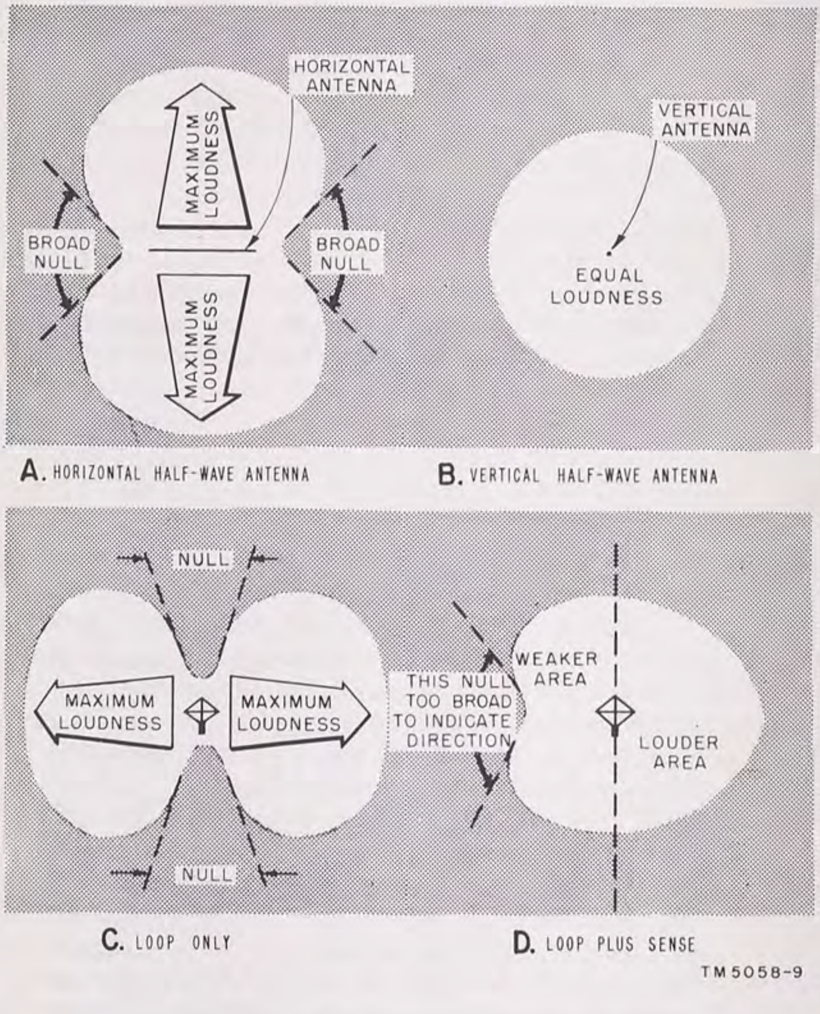

Figure 11. Antenna field strength patterns.

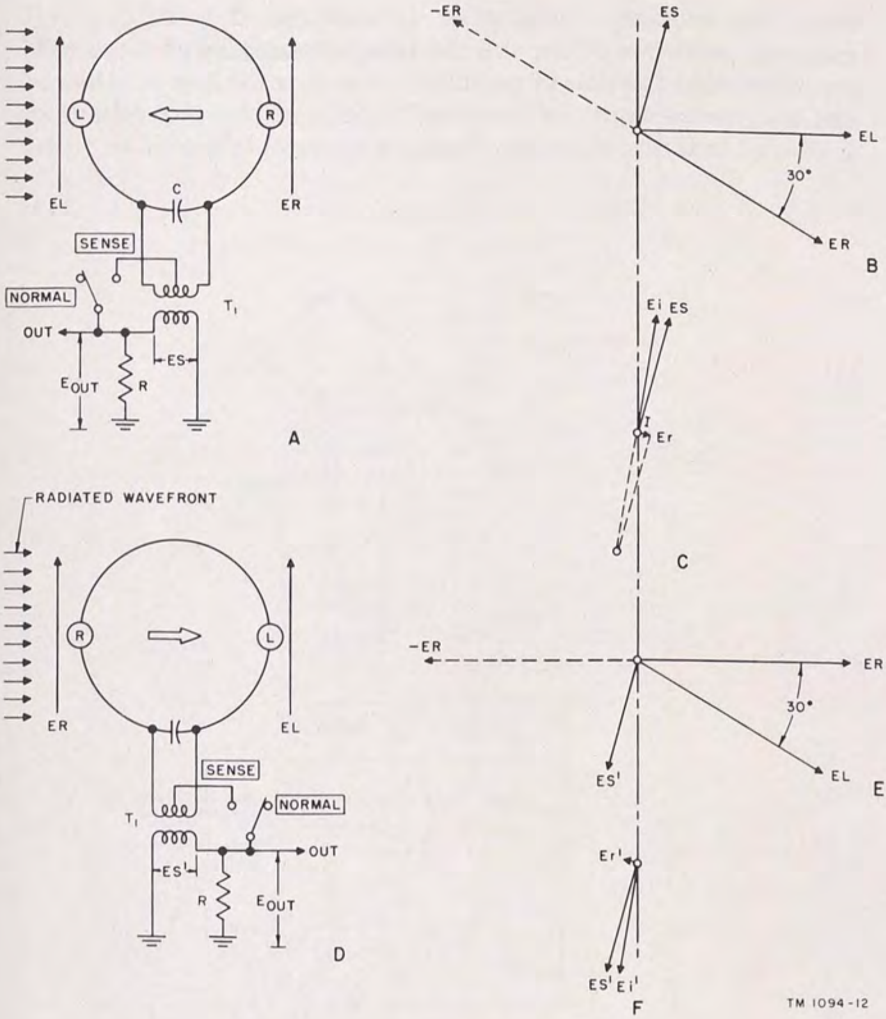

Figure 12. Radiated wave front striking edge of antenna.

34. Antenna AT-339/PRC or Antenna AT-340/PRC (fig. 13)

a. The loop is diamond-shaped, approximately 10 inches long on a side. A coupling transformer having an off-center-tapped primary is connected across the terminals of the loop and provides an inductive coupling between the loop and the transmission line.

b. The bearing obtained with a loop antenna will be incorrect unless the loop is carefully balanced electrostatically with ground. If the loop were not balanced in this way, there would be a residual antenna effect that would distort the directional pattern of the loop. The coupling transformer is constructed with one coil mounted inside the other, and the relative positions of these coils are adjusted at the time of manufacture so that the loop is balanced and the desired degree of coupling is obtained. The two coils then are sealed in this position and further adjustments cannot be made.

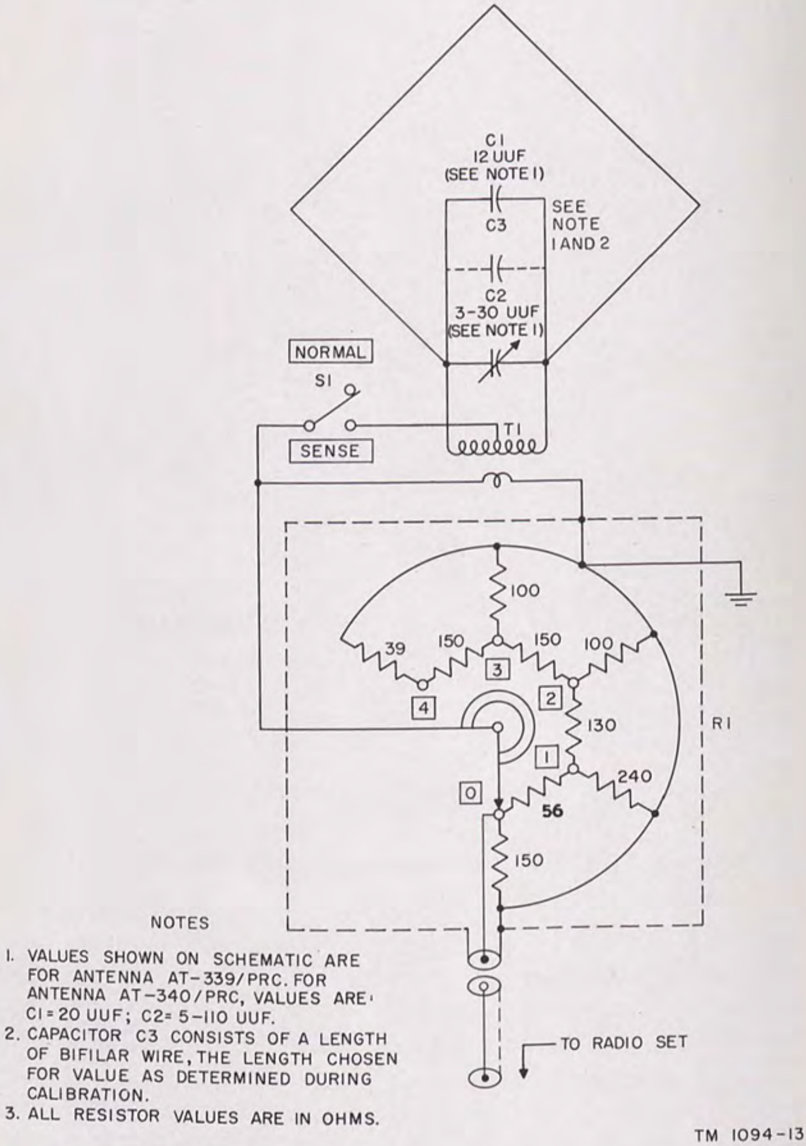

Figure 13. Antenna schematic diagram.

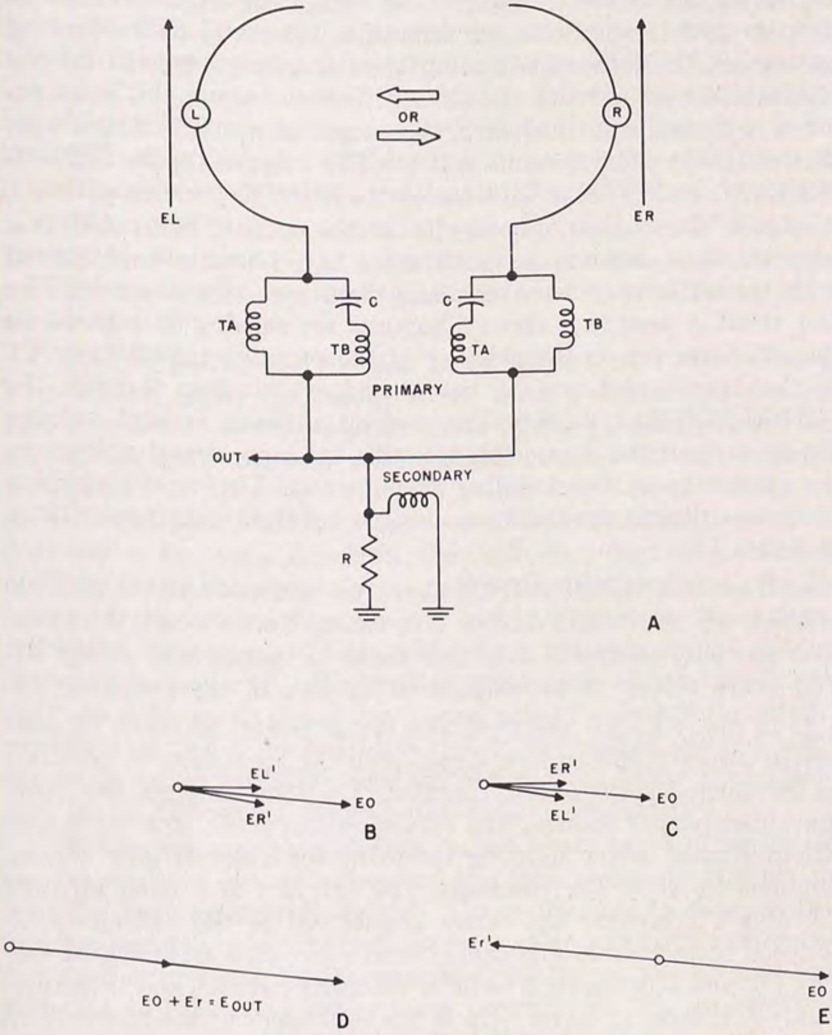

Figure 14. Analysis of sense circuit.

c. The primary coil of the coupling transformer is tuned to the desired operating frequency by variable capacitor C2 and fixed padder capacitors C1 and C3 which are connected in parallel with the primary and the loop. The attenuator R1 limits the signal strength applied to the receiver for proper operation.

d. As shown in C, figure 11, the pattern of a simple loop antenna possesses two identical nulls and two identical maximum points 180° apart. The pattern leaves a 180° uncertainty as to the direction of the transmitter, no matter which technique (maximum points or nulls) is used to find the direction. Since the transmitter may be either in front of, or behind the loop, another element is used to eliminate one direction. The sense of the bearing can be determind by introducing a small voltage derived from a vertical (sense) antenna. In other direction finders, the sense antenna is a simple vertical wire, the output of which is mixed with that of the loop. In Antenna AT-339/PRC, figure 13, the SENSE-NORMAL switch when thrown to the SENSE position causes a voltage of fixed phase to be applied to the output. This acts like a separate sense antenna, permitting the fixed phase to be compared with the different phases resulting from reversing the loop. The loop itself is used as a vertical antenna for sensing by connecting the off-center tap on the primary of the coupling transformer T1 to the ungrounded end of the secondary winding through the SENSE-NORMAL switch. The vertical antenna (sense) voltage obtained from the loop combines with the loop circuit voltage in the secondary of the coupling transformer. The vector addition of these voltages produces the desired cardioid response pattern D, figure 11.

e. When the SENSE-NORMAL switch is thrown to the SENSE position an additional circuit is created. This circuit is shown with the loop separated into two parts for analysis in figure 14. This sense voltage is the same with the loop in any position.

f. In the SENSE position, the transformer primary is converted into a tapped coil in series with the secondary in addition to the normal transformer function. The loop antenna has been conveniently split showing the current paths of EL to ground and ER to ground. After splitting the paths for analysis they will be combined to show the resultant. The primary is broken up into TA and TB because the series connection to the secondary is between these points. The capacitor C represents C1, C2, and C3. TA, TB, and C comprise a parallel resonant circuit (and therefore highly resistive) in series with R, the equivalent of the attenuator, to ground. With the attenuator in position 1, the condition of the circuit in A, figure 14 is correct. Since the secondary has at least six times the impedance of R, the reactive effects of that coil may be ignored in sense measurements in this position. The signal voltage EL may be considered a generator providing a current flow through TA, TB, C, and R to ground. This current produces a voltage drop across the highly resistive tank circuit, developing a weak voltage EL^1 across R without phase change. The voltage drop appears as a miniature version of EL. EL may be seen in B, figure 14, at the same phase angle as the original EL (B, fig. 12). Vectors in figure 14 have been exaggerated in length for clarity.

g. The signal voltage developed in the right side of the antenna, ER, produces a current which suffers no phase change when going through the same circuit as EL to develop ER across R. In B, figure 14, ER[1] is shown as having the same phase angle as ER (B, fig. 12), with reduced amplitude. The resultant of these two vectors, EO, appears across R (A, fig. 14). EO (B, fig. 14) is designated as the sense voltage actually fed to the receiver. Note that EL[1] and ER[1] are added, since the currents that produce these voltages flow through resistor R103 in the *same* direction.

h. Note that in C, figure 14, the reverse direction of the loop causes the resultant EO to have the same phase as in B. This is because the vertical sense antenna has a uniform response from all directions.

i. Superimposing the circular sense pattern over the figure 8 loop pattern (since they occur at the same instant) provides the loop plus sense cardioid pattern in D, figure 11. In D, figure 14, the vectors show the loop aimed at the station. EO is the sense voltage in any direction, while Er is the loop output voltage as shown in C, figure 12, with the loop aimed at the station. Since they are in the same direction, they add, and provide a marked increase in output signal to point the way to the station. In E, figure 14, the vectors show the loop aimed away from the station. EO is the same sense voltage, while Er is the loop output voltage shown in F, figure 12, with the loop away from the station. Since they are opposite in phase they cancel and give very little output, proving this is not the true direction to the station. By similarly summing up the circular sense pattern and the figure 8 loop pattern in all directions, the cardioid pattern is obtained.

j. While the sensing definitely points the correct direction to the transmitter, the broadness of the lobe makes it difficult to spot the bearing sharply enough. Using the null to sharpen the bearing and following the null to the station are standard direction-finding practices. If the operator gets turned around and has difficulty in relocating the general direction of the transmitter, the sense operation should again be followed.

k. The sense voltage must be equal to, or slightly less than, the net loop voltage. If the sense voltage is too small, a pattern consisting of one large lobe, one small lobe, and two nulls less than 180° apart is produced. If the sense antenna voltage is too high, it will mask the loop characteristics and produce a pattern with an indistinct maximum and minimum.

l. The signal strength should be of such an amplitude that operation is on the midpoint of the straight-line portion of the limiter curve in the receiver used with the antenna. In order to prevent strong signals from overloading the receiver and thereby masking the maximums and minimums, an attenuator circuit is provided. The received signal is attenuated through the use of a series-parallel combination of resistors and a switching arrangement providing for five different degrees of attenuation. The unit that is used to specify the amount of attenuation is the decibel (db). The attenuator has five steps numbered, 0, 1, 2, 3, and 4, providing O, 5, 15, 25, and 35 db attenuation. The attenuator has been so designed that the input impedance will remain approximately 50 ohms, regardless of the amount of attenuation, provided the output is properly loaded with a 50 ohm load. This is accomplished when the output of the attenuator is connected to the input of the radio set by means of the radio-frequency cable provided.

CHAPTER 5

FIELD MAINTENANCE

Section I.

TROUBLE SHOOTING AT FIELD MAINTENANCE LEVEL

35. Trouble Shooting Procedures

The first step in servicing a defective unit is to localize the fault. Localization means tracing the fault to the defective part responsible for the abnormal condition. Some faults like burned-out resistors, broken or unsoldered wires, or misalignment of capacitor plates often can be located by sight or smell. The majority of faults, however, must be localized by analyzing the operation of the antenna in detail and by making continuity checks. The tests listed below aid in isolating the source of trouble. To be effective the procedure should be followed in the order given. The service procedure is summarized as follows:

a. Visual Inspection. The purpose of visual inspection is to locate any visible trouble. Through this inspection alone, the repairman may frequently discover the trouble.

b. Operational Test. The operational test (par. 31) is important because it frequently indicates the general location of trouble. In many instances, the information gained will determine the exact nature of the fault. In order to utilize this information fully, all symptoms must be interpreted in relation to one another.

c. Resistance Readings. Connect an ohmmeter between the center conductor and the shell of the plug on the end of the transmission cable and rotate the attenuator control through its five positions. The positions should give the following resistance readings; position 0 should be 0 ohms, position 1 should be 31 ohms, position 2 should be 68 ohms, position 3 should be 75 ohms, and position 4 should be 16 ohms.

d. Trouble-Shooting Chart. The trouble symptoms listed in this chart (par. 40) will aid greatly in localizing trouble.

36. Trouble Shooting Data

Take advantage of the material supplied in this manual. It will help in the rapid location of faults. Consult the fololwing trouble-shooting data.

Figure No.	Description
8	Antenna controls.
13	Antenna schematic diagram.
15	Interior view of the antenna housing.

37. Tools and Test Equipment Required for Trouble Shooting

The test equipment required for trouble shooting is listed below.

Test equipment	Technical manual
Multimeter TS-352/U	TM 11-5527
Tool Equipment TE-113	

38. General Maintenance Precautions

Whenever the antenna is serviced, observe the following precautions very carefully.

a. The secondary winding of the coupling transformer has been very carefully balanced at the factory and fastened in the proper position. If the form on which the secondary is wound is moved even a few hundredths of an inch, the homing antenna will not operate properly and will have to be rebalanced under laboratory conditions in a doubly shielded screen room (par. 44).

b. Do not throw the transmit switch of the radio set when the homing antenna is connected to it. This procedure may burn out the attenuator or part of the tuning circuit.

c. Do not move or bend any of the leads of the transformer or capacitors and especially capacitor C3 which is very critical in value, because this may upset the balance of the circuit and realignment may be necessary. Usually, whenever any part other than the cable assembly is replaced, alignment will be necessary. Do not attempt to replace capacitor C3. A capacitor, switch or attenuator may possibly be replaced without alignment if the following precautions are taken.

(1) The replacement part must be identical with the old part both electrically and mechanically.

(2) It must be placed in exactly the same position as the old one.

(3) The wires connected to the old part must be unsoldered very carefully and not bent out of place when resoldered to the new part. If it is necessary to move the leads slightly to get the old part out, they must be bent back to exactly the same position.

Note. Even if all these precautions are followed exactly, realignment may still be necessary due to differences in internal distributed capacitances of identical parts.

39. Operational Test

If the radio set with which the homing antenna is used is available, operate the equipment as described in the equipment performance check list in paragraph 31. This check list is important because it frequently indicates the general location of trouble. To operate the equipment, it is necessary to have a signal source of some type. Another radio set that will transmit on the same frequency or a signal generator connected to an antenna are best but any station that can be picked up by the receiver can be used if no other signal source is available. The operational test should be performed out of doors in an open field or false bearings will be obtained.

40. Trouble-shooting Chart

The following chart is supplied as an aid in locating trouble in the homing antenna. The chart lists the symptoms which the repairmen would observe while performing a few simple tests.

40. Trouble-shooting Chart (cont)

Symptom	Probable trouble	Correction
No signal received when signal should be present.	Loose connection in connector of cable assembly.	Repair or replace connector.
	Defective contacts in attenuator.	Replace attenuator.
	Poor connections in loop joints, plates of variable capacitor touching, or fixed capacitor shorted.	Clean joints with #000 sandpaper or replace loop, realign plates or replace capacitor.
Signal present but the frequency control dial will not tune for maximum response.	Faulty fixed or variable capacitor or poor solder joints.	Replace capacitor or resolder any poor connections.
No null in signal response as antenna is rotated. (SENSE-NORMAL switch on NORMAL.)	Poor connection in loop joints.	Clean joints.
	Transformer badly unbalanced.	Align antenna. (See par. 43 and 44.)
No difference in response from opposite sides of the loop (SENSE-NORMAL switch on SENSE). *Note.* The difference is slight even when the equipment is working properly.	Faulty toggle switch.	Replace switch.
	Antenna not properly tuned.	Retune antenna. (See operating instructions in par. 14 and 15.)
Nulls or maximums not 180° apart, or maximums not of equal intensity. Nulls not sharply defined.	Antenna not properly tuned.	Retune. (See operating instructions in par. 14 and 15.)
	Transformer not balanced.	Realign. (See par 43 and 44.)
	Signals arriving from more than one direction due to reflections from nearby objects.	Test antenna out doors in area free from obstacles.

Section II. REPAIRS

41. Replacement of Parts

Most of the parts of Antenna AT-339/PRC or Antenna AT-340/PRC are readily accessible and are easily replaced if found to be faulty. Before attempting any replacement however, read the precautions in paragraph 38. If the coupling transformer is replaced, realignment will be necessary. If a resistor in the attenuator is faulty, replace the whole attenuator, even though an identical resistor is available, because the distributed capacity between the various parts of the wiring and the body of the attenuator and the exact resistance values are too critical for replacement.

42. Disassembly and Lubrication of Equipment at Field Maintenance Level

a. The attenuator switching mechanism has been lubricated at

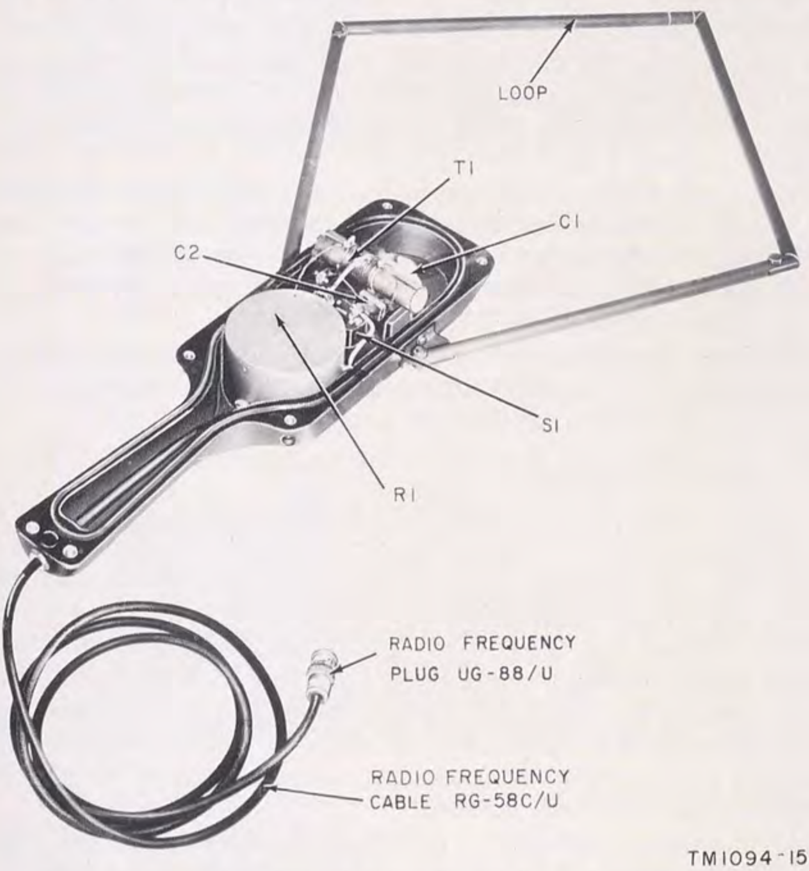

Figure 15. Interior view of the antenna housing.

the factory and normally should not require further attention.

b. To disassemble, remove the six screws from the case and pull off the back half of the case. This exposes all parts.

Section III. ALIGNMENT PROCEDURES

43. Test Equipment Required for Alignment

a. Signal Generator. The signal generator should be an accurately calibrated instrument producing frequency modulated rf signals such as Signal Generator AN/URM-48. The signal generator used must have a continuously variable output, and cover the range of frequencies covered by the antennas. For Antenna AT-339/PRC this is 38.0 to 55.4 mc. For Antenna AT-340/PRC this is 20.0 to 39.0 mc.

b. Screen Room. For best results in aligning Antenna AT-339/PRC and AT-340/PRC a doubly shielded copper screened room with overhead transmission line, specially built for aligning and testing these homing antennas, should be used. If the screened room is not available, the alignment and final testing must be made in the center of a large open field. There should be no obstructions of any type in the vicinity of the test area, such as trucks, hills, telephone or power lines.

c. Output Meter. The output meter should be a battery operated electronic voltmeter that will respond to direct current and have a full scale deflection of 3 to 5 volts, and an input resistance of at least one megohm such as Electronic Voltmeter AN/PRM-15 with Battery Power Supply PP-1247/PRM-15.

d. Radio Set. For aligning Antenna AT-340/PRC it is necessary to use Radio Set AN/PRC-8 and AN/PRC-9, for Antenna AT-339/PRC, Radio Set AN/PRC-10 is necessary.

44. Alignment Procedure

a. If an open field is used, connect the signal generator to a vertical antenna (a vertical piece of wire 5 or 6 feet long will do) and place the generator about 20 feet from the homing antenna and radio set. If the generator is fed from an external source of power through a long power cord, place the homing antenna and radio set on the opposite side of the generator from the side which the cable enters. Fasten the homing antenna to a nonconducting support, such as a wooden post or stick, so that antenna is in a vertical (normal operating) position and the center of the loop is at least 4 feet above the ground.

b. The screen room should be inclosed by a double screen. The outside screen should be well grounded and the inside screen insulated from the ground. The transmission line should be heavy tubing or rigid wire so that it will not sag from an overhead position. The transmission line is erected in the center of the screen room and suspended with insulators from the ceiling. The distance to the side walls should be equal to or greater than the distance to the top of the screen room. The line is terminated in a noninductive resistor connected to the grounded screen and equal to the characteristic impedance of the line as calculated from the following formula:

$$ZL = 138 \log_{10} \frac{4dc}{dw}$$

Where: ZL = characteristic impedance of the transmission line in ohms.

dc = distance in inches from the transmission line to the ceiling of screen room.

dw = diameter of wire in inches; should be at least .08 inch.

The other end of the line should be connected to a signal generator outside of the screen room. The ground side of the signal generator is connected to the grounded screen. The antenna is fastened to a nonconducting support in a vertical position directly under the line and in the center of the room. When taking readings, stay below the plane of the antenna and place the radio set directly beneath the antenna.

c. Perform the alignment as follows:

(1) Remove the back cover of the homing antenna (before fastening to the support if necessary), and connect the cable to the AUX ANT terminal of the radio set.

(2) Tune the signal generator and the radio set to the center of the antenna frequency range (46 mc for Antenna AT-339/PRC or 28 mc for Antenna AT-340/PRC).

(3) Connect the output meter between the limiter grid and ground of the radio set, with the lead between the squelch tube and the limiter grid disconnected (pin 4 of U105).

(4) Set the SENSE-NORMAL switch to NORMAL and tune the homing antenna for equal responses on opposite sides of the loop (see operating instructions par. 14 and 15), or as close to equal responses as possible.

Note. Use the meter scale and not the headset for responses, but leave the headset connected to the radio set.

(5) Rotate the antenna 90° and obtain a null. Turn up generator output if necessary.

(6) Adjust the secondary winding of the transformer for maximum null indication by moving the secondary back

and forth. Maximum null indication is indicated by a minimum reading on the output meter. When the winding is close to the balanced position, movements of a few hundredths of an inch will make a large difference. Keep rotating the antenna back and forth a few degrees to keep the antenna in null position.

Section IV. FINAL TESTING

45. General

This section is intended as a guide to be used in determining the quality of a repaired Homing Antenna AT-339/PRC and Antenna AT-340/PRC. The minimum test requirements outlined in paragraphs 48 and 52 may be performed by maintenance personnel with adequate test equipment and the necessary skills. Repaired equipment meeting these requirements will furnish uniformly satisfactory operation.

46. Test Equipment Required for Final Testing

All test equipment used for alignment (par. 43) is also used for final testing. In addition, the nonconducting support must be provided with a turntable with an accurately calibrated azimuth scale so that the amount of rotation can be observed within an accuracy of 1°.

47. Preparation

a. Put the azimuth indicating turntable, radio set, and antenna in the screen room.

b. Connect the output of the signal generator to the overhead transmission line.

c. Mount the antenna on the turntable.

d. Place the turntable and antenna under the transmission line so that the antenna is centered on the line and less than a foot below it.

e. Connect Electronic Voltmeter AN/PRM-15 to the limiter grid in the receiver. Disconnect the squelch lead from the limiter.

f. Connect the antenna to the radio set (par. 10*f*). Use AN/PRC-10 for the AT-339/PRC, and AN/PRC-8 and -9 for AT-340/PRC.

48. Frequency Settings

For the Antenna AT-339/PRC, tune the signal generator to 38.0, 47.0, 51.0, and 55.0 mc. For each setting, resonate the loop by turning the knob of the tuning condenser on the front of the case for maximum response of the electronic voltmeter. Check the calibration of the dial. Repeat for Antenna AT-340/PRC. Use frequencies of 20.0, 24.0, 28.0, 32.0, 35.0, and 39.0 mc.

49. Null Ratio Test

a. Test Setup. Use the same test setup as indicated in paragraph 47.

b. Procedure.

(1) Orient the antenna for maximum pick-up as indicated on the electronic voltmeter.

(2) Tune the antenna for maximum response.

(3) Adjust the signal generator output to a minimum reference level (convenient reading) on the voltmeter.

(4) Record the reading of the output attenuator of the signal generator.

(5) Rotate the antenna for minimum pick-up.

6) Increase the generator output to the same reference level on the voltmeter. The ratio between maximum and minimum readings should be 75:1. This is the null ratio. Repeat the test at all frequencies given in paragraph 48.

50. Bearing Accuracy

a. Test Setup. Use the same test setup indicated in paragraph 47.

b. Procedure.

(1) Rotate the antenna to a null position as indicated by the voltmeter.

(2) Record azimuth scale reading in degrees.

(3) Rotate antenna 180° to the opposite null. The second null should be 180° from the first null within plus or minus 3°. This test should be repeated for all frequencies given in paragraph 48.

51. Sense Indication

a. Test Setup. Use the same setup as indicated in paragraph 47.

b. Procedure.

(1) Set SENSE-NORMAL switch in NORMAL position.

(2) Orient the antenna for maximum pick up under the transmission line and tune to resonance.

(3) Set the SENSE-NORMAL switch to SENSE position and record the voltmeter reading as a reference level.

(4) Record the reading of the output attenuator of the signal generator.

(5) Rotate the antenna 180°.

(6) Change the signal generator output to obtain the same reference level reading on the electronic voltmeter as before. The ratio between the two signal generator readings should be 3.17 or 1 to 10 db.

52. Attenuation Tests

a. Test Setup. Use the same test setup as indicated in paragraph 47.

b. Procedure.

(1) Adjust the antenna for maximum pick-up.

(2) Tune the antenna to resonance.

(3) Set the signal generator to minimum usuable reference level on the electronic voltmeter with ATTENUATOR set to 0 position.

(4) Move the ATTENUATOR switch to No. 1 position.

(5) Increase the signal generator output to obtain the same reference level reading on the voltmeter. The voltage ratio between the two output readings of the signal generator should be 1.78 to 1 or 5 db.

(6) Repeat the above procedure for positions 2, 3, and 4. These steps should give a voltage ratio of 5.63, 17.8, and 56 to 1 which is an attenuation of 15, 25, and 35 db.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

53. Disassembly

If the antenna is connected to a radio set, disconnect it and collapse the loop.

54. Repacking for Shipment or Limited Storage

To prepare the equipment for shipment or limited storage, reverse the procedure given in paragraph 9 for uncrating and unpacking.

Section II. DEMOLITION OF MATERIAL TO PREVENT ENEMY USE

55. General

Demolition of the equipment will be accomplished only upon order of the commander. The demolition procedures outlined in paragraph 56 will be used to prevent the enemy from salvaging this equipment.

56. Methods of Destruction

a. Smash. Smash the case capacitors, transformers, switch, and attenuator; use sledges, axes, handaxes, pickaxes, hammers, crowbars, or heavy tools.

b. Cut. Cut the cable assembly; use axes, handaxes or machetes.

c. Burn. Burn the bag, case, wiring, transformer, and technical manuals; use gasoline, kerosene, oil, flame throwers, or incendiary grenades.

d. Bend. Bend the loop sections and handset clip.

e. Disposal. Bury or scatter the destroyed parts in slit trenches, fox holes, or other holes or throw them into streams.

INDEX