TM 11-513

WAR DEPARTMENT TECHNICAL MANUAL

RADIO SET AN/CRD-3

WAR DEPARTMENT · 31 JULY 1945

THIS ADDENDA WILL REMAIN IN EFFECT ONLY UNTIL THE INFORMATION IS PUBLISHED IN AN OFFICIAL WAR DEPARTMENT PUBLICATION.

ADDENDA

31 July 1945

ADDENDA TO

TM 11-513

RADIO SET AN/CRD-3

The following information corrects portions of TM 11-513, 31 July 1945. Personnel using the equipment and having custody of this technical manual will enter suitable notations beside each affected paragraph in the technical manual to indicate the presence of this information.

Page 18. Par. 9. Change nomenclature of counterpoise in paragraph heading to read: MX-318/CRD-3.

Page 18. Par. 9. In line 1 of subparagraph a, change "MC-318/" to read: MX-318/.

Page 37. Par. 17. In line 9 of subparagraph f(1), change "Case CY-253/CRD-3" to read: Chest CH-211.

Page 37. Par. 17. In line 2 of subparagraph f(2), change "Case CY-253/CRD-3" to read: Chest CH-211.

Page 38. Par. 19. Change paragraph heading to read:

19. BEARING INDICATOR ID-121/CRD-3.

Page 77. Transpose columns on this page.

Page 177. Par. 135. Change "Signal Generator S-72-( )" to read: Signals Generators I-72-G and I-72-H.

Page 191. Par. 147. Three lines from the bottom of page, change "Case CH-211" to read: Chest CH-211.

Page 192. Par. 147. Add the following after "Chest CY-409/U":

Chest CY-528/CRD-3.

Page 196. Par. 147. In lines 18 and 24, delete ( ) after "Radio Set AN/CRD-3( )".

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RADIO SET AN/CRD-3

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WAR DEPARTMENT,

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TM 11-513, Radio Set AN/CRD-3, is published for the information and guidance of all concerned.

[A. G. 300.7 (4 Jun 45).]

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,

Chief of Staff.

OFFICIAL:

EDWARD F. WITSELL,

Major General,

Acting The Adjutant General.

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

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DESTRUCTION NOTICE

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

WHEN - When ordered by your commander.

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

2. Cut - Use axes, handaxes, machetes.

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

4. Explosives - Use firearms, grenades, TNT.

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

USE ANYTHING IMMEDIATELY AVAILABLE FOR DESTRUCTION OF THIS EQUIPMENT.

WHAT - 1. Smash - All tubes, meters, switches, relays, instrument boards, castings, heaters, shelters, chests, gasoline engines, generator; and every electrical and mechanical part whether moving or fixed.

2. Cut - All wires, cables, fuel lines.

3. Burn - Charts, diagrams, and manuals.

4. Bury or scatter - Any or all of the above pieces after destroying.

DESTROY EVERYTHING

SAFETY NOTICE

VOLTAGES USED IN THIS EQUIPMENT ARE HIGH ENOUGH TO ENDANGER LIFE AND MAY BE FATAL IF CONTACTED BY OPERATING PERSONNEL. OPERATORS MUST BE CAREFUL NOT TO CONTACT HIGH-VOLTAGE PLATE CIRCUITS OR 115-VOLT, A-C INPUT CONNECTIONS WHILE CHECKING OR SERVICING EQUIPMENT. A FEW SERVICE CHECKS MUST BE MADE INSIDE THE SET WITH THE HIGH VOLTAGE ON. WHEN MAKING THESE CHECKS, ALWAYS HAVE THE PRESENCE AND ASSISTANCE OF ANOTHER PERSON CAPABLE OF RENDERING AID. KEEP ONE HAND IN YOUR POCKET WHILE MAKING HIGH-VOLTAGE MEASUREMENTS. THIS WILL PREVENT TOUCHING THE ELECTRICAL CIRCUIT WITH MORE THAN ONE PART OF THE BODY AT ONE TIME. MAKE CERTAIN THAT POWER IS TURNED OFF WHEN DISASSEMBLING ANY PART OF THE EQUIPMENT.

First Aid for Electric Shock

RESCUE.

In case of electric shock, shut off the high voltage at once and ground the circuits. If the high voltage cannot be turned off without delay, free the victim from contact with the live conductor as promptly as possible. Avoid direct contact with either the live conductor or the victim's body. Use a dry board, dry clothing, or other nonconductor to free the victim. An ax may be used to cut the high-voltage wire. Use extreme caution to avoid the resulting electric flash.

SYMPTOMS.

a. Breathing stops abruptly in electric shock if the current passes through the breathing center at the base of the brain. If the shock has not been too severe, the breath center recovers after a while and normal breathing is resumed, provided that a sufficient supply of air has been furnished meanwhile by artificial respiration.

b. The victim is usually very white or blue. The pulse is very weak or entirely absent and unconsciousness is complete. Burns are usually present. The victim's body may become rigid or stiff in a very few minutes. This condition is due to the action of electricity and is not to be considered rigor mortis. Artificial respiration must still be given, as several such cases are reported to have recovered. The ordinary and general tests for death should never be accepted.

TREATMENT.

a. Start artificial respiration immediately. At the same time send for a medical officer, if assistance is available. Do not leave the victim unattended. Perform artificial respiration at the scene of the accident, unless the victim's or operator's life is endangered from such action. *In this case only*, remove the victim to another location, but no farther than is necessary for safety. If the new location is more than a few feet away, artificial respiration should be given while the victim is being moved. If the method of transportation prohibits the use of the Shaeffer prone pressure method, other methods of resuscitation may be used. Pressure may be exerted on the front of the victim's diaphragm, or the direct mouth-to-mouth method may be used. Artificial respiration, once started, must be continued, without loss of rhythm.

b. Lay the victim in a prone position, one arm extended directly overhead, and the other arm bent at the elbow so that the back of the hand supports the head. The face should be turned away from the bent elbow so that the nose and mouth are free for breathing.

c. Open the victim's mouth and remove any foreign bodies, such as false teeth, chewing gum, or tobacco. The mouth should remain open, with the tongue extended. Do not permit the victim to draw his tongue back into his mouth or throat.

d. If an assistant is available during resuscitation, he should loosen any tight clothing to permit free circulation of blood and to prevent restriction of breathing. He should see that the victim is kept warm, by applying blankets or other covering, or by applying hot rocks or bricks wrapped in cloth or paper to prevent injury to the victim. The assistant should also be ever watchful to see that the victim does not swallow his tongue. He should continually wipe from the victim's mouth any frothy mucus or saliva that may collect and interfere with respiration.

e. The resuscitating operator should straddle the victim's thighs, or one leg, in such manner that:

(*1*) the operator's arms and thighs will be vertical while applying pressure on the small of the victim's back;

(*2*) the operator's fingers are in a natural position on the victim's back with the little finger lying on the last rib;

(*3*) the heels of the hands rest on either side of the spine as far apart as convenient without allowing the hands to slip off the victim;

(*4*) the operator's elbows are straight and locked.

f. The resuscitation procedure is as follows:

(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*2*) Swing back, suddenly releasing pressure, and sit on the heels.

(*3*) After 2 seconds rest, swing forward again, positioning the hands exactly as before, and apply pressure for another second.

g. The forward swing, positioning of the hands, and the downward pressure should be accomplished in one continuous motion, which requires 1 second. The release and backward swing require 1 second. The addition of the 2-second rest makes a total of 4

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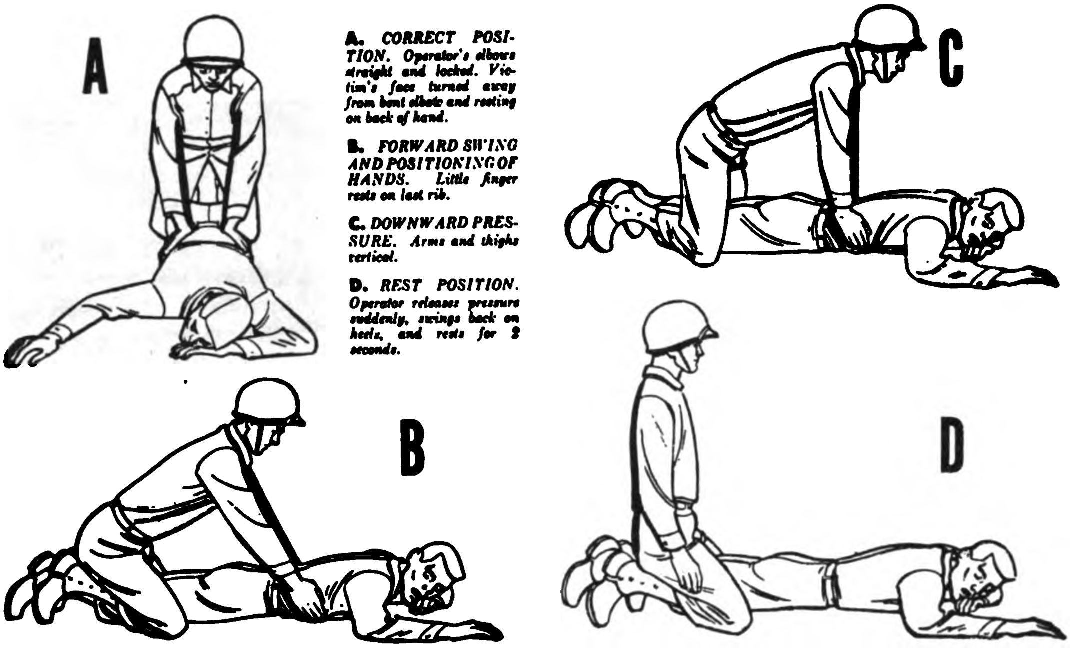

A. CORRECT POSITION. *Operator's elbows straight and locked. Victim's face turned away from bent elbow and resting on back of hand.*

B. FORWARD SWING AND POSITIONING OF HANDS. *Little finger rests on last rib.*

C. DOWNWARD PRESSURE. *Arms and thighs vertical.*

D. REST POSITION. *Operator releases pressure suddenly, swings back on heels, and rests for 2 seconds.*

seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence of the cycle, he should count the seconds aloud, speaking distinctly and counting evenly in thousands. Example: one thousand and one, one thousand and two, etc.

h. Artificial respiration should be continued until the victim regains normal breathing or is pronounced dead by a medical officer. Since it may be necessary to continue resuscitation for several hours, relief operators should be used if available.

RELIEVING OPERATOR.

The relief operator kneels beside the operator and follows him through several complete cycles. When the relief operator is sure he has the correct rhythm, he places his hands on the operator's hands without applying pressure. This indicates that he is ready to take over. On the backward swing, the operator moves and the relief operator takes his position. The relieved operator follows through several complete cycles to be sure that the new operator has the correct rhythm. He remains alert to take over instantly if the new operator falters or hesitates on the cycle.

STIMULANTS.

a. If an inhalant stimulant is used, such as aromatic spirits of ammonia, the individual administering the stimulant should first test it himself to see how close he can hold the inhalant to his own nostril for comfortable breathing. Be sure that the inhalant is not held any closer to the victim's nostrils, and then for only 1 or 2 seconds every minute.

b. After the victim has regained consciousness, he may be given hot coffee, hot tea, or a glass of water containing ½ teaspoon of aromatic spirits of ammonia. *Do not give any liquids to an unconscious victim.*

CAUTIONS.

a. After the victim revives, keep him LYING QUIETLY. Any injury a person may have received may cause a condition of shock. Shock is present if the victim is pale and has a cold sweat, his pulse is weak and rapid, and his breathing is short and gasping.

b. Keep the victim lying flat on his back, with his head lower than the rest of his body and his hips elevated. Be sure that there is no tight clothing to restrict the free circulation of blood or hinder natural breathing. Keep him warm and quiet.

c. A resuscitated victim must be watched carefully as he may suddenly stop breathing. *Never leave a resuscitated person alone until it is CERTAIN that he is fully conscious and breathing normally.*

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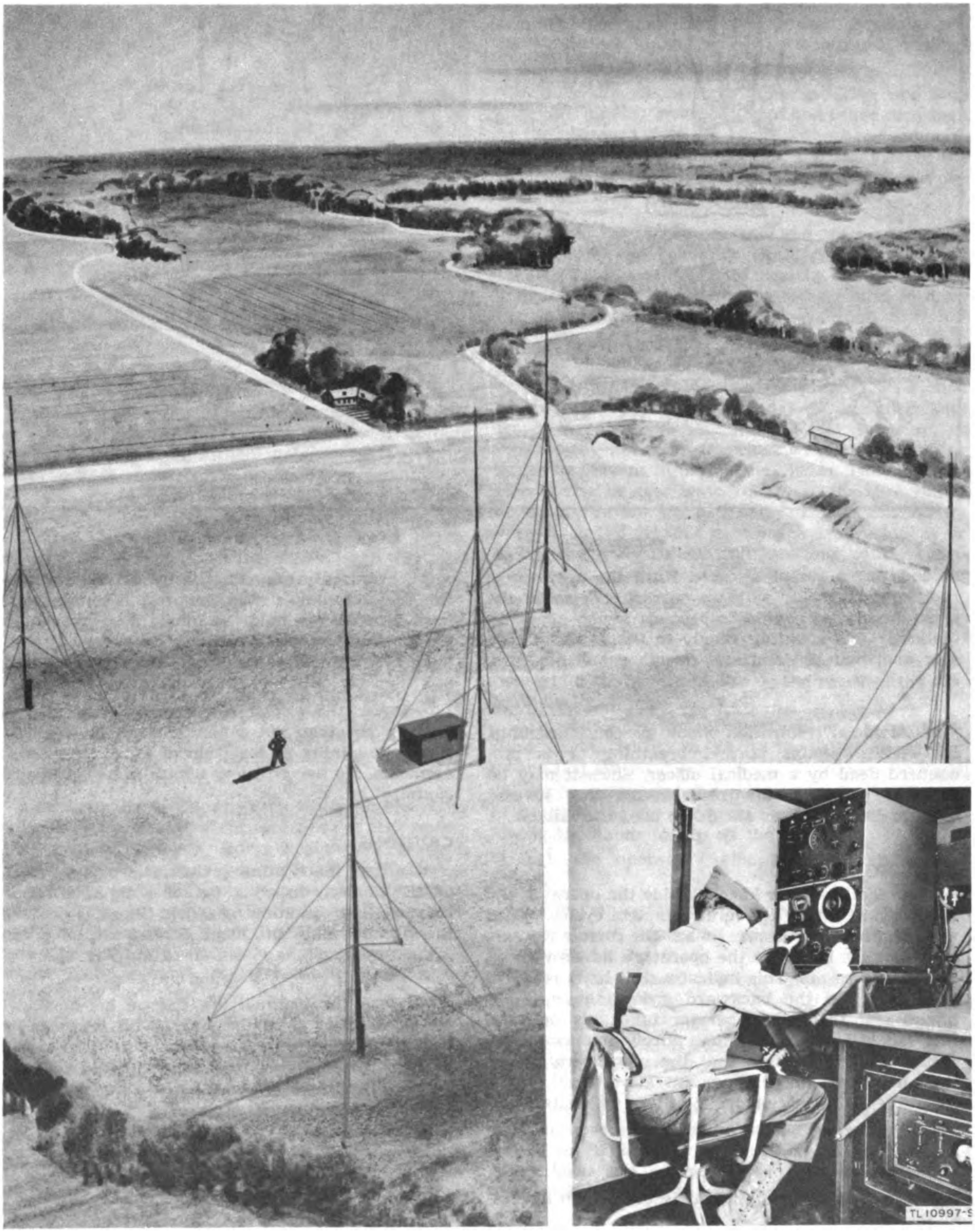

Figure 1. Radio Set AN/CRD-3.

PART ONE

INTRODUCTION

SECTION I

DESCRIPTION OF RADIO SET AN/CRD-3

1. GENERAL.

a. Radio Set AN/CRD-3 consists of a receiving and indicating system, crossed-U Adcock antennas, a sense antenna, and accessory equipment. It is designed for medium frequency radio direction finding; transportable by air or vehicle, and may be operated from commercial power or from the power generator supplied with the radio set.

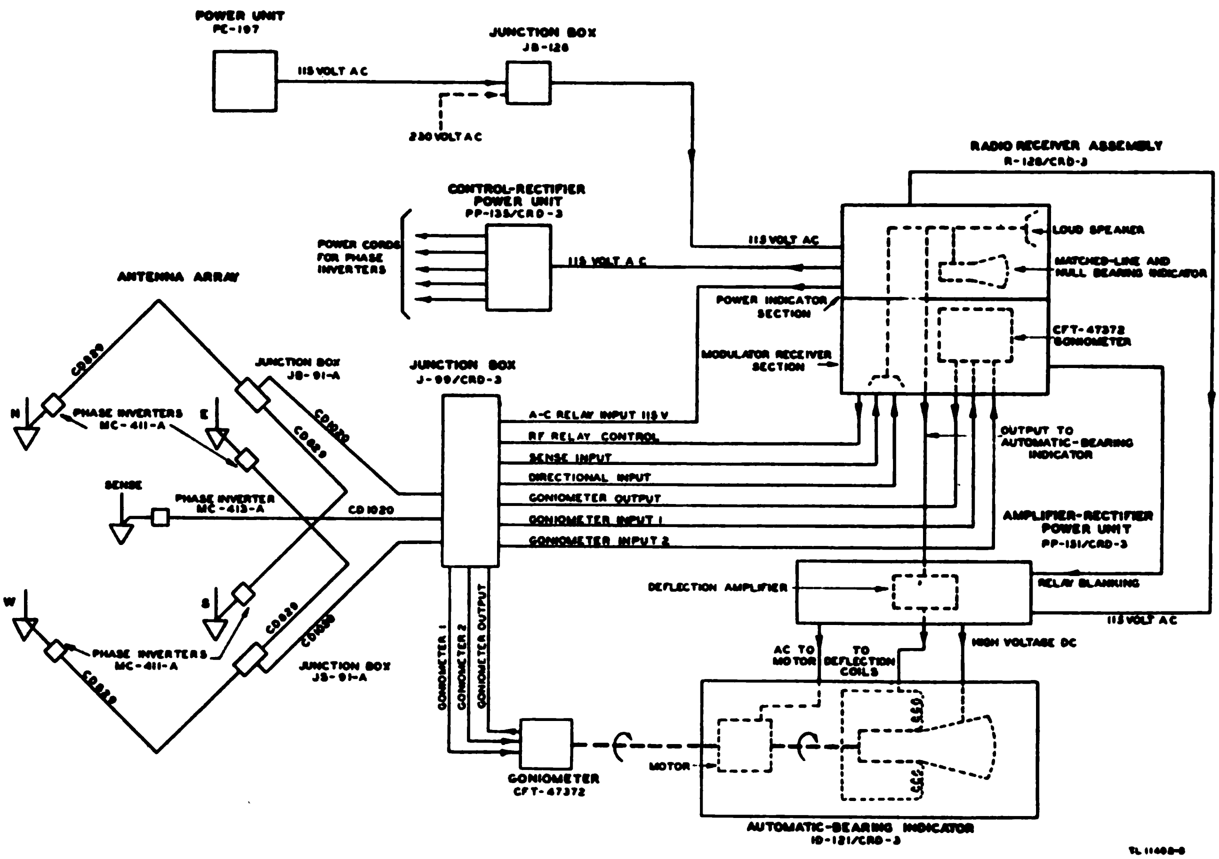

Figure 2. Block diagram of Radio Set AN/CRD-3.

b. The incoming signal is collected by an antenna array oriented with respect to north. Either of two goniometers combines the outputs of the antennas in proper relationship; one is used in taking azimuths manually, the other automatically. Three modes of indicating azimuths are provided:

(1) Matched-line indication on the face of a 2-inch cathode-ray tube through the use of a manually operated goniometer.

(2) Instantaneous propeller-shaped patterns on the face of a 5-inch cathode-ray tube through the use of a motor driven goniometer.

(3) Null method which can be observed aurally on the loudspeaker or visually on the 2-inch cathode-ray tube through the use of the manually operated goniometer.

c. Figure 2 is a simple block diagram showing the relationship between various components of the direction finder.

(1) The antenna array consists of five Antenna Assemblies AS-204/CRD-3. The antennas are approximately 64 feet high. Four of these are used for direction finding and are erected at the corners of a square whose diagonals measure 180 feet. The fifth antenna is erected in the center of the other four and functions as a sense antenna.

(2) Phase Inverters MC-411-A are installed at the base of each directional antenna. Phase Inverter MC-413-A is installed at the base of the sense antenna. The phase inverters act as coupling units between the antennas and transmission lines.

(3) Control-Rectifier Power Unit PP-135/CRD-3 provides the proper voltages for the operation of the phase inverters.

(4) Goniometers CFT-47372 combine the antenna outputs in proper relationship and feed them to the receiver input.

(5) Radio Receiver Assembly R-128/CRD-3 consists of two sections: the power indicator section, and the modulator section. The receiver assembly may be used independently for monitoring purposes, as well as for matched-line and null indication.

(6) Bearing Indicator ID-121/CRD-3 is the automatic or instantaneous azimuth indicator.

(7) Amplifier-Rectifier Power Unit PP-151/CRD-3 provides the alternating current and the rectified, filtered direct current voltages required for operation of the automatic bearing indicator. The indicator deflection coil amplifier and its power supply are also included in this power unit.

2. TECHNICAL CHARACTERISTICS OF RADIO SET AN/CRD-3.

Types of signals received..........c-w, m-c-w, i-c-w

Azimuth indications.Instantaneous automatic visual, manual matched-line visual, aural null, and visual null

Power requirements..0.5 kva at 115 volts, single-phase, 60-cycle, a-c

Frequency range:

Band 1.......250 to 610 kc

Band 2.......610 to 1,500 kc

Receiver type......superheterodyne

Receiver intermediate frequency........175 kc

Selectivity (two times down)

At 1000 kc (SHARP).....3.0 kc

At 1000 kc (BROAD).....7.5 kc

At 430 kc (SHARP)......2.3 kc

At 430 kc (BROAD)......5.0 kc

Sensitivity for ±1° repeatability:

SHARP selectivity position:

At 1500 kc......4 microvolts per meter

At 1000 kc......7 microvolts per meter

At 750 kc.......9 microvolts per meter

At 500 kc......12 microvolts per meter

At 250 kc......15 microvolts per meter

Power output:

Undistorted headphone output.......15 milliwatts

Maximum loudspeaker output (less than 5 percent harmonic distortion).1.5 watts

Antenna

Directional....Crossed-U Adcock, monopole type masts, with phase inverters

Sense..........Monopole type with phase inverter

3. TABLE OF COMPONENTS.

This table is located in the appendix, paragraph 147.

4. PACKAGING DATA.

This information is located in the appendix, paragraph 148.

5. DESCRIPTION OF MAJOR COMPONENTS.

a. Antenna System. The antenna system (fig. 1) used with Radio Set AN/CRD-3 is a type known as a U-Adcock system and consists of the following components:

(1) *Antenna Assembly AS-204/CRD-3.* The five monopoles of the system, consisting of two directional pairs and a sense antenna, are exactly alike. Four are installed at the corners of a square, whose diagonals are 180 feet, and the fifth at the intersection of the diagonals. Each monopole consists of a nine-section mast, approximately 64 feet high (fig. 3). The mast is supported on a swivel type base of steel. The base comprises a double tubular cast-steel socket and a steel plate to which a hinge support for the socket is welded. The socket is provided with an insulating sleeve for insulating the antenna mast. A silver-plated stripe on the bottom mast section indicates where the mounting collar for the phase inverter is to be fastened. A guy rope and chain assembly together with a stake type ground anchor forms an effective hold-down system for each mast. A 9 foot gin pole of aluminum alloy tubing that plugs into the mast base is used to aid in the raising of the antenna mast.

(2) *Antenna Mooring Platform AB-82/CRD-3.* This platform provides a more solid footing when the antennas are erected on soft ground. It is made of wood, 4 feet square, and equipped with four steel mounting plates which are threaded and so spaced that the mast base can be bolted to it. In ad-

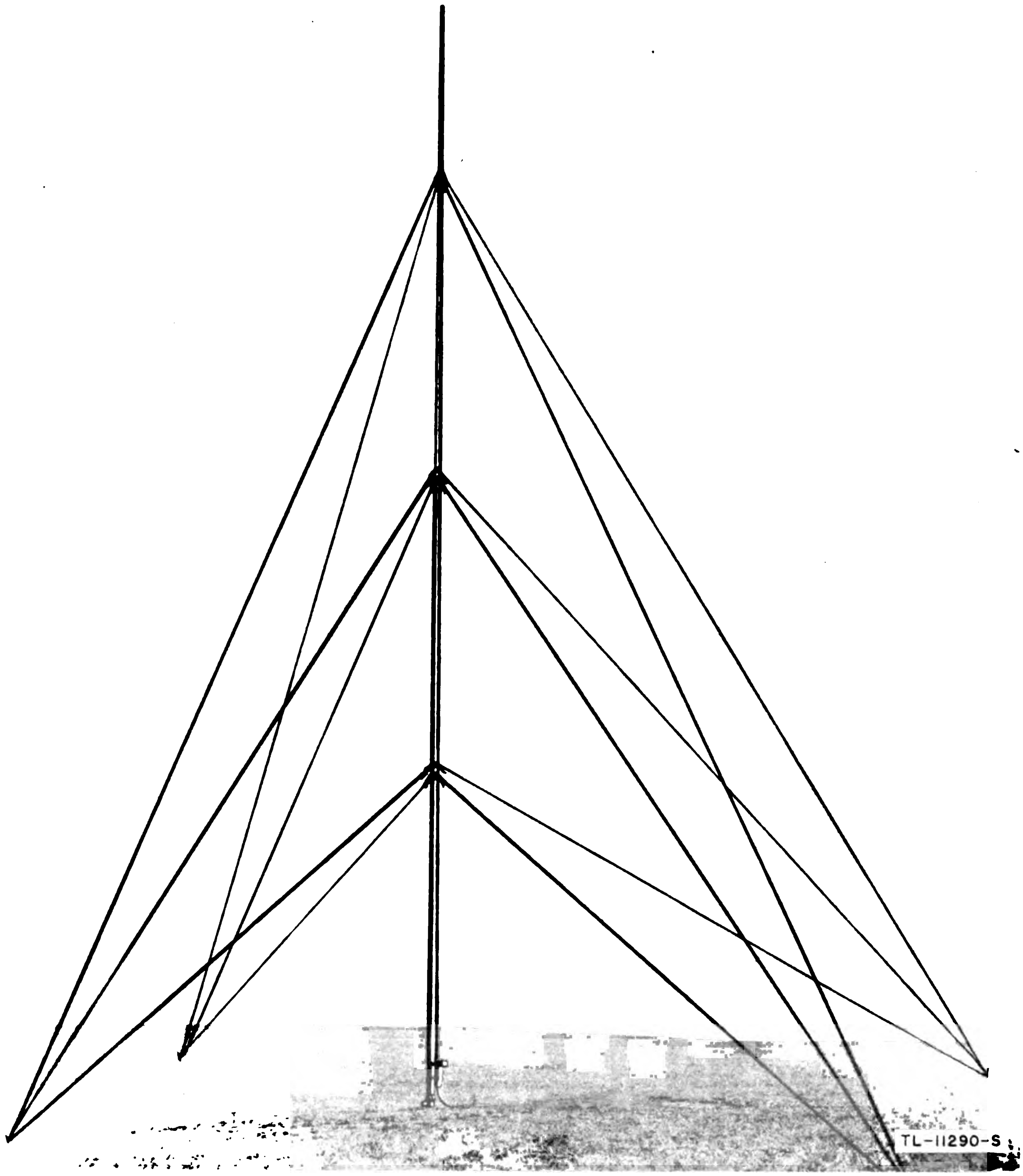

Figure 3. Antenna Assembly AS-204/CRD-3, (one monopole).

dition, each of the four corners of the platform has two 1/2-inch bolt holes so that the platform can be fastened to wooden piles by means of 1/2-inch lag screws (fig. 4).

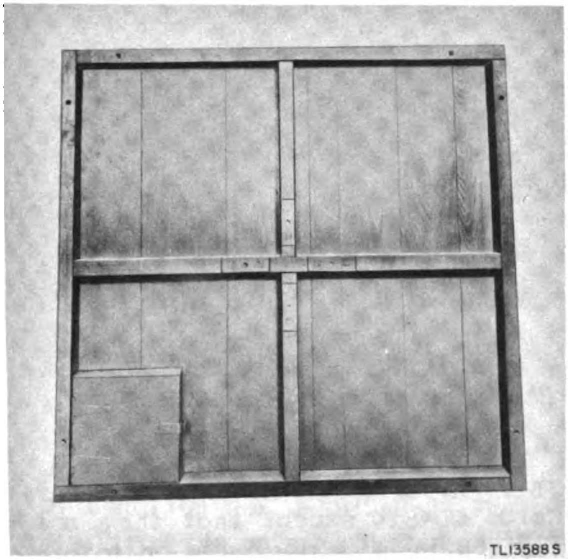

Figure 4. Mooring Platform AB-82/CRD-3.

(3) Counterpoise MX-318/CRD-3. Each antenna has its separate counterpoise system of the mat type connected to the respective phase inverter casing (figs. 20 and 22). Each of the five counterpoise mats is composed of a 32-foot square meshwork of tinned copper braid conductors at right angles to each other, and fastened together by means of male and female United Carr "Dot" fasteners. The counterpoise is attached to nine ground stakes by means of six-inch lengths of tinned copper braid. Eight of the stakes are equally spaced around the outer edge of the counterpoise, and one of the stakes is placed at approximately the center of the counterpoise.

(4) Phase Inverters MC-411-A and MC-413-A. Two types of phase inverter antenna coupling units (MC-411-A and MC-413-A) are used with Radio Set AN/CRD-3. One type (MC-411-A) (fig. 5) has two tubes, one in use and one spare, and is used with each of the four corner antennas. The other (MC-413-A) (fig. 6) has four tubes, two in use and two spares, and is used with the central or sense antenna. Phase Inverter MC-413-A is actually two Phase Inverters MC-411-A in a single mount casting with inputs connected in parallel. However, in Radio Set AN/CRD-3 only one of the outputs of MC-413-A is used. The unused output receptacle is covered with a metal cap. Each phase inverter is mounted in a cylindrical aluminum casting with overall dimensions of 7-1/4 and 12-3/4 inches. The internal radio-frequency (r-f) section is a plug-in unit, and all power and r-f connections are made simultaneously when it is properly

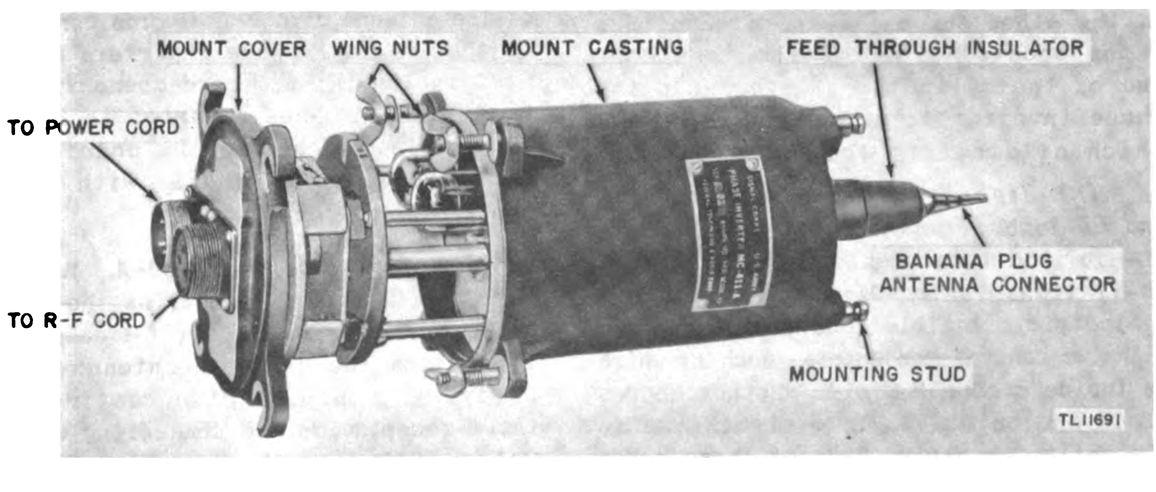

Figure 5. Dismantled view of Phase Inverter MC-411-A.

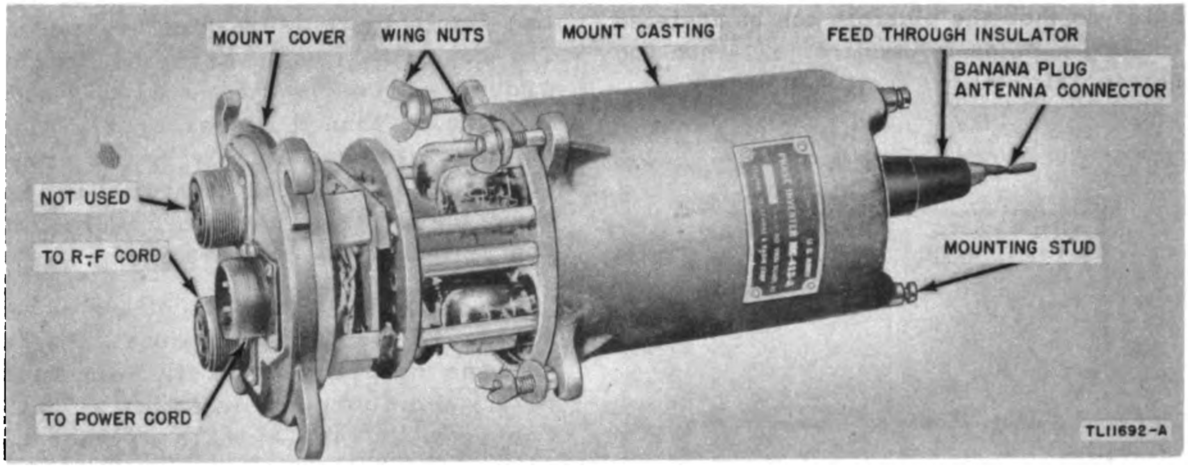

Figure 6. Dismantled view of Phase Inverter MC-413-A.

positioned and pushed into place in the mount casting. A cast-aluminum mount cover supports a terminal board to which the r-f unit makes connection on the inside. The AN type receptacles for the connecting cords are on the outside and each is color-coded to correspond to mating receptacles. Four hook-like extensions engage 5/16-inch threaded posts fastened to the cylindrical mount casting. Wingnuts and washers on the post hold the cover in place. A gasket on the cover keeps out moisture. A large banana plug for making connection to the banana jack on the mounting collar is supported by a feed-through insulator at the other end of the mount casting. Three grooved studs on the insulator end of the cylindrical cover hold the phase inverter to the mounting collar which attaches to the antenna mast.

(5) High-Frequency Cords CD-829 and CD-1020 (Transmission Lines). Cord CD-829 is a twin coaxial high-frequency (h-f) transmission line. It is a solid dielectric, flexible cable, 92 feet long with two central conductors, each of which is inside a copper braid. Another copper braid and outer vinylite sheath encase the entire assembly. Four of these cords are used to connect the phase inverters on the antenna masts to Junction Boxes JB-91-A. Cords CD-1020 are similar to Cords CD-829 except that they are 40 feet in length. Two Cords CD-1020 connect between Junction Boxes JB-91-A and Junction Box J-99/CRD-3. The third Cord CD-1020 connects between sense Phase Inverter and Junction Box J-99/CRD-3. Each cord is color-coded and labeled at both ends with its CD number on a metal band.

(6) Power Cords CX-402/CRD-3. From the Control-Rectifier Power Unit PP-135/CRD-3, five 5-conductor power cables are used to supply power to the individual phase inverter coupling units of the antenna array. The cords connecting to the MC-411-A phase inverters are 135 feet in length; the cord connecting to the MC-413-A phase inverter is 40 feet in length. Each cord is color-coded and labeled at both ends with its CD number on a metal band.

(7) Junction Box JB-91-A. Junction Box JB-91-A (fig. 7) contains the cross-over connections for the r-f transmission lines from the U-Adcock antenna of the array. It consists of a casting with three receptacles and connecting wiring. Color coding on the cover plate next to the receptacles corresponds to the coding of the mating plugs.

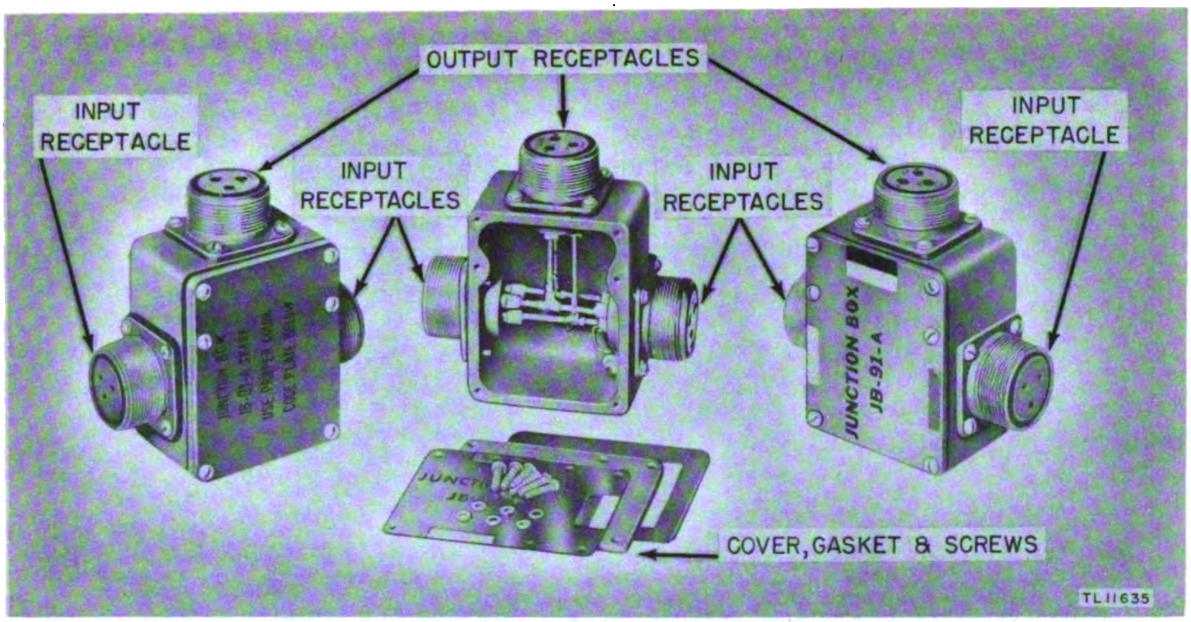

Figure 7. Junction Box JB-91-A.

b. Junction Box J-99/CRD-3. The r-f cables from the antenna system and from the receiver and indicator goniometers connect to Junction Box J-99/CRD-3. Photographs of the junction box are shown in figures 8 and 9 and a circuit diagram in figure 79. An electrically operated rotary switch inside the junction box switches the antenna, goniometer, and radio receiver assembly circuits to produce the three types of azimuth indication. The junction box is made of 1/16-inch sheet steel on a rigid steel framework. It is finished in baked gray wrinkle enamel and has over-all dimensions of 18 by 10-1/2 by 6-3/4 inches. The AN receptacles on the bottom connect to the receiver sense and directional input channels, and to the switch con-

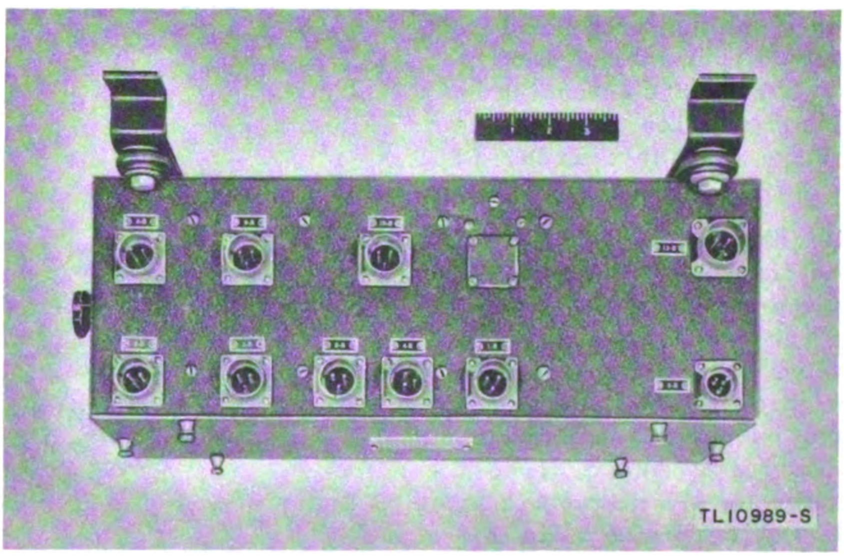

Figure 8. Junction Box J-99/CRD-3, bottom view.

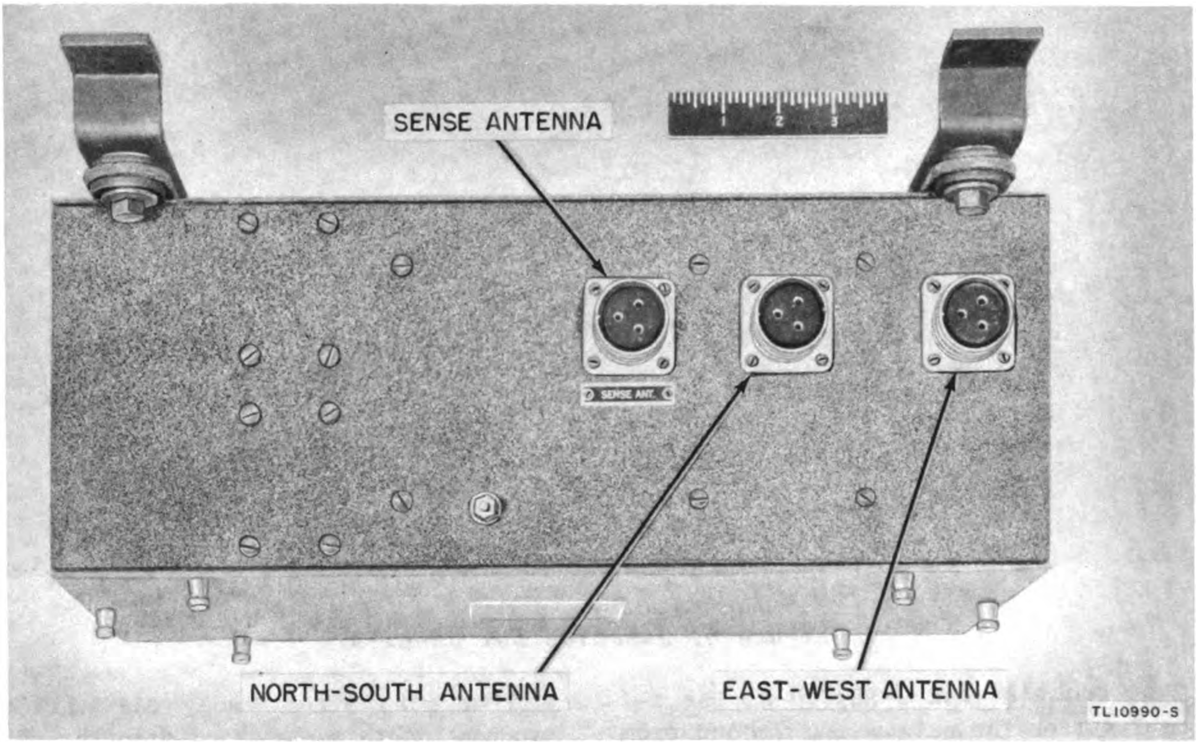

Figure 9. Junction Box J-99/CRD-3, top view.

trol circuits through suitable cables. Three AN type connectors on top feed the h-f transmission lines to the terminal strips inside the junction box. The individual connectors on top and bottom are color-coded, and numbered for easy identification of the connecting cables. Shields separate the junction box into five individual compartments. A knob on the end of a switch shaft extension on one side of the junction box permits manual operation of the switch, if required.

c. Goniometer Navy No. CFT-47372. The goniometer is a rotating r-f transformer which combines the outputs of the antenna assemblies in the proper phase and amplitude relationships and supplies the output from a rotor to the directional input of the radio receiver. A photograph is shown in figure 10 and a circuit diagram in figure 81. The components of Goniometer CFT-47372 are inside a die-cast aluminum housing 8-1/8 by 5-3/4 by 5-3/4 inches. Three AN-3102-5P type receptacles on the top connect to h-f cables from the switching circuits in the junction box. The indicator goniometer is held to the rear of the bearing indicator by knurled thumbscrews and is driven by the bearing indicator motor. Another Goniometer CFT-47372 is mounted inside the modulator receiver section of the Radio Receiver Assembly R-128/CRD-3 and is coupled to a 7-1/2 inch, 360° calibrated dial on the front panel.

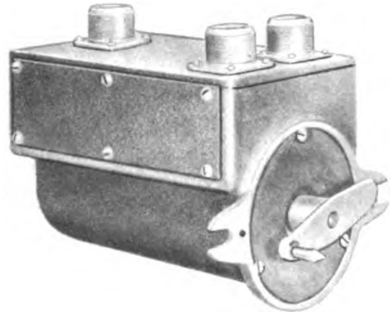

Figure 10. Goniometer CFT-47372.

d. Radio Receiver Assembly R-128/CRD-3. Radio Receiver Assembly R-128/CRD-3 is a highly sensitive superheterodyne and consists of two units (modulator receiver and power indicator) mounted one above the other in a single aluminum case 19 inches wide, 19 inches deep, and 26-1/4 inches high. The lower unit is the modulator receiver and the upper the power indicator. A photograph of the radio receiver assembly is shown in figure 11 and a block diagram is shown in figure 82. Circuit diagrams of the two units are contained in figures 157 and 158.

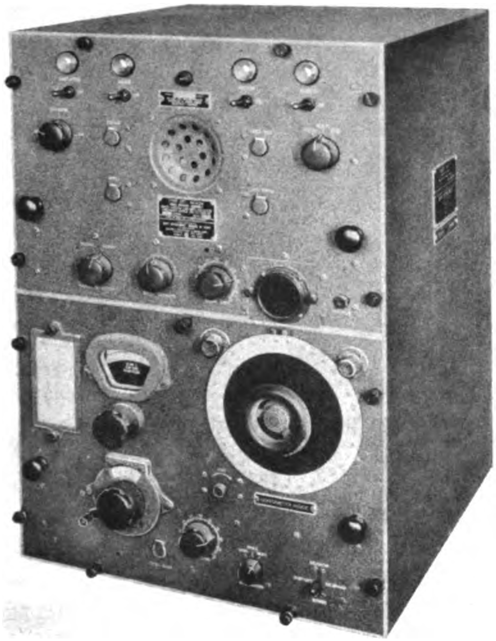

Figure 11. Radio Receiver Assembly R-128/CRD-3.

e. Amplifier-Rectifier Power Unit PP-151/CRD-3. This component operates from a 110- to 120-volt, 55- to 65-cycle, single-phase, alternating-current (a-c) source to provide the alternating current and the rectified, filtered direct-current (d-c) voltages required for operation of the automatic bearing indicator. The indicator deflection coil amplifier and its power supply are also included in the power unit. The aluminum front panel and aluminum chassis form an integral unit on which the component parts are mounted and wired. The chassis is mounted at right angles to the front panel and is supported on the three remaining sides by a stiff U-shaped aluminum wrap-around also attached to the front panel. The entire

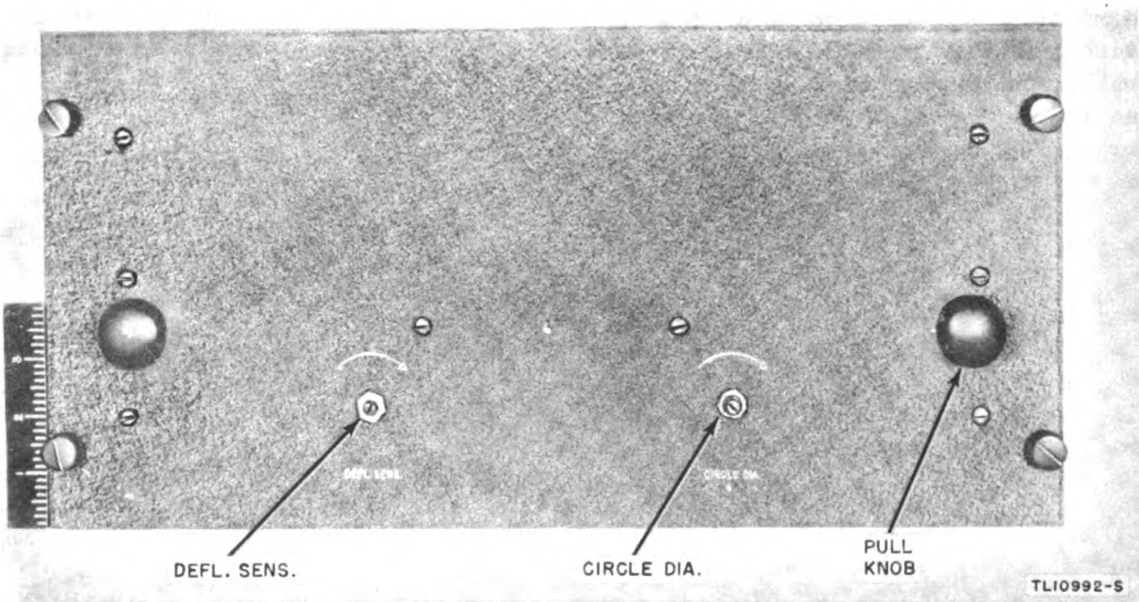

Figure 12. Amplifier-rectifier Power Unit PP-151/CRD-3.

unit is inclosed in an aluminum cabinet with over-all dimensions 19 inches wide by 8-3/4 inches high by 13-1/2 inches deep (fig. 12). There are louvers on the rear for ventilation. Two pull knobs are on the front panel to assist in removing the chassis from the cabinet. The entire assembly is mounted on a shelf on the mounting table to the rear of the automatic azimuth indicator.

f. Bearing Indicator ID-121/CRD-3. The bearing indicator is an electromechanical unit for producing instantaneous visual azimuth and sense patterns characteristic of the antenna and goniometer outputs. Goniometer CFT-47372 is mounted at the rear of the indicator and is driven by the indicator motor. A photograph of the two units is shown in figure 13 and circuit diagrams in figures 81 and 161. The principal housing consists of a tubular type heavy aluminum casting supported on a steel truss assembly attached to the equipment mounting table. Two shock mounts support the indicator in its normal operating position. By removing the shock-mount supporting nuts, the indicator may be lowered on a chain for minor servicing. The indicator motor is mounted at the rear and hinged thumbscrews clamp the goniometer in back of the motor. A hinged cover over the rotating assembly permits access to the brushes and slip rings.

(1) The control box is of the plug-in type and mounts under the front end of the cathode-ray tube. Receptacles J501 and J502, for connection to the rectifier power unit, are at the rear of the control box. The light shield and azimuth scale assembly may be swung aside for removing the cathode-ray tube.

(2) The motor is a 1/8 horsepower, single-phase, capacity start, induction run motor with a normal running speed of 1,140 revolutions per minute (rpm). A switch cuts out the capacity when the motor has reached its operating speed. At 110 volts the motor draws 3.2 amperes. It is designed for operation from a 110- to 120-volt, 55- to 65-cycle, single-phase alternating current.

g. Control-Rectifier Power Unit PP-135/CRD-3. Control-Rectifier Power Unit PP-135/CRD-3 operates from a 110- to 120-volt, 55- to 65-cycle a-c power source to provide the alternating current and the rectified, filtered d-c voltages required for operating Phase Inverters MC-411-A and MC-413-A. The steel front panel and chassis form a single unit on which the component parts are mounted and wired. Stiff side brackets secure the chassis to the panel. A steel bottom plate completely incloses the under chassis. The over-all dimensions of Control-Rectifier Power Unit PP-135/CRD-3

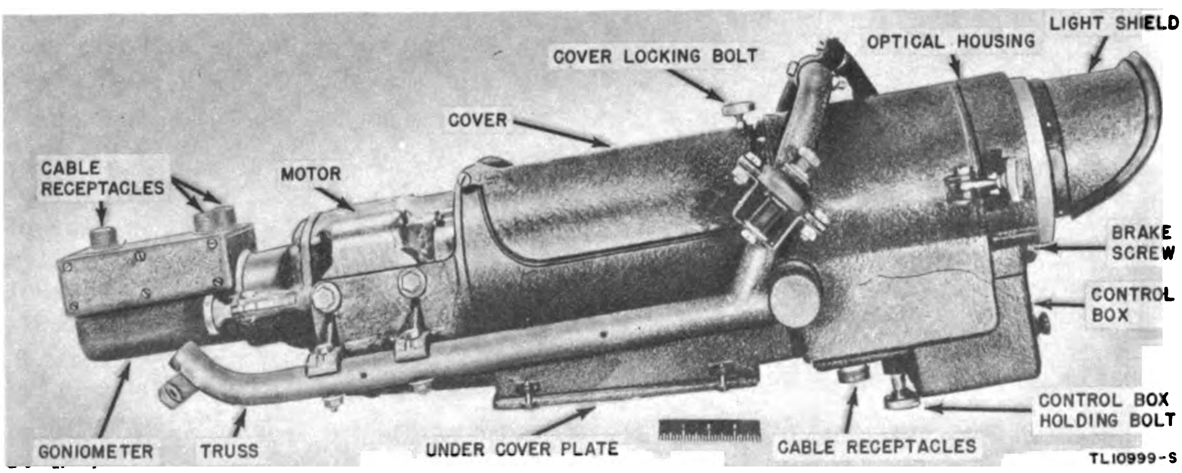

Figure 13. Bearing Indicator ID-121/CRD-3.

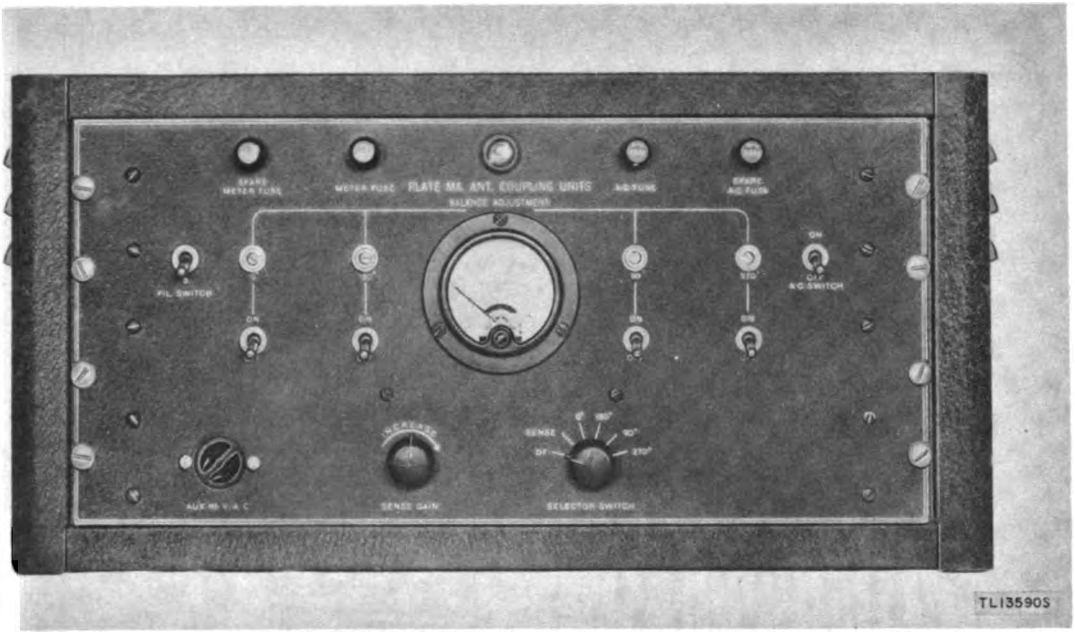

Figure 14. Control-rectifier Power Unit PP-135/CRD-3.

are 22 inches wide by 10-3/4 inches high by 11-1/4 inches deep (fig. 14). The front panel is finished in oven-baked, scratchproof gray wrinkle enamel and the rear of the panel, the chassis shields, bottom plate, etc. are finished in pastel gray lacquer.

h. Accessories. The accessories described below are part of Radio Set AN/CRD-3.

(1) Shelter HO-20-B. Shelter HO-20-B is a prefabricated housing for the main components of the direction finder. When assembled, it forms an insulated house approximately 5 feet by 9 feet by 6 feet, with a rounded roof (figs. 24 to 32), two side windows with screens and blackout blinds, and a door. The floor, roof, and side panels are made of fabricated plywood, and are numbered for ease of assembly. Cable entry cut-outs are provided in two of the walls. When dismantled, the shelter components, plus two folding tables and two chairs, are packed for shipment on two crates.

(2) Mounting Table MT-347/CRD-3. Radio Set AN/CRD-3 operating components are shock mounted on a compact equipment table (figs. 36 and 37). The table is constructed of a 1-1/4 inch outside diameter by a 1/8-inch thick, cold-drawn, seamless steel tubing. The over-all dimensions of the table are 24 inches wide by 36 inches high by 32-1/2 inches deep. It is finished in an oven-baked, scratchproof gray wrinkle enamel. The automatic bearing indicator is fitted with a truss which supports it in a diagonal position with the table frame, permitting easy view of its cathode-ray tube face. Two arms attached to the table frame slope downward at right angles to the bearing indicator axis, and support a hinged metal plate which surrounds the optical housing. The automatic bearing indicator mounting is such that it may be dropped on a chain for minor servicing or adjustment. The rectifier power unit is mounted on a shelf behind the automatic bearing indicator. By releasing a spring bar under the shelf it can be lowered a few inches to give access to the unit. The radio receiver is shock mounted on the table top. The table mounts to the floor on four flanged feet.

(3) Electric Heater. Two electric heaters for use with Shelter HO-20-B are part of Radio Set AN/CRD-3. A complete description is contained in the instructions accompanying the unit.

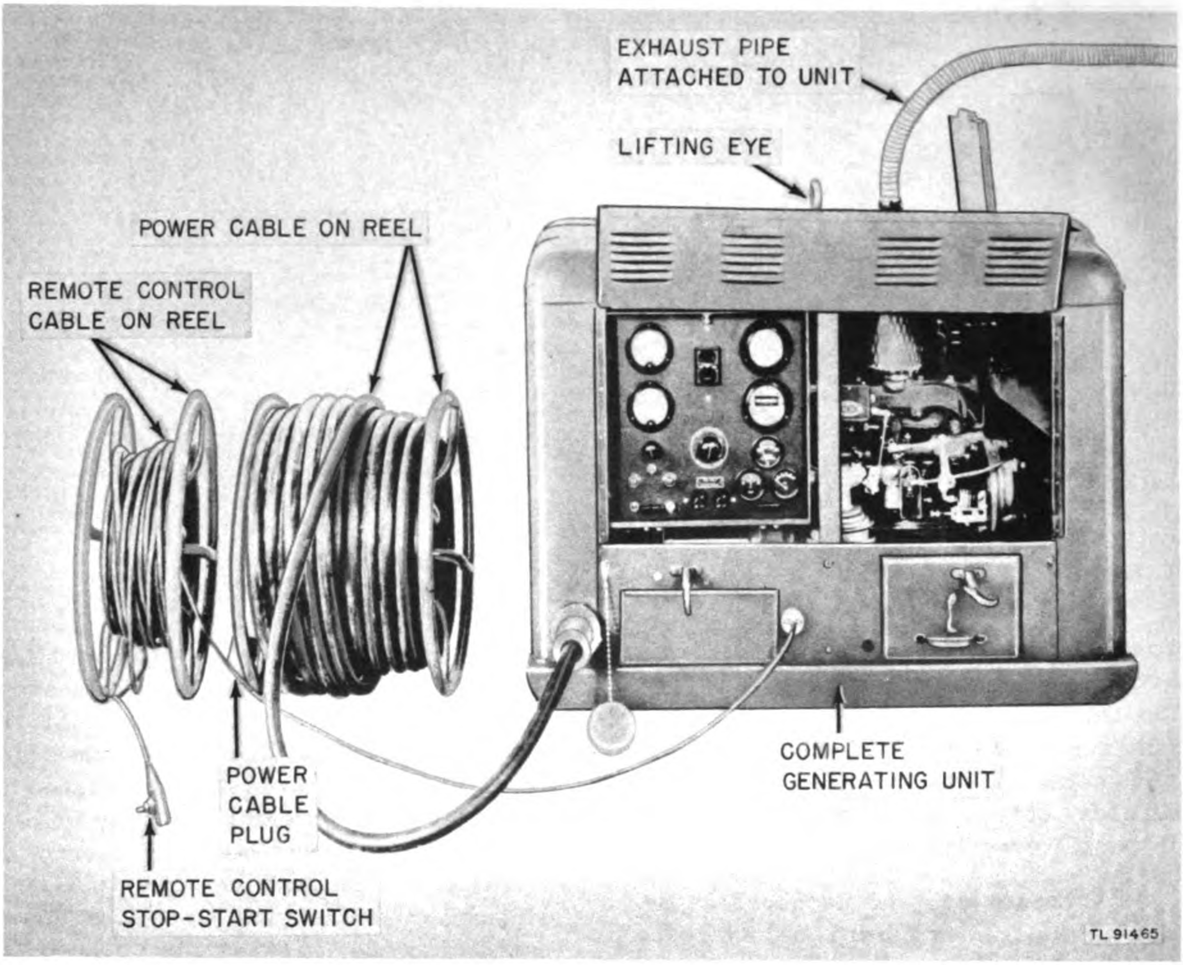

Figure 15. Power Unit PE-197 ready to operate.

(4) *Power Unit PE-197.* This is a self-contained power plate consisting of a gasoline engine, a power generator, and a control panel. The entire assembly is mounted on a welded steel skid base and inclosed in a sheet-metal housing (fig. 15). The engine, generator, control panel, fuel gauge, fuel filler cap, radiator filler cap, oil filler cap, and bayonet oil gauge can be reached through hinged panels on the sides and top of the housing. A storage battery can be reached through a hinged panel on one end of the unit. Five terminals, mounted on a terminal board, are reached through a hinged panel on the left side of the unit directly below the control panel. A 5-gallon fuel tank, mounted within the housing above the main generator, is provided with a fuel gauge and a hinged filler cap. A 150-foot power cable and a 150-foot remote control cable are mounted on separate reels. The power cable is provided with plugs on both ends, while the remote control cable has a plug on one end and an on-off remote control switch at the other. A flexible exhaust tube is also provided to carry the exhaust away from the unit.

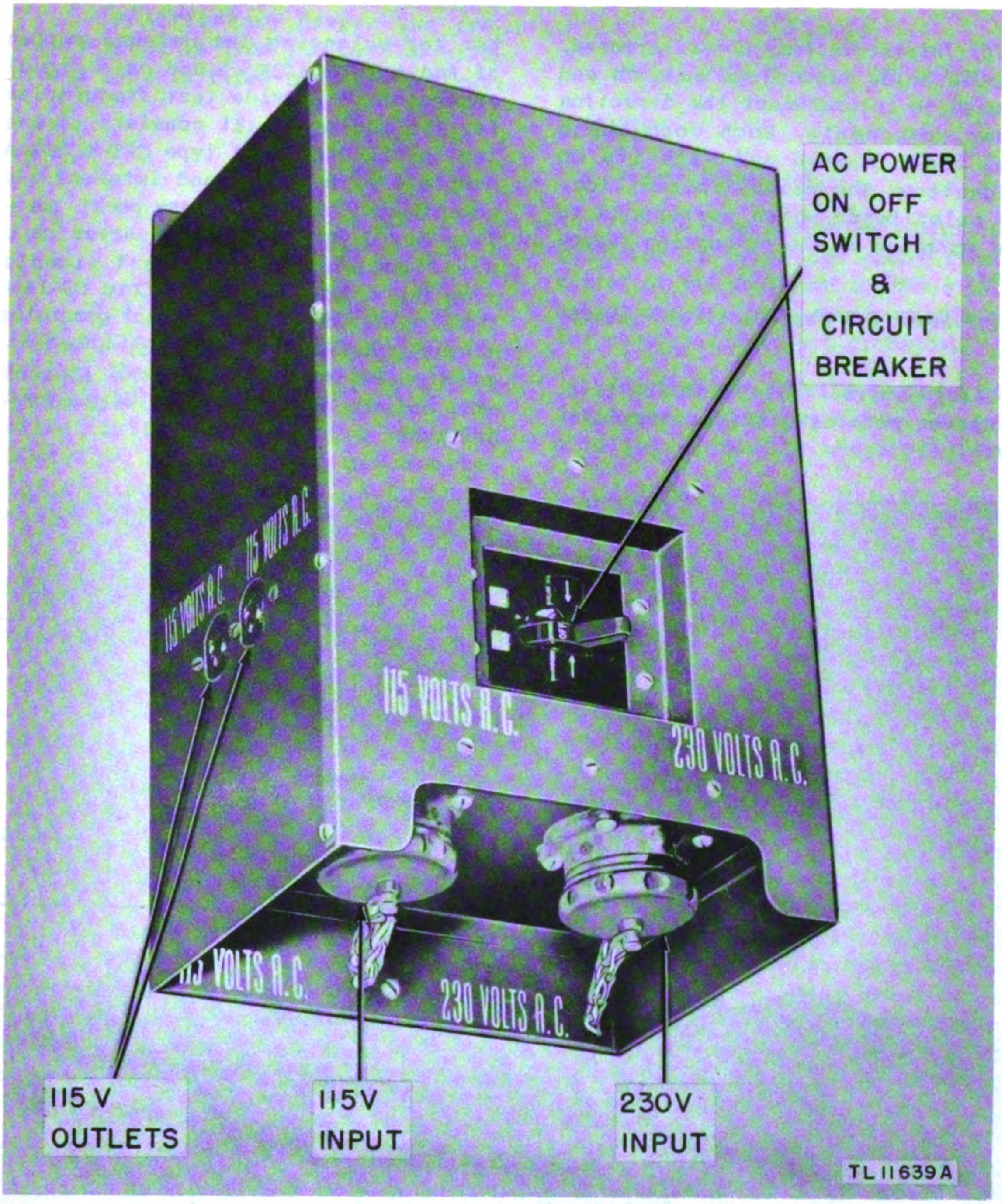

Figure 16. Junction Box JB-126.

(5) Junction Box JB-126-( ). This junction box (fig. 16) is a sheet-steel unit approximately 17 inches by 10 inches by 8 inches. It has a handle on the top, and two waterproof receptacles on the bottom for connection to the a-c cord from the power source. A circuit breaker is mounted on the front, three polarized 115-volt receptacles on one side, and two single a-c receptacles on the other. Inside the junction box is a 115- to 230-volt, 50- to 60-cycle autotransformer for transforming a 230-volt, 60-cycle, single-phase source 8 to 115 volts for operating the equipment.

(6) Interconnecting Cords. Armored, flexible cords with plugs on each end are used to interconnect the direction finder components. Each cord has a metal band on each end with its CD designation. The plugs, in addition, have color bands which correspond to color markings on the connecting receptacles.

(7) Model OAN Test Oscillator Equipment.

(a) General. This assembly (fig. 17) serves both as a target transmitter for balancing the antenna system of Radio Set AN/CRD-3 and as a signal generator to provide test frequencies for the radio set. It consists of one test oscillator unit type CFT-60054-A complete with tubes, and internal a-c power supply, and a battery pack; Junction Box J-97/CRD-3 which serves as a distribution point for test signals from the signal generator; Cord CG-241/CRD-3 which connects the signal generator to Junction Box J-97/CRD-3; a waterproof carrying case; and one 15-foot whip antenna type CFT-66082, with carrying case.

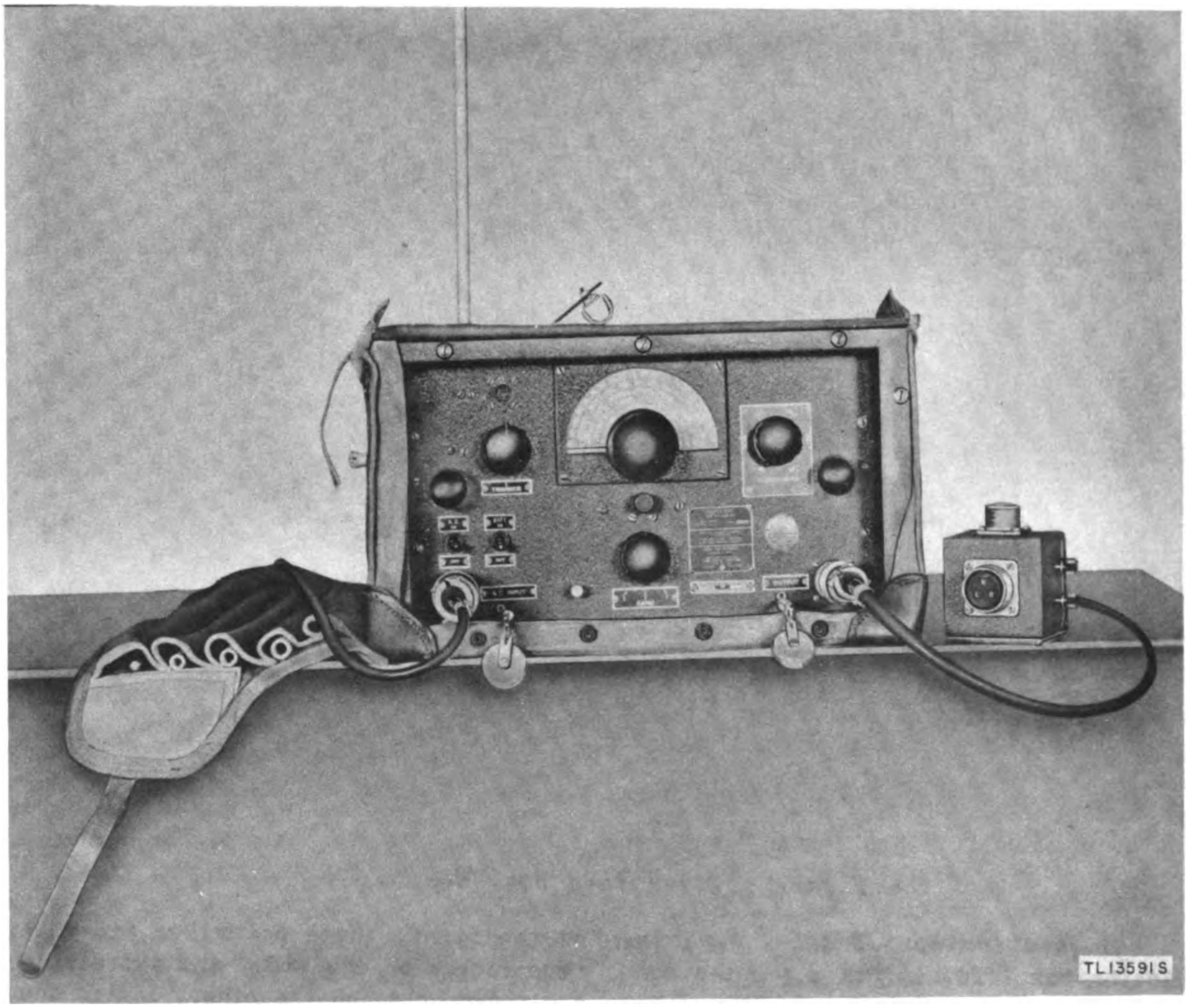

Figure 17. Model OAN test oscillator equipment.

(b) Frequency Range. The frequency range is from 200 to 2000 kilocycles (kc) in three bands as follows:

Band	Frequency range (kc)
1	200 - 500
2	500 - 1,000
3	1,000 - 2,000

(c) Power Requirements. Power is supplied by either seven dry batteries; three 45-volt B batteries (Battery BA-35) and four 1-1/2-volt A batteries (Battery BA-59), or a 115-volt, 60-cycle, single-phase, a-c source. The a-c power required is approximately 21 watts.

(d) Battery Life. The battery life is approximately as follows:

Tube type	Batteries	Continuous service (hrs)	Intermittent service (hrs)
JAN-6SK7	BA-59	5	3
	BA-35	35	50
JAN-6SS7	BA-59	15	20
	BA-35	35	50

(8) Tools and Test Equipment. A complete set of tools and test equipment, sufficient for maintenance and servicing, are supplied as part of Radio Set AN/CRD-3. They are listed in paragraph 147.

(9) Miscellaneous Spare Parts. A complete assortment of spare electrical and mechanical parts are supplied with Radio Set AN/CRD-3. These are listed in paragraph 147.

(10) Chests and Crates. Radio Set AN/CRD-3 can be dismantled and packed into separate units consisting of chests, crates, and reels. These are illustrated in paragraph 146.

SECTION II

INSTALLATION OF RADIO SET AN/CRD-3

6. SITING.

a. Visual Inspection.

(1) The area should be substantially flat for at least 150 yards from the center of the Radio Set AN/CRD-3 antenna system and not more than a gentle slope for several times that distance.

(2) The area should be the highest level area in the vicinity. A site in a valley is usually unsatisfactory.

(3) Mountainous or hilly country should be avoided.

(4) The area should be inland as far as possible from the shoreline of large bodies of water. If the installation must be made on or near the coast, the flattest area should be selected and the direction finder erected at a position on the coast where the center of the target area to be serviced is perpendicular to the coast.

(5) The earth at or around the site should have uniform high conductivity and moisture content. Areas uniformly covered with grass or vegetation usually meet this requirement. Rocky or sandy soil is poor as a site. However, areas having uniform low conductivity are preferable to areas having high conductivity spotted with rock formation, sand, or varying moisture content.

(6) Regions where there are abrupt discontinuities of the earth should be avoided, as this usually indicates the presence of rock or mineral outcroppings, or underground streams.

(7) The site should be removed from tall trees, buildings, wire fences, power or telephone lines, radio antennas, railroad tracks, sharp ground contours (mountains, cliffs, and ravines), buried metal conductors (cables and pipelines), chimney stacks, water towers, rivers, lakes, and streams.

(8) Distances to be maintained between Radio Set AN/CRD-3 and these obstructions, in order to minimize their effect on accuracy, are given in the following table.

DISTANCES BETWEEN RADIO SET AN/CRD-3 AND OBSTACLES

Obstruction	Distance to be maintained
Scattered trees and single small buildings.	300 yards.
Wire fences.	200 yards.
High cliffs and deep ravines.	More than 1 mile.
Buried metallic conductors (other than telephone lines to Radio Set AN/CRD-3).	300 yards.
Chimney stacks and water towers.	500 yards.
Overhead conductors and railroad tracks (power and telephone lines and antennas).	500 yards.
Rivers, streams, and lakes.	600 yards.
Forests and metal structures.	500 to 1,000 yards.
Mountains.	5 to 25 miles

b. Electrical Inspection. After the most favorable site has been surveyed, it is desirable to make the following electrical tests before installing Radio Set AN/CRD-3.

(1) *Noise Measurement.* Measure the noise level with a field strength meter at the major frequencies on which Radio Set AN/CRD-3 will be operated. If the equipment is to be used over a band of frequencies, measurements should be made throughout the band. For a suitable Radio Set AN/CRD-3 site, the noise level (other than temporary atmospheric noise) should not exceed 5 microvolts (uv) per meter.

(2) *Field Pattern.* This test is made to determine uniformity of reception for the site of Radio Set AN/CRD-3.

(a) Place a field strength meter at the spot where the antenna of Radio Set AN/CRD-3 is to be erected.

(b) Using the pocket transit compass, place the OAN Test Oscillator furnished with Radio Set AN/CRD-3 at a point 500 feet from the field strength meter and at an azimuth of magnetic North. See paragraph 30 for detailed instructions for setting up the OAN Test Oscillator as a target transmitter. Then place the target transmitter at an azimuth of 20°, then 40°, then 60°, continuing at intervals of 20°, keeping the distance at 500 feet in each case, until the transmitter has been moved in a complete circle (fig. 18). Mark these positions with stakes.

(c) Take field strength measurements for each position of the target transmitter on the major frequencies. Make all measurements as accurate as possible.

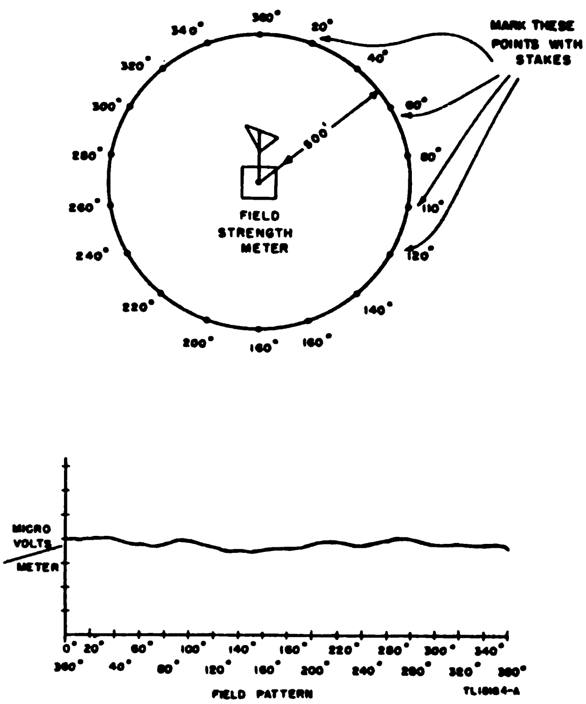

Figure 18. Field pattern.

(d) Plot on rectangular coordinate paper as field strength versus azimuth for each frequency. The resulting graph should be a substantially straight line Any irregularities indicate an absorption or reflection of the wave which would affect the accuracy of Radio Set AN/CRD-3. If the variations exceed 25 percent of the average field strength especially in azimuth arcs where extreme accuracy is desired, the site is unsuitable for direction finding. If the visual and electrical inspection discloses no objection to the use of the site, Radio Set AN/CRD-3 should be erected.

7. UNPACKING, UNCRATING, AND CHECKING.

a. The components of Radio Set AN/CRD-3 are shipped in 42 crates. Two packing lists are shipped with each box; one inside the crate and one outside. Do not open any crate until its contents are needed for immediate use. For example, if Radio Set AN/CRD-3 is to be operated on local commercial power, do not open crates Nos. 1 and 2 which contain the two Power Units PE-197.

b. The following procedure for uncrating, unpacking, and checking Radio Set AN/CRD-3 is recommended.

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

(2) Cut the steel straps.

(3) Remove the nails, using a nail puller, and remove the sides of the packing crate. *Prying the sides off may result in damage to the equipment.*

(4) Cut and remove the four metal straps around the corrugated fiberboard boxes.

(5) Remove the corrugated fiberboard boxes and moistureproof vaporproof barriers.

(6) Remove the pressure-sensitive tape that secures the handles of the chests.

(7) Open chests and remove dustproof bags containing dehydrating agent.

(8) Remove all blocks and braces used to secure items in chests.

(9) Check the contents of each crate against the packing list. Use particular care when handling the equipment because it may be damaged easily.

8. ORIENTATION OF ANTENNA SYSTEM.

a. General. After the site has been selected and properly cleared, drive a stake to mark the site of the sense antenna in the approximate center of the cleared area. The layout and connection of the antenna system for Radio Set AN/CRD-3 is shown in figure 164. The system must be installed exactly as shown with the antenna masts spaced on the corners of a square whose diagonals are 180 feet. These diagonals must point exactly to true North-South, East-West or magnetic North-South, East-West depending upon whether the direction finder is to be oriented to true North or magnetic North.

b. Orientation.

(1) Remove the compass and tripod from the proper chest. Calibrate the compass to magnetic North if magnetic North orientation is required or for proper declination of the particular locality if true North orientation is required. For this calibration rotate the compass azimuth scale by adjusting the screw on the side of the compass,

until the figure on the scale, corresponding to the local declination coincides with the scale index. Examples of compass clibrations are shown in figure 19 for magnetic North and for declinations of 10° East and 10° West respectively.

(2) When the compass is properly calibrated, attach it to the tripod and move the tripod to the position previously marked as the center of the sense antenna.

(3) Attach the plumb bob to the hook under the center of the tripod. Position the tripod so that the plumb-bob hangs directly over the center of the position marked for the center of the antenna system.

(4) With the compass correctly calibrated and leveled, and the tripod correctly positioned, turn the compass until the north end of the needle points to 0°. Sight through the compass sights and with the steel tape, measure along the line of sight a distance of 90 feet from the plumb-bob string attached to the tripod. At this point, exactly 90 feet from the plumb line, drive a stake to mark the position of the north antenna. Care must be exercised to locate this stake as accurately as possible.

(5) *Without disturbing the tripod position,* turn the compass until the north end of the needle points to 90° on the compass scale.

(6) Follow the same procedure used in locating the stake for the north antenna to mark the position for the 90° or east antenna.

(7) Similarly turn the compass until the north end of the needle points to 180°, and then to 270°, and mark the sites of the south and west antennas respectively.

> CAUTION: Do not move compass and tripod from its position until final alignment is completed.

9. INSTALLATION OF COUNTERPOISE MC-318/CRD-3.

a. Remove five Counterpoises MC-318/CRD-3 from two Reels DR-10-A and assemble as follows (fig. 20).

b. If possible, drive the stake marking the site of the directional antennas into the ground until it is even with the surface.

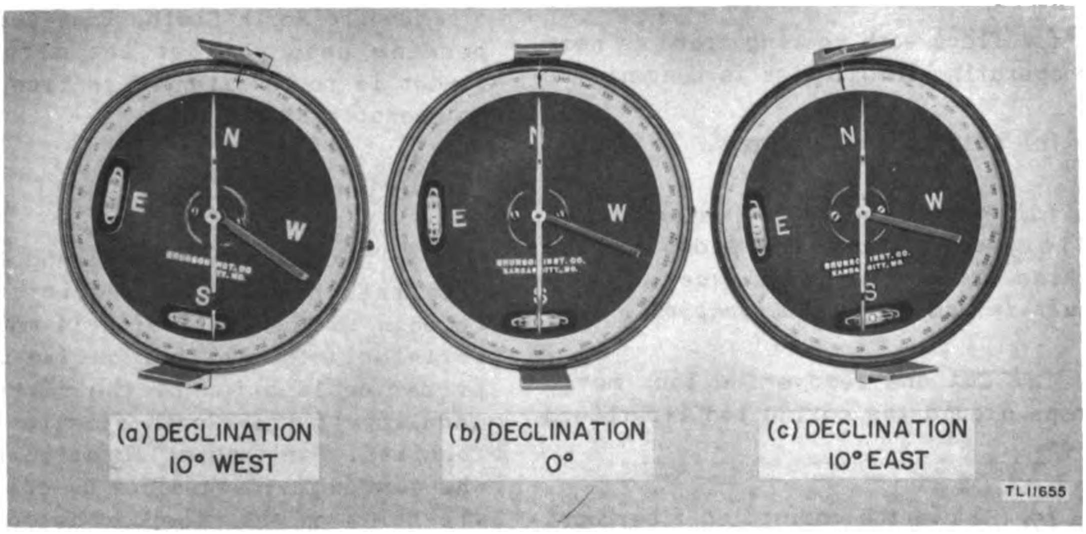

Figure 19. Compass scale settings for magnetic declinations of 0° or magnetic North, 10° East, and 10° West.

c. Select any two of the longest strips (32 feet) of braid and place them on the ground so that they bisect each other exactly over the location of the stake. Position the two strips in a North-South and East-West direction. Fasten the dot type fasteners at the point of crossing. These two conductors form the cross ribs for the remainder of the counterpoise, and mark the center for the location of the antenna base.

d. Assemble the remaining long strips (fig. 20) and fasten them securely in place.

e. Select the four medium length (8 feet) strips and assemble them according to the diagram. Carefully secure each intersection to accomplish adequate contact.

f. Fasten the four short strips (4 feet) in place as indicated in the diagram.

g. Remove eight Ground Conductors CX-463/CRD-3 (6-inch strip) from Reel DR-10-A. Fasten one to each corner of the counterpoise, and one at a point midway on each side.

h. Remove eight stakes GP-2 from Case CY-319/CRD-3. Drive one of these stakes not more than 6 inches from each ground conductor so that it passes through the terminal ring of the conductor and makes efficient electrical contact.

i. Follow the same procedure to assemble the four remaining counterpoises in their respective positions.

10. ERECTION OF ANTENNA MAST.

a. The four corner (directional) antennas are erected first. The tripod and compass are still in position over the site of the center (sense) antenna. The following instructions are given for one Antenna Assembly AS-204/CRD-3; the other assemblies are similar.

b. Place one Mast Base AB-57/CRD-3 on the counterpoise, centering the base directly over the siting stake (or the location of the siting stake if it has been removed). Drive a Stake GP-2 through the hole provided in each corner of the bottom plate of the mast base. Sight along the compass sights to check the location of the mast base. The center of the mast base should be in direct line.

> CAUTION: Do not sight on socket for gin pole. Make certain that sighting is accomplished on socket for mast sections.

Rotate the socket so that the antenna may be assembled on the ground. The socket for the gin pole should face away from the ground.

c. Insert Mast Section AB-65/CRD-3 into the mast base (fig. 164). Mast Section AB-65/CRD-3 is fitted with a rain shield and base plug.

d. Insert Mast Section AB-66/CRD-3 into the free end of Mast Section AB-65/CRD-3 and secure by a slight rotation of the mast section. Select the guy collar of the same diameter (3 in.) as the mast section and fasten near the top end of the mast section. Determine the most desirable position for the guys and orient the guy collar accordingly.

e. Insert Mast Section AB-67/CRD-3 into the previous section and secure.

f. Insert Mast Section AB-68/CRD-3 into the previous section and secure. Fit with proper guy collar. Orient in line with previous guy collar, and fasten in place.

g. Insert and secure Mast Section AB-69/CRD-3.

h. Insert and secure Mast Section AB-70/CRD-3. Fit with proper guy collar, orient, and fasten. Mast Section AB-70/CRD-3 is provided with a top plug and socket for Mast Section MS-116. Insert the three Mast Sections MS-116.

i. In a line perpendicular to the line of rotation of the gin pole, measure a distance of 30 feet on either side

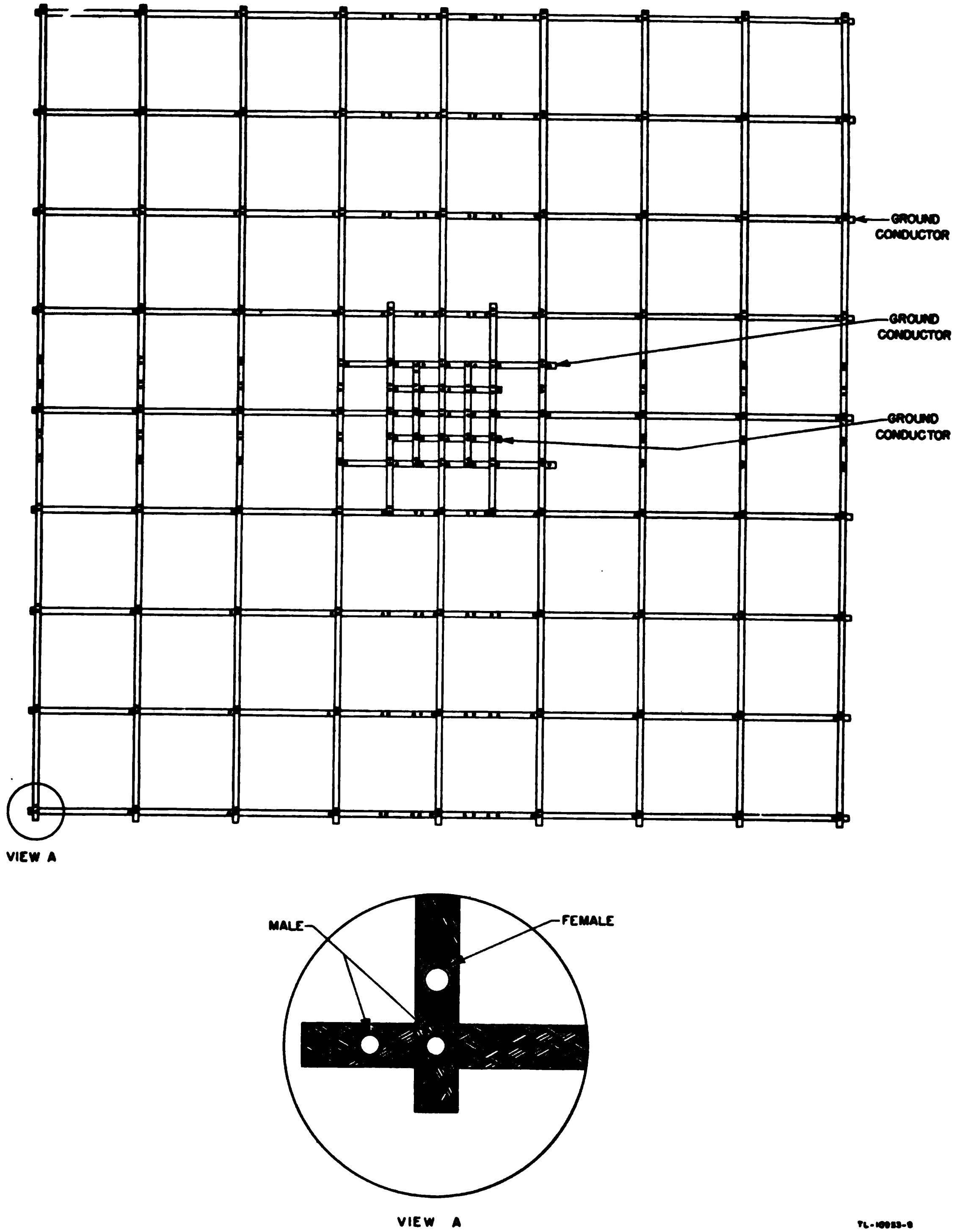

Figure 20. Counterpoise MX-318/CRD-3 Assembly.

from the center of the ground mat and mark with a Stake GP-25 driven through the terminal ring of a guy spreader chain (fig. 164). Similarly stake points 90° from the first two stakes and 30 feet from the center of the counterpoise.

j. Fasten four Guys MX-298/CRD-3 to the lowest guy collar. Fasten the other end of these guys to the guy spreader chains with the exception of the one that will fall into the line of rotation of the gin pole. The three guys that fall in this line are utilized in raising and lowering the antenna.

k. Fasten four Guys MX-299/CRD-3 to the middle guy collar. Fasten the other end of three of the guys to the respective guy spreader chains. In like manner, attach four Guys MX-300/CRD-3 to the top guy collar, and fasten three to the guy spreader chains.

> NOTE: The guys fastened to the stakes in a perpendicular line to the rotation of the gin pole should be relatively taut. These guys will aid in guiding the antenna erection.

The guys fastened to the stake in line with the rotation of the gin pole should be arranged in such a manner that they do not become fouled during the erection of the antenna. The guys fastened to the stake in line with the antenna mast should be adjusted to the same length as the two previous groups of guys. Also, they should be arranged in such a manner that they do not become fouled during the erection of the antenna mast.

l. Insert the gin pole into the socket provided in the mast base. Check the guys to prevent any mishaps during erection. Raise the antenna by pushing upward on the antenna mast while pulling on the gin pole and at the same time handle the free ends of the three guys to aid in raising the top portion of the antenna assembly.

m. When the antenna is settled in an upright position, fasten the free ends of the fourth set of guys to the remaining anchor chain. The guys are somewhat longer than required for the 30 ft. radial guy spacing. Therefore it may be necessary to loop the ends so that the adjusting S hooks will be within reach when leveling the antenna mast.

11. POSITIONING OF DIRECTIONAL ANTENNA.

a. Remove the spirit level from the chest containing it and hold it against the surface of the lower mast section. Adjust the guys until the lower mast section is vertical in all planes. Sight along the compass sights to check any shift occurring during erection. The lower mast section should now be in alignment.

b. Sight upward along the lower mast section and align the remaining portion of the antenna assembly by adjusting the guys. Frequently check the lower mast section with a level.

c. Remove Mounting Collar MT-334/CRD-3 from Chest CY-252/CRD-3 and fasten to the silver-plated portion of the lower mast section (fig. 21).

d. Follow the same procedure to erect the three remaining corner antennas.

e. On exceptionally soft ground or in swampy locations, it will be necessary to use the Antenna Mooring Platform AB-82/CRD-3 to provide a more solid footing for the antenna mast base. In such cases place the counterpoise over the mooring platform and erect the antenna assembly on the platform.

12. CHECK OF DIRECTIONAL ANTENNA ALIGNMENT.

a. Turn the compass until the north end of the needle reads 0° and drive a stake at approximately 150 yards from the center of the array, in line of sight of the compass. Follow the same procedure for the east or 90° direction.

b. Move the compass and tripod to the position marked off on the line of sight of the north and south antennas. Turn the compass until sighted on the north antenna. If the antenna system

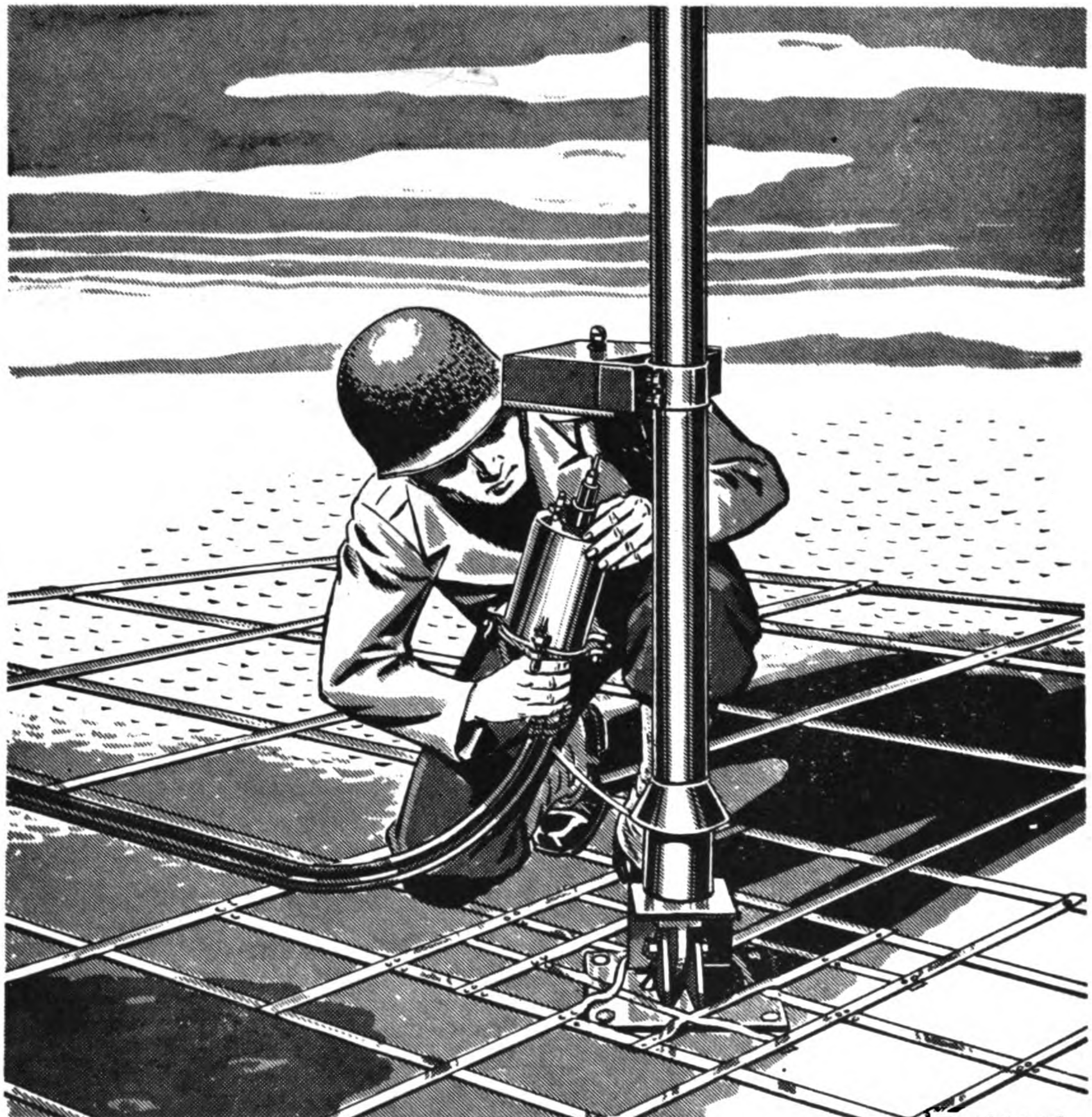

Figure 21. Installation of Phase Inverter MC-411-A.

is properly erected, the south antenna will follow in the line of sight of the north antenna.

c. Move the compass and tripod to the position marked on the line of sight of the east and west antennas. The east and west antennas should follow in the line of sight.

d. Measure the distance from the center of the counterpoise of the north antenna to the center of the counterpoise of the east seat antenna. This distance should be 127 feet, 4 inches, (± 6 inches). Similarly measure the distance between the east and south antennas, the south and west antennas, and west and north antennas. The distance in each case should measure 127 feet, 4 inches (± 6 inches).

e. If any of these final check measurements disclose errors in orientation, set up the tripod, compass, and plumb-bob exactly over the center of the antenna system and repeat the entire alignment procedure. Use extreme care and accuracy during alignment because the fundamental accuracy of the direction finder depends upon the correct orientation of the antenna system. If the check discloses no errors in orientation, continue with the installation.

13. POSITIONING OF SENSE ANTENNA.

a. Erect the center or sense antenna following the procedure described for the other masts.

b. Position the fifth mast base on the counterpoise directly over the spot marked as the center of the antenna system.

c. Check the vertical alignment of the antenna with the spirit level and make the necessary adjustments with the guys.

d. From the point previously marked 150 yards north of the center antenna, sight along the north and south antenna line. Move the sense antenna mast into this line of sight. From the point marked 150 yards east of the center antenna, sight along the east-west antenna line. Without disturbing the north-south alignment, place the sense antenna mast in this line of sight.

e. Fasten Mounting Collar MT-334/CRD-3 to the silver-plated part of the lower mast section.

14. PHASE INVERTER INSTALLATION.

a. Remove four Phase Inverters MC-411-A and one Phase Inverter MC-413-A from Chest CY-251/CRD-3. Attach Phase Inverter MC-411-A color-coded in green to the Mounting Collar MT-334/CRD-3 on the north antenna mast.

b. Insert the banana plug on the phase inverter into the antenna jack on the box of the mounting collar (fig. 21).

c. Push the studs on the top of the phase inverter into the keyed slots on the mounting plate of the box and turn. A spring clip latches over one stud of the phase inverter and locks it securely in place.

d. In a similar manner, attach the yellow color-coded phase inverter to the south antenna, the blue to the east antenna, and the brown to the west antenna.

e. Attach Phase Inverter MC-413-A, color-coded red, to the center or sense antenna mast.

> CAUTION: In attaching the phase inverters, position the top studs in such a manner that the bottom portion of the phase inverter does not make contact with the antenna mast.

15. INSTALLATION OF GROUND CONDUCTOR.

Attach Ground Conductor CX-459/CRD-3 in the following manner (fig. 22) making certain that good electrical contact is obtained.

a. Fasten the end lug under the outer wingnut of each phase inverter.

b. Fasten the second lug under the wingnut on the base plate of the antenna mast base.

c. Fasten the third lug under the wingnut located at the side of the gin-pole socket.

d. Fasten the other end (fitted with dot fasteners) to any convenient point on the counterpoise.

e. Be sure that all connections are securely made. Tighten all wingnuts and check frequently to make certain that they remain tight. Also check for corrosion which introduces high resistance contacts. If corrosion occurs, remove it with a file and coat the surface with petroleum jelly to protect against further corrosion.

> CAUTION: Position Ground Conductor CX-459/CRD-3 in such a manner that it will not touch the mast section or the rain shield attached to the mast section.

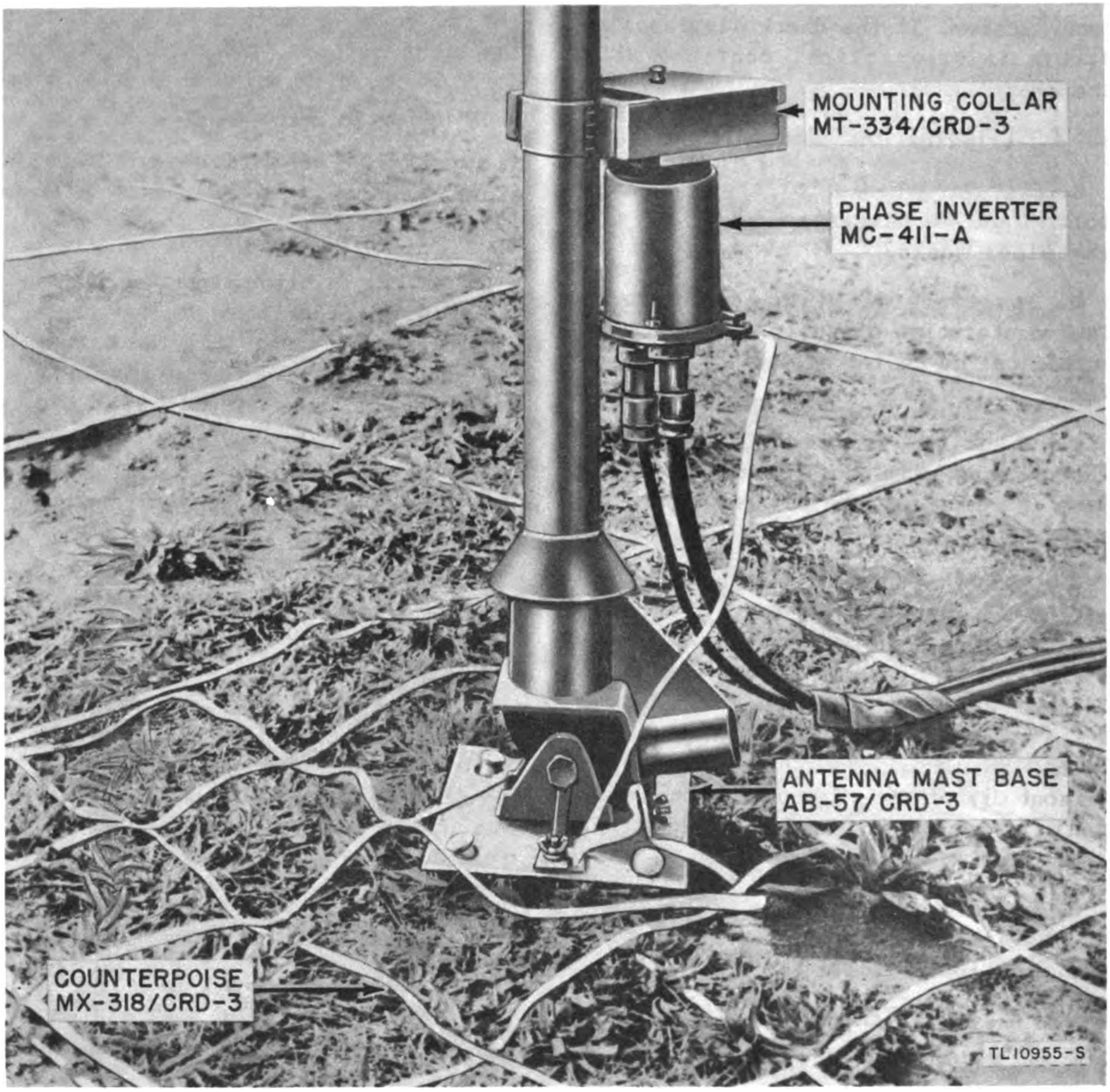

Figure 22. Mast base detail of antenna assembly.

16. ERECTION OF SHELTER HO-20-B.

a. General. The floor, roof, side panels, and the posts and roof supports of Shelter HO-20-B are numbered to facilitate assembly. The side panels, posts, and roof supports are numbered counterclockwise, starting from the first panel to the right of the door, and the floor and roof panels are numbered from front to rear.

b. Location. Shelter HO-20-B should be positioned with respect to the antenna array and at approximately the 45°, 135°, 225° or 315° position with respect to the directional antennas. Erect the shelter at the edge of the center counterpoise, between 15 and 20 feet from the sense antenna, and approximately midway between guy lines (fig. 164). The rear of the shelter should face the sense antenna. The shelter should be so positioned that it does not interfere with the erection and lowering of the sense antenna.

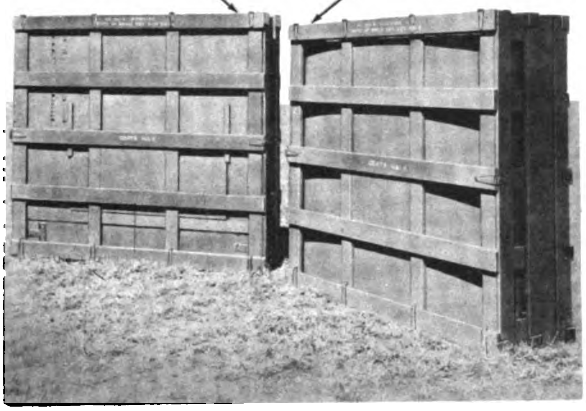

Figure 23. Shelter HO-20-B, crated.

c. Unpacking.

(1) Clean and level an area approximately 8 by 12 feet marking the position for the shelter.

(2) Place the two crates on the ground with their stencilled sides facing up.

(3) Remove the six cotter pins from the hasps on three sides of each crate lid and open the lids as far as possible.

(4) Remove the contents of both crates and place them on the ground near the shelter site. Each wooden part of the assembly is stencilled for identification. When the shelter is erected, all stencilling will be on the inside. When installing posts and panels, be sure that stencilled ends are near the top. All hardware required for the assembly of the shelter is stored in the kit box.

d. Erection.

(1) Place FLOOR No. 1 on the ground with its finished end next to the shelter site.

(2) Place FLOOR No. 2 against FLOOR No. 1 as shown in figure 24. Only one mud sill is provided on FLOOR No. 2. The other end is supported by the projecting sill on one end of FLOOR No. 1.

(3) Insert the FLOOR CONNECTOR in the groove between the two floor sections (fig. 25) so that the two cut-outs will drop over the steel hooks attached to the floor sections. In this position the connector will be flush with the floor surface, but will extend approximately 1 inch on one side of the floor. Drive the connector in until it is flush at both sides; the pins in the cut-outs will then be engaged with the steel hooks, and the floor sections will be locked together (fig. 26).

(4) Attach the four corner posts (POSTS No. 1, No. 3, No. 4, and No. 6) to the floor using the plates and wingnuts provided. Proceed in a counterclockwise direction beginning with POST No. 1 which must be positioned as shown in figure 26 with the stencilled end up.

(5) Position PANEL No. 6 at one end of the floor between POSTS No. 1 and 6. Rest the bottom of the panel on the floor and push the top into place. Six turnbuttons on the back of each panel should be turned to a horizontal position and the wingnuts tightened to hold the panel in place (fig. 27). The turnbutton on the outside of the shelter at the lower edge of the panel must be turned to a vertical position and its wingnut tightened. Follow this procedure for securing each of the remaining panels.

(6) Remove the two handles and setscrews from the kit box. Install the painted handle on the outside of the door and the plated handle on the inside, securing them to their shafts with setscrews.

(7) Install POST No. 2, using the plates and wingnuts provided. PANEL No. 1 should be placed in position while supporting POST No. 2 in the manner shown for installing POST No. 5 and PANEL No. 4 in figure 28.

(8) After PANELS No. 2 and 3 are fastened in place, repeat the procedure outlined in subparagraph *(7)* above for placing POST No. 5 and PANEL No. 4. Complete the panel installation by fastening PANEL No. 5 in place.

(9) Place five roof supports (No. 1, 2, 4, 5, and 7) into position. ROOF SUPPORT No. 1 is installed over PANEL No. 1; ROOF SUPPORT No. 2 over PANEL No. 2, etc. ROOF SUPPORT No. 7 is fastened between POST No. 2 and POST No. 5. Place four L bolts (stored in kit box) in the holes at one end of ROOF SUPPORTS No. 1, 2, 4, and 5 with one threaded end extending through the hole in the metal plate at the outside of the shelter (fig. 29). Before ROOF SUPPORTS No. 3 and 6 are seated in their grooves, the other ends of the L bolts must be pushed through the holes provided in each end. The threaded ends must extend through the metal plates at the outside of the shelter. Seat ROOF SUPPORTS No. 3 and 6 into grooves by tapping; thread wingnuts on both ends of the L bolts, and bolts directly opposite the L bolts on the roof supports; tighten all wingnuts (fig. 30).

(10) Install ROOF No. 1 over PANELS No. 1 and 5; ROOF No. 2 over PANELS No. 2 and 4 as shown in figure 31. Be sure that both roof sections are seated in the grooves.

(11) Insert a machine bolt and flatwasher in each end of the three battens. Fasten the battens over the roof and tighten down with wingnuts (fig. 32).

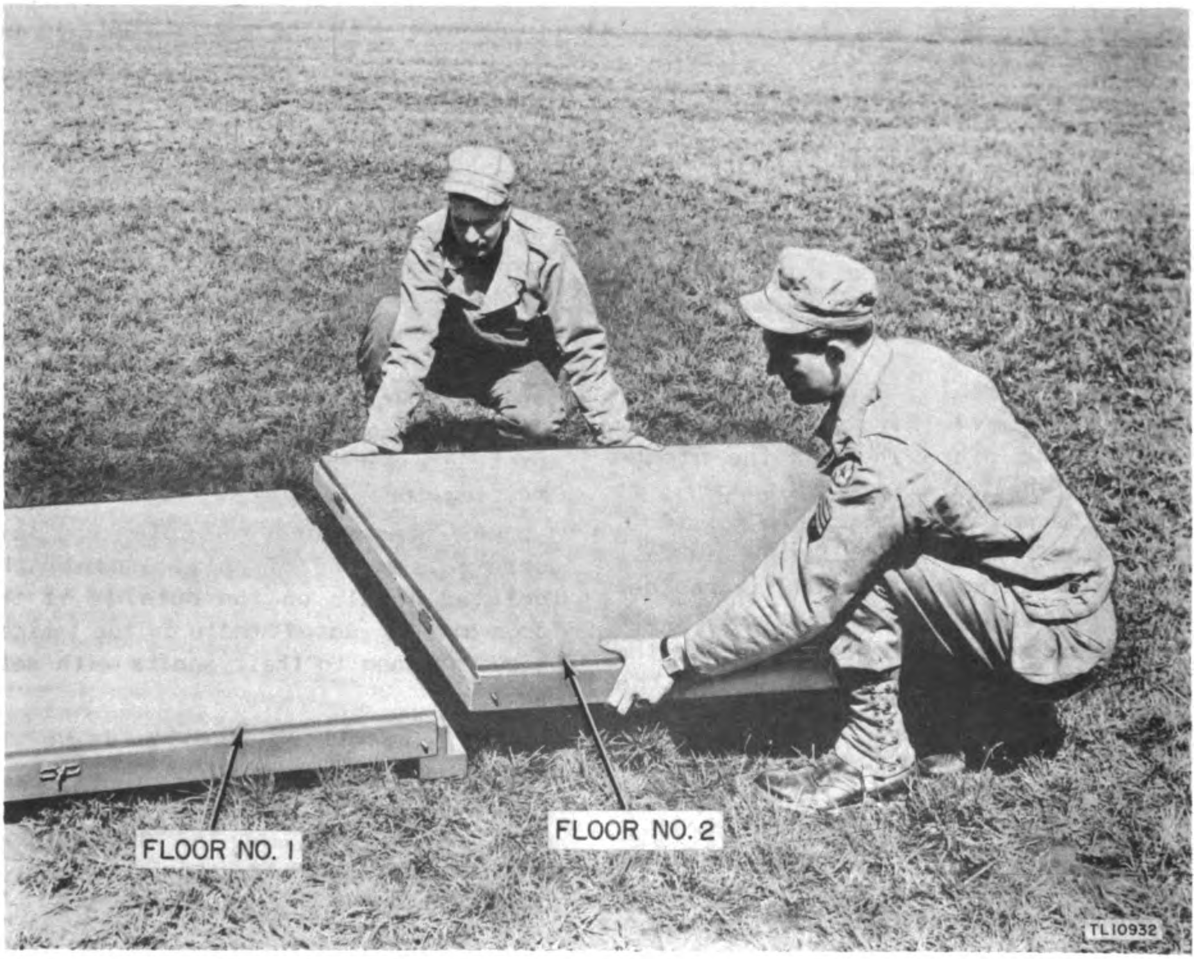

Figure 24. Floor section assembly.

Figure 25. Floor connector installation.

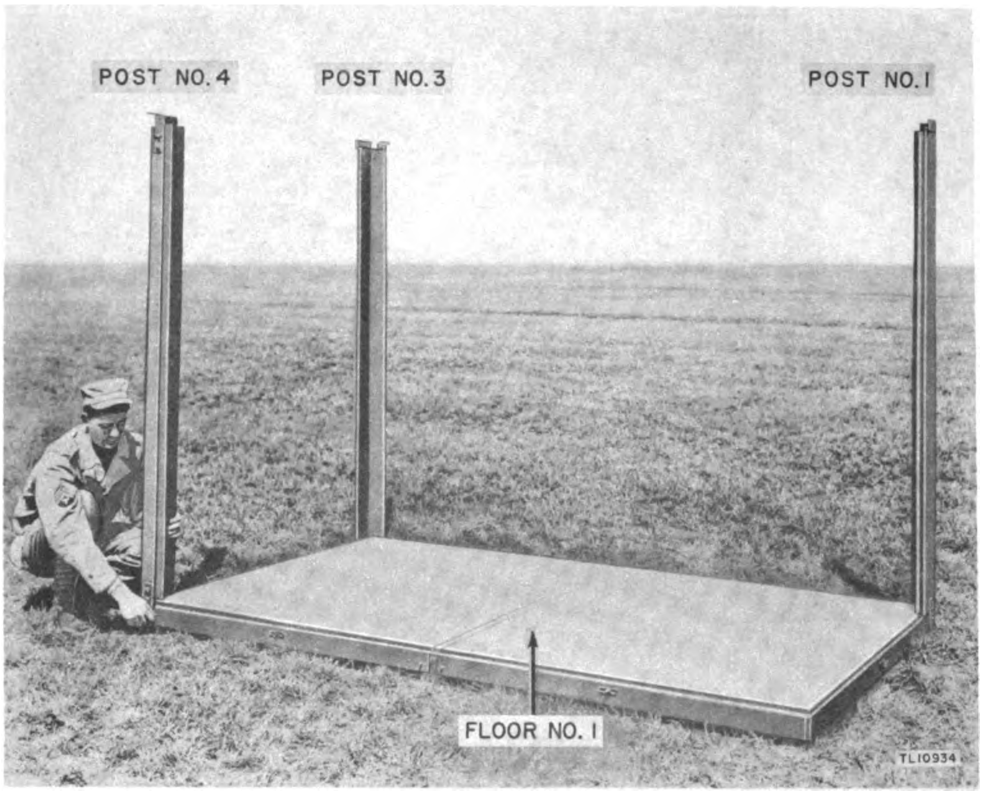

Figure 26. Corner post assembly.

Figure 27. Fastening panel in place.

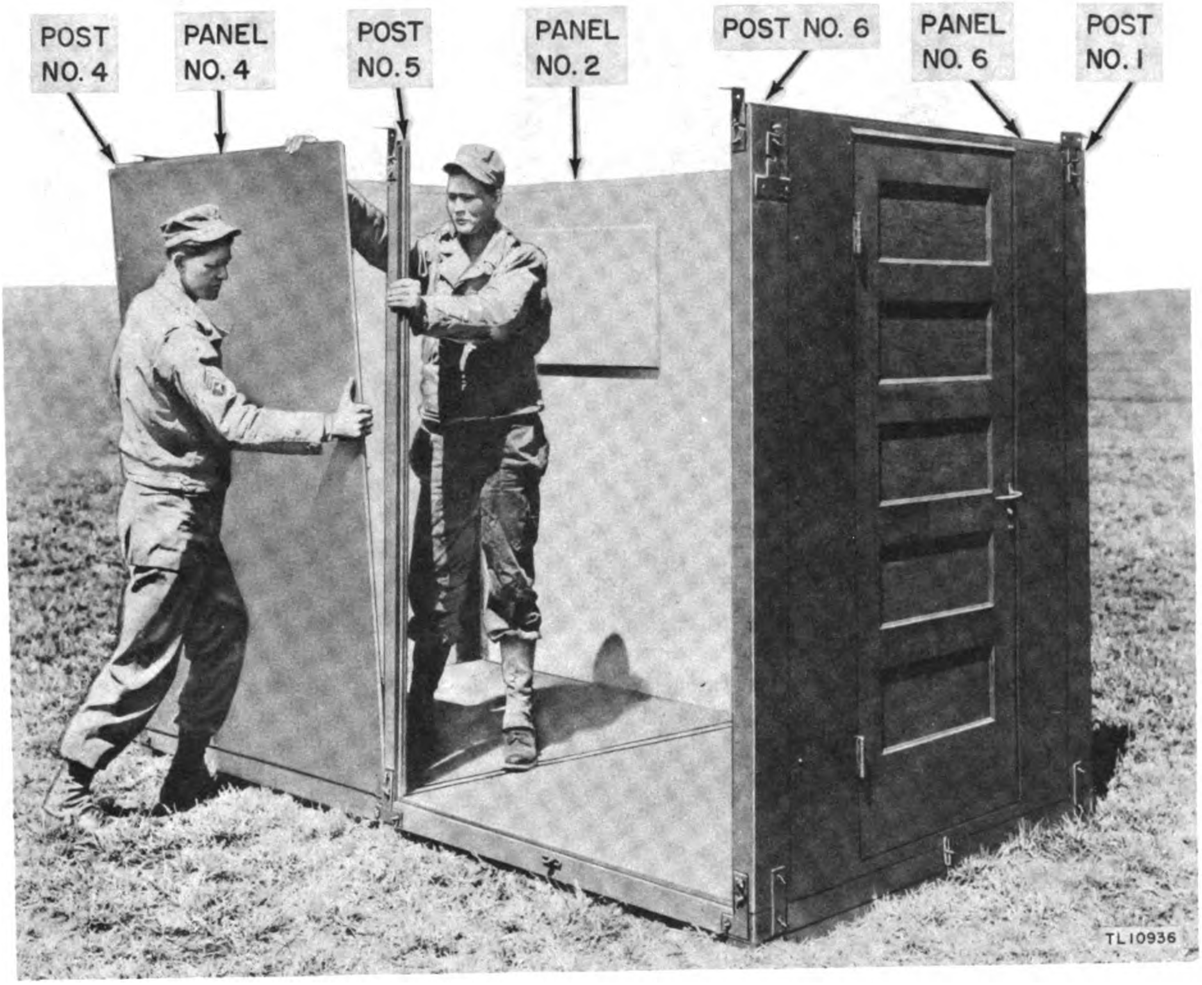

Figure 28. Panel installation.

e. Repacking Shelter HO-20-B.

(1) In dismantling Shelter HO-20-B, follow in reverse the procedure outlined for erection. All T and I brackets must be turned 180° from the position that they occupied during the shelter assembly. It is suggested that all angle brackets be removed and stored in the kit box to facilitate the placement of the posts in the packing crate. Place all wingnuts, not used to secure brackets to the posts, in the kit box.

(2) It is important that all shelter components be packed EXACTLY as shown in figures 152 and 153 or else the crates will not accomodate all of the parts. The order of placement of components is also stencilled on the inside of the lid on each crate. After both crates are packed, close the lids and secure with the cotter pins provided.

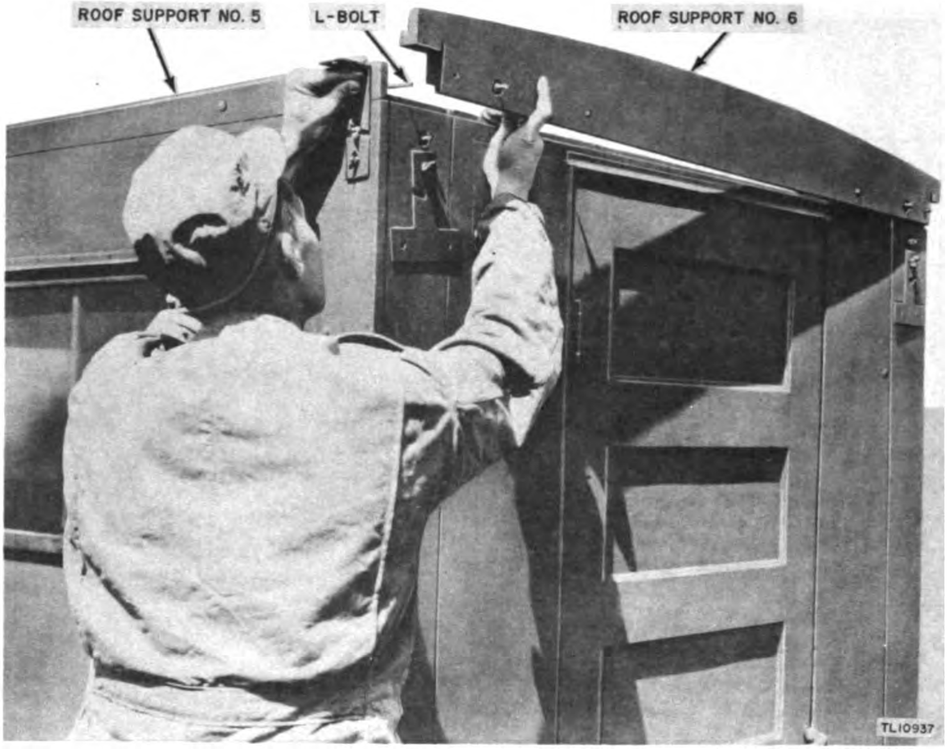

Figure 29. Installation of L-bolt in end roof support.

Figure 30. End roof support, installed.

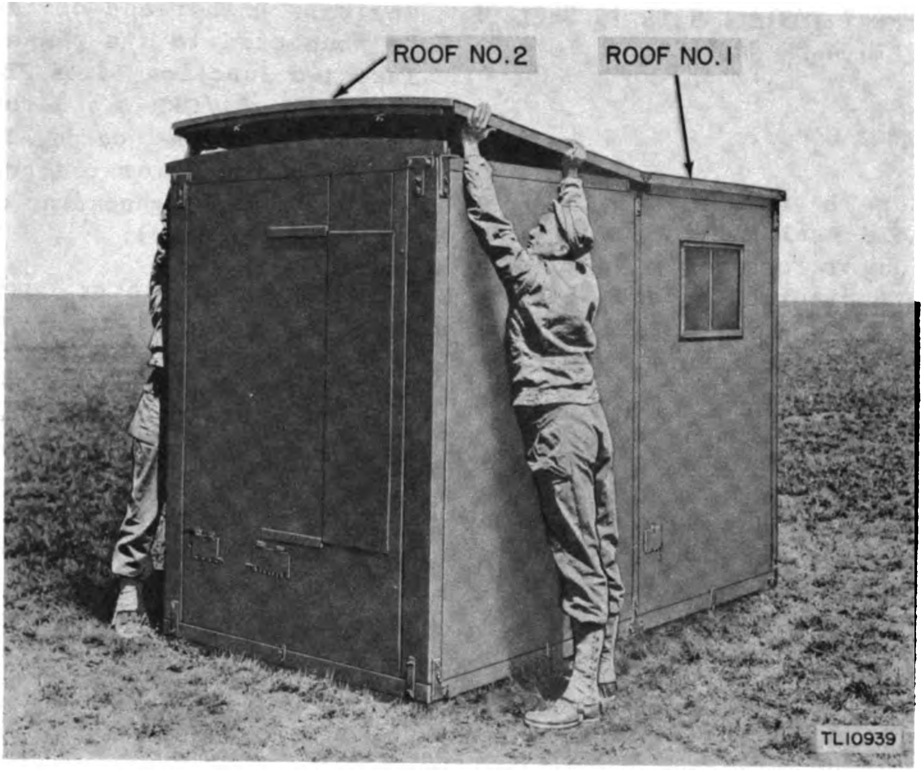

Figure 31. Roof section installation.

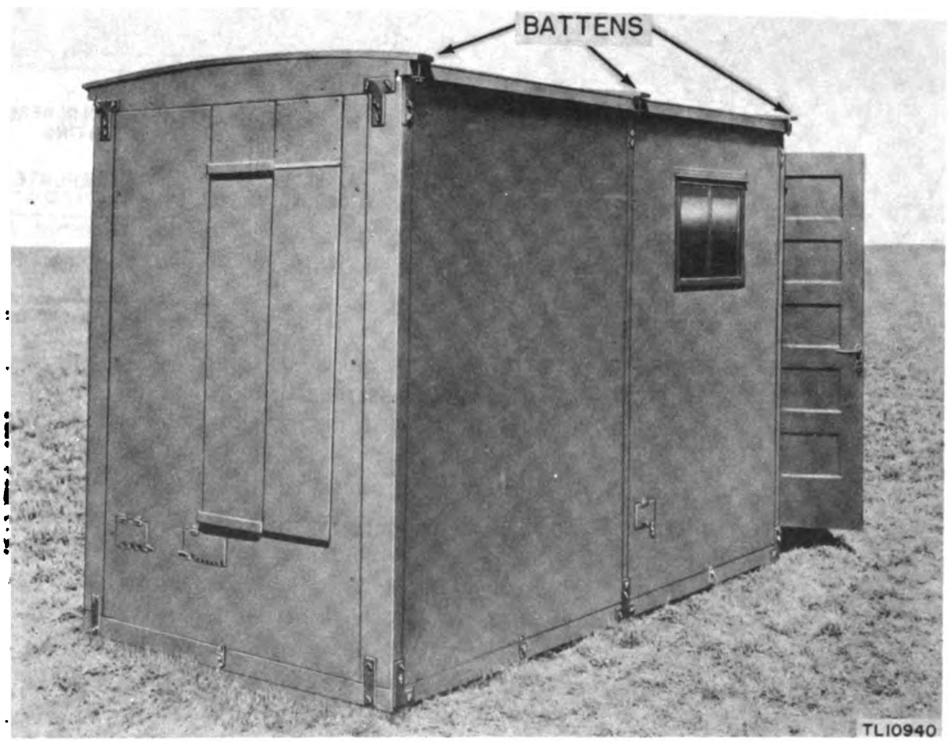

Figure 32. Shelter HO-20-B with roof battens in place.

17. EQUIPMENT INSTALLATION IN SHELTER AND CONNECTION OF CABLES.

a. Antenna Cords.

(1) Use Reel Unit RL-49-A (fig. 33) to hold Reels DR-10-A while unreeling the various cords. Refer frequently to figures 163 and 164 when connecting the cords. Follow these figures EXACTLY to insure proper performance of the equipment.

(2) Remove four Cords CD-829 from the reel, one at a time, positioning each one according to figure 164 as it is removed. Match the color coding on the cords with the phase inverters. Either end of the cord may be connected to the phase inverter. Take two Junction Boxes JB-91-A from Chest CH-251/CRD-3 and connect them to the proper h-f cords, being careful to match color codings on cover plates with corresponding color bands on cords (fig. 34).

(3) Remove three Cords CD-1020 from the reel. Select the cord color-coded green-yellow and connect either end to the connector of Junction Box JB-91-A similarly color-coded. Connect either end of the cord color-coded blue-brown to the connector of the remaining Junction Box JB-91-A. The color-coding should match. Attach Cord CD-1020 color-coded red to the

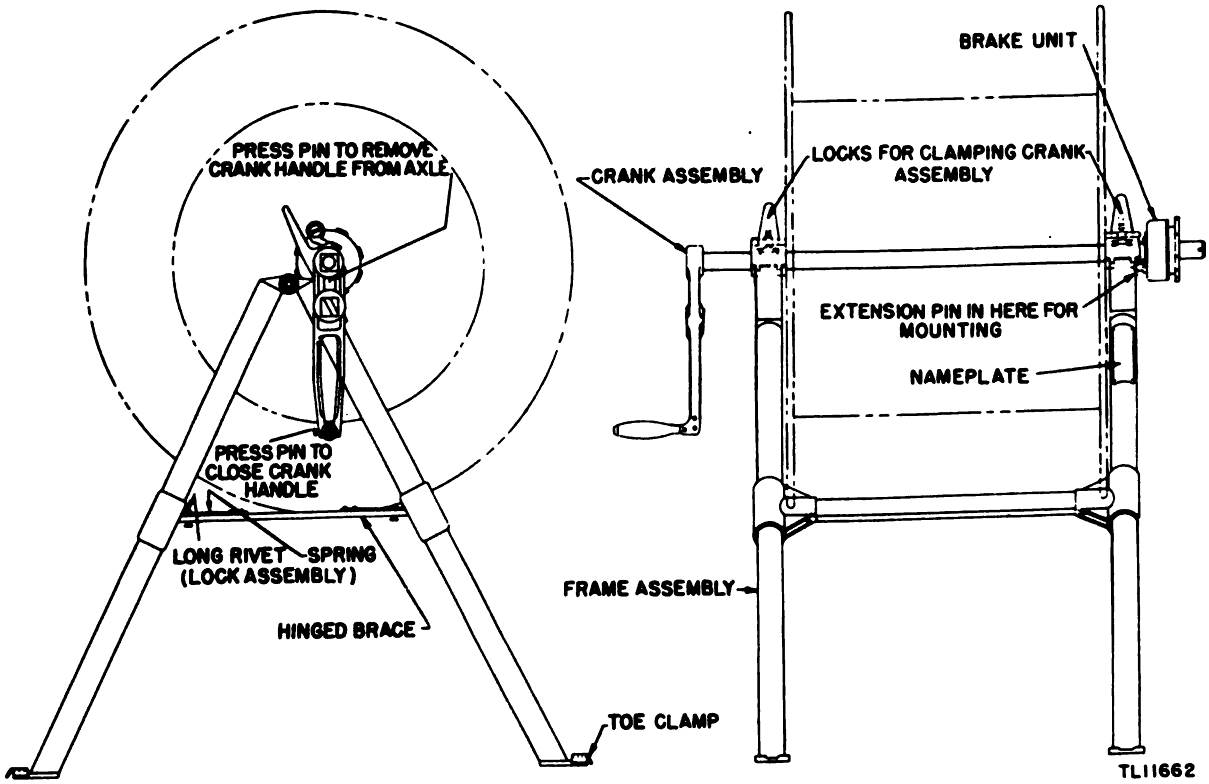

Figure 33. Reel DR-10-A in Reel Unit RL-49-A.

Figure 34. Installation of Junction Box JB-91-A.

proper connector of Phase Inverter MC-413-A (on sense antenna). Run Cords CD-1020 to the rear panel of Shelter HO-20-B.

b. Junction Box J-99/CRD-3.

(1) Locate the wooden frame for mounting Junction Box J-99/CRD-3 from the chest containing tools, hardware, and miscellaneous equipment. The necessary wood screws are packed with the frame. Fasten the wooden frame to the rear wall of Shelter HO-20-B, midway between the two sides of the panel, and approximately 4 to 6 inches from the top (fig. 36). Mount Junction Box J-99/CRD-3 to the wooden frame in the proper position so that the ten AN connectors on the junction box face downward. Allow sufficient clearance over the top of the junction box to permit easy bends in the cords to be attached to the box.

(2) Allow for enough length of Cords CD-1020 inside the shelter to make an easy bend along the side and top of the shelter. Connect Cords CD-1020 to the proper connectors on the top of Junction Box J-99/CRD-3, observing the color coding (fig. 36). Remove three harness clips and the necessary wood screws from the chest containing tools, hardware, and miscellaneous equipment. Fasten the harness clips around three Cords CD-1020 in the manner indicated in figure 36 and fasten to the wall of the shelter with wood screws.

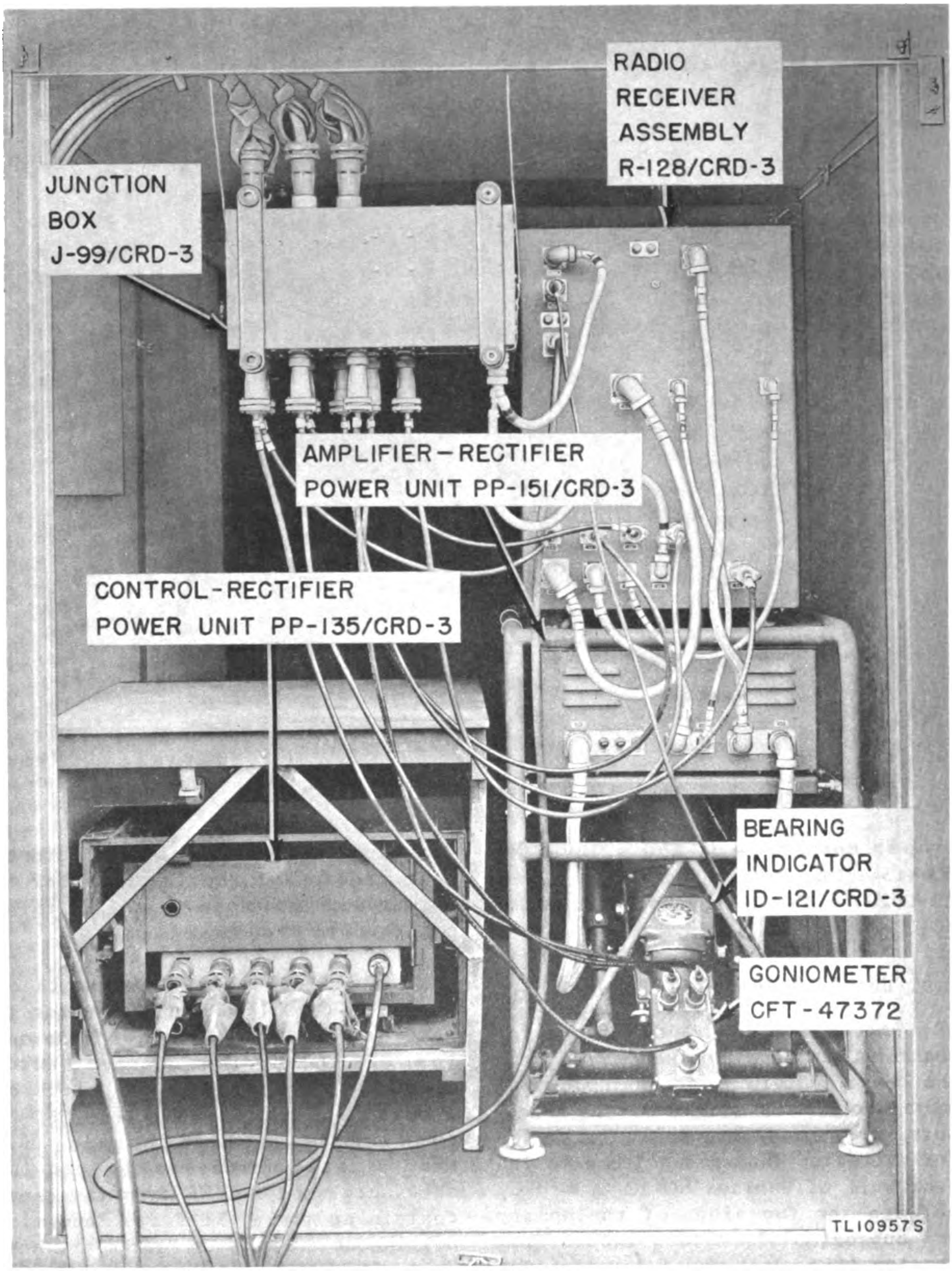

Figure 35. Radio Set AN/CRD-3 installed in Shelter HO-20-B, rear view.

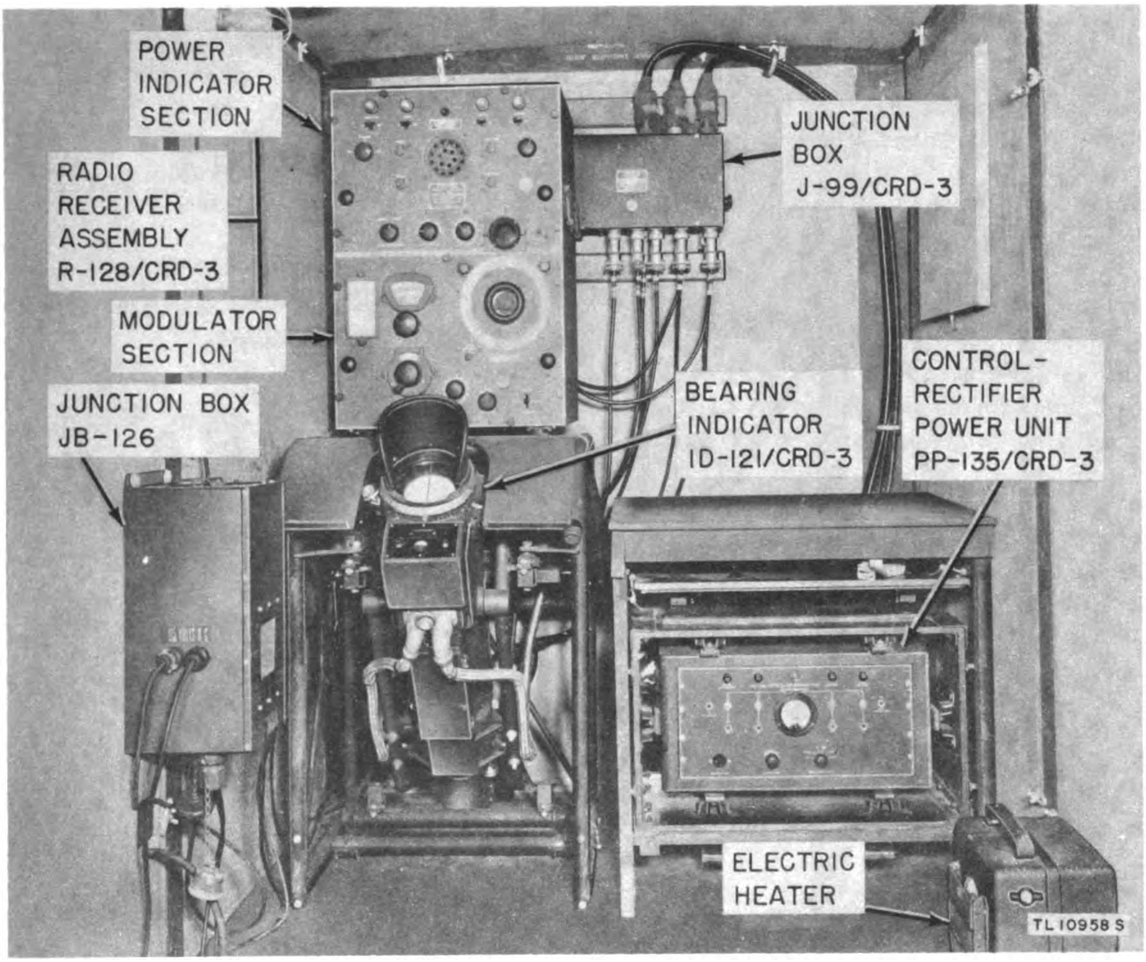

Figure 36. Radio Set AN/CRD-3 installed in Shelter HO-20-B, front view.

c. Mounting Table MT-247/CRD-3, Bearing Indicator ID-121/CRD-3, and Amplifier-Rectifier Power Unit PP-151/CRD-3.

(1) Locate Chest CY-318/CRD-3. Unpack Mounting Table MT-347/CRD-3 with assembled Bearing Indicator ID-121/CRD-3 and goniometer. Remove the two pins on the lower bearing indicator support at the base of the mounting table. Lift the hinged metal flap on the front of the mounting table and brace the back with the rod at the left of the hinge. Remove the two nuts on the shockmount support and drop the bearing indicator on its chain (fig. 37).

(2) Remove Amplifier-Rectifier Power Unit PP-151/CRD-3 from Chest CY-317/CRD-3. The shelf behind the bearing indicator is the mounting for this unit. Release the bar under the shelf and drop the shelf forward on its support. Loosen the screws that hold the rectifier power unit panel in its cabinet. Remove the unit and fasten the cabinet on the shelf of the mounting table with the hardware supplied. Slide the unit into its cabinet, tighten the captive screws, and return the shelf to its operating position.

d. Radio Receiver Assembly R-128/CRD-3.

(1) Remove Radio Receiver Assembly R-128/CRD-3 from Chest CY-315/CRD-3. Mount the assembly on the mounting table with the hardware supplied.

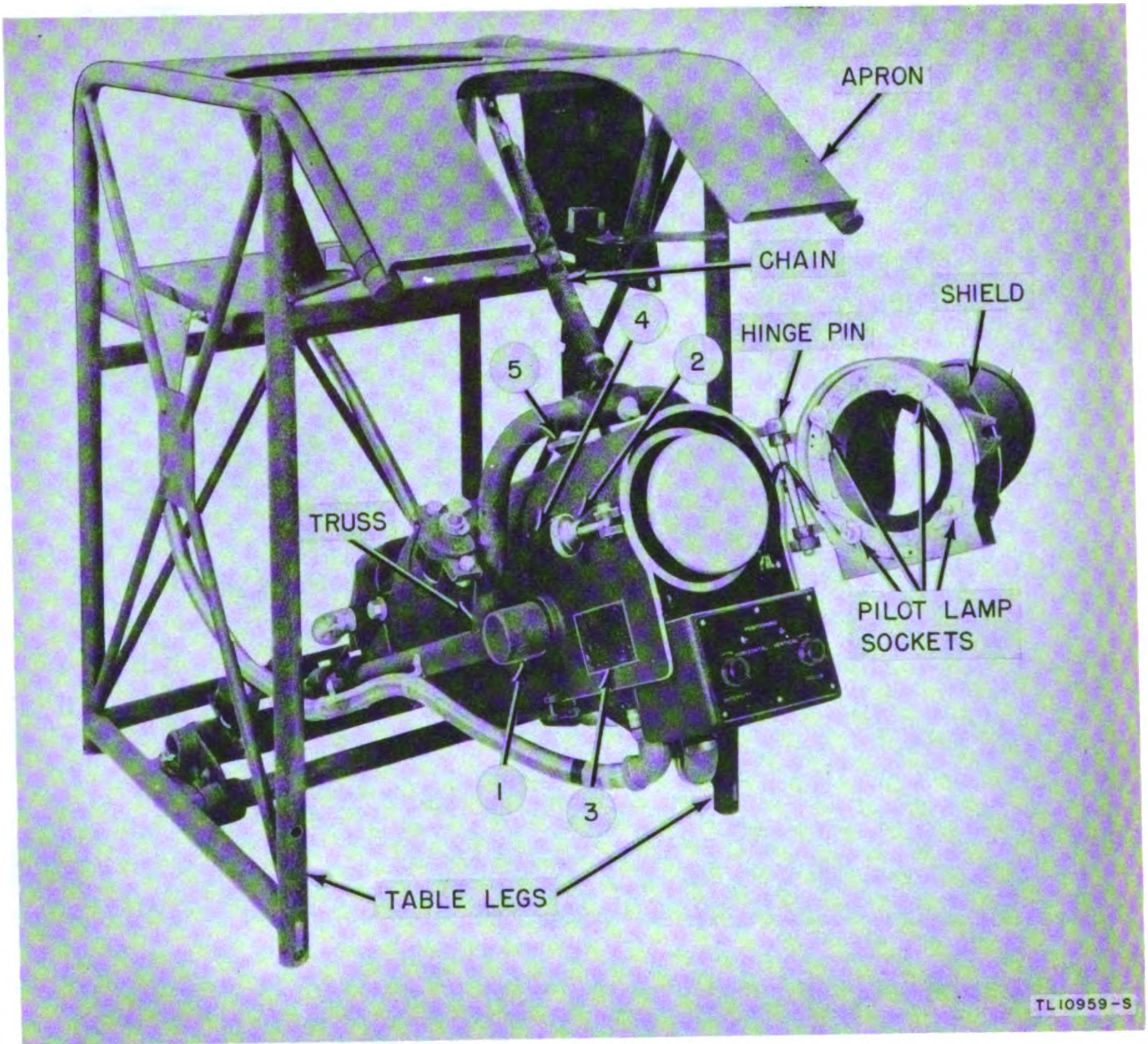

Figure 37. Bearing indicator and mounting table showing bearing indicator dropped on its chain.

(2) Connect all interconnecting cables between the radio receiver assembly, bearing indicator, Junction Box JB-99/CRD-3, and Amplifier-Rectifier Power Unit PP-151/CRD-3. Carefully study the cording diagram in figure 163 and then proceed to connect the cords. Figure 35 shows the interconnecting cables properly installed. These cords are located in Chests CY-317/CRD-3, CY-318/CRD-3, and CY-315/CRD-3.

e. Power Cords to Phase Inverters. Remove four Cords CX-402/CRD-3 (135 feet) from one of the Reels DR-10-A. Remove one Cord CX-402/CRD-3 (40 feet) from the same reel. Connect the proper end of each 135-foot cord to the remaining connector on each Phase Inverter MC-411-A. Connect the proper end of the 40-foot cord to Phase Inverter MC-413-A. Observe the color coding on the cords and phase inverters when making connections. Run the cords to Shelter HO-20-B.

f. Control-Rectifier Power Unit PP-135/CRD-3.

(1) Unpack and assemble one of the wooden tables (fig. 38) and place it in position next to the steel table. Remove the wooden frame for support-

ing PP-135/CRD-3 from the set of tools, hardware, and miscellaneous equipment. Fasten this frame at the bottom of the table (fig. 36) allowing enough clearance for Case CY-253/CRD-3 containing Control-Rectifier Power Unit PP-135/CRD-3.

(2) Remove the front and rear covers of Case CY-253/CRD-3 and place the case (with the unit installed) on the table frame. Stake the two covers on top of the case. Fasten the table leg supports.

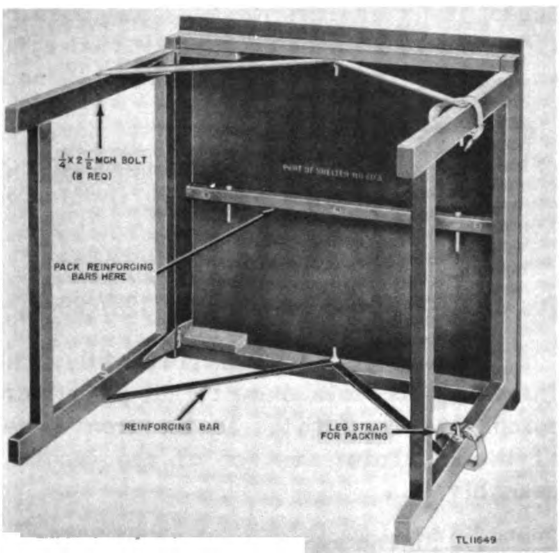

Figure 38. Shelter HO-20-B equipment table erection detail.

(3) Connect the phase inverter power cords (CX-402/CRD-3) to the connectors on the rear panel of Control-Rectifier Power Unit PP-135/CRD-3, observing the color coding (fig. 35).

(4) Connect one end (Hubbell connector) of Cord CX-456/CRD-3 to the control unit. Connect the other end (AN connector) to the Radio Receiver Assembly R-128/CRD-3, power indicator section (fig. 163).

(5) Connect the remaining cords according to figure 163.

g. Junction Box JB-126. Mount Junction Box JB-126 on the side wall of Shelter HO-20-B, at the left of the operator as illustrated in figure 36. Connect associated cords.

h. Miscellaneous Equipment.

(1) Mount the light fixture as indicated in figure 36. Plug the light fixture into Junction Box JB-126.

(2) Mount one heater on the front panel, directly behind the operator's chair. Plug it into Junction Box JB-126. If one heater is not sufficient, the other heater may be mounted in any convenient place for use.

(3) Place the operator's chair in a position near Mounting Table MT-347/CRD-3. Store the second collapsible wooden table at the left of the steel table.

(4) Telephone EE-8-B may be mounted at any convenient point on the shelter wall.

(5) The fire extinguishers should be mounted within easy reach.

18. POWER UNIT PE-197.

a. Refer to TM 11-940.

b. Install the power unit at a point approximately 275 ft. from the center of the antenna array and in the same azimuth position as Shelter HO-20-B.

c. Connect one end of the power extinguish cord (part of Power Unit PE-197) to the power unit, and the other end to Cord CX-565/CRD-3. Connect the other end of Cord CX-565/CRD-3 to Junction Box JB-126.

NOTE: No provision has been made to use the remote control cable.

PART TWO

OPERATING INSTRUCTIONS

NOTE: For information on destroying the equipment to prevent enemy use, refer to the destruction notice at the front of the manual.

SECTION III

CONTROLS AND THEIR USE

19. BEATING INDICATOR ID-121/CRD-3.

The front operating panel of the automatic bearing indicator control box (fig. 39) includes the following controls:

a. HORIZONTAL (R502) (screwdriver slotted) which controls the horizontal positioning of the automatic azimuth pattern on the screen, adjusts the d-c voltage applied to the cathode-ray tube horizontal deflection plates.

b. VERTICAL (R501) (screwdriver slotted) which controls the vertical positioning of the automatic azimuth pattern on the screen, adjusts the d-c voltage applied to the cathode-ray tube vertical deflection plates.

c. FOCUS (R506) which adjusts the focus (sharpness) of automatic azimuth pattern, varies the voltage applied to the cathode-ray tube first anode. An adjustment of this control produces a slight interaction on the adjustment of the INTENSITY control described below.

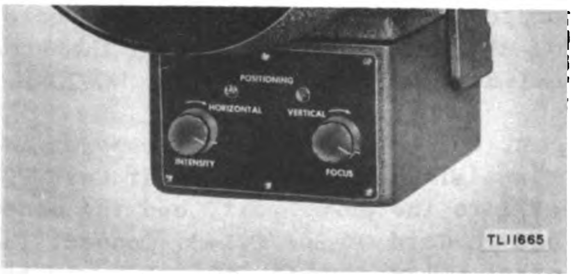

Figure 39. Bearing Indicator ID-121/CRD-3 control box.

d. INTENSITY (R507) which adjusts the intensity (brightness) of the automatic azimuth pattern, varies the bias applied to the cathode-ray tube control electrode. An adjustment of this control produces a slight interaction on the adjustment of the FOCUS control described above. It is necessary therefore to readjust both of these controls whenever one is varied until no further improvement can be obtained.

e. The azimuth scale lamps are dimmed or extinguished by control R509 located on the right-hand side of the indicator housing.

20. RADIO RECEIVER ASSEMBLY R-128/CRD-3.

a. **Modulator Section (fig. 40).** The following controls except that of subparagraph (9) are located on the front panel of the modulator section of the receiver assembly.

(1) Tuning control including a frequency calibrated dial.

(2) Frequency band change switch.

(3) R.F. GAIN (R131) varies the sensitivity of the receiver as follows:

(a) For M.V.C. or C.W. operation potentiometer R131A varies the amplification of the second r-f mixer and the intermediate-frequency (i-f) stages by adjusting the bias voltage applied to the grids of these tubes.

(b) For A.V.C. operation R131B varies amplification of the indicator i-f tube by adjusting the bias on this tube.

(4) The INDICATION switch (S107) has three positions: MAN.; NULL, and INST. It switches the signal input to either the

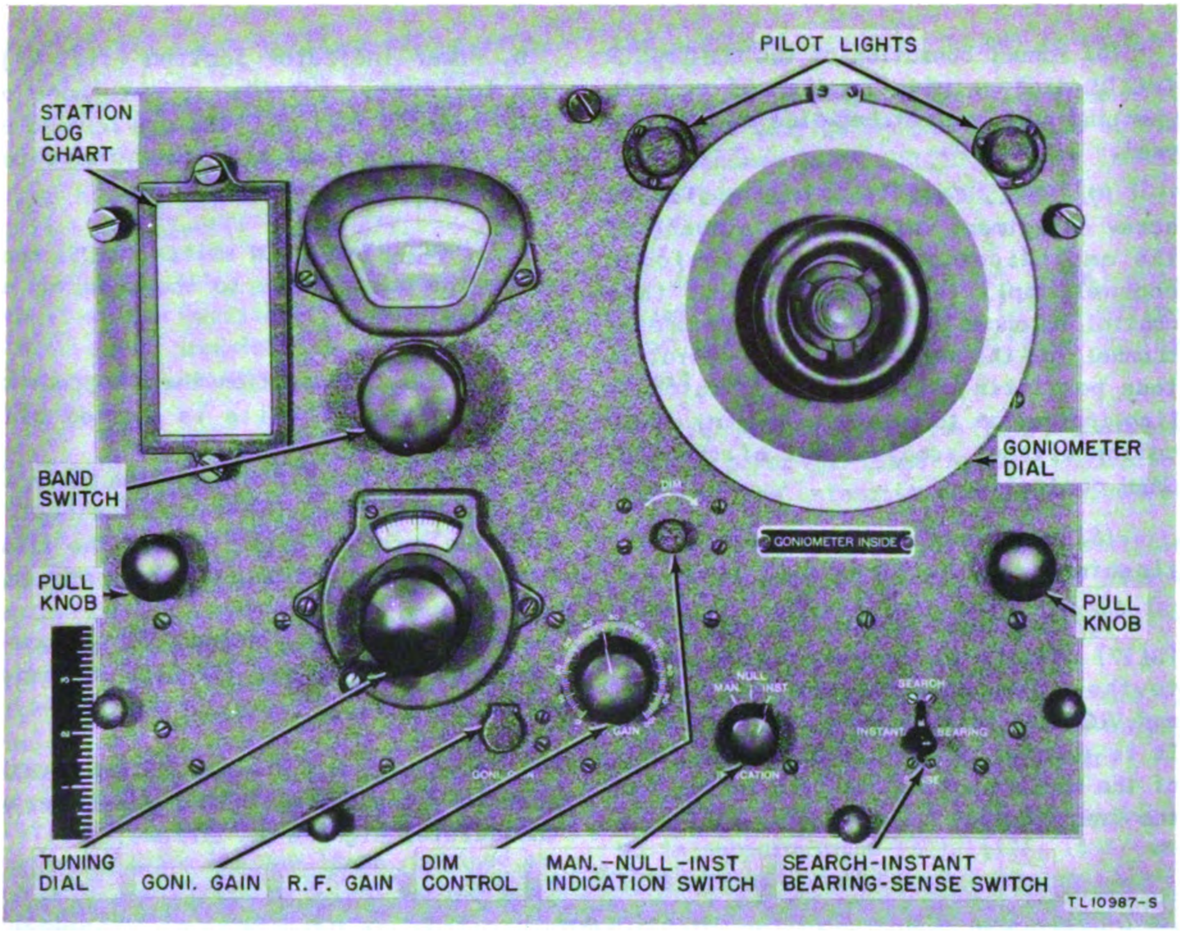

Figure 40. Modulator section of Radio Receiver Assembly R-128/CRD-3.

receiver goniometer or the automatic bearing indicator goniometer and switches in the proper circuits required for various methods of azimuth indication.

(a) In MAN. position the receiver goniometer and receiver cathode-ray indicator are used to obtain the matched-line method. Sense indication is obtained automatically.

(b) The NULL position allows an aural indication with the loudspeaker or heatset, or a visual indication on the receiver cathode-ray tube. The receiver goniometer is used.

(c) The INST. position permits continuous instantaneous visual azimuth indications. The automatic bearing indicator and its goniometer are used.

(5) SEARCH-INSTANT. BEARING-SENSE key switch (S106) controls the method of operation of the receiver indicating equipment in the NULL and INST. positions of the INDICATOR switch.

(a) The SEARCH position permits the use of the radio receiver without directional properties. Only the sense amplifier circuits are operating.

(b) The INSTANT. BEARING position permits reading of the azimuth by either the NULL or INST. methods. The direction amplifier circuits of the receiver are operating.

(c) The SENSE position is used for sense indication. In this position, sense and directional amplifiers are operating. This switch is rendered inoperative when INDICATION switch S107 is in the MAN. position.

(6) Manual operation of the GONIOMETER INSIDE dial permits reading of azimuth when the null and matched-line methods are used.

(7) GONI. GAIN (R117) is a slotted screw adjustment which allows varying of the amplification of the directional channel amplifier. Presetting of this control balances the gain of the goniometer channel for the various modes of operation thus permitting switching from matched-line indication to automatic azimuth indication without readjustment of the R.F. GAIN control.

(8) DIM control (R139) dims or extinguishes the receiver dial lamps.

(9) Balanced modulator adjustment (R127) adjusts the screen voltage supply to the balanced modulator tubes (V108 and V109) to balance their amplification. It is located on the top right-hand side of the chassis approximately 6 inches from the front panel.

b. Power Indicator Section (fig. 41). The following controls except those of subparagraphs (17) and (18) are located on the front panel of the power indicator of the receiver assembly.

(1) OFF-STANDBY-ON switch (S205) controls the power input to the receiver as follows:

(a) In OFF position the a-c power to the receiver circuits is turned off.

(b) In the STANDBY position the high-voltage direct current is disconnected from the receiver circuits, but the filament and bias voltages are left on.

(c) In the ON position the a-c power supply to the receiver circuits is turned on.

(2) A.V.C.-M.V.C.-C.W. switch (S202) *permits* reception of either modulated or unmodulated signals as follows:

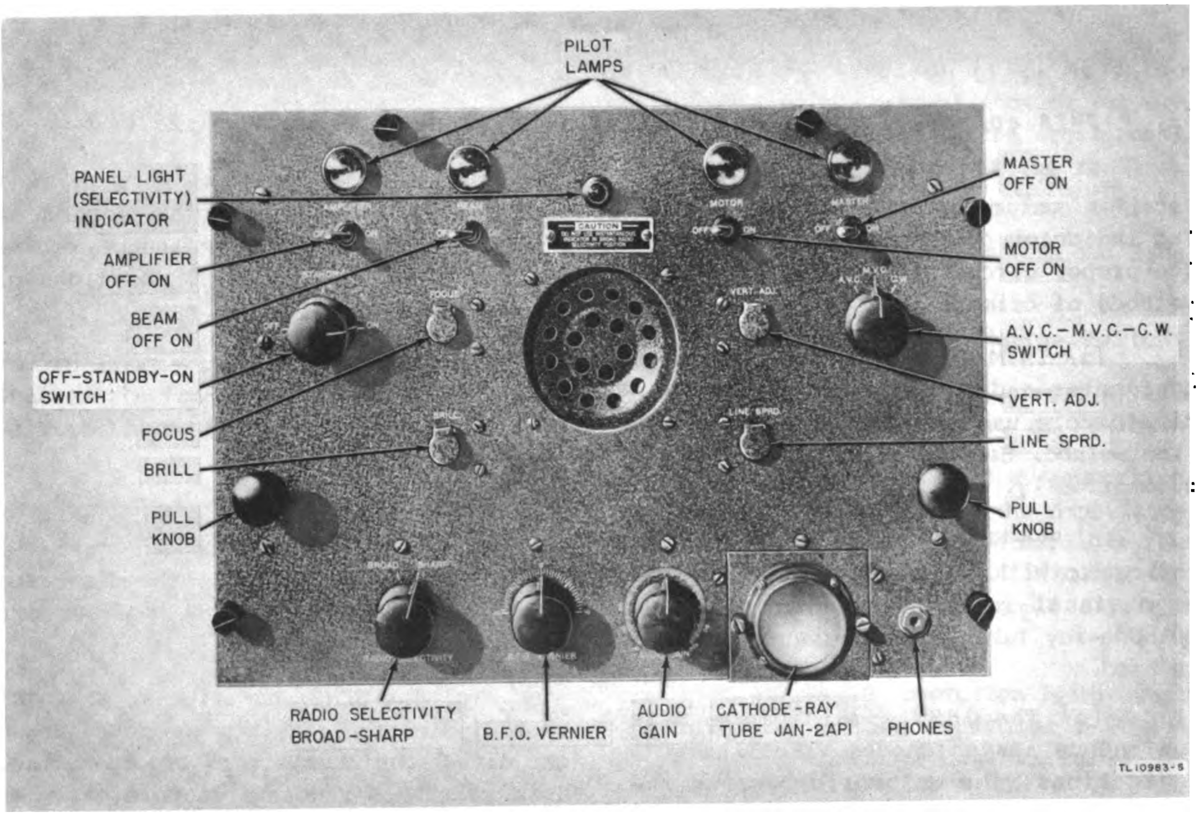

Figure 41. Power indicator of Radio Receiver Assembly R-128/CRD-3.

(a) The A.V.C. position allows automatic volume control. The beat-frequency oscillator is automatically turned off.

(b) The M.V.C. position allows manual volume control. The beat-frequency oscillator is automatically turned off.

(c) The C.W. position turns on the beat-frequency oscillator, and permits the reception of unmodulated signals using manual volume control.

(3) AUDIO GAIN control (R210) varies the audible output from the receiver by controlling the audio voltage applied to the first audio-frequency (a-f) stage.

(4) RADIO SELECTIVITY (BROAD-SHARP) switch (S201) controls the band width of the intermediate-frequency amplifier so that selectivity may be either BROAD or SHARP depending on the switch position used.

(5) LINE SPRD. control (R270) is a slotted screw adjustment to vary the spacing between the two lines obtained on the receiver cathode-ray tube in the MAN. position of the INDICATION switch.

(6) VERT ADJ. control (R264), a slotted screw adjustment, controls the vertical position of the trace on the receiver cathode-ray tube.

(7) FOCUS control (R266), a slotted screw adjustment, permits focusing of the beam of the receiver cathode-ray tube by varying the voltage applied to the first anode.

(8) BRILL control (R268), a slotted screw adjustment, controls the intensity (brilliance) of the trace on the receiver cathode-ray tube by varying the bias on the control electrode G1.

(9) PHONES jack (J204) provides connection to the audio output tube. The receiver loudspeaker is automatically disconnected when the headset is plugged into this jack. One side of the headset is grounded through the inserted headset plug.

(10) BFO VERNIER (C224) permits varying the pitch of the beat note obtained when the A.V.C.-M.V.C.-C.W. switch is on C.W.

(11) Panel light (I201) indicates that automatic bearing indicator should not be used because RADIO SELECTIVITY is in the BROAD position and bearings taken in this position are in error.

(12) MASTER power switch (S206) controls the a-c input power to the equipment through the other switches on the power indicator unit.

(13) MOTOR power switch (S207) controls the a-c power and lamps in the illuminated scale of the automatic bearing indicator.

(14) BEAM power switch (S208) controls the a-c power to the power supply of the automatic bearing indicator cathode-ray tube.

(15) AMPLIFIER power switch (S209) controls the a-c power to the power supply of the automatic indicator amplifier.

(16) Pilot lamps for switches as listed in subparagraphs (12), (13), (14), and (15) above.

(17) Blanking switch (S204) turns the trigger circuit ON or OFF for blanking the center portion of the receiver cathode-ray tube pattern. It is located on the right-hand side of the chassis about 8 inches from the front panel.

(18) Blanking control (R272) adjusts the amount of blanking of the receiver cathode-ray tube pattern by varying the trigger voltage supply to the control grid of the trigger amplifier tube. It is located on the right-hand front corner of the chassis.

21. CONTROL-RECTIFIER POWER UNIT PP-135/CRD-3 (fig. 42).

a. The SENSE GAIN control varies the sense antenna phase inverter output.

b. The ON OFF AC SWITCH turns the 115-volt power input to the control-rectifier power unit on or off.

c. The FIL SWITCH shifts the filament voltage from the No. 1 set of the phase inverter tubes to the No. 2 or spare set.

d. 0°, 180°, 90°, and 270°, ON-OFF switches turn the plate voltage to the respective Phase Inverter MC-411-A on or off.

e. The BALANCE ADJUSTMENT 0°, 180°, 90°, 270°, screwdriver controls adjust the plate current of the respective Phase Inverters MC-411-A.

f. The PLATE MA. ANT. COUPLING UNITS meter (50 milliamperes (ma)) indicates the plate current of all phase inverter units connected by the switches described in subparagraph d above.

g. SELECTOR SWITCH DF-SENSE-0°-180°-90°-270° performs the following functions:

(1) DF. In the DF (extreme left) position the total plate current of all four Phase Inverters MC-411-A are indicated on the panel meter provided of course the 0°, 180°, 90°, and 270° toggle switches are at the ON position.

(2) SENSE. In the SENSE position, the panel meter reads the plate current of the tubes in Phase Inverter MC-413-A. The meter is switched out of the circuits of the MC-411-A phase inverters.

(3) 0°, 180°, 90°, and 270°. By switching to any one of these four positions, it is possible to read the plate current of any one of the four Phase Inverters MC-411-A without turning the other phase inverters off.

h. The pilot lamp indicates when the ON OFF AC SWITCH is on.

i. AUX. 115 A.C receptacle is an auxiliary a-c outlet.

j. Fuses for the input a-c and meter circuits.

k. Spare fuses for the input a-c and meter circuits.

22. AMPLIFIER-RECTIFIER POWER UNIT PP-151/CRD-3 (fig. 12).

a. DEFL. SENS control (R401), a slotted screw adjustment, varies the size and shape of the automatic azimuth pattern by controlling the amount of the rectified

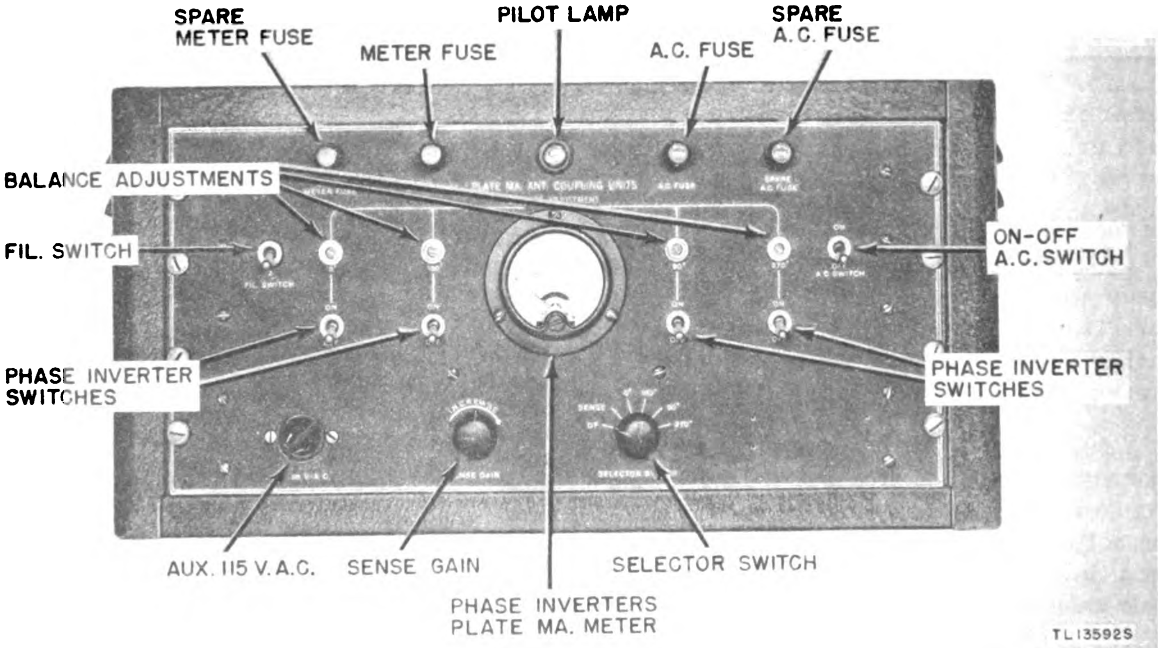

Figure 42.- Control-rectifier Power Unit PP-135/CRD-3 panel.

carrier voltage fed to the deflection amplifier grid.

b. CIRCLE DIA. control (R403), a slotted screw adjustment, controls the diameter of the circle on the automatic bearing indicator cathode-ray tube by varying the bias on the deflection amplifier tube. This in turn controls the current through the deflection coils.

23. JUNCTION BOX JB-126 (fig. 16).

The circuit breaker on the front of the junction box turns the power for entire equipment on or off.

24. POWER UNIT PE-197.

The controls for this unit are described in TM 11-940.

25. MODEL OAN TEST OSCILLATOR (fig. 43).

a. BAND 1-2-3, a three-position band switch (S601) is used to select the desired frequency range.

b. The frequency calibrated tuning dial selects the desired frequency, and the tuning dial is locked by means of the lock knob located below the tuning knob.

c. The A.C. INPUT is the a-c input receptacle (J601). It is provided with a shield.

d. The A.C. ON-OFF switch (S603) is a toggle switch in the lower left-hand corner of the panel. It controls the 115-volt input to the signal generator.

e. BATT. ON-OFF switch (S604) performs the double function of switching the oscillator-amplifier circuits from the a-c power supply outputs to the batteries and vice versa. When this switch is at the ON position, the output of the a-c power supply is disconnected and cannot deliver power whether energized or not. The BATT. ON-OFF switch must be OFF when a-c operation is desired. Turn to the ON position only that control corresponding to the type of operation required; i.e., alternating current or battery.

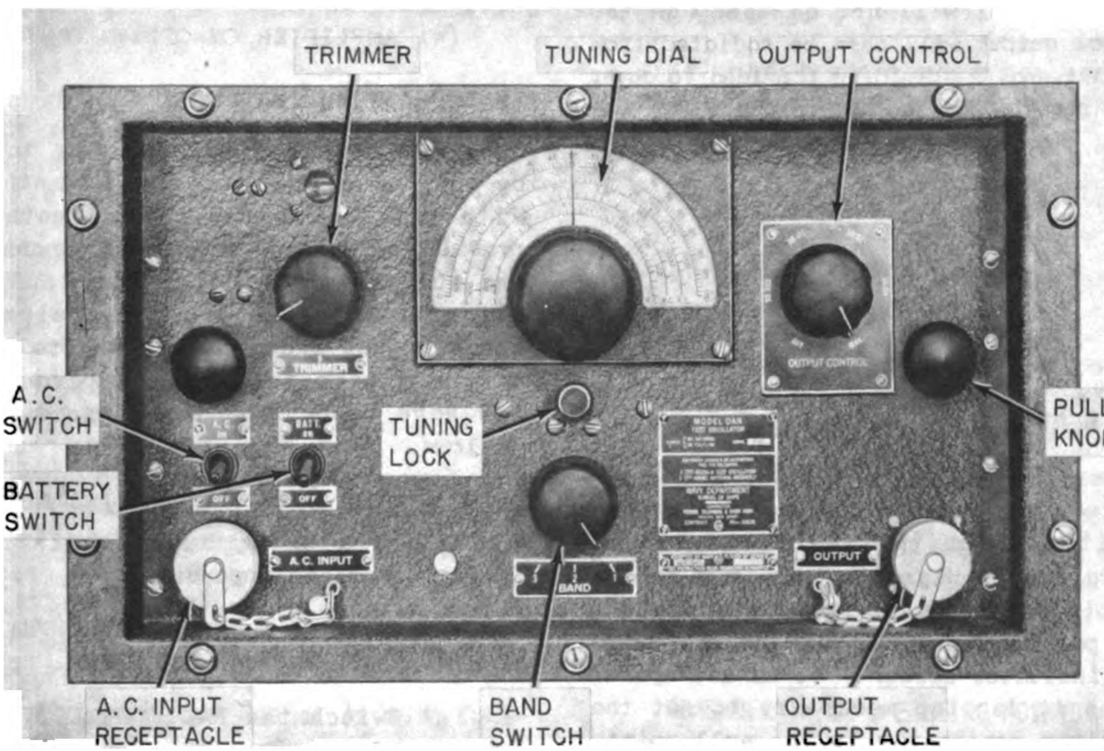

Figure 43. OAN test oscillator panel controls.

f. The TRIMMER control varies the tuning trimmer capacitor (C610) which is connected across the amplifier section (C601-D) of the main tuning capacitor, to peak for maximum output.

g. The tuning indicator, consisting of a neon lamp (V603) mounted behind a window in the upper left-hand corner of the panel, indicates when the TRIMMER control has been adjusted for maximum antenna current. Maximum brilliance of this lamp indicates maximum antenna current.

h. The OUTPUT CONTROL is a switch (S602) that varies the output of the signal generator in steps of 0.04, 0.02, 0.01, and 0.005 of maximum to zero. In the OFF position, the output at the OUTPUT receptacle located in the lower right-hand corner of the panel is zero. However, there is still an output at the antenna.

i. The OUTPUT control is a receptacle (J602) from which the output of the signal generator is taken. When the OAN Test Oscillator is used as a target transmitter, this control will not be used, as the signal output will then be radiated from the antenna. A shield is provided to cover this receptacle when not in use.

SECTION IV

OPERATION

26. GENERAL.

Operation of Radio Set AN/CRD-3 consists of selecting the proper switch positions for the required mode of operation, tuning the receiver to the required frequency, and interpreting the patterns which appear on the bearing indicator screen. For manual operations it is also necessary to set the receiver goniometer to the null point. Good judgement based on experience is more important than printed instructions. Be sure the initial alignment checks outlined in paragraph 125 have been made before the equipment is operated after installation or repair.

27. STARTING PROCEDURE.

a. Start the power unit.

b. Close the circuit breaker on Junction Box JB-126.

c. Turn the following switches located on the control-rectifier power unit to the ON position:

(1) ON-OFF AC SWITCH.

(2) Four switches ON-OFF 0°, 180°, 90°, and 270°.

d. Turn the following switches, located on the power indicator panel of the receiver assembly, to the ON position:

(1) OFF-STANDBY-ON.

(2) MASTER ON-OFF.

(3) MOTOR ON-OFF.

(4) BEAM ON-OFF.

(5) AMPLIFIER ON-OFF.

28. OPERATING INSTRUCTIONS.

a. **General.** Azimuths can be taken by any one of three different methods with this equipment. These methods provide instantaneous automatic, manual, and null azimuth indications. Before attempting to operate the equipment check to see that the proper preliminary adjustments given in paragraph 128 have been made. Then proceed as follows.

b. **Common Operating Adjustments.** Make the following adjustments for all three modes of operation.

(1) Switch the SEARCH-INSTANT. BEARING-SENSE switch to SEARCH.

(2) Switch the RADIO SELECTIVITY switch to BROAD.

(3) Select the proper frequency band and tune the main tuning dial to required frequency.

(4) Set the R.F. GAIN and AUDIO GAIN switches at approximately three-quarters of maximum.

(5) Turn ON the beat-frequency oscillator (BFO) to assist in tuning or monitoring the c-w or i-c-w signals.

(6) After the signal is tuned in, turn the RADIO SELECTIVITY switch to SHARP.

c. Operation for Null Azimuths.

(1) Make sure the common operating adjustments in subparagraph b above have been accomplished.

(2) Set the INDICATION switch at NULL.

(3) Set the SEARCH-INSTANT. BEARING-SENSE switch at INSTANT. BEARING.

(4) Rotate the receiver GONIOMETER dial until an aural null is obtained. The lines on the receiver cathode-ray tube screen will have minimum length at the GONIOMETER dial setting giving an aural null.

(5) Increase the R.F. GAIN control setting as much as necessary to accurately determine the null position on the GONIOMETER dial.

(6) Note the azimuth obtained on both the black and red scales of the GONIOMETER dial.

(7) Depress the STANDBY-INSTANT. BEARING-SENSE switch to SENSE.

(8) If the signal *decreases* when the GONIOMETER dial is rotated clockwise, read the azimuth on the black scale. If the signal *increases* when the GONIOMETER dial is rotated clockwise, read the azimuth on the red scale.

d. Operation for Manual Azimuth Indications.

(1) Make sure the common operating adjustments in subparagraph b above have been accomplished.

(2) Set the INDICATION switch at MAN.

(3) Set the SEARCH-INSTANT. BEARING-SENSE switch at INSTANT. BEARING.

(4) Rotate the goniometer dial slowly clockwise until the two lines on the receiver cathode-ray tube screen are the same length. Note the goniometer dial reading on both the black and red scales.

(5) Continue to rotate the goniometer dial slowly clockwise past the position for which the lines match. If the left-hand line shortens and the right-hand line lengthens, the black numeral indicates the azimuth. If, on the other hand, the left line lengthens and the right shortens, the red numerals indicate the azimuth (fig. 44).

NOTE: Remember the correct azimuth is obtained when the two lines are matched in length.

e. Operation for Instantaneous Automatic Azimuths.

(1) Make sure the common operating adjustments in subparagraph b above have been accomplished.

(2) Set the INDICATION switch at INST.

(3) Set the SEARCH-INSTANT. BEARING-SENSE switch at INSTANT. BEARING.

(4) Read the azimuth indication on both ends of the twin-leaf pattern in the automatic bearing indicator (par. 30b).

(5) Depress the SEARCH-INSTANT. BEARING-SENSE switch to SENSE. Read and interpret the sense of the signal (the correct end of the twin-leaf pattern) as outlined in paragraph 31b.

REMEMBER THESE OPERATING POINTS

1. Always tune the main tuning dial for maximum output each time the receiver is tuned to a new signal.

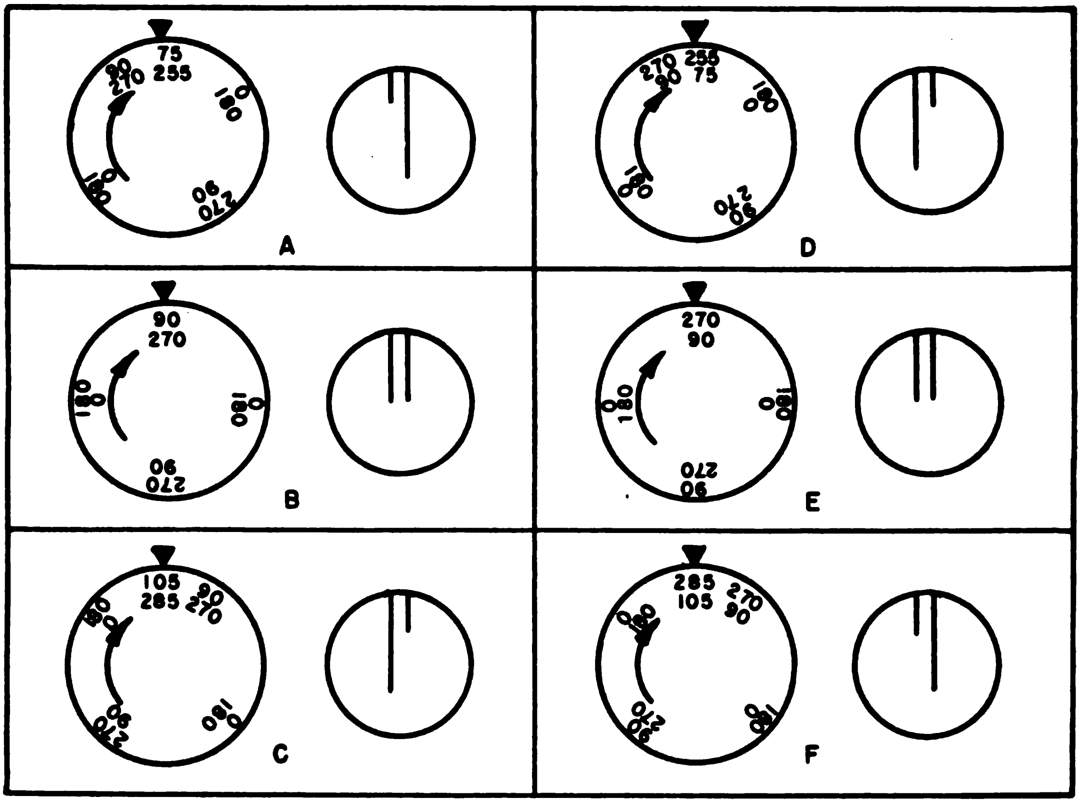

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Figure 44. Matched line indications for azimuth of 270° as the goniometer is rotated clockwise through the null point.

2. The automatic bearing indicator pattern is a good tuning indicator. The receiver is properly tuned when the twin-leaf pattern is narrowest. It may be necessary to reduce the R.F. GAIN control to observe this.

3. Proper setting of the R.F. GAIN control is that which makes the twin-leaf pattern just come together at the center *after* the signal is properly tuned.

4. Always take azimuths with the RADIO SELECTIVITY switch on SHARP.

5. Check and demagnetize the indicator, paragraph 130, daily or oftener if necessary. Accurate azimuths are impossible when parts of the indicator are magnetized.

29. STOPPING PROCEDURE.

a. Turn the following switches located on the power indicator panel of the receiver assembly to the OFF position:

(1) OFF-STANDBY-ON

(2) MASTER ON-OFF

(3) MOTOR ON-OFF

(4) BEAM ON-OFF

(5) AMPLIFIER ON-OFF

b. Turn the following switches located on the control-rectifier power unit to the OFF position:

(1) Four switches ON-OFF 0°, 180°, 90°, 270°.

(2) ON-OFF AC SWITCH.

c. Throw the switch on Junction Box JB-126 to the OFF position.

d. Shut down Power Unit PE-197.

30. OPERATION OF OAN TEST OSCILLATOR AS A TARGET TRANSMITTER.

a. Assemble the whip antenna type CFT-66082 and insert it in the receptacle located on the top of the test oscillator (type CFT-60054A).

b. Locate the oscillator on a reasonably level spot so that the antenna is vertical.

c. Ground the binding post provided on the front panel to avoid annoying shocks.

d. Turn on the battery switch (BATT. ON-OFF) and allow approximately 1 minute for the tubes to heat up.

e. Select the desired frequency by means of the band switch and tuning control, and lock the tuning by means of the lock knob below the tuning knob.

f. Now adjust the TRIMMER control for maximum antenna current which is indicated when the neon lamp behind the window in the panel glows at maximum brilliance. *Be sure the output control on the panel is in the OFF position.* This decouples the attenuator circuit loading from the amplifier and insures maximum antenna output. The unit is now ready for direction finder azimuth measurements.

> NOTE: Always turn OFF the power when the oscillator is not in use to conserve battery drain. It is also advisable to remove the antenna when moving the oscillator for a new azimuth measurement. After setting up the oscillator at the new location recheck the trimmer adjustment for maximum antenna current. This does not change the oscillator tuning, which has been locked, but merely compensates for any possible change in effective antenna capacity due to changing ground conditions.

31. AUTOMATIC BEARING INDICATOR PATTERN INTERPRETATION.

a. General. After the operating adjustments outlined in paragraph 28e above have been made, radio azimuths may be obtained as rapidly as the stations are tuned in, and readings taken of the resulting indicator patterns. The azimuth pattern is obtained when the SEARCH-INSTANT. BEARING-SENSE switch is on INSTANT. BEARING. The correct end of this pattern to read is shown by the position of the sense pattern, which is obtained by shifting the SEARCH-INSTANT. BEARING-SENSE switch to SENSE.

b. Example of Azimuth Determination. Figure 45 shows a typical twin-leaf azimuth pattern obtained with the SEARCH-INSTANT BEARING-SENSE switch on INSTANT. BEARING. The R.F. GAIN control has been advanced sufficiently to bring the center of the pattern together. This figure alone shows that the transmitter azimuth is either 127° or 307°;

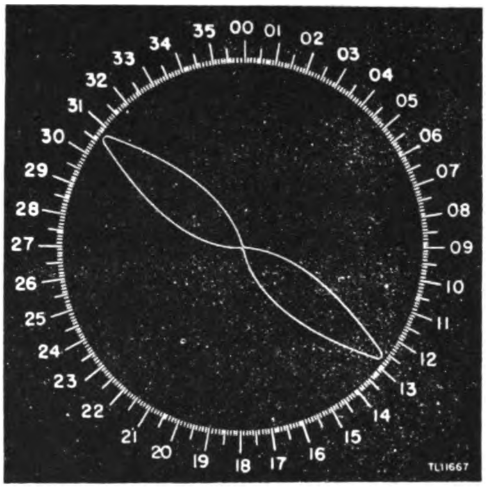
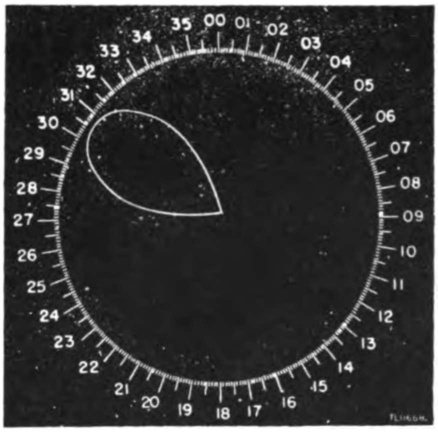


Figure 45. Azimuth pattern with SEARCH-INSTANT BEARING-SENSE switch on INSTANT BEARING. Shows transmitter azimuth is either 127° or 307°. Sense pattern figure 46 shows which end to read.

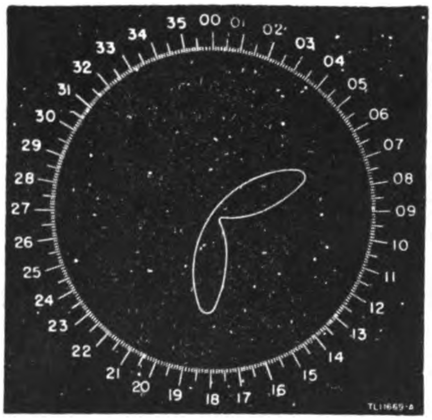
that is, an uncertainty of 180° exists. Figure 46 shows the pattern obtained when the SEARCH-INSTANT. BEARING-SENSE switch is pressed to SENSE. This pattern is opposite the end of the azimuth pattern which reads 127°, showing that the 127° reading gives the direct azimuth of the transmitter. The reciprocal bearing is then 307°. Figure 47



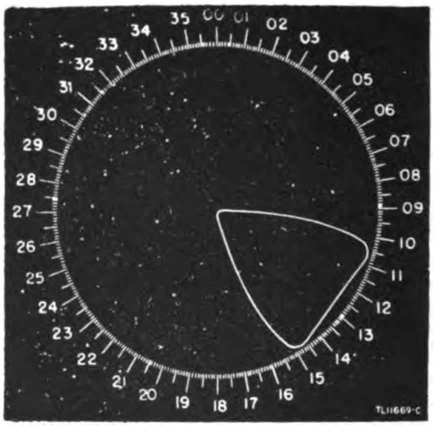
*gure 46. Sense pattern corre-
onding to azimuth pattern of figure
when switch is on SENSE. Since
is pattern is opposite the 127°
d of azimuth pattern, direct trans-*

shows four sense patterns corresponding to different settings of the SENSE GAIN control located on the control-rectifier power unit. All four patterns are for a transmitter whose direct azimuth is 307°, or just opposite that of figure 46. As the SENSE GAIN control is increased from a low value to a higher value, and the output of the SENSE antenna approaches or exceeds that of the directional antennas, the sense pattern changes progressively in shape but not position, as shown in figure 47.

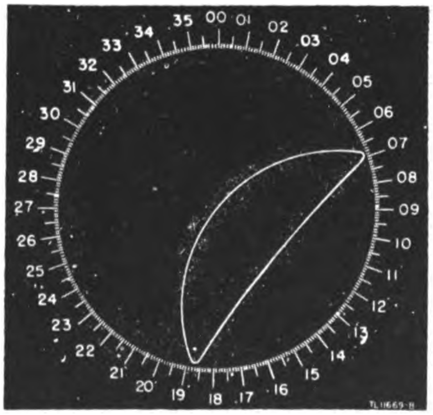
c. Typical Azimuth Patterns. Azimuth patterns obtained under different signal and noise conditions are shown in figures 48 to 55 inclusive.



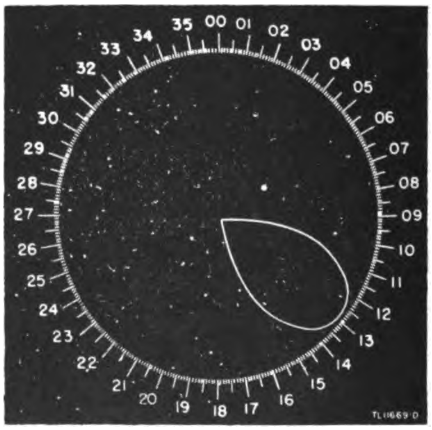
A. SENSE GAIN low.



C. SENSE GAIN further increased.



B. SENSE GAIN increased.



D. High SENSE GAIN.

Figure 47. Sense patterns showing the effect of SENSE GAIN control settings on the pattern shape.

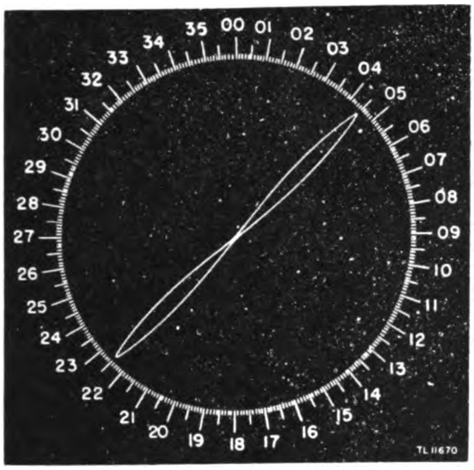


Figure 48. Strong signal without noise interference. Narrow pattern indicates receiver R.F. GAIN control turned slightly higher than necessary. All other controls are properly adjusted.

d. Azimuth Reliability. Skill increases with experience in the interpretation of the indicator patterns. With the type of azimuth equipment used in Radio Set AN/CRD-3, it is possible to take azimuths on signals of very short duration, or on signals whose phase and amplitude rapidly change at the point of reception. The bearing indicator pattern gives a continuous picture of receiving conditions. A little experience will enable the operator to take reliable azimuths under conditions which have hitherto made readings difficult, if not impossible. It will seldom be impossible to take azimuths unless the noise level is higher than the signal (fig. 54) or two stations are received on the same frequency. In general, the accuracy of azimuths taken under varying conditions differ only in the degree to which they can be read. Steady patterns with sharp ends can be read to a higher degree of accuracy than patterns with rounded and varying ends. Determine whether or not the azimuth is reliable by observing the following:

(1) Are the points of the twin-leaf pattern sharp? If not, the sensitivity of the receiver is improperly adjusted, or the propagation characteristics are varying along the transmission path of the received waves. This sometimes causes variation of the apparent angle of arrival of the waves which broadens the response null and abnormally rounds out the ends of the twin-leaf pattern.

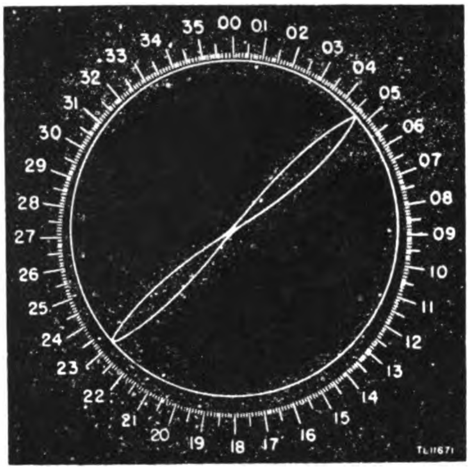


Figure 49. Strong keyed signal without noise interference showing circle pattern when carrier is off. Circle is off center and too small. Adjust POSITIONING and CIRCLE DIA. controls until circle is centered 1/16 inch inside scale.

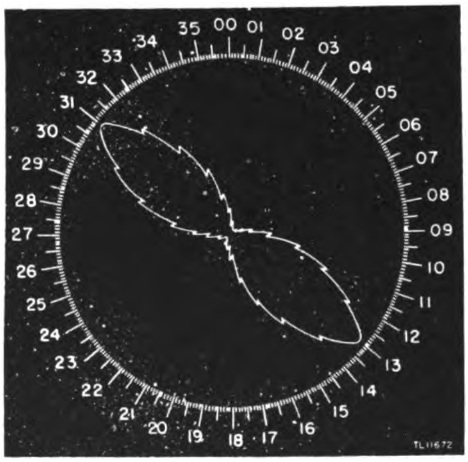


Figure 50. A weaker signal than in figures 48 and 49 with a-f modulation at fixed frequency. No noise interference present. Turn up receiver R.F. GAIN until center of pattern closes. Shifting modulation has no effect on null points.

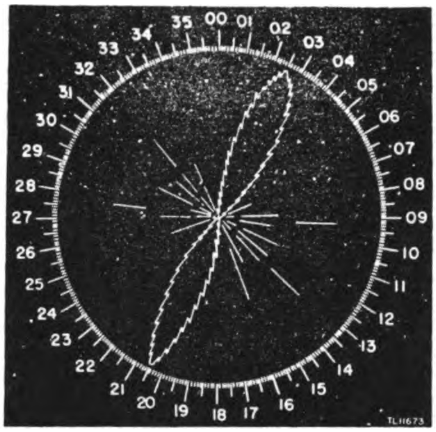


Figure 51. A somewhat weaker signal than figure 50. Higher setting of receiver R.F. GAIN control required to close pattern. Noise is amplified as shown by noise pattern. Azimuth readable to satisfactory accuracy.

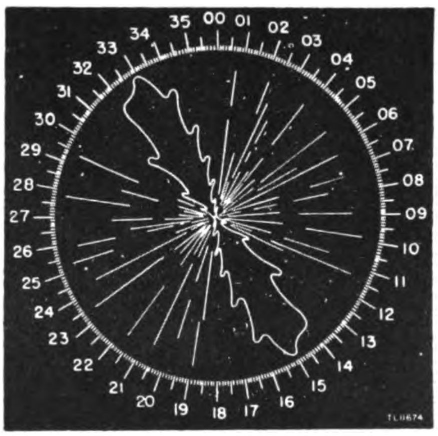


Figure 52. Highly modulated signal, weaker than figure 51 as shown by increased noise pattern. The shifting modulation envelope does not shift the null points. Readable accuracy of this pattern less than previous ones.

(2) Are the points of the pattern fixed? A shifting or rotating indicator pattern indicates that the polarization of the received wave is changing.

(3) Does the pattern change in width? If it does, this indicates a fading signal and may be accompanied by a slight shifting of the pattern as it changes in width.

(4) If the pattern varies in any or all of the above-mentioned ways it will generally be observed that these are times, even though they last only a fraction of a second, when the pattern will be steady and have normal well formed points. Azimuths at these times will be the most reliable, under the circumstances, although they will be less reliable than azimuths read from normal steady patterns free from variations.

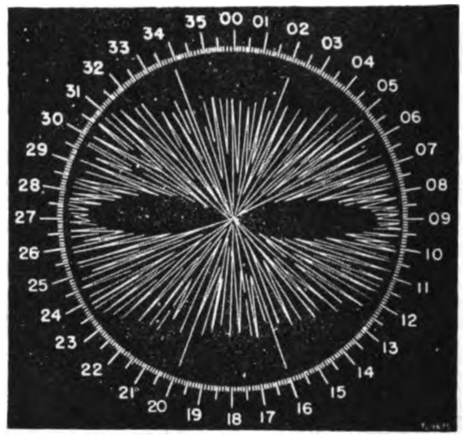


Figure 53. Very weak signal with predominant noise pattern. Readable azimuth accuracy reduced by constantly shifting noise patterns. This represents the practical limit of azimuth indications.

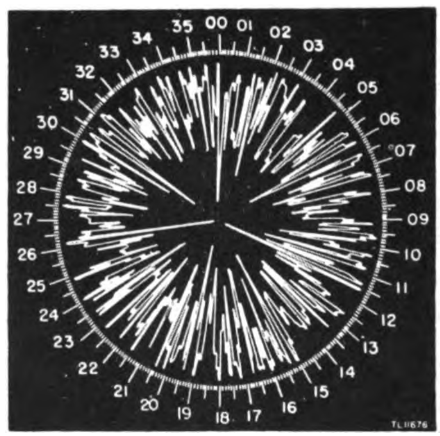


Figure 54. No signal or one so weak as to be less than noise level. No azimuths may be read under these conditions, although signal may occasionally increase sufficiently to give a momentary pattern like figure 53.

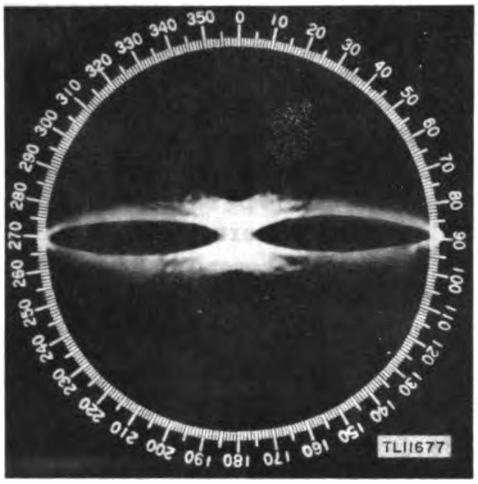


Figure 55. Photograph of a strong modulated signal without noise. This is similar to figures 50 and 51. Constantly moving modulation envelope is blurred because of photographic time exposure.

SECTION V

EQUIPMENT PERFORMANCE CHECK LIST

32. PURPOSE AND USE OF CHECK LIST.

a. General. The equipment performance check list (par. 33) will help the operator determine whether Radio Set AN/CRD-3 is functioning properly. The check list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. Check items 1 to 5 when starting, items 6 to 15 during operation, and items 16 to 19 when stopping (when turning the equipment off). Items 6 to 11 of this list should be checked at least once during a normal operating period or at least four times a day during continuous operation.

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

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator will perceive when he checks the items. In the case of meter readings, the allowable tolerances of the readings are given. When a meter reads between the limits specified, operation can be considered satisfactory. A meter reading outside the limits given is a sign of impending trouble. 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 the equipment in for repairs. When reference is made in the table to part five it indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is called for. If the set is completely inoperative or if the recommended corrective measures do not yield results, trouble shooting is necessary. However, if the tactical situation requires that communication be maintained and if the set is not completely inoperative, the operator must maintain the set in operation as long as it is possible to do so.

e. Items 1 to 5. Items 1 to 5 should be checked each time the equipment is put into operation.

f. Items 6 to 11. Items 6 to 11 show correct patterns on cathode-ray tube screens and correct meter readings when the equipment is properly adjusted prior to operation.

> NOTE: All readings and cathode-ray tube indications are correct for input voltages of 115 volts. If the input voltage exceeds 115 volts, slight-

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ly higher meter readings may be expected. The corrective measures listed in the last column are to be performed if the results for the various tests do not agree reasonably with the chart.

g. **Items 12 to 15.** These items represent operating characteristics of the direction finder for the three methods of azimuth determination and also include a check on the sense channel operation. The operator must become familiar with the characteristics of the set during normal operation; he must use that knowledge as a basis for recognizing changes in audible and visible indications such as the twin-leaf pattern on the screen of the 5-inch cathode-ray tube (in the automatic bearing indicator) and the matched-lines picture on the receiver cathode-ray tube screen when the set is not operating properly. Many illustrations are included throughout this technical manual showing various cathode-ray tube screen pictures and the conditions which obtain them.

h. **Items 16 to 19.** Items 16 to 19 are checked whenever the set is taken out of operation. Any abnormal indications at this time are probably caused by trouble in the set and should be corrected before the next expected period of operation.

33. EQUIPMENT PERFORMANCE CHECK LIST.

Radio Set AN/CRD-3.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
START	1	Power Unit PE-197.	Start up.	Generator starts and runs.	See TM 11-940.
	2	Circuit breaker on Junction Box JB-126.	Close by throwing to ON position.		
	3	ON-OFF AC SWITCH on control-rectifier power unit.	Throw to ON position.	Pilot lamp lights.	Check to see if plugs seat firmly in their mating receptacles. Coupling rings of plugs must be tight.
	4	ON-OFF 0°, 180°, 90°, 270° switches on control-rectifier power unit.	Throw to ON position.	Plate milliampere meter on control rectifier power panel reads.	Check meter fuse F352. See paragraph 111.
	5	OFF-STANDBY-ON, MASTER, MOTOR, BEAM, and AMPLIFIER ON-OFF switches.	Throw to ON position.	Pilot and dial lamps lighted.	Check to see if plugs seat firmly in their mating receptacles. Check fuse. See paragraph 111.

Radio Set AN/CRD-3 (contd).

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	6	Plate currents of phase inverters.	Turn SELECTOR SWITCH to the 0°, 180°, 90° and 270° positions. Observe reading on meter for each position.		Phase inverter plate currents should read as recorded per paragraph 129.
	7	Line voltage check.	Set SEARCH-INSTANT. BEARING-SENSE switch to SEARCH position. Set SELECTOR SWITCH on control-rectifier power unit to SENSE. Increase SENSE GAIN on control-rectifier power unit to maximum (clockwise). Throw FIL SWITCH on control-rectifier power unit to opposite position and repeat test.	Plate milliampere meter on control-rectifier power unit reads 20 to 30 ma.	Adjust output of Power Unit PE-197 accordingly. Throw FIL SWITCH to opposite position switching in spare tubes of Phase Inverter MC-413-A. Replace defective tube as soon as possible.
	8	Circle alignment.	Set SEARCH-INSTANT. BEARING-SENSE switch at INSTANT. BEARING. Set INDICATION switch at INST. Set R.F. GAIN at 0.	Circular trace on indicator screen should be: a. Centered. b. Sharp. c. Clear but not bright. d. Approximately 1/16 inch inside azimuth scale.	a. Adjust HORIZONTAL and VERTICAL POSITIONING controls on bearing indicator control box. b. Adjust FOCUS control. c. Adjust INTENSITY control. d. Adjust CIRCLE DIAMETER control.

33. EQUIPMENT PERFORMANCE CHECK LIST (contd).

Radio Set AN/CRD-3 (contd).

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	9	Matched-lines check.	Set INDICATION to MAN. and tune in a strong signal. Disconnect sense input cable at Junction Box J-99/CRD-3. Turn up R.F. GAIN and turn GONIOMETER to maximum.	Two vertical lines on receiver cathode-ray tube screen are:	See paragraph 111.
				a. Optimum intensity.	a. Adjust BRILL control.
				b. 1/16 inch apart.	b. Adjust LINE SPRD control.
				c. Sharp.	c. Adjust FOCUS control.
				d. Of equal length.	d. If not equal: (1) Adjust balanced modulator control R127. (2) Interchange modulator tubes V108 and V109. (3) See paragraph 111.
	10	GONI. GAIN.	Reconnect sense input cable. Set RADIO SELECTIVITY at SHARP. Set A.V.C.-M.V.C.-C.W. at M.V.C. Tune in a strong signal. Adjust GONIOMETER (inside receiver) until two lines in receiver cathode-ray tube match in length. Turn GONIOMETER off course 15°.	One line is approximately twice the length of the other.	Adjust GONI. GAIN control. See paragraph 111.

33. EQUIPMENT PERFORMANCE CHECK LIST (contd).

Radio Set AN/CRD-3 (contd).

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	11	DEFL. SENS.	Turn GONIOMETER dial back until two lines match again. Adjust R.F. GAIN to give a 1-1/2 inch line. Turn INDICATION switch to INST.	Center of bearing indicator pattern just comes together.	Adjust DEFL. SENS. control. See paragraph 130.
	12	Null azimuth indication.	Leave receiver tuned to strong signal. Set INDICATION switch at NULL. Set R. F. GAIN and AUDIO GAIN at approximately 3/4 of maximum. Rotate GONIOMETER dial.	Aural null (minimum signal) in loudspeaker or headphones. Line on receiver cathode-ray tube screen has minimum length.	See paragraph 111.
	13	Manual azimuth indication.	Set INDICATION switch at MAN. (SEARCH-INSTANT. BEARING-SENSE switch still at INSTANT. BEARING.) Rotate goniometer dial slowly.	Lines should match at only two positions of goniometer dial. Lines should shorten and lengthen either side of these settings.	See paragraph 111.
	14	Automatic azimuth indication.	(Receiver still tuned to strong signal). Set INDICATION switch to INST.	Twin-leaf pattern on screen of cathode-ray tube in bearing indicator.	Replace cable 12. See paragraph 111.

33. EQUIPMENT PERFORMANCE CHECK LIST (contd).

Radio Set AN/CRD-3 (contd.)

	Item No.	Item	Action or condition	Normal indications	Corrective measures
EQUIPMENT PERFORMANCE	15	Sense check.	Turn SENSE GAIN control on control-rectifier power unit clockwise to a medium position. Depress SEARCH-INSTANT. BEARING-SENSE switch to SENSE.	A sense pattern on screen of cathode-ray tube in bearing indicator.	See paragraph 111.
	16	OFF-STAND BY-ON, MASTER, MOTOR, BEAM, and AMPLIFIER ON-OFF switches.	Throw to OFF position.	Pilot and dial lamps go out.	
STOP	17	ON-OFF, 0°, 180°, 90°, 270° switches on control-rectifier power unit.	Throw to OFF position.	Plate ma meter reads 0.	
	18	Circuit breaker on Junction Box JB-126.	Open by throwing to OFF position.		
	19	Power unit PE-197.	Shut down.	Generator slows down and stops.	See TM 11-940.

PART THREE

MAINTENANCE INSTRUCTIONS

SECTION VI

PREVENTIVE MAINTENANCE TECHNIQUES

34. MEANING OF PREVENTIVE MAINTENANCE.

Preventive maintenance is a systematic series of operations performed at regular intervals on equipment, when turned off, to eliminate major break-downs, unwanted interruptions in service, and to keep equipment operating at top efficiency. To understand what is meant by preventive maintenance, it is necessary to distinguish between preventive maintenance, trouble shooting, and repair. The prime function of preventive maintenance is to *prevent break-downs* and, therefore, the need for repair. On the other hand, the prime function of trouble shooting and repair is to locate and correct *existing* defects. The importance of preventive maintenance cannot be overemphasized. A system of radio communication depends on the performance of every set. It must be *ready* to go on the air when it is needed, and it *must* operate efficiently. Therefore, it is vitally important that radio operators and repairman maintain their radio sets properly. See TB SIG 123, Preventive Maintenance Practices for Ground Signal Equipment.

NOTE: The operations in sections VI and VII are first and second echelon (organization operators and repairmen) maintenance. Some operations in section VIII and X are higher echelon maintenance.

35. DESCRIPTION OF PREVENTIVE MAINTENANCE TECHNIQUES.

a. General. Most of the electrical parts used in Radio Set AN/CRD-3 require routine preventive maintenance. This preventive maintenance varies. Some parts require a different kind of maintenance than others. Some require more, some less. Definite and specific instructions must be followed. Hit-or-miss techniques cannot be applied. This section of the manual contains these specific instructions to guide personnel assigned to perform the six basic maintenance operations: Feel, Inspect, Tighten, Clean, Adjust, and Lubricate. Throughout this manual the lettering system for the six operations will be as follows:

F - Feel

I - Inspect

T - Tighten

C - Clean

A - Adjust

L - Lubricate

The first two operations show if the other four are needed. Selection of operations is based on a knowledge of field needs. For example, dust encountered on dirt roads during cross-country travel filters into equipment no matter how much care is taken to prevent it. Rapid changes in weather (such as heavy rain followed by blistering heat), excessive dampness, snow, and ice tend to cause corrosion of exposed surfaces and parts. Without frequent inspections and the necessary tightening, cleaning, and lubricating operations, equipment becomes undependable and subject to break-down when it is needed most.

b. Feel. The feel operation is used most often to check rotating machinery, such as dynamotors, blower motors, and drive motors, also to determine whether electrical connections and bushings are overheated. Feeling will show the need for lubrication or the existence of other defects requiring correction. The maintenance man must become familiar with the normal operating temperatures of motors, transformers, and other parts, to recognize signs of overheating.

NOTE: It is important to perform the feel operation as soon as possible after shut-down and always before any other maintenance is done.

c. Inspect. Inspection is the most important operation in preventive maintenance. A careless observer will overlook evidences of minor trouble. Although these defects may not at the moment interfere with performance of the equipment, invaluable time and effort can be saved if they are corrected *before* they lead to major and costly breakdowns. To be able to recognize the signs of a defective set, make every effort to become thoroughly familiar with indications of *normal* functioning. Inspection consists of *carefully* observing all parts of the equipment, noticing their color, placement, state of cleanliness, etc. Inspect for the following conditions:

(1) Overheating, as indicated by discoloration, blistering, or bulging of the parts or surface of the container; leakage of insulating compounds; and oxidation of metal contact surfaces.

(2) Placement, by observing that all leads and cabling are in their original positions.

(3) Cleanliness, by carefully examining all recesses in the units for accumulation of dust, especially between connecting terminals and binding posts. Parts, connections, and joints should be free of dust, corrosion, and other foreign matter. In tropical and high-humidity areas, look for fungus growth and mildew.

(4) Tightness, by testing any connection or mounting which appears to be loose.

d. Tighten, Clean, and Adjust. These operations explain themselves. Specific procedures to be followed in performing them are given wherever necessary throughout part three.

CAUTION: Screws, bolts, and nuts should not be tightened carelessly. Fittings tightened beyond the pressure for which they are designed will be damaged or broken.

Whenever a loose connection is tightened, it should be moistureproofed and fungiproofed again by applying the varnish with a small brush. See section X for details of moistureproofing and fungiproofing.

e. Lubricate. Lubrication refers to the application of grease or oil to the bearings of motors or rotating shafts. It may also mean the application of a light oil to door hinges or other sliding surfaces on the equipment. Where the need for lubrication is indicated, refer to section VIII.

38. VACUUM TUBES.

NOTE: Do not work on the tubes immediately after shut-down. Severe burns may result from contact with the envelopes of hot tubes.

a. Inspect (I).

(1) Inspect glass and metal tube envelopes, tube caps, and tube connector clips for accumulation of dirt and for corrosion. Tubes with loose plate caps, grid caps, or envelopes should be replaced if possible.

(2) Examine the spring clips that make contact with the grid caps for corrosion and for loss of tension with resulting looseness. Check the condition of wires soldered to the spring clips. The wires should be free of frayed insulation or broken strands.

(3) Inspect the firmness of tubes in their sockets. Make the inspection by pressing the tubes down in the sockets and testing them in that position, *not* by partially withdrawing the tubes and jiggling them from side to side. Movement of a tube tends to weaken the pins in the base and unnecessarily spread the contacts in the socket. Inspect the tube sockets at the time the tubes are removed.

(4) Be careful when removing a tube from its socket, especially if it is a high-power tube. Never jar a warm tube. Always remove connections to the grid caps and plate caps.

b. Tighten (T). Tighten all loose connections to the tube sockets or to the tubes. If the connections are dirty or corroded, clean them before tightening. When tightening locknuts that hold the sockets to the insulated bushings, do not apply excessive pressure. Too much pressure will crack the bushings.

c. Clean (C).

(1) Clean the tubes, if necessary. Tubes operated at high voltage and with exposed plate and grid connections must be kept free of dirt and dust because of possible leakage between grid and plate terminals. In contrast, tubes operating at low voltages and not having exposed grid and plate caps do not require frequent cleaning. However, do not permit dirt to accumulate on low-voltage tubes.

(2) Remove dust and dirt from the glass or metal envelopes with a clean, lint-free, dry cloth. If proper care is used, the grid and plate caps may be cleaned with a piece of #0000 sandpaper by wrapping the paper around the cap and *gently* rubbing the surface. Excessive pressure is not needed; nor is it necessary to grip the cap tightly. Wipe the cap with a clean dry cloth.

(3) When tube sockets are cleaned and the contacts are accessable, fine sandpaper may be used to remove corrosion, oxidation, and dirt.

d. Adjust (A). Adjust loose tube connector clips. Do not flatten tube connector clips during adjustment. Flattened clips do not make adequate contact with the surface of the tube cap. If the clip is made of thin metal, it can be adjusted by gently compressing it with the fingers. If it is made of heavy-gauge metal, suitable pressure can be applied with a pair of long-nose pliers.

37. CAPACITORS.

a. Inspect (I).

(1) Inspect the terminals of large fixed capacitors for corrosion and loose connections. Carefully inspect the mountings to discover loose mounting screws, studs, or brackets. Examine the leads for poor insulation, cracks, and evidences of dry rot. Cut away frayed strands on the insulation. If the wire is exposed, wrap it with friction tape. See that the terminals of the capacitors are not cracked or broken.

(2) Thoroughly inspect the case of each large fixed capacitor for leaks, bulges, and discoloration.

(3) Inspect the plates of variable capacitors for dirt, dust, or lint. Examine the movable set of plates for signs of damage or misalignment that would cause them to touch the fixed plates during tuning. Rotate the movable plates, using the panel tuning control, and thus check for proper operation of the capacitor.

b. Tighten (T). Tighten loose terminals, mountings, and connections on the capacitors, when necessary. Do not break the bushing or damage the gasket.

c. Clean (C).

(1) Clean the cases of fixed capacitors, the insulated bushings, and all connections that are dirty or corroded. The capacitor cases and bushings

can usually be cleaned with a dry cloth. However, if the deposit of dirt is hard to remove, moisten the cloth in Solvent, Dry-cleaning.

(2) Clean the plates of variable capacitors with a small brush or pipe cleaner, removing all dust and lint. Dust, if present, may cause arcing.

d. Lubricate (L). Refer to section VIII.

38. RESISTORS.

a. General. Various types of resistors are used in Radio Set AN/CRD-3. The connections to the various resistors are either of the pigtail or solder-lug type.

b. Inspect (I). Inspect the coating of the vitreous-enameled resistors for signs of cracks and chipping, especially at the ends. Examine the bodies of all types of resistors for blistering, discoloration, and other indications of overheating. Inspect leads and all other connections for corrosion, dirt, dust, looseness, and broken strands in the connecting wires. Check the security of all mountings. Do not attempt to move resistors with pigtail connections, because there is danger of breaking the connections at the point where they enter the body of the resistor. Such defects cannot be repaired.

c. Tighten (T). Tighten resistor connections and mountings whenever they are found loose. If a resistor is allowed to remain loose, vibration may break the connection or damage the body.

d. Clean (C).

(1) Clean all carbon resistors with a small brush.

(2) The vitreous-enameled resistors must be kept clean to avoid leakage between the terminals. Wipe them with a dry cloth. However, if the dirt deposit is unusually hard to remove, use dry-cleaning solvent (SD).

(3) Resistors with discolored bodies cannot be cleaned. Discoloration indicates that there has been overloading and overheating at some time prior to the inspection. The discoloration is probably due to circuit trouble which requires analysis and correction. Trouble-shooting procecures are described in part five.

39. FUSES.

a. General. Fuses used in Radio Set AN/CRD-3 are easily removed for inspection. See that the fuse ends and holding clips on large fuses are kept clean and tight. If they are not, arcing and burning will occur and make the replacement of the complete holder necessary. Fuses should be thrown away when they blow.

b. Inspect (I). Inspect the fuse caps for evidence of burning, charring, and corrosion; the fuse clips for dirt, loose connections, and loss of tension.

c. Tighten(T) . The tension of the fuse clips may be increased by pressing the sides closer together. If necessary, use a pair of pliers to adjust the tension.

d. Clean (C). Clean fuse ends and fuse clips with #0000 sandpaper then wipe them with a clean cloth.

40. BUSHINGS AND INSULATORS.

a. Description.

(1) Insulated bushings are used in the high-voltage and r-f circuits. They are constructed of ceramic material with a glazed surface. Because an insulator is no better than its surface, deposits of foreign substances on the surface will reduce the insulation value of the bushing. Therefore, it is very important that all bushings used in the high-voltage circuits be inspected frequently.

(2) Insulated bushings are used as supports for high-voltage tube sockets, and for high-voltage terminals of capacitors. They are used as mountings for resistors in high-voltage circuits and as supports for panels which mount other

parts. The condition of insulated bushings that are used solely as panel supports is not too critical, but the condition of bushings used as high-voltage insulators is extremely important.

b. Inspect (I).

(1) Inspect the physical condition of the insulated bushings. They should be clean without cracks or chips. A highly glazed insulator may develop fine-line surface cracks where moisture and dust will accumulate and eventually form a leakage for a high-voltage flash-over.

(2) As a rule, the bushings are held in position with nuts screwed onto the threaded conductors. These can be replaced very easily. If replacement is not possible because of a shortage of supplies, clean the defective bushing frequently and thoroughly with dry-cleaning solvent (SD). Sometimes it is difficult to see dust on a glazed surface. A satisfactory check can be made by sliding a clean finger across the bushing.

c. Tighten (T). The procedure to be used in tightening loose bushings is self-evident. However, one precaution must be observed. *Avoid forcing the nuts or screws down too tight.* If excessive pressure is exerted on the bushings, damage or breakage is almost certain. If the threads on bushing stud bolts are found stripped so that they cannot be tightened, replace the entire bushing.

d. Clean (C). Insulated bushings are easily cleaned. Never use abrasive materials because the glazed finish will be destroyed, thus permitting moisture to be absorbed. A clean cloth is usually satisfactory. If deposits of grime or dirt on the surface of a bushing are hard to remove, use dry-cleaning solvent (SD). After the surface has been cleaned with solvent, carefully polish it with a dry cloth. Otherwise, a thin film of the solvent will be left which may impair the effectiveness of the bushing as a high-voltage insulator.

41. RELAYS.

The relays employed in Radio Set AN/CRD-3 are considered normal if the exteriors are free from dirt or dust; the contacts are not burned, pitted, or corroded; the contacts are lined up and correctly spaced; the moving parts travel freely and function in a satisfactory manner; the connections to the relays are tight; the wire insulation is not frayed or torn; the relay assembly is securely mounted; and the field coil shows no signs of overheating.

a. Inspect (I).

(1) Inspect the relay for defects. The contacts may be examined with the aid of a flashlight and mirror.

(2) Check the mechanical action of the relays to make certain that when the moving and stationary contacts come together they make positive contact and are directly in line with each other.

b. Tighten (T). Tighten all loose connections and mounting screws, but do not apply enough force to damage the screws or to break the parts they hold.

c. Clean (C).

(1) Relay Exterior. Brush the exterior of the relay with a soft brush. If it is very dirty, clean the exterior with a brush dipped in dry-cleaning solvent (SD). If connections are dirty or corroded, remove the leads and clean them. Replace carefully.

(2) Relay Contacts.

(a) When necessary to clean relay contacts, burnish with a clean blade of a burnishing tool (Tool, switchboard, contact burnisher, WECo No. 265C, Sig C stock No. 6R41065C), if available. Place the blade between the contacts of the relay and press the contacts together with slight pressure and move the blade back and forth as necessary to obtain desired results. When contacts are sufficiently dirty to require further cleaning,

remove remaining dirt with carbon tetrachloride applied with a toothpick and clean with the flat side of a clean dry toothpick or similar material. Again burnish using a clean blade of the burnishing tool.

(b) If a burnishing tool is not available, apply carbon tetrachloride with a toothpick as previously described, and clean with the flat side of a clean dry toothpick or similar material. Dry and polish the contacts by drawing a strip of smooth, *hard finish* paper between the contacts with slight pressure applied to press them together. Soft paper which will disintegrate and leave small particles on the contact surfaces must *not* be used.

42. SWITCHES.

a. Inspect (I).

(1) Inspect the mechanical action of each switch and, while so doing, look for signs of dirt or corrosion on all exposed elements. In some cases, it will be necessary to examine the elements of the switch visually; in others, the action of the switch is checked by flipping the control knob or toggle, or pressing the switch button and noting the freedom of movement and amount of spring tension.

(2) Examine all ganged switches to see that they are properly lubricated and that the contacts are clean. Inspection is visual. Do not pry the leaves of the switch apart. The rotary members should make good contact with the stationary members; and as the former slides into the latter, a spreading of the stationary contact leaves should be visible. Switch action should be free. Wiping action of contacts usually removes any dirt at the point of contact.

b. Clean (C). Clean the exterior surfaces of switches with a stiff brush, moistened with dry-cleaning solvent (SD).

c. Lubricate (L). Refer to section VIII.

43. RHEOSTATS AND POTENTIOMETERS.

a. Inspect (I).

(1) Inspect the mechanical condition of all rheostats and potentiometers. The arm should be keyed tightly to the shaft, and the shaft should turn easily in the bushing which supports it.

(2) Inspect the assembly and mounting screws, setscrews, and nuts.

(3) Examine the insulating body of the rheostat for dust, dirt, cracks, and chipped places.

(4) Examine all metallic parts for dust, dirt, and corrosion.

b. Tighten (T). Tighten loose assembly or mounting screws.

c. Clean (C).

(1) Clean the exposed contact surfaces of the rheostat and the connections whenever they are dirty or corroded.

(2) Remove grease and dirt from the rheostat parts with carbon tetrachloride.

(3) Clean the body of the rheostat or potentiometer with a brush or cloth.

44. TERMINAL BLOCKS.

a. Inspect (I).

(1) Inspect terminal blocks for cracks, breakage, dirt, loose connections, and loose mounting screws.

(2) Carefully examine connections for mechanical defects, dirt, and corrosion.

b. Tighten (T). Tighten loose screws, lugs, and mounting bolts. When tightening screws, be sure to select a screwdriver of correct size. Do not exert too much pressure. Tighten loose connections.

c. **Clean (C).** Clean terminal blocks, when they require it, with a dry brush. When necessary, use a cloth moistened with dry-cleaning solvent (SD). Thoroughly wipe the block with a cloth and then brush it to remove any lint.

45. CONNECTORS, PLUGS, AND RECEPTACLES.

The various components of Radio Set AN/CRD-3 are equipped with receptacles, connectors, and plugs, for connecting the components of the set together by means of interconnecting cords.

a. **Inspect (I).** Inspect the female ends of the connectors for corrosion and collected dust. Inspect the insulating part of the connectors for cracks. Inspect the male ends of the connectors for loose and broken pins.

b. **Clean (C).** Clean the male and female ends of the connectors with a brush moistened in carbon tetrachloride. Remove corrosion with #0000 sandpaper, then wipe with a clean cloth.

46. CORDS AND CABLES.

The cables in Radio Set AN/CRD-3 are the life lines of the equipment. Condition of the cabling must be closely observed. Operating equipment in all kinds of weather, subjects cabling to a great deal of punishment.

a. **Inspect (I).** Inspect the cables for cracked or deteriorated insulation, frayed or cut insulation at the connecting and supporting points, and improper placement which places the cables or connections under strain. Also watch for kinks and improper supports.

b. **Tighten (T).** Tighten loose cable clamps, coupling rings, and cable connections.

c. **Clean (C).** Clean connections on cables when they are dirty or corroded. Clean corroded connectors with #0000 sandpaper. Clean the entire surface of the connector. Make no attempt to remove individual prongs from cable plugs.

47. METERS.

Meters are extremely delicate instruments and must be handled carefully. They require very little maintenance. They are precision instruments and ordinarily cannot be repaired in the field. Excluding the meters on the panel of Power Unit PE-197, there is only one meter contained in Radio Set AN/CRD-3. It is located on the front panel of Control-Rectifier Power Unit PP-135/CRD-3 and is used to measure the plate currents of the various phase inverters.

a. **Inspect (I).** Inspect the leads and connections of the meters. Look for loose, dirty, and corroded connections. Look for cracked or broken cover glasses. Since the movement of a meter is extremely delicate, its accuracy will be seriously affected if the glass is broken and dirt and water filter through.

b. **Tighten (T).** Tighten all connections found loose. Any loose meter wires should be inspected for dirt or corrosion before they are tightened. The tightening of meter connections requires a special technique because careless handling can easily crack the meter case.

c. **Clean (C).** Meter cases can usually be cleaned with a dry cloth. If cleaning is difficult, dampen the cloth with dry-cleaning solvent (SD). Clean dirty connections with a small brush dipped in dry-cleaning solvent (SD), or with a small piece of cloth dipped in the solvent.

d. **Adjust (A).** Normally, meters in Radio Set AN/CRD-3 should indicate zero when the equipment is turned off. Before deciding that a meter needs readjusting, tap the meter case *lightly* with the tip of one finger. This will help the needle to overcome the slight friction which sometimes exists at the bearings and prevents an otherwise normal unit from coming to rest at zero. If adjustment is needed, insert the tip of the thinnest screwdriver available into the slotted screw head located below the meter glass and *slowly* turn the adjusting screw until the pointer is at zero. Lightly tap the meter case again and view the meter face and pointer *full on* and not from either side. Avoid turning the screw too far, because the needle may be bent or the hairspring damaged.

48. PILOT LAMPS.

Pilot lamps are used to indicate when power has been applied to a circuit. There is also a panel light on the power indicator panel of Radio Receiver Assembly R-128/CRD-3 to indicate when the RADIO SELECTIVITY switch is in BROAD position.

a. Inspect (I). Inspect the pilot-lamp assemblies for loose lamps, loose mounting screws, and loose, dirty, or corroded connections.

b. Tighten (T).

(1) Tighten loose mounting screws and resolder any loose connections. If the connections are dirty or corroded, clean them before soldering.

(2) Screw loose lamps tightly into their sockets.

49. JACKS AND PLUGS.

Jacks require very little attention, and then only at infrequent intervals. Occasionally it will be necessary to tighten the mounting nut, clean the contacts, or increase the spring tension. Remove dirt with a brush and carbon tetrachloride; remove corrosion with a piece of crocus cloth followed by a clean cloth. Increase spring tension, when necessary. Try the action of the jack after each adjustment. Be sure to keep all soldered connections intact. To clean dirty or corroded telephone-type plugs, use paste metal polish (Signal Corps stock No. 6G1516). After cleaning, remove all traces of polish remaining with carbon tetrachloride. Finish off with a clean dry cloth.

50. MOUNTING TABLE MT-347/CRD-3.

The Radio Set AN/CRD-3 operating components are shock-mounted on this compact equipment table.

a. Inspect (I). Inspect the tightness of the bolts that hold the four flanged feet of the table to the floor. Inspect the legs, truss, apron, and shelf for dirt, dust, scratches, rust, or chipped paint.

b. Tighten (T). Tighten the bolts that hold the four flanged feet to the floor.

c. Clean (C). Wipe the legs, truss, bearing indicator hinged support, apron and shelf with a clean dry cloth. Repaint any surface that is found scratched, rusted, or chipped.

d. Lubricate (L). Refer to section VIII.

51. REEL UNIT RL-49.

a. Inspect (I). Inspect the following parts of the reel unit for dirt, dust, and corrosion.

(1) Reel shaft bearings.

(2) Reel shaft clamp lock hinges and springs.

(3) Frame hinges and hinge bolts.

(4) Crank locking pins and springs.

(5) Reel shaft brake.

(6) Frame brace springs and hinges.

b. Clean (C). With a dry cloth, clean all the parts of the reel unit mentioned in subparagraph a above. Clean brake seat on reel shaft and flush out brake housing.

c. Lubricate (L). Refer to section VIII.

52. CABINETS, CHASSIS, AND MOUNTINGS.

Some of the cabinets which house the

various components of Radio Set AN/CRD-3 are constructed of sheet steel, coated with a baked gray wrinkle enamel and some are constructed of sheet aluminum also covered with a baked gray wrinkle enamel.

a. Inspect (I). Inspect the outside and inside of each cabinet thoroughly, paying strict attention to every detail. Check the ventilator mountings, the panel screws, and the zero setting of the meter in Control-Rectifier Power Unit PP-135/CRD-3. Examine the pilot-lamp covers for cracks and breaks. Inspect the panels for loose knobs, switches, and jacks.

b. Tighten (T). Tighten all loose mounting bolts, panel screws, plugs, and control knobs.

c. Clean (C). Clean each cabinet, outside and in, with a clean dry cloth. Use dry compressed air to blow out all accumulated dirt and dust. Repaint any surface that is found scratched, rusted, or chipped.

53. HEADSET AND LOUDSPEAKER.

These auxiliary items of equipment are essential to the operation of the radio set. The operator must therefore give them the same care as the radio itself.

a. Inspect (I). Inspect all external surfaces for dirt and corrosion. See that all cable connections are tight and that plugs and jacks fit together properly.

b. Clean (C). Clean all items of the equipment in accordance with the instructions outlined previously for relays, cords, jacks, cabinets, etc.

c. Lubricate (L). Refer to section VIII.

54. DRIVING MOTOR.

The driving motor for the indicator and goniometer is mounted coaxially with the deflection coil assembly on the rear of the main indicator casting. The only maintenance required on the motor is to tighten occasionally any of the mounting bolts which may have loosened because of vibration. See section VIII concerning lubrication of this unit.

55. COUPLING SHAFTS AND CONTROL KNOBS.

The control of various capacitors, switches, and resistors, found throughout the set is effected through coupling shafts that connect these items to control knobs on the front panels. It is important that these shafts and control knobs be kept tight at all times. Use the proper Allen head wrench and screwdriver to tighten these items whenever they are found loose. In Bearing Indicator ID-121/CRD-3, a flexible coupling is provided between the driving motor and the axle-and-worm coupling on the deflection coil assembly to compensate for any slight misalignment of these two components. This flexible coupling is a leather pad which is bolted to the motor shaft and the axle-and-worm coupling on the deflection coil assembly at four diametrically opposite points. If this coupling should break, replace it with one of the spare couplings provided with the set according to the instructions in subparagraph 117b.

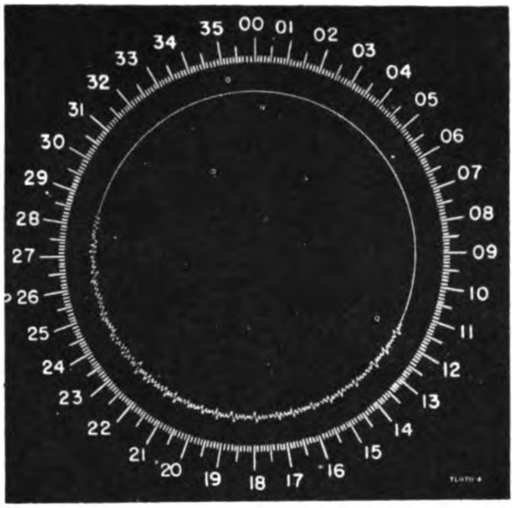
56. GEARS.

a. Inspect (I). Inspect the teeth of the gears contained in the band change, and tuning control gear housing of Radio Receiver R-128/CRD-3 for dirt and corrosion. Check the anti-backlash gears for operation by varying the panel tuning control.

b. Clean (C). If the gears are dirty, clean them with a pipe cleaner or small brush dipped in dry-cleaning solvent (SD).

c. Lubricate (L). Refer to section VIII.

57. POWER TRANSFORMERS, FILTER CHOKES, AND AUDIO TRANSFORMERS.



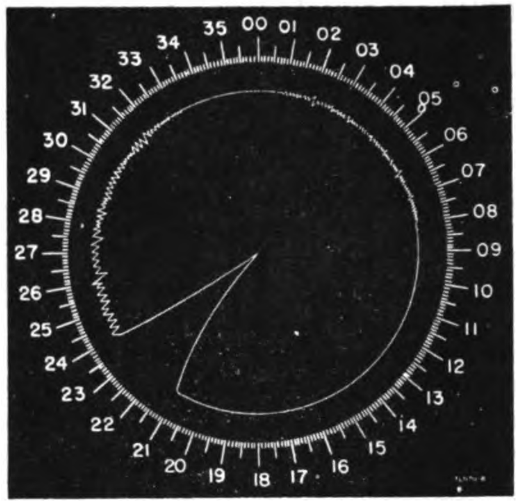


Figure 56. Typical indicator patterns due to poor brush and slip ring contact.

Since power transformers, filter chokes, and audio transformers used in Radio Set AN/CRD-3 are of similar potted construction, preventive maintenance for them is similar.

a. Feel (F). As soon as possible after shut-down, feel all filter chokes for abnormal heating which may indicate an overloaded condition, or imminent failure due to moisture absorption or other causes. Likewise feel audio transformers T201 and T202 for abnormal heating. Power transformers normally operate at a warm temperature. Feel for abnormal heating, but use care to avoid burns.

b. Inspect (I). Inspect all power transformers, filter chokes, and audio transformers T201 and T202, for signs of blistering, bulging, or leakage of tar or insulating compounds. Inspect for external signs of electrolytic action or corrosion.

c. Tighten (T). Tighten all mounting bolts or screws, but not to the point that threads are destroyed. The securing of such heavy parts as transformers and chokes to the chassis is very important in preventive maintenance. Should a heavy filter choke or transformer break loose from its mounting in vehicular use or in transit, it may smash tubes, variable capacitors, coils, and resistors, and at the same time sever a large number of connections.

d. Clean (C). Clean power transformers, filter chokes, and audio transformers with a dry cloth. Be sure that no dirt, lint, threads, or foreign material is present between terminals. Dirt, lint, and thread absorb moisture which may provide a leakage path for high voltages between these terminals. Be sure that none are present.

58. SLIP RINGS AND BRUSHES.

a. General. The slip rings and brushes are part of the deflection coil assembly contained in Bearing Indicator ID-121/CRD-3. The deflection coil assembly contains a front and rear bearing, a graduated ring, three slip rings and brushes, and the deflection coils (fig. 127). This assembly is driven by a motor and rotates the magnetic deflection coils about the neck of the cathode-ray tube to produce the bearing pattern. The slip rings and brushes connect the rotating deflection coils to the stationary control box. The only maintenance required of the bearings is lubrication. Instructions for this are contained in section VIII. There is no maintenance required of the deflection coils. When found defective, replace the coil according to instructions of subparagraph 117c. Complete and proper maintenance instructions for the slip rings and brushes are contained in the following subparagraphs.

> **CAUTION:** WHEN THE COVER OF BEARING INDICATOR ID-121/CRD-3 IS OPENED, CIRCUITS CARRYING VOLTAGES DANGEROUS TO HUMAN LIFE ARE EXPOSED. NEVER OPEN THIS COVER, BEFORE TURNING THE AMPLIFIER OR MASTER SWITCH OFF, EXCEPT AS SPECIFICALLY DIRECTED.

b. Inspect (I).

(1) Inspect for excessively worn brushes, sticking brushes, or brushes whose pigtails are corroded, have broken strands, or seem brittle. The pigtails should be long and flexible enough so as not to restrict the movement of the brush in the holder.

(2) Inspect for dirt under the rotating mount.

(3) Inspect the slip rings for pitting or scoring, dust, dirt, and oil. Never touch the slip rings with the bare fingers. Also check them for wear. The appearance of a light brown oxide film on the slip rings is beneficial and does not require polishing. However, make sure that any film present is the oxide film and not a combination of etching and tarnishing. The oxide film is somewhat shiny whereas etching and tarnishing has a dull appearance.

(4) With the MASTER and AMPLIFIER switches at the OFF position, turn the MOTOR switch ON and observe the brush springs pressure arm. Any perceptible up and down motion or vibration of the spring pressure arm indicates eccentricity of the rings, which must then be machined on a lathe and polished (par. 117).

(5) See that the spring pressure arm is not bent and rides freely within the brush-holder slot without touching the sides.

(6) Check the spring tension with a suitable gauge graduated to 1/2 ounce, by observing the gauge reading when the pressure arm is just lifted from the brush. For best operation the tension should be from 2 to 4 ounces, preferably 2-1/2 ounces.

(7) Check brushes to determine whether they are seated properly against the slip rings. Bad bedding of brushes is one of the greatest causes of flat spots and excessive slip ring and brush wear.

> NOTE: A good criterion of when maintenance is required on the slip rings and brushes is the pressure of a jagged or broken circle pattern on the bearing indicator cathode-ray tube screen.

c. Tighten (T). To tighten the slip rings, proceed as follows.

(1) Turn the MASTER and AMPLIFIER switches OFF.

(2) Loosen the two setscrews in the slip ring retainer (fig. 27).

(3) Tighten the slip ring retainer by turning it counterclockwise as viewed from the front of the indicator.

(4) Tighten slip ring retainer setscrews.

(5) Check the brush springs pressure arm as in subparagraph a(4) above.

d. Clean (C).

(1) To clean the slip rings and brushes, proceed as follows:

(a) Turn the MASTER and AMPLIFIER switches OFF.

(b) Remove the screws from the bakelite brush holders and allow the assemblies to hang over the side of the indicator.

(c) Saturate a pad of cheese cloth approximately 4 by 10 inches in carbon tetrachloride and pass it

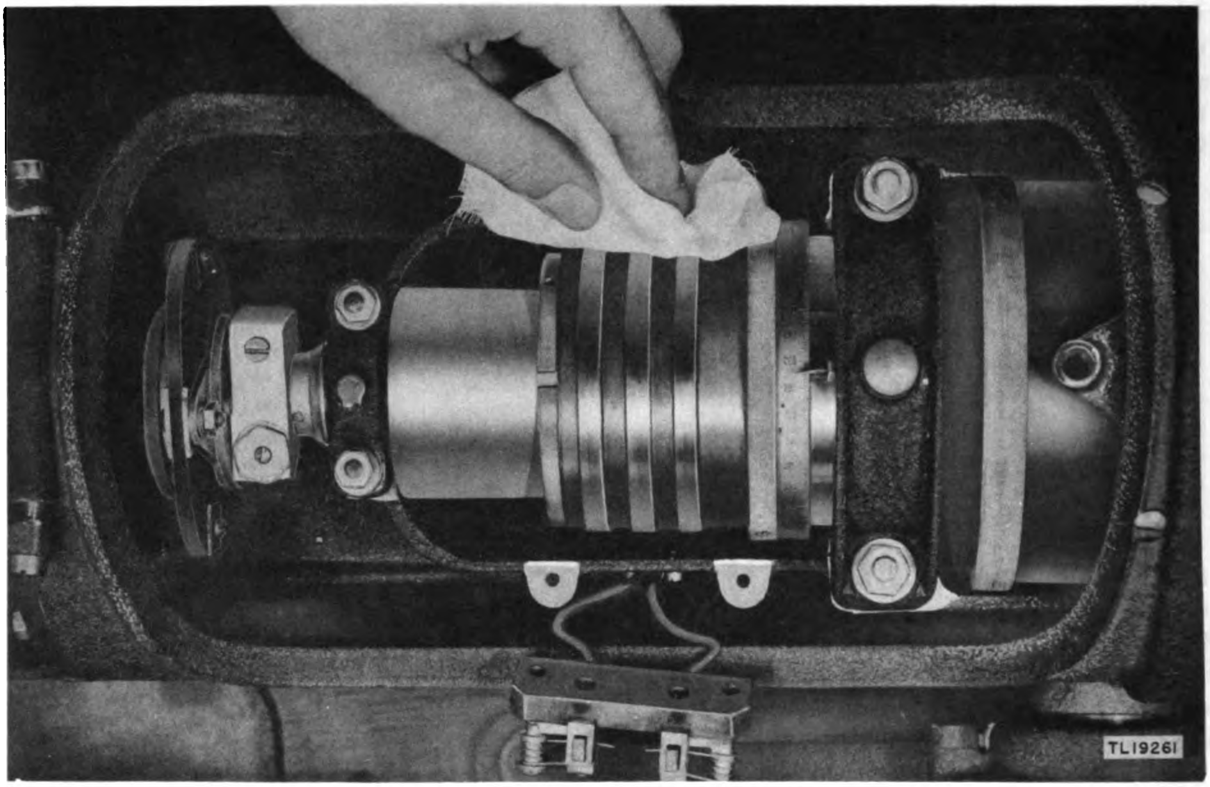


Figure 57. Deflection coil assembly, cleaning slip rings.

under the rotating unit by slowly turning the unit by hand.

(d) Pull the cheese cloth back and forth and sideways until all dirt and oil are removed from under the rotating mount.

(e) Remove the pad and clean the slip rings, with the motor running but with the AMPLIFIER switch OFF, by holding a small cheese cloth pad saturated with carbon tetrachloride firmly against the rotating rings.

(f) Turn off the motor, clean the brushes and insides of brush holders with carbon tetrachloride, and re-mount the brush assemblies in operating positions.

(g) Replace excessively worn brushes, sticking brushes, or brushes whose pigtails are corroded, have broken strands, or seem brittle.

(2) As mentioned under the inspection operation above, the appearance of a light brown oxide film on the slip rings is beneficial and does not require polishing. Before polishing refer to paragraph 58b. If polishing is required, proceed as follows:

(a) Turn the MASTER and AMPLIFIER switches OFF.

(b) Lift the brushes from the slip rings and hold them in position by allowing the spring pressure arm to press against the side of the brushes.

(c) Wrap a piece of crocus cloth, approximately 2 by 1 by 1/2 inches, around a bakelite block 2 by 3/4 by 1/8 inches or some other stiff, smooth surfaced material.

(d) With the indicator running, but with the AMPLIFIER switch OFF, press the block and crocus cloth firmly against the slip rings until the pitting or scoring has been removed, and the slip rings have been restored to their original mirror finish.

(e) Before stopping the indicator,

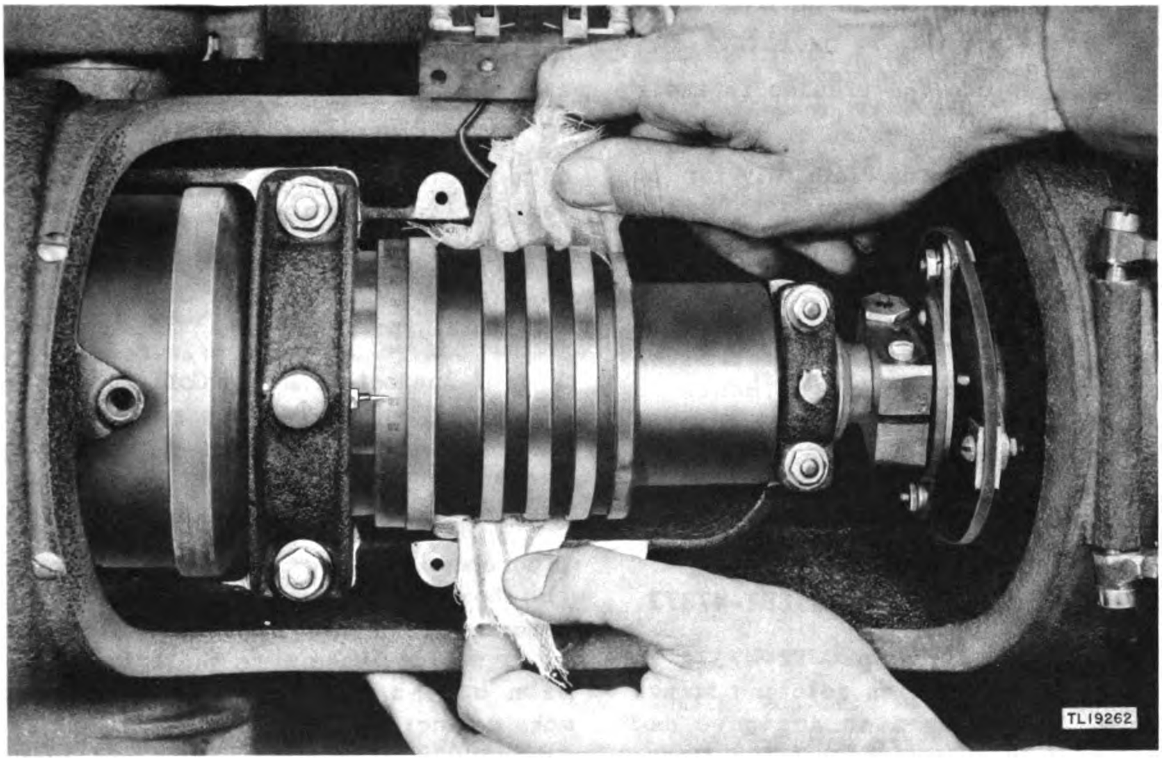


Figure 58. Deflection coil assembly, cleaning rotating mount.

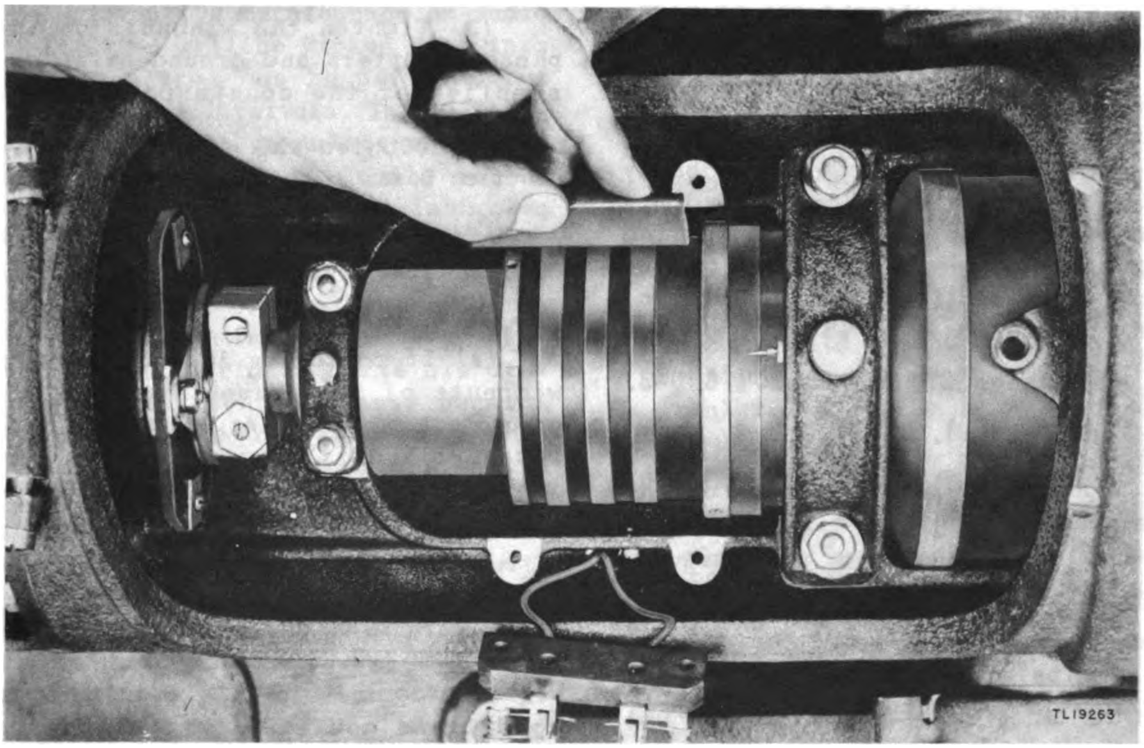


Figure 59. Deflection coil assembly, polishing the slip rings.

clean the slip rings with a piece of cheese cloth saturated in carbon tetrachloride.

(f) Replace the brushes in their running positions.

CAUTION: Use crocus cloth only for polishing the slip rings. Use carbon tetrachloride only for cleaning. Never touch the slip rings with the bare fingers.

e. Adjust (A). The correct brush pressure for maximum performance is 2-1/2 ounces. This can best be checked by a spring tension gauge. To adjust the spring arm to the required pressure, wind or unwind the coiled portion. Never bend the spring arm.

59. GONIOMETER NAVY TYPE CFT-47372.

Goniometer Navy type CFT-47372 is essentially a precision rotating transformer. It has been so designed and constructed that servicing of the transformer elements, stator, rotor, and coupling coils is both unnecessary and impossible under field conditions. Therefore, never attempt any maintenance beyond the instructions contained in the technical manual. If trouble develops in the transformer elements, replace the goniometer with a new one; any attempt at repair will probably result in the introduction of unbalance into the goniometer and cause bearing errors in the operation of the direction finder. See section VIII for lubrication information.

60. ANTENNA ASSEMBLY AS-204/CRD-3.

a. Inspect (I).

(1) Inspect the tautness of the antenna guys.

(2) Check the tightness of the wingnuts on the phase inverters and ground-strap assemblies of the counterpoise mats. Inspect these points for evidence of corrosion.

(3) Inspect the base insulator for cracks, dirt, and corrosion.

(4) See that the cover plates are tight on Junction Boxes JB-91-A.

(5) Check the antenna cords to see that there are no sharp bends.

(6) Check the alignment of the directional antennas as described in section II, paragraph 12.

(7) Check the vertical alignment of the sense antenna as described in section II, paragraph 13.

(8) Inspect Mounting Collar MT-334/CRD-3 at the base of each monopole and make sure it is securely fastened to the mast.

(9) Inspect the phase inverter plug connection to the antenna jack on the box of the mounting collar. The banana plug should be inserted as far as it can go. Make sure the bottom portion of the phase inverter does not make contact with the antenna.

b. Tighten (T).

(1) Tighten the antenna guys as described in section II.

(2) Tighten the wingnuts on the phase inverters and ground strap assemblies of the counterpoise mats.

(3) Tighten the cover plates on Junction Boxes JB-91-A.

(4) Tighten the bolts that hold the mounting collar to the mast base.

c. Clean (C).

(1) If corrosion is found on the wingnuts of the phase inverters and ground strap assemblies, clean the surfaces with a file or fine sandpaper and apply a protective coating of Petrolatum.

(2) In order to clean the mast sections, the antenna system will of course have to be dismantled. The intervals between which such cleaning is required depends largely upon service conditions and whether faults have developed. For example, cleaning is required at more frequent intervals

when the equipment is used in areas subject to dust or sand storms than in areas free from these conditions. The mast sections should be cleaned to be sure no corrosion or dirt exists at the ends which fit into one another. Mast Sections MS-116 should *not* be sanded down and repainted. Sanding will cut the coating of copper over the steel shaft and increase r-f resistance by forcing radio frequency to travel over the steel. These rods are painted with phenolic by the manufacturer.

(g) Clean the base insulator following the same procedure described in paragraph 40.

d. **Lubricate (L).** Refer to section VIII.

SECTION VII

ITEMIZED PREVENTIVE MAINTENANCE

61. INTRODUCTION.

For ease and efficiency of performance, preventive maintenance on Radio Set AN/CRD-3 will be broken down into operations that can be performed at different time intervals. In this section the preventive maintenance work to be performed on the radio set at the specific time intervals is broken down into units of work called items. The general techniques involved and the application of the FITCAL operations in performing preventive maintenance on individual parts are discussed in section VI. These general instructions are not repeated in this section. When performing preventive maintenance, refer to section VI if more information is required for the following items. Perform all work with the power removed from the equipment. After preventive maintenance has been performed on a given day, put the equipment into operation and check it for satisfactory performance. (See paragraph 33, Equipment Performance Check List.)

62. PREVENTIVE MAINTENANCE TOOLS AND MATERIALS.

The following preventive maintenance tools and materials will be needed:

Common hand tools.

Clean cloth.

#0000 sandpaper.

Crocus cloth.

Contact burnishing tool.

Paste metal polish (Signal Corps stock No. 6G1516).

Dry-cleaning solvent (SD).

Carbon tetrachloride.

Spring tension gauge (graduated to 1/2 ounce).

Petrolatum.

NOTE: Gasoline will not be used as a cleaning fluid for any purpose. Dry-cleaning solvent (SD) is available as a cleaning fluid through established supply channels. Oil, Fuel, Diesel (DA) may be used for cleaning purposes when dry-cleaning solvent is not available. However, dry-cleaning solvent or diesel fuel oil should not be used on electrical contact points of relays or other electronic equipment, contact surfaces of plugs, jacks, or sockets, or on the commutators of motors, generators or dynamotors. These items should be cleaned, when necessary, only with carbontetrachloride.

63. ITEM 1, MODULATOR SECTION OF RADIO RECEIVER ASSEMBLY R-128/CRD-3.

PRELIMINARY STEPS. Remove nuts on upper shock mount of automatic bearing indicator; remove the pins on lower supporting rod and lower indicator on chain. Remove all interconnecting cables from the modulator unit. Loosen captive screws on the front panel of the unit and remove the unit from the cabinet. Remove the bottom plate.

OPERATIONS.

IC	Connectors and receptacles.
ITCA	Tubes and sockets.
ITC	Capacitors.
ITC	Resistors.
ITC	Bushings and insulators.
ICL	Switches.
ITC	Rheostats and potentiometers.
ITC	Terminal blocks.
ITL	Coupling shafts and control knobs.
ICL	Gears.

64. ITEM 2, POWER INDICATOR SECTION OF RADIO RECEIVER ASSEMBLY R-128/CRD-3.

PRELIMINARY STEPS. Remove all interconnecting cables from the power indicator section of the receiver assembly. Loosen the captive screws on the front panel of the unit and remove the unit from the cabinet. Remove the bottom plate.

IC	Connectors and receptacles.
ITC	Cabinet.
ITCA	Tubes and sockets.
ITC	Capacitors.
ITC	Resistors.
ITC	Fuses.
ITC	Bushings and insulators.
IC	Switches.
ITC	Rheostats and potentiometers.
ITC	Terminal blocks.
IT	Pilot lamps.
ITC	Jacks and plugs.
ICL	Headset and loudspeaker.
IT	Coupling shafts and control knobs.
FITC	Power transformers and filter chokes.

65. ITEM 3, JUNCTION BOX J-99/CRD-3.

PRELIMINARY STEPS. Remove all interconnecting cables to the junction box. Loosen the six screws on the front panel plate and remove the plate.

OPERATIONS.

IC	Connectors and receptacles.
ITC	Capacitor.
ITC	Resistors.
ITC	Fuses.
ITC	Bushings and insulators.
ICL	Switches.
ITCL	Relays.
ITC	Cabinet, chassis, and mountings.
IT	Coupling shafts and control knob.

66. ITEM 4, DEFLECTION COIL ASSEMBLY OF BEARING INDICATOR ID-121/CRD-3.

PRELIMINARY STEPS. Remove the nuts on the upper shock mount of the bearing indicator; remove the pins on the lower supporting rod and lower indicator on the chain. Loosen the cover locking bolt and raise the hinged cover. Remove the under bottom plate by loosening the screws that hold it to the bottom of the indicator.

OPERATIONS.

IT	Driving motor.
ITC	Capacitor.
ITCA	Slip rings and brushes.
ITC	Principal housing (aluminum casting).
L	Bearing housings.

REMARKS. Bearing Indicator ID-121/CRD-3 is a delicate piece of electrical measuring equipment. It has been designed to give long and continuous service with the minimum of maintenance care. Never take the equipment apart just to see how it works as damage may result from the disassembly or assembly procedure. Excepting the three receptacles J851, J852, and J853, do not attempt any maintenance on Goniometer Navy type CFT-47372 as any attempt at maintenance will probably result in introduction of unbalance into the goniometer and cause bearing errors in the operation of the direction finder.

67. ITEM 5, OPTICAL HOUSING OF BEARING INDICATOR ID-121/CRD-3.

PRELIMINARY STEPS. Loosen hand screw and swing back the optical housing.

OPERATIONS.

IT	Pilot lamps.
ITC	Rheostat.
ITCA	Tube and socket.
ICL	Alidade optical assembly.

68. ITEM 6, CONTROL BOX.

PRELIMINARY STEPS. Remove the control box from the automatic bearing indicator by loosening the knurled nut under the box. Remove the cover plate.

OPERATIONS.

IC	Connectors and receptacles.
ITC	Capacitor.
ITC	Rheostats and potentiometers.
ITC	Terminal blocks.
ITC	Resistors.
ITC	Cabinet.

69. ITEM 7. AMPLIFIER-RECTIFIER POWER UNIT PP-151/CRD-3.

PRELIMINARY STEPS. Disconnect the cables at the rear. Remove the 2 nuts on the upper bearing indicator shock mount, and the pins on the lower supporting rod. Lower the indicator on its chain. Unhook the chain and carefully lower the indicator to the floor. Release the bar under the shelf by pulling it forward, and lower the shelf on its bracket. Loosen the captive screws around the panel on the amplifier-rectifier power unit and remove the unit from its cabinet.

OPERATIONS.

IC	Connectors and receptacles.
ITCA	Tubes and sockets.
ITC	Capacitors.
ITC	Resistors.
ITC	Bushings and insulators.
ITC	Rheostats and potentiometers.
ITC	Terminal blocks.
IT	Coupling shafts and control knobs.
PITC	Power transformers and filter chokes.
ITC	Fuses.
ITC	Cabinet.
ITC	Relay.

70. ITEM 8, CONTROL-RECTIFIER POWER UNIT PP-135/CRD-3.

PRELIMINARY STEPS. Disconnect the cables at the rear. Loosen the front panel screws and remove the unit from its cabinet.

OPERATIONS.

IC	Connectors and receptacles.
ITCA	Tubes and sockets.
ITC	Resistors.
ITC	Capacitors.
ITC	Rheostats and potentiometers.
ITC	Bushings and insulators.
PITC	Power transformer and filter chokes.

ITC Cabinet.

ITC Fuse.

IT Pilot lamp.

IT Coupling shaft and control knobs.

IC Switches.

71. ITEM 9, JUNCTION BOX JB-126.

PRELIMINARY STEPS. *Make certain that power coming into this junction box has been shut off before attempting any maintenance on it.* This is accomplished by stopping Power Unit PE-197 or disconnecting the input power cable to the junction box at either the 115-volt or 230-volt input receptacles.

OPERATIONS.

IC Connectors and receptacles.

FITC Autotransformer.

ITC Cabinet.

IC Switch.

72. ITEM 10, ANTENNA ASSEMBLY AS-204/CRD-3.

PRELIMINARY STEPS. Disconnect the power cables to the phase inverters on all five monopoles. If preventive maintenance is to be performed on the mast sections, the antenna system will have to be dismantled. All other maintenance can be performed accessibly at the base of the monopoles.

OPERATIONS.

IC Connectors and receptacles.

IT Antenna guys.

ITC Phase inverters.

ITC Junction Boxes JB-91-A.

IT Mounting Collar MT-224/CRD-3.

ITC Mast sections.

IC Base insulator.

REMARKS. The itemized preventive maintenance for the phase inverters listed above (ITC) refers only to the external parts of these units. Maintenance of the standard parts (resistors, capacitors, etc.) inside the phase inverters has been covered in previous paragraphs above.

73. ITEM 11, MOUNTING TABLE MT-347/CRD-3.

OPERATIONS.

ITC Mounting feet.

IC Legs and truss.

ICL Bearing indicator hinged support.

IC Apron and shelf.

74. ITEM 12, REEL UNIT RL-49.

PRELIMINARY STEPS. Remove brake unit.

OPERATIONS.

ICL Reel shaft bearings.

ICL Reel shaft clamp lock hinges and springs.

ICL Frame hinges and hinge bolts.

ICL Crank locking pins and springs.

ICL Reel shaft brake.

ICL Frame brace springs and hinges.

75. ITEM 13, INTERCONNECTING CABLES.

OPERATIONS.

IT Cable clamps.

IT Coupling rings.

I Cables proper.

ICL Cable connectors.

REMARKS. *Remember* the interconnecting cables in Radio Set AN/CRD-3 are the life lines of the equipment. Therefore, observe the condition of the cabling closely, especially those cables which are outside the shelter housing and exposed to all kinds of weather.

76. PREVENTIVE MAINTENANCE CHECK LIST.

The following check list is a summary of the preventive maintenance operations to be performed on Radio Set AN/CRD-3. The time intervals shown on the check list may be reduced at any time by the local commander. For best performance of the equipment, perform operations at least as frequently as called for in the check list. The echelon column indicates which operations are first echelon maintenance and which operations are second echelon maintenance. Operations are indicated by the letters of the word FITCAL. For example, if the letters ITCA appear in the "Operations" column, the item to be treated must be inspected (I), tightened (T), cleaned (C), and adjusted (A).

Item No.	Operations	Item	When performed: Before operation	After operation	Daily	Weekly	Monthly	Quarterly	Yearly	Echelon
1	ITCAL	Modulator section of Radio Receiver Assembly R-128/CRD-3.					X			2d
2	ITCAL	Power indicator section of Radio Receiver Assembly R-128/CRD-3.					X			2d
3	ITCL	Junction Box J-99/CRD-3.						X		2d
4	L	Deflection coil assembly of Bearing Indicator ID-121/CRD-3.				X				2d
4	ITCA	Deflection coil assembly of Bearing Indicator ID-121/CRD-3.					X			2d
5	ITCA	Optical housing of Bearing Indicator ID-121/CRD-3.					X			2d
6	ITC	Control box.					X			2d

NOTE: X indicates when operations are to be performed.

F	I	T	C	A	L
Feel	Inspect	Tighten	Clean	Adjust	Lubricate

Item No.	Operations	Item	When performed: Before operation	After operation	Daily	Weekly	Monthly	Quarterly	Yearly	Echelon
7	PITCA	Amplifier-Rectifier Power Unit PP-151/CRD-3.					X			2d
8	PITCA	Control-Rectifier Power Unit PP-135/CRD-3.					X			2d
9	PITC	Junction Box JB-126.			X					1st
10	ITC	Antenna Assembly AS-204/CRD-3.			X					1st
11	ITC	Mounting Table MT-347/CRD-3.			X					1st
11	L	Mounting Table MT-347/CRD-3.						X		1st
12	ICL	Reel Unit RL-49.					X			1st
13	ICT	Interconnecting cables.			•X					1st
13	L	Interconnecting cables (connector threads).						X		1st

NOTE: X indicates when operations are to be performed.

P	I	T	C	A	L
Feel	Inspect	Tighten	Clean	Adjust	Lubricate

SECTION VIII

LUBRICATION

77. APPROVED LUBRICANTS FOR RADIO SET AN/CRD-3.

The following table lists the lubricating materials necessary in servicing this equipment:

Symbols	Standard nomenclature
OE	Oil, Engine, SAE 10
PS	Oil, Lubricating, Preservative, Special
MO	Oil, Lubricating, for Aircraft Instruments and Machine Guns
GL	Grease, Lubricating, Special

78. BEARING INDICATOR ID-121/CRD-3.

a. Once each week, apply 1 or 2 drops of lubricating oil for aircraft instruments and machine guns (MO) in the snap oiler of the tube support housing rear bearing.

b. Once each week, remove the knurled screw plug and apply 1 or 2 drops of lubricating oil for aircraft instruments and machine guns (MO) to the tube support housing front bearing.

b. **Tuning Control Shaft Bearings.** These bearings to be lubricated by maintenance personnel at times of disassembly. The lubricant to be used is special preservative lubricating oil (PS).

82. OAN TEST OSCILLATOR EQUIPMENT.

This unit is used as test equipment when the set is placed in operation, but the unit is rarely utilized after the set is assembled. The test oscillator is fully inclosed and dustproof. Therefore this component will not require any relubrication service in the field.

83. GONIOMETER NAVY NO. CFT-47372.

The goniometers used in Radio Receiver Assembly R-128/CRD-3 and Bearing Indicator ID-121/CRD-3 are identical and their rotors are equipped with two Fafair ball bearings No. 201-DD and No. 36-DD Double Shield which are prelubricated and do not require relubrication.

84. BEARING INDICATOR DRIVE MOTOR.

The drive motor (Baldor Electric Company type YC31) is equipped with SKF No. 6202-RS ball bearings which are of the sealed type, prelubricated for life.

85. REEL UNIT RL-49-A.

a. Once each month, after proper cleaning, lubricate each reel shaft bearing with special lubricating grease (GL).

b. Once each month, after proper cleaning, lubricate the following with engine oil SAE 10 (OE):

(1) Reel shaft clamp lock hinges and springs.

(2) Frame hinges and hinge bolts.

(3) Crank locking pins and springs.

(4) Frame brace springs and hinges.

c. Remove the brake, clean the brake

c. The alidade notched sleeve ring is equipped with three ND-3R-3 ball bearings. Every three months, after removing and cleaning the ring and bearings as described in paragraph 58, relubricate by kneading special lubricating grease (GL) into the bearings.

79. MOUNTING TABLE MT-347/CRD-3.

The bearings on the bearing indicator hinged support trunion are coated with grease at the time of assembly. Thereafter, every three months, apply 4 or 5 drops of engine oil, SAE 10 (OE) to soften the grease.

80. JUNCTION BOX J-99/CRD-3.

Every three months, after cleaning Junction Box J-99/CRD-3 as described in paragraph 52, relubricate as follows:

a. **Solenoid Actuating Plungers.** After properly cleaning, coat lightly with special lubricating grease (GL).

b. **Band Switch Shaft Bearings.** Apply 2 or 3 drops of special preservative lubricating, oil (PS) to each bearing sparingly.

c. **Solenoid Limit Control Switch Plungers.** After properly cleaning, apply special lubricating grease (GL) sparingly to the plungers and the tip of the shaft switch arms.

d. **Positioning Cam and Rollers.** Apply 2 or 3 drops of special preservative lubricating oil (PS) to each roller and pin.

e. **Connecting Yokes and Link Pins.** Apply 1 or 2 drops of special preservative lubricating oil (PS) to each yoke and link pin.

81. RADIO RECEIVER ASSEMBLY R-128/CRD-3.

a. **Band Change and Tuning Control Gear Housing.** This unit is to be lubricated by maintenance personnel at times of disassembly. The lubricant to be used is special lubricating grease (GL).

seat on the reel shaft, and flush out the brake housing. Coat the brake seat with engine oil SAE 10 (OE). Lubricate the brake by applying engine oil SAE 10 (OE) sparingly in the openings at the ends between the hub and the housing.

86. POWER UNIT PE-197.

For lubrication, see War Department Lubrication Order No. 3014 contained in TM 11-940.

87. CABLE CONNECTORS.

Every three months, after proper cleaning, lubricate the cable connector threads sparingly with special lubricating grease (GL), to prevent rust and corrosion.

88. TELEPHONE EE-8-B.

Lubrication of this unit is covered in TM 11-333.

SECTION IX

MOISTUREPROOFING AND FUNGIPROOFING

89. GENERAL.

a. Excessive failure of parts and loss of operating efficiency are usually caused, not by inferior parts or equipment, but by the accumulated effects of moisture in high-humidity areas. Rapid temperature changes coupled with conditions of fog, rain, and dew or high humidity promote such failures.

b. The effects of moisture (and fungus growth) on resistors, capacitors, coils chokes, transformer windings, terminal boards, and insulating strips can be recognized in the form of corrosion, low insulation resistance, flash-overs, and crosstalk.

90. TREATMENT TO REDUCE FAILURES.

a. To reduce the above failures, a moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. The treatment consists of applying a film of moisture- and fungi-resistant varnish to all susceptable parts of the equipment. This film provides a nonwetting surface which forms a moisture barrier. Fungus growth is prevented by a fungicide in the varnish. Equipments which have been so treated are marked MFP and dated. Equipments not so marked should be examined and if it is obvious that the treatment has not been applied, the equipment should be returned at the first opportunity to third or higher echelon maintenance units for treatment.

b. Re-treatment may be required after a period of use. The need for this retreatment will be indicated by excessive failures or the effects outlined above (par. 89b).

91. MOISTUREPROOFING AND FUNGIPROOFING PROCEDURE.

For a detailed description of the varnish-spray method of moistureproofing and fungiproofing, refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment. TB SIG 13 with Changes thereto, together with the following information, gives the necessary procedure for treating the equipment. Extreme care must be exercised in moistureproofing and fungiproofing Phase Inverters MC-411-A and MC-413-A, Goniometer Navy No. CFT-47372, and Bearing Indicator ID-121/CRD-3. Processing of these components should not be attempted by inexperienced personnel.

a. Telephone EE-8-B. Refer to TB-333-2, Moistureproofing and Fungiproofing of Telephone EE-8, EE-8-A, and EE-8-B.

b. Phase Inverter MC-411-A.

(1) Mask the banana plug on the inside top of the phase inverter case. Apply approximately 1 inch masking tape completely around the machined edge at the bottom of the phase inverter

case. Spray the inside of the phase inverter case.

(2) Carefully apply a brush coat of lacquer to the wires, the bakelite disk and strip, the fixed capacitors, and the relay coil.

(3) Avoid getting lacquer on the tube socket pins, the contacts on Relay K301, banana plugs, and sockets.

c. Phase Inverter MC-413-A. Refer to subparagraph b above.

d. Bearing Indicator ID-121/CRD-3.

(1) Mask the 14 banana plugs, the knurled thumbscrew, and Control R509.

(2) Apply a brush coat of lacquer to wires within the metal shield and bakelite tubing inclosing the neck of the cathode ray tube and socket. While applying the lacquer, hold this part in a horizontal position so that the lacquer will not drip on the socket. Place in the oven for baking with open end down.

(3) Looking at the front end of the indicator, apply a light brush coat of lacquer to the white tape around the four deflection coils mounted on the inside of the rotating mechanism, and to the wires connecting these coils. Do not brush the rear of the deflection coils mounted on the inside of the rotating mechanism, and to the wires connecting these coils. Do not brush the rear of the deflection coils containing the coil terminals. Apply a brush coat of lacquer to all wires and the two papercased electrolytic capacitors in the cavity covered by the bottom cover plate of the indicator. Spray the inside of the indicator control box.

e. Goniometer Navy No. CFT-47372.

(1) Do not permit any lacquer to contact the ball-bearing races at the ends of the rotor, or the bearing surfaces at the inner rear of the goniometer case.

(2) Apply one coat of lacquer to the goniometer rotor. With the goniometer in a horizontal position and the open end toward the operator, apply a thin coat of lacquer to the circular goniometer stator coil and to the wires connected with it. Apply a brush coat of lacquer to the inside surfaces of the side cover plates.

f. Amplifier-Rectifier Power Unit PP-151/CRD-3. Mask the bottom of each of the four tube sockets, mask relay K401, controls R401 and R403, and the three fuses and contacts. Mask underside of lips of chassis. Spray with lacquer, then apply an additional brush coat of lacquer to all exposed wires.

g. Power Indicator Section, Part of Radio Receiver Assembly R-128/CRD-3.

(1) Top of Chassis. Apply a brush coat of lacquer to the hook-up wire and cabling, and fixed capacitors and resistors. Remove the shields from the i-f coils and the shield over the terminal strip. Carefully apply a brush coat of lacquer to the coils and the components mounted on the terminal strip. Avoid getting lacquer on the switches and potentiometers, the trimmer adjustments on the i-f coils, and the loudspeaker.

(2) Bottom of Chassis. Apply a brush coat of lacquer to the hook-up wire and cabling, and other fixed components requiring treatment. Avoid getting lacquer on the sixteen tube sockets, the phone jack, the b-f-o variable capacitor, the switches and potentiometers, and the loudspeaker.

h. Modulator Section, Part of Radio Receiver Assembly R-128/CRD-3.

(1) Top of Chassis.

(a) Remove the goniometer and treat it according to directions in subparagraph e above.

(b) Remove the shields from T101, T102, T103, T104, and T105, L411, L412

and L113. Carefully apply a brush coat to the coils. Do not let any lacquer touch the variable capacitors. (Mask variables, if necessary).

(c) Apply a brush coat of lacquer to the leads and cabling associated with the controls on the front panel. Do not let any lacquer touch rheostat R139.

(2) Bottom of Chassis. Carefully apply a brush coat to the fixed components requiring the lacquer treatment. Avoid dripping lacquer on the contacts of the five rotary ceramic band switches, the rotary indication switch, and the key sense switch, the three potentiometers, and the antenna relay.

i. Control-rectifier Power Unit PP-135/CRD-3. Carefully apply a brush coat of lacquer to the hook-up wire and circuit components requiring treatment. Avoid dripping lacquer on moving or variable parts, especially the six toggle switches, the rotary switches, and the sockets.

j. Junction Box J-99/CRD-3. Mask relays K451 and K452; solenoids K453 and K454 (the rotor switch may be rotated manually to aid in this operation); mask plungers of microswitches S454 and S455; and all moving parts of the gang switch and contacts of S451, S452, and S453. Spray and add brush coat to exposed wiring.

k. Junction Box JB-126. No masking is required. Do not bake at temperatures higher than 140° F.

l. Junction Box JB-91. Plug the pin jacks in the receptacles. Mask the threads on the receptacles. Spray.

m. Mast Base AB-57/CRD-3. Apply a brush coat of lacquer to all exposed portions of the phenolic sleeve.

n. Model OAN Test Oscillator.

(1) Top of Chassis. Remove the shield over the output control switch assembly and carefully apply a brush coat to the resistors, wires, and bakelite strips. Avoid dripping lacquer on the switch contacts. Apply a brush coat to the bakelite strip mounting V603, to the other bakelite strip, and to all exposed wiring.

(2) Bottom of Chassis. Remove the large shield over the oscillator and amplifier coils. Carefully apply a brush coat to the six coils, wiring, fixed resistors and capacitors, and the bakelite mounting strips. Avoid dripping lacquer on the coil adjustments, contacts on the band switch, the variable capacitors, and the bottom of the tube sockets. Remove the shield from the a-c filter unit. (Two screws on top of the chassis and on a-c toggle switch mounting on the front panel releases the unit.) Apply a brush coat to the four coils, wiring, and the bakelite mounting strip. Apply the brush coat to the battery cabling inside the main mounting case.

92. MOISTUREPROOFING AND FUNGIPROOFING AFTER REPAIRS.

If, during repair, the coating of protective varnish has been punctured or broken, and if complete treatment is not needed to reseal the equipment, apply a brush coat to the affected part. Be sure the break is completely sealed.

PART FOUR

AUXILIARY EQUIPMENT

"NOT USED"

PART FIVE

REPAIR INSTRUCTIONS

NOTE: Failure or unsatisfactory performance of equipment used by Army Ground Forces and Army Services Forces will be reported on W.D., A.G.O. Form No. 468 (Unsatisfactory Equipment Report); by Army Air Forces, on Army Air Forces Form No. 54 (Unsatisfactory Report). If either form is not available, prepare the data according to the sample form reproduced in figure 124.

SECTION X

THEORY OF EQUIPMENT

93. FUNDAMENTAL PRINCIPLES.

a. General. A radio direction finding system consists essentially of a directional antenna system, a sensitive radio receiver, and a suitable indicating device (fig. 60). The actual determination of the direction of arrival of the radio signal is accomplished by the antenna system. The radio receiver detects and amplifies the antenna voltages, and the indicator interprets the results for the human senses. The principle involved in determining the location of the radio transmitter is to find the direction of arrival of the received wave. Experience shows that this corresponds to the direction in which the signal source lies. Factors which might tend to alter this relationship are minimized by proper design of the receiving antenna system.

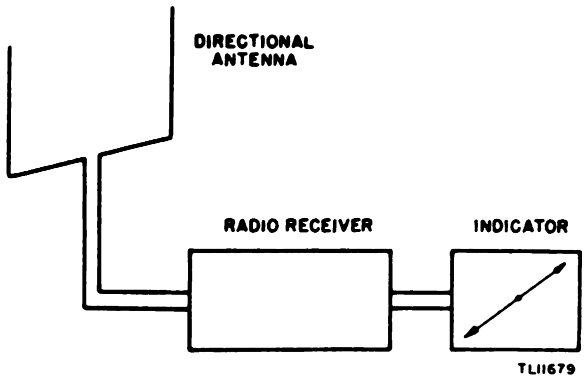


Figure 60. Elementary direction finder.

b. Monopole Antenna. The simplest form of antenna is a single vertical wire or monopole. When used as a receiving antenna it responds equally well to signals from any direction in the horizontal plane. Thus, if we move a small transmitter about the antenna we find that at equal transmitter distances identical responses are obtained. In other words, the monopole has no directional properties in the horizontal plane. A polar diagram of reception for a monopole showing responses plotted against angle of arrival of waves is shown in figure 61.

c. U-Adcock Antenna.

(1) To determine the direction of arrival of the received radio wave, it is necessary to use a receiving antenna system with directional properties. This means that the response of the antenna system must depend upon its orientation with respect to the direction of arrival of the radio wave.

(2) The U-Adcock antenna array complies with this requirement. It consists of two vertical monopole antennas spaced some distance apart and connected together in phase opposition. The output of this array, thus depends upon the phase difference between the voltages induced in the component antennas. The component monopoles are separated some distance from one another so an incoming radio wave will arrive at each monopole at a different time, depending upon the direction of arrival.

Since the phase difference of the voltages induced in the two component monopoles depends upon the difference in time of arrival of the wave, the output of the array will also depend upon the direction of travel.

(3) A polar diagram of reception showing response plotted against the angle of arrival of waves for a U-Adcock antenna system is shown in figure 62. When the transmitter is in the N or S direction, in the system illustrated, the output at the antenna terminals is maximum. If the transmitter is moved to the E or W direction the output at the antenna terminals will be zero or null. At intermediate directions the voltage across the U-Adcock is proportional to the cosine of the angle (θ in fig. 62) between the plane of the U-Adcock antenna system and the direction of arrival of the radio wave. The phase of the output voltage from terminals O-O (fig. 62) for all transmitter locations north of the E-W line perpendicular to the array, is just the reverse of the phase of the output voltage corresponding to transmitter locations south of the E-W line. In other words, the output voltage changes phase by 180° as the angle of arrival of the wave passes through the angles of antenna zero of null response. This is because waves arriving from the north of the E-W, or null line, arrive at the north component antenna first, while those from the south of the null line arrive at the south antenna first.

(4) Since the response of the U-Adcock antenna depends upon the direction of arrival of the wave with respect to the plane of the array, the antenna may be used to determine the azimuth of a transmitter, from a given point of observation, by rotating it to a null or zero response position. A pointer set perpendicular to the array and located at its center will point along the line of arrival of the radio waves. Observe, however, that for a U-Adcock antenna there are two null positions 180° apart. Either null gives the line of arrival of the wave but does not distinguish between two possible directions along the line, leaving a 180° ambiguity in the azimuth of the transmitter. This ambiguity may be eliminated by taking advantage of the phase reversal property at the nulls of a U-Adcock antenna and combining its output with the properly phased output of a single monopole antenna. The relationship between the response diagram of the combined antennas and that of the U-Adcock along shows which U-Adcock null corresponds to the transmitter azimuth. A monopole used for this purpose is called a sense antenna.

d. Combined Characteristics of U-Adcock and Monopole Antennas.

(1) Figure 63 shows four cardioid (heart-shaped) type polar response diagrams corresponding to the combined outputs of a U-Adcock antenna and a single monopole or sense antenna. The dotted figure eight and circle diagrams represent the individual U-Adcock and monopole response characteristics repectively. In order to indicate the phase

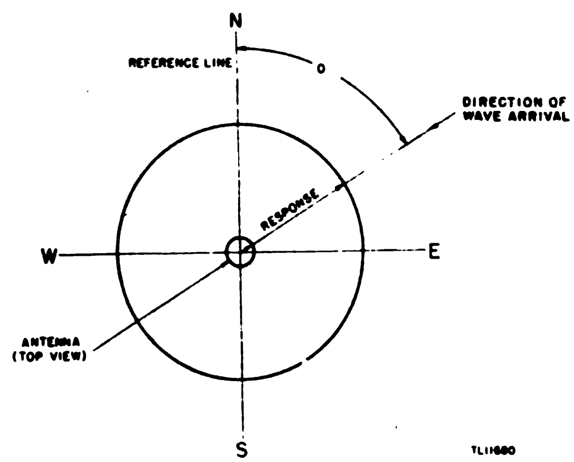


Figure 61. Monopole antenna polar response diagram.

reversal of the output from the U-Adcock antenna at the nulls, one lobe of its diagram is marked + and the other –. The monopole diagram is marked +, since the phase of its output voltage is independent of the angle of arrival of the wave and can be made equal to the phase of the U-Adcock output over one lobe of the figure eight diagram.

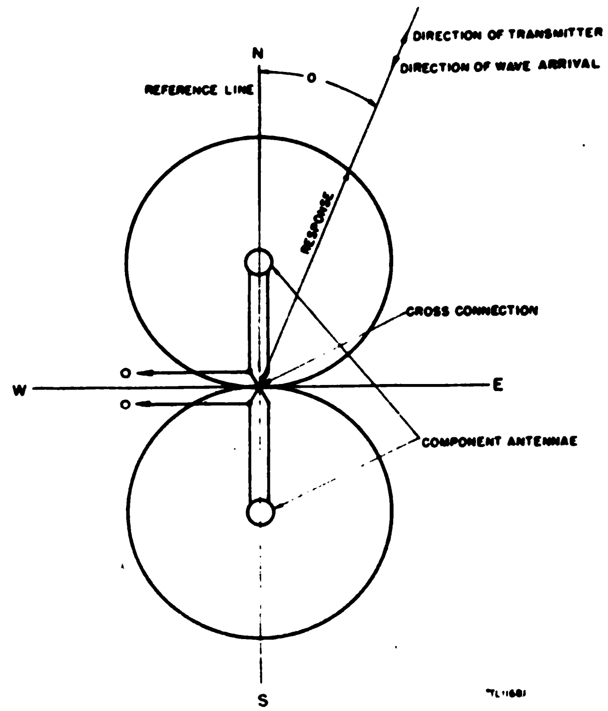


Figure 62. U-Adcock antenna polar response diagram.

(a) The combined response diagrams shown by the solid curve are formed by adding the two dotted diagrams algebraically. The differences in the diagrams of figure 63 are due to differences in the relative amplitudes of the monopole and maximum U-Adcock responses. Figure 63c shows the relationship most ideal for sense determination (monopole output equals maximum U-Adcock output). Observe that on one side of the U-Adcock nulls the combined response is greater than on the other side. The orientation of the cardioid diagram with respect to a U-Adcock null, clockwise or counterclockwise, determines which null to read for the direct transmitted azimuth. The other null indicates the reciprocal transmitter azimuth.

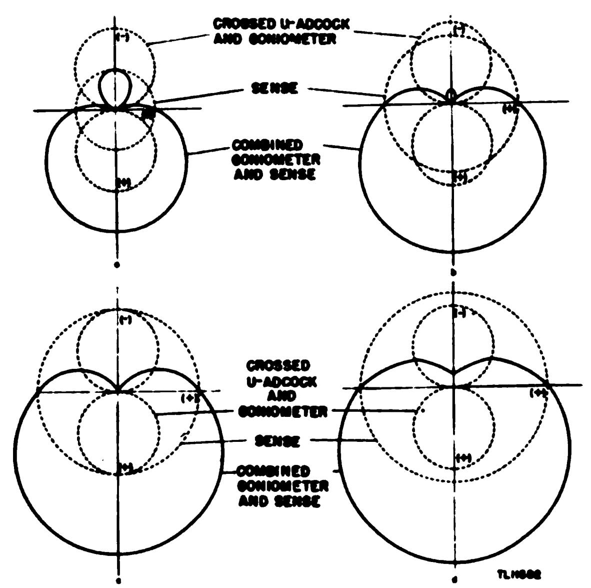


Figure 63. Combined U-Adcock and monopole antenna polar response diagram.

e. Crossed U-Adcock Antenna and Goniometer.

(1) Rotating a U-Adcock antenna is frequently impractical, because of the physical size of the array. The same effects may be obtained by using two identical Adcock arrays, set at right angles to one another, in conjunction with a goniometer or rotating transformer. The component antennas of the U-Adcock are located at diagonally opposite corners of a square. The goniometer (par. 97) consists essentially of two stator windings, set at right to one another, and a rotor winding. The rotor is connected to the receiver and indicator, and stators No. 1 and 2 are connected to the corresponding U-Adcock antennas (fig. 64).

(2) If a transmitter is in position N or S (fig. 64) the output of U-Adcock antenna No. 1 will be maximum while that from No. 2 will be zero. Current will then flow in goniometer stator No. 1 only. If rotor R is turned at right angles to stator No. 1 no voltage will be induced in it. If the transmitter were moved to position E or W the output of Adcock No. 2 will be maximum and that from No. 1 will be zero. Current will then flow only in goniometer stator No. 2. To obtain a goniometer null it will be necessary to turn the rotor 90°, or perpendicular to stator No. 2. With the transmitter at A or A', 45° between the N-E and S-W positions, the outputs of the two U-Adcock antennas are equal and so are the resulting stator currents.

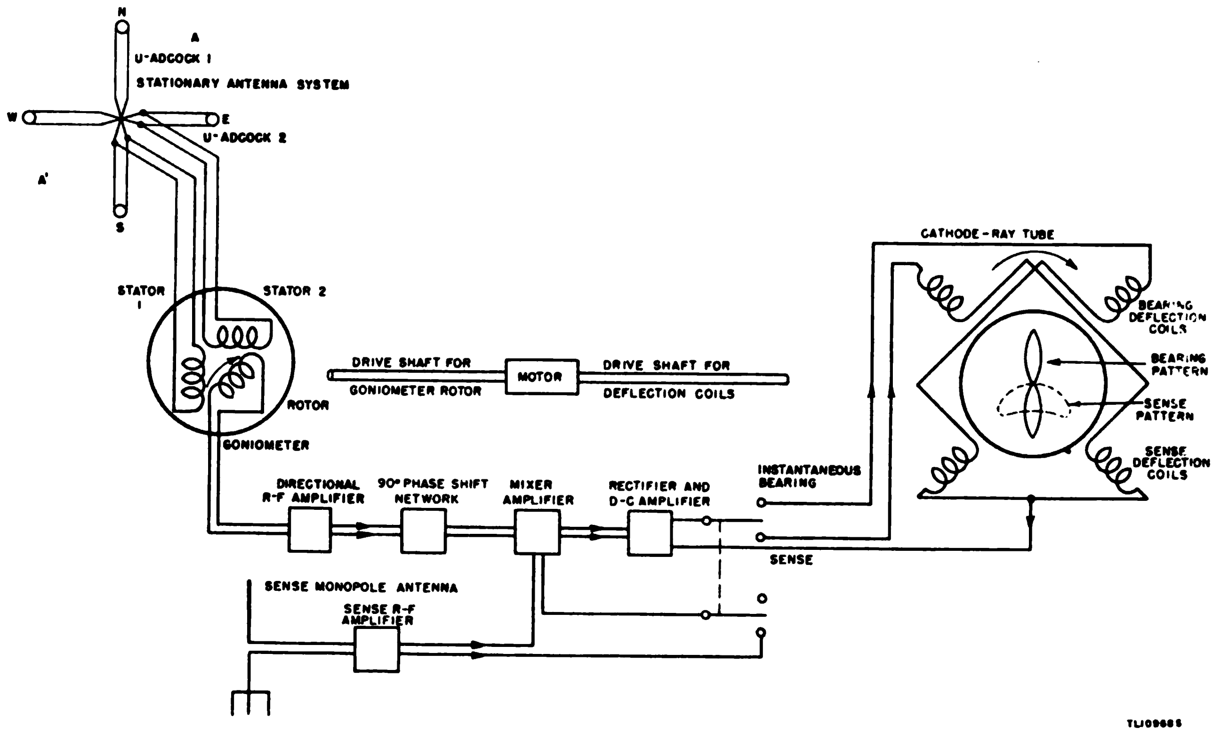


Figure 64. Block diagram of automatic bearing indicator system.

When the rotor is turned half way between the two stator windings (45° between the two previous positions) the voltages induced in the rotor will cancel each other, and the goniometer output will be zero or null. Maxima will always occur at rotor positions 90° from the nulls.

(3). Observe that the angular position of the goniometer rotor for the nulls changes by the same amount as the angle of arrival of the radio waves. A pointer fastened to the goniometer rotor, or an indicator pattern (fig. 64) whose orientation is controlled by the rotor position, will always show the line of arrival of the incoming radio waves, once it has been properly aligned for some known angle of arrival.

(4) The response characteristics of a pair of crossed U-Adcocks and a goniometer, with respect to the gonimeter rotor position, are identical to those of a single rotating U-Adcock antenna. The only difference is in the size of the rotating units, a small rotating goniometer rotor as compared with the complete antenna. The method of sense determination is the same.

(5) The rest of the direction finding equipment is used primarily to translate the response characteristics of the directional and non-directional antennas into simple indications relative to an azimuth scale. Radio Set AN/CRD-3 provides the following three types of azimuth indication: Aural or visual null indication; visual matched-line indication; and automatic azimuth indication. The same antenna system, consisting of a pair of crossed U-Adcocks and goniometer and a vertical monopole for sense, is used with all three indicator systems.

f. Aural Null Indication.

(1) The receiver is first tuned to the desired signal using only the goniometer input. The loudspeaker or a telephone headset is used to locate the goniometer nulls as the goniometer dial is turned. The 180° azimuth ambiguity, due to the two nulls, is eliminated by applying the sense antenna voltage

to the receiver sense channel. The phase of the directional input is shifted 90°, and the voltages in the directional and sense input channels are combined. This results in an increase of receiver response from the null by an amount corresponding to the added sense input. If the goniometer dial is rotated from its former null position, the voltage in the directional channel will either add or subtract from the sense channel voltage to further increase or decrease the receiver response (fig. 63). The polarities of the sense antenna and goniometer connections are arranged so that a clockwise goniometer rotation from the null corresponding to the direct transmitter azimuth will decrease the receiver response. A counterclockwise rotation from the goniometer null will then increase the goniometer response.

(2) Two 360° scales, displaced 180° from each other on the goniometer dial, are provided to facilitate the azimuth determination. The direct transmitter bearing corresponds to the null reading on the black scale, if the receiver response decreases with clockwise rotation of the goniometer after sense has been added. But if the response increases with clockwise rotation the azimuth null is read on the red scale.

(3) A visual aid to azimuth indication is provided by a single line pattern on the 2-inch cathode-ray tube. The length of the line is proportional to the receiver response. At a null, the line shrinks to a spot. When sense is added, the spot becomes a line. If the line decreases or increases in length with clockwise goniometer rotation, the azimuth is read on the black or red scales respectively.

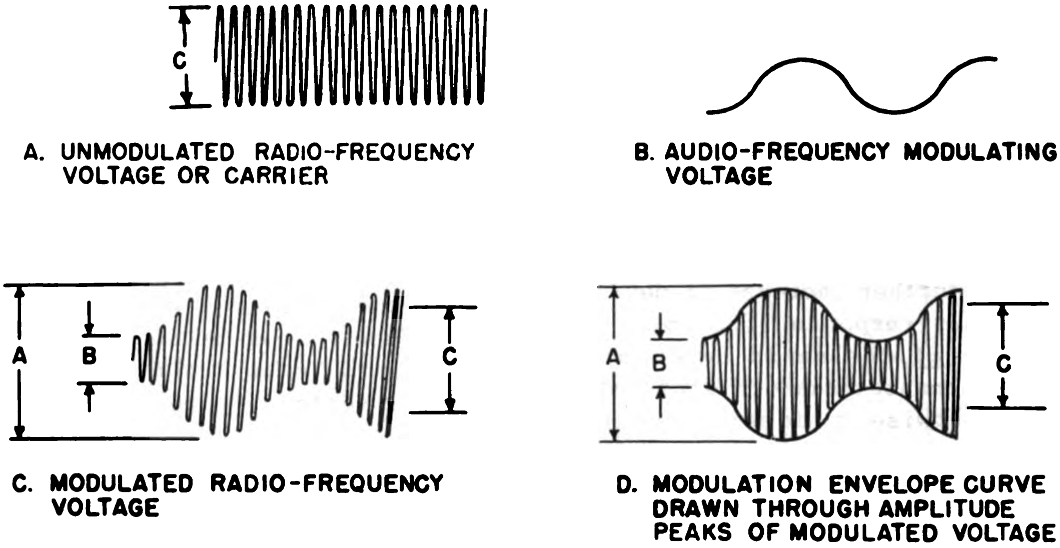
g. Visual Matched-Line Indication.

(1) General. In this method the goniometer and sense antenna outputs are fed to the receiver at all times. Two parallel lines appear on the cathode-ray tube, and their relative lengths for a given signal depend on the goniometer setting. Nulls are determined by turning the goniometer dial until the two lines are of equal length. The azimuth reading is taken from the black or red scale, depending upon whether the right-hand line increases or decreases relative to the left-hand line as the goniometer is rotated clockwise.

(2) Basic Principles of the Matched-Line System.

(a) Amplitude Modulation. If the amplitude of an r-f voltage is varied periodically at an audio frequency rate, it is said to be amplitude modulated. The r-f voltage is referred to as the carrier, the a-f voltage as the modulating voltage, and the resulting combination as the modulated voltage. A curve drawn through the amplitude peaks of the modulated voltage is known as the modulation envelope, and has the same shape as the modulating voltage. Figures 65 A, B, C, D, illustrate respectively the unmodulated r-f voltage or carrier, the a-f modulating voltage, the modulated voltage, and the modulation envelope drawn through the amplitude peaks. C in figure 65A is the unmodulated r-f amplitude which is the same as the average amplitude of the modulated voltage (fig. 65C). A and B of figure 65C are respectively the maximum and minimum amplitudes. The percentage modulation of a modulated voltage is defined as 100 times the ratio of the difference in average and minimum envelope amplitudes to the average envelope amplitude, or percent modulation $= \frac{C-B}{C} \times 100$. Analysis of a modulated voltage shows that it has three frequency components. One is the carrier, and the other two are the side frequencies or modulation products. The side frequencies are the sum and difference frequencies of the carrier and the modulating voltages. *The carrier may also be modulated by combining it with the proper side frequencies.*

(b) Balanced Modulator. The balanced modulator provides a simple means for generating the side frequencies and at the same time suppressing the r-f



A. UNMODULATED RADIO-FREQUENCY VOLTAGE OR CARRIER

B. AUDIO-FREQUENCY MODULATING VOLTAGE

C. MODULATED RADIO-FREQUENCY VOLTAGE

D. MODULATION ENVELOPE CURVE DRAWN THROUGH AMPLITUDE PEAKS OF MODULATED VOLTAGE

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Figure 65. Amplitude modulation.

carrier voltage. In one type, an r-f input is introduced in push-pull to the grids of two pentodes, while the a-f modulating voltage is applied to the screens which are connected in push-pull. If the plates are connected in parallel, the r-f carrier voltages on the plates will be combined out of phase and will be balanced out. This leaves only the a-f component and the two side frequencies. The parallel connected plates are then connected to a tuned output circuit which filters out the a-f voltage, leaving only the side frequencies in the output. If the modulating voltage is held constant the amplitudes of the side frequencies will depend only upon the r-f input voltage, varying from zero to maximum as the r-f input is varied in a similar manner. When the side frequencies are combined with another carrier of the same frequency and phase as the original carrier, a modulated voltage like that shown in figure 65c will be obtained. Shifting the phase of the r-f carrier to the balanced modulator by 180° relative to the new carrier reverses the phase of the side frequencies, thus reversing the phase of the modulation envelope on the new carrier. The percentage modulation of the new carrier will depend in either case upon the amplitude of the original r-f carrier applied to the balanced modulator.

(c) Trapezoid Modulation Pattern. Characteristic patterns are formed on a cathode-ray tube if the modulated r-f voltage is applied to the vertical plates while the modulating voltage is applied to the horizontal plates. Figure 66A shows the resulting trapezoid pattern whose sides are proportional to the maximum and minimum amplitudes, A and B, of the modulation envelope. If the modulation is removed (0 percent modulation) without altering the magnitude of the modulating voltage applied to the horizontal plates, the rectangular pattern of figure 66B will be obtained. Its sides are proportional to the unmodulated carrier amplitude C. If the carrier is again modulated, but with the phase of its modulation envelope reversed (shifted 180°), the pattern shown in figure 66C will be obtained. This pattern is the reverse of the one shown in figure 66A. If the modulation of an r-f voltage is gradually reduced from 100 percent to 0 percent and back to 100 percent, but with the

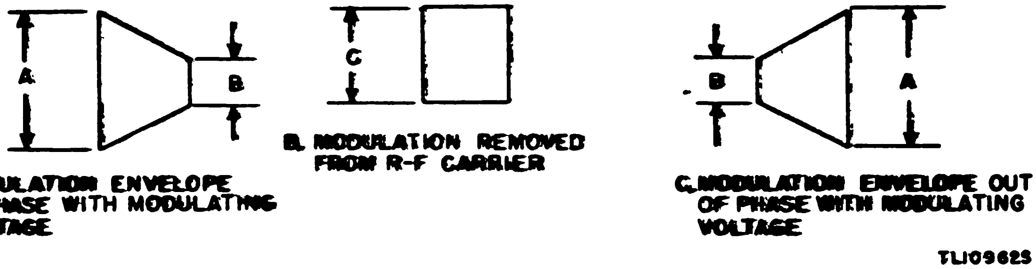

Figure 66. Trapezoid cathode-ray tube patterns with modulated r-f voltage on vertical plates. a-f modulating on horizontal plates.

phase of the modulation envelope reversed, the series of patterns shown in figures 67A and -C will be obtained. Over-modulation will distort the modulation envelope as shown in figures 68-A and -B and produce distorted patterns like those of figures 68-C and -D. *Observe that these series of patterns provide a means for detecting nulls and phase reversals of an r-f voltage by modulating an equivalent fixed voltage with its side frequencies.*

(3) Application of the Trapezoid Pattern to Matched-Line Azimuth Indication.

(a) Figure 69 shows a block diagram of the principle circuit components for matched-line azimuth indication.

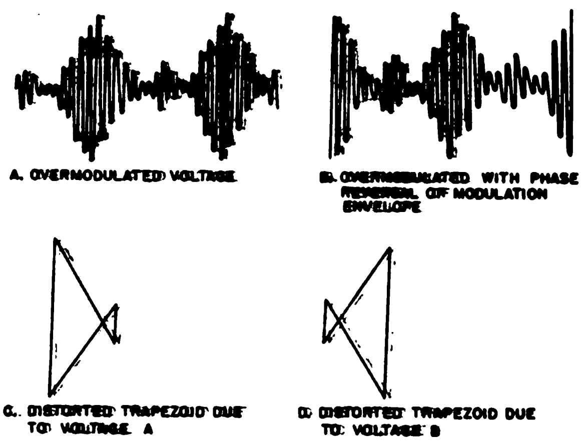

Figure 68. Overmodulated voltage and corresponding trapezoid patterns.

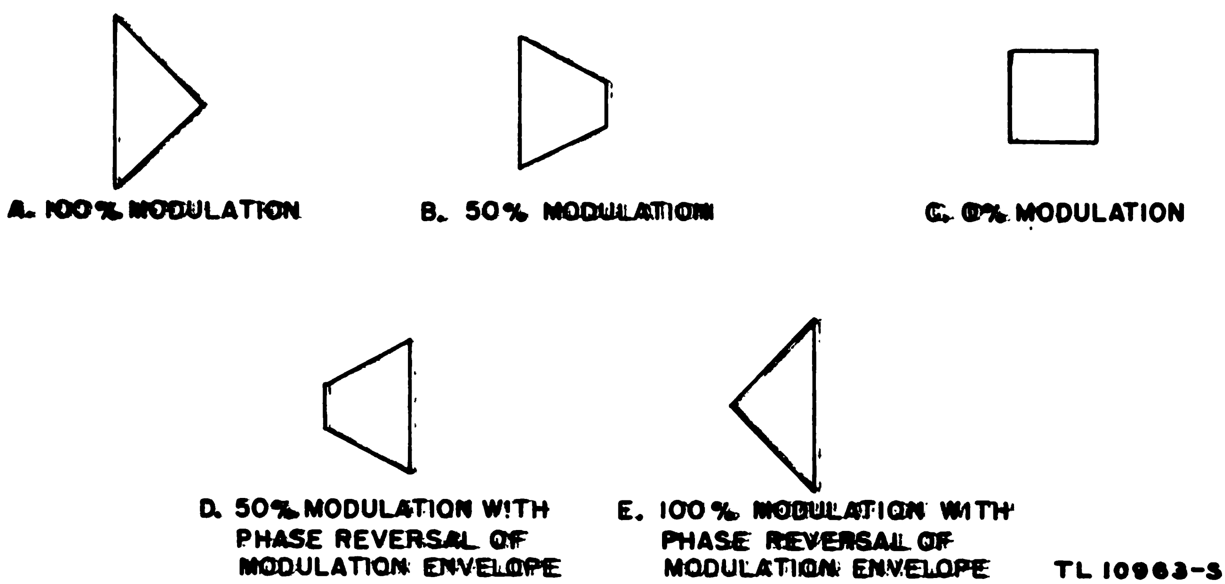

Figure 67. Series of trapezoid cathode-ray tube patterns corresponding to a change from 100% modulation envelope.

The goniometer output is amplified by an r-f amplifier in the direction channel of the receiver, shifted in phase 90°, and applied to the balanced modulator. The a-f modulating voltage is simultaneously applied to the modulator and to the horizontal plates of the cathode-ray tube. The sense antenna output is amplified by the r-f amplifier in the receiver sense channel and fed to the mixer r-f amplifier where it is combined with the side frequencies from the goniometer voltage. The modulated output of the mixer r-f amplifier is then applied to the vertical plates of the cathode-ray tube where it forms the trapezoid pattern as outlined in subparagraph g(2)c above.

(b) As the goniometer is rotated, the input to the balanced modulator varies according to the figure of eight goniometer response. At the nulls the modulator input is zero so that the amplified sense voltage applied to the cathode-ray tube plates is unmodulated. Therefore, at the goniometer nulls the tube pattern is rectangular. As the goniometer is rotated one way from a null the modulator input will increase and be in phase with the sense voltage. The side frequency amplitudes will increase, thereby increasing the modulation on the sense carrier to give a trapezoid pattern. A similar effect will result as the goniometer is rotated in the other direction from the null, or in the same direction from the opposite null, except that the phase of the modulator input will shift by 180°. This will produce a trapezoid pattern whose long and short sides are reversed (subpar. g(2)c above). The direct transmitter azimuth or the absolute direction of the received signal is then definitely related to the way in which the sides of the trapezoid pattern change, with goniometer rotation, from the rectangular null pattern.

(c) In practice the center portion of the trapezoid pattern is suppressed by a blanking circuit so that only the vertical lines corresponding to the sides of the pattern remain.

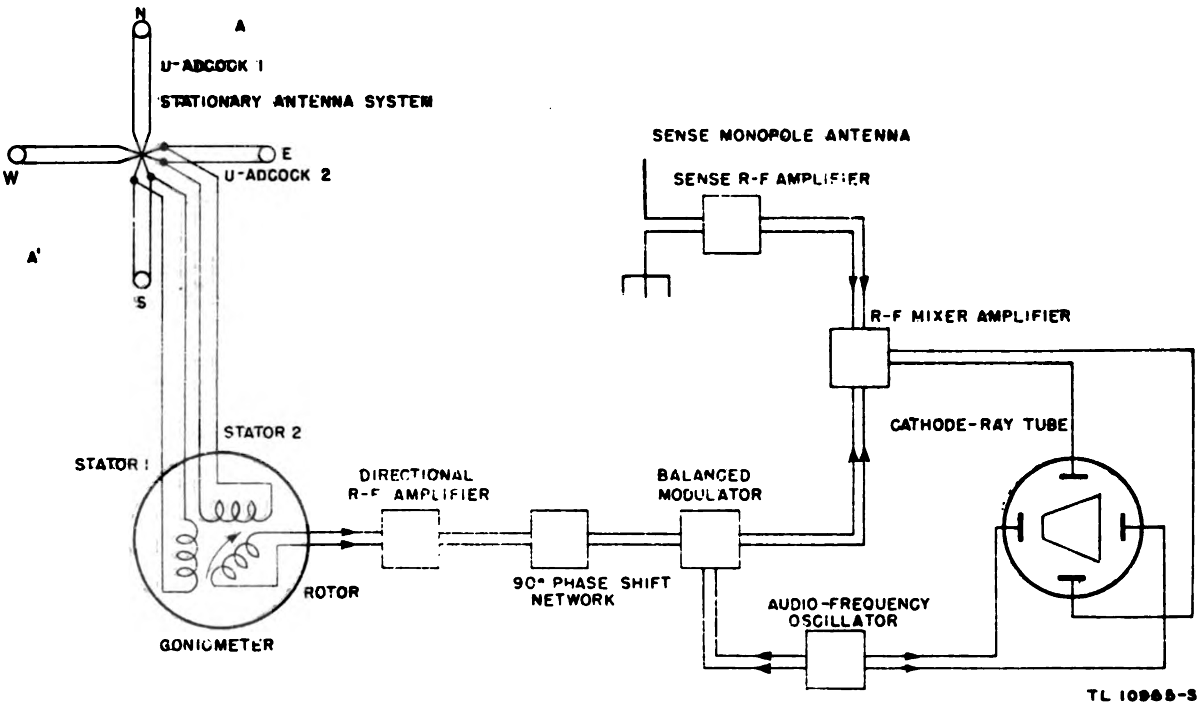

Figure 59. Block diagram of matched line azimuth indicator system.

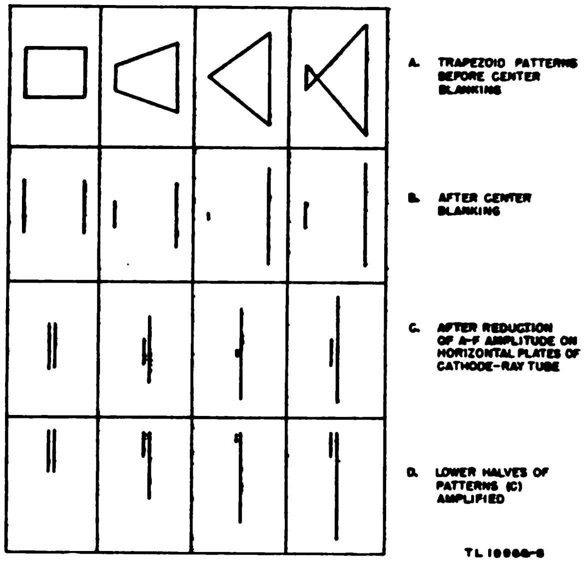

Figure 70. Evolution from trapezoid to matched line series of cathode-ray tube patterns.

These are brought close together in order to facilitate matching them in height, by reducing the amplitude of the modulating voltage applied to the horizontal plates. Since only the upper or lower halves of the lines are necessary, greater sensitivity for a given cathode-ray tube size is obtained by eliminating half the pattern and amplifying the other half to the full size of the screen. Figure 70 shows a series of patterns from 0 percent modulation to over-modulation, including the evolution from the trapezoid to matched-line series.

(4) Typical Matched-line Indicator Patterns.

(a) The goniometer dial has two 360° scales displaced 180° with respect to each other. The outer scale is black and the inner one is red. All connections are phased so that the direct transmitter azimuth is determined without ambiguity by reading the black scale if clockwise rotation of the dial from the null causes the right-hand line to lengthen. If the right-hand line shortens with clockwise rotation, the red scale reading gives the azimuth. In either case, the azimuths are given by the proper scale reading for which the two lines are exactly equal in length.

(b) Figure 71 shows a sequence of patterns corresponding to 360° of rotation of the goniometer dial in a clockwise direction. As the dial is rotated through the first null (fig. 71-D and -E) the left line lengthens and the right line shortens. The red or inner scale shows the azimuth to be 270°. As the dial is rotated still further and passes through the second null (fig. 71-J and -K, the left line shortens and the right line lengthens. The black or outer scale now shows the azimuth which is the same as before, namely 270°.

h. Automatic Azimuth Indications.

(1) General. In this method two types of patterns are automatically produced on a cathode-ray tube screen surrounded by a 360° azimuth scale. When the SEARCH-INSTANT. BEARING-SENSE switch is on INSTANT. BEARING, a twin-leaf type azimuth pattern is formed whose orientation depends upon the line of arrival of the received signal. The tips of the pattern are 180° apart on the azimuth scale, giving rise to a 180° uncertainty in the azimuth. When the sense antenna voltage is added by pressing the switch to SENSE, the azimuth pattern disappears and a sense pattern is formed. The sense pattern is off center on the screen opposite the azimuth scale reading for one tip of the azimuth pattern. Circuit connections are so arranged that the azimuth scale reading of the azimuth pattern tip opposite the succeeding sense pattern gives the absolute direction or direct azimuth of the transmitter.

(2) Receiving and Indicating Equipment.

(a) Figure 64 shows a block diagram of the principle circuit components for automatic azimuth indication. The equipment operates essentially as

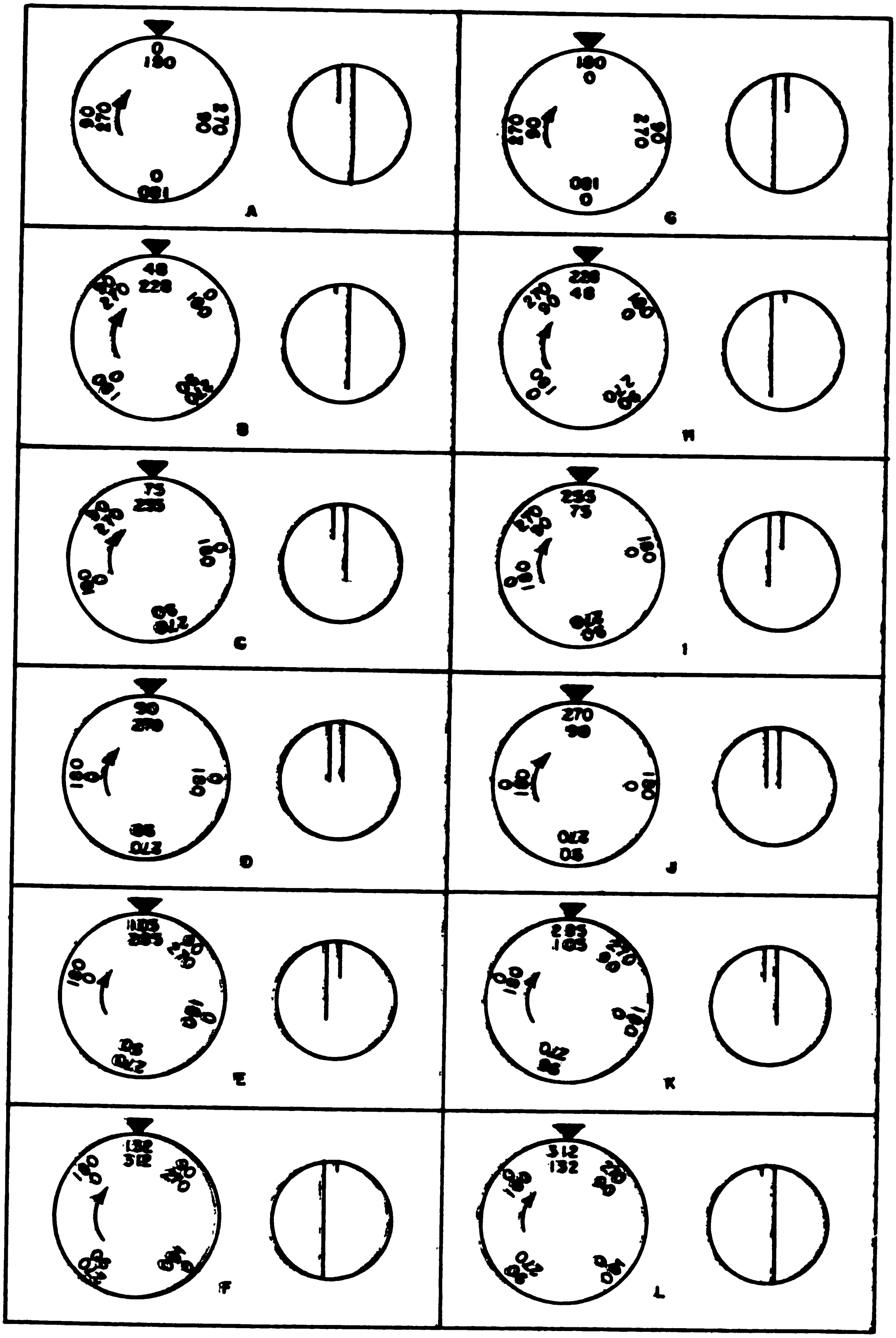

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Figure 71. Pattern variation for 360° rotation of goniometer dial for 270° bearing.

an automatic curve tracer, continually plotting the response characteristics for a given received signal. It is designed to plot the figure of eight and cardioid polar diagrams with respect to a zero reference circle, rather than from the zero reference point, used in the diagrams of figures 62 and 63. The resulting curves or patterns appearing on the cathode-ray indicator screen (figs. 72 and 74) are reciprocals of the curves in figures 62 and 63. That is the nulls of figures 62 and 63 look like maximums in figures 72 and 74 and vice versa.

(b) Referring to figure 64, the goniometer output is amplified by an r-f amplifier in the directional channel of the receiver, shifted in phase 90°, and applied to the mixer amplifier. The sense antenna output is amplified in the receiver sense channel and combined with the amplified goniometer response in the mixer amplifier, when required for sense. The output of the mixer amplifier is rectified and applied to the grid of a d-c amplifier. The plate current from the d-c amplifier flows through a pair of deflection coils which are mounted so the resulting magnetic field is always perpendicular to the axis of the cathode-ray tube. The magnitude of the d-c amplifier plate current through the deflection coils is adjusted, by proper bias at *zero* signal, so that the resulting magnetic field through the cathode-ray tube deflects the spot to the edge of the screen. As the deflection coils are rotated about the axis of the tube the spot follows around the edge of the screen to form the zero signal or circular trace (fig. 72).

(c) The rectified receiver output is properly polarized so as to bias the d-c amplifier toward cut-off and reduce the deflection coil current. This reduces the deflecting magnetic field and allows the cathode-ray tube spot to move back toward the center of the screen. Therefore, any signal, whether from the goniometer

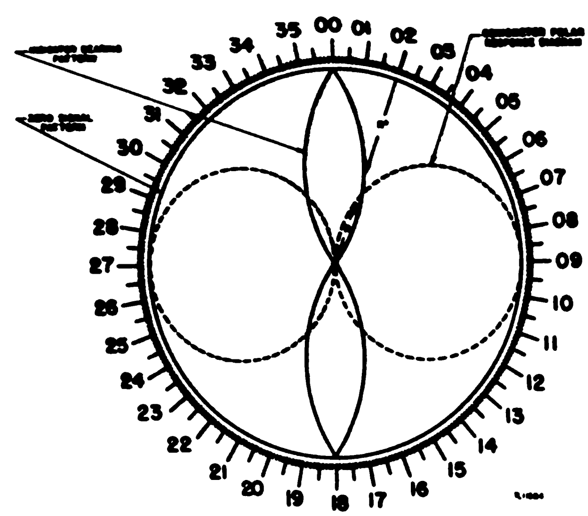


Figure 72. Indicator azimuth pattern corresponding to the figure eight crossed U-Adcock and goniometer response characteristics.

or sense channels, will deflect the cathode-ray tube spot toward the center of the screen by an amount proportional to the magnitude of the signal. The indicator patterns are then produced by driving the goniometer rotor and deflection coils by a common motor.

(3) Azimuth Pattern.

(a) The azimuth pattern is obtained by setting the SEARCH-INSTANT. BEARING-SENSE switch to INSTANT.BEARING. This connects the bearing deflection coils to the d-c amplifier output and disconnects the sense channel output from the mixer amplifier. The goniometer response, and hence the deflecting field of the deflection coils, varies with rotation as shown by the dotted figure of eight curve in figure 72. At the goniometer nulls, 0° and 180° in this figure, the receiver output is zero and the cathode-ray tube spot is at the edge of the screen. As the goniometer rotor and the deflection coils are turned from the nulls, the receiver output and bias on the d-c amplifier increases. This reduces the deflecting field and causes the cathode-ray tube spot to move toward the center of the screen as it rotates. For example in figure 72, at 20° of

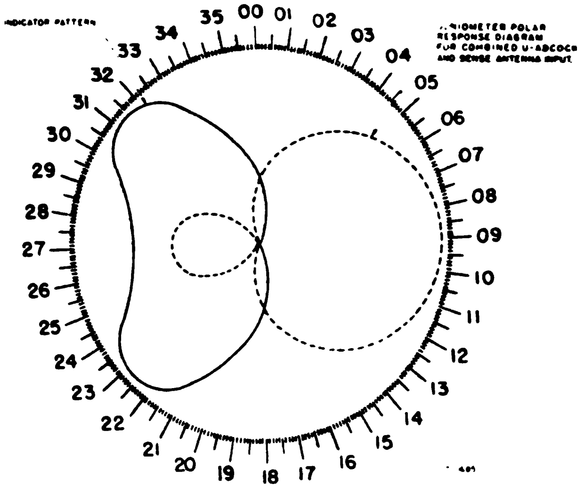


Figure 73. Indicator pattern corresponding to cardioid response diagram, as it would be traced by the bearing deflection coils.

rotation the goniometer response is R and the cathode-ray spot is deflected R' from the edge of the screen toward the center.

(b) The ends of the azimuth pattern, therefore, correspond to the goniometer nulls, while the center points correspond to the maximums. With keyed signals the azimuth and zero signal or circular pattern are traced alternately.

(4) Sense Pattern.

(a) The sense pattern is obtained by combining the sense and directional channel outputs in the mixer amplifier (fig. 64). The receiver response then varies as shown by the dotted curve in figure 73. The solid curve is the corresponding indicator pattern which would be traced if the d-c amplifier were still connected to the bearing deflection coils. However, this orientation of the pattern is not practical for sense determination. Figure 74 shows the actual sense pattern which is obtained by rotating the pattern of figure 73 by 90°. This is done automatically when switching to SENSE by switching the d-c amplifier output to the sense deflection coils, which are advanced 90° from the bearing deflection coils (fig. 64).

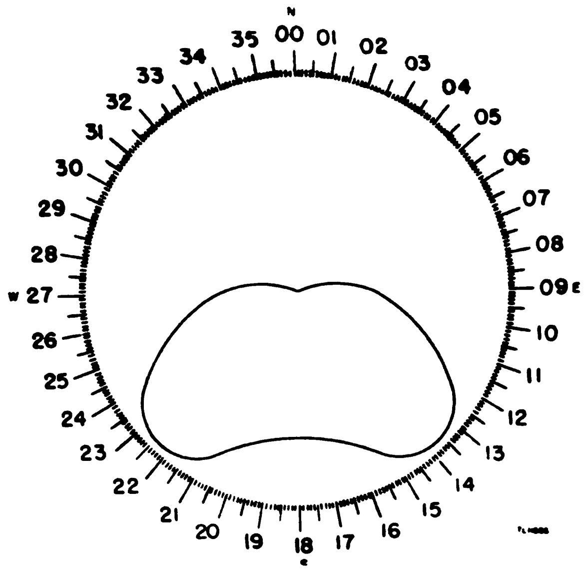


Figure 74. Sense pattern (figure 73 rotated 90°) traced by sense deflection coils which are advanced 90° from the bearing deflection coils.

(b) Observe that the sense pattern (fig. 74) is off center on the screen but is symmetrical with respect to the axis of the azimuth pattern of figure 72. All connections are phased so that the sense pattern lies opposite the end of the azimuth pattern which corresponds to the direct transmitter azimuth. This relationship between the azimuth and sense patterns is easy to remember because it is similar to the corresponding relationship between the head and tail of an arrow. That is, the head of the arrow points to the direct transmitter azimuth and the tail to the reciprocal azimuth, or the azimuth of the receiving station with respect to the transmitter

(c) Figure 75 shows the succession of azimuth and sense patterns, for a 0° direct transmitter azimuth, as the SEARCH-INSTANT. BEARING-SENSE switch is alternately switched from INSTANT. BEARING to SENSE. The sense pattern is shown dotted in figure 75 to emphasize that the two patterns are not obtained simultaneously on the indicator screen.

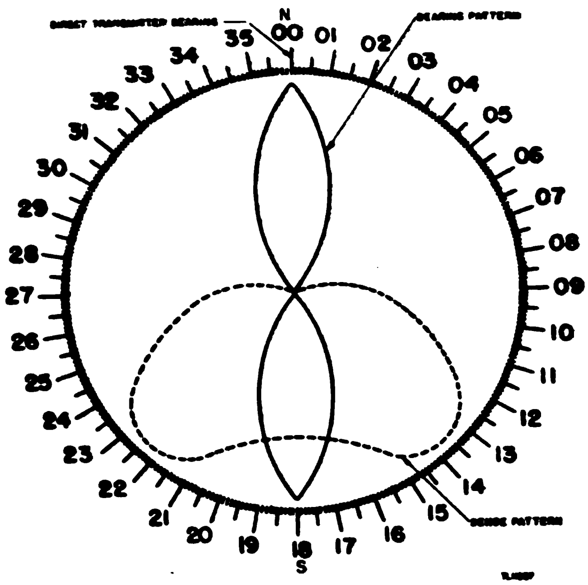


Figure 75. Composite view of the azimuth and sense patterns of figures 72 and 74 show their arrow-head and tail relationship gives the direct transmitter bearing.

94. RADIO SET AN/CRD-2.

Figure 2 shows a block diagram of the major operating components of this direction finding system, whose over-all functional principles were described in paragraph 93. Functional descriptions of the components are treated in the following paragraphs.

95. ANTENNA ARRAY.

a. **General.** The antenna array consists of a stationary crossed U-Adcock system whose component antennas are located at the corners of a square, 180 feet on the diagonal; and a centrally located sense antenna. The Counterpoise MX-318/CRD-3 ground mat system, Phase Inverters MC-411-A and MC-413-A, h-f Cords CD-829 and CD-1020, Power Cords CX-402/CRD-3; and Junction Boxes JB-91-A must also be considered functionally as a part of the antenna array, whose characteristics determine the direction of arrival of the radio waves.

b. **Antenna Assembly AS-204/CRD-3.** Antenna Assembly AS-204/CRD-3 consists of a nine-section mast approximately 64 feet high. The mast is supported on a swivel type steel base, and a guy rope and chain assembly together with a stake type ground anchor forms an effective hold-down system for each mast.

c. **Counterpoise MX-318/CRD-3.** Counterpoise MX-318/CRD-3 consists of a 32-foot square meshwork of copper braid conductors connected at right angles to each other and fastened together with dot fasteners. One counterpoise assembly is placed under each antenna monopole to insure a uniform electrical ground return. The counterpoise system reduces ground losses characteristic of poor and variable soil conductivities of a natural ground.

d. **Phase Inverters MC-411-A and MC-413-A.** Phase inverter type coupling units are used between the component antennas and h-f transmission lines. This type of coupling unit insures uniform energy transfer over the frequency range of the equipment

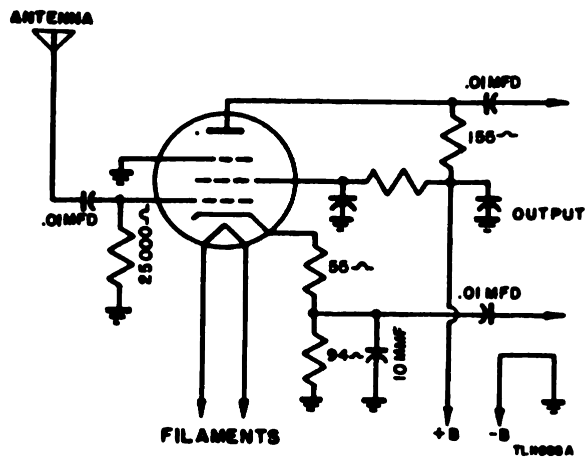


Figure 76. Functional diagram of Phase Inverter MC-411-A less spare tube. Phase Inverter MC-413-A consists of two single inverter circuits with inputs in parallel.

since it is aperiodic in operation. It also provides optimum impedance matching, independent of frequency, between the unbalanced antenna outputs and the balanced h-f transmission lines. Figure 76 shows a simplified functional diagram of the circuit of

Phase Inverter MC-411-A used for the component antennas of the U-Adcock array. Phase Inverter MC-413-A is essentially two inverter circuits of the type shown in figure 76 with inputs connected in parallel. The two MC-413-A phase inverter outputs are identical but independent. Only one of these outputs is used in Radio Set AN/CRD-3. The unused receptacle is covered with a metal cap. The inverter tune control grid No. 1 of figure 76 is connected through a 0.01-mf capacitor to the antenna through the mounting collar and the antenna output voltage is developed across the 25,000-ohm grid resistor. The output of the inverter tube is divided between the plate and cathode circuits, using carefully matched components to insure a balanced output to the transmission line. A 10-mmf silver mica capacitor is shunted across the 94-ohm tap of the cathode resistor to compensate for unequal phase shifts through the inverter tube because of interelectrode capacities. The complete circuit diagrams for Phase Inverters MC-411-A and MC-413-A are shown in figures 77 and 78 respectively. Phase Inverter MC-411-A has two loktal type JAN-7V7 hi-mu pentodes connected in parallel except for the filaments: one for use and one for spare. The tubes require 250-volt d-c plate voltage and 6.3-volt a-c filament voltage. The relay in the plate circuit of MC-411-A grounds the antenna when the plate voltage is turned off. Since Phase Inverter MC-413-A is equivalent to two single inverters, it has two pairs of tubes, with each pair connected in parallel. As before one tube of each pair is a spare. Dismantled views of Phase Inverters MC-411-A and MC-413-A are shown in figures 5 and 6 respectively. The No. 1 and 2 fila-

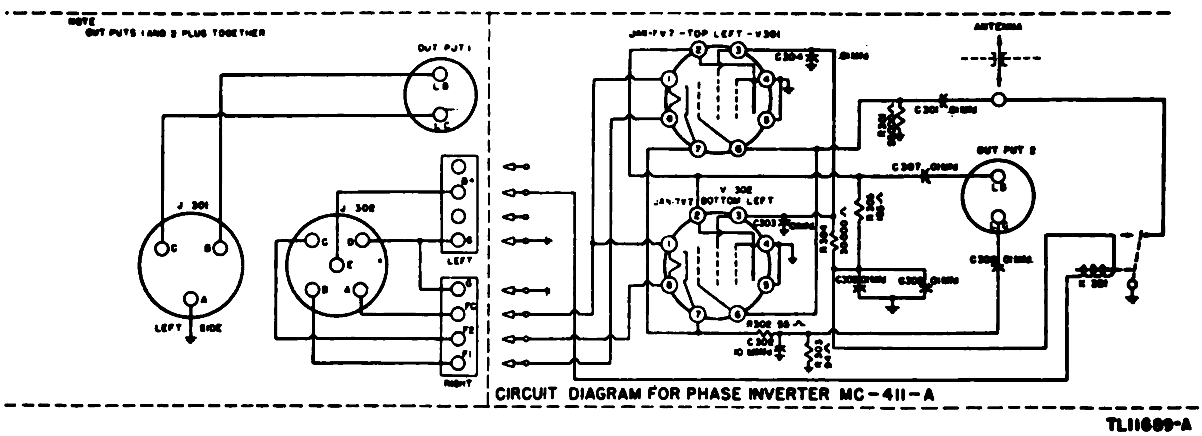


Figure 77. Circuit diagram of Phase Inverter MC-411-A.

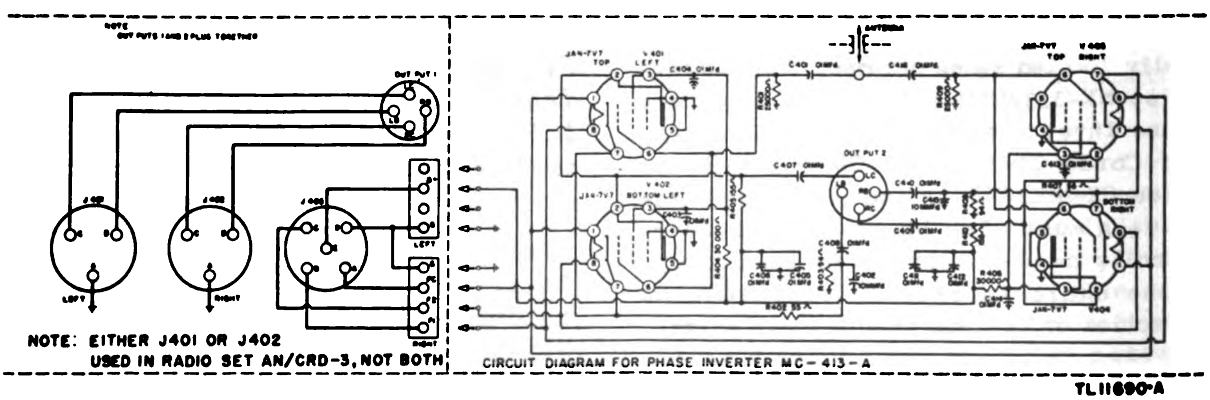


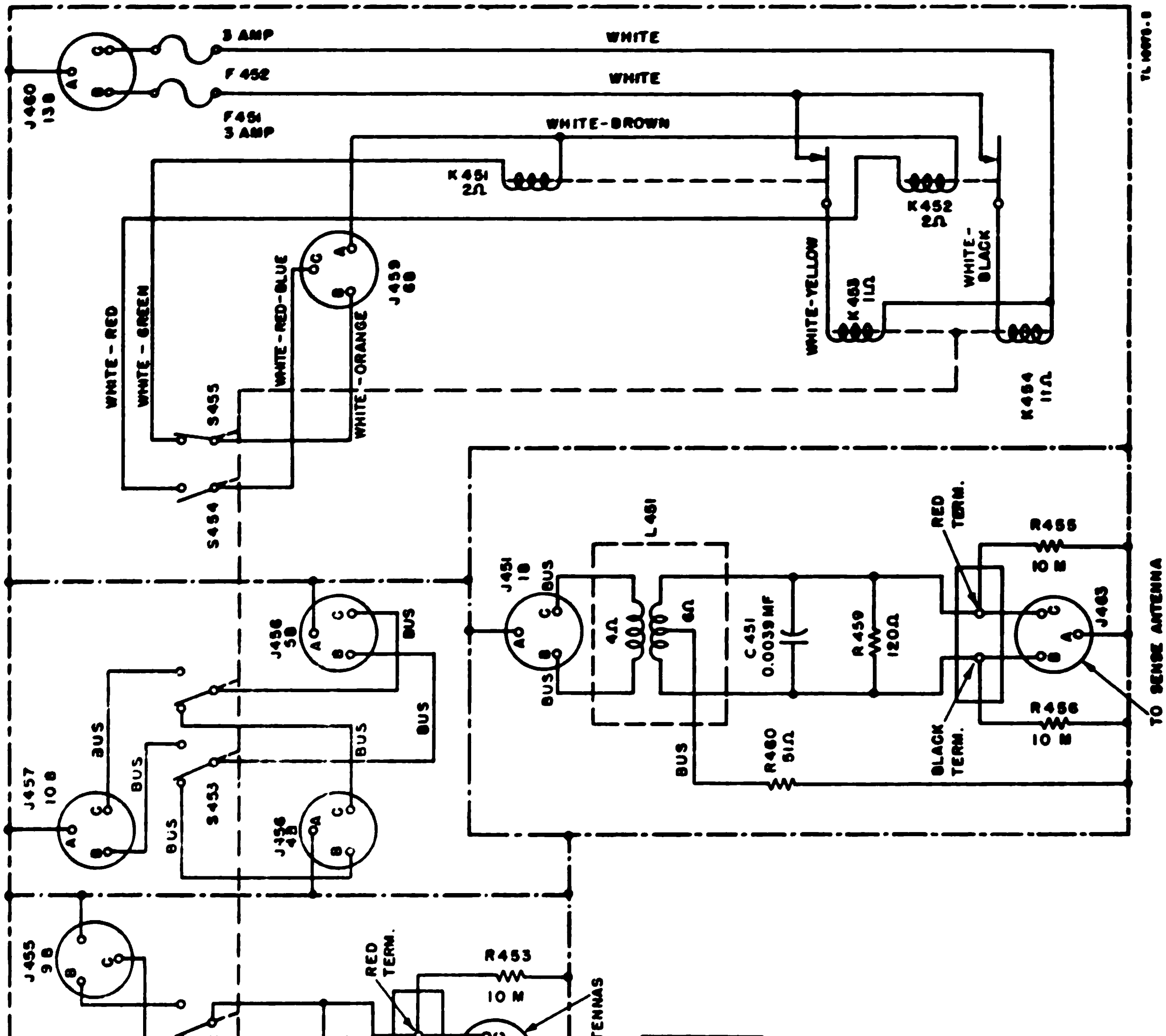
Figure 78. Circuit diagram of Phase Inverter MC-413-A.

ments of all phase inverters are connected in parallel to separate lines, either one of which may be switched to the filament supply by the filament switch on the panel of Control-Rectifier Power Unit PP-135/CRD-3. In the event of tube failure in any of the phase inverters, operation may be immediately resumed by switching the filament supply to the spare tubes.

e. High-frequency Transmission Cords CD-829 and CD-1020. These cords are of the shielded twin coaxial type. Cords CD-829 are approximately 92 feet long after adjustment to identical electrical lengths (same over-all phase shift and attenuation characteristics). Cords CD-1020 are approximately 40 feet long, and are also adjusted to identical electrical lengths. This insures the proper functioning of the direction finding equipment which depends upon unaltered, relative phase relationships of the component antenna voltages over the transmission line network. The output of Cord CD-829, connected to the north antenna, is combined in phase opposition by means of Junction Box JB-91-A to the output of Cord CD-829, which is connected to the south antenna. Cords CD-829, which connect to the east and west antennas, are connected in the same manner. Cords CD-1020 connect the outputs of Junction Boxes JB-91-A and sense Phase Inverter MC-413-A to Junction Box J-99/CRD-3, which in turn connects to the goniometers and receiver sense channel respectively. The necessary phase shift to compensate for the difference in r-f cable length between the directional and sense antenna cables is obtained by means of a 0.0039-mf capacitor, which is connected across the sense input terminals in Junction Box J-99/CRD-3.

96. JUNCTION BOX J-99/CRD-3.

The r-f cables from the antenna system and from the receiver and indicator goniometers connect to Junction Box J-99/CRD-3. An electrically operated rotary switch inside the junction box switches antenna and goniometer circuits for the several modes of operation of Radio Set AN/CRD-3. Shields separate the junction box into five individual compartments: one for each directional circuit, one for the goniometer output circuits, one for the sense circuit, and one for the switch operating circuit and its components. A knob on the end of a switch shaft extension on one side of the junction box permits manual operation of the switch, if required. A 10,000-ohm resistor is connected to ground from the color-coded terminals for each leg of the antenna r-f transmission lines. These resistors (R451, R452, R453, R454, R455, and R456) act as leaks for static charges collected by the directional and sense antennas. Three 120-ohm resistors (R457, R458, and R459), one across each of the dual lines, reduce peaks and assure a more uniform output from the lines over the frequency range of the equipment. The individual set of three resistors for each junction box are selected within very close tolerances to provide uniform impedance and voltage characteristics among the lines. A dummy-goniometer circuit consisting of an r-f transformer (L451) and a resistor (R460) in the sense antenna circuit simulates the electrical constants of the goniometer, in that it reflects the same impedance to the receiver sense channel as the goniometer does to the receiver directional channel. Capacitor C451 provides the proper sense antenna output voltage phase shift. Figure 80 shows the switching circuits. Sections S451 and S452 of the rotor switch connect the E-W and N-S inputs to the receiver or indicator goniometer and section S453 connects the output of the goniometer used to the receiver directional input channel. The rotor switch is operated electrically by solenoids K453 and K454. These solenoids operated by alternating current connect to the power lines through receptacle J46C.



PIN	J451 TO J101	J452 TO J107	J453 TO J851	J454 TO J108	J455 TO J852
A	GROUND	GROUND	GROUND	GROUND	GROUND
B	SENSE	STATOR	STATOR	STATOR	STATOR
C	SENSE	STATOR	STATOR	STATOR	STATOR

PIN	J456 TO J109	J457 TO J853	J458 TO J102	J459 TO J105	J460 TO J208
A	GROUND	GROUND	GROUND	RELAY	GROUND
B	ROTOR	ROTOR	DIRECTIONAL	A-B1	AC
C	ROTOR	ROTOR	DIRECTIONAL	C-R1	AC

PIN	J461	J462	J463
A	GROUND	GROUND	GROUND
B	DIRECTIONAL	DIRECTIONAL	SENSE
C	DIRECTIONAL	DIRECTIONAL	SENSE

NOTE: ⊣⊢ IS SYMBOL FOR FIXED CAPACITOR
M = 1,000 Ω.

Figure 79. Schematic diagram of Junction Box J-99/CRD-3.

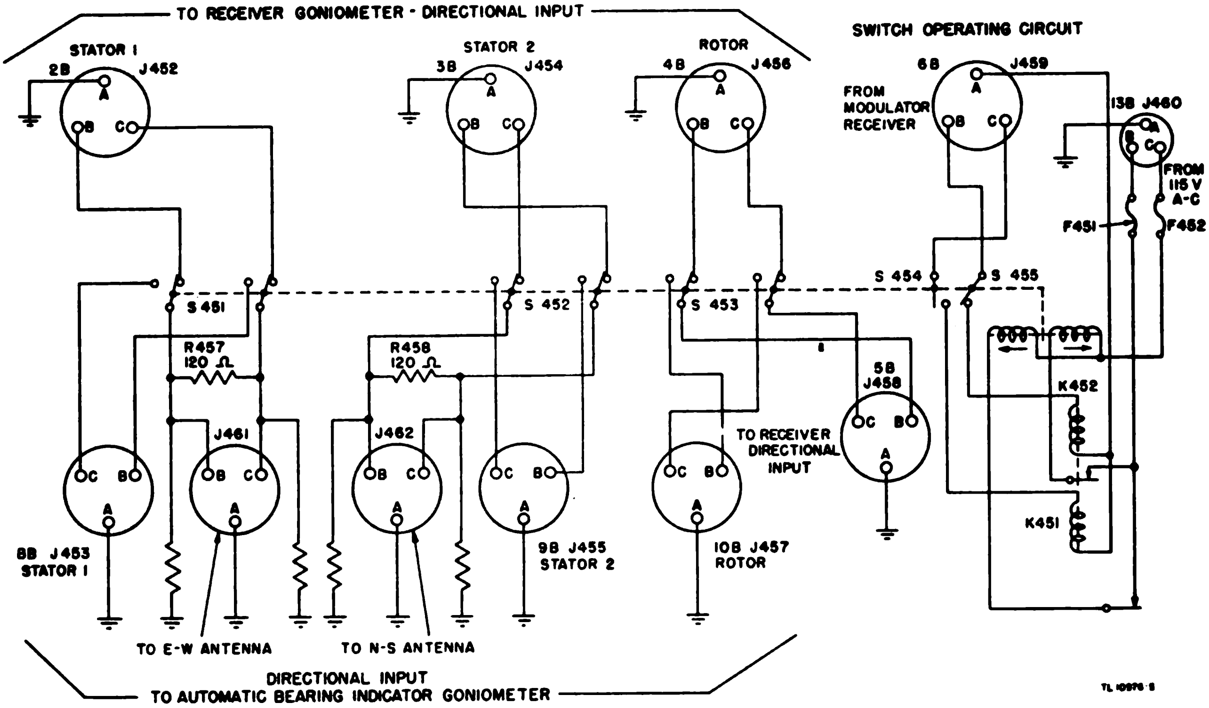


Figure 80. Switching circuit of Junction Box J-99/CRD-3.

Remote operation from the INDICATION switch in the receiver is accomplished by means of relays K451 and K452. Microswitches S454 and S455 disconnect the relays after each operation is completed. The a-c input to the junction box is suitably fused.

97. GONIOMETER CFT-47372.

Goniometer CFT-47372 has been described mechanically in paragraph 5c and its functional operation has been outlined in paragraph 92e. A schematic is shown in figure 81. Referring to this diagram the directional or crossed U-Adcock inputs are introduced at receptacles J-851 and J-852. They are connected to two mutually perpendicular stator windings No. 1 and No. 2 respectively. A rotor winding coupled to the two stator windings is connected to a second rotor winding or rotor primary of the output transformer. The secondary of this transformer is connected to output receptacle J853. The coupling between the rotor primary and secondary windings is inde-

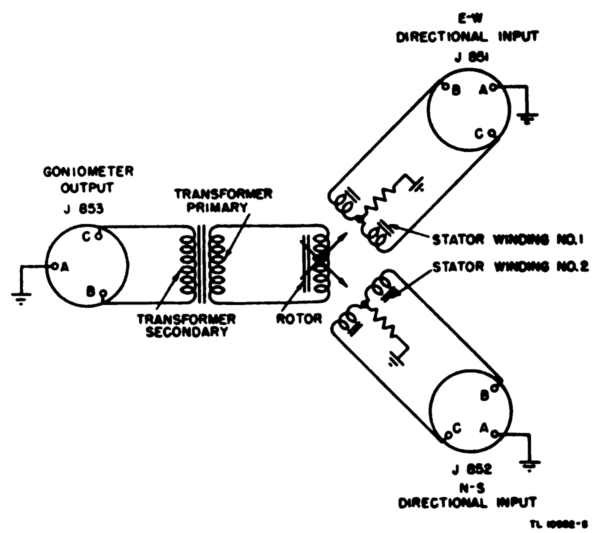


Figure 81. Circuit diagram of Goniometer Navy No. CFT-47372.

pendent of rotor position. Since stator No. 1 is perpendicular to stator No. 2, the voltage it induces in the rotor winding is in phase, or 180° out of phase, with the induced voltage from stator No. 2 depending on the rotor position. The goniometer output will then alternate between zero and maximum for every 90° turn of the rotor. The zero positions relative to a fixed scale depend upon the relative magnitude and phase of the stator currents, which in turn depend upon the direction of arrival of the radio wave (par. 93e). Each stator winding is center tapped and a 51-ohm resistor connects from each stator tap to ground to provide a balanced condition so that capacitive coupling to the rotor is neutralized.

98. RADIO RECEIVER ASSEMBLY R-128/CRD-3.

a. General. The function of the receiver is to amplify and rectify the characteristic goniometer and antenna response for the indicator control circuits. It also has the conventional beat-frequency oscillator and audio circuit with loudspeaker and phone outputs. The receiver can be used independently for monitoring and has complete facilities for the matched-line and null azimuth indications. It receives and gives bearings for continuous-wave (c-w), interrupted-continuous-wave (i-c-w), or modulated-continuous-wave (m-c-w) signals and has automatic volume control for fading signals. The principal sections of the receiver in their functional relationship are shown in the block diagram of figure 82. The progress of the input signal and the high frequency and b-f-o voltages is indicated by arrows. The complete circuit diagram is shown in figures 157 and 158.

b. R-f Circuits. The radio receiver has two r-f channels: one for the directional voltage from the goniometer, the other for the sense voltage (fig. 83).

(1) Goniometer Amplifier Input. The goniometer output is fed to a tuned r-f transformer (T101) through a balanced primary winding. This voltage is ampli-

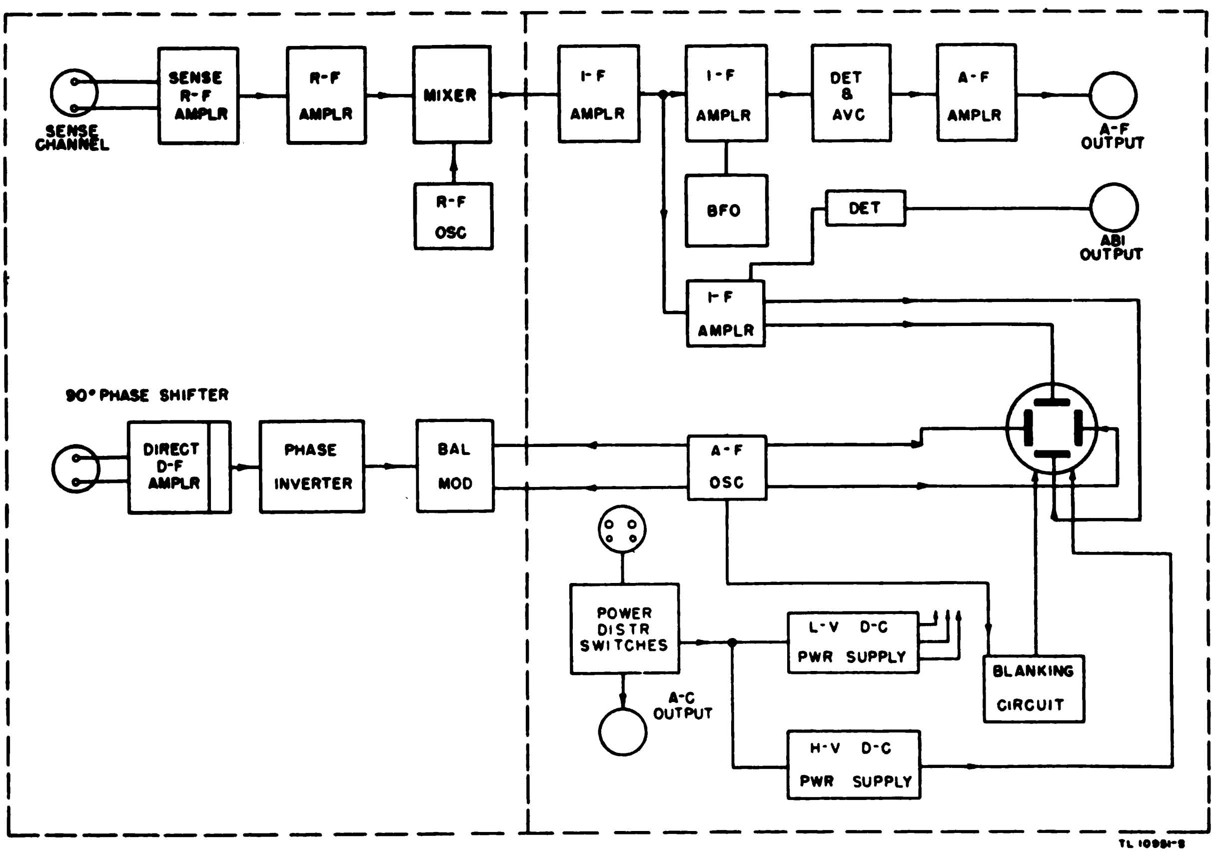


Figure 82. Block diagram of Radio Receiver Assembly R-128/CRD.

fied by goniometer channel amplifier Tube JAN-6AC7 (V106) which has a load (C131, L113, R114) that is capacitive at the operating frequencies and shifts the phase of the directional signal into proper relationship with respect to the sense voltage. The directional voltage is then impressed upon the grid of phase inverter Tube JAN-6AC7 (V-107) the output of which is balanced with respect to ground and impressed upon the grids of the balanced modulator Tubes JAN-6AC7 (V108 and V109). When INDICATION switch S107 is on manual azimuth position, the grids of the balanced modulator tubes are in push-pull and the plates are tied together in parallel. A modulating audio voltage is impressed from screen to screen through capacitors C138 and C139 so that as one screen becomes more positive, the other becomes less positive. The output of the balanced modulator under these conditions consist of the same type of voltage that would be obtained if the directional voltages were modulated by the audio and the carrier were suppressed. That is, the output of the balanced modulator consists of the upper and lower side frequencies only. When switch S107 is on instantaneous azimuth or on null position, one of the balanced modulator tubes (V109) is rendered inactive and the audio modulating voltage is removed from the screen grids. The remaining active tube (V108) acts as an r-f amplifier.

(2) Sense Channel Input. The sense channel input is fed to a tuned r-f transformer (T102) through a balanced primary winding, and is then amplified by sense channel amplifier tube V102. This voltage is then combined with the balanced modulator output. When the goniometer is on a null, and the controls set for manual azimuth indication, the output of the balanced modulator is zero. Thus, under these conditions the input to second r-f amplifier tube V102, consists of the sense voltage only. However if the goniometer is rotated off the null, a signal is fed into the balanced modulator and the two side frequencies in the output combine with the sense output from tube V102, which acts as a carrier, to form a modulated signal. The degree of modulation increases as the goniometer is further rotated off the null. The sense is open while azimuths are taken with the automatic bearing indicator and is combined with the goniometer channel voltage in order to yield an output suitable for sense determination (section X).

(3) Second R-f Amplifier. After combination of the sense and goniometer channels, the resultant is fed into tuned amplifier tube V103 through r-f transformer T103. This amplifier in conjunction with the previous tuned amplifiers insures adequate preselectivity and reduces image response to a minimum. I-f trap inductance coil L111 in the cathode circuit of tube V103 prevents signals of an intermediate frequency at the antenna from entering the i-f circuits.

(4) Sensitivity Control. The receiver sensitivity is manually controlled by variable resistors R134a and R134b (fig. 157). The gain of these stages is maintained essentially constant at any given RF GAIN control setting, by the a-v-c bias applied to the grids through their associated transformer secondaries when the AVC-MVC-CW switch is on AVC.

(5) Tuning. The r-f amplifiers, mixer, and high-frequency oscillator circuits are tuned by the corresponding sections of five-gain tuning capacitor C101. The h-f oscillator Tube JAN-6SJ7 (V110) tracks at 175 kc above the r-f amplifier and mixer circuits to produce the 175-kc intermediate-frequency output from the mixer stage, Tube JAN-6SA7 (V104).

c. A-f Oscillator. Modulation of the goniometer channel is obtained by impressing a low-frequency (100 cps) voltage upon the screen grids of the balanced modulator. The same audio voltage is impressed upon the horizontal deflection plates of cathode-ray Tube JAN-2AP1 (V-216) in the power-indicator

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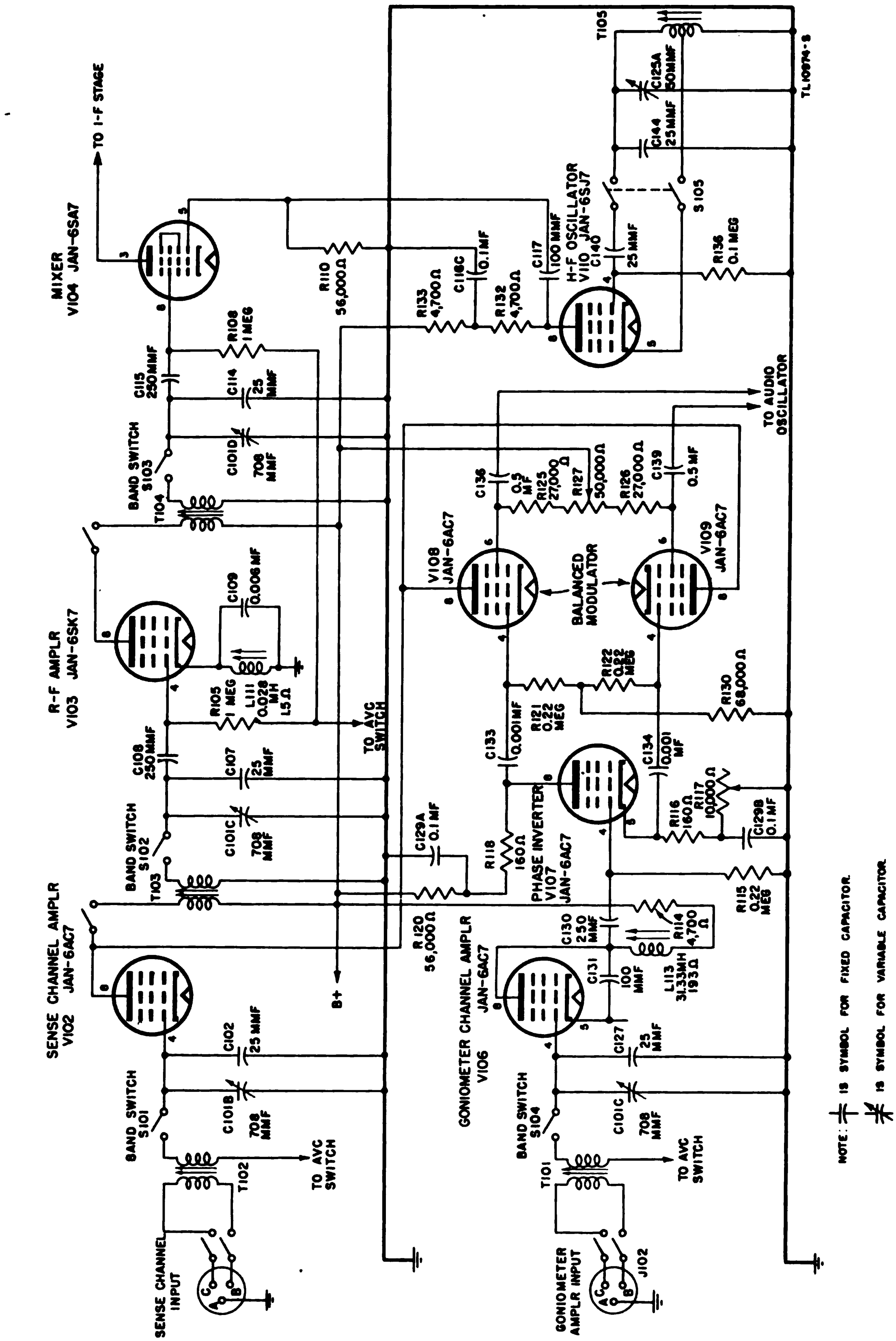

Figure 83. Functional diagram of r-f section.

section of the receiver so as to yield the pattern characteristic of the matched line system of azimuth indication. The source of this audio voltage is the low-frequency oscillator (fig. 84) consisting of Tube JAN-6SQ7 (V211) and Tube JAN-6SN7 (V212). The latter is a dual triode and only half is used with the oscillator. The oscillator is of the resistance-capacity phase-shift type employing inverse feedback (across resistor R254) to insure a high degree of voltage and frequency stability. The feedback voltage necessary for oscillation is fed from the cathode of tube V212 to the phase shift network through capacitor C237, and from there to the grid of tube V211. The frequency of oscillation is that frequency at which the total phase shift from the plate of tube V211 (through tube V212 and the phase shift network) to the grid of tube V211 is 180°.

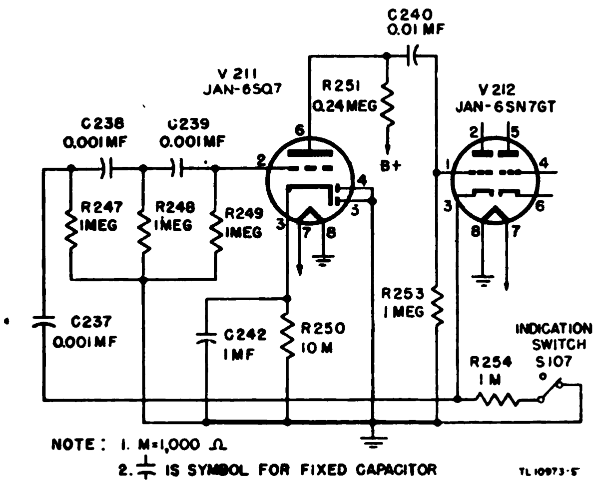

Figure 84. Functional diagram of audio-frequency oscillator.

d. I-f Amplifier. Two stages of i-f amplification are used (fig. 85). After amplification in the first stage (tube V201), the i-f signal is split into two channels: one feeds the audio channel, and the other feeds the indicator channel. This separation is required so that the beat-frequency oscillator, used for reception of c-w signals, produces an audible signal from the speaker or earphones without appearing as modulation on the azimuth patterns obtained. The degrees of selectivity (broad and sharp) are obtained

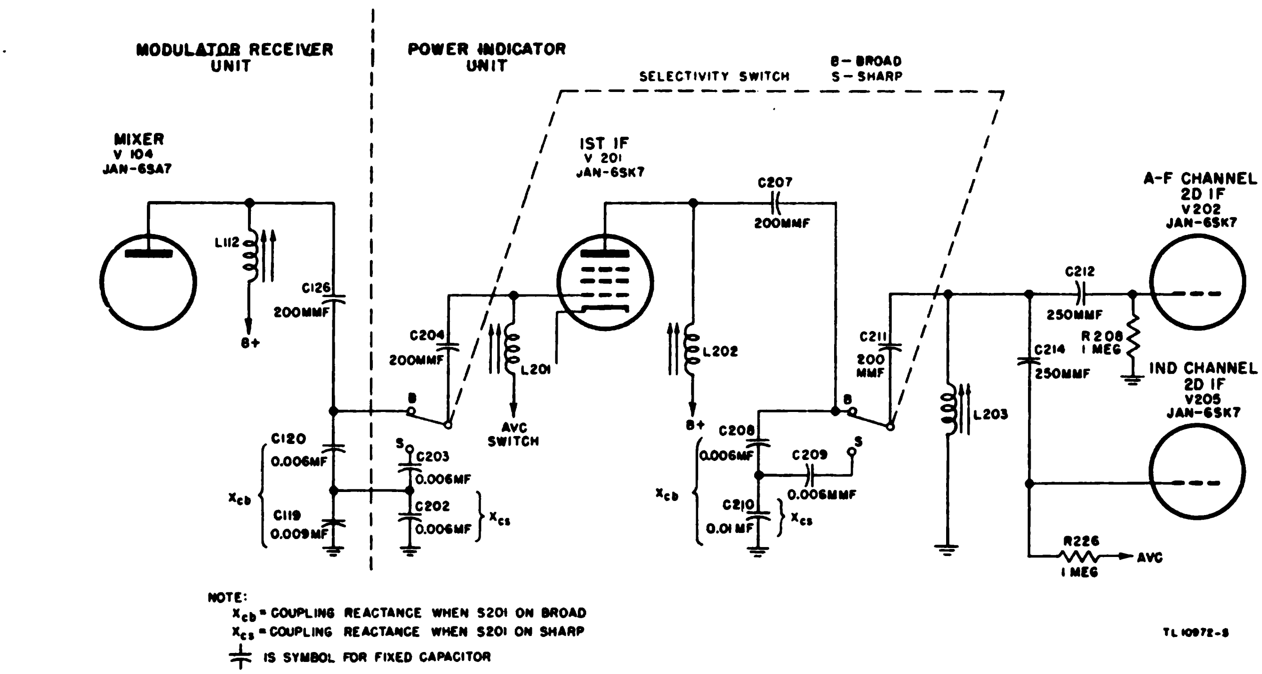

Figure 85. Functional diagram of i-f section.

by switching the coupling reactance of the interstage i-f circuits. The interstage coupling consists of two tuned circuits with part of the tuning capacitive reactance X_{cb} and X_{cs} common to both circuits. The magnitude of the coupling capacity determines the degree of coupling, which in turn determines the bandwidth or selectivity of the stage. When the selectivity control switch S201 is on BROAD the coupling reactance is X_{cb}, and when it is on SHARP, the coupling reactance is X_{cs}. Changing the selectivity does not alter the i-f tuning, since the total tuning capacity (series combination of 200 micromicrofarads (mmf), 0.006 microfarad (mf), and 0.015 mf for the first stage; and 200 mmf, 0.006 mf, and 0.01 mf for the second stage) is the same for both settings of the selectivity switch.

e. A-f Channel. The audio-frequency signal is fed from diode load resistor R213 of detector Tube JAN-6H6 (V203) (fig. 86) to the grid of cathode-follower Tube JAN-6J5 (V208). The output across cathode resistor R234 is attenuated by means of a T-pad (resistors R235, R236 and R237). This T-pad has a frequency characteristic introduced by the presence of capacitor C232 which discriminates against high audio-frequency noise voltages. The audio voltage is impressed upon the grid of a voltage amplifier Tube JAN-6SK7 (V209). After amplification it is fed to a power amplifier Tube JAN-6K6GT/G (V210). The audio output voltage is coupled to the speaker or headphones by means of output transformer T201 which has a 600-ohm winding for headphones and a 4-ohm winding for the speaker. The audio amplification is varied by means of the A.F. GAIN control R210.

f. Beat-frequency Oscillator. The beat-frequency oscillator (fig. 158) is designed to insure a high degree of frequency stability. Its operating frequency is near that of the intermediate frequency and it is coupled to the output of the second i-f stage in the audio channel, where it mixes with the i-f signal to produce a difference or audible pitch. This pitch can be varied by changing the frequency of the beat-frequency oscillator with tuning capacitor C224.

g. Cathode-ray Tube Circuits. The circuits associated with cathode-ray Tube JAN-2AP1 (V216) used for the matched-line system of azimuth indication are shown in figure 87. The audio voltage from the audio-frequency oscillator is fed to horizontal deflection plates DJ1 and DJ2 through amplifier tube V212 and capacitor C241. Potentiometer R270 controls the horizontal position of the spot. The 100 cycle-per-second (cps) modulated i-f output from the indicator channel is impressed upon the vertical plates through capacitor C228. Vertical positioning of the spot is controlled by potentiometer R264. The brilliance and focus are controlled by potentiometers R268 and R266, respectively. The center portion of the pattern is suppressed by a trigger circuit consisting of a rectifier Tube JAN-6H6 (V217) and an amplifier (half of Tube JAN-6SN7 V-212) leaving only two vertical lines. The trigger rectifier acts as a full-wave rectifier with the 100-cps input applied directly from the low-frequency oscillator through the transformer T202. The rectified pulses control the plate current of tube V212 which in turn controls bias on control electrode G1 and, therefore, the brilliance of the pattern. During the peaks of the audio wave, the rectified pulses are sufficiently high to completely blank out the tube. The degree to which the pattern is blanked out can be adjusted by blanking adjustment potentiometer R272. The blanking action can be removed entirely by the blanking switch S204 which opens the cathode circuit of the amplifier tube.

h. Voltage Supply Circuits.

(1) A-c Circuits. The a-c input to the radio receiver is introduced at receptacles J205 (fig. 158). Each input lead is shielded and fused (F203

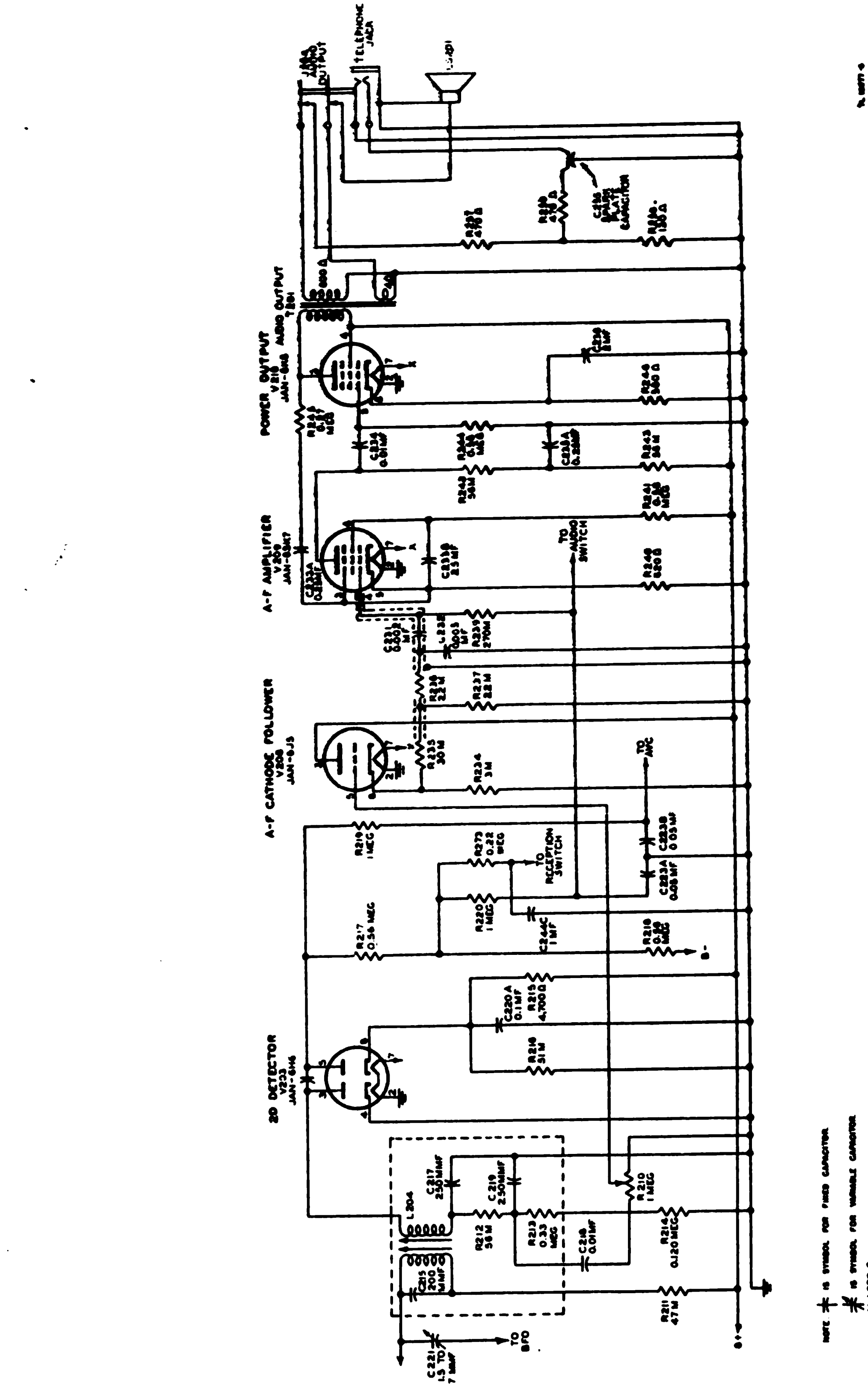

Figure 86. Functional diagram of receiver a-f section.

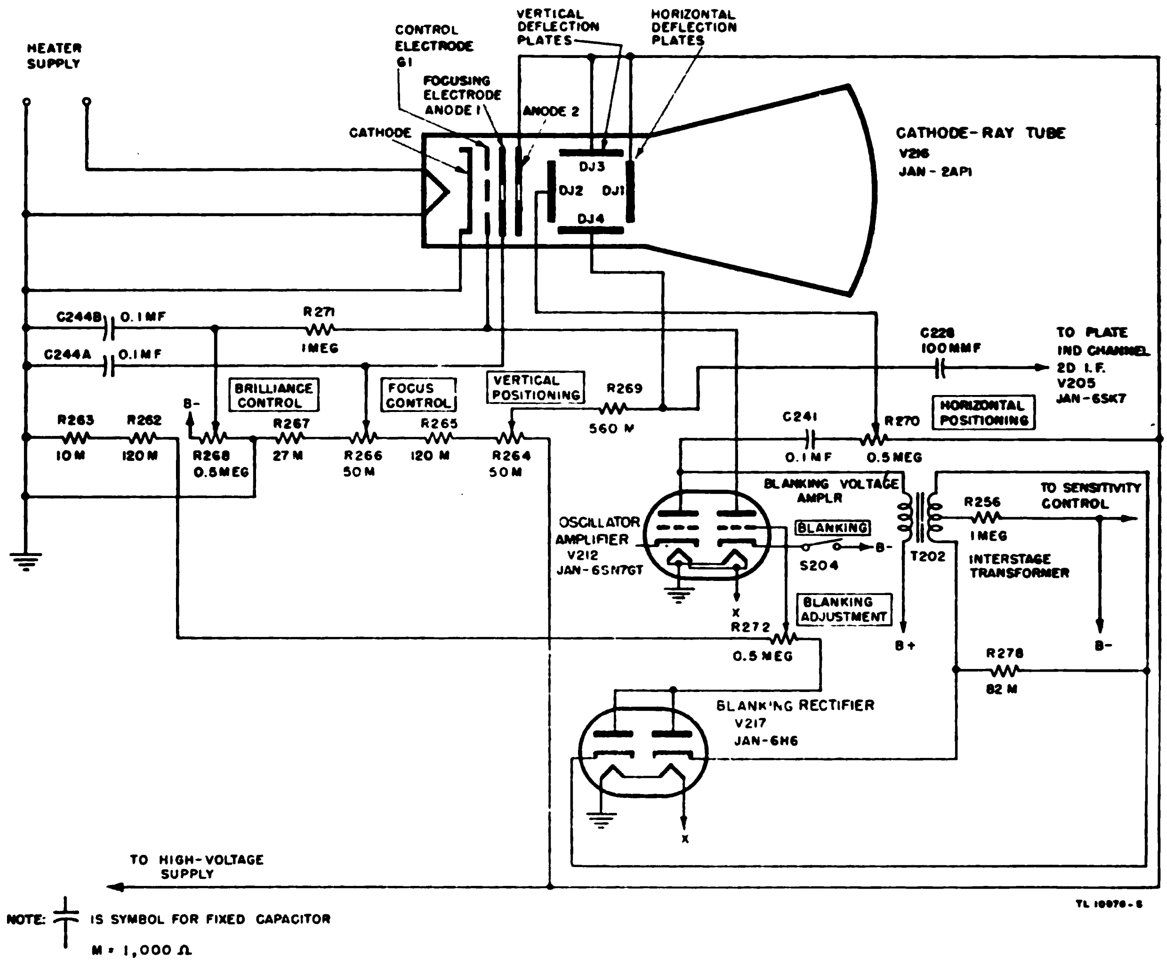

Figure 87. Cathode-ray tube controls.

and F204). A two-pole MASTER switch (S206) controls the supply to the receiver and the MOTOR, BEAM, and AMPLIFIER switches. Each of these switches, and the MASTER switch has an indicating panel lamp. Each leg of the a-c connections to receiver power transformer T203, is fused (F201 and F202) and filtered by a two-section capacity input network. Input capacitors C253 and C254 are spark plates. The primary of transformer T203 is tapped for operation on 110-, 115-, or 120-volt lines. The OFF-STANDBY-ON switch controls the a-c supply to the primary and interrupts the d-c output of the low- and high-voltage rectifiers in the OFF and STANDBY positions. The secondary of transformer T203 has five windings. One 6.3-volt winding supplies the heaters of all the 6.3 volt tubes except Tube JAN-2AP1 (V216) which has its own 6.3-volt winding. A 2.5-volt winding supplies heater voltage to Tube JAN-2X2 (V215) and a 5-volt winding to Tube JAN-5U4G (V213).

(2) Rectifier Circuits. The high-voltage winding is tapped at 400, 315, 0, 100, and 315. Three separate rectifiers are used with the radio receiver. Half-wave rectifier tube V215, connected to the 400-volt tap, supplies the high voltage to the receiver cathode-ray tube circuits. Full-wave rectifier tube V213 connected to the 315-volt tap, supplies the plate and screen voltages for the receiver circuits. Tube JAN-6H6 (V214), connected as a half-wave rectifier to the 100-volt tap, supplies bias voltage for the cathode-ray tube, the trigger amplifier, and the a-v-c return circuits.

The output voltages of these tubes have suitable filter and bleeder networks.

99. AMPLIFIER-RECTIFIER POWER UNIT PP-151/CRD-3.

a. General. Amplifier-rectifier Power Unit PP-151/CRD-3 operates from a 110- to 120-volt, 55- to 65-cycle, single-phase a-c source to provide the a-c voltages and the rectified, filtered d-c voltages required for operation of the automatic bearing indicator. The indicator deflection coil amplifier and its power supply are also included in the power unit.

b. Input. The a-c power input, from the switching circuits in the power indicator section of the radio receiver, is introduced at receptacle J405 (fig. 159). Fuses F401 and F403 protect the power connections to the primaries of the low- and high-voltage transformers T402 and T401, respectively. As a safety precaution, the return connection of transformer T401 primary is completed through receptacle J403 and a shorting bar in the automatic bearing indicator, only when both ends of Cord CX-549/CRD-3 are connected.

c. Low-voltage Supply Section. Power transformer T402 has three secondary windings. Two windings feed the plates and heaters of rectifier Tube JAN-6X5 (V402) and supplies the power to operate relay K401. The output of the rectifier is filtered by a two-section, choke input filter. Voltage regulator tube JAN-OD3/VR-150 (V404) regulates the screen supply to the deflection amplifier tube.

d. High-voltage Supply Section. Power transformer T401 has a multi-winding secondary for feeding the supply circuits of the automatic bearing indicator cathode-ray tube. The high-voltage winding supplies half-wave rectifier Tube JAN-2X2A (V403) whose output is filtered by a single-section capacitor input, resistance-capacity filter. A 2.5-volt winding supplies the heater of Tube JAN-2X2A. The third winding of transformer T401 supplies 6.3 volts for the heaters of the cathode-ray tube in the automatic bearing indicator. The output voltages to the bearing indicator connect to receptacle J404.

e. Deflection Coil Amplifier. The indicator output voltage from the radio receiver is introduced to the rectifier power unit at receptacle J401 (fig. 88). It is fed to the grid of deflection amplifier Tube JAN-6AC7 (V401) through the DEFL. SENS. control R401. CIRCLE DIA. control R403 adjusts the initial bias of the amplifier tube so that its plate current, through the automatic bearing indicator deflection coils can be set to deflect the cathode-ray tube spot to the edge of the screen. Rectified signal from the radio receiver indicator channel is polarized to bias the amplifier tube V401 toward cut-off. This reduces the plate current through the deflection coils and the cathode-ray tube spot returns toward the center of the indicator screen in proportion to the amplitude of the rectified signal.

100. BEARING INDICATOR ID-121/CRD-3.

a. General. Bearing Indicator ID-121/CRD-3 is an electromechanical unit for producing instantaneous visual azimuth and sense patterns characteristic of the antenna and goniometer outputs. Voltages from the rectifier power unit to the cathode-ray tube circuits are introduced at receptacle J501 (fig. 161). The output of the deflection amplifier and the a-c power circuits to the motor and azimuth scale lamps are introduced at receptacle J502.

b. Cathode-ray Tube Circuit. Cathode-ray Tube JAN-5NP1 (V501) with a 5-inch green screen is used in the indicator. The horizontal and vertical deflection plates of the cathode-ray tube are used only for centering the azimuth patterns on the screen. The INTENSITY (R507), FOCUS (R506), and POSITIONING (R501 and R502) controls function by varying the voltage supply to the various cathode-ray tube electrodes.

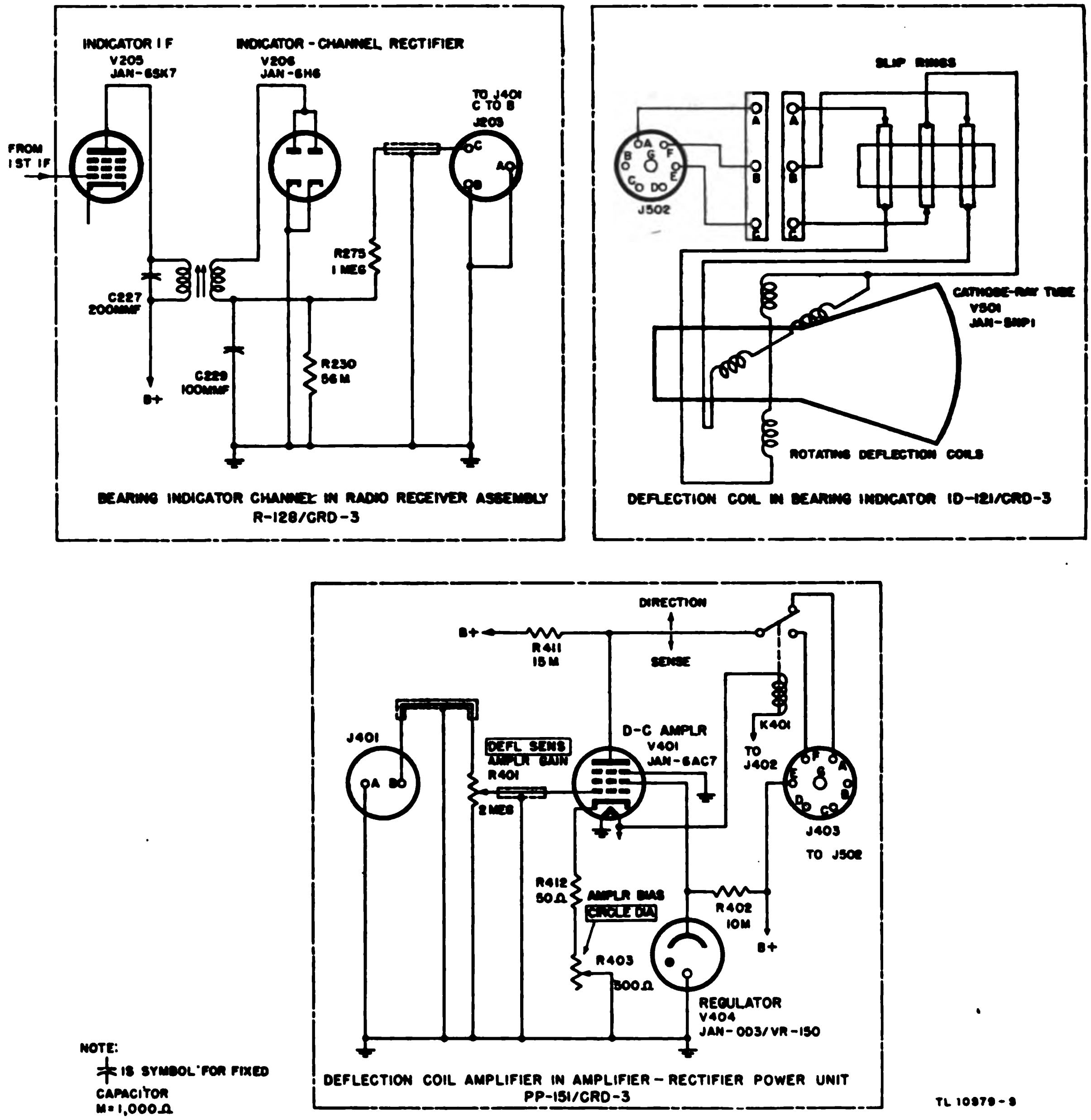

Figure 88. D-c deflection coil circuit.

c. **Deflection Coil Circuit.** The directional and sense deflection coils are connected in the plate circuit of the deflection coil amplifier for the respective azimuth bearing indication (fig. 88). Carbon brushes are used for electrical connections between the rotating and stationary circuits.

d. **Motor and Azimuth Scale Lamp Circuits.** The motor (fig. 161) is a 1/8-horsepower, single-phase, capacity-start, induction-run motor with a normal running speed of 1140 revolutions per minute (rpm). A centrifugal switch cuts out capacitor C502 when the motor has reached its operating speed. At 110 volts, the motor draws 3.2 amperes. It is designed for operation from 110 to 120 volts, 55 to 65 cycles, single-phase alternating current. The a-c input connections which supply the motor from receptacle J502 are also connected to transformer T501. The control R509 is connected in series with the four azimuth scale lamps I501, I502, I503, I504.

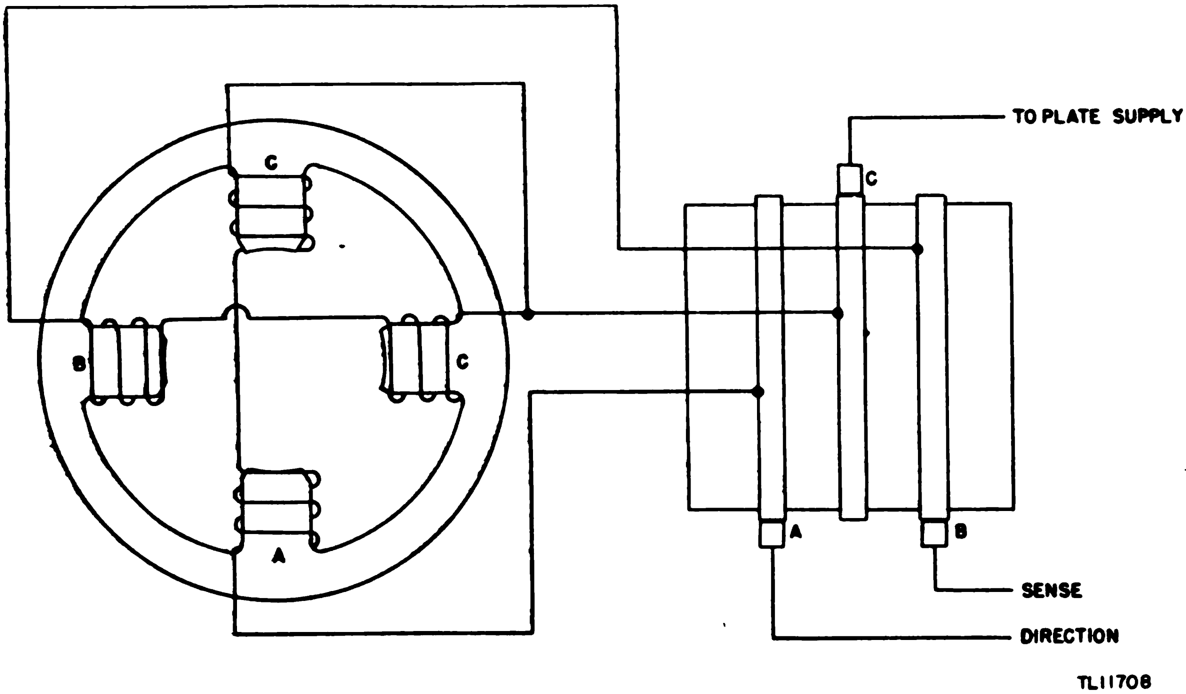

Figure 89. Indicator deflection coil circuit detail.

e. Optical System. The pattern on the cathode-ray tube screen is directly visible to the operator. The edge-lighted 350° lucite azimuth scale is positioned around the periphery of the screen. A rotatable clidade blade is provided to facilitate interpretation between the azimuth pattern and the scale.

101. CONTROL-RECTIFIER POWER UNIT PP-135/CRD-3.

a. General. Control-Rectifier Power Unit PP-135/CRD-3 serves primarily as a power supply for Phase Inverters MC-411-A and MC-413-A. It includes the phase inverter balancing circuits.

b. Input. The power input from receptacle J208 on Radio Receiver Assembly R-128/CRD-3 is introduced at receptacle J351 (fig. 160) which is in parallel with auxiliary a-c outlet receptacle J352 (AUX 115V AC) on the front panel. Switch S351 controls the power connection to the primary winding of the power supply transformer T351. Neon indicator lamp I301 protected by a 0.47-megohm resistor, lights when the ON CFF AC SWITCH is ON. Fuse F351 protects the circuits from overloads.

c. Power Supply Section. Power transformer T351 has a multiwinding secondary for feeding the supply circuits of the antenna phase inverters. The high-voltage winding (terminals 3 and 5) connect to the plates of full-wave rectifier Tube JAN-5U4G (V351) which has an output that is filtered by a two-section choke input filter incorporating Tube JAN-6L6G (V352) in a hum-bucking regulator circuit. Tube V352 functions as a variable resistance across the output of the power supply and operates within the voltage limits caused by the hum produced in the power supply. The voltage drop across resistor R352 is caused by the sum of the currents through tube V352 and the load on the power supply. This voltage is negative with respect to ground and provides control for the action of tube V352. When the output rises slightly (because of the hum component), the voltage drop across resistor R352 tends to increase and reduce the current through tube V352 because of higher grid bias. As the current through the tube decreases however, the drop across resistor R352 decreases sufficiently to maintain the voltage across the output to an essentially constant value. When the output voltage decreases slightly, the reverse actions take place. Resistor R353 in the plate circuit establishes the proper operating conditions for tube V352.

d. Control Circuits.

(1) *DF-SENSE-6°-180°-90°-270° SELECTOR SWITCH.* This is a multiple contact rotary switch which connects in meter M351 to measure the total or individual plate currents of Phase Inverters MC-411-A or the plate current of Phase Inverter MS-413-A. Regardless of what position the switch is thrown to, plate voltage is connected to all phase inverters, provided toggle switches S353 to S356 0°, 180°, 90°, and 270°) are at the ON position. This allows a constant load while measuring the various plate currents in contrast to the varying load and inaccurate readings that would be obtained if the plate currents of one phase inverter were measured by turning off the other phase inverter switches. The switching operations of S357 are as follows:

(a) *DF.* Plate voltage is connected to all phase inverters. Meter M351 is connected to measure the total plate current of the four Phase Inverters MC-411-A.

(b) *SENSE.* Plate voltage is connected to all phase inverters. Meter M351 is connected to measure the plate current in Phase Inverter MC-413-A only.

(c) *0°, 180°, 90°, or 270°.* In any of these positions, plate voltage is connected to all phase inverters. Meter M351 is connected to measure the plate current of that Phase Inverter MC-411-A corresponding to the 0°, 180°, 90°, or 270° antenna monopoles.

(2) *BALANCE ADJUSTMENT.* Resistors R355 to R358 (0°, 180°, 90°, and 270°) match the gain of the respective directional antenna Phase Inverters MC-411-A by varying the applied voltage.

(3) *SENSE GAIN.* Potentiometer R354 varies the output of sense antenna Phase Inverter MC-413-A by varying its plate voltage.

(4) *FIL SWITCH.* Switch S352 switches the heater supply voltage from one set of phase inverter tubes to the other for use in case of tube failure.

102. MODEL OAN TEST OSCILLATOR EQUIPMENT.

a. General. The Model OAN Test Oscillator equipment consists of a test oscillator (Type CFT-60054-A) unit complete with tubes, internal a-c power supply and battery pack; cable accessories and a waterproof carrying case; and a sectional type whip antenna.

b. CFT-60054-A Test Oscillator. This test oscillator (fig. 62) is of the master-oscillator, tuned-amplifier type with a fixed antenna output, and a variable 150-ohm balanced output, incorporating a constant impedance attenuator. A functional circuit of the oscillator is shown in figure 90. This output can be varied from maximum, in steps of 0.04, 0.02, 0.01, and 0.005 of maximum to zero. Zero output corresponds to the off position of the output control in which the attenuator is disconnected from the amplifier circuit. The a-c power supply and internal battery pack have separate on-off controls. The a-c control operates in the power input circuit and the battery control performs the double function of switching the oscillator amplifier circuits from the a-c power-supply outputs to the batteries and vice versa. When the battery power is on, the output of the a-c supply is disconnected and cannot deliver power whether energized or not. the BATT. switch *must* be OFF when a-c operation is desired. Turn ON only the control which corresponds to the type of operation required: a-c or battery. Tubes JAN-6SK7 are normally supplied for the oscillator amplifier circuits. For increased battery life Tubes JAN-6SS7 are recommended, since the total heater current required by them is 0.3 amperes, where Tubes JAN-6SK7 require 0.6 amperes. The unit operates

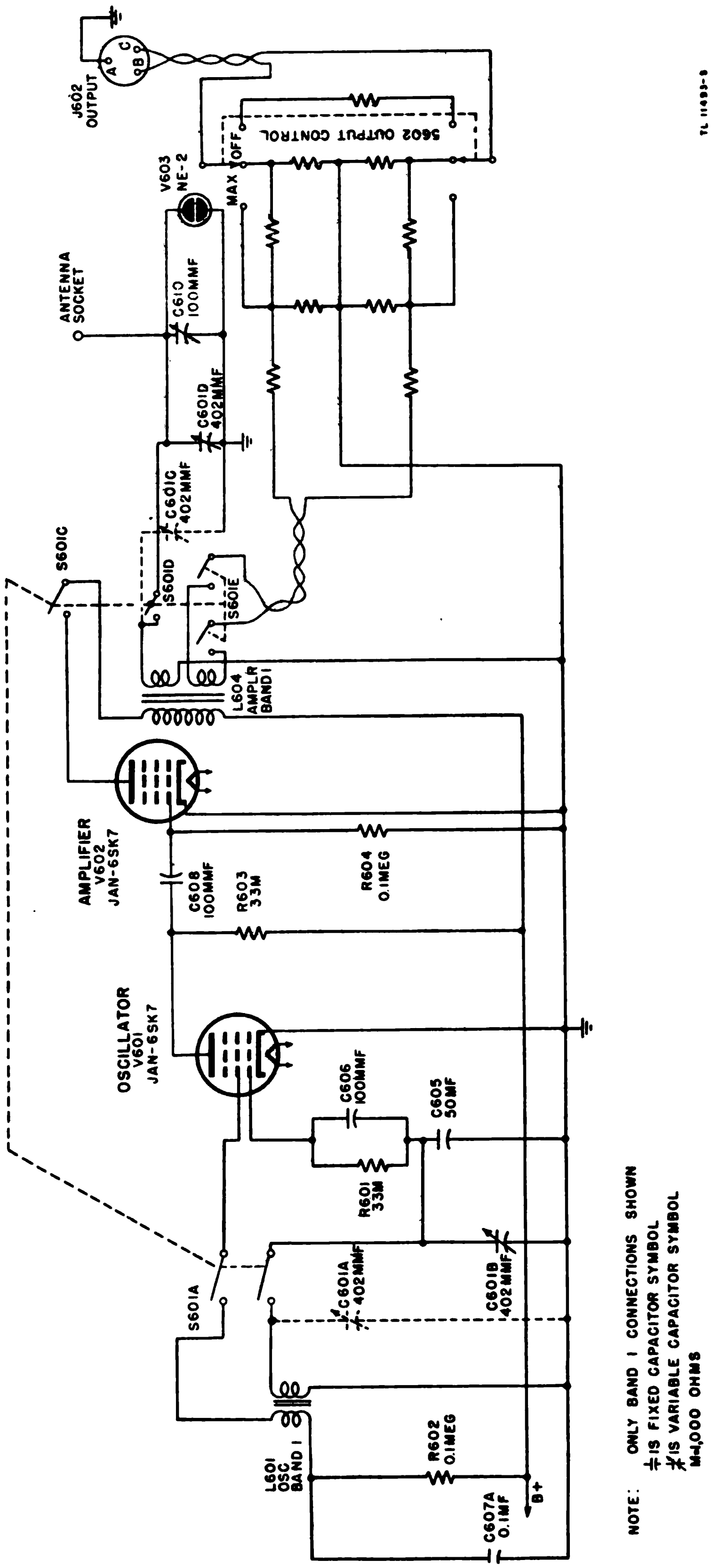

Figure 90. Functional diagram of oscillator-amplifier in OAN test oscillator.

equally well with either type. The tube sockets are labeled fot both type of tubes.

SECTION XI

TROUBLE SHOOTING

103. GENERAL TROUBLE-SHOOTING INFORMATION.

No matter how well equipment is designed and manufactured, faults occur in service. When such faults occur, the repairman must locate and correct them as rapidly as possible. This section contains general information to aid personnel engaged in the important duty of trouble-shooting.

a. Trouble-shooting Data. Take advantage of the material supplied in this manual to help in the rapid location of faults. Consult the following trouble-shooting data when necessary:

(1) Block diagram of Radio Set AN/CRD-3 (fig. 2).

(2) Complete schematic diagrams.

(3) Simplified and partial schematic diagrams. These diagrams are particularly useful in trouble shooting, because the repairman can follow the electrical functioning of the circuits more easily than on the regular schematics, thus speeding trouble location.

(4) Voltage and resistance data for all socket connections.

(5) Illustrations of components. Front, top, and bottom views which aid in locating and identifying parts.

(6) Pin connections. Pin connections on sockets, plugs, and receptacles are numbered or lettered on the various diagrams.

(a) Seen from the bottom, pin connections are numbered in a clockwise direction around the sockets. On octal sockets the first pin clockwise from the keyway is the No. 1 pin.

(b) Plugs and receptacles are numbered on the side to which the associated connector is attached. To avoid confusion, some individual pins are identified by letters which appear directly on the connector.

b. Trouble-shooting Steps. The first step in servicing a defective radio set is to sectionalize the fault. Sectionalization means tracing the fault to the component or 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 part responsible for the abnormal condition. Some faults such as burned-out resistors, and shorted transformers can be located by sight, smell, and hearing. The majority of faults, however, must be located by checking voltage and resistance.

c. Sectionalization. Careful observation of the performance of the radio set while turning the equipment on often sectionalizes the fault. Additional sectionalizing of the fault will be discussed in paragraph 110.

d. Localization. Paragraph 110 describes the method of localizing faults within the individual components. This paragraph is accompanied by trouble-shooting charts which list abnormal symptoms and their probable causes. The charts also give the procedure for determining which of the probable locations of the fault is the exact one. In addition, there are a number of drawings which show the resistance and voltage at every socket pin connection.

e. Voltage Measurements. Voltage measurements are an almost indispensable aid to the repairman, because most troubles either result from abnormal voltages or produce abnormal voltages. Voltage measurements are taken easily, because they are always made between two points in a circuit and the circuit need not be interrupted.

(1) Unless otherwise specified, the voltages listed on the voltage charts are measured between the indicated points and ground.

(2) Always begin by setting the voltmeter on the highest range so that the voltmeter will not be overloaded. Then, if it is necessary to obtain increased accuracy, set the voltmeter to a lower range.

(3) In checking cathode voltage, remember that a reading can be obtained when the cathode resistor is actually open. The resistance of the meter may act as a cathode resistor. Thus, the cathode voltage may be approximately normal only as long as the voltmeter is connected between cathode and ground. Before the cathode voltage is measured, make a resistance check with a cold circuit to determine whether the cathode resistor is normal.

f. Precautions Against High Voltage. Certain precautions must be followed when measuring voltages above a few hundred volts. High voltages are dangerous and can be fatal. When it is necessary to measure high voltages, observe the following rules:

(1) Connect the ground lead to the voltmeter.

(2) Place one hand in your pocket. This will eliminate the possibility of making accidental contact with either ground or another part of the circuit thus causing the electricity to travel from one hand to the other.

(3) If the voltage is less than 300 volts, connect the test lead to the hot terminal (which may be either positive or negative with respect to ground).

(4) If the voltage is greater than 300 volts, shut off the power, connect the hot lead, step away from the voltmeter, turn on the power, and note the reading on the voltmeter. Do not touch any part of the voltmeter, particularly when it is necessary to measure the voltage between two points which are above ground.

g. Voltmeter Loading. Voltmeter resistance must be at least 10 times as large as the resistance of the circuit across which the voltage is measured. If the voltmeter resistance is merely equal to the circuit resistance, the voltmeter will indicate a voltage *lower* than the actual voltage present when the voltmeter is removed from the circuit.

(1) The resistance of a voltmeter on any range can be calculated by this simple rule: Resistance of the voltmeter equals its ohms per volt multiplied by the full-scale range in volts. For example: The resistance of a 1,000-ohm-per-volt meter on the 300-volt range is 300,000 ohms (R = 1,000 ohms per volt times 300 volts = 300,000 ohms).

(2) To minimize voltmeter loading in high-resistance circuits, use the highest voltmeter range. Although only a small deflection will be obtained (possibly only 5 divisions on a 100-division scale), the electrical accuracy of the voltage measurement will be increased. The decreased loading of the voltmeter will more than compensate for the visual inaccuracy which results from reading only a small deflection on the voltmeter scale.

(3) Close observation of the meter when switching voltage ranges will show if the voltmeter is loading the circuit under test.

(a) Extremely heavy loading is indicated when the deflection of the pointer on the meter (not the voltage reading) is nearly the same for different ranges.

(b) Appreciable loading is indicated when the voltage readings (not the deflection) for different ranges do not agree.

(c) Negligible loading is indicated when the voltage readings (not the deflection) for different ranges do agree.

(4) The ohm-per-volt sensitivity of the voltmeter used to obtain the readings recorded on the voltage and resistance charts in this manual is printed on each chart. Use a meter having the same ohm-per-volt sensitivity. Otherwise it may be necessary to consider the effect of loading.

104. RESISTANCE MEASUREMENTS.

a. Normal Resistance Values. When a fault develops in a circuit, its effect very often shows up as a change in the resistance values. To assist in the localization of such faults, trouble-shooting data includes the normal resistance values as measured at the tube sockets and at key terminal points. These values are measured between the indicated points and ground unless otherwise stated. It is often desirable to measure the resistance from other points in the circuit in order to determine whether the particular points in the circuit are normal. The normal resistance values at any point can be determined by referring to the resistance values shown in the schematic diagram or by the use of the resistor color code (fig. 134).

b. Precautions.

(1) Before making any resistance measurements, turn off the power. An ohmmeter is essentially a low-range ammeter and battery. If the ohmmeter is connected to a circuit which already has current flowing in it, the needle will be knocked off scale and the meter movement may be burned out.

(2) Capacitors must always be discharged before resistance measurements are made. This is very important when checking power supplies that are disconnected from their load. The discharge of the capacitor through the meter will burn out its movement and in some cases may endanger life.

c. Correct Use of Low and High Ranges. It is important to know when to use the low-resistance range and when to use the high-resistance range of an ohmmeter. When checking the circuit continuity, the ohmmeter should be set on the lowest range. If a medium or high range is used, the pointer may indicate zero ohms, even if the resistance is as high as 500 ohms. When checking high resistances or measuring the leakage resistance of capacitors or cables, the highest range should be used. If a low range is used, the pointer will indicate infinite ohms, even though the actual resistance is less than 1 megohm.

d. Parallel Resistance Connections. In a parallel circuit, the total resistance is less than the smallest resistance in the circuit. This is important to remember when trouble shooting with the aid of a schematic diagram.

(1) When a resistance is measured and the value is found to be less than expected, make a careful study of the schematic to be certain that there are no resistances in parallel with the one that has been measured. Before replacing a resistor because its resistance measures too low, disconnect one terminal from the circuit and measure its resistance again to make sure that the low reading does not occur because some part of the circuit is in parallel with the resistor.

(2) In some cases it will be impossible to check a resistor because it has a low-voltage transformer winding connected across it. If the resistor must be checked, disconnect one terminal from the circuit before measuring its resistance.

e. Checking Grid Resistance. When checking grid resistance, a false reading may be obtained if the tube is still warm and the cathode is emitting electrons. Allow the tube to cool or reverse the ohmmeter test leads so that the negative ohmmeter test lead is applied to the grid.

f. Tolerance Values for Resistance Measurements. Tolerance means the normal difference that is expected between the rated value of the resistor and its actual value. Most resistors that are used in radio circuits have a tolerance of at least 20 percent. For example: The grid resistor of a stage might have a rated value of 1 megohm. If the resistor were measured and found to have a value between 0.8 megohm and 1.2 megohms, it would be considered normal. As a rule, the ordinary resistors used in circuits are not replaced unless their values are off more than 20 percent. Some precision resistors and potentiometers are used. When a resistor is used whose value must be very close to its rated value, the tolerance is usually stated on the diagram or the list of maintenance parts.

105. CAPACITOR TESTS.

Capacitors which are leaky or shorted can be found by resistance checks of the stage. A capacitor which is suspected of being open can best be checked by shunting a good capacitor across it. In i-f circuits, keep the lead to the capacitor as short as the original capacitor leads. In low-frequency circuits (less than 1 megacycle (mc)) the test capacitor leads may be several inches long. A capacitor color code is shown in the appendix (fig. 133) for checking the capacitor value against the value shown on the circuit diagram.

106. CURRENT MEASUREMENTS.

Current measurements are not ordinarily required in trouble shooting in the radio set. Under special circumstances where the voltage and resistance measurements alone are not sufficient to localize the trouble, a current measurement can be made by opening the circuit and connecting an ammeter to measure the current. This procedure is not recommended except in very difficult cases.

a. When inserting the meter in a circuit to measure current, insert it away from the r-f end of the resistance. For example, when measuring plate current, do not insert the meter beside the plate of a tube, but insert it beside the end of the resistor which connects to the power. This precaution is necessary to keep the meter from upsetting the r-f voltages.

> CAUTION: A meter has least protection against damage when it is used to measure current. Always set the current range to the highest value. Then, if necessary, decrease the range to give a more accurate reading. Avoid working close to full-scale reading because this increases the danger of overload.

b. In most cases, the current to be measured flows through a resistance which is either known or can be measured with an ohmmeter. The current flowing in the circuit can be determined by dividing the voltage drop across the resistor by its resistance value. The drop across the cathode resistor is a convenient method of determining the cathode current.

107. TUBE CHECKING.

a. Tube checkers are used primarily to check either the mutual conductance of a tube or the emission of electrons from the cathode and to test for shorted elements. Some tube checkers also have provision for checking for gassy and noisy tubes. Tube checkers will not test the performance of all tubes, such as high-voltage rectifier tubes. However, they are useful for checking standard receiving type tubes such as used in the various components of Radio Set AN/CRD-3.

b. Results obtained from a tube checker are not always conclusive because the conditions are not the same as those under which the tube operates in the set. For this reason, the final test of a tube must be its replacement with a tube which is known to be good. In many cases it is quicker and more reliable to replace a suspected tube with a good one than to check it with a tube checker.

108. PARTS REPLACEMENT.

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

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

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

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

d. 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.

e. When a part is replaced in r-f or i-f 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 circuits. Give particular attention to grounding when replacing a part. Use the same ground point as in the original wiring. Failure to observe these precautions may result in decreased gain or possibly in oscillation of the circuit.

109. TEST EQUIPMENT.

a. Voltohmmeter (Weston Model No. 564 Type 3c). A multirange d-c voltohmmeter (Weston model No. 564 type 3c), or equal, with test leads terminated in prods, is supplied with Radio Set AN/CRD-3. Its over-all dimensions are 4-33/64 by 3-45/64 by 2-9/16 inches; its weight is 1-3/4 pounds; and it is accurate within 2 percent. Power is supplied by a 4-1/2-volt C battery.

(1) Description. This is a completely self-contained pocket type multimeter measuring d-c voltage and resistance. All functions are designed around a d'Arsonval type meter with a basic sensitivity of 100 microamperes. The voltage and resistance ranges are available from 10-pin jack terminals located on the panel. The d-c voltage function has provisions for making measurements at the standard sensitivity of 1,000 ohms per volt. This function uses an individual set of selected multipliers and allows measurements from 0.1 to 600 volts in four ranges. The ohmmeter section uses the ring type parallel adjustment circuit and is powered by a self-contained battery. Measurement of resistances from 1 ohm to 1,000,000 ohms (1 megohm) can be made in four ranges. The ohmmeter has a center scale reading of 35 ohms on the first range and 350, 3,500, and 35,000 ohms on the remaining three ranges, respectively.

(2) Controls and Their Use.

(a) The meter on the front panel has a basic 100-microampere D'Arsonval type movement and contains two scales: an upper scale with nonlinear divisions used for resistance measurements, and a lower scale with linear divisions used for d-c voltage measurements.

(b) The ten pin jacks on the front panel are as follows: the jack marked (-) on the upper left-hand corner is the negative or return terminal for all d-c voltage ranges; the jacks marked 3V, 30V, 300V, 600V on the upper edge of the panel are positive terminals for the d-c voltage functions; the jack marked X on the lower left-hand corner of the panel is the common terminal for all ohmmeter ranges; and the jacks marked R, R x 10, R x 100, and R x 1,000 on the lower edge of the panel are the range selector terminals for ohmmeter function.

(c) The switch marked VM-RES. is a toggle type selector switch used to change the instrument from ohmmeter to voltmeter and vice versa.

(d) The rotary control marked BATTERY ADJUST is used for ohmmeter zero adjustment.

(3) *Operating Instructions.*

(a) For resistance measurements and continuity tests, throw the toggle switch to the RES. position. Insert one test lead in the pin jack marked X and the other in one of the pin jacks on the lower edge of the panel depending upon the value of the resistor to be measured. Then touch the two test leads together and adjust the BATTERY ADJUST control until the meter reads full scale (zero ohms). Repeat this adjustment each time the resistance range of the instrument is changed. The value of the unknown resistance is read on the OHMS (top) scale using the multiplying factor of the range.

(b) For d-c voltage measurements, throw the toggle switch to the VM position. Insert one test lead in the pin jack marked (-) and the other in one of the terminals on the upper edge of the panel. The value of the d-c voltage is read on the 0-300 or 0-600 (lower) scale depending on the range selected.

(4) *Applications.*

(a) A chart showing the ranges of measurements, switch positions, and corresponding meter scales is given in subparagraph (8) below.

(b) When in doubt as to the approximate value of the voltage being measured, first use the 600-volt range of the instrument and then change to a lower range if necessary. This will avoid overloading the meter movement.

(c) Always throw the toggle switch to the VM position when carrying the instrument.

(5) *Meter Zero Adjust.* Be sure that the meter needle is pointing to zero on the d-c volts scale before making any measurements with the instrument. If the needle is not indicating zero when test leads are removed, make an adjustment by turning the screw on the meter case directly below the window.

(6) *Battery Installation.* To install the 4½-volt battery which is used as a source of current in the ohmmeter section of the voltohmmeter, remove the four panel mounting screws and lift the tester out of its case. The battery will be found on the back of the instrument. Note the color coding of the battery leads, the red lead connecting to the positive terminal.

(7) *Battery Replacement.* When any of the ohmmeter ranges no longer adjusts to 0 ohms (full-scale deflection), replace the 4½-volt battery. Should replacement of the battery fail to rectify the trouble or should the instrument fail to function properly in any other respect, *do not attempt to repair the device. Considerable damage may be caused by an inexperienced repairman.*

(8) *Operating Chart.*

Type measurement	Range measurement	Toggle switch	Pin jacks used	Read on meter scale	To interpret reading
	0 to 100 ohms		X R	INF-1M-0	Read direct
	100 to 1,000 ohms		X R x 10	INF-1M-0	Multiply by 10
Resistance	1,000 to 10,000 ohms	RES.	X R x 100	INF-1M-0	Multiply by 100
	10,000 to 1,000,000 ohms		X R x 1000	INF-1M-0	Multiply by 1000
	0 to 3 volts		- 3V	0-300	Divide by 100
D-c voltage	3 to 30 volts		- 30V	0-300	Divide by 10
	30 to 300 volts	VM	- 300V	0-300	Read direct
	300 to 600 volts		- 600V	0-600	Read direct

b. Signal Generator I-72-J. This generator is supplied with Radio Set AN/CRD-3. Refer to TM 11-307J for operating and maintenance instructions.

110. TROUBLE-SHOOTING PROCEDURE.

a. Locate faults by following an orderly, systematic procedure. First determine whether the trouble is in the antenna system, the phase inverters, the junction boxes, the associated cables, the receiver, the goniometer, etc. After the difficulty is traced to one definite unit, proceed in a series of logical steps to isolate the fault further. For example, if the difficulty is in the receiver assembly, determine whether it is common to both frequency bands. If it is found to be in one band only, the trouble probably exists only in the radio-frequency or oscillator circuits, since the intermediate-frequency, audio-frequency and indicator-channel circuits are common to both bands. Moreover, if the trouble is confined to a single frequency band, elements common to both bands are not at fault. Thus, the main tuning capacitor, vacuum tubes with associated sockets and circuit components, the power supply and control circuits may be exempt from suspicion. Then check the coil assemblies and wave-band switch. At this point make a resistance analysis of the radio-frequency amplifier and oscillator circuits to determine which is defective. If, in the defective circuit, the indicated resistance value changes with a slight movement of the band switch, there may be a faulty contact. If the abnormal resistance value remains constant, the fault is probably in the coil assembly or wiring. Examine the switch and wiring of the particular stage. If these appear to be in operating condition, investigate the coil assembly.

b. A rough guide to the circuit position of the fault is the amount and nature of background noise in the output. Complete absence of any sound would possibly be due to power failure or to trouble in the output stage or output circuits. Normal microphonic sounds, without hiss, probably indicate a normal audio-amplifier system but a faulty radio-frequency system. Weak signals accompanied by background noise might indicate some fault in the antenna system or transmission lines. The indicator pattern is also an excellent guide in trouble location. For example, if the automatic bearing indicator pattern remains fixed at 0° and 180° or at 90° and 270° regardless of the direction of arrival of the radio signal, it indicates trouble in one pair of the directional phase inverters, its associated cables, or the goniometer winding. Magnetism in the iron parts of the automatic bearing indicator offsets the center points of the twin-leaf pattern. If the shafts of the goniometer and automatic bearing indicator rotating assembly are not exactly in line, the twin-leaf pattern will be bent (points less than 180° apart) for some azimuths but not for others.

c. The accompanying trouble-shooting chart, if properly used, simplifies trouble shooting. The chart lists the various symptoms which may be recognized easily by the operator, and gives the probable location for the existing trouble as well as the recommended correction. It tells the operator whether the trouble is in the antenna system, phase inverters, power supplies, cabling, automatic bearing indicator, junction boxes, etc. By proper use of this chart, the operator can isolate the trouble to one particular component of the equipment, and thus save time that might otherwise be lost in checking components that are free of trouble.

III. SECTIONALIZING TROUBLE IN RADIO SET AN/CRD-3.

Symptoms	Probable trouble	Corrections
1. All pilot and dial lamps out.	1. Blown fuse in a-c power supply.	1. Replace.
	Faulty ON-OFF switch.	Replace.
	Break in continuity of power input or output cable cords (possibly at a plug).	Seat plugs firmly in their mating receptacles. Coupling rings on plugs must be tight. Repair if necessary.
	Open circuit in filament voltage circuit.	Repair.
2. No signal, weak signal, or incorrect indication.	2. Burned-out or weak rectifier tube in power supply of receiver or power supply in the control-rectifier power unit.	2. Replace.
	Faulty contact to rectifier tube pins.	Clean.
	Break in continuity of power unit cords.	Repair.
	Shorted filter or bypass capacitor.	Replace.
	Poor contact between antenna input receptacles and mating plug or adapter.	Correct.
	Ground or open circuit in phase inverters, h-f cords, goniometer, or interconnecting cords.	Correct.
	Weak or burned-out vacuum tube.	If possible, check the tubes with a suitable test set. If this is not available, replace each tube, in turn, with a new one or with one in good condition.
	All d-c voltages low because of weak rectifier tube.	Replace.
	Open filter capacitor.	Replace.
	Short circuit in plate circuits.	Repair.
	Incorrect cable connection.	Correct.

III. SECTIONALIZING TROUBLE IN RADIO SET AN/CRD-3 (contd).

Symptoms	Probable trouble	Corrections
	Drop of solder on plates or bent plates of trimmer of tuning capacitor causing short circuit.	Locate cause and correct.
3. Noisy or intermittent reception.	3. Noise pick-up in antenna system.	3. Short circuit the antenna inputs and observe whether noise stops.
	Connectors loosely mated or breakage of a cord conductor.	Locate and correct.
	Defective control.	Replace.
	Defective switch.	Replace.
	Poor contact between vacuum tube and its socket.	Locate and clean.
	Defective vacuum tube.	Tap each tube lightly to locate; replace.
	Frayed or broken connection in wiring.	Check by shaking component in question; correct.
	Poor contact between pilot or dial lamp and its socket.	Locate and correct.
	Defective bypass or coupling capacitor.	Locate and replace.
	Loose retaining nut on shield can.	Locate and tighten.
4. Fading.	4. Defective or intermittent bypass or coupling capacitor.	4. Locate and replace.
	Heater element in a vacuum tube periodically makes and breaks contact due to expansion.	Tube tester does not generally indicate this type of defect. Check each tube in turn with a tube known to be operating.
	Magnetic storm causing unfavorable transmitting conditions.	Nothing. Condition will eventually improve even if only for short time intervals.

Symptoms	Probable trouble	Corrections
5. All sense indications reversed.	5. Deflection coil assembly in automatic bearing indicator rotated 180° with respect to goniometer.	5. Loosen locking screw and turn coupling adjustment until gradual ring has turned 180° (fig. 127).
6. Sense indications reversed in one pair of quadrants.	6. Junction Box JB-91-A on directional pair not connected to proper color coded r-f cords.	6. Correct connections.
	R-f cords for directional pair in question incorrectly connected to plugs.	Correct, being sure that pins A, B, and C, on the plugs at both ends of cord are connected to the shield and corresponding conductors of cord.
7. Sense voltage present when SEARCH-INSTANT. BEARING-SENSE switch on SENSE but no sense output or in correct sense pattern.	7. Defective tube in one output of Sense Phase Inverter MC-412-A.	7. Check by switching FILAMENT from 1 to 2 (to spare tubes). If this corrects trouble replace defective inverter tube.
	One output cord open or disconnected or short in one phase inverter circuit.	Check continuity of cables and phase inverter circuits.
8. Indicator pattern OK with SEARCH-INSTANT. BEARING-SENSE switch on INSTANT BEARING but no pattern on SENSE or vice versa.	8. Open directional or sense deflection coil.	8. Check continuity between slip rings C-A and C-B (fig. 127) and replace open coil, if any (par. 117c).
	Broken pigtail or one brush not in contact.	Check continuity and clean or replace defective brush (see par. 58).
9. Distorted indicator pattern indicating wrong direction.	9. Burned out or low emission tube in one phase inverter. Relay in Phase Inverter MC-411-A, drops out at 2 to 4 ma and pulls in at 6 to 8 ma.	9. Check phase inverter operation (par. 127). If plate current less than 8 ma direct current relay will ground this antenna. Switch FIL SWITCH to 2 (spare tubes) and replace defective tube as soon as practical.

Symptoms	Probable trouble	Corrections
10. Receiver tunes signal satisfactorily and circle on bearing indicator is satisfactory but no azimuths can be obtained.	10. Cable number 12 open. No receiver indicator channel output.	10. Check and repair. Check receiver indicator channel output with deflection amplifier connected and indicator goniometer rotating. Required voltage is approximately 4.0 volts direct current. If no voltage check circuits against applicable schematic diagrams.
11. Lack of sharp pattern from transmitter and one directional phase inverter.	11. Capacity currents from improperly grounded antenna introducing voltage in goniometer stator at right angles to the one corresponding to pair being balanced.	11. Clean surfaces of relay armature where it contacts frame of relay in one or both phase inverters of the other directional pair.
12. Saw tooth pattern on cathode-ray tube circular pattern (fig. 58).	12. Intermittent or vibrating contact due to pitted slip rings or low brush spring tension. Loose slip rings.	12. Clean and polish slip rings, check and adjust brush spring tension (par. 58). Tighten slip ring retainer (subpar. 58c).
13. No current indication in phase inverter plate current meter when AC SWITCH is ON.	13. Burned out meter fuse. Power cords disconnected. All 0°, 180°, 90°, and 270° switches or balancing resistors off. One or more balancing resistors open.	13. Replace fuse. Check. Check switches and balancing resistors.
Plate current low for any directional phase inverter.	Burned-out or low emission tube in corresponding phase inverter.	Switch FIL SWITCH to spare tubes and replace defective tube as soon as practical.

112. TUBE LOCATIONS.

Refer to figures 91 to 97.

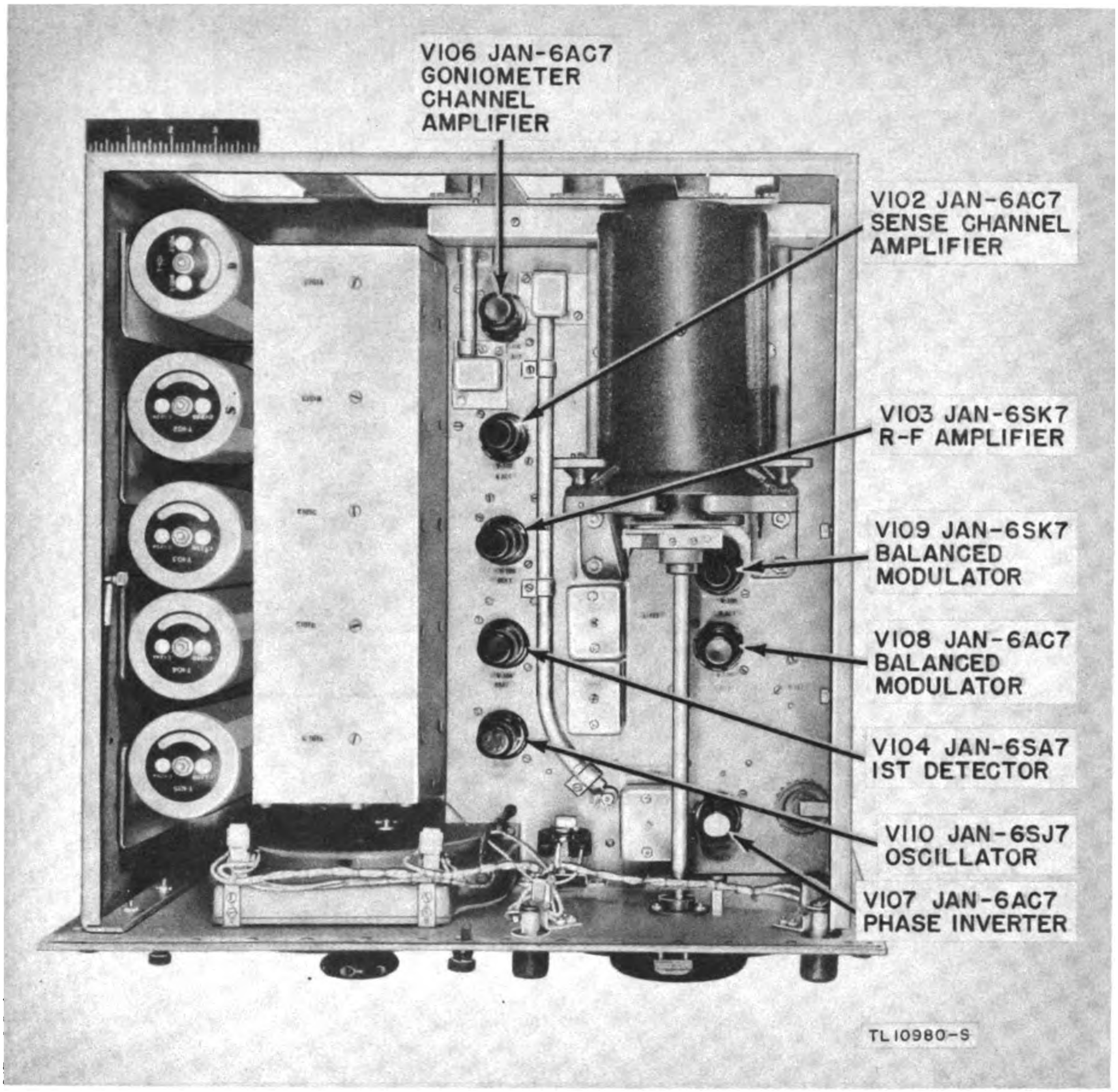

Figure 91. Modulator section of Radio Receiver Assembly R-128/CRD-3, top view of chassis.

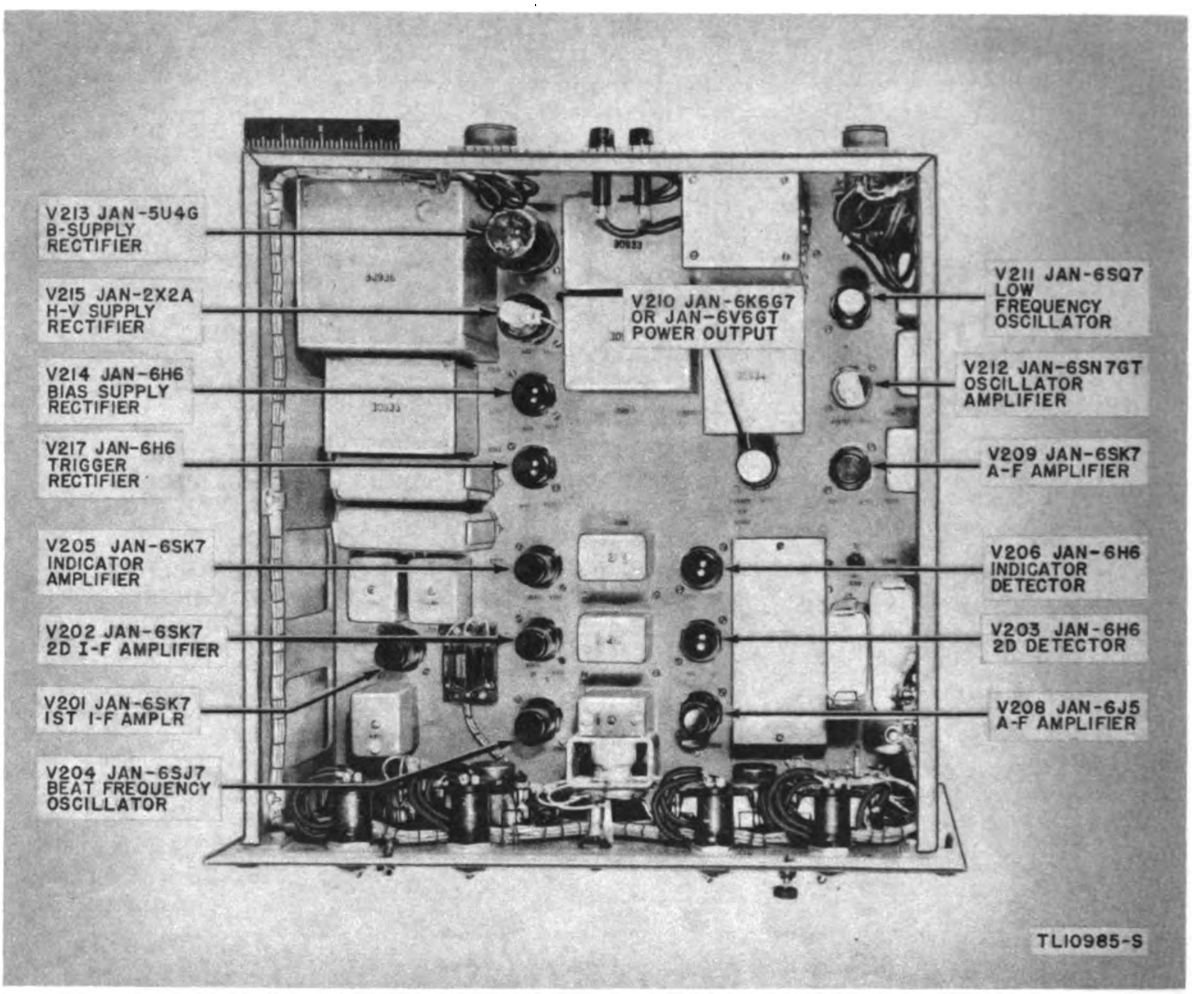

Figure 92. Power indicator section of Radio Receiver Assembly R-128/CRD-3, top view of chassis.

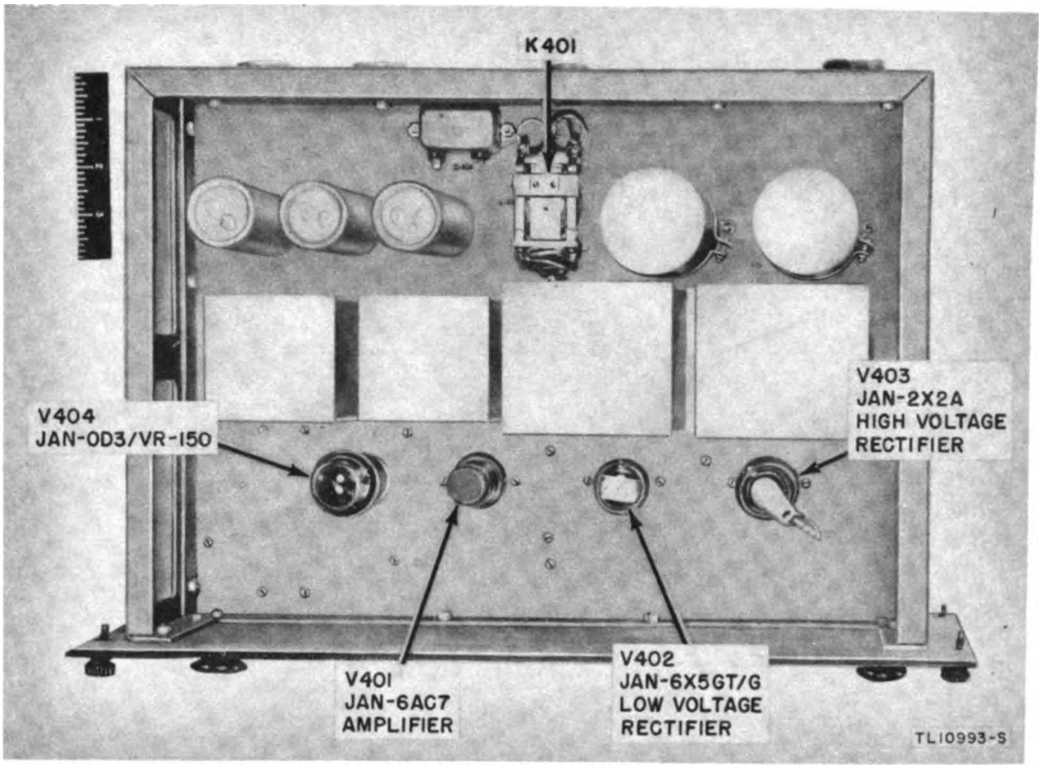

Figure 93. Amplifier-rectifier Power Unit PP-151/CRD-3, top view of chassis.

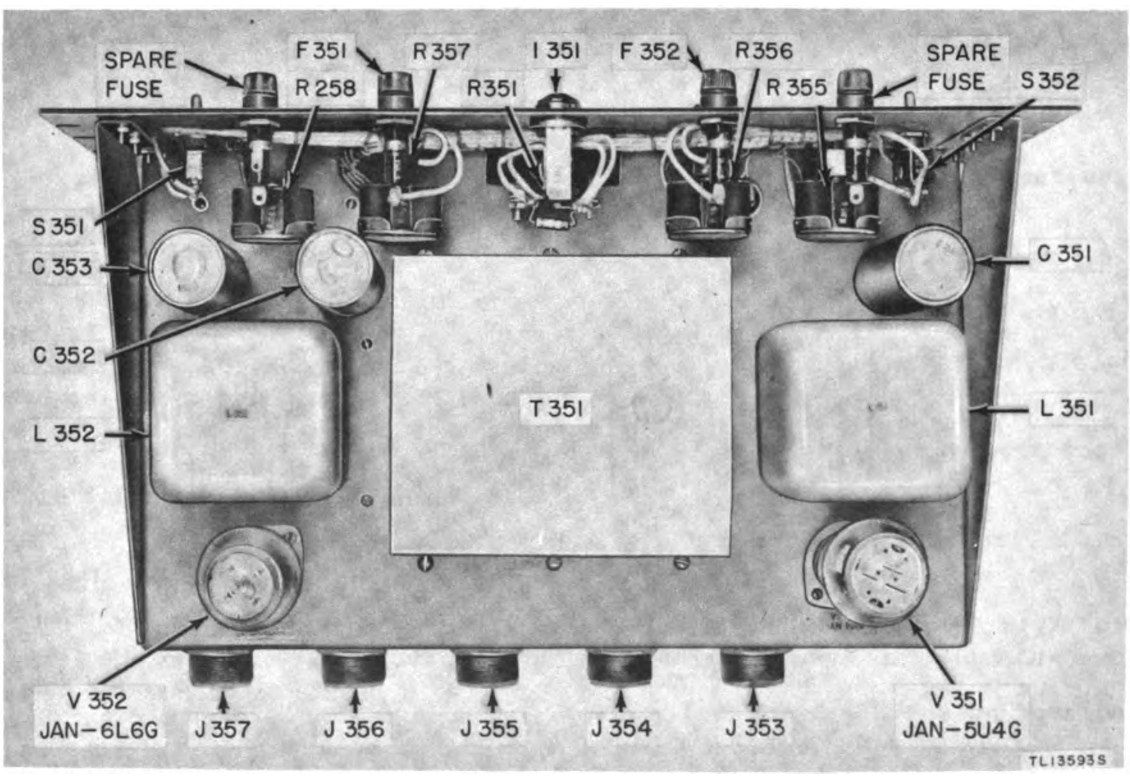

Figure 94. Control-rectifier-Power Unit PP-135/CRD-3 tube and parts locations, top view.

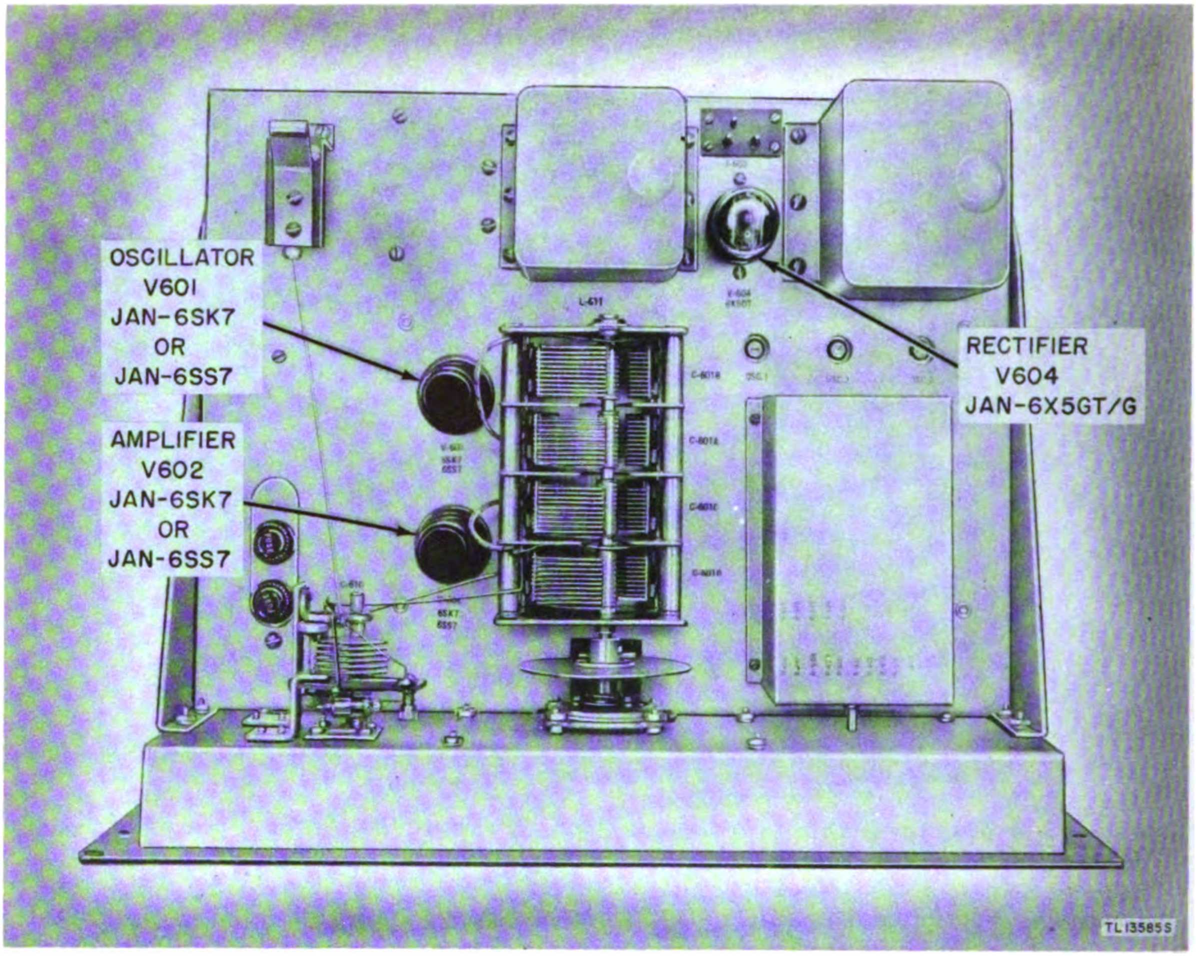

Figure 95. CAN test oscillator tube locations.

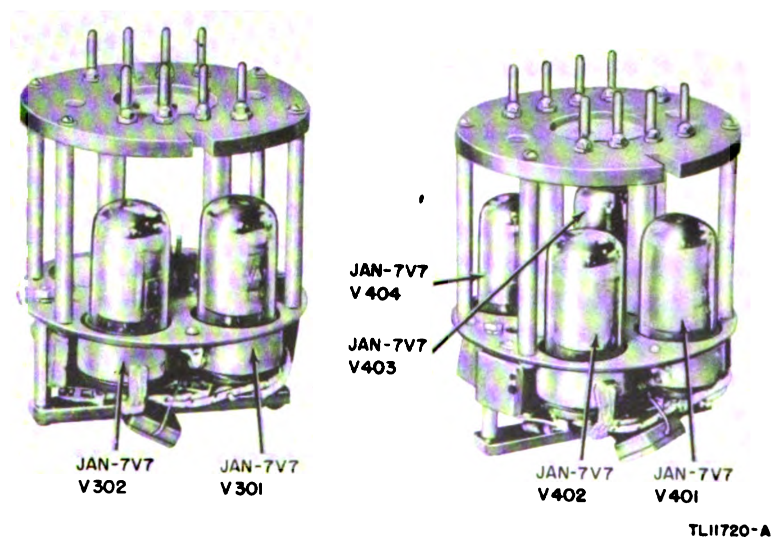

Figure 96. Phase Inverters MC-411-A and MC-413-A tube locations.

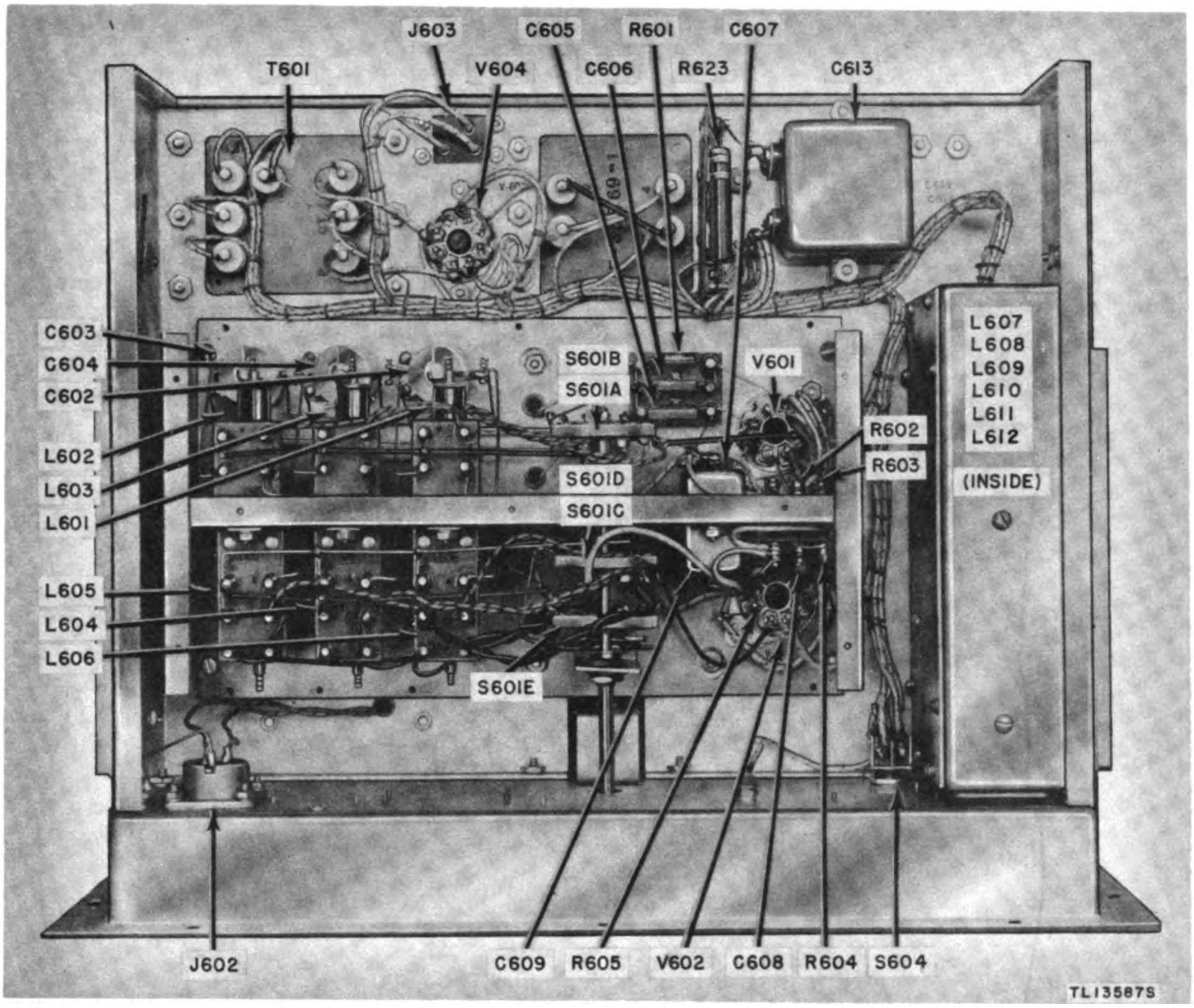

Figure 97. OAN test oscillator, bottom view, showing parts location.

113. VOLTAGE MEASUREMENTS.

a. General. The accompanying diagrams show voltage readings from socket pins to chassis measured by an electronic voltmeter under the conditions listed. Variations of more than 20 percent from the readings shown generally indicate a defective circuit or associated circuits, probably the tubes.

b. Radio Receiver Assembly R-128/CRD-3, Modulator Section Test Conditions.

(1) Remove the small cover plate located between receptacles J203 and J201 at the rear of the modulator section, and adjust the primary voltage link to the 115 volt tap.

(2) Adjust line voltage to 115 volts as described in paragraph 126.

(3) All tubes are in sockets.

(4) Set the A.V.C.-M.V.C.-C.W. switch to A.V.C.

(5) Vary resistor R137 for tube V103 readings.

(5) Vary resistor R117 for tube V107 readings.

(7) Adjust resistor R127 to half maximum for tubes V108 and V109 readings.

(8) Take readings on both band 1 and 2 for tubes V104 and V110.

(9) See figure 98 for voltage measurements.

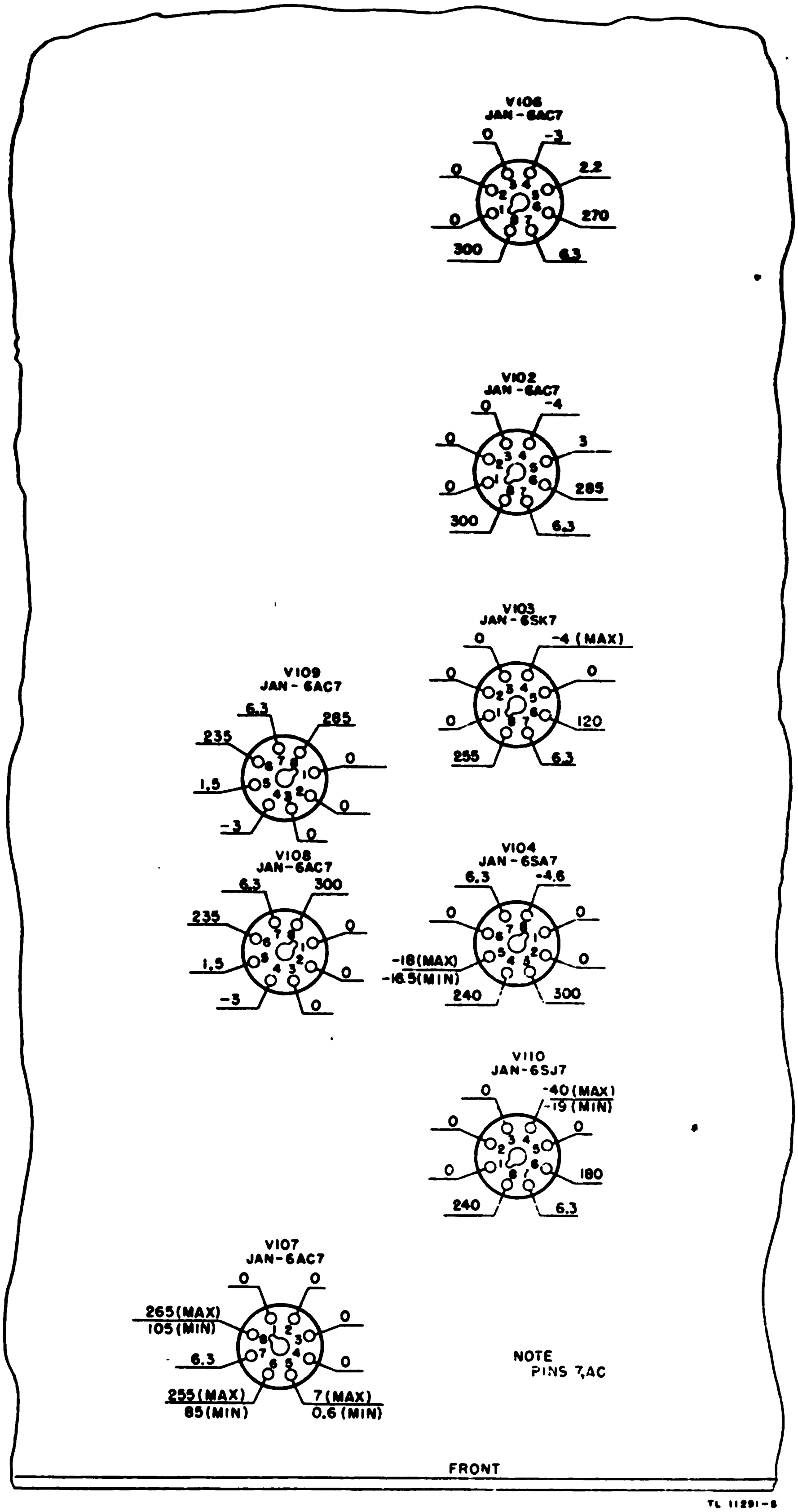

Figure 98. Modulator section voltage measurements.

c. **Radio Receiver Assembly R-128/CRD-3, Power Indicator Section Test Conditions.**

(1) Remove the small cover plate located between receptacles J203 and J201 at the rear of the modulator section, and adjust the primary voltage link to the 115-volt tap.

(2) Adjust the line voltage to 115 volts as described in paragraph 126.

(3) All tubes are in sockets.

(4) Set the A.V.C.-M.V.C.-C.W. switch to A.V.C. for all readings except tubes V203 and V204.

(5) Set the A.V.C. M.V.C.-C.W. switch to C.W. for tubes V203 and V204.

(6) Set the RADIO SELECTIVITY switch to SHARP for tube V201 readings.

(7) Adjust the VERT. ADJ., FOCUS and BRILL. controls for tube V216 readings.

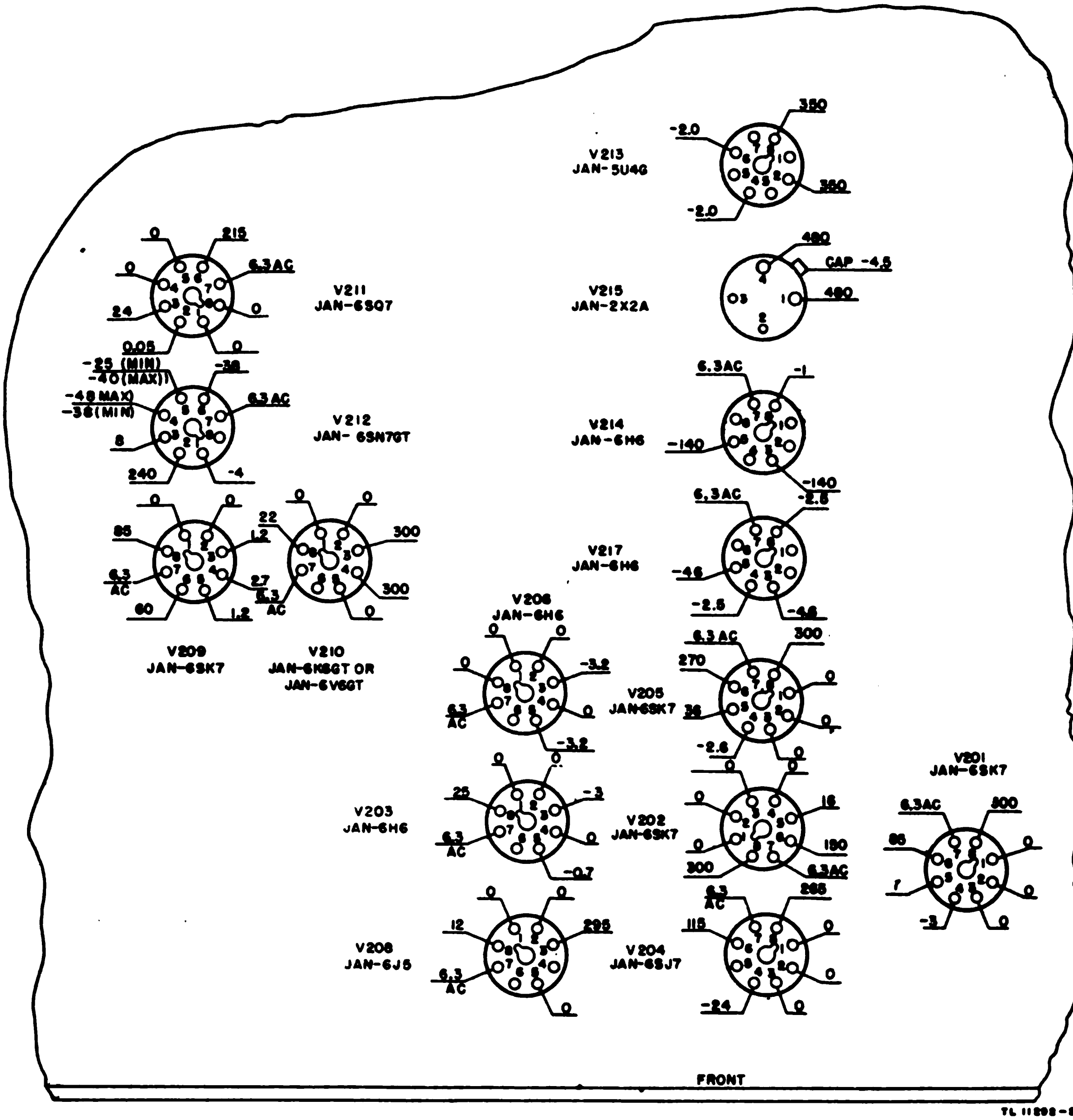

Figure 99. Power indicator voltage measurements.

(8) Turn blanking switch S204 on.

(9) Adjust blanking control R272 for tube V212 readings.

(10) See figure 99 for voltage measurements.

d. Amplifier-rectifier Power Unit Test Conditions.

(1) Adjust line voltage setting to 115 volts. Take readings from tube pin to chassis.

(2) All tubes are in sockets.

(3) Turn controls maximum clockwise.

(4) See figure 100 for voltage measurements.

e. Automatic Bearing Indicator Test Conditions.

(1) Connect cables to rectifier power unit.

(2) A-c input to rectifier power unit, 115 volts, 60 cycles.

(3) Cover plate on control box removed (fig. 116).

(4) See figure 101 for voltage measurements.

f. OAN Test Oscillator Test Conditions.

(1) Equipment oscillating under normal conditions on band 2,700 kc.

(2) A-c input 115 volts, 60 cycles.

(3) Battery operation will give approximately the same readings except for pin 7 which will then be direct current.

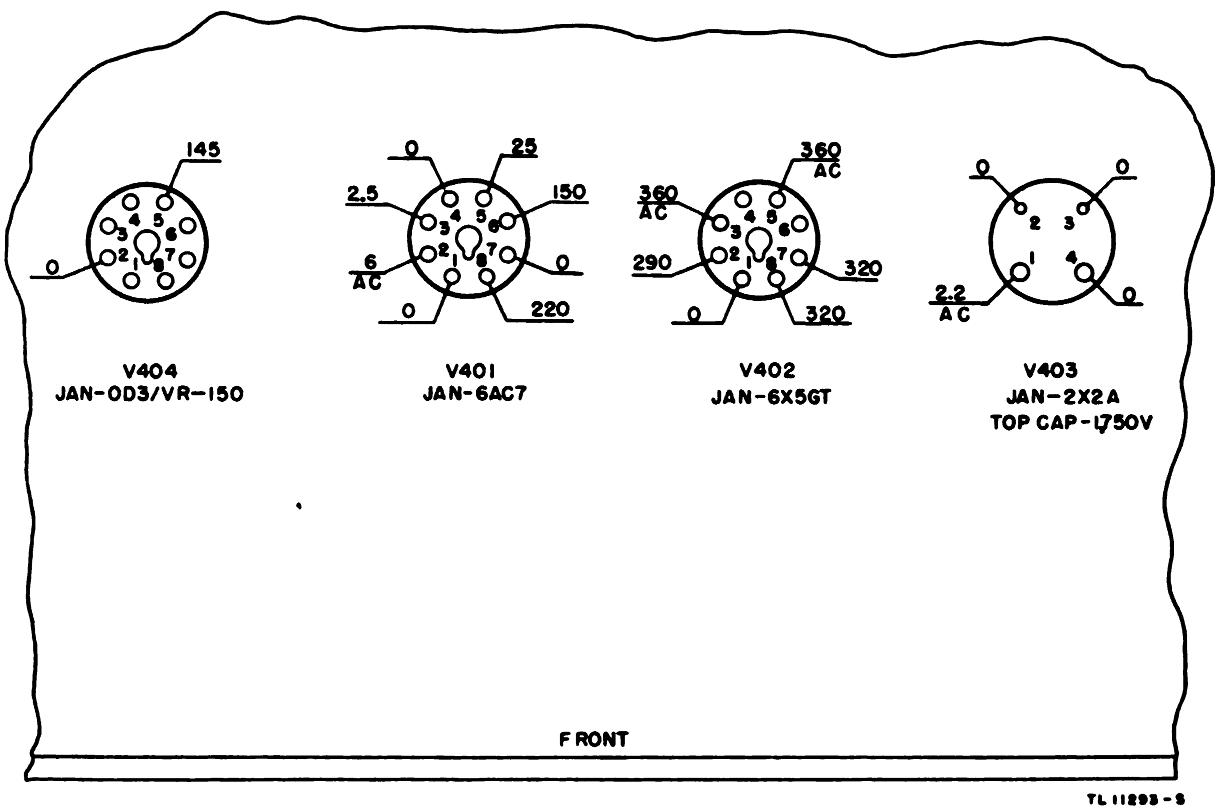

Figure 100. Amplifier-rectifier Power Unit PP-151/CRD-3 voltage measurements.

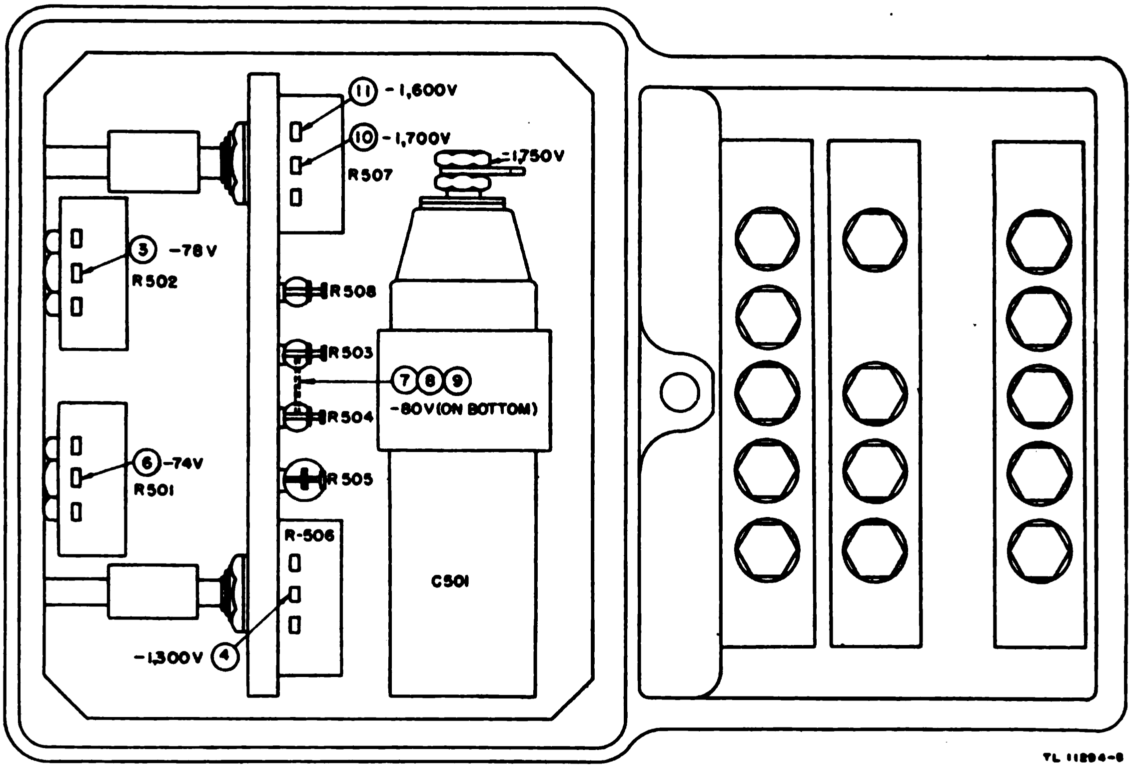

Figure 101. Automatic bearing indicator voltage measurements.

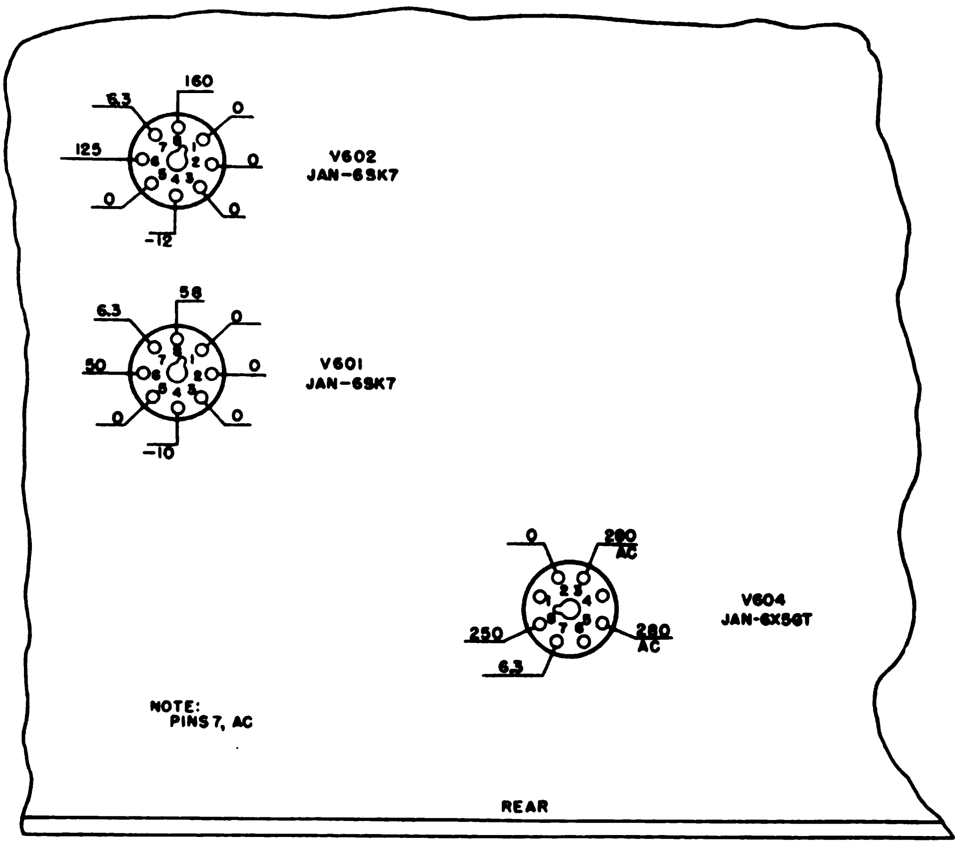

Figure 102. OAN test oscillator voltage measurements.

(4) Tube V604 is not used for battery operation.

(5) See figure 102 for voltage measurements.

g. Control-Rectifier Power Unit PP-135/CRD-3 Test Conditions.

(1) A-c input is 115 volts, 60 cycles.

(2) All tubes are in sockets.

(3) Remove all cords.

(4) Close switch S351.

(5) See figure 103 for voltages.

h. Phase Inverter MC-411-A Test Conditions.

(1) Connect by power cables to control-rectifier Power Unit PP-135/CRD-3.

(2) A-c input to control-rectifier is 115 volts, 60 cycles.

(3) All tubes are in sockets.

(4) FIL SWITCH is on 1 for tube V301 and on 2 for tube V302.

(5) Turn the 0°, 180°, 90°, or 270° switch for the corresponding phase inverter on and set the associated BALANCE ADJUSTMENT on the control-rectifier panel for control panel meter reading of 10 ma.

(6) Turn the SELECTOR SWITCH to 0°, 180°, 90°, or 270° positions for the corresponding phase inverter.

(7) See figure 111 for voltages.

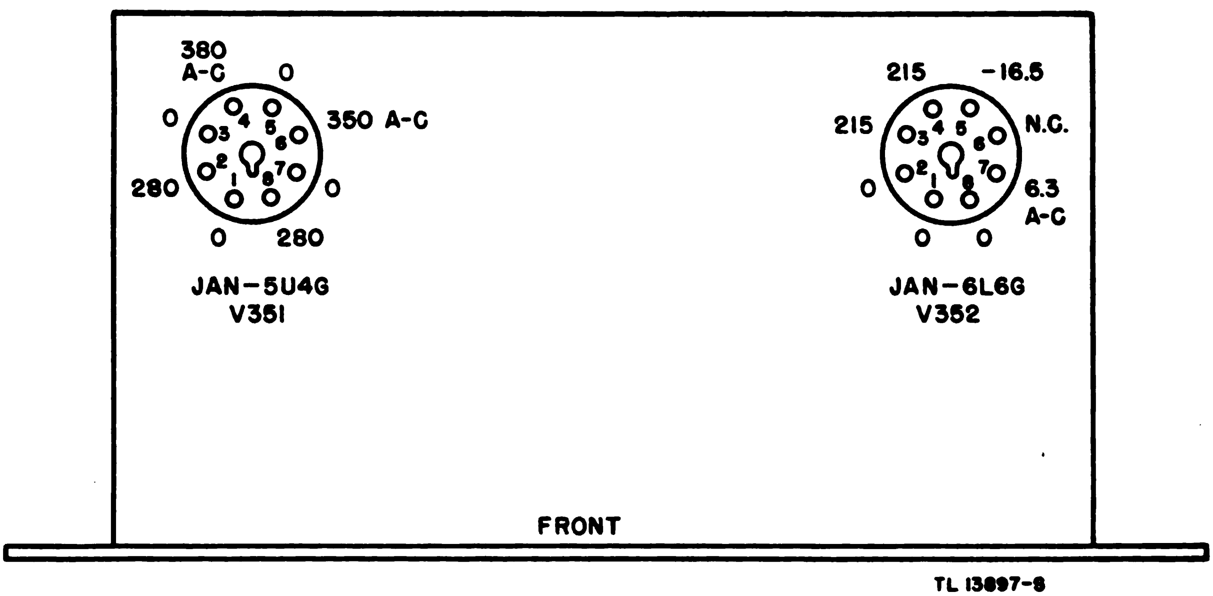

Figure 103. Control-rectifier Power Unit PP-135/CRD-3 voltage measurements.

i. Phase Inverter MC-413-A Test Conditions.

(1) Connect by power cable to control-rectifier Power Unit PP-135/CRD-3.

(2) A-c input to control-rectifier is 115 volts, 60 cycles.

(3) All tubes are in sockets.

(4) Turn the FIL SWITCH to 1 for tubes V401, V403, and on 2 for tubes V402, V404.

(5) Turn the SELECTOR SWITCH to SENSE.

(6) Set the SENSE GAIN control for panel meter reading of 43 ma.

(7) See figure 112 for voltages.

114. RESISTANCE MEASUREMENTS.

a. General. The accompanying tables show nominal readings between the points indicated, as measured with a voltohmmeter. Variations of more than 20 percent warrant c complete point-to-point circuit check of the associated circuits in accordance with the applicable diagram.

CAUTION: DISCONNECT POWER INPUTS OF ALL UNITS FROM THE SOURCE OF POWER.

b. Test Conditions.

(1) Line voltage is disconnected.

(2) Tubes are out of sockets, except for OAN Test Oscillator.

(3) Cables are disconnected.

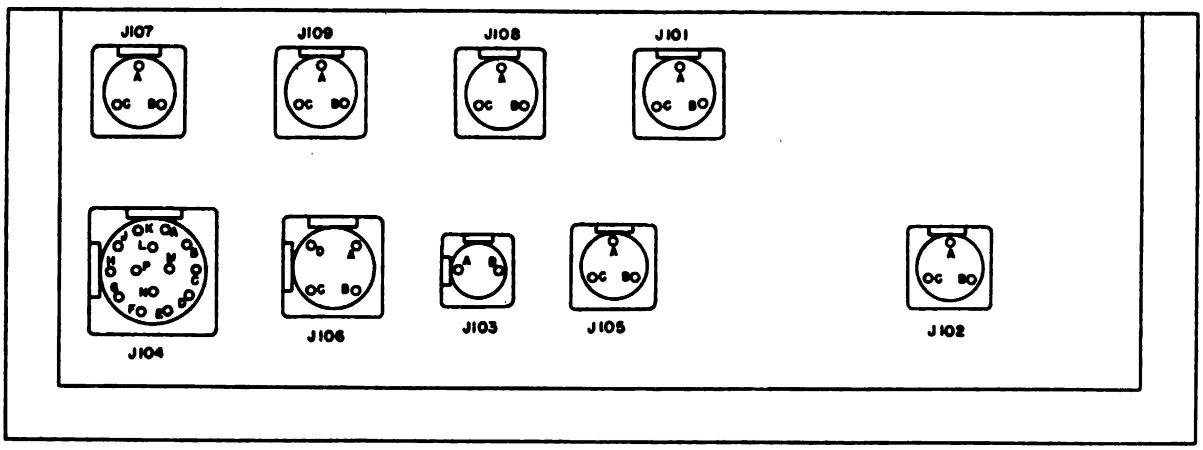

Figure 104. Modulator section receptacle pin positions.

c. Modulator Section.

See figures 98 and 104 for pin locations.

From tube or Receptacle	Pin No.	To	Conditions	Resistance (ohms)
V102	4	T102-G	Band 1	5
			Band 2	2
	8	J104-B	Band 1	1200
	8	J104-B	Band 2	1100
	2	Chassis		0.0
	3	Chassis		0.0
	4	Chassis		Infinity
	5	Chassis	STAND BY	1 K
	6	J104-B	Band 1 and band 2	56 K
	7	Chassis	Vary DIM control pilot lights in	4 to 25
	7	Chassis	pilot lights out	Infinity
V103	2	Chassis		0.0
	3	Chassis		0.0
	4	Chassis	Null only, vary R.F. GAIN control	1 to 2 meg
	5	Chassis		2
	6	J104-B		50 K
V104	2	Chassis		0.0
	3	J104-B		4700
	5	Chassis		56 K
	6	Chassis		2 meg.
	8	Chassis	Null MAN. and INST.	Infinity
V106	2	Chassis		0.0
	3	Chassis		0.0
	5	Chassis		620
	6	J104-B		56 K
	8	J104-B		4700
V107	2	Chassis		0.0
	3	Chassis		0.0
	4	Chassis		220 K
	5	Chassis	Vary GONI. GAIN control	160-10,260
V108	2	Chassis		0.0
	3	Chassis		0.0
	4	Chassis		220 K
	5	Chassis	ON sense and direction	220
	6	J104-B	Vary R-127	27 K to 70 K

c. Modulator Section (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
V108	8	J104-B		1000
V109	5	Chassis	ON MAN.	220
V110	2	Chassis		0.0
	3	Chassis		0.0
	4	Chassis		100 K
	6	Chassis	INST.	40 K
	6	Chassis	MAN. and NULL	80 K
J101	A	Chassis		0.0
	C	J101-B	Band 1 and band 2	2
	B	Chassis	Band 1 and band 2	1
	C	Chassis	Band 1 and band 2	1
J102	A	Chassis		0.0
	C	J102-B	Band 1 and band 2	2
	C	Chassis	Band 1 and band 2	1
	B	Chassis	Band 1 and band 2	1
J103	A	J103-B		Infinity
	A or B	Chassis		Infinity
J104	A	J104-D	MAN-NULL-INST. switch operating	MAN. NULL INST. 0.0 Infinity 0.0
	C	J104-L		0.0 Infinity 0.0
	E	J104-A		Infinity 0.0 Infinity
	F	Chassis	Vary R.F. GAIN control	0.0 2200 to 12K
	G	Chassis		Infinity 0.0 Infinity
	N	Chassis		Infinity 0.0 Infinity
	M	Chassis		0.0 0.0 0.0
	K	Chassis		0.0 Infinity Infinity
	H	Chassis	INDICATION switch any position	330 K
	B	V110-B		9,400
	P	J105-A		0.0
	B	Chassis	Vary R.F. GAIN control MAN. NULL INST.	68 K to 1 meg
J105	B	Chassis	INST.	0.0
			MAN. and NULL	Infinity
	C	Chassis	MAN. and NULL	0.0
	A	J106-B	INST.	
J106	A	Chassis		0.0
	B	Chassis		Infinity
	B	J104-D		0.0

c. Modulator Section (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
J106	D	Chassis	ON sense	0.0
V102	4	V101 (neon lamp)		0.0
V106	4	V105 (neon lamp)		0.0
V103	8	T104-B	Band 1	200
			Band 2	100
V104	3	L112-1	Band 1 and band 2	28
T105	1	Chassis	Band 1	5
	2	Chassis	Band 2	2
V106	8	L113-4	Band 1 and band 2	220
J107	A	Chassis		0
	C	B		3
	C	Chassis		50
	B	Chassis		50
J108	A	Chassis		0
	B	Chassis		40
	C	Chassis		40
	B	C		3
J109	A	Chassis		0
	B	Chassis		Infinity
	C	Chassis		Infinity
	B	C		1.5
*J110	C	J107-C		0
	B	J107-B		0
	A	J107-A		0
*J111	A	J108-C		0
	B	J108-B		0
	C	J108-C		0
*J112	A	J109-A		0
	B	J109-B		0
	C	J109-C		0
T101	1	V106-4	Band 1	0
			Band 2	2
	2	V106-4	Band 1	5
			Band 2	0

*Not shown in fig. 104. These receptacles are located inside modulator section of receiver chassis.

c. Modulator Section (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
T101	A1S	Chassis		0.5
	A2S	Chassis		0.5
	A1F	J102-B		0.5
	A2F	J102-C	Band 1	1
			Band 2	0
	G	V106-4	Band 1	5
			Band 2	2
T102	1	V102-4	Band 1	0
			Band 2	2
	2	V102-4	Band 1	5
			Band 2	0
	A1S	Chassis		0.5
	A1F	Chassis		0.5
	A2S	Chassis		0.5
	A2F	Chassis		0.5
	G	V102-4	Band 1	5
			Band 2	2
T103	1	Chassis	Band 1	4.5
			Band 2	0
	2	Chassis	Band 1	0
			Band 2	2
	B	V102-8	Band 1	180
			Band 2	100
	P1	V102-8	Band 1	0
			Band 2	60
	P2	V102-8	Band 1	120
			Band 2	0
	B	J104-B		1000
T104	1	Chassis	Band 1	4.5
			Band 2	0
	2	Chassis	Band 1	0
			Band 2	2
	P1	V103-8	Band 1	0
			Band 2	110
	P2	V103-8	Band 1	220
			Band 2	0
	B	J104-B		4700

c. Modulator Section (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
T105	1	V110-5	Band 1	4.5
			Band 2	0.5
	2	V110-5	Band 1	1
			Band 2	2
	T1	Chassis		1
	T2	Chassis		0.5
	G	Chassis		0
L111	1	V103-5		1.5
	2	Chassis		1.5
L112	1	V104-3		28
	2	J104-B		4700
	3	J103-A		0
L113	1	J104-B		5000
	2	V107-4		220 K
	3	Chassis		220 K
	4	V106-8		230

d. Power Indicator Section.

See figures 99 and 105 for pin locations.

From Tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
V201	2	Chassis		0
	3	Chassis		0
	4	L201 (1)		56 K
	5	Chassis	RADIO SELECTIVITY on SHARP	1,000
	5	Chassis	RADIO SELECTIVITY on BROAD	0
	6	J202 (B)		56 K
	7	Chassis		0.1
	8	J202 (B)		4700
V202	2	Chassis		0
	3	Chassis		0
	4	Chassis		1 meg
	5	Chassis		10 K
	6	J202 (B)		560 K
	7	Chassis		0.2

d. Power Indicator Section (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
V202	8	J202 (B)		4700
V203	2	Chassis		0
	3	Chassis		50,000
	4	Chassis		0
	5	J202 (D)	A.V.C.-M.V.C.-C.W. switch on A.V.C.	1 meg
	5	Chassis	A.V.C.-M.V.C.-C.W. switch on M.V.C.	600 K
	8	J202 (B)	A.V.C.-M.V.C.-C.W. switch on A.V.C. or M.V.C.	80 K
	8	J202 (B)	A.V.C.-M.V.C.-C.W. switch on C.W.	20 K
	8	Chassis		4.7 K
V204	2	Chassis		0
	3	Chassis		0
	4	Chassis		100 K
	5	Chassis		0.4
	6	Chassis	A.V.C.-M.V.C.-C.W. switch on C.W.	20 K
	6	J202 (B)	A.V.C.-M.V.C.-C.W. switch on M.V.C.	56 K
	7	Chassis		0.2
	8	J202 (B)	A.V.C.-M.V.C.-C.W. switch on C.W.	7.7 K
V205	2	Chassis		0
	3	Chassis		0
	4	J202 (G)		1 meg
V205	2	Chassis		0
	3	Chassis		0
	4	J202 (G)		1 meg
	4	Chassis	A.V.C.-M.V.C.-C.W. switch on M.V.C. or C.W.	1 meg
	5	J202 (F)		2200
	5	Chassis	A.V.C.-M.V.C.-C.W. switch on M.V.C. or C.W.	2200
	6	J202 (B)		22 K
	7	Chassis		0.2
	8	J202 (B)		4.7 K
V206	2	Chassis		0
	3	Chassis		56 K
	5	Chassis		56 K
	7	Chassis		0.2
	8	Chassis		0
V208	2	Chassis		0

d. Power Indicator Section (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
V208	3	J202 (B)		0
	5	Chassis	Vary AUDIO GAIN Control	0-1 meg
	7	Chassis		0.2
	8	Chassis		3000
V209	2	Chassis		0
	3	Chassis		620
	4	Chassis	A.V.C.-M.V.C.-C.W. switch on M.V.C. or C.W.	240 K
	4	Chassis	A.V.C.-M.V.C.-C.W. switch on A.V.C.	184 K
	5	Chassis		620
	6	J202 (B)		560 K
	7	Chassis		2
	8	J202 (B)		156 K
V210	2	Chassis		0
	3	J202 (B)		200
	4	J202 (B)		0
	5	Chassis		560 K
	6	Chassis		300 K
	7	Chassis		0.2
	8	Chassis		560 K
V211	2	Chassis		750 K
	3	Chassis		10 K
	4	Chassis		0
	5	Chassis		0
	6	J202 (B)		0.3 meg
	7	Chassis		0.2
	8	Chassis		0
V212	1	Chassis		1 meg
	2	J202 (B)		10 K
	3	J202 (K)		1,000
	4	Chassis	Vary R272	90 K to 0.6 meg
	5	V216 (10)		0
	6	J202 (L)	S204 OFF	Infinity
			S204 ON	0
	7	Chassis		0.2
	8	Chassis		0
V213	2	J202 (B)	OFF-STANDBY-ON switch ON	300

d. Power Indicator Section (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
V213	4	V213 (6)		90
	6	Chassis		45
	8	Chassis	OFF-STANDBY-ON switch ON	25 K
V214	2	Chassis		0
	3	Chassis		330 K
	4	Chassis		15
	5	Chassis		330 K
	7	Chassis		0.2
	8	Chassis		15
V215	1	Chassis	OFF-STANDBY-ON switch OFF	Infinity
	4	Chassis	OFF-STANDBY-ON switch ON	250 K
	Plate cap	Chassis		70
V217	2	Chassis		0
	3	Chassis		0.6 meg
	4	J202 (H)		0
	5	Chassis		0.6 meg
	7	Chassis		0.2
	8	J202 (J)		0
V216	1	Chassis		0
	2	Chassis		0
	3	Chassis		250 K
	4	Chassis	Vary FOCUS control	80 K to 77 K
	6	Chassis		0.3 meg
	7	Chassis		250 K
V216	8	Chassis	Vary LINE SPRD control	200 K to 747 K
	9	Chassis		200 K
	10	Chassis	Vary BRILL control	1,000 K to 1,140 K
	11	Chassis		0.2
L201	2	V201 (4)		0
	3	J201 (A)	RADIO SELECTIVITY switch on BROAD	0
	3	J201 (A)	RADIO SELECTIVITY switch on SHARP	Infinity
	4	V201 (4)		25
	4	J202 (A)		56 K
L202	1	V201 (3)		0
	2	L202 (1)		4700
	3	J202 (B)		4700
	4	L203 (4)	RADIO SELECTIVITY switch on BROAD	0

d. Power Indicator Section (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
L203	1	Chassis		25
	3	Chassis		0
	4	L202 (4)	RADIO SELECTIVITY on SHARP	Infinity
L204	1	V202 (3)		0
	2	V202 (3)		10
	3	Chassis		0
	4	Chassis		450 K
	5	Chassis		120 K
	6	L204 (4)		56 K
L205	1	Chassis		15
	2	Chassis		0
	3	Chassis		15
	4	Chassis		2
L206	1	V205 (3)		10
	2	J202 (B)		4700
	3	V206 (3)		56 K
	4	J203 (C)		0
	5	V206 (5)		0
	6	V216 (6)		0
J201	B	Chassis	RADIO SELECTIVITY SHARP and	Infinity
	A	Chassis	BROAD	Infinity
J202	A	Chassis		Infinity
	B	Chassis	A.V.C.-M.V.C.-C.W. switch on C.W.	20 K
	B	Chassis	A.V.C.-M.V.C.-C,W. switch on A.V.C. or M.V.C.	25 K
	C	Chassis		100 K
J202	D	Chassis	A.V.C.-M.V.C.-C.W. switch on A.V.C.	2 meg
	E	Chassis		Infinity
	F	Chassis	A.V.C.-M.V.C.-C.W. switch on M.V.C. or C.W.	0
	G	Chassis	A.V.C.-M.V.C.-C.W. switch on M.V.C. or C.W.	1.5 meg
	H	Chassis		1 meg
	J	Chassis		1 meg
	K	Chassis		Infinity
	L	Chassis		Infinity
	M	Chassis		0
	N	Chassis	A.V.C.-M.V.C.-C.W. switch on M.V.C. or C.W.	0

d. Power Indicator Section (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
J202	P	Chassis		0
J203	A	Chassis		Infinity
	B	Chassis		0
	C	Chassis		1 meg
J205	A	Chassis		0
	B	Chassis	OFF-STANDBY-ON switch OFF	Infinity
	C	Chassis	OFF-STANDBY-ON switch OFF	Infinity
	C	J205 (B)	MASTER and OFF-STANDBY-ON switches ON	2.8
J206	A	Chassis		0
	B	Chassis		Infinity
	C	Chassis		Infinity
	B	J206 (C)	OFF-STANDBY-ON switch ON	2
J207	A	Chassis	AMPLIFIER switch OFF	Infinity
	B	Chassis	MOTOR switch OFF	Infinity
	C	Chassis	BEAM switch OFF	Infinity
	D	Chassis	MASTER switch OFF	Infinity
	A	J206 (B)	MASTER switch ON	0
	B	J206 (C)	MASTER switch ON	0
	C	J206 (C)	BEAM switch ON	0
	D	J207 (B)	AMPLIFIER and MOTOR switches ON	0

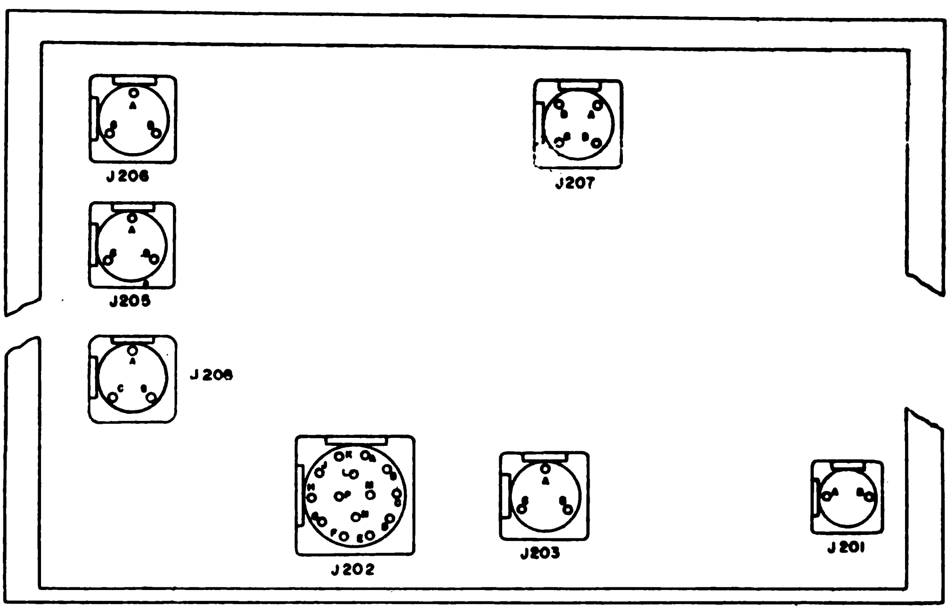

Figure 105. Power indicator section receptacle pin positions.

e. Amplifier-rectifier Power Unit.

See figures 100 and 106 for pin locations.

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
V401	1	Chassis		0
	2	Chassis		0
	3	Chassis		0
	4	Chassis	Vary DEFL. SENS. control	0 to 2 meg
	5	Chassis	Vary CIRCLE DIA. control	50 to 550
	6	Chassis		15 K
	7	Chassis		0
	8	Chassis		11 K
V402	2	Chassis		11 K
	3	Chassis		310
	5	Chassis		310
	7	Chassis		11 K
	8	Chassis		10.7 K
V403	1	Chassis		0
	4	Chassis		0
	Top cap	Chassis		4.6 meg
V404	2	Chassis		0
	4	Chassis		15 K
	5	Chassis		15 K

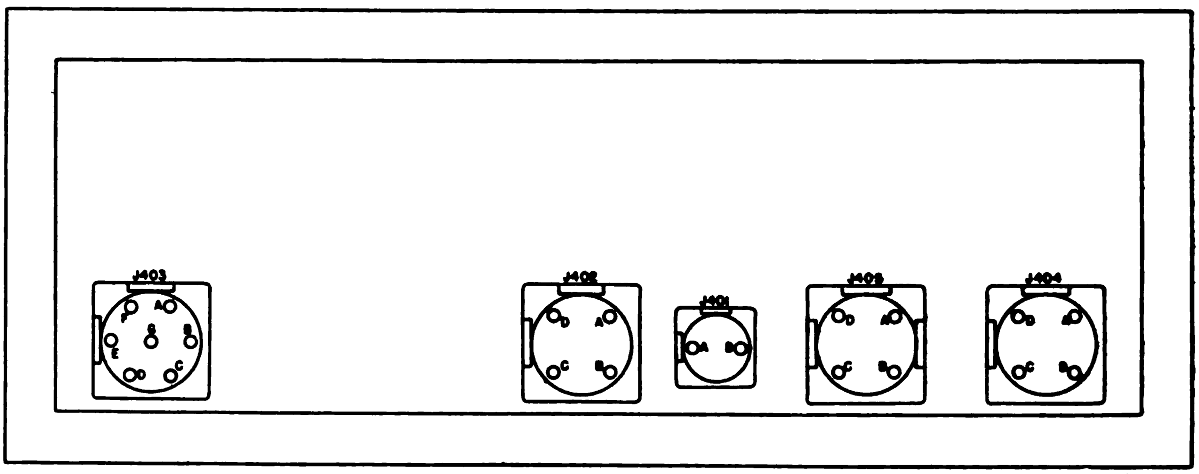

Figure 106. Amplifier-rectifier power unit receptacle pin positions.

e. Amplifier-rectifier Power Unit (contd)

From tube or receptacle	Pin No.	To Conditions	Resistance (ohms)
J401	A	Chassis	0
	B	Chassis	2 meg
J402	A	Pin 8, V401	15 K
	C	Chassis	1.2
	D	Chassis	0

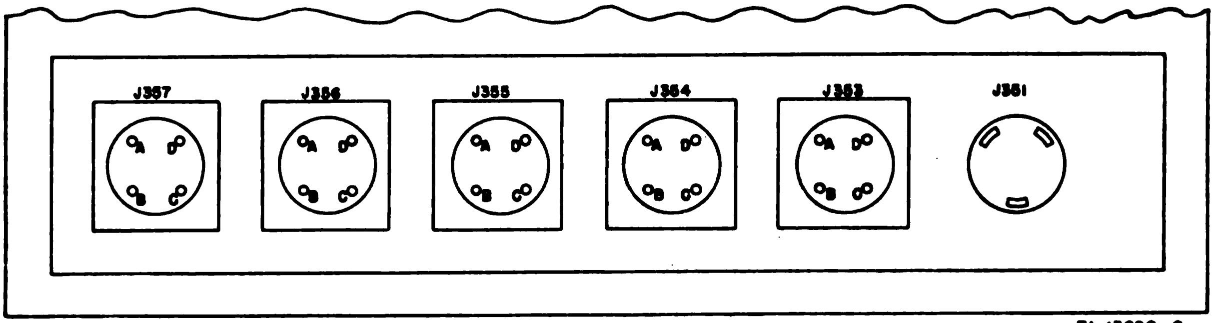

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Figure 107. Control-rectifier power unit receptacle pin positions.

J403	A	Chassis	Infinity
	B	Pin B, J405	0
	C	Pin C, J405	15
	D	Chassis	0
	E	Chassis	10 K
	F	Chassis	Infinity
	G	Pin A, J405	0
J404	A	Chassis	0
	B	Pin C, J404	0.4
	D	Chassis	4 meg
J405	D	Pin A, J405	8.5

f. Junction Box J-99/CRD-3.

See figure 108 for pin locations.

From tube or receptacle	Pin No.	To Conditions	Resistance (ohms)
J451	A	Chassis	0
	B	Pin C, J451	4
J452	A	Chassis	0
	B	Pin C, J452 Turn knob on side clockwise	120

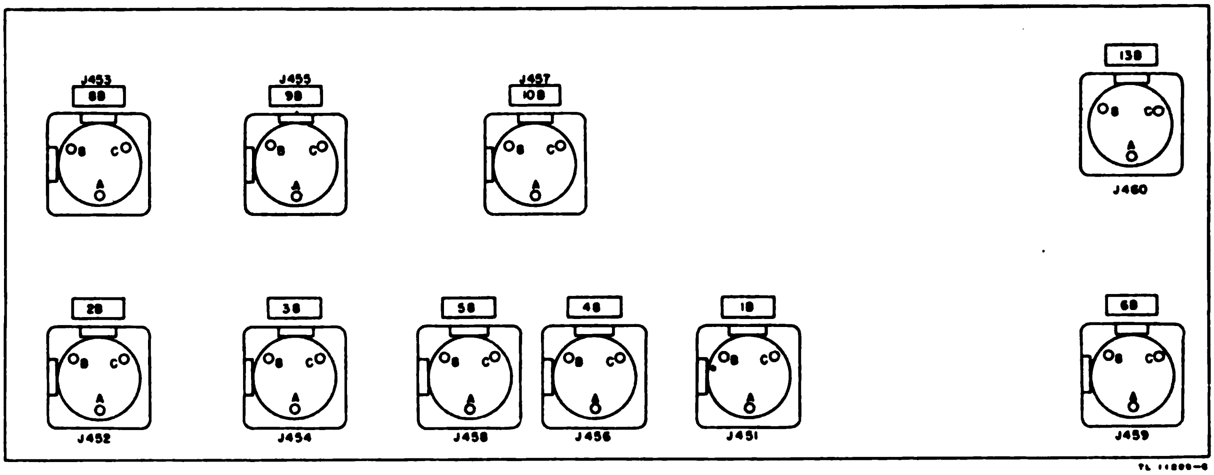


Figure 108. Junction Box J-99/CRD-3 receptacle pin positions.

f. Junction Box J-99/CRD-3 (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
J456	A	Chassis		0
	B	Pin B, J458	Turn knob on side clockwise	0
	C	Pin C, J458		0
J457	A	Chassis		0
	B	Pin B, J458	Turn knob on side	0
	C	Pin C, J458	counterclockwise	0
J458	A	Chassis		0
J459	B	Pin A, J459	Turn knob on side clockwise	2
	C	Pin A, J459	Turn knob on side counterclockwise	2

g. Automatic Bearing Indicator.

See figure 109 for pin locations.

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
	A	Chassis		0
J501	B	Pin C, J501	V501 out of socket	Infinity
	C	Pin D, J501		25 K
	D	Chassis		950 K
	A	Pin E, J502		900
J502	B	Pin G, J502		3
	C	Pin G, J502		0

g. Automatic Bearing Indicator (contd).

From tube or receptacle	Pin No.	To Conditions	Resistance (ohms)
J502	D	Chassis	0
	E	Pin F, J502	900

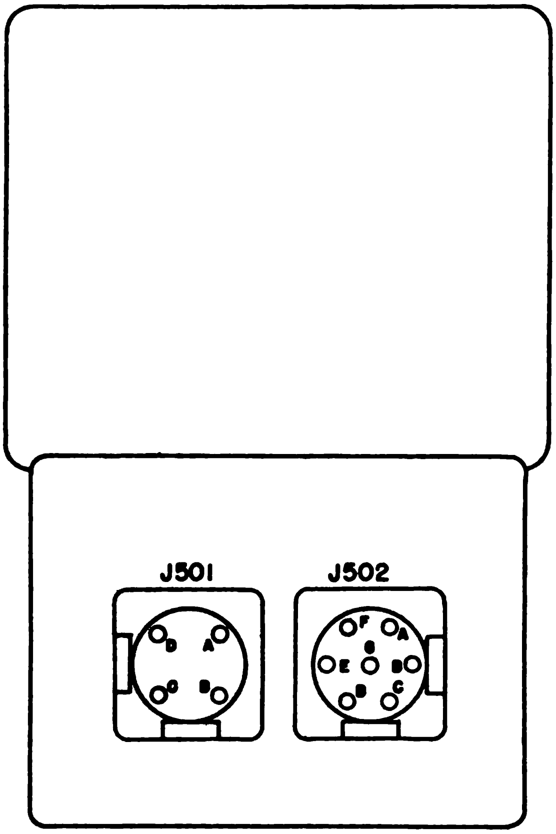


Figure 109. Automatic bearing indicator receptacle pin positions.

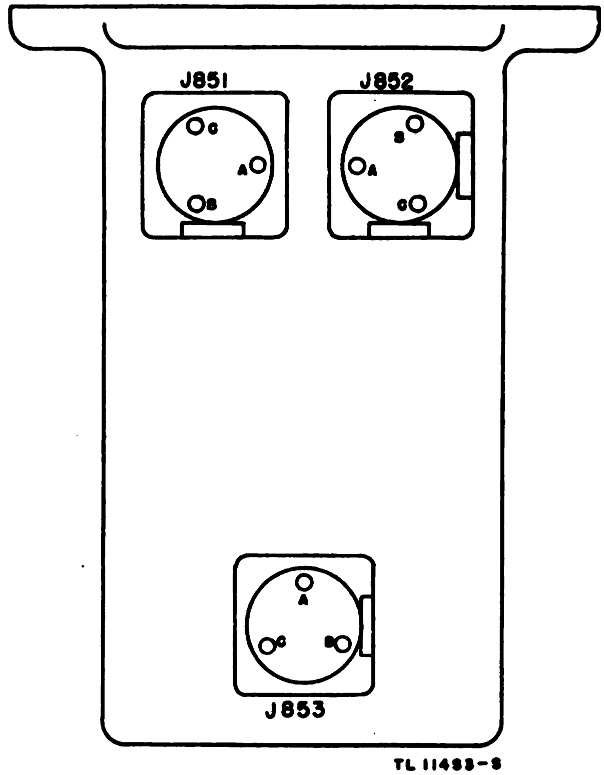


Figure 110. Goniometer receptacle pin positions.

h. Goniometers.

See figure 110 for pin locations.

From tube or receptacle	Pin No.	To Conditions	Resistance (ohms)
J851	A	J851-B	48
	A	J851-C	48
	B	J851-C	3
	A	Chassis	0
	B	Chassis	52
	C	Chassis	52
	A	J852-B	52

h. Goniometers (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
J852	A	J852-C		52
	B	J852-C		3
	A	Chassis		0
	B	Chassis		52
	C	Chassis		52
J853	B	J853-C		1
	A	Chassis		0

i. OAN Test Oscillator.

See figure 102 for pin locations.

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
V601	1	Chassis	All tubes in sockets,	0
	2	Chassis	BATT. switch OFF.	0
	3	Chassis		0
	4	Chassis		33 K
	5	Chassis		0
	6	Chassis		200 K
	7	Chassis		0.2
	8	Chassis		136 K
V602	1	Chassis		0
	2	Chassis		0
	3	Chassis		0
	4	Chassis		100 K
	5	Chassis		0
	6	Chassis		110 K
	7	Chassis		0.2
	8	Chassis		100 K
V604	2	Chassis		0
	3	Chassis		550
	5	Chassis		550
	7	Chassis		0.2
	8	Chassis		100 K
J601	A	Chassis		0
	B	J601-C	A.C. power switch ON	22

i. OAN Test Oscillator (contd).

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
J602	A	Chassis		0
	B	J602-C	OUTPUT CONTROL on MAX.	110
	B	J602-C	OUTPUT CONTROL all other positions	140

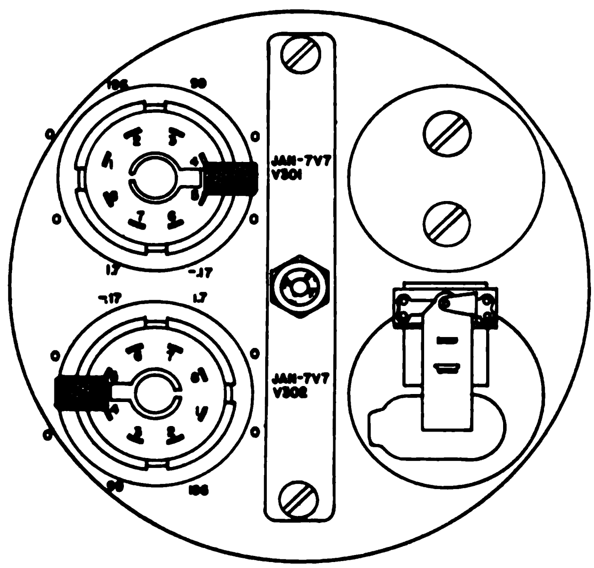
Note: K denotes thousand (38K equals 38,000)

j. Phase Inverters MC-411-A and MC-413-A.

See figures 111 and 112 for pin locations.

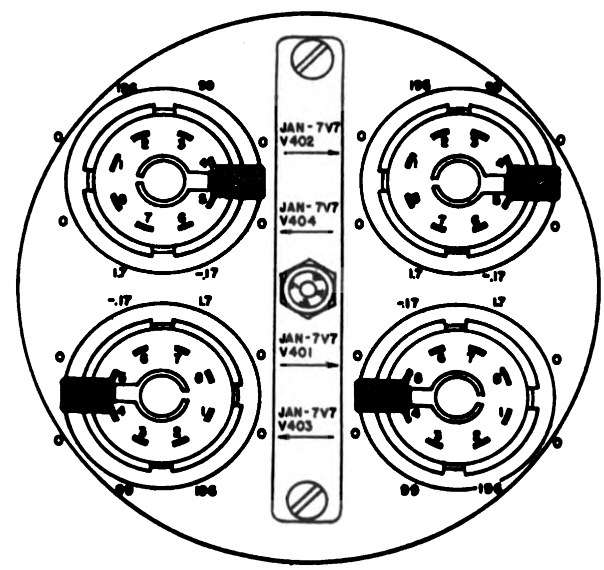
From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
V301*	1	Chassis		Infinity
	2	Chassis		Infinity
	3	Chassis		Infinity
	4	Chassis		0
	5	Chassis		0
	6	Chassis		25,000
	7	Chassis		150
	8	Chassis		Infinity

*Same readings apply to V302, and V401, and V404.



ALL MEASUREMENTS TO CHASSIS WITH ELECTRONIC VOLTMETER.
ALL TUBES IN RESPECTIVE SOCKETS.
PLATE DRAIN 10 MA PER TUBE.

Figure 111. Phase Inverter MC-411-A voltage analysis.



ALL MEASUREMENTS TO CHASSIS WITH ELECTRONIC VOLTMETER.
ALL TUBES IN RESPECTIVE SOCKETS.
TOTAL PLATE DRAIN 20 MA.

Figure 112. Phase Inverter MC-413-A voltage analysis.

k. Control-Rectifier Power Unit PP-135/CRD-3.

See figures 103 and 107 for pin locations.

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
	1		No connection	
	2	Chassis		0.2
	3	V351 pin 8		990
	4	V351 pin 8		990
	5	V351 pin 4		60
	5	V351 pin 6		60
	5	Chassis		200
	7	Chassis		0
V352	8	Chassis		0
	4	J355 pin E	Vary SENSE GAIN control	0-10,500
	4	J353 pin E	0° switch ON, vary 0° BALANCE ADJUSTMENT	0-10,500
	4	J354 pin E	180° switch ON, vary 180° BALANCE ADJUSTMENT	0-10,500
	4	J356 pin E	90° switch ON, vary 90° BALANCE ADJUSTMENT	0-10,500
	4	J357 pin E	270° switch ON, vary 270° BALANCE ADJUSTMENT	0-10,500
	2	V351 pin 8		0.1
V351	4	Chassis		260
	6	Chassis		260

SECTION XII

REPAIRS

115. GENERAL.

Be careful in maintaining and servicing this equipment. Servicing and repair, other than replacement of tubes (except the cathode-ray tubes) should be performed only by competent personnel equipped with adequate tools and instruments. An inexperienced operator attempting to locate and repair troubles may damage the equipment to such an extent that shipment to a higher repair echelon will be necessary. This is particularly true of indiscriminate adjustment of some of the frequency alignment capacitors. Most of the parts in Radio Set AN/CRD-3 are readily accessible and are easily replaced if they are faulty. However, there are several exceptions, notably the cathode-ray tube in the automatic bearing indicator. Before attempting repairs, make every effort to obtain the proper tools for the job.

116. REPLACEMENT OF PARTS IN RECEIVER ASSEMBLY.

a. Replacing Potentiometer Controls and Switches.

(1) Remove bottom cover plate if necessary.

(2) Remove knob after loosening setscrews with Allen head wrench.

(3) Unsolder connections one at a time, and tag them to insure proper reconnection.

(4) Remove hexagon nuts and washers from shaft bushings and remove unit from panel.

(5) Mount replacement unit, replace washers and hexagon nuts, and resolder connections.

(6) Replace bottom cover plate.

b. Replacing I-f Transformer Components.

(1) Remove bottom cover plate.

(2) Remove two tap screws and lift the shield from the required transformer assembly associated with coils L201 to L206, L111 to L113 (figs. 131 and 132).

(3) Remove the nearby tubes.

(4) Before unsoldering any leads make a sketch showing all connections and record color codes of associated leads, or tag them for identification.

(5) Place the receiver on its left side while soldering or unsoldering.

(6) It may be found more convenient to remove the entire assembly for repair. To do this, disconnect under chassis connections for the assembly in question, being careful to identify all terminals and leads for reconnection, and remove frame mounting nuts.

(7) All assemblies may be removed directly after connections are unsoldered.

c. Removing R-f, Mixer, or H-f Oscillator Coil Assemblies.

(1) Remove the bottom cover plate.

(2) Remove the shield holding the nut on the top center of the shield can (fig. 114).

(3) Remove the connections from lugs on bottom coil assembly, tagging each for identification.

(4) Remove the nuts, washers, and bushings holding the coil to the chassis (fig. 114).

(5) Remove the coil.

d. Replacing Main Tuning Capacitor. Do not remove the main tuning capacitor unless it is absolutely necessary. Access to the interior of the capacitor may be obtained without removing the capacitor from the chassis. Remove only the capacitor shield. If main tuning capacitor must be removed, proceed as follows:

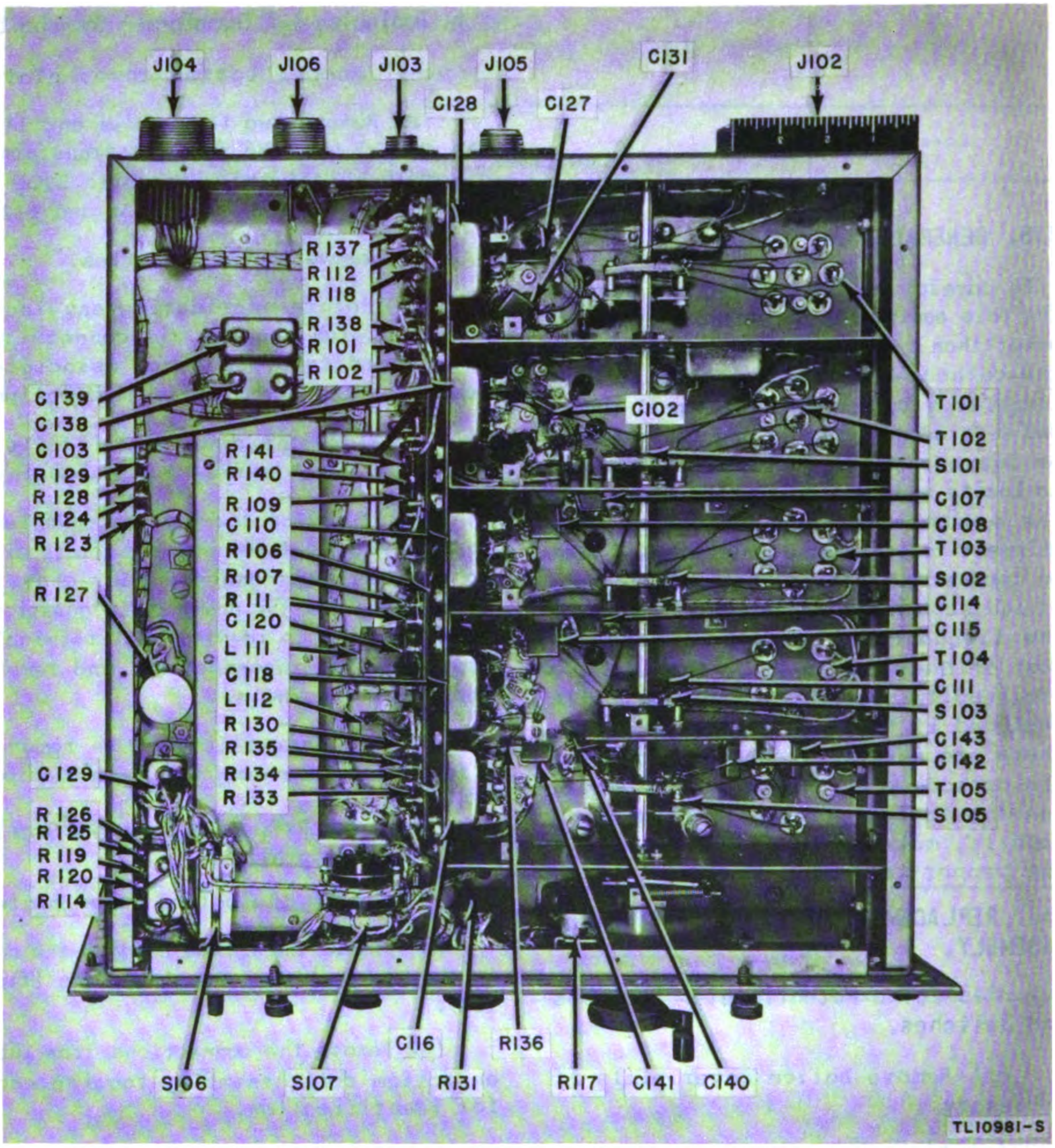


Figure 113. Modulator section of Radio Receiver Assembly R-128/CRD-3, bottom view showing parts location.

(1) Remove the bottom cover plate.

(2) Loosen the two Allen head screws securing the counterweighted coupling to the capacitor shaft and drive out the taper pin. Be sure to drive the small end of the taper pin. To determine which end is the smaller, test each one with a few light hammer blows.

(3) Disconnect all wiring to the five stator terminals and unsolder the five rotor-grounding braided leads from the chassis ground terminals.

(4) The capacitor is secured to the chassis by three fillister-head machine screws, one at the rear and two at the front. The screws are ac-

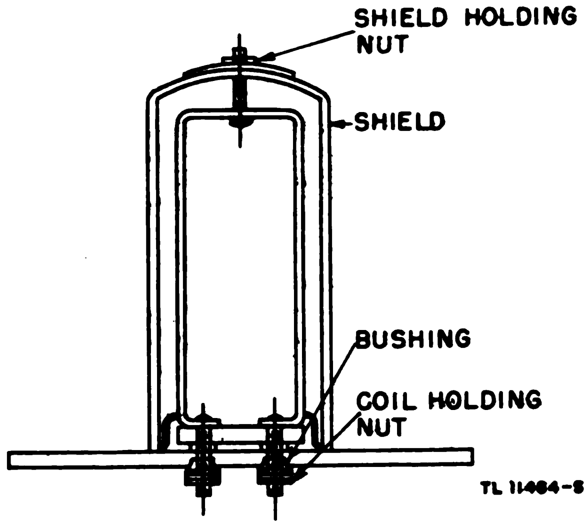


Figure 114. R-f coil removal detail.

cessible from the bottom side of the chassis. Each mounting screw passes through an adjustable mounting device which permits precise control of elevation and alignment of the tuning capacitor shaft with the drive shaft. The adjustment of these mountings has been carefully made at the factory for the particular capacitor in the receiver; the adjustment is locked by the large hexagon nut. To remove the capacitor, remove the fillister-head machine screws. Don't loosen the mounting locknut.

(5) Turn the chassis on the right side (as seen facing the panel), place the left hand under the rear of the

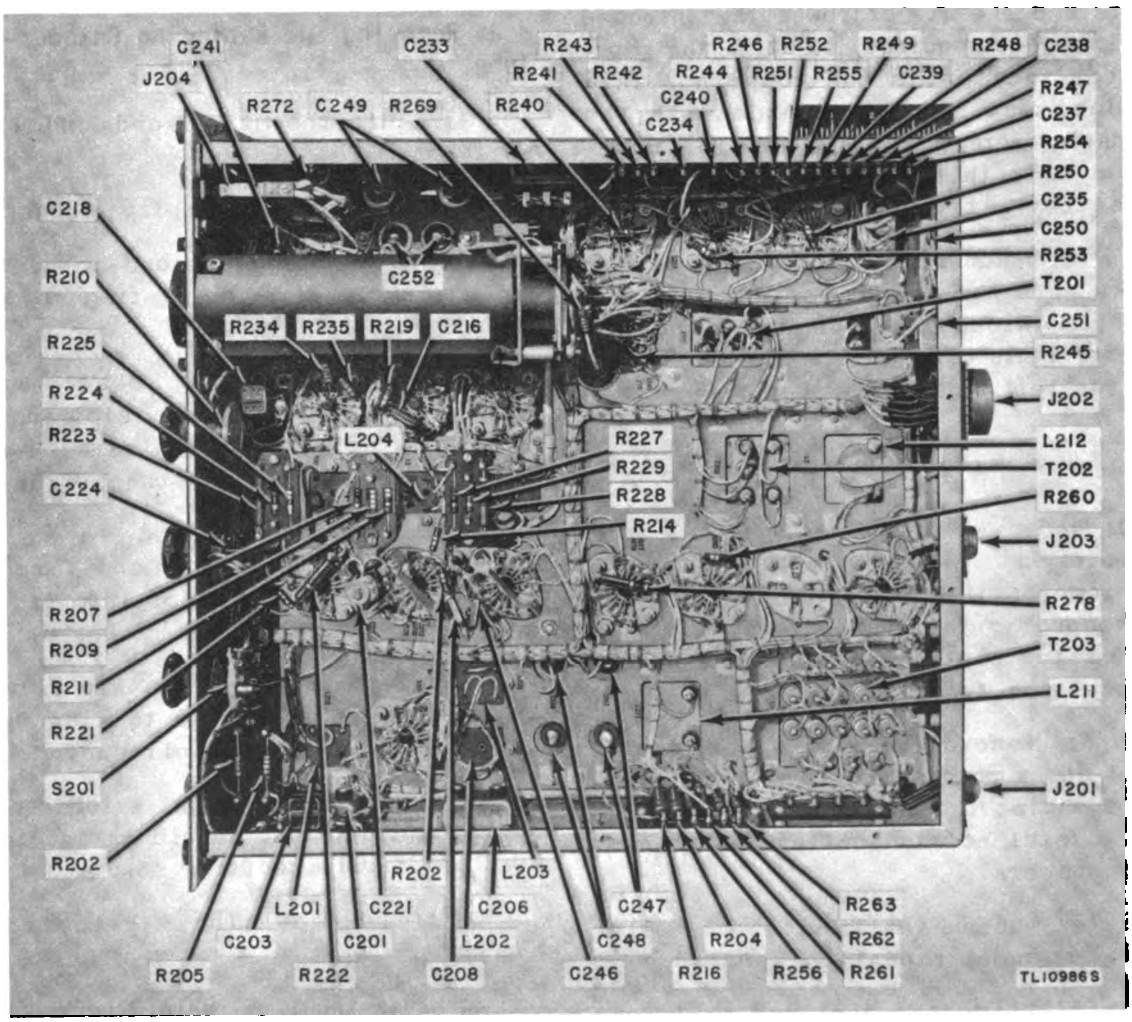


Figure 115. Power indicator section of Radio Receiver Assembly R-128/CRD-3, bottom view showing parts location.

main tuning capacitor and remove the rear mounting screw.

(6) Holding the rear of the capacitor to avoid strain on the shafts, turn the chassis on its base (that is, to the normal operating position) allowing the front edge of the chassis to overhang the edge of the table by a few inches. Remove the two front capacitor-mounting machine screws with the chassis in this position to avoid strains on the capacitor and drive shafts.

(7) Slide the capacitor directly to the rear and lift it up and out.

(8) If a new capacitor is to be installed, it may be necessary to readjust the height of the three mounting assemblies. To do this, loosen the locknuts and elevate or lower the threaded spacers, as required, to align the capacitor shaft with the coupling. This adjustment should be made with the mounting screws in place, but not tightened; for this operation the chassis must be resting on its base.

(9) When rewiring the capacitor, take care not to drop solder into the plates through the terminal clearance holes; it is advisable to lay the chassis on its left side when soldering.

e. Removing Receiver Goniometer.

In order to remove the receiver goniometer, it is necessary to release the goniometer dial and drive shaft before disengaging the thumbscrews. With the modulator section out of the cabinet, proceed as follows:

(1) Remove the plastic goniometer dial index pointer from the front panel by removing the two screws (fig. 129). Be careful not to scatter the washers and spacers.

(2) Loosen the front shaft collar by loosening the Allen head screws.

(3) Slide the dial and shaft out sufficiently for the shaft to clear the goniometer coupling.

(4) Loosen the goniometer thumbscrews and swing them clear.

(5) Remove the goniometer by pulling it straight up.

(6) After the goniometer is replaced check its mechanical alignment (par. 131b).

117. REPLACEMENT OF PARTS IN AUTOMATIC BEARING INDICATOR.

CAUTION: WHEN THE COVER ON TOP OF THE INDICATOR IS OPENED, CIRCUITS CARRYING VOLTAGES DANGEROUS TO HUMAN LIFE ARE EXPOSED. NEVER OPEN THIS COVER BEFORE TURNING THE AMPLIFIER OR MASTER SWITCH OFF EXCEPT AS SPECIFICALLY DIRECTED.

a. Removing and Replacing Cathode-ray Tube.

(1) Turn the MASTER and AMPLIFIER switches OFF.

(2) Swing back the optical housing.

(3) Grasp the tube and carefully pull it out by working it from side to side very slightly.

(4) In replacing it observe the position of the socket key slot in the tube housing, orient the cathode-ray tube so the key in the base lines up with the socket slot.

(5) Insert the tube and turn it slowly until the key slips into place. *Don't force it.*

(6) Then push the tube in firmly by working it from side to side very slightly until it is well seated.

(7) Release both light shield brake screws and pull the shield as far forward as it will go (fig. 13).

(8) Close and lock the optical housing.

(9) Push the light shield back carefully until it just touches the tube.

(10) Tighten the brake screws.

b. Replacing Flexible Motor Coupling.

(1) To replace the leather pad, remove the four screws in the pad. Loosen the setscrew on the motor half of the coupling. Insert the new pad, replace the screws, and lock the setscrew on the motor shaft.

(2) If the entire flexible coupling

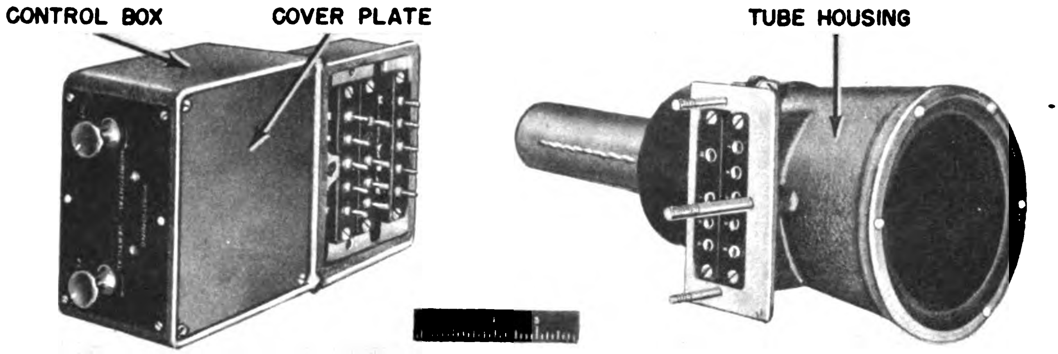


Figure 116. Control-box and cathode-ray tube housing showing controls and connecting pins.

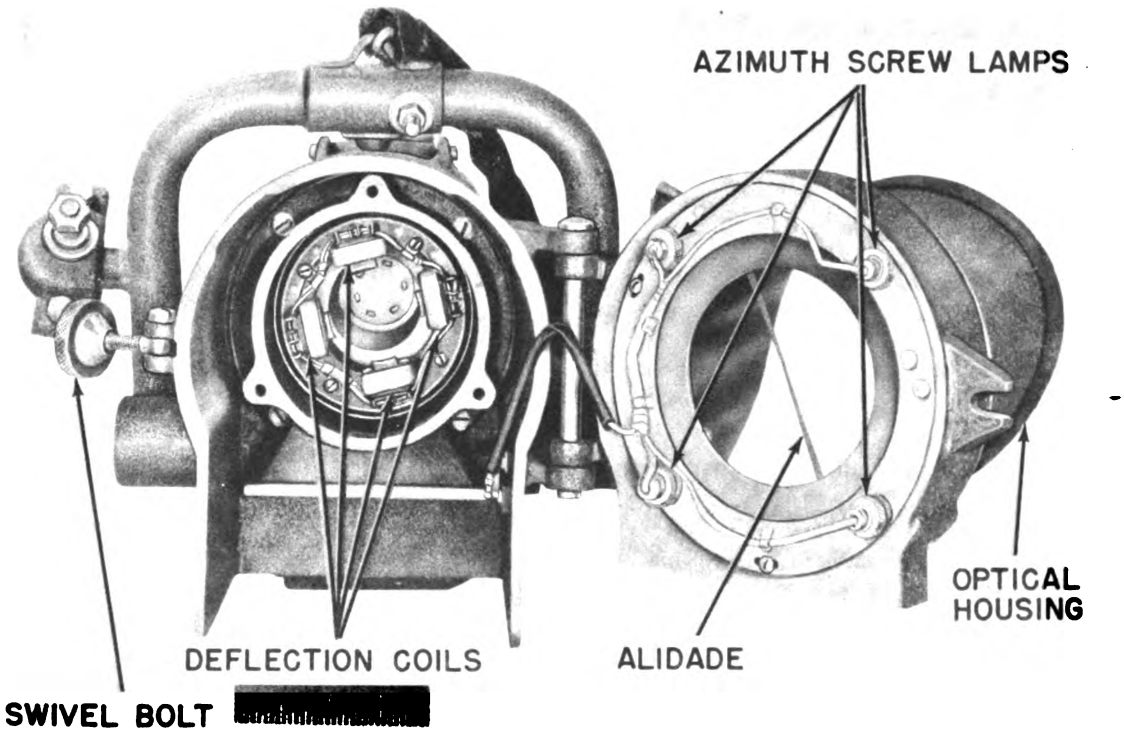


Figure 117. Bearing Indicator ID-121/CRD-3 (without cathode ray tube housing) showing deflection coils.

assembly must be replaced, remove the rotating assembly and reassemble as outlined in paragraph 118.

(3) Realign the goniometer (par. 131a).

c. Replacing Deflection Coils.

(1) Turn OFF all power switches.

(2) Turn back the optical housing, the drop control box, and remove the tube and tube housing.

(3) Open the top cover of the automatic bearing indicator and check the continuity of the deflection coils across the coil terminals. A reading of infinity indicates an open coil.

(4) Unsolder the leads to the defective coil and tag them so there will be no mistake in connecting them to the proper terminals of the replacement coil.

(5) Straighten the bent lamination, holding the coil by pressing on it with a screwdriver from the front of the indicator, and remove the coil.

(6) Insert the new coil and secure it by bending over the front lamination as before and resolder the leads to the terminals.

(7) Replace the tube housing and cathode-ray tube, attach the control box, and close the optical housing.

(8) Check the goniometer alignment (par. 131).

118. REMOVING SLIP RING ECCENTRICITY IN AUTOMATIC BEARING INDICATOR.

a. To check for eccentricity, observe the protruding arm of the brush pressure spring while the indicator is running. If the spring remains stationary in its slot, the slip ring is concentric within the allowable limits. Any receptible movement of the brush pressure spring arm is an indication of eccentricity and immediate steps should be taken to restore the slip to its original concentric shape. Figure 18 illustrates such an adjustment of the slip rings. Proceed as follows:

(1) Throw the MOTOR, MASTER, and AMPLIFIER switches OFF.

(2) Rotate the slip rings until the *high spot* of eccentricity is located and this *high spot* is in an accessible position.

(3) Place the end of a rod of bakelite, or other nonmetallic material with a square smooth end on the *high spot* of the ring and lightly tap the other end of the rod.

(4) Recheck the high spot, and if necessary repeat the above procedure until there is no movement of the brush spring arm during the full rotation of the slip ring.

b. Occasionally the eccentricity of the slip rings cannot be removed by the above described method. In such cases the slip rings must be machined in a lathe. Proceed as follows:

(1) Swing back the optical housing, lower the control box and remove the tube and tube housing (figs. 116 and 117).

(2) Remove the screws from the leather pad of the flexible motor coupling holding axle and worm coupling (fig. 127).

(3) Remove the front and rear top bearing housings and lift out the rotating assembly.

(4) Remove the axle and worm coupling and mount the rear shaft of the rotating assembly in a lathe, being careful not to damage the gear on the shaft.

(5) Clamp the front of the assembly by means of the front oilite bearing in a lathe center rest, and carefully machine all three slip rings just enough to remove eccentricity. Exercise care in tightening the steady support so as to prevent damage to the bearing.

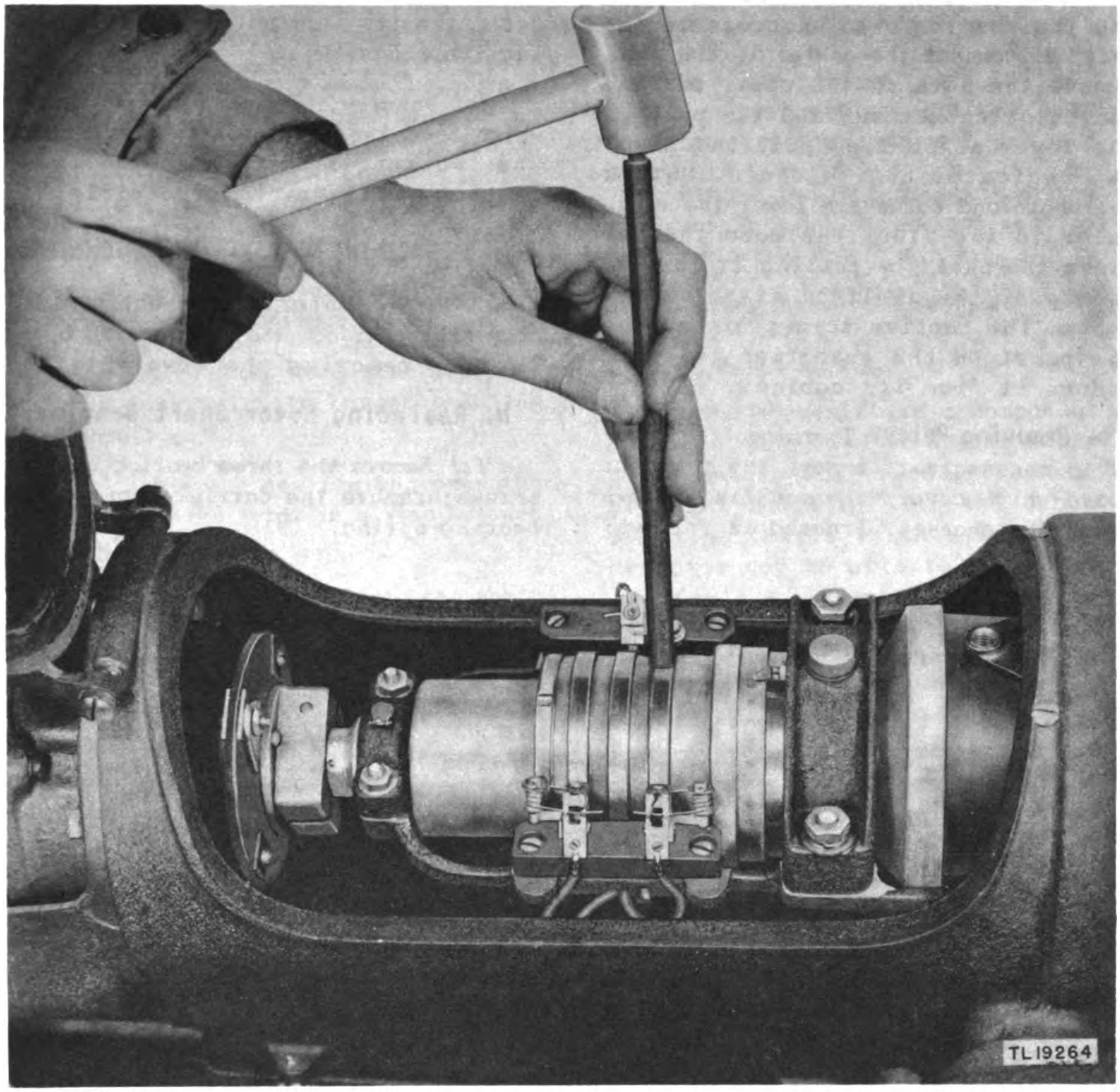


Figure 118. Deflection coil assembly, removing eccentricity.

(6) Polish the rings before removing from the lathe as described in paragraph 58.

(7) Remove the rings from the lathe and attach the axle and worm coupling, carefully seating the guide spacer in the slot under the locking screw.

(8) Reassemble in the bearing indicator, being careful to fit the pin next to the oil hole in the front bearing housing into the slot in the oilite bearing.

(9) Be very careful to properly shim the front bearing housing so as not to jam the oilite bearing.

(10) Check the brush spring pressure (par. 58).

(11) Realign the goniometer (par. 131).

119. REPLACEMENT OF PARTS IN AMPLIFIER-RECTIFIER POWER UNIT PP-151/CRD-3.

a. General. Amplifier-rectifier Power Unit PP-151/CRD-3 is in a cabinet (on a shelf) to the rear of the automatic bearing indicator. To gain access to the unit, disconnect the cables at the rear, remove the nuts on the upper bearing indicator shockmount and the pins on the lower supporting rod, and lower the indicator on its chain. Unlock the chain and carefully lower the indicator to the floor. Release the bar under the shelf by pulling it forward and lower the shelf on its bracket. Loosen the captive screws around the the panel on the rectifier unit and remove it from its cabinet.

b. Removing Relay. To remove the relay it is necessary to remove the resistor board which covers the mounting screws under the chassis. Proceed as follows:

(1) Carefully unsolder resistor R413 from its terminals without damaging its leads.

(2) Unscrew the four flathead screws which hold the board to its insulators. The two screws which hold the relay in place will now be accessible.

120. REPLACEMENT OF PARTS IN GONIOMETERS.

a. General. Interior connections are accessible through the side or top openings by removing the cover plates.

b. Replacing Rotor Shaft Bearings.

(1) Remove the three bearing carrier screws; remove the carrier, rotor, and bearing spring.

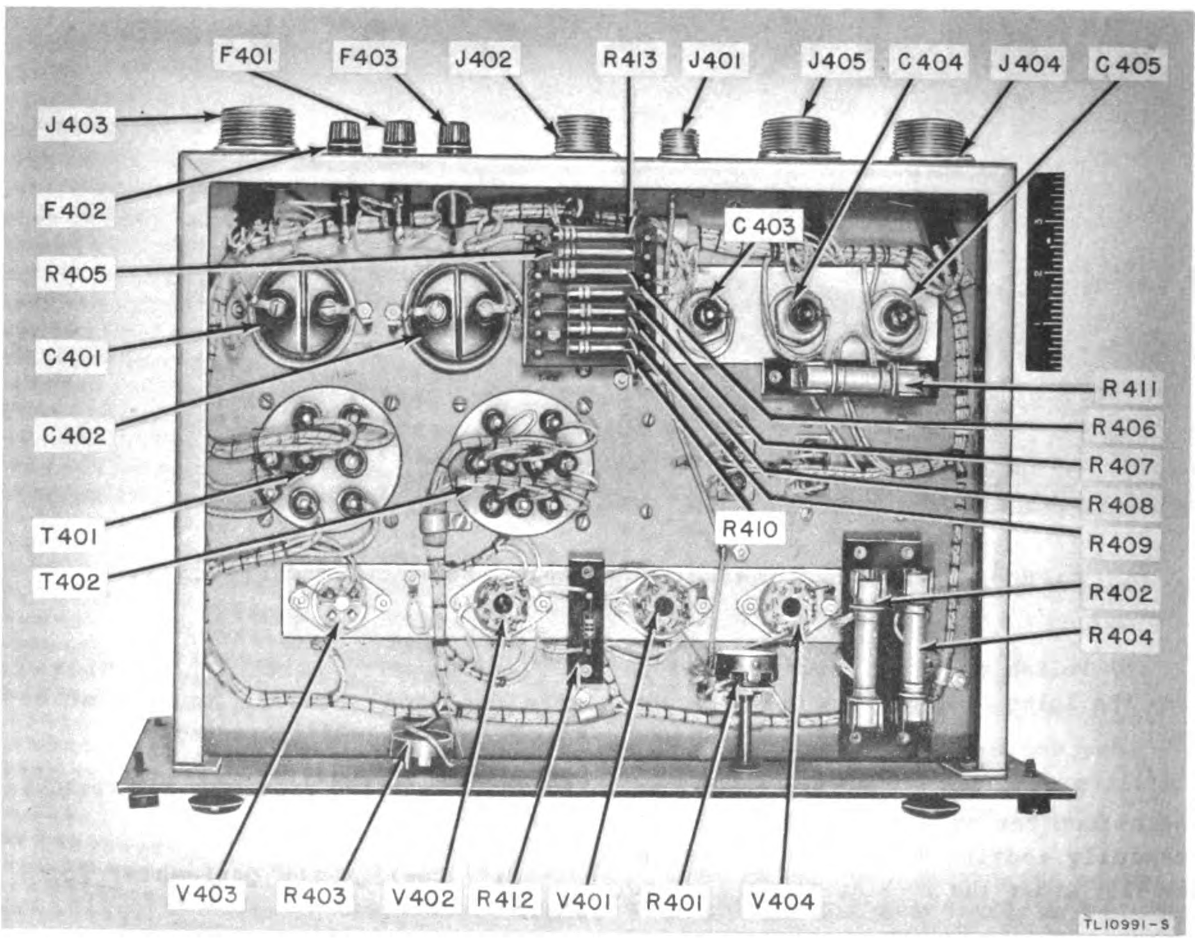


Figure 119. Amplifier-Rectifier Power Unit PP-151/CRD-3, bottom view showing parts location.

(2) Drive out the taper pin holding the coupling to the shaft, and remove the coupling and front bearing carrier.

(3) Pull off the bearing, using a wheel puller if necessary. Use proper precautions to prevent damage to the shaft and bearing seat.

(4) Clean the shaft and bearing spring with a clean piece of cheese cloth saturated with carbon tetrachloride.

(5) Prepare two wood blocks with a hole in each slightly larger than the rotor shaft.

(6) Slide the new bearing over the shaft. Mount the rotor in a vise between the two blocks.

(7) Force the bearing onto the shaft by tightening the vise slowly until the bearing makes contact with the shoulder.

(8) Reassemble the front bearing carrier and coupling to the shaft.

(9) Replace the bearing spring and rotor into the goniometer housing and replace the screws.

(10) After assembly, press on the projecting end of the shaft with sufficient finger pressure to compress the flat spring under the rear bearing. When properly assembled the bearing must be free enough in the housing to permit the shaft to return to its original position when the pressure is removed.

121. REMOVING ROTARY SWITCH WAFER IN JUNCTION BOX J-99/CRD-3.

a. Loosen the Allen head setscrew and remove the knob (fig. 121) on the side of the junction box.

b. Unscrew the hexagon nut on the shaft bushing and remove the bushing.

c. Loosen the Allen head setscrews in the front shaft coupling and remove the shaft extension, coupling, washers, and hexagon nut.

d. Loosen the Allen head setscrews on the end shaft coupling and slide the switch shaft out through the wafer sections and hole in the junction box.

e. Unsolder connections to the defective wafer switch section, tagging each for proper replacement.

f. Remove nuts, screws, washers and bushings holding the switch section to the partition.

g. Remove the switch section.

122. EMERGENCY REPAIR.

Trouble may exist in a component of Radio Set AN/CRD-3 at a time when the equipment is most vitally needed. By becoming familiar with the trouble-shooting charts in this manual, the operator may be able to sectionalize the fault to a specific component. Since spare antenna assemblies, antenna mooring platforms, counterpoises, goniometers, Junction Boxes JB-91-A, phase inverters, and a spare power unit are provided, rapid emergency repairs can be effected by substituting a unit in good condition for a faulty one.

123. RUSTPROOFING AND REPAINTING.

When the finish on the case or panel has been scarred or damaged, rust and corrosion can be prevented by touching up the bared surface as follows:

a. Use #00 or #000 sandpaper to clean the surface down to the bare metal. Obtain a bright, smooth finish.

b. When a touch-up job is necessary, apply paint with a small brush. If numerous scars and scratches warrant complete repainting remove the unit to be painted and paint it with a spray gun or a brush. Remove rust by cleaning corroded metal with dry-cleaning solvent (SD). In severe cases it may be necessary to use dry-cleaning solvent (SD) to soften the rust, and sandpaper to complete the preparation for painting.

124. UNSATISFACTORY EQUIPMENT REPORT.

a. When trouble in equipment used by Army Ground Forces or Army Service

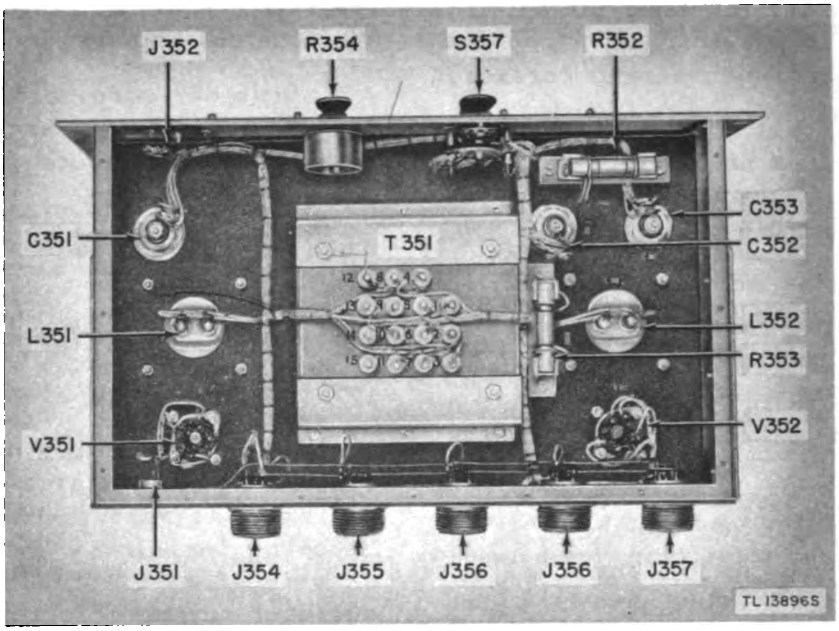


Figure 120. Control-Rectifier Power Unit PP-135/CRD-3, bottom view showing parts location.

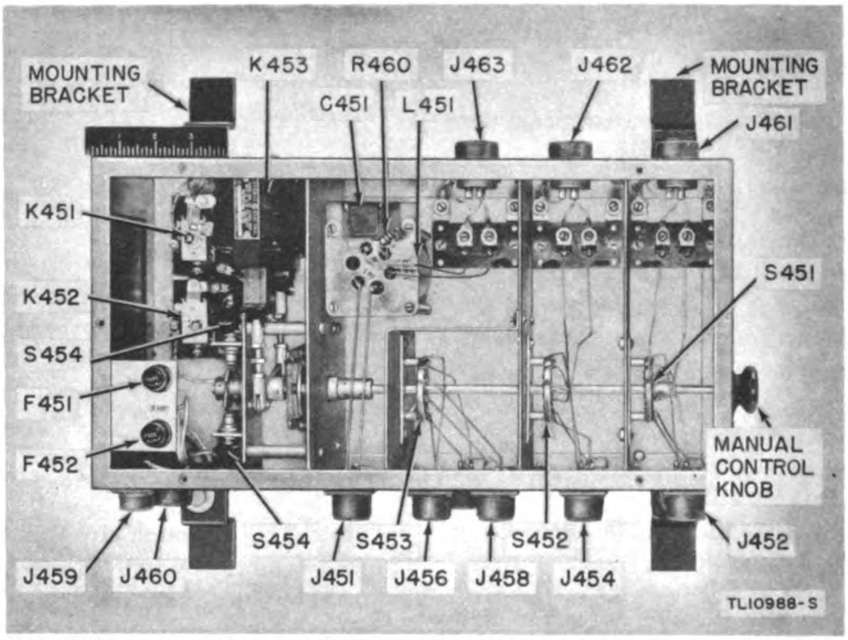


Figure 121. Junction Box J-99/CRD-3, front view without cover showing parts location.

Forces occurs more often than repair personnel feel is normal, War Department Unsatisfactory Equipment Report, W.D., A.G.O. Form No. 468 should be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D. C.

b. When trouble in equipment used by Army Air Forces occurs more often than repair personnel feel is normal, Army Air Forces Form No. 54 should be filled out and forwarded through channels.

c. If either form is not available, prepare the data according to the sample form reproduced in figure 124.

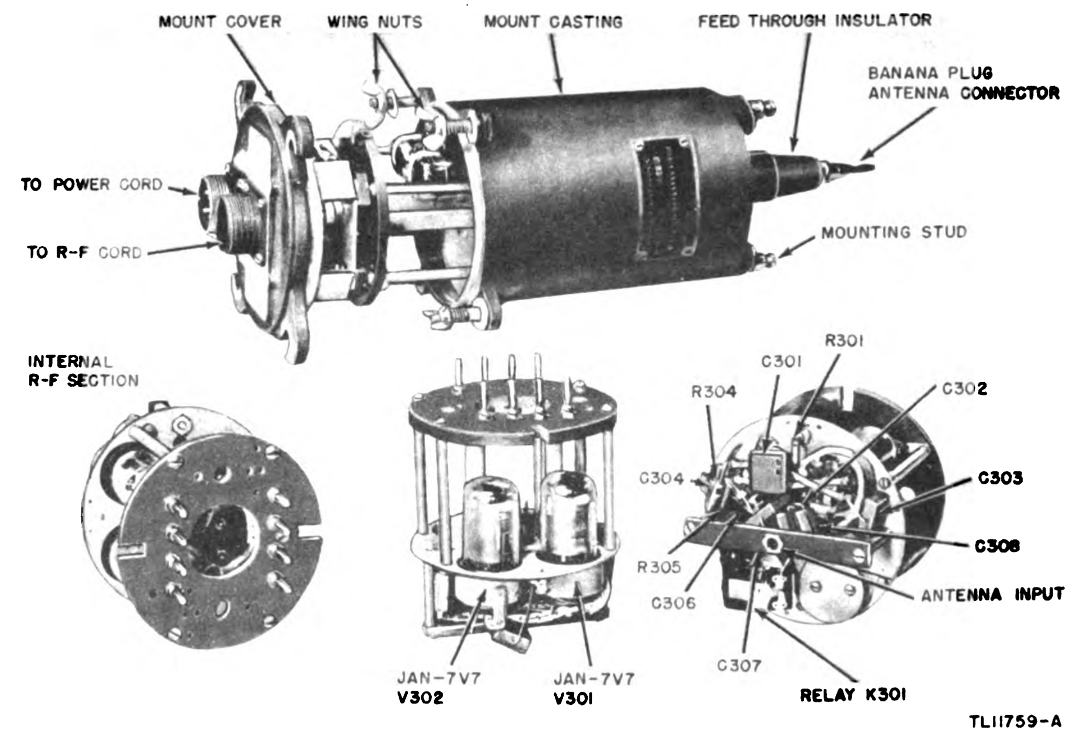


Figure 122. Phase Inverter MC-411-A, component locations.

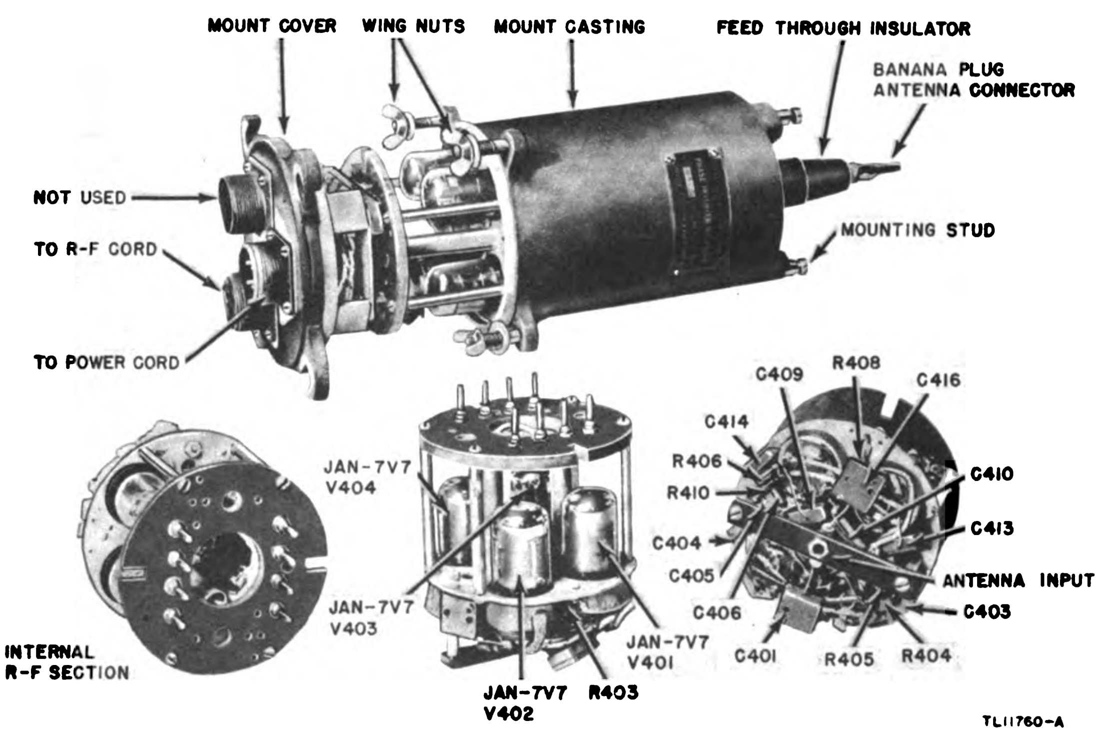
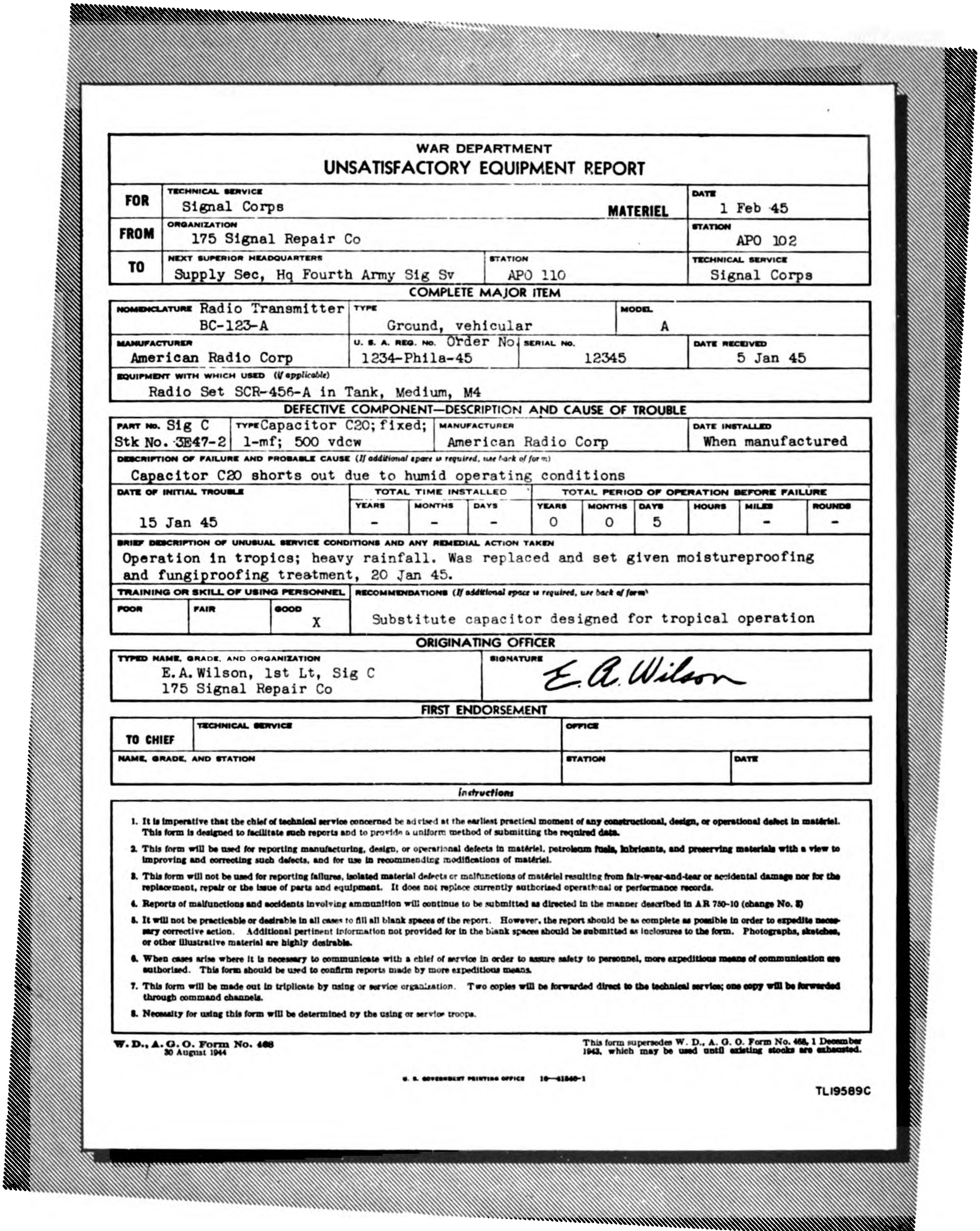


Figure 123. Phase Inverter MC-413-A, component locations.



WAR DEPARTMENT

UNSATISFACTORY EQUIPMENT REPORT

FOR	TECHNICAL SERVICE: Signal Corps	**MATERIEL**	DATE: 1 Feb 45
FROM	ORGANIZATION: 175 Signal Repair Co		STATION: APO 102
TO	NEXT SUPERIOR HEADQUARTERS: Supply Sec, Hq Fourth Army Sig Sv	STATION: APO 110	TECHNICAL SERVICE: Signal Corps

COMPLETE MAJOR ITEM

NOMENCLATURE: Radio Transmitter BC-123-A	TYPE: Ground, vehicular	MODEL: A	
MANUFACTURER: American Radio Corp	U. S. A. REG. NO. Order No. 1234-Phila-45	SERIAL NO. 12345	DATE RECEIVED: 5 Jan 45

EQUIPMENT WITH WHICH USED (If applicable): Radio Set SCR-456-A in Tank, Medium, M4

DEFECTIVE COMPONENT—DESCRIPTION AND CAUSE OF TROUBLE

PART NO. Sig C Stk No. 3E47-2	TYPE Capacitor C20; fixed; 1-mf; 500 vdcw	MANUFACTURER: American Radio Corp	DATE INSTALLED: When manufactured

DESCRIPTION OF FAILURE AND PROBABLE CAUSE (If additional space is required, use back of form): Capacitor C20 shorts out due to humid operating conditions

DATE OF INITIAL TROUBLE	TOTAL TIME INSTALLED			TOTAL PERIOD OF OPERATION BEFORE FAILURE					
	YEARS	MONTHS	DAYS	YEARS	MONTHS	DAYS	HOURS	MILES	ROUNDS
15 Jan 45	-	-	-	0	0	5		-	-

BRIEF DESCRIPTION OF UNUSUAL SERVICE CONDITIONS AND ANY REMEDIAL ACTION TAKEN: Operation in tropics; heavy rainfall. Was replaced and set given moistureproofing and fungiproofing treatment, 20 Jan 45.

TRAINING OR SKILL OF USING PERSONNEL			RECOMMENDATIONS (If additional space is required, use back of form)
POOR	FAIR	GOOD	
		X	Substitute capacitor designed for tropical operation

ORIGINATING OFFICER

TYPED NAME, GRADE, AND ORGANIZATION: E.A. Wilson, 1st Lt, Sig C, 175 Signal Repair Co	SIGNATURE: E. A. Wilson

FIRST ENDORSEMENT

TO CHIEF	TECHNICAL SERVICE	OFFICE	
NAME, GRADE, AND STATION		STATION	DATE

Instructions

1. It is imperative that the chief of technical service concerned be advised at the earliest practical moment of any constructional, design, or operational defect in matériel. This form is designed to facilitate such reports and to provide a uniform method of submitting the required data.
2. This form will be used for reporting manufacturing, design, or operational defects in matériel, petroleum fuels, lubricants, and preserving materials with a view to improving and correcting such defects, and for use in recommending modifications of matériel.
3. This form will not be used for reporting failures, isolated material defects or malfunctions of matériel resulting from fair-wear-and-tear or accidental damage nor for the replacement, repair or the issue of parts and equipment. It does not replace currently authorized operational or performance records.
4. Reports of malfunctions and accidents involving ammunition will continue to be submitted as directed in the manner described in AR 750-10 (change No. 3)
5. It will not be practicable or desirable in all cases to fill all blank spaces of the report. However, the report should be as complete as possible in order to expedite necessary corrective action. Additional pertinent information not provided for in the blank spaces should be submitted as inclosures to the form. Photographs, sketches, or other illustrative material are highly desirable.
6. When cases arise where it is necessary to communicate with a chief of service in order to assure safety to personnel, more expeditious means of communication are authorized. This form should be used to confirm reports made by more expeditious means.
7. This form will be made out in triplicate by using or service organization. Two copies will be forwarded direct to the technical service; one copy will be forwarded through command channels.
8. Necessity for using this form will be determined by the using or service troops.

W. D., A. G. O. Form No. 468
30 August 1944

This form supersedes W. D., A. G. O. Form No. 468, 1 December 1943, which may be used until existing stocks are exhausted.

U. S. GOVERNMENT PRINTING OFFICE 16—41840-1

TL19589C

Figure 124. Unsatisfactory Equipment Report.

SECTION XIII

ALIGNMENT AND ADJUSTMENT

125. INITIAL ALIGNMENT.

The following alignment must be performed after installation, and before placing the equipment in service. Read section IV to become familiar with the performance of the equipment before proceeding with these instructions.

a. Start Radio Set AN/CRD-3 according to instructions given in paragraph 27.

b. Check the line voltage (par. 126).

c. Check the preliminary adjustments of the radio receiver assembly (par. 128).

d. Check for and remove the bearing indicator magnetization, if any (par. 130).

e. Check the alignment of the goniometers (par. 131).

f. Check the phase inverter balance (par. 129).

126. LINE VOLTAGE CHECK.

a. Start Radio Set AN/CRD-3 according to instructions given in paragraph 27.

b. Set SEARCH-INSTANT. BEARING-SENSE switch at SEARCH position.

c. Set SELECTOR SWITCH on the control-rectifier power unit at SENSE.

d. Increase the SENSE GAIN on the control-rectifier unit to maximum (clockwise).

e. The line voltage is normal if the PLATE MA ANT COUPLING UNITS meter reads 20 to 30 ma. If the reading is less than 20 or more than 30 ma for both filament switch positions, adjust the output of the power unit accordingly. A reading of approximately one-half the required value on either filament position indicates an inactive tube in sense Phase Inverter MC-413-A.

127. PRELIMINARY ADJUSTMENT OF PHASE INVERTERS.

a. Turn the SEARCH-INSTANT. BEARING SENSE switch to INSTANT-BEARING.

b. Check the 0°, 180°, 90°, and 270° phase inverter plate currents by turning the SELECTOR SWITCH to the 0°, 180° etc positions. Adjust the 0°, 180°, 90°, and 270° screwdriver controls if necessary to obtain the plate current readings recorded when the phase inverters were last balanced (par. 129). Be sure the FIL SWITCH on the control-rectifier power unit is also in the corresponding position (positions 1 or 2).

128. PRELIMINARY ADJUSTMENT OF RADIO RECEIVER ASSEMBLY.

a. **Manual Azimuth Adjustments.**

(1) Set the INDICATION switch at MAN.

(2) Tune in a strong signal.

(3) Adjust the BRILL control for optimum cathode-ray tube intensity.

(4) Set the LINE SPRD. so that lines on the cathode-ray tube screen are approximately 1/16 inch apart.

(5) Adjust the FOCUS control for sharpness of lines.

(6) Set the R.F. GAIN at 0.

(7) Adjust the VERT. ADJ. so that two dots on the cathode-ray tube are just at the top of the screen.

(8) Disconnect the sense input cable at Junction Box J-99/CRD-3.

(9) Turn up the R.F. GAIN, and turn the GONIOMETER to maximum.

(10) Adjust the balanced modulator control (R127) until the two lines on the 2-inch cathode-ray tube screen

are equal. This control is located on the right-hand side of the chassis. If the lines will not equalize, interchange modulator tubes V108 and V109.

(11) Reconnect the sense input cable at Junction Box J-99/CRD-3.

b. Automatic Azimuth Adjustments.

(1) Set the INDICATION switch at INST.

(2) Set the R.F. GAIN at O.

(3) Adjust the INTENSITY control for optimum brilliance of the circular pattern.

(4) Adjust the FOCUS control for a sharp trace.

(5) Adjust the CIRCLE DIA. control for a circle 1/16 inch inside the azimuth scale.

c. Other Adjustments.

(1) To align the sense input stage refer to paragraph 132.

(2) To align the directional input stage refer to paragraph 132.

(3) To adjust the GONI. GAIN stage proceed as follows:

(a) Set the RADIO SELECTIVITY switch at SHARP.

(b) Set the A.V.C.-M.V.C.-C.W. switch at M.V.C.

(c) Set the INDICATION switch at MAN, and adjust SENSE GAIN to mid position.

(d) Tune in a strong signal near 610 KC on band 2.

(e) Adjust the GONIOMETER (inside receiver) until two lines on the receiver cathode-ray tube match in length.

(f) Set the VERT. ADJ. control to bring the two lines to the center of the tube.

(g) Turn the GONIOMETER control off course 15°.

(h) Adjust the GONI. GAIN control until the longer line is approximately twice the length of the shorter line.

(i) Turn down the R.F. GAIN control until the lines become dots.

(j) Reset the VERT. ADJ. to bring the dots to the top of the cathode-ray tube.

(4) To adjust the DEFL. SENS. proceed as follows:

(a) Set the INDICATION switch at NULL.

(b) Set SEARCH-INSTANT. BEARING-SENSE to INSTANT. BEARING.

(c) Tune in a strong signal near 610 kc on band 2.

(d) Adjust the R.F. GAIN control to give a 1-1/2-inch line on the receiver cathode-ray tube.

(e) Switch the INDICATION switch to INST., and adjust the DEFL. SENS. control so that the center of the automatic bearing indicator pattern just comes together.

NOTE: All the adjustments must be checked frequently for optimum equipment performance.

129. PHASE INVERTER BALANCE.

a. With INDICATION switch at INST., and SEARCH-INSTANT. BEARING-SENSE switch at INSTANT. BEARING, set up the OAN test oscillator exactly in line with the north and south antennas at a distance of approximately 800 feet north from the center of the array. Tune the transmitter to a clear channel at 600 kc.

b. Check the goniometer alignment (par. 131).

c. Turn the 0°, 90°, 180°, and 270° switches ON, and adjust the receiver for a good pattern.

d. Set the 0°, 90°, 180°, and 270° screwdriver BALANCE ADJUSTMENTS at approximately the middle of their range.

e. Turn the 0° and 180° switches OFF.

f. Alternately adjust the 90° and 270° BALANCE ADJUSTMENTS, completing approximately half the correction with each control, until the pattern is as nearly circular as possible (largest north-south diameter will probably be 1/4 inch less than east-west diameter). If it is impossible to obtain this circular pattern, check the phase inverter tubes, and check the r-f cords for continuity and shorts. Check for loose or corroded counterpoise ground-strap connections. If balance is still impossible, try a spare phase inverter in either position; then replace the r-f cords one at a time.

g. Record the north and south azimuth scale readings as the receiver is tuned to the transmitter frequencies in clear channels at approximately 250, 450, 750, 1000, and 1500 kc (all antenna switches ON).

h. Move the target transmitter to a similar position exactly in line with the east-west antennas, east of the center of the array, and repeat steps c, e, f, and g, above except that the instructions referring to the 0° and 180° controls now apply to the 90° and 270° controls, and vise versa.

i. Now repeat step g above (all an-antenna switches ON) with the transmitter at the south, west, and 45° positions, at distances approximately 800 feet from the antenna system. Check the sense indication. Refer to the trouble-shooting chart (par. 111) and correct reversed sense indications, if any.

j. If azimuth errors are observed over the operating frequency range, check for loose or corroded counterpoise ground-strap connections. (Poor ground connections may cause errors as high as 6°). Recheck the phase inverter balance and azimuth accuracy. If errors greater than 4° still exist, the site is probably unsuitable for direction finging purposes.

k. Record the phase inverter plate currents after balance by turning the SELECTOR SWITCH on the control-rectifier power unit panel to the 0°, 180° etc. positions. Rebalance the phase inverters with the FIL SWITCH in the other position, and record the phase inverter plate currents for the spare phase inverter circuits.

l. Record the directional phase inverter plate currents for both filament switch positions as follows:

Filament switch position	Phase inverter plate currents			
	0°	180°	90°	270°
1	--	--	--	--
2	--	--	--	--

m. When checking the sense indications, using the target transmitter as the signal source, it is necessary to locate the target transmitter at a distance from the center of the antenna array that is greater than one-quarter wavelength at the operating frequency. Otherwise a reversal of the sense indication will result. Since the output of the target transmitter is considerably less at the lower frequencies where the required distance between the target and the antenna array is greatest, it is recommended that commercial stations of known azimuths be used to check the sense indications at the lower frequencies. If the sense indications are still reversed, refer to paragraph 111.

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130. AUTOMATIC BEARING INDICATOR DEMAGNETIZATION.

a. Check for Magnetism.

(1) Set the equipment in operation (section IV) and tune in a strong signal, preferably continuous wave or one having a minimum of modulation, so as to insure a clear, steady twin-leaf pattern.

(2) If the centers of the twin-leaf trace are offset from one another as in figure 125 some part of the rotating assembly has residual magnetism. The pattern may also be slightly bent as in figure 126.

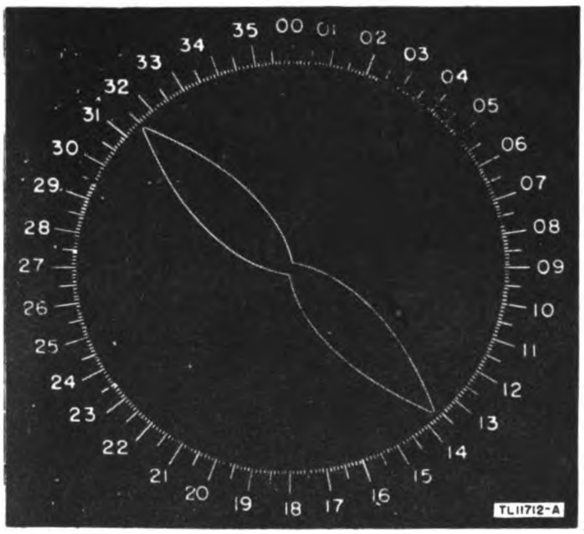

Figure 125. Pattern bent and center points displaced due to residual magnetism in the rotating assembly.

(3) As a further check turn the AMPLIFIER switch OFF. The presence of a small circular trace as shown in figure 126 instead of a dot also indicates residual magnetism in the rotating assembly.

(4) Turn the AMPLIFIER switch ON. Turn the receiver OFF-STANDBY-ON switch OFF. If the circular trace appears elliptical or has bulges or depressions, some of the studs, or fixed portions of the indicator, around the rotating assembly are magnetized sufficiently

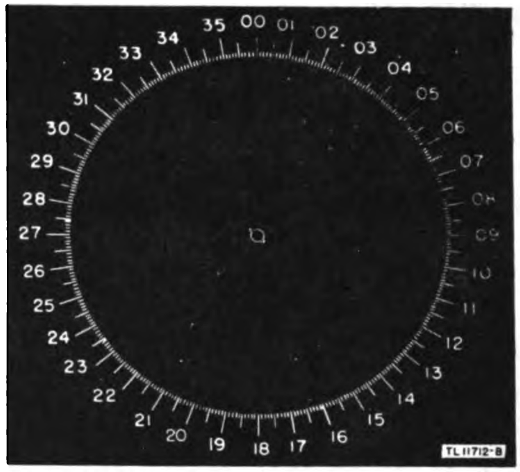

Figure 126. With AMPLIFIER switch OFF small circle instead of a dot shows residual magnetism.

to deflect the cathode-ray tube spot from its normal circular path on the screen.

b. Demagnetizing Procedure.

(1) Never attempt to demagnetize the equipment until careful checking insures that magnetism is present.

(2) Plug the demagnetizer into a 115-volt, a-c outlet, and if tests indicate magnetism proceed as follows:

(a) Turn the MASTER switch OFF.

(b) At about 3 feet from the automatic bearing indicator, turn the demagnetizer on by depressing the snap switch on the cord, bring it as close to the point to be demagnetized as possible, withdraw it to the starting point, and turn it off. This operation should take about 15 or 20 seconds when the demagnetizer is moved at a uniform rate of speed.

CAUTION: NEVER LEAVE THE DEMAGNETIZER ON MORE THAN 30 SECONDS FOR EACH OPERATION OR IT WILL BURN OUT.

(c) The demagnetizer has been designed to give a strong alternating current field and can still be physically small enough to fit inside,

the cathode-ray tube housing as required for demagnetizing the rotating assembly.

(d) Repeat this procedure for each of the fixed pins and studs whose location is shown in figures 37 and 127. Move the demagnetizer up and down past the points shown, on both sides of the indicator, while it is close to them.

(e) Now swing back the optical housing and carefully remove the cathode-ray tube (par. 117).

(f) Demagnetize the rotating assembly according to step (b) above by inserting the demagnetizer, with a twisting motion, as far into the housing as it will go. During this operation turn the MASTER and MOTOR switches ON, and the receiver and BEAM and AMPLIFIER switches OFF.

(g) Replace the tube, close the optical housing, check to make sure the magnetism has been removed, and repeat these operations if necessary.

131. GONIOMETER ALIGNMENT.

a. Automatic Bearing Indicator Goniometer.

(1) With the equipment set up for normal automatic bearing indicator operation (par. 28), tune in a strong signal at approximately 600 kc. If no satisfactory signal is found, use the target transmitter as described in paragraph 129a.

(2) Turn off the 90°, 180°, and 270° switches leaving only the 0° switch on. Adjust the receiver-sensitivity control until the pattern just closes at the center.

(3) The points of the pattern should read 0° and 180° on the azimuth scale.

(4) Check the 90° to 270° pattern by turning the 0° switch off and the 90° switch on.

(5) If the 0° and 90° readings are in error by more than 1° proceed as instructed in subparagraph b below.

b. 0° and 180° Adjustment. Leave the 0° switch on and the 90°, 180°, and 270° switches off. If the twin leaf pattern does not point exactly to 0°, proceed as follows:

(1) Record the exact reading of the pattern in degrees plus or minus from 0° on the azimuth scale.

(2) Now turn the motor, beam, and amplifier switches off; unlock the automatic bearing cover, and remove it by removing the hinge screws. Do not replace the cover until the adjustment is complete.

(3) Grasp the flexible leather coupling and loosen the locking screw on the worm coupling (fig. 27). While holding the flexible coupling, turn the coupling adjustment in the proper direction to rotate the unit the same number of degrees (as indicated on the graduated ring), and in the opposite direction to the deviation. Tighten the locking screw.

(4) Turn the equipment on and recheck the 0° pattern orientation. Repeat if the pattern is not on 0°.

(5) Turn the 90° switch on and the 0° switch off. Check the 90° pattern, but make no further adjustments.

c. Receiver Goniometer.

(1) Remove the nuts on the upper mount of the automatic bearing indicator. Remove the pins on the lower supporting rod and lower the indicator on the chain.

(2) Remove all interconnecting cables from the modulator section of the receiver (lower half of receiver assembly).

(3) Loosen all captive screws and remove the unit from its cabinet.

(4) Place the unit on the wooden table adjoining the metal mounting table.

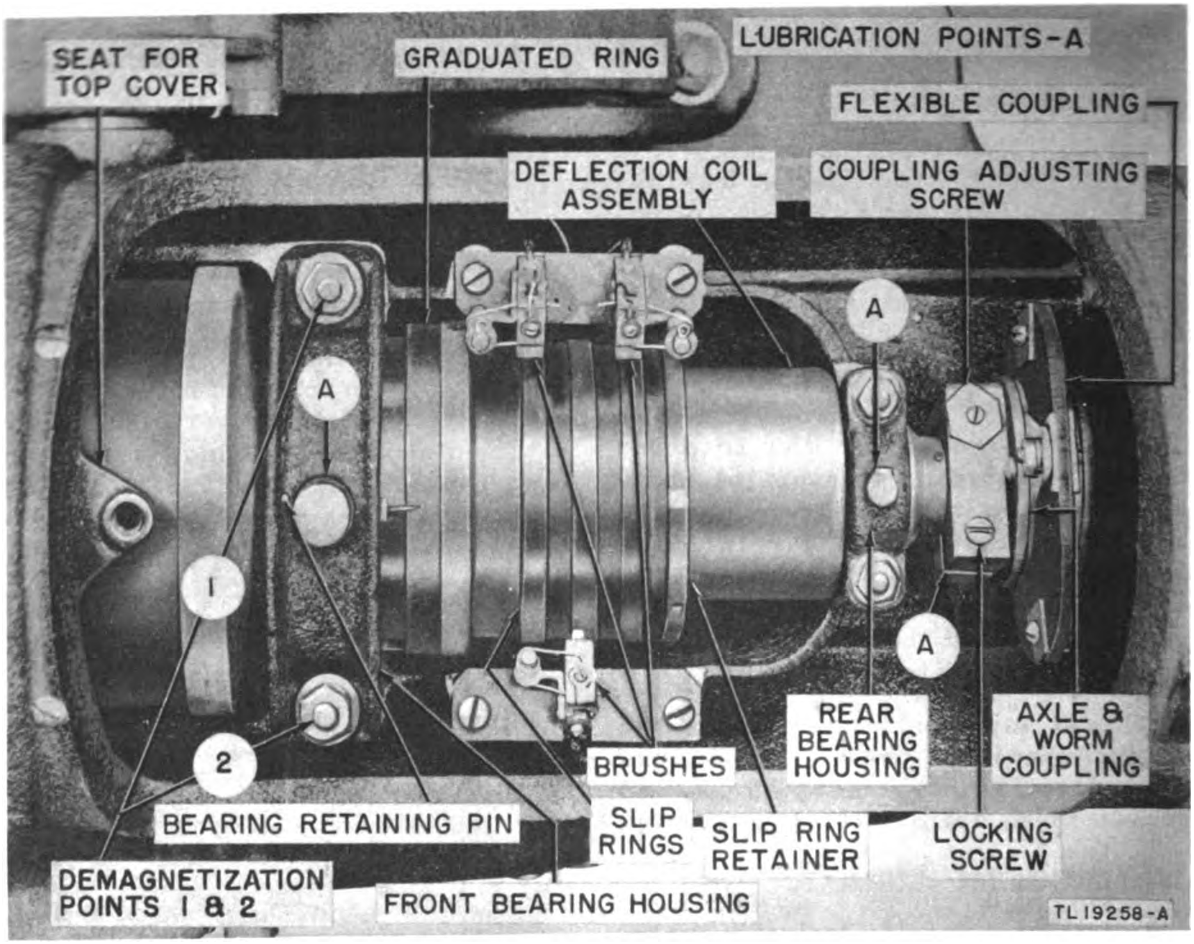

Figure 127. Bearing Indicator ID-121/CRD-3, top view.

(5) Reconnect the r-f and power cords to the modulator section.

(6) Turn the power on and the indication switch to NULL.

(7) Turn the 0° switch on and the 90°, 180°, and 270° switches off.

(8) Tune in a strong signal at approximately 600 kc. If no satisfactory signal is found, the target transmitter must be used as described in paragraph 129a.

(9) An azimuth should be obtained at 0° and 180°.

(10) If the azimuth does not read exactly 0° and 180°, loosen the locking screws on the worm coupling (fig. 129). Set the dial to the desired reading, and tighten the bakelite brake on the goniometer shaft. Turn the adjusting screw on the worm coupling until a bearing is obtained at 0° and 180°.

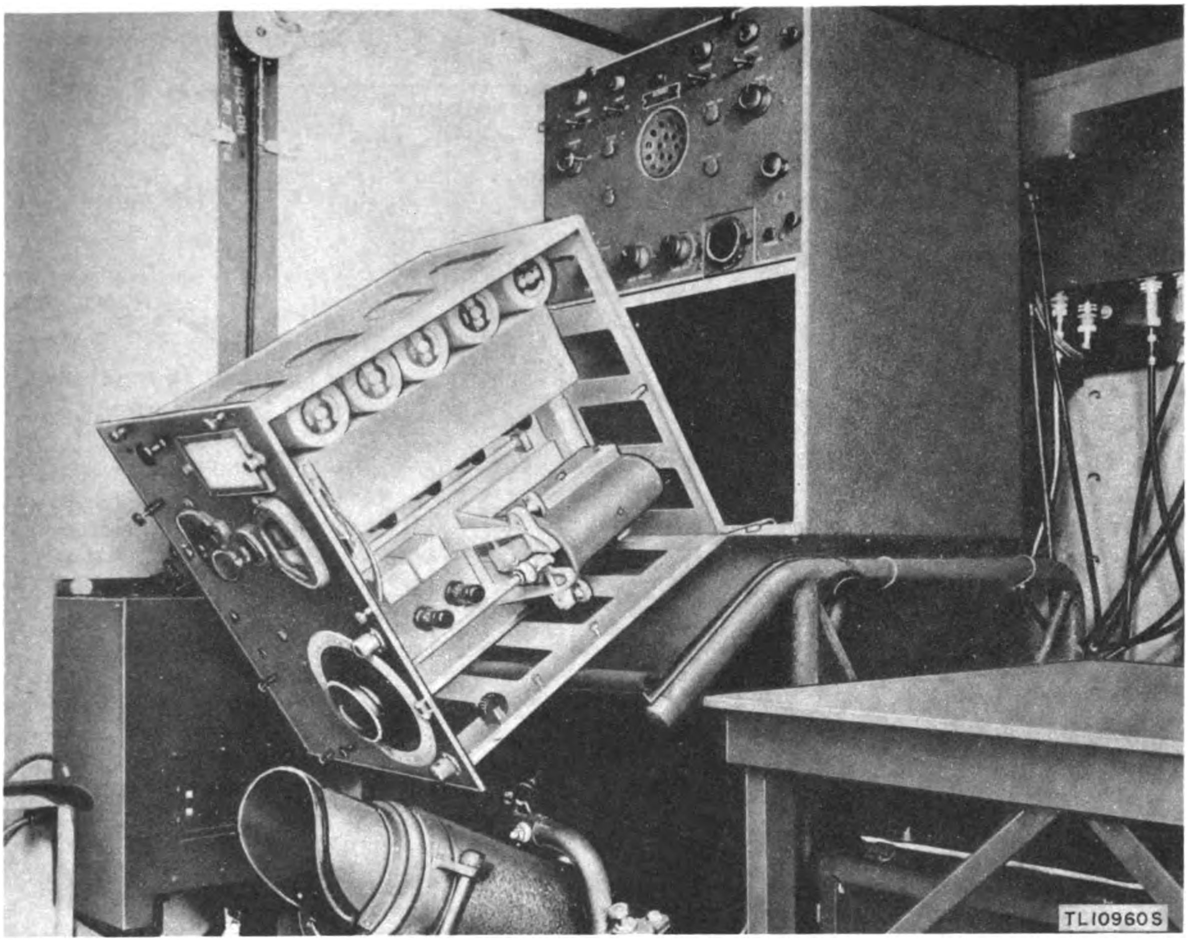

Figure 128. Radio Set AN/CRD-3 in position for servicing receiver assembly.

(11) Tighten the locking screw and loosen the brake to the desired drag.

(12) Check to see if the azimuth is correct. If not, the adjustment must be repeated.

(13) Turn the 90° switch on and the 0° switch off. Check the 90° azimuth, but make no further adjustments.

(14) Turn the power off and disconnect the test set-up.

(15) Replace the equipment in the normal operating condition and check.

NOTE: The maximum error between direct and reciprocal azimuths is limited to 1° at the factory for both the automatic and manually operated goniometers.

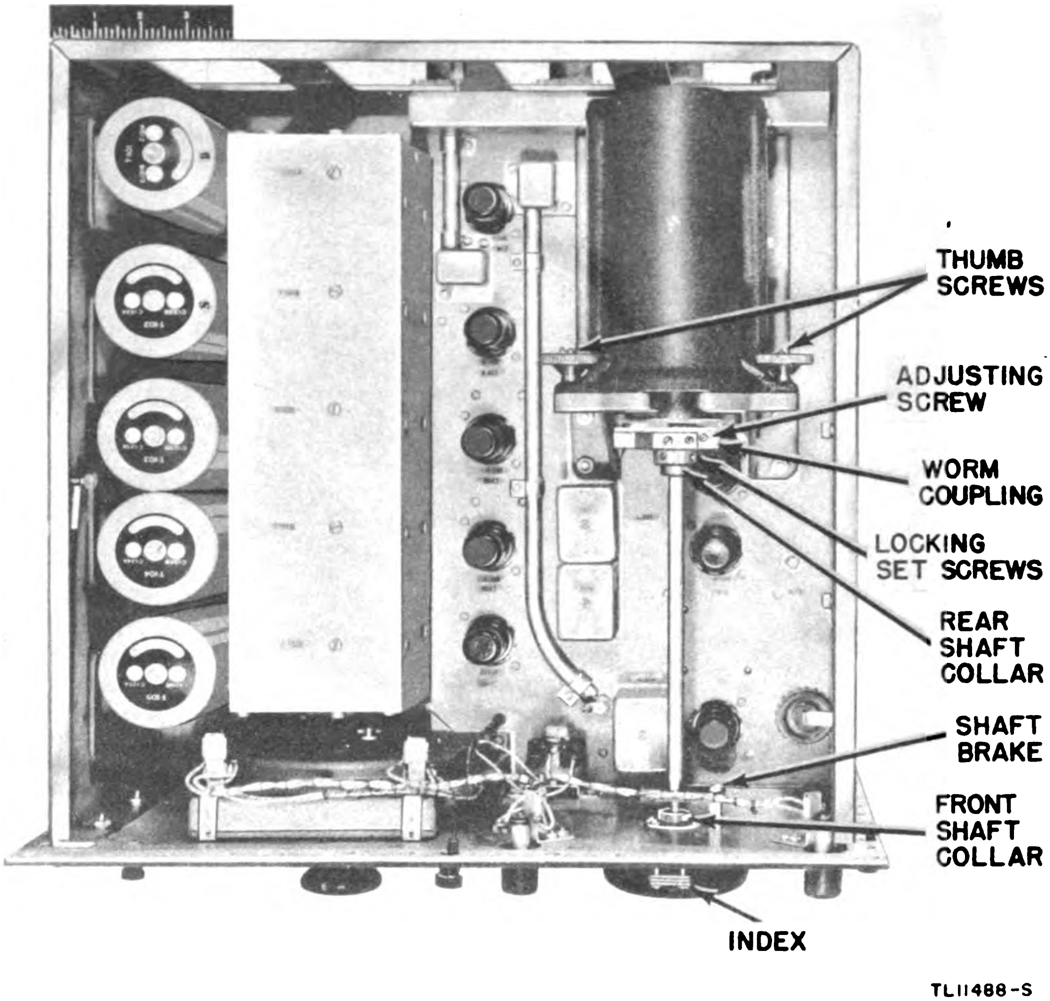

Figure 129. Top view of modulator section showing goniometer coupling.

132. RADIO RECEIVER ALIGNMENT.

The receiver has been carefully and completely aligned at the factory; do not attempt complete realignment in the field.

a. Equipment Required.

(1) One standard signal generator accurately calibrated at 175 kc, 260 kc, 580 kc, 640 kc, and 1420 kc.

(2) A target transmitter or test oscillator transmitter calibrated at frequencies of 260 kc, 580 kc, 640 kc, and 1420 kc.

(3) Two* d-c vacuum tube voltmeters ($VTVM_1$ and $VTVM_2$) with a range to 50 volts direct current.

(4) One fixed capacitor 0.01 mf or larger.

(5) The complete Radio Set antenna system AN/CRD-3, comprising U-Adcock

* *If only one vacuum tube voltmeter is available alternately connect it as required for $vtvm_1$ and $vtvm_2$.*

antennas, sense antenna and r-f transmission lines, and the receiver Junction Box J-99/CRD-3 installed as used with the receiver to be aligned.

(6) I-f test cable (RF-1812-2) and power test cable (RF-1813-3).

b. Preliminary Preparations for Alignment.

(1) Remove the nuts on the upper shockmount of the automatic bearing indicator; remove the pins on the lower supporting rod and the lower indicator on the chain.

(2) Remove all interconnecting cables from both the power-indicator and modulator-receiver units.

(3) Loosen all captive screws and remove both units from the cabinet.

(4) Place the units on a bench, each on its left side.

(5) Remove the bottom plate from each unit.

(6) Reconnect power cable 18, and i-f cable 17.

(7) Connect the a-c power cable (No. 16) directly to the a-c power input on power-indicator unit.

(8) Turn switch OFF-STANDBY-ON to ON and allow 1/2 hour to warm up.

c. Control Settings.

AUDIO GAIN	Maximum
R.F. SELECTIVITY	SHARP
A.V.C-M.V.C.-C.W.	M.V.C.
INDICATION	NULL
SEARCH-INSTANT.BEARING-SENSE	As required
R.F. GAIN	As required
GONI. GAIN	1/2 maximum
GONIOMETER	As required

NOTE: USE A 0.01 MF CAPACITOR IN SERIES WITH THE SIGNAL GENERATOR TO THE GRIDS OF THE VARIOUS TUBES.

d. I-f Alignment.

(1) Set the signal generator to 175 kc. Connect the first vacuum-tube voltmeter ($vtvm_1$) to J203 (or to 3 and 4 of L206) in the power indicator unit (fig. 130). Connect the second $vtvm_2$ across the diode load (R213) or from lug number 4 on L204 to ground.

(2) Before attempting alignment set the powdered-iron cores of all i-f transformers all the way out. Feed in sufficient signal *without modulation* to the control grid (pin number 8) of V104 (fig. 130) to get a reading on the second vtvm across R213.

(3) Adjust the core of L204 (fig. 131) for maximum reading on the $vtvm_2$ and the core of L206 for maximum reading on $vtvm_1$.

(4) Adjust L203, L202, L201, and L112, individually for maximum reading on $vtvm_1$.

(5) Adjust L204 for maximum reading of the $vtvm_2$.

(6) Adjust L206, L203, L202, L201, and L112, individually for maximum reading of $vtvm_1$.

(7) Adjust L203, L202, L201 and L112, individually for maximum reading of $vtvm_2$.

(8) Repeat step (7) as often as necessary to secure a final peak.

(9) Vary the frequency, and observe whether both vtvms peak together. If they do, the alignment is complete.

(10) If the vtvms do not peak together, check the alignment of L206 and L204.

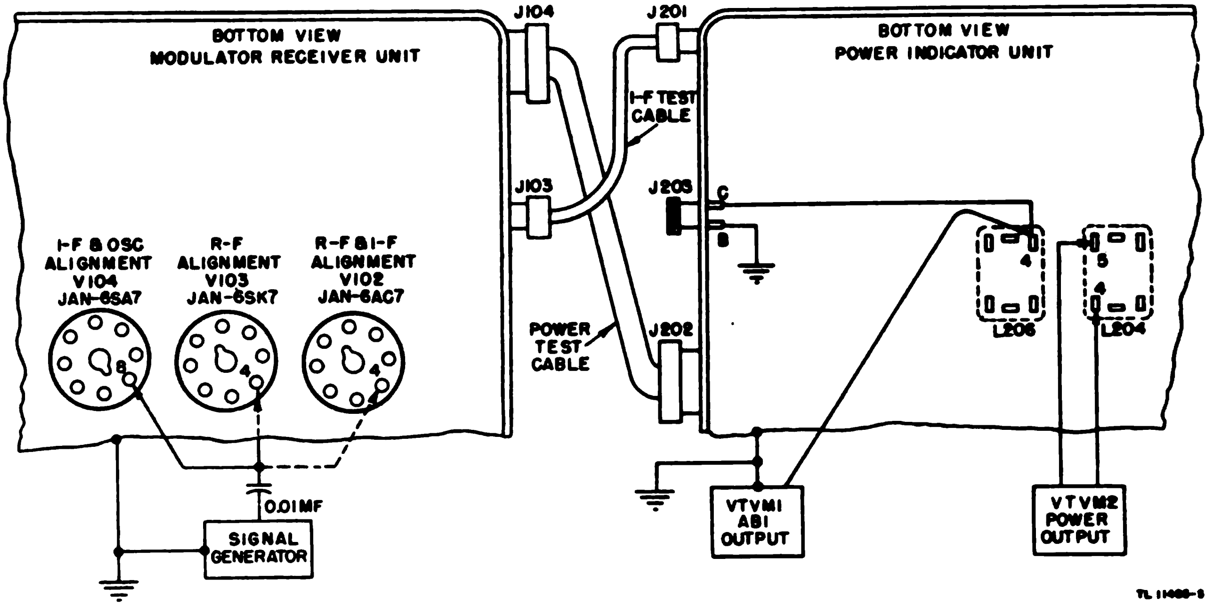

Figure 130. Receiver alignment hookup.

(11) After i-f alignment, check beat-frequency oscillator output. If the output interferes on indicator pattern, adjust C221 to just remove interference. If C221 is adjusted, repeat adjustment of C204.

e. I-f Trap Alignment. With the equipment set up as for the i-f alignment, feed sufficient 175 kc signal to the control grid (pin number 4) of the 6AC7 sense input tube (V102) to make $vtvm_2$ read near the center of its scale. Adjust the iron core L111 for *minimum* indication on $vtvm_2$. Increase the generator output and repeat the adjustment.

f. Low-band Alignment.

(1) Necessary alignment frequencies are: inductance (core adjustment) 260 kc, and capacitance (trimmer adjustment) 580 kc.

(2) With the equipment set up as for i-f alignment connect the signal generator to the signal grid (pin No. 8) of V104 in the modulator-receiver unit (fig. 130). Adjust the oscillator coil L109 (fig. 132) and trimmer C125a for maximum output at the frequencies given above. Repeat until the alignment is accurate at both frequencies.

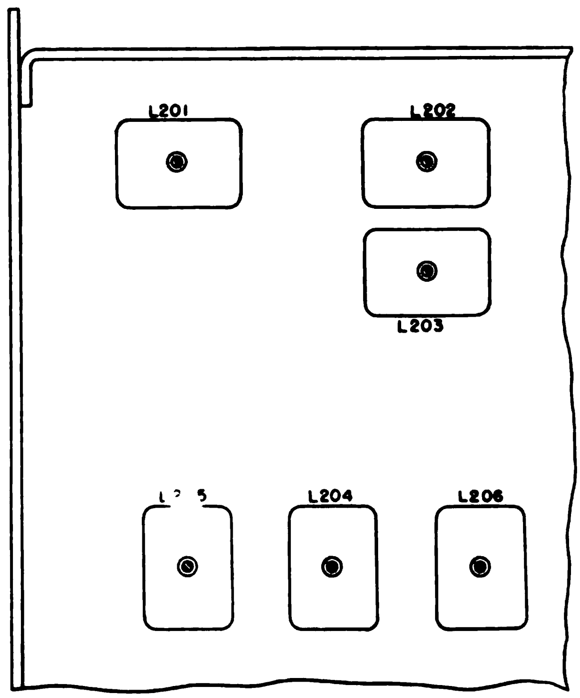

Figure 131. I-f trimmer locations.

(3) Connect the signal generator to the grid (pin No. 4) of V102 (fig. 130) and adjust the inductance L107b and the trimmer C124a of the mixer tube V104 for maximum output and switch SEARCH-INSTANT.BEARING-SENSE to SEARCH.

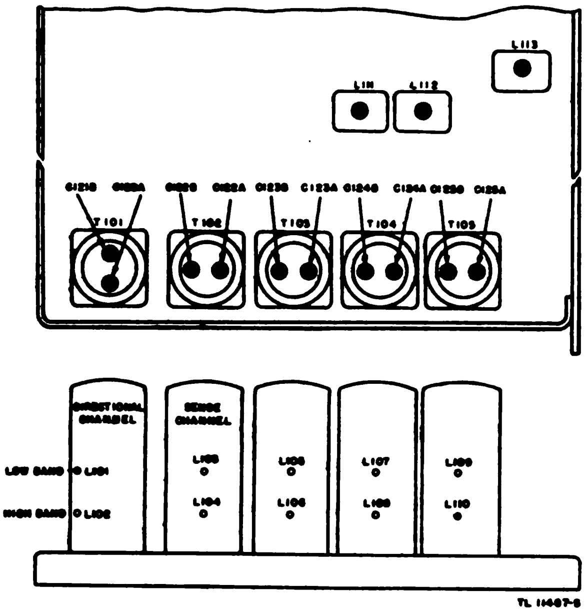

Figure 132. R-f trimmer locations.

Adjust the inductance L105b and trimmer C123a for maximum output at the frequencies given. Repeat until the alignment is accurate at both frequencies.

g. High Band 610 to 1500 kc.

(1) Necessary alignment frequencies are inductance (core adjustment) 640 kc, and capacitance (trimmer adjustment) 1420 kc.

(2) Align the high band in the same manner as the low band adjusting the following circuits:

Circuit	*Inductance*	*Trimmer*
Oscillator	L110	C125b
Mixer	L108b	C124b
R-f amplifier	L106b	C123b

h. Sense Input Stage Alignment.

(1) With the equipment set up in its normal operating position remove the nuts on the upper shockmount of the automatic bearing indicator, and the pins on lower supporting rod and lower indicator on chain.

(2) Cover the indicator apron with canvas included with the tools and test equipment.

(3) Remove the hooks from the pocket and hook one at each edge on top of the mounting table.

(4) Remove all interconnecting cables from the modulator-receiver unit (the lower half or radio receiver).

(5) Loosen all captive screws and remove the unit from the cabinet.

(6) Place the unit in its left side on top of the apron using the hooks to hold it in place (fig. 128).

(7) Connect the cables to the unit as follows:

(a) Use the power test cable (RF-1813-3) and i-f test cable (RF-1812-2) in place of cables 18 and 17 respectively, running them through the cutouts in the rear of the cabinet to the power indicator unit.

(b) Reconnect cables 1 and 5.

(c) Remove cables 8, 9, and 10 from the indicator goniometer and connect them to the receiver goniometer. Substitute cable 8 for cable 2, cable 9 for 3, and cable 10 for 4.

(8) By means of the external knob on the junction box, switch to manual operation. Leave the controls as indicated in paragraph 132c.

(9) Set the SEARCH-INSTANT.BEARING-SENSE switch at SEARCH.

(10) Set the target transmitter at 580 kc and place it as far as possible, up to 500 feet, from the antenna system. Tune the receiver to the signal.

(11) Set R.F. GAIN control so as to give a line approximately 1-1/2 inches long on the receiver cathode-ray tube.

(12) Adjust trimmer C122A for maximum length of line. *This must be done very accurately.*

(13) Tune the target and receiver to 260 kc and set R.F. GAIN control so as to give a line approximately 1-1/2 inches long.

(14) Adjust L403 for maximum length of line. *This must be done very accurately.*

(15) Repeat steps (10) through (14) as often as is necessary to result in accurate alignment at both frequencies.

(16) Using frequencies of 1,420 kc and 640 kc repeat steps (10) through (15), adjusting C122B and L404.

i. Directional Input Stage Alignment.

(1) Set the SEARCH-INSTANT.BEARING-SENSE switch to INSTANT.BEARING.

(2) Tune the target and receiver to 580 kc.

(3) Set the receiver GONIOMETER to give maximum length of line on a 2-inch cathode-ray tube.

(4) Set the R.F. GAIN control so as to give a line 1-1/2 inches long.

(5) Adjust C121A for maximum length of line. *This must be done very accurately.*

(6) Tune the target and receiver to 260 kc and set the GONIOMETER to give maximum length of line.

(7) Adjust inductance L401 for maximum line length on a 2-inch cathode-ray tube. *This must be done very accurately.*

(8) Repeat steps (2) through (7) as often as is necessary to result in accurate alignment at both frequencies.

(9) Using frequencies of 1,420 kc and 640 kc repeat steps (3) through (8) above, adjusting C121B and L402.

APPENDIX

SECTION XIV

REFERENCES

JOINT ARMY-NAVY TYPE DESIGNATION CODES FOR ELECTRICAL COMPONENTS

INTRODUCTION: Fixed and variable resistors and fixed capacitors manufactured under JAN specifications may be labeled with a *type designation code* instead of a color code or actual electrical value. For resistors and capacitors marked with the JAN type designation code, electrical values and other data can be determined by consulting the following information.

RESISTORS

FIXED, COMPOSITION

RC	10	AE	153	M
COMPONENT	STYLE	*CHARACTERISTIC	RESISTANCE	*TOLERANCE

COMPONENT: RC signifies *fixed, composition resistor.*

STYLE: A two-digit symbol indicates power rating and physical size.

Resistor style	Wattage
RC10, RC15, RC16	¼ WATT
RC20, RC21, RC25	½ WATT
RC30, RC31, RC35, RC38	1 WATT
RC40, RC41, RC45	2 WATTS
RC65	4 WATTS
RC75, RC76	5 WATTS

RESISTANCE: A three-digit symbol indicates the resistance value in ohms. The first two digits give the first two figures of the resistance value; the third digit gives the number of zeros which follow the first two figures.

RESISTORS

VARIABLE, WIRE-WOUND

RA	15	A	1	RH	103	A	K
COMPONENT	STYLE	SWITCH	*TORQUE	*SHAFT	RESISTANCE	*TAPER	*TOLERANCE

COMPONENT: RA signifies *variable, wire-wound resistor.*

STYLE: A two-digit symbol indicates power rating and physical size and shape.

SWITCH: Symbol A indicates no switch. Symbol B indicates a switch turned ON at start of clockwise rotation.

RESISTANCE: A three-digit symbol indicates the resistance value in ohms. The first two digits give the first two figures of the resistance value; the final digit gives the number of zeros which follow the first two figures. The letter *R* may be substituted to represent a decimal point; but when *R* is used, the last digit of the group becomes significant.

RHEOSTATS

WIRE-WOUND, POWER-TYPE

RP	35	2	FD	252	KK
COMPONENT	STYLE	OFF POSITION	*SHAFT	RESISTANCE	*TOLERANCE

COMPONENT: RP signifies all *rheostats.*

STYLE: Same as for variable, wire-wound resistors.

OFF POSITION:

Numeral	OFF position
1	None.
2	At end of counterclockwise rotation.
3	At end of clockwise rotation.

RESISTANCE: Same as for variable, wire-wound resistors.

*Items starred are of interest primarily to depot and higher echelon repair personnel.

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CAPACITORS

FIXED, MICA-DIELECTRIC

CM	20	B	511	K
COMPONENT	CASE	*CHARACTERISTIC	CAPACITANCE	*TOLERANCE

COMPONENT: CM signifies *fixed, mica-dielectric capacitor.*

CASE: A two-digit symbol identifies a physical case size and shape.

CAPACITANCE: A three-digit symbol indicates the capacitance value in micromicrofarads. The first two digits give the first two figures of the capacitance value; the final digit gives the number of zeros which follow the first two figures. When more than two significant figures are required, additional digits may be used, the last digit always indicating the number of zeros.

D-C WORKING VOLTAGE FOR CAPACITANCE RANGE

Case	Capacitance range	Vdcw
CM20	5-510 mmf	800
CM25	5-1,000 mmf	500
CM30	470-3,300 mmf	500
CM35	470-6,200 mmf	500
	6,800-10,000 mmf	500
CM40	3,300-8,200 mmf	500
	9,100-10,000 mmf	300

NOTE: Working voltages for capacitors above CM40 are stamped on the case.

The d-c working voltage of a capacitor can be determined from the above table when the case size and value of capacitance are known.

CAPACITORS

FIXED, MOLDED, PAPER-DIELECTRIC†

CN	36	A	302
COMPONENT	CASE	*CHARACTERISTIC	CAPACITANCE

COMPONENT: CN signifies *fixed, molded, paper-dielectric capacitor.*

CASE: Same as for fixed, mica-dielectric capacitors.

CAPACITANCE: A three-digit symbol indicates the capacitance value in micromicrofarads. The first two digits give the first two figures of the capacitance value; the third digit gives the number of zeros which follow the first two figures.

D-C WORKING VOLTAGE FOR CAPACITANCE RANGE

Case	Capacitance	Vdcw
CN35	3,000 mmf	800
	6,000 mmf	600
	10,000 mmf	400
CN36	3,000 mmf	400
	6,800 mmf	400
	10,000 mmf	300
CN40	3,000 mmf	400
	6,000 mmf	300
	10,000 mmf	300
CN41	3,000 mmf	600
	6,000 mmf	600
	10,000 mmf	400

The d-c working voltage of a capacitor can be determined from the above table when the case size and value of capacitance are known.

CAPACITORS

FIXED, CERAMIC-DIELECTRIC

CC	20	AH	100	G
COMPONENT	CASE	*CHARACTERISTIC	CAPACITANCE	*TOLERANCE

COMPONENT: CC signifies *fixed, ceramic-dielectric capacitor.*

CASE: Same as for fixed, mica-dielectric capacitors.

CAPACITANCE: Same as for fixed, molded, paper-dielectric capacitors.

NOTE: All fixed, ceramic-dielectric capacitors have a working voltage of 500 volts, d-c.

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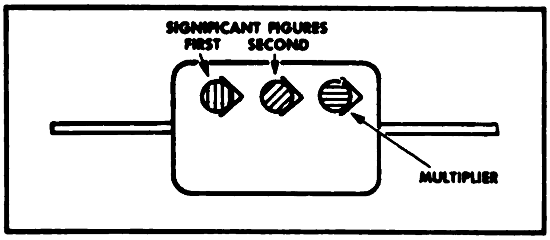
*Items starred are of interest primarily to depot and higher echelon repair personnel.

†This is not a JAN specification. These capacitors are covered by AWS C75/221.

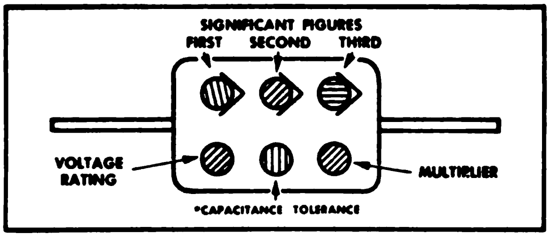
CAPACITOR COLOR CODES

RMA 3-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS

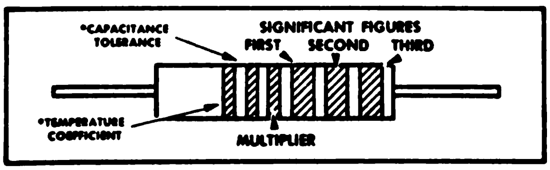


Capacitors marked with this code have a voltage rating of 500 volts.

RMA 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



RMA COLOR CODE FOR TUBULAR CERAMIC-DIELECTRIC CAPACITORS

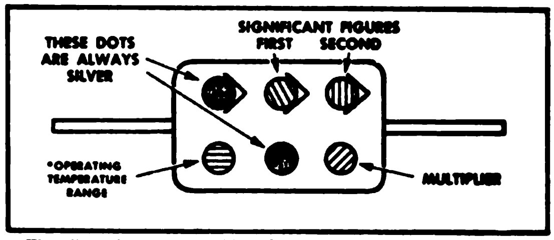


Capacitors marked with this code have a voltage rating of 500 volts.

RMA Radio Manufacturers Association JAN Joint Army Navy

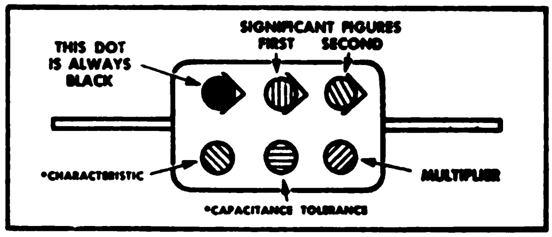
Note These color codes give all capacitances in micromicrofarads.
*Items marked with an asterisk are of interest primarily to depot and higher echelon repair personnel

JAN 6-DOT COLOR CODE FOR PAPER-DIELECTRIC CAPACITORS



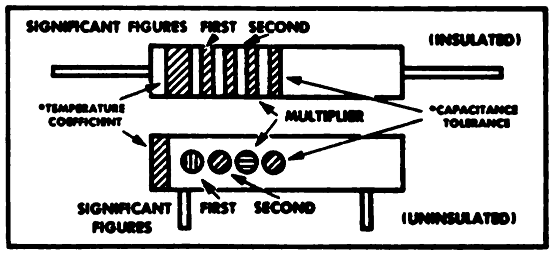
The silver dots serve to identify this marking. For working voltages see JAN type designation code.

JAN 6-DOT COLOR CODE FOR MICA-DIELECTRIC CAPACITORS



The black dot serves to identify this code. For working voltages see JAN type designation code.

JAN COLOR CODE FOR FIXED CERAMIC-DIELECTRIC CAPACITORS



Capacitors marked with this code have a voltage rating of 500 volts. Either the band or dot code may be used.

COLOR	SIGNIFICANT FIGURE	MULTIPLIER: RMA MICA-AND CERAMIC-DIELECTRIC	MULTIPLIER: JAN MICA-AND PAPER-DIELECTRIC	MULTIPLIER: JAN CERAMIC-DIELECTRIC	RMA VOLTAGE RATING
BLACK	0	1	1	1	
BROWN	1	10	10	10	100
RED	2	100	100	100	200
ORANGE	3	1,000	1,000	1,000	300
YELLOW	4	10,000			400
GREEN	5	100,000			500
BLUE	6	1,000,000			600
VIOLET	7	10,000,000			700
GRAY	8	100,000,000		0.01	800
WHITE	9	1,000,000,000		0.1	900
GOLD		0.1	0.1		1,000
SILVER		0.01	0.01		2,000
NO COLOR					500

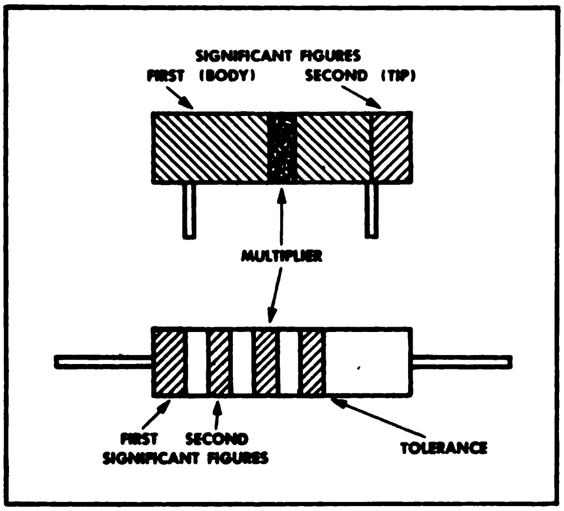
TL 13417 A

858-Ft. Mon.-6-6-45-500

Figure 133. Capacitor color codes.

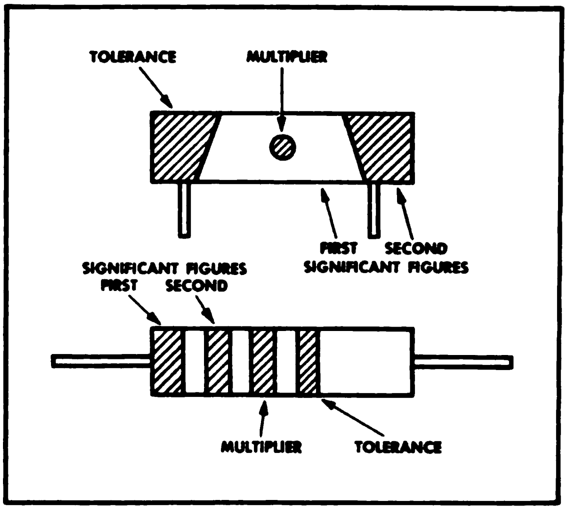
RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS



Insulated fixed composition resistors with axial leads are designated by a natural tan background color. Non-insulated fixed composition resistors with axial leads are designated by a black background color.

JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS



Resistors with axial leads are insulated. Resistors with radial leads are uninsulated.

COLOR	SIGNIFICANT FIGURE	MULTIPLIER	TOLERANCE (PERCENT)
BLACK	0	1	
BROWN	1	10	
RED	2	100	
ORANGE	3	1,000	
YELLOW	4	10,000	
GREEN	5	100,000	
BLUE	6	1,000,000	
VIOLET	7	10,000,000*	
GRAY	8	100,000,000*	
WHITE	9	1,000,000,000*	
GOLD		0.1*	5
SILVER		0.01*	10
NO COLOR			20

*JAN ONLY

Example: A 50,000-ohm resistor with a standard tolerance of 20 percent (no color) would be indicated by a green ring (5), a black ring (0), and an orange ring (000)

RMA: Radio Manufacturers Association
JAN: Joint Army-Navy

TL 13418 A

Figure 134. Resistor color codes.

133. ARMY REGULATIONS.

AR 380-5	Safequarding Military Information.

134. SUPPLY PUBLICATIONS.

SIG 1	Introduction to ASF Signal Supply Catalog.
SIG 2	Complete Index to ASF Signal Supply Catalog.
SIG 3	List of Items for Troop Issue.
SIG 4-1	Allowances of Expendable Supplies.
SIG 4-2	Allowances of Expendable Supplies for Schools, Training Centers, and Boards.
SIG 5	Stock List of All Items.
SB 11-6	Dry Battery Supply Data.
SB 11-8	Chests for Running Spares.
SB 11-10	Signal Corps Kit and Materials for Moisture and Fungi-Resistant Treatment.
SB 11-17	Electron Tube Supply Data.

135. TECHNICAL MANUALS ON AUXILIARY EQUIPMENT AND TEST EQUIPMENT.

TM 11-333	Telephones EE-8-A, EE-8-B, and EE-8.
TM 11-307	Signal Generator S-72-( )
TM 11-940	Power Unit PE-197

136. PAINTING, PRESERVING, AND LUBRICATION.

TB SIG 6	A Method of Prolonging the Life of Dry Batteries.
TB SIG 13	Moistureproofing and Fingiproofing Signal Corps Equipment.
TB SIG 69	Lubrication of Ground Signal Equipment.

137. CAMOUFLAGE.

FM 5-20	Camouflage, Basic Principles.

138. SHIPPING INSTRUCTIONS.

U.S. Army Spec No. 100-14A.	Army-Navy General Specification for Packaging and Packing for Overseas Shipment.

139. DECONTAMINATION.

TM 3-220	Decontamination.

140. DEMOLITION.

FM 5-25	Explosives and Demolitions.

141. OTHER PUBLICATIONS.

FM 21-6*	List and index of Publications for Training.
FM 24-18	Radio Communication.
TB SIG 5	Defense Against Radio Jamming.
TB SIG 25	Preventive Maintenance of Power Cords.
TB SIG 66	Winter Maintenance of Ground Signal Equipment.
TB SIG 72	Tropical Maintenance of Ground Signal Equipment.
TB SIG 75	Desert Maintenance of Ground Signal Equipment.
TB SIG 123	Preventive Maintnenace Practices for Ground Signal Equipment.
TM 1-455	Electrical Fundamentals
TM 11-227	Signal Communication Equipment Directory Radio Communication Equipment.
TM 11-310	Schematic Diagrams for Maintenance of Ground Radio Communication Sets.
TM 11-314	Antennas and Antenna System.
TM 11-453	Shop Work.
TM 11-455	Radio Fundamentals.
TM 11-462	Reference Data.
TM 11-483	Suppression of Radio Noises.
TM 11-496	Training Text and Applicatory Excercises for Amplitude-modulated Radio Sets.
TM 11-499	Radio Propagation.
TM 37-250	Basic Maintenance Manual.
TB 11-499-( )≠	Basic Radio Propagation Predictions.

142. FORMS.

W.D., A.G.O. Form No. 468 (Unsatisfactory Equipment Report).

Army Air Forces Form No. 54 (Unsatisfactory Report).

* Refer to for applicable techaical bulletins, supply bulletins, modification work orders, and Changes.

≠ A new TB in this series is issued monthly which gives propagation prediction 3 months in advance.

143. ABBREVIATIONS.

abi	automatic bearing indicator
a-c	alternating current
ADJ.	adjustment
a-f	audio-frequency
amp	amperes
amplr	amplifier
approx.	approximately
aux.	auxiliary
A.V.C.	automatic volume control
bal	balanced
bfo	beat frequency oscillator
BRILL	brilliance
cps	cycles per second
c-r	cathode-ray
c-w	continuous-wave
d-c	direct-current
defl.	deflection
DIA.	diameter
E-W	east-west
fig.	figure
fil	filament
GONI.	goniometer
h-f	high-frequency
i-c-w	interrupted-continuous-wave
i-f	intermediate-frequency
INSTANT.	instantaneous
INST.	instantaneous
kc	kilocycles
kva	kilovolt-ampere
ma.	milliamperes
mf	microfarad

817044 O—49——13

143. ABBREVIATIONS (contd).

mmf	micromicrofarad
m-c-w	modulated-continuous-wave
MAN.	manual
M.V.C.	MANUAL VOLUME CONTROL
mh	millihenry
mod	modulator
No.	number
N-S	NORTH-SOUTH
osc	oscillator
RES.	resistance
SENS.	sensitivity
SPRD	spread
term.	terminal
VERT.	vertical
VTVM	vacuum-tube voltmeter

144. GLOSSARY.

Refer to TM 11-455 for a glossary of the common radio terms.

145. OUTLINE DRAWINGS.

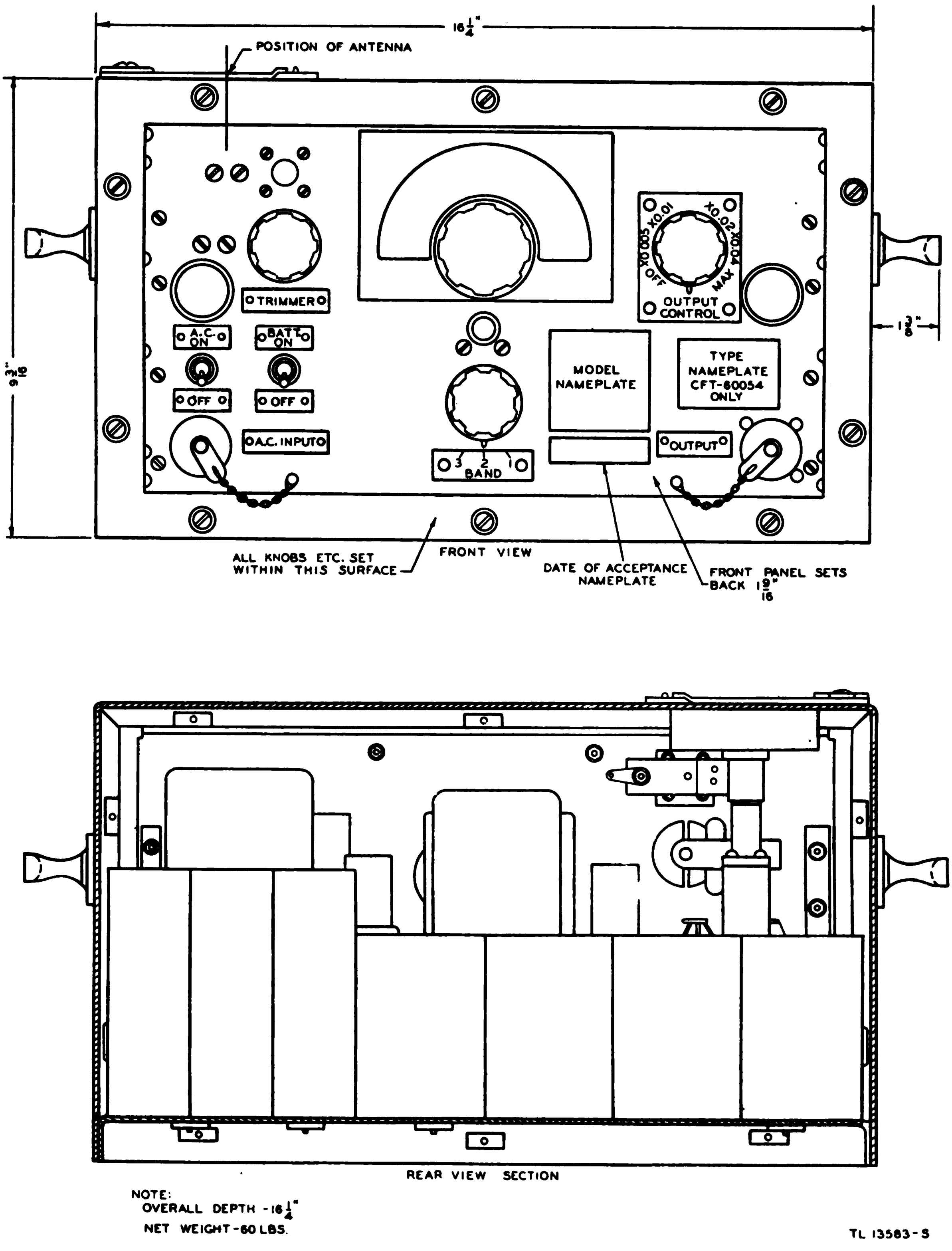


Figure 135. Outline drawing of OAN test oscillator.

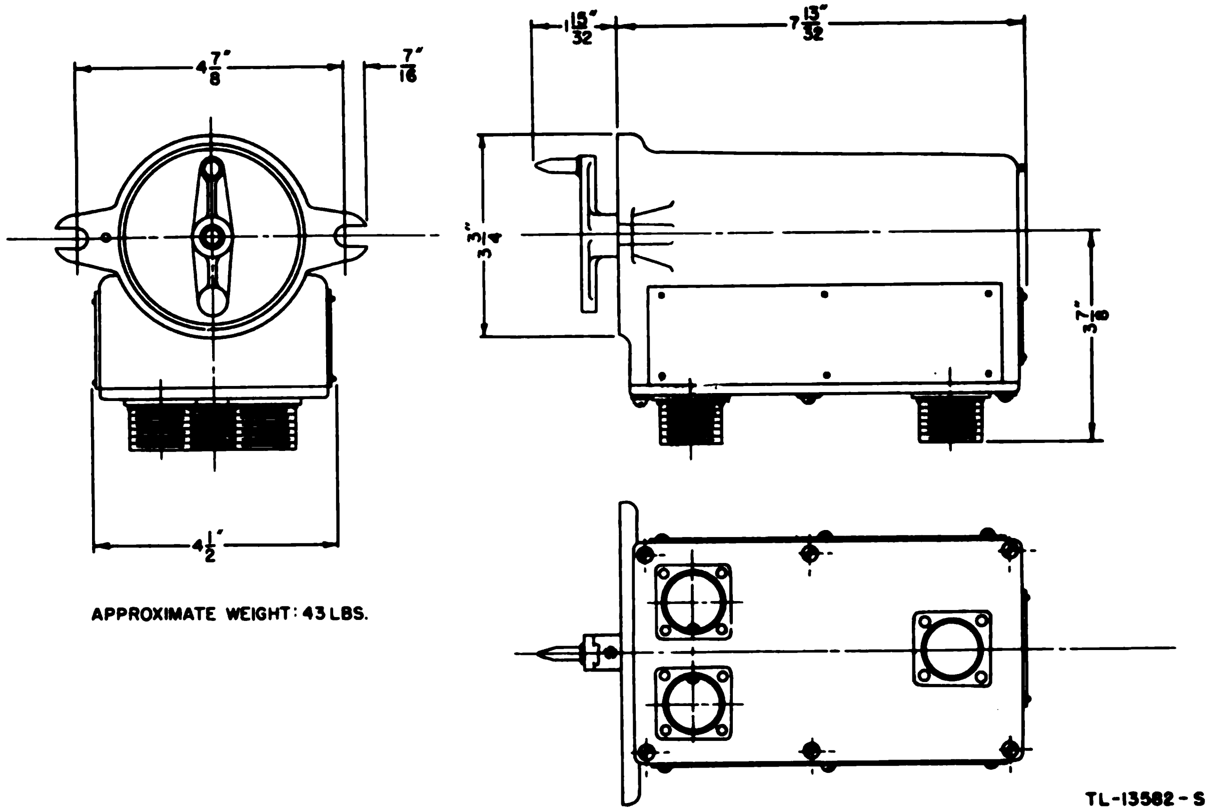


Figure 136. Outline drawing of Goniometer Navy No. CFT-4732.

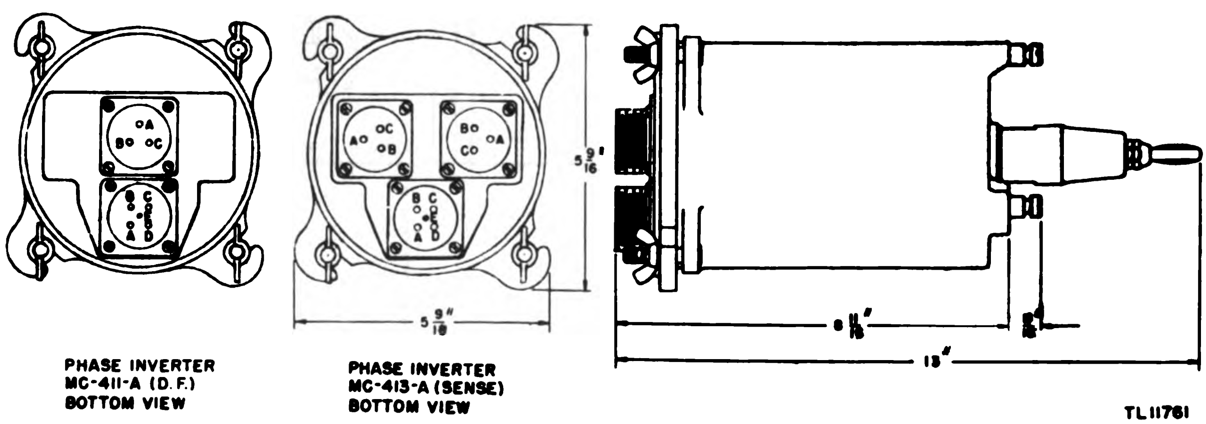


Figure 137. Outline drawing of Phase Inverter MC-411-A and MC-413-A.

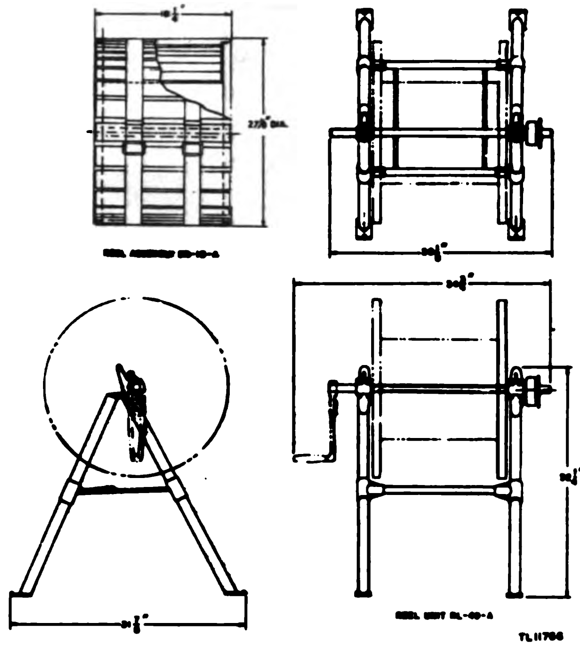


Figure 138. Outline drawing of Reel DR-10-A and Reel Unit RL-49-A.

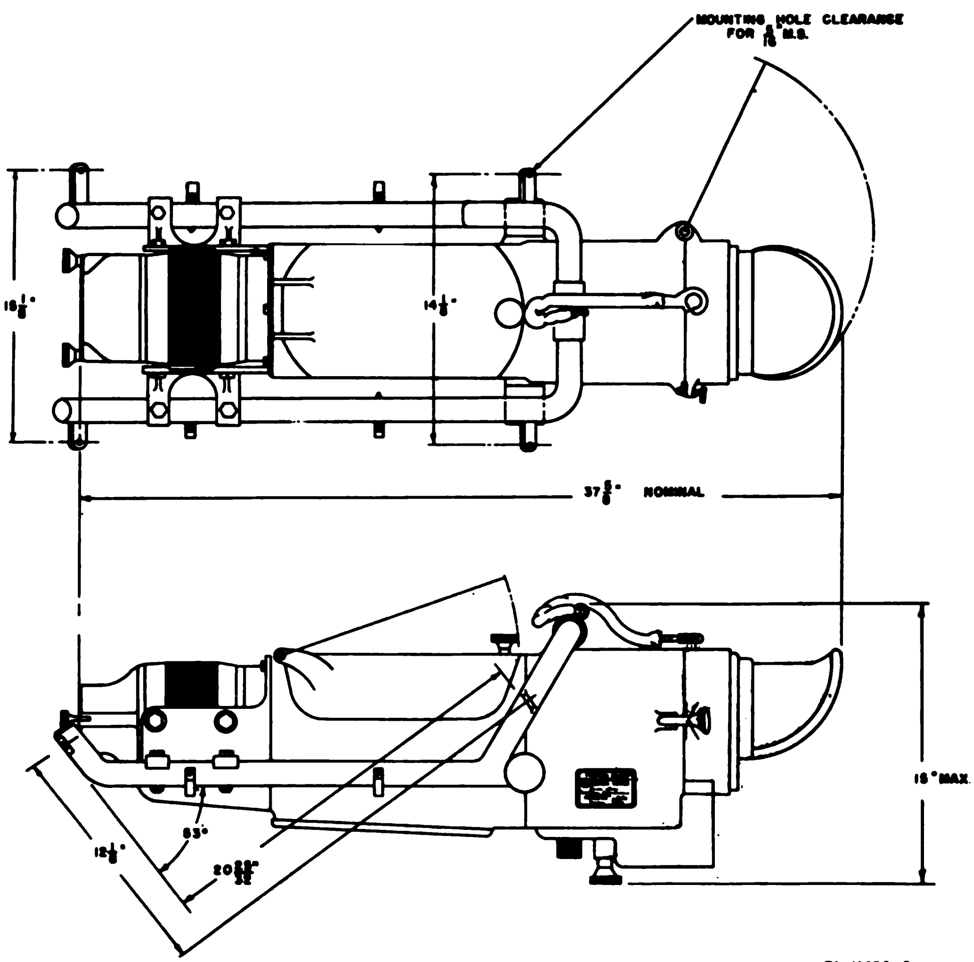


Figure 139. Outline drawing of Bearing Indicator ID-121/CRD-3.

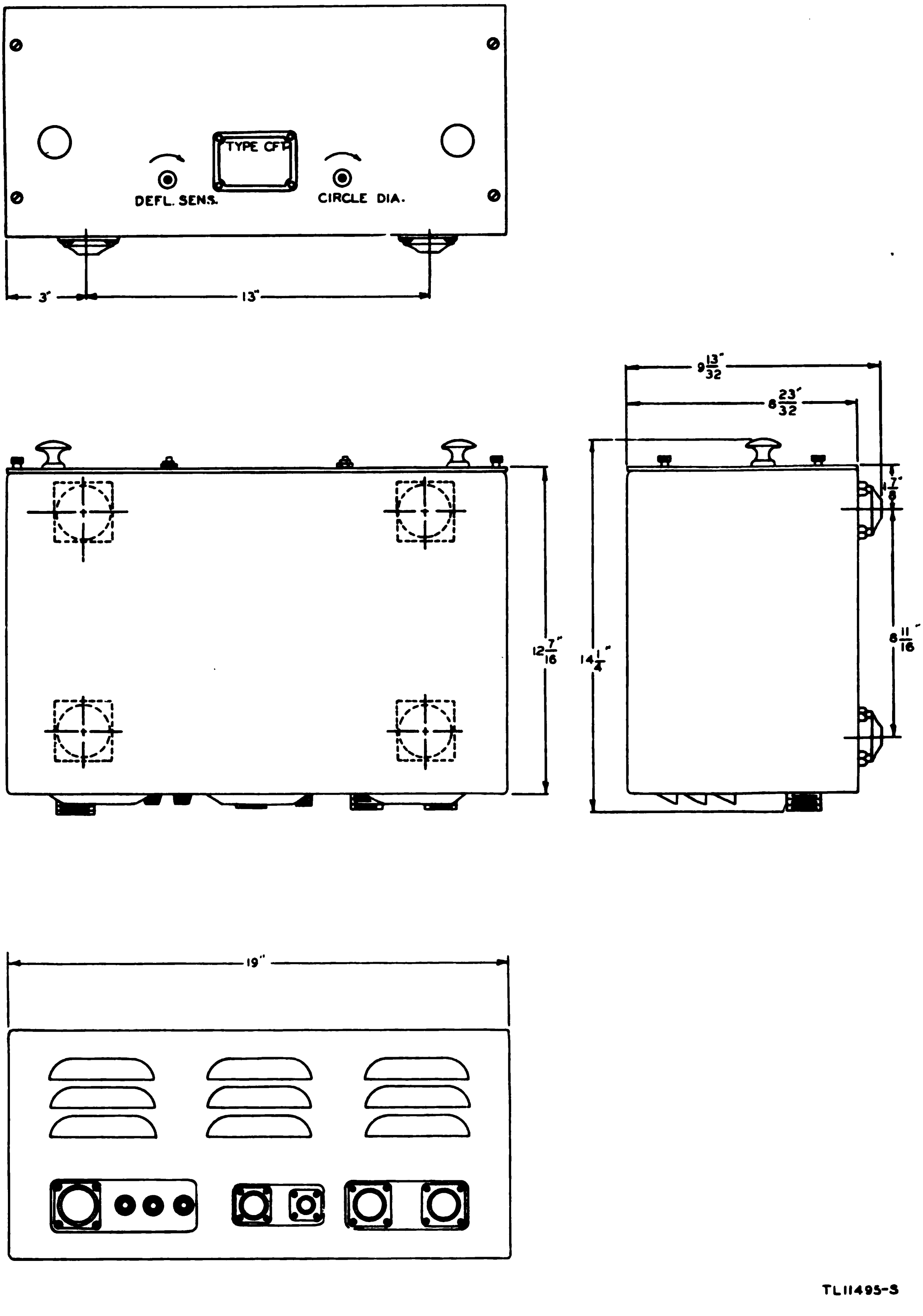


Figure 140. Outline drawing of Rectifier-Power Unit PP-151/CRD-3.

146. CHESTS AND CRATES.

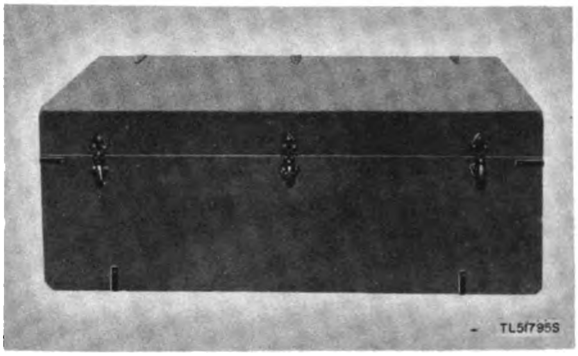


Figure 142. Chest CY-315/CRD-3.

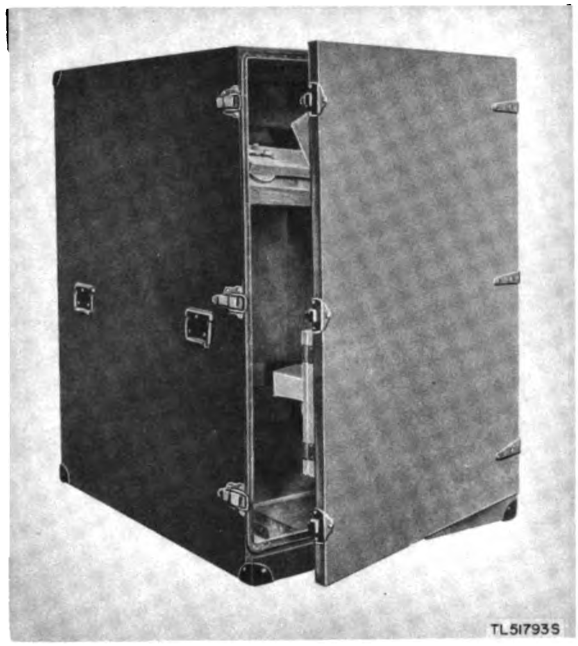


Figure 141. Chest CY-315/CRD-3.

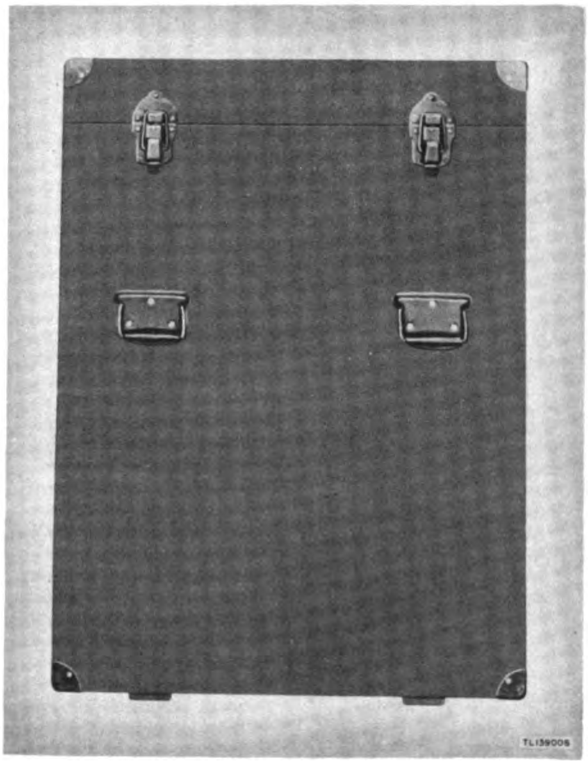


Figure 144. Chest CY-318/CRD-3.

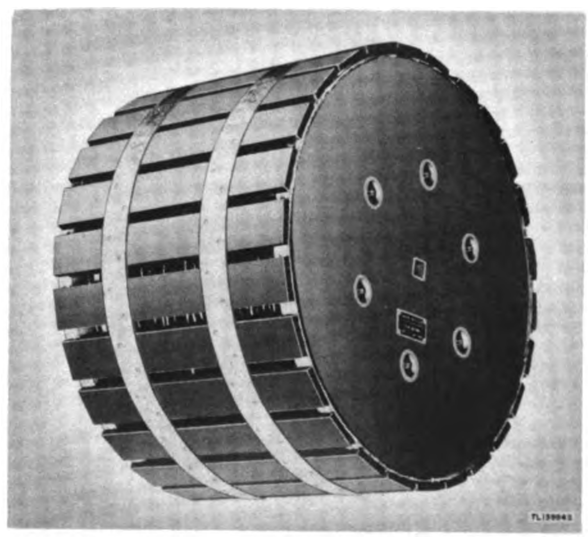


Figure 143. Reel DR-10-A and cable protector.

Figure 145. Case CY-319/CRD-3.

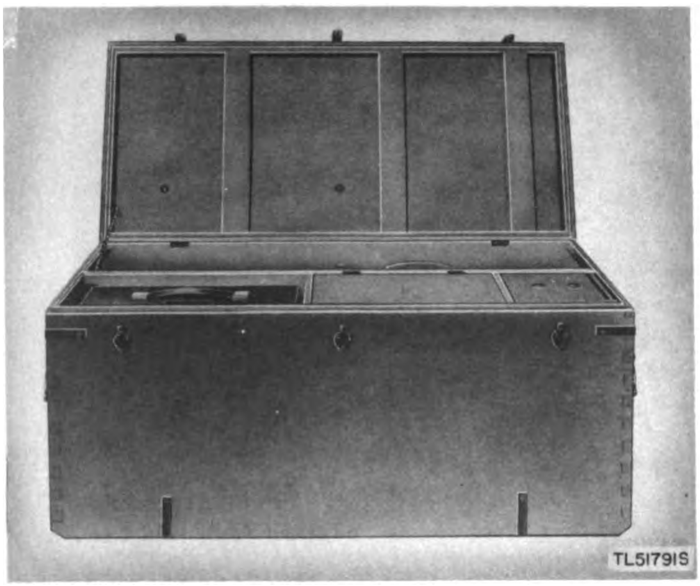


Figure 146. Chest CY-251/CRD-3.

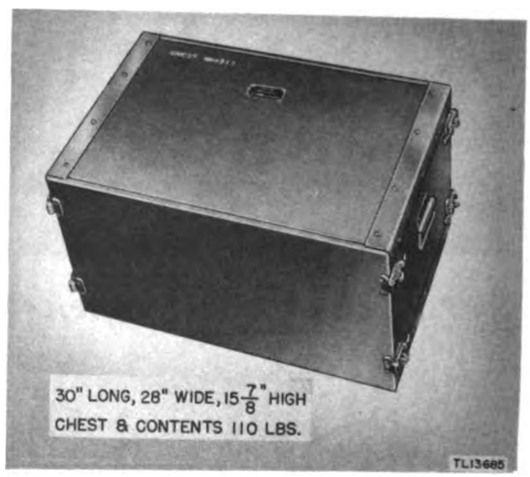


Figure 147. Chest CH-211.

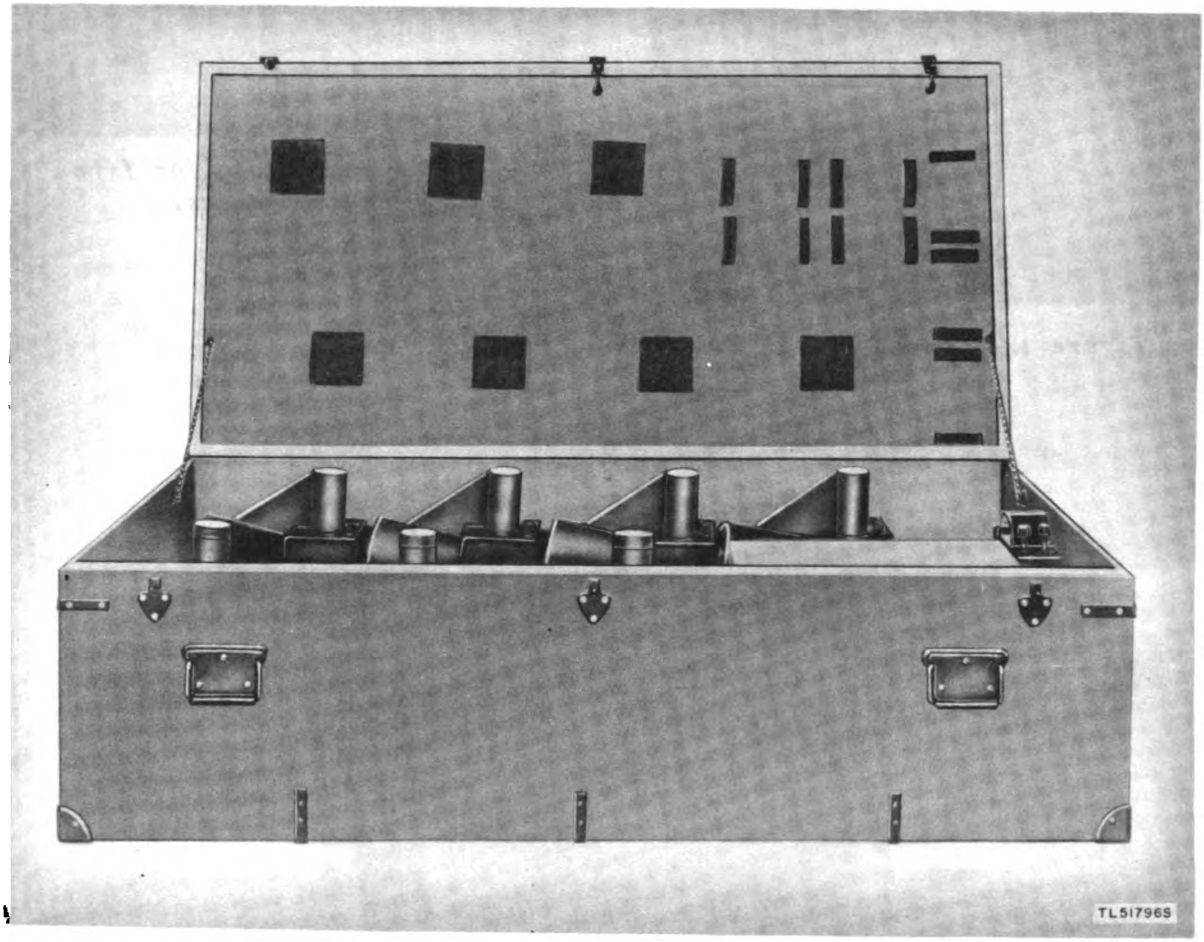


Figure 148. Chest CY-252/CRD-3.

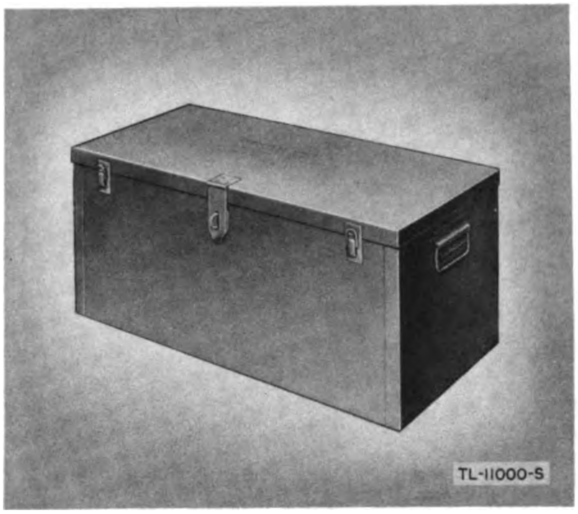


Figure 149. Chest CY-409/U.

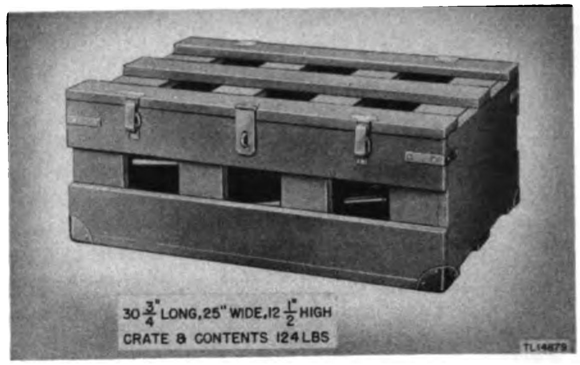


Figure 151. Crate for fire extinguishers.

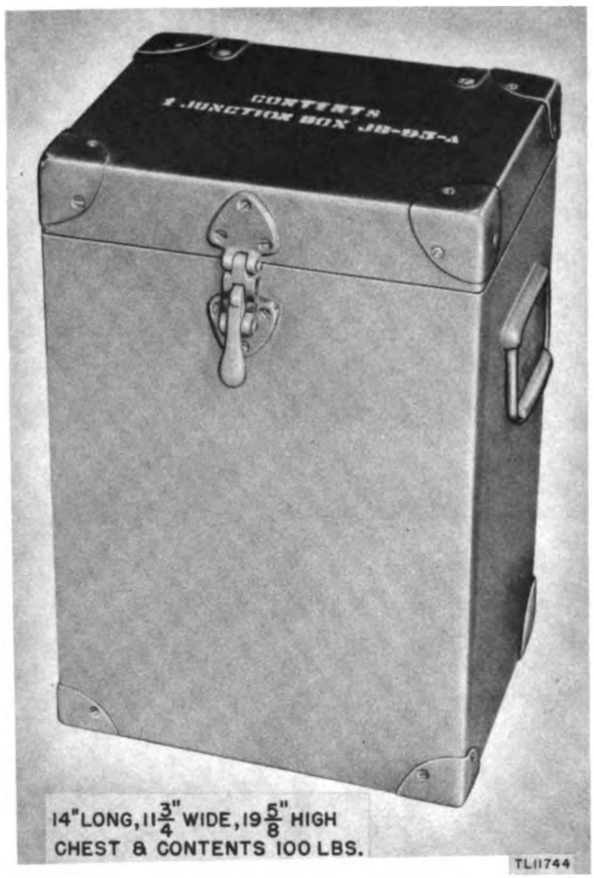


Figure 150. Chest CH-210-A for Junction Box JB-126.

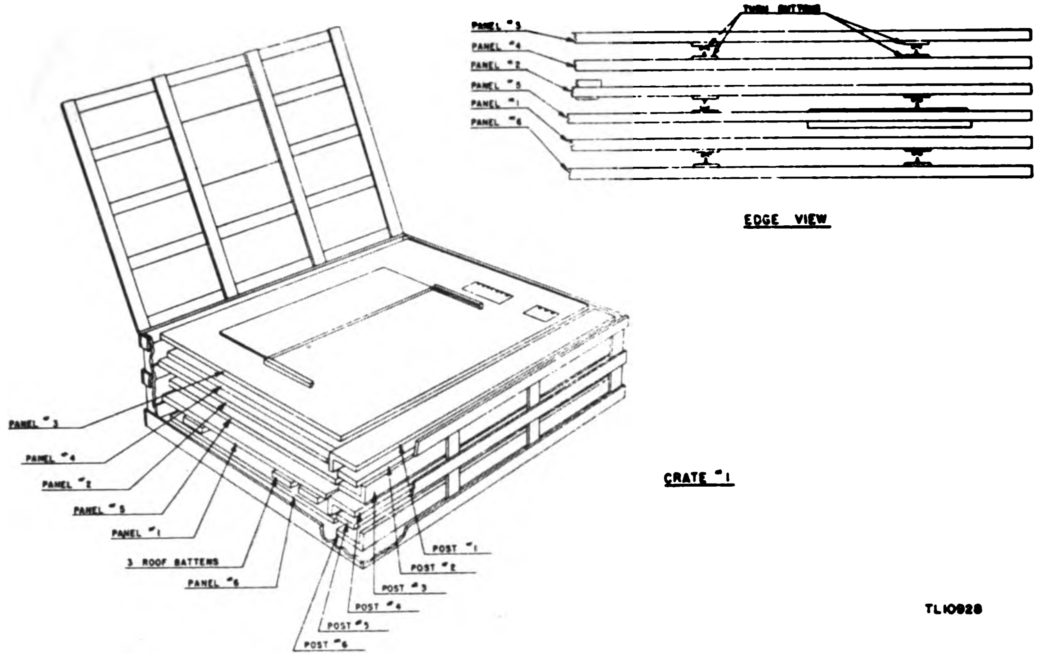


Figure 152. Packing of Shelter HO-20-B in detail, crate No. 1.

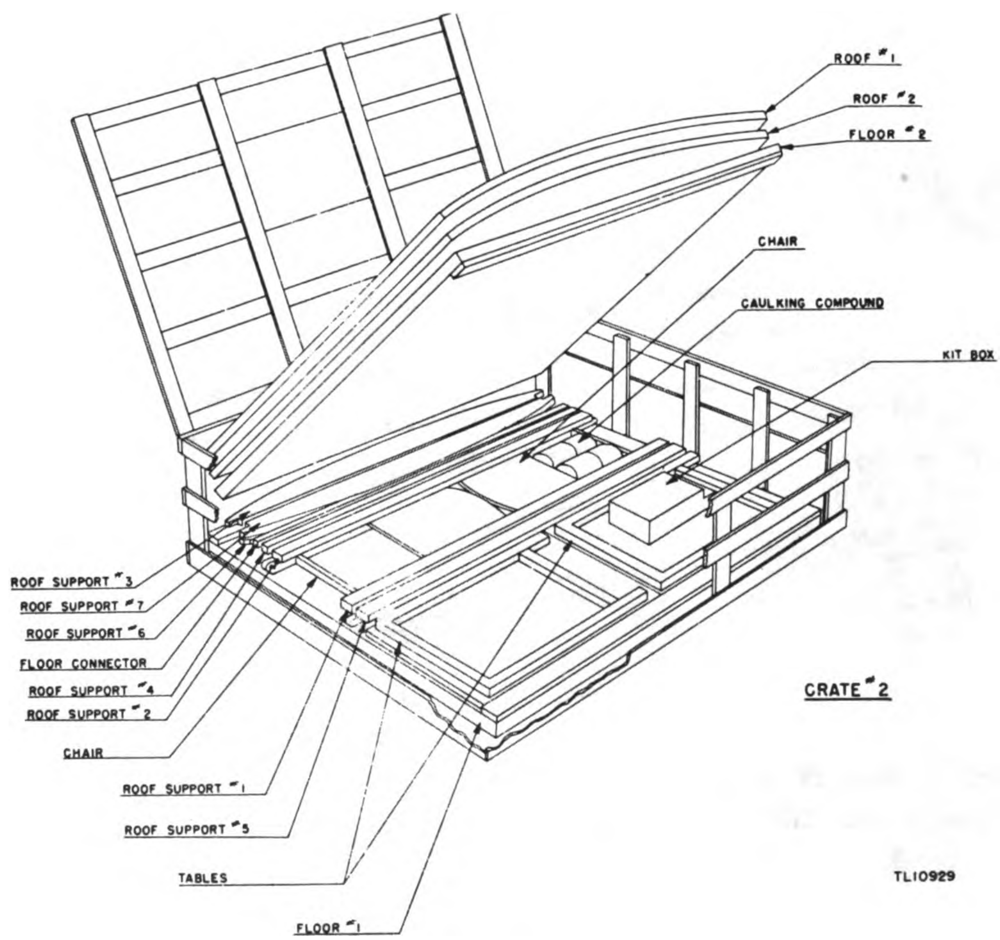


Figure 153. Packing of Shelter HO-20-B in detail, crate No. 2.

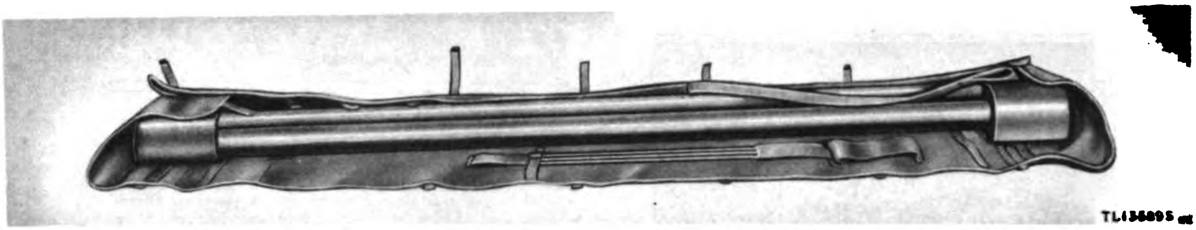


Figure 154. Bag CW 120/CRD-3 open showing mast sections.

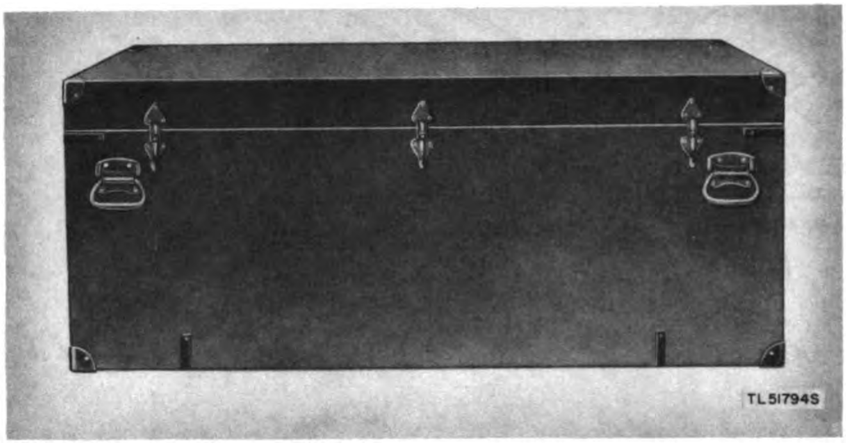


Figure 155. Chest CY-317/CRD-3.

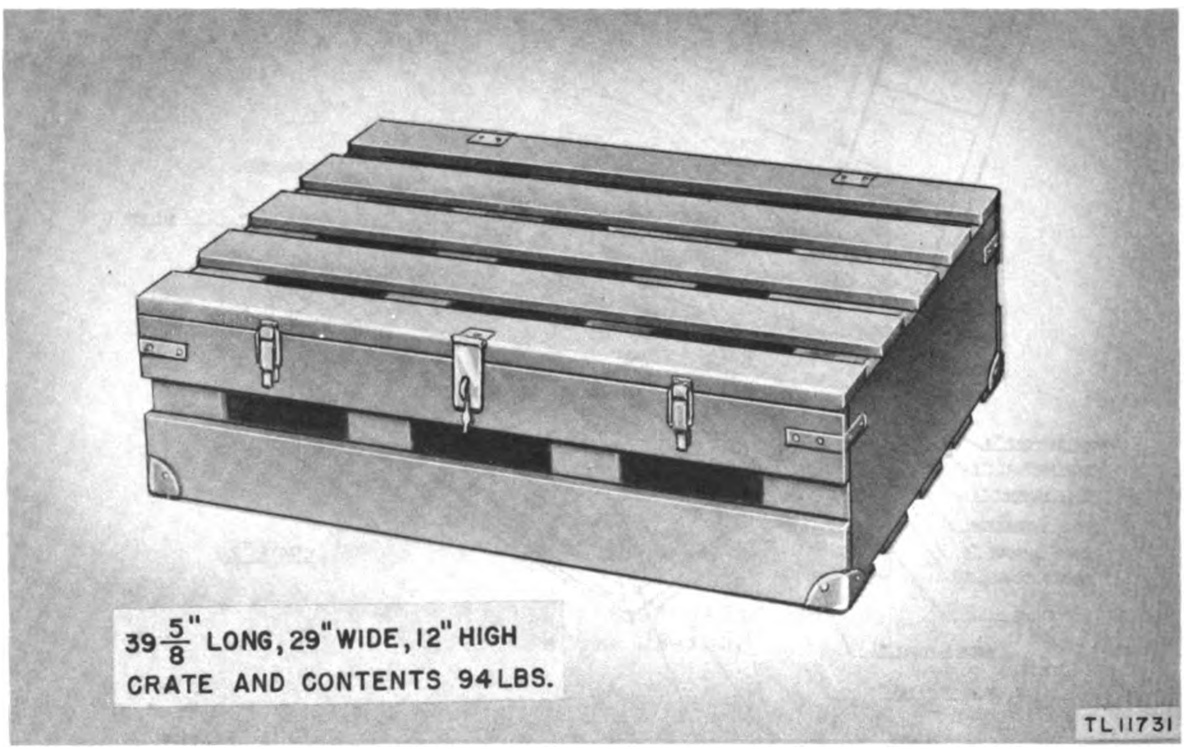


Figure 156. Crate for Reel Unit RL-49-A.

147. TABLE OF COMPONENTS.

Description	Quantity	
	Used in equipment	Running spares
Amplifier-Rectifier Power Unit PP-151/CRD-3, includes:	1	0
Tube JAN-OD3/VR-150	1	1
Tube JAN-2X2A	1	1
Tube JAN-6AC7	1	1
Tube JAN-6X5GT/G	1	1
Fuse, FU-26	2	20
Fuse, 5-amp, 250-volt Littelfuse (3AG) No. 1358 or equal	1	10
Antenna Assembly AS-204( )/CRD-3; includes:	5	2
Mast Base AB-57/CRD-3	1	0
Mast Section AB-65/CRD-3	1	0
Mast Section AB-66/CRD-3	1	0
Mast Section AB-67/CRD-3	1	0
Mast Section AB-68/CRD-3	1	0
Mast Section AB-69/CRD-3	1	0
Mast Section AB-70/CRD-3	1	0
Mast Section MS-116-A	3	0
Guys MX-298/CRD-3	4	0
Guys MX-299/CRD-3	4	0
Guys MX-300/CRD-3	4	0
Stakes GP-25	4	2
Stakes GP-2	4	2
Ground Connector CX-459/CRD-3	1	1
Guy spreader chain	4	0
Antenna Mooring Platform AB-82/CRD-3 includes:	5	2
Box of bolts, screws, and washers, consisting of:	1	0
Bolt, hex. head, steel 1/2 x 1-1/2	6	0
Lag screws, 1/2 x 7	12	0
Washers for lag screws	12	0
Bag CW-120/CRD-3 (to carry mast sections o Antenna Assembly AS-204/CRD-3)	5	2
Bearing Indicator ID-121/CRD-3; includes:		
Coupling, flexible, Federal Telephone	1	0
& Radio No. NL-40101; or equal,	1	2
Tubes JAN-5NP1	1	1
Case, compass, sewed leather, Eugene Dietzgen Co. No. 6221, or equal	1	0
Case CH-211 (to hold Control-Rectifier Power Unit PP-135/CRD-3)	1	0
Case CY-319/CRD-3 (to hold stakes and chains)	2	0

147. TABLE OF COMPONENTS (contd).

Description	Quantity	
	Used in equipment	Running spares
Chair FN-12/U	1	0
Chest CH-210-A	1	0
Chest CY-251/CRD-2	1	0
Chest CY-252/CRD-2	1	0
Chest CY-315/CRD-2	1	0
Chest CY-316/CRD-2	1	0
Chest CY-317/CRD-2	1	0
Chest CY-318/CRD-2	1	0
Chest CY-409/U, for spare and auxiliary parts	2	0
Chest Set TD-1-A	1	0
Compass, pocket transit, brunton design, Eugene Dietzgen Co. No. 6620, or equal	1	0
Control-Rectifier Power Unit PP-125/CRD-2 includes:	1	0
Fuse, 250-volt, 1/8-amp; Littelfuse type 3AG, No. 1044, or equal	1	10
Fuse, FU-50	1	10
Lamp, pilot; 1/4-watt, 110-volt, neon glow lamp, Westinghouse type T-4-1/2, or equal	2	6
Tube JAN-6L6G	1	1
Tube JAN-OC3/VR-105	1	1
Tube JAN-5U4G	1	1
Cord, power 150 ft length of 2 conductor (No. 4 AWG). Both ends terminate in a connector, Crouse Hinds APJ-6275, or equal (Used to connect Power Unit PE-197 to Cord CX-565/CRD-2)	1	0
Cord CD-201	1	0
Cord CD-829	4	2
Cord CD-845	1	0
Cord CD-1020	2	2
Cord CG-271/CRD-2	3	4
Cord CX-402/CRD-2, (125 ft)	4	2
Cord CX-402/CRD-2, (40 ft)	1	1

147. TABLE OF COMPONENTS (contd).

Description	Quantity	
	Used in equipment	Running spares
Cord CX-456/CRD-3	1	1
Cord CX-458/CRD-3	1	1
Cord CX-465/CRD-3	1	1
Cord CX-547/CRD-3	1	1
Cord CX-548/CRD-3	1	1
Cord CX-549/CkD-3	1	1
Cord CX-550/CRD-3	1	1
Cord CX 551/CRD-3	1	1
Cord CX-552/CRD-3	1	1
Cord CX-565/CRD-3	1	0
Cord CX-566/CRD-3	1	1
Counterpoise MX-318/CRD-3 includes:	5	2
Ground Conductors CX-460/CRD-3	18	0
Ground Conductors CX-461/CRD-3	4	0
Ground Conductors CX-462/CRD-3	4	0
Ground Connectors CX-463/CRD-3	9	0
Stake GP-2	9	0
Crate, slatted wood, 20 x 77 x 57 inches, for Shelter HO-20	1	0
Crate, slatted wood, 24 x 70 x 62 inches, for Shelter HO-20	1	0
Crate, slatted wood, for Reel Unit RL-49-A	1	0
Crate, slatted wood, for 2 fire extinguishers	1	0
Fire extinguisher, Walter Kidde and Co. Model 4, or equal	2	0
Gin Pole MX-319/CRD-3	2	0
Goniometer Navy No. CPT-47372	1	1
Headset HS-29	1	0
Heater, electric, portable 1.5 kw, Electric Air Heater Co., Miskawaka, Ind., Model AA15, or equal	2	0
Jack JK-39	1	0

147. TABLE OF COMPONENTS (contd).

Description	Quantity	
	Used in equipment	Running spares
Junction Box JB-91, color-coded green, yellow, and yellow-green	1	0
Junction Box JB-91, color-coded blue, brown, and blue-brown	1	0
Junction Box JB-91, uncolored, running spares	0	2
Junction Box JB-126	1	0
Junction Box J-99/CRD-2, color-coded green-yellow, blue-brown, and red	1	0
Mounting Collar MT-334/CRD-2	5	2
Mounting Table MT-347/CRD-2	1	0
Phase Inverter MC-411-A, color-coded green, includes:	1	0
Tube JAN-7V7	2	1
Phase Inverter MC-411-A; color-coded yellow, includes:	1	0
Tube JAN-7V7	2	1
Phase Inverter MC-411-A; color-coded blue, includes:	1	0
Tube JAN-7V7	2	1
Phase Inverter MC-411-A; color-coded brown, includes:	1	0
Tube JAN-7V7	2	1
Phase Inverter MC-411-A; uncolored, running spares, includes:	0	2
Tube JAN-7V7	2	1
Phase Inverter MC-412-A, color-coded red, includes:	1	0
Tube JAN-7V7	4	1
Phase Inverter MC-412-A, uncolored, running spare, includes:	0	1
Tube JAN-7V7	4	1
Power Unit PE-197	1	1
Radio Receiver Assembly R-128/CRD-2, includes:	1	0
Fuse, 8 amp, 250-volt, 3AG, Littelfuse No. 1260 or equal	2	20
Fuse, FU-50	2	20

Description	Quantity	
	Used in equipment	Running spares
Lamp, GE-T2, or equal	2	4
Lamp, LM-52	5	10
Lamp, 1/4 watt neon, Westinghouse T-4-1/2, or equal	4	2
Cord CG-270/CRD-2	1	1
Cord CX-546/CRD-2	1	1
Tube JAN-2AP1	1	1
Tube JAN-2X2A	1	1
Tube JAN-5U4G	1	1
Tube JAN-6AC7	5	1
Tube JAN-6H6	4	1
Tube JAN-6J5	1	1
Tube JAN-6SA7	1	1
Tube JAN-6SJ7	2	1
Tube JAN-6SK7	5	1
Tube JAN-6SN7GT	1	1
Tube JAN-6SQ7	1	1
Tube JAN-6V6	1	1
Reel DR-10-A	6	0
Reel Unit RL-49-A	1	0
Screws, nuts, and bolts, running spares	0	1 Kit
Shelter HO-20-B includes:	1	0
Tables, wooden	2	0
Chairs, wooden	2	0
Signal Generator I-72	1	1
Tags, color-coded	1 Kit	0
*Target transmitter and signal generator assembly; includes:	1	0
Signal Generator TS-200( )/CRD-2; contains the following:	1	0
Battery BA-22	2	4

* In some cases, the model OAN test oscillator has been supplied instead of Signal Generator TS-200/CRD-2.

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147. TABLE OF COMPONENTS (contd).

Description	Quantity	
	Used in equipment	Running spares
Battery BA-222/U	1	2
Tube JAN-1R5	1	1
Tube JAN-6G6G	2	1
Mast Section MS-116-A	4	2
Mast Section MS-117-A	1	1
Mast Section MS-118-A	1	1
Junction Box J-97/CRD-2	1	0
Cord CG-241/CRD-2	1	0
Cord (counterpoise), 20 feet, one conductor 64.08 mils diameter (#14 AWG) Buna S insulation 18 mils minimum thickness. Has a spade lug at one end and free on the other end.	4	0
Bag CW-122/CRD-2 (for Mast Sections MS-116-A, MS-117-A, and MS-118-A)	1	0
Cover CW-121/CRD-2 (to cover Signal Generator TS-300( )/CRD-2)	1	0
TM 11-512 for Radio Set AN/CRD-2( )	2	0
TM 11-333 for Telephone EE-8-( )	2	0
Telephone EE-8-B	1	0
Tool Equipment TE-41	1	0
Tools, hardware, and miscellaneous equipment for erecting operating and maintaining Radio Set AN/CRD-2( ); includes:	1 Group	0
Cord, test, Federal Telephone and Radio RF-1065-2, or equal	1	0
Hammer, sledge, 6 pounds, double face, with handle, regular pattern	1	0
Level, 12", Stanley #36, or equal	1	0
Oiler, 1/2 oz Eagle Mfg. Co. #254C, or equal	1	0
Oiler, 1/2 pt metal, 6" spout, Eagle Mfg. Co. #3006, or equal	1	0
Pt oil, lubricating, Univis #40, or equal	1	0
Plumb Bob, 12 oz, brass, Federal Telephone and Radio RF-689-1A, or equal	1	0
Tape, measuring, steel, 100 ft 1/2" wide, Lufkin Rule Co., #266, or equal	1	0

147. TABLE OF COMPONENTS (contd).

Description	Quantity: Used in equipment	Quantity: Running spares
Screwdriver, spiral ratchet, Yankee #130A, or equal	1	0
Socket combination, 7/17" square, to fit spiral ratchet wrench North Bros. Yankee type, or equal	1	0
Wrench, Allen 1/16" crossflats Bendix dwg #B-15447 screw, or equal	1	0
Wrench, Allen 5/64-in. for #8 set screw, or equal	1	0
Wrench, Allen 3/32-in. or equal	1	0
Wrench, Allen 1/8-in., Continental Elec. dwg No. 148-30672-11, or equal	1	0
Wrench, Allen 5/32-in., or equal	1	0
Wrench, Allen 3/16-in., or equal	1	0
Wrench, Allen 7/32-in., or equal	1	0
Wrench, Allen 1/4-in., Magnavox No. 80004-5G9 or equal	1	0
Wrench, Stevens Spintite #3408, or equal	1	0
Wrench, Stevens Spintite #3410, or equal	1	0
Wrench, Stevens Spintite #3411, or equal	1	0
Wrench, TL-108	1	0
Wrench, end, 6 in. adjustable, TL-111	1	0
Wrench, TL-112	1	0
Wrench, end, 15-degree, Chrome-alloy, Williams type No. 1721, or equal	2	0
Wrench, end, 15-degree, Chrome-alloy, Williams type No. 1725, or equal	2	0
Wrench, end, 15-degree, Chrome-alloy Williams type No. 1727, or equal	2	0
Wrench, end, 15-degree, Chrome-alloy, Williams type No. 1029, or equal	2	0
Bench vise	1	0
Fuel pipe and ventilating assembly	1	0
Wooden frame for mounting J-99/CRD-3	1	0
Wooden frame for supporting PP-135/CRD-3	1	0
Wire harness clips, type B, part No. 49163, size 6, United Carr Fastener Corp. or equal	12	0
Hooks for hanging Telephone EE-8-B	2	0
Tripod, Eugene Dietzgen Co., metal telescoping tripod No. 6624A, or equal	1	0
Voltohmmeter, Weston Electric Instrument Corp. Model No. 564, Type 3C, or equal	1	0
Yoke with ball and socket-joint, Eugene Dietzgen Co. No. 6622, or equal	1	0

147. TABLE OF COMPONENTS (contd).

Description	Quantity
Service items include:	
Test cable, Federal Telephone and Radio RF-1812-2, or equal	1
Test cable, Federal Telephone and Radio RF-1813-3, or equal	1
Test cable, Federal Telephone and Radio RF-1984-2, or equal	1
Repair apron	1
Demagnetizer, Federal Telephone and Radio No. NLA 42970-2, or equal	1
Univis No. 40 Oil, Federal Telephone and Radio RF-759-1, or equal	1 can
(1/2 pt) Permatex, No. 3 or equal	1 can
Spare parts include:	
Gaskets	1 set
Paper capacitors, Federal Telephone and Radio RF-2578-1, or equal	1 set
Mica capacitors, Federal Telephone and Radio, RF-2575-1, or equal	1 set
Transformers, Federal Telephone and Radio RF-2568-2-1, or equal	1 set
Transformers, Federal Telephone and Radio, RF-2586-2-2, or equal	1 set
Resistors and pots, Federal Telephone and Radio RF-2591-1, or equal	1 set
Resistors and pots, Federal Telephone and Radio RF-2590-1, or equal	1 set
Sockets and contacts, Federal Telephone and Radio RF-2587-2-2, or equal	1 set
Switches, Federal Telephone and Radio RF-2589-1, or equal	1 set

147. TABLE OF COMPONENTS (contd).

Description	Quantity
Relays, Federal Telephone and Radio RF-2588-2-2, or equal	1 set
Receptacles, Federal Telephone and Radio RF-2577-1, or equal	1 set
Brushes, springs, and coils, Federal Telephone and Radio RF-2576-2-2, or equal	1 set
Tools, Federal Telephone and Radio RF-2578-2-1, or equal	1 set
Oscillator coil, L-603, Federal Telephone and Radio RF-2583-3-3, or equal	1
Oscillator coil, L-601, Federal Telephone and Radio RF-2583-3-1, or equal	1
Oscillator coil, L-110, Federal Telephone and Radio RF-2584-3-6, or equal	1
Oscillator coil L-602, Federal Telephone and Radio RF-2583-3-2, or equal	1
Oscillator coil, L-109, Federal Telephone and Radio RF-2584-3-5, or equal	1
B-f-o coil, L-205, Federal Telephone and Radio RF-2582-3-6, or equal	1
Amplifier transformer, L-605, Federal Telephone and Radio RF-2583-3-5, or equal	1
Amplifier transformer, L-604, Federal Telephone and Radio RF-2583-3-4, or equal	1
Amplifier transformer, L-606, Federal Telephone and Radio RF-2583-3-6, or equal	1
Antenna transformers, Federal Telephone and Radio RF-2584-3-1, or equal	1 set
R-f transformers, L-106 and L-108, Federal Telephone and Radio RF-2584-3-4, or equal	1 set
R-f transformers, L-105 and L-107, Federal Telephone and Radio RF-2584-3-3, or equal	1 set
Antenna transformers, L-102 and L-104, Federal Telephone and Radio RF-2584-3-2, or equal	1 set

147. TABLE OF COMPONENTS (contd).

Description	Quantity
I-f output transformer, L-206, Federal Telephone and Radio RF-2582-3-5, or equal	1
I-f amplifier coil, L-203, Federal Telephone and Radio RF-2582-3-4, or equal	1
I-f trap coil, L-111, Federal Telephone and Radio RF-2582-3-1, or equal	1
Converter plate coils, L-112, L-201, L-202 Federal Telephone and Radio RF-2582-3-2, or equal	1 set
Goniometer Amplifier plate coil, L-113, Federal Telephone and Radio RF-2582-3-3, or equal	1
Converter plate assembly, Federal Telephone and Radio RF-2581-3-5, or equal	1
Dummy Goniometer assembly, L-401, Federal Telephone and Radio RF-2581-3-3, or equal	1
Dummy loop coil, L-301, Federal Telephone and Radio RF-2581-3-2, or equal	1
I-f trap assembly, Federal Telephone and Radio RF-2581-3-4, or equal	1
Indicator, i-f, output transformer L-206, Federal Telephone and Radio RF-2581-3-1, or equal	1
Goniometer amplifier plate assembly, Federal Telephone and Radio RF-2581-3-6, or equal	1
I-f output assembly, Federal Telephone and Radio RF-2580-3-4, or equal	1
I-f amplifier plate assembly, Federal Telephone and Radio RF-2580-3-2, or equal	1
Indicator channel output assembly, Federal Telephone and Radio RF-2580-3-6, or equal	1
I-f amplifier grid assembly, Federal Telephone and Radio RF-2580-3-3, or equal	1
I-f amplifier assembly, Federal Telephone and Radio RF-2580-3-1, or equal	1

147. TABLE OF COMPONENTS (contd).

Description	Quantity
Tube JAN-OD3/VR-150	1
Tube JAN-2AP1	1
Tube JAN-2X2A	2
Tube JAN-5NP1	1
Tube JAN-6AC7	10
Tube JAN-6H6	7
Tube JAN-6J5	1
Tube JAN-6SA7	1
Tube JAN-6SJ7	3
Tube JAN-6SK7	13
Tube JAN-6SN7GT	1
Tube JAN-6SQ7	1
Tube JAN-6V6	1
Tube JAN-6V5GT/G	3

148. PACKAGING DATA.

Radio Set AN/CRD-3 is packed in crates, the dimensions, volume and weight of which are shown in the following table.

	Length (in.)	Width (in.)	Height (in.)	Volume (cu ft)	Weight (lbs)
Crate 1:					
Power Unit PE-197	30	34	39-1/2	61.7	1420
Crate 2:					
Power Unit PE-197	30	34	39-1/2	61.7	1420
Crate 3:					
Electrolyte	18	8-1/2	10	0.9	80
Crate 4:					
Electrolyte	18	8-1/2	10	0.9	80
Crate 5:					
Antenna mooring platform	51-1/4	49-1/2	6-1/2	9.5	100
Crate 6:					
Antenna mooring platform	51-1/4	49-1/2	6-1/2	9.5	100
Crate 7:					
Antenna mooring platform	51-1/4	49-1/2	6-1/2	9.5	100
Crate 8:					
Antenna mooring platform	51-1/4	49-1/2	6-1/2	9.5	100
Crate 9:					
Antenna mooring platform	51-1/4	49-1/2	6-1/2	9.5	100
Crate 10:					
Antenna mooring platform	51-1/4	49-1/2	6-1/2	9.5	100
Crate 11:					
Antenna mooring platform	51-1/4	49-1/2	6-1/2	9.5	100
Crate 12:					
Fire extinguishers (2 each in crate)	36	27-7/8	16	9.3	202
Crate 13:					
Shelter, HO-20-B	75	65-1/2	26-1/2	75.3	870
Crate 14:					
Shelter, HO-20-B	81	63	19-1/2	62.1	350

148. PACKAGING DATA (contd).

	Length (in.)	Width (in.)	Height (in.)	Volume (cu ft)	Weight (lbs)
Crate 15:					
Bag, CW-120/CRD-8	117-1/2	19-3/4	12-1/4	16.4	170
Contents:					
1 ea Mast Section AB-65/CRD-8					
1 ea Mast Section AB-66/CRD-8					
1 ea Mast Section AB-67/CRD-8					
1 ea Mast Section AB-68/CRD-8					
1 ea Mast Section AB-69/CRD-8					
1 ea Mast Section AB-70/CRD-8					
3 ea Mast Section MC-116					
Crate 16:					
Bag, CW-120/CRD-8 (contents same as crate 15)	117-1/2	19-3/4	12-1/4	16.4	176
Crate 17:					
Bag, CW-120/CRD-8 (contents same as crate 15)	117-1/2	19-3/4	12-1/4	16.4	176
Crate 18:					
Bag, CW-120/CRD-8 (contents same as crate 15)	117-1/2	19-3/4	12-1/4	16.4	176
Crate 19:					
Bag, CW-120/CRD-8 (contents same as crate 15)	117-1/2	19-3/4	12-1/4	16.4	170
Crate 20:					
Bag, CW-120/CRD-8	117-1/2	19-3/4	12-1/4	16.4	175
Contents:					
1 ea Mast Section AB-65/CRD-8					
1 ea Mast Section AB-66/CRD-8					
1 ea Mast Section AB-67/CRD-8					
1 ea Mast Section AB-68/CRD-8					
1 ea Mast Section AB-69/CRD-8					
1 ea Mast Section AB-70/CRD-8					
3 ea Mast Section MS-116					
1 ea Gin Pole MX-319/CRD-8					
Crate 21:					
Bag, CW-120/CRD-8 (contents same as crate 20)	117-1/2	19-3/4	12-1/4	16.4	175

148. PACKAGING DATA (contd).

	Length (in.)	Width (in.)	Height (in.)	Volume (cu ft)	Weight (lbs)
Crate 22:					
Reel DR-10-A, and cable assembly		18-3/8	27-1/4 (diam)	0.7	200
Contents:					
4 ea Cords CX-402/CRD-8 135 ft long					
1 ea Cord CX-402/CRD-8 40 ft long					
2 ea Cords CD-1020					
1 ea Reel, DR-10-A					
Crate 23:					
Reel DR-10-A, and cable assembly		18-3/8	27-1/4 (diam)	6.7	206
Contents:					
4 ea Cords CD-829 94 ft long					
1 ea Cord CD-1020					
1 ea Reel, DR-10-A					
Crate 24:					
Reel DR-10-A, and cable assembly		18-3/8	27-1/4 (diam)	9.7	206
Contents:					
2 ea Cord CD-829 (spares) 94 ft long					
2 ea Cord CD-1020 (spares) 40 ft long					
2 ea Cord CX-402/CRD-8 (spares) 135 ft long					
1 ea Cord CX-402/CRD-8 (spares) 40 ft long					
1 ea Reel, DR-10-A					
Crate 25:					
Reel DR-10-A, and cable assembly		18-3/8	27-1/4 (diam)	0.7	206
Contents:					
1 ea Cord CX-565/CRD-8					
1 ea Cord CD-845 175 ft long					
1 ea Reel DR-10-A					
Crate 26:					
Reel DR-10-A, and ground conductor assembly		18-3/8	27-1/4 (diam)	0.7	150
Contents:					
1 ea Reel DR-10-A					

148. PACKAGING DATA (contd).

	Length (in.)	Width (in.)	Height (in.)	Volume (cu ft)	Weight (lbs)
54 ea Ground Conductor CX-460/CRD-3					
12 ea Ground Conductor CX-461/CRD-3					
12 ea Ground Conductor CX-462/CRD-3					
Crate 27:					
Reel DR-10-A, and ground conductor assembly		18-3/8	27-1/4 (diam)	0.7	150
Contents:					
1 ea Reel, DR-10-A					
72 ea Ground Conductor CX-460/CRD-3					
16 ea Ground Conductor CX-461/CRD-3					
16 ea Ground Conductor CX-462/CRD-3					
Crate 28:					
Reel Unit RL-49-A	45-1/4	33-1/8	15-5/8	13.5	94
Crate 29:					
Chest, CY-316/CRD-3	66-7/8	27-3/4	29-1/2	31.1	415
Contents:					
1 ea Operator's chair					
2 ea Electric heaters					
1 ea Tripod					
1 ea Compass adapter					
1 ea Adapter assembly					
1 Set of tools					
1 ea Compass					
1 ea Chest Set TD-1-A					
1 ea Headset HS-29					
1 ea Jack JK-39					
1 Set misc nuts, screws, etc.					
1 Set of tags					
1 ea Telephone EE-8-B					
1 ea Sledge hammer					
3 ea Flexible motor coupling					
2 ea Technical Manual					
1 Cord CD-201					
28 ea Guy rope fasteners					

148. PACKAGING DATA (contd).

	Length (in.)	Width (in.)	Height (in.)	Volume (cu ft)	Weight (lbs)
Crate 30:					
Chest, CH-211	36-1/2	33-5/8	22	29.2	180
Contents:					
1 ea Control Rectifier Power Unit PP-135/CRD-3					
Crate 31:					
Chest, CY-252/CRD-3	67-1/4	33-7/8	17-3/4	23.4	350
Contents:					
7 ea Mast Base AB-57/CRD-3					
14 ea Ground Conductor CY-450/CRD-3					
63 ea Ground Conductor CY-463/CRD-3					
7 ea Mounting Collar MT-334/CRD-3					
Crate 32:					
Chest CY-528/CRD-3	67-1/4	33-7/8	15-3/4	20.8	350
Contents:					
28 ea Guy MX-298/CRD-3					
28 ea Guy MX-299/CRD-3					
28 ea Guy MX-300/CRD-3					
Crate 33:					
Chest CY-315/CRD-3	36-3/8	33-5/8	46-3/4	30.7	400
Contents:					
1 ea Radio Receiver Assembly R-128/CRD-3					
1 ea Cord CG-270/CRD-3					
1 ea Cord CX-546/CRD-3					
2 ea Cord CX-456/CRD-3					
2 ea Cord CX-458/CRD-3					
Crate 34:					
Chest CY-318/CRD-3	53-5/8	36-7/8	45-1/2	52.2	550
Contents:					
1 ea Bearing Indicator ID-121/CRD-3					
1 ea Goniometer CPT					
1 ea Mounting Table MT-347/CRD-3					
1 ea Cord CX-465/CRD-3					
1 ea Cord CX-549/CRD-3					

148. PACKAGING DATA (contd).

	Length (in.)	Width (in.)	Height (in.)	Volume (cu ft)	Weight (lbs)
Crate 35:					
Chest CH-210-A	20-1/2	15-3/4	25-3/8	4.7	195
Contents:					
1 ea Junction Box JB-126					
Crate 36:					
Chest CY-317/CRD-3	51-1/2	28	22-3/4	18.9	275
Contents:					
1 ea Amplifier Rectifier Power Unit PP-151/CRD-3					
3 ea Cord CG-271/CRD-3					
1 ea Cord CX-547/CRD-3					
1 ea Cord CX-548/CRD-3					
1 ea Cord CX-550/CRD-3					
1 ea Cord CX-551/CRD-3					
1 ea Cord CX-552/CRD-3					
1 ea Tool Equipment TE-41					
1 ea Junction Box J-99/CRD-3					
Crate 37:					
Case CY-319/CRD-3	44-3/8	25-3/8	16-1/2	10.8	290
Contents:					
53 ea Stake GP-2					
21 ea Stake GP-25					
14 ea Guy spreader chain					
Crate 38:					
Case CY-319/CRD-3	44-3/8	25-3/8	16-1/2	10.8	290
Contents:					
52 ea Stake GP-2					
21 ea Stake GP-25					
14 ea Guy spreader chain					
Crate 39:					
Chest CY-251/CRD-3	46-1/4	22	23-3/8	13.7	265
Contents:					
1 ea N Phase Inverter MC-411-A					
1 ea S Phase Inverter MC-411-A					
1 ea E Phase Inverter MC-411-A					
1 ea W Phase Inverter MC-411-A					
1 ea C Phase Inverter MC-411-A					

148. PACKAGING DATA (contd).

	Length (in.)	Width (in.)	Height (in.)	Volume (cu ft)	Weight (lbs)
2 ea Phase Inverter MC-411-A					
1 ea Phase Inverter MC-412-A					
1 ea Junction Box JB-91-A (yellow-green)					
1 ea Junction Box JB-91-A (blue-brown)					
2 ea Junction Box JB=91-A (spare)					
1 ea Junction Box J-97/CRD-2					
1 ea Signal Generator I-72					
1 ea Goniometer CPT-47372					
1 ea Voltohmeter					
Crate 40:					
Chest CY-409/U (1)	47-3/8	22-3/4	16-7/8	10.6	200
Contents:					
Misc spare parts					
Crate 41:					
Chest CY-409/U (2)	47-3/8	22-3/4	16-7/8	10.6	200
Contents:					
Misc spare parts					
Crate 42:					
Chest CY-409/U (3)	47-3/8	22-3/4	16-7/8	10.6	200

149. MODEL OAN TEST EQUIPMENT.

Model OAN test equipment consists of the following:

1 CFT-60054-A Test Oscillator unit.

1 waterproof carrying case.

1 Fifteen-foot type CFT-66082 whip antenna with carrying case.

1 Junction Box J-97/CRD-3.

1 Cord CG-241/CRD-3.

4 Battery BA-35.

3 Battery BA-59.

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3.

The following information was compiled on 21 July 1945. The appropriate pamphlets of the ASF Signal Supply Catalog for Radio Set AN/CRD-3 are:

Sets of equipment

SIG 6-TE-41

Organizational spare parts

SIG 7-PE-197

Higher echelon spare parts

SIG 8-EE-8

SIG 8-GN-38

SIG 8-PE-197

SIG 8-TS-9

Combined organizational and higher echelon spare parts

SIG 7- & 8-AN/CRD, (when published)

SIG 7- & 8-HS-29, (when published)

SIG 7- & 8-I-239, (when published)

For an index of available catalog pamphlets, see the latest issue of ASF Signal Supply Catalog SIG 2.

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3.

Ref symbol	Signal Corps stock No	Name of part and description
	2S1515	RADIO SET AN/CRD-3: semi-transportable, semi-fixed, ground station radio direction finder; cw, mcw and icw; Sig C spec #271-3175.
	3H138.1-151	AMPLIFIER - RECTIFIER POWER UNIT PP-151/CRD-3: electron tube rectifier; input 110/120 v, 55/65 c single ph; 8-3/4" x 19" x 13-1/2"; Sig C spec #271-3175.
	2A264-204	ANTENNA ASSEMBLY AS-204/CRD-3: steel and aluminum; olive drab; telescopic, 9 sect; 64 ft extended, 9 ft collapsed, 3" OD; w/Mast Base AB-57/CRD-3; Sig C spec #271-3175.
	2A312-120	BAG CW-120/CRD-3: antenna; hard-texture duck; Sig C spec #271-3175 (for carrying Mast sections, gin pole and antenna guy collars).
	6Q2104-16	BAG, tool: canvas; olive drab; 4-1/4" wd x 4-1/2" h when open; Fed Tele & Rad part/dwg #RF-1156-2-34 (for plumb-bob).
	6Q2104-17	BAG, tool: canvas; olive drab; 9" wd x 9" h; Fed Tele & Rad part/dwg #1156-2-35 (for wrenches).
	2C1565-121	BEARING INDICATOR ID-121/CRD-3: an electro-mechanical unit for producing instantaneous hearing and sense patterns characteristic of the antenna and goniometer; w/a 1150 rpm driving motor; Navy #CFT-55092-A.
	6R19130/S1	BIT, screwdriver: combination socket type; used on stove bolts and hex nuts for spiral ratchet screwdriver; 7/16".
	3E1201	CABLE ASSEMBLY, AF: Sig C Cord CD-201; telegraph key; RC; 60" lg; 2 #18 AWG copper cond ea comprising 41 #34 AWG strands; w/Plug PL-55 one end and 2 spade Terminal TM-29 on the other end.

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	3E1829	CABLE ASSEMBLY RF: Sig C Cord CD-829; twin-axial; flexible; characteristic impedance 125 ohms; 92 ft lg; 2 cond ea comprising 7 #21 AWG strands; Intelin type 45 solid dielectric; with Amphenol #AN-3106-22-2S socket one end, Amphenol #AN-3106-22-2P plug other end (connects Phase Inverter MC-411 to Junction Box JB-91).
	3E1845	CABLE ASSEMBLY, RF: Sig C Cord CD-845; general purpose; RC; 150 ft lg; 2 cond #14 AWG; with Universal type male plug one end; Universal type female socket other end; Sig C spec #271-1612 (utility).
	3E1999-20	CABLE ASSEMBLY RF: Sig C Cord CD-1020; twin-axial; flexible; characteristic impedance 125 ohms; 40 ft lg; 2 stranded cond; solid styrene dielectric; with Amphenol #AN-3106-22-2P plug ea end (connects Junction Box J-91 to Junction Box J99/CRD-3 and Junction Box J-99/CRD-3 to Phase Inverter MC-413).
	1F430-271	CABLE ASSEMBLY, RF: Army-Navy Cord CG-271/CRD-3; twin-axial; flexible; impedance 95 ohms; 66" lg; ea cond composed of 7 strands of 0.0152" diam plain copper wire; polythylene dielectric (connects Junction Box J-99/CRD-3 to goniometer and radio receiver assembly).
	3E6015-270	CABLE ASSEMBLY, power: Army-Navy Cord CG-270/CRD-3; general purpose; aluminum shielding; 36" lg; 2 cond #20 AWG stranded hook-up wire; with Amphenol #AN-3108-12S-3P connector ea end (i-f between two sect of R-128/CRD-3).

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	3E6000-402-480	CABLE ASSEMBLY, power: Army-Navy Cord CX-402/CRD-3; Buna S jacketed; 40 ft lg; 5 cond, 3 #14 AWG and 2 #16 AWG cond; Amphenol #AN-3106-22-13S connector one end Amphenol #AN-3106-22-13P other end (connects coupling unit to control rectifier power unit).
	3E6000-402-1620	CABLE ASSEMBLY, power: Army-Navy Cord CX-402/CRD-3; Buna S jacketed; 135 ft lg; 5 cond, 3 #14 AWG and 2 #16 AWG; Amphenol #AN-3106-22-13S connector one end Amphenol #AN-3106-22-13P connector other end (connects coupling unit to rectifier power unit).
	3E6000-456-39	CABLE ASSEMBLY, power: Army-Navy Cord CX-456/CRD-3; Buna S jacketed; 39" lg; 3 #16 AWG cond; Amphenol connector AN-3108-20-6S one end, Amphenol connector #AN-3108-20-6P other end (connects rectifier power unit to receiver assembly).
	3E6000-458	CABLE ASSEMBLY, power: Army-Navy Cord CX-458/CRD-3; Buna S jacketed; 15 ft lg; 3 #16 AWG cond; Amphenol connector #AN-3106-20-6S one end Hubbell #7573 connector other end (connects receiver to junction box).

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	3E6000-460-387	CABLE ASSEMBLY, power: Army-Navy Ground Conductor CX-460/CRD-3; 32 ft 3" of 5/8" flat copper tinned braid; with 13 Dot male and 13 female fasteners (for distributing ground currents in the vicinity of antenna system; p/o Counterpoise MX-318/CRD-3).
	3E6000-461	CABLE ASSEMBLY, power: Army-Navy Ground Conductor CX-461/CRD-3; 8 ft lg of 5/8" flat copper tinned braid; with 7 male and 7 female Dot fasteners (for distributing ground current in the vicinity of antenna system; p/o Counterpoise MX-318/CRD-3).
	3E6000-462-99	CABLE ASSEMBLY, power: Army-Navy Ground Conductor CX-462/CRD-3; 8 ft 3" lg of flat copper tinned braid with 5 Dot male fasteners and 5 female fasteners (for distributing ground currents in the vicinity of antenna system; p/o Counterpoise MX-318/CRD-3).
	3E6000-463-72	CABLE ASSEMBLY, power: Army-Navy Cord CX-463/CRD-3; general purpose; flat, 5/8" wd; 6" lg; copper braid; with clamp on 1 end and double Dot fastener other end; (to connect Sig C Stoke GP-2 to Army-Navy Counterpoise, MX-318/CRD-3; p/o Counterpoise MX-318/CRD-3).
	3E6000-465	CABLE ASSEMBLY, power: Army-Navy Cord CX-465/CRD-3; aluminum shielding; 48" lg; 2 #16 AWG stranded hook-up wires, 2.7 mm ignition wire per spec AN-J-C-56; one end terminated in Amphenol connector AN-3108-22-10S and 1 amphenol connector AN-3108-22-10P (connects rectifier power unit to bearing indicator).
	3E6000-546	CABLE ASSEMBLY, power: Army-Navy Cord CX-546/CRD-3; general purpose; aluminum shielding; 36" lg; 14 cond, 12 #16 AWG and 2 #12 AWG stranded hook-up wire; with Amphenol #AN-3108-28 2P connector ea end (power between two sect of R-128/CRD-3).

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	3E6000-547	CABLE ASSEMBLY, power: Army-Navy Cord CX-547/CRD-3; general purpose; aluminum shielding; 30"; 3 #16 AWG stranded hook-up wire cond; with Amphenol #AN-3106-16S-5S connector one end Amphenol #AN-3108-16-5P connector other end (connects Junction Box J-99/CRD-3 to Receiver R-128/CRD-3).
	3E6000-548	CABLE ASSEMBLY, power: Army-Navy Cord CX-548/CRD-3; general purpose; aluminum loom; 24" lg; 3 cond; with Amphenol #AN-3106-20-6S connector one end Amphenol #AN-3108-20-6P connector other end; Sig C spec #271-3175 (connects Receiver R-128/CRD-3 to Junction Box J-99/CRD-3).
	3E6000-549	CABLE ASSEMBLY, power: Army-Navy Cord CX-549/CRD-3; general purpose; aluminum shielded; 48" lg; 7 cond, 5 #16 AWG and 2 #12 AWG stranded hook-up wire; with Amphenol #AN-3108-24-3S connector 1 end, Amphenol #AN-3108-24-3P other end; Sig C spec #271-3175 (connects rectifier power unit to bearing indicator).
	3E6000-550-18	CABLE ASSEMBLY, power: Army-Navy Cord CX-550/CRD-3; general purpose; aluminum shielded; 18" lg; 4 cond; #16 AWG with Amphenol #AN-3108-18-4S connector 1 end, Amphenol #AN-3108-18-4P other end; Sig C spec #271-3175 (connects receiver to rectifier power unit) color coded 0.745" OD.
	3E6000-551	CABLE ASSEMBLY, power: Army-Navy Cord CX-551/CRD-3; general purpose; 18" lg; 4 #16 AWG stranded hook-up wire cond; with Amphenol #AN-3108-22-10S connector ea end; (R-128/CRD-3 to rectifier power unit).

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	3E6000-552	CABLE ASSEMBLY, power: Army-Navy Cord CX-552/CRD-3; general purpose; aluminum shielded; 36" lg; 2 cond; with Amphenol #AN-3108-12S-3S connector 1 end Amphenol #AN-3108-14S-1P connector other end (R-128/CRD-3 to rectifier power unit).
	3E6000-565	CABLE ASSEMBLY, power: Army-Navy Cord CX-565/CRD-3; general purpose; 150 ft; 2 #4 AWG cond; with Crouse-Hinds #APR-6255 connector one end, Pile National #2P-30A other end; Sig C spec #271-3175 (connects Junction Box JB-126 to power cable from PE-197).
	3E6000-566	CABLE ASSEMBLY, power: Army-Navy Cord CX-566/CRD-3; vinylite jacketed; 70" lg; 2 cond #20 AWG stranded tinned copper wire; Amphenol #AN-3106-14S-1P plug one end Amphenol #AN-3106-14S-1S connector other end (connects Radio Receiver Assembly R-128/CRD-3 to Control Rectifier Power Unit PP-135/CRD-3).
	3E7201	CABLE ASSEMBLY, power: double cotton braid and RC; 1-1/8" diam; 150 ft; 2 #14 AWG soft tinned copper cond ea comprising 7 #12 AWG strands; Crouse-Hinds APJ6275 Arktite RC plug at ea end; Hobart Bros SJ402 (connects Power Unit PE-197 to Cord CX-565/CRD-3).
	6M217-3	CHAIR: steel, grey finish; without arms; folded 36" h x 17" wd x 2-3/4" thk; unfolded 30-1/2" h x 17" wd x 19-3/4" thk; Fed Tele & Rad part/dwg #RF-4166-1 Amer. Seating Co. Type VII.
	2Z2636-70	CLAMP: cable; #24 B&S ga steel; clear lacquer finish; 4 cupped booth rivets; 2-5/8" ID, 0.81" h x 3/8" thk, clip 0.020 thk; United Carr #49163 size #6.

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	2Z4886	COIL, RF: Goniometer; Assembly r-f transformer; 2 stator windings 1 rotor winding, pri and secd transformer on same form as rotor; shielded; 8-1/8" wd x 5-3/4" h x 5-3/4" d RF-1485-14; Navy #CFT-47372.
	6Z2203-2	COMPASS, magnetic: moving needle; compass ring graduated 0-360°, counterclockwise; aluminum case; 2-3/4" lg x 2-3/4" wd x 1-1/2" thk; Dietzgen #6620.
	2Z5594.10	CONNECTOR, female contact: 1 cont; straight; nickel pl brass; 5/8" diam head; body 7/8" lg x 1/2"-20 thd: Birnbach #399 (p/o Junction Box J-97/CRD-3).
	2Z8673.1	CONNECTOR, female contact: 3 #8 round cont; straight; 1-11/32" lg x 1-5/8" h x 1-5/8" wd; Amphenol AN-3102-22-2S; Fed Tele & Rad spec #AN-9534 (p/o Junction Box J-97/CRD-3).
J-451	2Z8799-129	CONNECTOR, male contact: 2 #12 round cont and 1 #16 round cont; straight; 1-3/8" lg x 1-3/8" h x 1-11/32" wd, less cont; Amphenol #AN-3102-18-5P; (p/o Junction Box J-97/CRD-3).
J-851, 852, 853	2Z8799-127	CONNECTOR, male contact: Sig C Socket SO-127; 3 round polarized cont, two #12 and one #16 cont; 1-3/8" sq x 1-11/32" lg; Amphenol #AN-3102-18-5P (p/o Navy #CFT-47372 goniometer).
	3H1099-135	CONTROL-RECTIFIER POWER UNIT PP-135/CRD-3: steel chassis, panel and cabinet, chassis zinc pl grey wrinkle finish; input 117 v 50/60 c, #1 output 250 v dc, #2 output 7.5 v ac; 22-11/16" lg x 10-7/8" wd x 11-1/4" d; Fed Tele & Rad part/dwg #RF-4353-1.

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	2A722-318	COUNTERPOISE MX-318/CRD-3: copper braid cond; 32 ft sq meshwork cond at right angles to ea other and fastened by Dot fasteners; consists of 35 elements composed of Ground Conductor MX-461/CRD-3, MX-460/CRD-3, MX-462/CRD-3 and Cord MX-463/CRD-3; Sig C spec #271-3175.
	2Z3606	DEMAGNETIZER: iron core coil; for demagnitizing bearing indicator; coil 1-3/4" x 1-1/4", handle 3/4" diam x 4" lg; mtd on handle with attachment cord having momentary cont sw and plug; Fed Tele & Rad #NLA-42970-3 (p/o Bearing Indicator ID-121/CRD-3).
	6Z3786-4	EXTINGUISHER, fire: carbon dioxide; permanent shut-off seat type valve; 4 lb; 18" lg x 4-1/2" diam, hose 18" lg x 5/16" diam; Walter Kidde #4.
	2A2995-319	GIN POLE MX-319/CRD-3: stainless steel tubing; for handling guys while erecting antenna; 2" OD x 9-1/2 ft lg; 1 end fitted with solid dural plug other end with ring; Sig C spec #271-3175.
	6Q50201-6H	HAMMER: sledge; 6 lb with handle; regular pattern, double face.
	2B829	HEADSET HS-29: magnetic; total impedance 250 ohms; consists of 4 receivers ea 125 ohms impedance, connected series-parallel; ea receiver 0.770" max diam x 0.485" max d w/6 ft 3" Cord CD-656, 2 Headbands HB-30 and 4 Inserts M-300.
	2Z5020	HEATER, air: electric; Elec Air Htr #AA-15 modified.
	2Z5539	JACK JK-39: portable jack; fits Plug PL-55; Sig C dwg #SC-A-2640.

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	2Z5600-97	JUNCTION BOX J-97/CRD-3: for 3 Amphenol connectors and 2 banana jacks; sheet steel, grey wrinkle E; 3" x 3" x 3"; Sig C spec #271-3175 (voltage distribution box).
	2Z5600-99	JUNCTION BOX J-99/CRD-3: sheet steel, grey wrinkle E; 18" lg x 10-1/2" d x 6-3/4" h; Fed Tele & Rad part/dwg RF-1748-2; Navy #CFT-62127.
	2Z5652-91A	JUNCTION BOX JB-91-A: brass, olive drab E; with cover; case 2-3/4" x 3-3/8" x 1-7/8"; Sig C spec #271-16-12 (uncolored).
	2Z5652-126	JUNCTION BOX JB-126: sheet steel, olive drab; with cover; 17" h x 10" wd x 8" d.
	3E4390-24	LEAD, test: test cord; RC; round shape, 5/16" diam; 2 cond #18 AWG comprising 16 strands #30 AWG; with AH&H female plug type MB and Hubbell male plug #9754; Fed Tele & Rad dwg #RF-1065.
	6Q63012	LEVEL, spirit: carpenters; japanned finish with nickel pl trim; 18" lg; Stanley #36.
	3H2689A.1	LINE ASSEMBLY fuel: brass; cadmium pl; for insertion in fuel drum; approx 32-1/8" lg x 2-3/4" wd x 1-1/2" d; consists of elbow, bushing and nipple; Fed Tele & Rad part/dwg #RF-4859-3.
	4Z5842-3	MARKER SET, cable: tags, color coded; #26 B&S ga brass; zinc pl; 1/2" wd; Sig C spec #271-3175 (identification for r-f cords).
	3F4056A/V1	METER, multi-scale: dc; 0 to 3/30/300/600 v; 0 to 1000/10,000/100,000/1,000,000 ohms; 4-33/64" x 3-45/64" x 2-9/16"; Weston #564.

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	2A490-334	MOUNTING COLLAR MT-334/CRD-3: brass; olive drab E; for mtg Phase Inverter MC-411-A or MC-413-A on antenna mast; approx 7-1/4" wd x 10-1/4" lg x 4-1/4" h overall.
	2Z6763-347	MOUNTING TABLE MT-347/CRD-3: 1-1/4" diam cold drawn steel tubing; baked grey wrinkle E; used to mount bearing indicator, rectifier power unit and receiver assembly; 24" wd x 32-1/2" d x 36" h; Sig C spec #271-3175.
	Deleted	OIL, lubricating: 1 gal; AXS #1580.
	6Z7301-.5	OILER, hand: 1/2 oz; 4-3/8" spout; Eagle #254C.
	6Z7308.5	OILER, hand: 1/2 pt; 6" bend spout; Eagle #3006.
	2A2771A	PHASE INVERTER MC-411-A: aluminum case; olive drab E; coupling unit between directional antenna and goniometer; 7-1/4" diam x 12-3/4" h; Sig C spec #271-1612.
	2A2773A	PHASE INVERTER MC-413-A: aluminum case; olive drab E; coupling unit between sense antenna and goniometer; 7-1/4" diam x 12-3/4" h; Sig C spec #271-1612.
	6R5012	PLUMB - BOB: brass with steel tip; 12 oz size, 5-1/8" lg x 1-5/16" diam with 30 oz braided cord 60" lg x 1-5/16" diam; Fed Tele & Rad dwg #RF-689-1A.
	3Z737-13.3	POST, binding: screw type; 2" lg x 17/32" diam; with 6-32 thd x 9/16" lg mtg stem; Eby #38 (p/o Junction Box J-97/CRD-3).
	3H4600-197	POWER UNIT PE-197: gasoline; 6.3 kva at 80% pf; 1,200, 52.5 amp 60 c, single ph; 44" lg x 22-1/2" wd x 30" h; Sig C spec #SC-L-71-3016.

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	2C4180-128	RADIO RECEIVER ASSEMBLY R-128/CRD-3: cw, mcw, icw; a-f output 15 vdcw into 600 ohms load, 1.5 w into 4 ohms load; 115 v 60 c 143 w; 19" wd x 28-27/32" h x 21-5/16" d; 2 units in one steel cabinet; Navy type #46183-A.
	6H2510A	REEL DR-10-A: cable; plywood, reinforced with steel; olive drab; 27-1/8" diam x 18-1/2" lg with protective lagging.
	6H2549A	REEL UNIT RL-49-A: steel tubing; olive drab; 34-3/4" wd x 31-7/8" d x 32-1/4" lg overall; collapsible frame with handle and brake.
R-851, 852	3RC21BE510J	RESISTOR, fixed: composition; 51 ohms ±5%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE510J (p/o Navy CFT #47372 Goniometer).
	6R19130	SCREWDRIVER: spiral ratchet; complete with 3 bits, 20" lg with bit extended, 14-3/4" lg with bit closed; Yankee #130A.
	3Z7700-20B	SHELTER HO-20-B: sectional plywood panel construction, canvas roof cover; olive drab; houses components; 8 ft lg x 72" h x 60" wd.
	3F3852Z	SIGNAL GENERATOR I-72: 100 kc to 32 mc with 400 c modulation; metal case with leather handle and removable cover; 15-1/8" x 6-3/4" x 9-7/16" overall; Sig C spec #71-968.
	2A3302	STAKE GP-2: ground; wrought steel; galv; 16" lg x 3/4" diam; Sig C spec #71-393 (p/o Counterpoise MX-318/CRD-3).
	6R36027	TAPE, measuring: steel; 100 ft lg x 3/8" wd; brown leather case with folding flush handle nickel pl; Lufkin Challenge 266.

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	4B5008	TELEPHONE EE-8: portable; local or common battery; self contained; 3-1/2" x 7-7/16" x 9-1/2"; with carrying case and strap; Sig C spec #71-631.
	6R38041	TOOL EQUIPMENT TE-41: consists of radio repair tools in Bag BG-44.
	2Z10100-1	TRIPOD, telescope: collapsible; 18" collapsed, 61" extended; aluminum; Dietzgen #6624A (support for compass).
	6R47040.6	VISE: bench; machinists; extra pipe jaw, 6" opening.
	6R55561	WRENCH: double open ends; 4-1/2" lg, thk of head 3/16"; 5/16" and 3/8" openings; Williams JH #1721.
	6R55563	WRENCH: double open ends; 5-5/8" lg x 15/64" thk; openings 7/16" and 1/2"; Williams JH #725.
	6R55565	WRENCH: double open ends; 6-5/8" lg x 17/64" thk; openings 9/16" and 5/8"; Williams JH #1727.
	6R55567	WRENCH: double open ends; 8-1/2" lg x 5/16" thk; openings 11/16" and 25/32"; Williams JH #1029.
	6R55075	WRENCH: setscrew; L shape 1/8" across flats; Cetron dwg #MS-30672-11 (fits 1/4" diam Allen setscrew and #8 0.164" diam cap screw).
	6R57400-1	WRENCH: setscrew; L shape, 3/16" across flats (fits Allen 3/8" diam setscrew, 1/4" diam cap screw, 3/8" diam shoulder screw and 1/8" diam pipe plug).
	6R57400-2	WRENCH: setscrew; L shape, 7/32" across flats (fits Allen 7/16" diam setscrew and 5/16" diam cap screw).

150. MAINTENANCE PARTS FOR RADIO SET AN/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	6R55496	WRENCH: setscrew; L shape, 3/32" across flats (fits Allen #10-0.190" diam setscrew; #5, 0.125" diam and #6 cap screw).
	6R57400-6	WRENCH: setscrew; L shape, 1/16" across flats; Bendix dwg #B-15447 (fits Allen setscrew #5 and #6).
	6R57500	WRENCH: setscrew; 5/64" across flats (fits Allen #8 setscrew).
	6R57400-3	WRENCH: socket; L shape 1/4" across flats; Magnovox #80004-5G9 (fits Allen 1/2" diam setscrew, 1/2" diam shoulder screw and 1/4" diam pipe plug).
	6R57400-10	WRENCH: socket; L shape, 5/32" across flats (fits Allen 5/16" diam and #10,0.190" diam setscrews).
	6R57413-3	WRENCH: socket; 6" lg; 1/4"; Stevens-Walden Spintite #3408.
	6R57413	WRENCH: socket; 6" overall; 1/4"; Stevens-Walden Spintite #3410.
	6R57413-8	WRENCH: socket; 6" overall; 11/32"; Stevens-Walden Spintite #3411.
	6R57412	WRENCH TL-108: socket; 6" lg overall; 3/8" hex.
	6R55006	WRENCH TL-111: adjustable; 6" lg; 3/4" capacity.
	6R55010	WRENCH TL-112: adjustable; 10" lg; 1-1/8" capacity.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3.

Ref symbol	Signal Corps stock No.	Name of part and description
	2C4180-128	RADIO RECEIVER ASSEMBLY R-128/CRD-3: cw, mcw, icw; power output 15 milliwatts into 600 ohm load; 115 v, 60 c, 143 w; 2 units in one steel cabinet; 19" wd x 28-27/32" h x 21-5/16" d; 1.5 w through 4 ohm load; Navy type #46183-A.
C106, 113	3DB2-95	CAPACITOR, fixed: mica; 2 mmf ±0.5 mmf; 500 vdcw; 11/16" lg x 7/16" wd x 11/64" thk; Solar #MOBW; Navy #-48842.
C145	3K2510021	CAPACITOR, fixed: mica; 10 mmf ±10%; 500 vdcw; max body dimen 1-1/16" sq x 7/32" thk; JAN type CM25B100K.
C102 104, 107, 111, 114, 127, 140, 141, 144, 148	3K2527021	CAPACITOR, fixed: mica; 25 mmf ±10%; 500 vdcw; max body dimen 1-1/16" sq x 7/32" thk; JAN type CM25B270K.
C105, 112, 117, 131, 216, 228, 229	3K2510121	CAPACITOR, fixed: mica; 100 mmf ±10%; 500 vdcw; max body dimen 1-1/16" lg x 15/32" wd x 7/32" thk; JAN type CM 25B101K.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
C126, 204, 207, 211, 215, 227	3K2520122	CAPACITOR, fixed: mica; 200 mmf ±5%; 500 vdcw; max body dimen 1-1/16" lg x 15/32" wd x 7/32" thk; JAN type CM25B201J.
C108, 115, 130, 212, 214, 217, 219, 225	3D9250-9	CAPACITOR, fixed: mica; 250 mmf ±10%; 500 vdcw; 11/16" lg x 7/16" wd x 11/64" thk; Solar type MOBW; Navy #-48690.
C222	3K2551112	CAPACITOR, fixed: mica; 500 mmf ±5%; 500 vdcw; max body dimen 1-1/16" lg x 15/32" wd x 7/32" thk; JAN type CM25A511J.
C237, 238, 239	3K3510233	CAPACITOR, fixed: mica; 1,000 mmf ±2%; 500 vdcw; max body dimen 53/64" lg x 53/64" wd x 11/32" thk; JAN type CM 35C102G.
C133, 134	3K2510221	CAPACITOR, fixed: mica; 1,000 mmf ±10%; 500 vdcw; max body dimen 1-1/16" lg x 15/32" wd x 7/32" thk; JAN type CM 25B102K.
C143	3DA1.145	CAPACITOR, fixed: mica; 1,145 mmf ±1%; 500 vdcw; 3/4" sq x 1/4" thk; Solar type MWSCW (r-f oscillator, band #1 padder).

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
C231	3K3520222	CAPACITOR, fixed: mica; 2,000 mmf ±5%; 500 vdcw; max body dimen 53/64" lg x 53/64" wd x 7/32" thk; JAN type CM 35B202J.
C142	3DA2.610	CAPACITOR, fixed: mica; 2,610 mmf ±1%; 500 vdcw; 3/4" sq x 1/4" thk; Solar type MWSCW (r-f oscillator, band #2 padder).
C136, 137, 232	3DA5-37	CAPACITOR, fixed: mica; 0.005 mf ±10%; 500 v; Solar type MWBW.
C109, 120, 202, 203, 208, 209	3K3562232	CAPACITOR, fixed: mica; 6,200 mmf ±5%; 500 vdcw; max body dimen 53/64" lg x 53/64" wd x 11/32" thk; JAN type CM35C622J.
C119	3K3591222	CAPACITOR, fixed: mica; 9,100 mmf ±5%; 300 vdcw; max body dimen 53/64" lg x 53/64" wd x 11/32" thk; JAN type CM 35B912J.
C210	3K3510322	CAPACITOR, fixed: mica; 10,000 mmf ±5%; 500 vdcw; max body dimen 53/64" lg x 53/64" wd x 11/32" thk; JAN type CM 35B103J.
C218	3K3510321	CAPACITOR, fixed: mica; 10,000 mmf ±10%; 500 vdcw; max body dimen 53/64" lg x 53/64" wd x 11/32" thk; JAN type CM 35B1C3K.
C234, 240	3DA10-357	CAPACITOR, fixed: mica; 10,000 mmf ±10%; 500 vdcw; 2-11/32" lg x 1" wd x 9/16" thk; Solar type XBBW.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
C118, 132, 146, 147, 201, 206	3DA50-247	CAPACITOR, fixed: paper; 50,000 mmf ±10%; 600 vdcw; Dubilier type DY; Navy type #-481391.
C223	3DA50-246	CAPACITOR, fixed: paper; 2 sect; 50,000 - 50,000 mmf ±15%; 600 vdcw; Navy #-48315.
C241	3DA100-617	CAPACITOR, fixed: paper; 100,000 mmf ±10%; 1,000 vdcw; Fed Tele & Rad dwg #F-36434-1; Navy #48197.
C103, 110, 116, 128, 129, 135, 205, 213, 220, 226, 244	3DKA100-92.1	CAPACITOR, fixed: paper; 3 sect; 100,000-100,000-100,000 mmf ±20%; 600 vdcw; Fed Tele & Rad #F-36416-1.
C233, 235, 245, 246	3DA250-312	CAPACITOR, fixed: paper; 2 sect; 250,000-250,000 mmf ±15%; 600 vdcw; 1-13/16" lg x 1-1/4" wd x 3/4" thk; Dubilier #DYRT-6022-2.
C138, 139, 251	3DA500-393	CAPACITOR, fixed: paper; 500,000 mmf ±10%; 600 vdcw; Dubilier type DY; Navy #-481002.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
C250	3DA500-443	CAPACITOR, fixed: paper; 2 sect; 500,000-500,000-mmf ±15%; 600 vdcw; Fed Tele & Rad dwg #F-38362-1; Navy #-481339.
C242, 243	3DB1.6100G-2	CAPACITOR, fixed: paper; 1 mf ±10%; 600 vdcw; Fed Tele & Rad dwg #F-36436-1.
C236	3DB2.6200G-2	CAPACITOR, fixed: paper; 2 mf ±10%; 600 vdcw; Fed Tele & Rad dwg #F-36435-1.
C252	3DB4-238	CAPACITOR, fixed: paper; 4 mf ±10%; 1,000 vdcw; Fed Tele & Rad dwg #F-36694-1; Navy type #-481903.
C247, 248, 249	3DB8-180	CAPACITOR, fixed: paper; 8 mf ±10%; 600 vdcw; Fed Tele & Rad dwg #F-36695-1.
C101	3D9708V	CAPACITOR, variable: air; 0 to 708 mmf ea sect; 5 sect; Fed Tele & Rad dwg #F-33747-14 (maintaining capacitor).
C224	3D9022V-3	CAPACITOR, variable: air; 17 mmf +20%-5%; Fed Tele & Rad dwg #F-34481-2-1(BFO vernier).
C121, 122, 123, 124, 125	3D9050V-114	CAPACITOR, variable: air; 50 mmf +20%-5%; Fed Tele & Rad dwg #F-28180-2-2 (trimmer).
C221	3D9007V-10	CAPACITOR, variable: ceramic; 1.5 to 7 mmf; Fed Tele & Rad dwg #F-38149-1 (BFO coupling).
	2Z2712.1	CLIP, tube contact: Fed Tele & Rad dwg #F-41035-1 (grid cap).

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
L211, 212	3C574K-2	COIL, AF: filter choke; single winding; inductance 10 h +30% -0%; at 150 ma dc, 0.15 amp, 150 ohms; 3,260 turns E wire; UTC as per Fed Tele & Rad dwg F-33094-1; Navy #-30933 (filter choke).
L207, 208, 209, 210	3C315-117	COIL, AF: filter; single winding; inductance 20 mh +20%, variable inductance; d-c resistance 0.193 ohms; Fed Tele & Rad dwg RF-1633-1(r-f line filter).
	3C1084K-59	COIL, RF: i-f trap; inductance 0.028 mh, d-c resistance 1.50 ±.06 ohms; Fed Tele & Rad dwg #F-35510-3-6.
L110	3C1084K-57	COIL, RF: oscillator; single winding; total inductance 70 mh ±4% at 2,000 and 1,000 kc, d-c resistance 2.5 ohms; Fed Tele & Rad dwg 38329-3-4.
L109	3C1084K-60	COIL, RF: oscillator; single winding; total inductance 287 mh ±4% at 1,100 and 5,000 kc, total d-c resistance 4.8 ohms; Fed Tele & Rad dwg 38329-3-1.
	2Z9641.232	COIL, RF: BFO coil assembly; single winding; variable inductance; shielded; 175 kc; Fed Tele & Rad dwg #F-40654-2.
L205	3C1084K-53	COIL, RF: BFO grid coil; single winding; inductance 0.98395 mh, d-c resistance 18.4 ±4 ohms; Fed Tele & Rad dwg F-35510-3-5 (i-f output).
	2Z9641.239	COIL, RF: first i-f amplifier grid coil assembly; single winding; variable inductance; shielded; 175 kc; Fed Tele & Rad dwg #F-40651-2.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	2Z9641.236	COIL, RF: first i-f amplifier plate coil assembly; single winding; variable inductance; shielded; 175 kc; Fed Tele & Rad dwg #F-40652-2.
	2Z9641.240	COIL, RF: second i-f amplifier grid; single winding; variable inductance; shielded; 175 kc; Fed Tele & Rad dwg #F-40646-2.
L203	3C315-119	COIL, RF: i-f grid coil; single winding; inductance 0.28 mh, d-c resistance 29.0 ±5 ohms; Fed Tele & Rad dwg F-35510-3-2 (second i-f amplifier grid coil).
L206	2Z9641.241	COIL, RF: i-f transformer; 2 windings; secd inductance 0.16 mh, d-c resistance 11.3 ±2 ohms, primary inductance 1.3 mh, primary d-c resistance 11.0 ±5 ohms; Fed Tele & Rad dwg 35510-3-4 (i-f indicator channel).
L204	2Z9641.242	COIL, RF: i-f transformer; 2 windings; secondary inductance 1.994 mh, secd d-c resistance 43 ±5 ohms, primary inductance 1.2648 mh, pri d-c resistance 11.4 ±5 ohms; Fed Tele & Rad dwg 35510-3-3 (i-f output).
L101, 103	3C1084K-58	COIL, RF: r-f transformer; 2 windings; secd inductance 545 mh ±4% at 700 and 350 kc, secd d-c resistance 5.3 ohms, primary 4 ft #38SS enamel wire; Fed Tele & Rad dwg F-38329-3-3.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Major component	Ref symbol	Signal Corps stock No.	Name of part and description	Mfr's part and code No.
	L106, 108	3C1084K-56	COIL, RF: r-f transformer; 2 windings; secd inductance 91.2 mh ±4% at 1600 and 800 kc, secd d-c resistance 1.9 ohms, primary 180 ft #38SS enamel wire, primary d-c resistance 110 ohms; Fed Tele & Rad dwg F-38329-3-5.	
	L102, 104	3C1084K-55	COIL, RF: r-f transformer; 2 windings; secd inductance 92 mh ±4% at 1,600 and 800 kc, secd d-c resistance 2 ohms, primary 5 ft #38SS enamel wire; Fed Tele & Rad dwg F-38329-3-6.	
	L105, 107	3C1084K-54	COIL, RF: r-f transformer; 2 windings; secd inductance 537 mh ±4% at 700 and 350 kc, secd 5.1 ohms resistance, primary 350 ft #38SS enamel wire; primary d-c resistance 209 ohms; Fed Tele & Rad dwg F-38329-3-2.	
	L112	2Z9641.237	COIL, RF: r-f transformer assembly; 2 windings, variable inductance; Fed Tele & Rad dwg #F-40648-2 (converter plate assembly).	
	L11	2Z9641.238	COIL, RF: 175 kc; variable inductance; i-f trap coil assembly; shielded; Fed Tele & Rad dwg #F-40647-2.	
	L113	2Z9641.235	COIL, RF: 175 kc; variable inductance; converter plate assembly; shielded; Fed Tele & Rad dwg #F-40653-2 (goniometer amplifier plate assembly).	
	L201, 202	3C315-118	COIL, RF: variable inductor; single winding; inductance 2.214 mh, d-c resistance 29.5 ±5 ohms; Fed Tele & Rad dwg F-35510-3-1 (converter plate).	

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151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	3C315-120	COIL, RF: variable inductor; single winding; inductance 31.33 mh, d-c resistance 193. ±20 ohms; Fed Tele & Rad dwg F-35510-3-7 (goniometer plate amplifier).
J204	4C4312-2	CONNECTOR, female contact: telephone jack; 2 cond; 1 make, 1 break; straight; 3-1/8" lg x 5/8" w x 1-1/8" h overall; Fed Tele & Rad dwg #F-36116-1 (audio output).
J103, 201	2Z8672.47	CONNECTOR, female contact: 2 round cont; straight; 1-3/32" sq x 19/32" lg less cont; Amphenol #AN-3102-12S-3S.
J203	2Z8673.20	CONNECTOR, female contact: 3 round cont; straight; 1-3/16" sq x 29/32" lg less cont; Amphenol #AN-3102-14S-1S (d-c amplifier input).
J110, 111, 112	2Z3064-78	CONNECTOR, female contact: 3 round cont; straight; 1-5/16" sq x 1-13/32" lg; Amphenol #97-5105-18-5S.
J105	2Z8673.33	CONNECTOR, female contact: 3 round cont; straight; 1-9/32" sq x 29/32" lg less cont; Amphenol #AN-3102-16S-5S (antenna relay).
J206	2Z8673.2	CONNECTOR, female contact: 3 round cont; straight; 1-1/2" sq x 1-11/32" lg less cont; Amphenol #AN-3102-20-6S (a-c outlet for junction box).
J208	2Z8673.2	CONNECTOR, female contact: 3 round polarized cont; straight; 1-1/2" wd x 1-1/2" h x 1-11/32" lg less lugs; Amphenol #AN-3102-20-6S.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
J207	2Z8799-163	CONNECTOR, female contact: 4 round cont; straight; 1-5/8" sq x 1-11/32" lg less cont; Amphenol #AN-3102-22-10S(a-c outlet for indicator power supply).
J104, 202	2Z8799-189	CONNECTOR, female contact: 14 round cont; straight; 2" sq x 1-11/32" lg less cont; Amphenol #AN-3102-28-2S.
J101, 102, 107, 108, 109	2Z8799-129	CONNECTOR, male contact: 3 round cont; straight; 1-3/8" sq x 1-11/32" lg less cont; Amphenol #AN-3102-18-5P.
J205	2Z7113.9	CONNECTOR, male contact: 3 round cont; straight; 1-1/2" sq x 1-11/32" lg less cont; Amphenol #AN-3102-20-6P (a-c input).
J106	2ZK7409-2	CONNECTOR, male contact: 4 round cont; straight; 1-3/8" sq x 1-11/32" lg less cont; Amphenol #3102-18-4P (sense control).
	2Z3273-70	COUPLING: Fed Tele & Rad dwg 34241-2-1 (goniometer line up coupling).
	2Z3876.85	DRIVE ASSEMBLY, capacitor: variable; Fed Tele & Rad dwg #F-34340-14 (condenser drive assembly).
F201, 202	3Z1950	FUSE FU-50: 3 amp; 250 v; glass body; nickel plated ferrule ends, 1-1/4" lg x 1/4" (receiver).
F203, 204	3Z2608.1	FUSE, cartridge: 8 amp, 250 v; glass; ferrule 1/4" diam x 1/4" lg; 1-1/4" lg x 1/4" diam; Littlefuse #3AG-1360 (master).

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	3Z3285-3	HOLDER, fuse: extractor post; Fed Tele & Rad dwg #F-37118-1 (fuse extractor post).
	3G87-3.1	INSULATOR, bead: single; round; transparent polystyrene; 1/2" lg x 5/16" diam w/0.080" diam hole; Amphenol #73.
	3G87-3.3	INSULATOR, bead: round; polystyrene; 1/2" lg x 11/32" diam, 2 holes 0.050" diam; Amphenol #73-2.
	3H4683-49A/J2	INSULATOR: white ceramic, glazed; diam 3/8" tapped for #6-32 thd; Isolantite #395L-3/4".
	3G1250-5.1	INSULATOR, bushing: isolantite; Isolantite #4AL1/4 (shoulder bushing).
	3G3501-04	INSULATOR, standoff: round post; white ceramic, glazed; 1/2" lg overall; tapped #6-32 thd both ends; Isolantite #395-L-1/2.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	3G1250-16.6	INSULATOR, stand-off: round post; white ceramic glazed; 1" lg x 3/8" diam, tapped #6-32 thd, both ends; Isolantite #395-L-1.
V101, V105	2Z5889	LAMP, glow: neon; striking v, 65 ac, 90 v dc; ext resistance 200,000 ohms; 1/25 w; T-2 bulb, clear; approx lg of glass 1-1/16" unbiased w/2 wire leads; GE #T-2 (over-voltage protection).
I202, 203, 204, 205	2Z5889-13	LAMP, glow: 105 to 125 v, 1/4 w; bulb T 4-1/2 clear; 1-1/2" lg; candelabra screw; neon; GE #T-4-1/2 (power indicator).
I101, 102, 103, 104, 201	2Z5952	LAMP LM-52: 6 to 8 v, 0.15 amp; T-3-1/4 clear; 15/16" lg; miniature bayonet (pilot).
	2Z5991-57	LIGHT, indicator: Fed Tele & Rad. dwg #F-28790-1.
	2Z8405-11	MOUNT, vibration: rectangular; 60 lb load rating; 2-1/4" h x 2-1/4" x 1-13/16" wd; rubber cushion 2" diam x 1-13/16" thk; Lord #200XP60.
R258	3RC31BE131J	RESISTOR, fixed: composition; 130 ohms ±5%; 1 w; max body dimen 1.28" lg x 0.310" diam; RC31BE131J.
R116, 118	3RC21BE161J	RESISTOR, fixed: composition; 160 ohms ±5%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE161J.
R123, 124	3RC21BE221K	RESISTOR, fixed: composition; 220 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE221K.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
R257, 259	3RC40BE471J	RESISTOR, fixed: composition; 470 ohms ±5%; 2 w; max body dimen 1.41" lg x 0.405" diam; JAN type RC40BE471J.
R246	3RC40BE561K	RESISTOR, fixed: composition; 560 ohms ±10%; 2 w; max body dimen 1.41" lg x 0.405" diam; JAN type RC40BE561K.
R112, 240	3RC21BE621J	RESISTOR, fixed: composition; 620 ohms ±5%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE621J.
R104	3RC31BE102J	RESISTOR, fixed: composition; 1,000 ohms ±5%; 1 w; max body dimen 1.28" lg x 0.310" diam; JAN type RC31BE102J.
R101, 202, 254	3RC21BE102K	RESISTOR, fixed: composition; 1,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE102K.
R141, 227	3RC21BE222K	RESISTOR, fixed: composition; 2,200 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE222K.
R224, 234	3RC21BE302J	RESISTOR, fixed: composition; 3,000 ohms ±5%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE302J.
R107, 111, 114, 132, 133, 206, 211, 225, 229	3RC21BE472K	RESISTOR, fixed: composition; 4,700 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE472K.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
R207, 250, 263	3RC21BE103K	RESISTOR, fixed: composition; 10,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE103K.
R255	3RC31BE103K	RESISTOR, fixed: composition; 10,000 ohms ±10%; 1 w; max body dimen 1.28" lg x 0.310" diam; JAN type RC31BE103K.
R134	3RC21BE183K	RESISTOR, fixed: composition; 18,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE183K.
R236 R237	3RC21BE223K	RESISTOR, fixed: composition; 22,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE223K.
R109	3RC40BE223K	RESISTOR, fixed: composition; 22,000 ohms ±10%; 2 w; max body dimen 1.41" lg x 0.405" diam; JAN type RC40BE223K.
R267	3RC21BE273K	RESISTOR, fixed: composition; 27,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE273K.
R125, 126	3RC31BE273K	RESISTOR, fixed: composition; 27,000 ohms ±10%; 1 w; max body dimen 1.28" lg x 0.310" diam; JAN type RC31BE273K.
R203, 274, 235, 276, 277	3RC21BE303J	RESISTOR, fixed: composition; 30,000 ohms ±5%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE303J.
R222, 223	3RC31BE333K	RESISTOR, fixed: composition; 33,000 ohms ±10%; 1 w; max body dimen 1.28" lg x 0.310" diam; JAN type RC31BE333K.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
R204, 216	3RC40BE513J	RESISTOR, fixed: composition; 51,000 ohms ±5%; 2 w; max body dimen 1.41" lg x 0.405" diam; JAN type RC40BE513J.
R110, 119, 137, 138, 201, 212, 230, 243, 252	3RC21BE563K	RESISTOR, fixed: composition; 56,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE563K.
R102, 106, 113, 120	3RC31BE563K	RESISTOR, fixed: composition; 56,000 ohms ±10%; 1 w; max body dimen 1.28" lg x 0.310" diam; JAN type RC31BE563K.
R130, 135	3RC21BE683K	RESISTOR, fixed: composition; 68,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE683K.
R140, 278, 228	3RC31BE823K	RESISTOR, fixed: composition; 82,000 ohms ±10%; 1 w; max body dimen 1.28" lg x 0.310" diam; JAN type RC31BE823K.
R136, 221, 242, 260, 261	3RC21BE104K	RESISTOR, fixed: composition; 100,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE104K.
R214	3RC21BE124K	RESISTOR, fixed: composition; 120,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE124K.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
R262, 265	3RC31BE124K	RESISTOR, fixed: composition; 120,000 ohms ±10%; 1 w; max body dimen 1.28" lg x 0.310" diam; JAN type RC31BE124K.
R115, 121, 122, 273	3RC21BE224K	RESISTOR, fixed: composition; 220,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE224K.
R251	3RC21BE224J	RESISTOR, fixed: composition; 240,000 ohms ±5%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE224J.
R239, 245	3RC21BE274J	RESISTOR, fixed: composition; 270,000 ohms ±5%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE274J.
R128, 129, 213	3RC21BE334K	RESISTOR, fixed: composition; 330,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE334K.
R205, 209, 217, 218, 241, 244, 269,	3RC21BE564K	RESISTOR, fixed: composition; 560,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE564K.
R247, 248, 249	3RC40BE105J	RESISTOR, fixed: composition; 1 meg ±5%; 2 w; max body dimen 1.41" lg x 0.405" diam; JAN type RC40BE105J.
R105, 108, 208, 219, 220, 226, 253, 256, 271, 275	3RC21BE105K	RESISTOR, fixed: composition; 1 meg ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BE105K.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
R117	3Z7410-59	RESISTOR, variable: carbon; 10,000 ohms ±10%; Fed Tele & Rad dwg #F-34327-2-2; Navy type-631432.
R127, 264, 266	3Z7450-41	RESISTOR, variable: carbon; 50,000 ohms ±10%; IRC type C; Navy #631343.
R210	3Z7499-1.40	RESISTOR, variable: carbon; 1 meg ±10%; IRC type C; Navy #631314.
R131	3Z7499-1.39	RESISTOR, variable: carbon; dual sect; 1 meg ±10% from sect, 10,000 ohms ±10% rear sect; IRC type C; Navy type - 631341.
R139	2Z7277.81	RESISTOR, variable: wire-wound; 2 lugs; 15 ohms; 25 w; 1-9/16" diam x 1-3/8" d; Ohmite #0146 (dial dimmer).
R268, 270, 272	3Z7498-50.46	RESISTOR, variable (potentiometer): 500,000 ohms ±10%; IRC type C; Navy type #631344.
X215	2Z8762	SOCKET, tube: 4 prong wafer; ceramic; Navy #49362.
X102, 103, 104, 106, 107, 108, 109, 110, 201, 202, 203, 204, 205, 206, 208,	2Z8678.29	SOCKET, tube: octal; ceramic; Navy #49367.

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
X209, 210, 211, 212, 213, 214, 217		
X216	2Z8637-1	SOCKET ASSEMBLY, tube: 11 prong wafer; ceramic; Amphenol #49-11-L; Navy #49387.
S106	4C4999.1	SWITCH, lever: Fed Tele & Rad spec #RF-1109-1, and dwg #RF-2145-2 (sense switch).
S205	3Z9903A-4.1	SWITCH ASSEMBLY: rotary; 1 SPST switch, 1 SPDT switch; non-shorting fiber; 2" h x 1-3/4" lg x 13/16" d, shank 15/32" diam; AH&H part #1570NF; Navy #24161 (power – standby).
S107	3Z9826-83.3	SWITCH, rotary: SPDT; 3 position; OAK as per Fed Tele & Rad dwg #F-34455-2-3 (function switch).
S105	3Z9903E-22.2	SWITCH, rotary: 2 position, 3 circuits; ceramic; OAK as per Fed Tele & Rad dwg #36710-1 (oscillator band switch).
S102, 103	3Z9903E-22	SWITCH, rotary: 2 position, 4 circuits; ceramic; OAK as per Fed Tele & Rad dwg #F-36708-1 (r-f amplifier band switch).
S101, 104	3Z9903E-22.1	SWITCH, rotary: 2 position, 4 circuits; ceramic; OAK as per Fed Tele & Rad dwg #36709-1 (sense amplifier band switch).
S201	3Z9550.7	SWITCH, rotary: 2 position, 4 circuits; ceramic; 2" lg x 1-7/8" diam; mtg bushing 3/8" x 3/8"-32 thd, shaft 7/16" lg x 1/4" diam; Fed Tele & Rad dwg #F-34455-2-1 (i-f selectivity switch).
S202	3Z9826-83.4	SWITCH, rotary: 3 position, 5 circuits; ceramic; OAK as per Fed Tele & Rad dwg #F-34455-2-2 (reception switch).

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
S207, 208, 209	3Z9859-38.2	SWITCH, toggle: 20 amp, 250 v; C-H part #7403K3; Fed Tele & Rad dwg NCP-40-17 (motor power).
S204	3Z9858-8.178	SWITCH, toggle: SPDT; Navy #24,000 (blanking).
S206	3Z9847-1.1	SWITCH, toggle: DPST; bakelite body; 2-41/64" lg x 1-9/32" wd x 1-17/64" d overall behind panel; bushing 13/32"-32 x 11/32" lg; C-H #7402K3 (master a-c power).
T202	2Z9636.99	TRANSFORMER, AF: interstage; pri 1025 ohms, secd 4500 ohms ct at 2; UTC #66389; Navy #30935 (interstage).
L206	2Z9641.241	TRANSFORMER, AF: output; secd inductance 0.16 mh, d-c resistance 11.3 ±2 ohms, pri inductance 1.3 mh, pri d-c resistance 11 ±.5 ohms; Fed Tele & Rad dwg #F-35510-3-4 (i-f indicator channel).
T201	2Z9632.417	TRANSFORMER, AF: output; pri 188 ohms, sec #1, 15.3 ohms, sec #2, 0.22 ohms; UTC as per Fed Tele & Rad dwg #F-33093-1; Navy #30934 (audio output).
	2Z9641.234	TRANSFORMER, IF: 175 kc; variable inductance; indicator channel i-f output assembly; shielded; Fed Tele & Rad dwg #F-40649-2 (indicator channel i-f output assembly).
	2Z9641.233	TRANSFORMER, IF: 175 kc peak freq; variable inductance; i-f output assembly; shielded; Fed Tele & Rad dwg #40650-2.
T203	2Z9613.472	TRANSFORMER, power: plate and fil, pri 115 v 60 cps; secd #1.5 v 3 amp, secd #2,500 v 2 ma, secd #3,630 v 150 ma, secd #4,100 v 2 ma, secd #5,2.5 v 1.75 amp, secd #6,6.3 v 0.6 amp, secd #7,6.6 v 8 amp; UTC #66391; Navy #30936 (power).
V216	2J2AP1	TUBE, electron: JAN-2AP1 (cathode-ray bearing indicator).
V215	2J2X2A	TUBE, electron: JAN-2X2A (h-v supply rectifier).

151. MAINTENANCE PARTS FOR RADIO RECEIVER ASSEMBLY R-128/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
V213	2J5U4-G	TUBE, electron: JAN-5U4-G (B-supply rectifier).
V102, 106, 107, 108, 109	2J6AC7	TUBE, electron: JAN-6AC7 (sense channel-amplifier).
V203, 206, 214, 217	2J6H6	TUBE, electron: JAN-6H6 (2d detector).
V208	2J6J5	TUBE, electron: JAN-6J5 (a-f amplifier).
V104	2J6SA7	TUBE, electron: JAN-6SA7 (1st detector).
V110, 204	2J6SJ7	TUBE, electron: JAN-6SJ7 (r-f oscillator).
V103, 201, 202, 205, 209	2J6SK7	TUBE, electron: JAN-6SK7.
V212	2J6SN7GT	TUBE, electron: JAN-6SN7-GT (oscillator amplifier).
V211	2J6SQ7	TUBE, electron: JAN-6SQ7 (low-frequency oscillator).
V210	2J6V6	TUBE, electron: JAN-6V6 (power output).

152. MAINTENANCE PARTS FOR CONTROL-RECTIFIER POWER UNIT PP-135/CRD-3.

Ref symbol	Signal Corps stock No.	Name of part and description
	3H1099P-135	CONTROL-RECTIFIER POWER UNIT PP-135/CRD-3: steel chassis, panel and cabinet, chassis zinc pl; grey wrinkle finish; electron tube type; input 117 v 50/60 c ac, #1 output 250 v dc, #2 output 7.5 v ac; 22-11/16" lg x 10-7/8" wd x 11-1/4" d; Fed Tele & Rad part/dwg #RF-4353-1.
	2Z9402.334	BOARD, terminal: two 30 amp fuse clips w/tinned copper solder lugs; bakelite; 3-5/8" lg x 3/4" wd x 1-5/16" h; marked R-353 in black characters; Fed Tele & Rad part/dwg #RF-4383-1-1 (resistor mtg).
	2Z9402.333	BOARD, terminal: two 30 amp fuse clips w/tinned copper solder lugs; bakelite; 3-5/8" lg x 3/4" wd x 1-5/16" h; marked R-352 in black characters; Fed Tele & Rad part/dwg #RF-4383-1-2 (resistor mtg).
C351, C352, C353	3DB4-234	CAPACITOR, fixed: paper, oil filled; 4 mf +20% -10%; 600 vdcw; 1-1/2" diam x 4-1/2" lg; JAN type CP40B2FF405V.
L351, 352	3C315-10	COIL, AF: filter choke; single winding; inclosed metal case; 10 h +30% -0%; 120 ma dc; 220 ohms ± 10%; 3-5/8" lg x 3-1/4" wd x 5-5/16" overall; Fed Tele & Rad part/dwg #NCP-104-1-8.

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152. MAINTENANCE PARTS FOR CONTROL-RECTIFIER POWER UNIT PP-135/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
J352	6Z8367-2	CONNECTOR, female contact: 2 flat polarized cont; straight; 1-9/32" wd x 1-7/8" lg x 33/64" thk; Amphenol #M1P-61F (auxiliary ac).
J353, J354, J355, J356, J357	2Z8675.15	CONNECTOR, female contact: 5 round polarized cont; straight; 1-5/8" wd x 1-5/8" lg x 1-11/32" thk; Amphenol #AN-3102-22-13S (phase inverter power).
J351	6Z7813-2	CONNECTOR, male contact: 3 twist lock blade polarized cont; straight type; 1-1/2" diam x 1-1/8" h; Hubbel #7556.
F352	3Z2585	FUSE, cartridge: 1/8 amp, 250 v; glass body; metal ferrules 1/4" diam x 1/4" lg; 1-1/4" lg x 1/4" diam overall; Littelfuse #1044, type 3AG (meter fuse).
F351	3Z2605.2	FUSE, cartridge: 5 amp, 250 v; glass body; metal ferrules 1/4" lg : 1/4" diam; 1-1/4" lg x 1/4" diam overall; Littelfuse #1358, type 3AG (power fuse).
	3Z3285-2	HOLDER, fuse: extractor post; for single 3AG fuse; bakelite and metal; 2-13/32" lg x 11/16" diam; white filled arrow and word FUSE on knob; Buss type NAM.

152. MAINTENANCE PARTS FOR CONTROL-RECTIFIER POWER UNIT PP-135/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	3G1838-220.1	INSULATOR, washer: round; xxx paper base bakelite; 3/32" thk x 55/64" OD, 49/64" ID; Fed Tele & Rad part/dwg #RF-2299-1.
I351	2Z5889-13	LAMP, glow: 105-125 v, 1/4 w; T4 - 1/2 clear, 1-1/2" lg; candelabra screw base; neon gas filled; Wemco #T4-1/2 (power pilot).
M351	3F905-32	METER, milliammeter: dc; 0 to 50 ma w/50 one ma divisions; round flush mtg bakelite case; body dimen 2.8" diam x 2.8" max d w/3-1/2" diam flange; JAN type MR34W050DCMA (plate current).
	6L3507-32-12Z	NUT, hexagon: brass, zinc pl; 15/32"-32 thd; 1/8" thk; 3/4" across flats; Fed Tele & Rad part/dwg #NL-43070-1
R351	3RC21BF474K	RESISTOR, fixed: composition; 470,000 ohms ± 10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BF474K.
R352	3RW20115	RESISTOR, fixed: wire-wound; 200 ohms ±5%; 15 w; body dimen 1-3/8" lg x 3/4" diam w/2 ferrules ea 1/2" lg x 9/16" diam; JAN type RW16F201 (regulator bias).
R353	3RW22504	RESISTOR, fixed: wire-wound; 500 ohms ±5%; 15 w; body dimen 1-3/8" lg x 3/4" diam w/2 ferrules ea 1/2" lg x 9/16" diam; JAN type RW16F501 (regulator load).

152. MAINTENANCE PARTS FOR CONTROL-RECTIFIER POWER UNIT PP-135/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
R355, R356, R357, R358	3RA7514	RESISTOR, variable: wire-wound; 10,000 ohms ±10%; 4 w; 3 term; max body dimen 1-7/8" diam x 0.98" thk; bushing 0.375" lg, slotted shaft 1/4" diam x 1-1/4" lg; JAN type RA30A1SG103AK (gain).
R354	2Z7280-13	RESISTOR, variable: wire-wound; 10,000 ohms; 25 w; 3 term; 1-5/8" diam x 1-1/8" d w/1/4" shaft 7/8" lg; Clarostat type PW-25-W per Fed Tele & Rad part/dwg #NCP-32-2-159 (sense gain).
	2Z2642.2	RETAINER, tube: spring, brass; cadmium pl; 2-3/16" lg x 1-13/16" wd x 0.015" thk; Cinch #8526.
X351	2Z8659-6	SOCKET, tube: octal; molded bakelite w/metal mtg plate; 1-9/32" wd x 1-7/8" lg x 45/64" d; Amphenol #MIP8-M.
	2Z1410-8	STUD: brass, dull white nickel pl; male to female w/hex shoulder; 1" lg x 5/8" across flats, shoulder 1/2" lg tapped 3/8"-32 thd 5/16" d, shank 1/2" lg w/15/32"-32 thd, 0.277 axial hole thru center; Fed Tele & Rad part/dwg #NL-43071-1 (for mounting potentiometer to panel).
S357	2Z9826-83	SWITCH, rotary: 6 position; 2 sect; ceramic; 2-1/8" lg x 1-5/8" wd x 1-15/16" d; Oak type HC per Fed Tele & Rad part/dwg #RF-4330-2.

152. MAINTENANCE PARTS FOR CONTROL-RECTIFIER POWER UNIT PP-135/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
S351, S353, S354, S355, S356	3Z9865-42A	SWITCH, toggle: SPST; phenolic body; 41/64" wd x 1-9/16" lg x 2-7/32" h overall; AWS type ST42A.
S352	3Z9849.107	SWITCH, toggle: SPDT; bakelite body; 41/64" wd x 1" lg x 2-7/32" h overall; AWS type ST42D.
T351	2Z9613.59	TRANSFORMER, power: plate and fil; inclosed metal case; pri 115 v 50/60 c, secd #1,700 v, 120 ma ct; secd #2, 5 v, 3 amp ct, secd #3 6.3 v 3 amp, secd #4 12 v 10 amp tapped at 7.5, 9, and 10.5 v; Fed Tele & Rad part/dwg #NCP-104-2-7.
V351	2J5U4G	TUBE, electron: JAN-5U4G.
V352	2J6L6G	TUBE, electron: JAN-6L6G.
	2JOC3/VR-105	TUBE, electron: JAN-OC3/VR-105.

153. MAINTENANCE PARTS FOR AMPLIFIER-RECTIFIER POWER UNIT PP-151/CRD-3.

Ref symbol	Signal Corps stock No.	Name of part and description
	3H138.1-151	AMPLIFIER RECTIFIER POWER UNIT PP-151/CRD-3: electron tube; furnishes fil and plate voltage for bearing indicator; input 110/120 v 55/65 c, 51.2 w; 19" wd x 8-3/4" h x 13-1/2" lg; Navy type 20209.
C406	3DA50-46	CAPACITOR, fixed: paper; 50,000 mmf +10%-3%; 600 vdcw; 1-13/16" lg x 1" wd x 3/4" thk; Dubilier #DY-6005.
C401, 402	3DA100-616	CAPACITOR, fixed: paper, oil filled; 100,000 mmf; 7,500 vdcw; 2-1/4" diam x 4-3/4" h; Aerovox #7512 (high-voltage filter).
C403, 404, 405,	3DB4-43	CAPACITOR, fixed: paper, oil filled; 4 mf ±10%; 600 vdcw; 1-1/2" diam x 4-1/2" lg; Dublier #TLA-6040 (low-voltage filter).
L401, 402	3C315-47	COIL, AF: filter reactor; single winding; 15 h; 85 ma, 375 ohms; 1,000 v dc; 2-11/16" wd x 2-13/16" lg x 3-9/16" h; Fed Tele & Rad dwg #NCP-4-6 (low-voltage filter).
J402	2Z8674.21	CONNECTOR, female contact: 4 round cont; straight, 1-3/8" sq x 1-11/32" lg; Amphenol #AN-3102-18-4S (relay control).
J404	2Z8799-163	CONNECTOR, female contact: 4 round cont; straight; 1-5/8" sq x 1-11/32" lg; Amphenol #AN-3102-22-10S (high-voltage output).
J403	2Z8799-242	CONNECTOR, female contact: 7 cont; straight; 1-3/4" sq x 1-11/32" lg; Amphenol #AN-3102-24-3S (a-c power and deflection coil connections).
J401	2Z8799-155	CONNECTOR, male contact: 2 round cont; straight; 1-3/32" sq x 29/32" lg; Amphenol #AN-3102-12S-3P (amplifier input cable).

153. MAINTENANCE PARTS FOR AMPLIFIER-RECTIFIER POWER UNIT PP-151/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
J405	2Z8799-209.1	CONNECTOR, male contact: 4 round cont; straight; 1-5/8" sq x 1-11/32" lg; Amphenol #AN-3102-22-10P.
F401, 403	3Z1926	FUSE FU-26: cartridge; 1 amp, 250 v; glass body; ferrule 1/4" diam x 1/4" lg; 1/4" diam x 1-1/4" lg overall (power).
F402	3Z1957	FUSE FU-57: cartridge; 5 amp, 250 v; glass body ferrule; 9/16" diam x 1/4" lg; 9/16" diam x 2" lg overall (motor).
	3Z3275	HOLDER, fuse: extractor post; for #3AG fuse; molded black bakelite; 10 amp max; Littelfuse #1075.
	3Z3275-5	HOLDER, fuse: for Fuse FU-57.
K401	2Z7588-45	RELAY, armature: DPDT normally closed; 2-3/4" lg x 1-5/16" h x 1-13/32" wd; Adv Elec #1000 (sense relay).
R412	3RC20BF510J	RESISTOR, fixed: composition; 51 ohms ±5%; 1/2 w; max body dimen 0.468" lg x 0.249" diam; JAN type RC20BF510J (fixed cathode bias).
R405, 406	3RC41BF184K	RESISTOR, fixed: composition; 180,000 ohms ±10% 2 w; max body dimen 1.78" lg x 0.405" diam; JAN type RC41BF184K (high-voltage filter).
R407, 408, 409, 410	3RC31BF105K	RESISTOR, fixed: composition; 1 meg ±10%; 1 w; max body dimen 1.28" lg x 0.310" diam; JAN type RC31BF105K (high-voltage bleeder).
R404	3RW28506	RESISTOR, fixed: wire-wound; 5,000 ohms ±5%; 20 w; 2-13/16" lg x 3/4" diam; Sprague #20F (screen).

153. MAINTENANCE PARTS FOR AMPLIFIER-RECTIFIER POWER UNIT PP-151/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
R402	3Z6610-269	RESISTOR, fixed: wire-wound; 10,000 ohms ±5%; 20 w; 2-15/16" lg x 3/4" diam; Sprague #20F (low-voltage bleeder).
R411	3Z6615-151	RESISTOR, fixed: wire-wound; 15,000 ohms ±5%; 10 w; 2-3/8" lg x 3/4" diam; Sprague #10F (deflection coils current limiting).
R403	2Z7278-44	RESISTOR, variable: wire-wound; 500 ohms ±10%; 2 w; 1-1/4" diam x 9/16" d; IRC #W-500 (amplifier bias).
R401	3Z7499-2.17	RESISTOR, variable: 2 meg ±10%; 1/2 w; 1-1/4" diam x 9/16" d w-3/8" x 3/8" bushing; IRC type CB per Fed Tele & Rad dwg #NCP-32-16 (amplifier gain).
X403, 404	2Z8762.1	SOCKET, tube: 4 prong; steatite; fits 1.172" mtg hole or w/mtg plate to fit 1-1/2" centers; Amphenol #RSS4.
X401, 402	2ZK8678.74	SOCKET, tube: std octal; steatite; fits 1.172" mtg hole or w/mtg plate to fit 1-1/2" centers; Amphenol #RSS8.
T402	2Z9613.293	TRANSFORMER, power: pri 115 v, 60 c; secd #1, 700 v, 0.070 amp, ct; secd #2, 6.3 v, 6 amp, secd #3, 63 v, 2 amp; Fed Tele & Rad dwg #NCP-47-10.
T401	2Z9613.470	TRANSFORMER, power: pri 115 v, 60 c; secd #1, 2300 v, 0.002 amp, secd #2, 2.5 v, 1.75 amp, secd #3, 6.3 v, 0.6 amp; Fed Tele & Rad dwg #NCP-47-8 (high-voltage power).
V403	2J2X2	TUBE, electron: JAN-2X2 (high-voltage rectifier).
V401	2J6AC7	TUBE, electron: JAN-6AC7 (deflection amplifier).
V402	2J6X5GT/G	TUBE, electron: JAN-6X5-GT/G (low-voltage rectifier).
V404	2JOD3/VR150	TUBE, electron: JAN-VR-150-30 (voltage regulator).

154. MAINTENANCE PARTS FOR PHASE INVERTER MC-411-A.

Ref symbol	Signal Corps stock No.	Name of part and description.
	2A2771A	PHASE INVERTER MC-411-A: mounted in cylindrical casting; 5-9/16" wd x 5-9/16" h x 13" lg overall; Sig C spec #271-1612.
C302	3K2010021	CAPACITOR, fixed: mica; 10 mmf ±10%; 500 vdcw; max body dimen 51/64" lg x 15/32" wd x 7/32" thk; CM20B100K.
C301, 307, 308	3K4010312	CAPACITOR, fixed: mica; 10,000 mmf ±5%; 300 vdcw; max body dimen 1-1/32" lg x 41/64" wd x 11/32" thk; CM40A103J (input coupling).
C303, 304, 305, 306	3K4010311	CAPACITOR, fixed: mica; 10,000 mmf ±10%; 300 vdcw; max body dimen 1-1/32" lg x 41/64" wd x 11/32" thk; CM40A103K.
	2Z5574.1	CONNECTOR, female contact: single round cont; straight; 3/8" diam x 1/2" lg overall; GR #274-J (plate and filament contact).
	2Z7111.21	CONNECTOR, male contact: single giant banana cont; straight; 1-7/16" lg overall, drilled and tapped for 1/4"-20; Birnbach #397 (for antenna).
J301	2Z8673.1	CONNECTOR, female contact: 3 round cont; 1-3/4" lg x 1-5/8" sq overall; Amphenol #AN-3102-22-28 per AN 9534 (plate and cathode r-f connection).
	2Z7227-4	CONNECTOR, male contact: single banana type cont; straight; 1" lg overall; GR #274P; Air Forces dwg #X34A4793 (plate and filament male contact).
J302	2Z7123	CONNECTOR, male contact: 5 round cont; straight; 1-3/4" lg x 1-5/8" sq overall; Amphenol #AN-3102-22-13P per AN 9534 (plate and filament power supply).

154. MAINTENANCE PARTS FOR PHASE INVERTER MC-411-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
K301	2Z7585-8	RELAY, armature: SPDT; 1-7/16" h x 1" wd x 15/16" d; Kurman #12C-40 (grounding antenna relay).
R302	3Z6005A1-6	RESISTOR, fixed: composition; 55 ohms ±0.5 ohm; 1/2 w; 0.780" lg x 0.280" diam.
R303	3Z6008B2-7	RESISTOR, fixed: composition; 94 ohms ±1.5 ohms; 1/2 w; 0.780" lg x 0.280" diam.
R305	3Z6013-4	RESISTOR, fixed: composition; 155 ohms ±2.5 ohms; 1/2 w; 0.780" lg x 0.280" diam.
R301	3RC21BE243J	RESISTOR, fixed: composition; 24,000 ohms ±5%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; RC21BE243J.
R304	3RC21BE303J	RESISTOR, fixed: composition; 30,000 ohms ±5%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; RC21BE303J.
	2Z8678.35	SOCKET, tube: loctal; mica filled bakelite; Amphenol #78-8LT (fits in 1.172" hole w/retainer ring).
V301, 302	2J7V7	TUBE, electron: JAN-7V7.

155. MAINTENANCE PARTS FOR PHASE INVERTER MC-413-A.

Ref symbol	Signal Corps stock No.	Name of part and description
	2A2773A	PHASE INVERTER MC-413-A: mtd in cylindrical casting, 5-9/16" wd x 5-9/16" h x 13" lg overall; Sig C spec #71-1612.
C402 C415	3K2010021	CAPACITOR, fixed: mica; 10 mmf ±10%; 500 vdcw; max body dimen 51/64" lg x 15/32" wd x 7/32" thk; CM20B100K.
C401, 407, 408, 409, 410, 416	3K4010312	CAPACITOR, fixed: mica; 10,000 mmf ±5%; 300 vdcw; max body dimen 1-1/32" lg x 41/64" wd x 11/32" thk; CM 40A103J.
C403, 404, 405, 406, 411, 412, 413, 414	3K4010311	CAPACITOR, fixed: mica; 10,000 mmf ±10%; 300 vdcw; max body dimen 1-1/32" lg x 41/64" wd x 11/32" thk; CM 40A103K.
	2Z5574.1	CONNECTOR, female contact: single round cont; straight; 3/8" diam x 1/2" lg overall; GR #274-J (plate and filament contact).
J401 J402	2Z8673.1	CONNECTOR, female contact: 3 round cont; 1-3/4" lg x 1-5/8" sq overall; Amphenol #AN-3102-22-2S, per #AN-9534 (plate and cathode RF cable connector).

155. MAINTENANCE PARTS FOR PHASE INVERTER MC-413-A (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	2Z7111.21	CONNECTOR, male contact: single giant banana type cont; straight; 1-7/16" lg overall, drilled and tapped for 1/4"-20; Birnbach #397 (for antenna).
	2Z7227-4	CONNECTOR, male contact: single banana type cont; straight; 1" lg overall; GR #274P; Air Forces dwg #X34A4793 (plate and filament connection).
J403	2Z7123	CONNECTOR, male contact: 5 round cont; straight; 1-3/4" lg x 1-5/8" sq overall; Amphenol #AN-3102-22-13P, per AN-9534 (plate and filament power supply connector).
R402, 407	3Z6005A1-6	RESISTOR, fixed: composition; 55 ohms ±0.5 ohm; 1/2 w; 3/8" lg x 9/64" diam; Allen Bradley type E modified.
R403, 408	3Z6008B2-7	RESISTOR, fixed: composition; 94 ohms ±1.5 ohms; 1/2 w; 3/8" lg x 9/64" diam; Allen Bradley type E modified.
R405, 410	3Z6013-4	RESISTOR, fixed: composition; 155 ohms ±2.5 ohms; 1/2 w; 3/8" lg x 9/64" diam; Allen Bradley type modified.
R401, 409	3Z6625-4	RESISTOR, fixed: composition; 25,000 ohms ±5%; 1/2 w; 5/8" lg x 1/4" diam; IRC #BT-1/2.
R404, 406	3RC21BF303J	RESISTOR, fixed: composition; 30,000 ohms ±5%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; RC21BF303J.
	2Z8678.35	SOCKET, tube: loctal; mica filled bakelite; Amphenol #78-8LT (fits in 1.172" hole, w/retainer ring).
V401, 402, 403, 404	2J7V7	TUBE, electron: JAN-7V7.

156. MAINTENANCE PARTS FOR TEST OSCILLATOR (NAVY MODEL OAN).

Ref symbol	Signal Corps stock No.	Name of part and description
	3F3864-1	TEST OSCILLATOR (Navy Model OAN): r-f signal; am 200 to 2000 kc in three bands; metal portable case with handle on each end; 16-1/4" wd x 16-3/16" d x 9-3/16" h; Navy type CFT-60054-A.
	2A272-29	ANTENNA ASSEMBLY: whip; cold drawn seamless steel tubing, cadmium pl over copper; sectionalized, 5 sect; 15 ft extended, 36" collapsed, 1/2" OD tapering to 5/16" OD; Navy type CFT-66082.
B604, B605, B606, B607	3A35	BATTERY BA-35: dry; 1.5 v; rectangular; 2-11/16" lg x 2-11/16" wd x 4" h; Burgess #4FH; Navy spec #RE-19AA-105 (heater supply).
B601, B602, B603	3A59	BATTERY BA-59, dry: 45 v; rectangular; 3-9/16" h x 1-13/16" wd x 5-5/8" h; Bright Star #30-33; Navy spec #RE-15A-101 (plate and screen supply).
	1F425-22.120	CABLE ASSEMBLY, RF: coaxial; flexible; 10 ft lg; 2 axial cond; air dielectric with polystyrene beads; Fed Tele & Rad dwg #RF-1516-2-2.
C605	3D9050-21	CAPACITOR, fixed: silver mica; 50 mmf ±5%; 500 vdcw; Dubilier #5RST; Navy type CFT-48895-D5.
C606, C608	3D9100-72	CAPACITOR, fixed: mica; 100 mmf ±10%; 500 vdcw; Dubilier #5WLS; Navy type CFT-48674-B-10.
C607-A, B C609-A, B	3DA100-444	CAPACITOR, fixed: paper, oil filled; 2 sect; 100,000 - 100,000 mmf, ±15%; 600 vdcw; Dubilier #DYRT-6011-12; Navy type CFT-481674.

156. MAINTENANCE PARTS FOR TEST OSCILLATOR (NAVY MODEL OAN) (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
C611, C612	3DA250-20.2	CAPACITOR, fixed: paper, oil filled; 2 sect; 250,000 - 250,000 mmf, ±15%; 600 vdcw; Dubilier #DYRT-6022-1; Navy type CFT-481003-15.
C613, C614	3DB2.6200-6	CAPACITOR, fixed: paper, 2 mf ±10%; 600 vdcw; Dubilier #DYR-6200-5; Navy type CFT-48403-B10.
C602, C603, C604	3D9050V-113	CAPACITOR, variable: ceramic; 50 mmf +20% - 5%; 0.0195" air gap; Fed Tele & Rad dwg #F-34356-2-3; Navy type CFT-481695 (oscillator trimmer - band 1).
C610	3D9100V-73	CAPACITOR, variable: ceramic; 100 mmf +20% - 5%; 0.0245" air gap; Fed Tele & Rad #F-41846-2; Navy type CFT-481696 (amplifier tuning trimmer).
C601-A, B, C, D	3D9402V-5	CAPACITOR, variable: 4 sect; 402 mmf ea sect; Fed Tele & Rad dwg #F-35867-2 (oscillator and amplifier tuning).
L607, L608, L609, L610	3C574K-3	COIL, AF: filter; Fed Tele & Rad dwg #F-36920-1-5; Navy type CFT-30966 (line filter).
L611	3C574K-4	COIL, AF: filter; 120 h; 17 ma; Fed Tele & Rad dwg #F-35869-1; Navy type CFT-301189.
L601	3C1084K-64	COIL, RF: oscillator band 1; Fed Tele & Rad dwg #RF-1411-3-1.
L604	3C1084K-65	COIL, RF: r-f amplifier band 1; Fed Tele & Rad dwg #RF-1411-3-4.
L602	3C1084K-63	COIL, RF: oscillator, band 2; Fed Tele & Rad dwg #RF-1411-3-2.
L605	3C1084K-61	COIL, RF: r-f amplifier, band 2; Fed Tele & Rad dwg #RF-1411-3-5.

156. MAINTENANCE PARTS FOR TEST OSCILLATOR (NAVY MODEL OAN) (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
L603	3C1084K-62	COIL, RF: oscillator, band 3; Fed Tele & Rad #1411-3-3.
L606	3C1084K-66	COIL, RF: r-f amplifier, band 3; Fed Tele & Rad dwg #1411-3-6.
J602	2Z8799-127	CONNECTOR, male contact: Sig C Socket SO-127; 3 cont; straight; 1-3/8" sq x 1-11/32"; Amphenol #AN-3102-18-5P.
J601	2Z7113.9	CONNECTOR, male contact: 3 cont; straight; 1-1/2" lg x 1-11/32" sq; Amphenol #AN-3102-20-6P (power).
F601, F602	3Z1926	FUSE FU-26: 1 amp, 250 v; glass body; ferrule, 1/4" diam x 1/4" lg; 1/4" diam x 1-1/4" lg.
V603	2Z5954	LAMP LM-54: glow; 105-125 v; bulb T-2, clear (neon indicator).
R612, 613, 615, 616, 618, 619, 620, 628	3RC21BE101J	RESISTOR, fixed: 105 ohms ±5%; (except 2/100 ohm marking) 1/2 w; Navy spec RE-13A-340 (attenuator series).
R608, 611, 624, 625	3RC21BF111J	RESISTOR, fixed: 111 ohms ±5%; (except w/110 ohm marking) 1/2 w; JAN type RC21BF111J (attenuator shunt).
R606, 607	3Z6012-4	RESISTOR, fixed: 116 ohms ±5%; (except w/120 ohm marking) 1/2 w; Navy type CFT-63335 (attenuator series).

156. MAINTENANCE PARTS FOR TEST OSCILLATOR (NAVY MODEL OAN) (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
R621	3Z6014-10	RESISTOR, fixed 140 ohms ±5%; 1/2 w; Navy type CFT-63335 (output load)
R614, 617, 626, 627	3Z6021-4	RESISTOR, fixed: 210 ohms ±5%; 1/2 w; Navy type CFT-63335 (attenuator shunt).
R609, 610	3Z6170	RESISTOR, fixed: 1,747 ohms ±5%; (except w/1,700 ohm marking) 1/2 w; Navy type CFT-63335 (attenuator series).
R623	3RC41BE332K	RESISTOR, fixed: composition; 3,300 ohms ±10%; 2 w; JAN type RC41BE332K (series plate supply).
R605	3RC30BE103K	RESISTOR, fixed: composition; 10,000 ohms ±10%; 1 w; 0.718" lg x 0.280" diam; JAN type RC30BE103K (amplifier screen bias).
R601, 603	3RC21BF333K	RESISTOR, fixed: composition; 33,000 ohms ±10%; 1/2 w; 0.655" max lg x 0.249" diam; JAN type RC21BF333K (oscillator grid bias).
R602, 604	3RC21BF104K	RESISTOR, fixed; composition; 100,000 ohms ±10%; 1/2 w; max body dimen 0.655" lg x 0.249" diam; JAN type RC21BF104K (oscillator screen bias).
R622	3RC41BE104K	RESISTOR, fixed: composition; 100,000 ohms ±10%; 2 w; max body dimen 1.78" lg x 0.342" diam; JAN type RC41BE104K (rectifier filter bleeder).
X601, 602, 604	2Z8762.1	SOCKET, tube: octal; steatite; Amphenol type RSS8.
S601	3Z9826-83.1	SWITCH, rotary: 3 position; 3 section; ceramic; Oak type H per Fed Tele & Rad dwg #F-38517-2 (band switch).

156. MAINTENANCE PARTS FOR TEST OSCILLATOR (NAVY MODEL OAN) (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
S602	3Z9826-83.2	SWITCH, rotary: 6 position; 4 section; ceramic; Oak type H per Fed Tele & Rad dwg #F-38515-2 (output control).
S603	3Z9859-56	SWITCH, toggle: DPST; 5/8" lg; AH & H type 2902-GP; Navy spec #RE-24AA-118 (power input).
S604	3X9859-56.1	SWITCH, toggle: DPDT; AH & H type #20905-GL (battery ON - OFF).
T601	2Z9613.469	TRANSFORMER, power: pri 115 v, 60 c; secd 510 v ct, 25 ma, 6.3 v, 2.1 amp; Fed Tele & Rad dwg #F-35865-1 (power supply).
V601, 602	2J6SK7	TUBE, electron: JAN-6SK7.
V604	2J6X5GT/G	TUBE, electron: JAN-6X5GT/G.

157. MAINTENANCE PARTS FOR ANTENNA ASSEMBLY AS-204/CRD-3.

Ref symbol	Signal Corps stock No.	Name of part and description
	2A264-204	ANTENNA ASSEMBLY AS-204/CRD-3: steel and aluminum; olive drab; telescopic in 9 sect; 64 ft extended, 9 ft collapsed, 3" OD; w/Mast Base AB-57/CRD-3; Sig C spec #271-3175.
	3E6000-459	CABLE ASSEMBLY, power: Army-Navy Ground Conductor CX-459/CRD-3; general purpose; flat, 5/8" wd; 44" lg; tinned copper braid; with one set of Dot fasteners at one end, 1 spade lug opposite ends, 1 spade lug 24" from end and one 32" from end; Sig C spec #271-3175.
	2A1348-298	GUY MX-298/CRD-3: nylon; green; 4,000 lb breaking strength; 40 ft lg x 5/16" diam; ring and Fastner FT-9 one end, snap hook and thimble other end.
	2A1348-299	GUY MX-299/CRD-3: nylon; green; 4,000 lb breaking strength; 55 ft lg x 5/16" diam; ring and Fastner FT-9 one end, snap hook and thimble other end.
	2A1348-300	GUY MX-300/CRD-3: nylon; green; 4,000 lb breaking strength; 70 ft lg x 5/16" diam; ring and Fastner FT-9 one end, snap hook and thimble other.
	2A2450-57	MAST BASE AB-57/CRD-3: cast steel; olive drab; supports Antenna Assembly AS-204/CRD-3; 12" x 12" x 12" overall; base 12" x 1/2" thk; Sig C spec #271-3175.
	2A2450-65	MAST SECTION AB-65/CRD-3: antenna; steel and aluminum; olive drab E; 9 ft x 3" diam; Sig C spec #271-3175.

157. MAINTENANCE PARTS FOR ANTENNA ASSEMBLY AS-204/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	2A450-66	MAST SECTION AB-66/CRD-3: antenna; steel and aluminum with brass sleeve; olive drab; 9 ft 6" lg x 3" diam; Sig C spec #271-3175.
	2A2450-67	MAST SECTION AB-67/CRD-3: antenna; steel and aluminum; olive drab E; 9 ft 6" lg x 2-1/4" diam; Sig C spec #271-3175.
	2A2450-68	MAST SECTION AB-68/CRD-3: antenna; steel and aluminum; olive drab E; 9 ft 6" lg x 2-1/4" diam; Sig C spec #271-3175.
	2A2450-69	MAST SECTION AB-69/CRD-3: antenna; steel and aluminum; olive drab E; 9 ft 6" lg x 2" diam; Sig C spec #271-3175.
	2A2450-70	MAST SECTION AB-70/CRD-3: antenna; steel and aluminum; olive drab E; 9 ft lg x 2" diam; Sig C spec #271-3175.
	2A2416	MAST SECTION MS-116A: antenna; steel tubing; copper pl; 3/8" diam x 39-1/2" lg; Sig C dwg #SC-D-12521.
	2A3302	STAKE GP-2: steel; galv; 16" lg x 3/4" diam; Sig C spec #71-393.
	2A3325	STAKE GP-25: metal; 36" lg x 1.34" diam at top tapering to 1/8" diam at bottom w/2-3/8" diam cap on top and bolt w/wing nut 2-1/4" from top of shaft; Sig C dwg #RL-D-5659.

158. MAINTENANCE PARTS FOR BEARING INDICATOR ID-121/CRD-3.

Ref symbol	Signal Corps stock No.	Name of part and description
	2C1565-121	BEARING INDICATOR ID-121/CRD-3: cast aluminum housing; olive drab E; consists of goniometer, cathode ray tube and control circuit; 9" wd x 12" h x 38" d; Sig C spec #271-3175.
	2Z5991-57	ALIDADE ASSEMBLY: Fed Tele & Rad dwg #NL-43234-2.
	2C1557-1159A/B1	BRUSH, electrical contact: carbon; 11/16" lg x 9/32" wd x 5/32" thk excluding pigtail; Fed Tele & Rad dwg #NL-40174 (for rotating unit).
C502	3DB70	CAPACITOR, fixed: electrolytic; 70 mf; 110 v ac; Aerovox #196 (motor starting).
C501	3DB1-76	CAPACITOR, fixed: paper, oil filled; 1 mf ±10% 2000; vdcw; 2-1/2" lg x 13/16" wd x 3-3/8" h; Dubilier #T-20010.
	3C388	COIL, deflection: single winding, layer wound; 155 mh ±10%; 0-14 ma, pulsating dc, 470 ohms resistance; 1-9/16" x 1-1/4" x 9/16"; Fed Tele & Rad dwg #NL-41203 (replacement for coils #NL-40954, #NL-40955-1 and #NL-40956-1).
	2Z7227-4	CONNECTOR, male contact: single banana type cont; straight; metal head; Fed Tele & Rad dwg #NCP-19-4 (u/w control unit).
J501	2Z8799-209.1	CONNECTOR, male contact: 4 round cont; straight; 1-5/8" sq x 1-11/32" lg less cont; Amphenol #AN-3102-22-10P (high-voltage supply).
J502	2Z8799-241	CONNECTOR, male contact: 7 round cont; straight; 1-3/4" sq x 1-11/32" lg less cont; Amphenol #AN-3102-24-3P (deflection coil current).
	2Z6912	COUPLING, flexible: leather w/4 metal spacers; 2-5/8" ID, 3-7/8" OD x 5/32" thk; Fed Tele & Rad #NL-40142.

158. MAINTENANCE PARTS FOR BEARING INDICATOR ID-121/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	2Z4868.349	GASKET: neoprene; Fed Tele & Rad dwg #NL-42109.
	2Z4868.346	GASKET: neoprene; Fed Tele & Rad dwg #NL-40140.
	2Z4868.347	GASKET: neoprene; Fed Tele & Rad dwg #NL-42966.
	2Z4868.348	GASKET: neoprene; Fed Tele & Rad dwg #NL-40139.
	3H2507-45	HOLDER, contact brush: Fed Tele & Rad dwg #RF-1370-2 (for rotating unit).
	3Z3285-3	HOLDER, fuse: extractor post; Fed Tele & Rad dwg #F-37118-1.
I501, 502, 503, 504	2Z5934-1	LAMP, incandescent: 6-8 v, 0.2 amp; bayonet base; 15/16" lg x 7/16" diam; GE #51-G3-1/2 (pilot lamp).
	3H3000A12-8	MOTOR, AC: induction; 1/8" hp; 110-120 v, 55/65 c, single ph, 3.2 amp; 1140 rpm; Fed Tele & Rad #NL-42183.
R503, 504	3RC21BE513J	RESISTOR, fixed: composition; 51,000 ohms ±5%; 1/2 w; max dimen 0.655" lg x 0.249" diam; RC21BE513J (voltage divider).
R508	3RC31AE104K	RESISTOR, fixed: composition; 100,000 ohms ±10%; 1 w; max dimen 1.28" lg x 0.310" diam; RC21AE104K (voltage divider).
R505	3RC41BE514J	RESISTOR, fixed: composition; 500,000 ohms ±5%; 2w; max body dimen 1.78" lg x 0.405" diam; RC41BE514J (voltage divider).
R507	2Z7296-25M	RESISTOR, variable (potentiometer): carbon; 25,000 ohms; 1/2 w; 3 term; body 1-1/4" diam x 9/16" d, shaft 1/4" diam x 5/8" lg; IRC type CS per Fed Tele & Rad #NCP-32-10 (intensity control).

158. MAINTENANCE PARTS FOR BEARING INDICATOR ID-121/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
R506	2Z7272-18	RESISTOR, variable: carbon; 250,000 ohms; 1/2 w; 3 term; body 1-1/4" diam x 9/16" d, shaft 1/4" diam x 5/8" lg; IRC type CS per Fed Tele & Rad #NCP-32-9 (focus control).
R501, 502	2Z7274-2	RESISTOR, variable (potentiometer): carbon; 2 meg; 1/2 w; body 1-1/4" diam x 9/16" d, shaft 1/4" diam x 33/64" lg; IRC type CS per Fed Tele & Rad #NCP-32-11 (deflection control).
R509	2Z7277.81	RESISTOR; variable: wire-wound; 15 ohms ±10%; 25 w; 1-9/16" diam x 1-3/8" d; Ohmite type H #0146 (ac limiting).
	2Z3876.86	ROTATING UNIT ASSEMBLY: Fed Tele & Rad #RF-2073-14.
X501	2Z8637-1.1	SOCKET, tube: 11 round cont; ceramic; 1-23/32" diam x 0.646" h; w/spcl mtg ring; Fed Tele & Rad #RF-2688-1 (for V-501).
	2C1557-1159A/ B1/1	SPRING: extension; 4 turns #20 cadmium pl spring steel wire, wound counterclockwise; 3/16" diam x 9/32" lg; Fed Tele & Rad dwg #NL-40816 (spring for motor brush).
T501	2Z9611.383	TRANSFORMER, power: pri 115 v, 10 amp; secd 8 v, 1 amp, ct; Fed Tele & Rad dwg #NCP-104-4 (pilot light).
V501	2J5NP1	TUBE, electron: JAN-5NP1 (pattern).
	2ZA1352-116	WINDOW: clear plastic; 1/64" thk x 5" diam; Fed Tele & Rad dwg #NL-42141 (anti-reflection lens).

159. MAINTENANCE PARTS FOR JUNCTION BOX J-99/CRD-3.

Ref symbol	Signal Corps stock No.	Name of part and description
	2Z5600-99	JUNCTION BOX J-99/CRD-3: sheet steel; gray wrinkle E; 18" lg x 10-1/2" d x 6-3/4" h; Navy No CFT-62127.
C451	3K3539232	CAPACITOR, fixed: mica; 3,900 mmf ±5%; 500 vdcw; max body dimen 53/64" sq x 11/32" thk; JAN type CM35C392J.
L451	3C1084K-52	COIL, RF: dummy goniometer; pri 565 ohms d-c resistance, secd 3.27 ohms d-c resistance; Fed Tele & Rad part/dwg #RF-723-2 (simulates goniometer in sense channel).
J461, 462, 463	2Z8673.1	CONNECTOR, female contact: 3 round polarized cont; straight; 1-5/8" lg x 1-5/8" wd x 1-1/32" d less solder lugs; Amphenol #AN-3102-22-2S.
J451, 452, 453, 454, 455, 456, 457, 458	2Z8799-129	CONNECTOR, male contact: Sig C Socket SO-129; 3 round polarized cont; straight; 1-3/8" sq x 1-11/32" lg; Amphenol #AN-3102-18-5P (receives non-directional channel input).
J459	2Z7115.3	CONNECTOR, male contact: 3 round polarized cont; straight; 1-9/32" x 58/64"; Amphenol #AN-3102-16S-5P (receiver junction box control).
J460	2Z7113.9	CONNECTOR, male contact; 3 round polarized cont; straight; 1-1/2" x 1-11/32"; Amphenol #AN-3102-20-6P (power input).
F451 F452	3Z1950	FUSE FU-50: cartridge; 3 amp, 250 v; glass body; metal ferrules 1/4" diam x 1/4" lg; 1-1/4" lg x 1/4" diam overall (power).
K-451, K-452	2Z7585-145	RELAY, armature: SPST, normally open; 15 amp, 115 v ac; 6 v a-c coil; WL per Fed Tele & Rad #F37217-1, Navy type #29187.

159. MAINTENANCE PARTS FOR JUNCTION BOX J-99/CRD-3 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
K453, K454	3C1999-6G	RELAY, solenoid: 115 v ac coil rated at 4.5 lb pull at 1" displacement; GE #F-37094-2 (actuates switches S-451,452 & 453).
R460	3RC20AE510J	RESISTOR, fixed: composition; 51 ohms ±5%; 1/2 w; max body dimen 0.468" lg x 0.249" diam; JAN type RC20AE510J.
R457, 458, 459	3RC20AE121J	RESISTOR KIT: fixed; composition; three 120 ohms 1/2 w; JAN type RC20AE121J; resistors matched to ±1%; ea max body dimen 0.468" lg x 0.249" diam, (loop transmission line terminating).
R451 thru R456	3RC21AE103J	RESISTOR, fixed: composition; 10,000 ohms ±5%; 1/2 w; max body dimen 0.655" lg x 0.249"; JAN type RC21AE103J.
S451, S452, S453	3Z9550.6	SWITCH, rotary; 12 cont, 2 ckt, 4 position; ceramic wafer; 1-9/16" diam x 0.180" thk; Fed Tele & Rad #F-36334-1 (r-f switching).
S454, S455	3Z9558-16	SWITCH, sensitive: SPST normally closed; micro sw #WZRQ1 (limit control on solenoid).

160. MAINTENANCE PARTS FOR HEADSET HS-29-( ).

Ref symbol	Signal Corps stock No.	Name of part and description
	2B1300	INSERT M-300.
	3Z10161	TERMINAL TM-161: (ring tip, solderless).
	3Z10163	TERMINAL TM-163: (spade tip, solderless).

161. MAINTENANCE PARTS FOR TOOL EQUIPMENT TE-41.

Ref symbol	Signal Corps stock No.	Name of part and description
	6R38041	TOOL EQUIPMENT TE-41: 2d echelon radio repair kit.
	6Q335	ALIGNMENT TOOL: neutralizing and compensating; 5-in 1; ICA #1022.
	6Q2044	BAG BG-44: tool; canvas.
	6Z1372	BRUSH TL-72: camel's hair; flat; 1/2".
	6G184.1	CARBON TETRACHLORIDE: in 8 oz metal screw-top can.
	6Q38033-8	FILE: flat; second-cut, 8".
	6Q38500-6	FILE: TL-133: round, bastard; 6".
	6Z4002	FLASHLIGHT TL-122: Includes the following:
	6Z6762	LAMP: flashlight; pre-focused; 2.7v, 0.15 amp, single cont; miniature flange base; B-3-1/2 bulb; GE #PR-9.
	6Q49712	HAMMER: machinist's; ball pein; 12 oz.
	6Q52208	HOLDING TOOL: 8" reach, 10-3/4" overall; Bonney #K8.
	6Q60229	KNIFE TL-29.
	6Z7072	MIRROR: dental; 6-3/4" lg overall WECo #376A.
	6R1913	NUT DRIVER: hollow shaft; nut size 3/8", depth of hole 5", 6" lg, Xcelite #HS-12.
	6R4513	PLIERS TL-13: side cutting, 6".
	6R4603	PLIERS TL-103: diagonal cutting, 5".
	6R4626	PLIERS TL-126: lg chain nose, 6 or 6-1/2" lg.
	6R4712-6	PLIERS: short chain nose; 6".

161. MAINTFNANCE PARTS FOR TOOL EQUIPMENT TE-41 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	6R4719-7A	PLIERS: combination, side cutting, 7-1/2", Bonney #B537.
	6R15371	SCREWDRIVER: 2-1/2" blade, 5/16" diam, 5/32" tip; knurled handle, 5" overall; swivel hex head and chuck to admit interchange of blades, complete w/2 blades and screw holder; Starrett #552.
	6R15999	SCREWDRIVER: Phillips #1A; 3".
	6R15600	SCREWDRIVER: 4" blade; Phillips #2A.
	6R15811	SCREWDRIVER: 5" blade; 8-1/2" overall; insulated wood handle; Stanley #77.
	6R16410	SCREWDRIVER TL-105: 8" blade, 5/16" tip; insulated wood handle; 15" overall; Stanley #25.
	6R16890	SCREWDRIVER: 10" blade, 3/16" diam, 13-3/8" overall; Stanloid handle; Stanley #1008.
	6R24617	SOLDERING IRON TL-117: 110v, 70/100w.
	6R24503H	SOLDERING IRON TL-132: 3 oz, jewelers', w/ handle.
	6R24618	SOLDERING IRON: 100w, 12v; American Beauty #3138.
	6R41065C	TOOL: swbd; contact burnisher; WECo #265-C: Includes the following:
	6R41066B	BURNISHER: steel blade; for cleaning surface of relay cont; WECo #266B.
	6R41066C	BURNISHER: steel music wire; for cleaning pits on relay cont; WECo #266C.
	6R42167	TORCH TL-130: blow, gasoline, 1 pt, flat type.
	6R38005/2C	TWEEZERS: 5" steel.

161. MAINTENANCE PARTS FOR TOOL EQUIPMENT TE-41 (contd).

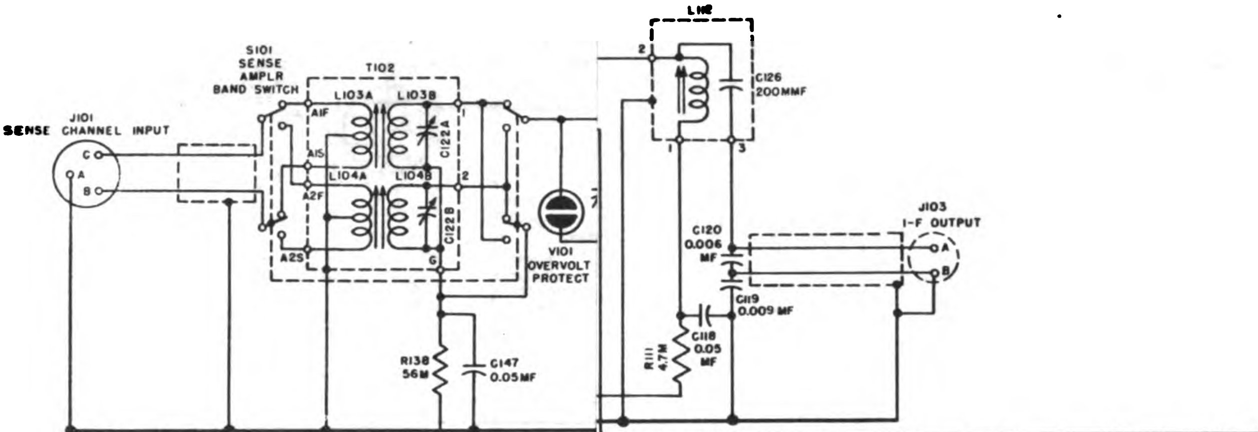
Ref symbol	Signal Corps stock No.	Name of part and description
	6R55006	WRENCH TL-111: adj; single end; 6", 3/4" capacity; Crescent #A-16.
	6R55502	WRENCH SET: midget; J.H. Williams Co. #1285P; in steel case 5-1/2" x 3 x 1: Contains the following:
	6Q36881	EXTENSION DRIVER: 5-3/8" lg; w/1/4" sq dr; Williams #NM-110.
	6Q51207-1	HANDLE: wrench; sliding T; 4-1/2" lg; Williams #NM-20A.
	6R4780-4.5	PLIERS: slip joint; 4-1/2" lg; 4 position joint opens 0-9/16"; Williams superpliers #1519.
	6R24313-6	SOCKET: wrench; hex; 3-1/6", 1/4" sq dr; Williams Supersocket #NM-606.
	6R24313-7	SOCKET: wrench; hex; 7/32", 1/4" sq dr; Williams Supersocket #NM-607.
	6R24313-8	SOCKET: wrench; hex; 1/4", 1/4" sq dr; Williams Supersocket #NM-608.
	6R24313-9	SOCKET: wrench, hex; 9/32", 1/4" sq dr; Williams Supersocket #NM-609.
	6R24313-10	SOCKET: wrench; 12 point; 5/16", 1/4" sq dr; Williams Supersocket #NM-1210.
	6R24313-11	SOCKET: wrench; 12 point; 11/32", 1/4" sq dr; Williams Supersocket #NM-1211.
	6R24313-12	SOCKET: wrench; 12 point; 3/8", 1/4" sq dr; Williams Supersocket #NM-1212.
	6R24313-14	SOCKET: wrench; 12 point; 7/16", 1/4" sq dr; Williams Supersocket #NM-1214.

161. MAINTENANCE PARTS FOR TOOL EQUIPMENT TE-41 (contd).

Ref symbol	Signal Corps stock No.	Name of part and description
	6R55507-7	WRENCH: double open end; 7/32" - 13/64"; Williams Superwrench #1106.
	6R55507-8.1	WRENCH: double open end; 15/64" - 1/4"; Williams Superwrench #1107.
	6R55511-9	WRENCH: double open end; 11/32" - 9/32"; Williams Superwrench #1108.
	6R55510-12.1	WRENCH: double open end; 5/16" - 3/8" Williams Superwrench #1109.
	6R57400	WRENCH: hex, Allen; 5/64" w; for #8 setscrew, #4 cap screw.
	6R55496	WRENCH: hex, Allen; 3/32" w; for #10 setscrew, #5 & #6 cap screw.
	6R55230	WRENCH: hex, spline type, Bristol #6.
	6R55231	WRENCH: hex, spline type; Bristol #8.
		EXPENDABLE SUPPLIES
	6Q51014	HANDLE TL-14: file; wood; w/brass ferrule; 4" overall.
	6Q51135	HANDLE TL-215: file; wood; w/brass ferrule; 4-1/2" overall.
	6G1007	OIL: PS: lubricating; preservative special; 4 oz.
	6Z7500-000	PAPER: sand; flint, 9 x 11, #000.
	6N4102	PASTE: soldering; 2 oz cans.
	6N7531	SOLDER M-31: resin core.
	6N8583	TAPE TL-83: friction, cotton; 3/4"; 1/2 lb rolls.
	6N8692	TAPE TL-192: rubber; 3/4"; 15 ft rls.

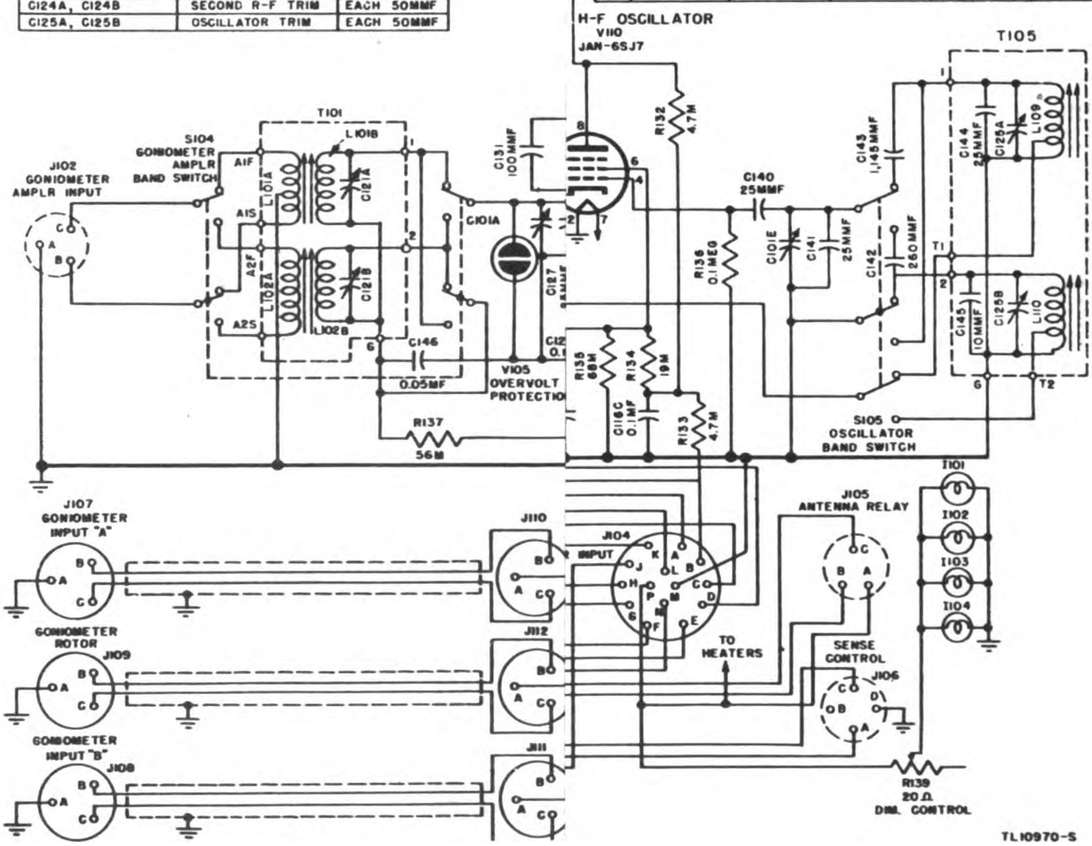
161. MAINTENANCE PARTS FOR TOOL EQUIPMENT TE-41 (contd).

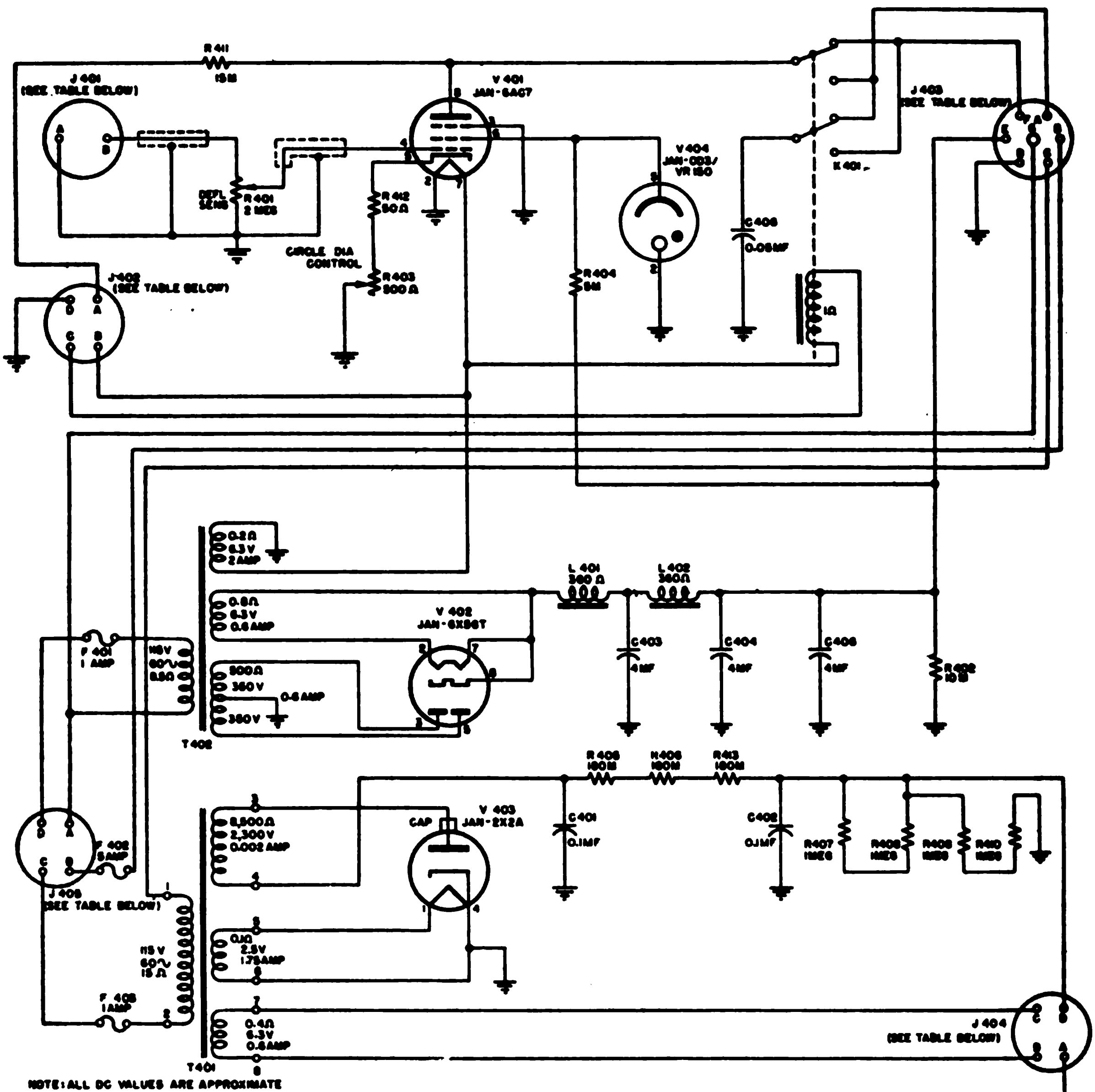
Ref symbol	Signal Corps stock No.	Name of part and description
	6G2203	VARNISH: blue, posting; air drying glyptal; 4 oz, GE #1153.
	1B7.1	WIRE W-7: single #18 AWG; solid.
	1B1318.7	WIRE: radio and instrument hookup; #18 AWG; stranded; synthetic insulation; braided; color coded black.



PINS	J101 FROM J451	J102 FROM J458	J103 FROM J201	J104 FROM J202	J105 FROM J459	J106 FROM J402
A	GND	GND	I-F	AVC	RELAY	ABI BLANKING
B	SENSE	DIRECTIONAL	I-F	B+	ABI	NO FUNCTION
C	SENSE	DIRECTIONAL		BIAS	CRI	RELAY CONTROL
D				AVC		GND
E				AVC		
F				V205 CATHODE		
G				AVC		
H				A-F OSC OUTPUT		
J				A-F OSC OUTPUT		
K				V109, V212 CATHODES		
L				BLANK SWITCH		
M				GND		
N				AVC		
P				6.6 V A-C		

VARIABLE CAPACITORS		
NO.	FUNCTION	VALUES
C101A, C101B, C101C C101E, C101D	MAIN TUNING	EACH 708MMF
C121A, C121B	GONIO AMPLR TRIM	EACH 50MMF
C122A, C122B	SENSE AMPLR TRIM	EACH 50MMF
C123A, C123B	FIRST R-F TRIM	EACH 50MMF
C124A, C124B	SECOND R-F TRIM	EACH 50MMF
C125A, C125B	OSCILLATOR TRIM	EACH 50MMF





NOTE: ALL DC VALUES ARE APPROXIMATE

IS SYMBOL FOR FIXED CAPACITOR

M = 1,000 Ω

PINS	J 401 TO J 203 POWER INDICATOR	J 402 TO J 106 MODULATOR RECEIVER	J 403 TO J 502 ABI CF.T - 55092 - A	J 404 TO J 501 ABI CFT - 55092 - A	J 405 TO J 207 POWER IND
A	GROUND	ABI BLANK	DEFLECTION COIL	GROUND	COMMON
B	ABI OUT	NO FUNCTION	MOTOR	CRT FIL	MOTOR
C		RELAY CONTROL	RETURN FOR HV	CRT FIL	BEAM
D		GROUND	GROUND	HIGH VOLTAGE	AMPLIFIER
E			DEFL COIL COMMON		
F			DEFLECTION COIL		
G			MOTOR COMMON		

TL 10060-B

Figure 159. Schematic diagram of Amplifier-Rectifier Power Unit PP-135/CRD-3.

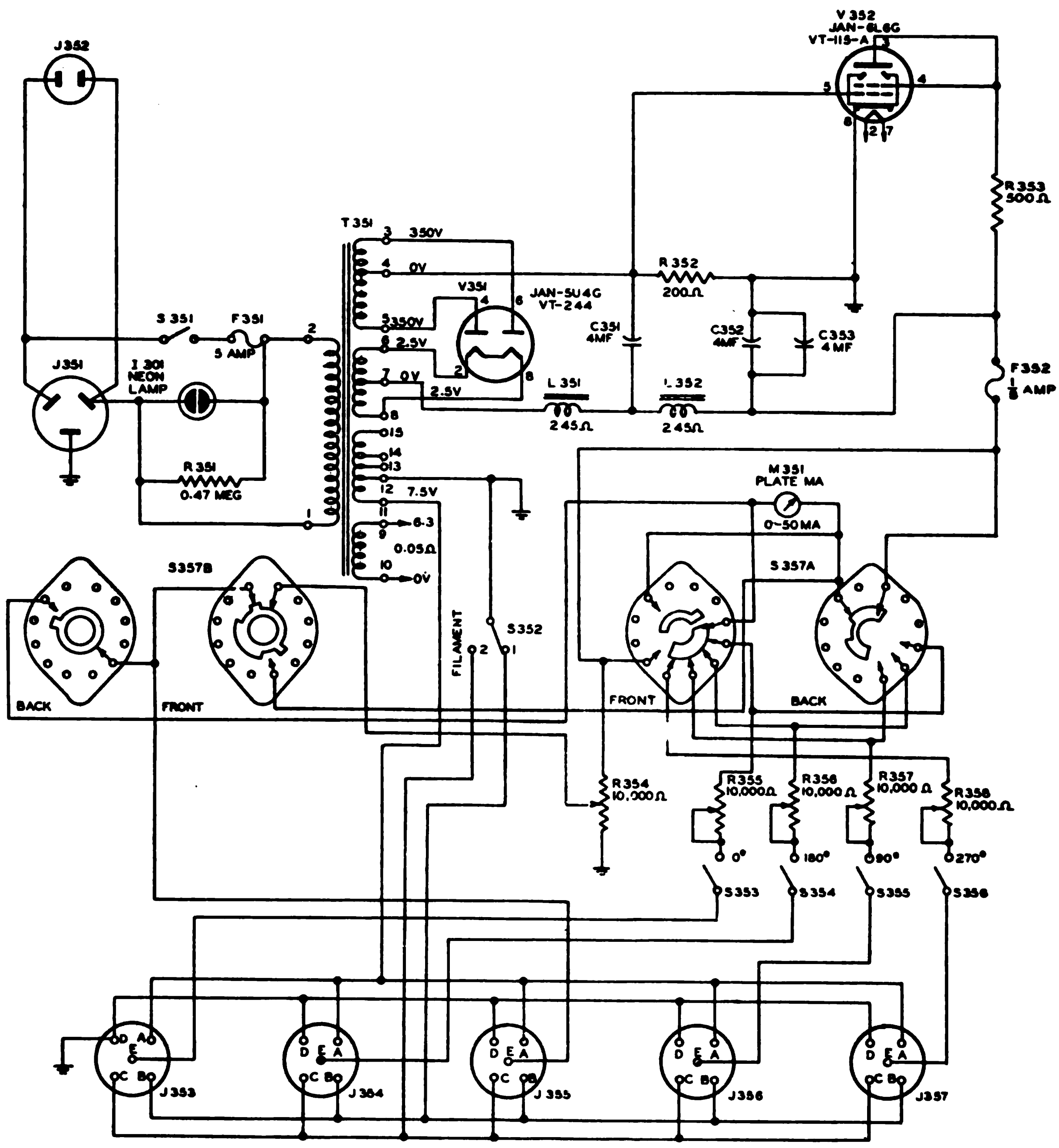


Figure 160. Schematic diagram of Control-Rectifier Power Unit PP-135/CRD-3.

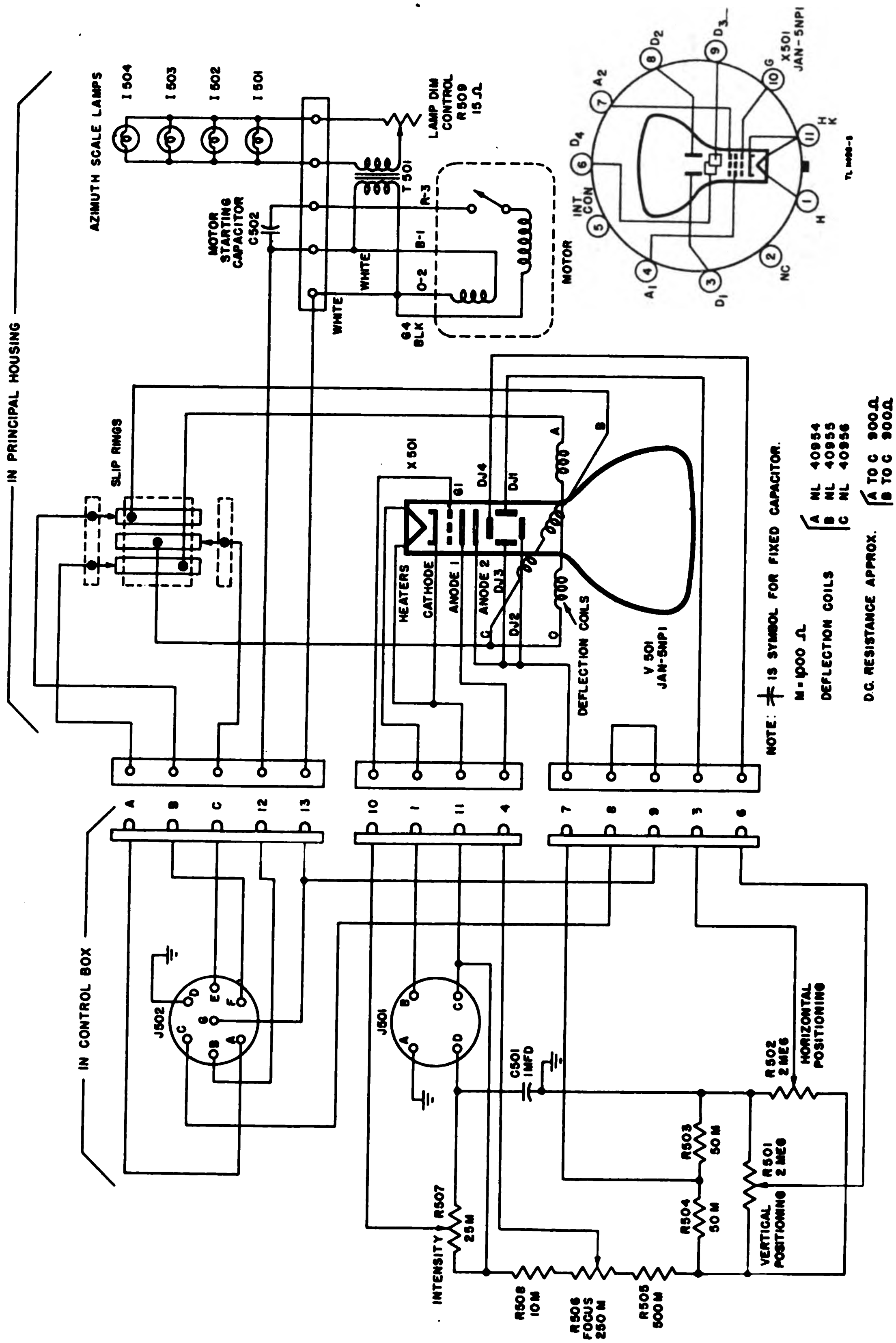


Figure 161. Schematic diagram of Bearing Indicator ID-121/CRD-3.

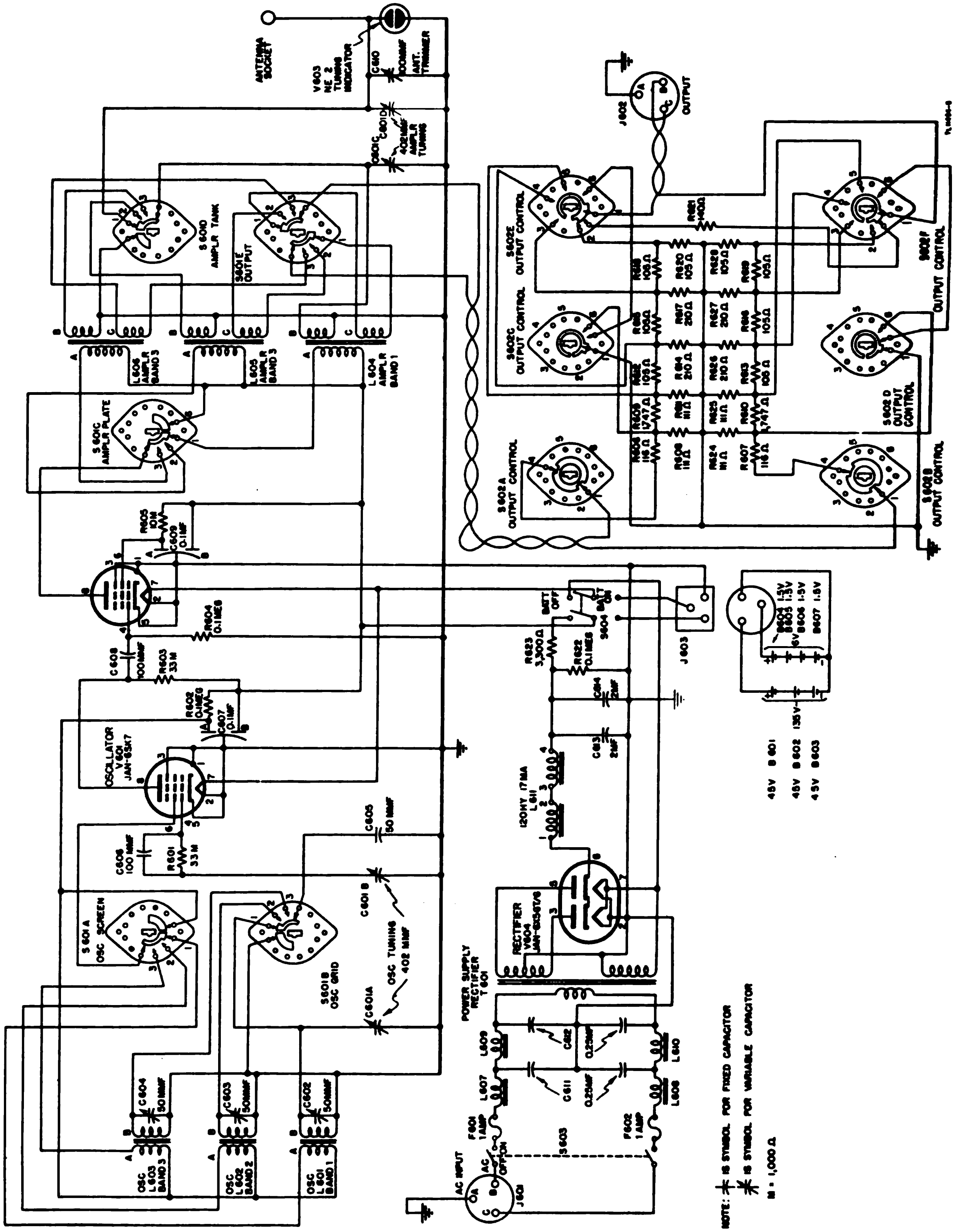


Figure 162. Schematic diagram of OAN test oscillator.

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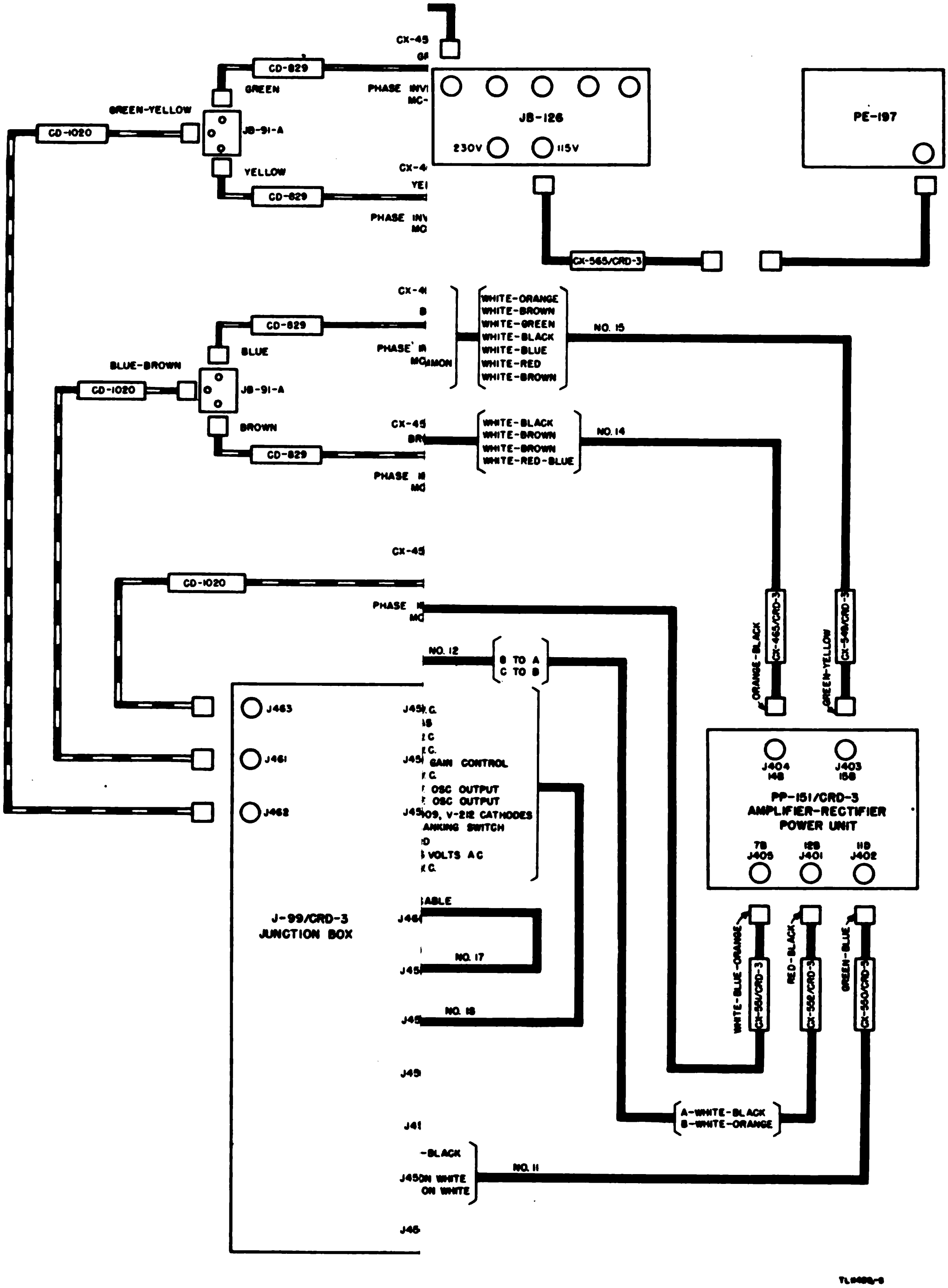
CD-829
GREEN
GREEN-YELLOW
CD-1020
JB-91-A
YELLOW
CD-829
CX-45
PHASE INV
JB-126
230V
115V
PE-197
CX-565/CRD-3
WHITE-ORANGE
WHITE-BROWN
WHITE-GREEN
WHITE-BLACK
WHITE-BLUE
WHITE-RED
WHITE-BROWN
NO. 15
BLUE
BLUE-BROWN
BROWN
WHITE-BLACK
WHITE-BROWN
WHITE-BROWN
WHITE-RED-BLUE
NO. 14
NO. 12
B TO A
C TO B
J463
J461
J462
GAIN CONTROL
OSC OUTPUT
OSC OUTPUT
V-212 CATHODES
VOLTS AC
J-99/CRD-3
JUNCTION BOX
NO. 17
NO. 18
ORANGE-BLACK
CX-465/CRD-3
GREEN-YELLOW
CX-549/CRD-3
J404
14B
J403
15B
PP-151/CRD-3
AMPLIFIER-RECTIFIER
POWER UNIT
7B
J405
12B
J401
11B
J402
WHITE-BLUE-ORANGE
CX-551/CRD-3
RED-BLACK
CX-552/CRD-3
GREEN-BLUE
CX-550/CRD-3
A-WHITE-BLACK
B-WHITE-ORANGE
NO. 11
-BLACK
ON WHITE
ON WHITE

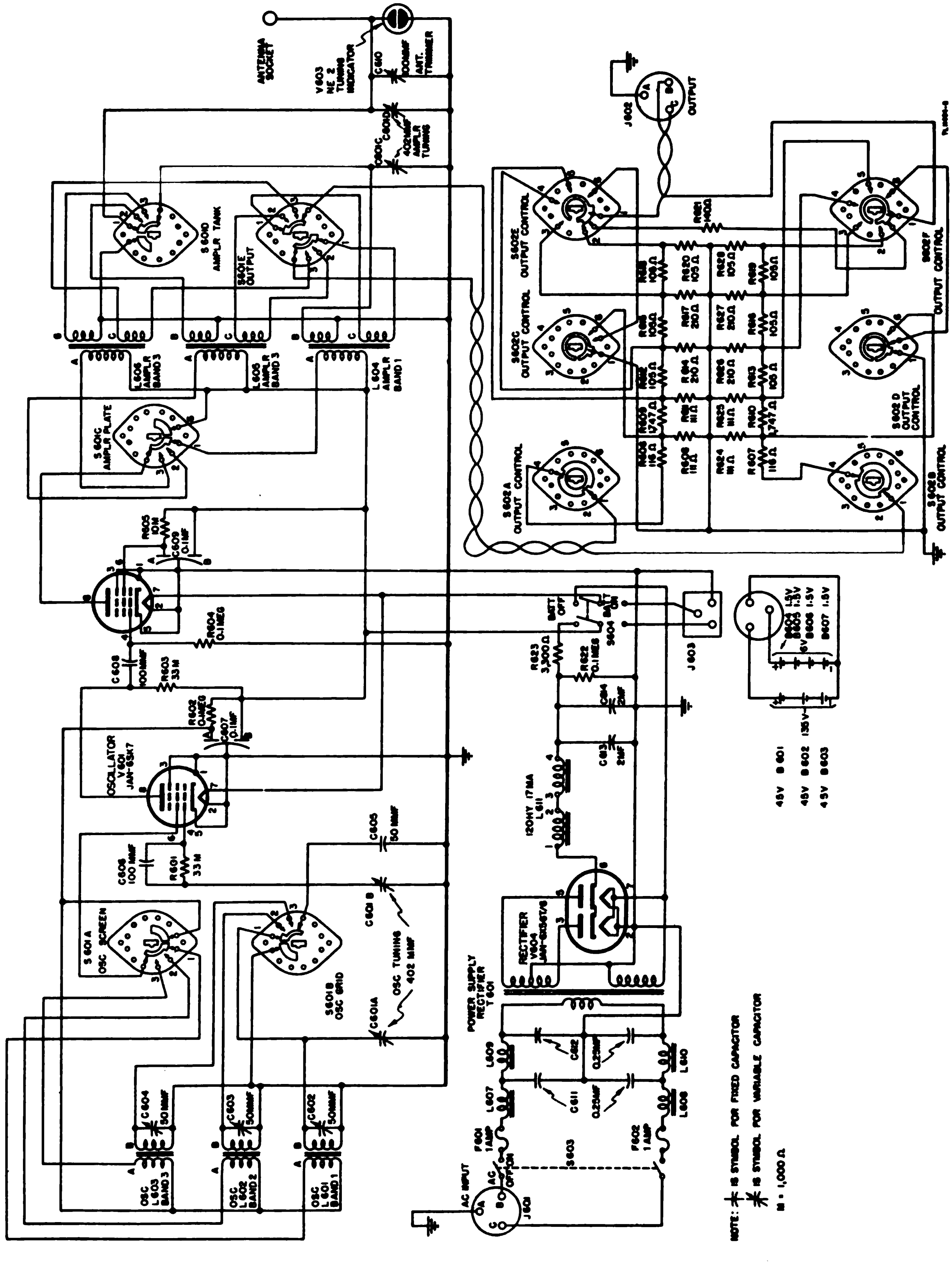

Figure 162. Schematic diagram of OAN test oscillator.

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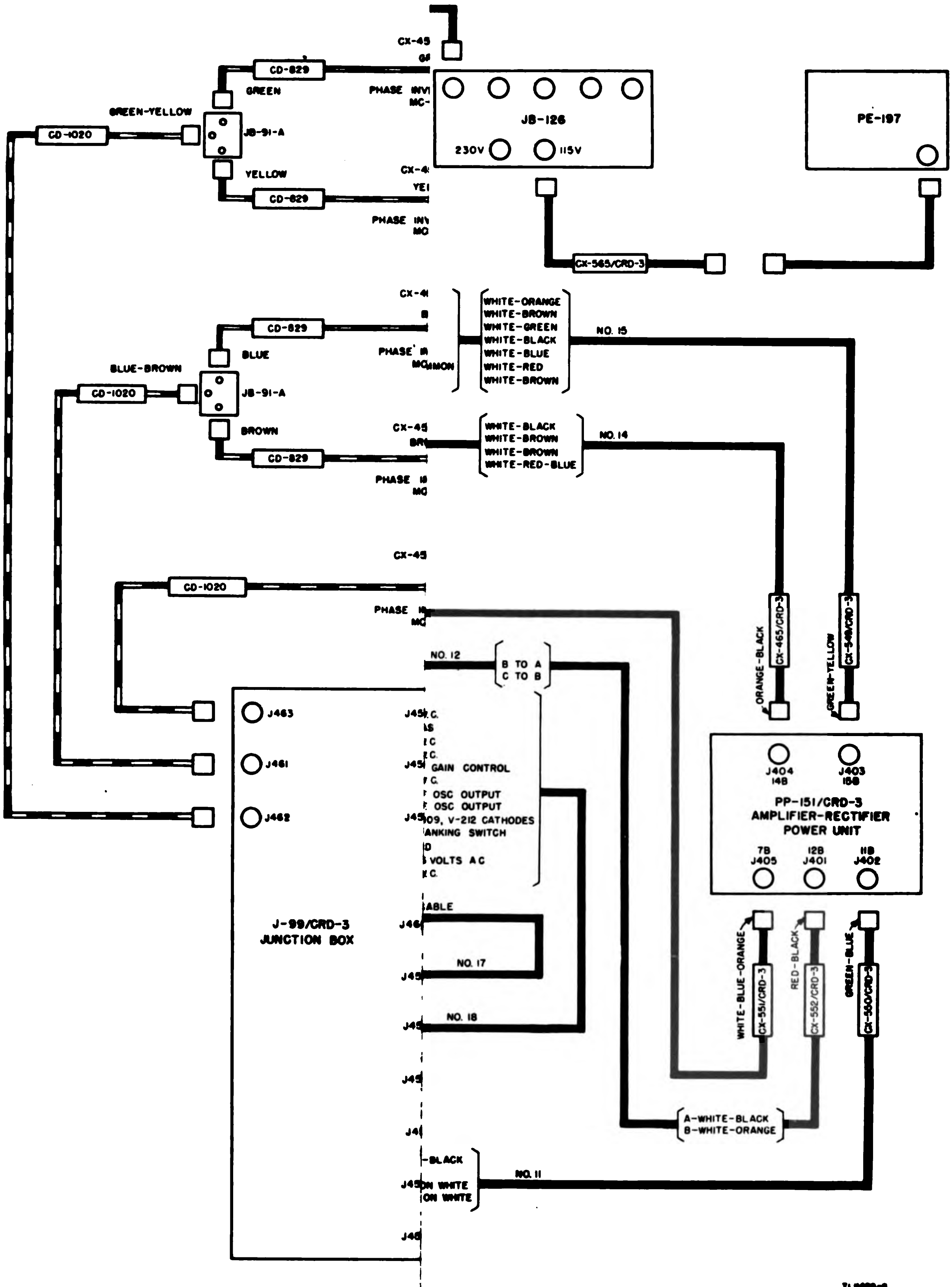

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