TM 11-243

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADIO SET SCR-291-A

DUPLICATE COPY

DEPARTMENT OF THE ARMY • SEPTEMBER 1949

TECHNICAL MANUAL

RADIO SET SCR-291-A

CHANGES No. 1

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *9 October 1950*

TM 11-243, 1 September 1949, is changed as follows:

37. Phase Inverter Installation

*   *   *   *   *   *   *

c. (Added.) WEATHERPROOFING. After the installation is completed, all cable connectors should be carefully tightened. When the complete set has been checked and found in good working order, all connector-receptacle assemblies exposed to the weather should be weatherproofed. Material from Moisture & Fungus Proofing Equipment MK-2/GSM (as specified in JAN-C-173) should be applied according to TB SIG 13. The moistureproofing and fungiproofing kit is available under Air Force stock No. 7300-046760, Signal Corps stock No. 6Z6609-2. The feed-through insulator (fig. 5) should be carefully moistureproofed. Moistureproofing and fungiproofing varnish, Signal Corps stock No. 6G1005.3, may be used to paint connector-receptacle assemblies for weatherproofing.

39. Cording

d. (Added.) WEATHERPROOFING. After the cords have been connected to their respective receptacles and the set tried for proper operation, the connector-receptacle assemblies that are exposed to the weather should be weatherproofed and moistureproofed. Applicable portions of TB SIG 13 should be carefully followed. Material may be taken from Moisture & Fungus Proofing Equipment MK-2/GSM, Air Force stock No. 7300-046760, Signal Corps stock No. 6Z6609-2, may be used for these treatments. Applicable weatherproofing and fungiproofing materials are made under JAN-C-173 specifications.

93. Bushings and Insulators

*   *   *   *   *   *   *

e. (Added.) WEATHERPROOFING. Weatherproof all connector-receptacle assemblies that are exposed to the weather. Moistureproofing of the bakelite feedthrough insulators on Phase Inverters MC-411-A should be carefully done. Use material from Moisture & Fungus Proofing Equipment MK-2/GSM, Air Force stock No. 7300-046760, Signal Corps stock No. 6Z6609-2, and follow applicable portions of TB SIG 13.

100. Cords and Cables

*   *   *   *   *   *   *

d. (Added.) WEATHERPROOFING. Weatherproof all connector-receptacle assemblies according to the instructions given and referred to in paragraphs 37*c*, 39*d*, 93*e*, and applicable portions of TB SIG 13.

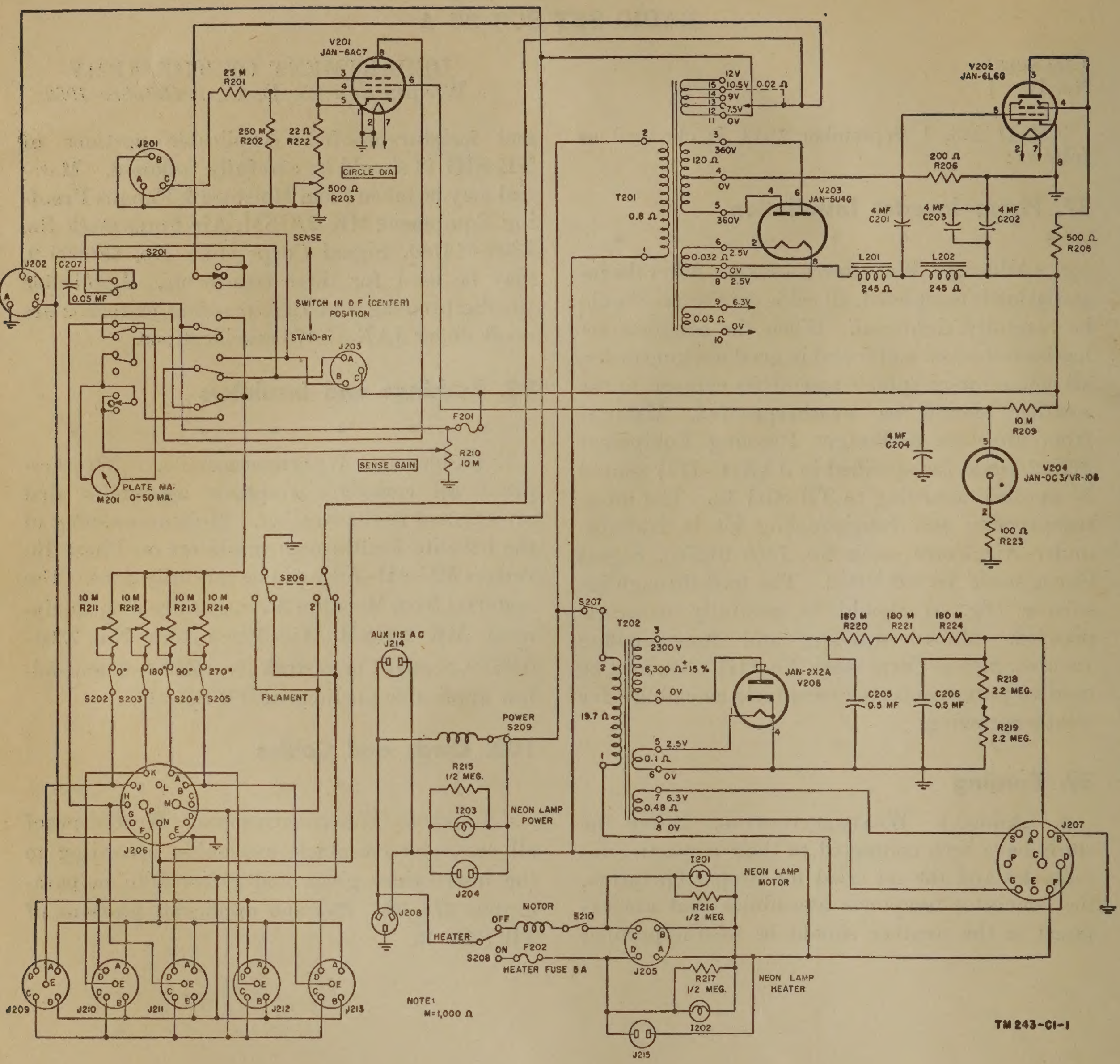


Figure 150. (Superseded.) Control Panel PN-31-A, schematic diagram

APPENDIX II

FIXED ANTENNA EQUIPMENT RC–301

*   *   *   *   *   *   *

7. Operation

*   *   *   *   *   *   *

c. (Added.) Multiple operation is not generally recommended, except as an expedient where space limitations prevent the use of additional antenna systems. When two equipments are operated from the same antenna, steps should be taken to prevent the grounding of the antenna elements through the plate circuit relay in Phase Inverters MC–411–A. The grounding of the antenna elements occurs when the plate current of any one of the phase inverters is switched off by the individual phase inverter switches or when the STAND-BY-D.F.-SENSE switch on Control Panel PN–31–A is in the STAND-BY position. Therefore, to prevent the grounding out of the antenna elements, it is necessary to keep the plate current to all phase inverters continuously on or to remove the plate current relays. If the latter procedure is adopted, it will be necessary to provide an external ground to the unused antennas during those periods when the antenna system is being balanced. The bearing accuracy of this radio set is largely dependent on the balance of the antenna system. It is, therefore, necessary that considerable care be taken to maintain this balance at a high value, since any unbalance due to faulty phase inverters or cables of one radio set will influence the operation of the other radio sets connected to the common antenna equipment.

[AG 413.44 (25 Sep 50)]

BY ORDER OF THE SECRETARY OF THE ARMY:

OFFICIAL:
EDWARD F. WITSELL
Major General, USA
The Adjutant General

J. LAWTON COLLINS
Chief or Staff,
United States Army

DISTRIBUTION:

Tech Svc (2) except 11 (50); Arm & Svc Bd (1); AFF Bd (ea Svc Test Sec) (1); AFF (5); OS Maj Comd (5); Base Comd (3); MDW (5); A (20); CHQ (2); FC (2); USMA (5); Sch (2) except 11 (10); Gen Dep (2); Dep 11 (5); Tng Div (2); PE (10), OSD (2); Lab 11 (2); 4th & 5th Ech Maint Shops 11 (2); Two (2) copies to each of the following T/O & E's: 11–47; 11–107; 11–127; 11–587; 11–592; 11–597; SPECIAL DISTRIBUTION.

For explanation of distribution formula see SR 310–90–1

U. S. GOVERNMENT PRINTING OFFICE: 1950

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

TM 11-243

This manual supersedes TM 11-243, 24 March 1944; TB 11-243-1, 26 May 1944; TB 11-243-2, 15 October 1944; TB 11-243-3, 14 August 1947; and TB 11-243-4, 16 March 1948

RADIO SET SCR-291-A

DEPARTMENT OF THE ARMY SEPTEMBER 1949

United States Government Printing Office
Washington: 1949

DEPARTMENT OF THE ARMY
WASHINGTON 25, D. C., *1 September 1949*

TM 11-243, Radio Set SCR-291-A, is published for the information and guidance of all concerned.

[AG 300.7 (17 Jun 46)]

BY ORDER OF THE SECRETARY OF THE ARMY:

OFFICIAL:
EDWARD F. WITSELL
Major General
The Adjutant General

J. LAWTON COLLINS
Chief of Staff, United States Army

DISTRIBUTION:

Army:

Tech Sv (2) Arm & Sv Bd (1); AFF Bd (ea Sv Test Sec) (1); AFF (5); OS Maj Comd (5); Base Comd (3); MDW (5); A (ZI) (20), (Overseas) (5); CHQ (2); FC (2); USMA (2); Sch (2) except 11 (10); Gen Dep (10); Dep 11 (5) except Baltimore & Sacramento (20); Tng Div (2); PE (10); OSD (2); Lab 11 (2); 4th & 5th Ech Maint Shops 11 (2); T/O & E 11-47 (2); 11-107 (2); 11-127 (2); 11-587 (2); 11-592 (2); 11-597 (2); SPECIAL DISTRIBUTION.

Air Force:

USAF (5); USAF Maj Comd (5); USAF Sub Comd (3); Services (MATS) (2); Class III Instls (2); SPECIAL DISTRIBUTION.

For explanation of distribution formula, see SR 310-90-1.

CONTENTS

WARNING

HIGH VOLTAGE

is used in the operation of
this equipment.

DEATH ON CONTACT

may result if operating personnel
fail to observe safety precautions.

DEMOLITION TO PREVENT ENEMY USE

WHY— To prevent the enemy from using or salvaging this equipment.

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—Racks, panels, tubes, shelters, power units, receiver, indicator.
2. Cut—Cords, cables, antenna wires.
3. Burn—Shelters, cables, plywood masts.
4. Bend—Antenna masts, frames.
5. Bury or scatter—Everything possible.

DESTROY EVERYTHING

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:

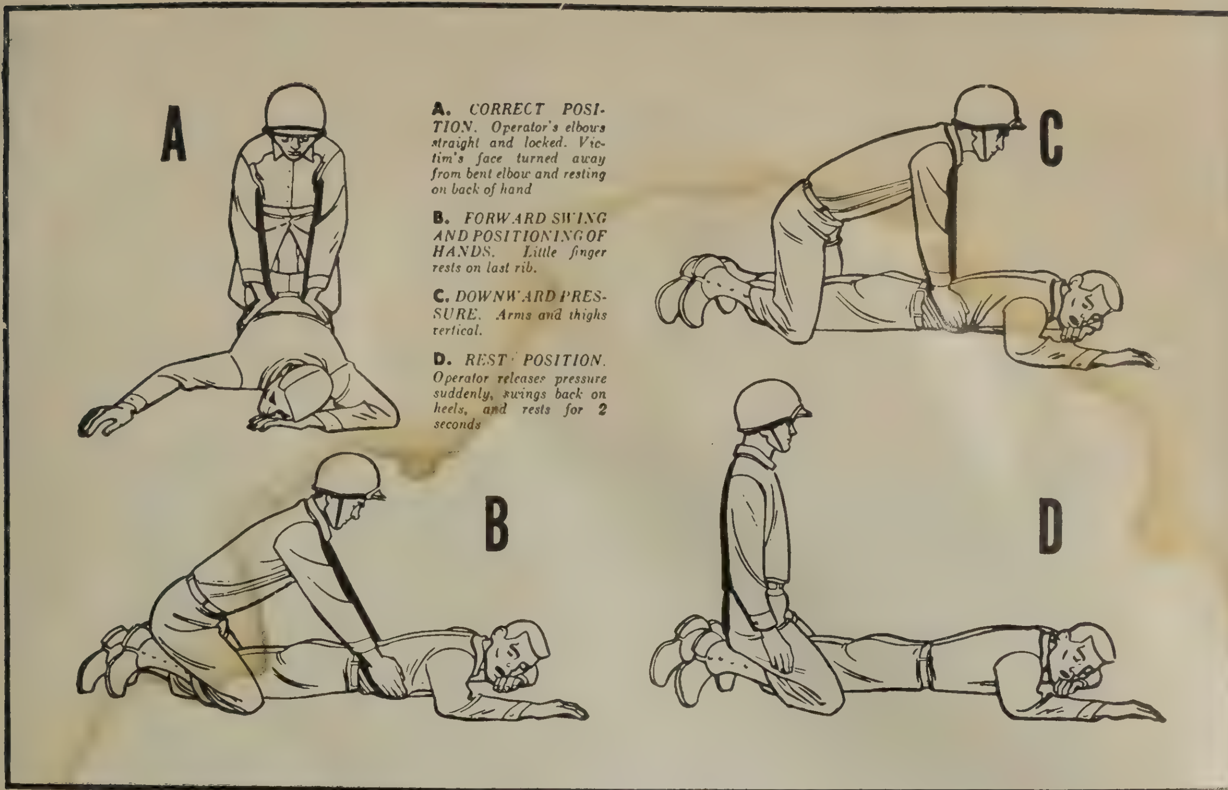
(*1*) Exert downward pressure, not exceeding 60 pounds, for 1 second.

(*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

TL15338-D



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.*

TL15338-E

Figure 1. Radio Set SCR-291-A.

This manual supersedes TM 11–243, 24 March 1944; TB 11–243–1, 26 May 1944; TB 11–243–2, 15 October 1944; TB 11–243–3, 14 August 1947; and TB 11–243–4, 16 March 1948.

CHAPTER 1
INTRODUCTION

Section I. DESCRIPTION

1. General

a. APPLICATION. Radio Set SCR–291–A (Direction Finding) is a semiportable, visual-indicator type of ground station radio direction finder (fig. 1). Azimuth bearings can be taken on any type of radio transmission within the r-f (radio-frequency) ranges of the radio set. For direction finding the normal frequency range is from 2 to 10 mc (megacycles), but the range can be extended to 20 mc. Simultaneous bearing indications and audio monitoring signals are available over the D/F (direction finding) range; any transmission within the 1.5- to 30-mc range of the receiver can be monitored. The bearing indicator, radio receiver, control panel, and telephone panel are installed in a prefabricated shelter (fig. 2). Bearing indications are continuously and automatically traced on the screen of a 5-inch cathode-ray tube in the indicator, and bearings can be taken as rapidly as the superheterodyne receiver can be tuned to various transmitters. The antenna system is composed of crossed U-Adcock antennas and a vertical sense antenna. The necessity for rotating the antenna system is eliminated by a motor-driven goniometer which produces electrically the equivalent of mechanically rotating the antenna. The radio set will operate on any suitable 115/230-volt, single-phase, 60-cycle, a-c (alternating-current) power source that will furnish 1.5 kw (kilowatts). Usually, a gasoline-driven generator is used as the power source.

b. BLOCK DIAGRAM (fig. 3). The antenna array portion of the block diagram is a plan view of the U-Adcock antennas, the sense antenna, the interconnecting cables, and the

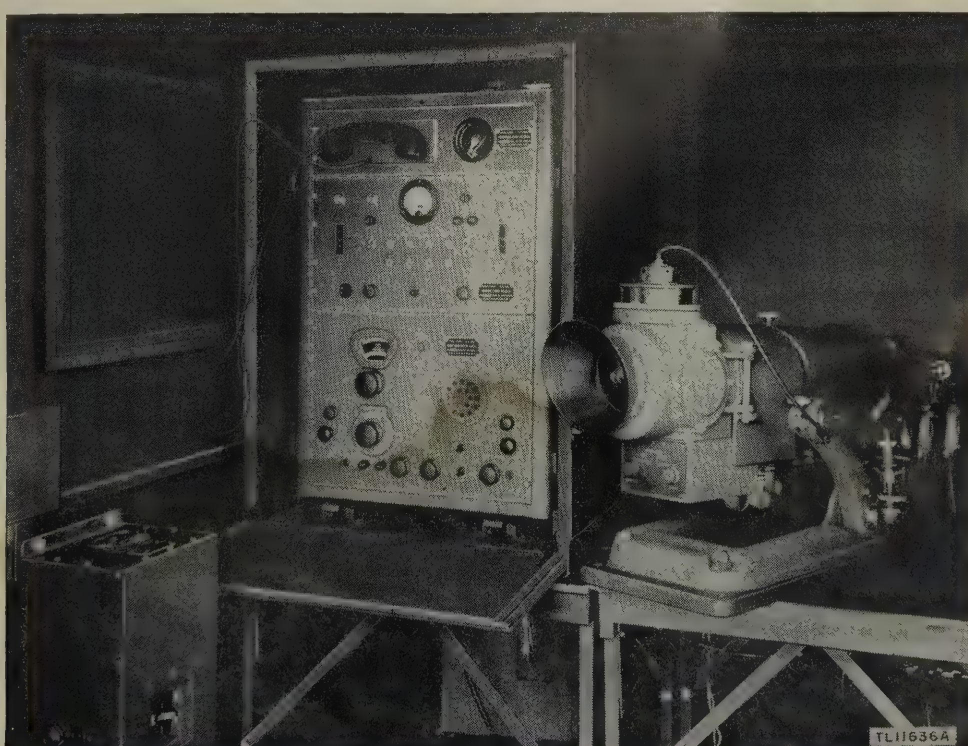


Figure 2. Radio Set SCR–291–A, receiver, control panels, and indicator.

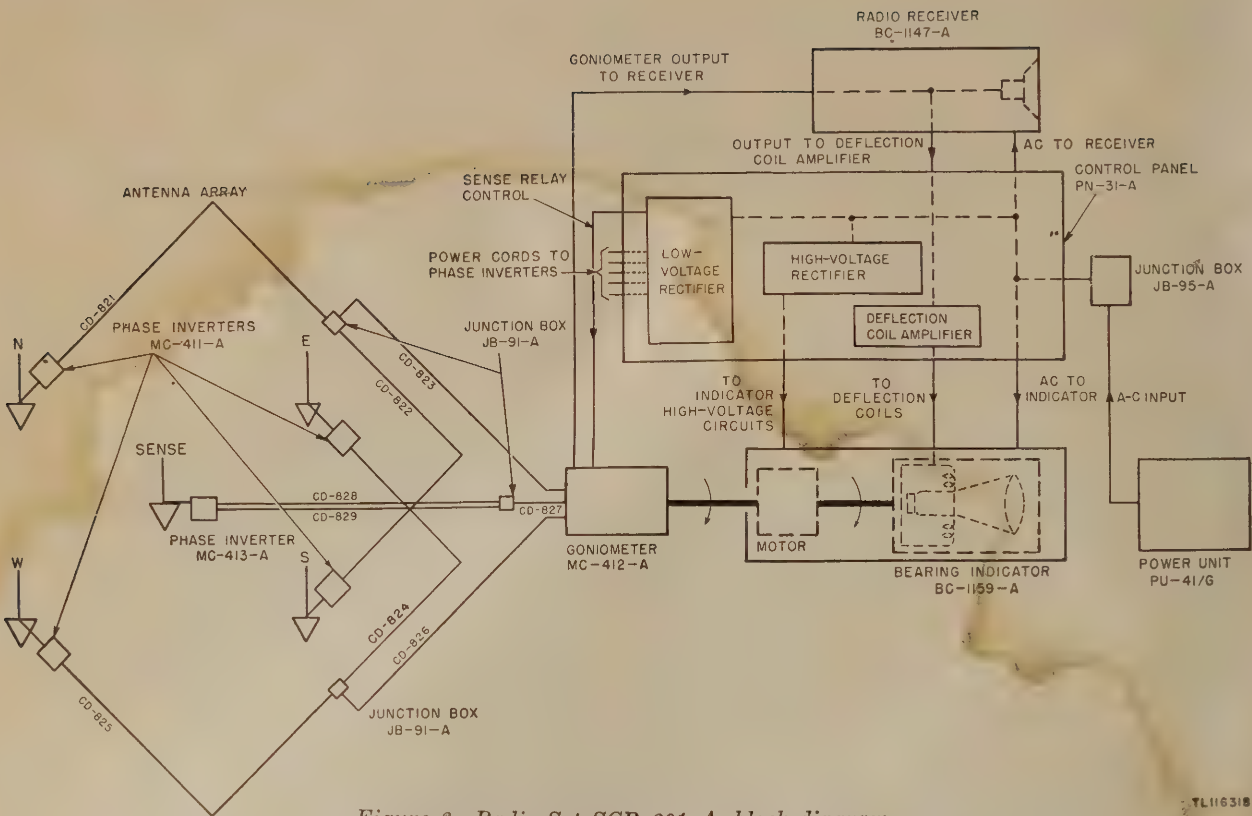


Figure 3. Radio Set SCR-291-A, block diagram.

junction boxes in the antenna system. The output signal from the antenna system to the goniometer is a function of the direction from which the received signal arrives at the antenna. The instantaneous signal from the goniometer to the receiver is a function of the received signal and the position of the rotating coil of the goniometer. The goniometer output signal is amplified in Radio Receiver BC–1147–A and then passed simultaneously through the monitor and indicator channels. The indicator channel signal is amplified by the deflection amplifier in Control Panel PN–31–A and then applied to deflection coils that rotate about the cathode-ray tube in Bearing Indicator BC–1159–A. The phasing of the system is properly adjusted to produce on the screen of the cathode-ray tube an indication of the direction from which the antenna signal arrived. Power for the receiver, the bearing indicator, and the phase inverters is obtained from a gasoline-driven power unit. The control panel is a distribution point for the power supply.

c. Explanation of Symbol. Basic nomenclature followed by ( ) with no number or symbol in the parentheses is used in this manual to make general reference to all models of the equipment, regardless of their procurement.

2. Technical Characteristics

Frequency ranges:

- Direction finding . . . Normal, 2 to 10 mc; special, 2 to 20 mc.
- Monitoring . . . . 1.5 to 30 mc.

Sensitivity . . . . 5 to 10 microvolts per meter, for bearing indications readable to 2°.

Types of signals:

- Direction finding . . . Any r-f transmission within the frequency range.
- Monitoring (loudspeaker or headphones) . . Any c-w (continuous-wave), a-m (amplitude-modulated), or f-m (frequency-modulated) signal within the frequency range.

Antenna system........Two stationary, crossed U-Adcock antennas and a vertical sense antenna; phase inverters provide correct phasing.

Bearing indications....Visual, traced on cathode-ray tube in Bearing Indicator BC–1159–A.

Selectivity ....Sharp or broad, according to position of SELECTIVITY switch. Band widths are given in chapter 4.

Number of tubes.......31.

Power output:

To loudspeaker....1.5 watts.

Power input ....1.5 kva (kilovolt-amperes), at 115- or 230-volt, single-phase, 60-cycle ac.

3. Table of Components

The following table lists the required number (including spares), the unpacked dimensions, the volume, and the weight of each major component in Radio Set SCR–291–A. For information on repacking the radio set into 23 chests and crates, refer to paragraph 40.

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

Component	Required No.*	Unpacked dimensions (in. over-all)				Vol (cu ft)	Weight (lb)
		Height	Width	Depth	Length		
Antenna Equipment RC–223–A (telescoped)	7	--------	--------	9 (diam)	108	4	100 (approx)
Bearing Indicator BC–1159–A (with Goniometer MC–412–A)	1	25	13	51¼	--------	7.2	20[illegible] (approx)
Chest CH–161–( )	1	37¾	29¼	28	--------	17.8	401†
Chest CH–162–( )	1	26¼	48	16	--------	11.7	225†
Chest CH–163–( )	1	20	37	20	--------	8.6	200†
Chest CH–164–( )	1	21½	113	22⅜	--------	31	413†
Chest CH–167–( )	1	19⅛	39⅛	16⅛	--------	7	185†
Chest CH–209–( )	1	14⅜	62⅛	19⅛	--------	9.8	246†
Chest CH–210–( )	1	19⅝	14	11¾	--------	1.9	100†
Chest, spare parts	1	--------	--------	--------	--------	--------	--------
Control Panel PN–31–A (fitted into Chest CH–161–A)	1	10⅜	19	15½	--------	1.7	--------
Counterpoise CP–17–A	5	--------	108	--------	108	--------	--------
Junction Box JB–91–A	5	1¾	2	4	--------	--------	--------
Junction Box JB–95–A‡	1	17	10	8	--------	0.8	--------
Phase Inverter MC–411–A	5	--------	--------	7¼ (diam)	12¾	0.3	--------
Phase Inverter MC–413–A	2	--------	--------	7¼ (diam)	12¾	0.3	--------
Power Unit PU–41/G	2	37	17	36	--------	13.1	497
Rack FM–61–A (fitted into Chest CH–161–A)	1	31⅞	23	22	--------	--------	--------
Radio Receiver BC–1147–A (fitted into Chest CH–161–A)	1	14	19	19¼	--------	2.9	--------
Radio Transmitter BC–1149–A (less tripod)	1	7¼	7¼	12¼	--------	0.34	--------
Reel DR–10–( ) (with cords)	4	--------	--------	27¼	18¾	10.8	250 (approx)
Reel Unit RL–49–A (in carrying crate)	1	12	39⅝	29	--------	8	94
Shelter HO–19–A (assembled)	1	54	65	44	--------	--------	--------
Shelter HO–20–A (assembled)	1	72	66	108	--------	--------	--------
Telephone Panel PN–32–A	1	5$\frac{3}{16}$	19	10¼	--------	0.6	--------
Technical manual	2	8	10½	--------	--------	--------	--------

* Including spares issued with radio set.
† Including contents.
‡ Or Junction Box JB–126.
Note. Bearing Indicator Kit MC–551 (appendix I) and Fixed Antenna Equipment RC–301 (appendix II) are components of some Radio Sets SCR–291–A.

4. Packaging Data

The export shipping weights and dimensions of Radio Set SCR–291–A are given in the table below; typical packaging is shown in figures 18 through 32.

Component	Height (in.)	Depth (in.)	Length (in.)	Vol (cu ft)	Weight* (lb)
Radio Receiver BC–1147–A	17	23	29	6.56	100
Control Panel PN–31–A	16	23	27	5.7	100
Chest CH–161–A (less receiver and control panel)	40	34	32	25.1	400
Chest CH–162–A (and contents)	30	22	55	21	275
Chest CH–163–A (and contents)	25	25	45	16.3	200
Chest CH–164–A (and contents)	24	27	118	43.0	413
Chest CH–167–A (and contents)	23	20	45	12.6	185
Spare parts chest (and contents)	20	28	45	14.6	250
Chest CH–209–A (and contents)	18	22	65	14.9	275
Chest CH–210–A (and contents)	17	24	19	4.5	100
Reels DR–10–( ) (and cables)	20	30	30	1.1	275
Reel Unit RL–49–A	15	32	44	12.2	125
Antenna Equipment RC–223–A (crate for two)	25	23	117	38.4	400
Antenna Equipment RC–223–A (crate for three)	25	30	117	50	550
Gasoline heater (crated)	28	26	100	42.0	400
Fire extinguishers**					

* Estimated.
** Packaging varies with procurement.

5. Antenna System (fig. 4)

Note. For information on Fixed Antenna Equipment RC–301 refer to appendix II.

a. GENERAL. The antenna system of Radio Set SCR–291–A includes five Antenna Equipments RC–223–A, four Phase Inverters MC–411–A, one Phase Inverter MC–413–A, and five Counterpoises CP–17–A. Twin coaxial r-f transmission lines and three Junction Boxes JB–91–A interconnect the r-f circuits of the antenna system and feed the antenna output to Goniometer MC–412–A on Bearing Indicator BC–1159–A. Separate power cords carry plate and filament voltages to the phase inverters in the system. The antenna components are described below.

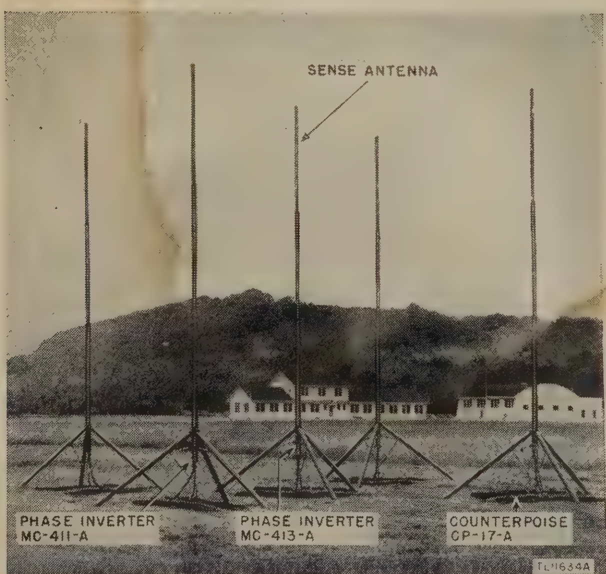


Figure 4. Antenna Equipments RC–223–A in operating positions.

b. ANTENNA EQUIPMENT RC–223–A. Antenna Equipment RC–223–A consists of a single-wire vertical antenna (monopole) and a supporting tripod. The vertical wire is supported within a 24-foot, 3-section, telescoping mast of plywood tubing. The vertical mast is mounted on a tripod formed of three 8-foot leg pieces of plywood tubing. A monopole is placed at each corner of a 25-foot square, and a fifth monopole is positioned at the intersection of the diagonals of the square. Each diagonally opposite pair of monopoles forms a single U-Adcock type of D/F antenna; thus, the four corner monopoles make up a crossed U-Adcock D/F antenna and the fifth monopole is the sense antenna. A turnbuckle arrangement on each tripod enables adjustment of the tripod height above the ground. Each monopole assembly weighs about

100 pounds and is anchored by means of chains and turnbuckles on the tripod and a corkscrew type of anchor in the ground.

c. PHASE INVERTERS MC–411–A AND MC–413–A. (fig. 5). Phase Inverters MC–411–A and MC–413–A are antenna coupling units. Phase Inverters MC–411–A are used with the D/F (corner) antennas, and Phase Inverter MC–413–A is used with the sense antenna. Externally, the phase inverters are the same, except that three cable connectors are fitted to the base of Phase Inverter MC–413–A and only two cable connectors are attached to Phase Inverter MC–411–A. The case of each phase inverter is a 7¼- by 12¾-inch aluminum casting. A plug-in type of r-f unit fits a terminal board on the cover, or base which is clamped to the casting by wingnuts. When the r-f unit is inserted into the terminal board, connections are automatically made to the r-f and power circuits. When the unit is inserted into the casting, connections are made by means of a feed-through insulator to a banana plug at the antenna end of the casting. Studs on the antenna end of the casting fit into slots on the antenna base and hold the phase inverter to the bottom of the antenna mast (fig. 4). Phase Inverter MC–411–A contains a single antenna coupling circuit with two tubes connected in parallel. However, a switching arrangement (operated from Control Panel PN–31–A) enables application of filament voltage to either tube, so that the second tube acts as a spare that can be switched into the circuit immediately if the tube

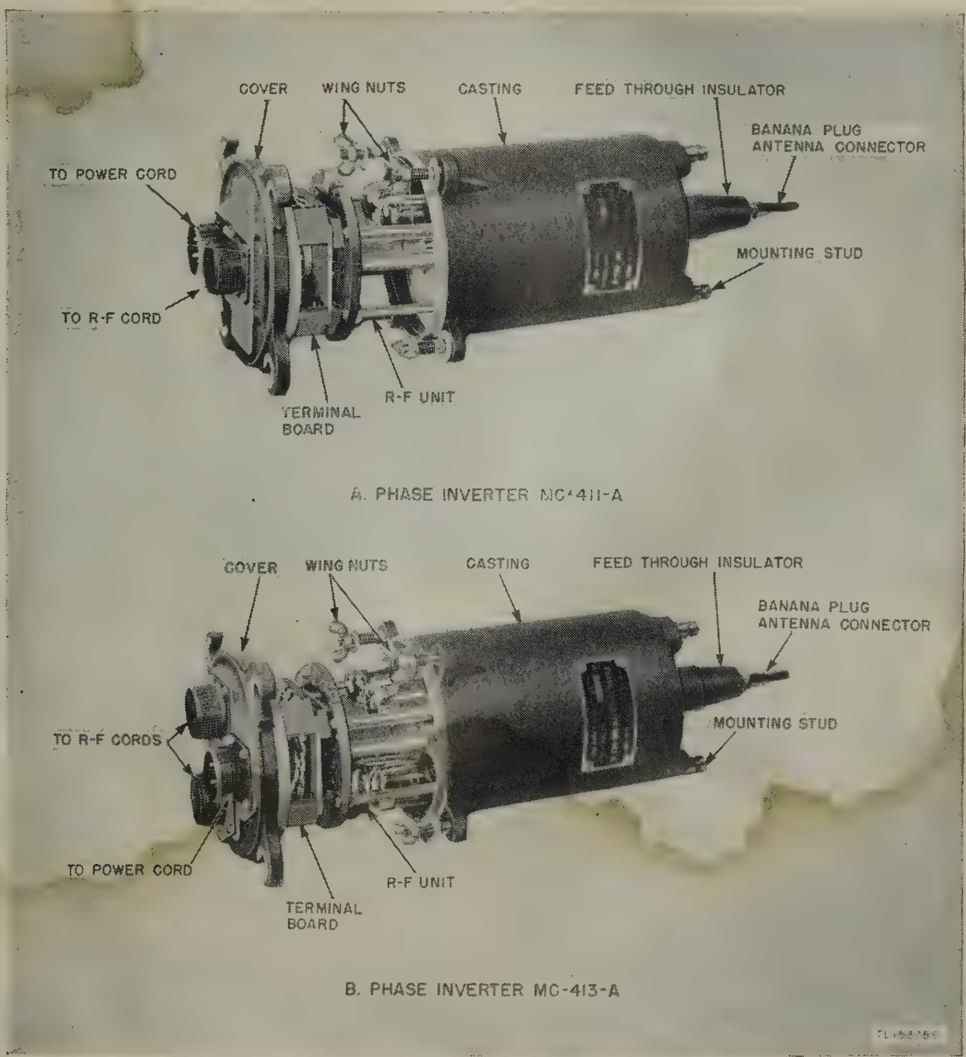


Figure 5. Phase Inverters MC–411–A and MC–413–A.

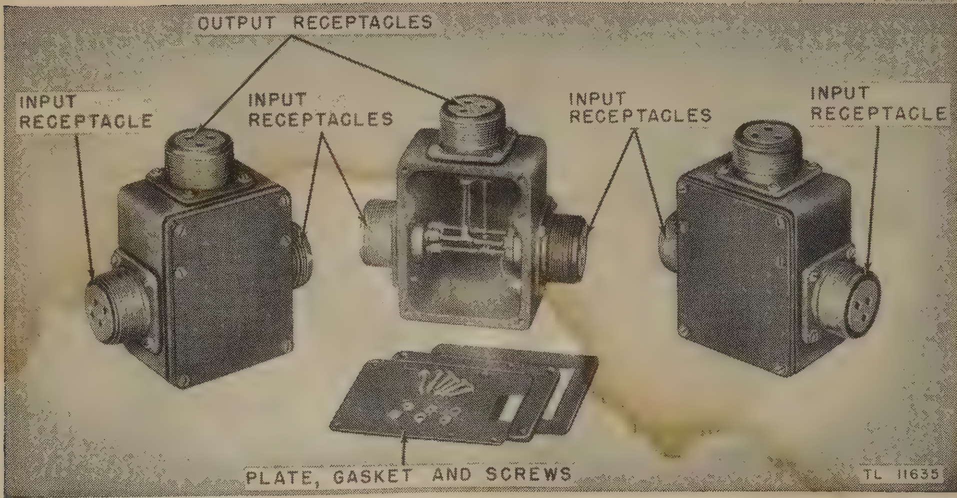


Figure 6. Junction Box JB–91–A.

in use should burn out. A plate circuit relay grounds the antenna when the plate voltage is turned off. Phase Inverter MC–413–A contains two complete coupling circuits like that in Phase Inverter MC–411–A. The inputs of the two circuits are connected in parallel to the lower end of the sense antenna, but the outputs are fed to separate transmission lines.

d. COUNTERPOISE CP–17–A (fig. 62). Counterpoise CP–17–A is composed of two 4- by 9-foot sections of 20-mesh copper screening. The 4-foot ends of the screening are reinforced by 4½-foot wooden end rails. The two sections are spread 1 foot apart beneath each antenna mast and form a 9- by 9-foot counterpoise which is connected to the phase inverter at the bottom of the mast.

e. CORDS.

(1) *R-f Cords CD–820, CD–828, and CD–829.* Cords CD–820, CD–828, and CD–829 are flexible, twin-coaxial, r-f transmission lines. Each r-f line is composed of a length of Cord RG–23/U and suitable cable connectors. Color coding indicates the points between which each cord should be connected (par. 39). Cords CD–820 are 80 feet long, Cord CD–828 is 68 feet long, and Cord CD–829 is 92 feet long. Seven Cords CD–820 are used in Radio Set SCR–291–A.

(2) *Power Cord CD–831.* Cord CD–831 is a five-conductor, shielded, vinylite-covered, 160-foot power cable with a connector at each end. Five Cords CD–831 are used to carry power from Control Panel PN–31–A to the phase inverter coupling units. Each cord is color-coded to indicate the points between which it should be connected.

f. JUNCTION BOX JB–91–A (fig. 6). Junction Box JB–91–A is a 1¾- by 3 7/16- by 1⅞-inch bronze casting with three cable connector receptacles and internal interconnection wiring. A cover plate is held by six screws and lock-washers, and a rubber gasket keeps out moisture. Color-code markings adjacent to the cable receptacles correspond to the color coding of the cable that should be connected to each receptacle (par. 39).

g. JUNCTION BOX JB–95–A (fig. 17). This junction box is used to interconnect the power unit and the radio set. It is a sheet steel unit about 17 inches high, 10 inches wide, and 8 inches deep and contains a 115/230-volt, 50-60-cycle autotransformer. A circuit breaker is mounted on the front panel. Twin, polarized 115-volt receptacles are on the right side, two single a-c receptacles are on the other side, and two waterproof receptacles are at the bottom of the unit.

6. Goniometer MC–412–A (fig. 7)

Knurled thumbscrews are used to attach Goniometer MC–412–A to the rear of Bearing Indi-

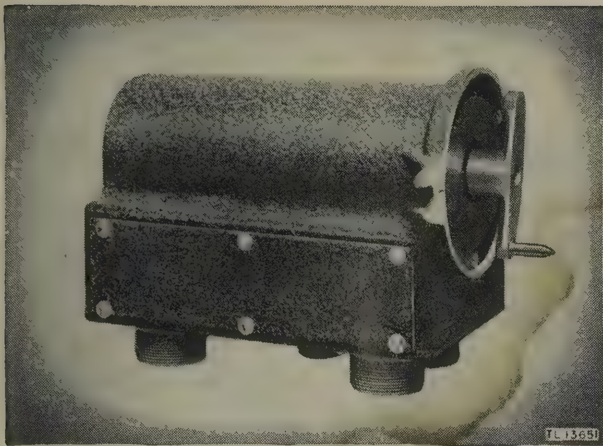


Figure 7. Goniometer MC–412–A.

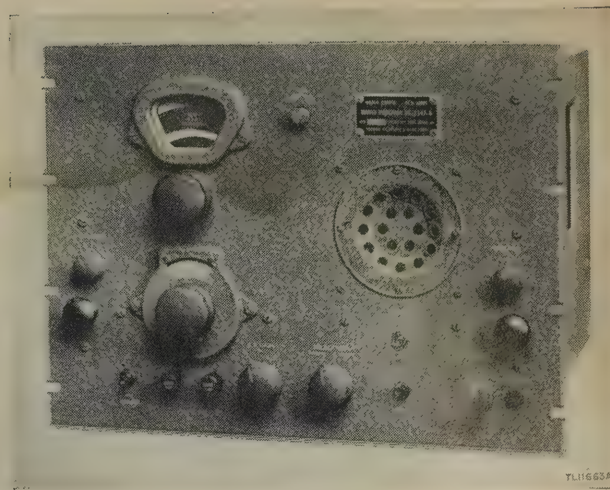


Figure 8. Radio Receiver BC–1147–A.

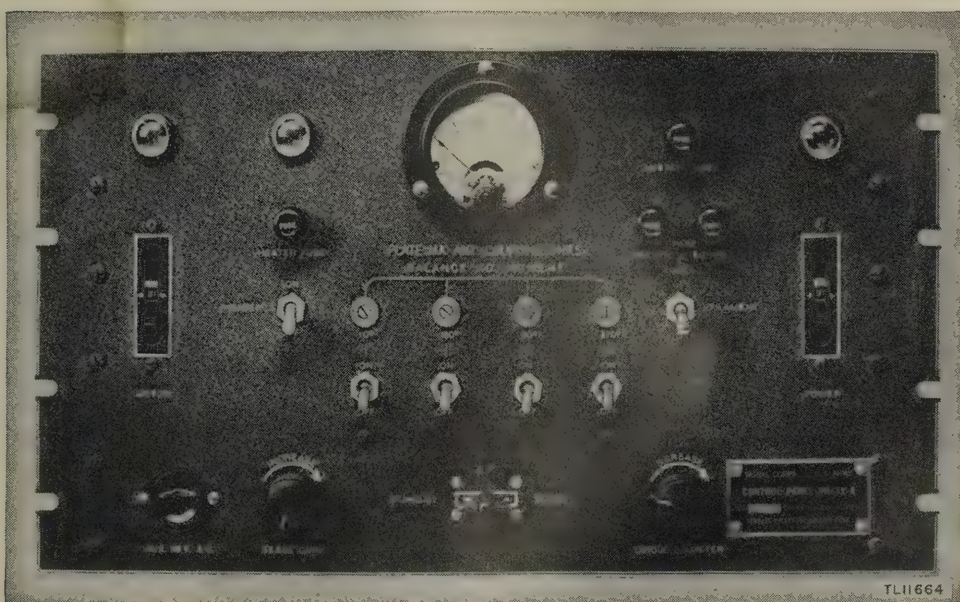


Figure 9. Control Panel PN–31–A.

cator BC–1159–A. The component parts of the goniometer are mounted in a 4½- by 5½- by 7½-inch aluminum casting which has a scratch-proof, gray enamel finish. Four sockets for r-f cords and one socket for the goniometer relay cord are fitted to the casting. The goniometer rotor is driven by the motor in Bearing Indicator BC–1159–A.

7. Radio Receiver BC–1147–A (fig.8)

Radio Receiver BC–1147–A is a 4-band, 13-tube, superheterodyne receiver for use in D/F equipment. The dimensions of the receiver chassis are 19 by 14 by 19½ inches, and the 3/16-inch, gray enamel finish front panel is 19 inches long and 14 inches wide. Cable connections to the receiver are made through sockets at the rear of the chassis, and the a-c power cord is brought out through the rear of the receiver. The front panel controls are described and explained in paragraph 56. The receiver is mounted in Rack FM–61–A (figs. 2 and 52).

8. Control Panel PN–31–A (fig. 9)

Control Panel PN–31–A is mounted in Rack FM–61–A and forms a control center for Radio

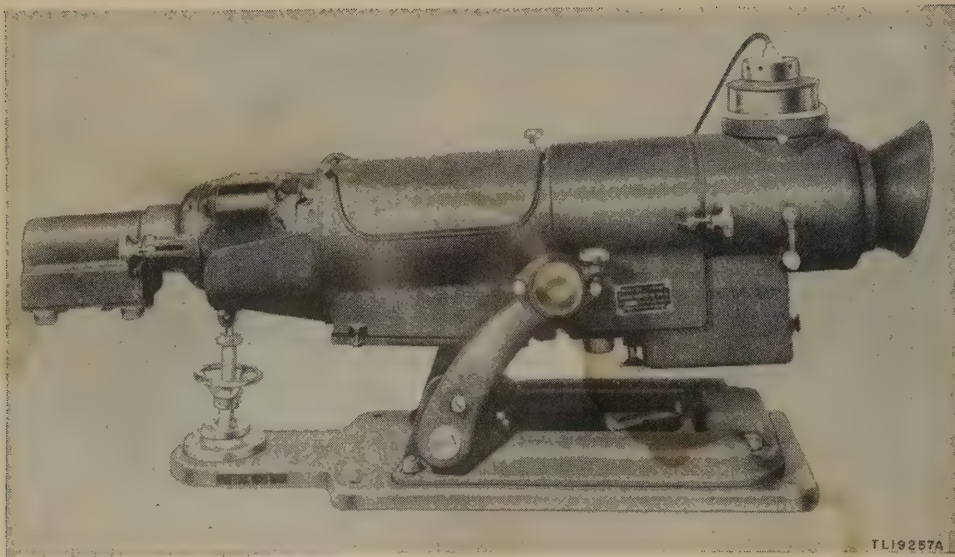


Figure 10. Bearing Indicator BC–1159–A.

Set SCR–291–A. The control panel includes a deflection coil amplifier, circuits to provide a-c and d-c (direct-current) voltages for the phase inverters and for Bearing Indicator BC–1159–A, and controls for the r-f and power supply circuits of the radio set. A steel front panel and a steel chassis form a single 19- by 10⅜- by 15½-inch unit on which the components are mounted. The front panel is finished to match the other units in Rack FM–61–A. Color-coded cable connector sockets are mounted on the rear of the chassis, and additional receptacles carry alternating current (115 volts) to the receiver and the heater lamp in Rack FM–61–A. An auxiliary 115-volt a-c outlet is on the front panel.

9. Telephone Panel PN–32–A (fig. 52)

Telephone Panel PN–32–A is a 19- by 5¾- by 10¼-inch unit which is mounted in Rack FM–61–A. Telephone EE–8–( ) and associated equipments are fastened to the telephone panel. The panel finish matches that of the other rack components. The telephone equipment is for intercommunication when the radio set is used in a D/F network.

10. Bearing Indicator BC–1159–A (fig. 10)

Note. For information on Bearing Indicator Kit MC–551, refer to appendix I. Bearing Indicator BC–1159–A contains the cathode-ray tube upon which bearing indications are traced. The bearing indicator also includes the optical and electrical components associated with the cathode-ray tube. The over-all dimensions of the indicator are 44 by 21½ by 13 inches, and the unit is finished to match the components in Rack FM–61–A. The indicator housing, mounting base, auxiliary parts, supporting arms, and brackets are aluminum castings. The adjustable side and the tilt regulator bear the weight of the cylindrical housing and enable positioning the indicator for convenient viewing of the scope patterns. Goniometer MC–412–A is mounted at the rear of the indicator. At the front of the indicator, the optical housing is fastened by a hinge at one side and a locknut at the other. With the locknut unfastened, the optical housing can be swung on the hinge to permit removal of the cathode-ray tube.

11. Shelter HO–20–( ) (fig. 11)

Shelter HO–20–( ) is a prefabricated, insulated, plywood house for the receiver, control panels, bearing indicator, and operators of Radio Set SCR–291–A. Disassembled, the component parts of Shelter HO–20–A are packed in five crates; the parts for Shelter HO–20–B are packed in two crates. Assembled, Shelter HO–20–( ) is approximately 5½ feet wide, 9 feet long, and 6 feet high. Instructions for erecting Shelters HO–20–A and HO–20–B are given in paragraphs 22 and 23, respectively.

12. Gasoline Heater

The gasoline heater (attached to Shelter HO–20–B (fig. 11)) is fully described in the instruc-

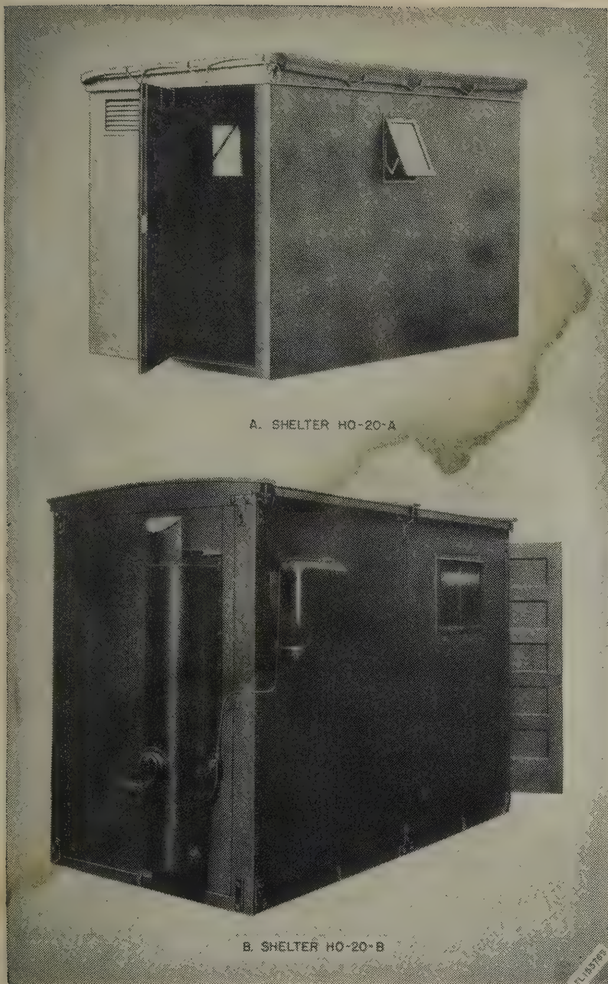


Figure 11. Shelters HO–20–A and HO–20–B.

tion book for that unit. The heater is used to maintain a comfortable working temperature within the shelter during cold weather.

13. Shelter HO–19–A (fig. 12)

Shelter HO–19–A is a prefabricated, plywood housing for the gasoline-driven power units used with Radio Set SCR–291–A. The shelter is approximately 65 inches long, 54 inches high, and 44 inches wide. Additional information is given in paragraph 27.

14. Power Units

Radio Set SCR–291–A can be operated from any 1.5-kw source of 115/220-volt single-phase, 60-cycle ac. The following gasoline-engine driven power units are suitable sources of power for the radio set:

a. Power Unit PU–41/G (fig. 13). This power unit (Kohler model 1M–21–A) is a manual-starting, 110-volt, single-phase, 60-cycle, 1,500-watt, a-c generator. The power unit is approximately 17 inches wide, 40 inches long, and 37 inches high. For detailed information on the power unit, refer to TM 11–935, 1½-KVA Kohler Power Unit Model 1M–21–A.

b. Power Unit PU–58/G. This power unit is a self-starting, 120/240-volts, 60-cycle, single-phase, a-c generator. The rated capacity of the power unit is 5 kw at unity power factor, and 6.25 kva at 80 percent power factor. The power unit is approximately 28¼ inches wide, 69¼ inches long, and 41 inches high. Refer to TM 11–980, Power Unit PU–58/G, for detailed information.

15. Cords CD–830 and CD–839 through CD–844

Cords CD–830 and CD–839 through CD–844 are flexible armored cables with a connecting plug on each end. The cords are used to interconnect components within Shelter HO–20–( ). Each cord plug is color-coded to indicate the receptacle to which it should be connected (par. 39).

16. Radio Transmitter BC–1149–A (Target)

Radio Transmitter BC–1149–A (Target) is a complete low-power transmitter with self-contained power supply. The transmitter can be mounted on a tripod (fig. 14) and easily moved around the D/F antenna array to provide test signals from any azimuth point. The transmitter consists of a four-band, vacuum-tube oscillator, a self-excited vacuum-tube interrupter, and a battery power supply. A welded steel chassis and front panel form a single unit upon which the component parts are mounted. The chassis and front panel fit into a welded, 7¼- by 7¼- by 12¼-inch steel cabinet. The transmitting antenna is made up of rod sections which fit antenna connectors at the top and bottom of the cabinet. During stormy weather a transparent vinylite rain cover is placed over the transmitter. With this rain cover in place, the controls are easily reached and the transmitter is protected from the weather. For detailed information on the target transmitter refer to TM

843134°—49—2

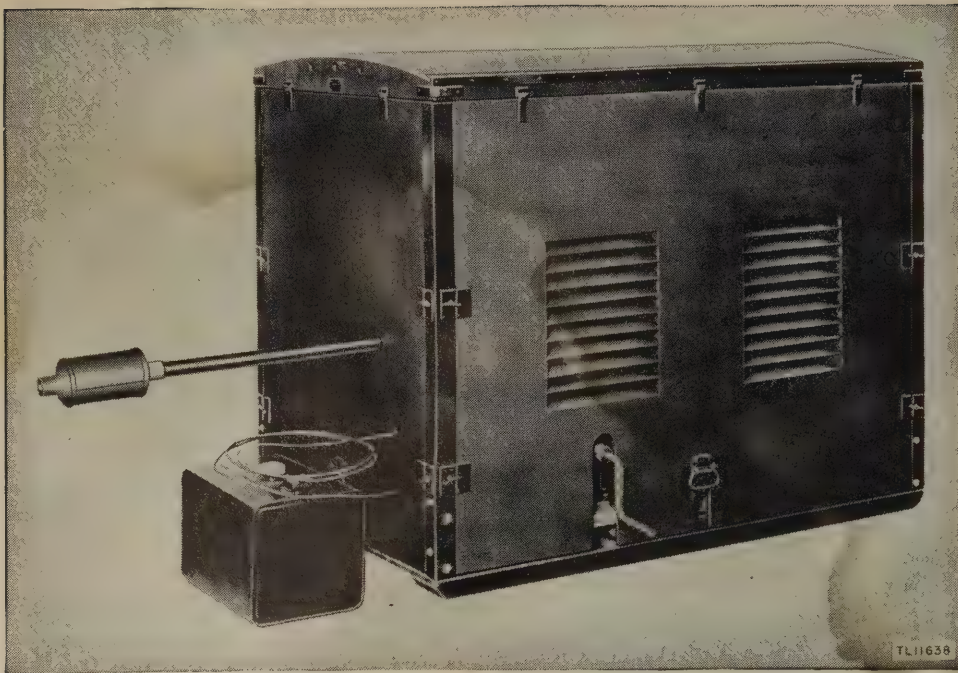


Figure 12. Shelter HO–19–A.

11–849, Radio Transmitter BC–1149–A, and TM 11–4040, Radio Transmitters BC–1149 and BC–1149–A (Target).

17. Tools and Test Equipment (fig. 15).

Tool Equipment TE–41–( ), set of wrenches, a steel tape, a spirit level, a blow torch, a demagnetizer, and several special tools are furnished with Radio Set SCR–291–A. Compass MC–324–( ) is used in laying out the antenna system. Signal Generator I–72–( ) and Voltohmmeter TS–337–( )/TND–1 (Weston model 564, type 3–C), or equal, are used for test and alinement of the D/F circuits.

18. Differences in Models

a. Bearing Indicator BC–1159–A.

(1) *Alidade.* Earlier models of Bearing Indicator BC–1159–A are not equipped with an alidade. An alidade kit is furnished, so that the alidade can be installed in the field. Instructions for installing it are given in Section III, Chapter 4. Later models of the bearing indicator have the alidade installed.

(2) *Glass mirror.* A cellulose acetate mirror is used in earlier models of the bearing indicator. In later models, the cellulose acetate mirror is replaced by a glass mirror, and a lamp dimmer adapter is included (Sec. III, Ch. 4).

(3) *Goniometer MC–412–A* (fig. 16). The early models of Goniometer MC–412–A have a drive arrangement different from the later models (fig. 7), and the rear bearing housing and locknut of the earlier models are not used in the later models.

b. Bearing Indicator Kit MC–551. For information on this kit, refer to appendix I.

c. Shelter HO–20–( ) (fig. 11).

(1) Shelter HO–20–A, packed in five crates, was furnished on some orders of Radio Set SCR–291–A. Refer to paragraph 22 for constructional details.

(2) Shelter HO–20–B is an improved shelter packed in two crates. Refer to paragraph 23 for constructional details.

d. Antenna Equipment RC–223–A. As originally furnished with Radio Set SCR–291–A, the monopole mast of Antenna Equipment RC–223–A is open at the top. A mast cap is now used to close the mast top and provide greater protection from the weather.

e. FIXED ANTENNA EQUIPMENT RC–301. For information on this equipment, refer to appendix II.

f. JUNCTION BOXES JB–95–A AND JB–126 (fig. 17). These junction boxes are alike except that Junction Box JB–126 has an additional polarized outlet receptacle on the right side. Junction Box JB–95–A was issued with earlier models of the radio set; Junction Box JB–126 is issued with later equipments.

g. CHESTS. In general, chests with the same nomenclature but with different issue letters are the same except for minor differences in dimensions and the arrangement of compartments. The various chests, reels, and crates are described and illustrated in paragraphs 40 through 55.

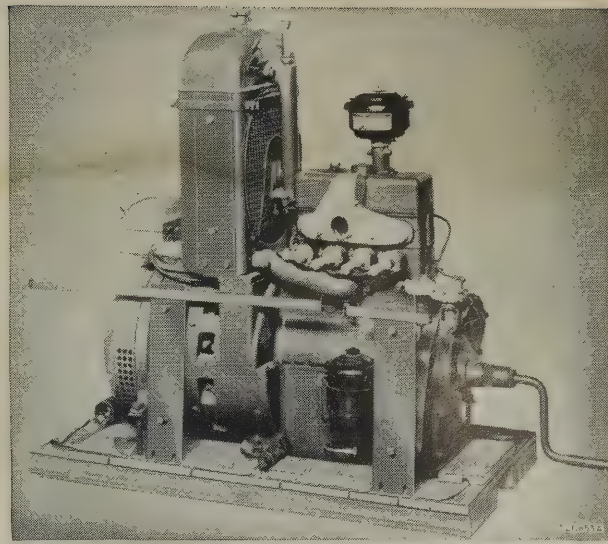


Figure 13. Power Unit PU–41/G.

Section II. INSTALLATION

19. Siting

a. GENERAL. Proper siting of Radio Set SCR–291–A will reduce bearing errors and increase the effectiveness of the direction finder. For military purposes it may be necessary to install the equipment in an area that would ordinarily be considered unsuitable. For detailed information on determining the suitability of a site, refer to TM 11–476, Radio Direction Finding. A few of the factors to be considered in selecting a site are given below.

b. SITE SELECTION.

(1) *Visual inspection.* After the general area has been determined in accordance with military needs, inspect the area for a site which will satisfy the following conditions as closely as possible:

(*a*) The site should be substantially flat for at least 200 yards from the direction finder antenna system and have only a gentle slope for a distance of several hundred yards.

(*b*) The site should be on the highest level area in the vicinity. A site in a valley is unsatisfactory.

(*c*) Mountainous or hilly country should be avoided, if possible.

(*d*) The site should be well inland from the shore line of large bodies of water. If the installation must be made on or near the coast, the flattest area will be most satisfactory, and the direction finder should be oriented for best results under this condition (TM 11–476).

(*e*) The earth at the site and in the vicinity of the site should have a uniform high conductivity and moisture content. Areas uniformly covered with grass or vegetation usually meet this requirement. Rocky or sandy soil is poor for a site. However, areas of uniform low conductivity are preferable to high conductivity areas that are spotted with rock formations, sand, or varying moisture content.

(*f*) Avoid areas in which there are abrupt discontinuities such as cliffs, cuts, fills, ravines, or gaps. These may indicate the presence of rock or mineral formations or underground streams.

(*g*) The site should be away from tall

trees, buildings, wire fences, power and telephone lines, radio antennas, railroad tracks, sharp ground contours, buried metallic conductors (cables and pipes), chimney stacks, water towers, rivers, lakes, and streams. Refer to TM 11–476 for a table of the distances that should be maintained between the radio direction finder and various obstacles.

(2) *Electrical tests for site.* Whenever possible, make the electrical inspection described in TM 11–476 before Radio Set SCR–291–A is installed at the site chosen by visual examination.

Figure 14. Radio Transmitter BC–1149–A (Target).

20. Uncrating, Unpacking, and Checking

a. EXPORT SHIPMENTS. Radio Set SCR–291–A includes chests and crates in which the components can be repacked for transportation (par. 40). For export shipment, waterproofed and vaporproofed containers are wrapped about the components, most of the equipment is packed into the chests and crates, and unit packages are places in outer wooden boxes that give greater protection during transit. Typical export packaging of Radio Set SCR–291–A is shown in figures 18 through 32. The following unpacking procedure is recommended:

(1) If the equipment is to be unpacked at the installation site, place the boxed equipment convenient to its final location. If the equipment is to be unpacked and prepared for transportation, place the boxed equipment in any convenient working space.

(2) Cut the steel straps on each box.

(3) Use nail-pullers to remove nails from the boxes. Do not pry the covers and sides from boxes; prying may damage the equipment within the box.

(4) Refer to the unpacking, uncrating, and checking illustrations (figs. 18 through 32) before starting to unpack any box or crate. These illustrations show how the equipment is placed in each box and therefore enable unpacking with less danger of damaging the equipment.

(5) If the equipment is packed in an inner box or chest, remove the inner box from the outer box before attempting to remove the equipment.

(6) Carefully remove waterproof and vaporproof wrappings, other packing material, and dehydrating agents (usually silica gel). Be careful not to damage any protective material, such

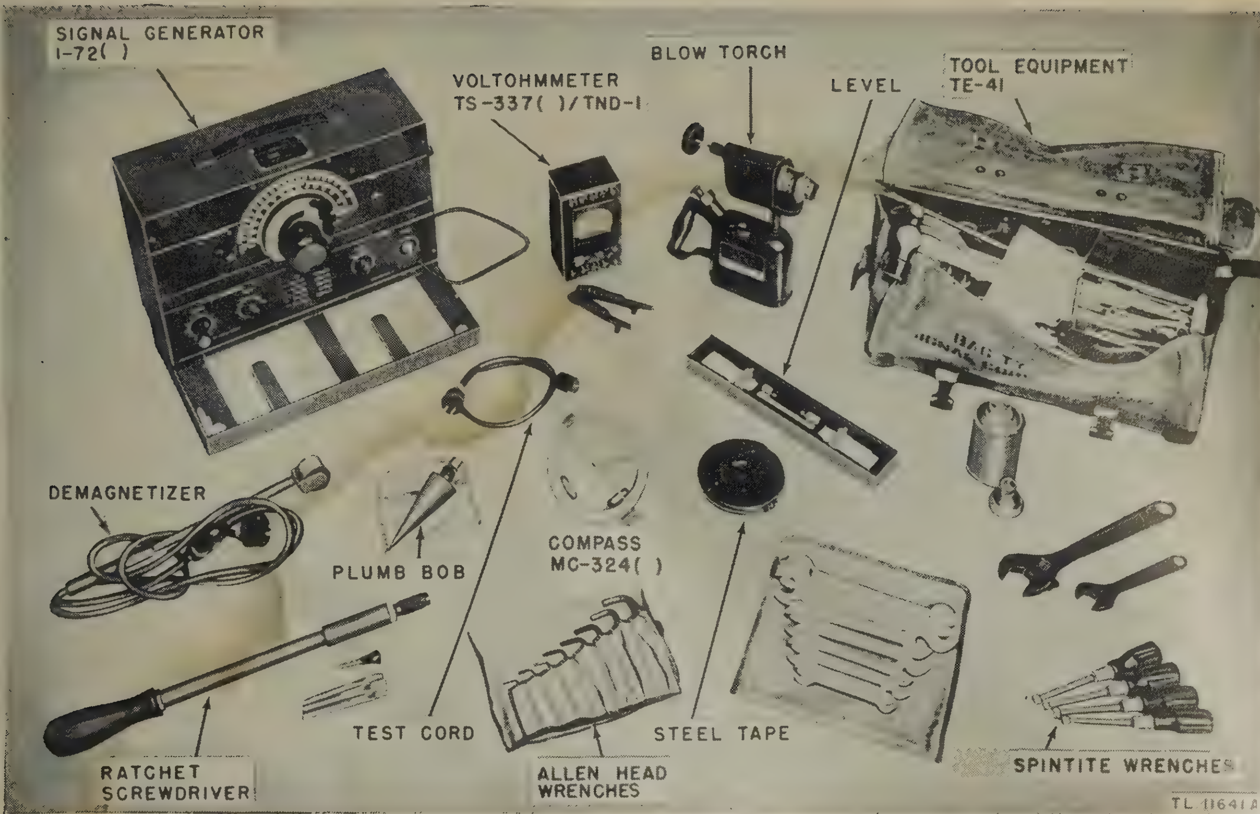


Figure 15. Tools and test equipment.

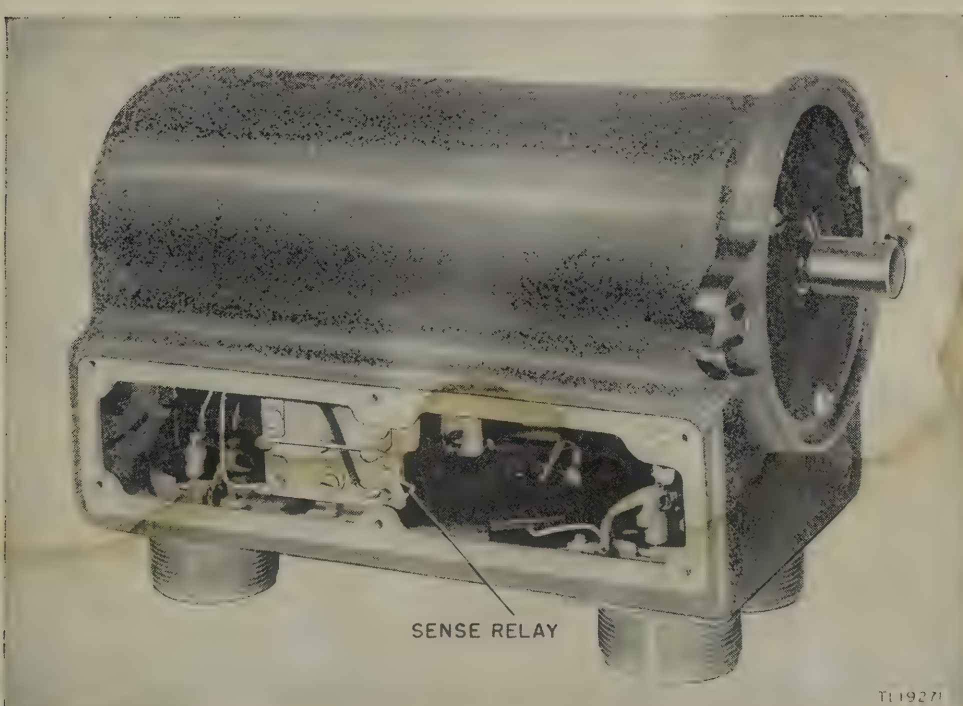


Figure 16. Goniometer MC-412-A, early model.

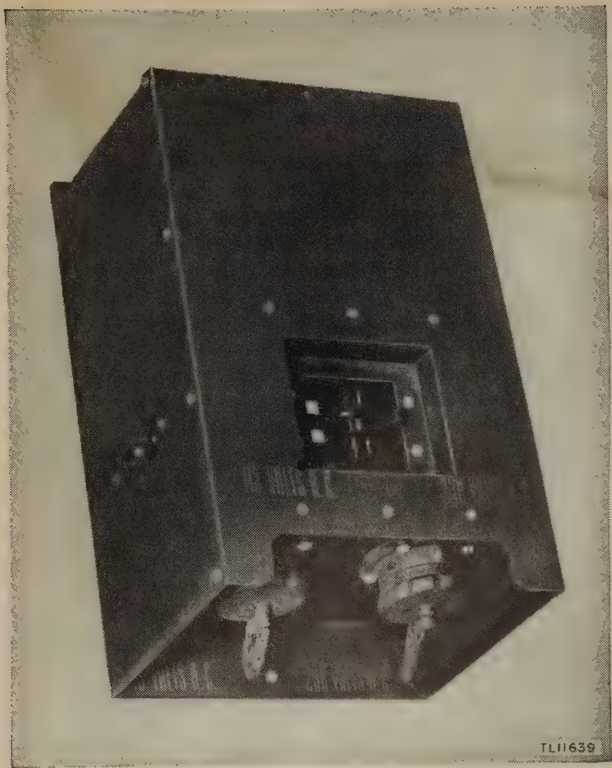


Figure 17. Junction Box JB–95–A.

as moistureproofing and fungiproofing varnish, that should remain on the equipment.

(7) Check the contents of each package against the packing slip that comes with the package.

(8) Check the packing material to be sure that a small component which may have been wrapped and stowed in the loose material is not overlooked.

b. CHESTS AND CRATES. The radio set chests and crates should be carefully unpacked, and the contents of each should be checked against the packing list. Some of the radio set components are bolted to the chests or crates in which they are packed for shipment or transportation. Save nuts and bolts removed during unpacking; they will be needed when the equipment is repacked for transportation (par. 40).

21. Preliminary Layout

The antenna array must be oriented to magnetic or to true north. The r-f and power cords that interconnect Phase Inverters MC–411–A and MC–413–A to Junction Boxes JB–91–A must be laid out to form a U. The cables may be placed in one of four possible positions, and the cable positioning determines the location of Shelters HO–20–( ) and HO–19–A. The layout described in *b* below is shown in figures 33 and 34. The four possible arrangements are given in the following chart:

Direction of sides of N–S U	Direction of sides of E–W U	Direction of sense cables	Direction of Shelter HO–20–( ) with respect to center of antenna	Direction of Shelter HO–19–A with respect to Shelter HO–20–( )
West*	South*	Southwest*	100 ft Southwest*	140 ft. Southwest*.
West	North	Northwest	100 ft Northwest	140 ft Northwest.
East	North	Northeast	100 ft Northeast	140 ft Northeast.
East	South	Southeast	100 ft Southeast	140 ft Southeast.

*Described in paragraph 21*b*.

a. CLEARING SITE. After a site has been chosen, clear an area of at least 200 yards diameter of all obstacles that would interfere with erection of the radio set. If possible, clear an area several hundred yards in diameter of large objects (trees, etc.) that would reduce the effectiveness of the radio set.

b. LAYOUT OF COMPONENTS (fig. 33).

(1) *Antenna system.* At the center of the cleared area, drive a stake to mark the center of the antenna system.

(2) *Shelter HO–20–( ).* At a point about 100 feet southwest of the antenna stake drive a second stake to indicate the spot at which Shelter HO–20–( ) will be erected.

(3) *Shelter HO–19–A.* At a distance of 140 feet southwest of the second stake, drive a third stake to mark the point

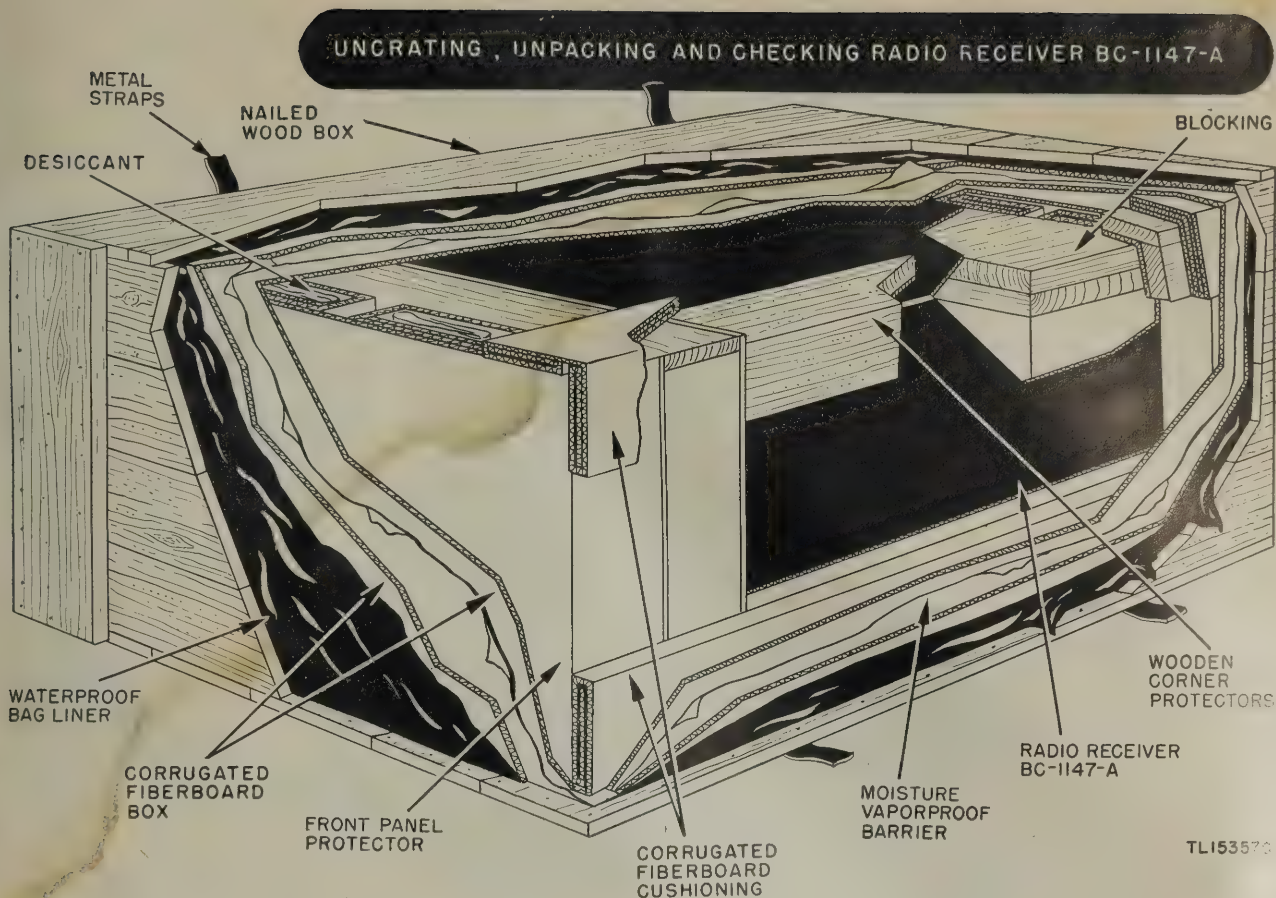


Figure 18. Radio Receiver BC–1147–A, export packaging.

at which Shelter HO–19–A will be erected for the power units.

22. Erection of Shelter HO–20–A

a. General. The crates (fig. 68) and components of Shelter HO–20–A are numbered to facilitate assembly. The side panels are numbered counterclockwise, beginning with the panel at the right of the door. The floor and roof panels are numbered consecutively from front to rear.

b. Assembly Procedure.

(1) Clear and level an 8- by 12-foot area around the stake that marks the shelter position.

(2) Unpack two long and two short 2- by 4-inch foundation beams (crate No. 4) and bolt them together (fig. 35).

(3) Unpack the floor panels (crate No. 1) and bolt them to the foundation beams (fig. 35).

(4) Place the assembled foundation on the prepared area so that the rear of floor section No. 3 is toward the antenna array stake. Use the spirit level to check the floor and, if necessary, prop the foundation to make the floor level.

(5) In operations (6) through (10) below, start all nuts and bolts by hand, but do not tighten them until the panels are all in position. The resulting slack will permit a slight shifting of the end rails and corner posts, so that the side and roof panels can be put together without difficulty.

(6) Unpack the corner posts and braces

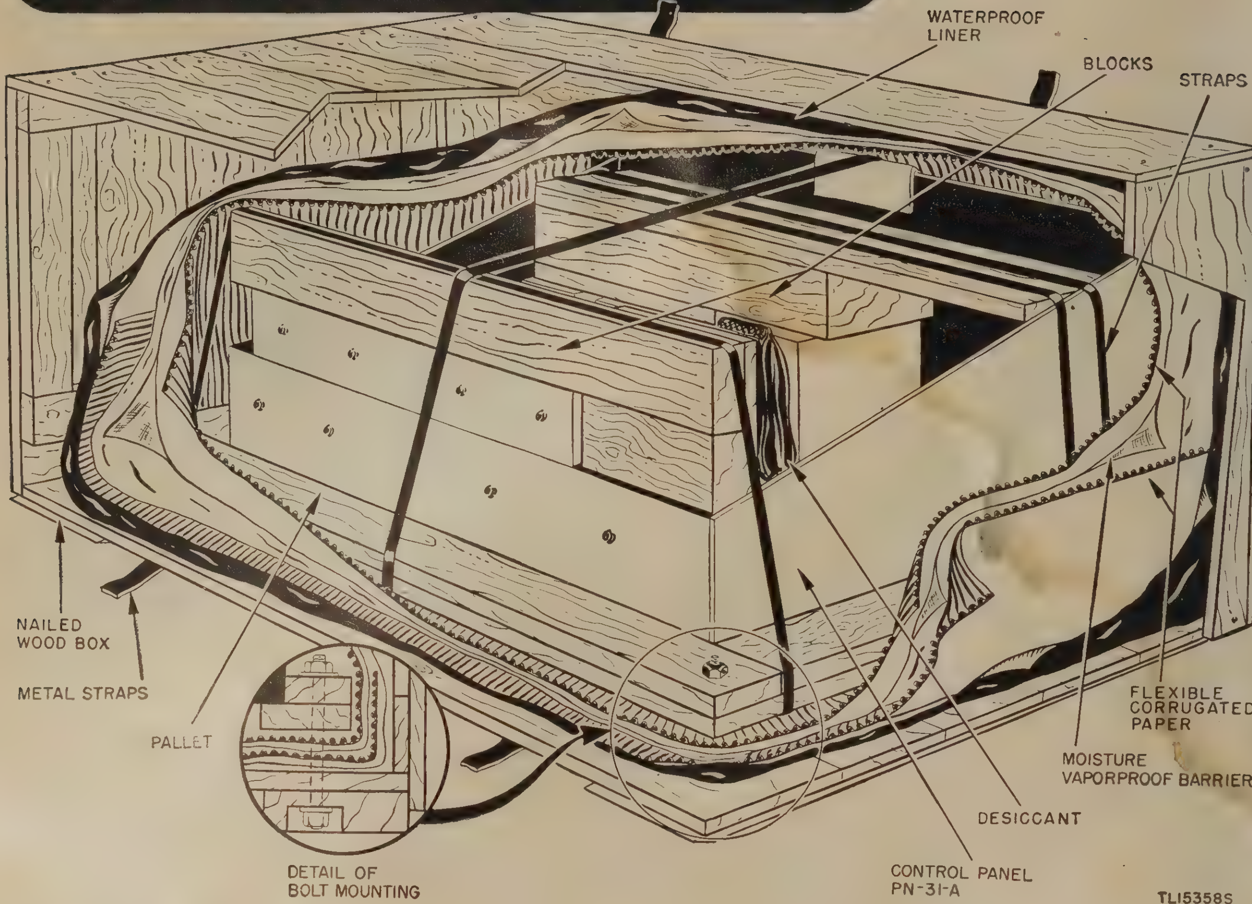


Figure 19. Control Panel PN–31–A, export packaging.

(figs. 36 and 37). The notch in each corner post should be outward and toward the side (fig. 36).

(7) Bolt the two roof side rails in place.

(8) Bolt the two roof end rails in place.

(9) Unpack the roof panels and put them in position in the following order: 1, 3, and 2 (fig. 38). Do *not* put the bolts in place.

(10) Unpack the side panels and bolt them to the shelter framework in the following order: 1, 3, 2, 5, 4, 6, 8, 7, 10 (door), and 9.

(11) Tighten all bolts.

(12) Unpack the canvas roof cover and put it over the roof. Secure the cover under the hooks along the side and end rails (fig. 11A).

c. INSULATION. Where climatic conditions necessitate additional insulation against cold or moisture, install the inner panels (crate No. 5) in Shelter HO–20–A. The inner panels are numbered in the same order as the corresponding outer panels. Use ¾-inch, flathead, wood screws to fasten the inner panels in position. A caulking gun and compound are furnished for sealing the seams of the inner panels, if necessary. When the radio set is to be used in an extremely cold or hot climate it may be necessary to substitute a more substantial shelter for Shelter HO–20–A. Refer to paragraph 24 for instructions on a substitute shelter.

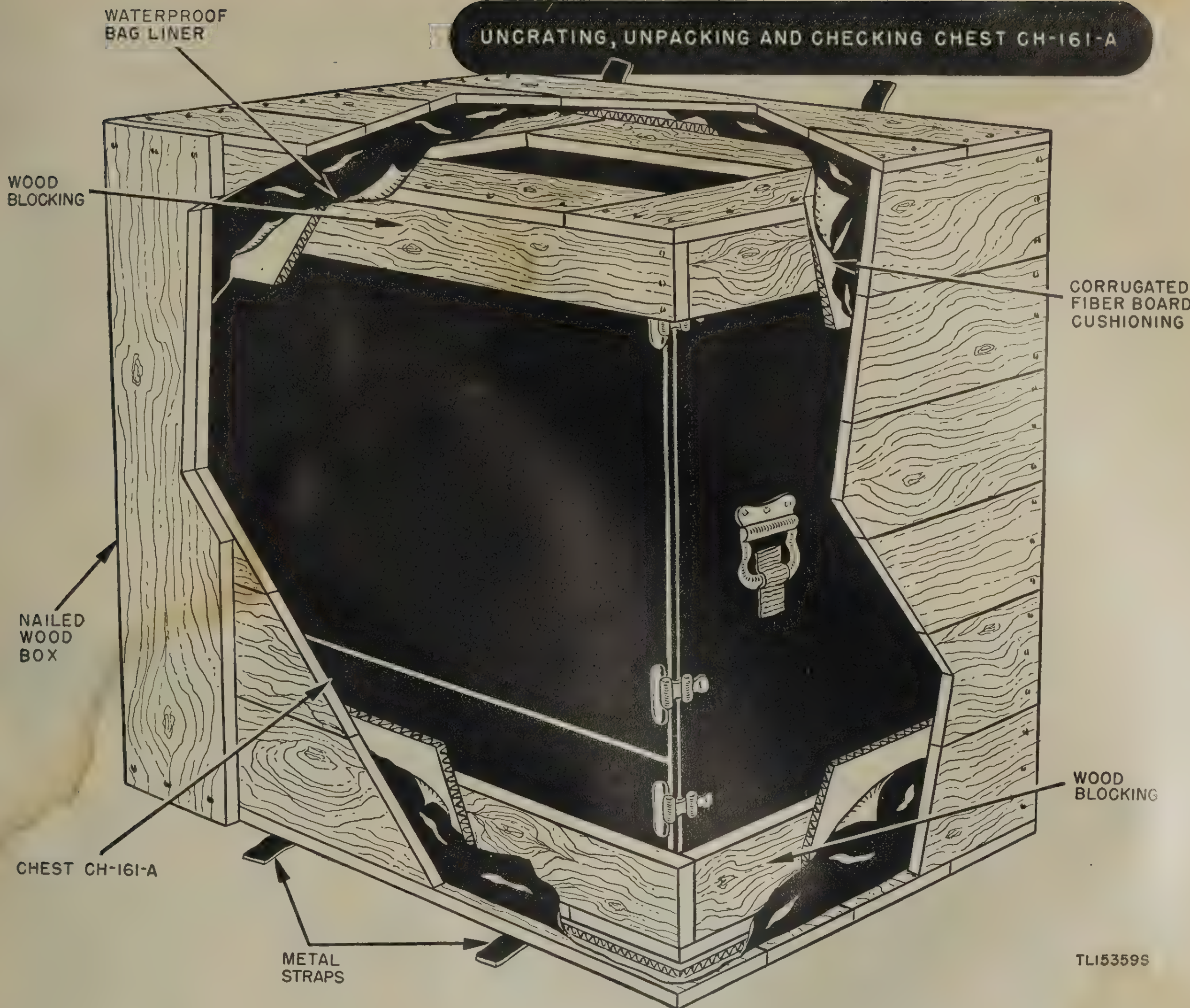


Figure 20. Chest CH–161–A, export packaging.

23. Erection of Shelter HO–20–B

a. GENERAL. Disassembled Shelter HO–20–B is shipped in two crates (fig. 39). Each wooden part of the assembly is stenciled for identification. When the shelter is erected all stenciling will be on the inside. When installing posts and panels, be sure that the stenciled ends are near the top. All hardware for the assembly is stored in a kit box. Insulating material is installed between the outer and inner sections of the walls, roof, and floor.

b. UNPACKING.

(1) Place the two shipping crates on the ground, stenciled sides up.

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

(3) Put the contents of both crates on the ground close to the shelter site.

c. ERECTION.

(1) Place FLOOR No. 1 in position on the ground.

(2) Place FLOOR No. 2 against FLOOR No. 1 (fig. 40). Only one end of FLOOR No. 2 is provided with a mud sill; the other end is supported by the projecting sill on FLOOR No. 1.

(3) Insert the FLOOR CONNECTOR in the groove between the two floor

sections (fig. 41) so that the two cut-outs in the connector drop over the steel hooks attached to the floor sections. In thiis position the connector is flush with the floor surface but extends about 1 inch beyond the floor edge. To engage the connector cut-outs with the steel hooks, and to lock the floor sections together (fig. 42), drive the connector flush with the floor edges.

(4) Attach the four corner posts (POSTS No. 1, 3, 4, and 6) to the floor, using the plate and wingnuts provided. Proceed in a counterclockwise direction beginning with POST No. 1, which must be positioned as shown in figure 42 (stenciled end up).

(5) Position PANEL No. 6 at one end of the floor between POSTS No. 1 and 6 (fig. 43). Rest the bottom of the panel on the floor and push the top into place. Turn the six turnbuttons on the back of each panel to a horizontal position and tighten the wingnuts to hold the panel in place (fig. 44). Outside the shelter turn the turnbutton at the lower edge of the panel to a vertical position and tighten the wingnut. Follow this procedure for securing each of the remaining panels.

(6) Remove the two door handles and setscrews from the kit box. The painted handle is used on the outside of the

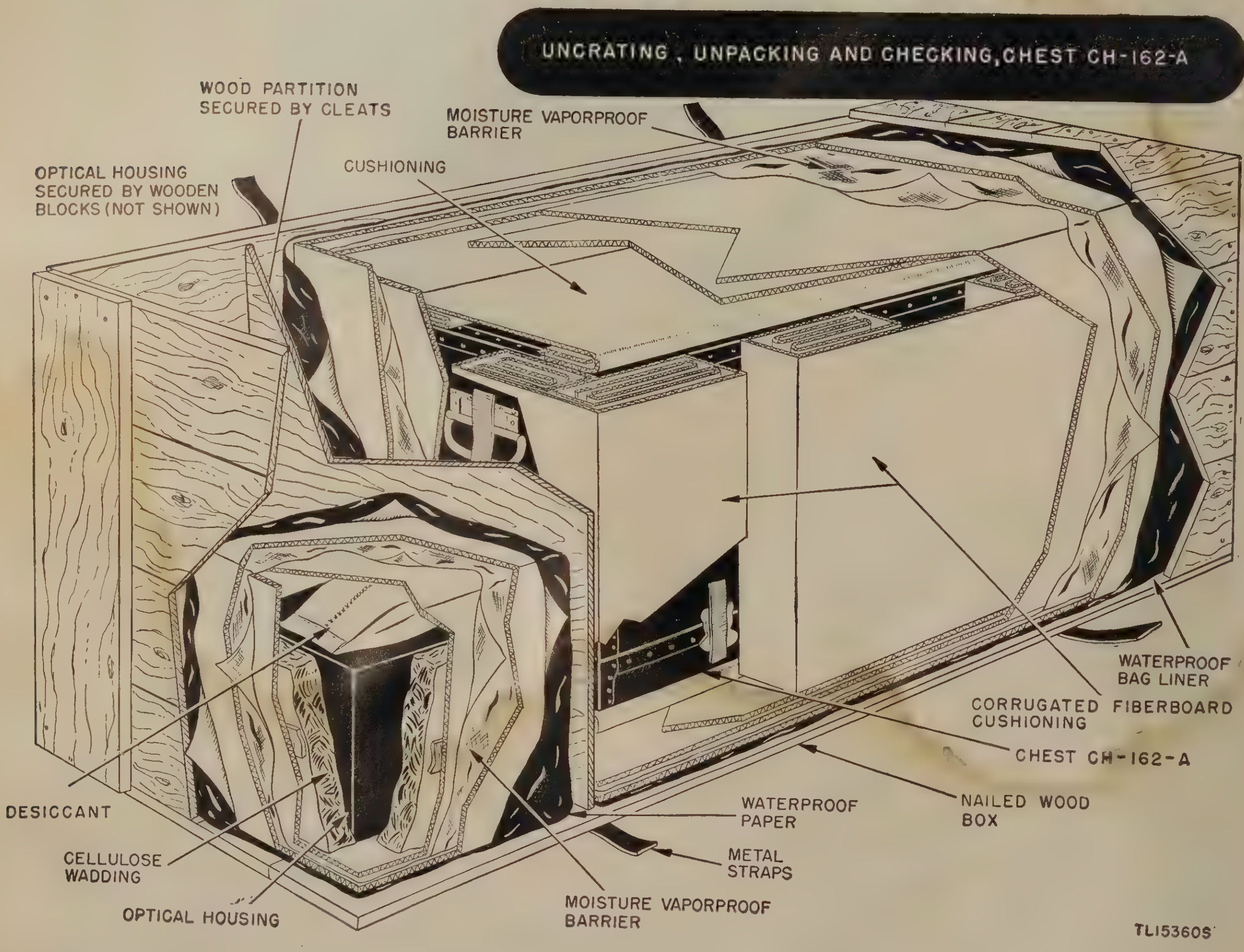


Figure 21. Chest CH–162–A, export packaging.

door; the plated handle, on the inside. Secure the handles to their shafts with setscrews.

(7) Install POST No. 2. Use the plate and wingnuts provided. Support POST No. 2 and place PANEL No. 2 in position as shown in figure 43 for POST No. 5 and PANEL No. 4.

(8) After PANELS No. 2 and 3 are fastened in place, repeat the procedure outlined in (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) in 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. Let one threaded end of each L-bolt extend through the hole in the metal plate outside the shelter (fig. 45). Before ROOF SUPPORTS No. 3 and 6 are seated in their grooves, push the other ends of the L-bolts through the holes provided in each end of these ROOF SUPPORTS. The threaded ends must extend through the metal plates on the outside of the shelter. Seat ROOF SUPPORTS No. 3 and 6 into grooves by tapping; put wingnuts on both ends of the L-bolts. Also put

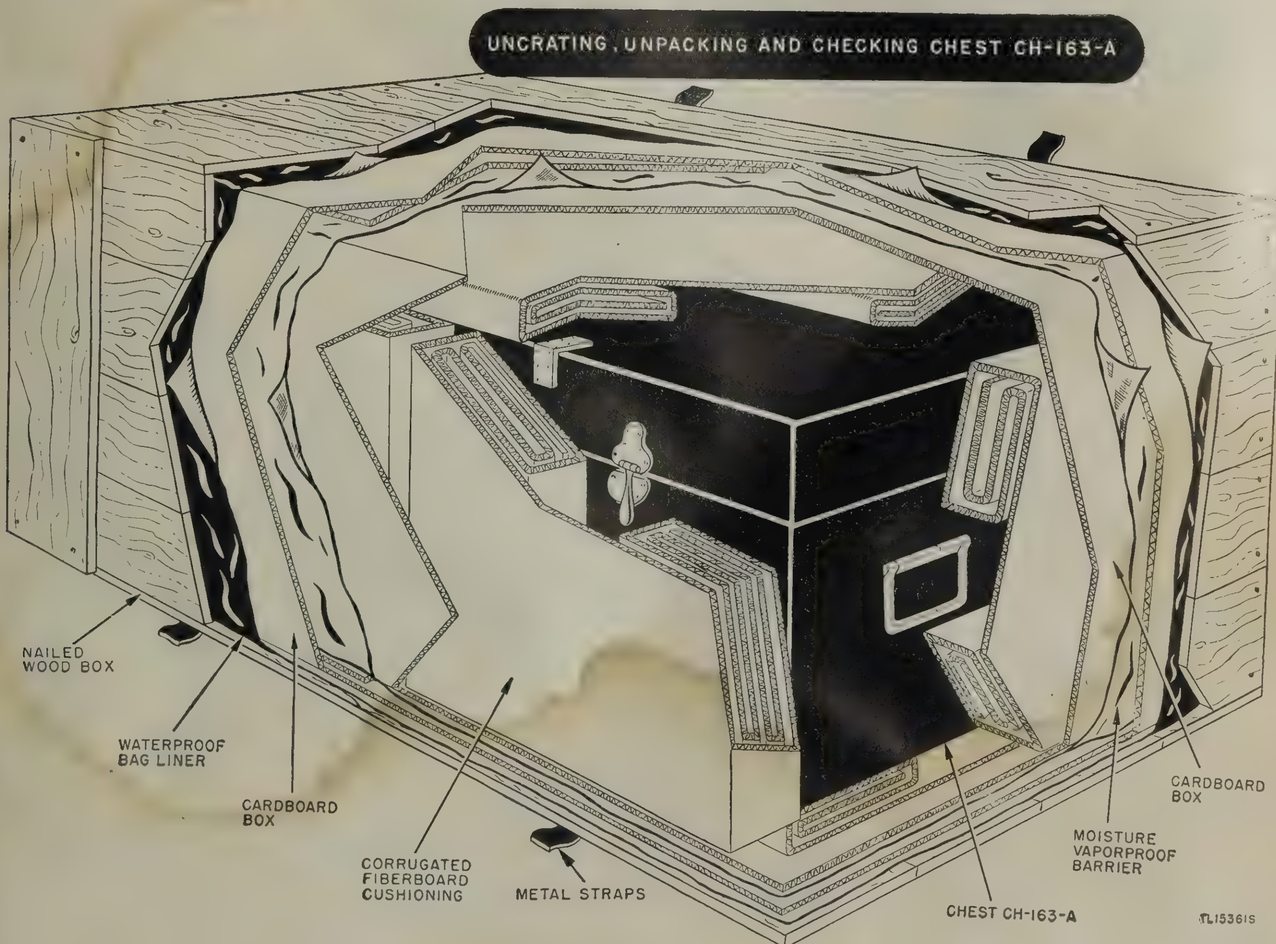


Figure 22. Chest CH-163-A, export packaging.

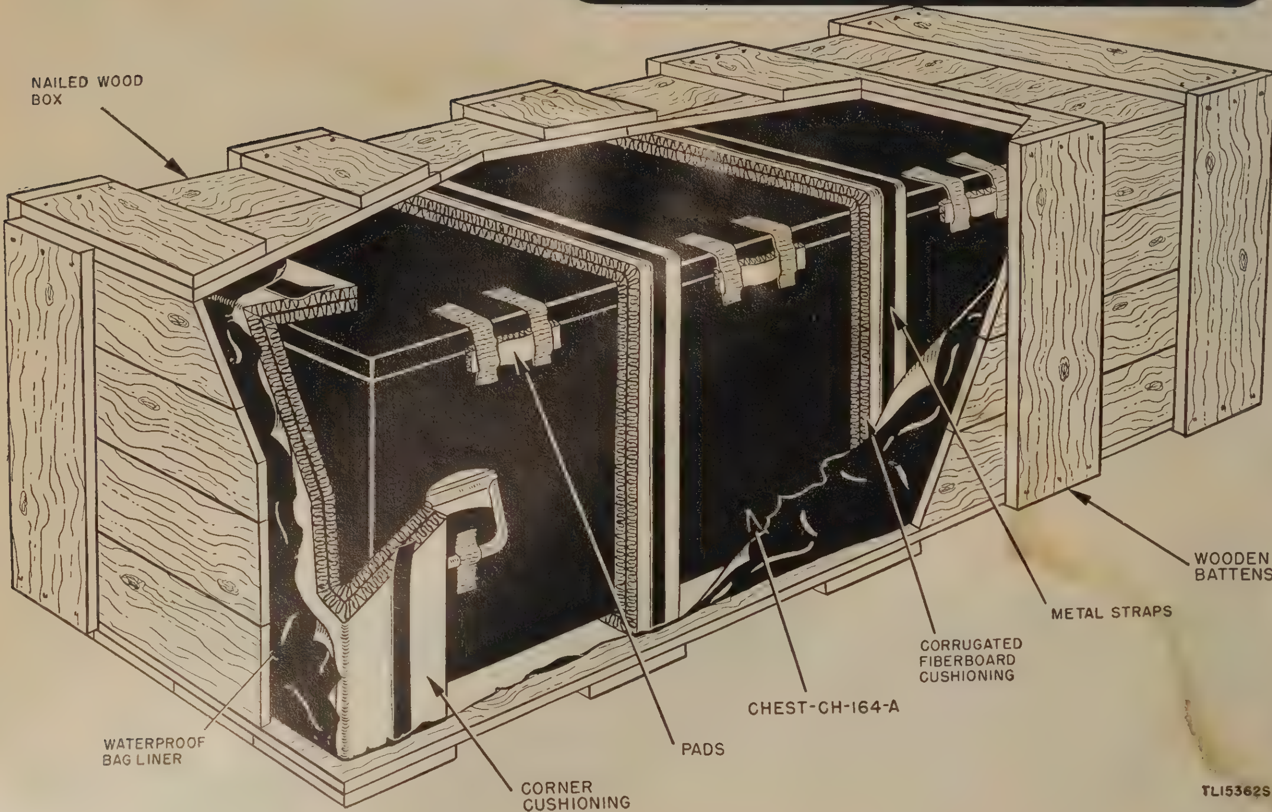


Figure 23. Chest CH–164–A, export packaging.

wingnuts on the bolts directly opposite the L-bolts on the roof supports; tighten all wingnuts (fig. 46).

(10) Install ROOF No. 1 over PANELS No. 1 and 5; ROOF No. 2 over PANELS No. 2 and 4 (fig. 47). Be sure that both roof sections are seated in the grooves.

(11) Insert a machine bolt and flat washer in each end of the three battens. Fasten the battens over the roof and tighten down with wingnuts (fig. 48).

24. Substitute for Shelter HO–20–( )

a. General. Under certain conditions of use and climate, Shelter HO–20–( ) may be too small or may not provide adequate protection for the equipment and operators. In the arctic, it may be necessary to use a substantial, well-insulated building and better heating facilities. In the tropics a tent may be adequate protection for the equipment and cooler for the operators.

b. Shelter Requirements. When substituting a shelter for Shelter HO–20–( ), observe the following requirements:

(1) Use a wooden building (or a tent) that will give the equipment adequate protection from the weather. Do not use a metal building, or a building with a metal roof because any near-by mass of metal will cause increased bearing errors and reduce the efficiency of the direction finder.

(2) Place the shelter on level ground. (When protection from bombing and strafing is required, the shelter may be put underground.)

(3) The shelter dimensions should not exceed 20 feet in length, 20 feet in width, and 8 feet in height.

(4) The shelter should not contain more metal than Shelter HO–20–( ).

(5) Use the minimum amount of wire for light and power circuits, and keep the wiring as low as possible. (Most of the wiring should be at floor level.)

(6) A wood, oil, or coal burning stove may be used for heating the shelter. A smokestack of nonmetallic material is preferable to a metallic stack. If used, a metallic smokestack must not be higher than 8 feet above the ground.

(7) Wire guys may be used to anchor the structure, provided that insulators are inserted at 5-foot intervals along each guy.

(8) The shelter must be properly positioned with respect to the antenna system (par. 21).

c. TABLE FOR BEARING INDICATOR BC–1159–A. If a sturdier table is substituted for the bearing indicator table, the vibration noise will be reduced considerably. A sturdier table can be used when a more substantial shelter is substituted for Shelter HO–20–( ).

25. Gasoline Heater

a. GENERAL. The gasoline heater is packed in a wooden crate (fig. 87). Refer to the heater instruction book and to figures 49, 50, and 11 before attempting to install the heater in Shelter HO–20–( ).

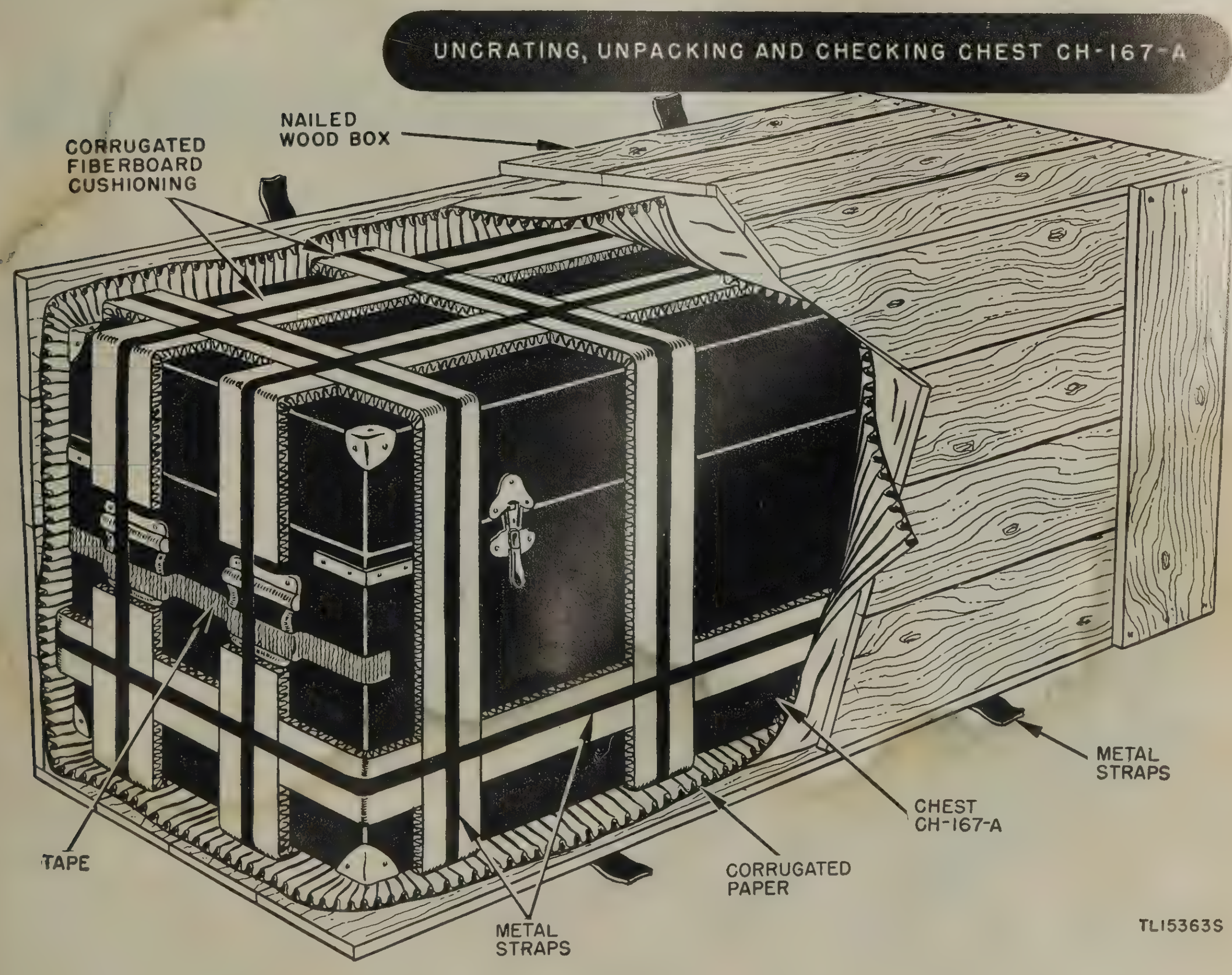


Figure 24. Chest CH–167–A, export packaging.

b. PROCEDURE.

(1) Unpack the heater and place the components convenient to the shelter.

(2) After pulling the armored cable through the ¾-inch hole in the rear of the shelter (fig. 49), bolt the heater assembly to the outside of the shelter (figs. 50 and 11).

(3) Inside the shelter, mount the circulating fan, hinged side down, to the circulating fan cut-out (fig. 49).

(4) Inside the shelter, mount the outlet louver to the outlet louver cut-out.

(5) Mount the fuel tank outside the shelter.

(6) Run the fuel line from the compression fitting on the fuel tank to the fitting on the heater.

(7) Mount the heater switchbox inside the shelter.

(8) Inside the shelter, connect the two wires in the armored cable to the heater junction box.

(9) Mount the heater junction box below the circulating fan.

(10) Outside the shelter, fasten the heater instruction plate adjacent to the heater.

(11) Set the control valve to OFF.

(12) Refer to the heater instruction book for information on operating the heater.

Note. When the wind is toward the rear of the shelter, a downdraft through the circulating jacket has a tendency to extinguish the heater flame. This trouble may be eliminated by attaching a wooden or metallic shield to the top of the heater, thus blocking the flow of air toward the rear of the shelter.

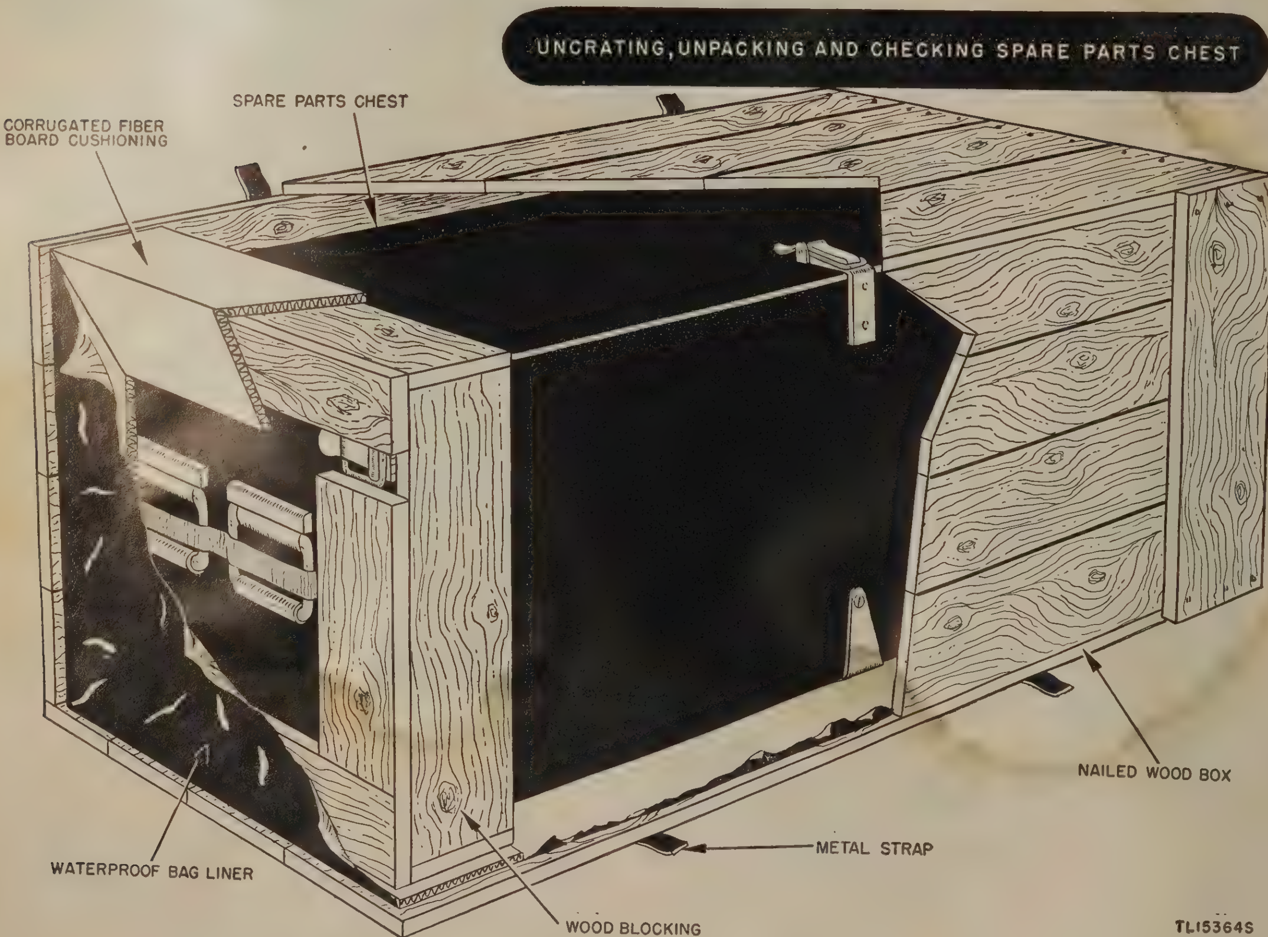


Figure 25. Spare parts chest, export packaging.

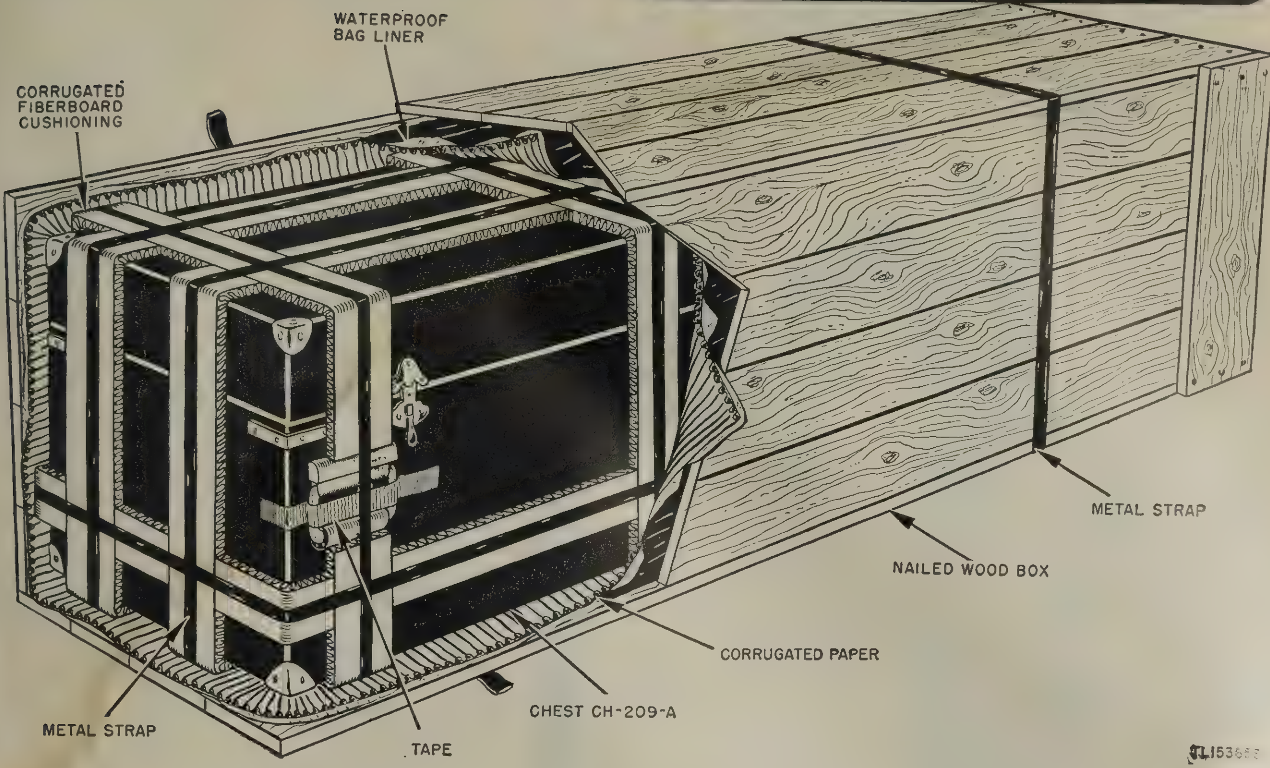


Figure 26. Chest CH–209–A, export packaging.

26. Equipment in Shelter HO–20–( )

Chest CH–161–A, Rack FM–61–A, Junction Box JB–95–A (or JB–126), Bearing Indicator BC–1159–A, a lamp assembly, two tables, and two chairs are installed in Shelter HO–20–( ). Rack FM–61–A is mounted in Chest CH–161–A and contains Telephone Panel PN–32–A, Control Panel PN–31–A, and Radio Receiver BC–1147–A. The line drawing (fig. 51) of the equipment layout is applicable to Shelters HO–20–A and HO–20–B and includes the interconnecting cords and cables. For equipments on certain orders, the interconnections may be somewhat different from those shown, therefore, always refer to the cording diagram on the rear door of Rack FM–61–A before making the interconnections.

a. PRELIMINARY PREPARATION. For export shipment certain components of Radio Set SCR–291–A are disassembled, and the parts are packaged separately for greater safety. For example, components normally mounted in Rack FM–61–A are taken out of the rack and separately packaged, and the optical housing of Bearing Indicator BC–1159–A is usually removed from the indicator assembly and placed in a unit package. Thus, whenever Radio Set SCR–291–A is being installed directly from export packages, it will be necessary to reassemble some items before final installation can be made. Because the extent of disassembly and separate packaging is not the same for all equipments, only general information can be given here. A study of the typical packaging illustrations (figs. 18 through 32) will be of assistance in preparing equipment for installation in the field. The information on replacement of parts and the illustrations in section III Chapter 4 will also be of assistance.

b. INSTALLATION.

(1) Refer to figures 51 and 52 which show, respectively, a line drawing and a photograph of the equipment layout within Shelter HO–20–( ).

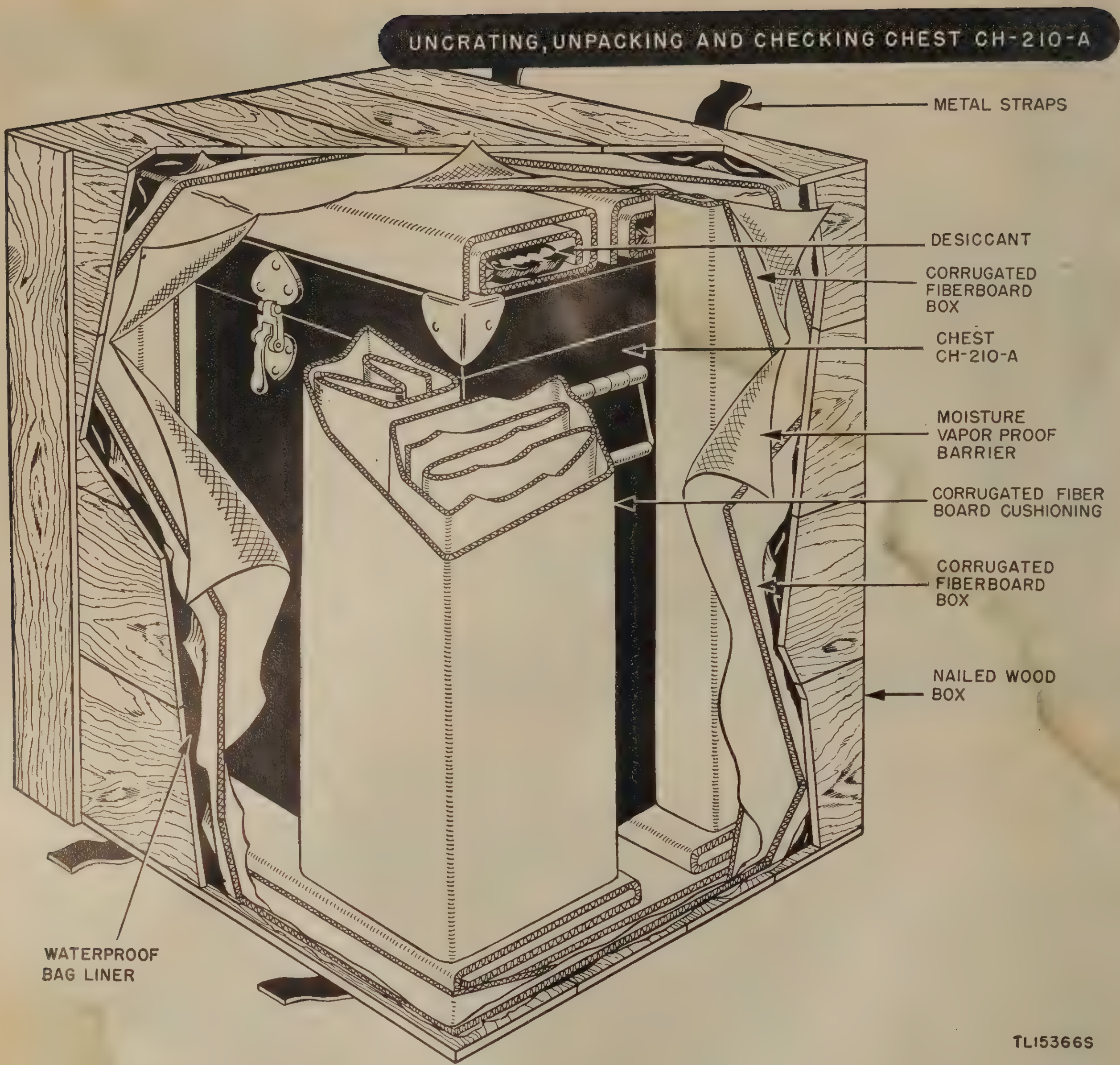


Figure 27. Chest CH–210–A, export packaging.

(2) Attach the lamp assembly to the ceiling of Shelter HO–20–( ).

(3) Assemble one table (fig. 53) and place it at the Chest CH–161–A position in the shelter.

(4) Bring Chest CH–161–A into the shelter, set it on the table, and remove the front and back door covers.

(5) Assemble the second table and place it at the bearing indicator position within the shelter.

(6) To remove the bearing indicator and goniometer from Chest CH–162–A, unstrap the bearing indicator and remove the block (fig. 83). If the bearing indicator is packed in alternate Chest CH–162–A, refer to figure 84.

(7) Clamp Goniometer MC–412–A (connectors down) to the rear of Bearing Indicator BC–1159–A (fig. 54).

(8) On certain orders, a felt pad is furnished for use with Bearing Indicator BC–1159–A. Place this shock absorbing pad on the bearing indicator table

in the shelter. Bring the assembled indicator into the shelter and position it on the felt pad.

(9) Attach the lamp assembly and cord to the bearing indicator.

(10) Mount Junction Box JB–95–A (or JB–126) in the shelter (fig. 52).

(11) Take the interconnecting cords and cables out of Chest CH–163–A.

(12) Refer to paragraphs 15 and 39, and to the cording diagram on the rear door of Rack FM–61–A. Connect the interconnecting cords and cables between the components in the shelter.

Note. The cording diagrams (figs. 33 and 55) are for general information only. For equipments supplied on certain orders, Cords CD–831 through CD–836 are all marked CD–831, and Cords CD–820 through CD–827, are all marked CD–820. Individual cords in each group are distinguished by color coding.

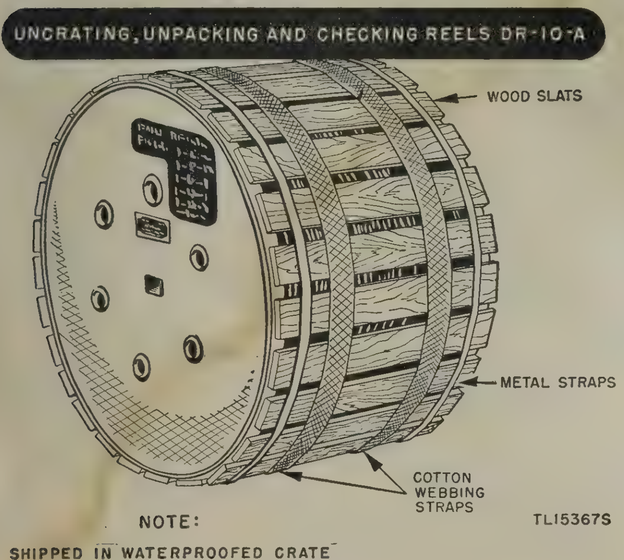


Figure 28. Reel DR–10–A, export packaging.

27. Shelter HO–19–A

a. Erection. The component parts from which Shelter HO–19–A is constructed are packed in one crate (fig. 86). To erect the power unit shelter, proceed as follows:

(1) Unpack the floor assembly and place it at the position previously marked as the power unit site.

(2) Bolt the eight corner brackets in place. The flat sides of the brackets face the inside of the shelter (fig. 56).

(3) Bolt the corner posts in position. The button fasteners face outward.

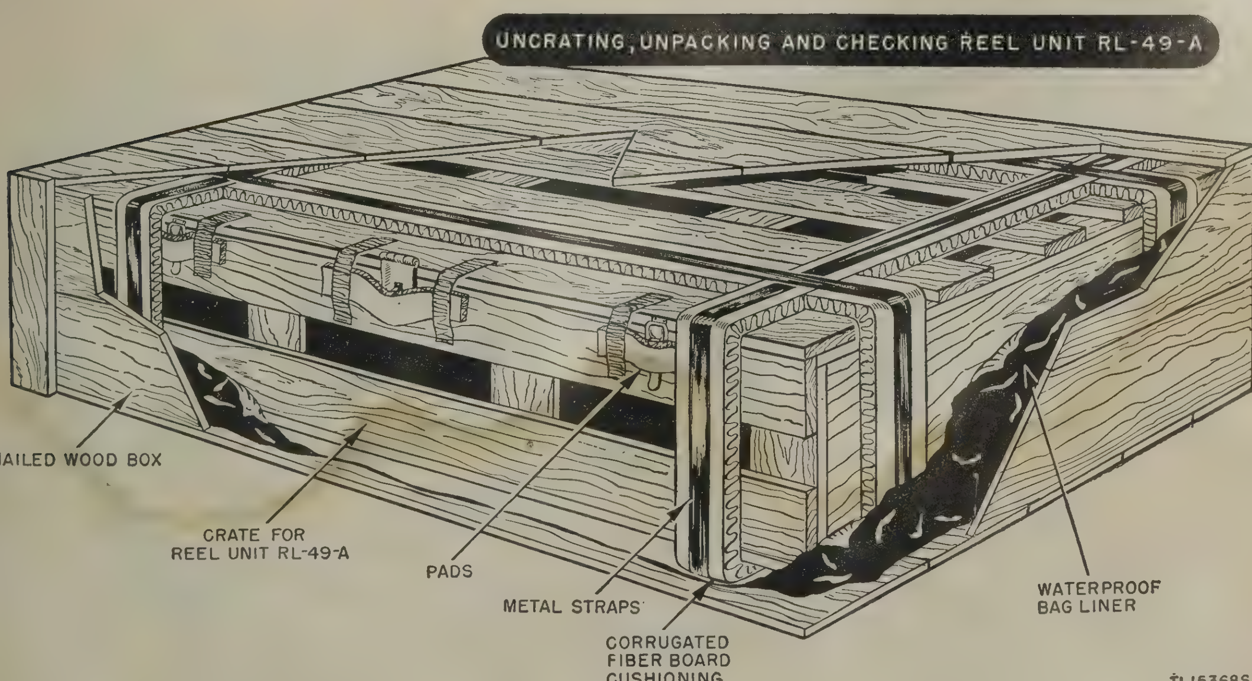


Figure 29. Reel Unit RL–49–A, export packaging.

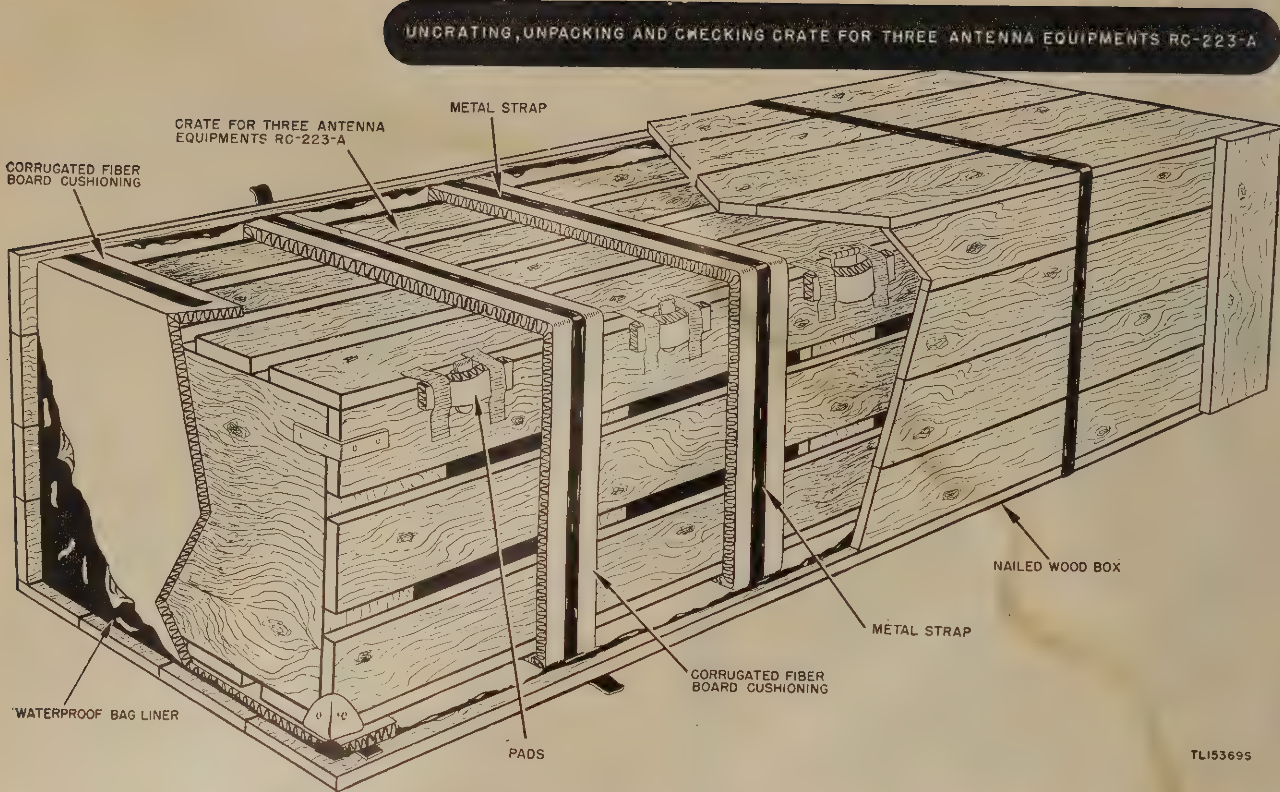


Figure 30. Antenna Equipments RC–223–A, export packaging.

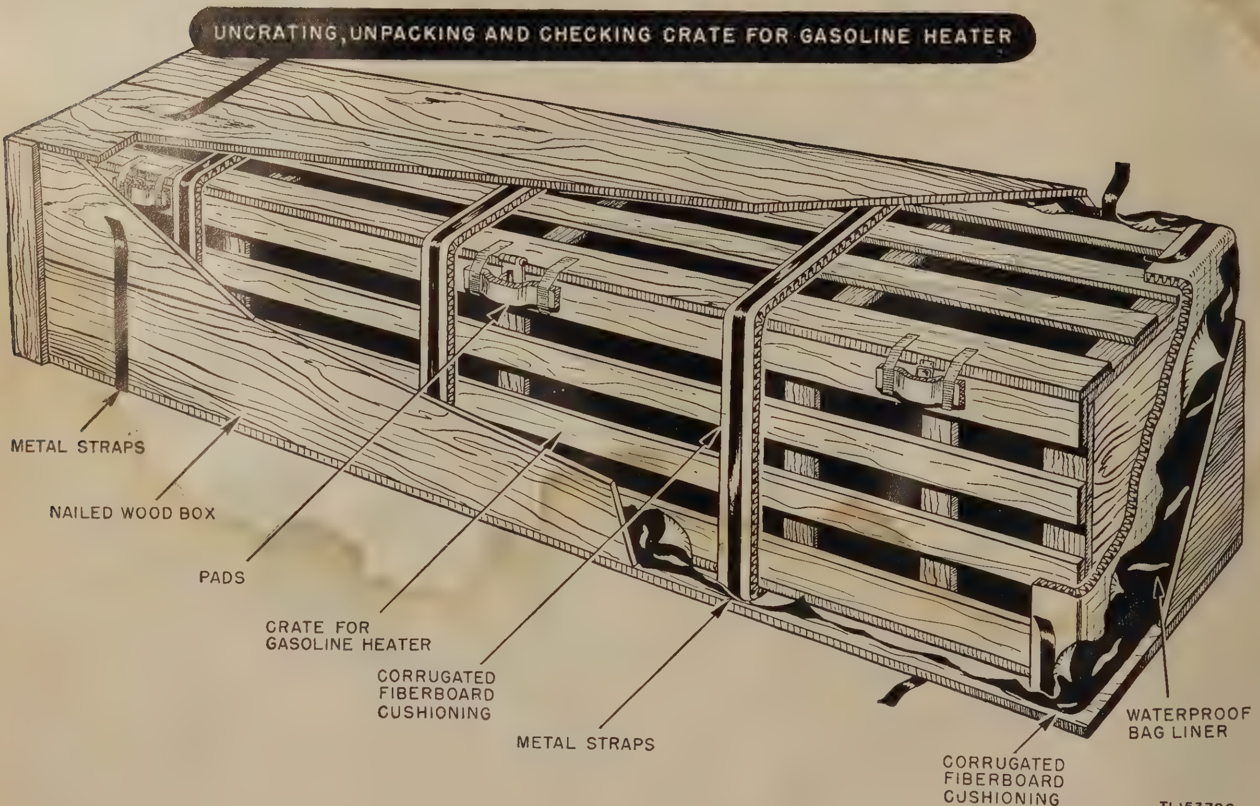


Figure 31. Gasoline heater, export packaging.

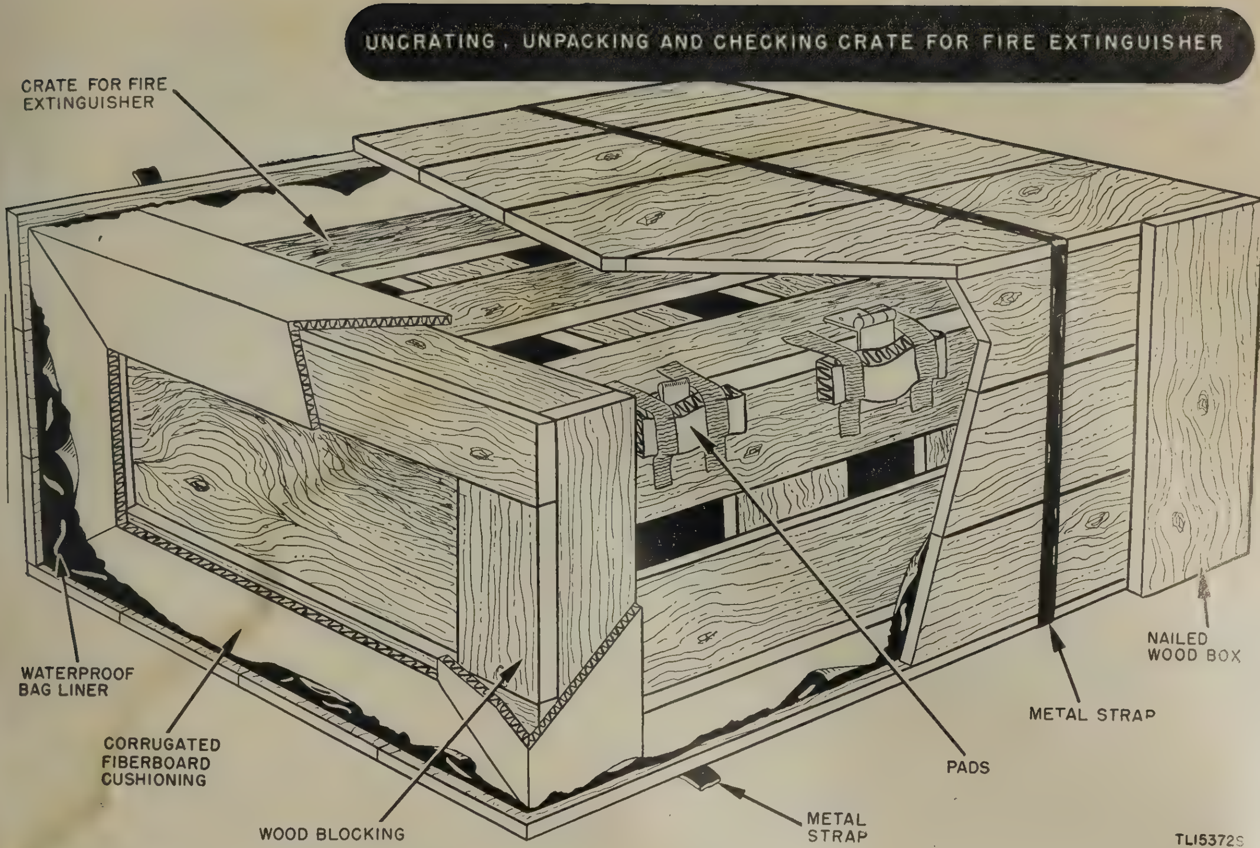


Figure 32. Fire extinguisher, export packaging.

(4) Mount the shelter roof on the corner posts and bolt it in place.

b. Installing Power Unit PU–41/G. Refer to figure 57 and to TM 11–935 for information on unpacking the shipping crate and installing Power Unit PU–41/G in Shelter HO–19–A. To attach an intake duct (fig. 56) to each unit, proceed as follows:

(1) Loosen two bolts on each side of the radiator (fig. 58) and attach an intake duct harness to each unit.

(2) Slip the intake duct over the support bolts on the harness of each radiator and tighten the nuts.

c. Substitute for Shelter HO–19–A. In arctic regions, in humid climates, and in regions where the air is very dirty (for example, in the desert), Shelter HO–19–A may be replaced with a substitute structure that will provide greater protection for the power units. A substitute shelter should be no larger than is necessary to protect the power units, and it must not contain more metal than Shelter HO–20–A. The shelter should include pedestals of planks, brick, or other material upon which the power units can be mounted. The pedestals should be high enough to permit placing a can or bucket under the power unit oil drain. Planks and bars can be used as levers for raising the power units to mount them on the pedestals.

28. Connections to Power and Telephone Lines

When power for operation of the radio set is obtained from power lines, the power cable should be run in such a direction that it is as far as possible from the antenna array. The cable should be run on the ground for a distance of 500 feet from the antennas but may be put on poles at distances greater than 500 feet from the antenna array. If the soil conductivity is poor at the radio set site it is desirable to bury the cable at least 1 foot below the ground surface at distances less than 300 feet from the antenna array.

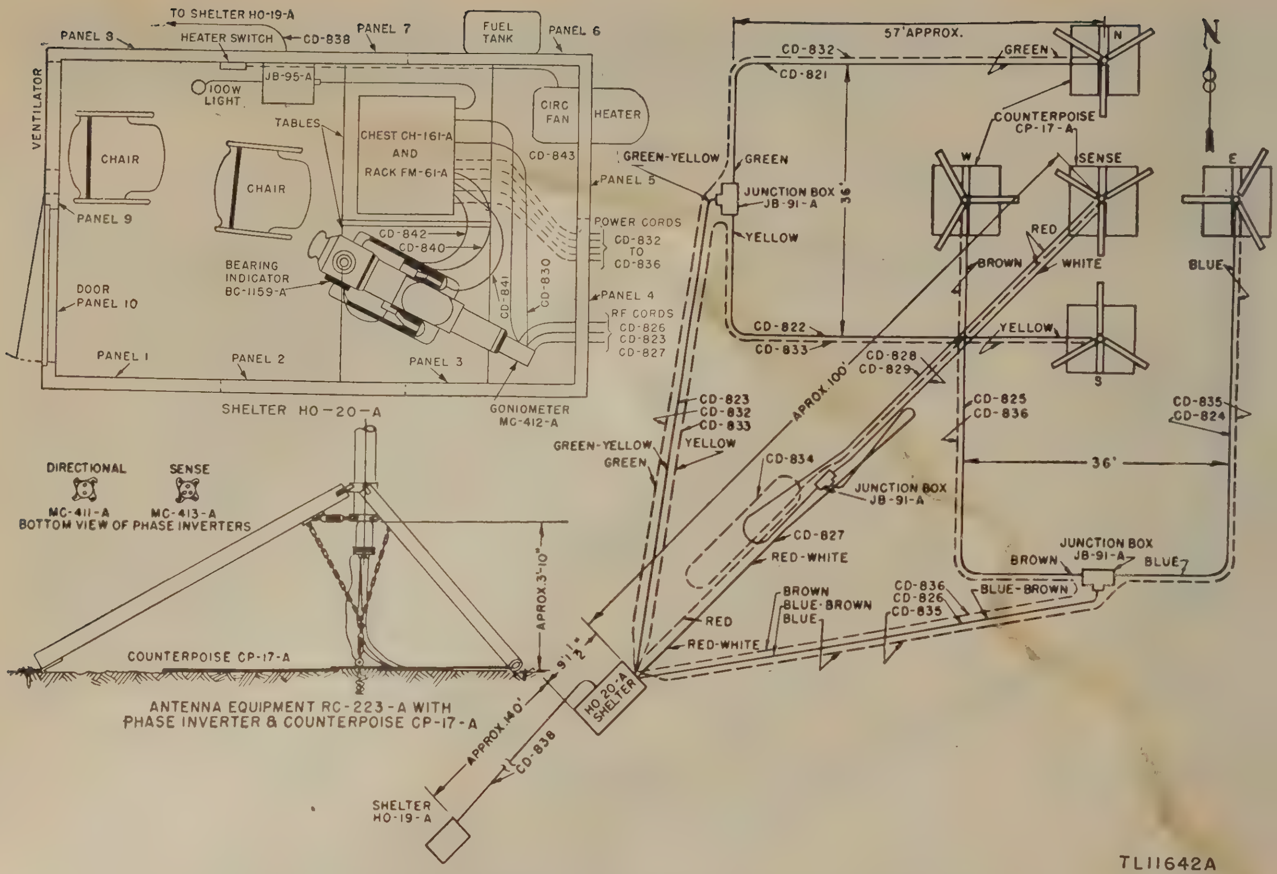


Figure 33. Radio Set SCR–291–A, layout of components.

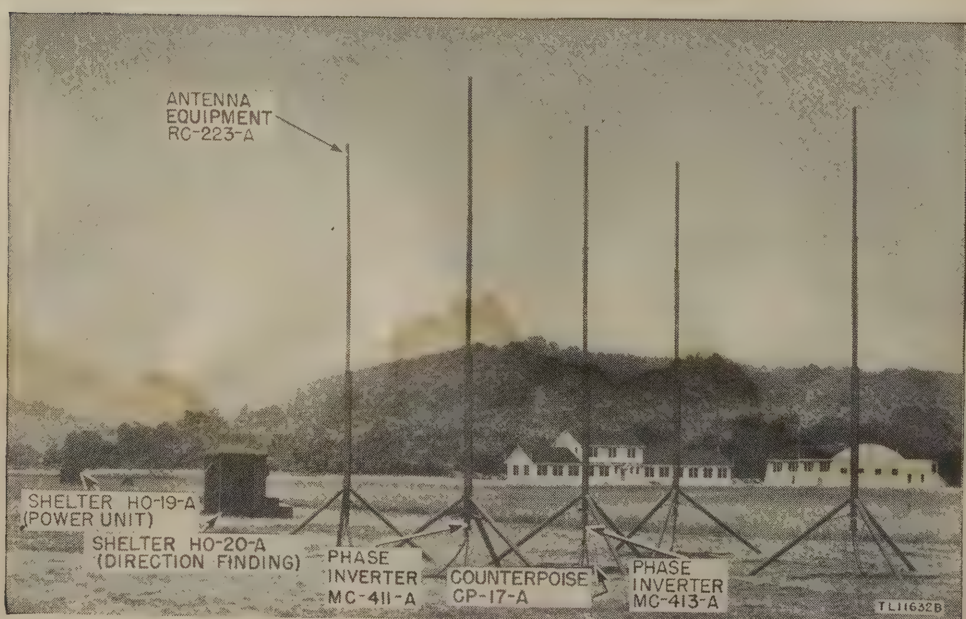


Figure 34. Radio Set SCR–291–A, completed installation.

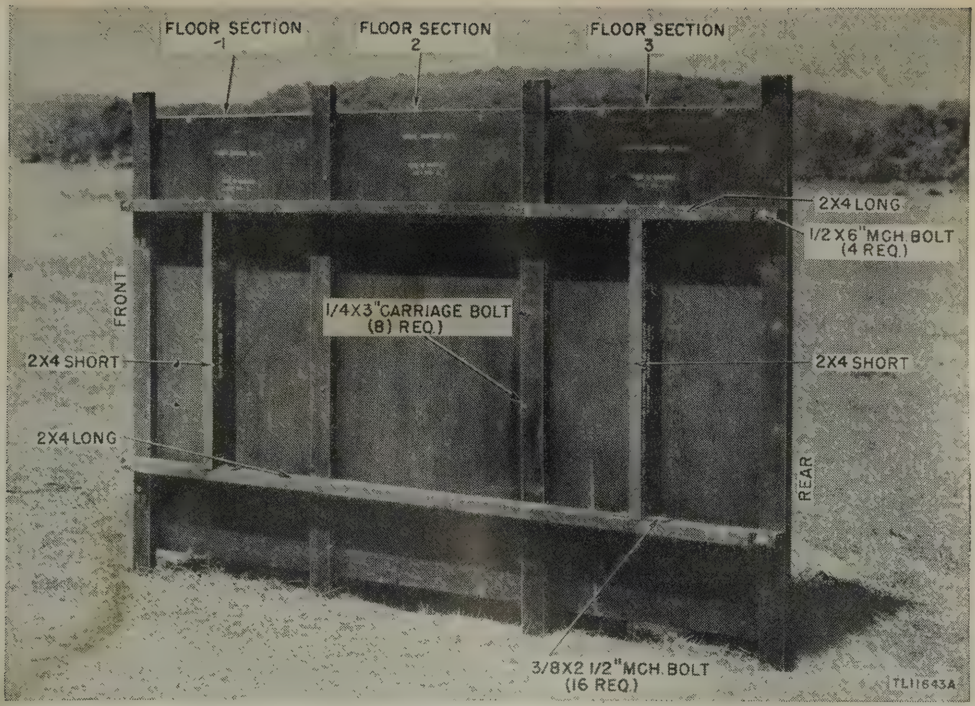


Figure 35. Shelter HO–20–A, foundation and floor.

29. Antenna System

The layout and interconnections of the antenna system are shown in figure 59. The antenna system must be installed exactly as shown. Each D/F mast is at the corner of a square the diagonals of which are 36 feet long. The diagonals must coincide with the true north-south and the true east-west lines, respectively, if the antenna system is to be oriented to true north. When the antenna system is to be oriented to magnetic north, the diagonals must coincide with the magnetic north-south and the magnetic east-west lines. Antenna orientation and erection are described in paragraphs 30 through 34 below.

Note. Refer to TM 11–476 for additional information.

30. Antenna Orientation

a. COMPASS CALIBRATION.

(1) Remove the compass and tripod from Chests CH–163–A and CH–209–A, respectively.

(2) Use the adjusting screw on the side of the compass to rotate the compass azimuth scale. If the antenna system is to be oriented to magnetic north, make the scale index (zero on the azimuth scale) and the north end (identified by N) of the compass needle coincide (fig. 60A). (This is also the calibration for true north in areas where the magnetic declination is zero.)

(3) If the antenna system is to be oriented to true north, the azimuth scale must be adjusted to compensate for the magnetic declination at the site. The magnetic declination is the difference in degrees between true north and the direction in which the north end (N) of the compass needle points; for example if the magnetic declination is 15° west, the compass needle points 15° to the west of true north. To compensate Compass MC–324–( ) for a westward declination the azimuth scale must be adjusted so that the reading under the scale index is equal to 360° *minus* the declination. To compensate for an easterly declination, the azimuth scale must be adjusted so that the reading under the scale index is equal to 0° *plus* the declination.

Example 1—For a magnetic declination of 10° west, adjust the azimuth scale for a reading of 350° (360° — 10°) under the scale index (fig. 60B). When the compass is rotated to bring the needle to 0° on the azimuth scale, the *sights* will point to true north. Similarly, if the compass is rotated to bring the compass needle (N) to 90° on the azimuth scale, the *sights* will point to east, and so on.

Example 2—For a magnetic declination of 10° east, adjust the azimuth scale for a reading of 10° under the scale index (fig. 60C). When the compass is rotated to bring the needle (N) to 0° on the azimuth scale, the *sights* will point to true north.

(4) Mount the compass on the tripod. Move the tripod to the position previously marked as the center of the antenna system (fig. 61).

b. Siting Corner Antennas.

(1) Remove the plumb-bob from Chest CH–163–A and attach it to the hook on the under side of the tripod.

(2) Position the tripod so that the plumb-bob is over the stake that marks the

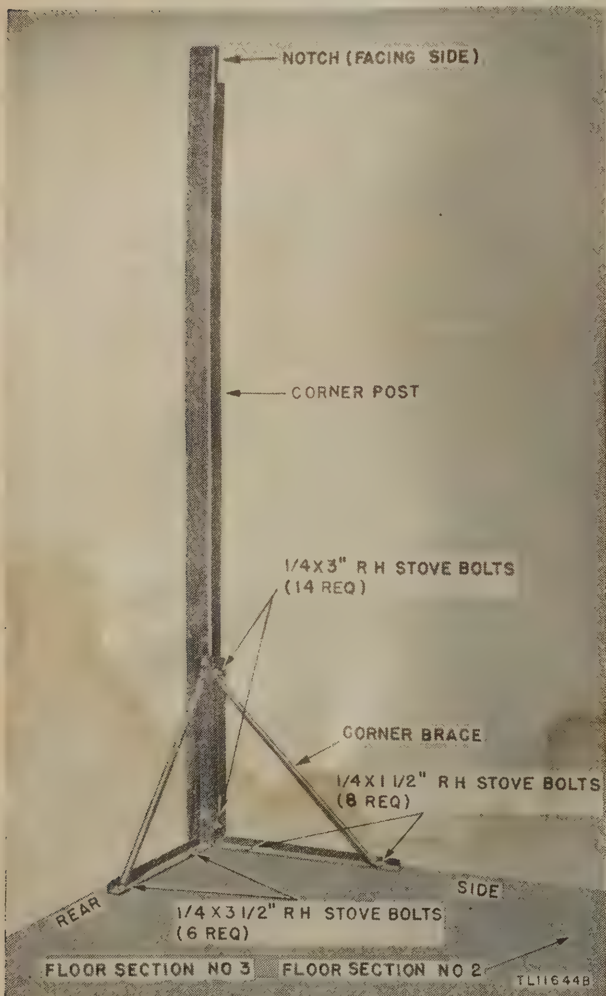


Figure 36. Shelter HO–20–A, corner post erection.

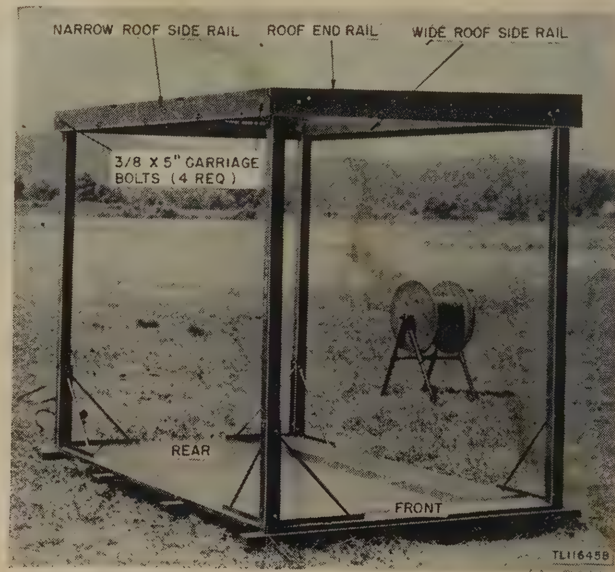


Figure 37. Shelter HO–20–A, frame.

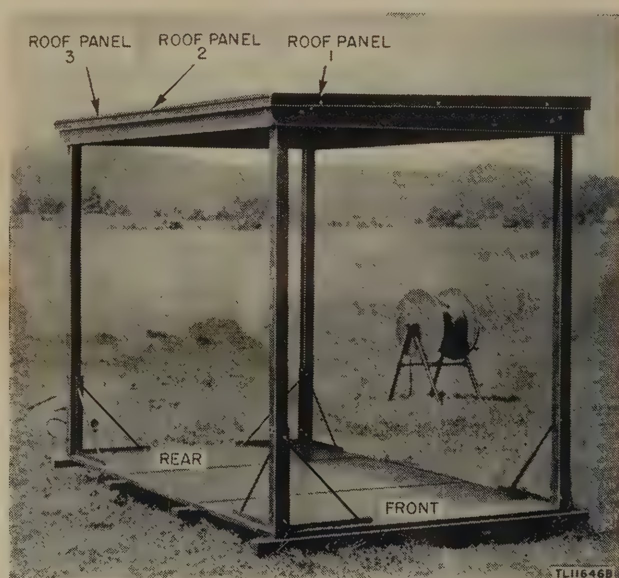


Figure 38. Shelter HO–20–A, roof mounted on frame.

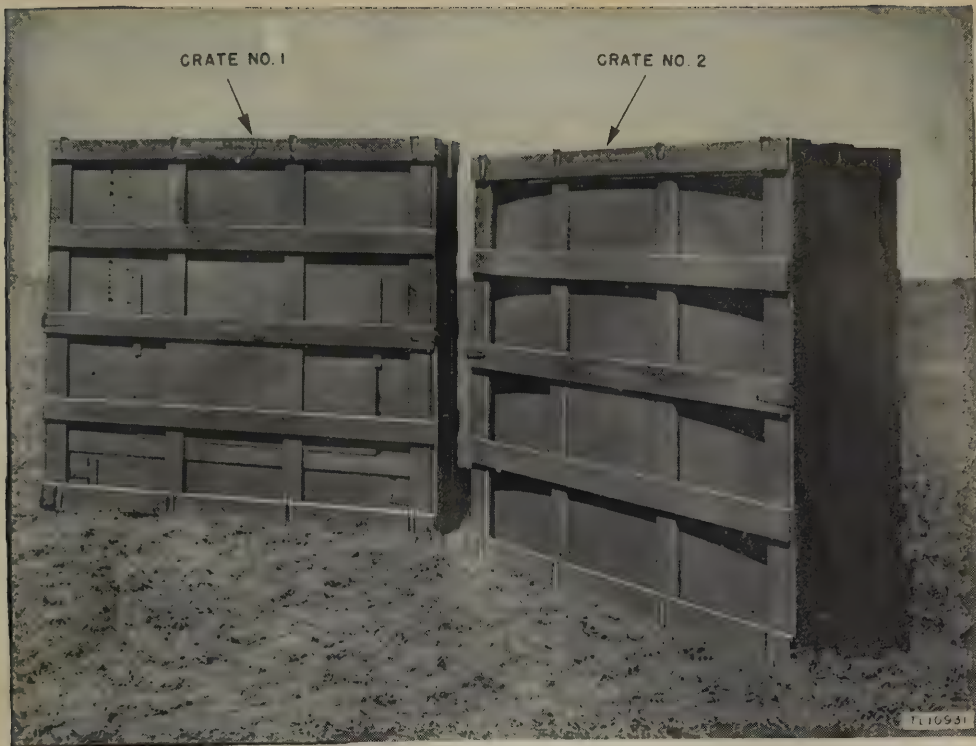


Figure 39. Shelter HO-20-B, crated.

Figure 40. Shelter HO-20-B, floor assembly,

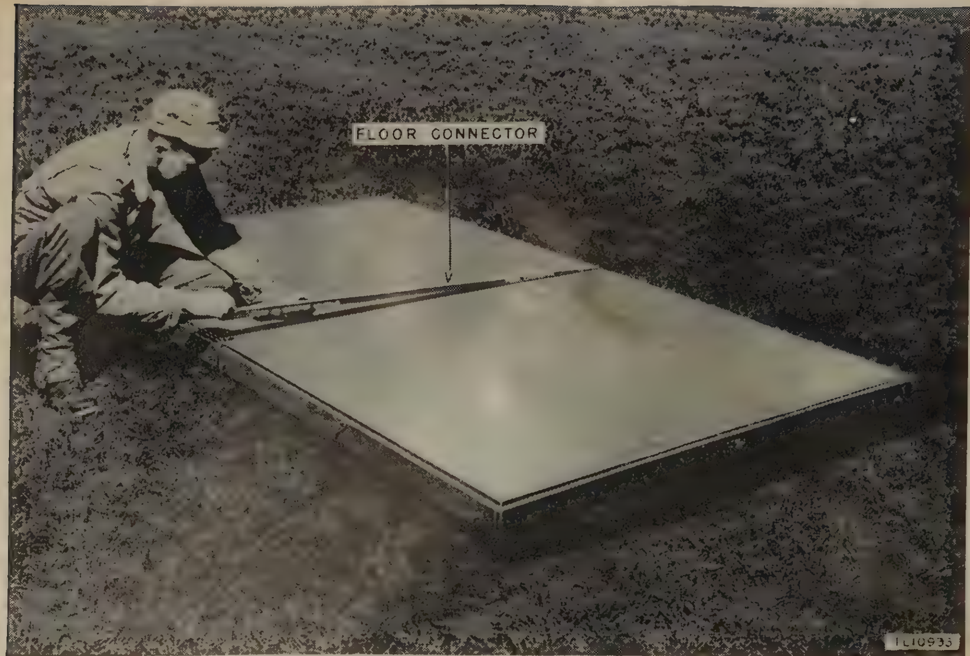


Figure 41. Shelter HO-20-B, installing floor connector.

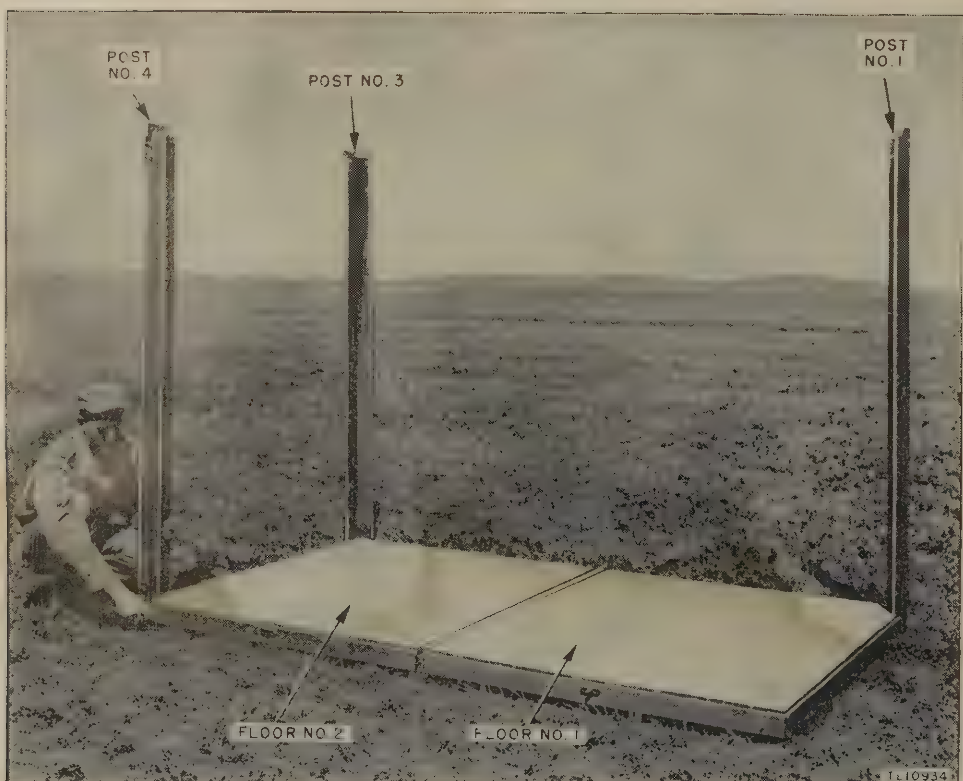


Figure 42. Shelter HO-20-B, installing corner posts.

center of the antenna system (fig. 61).

(3) Remove five antenna masts from the antenna crates and lay them beside the crates.

(4) Remove five anchor screws from the antenna crates. Also take the steel measuring tape from Chest CH–163–A.

(5) Again check that the compass is level and correctly calibrated. Make certain that the tripod is properly positioned over the marker stake.

(6) Turn the compass to bring the north end of the needle to 0° on the azimuth scale.

(7) Along the line of sight measure a distance of exactly 18 feet from the plumb-bob on the tripod.

(8) At this 18-foot point use the metal turning rod (or a spare exhaust pipe from the power unit) to turn an anchor screw into the ground. The anchor screw should be driven until the screw eye is within an inch of the ground (fig. 62). The center of the eye should be in line with the compass sights and exactly 18 feet from the plumb-bob.

Note. Because of the spiral path described by the anchor as it is twisted into the ground, slight inaccuracies may develop. However, the anchor should be positioned as accurately as possible. Refer to paragraph 32*b* for information on substitutes for the anchor screws.

(9) Without disturbing the tripod position, turn the compass to bring the north end of the needle to 90° on the azimuth scale.

(10) Install the east anchor by repeating (7) and (8) above.

(11) Turn the compass so that the needle points to 180° on the azimuth scale. Install the south anchor by repeating (7) and (8) above.

(12) Turn the compass so that the needle points to 270° on the azimuth scale. Install the west anchor by repeating (7) and (8) above.

Note. The anchor screws mark the positions of the four corner antennas. Do not move the compass from its position until the four corner antennas are erected and alined (fig. 61).

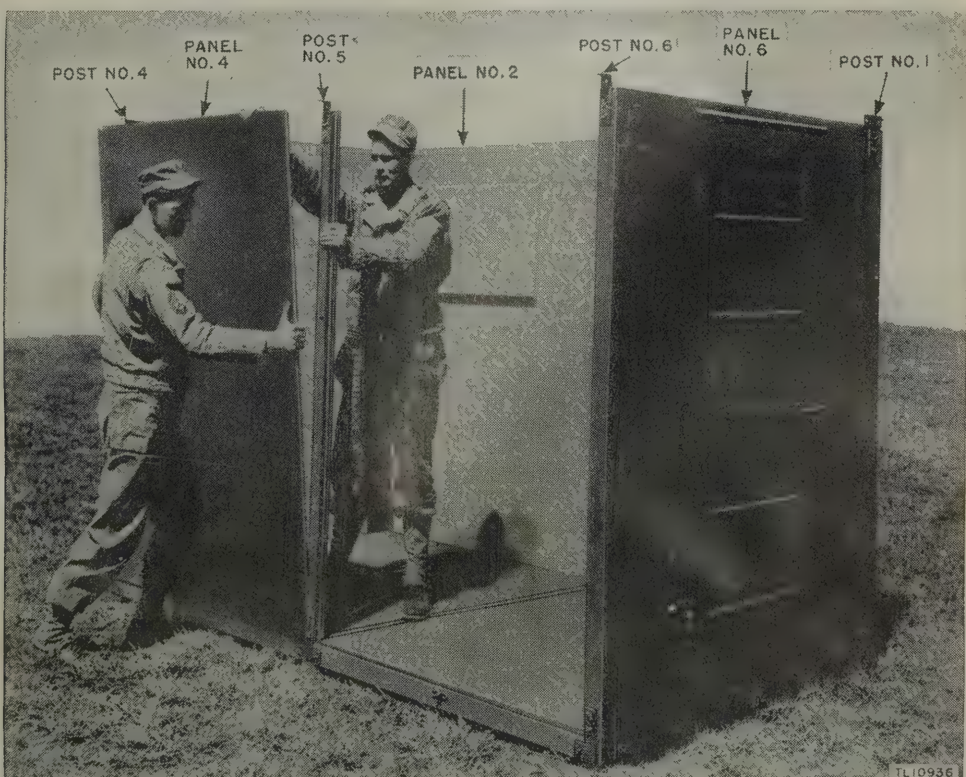


Figure 43. Shelter HO–20–B, installing panels.

Figure 44. Shelter HO–20–B, fastening panel.

31. Special Instructions

When Radio Set SCR–291–A is installed in regions where the climatic and terrain conditions are severe, the usual installation procedure must be modified so that the equipment will be secure and protected from the elements. General instructions for adverse conditions are given in paragraphs 32 and 33. It is impossible to give specific directions because of the many different conditions that are likely to be met in the field.

32. Strengthening Antenna System

a. USE OF GUYS. In regions where high winds prevail, it may be necessary to guy the antenna monopoles (par. 34). Rope or wire guys may be attached to the monopoles and anchored to stakes driven into the ground. If wire guys are used, insert ceramic or bakelite insulators at 5-foot intervals along the length of each guy. Breaking the guy into a number of short lengths, instead of using a continuous length of wire, will reduce the bearing errors caused

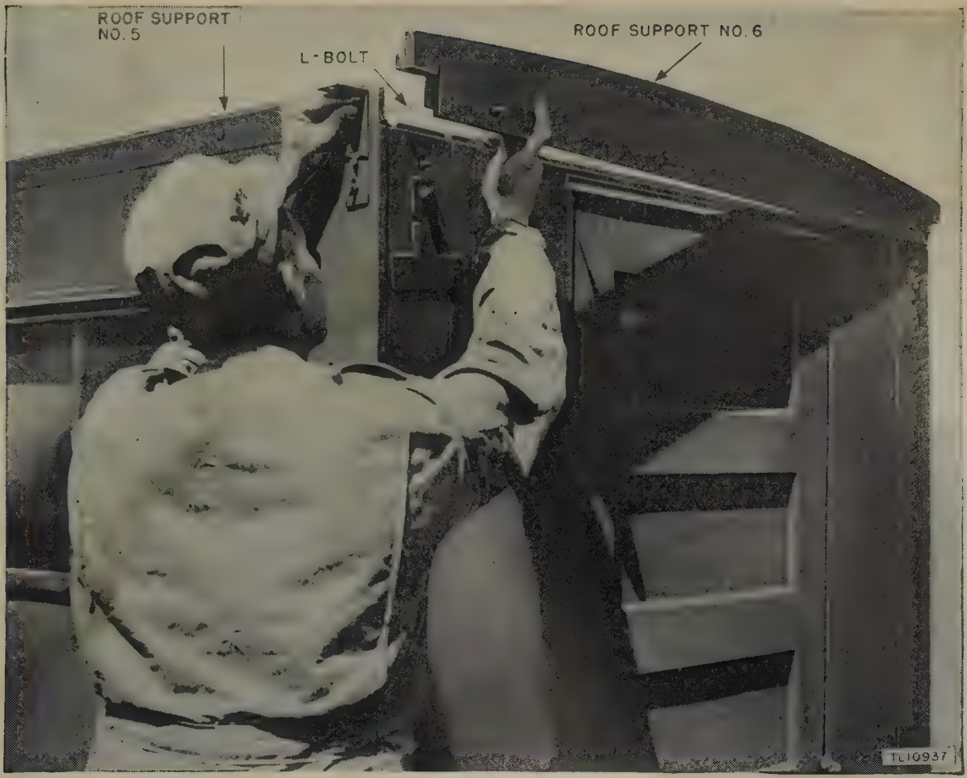


Figure 45. Shelter HO–20–B, installing roof support.

Figure 46. Shelter HO–20–B, tightening wingbolts.

Figure 47. Shelter HO–20–B, installing roof sections.

by the increased quantity of metal in the antenna array.

b. SUBSTITUTES FOR ANCHOR SCREWS. If the ground at the site is frozen, marshy, rocky, or loose sandy soil, it may be impossible to use the screw anchors and ground stakes. The following substitute anchoring methods may be satisfactory:

(1) If the ground is frozen or rocky, the anchor screws may be replaced with pipes or bars driven into the ground beneath each antenna.

(2) When the radio set must be erected on marshland, wooden piles can be driven deep enough to provide a secure anchorage for the hold-down assemblies.

(3) If the radio set is erected on loose sandy soil, it may be necessary to dig holes at the points where anchor screws are required. A firm anchorage will be secured when the holes are refilled with stones, clay, or firm earth.

c. COUNTERPOISE CP–17–A. It may be necessary to anchor Counterpoises CP–17–A when the radio set is erected in regions of prevailing high winds. Wooden stakes may be used for this purpose. *Metal stakes must not be used.*

33. Handling R-f Cords

In very cold weather, the r-f cords will become stiff and difficult to handle. Whenever possible, cold reels of cable should be placed in a heated building for 12 to 24 hours before it is necessary to handle the cables. Cold cables must be reeled very slowly and carefully to avoid cracking the outer jacket and the dielectric material. Never make sharp bends in cold cables.

34. Antenna Erection

a. GENERAL. The antenna masts telescope into 9-foot lengths. Before shipment, the telescope mast sections are clamped together by means of two expanding clamps, one within the lower end of the top section and one within the lower end of the center section. The clamp adjusting screws are reached through two holes in the lower end of the bottom mast section (fig. 62). An Allen wrench is inserted through these holes, and the adjusting screws are turned clockwise to expand the top and center sections, so that the three mast sections are tightened together and cannot come apart during transit. These expansion clamps must be loosened before the antenna sections can be extended.

b. Mast Assembly.

(1) Lay the telescoped section on the ground.

(2) Insert the Allen wrench through the upper hole in the lower end of the outside (bottom) section. Turn the adjusting screw counterclockwise to free the top section from the center section.

(3) Similarly insert the Allen wrench in the lower hole and free the center section from the bottom section.

(4) Remove the antenna wire (fig. 63) from the antenna crate.

(5) Raise the lower end of the assembly above the ground and feed the spring end of the antenna wire through the mast base (fig. 64).

(6) Continue feeding the antenna wire through the mast base until the spring end appears at the opening in the top section. Then clip the spring to the rod across the opening.

(7) Straighten out the remainder of the antenna wire.

(8) Use the Allen wrench to loosen the movable collars (fig. 65).

(9) With the assembly flat on the ground, extend the antenna mast to its full length. While extending the sections, guide the antenna wire through the antenna mast base.

(10) Slide the movable collar of the center section toward the bottom section and

Figure 48. Shelter HO–20–B, battens fastened over roof.

line up the wingnut and slot (fig. 65). Tighten the wingnut.

(11) Twist the center section to aline the locating clamp with the locating slot in the fixed collar of the bottom section.

(12) Push the center section into the bottom section so that the locating clamp is in the locating slot.

(13) Insert the Allen wrench in the upper mast hole (fig. 65) and turn the adjusting screw clockwise. This will expand the center section and tighten it against the inside of the bottom section.

(14) Tighten the movable collar by turning its Allen screw clockwise.

(15) Similarly aline the top and center sections and clamp them firmly together. Put the antenna mast cap on the top section.

(16) Position the antenna wire support assembly as shown in figure 64. Fasten the assembly to the phase inverter mounting base by turning the fastener studs a half turn.

c. LEG PIECES.

(1) Unhook the turnbuckles from the clamps that hold them flat against the bottom mast section.

(2) Attach one leg piece by hooking the leg bracket (fig. 62) to the mast collar and fitting the corresponding turn-

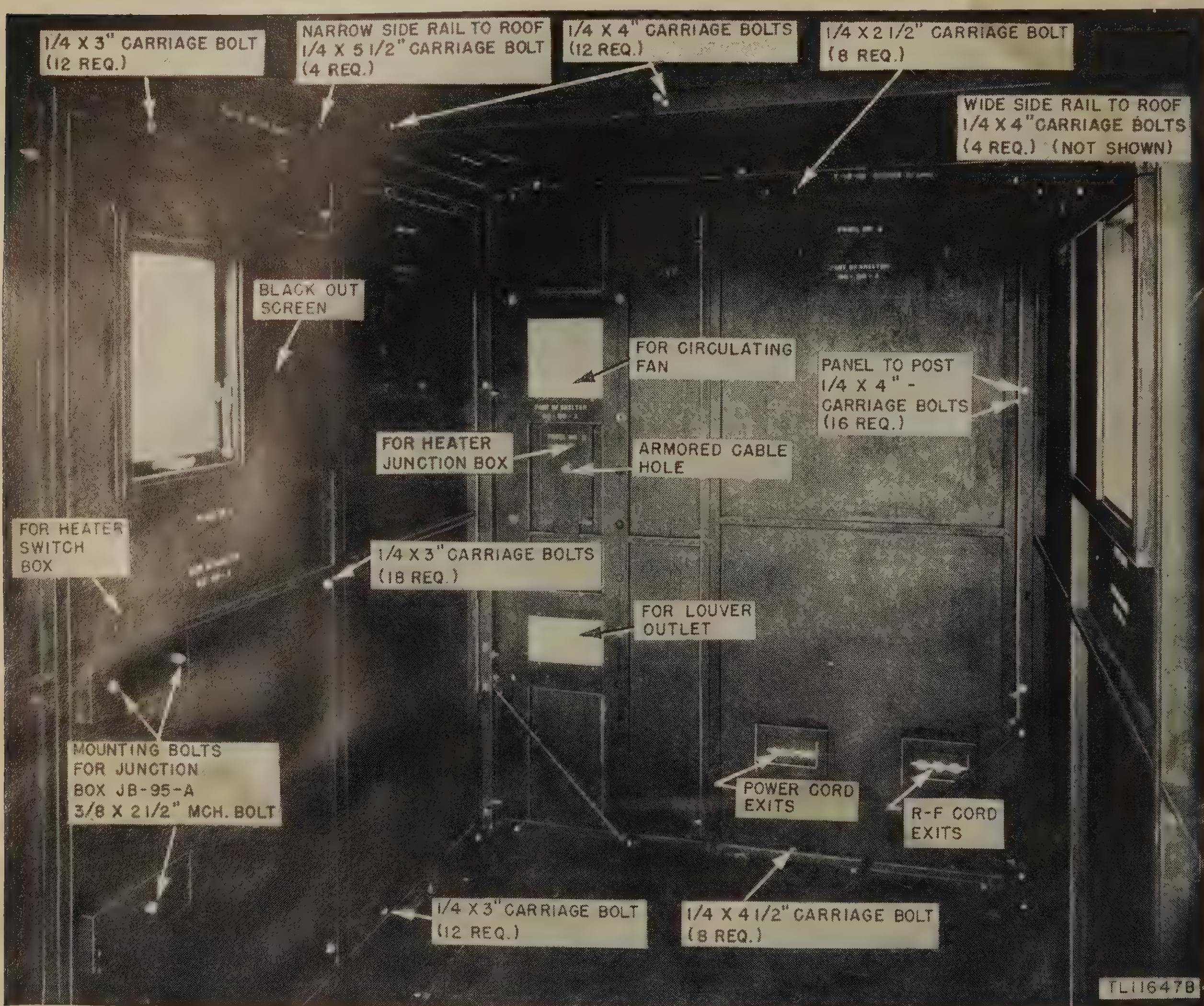


Figure 49. Shelter HO-20-A, interior.

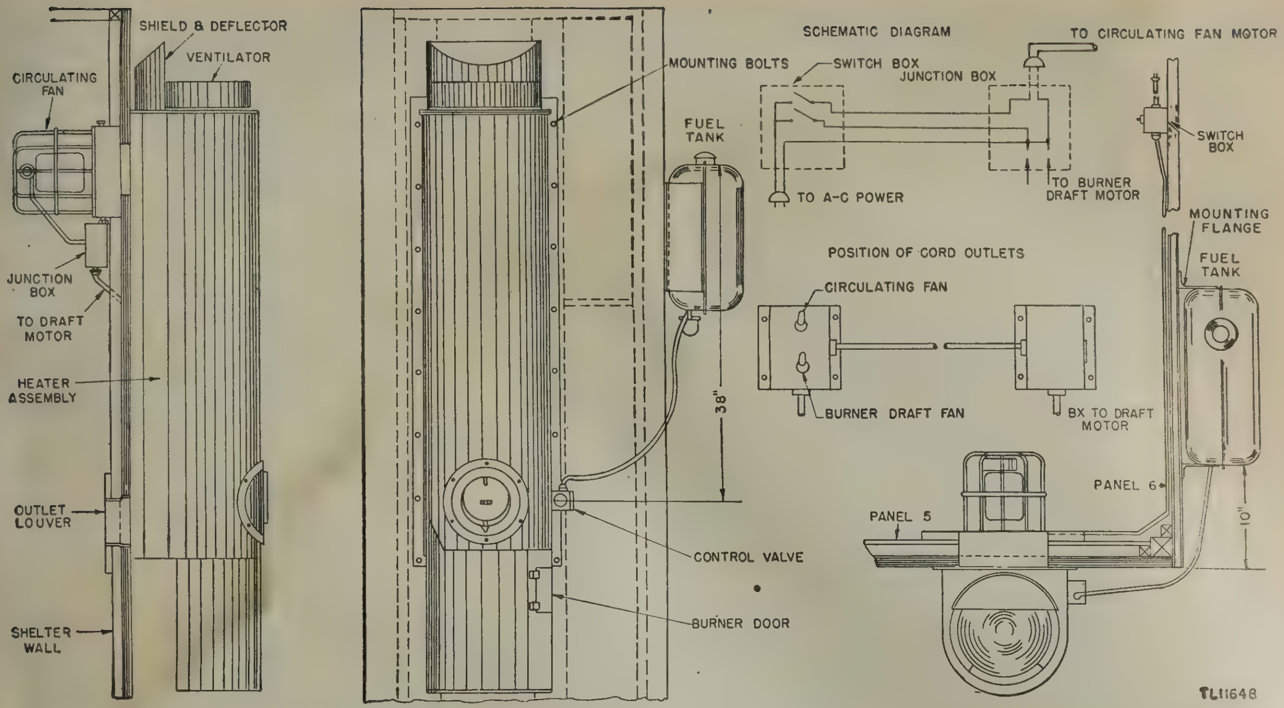


Figure 50. Installation details for gasoline heater.

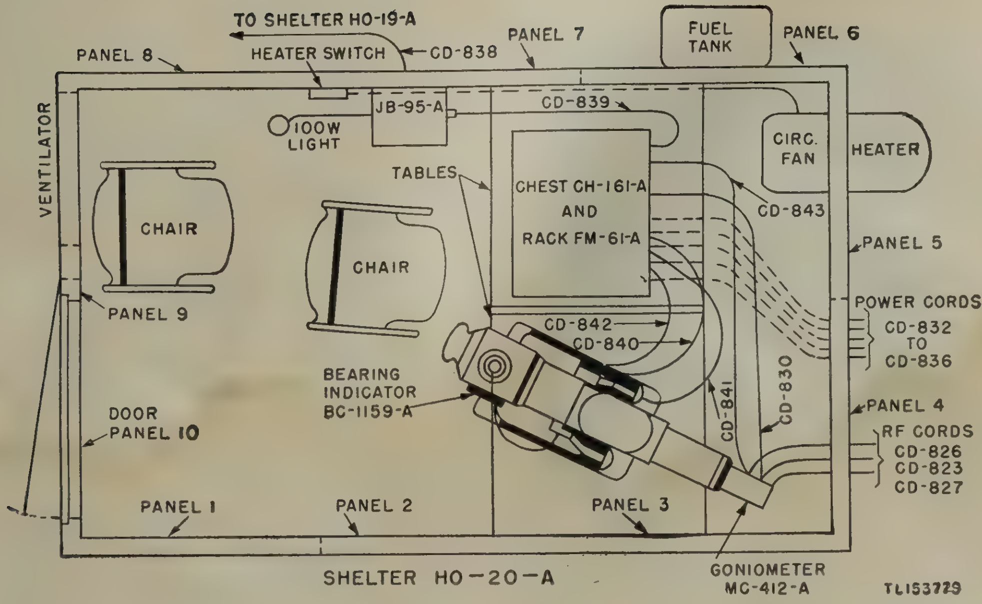


Figure 51. Shelter HO-20-A, layout of components.

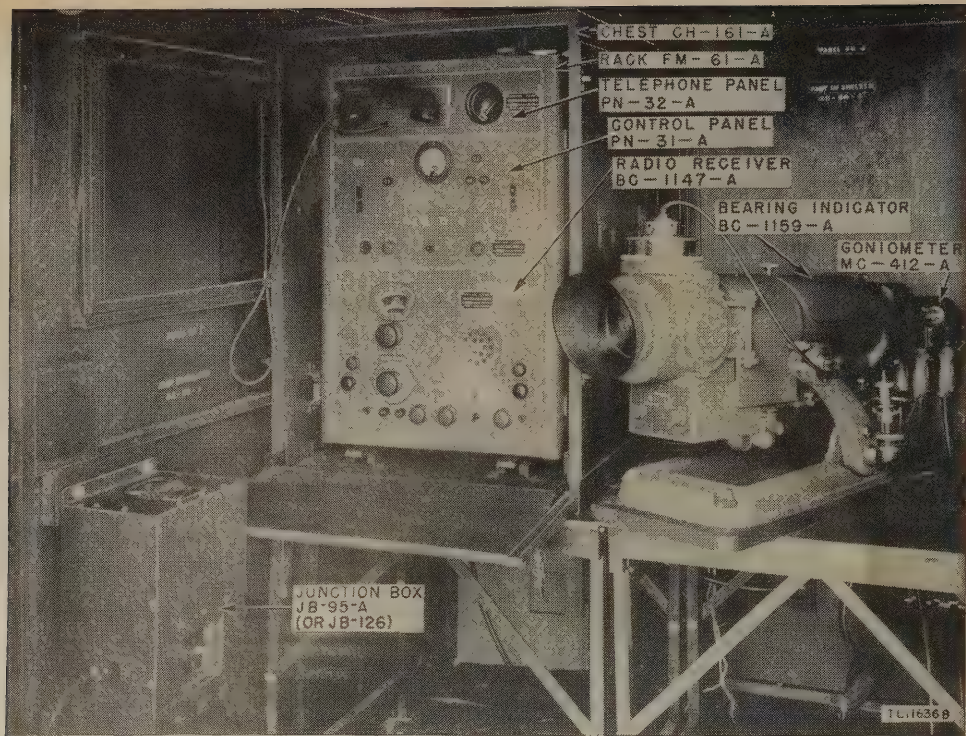


Figure 52. Shelter HO–20–( ), components installed.

buckle lug into the hook on the leg piece. A quarter turn of the turnbuckle crossbar will fasten the turnbuckle securely to the leg piece.

(3) Similarly fasten a second leg piece to the mast assembly.

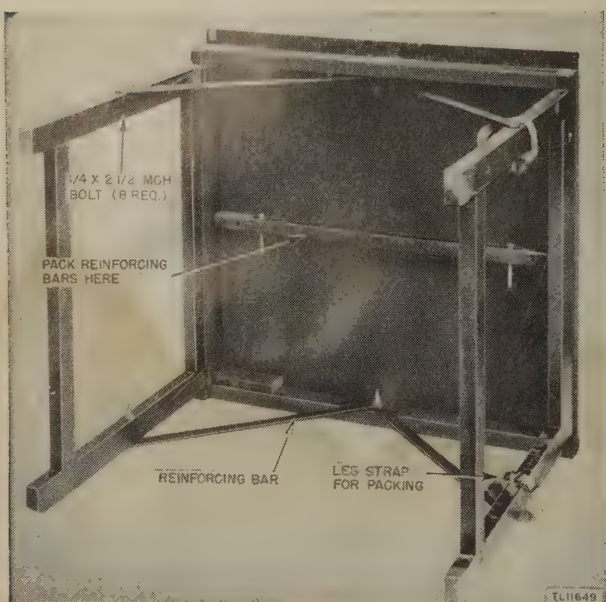


Figure 53. Assembly detail of table.

(4) With the mast top on the ground and with the bottom supported by the two attached leg pieces, attach the third leg piece to the mast assembly.

(5) Erect the mast by lifting the mast top and walking toward the leg assembly until the third leg comes down far enough to be reached. One man can then guide the mast by means of the third leg, while a second man continues to raise the mast to its vertical position.

35. Antenna Positioning

a. PROCEDURE.

(1) Turn the compass so that the north end of the needle is at 0°.

(2) On the line of sight and at a distance of 100 yards from the compass, drive a marker stake.

(3) Center the antenna assembly over the north anchor.

(4) Adjust the turnbuckles to raise or lower the mast, so that the distance from the bottom edge of the phase inverter mounting plate to the ground is 3 feet 10 inches ($\pm\frac{1}{2}$ inch).

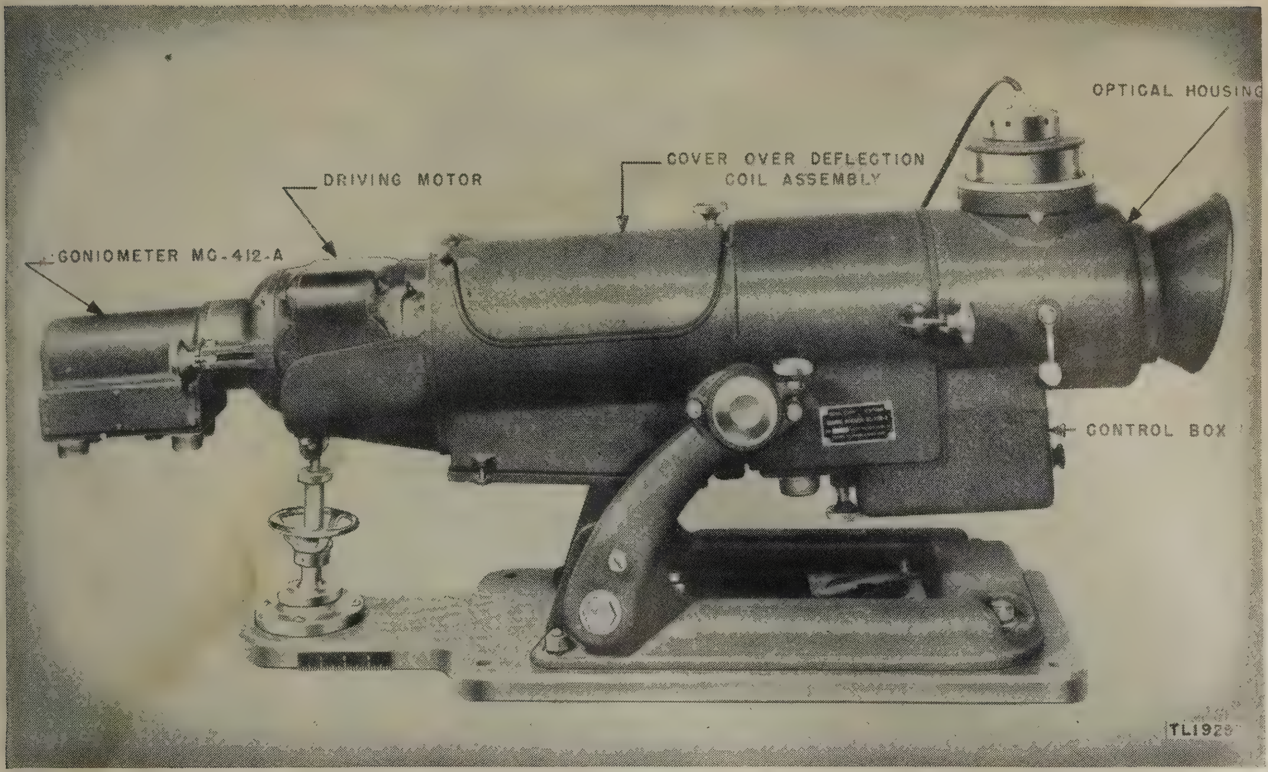


Figure 54. Goniometer MC–412–A and lamp assembly, mounted on Bearing Indicator BC–1159–A.

(5) With the spirit level (packed in Chest CH–163–A), check the vertical alinement of the mast. Make the check by holding the spirit level vertically against the bottom mast section and immediately above one of the leg pieces. Adjust the leg piece turnbuckles until the horizontal bubble in the spirit level is in the exact center of the viewing tube.

(6) Repeat (5) above for each leg piece.

(7) Attach a plumb-bob to the antenna jack in the antenna mast base.

(8) Carefully move the mast to put the plumb-bob exactly over the ground anchor. The plumb-line and the marker stake should now be exactly in line when viewed from the compass. The distance betwen the antenna plumb-line and that on the compass should be 18 feet.

(9) Without disturbing the position of the antenna, slide a base plate under each antenna leg and drive in the anchor spikes (fig. 66).

(10) Attach the hold-down assembly as shown in figure 62 and tighten the turnbuckles until the assembly is tight and the mast secure.

Caution: Do not tighten the hold-down assembly enough to shift the antenna from its correct position.

(11) Carefully recheck the vertical alinement and positioning of the antenna. Make any readjustments needed to obtain correct distances or to make the antenna vertical.

(12) With the compass turned successively to 90°, 180°, and 270°, install the east, south, and west antennas, respectively (fig. 61). With the compass at 90°, drive a marker stake on the line of sight and at a distance of 100 yards from the compass.

b. Checking Antenna Alinement.

(1) Move the compass and tripod to the north marker stake (*a*(2) above).

(2) With the compass exactly over the marker stake, sight the compass on the north antenna. If the north-south

843134°—49—4

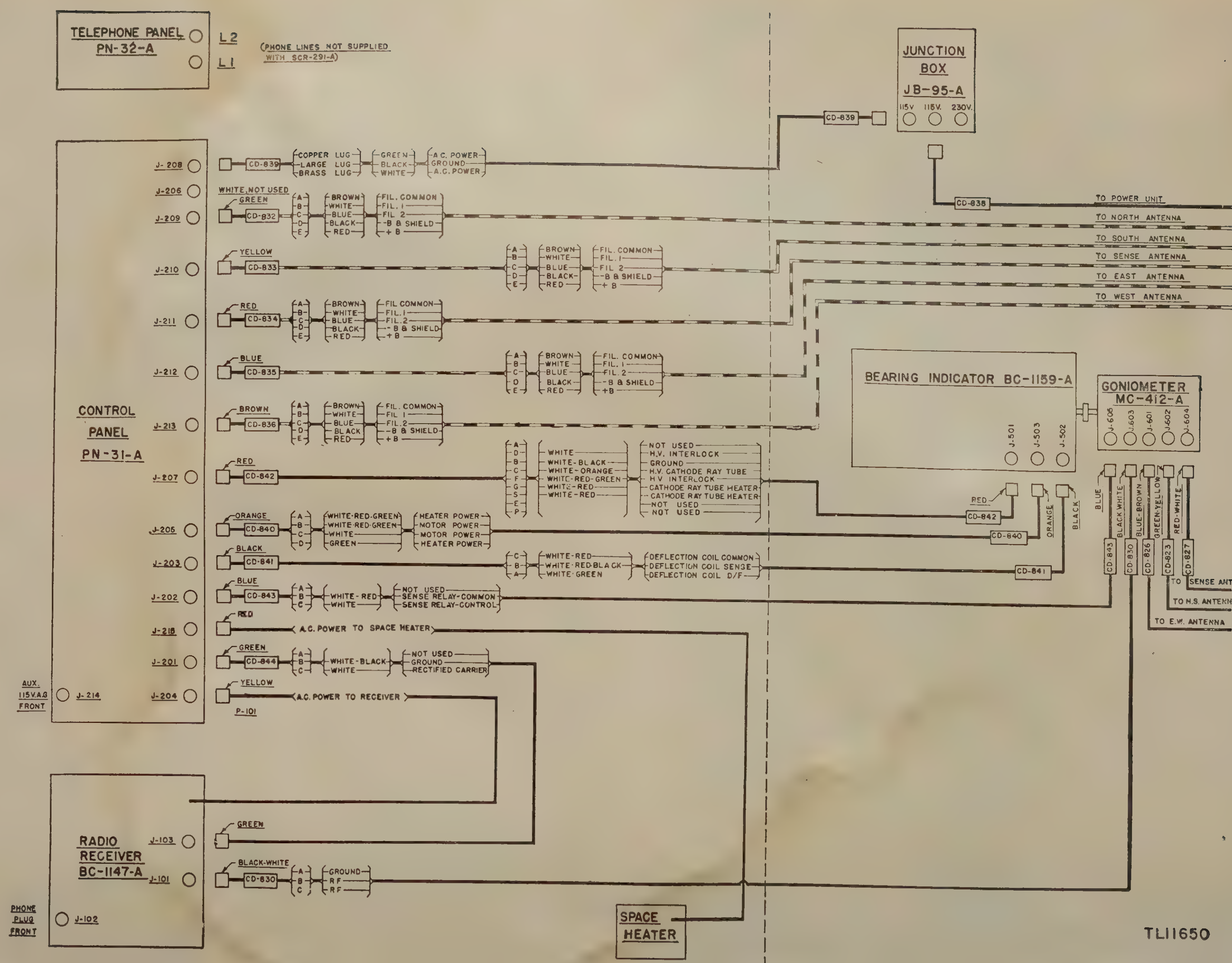


Figure 55. Radio Set SCR-291-A, cording diagram.

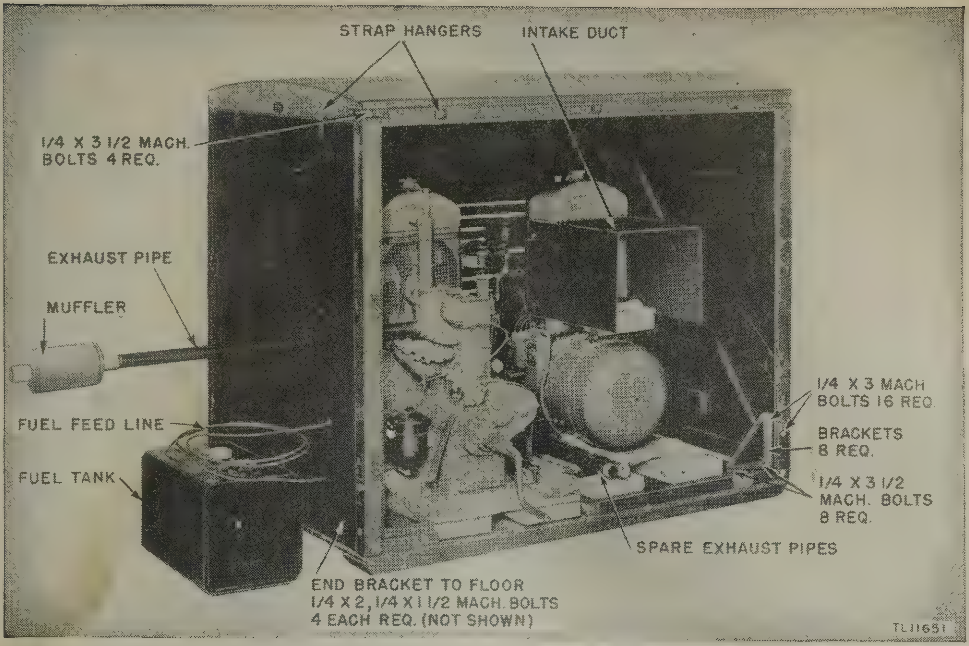


Figure 56. Shelter HO–19–A, construction details.

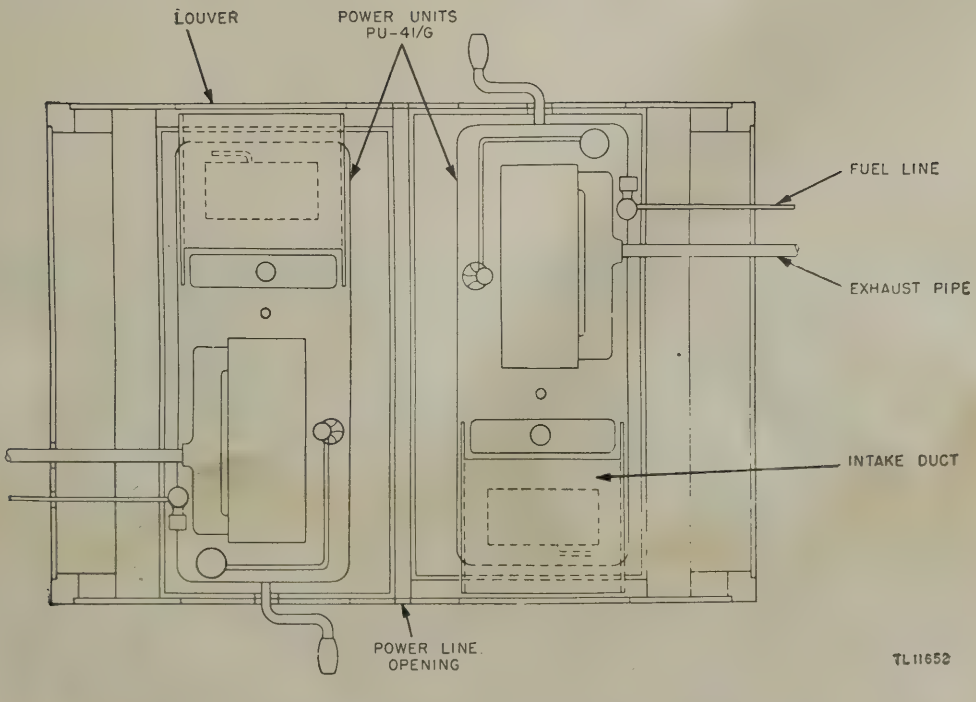


Figure 57. Shelter HO–19–A, plan view of power unit layout.

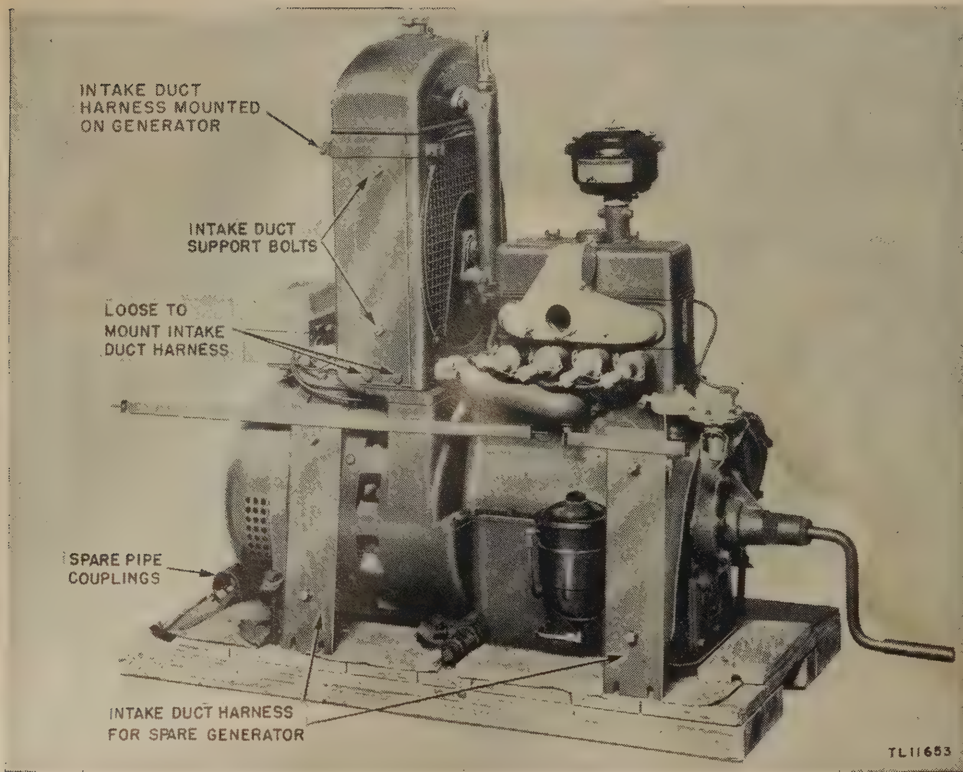


Figure 58. Power Unit PU–41/G, installation of intake ducts.

antennas are properly positioned, the south antenna will be exactly in line with the north antenna.

(3) Move the compass to the east marker stake and sight on the east antenna. The west antenna should be exactly in line with the east antenna.

(4) Measure the distance between the centers of each pair of diagonally opposite monopoles. The distances should be 36 feet ($\pm\frac{1}{2}$ inch).

(5) Measure the shortest distances between the phase inverter mounting plates on the north and east, the east and south, the south and west, and the west and north antennas. Each of these distances should be 25 feet $\frac{3}{8}$ inch ($\pm\frac{1}{2}$ inch).

(6) If the check measurements are incorrect, carefully repeat the entire alinement procedure. The final accuracy in the operation of this direction finder is determined largely by the accuracy of the antenna orientation.

36. Sense Antenna

a. Erecting Sense Antenna. Assemble the sense antenna and position it over the marker stake at the center of the antenna array.

b. Positioning Sense Antenna. Adjust the mast height so that the phase inverter mounting plate is 3 feet 10 inches from the ground. Check the vertical alinement of the antenna and then proceed as follows:

(1) With the compass set at the north marker stake, sight along the north-south antennas. Move the sense antenna exactly in line with the north-south antennas.

(2) Move the compass to the east marker stake and sight along the east-west antennas. Keeping the sense antenna in line with the north-south antennas, move it exactly in line with the east-west antennas.

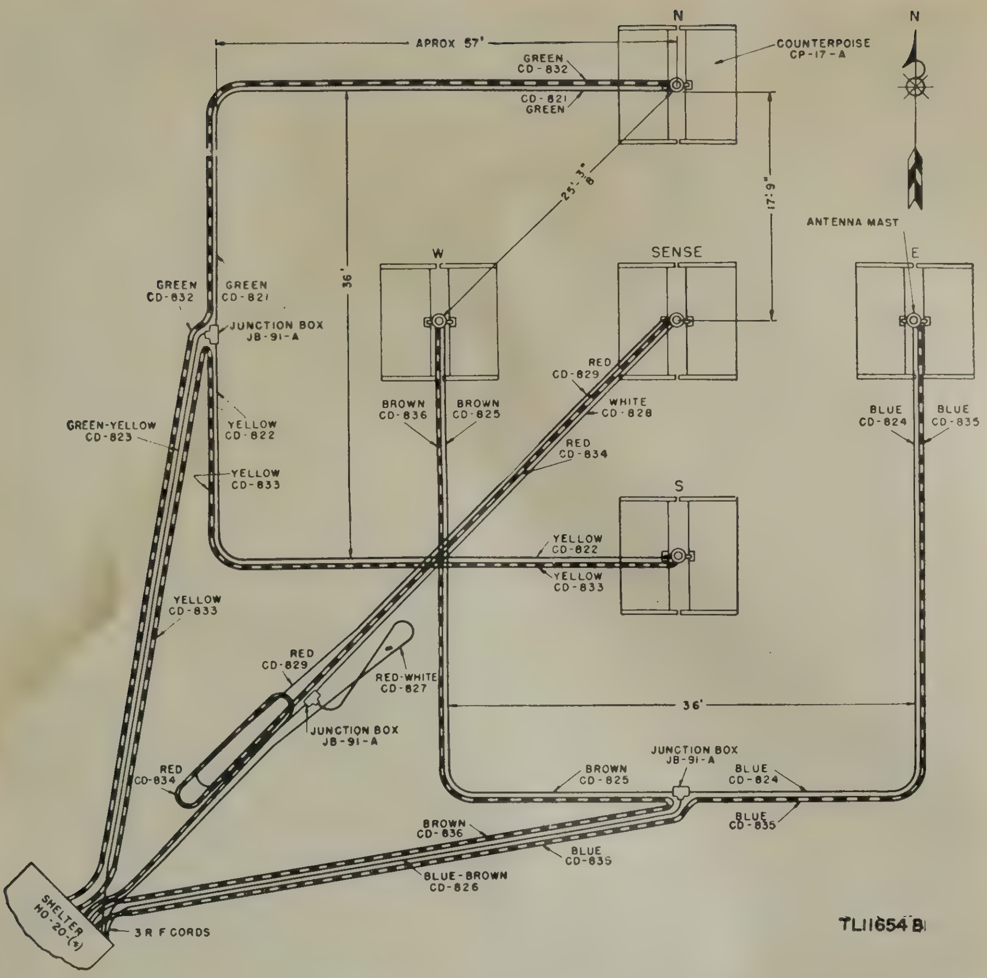


Figure 59. Antenna system layout and installation diagram.

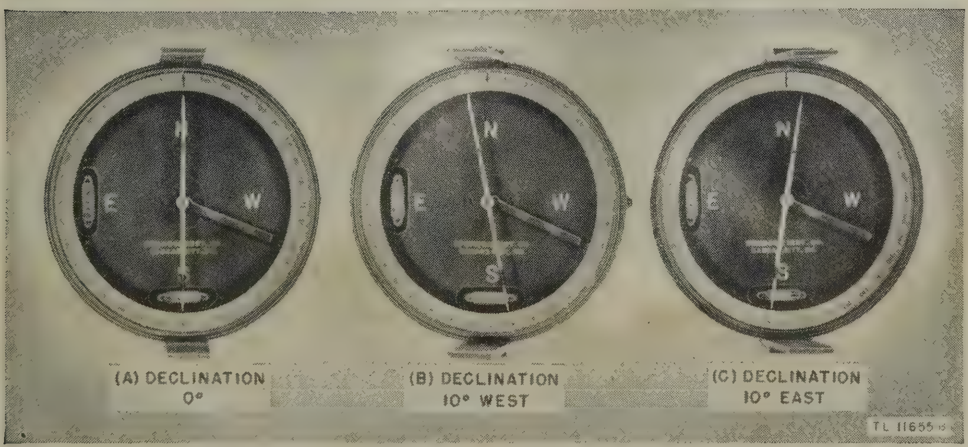


Figure 60. Calibration of Compass MC–324–( ).

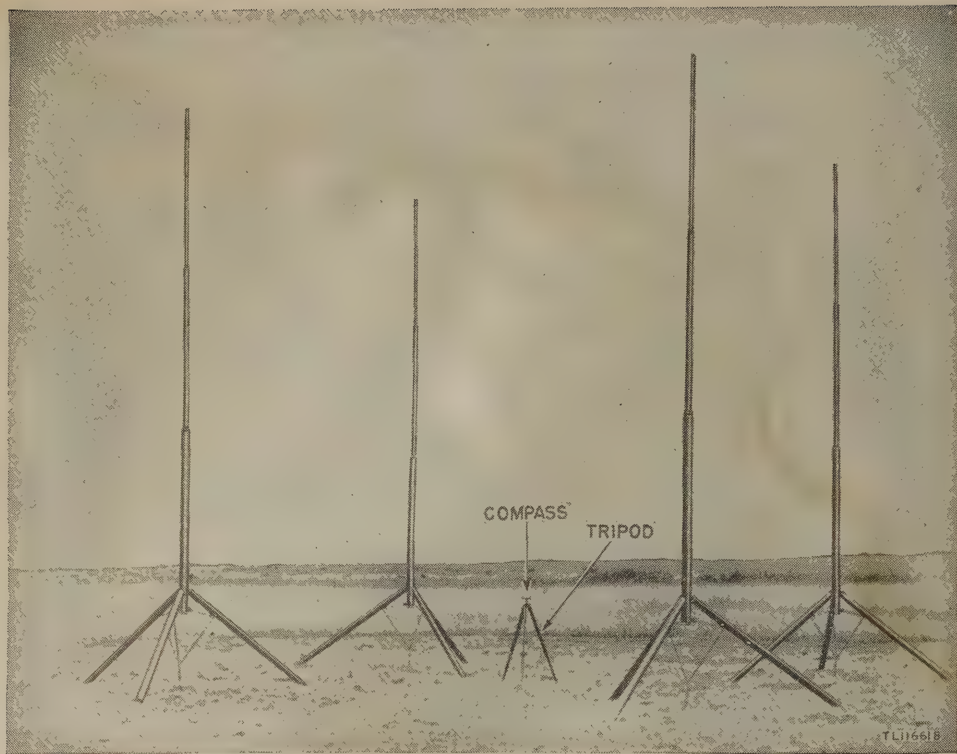


Figure 61. Compass and tripod at center of antenna array.

(3) Slip the base plates under the sense antenna legs and drive in the anchor stakes.

(4) Recheck the vertical alinement. Also make sure that the sense antenna is exactly in line with the north-south and the east-west antennas.

37. Phase Inverter Installation

a. General. The phase inverters are stored in Chest CH–163–A. Each phase inverter is marked to indicate the antenna with which it should be used. Thus, the stencil marking E, W, N, S, or C indicates that the inverter should be attached to the east, west, north, south, or center (sense) antenna, respectively.

b. Installation.

(1) Insert the phase inverter banana plug into the antenna jack in the antenna base (fig. 64).

(2) Push the phase inverter upward and insert the phase inverter studs into the keyed slots of the phase inverter mounting plate.

(3) Twist the phase inverter clockwise as far as it will go. A spring clip latches over one of the mounting studs and locks the inverter in place.

(4) After the four Phase Inverters MC–411–A have been installed on the corner antennas, install Phase Inverter MC–413–A on the sense antenna.

38. Counterpoise Installation

a. General. The counterpoises must be carefully installed. All connections must be clean and tight, and the counterpoises should be checked frequently for loose connections or corrosion. Improperly installed counterpoises can cause large bearing errors.

b. Installation.

(1) Remove the 10 counterpoise screen sections from Chest CH–209–A.

(2) Position one pair of screens under each antenna mast (fig. 62) so that

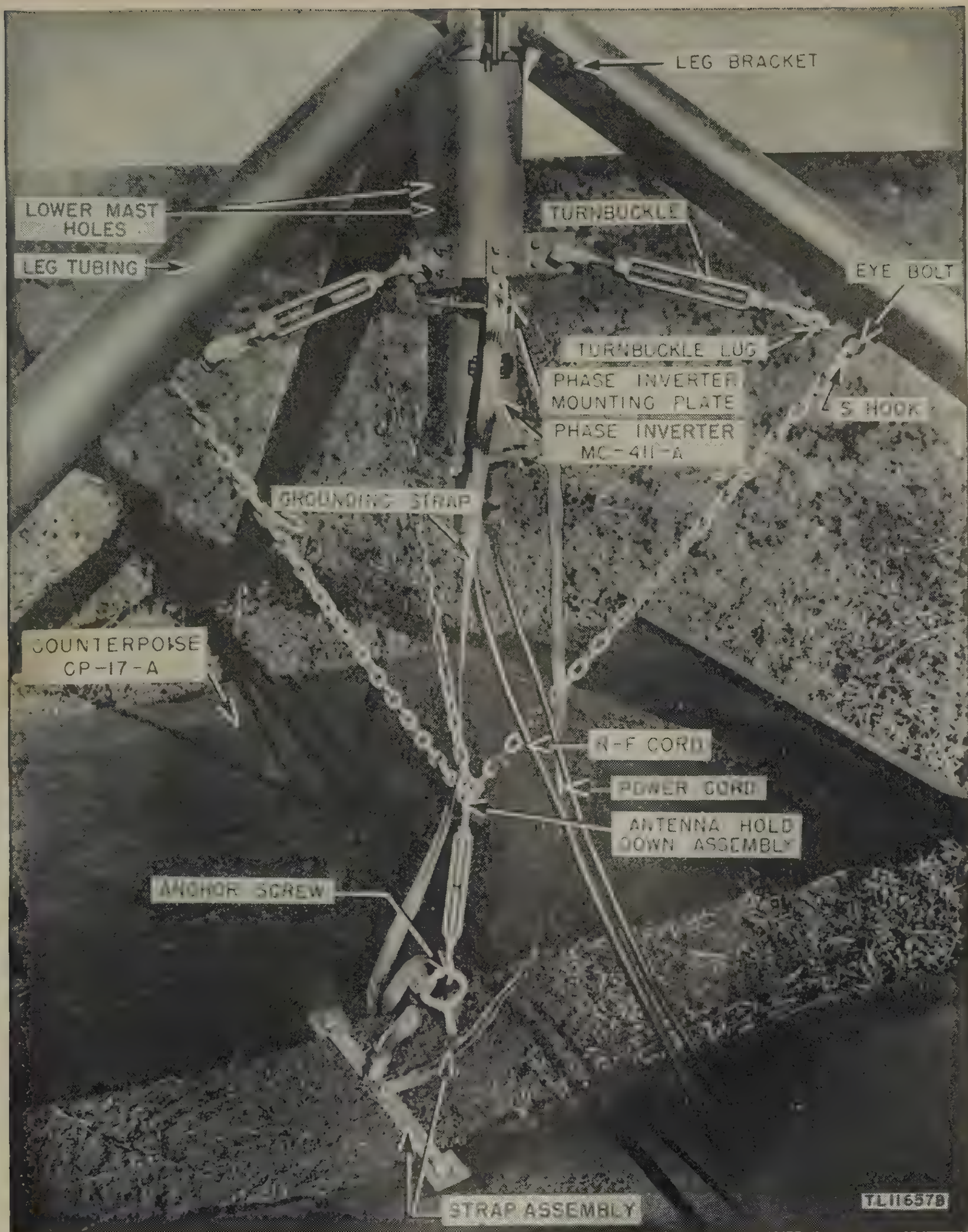


Figure 62. Antenna hold-down assembly and Counterpoise CP–17–A.

the wooden strips just meet and the anchor screw is at the center of the space between the screen sections.

(3) Remove a strap assembly from the cover of Chest CH–209–A and connect the crossbar between the copper plates on the screen sections.

(4) Under one of the wingnuts on the phase inverter housing at the antenna mast base, fasten the lug at the braid end of the assembly.

(5) Remove a grounding strap from the right-hand compartment of Chest CH–209–A and fasten the clamp to the anchor screw under the antenna mast.

(6) Fasten one of the grounding strap lugs under the wingnut on the crossbar assembly; fasten the other lug under the wingnut on the lower mast collar (fig. 62).

(7) Install the five counterpoises by following (2) through (6) above.

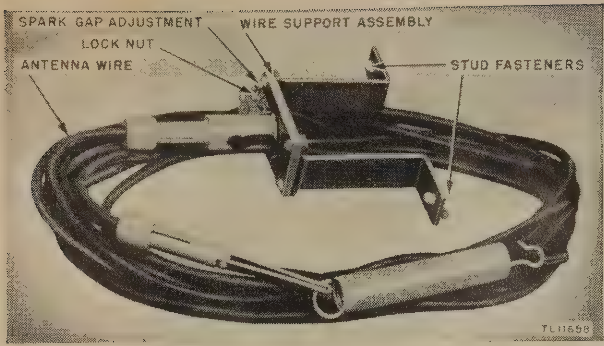


Figure 63. Antenna wire assembly.

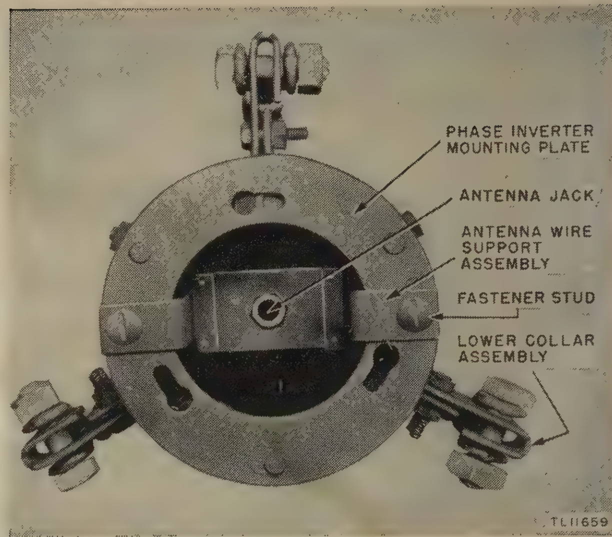


Figure 64. Antenna mast, base detail.

39. Cording

a. GENERAL. Use Reel Unit RL–49–A (fig. 67) to unreel cords from Reels DR–10–A. To avoid tangling the cords, place each one in position as it is unreeled. Refer to figures 55 and 59, *and to the cording diagram on the rear door of Rack FM–61–A.* The cords must be laid out accurately to insure proper operation of the direction finder.

b. R-F CORDS CD–821 THROUGH CD–829.

(1) Mount Reel DR–10–A, Unit RF–724–1, on Reel Unit RL–49–A.

(2) Unreel and position Cords CD–825, CD–824, CD–822, CD–821, and CD–823, in that order.

(3) Remove the empty reel and mount Reel DR–10–A, Unit RF–725–1, on the reel unit.

(4) Unreel and position Cords CD–826, CD–829, CD–828, and CD–827, in that order.

(5) Leaving Cord CD–845 (trouble cord) on the reel, remove Unit RF–725–1 from the reel unit.

(6) Take three Junction Boxes JB–91–A from Chest CH–163–A and connect

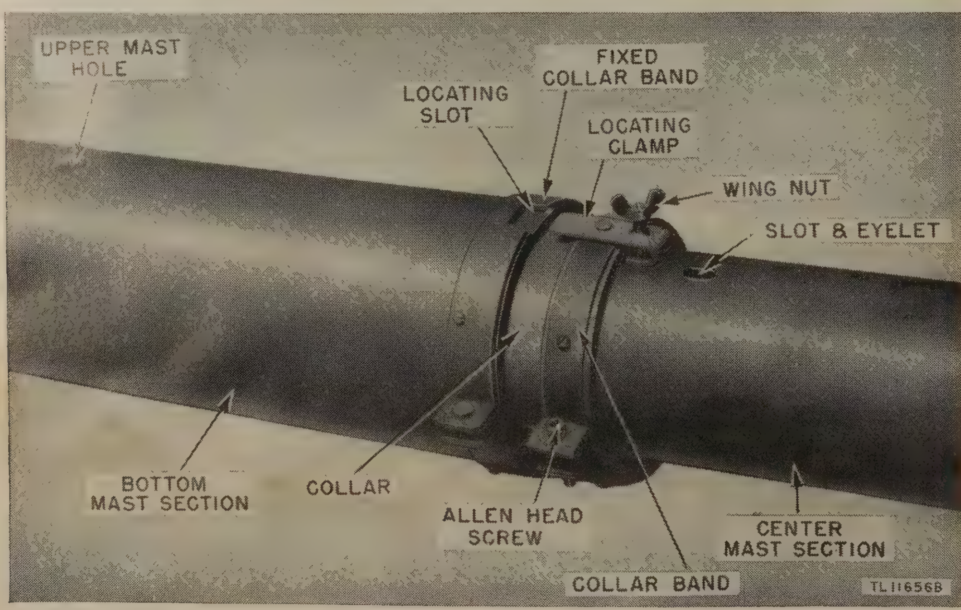


Figure 65. Antenna section clamping detail.

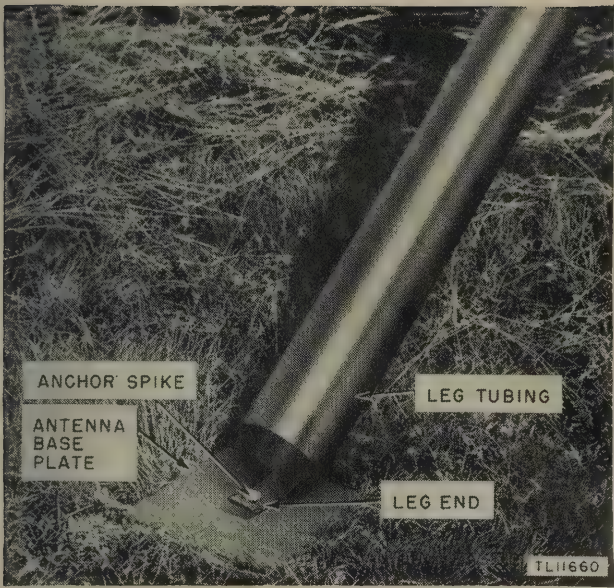


Figure 66. Antenna leg anchored through base plate.

them to the r-f cords. Be careful to match the color coding on the junction box plates with the color coding on the cord plugs.

(7) Connect the cords to the antenna phase inverters. Be sure that the color codings on the phase inverter receptacles match the color codings on the cord plugs.

(8) Pass the ends of r-f Cords CD–823, CD–826, and CD–827 through the three-slot cable entrance in the rear of Shelter HO–20–( ). Connect these r-f cords to the goniometer, as indicated on the cording diagram attached to the rear door of Rack FM–61–A.

c. Power Cords CD–832 Through CD–836, and CD–838.

(1) Mount Reel DR–10–A, Unit RF–726–1, on the reel unit.

(2) Unreel and position phase inverter power Cords CD–832 through CD–836, in that order. Connect these cords as shown in figure 59.

(3) Unreel the a-c power Cord CD–838 and connect the spade lug end to the power unit in Shelter HO–19–A. Pass the other end of this cord through the entrance in the side of Shelter HO–20–( ), and connect it to the 115-volt

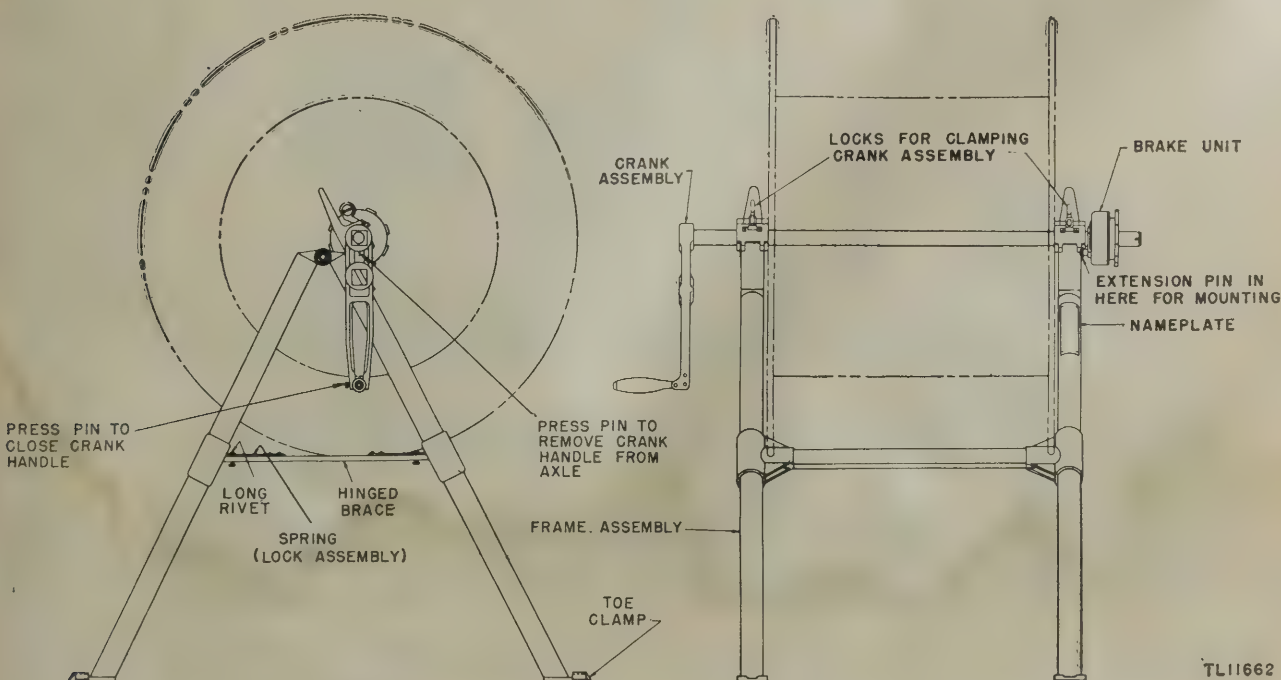


Figure 67. Reel DR–10–A in Reel Unit RL–49–A, line drawing.

receptacle on the bottom of Junction Box JB–95–A (or JB–126).

Note. If a 230-volt power supply is being used, connect Cord CD–838 to the 230-volt receptacle on the bottom of Junction Box JB–95–A.

(4) Pass the ends of the phase inverter power cords through the five-slot cable entrance in the rear of Shelter HO–20–( ). Refer to the cording diagram on the rear door of Rack FM–61–A and connect the power cords to Control Panel PN–31–A.

40. Repacking Radio Set SCR–291–A (fig. 68)

If the additional protection of export packaging is not required, the crates and chests furnished with Radio Set SCR–291–A are suitable for transporting the components. To dismantle the radio set, reverse the sequence followed in the installation procedure. Usually, local conditions will determine the order in which the components can be most conveniently dismantled and repacked. The crates and chests, the contents of each, and necessary repacking instructions are given in paragraph 41 through 55.

41. Reels DR–10–A (fig. 69)

a. GENERAL. The phase inverter and power unit cords are rewound on four Reels DR–10–A. Each reel is marked with an identification number, and the subparagraphs which follow list the order in which the cords should be rewound on the reels. After the cording has been rewound, replace the reel protectors to prevent damage to the cording during transit. On later order numbers, the cord numbers of Cords CD–832 through CD–836 have all been changed to CD–831, and Cords CD–821 through CD–827 have all been changed to CD–820. The color cod-

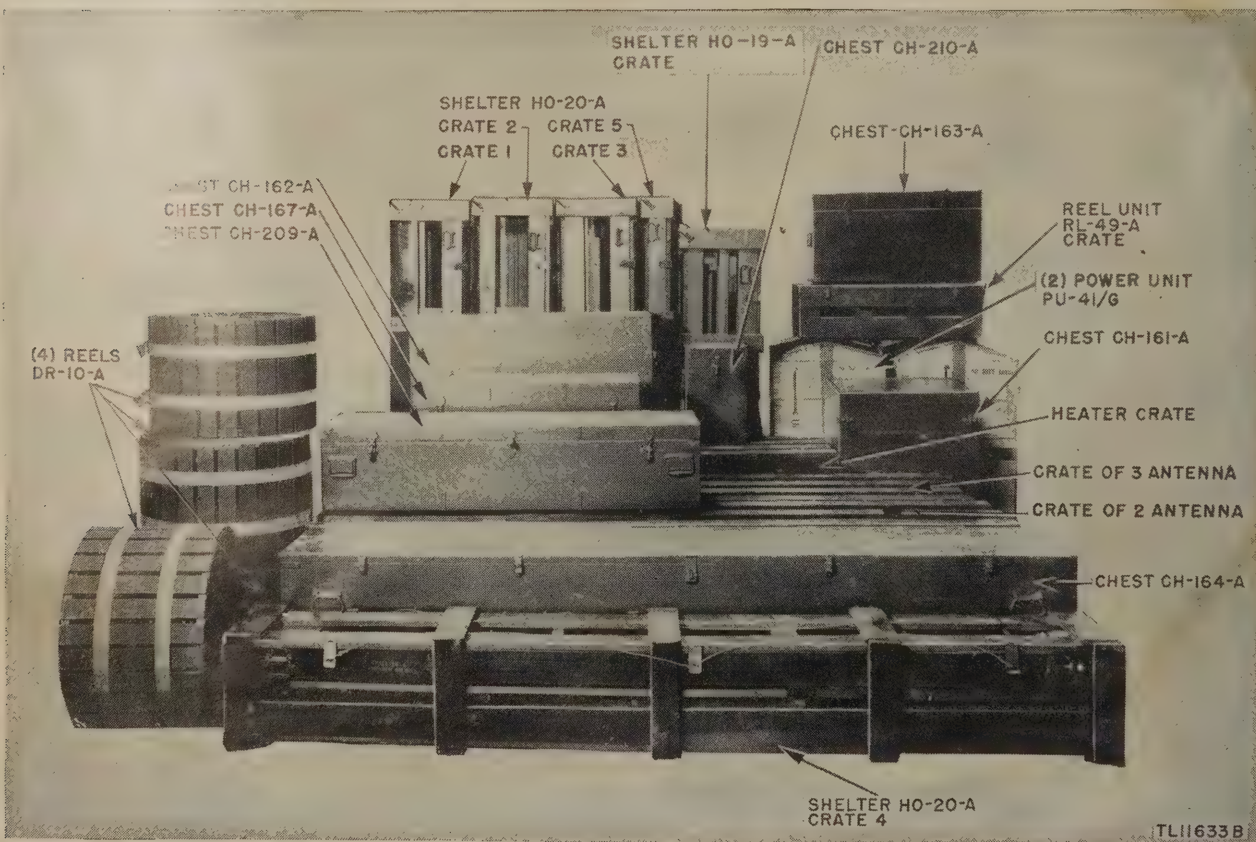


Figure 68. Radio Set SCR–291–A, repacked for transportation

Figure 69. Reel DR–10–A and cable protector.

ing is unchanged, however, and is given in the subparagraphs below.

b. Reel Assembly RF–726–1. If the cords are marked CD–831, observe the color code. Rewind in the following order:

(1) Cord CD–838 (not color-coded).
(2) Cord CD–836 (brown).
(3) Cord CD–835 (blue).
(4) Cord CD–834 (red).
(5) Cord CD–833 (yellow).
(6) Cord CD–832 (green).
(7) Replace the reel protector.

c. Reel Assembly RF–725–1. If the cords are marked CD–820, observe the color code. Rewind in the following order:

(1) Cord CD–845 (not color-coded).
(2) Cord CD–827 (red-white).
(3) Cord CD–828 (white).
(4) Cord CD–829 (red).
(5) Cord CD–826 (blue-brown).
(6) Replace the reel protector.

d. Reel Assembly RF–724–1. If the cords are marked CD–820, observe the color code. Rewind in the following order:

(1) Cord CD–823 (green-yellow).
(2) Cord CD–821 (green).
(3) Cord CD–822 (yellow).
(4) Cord CD–824 (blue).
(5) Cord CD–825 (brown).
(6) Replace the reel protector.

e. Reel Assembly RF–727–1. Rewind the following spare cords in the order indicated:

(1) Cord CD–820 (not color-coded).
(2) Cord CD–828 (white).
(3) Cord CD–829 (red).
(4) Cord CD–831.
(5) Replace the reel protector.

42. Reel Unit RL–49–A (fig. 70)

After the cords have been rewound on the reels, disassemble Reel Unit RL–49–A and pack it in the reel unit crate.

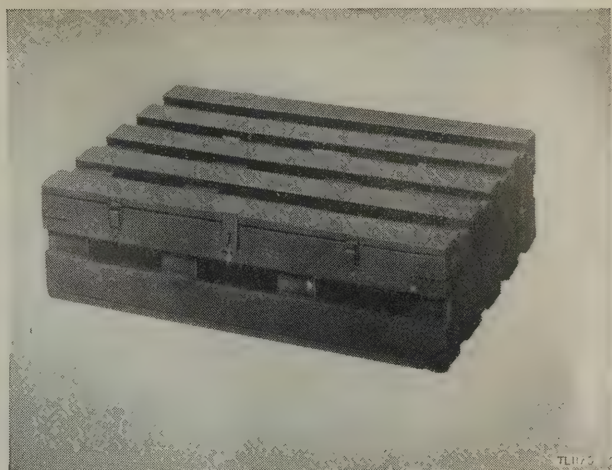


Figure 70. Reel Unit RL–49–A, crated

43. Chest CH–209–A (fig. 71)

Refer to the contents list attached to the inside of the chest cover. Repack the contents (fig. 72).

44. Chest CH–164–A (fig. 73)

a. Chest CH–164–A contains two spare Antenna Equipments RC–223–A, including two telescoped mast sections, six leg sections, six antenna base plates, six anchor spikes, two antenna hold-down assemblies, two antenna wire assemblies and two anchor screws.

b. If the spare antennas have been removed from the chest, repack as follows:

(1) Remove the blocks from the chest.
(2) Place the two anchor screws at the front of the chest bottom.

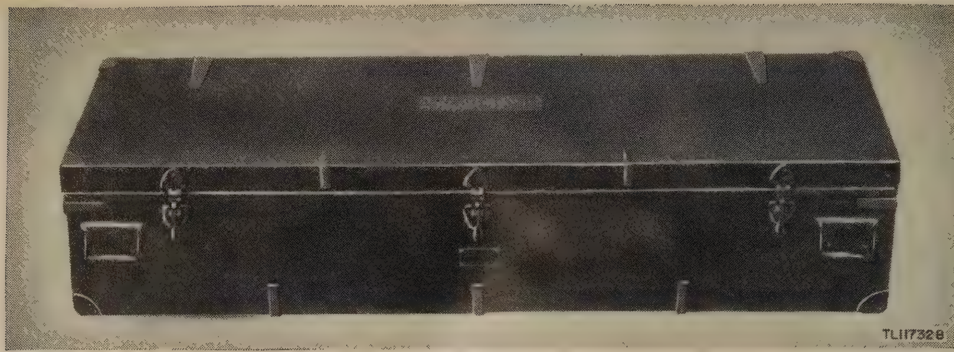


Figure 71. Chest CH–209–A.

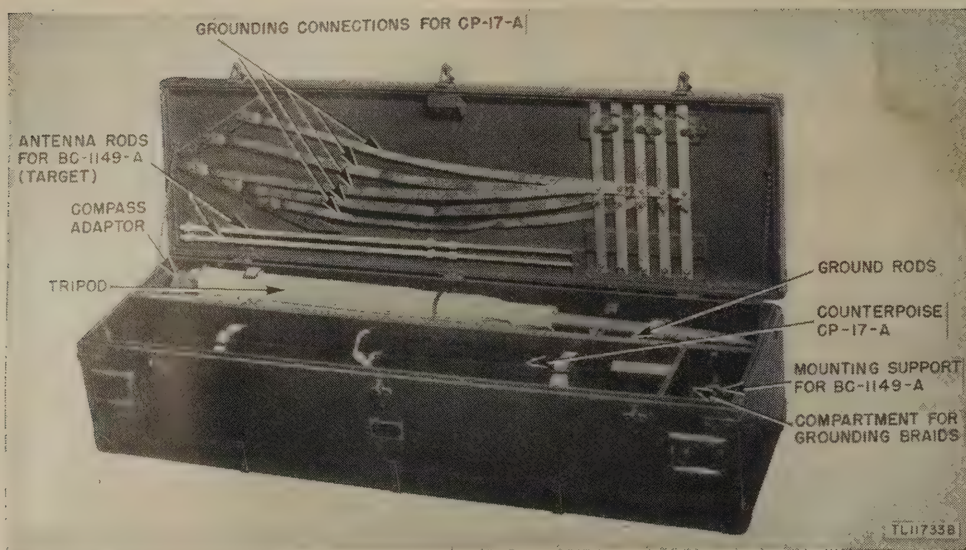


Figure 72. Chest CH–209–A, arrangement of contents.

(3) Place the two telescoped mast sections, with turnbuckles turned back and caught on the turnbuckle catch, on the bottom of the chest.

(4) Replace the two blocks in the chest.

(5) Place the two groups of leg sections on top of the blocks.

(6) Put the six anchor spikes in the compartment holes at the upper front corner of the chest.

(7) Put the six antenna base plates alongside the spikes.

(8) Put the two hold-down assemblies at the rear of the same compartment.

(9) Put the two antenna wire assemblies in the second compartment.

45. Crates for Antenna Equipments RC–223–A

a. The crate (fig. 74) for two Antenna Equipments RC–223–A is similar to Chest CH–164–A. The repacking procedure is the same as that for Chest CH–164–A.

b. The crate for three Antenna Equipments RC–223–A (fig. 75) is somewhat larger than Chest CH–164–A. Except that three equipments are packed in the crate, the repacking procedure is the same as that described for Chest CH–164–A.

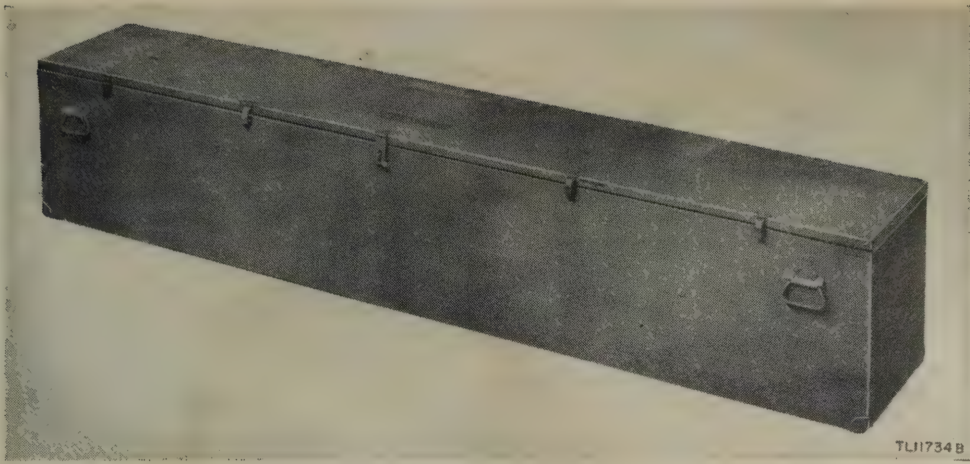


Figure 73. Chest CH–164–A.

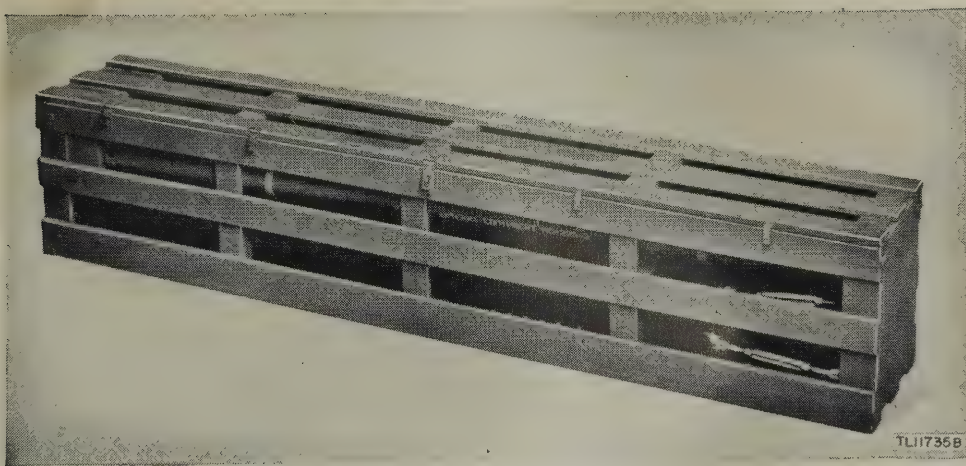


Figure 74. Crate for two antennas.

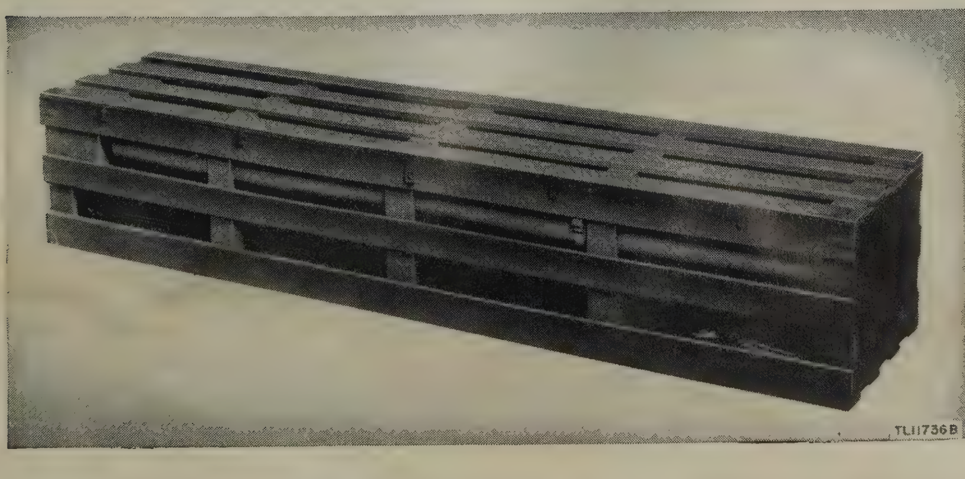


Figure 75. Crate for three antennas.

46. Chests CH–163–A, CH–167–A, and CH–167–B

a. Refer to the contents list on the inside of the cover of each chest.

b. Repack the contents of Chests CH–163–A and CH–167–A as shown in figures 77 and 79, respectively.

c. On certain orders of Radio Set SCR–291–A, Chest CH–167–A is replaced by Chest CH-167–B. Refer to the contents list accompanying the chest and to figure 80, when repacking Chest CH–167–B.

Figure 76. Chest CH–163–A, closed.

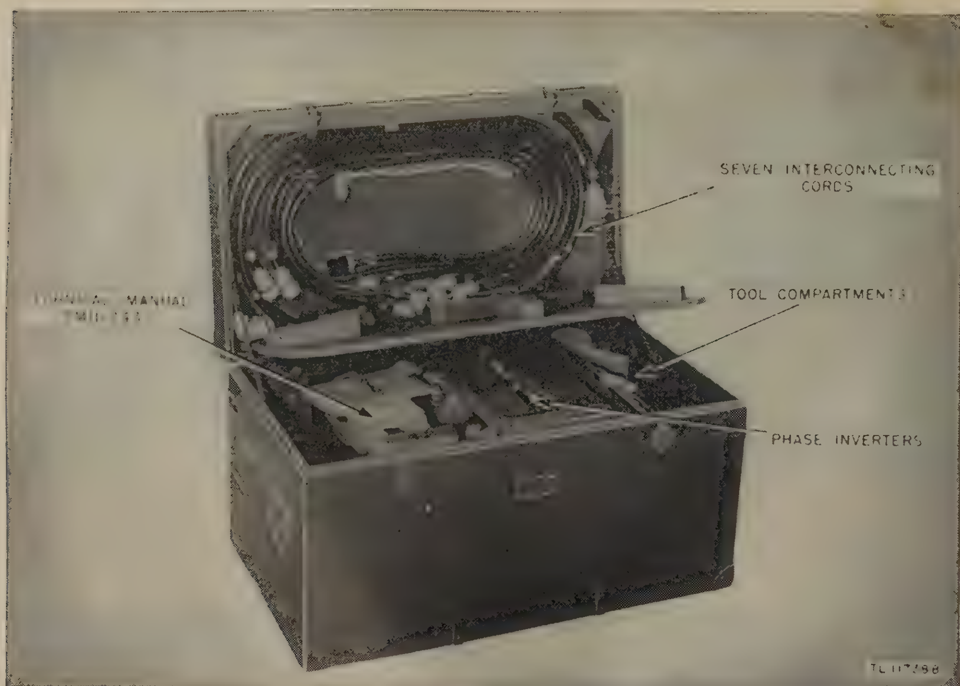


Figure 77. Chest CH–163–A, repacked.

47. Chest CH–161–A (fig. 81)

Chest CH–161–A contains Rack FM–61–A, the radio receiver, a control panel, and a telephone panel (fig. 52). To prepare Chest CH–161–A for transportation, it is necessary only to replace the panels and secure the catches.

48. Chest CH–162–A (figs. 82 and 83)

a. Bearing Indicator BC–1159–A and Goniometer MC–412–A are repacked in Chest CH–162–A.

b. To repack the chest, proceed as follows:

(1) Loosen the knurled knobs that hold the goniometer to the bearing indicator.

(2) Remove the goniometer from the indicator.

(3) Fasten the bearing indicator and the

goniometer to the bottom of Chest CH–162–A.

(4) Adjust the bearing indicator bracket arm to the second notch from the rear of the base.

(5) Loosen the tilt regulator and place the block under the bearing indicator. Readjust the tilt regulator to hold the block firmly in position.

(6) Fasten the retaining straps.

(7) Remove the lamp shield and power cord assembly. Pack the assembly in the indicator base compartment.

(8) Place the chest cover over the indicator and secure the catches.

Figure 78. Chest CH–167–A, closed.

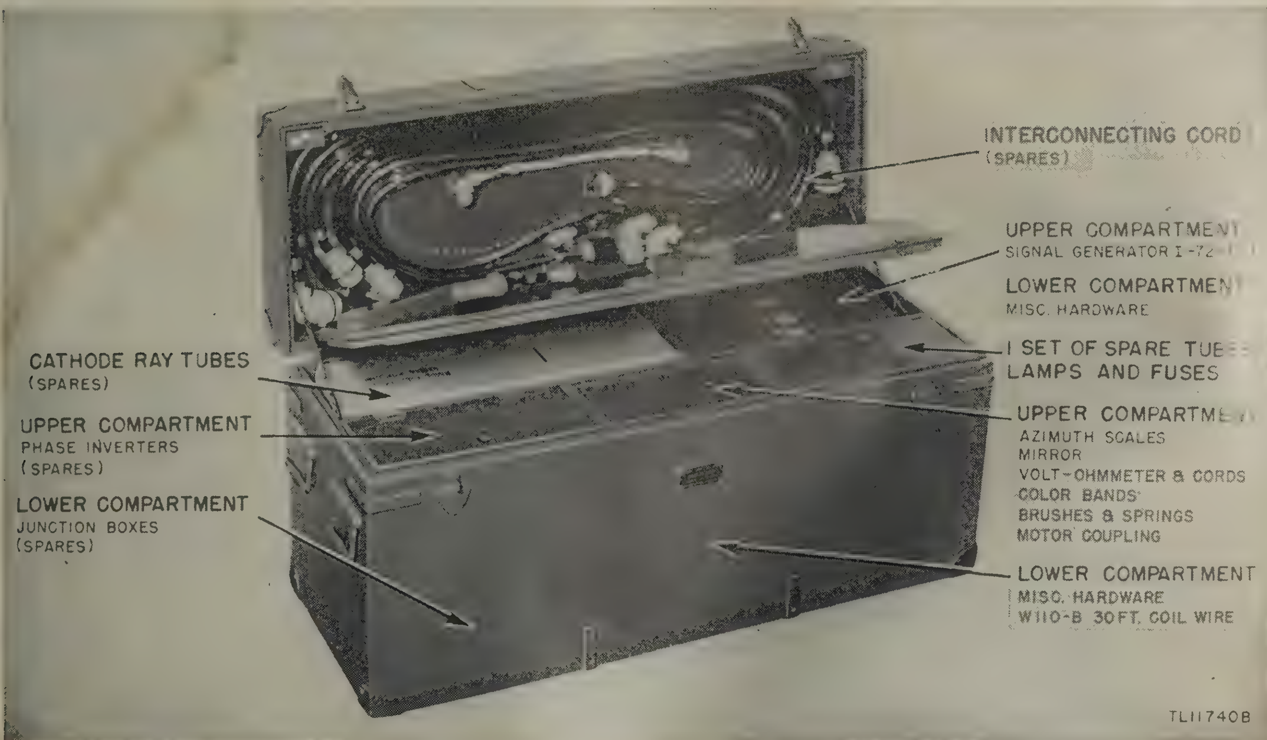


Figure 79. Chest CH–167–A, repacked.

49. Alternate Chest CH–162–A

a. An alternate design of Chest CH–162–A (fig. 84) is furnished on certain orders of Radio Set SCR–291–A.

b. To repack the alternate chest proceed as follows:

(1) Open the chest by lifting the lid straight up, to prevent binding of the lateral support clamps at the edges.

(2) Remove the scale lamp assembly from the head of the indicator. Place the assembly in the baseboard compartment of the indicator (under the control box). Lock the lamp assembly in place with the bracket, and insert the cord plug in the clip at the center of the baseboard.

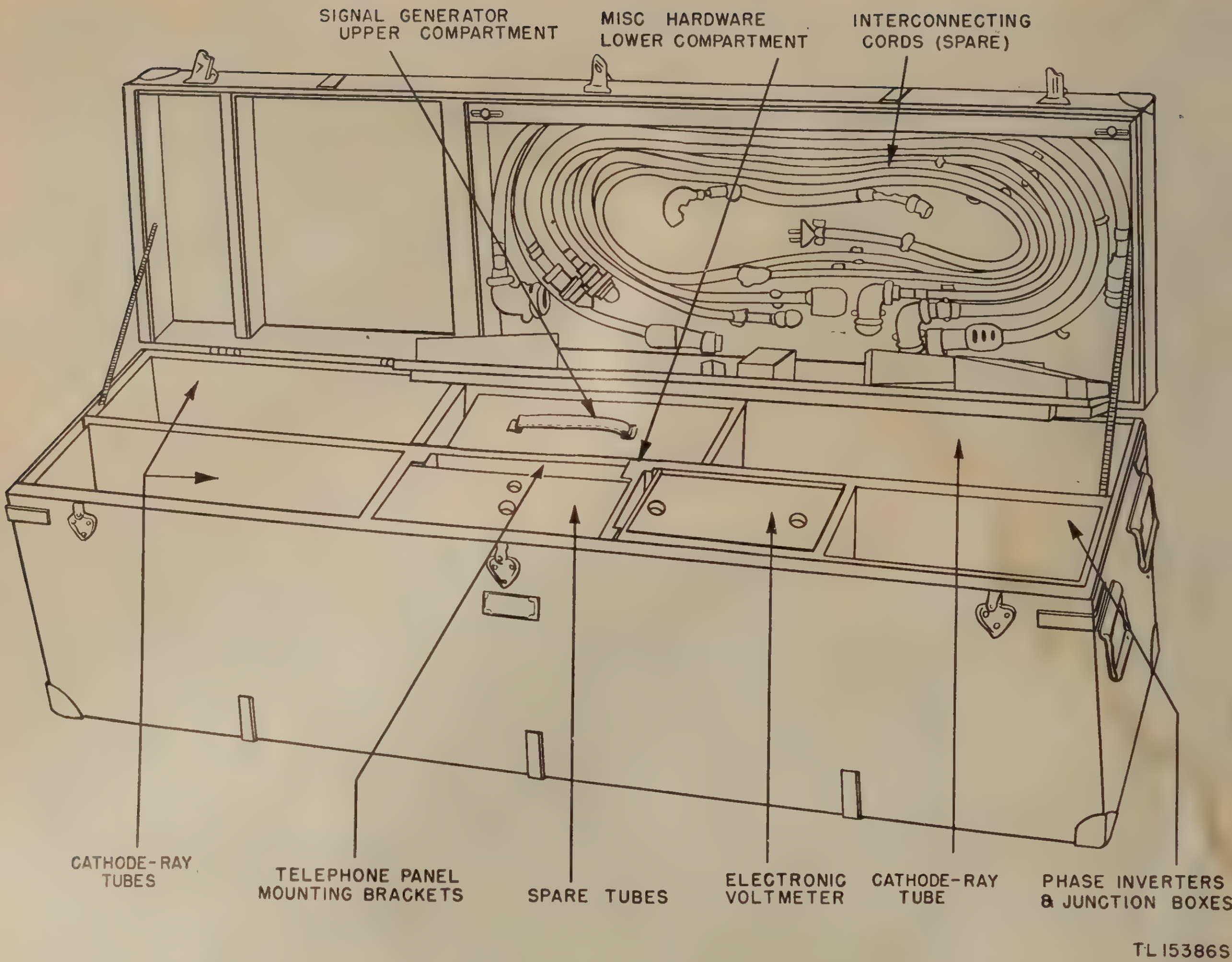


Figure 80. Chest CH–167–B.

(3) Loosen the knurled knobs and remove the goniometer from the indicator. Turn the bolts so that the knobs face outward. Tighten the knobs to prevent rattling during transport.

(4) Place the goniometer (receptacles up) in the compartment at the front of the chest. Lock the goniometer in place with the hinged bracket.

(5) Before attempting to put the indicator in the chest see that the elevating studs on the indicator support arms are in the next to the highest of the four possible positions. Put the bracing block under the front of the indicator motor and lower the back of the indicator so that it rests on the block.

(6) Place the indicator in the chest; the bolts in the chest must enter the holes in the indicator base. Replace the washers and wingnuts on the bolts and tighten the wingnuts.

(7) Insert the yokes to hold the indicator. Compress the shock springs far enough to permit sliding the catch bolts in place.

(8) Roll the felt pad and place it in the chest.

(9) Replace the chest cover and fasten the catches.

50. Chest CH–210–A (fig. 85)

Repack Junction Box JB–95–A (or JB–126) in

Figure 81. Chest CH–161–A.

Figure 82. Chest CH–162–A, closed.

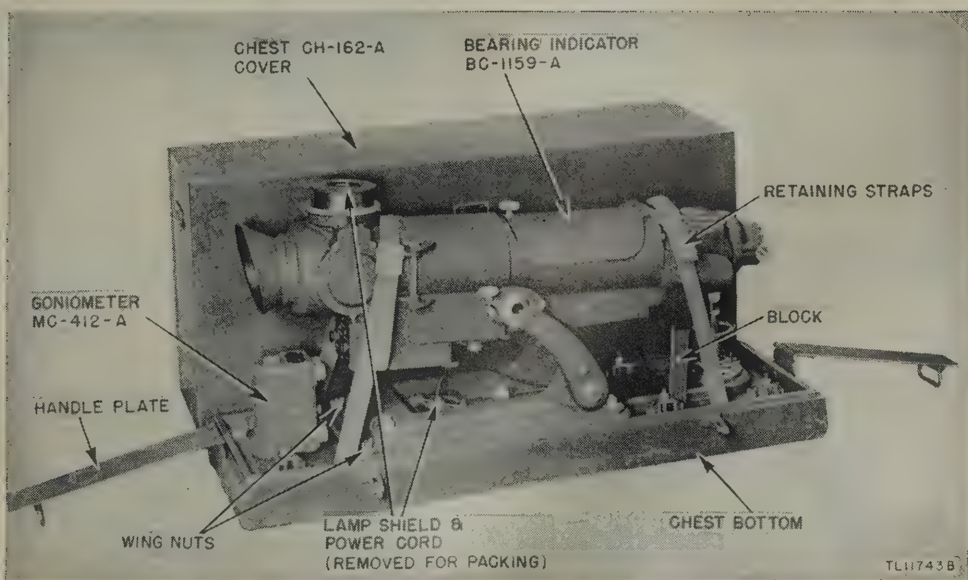


Figure 83. Chest CH–162–A, open.

Chest CH–210–A. The junction box should be placed handle up, with the circuit breaker to the front of the chest.

51. Crate for Shelter HO–19–A (fig. 86)

a. Disassembled, Shelter HO–19–A is repacked in a single crate. Place the crate so that the skid side is to the right.

b. After disassembling the shelter, repack the crate as follows:

(1) At the left end of the crate put:

(*a*) One end section with the stenciled side up and the handle to the rear.

843134°—49—5

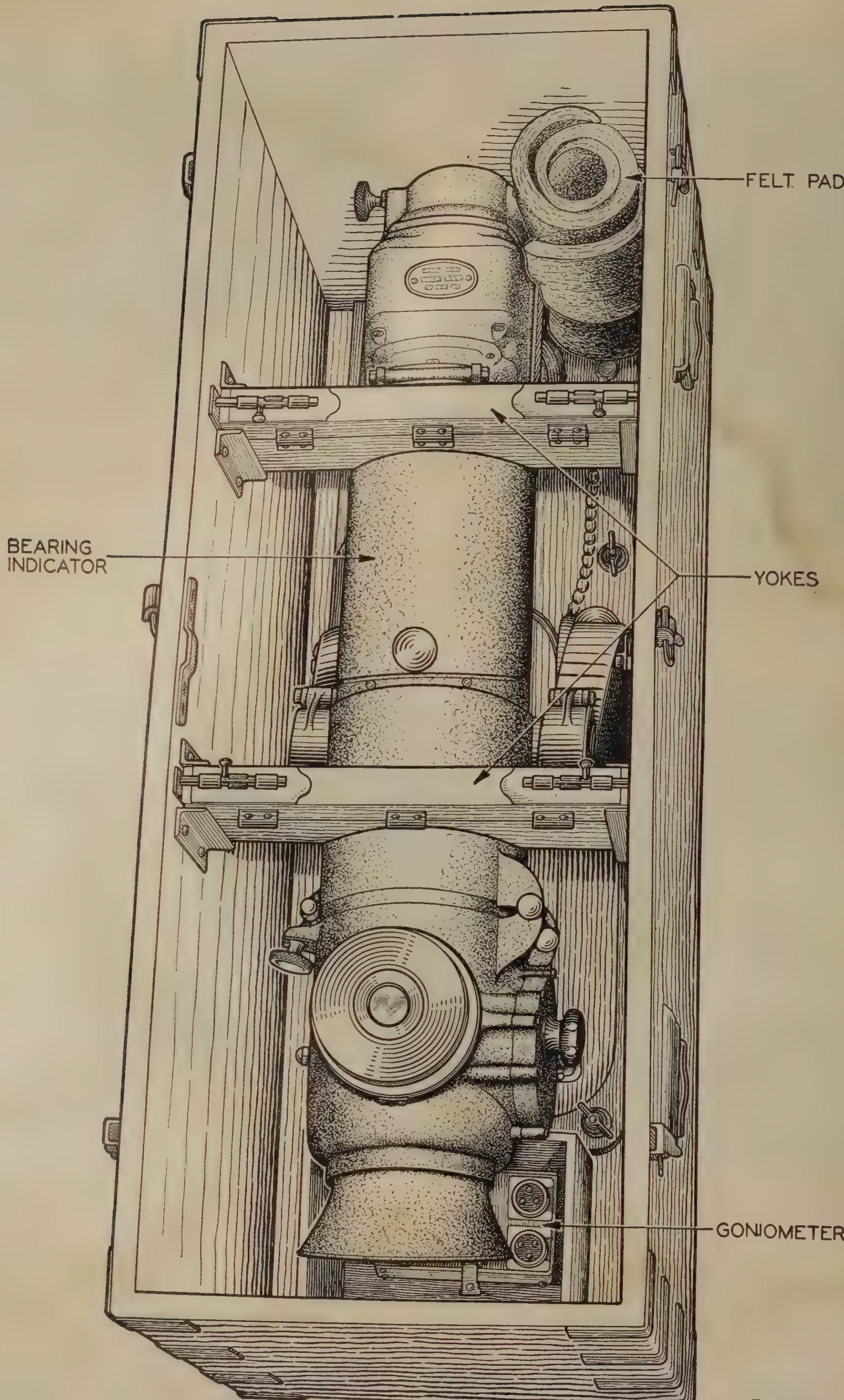


Figure 84. Alternate Chest CH–162–A, open.

Figure 85. Chest CH–210–A, closed.

(*b*) Two sets of radiator harness (between the frame members).

(*c*) The bag of nuts and bolts.

(2) In the right rear corner of the crate put:

(a) Two wood funnels.

(*b*) Eight corner braces.

(c) The second end section with the stenciled side down and the handle toward the front.

(3) To the right of the end sections, place one corner post.

(4) Place one side section close to the front, with the stenciled side down and the handle to the right.

(5) Place the second side section on top of the first side section, with the stenciled side down and the handle to the left.

(6) Place the bottom section at the left of the crate, close to the front and with the stenciled side down.

(7) Place the top section, stenciled side down, on top of the bottom section.

(8) Place the remaining corner posts to the right of the roof section as follows: second corner post, turnbuttons up and to the left; third corner post, tur-

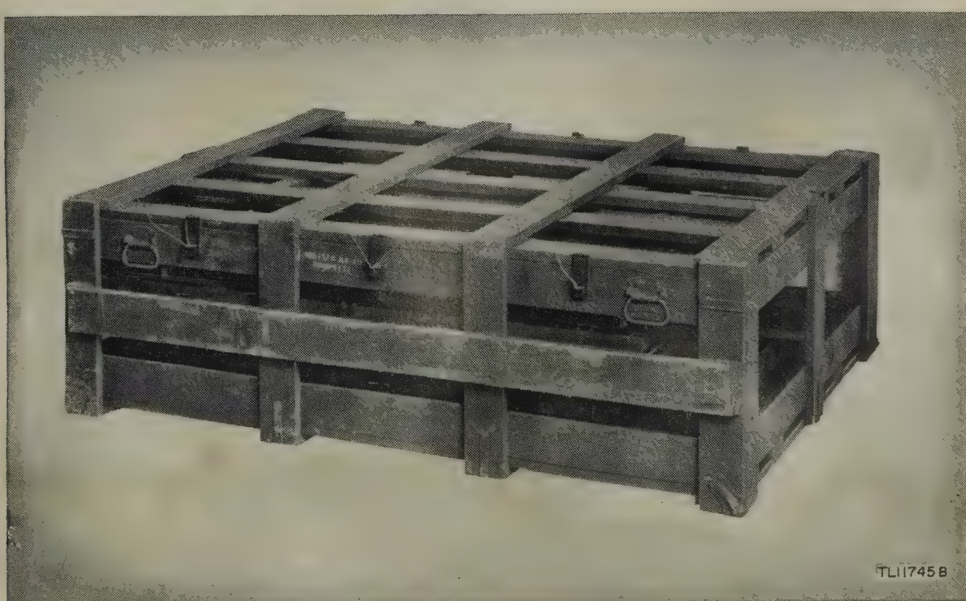


Figure 86. Crate for Shelter HO–19–A.

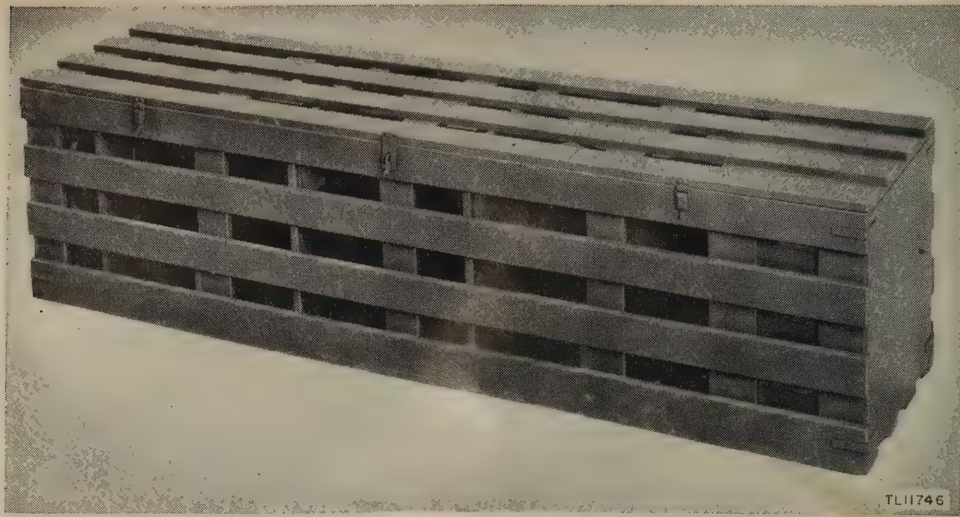


Figure 87. Crate for gasoline heater.

buttons down and to the left; fourth corner post, turnbuttons up and to the right.

52. Crate for Gasoline Heater

a. The gasoline heater is packed in a crate with three compartments (fig. 87).

b. Place the crate with the hinges to the rear and repack the gasoline heater as follows:

(1) Remove the spacing blocks from the crate and put the heater unit assembly, flange side down, in the center compartment of the crate.

(2) Replace the spacing blocks.

(3) In the left compartment place the fuel tank so that the gas filter is up and the mounting flange is toward the center compartment of the crate.

(4) Place the circulating fan, cage up, in the bottom of the rear right-hand compartment.

(5) Put the partition over the fan.

(6) Pack the outlet louver assembly in the compartment over the fan.

(7) Pack the fuel lines, junction boxes, switch, caulking compound, and loose hardware in the right front compartment.

(8) Close the crate lid and fasten the catches.

53. Crates for Shelter HO–20–A

a. General. After disassembly, Shelter HO–20–A is repacked in five crates. In the following instructions, the term *front* means the stenciled side of a crate. The parts that go into each crate are listed below, and this listing must be observed in repacking; otherwise it will be impossible to fit the components into the crates.

b. Crate No. 1 (fig. 88).

(1) Floor section No. 2, stenciling down.

(2) Floor section No. 3, stenciling down.

(3) Floor section No. 1, stenciling down.

(4) Wall panel No. 9, stenciling down, louver toward the front.

(5) Place two disassembled tables in the crate, from left to right, with the irons running from front to back.

(6) Place the canvas cover at the right.

c. Crate No. 2 (fig. 89).

(1) Wall panel No. 5, stenciling down, between the block on the bottom and the right side of the crate.

(2) Wall panel No. 2, stenciling up.

(3) Wall panel No. 7, stenciling down and to rear.

(4) Wall panel No. 6, stenciling down.

(5) Wall panel No. 3, stenciling up.

(6) Wall panel No. 10, stenciling down and to rear. Attach three keys to the handle.

(7) Wall panel No. 1, stenciling down.

d. CRATE No. 3 (fig. 90).

(1) Roof section No. 2, stenciling up.
(2) Seven brackets: four in front section, three in other.
(3) Roof section No. 3, stenciling up.
(4) Roof section No. 1, stenciling up.
(5) Wall panel No. 4, stenciling up.
(6) Wall panel No. 8, stenciling up.
(7) Two chairs in section of panel No. 8 (to rear of crate), tops toward right side.
(8) Electrical supplies and one chair (packed in crate No. 4 on some orders).

e. CRATE No. 4 (fig. 91).

(1) Two long foundations (two-by-fours) placed on flat side at outer side of crate facing hardware box.
(2) High side rail, between long foundations, stenciling down.
(3) Two corner posts, on two-by-four at right side of crate.
(4) Low side rail, on top of high side rail, stenciling up, and sash clasp to left side. (Be sure clasps clear the high side rail.)
(5) One corner post, between corner post on right side of crate and low side rail.
(6) One corner post on left side of crate.
(7) Place two end rails (1 pair, right and left), stenciling up, on top of low side rail and corner posts, small and wide ends opposite, and angle irons snug against hardware box.
(8) Place two foundation crossmembers at rear of crate, stenciling up, one on right side and the other on left side of crate.

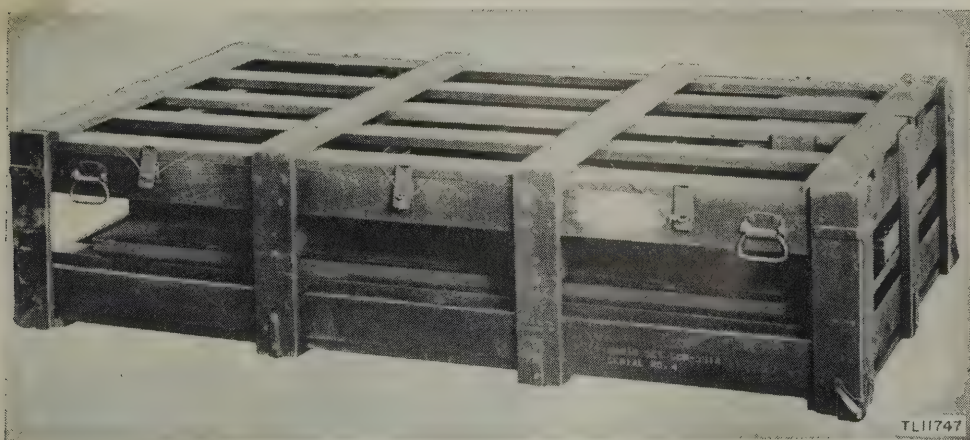


Figure 88. Shelter HO–20–A, crate No. 1

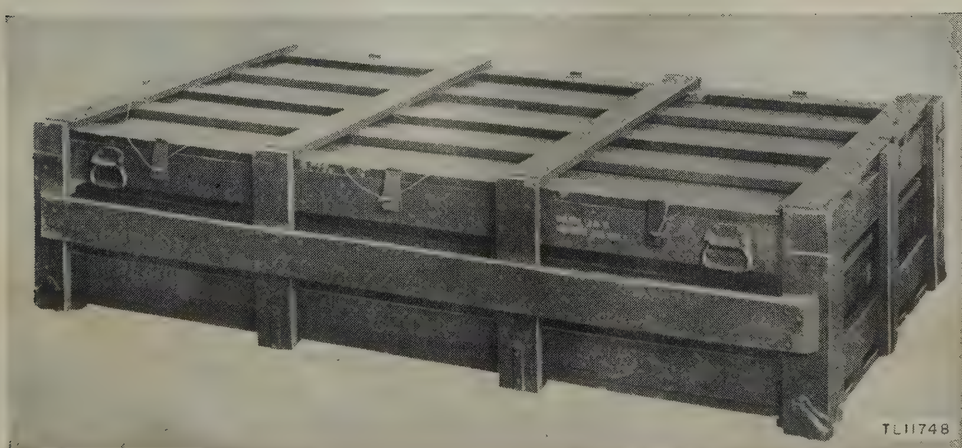


Figure 89. Shelter HO–20–A, crate No. 2

Figure 90. Shelter HO–20–A, crate No. 3

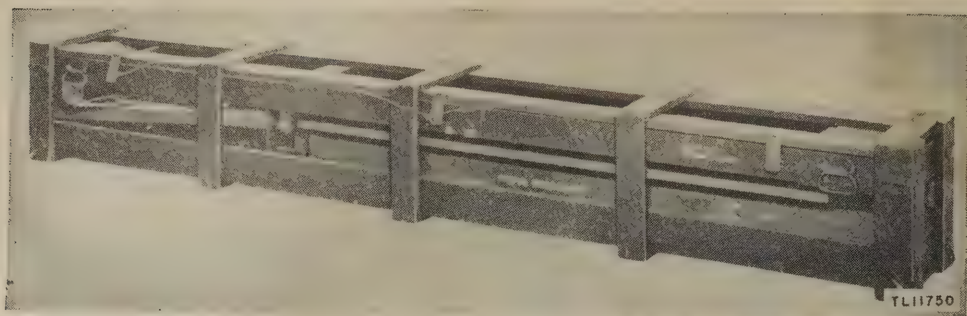


Figure 91. Shelter HO–20–A, crate No. 4.

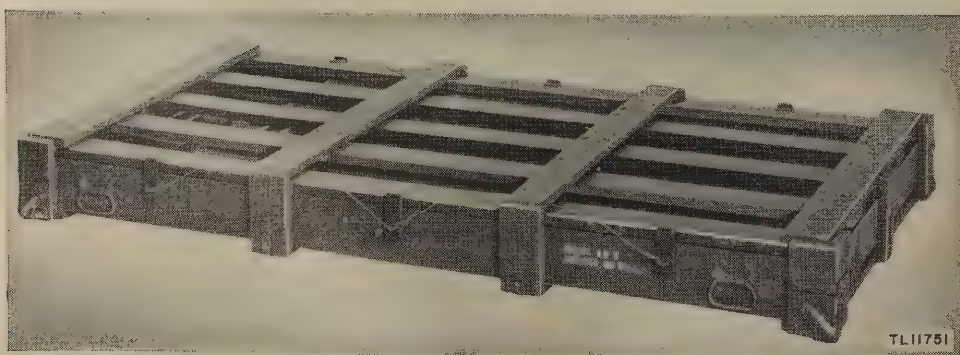


Figure 92. Shelter HO–20–A, crate No. 5.

(9) Pack caulking compound at far end of crate, top to side of crate.

(10) Pack caulking gun carton on its edge next to caulking compound.

(11) Pack the three cloth bags containing screws, nuts, bolts, and other accessories in the hardware box (space for electrical supplies in some models).

f. CRATE NO. 5 (fig. 92). Pack interior panels, except for interior panel No. 10 which remains attached to panel No. 10, in the following order: 9, 5, 8, 4, 3, 1, 6, 7, 2, and interior roof panels 2, 1, and 3.

54. Spare Parts Chest

a. The spare parts chest (fig. 93) is furnished on Order No. 1435–MPD–45.

b. To repack this chest, refer to the contents list and to figures 94, 95, and 96,

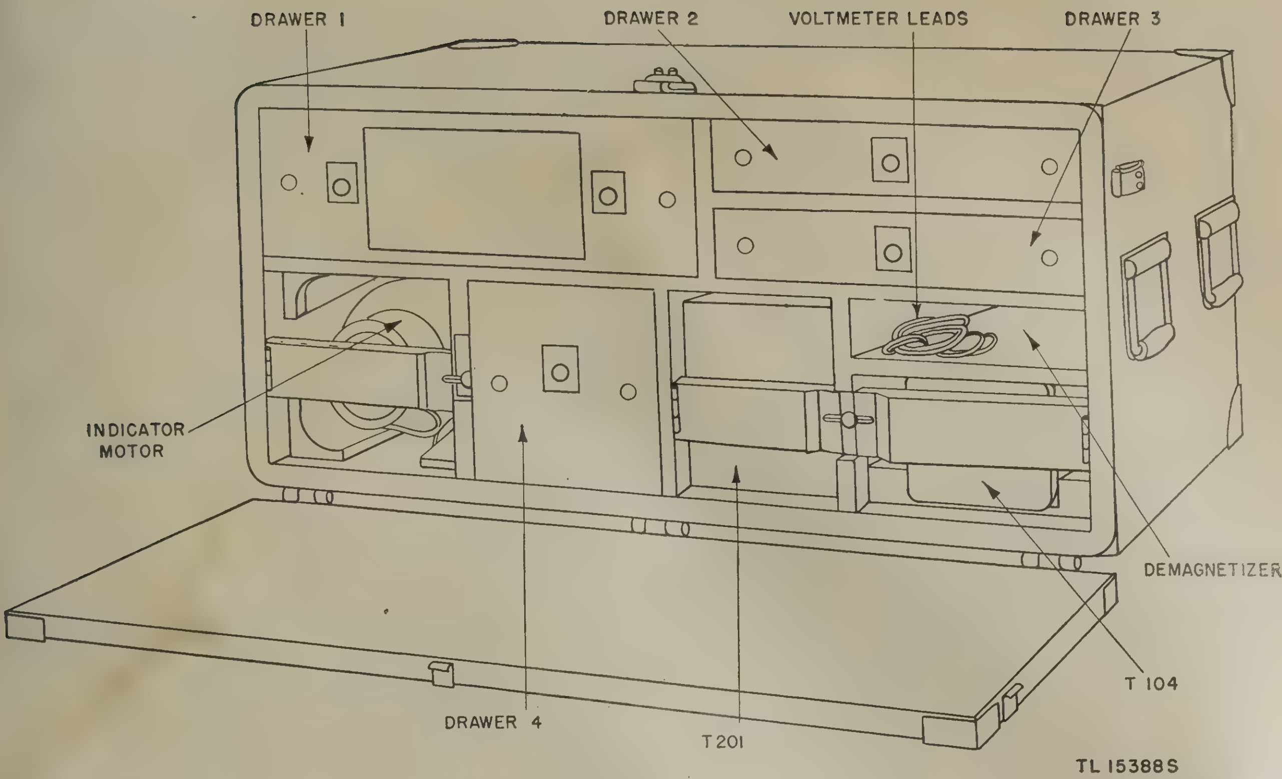


Figure 93. Spare parts chest, open.

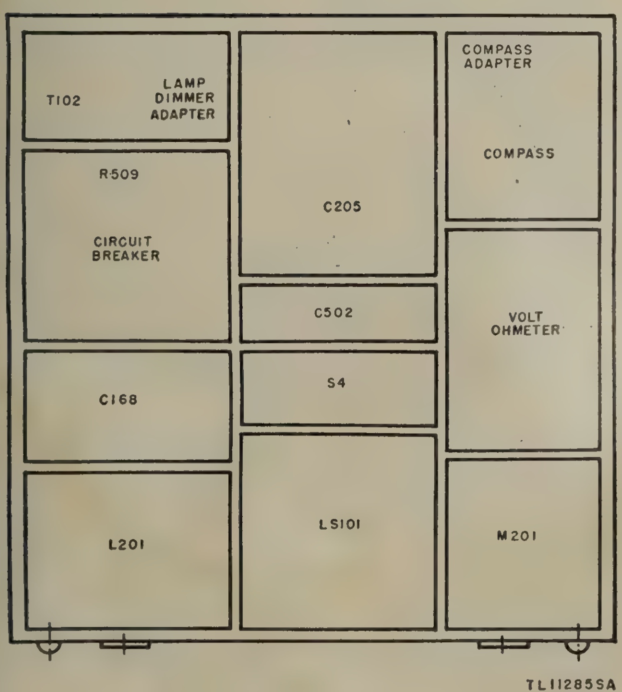


Figure 94. Drawer No. 1, spare parts chest.

55. Crate for Fire Extinguishers

a. A three-compartment crate (fig. 97) is furnished for the two fire extinguishers furnished on Order No. 1435–MPD–45.

b. Repack as follows:

(1) Remove the extinguisher horn nozzles and pack them in the narrow front compartment.

(2) Repack an extinguisher with its handle up, in each of the other compartments.

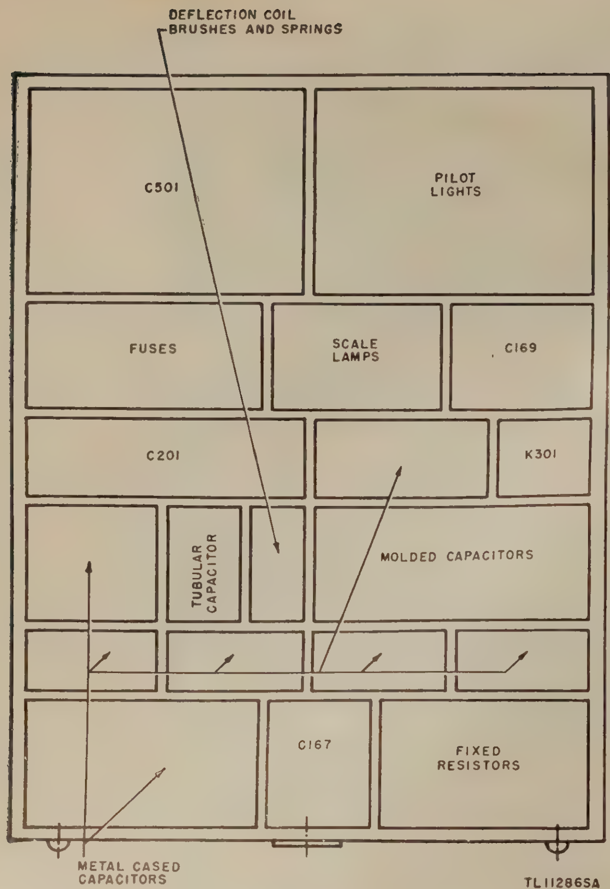


Figure 95. Drawer No. 2, spare parts chest.

Figure 96. Drawer No. 3, spare parts chest.

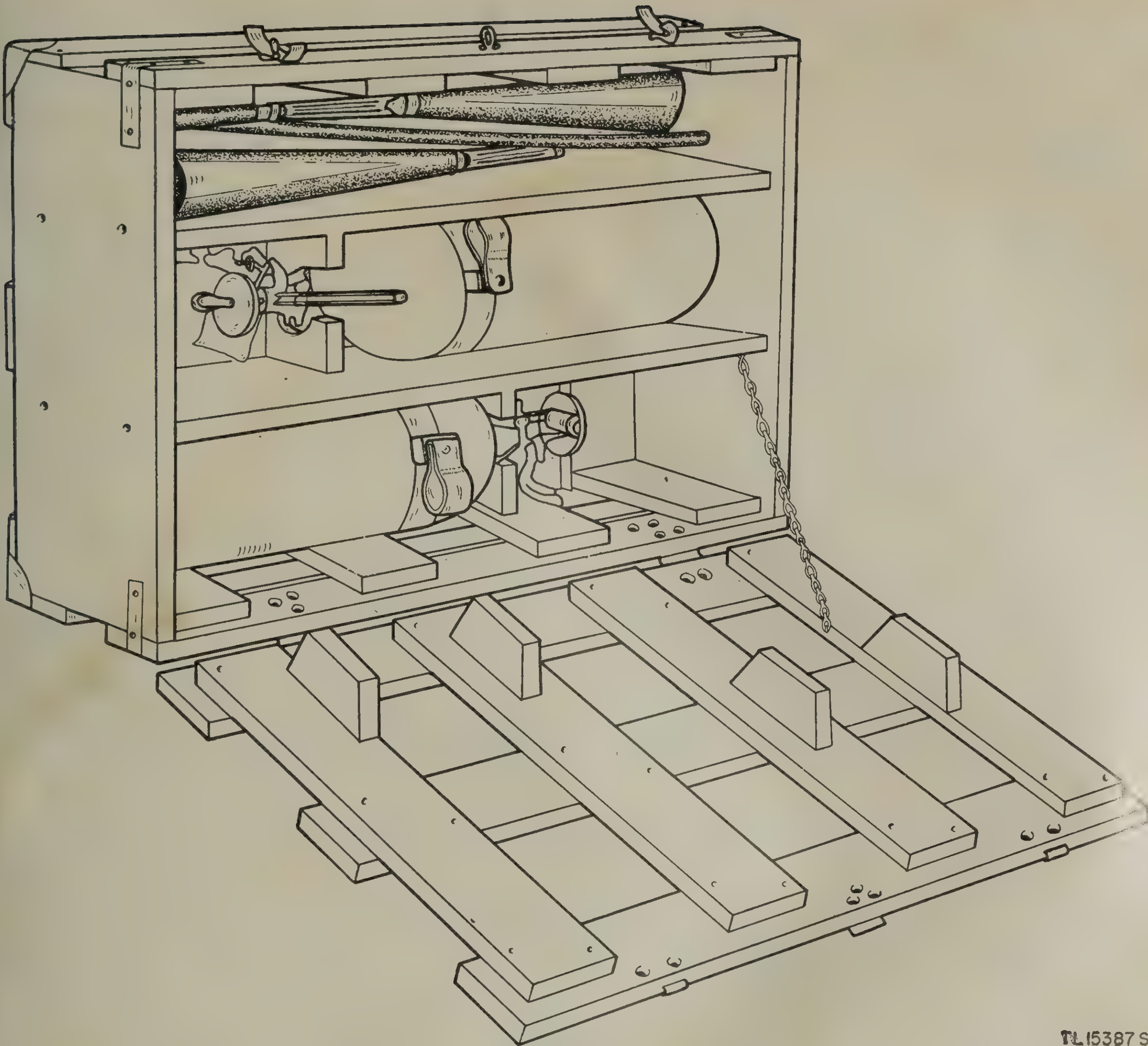


Figure 97. Fire extinguishers in crate.

CHAPTER 2
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 I. CONTROLS AND THEIR USE

56. Radio Receiver BC–1147–A (fig. 98)

a. BAND SWITCH. This switch selects the proper receiver circuits for operation in any one of four frequency bands.

b. TUNING CONTROL. This control tunes the receiver input circuits to any frequency within the frequency range to which the band switch is set.

c. SENSITIVITY. Turning the SENSITIVITY control clockwise from 0 to 10 varies the receiver sensitivity from minimum to maximum.

d. A. F. GAIN. This is a volume control for the audio output of the receiver. Turning the A.F. GAIN control clockwise from 0 to 10 varies the audio output from minimum to maximum.

e. ANT. COMP. This control adjusts the receiver input circuit to compensate for variations of input impedance as the receiver is tuned to different frequencies. The ANT. COMP. control must be adjusted for maximum output of the received signal.

f. BFO ADJ. This control varies the frequency of the bfo (beat-frequency oscillator) and, therefore, adjusts the frequency of the audio output.

g. SELECTIVITY (BROAD-SHARP) SWITCH. This switch changes the bandwidth of the intermediate amplifier. With the switch at BROAD the receiver tuning is broad; with the switch at SHARP the receiver circuit is selective. For stand-by operation, the SELECTIVITY switch is placed at BROAD to enable reception over a relatively broad frequency band. While bearings

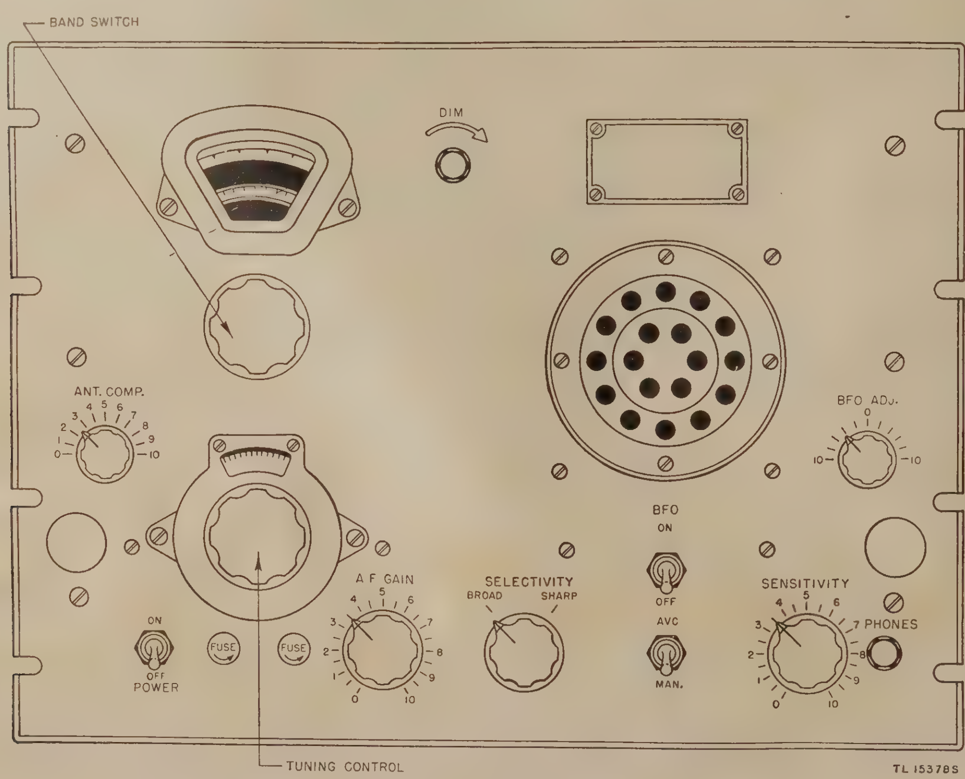


Figure 98. Radio Receiver BC–1147–A, control panel

are being taken, the SELECTIVITY switch *must* be placed at SHARP.

h. PHONES. The PHONES jack is connected to the audio output transformer. When a phone plug is inserted into the PHONES jack, it disconnects the loudspeaker and switches the audio output to the phones.

i. POWER (ON-OFF) SWITCH. This switch turns the receiver on and off.

j. BFO (ON-OFF) SWITCH. This switch turns the bfo on and off.

k. AVC-MAN. SWITCH. This switch shifts the receiver circuits for manual (MAN.) or automatic (AVC) control of the volume.

l. DIM. THE DIM control varies the brilliance of the dial lamps.

m. DIAL LAMPS. The dial lamps illuminate the dial scales and indicate that power is applied to the receiver.

n. FUSES. FUSES F101 and F102 are in the a-c input line.

57. Control Panel PN–31–A (fig. 99)

a. SENSE GAIN. This control varies the output of the sense antenna (Phase Inverter MC–413–A). As the SENSE GAIN control is turned clockwise, the receiver input from the sense antenna is increased.

b. CIRCLE DIAMETER. This control varies the diameter of the circular trace on the bearing indicator cathode-ray tube.

c. MOTOR (ON-OFF) SWITCH. This switch turns the bearing indicator motor on and off.

d. POWER (ON-OFF) SWITCH. This switch turns the control panel power supplies on and off. In the ON position this switch also connects a-c power to the receiver. However, the receiver is not turned on unless the receiver POWER switch is also thrown to ON.

e. 0°, 180°, 90°, and 270° (ON-OFF). The switches marked 0°, 180°, 90°, and 270° (ON-OFF) apply plate voltage to the N, S, E, and W monopole Phase Inverters MC–411–A, respectively. Effectively, these switches turn the N, S, E, and W antennas on and off.

f. BALANCE ADJUSTMENT. Each of these screwdriver controls is used to adjust the plate current of the Phase Inverter MC–411–A to which it is connected.

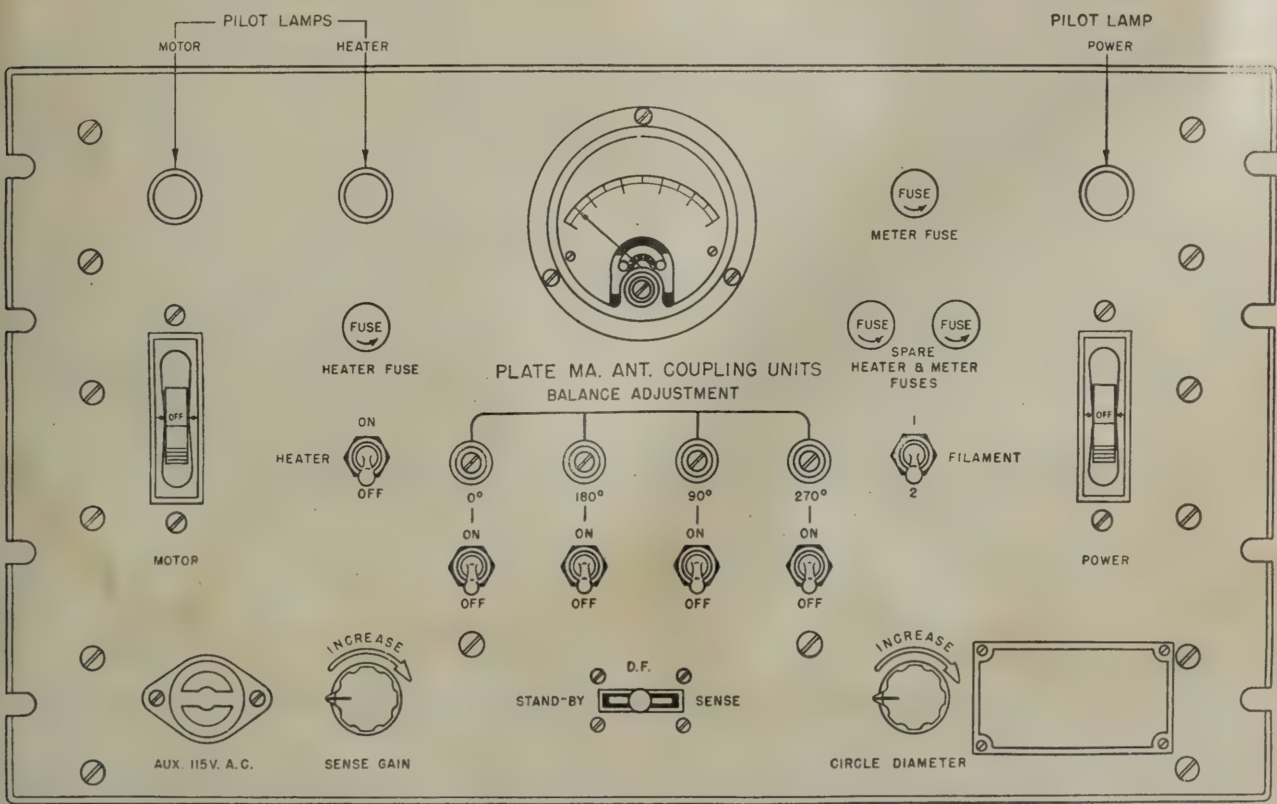


Figure 99. Control Panel PN–31–A, front panel.

g. PLATE MA. ANT. COUPLING UNITS. This meter is connected to the phase inverter units by the switches described in *e* above. The meter indicates the plate currents of the phase inverters.

h. FILAMENT (1–2). With the FILAMENT switch at 1 the filament voltage is applied to the No. 1 set of phase inverter tubes; with the switch at 2 the No. 2 (spare) set of tubes is in operation.

i. HEATER (ON-OFF). This switch simultaneously turns on, or off, the heater lamp in Rack FM–61–A and the heater in Bearing Indicator BC–1159–A. With the HEATER switch at ON, the MOTOR switch is disconnected.

j. STAND-BY–D. F.–SENSE. With the switch in the STAND-BY (left-hand) position, only the center (sense) antenna is in use, and the output of the deflection amplifier is connected to the D/F set of deflection coils in the bearing indicator. The STAND-BY position is used only for routine monitoring and gives no bearing indications. Bearings are taken with the switch at D.F.; the four corner (directional) antennas are used and the output of the deflection amplifier is connected to the D/F set of deflection coils in the bearing indicator. With the switch at SENSE the five monopoles are in use, and the output of the deflection amplifier is connected to the SENSE set of deflection coils in the bearing indicator.

k. PILOT LAMPS. These lamps indicate, respectively, when the MOTOR, HEATER, and POWER switches are on.

l. AUX. 115V. A.C. The receptacle marked AUX. 115V. A.C. is an auxiliary a-c outlet.

m. FUSES. The FUSES provide protection for the heater in Rack FM–61–A and for the meter on the control panel.

58. Bearing Indicator BC–1159–A (fig. 100)

a. HORIZONTAL POSITIONING. This screwdriver control varies the voltage of the horizontal deflection plates and the horizontal position of the pattern on the cathode-ray tube screen.

b. VERTICAL POSITIONING. This screwdriver control varies the voltage on the vertical deflection plates and adjusts the vertical position of the pattern on the cathode-ray tube screen.

c. FOCUS. This control is used to focus the cathode-ray tube pattern.

d. INTENSITY. This control varies the brilliance of the cathode-ray tube trace. Adjustment of this control affects the focusing and it is usually necessary to readjust the FOCUS control when the INTENSITY control is varied.

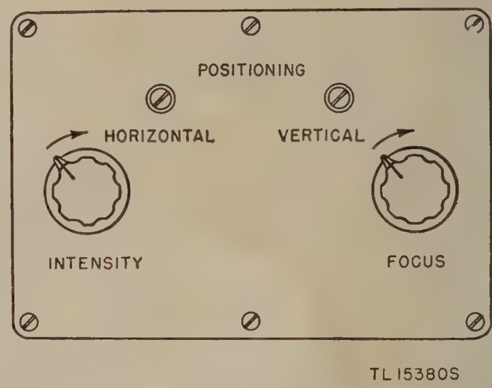


Figure 100. Bearing Indicator BC–1159–A, control box.

59. Telephone Panel PN–32–A

Figure 52 shows Telephone Panel PN–32–A mounted in Rack FM–61–A. For a description of the telephone equipment see TM 11–333, Telephones EE–8, EE–8–A, and EE–8–B.

60. Power Unit PU–41/G

The controls for the power unit are described in TM 11–935.

61. Junction Box JB–95–A

The circuit breaker on the front of Junction Box JB–95–A acts as a main power switch. With the circuit breaker in its ON position, power is applied to the autotransformer within the junction box. When the circuit breaker is at OFF, no power is available for application to the radio set components.

Section II. PRELIMINARY ADJUSTMENTS

62. General

After the components of Radio Set SCR–291–A have been installed, a number of preliminary adjustments must be made before the radio set is ready for use. The preliminary steps include initial starting, alinement of the circular trace on the cathrode-ray tube, demagnetization of the bearing indicator, a check for parallax in the optical system, alinement of the goniometer, and balancing the phase inverters. Only experienced personnel should make the preliminary adjustments given in this section.

Note. No adjustments should be made unless a careful check has established the need for them.

63. Initial Starting Procedure

a. Checking Line Voltage.

(1) See that the radio set controls, including the circuit breaker on Junction Box JB–95–A (or JB–126), are at OFF.

(2) Check the connection of Cord CD–838 to the junction box. If a 230-volt power source is being used. Cord CD–838 must be connected to the 230 VOLTS A.C. receptacle on the bottom of the junction box; if a 115-volt power source is being used, connect Cord CD–838 to the 115 VOLTS A.C. receptacle.

(3) Refer to the power unit technical manual, and start the power unit.

(4) Throw the circuit breaker (Junction Box JB–95–A) to ON.

(5) Turn the control panel MOTOR switch to ON.

(6) After the indicator motor has reached its running speed, turn the receiver and control panel POWER switches to ON, set the STAND-BY – D.F. – SENSE switch at STAND-BY, adjust the SENSE GAIN control to maximum clockwise, and set the FILAMENT switch at 1.

(7) Observe the reading on the meter labeled PLATE MA.

(8) Throw the FILAMENT switch to 2. If the PLATE MA. readings are between 20 and 30 ma (milliamperes) for both positions of the filament switch, the line voltage is satisfactory. If both readings are below 20, or above 30, the line voltage must be adjusted (*b* below) to obtain readings within the specified limits.

Note. If the PLATE MA. reading for one position of the FILAMENT switch is approximately one-half that for the other position, one of the tubes in Phase Inverter MC–413–A may be inactive. The defective tube should be replaced before the line voltage is adjusted.

b. Line Voltage Adjustment. To adjust the line voltage, refer to the technical manual accompanying the power unit. Follow the technical manual instructions for adjusting the power unit field rheostat to obtain correct output voltage.

c. Alternate Line Voltage Check.

(1) Turn the equipment on by following (1) through (6) in *a* above.

(2) If an a-c voltmeter is available, measure the a-c voltage at the AUX. 115V. A.C. outlet on Control Panel PN–31–A.

The voltage should be 115 volts *with the equipment running.*

64. Circle Alinement

a. Focus and Intensity.

(1) Refer to paragraph 76 for information on receiver operation.

(2) Turn the receiver SENSITIVITY control to 0.

(3) Set the STAND-BY – D.F. – SENSE switch at D.F.

(4) Alternately adjust the FOCUS and INTENSITY controls to obtain on the cathode-ray tube a trace that is sharp and clear but not too brilliant.

b. Diameter and Position.

(1) Adjust the CIRCLE DIAMETER control so that the circular trace is just inside the azimuth scale.

(2) Center the circle by adjusting the HORIZONTAL and VERTICAL POSITIONING controls.

(3) Alternately adjust the CIRCLE DIAMETER and POSITIONING controls to make the circular trace touch the outer ends of the short subdivisions on the azimuth scale.

Note. If the bearing indicator is not equipped with an alidade, make the circular trace coincide with the inner circumference of the azimuth scale.

(4) With the trace circular and properly centered, readjust the CIRCLE DIAMETER control, so that the trace is approximately 1/16 inch inside the azimuth scale image. Failure to obtain the correct pattern may be attributed to

magnetization of parallax (pars. 65 and 66).

65. Indicator Demagnetization

a. CHECK FOR MAGNETISM.

(1) Turn the receiver SENSITIVITY control to 7 or 8.

(2) Set up Radio Transmitter BC–1149–A (Target) at a distance of 500 feet north of the antenna array and in line with the north-south monopoles.

(3) Refer to TM 11–849 for information on operating the target transmitter. Turn the target transmitter ON–OFF switch to ON, the HI–LO switch to HI, and the ICW–CW switch to CW.

(4) Tune the target transmitter to approximately 5 mc.

(5) Tune the receiver (par. 76) to the target transmitter signal, and adjust for a clean, steady, twin-leaf pattern. If the center points of the twin-leaf pattern are offset from one another (fig. 101A), it is an indication of residual magnetism in the rotating assembly.

(6) Advance the receiver SENSITIVITY control to 10. The presence of a small circular trace (fig. 101B), instead of a dot, also indicates residual magnetism in the rotating assembly.

(7) Turn the receiver SENSITIVITY control to 0. If the trace is oval or otherwise distorted, the studs and fixed portions of the indicator housing close to the rotating assembly may be magnetized, so that the cathode-ray spot is deflected from its normal circular path.

b. DEMAGNETIZATION PROCEDURE.

(1) With the receiver turned to the target transmitter, and with the bearing indicator running, advance the receiver SENSITIVITY control to 10. Open the bearing indicator cover.

(2) Remove the demagnetizer (fig. 15) from Chest CH–163–A and plug it into the AUX. 115V. A.C. outlet on Control Panel PN–31–A.

(3) Hold the demagnetizer head close to, *but not in contact with,* the front bearing housing (fig. 102).

Caution: High voltages are present at the indicator brushes and slip rings. The demagnetizer must not touch these points. Never keep the demagnetizer on for more than 30 seconds at a time; doing so will burn out the demagnetizer.

Figure 101. Bearing indicator pattern; offset center points indicate magnetism.

(4) Snap the demagnetizer on and off and at the same time observe the indicator pattern. Each time the demagnetizer is snapped on and off, the indicator pattern will change. Demagnetization is indicated when the original small circle (fig. 101) becomes a dot.

(5) If step (4) does not remove the magnetism, shift the demagnetizer back and forth between the front bearing housing and the seat for the top cover. Observe the pattern while snapping the demagnetizer on and off in each position.

(6) Recheck for magnetism by repeating (5) through (7) in *a* above.

Note. Demagnetization, steps (1) through (5), almost invariably will remove magnetism from the indicator. The steps that follow are difficult and rarely necessary. Use them only if the preceding steps fail to demagnetize the indicator.

(7) If the recheck of step (7) in *a* above shows that the circle is distorted (oval) enough to cause bearing errors, turn the MOTOR switch to OFF and demagnetize each of the pins and studs indicated in figure 103. In the illustration, points 1 through 7 refer to corresponding pins and studs on both sides of the indicator. Points 6, 7, and 8 are just inside the indicator and cannot be reached unless the control box is removed. Point 5 refers to two items: the clamp pin on the left side of the indicator and the optical housing hinge pin on the right side of the indicator. Point 11 refers to the screws and clamps (not visible) that hold the lamp assembly during shipment. Test for magnetism and repeat this procedure, if necessary. Proceed to step (8) *only* if remaining magnetism interferes with bearing accuracy.

(8) With no power applied to the bearing indicator, swing back the optical housing and *carefully* remove the cathode-ray tube.

(9) Demagnetize the rotating assembly by using a twisting motion while in-

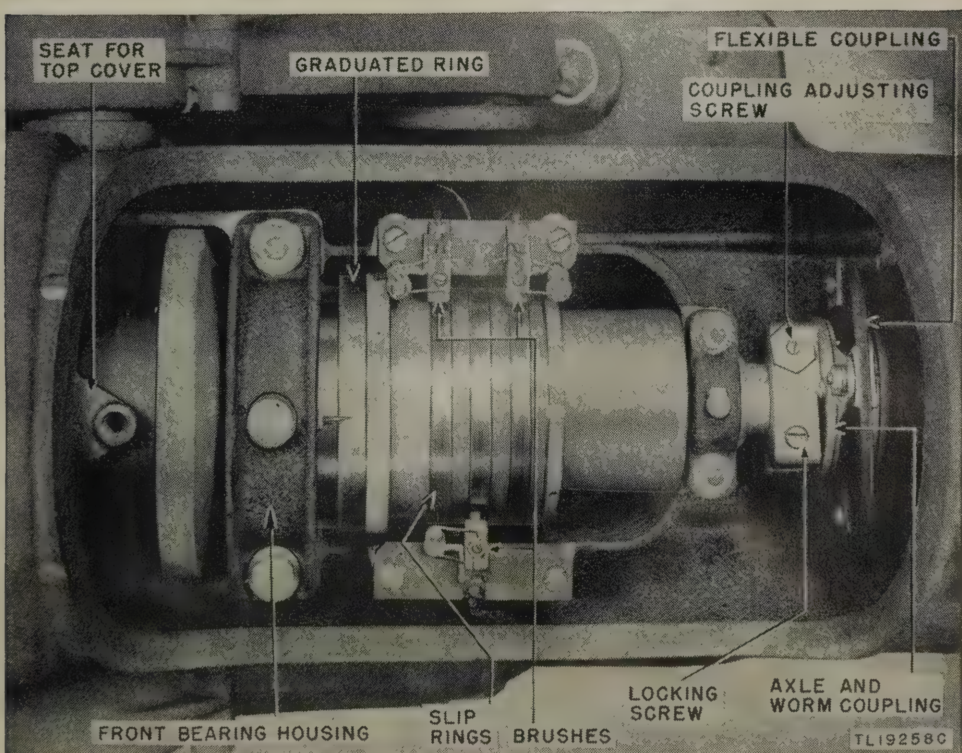


Figure 102. Bearing Indicator BC–1159–A, demagnetizing and goniometer adjustments.

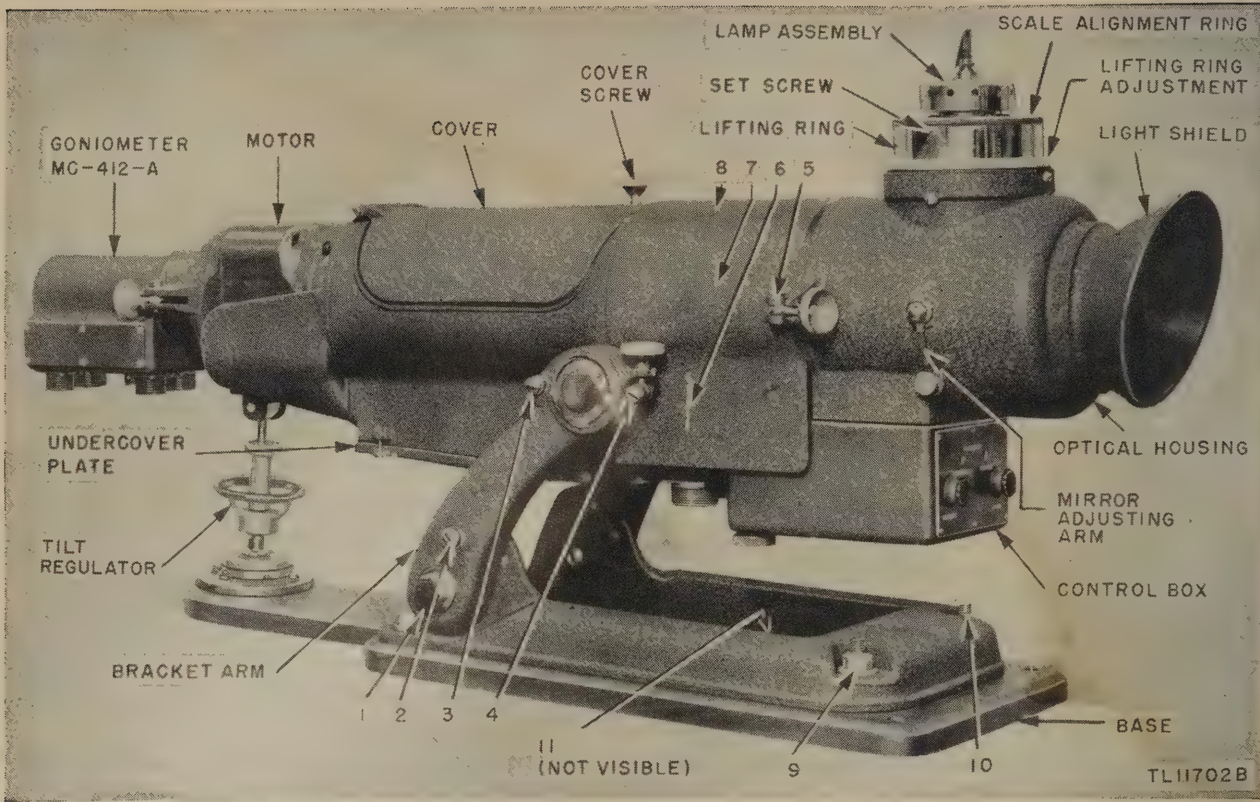


Figure 103. Bearing Indicator BC-1159-A, demagnetizing adjustments.

serting the demagnetizer as far as possible into the tube housing. While inserting the demagnetizer, snap the MOTOR switch ON and OFF as rapidly as possible. Under this condition the motor will run but cannot reach its normal synchronous speed.

(10) *Carefully* replace the cathode-ray tube.

(11) Close the optical housing and recheck the indicator for magnetism (*a* above).

66. Elimination of Parallax

a. CHECKING FOR PARALLAX.

(1) With the STAND-BY – D.F. – SENSE switch at D.F., and with the indicator in operation, turn on the receiver and tune in the target transmitter signal.

(2) With only the 0° antenna switch at ON, adjust the receiver (par. 76*c*) for a twin-leaf pattern (fig. 104A).

(3) If the pattern tips are more than 1/16 inch from the inner circumference of the azimuth scale adjust the CIRCLE DIAMETER control.

(4) Note whether or not the pattern is in the same plane as the scale image. The entire pattern may appear in front of or behind the scale image or one tip may appear behind and the other in front of the image.

(5) Alternately view the pattern from points to the right and left of center and note whether or not the pattern appears to move with respect to the azimuth scale. If the entire pattern is above or below the azimuth scale, the cause may be parallax resulting from incorrect adjustment of the scale lifting ring. If the pattern is tilted so that one tip is above and the other is below the azimuth scale, the mirror angle is incorrect.

(6) Turn the 0° antenna switch to OFF and turn the 90° antenna switch to

ON. The points of the twin-leaf pattern will now be adjacent to the 90° and 270° azimuth scale markings.

(7) Alternately view the pattern from points above and below the pattern. If the pattern seems to move with respect to the azimuth scale image, the parallax is caused by improper closing of the optical housing.

b. ELIMINATION OF PARALLAX.

(1) Make certain that the optical housing is properly closed and tightened against the indicator frame.

(2) Carefully readjust the alinement of the circular trace (par. 64).

(3) With only the 90° antenna switch at ON, tune the receiver to the target transmitter and adjust for a twin-leaf pattern on the indicator.

(4) Carefully adjust the lifting ring, so that the distance between the true azimuth scale and the mirror is correct as indicated by the elimination of parallax from the 90° – 270° pattern.

(5) Throw the 90° antenna switch to OFF and set the 0° switch to ON.

(6) Adjust the mirror arm (fig. 103) so that the mirror angle is correct as indicated by the elimination of parallax from the 0° – 180° pattern.

Note. A satisfactory adjustment is made when both ends of the pattern coincide with (are in the same plane as) the azimuth scale image. It may be impossible to eliminate the parallax entirely. The final adjustment is indicated when the parallax has been reduced to the minimum possible amount.

(7) Repeat (2) through (6) above. Readjust the HORIZONTAL and VERTICAL POSITIONING controls whenever necessary to keep the pattern centered. Note that adjustment of the lifting ring changes the distance between the true azimuth scale and the mirror; adjustment of the mirror angle tilts the pattern to bring it into the same plane.

67. Goniometer Alinement

a. CHECKING ALINEMENT.

(1) With the target transmitter operating, adjust the azimuth scale alinement ring (fig. 103) to make the azimuth scale figures 0° and 180° vertical.

(2) With only the 0° antenna switch at ON and the SELECTIVITY switch on the radio receiver at SHARP, the twin-leaf pattern should point to exactly 0° on the azimuth scale. If the pattern does not point to the 0° mark, record the exact deviation (in degrees ±) from zero.

b. ALINEMENT PROCEDURE.

(1) Turn the control panel MOTOR and POWER switches to OFF.

(2) Open the bearing indicator cover.

(3) Grasp the flexible leather coupling and use a screwdriver to loosen the locking screw on the axle and worm coupling (fig. 102).

(4) Observe the graduated ring reading under the index stud.

(5) Hold the flexible coupling firmly in position and turn the coupling adjustment screw in the same direction that the pattern must be moved to correct the error. While turning the adjustment screw, watch the graduated ring reading. When the reading changes by the same number of degrees as the pattern error, *tighten the locking screw.*

Example 1—The pattern points to 358° on the azimuth scale, indicating that there is an error of —2° and that the pattern must be moved clockwise to 0° on the scale. Note the graduated ring reading and turn the adjustment screw clockwise until the ring reading changes 2°.

Example 2—The pattern points to 2° on the azimuth scale, indicating an error of +2° and that the pattern must be moved counterclockwise to 0°. Note the graduated ring reading and turn the adjustment screw counterclockwise until the ring reading changes 2°.

(6) *Make sure that the locking screw is tight,* start the indicator, and check the pattern error.

(7) If the error is now less than 1°, loosen

the scale alinement ring setscrew and turn the alinement ring to compensate for the error. If the error is greater than 1°, repeat the goniometer alinement procedure.

68. Checking Antenna System Operation

a. SENSE ANTENNA AND PHASE INVERTER MC–413–A. After the radio set is started—

(1) Set the FILAMENT switch to 1.

(2) Put the STAND-BY–D.F.–SENSE switch to STAND-BY.

(3) Set the SENSE GAIN control to maximum.

(4) The PLATE MA. reading should be between 20 and 30 ma.

(5) Tune the radio receiver for signals at approximately 5 mc. (If transmitting stations cannot be picked up, use the target transmitter to obtain a test signal.) Satisfactory reception is an indication that the sense monopole and Phase Inverter MC–413–A are working normally.

(6) Set the FILAMENT switch at 2 and repeat (4) and (5) above.

b. CORNER MONOPOLES AND PHASE INVERTERS MC–411–A.

(1) Set the FILAMENT switch to 1.

(2) Set the STAND-BY–D.F.–SENSE switch to D.F.

(3) Check the PLATE MA. reading of each Phase Inverter MC–411–A, by successively putting each antenna switch at ON with the other three switches at OFF. The individual readings should be approximately 10 ma but are not necessarily identical.

(4) Set the 0° switch at ON; set the other three switches at OFF. Tune in a strong 5-mc signal and adjust the receiver SENSITIVITY control to obtain a twin-leaf pattern with the center points about 1/8 inch apart.

(5) Without readjusting the receiver controls, successively check the indicator patterns obtained with each antenna switch at ON and the other three switches at OFF.

(6) If the patterns obtained in (4) and (5) are approximately the same, it is an indication that each corner monopole and its Phase Inverter MC–411–A are functioning normally. (The preceding test shows that the *gain* is nearly the same throughout the antenna system. The test does *not* indicate phase inverter and antenna system *balance.*)

69. Checking Phase Inverter Balance

There is no simple test that will indicate phase inverter and antenna system balance. However, after the radio set has been properly balanced according to the procedure described in this paragraph, daily azimuth checks should be made on near-by stations of known azimuth. If erroneous bearings are obtained on the known stations, the antenna system should be rechecked for proper balance.

a. CHECKING BALANCE OF EAST-WEST ANTENNAS. With the target transmitter in operation 500 feet from the antenna array and in line with the north-south antennas proceed as follows:

(1) Check the alinement of the circular trace on the indicator screen (par. 64).

(2) Check for parallax and goniometer alinement (pars. 66 and 67).

(3) Set the 0°, 90°, 180°, and 270° switches at ON and adjust the receiver for a good indicator pattern.

(4) Set each of the four screwdriver type balance adjustment controls to its midrange position.

(5) Throw the 0° and 180° switches to OFF. Alternately adjust the 90° and 270° balance controls to make the indicator pattern as circular as possible.

(6) Turn the 90° switch to OFF, but leave the 270° switch at ON.

(7) Recheck the receiver tuning and readjust the SENSITIVITY control to bring the twin-leaf pattern together at the center.

(8) Throw the 90° switch back to ON and repeat the balancing procedure given in (5).

(9) The pattern should now be very nearly a perfect circle. If the pattern diameter as measured through 0° and 180°

is not more than 0.6 inch shorter than the diameter measured through 90° and 270°, the east-west antenna system, including phase inverters and cables, is satisfactorily balanced.

b. CHECKING BALANCE OF NORTH-SOUTH ANTENNAS.

(1) Move the target transmitter to a point 500 feet from the antenna array and in line with the east-west antennas.

(2) Throw the 90° and 270° switches to OFF. Put the 0° and 180° switches at ON.

(3) Alternately adjust the 0° and 180° balance controls to make the indicator pattern as nearly circular as possible.

(4) Turn the 180° switch to OFF, but leave the 0° switch at ON.

(5) Repeat (7) of *a*.

(6) Throw the 180° switch back to ON and repeat the balancing procedure given in (3) above.

(7) If the pattern diameters as measured through 90° and 270° is not more than 0.6 inch shorter than the diameter measured through 0° and 180°, the north-south antennas, including phase inverters and cables, are properly balanced.

70. Checking Cause of Unbalance

If the antennas and phase inverters cannot be balanced by the procedure in paragraph 69, it is necessary to determine the cause of unbalance. Suitable methods of finding the fault are given in the following subparagraphs.

a. GROUND AND CABLE CONNECTIONS. Check all ground and cable connections between the antennas and the goniometer. Use a file to remove corrosion, and apply a thin coating of petrolatum to the cleaned connections. All connections must be tight.

b. FILAMENT CIRCUITS. If the system cannot be balanced after the connections have been cleaned and tightened, throw the FILAMENT switch to the alternate position. If balancing is now possible, the trouble is in the phase inverter tubes in use with the switch in its original position.

c. CHECK FOR SITE ERROR.

(1) Balance the east-west antenna system as carefully and accurately as possible. Without touching the radio set controls, move the target from its original north position to successive test positions 10 feet apart on the circumference of the circle (500-foot radius) about the antenna system. The target should be moved to three points on each side of its original position. If, with the target transmitter at any of the test positions, the circular pattern meets the specifications of paragraph 69*a*(9), the balance of the east-west antennas can be considered satisfactory. The apparent unbalance with the target transmitter in line with the north-south antennas is caused by a site condition. (Certain site conditions will shift the electrical null, so that the mechanical and electrical nulls do not coincide.)

(2) Make a similar check of the north-south antenna system.

71. Use of Signal Generator to Check Unbalance

It will be necessary to use a signal generator (I–72–( ) or equal) to check for the cause of unbalance, whenever the methods of paragraphs 69 through 70 fail to produce balance.

a. CHECKING FOR UNIFORMITY OF GROUND CONDUCTIVITY.

(1) Put Signal Generator I–72–( ) in operation at a frequency of 5 mc.

(2) Cut a piece of insulated wire into four 1-foot lengths.

(3) Connect two of the 1-foot lengths to the ground terminal of the signal generator, and connect the other two lengths to the output terminal.

(4) Remove the phase inverters from the east-west monopoles.

(5) Lay the two phase inverters beside each other, and connect one of the signal generator output leads to the banana plug on the east phase inverter. Connect one of the signal generator ground leads to the ground terminal on the same inverter.

(6) Tune the radio receiver to the signal

generator frequency. Throw the 0° and 180° antenna switches to OFF.

(7) With the 90° and 270° switches at ON, set the receiver SENSITIVITY control at 5 and readjust the signal generator output to obtain a twin-leaf indicator pattern that is just closed.

(8) Using the 1-foot lengths previously connected to the signal generator ((3) above), connect the west phase inverter in parallel with the east phase inverter which is already across the signal generator output terminals ((5) above).

(9) Alternately adjust the 90° and 270° balance controls to obtain a circular pattern on the indicator scope screen.

(10) If the diameters of the pattern now meet the specifications of paragraph 69*a*(9), the east-west antenna phase inverter system is satisfactory. The lack of balance on the target transmitter test (par. 69) is caused by nonuniform ground conductivity beneath the antennas, and, if the counterpoise and cable connections are clean and tight, balance cannot be obtained without moving the antenna system to a new position. In some instances, moving the antenna as little as 50 to 100 feet has enabled proper balancing of the antenna system.

(11) Make a similar check of the north-south phase inverter system. If the diameters of the pattern meet the specifications of paragraph 69*b* (7), the balance of the N–S phase inverter system is satisfactory. Lack of balance on the target transmitter test (par. 69*b*) is caused by nonuniform ground conductivity (*a* (10) above).

b. CHECKING FOR DEFECTIVE PHASE INVERTER. If the phase inverter system cannot be balanced with the signal generator, the trouble lies in the phase inverters, cords, or the goniometer. Check each phase inverter by replacing it with the spare phase inverter and using the signal generator to test for balance. Balance may be obtained when the defective phase inverter is replaced with the spare.

c. CHECKING FOR DEFECTIVE GONIOMETER.

(1) Remove the lead-in cord for the east-west antennas (Cord CD–826) from goniometer receptacle J601 (blue-brown) and connect it to receptacle J602 (green-yellow) on the goniometer. (Normally, Cord CD–823 from the north-south antennas is connected to receptacle J602.)

(2) Check the balance of the east-west antennas (*a* above). If balance can now be obtained, trouble in the goniometer was causing the previous unbalance. Check resistor R601, the wiring, and the goniometer coils. Replace the defective resistor and repair defective wiring. *Goniometer coils cannot be repaired in the field.*

(3) If the rebalance check does *not* improve the east-west balance, the goniometer is not defective. Replace Cords CD–823 and CD–826 in their proper receptacles.

(4) Make a similar test on the north-south antennas.

d. CHECKING FOR DEFECTIVE R-F CORDS.

(1) Replace Junction Box JB–91–A to which Cords CD–824, CD–825, and CD–826 are connected. If balance can now be obtained, the original junction box is defective.

(2) Replace Cords CD–824, CD–825, and CD–826 one at a time. Check for balance as each cord is replaced. Balance should be obtained when a defective cord is replaced by the spare.

e. CHECKING PERFORMANCE. After the antenna system has been balanced, the performance of the radio set should be checked. A suitable performance check follows:

(1) With the target transmitter in line with the north-south antennas and at a distance of 500 feet, successively tune the target transmitter to 2, 4, 6, 8, and 10 mc, taking azimuth bearings on the target at each frequency. Record the north and south bearings; that is, the azimuth readings at both ends of the indicator pattern. (All of the antenna switches on Control Panel

PN–31–A should be at ON.) Also record the sense indication at each frequency.

(2) Repeat (1) with the target transmitter at successive 45° positions along the circumference of the 500-foot circle around the antenna array. Be sure to list the azimuth readings at both ends of the pattern, indicating which is the true bearing and which is the reciprocal bearing. Also record the sense indications.

(3) If the average error over the operating frequency range is greater than 3°, check the counterpoises for loose or corroded connections, recheck the accuracy of the antenna balance (par. 69), correcting reversed sense indications (if any) in accordance with the information in paragraph 168, item 7.

72. Extension of Frequency Range

The normal frequency range of the radio set can be extended to 1.5 mc at the low-frequency end, and to 20 mc at the high-frequency end. No installation changes are necessary for extending the range to 1.5 mc, but certain installation changes must be made to provide satisfactory operation at frequencies above 10 mc.

a. EXTENDING RANGE TO 1.5 MC. Bearings can be taken in the frequency range from 2 to 1.5 mc without changes in the equipment or the use of calibration charts. In this lower range, however, the over-all sensitivity of the radio set is somewhat lower than in the normal range.

b. EXTENDING RANGE TO 20 MC. Radio Set SCR–291–A can be used to take accurate azimuth bearings on frequencies between 10 and 20 mc, provided that necessary adjustments, tests, and calibration procedures are first carried out.

(1) *Sense indication test.*

(*a*) Remove the covers from Phase Inverters MC–411–A. In each inverter connect a 400-ohm, 10-percent tolerance resistor between the jack for the input banana plug and ground (case). The 400-ohm resistors enable accurate sense indications in the 10- to 20-mc range but have no effect in the normal frequency range. With the resistors securely connected, replace the phase inverters on the monopoles.

(*b*) Set up Radio Transmitter BC–1149–A at a distance of 500 feet along the 45° azimuth bearing from the antenna array.

(*c*) Successively tune the transmitter to frequencies no more than 500 kc (kilocycles) apart in the frequency range from 10 to 20 mc, taking sense indications at each frequency.

(*d*) Make a chart (table I) of the frequencies and the sense indications obtained on each frequency. A reversed sense bearing is one in which the indicated true bearing is actually a reciprocal bearing. In general, sense bearings should be correct and definite from 10 to 18 mc; from 19 to 20 mc the sense bearing is likely to be definite, but reversed.

Table I. Sense Indication Chart

Sense indication chart
RADIO SET SCR–291–A
Serial No.______________
Frequency range 10 to 20 mc

Frequency (mc)	Sense pattern
10.0	
10.5	
11.0	
11.5	
12.0	
12.5	

Example of completed
Sense indication chart

Frequency (mc)	Sense pattern
10.0	Normal.
10.5	Normal.
11.0	Normal.
11.5	Small pattern.
	Definite and proper indication.
12.0	Normal.
12.5	Normal.

Frequency (mc)	Sense pattern
13.0	
13.5	
14.0	
14.5	
15.0	
15.5	
16.0	
16.5	
17.0	
17.5	
18.0	
18.5	
19.0	
19.5	
20.0	

Frequency (mc)	Sense pattern
13.0	Normal.
13.5	Normal.
14.0	Normal.
14.5	Normal.
15.0	Small pattern. Definite and proper indication.
15.5	Normal.
16.0	Normal.
16.5	Normal.
17.0	Normal.
17.5	Normal.
18.0	Normal.
18.5	Reversed indication.
19.0	Reversed indication.
19.5	Reversed indication.
20.0	Reversed indication.

(2) *Goniometer zero shift measurement.*

(*a*) Remove Phase Inverter MC–411–A from the north antenna.

(*b*) Connect Signal Generator I–72–( ) (or equal) to the phase inverter.

(*c*) Adjust the signal generator to successive frequencies 1 mc apart in the frequency range from 5 to 20 mc, taking bearings at each frequency with the 90°, 180°, and 270° switches at OFF.

(*d*) Record the indicated true bearing (closest to 0) at each frequency. If the two pattern lobes are not 180° apart, adjust the alidade so that the ends of one hairline are equidistant from the ends of the two lobes. Record the true bearing as the azimuth closest to 0. List any frequency at which this procedure fails to produce a true bearing.

(3) *Correction charts.* Use the preceding data to complete a Goniometer Zero Shift Correction Chart (table II). To complete the shift correction column, subtract the indicated bearing at each test frequency from 0° and enter this figure in the column. Then assign a positive or negative sign to the correction as follows:

(*a*) If the indicated bearing is greater than 0°, use the negative sign.

(*b*) If the true indicated bearing is less than 360°, use the positive sign.

Note. Instructions for operating in the extended frequency range from 10 to 20 mc are given in paragraph 81.

Table II. Goniometer Zero Shift Correction Chart

Goniometer Zero Shift Correction Chart
RADIO SET SCR–291–A
Serial No.________________
Frequency Range 5 to 20 mc

Frequency (mc)	Indicated bearing (degrees)	Shift correction (degrees)
5		
6		
7		
8		
9		
10		
11		

Example of Completed
Goniometer Zero Shift Correction Chart

Frequency (mc)	Indicated bearing (degrees)	Shift correction (degrees)
5	0	0
6	0	0
7	0	0
8	0.3	−0.3
9	0.6	−0.6
10	0.9	−0.9
11	1.2	−1.2

Frequency (mc)	Indicated bearing (degrees)	Shift correction (degrees)
12		
13		
14		
15		
16		
17		
18		
19		
20		

Frequency (mc)	Indicated bearing (degrees)	Shift correction (degrees)
12	1.6	−1.6
13	2.0	−2.0
14	2.5	−2.5
15	3.0	−3.0
16	1.0	−1.0
17	358.6	+1.4
18	358.0	+2.0
19	357.5	+2.5
20	357.0	+3.0

73. Site Calibration of Radio Set SCR–291–A

Site calibration of Radio Set SCR–291–A should never be attempted for the frequency range of 10 to 20 mc. Such a calibration would necessarily include calibration for octantal, goniometer, and site errors. Because of the magnitude of octantal and goniometer shift errors relative to site errors, site calibration is *impossible*.

Section III. OPERATION

74. General

After the preliminary adjustments have been made (sec. II, ch. 2), operater Radio Set SCR–291–A by following a rountine starting procedure, tuning the receiver, making simple adjustments to obtain suitable indicator patterns, interpreting the patterns, and using a routine stopping procedure. Accurate interpretation of the bearing patterns is important, and therefore a detailed discussion of indicator patterns is given in this section. Whenever the radio set is used to take bearings at frequencies above 6 mc, calibration and correction charts (par. 81) must be used.

75. Starting Radio Set SCR–291–A

a. PRELIMINARY STARTING CHECKS.

(1) See that the circuit breaker of Junction Box JB–95–A (or JB–126) is at OFF.

(2) The POWER, MOTOR, and HEATER switches of Control Panel PN–31–A must also be at OFF.

b. STARTING PROCEDURE.

(1) Start the power unit. (Refer to the power unit technical manual.)

(2) Throw the circuit breaker (JB–95–A) to ON.

(3) Throw the HEATER switch to ON.

(4) After the HEATER switch has been on for at least ½ hour, throw the switch to OFF.

Note. Steps (3) and (4) may be omitted in warm climates. In very cold climates the bearings of Bearing Indicator BC–1159–A become stiff during extended periods of idleness; thus, unless steps (3) and (4) are followed, it will be impossible to start the indicator drive motor.

(5) Throw the MOTOR switch to ON.

(6) After the bearing indicator motor reaches its operating speed, throw the control panel POWER switch to ON.

(7) Set the STAND-BY – D.F. – SENSE switch to STAND-BY, the SENSE GAIN control fully clockwise (maximum gain), and the FILAMENT switch to 1 (or to the position it occupied when the phase inverters were last balanced).

(8) Throw the receiver POWER switch to ON.

(9) Check the line voltage (par. 63).

(10) Adjust the circle diameter and position (par. 64).

76. Receiver Operation

a. FOR TAKING BEARINGS.

(1) Set the SENSITIVITY and A.F. GAIN controls to 7 or 8.

(2) Set the band switch for operation in the desired frequency band.

(3) Set the STAND-BY – D.F. – SENSE switch to D.F., and see that all the antenna switches (Control Panel PN–31–A) are at ON.

(4) Make a preliminary tuning of the desired signal as follows:

(*a*) Set the SELECTIVITY switch to BROAD.

(*b*) Set the AVC-MAN. switch to AVC.

(*c*) Use the tuning control to select a signal on which a bearing is to be taken.

(5) Accurately tune the selected signal as follows:

(*a*) Set the SELECTIVITY switch to SHARP.

(*b*) Set the AVC-MAN. switch to MAN.

(*c*) Use the tuning control to retune the receiver, and simultaneously adjust the ANT. COMP. control to obtain an indicator pattern of minimum width.

(*d*) Adjust the SENSITIVITY control so that the indicator pattern just closes at the center (fig. 104A).

(*e*) If c-w signals are to be monitored, throw the BFO ON-OFF switch to ON and adjust the BFO ADJ. control for a suitable audio tone. The A.F. GAIN control is used to set the loudspeaker output to a suitable level.

Note. When bearings are being taken, the SELECTIVITY switch must be set to SHARP. In the BROAD position the SELECTIVITY switch adds phase shift to the receiver circuits, and the bearing indication is in error. Similarly, while bearings are being taken, the AVC-MAN. switch must be at MAN. With the avc (automatic volume control) circuits in operation, it is practically impossible to observe fading.

b. FOR STAND-BY. Detailed instructions for stand-by operation are given in paragraph 82.

e. FOR ALINEMENT AND CALIBRATION. During alinement and calibration of the radio set, including the balancing procedure for the antennas and phase inverters (sec. II, ch. 2), always set the receiver SELECTIVITY switch to SHARP and set the AVC-MAN. switch to MAN.

77. Routine Performance Checks

a. CHECK FOR MAGNETISM. When the bearing indicator is started after a period of idleness, always check it for magnetism. The instructions in paragraph 65 are suitable for a routine check and for demagnetizing the indicator, except that any good signal of approximately 5 mc is used instead of the target transmitter.

b. CHECK FOR PARALLAX. Check the optical system, daily, for parallax. The instructions in paragraph 66 are suitable for a rountine check on parallax, except that any good 5-mc signal is used instead of the target transmitter.

c. GONIOMETER ALINEMENT CHECK. Check the goniometer alinement daily. Use any good 5-mc signal as a test signal for the goniometer check (par. 67). If realinement of the goniometer is required, the necessary adjustments are to be made by experienced personnel only.

d. ANTENNA SYSTEM AND PHASE INVERTER BALANCE CHECK. There is no simple routine check for correct antenna system and phase inverter balance. In general, take daily bearings on stations of known azimuth. If the check bearings are in error, tighten and clean all connections in the antenna system, check the bearing indicator for magnetism and parallax, and check the goniometer alinement. If the preceding tests do not locate the cause of erroneous check bearings, only experienced personnel should check and readjust the antenna system balance.

78. Interpretation of Patterns

a. IDEAL PATTERN. An ideal pattern, obtained with the STAND-BY – D.F. – SENSE switch at D.F. and with all the antenna switches (Control Panel PN–31–A) at ON, is shown in figure 104A. The center points just touch and are not offset from each other, indicating correct adjustment of the SENSITIVITY control and no magnetism in the bearing indicator. The absence of noise patterns shows that the signal is well above the prevailing noise level. As the pattern stands, however, it is impossible to tell whether the correct azimuth is 127° or 307°.

b. SENSE PATTERN. To determine which of the two possible azimuths (fig. 104A) is correct, the STAND-BY – D.F. – SENSE switch is thrown to SENSE, and the SENSE GAIN control is adjusted to obtain the pattern shown in figure 104B. Here the pattern represents the

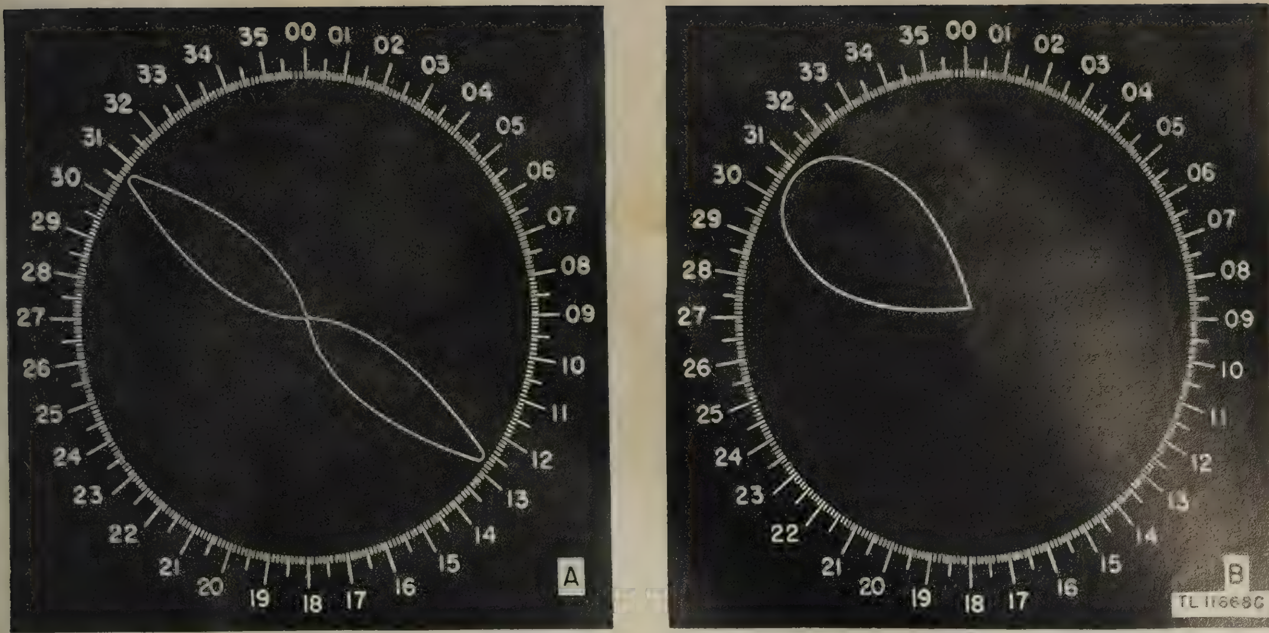


Figure 104. Correct D/F and SENSE patterns.

tail of an arrow which is pointing to 127°, which is the correct azimuth bearing. If the correct azimuth were 307°, the sense pattern would appear as shown in figure 105D.

c. VARIATIONS OF SENSE PATTERN. For a given signal input, the size and shape of the sense pattern is a function of the setting of the SENSE GAIN control. In figure 105A the true bearing is 307°, and the SENSE GAIN setting is very low; B, C, and D of this figure show progressive changes of the sense pattern as the SENSE GAIN control is advanced. Note that, regardless of the SENSE GAIN setting, the sense pattern is closer to the reciprocal bearing than to the true bearing (307°). Consequently, each of these patterns is a suitable indication of sense. However, it is usually best to advance the SENSE GAIN sufficiently to obtain, if possible, the definite clear pattern of figure 105D.

d. TYPICAL INDICATOR PATTERNS.

(1) *Strong c-w signal* (fig. 106). The narrow pattern with overlapping center points is caused by advancing the SENSITIVITY control too far. The absence of noise pattern, even with the SENSITIVITY so far advanced, shows that the incoming signal is well above the noise level.

(2) *Strong keyed c-w signal* (fig. 107). The circular and bearing patterns appear simultaneously because of the no-signal intervals between the keyed signals. The circular pattern in this illustration is too small and off-center. The POSITIONING and CIRCLE DIAMETER controls should be readjusted to center the pattern and to increase the circle diameter to the proper size (par. 64).

(3) *Modulated signal* (fig. 108). The pattern is jagged because of the a-f (audio-frequency) modulation at a fixed frequency. The usability of the pattern will be improved if the SENSITIVITY control is advanced to bring the center points together. As in the two preceding illustrations, the signal is well above the noise level.

(4) *Weak modulated signal* (fig. 109). With the SENSITIVITY control advanced just far enough to close the pattern center points, the noise is amplified and appears on the indicator scope. However, the noise is slight and will not interfere with obtaining a satisfactory azimuth bearing from this pattern.

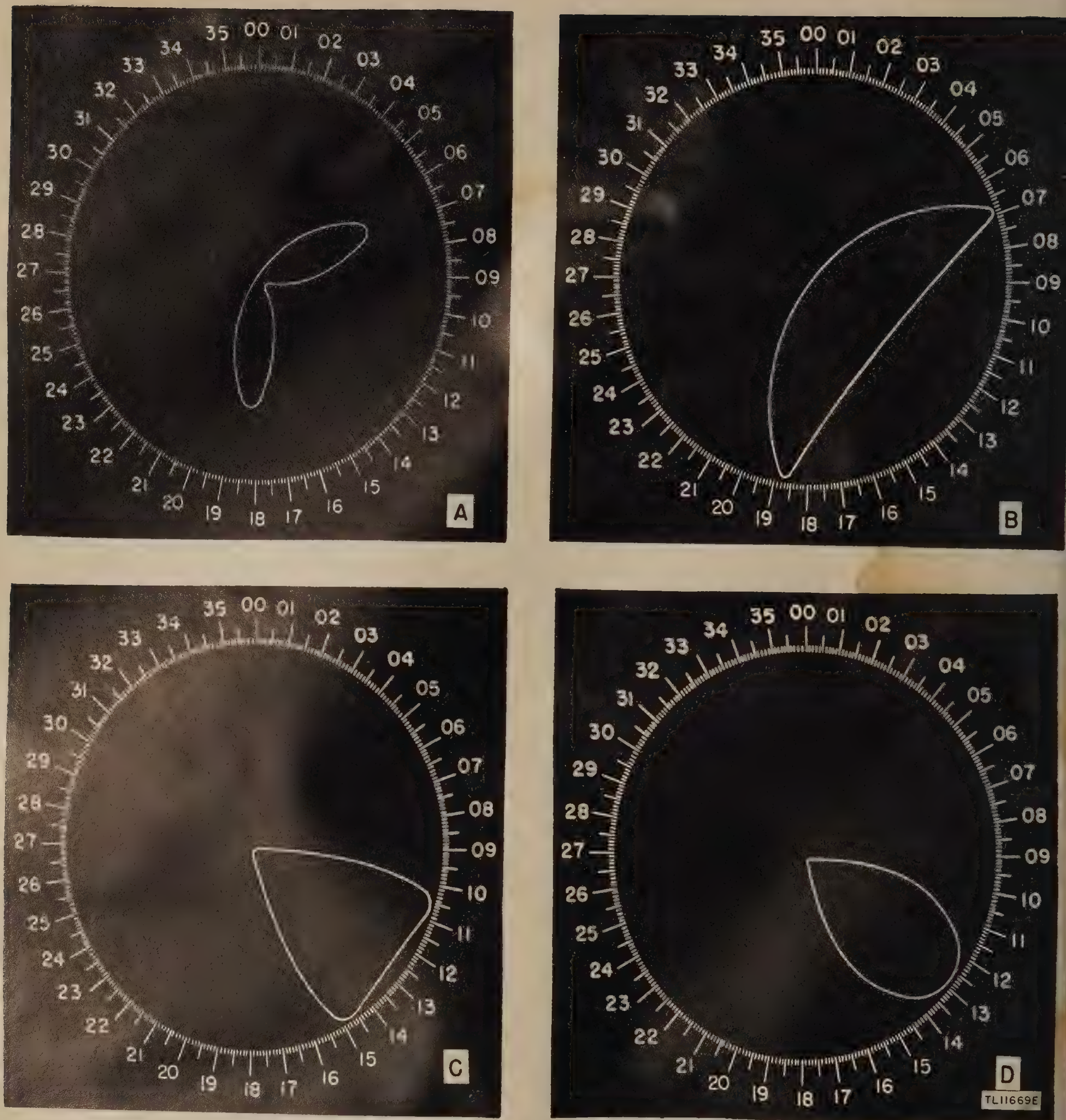


Figure 105. Variations of sense pattern with SENSE GAIN.

(5) *Weaker modulated signal* (fig. 110). For weaker signals the SENSITIVITY control must be advanced, the noise increases. Azimuth bearings taken from this type of pattern are not as dependable as those obtained with stronger signals.

(6) *Very weak signal* (fig. 111). With very weak signals, the SENSITIVITY control must be so far advanced that the noise pattern predominates and shifts rapidly. The shifting noise pattern reduces the accuracy with which an azimuth bearing can be determined,

Figure 106. Bearing indicator pattern, strong c-w signal.

Figure 107. Bearing indicator pattern, keyed c-w signal.

and the illustration represents the practical limit of usability.

(7) *Extremely weak signal* (fig. 112). When extremely weak signals are received, the noise pattern usually wipes out all trace of the signal pattern, and it is impossible to take bearings.

Figure 108. Bearing indicator pattern, modulated signal.

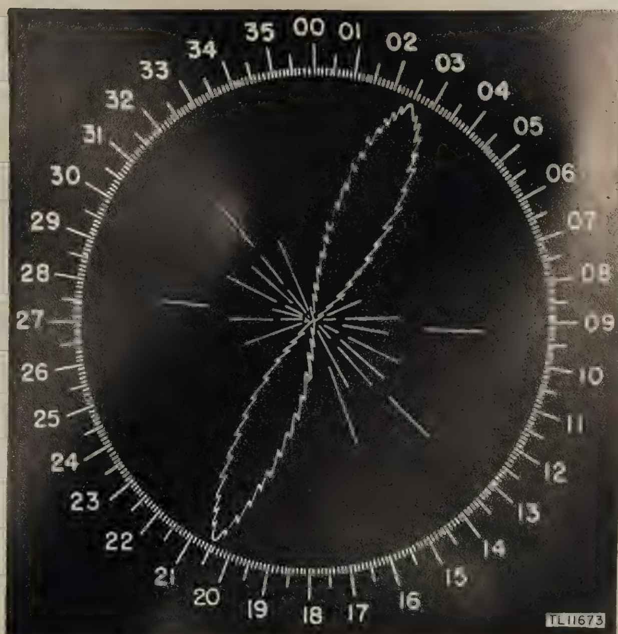


Figure 109. Bearing indicator pattern, weak modulated signal.

Occasionally, the signal may fade in (increase) sufficiently to give a momentary pattern like that shown in figure 111.

79. Bearing Reliability

The principal advantages of the visual indicator

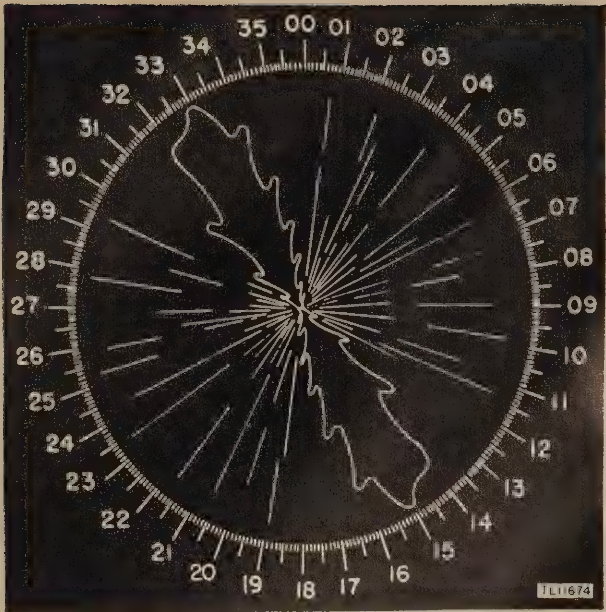


Figure 110. Bearing indicator pattern, relatively weak modulated signal.

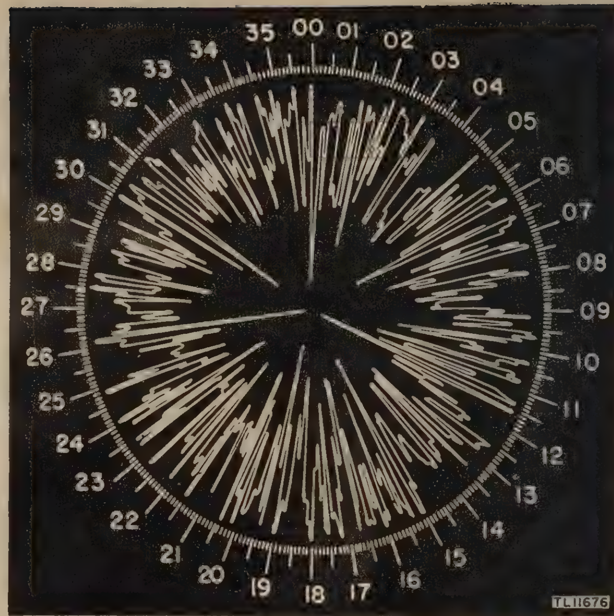


Figure 112. Bearing indicator pattern, extremely weak signal.

in Radio Set SCR–291–A are that it gives a continuous picture of received signals and that bearings can be taken very quickly. Even under very adverse conditions of reception, there are likely to be brief moments of good reception during which the indicator pattern is an accurate indication of azimuth. Thus, the operator should watch for the following indications of suitable patterns and take azimuth readings when they occur.

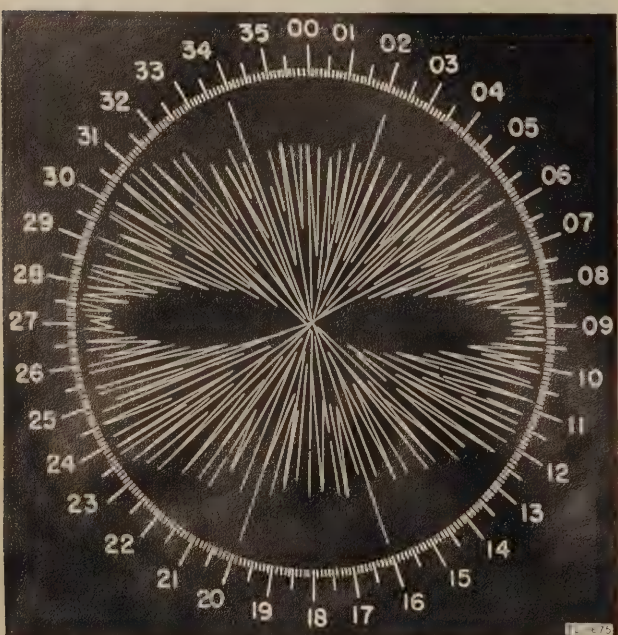


Figure 111. Bearing indicator pattern, very weak signal.

a. SHARP PATTERN POINTS. Sharp pattern points (nulls) indicate that the received signal is coming in over an unchanging propagation path. Conversely, broad null points indicate that the received signals are arriving over a shifting propagation path. Only approximate bearings are possible while the nulls are excessively rounded.

b. FIXED PATTERN POINTS. If the pattern points remain fixed in one position, the signals are arriving with unchanging polarization and direction of arrival. If the pattern points are constantly swinging, it is an indication that the polarization and direction of arrival of the received waves are constantly changing and the indicator pattern is difficult to read accurately.

c. FIXED PATTERN WIDTH. Variations of the pattern width are indicative of a fading signal. Fading is frequently accompanied by changing polarization. Bearings are difficult to take when the pattern width is varying.

80. Use of Alidade

a. SWINGING SIGNALS. The alidade is useful in averaging swinging patterns (*b* and *c* above).

The swinging pattern is particularly troublesome when bearings are being taken on signals coming from across the sunrise or sunset lines. Generally, the average position of the pattern (midpoint between swings in opposite directions) is close to the true azimuth bearing. By setting the crossline of the alidade to the average position, it is possible to read the azimuth under the crossline.

b. BRIEF SIGNALS. Transmissions are sometimes of such short duration that it is impossible to take a bearing on them. The alidade can be set to the approximate azimuth as observed on the first set of signals. Accurate adjustment can then be made when transmission is repeated.

c. WEAK SIGNALS. When weak signals are received, or when the noise level is high, the pattern nulls may be poor, and the pattern points may pull in from the azimuth scale as the SENSITIVITY setting is advanced. Use of the alidade will eliminate the error which would occur if attempts were made to estimate the point at which the pattern should intersect the azimuth scale.

d. SENSE PATTERNS. The shifting of weak sense patterns toward the reciprocal bearing can be more readily observed when the alidade is used. Consequently, the alidade enables easier determination of sense.

81. Correction Curves and Charts

a. FOR 1.5– TO 10–MC RANGE. An error, known as octantal error, is characteristic of Radio Set SCR–291–A. The error is a function of the spacing between the monopoles in the antenna array. At frequencies below 6 mc, octantal error is small and may be neglected. For frequencies above 6 mc, however, the error is greater than 1° and the octanal error curves (fig. 113) must be used.

Example 1—The bearing indicator shows a bearing of 100° for a 10-mc signal. The 10-mc curve (fig. 113) shows that 100° bearing at 10 mc must be corrected by subtracting 2.1° from the indicator reading. Thus, the corrected azimuth true bearing is 97.9°.

Example 2—The bearing indicator shows a bearing of 30° for a 9-mc signal. Since there is no 9-mc curve drawn in figure 113, it is necessary to interpolate. If drawn, the 9-mc curve would fall midway between the 8- and 10-mc curve; consequently, the 9-mc curve would cross the 30° line at —2.8°, and the true bearing is 30° —2.8°, or 27.2°.

Example 3—The bearing indicator reading is 245° for a 7-mc signal. Again it is necessary to interpolate. The 7-mc curve would cross the 24

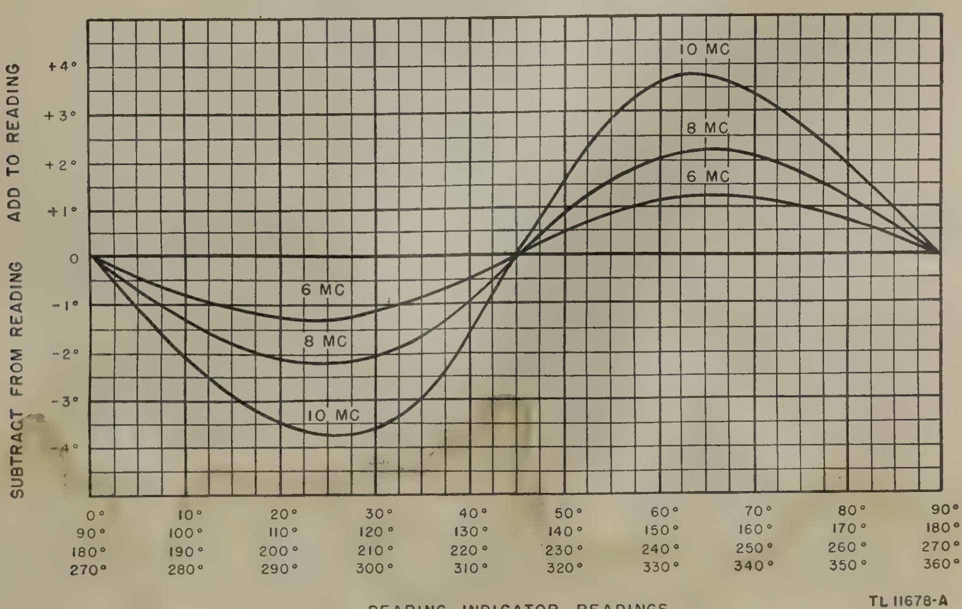


Figure 113. Octantal error curves, 5 to 10 megacycles.

line at +1.8°. Therefore, the true bearing is 245° +1.8°, or 246.8°.

Note. The octantal error curves in this manual are suitable for use only with the antenna spacing specified in paragraph 29.

b. For 10– to 20–MC Range. Follow the routine operating procedure to obtain bearing indicator twin-leaf and sense patterns. Then refer to the Sense Indication Chart for the radio set (*not* to the example) and determine which of the two possible azimuth bearings is correct. The indicator reading must now be corrected for goniometer zero shift and for octantal error. The two errors may be corrected by either of the two methods given below.

(1) *Use of correction curves.*

(*a*) Refer to the Goniometer Zero Shift Correction Chart for the radio set. Correct the indicator reading by adding or subtracting the number of degrees given in the shift correction column.

(*b*) Refer to the 10- to 20-mc octantal error curves (figs. 114 through 117) and determine the true bearing.

Example—Assume that at 14 mc a reading of 25° is obtained on the bearing indicator, that the Sense Indication Chart shows that the bearing indicator sense pattern is correct, and that the Goniometer Zero Shift Correction Chart gives —3° as the shift correction. Subtract this 3° from the 25° reading to get a corrected reading of 22°. Refer to the octantal error curve (fig. 114) and determine that the true bearing is 15°.

(2) *Use of slide rule.* Instructions and the materials for preparing an error correction slide rule are given in appendix

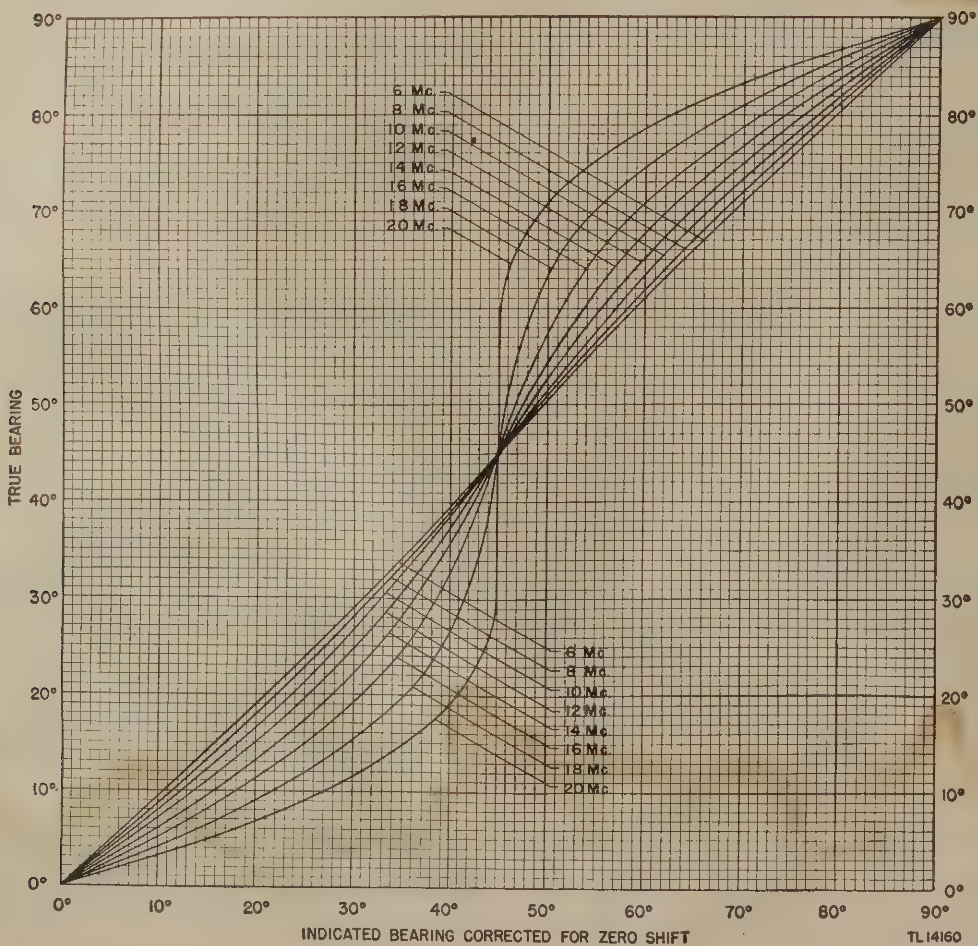


Figure 114. Octantal error curves.

V of this manual. The completed slide rule is illustrated in figure 118. To use the slide rule, proceed as follows:

(*a*) Rotate the slider to place the indicator bearing above the pointer at the base of the slider window.

(*b*) Follow the center line of the slider to the concentric line corresponding to the frequency at which the bearing was taken.

(*c*) Follow this frequency line to the slider edge which has been cut to compensate for the goniometer zero shift error.

(*d*) Follow the curved line (or an equivalent curved line, if the frequency line does not meet one of the curved lines) to the scale on the outer edge of the slide rule.

(*e*) Read the true bearing on the outer azimuth scale.

Example — The bearing indicator gives an azimuth reading of 35°. In figure 118 the slider has been set so that the pointer at the base of the slide window is at 35°. For a frequency of 12 mc, the frequency line is between the curved lines which touch the outer scale at 28° and 30°, respectively. Read the true bearing as 29° on the outer scale. Additional true bearings for an indicated bearing of 35° have been obtained from figure 118 and tabulated in table III for frequencies from 5 to 20 mc.

Caution: At four points on the circumference of the inner azimuth scale on the slide rule (fig. 118) there are blank segments through which the curved lines from the outer scale have not been extended to the inner scale. Bearings at frequencies and angles that fall within these blank segments may be in error by as much as 20° and should not be used.

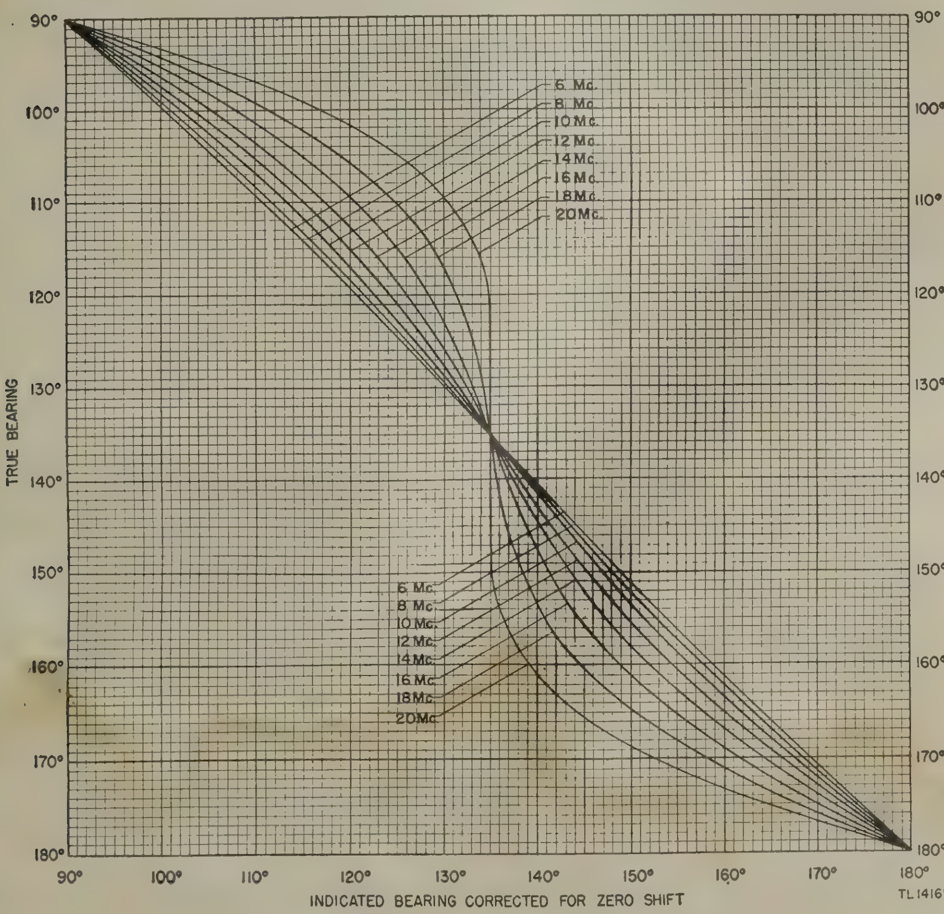


Figure 115. Octantal error curves.

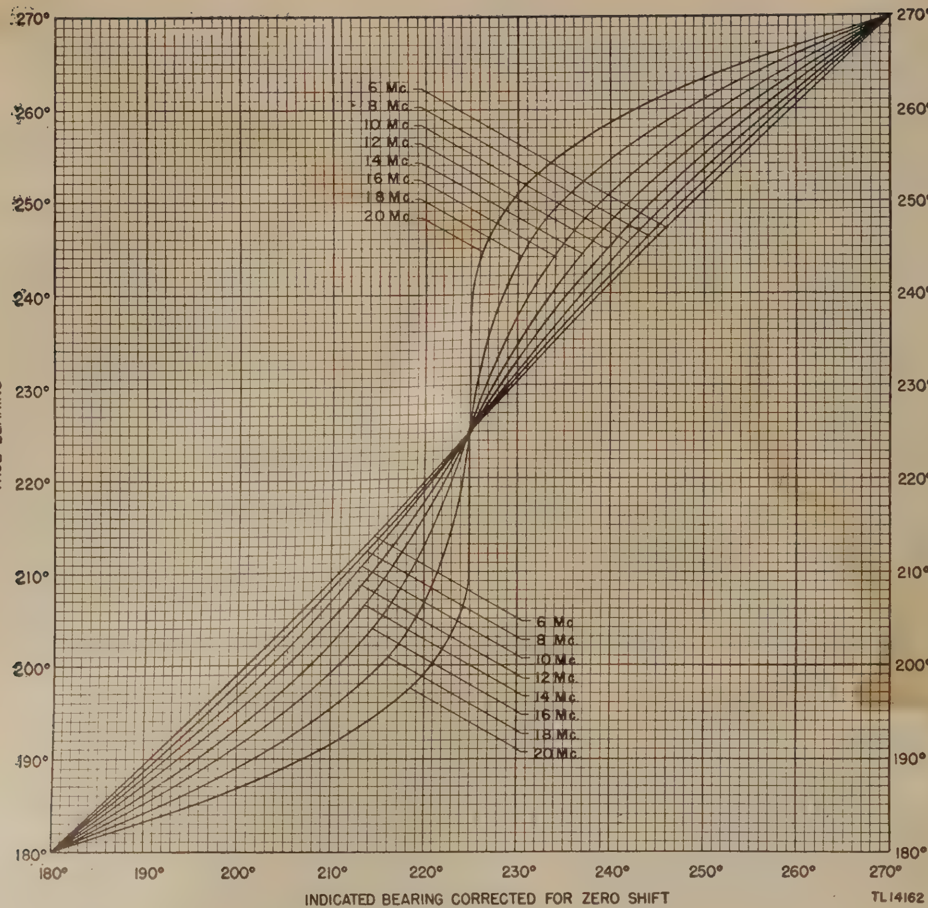


Figure 116. Octantal error curves.

Table III. True Bearings Obtained by Using Slide Rule

Indicated bearing (degrees)	Frequency (mc)	True bearing (degrees)
35	5	35.0
35	6	34.5
35	7	34.3
35	8	33.7
35	9	33.0
35	10	32.0
35	11	30.6
35	12	29.0
35	13	27.5
35	14	25.2
35	15	23.3
35	16	23.5
35	17	24.2
35	18	22.5
35	19	19.6
35	20	17.5

82. Monitoring

When Radio Set SCR–291–A is used as a monitoring station, with bearings to be taken at infrequent intervals, needless wear can be avoided by not running the indicator motor during the monitoring periods. To operate the radio set under the preceding conditions, proceed as follows:

a. Monitoring Operation.

(1) Throw the STAND-BY – D.F. – SENSE SWITCH to STAND-BY.

(2) Turn the SENSE GAIN control to its maximum clockwise position.

(3) Set the AVC-MAN, switch to AVC.

(4) Set the BFO ON-OFF switch to ON.

(5) Adjust the A.F. GAIN control for a suitable loudspeaker output.

(6) Turn the FOCUS control (bearing indicator control box) to a position at which the cathode-ray tube spot is completely defocused.

(7) Throw the MOTOR switch to OFF.

(8) Operate the receiver in the usual manner (par. 76).

b. Bearing Operation.

(1) Throw the MOTOR switch to ON.

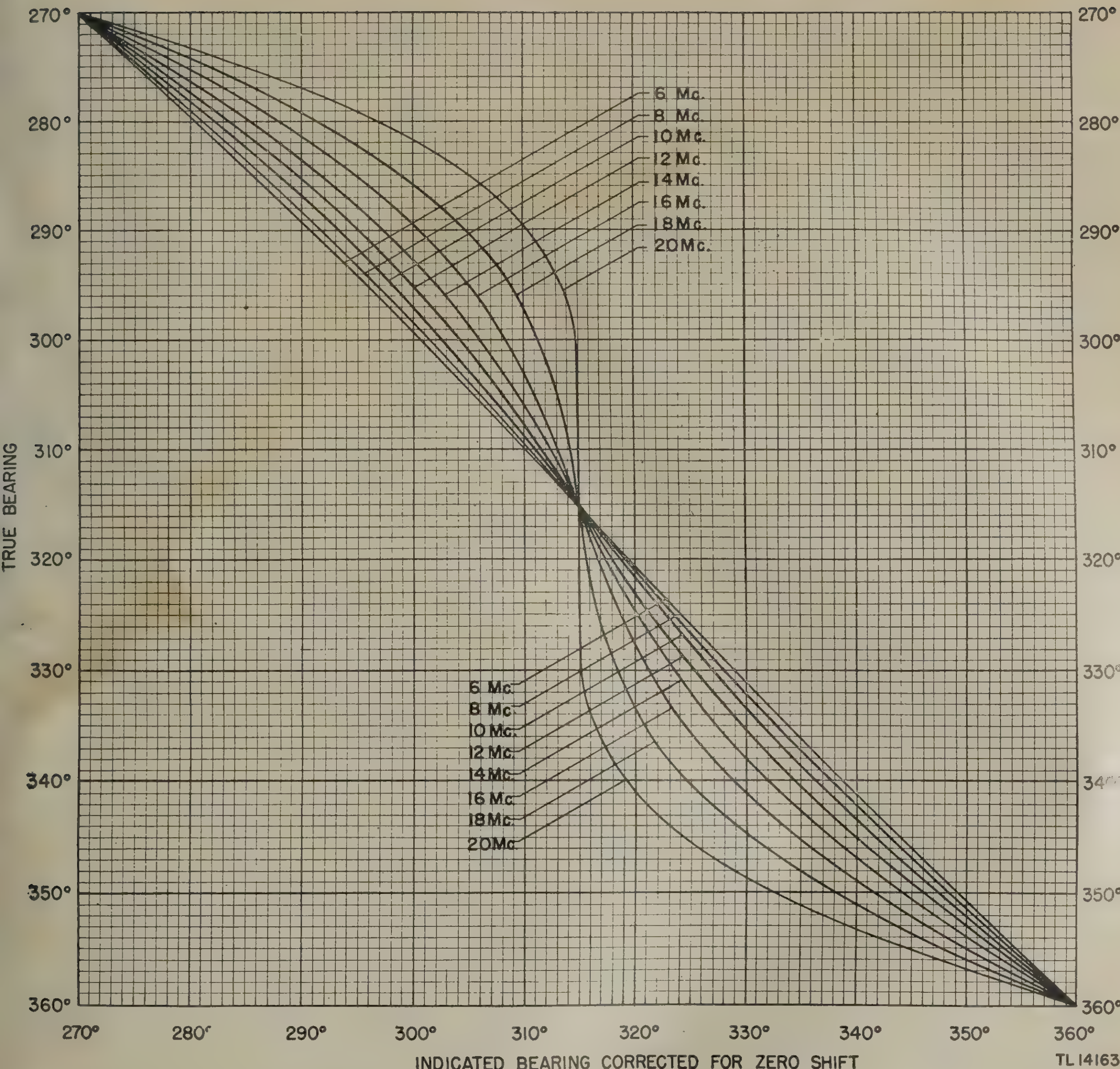


Figure 117. Octantal error curves.

(The bearing indicator motor will come up to normal speed in about 5 seconds.)

(2) Set the STAND-BY – D.F. – SENSE switch to D.F.

(3) Refocus the circular trace on the cathode-ray tube screen by readjusting the FOCUS control.

(4) Adjust the receiver controls for azimuth patterns on the bearing indicator.

(5) After bearings have been taken, resume monitoring by making the adjustments described in *a* above.

83. Stopping Procedure

a. Complete Shut-Down.

(1) Throw the control panel MOTOR and POWER switches to OFF.

(2) Throw the receiver POWER switch to OFF.

(3) Set the circuit breaker of Junction Box JB–95–A to OFF.

(4) Refer to the power unit technical manual for instructions on stopping the power unit.

b. Heater Switch Left at On. In extremely cold climates, it may be necessary to keep the power unit in operation and to put the HEATER switch at ON, so that the heaters in Bearing Indicator BC–1159–A can function to prevent the indicator motor bearings from becoming stiff. In humid climates, it may also be desirable to keep the HEATER switch at ON, so that the heater lamp of Rack FM–61–A operates to keep the interior of the rack dry. If the HEATER switch is to be left at ON, the following stopping procedure is applicable:

(1) Throw the control panel MOTOR and POWER switches to OFF.

(2) Throw the receiver POWER switch to OFF.

(3) Throw the HEATER switch to ON.

84. Operation of Radio Transmitter BC–1149–A

For detailed information on setting up and operating the target transmitter, refer to TM 11–849.

Section IV. EQUIPMENT PERFORMANCE CHECKLIST

85. Purpose and Use of Checklist

a. General. The equipment performance checklist (par. 86) will help the operator determine whether Radio Set SCR–291–A is functioning properly. The checklist 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 make. Check items 1 and 2 before starting (before turning on the equipment), items 3 through 7 when starting, items 8 through 16 before operation, and items 17 through 19 when stopping (when turning off the equipment). Items 14, 15, and 16 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 various switch and control settings under which the item is to be checked. For other items it represents an action that must be taken to check the normal indication given in the normal indications column.

c. Normal Indications. The normal indications listed include the visible and audible signs that the operator should 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 may be a sign of 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 in the equipment for repairs. A reference to part five in this column indicates that the trouble cannot be corrected during operation and that trouble shooting by an experienced repairman is necessary. If the set is completely inoperative or if the recommended corrective measures do not yield the desired 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 Through 16. Items 1 through 16 should be checked each time the equipment is put into operation.

f. Items 5 Through 16. These items represent general operating characteristics. 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 when the set is not operating properly.

g. Item 12. The operator should familiarize himself with the operation of Radio Receiver BC–1147–A, so that he knows the characteristics of its reception of normal signals. By becoming familiar with the operation of the receiver, the operator will know the normal position of the SENSITIVITY control. This will aid in an approximate determination of the sensitivity and amplification of the receiver.

h. Items 17 Through 19. Items 17 through 19 are checked whenever the station 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.

86. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
PREPARATORY	1	Junction Box JB-95-A (or JB-126).	Check position of circuit breaker.	Should be at OFF	Set to OFF.
	2	Control Panel PN-31-A	Check position of HEATER, MOTOR, and POWER switches.	Should be at OFF	Set to OFF.
START	3	Power unit	Start	Refer to technical manual for power unit.	
	4	Junction Box JB-95-A (or JB-126).	Throw circuit breaker to ON.		
	5	Control Panel PN-31-A	Throw MOTOR switch to ON.	Motor pilot lamp lights; motor starts and quickly comes to running speed.	If pilot lamp fails to light and if no power is applied to motor, check for a-c power by plugging test lamp into AUX. 115V. A.C. receptacle. Check connections of Cords CD-839 and CD-840; check pilot lamp. If pilot lamp lights but motor overloads power unit or starts slowly, throw MOTOR switch to OFF. Check for cold motor bearings. Put HEATER switch to ON, and do not attempt to restart motor until heater has been on for ½ hour.
	6	Control Panel PN-31-A and Radio Receiver BC-1147-A.	Throw control panel and receiver POWER switches to ON.	Power pilot lamp lights; receiver dial lamps light.	Check pilot lamp; check receiver fuses F101 and F102; check receiver a-c power cord connection to J204; check receiver dial lamps.
	7	Line voltage	Set STAND-BY-D.F.-SENSE switch to STAND-BY, SENSE GAIN to 10, and FILAMENT switch to 1.	PLATE MA. meter reads between 20 and 30 ma.	Try FILAMENT switch in position 2; see *Note* (in par. 63*a* (8)); adjust power unit output voltage (par. 63*b*).
EQUIPMENT PERFORMANCE	8	FOCUS and INTENSITY controls.	Set SENSITIVITY to 0, STAND-BY-D.F.-SENSE switch to D.F.; alternately adjust FOCUS and INTENSITY controls.	Adjustment of FOCUS will change focusing of screen image; adjustment of INTENSITY will change brilliance of image.	Refer to chapter 4.
	9	CIRCLE DIAMETER	Adjust CIRCLE DIAMETER control.	Diameter of circular trace will change.	Refer to chapter 4.
	10	POSITIONING controls	Adjust HORIZONTAL and VERTICAL POSITIONING controls.	Screen image moves horizontally or vertically as HORIZONTAL or	Refer to chapter 4.

Item No.	Item	Action or condition	Normal indications	Corrective measures
			VERTICAL control respectively, is adjusted.	
11	Antenna monopoles and phase inverters.	Set STAND-BY–D.F.–SENSE switch to D.F. and set each antenna switch (Control Panel PN–31–A) successively at ON; with the other three switches at OFF, tune the receiver (par. 76) to a 5-mc signal.	Approximately equal signals will be received on each antenna; PLATE MA. will read approximately 10 ma for each antenna.	Refer to paragraph 68*b*.
12	Receiver controls	Set BFO switch to ON, A.F. GAIN control to 10, and AVC-MAN. switch to AVC, and tune receiver to signal from one monople (11 above).	Beat note heard in loudspeaker; pattern appears on scope screen.	Refer to chapter 4.
		Adjust A.F. GAIN control. Adjust BFO ADJ. control. Throw BFO-ON-OFF switch to OFF.	Loudspeaker outout varies. Audio tone changes. Beat note is no longer heard.	
		Set AVC-MAN. switch to MAN. and tune in various stations.	Output varies with strength of received signals.	
		Adjust SENSITIVITY control.	Gain varies with setting of control.	
		Set band switch successively to each band, and tune receiver.	Signals can be tuned in each band.	
13	Sense monopole and phase inverter.	Set the STAND-BY–D.F.–SENSE switch to SENSE, advance SENSE GAIN control clockwise, and set all antenna switches to ON; tune receiver.	Signals will be received, and normal sense pattern appears on scope screen.	Refer to paragraph 68*a*.
14	Bearing Indicator BC–1159–A, check for magnetism.	Set SENSITIVITY to 7 or 8, and tune in a signal at approximately 5 mc.	Center points of screen pattern will not be offset.	Refer to paragraph 65.
		Readjust SENSITIVITY control to bring twin-leaf pattern points together.		Refer to paragraph 65.
		Set SENSITIVITY control to 0.	Bearing indicator pattern becomes a circle.	Refer to paragraph 65.
15	Bearing indicator, check for parallax.	With only the 0° antenna switch at ON, tune the receiver to a signal of	Twin-leaf pattern is in same plane as image of azimuth scale.	Refer to paragraph 66.

	Item No.	Item	Action or condition	Normal indications	Corrective measures
			approximately 5 mc, and adjust for a twin-leaf pattern.		
	16	Goniometer alinement	With the equipment operating as in item 15 above, check position of pattern points with respect to azimuth scale.	True bearing (0°) will be less than 1° off. Reciprocal may not be exactly 180° from true bearing, but the error will be small.	Refer to paragraph 67.
STOP	17	MOTOR switch	Throw to OFF	Bearing indicator stops	Refer to chapter 4.
	18	POWER switch (Control Panel PN-31-A).	Throw to OFF	Pilot lamps go out; power removed from receiver and control panel circuits.	Refer to chapter 4.
	19	Power unit	Stop	Refer to technical manual for power unit.	

CHAPTER 3

MAINTENANCE INSTRUCTIONS

Section I. PREVENTIVE MAINTENANCE TECHNIQUES

87. Introduction

a. MEANING. PM (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 PM, it is necessary to distinguish PM from trouble shooting and repair. The prime function of PM 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.*

b. IMPORTANCE. The importance of PM 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 repairmen maintain their radio sets properly.

Note. The operations in sections I and II of this chapter are organizational maintenance (organization operators and maintenance personnel). Some operations in sections I and III are field or base maintenance.

88. Description of Techniques

a. GENERAL.

(1) Most of the electrical parts used in Radio Set SCR–291–A require routine PM of one kind or another. Definite and specific instructions must be followed; hit-or-miss methods cannot be used. This section of the manual contains these specific instructions and serves as a guide to maintenance personnel. The standard lettering system for the six basic operations is as follows:

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

(2) The first two operations will show whether any further work is needed. The kind of maintenance necessary is determined by field conditions. 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, adjusting, and lubricating, equipment becomes undependable and may 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, and 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 in order 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 break-downs. 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) Improper placement, by observing that all leads and cabling are in their original positions.

(3) Lack of 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 from dust, corrosion, and other foreign matter. In tropical and high-humidity areas, look for fungus growth and mildew.

d. TIGHTEN, CLEAN, AND ADJUST. These operations are self-explanatory. Specific procedures to be followed in performing them are given whenever necessary throughout chapter 3. Whenever a loose connection is tightened, it should be moistureproofed and fungiproofed again by applying the varnish with a small brush. See section IV of this chapter for details of moistureproofing and fungiproofing.

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

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 III of this chapter.

89. 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.

(1) Inspect glass and metal tube envelopes, tube caps, and tube connector clips for dirt and 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 tubes in their sockets for firmness. 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. 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. ADJUST. 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 gage metal, suitable pressure can be applied with a pair of long-nose pliers.

d. CLEAN.

(1) Clean the tubes, if necessary. Tubes operated at high voltages and with exposed plate and grid connections must be kept free from 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 any tube.

(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 by wrapping a piece of No. 0000 sandpaper around the cap and *gently* rubbing the surface. Excessive pressure is not needed; it is also unnecessary to grip the cap tightly. After using sandpaper, wipe the cap with a clean dry cloth.

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

90. Capacitors

Caution: Because of dielectric absorption, capacitors remain charged after the equipment has been shut down. To avoid dangerous shocks, short-circuit the terminals of all high-voltage capacitors before starting maintenance work.

a. INSPECT.

(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 misalinement that would cause them to touch the fixed plates during tuning.

(4) Rotate the movable plates, using the panel tuning control, and thus check for proper operation of the capacitor.

b. TIGHTEN. Tighten loose terminals, mountings, and connections on the capacitors. Do not break the bushing or damage the gasket.

c. CLEAN.

(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 (SD).

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

d. LUBRICATE. Refer to section III of this chapter.

91. Resistors

a. GENERAL. Various types of resistors are used in Radio Set SCR–291–A. The connections to the various resistors are either the pigtail or the solder-lug type.

b. INSPECT. 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. 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.

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

(2) The vitreous-enameled resistors must be qept clean to avoid leakage between the terminals. Wipe them with a dry cloth. However, if the dirt deposit is unusually hard to remove, use 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 procedures are described in part five.

92. Fuses

a. GENERAL. Fuses used in Radio Set SCR–291–A are the glass case type. The glass case fuses 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. Strip-type fuses can be removed only after the screws holding them in place have been taken out. Fuses should be thrown away when they blow.

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

c. TIGHTEN. The tension of the fuse clips may be increased by pressing the sides closer together. If necessary, use pliers to adjust the tension.

d. CLEAN. Clean fuse ends and fuse clips with emery cloth; then wipe them with a clean cloth. If necessary, a file may be used to remove deep pits on the clips, fuse ends, or contacts. When using a file, be sure that filings or chips do not fall into or on components; such metallic particles cause electrical leakages and short circuits. Make a final cleaning with crocus cloth to leave a smooth contact surface; then, as a final step, wipe the surface with a clean dry cloth.

93. 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, for high-voltage terminals of capacitors, and for tank coils. 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.

(1) Inspect the physical condition of the insulated bushings. They should be clean and 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 path for a high-voltage flash-over.

(2) As a rule, the bushings are held in position with nuts screwed onto the threaded conductors. These bushings can be replaced very easily. If replacement is not possible because of a shortage of supplies, clean the defective bushing frequently and thoroughly with 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. In tightening loose bushings, *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 of bushing stud bolts are found stripped so that they cannot be tightened, replace the entire bushing.

d. CLEAN. 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 solvent (SD). After the surface has been cleaned with solvent (SD). 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.

94. Relays

a. NORMAL INDICATIONS. Relays K601 and K301 are considered normal if the following conditions exist:

(1) The relays are free from dirt or dust.

(2) The contacts are not burned, pitted, or corroded.

(3) The contacts are lined up and correctly spaced.

(4) The moving parts travel freely and function in a satisfactory manner.

(5) The connections to the relay are tight.

(6) The wire insulation is not frayed or torn.

(7) The relay assembly is securely mounted.

(8) The coils show no signs of overheating.

b. INSPECT.

(1) Inspect each 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 be sure that when the moving and stationary contacts come together they make positive contact and are directly in line with each other.

c. TIGHTEN. Tighten all loose connections and mounting screws, but do not apply enough force to damage the screws or to break the parts they hold.

d. CLEAN.

(1) *Relay exterior.* Brush the exterior of each relay with a soft brush. If the connections are dirty, remove the leads and clean them. Replace carefully.

(2) *Relay contacts.*

(*a*) Before removing relay covers, see that all apparatus is free from dust, dirt, or other foreign matter which might fall into the relay contacts.

(*b*) Remove loose dust or lint from the relay and relay contacts. Use a soft-bristle brush.

(*c*) Inspect the relay contacts thoroughly. If they are dirty, burned, pitted, or corroded, service them in accordance with the instructions below.

Note. The brown discoloration on silver or silver-plated contacts is silver oxide and is a good conductor. It should not be removed, unless the contacts must be cleaned for some other reason. It may be removed at any time, either by burnishing or by using a cloth moistened with carbon tetrachloride.

(*d*) To clean contacts, insert a clean flat blade in the burnishing tool. (Tool, switchboard, contact burnisher, WECo 265C, Signal Corps stock No. 6R41065C.) Keep the blade clean by frequent wiping with a lint-free cloth moistened with carbon tetrachloride. To burnish normally open contacts, press them together with the orange stick (or suitable substitute) or operate the relay manually to give a slight pressure against the blade of the burnisher. At the same time move the blade back and forth two or three times or enough to brighten the contacts; avoid excessive burnishing. When too much of the contact metal is removed, the contact follow is destroyed and readjustment is necessary. For burnishing normally closed contacts, the tension of the springs themselves will usually supply enough pressure against the burnisher. If the spring tension is heavy, lift one of the springs away sufficiently to insert the burnisher.

(*e*) If burnishing does not eliminate the contact trouble, use carbon tetrachloride to clean the contact surfaces more thoroughly. Dip the flat end of a clean tooth-pick into the carbon tetrachloride. Then, holding the contacts slightly separated, deposit the liquid on the contacts without rubbing. Use the flat end of another toothpick to deposit more carbon tetrachloride on the contact to flush away dirt loosened by the first application. Do not rub. Be careful to keep the carbon tetrachloride from all insulating materials. When the contacts are thoroughly dry, burnish them ((*d*) above) to remove all deposit or residue. Always burnish the contacts after cleaning with carbon tetrachloride.

(*f*) Contact points which are badly pitted or built up may be reconditioned as follows: Remove the build-ups with a fine-cut point file (or in emergencies, crocus cloth). Burnish the pits with the ball-point burnisher blade furnished with the switchboard contact burnishing tool. If the pit is small, place the ball point of the burnisher in the pit and rotate the barrel of the tool between the thumb and finger, at the same time applying slight pressure. If the pit is large, move the ball point of the burnisher over the surface of the pit with a circular motion. After removing build-ups and cleaning pits, again burnish the contacts with a flat blade of the contact burnisher. Always be careful to avoid excessive removal of the contact metal. Otherwise contact follow and separation requirements will be affected and readjustment will be necessary.

Caution: Never use highly abrasive material, such as sandpaper or emery cloth, to clean relay contacts.

(*g*) Relay pole faces and armature faces must be cleaned occasionally. These are the surfaces of the core and armature which touch each other when the relay operates. Need for cleaning is indicated by a tendency to stick during operation. Clean with a burnisher and carbon tetrachloride, or use the following method: Insert a strip of hard-finish bond paper between the armature and the core. Lightly press the armature against the core and withdraw the paper. Repeat with clean paper until the paper shows no evidence of dirt.

Caution: Do not use paper to clean relay contacts. Minute burrs on the contact surface may retain fine shreds of paper and cause faulty contact.

95. Switches

a. INSPECT.

(1) Inspect the mechanical action of each switch and, while doing so, 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 by pressing the switch button and noting the freedom of movement and amount of spring tension.

(2) Examine ganged switches S101, S102, S103, S104, and S105 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 visable. Switch action should be free. Wiping action of contacts usually removes any dirt at the point of contact.

b. CLEAN. Clean the exterior surfaces of switches with a stiff brush moistened with solvent (SD).

c. LUBRICATE. Refer to section III of this chapter.

96. Coils

a. INSPECT. Inspect all coils for cleanliness of the coil form and secureness of mounting supports. Check all connections for proper contact and spring tension.

b. TIGHTEN. Tighten any loose coil mounting or connections by tightening screws or resoldering wires.

c. CLEAN. Clean the coil form and coil with a soft brush. Remember that coil forms are actually performing the function of insulators. Therefore, the same PM will apply to coil forms as to high-voltage insulators and bushings.

97. Rheostats and Potentiometers

a. INSPECT.

(1) Inspect the mechanical condition of all rheostats and potentiometers. The movable contact arms should be keyed tightly to the shafts, and all shafts should turn easily.

(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. Tighten loose assembly or mounting screws.

c. CLEAN.

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

(2) Use carbon tetrachloride to remove grease and dirt from the rheostat parts.

(3) If the contact surfaces are corroded, clean them with crocus cloth.

(4) Clean the contact surface of the arm by inserting a strip of crocus cloth between the arm and the rheostat winding and then drawing the cloth back and forth.

(5) Use a brush or cloth to clean the body of the rheostat or potentiometer.

98. Terminal Blocks

a. INSPECT.

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

99. Multiple Connectors

Multiple connectors and plugs are used to interconnect the components of Radio Set SCR–291–A.

a. INSPECT. Inspect the female ends of the connectors for corrosion and collected dust. Inspect the mountings for cracks and loose connections. Inspect the male ends for loose and broken pins and for proper tension in the banana plugs.

b. CLEAN. Clean the male and female ends of the connectors with a brush moistened in carbon tetrachloride. Remove corrosion with No. 0000 sandpaper; then wipe with a clean cloth.

100. Cords and Cables

The cables in Radio Set SCR–291–A are the life lines of the equipment. Condition of the cabling must be closely observed. Operating equipment in all kinds of weather and moving it on all kinds of roads subjects cabling to a great deal of wear.

a. INSPECT. 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. Tighten loose cable clamps, coupling rings, and cable connections.

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

101. 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.

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

d. ADJUST. Normally, meters in Radio Set SCR–291–A should indicate 0 when the equipment is turned off. Before deciding that a meter needle should be reset to 0, tap the meter case *lightly* with the tip of one finger. This will overcome the slight friction which sometimes exists at the bearings and prevents the needle of an otherwise normal unit from coming to rest at 0. If adjustment is needed, insert the tip of a suitable screwdriver into the zero reset adjustment screw (usually located below the meter glass) and *slowly* turn the adjusting screw until the pointer is at 0. Avoid turning the screw too far, because the needle may be bent or the hairspring damaged. Check the adjustment by lightly tapping the meter case and viewing the meter face and pointer *full on* and not from either side.

102. Pilot Lamps

Pilot lamps are used to indicate when power has been applied to a circuit. They are easily removed and replaced.

a. INSPECT. Inspect the pilot lamp assemblies for loose or blackened lamps, loose mounting screws, and loose, dirty, or corroded connections.

b. TIGHTEN.

(1) Tighten loose mounting screws and resolder any loose connections. Clean dirty or corroded connections before soldering them.

(2) Screw loose lamps tightly into their sockets.

c. CLEAN. Clean dirty connections.

Note. Replace blackened lamps.

103. 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 and then wipe with 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 Polish, Metal, Paste (Signal Corps stock No. 6G1516). After cleaning, use carbon tetrachloride to remove all traces of polish remaining. Finish off with a clean dry cloth.

104. Cabinets, Chassis, and Mountings

The cabinets which house the various components of Radio Set SCR–291–A are constructed of sheet steel. The bearing indicator and phase inverter housings are aluminum castings.

a. INSPECT. 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 settings of the meters. Examine the pilot lamp covers for cracks and breaks. Inspect the panels for loose knobs, switches, and jacks.

b. CLEAN. 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.

c. TIGHTEN. Tighten all loose mounting bolts panel screws, plugs, and control knobs.

105. Headset and Loudspeaker

These items of equipment are essential to the operation of the radio set. The operator must, therefore, give them the same care as any other component.

a. INSPECT. 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. Clean all items of the equipment in accordance with the instructions outlined previously for relays, cords, jacks, cabinets, etc.

106. Coupling Shafts and Control Knobs

The control of various capacitors, switches, and resistors in the set is effected through coupling shafts that connect these items to control knobs located on the front panels. It is important that these shafts and control knobs be kept tight at all times.

107. Gears

a. INSPECT. Inspect the teeth of the gears on the band change mechanism for dirt or corrosion. Check the gears for proper operation by varying the band switch position.

b. CLEAN. If the gears are dirty, clean them with a pipe cleaner or small brush dipped in solvent (SD).

c. LUBRICATE. Refer to section III of this chapter.

108. Power Transformers, Filter Chokes, and Audio Transformers

Since power transformers, filter chokes, and audio transformers used in Radio Set SCR–291–A are of similar construction, PM for them is similar.

a. FEEL. As soon as possible after shut-down, feel filter chokes for abnormal heating which may indicate an overloaded condition or imminent failure due to moisture absorption or other causes. Feel audio transformers for abnormal heating. Power transformers normally operate at a warm temperature. Feel for abnormal heating, but be careful to avoid burns.

b. INSPECT. Inspect power transformers, filter chokes, and audio transformers for signs of blistering, bulging, or leakage of tar or insulating compounds. Inspect for external signs of electrolytic action or corrosion.

c. TIGHTEN. 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 PM. 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. Use a dry cloth to clean power transformers, filter chokes, and audio transformers. 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 is present.

109. Motors

There are two motors in the gasoline heater: one to provide draft for the burner, and the other to circulate the heated air.

a. FEEL. Feel the motors to see if they are operating at a temperature warmer than normal. If the motor bearings are too warm, lubrication (sec. III) usually is required immediately, or the bearings may be defective. Overheating of other parts of the motor indicates trouble, such as overloading or defective circuits.

b. INSPECT. Inspect motors for excess oil or grease, charred coil insulation, and loose mounting bolts.

c. TIGHTEN. Tighten all loose mounting bolts and bolts which hold the end bells to the frame.

d. CLEAN. Clean accumulated dust, grease, and oil from motors. Use a dry cloth or, if necessary, a cloth dampened with solvent (SD).

e. LUBRICATE. Refer to section III of this chapter.

110. Bearing Indicator BC–1159–A and Goniometer MC–412–A

Bearing Indicator BC–1159–A and Goniometer MC–412–A are precision measuring instruments which are composed of delicately balanced electrical circuits and component parts. Some of the parts are machined to very close tolerances and rotate at 1,800 rpm (revolutions per minute). These components will perform satisfactorily over long periods of time, provided that adequate PM is carried out by competent personnel only. Because improper PM techniques will result in misalinement and damage to the equipment, detailed instructions are given in paragraphs 111 through 114.

111. Drive Motor (fig. 54)

The drive motor of Bearing Indicator BC–1159–A is designed for continuous operation at a temperature of 180° F. Personnel should become familiar with the feel of the motor at normal operating temperature. An excessive temperature rise is usually an indication of overload or wiring defects. The only other PM operations are inspection and tightening of the mounting bolts, which may become loose because of vibration. Periodic lubrication is not required, for the motor is equipped with sealed bearings. If the bearings are damaged or lose their lubrication, it will be necessary to replace the drive motor with a new one.

112. Flexible Coupling (fig. 119)

The flexible coupling requires no PM other than periodic inspection for signs of deterioration or breaks. To inspect the coupling unit, remove the deflection coil assembly cover (fig. 54). A defective flexible coupling unit must be replaced (sec. III, ch. 4).

113. Axle and Worm Assembly (fig. 120)

To prevent corrosion of the axle and worm assembly, a *few drops* of lubricating oil should

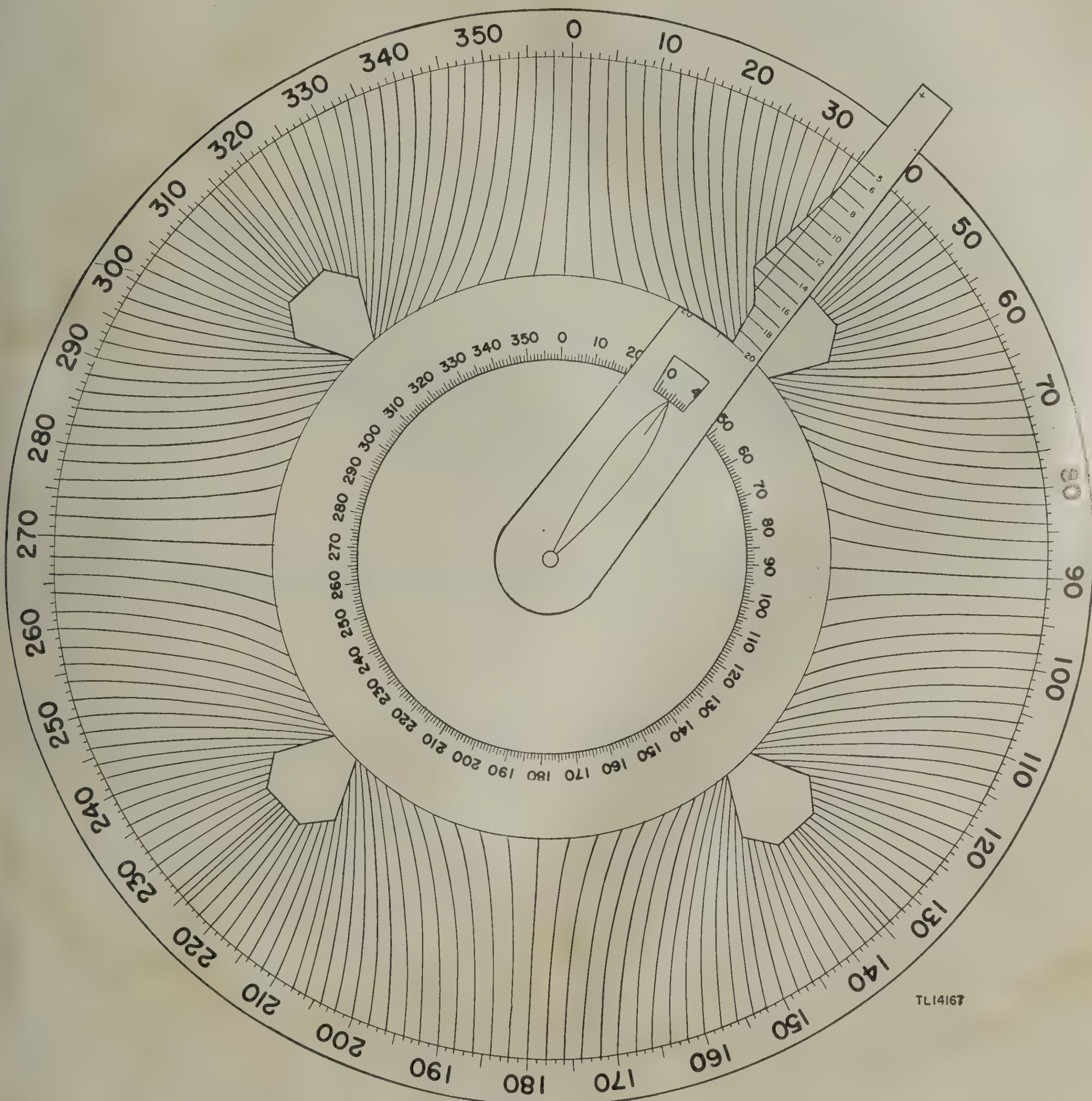


Figure 118. Completed slide rule.

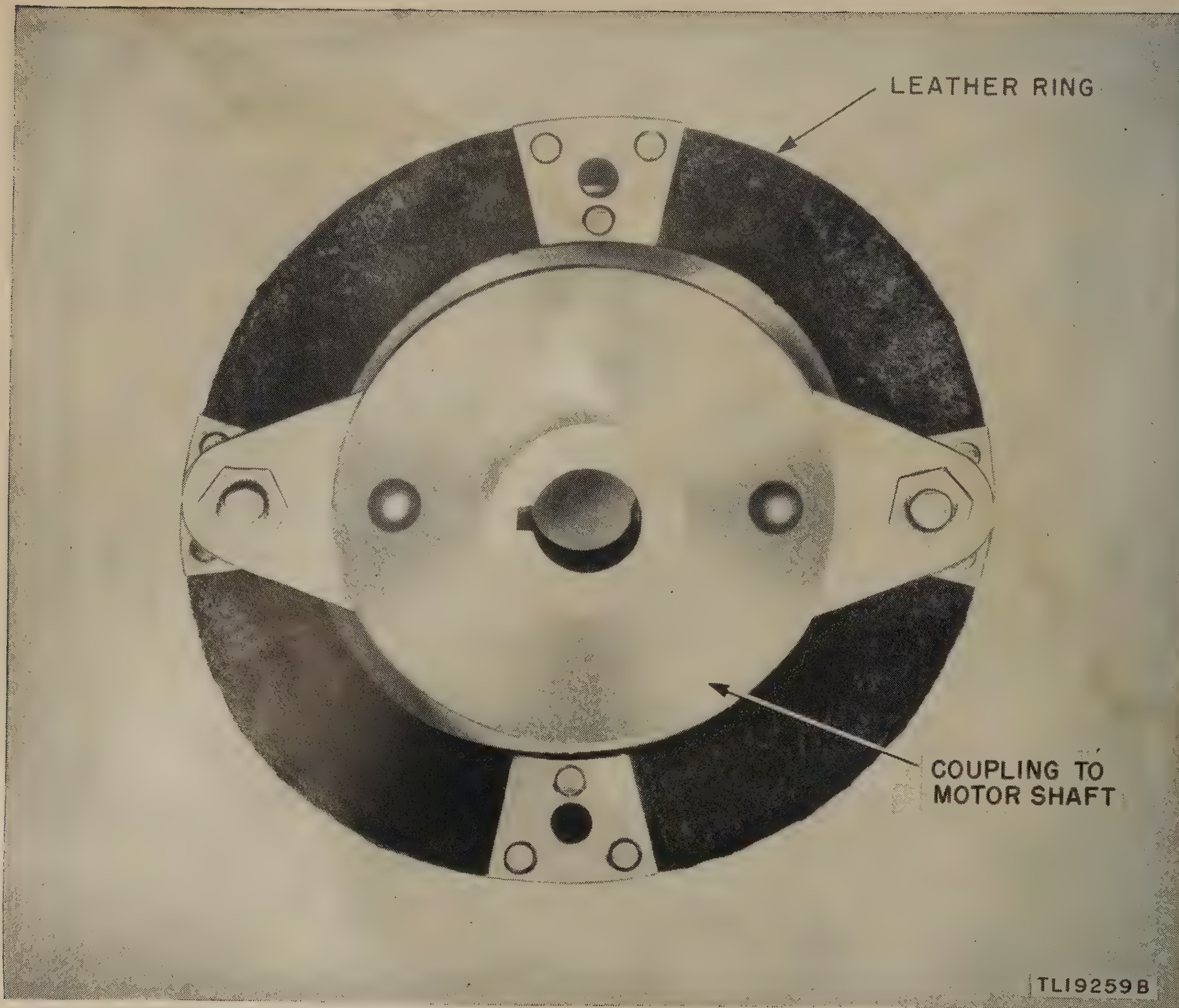


Figure 119. Bearing Indicator BC–1159–A, flexible coupling.

be placed in the coupling slot. Refer to paragraph 131 for specific lubrication instructions.

114. Deflection Coil Assembly (fig. 121)

The deflection coil assembly contains front and rear bearings, a graduated ring, slip rings, brushes, and deflection coils. The inspecting, tightening, cleaning, and lubricating operations must be performed regularly on the assembly. Because of the importance of a properly functioning assembly, certain operations that are primarily repair operations (ch. 4) are mentioned in the following discussions of PM operations.

a. FRONT AND REAR BEARINGS. Because the front and rear bearings are machined to close tolerances, the cleaning and lubricating operations must be performed regularly to prevent wear and scoring of the bearing surfaces. The rear bearing is a ball type bearing and should be lubricated every week. The front bearing is a sleeve type, Oilite bearing which must also be lubricated weekly. Refer to paragraph 131 for specific lubricating instructions. At intervals of approximately 3 months, the bearings should be thoroughly cleaned with solvent (SD). If the unit is being used in an area where the air is particularly dirty, the cleaning operation should be performed more frequently. To clean the bearings it is necessary to remove the deflection coil assembly from the indicator hous-

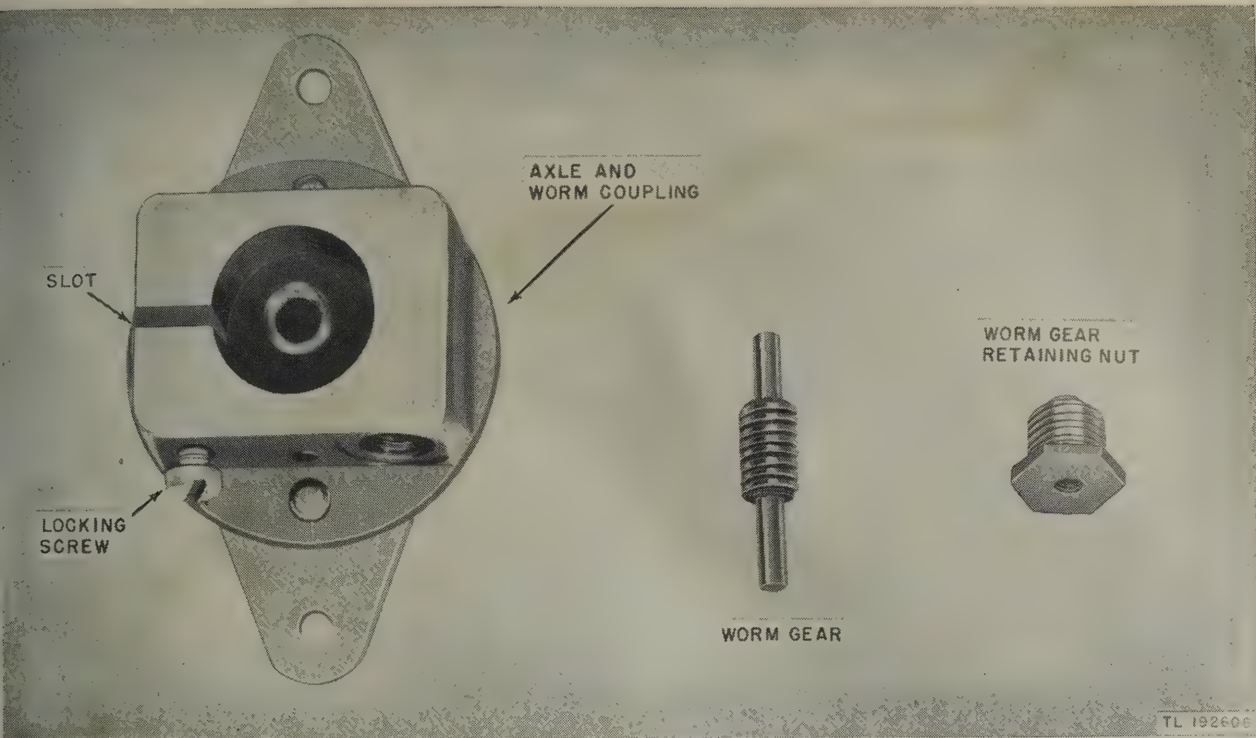


Figure 120. Bearing Indicator BC–1159–A, axle and worm assembly.

ing; therefore, only competent personnel should clean the bearings. Instructions for removing the deflection coil assembly are given in paragraph 174.

b. Slip Rings and Brushes (fig. 122). The slip rings and brushes should be inspected and cleaned at regular intrevals. A jagged or broken circle pattern on the indicator scope screen is usually an indication that the slip rings and brushes require immediate attention. If inspection indicates the need for repair, the defective items should be immediately brought to the attention of repair personnel. To clean the slip rings and brushes, proceed as follows:

(1) Throw the POWER switch (Control Panel PN–31–A) to OFF, but leave the MOTOR switch at ON.

(2) Remove the screws from the bakelite brush holders and hang the assemblies over the side of the indicator housing.

(3) Saturate a small pad of cheesecloth with carbon tetrachloride. With the motor running, hold the cloth firmly against the slip rings.

(4) Turn the MOTOR switch to OFF. Clean the brushes and brush holders with carbon tetrachloride.

(5) Replace the brush holders.

c. Rotating Mount (fig. 123). The rotating mount should be cleaned regularly. The cleaning operation may be performed while the brush holders are removed for cleaning the slip rings and brushes. However, the cleaning operation should be performed whenever inspection indicates the need. To clean the rotating mount, proceed as follows:

(1) Throw the MOTOR and POWER switches of Control Panel PN–31–A to OFF.

(2) Remove the brush holder assemblies (*b* above).

(3) Saturate a long, narrow pad of cheesecloth (about 4 by 10 inches) in carbon tetrachloride. Pass one end of the cloth under the slip rings. Rotate the rings by hand and feed the pad through until it can be reached on the other side of the rings.

(4) Pull the pad back and forth to remove

843134°—49—8

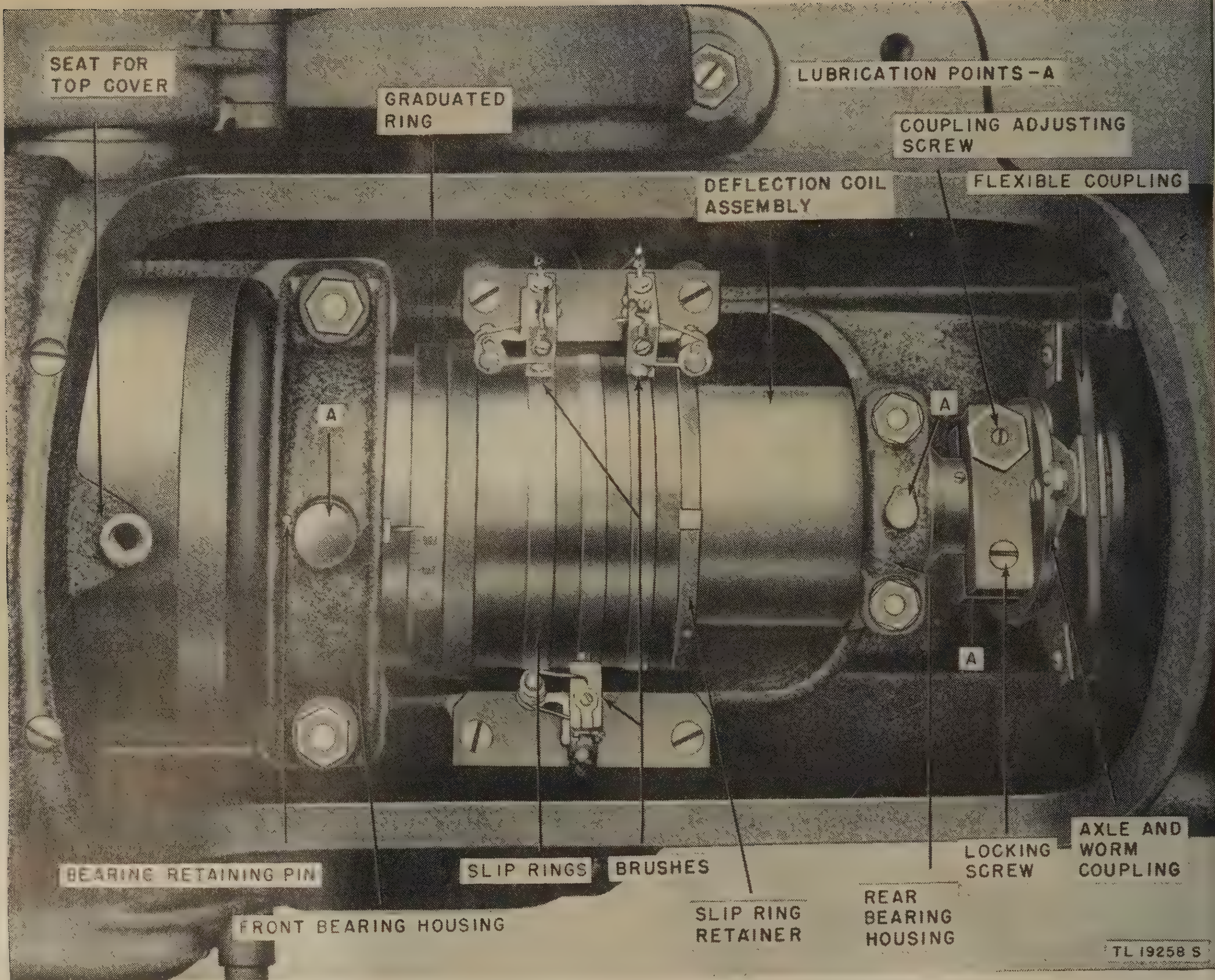


Figure 121. Bearing Indicator BC-1159-A, deflection coil assembly.

all dirt, dust, and grease from the portion of the mount beneath the slip rings.

(5) After the mount has been thoroughly cleaned, replace the brush holders.

d. Polishing Slip Rings (fig. 124). Normally, a light brown oxide film forms on the slip rings. The oxide coating is beneficial and should not be removed. However, it is necessary to distinguish between the normal oxide film and a coating of tarnish, which is harmful. Slip rings with only an oxide coating are shiny, but tarnished slip rings have a dull, dirty appearance. To remove the tarnish and to polish the slip rings, proceed as follows:

(1) Throw the POWER switch to its OFF position.

(2) Remove the brush holders (*b* above).

(3) Wrap a piece of crocus cloth around a 2- by ¾- by ⅛-inch block of bakelite (or other stiff, smooth-surfaced material).

(4) Throw the MOTOR switch to ON, and, with the indicator running, press the block and crocus cloth against the slip rings (fig. 124) to remove pitting and scoring and to give the slip rings a mirror finish.

(5) Before stopping the indicator, clean the slip rings (*b* above).

e. Tightening Slip Rings. The slip rings can be tightened by means of the slip ring retainer (fig. 121). The tightening procedure is as follows:

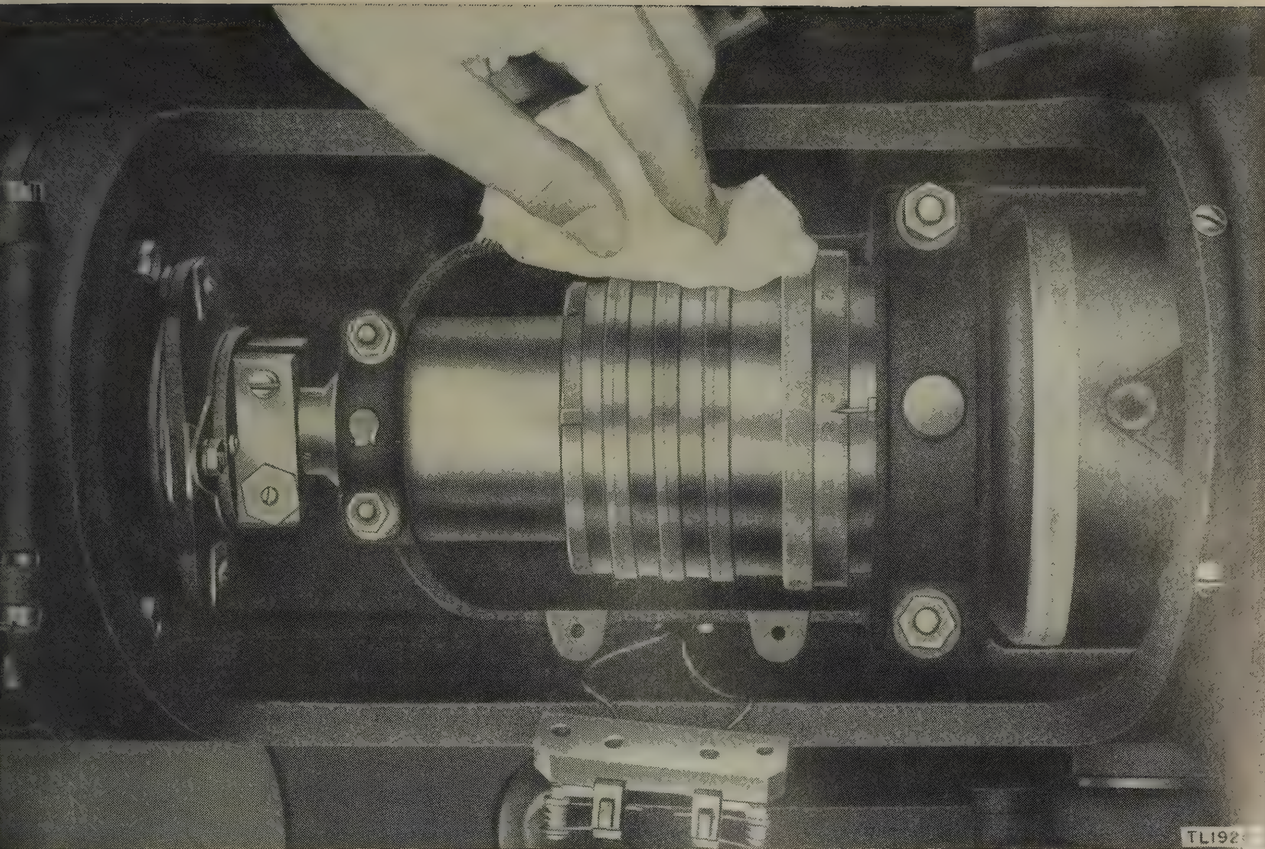


Figure 122. Bearing Indicator BC-1159-A, slip rings and brushes.

(1) Throw the MOTOR and POWER switches to OFF.

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

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

(4) Tighten the setscrews to hold the retainer in the new position.

f. Slip Ring Eccentricity (fig. 125). The slip rings may become eccentric. Generally the eccentricity can be eliminated only by machining and polishing the rings in a lathe. Occasionally, the defect can be repaired by the simple procedure explained below.

(1) Inspect for eccentricity by observing the protruding arm of the brush pressure spring while the indicator is running. Any perceptible movement of the brush pressure spring arm is an indication of eccentricity, and immediate steps should be taken to restore the ring to its original concentric shape.

(2) Throw the MOTOR and POWER switches to OFF.

(3) Rotate the slip rings by hand until the high spot is located.

(4) With the high spot turned to an easily reached position, place the square, smooth end of a bakelite rod (or a rod of other suitable material) on the high spot and lightly tap the other end of the rod.

(5) Recheck the high spot and, if necessary, repeat the above procedure.

(6) Again check the entire slip ring for high spots. If there is no movement of the brush spring arm during the full rotation of the ring, the slip ring can be considered satisfactory.

Note. If light tapping will not correct the defect, do not attempt to repair by hammering. Lathe work is necessary to repair the defective rings.

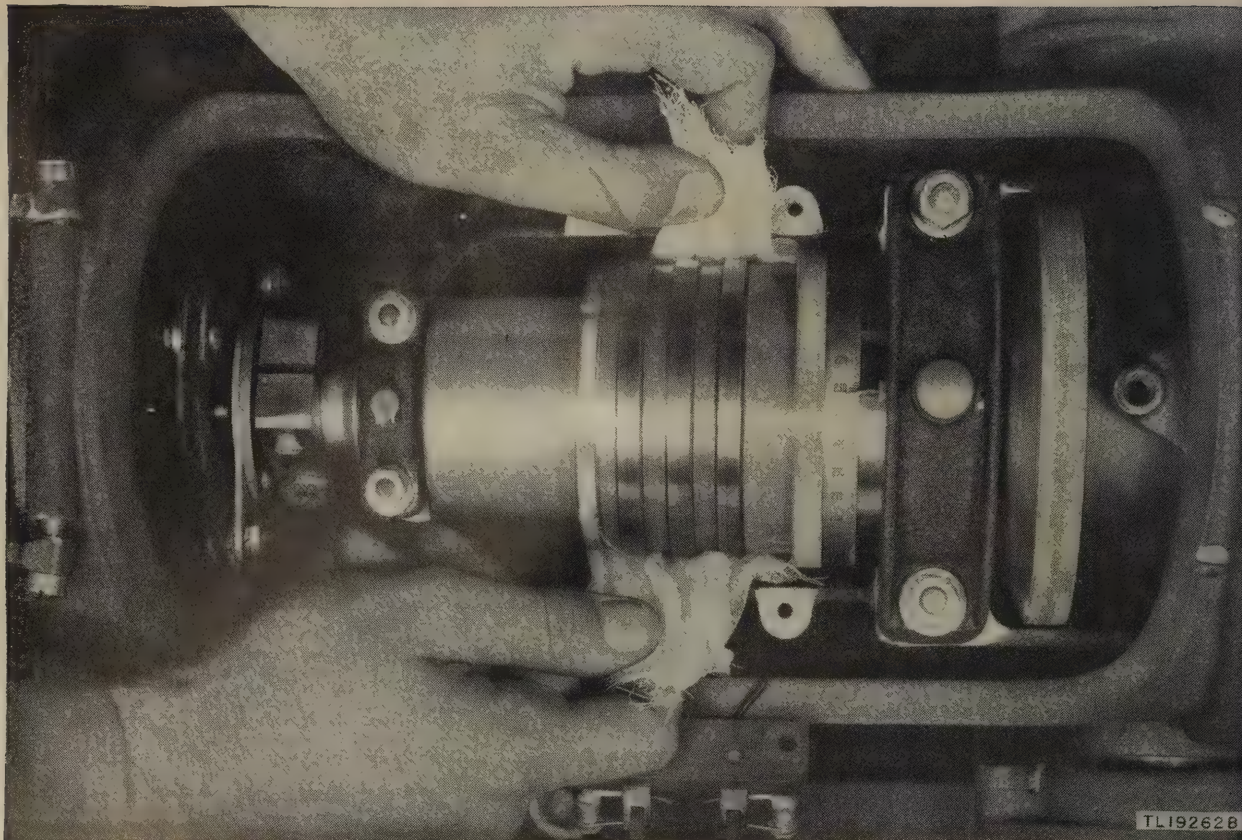


Figure 123. Bearing Indicator BC–1159–A, rotating mount.

g. Brushes (fig. 121). The bearing indicator brushes should be inspected at least once a week. Examine the brushes for improper seating against the slip rings and for dirt and grease. Improper seating of the brushes against the slip rings causes excessive wearing of both the brushes and the slip rings. The PM procedure includes the following:

(1) Remove the brushes from the brush holders and clean them with a pad saturated in carbon tetrachloride. Each brush should be replaced in the holder from which it was removed, because a brush will not fit properly against the slip ring beneath a different holder.

(2) Check the brushes for freedom of motion in the brush holders. Only the spring pressure arm should affect the brush movement. If a brush binds in its holder, remove the brush and clean the holder carefully. Also examine the brush for cracks and crumbling edges. Defective brushes should be replaced.

(3) Inspect the brush pigtails (flexible leads) for corrosion, broken strands, and flexibility. Tighten connections to the brush holders and leave sufficient lead length to permit free movement of the brushes.

(4) Examine the brush spring arm of the brush holder. If bent, or if scraping against the sides of the holder, the spring arm should be straightened so that it rides freely in the center of the brush slot.

(5) The correct brush pressure is 2½ ounces (checked with a spring gage). To adjust the spring arm for the required pressure, wind or unwind the spring coil. Never bend the spring arm.

(6) Before placing a new brush in a brush holder, grind the brush to fit the slip ring. Use the following procedure for grinding in a new brush:

(*a*) With the bearing indicator off, wrap a piece of fine sandpaper around the

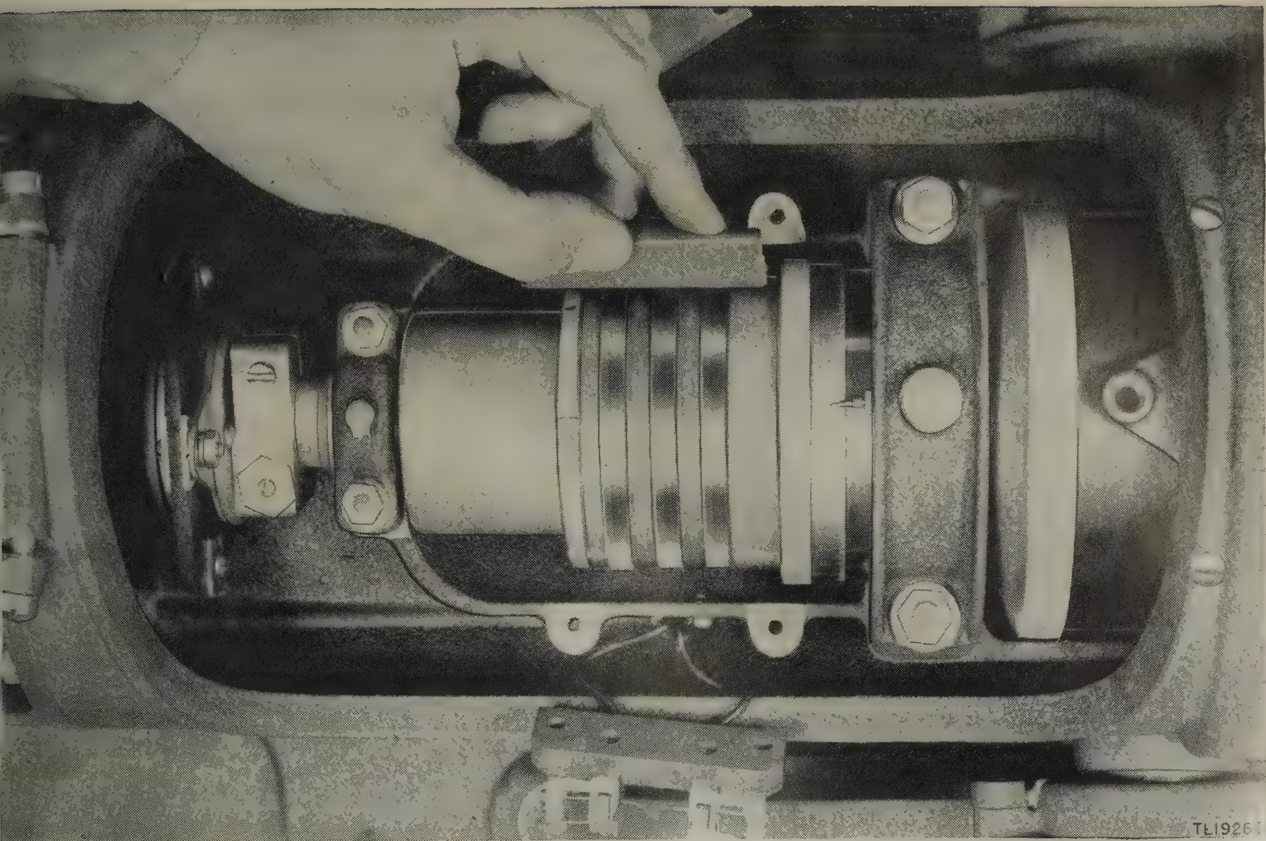


Figure 124. Bearing Indicator BC–1159–A, polishing slip rings.

slip rings so that the abrasive side is up.

(*b*) Install the new brush in the holder and see that the pressure spring holds the brush against the sandpaper around the ring.

(*c*) Rock the rotating mount so that the sandpaper grinds the brush to fit the slip ring.

Note. New brushes are preground to fit new selector rings, but it is advisable to grind each brush to fit the ring with which it is to be used. Normal wear will reshape a slip ring somewhat, and therefore, new brushes will not exactly fit worn rings.

Section II. ITEMIZED PREVENTIVE MAINTENANCE

115. Introduction

For ease and efficiency of performance, PM on Radio Set SCR–291–A is broken down into operations that can be performed at different time intervals. In this section the PM 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 PM on individual parts are discussed in section I of this chapter. These general instructions are not repeated in this section. When performing PM, refer to section I of this chapter if more information is required for the various items. Perform all work with the power removed from the equipment. After PM has been performed on a given day, put the equipment into operation and check it for satisfactory performance. (See par. 86, Equipment Performance Checklist.)

116. Preventive Maintenance Tools and Materials

The following PM tools and materials will be needed:

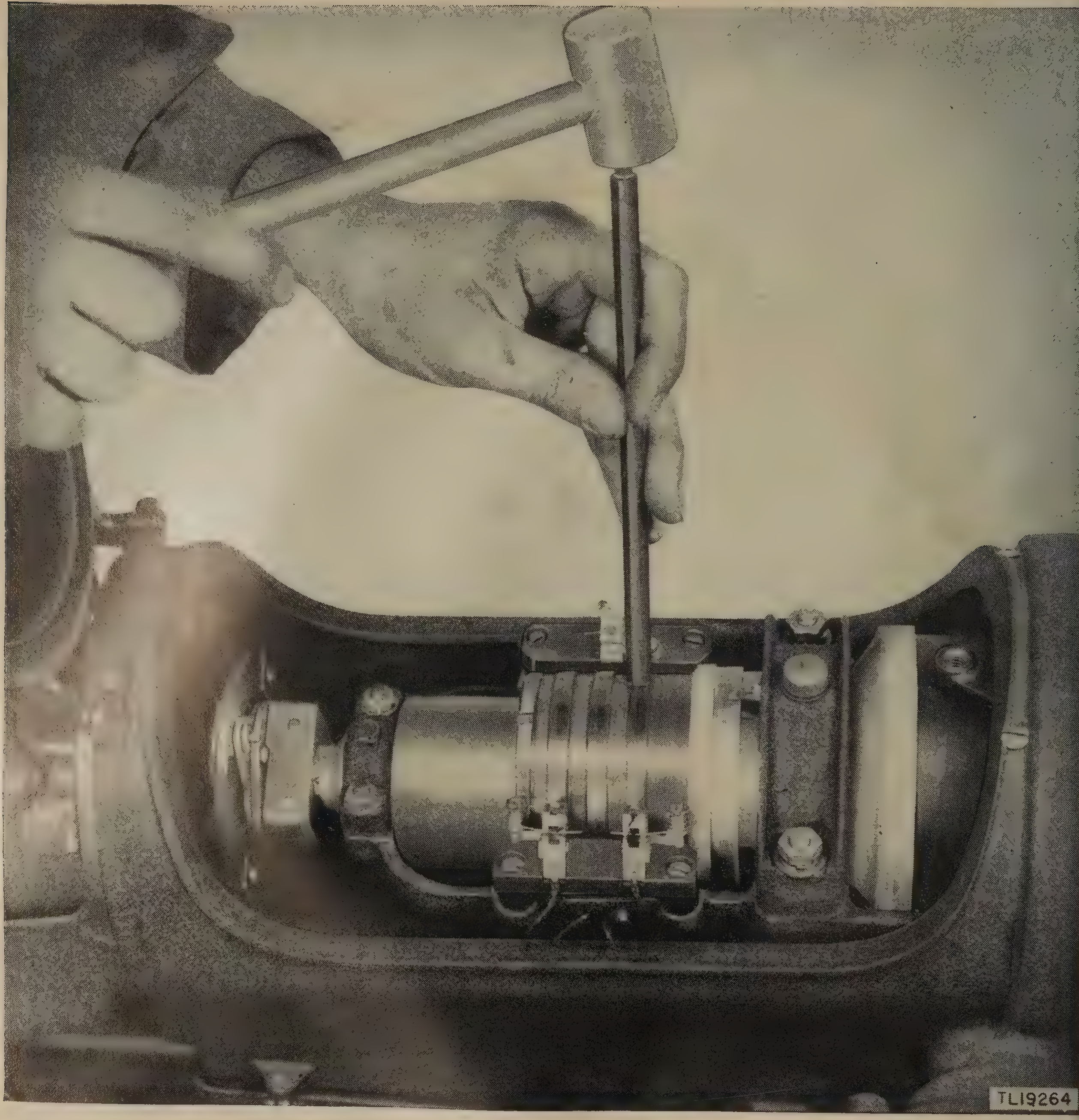


Figure 125. Bearing Indicator BC–1159–A, correcting slip-ring eccentricity.

Common hand tools.
Clean cloth.
No.0000 sandpaper.
Crocus cloth.
File (WECo KS–2662, Signal Corps stock No. 6Q37104).
Paste metal polish (Signal Corps stock No. 6G1516).
Carbon tetrachloride (technical grade).
Dry-cleaning solvent (SD).
Switchboard contact burnishing tool (WECo 265C, Signal Corps stock No. 6R41065C).
Orange stick (Signal Corps stock No. 6Z7360).
Toothpicks (Signal Corps stock No. 6Z8666).
Cheeseloth.
Small mirror.

Note. Gasoline will not be used as a cleaning fluid.

117. Item 1, Bearing Indicator BC–1159–A

Operations:

IC .... Exterior (all items).
FIT .... Drive motor.
IC .... Flexible coupling.
FCL .... Front and rear bearings.
ITCA .... Slip rings.
ITCA .... Brushes.
IC .... Rotating mount.
IC .... Interior of control box (all items).
IC .... Optical housing (all items).

Remarks: Section III of chapter 4 contains instructions for gaining access to components in the control box. For instructions on lubrication refer to section III of this chapter. Only experienced personnel should tighten and adjust slip rings and clean the front and rear bearings.

118. Item 2, Goniometer MC–412–A

Operations:

IC .... Exterior (all items).
ITC .... Cable connectors.
ICA .... Relay K601.

119. Item 3, Radio Receiver BC–1147–A

Operations:

IC .... Exterior (all items).
IT .... Control knobs.
IC .... Interior (all items).
L .... Band switch.
ITCL .... Four-gang tuning capacitor.
ITC ...... All connections, including cable connectors.
IT .... All mounting bolts.

Remarks: Section III of chapter 4 contains instructions for gaining access to the interior of the receiver. In performing PM operations, do not disturb the adjustment of any component that is preset during alinement procedures. For instructions on lubrication refer to section III of this chapter.

120. Item 4, Control Panel PN–31–A

Operations:

IC .... Exterior (all items).
IT .... Control knobs.
IC .... Interior (all items).
ITC .... Potentiometers.
ITC .... Switches, jacks, and cable connectors.
ITC .... Tubes and sockets.
ITC .... Pilot lamps.
IT .... All mounting bolts.

121. Item 5, Telephone Panel PN–32–A

Operations:

IC .... Exterior.

Remarks: Refer to TM 11–333 for information on Telephone Equipment EE–8–(*).

122. Item 6, Antenna System

Operations:

IC .... Exterior (all items).
ITC .... All cable connectors.
ITC .... Interior of phase inverters (all items).
ITC .... Mast sections.
ITC .... Hold-down assemblies.

123. Item 7, Power Unit

Operations:

ITC .... Exterior (all items)

Remarks: For further PM information, such as lubrication, refer to the technical manual for the power unit.

124. Item 8, Gasoline Heater

Operations:

ITC .... Exterior (all items).

Remarks: For other PM information, refer to the instruction book for the gasoline heater.

125. Item 9, Shelters HO–20–( ) and HO–19–A

Operations:

IC .... Interior.
IC .... Exterior.
IT .... Wing nuts and bolts.

126. Item 10, Radio Transmitter BC–1149–A

Operations:

IC .... Exterior (all items).

Remarks: Refer to TM 11–849 for further information.

127. Preventive Maintenance Checklist

The following checklist is a summary of the PM operations to be performed on Radio Set SCR–291–A. The time intervals shown on the checklist 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 checklist. The last column on the right indicates which operations are organizational maintenance (O) and which operations are performed by maintenance personnel (M). 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: After operation	Daily	Weekly	Monthly	Quarterly	Maintenance performed by
1		Bearing Indicator BC–1159–A:						
	IC	Exterior (all items)		X				O
	F	Drive motor	X					O
	IT	Drive motor			X			O
	IC	Flexible coupling			X			O
	F	Front and rear bearings	X					O
	C	Front and rear bearings					X	M
	L*	Front and rear bearings						
	I	Slip rings and brushes	X					O
	C	Slip rings and brushes			X			O
	TA	Slip rings and brushes				X		M
	IC	Rotating mount			X			O
	IC	Interior of control box (all items)				X		M
	IC	Optical housing components				X		O
2		Goniometer MC–412–A:						
	IC	Exterior (all items)		X				O
	ITC	Cable connectors			X			O
	ICA	Relay K601					X	M
3		Radio Receiver BC–1147–A:						
	IC	Exterior (all items)		X				O
	IT	Control knobs			X			O
	IC	Interior (all items)				X		M
	L*	Band switch						
	ITC	Four-gang tuning capacitor				X		M
	L*	Four-gang tuning capacitor						
	ITC	All connections, including cable connectors			X			M
	IT	Mounting bolts			X			O
4		Control Panel PN–31–A:						
	IC	Exterior (all items)		X				O
	IT	Control knobs			X			O
	IC	Interior (all items)				X		M
	ITC	Potentiometers				X		M
	ITC	Switches, jacks, and cable connectors				X		M
	ITC	Tubes and sockets				X		M
	ITC	Pilot lamps				X		M
	IT	All mounting bolts			X			O
5		Telephone Panel PN–32–A:						
	IC	Exterior (all items)		X				O
6		Antenna system:						
	IC	Exterior (all items)			X			O
	ITC	All cable connectors			X			O
	ITC	Interior of phase inverters (all items, including relays K301 in Phase Inverters MC–411–A)				X		M
	ITC	Mast sections			X			O
	ITC	Hold-down assemblies		X				O

Item No.	Operations	Item	When performed: After operation	Daily	Weekly	Monthly	Quarterly	Maintenance performed by
7		Power units:**						
	IC	Exterior (all items)		X				O
	T	Exterior (all items)			X			M
	L**							
8		Gasoline heater:						
	ITC	Exterior (all items)		X				O
9		Shelters HO-20-( ) and HO-19-A:						
	IC	Interior		X				O
	IC	Exterior		X				O
	IT	Wingnuts and bolts			X			O
10		Radio Transmitter BC-1149-A:						
	IC	Exterior (all items; see TM 11-849)			X			O

Note. X indicates when operations are to be performed, O indicates operator, and M indicates maintenance personnel.
F Feel; I Inspect; T Tighten; C Clean; A Adjust; L Lubricate

* Refer to section III of this chapter for lubrication data.
** See power unit technical manual.

Section III. LUBRICATION

128. Lubrication Orders

LO's (Lubrication Orders) are illustrated, numbered, and dated cards or decalcomania labels which prescribe approved organizational and maintenance personnel lubrication instructions for mechanical equipment which requires lubrication by using organizations. Current LO's which are available are listed in the latest edition of FM 21-6, List and Index of Department of the Army Publications. Lubrication orders should be requisitioned in conformance with instructions and lists in SR 310-90-1.

129. Compliance with Lubrication Orders

Instructions contained in LO's are mandatory and supersede all conflicting lubrication instructions of an earlier date. Applicable LO's which are available will be obtained, carried with the equipment at all times, and fully complied with. Difficulties experienced in obtaining and complying with such orders will be reported through channels.

130. Location of Lubrication Orders

The LO's (figs. 126 through 129) for Radio Set SCR-291-A should be kept with the equipment at all times.

131. Special Lubrication Instructions

The lubrication operations listed below will be performed only when Radio Set SCR-291-A (Direction Finding) is received at field or base repair shops for general overhaul, or if a particular assembly requires other repair.

a. Band Change and Tuning Control Gear Housing. Apply Grease, Lubricating, Special (GL) to gear teeth.

b. Beat Frequency Oscillator Adjustment Control Shaft Bearing. Apply 1 drop of Oil, Engine (OE-10).

c. Goniometer Drive Motor Bearings. Clean with solvent (SD). After the bearings have dried, repack with Grease, General Purpose No. 2 (WB) for temperatures above 0° F., or with grease (GL) for temperatures below 0° F.

d. Goniometer and Bearing Indicator Axle and Worm Coupling Adjustments. Coat worm and threads of the coupling adjustments with grease (GL) for all temperatures.

(This equipment covered by 2 Lubrication Orders, No. 3108 and No. 3108A.)

No. 3108A

WAR DEPARTMENT LUBRICATION ORDER

WAR DEPARTMENT WASHINGTON 25, D.C., 3 JULY 1944

RADIO SETS SCR-291 & SCR-502

Bearing Indicator BC-1159 & Goniometer Drive RM-43

CAUTION Voltages dangerous to life are present within these units. To avoid casualties always turn the drive motor switch and the switch on the Control Panel PN-31 "OFF" before raising cover on top of Bearing Indicator. Always shut down motor generator or other power equipment and remove power, discharge and ground circuits before attempting to service.

DO NOT FORGET THIS

Lubricant • Interval

Tube Support Housing Rear Bearing **MO W**
1 or 2 drops

Lifting and Adjusting Rings **PS M**
Remove, clean and allow to thoroughly dry
Wipe surface and threads with clean cloth lightly dampened with PS.

Alidade Control Gear and Bevel Pinions **GL 2M**
Clean and coat gear and pinion teeth. Remove excess lubricant.

Alidade Control Pinion Shaft Bearings **PS M**
1 or 2 drops, each

Tube Support Housing Front Bearing **MO W**
Remove plug. 1 or 2 drops

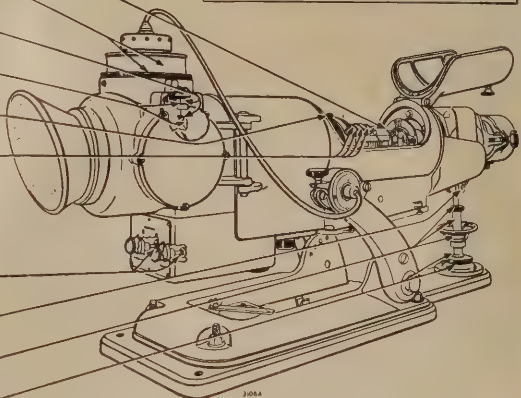
Slip Rings and Brushes **W**
Remove screws from brush holders, clean brushes and inside of brush holders with SOLVENT, dry cleaning. Saturate cheese cloth pad approximately 4 in. by 10 in. with SOLVENT, dry cleaning and pass it under rotating mount by slowly rotating unit. Pull pad back and forth and sideways until all dirt and oil are removed from under the rotating mount. Start motor, then clean slip rings by holding cheese cloth pad saturated with SOLVENT, dry cleaning firmly against them.

Focus and Intensity Control Switch Shaft Bearings **PS M**
Remove control box and cover plate. 1 drop, each

Tilt Regulator Pivot Shaft **PS M**
1 or 2 drops, each end

Tilt Regulator Locking Sleeve and Shaft **PS M**
Clean threads, lubricate sparingly.

Tilt Regulator Ball Socket and Retaining Cap **GL 2M**
Clean ball, socket and retaining cap. Lubricate surfaces and retaining cap threads sparingly.

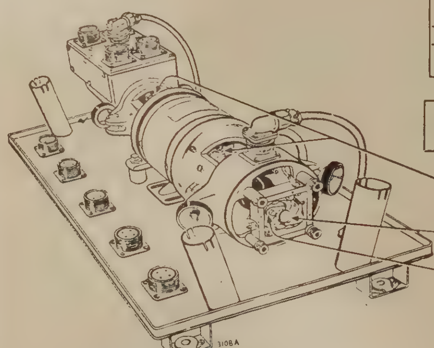


BEARING INDICATOR BC-1159
WITH CONTACTOR MC-473 ATTACHED

—KEY—

LUBRICANTS	LOWEST EXPECTED AIR TEMPERATURE		
	above +32°F.	+32°F. to 0°F.	below 0°F.
OE—OIL, engine	**OE** SAE 30	**OE** SAE 10	**PS**
MO—OIL, lubricating, for aircraft instruments and machine guns. All air temperatures.			**INTERVALS**
GL—GREASE, lubricating, special. All air temperatures.			**W**—Weekly **M**—Monthly **2M**—2 months
PS—OIL, lubricating, preservative, special. All air temperatures.			

NOTICE Goniometer Drive RM-43 is a component only of Radio Set SCR-502. This unit is not used in conjunction with Radio Set SCR-291. The same lubrication service attention indicated below for Contactor MC-473 should also be given Contactor MC-473 mounted at the rear of Bearing Indicator BC-1159 used in Radio Set SCR-502.



Interval • Lubricant

2M OE Drive Motor Bearings
Remove plug at each end of drive motor. Lubricate with 6 to 8 drops in each plug hole. Re-install plugs.

2M GL Contactor MC-473 Breaker Cam
Remove cover and end plate. Coat cam surface, remove excess lubricant.

2M OE Contactor MC-473 Breaker Arm Pivot
Remove cover and end plate. Lubricate with 1 drop OE. Spare breaker arm provided at this location.

GONIOMETER DRIVE RM-43 REMOVED FROM CHEST

CLEAN parts with SOLVENT, dry cleaning. Allow parts to dry thoroughly before lubricating.
POLISHED METAL SURFACES — Every 2 months, clean all exposed, polished metal surfaces and wipe with clean, lint-free cloth lightly dampened with PS.
GREASE POINTS — Every 2 months, clean and sparingly lubricate Cable Connector Threads, Focus and Intensity Control Box Retaining Bolt and Positioning Studs with GL to prevent rust and corrosion.
OIL CAN POINTS — Every 2 months, sparingly lubricate Hinged Thumbscrew Threads and Pivots, Clamping Knob Threads, Hinges with PS.

DO NOT LUBRICATE — Goniometers MC-412 and MC-472 Rotor Shaft Bearings, Contactor MC-473 Drive Shaft Bearings, Bearing Indicator Drive Motor Bearings.

LUBRICATED BY MAINTENANCE PERSONNEL — Goniometer Drive Motor Bearings (complete disassembly service), Goniometer and Bearing Indicator Axle and Worm Coupling Adjustments.

REFERENCE — Technical Manual, TM 11-243 for Radio Set SCR-291 and Technical Manual TM 11-256 for Radio Set SCR-502.

Copy of this Lubrication Order will remain with the equipment at all times. Instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 3 July 1944.

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

Requisition additional lubrication orders in conformance with instructions and lists in FM 21-6.

No. 3108A

TL17176A

Figure 126. Bearing Indicator BC–1159–A and Goniometer Drive RM–43, War Department Lubrication Order No. 3108A.

(This equipment covered by 2 Lubrication Orders, No. 3108 and No. 3108A.)

No. 3108A

WAR DEPARTMENT LUBRICATION ORDER

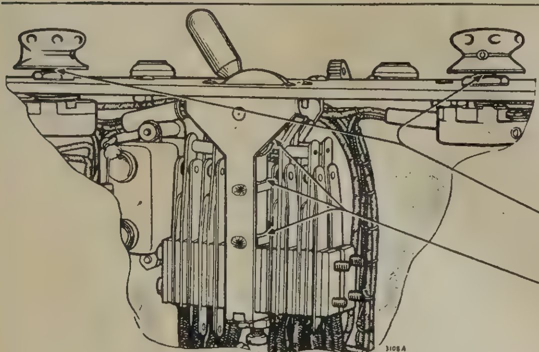
WAR DEPARTMENT WASHINGTON 25, D.C., 3 JULY 1944

RADIO SETS SCR-291 & SCR-502

Synchronizing Unit RM-44, Control Panel PN-31, Reel Unit RL-49 & Shelter Circulating Fan Motor

CAUTION Voltages dangerous to life are present at various points within this equipment. To avoid casualties, always shut down motor generator or other power equipment and remove power, discharge and ground circuits before attempting to service.
DO NOT FORGET THIS

NOTE These features of Control Panel PN-31 require lubrication in both Radio Sets SCR-291 and SCR-502 as indicated. However, Synchronizing Unit RM-44 having these same features requiring lubrication is a component only of Radio Set SCR-502.



BOTTOM VIEW — COVER REMOVED

Interval • Lubricant

2M PS Switch Control Shaft Bearings
Remove control knob to lubricate.
1 or 2 drops, each

2M OE Switch
Lubricate switch plunger guide plates, plunger, control lever shaft pivots and positioning roller shafts and disc by applying lubricant sparingly with fine, pointed brush. Use OE SAE 10 above +32°F., below +32°F. use PS
Do not damage or allow lubricant to get on switch contacts.

Lubricant • Interval

Reel Shaft Clamp Lock Hinges and Springs **OE M**
Clean and lubricate

Reel Shaft Clamp Hinges **OE M**
Clean and lubricate

Frame Hinges and Hinge Bolts **OE M**

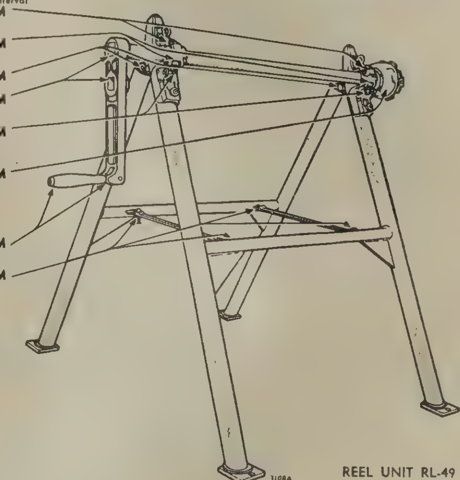
Crank Locking Pins and Springs **OE M**
Clean and lubricate

Reel Shaft Bearings **GL M**
Clean and lubricate
(Some models equipped with fittings)

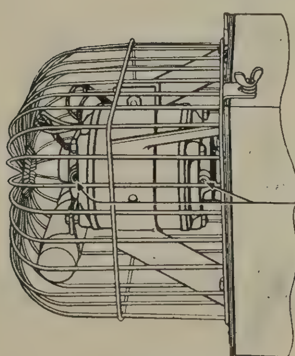
Reel Shaft Brake **OE M**
Remove brake, clean brake seat on reel shaft and flush out brake housing to clean. Coat brake seat with lubricant and lubricate brake by applying lubricant sparingly in openings at ends between hub and housing.

Crank Handle Lock and Handle **OE M**
Lubricate sparingly

Frame Brace Spring Locks and Hinges **OE M**



REEL UNIT RL-49



Interval • Lubricant

M OE Fan Motor Bearings
Saturate wicks with 4 to 6 drops, each.

SHELTER CIRCULATING FAN MOTOR

— KEY —

LUBRICANTS	LOWEST EXPECTED AIR TEMPERATURE		
	above +32°F.	+32°F. to 0°F.	below 0°F.
OE—OIL, engine	**OE** SAE 30	**OE** SAE 10	PS
GL—GREASE, lubricating, special. All air temperatures.			**INTERVALS**
PS—OIL, lubricating, preservative, special. All air temperatures.			M—Monthly 2M—2 months

FITTINGS — Clean before applying lubricant.
CLEAN parts with SOLVENT, dry cleaning. Allow parts to dry thoroughly before lubricating.

GREASE POINTS — Every 2 months, clean and sparingly lubricate Cable Connector Threads with GL to prevent rust and corrosion. Remove excess lubricant.

OIL CAN POINTS — Every 2 months, lubricate Control Panel PN-31 Interlock Safety Switch, Circulating Fan Motor Support Hinge and Wing Nuts sparingly with OE.

LUBRICATED BY MAINTENANCE PERSONNEL — Shelter Heater Draft Fan Motor Bearings.

REFERENCE — Technical Manual TM 11-243 for Radio Set SCR-291 and Technical Manual TM 11-256 for Radio Set SCR-502.

Copy of this Lubrication Order will remain with the equipment at all times. Instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 3 July 1944.

BY ORDER OF THE SECRETARY OF WAR:
G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

Requisition additional lubrication orders in conformance with instructions and lists in FM 21-6.

No. 3108A

TL17177A

Figure 127. Synchronizing Unit RM–44, Control Panel PN–31 Reel Unit RL–49, and circulating fan motor, War Department Lubrication Order No. 3108A.

(This equipment covered by 2 Lubrication Orders, No. 3108 and No. 3108A.)

No. 3108

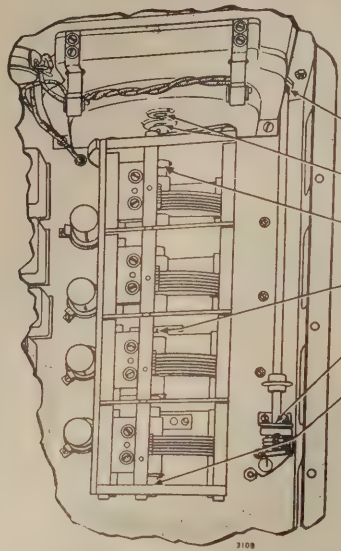
WAR DEPARTMENT LUBRICATION ORDER

WAR DEPARTMENT WASHINGTON 25, D.C., 3 JULY 1944

RADIO SETS SCR-291 & SCR-502

Radio Receiver BC-1147

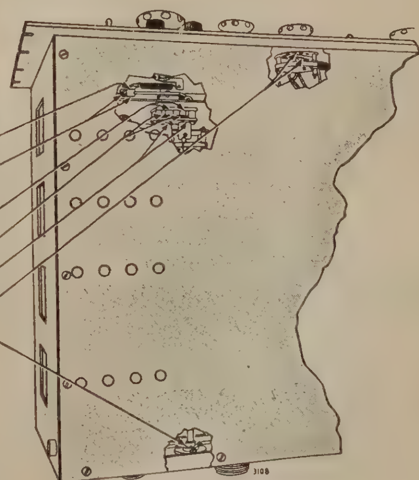
CAUTION Voltages dangerous to life are present at various points within this equipment. To avoid casualties, always shut down motor generators or other power equipment and remove power, discharge and ground circuits before attempting to service. DO NOT FORGET THIS.



TOP VIEW — COVER AND TUNING CAPACITOR SHIELD REMOVED

Interval • Lubricant	
2M OE	Antenna Compensator Control Shaft Bearing 2 or 3 drops
2M OE	Tuning Control Shaft Bearings 2 or 3 drops, each
2M OE	Tuning Capacitor Shaft Bearing 2 or 3 drops
2M OE	Tuning Capacitor Shaft Bearing 1 or 2 drops
2M OE	Antenna Compensator Control Shaft Bearing 1 drop
2M OE	Tuning Capacitor Shaft Bearing 1 drop

	Lubricant • Interval
Band Change Positioning Roller Clean and coat sparingly	**GL 2M**
Band Change Positioning Roller Shaft and Pivot Lever 1 or 2 drops, each	**OE 2M**
Band Change Gear Shaft Bearings 1 or 2 drops, each	**OE 2M**
Band Change Gears Clean and coat teeth	**GL 2M**
Band Change Gear Shaft Bearings 1 or 2 drops, each	**OE 2M**
Selectivity Switch Positioning Ball and Disc Clean and coat sparingly	**GL 2M**
Band Change Control Shaft Bearing 2 or 3 drops	**OE 2M**



BOTTOM VIEW

KEY

LUBRICANTS	LOWEST EXPECTED AIR TEMPERATURE		
	above +32°F.	+32°F. to 0°F.	below 0°F.
OE—OIL, engine	OE SAE 10	PS	PS
GL—GREASE, lubricating, special. All air temperatures.			INTERVALS
PS—OIL, lubricating, preservative, special.			2M—2 months

CLEAN parts with clean, lint-free cloth lightly dampened with SOLVENT, dry cleaning. Allow parts to dry thoroughly before lubricating. Do not allow cleaning fluid to get on other parts of receiver.

CABLE CONNECTORS — Every 2 months, clean and lubricate Cable Connector Threads sparingly with GL to prevent rust and corrosion.

OIL CAN POINTS — Every 2 months, lubricate Sensitivity, Selectivity and A.F. Gain Switch Shafts with 1 or 2 drops of OE by removing knobs.

GREASE POINTS (Miscellaneous) — Every 2 months, clean and lubricate Antenna Turnbuckle Threads, Junction Box and Phase Inverter Cable Connector Threads, Cabinet Chassis Slides sparingly with GL.

OIL CAN POINTS (Miscellaneous) — Every 2 months, lubricate Phase Inverter Retaining Studs and Plates and Wing Nuts, Panel PN-32 Telephone Hook Shaft Bearings, Cabinet Hinge and Lock, Shelter and Carrying Chest Hinges and Locks and Fasteners with OE.

LUBRICATED BY MAINTENANCE PERSONNEL — Band Change and Tuning Control Gear Housing, BFO Adjustment Control Shaft Bearing.

REFERENCE — Technical Manual TM 11-243 for Radio SCR-291 and Technical Manual TM 11-256 for Radio Set SCR-502.

Copy of this Lubrication Order will remain with the equipment at all times. Instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 3 July 1944.

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

Requisition additional lubrication orders in conformance with instructions and lists in FM 21-6.

No. 3108

TL17178A

Figure 128. Radio Receiver BC–1147, War Department Lubrication Order No. 3108.

(This equipment covered by 2 Lubrication Orders, No. 3108 and No. 3108A.)

No. 3108

WAR DEPARTMENT LUBRICATION ORDER

WAR DEPARTMENT WASHINGTON 25, D.C., 3 JULY 1944

RADIO SETS SCR-291 & SCR-502

Radio Transmitter BC-1149 (Target)

Lubricant • Interval

Band Selector Switch Shaft Bearing **OE 3M**
1 drop

Band Selector Switch Positioning Ball and Disc **GL 3M**
Clean and coat ball and disc sparingly.

Band Selector Switch Shaft Bearings **OE 3M**
2 or 3 drops, each

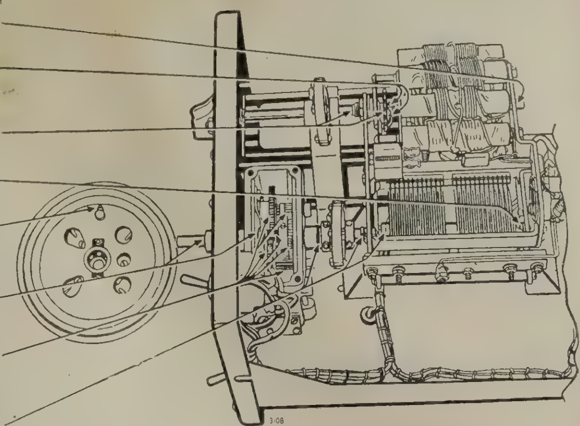
Tuning Capacitor Shaft Bearing **OE 3M**
1 drop

Tuning Control Dial Gears **GL 6M**
Remove dial, retaining screws and separate dial assembly to expose gears. Clean and coat gear teeth with lubricant.

Tuning Control Dial Shaft Bearings **OE 3M**
Remove dial knob to lubricate front bearing. 1 or 2 drops, each

Tuning Control Gears and Pinions **GL 6M**
Remove cover, clean and coat teeth liberally with lubricant. Also, lubricate bearing at each end of gear and pinion shafts with 1 or 2 drops each of OE.

Tuning Capacitor Shaft Bearings **OE 3M**
1 or 2 drops, each



MAIN COVER, TUNING CONTROL GEAR HOUSING COVER AND DIAL KNOB REMOVED

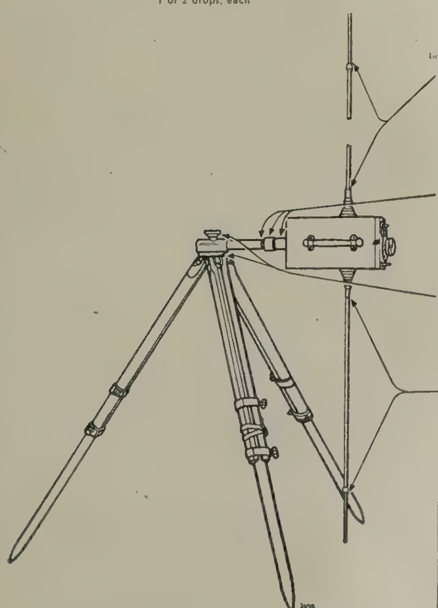
Interval • Lubricant

3M PS Antenna Rod
Loosen rod locking nut and extend sections of rod. Clean sliding and exposed surfaces of rod, then wipe with clean cloth dampened with PS. Also, lubricate rod locking nut and adaptor threads sparingly with PS.

3M GL Mounting Support and Sleeve
Clean sliding and exposed surfaces, then coat sparingly with GL and remove excess lubricant. Also, lubricate mounting sleeve clamp nut threads with OE.

3M GL Mounting Support and Retaining Knob
Clean and coat threads sparingly.

3M PS Antenna Rod
Loosen rod locking nut and extend sections of rod. Clean sliding and exposed surfaces of rod, then wipe with clean cloth dampened with PS. Also, lubricate rod locking nut and adaptor threads sparingly with PS.



TRANSMITTER ASSEMBLED FOR OPERATION ON TRIPOD

—KEY—

LUBRICANTS	LOWEST EXPECTED AIR TEMPERATURE		
	above +32°F.	+32°F. to 0°F.	below 0°F.
OE—OIL, engine	OE SAE 10	PS	PS
GL—GREASE, lubricating, special. All air temperatures.			INTERVALS
PS—OIL, lubricating, preservative, special. All air temperatures.			3M—3 months 6M—6 months

CLEAN parts with SOLVENT, dry cleaning. Allow parts to dry thoroughly before lubricating. Do not allow cleaning fluid to get on other parts of transmitter.

OIL CAN POINTS — Every 3 months, lubricate Tripod Leg Locking Clamp Threads, Front Panel Locking Wing Nut Threads with OE.

REFERENCE — Technical Manual TM 11-243 for Radio Set SCR-291 and Technical Manual TM 11-256 for Radio Set SCR-502.

Copy of this Lubrication Order will remain with the equipment at all times. Instructions contained therein are mandatory and supersede all conflicting lubrication instructions dated prior to 3 July 1944.

Requisition additional lubrication orders in conformance with instructions and lists in FM 21-6.

BY ORDER OF THE SECRETARY OF WAR:

G. C. MARSHALL,
Chief of Staff.

OFFICIAL:
J. A. ULIO,
Major General,
The Adjutant General.

No. 3108

TL17179A

Figure 129. Radio Transmitter BC-1149 (Target), War Department Lubrication Order No. 3108.

132. Lubrication of Drive Fan Motor

Annually, apply 2 or 3 drops of oil (OE–10) to the felt pad in each bearing. Remove the motor from the heater as follows:

a. Close the shut-off valve at the fuel tank and the control valve in the heater.

b. Remove the burner shield.

c. Disconnect the flexible fuel line from the burner assembly by unscrewing the lower connection.

d. Loosen two wingnuts and swing the burner assembly outward and upward, thus disengaging the burner from the heater.

e. Remove the screw which holds the bottom bulkhead in place and take out the bulkhead.

f. Unfasten the electrical connection at the motor. Remove the cable connector by unscrewing the jam nut.

g. Remove the screws that hold the motor bulkhead. Take out the motor assembly.

Section IV. WEATHERPROOFING

133. General

Signal Corps equipment, when operated under the severe climatic conditions which prevail in the tropical, arctic, or desert regions, requires special treatment and maintenance.

134. Tropicalization

a. GENERAL. Because fungus growth, insects, corrosion, salt spray, and excessive moisture harmfully affect most materials, a special moistureproofing and fungiproofing treatment has been devised which, if properly applied, provides a reasonable degree of protection. Refer to TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment, for a detailed description of the varnish-spray method of moistureproofing and fungiproofing and the supplies and equipment required in this treatment. Also refer to TB SIG 72, Tropical Maintenance of Ground Signal Equipment. The following problems may be encountered:

(1) Resistors, capacitors, coils, chokes, transformer windings, etc., fail because of the effects of fungus growth and excessive moisture.

(2) Electrolytic action, often visible in the form of corrosion, takes place in resistors, coils, chokes, transformer windings, etc., causing eventual breakdown.

(3) Hook-up wire insulation and cable insulation break down. Fungus growth accelerates deterioration.

(4) Moisture forms electrical paths on terminal boards and insulating strips, causing flash-overs and crosstalk.

Caution: Varnish spray may have poisonous effects if inhaled. To avoid inhaling spray, use a respirator if available; otherwise fasten cheesecloth or other cloth material over nose and mouth. Never spray varnish or lacquer near an open flame. Do not smoke in a room where varnish or lacquer is being sprayed; the spray may be highly explosive.

b. RE-TREATMENT. Radio Set SCR–291–A is protected by a moistureproofing, fungiproofing varnish treatment which is applied at the factory. Retreatment may be required after a period of use. The need for retreatment is indicated by excessive failures or by the effects listed in *a* above.

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

135. Winterization

Special precautions are necessary to prevent poor performance or total operational failure of equipment in subzero temperatures. Most signal equipment can be used in winter if difficulties common in low temperatures are anticipated and precautions taken to prevent them. For operation purposes, place equipment in heated rooms whenever possible. Wrap it in blankets when on the march to protect it from winds and freezing temperatures. Refer to TB SIG 66, Winter Maintenance of Signal Equipment, for complete information. The following problems may be encountered:

a. STEEL. Steel shrinks and becomes brittle in subzero temperatures.

b. GLASS. Glass is especially susceptible to sudden temperature changes. The difference between a low air temperature and the warmth of a man's breath may be sufficient to shatter a lens.

c. RUBBER. Natural rubber resists cold weather well, but certain types of synthetic rubber are unreliable and become brittle.

d. CANVAS. Canvas freezes and loses its pliability in cold weather.

e. LUBRICANTS. Lubricants become stiff, causing drag and also causing moving parts to stick. Refer to section III of this chapter for detailed lubrication instructions.

136. Dustproofing

Signal Corps equipment operated in desert localities is affected by the extremely high temperatures and the amount of dirt, dust, sand, and other foreign matter in the air. Take care to keep such elements from filtering into lubricated parts. Cover the equipment when it is not in use. Thorough cleanliness is imperative. Instead of merely adding new lubricants at regular intervals, whenever practicable clean and lubricate all moving parts. If possible, inspect and clean the equipment daily. In any case, inspect the air filters and similar protective devices every day and clean them whenever necessary. Refer to TB SIG 75, Desert Maintenance of Ground Signal Equipment. Some of the problems encountered are the following:

a. LUBRICANTS. Lubricants become thin and drain from moving metal and fiber parts rapidly. Refer to section III of this chapter for detailed lubrication instructions.

b. FOREIGN MATTER. Foreign matter, such as dirt, dust, and sand, acts as an abrasive, causing excessive wear, clogging air cleaners, and impeding the flow of air.

137. Tropical Operation

Radio Set SCR–291–A is protected against deterioration under tropical climatic conditions by a moistureproofing and fungiproofing varnish treatment applied at the time of manufacture. TB SIG 13 provides adequate instructions for field or base retreatment. Also refer to TB SIG 72. Do not apply varnish by spraying. *Brush-coat* only those surfaces specified in TB SIG 13.

138. Desert Operation

The precautions outlined in TB SIG 75 are adequate to prevent equipment failures that might be caused by the infiltration of dust or dirt. Follow the lubrication procedures of section III of this chapter.

139. Arctic Operation

Radio Set SCR–291–A will perfrom satisfactorily under arctic or winter low-temperature conditions. In placing the radio set in operation at extremely low temperatures, allow the maximum possible warm-up time to insure proper functioning of moving parts. Special lubrication is required and is specified in section III of this chapter. For additional information on low-temperature operation of signal equipment, refer to TB SIG 66.

CHAPTER 4

REPAIR INSTRUCTIONS

Section I. THEORY OF EQUIPMENT

140. Block Diagram of Radio Set SCR–291–A

a. ANTENNA ARRAY (fig. 130). The antenna array of Radio Set SCR–291–A is composed of five vertical antennas, one at each corner of a 25-foot square and one at the center of the square. The N and S antennas, together with Cords CD–821 (par. 39) and CD–822, form a U-Adcock type of antenna. Similarly, the W and E antennas, together with Cords CD–824 and CD–825, form a second U-Adcock antenna. Thus, the array is composed of crossed U-Adcock antennas and a central sense antenna. Signals picked up on the N-S antenna are coupled through phase inverters to r-f transmission lines (Cords CD–821 and CD–822). The transmission line output terminals are connected in phase opposition within Junction Box JB–91–A, and the junction box output is fed through Cord CD–823 to a stationary winding in Goniometer MC–412–A. The output voltages of the E-W antenna are similarly fed through phase inverters, Cords CD–824 and CD–825, a junction box, and Cord CD–826 to a second stationary winding in Goniometer MC–412–A. The sense antenna output is coupled through Phase Inverter MC–413–A, Cords CD–828 and CD–829, a third junction box, and Cord CD–827 to a dummy goniometer (actually a transformer).

b. GONIOMETER MC–412–A. A rotary winding, driven by the bearing indicator motor, revolves close to two stationary windings (*a* above). Thus, the instantaneous voltage across the rotary winding is a function of its position with respect to the stationary windings. The rotary winding is connected to one of two primary windings on the goniometer output transformer (fig. 145). The output winding of the dummy goniometer is connected to the second primary winding on the output transformer. With the standby–D. F.–SENSE switch at D. F., the goniometer relay opens, the winding connected to the rotor is active, and the goniometer output is a function of the signals received by the four corner antennas. With the switch at SENSE; the relay closes, both primary windings are active, and the goniometer output is a function of the signals received by the five monopoles in the array.

c. RADIO RECEIVER CHANNELS. The goniometer output is applied to the input circuits of Radio Receiver BC–1147–A. In the receiver the r-f signals are selected and amplified in the r-f and i-f (intermediate-frequency) stages. From the i-f stages the signals are passed through an audio channel to a loudspeaker for monitoring purposes and through an indicator channel to the deflection coil amplifier in Control Panel PN–31–A. The output of the deflection amplifier is applied to the deflection coils for the cathode-ray tube in Bearing Indicator BC–1159–A. From antenna array to oscilloscope screen the system is coordinated to produce on the oscilloscope screen an indication of the direction from which received signals arrive at the antenna array.

d. POWER SUPPLIES. Power is usually obtained from a gas-driven generator, such as Power Unit PU–41/G. The power unit output is connected through Junction Box JB–95–A to Control Panel PN–31–A. The low-voltage rectifier furnishes plate voltage for the phase inverters in the antenna array, and the high-voltage rectifier furnishes d-c voltages for the cathode-ray tube, including the electrostatic deflection plates. Power for the indicator motor is also carried through a power cord from the control panel to the bearing indicator.

141. U-Adcock Antenna

Note. In this section, only vertically polarized waves are considered.

In its simplest form the U-Adcock antenna is comprised of two vertical wires which are usually spaced less than one-half wavelength apart and suitably arranged for rotation in azimuth

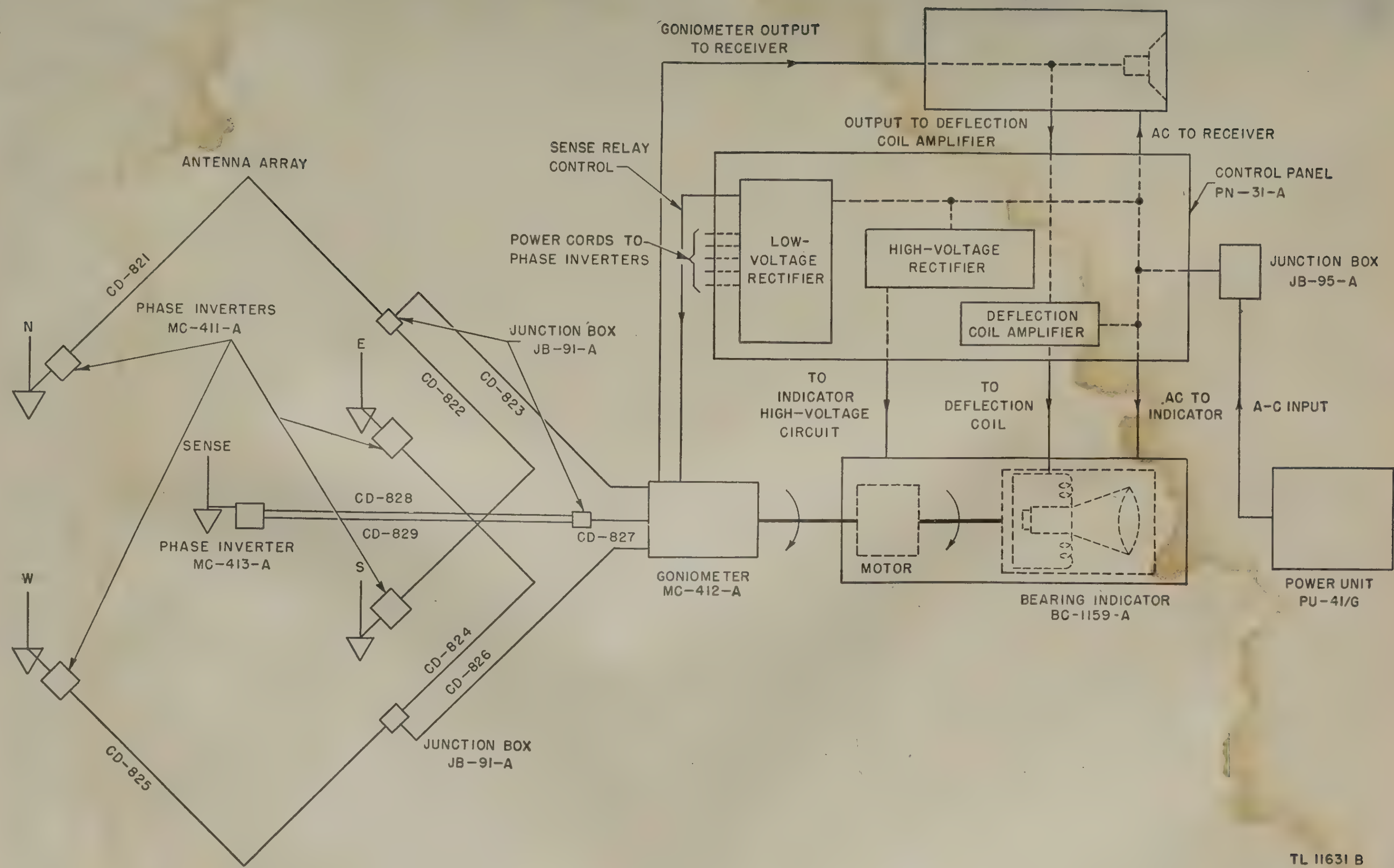


Figure 130. Antenna array of Radio Set SCR-291-A, block diagram.

843134°—49—9

(fig. 131). For convenience the vertical plane containing the antenna wires is called the plane of the antenna. When the plane of the antenna is broadside to an arriving wave front, equal inphase voltages are induced in the vertical wires. Under this condition there is no potential difference between the receiver input terminals and, therefore, no output from the receiver to the indicating device. As the antenna is rotated from this position, however, one of the vertical wires is moved closer to the transmitter from which the wave front is arriving, and the other wire is moved farther away. Consequently, the arriving wave front must pass through one wire earlier than it passes through the second wire. Thus, the antenna voltages are out of phase, and a potential difference is produced between the receiver input terminals. The amplitude of this input voltage is a function of the angle between the wave front and the plane of the antenna. With the plane broadside to the wave front the input voltage is zero. As the antenna is rotated through 360° from this initial position, the input increases to maximum at 90°, falls to zero with continued rotation to 180° (the plane of the antenna is again broadside to the arriving wave front), rises to maximum with continued rotation to 270°, and drops to zero as the antenna is returned to its original position. During this rotation of the antenna, the receiver input voltage and, hence, the output to the indicating device are a function of the antenna position with respect to the wave front. Conversely, if the antenna is stationary (fig. 132), the receiver output is a function of the direction from which the wave front arrives at the antenna. Thus, with the plane of the N-S antenna broadside to a wave front arriving from the east or west, the potential difference between terminals 0–0 is zero, and no signal is received. For a signal from the north or south the plane of the N-S antenna is in line with the transmitter antenna and a maximum signal is received. The response for waves arriving from other directions is a function of the angle between the N-S reference line and the direction of arrival. As will be explained later, ambiguity due to the presence of two null and two maximum points is eliminated by combining the output of the U-Adcock antenna with that of a third vertical (sense) antenna.

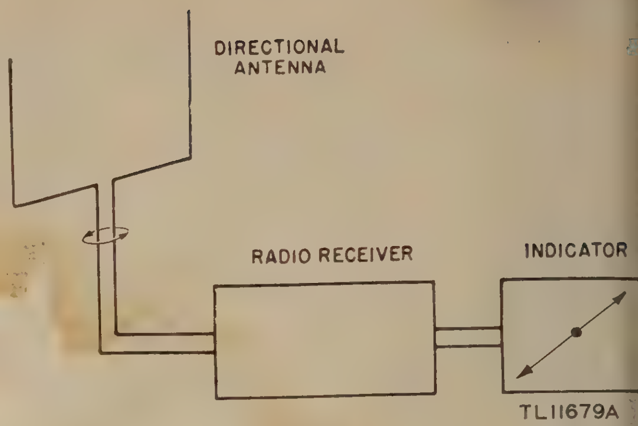


Figure 131. Simple direction finding system.

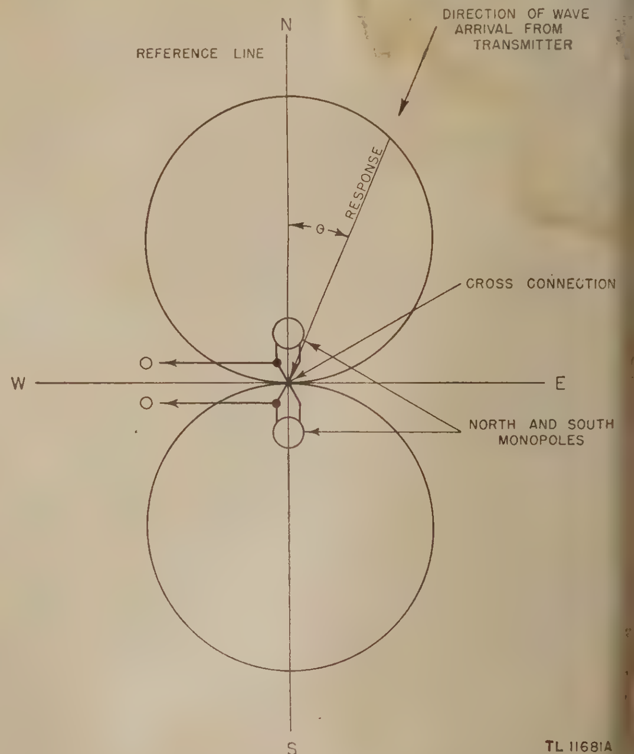


Figure 132. Directivity pattern of N–S monopoles.

142. Horizontal Directivity Patterns (fig. 133)

The horizontal directivity pattern of a U-Adcock antenna does not remain constant for all signal frequencies, because the phase difference between the antenna voltages changes as the frequency is changed; or, what amounts to the same thing, for a given frequency the directivity pattern is a function of the spacing between the wires. As the frequency (or spacing) is changed, the pattern change is gradual. Patterns typical of a fixed physical spacing and a change of frequency are described below.

a. PATTERN FOR QUARTER-WAVE SPACING. If the spacing between the vertical wires is a quarter wavelength at the frequency of the received signal, the maximum phase difference between the antenna voltages is 90°, and the $\lambda/4$ pattern of figure 133 is obtained. (This is a fig. 8 pattern.)

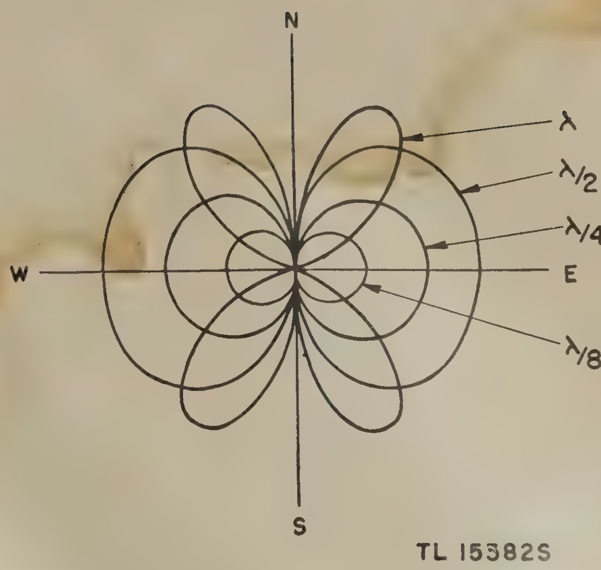
b. PATTERNS AT LOWER FREQUENCIES. When the frequency (*a* above) is halved, the effective spacing is one-eighth wavelength, the maximum phase difference between the antenna voltages is 45°, and the $\lambda/8$ pattern is produced. (This is also a fig. 8 pattern.) Note that as the frequency is lowered, the antenna sensitivity also becomes lower.

c. PATTERNS AT HIGHER FREQUENCIES. For a signal frequency twice that at which the effective spacing is $\lambda/4$, the effective spacing is $\lambda/2$, the maximum phase difference becomes 180°, and the $\lambda/2$ pattern is obtained. (At an effective spacing of $\lambda/2$, the antenna sensitivity is maximum.)

d. PATTERNS FOR EFFECTIVE SPACINGS GREATER THAN $\lambda/2$. If the frequency is increased further, so that the effective spacing becomes λ, the phase difference becomes 360° and the four-leafed pattern is obtained.

e. LIMITATION OF FREQUENCY RANGE. The effects described above place a limitation on the frequency range over which Radio Set SCR–291–A can be used without correction curves. Comparison of the patterns (fig. 133) will show that at low frequencies the sensitivity of the array is proportional to the frequency as indicated by the relative sizes of the figure 8 patterns. For frequencies at which the effective spacing becomes greater than $\lambda/4$, the sensitivity increases as the effective spacing approaches $\lambda/2$, but the maximum points broaden. When the effective spacing is increased beyond $\lambda/2$, the resulting pattern becomes dimpled and no longer resembles the figure 8 pattern, and eventually four null and four maximum points appear (λ in fig. 133).

f. MONOPOLE SPACING. The dimensions for laying out the antenna array of Radio Set SCR–291–A have been carefully worked out for maximum efficiency over the frequency range of the



NOTE: PLANE OF ANTENNA IS ALONG E-W LINE.

Figure 133. Directing patterns of U-Adcock antenna, for various spacings and frequencies.

set. Thus, it is important to install the antenna system exactly as described in section II chapter 1. It is equally important to use correction charts for operation in the extended frequency range (sec. III, ch. 2).

143. Crossed U-Adcock Antenna

a. GENERAL. A plan-view schematic of the radio set monopoles is shown in figure 134. The N and S monopoles form one U-Adcock type antenna which is crossed by a second U-Adcock antenna comprised of the E and W monopoles. For simplicity the r-f lines from the antennas are shown schematically; the cross-overs in the E-W and N-S lines represent the phase-opposition connections.

b. SIGNAL ARRIVING FROM NORTH. When a signal arrives from the north, the plane of the N-S U-Adcock antenna is at right angles to the wave front and the output to stator 1 is maximum. At the same time, the plane of the E-W U-Adcock antenna is broadside to the arriving wave front; consequently, there is no output voltage to stator 2. The solid-line N-S pattern (fig. 134) appears on the scope.

c. SIGNAL FROM NORTHEAST. When a signal arrives from the northeast, the planes of both antennas are at an angle of 45° to the arriving wave front. Under this condition, the output of

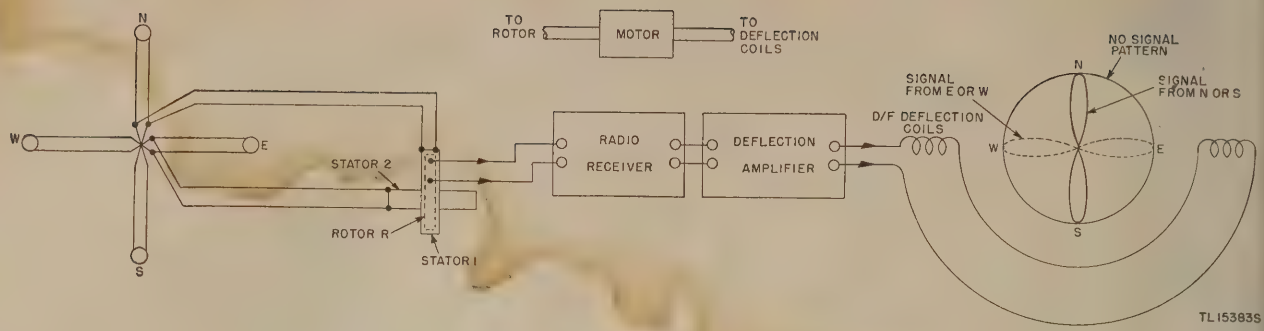


Figure 134. Development of directional pattern, simplified diagram.

the N-S antenna is equal to that of the E-W antenna, and equal voltages are applied to stators 1 and 2. The pattern would appear along the N-E and S-W line on the scope (not illustrated).

d. SIGNAL FROM EAST. When a sagnal arrives from the east, the plane of the N-S antenna is broadside to the arriving wave front and there is no output to stator 1. At the same time, however, the vertical plane of the E-W antenna is maximum to stator 2. Under this condition the E-W pattern (broken line in figure 134) appears on the scope.

e. SIGNAL FROM ANY DIRECTION. For a signal from any direction, the input to each goniometer stator is a function of the angle between the arriving wave front and the plane of the antenna to which the stator is connected.

144. Goniometer.

The simplified diagram of a goniometer coil arrangement (fig. 135) shows that stator 1, to which the output of the N-S antenna is applied, is effectively at right angles to stator 2, to which the output of the E-W antenna is applied. In other words, stators 1 and 2 are arranged so that there is a minimum of mutual coupling between them. The rotor R, however, can be rotated in the magnetic field produced by the two stators. When a signal arrives at the antenna, the resultant field in the goniometer is composed of two components: one caused by current through stator 1 and the other caused by current through stator 2. As the current in each of these windings is a function of the direction of wave arrival, so is the resultant field a function of the direction from which a signal arrives at the antenna.

a. SIGNAL FROM NORTH. When a signal arrives from the north (or south), there is no output from the E-W antenna to stator 2, and the output from the N-S antenna is maximum. Under this condition, therefore, the magnetic field produced by stator 2 is zero, and the resulttant field is produced by stator 1 only. Consequently, the field lies along the axis of stator 1 (A, fig. 135). As the rotor revolves in this field, the *amplitude* of the rotor r-f output varies sinusoidally. This is similar to the way the output of a simple, single-turn armature varies with rotation between opposite poles in an a-c generator. Thus, with the rotor in the position shown in figure 135A, the rotor output is maximum, decreasing to zero as the rotor turns through 90° to E, *shifting 180° in phase (reversing in polarity) as the rotor passes through 90°*, and increasing to maximum as the rotor approaches the 180° position (S). With continued rotation the output decreases to zero at 270°, shifts 180° in phase as the rotor passes through 270°, and increases to maximum as the rotor approaches its original position.

Note. In figure 135A the arrow indicates *position* rather than direction of the field.

b. SIGNALS FROM NORTHEAST. When a signal arrives from the northeast (or southwest) the outputs of the N-S and E-W antennas are of the same amplitude, and equal currents flow through stators 1 and 2. Consequently, the resultant magnetic field lies in the position indicated in B, figure 135. The goniometer output is maximum when the rotor is in the position shown and minimum when the rotor is at right angles to this position.

c. SIGNALS FROM ANY DIRECTION. For any signal the resultant field is a function of the direction of wave arrival. Thus, there is a

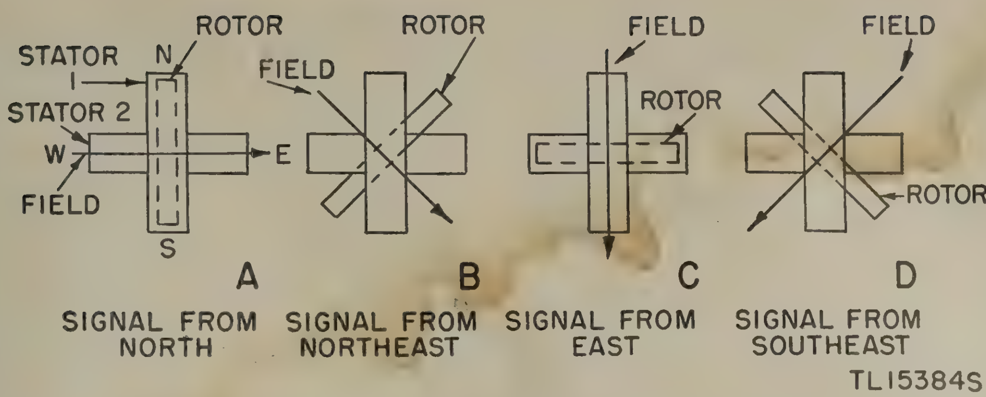


Figure 135. Goniometer coil arrangement, simplified diagram.

definite relationship between the direction of wave arrival, the goniometer magnetic field, and the rotor output to the radio receiver.

145. Bearing Indicator

a. Development of Circular Trace. In the absence of signal voltages the bearing indicator scope screen pattern is a circular trace (fig. 134). The D/F deflection coils are rotated about the cathode-ray tube, and the cathode-ray beam must pass through the magnetic field between them (fig. 136). Assume that there is no current through the deflection coils and that electrons in the beam are traveling out of the paper toward the reader. Under this condition the horizontal and vertical deflection plate voltages can be adjusted to bring the spot to point 1 on the screen. With the spot centered at 1, and with the coils *stationary* in the position shown, current passing through the coils creates a magnetic field in the direction indicated. The interaction between this field and the magnetic field produced by the beam current (moving electrons) forces the beam upward and the spot appears at point 2 on the screen. If the deflection coils are now rotated clockwise, their magnetic field must rotate with them, and the spot must trace a circle on the scope screen. The circle diameter can be increased by increasing the current through the deflection coils. The position of the circle can be adjusted by means of the horizontal and vertical positioning controls.

b. Development of D/F Pattern. As explained in paragraphs 143 and 144, the goniometer output at any instant is determined by its position in the magnetic field produced by stators 1 and 2. This output voltage is applied to the receiver, amplified, rectified, and applied as bias voltage to the deflection amplifier. Thus, when the signal is maximum, the deflection amplifier bias is maximum, the plate current through the D/F deflection coils is minimum, and the oscilloscope stop is near the center of the screen. As the goniometer rotor turns from the position of miximum output, both the receiver output and the deflection amplifier bias decrease, and the current through the deflection coils increases. Consequently, the spot moves outward at the same time that it is being moved around the center of the screen (*a* above). However, as the goniometer output increases with rotation of the rotor, the deflection amplifier bias increases, the deflection coil current decreases, and the spot moves inward at the same

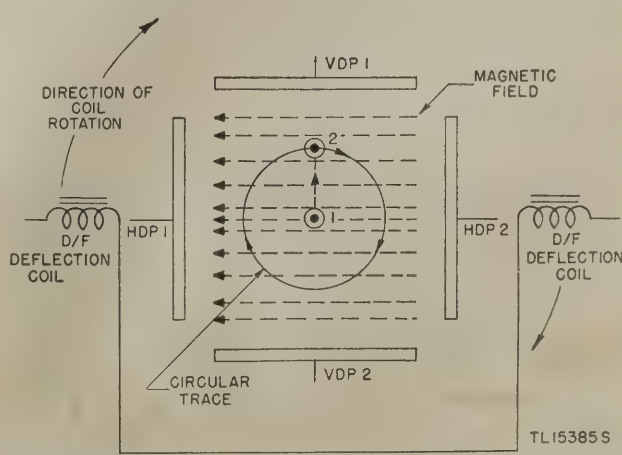


Figure 136. Development of circular trace, simplified diagram.

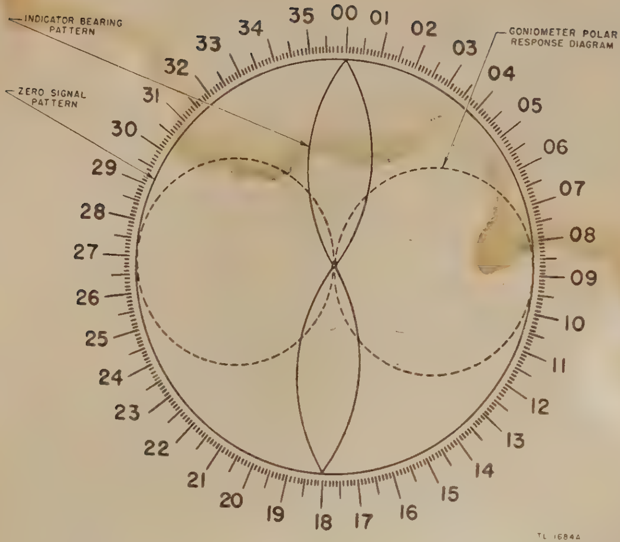


Figure 137. Zero signal and bearing patterns on scope screen.

time that it is moving around the center of the screen. With no signal input, then, the spot traces a circle; with signal input the spot traces the directional pattern on the screen (fig. 137). The broken-line figure 8 pattern does not appear on the scope screen; it is the polar diagram of the goniometer output when a signal is received from the north. It is also the pattern of a single U-Adcock antenna rotated to the proper position for a null reading on a signal from the north. Note that the bearing indicator pattern marks the direction of the null points in the figure 8 pattern. Thus, by the use of a stationary crossed U-Adcock antenna array and a rotating goniometer, the equivalent of rotating a single U-Adcock antenna is attained.

146. Sense Determination

a. Combined U-Adcock and Sense Output. The bearing indicator pattern of figure 137 is ambiguous, for the operator cannot tell whether the signal is arriving from the north or from the south. To eliminate the ambiguity, the output of a single vertical (sense) antenna is combined with that of the U-Adcock directional antennas (fig. 138). Because of the phase shift (polarity reversal, par. 144) at the null points of the figure 8 pattern, one of its circles is assigned a plus sign, the other a minus sign. The sense antenna output is fed to *two* transmission lines that differ in length, so that there is a phase difference between the output voltages of the lines. By properly choosing the line lengths, and by combining the two out-of-phase voltages in a Junction Box JB–91–A, a third voltage is obtained. When applied through a dummy goniometer (fig. 145) which is designed to produce the same phase shift in the sense voltage as the goniometer produces in the Adcock voltages, this third voltage will be of proper phase (over the normal frequency range of the radio set) to combine with the rotor output (figure 8 pattern) and produce a resultant pattern that can be used to determine the true azimuth bearing. The exact sense pattern will depend on the relative amplitudes and phase of the sense and D/F antenna outputs. In figure 138A the sense output is considerably lower than the D/F output; in B the sense output is almost equal to the D/F output; in C a cardioid pattern is obtained because the sense and D/F outputs are equal; and in D the sense output is greater than the D/F output.

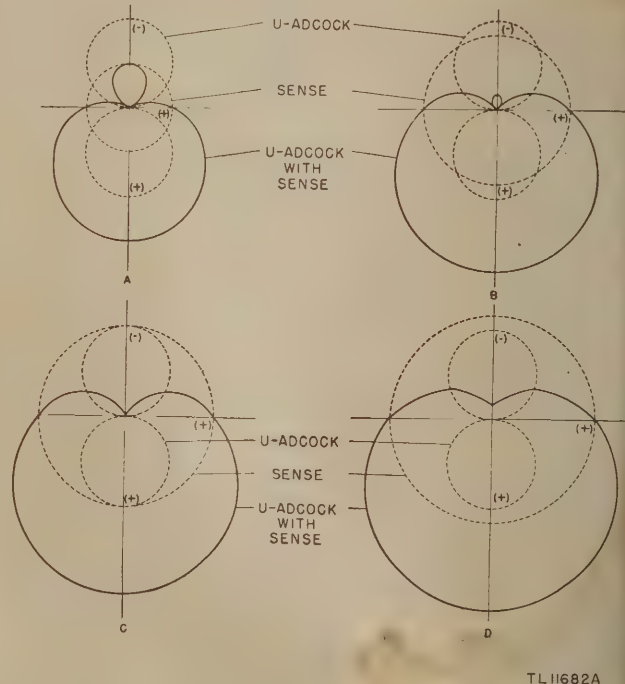


Figure 138. Development of typical sense patterns.

b. Position of Sense Pattern. As shown in figure 138, the U-Adcock with sense polar diagram is at right angles to the line through the null point of the U-Adcock diagram. Thus, if the deflection amplifier output were applied to

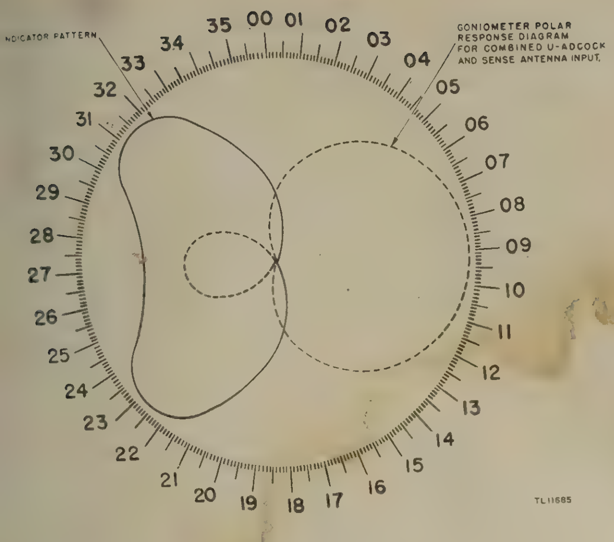


Figure 139. Sense signal through D/F coils places indicator pattern in wrong position.

the D/F set of deflection coils, the sense indicator pattern (fig. 139) would be at right angles to the D/F pattern (fig. 137) and would be unsuitable for determining the correct azimuth reading. Whenever the STAND-BY – D.F. – SENSE switch is held in the SENSE position, the deflection amplifier output is automatically disconnected from the D/F deflection coils and applied to a separate set of sense deflection coils. The sense coils are at right angles to the D/F coils and, therefore, produce a magnetic field which is at right angles to that present when the D/F coils are connected to the deflection amplifier; thus, the pattern is shifted 90° on the scope screen (fig. 140). If the STAND-BY – D.F. – SENSE switch is alternately placed in the D.F. and SENSE positions, the bearing and sense patterns will appear alternately on the screen (fig. 141).

c. Interpretation of Sense Pattern. The radio set is so designed that the various voltages combine to produce a sense pattern in the semicircle *opposite* to that in which the correct azimuth reading lies. The sense pattern can be considered as the tail of an arrow which is pointing to the correct azimuth reading, 0° in figure 141.

147. Phase Inverter MC–411–A

A Phase Inverter MC–411–A is mounted at the lower end of each corner monopole, and it functions to couple the unbalanced output of the monopole to a balanced r-f transmission line. As shown in the functional diagram (fig. 142), the antenna output is coupled through a 0.01-mf (microfarad) capacitor (C301) to a 25,000-ohm resistor (R301), and the voltage across the resistor is applied to the control grid (pin 6)

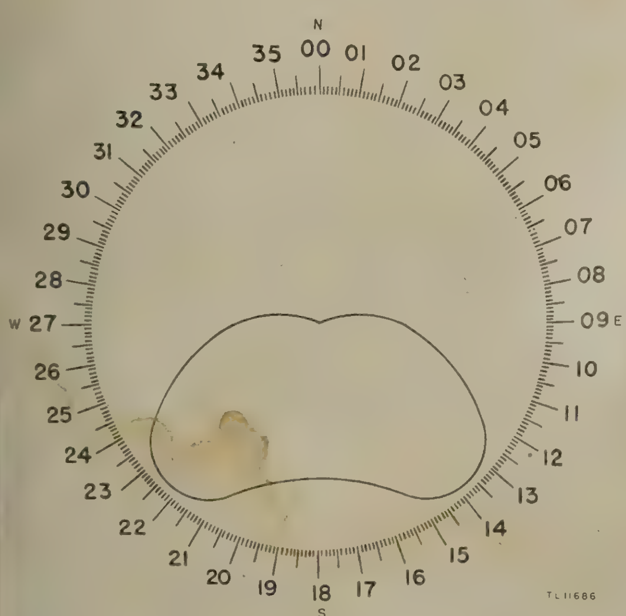


Figure 140. Use of sense coils shifts indicator pattern to correct position.

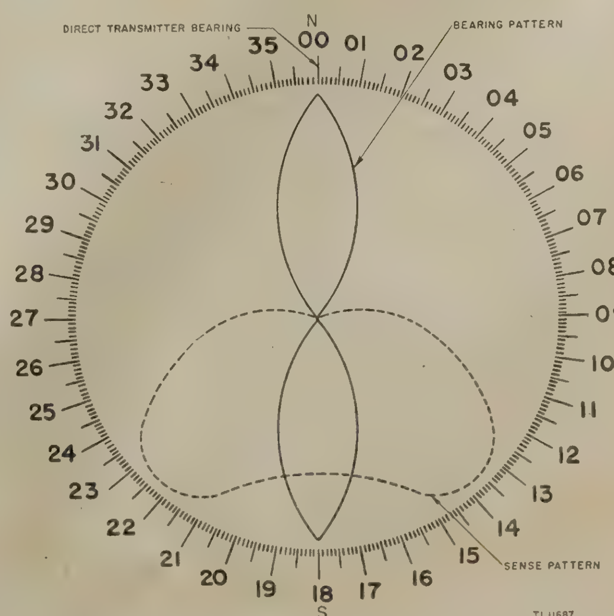


Figure 141. Bearing pattern and corresponding sense pattern for signal from north.

of Tube JAN–7V7. Plate voltage is applied through 155-ohm resistor R305; screen voltage is applied through 30,000-ohm resistor R304. Parallel 0.01-mf capacitors C305 and C306 (C306 not shown) form a decoupling capacitance in the plate circuit. Capacitor C303 is a screen bypass capacitor. The plate output voltage is coupled through capacitor C307 to one input termina of the r-f transmission line. The 55-ohm resistor R302 and the 94-ohm resistor R303 are connected in series between cathode and ground. The cathode output voltage is taken across resistor R303 and coupled through capacitor C308 to the second input terminal on the r-f line. Capacitor C302 across resistor R303 is used to balance the circuit by providing in the cathode circuit a capacitance equal to the plate-to-cathode capacitance of the tube. The circuit is untuned, and the frequency response is essentially equal over the normal frequency range of the radio set. Although two tubes are in the phase inverter (fig. 143), only one is active at a time. The choice of tubes is made by means of the FILAMENT 1–2 switch on Control Panel PN–31–A. With this switch in position 1, filament voltage is applied to one of the tubes but not to the other (and vice versa). Relay K301 is normally closed and is controlled by plate current of the phase inverter. When the plate current is switched off, either by the individual phase inverter switch on the control panel or by the STAND-BY – D.F. – SENSE switch in the STAND-BY position, no current is applied to the relay winding, the contacts are closed, and the monopole antenna wire is grounded. Filament and plate voltages are brought from Control Panel PN–31–A to Phase Inverters MC–411–A through Cords CD–832, CD–833, CD–835, and CD–836 (figs. 33 and 55).

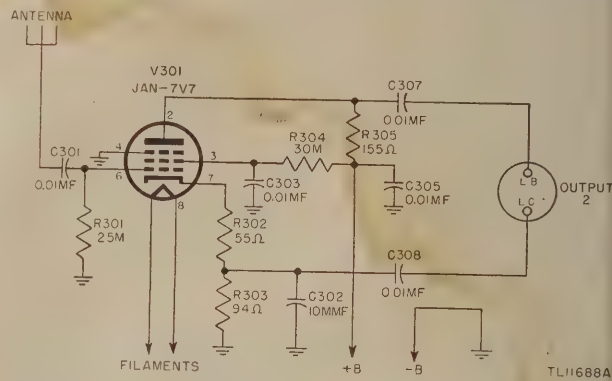


Figure 142. Phase Inverter MC–411–A, functional diagram.

148. Phase Inverter MC–413–A (fig. 144)

Phase Inverter MC–413–A is effectively two Phase Inverters MC–411–A in a single mount-

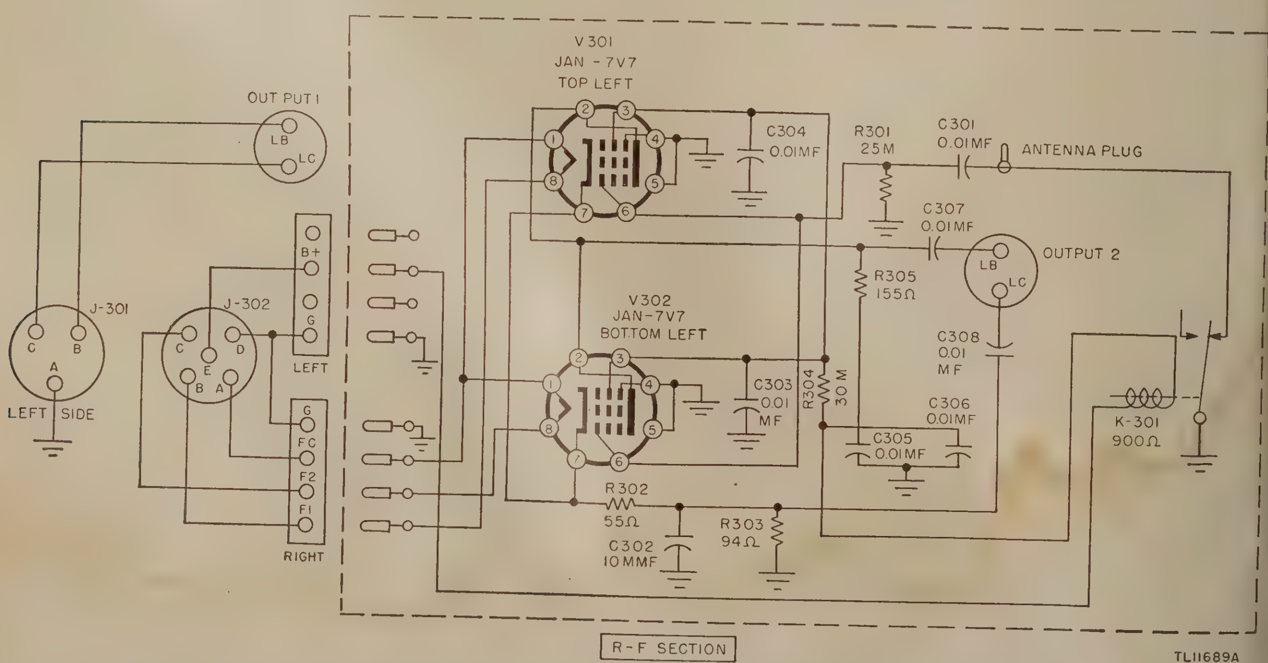
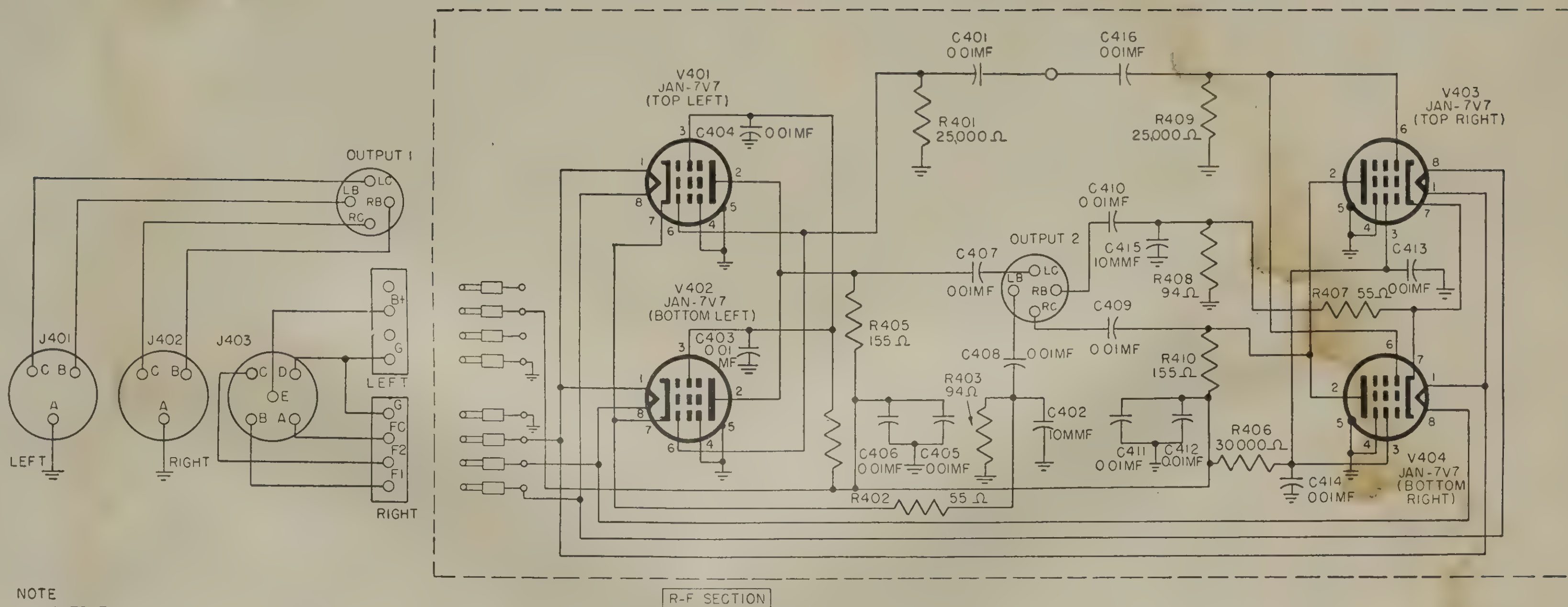


Figure 143. Phase Inverter MC–411–A, schematic diagram.



NOTE
OUTPUTS 1 AND 2 PLUG TOGETHER

Figure 144. Phase Inverter MC-413-A, schematic diagram.

ing. The sense antenna voltage is applied simultaneously through capacitors C401 and C416 to the inputs of the separate stages. The output of one stage is applied to Cord CD–828, and the output of the other stage is applied to Cord CD–829. A relay is not used in Phase Inverter MC–413–A, for the output is controlled through relay K601 in Goniometer MC–412–A.

149. Cords CD–824 through CD–829 (fig. 130)

R-f transmission lines carry the D/F and sense antenna outputs to the goniometer on Bearing Indicator BC–1159–A. Cords CD–821 through CD–827 are approximately 80 feet long. Electrically, these cords are the *same* length and have the same phase shift and attenuation characteristics, so that the received signals will be of proper phase and amplitude after traveling through the lines to the goniometer. Cord CD–828 is about 68 feet long (80—12), and Cord CD–829 is about 92 feet long (80+12). These two cords connect the sense antenna output through Junction Box JB–91–A and Cord CD–827 to the dummy goniometer in Goniometer MC–412–A. The difference in length between Cords CD–828 and CD–829 produces between the two sense antenna outputs the same relative phase difference that exists between the N-S, or the E-W, antenna outputs because of the 36-foot spacing between them. The difference in cable lengths is less than 36 feet, however, because a shorter length of cable is the electrical equivalent of the greater spacing between the monopoles.

150. Power Cords CD–832 through CD–836

Power Cords CD–832 through CD–836 carry plate and filament voltages to Phase Inverters MC–411–A and MC–413–A. Additional information on the power cords is given in section II.

151. Goniometer MC–412–A (fig. 145)

The functioning of Goniometer MC–412–A is described in paragraph 144. The output of the E-W antenna is applied through connector J601 to the stator. The 51-ohm resistor R601 provides a load in which unbalanced signals are absorbed. The output of the N-S antenna is applied through connector J602 to the stator, and resistor R602 provides a conection to ground similar to that of R601. The rotor winding is coupled to the stator windings, and the rotor output is applied to the output transformer rotor primary. The transformer secondary is connected to goniometer output connector J603. The sense antenna output is applied through connector J604 to the primary winding of the dummy goniometer. When the STAND-BY – D.F. – SENSE switch is at D.F., the secondary of the dummy goniometer is grounded through the contacts on relay K601, so that no sense voltage is applied to the sense primary winding on the output transformer. Whenever the STAND-BY – D.F. – SENSE switch is at SENSE, or at STAND-BY, power is applied through connector J605 to the relay winding, and the relay connects the dummy goniometer output to the sense primary. Thus, with the STAND-BY – D.F. – SENSE switch at SENSE, the outputs of the D/F and sense antennas are combined and applied through connector J603 to the input of the radio receiver. With the STAND-BY – D.F. – SENSE switch at STAND-BY, the D/F antennas are grounded and only the output of the sense antenna is applied to the receiver input terminals. The 0.01-mf capacitors, C601 and C602, form a filter across the winding of relay K601.

152. Radio Receiver BC–1147–A (fig. 146)

a. Block Diagram (fig. 146). The output of Goniometer MC–412–A is applied through connector J101 to the primary winding of the input transformer to the first r-f stage in the superheterodyne receiver. A second r-f stage is used to improve the signal-to-noise and image frequency ratios. The output of the second r-f stage is fed to the mixer stage in which it is combined with the output of the h-f (high-frequency) oscillator stage. The combined signals produce the i.f. in the output of the nonlinear mixer stage. The i.f. is amplified in the first i-f amplifier and applied simultaneously to the input circuits of separate audio and bearing indicator channels. From the i-f stage in the audio channel the signal is passed through a diode detector, first audio stage, output stage, and then to the loudspeaker. The audio output may be fed to a headset plugged into the

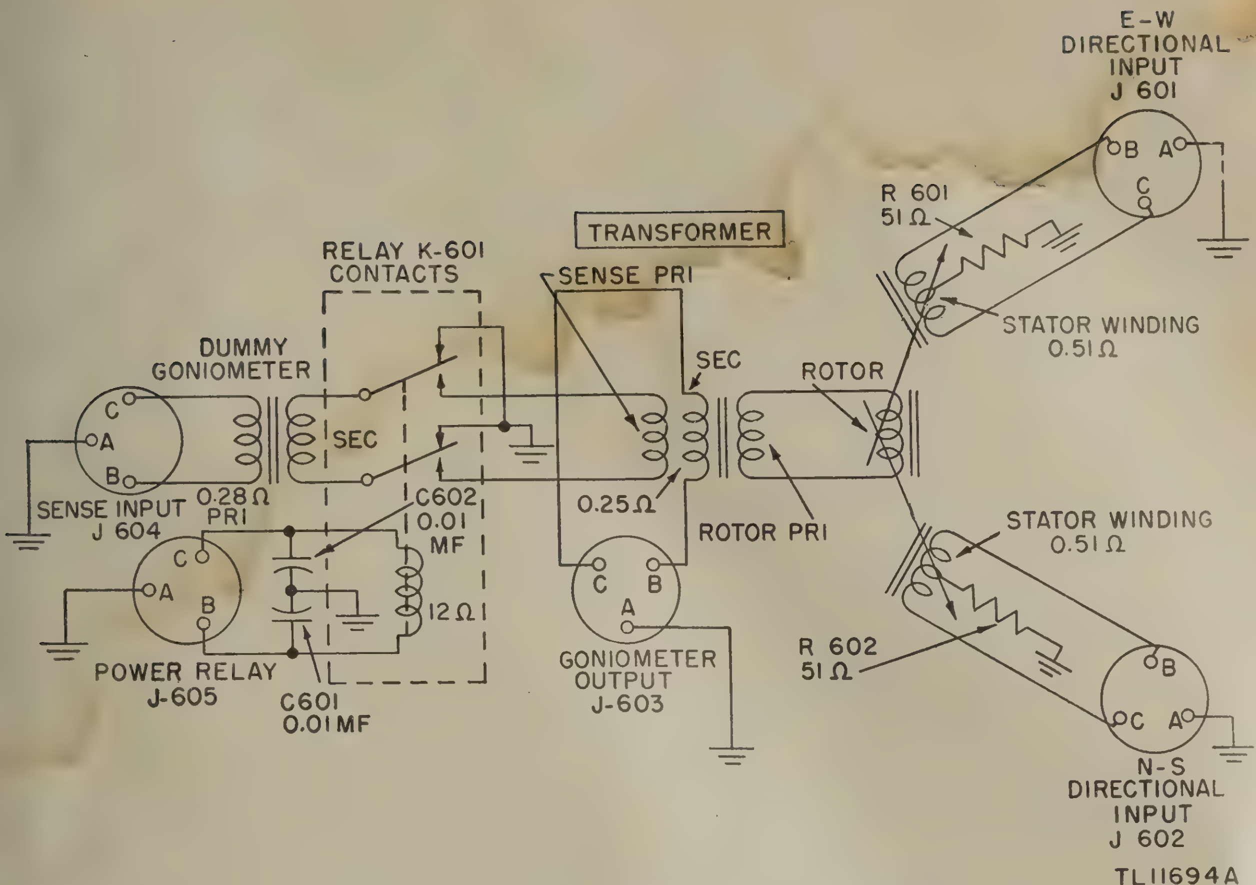


Figure 145. Goniometer MC–412–A, schematic diagram.

PHONES jack. Inserting the headset plug into the PHONES jack automatically disconnects the loudspeaker. From the i-f stage in the bearing indicator channel the signal is applied to a diode detector. The rectified output of the detector is applied, through connector J103 and a connecting cable, to the deflection amplifier in Control Panel PN–31–A. The diode circuit of the indicator channel also furnishes avc (automatic volume control) voltage to the second r-f, mixer, and first i-f stages. Plate voltage for the h-f oscillator and screen voltage for the mixer are obtained from the voltage regulator circuit. All other plate and screen voltages are obtained directly from the power supply rectifier and filter circuits. The output of the bfo stage is capacity-coupled to the diode detector in the audio channel.

b. INDIVIDUAL STAGES. The individual stages are described in paragraphs 153 through 158. Unless otherwise specified, references are to the complete schematic diagram (fig. 212).

153. R-f and H-f Oscillator

a. R-F INPUT CIRCUITS. With the band switch at position 1, the goniometer output is applied through connector J101 and band switch S101 to the primary of input transformer L101. The coupling between the transformer primary and secondary can be varied by adjusting the iron core in the transformer. The secondary is tuned by capacitor C101A, the first section of the main, four-gang tuning capacitor, C101. Capacitors C170 and C171 are 5-mmf (micromicrofarad) padding capacitors across the secondary winding. ANT. COMP. capacitor C102 is a variable 17-mmf capacitor for tuning the input circuits precisely to the desired signal.

b. FIRST R-F STAGE. Tube JAN–6SH7, an h-f amplifier pentode, is used in the first r-f stage, V101. One end of the cathode (pin 5) is bypassed to ground through 0.01-mf capacitor C104. A 100-ohm cathode bias resistor and its 0.1-mf bypass capacitor, C103, are connected between the other cathode terminal (pin 3)

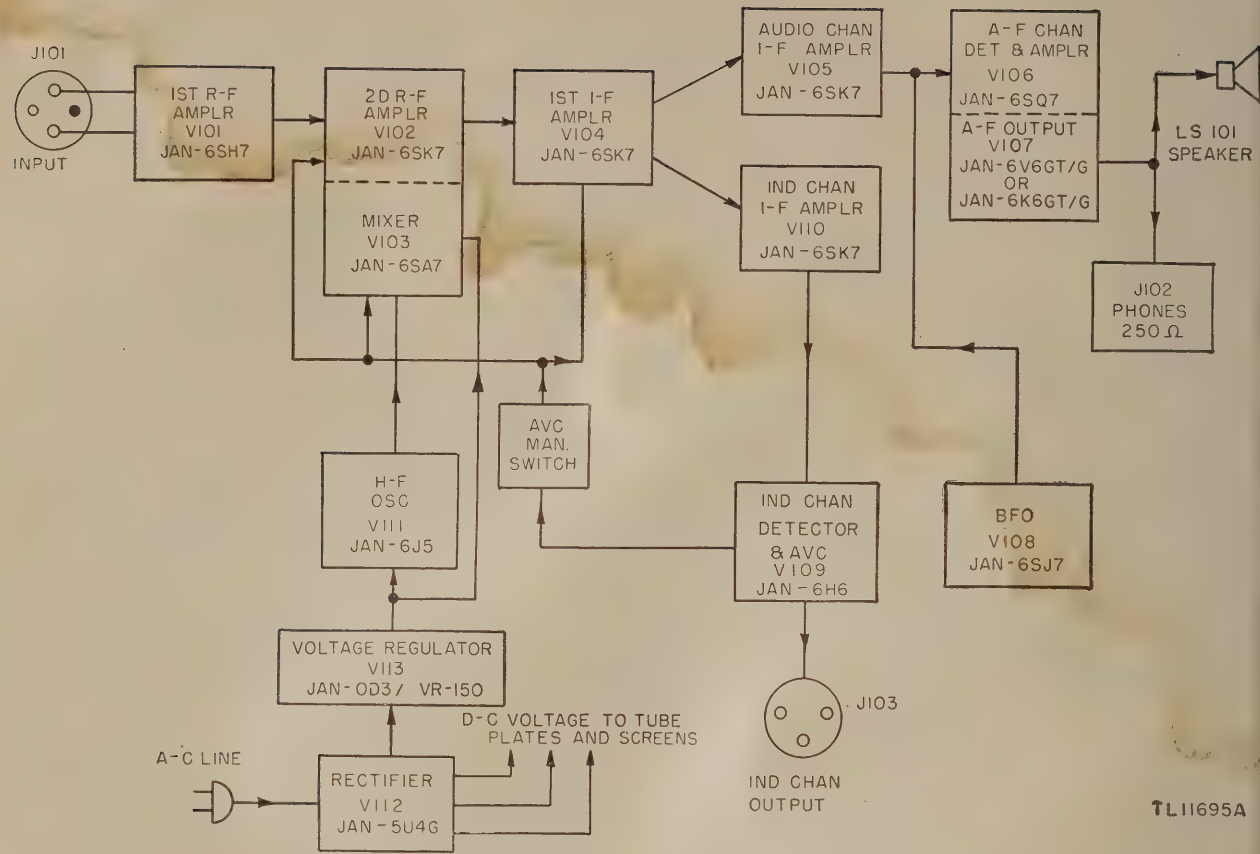


Figure 146. Radio Receiver BC–1147–A, block diagram.

and ground. Plate and screen voltages are obtained from the filter output; the screen voltage is applied through a 30,000-ohm series resistor, R102; the plate, through 2,200-ohm decoupling resistor R104 and the primary winding of transformer L105. Screen pin 6 is bypassed to cathode by a 0.01-mf capacitor, C105. Capacitor C106 is a 0.01-mf capacitor in the decoupling filter composed of R104 and C106.

c. SECOND R-F STAGE. Tube JAN–6SK7, an r-f pentode amplifier, is used in the second r-f stage, V102. The output of the first r-f stage is coupled through transformer L105 to the control grid (pin 4) of V102. The coupling between the transformer primary and secondary can be varied by adjusting the position of the iron core in the transformer. The secondary is tuned by the second section of tuning capacitor C101 (C101B). Capacitor C107 is a 25-mmf trimmer. Capacitor C111 is a 0.03-mf blocking capacitor; it effectively connects the secondary winding to ground at radio frequencies but blocks the avc voltage. Cathode pin 5 is connected to ground through the 180-ohm, minimum-bias resistor, R108, in series with the 10,000-ohm SENSITIVITY control R106. The SENSITIVITY control is bypassed by capacitors C112 (0.01 mf) and C113 (0.1 mf). Plate voltage is applied through the 2,200-ohm decoupling resistor, R111, and the primary winding of transformer L109. Screen voltage is applied through a 47,000-ohm series resistor, R109, and the screen is bypassed to ground by 0.01-mf capacitor C114. Capacitor C115 (0.01 mf) and resistor R111 decouple the plate circuit from the power supply. When the receiver AVC-MAN. switch is at AVC, avc voltage is applied to the control grid (pin 4) through a 10,000-ohm filter resistor, R107, and the secondary winding of L105. With the AVC-MAN. switch at MAN., the receiver sensitivity is controlled by adjusting SENSITIVITY control R106 to vary the cathode bias of the second r-f, the mixer, and the first i-f stages.

d. MIXER STAGE. The output of the second r-f stage is coupled through transformer L109 to the r-f grid (pin 8) of pentagrid converter Tube JAN–6SA7, V103. The transformer secondary is tuned by a third section, C101C, of the main tuning capacitor, and C116 is a 25-mmf trimmer capacitor. Coupling between the transformer primary and secondary can be varied by changing the position of the iron core in the windings. With the AVC-MAN. switch at AVC, avc voltage is applied through 10,000-ohm filter resistor R113 and the secondary winding of the transformer to the r-f input grid of the mixer. The mixer tube cathode (pin 6) is bypassed to ground by capacitor C121 (0.01 mf) and C122 (0.1 mf). Cathode bias is applied from the SENSITIVITY control through 180-ohm resistor R114 which prevents the bias from falling to zero when the SENSITIVITY is set to maximum. The output of the h-f oscillator (V111) is applied through 50-mmf capacitor C158 to the oscillator input grid (pin 5) of the mixer tube. A 22,000-ohm resistor is connected as a grid leak between this grid (pin 5) and the cathode (pin 6). Plate voltage is applied through a decoupling filter (2,200-ohm resistor R117 and 0.1-mf capacitor C124) and inductance L117. L117 is tuned by changing the position of its iron core (permeability tuning). D-c voltage is also applied from the voltage regulator (V113) through a 22,000-ohm series resistor, R116, to pin 4 (grids 2 and 4 in the mixer) which is bypassed to ground by 0.01-mf capacitor C123.

e. H-F OSCILLATOR. A tube JAN–6J5 is used in the h-f oscillator stage V111. The feedback necessary for sustained oscillation is due to mutual coupling betwen the plate and grid windings of transformer L113; the coupling and, hence, the feedback can be varied by changing the position of the iron core in the windings. A 920-mmf capacitor, C148, is used as an l-f (low-frequency) padder; tuning is accomplished by the fourth section, C101D, of the main tuning capacitor, and capacitor C152 is a 25-mmf trimmer capacitor. C157 is a 50-mmf grid capacitor, and resistor R135 is a 47,000-ohm grid leak. The grid capacitor and grid leak develop bias voltage for the oscillator. The oscillator output is coupled from the grid through capacitor C158 to the oscillator input grid of mixer V103. Plate voltage is obtained from voltage regulator V113 and applied through R134 (2,200 ohms) and the plate winding of L113. Resister R134 and capacitor C151 form a decoupling filter to kep rf out of the power supply.

154. I-f Amplifier Stages

Two stages of i-f amplification are used; one Tube JAN–6SK7 is used in the first stage, and two Tubes JAN–6SK7 are used in the second stage. As shown in the functional diagram (fig. 147) the output of the first i-f stage (V104) is applied simultaneously to the control grids of the two tubes in the second stage. The output of V105, however, is applied to the diode sections of Tube JAN–6SQ7 (V106) in the audio channel; the output of V110 is applied to Tube JAN–6H6 (V109) in the deflection amplifier channel. The intercoupling components between V103 and V104, between V104 and V105 and between V104 and V110 are designed to provide BROAD or SHARP selectivity, according to the setting of the SELECTIVITY switch, S106.

a. INTERSTAGE COUPLING. The interstage coupling in the intermediate amplifier is designed to permit changing at will the selectivity of the i-f amplifier from sharp to broad. Thus, with the SELECTIVITY switch at BROAD, the coupling circuit between the mixer (V103) and the first i-f stage (V104) is as shown in figure 148A. Coil L117 is permeability-tuned to adjust the circuit composed of L117, C128, C126, and Cc to resonance at the intermediate frequency. Coil L118 is similarly tuned to resonate L118, C129, C126, and Cc to the intermediate frequency. Capacitors C126 and Cc are in series and comprise a capacitive reactance X_{Cb}, which is common to both circuits. SELECTIVITY switch is placed at SHARP, the circuit (A) is changed to that shown in B. Under this condition the resonant frequency of each circuit is the same as before, because C127, equal to C126, has been added to the L118 branch to compensate for the removal of C126 from the common branch to the L117 branch. Only capacitor Cc is now common to both branches of the coupling circuit and therefore the common capacitive reactance, X_{Cs}, has been reduced to approximately one-third of its previous value. The higher common reactance provides closer, or tighter, coupling between the two circuits than the lower reactance. As shown in the functional diagram (fig. 147) a similar coupling circuit is used betwen the first i-f stage (V104)

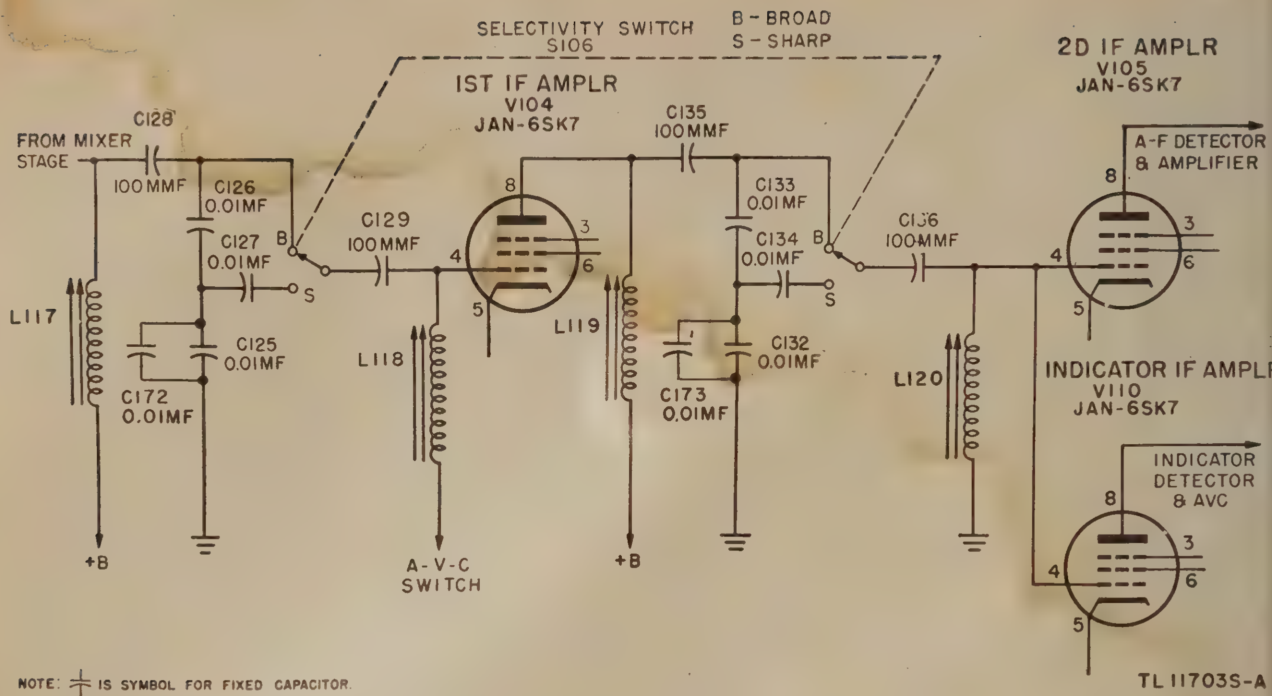


Figure 147. I-f amplifier, interstage coupling circuit.

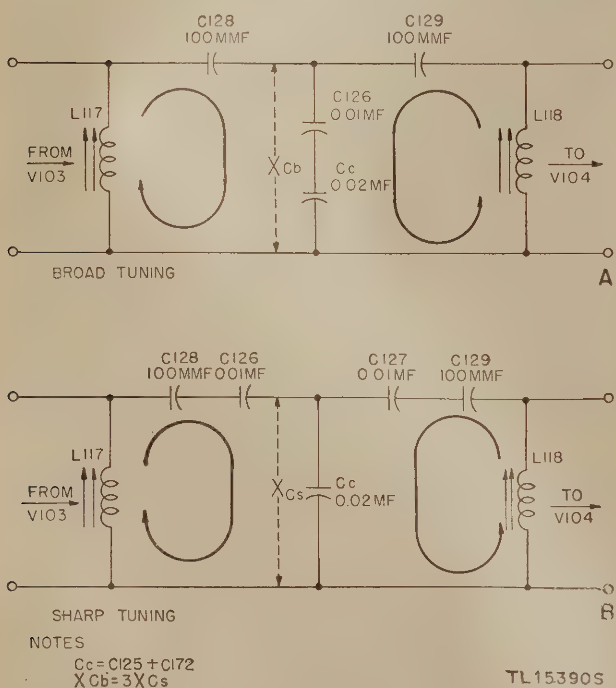


Figure 148. Interstage coupling circuit operation.

and the second i-f stage (V105–V110). Consequently, as indicated in the following chart, with the SELECTIVITY switch at BROAD the i-f amplifier tuning is broadened, but with the SELECTIVITY switch at SHARP the i-f amplifier tuning is sharp.

Receiver Selectivity (over-all)

Input (microvolts)	SELECTIVITY switch at: SHARP Bandwidth (kc)	BROAD Bandwidth (kc)
4	1.5 to 3.0	5.0 to 7.5
20	4.0 to 6.5	9.0 to 13.0
200	9.5 to 14.0	17.5 to 24.0
2,000	17.0 to 27.0	28.0 to 38.0

Note. Bearings always should be taken with the SELECTIVITY switches at SHARP. With the SELECTICVITY switch at BROAD, there is a phase shift which causes bearing errors.

b. FUNCTION OF PARTS (fig. 212). Plate voltage is applied through a decoupling filter (4,700-ohm resistor R121 and the 0.1-mf section C of capacitor C131) and coil L119 to pin 8 of V104. Screen voltage is applied through 56,000-ohm series resistor R120. The screen is bypassed by the 0.1-mf section B of capacitor C131. The cathode is connected through 470-ohm resistor R119 to SENSITIVITY control R106. The mixer (V103) output is coupled through the tuned circuits (*a* above) to the grid (pin 4) of V104. Avc voltage is applied through 10,000-ohm resistor R118 and coil L118 to the grid; the 0.03-mf capacitor, C130, completes the r-f circuit to ground. A circuit similar to that between the mixer and first i-f stages (fig. 149) is used to couple the output of the first i-f stage to the input of the second i-f stage (V105–V110). Plate voltage is applied to Tube JAN–6SK7 (V105) through a decoupling network (4,700-ohm resistor R124 and the 0.1-mf section C of capacitor C137) and through the primary of transformer T101. The transformer primary and capacitor C138 (100 mmf) form a tuned plate circuit, and the coupling is changed by varying the position of the transformer iron core. The cathode of V105 is grounded through a 4,700-ohm resistor, R122, which is bypassed by the 0.1-mf section A of capacitor C137. Screen voltage is applied through 56,000-ohm series resistor R123, and a third 0.1-mf section of C137 is used to bypass the screen. The control grid (pin 4 of V105) is connected to L120, which is grounded. The output of the first stage is also applied to Tube JAN–6SK7 (V110) in the deflection amplifier channel. Plate voltage is applied to V110 through a decoupling network (4,700-ohm resistor R138 and a 0.1-mf section C of capacitor C159) and through the primary winding of transformer T103. Capacitor C160 (100 mmf) is connected across the primary winding, and the coupling is varied by adjusting the movable iron core. The cathode (pin 5) is biased by means of 270-ohm resistor R136 and the 0.1-mf section A of capacitor C 159. Screen voltage is applied through 56,000-ohm series resistor R137, and the screen is bypassed to ground by the 0.1-mf section B of capacitor C159.

155. Audio Channel (fig. 212)

Tube JAN–6SQ7 is used as a diode detector and triode amplifier in the first a-f stage (V106) of the audio channel. One end of the secondary of transformer T101 is connected through 22,000-ohm resistor R146 to the diode plates which are tied together; the other end of the secondary is connected through the series combination of 56,000-ohm resistor R126 and 560,000-ohm resistor R127 to the cathode of V106 (pin 3). Resistor R126 and capacitors C140 and C141 (100 mmf each) form an r-f filter in the detector circuit. The a-f component of the detector voltage across R127 is coupled through capacitor C142 (0.01 MF) to the 1-megohm volume control, and the control grid of the triode (pin 2) is connected to the movable contact on the potentiometer. The triode amplifier section of V106 is cathode-biased by means of 2,200-ohm resistor R129 and the 0.1-mf section A of capacitor C144. Plate voltage is applied through 220,000-ohm resistor R130 and 100,000-ohm resistor R131. Resistor R130 is the plate load of the triode section of V106, and 250-mmf capacitor C145 is an r-f bypass capacitor. Resistor R131 (100,000 ohms) and section B (0.1 mf) of capacitor C144 form a decoupling network. The output of V106 is coupled through capacitor C146 (0.01 mf) and grid resistor R132 to the control grid of V107. A tube JAN–6K6GT/G or a Tube JAN–6V6GT/G may be used in the output stage V107. The cathode of V107 is biased by 470-ohm resistor R133, which is not bypassed. Plate voltage is applied through the primary winding of output transformer T102. Screen voltage is applied directly from the power supply filter. The plate of V107 is bypassed by 0.006-mf capacitor C147 to prevent undesired oscillations. The output transformer secondary is tapped to provide a suitable impedance match between the output stage and loudspeaker LS101, or between the output stage and a 250-ohm headset plugged into the phones jack, J102.

156. Bfo Stage (fig. 212)

Tube JAN–6SJ7 is used as a beat-frequency oscillator, V108. The circuit is a shunt-fed Hartley. The inductance coil, L121, is tapped, and the cathode is connected to the tap. One end of the coil is grounded and the other end is connected through grid capacitor C164 (100 mmf) to the control grid (pin 4). Resistor R140 is a 100,000-ohm grid leak. The resonant circuit consists of L121, capacitor C162 (200-mmf), and trimmer capacitor C163 (17 mmf). The inductance is permeability-tuned, and the trimmer capacity is varied from the front panel control (BFO ADJ.) to obtain the desired audio beat note. The screen (pin 6), suppressor (pin 3), and plate (pin 8) are tied together so that the stage is a triode oscillator. Plate voltage is applied through a decoupling network composed of R141 (15,000 ohms), R142 (33,000 ohms), and capacitor C166 (sections B and C of 0.1 mf each). Heater pin 2 is bypassed to ground through capacitor C166, section A, 0.1 mf. R-f energy is coupled from the plate to the tank circuit in the grid circuit through a 0.01-mf capacitor, C165. The r-f output is coupled through 5-mmf capacitor C139 to the plate circuit of the diode detector in the first audio stage (V106). Switch S108 is the BFO ON-OFF switch.

157. Indicator Channel (figs. 149 and 150)

The output of the second i-f stage, V110, is coupled through transformer T103 to Tube JAN–6H6, the indicator channel detector and avc stage V109. The diode plates, pins 3 and 5, are tied together and connected to one end of the transformer secondary winding. The other end of the secondary is connected through 56,000-ohm load resistor R139 to ground. The diode cathodes, pins 4 and 8, are connected together to ground C161 is a 100-mmf, r-f filter capacitor across the diode load resistor. The detector output voltage is negative with respect to ground and is fed through 1-megohm resistor R147 to contact C on connector J103. From J103 the output is carried through a connecting cable to input connector J201 on Control Panel PN–31–A (fig. 150). The detector output voltage is also used as avc voltage in the receiver. For this purpose, the negative voltage across resistor R139 is applied through a filter, composed of resistor R125 (2.2 megohms) and capacitor C143 (0.25 mf), to the avc contact of the AVC-MAN. switch (fig. 212).

158. Power Supply (fig. 212)

The receiver power supply consists of power transformer T104 and Tube JAN–5U4G in a full-wave rectifier circuit. The filter is composed of chokes. L122A and L122B and capacitors C168 and C169. The power transformer primary is connected through fuses F101 and F102, a line cord, and plug P101 to the a-c power source. The 125-mmf capacitors A and B of C167 form an r-f filter across the a-c line. The center tap of the high-voltage secondary winding is grounded, and high voltage is applied to the rectifier tube plates, pins 4 and 6. The transformer filament winding is connected to pins 2 and 8 of V112, and a second low-voltage winding is connected to the receiver dial lights (I101 and I102) through a variable, 50-ohm DIM control, R143. The rectifier output (positive) is taken from pin 8 of V112 and applied to the filter input section (A) of capacitor C168. Capacitor C168 also contains two other 4-mf sections which are connected as shown in figure 212. To improve the filtering action, a 1.0-mf capacitor, C169, is shunted across choke L122B. Plate voltage for the audio output stage (V107) is taken from the output of the first filter section. The h-f oscillator plate voltage and screen voltage for the mixer stage are taken from the output of a voltage regulator Tube JAN–OD3/-VR–150, V113. In this circuit, resistors R144 (3,500 ohms) and R145 (75,000 ohms) form a voltage divider with Tube JAN–OD3/VR–150 connected across R145. Resistor R144 and the regulator tube function to maintain a constant voltage at pin 5 of V113.

159. Control Panel PN–31–A

Control Panel PN–31–A is a combined power supply and control unit for the receiving and indicating components of the radio set. The panel includes phase inverter balancing circuits, a d-c deflection amplifier for the indicator channel, and power distribution circuits. The various circuits are discussed in paragraphs 160 through 163; figure 150 is the schematic diagram.

160. Power Input Circuits

Input power is applied from Junction Box JB–95–A through connector J208. The AUX. 115V. A. C. outlet J214 is in parallel with J208. Safety switch S207 is arranged to close only when the bottom cover is on; this provides protection from the high-voltage circuits while the control panel is out of the rack. Thus, in normal operation the circuit-breaker type POWER switch, S209, controls the application of power to transformer T201 and to the high-voltage power supply transformer, T202. When the POWER switch is at ON, voltage is also applied to the parallel combination of resistor R215 (½ megohm) and the neon type lamp I203. The circuit-breaker type HEATER switch controls the application of power to heater units in Rack FM–61–A and in the bearing indicator. When the HEATER switch is ON, voltage is also applied to resistor R217 (½ megohm) and

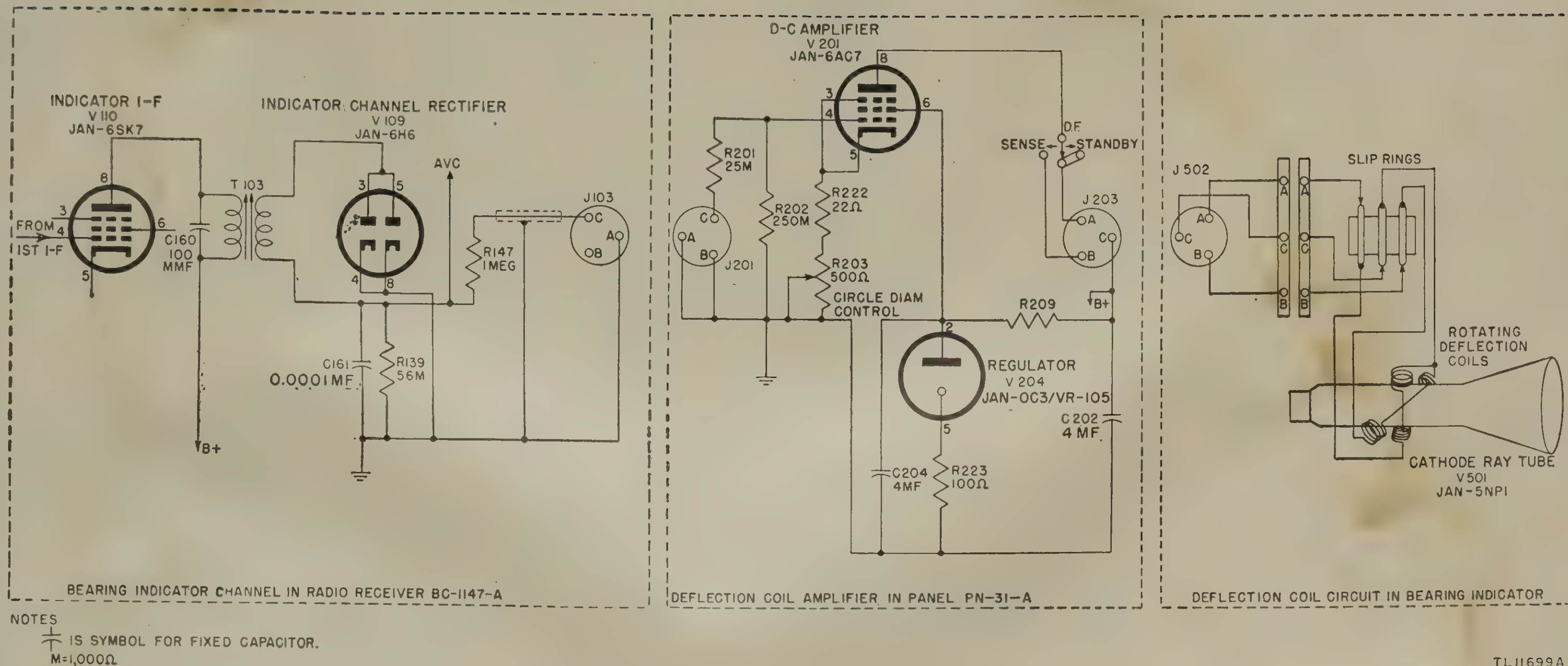


Figure 149. Indicator channel, schematic diagram.

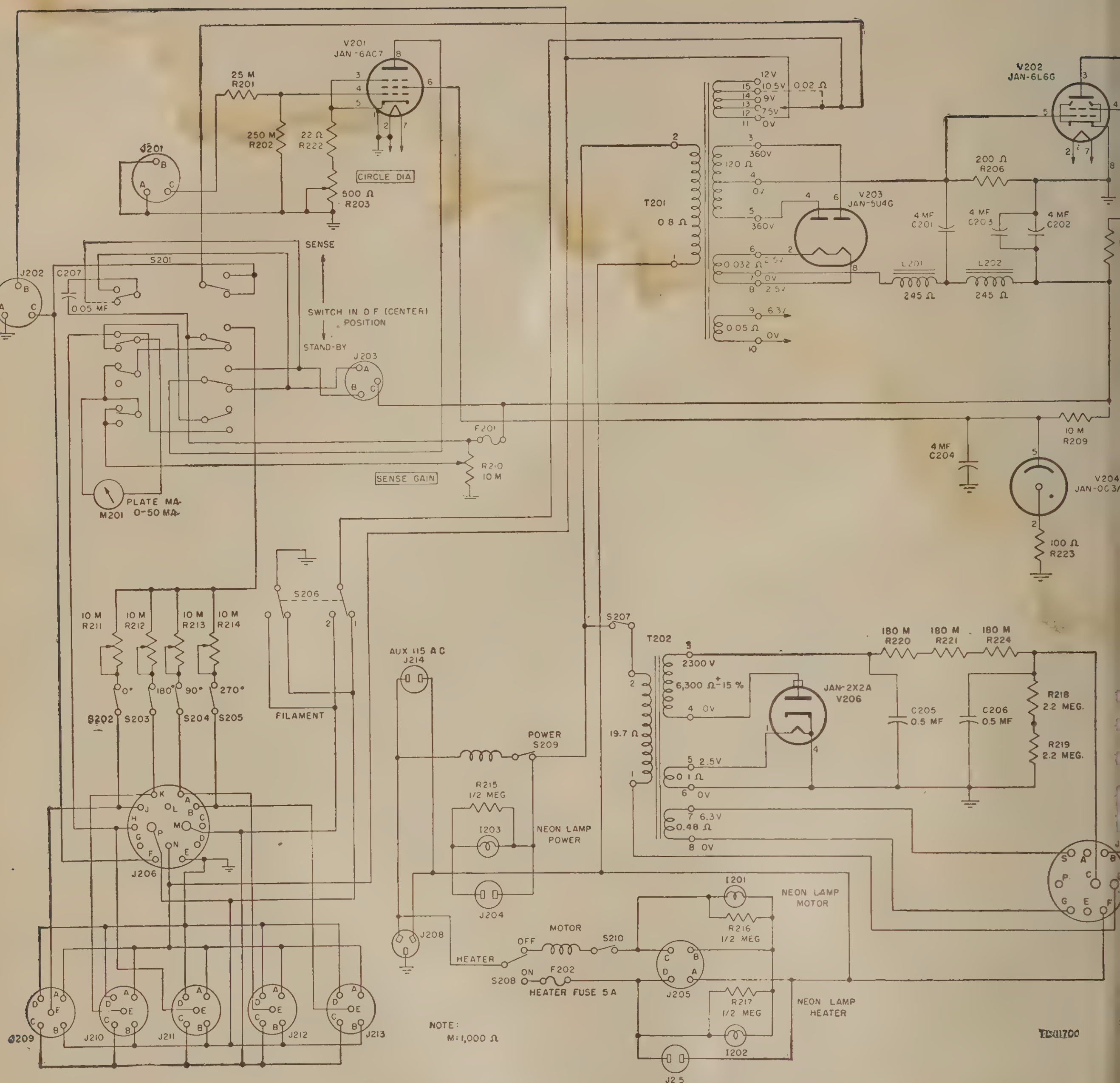


Figure 150. Control Panel PN–31–A, schematic diagram.

lamp I202. While the HEATER switch is ON, power cannot be applied to the bearing indicator motor. With the HEATER switch at OFF, however, power can be applied to the motor by putting the circuit-breaker type MOTOR switch S210, to ON. Lamp I201, across ½-megohm resistor R216, will glow while the MOTOR switch is at ON. In addition to the protection of the safety switch S207, the primary circuit of the high-voltage transformer is completed through connector J207 and a shorting bar in the bearing indicator. Consequently, the transformer circuit cannot be closed unless Cord CD–824 is connected. Fuse F202 provides overload protection in the heater circuits; the motor and power circuits are similarly protected by the circuit-breaker type ON-OFF switches used.

161. Deflection Amplifier

The indicator channel output of the receiver (fig. 149) is applied through connector J201, contact C, and a voltage divider composed of 25,000-ohm resistor R201 and 250,000-ohm resistor R202 to the control grid (pin 4) of Tube JAN–6AC7 (commercial type 6AC7/1852), V201. The cathode (pin 5) and suppressor (pin 3) are tied together and are connected through 22-ohm resistor R222 and the 500-ohm CIRCLE DIAMETER control R203 to ground. The d-c amplifier output is applied through the STAND-BY–D.F.–SENSE switch to the D/F or to the sense set of deflection coils (fig. 152). The deflection amplifier power supply (fig. 150) is composed of transformer T201; rectifier Tube JAN–5U4G; 4-mf capacitors C201, C202, and C203; a voltage regulator circuit composed of Tube JAN–6L6, 200-ohm resistor R206, and 500-ohm resistor R208; and a second voltage regulator circuit composed of Tube JAN–OC3/-VR–105 and 4-mf capacitor C204. The regulated rectifier output voltage is applied through contact C of connector J203, the bearing indicator deflection coils, and back through J203 and the STAND-BY–D.F.–SENSE switch to the plate of V201. The regulated output voltage of V204 s applied to the screen (pin 6) of V201.

162. High-voltage Power Supply

The high-voltage power supply furnishes d-c voltages for the electrostatic deflection plates of the cathode-ray tube in the bearing indicator. This power supply (fig. 150) consists of transformer T202; rectifier Tube JAN–2X2A (commercial type 2X2/879); a resistance-capacitance filter composed of three 180,000-ohm resistors, R220, R221, and R224, and two 0.5-mf capacitors C205 and C206; and a bleeder composed of two 2.2-megohm resistors R218 and R219. The cathode of the half-wave rectifier is grounded, and therefore a high negative voltage is developed at the output of the rectifier. This negative output voltage from the filter is connected to contact C of connector J207. A filament winding on the transformer (T202) secondary furnishes filament voltage through contacts S and G of connector J207 to the cathode-ray tube in the bearing indicator.

163. Control Circuits (fig. 151)

a. Stand-By–D.F.–Sense Switch S201. This is a multispring contact switch which locks in the D.F. or STAND-BY position but must be held in the SENSE position. In figure 151, the component switches are shown separately in the D.F. position, with arrows indicating the SENSE and STAND-BY positions. The connections are as follows:

(1) *Switch at D.F.* The D/F deflection coils are connected into the plate circuit of deflection amplifier V201. Plate voltage for Phase Inverters MC–411–A is connected through switches S202 through S205 and meter M201. Switches S202 through S205 enable measurement of total, or individual, plate current of the phase inverters. Plate voltage is disconnected from the sense Phase Inverter MC–413–A. The relay in the goniometer is not activated, so that the sense antenna output is not applied to the goniometer.

(2) *Switch at SENSE.* The sense deflection coils are connected into the plate circuit of V201, and the D/F coils are disconnected. Plate voltage is applied to all phase inverters. Meter M201 is connected to measure plate current in Phase Inverter MC–413–A. The relay in Goniometer MC–412–A is activated, so that the sense antenna output is applied to the goniometer.

(3) *Switch at STAND-BY.* The D/F deflection coils are connected in the plate circuit of V201. Plate voltage is applied only to the sense Phase Inverter MC–413–A. The relay in Goniometer MC–412–A is activated, so that the sense antenna output is applied to the goniometer.

b. Balance Adjustment. The 10,000-ohm resistors, R211 through R214 (0°, 180°, 90°, 270°), are used to balance the outputs of the phase inverter pairs; that is, the N-S and the E-W Phase Inverters MC–411–A. Each of these resistors adjusts the plate voltage of the phase inverter circuit in which it is connected.

c. Sense Gain. The 10,000-ohm SENSE GAIN control R210, varies the plate voltage of the sense antenna Phase Inverter MC–413–A and, therefore, adjusts the phase inverter gain.

d. Filament 1–2. The FILAMENT 1–2 switch, S206, is used to switch the filament supply voltage from one set of phase inverter

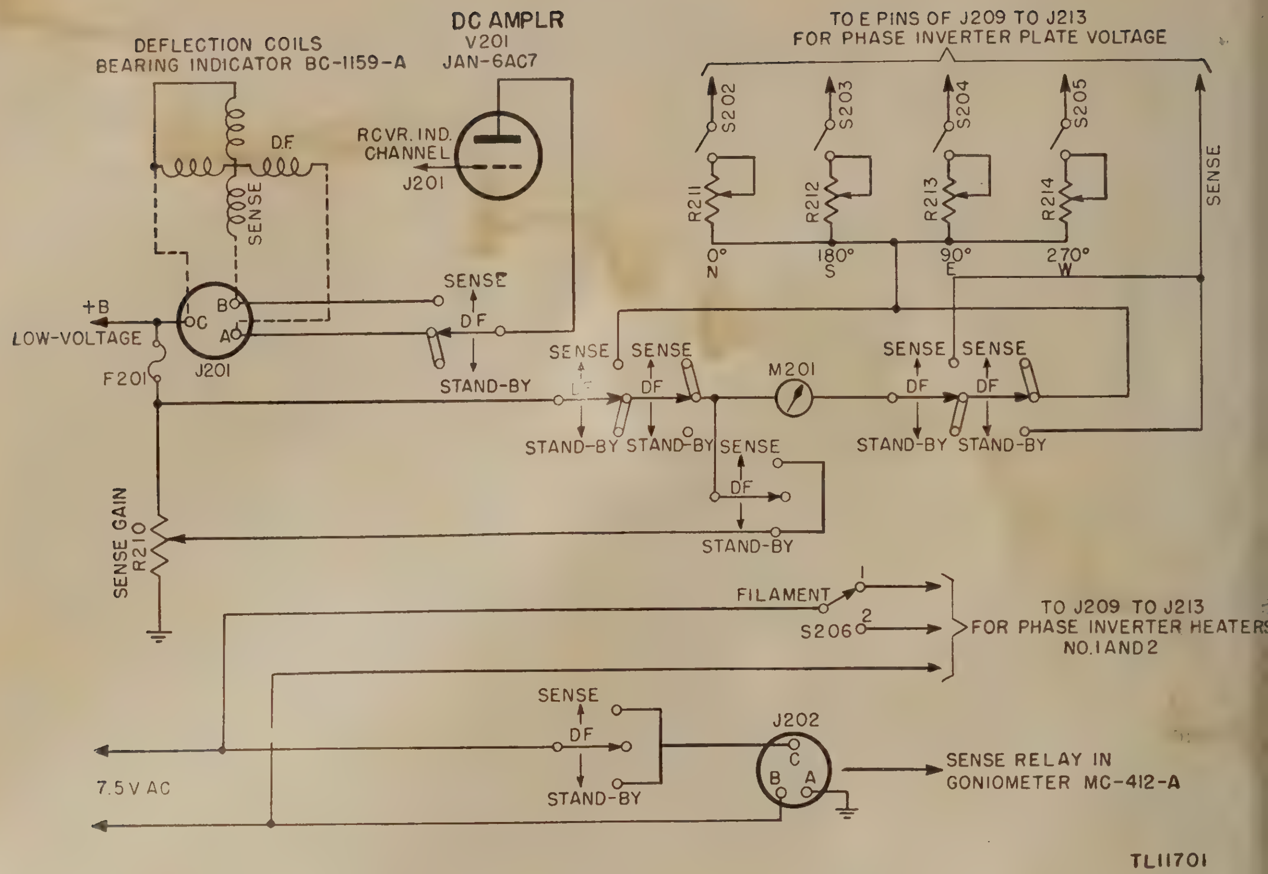


Figure 151. STAND-BY–D.F.–SENSE switch, simplified diagram.

tubes to the other. Thus, operation can be continued if there is tube failure in one set of phase inverter tubes.

e. RECEPTACLE J206. Receptacle J206 is not used when the control panel is used with Radio Set SCR–291–A.

164. Bearing Indicator BC–1159–A

a. GENERAL. Bearing Indicator BC–1159–A is an electromechanical, optical unit for producing visual bearing and sense patterns. Goniometer MC–412–A is mounted at the rear of the indicator and is driven by the indicator motor. The bearing indicator contains a 1/4-hp (horsepower), 1,800-rpm, synchronous motor; two sets of deflection coils (one for D.F. and one for SENSE) which are mounted on a motor-driven housing around the cathode-ray tube (fig. 152); an optical system composed of a lamp, azimuth scale, and a mirror assembly for projecting the azimuth scale image into the plane of the scope screen; and a control box that contains circuits for centering, focusing, and adjusting the intensity of the cathode-ray tube patterns.

b. MECHANICAL CONSTRUCTION. The indicator housing is a heavy aluminum casting (fig. 103) which is supported by two adjustable brackets and a tilt regulator that are mounted on a cast aluminum base. The bracket arms can be adjusted by means of a setscrew above the base support bolt. The motor is mounted to the rear of the housing, and hinged thumbscrews are used to clamp the goniometer to the motor. The control box is a plug-in arrangement; it fits under the optical housing. Connectors J501 and J502 are at the rear of the control box, and connector J503 is on the main housing. The optical housing is mounted on a hinge and may be swung to one side, so that the cathode-ray tube can be removed from the indicator. The lamp assembly is mounted over the optical housing, and a connecting cord fits receptacle J504 on the right-hand bracket.

c. ROTATING ASSEMBLY. The two sets of deflection coils are mounted on a four-pole, laminated yoke (fig. 152). The yoke is mounted in a tubular aluminum shell within a steel shell and shaft assembly. The assembly is rotated around a hollow bakelite housing which is attached to the tube support housing. The support housing is bolted to the flange in front of the rotating assembly. The flexible coupling, axle and worm coupling, front and rear bearing housing, oil holes, brushes, slip rings, and graduated ring are shown in figure 153. The deflection coil yoke is under the flared portion of the assembly, between the front bearing housing and point A. Point A is the threaded seat for the cover thumbscrew. Connections from the control box circuits are made through the brushes and slip rings.

d. COUPLING ALINEMENT.

(1) *Goniometer.* The ganiometer is direct-coupled to the motor shaft by a pin and slot arrangement (figs. 7 and 16).

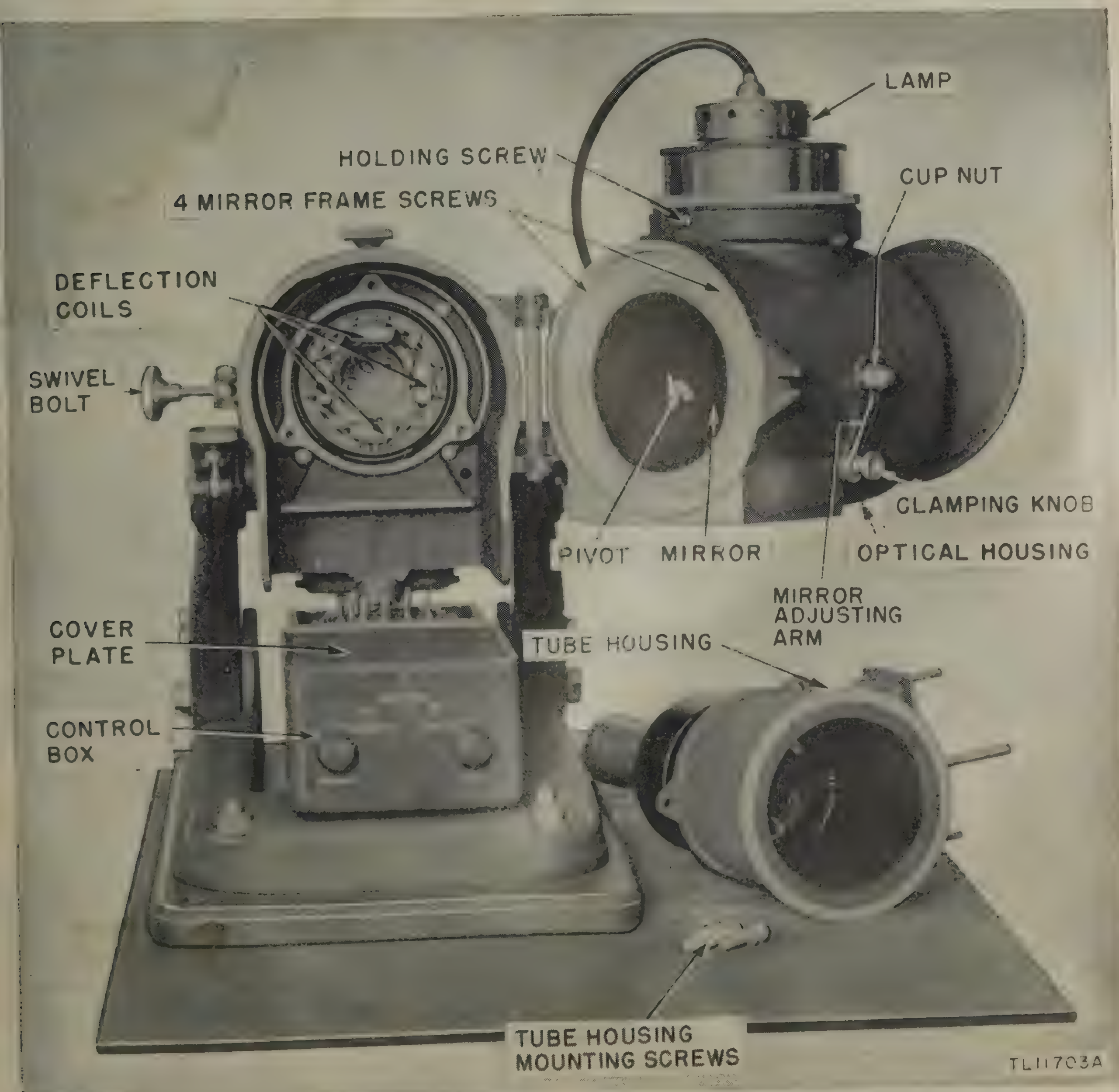


Figure 152. Bearing Indicator BC–1159–A, partially dismantled.

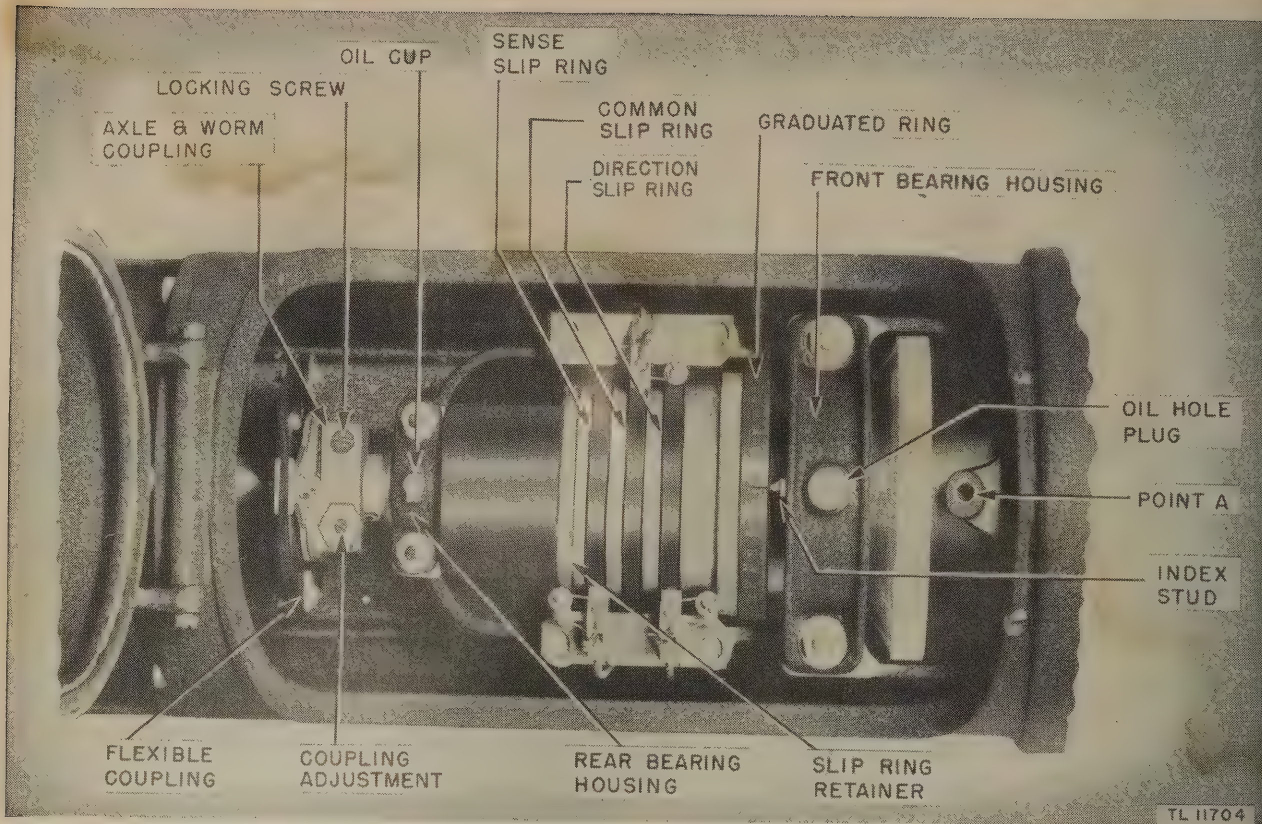


Figure 153. Top view of indicator showing rotating assembly.

(2) *Rotating assembly.* A flexible leather coupling is used to couple the motor shaft to the rotating assembly. A screwdriver adjustment on the axle and worm assembly (fig. 53) together with the graduated ring and index stud, enables proper positioning of the deflection coils with respect to the goniometer rotor.

e. OPTICAL SYSTEM (fig. 154). The optical system reflects the image of the azimuth scale, so that it appears to be in the plane of the cathode-ray tube screen. Light from lamp I501 passes through a diffusing screen and through the azimuth scale directly beneath the diffusing screen. A transparent cellulose acetate mirror (a glass mirror in later models) is mounted below the azimuth scale so that it is equally distant from the azimuth scale and from the scope screen. Light through the azimuth scale is reflected *from* the mirror to the observer; light from the scope screen goes through the mirror to the observer. The azimuth scale then appears to be at the cathode-ray tube screen. Parallax between the azimuth scale image and the scope screen patterns is eliminated (par. 66) by adjusting the lifting ring in the lamp assembly. This adjusts the scale-to-mirror distance, so that the scale image coincides with the screen pattern. The alinement ring is used to rotate the azimuth scale, so that the 0° (north) marking is at the top of the image. The curved mirror reduces glare by reflecting unwanted light out of the line of vision.

165. Bearing Indicator Circuits (fig. 155)

a. GENERAL. Operating voltages from Control Panel PN–31–A to the cathode-ray tube circuits are connected through Cord CD–842 to receptacle J501. The deflection amplifier output is connected through Cord CD–841 to J502. Power for the indicator motor B501, heater R509, and lamp I501 is connected through Cord CD–840 to receptacle J503.

b. CONTROL BOX CIRCUITS. The cathode-ray tube and control box circuits (fig. 156) include

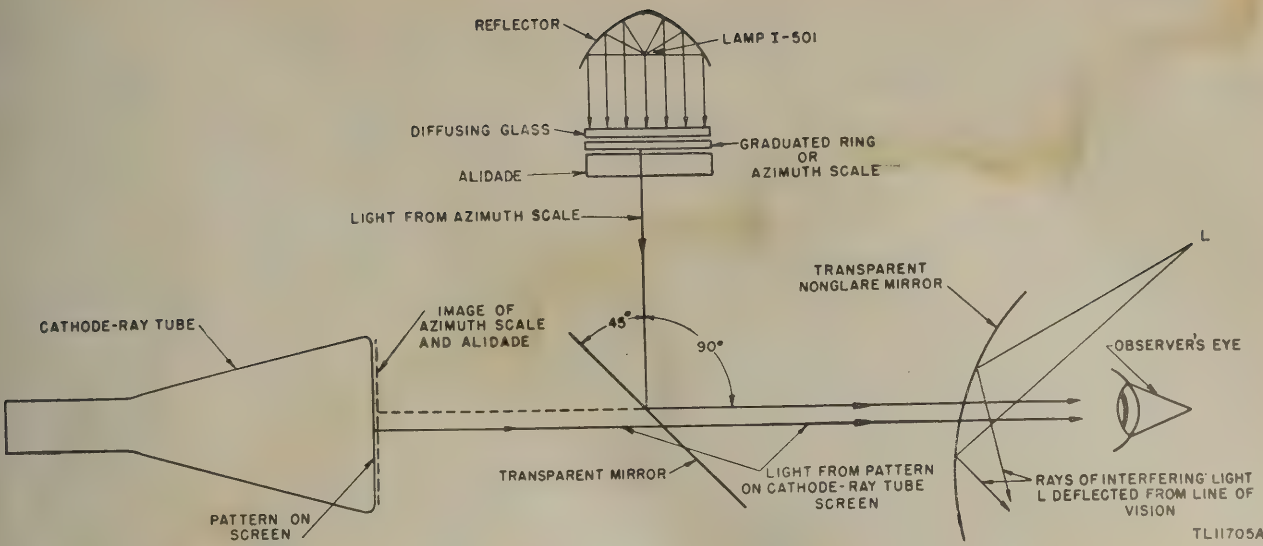


Figure 154. Indicator optical system, functional diagram.

the INTENSITY, FOCUS, and POSITIONING controls. Resistors R504 (INTENSITY), R508, R503 (FOCUS), R507, R510, R506, and R505 form a voltage divider across the output of the high-voltage power supply in Control Panel PN–31–A. Capacitor C501, 1.0 mf, is a filter across the divider network. The cathode of the scope tube is connected to the junction of R504 (25,000 ohms) and R508 (100,000 ohms). When the movable contact of the INTENSITY control is at the junction of R504 and R508, grid No. 1 will be at the same potential as the cathode, and the spot is at its maximum intensity. As the control is changed from this position, the grid is made increasingly negative, so that the intensity of the spot is reduced. The focusing anode No. 1 is connected to the movable contact on the FOCUS control. With the contact at the junction of R508 and R503 (250,000 ohms) anode No. 1 is at its lowest potential; but as the movable arm is moved toward R507, the anode becomes increasingly positive. This changing potential changes the electric field between anode No. 1 and anode No. 2, so that the electrons can be focused to a spot on the scope screen. The remainder of the voltage divider is made up of 200,000-ohm resistor R510, 50,000-ohm resistor R506, 50,000-ohm resistor R505, and 300,000-ohm resistor R507, Anode No. 2 and deflection plates D3 and D1 are connected to the junction of resistors R506 and R505. The HORIZONTAL and VERTICAL POSITIONING controls R502 (2 megohms) and R501 (2 megohms), respectively, are connected from the junction of R510 and R506 to ground. The movable contact of R501 (VERTICAL) is connected to deflection plate D4. Thus, with the contact arm at the junction of R510 and R506, deflection plate D4 is *negative* with respect to D3 and the spot is deflected upward on the scope screen. With the contact at the center of R501, plates D3 and D4 are at the same potential and the spot is at the center of the screen. With the contact at ground, deflection plate D4 is positive with respect to D3 and the spot is moved downward on the screen. Similarly, as the HORIZONTAL control is moved, the spot is positioned horizontally on the scope screen.

c. DEFLECTION COIL CIRCUIT. The interconnections between the deflection coils and the deflection amplifier are shown in figure 149. The effect of the deflection coils is explained in paragraph 145. The coil and slip ring arrangement is shown diagrammatically in figure 157.

d. MOTOR. When the MOTOR switch on Control Panel PN–31–A is thrown to ON, the centrifugal switch (fig. 155) is closed and power is applied through starting capacitors C502 and C503 (115 mf each), through the start coil, and through the run coil. As the motor comes up to its normal running speed, the centrifugal switch opens automatically and the motor continues to

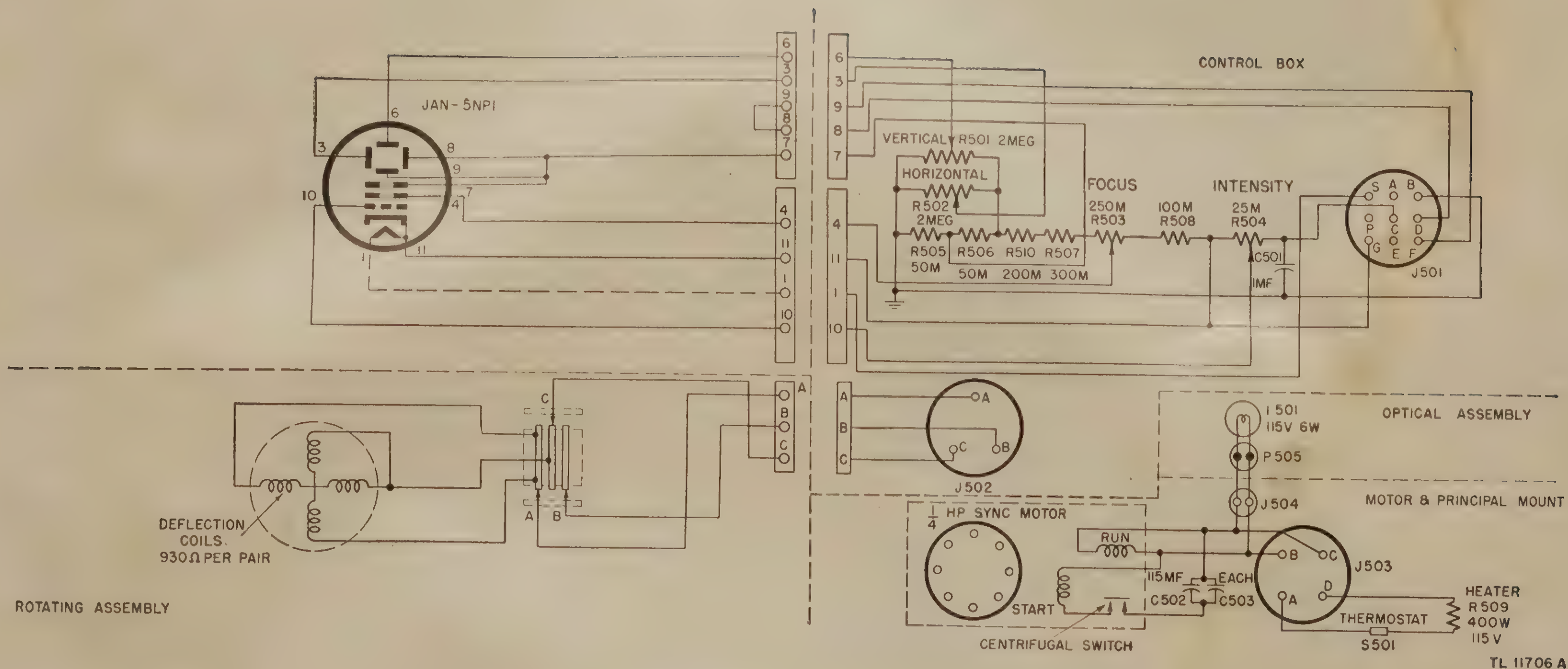


Figure 155. Bearing Indicator BC-1159-A, circuit diagram.

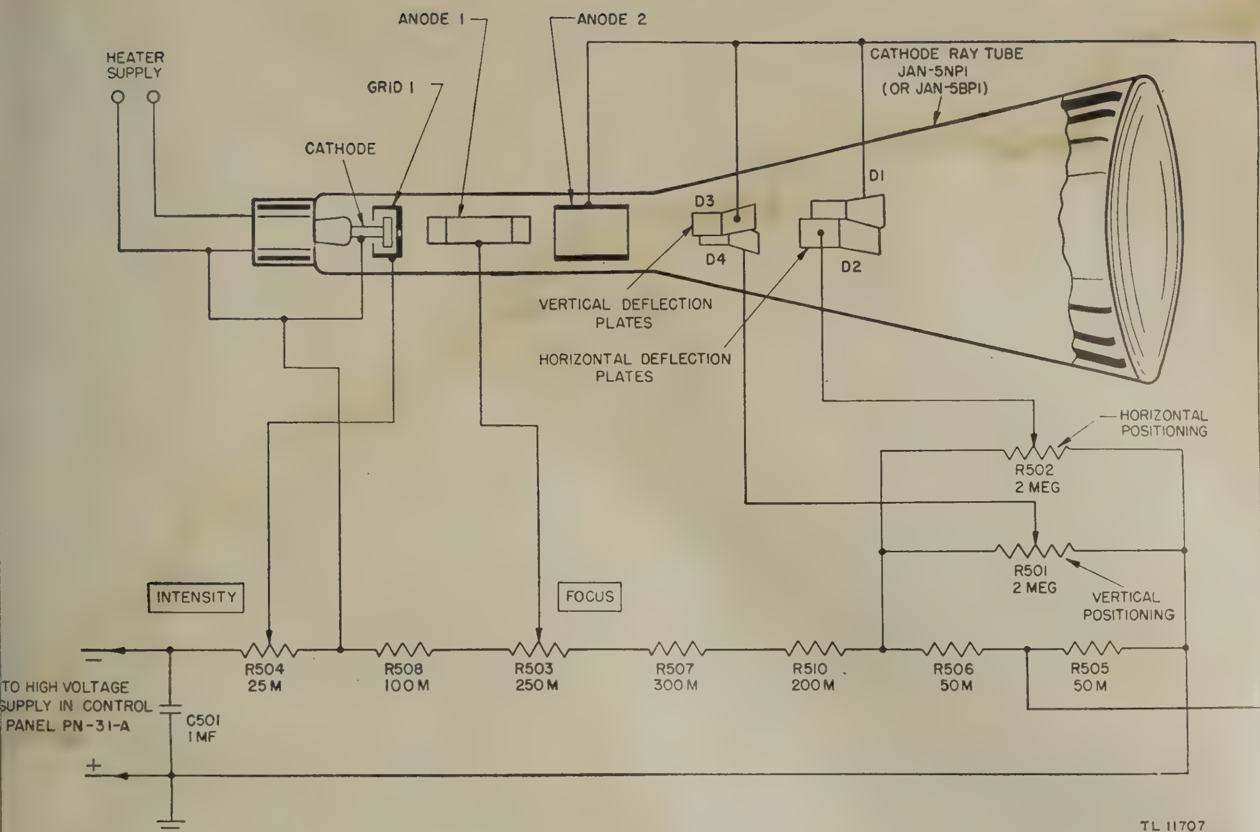


Figure 156. Indicator cathode-ray tube control circuit, functional diagram.

run with power applied only through the run coil.

e. HEATER. When the control panel HEATER switch is at ON, power is applied through thermostat S501 to the 400-watt heater unit, R509. The heater keeps the motor bearings warm to permit easy starting in cold climates. In warm climates the thermostatic switch remains open, and no power is applied to the heater.

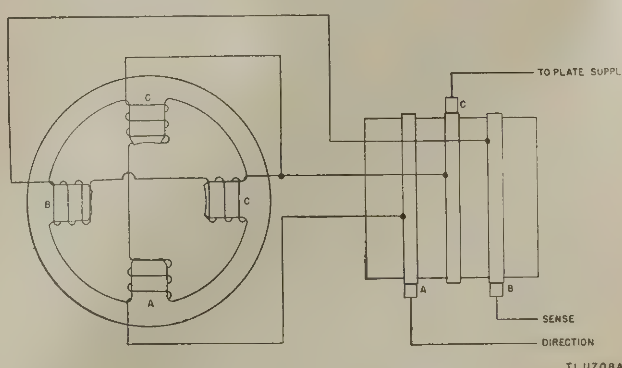


Figure 157. Detail of indicator deflection coil circuit.

Section II. TROUBLE SHOOTING

166. 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 highly important duty of trouble shooting.

a. TROUBLE-SHOOTING DATA. Take advantage of the material supplied in the manual. It will help in the rapid location of faults. Consult the following trouble-shooting data:

(1) Block diagrams (figs. 130 and 146).

(2) Complete schematic diagrams (figs. 143, 144, 145, 150, and 155).

(3) Simplified and partial schematic dia-

grams. These diagrams are particularly useful in trouble shooting, because the repairman can follow the electrical functioning of the circuits more quickly than with 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; to avoid confusion, color coding is also used and certain pins are identified by letters.

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, arcing, and shorted transformers can often be located by sight, smell, and hearing. Most faults, however, must be located by checking voltages and resistances.

(1) *Sectionalization*. Careful observation of the performance of the radio set, while turning the equipment on, often sectionalizes the fault to the control panel, receiver, bearing indicator, or antenna. Careful observation of the meter often determines the stage or circuit at fault. Additional sectionalizing of the fault will be discussed in paragraph 167.

(2) *Localization*. Paragraph 167 describes the method of localizing faults within the individual components. These paragraphs are accompanied by trouble-shooting charts which list abnormal symptoms and their probable causes. These charts also give 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 each socket pin connection.

c. VOLTAGE MEASUREMENTS. Voltage measurements are an almost indispensable aid. Most troubles *result* from abnormal voltages or *produce* abnormal voltages. Voltage measurements are taken easily, because they are always made between two points in a circuit. The circuit need not be interrupted.

(1) Unless otherwise specified, 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 set the voltmeter to a lower range to obtain a reading which is closer to full scale.

(3) When checking cathode voltage, remember that a reading may be obtained even though the cathode resistor is actually open. The resistance of the meter may act as a cathode resistor. Thus, the cathode voltage may seem approximately normal while the voltmeter is connected between cathode and ground. If there is any doubt about the cathode resistor, make a resistance check with power off.

d. 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 reduce the danger of making accidental contact with the circuit.

(3) If the voltage is known to be 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 approximate voltage is unknown or known to exceed 300 volts, shut off the power. Connect the hot lead, step away from the voltmeter, turn on the power, and then note the reading on the voltmeter. Do not touch any part of the voltmeter, paricularly when measuring the voltage between two points which are not at ground potential. Before attempting to disconnect the voltmeter, shut off the power and allow enough time for circuit capacitors to discharge.

e. VOLTMETER LOADING. If a low-resistance voltmeter is used in a high-resistance circuit, it will draw excessive power and give erroneous readings. If the voltmeter resistance is nearly equal to the circuit resistance, the voltmeter will indicate a voltage *lower* than the voltage actually present when the voltmeter is not in the circuit. For reasonably accurate readings the meter resistance should be 10 times as high as the circuit resistance.

(1) The resistance of a voltmeter on any range can be calculated by this simple rule — Resistance of the voltmeter (Rm) equals its ohms-per-volt rating multiplied by the full-scale reading in volts. For example, the resistance of a 1,000-ohm-per-voltmeter on the 300-volt range is 300,000 ohms: ($Rm = 1{,}000 \times 300 = 300{,}000$ 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 decreased loading effect will more than compensate for the inherent inaccuracy of the meter at the low end of the scale.

(3) Observing 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 the different ranges do not agree.

(*c*) *Negligible loading* is indicated when the voltage readings (not the deflection) for different ranges do agree.

(4) The voltage readings given in the charts in this manual were made with a vacuum-tube voltmeter. It is necessary to consider the loading effect when any other type of voltmeter is used.

167. Trouble-shooting Procedures

a. SYSTEM SECTIONALIZATION. System sectionalization means tracing a fault to the unit in which it is present. The equipment performance checklist (par. 86) gives the normal operation to be expected as each of the starting, operating, and stopping steps is carried out. Consequently, the equipment performance checklist may be used as a first step in system sectionalization.

b. UNIT SECTIONALIZATION. Unit sectionalization means tracing the fault to a circuit in the unit to which the fault has been isolated by system sectionalization. For example, if system sectionalization shows the fault to be in the receiver, unit sectionalization would trace the fault to the r-f, i-f, audio, or indicator circuit. Thus, if normal operation is obtained with the band switch in every position except band 1, it is unlikely that the fault is in the i-f, audio, or indicator circuits; the fault is most likely in the band switch or in the r-f and oscillator circuits activated when the band switch is in the band 1 poistion. The bearing indicator pattern is an excellent guide to the probable location of a fault. Suppose that the pattern remains fixed at 0° and 180°, or at 90° and 270°, regardless of the direction from which the received signal is arriving. The trouble is probably in the antenna system: a broken antenna wire, defective cables or phase inverters, or improper operation of the control panel antenna switches.

c. LOCALIZATION. Localization is tracing the fault to the defective part that is causing abnormal operation of the radio set. In general, localization procedures consist of taking voltage and resistance measurements in the circuits believed to be abnormal. Voltage and resistance measurements for the radio receiver are given in figure 158; voltage readings for the control panel, the phase inverters, and the bearing indicator control box are given in figures 159 through 162; tube locations are shown in figures 166, 167, 172, and 173; and parts are located and identified in figures 168 through 174.

d. TROUBLE-SHOOTING CHART. The trouble-shooting chart (par. 168) lists a number of possible trouble symptoms and their probable causes. The equipment performance checklist (par. 86) and section II, chapter 2, contain valuable trouble-shooting information. Use them with the trouble-shooting chart.

e. RESISTANCE MEASUREMENTS CHART. The following chart gives resistance measurements for the control panel, phase inverters, and bearing indicator control box.

(1) Control Panel PN-31-A—

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
V201	1	Chassis		0
	2	Chassis		0
	3	Chassis	Vary CIRCLE DIAMETER control	22-522
	4	Chassis		250,000
	4	J201 pin C		25,000
	5	Chassis	Vary CIRCLE DIAMETER control	22-522
	6	V203 pin 8		10,480
	7	Chassis		0.2
	8	J203 pin B	STAND-BY-D.F.-SENSE switch on SENSE	0
	8	J203 pin A	STAND-BY-D.F.-SENSE switch on SENSE	0
V202	1		No connection	
	2	Chassis		0.2
	3	V203 pin 8		980
	4	V203 pin 8		980
	5	V203 pin 4		60
	5	V203 pin 6		60
	5	Chassis		200
	7	Chassis		0
	8	Chassis		0
V203	2	V203 pin 8		0.1
	4	Chassis		255
	6	Chassis		255
	8	J203 pin C		480
V204	2	Chassis		100
	5	J203 pin C		10,000
V206	1	Chassis		0.2
	4	Chassis		0
	4	V206 pin 1		2
J203	C	Chassis		10,000
	C	J206 pin J	0° switch ON, STAND-BY-D.F.-SENSE switch at D.F., vary 0° BALANCE ADJUSTMENT.	0-10,000
	C	J209 pin E	0° switch ON, STAND-BY-D.F.-SENSE switch at D.F., vary 0° BALANCE ADJUSTMENT.	0-10,000
	C	J206 pin K	180° switch ON, STAND-BY-D.F.-SENSE switch at D.F., vary 180° BALANCE ADJUSTMENT.	0-10,000
	C	J210 pin E	180° switch ON, STAND-BY-D.F.-SENSE switch at D.F., vary 180° BALANCE ADJUSTMENT.	0-10,000
	C	J206 pin A	90° switch ON, STAND-BY-D.F.-SENSE switch at D.F., vary 90° BALANCE ADJUSTMENT.	0-10,000
	C	J212 pin E	90° switch ON, STAND-BY-D.F.-SENSE switch at D.F., vary 90° BALANCE ADJUSTMENT.	0-10,000
	C	J206 pin B	270° switch ON, STAND-BY-D.F.-SENSE switch at D.F., vary 270° BALANCE ADJUSTMENT.	0-10,000
	C	J213 pin E	270° switch ON, STAND-BY-D.F.-SENSE switch at D.F., vary 270° BALANCE ADJUSTMENT.	0-10,000

From tube or receptacle	Pin No.	To	Conditions	Resistance (ohms)
J207	B	Chassis		0
	F	J208 pin R		0 (approx)
	F	J205 pin C		500,000
	F	J205 pin D		500,000
	C	Chassis		4,400,000
	C	V206 cap		540,000
	F	J207 pin D	Safety switch S207 closed	500,000
	G	J207 pin S		0.5

(2) Phase Inverters MC–411–A and MC–413–A—

V–301*	1	Chassis		Open
	2	Chassis		Open
	3	Chassis		Open
	4	Chassis		0
	5	Chassis		0
	6	Chassis		25,000
	7	Chassis		150
	8	Chassis		Open

* Same readings apply to V302 and V401 through V404.

(3) Bearing Indicator BC–1159–A Control Box—

From one side of	To other side of	Conditions	Resistance (ohms)
R505	R505		50,000
R506	R506		50,000
R507	R507		300,000
R508	R508		100,000
R510	R510		200,000
C501 (high side)	Chassis		1,000,000
From one side of	**To arm of**	**Conditions**	**Resistance (ohms)**
R501	R501	Vary VERTICAL POSITIONING	0–100,000
R502	R502	Vary HORIZONTAL POSITIONING	0–100,000
R503	R503	Vary FOCUS control	0–250,000
R504	R504	Vary INTENSITY control	0–25,000

168. Trouble-Shooting Chart

Note. For trouble-shooting purposes, take bearings on known stations with known azimuths.

Symptoms	Probable trouble	Corrections
1. Power unit fails to start	1. Refer to power unit technical manual.	1. Refer to power unit technical manual.
2. Indicator motor fails to start	2. HEATER switch at ON; defective starting capacitors C502 and C503; defective centrifugal switch.	2. HEATER switch must be at OFF. Check starting capacitors and switch.
3. All pilot lamps fail to light	3. Circuit breaker of Junction Box JB–95–A not in ON position; defective cable or connections from power unit.	3. Check circuit breaker; check cable and connections from power unit.
4. Indicator motor runs slowly and will not come up to normal speed.	4. Cold motor bearings; low line voltage.	4. If weather is cold, put HEATER switch at ON for ½ hour; check line voltage.
5. Circular trace on scope; but no indicator patterns. Loudspeaker output normal.	5. Fault in indicator channel	5. Check indicator channel circuits of receiver and Control. Panel PN–31–A. Replace defective tubes or parts.
6. Indicator patterns with STAND-BY–D.F.–SENSE switch at SENSE; no pattern (including circular trace) with switch at D.F.	6. Open D/F coils in bearing indicator; defective STAND-BY–D.F.–SENSE switch; dirty brushes and slip rings in bearing indicator.	6. Check D/F coil continuity; check rings and brushes; check switch.
7. All Sense patterns reversed	7. *a.* Improper alinement of deflection coil assembly and goniometer.	7. *a.* Loosen locking screw on rotating assembly and turn the coupling adjustment to rotate the assembly so that the graduated ring turns 180°.
	b. Reversed cable connections at sense Junction Box JB–91–A.	*b.* Reverse cable connections.
8. Sense indications reversed in one pair of quadrants.	8. Junction Box JB–91–A for one directional pair of monopoles not connected to correct r-f cord. R-f cords not properly connected.	8. Check color coding and connections.
9. Sense voltage present when STAND-BY–D.F.–SENSE switch is at SENSE, but no sense output or incorrect pattern (FILAMENT switch at either 1 or 2).	9. Defective Phase Inverter MC–413–A.	9. Check phase inverter tubes, connections, and cables. Check sense antenna for broken wire.
10. Sense pattern interrupted on cathode-ray tube, or pattern is a series of radial lines.	10. Vibration of relay contacts is causing intermittent connection of sense circuit to goniometer.	10. Adjust spring tension of sense relay; clean and burnish contacts.
11. Distorted indicator pattern which indicates wrong direction.	11. Burned-out or low emission tube in one phase inverter; broken or grounded antenna wire in monopole; shorted spark gap; improper operation of phase inverter relay.	11. Check tubes by throwing FILAMENT switch; check antenna wire; test spark gap for short; check for excessive spring tension in relay.
12. Indicator pattern normal with STAND-BY–D.F.–SENSE switch at SENSE but no pattern at D.F., or vice versa.	12. Open D/F or sense deflection coils; no connection through brushes and slip rings.	12. Check deflection coils for continuity; examine brushes and slip rings.
13. Saw-tooth pattern or intermittent circular trace.	13. *a.* Poor voltage regulation.	13. *a.* Change voltage regulator tubes in power supply.
	b. Loose brushes; dirty and pitted slip rings; worn brushes.	*b.* Check slip rings and brushes. Replace brushes, clean slip rings.
14. No current indication on PLATE MA. meter, regardless of position of antenna switches.	14. Burned-out meter fuse. Power cords not properly connected. Switches defective; resistors open.	14. Check fuse, replace. Check connections. Check switches and balancing resistors.
15. Plate current low for individual phase inverter.	15. Poor tube; poor connections	15. Check phase inverter tubes. Check cable connections.

Symptoms	Probable trouble	Corrections
16. Weak signals	16. Low line voltage; poor rectifier tubes in receiver and control panel.	16. Check line voltage; refer to power unit technical manual for information on increasing line voltage. Check rectifier tubes.
17. Intermittent signals; excessive noise	17. Loose connections in antenna system; faulty tubes; bearing indicator slip rings and brushes loose and dirty.	17. Check antenna system and cables for loose connections. Check tubes; replace brushes; polish slip rings if necessary.
18. No pattern on scope	18. Improper adjustment of or defective FOCUS and INTENSITY controls.	18. Check adjustment of controls; check high-voltage rectifier and associated circuits.
19. Distorted, irregular, and wavy patterns.	19. Cellulose acetate mirror loosened by accumulation of moisture.	19. Open optical housing and allow mirror to dry.

Section III. REPAIRS

169. Bearing Indicator BC–1159–A

Brief instructions for replacing certain parts of this equipment are given in paragraphs 170 through 180. The bearing indicator is a precision instrument. Part replacements should be made carefully, so that the alinement will not be disturbed. For additional details on repair procedure, refer to TM 11–4063, Bearing Indicator BC–1159–A, Repair Instructions.

170. Installation of Alidade

a. GENERAL. An alidade was not installed as original equipment in certain models of Radio Set SCR–291–A. A kit of alidade components (fig. 175) was furnished for installation in the field. The lamp housing (1) is a cast aluminum cylinder into which the lamp assembly is inserted. The assembly contains a polished metal reflector and a diffusing glass. A graduated scale is mounted across the lower opening. The new azimuth scale has a transparent field; the original azimuth scale had an opaque center. The lamp reflector lifting ring (2) is a metal cylinder that fits over the lamp housing. A small setscrew through the upper edge of the ring fits into a groove around the top edge of the lamp housing. This permits rotation of the lamp housing for scale alinement but prevents vertical motion. The alidade is within a gear assembly which is also fitted inside the lamp housing assembly. The lower edge of the lifting ring is threaded. The adjusting ring (4) threads onto the lamp housing and is used to raise and lower the housing, so that corrections for parallax can be made (par. 66). The alidade drive assembly (5) consists of a cover plate, which is bolted to the indicator optical housing, and a drive mechanism. Velumoid gaskets (6) are used between the cover plate and the indicator housing. Lockwashers and bolts (7 and 8) are included with the kit.

b. REMOVAL OF ORIGINAL ASSEMBLY.

(1) Remove the lamp assembly by grasping the shield and lifting.

(2) Remove the lifting ring holding screws at the front and rear.

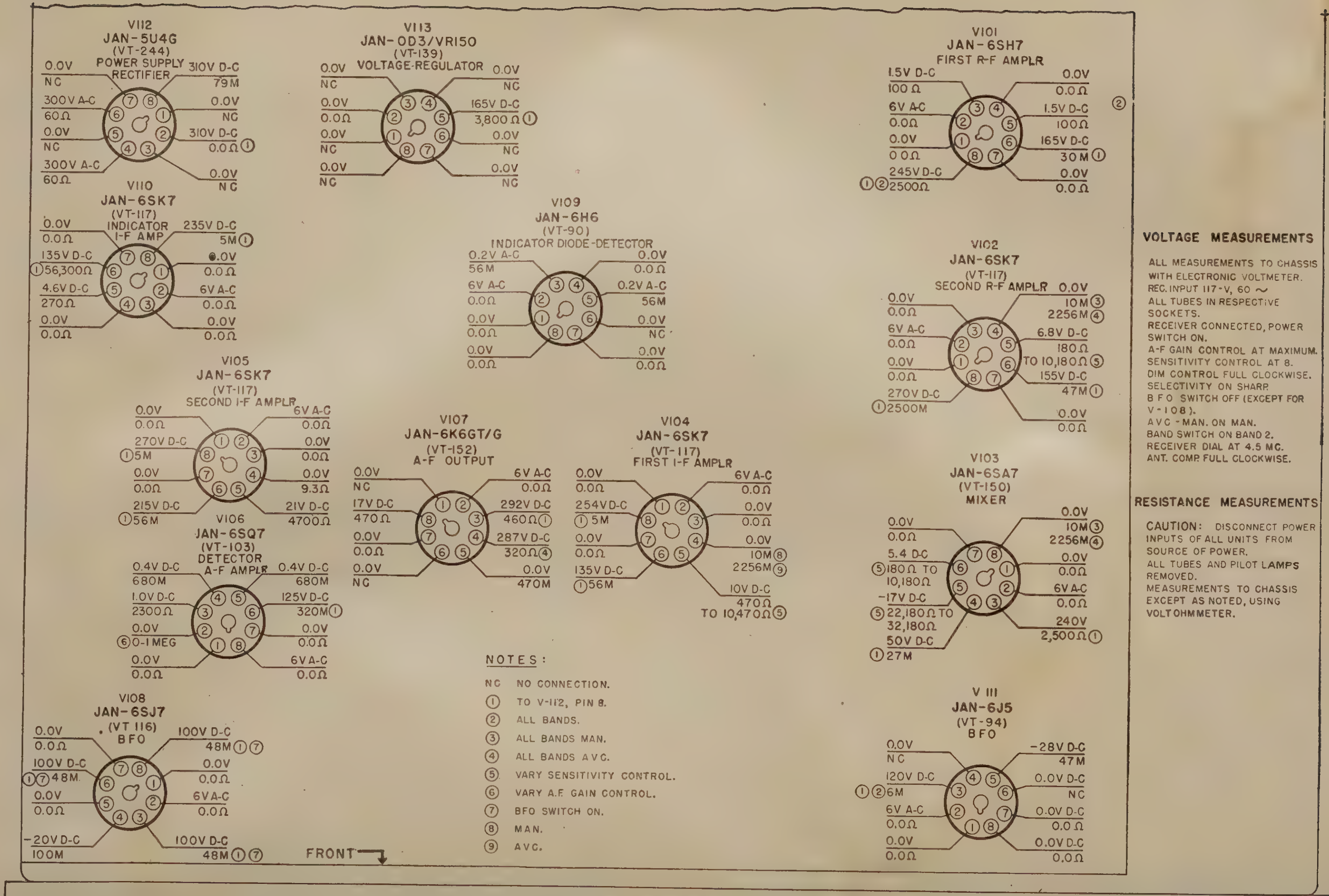
(3) Remove the guide screw at the left side of the optical housing.

(4) Grasp the unit by the knurled adjusting ring and lift the unit. The entire scale assembly will slide out.

(5) Remove the six screws holding the original cover plate to the right side of the optical housing.

c. INSTALLATION.

(1) Insert the alidade assembly into the optical housing. Do this carefully, without forcing the unit. Make certain that the assembly is not tilted. After the knurled adjusting ring has reached the top of the optical housing, grasp the lifting ring. Rotate the assembly to bring the vertical slot at the lower edge of the lifting ring in line with the stud hole on the left side of the optical housing. Make certain that the stud enters the slot; otherwise it will



TL 11709-S

Figure 158. Radio Receiver BC–1147–A, voltage and resistance measurements.

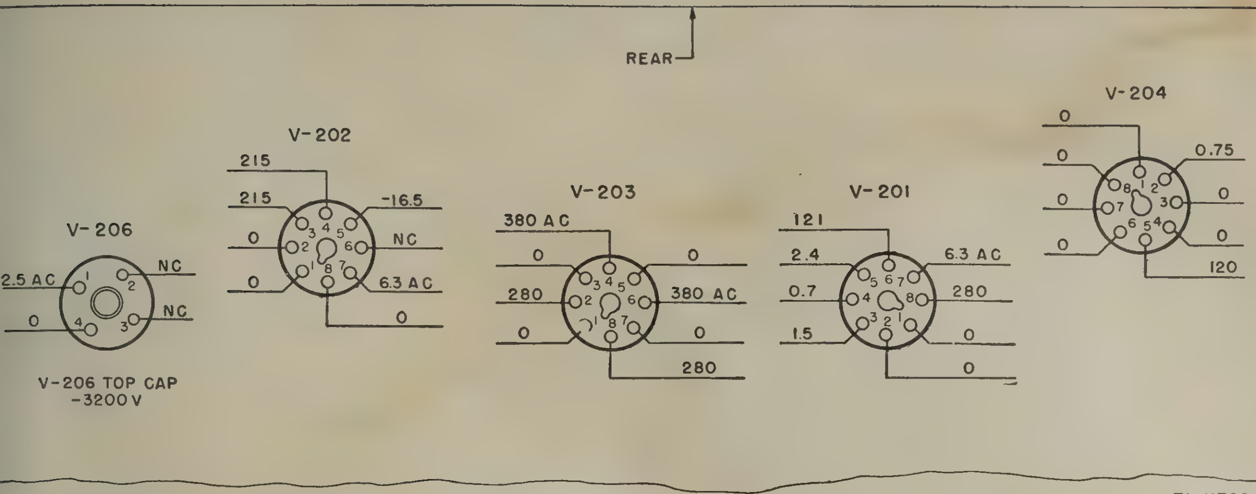


Figure 159. Control Panel PN-31-A, voltage measurements, bottom view.

jam the lifting ring. The stud prevents rotation of the azimuth scale when the knurled adjusting ring is turned. Secure the adjusting ring by replacing the screws at the front and rear of the optical housing. The gear teeth should be visible through the opening in the right side of the optical housing (fig. 176). The ring should rotate freely when pushed with the finger.

(2) Install the alidade drive assembly with three gaskets. Fasten the cover plate securely with the six screws. If backlash is observed in the alidade control action, remove one gasket. Repeat the test for backlash. Remove a second gasket to eliminate backlash, if necessary. Be careful, however, not to reduce the gasket spacing enough to jam the alidade control action.

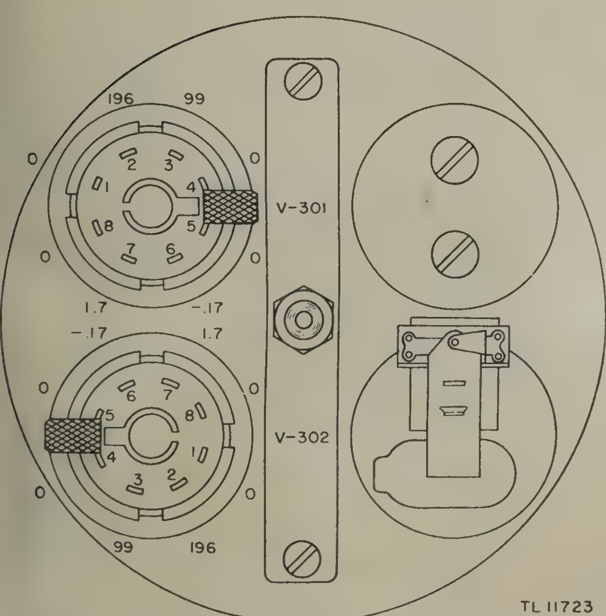


Figure 160. Phase Inverter MC-411-A, voltage measurements.

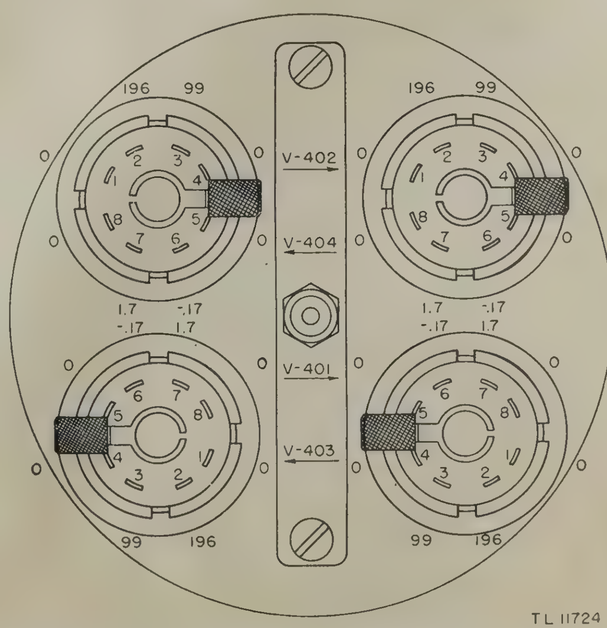


Figure 161. Phase Inverter MC-413-A, voltage measurements.

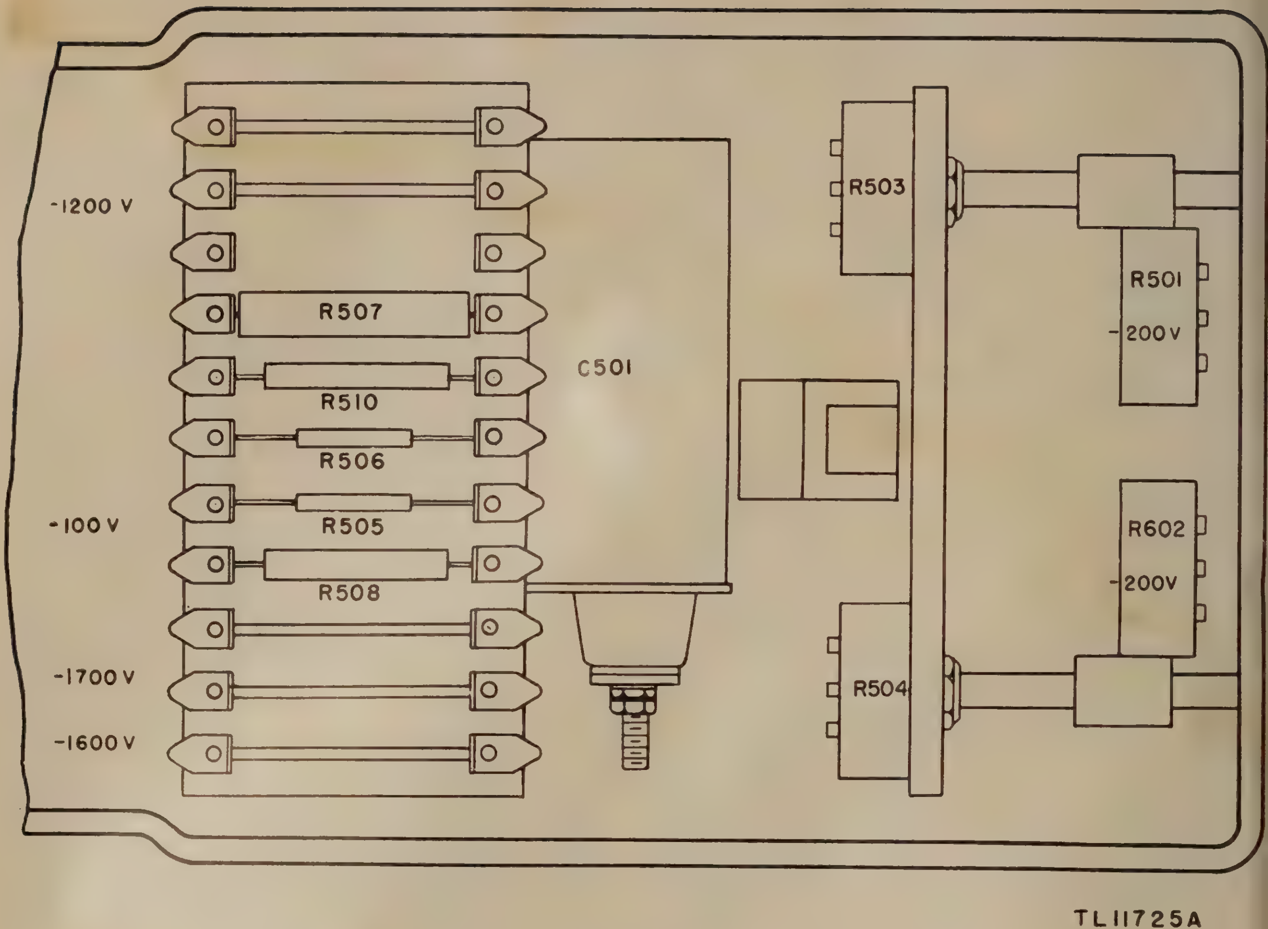


Figure 162. Bearing Indicator BC-1159-A, voltage measurements.

171. Azimuth Scale Replacement

a. DISASSEMBLY.

(1) Remove the lamp assembly.

(2) Take out the lifting ring setscrews and remove the lamp housing.

(3) Hold the lamp housing with the scale side up. Remove the retaining ring screws and the retaining ring. (The azimuth scale and diffusing glass will fall out if the lamp housing is not held properly.)

(4) Before removing the azimuth scale, note that the scale numbers read backward. The scale will have to be reinserted this way.

(5) Lift out the azimuth scale, spacer, diffusing glass, and reflector.

(6) Carefully clean the housing. Use a clean, soft, dry piece of cheesecloth or a camel's-hair brush.

b. REASSEMBLY.

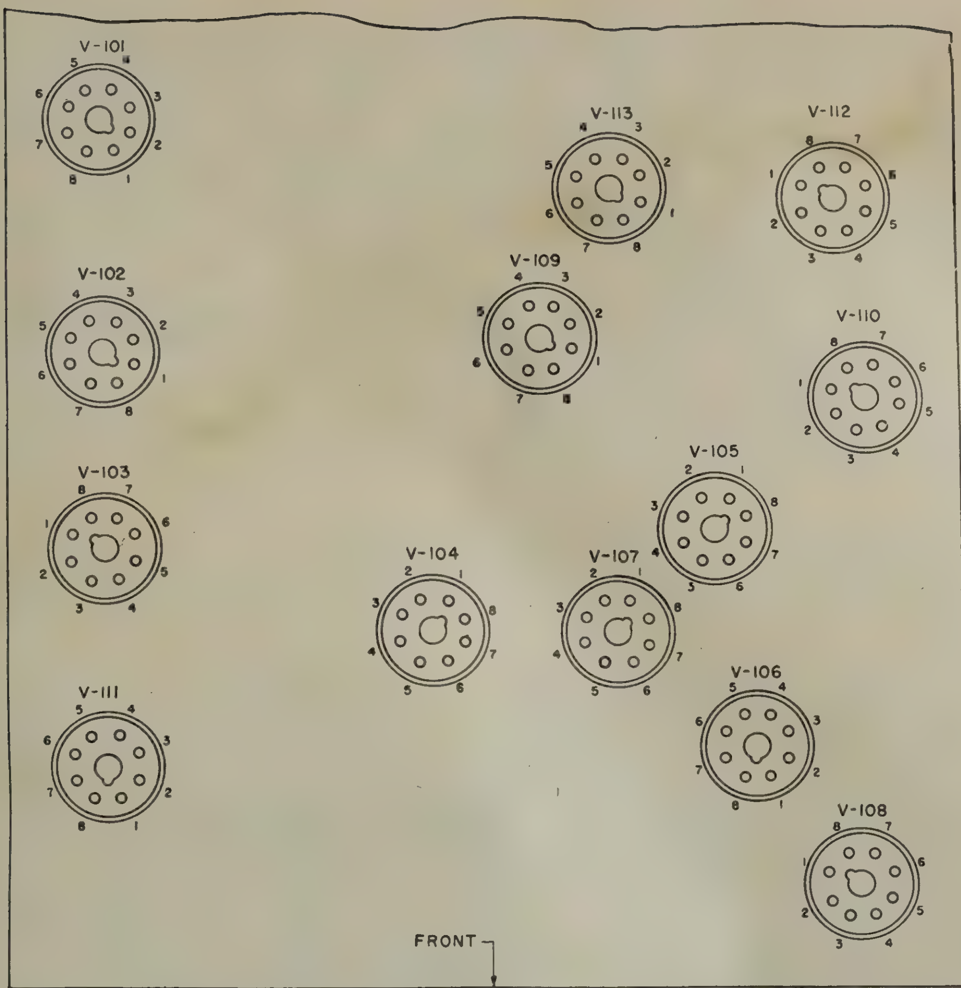
(1) Replace the defective azimuth scale with a new one (Chest CH-167-A). Before replacing the retaining ring and screws, be sure that the scale numbers read backward and that the scale is centered exactly.

(2) Replace the parts in their proper order. Replace only *two* of the azimuth scale retaining screws.

(3) Replace the assembly, including the lamp, in the lifting ring, but do not tighten the setscrews.

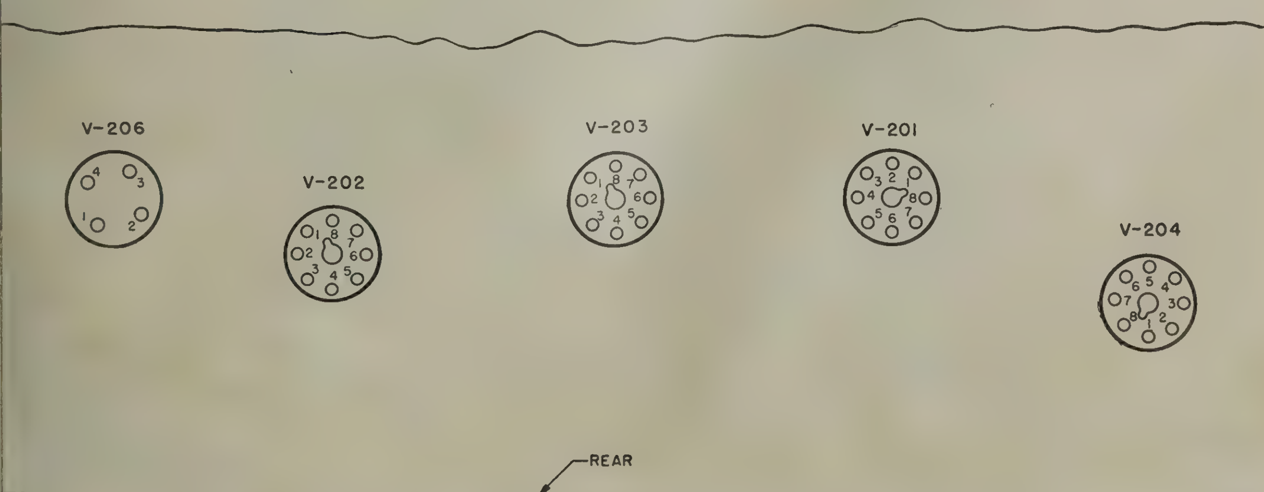
Caution: Excessive tightening of the retaining ring screws will break the glass azimuth scale. The lockwasher under the screwhead serves as a guide; tighten just enough to flatten the washer.

(4) Use the test cord (Chest CH-163-A) to light up the azimuth scale. Observe



TL 11727

Figure 163. Radio Receiver BC-1147-A, socket pin locations, top view.



TL 11728

Figure 164. Control Panel PN-31-A, socket pin locations, top view.

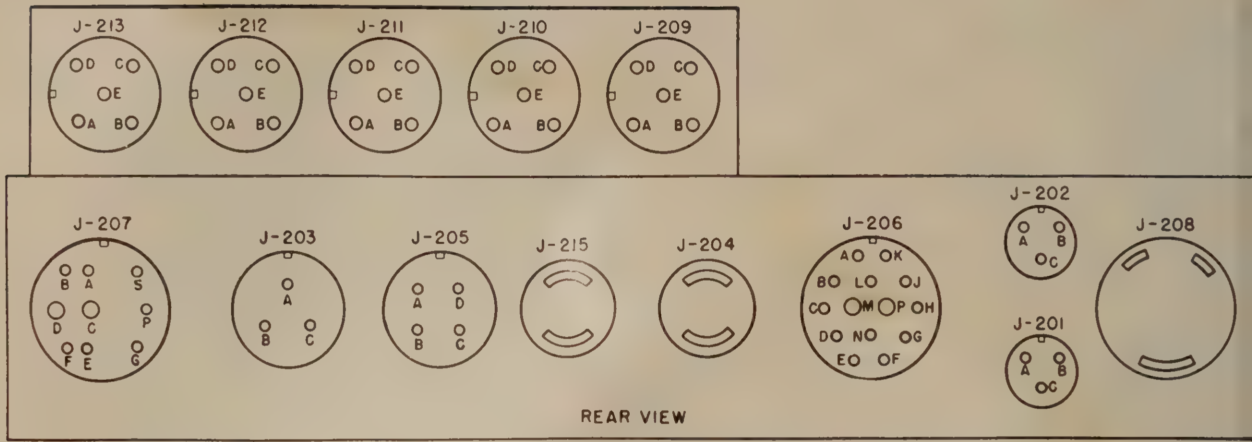


Figure 165. Control Panel PN-31-A, receptacle pin locations, rear view. TL 11729A

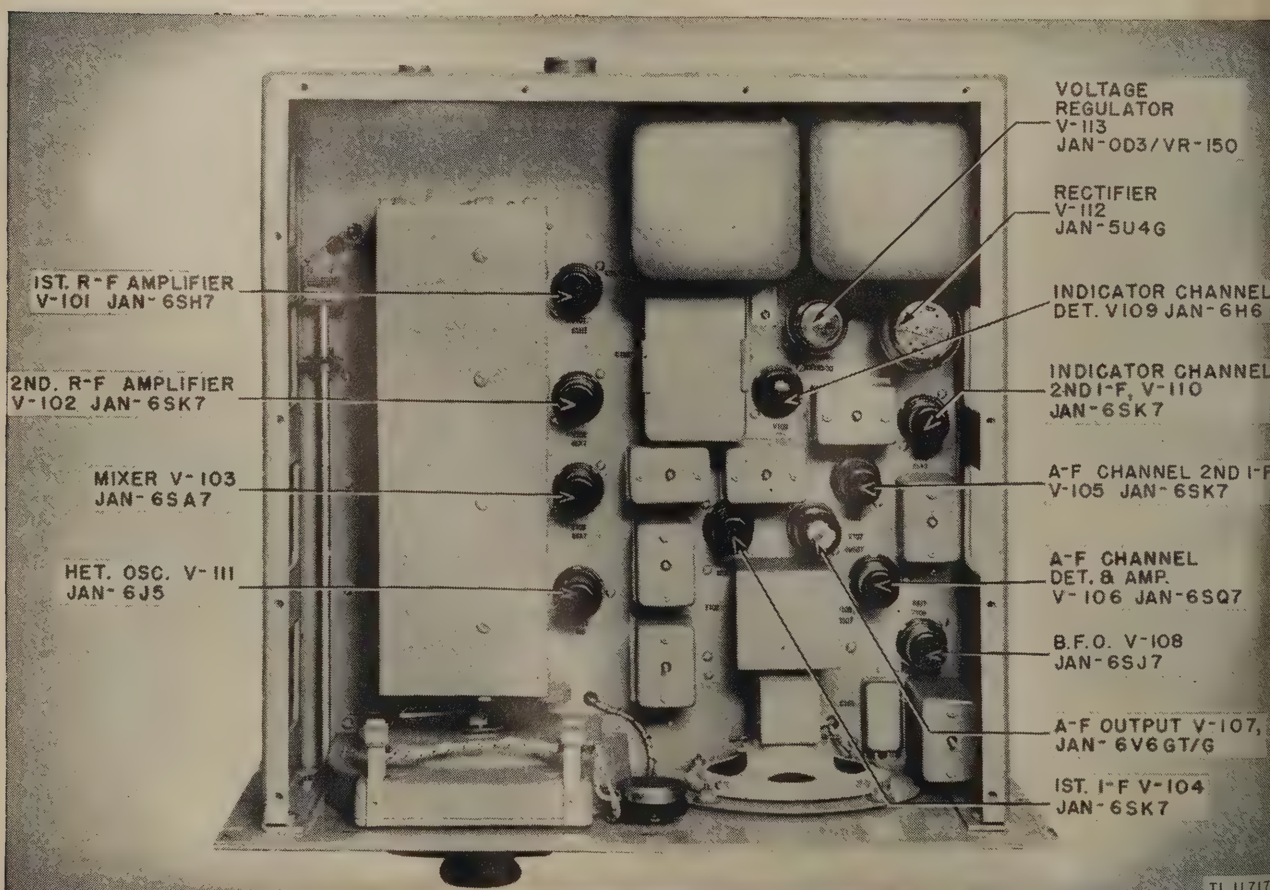


Figure 166. Radio Receiver BC-1147-A, tube locations.

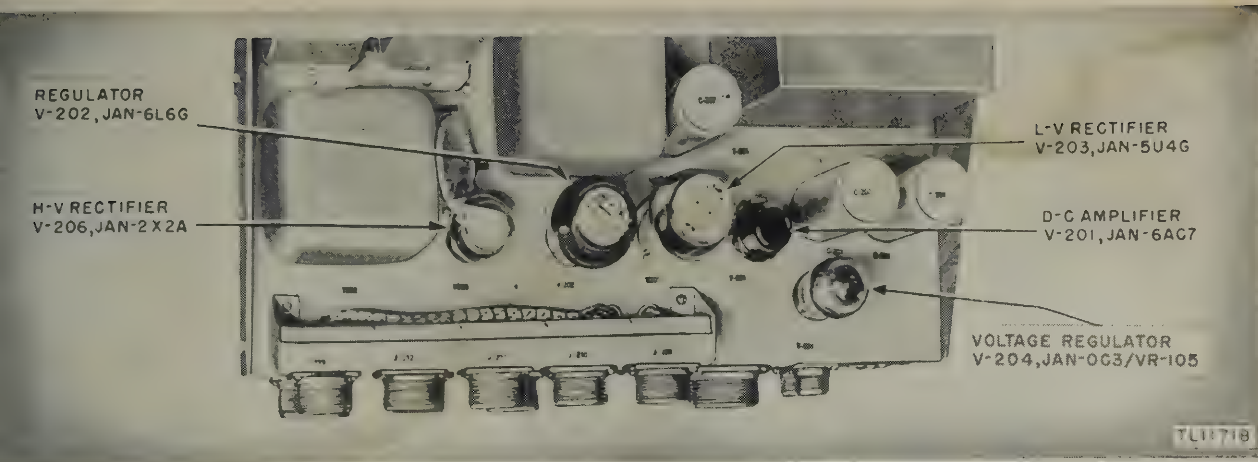


Figure 167. Control Panel PN-31-A, tube locations.

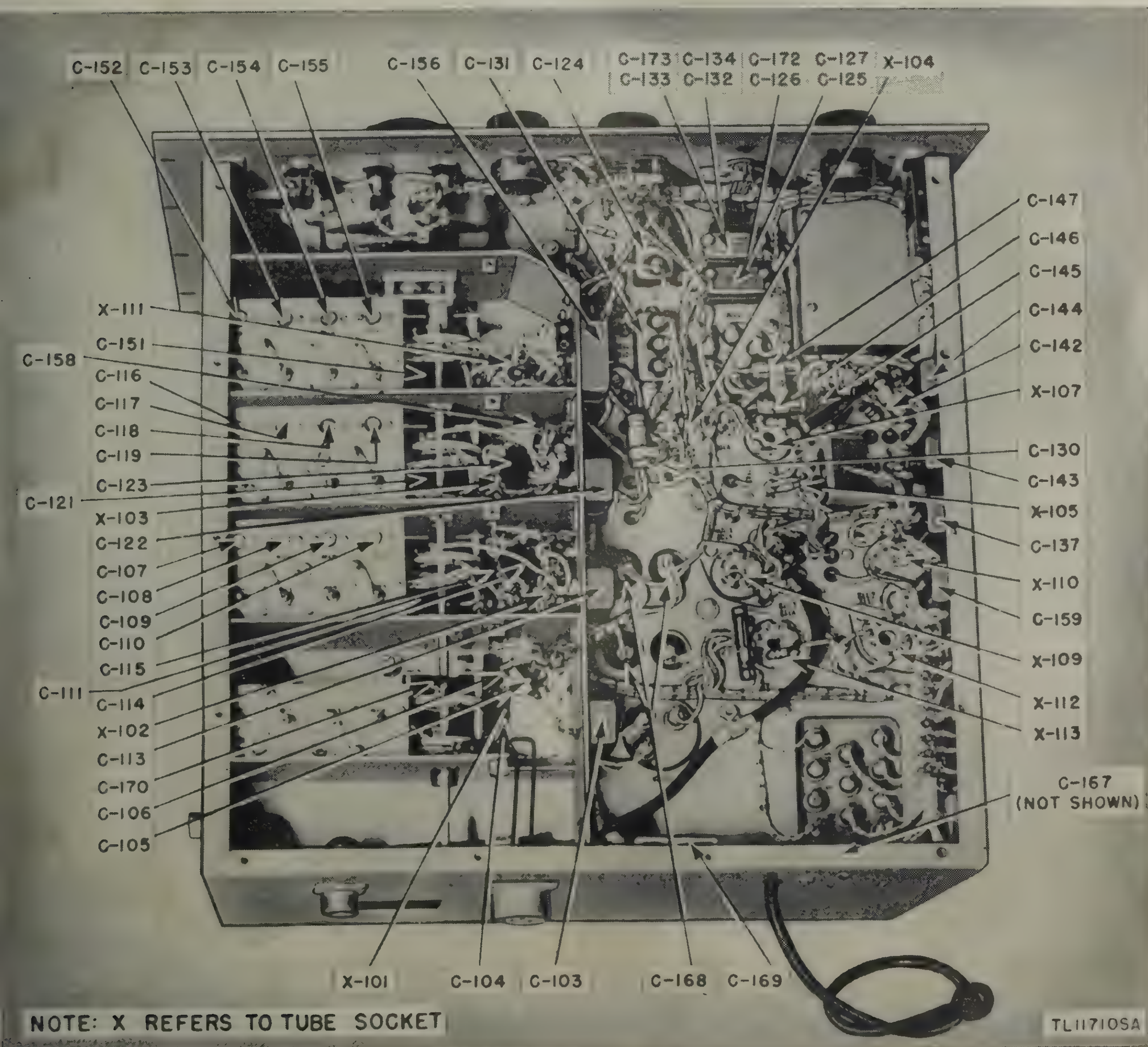


Figure 168. Radio Receiver BC-1147-A, capacitors and tube sockets.

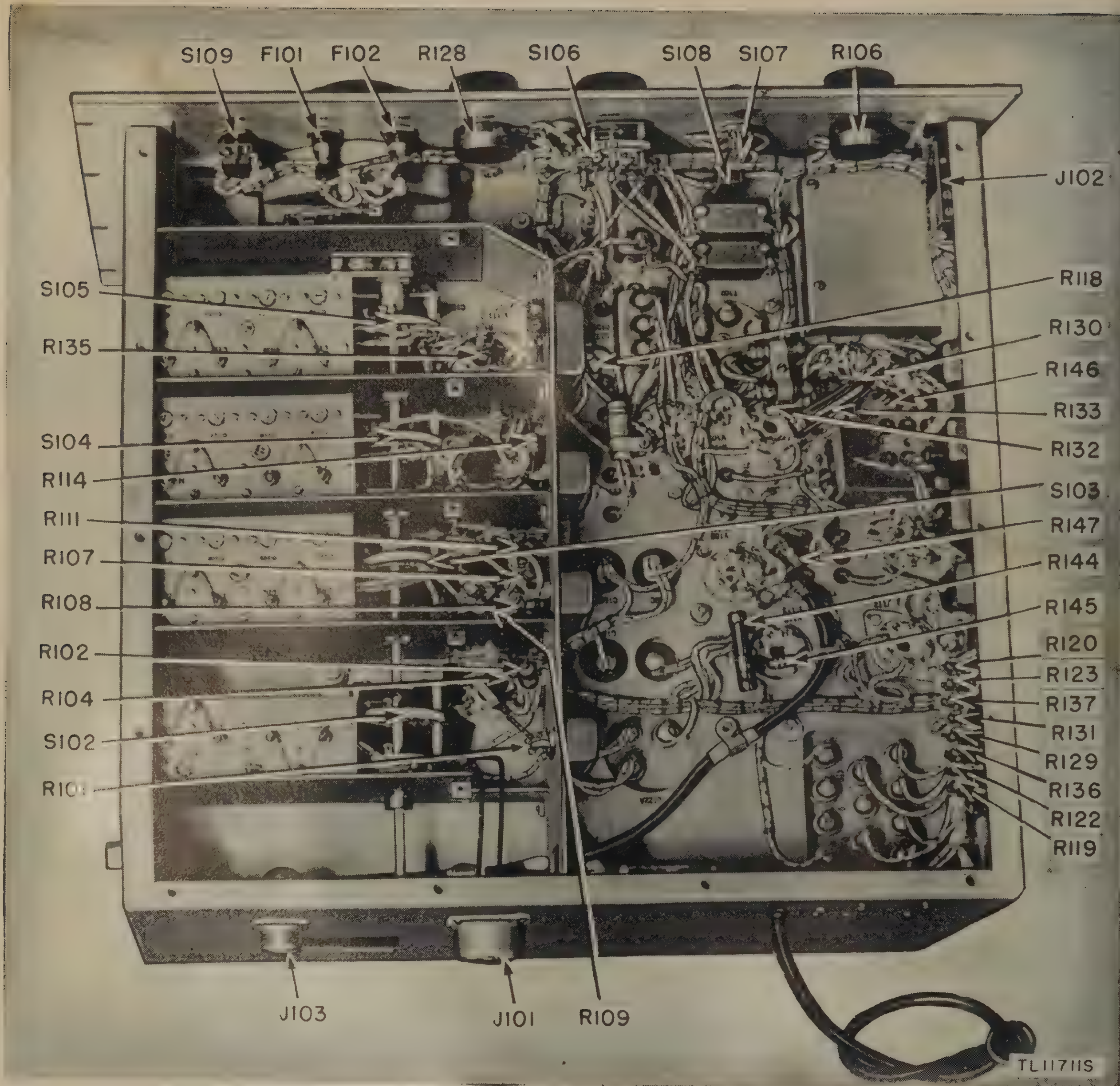


Figure 169. Radio Receiver BC–1147–A, resistors, receptacles, switches, and fuses.

the azimuth scale and alidade from the front of the indicator. The alinement tolerance of the cross hairs is $\pm 0.5°$ at opposite ends of either line in any quadrant. Loosen the azimuth scale retaining screws, and slide the azimuth scale to obtain correct alinement.

(5) Replace the remaining azimuth scale retaining screws. Tighten all retaining screws.

(6) Refer to paragraphs 66 and 67 for instructions on realining the optical system.

172. Replacement of Mirror

a. DISASSEMBLY.

(1) Swing the optical housing to one side.

(2) Remove four mirror frame screws.

(3) Remove the cup nut on the mirror. Use a 5/8-inch wrench (Chest CH–163–A).

(4) Remove the 1¼-inch screw from the coupling pin under the cup nut.

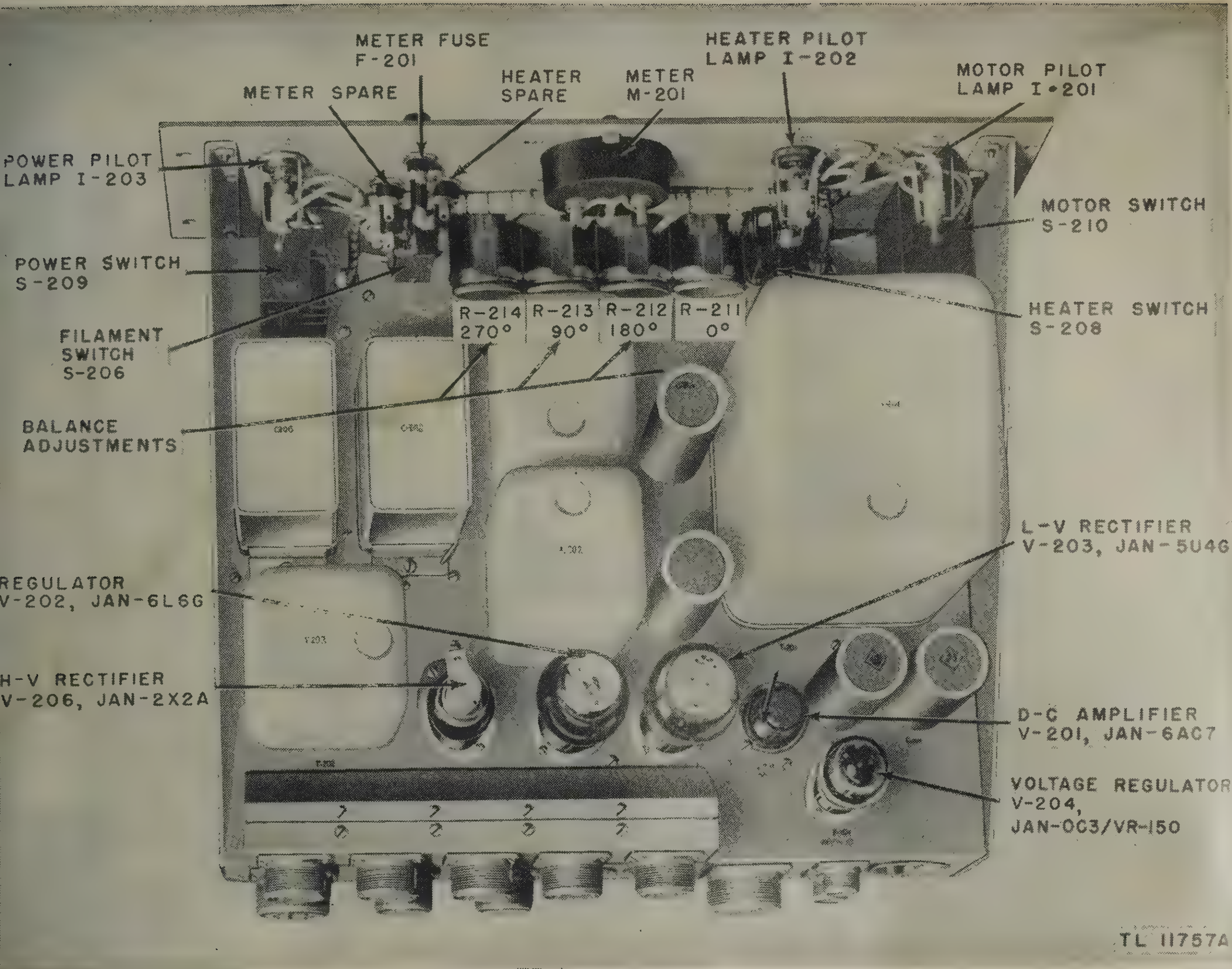


Figure 170. Control Panel PN–31–A, placement of parts, top view.

(5) Steady the mirror support ring with one hand and loosen the clamping knob halfway. Drop the adjusting arm so that it hangs from the clamping knob.

(6) Carefully withdraw the mirror support ring without tilting the mirror.

(7) Place the assembly on a table. Set it with the mirror up and the slotted bracket mounting pin at the right.

(8) Remove the four mirror mounting screws, thus releasing the old mirror.

(9) Install the new mirror plate (Chest CH–167–B) so that the surface with the stock number is on top. See that the gaskets are correctly positioned to provide adequate cushioning for the glass. Do not tighten the mounting screws excessively.

(10) Clean the mirror.

b. REASSEMBLY.

(1) Replace the mirror mount in the optical housing. Keep the slotted coupling pin to the right. Keep the mirror at its 45° position to avoid hitting the azimuth scale on the curved antiglare lens toward the front of the optical housing.

(2) Replace the adjusting arm in the slot, but do not replace the 1¼-inch holding screw in the adjusting arm.

(3) Replace two mirror frame screws; then replace the 1¼-inch holding screw in the adjusting arm.

(4) Loosen the clamping knob and test the mirror arm action.

(5) Replace the remaining two mirror frame screws. Replace the cup nut over the adjusting arm.

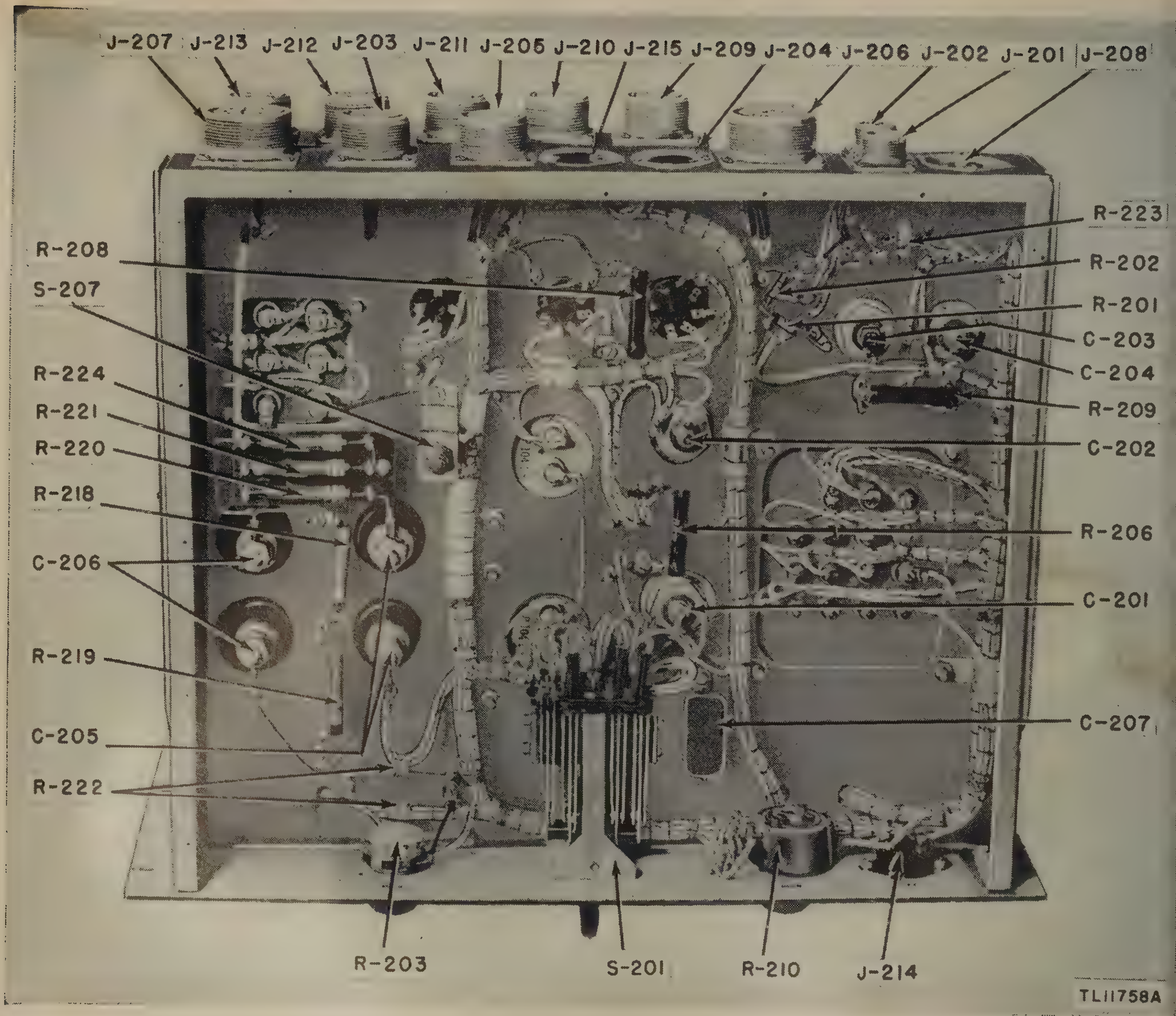


Figure 171. Control Panel PN–31–A, placement of parts, bottom view.

(6) If necessary, make adjustments for parallax (par. 66).

173. Replacing Cathode-ray Tube

a. Removal of Old Tube.

(1) With the control panel POWER and MOTOR switches at OFF, swing back the optical housing (fig. 152).

(2) Grasp the tube and pull while *carefully* working it *very slightly* from side to side.

b. Replacement.

(1) Before attempting to replace the tube, note the position of the socket key slot. Hold the tube so that the key in the tube base lines up with the socket slot.

(2) Before trying to push the tube into the socket, insert the tube and make certain that the key fits into the slot.

(3) Push the tube into the socket by working it *very slightly* from side to side until it is well seated in the socket. *Do not force the tube.*

(4) Close and lock the optical housing.

174. Deflection Coil Replacement

a. Disassembly.

(1) With the MOTOR and POWER switches at OFF, swing back the optical housing, lower the control box (par. 176*a*(3)), and remove the cathode-ray tube (par. 173) and housing.

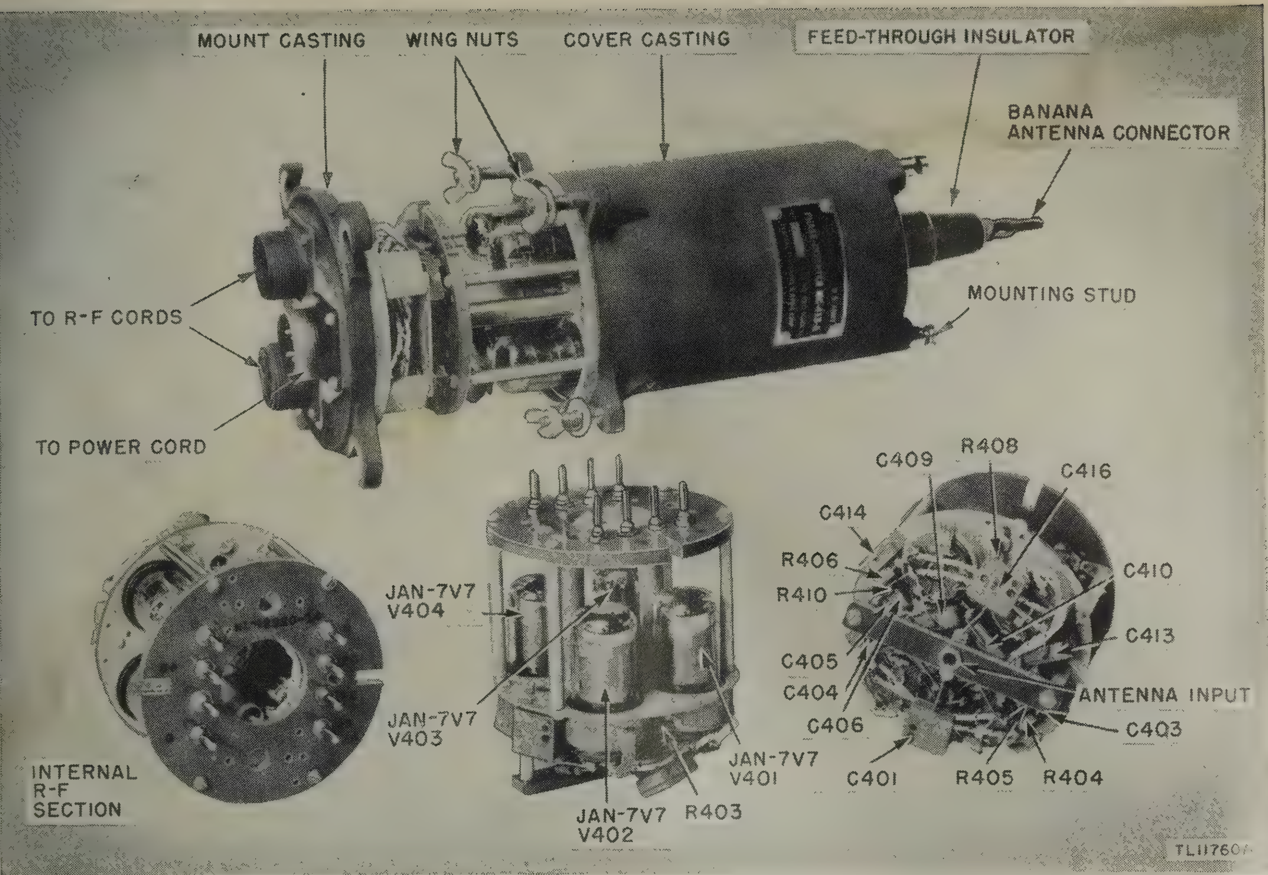


Figure 172. Phase Inverter MC–413–A, assembly and placement of parts.

(2) Unsolder the leads to the defective coil (fig. 177). Tag the leads.
(3) Straighten the bent lamination which holds the defective coil in place.
(4) Remove the coil.

b. REASSEMBLY.

(1) Insert the new coil and secure it in place by bending the lamination over it.
(2) Resolder the leads to the coil terminals.
(3) Replace the tube housing, the cathode-ray tube, and the control box.
(4) Check the goniometer alinement and parallax (par. 66 and 67). If parallax is present, check to see whether the cathode-ray tube is properly seated in its socket.

175. Flexible Coupling Replacement

a. DISASSEMBLY.

(1) Remove the four screws in the pad.
(2) Loosen the setscrew on the motor half of the coupling and slide the coupling toward the motor.
(3) Remove the old leather pad.

b. REASSEMBLY.

(1) Insert the replacement pad and replace the four screws.
(2) Retighten the setscrew on the motor half of the coupling.

176. Tube Housing Replacement

a. DISASSEMBLY.

(1) Remove the cathode-ray tube (par. 173).
(2) Remove the rubber ring and magnetic shield (fig. 178) which supports the front of the cathode-ray tube.
(3) Loosen the knurled screw at the rear of the control box and pull the control box away from the indicator.
(4) Remove three screws which hold the cathode-ray tube housing to the indi-

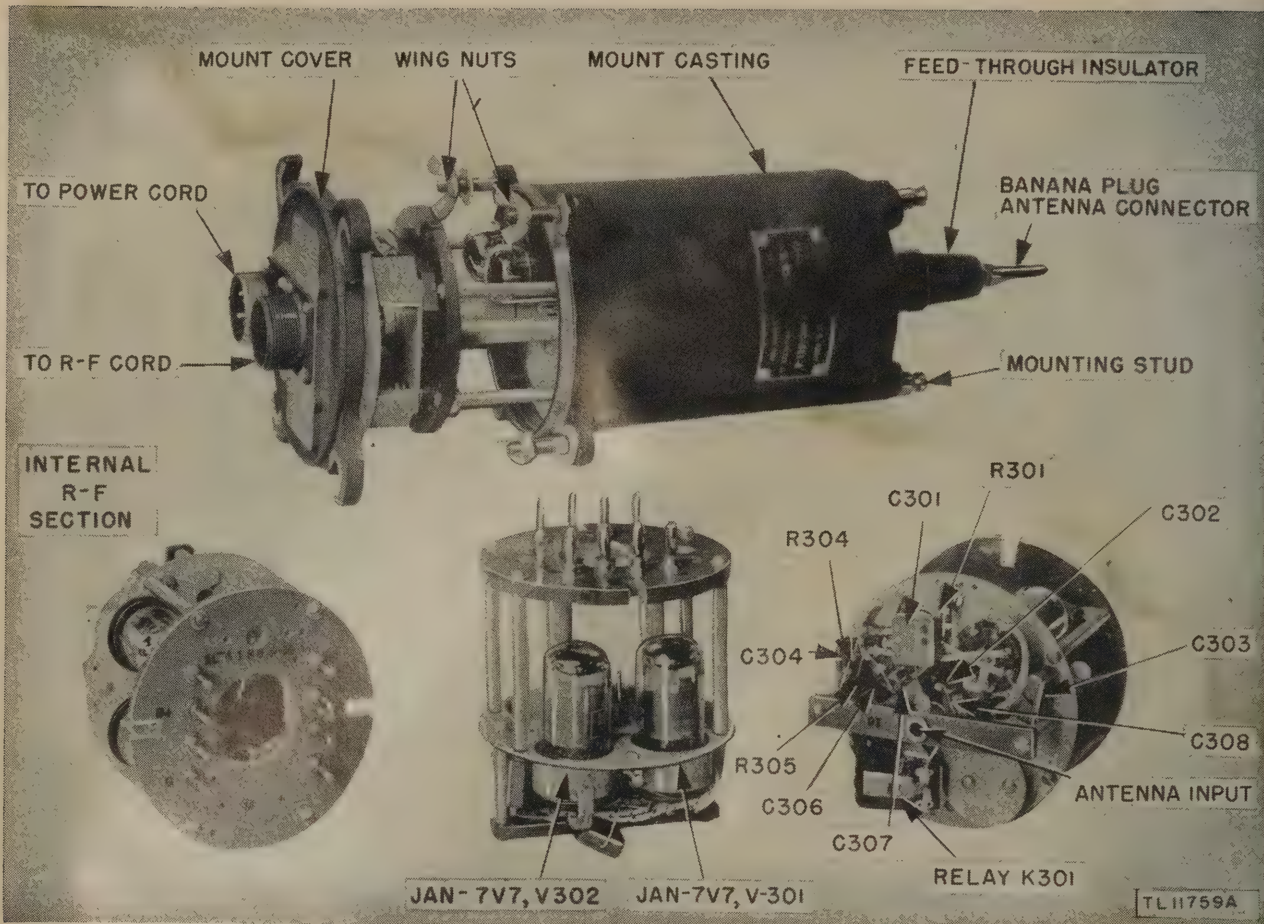


Figure 173. Phase Inverter MC–411–A, assembly and placement of parts.

cator casting. Remove the housing from the slip-ring assembly.

b. Removal of Defective Cathode-Ray Tube Socket.

(1) With the tube housing removed (*a* above), take out the four screws which hold the cover on the rear of the bakelite tubing (fig. 179).

(2) Remove the cap.

(3) Tag the socket leads before removing them so that replacement can be made without error.

(4) Mark the position of the socket keyway with respect to the metal retaining ring.

(5) Loosen the spring clip which holds the socket in the retaining ring. Remove the socket.

(6) Replace the defective socket with a new one. Reassemble the housing.

c. Reassembly. Replace the cathode-ray tube housing by following in reverse order the disassembly instruction (*a* above).

177. Removal of Deflection Coil Assembly

a. Disassembly.

(1) Swing back the optical housing. Remove the control box, cathode-ray tube, and tube housing.

(2) Remove the flexible coupling (par. 175).

(3) Remove the nuts which hold the front and rear top bearing housing; then remove the housing.

(4) Remove the screws from the bakelite brush holders. Hang the holder over the side of the indicator.

(5) Remove the two screws that hold the threaded seat for the deflection coil assembly cover; remove the threaded seat.

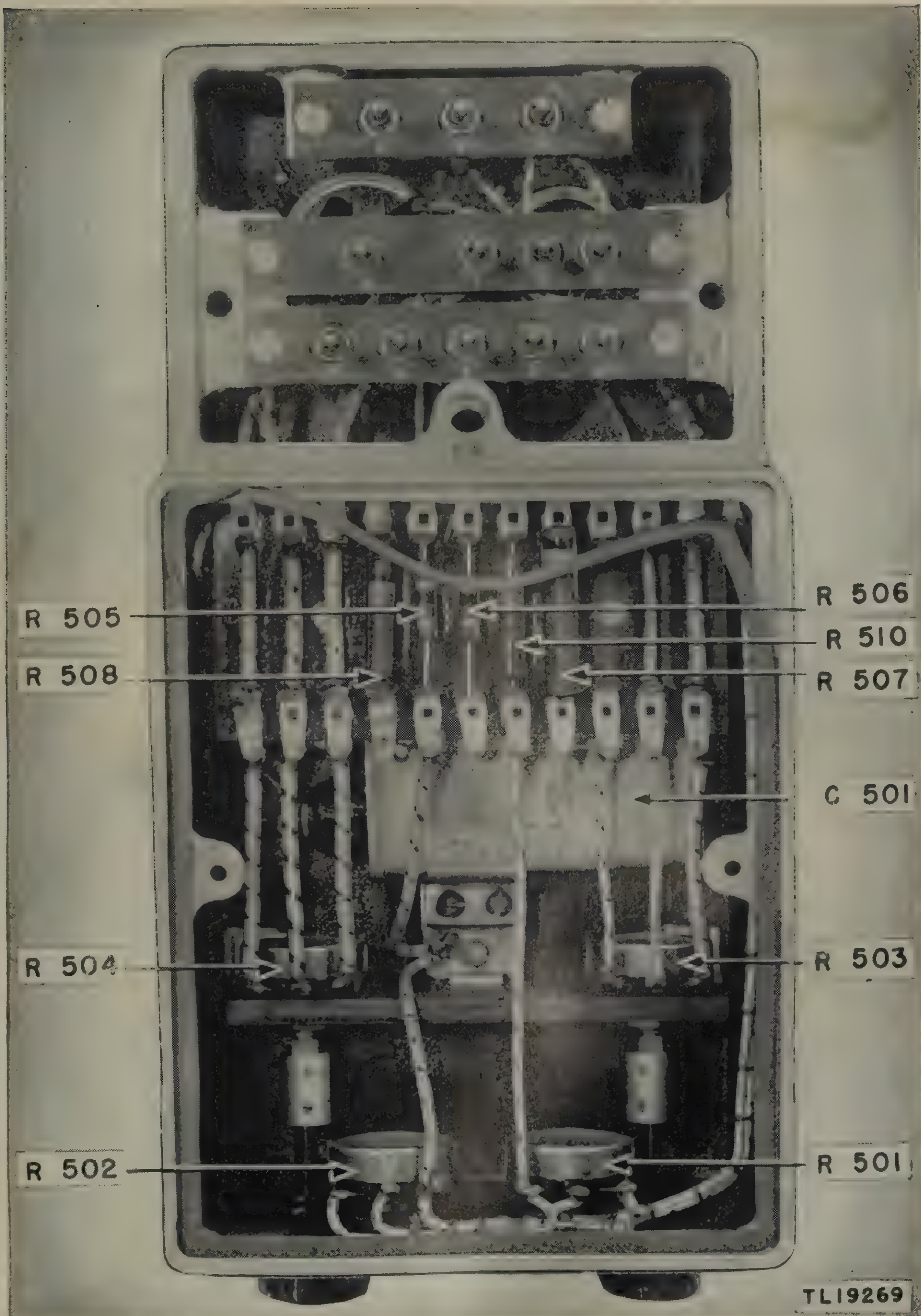


Figure 174. Bearing indicator control box, placement of parts.

(6) Lift the deflection coil assembly (fig. 180) from the bearing supports.

(7) Remove the axle and worm coupling from the end of the assembly (par. 178).

b. MACHINING SLIP RINGS.

(1) Mount the front end of the assembly in a lathe, with jaws of chuck gripping surface of casting over laminated pole pieces.

(2) Clamp the rear of the assembly by means of the rear ball type bearing

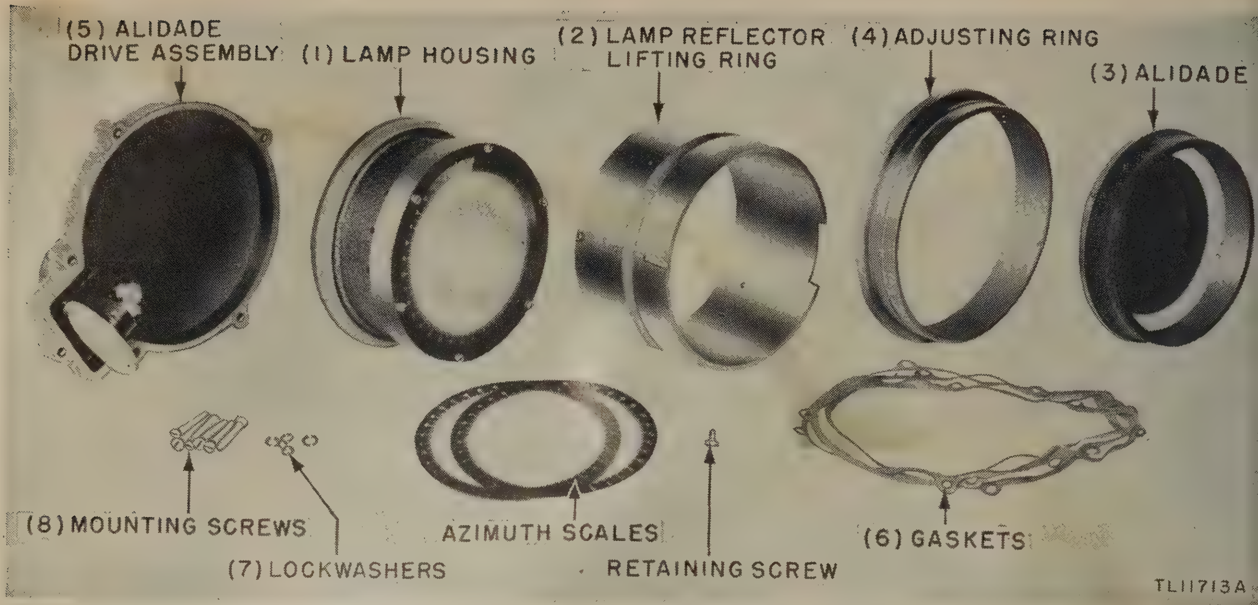


Figure 175. Alidade assembly, dismantled.

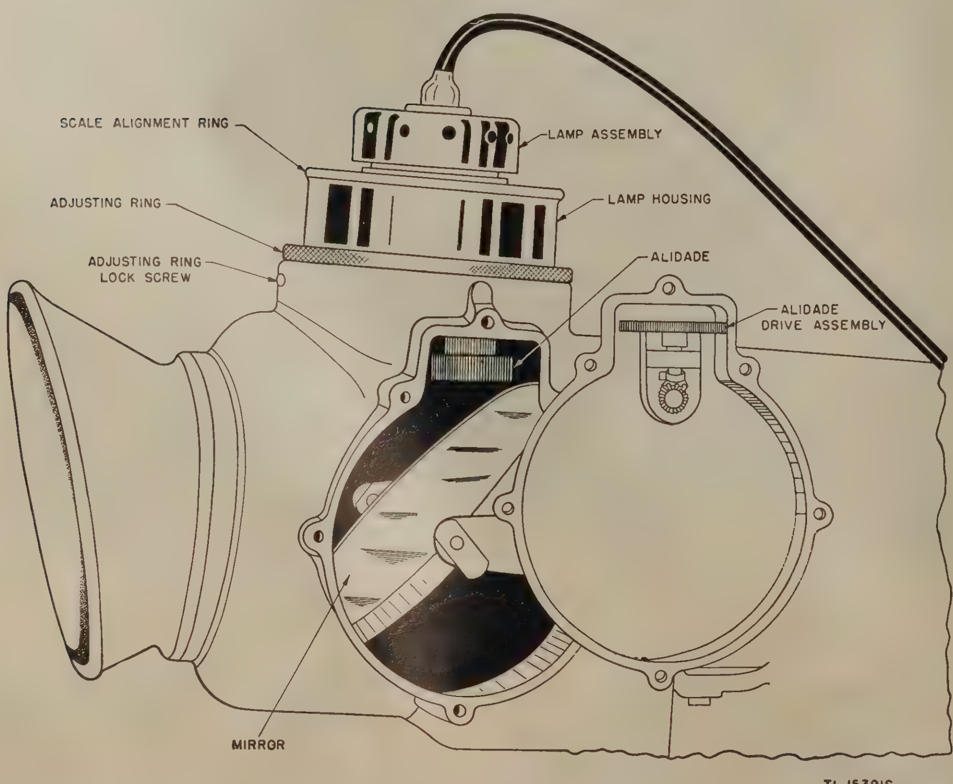


Figure 176. Optical housing.

Figure 177. Deflection coils.

in the lathe center-rest. Be very careful when tightening the center-rest in order not to damage the bearing.

(3) Adjust the lathe chuck until the dial indicator held against the bearing surface beneath the Oilite bearing indicates concentric rotation of assembly. Perform this operation carefully to assure that the slip rings are mechanically concentric with the bearings on the assembly.

(4) Carefully machine the three slip rings just enough to remove eccentricity.

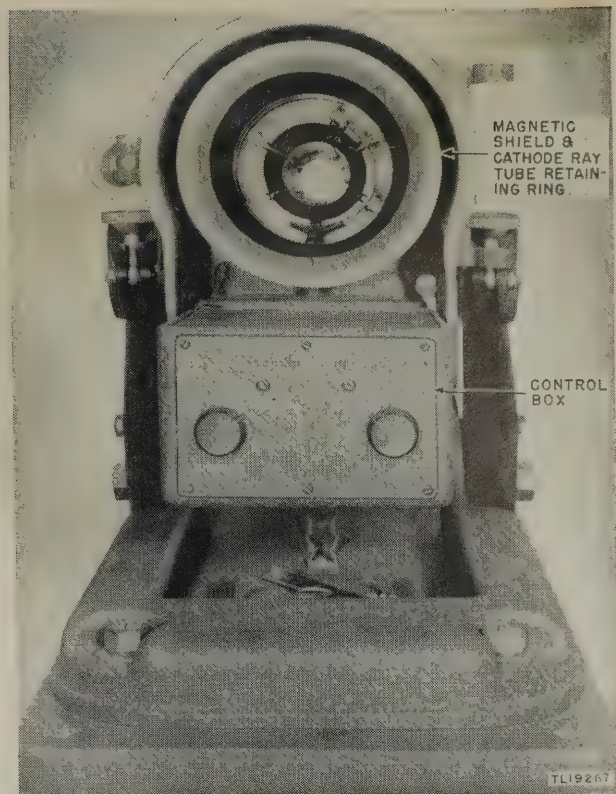


Figure 178. Bearing Indicator BC–1159–A, showing tube housing removed.

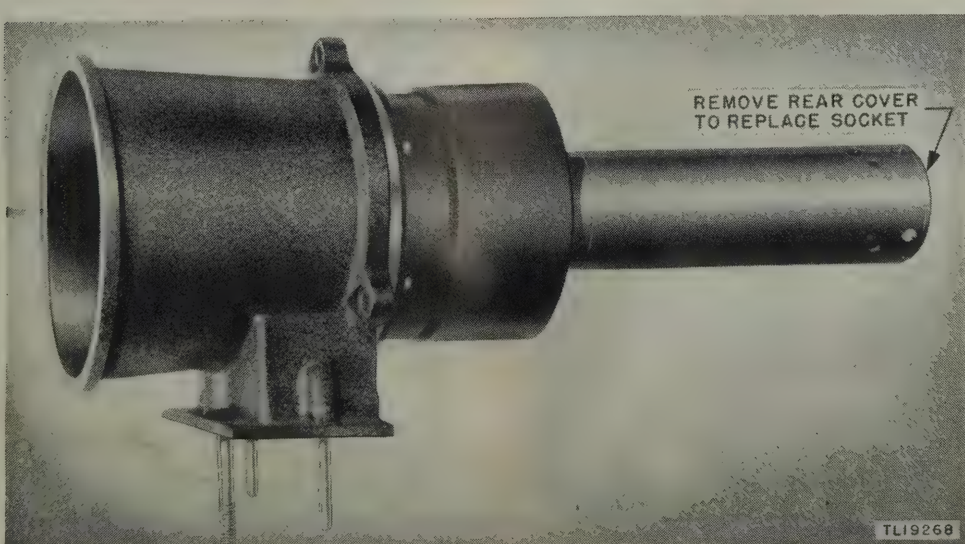


Figure 179. Tube housing.

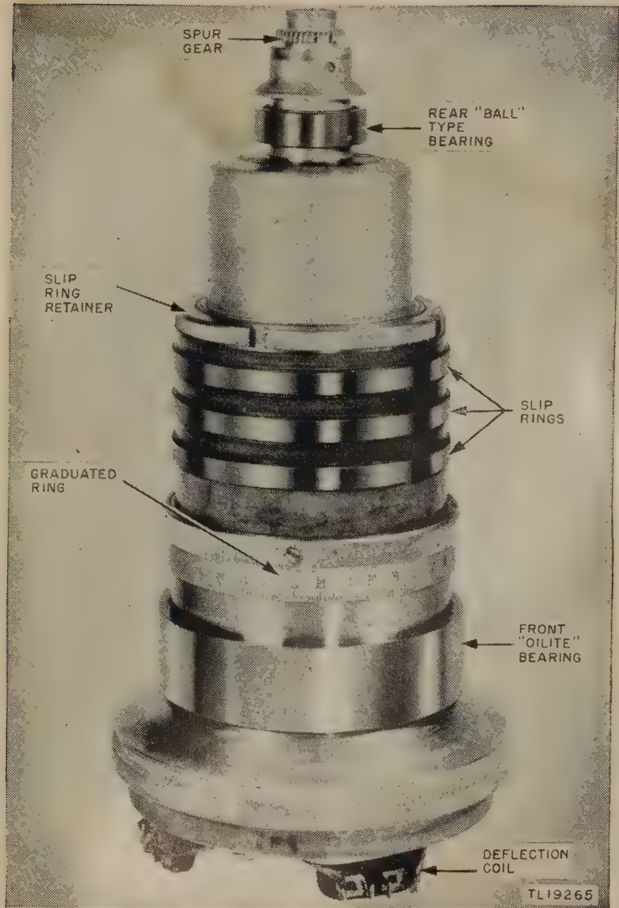


Figure 180. Deflection coil assembly.

(5) Polish slip rings before removing them from the lathe.

c. REASSEMBLY.

(1) Attach the axle and worm coupling unit and replace the deflection coil assembly in the bearing support.

(2) Check for proper operation. Poor brush and slip ring contact causes indicator patterns such as those shown in figure 181.

(3) Replace the bearing housing. Be very careful to fit the pin, next to the oil-hole in the front bearing housing, into the hole in the Oilite bearing, and to shim properly the front bearing housing so as not to jam the Oilite bearing.

(4) Replace seat for cover, flexible coupling, and bakelite brush holders. Check for brush tension.

178. Axle and Worm Coupling

It should never be necessary to replace the axle and worm coupling (fig. 120). If it must be removed, proceed as follows:

a. Remove the flexible coupling (par. 175).

b. Remove the deflection coil assembly (par. 177).

c. Remove the hexagonal locking screw on the worm gear adjusting screw.

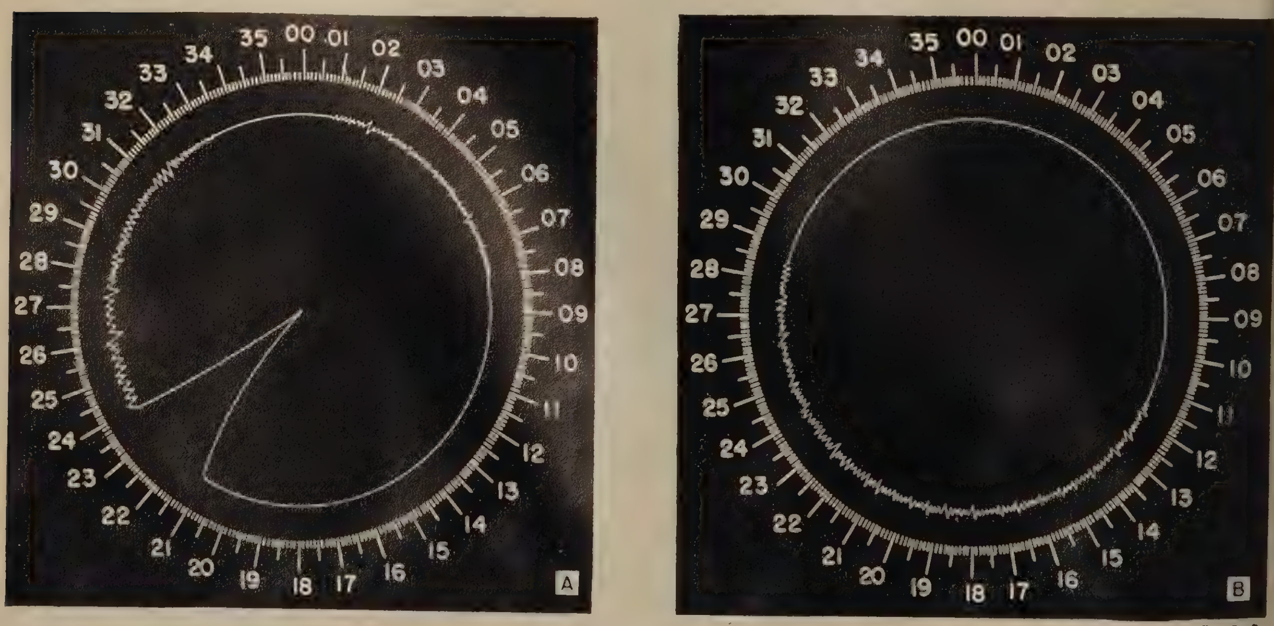


Figure 181. Indicator patterns showing poor brush and slip ring contact.

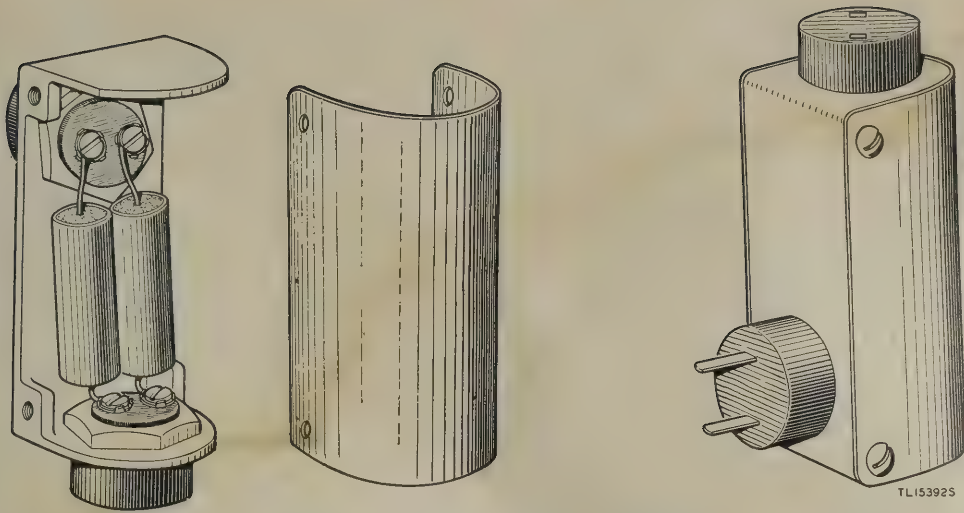


Figure 182. Lamp dimmer adapter.

d. Screw the worm gear from the hole in the coupling.

e. Loosen the coupling locking screw and pull the coupling from the rear of the deflection coil assembly.

f. To replace the axle and worm coupling, follow the above instructions in reverse order.

179. Lamp Dimmer Adapter (fig. 182)

The glass mirror in the optical housing is a better reflector than the cellulose acetate mirror issued with earlier models. Consequently, the reflected image of the azimuth scale is more brilliant than the scope pattern. To reduce the scale brilliance, a lamp dimmer adapter is used to reduce the voltage applied to the lamp. The dimmer consists of two 880-ohm resistors, one in each side of the line to the lamp. The adapter is fitted with a two-prong plug for connection to the 110-volt lamp supply (J504) on the support arm of the bearing indicator. The lamp cord is plugged into a receptacle at the other end of the adapter. A spare adapter is included in the spare parts chest.

180. Goniometer MC–412–A

Goniometer MC–412–A is a precision rotating transformer. Servicing of the stator, rotor, and coupling coils is both unnecessary and impossible under field conditions. Therefore, never attempt maintenance beyond the instructions in this manual. If trouble develops in the transformer elements, replace the goniometer; any attempt at repair will probably result in unbalance and cause bearing errors.

a. MAINTENANCE OF BEARINGS. The goniometer rotor is supported by, and rotates in two sealed type ball bearings which require no maintenance throughout the life of the equipment. Therefore, never remove the end plate from the motor shaft end of the goniometer. Maintenance at this point is unnecessary; removal of the end plate may damage the rotor assembly. In the early models of Goniometer MC–412–A (fig. 16) the large nut and screw on the rear of the housing support the rear rotor bearing and can be adjusted to compensate for excessive end thrust. This bearing support is carefully adjusted during manufacture and should never require readjustment. If the bearing support has been tampered with, or if the goniometer develops excessive noise, the support may be readjusted as follows:

(1) Tighten the three screws on the end plate at the motor shaft end of the goniometer.

(2) While holding the slotted screw in position with a large screwdriver, loosen the locking nut.

(3) While slowly rotating the goniometer shaft with one hand, carefully tighten or loosen the adjusting screw. Adjust the screw so that the goniometer shaft

just begins to bind and rotation is no longer entirely free. Then back off the adjusting screw about 1/8 turn. The shaft should rotate freely, but no perceptible end motion should be felt when the shaft is pulled back and forth. Holding the adjusting screw in the position of proper adjustment, tighten the locknut securely.

(4) In the later models of Goniometer MC–412–A (fig. 7), a spring arrangement in the rear of the goniometer housing is used to compensate for end play. Consequently, the screw and locknut arrangement is not provided.

b. RELAY MAINTENANCE. Relay K601, used to connect the sense input to the goniometer, may require occasional attention to assure satisfactory operation. Improper operation is indicated by a ragged or intermittent sense pattern on the indicator. To repair the relay proceed as follows:

(1) Remove the left cover plate from the goniometer (fig. 16).

(2) Burnish the relay contacts with a burnishing tool. The contacts may be cleaned with carbon tetrachloride. Never use sandpaper or a file, or the contacts may be scored and permanently damaged.

(3) Check operation and continue cleaning the contacts until a steady, hash-free pattern is obtained.

(4) Replace the side cover.

c. MOTOR AND GONIOMETER COUPLING. The goniometer is driven through a rigid sleeve type coupling, with the goniometer shaft fitting into a sleeve on the motor shaft. This coupling is a frequent source of noise which, while not harmful, is a source of annoyance. When noise develops, check the coupling. Tighten the spring tension against the goniometer shaft and carefully tighten the two thumbscrews that secure the goniometer to the motor. The screws should be equally tight. If the noise persists, but can be definitely traced to the coupling, the condition will not damage the equipment or cause bearing errors.

181. Radio Receiver BC–1147–A

a. GENERAL. Brief instructions for replacing parts are given in this paragraph. For detailed repair information, refer to TM 11–4041, Radio Receivers BC–1147 and BC–1147–A, Repair Instructions. For part locations refer to figures 168 through 174 in this manual.

b. POTENTIOMETER CONTROLS AND SWITCHES. To replace potentiometers and switches proceed as follows:

(1) Remove the bottom cover plate.

(2) Loosen knob setscrews with an Allen hexagonal wrench and remove the knob.

(3) Unsolder leads, one at a time, and tag each lead.

(4) Remove hexagonal nuts and washers from shaft bushings, mount the replacement unit, and resolder all connections.

c. I-F TRANSFORMER COMPONENTS.

(1) Remove the top and bottom cover plates.

(2) Take out two tap screws and lift the shield from the transformer assembly.

(3) Remove adjacent tubes.

(4) Before unsoldering leads, make a sketch of the connections, showing color coding. Tag all leads.

(5) While soldering or unsoldering connections, keep the receiver on its left side.

(6) It may be more convenient to remove an entire assembly. To do this, disconnect under chassis connections. Tag all terminals and leads. Then remove the frame mounting screws.

(7) All assemblies except L121 for the beat-frequency oscillator may be removed directly.

(8) To remove the L121 assembly, proceed as follows: take off the under chassis shield; unsolder the necessary connections; take out the coil assembly mounting screws; remove the knobs from the BFO ADJ., ANT. COMP., and band switch controls; take out the front panel mounting screws; pull the panel away from the chassis so that it clears the BFO ADJ. shaft; then remove the coil L121 assembly.

d. R-F, MIXER, OR H-F OSCILLATOR.

(1) Remove the bottom cover plate.

(2) Loosen the setscrews on the band switch shaft; remove the shaft.

(3) Remove the screws from the cross partitions between the r-f coil assemblies; then move back the long, common partition.

(4) Lift out the rear, cross partition which is adjacent to the r-f assembly being removed.

(5) Take out the screws which hold the switch wafer bracket to the chassis.

(6) Unsolder the connections from the chassis mounted components to the switch wafer and coil assembly. Tag all connections for identification during reassembly.

(7) Remove the two mounting screws from the coil and capacitor trimmer board; lift out the assembly.

(8) When replacing defective components or connections, make certain that the original length and location of leads is unchanged.

Caution: Do not change core or trimmer capacitor adjustments.

(9) In reassembling the unit, set all switch wafer keys to the band 1 position and, with the dial mask on band 1, tighten the setscrews. Then turn the band switch to the band 4 position and tighten the setscrew on the gearbox.

e. CAPACITOR C101.

Note. Capacitor C101 should not be removed unless absolutely necessary. The capacitor can be reached for most purposes by removing the capacitor shield.

(1) Remove the top and bottom cover plates.

(2) Loosen the two Allen head setscrews which secure the counterweighted coupling to the capacitor shaft. Take out the taper pin by driving the *small* end of the pin.

(3) Disconnect all wiring from the five stator terminals; unsolder the five braided, rotor-grounding leads from the chassis ground terminals.

(4) The capacitor is secured to the chassis by three fillister-head machine screws: one at the rear, two at the front. The screws can be reached through the bottom of the chassis. Each mounting screw passes through an adjustable mounting device. This enables precise alinement of the tuning capacitor shaft with the drive shaft. At the factory the mountings are carefully adjusted for the capacitor in the receiver. The adjustment is locked by a large hexagonal nut. In removing the capacitor, take out the fillister-head screws, but *do not* loosen the locking nut.

(5) Turn the chassis on its right side (as seen from the front). With the left hand under the rear of the capacitor, remove the rear mounting screw.

(6) Support the rear of the capacitor to avoid strain on the shafts and turn the chassis onto its base (normal position), so that the front edge of the chassis extends a few inches out from the table top. With the chassis in this position, remove the two front capacitor mounting screws.

(7) Slide the capacitor to the rear and lift it up and out.

(8) If a new capacitor is being installed, it may be necessary to readjust the height of the three mounting assemblies. Loosen the locknuts and raise or lower the thread spacers to aline the capacitor shaft with the coupling. The adjustment should be made with the mounting screws in place but not tightened. The chassis must be resting on its base when the adjustment is made.

(9) When rewiring the capacitor, it is advisable to lay the chassis on its left side. This will lessen the chance of dropping solder through the terminal holes into the capacitor plates.

182. Control Panel PN-31-A

To replace controls on Control Panel PN-31-A, first loosen the STAND-BY - D.F. - SENSE switch. Then drop the front panel before removing any of the above chassis controls, except the POWER and MOTOR switches. These switches and the subchassis controls may be removed without freeing the front panel from the chassis.

843134°—49—12

183. Telephone Panel PN–32–A

For information on Telephone Panel PN–32–A refer to TM 11–333. If operation in Rack FM–61–A is inconvenient, Telephone Panel PN–32–A may be mounted on the shelter wall.

184. Rustproofing and Repainting

When the finish on cabinets and cases has been badly scarred or damaged, rust and corrosion can be prevented by touching up the bared surface as follows:

a. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal. Obtain a bright smooth finish.

Caution: The use of steel wool, although permitting rapid removal of rust, is not recommended. Minute particles of steel wool frequently enter the case and cause harmful internal shorting or grounding of circuits.

b. When a touch-up job is necessary, apply paint with a small brush. When numerous scars and scratches warrant complete repainting, remove the radio set chassis and spray paint over the entire case. Remove rust from the case by cleaning corroded metal with Solvent, Dry Cleaning (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and sandpaper to complete the preparation for painting. Use paint that is authorized and consistent with existing regulations.

185. Unsatisfactory Equipment Report

a. WD AGO FORM 468 (UNSATISFACTORY EQUIPMENT REPORT) FOR EQUIPMENT USED BY THE ARMY. WD AGO Form 468 will be filled out and forwarded through channels to the Office of the Chief Signal Officer, Washington 25, D. C., when trouble occurs more often than is normal, as determined by qualified repair personnel.

b. AF FORM 54 (UNSATISFACTORY REPORT) FOR EQUIPMENT USED BY THE AIR FORCE. AF Form 54 will be filled out and forwarded to Commanding General, Air Matériel Command, Wright-Patterson Air Force Base, Dayton, Ohio in accordance with AF Regulation 15–54.

Section IV. ALINEMENT AND ADJUSTMENT

186. General

System alinement procedures, including antenna alinement, phase inverter balancing, bearing indicator adjustments, and goniometer adjustments, are given in section II of chapter 2. The procedure for alining Radio Receiver BC–1147–( ) is given in this section. Refer also to TM 11–4041.

187. Test Instruments for Receiver Alinement

a. ACCURATE ALINEMENT. To make an accurate alinement of the receiver circuits, obtain the following equipment:

Item	*Description*
Signal generator	Signal Generator I–72–( ), or
Frequency meter	equal.
Vacuum-tube voltmeter (VTVM)	Frequency Meter Set I–129–( ), or equal.
Capacitor	A-c/d-c type, 2 required.
Resistors	0.001 mf.
Output meter	Two 68-ohm, noninductive. 4,000 = ohm impedance

b. EMERGENCY ALINEMENT. When vacuum-tube voltmeters are not available, the bearing indicator may be used as an alinement indicator (par. 190).

188. I-f Alinement

a. TEST CONDITIONS AND INSTRUCTIONS.

(1) Receiver on left side with top and bottom plates off.

(2) Signal generator output to pin 8, the signal grid of Tube JAN–6SA7, (V103).

(3) Frequency 455 ks; output 2,000 microvolts unmodulated.

(4) VTVM1 across R127 (from high side of C142 to pin 3 of Tube JAN–6SQ7, (V106). VTVM1 on 100-volt range.

(5) VTVM2 across pins B and C of J103 (pin B is ground). VTVM2 on 100-volt range.

(6) Receiver control settings:

ANT. COMP.	3
A.F. GAIN	10
SELECTIVITY	SHARP
BFO	OFF
AVC-MAN.	MAN.
BFO ADJ.	0
SENSITIVITY	6 (approx.)
Tuning Control	2.5 mc (band 1)

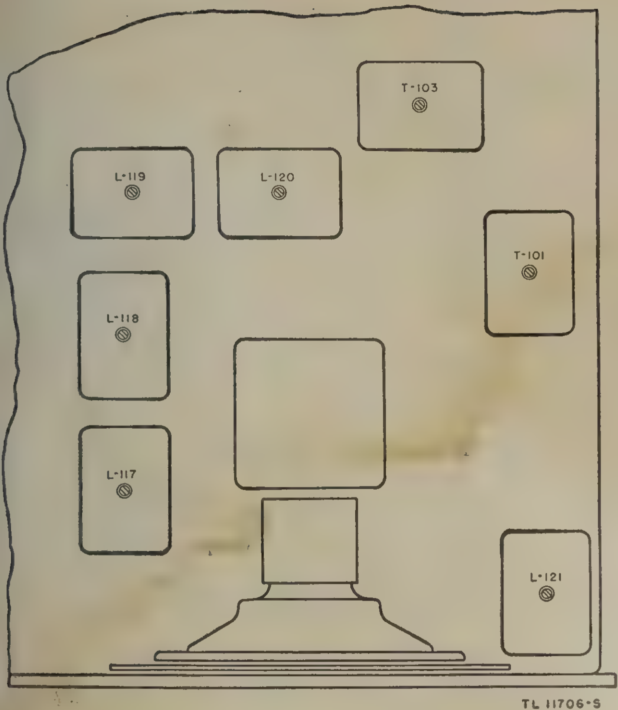


Figure 183. I-f trimmers, locations.

(7) Allow receiver and test equipment to warm up for ½ hour before proceeding with alinement.

(8) Use bakelite or high dielectric screwdriver for trimming.

(9) See figure 183 for trimmer locations.

Note. If only one VTVM is available, alternately connect it as required for VTVM1 and VTVM2. During alinement reduce the SENSITIVITY as required to maintain constant output to each VTVM (approx. 15 volts). If an interfering signal is found at 2.5 mc, set tuning control elsewhere in band 1.

b. ADJUSTMENTS.

(1) Trim T101 for maximum reading on VTVM1.

(2) Trim T103 for maximum reading on VTVM2.

(3) Repeat steps 1 and 2 until no further improvement is obtained.

(4) Trim L120, L119, L118, and L117 in this sequence for maximum readings on VTVM1 and VTVM2, and repeat until no further improvement is obtained.

(5) Turn the BFO control to ON and trim L121 to zero pitch audible output.

(6) Check to see that pitch of audible output may be varied from 0 to approximately 10,000 cps (cycles per sec.) as BFO ADJ. is turned in either direction from 0.

189. R-f Alinement

a. TEST CONDITIONS AND INSTRUCTIONS.

(1) Place the receiver on the left side with the top and bottom plates on.

(2) Connect the signal generator, goniometer, receiver, and VTVM (100-volt range) as shown in figure 185A for alinement of bands 1, 2, and 3.

(3) Connect the signal generator, receiver, and VTVM (100-volt range) as shown in figure 185B for alinement of band 4.

(4) Set the signal generator output at 5 to 10 microvolts unmodulated.

(5) Set the receiver controls as follows: ANT. COMP. to 3; SELECTIVITY

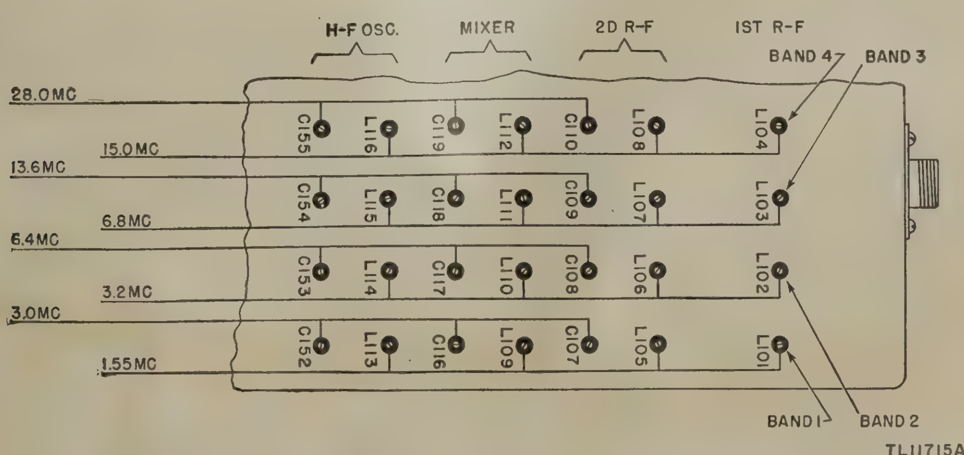


Figure 184. R-f trimmers, locations.

to SHARP; AVC-MAN. to MAN.; SENSITIVITY to 6. Reduce SENSITIVITY as required to keep the VTVM reading at approximately 15 volts.

(6) Allow the equipment to warm up for one-half hour before alinement.

(7) Use a bakelite or high dielectric screwdriver for trimming.

(8) See figure 184 for trimmer locations.

(9) Refer to the r-f alinement chart (*b* below). Check the receiver tuning accuracy (colm. 3) at both ends of band (colm. 2).

(10) If the tuning error is less than shown in column 3A, omit column 5. Alternately trim the L's and C's of the r-f and mixer stages at both ends of the band (colm. 6), beginning at the low end. Repeat until no further improvement is possible.

(11) If the tuning error is greater than shown in column 3B, alternately trim the L's and C's (colm. 5) with the signal generator and receiver dials exactly set at values as shown in columns 2 and 4. Begin at the low end of the band and repeat until the receiver dial error ((9) above) at both ends of the band is less than shown in column 3A. Then trim the r-f and mixer stages ((10) above).

(12) If the final adjustment of the ANT. COMP. control at the high end of the band is greater than 9.5 proceed from left to right and from top to bottom according to the instructions given in columns 7 through 10.

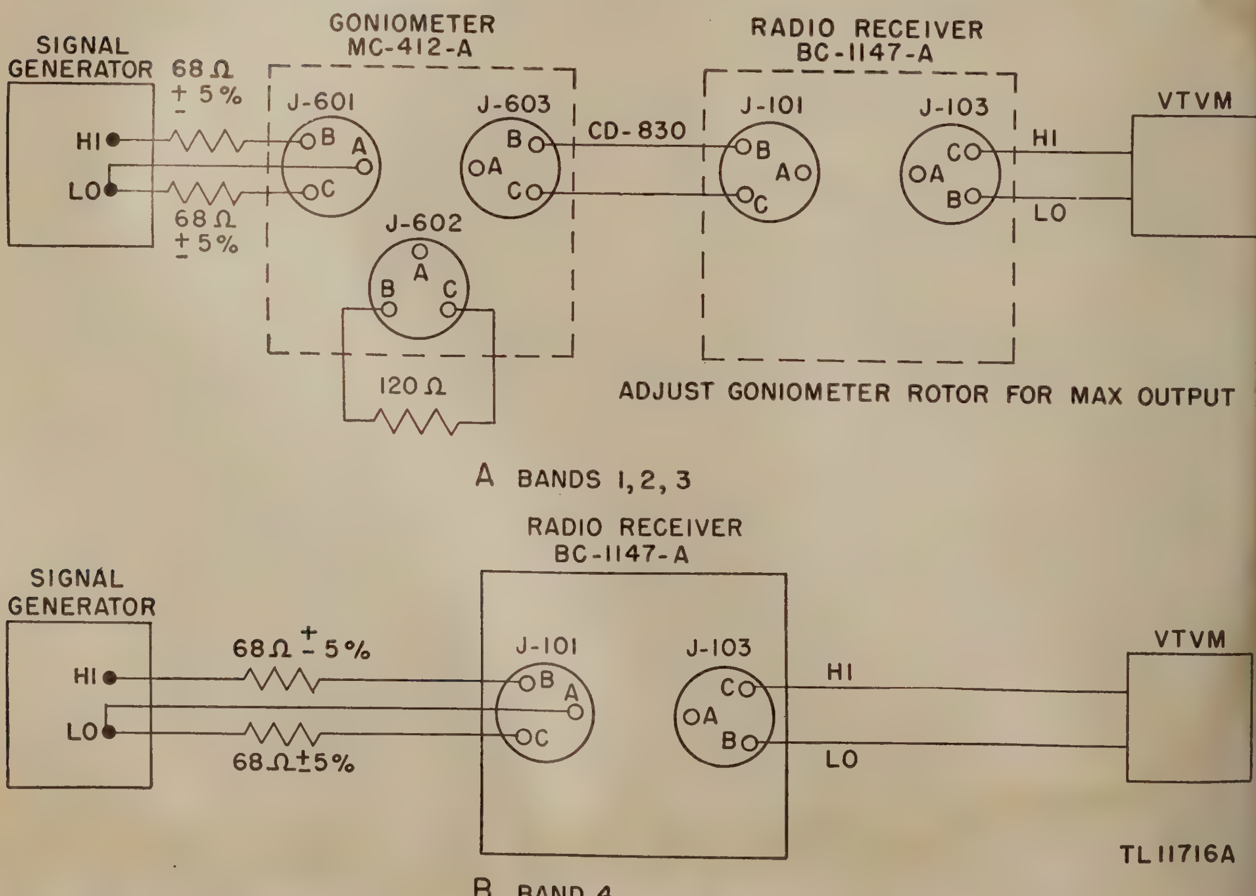


Figure 185. Radio Receiver BC–1147–A, r-f alinement arrangement.

b. R-F ALIGNMENT CHART.

1	2	3		4	5	6	Retrim, if ANT. COMP. setting is above 9.5 at high end of band			
		Tune rcvr for max VTVM reading					7	8	9	10
Band	Sig gen freq (mc)	A Dial error less than (%)	B Dial error more than (%)	Rcvr dial exactly (mc)	Trim for max VTVM reading	Trim in sequence for max VTVM reading Repeat several times.	Sig gen freq (mc)	Trim for max VTVM reading	Tune rcvr trim for max VTVM reading	Trim in sequence for max VTVM reading. Repeat several times.
1	1.55	0.6	0.6	1.55	L113	L109, L105, L101	3.0	L101 with ANT. COMP. at 9.5		
	3.0	0.6	0.6	3.0	C152	C116, C107, ANT. COMP.	1.55		ANT. COMP. (approx 3).	L109, L105, L101.
							3.0			C116, C107, ANT. COMP.
2	3.2	0.6	0.6	3.2	L114	L110, L106, L102	6.4	L102 with ANT. COMP. at 9.5		
	6.4	0.6	0.6	6.4	C153	C117, C108, ANT. COMP.	3.2		ANT. COMP. (approx 3).	L110, L106, L102.
							6.4			C117, C108, ANT. COMP.
3	6.8	0.6	0.6	6.8	L155	L111, L107, L103	13.6	L103 with ANT. COMP. at 9.5		
	13.6	0.6	0.6	13.6	C154	C118, C109, ANT. COMP.	6.8		ANT. COMP. (approx 3).	L111, L107, L103.
							13.6			C118, C109, ANT. COMP.
4	15.0	1.0	1.0	15.0	L116	L112, L108, L104	28.0	L104 with ANT. COMP. at 9.5		
	28.0	1.0	1.0	28.0	C155	C119, C110, ANT. COMP.	15.0		ANT. COMP. (approx 3).	L112, L108, L104.
							28.0			C119, C110, ANT. COMP.

Note. If goniometer is unavailable, use test condition 3 for all bands.

190. Emergency Alinement of Receiver

When a VTVM is unavailable, the bearing indicator can be used as an alinement indicator. The procedure is as follows:

a. Remove the receiver and control panel from Rack FM–61–A and place them on a table adjacent to the bearing indicator table. Reconnect all cables, except the east, west, south, and sense phase inverter cables. Set the equipment in operation for D/F, but turn the 0° switch to OFF.

b. Follow the i-f alinement procedure (par. 188), omitting instructions *a*(4) and (5). Adjust the trimmers to obtain a minimum pattern diameter of about ¼ inch, reducing the receiver sensitivity as required to prevent a narrower pattern width. Adjust the bfo for an a-f signal of about 400 cycles and trim T101 for maximum audio output on the loudspeaker or headphones.

c. Remove the north phase inverter and bring it into the shelter (with cables). Turn the 0° switch to ON. Connect the signal generator to the phase inverter antenna connector (banana plug) and to one of the mounting studs (ground). Follow the r-f alinement procedure (par. 189), omitting instructions *a*(2) and (3). Reduce the receiver sensitivity as required to prevent the pattern width from becoming less than ¼ inch. It may be impossible to trim the ANT. COMP. control so that the resonant point is lower than 9.5 at the high end of band 4.

APPENDIX I

BEARING INDICATOR KIT MC–551

Section I. DESCRIPTION

. Application

Bearing Indicator Kit MC–551 is used to replace Bearing Indicator BC–1159–A in Radio Set SCR–291–A, as authorized by MWO SIG 11–43–4. The kit consists of 15-tube electronic Bearing Indicator BC–1338, Goniometer Drive Unit RC–295, and accessories. The major components of the kit are mounted in operating Chest CH–300 (figs. 186 through 188).

. Technical Characteristics

a. When the indicator kit is substituted for Bearing Indicator BC–1159–A, instantaneous, olid-pattern bearing indications of the received ignal, instead of line-type patterns, appear on he oscilloscope of Bearing Indicator BC–1338. The solid patterns are easier to observe and are btained electronically without the necessity of moving parts in the bearing indicator. The bearings can be read directly on an illuminated azimuth scale in the same plane as the screen of the cathode-ray tube. An alidade assembly facilitates reading the bearings and reduces the chance of reading errors on all bearings.

b. Goniometer Drive Unit RC–295 (figs. 189 and 190) consists of a 1/10-hp motor coupled by a rubber belt to a two-phase permanent-magnet type alternator. Provision is made for mounting Goniometer MC–412–A and coupling it to the shaft of the alternator. The unit rotates the goniometer and synchronizes the pattern on the bearing indicator with the rotation of the goniometer. The goniometer drive unit requires 75 watts at 110–115 volts ac, 50–60 cycles.

c. The indicator kit requires 220 watts at 110–115 volts ac, 50–60 cycles.

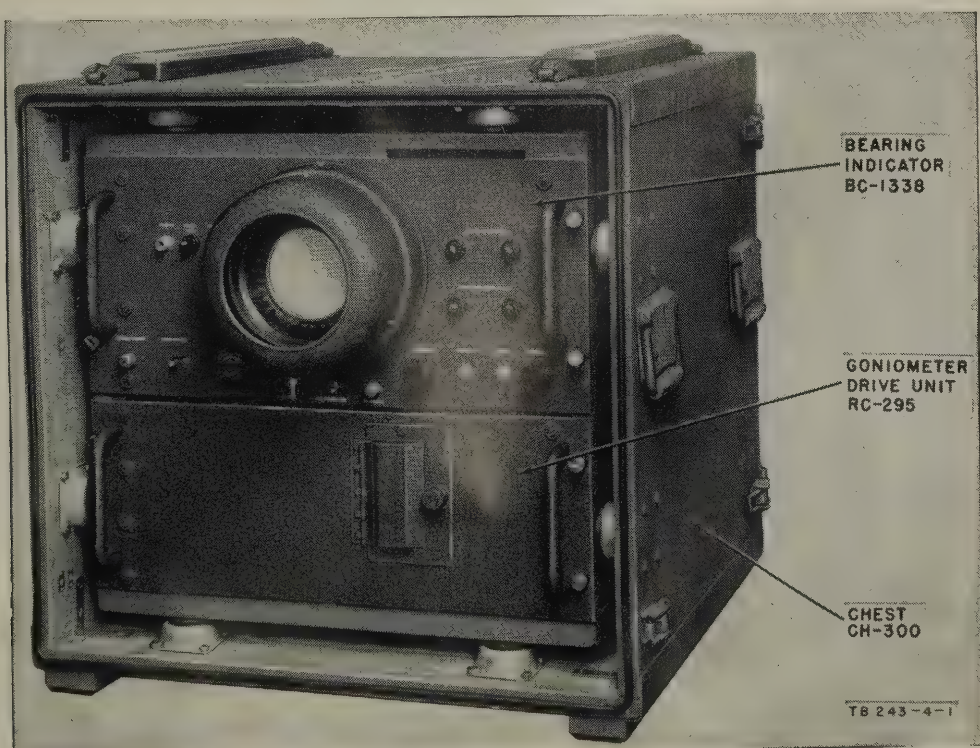


Figure 186. Bearing Indicator BC–1338 and Goniometer Drive Unit RC–295 in Chest CH–300.

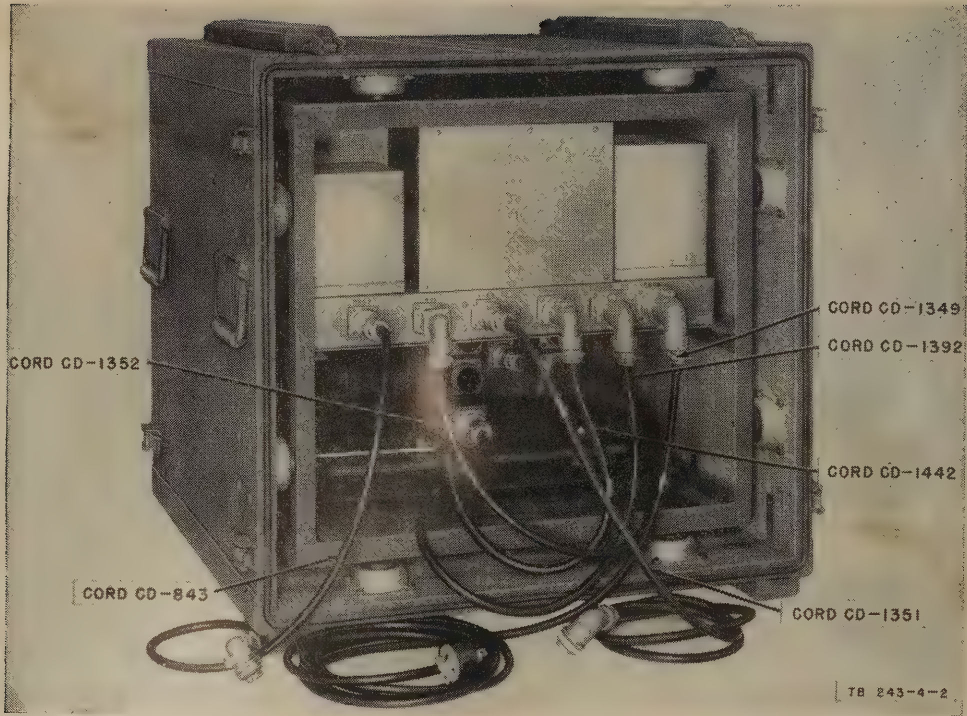


Figure 187. Chest CH–300, rear view, cover off.

3. Table of Components

Component	Required No.	Height (in.)	Depth (in.)	Length (in.)	Volume (cu ft)
Bearing Indicator BC-1338, complete with tubes, fuses, and lamps	1	8¾	19	19	1.825
Goniometer Drive Unit RC–295	1	7	19	10	0.77
Chest CH–300, containing indicator, drive unit, and cords	1	23½	24½	27½	9.15
Chest CH–301, containing spare parts	1	20¾	17¾	17⅜	3.7

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

4. Packaging Data

Bearing Indicator Kit MC–551 is packed for export. Chests CH–300 and CH–301 are placed in separate cardboard cartons and then into separate packing cases. The cases are lined with a water proof bag and strapped with metal tape. Components in spare parts Chest CH–301 are waterproofed and contained in cardboard cartons. All tubes installed in the indicator are fastened down with masking tape.

5. Description of Major Components

a. BEARING INDICATOR BC–1338. The front panel of the indicator is a standard 8¾- by 9-inch rack panel finished in olive drab crackle. The front panel is attached to the indicator chassis. The entire assembly slides into the upper rack of Chest CH–300 and is held in place by four captive screws on the front panel.

b. GONIOMETER DRIVE UNIT RC-295. The front panel of the goniometer drive unit is a standard 7- by 19-inch rack panel. To this panel is fastened a chassis on which are mounted the goniometer, alternator, and drive motor. The entire unit slides into the bottom rack of Chest CH–300 and is held in place by four captive screws on the front panel (figs. 189 and 190).

c. CHEST CH–300. This chest is a rugged, waterproof, plywood chest which houses Bearing Indicator BC–1338 and Goniometer Drive Unit RC–295. It is used as a transporting and operating chest. A steel frame, shock-mounted within the chest, supports Bearing Indicator BC–1338 and Goniometer Drive Unit RC–295. The front and rear covers are removable and

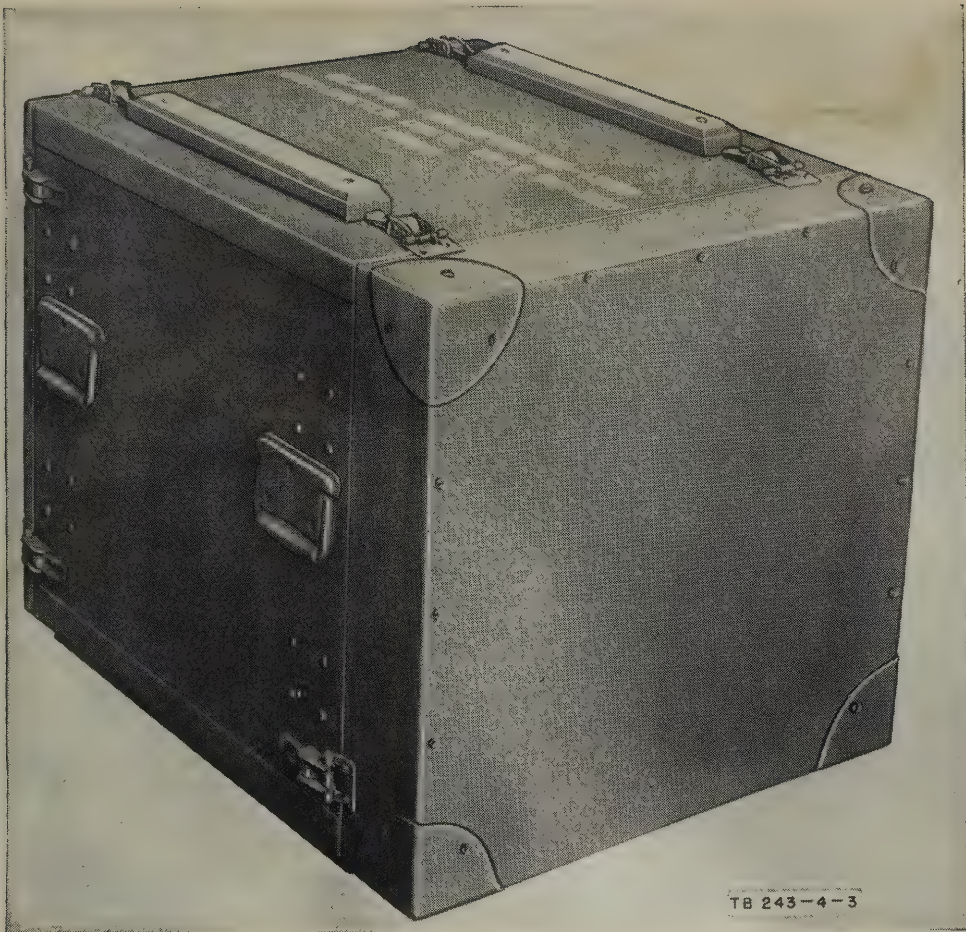


Figure 188. Chest CH–300, ready for transportation.

are secured by trunk catches while the chest is in transit. Cords CD–1349, CD–1351, CD–1352, CD–1392, and CD–1442 are fastened to the front removable cover during transportation. A complete cording diagram is included on the inside of the rear removable cover.

(1) Cord CD–1349 is a two-conductor, Buna S jacketed cord 10 feet long and has connector AN–3108–18–5S on one and Hubbell connector No. 9754 on the other. The cord connects Bearing Indicator BC–1338 to the 115-volt line through Junction Box JB–95–A.

(2) Cord CD–1351 is a three-conductor, shielded braid, Buna S jacketed cord, 5 feet long. Connector AN–3108–14S–1P is at one end of the cord and a connector AN–3106–14S–1P is on the other. The cord connects the diode output of Radio Receiver BC–1147–A to the control circuit of Bearing Indicator BC–1338.

(3) Cord CD–1352 is a three-conductor, Buna S jacketed cord, 30 inches long. Connector AN–3108–14S–1P is on one end of the cord and a connector AN–3106–14S–1S is on the other end of the cord. The cord connects the sense relay power from Bearing Indicator BC–1338 to Goniometer MC–412–A.

(4) Cord CD–1392 is a four-conductor, Buna S jacketed cord, 2 feet long, and has connector AN–3108–16S–8P at one end and a connector AN–3106–16S–8S at the other. The cord connects the goniometer drive motor to Bearing Indicator BC–1338.

(5) Cord CD–1442 is a four-conductor, shielded braid, Buna S jacketed cord, 30 inches long. A connector AN–3108–

14S–2S is on each end of the cord. The cord connects low-frequency voltages from Goniometer Drive Unit RC–295 to Bearing Indicator BC–1338.

d. CHEST CH–301 (fig. 191). This chest is a rugged, waterproof, plywood chest. The top cover is hinged and secured by trunk catches. The chest contains a rack which holds three cathode-ray tubes in one compartment and all other spare parts in another compartment.

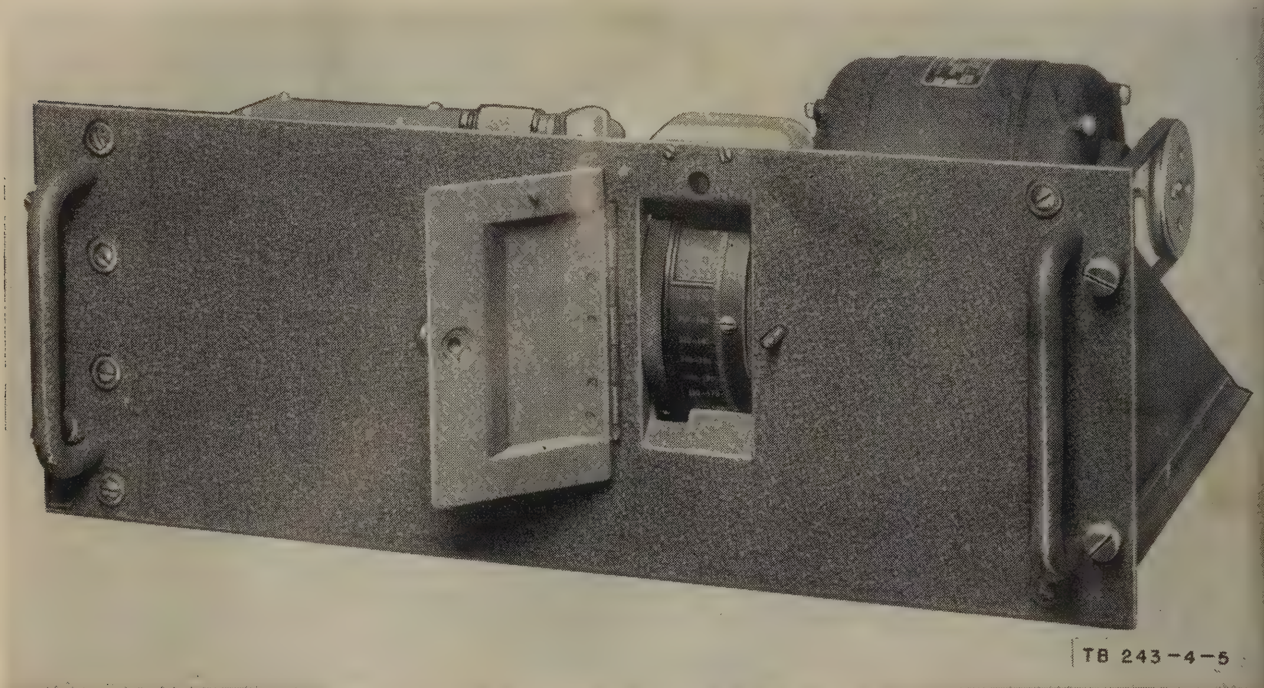


Figure 189. Goniometer Drive Unit RC–295, front view.

Section II. INSTALLATION

6. Unpacking, Uncrating, and Checking

Be very careful when unpacking or handling the equipment, because it may be damaged easily when not protected by the packing case. Do not apply pressure to the alidade assembly. In unpacking the indicator, follow the steps outlined below:

a. Place the packing case as near the operating location as convenient.

b. Cut the steel straps.

c. Remove the nails, using a nail puller, and remove the sides of the packing case.

d. Remove the top of the packing case and all protective wrappings.

e. Remove Chest CH–300 from its case.

f. Remove the front cover of the chest and remove the screws holding the indicator in place; pull the indicator forward gently.

g. Grasp the tubes in one hand and remove the masking tape with the other. This method of handling eliminates the possibility of damaging the prongs of the tubes or the sockets.

h. Follow the precautions outlined above when unpacking spare parts Chest CH–301.

i. While inspecting the equipment for damage after removal from the packing case, check the components against the master packing slip.

7. Removal of Waterproofing and Other Protective Coatings

When removing waterproofing and other protective coatings, be careful not to damage vital parts of the indicator kit. Do not scrape off moistureproofing and fungiproofing coatings.

8. Connections and Interconnections

Note. Steps *a* through *c* below are required only if Bearing Indicator BC–1159–A has been used for emergency operations.

a. Remove all cables from Bearing Indicator BC–1159–A and Goniometer MC–412–A.

b. Place Bearing Indicator BC–1159–A and Goniometer MC–412–A in Chest CH–162–A.

c. Remove Cords CD–840, CD–841, and CD–842 from Control Panel PN–31–A. Remove Cord CD–844 from Radio Receiver BC–1147–A and Control Panel PN–31–A. Place all the above cords in Chest CH–163–A.

d. Place Chest CH–300 (containing Bearing Indicator BC–1338 and Goniometer Drive Unit RC–295) on the operating table in the position formerly occupied by Bearing Indicator BC–1159–A and remove the front and rear covers (figs. 186 and 187).

e. Remove Cords CD–1349, CD–1351, CD–1352, CD–1392, and CD–1442 from the removable front cover of Chest CH–300.

f. Before connecting the cords, refer to the cording diagram on the inside of the rear cover of Chest CH–300. Also refer to figures 187, 190, and 193, which show cord receptacles.

Note. The typical cording diagram shown in figure 192 should *not* be used for installation. Use the specific cording diagram on rear cover of Chest CH–300, of the equipment being installed.

g. Reconnect r-f Cords CD–823, CD–826, CD–827, and CD–830 to Goniometer MC–412–A (attached to Goniometer Drive Unit RC–295) in the same positions they occupied on the goniometer previously attached to Bearing Indicator BC–1159–A.

h. Connect the sense power Cord CD–843 from receptacle J202 on the control panel to receptacle P802 on the rear of Bearing Indicator BC–1338.

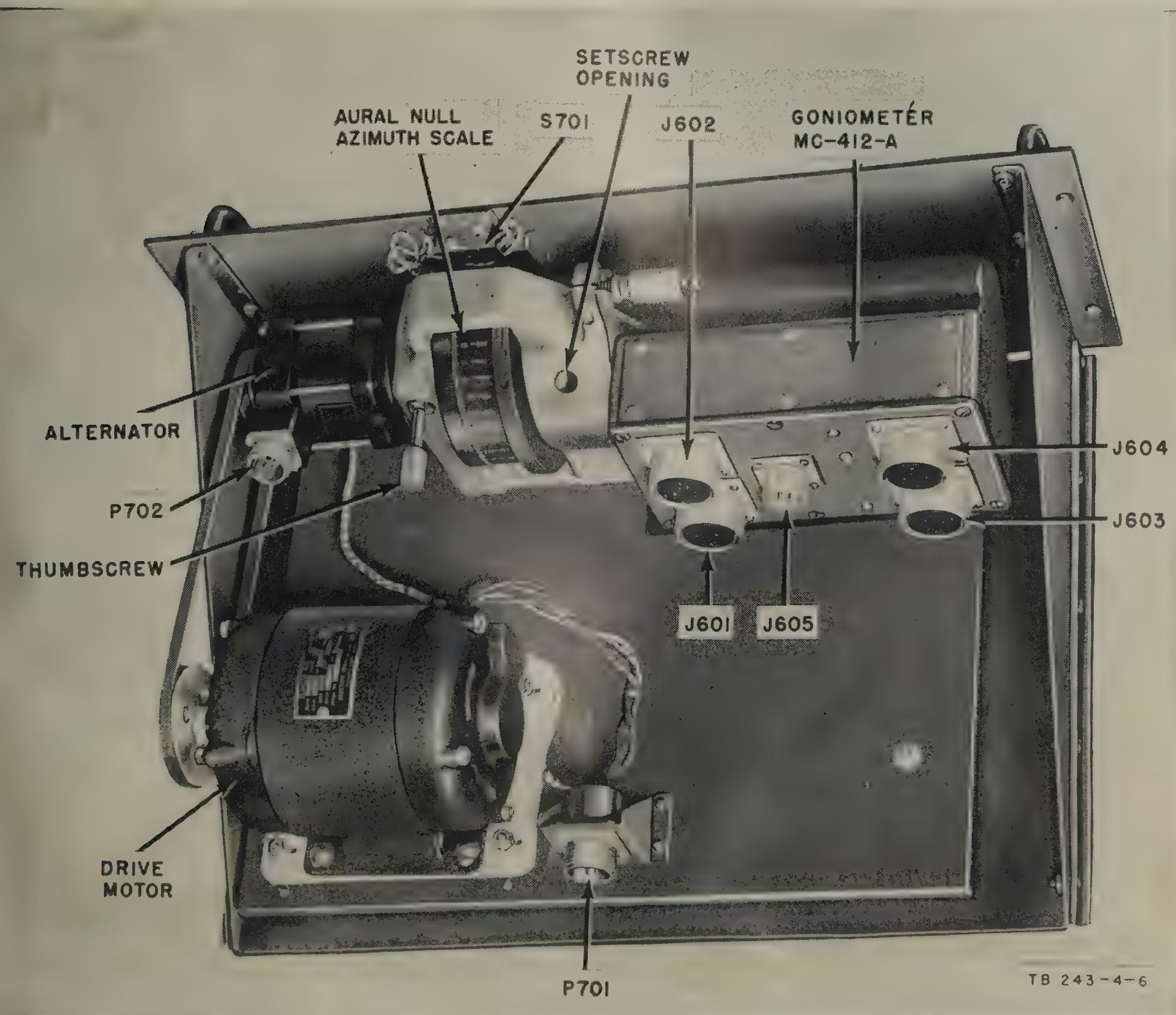


Figure 190. Goniometer Drive Unit RC–295, top view.

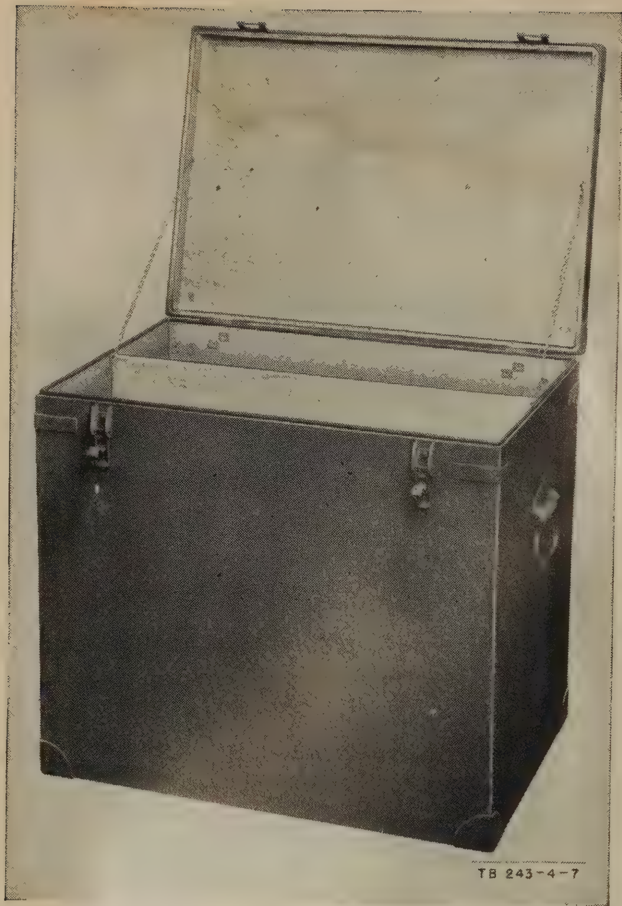


Figure 191. Spare parts Chest CH–301.

i. Connect Cord CD–1352 to receptacle J801 on the rear of Bearing Indicator BC–1338 and to receptacle J605 on Goniometer MC–412–A.

j. Connect Cord CD–1351 to receptacle J802 on the rear of Bearing Indicator BC–1338 and to receptacle J103 on Radio Receiver BC–1147–A.

k. Connect Cord CD–1442 to receptacle P801 on the rear of Bearing Indicator BC–1338 and to receptacle P702 on the alternator part of Goniometer Drive Unit RC–295.

l. Connect Cord CD–1392 to receptacle J803 on the rear of Bearing Indicator BC–1338 and to receptacle P701 on Goniometer Drive Unit RC–295.

m. Connect Cord CD–1349 to receptacle P803 on the rear of Bearing Indicator BC–1338 and to Junction Box JB–95–A.

9. Installation

a. TUBES. Remove the tubes from their packing cases, making certain that all tubes are in good physical condition. Figure 194 shows the proper location of each tube in the indicator. The correct tube type number is stamped at the side of each tube socket. When inserting tubes in their respective sockets, aline the guide of the tube pin with the slot in the tube socket and push the tube straight down.

b. CATHODE-RAY TUBE. Unscrew the three mounting screws which hold the alidade assembly to the front panel of the indicator, and remove the assembly. Insert the tube, base first, through the panel. Slowly rotate the tube until the key on the base of the tube fits into the slot on the socket. Then push the tube in as far as possible. Connect the snap connector on the tube shield to the third anode on the side of the cathode-ray tube. Replace the alidade assembly and tighten the supporting screws.

10. Repacking Information

Disconnect all cords from Bearing Indicator Kit MC–551. Unscrew the four screws which hold the bearing indicator in the rack. Slide the bearing indicator out and remove all the tubes (par. 48). Put the indicator back into the rack and screw it into place. Place Cords CD–1349, CD–1351, CD–1352, CD–1392, and CD–1442 on the front cover of Chest CH–300. Put the covers in place and lock. Place the tubes in their original cartons (or equal) and place in Chest CH–301. Pack snugly to prevent breakage; close the lid and lock.

Section III. CONTROLS AND THEIR USE

11. Indicator Panel Controls (fig. 195).

a. The OFF-POWER-ON switch controls the a-c power input to the bearing indicator and goniometer drive unit. Power is obtained directly from Junction Box JB–95–A and is *not* controlled by the main power switch on Control Panel PN–31–A. Operate both switches when shutting down or starting up the direction finder.

b. The STAND-BY-D/F switch provides normal operation of the indicator in the D/F position and cuts off power to the cathode-ray tube

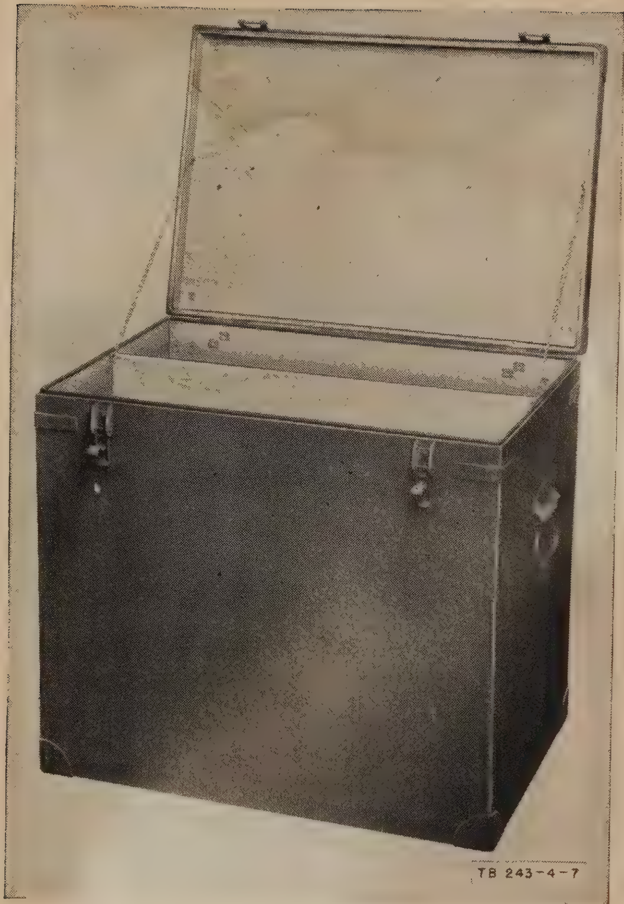


Figure 191. Spare parts Chest CH–301.

i. Connect Cord CD–1352 to receptacle J801 on the rear of Bearing Indicator BC–1338 and to receptacle J605 on Goniometer MC–412–A.

j. Connect Cord CD–1351 to receptacle J802 on the rear of Bearing Indicator BC–1338 and to receptacle J103 on Radio Receiver BC–1147–A.

k. Connect Cord CD–1442 to receptacle P801 on the rear of Bearing Indicator BC–1338 and to receptacle P702 on the alternator part of Goniometer Drive Unit RC–295.

l. Connect Cord CD–1392 to receptacle J803 on the rear of Bearing Indicator BC–1338 and to receptacle P701 on Goniometer Drive Unit RC–295.

m. Connect Cord CD–1349 to receptacle P803 on the rear of Bearing Indicator BC–1338 and to Junction Box JB–95–A.

9. Installation

a. TUBES. Remove the tubes from their packing cases, making certain that all tubes are in good physical condition. Figure 194 shows the proper location of each tube in the indicator. The correct tube type number is stamped at the side of each tube socket. When inserting tubes in their respective sockets, aline the guide of the tube pin with the slot in the tube socket and push the tube straight down.

b. CATHODE-RAY TUBE. Unscrew the three mounting screws which hold the alidade assembly to the front panel of the indicator, and remove the assembly. Insert the tube, base first, through the panel. Slowly rotate the tube until the key on the base of the tube fits into the slot on the socket. Then push the tube in as far as possible. Connect the snap connector on the tube shield to the third anode on the side of the cathode-ray tube. Replace the alidade assembly and tighten the supporting screws.

10. Repacking Information

Disconnect all cords from Bearing Indicator Kit MC–551. Unscrew the four screws which hold the bearing indicator in the rack. Slide the bearing indicator out and remove all the tubes (par. 48). Put the indicator back into the rack and screw it into place. Place Cords CD–1349, CD–1351, CD–1352, CD–1392, and CD–1442 on the front cover of Chest CH–300. Put the covers in place and lock. Place the tubes in their original cartons (or equal) and place in Chest CH–301. Pack snugly to prevent breakage; close the lid and lock.

Section III. CONTROLS AND THEIR USE

11. Indicator Panel Controls (fig. 195).

a. The OFF-POWER-ON switch controls the a-c power input to the bearing indicator and goniometer drive unit. Power is obtained directly from Junction Box JB–95–A and is *not* controlled by the main power switch on Control Panel PN–31–A. Operate both switches when shutting down or starting up the direction finder.

b. The STAND-BY-D/F switch provides normal operation of the indicator in the D/F position and cuts off power to the cathode-ray tube

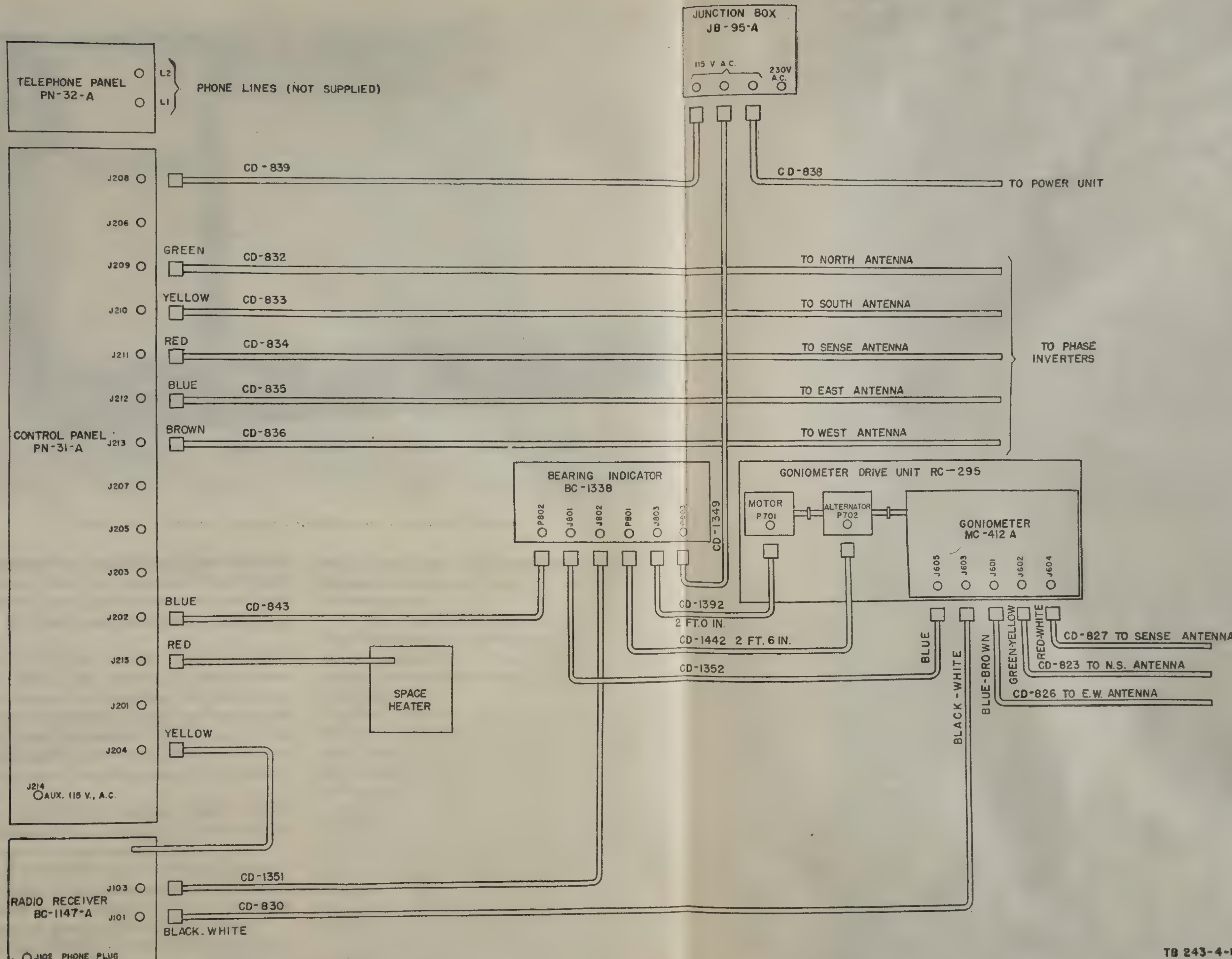


Figure 192. Bearing Indicator Kit MC–551, typical cording diagram.

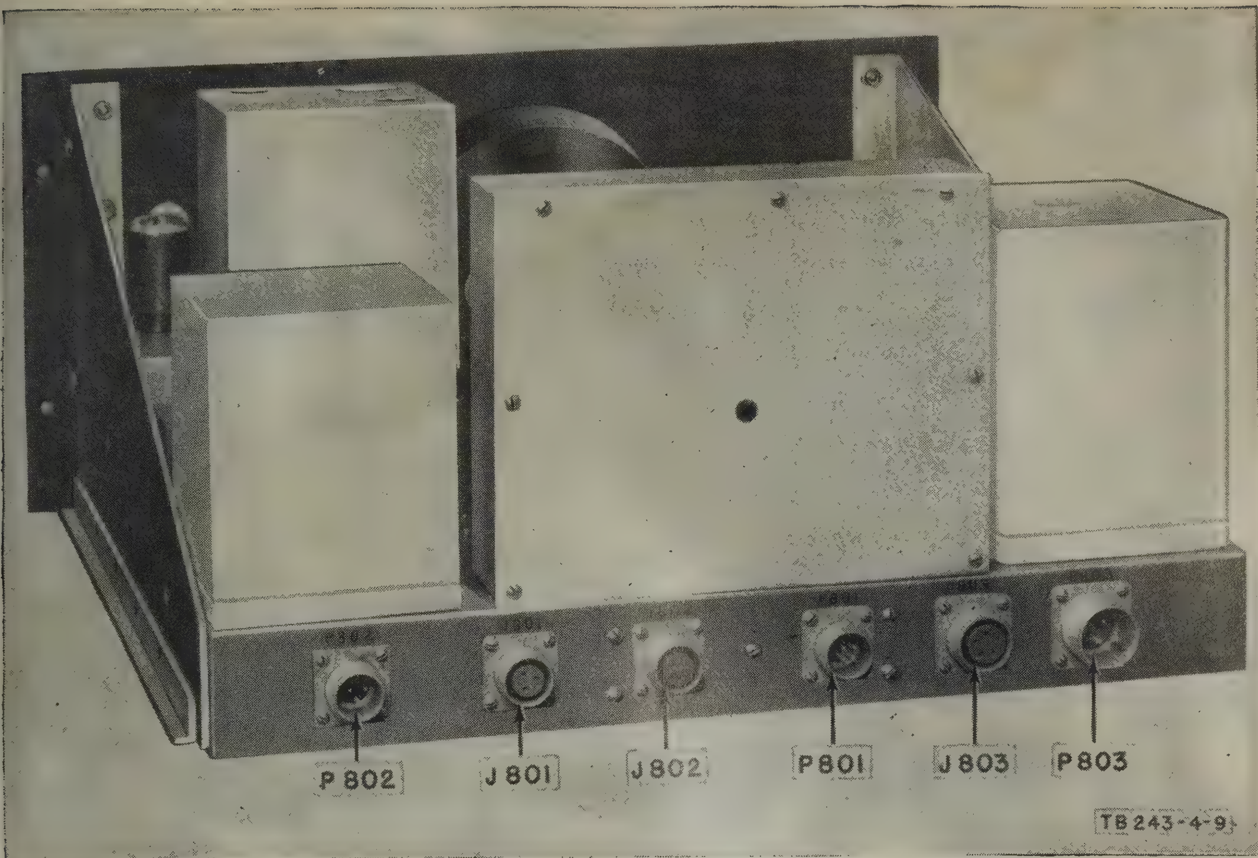


Figure 193. Bearing Indicator BC–1338, rear receptacles identified.

and the goniometer drive motor in the STAND-BY position. With the switch at STAND-BY, the equipment may be used for aural-null indication of the bearing as described in paragraph 17.

c. The PATTERN SIZE control (R849) varies the size of the pattern on the cathode-ray tube screen by changing the amount of 200-kc voltage applied to the control modulator.

d. The FOCUS control (R845) varies the focus of the cathode-ray tube pattern by changing the voltage on the first anode of the cathode-ray tube.

e. The INTENSITY control (R847) varies the brightness of the pattern by controlling the grid voltage of the cathode-ray tube.

f. The H-CENTER and V-CENTER controls (R839 and R840) vary the horizontal and vertical positions of the pattern on the horizontal and vertical deflection plates, respectively.

g. The BALANCE controls (R830 and R833) affect the separation of the two circular patterns on the cathode-ray tube screen by varying the bias on each pair of balanced modulator tubes. Balance is achieved when the two circles are superimposed.

h. The PATTERN SHAPE control (R805) affects the shape of the circular pattern by varying the amount of l-f voltage (47 cycles) applied to one of the phase inverters from the two-phase alternator.

i. The azimuth scale on Bearing Indicator BC–1338 will hereafter be referred to as *azimuth scale.* The azimuth scale on Goniometer Drive Unit RC–295 will be referred to as *aural-null azimuth scale.*

Note. When Bearing Indicator Kit MC–551 is used, the CIRCLE DIAM control on Control Panel PN–31–A is not used. The MOTOR switch on the control panel should be left in the OFF position and the HEATER switch should be used to operate the lamp type heater in the rear of Rack FM–61–A when necessary.

12. Other Indicator Controls (fig. 196)

a. VOLTAGE CONTROL (R869). This potentiometer controls the value of the B voltage and is normally adjusted for 300 volts.

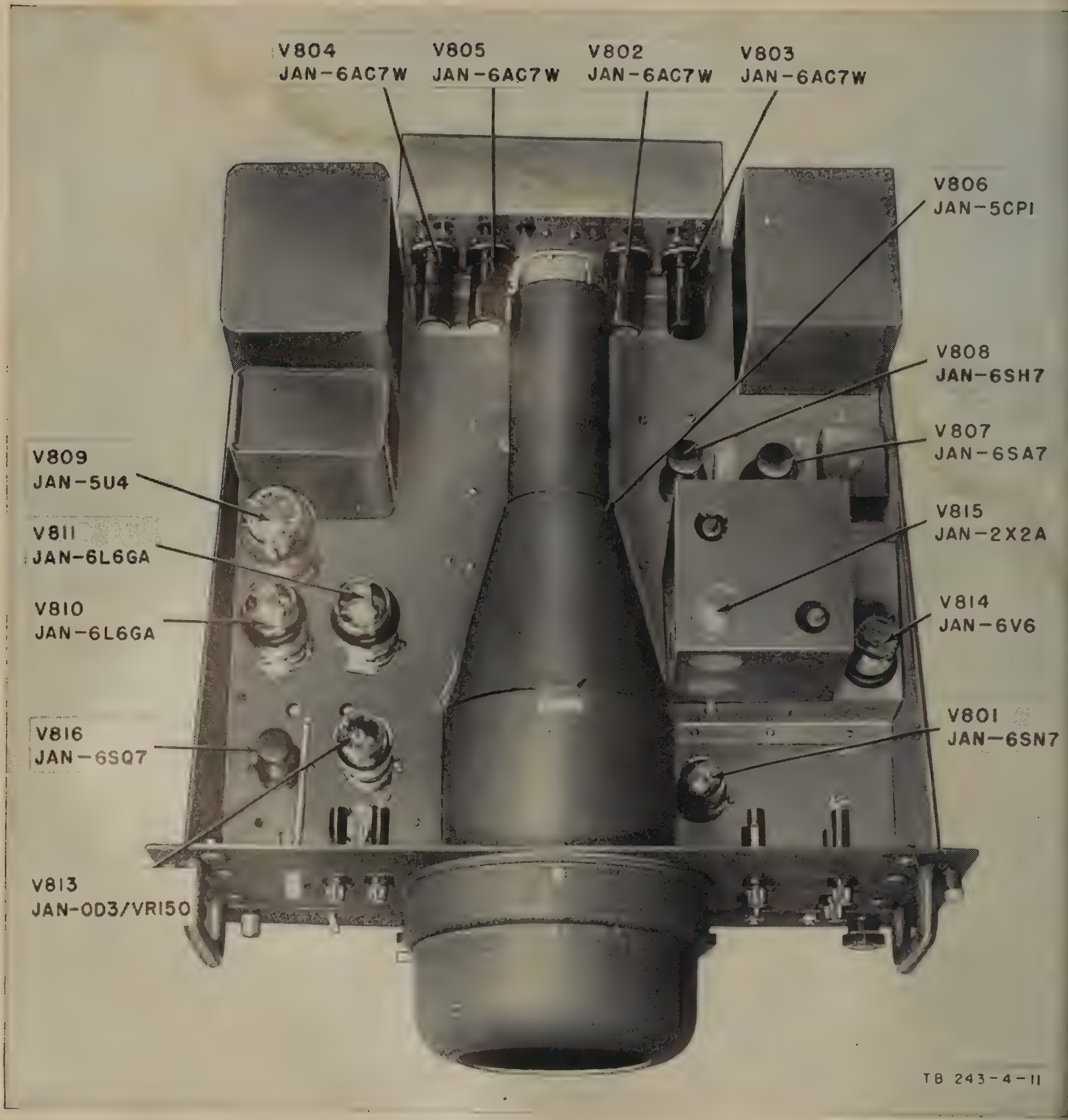


Figure 194. Bearing Indicator BC–1338, tube locations.

b. HUM ADJUSTMENT CONTROL (R865). This control is essentially a hum-balance control; it is adjusted for minimum hum as indicated by minimum flickering of the circular pattern on the cathode-ray tube screen.

c. HORIZONTAL AND VERTICAL DIFFERENTIAL INDUCTANCE ADJUSTMENTS (L801 AND L802). These adjustments vary the position of an iron core in the plate coils of the balanced modulators and effectively balance the inductance of the two halves of the coils.

d. HORIZONTAL AND VERTICAL BALANCE MODULATOR TUNING CONTROLS (C817A AND C816A). These controls vary the capacitors which are shunted across the balanced modulator coils and resonate the coils to the oscillator frequency (200 kc).

e. HORIZONTAL AND VERTICAL BALANCE

MODULATOR DIFFERENTIAL CAPACITORS (C817B AND C816B). These controls vary the differential capacitors across the balanced modulator coils. They neutralize the internal capacities existing between the deflection plates of the cathode-ray tube.

f. R-F POWER SUPPLY GRID TUNING CAPACITOR (C836). This control is a variable capacitor which tunes the grid coil of the 200-pc oscillator Tube JAN–6V6GT.

g. R-F POWER SUPPLY PLATE TUNING CAPACITOR (C844). This control is a variable capacitor. Its tuning does not materially affect the frequency of the oscillator. Its function is to resonate the plate circuit of the 200-kc oscillator Tube JAN–6V6GT, so that maximum energy is coupled to the high-voltage secondary. It is adjusted to the point at which the high voltage at the grid of the cathode-ray tube is 2,000 volts with approximately minimum oscillator plate current.

h. COMPENSATING CONTROL (R801) WHEN CHANGING CATHODE-RAY TUBES. In the production of cathode-ray tubes, the deflection plates are not always placed in exact quadrature. This control, R801, compensates for the error in cathode-ray tubes and has a range of approximately $\pm 5°$. (See par. 48*a* before replacing the cathode-ray tube.)

i. BIAS CONTROLS (R882 AND R883). These controls are used in conjunction with the BALANCE controls (R830 and R833) to aline the balanced modulator circuits.

Section IV. OPERATION

13. Starting Procedure

Warning: When the indicator is removed from Chest CH–300, circuits carrying voltages dangerous to life are exposed. Never remove the indicator unless the power switch on the indicator panel is OFF, except as specifically directed.

a. Before proceeding, recheck all cords and make certain they are connected properly. Check

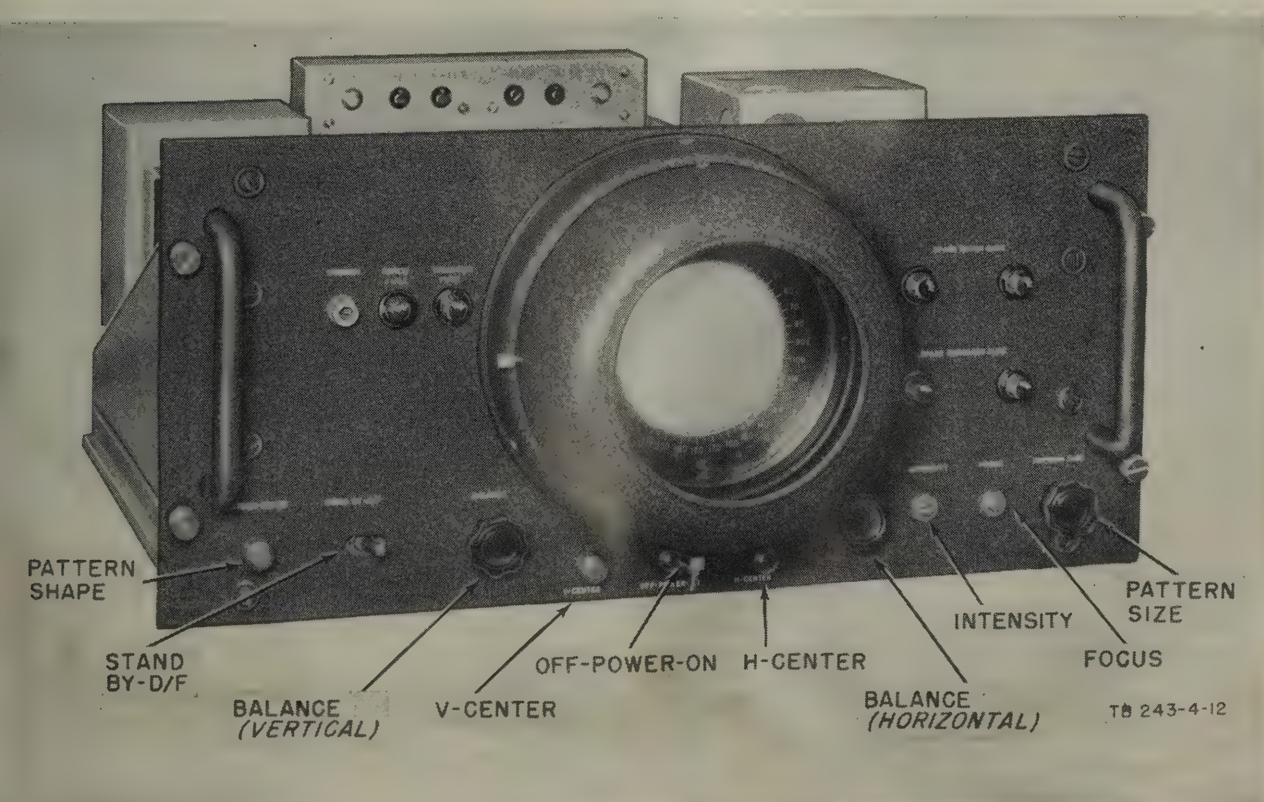


Figure 195. Bearing Indicator BC–1338, panel controls.

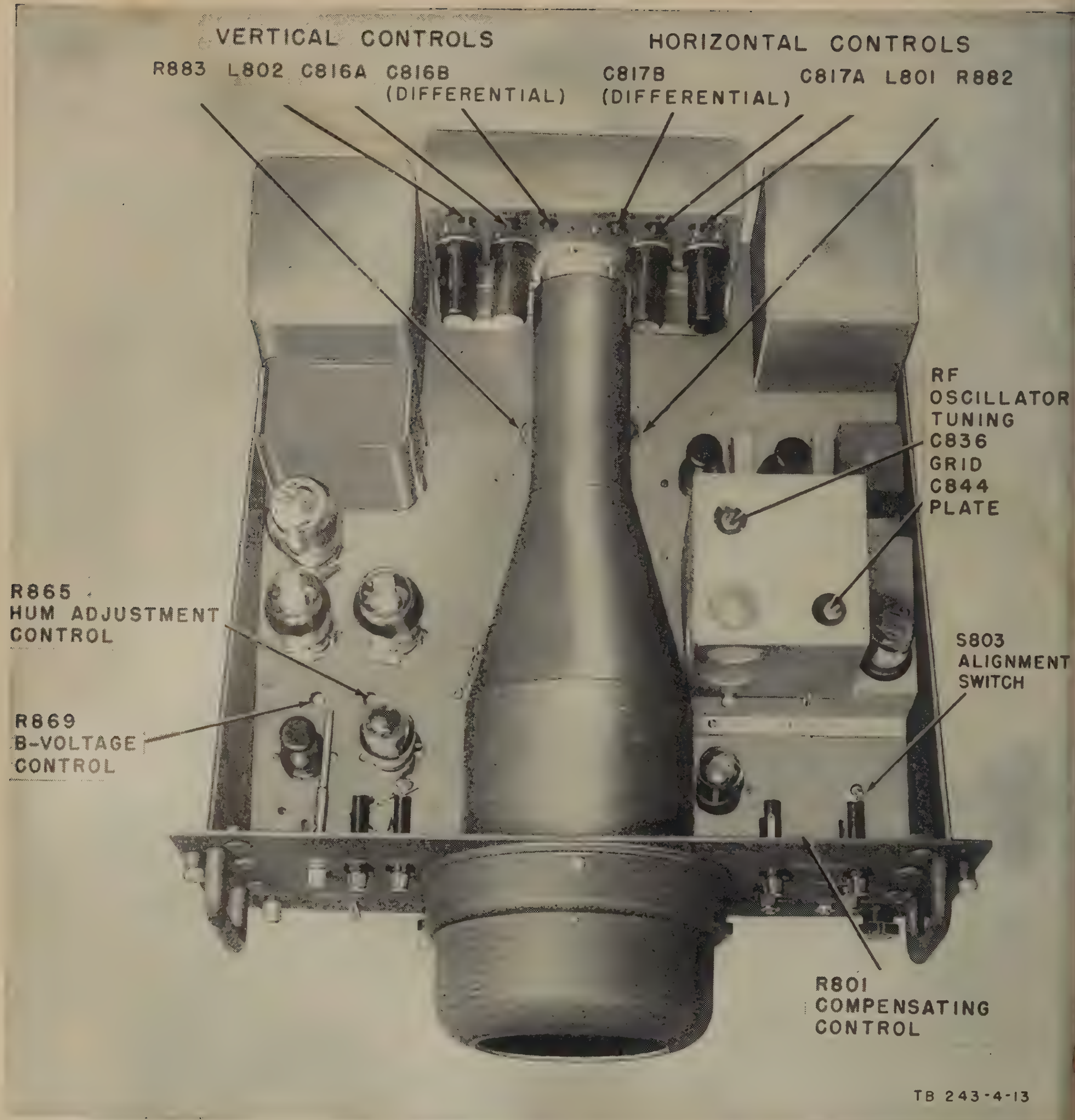


Figure 196. Bearing Indicator BC–1338, alinement controls.

against the cording diagram on the removable rear cover of Chest CH–300. The incorporation of Bearing Indicator Kit MC–551 in place of Bearing Indicator BC–1159–A does not affect the operation of the rest of the system. All precautions and procedures set forth in part two of this manual must be observed.

b. Turn the master power switch of Control Panel PN–31–A to ON and adjust the SENSITIVITY control on Radio Receiver BC–1147–A to 0.

c. Turn the POWER switch on the front panel of Bearing Indicator BC–1338 to the ON position and the STAND-BY–D/F switch to D F.

d. Allow Bearing Indicator BC–1338 to warm up for approximately 5 minutes.

14. Preliminary Alinement Instructions

Note. If the PATTERN SIZE control does not provide a large enough pattern, readjust the high-voltage power supply (par. 50*b*) and the balanced modulators (par. 50*c* and *d*). If the BALANCE and/or the PATTERN SHAPE controls cannot be properly adjusted, as called for in subparagraphs d and e below, readjust the balanced modulators (par. 50*c* and *d*). If any of the above adjustments fail to permit proper operation of the indicator, the equipment is defective and the procedure described in sections XI and XII of this appendix should then be followed.

a. Turn the PATTERN SIZE control to zero and adjust the FOCUS and INTENSITY controls until a sharp dot appears.

b. Adjust the H-CENTER and V-CENTER controls until the dot is exactly at the intersection of the two crossed hairlines.

c. Adjust the PATTERN SIZE control until the two circular patterns are about 2½ inches in diameter.

d. Adjust the BALANCE controls on the front panel of the indicator until the two circular patterns are superimposed.

e. Adjust the PATTERN SHAPE control until the patterns are as nearly circular as possible.

f. Turn the PATTERN SIZE control to zero and recheck the position of the small dot. If the small dot is not centered at the intersection of the crossed hairlines, readjust the centering controls until it is. Then increase the PATTERN SIZE control until the pattern just comes to the inner edge of the azimuth scale. Readjust the FOCUS and INTENSITY controls for the most comfortable brilliance and sharpness.

g. Advance the SENSITIVITY control on Radio Receiver BC–1147–A until noise begins to appear around the edges of the circular pattern.

h. Readjust the PATTERN SIZE control until the circular pattern just comes to the inner circumference of the azimuth scale.

i. Check the goniometer alinement as follows:

(1) If possible, tune in a strong, steady 5-mc ±0.5-mc signal of known azimuth which gives a steady pattern. If no satisfactory signal is found, use the target transmitter, placing it about 500 feet from the north antenna in line with the north-south antenna.

(2) Turn OFF the 90°, 180°, and 270° switches on Control Panel PN–31–A leaving the 0° switch ON, and 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. To correct any discrepancy, loosen the four screws on the front panel of Goniometer Drive Unit RC–295 and slide the unit forward about 6 inches. Loosen the thumbscrew (fig. 190) which holds the alternator in position, and rotate the alternator frame until the points of the bearing pattern are exactly at 0° and 180°. Tighten the thumbscrew, slide the drive unit back into position, and tighten the four panel screw.

(4) Turn ON the 90°, 180°, and 270° switches on Control Panel PN–31–A, and throw the STAND-BY – D.F. – SENSE switch to the SENSE position. Adjust the SENSE GAIN control to provide a good sense pattern. The pattern should point in the direction of the signal source.

j. If reversed sense is observed, or if the goniometer cannot be alined because the range of adjustment of the alternator is inadequate, then the relative position of the goniometer with respect to the alternator must be shifted as follows:

(1) Rotate the alternator frame to mid-position (connector P702 approximately horizontal).

(2) Note the number of degrees the pattern should be rotated to read 0° – 180° with the correct sense.

(3) Throw the STAND-BY–D/F switch to STAND-BY, and slide the goniometer drive unit forward about 8 inches.

(4) The coupling mechanism between the goniometer and the alternator is located in the main casting to the right of the goniometer. The male half of the coupling is permanently attached to the goniometer. The mating half of the coupling is mounted on the end of the main shaft and is held in position by two 1/16-inch hexagonal socket screws (No. 6) which are positioned

radially with respect to the shaft and at right angles to each other. The setscrews are accessible, one at a time, through a hole in the top of the casting (fig. 190).

(5) Loosen one of the screws, rotate the shaft until the second setscrew is accessible, place the wrench in the socket of the second screw, and note the bearing indicated on the aural-null scale to provide a reference point.

(6) Loosen the second setscrew but keep the Allen wrench in the socket to prevent the goniometer from rotating, and then rotate the azimuth scale by the number of degrees noted in (2) above. Tighten the two setscrews. For example, if the bearing indicated in (2) is 240°, rotate the aural-null scale 120° in the direction of increasing numbers. However, if the bearing in (2) is less than 180°, rotate the aural-null scale in the opposite direction by the number of degrees indicated.

(7) Check the goniometer alinement in accordance with *i* above.

k. Check the orientation of the aural-null azimuth scale located on Goniometer Drive Unit RC–295 (par. 18).

l. The use of Bearing Indicator Kit MC–551 imposes more stringent requirements on the alinement of Radio Receiver BC–1147–A. Receiver realinement is necessary if the bearing on a steady signal varies by more than 1° as the receiver is tuned back and forth through resonance between points where a noticeable decrease in audio output can be detected. Refer to chapter 4, paragraphs 188 and 189.

15. Operating Instructions

The use of Bearing Indicator Kit MC–551 in place of Bearing Indicator BC–1159–A does not change the operation of Radio Set SCR–291–A for obtaining instantaneous visual indications of the bearing. Operation to obtain bearings by aural-null indication is given in paragraph 17.

16. Pattern Interpretation

a. General. The pattern interpretation of Bearing Indicator BC–1338 is essentially the same as for Bearing Indicator BC–1159–A, the most important difference being a solid filled-in pattern instead of the outline type. The solid pattern may seem strange at first, but after a few hours of observation, it will be found that the solid pattern is actually easier to read than the open type pattern of Bearing Indicator BC–1159–A.

b. Separated Patterns. In some instances the signal patterns will separate slightly due to stray signal pickup. To take a bearing, position

Figure 197. Bearing pattern, showing split.

Figure 198. Bearing pattern, showing noisy signal.

Figure 199. Bearing pattern, showing ideal signal.

the alidade hairline at the intersection of the split (fig. 197).

c. Sense. Turn the STAND-BY – D.F. – SENSE switch to SENSE. The resulting pattern will point toward the azimuth from which the signal is actually arriving.

d. Typical Bearing Patterns. Bearing patterns obtained under various conditions of operation are shown in figures 197 through 201.

Figure 200. Pattern with no signal.

17. Aural-null Operation

a. In cases of emergency operations, such as when failure of Bearing Indicator BC–1338 occurs, or when conditions are adverse to instantaneous visual bearing indications, Bearing Indicator Kit MC–551 may be operated as an aural-null indicator by manually rotating the goniometer.

b. Throw the STAND-BY–D/F switch to the STAND-BY position.

c. Open the door on the front panel of Goniometer Drive Unit RC–295.

Warning: *Do not* touch the azimuth scale while it is spinning. The knurled handwheel is like a buzz-saw.

d. Tune the receiver to the desired signal and adjust the ANT. COMP. control for maximum output.

e. Rotate the azimuth scale handwheel until a null or minimum in signal output from the loudspeaker is observed. Rock the handwheel back and forth to determine the extremes of the null and then set the handwheel as close to the center of the null as possible.

f. The line of bearing of the received signal is indicated by the index alongside the aural-null azimuth scale. Sense, or the determination of the direction of the bearing, is obtained as follows:

(1) Throw the STAND-BY–D.F.–SENSE

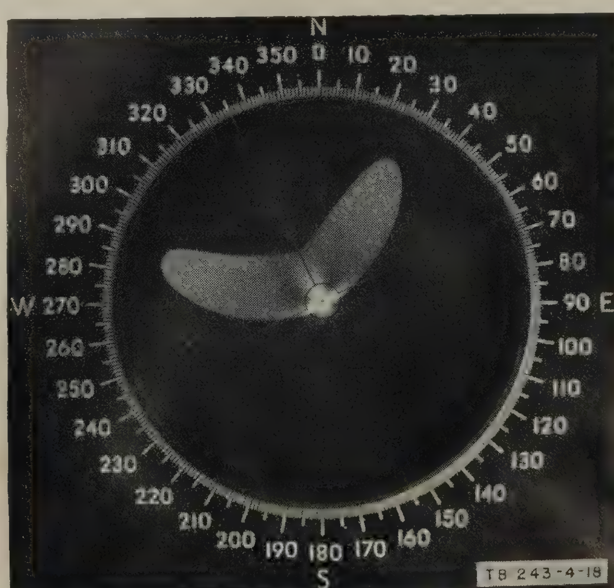


Figure 201. Typical sense pattern.

switch on Control Panel PN–31–A to the SENSE position and hold it there.

(2) Note the signal output level and then rotate the handwheel to either side of the bearing (not more than 90°) until a definite *decrease* in signal level is observed.

(3) If the direction of rotation to the decrease in signal is *upward* (increasing numbers on the azimuth scale), the bearing (*e* above) is *direct* and is read off the *white* scale; if the direction of rotation is *downward*, the bearing is reciprocal and is read off the *red* scale.

18. Aural-null Orientation

a. Bearing Indicator Kit MC–551 is adjusted at the factory to provide the same bearing on a given signal when using either visual indication or aural-null indication. Rotating the alternator frame for orientation of the pattern on the cathode-ray tube screen simultaneously moves the index against which the aural-null azimuth scale is read and thereby provides the same orientation for aural-null indication.

b. Check the aural-null orientation by comparing an aural-null bearing to a visual indicator bearing obtained on the same target transmitter signal. These two bearings should coincide.

(1) Discrepancies of less than 5° can be corrected by shifting the index wheel. This wheel is held in position by a single 5/64-inch hexagonal socket screw (No. 8) located diametrically opposite the index.

(2) Discrepancies greater than 5°, which are likely to occur when the goniometer or the alternator is replaced, can be roughly corrected by shifting the aural-null azimuth scale with respect to the shaft. The scale is held on the shaft by four 5/64-inch hexagonal socket screws (No. 8) located on the edge of the handwheel. Loosen these setscrews, rotate the goniometer to the null by moving the drive belt or pulley, set the azimuth scale approximately to the correct bearing, and tighten the setscrews. For fine adjustment, shift the index wheel as described above.

(3) Check the sense indication. If reversed sense is observed, shift the aural-null azimuth scale 180° with respect to the shaft.

Caution: When making aural-null adjustments, do not change the position of the alternator, which was set in accordance with paragraph 14*i* above.

19. Stopping Procedure

Turn the OFF-POWER-ON switch on the front panel of the bearing indicator to OFF. Then turn the master power switch located on Control Panel PN–31–A to OFF.

Section V. EQUIPMENT PERFORMANCE CHECKLIST

20. Purpose and Use of Checklist

a. General. The equipment performance checklist (par. 21) will help the operator determine whether Bearing Indicator BC–1338 is functioning properly. The checklist gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerance of correct operation, and the corrective measures that the operator can take. Item 1 is checked before starting, item 2 when starting, items 3 through 9 during operation, and item 10 when stopping. Items 3 through 9 should be checked at least once an hour during normal operation.

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

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

d. CORRECTIVE MEASURES. The corrective measures listed are those that the operator can make without turning in the equipment for repairs. Reference in the table to sections XI, XII, and XIII of this appendix indicates that the correction of the trouble cannot be effected 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 possible.

e. ITEMS 1 THROUGH 3. Items 1 through 3 should be checked each time the equipment is put into operation.

f. ITEMS 2 AND 3. Items 2 and 3 represent general operating characteristics of the indicator. 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 whine of the drive unit, pattern appearance, etc., when the set is not operating properly.

g. ITEMS 4 THROUGH 9. The operator should familiarize himself with the operation of Bearing Indicator Kit MC–551 so that he knows the characteristics of its reception of normal signals. By becoming familiar with the operation of the indicator, the operator will know the normal appearance of the pattern. This will aid in determining the correctness of readings of the indicator.

h. ITEM 10. Item 10 is checked whenever the station 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.

i. PRECAUTIONS. At frequent intervals during the first hour of operation and at hourly intervals thereafter, check all adjustments indicated in paragraph 14. Pay particular attention to the superimposed patterns which may split slightly because of temperature changes, line voltage variations, and other factors which cannot be controlled. Whenever such a split becomes apparent, turn the receiver SENSITIVITY control to zero and readjust the indicator BALANCE controls so that the circles are superimposed.

j. OBSERVATIONAL CHECK.

(1) The superposition of the two circles should be checked at least each hour or more often if unbalance becomes more apparent.

(2) Check the circle alinement whenever focus or intensity is varied. Make certain that the small dot in the center of the circle is always lined up with the intersection of the crossed hairlines.

(3) Check the circle size hourly and keep it adjusted so that the circular pattern just comes to the inner circumference of the azimuth scale.

k. DAILY CHECK. Follow the instructions outlined in paragraph 14 each day to insure optimum operation.

21. Equipment Performance Checklist

	Item No.	Item	Action or condition	Normal indications	Corrective measures
START	1	Cords	All cords must check with cording diagram.		
	2	OFF-ON switch	Turn power switches on indicator and control panel to ON.	Dial lamps light	Check fuse F802. Check lamps.
EQUIPMENT PERFORMANCE	3	STAND-BY-D/F switch	Turn to D/F	Motor runs. Circular pattern means no signal. Propeller shaped pattern indicates signal.	Check fuse F801. See sections XI, XII, XIII.
	4	H-balance, V-balance	Turn left and right	Superimposes the two patterns.	See sections XI, XII, and XIII.
	5	PATTERN SHAPE	Turn	Makes pattern circular	See sections XI, XII, and XIII.
	6	PATTERN SIZE	Turn	Changes size of pattern	See sections XI, XII, and XIII.
	7	H-CENTER, V-CENTER	Turn	Changes position of pattern.	See sections XI, XII, and XIII.
	8	INTENSITY	Turn	Changes brightness of pattern.	See sections XI, XII, and XIII.
	9	FOCUS	Turn	Regulates sharpness of pattern.	See sections XI, XII, and XIII.
STOP	10	OFF-ON switch	Turn power switches on indicator and control panel to OFF. Turn STAND-BY-D/F switch to STAND-BY.	Motor stops running, lamps go out, and pattern disappears.	Pull out power plug. See sections XI, XII, and XIII.

Section VI. PREVENTIVE MAINTENANCE TECHNIQUES

22. Meaning

For information on preventive maintenance techniques, refer to chapter 3 of this manual.

Section VII. ITEMIZED PREVENTIVE MAINTENANCE

23. Introduction

For ease and efficiency of performance, PM of Bearing Indicator Kit MC–551 will be broken down into operations that can be performed at different time intervals. In this section the PM work to be performed on the radio set at the specified time intervals is broken down into units of work called items. The general techniques involved and the application of the FITCAL operations in performing PM on individual parts are discussed in chapter 3 of this manual. These general instructions are not repeated in this section. When performing preventive maintenance, refer to part 3 if more information is required for the items in this section. Perform all work with the power removed from the equipment. After PM has been performed on a given day, put the equipment into operation and check it for satisfactory performance (par. 22).

24. Preventive Maintenance Tools and Materials

PM tools and materials are listed in chapter 3.

25. Item 1, Exterior Of Bearing Indicator Kit MC–551

Operations—

IT—Panel screws.
IT—Control knobs.
IT—Alidade support screws.
ITC—Cords.

Remarks: With an Allen wrench, tighten all loose control knobs. Four Allen wrenches are provided in spare arts Chest CH–301. An adjusting tool is located on the front panel of the bearing indicator. Choose a wrench of proper size.

26. Item 2, Interior Of Bearing Indicator BC–1338

Preliminary steps—Remove the indicator from the chest. Make sure all cords are disconnected from the rear of the indicator. Remove all shield covers and dust plates.

Operations—

ITC—Tubes and sockets.
ITC—Capacitors.
ITC—Resistors.
ITC—Rheostats and potentiometers.
ITC—Bushings and insulators.
ITC—Switches.
I—Cables.
IC—Relays.
IT—Couplings.
ITC—Coils.
ITC—Terminal blocks.

27. Item 3, Interior Of Goniometer Drive Unit RC–295

Preliminary steps—Remove all cords from the rear of the drive unit. Remove the unit from Chest CH–300.

Operations—

ITC—Chassis.
ITC—Motor.
ITCA—Alternator.
ITC—Goniometer.
ITC—Pulleys.
FICA—Drive belt.
ITC—Pilot light.
ITCA—Aural-null scale.

28. Preventive Maintenance Checklist

a. GENERAL. The following checklist is a summary of the PM operations to be performed on Bearing Indicator Kit MC–551. The time intervals shown on the checklist may be reduced at any time by the local commander. For best performances of the equipment, perform operations at least as frequently as called for in the checklist. Operations are indicated by the letters 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	Daily	Weekly	Monthly	Performed by
1	ITC	Exterior of indicator kit		X			O
2	ITC	Interior of bearing indicator			X		O
3	FITCA	Interior of goniometer drive unit			X		O
3	ITC	Motor			X		O
3	FICA	Belt			X		O
3	ITCA	Alternator	X				
3	ITC	Goniometer	X				
1	IT	All screws			X		O
1	IT	Control knobs				X	O
3	ITCA	Aural-null scale	X				
1	ITC	Cords	X	X			
3	IT	Check alinement (par. 14*i*)	X	X			

Note. X indicates when operations are to be performed. O indicates operator.

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

b. Bearing Indicator BC–1338. This is a precision instrument and must be periodically inspected and checked after the initial installation.

c. Daily Inspection.

(1) Check line voltage.

(2) Check circle roundness.

(3) Check circle alinement.

(4) Check orientation.

d. Hourly Check. During the first hour of operation the superimposed circular patterns may split slightly because of the long warm-up period. When this happens, turn the receiver SENSITIVITY control down and readjust the BALANCE controls so that the circles are superimposed. After the first hour of operation, the superimposed circles will remain quite stable, but it is well to check them every hour or whenever it becomes necessary. A bearing taken when the circles are not exactly superimposed will be accurate if the bearing is taken at the intersection of the split pattern.

e. Goniometer MC–412–A. The goniometer will seldom, if ever, require servicing. Interior connections are accessible through the side opening by removing the side cover plates (fig. 16).

29. General Overhaul Inspection

a. General. General overhaul inspection includes a complete examination of the equipment as to the condition of the internal wiring, mechanical and general electrical operation, and the necessary cleaning to remove any dust inside. The intervals at which such inspection is required depend largely upon service conditions and upon whether or not faults have developed. For example, cleaning is required more often when the equipment is used in areas subject to dust or sand storms than when it is used in areas free from these conditions. An overhaul inspection is recommended as a precautionary measure after the first or second month of operation and then at intervals of 3 to 6 months, depending upon how often the equipment has been removed from its container. Major repairs, electrical alinements, and most replacements of circuit components should not be attempted in the field but rather at a depot base equipped with adequate laboratory equipment. In general, the less the equipment is tampered with the better, except to clean it, locate trouble, and correct for short or open circuits. In the event of trouble which has been traced to a particular component, first check the tubes and then analyze the circuit voltages and resistances (fig. 202).

b. Electrical Inspection.

(1) See that all dial and pilot lamps light when the respective switches are turned on. Make replacements if necessary.

(2) Check electrical and mechanical operation of all switches and controls.

(3) Check all tubes with a suitable tube checker and replace all which are less than 75 percent normal. In replacing tubes, be sure they are well seated and that the pins and contacts are clean. When cleaning is required, use carbon tetrachloride on a soft cloth or brush; No. 0000 sandpaper may be used carefully but never use emery cloth.

c. Mechanical Inspection.

(1) Disconnect the cables and remove the units from the rack; remove bottom and rear plates; examine and, if possible, repair component parts and wiring.

(2) If more than two strands of a stranded conductor are broken at the soldered joint, cut off the defective lead as close to the joint as possible and resolder.

(3) Clean tube socket contacts, tube base pins, and contact elements of cable plugs and receptacles. If necessary, use carbon tetrachloride on a cloth or brush. Never use emery cloth.

(4) Clean out dust, chips, and loose solder, if any, from repaired areas, and check for traces of corrosion. Clean and touch up where necessary.

(5) Tighten all loose nuts, bolts, and screws on chassis and on panels of all units. Do not tamper with glyptal-coated screws unless it is certain that they are loose. In that case remove the old glyptal, tighten the screw, and recoat with fresh glyptal.

(6) Check tightness of control knob setscrews with proper Allen head wrench from Chest CH–301.

(7) Reassemble and attach all cover plates

and shields. Be sure to replace all screws and lockwashers.

(8) Replace each unit in its proper operating position, securely connect all cables, and check over-all performances as given in paragraph 14.

Section VIII. LUBRICATION

Note. No lubrication is required for Bearing Indicator Kit MC–551. All bearings connected with rotating parts have been filled with grease and sealed. Do not remove these seals.

Section IX. WEATHERPROOFING

30. General

For information on weatherproofing, refer to chapter 3 of this manual.

Section X. THEORY OF EQUIPMENT

31. General

Bearing Indicator Kit MC–551 consists of an instantaneous type bearing indicator and a goniometer drive unit. An electronically rotated sweep line is used instead of a mechanically rotated spot which is accomplished by the physical rotation of the magnetic deflection coils, as used in the original indicator (ch. 4). Rotating a base line produces solid, or filled-in, patterns (figs. 197 through 201) which are easier to observe than the line patterns (figs. 106 through 112). The higher rate of rotation (2,700 rpm as compared with 1,800 rpm in Bearing Indicator BC–1159–A) provides a bearing pattern which is less likely to be broken up by keyed signals. The aural-null feature provides an alternate method of operation useful under adverse conditions. For example, when two signals of the same frequency but displaced in azimuth are received simultaneously, the instantaneous indicator may give a false indication, usually somewhere between the two proper bearings. With aural-null indication, however, the operator can discriminate against the undesired signal and take an accurate bearing on the desired signal.

32. Signal Paths

Figure 202 shows the signal paths through the indicator kit. The outputs from the corner antennas are applied to their respective stators in Goniometer MC–412–A. The goniometer rotor output is then passed to the receiver. The rectified output of the receiver goes to the third grid of the control modulator tube, V807. Oscillator tube V814 creates a 200-kc signal which is fed into the first grade of control modulat tube V807. The modulated 200-kc signal is passed through r-f amplifier tube V808 and fed to the grids of the balanced modulators, V802, V803, V804, and V805. The l-f signal from each phase of the alternator (approx. 43 cps) is fed through l-f filter circuits to the two grids of a phase inverter, V801. From the plate and cathode of one triode of the phase inverter, the signal is fed to the first grids of the two horizontal balanced modulators, V802 and V803. From the other triode of V801 the signal is fed to the two vertical balanced modulators, V804 and V805. The output of the four modulators is then fed to the deflection plates of the cathode-ray tube, V806, causing the characteristic propeller-shaped pattern.

33. Alternator (fig. 190)

a. The function of the alternator is to generate the voltages which ultimately produce the rotating sweep on the cathode-ray tube. These voltages are maintained in exact synchronism and proper phase relationship with the goniometer rotation since the alternator and goniometer rotors are coupled together mechanically.

b. The rotor of the alternator is a permanent

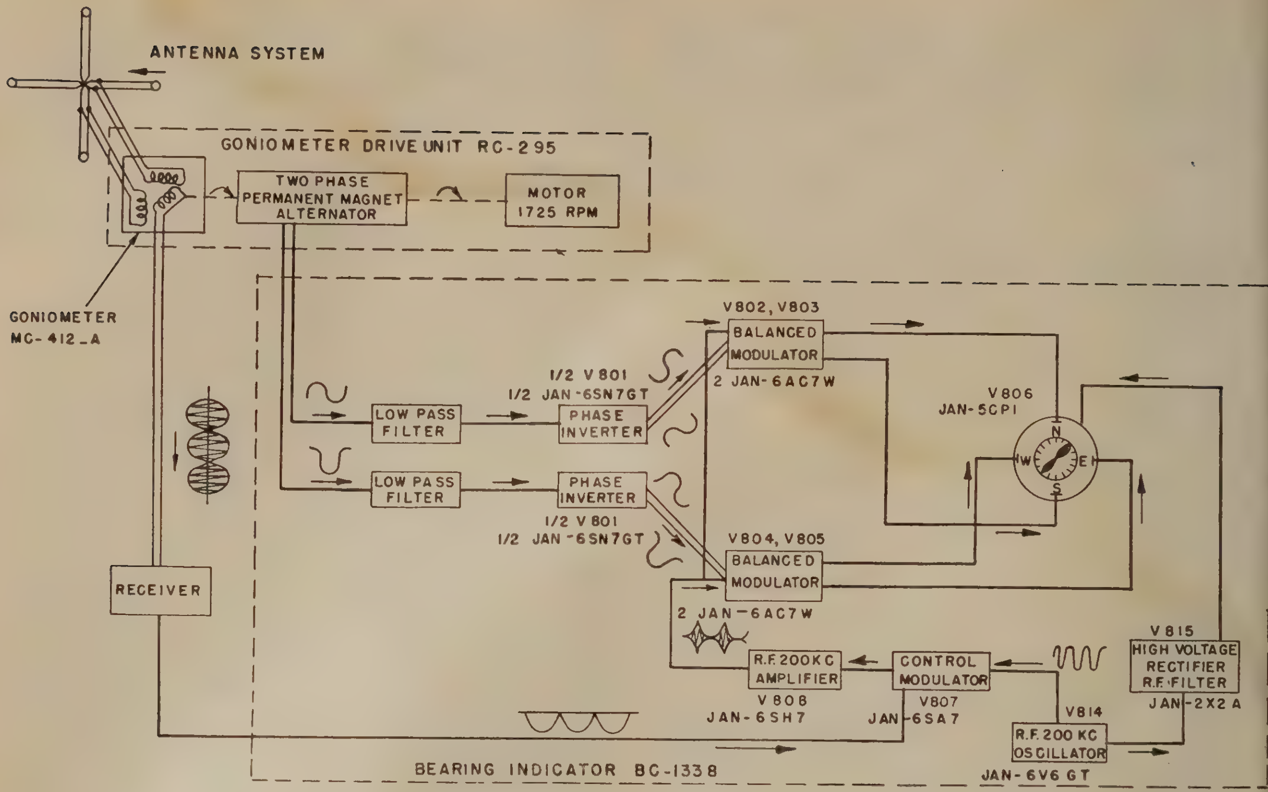


Figure 202. Bearing Indicator Kit MC–551, block diagram.

magnet which is turned by a 1/10-hp a-c motor through belt and pulleys. The stator consists of two coils which are so wound that the voltages induced in them, by the rotation of the rotor, are 90° out of phase with one another. These l-f voltages (approximately 43 cps) are fed through receptacle P702 on the alternator to the bearing indicator chassis.

34. Goniometer MC–412–A

The essential function of Goniometer MC–412–A is the same as in the original equipment. A complete description is available in paragraphs 6, 67, 144, and 151 of this manual.

35. Power Supply and Electronic Voltage Regulator (fig. 204)

a. The bearing indicator power supply section consists of a multiwinding power transformer (T801), a filament transformer (T802), a full-wave rectifier Tube JAN–5U4G (V809), and an effective filter and electronic voltage regulator. Filament voltages, except for Tube JAN–5U4G and the h-f rectifier Tube JAN–2X2A (V815), are obtained from four 6.3-volt windings. Tube JAN–5U4G filament voltage is obtained from the 5-volt winding of the power transformer, and Tube JAN–2X2A filament voltage is obtained from the 2.5-volt winding of the filament transformer.

b. The control modulator and balanced modulator circuits are critical to variations in B voltage such as would be produced by a fluctuating line voltage. A varying B voltage causes the pattern size to change and also results in a splitting of the superimposed patterns. The electronic voltage regulator in the power supply maintains the B voltage constant within +0.05 volt for variations in line voltage from 111 to 120 volts. The regulator circuit uses four tubes —two Tube JAN–6L6GA series regulators (V810 and V811), one Tube JAN–6SQ7 amplifier (V812), and one Tube JAN–OD3/VR–150 bias regulator (V813) for the amplifier tube. The B voltage can be adjusted by means of a potentiometer (R869) which controls the amount of voltage applied to the grid of amplifier Tube JAN–6SQ7.

c. The hum balance control potentiometer (R865) controls the amount of ripple or hum in the B voltage. The control applies a small amount of unregulated voltage to the grid of the control amplifier Tube JAN–6SQ7. This voltage is amplified by Tube JAN–6SQ7 and fed to the input grid of the series regulator in such phase as to cancel effectively the hum or ripple in the output.

36. R-f Power Supply (fig. 204)

The r-f power supply is a source of high d-c voltage for operation of the cathode-ray tube and, in addition, is the source of 200-kc voltage for operation of the control modulator and sense blanking circuit. The r-f oscillator is a modified electron-coupled oscillator using a Tube JAN–6V6GT (V814). A tuned circuit (B of L805 and capacitors C843 and C844) in the plate of the oscillator couples to a high inductance secondary (A of L805) which gives a step-up ratio of 7 to 1. The high voltage in the secondary is rectified by Tube JAN–2X2A (V815) and then filtered by a resistance-capacitance filter composed of resistors R875 and R876 and capacitors C845, C846, and C847. Two thousand volts across an approximately 1-megohm voltage divider (resistors R839 through R847) are available for operation of the cathode-ray tube. Also coupled to the oscillator plate circuit is a small pick-up coil (C of L805) which develops approximately 15 volts for operation of the sense blanking circuit and the control modulator.

37. Control Modulator and Amplifier

The control modulator consists of Tube JAN–6SA7 (V807) which determines the amount of 200-kc voltage applied to the balanced modulator grids. A 200-kc voltage is fed to the control grid (pin 5) of the control modulator, amplified by Tube JAN–6SH7 (V808), and applied to the control grids of the balanced modulator tubes. With no voltage from the receiver diode, the amplitude of the 200-kc voltage is determined by the position of the PATTERN SIZE control (R849). When the receiver diode delivers its negative signal output voltage to the injection grid (pin 8 of V807), the gain of the control circuit is reduced and the amplitude of the 200-kc voltage is decreased proportionally. This action is sometimes called negative modulation. The sensitivity of the control circuit is such that a 5.0-volt negative bias from the receiver diode will reduce the 200-kc voltage to zero.

38. Low-frequency Filter Circuits (fig. 213)

The two voltages delivered by the two-phase alternator on Goniometer Drive Unit RC–295 contain about 2 percent harmonic distortion. This distortion is reduced to less than 1 percent by the l-f filter circuits (R808 and C804, and R811 and C805). The frequency of these voltages is determined by the speed of the 1/10-hp motor which is controlled by the 110-volt, 60-cycle line. Any change in the line frequency produces a frequency change of the l-f voltages. The filter circuits were designed with as large a phase angle as possible (87°), because filters with phase angles in the vicinity of 90° exhibit almost constant phase shift through them for slight variations of input frequency. If a change in phase shift occurred through the filter circuits when the input frequency varied, a bearing error would result equal to the amount of phase-shift change.

39. Phase Inverters (fig. 213)

From the alternator two l-f voltages which are displaced 90° from each other are applied to the grids of a dual triode Tube JAN–6SN7/GT (V801), which is used as two phase inverters. The voltage output is taken across equal load resistors in the plate and cathode circuits of each phase inverter. Four voltages in quadrature phase are produced by these circuits; that is, 0° and 180° from one triode and 90° and 270° from the other triode. The actual grid-to-cathode bias of each phase inverter is determined by the difference between the voltage developed across the cathode resistor and a fixed positive voltage which is applied directly to the grids. This positive voltage is obtained from a voltage divider, R806 and R809, on the 300-volt power supply.

40. Balanced Modulator Assembly

The balanced modulator assembly consists of two balanced modulator circuits each using two Tubes JAN–6AC7W (V802 and V803, and V804 and V805). The four l-f quadrature voltages from the phase inverters are applied to the four balanced modulator tube grids. One balanced modulator receives the 0° and 180° l-f voltages and the other the 90° and 270° voltages. In addition the 200-kc voltage from the control modulator is applied in phase to all four balanced modulator grids. The output voltages of the balanced modulators are applied to the deflection plates of the cathode-ray tube and produce on the screen a rotating line. The rotating line appears as two superimposed solid circles; that is, one complete circle is formed for every 180° of rotation of the line. This line rotation is maintained in exact synchronism with the goniometer rotor. Under the condition of zero output from the receiver diode, the rotating line produces two superimposed solid circular patterns. In the presence of a signal, the diode output of the receiver varies directly as the magnitude of the input signal to the receiver. At a null position of the goniometer, the indicator control circuit receives zero voltage from the receiver diode, and the rotating line is of maximum length. At any instant other than null, the receiver diode will be delivering negative voltage to the control modulator of the indicator, and the rotating line will vary in length inversely as the magnitude of this negative voltage. At the position of the null, the tips of the line remain at the circumference of the circle, while at all other points the tips of the line are drawn in toward the center and a propeller, or twin-leaf, pattern is formed. Figures 197 through 201 illustrate bearing patterns under various operating conditions. The nulls are produced when the angle of rotation of the goniometer rotor is such that zero voltage is induced in it by the stationary coils of the goniometer. The goniometer and the antenna system are so designed and oriented that the angle at which the nulls occur corresponds to the direction of arrival of the incoming signal. Because the rotating line is in exact phase and synchronism with the goniometer rotor, the null, or extremities of the propeller-like pattern, will indicate the direction of the incoming signal on the azimuth scale.

41. Cathode-ray Circuit

A diagram of the cathode-ray circuit is shown in figure 213. The H-CENTER and V-CENTER controls (R839 and R840, respectively) are 500,000-ohm carbon potentiometers. They control the position of the electron beam by varying the d-c voltages applied to the deflection plates of the cathode-ray tube, V806. The INTENSITY control (R847) is a 50,000-ohm potentiometer that controls the brightness of the pattern by varying the grid (pin 3) voltage of the cathode-ray tube. The FOCUS control (R845) is a 250,000-ohm carbon potentiometer that controls the sharpness of the pattern by controlling the accelerating voltage on the first anode (pin 5) of the cathode-ray tube.

42. Sense Circuits

The sense circuits are controlled by two 6-volt relays (K801 and K802) which receive their energizing voltages when the sense switch on Control Panel PN–31–A is thrown to SENSE. The effect on the bearing pattern when sense voltage is introduced into the goniometer circuit is to cause the superimposed patterns to split. The blanking relay, K802 (fig. 213), applies 200-kc voltage to the intensity grid of the cathode-ray tube and blanks out one half of each of the split patterns. At the same time, the l-f voltage relay (K801) shifts the phase of the l-f voltages 90° so that the sense pattern forms points in the correct direction (fig. 201).

43. Over-all System Function

a. Bearing Pattern.

(1) The bearing pattern is obtained by setting the STAND-BY–D.F.–SENSE switch on the control panel to D.F. and the STAND–BY–D/F switch on the bearing indicator to D/F. In this position, only the corner antennas are connected to the receiver through the goniometer. The goniometer output then varies with rotation as shown by the dotted curve of figure 137. At the nulls, 0° and 180°, the goniometer output is zero and the rotating line on the cathode-ray tube screen is of maximum length. As the goniometer rotor and alternator rotor turn from the null positions, the goniometer output to the

receiver, and hence the negative bias applied to the control modulator, increases. This reduces the length of the rotating line.

(2) The ends of the bearing pattern correspond to the goniometer nulls while the center points correspond to the maximums. For keyed signals the bearing and zero signal patterns are formed alternately. The end of the twin-leaf pattern, corresponding to the direct transmitter bearing, is shown by the location of the sense pattern.

b. Sense Pattern.

(1) The sense pattern is obtained by setting the STAND-BY–D.F.–SENSE switch on the control panel to SENSE and the STAND-BY–D/F switch on the bearing indicator to D/F. In this position the properly phased output of the sense antenna is combined in the goniometer with the bearing antennas output. The goniometer output then varies with rotations as shown by the solid curve of figure 138 (combined sense and bearing antenna diagram).

(2) The solid curve of figure 139 shows the pattern, corresponding to the cardioid type of goniometer output, which would be obtained if the control modulator output were applied to the same deflection plates used in the bearing pattern. This orientation of the pattern is not practical for sense determination. When the STAND-BY–D.F.–SENSE switch is thrown to the SENSE position, the phase of the l-f voltages applied to the deflection plates is shifted 90°. The actual sense pattern is shown in figure 140.

(3) Observe that the sense pattern (fig. 201) is off center on the screen but symmetrical with respect to the bearing pattern of figure 199. By properly polarizing the sense antenna and deflection plate connections, the sense pattern is made to lie opposite the end of the twin-leaf pattern corresponding to the direct transmitter bearing. This relationship between the bearing and sense patterns is easy to remember because it is similar to the corresponding relationship between an arrow and its tail. That is, the point of the arrow is toward the direct bearing and the tail is toward the reciprocal bearing.

(4) Figure 141 shows the succession of bearing and sense patterns for a transmitter located due north of the direction finding station as the STAND-BY–D.F.–SENSE switch is alternately thrown from D.F. to SENSE. The dotted curve of figure 141 for the sense pattern indicates that this pattern is not seen on the cathode-ray tube screen at the same time as the bearing indicator pattern.

c. Aural-Null Indication.

(1) With the STAND-BY–D.F.–SENSE switch on Control Panel PN–31–A in the D.F. position and the STAND-BY–D/F switch on the bearing indicator in the STAND-BY position, the antennas are connected to the receiver through the goniometer, but the high voltage to the cathode-ray tube and the power to the motor which rotates the goniometer are cut off. The goniometer output varies with manual rotation of the goniometer rotor (dotted curve of figure 137) and is applied to the receiver. An audio signal, directly proportional to the goniometer output, is then obtained in the audio sections of the receiver. (The BFO in the receiver must be turned on if the received signal is cw.) The aural-nulls or minimums correspond to the goniometer nulls, and the bearing is read off the aural-null azimuth scale.

(2) With the STAND-BY–D.F.–SENSE switch in the SENSE position, the cardioid type of goniometer output results, corresponding to the solid curve of figure 139. This response curve has only one minimum and by establishing the relationship between the new minimum and that indicated in (1) above, the ambiguity (direct or reciprocal) can be resolved (par. 17*f*).

44. General

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 assigned to perform trouble shooting. Also refer to chapter 4 of this manual.

a. TROUBLE-SHOOTING DATA. The material supplied in this appendix will help in the rapid location of faults. Refer to the following trouble-shooting data when necessary:

(1) Block diagram of Bearing Indicator Kit MC–551 (fig. 202).

(2) Complete schematic diagrams (figs. 208 and 213). These diagrams aid the repairman in following the electrical functioning of the circuits more easily, thus speeding trouble location.

(3) Voltage and resistance data chart for all socket connections.

(4) Illustrations of components. Rear, top, and bottom views which aid in locating and identifying parts (figs. 193 through 196, figs. 204 through 207).

(5) Pin connection. 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. Refer to chapter 4 of this manual.

c. SECTIONALIZATION. Careful observation of the performance of the equipment (par. 22) often sectionalizes the fault. Additional sectionalizing of the fault is discussed in paragraph 47.

d. LOCALIZATION. The trouble-shooting chart (par. 47*a*) lists abnormal symptoms and their probable causes. The chart also gives the procedure for determining which of the probable locations of the fault is the correct one. In addition, a tube socket layout and a voltage and resistance analysis chart (par. 47*b*) are provided in figure 203.

45. Test Equipment

No special test equipment is needed. Use a high-resistance, 20,000-ohm-per-volt voltmeter when measuring the high voltage on the r-f power supply to prevent loading the power supply tube.

46. Trouble-shooting Procedures

The accompanying trouble-shooting chart, if properly used, simplifies trouble shooting. The chart shows the sectionalization of trouble in Bearing Indicator Kit MC–551. This chart will aid in determining which stage in the indicator is at fault and which individual part in the circuit is causing the abnormal condition.

47. Sectionalizing Trouble in Bearing Indicator Kit MC–551

a. TROUBLE-SHOOTING CHART.

Symptom	Probable trouble	Correction
1. All alidade lamps out	1. Failure of a-c power supply: blown fuse, faulty ON-OFF switch, break in power cord, bad power connector, open transformer winding.	1. Repair or replace defective part.
2. No luminous spot on cathode-ray tube.	2. *a.* R-f power supply not operating; defective Tube JAN–6V6 or JAN–2X2. *b.* Incorrect or no high d-c voltage: high-voltage mica capacitor defective, open or short circuit in high-voltage voltage divider.	2. Locate and replace defective parts.

Symptom	Probable trouble	Correction
	c. FOCUS or INTENSITY not operating properly; defective control.	
3. Luminous spot on cathode-ray tube screen, but no pattern.	3. *a.* All d-c voltages low: weak rectifier tube, open filter capacitor, short in plate circuit.	3. *a.* Replace or repair.
	b. Defective control modulator Tube JAN–6SA7	*b.* Replace.
	c. Defective r-f amplifier Tube JAN–6SH7	*c.* Replace.
	d. Defective pattern size control; wear in control	*d.* Replace.
	e. Defective coupling capacitor or bypass in control modulator and r-f amplifier circuit.	*e.* Locate and replace.
	f. Defective Tube JAN–6SN7GT	*f.* Replace.
	g. Belt driving alternator broken or slipping	*g.* Replace if belt is broken. Adjust motor position if belt is slipping.
4. Distorted circular pattern	4. *a.* Defective balance modulator Tube JAN–6AC7W	4. *a.* Replace.
	b. Defective coupling capacitor in l-f circuit	*b.* Locate and replace.
	c. Distortion in r-f voltage; defective tube in control modulator (JAN–6SA7).	*c.* Replace tube.
	d. Defective capacitor in grid circuit of balanced modulator.	*d.* Locate and replace.
	e. Worn alternator bearings on Goniometer Drive Unit RC–295.	*e.* Replace.
5. Large diamond in center of circle; cannot be corrected by adjustment of vertical and horizontal differential capacitors C816B and C817B, respectively.	5. Defective or weak balanced modulator tubes	5. Locate and replace.
6. Excessive hum or flicker in circular pattern.	6. *a.* Defective tube in electronic voltage regulator circuit	6. *a.* Replace.
	b. Defective filter capacitor	*b.* Replace.
	c. Hum control R865 not properly adjusted	*c.* Adjust for minimum flicker in pattern.
	d. Vacuum tube with cathode to filament short	*d.* Locate by tapping tube and replace.
7. Sense circuit not operating properly.	7. *a.* Defective l-f switching relay K801	7. *a.* Replace.
	b. Defective sense blanking relay K802	*b.* Replace.
	c. Open high-voltage coupling capacitor C835 to intensity grid.	*c.* Replace.

b. VOLTAGE AND RESISTANCE MEASUREMENTS.

(1) Voltage measurements were made with the goniometer drive unit disconnected, power on, PATTERN SHAPE and PATTERN SIZE controls set at maximum, normal focus, intensity, and beam positioned in center of the cathode-ray tube screen. The chassis was used as ground or minus return for all readings. The a-c line supply voltage was 117 volts.

(2) If 1,000-ohms-per-volt meter is used (*c* below), the voltage readings may be used as a reliable indication of trouble, provided the *chart* reading is not 0 or does not differ by more than 30 percent from the corresponding reading given in figure 203 for the 20,000-ohms-per-volt meter.

c. VOLTAGE READINGS WITH 1000-OHMS-PER-VOLT METER.

Tube		Pin No.	Volts measured using sensitivity of 1,000 ohms per volt
Number	JAN Type		
V801	6SN7GT/G	1	0
		2	200
		3	57
		4	0
		5	195
		6	54
		7	6.2 V AC across 7–8
		8	
V802	6AC7W	1	0
		3	4.13**
		4	0
		5	4.13**
		6	170**
		8	290**
		2	6.24 V AC across 2–7
		7	
V803	6AC7W	1	0
		3	4.13**
		4	0
		5	4.13**
		6	170**
		8	290**
		2	6.24 V AC across 2–7
		7	
V804	6AC7W	1	0
		3	3.5**
		4	0
		5	3.5**
		6	160**
		8	290**
		2	6.24 V AC across 2–7
		7	
V805	6AC7W	1	0
		3	4.05**
		4	0
		5	4.05**
		6	160**
		8	290**
		2	6.23 V AC across 2–7
		7	
V806	5CP1	1	(Use 20,000 ohms/volt meter)
		2	
		3	
		4	
		5	
		6	
		7	
		8	
		9	
		10	
		11	
		12	
		13	
		14	
		CAP	
V807	6SA7	1	0
		3	95
		4	7.5
		5	0
		6	1.17
		8	0
		2	6.2 V AC across 2–7
		7	
V808	6SH7	1	0
		3	1.85
		4	0
		5	1.85
		6	102
		8	235
		2	6.25 V AC across 2–7
		7	
V809	5U4G	1	
		3	
		4	
		5	
		6	
		7	
		2	590 DC 5.4 V AC
		8	590DC across 2–8
V810	6L6G	1	0
		3	590
		4	590
		5	260

Tube Number	Tube JAN Type	Pin No.	Volts measured, using sensitivity of 1,000 ohms per volt
		6	
		8	0
		2	6.27 V AC across 2–7
		7	
V811	6L6G	1	0
		3	590
		4	590
		5	260
		6	
		8	0
		2	6.27 V AC across 2–7
		7	
V812	6SQ7	1	0
		2	100
		3	145
		4	
		5	
		6	265
		7	6.25 V AC across 7–8
		8	
V813	OD3/VR–150	1	
		2	0
		3	
		4	
		5	147
		6	
		7	
		8	
*V814	6V6GT	1	0
		3	300
		4	300
		5	0
		6	
		8	0
		2	
		7	
*V815	2X2A	1	2.4 V AC across 1–2
		2	
		3	
		4	
		CAP	

* Voltages and resistance measured with tube removed from socket. all
** These voltages may vary considerably according to setting of balance modulator controls.

Section XII. REPAIRS

48. Replacement of Parts

a. CATHODE-RAY TUBE.

(1) Remove Bearing Indicator BC–1338 from operating Chest CH–300.

(2) Unscrew the three mounting screws which hold the alidade assembly to the front panel of the indicator and remove the alidade assembly.

(3) Remove the snap connector from the third anode pin which is located on the side of the cathode-ray tube.

(4) A 3/8-inch hole in the rear cover of the balanced modulator assembly (fig. 193) is exactly in line with the cathode-ray tube base. Insert a screwdriver in this hole and gently push the cathode-ray tube out of its socket. Keep one hand on the face of the tube.

(5) A key is provided on the base of the cathode-ray tube. Slowly rotate the new tube until the key fits into the slot on the socket. Push the tube in as far as possible. Refasten the snap connector to the third anode.

(6) Replace the alidade assembly. Loosen the four screws which hold the balanced modulator assembly in position (these screws are accessible by removing the bottom cover plate from the indicator), and move the entire assembly until the front of the cathode-ray tube is against the alidade. Then move the balanced modulator assembly back until the plate with the crossed hairlines moves freely.

(7) Retighten the balanced modulator chassis screws.

(8) After the cathode-ray tube has been replaced, but before replacing the indicator in the chest, turn on only the indicator and Goniometer Drive Unit RC–295. Let the indicator warm up for a 10-minute period and then balance the two superimposed circles. Observe whether there is a diamond-shaped pattern in the center of the circular pattern. If there is, alternately adjust the horizontal and vertical differential capacitors, C817B and C816B, respectively (see fig. 196 for location), until the diamond

changes to a small dot or a very small diamond. If a small diamond cannot be obtained, follow the alinement procedure of paragraph 50.

(9) After the cathode-ray tube has been replaced and the entire system placed in operation, repeat that part of the orientation procedure outlined in paragraph 14. See paragraph 50*g* to correct for cathode-ray tube differences.

b. BALANCED MODULATOR TUBE REPLACEMENT.

(1) If it becomes impossible to superimpose the two circular patterns by means of the BALANCE controls on the front panel of the indicator, one of the balanced modulator tubes is weak. Of the four tubes in the balanced modulator chassis, the two on the right-hand side are in the horizontal channel and the two on the left-hand side are in the vertical channel.

(2) Note which BALANCE control does not balance and change one of the balanced modulator tubes in that channel. Allow the tube to warm up for about 5 minutes and try to superimpose the two circular patterns by use of the BALANCE controls.

(3) If the circles do not superimpose, put the old tube back in its socket and put the new tube in the other half of the same balanced modulator.

(4) Allow 5 minutes for the tube to warm up and then superimpose the two circular patterns by use of the BALANCE controls on the front panel.

(5) If there is a diamond-like pattern in the center of the circular pattern, proceed as in *a*(8) above.

c. DRIVE BELT. The tension on the drive belt should be checked if a luminous spot is observed on the cathode-ray tube screen but no pattern, or if the goniometer and alternator take an exceptionally long time to come up to speed. The tension can be increased by shifting the motor away from the alternator. The mounting screw holes in the motor base are slotted to allow adjustment. When retightening the motor mounting screws, make sure the pulleys are in line and that the axis of the motor is in line with the axis of the alternator. If the belt is chewed up so that it does not run smoothly, is stretched beyond range of adjustment, or is broken, replace it with a new belt. Always adjust the tension so that some slack exists; otherwise, excessive wear will result in the belt and in the motor and alternator bearings.

d. ALIDADE ADJUSTMENT.

(1) With no pattern on the cathode-ray tube screen, aline the alidade so that one hairline is exactly at 0° and 180°. The crossed hairline should be exactly at 90° and 270°.

(2) If the hairlines are not in the correct position or if excessive play is present, adjust as follows:

(*a*) Remove the light shade which is held in place by three screws.

(*b*) Loosen the three setscrews near the outer edge of the alidade.

(*c*) Adjust the three eccentrics until the hairlines are properly alined with no play or binding.

(*d*) Tighten the setscrews and replace the light shade.

e. SPECIAL TOOLS. No special tools are required. Four Allen wrenches, a Spintite tool, and an adjusting wrench (which fits on the front panel of the indicator) are packed in the spare parts chest.

Section XIII. ALINEMENT AND ADJUSTMENT

49. Test Instruments Used for Alinement and Adjustment

The following test equipment should be used for alinement and adjustment of Bearing Indicator BC–1338:

a. Voltohmmeter having a sensitivity of 1,000 ohms per volt, such as Test Set I–56–( ).

b. Voltmeter having a sensitivity of 20,000 ohms per volt.

c. Frequency meter covering 200 kc.

50. Alinement of Bearing Indicator BC–1338

Check test instruments before using them. Make all tests with all cables connected and with the receiver SENSITIVITY control at 0.

a. Adjust regulated power supply.

(1) Connect voltmeter between pin 8 of V810 and ground.

(2) Adjust R869 for 300 volts on the voltmeter.

(3) Adjust R865 for minimum ripple on the pattern.

b. Adjust high-voltage power supply.

(1) Loosely couple the frequency meter to L805.

(2) Tune C836 for 200 kc on the frequency meter.

(3) Connect a 50-ma d-c milliammeter across the B+ contacts of the STAND-BY–D/F switch (the B+ leads are white with a red tracer). Be sure to connect the + terminal of the meter to the *outside* terminal of the switch; that is, to the terminal closest to the *side* of the cabinet.

(4) Throw the STAND-BY–D/F switch to STAND-BY. This places the meter in series with the B+ to the high-voltage power supply.

(5) Tune C844 for *minimum* current on the meter (approx. 40 ma).

(6) Repeat steps (2) and (5) above until C844 is adjusted for minimum current and the oscillator is set at 200 kc.

c. Adjust balanced modulators for tuning.

(1) Adjust size, shape, and balance controls for workable, round patterns with the circles superimposed. Readjust, whenever necessary, during the following steps.

(2) Tune C816A and C817A for maximum deflection of pattern (disregard shape of pattern).

(3) Tune L801 and L802 for superposition of peaks of hypocycloidal figures.

(4) Tune C816B and C817B for minimum size of hypocycloidal figures.

(5) Repeat (1), (2), (3), and (4) above.

d. Adjust balanced modulators for balance.

(1) *Vertical balance.*

(*a*) Set R883 at maximum clockwise position.

(*b*) Adjust the vertical BALANCE control for superimposed circles or as close to superposition as possible.

(*c*) If the circles cannot be superimposed with the BALANCE control, rotate R883 counterclockwise until adjustment can be made with the BALANCE control.

(*d*) Turn the PATTERN SHAPE control down to its extreme counterclockwise position.

(*e*) If a double trace is observed, rotate R883 a small amount counterclockwise. If the lines move closer together, rotate R883 a little more in the same direction until the lines are superimposed. If the lines move farther apart, rotate R883 clockwise to superimpose the lines.

(*f*) Turn the PATTERN SHAPE control to make a circular pattern.

(*g*) Adjust the vertical BALANCE control for superimposed circles.

(*h*) Repeat (*d*), (*e*), (*f*), and (*g*) above until the circles are superimposed with the shape control turned up and the lines are superimposed with the shape control turned down.

(*i*) When balance cannot be achieved at any point within the range of R883, repeat the balancing procedure with:

1. The two tubes (V804 and V805) interchanged.

2. V804 replaced by a new tube.

3. The original V804, with V805 replaced by a new tube.

4. V804 and V805 replaced by new tubes.

5. The two new tubes interchanged.

(*j*) With normal run-of-the-mill tubes, the condition specified in (*h*) above can be achieved about 80 percent of the time. It may be necessary, therefore, in some instances to run through the balancing procedures with several different combinations of tubes before balance is achieved.

(2) *Horizontal balance.*

(*a*) Follow the same procedure as for the vertical channel except that switch S803 is used in place of the PATTERN SHAPE control to obtain the line trace. (To obtain a line trace, close switch S803.) R882 is used in place of R883, and the horizontal BALANCE control is used in place of the vertical BALANCE control.

(*b*) Check the vertical balance ((1) above) and repeat adjustments if necessary; then recheck horizontal balance.

e. HUM AND VOLTAGE ADJUSTMENTS.

(1) When replacing tubes in the electronic voltage regulator (Tubes JAN–6L6GA, JAN–6SQ7, and JAN–0D3/-VR–150), it may be necessary to readjust the B voltage R869 and the hum control, R865.

(2) Remove the phase inverter tube (Tube JAN–6SN7GT) (see fig. 194 for location) and insert the positive test lead from a d-c voltmeter into socket contact No. 2 or No. 5; connect the negative test lead to the chassis, and adjust R869 (see fig. 196 for location) to 300 volts. Then replace Tube JAN–6SN7GT.

(3) Observe the circular pattern and adjust R865 (see fig. 196 for location) for minimum flicker around the edge of the pattern.

f. CIRCLE ALINEMENT AND ROUNDNESS.

(1) Turn the PATTERN SIZE control to zero and adjust the H-CENTER controls until the dot is exactly on the intersection of the two crossed hairlines. This will aline the circle properly.

(2) Increase the PATTERN SIZE until the edge of the circle is just within the azimuth scale. Adjust the PATTERN SHAPE control until the circle appears as round as possible.

(3) Repeat (1) and (2) above.

g. ORIENTATION CHECK.

(1) Set the equipment in operation as described in paragraph 14.

(2) Tune in a strong signal of 5 mc ± 0.5 mc from a known and constant bearing. If no satisfactory signal is available, the target transmitter must be used as described in paragraph 14i.

(3) Turn OFF the 90°, 180°, and 270° switches on Control Panel PN–31–A, leaving only the 0° switch ON, and adjust the receiver SENSITIVITY control until the pattern just closes at the center.

(4) The points of the pattern should read 0° and 180° on the azimuth scale; if not, recheck the circle alinement as described in *f* above and then repeat (2) and (3) above.

(5) Check the 90° and 270° pattern by turning the 0° switch OFF and the 90° switch ON. The points of the pattern should read 90° and 270°. If they do not, adjust the horizontal centering control (R839) until the points of the pattern are at 90° and 270°.

(6) Recheck 0° and 180° points.

(7) If it is not possible to adjust the 0° and 90° patterns so that they are exactly 90° displaced, according to the above outlined procedure, it will be necessary to adjust the cathode-ray compensating control (R801) (see fig. 196 for location).

(8) Check the 0°–180° and the 90°–270° patterns and adjust R801 until they are exactly 90° displaced.

(9) If the 0° and 90° patterns are exactly 90° displaced but in error more than 1° as read on the azimuth scale (that is, if the 0° reading is at 1° or more and the 90° reading is at 91° or more), proceed as outlined in paragraph 14i. For errors less than 1°, loosen the mounting screws on the alidade assembly and rotate the complete assembly until the error is zero; then retighten the mounting screws.

(2) *Horizontal balance.*

(*a*) Follow the same procedure as for the vertical channel except that switch S803 is used in place of the PATTERN SHAPE control to obtain the line trace. (To obtain a line trace, close switch S803.) R882 is used in place of R883, and the horizontal BALANCE control is used in place of the vertical BALANCE control.

(*b*) Check the vertical balance ((1) above) and repeat adjustments if necessary; then recheck horizontal balance.

e. Hum and Voltage Adjustments.

(1) When replacing tubes in the electronic voltage regulator (Tubes JAN–6L6GA, JAN–6SQ7, and JAN–0D3/-VR–150), it may be necessary to readjust the B voltage R869 and the hum control, R865.

(2) Remove the phase inverter tube (Tube JAN–6SN7GT) (see fig. 194 for location) and insert the positive test lead from a d-c voltmeter into socket contact No. 2 or No. 5; connect the negative test lead to the chassis, and adjust R869 (see fig. 196 for location) to 300 volts. Then replace Tube JAN–6SN7GT.

(3) Observe the circular pattern and adjust R865 (see fig. 196 for location) for minimum flicker around the edge of the pattern.

f. Circle Alinement and Roundness.

(1) Turn the PATTERN SIZE control to zero and adjust the H-CENTER controls until the dot is exactly on the intersection of the two crossed hairlines. This will aline the circle properly.

(2) Increase the PATTERN SIZE until the edge of the circle is just within the azimuth scale. Adjust the PATTERN SHAPE control until the circle appears as round as possible.

(3) Repeat (1) and (2) above.

g. Orientation Check.

(1) Set the equipment in operation as described in paragraph 14.

(2) Tune in a strong signal of 5 mc ±0.5 mc from a known and constant bearing. If no satisfactory signal is available, the target transmitter must be used as described in paragraph 14i.

(3) Turn OFF the 90°, 180°, and 270° switches on Control Panel PN–31–A, leaving only the 0° switch ON, and adjust the receiver SENSITIVITY control until the pattern just closes at the center.

(4) The points of the pattern should read 0° and 180° on the azimuth scale; if not, recheck the circle alinement as described in *f* above and then repeat (2) and (3) above.

(5) Check the 90° and 270° pattern by turning the 0° switch OFF and the 90° switch ON. The points of the pattern should read 90° and 270°. If they do not, adjust the horizontal centering control (R839) until the points of the pattern are at 90° and 270°.

(6) Recheck 0° and 180° points.

(7) If it is not possible to adjust the 0° and 90° patterns so that they are exactly 90° displaced, according to the above outlined procedure, it will be necessary to adjust the cathode-ray compensating control (R801) (see fig. 196 for location).

(8) Check the 0°–180° and the 90°–270° patterns and adjust R801 until they are exactly 90° displaced.

(9) If the 0° and 90° patterns are exactly 90° displaced but in error more than 1° as read on the azimuth scale (that is, if the 0° reading is at 1° or more and the 90° reading is at 91° or more), proceed as outlined in paragraph 14i. For errors less than 1°, loosen the mounting screws on the alidade assembly and rotate the complete assembly until the error is zero; then retighten the mounting screws.

NOTES:

* VOLTAGES AND RESISTANCE MEASURED WITH TUBE REMOVED FROM SOCKET.

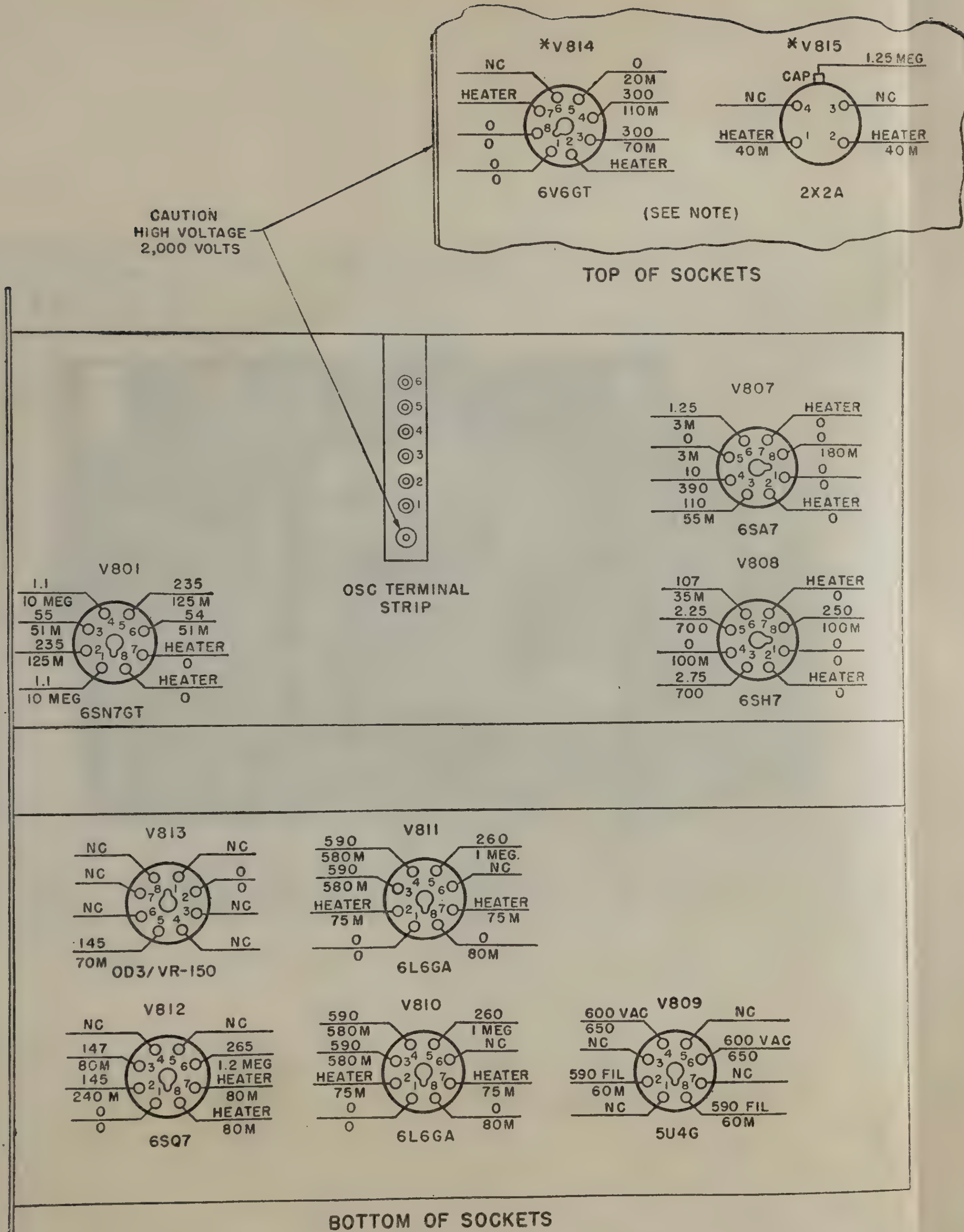
** THESE VOLTAGES MAY VARY CONSIDERABLY ACCORDING TO SETTING OF ALL BALANCE MODULATOR CONTROLS.

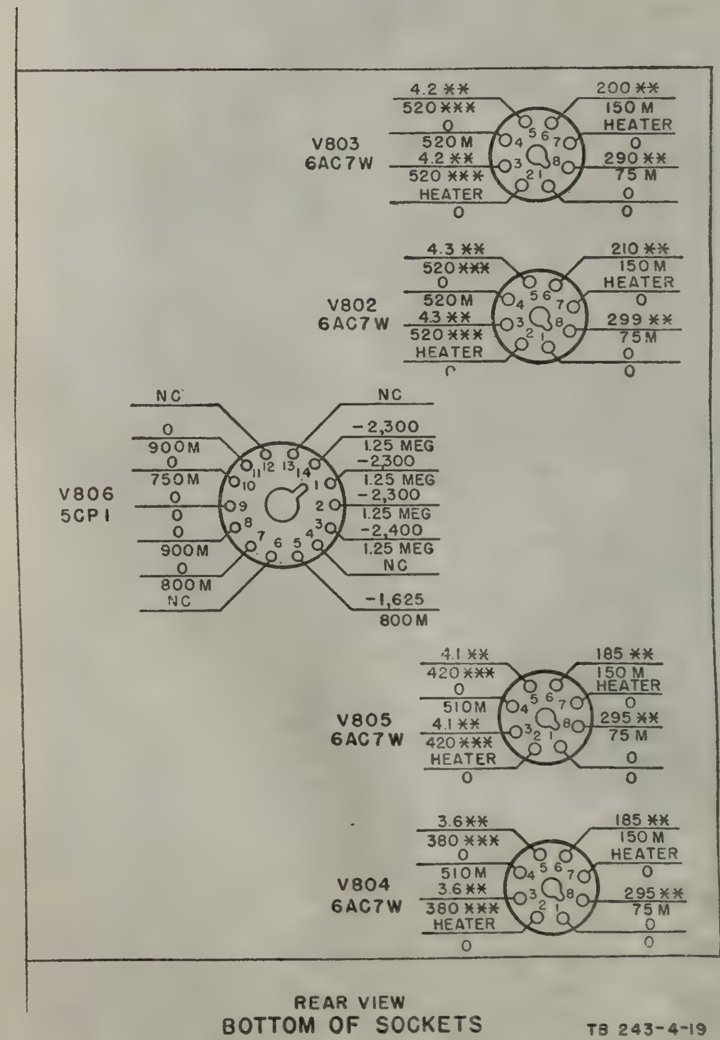
*** THESE RESISTANCES MAY VARY FROM 220 TO 1,420 OHMS DEPENDING ON ADJUSTMENT OF R882, R830, R883 AND R833.

M=1,000 Ω

VOLTAGE MEASUREMENTS ACROSS HEATER PINS

TUBE	VAC	PINS	TUBE	VAC	PINS
V801	6.2	7-8	V808	6.25	2-7
V802	6.24	2-7	V809	5.4	2-8
V803	6.24	2-7	V810	6.27	2-7
V804	6.24	2-7	V811	6.27	2-7
V805	6.23	2-7	V812	6.25	7-8
V807	6.2	2-7	V815	2.4	1-2





TS 243-4-19

Figure 203. Bearing Indicator BC–1338, voltage and resistance measurements.

843134—49 (Face p. 204)

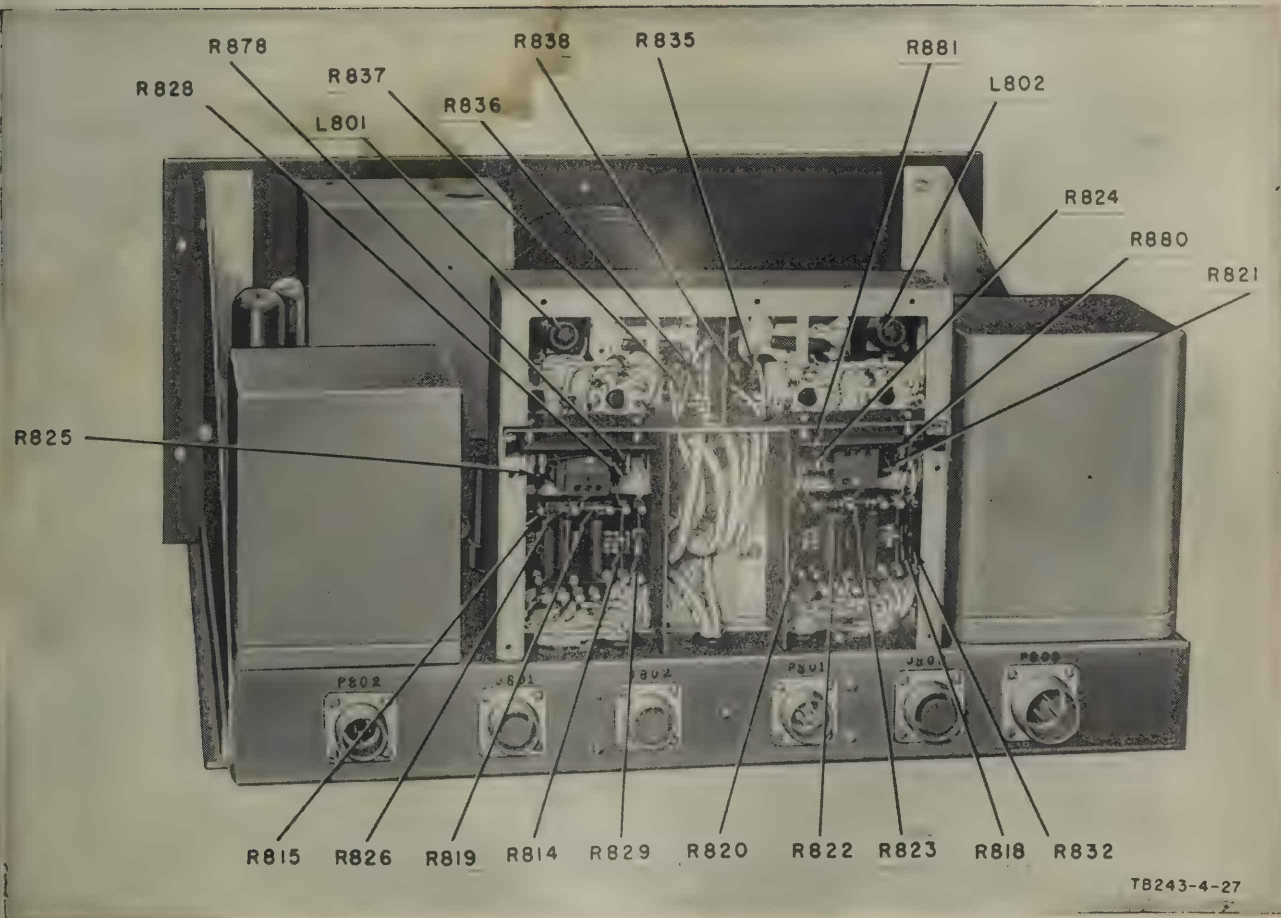


Figure 204. Bearing Indicator BC-1338, identification of parts, rear view.

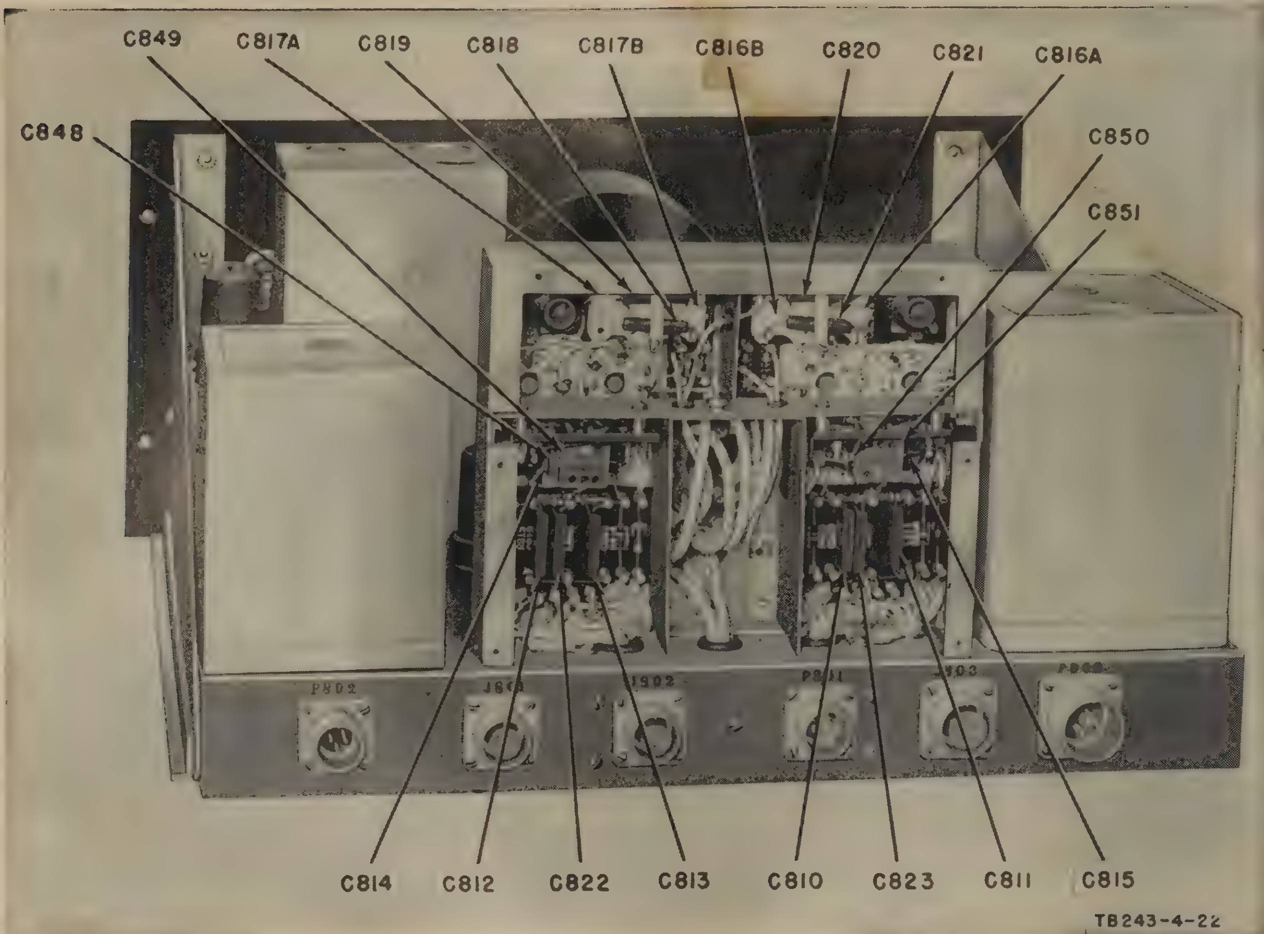


Figure 205. Bearing Indicator BC–1338, identification of parts, rear view.

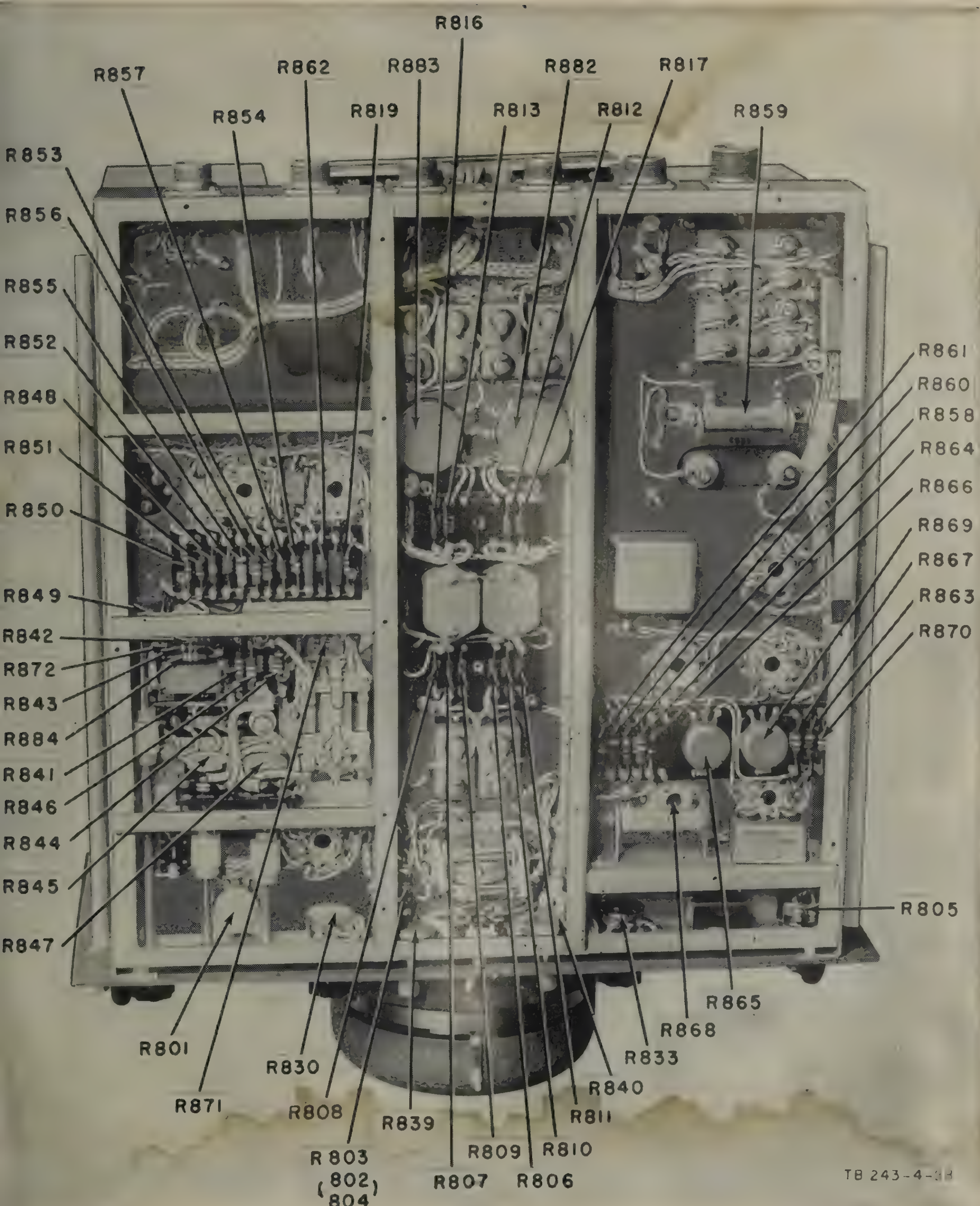


Figure 206. Bearing Indicator BC–1338, identification of parts, bottom view.

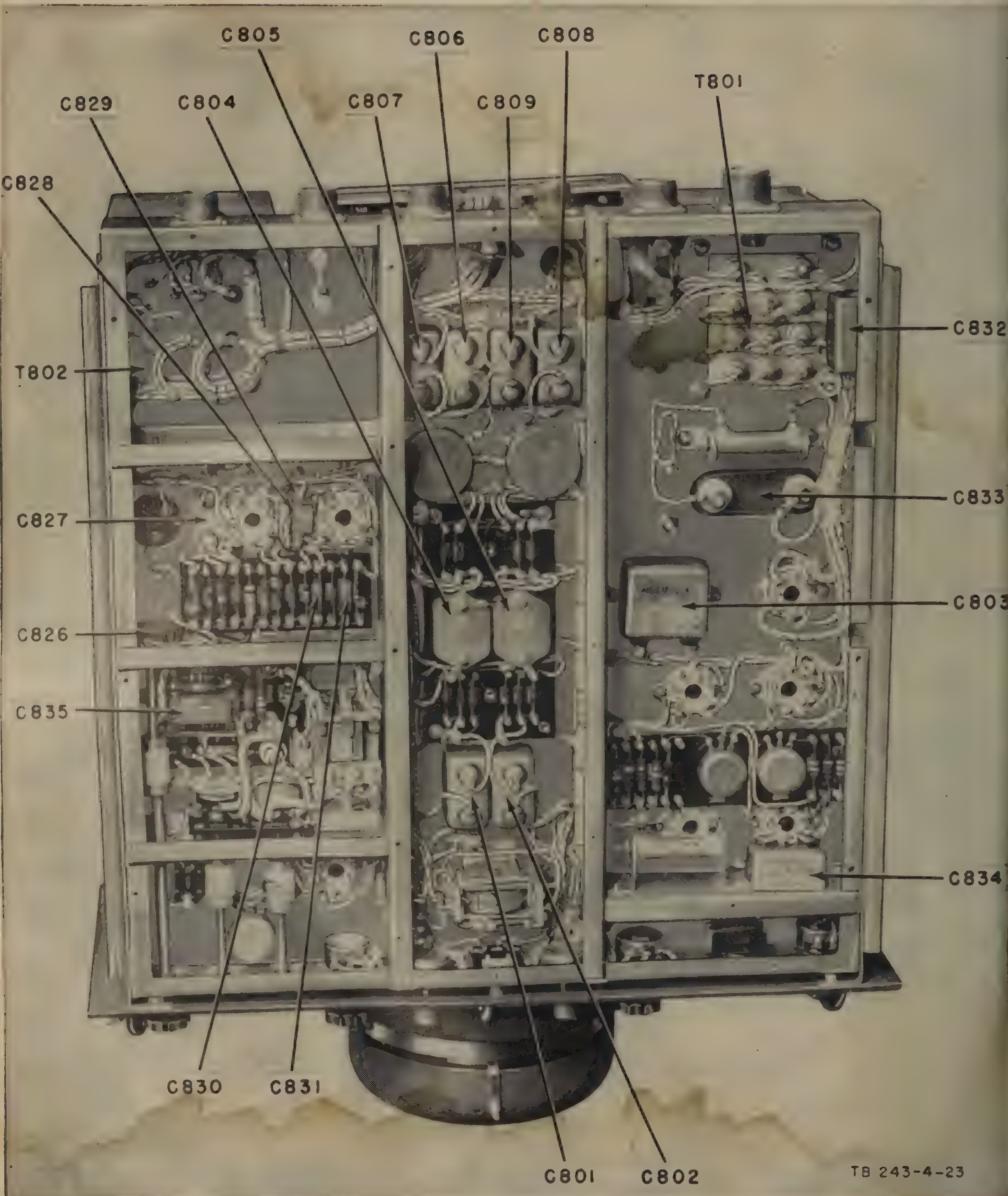
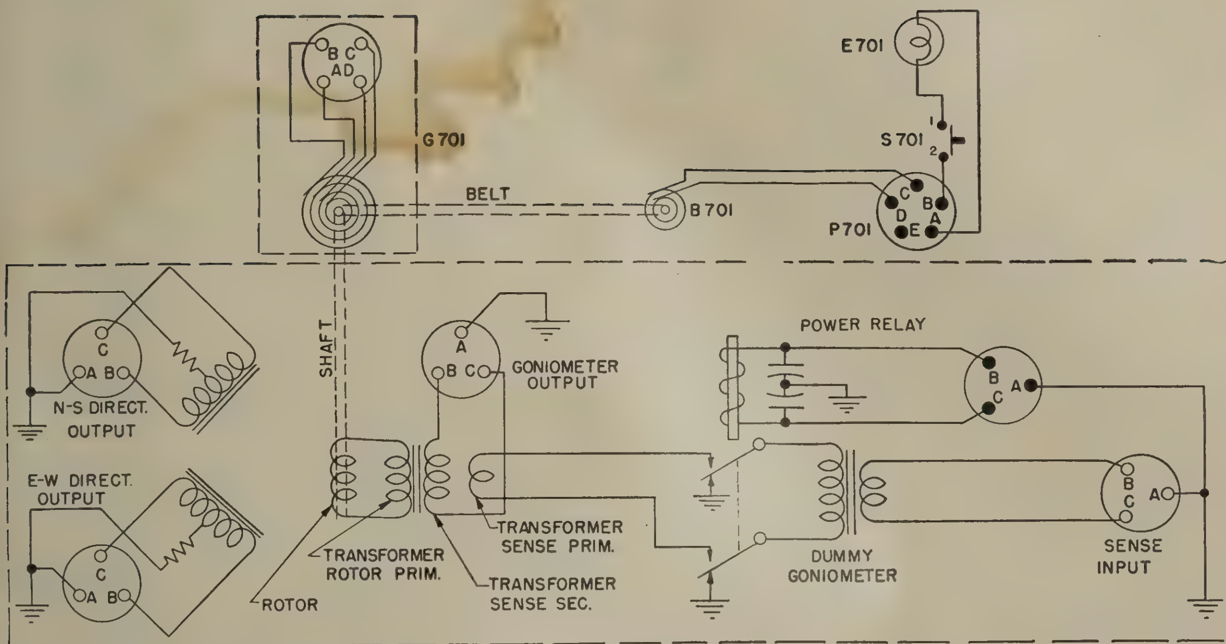


Figure 207. Bearing Indicator BC–1338, identification of parts, bottom view.



LEGEND

REF SYM	S. C. STOCK NO.	NAME AND DESCRIPTION	REF SYM	S. C. STOCK NO.	NAME AND DESCRIPTION
B701		MOTOR, A.C., 110 V., 1/10 H.P.	G701		ALTERNATOR, 2 PHASE, PERMANENT MAGNET
S701	3Z9824-60	SWITCH, PUSH, S.P.S.T. N.C.	E701	2Z5934-1	LAMP, INCANDESCENT MAZDA 51 MIN. BAYONET
P701		CONNECTOR, MALE CONTACT, 5 CONT.			

TB 243-4-25

Figure 208. Goniometer Drive Unit RC–295, schematic diagram.

APPENDIX II
FIXED ANTENNA EQUIPMENT RC–301

1. Purpose

Fixed Antenna Equipment RC–301 is used to change the original transportable antenna system of Radio Set SCR–291–A to a permanent or semipermanent antenna system.

2. Components

Note. Components are listed in the approximate order of assembly. Item numbers correspond to the encircled numbers in figure 210.

Component	Item No.	Used	Running spares	Signal Corps stock No.
Antenna Assembly AN–202	--------	4	1	2A275–202
Antenna Assembly AN–203	--------	1	1	2A275–203
These assemblies consist of the following:				
Mounting, antenna, pedestal, bottom section	1	5	2	2A2665–12
Base plate	2	5	2	2A326–12
Mounting, antenna, pedestal, top section	3	5	3	2A2665–13
Hub assembly	4	5	2	2A1525
Insulator, porcelain	5	5	2	3G1350–176
Clamp, antenna contact	6	5	2	2A478.9
Antenna section, bottom	7	5	2	2A296A
Antenna section, middle	8	5	2	2A296A–1
Plate, guy, for guy attachment, 3 holes	9	4	1	2A2819–17
Plate, guy, for guy attachment, 4 holes	10	1	1	2A2819–8
Antenna section, top	11	5	2	2A296A–2
Guy GY–45	12	12	3	2A1339–45
Guy GY–46	13	4	4	2A1339–46
Plate, mounting, inverter	14	5	7	2A2822–12
Lead, electrical	15	5	7	3E7998–10.1
Screw, machine, hex, head, 5/8″–11 x 3½″ lg, steel	16	20	------	6L4910–56
Lockwasher, 5/8″	17	20	--------	6L71010C
Screw, machine, hex, head, 5/16″–24 x ½″ lg, steel	18	5	------	6L7924–5–8.81P
Lockwasher, 5/16″	19	5	------	6L72218C
Screw, machine, hex, head, 5/16″–18 x ¾″ lg	20	5	------	6L7918–5–12.81S
Lockwasher, 5/8″	21	5	------	6L72281C
Gasket, guy plate, lead	22	5	2	2A1173.6–1
Stake GP–25	23	20	15	2A3325
Anchor AH–13	24	8	15	5B113
Counterpoise CP–19	25	5	2	2A720–19
Stake GP–2	26	20	15	2A3302
Protector MX–608/U	27	5	2	3Z76–608
Tools, as follows:				
Bar LC–2–A, 8 ft	--------	1	--------	6Q3002A
Cap, drive, with 5″ nipple	--------	1	--------	6Z1731–2.5
Hammer HM–3	--------	1	------	6Q49003
Wrench, 36″, for ¼″ to 4″ pipe; Walworth Co. No. 4111, or equal	--------	1	--------	6R56536
Wrench, 18″, for ¼″ to 2″ pipe	--------	1	--------	6R56618
Vise, chain, for ¼″ to 4″ pipe	--------	1	------	6R47174
Grease, general purpose No. 2, in 1-lb container	--------	2	------	6G606M
Wrench, socket; Allen type No. 6, or equal	--------	1	------	6R57400–6
Frames, hacksaw, pistol-grip 8″ to 12″ adjustable; Snap-On Tool Corp No. HS–3, or equal	--------	1	-	6Q41002
Brush, varnish, flat, 3″ x 2″	--------	1	--	6Z1553–1
Hardware and accessories, as follows	--------	1 set		
Blade, hacksaw, 12″ x 9/16″ x 0.025″, 24 teeth per inch, high-speed; Snap-On Tool Corp No. HS–1224, or equal	--------	12	--------	6Q8112–24
Wire, braid, 5/8″; Belden Mfg. Co. Code Faun, or equal	--------	30 ft	--------	1F7B1–3
Fitting, solderless; Sherman No. GF3, or equal	--------	6	--------	
Flange; Walworth Co. No. 1428, or equal	--------	7	--------	6Z3887–1
Hardware kit	--------	1	--------	6L80156
Lug, soldering, 1¾″ lg with 11/32″ hole; Sherman No. A–½, or equal	--------	12	------	
Paint, lusterless, OD, in 1-qt can	--------	1	--------	6G1506.1

3. Description

a. Antenna Assemblies AN–202 and AN–203.

(1) Four Antenna Assemblies AN–202 and one Antenna Assembly AN–203 (figs. 209 and 210) are replacements for the five Antenna Equipments RC–223–A of the original crossed U-Adcock antenna system plus the sense antenna of Radio Set SCR–291–A. The replacement assemblies are alike, except that Antenna Assembly AN–202 is equipped with a three-hole guy plate (item 9) and three Guys GY–45 (item 12), and Antenna Assembly AN–203 is equipped with a four-hole guy plate (item 10) and four Guys GY–46 (item 13). The guying arrangement shown in figure 209 *must* be used to provide a symmetrical layout of the antenna system.

(2) Each antenna mast is suported on a pedestal assembly (items 1, 2, and 3), the bottom section (item 1) of which is imbedded in the earth for a semi-permanent installation, or set in concrete (fig. 211) for a permanent installation. The antenna is insulated from ground by a porcelain insulator (item 5) below which a mounting plate (item 14) is provided for Phase Inverter MC–411–A or MC–413–A.

b. Counterpoise CP–19. Counterpoise CP–19 is a replacement for Counterpoise CP–17–A. Each counterpoise mat (item 25) is a 9-foot square of crisscrossed, heavy, copper braid soldered at each intersection. Snap fasteners, running from one side of the mat to an opening in the center, permit laying the mat after the antenna is erected. A ground clamp is provided in each corner of the mat for Stakes GP–2 (item 26), and two ground straps are provided for connections to the pedestal and phase inverter.

c. Protector MX–608/U. Protector MX–608/U consists of a spark gap which is shunted by a 500,000-ohm resistor. The protector (item 27) acts as a lightning arrester and provides a leakage path to ground for static electricity which would otherwise accumulate on the antenna. One protector is connected across the input of each phase inverter.

d. Tools. Tools, hardware, and accessories for the assembly, erection, and maintenance of Fixed Antenna Equipment RC–301 are listed in paragraph 2. The chain vise should be mounted on a carpenter's horse, or on a length of four-by-four lumber, for use when assembling the antenna masts at the installation site.

4. Initial Preparation

Detailed instructions on site selection, orientation, and antenna spacing given in part one are applicable to Fixed Antenna Equipment RC–301. The exact orientation and positioning procedures differ somewhat from those described in part one because of the differences between Antenna Equipment RC–223–A and Antenna Assemblies AN–202 and AN–203. Correct procedures are given in paragraphs 5 and 6 of this appendix.

a. If the original antenna system is installed on the site, apply the dismantling and repacking instructions given in section two. Reel up the antenna cords and set them out of the way. Remove the phase inverters and temporarily store them.

b. After the site has been properly cleared, drive a stake to mark the center of the antenna array.

c. To assure accurate installation of the corner antennas, use a transit with a compass attached instead of the compass furnished with Radio Set SCR–291–A. It is difficult to shift the mast pedestals after installation; therefore, *each pedestal must be accurately positioned the first time*. The antenna layout and all critical distances are given in figure 209.

5. Orientation

a. Attach the transit and compass to the tripod.

b. Calibrate the compass to true north or magnetic north as required (par. 30*a* and fig. 60 of this manual).

c. Attach the plumb-bob to the hook under the tripod. Position the tripod so that the plumb-bob is directly over the center stake for the antenna system (par. 4*b* above).

d. With the compass correctly calibrated and leveled, turn the transit until the north end of the compass needle points to 0. Drive a stake 100 yards from the center of the array and on the line of sight from the transit.

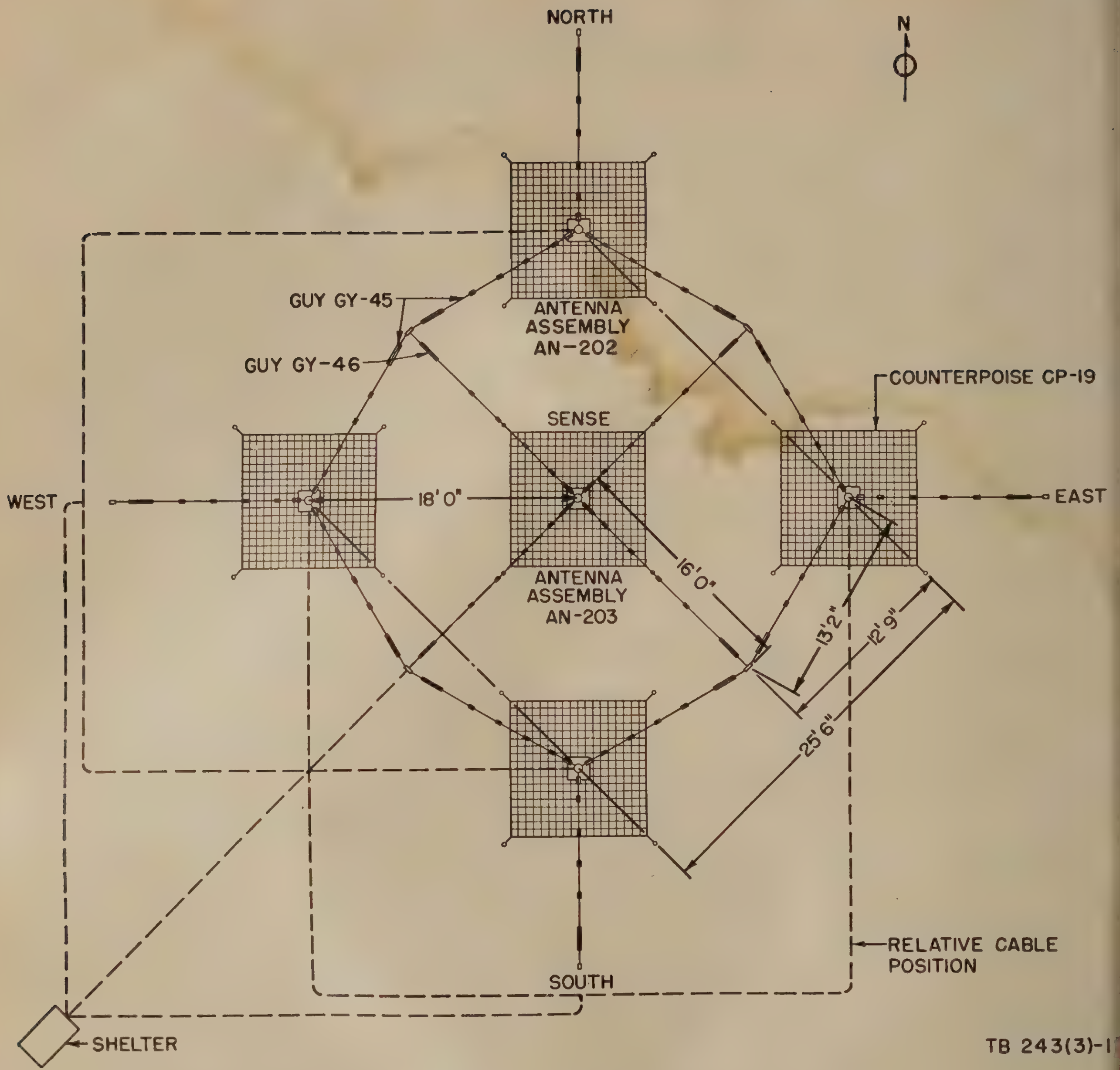


Figure 209. Symmetrical layout for Fixed Antenna Equipment RC–301.

e. Using the steel tape (furnished with Radio Set SCR–291–A), measure a distance of 18 feet from the plumb-bob string along the same line of sight. At this 18-foot point, drive a stake to indicate the position of the north antenna. Along the same line of sight measure a distance of 13 feet 2 inches beyond the north antenna stake. At this point drive a stake to indicate the position of the guy wire ground anchor.

f. Repeat *d* and *e* above for the east (90°) direction. The two stakes located 100 yards from the center are used to check the antenna orientation and alinement.

g. Repeat *e* above for the south (180°) direction.

h. Repeat *e* above for the west (270°) direction.

6. Installation

a. Antenna Positioning.

(1) Use Bar LC–2–A and a shovel or post-

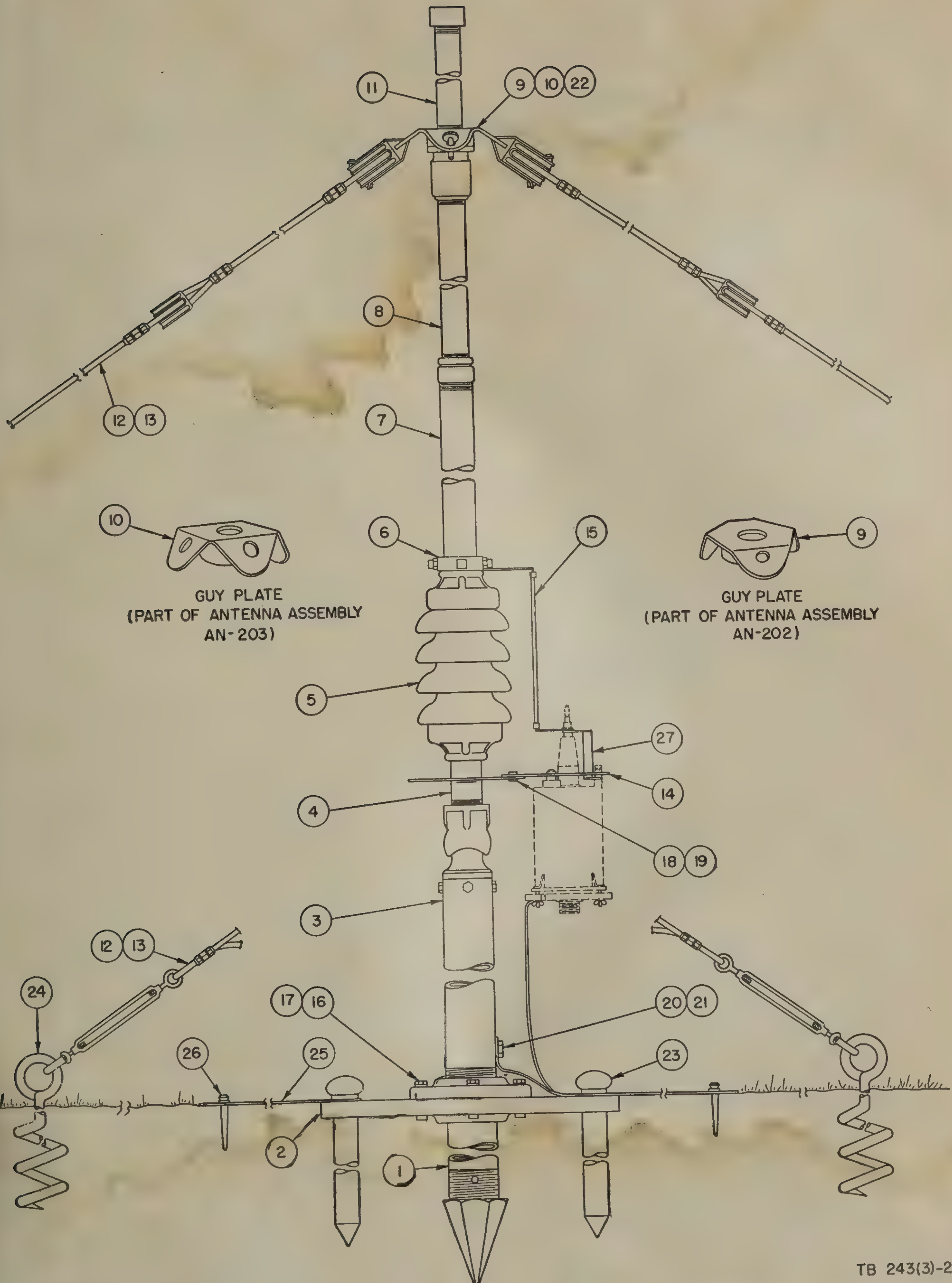


Figure 210. Antenna Assemblies AN–202 and AN–203, assembly details.

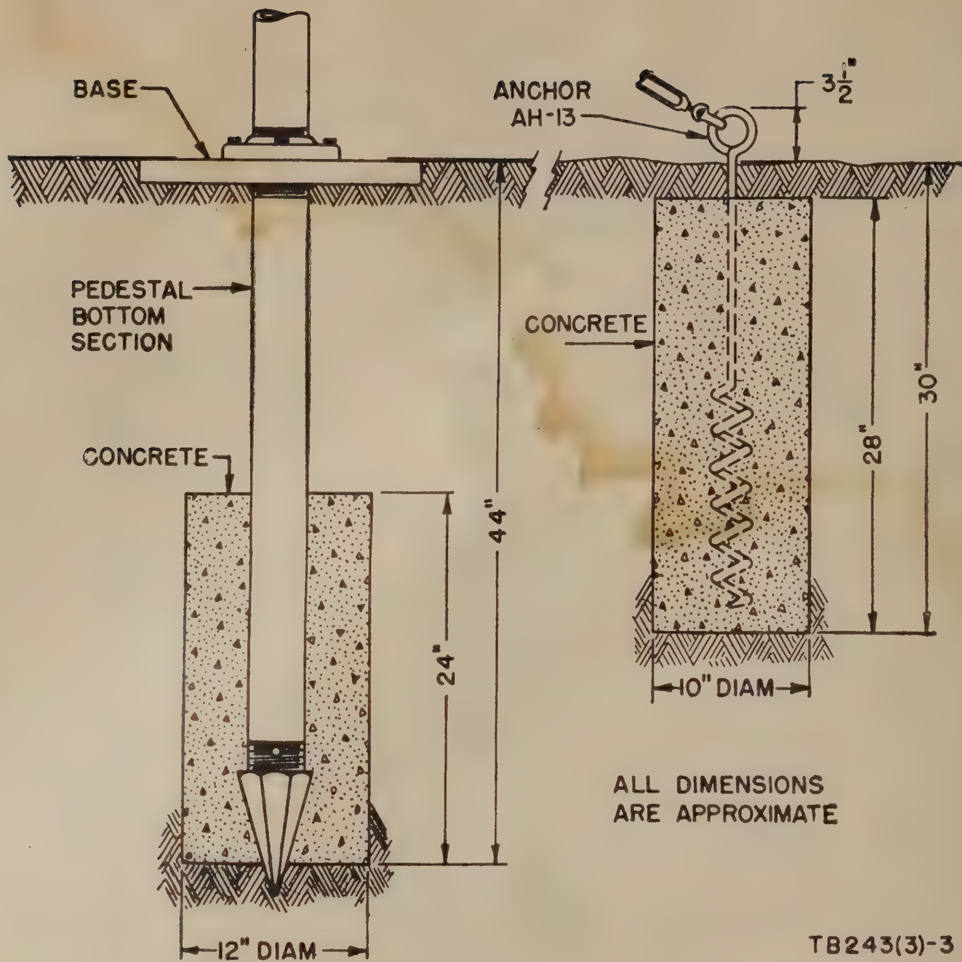


Figure 211. Method of setting pedestals and anchors in concrete.

hole digger to dig a hole, about 44 inches deep, at each antenna position.

(2) Place a pedestal lower section (item 1) in the north hole. The top of the section should protrude about 1 inch above the ground.

(3) Use the spirit level, steel tape, and transit to position the pedestal as accurately as possible. Shift the pedestal until it is vertical and is centered 18 feet along the line of sight from the plumb-bob string on the transit.

(4) Place the drive cap on the pedestal, and, using a sledge hammer, drive the pedestal down until the top of the flange is flush with the ground level.

(5) Shovel in enough earth to hold the pedestal in position.

(6) Similarly install the other three corner pedestals. Refer to (1) through (5) above.

(7) For alinement purposes bolt a pedestal top section (item 3) to each of the four bottom sections. The top sections are removed later (*c*(4) below).

(8) Move the transit and tripod to the 100-yard position previously marked on the line of sight of the north and south antennas.

(9) Sight the transit on the north pedestal. If the pedestals are properly erected, the south pedestal will be exactly in the line of sight.

(10) Move the transit to the 100-yard position marked on the line of sight of the east and west antennas. Check the alinement of the east and west pedestals.

(11) Refer to figure 209.

(12) Measure the distance between centers of the north and south pedestals. This distance must be 36 feet.

(13) Measure the distance between centers of the east and west pedestals. This distance must be 36 feet.

(14) Measure the distance between the centers of the north and east pedestals. This distance must be 25 feet 6 inches.

(15) Measure the distance between centers of the east and south, south and west, and west and north pedestals. Each of these distances must be 25 feet 6 inches.

Note. The above distances must be within ½ inch of figures given. The accuracy of the direction finder depends on the correct positioning and orientation of the antenna system.

(16) Tamp the earth firmly around each of the four pedestals and level it off to the top of the bottom pedestal section. Make a final check of the distances given in (12) through (15) above.

b. ANCHOR SCREW POSITIONING. Eight Anchors AH–13 (item 24) are used in guying Fixed Antenna Equipment RC–301: one anchor at each of the four positions previously determined (par. 5*e* through *h* above), the other four anchors at the positions described below.

(1) Drive a stake at each of the midpoints between adjacent antennas. These points (12 feet 9 inches, fig. 209) car be located conveniently when checking the 25-foot 6-inch measurements (*a*(14) and (15) above).

(2) Sixteen feet from the center stake and in line with each midpoint, as shown in figure 209, drive a stake to mark the positions for the four anchors.

(3) Measure the distances between each anchor stake and the adjacent antennas. These distances should all be 13 feet 2 inches, as shown in figure 209.

(4) At each of the eight positions turn an anchor screw into the ground until the top of the eye is about 3½ inches above the ground level.

c. SENSE ANTENNA POSITIONING. Dig a hole at the position marked by the center stake and install a pedestal (*a* above), positioning it as described below.

(1) Sight along the north and south pedestals, from a distance of approximately 150 feet from the north pedestal. Move the sense (center) antenna pedestal into this line of sight.

(2) Similarly, sight along the east and west antenna pedestals and, *without disturbing the north-south alinement,* move the sense antenna pedestal into the east-west line of sight.

(3) Use the spirit level to check the vertical alinement of the pedestal. Tamp the earth down firmly and recheck the alinement ((1) and (2) above).

(4) Remove the five pedestal top sections preparatory to final assembly (*e* below).

d. ALTERNATE METHOD OF ANCHORAGE. For a more permanent installation, the pedestals and ground anchors may be imbedded in concrete as shown in figure 211. The positioning procedure described in *a*(1) through (4) above is applicable. After completing *a*(4), proceed as follows:

(1) Fill the hole to a depth of 24 inches with a coarse grade of concrete.

(2) Bolt a pedestal upper section to the bottom section. Prop the assembly in position with lumber until the concrete has set. Fill the hole with earth and complete the assembly as previously described.

(3) Stakes GP–25 (*e*(4) below) are not required when the pedestals are set in concrete.

(4) Imbed Anchors AH–13 in concrete as shown in figure 211.

Caution: Check the orientation and positioning of the pedestals and anchors before the concrete has set.

e. MAST ASSEMBLY. The same assembly procedure is applicable to each of the five masts. The mast assembly and sketches of the two guy plates are shown in figure 210. The components are identified by reference numbers which are keyed to the list of components (par. 2).

(1) Put a base plate (item 2) on the north pedestal. Line up the four holes in the center of the plate with the holes in the pedestal flange.

(2) Set a pedestal top section (item 3) on the base plate and line up the four pedestal holes with those in the base plate and bottom pedestal.

(3) Use the four machine screws (item 16) and lockwashers (item 17) to bolt

the pedestal sections together. After the screws have been partially tightened, stop on the edges of the base plate to press the lip into the soil; then tighten the screws until the lockwashers are fully compressed.

(4) Drive one Stake GP–25 (item 23) in each corner of the base plate.

(5) Assemble a pedestal at each of the other four antenna positions.

(6) Place a dab of grease (par. 2) on the ball top of each pedestal.

(7) Slip a contact clamp (item 6) onto the bottom antenna section pipe assembly (item 7). Temporarily fasten the clamp about 2 feet up from the end.

(8) Clamp the bottom antenna section pipe assembly in the chain vise and attach the insulator (item 5) and hub assembly (item 4), using the pipe wrenches provided.

(9) Attach the middle antenna section pipe assembly (item 8); then shift the assembly in the chain vise so that the vise is holding the upper end of the middle section.

(10) Slip a three-hole guy plate (item 9) and a lead gasket (item 22) onto the top antenna section pipe assembly (item 11). Slide the guy plate and gasket up to clear the threaded portion of the pipe.

(11) Attach the top antenna section pipe assembly to the middle section. Slide the gasket down into the recess of the reducer coupling and screw the guy plate down tight to seal the gasket.

(12) Attach three Guys GY–45 (item 12) to the guy plate. Loosen the angle bolt on the insulator, pass it through the hole in the guy plate, and tighten.

(13) Assemble four masts ((7) through (12) above) for use in the corner positions.

(14) To assemble the sense antenna mast, follow the procedure of (1) through (12) above, but in (10) use the four-hole guy plate (item 10) and in (12) attach four Guys GY–46 (item 13).

f. Antenna Mast Erection.

(1) Erect the sense antenna first.

(2) Position the mast on the ground, so that it is midway between any two of the corner antennas, with the hub assembly resting on the center pedestal base plate.

(3) Lay the guy rope, which is to be attached to the farthermost anchor, alongside the mast and extend it beyond the base. Attach the other three guy ropes to their respective anchors, laying each rope in a smooth arc to prevent snarling when the mast is erected.

(4) Loosen the guy turnbuckles until they are fully extended.

(5) With one man holding down the bottom end, have two men lift the far end of the mast and walk toward the base. When the mast has been tilted to 45°, have a fourth man assist by pulling on the fourth guy rope. Keep the bottom end of the mast on the base plate.

(6) When the mast is erect, hold it in position and attach the fourth guy rope to its anchor. Then lift the mast and place the socket on the pedestal ball.

(7) Adjust the turnbuckles until the guy ropes are taut and the mast is vertical.

(8) Place one of the corner antenna masts on the ground midway between its outer ground anchor and either of its other ground anchors. Attach two of the guy ropes to their respective anchors. Use the third guy rope to help erect the mast.

(9) Erect the corner mast as described in (4) through (7) above.

(10) Erect the other three corner masts. Readjust the turnbuckles until the masts are vertical.

(11) Check the alinement of the array from the 100-yard position marked on the north-south line of sight. If the system has been properly installed, the north, south, and sense antennas will be directly in line.

(12) Similarly, check the array from the 100-yard position marked on the east-west line of sight. If the system has been properly installed, the east, south,

and sense antennas will be directly in line.

g. FINAL ASSEMBLY.

(1) Attach a mounting plate (item 14) to the hub assembly on each mast. Select the flange mounting holes that will position the phase inverter in line with the cable approach to the mast (fig. 210).

(2) To attach a Protector MX–608/U (item 27) to each of the phase inverters, proceed as follows:

(*a*) Unscrew, by a few turns, the banana plug on the phase inverter.

(*b*) Position the protector so that the hole in its base fits over one of the phase inverter mounting studs and the forked terminal is under the banana plug.

(*c*) With the Allen socket wrench provided, tighten the two setscrews.

(3) Attach the north Phase Inverter MC–411–A (stenciled N) to the mounting plate on the north antenna.

(4) Attach the E, S, and W Phase Inverters MC–411–A to their respective antennas. Attach Phase Inverter MC–413–A to the sense antenna.

(5) Slide the contact clamp (item 6), on the bottom antenna section of each mast, down to the insulator (item 5). Rotate the clamp to bring one of the screws in line with the phase inverter. Tighten the four screws.

(6) Connect a lead (item 15) between the contact clamp and the phase inverter. Place the short end terminal of the lead under the banana plug and the other end under the locknut on the contact clamp. Screw down the banana plug and the locknut.

(7) Refer to paragraph 39 for information on installing the cords. It is advisable to dig trenches and bury the cables about 2 feet, instead of laying them on the surface. If the cables are buried, the following changes in the layout (fig. 59) are required:

(*a*) Maintain the 36-foot dimensions, but shorten the 57-foot dimensions by approximately the depth of the trench.

(*b*) Between the phase inverters and the point at which the cords enter the ground, leave about 3 inches of slack in the cords to permit expansion and contraction with temperature changes.

(*c*) To insure a watertight seal, tape and coat with varnish all connectors and junction boxes.

(8) Position one Counterpoise CP–19 around the base of each antenna as shown in figure 209. Connect the snap fasteners to close the opening. Drive one Stake GP–2 through the clamp in each corner of the counterpoise. Tighten the clamp screws.

(9) Fasten the lug on the short grounding strap to the pedestal. Fasten the other grounding strap lug under a wingnut on the phase inverter, as shown in figure 210.

7. Operation

a. The operation of Radio Set SCR–291–A with Fixed Antena Equipment RC–301 is the same as with the transportable antennas originally supplied.

b. Facilities are provided on Fixed Antenna Equipment RC–301 to permit multiple operation; that is, for operating up to four sets from each antenna system. The additional phase inverters are mounted around the hub assembly on each mast and connected to the contact clamp. The additional cords must be positioned in exactly the same pattern and alongside the first set of cords.

843134°—49—15

APPENDIX III

REFERENCES

Note. For availability of items listed, check FM 21–6 and Department of the Army Supply Catalog SIG 1. Also see latest issue of FM 21–6 for applicable technical bulletins, supply bulletins, modification work orders, and changes.

1. Army Regulations

AR 380–5, Safeguarding Military Information.

2. Supply Publications

SIG 1, Introduction and Index
SIG 3, List of Items for Troop Issue.
SIG 4–1, Allowances of Expendable Supplies.
SIG 4–2, Allowances of Expendable Supplies for Tactical Organizations, Training Centers, Boards, and Fixed Installations.
SIG 5, Stock List of All Items.
SIG 6, Sets of Equipment.
SIG 7 & 8, Organizational and Higher Echelon Spare Parts.
SIG 10, Fixed Plant Maintenance Lists.
SB 11–6, Dry Battery Supply Data.
SB 11–76, Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.
SB 11–17, Electron Tube Supply and Reference Data.

3. Technical Manuals on Auxiliary Equipment and Test Equipment

TM 11–300, Frequency Meter Sets SCR–211–(*).
TM 11–303, Test Sests I–56–C, –D, –H, and –J.
TM 11–307, Signal Generators I–72–G, H, J, and K.
TM 11–321, Test Set I–56–E.
TM 11–472, Repair and Calibration of Electrical Measuring Instruments.
TM 11–2613, Voltohmmeter I–166.
TM 11–2626, Test Unit I–176.
TM 11–2627, Tube Tester I–177.

4. Painting, Preserving, and Lubrication

TB SIG 13, Moistureproofing and Fungiproofing Signal Corps Equipment
TB SIG 69, Lubrication of Ground Signal Equipment.

5. Camouflage

FM 5–20, Camouflage, Basic Principles.

6. Decontamination

TM 3–220, Decontamination.

7. Demolition

FM 5–25, Explosives and Demolitions.

8. Packaging and Packing Instructions

a. Joint Army-Navy Packaging Specifications.
JAN–D–169, Desiccants, Activated.
JAN–P–100, General Specifications.
JAN–P–106, Boxes, Wood, Nailed.
JAN–P–116, Preservation, Methods of.
JAN–P–125, Barrier Material, Waterproof.
JAN–P–131, Barrier Material, Moisture-Vaporproof, Flexible.
b. U. S. Army Specifications.
100–2E, Marking Shipments by Contractors (and Signal Corps Supplement thereto).
c. Signal Corps Instructions.
720–7, Standard Pack.
726–15, Interior Marking.

9. Other Publications

FM 21–6, List and Index of Department of the Army Publications.
FM 24–18, Radio Communication.
FM 72–20, Jungle Warfare.
TB SIG 4, Methods for Improving the Effectiveness of Jungle Radio Comunication.
TB SIG 5, Defense against Radio Jamming.
TB SIG 25, Preventive Maintenance of Power Cords.
TB SIG 54, Working through Jamming with Frequency Modulated Radio Sets.

TB SIG 66, Winter Maintenance of Signal Equipment.
TB SIG 72, Tropical Maintenance of Ground Signal Equipment.
TB SIG 75, Desert Maintenance of Ground Signal Equipment.
TB SIG 123, Preventive Maintenance Practices for Ground Signal Equipment.
TB SIG 178, Preventive Maintenance Guide for Radio Communication Equipment.
TM 1–455, Electrical Fundamentals.
TM 11–310, Schematic Diagrams for Maintenance of Ground Radio Communication Sets.
TM 11–314, Antennas and Antenna Systems.
TM 11–333, Telephones EE–8, EE–8–A, and EE–8–B.
TM 11–430, Storage Batteries for Signal Communication Except Those Pertaining to Aircraft.
TM 11–453, Shop Work.
TM 11–455, Radio Fundamentals.
TM 11–476, Radio Direction Finding.
TM 11–483, Suppression of Radio Noises.
TM 11–486, Electrical Communication Systems Engineering.
TM 11–496, Training Text and Applicatory Exercises for Amplitude-modulated Radio Sets.
TM 11–499, Radio Propagation Handbook.
TB 11–499–( )*, Basic Radio Propagation Predictions.
TM 11–849, Radio Transmitter BC–1149–A.
TM 11–935, 1½-KVA Kohler Power Unit Model IM–21–A.
TM 11–980, Power Unit PU–58/G.
TM 11–4000, Trouble Shooting and Repair of Radio Equipment.
TM 11–4040, Radio Transmitters BC–1149 and BC–1149–A (Target). Repair Instructions.
TM 11–4041, Radio Receivers BC–1147 and BC–1147–A, Repair Instructions.
TM 11–4063, Bearing Indicator BC–1159–A, Repair Instructions.
TM 38–650, Basic Maintenance Manual.

*A new TB in this series is issued monthly which gives propagation predictions 3 months in advance.

10. Forms

WD AGO Form 468 (Unsatisfactory Equipment Report).

11. Abbreviations

a-c	alternating-current.
a-f	audio-frequency.
a-m	amplitude-modulated.
avc	automatic volume control.
bfo	beat-frequency oscillator.
cps	cycles per second.
c-w	continuous-wave.
DALO	Department of the Army Lubrication Order.
d-c	direct-current.
D/F	direction finding.
f-m	frequency-modulated.
h-f	high-frequency.
hp	horsepower.
i-f	intermediate-frequency.
kc	kilocycle.
kva	kilovolt-ampere.
kw	kilowatt.
l-f	low-frequency.
ma	milliampere.
mc	megacycle.
mf	microfarad.
mmf	micromicrofarad.
PM	preventive maintenance.
r-f	radio-frequency.
rpm	revolutions per minute.
VTVM	vacuum-tube voltmeter.

12. Glossary

Refer to the glossary in TM 11–455.

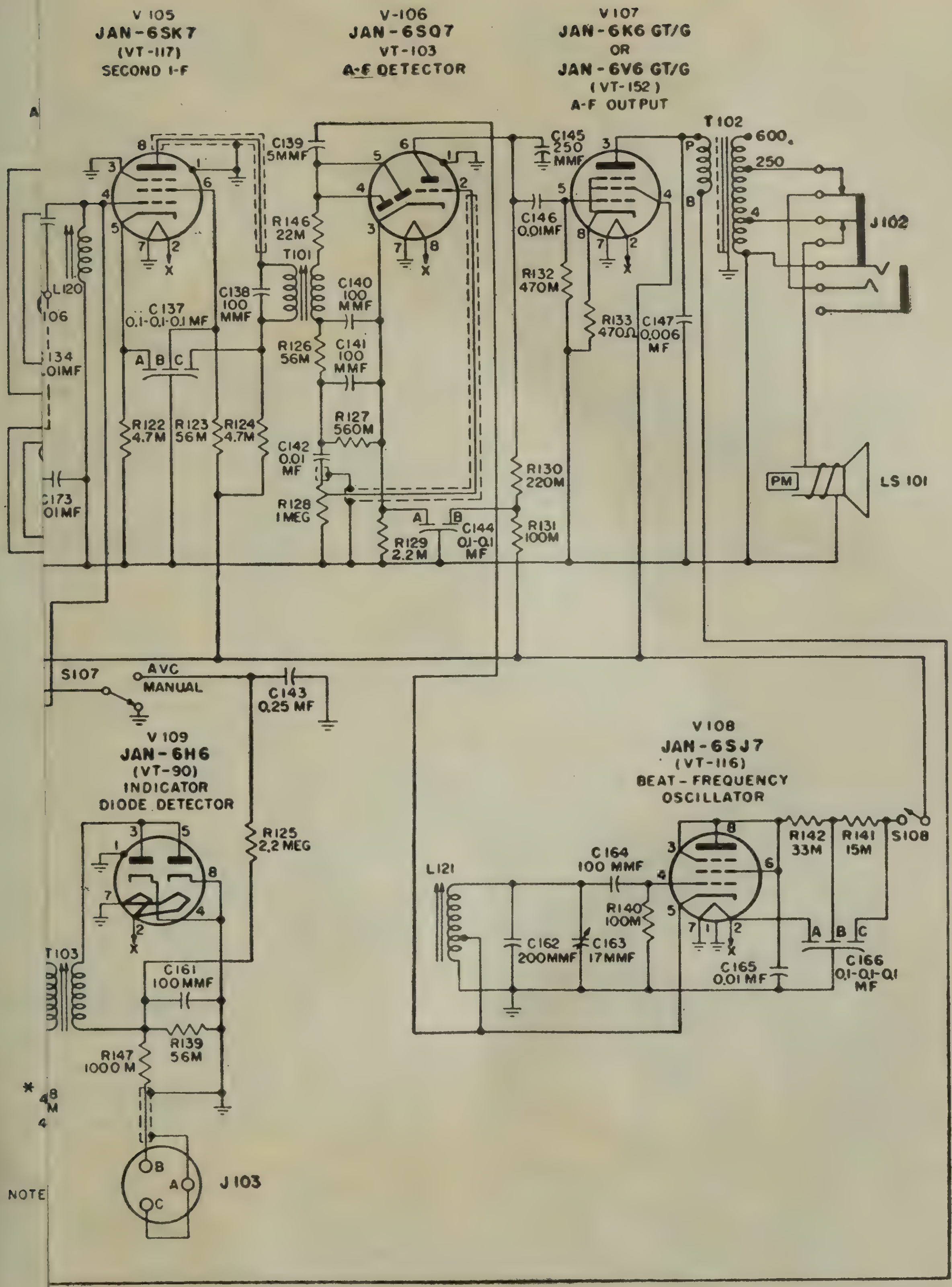
APPENDIX IV

IDENTIFICATION TABLES OF PARTS

Note. The fact that a part is listed in one of these tables is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O&E, T/E, T/A, T/BA, SIG 6, SIG 7&8, SIG 7-8-10, SIG 10, list of allowances of expendable material, or another authorized supply basis. Pamphlets of the Department of the Army Supply Catalog applicable to the equipment covered in this manual are listed in paragraphs 2 and 4 below.

1. Identification Table of Parts for Radio Set SCR-291-A

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RADIO SET SCR 291-A: semifixed station; AM; 1.5 to 30 mc in 4 bands; 115/230 volts, 60 cps, single phase.	Direction finding, semi-fixed station.	2S291-A
	TECHNICAL MANUAL: TM 11-243	Technical manual	(Order through AGO channels)
	ADAPTER, connector: male 1 end, female other end; 2 flat parallel blades 1 end, 2 rectangular female cont other end; 90 deg angle; reduces illumination provided for azimuth scale; 3 1/16" lg x 1 1/4" wd x 1 5/8" d less cont; Fed Tele & Rad part/dwg #RF-4123-2A.	Reduces illumination provided for azimuth scale.	2Z307-46
	ADAPTER, tripod head: brass body, knurled edge; 4 9/16" diam x 11/16" thk; mts by disk w/3 1/2"-8 thd Fed Tele & Rad #RF-332-2.	For adapting compass to tripod.	3F5
	ADAPTER, tripod head: Sig C Radio Transmitter BC-1149-A; brass, olive drab finish; disk 3 3/8" ID x 4 7/16" OD x 5/8" wd w/tube 1 1/4" diam x 8 15/16" lg, 3 1/2"-8 female thd; RCA dwg #728191-1.	Mounts transmitter tirpod	2Z306-20
	ANTENNA EQUIPMENT RC-223-A: used in groups of 5 (4 directional, 1 sense), forming a fixed U-Adcock antenna system for direction finding; plywood; approx 24 ft lg.	Fixed U-Adcock antenna system for direction finding.	2A289-223A
	BAG: tool; canvas, olive drab; 9" wd x 9" h overall; tie tape for closing; single compartment; tropicalized; stamped *wrenches*.	For wrenches	6Q2104-17
	BAG: tool; canvas, olive drab; 8 1/2" wd x 11" lg, open; closed by tie cord; 8 pockets; Allen Mfg.	For L-shaped wrenches	6Q2107-11
	BAG: tool; canvas, olive drab; 4 1/4" wd x 4 1/2" h overall; braid tie tape for closing; single compartment; tropicalized and stamped *Plumb Bob* in black ink.	For plumb bob	6Q2104-16
	BEARING INDICATOR BC-1159-A: 5" CR tube; 47 5/32" lg x 13" wd x 25" h overall.	Produces visual patterns for azimuth indications.	2C1557-1159A
CD-831	CABLE ASSEMBLY, power: Sig C Cord CD-831; Buna S rubber jacket; 160 ft excl term; Fed Tele & Rad #NL-43374-2-2 plug on one end and Fed Tele & Rad #NL-43374-2-3 plug on other end.	Spare for CD-832 through CD-836.	3E1831


V 105
JAN-6SK7
(VT-117)
SECOND I-F
V-106
JAN-6SQ7
VT-103
A-F DETECTOR
V 107
JAN-6K6 GT/G
OR
JAN-6V6 GT/G
(VT-152)
A-F OUTPUT
T102
600
250
J102
LS 101
PM
C139 5MMF
C145 250 MMF
C146 0.01MF
R146 22M
T101
C138 100 MMF
C137 0.1-0.1-0.1 MF
C140 100 MMF
C141 100 MMF
R126 56M
R127 560M
R132 470M
R133 470Ω
C147 0.006 MF
L120
C134 .01MF
R122 4.7M
R123 56M
R124 4.7M
C142 0.01 MF
R128 1 MEG
R129 2.2M
C144 0.1-0.1 MF
R130 220M
R131 100M
C173 .01MF
S107
AVC
MANUAL
C143 0.25 MF
V 109
JAN-6H6
(VT-90)
INDICATOR
DIODE DETECTOR
R125 2.2 MEG
T103
C161 100MMF
R139 56M
R147 1000 M
J 103
V 108
JAN-6SJ7
(VT-116)
BEAT-FREQUENCY
OSCILLATOR
L121
C164 100 MMF
R140 100M
C162 200MMF
C163 17MMF
R142 33M
R141 15M
S108
C165 0.01 MF
C166 0.1-0.1-0.1 MF
NOTE

TL 11726S

APPENDIX IV

IDENTIFICATION TABLES OF PARTS

Note. The fact that a part is listed in one of these tables is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O&E, T/E, T/A, T/BA, SIG 6, SIG 7&8, SIG 7–8–10, SIG 10, list of allowances of expendable material, or another authorized supply basis. Pamphlets of the Department of the Army Supply Catalog applicable to the equipment covered in this manual are listed in paragraphs 2 and 4 below.

1. Identification Table of Parts for Radio Set SCR–291–A

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RADIO SET SCR 291–A: semifixed station; AM; 1.5 to 30 mc in 4 bands; 115/230 volts, 60 cps, single phase.	Direction finding, semi-fixed station.	2S291–A
	TECHNICAL MANUAL: TM 11–243	Technical manual	(Order through AGO channels)
	ADAPTER, connector: male 1 end, female other end; 2 flat parallel blades 1 end, 2 rectangular female cont other end; 90 deg angle; reduces illumination provided for azimuth scale; $3\frac{1}{16}''$ lg x $1\frac{1}{4}''$ wd x $1\frac{5}{8}''$ d less cont; Fed Tele & Rad part/dwg #RF–4123–2A.	Reduces illumination provided for azimuth scale.	2Z307–46
	ADAPTER, tripod head: brass body, knurled edge; $4\frac{9}{16}''$ diam x $\frac{11}{16}''$ thk; mts by disk w/$3\frac{1}{2}''$–8 thd Fed Tele & Rad #RF–332–2.	For adapting compass to tripod.	3F5
	ADAPTER, tripod head: Sig C Radio Transmitter BC–1149–A; brass, olive drab finish; disk $3\frac{3}{8}''$ ID x $4\frac{7}{16}''$ OD x $\frac{5}{8}''$ wd w/tube $1\frac{1}{4}''$ diam x $8\frac{15}{16}''$ lg, $3\frac{1}{2}''$–8 female thd; RCA dwg #728191–1.	Mounts transmitter tirpod	2Z306–20
	ANTENNA EQUIPMENT RC–223–A: used in groups of 5 (4 directional, 1 sense), forming a fixed U-Adcock antenna system for direction finding; plywood; approx 24 ft lg.	Fixed U-Adcock antenna system for direction finding.	2A289–223A
	BAG: tool; canvas, olive drab; $9''$ wd x $9''$ h overall; tie tape for closing; single compartment; tropicalized; stamped *wrenches*.	For wrenches	6Q2104–17
	BAG: tool; canvas, olive drab; $8\frac{1}{2}''$ wd x $11''$ lg, open; closed by tie cord; 8 pockets; Allen Mfg.	For L-shaped wrenches	6Q2107–11
	BAG: tool; canvas, olive drab; $4\frac{1}{4}''$ wd x $4\frac{1}{2}''$ h overall; braid tie tape for closing; single compartment; tropicalized and stamped *Plumb Bob* in black ink.	For plumb bob	6Q2104–16
	BEARING INDICATOR BC–1159–A: $5''$ CR tube; $47\frac{5}{32}''$ lg x $13''$ wd x $25''$ h overall.	Produces visual patterns for azimuth indications.	2C1557–1159A
CD–831	CABLE ASSEMBLY, power: Sig C Cord CD–831; Buna S rubber jacket; 160 ft excl term; Fed Tele & Rad #NL–43374–2–2 plug on one end and Fed Tele & Rad #NL–43374–2–3 plug on other end.	Spare for CD–832 through CD–836.	3E1831

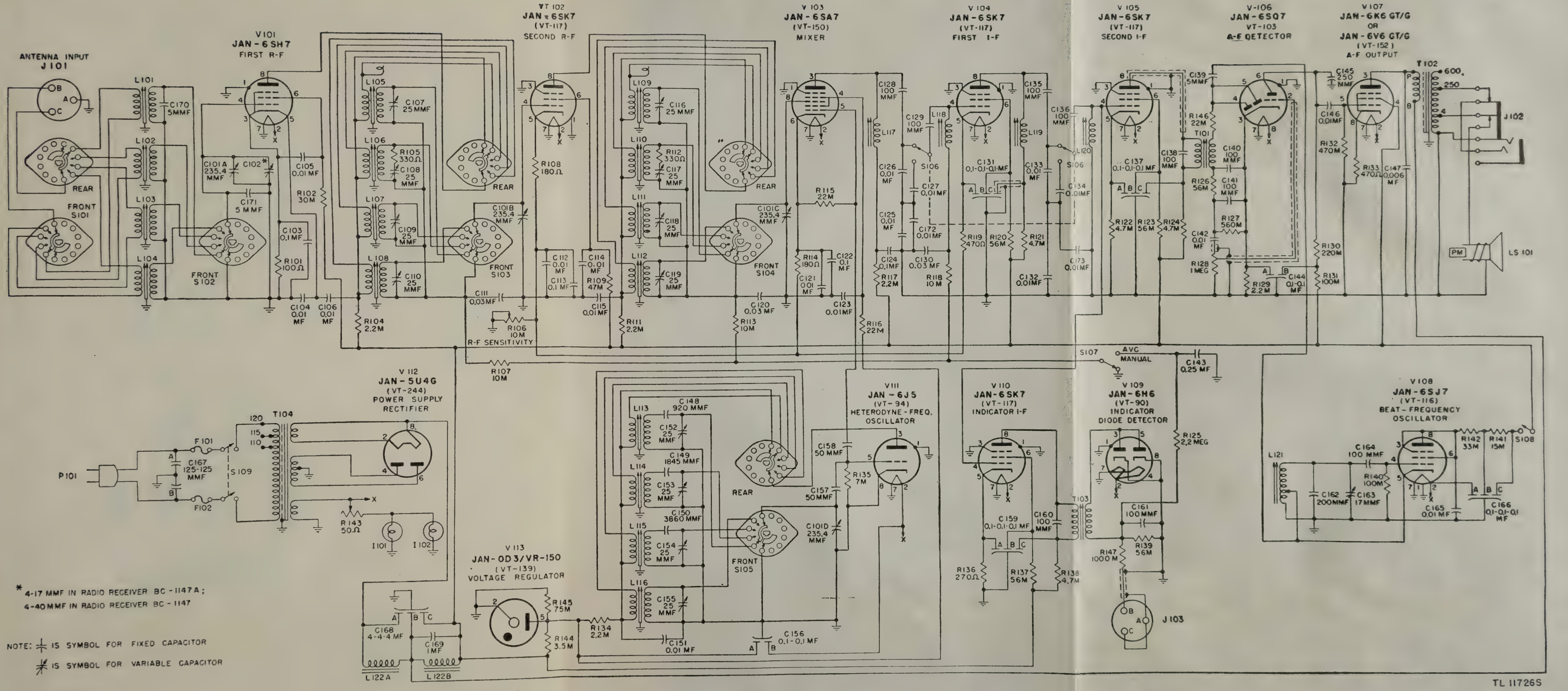
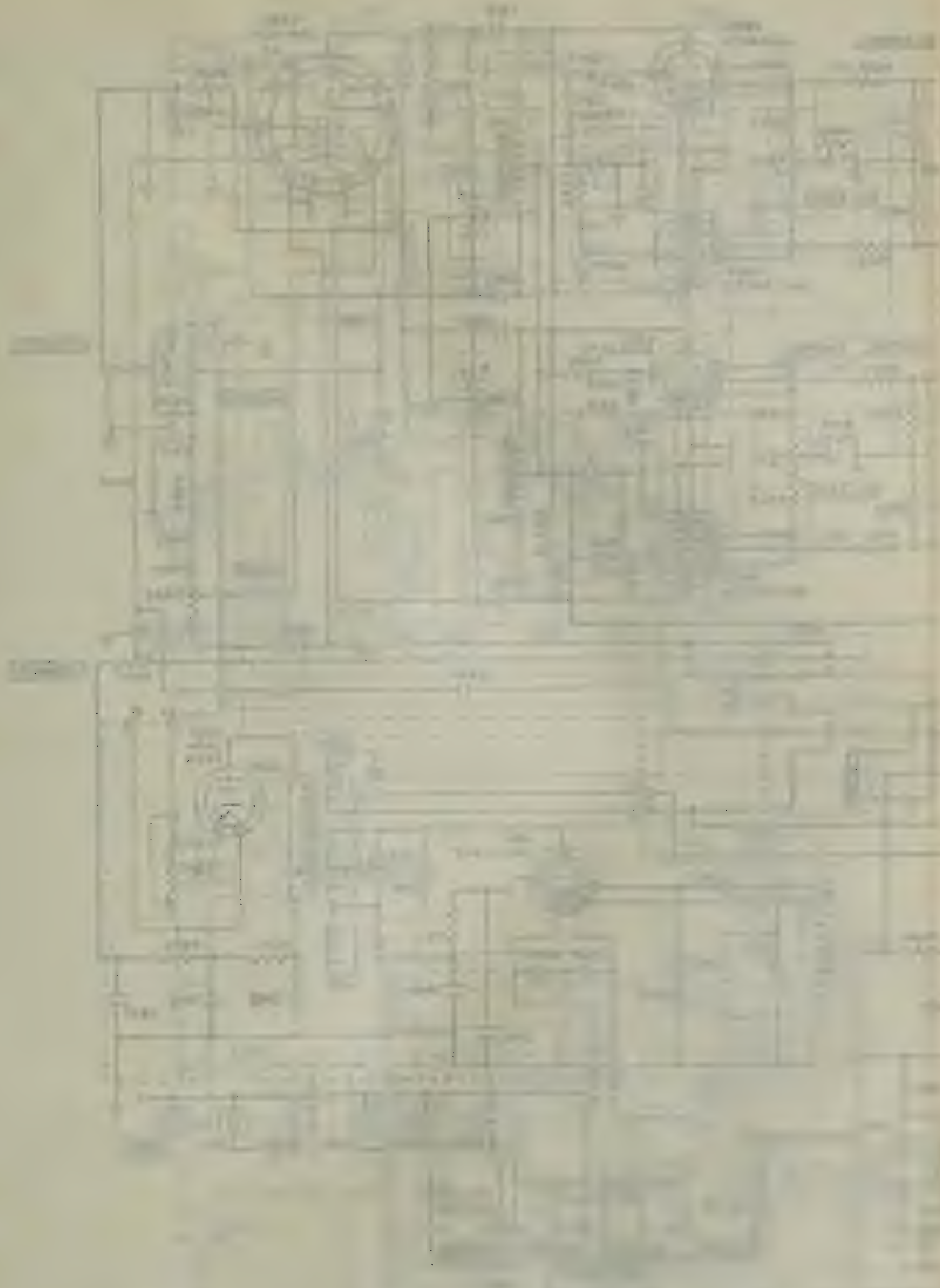


Figure 212. Radio Receiver BC-1147-A, schematic diagram.



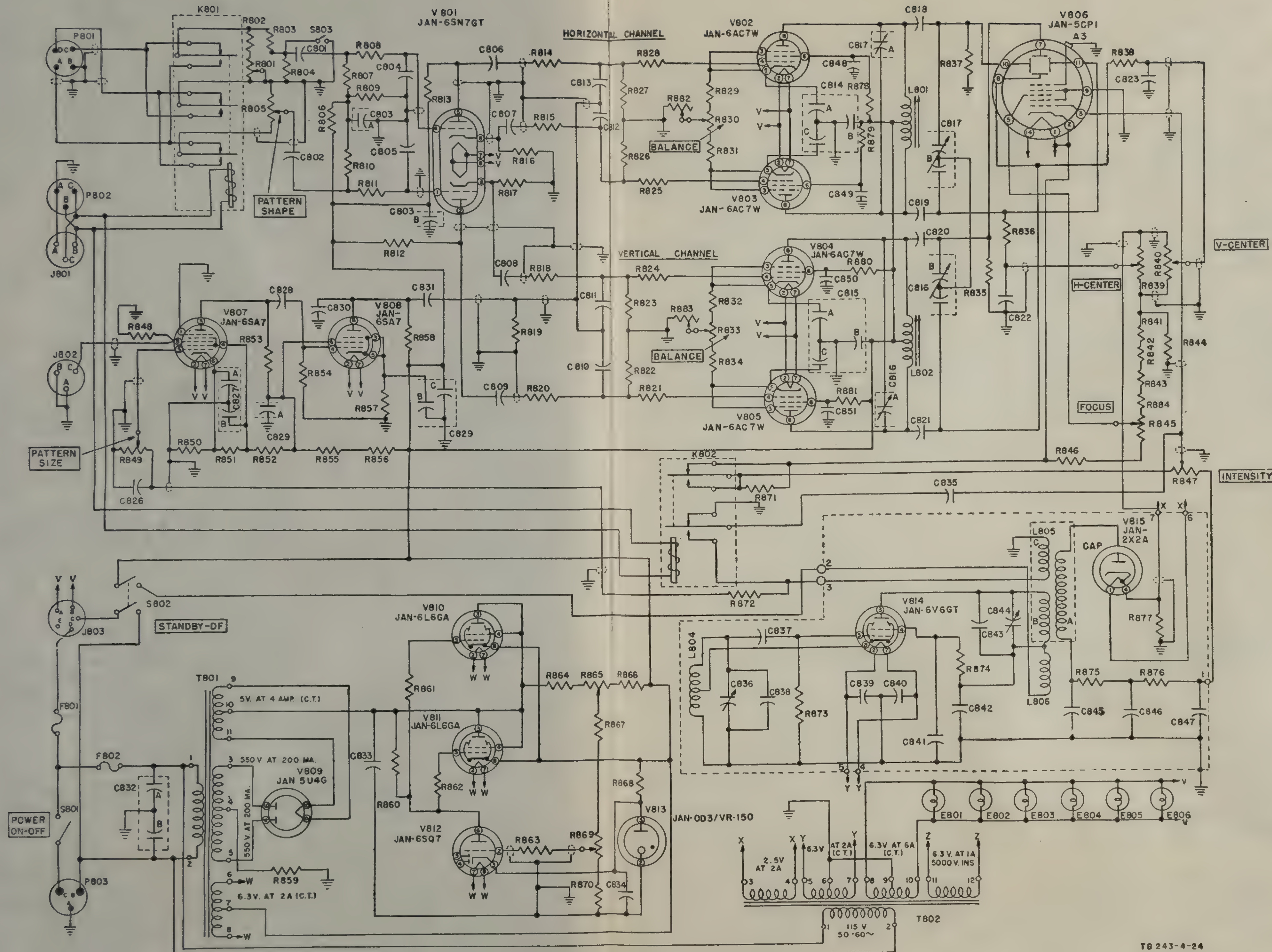


Figure 213. Bearing Indicator BC-1338, schematic diagram.

REF. SYM.	S.C. STOCK. NO.	NAME AND DESCRIPTION
C801		CAPACITOR, FIXED, PAPER, .5µf, ±10%, 400V.
C802		.5µf, ±10%, 400V.
C803		A=1µf, B=1µf, +40% -15%, 600V.
C804		MICA, 47,000µµf, ±2%, 600V.
C805		MICA, 47,000µµf, ±2%, 600V.
C806		PAPER, .5µf, ±10%, 400V.
C807		.5µf
C808		.5µf
C809		.5µf
C810	3K2510243	MICA, 1,000µµf, ±2%, 500V., SILVER
C811		1,000µµf
C812		1,000µµf
C813		1,000µµf
C814		PAPER, A, B & C=.1µf, +40%, -15%, 600V.
C815		PAPER, A, B, & C=.1µf, +40%, -15%, 600V.
C816		VARIABLE, AIR, A=4-50µµf, B=2.8-14µµf, EA.SECT.
C817		VARIABLE, AIR, A=4-50µµf, B=2.8-14µµf, EA.SECT.
C818	3K2510243	FIXED, MICA, 1,000µµf, ±2%, 500V., SILVER
C819		1,000µµf
C820		1,000µµf
C821		1,000µµf
C822		1,000µµf
C823		1,000µµf
C824	3K2051142	510µµf ±5%
C825	3K2051142	510µµf ±5%
C826	3K2015133	150µµf ±2%
C827		PAPER, A & B=.1µf, +40% -15%, 600V.
C828	3K2051142	MICA, 510µµf, ±5%, 500V., SILVER
C829		PAPER, A, B, & C=.1µf, +40%, -15%, 600V.
C830	3K2051142	MICA, 510µµf, ±5%, 500V., SILVER
C831	3K2051142	MICA, 510µµf, ±5%, 500V., SILVER
C832		PAPER, A & B=.1µf, +40%, -15%, 600V.
C833		10µf, +40%, -15%, 1,000V.
C834		.5µf, ±10%, 400V.
C835		MICA, 4,300µµf, ±5%, 2,500V.
C836	3D293	VARIABLE, AIR, 210µµf, CA-293
C837		FIXED, MICA, 4,300µµf, ±5%, 500V., SILVER
C838	3K2015133	150µµf, ±2%
C839	3K3510344	10,000µµf, ±20%, 300V.
C840		10,000µµf
C841		10,000µµf,
C842		6,200µµf, 500V.
C843	3K2047141	470µµf, ±2%, 500V.
C844	3D293	VARIABLE, AIR, 210µµf, CA-293
C845		FIXED, MICA, 4,300µµf, ±5%, 2,500V.
C846		4,300µµf,
C847		4,300µµf,
C848	3K3510324	10,000µµf, ±10%, 300V.
C849		
C850		
C851		
E801	2Z5934-1	LAMP, INCANDESCENT, 6-8V., .2A., BAYONET
E802		
E803		
E804		
E805		
E806		
F801	3Z2605.2	FUSE, CARTRIDGE, 5 A.
F802	3Z1927	FUSE, CARTRIDGE, FU-27, 2 A., 250V.
J801	2Z8673.20	CONNECTOR, FEMALE CONTACT, 3 CONTACTS

REF. SYM.	S.C. STOCK NO.	NAME AND DESCRIPTION
J802	2Z8673.20	CONNECTOR, FEMALE CONTACT, 3-CONTACTS
J803	2Z867.39	CONNECTOR, FEMALE CONTACT, 5-CONTACTS
K801		RELAY, 3-POLE, DOUBLE THROW
K802		RELAY, 2-POLE, DOUBLE THROW
L801		COIL, RF, BALANCED MODULATOR, 18.6mh
L802		BALANCED MODULATOR, 18.6mh
L803		FILTER, 80mh
L804		GRID, POWER SUPPLY, 2.43mh
L805		A=90.4mh, B=.94mh, C=.0129mh
L806		FILTER, 5.5mh
P801	2Z8799-220	CONNECTOR, MALE CONTACT, SOCKET SO-220, 4-CONTACTS
P802	2Z7113.6	3-CONTACTS
P803		3-CONTACTS
R801		RESISTOR, VARIABLE, COMPOSITION, 25,000 OHMS, LINEAR
R802	3RC30BF682K	FIXED, 6,800 OHMS, ±10%, 1W.
R803	3RC20BF253K	25,000 OHMS, 1/2W
R804	3RC20BF153K	15,000 OHMS,
R805		VARIABLE, 10,000 OHMS, LINEAR
R806	3RC20BF106K	FIXED, 10 MEGOHMS, ±10%, 1/2W.
R807	3RC20BF515K	5.1 MEGOHMS, ±10%
R808	3RC20BF205J	2 MEGOHMS, ±5%
R809	3RC20BF205J	2 MEGOHMS, ±5%
R810	3RC20BF515K	5.1 MEGOHMS, ±10%
R811	3RC20BF205J	2 MEGOHMS, ±5%
R812	3RC20BF513J	51,000 OHMS,
R813	3RC20BF513J	51,000 OHMS,
R814	3RC20BF104J	100,000 OHMS,
R815	3RC20BF104J	100,000 OHMS,
R816	3RC20BF513J	51,000 OHMS,
R817	3RC20BF513J	51,000 OHMS,
R818	3RC20BF104J	100,000 OHMS,
R819	3RC20BF272J	2,700 OHMS,
R820	3RC20BF104J	100,000 OHMS,
R821	3RC20BF101K	100 OHMS, ±10%
R822	3RC10BF514J	510,000 OHMS, ±5%, 1/4W
R823	3RC10BF514J	510,000 OHMS, ±5%,
R824	3RC20BF101K	100 OHMS, ±10%, 1/2W
R825	3RC20BF101K	100 OHMS, ±10%,
R826	3RC10BF514J	510,000 OHMS, ±5%, 1/4W
R827	3RC10BF514J	510,000 OHMS, ±5%,
R828	3RC20BF101K	100 OHMS, ±10%, 1/2W.
R829	3RC20BF221J	220 OHMS, ±5%
R830		VARIABLE, WIREWOUND 200 OHMS,
R831	3RC20BF221J	FIXED, COMPOSITION, 220 OHMS, ±5%, 1/2W.
R832	3RC20BF221J	220 OHMS, ±5%,
R833		VARIABLE, WIREWOUND, 200 OHMS,
R834	3RC20BF221J	FIXED, COMPOSITION, 220 OHMS, ±5%, 1/2W.
R835	3RC10BF754J	750,000 OHMS, ±5%, 1/4W.
R836		750,000 OHMS,
R837		750,000 OHMS,
R838		750,000 OHMS,
R839		VARIABLE, 500,000 OHMS, LINEAR
R840		VARIABLE, 500,000 OHMS, LINEAR
R841	3RC30BF184K	FIXED, 180,000 OHMS, ±10%, 1W.
R842	3RC30BF224K	220,000 OHMS, ±10%,
R843	3RC30BF184K	180,000 OHMS, ±10%,
R844	3RC30BF473K	47,000 OHMS, ±10%,
R845		VARIABLE, 250,000 OHMS, LINEAR
R846	3RC30BF154K	FIXED, 150,000 OHMS, ±10%, 1W
R847		VARIABLE, 50,000 OHMS, LINEAR

REF. SYM.	S.C. STOCK NO.	NAME AND DESCRIPTION
R848	3RC20BF224K	RESISTOR, FIXED, COMPOSITION, 220,000 OHMS, ±10%, 1/2W.
R849		VARIABLE, 5,000 OHMS, LINEAR
R850	3RC20BF391K	FIXED 390 OHMS, ±10%, 1/2W.
R851	3RC20BF332K	3,300 OHMS, ±10%,
R852	3RC30BF333J	33,000 OHMS, ±5%, 1W.
R853	3RC20BF203J	20,000 OHMS, 1/2W.
R854	3RC20BF104J	100,000 OHMS,
R855	3RC30BF273K	27,000 OHMS, ±10%, 1W.
R856	3RC30BF223K	22,000 OHMS,
R857	3RC20BF751J	750 OHMS, ±5%, 1/2W.
R858	3RC20BF203J	20,000 OHMS,
R859		WIREWOUND, 500 OHMS 16W.
R860	3RC30BF514J	COMPOSITION, 510,000 OHMS, ±5%, 1W.
R861	3RC30BF102K	1,000 OHMS, ±10%,
R862		1,000 OHMS,
R863		1,000 OHMS,
R864	3RC30BF514J	510,000 OHMS, ±5%
R865		VARIABLE, 5,000 OHMS, LINEAR
R866	3RC30BF202J	FIXED, 2,000 OHMS, ±5%, 1W
R867	3RC30BF154K	150,000 OHMS, ±10%,
R868		WIREWOUND, 4,000 OHMS 16W.
R869		VARIABLE, COMPOSITION, 50,000 OHMS, LINEAR
R870	3RC30BF154K	FIXED, 150,000 OHMS, ±10%, 1W.
R871	3RC20BF752J	7,500 OHMS, ±5%, 1/2W.
R872	3RC20BF104J	100,000 OHMS,
R873	3RC30BF203J	20,000 OHMS, 1W.
R874	3RC30BF393K	39,000 OHMS, ±10%,
R875	3RC20BF223J	22,000 OHMS, ±5%, 1/2W.
R876	3RC20BF223J	22,000 OHMS, ±5%,
R877	3RC30BF473K	47,000 OHMS, ±10%, 1W.
R878	3RC20BF683K	68,000 OHMS, 1/2W.
R879		68,000 OHMS,
R880		68,000 OHMS,
R881		68,000 OHMS,
R882		VARIABLE, WIREWOUND 1,000 OHMS, LINEAR
R883		1,000 OHMS,
R884	3RC30BF184K	FIXED, COMPOSITION, 180,000 OHMS, ±10% 1W.
S801	3Z9863-42A	SWITCH, TOGGLE, SPST
S802		SWITCH, TOGGLE, DPST
S803	3Z9863-42A	SWITCH, TOGGLE, SPST
T801		TRANSFORMER, POWER, PRI. 115V., 50-60~, SEC. 550-0-550V.-
		200MA, 5V-4A, 6.3V.-2A.
T802		FILAMENT, PRI. 115V., 50-60~, SEC. 2.5V.-2A,
		6.3V., C.T.,-2A., 6.3V., C.T.,-6A.,
		6.3V.-1A (5000 V. INS.)
V801	2J6SN7GT	TUBE, ELECTRON, JAN-6SN7GT
V802	2J6AC7W	JAN-6AC7W
V803		
V804		
V805		
V806	2J5CP1	JAN-5CP1
V807	2J6SA7	6SA7
V808	2J6SH7	6SH7
V809	2J5U4G	5U4G
V810	2J6L6GA	6L6GA
V811	2J6L6GA	6L6GA
V812	2J6SQ7	6SQ7
V813	2J0D3/VR-150	0D3/VR-150
V814	2J6V6GT/G	6V6GT/G
V815	2J2X2A	2X2A

TB 243-4-26

Figure 214. Bearing Indicator BC-1338, legend of parts.

843134—49 (Face p. 220)

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
CD–838	CABLE ASSEMBLY, power: Sig C Cord CD–838; Buna S rubber jacket; 150 ft excl term; two 50–amp NEC std solder lugs on one end and Pyle-National female connector #SZED–83022–S–WS w/cover on other end.	Main power	3E1838
CD–839	CABLE ASSEMBLY, power: Sig C Cord CD–839; rubber jacketed; 10 ft excl term; Hubbell #7559 female twist-lock connector on one end and Hubbell #7573 male twist-lock connector on other end.	Power cord from transformer to equipment.	3E1839
CD–840	CABLE ASSEMBLY, power: Sig C Cord CD–840; rubber jacketed; 52″ lg excl term; #AN–3106–22–10P w/clamp #AN–3057–12 on one end and #AN–3108–22–10S w/clamp #AN–3057–12 on other end.	Motor and heater supply from control panel to indicator.	3E1840
CD–820 through CD–827	CABLE ASSEMBLY, RF: Sig C Cord CD–820; twin coaxial; characteristic impedance 125 ohms; 80 ft excl term; #AN–3106–22–2P connector at one end and #AN–3106–22–2S connector at other end; modified by Fed Tele & Rad dwgs #NL–43378–12D and #NL–43379–12D.	CD–820: Spare for CD–821 through CD–827. CD–821 through CD–827: R-f transmission between different units of antenna equipment and direction finding equipment.	3E1820
CD–828	CABLE ASSEMBLY, RF: Sig C Cord CD–828; twin coaxial; characteristic impedance 125 ohms; 68 ft excl term; #AN–3106–22–2P connector at one end and #AN–3106–22–2S connector at other end; modified by Fed Tele & Rad dwgs #NL–43378–12D and #NL–43379–12D; color-coded white.	R-f transmission from the sense phase inverter to the sense junction box.	3E1828
CD–829	CABLE ASSEMBLY, RF: Sig C Cord CD–829; twin coaxial; characteristic impedance 125 ohms; 92 ft excl term; #AN–3106–22–2P connector at one end and #AN–3106–22–2S connector at other end; modified by Fed Tele & Rad dwgs #NL–43378–12D and #NL–43379–12D; color-coded red.	R-f transmission from the sense phase inverter to the sense junction box.	3E1829
CD–830	CABLE ASSEMBLY, RF: Sig C Cord CD–830; twin coaxial; characteristic impedance 125 ohms; 6 ft excl term; #AN–3106–22–2P on both ends; modified by Fed Tele & Rad dwgs #NL–43378–12D and #NL–43379–12D; color-coded black and white.	R-f transmission from the goniometer to the radio receiver.	3E1830
	CABLE ASSEMBLY, special purpose: Sig C Cord CD–841; 3 cond #16 AWG stranded; 58″ lg excl term; Amphenol 90 deg angle #AN–3108–22–9S at one end and #AN–3106–22–9P at other end.	Connecting cable for deflection coils from the control panel to the indicator.	3E1841
CD–842	CABLE ASSEMBLY, special purpose: Sig C Cord CD–842; 6 cond #16 AWG stranded; 54″ excl term; Amphenol 90 deg angle #AN–3108–28–4S at one end and #AN–3106–28–4P at other end.	Connecting cable for high voltage from the control panel to the indicator.	3E1842
CD–843	CABLE ASSEMBLY, special purpose: Army-Navy Cord CX–566/CRD–3; 2 cond #20 AWG stranded tinned copper wire; 70″ excl term; #AN–3106–14S–1P at one end and #AN–3106–14S–1S at other end.	Connecting cable sense relay from the control panel to the goniometer.	3E6000–566

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
CD–844	CABLE ASSEMBLY, power: Sig C Cord CD–844; rubber jacketed; 2 cond #18 AWG stranded copper wire; 13⅛″ lg; Amphenol connector #AN–3106–14S–1S and clamp #AN–3057–6 on one end and Amphenol connector #AN–3108–14S–1P and clamp #AN–3057–6 at other end.	Connecting cable for the receiver rectified output from the receiver to the control panel.	3E1844
CD–845	CABLE ASSEMBLY, power: Sig C Cord CD–845; rubber jacketed; round; 2 #14 AWG cond; 150 ft excl term; Hubbell #7187-plug one end, Universal type socket other end.	Trouble or utility power cable	3E1845
	CIRCUIT BREAKER: toggle type; DPST; 25 amp, 230 v; bakelite case; 5⅜″ x 3″ x 3½″; Heinemann #0322–25; Fed Tele & Rad dwg #RF–1895–2.	Circuit breaker	3H900–25–6
	COMPASS, magnetic: moving needle type; 1 deg scale division from 0 to 360 deg counterclockwise with zero point at north position; brass case, black enamel finish; 4¹³⁄₁₆″ diam x 4⅛″ h w/sights in open position, ⅞″ h w/sights closed; equipped w/2 levels, hinged sight and needle lock stop; K&KECo #5334; RCA part/dwg #728754–2.	To line up antennas during erection of antenna system.	3F2660–1
	CONNECTOR, female contact: 2 cont; 5⁵⁄₁₆″ lg x 2³⁄₁₆″ overall; dust cap and chain attached; Pyle-National #SZED–83022–S–WS.	----------	2Z3014–2
	CONNECTOR, female contact: 3 round cont, pol; straight; 1¹¹⁄₃₂″ lg x ¹⁄₁₆″ diam overall; Army-Navy Aeronautical type #AN–3106–14S–1S.	----------	2Z3096
	CONNECTOR, female contact: 1 female cont; straight type; hex head, thd body ⅞″ lg x ½″–20 thd w/⁵⁄₁₆″ jack hole; Birnbach #399.	----------	2Z5594.10
	CONNECTOR, female contact: Sig C Plug PL–Q229; 4 round pol cont; 90 deg angle type; 2⁷⁄₁₆″ lg x 1⅜″ h to junction of axial ctr lines, 1¹⁹⁄₃₂″ overall OD; cylindrical L-shape aluminum body w/sand blast finish.	----------	2Z7226–229.1
	CONNECTOR, female contact: Sig C Plug PL–Q247; 3 round cont, pol; 90 deg angle; 2⁷⁄₁₆″ lg x 1⅜″ h to junction of axial ctr lines, 1¹⁹⁄₃₂″ overall OD.	----------	2Z7226–Q247
	CONNECTOR, female contact: 3 round cont, pol; straight; 1¹¹⁄₃₂″ lg x 1⅜″ diam w/1⅝″ sq flange; Army-Navy type #AN–3102–22–2S.	----------	2Z8673.1
	CONNECTOR, female contact: 5 female cont; straight; 4½″ lg x 1⅝″ OD; Fed Tele & Rad #NL–43374–2–3.	----------	2Z8675.14
	CONNECTOR, female contact: 3 female cont; straight; bakelite; twist-lock; Hubbell Twist-Lock #7559.	----------	6Z7591–3.1
	CONNECTOR, female contact: 2 cont; T-slot; 2⅛″ h x 1⁵⁄₁₆″ diam; Hubbell #7187.	----------	6Z7591–10

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	CONNECTOR, female contact: 2 flat cont; straight; $3\frac{5}{16}''$ mtg/c; Hubbell Twist-Tite #9200.	-----------------	6Z7809-5
	CONNECTOR, female contact: 3 flat cont; straight; $1\frac{1}{2}''$ base diam x $1\frac{11}{32}''$ h; 1.937″ mtg ctrs; Hubbell Twist-Lock #7557.	-----------------	6Z7813-1
	CONNECTOR, male contact: 2 flat cont; straight; 3″ diam x $3\frac{1}{8}''$ lg; four $\frac{1}{4}''$ diam mtg holes $2\frac{1}{16}''$ ctrs; Pyle-National #ZZE-3022-S.	-----------------	2Z7112.14
	CONNECTOR, male contact: 3 round cont, pol; 90 deg angle; $1\frac{3}{4}''$ lg x $1\frac{1}{8}''$ overall OD; Amphenol #AN-3108-14S-1P.	-----------------	2Z7113.14
	CONNECTOR, male contact: 3 round male cont; straight; $1\frac{11}{32}''$ lg x $1\frac{11}{16}''$ max diam; Army-Navy type #AN-3106-14S-1P.	-----------------	2Z7113.16
	CONNECTOR, male contact: 5 male cont; straight; $4\frac{1}{2}''$ lg x $1\frac{5}{8}''$ OD; Fed Tele & Rad #NL-43374-2-23.	-----------------	2Z7115.8
	CONNECTOR, male contact: Sig C Plug PL-P243; 4 round male cont; JAN spec #AN-W-C-591; straight; $2\frac{1}{8}''$ lg x $1\frac{19}{32}''$ max diam; cylindrical cast aluminum body; #AN-3106-22-10P.	-----------------	2Z7226-P243
	CONNECTOR, male contact: Sig C Plug PL-P248; 3 round cont; straight; $2\frac{1}{8}''$ lg x $1\frac{19}{32}''$ diam; cylindrical aluminum body, sand blast finish.	-----------------	2Z7226-P248
	CONNECTOR, male contact: Sig C Plug PL-P252; 9 round cont, pol; straight; $2\frac{5}{16}''$ lg x $1\frac{31}{32}''$ diam.	-----------------	2Z7226-P252
	CONNECTOR, male contact: Sig C Plug PL-Q252; 9 round cont, pol; 90 deg angle; $2\frac{11}{16}''$ lg x $1\frac{9}{16}''$ h to junction of axial ctr lines, $1\frac{31}{32}''$ overall OD; Army-Navy #AN-3108-28-4P.	-----------------	2Z7226-Q252
	CONNECTOR, male contact: 2 parallel blades; straight; Hubbell #9937.	-----------------	6Z7565.2
	CONNECTOR, male contact: 3 pol cont; straight; metal covered; twist-lock; Hubbell Twist-Lock #7573.	-----------------	6Z7591-2.1
	CONTAINER: metal; $\frac{1}{2}$ pint; $4\frac{1}{8}''$ h x $2\frac{1}{2}''$ diam w/cap.	-----------------	6Z1698
	CONTROL PANEL PN-31-A: metal case; 19″ wd x $10\frac{1}{2}''$ h x 17″ d.	Supplies power for phase inverters and bearing indicator.	2C667-31A
CP-17-A	COUNTERPOISE CP-17-A: screen type; 9 ft x 4 ft; 2 sect joined by 12″ copper strap; Sig C spec #271-1612.	Counterpoise-----------------	2A717A
	COUPLING, flexible: ball and socket type; brass; olive drab finish; approx $2\frac{1}{2}''$ lg x $1\frac{3}{8}''$ wd x $1\frac{1}{8}''$ d overall; mts by $\frac{5}{8}''$-24 male thd one end, $\frac{7}{8}''$-27 female thd other end; RCA part/dwg #728754-504.	For leveling compass---------	2Z306-19

Ref symbol	Name of part and description	Function of part	Signal Corps stock No
	DEMAGNETIZER: iron core coil; coil 1¾″ x 1¼″, handle grip ¾″ diam x 4″ lg; mtd on handle w/attachment cord having momentary cont sw and plug; Fed Tele & Rad #NLA–42970–3.	Indicator demagnetizer	2Z3606
	GONIOMETER MC–412–A: 2 stators and 1 rotor; operates from 2 to 10 mc; inclosed metal case; 9⅞″ lg x 5¾″ wd x 5¾″ h overall.	Variable inductive coupling between phase inverters output and receiver.	2C1549–412A
	JUNCTION BOX JB–91–A: Fed Tele & Rad #NL–4306–12–4; Sig C spec #271–1612.	Connects h-f cords	2Z5652–91A
	JUNCTION BOX JB–126: Fed Tele & Rad #RF–843–14; Sig C spec #271–1684.	For power input	2Z5652–126
	LEVEL, spirit: plumb; iron, smooth bottoms, japan finish w/nickle-pl trim; 12″ lg; 3 proved levels; Stanley #36.	For erection of Radio Set SCR–291–A.	6Q63012
	MARKER SET, cable: #26 B&S ga brass, electro-pl zinc; 11/16″ wd x 3 15/16″ lg overall; black etched numbers, color-coded, w/3 stripes, 10 tags color-coded, w/2 stripes.	Identification	2Z5727–2
	METER, multimeter: Army-Navy Multimeter TS–297/U; portable; meter ranges: volts AC–DC, 0/4/10/40/100/400/1000; ma DC, 0/4/40/100/-400; ohms, 0/1000/10,000/100,000; drawn aluminum, gray wrinkle finish case, 3⅛″ wd x 6″ h x 3½″ d, w/removable hinged lid.	Test equipment	3F4325–297
	OILER, hand: ½ oz cap; 4⅜″ spout; Eagle #2546.	For lubrication	6Z7301–5
	PHASE INVERTER MC–411–A: mtd on cylindrical casting; 13″ lg x 5 9/16″ wd x 5 9/16″ h overall.	Provides optimum impedance matching between unbalanced antenna outputs and balanced transmission lines.	2A2771A
	PHASE INVERTER MC–413–A: mtd in cylindrical casting; 13″ lg x 5 9/16″ wd x 5 9/16″ h overall.	Provides optimum impedance matching between unbalanced sense antenna output and balance transmission lines.	2A2773A
	PLUMB BOB: brass, steel tip; 12 oz; overall dimen 5⅛″ lg x 1 5/16″ diam; incl 30 oz braided cord 5 ft lg.	With telescope and tripod	6R5012
	POWER UNIT PU–58/G: Army-Navy Power Unit PU–58/G, gasoline engine driven; 5 kw, 80% pf; output 120–240 v AC, 26 to 52 amp, 60 cyc, single-phase, 3 wire; 5 ft 9¼″ lg x 2 ft 2¼″ wd x 3 ft 5″ h overall; control panel incl; direct drive; Willys model MB engine; automatic starting.	To supply power for the radio set.	3H4531–58
	RADIO RECEIVER BC–1147–A: AM; 1.5 to 30 mc in 4 bands; 110 v, 50/60 cyc, 110 w; mts in metal rack; 19″ wd x 10½″ h x 17″ d.	To receive the output from the goniometer.	2C5066–1147A
	RADIO TRANSMITTER BC–1149: AM; 1.5 to 32 mc in 4 bands; 7¼″ sq x 12¼″ lg.	Target transmitter	2C6596–1149

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	REEL DR-10: plywood, reinforced w/steel, olive drab; flanges 26″ in diam, 16″ between flanges.	To hold and facilitate unreeling of cords.	6H2510
	SCREWDRIVER; complete w/3 bits, 20″ lg w/bit extended, 14¾″ w/bit closed; reversible spiral ratchet w/spring return; North Bros Yankee #130A.	For slot drive	6R19130
	SIGNAL GENERATOR I-72-B: AM; 100 kc to 32,000 kc in 5 bands; metal portable case w/handle; approx 9 7/16″ h x 15½″ wd x 6¾″ overall; 400 cyc internal modulation; operates from 110-125 v, 60 cyc AC; incl spare fuse, output cord, and TM mounted to cover.	Test equipment, receiver alinement.	3F3852
	SOCKET, wrench: combination hex and sq; 7/16″ across flats; 9/32″ diam shank x 2¾″ lg overall; steel; fits Yankee #30A and #130A spiral screwdriver.		6R19130/S1
	TAPE, measuring: steel; 100 ft lg extended; graduated in feet, inches, and eighths of an inch; ⅜″ wd; Lufkin Rival #246.	For use in antenna system erection.	6R36026
	TELEPHONE PANEL PN-32-A: self-contained ringer box; p/o Sig C Radio Set SCR-291-A; Fed Tele & Rad #NL-43168-14.	For communication with direction finder central.	2Z6950-32A
	TERMINAL, lug: ring type; tinned copper; #6 AWG; 0.030″ thk; 7/32″ diam stud hole, 1⅛″ overall; Sherman type #6 (4 ears).		3Z12025-7
TE-41	TOOL EQUIPMENT TE-41: for complete components.	For radio repair	6R38041
	TRIPOD: extension leg type; 77¼″ lg extended; 56½″ lg collapsed; wood legs; metal feet, head, and clamps; olive drab finish; pan head; Fed Tele & Rad #RF-481-1.	For compass	3F5310
	WRENCH: combination socket wrench and screwdriver; hex socket ¼″ across flats; ¼″ d; overall dimen 4⅜″ lg x 7/16″ diam; steel drill rod material, nickel pl as per US Army spec 72-53, table II; straight wrench head; round handle; hex end of tool knurled ⅜″ lg x 7/16″ diam; 2d portion of handle 15/16″ lg x 0.250″ diam; 3d portion of handle ⅛″ lg x 3/16″ diam; 4th portion of handle 15/16″ lg x 0.250″ diam; overall lg of handle 2⅜″ lg; other end of wrench w/screwdriver blade 2″ lg x 3/16″ diam, end of blade 1/32″ thk x 3/16″ wd.	Tool, installation	6R41708
	WRENCH: Sig C Wrench TL-112; adj single open end; 1⅛″ max opening; 10″ size; alloy steel polished finish; 15 deg head; straight flat handle.	Tool, installation	6R55010
	WRENCH: Allen type hex key; ⅛″ across flats; L-shape; fits ¼″ diam Allen socket head and setscrew and #8, 0.164″ diam Allen socket head cap screw; Continental Elec dwg #MS-30672-11.	Tool, installation	6R55075
	WRENCH: Allen type hex key; 3/32″ across flats; inside dimen 2″ lg x 21/32″ wd; steel, parkerized L-shape; for Allen #10 and #12 setscrews, and #5 and #6 socket head cap screws and #8 FH cap screws.	Tool, installation	6R55496

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	WRENCH: double open end; 5/16" and 3/8" openings; 4 1/2" lg x 3/16" thk overall; chrome alloy steel, chrome pl, polished ends; 15 deg angle; flat straight handle.	Tool, installation	6R55561
	WRENCH: double open end, engineers'; 7/16" and 1/2" openings; 5 5/8" lg, thk of head 15/64"; chrome alloy steel; 15 deg angle; Williams JH #1725.	Tool, installation	6R55563
	WRENCH: engineers' double open end; 9/16" and 5/8" openings; 6 5/8" lg, heads 17/64" thk; chrome alloy steel; 15 deg angle; Williams JH #1727.	Tool, installation	6R55565
	WRENCH TL–479/U: engineers' double open end; 11/16"–25/32" openings; 8 1/2" lg overall; heads 5/16" thk; chrome alloy steel, polished heads; 15 deg angle; straight flat handle; Williams JH #1029 and Stevens Walden #1029.	Tool, installation	6R55567
	WRENCH: setscrew short arm series; 5/64" across flats; 39/64" x 1 7/8" lg; steel parkerized for rust roofing or cadmium pl; L-shape; solid hex, to fit Allen type #8 socket head setscrews and Allen #4 socket head cap screw; Sig C dwg #SC–B–2399.	Tool, installation	6R57400
	WRENCH: Allen type hex key; 3/16" across flats; 2 27/32" lg x 1 1/32" wd overall; steel; L-shape; for Allen 3/8" setscrew and 1/4" cap screw, and 5/16" FH cap screws; Allen mfg #3/16".	Tool, installation	6R57400–1
	WRENCH: Allen short arm series; 7/32" across flats; L-shape; fits 7/16" diam Allen socket head setscrew and 5/16" diam Allen socket head cap screw; WECo #B–46043.	Tool, installation	6R57400–2
	WRENCH: setscrew; hex key; 1/4" across flats; long arm 3 11/32" lg, short arm 1 1/32" lg; steel, heat-treated; L-shape handle; fits Allen 1/2" setscrew, 1/2" shoulder screw, and 1/4" pipe plug.		6R57400–3
	WRENCH: Allen type hex key, short arm series; 1/16" across flats; inside dimen of long arm 1 3/4", inside dimen of short arm 1/2"; alloy steel, parkerized; zinc, cad, or nickel pl; L-shape; for Allen type #5 and #6 setscrews.	Tool, installation	6R57400–6
	WRENCH: hex; 5/32" across flats; 5/32" x 2 1/2" long arm, 27/32" short arm; steel; L-shape; fits 5/16" Allen socket head setscrew and #10 Allen socket head cap screws.	Tool, installation.	6R57400–10
TL–108	WRENCH TL–108: socket, spin type, 3/8", hex; 6" lg overall; hollow steel shank and socket; straight type; fluted screwdriver handle; Stevens Walden Spintite #3412.	Tool, installation	6R57412
	WRENCH: socket, spin type, 5/16", hex; 6" overall; galv hollow shank; wood handle; Stevens Walden Spintite #3410.		6R57413
	WRENCH: socket, spin type, 1/4", hex; 6" overall; galv hollow shank; wood handle; Stevens Walden Spintite #3408.	Tool, installation	6R57413–3
	WRENCH: socket, spin type, 11/32", hex; 6" overall; galv hollow shank; wood handle; Stevens Walden Spintite #3411.	Tool installation	6R5A13–8

a. RADIO RECEIVER BC–1147–A.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	RECEIVER, radio: Sig C Radio Receiver BC–1147–A; AM; 1.5 to 30 mc in 4 bands; 110v, 50/60 cyc, 110 w; mts in metal rack; 19″ wd x 10½″ h x 17″ d.	Radio receiver and rectified d-c output.	2C5066–1147A
	TECHNICAL MANUAL: TM 11–243	Technical manual	(Order through AGO channels)
C139, C170, C171	CAPACITOR, fixed: mica; 5 mmf ±20%; 500 vdcw; max body dimen 51/64″ lg x 15/32″ wd x 7/32″ thk; JAN type CM20B050M.	C139: Bfo coupling C170 and C171: R-f tracking	3K2005024
C157, C158	CAPACITOR, fixed: ceramic; 51 mmf ±5%; neg temp coef 0.00075 mmf/mmf °C; 500 vdcw; 0.562″ lg x 0.250″ diam; JAN type CC21UJ510J.	C157: Oscillator grid capacitor. C158: Oscillator coupling	3D9151
C128, C129, C135, C136, C138, C160	CAPACITOR, fixed: mica; 100 mmf ±2%; 500 vdcw; max body dimen 51/64″ lg x 15/32″ wd x 7/32″ thk; JAN type CM20C101G.	C128: First i-f primary coupling. C129: First i-f secondary coupling. C135: Second i-f primary coupling. C136: Second i-f secondary coupling. C138: Across diode transformer primary. C160: Across indicator diode transformer.	3K2010133
C140, C141, C161, C164	CAPACITOR, fixed: mica; 100 mmf ±20%; 500 vdcw; max body dimen 51/64″ lg x 15/32″ wd x 7/32″ thk; JAN type CM20B101M.	C140: Diode filter C141: Diode filter. C161: Indicator diode bypass. C164: Bfo grid coupling.	3K2010124
C167	CAPACITOR, fixed: mica; 2 sect, 125–125 mmf; 100 vdcw; 2⅜″ lg x 1½″ wd x 0.032″ thk; Fed Tele & Rad dwg #RF–363–1, items #24 to #29.	A-c line filter	3D9125–1
C162	CAPACITOR, fixed: mica; 200 mmf ±2%; 500 vdcw; max body dimen 51/64″ lg x 15/32″ wd x 7/32″ thk; JAN type CM20D201G.	In bfo tank	3K2020143
C145	CAPACITOR, fixed: mica; 240 mmf ±5%; 500 vdcw; max body dimen 51/64″ lg x 15/32″ wd x 7/32″ thk; JAN type CM20B241J.	First a-f plate bypass	3K2024122
C148	CAPACITOR, fixed: mica; 910 mmf ±2%; 500 vdcw; max body dimen 53/64″ sq x 9/32″ thk; JAN type CM30D911G.	Oscillator padder	3K3091143
C149	CAPACITOR, fixed: mica; 1800 mmf ±2%; 500 vdcw; max body dimen 53/64″ sq x 9/32″ thk; JAN type CM30C182G.	Oscillator padder	3K3018233
C150	CAPACITOR, fixed: mica; 3900 mmf ±2%; 500 vdcw; max body dimen 53/64″ sq x 11/32″ thk; JAN type CM35C392G.	Oscillator padder	3K3539233
C147	CAPACITOR, fixed: paper; 6000 mmf ±20%; 600 vdcw; 1 5/16″ lg x ½″ diam; JAN type CP26A1EF602M.	Second a-f plate bypass	3DA6–102

Ref symbol	Name of part and dscription	Function of part	Signal Corps stock No.
C125, C126, C127, C132, C133, C134, C172, C173	CAPACITOR, fixed: mica; 10,000 mmf ±5%; 2000 vdcw; max body dimen 3 9/64″ lg x 1 17/64″ wd x 2 1/4″ d; 2 screw term; JAN type CM70B103J.	C125, C126, C127, and C172: First i-f interstage coupling. C132, C133, C134, and C173: Second i-f interstage coupling.	3K7010322
C104, C105 C106, C112, C114, C115, C121, C123, C151, C165	CAPACITOR, fixed: paper; 10,000 mmf ±20%; 400 vdcw; 53/64″ sq x 9/32″ thk; JAN type CN30A103M.	C104: First r-f cathode bypass. C105: First r-f screen bypass. C106: First r-f plate bypass. C112: Second r-f cathode bypass. C114: Second r-f screen bypass. C115: Second r-f plate bypass. C121: Mixer cathode bypass. C123: Mixer screen bypass. C151: Oscillator plate bypass. C165: Bfo plate bypass.	3DA10-387
C142, C146	CAPACITOR, fixed: paper; 10,000 mmf ±20%; 600 vdcw; 1 5/16″ lg x 1/2″ diam; JAN type CP26A1EF103M.	C142: Diode filter and first a-f coupling. C146: Second a-f coupling.	3DA10-388
C111, C120, C130	CAPACITOR, fixed: paper; 30,000 mmf +30%; −10%; 100 vdcw; 1 1/4″ lg x 7/16″ diam; Sprague #S-7-11.	C111: Second r-f, avc decoupling bypass. C120: Mixer, avc decoupling bypass. C130: First i-f, avc decoupling bypass.	3DA30-15
C103, C113, C122	CAPACITOR, fixed: paper; 100,000 mmf ±10%; 600 vdcw; 1 13/16″ wd x 1″ d x 3/4″ h; 2 solder lug term on bottom; JAN type CP55B1EF104K.	C103: First r-f cathode bypass. C113: Second r-f cathode bypass. C122: Mixer cathode bypass.	3DA100-728
C124	CAPACITOR, fixed: paper; 100,000 mmf ±10%; 600 vdcw; 1 13/16″ wd x 1″ d x 3/4″ h; 2 solder lug term on top; JAN type CP54B1EF104K.	Mixer plate bypass.	
C144	CAPACITOR, fixed: paper; 2 sect; 100,000-100,000 mmf ±15%; 600 vdcw; 1 13/16″ wd x 1″ d x 3/4″ h; 3 solder lug term on top; JAN type CP54B4FF104L.	First a-f plate bypass: section A, cathode; section B, plate, filter.	
C156	CAPACITOR, fixed: paper; 2 sect; 100,000-100,000 mmf ±15%; 600 vdcw; 1 13/16″ wd x 1″ d x 3/4″ h; 3 solder lug term on bottom; JAN type CP55B4EF104L.	Oscillator bypass: section A, plate bypass, filter; section B, heater bypass.	
C131, C137, C159	CAPACITOR, fixed: paper; 3 sect; 100,000-100,000 mmf ±20%; 600 vdcw; 1 13/16″ wd x 1″ d x 3/4″ h; 3 solder lug term on bottom; JAN type CP53B5FF104M.	C131: First i-f bypass________ C137: Second i-f bypass; C159: Indicator i-f bypass: sections A, cathode; sections B, screen; sections C, plate.	3DA100-696
C166	CAPACITOR, fixed: paper; 3 sect; 100,000-100,000-100,000 mmf ±20%; 600 vdcw; 1 13/16″ wd x 1″ d x 3/4″ h; 3 solder lug term on bottom; JAN type CP55B5EF104M.	Bfo bypass: section A, heater; section B, plate bypass, filter; section C, plate bypass, filter.	

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C143	CAPACITOR, fixed: paper; 250,000 mmf ±10%; 600 vdcw; 1 13/16″ wd x 1″ d x ¾″ h; 2 solder lug term on top; JAN type CP54B1FF254K.	Avc line filter	3DA250-372
C169	CAPACITOR, fixed: paper; 1 mf +20% −10%; 600 vdcw; 2″ wd x 1¾″ d x ⅞″ h; 2 solder lug term on bottom; JAN type CP53B1FF105V.	Part of B-supply filter network.	
C168	CAPACITOR, fixed: paper; 3 sect; 4-4-4 mf ±20%; 600 vdcw; 3¾″ lg x 2½″ wd x 3″ h; Dubilier #PC-2125.	B-supply filter, sections A, B, and C.	3DB4-69
C163	CAPACITOR, variable: air; 1.2 to 19.8 mmf; 0.0195″ air gap; 7 plates; body 15/16″ wd x 1 7/32″ h x ⅞″ d, shaft ¼″ diam x 1½″ lg; Fed Tele & Rad dwg #F-34481-2-3.	Bfo pitch adjustment	3D9017VE8
C108, C110, C117, C119, C153, C155	CAPACITOR, variable: air; 4 to 25 mmf; 500 vdcw; 9 plates; body ⅞″ wd x 1¼″ h x 1¼″ d, ¼″ diam screwdriver slotted shaft; Fed Tele & Rad dwg #F-34356-2-1.	C108 and C110: Second r-f trimmers, bands 2 and 4. C117 and C119: Mixer trimmers, bands 2 and 4. C153 and C155: Oscillator trimmers, bands 2 and 4.	3D9025V-25.1
C107, C109, C116, C118, C152, C154	CAPACITOR, variable: air; 4 to 25 mmf; 500 vdcw; 9 plates; body ⅞″ wd x 1¼″ h x 1¼″ d, ¼″ diam screwdriver slotted shaft; Fed Tele & Rad dwg #F-34356-2-2.	C107 and C109: Second r-f trimmers, bands 1 and 3. C116 and C118: Mixer trimmers, bands 1 and 3. C152 and C154: Oscillator trimmers, bands 1 and 3.	3D9025V-25.2
C102	CAPACITOR, variable: air; 4 to 40 mmf; 0.030″ air gap; 13 plates; body 1″ wd x 1½″ h x 1½″ d, shaft ¼″ diam x ⅝″ lg; Fed Tele & Rad dwg #FTR-F-38332-2.	Antenna compensator	3D9040V-11
C101	CAPACITOR, variable: air; 4 sect; ea sect 23.5 to 235.4 mmf; 0.02185″ air gap; body 4¼″ wd x 5½″ h x 11⅜″ d, shaft 7/16″ diam x ⅝″ lg; Fed Tele & Rad dwg #F-37946-14.	Section A, first r-f tuning; section B, second r-f tuning; section C, mixer tuning; section D, oscillator tuning.	3DE235VA4
L104	COIL, RF: antenna; 2 windings, single layer wound; unshielded; pri 1½ turns #26 E copper wire, secd 4½ #18 E copper wire; 2″ lg x ⅝″ diam; Fed Tele & Rad dwg #F-37885-1 (band 4).	First r-f, band 4	3C301-6
L103	COIL, RF: antenna; 2 windings, single layer wound; unshielded; pri 4½ turns #26 E copper wire, secd 11½ turns #20 E copper wire; 2″ lg x ⅝″ diam; Fed Tele & Rad dwg #F-37886-1 (band 3).	First r-f, band 3	3C301-5
L102	COIL, RF: antenna; 2 windings, single layer wound; unshielded; pri 5½ turns #26 E copper wire, secd 24½ turns #26 E copper wire; 2″ lg x ⅝″ diam; Fed Tele & Rad dwg #F-37887-1 (band 2).	First r-f, band 2	3C301 3
L101	COIL, RF: antenna; 2 windings, single layer wound; unshielded; pri 8½ turns #30 SS E copper wire, secd 51½ turns Litz #7/41 copper wire; 2″ lg x ⅝″ diam; Fed Tele & Rad dwg #F-37888-1 (band 1).	First r-f, band 1	3C301-4

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
L108, L112	COIL, RF: mixer; 2 windings, single layer wound; unshielded; pri 3½ turns #30 SS E copper wire, secd 4½ turns #18 E copper wire; 2″ lg x ⅝″ diam; Fed Tele & Rad dwg #F-38052-1 (band 4).	L108: Second r-f, band 4 L112: Mixer r-f, band 4.	3C1084K-3
L107, L111	COIL, RF: mixer; 2 windings, single layer wound; unshielded; pri 6½ turns #30 SS E copper wire, secd 11½ turns #20 E copper wire; 2″ lg x ⅝″ diam; Fed Tele & Rad dwg #F-38054-1 (band 3).	L107: Second r-f, band 3 L111: Mixer r-f, band 3.	3C1084K-2
L106, L110	COIL, RF: mixer; 2 windings, single layer wound; unshielded; pri 14½ turns #30 SS E copper wire, secd 24½ turns #26 E copper wire; 2″ lg x ⅝″ diam; Fed Tele & Rad dwg #F-38126-1 (band 2).	L106: Second r-f, band 2 L110: Mixer r-f, band 2.	3C1084K-1
L105, L109	COIL, RF: mixer; 2 windings, single layer wound; unshielded; pri 275 turns #38 SS E copper wire, secd 51½ turns Litz stranded #41 copper wire; 2¼″ lg x ⅝″ diam; Fed Tele & Rad dwg #F-38457-1 (band 1).	L105: Second r-f, band 1 L109: Mixer r-f, band 1.	3C1084K
L113	COIL, RF: oscillator; 2 windings, single layer wound; unshielded; pri 20½ turns #30 E copper wire, secd 44½ turns Litz stranded #10-41 copper wire; 2″ lg x ½″ diam; Fed Tele & Rad dwg #F-38049-1 (band 1).	Oscillator coil, band 1	3C1081-11E
L116	COIL, RF: oscillator; 2 windings, single layer wound; unshielded; pri 3½ turns #30 SS E copper wire, secd 4½ turns #18 E copper wire; 2″ lg x ⅝″ diam; Fed Tele & Rad dwg #F-38051-1 (band 4).	Oscillator coil, band 4	3C1081-11A
L115	COIL, RF: oscillator; 2 windings, single layer wound; unshielded; pri 6½ turns #30 SS E copper wire, secd 11½ turns #20 E copper wire; 2″ lg x ⅝″ diam; Fed Tele & Rad dwg #F-37956-1 (band 3).	Oscillator coil, band 3	3C1081-11B
L114	COIL, RF: oscillator; 2 windings, single layer wound; unshielded; pri 12½ turns #30 SS E copper wire, secd 23½ turns #26 E copper wire; 2″ lg x ⅝″ diam; Fed Tele & Rad dwg #F-38041-1 (band 2).	Oscillator coil, band 2	3C1081-11C
J103	CONNECTOR, receptacle: female; 3 cont; straight; 29/32″ lg x ¾″ diam w/ 13/16″ sq flange; AN type #AN-3102-14S-1S.	Indicator channel output	2Z8673.20
J101	CONNECTOR, receptacle: female; 3 cont; straight; 111/32″ lg x 1⅜″ diam w/ 1⅝″ sq flange; AN type #AN-3102-22-2S.	Antenna input	2Z8673.1
P101	CONNECTOR, plug: male; 2 cont; straight; 15/16″ lg x 1″ diam overall; Hubbell Twist-lock #7465.	A-c line	6Z3151/1
L101, L102, L103, L105, L106, L107, L109, L110, L111, L113, L114, L115	CORE, adjustable turning: iron, cadmium pl; 1⅞″ lg x 5/16″ diam overall; Stackpole #C4390, grade G1-SPL; Fed Tele & Rad dwg #F37863-1-1.	L101 thru L103: Core, part of coils L101 thru L103. L105 thru L107: Core, part of coils L105 thru L107. L109 thru L111: Core part of coils L109 thru L111. L113 thru L115: Core, part of coils L113 thru L115.	2Z9646.3

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
L104, L108, L112, L116	CORE, adjustable turning: iron, cadmium pl; 1⅞″ lg x 5/16″ diam overall; Stackpole #C4392, grade G–7; Fed Tele & Rad dwg #F–37863–1–2.	L104: Core, part of coil L104. L108: Core, part of coil L108. L112: Core, part of coil L112. L116: Core, part of coil L116.	2Z9646.4
F101, F102	FUSE, cartridge: 5 amp, 250 v; glass body; ferrule term; 1¼″ lg x ¼″ diam overall; Littelfuse #1358, type 3AG.	A-c line fuse	3Z2605–2
	HOLDER, fuse: extractor post; for single 3AG fuse; black bakelite; 15 amp, 115 v; 2″ lg x 7/16″ diam; Buss #HKM.	Holds a-c line fuse	3Z3285–2
J102	JACK, telephone: for 2-cond plug; 3⅛″ lg x ⅝″ wd x 1⅛″ h overall; Fed Tele & Rad dwg #F–36116–1.	Headphone jack	4C4312–2
	KNOB: round; black bakelite; for ¼″ diam shaft; single #6–32 setscrew; white engraved arrow; 1⅛″ diam x 9/16″ h; Mallory #368.	To turn receiver control shafts	2Z5788–7
	KNOB: round; black bakelite; for ¼″ diam shaft; 2 #10–32 setscrews; white pointer; 1⅝″ diam x ¾″ h; Kurtz-Kasch #S–380–3L.	To turn receiver control shafts	2Z5753.10
	KNOB: round; black bakelite; for ⅜″ diam shaft; 2 #10–32 setscrews; 2⅜″ diam x ⅞″ h; Ohmite #5130.	Pull knobs	2Z5788–38
I101, I102	LAMP LM–52: incandescent; 6–8 v, 0.15 amp; bulb T–3–¼ clear; 1 3/16″ lg; miniature bayonet base.	Dial light	2Z5952
	MOUNT, vibration: round; ¼″ ID, ⅝″ OD x 3/16″ thk; Fed Tele & Rad dwg #RF–398–1.	Vibration mount	2Z8495.5
L122	REACTOR: filter choke; single winding; 10 hy, 0.150 amp; 150 ohms DC resistance; 4 9/16″ lg x 4 7/64″ wd x 5⅜″ h; Fed Tele & Rad dwg #F–39306–1.	Filter choke, B-supply	3C315–11
R108, R114	RESISTOR, fixed: comp; 180 ohms ± 5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF181J.	R108: Second r-f cathode resistor. R114: Mixer cathode resistor.	3RC20BF181J
R136	RESISTOR, fixed: comp; 270 ohms ± 5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF271J.	Indicator i-f cathode resistor	3RC20BF271J
R105, R112	RESISTOR, fixed: comp; 330 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF331K.	R105: Gain equalizer, first r-f. R112: Gain equalizer, second r-f.	3RC20BF331K
R101, R119	RESISTOR, fixed: comp; 470 ohms ± 5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF471J.	R101: First r-f cathode resistor. R119: First i-f cathode resistor.	3RC20BF471J
R133	RESISTOR, fixed: comp; 470 ohms ± 10%; 2 w; 1.78″ x 0.405″ diam; JAN type RC41BF471K.	Second a-f cathode resistor	3RC41BF471K
R104, R111, R117, R129, R134.	RESISTOR, fixed: comp; 2200 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF222K.	R104: First r-f plate resistor. R111: Second r-f plate resistor. R117: Mixer plate resistor. R129: First a-f cathode resistor. R134: Oscillator plate resistor.	3RC20BF222K

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R144	RESISTOR, fixed: ww; 3500 ohms ± 10%; 10 w; 1¾″ lg x 5⁄16″ diam; Ohmite Brown Devil.	Voltage regulator dropping	3Z6350-15
R121, R124, R138	RESISTOR, fixed: comp; 4700 ohms ± 10%; ½ w; 0.655″ lg x 0.249″ diam; JAN type RC21BF472K.	R121: First i-f plate resistor. R124: Second i-f plate resistor. R138: Indicator i-f plate resistor.	3RC21BF472K
R107, R113, R118	RESISTOR, fixed: comp; 10,000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF103K.	Avc decoupling	3RC20BF103K
R141	RESISTOR, fixed: comp; 15,000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF153K.	Bfo plate filter	3RC20BF153K
R115, R116, R146	RESISTOR, fixed: comp; 22,000 ohms ± 10%; ½ w; 0.655″ lg x 0.249″ diam; JAN type RC21BF223K.	R115: Mixer injection grid. R116: Mixer screen resistor. R146: Diode detector decoupling.	3RC21BF223K
R142	RESISTOR, fixed: comp; 33,000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BD333K.	Bfo plate filter	3RC20BF333K
R109, R135	RESISTOR, fixed: comp; 47,000 ohms ± 10%; ½ w; 0.655″ lg x 0.249″ diam; JAN type RC21BF473K.	R109: Second r-f screen resistor. R135: Oscillator plate.	3RC21BF473K
R120, R123, R126, R137, R139	RESISTOR, fixed: comp; 56,000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF563K.	R120: First i-f screen resistor. R123: Second i-f screen resistor. R126: Diode filter. R137: Indicator i-f screen resistor. R139: Indicator diode load.	3RC20BF563K
R145	RESISTOR, fixed: comp; 75,000 ohms ± 5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF753J.	Voltage regulator bleeder	3RC20 BF753J
R102	RESISTOR, fixed: comp; 75,000 ohms ± 5%; 1 w; 1.28″ lg x 0.310″ diam; JAN type RC31BF753J.	First r-f screen resistor	3RC31BF753J
R131, R140	RESISTOR, fixed: comp; 100,000 ohms ± 10%; ½ w; 0.655″ lg x 0.249″ diam; JAN type RC21BF104K.	R131: First a-f plate filter. R140: Bfo grid resistor.	3RC21BF104K
R130	RESISTOR, fixed: comp; 220,000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF224K.	First a-f plate load	3RC20BF224K
R132	RESISTOR, fixed: comp; 470,000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF474K.	Second a-f grid resistor	3RC20BF474K
R127	RESISTOR, fixed; comp; 560,000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF564K.	Diode load	3RC20BF564K
R147	RESISTOR, fixed: comp; 1 meg ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF105K.	Indicator diode filter	3RC20BF105K
R125	RESISTOR, fixed: comp; 2.2 meg ± 10%; ½ w; 0.655″ lg x 0.249″ diam; JAN type RC21BF225K.	Avc filter	3RC21BF225K
R143	RESISTOR, variable (potentiometer): WW; 50 ohms ± 10%; 2 w; 3 term; inclosed body 1.28″ diam x 1.18″ d; shaft ¼″ diam x ½″ lg, screwdriver slot; JAN type RA20A1SA500AK.	Dial lamp dimmer	2Z7277.97

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R106	RESISTOR, variable (potentiometer): comp; 10,000 ohms ± 10%; ½ w; 3 term; inclosed body 1¼″ diam x 9/16″ d; shaft ¼″ diam x ½″ lg, screwdriver slot; IRC type #C; Fed Tele & Rad dwg #F34327-2-7.	R-f sensitivity	2Z7269.23
R128	RESISTOR, variable (potentiometer): comp; 1 meg ±20%; ½ w; 3 term; inclosed body 1¼″ diam x 9/16″ d; round shaft ¼″ diam x ⅞″ lg; IRC type #C; Fed Tele & Rad dwg #F-34327-2-6.	A-f gain adjustment	2Z7298-2
X101 through X113	SOCKET, tube: octal; steatite; 1¼″ diam x 51/64″ h mtg plates w/slotted mtg holes for ½″ to 1⅞″ mtg ctr; Amphenol #RSS8M.	Hold vacuum tubes	2Z8678.34
LS101	SPEAKER, dynamic: 5″ diam cone; PM; output 2½ w; voice coil impedance 4 ohms; approx 5½″ diam x 2⅝″ d overall; Jensrad #PM5FS.	Audio output	6C35-6
S106	SWITCH, rotary: 12 pole, 2 position; single sect; ceramic body; 1⅞″ diam x 2″ d; Fed Tele & Rad dwg #F-34455-2-1.	Selectivity, BROAD-SHARP	3Z9550.7
S101 through S105	SWITCH, rotary: 12 pole, 4 position; single sect; ceramic body; approx 1 9/16″ diam x 2¼″ d; Fed Tele & Rad dwg #F-37840-1.	Band change	3Z9550.6
S108	SWITCH, toggle: DPDT; 1 amp, 250 v, 3 amp, 125 v; phenolic body; 1½″ lg x ⅝″ wd x 11/16″ d; Amer Rad Hdwe #1032.	BFO ON-OFF	3ZK9857.2
S107	SWITCH, toggle: SPDT; 3 amp, 125 v; phenolic body; 1 9/16″ lg x 15/32″ wd x 1 3/32″ d; Fed Tele & Rad dwg #RF-261-1B.	AVC-MAN	3Z9550.4
S109	SWITCH, toggle: SPST; 3 amp, 250 v; phenolic body; 1 3/16″ lg x 15/32″ wd x 1 3/32″ d; AH & H #CHH24000.	POWER ON-OFF	3Z9857.25
T102	TRANSFORMER, AF: output; pri 8000 ohms, secd 4250/600 ohms; inclosed metal case; 3⅛″ h x 2½″ wd x 2⅜″ d; Fed Tele & Rad dwg #RF-145.1.	A-f output	2Z9632.60
T103	TRANSFORMER, IF: 455 kc; BFO; shielded; ½″ diam x 1¾″ lg; Fed Tele & Rad dwg #RF-452-2.	Diode transformer, indicator channel.	2Z9641.33
L121	TRANSFORMER, IF: 455 kc; BFO; shielded; 2″ lg x 1½″ wd x 4″ h; Fed Tele & Rad dwg #RF-447-2.	Bfo tank	2Z9644.3
T101	TRANSFORMER, IF: 455 kc; indicator diode; shielded; 2″ lg x 1½″ wd x 2¼″ h; Fed Tele & Rad dwg #RF-450-2.	A-f channel diode	2Z9641.32
L117	TRANSFORMER, IF: 455 kc; interstage; shielded; 2″ lg x 1½″ wd x 2¼″ h; Fed Tele & Rad dwg #RF-453-2.	First i-f, primary	2Z9641.30
L118	TRANSFORMER, IF: 455 kc; input; shielded; 2″ lg x 1½″ wd 2¼″ h; Fed Tele & Rad dwg #RF-449-2.	First i-f, secondary	2Z9641.28

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
L119	TRANSFORMER, IF: 455 kc; interstage; shielded; 2″ lg x 1½″ wd x 2¼″ h; Fed Tele & Rad dwg #RF–449–2.	Second i-f, primary	2Z9641.29
L120	TRANSFORMER, IF: 455 kc; output; shielded; 2″ lg x 1½″ wd x 2¼″ h; Fed Tele & Rad dwg #RF–451–2.	Second i-f, secondary	2Z9641.31
T104	TRANSFORMER, power: plate and fil; pri, 110/115/120 v, 60 cyc; secd #1, 5 v, 3 amp; secd #2, 315–0–315 v, 15 amp; secd #3, 6.3 v, 5 amp; inclosed metal case; 4½″ lg x 4⅛″ wd x 5 5/16″ h; Fed Tele & Rad dwg #F–39303–1.	Power supply	2Z9613.55
V113	TUBE, electron: JAN–OD3/VR150	Voltage regulator	2JOD3/VR150
V112	TUBE, electron: JAN–5U4G	Power supply rectifier	2J5U4G
V109	TUBE, electron: JAN–6H6	Indicator diode detector	2J6H6
V111	TUBE, electron: JAN–6J5	Heterodyne-frequency oscillator.	2J6J5
V103	TUBE, electron: JAN–6SA7	Mixer	2J6SA7
V101	TUBE, electron: JAN–6SH7	First r-f amplifier	2J6SH7
V108	TUBE, electron: JAN–6SJ7	Beat-frequency oscillator (bfo)	2J6SJ7
V102, V104, V105, V110	TUBE, electron: JAN–6SK7	V102: Second r-f amplifier. V104: First i-f amplifier. V105: Second i-f amplifier. V110: Indicator i-f amplifier.	2J6SK7
V106	TUBE, electron: JAN–6SQ7	Detector, a-f amplifier	2J6SQ7
V107	TUBE, electron: JAN–6V6GT/G	A-f output	2J6V6GT/G

b. Control Panel PN–31–A.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	CONTROL PANEL PN–31–A: metal case; 19″ wd x 10½″ h x 17″ d.	Supplies power for phase inverters and bearing indicator.	2C667–31A
	TECHNICAL MANUAL: TM 11–243	Technical manual	(Order through AGO channels)
	BRACKET: capacitor mtg; J-shape; 1 31/32″ wd x approx 3⅞″ lg w/mtg foot; JAN type CPO7FE3.	Capacitor mounting	
C207	CAPACITOR, fixed: paper; 50,000 mmf +20% −10%; 600 vdcw; 1 13/16″ wd x 1″ d x ¾″ h; 2 solder lug term on side; JAN type CP53B1EF503V.	Bypass	3DA50–296
C205, C206	CAPACITOR, fixed: paper; 500,000 mmf ±10%; 4000 vdcw; 2¾″ wd x 2¼″ d x 3⅞″ h; 2 screw post term; JAN type CP70E1FM504K (use bracket CPO7FE3).	High-voltage filter	

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C201 through C204	CAPACITOR, fixed: paper; 4mf ±10%; 600 vdcw; 4½″ lg x 1½″ diam; 1 screw term w/gnd lug; JAN type CP40C2FF405K.	Low-voltage filter	3DB4–255
S209	CIRCUIT BREAKER: magnetic; SPST; 120 v AC, 5 amp; black bakelite; 3⁷⁄₃₂″ lg x 2¹¹⁄₁₆″ wd x 1⁷⁄₁₆″ h; Heinemann #0111–5	Power circuit breaker	3H900–5–5
S210	CIRCUIT BREAKER: magnetic; SPST; 120 v AC, 25 amp; black bakelite; 3⁷⁄₃₂″ lg x 2¹¹⁄₁₆″ wd x 1⁷⁄₁₆″ h; Heinemann #0111–25.	Motor circuit breaker	3H900–25–5
	CLIP: tube cont; ceramic w/metal insert; 1⅛″ lg x ⅝″ wd x ⁹⁄₁₆″ h; Millen #36002.	Tube contact clip for plate of V206.	2Z2712.1
J204, J215	CONNECTOR, receptacle: female; 2 cont; straight; ²⁵⁄₃₂″ lg x 1¹⁄₃₂″ diam w/1⅝″ diam flange; 250 v, 10 amp, 115 v, 15 amp; Hubbell Twist-Lock #7468.	A-c output connector	6Z7813–3
J214	CONNECTOR, receptacle: female; 2 cont; straight; ³³⁄₆₄″ lg x 1⅛″ diam w/mtg flange 1½″ c to c; Amphenol type #MIP–61F.	Auxiliary a-c input supply	6Z8367–2
J22	CONNECTOR, receptacle: female; 3 cont; straight; ²⁹⁄₃₂″ lg x ¾″ diam w/1³⁄₁₆″ sq flange; AN type #AN–3102–14S–1S.	Sense relay supply	2Z8673.20
J203	CONNECTOR, receptacle: Sig C Socket SO–185; female; 3 cont; straight; 1¹¹⁄₃₂″ lg x 1¼″ diam w/1⅝″ sq flange.	Deflection coil supply	2Z8799–185
J205	CONNECTOR, receptacle: Sig C Socket SO–163; female; 4 cont; straight; 1¹¹⁄₃₂″ lg x 1¼″ diam w/1⅝″ sq flange.	Indicator motor and heater supply.	2Z8799–163
J209 through J213	CONNECTOR, receptacle: female; 5 cont; straight; 1¹¹⁄₃₂″ lg x 1¼″ diam w/1⅝″ sq flange; AN type #AN–3102–22–13S.	Power to four antenna and sense phase inverters.	2Z8675.15
J207	CONNECTOR, receptacle: Sig C Socket SO–250; female; 9 cont; straight; 1¹¹⁄₃₂″ lg x 1⅝″ diam w/2″ sq flange	High-voltage supply	2Z8799–250
J206	CONNECTOR, receptacle: Sig C Socket SO–189; female; 14 cont; straight; 1¹¹⁄₃₂″ lg x 1⅝″ diam w/2″ sq flange.	Power output	2Z8799–189
J208	CONNECTOR, receptacle: male; 3 cont; straight; 1⅛″ lg x 1½″ diam w/mtg flange 1¹⁵⁄₁₆″ c to c; Hubbell Twist-lock #7556.	Power connector to auxiliary set of four antenna and sense phase inverters (if required).	6Z7813–2
J201	CONNECTOR, receptacle: Sig C Socket SO–133; male; 3 cont; straight; ²⁹⁄₃₂″ lg x ¾″ diam w/1³⁄₁₆″ sq flange.	Indicator output from receiver.	2Z8799–33
F201, F202	FUSE, cartridge: ⅛ amp, 250 v; glass body; ferrule term; 1¼″ lg x ¼″ diam overall; Littelfuse #1044, type 3AG.	F201: Meter fuse F202: Heater fuse.	3Z2585
	FUSE FU–46: cartridge; ½ amp, 250 v; glass body; ferrule term; 1¼″ lg x ¼″ diam overall.	Meter fuse, spare	3Z1946

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	FUSE FU-50: cartridge; 3 amp, 250 v; glass body; ferrule term; 1¼″ lg x ¼″ diam overall.	Heater fuse, spare	3Z1950
F201, F202	HOLDER, fuse: extractor post; for single 3AG fuse; black bakelite; 15 amp, 115 v; 2″ lg x 7/16″ diam; Buss #HKM.	Fuse holder	3Z3285-2
	KNOB: round; black bakelite; for ¼″ diam shaft; 2 #10-32 setscrews; white pointer; 1⅝″ diam x ¾″ h; Kurtz-Kasch #S-380-3L.	To turn control panel control shafts.	2Z5753.10
I201 through I203	LAMP, glow: 105-125 v, ¼ w; bulb T-4-½ clear; 1½″ lg overall; candelabra screw base; GE type #NE-48.	I201: Motor pilot I202: Heater pilot. I203: Main power input pilot.	2J991
M201	METER, ammeter: DC; 0 to 50 ma; rectangular flange 3.13″ h x 3″ wd; body 2.75″ lg x 2.88″ h x 1.46″ d; Weston type #731; Fed Tele & Rad dwg #NCP-23-1-71.	Measures phase inverter plate currents.	3F905-23
L201, L202	REACTOR: filter choke; single winding; 10 hy, 120 ma; 245 ohms DC resistance; 3⅝″ lg x 3¼″ wd x 4⅜″ h; Fed Tele & Rad dwg #NCP-104-1-8.	Filter, low-voltage supply	3C315-10
R222	RESISTOR, fixed: comp; 22 ohms ±10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF220K.	Cathode resistor	3RC20BF220K
R223	RESISTOR, fixed: comp; 100 ohms ±10%; 1 w; 1.28″ lg x 0.310″ diam; JAN type RC31BF101K.	Voltage regulator load	3RC31BF101K
R206	RESISTOR, fixed: ww; 200 ohms ±10%; 10 w; 1¾″ lg x 5/16″ diam; IRC type #AB.	Electronic voltage regulator bias.	3Z6020-98
R208	RESISTOR, fixed: ww; 500 ohms ±10%; 10 w; 1¾″ lg x ⅜″ diam; IRC type #BW-2.	Electronic voltage regulator load.	3Z6050-102
R209	RESISTOR, fixed: ww; 10,000 ohms ±10%; 10 w; 1¾″ lg x 5/16″ diam; IRC type #AB.	Voltage regulator limiting	3Z6610-173
R201	RESISTOR, fixed: comp; 24,000 ohms ±5%; ½ w; 0.655″ lg x 0.249″ diam; JAN type RC21BF243J.	Input resistor	3RC21BF243J
R220, R221, R224	RESISTOR, fixed: comp; 180,000 ohms ±10%; 2 w; 1.78″ lg x 0.405″ diam; JAN type RC41BF184K.	High-voltage filter	3RC41BF184K
R202	RESISTOR, fixed: comp; 240,000 ohms ±5%; ½ w; 0.655″ lg x 0.249″ diam; JAN type RC21BF244J.	Grid leak	3RC21BF244J
R215 through R217	RESISTOR, fixed: comp; 510,000 ohms ±5%; ½ w; 0.655″ lg x 0.249″ diam; JAN type RC21BF514J.	R215: Power lamp bleeder R216: Motor lamp bleeder. R217: Heater lamp bleeder.	3RC21BF514J
R218, R219	RESISTOR, fixed: comp; 2.2 meg ±10%; 2 w; 1.78″ lg x 0.405″ diam; JAN type RC41BF225K.	High-voltage bleeder	3RC41BF225K
R203	RESISTOR, variable (potentiometer): comp; 500 ohms ±20%; ½ w; 3 term; inclosed body 1¼″ diam x 9/16″ d; round shaft ¼″ diam x ¾″ lg; IRC type #W-CS.	CIRCLE DIAMETER control.	2Z7267.2

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R211 through R214	RESISTOR, variable (potentiometer): ww; 10,000 ohms ±10%; 4 w; 3 term; inclosed body 2.19" diam x 0.98" d; flatted shaft ¼" diam x 2½" lg; JAN type RA30A1FK103AK.	R211: Balance 0°. R212: Balance 180°. R213: Balance 90°. R214: Balance 270°.	3RA7513
R210	RESISTOR, variable (potentiometer): ww; 10,000 ohms ±10%; 25 w; 3 term; inclosed body 1⅝" diam x 1⅛" d; round shaft ¼" diam x ⅞" lg; Clarostat type #PW-25-W.	SENSE GAIN	2Z7280-13
	SOCKET, tube: 4 cont; bakelite, 1⅐⁄₆₄" diam x ²⁹⁄₆₄" h w/mtg flange 1½" c to c; Amphenol #MIP-4.	To hold tube	2Z8654.1
	SOCKET, tube: octal; bakelite, 1⅐⁄₆₄" diam x ²⁹⁄₆₄" h w/mtg flange 1½" c to c; Amphenol #MIP-8.	To hold tubes	2Z8659-6
S201	SWITCH, lever: 3 position; momentary lock; 10 amp, 110 v; bakelite body; 4⅛" lg x 1¼" wd x 2⅛" h; Fed Tele & Rad dwg #NCP-41-2-3.	STAND-BY-D.F.-SENSE	3Z9580-5
S207	SWITCH, push: SPST; 3 amp, 250 v; bakelite body; 1⁵⁄₃₂" lg x ½" wd x 1¹⁷⁄₃₂" h; momentary action; AH&H #3592.	High-voltage, safety	3Z9559
S202, S203 through S205	SWITCH, toggle: SPST; 20 amp, 24 v; bakelite body; 1⁹⁄₆₄" lg x ⁴¹⁄₆₄" wd x 1¹⁄₁₆" d; JAN type ST-42A.	Permits meter reading of four phase inverters.	3Z9863-42A
S206, S208	SWITCH, toggle: DPDT; 10 amp, 250 v; bakelite body; 2½" lg x 1⁵⁄₃₂" wd x 1¹⁄₃₂" d; C-H #8690.	S206: Filament selection. S208: Heater ON-OFF	3Z9849.37
T202	TRANSFORMER, power: plate and fil; pri,115 v AC; secd #1, 2300 v, 600 ma; secd #2, 2.5 v, 1.75 amp; secd #3, 6.3 v, 6 amp; inclosed metal case; 3¼" lg x 3¹⁵⁄₁₆" wd x 4⁵⁄₁₆" h; Fed Tele & Rad dwg #NCP-104-1-9.	High-voltage power	2Z9613.58
T201	TRANSFORMER, power: plate and fil; pri, 115 v AC; secd #1, 6.3 v, 3 amp; secd #2, 5 v, 3 amp, CT; secd #3, 350 v, 120 ma, CT; secd #4, 12 v, 10 amp, CT; inclosed metal case; 6⅛" lg x 5¼" wd x 7⁵⁄₃₂" h; Fed Tele & Rad dwg #NCP-104-2-7.	Low-voltage power	2Z9613.59
V206	TUBE, electron: JAN-2X2A	High-voltage half-wave rectifier.	2J2X2A
V203	TUBE, electron: JAN-5U4G	Low-voltage full-wave rectifier.	2J5U4G
V201	TUBE, electron: JAN-6AC7Y	D-c amplifier	2J6AC7Y
V202	TUBE, electron: JAN-6L6G	Voltage regulator, electronic	2J6L6G
V204	TUBE, electron: JAN-OC3/VR105	Voltage regulator, neon	2JOC3/VR105

c. PHASE INVERTER MC-411-A.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	CONVERTER, phase: Sig C Phase Inverter MC-411-A; provides optimum impedance matching; mtd in cylindrical casting; 13″ lg x 5$\frac{9}{16}$″ wd x 5$\frac{9}{16}$″ h overall.	Antenna coupling (directional)	2A2771A
	TECHNICAL MANUAL: TM11-243	Technical manual	(Order through AGO channels)
C302	CAPACITOR, fixed: mica; 10 mmf ± 10% 500 vdcw; max body dimen $\frac{51}{64}$″ lg x $\frac{15}{32}$″ wd x $\frac{7}{32}$″ thk; JAN type CM20B100K.	Phase correction	3K2010021
C301, C303, through C308	CAPACITOR, fixed: mica; 10,000 mmf ± 5%; 300 vdcw; max body dimen 1$\frac{1}{32}$″ lg x $\frac{41}{64}$″ wd x $\frac{11}{32}$″ thk; JAN type CM40B103J.	C301: Input coupling. C303 and C304: Screen bypass. C305 and C306: Plate bypass. C307: Plate output coupling. C308: Cathode output coupling.	3K4010322
	CONNECTOR, receptacle: female; single cont; straight; ½″ lg x ⅜″ diam; nickel pl thd stud fitted w/beryllium copper spring; ⅜″ hex head nut, bushing ⅜″ x ¼″-28 thd; GR #274-J.	Input and output connections	2Z5574.1
J301	CONNECTOR, receptacle: female; 3 cont; straight; 1$\frac{11}{32}$″ lg x 1⅜″ diam w/1⅝″ sq flange; AN type #AN-3102-22-2S.	R-f output	2Z8673.1
J302	CONNECTOR, receptacle: male; 5 cont; straight; 1¾″ lg x 1¼″ diam w/1⅝″ sq flange; AN type #AN-3102-22-13P.	Plate and filament supply input	2Z7123
	CONTACT, connector: banana type; single male cont; straight; 1$\frac{1}{32}$″ lg x $\frac{5}{16}$″ wd overall; GR #274-P.	Input and output contact	2Z7227-4
	CONTACT, connector: banana type; single male cont; straight; 1$\frac{1}{16}$″ lg overall; Birnbach #397.	Antenna connector	2Z7111.21
K301	RELAY, armature: SPDT; 3.2 v at 4 to 8 ma operation; 800 ohms DC resistance; 1$\frac{1}{16}$″ h x 1″ wd x $\frac{15}{16}$″ d; Kurmelec #12C-40.	Grounding antenna	2Z7585-8
R302	RESISTOR, fixed: comp; 55 ohms ± 0.5 ohm; ½ w; 0.375″ lg x 0.140″ diam; AB type #E.	Cathode resistor	3Z6005A1-6
R303	RESISTOR, fixed: comp; 94 ohms ± 1.5 ohms; ½ w; 0.375″ lg x 0.140″ diam; AB type #E.	Cathode resistor	3Z6008B2-7
R305	RESISTOR, fixed: metallized; 155 ohms ± 0.5%; ½ w; ⅝″ lg x $\frac{9}{32}$″ diam; Concarbon type #UX ½.	Plate resistor	3Z6013-4
R301	RESISTOR, fixed: comp; 24,000 ohms ± 5%; ½ w; 0.655″ lg x 0.249″ diam; JAN type RC21BF243J.	Grid resistor	3RC21BF243J
R304	RESISTOR, fixed: comp; 30,000 ohms ± 5%; ½ w; 0.655″ lg x 0.249″ diam; JAN type RC21BF303J.	Screen resistor	3RC21BF303J
X101, X102	SOCKET, tube: loctal; 8 cont; mica-filled bakelite, fits in 1.172″ hole w/retainer ring; Amphenol #78-8LT.	To hold tubes	2Z8678.35
V301, V302	TUBE, electron: JAN-7V7	Amplifier	2J7V7

d. PHASE INVERTER MC–413–A.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	CONVERTER, phase: Sig C Phase Inverter MC–413–A; provides optimum impedance matching; mtd in cylindrical casting; 13″ lg x 5 9/16″ wd x 5 9/16″ h overall.	Sense antenna coupling	2A2773A
	TECHNICAL MANUAL: TM 11–243	Technical manual	(Order through AGO channels)
C402, C415	CAPACITOR, fixed: mica; 10 mmf ± 10%; 500 vdcw; max body dimen 51/64″ lg x 15/32″ wd x 7/32″ thk; JAN type CM20B100K.	C402: Phase correction C415: Cathode coupling.	3K2010021
C401, C403 through C414, C416	CAPACITOR, fixed: mica; 10,000 mmf ± 5%; 300 vdcw; max body dimen 1 1/32″ lg x 41/64″ wd x 11/32″ thk; JAN type CM40B103J.	C401: Input coupling C403, C404, C413, and C414: Screen bypass. C405, C406, C411, and C412: Plate bypass. C407 and C409: Plate output coupling. C408 and C410: Cathode coupling. C416: Input coupling.	3K4010322
	CONNECTOR, receptacle: female; single cont; straight; 1/2″ lg x 3/8″ diam; nickel pl thd stud fitted w/beryllium copper spring; 3/8″ hex head nut, bushing 3/8″ x 1/4″–28 thd; GR #274J.	Input and output connections	2Z5574.1
J401, J402	CONNECTOR, receptacle: female; 3 cont; straight; 1 11/32″ lg x 1 3/8″ diam w/1 5/8″ sq flange; AN type #AN–3102–22–2S.	J401: R-f output, #1 J402: R-f output, #2	2Z8673.1
	CONTACT, connector: banana type; single male cont; straight; 1 7/16″ lg overall; Birnbach #397.	Antenna coupling	2Z7111.21
	CONTACT, connector: banana type; single male cont; straight; 1 1/32″ lg x 5/8″ wd overall; GR #274–P.	Input and output contact	2Z7227–4
R402, R407	RESISTOR, fixed: comp; 55 ohms ±0.5 ohm; 1/2 w; 0.375″ lg x 0.140″ diam; AB type #E.	Cathode resistor	3Z6005A1–6
R403, R408	RESISTOR, fixed: comp; 94 ohms ±1.5 ohm; 1/2 w; 0.375″ lg x 0.140″ diam; AB type #E.	Cathode resistor	3Z6008B2–7
J403	CONNECTOR, receptacle: male; 5 cont; straight; 1 3/4″ lg x 1 1/4″ diam w/1 5/8″ sq flange; AN type #AN–3102–22–13P.	Plate and filament supply input.	2Z7123
R405. R410	RESISTOR, fixed: metallized; 155 ohms ±0.5%; 1/2 w; 5/8″ lg x 9/32″ diam; Concarbon type #UX 1/2.	Plate resistor	3Z6013–4
R401, R409	RESISTOR, fixed: comp; 24,000 ohms ±5%; 1/2 w; 0.655″ lg x 0.249″ diam; JAN type RC21BF243J.	Grid Resistor	3RC21BF243J
R404, R406	RESISTOR, fixed: comp; 30,000 ohms ±5%; 1/2 w; 0.655″ lg x 0.249″ diam; JAN type RC21BF303J.	Screen resistor	3RC21BF303J

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	SOCKET, tube: loctal; 8 cont; mica-filled bakelite, fits in 1.172″ hole w/retainer ring; Amphenol #78–8LT.	Holds tube in place	2Z8678.35
V401 through V404	TUBE, electron: JAN–7V7	Amplifier	2J7V7

e. BEARING INDICATOR BC–1159–A

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	BEARING INDICATOR BC–1159–A: 5″ CR tube; 47⁵⁄₃₂″ lg x 13″ wd x 25″ h overall.	Produces visual patterns for azimuth indications.	2C1557–1159A
	TECHNICAL MANUAL: TM 11–243	Technical manual	(Order through AGO channels)
	BRUSH, electrical contact: carbon w/standard copper lead; rectangular shape, ¹¹⁄₁₆″ lg x ⁹⁄₃₂″ wd excl pigtail; Fed Tele & Rad dwg #RF–2592–1.	Electrical contact, indicator motor.	2C1557–1159A/B1
C501	CAPACITOR, fixed: paper; 1 mf ±20%; 2000 vdcw; 2½″ wd x 4¾″ h x 1³⁄₁₆″ d; 2 screw post term 1¾″ lg; JAN type CP70E1EJ105K.	Filter	3DB1–69
C502, C503	CAPACITOR, fixed: electrolytic; 115 mf; 110 vdcw; 3⅝″ lg x 1⁷⁄₁₆″ diam; round metal case; 2 solder lugs on top, ½″ ctr; Fed Tele & Rad dwg #RF–581–1 (motor starting).	Motor starting	3DB115–1
	COIL, tube deflection: single winding, layer wound; 155 mh ±10%; 0–14 ma, pulsating DC, 470 ohms resistance; 1¼″ ID, 1⁹⁄₁₆″ OD x ⁹⁄₁₆″ d; Fed Tele & Rad dwg #NL–41203–1.	Deflection	3C388
	CONNECTOR, receptacle: female; single cont; straight; ½″ lg x ⅜″ diam; GR #274–J.		2Z5574.1
J505	CONNECTOR, plug: male; 2 cont; straight; 1½″ lg x ¾″ diam excl cont AH & H type #MC.	Scale light supply	6Z7591–9
J504	CONNECTOR, receptacle: female; 2 cont; straight; approx 1″ lg x ¾″ diam; AH & H #757.	Scale light supply	6Z7783
	CONNECTOR, adapter: male one end, female other end; 2 flat parallel blades one end, 2 rectangular cont other end; 90 deg angle; 3¹⁄₁₆″ lg x 1¼″ wd x 1⅝″ d less cont; Fed Tele & Rad part/dwg #RF–4123–2A.		2Z307–46
J502	CONNECTOR, receptacle: Sig C Socket SO–187; male; 3 cont; straight; 1¹¹⁄₃₂″ lg x 1⅜″ diam w/1⅝″ sq flange.	Deflection coil input	2Z8799–187
J503	CONNECTOR, receptacle: Sig C Socket SO–209; male; 4 cont; straight; 1¹¹⁄₃₂″ lg x 1⅜″ diam w/1⅝″ sq flange.	A-c motor and heater supply	2Z8799–209

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
J501	CONNECTOR, receptacle: Sig C Socket SO–243; male; 9 cont; straight; 1 11/32″ lg x 1 5/8″ diam w/2″ sq flange	Cathode-ray tube supply	2Z8799–243
	CONTACT, connector: banana type; single male cont; straight; 1 1/32″ lg x 5/16″ wd overall; GR #274–P.		2Z7227–4
	COUPLING, flexible: motor coupling; leather; 2 5/8″ ID, 3 7/8″ OD x 5/32″ thk; Fed Tele & Rad dwg #NL–40142	Motor coupling	2Z6912
	DRIVE, alidade: consists of aluminum casting, spur and miter gears, shaft and control knob; 7 1/8″ lg x 6 1/8″ wd x 3 3/4″ d overall; Fed Tele & Rad dwg #RF–2459–3.	To turn alidade	2Z3876–78
	GASKET, alidade drive: paper fiber; rectangular, 7 1/8″ lg x 6 1/8″ wd x 0.025″ thk w/cutout 6 3/16″ lg x 5 1/4″ wd; Fed Tele & Rad dwg #RF–2749–2.	For alidade drive	2Z4868.259
	GLASS: anti-reflection; clear plastic; concave shape; 5″ diam x 1/64″ thk; Fed Tele & Rad dwg #NL–40120	In optical system, anti-reflection lens.	2Z6125
R509	HEATING ELEMENT, electrical: disk type; 115 v, 400 w; single sect; 3 1/4″ diam x 5/16″ thk; Wiegand #HSP–3.	Heater element	2Z5015–13
	KNOB: round; black bakelite; for 1/4″ diam shaft; 2 #10–32 setscrews; white pointer; 1 5/8″ diam x 3/4″ h; Kurtz-Kasch # –380–3L.	To turn the shafts of the controls in the bearing indicator.	2Z5753.10
I501	LAMP, incandescent: 120 v, 6 w; S–6 clear; double cont bayonet candelabra base; Mazda #6S6/DC.	Azimuth scale lighting	6ZK6931–2
	LAMPHOLDER: candelabra bayonet base; 1 1/2″ lg w/flange thd adapter ring 1″ diam x 1/2″ d; Fed Tele & Rad dwg #NL–40106.	To hold azimuth scale lamp	2Z5885–6
	MIRROR: octagonal, glass; 6 9/16″ lg x 5 1/16″ wd x 9/64″ thk; nonmagnifying; Fed Tele & Rad dwg #RF–3683–2.	Reflects azimuth scale	2Z6550–2
	MIRROR ASSEMBLY: transparent, nonmagnifying; octagonal mirror, 1/2″ thk x 6 3/4″ lg x 5 1/4″ wd; Fed Tele & Rad part/dwg #RF–3683–2.	Reflects azimuth scale	2Z6550–3
B501	MOTOR, AC: synchronous; 1/4 hp, 1800 rpm, 115 v, 60 cyc, single ph; 9 3/8″ lg x 5 15/16″ wd x 5 15/16″ h w/shaft 10 7/8″ x 1/2″ diam; Balder spec #4679; Fed Tele & Rad dwg #NL–43255–14.	Driving unit for deflection coils.	3H3000A25–1
	MOUNT, vibration: round mtg; rubber; 1 1/2″ ID, 2 1/2″ OD x 1.185″ thk; Fed Tele & Rad dwg #NL–40112.	Vibration mounting	2Z8495.6
R505, R506	RESISTOR, fixed: comp; 51,000 ohms ±5%; 1/2 w; 0.655″ lg x 0.249″ diam; JAN type RC21BF513J.	R505: Dropping, for second anode. R506: Dropping for centering controls.	3RC21BF513J

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R508	RESISTOR, fixed: comp; 100,000 ohms ±10%; 1 w; 1.28″ lg x 0.310″ diam; JAN type RC31BF104K.	Dropping, for cathode	3RC31BF104K
R510	RESISTOR, fixed: comp; 200,000 ohms ±5%; 1 w; 1.28″ lg x 0.310″ diam; JAN type RC31BF204J.	Dropping, for first anode	3RC31BF204J
R507	RESISTOR, fixed: comp; 300,000 ohms ±5%; 2 w; max body dimen 1.78″ lg x 0.405″ diam; JAN type RC41BF304J.	Dropping, for first anode	3RC41BF304J
R504	RESISTOR, variable (potentiometer): comp; 25,000 ohms ±10%; ½ w; 3 term; inclosed body 1¼″ diam x 9/16″ d; round shaft ¼″ diam x 11/16″ lg; IRC type CS, Fed Tele & Rad dwg #NCP-3210.	INTENSITY control	2Z7296-25M
R503	RESISTOR, variable (potentiometer): comp; 250,000 ohms ±10%; ½ w; 3 term; inclosed body 1¼″ diam x 9/16″ d; round shaft ¼″ diam x 11/16″ lg; IRC type CS, Fed Tele & Rad dwg #NCP-32-9.	FOCUS control	2Z7272-138
R501, R502	RESISTOR, variable (potentiometer): comp; 2 meg ±20%; ½ w; 3 term; inclosed body 1¼″ diam x 9/16″ d; shaft ¼″ diam x 33/64″ lg, screwdriver slot; IRC type CS, Fed Tele & Rad dwg #NCP-32-11.	R501: VERTICAL positioning control. R502: HORIZONTAL positioning control.	2Z7274-2
	SCALE: azimuth; photographic plate glass; ctr transparent; 4 23/64″ diam x 1/16″ thk overall; 360 scale divisions; figures 0 to 35 at 10 deg intervals clockwise; Fed Tele & Rad dwg #RF-2473-1B.	Scale for pattern readings	2Z3724.42
	SCREEN, diffusing: fine ground glass; 4 5/16″ diam x ⅛″ thk; Fed Tele & Rad dwg #RF-2472-1.	Diffusing lens	2C1557-1159A/G1
	SOCKET, tube: 11 cont magnal; steatite, 1.625″ diam x ⅞″ h overall w/spcl mtg ring; Amphenol #49-11-L; Fed Tele & Rad dwg #RF-2688-1A.	To hold cathode-ray tube	2Z8637-1.1
	SPRING: helical compression; tension for brush; #20 cad pl spring steel wire; 4 turns clockwise; 9/32″ lg x 3/16″ diam; Fed Tele & Rad dwg #NL-40175.	Spring for brushes	2C1557-1159A/2
	SPRING: helical compression; tension for brush; #20 cad pl spring steel wire; 4 turns counterclockwise; 9/32″ lg x 3/16″ diam; Fed Tele & Rad dwg #NL-40816.	Spring for brushes	2C1557-1159A/3
S501	SWITCH, thermostatic: SPST; cont rating 10 amp; bakelite body; 2⅜″ lg x 13/16″ wd x 1⅝″ d overall; Klixon thermo snap; Spencer Thermo #C-4351-17.	Control for heater	3Z9652-4.1
	TERMINAL, lug: ring type; 7/16″ lg x 3/16″ wd x 0.018″ thk, 0.068″ diam hole; Zierick #101.		3Z12072-16
	TERMINAL, lug: locking type; ⅞″ lg x 9/32″ wd; for #10 screw; Shakeproof #2103-10.		3Z12059-12
	TERMINAL, lug: locking type; 11/16″ lg x 5/16″ wd; for #4 screw; Shakeproof #2102-4.		3Z12059-23
V501	TUBE, electron: JAN 5NP1	Cathode-ray tube, type 5NP1	2J5NP1

f. GONIOMETER MC–412–A.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	GONIOMETER MC–412–A: 2 stators and 1 rotor; operates from 2 to 10 mc; inclosed metal case; 9⅞″ lg x 5¾″ wd x 5¾″ h overall.	Variable inductive coupling between phase inverters output and receiver.	2C1549–412A
	TECHNICAL MANUAL: TM 11–243		(Order through AGO channels)
C601, C602	CAPACITOR, fixed: paper; 10,000 mmf ±20%; 300 vdcw; 53/64″ sq x 11/32″ thk; JAN type CM35D103M.	Relay power line filter	3K3510344
J601 through J604	CONNECTOR, receptacle: female; 3 cont; straight; 1 11/32″ lg x 1⅜″ diam w/1⅝″ sq flange; AN type #AN–3102–22–2S.	J601, J602, and J604: Antenna input connectors. J603: Output connector.	2Z8673.1
J605	CONNECTOR, receptacle: female; 3 cont; straight; 29/32″ lg x ¾″ diam w/1 3/16″ sq flange; AN type #AN–3102–14S–1P.	Relay power connector	2Z7113.6
K601	RELAY, solenoid: DPDT; 10 amp, 110 v, 50/60 cyc; 1 ohm DC resistance; fast action; 2¾″ lg x 1½″ wd x 1 5/16″ h; Adv Elec #1000.	Sense circuit switching	2Z7588–45
R601, R602	RESISTOR, fixed: comp; 51 ohms ±5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF510J.	Terminating resistors	3RC20BF510J

g. ANTENNA EQUIPMENT RC–223–A.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	ANTENNA EQUIPMENT RC–223–A: used in groups of 5 (directional, 1 sense), forming fixed Adcock antenna system for direction finding; plywood; approx 24 ft lg.	Antenna array	2A289–223A
	TECHNICAL MANUAL: TM 11–243	Technical manual	(Order through AGO channels)
	ANCHOR, screw: Sig C Anchor AH–13; screw type; electro-galv steel; ½″ diam x 32″ lg overall; anchor eye one end; other end coiled 6 turns w/2 3/16″ pitch to form 2¾″ diam pointed screw approx 14″ lg; holding power approx 450 lb; Sig C dwg #SC–D–15661.	To anchor antenna	5B113
	ANTENNA: Adcock type; consists of 24 ft #14 AWG stranded wire; 19 #26 AWG strands, RC; w/banana jack one end, coil spring 4″ lg x ½″ diam other end; Maryland Eng part/dwg #DA4030–9, item #20.	For direction finding	2A298–4
	LEG, tripod: plywood; 8 ft lg x 4″ diam x ⅜″ thk wall; top has steel hoop band for attaching leg to mast; base has band hook of 2″ steel strip bent at angle w/hole to take ⅜″ diam spike to base plate; Maryland Eng part/dwg #4030–6, item #26.	For antenna mast	2A1825–3

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	LINK, sling: consists of 3 sect; ea 2 ft 6″ lg, 1 end of ea sect attached to eye of 6″ x ⅜″ turnbuckle; other end of ea sect an S-hook; galv wrought iron; Maryland Eng part/dwg #A-4030.	Antenna hold-down assembly	6Z1810-2
	MAST, antenna support: sectional telescoping type; consists of 3 sect; one sect 8 ft 7½″ lg x 5¼″ OD x 7/16″ thk wall; one sect 8 ft 8″ lg x 4″ OD x ⅜″ thk wall; one sect 8 ft 3″ lg x 3″ OD x ¼″ thk wall; 3 turnbuckles 6″ x ½″ equally spaced on largest sect w/slotted collar to hold leg tripod; plywood; Maryland Eng part/dwg #CA-4030.	Antenna support	2A2065-63
	PLATE, base: galv steel; 8″ sq x ⅛″ thk w/hole in ctr to pass ⅜″ diam anchor spikes; Maryland Eng part/dwg #4030-6, item #31.	For leg supports of antenna	2A2822.3-4
	SPIKE: base plate; 7½″ lg; galv iron ⅜″ diam; FH; Maryland Eng dwg #DA-6100-16.	Base plate	6L1466
	WRENCH SET: hex key setscrew type; 4 items w/o container; 3 interchangeable straight hex shape blades 3″, 4″, 5″ lg, for #5 and #6 cap screw and #10 setscrew, T-handle fitted w/setscrew for holding blades; steel; Allen Mfg #609.	Tools for antenna installation and maintenance.	6R57656

2. Supply Catalog Pamphlets for Bearing Indicator Kit MC-551

The following information was compiled on 3 March 1948. The appropriate pamphlet of the Department of the Army Supply Catalog is —

Organizational Maintenance Allowances, and Field and Base Maintenance Stockage Guide (including Fixed Plant Maintenance Lists).

SIG 7-8-10 RC-295.

SIG 7-8-10 BC-1338.

For an index of available catalog pamphlets, see the latest issue of Department of the Army Supply Catalog SIG 1.

3. Identification Table of Parts for Bearing Indicator Kit MC-551

a. GONIOMETER DRIVE UNIT RC-295.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	GONIOMETER DRIVE UNIT RC-295: input 115 v, 50/60 cyc, 1/10 hp motor; 19″ lg x 13″ wd x 7″ h overall; Fed Tele & Rad part/dwg #FRA-8590-14.		3H3818-295
	TECHNICAL MANUAL: TM 11-243		(Order through AGO channels)
P701	CONNECTOR, receptacle: male; 5 cont; straight; 29/32″ lg x 19/32″ sq; AN type #AN-3102-16S-SP.	Motor power and pilot light connector.	2Z8799-244
G701	GENERATOR, AC: 2700 rpm; 95 v, 45 cyc, 2 ph, 90 deg displaced; closed frame; 7 9/16″ lg x 3 3/16″ wd x 4 5/32″ h overall; self-excited; Kollsman Instr #1054G-0170201-0.	Provides low-frequency voltage.	3H2440-14

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
E701	LAMP, incandescent: 6–8 v, 0.2 amp; G–3½ clear; 15⁄16" lg overall; miniature bayonet base; Mazda type #51.	Dial lamp	2Z5934–1
J701	LAMP HOLDER: miniature bayonet; steel shell body w/bracket; 1⅝" lg x ⅝" wd x 15⁄16" d; Fed Tele & Rad part/dwg #FRB–7404–1A.	Supports scales light	2Z5883–325
B701	MOTOR, AC: split phase; 110 v, 60 cyc, 2.0 amp, 1⁄10 hp, 1725 rpm; 5⅞" lg x 4¼" wd x 4 13⁄16" h; Elec Indicator part/dwg #GFZ–241.	Goniometer and alternator drive.	3H3000A10–5
A702A, B, C, D	MOUNT, vibration: round mtg; 1.664" lg x 1" wd x 0.406" h; Lord type #102 PD–6.		2Z8403–6
A710A, B, C, D	MOUNT, vibration: sq mtg; 2⅜" sq x 1 1⁄16" h; Lord type #153PH–15.	Shock mount	2Z8404–6
H702	NUT, knurled: brass, nickel finish; ⅜"–16 thd; 1⅜" thk x ⅝" diam; Fed Tele & Rad part/dwg #FRB–7397–1.		6L3426–16.1
O702	PULLEY: 1-step grooved; aluminum; 1.660" diam x ⅝" d; Fed Tele & Rad part/dwg #FRB–7402–1.		6Z7682–16
O701	PULLEY: 1-step grooved; aluminum; 2.410" diam x ⅝" d; four ⅜" diam holes 90 deg apart; Fed Tele & Rad part/dwg #FRB–7396–1.		6Z7682–16.1
H704	SCREW, pivot: slot drive; RH; steel; #8–32; 1.156" lg; thd portion 7⁄16" lg; Fed Tele & Rad part/dwg #FRB–7403–1.		6L20908-18
H705	SCREW, set: hollow hex socket; headless; steel; #8–32; ¼" lg; Allen Mfg type #8–32 x ¼".		6L18508–4.39
H701	SCREW, thumb: knurled head ¼" thk x ½" diam; steel; #10–32; ¾" lg under head; thd 5⁄16" lg; Fed Tele & Rad part/dwg #FRB–7395–1.		6L17460–12.8K
H703	STUD, pivot: brass, nickel plated; 2¼" lg x 0.437" diam; one end thd 1 11⁄32" lg w/⅜"–16 thd; Fed Tele & Rad part/dwg #FRB–7401–1.		6L31129–10
S701	SWITCH, push: 2 ckt, 1 normally open, 1 normally closed; bakelite body; 1¼" lg x ½" sq; GE type #CR–1070–C103C3.	Dial light switch	3Z9824–60
	WRENCH: setscrew, hex; L-shape; 1⁄16" across flats; fits Allen #6 setscrew.	Alinement tool	6R57400–6
	WRENCH: setscrew, hex; L-shape; 5⁄64" across flats; fits Allen #8 setscrew.	Alinement tool	6R57400
	WRENCH: setscrew, hex; L-shape; 3⁄32" across flats; fits Allen #10 setscrew.	Alinement tool	6R55496

b. Bearing Indicator BC–1338.

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	BEARING INDICATOR BC–1338: 5″ diam screen; 115 v, 60 cyc; 19″ lg x 18″ wd x 8¾″ h; Fed Tele & Rad part/dwg #FRA–8589–14.	Main component of system	2C1557–1338
	TECHNICAL MANUAL: TM 11–243		(Order through AGO channels)
O804	BELT, V: comp; ¼″ wd x 3/16″ thk; Gates Rub type #4J68.	Drive belt that connects motor to goniometer and alternator.	3H340–5
O801	BLOCK, spacing: steel; overall dimen 1″ lg x ⅜″ wd x ⅜″ thk; two #6–32 tapped holes on 0.500″ ctr; Fed Tele & Rad part/dwg #FRB–7387–1.		2Z736–29
W801	CABLE ASSEMBLY, power: Sig C type Cord CD–1349; 2 cond #16 AWG; 10 ft 8″ lg; Amphenol connector type #AN–3108–18–5S on one end and Hubbell plug cap type #9754 on other end.	A-c power cord	3E1999–349
W804	CABLE ASSEMBLY, power: Sig C type Cord CD–1352; 3 cond #18 AWG; 2 ft 11″ lg; Amphenol connector type #AN–3106–14S–1S on one end and #AN–3108–14S–12P pos reverse #2 on other end.	Sense relay circuit connector	3E1999–352
W803	CABLE ASSEMBLY, power: Sig C type Cord CD–1351; 3 cond #18 AWG; 5 ft 5¼″ lg; Amphenol connector type #AN–3106–14S–1P on one end and type #AN–3108–14S–1P on other end.	Receiver output	3E1999–351
W805	CABLE ASSEMBLY, power: Sig C type Cord CD–1392; 4 cond #18 AWG (Sig C Cordage CO–135); 2 ft 5″ lg; Amphenol connector type #AN–3108–16S–8P on one end and #AN–3106–16S–8S on other end.	Connects goniometer drive motor to Bearing Indicator BC–1338.	3E1999–392–24
W802	CABLE ASSEMBLY, power: Sig C type Cord CD–1442; 4 cond #18 AWG (Sig C Cordage CO–135); 3 ft lg; ea end terminates into one Amphenol connector type #AN–3108–14S–2S.	Connects alternator to Bearing Indicator BC–1338.	3E1999–442–3
C826, C838	CAPACITOR, fixed: mica; 150 mmf ±2%; 500 vdcw; 51/64″ lg x 15/32″ wd x 7/32″ d; JAN type CM20C151G.	C826: Sense blanking phase shift. C838: R-f power supply, fixed grid tuning.	3K2015133
C843	CAPACITOR, fixed: mica; 470 mmf ±2%; 500 vdcw; 51/64″ lg x 15/32″ wd x 7/32″ d; JAN type CM20D471G.	R-f power supply, fixed plate tuning.	3K2047143
C828, C830, C831	CAPACITOR, fixed: mica; 510 mmf ±5%; 500 vdcw; 51/64″ lg x 15/32″ wd x 7/32″ d; JAN type CM20D511J.	C828: Coupling C830: Plate bypass. C831: Coupling.	3K2051142
C810 through C813, C818 through C823	CAPACITOR, fixed: mica; 1000 mmf ±2%; 500 vdcw; 1 1/16″ lg x 15/32″ wd x 7/32″ d; JAN type CM25D102G.	C810 through C813: Coupling C818 through C821: Coupling. C822 and C823: Bypass.	3K2510243

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C835, C845 through C847	CAPACITOR, fixed: mica; 4300 mmf ±5%; 2500 vdcw; 1¼" lg x 1⅓" wd x 29⁄64" d; JAN type #CM50B432J.	C835: Coupling capacitor for blanking voltage. C845 through C847: Filter capacitors.	3K5043222
C837	CAPACITOR, fixed: mica; 4300 mmf ±5%; 500 vdcw; 53⁄64" lg x 53⁄64" wd x 11⁄32" d; JAN type #CM35D432J.	Grid leak	3K3543242
C842	CAPACITOR, fixed: mica; 6200 mmf ±20%; 500 vdcw; 53⁄64" lg x 53⁄64" wd x 11⁄32" d; JAN type #CM35D622M.	Screen bypass	3K3562244
C848 through C851	CAPACITOR, fixed: mica; 10,000 mmf ±10%; 300 vdcw; 53⁄64" lg x 53⁄64" wd x 11⁄32" d; JAN type CM35C103K.	Screen decoupling	3K3510331
C839 through C841	CAPACITOR, fixed: mica; 10,000 mmf ±20%; 300 vdcw; 53⁄64" lg x 53⁄64" wd x 11⁄32" d; JAN type CM35D103M.	C839 and C840: Heater decoupling. C841: Screen decoupling.	3K3510344
C804, C805	CAPACITOR, fixed: mica; 47,000 mmf ±2%; 600 vdcw; 125⁄32" wd x 111⁄32" d x ¾" h; JAN type #CM60B473G.	Low-frequency filter capacitors	3K6047323
C801, C802, C806 through C809, C834	CAPACITOR, fixed: paper; 500,000 mmf ±10%; 600 vdcw; 113⁄16" lg x 1" wd x ⅞" d; 2 solder lug term on top; JAN type CP54B1FF504K.	C801 and C802: Alternator coupling. C806 through C809: Phase inverter coupling. C834: Cathode bypass.	3DA500-520
C827A, B	CAPACITOR, fixed: 2 sect; 0.1 mf +40% −15% ea sect; 600 vdcw; 1¾" wd x 41⁄64" d x 1½" h; 2 solder lug term on bottom; JAN type CP69B6EF104X.	C827A: V807 cathode bypass. C827B: B807 screen bypass.	3DA100-772
C832A, B	CAPACITOR, fixed: paper; 2 sect; 0.1 mf +40% −15% ea sect; 600 vdcw; 113⁄16" wd x 1" d x ¾" h; 2 solder lug term on side; JAN type CP53B6EF104X.	Line filter capacitor	3DA100-773
C814A, B, C; C815A, B, C; C829A, B, C	CAPACITOR, fixed: paper; 3 sect; 0.1 mf +40% −15% ea sect; 600 vdcw; 1¾" wd x 41⁄64" d x 1½" h; 3 solder lug term on bottom; JAN type CP69B5EF104X.	C814A and C, C815A and C: Cathode bypass. C814B and C815B: Screen bypass. C829A: Filter capacitor. C829B: Cathode bypass. C829C: Filter capacitor.	3DA100-756
C803A, B	CAPACITOR, fixed: paper; 2 sect; 1 mf +40% −15% ea sect; 600 vdcw; 2" wd x 2" d x 1⅛" h; 2 solder lug term on side; JAN type CP53B6EF105X.	Filter capacitors	3DB1-182
C833	CAPACITOR, fixed: paper; 10 mf +40% −15%; 1000 vdcw; 3¾" wd x 2¼" d x 4¾" h; 2 screw post term on top; JAN type CP70E1EG106X.	Power supply filter capacitor	3DB10-187
C816A, B; C817A, B	CAPACITOR, variable: air dielectric; plate meshing, dual sect; 4-50 mmf and 2.8-14 mmf ±10%; 115⁄16" lg x 17⁄16" wd x 23⁄16" d; Sickles FW type #ARF.	C816A and C817A: Plate coil tuning capacitor. C816B and C817B: Plate circuit differential balancing capacitors.	3D9050-138

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
C836, C844	CAPACITOR, variable: plate meshing type; 12.5 to 210 mmf; 2 27/64" lg x 1 5/8" wd x 1 9/32" h; Hammarlund type #APC-210.	C836: R-f power supply, grid tuning. C844: R-f power supply, plate tuning.	3D293
	CLIP: electron; tube cont; ceramic low loss ins; 1 1/8" lg x 5/8" wd x 9/16" h; Natl Co type #SPP-3.	Cap connector of rectifier tube for high-voltage rectifier.	2Z2712-1
H806	CLAMP: tube; stainless steel; 1 5/32" ID x 3/4" h; for 1 5/32" diam tube base; buckle type lock; Birtcher #926A.	Vacuum tube clamps	2Z2636-28
H805, H814, H815	CLAMP: tube; stainless steel; 1 1/2" OD x 1 3/8" ID x 7/8" thk overall; for 1 3/8" diam tube base; buckle type lock; Birtcher #926C.	Vacuum tube clamps	2Z2636-26
L801, L802	COIL, RF: 6 pie universal wound; unshielded; 18.6 mh, approx DC resistance 2 ohms; 1 5/8" lg x 15/16" diam; iron core adj; 4 wire lead term; Fed Tele & Rad part/dwg #FRA-7561-1.	R-f balanced modulator coil	3C315-40.1
L806	COIL, RF: 4 pie winding; unshielded; 5.5 mh, 125 ma DC resistance 60 ohms; 1 1/2" lg x 3/4" diam; 2 leads; Bud Rad type #CH-922W.	Choke coil	3C323-50E
L804	COIL, RF: single pie winding; unshielded; 2.43 mh, approx DC resistance 0.005 ohms; 250 turns #7/40 Litz wire tapped at 30 turns; 1" lg x 1 3/8" diam overall; plastic form; Fed Tele & Rad part/dwg #FRA-7322-1.	Oscillator inductance	3C315-40.2
L805A, B, C	COIL, RF: 3 winding, 7 pies; unshielded; 3" lg x 1 3/8" diam; 6 pigtail leads; stamped L805; Fed Tele Rad part/dwg #FRA-7323-1.	Transformer	3C315-40.3
J802	CONNECTOR, receptacle: female; 3 cont; straight; 29/32" lg x 1 3/16" sq; #AN-3102-14S-1S.	Input connector from receiver	2Z8673.20
J801	CONNECTOR, receptacle: female; 3 cont; straight; 29/32" lg x 1 3/16" sq; #AN-3102-14S-12S-P2.	Sense relay power connector	2Z3064-99
P802	CONNECTOR, receptacle: male; 3 cont; straight; 29/32" lg x 1 3/32" sq; #AN-3102-14S-1P.	Sense control voltage	2Z7113.6
P803	CONNECTOR, receptacle: male; 3 cont; straight; 1 11/32" lg x 1 3/8" sq; #AN-3102-18-5P.	A-c power input	3Z1462-1
P801	CONNECTOR, receptacle: male; 4 cont; straight; 29/32" lg x 1 3/32" sq; #AN-3102-14S-2P.	Alternator input	2Z87799-220
J803	CONNECTOR, receptacle: female; 5 cont; straight; 29/32" lg x 1 9/32" sq; #AN-3102-16S-8S.	A-c power goniometer drive connector.	2Z8675.39
O803	COUPLING, rigid: sleeve; 1/4" shaft size at ea end; setscrew mtg; 1 3/32" lg x 11/16" diam; steatite, leakage path 1 1/8" lg; Johnson EF type #252	Potentiometer coupling	2ZK3269-11
F802	FUSE FU-27: cartridge; 2 amp 250 v; nonrenewable; glass body; ferrule type; 1 1/4" lg x 1/4" diam; Littelfuse type #3AG.	Protects circuit from overload	3Z1927

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
F801	FUSE, cartridge: 5 amp 125 v; nonrenewable; glass body; ferrule type; 1¼″ lg x ¼″ diam; Littelfuse type #3AG.	Protects circuit from overload	3Z2605.2
	GASKET: rubber; for Chests CH–300 and CH–301; ¾″ wd x 1/16″ wall thk x ¼″ h overall; Atlan India Rub type #X–286.	----------	2Z4867.521
E817 through E822	HOLDER, fuse: extractor fuse type; for single 3AG amp fuse; 2⅛″ lg x ½″ diam overall; Littelfuse type #1075–A.	Fuse holders	3Z3275-1
E816	INSULATOR, stand-off; round post shape; steatite; 0.750″ lg x ⅜″ diam; #6–32 tapped hole ¼″ d in ea end; JAN type #NS3W0106.	High-voltage insulators	3G1250–12.16
H803, H810, H811	KNOB: round; brass; for ¼″ diam shaft; single #6–32 setscrew; ⅝″ lg x ½″ diam; Fed Tele & Rad part/dwg #FRB–7389–1.	----------	2Z5822–213
H804, H812, H813	KNOB: round; black bakelite; for ¼″ diam shaft; setscrew fastening; finger grip type; 1⅛″ diam x 13/16″ d; ICA type #1165.	Control knobs	2Z5788–46
E801 through E806	LAMP TS–53: incandescent; 6–8 v. 1 cp; G–3½ clear; 15/16″ long overall; miniature bayonet base; Mazda type #51.	Dial lamps	2Z5934–1
A901 through A916	MOUNT, vibration: sq mtg; rubber; 2⅜″ sq x 1 1/16″ h; Lord type #153PH–20.	Shock mountings	2Z8404–36
K802	RELAY, solenoid: DPDT; 10 amp, 110 v, 50/60 cyc; 1 ohm DC resistance; fast action; 2¾″ lg x 1½″ wd x 1 5/16″ h; Adv Elec type #1000–2B.	Sense blanking relay	2Z7587–187
K801	RELAY, solenoid: 3PDT; 10 amp, 110 v, 50/60 cyc; 1 ohm DC resistance; fast action; 2¾″ lg x 1 13/32″ wd; x 1 5/16″ h; Adv Elec type #1000–3B.	Low-frequency voltage relay	2Z7593–120
R821, R824, R825, R828	RESISTOR, fixed: comp; 100 ohms ±10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF101K.	Grid suppressors	3RC20BF101K
R829, R831, R832, R834	RESISTOR, fixed: comp; 220 ohms ±5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF221J.	Cathode bias	3RC20BF221J
R850	RESISTOR, fixed: comp; 390 ohms ±10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF391K.	Voltage divider for modulator bias circuit.	3RC20BF391K
R859	RESISTOR, fixed: WW; 500 ohms ±5%; 16 w; 2″ lg x 19/32″ diam; JAN type #RW32G501	Current limiting resistor	3RW22508
R857	RESISTOR, fixed: comp; 750 ohms ±5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20 BF751J.	Cathode bias	3RC20BF751J
R861 through R863	RESISTOR, fixed: comp; 1000 ohms ±10%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF102K.	R861 and R862: Grid resistors for series regulating tubes. R863: Power supply control regulating grid resistor.	3RC30BF102K

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R866	RESISTOR, fixed: comp; 2000 ohms ±5%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF202J.	Regulator screen grid resistor	3RC30BF202J
R819	RESISTOR, fixed: comp; 2700 ohms± 5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF272J.	Circuit return	3RC20BF272J
R851	RESISTOR, fixed: comp; 3300 ohms ±10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF332K.	Voltage divider	3RC20BF332K
R868	RESISTOR, fixed: WW; 4000 ohms ±5%; 16 w; 2″ lg x 19/32″ diam; JAN type RW32G402.	Voltage regulator resistor	3RW27907
R802	RESISTOR, fixed: comp; 6800 ohms ±10%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF682K.	Alternator terminating resistor.	3RC30BF682K
R871	RESISTOR, fixed: comp; 7500 ohms ±5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF752J.	Sense voltage dropping resistor.	3RC20BF752J
R804	RESISTOR, fixed; comp; 15,000 ohms ±10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF153K.	Alternator terminating	3RC20BF153K
R853, R858	RESISTOR, fixed: comp; 20,000 ohms ±5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF203J.	Plate resistors	3RC20BF203J
R873	RESISTOR, fixed: comp; 20,000 ohms ±5%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF203J.	Grid resistor, r-f power supply.	3RC30BF203J
R875, R876	RESISTOR, fixed: comp; 22,000 ohms ±5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF223J.	Filter resistors, power supply.	3RC20BF223J
R856	RESISTOR, fixed: comp; 22,000 ohms ±10%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF223K.	Voltage divider, power supply.	3RC30BF223K
R803	RESISTOR, fixed: comp; 24,000 ohms ±5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF243J.	Alternator terminating	3RC20BF243J
R855	RESISTOR, fixed: comp; 27,000 ohms ±10%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF273K.	Power supply voltage divider.	3RC30BF273K
R852	RESISTOR, fixed: comp; 33,000 ohms ±5%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF333J.	Power supply voltage divider.	3RC30BF333J
R874	RESISTOR, fixed: comp; 39,000 ohms ±10%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF393K.	Screen resistor	3RC30BF393K
R844, R877	RESISTOR, fixed: comp; 47,000 ohms ± 10%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF473K.	R844: High-voltage supply divider. R877: High-voltage rectifier cathode resistor.	3RC30BF473K
R812, R813, R816, R817	RESISTOR, fixed: comp; 51,000 ohms ± 5%; ½ w; 0.468″ x 0.249″ diam; JAN type RC20BF513J.	R812 and R813: Phase inverter plate resistors. R816 and R817: Phase inverter cathode resistors.	3RC20BF513J
R878 through R881	RESISTOR, fixed: comp; 68,000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF683K.	Screen decoupling	3RC20BF683K
R814, R815, R818, R820, R854, R872	RESISTOR, fixed: comp; 100,000 ohms ± 5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF104J.	R814, R815, R818, and R820: Filter resistors. R854: Grid resistor. R872: Phase shifting resistor.	3RC20BF104J

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R846, R867, R870	RESISTOR, fixed: comp; 150,000 ohms ± 10%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF154K.	R846: High-voltage divider. R867 and R870: Regulator divider resistors.	3RC30BF154K
R841, R843, R884	RESISTOR, fixed: comp; 180,000 ohms ± 10%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF184K.	High-voltage divider resistors.	3RC30BF184K
R848	RESISTOR, fixed: comp; 220,000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam: JAN type RC20BF224K.	Grid resistor	3RC20BF224K
R842	RESISTOR, fixed: comp; 220,000 ohms ± 10%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF224K.	High-voltage divider resistor.	3RC30BF224K
R822, R823, R826, R827	RESISTOR, fixed: comp; 510,000 ohms ± 5%; ¼ w; 0.406″ lg x 0.170″ diam; JAN type RC10BF514J.	Grid return resistors	3RC10BF514J
R860, R864	RESISTOR, fixed: comp; 510,000 ohms ± 5%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF514J.	R860: Grid resistor R864: Screen resistor	3RC30BF514J
R835 through R838	RESISTOR, fixed: comp; 750,000 ohms ± 5%; ¼ w; 0.406″ lg x 0.170″ diam; JAN type RC10BF754J.	Deflection circuit return	3RC10BF754J
R808, R809, R811	RESISTOR, fixed: comp; 2 meg ± 5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF205J.	R808: Phase inverter screen resistor. R809: Voltage divider resistor. R811: Phase inverter resistor.	3RC20BF205J
R807, R810	RESISTOR, fixed: comp; 5.1 meg ± 5%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF515J.	Grid return resistors	3RC20BF515J
R806	RESISTOR, fixed: comp; 10 meg ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF106K.	Voltage divider resistor	3RC20BF106K
R830, R833	RESISTOR, variable: WW; 200 ohms ± 10%; 2 w; 3 solder lug term; metal inclosed case 1.28″ diam x 0.62″ d; round shaft 1″ lg; mtg bushing ⅜″–32 x 0.375″ lg; JAN type RA20A1RE201AK.	Differential bias control	3RA4213
R882, R883	RESISTOR, variable: WW; 1000 ohms ± 10%; 4 w; 3 solder lug term; metal inclosed case 1.78″ diam x 0.98″ d; slotted shaft ½″ lg; mtg bushing ⅜″–32 x 0.375″ lg; JAN type RA30A1SA102AK.	Bias controls	3RA5704
R865	RESISTOR, variable: comp; 5000 ohms ± 10%; 2 w; 3 solder lug term; metal inclosed case 1¹⁄₁₆″ diam x ⁹⁄₁₆″ d; flatted shaft ¾″ lg; mtg bushing ⅜″–32 x ⅜″ lg.	Hum control	3Z7350–71
R849	RESISTOR, variable: comp; 5000 ohms ± 10%; 2 w; 3 solder lug term; metal inclosed case 1¹⁄₁₆″ diam x ⁹⁄₁₆″ d; flatted shaft 1⅜″ lg; mtg bushing ⅜″–32 x ⅜″ lg; Allen Bradley type J.	Pattern size control	3Z7350–70
R805	RESISTOR, variable: comp; 10,000 ohms ± 10%; 2 w; 3 solder lug term; metal inclosed case, 1¹⁄₁₆″ diam x ⁹⁄₁₆″ d; flatted shaft 1″ lg; bushing ⅜″–32 x ⅜″ lg; Allen Bradley type J.	Pattern shape control	3Z7410–49
R801	RESISTOR, variable: comp; 25,000 ohms ± 10%; 2 w; 3 solder lug term; metal inclosed case 1¹⁄₁₆″ diam x ⁹⁄₁₆″ d; flatted shaft ⅜″ lg; bushing ⅜″–32 x ⅜″ lg; Allen Bradley type J.	Deflection plate compensating control.	3Z7425–51

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
R869	RESISTOR, variable: comp; 50,000 ohms ± 10%; 2 w; 3 solder lug term; metal inclosed case 1 1/16″ diam x 9/16″ d; flatted shaft 3/4″ lg; mtg bushing 3/8″–32 x 3/8″ lg; Allen Bradley type J.	Voltage control	3Z7450–76
R847	RESISTOR, variable: comp; 50,000 ohms ± 10%; 2 w; 3 solder lug term; metal inclosed case 1 1/16″ diam x 9/16″ d; flatted shaft 1 3/8″ lg; bushing 3/8″–32 x 3/8″ lg; Allen Bradley type J.	Intensity control	3Z7450–77
R845	RESISTOR, variable: comp; 250,000 ohms ± 10%; 2 w; 3 solder lug term; metal inclosed case 1 1/16″ diam x 9/16″ d; flatted shaft 1 3/8″ lg; bushing 3/8″–32 x 3/8″ lg; Allen Bradley type J.	Focus control	3Z7498–25.51
R839, R840	RESISTOR, variable: comp; 500,000 ohms ± 10%; 2 w; 3 solder lug term; metal inclosed case 1 1/16″ diam x 9/16″ d; flatted shaft 1″ lg; bushing 3/8″–32 x 3/8″ lg mtg bushing; Allen Bradley type J.	Centering controls	3Z7498–50.34
O802	SCALE: Alidade, assembly; a/o light mount assy; lens assy, dial, shield, housing and hook overall dimen 7.406″ diam x 7 3/16″ d; scale calibrated 0 to 360 in 360 divisions marked every 10 divisions; Fed Tele & Rad part/dwg #FRA–8134–1.	Azimuth scale	2Z8076–103
H802 through H807, H809	SCREW, thumb: knurled head; steel; #10–32, 3/4″ lg under head; head 1/4″ thk x 1/2″ diam; Fed Tele & Rad part/dwg #FRB–7395–1.	Holds alternator in position	6L17110–12.8K
X815	SOCKET, tube: 4 cont; retainer ring mtg; 1 1/4″ diam x 51/64″ h; Amphenol socket #SS4.	High-voltage rectifier tube socket.	2Z8674.85
X801, X807 through X814	SOCKET, tube: octal; ceramic; one-piece saddle mtg; 1 25/32″ lg x 1 1/4″ h x 11/16″ d; Ucinite part/dwg #115001–1A.	Tube sockets	2Z8678.195
X802 through X805	SOCKET, tube: octal; ceramic; one-piece saddle mtg; 1 25/32″ lg x 1 1/4″ wd x 11/16″ d; w/stop nuts; Ucinite part/dwg #115001–A.	Tube sockets	2ZK8678.35
X806	SOCKET, tube: 14 cont diheptal; retainer ring mtg; four 9/64″ wd x 7/8″ lg mtg holes; 1 1/8″ lg x 2.219″ diam; Cinch type #9453.	Cathode-ray tube socket	2Z8684–14
S801, S803	SWITCH, toggle: SPST; bakelite body; 1 9/64″ lg x 41/64″ wd x 1 1/16″ d; mtg bushing 15/32″–32 x 15/32″ lg; JAN type ST–42A.	S801: Power ON-OFF switch. S803: Alinement switch.	3Z9863–42A
S802	SWITCH, toggle: DPST; bakelite body; 1 21/64″ lg x 49/64″ wd x 1 1/16″ d; mtg bushing 15/32″–32 x 15/32″ lg; JAN type ST–52K.	STAND-BY–D/F switch	3Z9863–52K
E807	TERMINAL, lug: pressure type; phosphor bronze; two 0.128″ diam holes; 3/8″ lg x 1/4″ wd x 3/16″ d; Fed Tele & Rad part/dwg #FRB–7393–1A.		3Z11085–8.1
T802	TRANSFORMER, power: filament type; input 115 v, 50–60 cyc; secd #1, 2.5 v at 2 amp; secd #2, 6.3 v at 2 amp, CT; secd #3, 6.3 v at 6 amp, CT; secd #4, 6.3 v at 1 amp; HS case 12 solder lug term; 4 1/4″ lg x 3 3/4″ wd x 4 3/4″ h; Freed Trans cat. #12319.	Power transformer	2Z9611.459

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
T801	TRANSFORMER, power: filament and plate; input 115 v, 50–60 cyc; secd #1, 550–0–550 v at 200 ma; secd #2, 5 v at 4 amp; secd #3, 6.3 v at 6 amp; HS case; 11 solder lug term; 5⅛" lg x 4⅜" wd x 5¾" h excl term; Freed Trans cat. #12318.	Power transformer	2Z9613.548
V801	TUBE, electron: JAN–6SN7GT	Phase inverter	2J6SN7GT
V802 through V805	TUBE, electron: JAN–6AC7W	Balanced modulator	2J6AC7W
V806	TUBE, electron: JAN–5CP1A	Cathode-ray tube	2J5CP1A
V807	TUBE, electron: JAN–6SA7Y	Control modulator	2J6SA7Y
V808	TUBE, electron: JAN–6SH7	Amplifier	2J6SH7
V809	TUBE, electron: JAN–5U4G	Rectifier	2J5U4G
V810, V811	TUBE, electron: JAN–6L6GAY	Voltage regulators	2J6L6GAY
V812	TUBE, electron: JAN–6SQ7	Control regulator	2J6SQ7
V813	TUBE, electron: JAN–OD3/VR150	Voltage regulator	2JOD3/VR150
V814	TUBE, electron: JAN–6V6GT	Power supply oscillator	2J6V6GT
V815	TUBE, electron: JAN–2X2A	Rectifier, high-voltage	2J2X2A
H801	WRENCH: combination socket wrench and screwdriver; hex socket ¼" across flats; 4¾" lg x 7/16" diam; Sig C dwg #SC–D–15550B–3.	Alinement tool	6R41708
H807	WRENCH, socket 7/16" opening; 7⅛" lg x 1 3/16" diam overall; Stevens Walden Spintite #3415.	Tool	GR57413–2

4. Supply Catalog Pamphlet for Fixed Antenna Equipment RC–301

The following information was compiled on 8 February 1949. The appropriate pamphlet of the Department of the Army Supply Catalog is —

Fixed Plant Maintenance Lists
SIG 10 RC–301

For an index of available catalog pamphlets, see the latest issue of Department of the Army Supply Catalog SIG 1.

5. Identification Table of Parts for Fixed Antenna Equipment RC–301

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	FIXED ANTENNA EQUIPMENT RC–301: 5 monopole type for radio direction finders use; steel; Sig C dwg #SC–D–15640.		2A289.301
	TECHNICAL MANUAL: TM 11–243		(Order through AGO channels)

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	ANCHOR AH–13: screw type; steel, electro-galv; ½″ diam x 32″ lg overall; anchor eye one end, other end coiled 6 turns w/2³⁄₁₆″ pitch to form 2¾″ diam pointed screw approx 14″ lg; holding power approx 450 lb; Sig C dwg #SC–D–15661.	Anchor for Guys GY–45 and GY–46.	5B113
	ANTENNA ASSEMBLY AN–202; monopole type; for receiving; steel tubing, galv; sectionalized; approx 28 ft h overall; 3 sect ea approx 8 ft lg; bottom mast ins attached to socket which mts on ball joint; range 1.5 to 10 mc; matches thru inverter to 125-ohm flat transmission line, untuned; guyed 3 ways at bottom of top sect; Sig C dwg #SC–D–15641.	Corner antenna of crossed U-Adcock antenna system.	2A275–202
	ANTENNA ASSEMBLY AN–203: monopole type; for receiving; steel tubing, galv; sectionalized; approx 28 ft h overall; 3 sect ea approx 8 ft lg; bottom mast ins attached to socket which mts on ball joint; range 1.5 to 10 mc; matches thru inverter to 125-ohm flat transmission line, untuned; guyed 4 ways at bottom of top sect; Sig C dwg #SC–D–15641.	Sense antenna for crossed U-Adcock antenna system.	2A275–203
	BAR, crow and digging: steel; 1⅛″ x 6 ft lg; one end pointed, other end sharp wedge; Hubbard #266.	Installation tool, for digging holes for antenna pedestals.	6Q3001
	BLADE, saw: hacksaw; 12″ lg x ⁹⁄₁₆″ wd x 0.025″ thk; 24 teeth per inch; steel; flat; Snap-On #HS–1224.	Installation tool, for cutting pipe.	6Q8152–24
	BRUSH, painting: flat; chinese bristle; 8¼″ lg overall x 3″ wd; bristles 2″ lg; rubber vulcanized; metal ferrule.	Installation tool, for touching up paint on masts.	6Z1553–1
	CAP: drive head for 2½″ pipe nipple; mal iron galv; approx 5½″ OD x 3½″ h; Walworth #9321.	Assists in driving antenna base assembly into ground.	6Z1731–2.5
L1, L101	COUNTERPOISE CP–19: mesh type; 9 ft sq; bare, tinned braided cable, ⅝″ wd x 0.040″ thk, 38 strands meshed 6″ apart; soldered at intersections; ¾″ grounding wire clamp soldered at ea corner, 2 gnd jumpers soldered at center, solderless term lug other end; Sig C dwg #SC–D–15653.	Acts as a ground plane for antenna.	2A720–19
	FRAME: hacksaw; approx 15″ lg overall; pistol grip; adj 8″ to 12″; Miller Falls #S–1237.	For hacksaw blades used to cut pipe.	6Q41004
MS201	GREASE: general purpose #2; 1 lb can; US Army spec #2–108A.	For lubricating the ball top of each pedestal.	6G606M
	HAMMER HM–3: hand; cross peen; 8 lb; cast steel head 7⅛″ lg x 2¼″ wd x 2⅛″ thk; wooden handle 32″ lg; 2 wooden and 1 metal wedge.	Installation tool	6Q49003
	HANDLE, hammer: hickory; 36″ lg. 1″ diam x 1¼″ wd on head end; incl one forged steel wedge; Fed Spec #NH–H–91, type B–ID (for Hammer HM–3).	Installation tool	6Q51146–36
	HARDWARE KIT: for maintaining antenna equip; 6″ sq cloth bag w/drawstring.	Installation item	6L80156

Ref symbol	Name of part and description	Function of part	Signal Corps stock No.
	PAINT: lacquer; ready mixed; alkaloid base, 32″ phthalic anhydride; olive drab; 1 qt can; quick air drying; lusterless; Murphy Varnish Co; Fed Spec #3–173, grade I.	Touch up masts	6G1506.4
	PIPE: galv wrought iron; 2½″ size; std pipe thd; 5″ straight lg; std weight; Brach #0832–4.	For making hole for bottom pedestal.	6Z7557–20.3
E3, E103	PROTECTOR MX–608/U: combination resistor-air gap; outside use; approx 2¾″ lg x ⅞″ diam; 900 v peak; phenolic body, bronze base; solderless lug term; Sig C dwg #SC–D–15652.	Acts as lightning arrester	3Z76–608
	STAKE GP–2: guy; galv iron; 16″ lg x ¾″ diam; w/eyebolt welded to stake; Sig C dwg #RL–A–120.	For anchoring corners of counterpoise.	2A3302
	STAKE GP–25: guy: steel; one end pointed, other end 2⅜″ diam cap; 36″ lg overall x 1.344″ diam pipe; marked GP–25; w/bolt and wingnut 2¼″ from cap end; Sig C dwg #RL–D–5659.	Antenna anchor	2A3325
	TERMINAL, lug: ring type; brass; for #0 AWG wire; ¾″ wd x 1¾″ lg, 11/32″ diam stud hole; solder connects to wire; Sherman #A–½.	Spare connector for grounding purposes.	3Z12075–22
	VISE: pipe; chain operation; for ¼″ to 4″ pipe; steel; V jaws w/serrated faces; fixed base; Williams JH Vulcan #2.	For use in assembling antenna sections.	6R47174
W102	WIRE BRAID: bare copper; ⅝″ wd x 0.047″ thk; Belden-Faun (lead-in).	Spare wire for maintenance	1F7B1–3
	WRENCH: setscrew; 1/16″ across flats; long arm 127/32″ lg, short arm 21/32″ lg; steel; head 90 deg offset; L-shaped; for Allen #6 setscrew; Allen #6.	Installation tool	6R57400–6
	WRENCH: Stillson; ¼″ to 4″ opening; 36″ lg overall; steel; straight head; flat straight handle; Walworth #4111–36.	Installation tool	6R56536
	WRENCH: Stillson; ¼″ to 2″ opening; 18″ lg overall; steel; straight head; flat straight handle; Walworth #4111–18.	Installation tool	6R56618

APPENDIX V

ERROR CORRECTION SLIDE RULE

1. Purpose

A calibrated slide rule is used to correct the indicated bearing for goniometer zero shift and octantal error (ch. 2, sec. III, par. 81).

2. Construction

The materials needed to construct this slide rule and pointer are included in figures 215, 216, and 217. The completed slide rule can be prepared in accordance with the following instructions:

a. Remove one of the pieces of graph paper, figure 215. The radial lines are graduated in terms of degrees, 10° either side of the 0° line. The concentric lines are graduated in megacycles from 5 to 20 mc. On this graph, plot the goniometer correction at each frequency from 5 to 20 mc. For example, if the goniometer zero shift correction chart (table II, ch. 2, sec. III, par. 72) indicated a goniometer zero shift correction of —1.2° at 7 mc, place a point at —1.2° (to the left of the 0° line) on the 7-mc concentric line. If at 15 mc the goniometer zero shift is —6.5°, place a point at —6.5° on the 15-mc concentric line. A graph plotted for a typical goniometer whose zero shift is given in table II is shown in figure 218.

b. Carefully cut out the pointer, figure 216.

c. Place the plotted graph of subparagraph *a* over this pointer so that the 0° radial line coincides with the center radial line on the pointer and so that the 20-mc and 5-mc concentric lines on the graph coincide with the corresponding lines on the pointer.

d. Holding the graph paper securely in place, transfer the points previously plotted on the graph paper to the pointer. This can be done easily by pricking the pointer through the points on the graph with any sharp-pointed instrument such as a needle or an awl.

e. After the points have been transferred to the pointer, remove the graph paper. With a pencil, connect the marked points with straight lines.

f. With a sharp knife or scissors, cut the pointer along that line. A pointer so cut is shown in figure 129.

g. Cut out the window in the pointer (fig. 118).

h. Carefully cut out the circular section, figure 217.

i. Assemble the pointer on the exact center of this circular scale with a nut, bolt, and flat washers. This completes the preparation of the slide rule to include the correction for the goniometer zero shift. A slide rule prepared only from the data obtained from table II is shown in figure 118.

3. Use

Refer to chapter 2, section III, paragraph 81*b* for the correct use of this special slide rule.

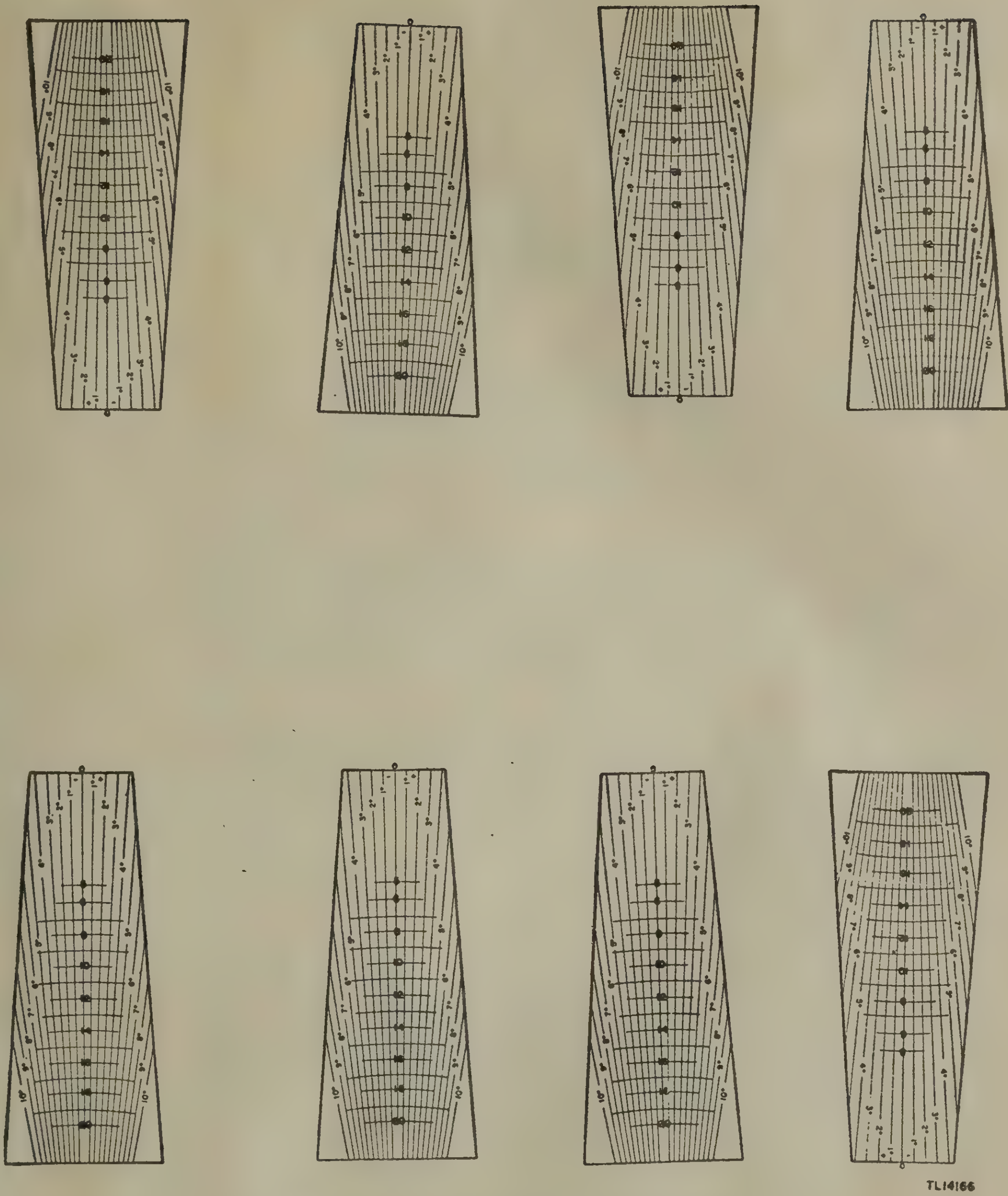


Figure 215. Zero shift correction graph paper.

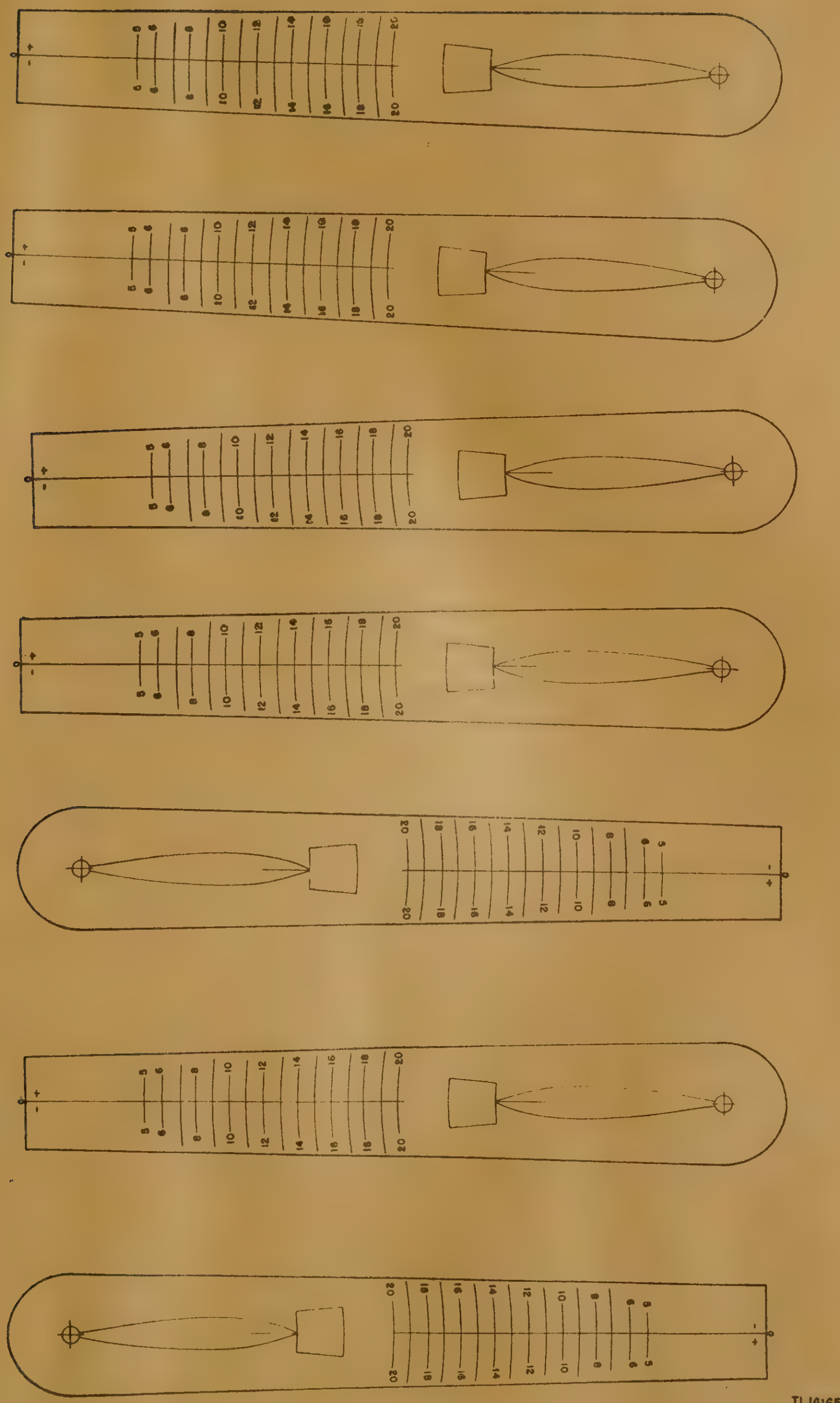


Figure 216. Pointer for circular slide rule.

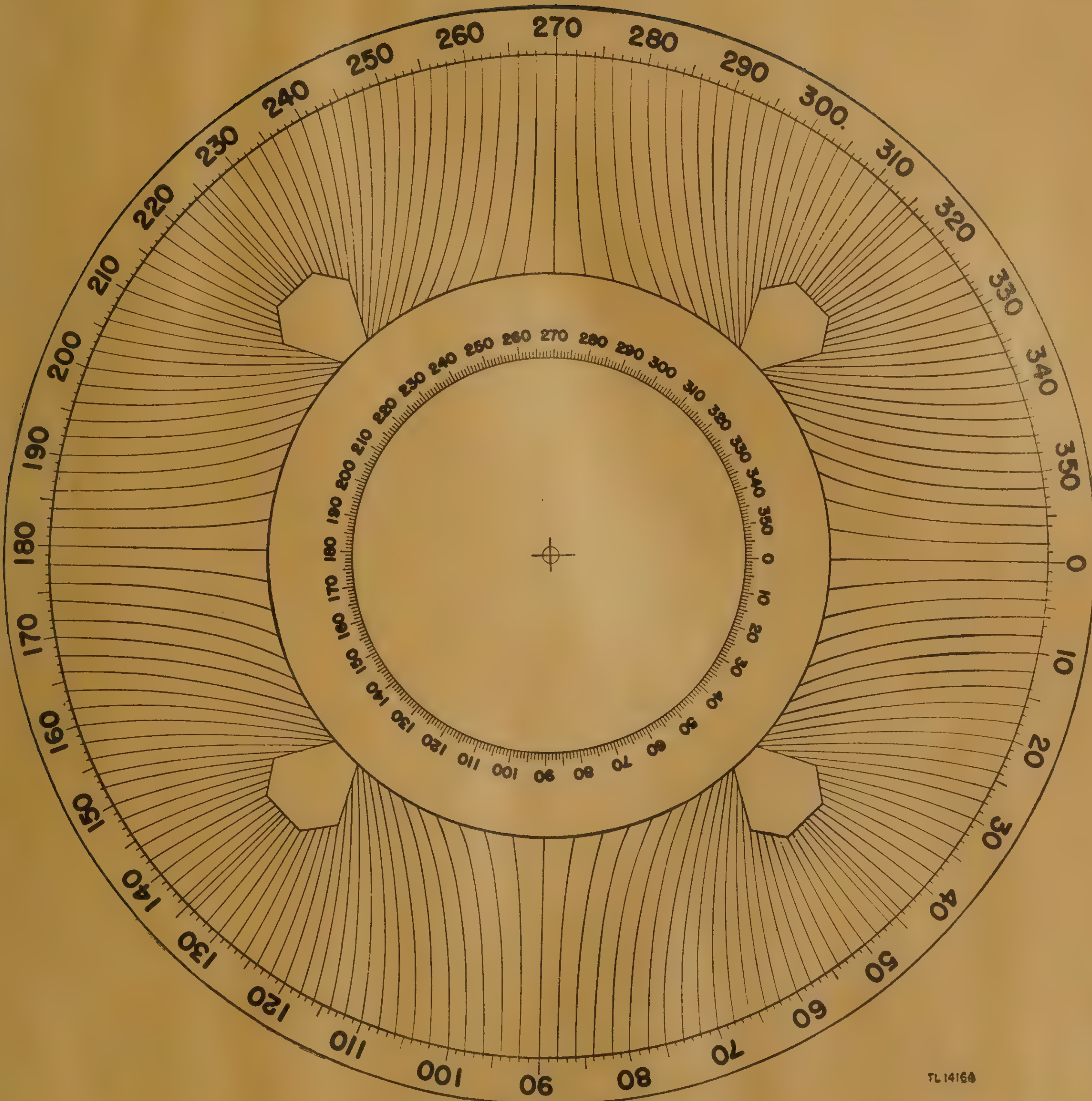


Figure 217. Base for circular slide rule.

Figure 218. Sample plotted graph of goniometer zero shift.

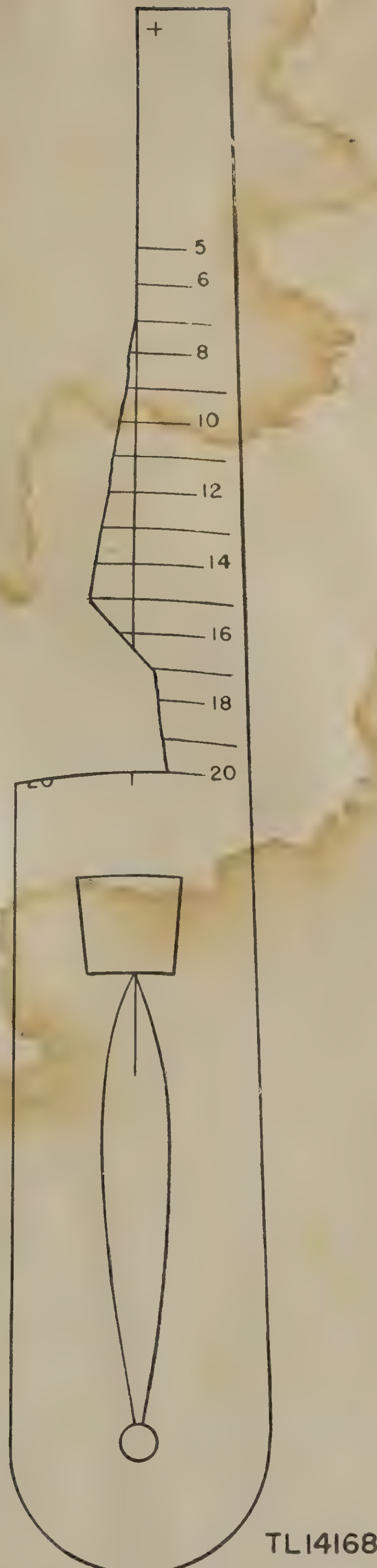


Figure 219. Sample slide rule pointer.

G

HO-19-

20-()

U. S. GOVERNMENT PRINTING OFFICE: 1949—843134

SCHIELD BANTAM CO., INC

Part No. 450-H-43