TM 11-514

DEPARTMENT OF THE ARMY TECHNICAL MANUAL

RADIO SET AN/CRD-2

DEPARTMENT OF THE ARMY · FEBRUARY 1950

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WARNING

HIGH VOLTAGE

is used in the operation
of this equipment.

DEATH ON CONTACT

may result if personnel fail
to observe safety precautions.

When working on or near this equipment, be careful not to contact high-voltage connections on the interior of the components or 115-volt connections. When working inside the equipment, after the power has been turned off, always short-circuit the high-voltage capacitors.

EXTREMELY DANGEROUS POTENTIALS

exist in the following components:
- Modulating Voltage Generator O–15/CRD–2
- Radio Receiver R–127/CRD–2
- Bearing Indicator ID–64/CRD–2
- Junction Box J–95/CRD–2

CONTENTS

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,

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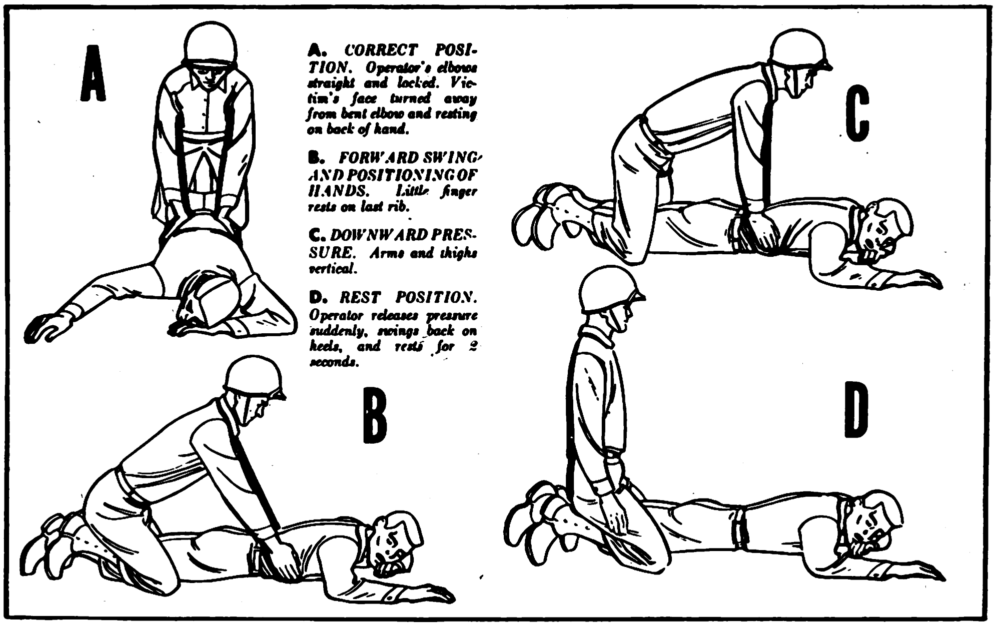

A. *CORRECT POSITION. Operator's elbows straight and locked. Victim's face turned away from bent elbow and resting on back of hand.*

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

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

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

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, 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 seconds for a complete cycle. Until the operator is thoroughly familiar with the correct cadence

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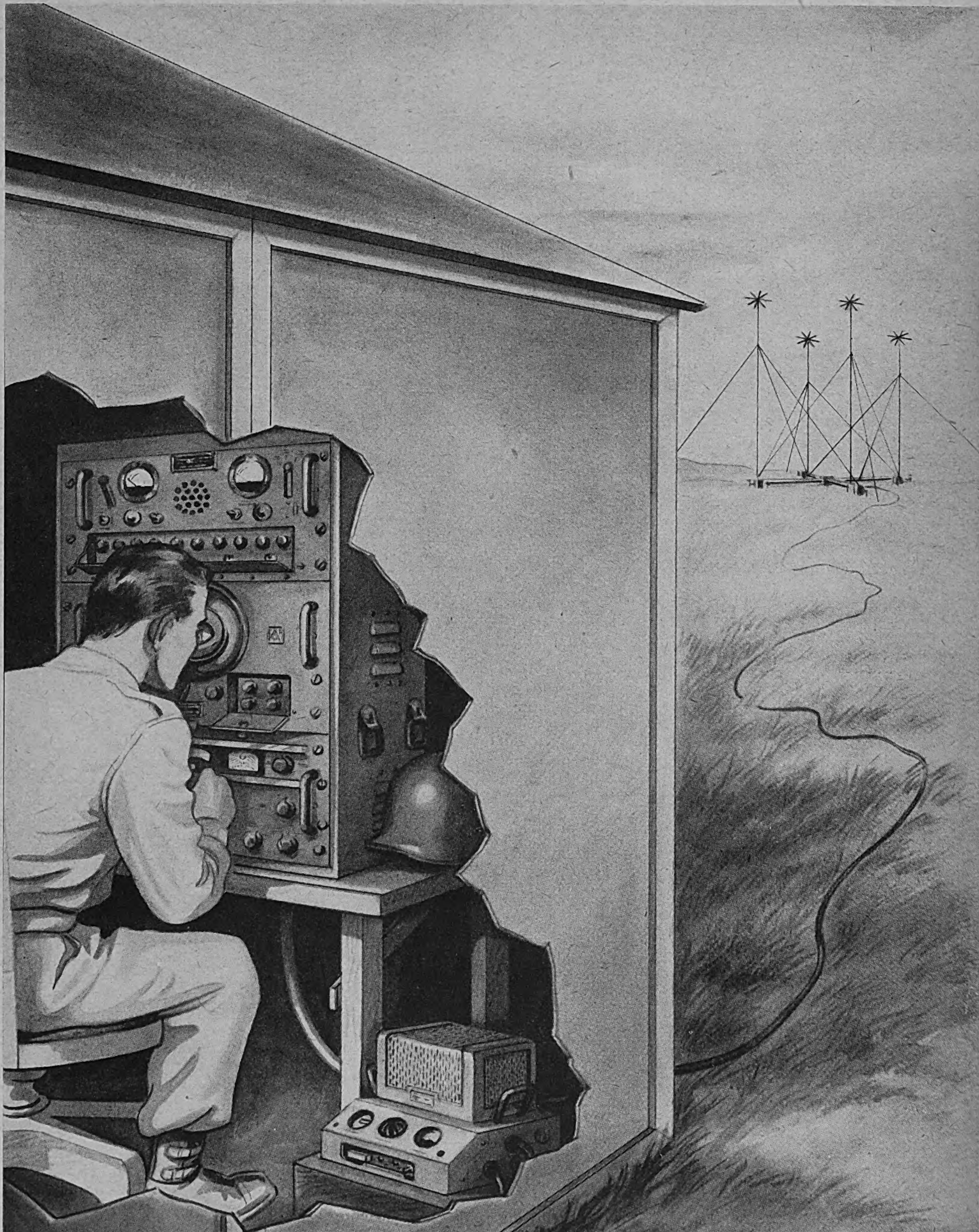


Figure 1. Radio Set AN/CRD-2.

This manual supersedes TB 11-514-1, 18 March 1948

CHAPTER I
INTRODUCTION

Section I. GENERAL

1. Scope

This technical manual is written for the instruction and guidance of personnel operating, maintaining, or handling Radio Set AN/CRD-2. It contains a general description, installation and operation instructions, maintenance and trouble-shooting data, circuit theory, repair procedures, and shipping and storage information. There are two appendixes, one containing reference literature, and the other an identification table of parts.

2. Forms and Records

The forms listed below are used in reporting receipt, operation, and maintenance of the equipment. Use other forms and records as authorized.

NME Form 6, Report of Damaged or Improper Shipment.

DA AGO Form 468, Unsatisfactory Equipment Report.

AF Form 54, Unsatisfactory Report.

a. NME FORM 6 (REPORT OF DAMAGED OR IMPROPER SHIPMENT FOR EQUIPMENT USED BY THE ARMY). NME Form 6 will be filled out and forwarded in accordance with AR 700-30 or AFR 67-5, when equipment is received in a damaged condition or when it is necessary to report unsatisfactory preservation, packaging, packing, marking, loading, unloading, and handling of supplies.

b. DA AGO FORM 468 (UNSATISFACTORY EQUIPMENT REPORT FOR EQUIPMENT USED BY THE ARMY). DA 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.

c. 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 II. DESCRIPTION AND DATA

3. Purpose and Use

Radio Set AN/CRD-2 (fig. 1) is an air-transportable, ground station radio direction finder which consists of a fixed oriented antenna array, an electronic goniometer, a highly sensitive radio receiver, a visual bearing indicator, an aural-null indicator, a modulating voltage generator, a power distribution unit, and other associated equipment.

a. Through the use of this equipment, the azimuth angle of arrival of a radio wave at the antenna system, with respect to magnetic north or some other reference direction, can be determined. Thus, bearing information is obtained on practically any radio transmitter from which signals can be received.

b. During actual operation, instantaneous visual bearing indications in the form of a propeller-shaped pattern on the screen of a cathode-ray tube are displayed as fast as the receiver can be tuned to various signals. Thus, bearings may be taken on practically all kinds of signals, even those of extremely short time duration.

c. The frequency range of the equipment is from 0.54 to 30 mc (megacycles).

d. In addition to visual bearing indications, aural-null bearings also may be taken.

e. The use of one Radio Set AN/CRD-2 enables a determination of only the direction or bearing of a radio transmitter. However, through the use of two or more of these sets, the approximate location of the radio transmitter can be found.

f. This radio direction finder, along with other similar equipment, is used extensively as an aid to navigation and as a source of signal intelligence.

(1) As navigational devices, radio direction finding equipments are used either alone or in combination with radio communication systems, depending upon the service which is to be provided. Such services include the positioning, controlling, and homing of ground, sea, and air forces. Radio direction finders also play an essential part in the air-sea rescue service.

(2) The increased use of radio in military communications has increased the value of radio direction finders in furnishing signal intelligence. Even if the enemy is careful, his transmissions by radio can be intercepted and the location of his transmitter determined.

4. Application of Equipment

A simplified block diagram of the radio set, showing the relationships of the various components, is given in figure 2. Briefly, the equipment functions are as follows:

a. An incoming radio wave, in sweeping across the antenna system, induces r-f (radio-frequency) voltages in each of four antenna elements. These induced voltages then pass through an "electronic goniometer" circuit and are combined to produce a single, modulated r-f wave which is fed to the radio receiver.

b. The receiver amplifies and detects the modulated wave in order to produce an l-f (low-frequency) signal with amplitude and waveshape suitable for bearing indicator operation.

c. The bearing indicator has two signal inputs: the signal from the receiver and a synchronizing voltage from the modulating voltage generator. These two signals are so combined in the circuits of the indicator that an instantaneous visual display is produced on the screen of a cathode-ray tube in the form of the propeller-shaped pattern of illumination. The location of the tips of the propeller are used for bearing determination. However, since there

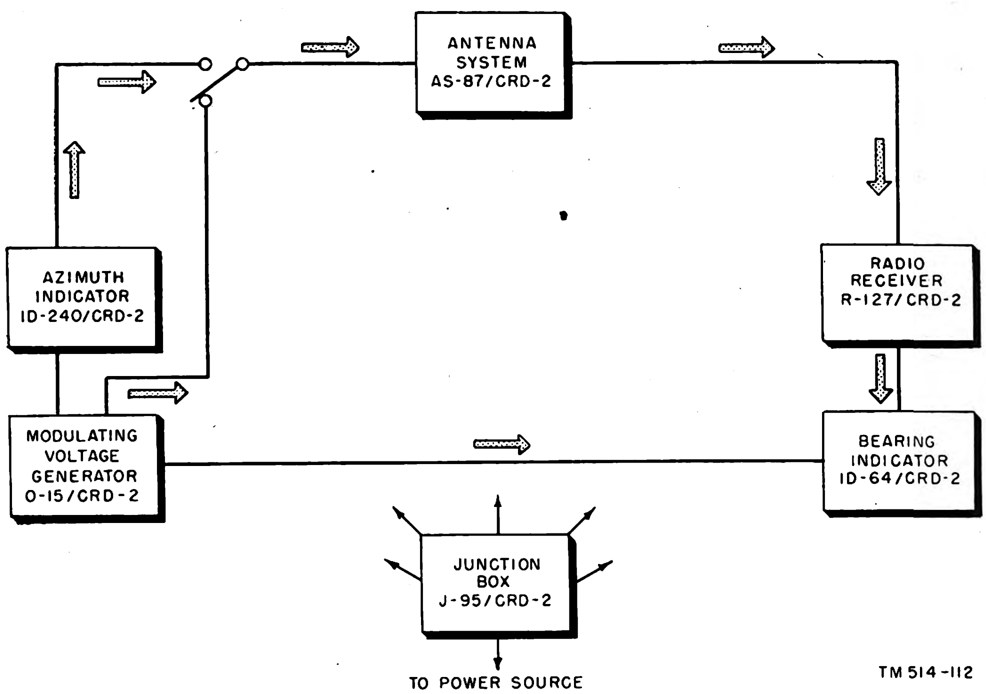
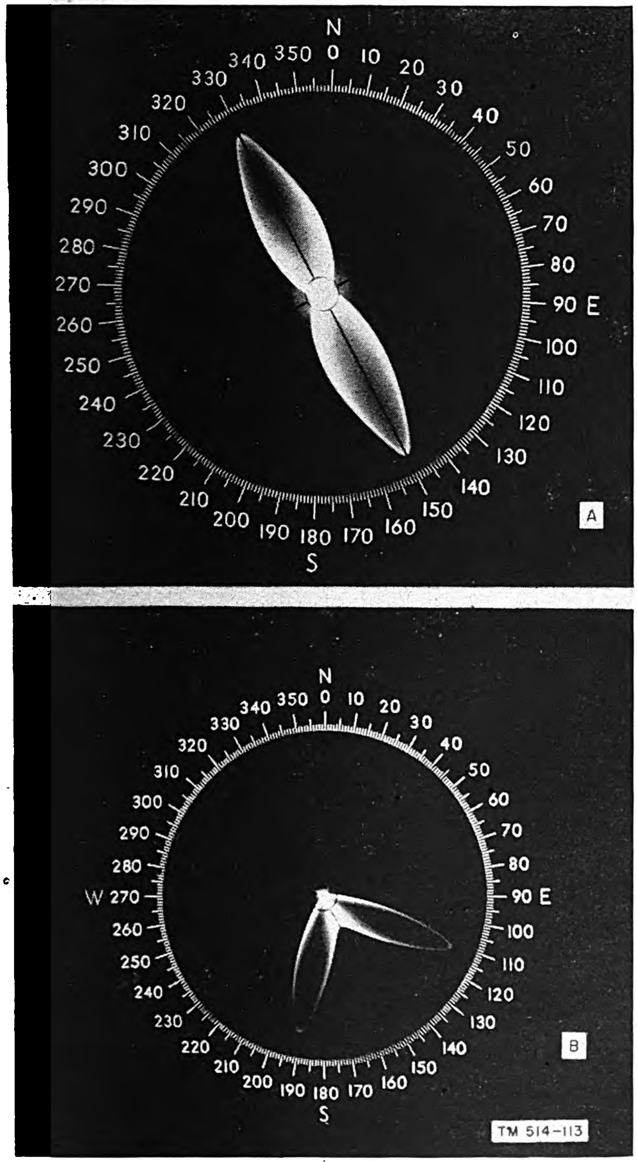


Figure 2. Radio Set AN/CRD-2, simplified block diagram.

are two propeller tips and either tip may indicate the true bearing, sense circuits are added to the equipment in order to resolve ambiguity; that is, to indicate which tip is the true bearing and which is the reciprocal bearing. The pattern on the screen of the cathode-ray tube for sense operation is, of necessity, different from that obtained during bearing operation. (See fig. 3.)

d. When aural-null indication is desired instead of instantaneous visual indication, the azimuth indicator can be switched into operation. The azimuth indicator is manually operated and is used in conjunction with the aural response of the speaker.



A. Typical bearing pattern
B. Typical sense pattern
Figure 3. Cathode-ray tube presentations.

e. The junction box provides a means of distributing the 115/230-volt, 50/60-cycle, a-c (alternating current) power to the various components of the radio set.

5. Technical Characteristics

Frequency range	0.54 to 30 mc.
Antenna system	Four-element spaced collector.
Types of signals received	A-m (amplitude-modulated), f-m (frequency-modulated), and c-w (continuous-wave).
Bearing indication	Visual or aural-null.
Visual pattern	See figure 3.
Range of electronic orientation	± 50°.
Instrumental accuracy	Error (for vertical polarized waves) does not exceed 2°.
Octantal error	Varies with frequency and antenna spacing (fig. 47).
Receiver audio output	2.5 watts.
Input power	500 watts from 115/230-volt, 50/60-cycle source.
Number of tubes	59.
Weight, in chests and crates	3,208 pounds.

6. Packaging Data

a. Domestic. For domestic shipment, Radio Set AN/CRD-2 is packed in 12 crates and chests, as shown in the following chart (fig. 17):

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

Quantity	Item	Dimensions (in.)			Approximate volume (cu ft)	Approximate weight (lb)
		Length	Depth	Height		
1	Chest CY-357/CRD-2	29¾	30¼	29⅛	16.5	257
1	Chest CY-358/CRD-2	25	26½	22½	8.7	298
1	Chest CY-359/CRD-2	98½	18½	14	14.9	373
1	Chest CY-360/CRD-2	98½	18½	14	14.9	387
1	Chest CY-361/CRD-2	98	14⅝	9¾	8.1	207
1	Chest CY-362/CRD-2	38¾	26½	27⁷⁄₁₆	16.4	463
1	Chest CY-363/CRD-2	72⅞	24	13¾	14.1	385
1	Chest CY-364/CRD-2	25⁹⁄₁₆	15⅞	20¼	4.8	146
1	Chest CY-365/CRD-2	105⅛	18¼	10	10.1	333
2	Reel Assembly RL-125/CRD-2	32	21¹³⁄₁₆	32	13.1	343
1	Chair (swivel)	39	23½	25½	13.6	16

b. EXPORT. For export shipment, the chests and crates listed above are placed in moisture-proof-vaporproof containers and then in export shipping boxes (figs. 4 and 5). The total weight of Radio Set AN/CRD-2, when packed for export shipment, is 5,599 pounds, and the total volume is 327 cubic feet.

7. Table of Components

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

The components of Radio Set AN/CRD-2 are listed according to the units in which they are packed, as follows:

Packing unit	*Contents*
Chest CY-357/CRD-2	2 antenna support assemblies, each including:
	1 Antenna Support AB-64/CRD-2
	1 Antenna Coupling Unit CU-34/CRD-2, including 3 Tubes JAN-6AC7
	1 junction box assembly, including:
	1 Junction Box J-96/CRD-2
	1 Voltage Distribution Unit J-59/CRD-2
	1 Coupling Unit CU-69/CRD-2
	1 Coupling Unit CU-68/CRD-2

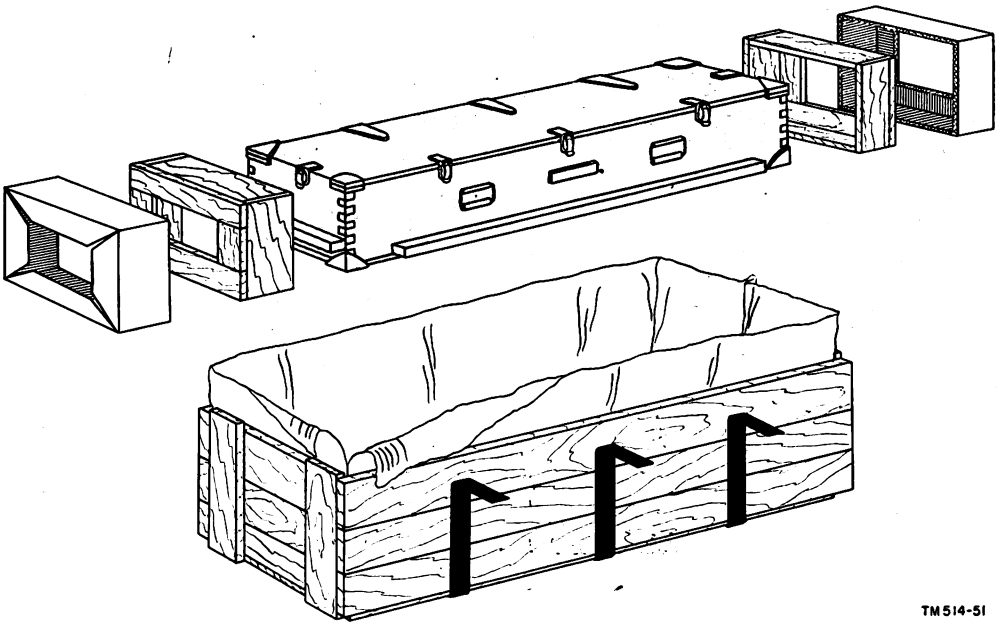


Figure 4. Typical packaging for export shipment, long chest.

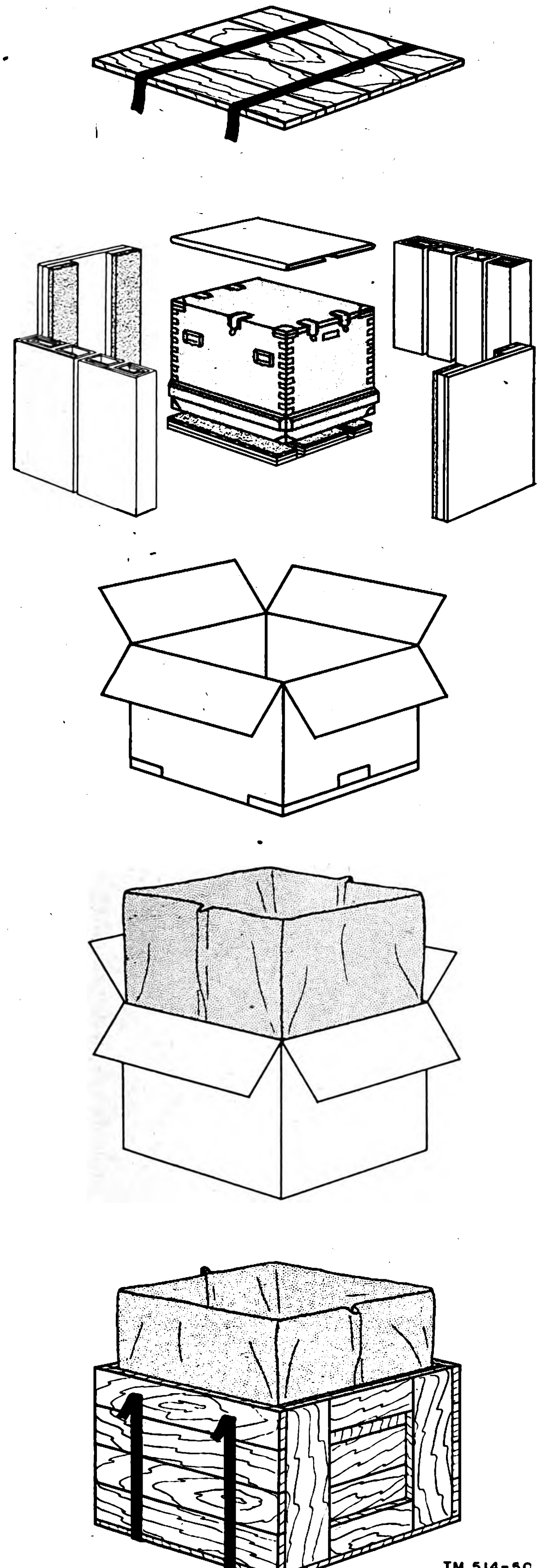

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Figure 5. Typical packaging for export shipment, short chest.

Packing unit	Contents
Chest CY-358/CRD-2	2 Antenna support assemblies, including:
	1 Antenna Support AB-64/CRD-2
	1 Antenna Coupling Unit CU-34/CRD-2, including: 3 Tubes JAN-6AC7
	16 legs, adjustable, long (4 spares)
	3 legs, adjustable, short (1 spare)
	4 plug assemblies, long (spares)
	2 plug assemblies, short (spares)
	14 grounding straps (6 spares)
Chest CY-359/CRD-2	4 supports MT-333/CRD-2
	4 Cords CG-240/CRD-2 (9 ft, 8 in., green)
	4 Cords CG-240/CRD-2 (9 ft, 8 in., red)
	4 Cords CG-240/CRD-2 (9 ft, 8 in., no code) (spares)
	6 Cords CX-455/CRD-2 (9 ft, 8 in., no code) (2 spares)
	10 Stakes GP-2 (modified) (2 spares)
	5 Antenna Skirts MX-849/CRD-2 (1 spare)
Chest CY-360/CRD-2	5 Mast Sections AB-60/CRD-2 (¾ in. diam, approx 71 in. long) (1 spare)
	4 Supports MT-333/CRD-2
	4 Cords CG-240/CRD-2 (17 ft, 2 in., green)
	4 Cords CG-240/CRD-2 (17 ft, 2 in., red)
	4 Cords CG-240/CRD-2 (17 ft, 2 in., no code) (spares)
	6 Cords CX-455/CRD-2 (17 ft, 2 in., no code) (no spares)
	14 guy line assemblies (2 spares)
Chest CY-361/CRD-2	5 Mast Sections AB-61/CRD-2 (⅞ in. diam, approx 94 in. long) (1 spare)
	5 Mast Sections AB-62/CRD-2 (1 in. diam, approx 94 in. long) (1 spare)

Packing unit	*Contents*
	5 Mast Sections AB-63/CRD-2 (1¼ in. diam, approx 95 in. long) (1 spare)
Chest CY-362/CRD-2	1 rack assembly, including:
	1 Rack MT-332/CRD-2
	1 Radio Receiver R-127/CRD-2, including:
	2 Tubes JAN-6H6
	2 Tubes JAN-6J5
	1 Tube JAN-6K6
	1 Tube JAN-6SA7
	6 Tubes JAN-6SG7
	1 Tube JAN-6SJ7
	1 Tube JAN-6SN7
	1 Tube JAN-5Y3
	1 Tube JAN-OD3/VR150
	1 Bearing Indicator ID-64/CRD-2, including:
	1 Alidade Scale Assembly MX-316/CRD-2
	5 Tubes JAN-6AC7
	2 Tubes JAN-6B4
	1 Tube JAN-6L6
	1 Tube JAN-6SA7
	3 Tubes JAN-6SN7
	1 Tube JAN-6SQ7
	1 Tube JAN-5R4
	1 Tube JAN-2X2A
	1 Tube JAN-5CP1
	1 Tube JAN-OC3/VR105
	1 Tube JAN-OD3/VR150
	1 Modulating Voltage Generator O-15/CRD-2, including:
	2 Tubes JAN-6B4
	2 Tubes JAN-6SL7
	3 Tubes JAN-6SN7
	1 Tube JAN-6SQ7
	1 Tube JAN-5U4
	1 Tube JAN-OC3/VR105
	1 Tube JAN-OD3/VR150
	2 Cords CG-237/CRD-2 (14 in., no code) (1 spare)
	2 Cords CG-238/CRD-2 (12 in., no code) (1 spare)
	3 Cords CX-1115/U (2½ ft, no code) (1 spare)
	3 Cords CX-1115/U (10 ft, no code) (1 spare)
	2 Cords CX-638/CRD-2 (2½ ft, no code) (1 spare)
Chest CY-363/CRD-2	1 Radio Transmitter BC-1149-A, including:
	2 antenna rods
	1 tripod
	1 tripod adapter
	1 radio transmitter adapter
	1 Tube JAN-1R5
	1 Tube JAN-3B7/1291
	1 Junction Box J-95/CRD-2
	1 Set of tools, including:
	3 oz oil
	4 oz grease
	1 paint brush (1 in. flat)
	1 paint brush (½ in. flat)
	1 level
	1 tape (50 ft)
	1 pipe wrench (18 in.)
	1 pipe wrench (12 in.)
	1 bulb
	8 oz lacquer (green)
	8 oz lacquer (red)
	16 oz lacquer (fungus-resistant)
	1 kit of wrenches, including:
	1 1/16-in. wrench
	1 5/64-in. wrench
	1 3/32-in. wrench
	1 3/16-in. wrench
	1 5/32-in. wrench
	2 straps (spares for 12-in. wrench)
	2 straps (spares for 18-in. wrench)
	1 Test Set I-56-K
	1 Signal Generator I-72
	1 Tool Equipment TE-41
	1 canvas cover (for Radio Transmitter BC-1149-A)
	38 bag assemblies
	2 technical manuals, TM 11-849 (Radio Transmitter BC-1149-A)
Chest CY-364/CRD-2	1 Antenna Coupling Unit CU-34/CRD-2 (spare), including:
	3 Tubes JAN-6AC7
	1 compass, including:
	1 ball and socket mounting assembly
	1 carrying case
	1 Jack JK-39

Packing unit	Contents
	1 Telephone EE-8-B
	1 Chest Set H-18/GT
	1 Headset HS-29
	1 Cord CD-201
	1 set of spare tubes, lamps, and fuses, including:
	1 Tube JAN-6L6
	2 Tubes JAN-6SA7
	1 Tube JAN-2X2A
	13 Tubes JAN-6AC7
	1 Tube JAN-5CP1A
	5 Tubes JAN-6SN7
	3 Tubes JAN-OC3/VR105
	3 Tubes JAN-OD3/VR150
	2 Tubes JAN-6SQ7
	4 Tubes JAN-6B4
	4 Tubes JAN-5R4
	1 Tube JAN-6SL7
	2 Tubes JAN-6SG7
	1 Tube JAN-6J5
	1 Tube JAN-6H6
	1 Tube JAN-6SJ7
	1 Tube JAN-6K6
	2 Tubes JAN-5Y3
	2 Tubes JAN-1R5
	2 Tubes JAN-3B7/1291
	1 Azimuth Indicator ID-240/CRD-2, including:
	1 Tube JAN-5Y3
	1 Tube JAN-OC3/VR105
	2 Cords CX-1116/CRD-2 (6 ft) (1 spare)
	2 Cords CX-1114/CRD-2 (6 ft) (1 spare)
Chest CY-365/CRD-2	1 Counterpoise MX-313/CRD-2
	36 counterpoise clamps
	18 ground rods (6 ft)
Reel Assembly RL-125/CRD-2	2 Reel Assemblies RL-125/CRD-2, each including:
	1 reel crank
	1 Cord CG-239/CRD-2 (3 cond male and female plugs)
	1 Cord CX-452/CRD-2 (2 cond male and female plugs)
	1 Cord CX-454/CRD-2 (2 cond male and female plugs)
Box	1 chair, swivel

8. Major Components

Radio Set AN/CRD-2 consists of the following major components:

a. Antenna System AS-87/CRD-2, including—

(1) Four vertical antenna masts or monopoles.

(2) Four Antenna Skirts MX-849/CRD-2.

(3) Four Antenna Support AB-64/CRD-2, each containing an Antenna Coupling Unit CU-34/CRD-2.

(4) One Junction Box J-96/CRD-2, containing Voltage Distribution Unit J-59/CRD-2 and Coupling Unit CU-68/CRD-2 or Coupling Unit CU-69/-CRD-2.

(5) Support MT-333/CRD-2 (four or eight in use depending upon operating frequency range).

b. Counterpoise MX-313/CRD-2.

c. Rack MT-332/CRD-2, including—

(1) Radio Receiver R-127/CRD-2.

(2) Modulating Voltage Generator O-15/CRD-2.

(3) Bearing Indicator ID-64/CRD-2.

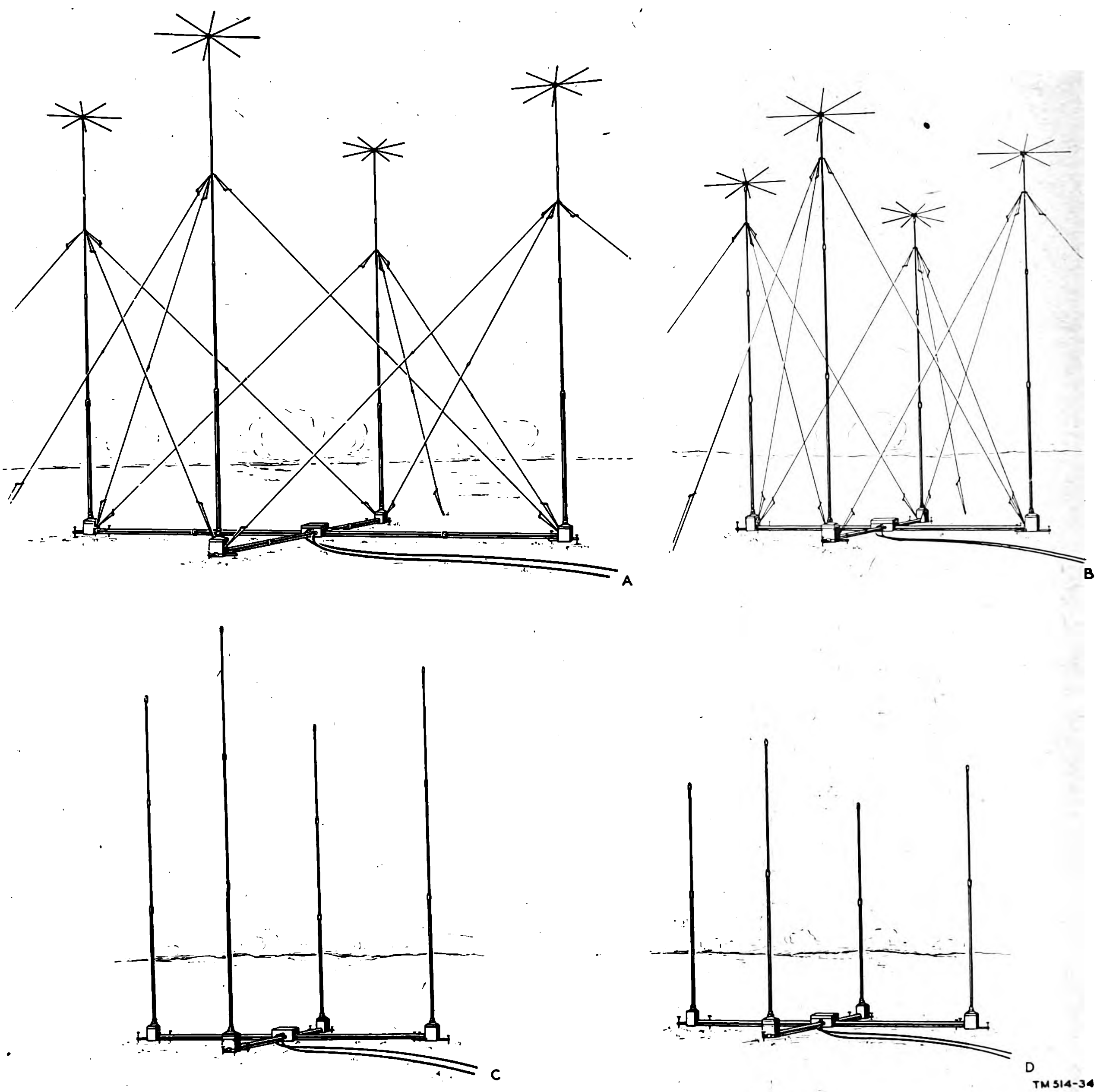
d. Azimuth Indicator ID-240/CRD-2.

e. Junction Box J-95/CRD-2.

9. Description of Antenna System AS-87/CRD-2 and Counterpoise MX-313/CRD-2

a. The four-element, spaced-collector antenna (fig. 6) consists of four vertical monopoles, each of which is mounted on an Antenna Support AB-64/CRD-2. Each monopole consists of a combination of Mast Sections AB-60/CRD-2, AB-61/CRD-2, AB-62/CRD-2, and AB-63/-CRD-2. Antenna Skirt MX-849/CRD-2 is used for top-loading each monopole for optimum performance on the lower frequencies.

(1) Mast Section AB-60/CRD-2 is a ¾-inch diameter, stainless steel tube approximately 71 inches long (fig. 22). A clamping collet at the upper end of this section is used to clamp the section to Antenna Skirt MX-849/CRD-2. A nonremovable collar, 6 inches above the lower end of the section, serves as a stop when this section is coupled to the upper end of Mast Section AB-61/CRD-2.



A. Low-frequency antenna with four monopole sections and skirts.
B. High-frequency antenna with three monopole sections and skirts.
C. High-frequency antenna with three monopole sections.
D. High-frequency antenna with two monopole sections.

Figure 6. Antenna installations.

(2) Mast Section AB–61/CRD–2 is similar to Mast Section AB–60/CRD–2 except that it is made of a 7/8-inch diameter tube approximately 94 inches long (fig. 21) and has a guy clamp fastened to the upper end of the section just below the clamping collet.

(3) Mast Section AB–62/CRD–2 is similar to Mast Section AB–60/CRD–2 except that it is made of a 1-inch diameter, stainless steel tube approximately 94 inches long (fig. 21).

(4) Mast Section AB–63/CRD–2 is a 1¼-inch diameter, stainless steel tube ap-

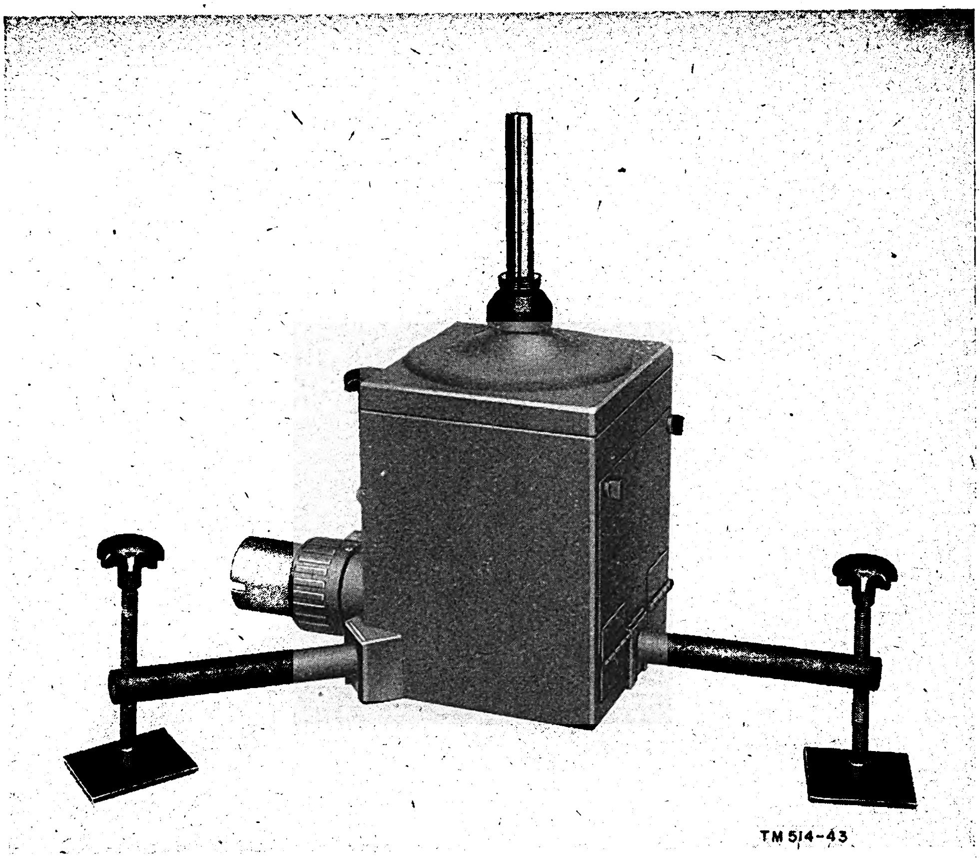


Figure 7. Antenna Support AB–64/CRD–2, mounted on adjustable legs.

proximately 95 inches long (fig. 21). A clamping collet at the upper end of the section is used to clamp the section to Mast Section AB–62/CRD–2. An internally threaded coupling ring is used to attach Mast Section AB–63/-CRD–2 to Antenna Support AB–64/-CRD–2.

(5) Antenna Skirt MX–849/CRD–2 (figs. 22 and 33) consists of eight 3-foot stainless steel rods which are arranged symmetrically about a common axis. The skirt can be mounted to the top of Mast Section AB–60/CRD–2 or AB–61/CRD–2. The antenna skirts are collapsible for shipment or storage purposes.

b. Antenna Support AB–64/CRD–2 (fig. 7) is a weatherproofed metal box which contains Antenna Coupling Unit CU–34/CRD–2. A threaded steel stem, which is mounted on the insulated top of the box, provides a mounting for the monopole. The support also has a male coupling into which the female end of Support MT–333/CRD–2 is threaded. Three separately adjustable legs (long) are provided for each antenna support and are used to level the unit. The interior of the box is reached through a hinged door which is held in place by two thumb-screws.

c. Antenna Coupling Unit CU–34/CRD–2 (fig. 8) is a metal box containing the antenna balanced modulator and associated sense circuits. The top of the box is provided with four metal studs (for mounting the unit to the inside of Antenna Support AB–64/CRD–2) and a banana jack, J–802, for connections to the antenna mast. Receptacles for r-f and power cables, three Tubes JAN–6AC7, and a banana jack for grounding purposes are mounted on the bottom of the box. The output of each antenna coupling unit is connected to either Coupling Unit CU–68/CRD–2 or CU–69/CRD–2 through two coaxial interconnecting r-f cables.

d. Support MT–333/CRD–2 (fig. 21) is a 3-

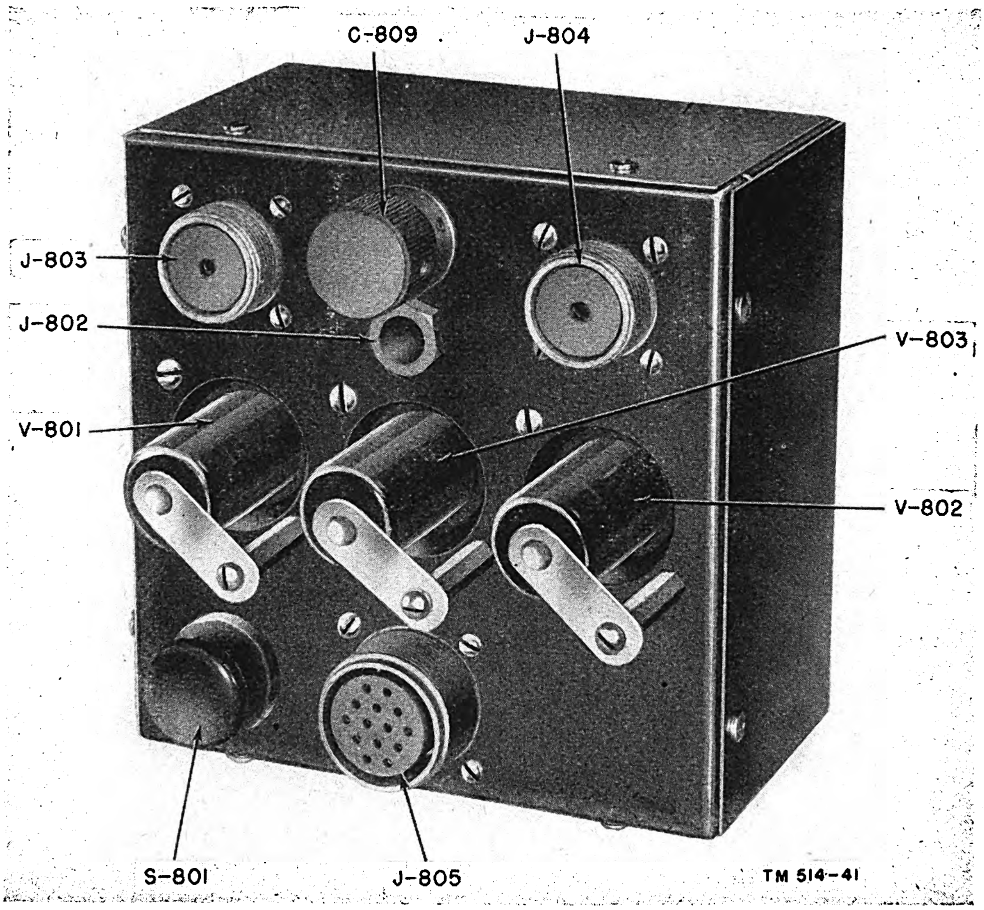


Figure 8. Coupling Unit CU–34/CRD–2, removed from Antenna Support AB–64/CRD–2.

inch diameter steel tube approximately 8 feet long. One end of the support is threaded and connects to Antenna Support AB–64/CRD–2; the other end is equipped with an internally threaded collar and connects to Junction Box J–96/CRD–2 or to another Support MT–333/CRD–2.

e. Junction Box J–96/CRD–2 (fig. 21) is a weatherproofed steel box which contains Voltage Distribution Unit J–59/CRD–2. On top of the distribution unit are a filament transformer, a number of receptacles, and a sliding ring clamp for Coupling Unit CU–68/CRD–2 or CU–69/CRD–2. The coupling unit serves as a combination impedance for the outputs of Antenna Coupling Units CU–34/CRD–2. The distribution unit is shipped with the l-f (0.54 to 6 mc) Coupling Unit CU–68/CRD–2 (fig. 9) installed. For operation in the h-f (high-frequency) range this coupling unit should be replaced with Coupling Unit CU–69/CRD–2. The distribution unit is fastened in Junction Box J–96/CRD–2 by four screws. Two adjustable legs (short) are used to level the box.

f. Counterpoise MX–313/CRD–2 (fig. 19) is approximately 75 feet square when unfolded and placed directly on the ground in a clear area. It consists of nine 75- by 8-foot sections of 18-inch mesh constructed of No. 12 gage stranded tinned copper wire. Each section has an 8-foot wooden piece at each end. The nine sections are joined to one another by strips of ¼-inch tinned copper braid. The counterpoise is secured to the ground by metal clamps which fit over the wooden end pieces. For packing purposes, the nine sections are folded over one another toward the center section, forming one pile 75 feet long by 8 feet wide. This pile then is rolled from each end toward the center, tied, and placed in Chest CY–365/CRD–2.

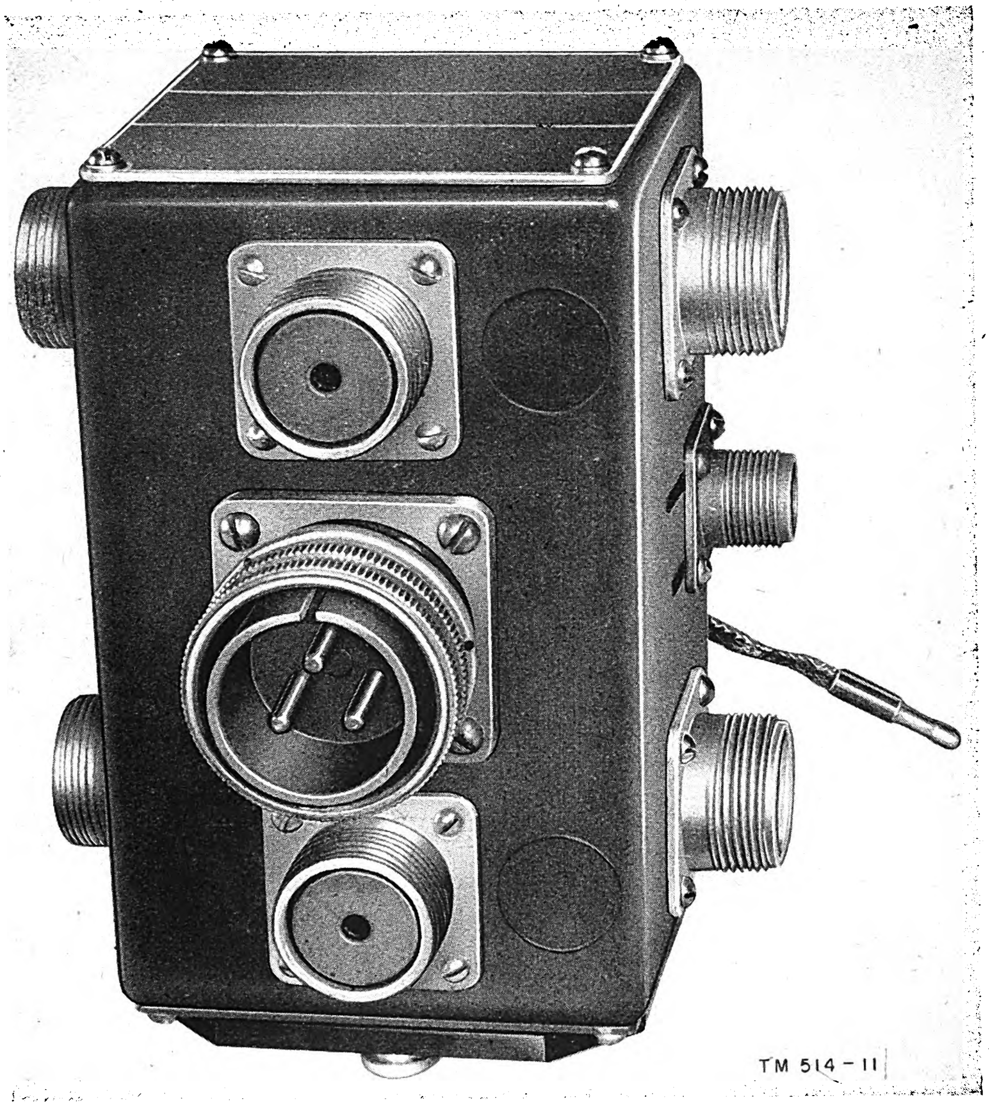


Figure 9. Coupling Unit CU–68/CRD–2, removed from Voltage Distribution Unit J–59/CRD–2.

10. Description of Rack MT–332/CRD–2 and Its Major Components

Rack MT–332/CRD-2 (fig. 10) is a reinforced steel frame approximately 21 inches wide, 33½ inch high, and 20 inches deep. It is designed for vehicular as well as for ground installation and provides adequate shock mounting for the components. The rear of the rack is screen-protected, except for the rear apron. The following items are mounted in the rack: Radio Receiver R–127/CRD–2, Bearing Indicator ID–64/CRD–2, and Modulating Voltage Generator O–15/CRD–2. Shock mounts for vehicular installation also are stored in the rack.

a. Radio Receiver R–127/CRD–2 (fig. 11) is a six-band, superheterodyne receiver covering the frequency range 0.54 to 32 mc. The radio receiver components, including 16 tubes, are mounted on a steel chassis. All switches, controls, two dials, nameplate, and a phone jack are mounted on the front panel. The power input receptacle, a bearing indicator output connector, an antenna input connector, and headphone and speaker terminal boards are located at the rear. The radio reecivver fits in the bottom of Rack MT–332/CRD–2 and is held in place with eight thumbscrews. A carrying handle is provided at each end of the front panel. The receiver amplifies and rectifies the resultant output of the antenna system, thus producing proper input voltage to the bearing

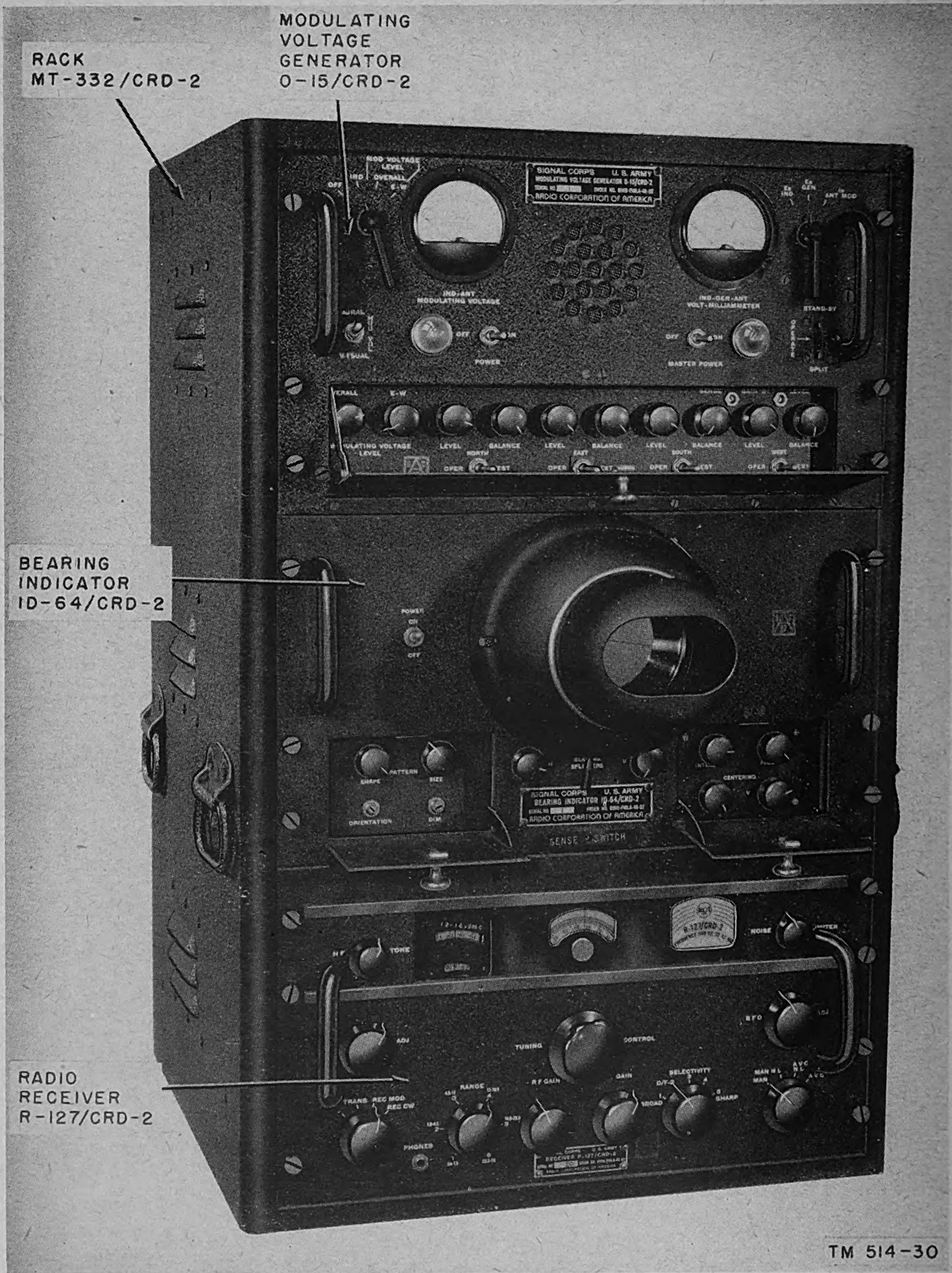


Figure 10. Rack MT–332/CRD–2, components installed.

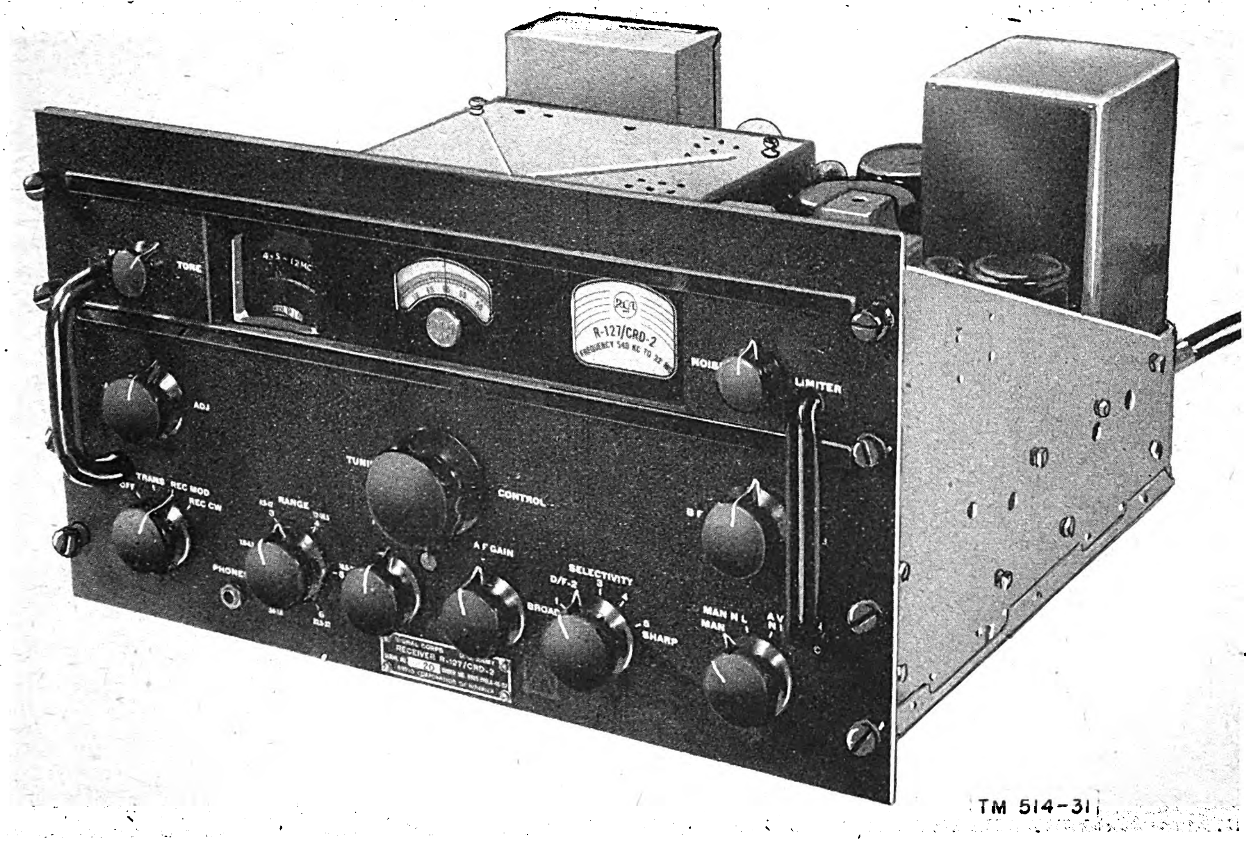


Figure 11. Radio Receiver R–127/CRD–2.

indicator control circuits. The receiver also has conventional bfo (beat-frequency oscillator) and audio circuits, with provision for loudspeaker and phone operation, stand-by service, and simultaneous aural monitoring while taking bearings.

Note. The nomenclature "Radio Receiver R–127/CRD–2," as used in this manual, and "Receiver R–127/CRD–2," as shown on the nameplate for this component, both refer to the same equipment Radio Receiver R–127/CRD–2.

b. Modulating Voltage Generator O–15/-CRD–2 (fig. 12) consists of a chassis assembly complete with 11 tubes and a control panel. The operating switches, controls, nameplate, and loudspeaker are mounted on the control panel. Three a-c receptacles, one a-c output connector, one 20-conductor cable connector, one synchronizing voltage connector, and one loudspeaker input connector are attached to the rear of the chassis. The modulating voltage generator mounts at the top of Rack MT–332/CRD–2 and is held in place with six thumbscrews. A carrying handle is provided at each end of the front panel. This unit serves as the source of the modulating voltage and also contains the metering and control circuits for the various voltages and currents applied to the antenna system.

c. Bearing Indicator ID–64/CRD–2 (fig. 13) consists of a chassis assembly complete with 18 tubes, including a 5-inch cathode-ray tube, and a control panel. The operating controls, switches, nameplate, and alidade scale assembly (with removable shield) are mounted on the control panel. One a-c receptacle, one auxiliary connector (unused), one bearing indicator channel input connector, and one synchronizing voltage connector are on the rear of the chassis. The bearing indicator fits into the center of Rack MT–332/CRD–2 and is held in place with six thumbscrews. A carrying handle is provided at each end of the front panel. The controls permit electronic orientation of the antenna system, sense determination, and

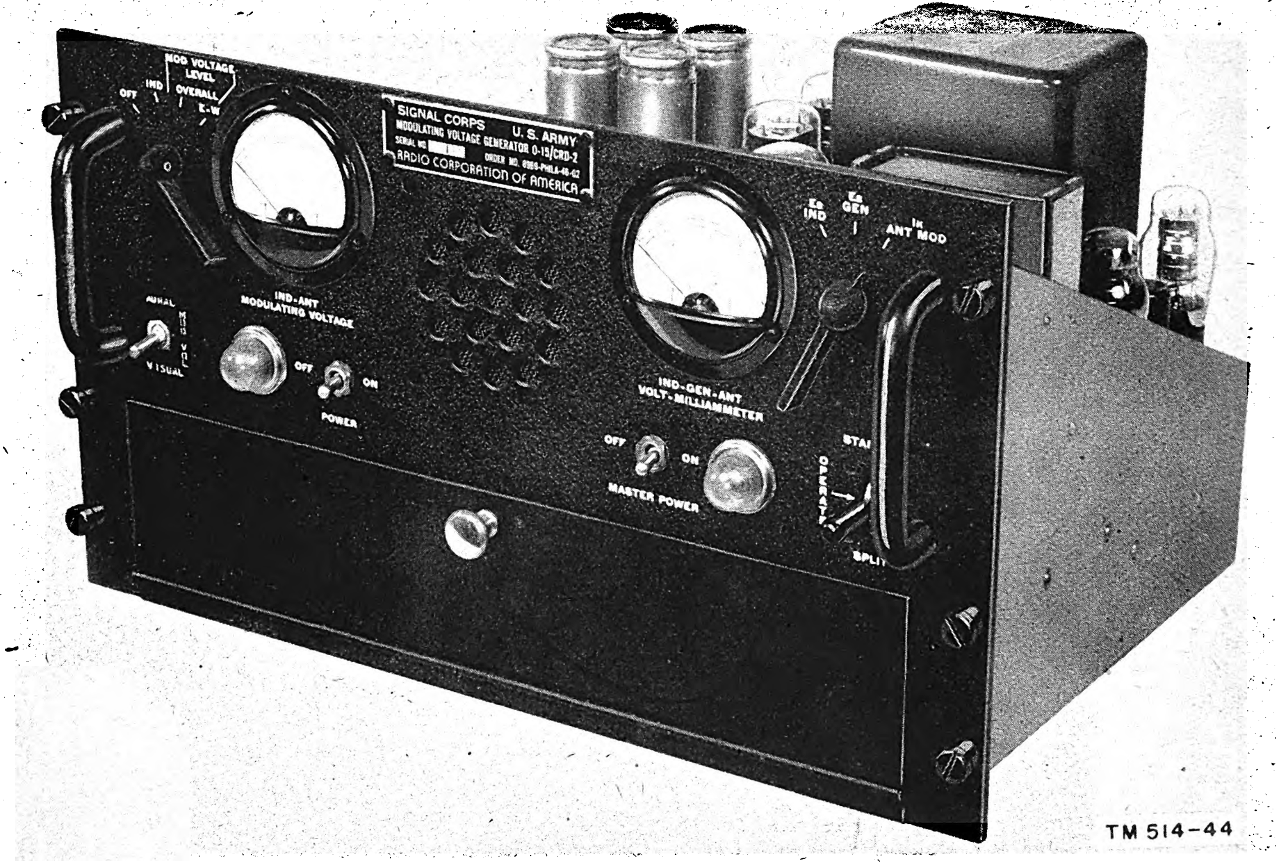


Figure 12. Modulating Voltage Generator O–15/CRD–2.

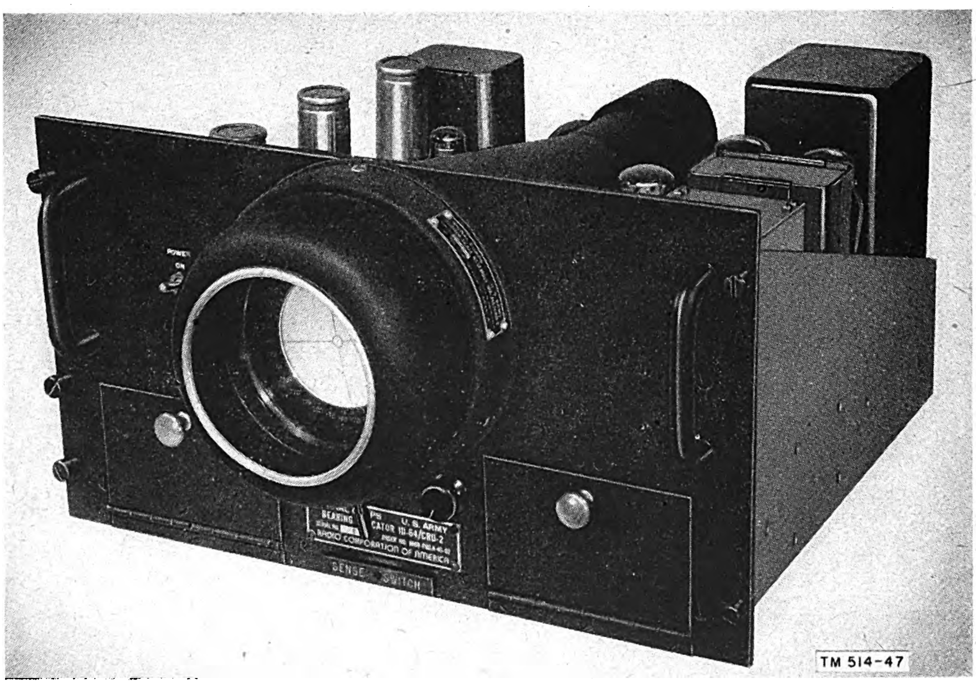


Figure 13. Bearing Indicator ID–64/CRD–2.

Figure 14. Azimuth Indicator ID–240/CRD–2.

proper adjustment of the cathode-ray tube voltages. The visual bearing indications appear in the form of a propeller-shaped pattern on the cathode-ray tube (A, fig. 3).

d. Azimuth Indicator ID–240/CRD–2 (fig. 14) is an aural-null indicator which consists of a metal chassis assembly, a control panel, a two-tube power supply, and a sine-wave potentiometer. All components are inclosed in a metal cabinet for table mounting. The VISUAL-AURAL and aural-null SENSE switches, two potentiometers, an azimuth dial (coupled to the sine-wave potentiometer), the nameplate, and two carrying handles are mounted on the control panel. The chassis and control panel are held to the cabinet by means of four thumbscrews. Four circular holes in the cabinet provide access to the four cable connectors (2 for 20-conductor cable, 2 for 2-conductor cable) attached to the rear of the chassis. Four shock mounts are mounted on the bottom of the aural-null adapter assembly.

e. Junction Box J–95/CRD–2 (fig. 15) is used as a control and distribution point for the main power source. It is a metal box which contains one autotransformer, load resistors, meters, and switches. The indicating meters and control switches are located in two recessed panels. One 115-volt a-c input connector and one 230-volt a-c input connector are attached to another side of the box. Two carrying handles are provided.

11. Description of Minor Components and Running Spares

In addition to the major components described in paragraph 10, many other minor components and running spares are included

Figure 15. Junction Box J–95/CRD–2.

with each Radio Set AN/CRD–2. These are used for purposes of installation, orientation, operation, maintneance, trouble shooting, and repair.

a. RADIO TRANSMITTER BC–1149–A (fig. 16). This transmitter is a self-contained, two-tube, four-band, battery-operated portable unit which emits a low-power c-w or icw (interrupted continuous wave) signal. The unit can be used as a target transmitter or signal source for calibrating and checking the operation of Radio Set AN/CRD–2. TM 11–849 covers this transmitter. As supplied with Radio Set AN/CRD–2, the transmitter is complete with two antenna rods, a tripod, a tripod adapter, two sparetubes, and a canvas cover.

b. CORDS. Many cords, as listed in the table of components (par. 7), are supplied with the equipment. These cords are used for electrical connection of various major components.

c. GROUNDING STAKES AND STRAPS. Grounding stakes and straps, used at various locations in the area of the radio set, are supplied with the equipment (par. 7).

d. COMPASS. For purposes of orienting the radio set during installation, a compass, a ball

Figure 16. Radio Transmitter BC–1149–A, mounted on tripod.

and socket mounting assembly, and a carrying case are furnished.

e. OPERATOR'S CHAIR. A chair for the operator is furnished with the radio set.

f. SPARE TUBES. Over 50 spare tubes of various types are furnished as running spares; see list in paragraph 7.

g. OTHER COMPONENTS. In addition to the parts described above, the radio set also has a Headset HS–29, a Chest Set H–18/GT, a Telephone EE–8–B, a Jack JK–39, 38 bag assemblies, guy lines for supporting the antenna monopoles, and technical manuals.

12. Description of Tools and Test Equipment

a. TOOLS. A complete set of tools for installing and repairing the radio set is included with the equipment. Included are wrenches, a level, tape, Tool Equipment TE–41, lacquer, brushes, grease, and lubricating oil.

b. TEST EQUIPMENT. One Signal Generator I–72 and one Test Set I–56–K, used when servicing the equipment, are packed in Chest CY–363/CRD–2.

CHAPTER 2

OPERATING INSTRUCTIONS

Section I. SERVICE UPON RECEIPT OF MATÉRIEL

13. Site Selection

Note. The following information is supplied to aid in selecting the optimum site for Radio Set AN/CRD-2. The accuracy of results definitely is related to the location of any direction-finding equipment; therefore, be extremely careful in choosing the site.

a. VISUAL INSPECTION.

(1) The site area should be substantially flat for at least 150 yards from the center of the antenna system with not more than a gentle slope for several times that distance.

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

(3) Mountainous or hilly country should be avoided.

(4) The antenna system should be as far inland as possible from the shore line or large bodies of water. If the installation must be made on or near the coast, the flattest area should be selected and the antenna site chosen so that signals from the target area cross the coast line at right angles.

(5) The earth surrounding the antenna system should have uniformly high conductivity and moisture content. Areas uniformly covered with grass or vegetation usually meet this requirement. Rocky or sandy soil has low conductivity; however, an area with *uniform* low conductivity is preferable to an area of high conductivity which is spotted with rock, sand, or varying moisture content.

(6) Regions having abrupt discontinuities of the earth should be avoided. This usually indicates the presence of rock or mineral outcroppings, or underground streams.

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

(8) Listed below are recommended distances to be maintained between the antenna system and various obstructions to minimize their effect on the accuracy of bearings.

Obstruction	*Distance to be maintained*
Scattered trees and single, small buildings	300 yards.
Wire fences	200 yards.
High cliffs and deep ravines	More than 1 mile.
Buried metallic conductors (other than telephone lines to Radio Set AN/CRD-2)	300 yards.
Chimney stacks and water towers	500 yards.
Overhead conductors and railroad tracks (power and telephone lines and antennas)	500 yards.
Rivers, streams, and lakes	600 yards.
Forests and metal structures	500 to 1,000 yards.
Mountains	5 to 25 miles.

b. ELECTRICAL INSPECTION. After the most favorable area has been selected by visual inspection, it is desirable to make the electrical tests specified in paragraph 95 of TM 11-476.

14. Site Preparation

a. LOCATION OF ANTENNA SYSTEM. Clear and level off an area about 75 feet square for erection of the antenna system and counterpoise.

b. LOCATION OF SHELTER. Mark off a point 140 feet northeast of the center of the antenna location; clear and level off an area near this point for erection of a shelter or tent.

c. LOCATION OF POWER UNIT. If a power unit is required, clear and level off an area for installation at a distance of about 140 feet from the shelter location and in a direction away from the antenna system.

15. Uncrating, Unpacking, and Checking (figs. 4 and 5)

a. REMOVAL OF EXPORT CRATING.

(1) Cut or break the metal straps around the crate.

(2) Remove the nails which secure the sides and ends to the top or bottom.

(3) When a skid is used, lift the crate from the skid assembly.

(4) Carefully remove the moistureproof-vaporproof barrier and other packing materials from the chests and chair.

(5) Remove the nuts from the bolts which hold the cradle to the skid (when applicable).

(6) Cut or break the metal straps securing the chest to the cradle (when applicable).

(7) Remove the bolts securing the chair to the skid.

(8) Lift the chests from the cradle.

Note. Place all containers with top side up. Do not place any chests within a radius of 50 feet from the center of the antenna site. When removing the contents of each chest, check the items against the table of components (par. 7).

b. COUNTERPOISE MX-313/CRD-2 AND MAIN CABLES. Place Case CY-365/CRD-2 (fig. 17), containing the counterpoise, at the antenna site.

c. TOOLS FOR ORIENTATION. Place Chests CY-363/CRD-2 and CY-364/CRD-2 (fig. 17), containing the orientation tools and spare parts, about 15 feet away from the shelter location.

d. ANTENNA SYSTEM AS-87/CRD-2. Place the following chests, containing all parts of the antenna system, about 50 feet from the center of the antenna site:

Chest CY-357/CRD-2
Chest CY-358/CRD-2
Chest CY-359/CRD-2
Chest CY-360/CRD-2
Chest CY-361/CRD-2

e. RACK MT-332/CRD-2. Place Chest CY-362/CRD-2, containing the operating rack, about 8 feet away from the shelter location.

f. REEL ASSEMBLY RL-125/CRD-2. Place the reel assembly about 8 feet away from the shelter location.

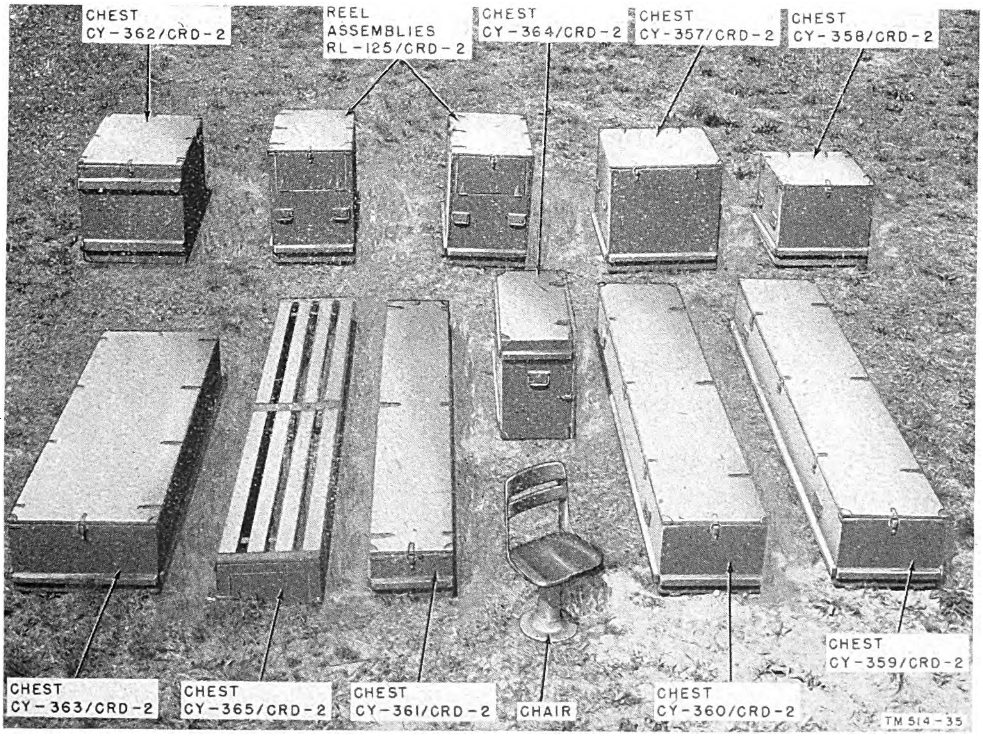


Figure 17. Radio Set AN/CRD-2, showing chests and crates which contain the equipment.

16. Orientation

a. MARKERS.

(1) Drive a small stake into the center of the antenna site (par. 14) so that about 2 inches of the stake is above ground.

(2) Remove the tripod from Chest CY–363/CRD–2 and, using a plumb line, erect it so that the center of the tripod is directly over the center of the stake (fig. 18).

(3) Carefully remove the carrying case containing the compass and ball socket unit from Chest CY–364/CRD–2.

(4) Remove the small screw cap at the top of the adapter on the tripod.

(5) Install the compass on the tripod, using the ball and socket unit.

(6) Level the compass by adjusting the ball and socket unit until the air bubbles in the spirit levels appear in the center of the liquid.

b. COMPASS ADJUSTMENT. The antenna system should be oriented to either true or magnetic north as directed by the using organization. Except for the compass adjustments described below, the orientation procedures are identical.

(1) *Scale adjustment.* Adjust the compass scale so that the 0–360° mark coincides with the index.

(2) *Magnetic north.* Release the compass needle by turning the screw on the bottom plate of the compass. When the needle stops swinging, rotate the compass until the north end of the needle and the 360° mark on the compass coincide. The viewing sights then point to magnetic north.

(3) *True north.* By referring to a suitable map, determine the magnetic declination for the locality in which the radio set is to be installed. Rotate the compass for the number of degrees and in the direction which will compensate for the magnetic declination.

Example. (*a*) To compensate for a magnetic declination of 11° west, rotate the compass so that the north end of the needle points to the 11° mark on the compass. The viewing sights then point to true north.

(*b*) If the declination is 11° east, rotate the compass so that the north end of needle points to 349° on the compass. The viewing sights then point to true north.

Note. Magnetic declination may be defined as the angle between true north and the direction indicated by a magnetic compass. This angle varies for different locations on the earth. It is necessary, therefore, to use charts or maps which show declination and the annual change in declination.

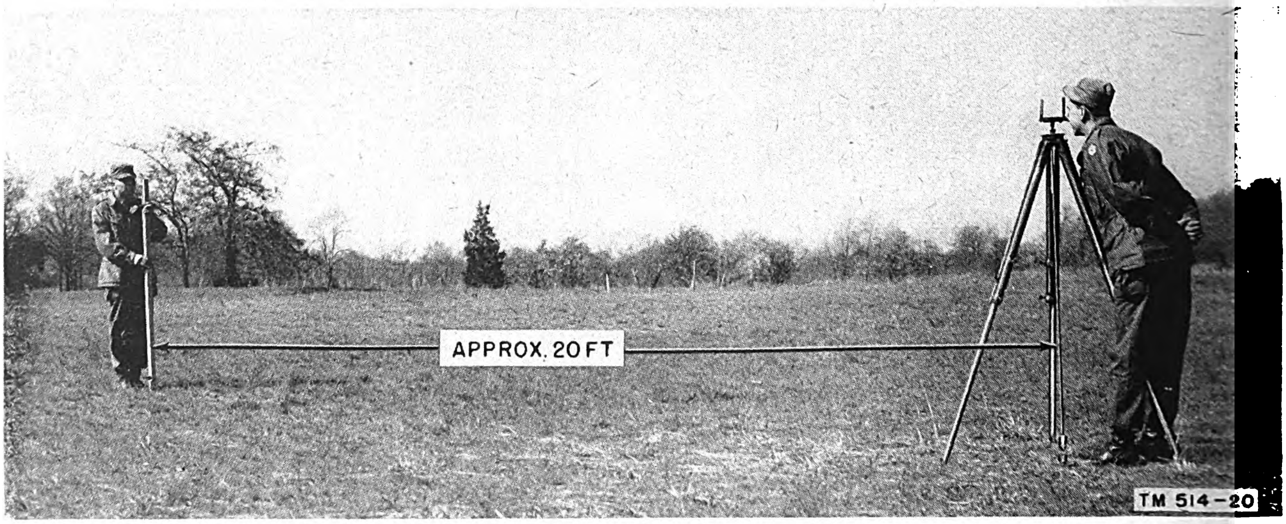


Figure 18. Use of compass sights to check north stake alinement.

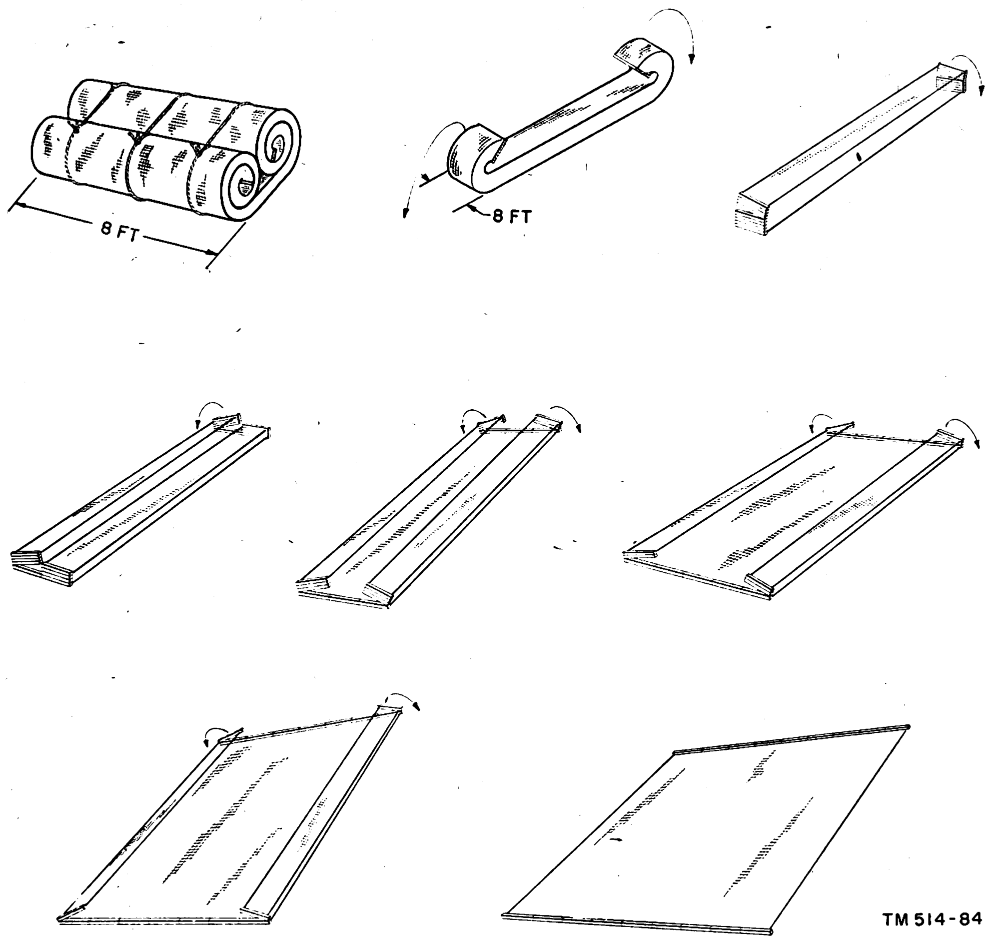


Figure 19. Counterpoise MX-313/CRD-2, unfolding.

c. STAKE ALINEMENT. With the compass adjusted to point to either true or magnetic north, drive a north marker stake into the ground in line with the sights and about 20 feet from the center stake (fig. 18). Rotate the compass exactly 180° and drive a south marker stake into the ground at a distance of 20 feet from the center stake. Check the compass level, the compass orientation, and the stake alinement when viewed through compass sights (fig. 18). If alinement is satisfactory, set aside the compass, tripod, and other accessories. Drive the stakes into the ground until about one-half inch of each stake is visible above ground.

17. Main Cables

It is preferable to lay the three main cables (Cords CG-239/CRD-2, CX-454/CRD-2, and CX-452/CRD-2) so that they will be under the counterpoise for the maximum possible distance. Place Reel Assembly RL-125/CRD-2 at the shelter site and unreel the three cables, pulling them toward the antenna center location. When they have been completely unreeled, arrange the three cables so that there is about 1 foot of slack at the center of the antenna site to facilitate their connection later. The fourth cable on the reel is Cord CX-639/CRD-2 for connecting Junction Box J-95/CRD-2 to the power source.

18. Counterpoise MX-313/CRD-2 (fig. 19)

Open Chest CY-365/CRD-2; remove the counterpoise and place it at the center of the antenna site. Turn the counterpoise so that one end will unroll toward south and the other toward north as indicated by the marker stakes (par. 16*c*). Unroll the ends as far as possbile, forming a mat of wire 75 feet long and about 8 feet wide. This mat will unfold four times toward east and four times toward west. The unfolding is accomplished most easily by having a man at each end lift four of the wooden end pieces and unfold the counterpoise away from the center. This procedure is continued until the entire counterpoise has been laid out flat. Adjust the counterpoise so that its center is exactly over the center marker stake. Use two counterpoise clamps (from Chest CY-365/-CRD-2) to hold each wooden end piece in place after the counterpoise has been straightened out (fig. 20). Also attach a line from the south to the center to the north marker stake.

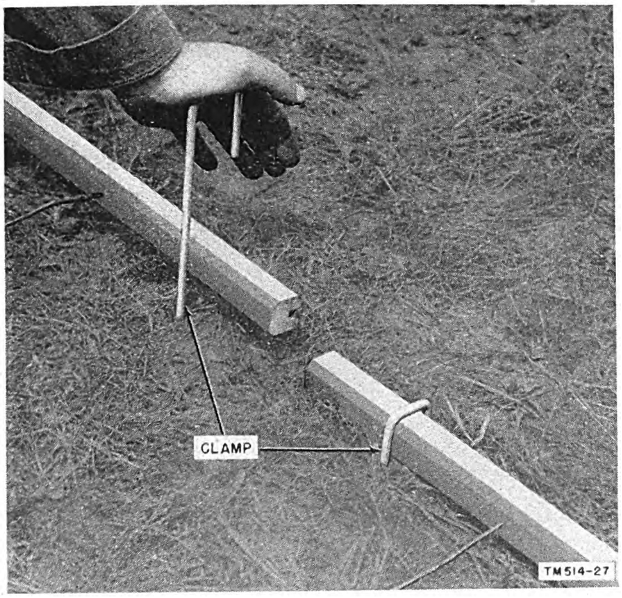


Figure 20. Pressing counterpoise clamp into position.

Note. In fixed station installations and particularly when operating with the l-f antenna combination, improved operation will result if a larger counterpoise is used. The counterpoise can be enlarged by connecting eight 150-foot conductors radially from the counterpoise, one to the center of each side and one to each corner. Use ground rods (Chest CY-365/CRD-2) for grounding the counterpoise at each corner and at the center of each edge. Connect the rods to the tabs that are affixed to each corner of the counterpoise, as well as the center of the side with the wooden edge pieces. Two additional tabs are packed with the counterpoise, to provide grounding points for the centers of the other two edges. The latter tabs should be attached to the counterpoise by soldering directly to the counterpoise wires.

19. Antenna Arrangements

For optimum performance, the proper combination of antenna spacing, top-loading, and mast height must be used (fig. 6). Also, the correct coupling unit (Coupling Unit CU-68/-CRD-2 or CU-69/CRD-2) must be used in Junction Box J-96/CRD-2, and the SENSE switch on each Antenna Coupling Unit CU-34/CRD-2 must be at the correct position.

a. Low-Frequency Combination. When the radio set is to be operated only in the frequency range of 0.54 to 8 mc, use two Supports MT-333/CRD-2 in each of the four horizontal arms and erect each monopole with four mast sections and an antenna skirt (A, fig. 6). Also use Coupling Unit CU-68/CRD-2 in Junction Box J-69/CRD-2, and place the SENSE switch on each Antenna Coupling Unit CU-34/CRD-2 at the L position.

Note. This l-f combination may be used for frequencies up to 10 mc. However, octantal errors as great as 3° may occur, and no octantal error correction chart is provided. Under certain conditions, the sense indications also may be inadequate at frequencies above 8 mc. The l-f antenna combination should not be used at frequencies above 10 mc because of the large octantal errors which are present.

b. High-Frequency Combinations. There are three h-f antenna combinations (B, C, and D, fig. 6). For any h-f combination, use one Support MT-333/CRD-2 in each of the four horizontal arms and install Coupling Unit CU-69/CRD-2 in Junction Box J-96/CRD-2. Also place the SENSE switch on each of the four Antenna Coupling Units CU-34/CRD-2 at the H position. The number of mast sections to be used in each monopole and whether or not antenna skirts are to be used are functions of the frequency range to be covered by the radio set. The proper h-f combination can be selected by referring to figure 23 to determine which combination will produce the best average performance over the desired frequency range.

Example 1. If the radio set is to be operated principally over the frequency range of 6 to 10 mc, the curves show that the best average performance (increased sensitivity) will be obtained by use of the h-f combination indicated by curve 1. This combination (B, fig. 6) consists of three mast sections and an antenna skirt for each monopole (Mast Sections AB-6/CRD-2 are not used). Curve 1 also shows that this combination will allow the radio set to be operated at frequencies as low as 2 mc without appreciable loss in sensitivity. How-

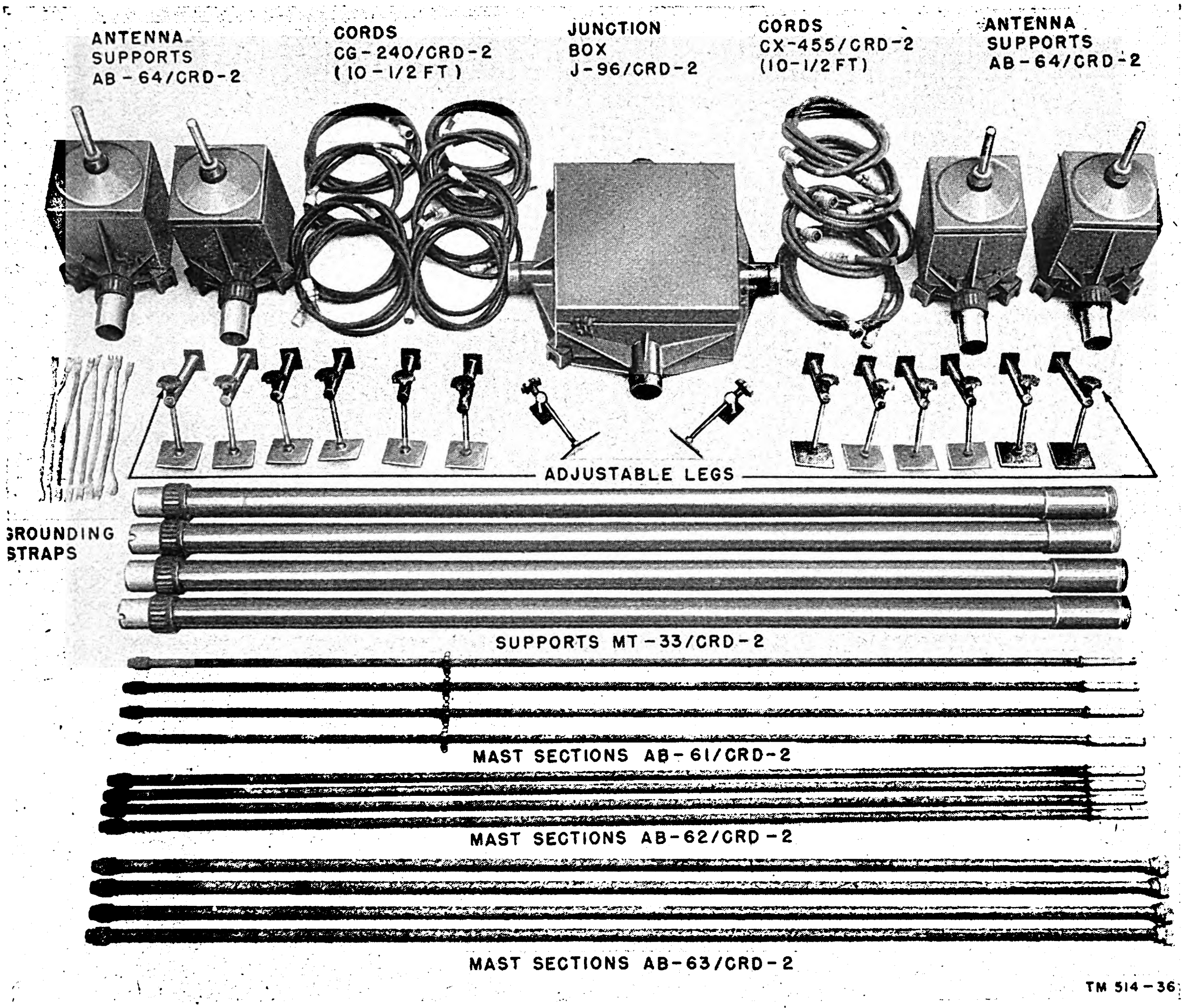


Figure 21. Components required for installation of the high-frequency antenna (C, fig. 6).

ever, for operation above 12 mc, the antenna combination indicated by curve 2 would show a higher gain.

Example 2. If the radio set is to be operated over the frequency range of 11 to 30 mc, the curves show that the combination indicated by curve 2 will give the best average performance. This combination (C, fig. 6) consists of three mast sections for each monopole (Mast Sections AB–60/CRD–2 and the antenna skirts are omitted). In the 22- to 30-mc range, curve 2 is substantially the same as curve 3. In the 16- to 22-mc range, curve 3 shows a gain over curve 2. However, curve 2 shows the best average gain over the range of 11 to 30 mc. This combination is used when wide-band operation (frequencies between 2 and 30 mc) is desired.

Example 3. If the radio set is to be operated only at frequencies above 16 mc, the curves show that optimum performance will be obtained by the use of the antenna combination indicated by curve 3. This combintaion (D, fig. 6) consists of two mast sections for each monopole (Mast Sections AB–60/CRD–2, Mast Sections AB–61/CRD–2, and the antenna skirts are omitted).

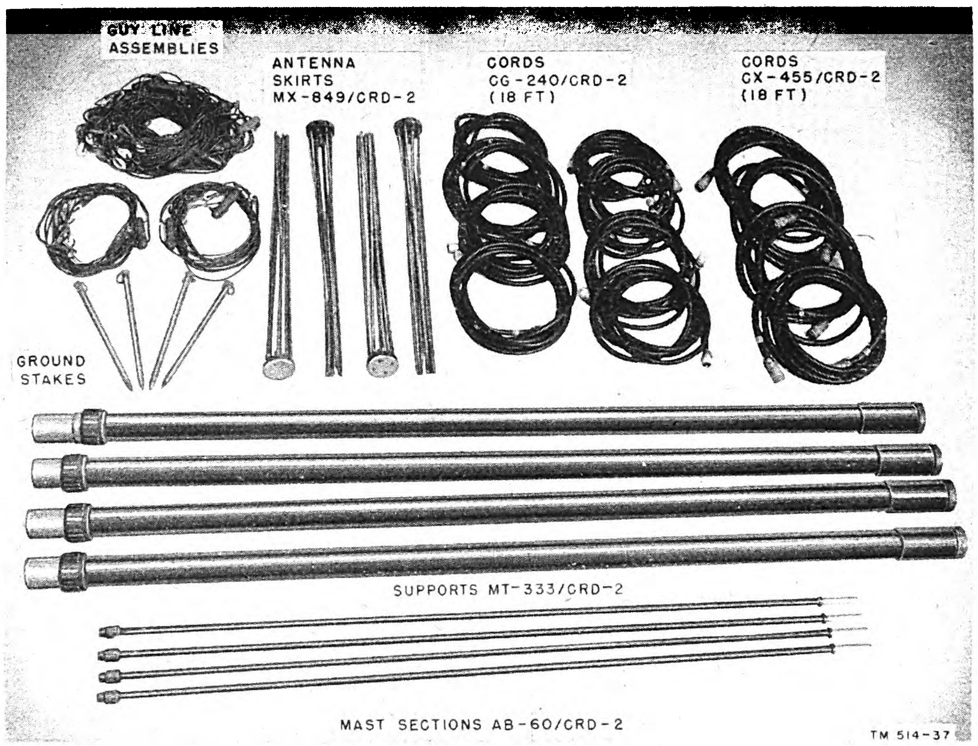


Figure 22. Additional components and substitute cables required for installation of low-frequency antenna combination.

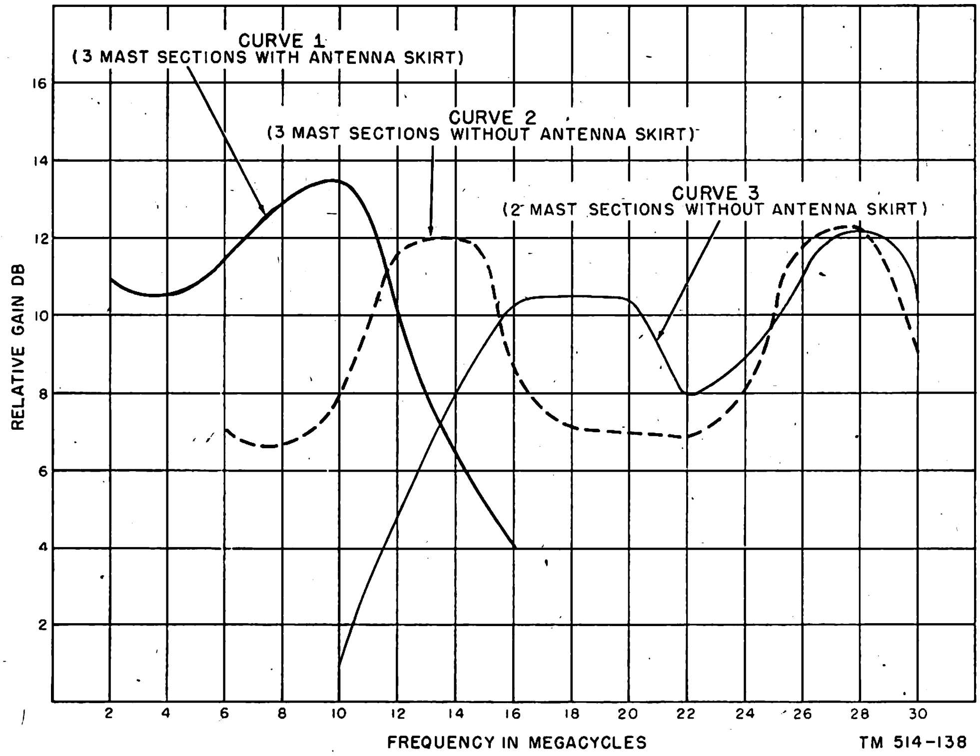


Figure 23. Relative gain versus frequency curves for the three high-frequency antenna combinations.

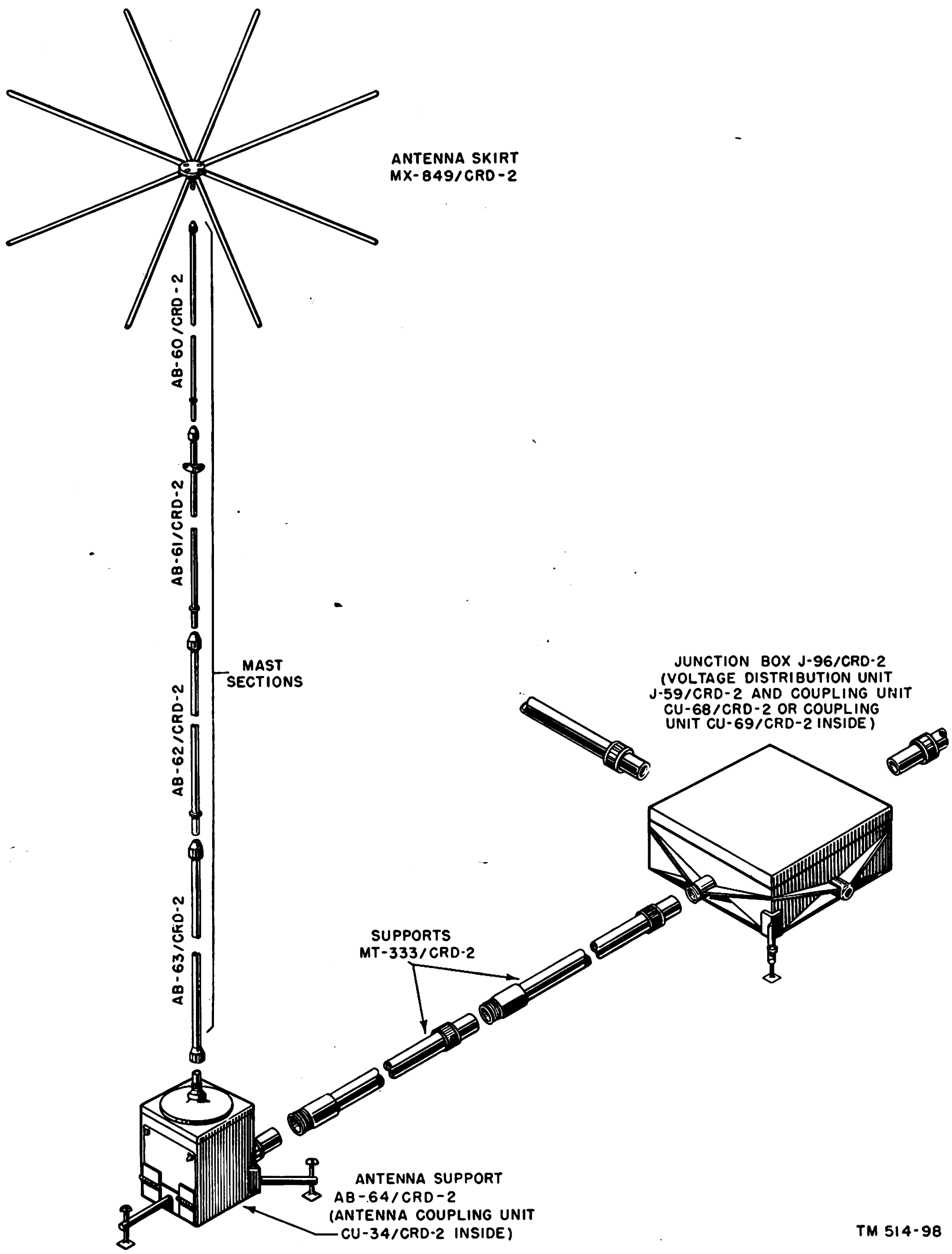


Figure 24. Exploded view of low-frequency antenna combination, showing center junction box, one of the four monopoles, and an antenna skirt.

20. Erection of Antenna

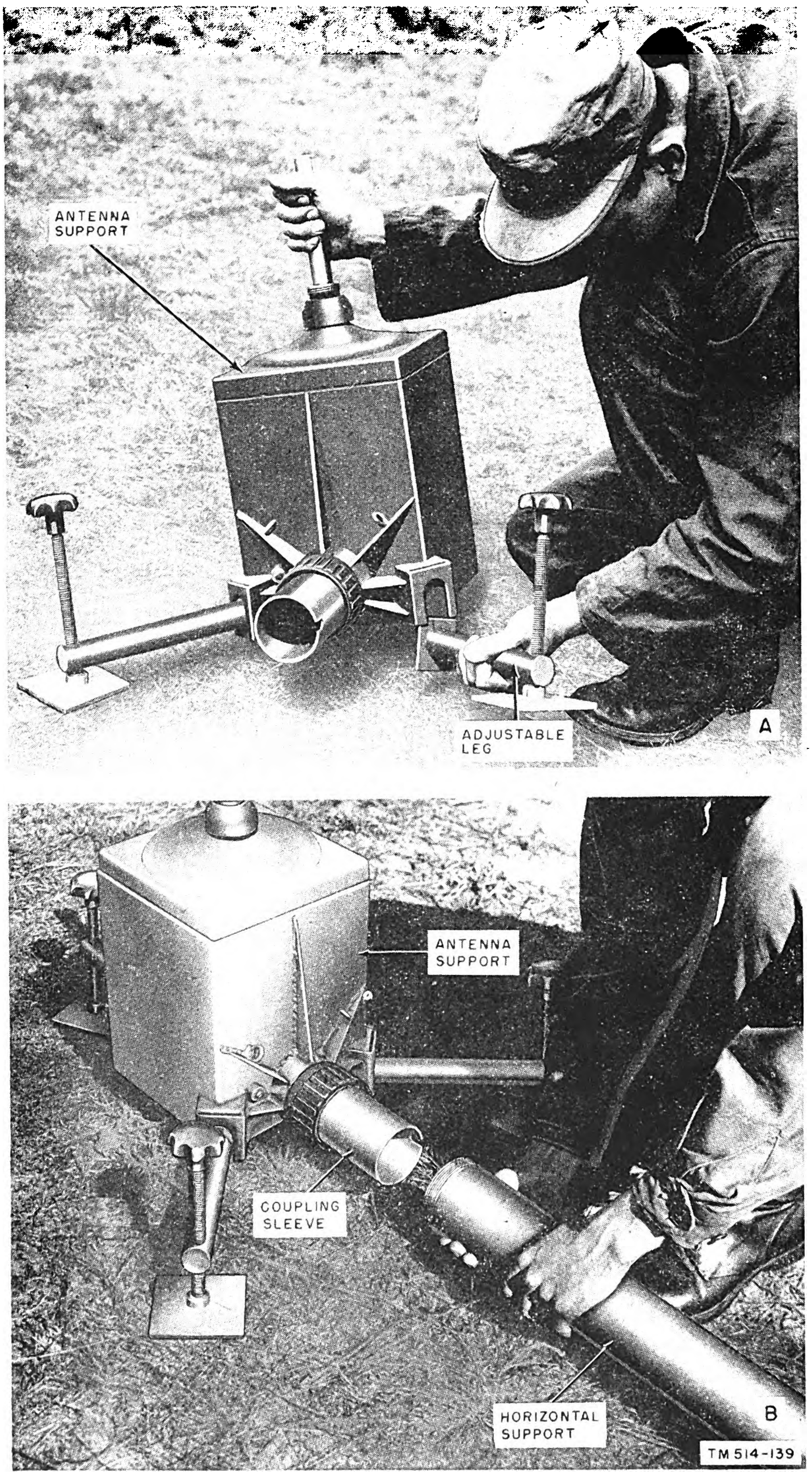
a. Antenna Supports AB–64/CRD–2.

(1) Remove the four antenna support assemblies, Junction Box J–96/CRD–2, and all the adjustable legs from Chests CY–357/CRD–2 and CY–358/CRD–2.

(2) Attach three of the long adjustable legs to each of the four antenna supports (fig. 25) and attach two of the short legs to the center junction box.

(3) Adjust all legs so that the antenna supports and junction box are as close to the ground as possible.

Caution: Keep threads on coupling sleeves free from sand or dirt.



A. Attaching adjustable leg to antenna support
B. Inserting horizontal support into coupling sleeve on antenna support

Figure 25.

(4) Place the junction box over the center stake at the antenna site, with the side containing the cable entrance holes facing east.

(5) Place one antenna support opposite each of the four coupling sleeves on the center junction box and at a distance of about 8 feet (for 4- to 30-mc operation) or 16 feet (for 0.54- to 8-mc operation) from the junction box.

b. Supports MT–333/CRD–2.

(1) Remove the required number of horizontal supports (par. 19) from Chests CY–359/CRD–2 and CY–360/CRD–2.

(2) Place one or two (as required) of the horizontal supports between the junction box and the north antenna support. The horizontal support should rest over the wire which runs between the north, center, and south marker stakes (par. 18).

(3) Run a wire or line (longer than the support) through the horizontal support. This will be used later (*e* below) to pull the interconnecting cables through the support.

(4) Insert the horizontal support into the coupling sleeve on the antenna support (fig. 25). Connect the other end to the center junction box. If the antenna support and the junction box are not all on the same level, adjust the legs to facilitate insertion. Be sure that the plated end of the horizontal support is inserted into the coupling sleeve completely. Do not screw coupling rings onto ends of pipe until after leveling (*c* below).

(5) In a similar manner connect the other horizontal supports to the antenna supports and junction box.

c. Leveling.

(1) Using the 12-inch level from Chest CY–363/CRD–2, level each of the four horizontal supports by placing the level on the end which is connected to the antenna support (fig. 26). Adjust only the outside leg, attached to the antenna support, until the horizontal support is level.

(2) Place the level on top junction box and level it by adjusting its two leveling legs.

(3) Check the level of each antenna support and, if necessary, level by adjust-

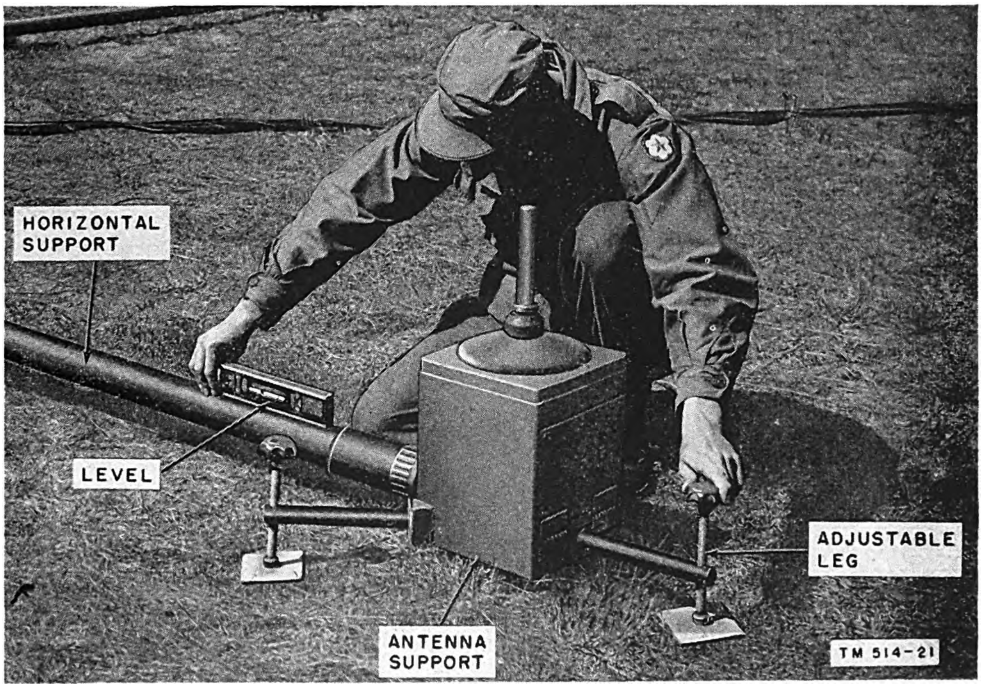


Figure 26. Leveling horizontal support.

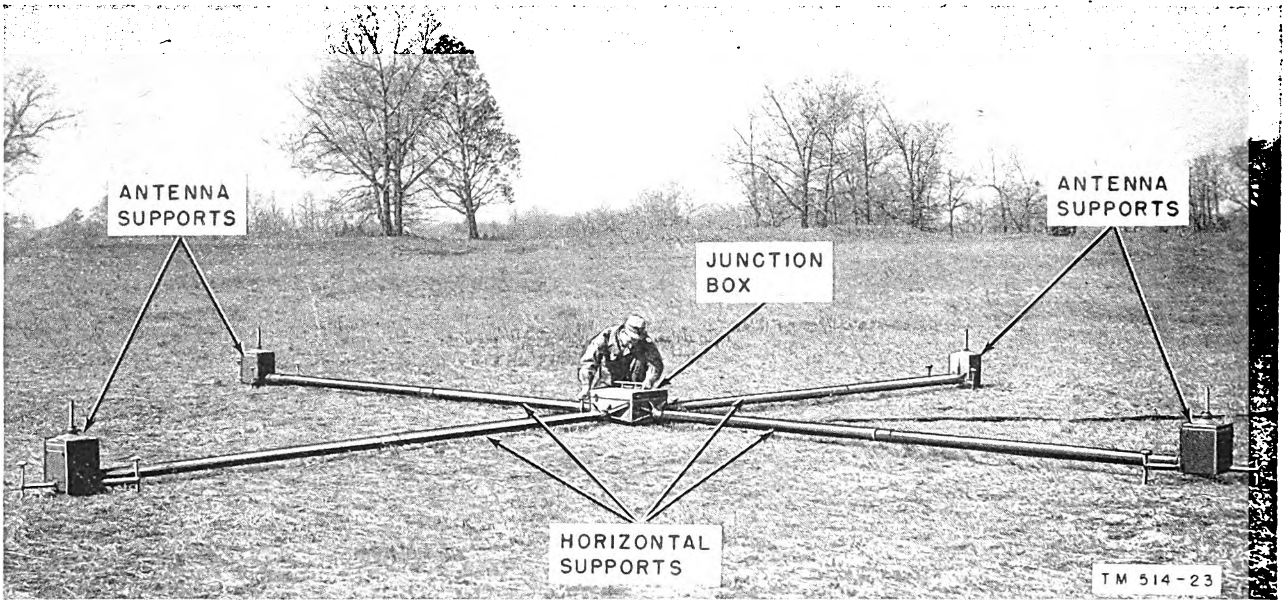


Figure 27. Leveling junction box.

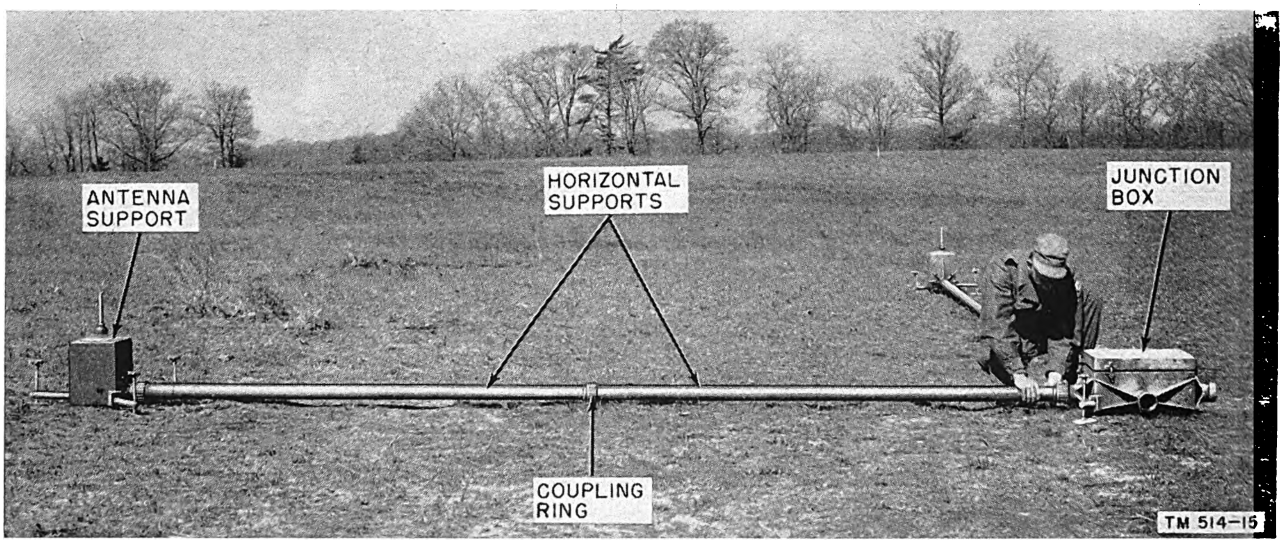


Figure 28. Tightening coupling ring on junction box.

ing only the two legs at the sides of the supports.

d. COUPLING RINGS. Screw all the coupling rings to the coupling sleeves on the antenna supports and the center junction box. Use the large strap wrench from Chest CY-363/CRD-2 for tightening these coupling rings (figs. 28 and 29). If the coupling rings will not screw on easily, the rings may be dirty or the antenna system may not be quite level.

e. INTERCONNECTING CABLES.

(1) If only one Support MT-333/CRD-2 is used (par. 19*b* or *c*), remove all interconnecting cables from Chest CY-359/CRD-2. If two supports are used (par. 19*a*), remove all interconnecting cables from Chest CY-360/CRD-2. Canvas bags are provided to protect the cable connectors from dirt or water. These bags should be attached to

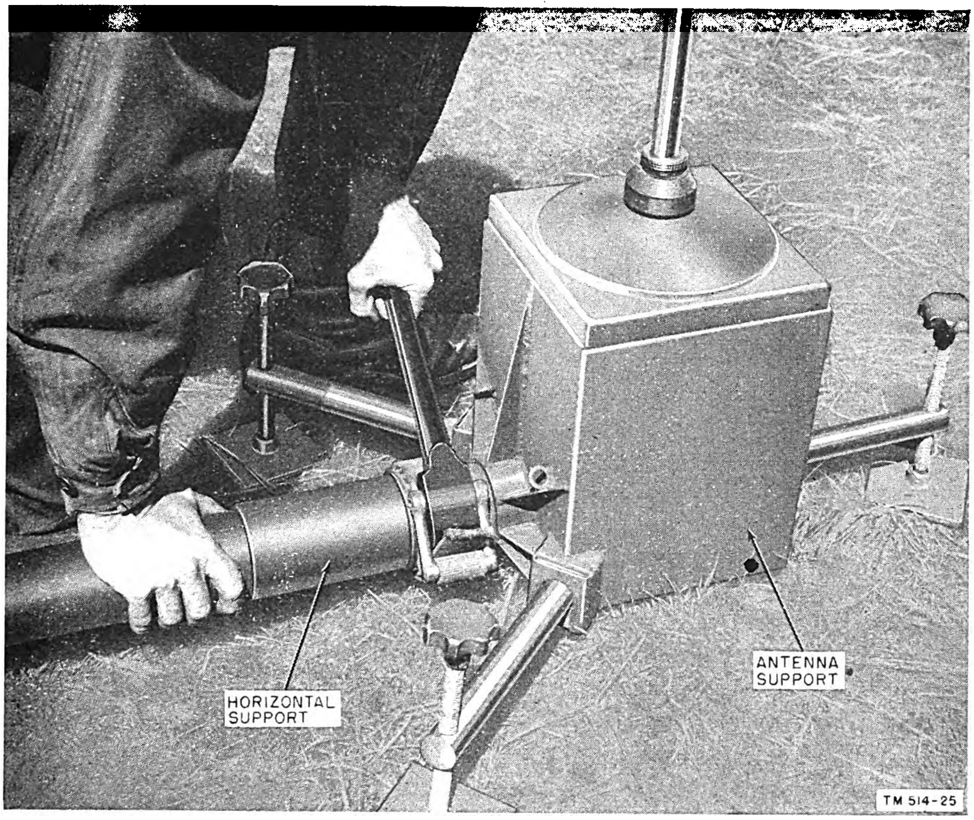


Figure 29. Using strap wrench to tighten coupling ring.

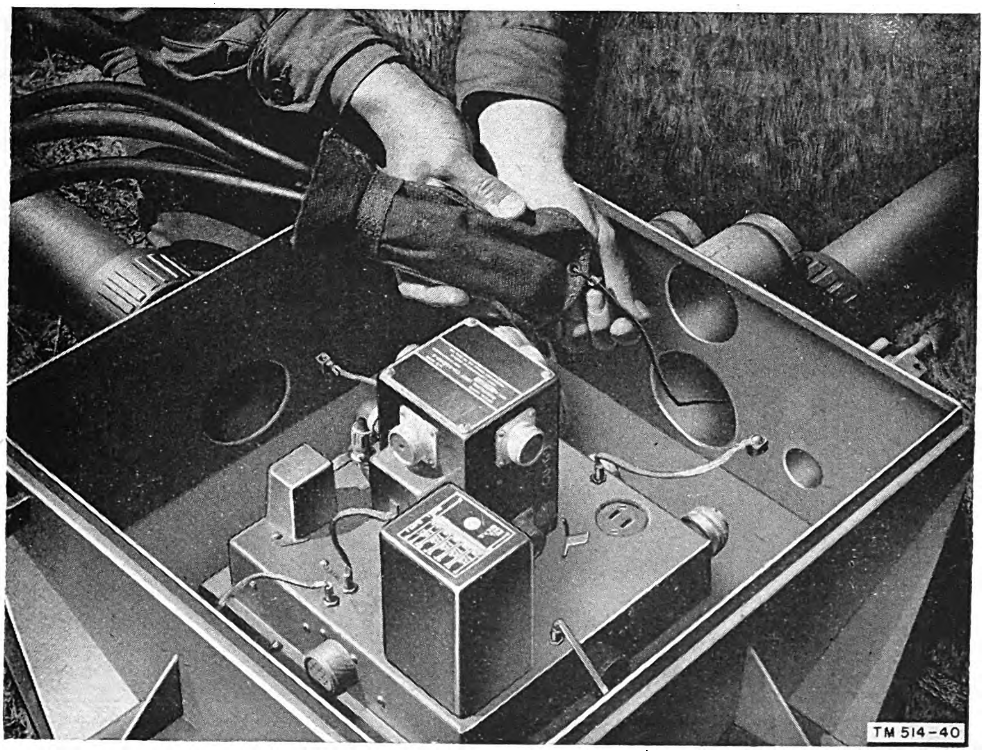


Figure 30. Using bags to protect connectors while pulling cables through supports.

the cable ends during installation. The bags also may be used to pull the three interconnecting cables ((3) below) through the horizontal supports by attaching a long piece of line or wire (*b*(3) above) to the eyelet at the end of the bag (fig. 30).

(2) Open the door on each outer box.

(3) Insert a set of interconnecting cables into each horizontal support, starting from the junction box and pulling them toward the antenna support. One set of interconnecting cables consists of: interconnecting control cable Cord CX–455/CRD–2, interconnecting r-f cable (plug color-coded red) Cord CG–240/CRD–2, and interconnecting r-f cable (plug color-coded green) Cord CG–240/CRD–2.

(4) After the cables have been pulled through the horizontal supports, proceed as follows:

(*a*) Plug the four control cables (Cord CX–455/CRD–2) into their respective chassis connectors on Voltage Distribution Unit J–59/CRD–2 and tighten all coupling rings. (The voltage distribution unit is mounted inside Junction Box J–96/CRD–2.)

(*b*) Make certain that the proper Coupling Unit CU–68/CRD–2 or CU–69/CRD–2 (par. 19) is installed on the voltage distribution unit chassis. Plug the four green r-f plugs into their respective green chassis connectors near the bottom of the coupling unit and *thread all the way*.

(*c*) Plug the four red r-f plugs into their respective red chassis connectors near the top of the coupling unit and *thread all the way*. (See fig. 31.)

(5) At Antenna Coupling Unit CU–34/CRD–2 in each antenna support—

(*a*) Insert the banana plug at the end of the ground strap into its receptacle on the antenna coupling unit. Also see that the other end of the ground strap is connected to the grounding block in the antenna support.

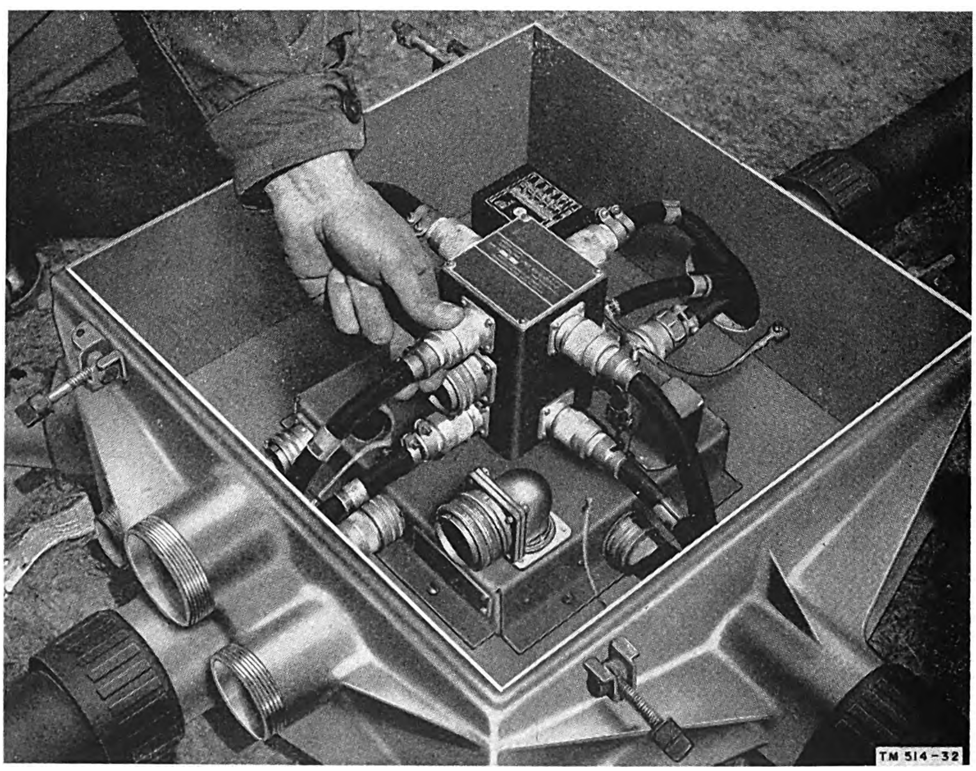


Figure 31. Connecting r-f cable to Coupling Unit CU–68/CRD–2 (or CU–69/CRD–2).

(*b*) Insert the r-f plug (color-coded red) into the right-hand chassis connector (color-coded red).

(*c*) Insert the r-f plug (color-coded green) into the left-hand chassis connector (color-coded green).

(*d*) Plug the 14-contact control cable connector into the chassis connector.

(*e*) Tighten all coupling rings. Be sure that they are threaded *all the way*.

(*f*) Adjust the cables coming into antenna supports and the junction box so that turns are not too sharp and strain on the inner conductors is minimized. Before installing antenna masts, be sure that the centers of the north and south horizontal supports are exactly over the line which was between the north, center and south stakes. Close the door on each antenna support.

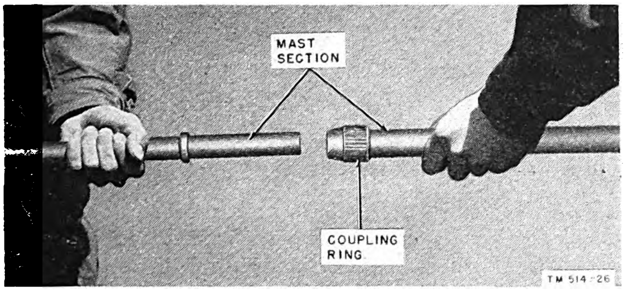


Figure 32. Assembling mast sections.

f. ANTENNA MASTS AND ANTENNA SKIRTS.

(1) *Removal from chests.* Remove the required antenna mast sections (par. 19) from Chests CY-361/CRD-2 and CY-360/CRD-2. Remove the antenna skirts from Chest CY-359/CRD-2.

(2) *Antenna masts.* Assemble four complete antenna masts by fitting together the number of sections to be used (par. 19). Tighten the coupling rings with the small strap wrench in Chest CY-363/CRD-2. In fitting antenna sections together, be sure that collars on the inserted sections are flush with coupling rings (fig. 32). Keep threaded ends of antenna mast sections free of sand or dirt.

(3) *Antenna skirts.*

(*a*) Raise the rods away from the center stub to a horizontal position and screw the rods tightly into the hub (par. 19).

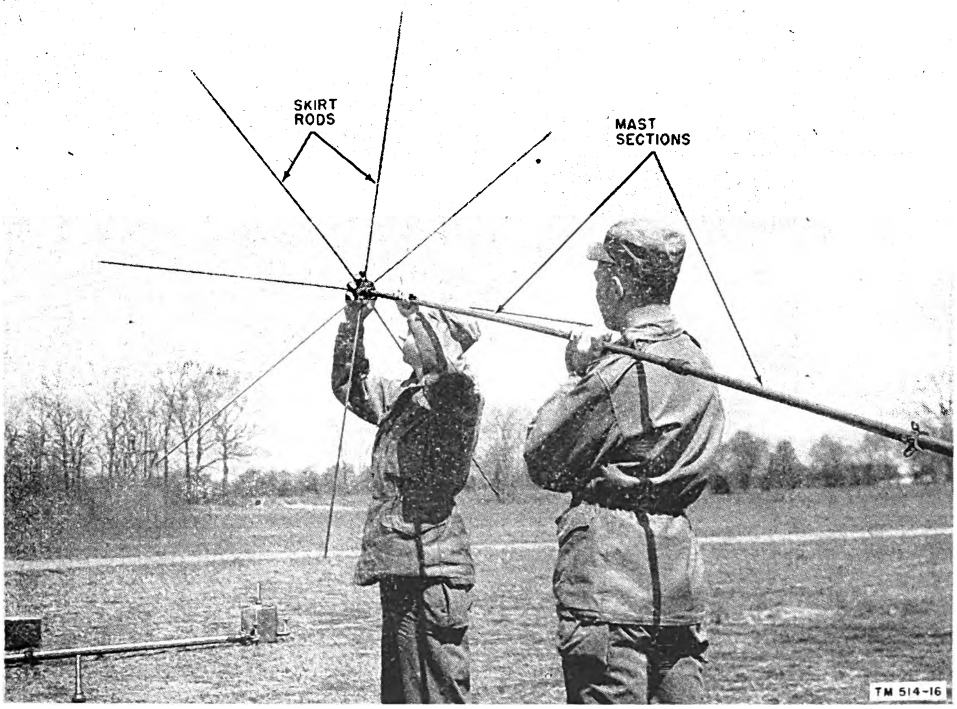


Figure 33. Inserting center stub of antenna skirt into top of mast section.

(*b*) Mount the antenna skirt to the mast by inserting the center stub into the top of the mast section (check to see that the stub is all the way in) and tighten the coupling ring on the mast section until the collet inside the ring is fastened securely around the stub (fig. 33).

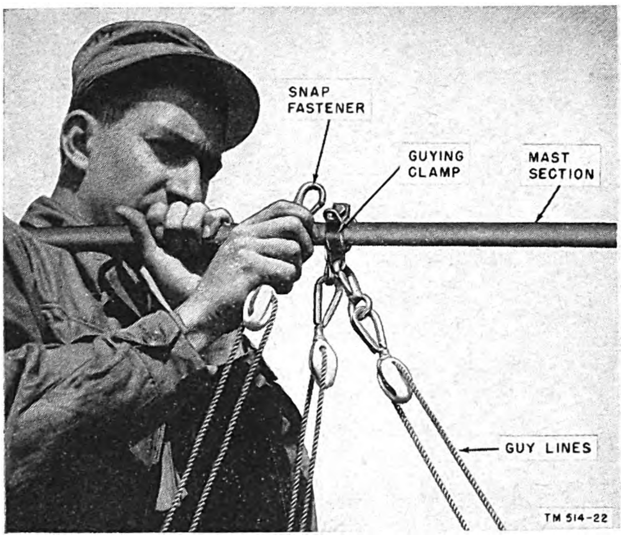


Figure 34. Connecting snap fastener to clamp on mast section.

g. GUYING INSTRUCTIONS.

(1) Remove the guy line assemblies and stakes from Chest CY–359/CRD–2.

(2) Attach three guy lines to each monopole by connecting the snap fasteners to the guying clamps located near the top of the third mast section (fig. 34).

(3) Drive four guying stakes into the ground toward the outer edge of Counterpoise MX–313/CRD–2, one stake in line with each horizontal support. Each stake should be approximately 10 feet from the nearest antenna support when one horizontal support is used and 20 feet from the nearest antenna support when two horizontal supports are used.

(4) From the mast being erected, attach one guy line to the antenna support at the right of the mast. Fasten a second guy line to the stake in line with the mast ((3) above).

Note. A wooden slide fastener is provided at each end of the guy line. The top fastener should be adjusted to permit tightening the guy line by adjusting the fastener at the ground end, after the mast has been erected.

h. MAST ERECTION (fig. 35).

(1) Raise the mast to a vertical position

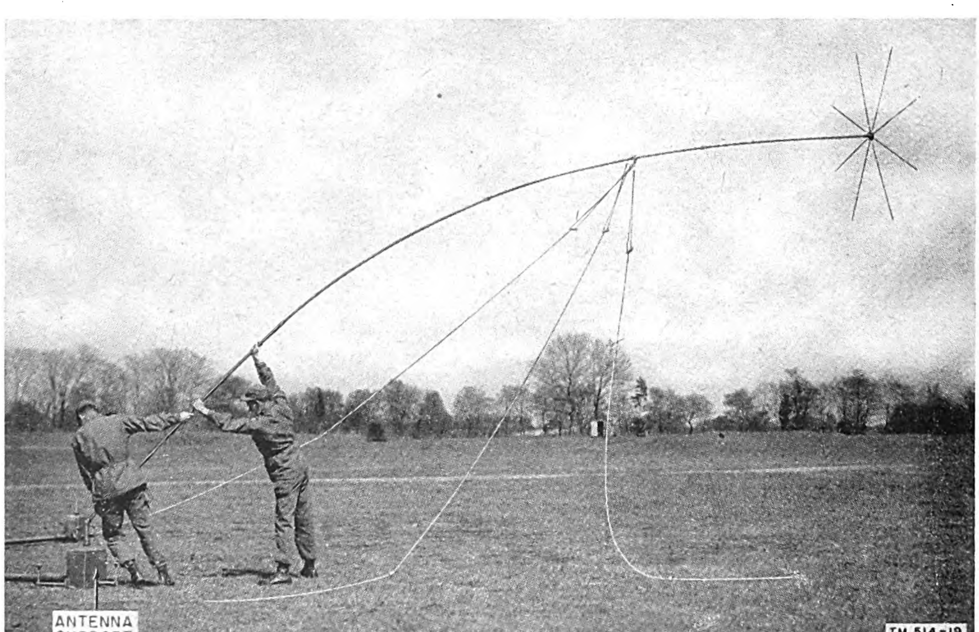


Figure 35. Raising a mast.

gradually in order to prevent excessive bending and undue strain on the mast. Keep the bottom of the mast free from dirt.

(2) When the mast has been raised to its vertical position, slide the bottom end over the shaft extending above the top of the antenna support. Tighten the coupling ring.

(3) Attach the third guy line to the antenna support located at the left of the mast.

(4) Take up the slack in the guy lines by adjusting the slide fasteners at the ground end (fig. 36).

Caution: Do not tighten the guy lines excessively. Excessive tightening will buckle the mast.

(5) Similarly, erect the remaining three masts.

(6) When the four antenna masts have been erected, check the level of all antenna supports as outlined in the leveling instructions (*c* above). In addition, check to see whether all masts are perfectly vertical by siting across diagonal pairs from a distance of about 100 feet. Adjust the guy lines of any mast which is not vertical. Also recheck alinement of the north and south monopoles with the orientation stakes.

i. 25- TO 30-MC OPERATION. When finest performance is desired for 25- to 30-mc operation, connect a short wire from the center of each horizontal support to the counterpoise. Make sure that good soldered connections are made.

21. Rack MT–332/CRD–2 (Operating Rack)

a. GENERAL. A small house, tent, vehicle, or dugout (see note below) may be used as a shelter for the operating rack, azimuth indicator, Junction Box J–95/CRD–2, and operator's chair. In order to facilitate placement of the main cables, it is preferable to locate the shelter in a northeast direction about 145 feet from the center of the antenna system. This permits the three main cables to remain under the counterpoise for the maximum possible distance. For operation, the operating rack is placed in an

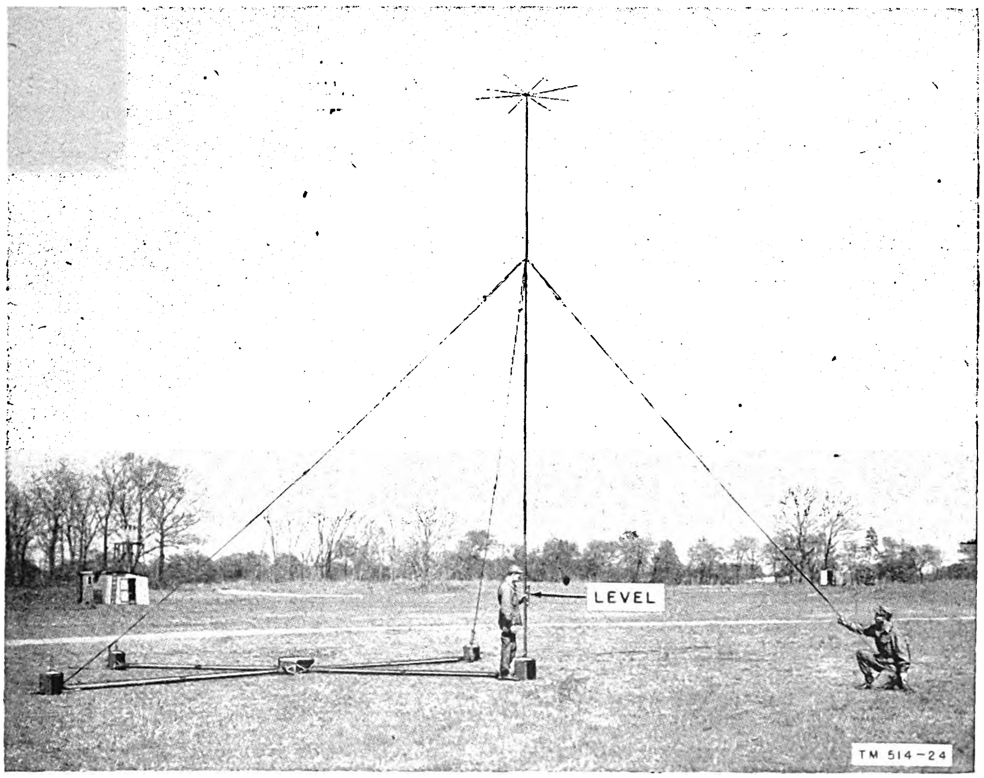


Figure 36. Adjusting guys.

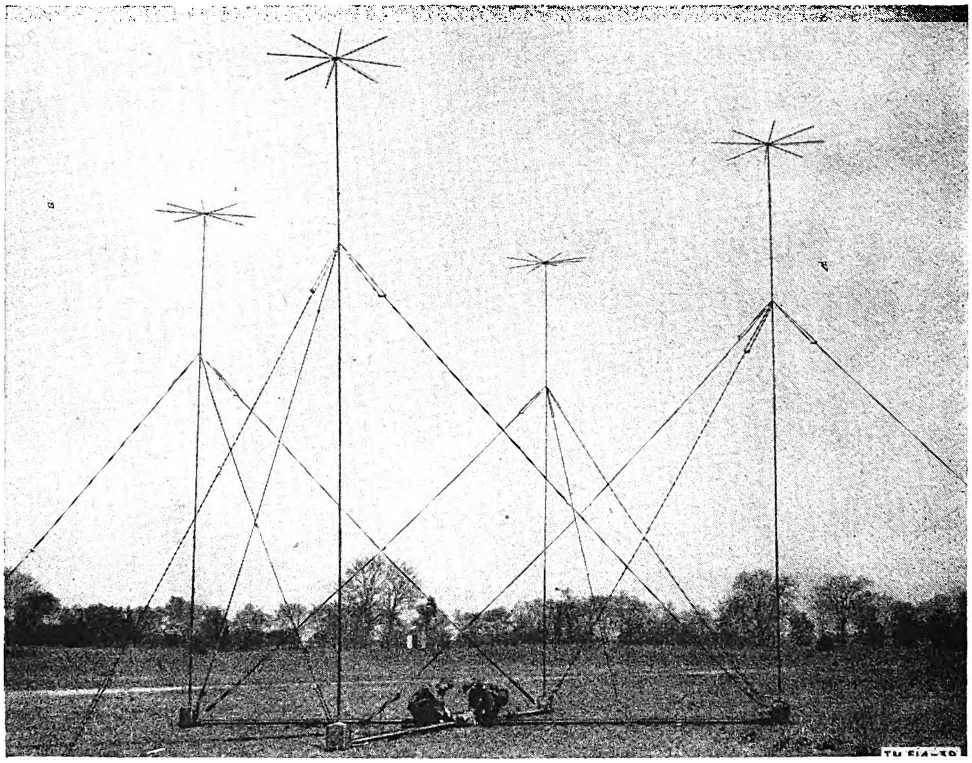


Figure 37. Low-frequency antenna, erected.

upright position on a table or chest inside the shelter. It should be placed so that the eyes of a seated operator are on the same level as the cathode-ray tube of the bearing indicator.

Note. For vehicular installation, use the shock-mounts which normally are stored within the rack (top rear).

b. INSTALLATION.

(1) Carry Chest CY–362/CRD–2 into the shelter and lay it on the floor, top side up.

(2) Remove the cover of the chest. Then carefully place the chest on its side so that the rack is upright in it. Slide the rack out and place it on a table or chest. Turn the rack so that no light shines directly into the face of the cathode-ray tube, and keep it far enough from any walls to make the back of the rack accessible.

(3) Fit the sun shade into the alidade scale assembly on the front panel of the bearing indicator. This sun shade may be removed if it is not required.

(4) Be sure that the MASTER POWER OFF-ON switch on the front panel of the modulating voltage generator is at OFF.

(5) Remove Azimuth Indicator ID–240/CRD–2 from Chest CY–364/CRD–2 and place it at any convenient position near the operating rack.

22. Interconnecting Cords and Cables

a. RACK MT–332/CRD–2 (FIGS. 10 AND 38).

(1) Check all cables already installed between units and the rear apron for tightness. Connections should be as shown in the cording diagram (fig. 39).

(2) Connect Cord CX–1115/U (10 feet) from Junction Box J–95/CRD–2 to the a-c connector on the rear apron.

(3) Connect Cord CG–239/CRD–2 (main r-f cable) to the rear apron.

(4) Connect the 6-foot length of Cord CX–1114/CRD–2 to the rear apron.

(5) Connect the 6-foot length of Cord CX–1116/CRD–2 to the rear apron.

b. AZIMUTH INDICATOR ID–240/CRD–2 (fig. 14).

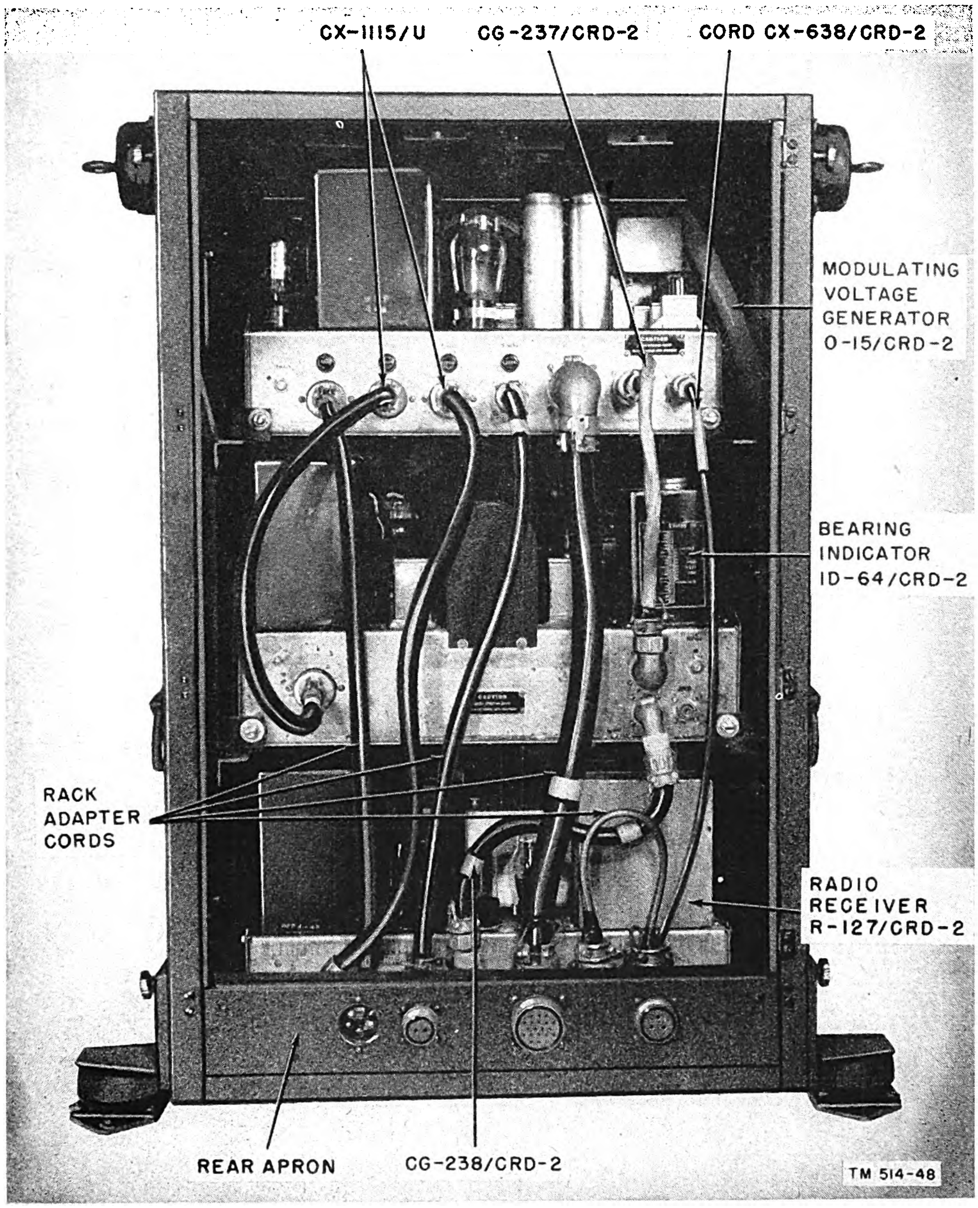


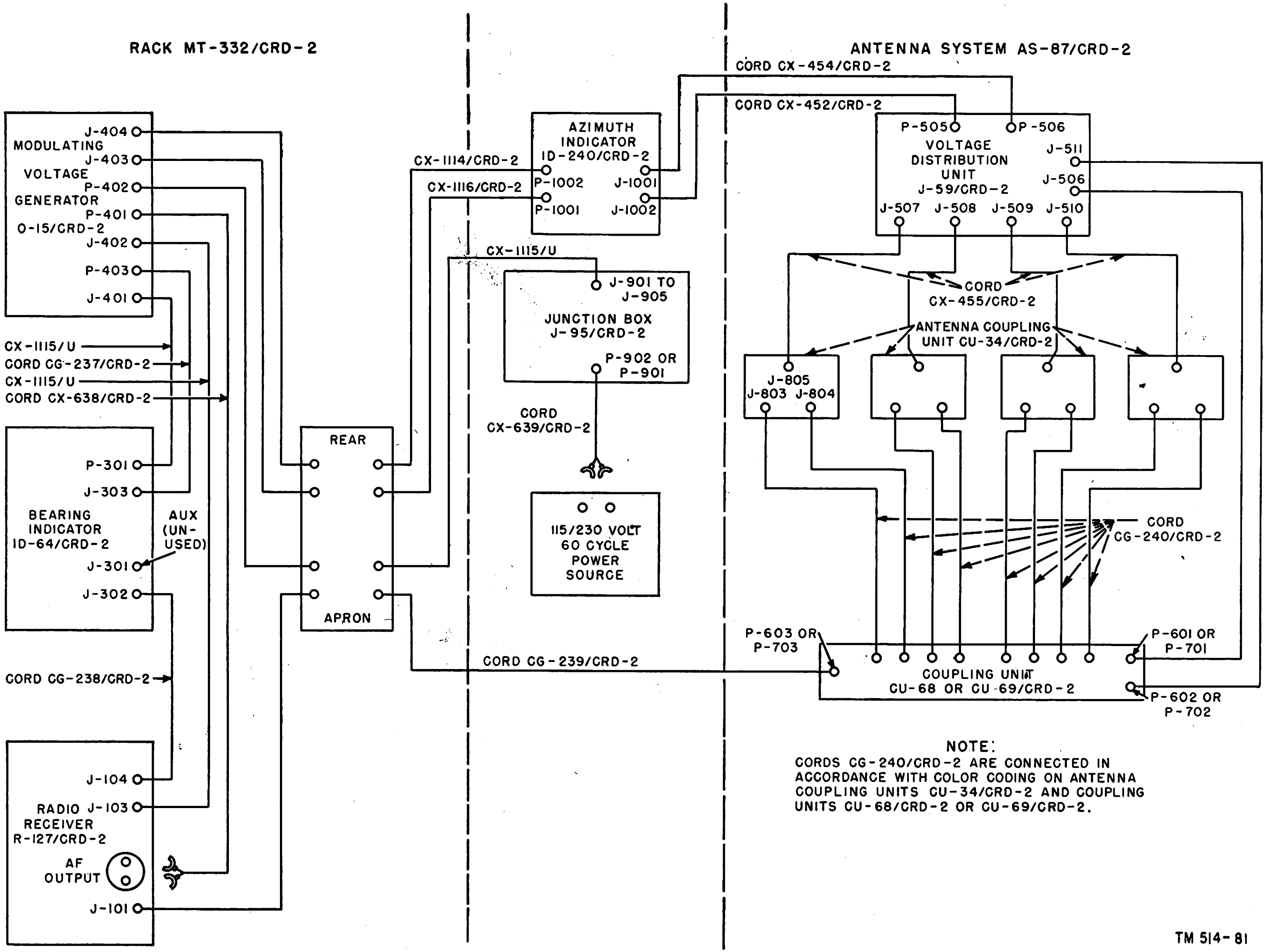
Figure 38. Rack MT–332/CRD–2, back view, showing cables.

(1) Connect Cord CX–1114/CRD–2 coming from the rear apron to connector P–1002.

(2) Connect Cord CX–1116/CRD–2 coming from the rear apron to connector P–1001.

(3) Connect the ends of the two remaining cords coming from the antenna system (Cord CX–454/CRD–2 and Cord CX–452/CRD–2) to connectors J–1001 and J–1002, respectively.

c. ANTENNA SYSTEM AS–87/CRD–2. On the east side of the center junction box of the antenna system, three coupling conduits are provided for insertion of the three main cables. Insert the three cables into the junction box, connect each to its proper plug, and tighten each connector. Screw the waterproofing connectors to the conduits. Connect all ground straps between the voltage distribution unit and the center junction box and between Coupling Unit CU–68/CRD–2 or Coupling Unit CU–69/CRD–2 and the voltage distribution unit. Make sure that connector J–506 and all other cable



NOTE:
CORDS CG-240/CRD-2 ARE CONNECTED IN ACCORDANCE WITH COLOR CODING ON ANTENNA COUPLING UNITS CU-34/CRD-2 AND COUPLING UNITS CU-68/CRD-2 OR CU-69/CRD-2.

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Figure 39. Radio Set AN/CRD-2, cording diagram.

connectors inside the center junction box are connected properly. Replace the cover on the junction box and secure by tightening fasteners provided. Connect the four ground straps (from Chest CY-358/CRD-2) between the outside of the junction box to the counterpoise (fig. 40). Connect the ground strap from the main r-f cable to the counterpoise. Connect a ground strap (from Chest CY-358/CRD-2) between each antenna support and the counterpoise.

d. POWER SOURCE. Plug the connector on Cord CX-639/CRD-2 into Junction Box J-95/CRD-2 (fig. 15), being careful to insert the plug into the correct input socket (depending upon whether the power source is 115 volts or 230 volts). The other end of this cord has two spade terminals attached to it for connection to the power source.

23. Service upon Receipt of Used or Reconditioned Equipment

a. Follow the instructions in paragraph 15 for uncrating, unpacking, and checking the equipment.

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

Section II. CONTROLS AND INSTRUMENTS

24. Antenna System Controls

The only controls located at the antenna system are those on Antenna Coupling Units CU-34/CRD-2 (fig. 81).

a. SENSE H-L SWITCH (S-801). This switch provides for optimum sense indications. Set the switch to H when it is desired to operate in the h-f ranges (4 to 30 mc); set it to L for operation in the l-f range (0.54 to 8 mc).

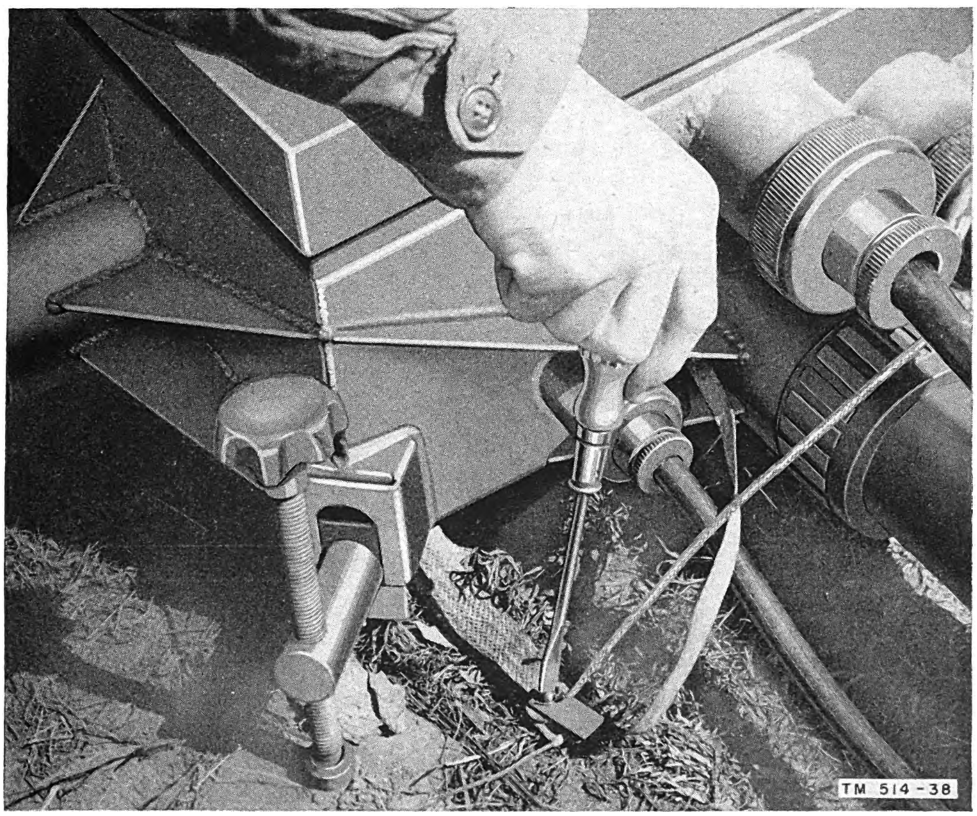

Figure 40. Connecting a ground strap for Junction Box J-96/CRD-2.

b. CONTROL C–809. This balancing control is used to compensate for the output capacity of the sense tube and also for capacitive inequalities in Cords CG–240/CRD–2. It has a detent set at the factory at the position which is correct when the cables are perfectly balanced. As the cables become unbalanced through use and rough handling, the balancing control can be adjusted by turning to the left or right of the detent to compensate for the amount of the capacitive unbalance (par. 45*a*).

25. Junction Box J–95/CRD–2 Controls

(fig. 15)

a. LINE FRECUENCY METER. Indicator M–902 is a 55- to 65-cycle, vibrating reed type frequency meter which indicates the frequency of the power supply voltage.

b. OUTPUT VOLTAGE METER. Indicator M–901 is a 0–150-volt a-c meter which indicates the output voltage from Junction Box J–95/CRD–2.

c. OUTPUT VOLTAGE CONTROL. Switch S–902 is a nine-position switch which permits adjustment of the a-c output voltage to 115 volts.

d. LINE INPUT 115V-OFF-230V SWITCH. Swith S–901 connects input power to the proper tap on the line voltage transformer for 115- or 230-volt operation.

e. CIRCUIT BREAKERS 115V–230V. Relays K-901 and K-902 are overload relays with push-to-reset buttons (5- to 10-ampere ratings).

f. OUTPUT LOAD EQUIPMENT-OFF-DUMMY SWITCH. Switch S–903 is a three-pole, three-position, toggle switch which applies the a-c supply voltage to the equipment or to the dummy load and opens the output voltage circuit in OFF position.

26. Modulating Voltage Generator Controls

(figs. 12 and 41)

a. MASTER POWER OFF-ON SWITCH. Switch S–402 controls power input to the operating equipment in the rack. A pilot lamp (E-402) is illuminated when the switch is at ON.

b. POWER OFF-ON SWITCH. Switch S–401 controls power input to the modulating voltage generator. Pilot lamp E-401 is illuminated when the switch is at ON.

c. STAND-BY OPERATE-SPLIT SWITCH. With this switch (S–403) at STAND-BY, there is no modulating voltage output and the receiver may be used for monitoring purposes; with the switch at OPERATE, the direction finder is used for normal direction-finding operations; with the switch at SPLIT, the normal bearing pattern on the cathode-ray tube is split into a pair of intersecting patterns which are useful for reading weak signals.

d. MOD VOLTAGE LEVEL SWITCH. With this switch (S–409) at OFF, the MODULATING VOLTAGE meter (M–401) is disconnected from the metering circuit; with the switch at IND, the voltage applied to the grids of the balanced modulator tubes (V–308 and V–309) in Bearing Indicator ID–64/CRD–2 may be measured on meter M–401; with the switch at OVERALL, the modulating voltage on the north and south antenna balanced modulators may be read on meter M–401; with the switch at E–W, the modulating voltage on the east and west antenna balanced modulators may be read on meter M–401.

e. IND-ANT MODULATING VOLTAGE METER. Meter M–401 is a 0–1 ma (milliampere) meter with the scale calibrated 0 to 5 volts. The meter is used to measure modulating voltages as described in *d* above. It is used also to measure the d-c (direct-current) modulating voltage of Azimuth Indicator ID–240/CRD–2 when switch S–410 (*f* below) is at AURAL.

f. MOD VOL AURAL-VISUAL SWITCH. With this switch (S–410) at VISUAL, the MODULATING VOLTAGE meter (M–401) is connected to rectifier CR–401 and the meter will measure the modulating voltage level; with the switch at AURAL, the meter is connected to the meter shunt (R–1005) at the input of the sinusoidal potentiometer (R–1008) of Azimuth Indicator ID–240/CRD–2 (figs. 14 and 52) and the meter measures the d-c modulating voltage of Azimuth Indicator ID–240/CRD–2.

g. E_B IND-E_B GEN-I_K ANT MOD SWITCH. With this switch (S–408) at E_B IND, the plate voltage in the bearing indicator may be read on the IND-GEN-ANT VOLT-MILLIAMMETER (M–402), using the 0–500-volt scale; with the switch at E_B GEN, the plate voltage in the modulating voltage generator may be read on meter M–402; with the switch at I_K ANT MOD, the cathode current on each or all of the antenna coupling units may be read on the 0–50 ma scale of meter M–402 when one or more of the

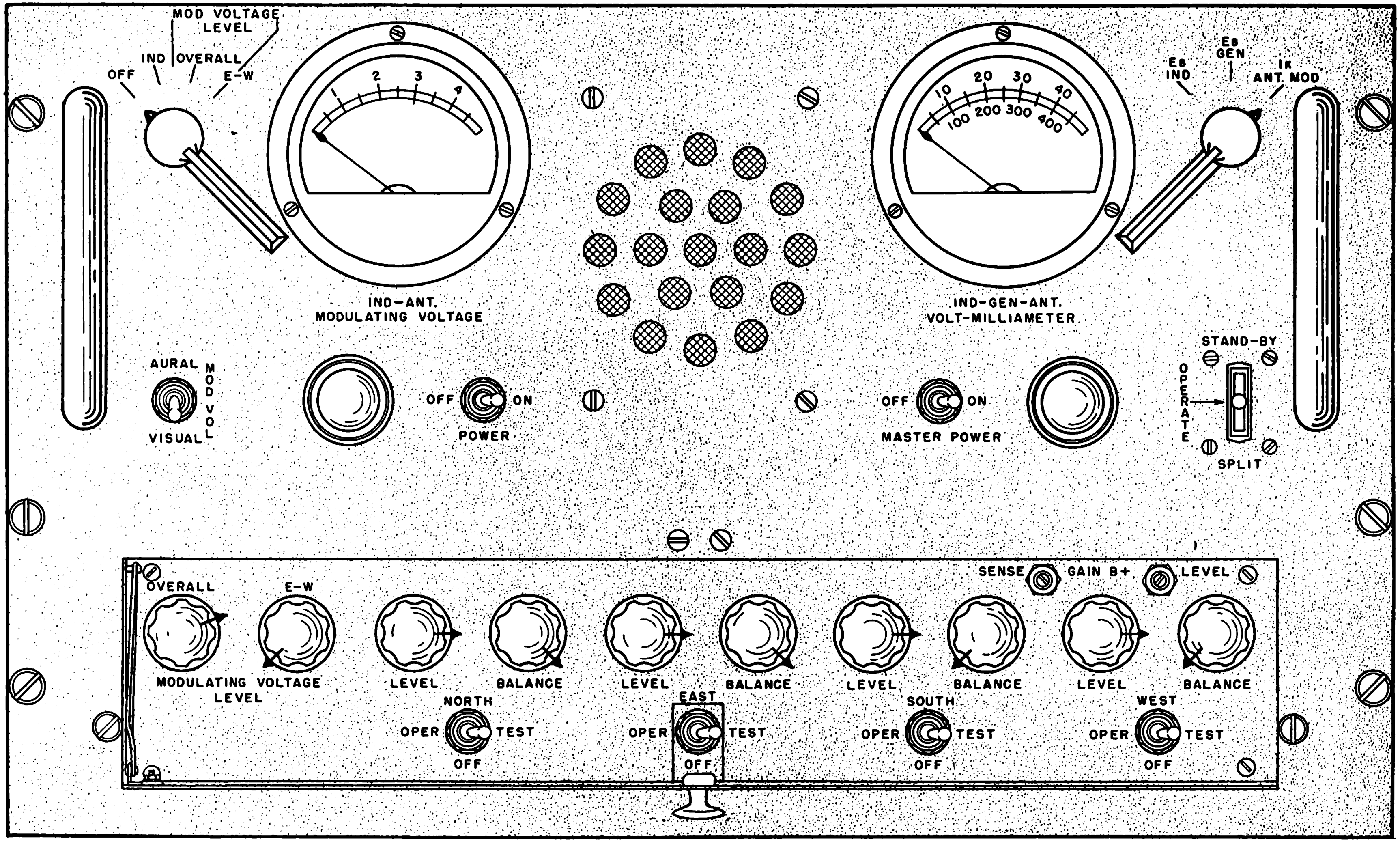

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Figure 41. Modulating Voltage Generator O-15/CRD-2, front panel controls.

antenna switches (NORTH, EAST, SOUTH, WEST switches) are in the TEST position.

Note. Take current readings on each individual antenna balanced modulator with the OPER-OFF-TEST switch for the particular modulator in its TEST position. Set the remaining three OPER-OFF-TEST switches to OFF. See *l* below.

h. IND-GEN-ANT VOLT-MILLIAMMETER METER. Meter M–402 is calibrated from 0–500 volts and from 0–50 ma. This meter is used as described in *g* above.

i. MODULATING VOLTAGE LEVEL OVER-ALL–E-W CONTROLS. The OVER-ALL control determines the level of 147-cycle audio voltage fed to the antenna balanced modulators. The E-W control is used to adjust the level of the voltage fed to the east and west balanced modulators with respect to that fed to the north and south balanced modulators.

j. LEVEL (NORTH, EAST, SOUTH, WEST) CONTROLS. These controls adjust the cathode current of the individual antenna balanced modulators.

k. BALANCE (NORTH, EAST, SOUTH, WEST) CONTROLS. These controls are used to superimpose the patterns on the cathode-ray tube by balancing the balanced modulator circuits in Antenna Coupling Units CU–34/CRD–2.

l. OPER-OFF-TEST (NORTH, EAST, SOUTH, WEST) SWITCHES. All these switches should be in their OPER positions for normal direction-finding operation. When making current measurements, measure each antenna balanced modulator separately with its switch in the TEST position. All other antenna balanced modulator switches should be placed in the OFF position.

m. SENSE GAIN CONTROL. This screw driver control adjusts the shape of the sense pattern.

n. B+ LEVEL CONTROL. This screw driver control is used to adjust plate voltage to 300 volts when the E_B IND - E_B GEN - I_K ANT MOD meter switch is in the E_B GEN position.

o. HUM CONTROL. Hum control R–463 is a screw driver adjustment on the *rear* of the modulating voltage generator chassis. This control is used to balance out hum voltages in the power supply; it is adjusted at the factory and should not require readjustment.

27. Bearing Indicator Controls
(figs. 13 and 42)

The front panel controls of the bearing indicator are as follows:

a. POWER ON-OFF SWITCH. Switch S–302 controls the application of a-c power in the bearing indicator.

b. PATTERN SHAPE AND SIZE CONTROLS. The SIZE control (R–306) varies the level of the 200-kc (kilocycle) r-f voltage applied to the vertical and horizontal balanced modulators. The SHAPE control (R–360) varies the level of the 147-cps modulating voltage fed to the vertical balanced modulators. The SIZE control varies the size of the illuminated area on the cathode-ray tube, and the SHAPE control varies the shape of this area.

c. ORIENTATION CONTROL. This screw driver control (R–351) is used for rotating the bearing pattern to compensate for incorrect orientation.

d. DIM CONTROL. This screw driver control (R–384) varies the brightness of the pilot lamps in the alidade assembly.

e. INTENSITY CONTROL. This control (R–312) provides a means of varying pattern intensity (brightness) on the cathode-ray tube.

f. FOCUS CONTROL. This control (R–316) adjusts the focus (sharpness) of patterns on the cathode-ray tube.

g. CENTERING H (R–318) AND V (R–319) CONTROLS. These controls are used to center the patterns on the screen; H is used for horizontal movement and V for vertical movement.

h. BEARING SPLITTERS H (R–339) AND V (R–328) CONTROLS. These controls are used when making preliminary adjustments to eliminate split patterns on the cathode-ray tube (due to bearing indicator unbalances); V is used for vertical alinement and H for horizontal alinement.

i. SENSE SWITCH. Switch S–301 is used in normal direction-finding operation to determine the direct bearing of the incoming signal. Depressing this switch changes the propeller-shaped pattern to a sense pattern (fig. 3).

j. ALINEMENT CONTROLS. The audio level (R–344), d-c level (R–377), hum (R–381), 200-kc peaking (C–307), sense blanking (C–309), vertical modulator peaking (C–325A), vertical modulator balance (C–325B), horizontal modulator peaking (C–335A), horizontal modulator balance (C–335B) and horizontal modulator balance controls are factory-adjusted. Readjustment of these controls is not required unless faulty operation indicates the

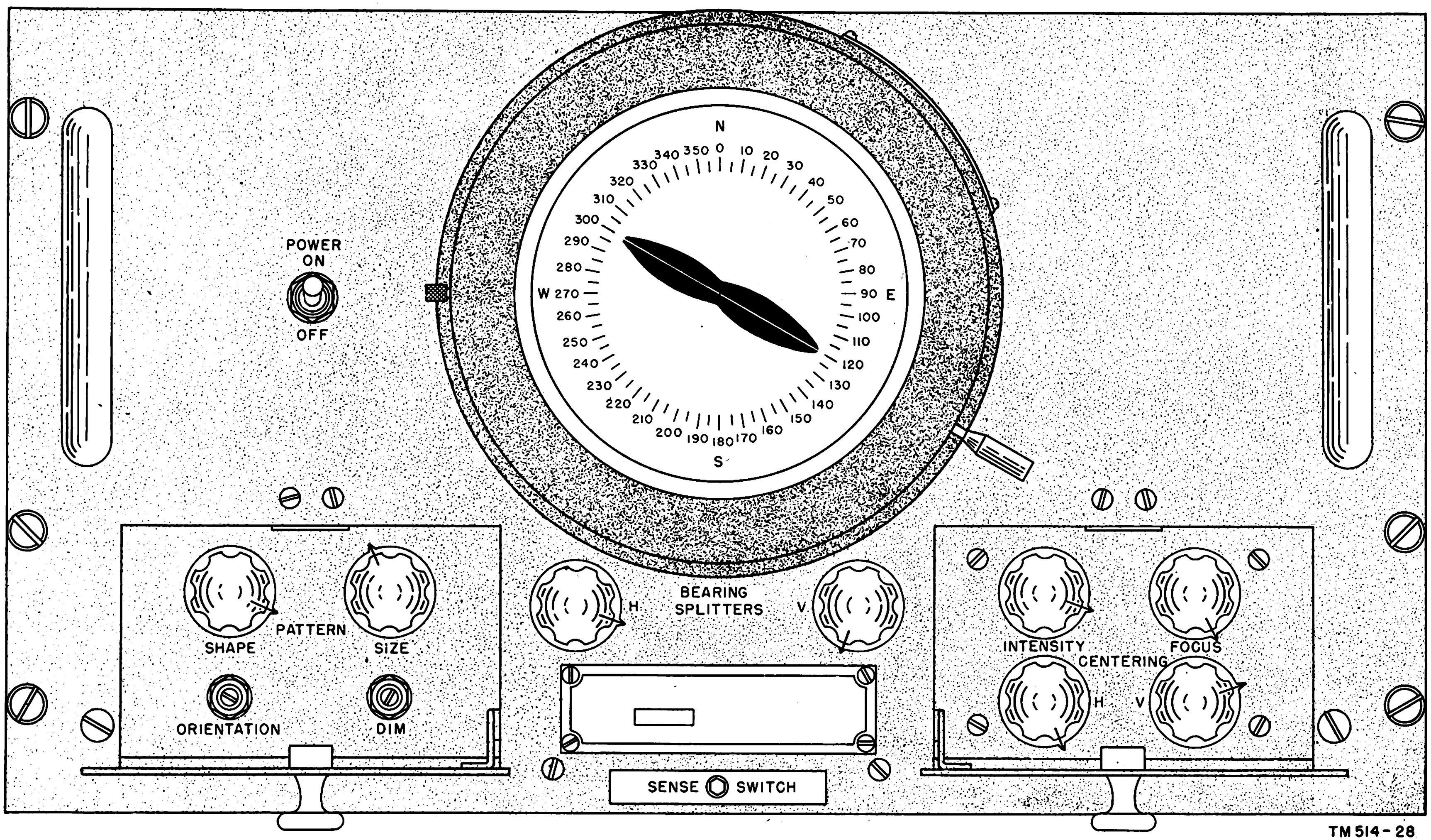


Figure 42. Bearing Indicator ID-64/CRD-2, front panel controls.

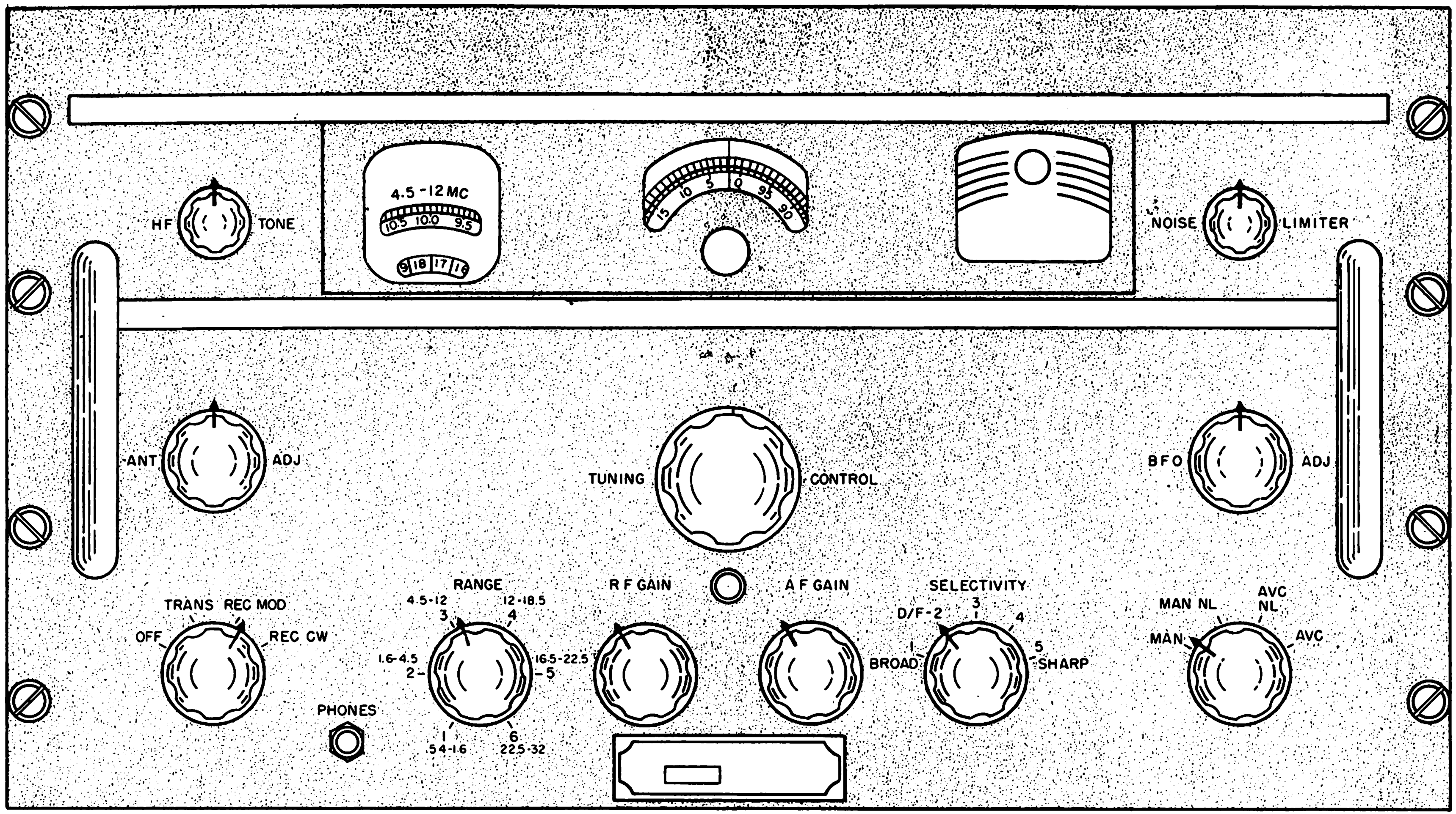


Figure 43. Radio Receiver R–127/CRD–2, front panel controls.

need for realinement of the bearing indicator (par. 168).

28. Radio Receiver Controls (figs. 11 and 43)

The following controls, switches, dials, and jacks are mounted on the front panel of the radio receiver:

a. OFF - TRANS - REC MOD - REC CW SWITCH. This four-position switch has the following functions:

(1) The OFF position turns the receiver power off.

(2) The TRANS position closes the receiver tube filament circuits and opens the plate circuits.

(3) The REC MOD position provides for normal voice reception.

(4) The REC CW position turns on the bfo and provides for reception of c-w signals.

b. RANGE SWITCH. This switch provides for selection of any one one of the six frequency ranges. (See *d*(1) below.)

c. ANT ADJ CONTROL. This control rotates variable trimmer capacitor, C–102, used to aline the first r-f amplifier tuned input circuits.

d. TUNING CONTROL. This control is geared to both tuning dials and main tuning capacitors C–103–A, –B, –C, –D, –E, –F, –G, and –H.

(1) The main tuning dial consists of a disk with seven scales, one for each of the six bands and a logging scale. Band 1, the standard broadcast band, is calibrated in kilocycles, and bands 2 through 6 are calibrated in megacycles. The scales provided for the six bands have the following ranges and dial divisions:

Band	Range	Dial divisions
1	540 to 1,600 kc	10 kc
2	1,570 to 4,550 kc	20 and 50 kc
3	4,450 to 12,150 kc	50 kc
4	11,900 to 16,600 kc	100 kc
5	16,100 to 22,700 kc	100 kc
6	22,000 to 32,000 kc	100 kc

(2) The vernier dial has a linear scale calibration with dial divisions from 0 to 100. It is used in conjunction with the log scale on the main tuning dial to give additional figures for logging and tabulation of exact log records of particular stations.

e. TUNING LOCK. This is used when it is desired to lock the TUNING CONTROL and capacitors in position. To lock, turn moderately tight in a clockwise direction.

f. NOISE LIMITER CONTROL. This potentiometer (R–135) is used to set the receiver at the required level of noise limitation. In the extreme clockwise position, the control limits the noise interference to 100 percent modulation. In the extreme counterlockwise position, the control limits the noise interference to a minimum percentage of modulation. Normally, the maximum clockwise position should be used but, under extreme conditions of interference, a compromise must be made for maximum clarity of the signal with least distortion and least noise.

g. SELECTIVITY SWITCH. This switch (S–102) provides five degrees of selectivity. This is accomplished by the use of four switches mounted on the same shaft. The first two positions are for modulated reception: position 1, BROAD, is the least selective and provides high-fidelity reception; position 2, D/F, provides normal modulated reception. In the last three positions, a crystal filter is used: position 3 is for normal c-w or selective modulated reception; position 4 provides for sharp c-w reception; position 5, SHARP, is for extremely sharp c-w reception. The D/F position of the SELECTIVITY switch should be used for visual direction finding, and the more selective positions are used only for aural-null operation.

h. MAN - MAN NL - AVC NL - AVC SWITCH. This noise-limiter, avc (automatic volume control) switch consists of switches S–103–A and –B, which provide for the selection of any one of four different types of operation.

(1) In the MAN position, output volume is adjusted manually with the RF GAIN and AF GAIN controls. With the switch in this position, there is no avc or noise-limiting action. For taking bearings, always place this switch in the MAN position.

(2) In the MAN NL position, output vol-

ume also is adjusted manually. In this position, a noise-limiting circuit is in operation, but there is no avc action. This position is used most commonly when receiving cw with the presence of noise interference.

(3) In the AVC NL position, output volume is adjusted manually with the AF GAIN control while the RF GAIN control sets the level at which avc action takes place. In this position, the noise-limiting circuit is in operation. Normally, the RF GAIN control is set fully clockwise, setting the delay voltage for avc comparatively low. Under conditions of extreme noise interference, the delay voltage should be increased by setting back (counterclockwise) the RF GAIN control, thus allowing the noise-limiting stage to be more effective. The AVC NL position is used most commonly when receiving modulated signals with the presence of noise interference.

(4) In the AVC position, used for monitoring only, output volume is adjusted manually with the AF GAIN control, while the RF GAIN control sets the level at which avc action takes place. In this position, there is no noise-limiting action; therefore, this position is used most commonly when receiving modulated signals without the presence of noise interference.

i. AF GAIN CONTROL. This potentiometer (R–150) controls the input voltage to the first a-f (audio-frequency) amplifier.

j. RF GAIN CONTROL. This potentiometer (R–145) controls the gain of the first and second r-f stages and the first and second i-f (intermediate-frequency) stages when the receiver is set for manual volume control. During avc operation, the RF GAIN control sets the delay voltage for avc. As the control is rotated counterclockwise, a greater delay voltage is developed and avc action does not take place until the signal voltage is of a greater magnitude.

k. HF TONE CONTROL. This potentiometer (R–157) is used to attenuate the higher audio frequencies. It is in series with capacitor C–190, and the combination of the two is connected across the output of the first a-f amplifier. With the control in the extreme clockwise position, normal tone is obtained. To attenuate the higher audio frequencies, rotate the control counterclockwise.

l. BFO ADJ CONTROL. This control adjusts trimmer capacitor C–205 which is used to vary the audio tone of c-w signals. After the signal has been tuned accurately, adjust this control to the desired audio tone. The BFO has greatest usefulness when the aural-null feature is used. For example, when two stations have nearly the same frequency, the BFO can be set for zero-beat on the unwanted signal and the aural-null bearing can be taken on the desired signal.

m. PHONES JACK. This is a two-position jack, J–102, which allows for selection of either phone or phone-and-speaker output. With the phone plug in the first position (halfway in), the phones are across the 2.5-ohm output and the speaker and phone circuits both are closed. With the phone plug in the second position (fully in), the phones are across the headphone winding and the speaker circuit is open. If neither the 2.5- nor the 250-ohm output circuit is loaded, the phone plug should be in the second position (fully in) to prevent improper loading of the output circuit and resulting distortion.

29. Azimuth Indicator Controls
(figs. 14 and 44)

The front panel of the assembly includes the following controls:

a. VISUAL-AURAL. With this switch (S–1002) at VISUAL, the direction finder is operated to obtain normal visual bearings. With the switch at AURAL, bearings are obtained by the aural-null method.

b. SENSE WHITE-RED. The switch (S–1001) is used for sense indication (determining correct direction).

c. AZIMUTH SCALE. The third control (unmarked) is used to rotate the 360° azimuth scale.

d. MODULATING LEVEL CONTROL. This control (R–1002) is used to adjust the d-c modulating voltage to equal that of the peak a-c modulating voltage of the modulating voltage generator.

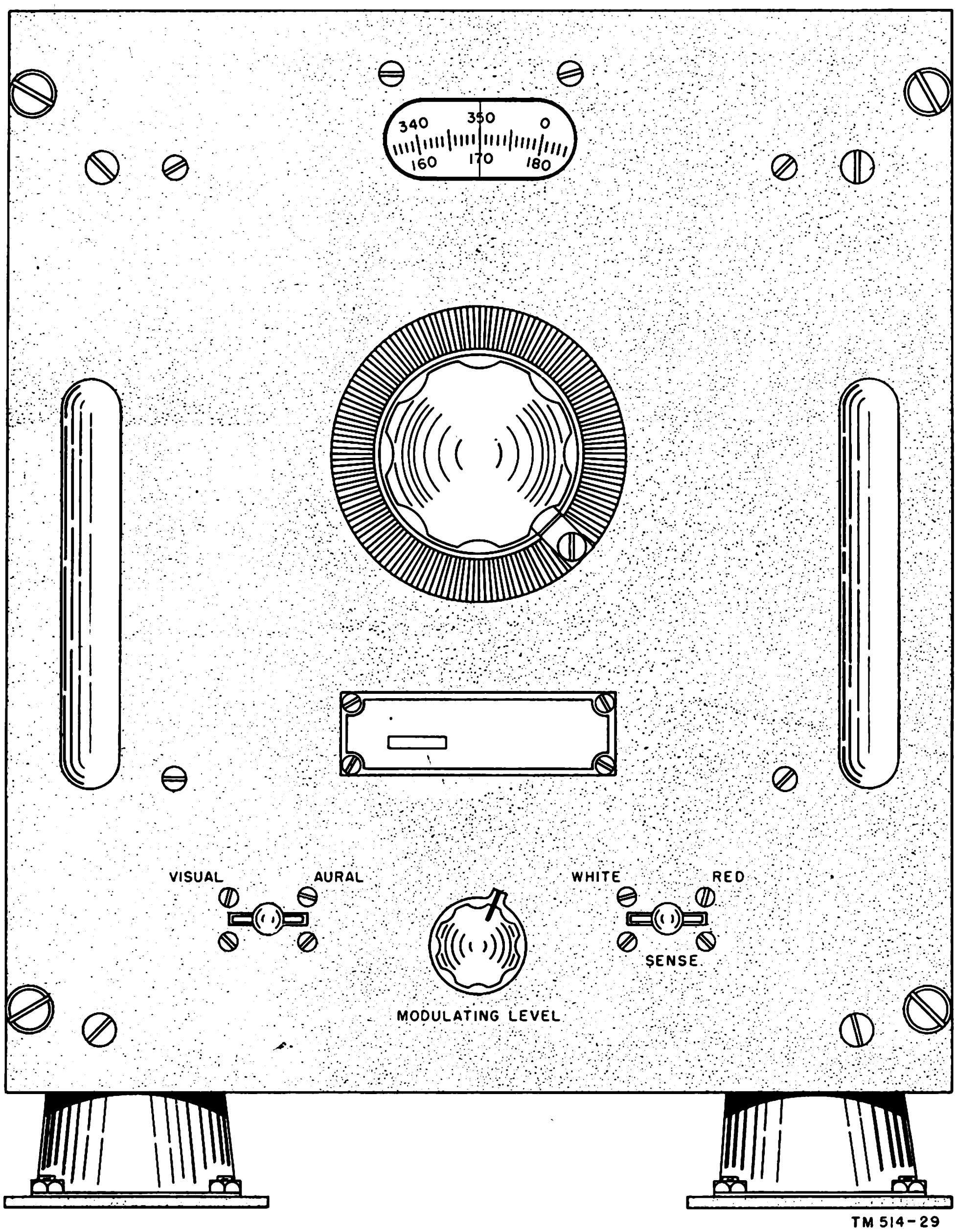


Figure 44. Azimuth Indicator ID–240/CRD–2, front panel controls.

Section III. OPERATION UNDER USUAL CONDITIONS

Note. Prior to initial operation of equipment after installation or repair, see section V of this chapter.

30. Starting

*Perform the preliminary starting procedure given in **a** below before using the actual starting procedure given in **b**.*

a. PRELIMINARY STARTING PROCEDURE.

(1) On Junction Box J–95/CRD–2—

(*a*) Set OUTPUT LOAD switch at OFF.

(*b*) Set LINE INPUT switch at OFF.

(*c*) Set OUTPUT VOLTAGE CONCONTROL at 1.

(2) On Azimuth Indicator ID–240/CRD–2—

(a) Set VISUAL-AURAL switch at VISUAL.
(b) Set MODULATING LEVEL control at midposition.

(3) On Modulating Voltage Generator O–15/CRD–2—

Note. Do not touch any LEVEL or BALANCE controls. These controls have been preset in accordance with the system balancing instructions given in paragraph 45.

(a) Set MASTER POWER switch at OFF.
(b) Set POWER switch at OFF.
(c) Set MOD VOL switch at VISUAL.
(d) Set STAND-BY - OPERATE - SPLIT switch at OPERATE.
(e) Set E_B IND - E_B GEN - I_K ANT MOD switch at E_B GEN.
(f) Set MOD VOLTAGE LEVEL switch at OFF.
(g) Set NORTH, EAST, SOUTH, and WEST swtiches at OFF.

(4) On Bearing Indicator ID–64/CRD–2—

Note. Do not touch the ORIENTATION control.

(a) Set POWER switch at OFF.
(b) Rotate INTENSITY and FOCUS controls fully counterclockwise.
(c) Set H and V CENTERING controls at midposition.
(d) Set BEARING SPLITTERS at midposition.
(e) Rotate DIM control fully clockwise.
(f) Set PATTERN SHAPE control at midposition.
(g) Rotate PATTERN SIZE control fully counterclockwise.

(5) On Radio Receiver R–127/CRD–2—

(a) Set OFF - TRANS - REC MOD - REC CW switch at OFF.
(b) Set RANGE switch at 3 if h-f antenna combination is in use, or at 2 if l-f antenna is in use.
(c) Rotate RF GAIN and AF GAIN controls fully counterclockwise.
(d) Set SELECTIVITY switch at D/F–2.
(e) Set MAN - MAN NL - AVC NL - AVC switch at MAN.
(f) Rotate BFO ADJ and ANT ADJ controls until the pointers are straight up.
(g) Set NOISE LIMITER and HF TONE controls to midposition.

b. STARTING PROCEDURE.

Note 1. Perform the steps in the starting procedure in the exact order and in exactly the same manner as described below. If departures are made in the sequence of the starting procedure, the normal conditions listed in each step may not be obtained.

Note 2. If, during the starting procedure, an abnormal result is obtained, see paragraph 60 in chapter 3 for corrective measures.

After completing the preliminary starting procedure given in *a* above, perform the following steps:

STEP 1: On Junction Box J–95/CRD–2, throw OUTPUT LOAD switch to DUMMY.

STEP 2: On Junction Box J–95/CRD–2, throw LINE INPUT switch to the position which corresponds to the voltage of the a-c power source. For example, if the voltage of the a-c power source is between 100 and 120 volts, throw the switch to the 115V position. The normal indications are—

The OUTPUT VOLTAGE meter will indicate less than 115 volts.

The LINE FREQUENCY meter will indicate approximately 60 cycles.

The meter readings should not fluctuate.

STEP 3: On Junction Box J–95/CRD–2, rotate the OUTPUT VOLTAGE control clockwise until the OUTPUT VOLTAGE meter indicates approximately 115 volts.

STEP 4: On Junction Box J–95/CRD–2, throw OUTPUT LOAD switch to EQUIPMENT. There may or may not be a change in the OUTPUT VOLTAGE meter reading, depending on regulation of a-c power source.

Note. After the radio set has been turned on completely, there should be no appreciable change in the meter readings as the switch is thrown from EQUIPMENT to DUMMY. The dummy load built into the junction box is approximately equal to the equipment load imposed by the radio set.

STEP 5: On the modulating voltage generator, throw the MASTER POWER switch to ON. The pilot light adjacent to this switch will light.

STEP 6: On the modulating volatge generator, throw the POWER switch to ON. The normal indications are—

The pilot light adjacent to this switch will light.

The IND-GEN-ANT VOLT-Milliammeter will indicate 300 volts.

STEP 7: On the modulating voltage generator, throw the E_B IND - E_B GEN - I_K ANT MOD switch to I_K ANT MOD, throw the NORTH switch to TEST, observe the reading of the IND-GEN-ANT VOLT-MILLIAMMETER, and then throw the NORTH switch to OFF. The observed reading will be between 7 and 13 ma.

STEP 8: Repeat the operation described in step 7, successively, for the EAST, SOUTH, and WEST switches. When any one of these switches is at TEST, the IND-GEN-ANT VOLT-MILLIAMMETER will read between 7 and 13 ma.

STEP 9: On the modulating voltage generator, rotate the MOD VOLTAGE LEVEL switch to OVERALL. The IND-ANT MODULATING VOLTAGE meter will read 3 volts.

STEP 10: On the modulating voltage generator, rotate the MOD VOLTAGE LEVEL switch to E-W. The IND-ANT MODULATING VOLTAGE meter will read 3 volts.

STEP 11: On the bearing indicator, throw the POWER switch to ON. The dial lights on the azimuth scale will light.

Note. After performing this step, allow 15 minutes for the equipment to warm up.

STEP 12: On the modulating voltage generator, rotate the E_B IND - E_B BEN - I_K ANT MOD switch to the E_B IND position. The IND-GEN-ANT VOLT-MILLIAMMETER will read 300 volts.

STEP 13: On the modulating voltage generator, rotate the MOD VOLTAGE LEVEL switch to IND. The IND-ANT MODULATING VOLTAGE meter will read 1.5 volts.

STEP 14: On the bearing indicator, rotate the INTENSITY control clockwise until illumination is observed on the screen of the cathode-ray tube.

STEP 15: On the bearing indicator, rotate the FOCUS control clockwise until the illumination appears as a sharply defined, small spot.

STEP 16: On the bearing indicator, adjust the H and V CENTERING controls until the spot of illumination is centered on the screen. The normal indications are—

The spot of illumination moves vertically as the V control is rotated.

The spot of illumination moves horizontally as the H control is rotated.

STEP 17: On the bearing indicator, rotate the PATTERN SIZE control clockwise until the extremities of the illuminated area are just within the inner diameter of the azimuth scale.

Note. The size of the illumniated area will vary with the setting of the SIZE control. The illuminated area will consist of two circular or elliptical patterns not necessarily superimposed.

STEP 18: On the bearing indicator, adjust the H and V BEARING SPLITTERS until the elliptical or circular patterns are superimposed. The normal indications are—

The H BEARING SPLITTER control will superimpose the patterns in the horizontal plane.

The V BEARING SPLITTER control will superimpose the patterns in the vertical plane.

STEP 19: On the bearing indicator, rotate the PATTERN SHAPE control until a circular pattern is obtained. Readjust the SIZE control as necessary (step 17).

Note. This circular pattern should be stationary.

STEP 20: On the bearing indicator, rotate one of the BEARING SPLITTER controls until the two circular patterns are not superimposed. Then depress the SENSE switch. One of the circular patterns will appear faint or will disappear when the SENSE SWITCH is depressed.

STEP 21: Repeat step 18.

STEP 22: On the radio receiver, rotate the OFF - TRANS - REC MOD - REC CW switch to REC MOD. The dial lights will light.

STEP 23: On the radio receiver, rotate the RF GAIN and the AF GAIN controls fully clockwise and rotate the ANT ADJ control for maximum noise output from the speaker. Then adjust the AF GAIN control for a desirable audio output. The normal indications are—

A noise output will be heard from the speaker.

The circular pattern on the screen of the cathode-ray tube will become noise-modulated.

STEP 24: On the modulating voltage generator, throw the NORTH switch to TEST. Then tune in a strong, steady signal of known azimuth by rotating the TUNING CONTROL and the ANT ADJ control on the radio receiver. Next, rotate the RF GAIN and the AF GAIN controls, as necessary, until a propeller-shaped pattern (or two propeller-shaped patterns not superimposed) is observed on the screen of the cathode-ray tube and a desirable audio output is obtained from the speaker. Finally, throw the NORTH switch to OFF. The normal indications are—

When the NORTH switch is at TEST, the pattern on the screen will change from circular to propeller-shaped.

When the NORTH switch is at TEST, a signal will be heard from the speaker.

STEP 25: Repeat the actions given in step 24, successively, for the EAST, SOUTH, and WEST switches. For normal indication see step 24.

Note. The angular position of the pattern will be the same for the north and south checks but will be displaced 90° for the east and west checks.

STEP 26: Repeat the actions given for step 24 to obtain the propeller-shaped pattern when the NORTH switch is at TEST. Then if two patterns not superimposed are observed on the screen, adjust the BALANCE control located above the NORTH switch until the patterns are superimposed. Then throw the NORTH switch OFF.

STEP 27: Repeat the actions given in step 26 except use, in turn, the EAST, SOUTH, and WEST switches instead of the NORTH switch. Also use the BALANCE control above the switch in use. For example, when the WEST switch is at TEST and a split pattern is obtained, adjust the BALANCE control located above the WEST switch to superimpose the patterns.

STEP 28: Throw the NORTH, EAST, SOUTH, and WEST switches to OPER and obtain a bearing (propeller-shaped) pattern from a strong station of known azimuth by rotating the controls of the radio receiver. One tip of the propeller-shaped pattern will indicate the direct azimuth of the received signal. The other tip of the pattern will indicate the reciprocal azimuth of the signal.

STEP 29: While observing the propeller-shaped pattern on the screen, depress the SENSE SWITCH on the bearing indicator. The propeller-shaped pattern will change to a sense pattern similar to one of those shown in figure 46. The direct azimuth of the received signal will be indicated by the position of the sense pattern with respect to the propeller-shaped pattern. The frequency of the audio output will become lower.

STEP 30: Obtain the bearing pattern by performing the actions given in step 28. Then move the STAND-BY - OPERATE - SPLIT switch on the modulating voltage generator to SPLIT. This action will cause the bearing pattern to split with the intersection of the split indicating the same azimuth as did the tip of the single, propeller-shaped pattern.

STEP 31: While observing the bearing pattern, move the STAND-BY - OPERATE - SPLIT switch to STAND-BY. The bearing pattern will be replaced by a circular pattern, the diameter of which will change with the setting of the RF GAIN control, and the audio output will not be modulated by the 2 x 147-cps (cycle per second) signal.

STEP 32: With the STAND-BY - OPERATE - SPLIT switch at OPERATE and the OFF - TRANS - REC MOD - REC CW switch at REC CW, adjust the BFO ADJ control to obtain any desired audio pitch. An audio beat note will be obtained, and the frequency of this beat note will vary with rotation of the BFO ADJ control (see note below). After completing this step, rotate the OFF - TRANS - REC MOD - REC CW switch to REC MOD.

Note. A beat note will be obtained for any position of the STAND-BY - OPERATE - SPLIT switch. However, the 2 x 147-cps modulating component in the audio signal will not be heard in the STAND-BY position of the switch.

STEP 33: On the azimuth indicator, throw the VISUAL-AURAL switch to AURAL, and on the modulating voltage generator, throw the MOD VOL switch to AURAL and the STAND-BY - OPERATE - SPLIT switch to OPERATE. The normal indications are—

The lights for the red and white scales of the dial light will light.

The IND-ANT MODULATING VOLTAGE meter will read 3 volts.

The pattern will change from a propeller-shaped pattern to a circular pattern, the diameter of which will change with the setting of the azimuth indicator dial knob and the RF GAIN control. Also the aural output of the speaker will vary with the setting of these controls, and the 2 x 147-cps modulating component of the audio signal will not be heard in the speaker output.

STEP 34: Rotate the azimuth indicator dial knob to obtain a null or minimum output from speaker. The speaker output will vary as the control is rotated. At the aural-null position, the bearing, as indicated by the dial on the azimuth indicator, will be the same as the visual bearing as observed in step 28 on the cathode-ray tube indicator.

STEP 35: With the azimuth dial at an aural-null setting, throw the SENSE switch on the azimuth indicator first to RED and then to WHITE. The normal indications are—

With the switch at RED, only the red scale of the dial will be illuminated. With the switch at WHITE, only the white scale of the dial will be illuminated.

In one postiion of the switch, the signal will be louder than in the other position. At the louder position, the direct azimuth will be indicated on the illuminated dial, and this azimuth will be the same as the direct azimuth observed during visual indication (steps 28 and 29).

STEP 36: Upon completion of step 35, the radio set is ready for aural-null operation. If visual operation is desired instead of aural-null operation, throw the VISUAL-AURAL switch on the azimuth indicator to VISUAL and throw the MOD VOL switch on the modulating voltage generator to VISUAL.

31. Operaitng Procedure

a. Rario Receiver R–127/CRD–2.

(1) Tune the receiver carefully and accurately.

(2) Adjust the ANT ADJ control to obtain maximum output.

(3) After the receiver has been tuned to a signal, adjust the RF GAIN control for a pattern as shown in figure 45A with the collapsed sides of the circular area just meeting at the center.

(4) Keep SELECTIVITY switch in D/F–2 position at all times for visual operation. For aural-null operation, the more selective switch positions may be used.

b. Modulating Voltage Generator O–15/-CRD–2. The only adjustment used during operation is the STAND-BY - OPERATE - SPLIT switch. Set this switch to OPERATE position for normal (direction-finding) operation, to SPLIT for reading extremely weak steady signals (C, fig. 45), and to STAND-BY for monitoring and high-sensitivity searching.

c. Bearing Indicator ID–64/CRD–2.

(1) Use the cross hair arrangement on the alidade assembly to facilitate reading of bearings.

(2) Depress the SENSE switch for determination of direct bearing as compared to reciprocal bearing.

d. Azimuth Indicator ID–240/CRD–2.

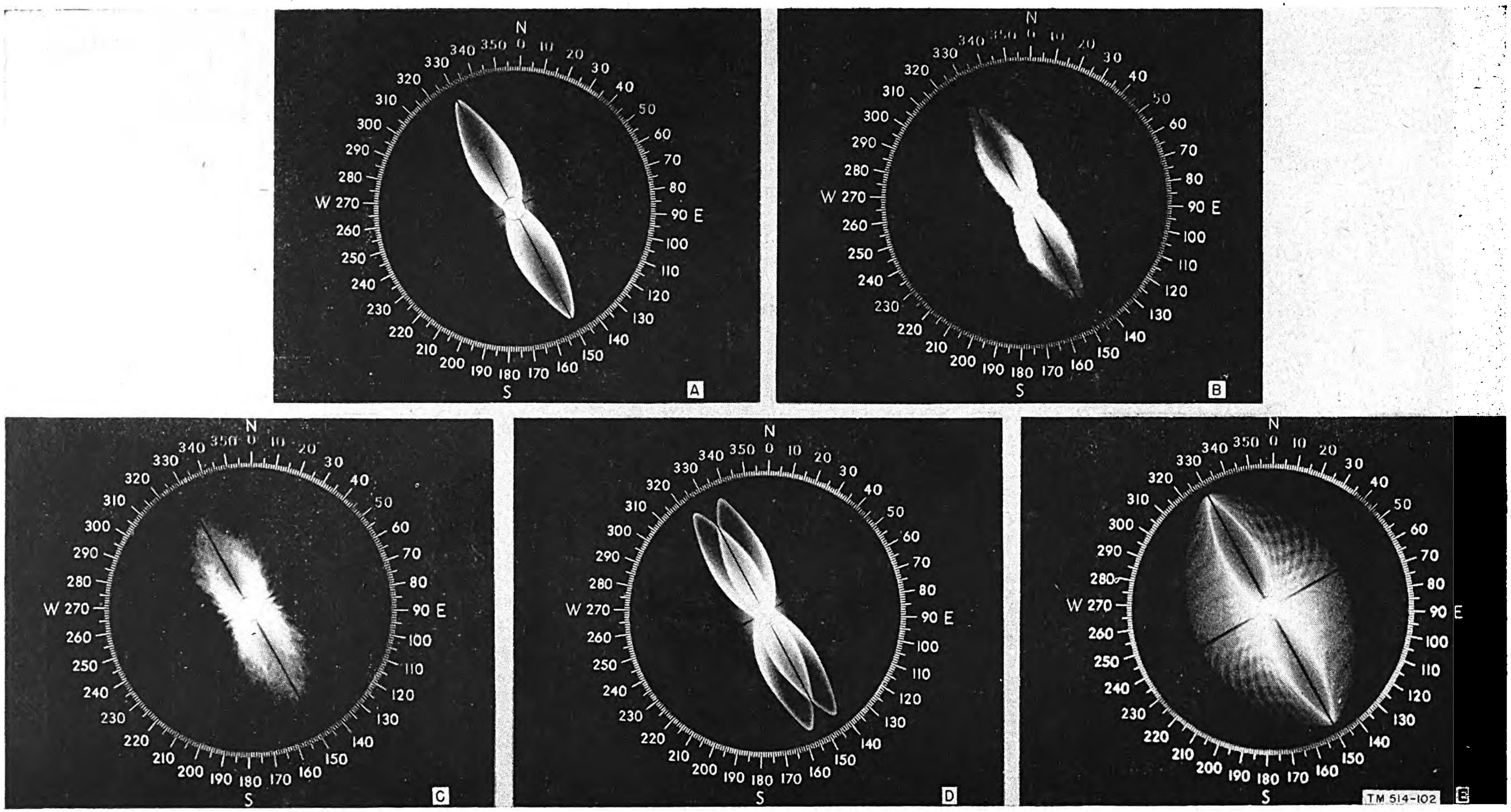
(1) Turn the azimuth scale until a null (minimum signal) is obtained. Two nulls will be found 180° apart on the azimuth scale; either null may be used as indicated in (2) below.

(2) Move the SENSE WHITE-RED switch alternately to the RED and WHITE positions. In one position the signal will be louder; read the direct bearing on the azimuth scale corresponding in color to the sense switch position which produced the louder indication.

Example 1: If, in alternately switching the SENSE switch from the RED to the WHITE position, the signal is louder in the RED position, read the red azimuth scale as the direct bearing. The white azimuth scale will indicate the reciprocal bearing.

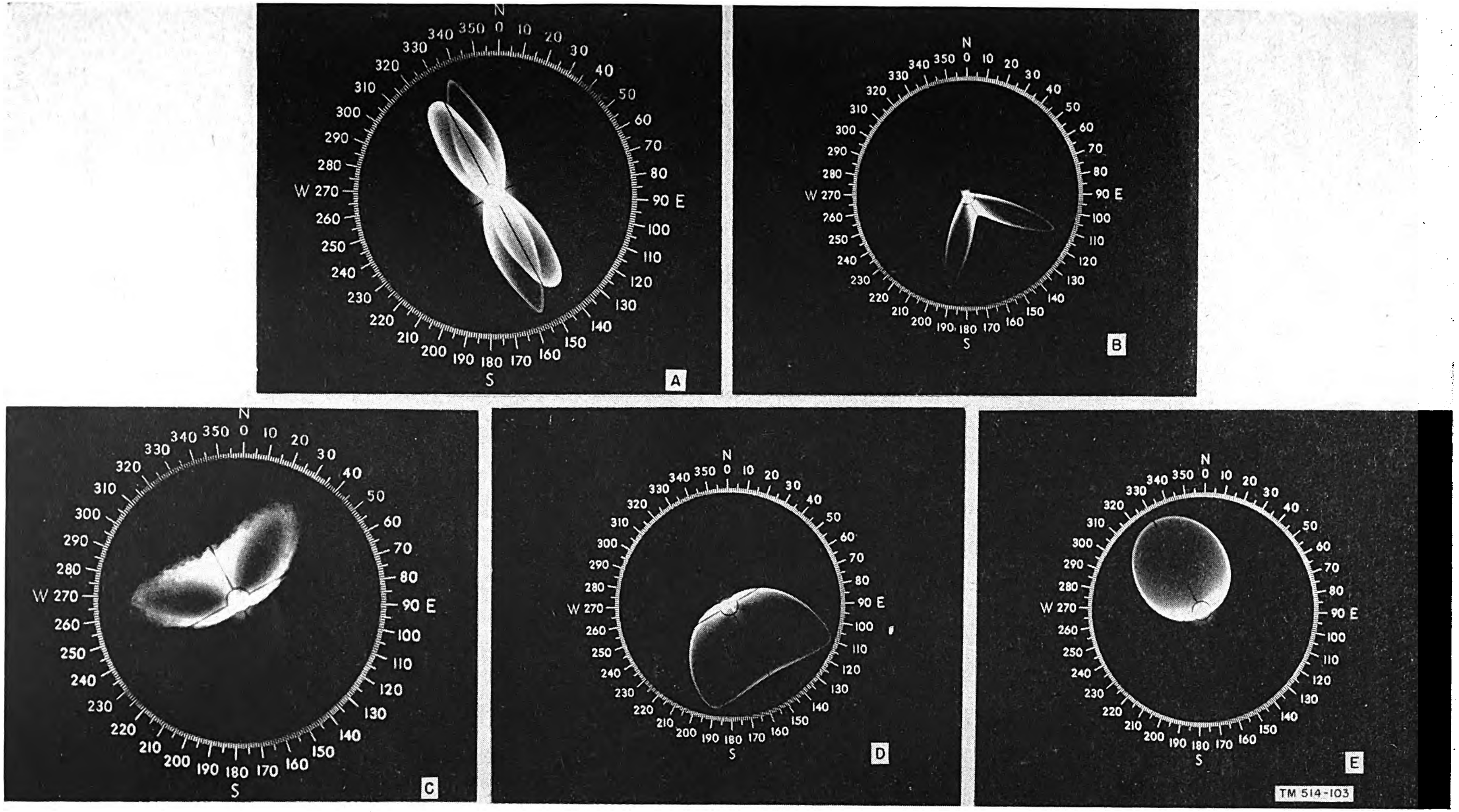
Example 2: If the WHITE position of the SENSE switch produces the louder signal, read the white azimuth scale for the direct bearing. The red azimuth scale will indicate the reciprocal bearing.

(3) In taking bearings with the aural indicator, it is advisable to observe both the direct and reciprocal bearing in-



A. Normal bearing pattern, strong signal.
B. Normal bearing pattern, moderately weak signal.
C. Normal bearing pattern, weak signal.
D. Symmetrically split bearing pattern, strong signal.
E. Normal bearing pattern, strong signal with modulation.

Figure 45. Cathode-ray tube presentations.



A. Unsymmetrically split bearing pattern, strong signal.
B. Sense pattern, strong signal and medium sense voltage.
C. Sense pattern, weak signal.
D. Sense pattern, strong signal and medium sense voltage lower setting of RF GAIN control than for pattern in 46B.
E. Sense pattern, strong signal and high sense voltage.

Figure 46. Cathode-ray tube presentations.

dications. In the event that these two bearings are not 180° apart in azimuth, it is necessary to average the two bearings to obtain a correct reading. This is accomplished in the following manner: Subtract the smaller bearing from the larger. Then proceed as follows:

(*a*) If the resulting figure is less than 180°, subtract it from 180°. Subtract half of the difference so obtained from the smaller bearing and add half of the difference to the larger bearing to obtain the correct direct and reciprocal bearing. For example, suppose the two indicated bearings are 4° and 178°. Their difference is 174° (178° — 4° = 174°), which is less than 180°. Then 180° minus 174° is equal to 6°. Half of this difference, 3°, (6° ÷ 2), is subtracted from the smaller bearing, 4°; and half is added to the larger bearing, 178°, to obtain correct bearings of 1° and 181°, respectively.

(*b*) If the resulting figure is greater than 180°, subtract 180° from the figure. Add half of the difference so obtained to the smaller bearing and subtract half of the difference from the larger bearing to obtain the correct direct and reciprocal bearing. For example, suppose the two indicated bearings are 4° and 188°. The difference is 184° (188° — 4° = 184°), which is greater than 180°. Then 184° minus 180° is 4°. Half of this difference, 2°, (4° ÷ 2), is added to the smaller bearing, 4°; and half is subtracted from the larger bearing, 188°, to obtain correct bearings of 6° and 186°, respectively.

32. Octantal Error

a. GENERAL. An error known as octantal error is encountered with Radio Set AN/CRD-2 is used in the frequency range of 6 to 30 mc. The error is a function of antenna monopole spacing, the angle of arrival, and the frequency of the received signal.

b. OCTANTAL ERROR CORRECTION CHART. An octantal error correction chart for the h-f combinations (18-foot, 10-inch diagonal antenna spacing) is shown in figure 47. The curves on the chart show the number of degrees which either must be added or subtracted from the observed bearing in order to compensate for the octantal error.

Example 1: If the observed azimuth bearing on the indicator is 110° at a frequency of 24 mc, reference to the error correction chart shows that 5° must be subtracted from the observed bearing of 110° in order to obtain 105°, the correct bearing.

Example 2: If the observed bearing on the indicator is 75° at a frequency of 18 mc, reference to the error correction chart shows that 2.5° must be added to the observed bearing of 75° in order to obtain 77.5°, the correct bearing.

Note. If the antenna system is not oriented physically to either true or magnetic north (par. 16), the octantal error correction chart cannot be used directly. The following text describes what must be done in order to use the octantal error correction chart for the above condition.

(1) If the antenna system is oriented east of either true or magnetic north, *subtract* from the observed bearing the number of degrees that the antenna system is misoriented east of either true or magnetic north. The remainder then is used (instead of the observed bearing) to determine the correction by means of the octantal error correction chart. The correction indicated by the chart is used to correct the *original* observed bearing.

(2) If the antenna system is oriented west of either true or magnetic north, *add* to the observed bearing the number of degrees that the antenna system is misoriented west of either true or magnetic north. The sum then is used (instead of the observed bearing) to determine the correction by means of octantal error correction chart. The correction as indicated by the chart is used to correct the *original* observed bearing. The following examples show how the chart may be used for the above conditions.

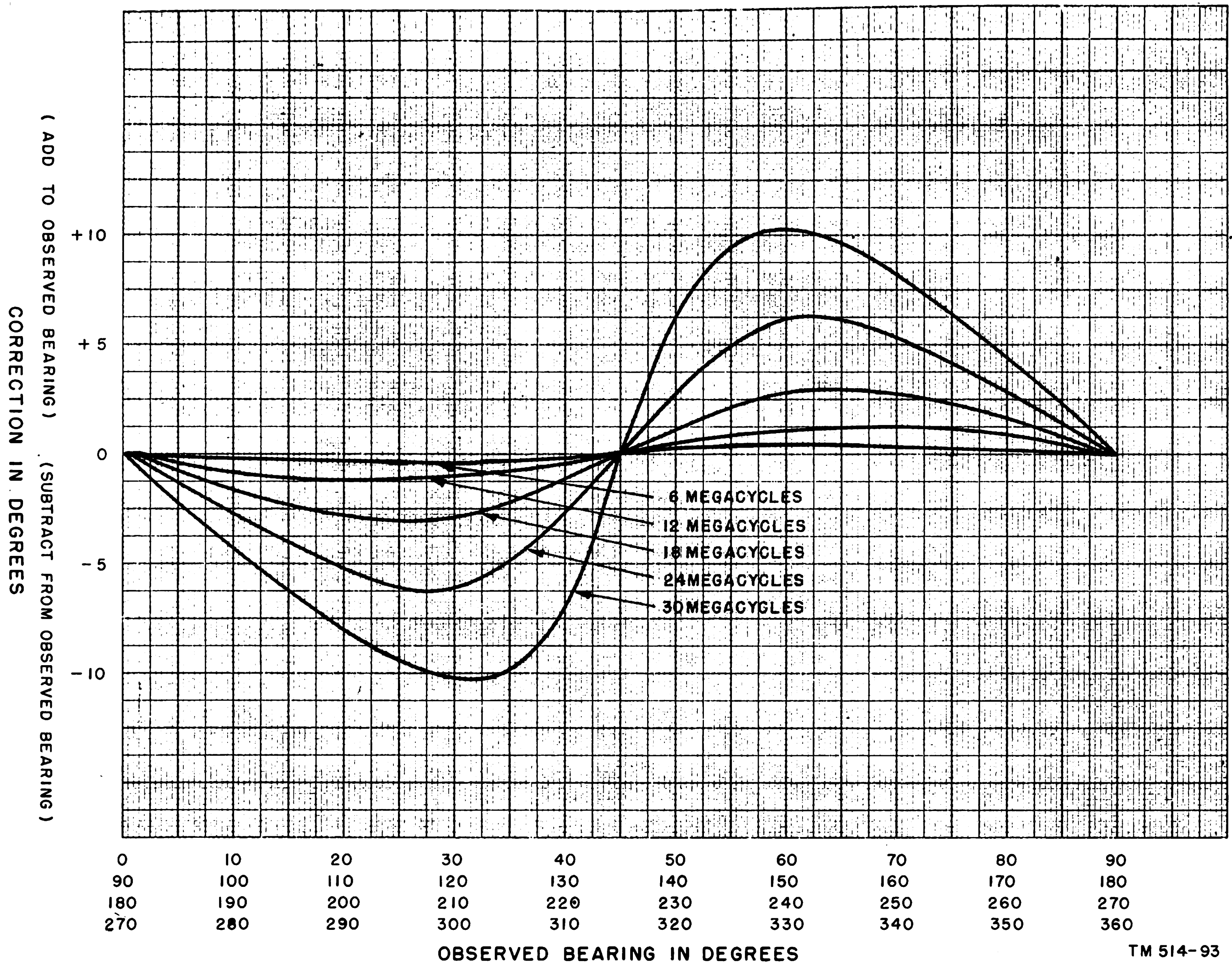


Figure 47. Octantal error correction chart for the high-frequency antenna combinations (four-element, spaced-collector array with 18-foot, 10-inch diagonal spacing).

Example 1: If the antenna system is physically oriented to 10° east of either true or magnetic north and the observed bearing for an 18-mc signal is 33°, *subtract* 10° from 33°. Using the remainder, 23°, instead of the observed bearing, determine the correction by means of the error correction chart. Reference to the error correction chart shows that 3.0° must be subtracted from the *original* observed bearing of 33° to obtain the correct bearing of 30°.

Example 2: If the antenna system is oriented physically to 10° west of either true or magnetic north and the observed bearing for a 24-mc signal is 46°, *add* 10° to the 46°. Using the sum, 56°, instead of the observed bearing, determine the correction by means of the error correction chart. Reference to the error correction chart shows that 5° must be added to the original observed bearing of 46° to obtain the correct bearing of 51°.

Note. To determine octantal error correction for signals on frequencies other than those shown on the chart (fig 47), interpolate between the curves shown.

33. Pattern Interpretation

Type of indication	Characteristics	How or when to read bearing most effectively	Reliability and interpretations of bearing
a. Steady indication on a c-w signal, an icw signal, or a modulated signal.	Sharp propeller tips (A, fig. 45); does not swing more than 1°; no fading.	Read any time after tuning in; use cross hairs.	Very reliable.
b. Slightly fading or swinging indication on any signal.	Propeller tips sharp at times; when signal fades, propeller tips may get slightly round and signal may swing 3° to 6°; pattern may open up slightly.	Read when signal is strongest and tips are sharp; or watch swing and set cross hairs at point about which the pattern is swinging.	Very reliable if read carefully; swinging is due to space-diversity effects which cause signal to fade at a *different* time for each antenna.
c. Badly fading and swinging indication on any signal.	Propeller tips sharp at times; signal fades very slowly and at the same time swings 10° or 20° or rotates very slowly; pattern almost disappears at times.	Pattern may stop for just a moment at a certain point when signal will be strongest and tips sharp; watch for these stops and set cross hair immediately. If pattern seems to stop at same bearing every time *after* it fades, read bearing at that point. If stopping points vary and signal is very wild, do not take a reading unless it is absolutely necessary.	Reliability depends on experience of operator; a very slow, gradual change in polarization of the received signal causes large changes and differences in the voltages induced in the individual antennas and results in a badly swinging and rotating pattern.
d. Steady or slightly swinging indication on a *weak* signal.	Poorly defined, fuzzy propeller tips (B, fig. 45).	Use cross hairs and read when signal is strongest. *or* Throw STAND-BY - OPERATE - SPLIT switch to SPLIT, set cross hairs, and read bearing at intersection of the two patterns.	Reliable if read carefully when signal is steady. (An extremely weak signal pattern is shown in sketch C of figure 45.)
e. Symetrically split indication. (A strong signal with symmetrical split is shown in figure 45D.)	Two propeller-shaped patterns, equal in length, whose tips are from 2° to 10° apart.	Set cross hairs and read at intersection of patterns. If signal is fading or swinging, follow additional instructions given in *b* above.	Reliable. IF MORE THAN 10 PERCENT OF PATTERNS ARE SPLIT, CHECK BALANCE OF INDIVIDUAL ANTENNA COUPLING UNITS, GROUND STRAPS, AND CABLE CONNECTORS.

Type of indication	Characteristics	How or when to read bearing most effectively	Reliability and interpretations of bearing
f. Unsplit indication with draw-in.	Two propeller-shaped patterns *unequal* in length whose tips are on same radial line (usually tips of shorter propeller blade are rounded).	If draw-in is steady, use cross hairs as for normal indication. If draw-in varies, read when signal is strongest and propeller tips are sharp.	Reliable if read carefully and not swinging more than 7° or 8°. IF MORE THAN 10 PERCENT OF PATTERNS ARE DRAWN IN, CHECK ALL GROUND STRAPS, R-F CABLES, AND CONNECTIONS.
g. Unsymmetrically split indications.	Two propeller-shaped patterns *unequal* in length whose tips are 2° to 10° apart (A, fig. 46). (This is a combination of *e* and *f* above.)	If the split varies in width, watch for the moment when it becomes symmetrical and read at intersection as for *e* above. If split is constantly unsymmetrical and does not vary in width, read azimuth for each pattern separately and take the average of the two readings. (DO NOT READ BEARING AT THE INTERSECTION OF AN UNSYMMETRICALLY SPLIT INDICATION.)	Reliable if read carefully. IF MORE THAN 10 PERCENT OF PATTERNS ARE UNSYMMETRICALLY SPLIT, CHECK BALANCE OF ANTENNA COUPLING UNITS AND ALL GROUND STRAPS.

34. Stopping

a. EMERGENCY STOPPING. Throw the LINE INPUT switch on Junction Box J–95/CRD–2 to OFF.

b. NORMAL STOPPING.

(1) Throw the POWER switch on the bearing indicator to OFF.

(2) Rotate the OFF - TRANS - REC MOD - REC CW switch on the radio receiver to OFF.

(3) Throw the VISUAL-AURAL switch on the azimuth indicator to VISUAL.

(4) Throw the POWER and MASTER POWER switches on the modulating voltage generator to OFF.

(5) Throw the LINE INPUT and OUTPUT LOAD switches on Junction Box J–95/CRD–2 to OFF.

Note. The other switches and controls can be placed in the positions specified in paragraph 30*a* if desired. In this way the radio set will be ready to start (par. 30*b*) when another period of operation is required.

Section IV. OPERATION UNDER UNUSUAL CONDITIONS

35. General

The operation of Radio Set AN/CRD–2 may be difficult in regions where extreme cold, heat, humidity and moisture, sand conditions, etc., prevail. In the following paragraphs, instructions are given on procedures for minimizing the effect of these unusual operating conditions.

36. Operation in Arctic Climates

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

a. Handle the equipment carefully.

b. Keep the equipment warm and dry. Keep the filaments of vacuum tubes lighted constantly, provided this does not overtax the power supply.

c. Locate the equipment inside a heated inclosure where there is no danger of a cold draft striking the glass tubes when a door is opened. A sudden draft of cold air often is sufficient to shatter the glass envelope of a heated tube. If the inclosure is so constructed that this precaution is imposible, place a blanket or some barrier between the source of the draft and the equipment.

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

e. When equipment which has been exposed to the cold is brought into a warm room, it will start to sweat and will continue to do so until it reaches room temperature. When the equipment has reached room temperature, dry it thoroughly; this condition also arises when equipment warms up during the day after exposure during a cold night.

f. Use any improvised means to protect dry batteries, since they will fail if not protected against the cold. Preheat the batteries. To prevent heat loss, place them in bags lined with kapok, spun-glass fiber materials, animal skins, or woolen clothing.

g. See TB SIG 66 for additional data.

37. Operation in Tropical Climates

When operated in tropical climates, radio equipment may be installed in tents, huts, or, when necessary, in underground dugouts. When equipment is installed below ground and frequently when it is set up in swampy areas, moisture conditions are more acute than normal in the Tropics. Ventilation is usually very poor, and the high relative humidity causes condensation of moisture on the equipment whenever the temperature of the equipment becomes lower than the ambient air. To minimize this condition, place lighted electric bulbs under the equipment. See TB SIG 72 for additional information.

38. Operation in Desert Climates

a. Conditions similar to those encountered in tropical climates often prevail in desert areas. Use the same measure to insure proper operation of the equipment.

b. The main problem which arises with equipment operation in desert areas is the large amount of sand or dust and dirt which enters the moving parts of radio equipment, such as motors and power units. The ideal preventive precaution is to house the equipment in a dustproof shelter. Since, however, such a building seldom is available and would require air conditioning, the next best precaution is to make the building in which the equipment is located as dustproof as possible with available materials. Hang wet sacking over the windows and doors, cover the inside walls with heavy paper, and secure the side walls of tents with sand to prevent them from flapping in the wind.

c. Never tie power cords, signal cords, or other wiring connection to either the inside or the outside of tents. Desert areas are subject to sudden wind squalls which may jerk the connections loose or break the lines.

d. Take care to keep the equipment as free from dust as possible. Make frequent preventive maintenance checks as explained in chapter 3. Pay particular attention to the condition of the lubrication of the equipment. Excessive amounts of dust, sand, or dirt that come into contact with oil and grease result in grit, which will damage the equipment.

e. For additional data, see TB SIG 75.

Section V. INITIAL ADJUSTMENT OF EQUIPMENT

39. Initial Adjustment of Radio Transmitter BC–1149–A (Target Transmitter)

This transmitter is a source of strong, steady signals for checking operation of the radio direction finder. While the direction finder is warming up, erect the transmitter at a distance of approximately 500 feet and at an azimuth of 315° from the antenna system. The azimuth of 315° can be determined to the required accuracy by sighting the point at the 500-foot radius at which it is possible to look toward the north and west antennas and see them symmetrically disposed in front of the east and south antennas, respectively. Turn the ON-OFF switch on the target transmitter to ON, the ICW-CW switch to CW, and the HI-LO switch to HI. Tune the target transmitter to about 13 mc, if the medium-frequency antenna combination is to be used; or to 2.5 mc if the l-f combination is to be used. For detailed information on Radio Transmitter BC-1149-A, see TM 11-849.

40. Initial Voltage Measurements

a. To read the plate voltage in the bearing indicator, set the E_B IND - E_B GEN - I_K ANT MOD switch on the modulating voltage generator to the E_B IND position. The VOLT-MILLIAMMETER should indicate 300 (volts) on the lower scale. If the 300-volt reading is not obtained, adjust potentiometer R-377.

b. To read the plate voltage in the modulating voltage generator, set the E_B IND - E_B GEN - I_K ANT MOD switch to the E_B GEN position. The VOLT-MILLIAMMETER should indicate 300 (volts) on the lower scale (par. 26*n*).

c. With the MOD VOL switch in the VISUAL position, and the MOD VOLTAGE LEVEL switch in the IND position, the IND-ANT MODULATING VOLTAGE meter should indicate 1.5 volts. The level of this voltage is preset at the factory and is controlled by R-344, a screw driver adjustment located at the rear of Bearing Indicator ID-64/CRD-2.

41. Initial Adjustments to Bearing Indicator ID-64/CRD-2

Make the following adjustments on the front panel and recessed panel of the bearing indicator to obtain a single, sharply defined, 3-inch circular pattern, centered on the screen of the cathode-ray tube.

a. Adjust the INTENSITY control for the desired brightness of the pattern.

Caution: Do not make the pattern too bright; damage to the screen of the cathode-ray tube will result. Also loosen the knurled locking screw before attempting to rotate the alidade.

b. Adjust the FOCUS control for sharp definition of the pattern.

c. Adjust the H and V BEARING SPLITTERS until the two circular patterns are perfectly superimposed. (Be sure the receiver RF GAIN control is at the minimum position when making this adjustment.)

d. Adjust the PATTERN SHAPE control until the pattern becomes a circle. Use the inner edge of the azimuth scale as a reference.

e. Adjust the PATTERN SIZE control until the pattern is reduced to the size of a dot.

f. Center the dot on the screen of the cathode-ray tube by adjusting the H and V CENTERING controls.

g. Increase the size of the dot to a circle about 3 inches in diameter (use the inner edge of the azimuth scale as a reference) by adjusting the PATTERN SIZE control. If a perfect circle is not obtained, repeat steps *c*, *d*, *e*, and *f* above.

42. Initial Adjustments to Modulating Voltage Generator O-15/CRD-2

To fix the level and balance of modulating voltage, and to fix the level of cathode current in each antenna coupling unit (I_K ANT MOD), make the following adjustments on the recessed panel of the modulating voltage generator:

a. Turn the MOD VOLTAGE LEVEL switch to the OVER-ALL position.

b. Adjust the OVER-ALL (MODULATING VOLTAGE LEVEL) control until a reading of 3 volts is indicated on the IND-ANT MODULATING VOLTAGE meter.

c. Turn the MOD VOLTAGE LEVEL switch to the E-W position.

d. Adjust the E-W (MODULATING VOLTAGE LEVEL) control until a reading of 3 volts is indicated on the IND-ANT MODULATING VOLTAGE meter.

e. Turn the MOD VOLTAGE LEVEL switch to OFF.

f. Turn the NORTH antenna switch to the TEST position.

g. Turn the EAST, SOUTH, and WEST antenna switches to OFF.

h. Adjust the NORTH LEVEL control until the VOLT-MILLIAMMETER indicates 10 (ma) on upper scale (right-hand meter switch in I_K ANT MOD position). Turn the NORTH switch to OFF.

i. Repeat the operation in *f*, *g*, and *h* above for the EAST, SOUTH, and WEST antennas, in turn.

j. Turn the NORTH antenna switch to OPER.

43. Initial Adjustments to Radio Receiver R–127/CRD–2

a. Turn the RF GAIN control about three-quarters of the way on (clockwise).

b. Adjust the ANT ADJ control for maximum signal (or background noise).

c. Turn the TUNING CONTROL to tune in the target transmitter signal.

Note. As the receiver is tuned to the signal, the circular pattern on the indicator screen should contract to form a propeller-shaped pattern (A, fig. 45).

d. Readjust the RF GAIN control so that the sides of the pattern which collapse toward the center just meet.

e. Readjust the AF GAIN control for the desired output from the loudspeaker.

f. Lock the TUNING CONTROL (if required) by turning the lock clockwise.

44. Additional Initial Adjustment to Modulating Voltage Generator O–15/CRD–2

a. With only the NORTH antenna switch in the OPER position, and all other antenna switches OFF, if the two patterns forming the bearing indication are not superimposed perfectly, adjust the NORTH BALANCE control until they are superimposed.

b. Turn the NORTH antenna switch OFF.

c. Repeat adjustments in *a* above for the SOUTH, EAST, and WEST antenna switches, in turn.

Note. If the pattern still is split (not superimposed), turn the OFF - TRANS-REC MOD - REC CW switch on the radio receiver to the TRANS position and recheck in accordance with paragraph 41*d*. If these adjustments fail to superimpose the two circular patterns, repairs or realinement of the bearing indicator may be necessary. Realinement should be performed only by experienced personnel. However, if the two circular patterns (no-signal) can be superimposed by the adjustments described in paragraph 41*d* and the propeller-shaped (signal) patterns still are split, refer to paragraph 168.

45. System Balance

a. Cable Balance. After each individual bearing pattern is superimposed, as outlined in paragraph 44, the tips of the pattern still may appear to move in and out along a radial line as the receiver is tuned from one side of resonance to the other side at the frequency of the target transmitter. This is an indication of r-f cable (Cords CG–240/CRD–2) unbalance. Control C–809 on Antenna Coupling Unit CU–34/CRD–2 will tend to compensate for this unbalance. With all except one of the antenna switches in the OFF position, rotate C–809 on the operating coupling unit and note the effect on the pattern. If the pattern shift with tuning is decreased, continue to rotate the control in the same direction until this effect is minimized. If the pattern shift is greater than before, the capacitor control should be turned in the opposite direction until the shift is minimized or removed. Each antenna should be checked and adjusted in turn.

b. Amplitude Balance. It is necessary to adjust all Antenna Coupling Units CU–34/CRD–2 to equal gain for good bearing accuracy. This should be done in the following manner:

(1) Turn the NORTH antenna switch on the modulating voltage generator to the TEST position and retune the radio receiver to the target transmitter signal if necessary. Adjust the ORIENTATION control on the bearing indicator so that the indicated azimuth is 0°. Make sure the target is placed according to instructions in paragraph 39.

(2) Without changing the receiver RF GAIN control, turn the WEST antenna switch to the TEST position and adjust the WEST LEVEL to produce a bearing of 315°. If the pattern should be split, read the correct bearing at the intersection of the split patterns.

(3) Turn the North antenna to OFF and remove any pattern split with the WEST BALANCE control.

(4) Place the SOUTH antenna switch in the TEST position.

(5) Place the target transmitter at 225° and at approximately the same distance from the antenna system as previously. Determine the 225° azimuth position in the manner described in paragraph 39; for this azimuth, however, the south and west antennas should appear symmetrically disposed in front of the east and north antenna, respectively.

(6) Retune the receiver if necessary and adjust the SOUTH LEVEL to produce an azimuth indication of 225°.

(7) Turn the WEST antenna OFF and remove any split with the SOUTH BALANCE control.

(8) Place the EAST antenna switch in the TEST position.

(9) Move the target transmitter to the 135° azimuth position.

(10) Adjust the EAST LEVEL to give a bearing indication of 135°.

(11) Turn the SOUTH antenna OFF and remove any split with the EAST BALANCE control.

(12) Carry the target to a similar position in the northeast (45°) direction.

(13) Turn the NORTH antenna to OPERATE. The indicated bearing should be within 2° of the 45° point without further adjustment. If excessive bearing error is obtained, repeat the entire amplitude balance procedure.

c. AMPLITUDE BALANCE (ALTERNATE METHOD). An alternate method for obtaining amplitude balance requires the use of a signal generator, as follows:

(1) Connect a power extension cord to the line cord on Signal Generator I–72 or any standard signal generator having the same frequency range. Locate the signal generator at the north antenna. Remove the cover from Junction Box J–96/CRD–2 and insert the extension cord plug into receptacle J–505 on Voltage Distribution Unit J–59/CRD–2. Adjust the signal generator to provide an output signal of approximately 500 microvolts on a clear channel on or near a frequency of 13 mc if the medium-frequency antenna combination is used, or 2.5 mc for the l-f system.

(2) Connect the "hot" lead of the signal generator output to the large knurled nut at the bottom of the north antenna mast. Open the door of Antenna Support AB–64/CRD–2 and connect the ground lead of the signal generator to the case of Antenna Coupling Unit CU–34/CRD–2.

(3) Turn the NORTH switch on Modulating Voltgae Generator O–15/CRD–2 to the TEST position. Turn the EAST, SOUTH, and WEST switches to OFF. Tune the radio receiver to resonance at the signal generator frequency (approximately 13 mc) and adjust the sensitivity control to produce a bearing pattern in which the sides that collapse toward the center are spaced one quarter inch. If the pattern is split, adjust the NORTH BALANCE control to eliminate this condition. Any radial shift with receiver tuning can be removed as described in paragraph 45*a*.

(4) Without changing the receiver RF GAIN control setting or the output level of the signal generator, move the signal generator to the EAST antenna location and connect it as described in (2) above. Turn the NORTH switch on the modulating voltage generator to OFF and the EAST switch to TEST. Retune the receiver to resonance if necessary and adjust the EAST LEVEL to produce a pattern having exactly the same ¼-inch spacing at the center as was obtained with the north antenna. Also remove any radial shift with tuning, using the cable balance method (par. 45*a*).

(5) Connect the signal generator to the south and west antennas, in turn, and repeat the operation described in (2) and (4) above.

(6) Recheck the north antenna. The pattern should be the same as obtained in (3) above. If it is not, repeat instructions contained in (3).

d. INTERVAL BALANCE CHECKS. It is advisable to check the system for accuracy at certain intervals after the initial adjustments have been made, preferably once each day. For these checks, it will not be necessary to repeat entirely either previously outlined procedure. A strong steady signal, regardless of azimuth position, may be used in place of the target transmitter, as follows:

(1) With all four antenna switches in the TEST position, tune in a strong signal in the frequency range of 5 to 6 mc when using the medium- or h-f-anten-

na system, or 1.5 to 2.5 mc when using the l-f array. If there is any fading (pattern opens and closes at center) or bearing swing, discard the signal and search the spectrum for a steady one. If no usable signal can be found, it will be necessary to use the target transmitter, placed at any arbitrary azimuth and about 500 feet from the antenna system.

(2) Place all the antenna switches except the NORTH in the OFF position.

(3) Adjust the RF GAIN control on the radio receiver until the exact center of the pattern is one quarter inch thick.

(4) Turn the NORTH antenna to OFF and the EAST to TEST; make no other control adjustments. The center of the observed pattern should be the same size as the NORTH pattern and in no case more than one-sixteenth inch larger or one-sixteenth inch smaller.

(5) Observe the SOUTH and WEST antennas in turn, noting each pattern center size.

(6) Differences in center displacement of the pattern over one-sixteenth inch indicate a need for system rebalancing. It then will be necessary to repeat one of the system balance methods previously outlined in *b* or *c* above.

46. Pattern Orientation

The angular position of the propeller-shaped pattern on the cathode-ray tube must be adjusted so that it corresponds to the physical orientation of the antenna system. With the receiver tuned to a 5-mc (approximately) signal from the target transmitter or to a steady signal from a commercial station, with the NORTH antenna switch at its OPER position, and with the EAST, WEST, and SOUTH switches at OFF, proceed as follows:

a. If bearings are to be taken with respect to true north and the antenna system is oriented to true north (par. 16), adjust the ORIENTATION control so that the tips of the bearing pattern on the cathode-ray tube are on 0° and 180°.

b. If bearings are to be taken with respect to magnetic north and the antenna system is oriented to magnetic north (par. 16), adjust the ORIENTATION control as in *a* above.

c. If it is not convenient to orient the antenna system to either true north or magnetic north and bearings are to be taken with respect to either true north or magnetic north, determine the number of degrees and the direction of misorientation from either true or magnetic north. Adjust the orientation control so that the bearing pattern will be rotated the same number of degrees and in the same direction as the misorientation.

47. Sense Determination

a. Set all antenna switches (on the recessed panel of the modulating voltage generator) to OPER.

b. Adjust the ANT ADJ control on the receiver for maximum signal and set the RF GAIN control so that the center of the propeller-shaped pattern just closes.

c. Depress the SENSE SWITCH on the bearing indicator. The pattern should fold away from the center and shift to form the shape of an arrowhead. The direct bearing (as differentiated from the reciprocal bearing) is the one toward which the arrowhead pattern points (B, fig. 46).

48. Azimuth Scale Orientation

a. Before Azimuth Indicator ID–240/CRD–2 can be used to take aural-null bearings, its scale must be adjusted to give the same azimuth bearing as the visual indicator when the radio set is tuned to the same signal. The knob which turns the azimuth scale consists of two sections: an inner section which is coupled to the azimuth scale, and an outer setcion which is coupled to the sine wave potentiometer. In operation, the two sections are held together by a clamp and rotate in unison. For orientation purposes, the azimuth scale can be rotated with respect to the sine wave potentiometer. (Release the clamping device before attempting to rotate the azimuth scale with respect to the sine wave potentiometer and tighten it after the adjustment has been completed.)

b. To adjust the aural-null azimuth scale, proceed as follows:

(1) After the radio set has been adjusted to take correct visual bearings, take a bearing on the visual indicator. Record this azimuth reading.

(2) Set the azimuth indicator VISUAL-AURAL switch to AURAL.

(3) Set the MOD VOL AURAL-VISUAL switch on the modulating voltage generator to AURAL. Adjust the azimuth indicator MODULATING LEVEL control to obtain a reading of approximately 3 volts.

(4) Rotate the azimuth scale knob to a null position (minimum signal). Move the SENSE switch alternately to the RED and WHITE positions and determine in which position the louder signal is received.

(5) Adjust the indicator scale as follows:

(*a*) If the louder signal is received with the SENSE switch at the WHITE position, hold the outer section of the knob firmly and rotate the inner section of the knob to obtain the recorded reading (*b*(1) above) on the white scale.

(*b*) If the louder signal is received with the SENSE switch at the RED position, hold the outer section of the knob firmly and rotate the inner section of the knob to obtain the recorded reading on the red scale.

(*c*) Repeat steps (*a*) and (*b*) above until the bearings obtained on the visual and aural indicators correspond exactly.

Caution: The outer section of the azimuth scale knob must not move while the inner section is being rotated.

49. Recheck of Meter Readings upon Completion of Initial Adjustments

After completing the adjustments described in paragraphs 39 through 48, the meter readings should be as shown in the table below:

Item checked	*Meter reading*
E_b GEN	300 volts
E_b IND	300 volts
I_k ANT MOD	7 to 13 ma for each antenna balanced modulator
MOD VOLTAGE LEVEL:	
OVER-ALL	3 volts
E-W	3 volts
IND	1.5 volts
MODULATING LEVEL	3 volts
A-c input to equipment	115 volts, 50/60 cycles

CHAPTER 3

ORGANIZATIONAL MAINTENANCE INSTRUCTIONS

Section I. ORGANIZATIONAL TOOLS AND EQUIPMENT

50. Tools and Materials Supplied with Radio Set AN/CRD-2

Tools and materials supplied with the radio set are listed below. The tools and materials contained in Tool Equipment TE-41 are listed in Department of the Army Supply Catalog SIG 6-TE-41.

- 1—Tool Equipment TE-41.
- 1—Level.
- 1—Pipe wrench (18-inch), including 2 spare straps (par. 51).
- 1—Pipe wrench (12-inch), including 2 spare straps (par. 51).
- 1—Kit of wrenches, including:
  - 1—1/16-inch wrench.
  - 1—5/64-inch wrench.
  - 1—3/32-inch wrench.
  - 1—3/16-inch wrench.
  - 1—5/32-inch wrench.
- 1—Oil, 3-ounce container.
- 1—Grease, 4-ounce container.
- 1—Paint brush (1-inch, flat).
- 1—Paint brush (½-inch, flat).
- 1—Tape (50-foot roll).
- 1—Bulb.
- 1—Lacquer, green (8-ounce container).
- 1—Lacquer, red (8-ounce container).
- 1—Lacquer, fungus-resistant (16-ounce container).

51. Special Tools Issued for Radio Set AN/CRD-2

Two strap wrenches are the only special tools supplied with the radio set. These tools, located in Chest CY-363/CRD-2, are used to tighten or loosen the antenna mast and horizontal support coupling rings (par. 20 and fig. 29).

Section II. PREVENTIVE MAINTENANCE SERVICES

52. Definition

PM (preventive maintenance) is work performed on equipment (usually when the equipment is not in use) to keep it in good working order so that break-downs and needless interruptions in service will be kept to a minimum. PM differs from trouble shooting and repair since its object is to prevent certain troubles from occurring. See TM 38-650.

53. General Preventive Maintenance Techniques

a. Use No. 0000 sandpaper to remove corrosion.

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

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

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

c. If available, dry compressed air may be used at a line pressure not exceeding 60 pounds per square inch to remove dust from inaccessible places; be careful, however, or mechanical damage from the air blast may result.

d. For further information on preventive maintenance techniques, refer to TB SIG 178.

54. Performing Preventive Maintenance

The following preventive maintanance operations should be performed by organizational personnel at the intervals indicated, unless

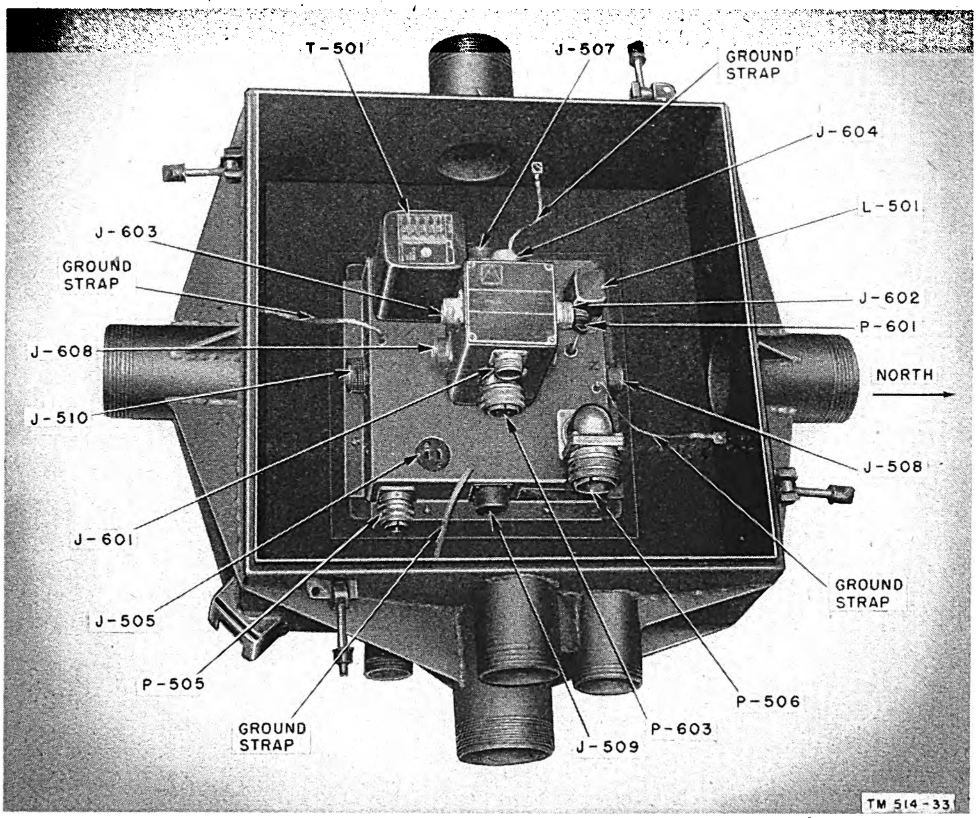


Figure 48. Junction Box J–96/CRD–2, with cover removed, showing Voltage Distribution Unit J–59/CRD–2 and Coupling Unit CU–68/CRD–2.

these intervals are reduced by the local commander.

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

a. DAILY OPERATIONS.

(1) Clean exterior of rack and front panels of rack components.

(2) Clean front panel and cabinet of Azimuth Indicator ID–240/CRD–2 and Junction Box J–95/CRD–2.

(3) Check alidade assembly on Bearing Indicator ID–64/CRD–2 for proper mechanical operation.

b. WEEKLY OPERATIONS.

(1) Check all ground straps for corrosion and tightness of connection.

(2) Check level of antenna system, including masts and horizontal supports (par. 20).

(3) Check meters for zero adjustment.

(4) Check all connectors at back of rack (fig. 38), azimuth indicator, junction boxes, and antenna coupling units for looseness of coupling rings, corrosion, and loose contacts.

(5) Check tension and general condition of guys used to support antenna masts.

Caution: Disconnect all power before performing the following operations.

c. SEMIANNUAL OPERATIONS (PRELIMINARY).

(1) Remove all connections at rear of rack; then loosen captive screws on front panels of rack components and remove components from the rack.

(2) Remove the azimuth indicator from its cabinet after loosening connectors at back of cabinet and captive screws on front panel.

(3) Remove connectors from Junction Box J–95/CRD–2.

(4) Remove bottom plates from rack components and junction box.

(5) Remove the large shield which pro-

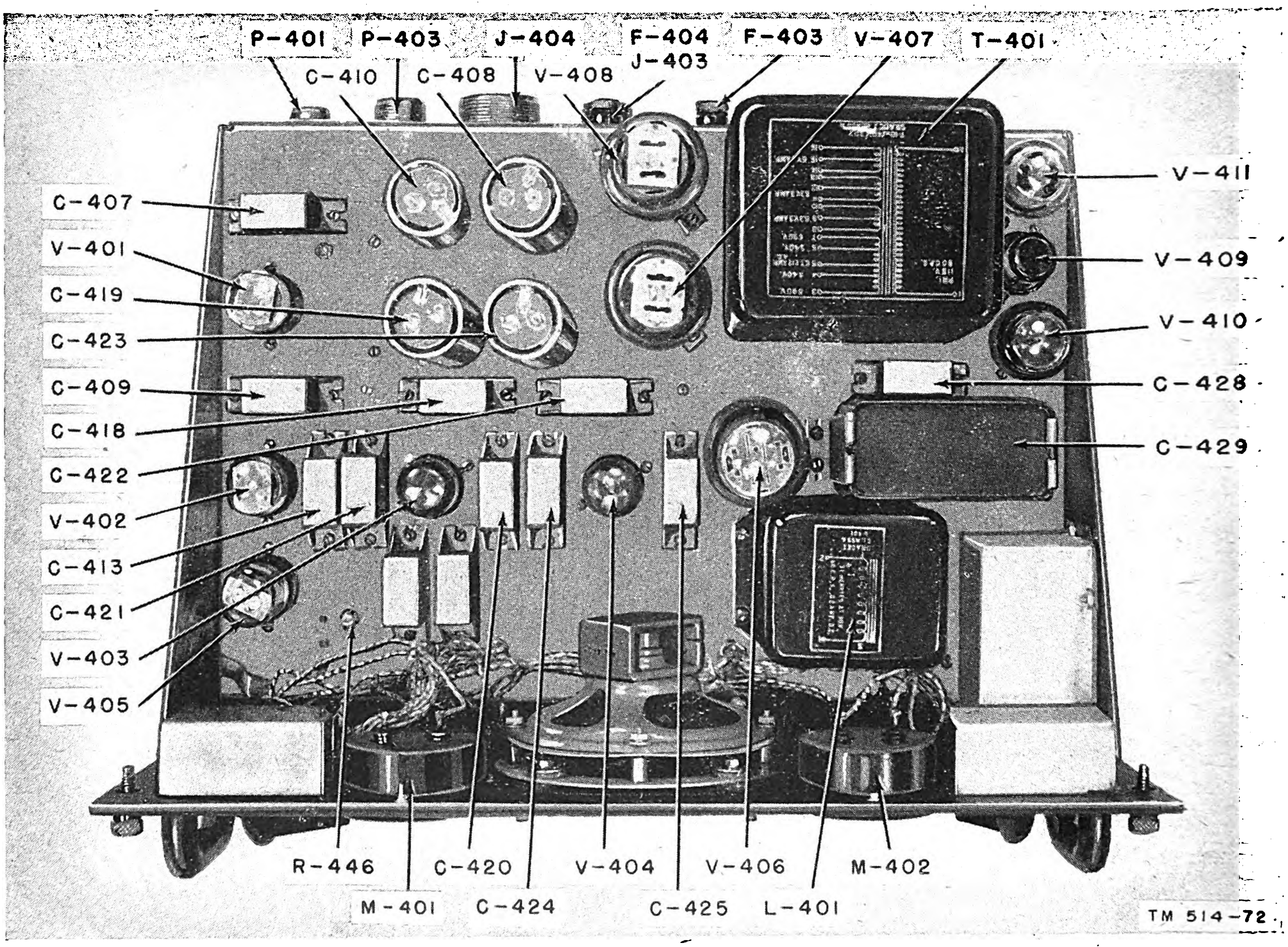


Figure 49. Modulating Voltage Generator O–15/CRD–2, top view of chassis, tube and parts location.

tects the ganged capacitors located on top of the receiver chassis.

(6) Loosen the captive screws on top of Junction Box J–96/CRD–2 and lift off the top cover. Remove all connectors from the voltage distribution unit and the antenna coupling unit. Remove the four screws holding down the voltage distribution unit; then lift the unit out of the junction box.

(7) Remove the connectors from all four Antenna Coupling Units CU–34/CRD–2, located in the antenna supports. Then lift and, at the same time, turn the coupling unit counterclockwise until the unit is free of the support assembly.

(8) Remove screws on cover of each antenna coupling unit and remove covers.

(9) Lower the antenna masts by reversing the installation procedure (par. 20).

d. SEMIANNUAL OPERATIONS. Inspect all items given below; tighten and/or clean *if necessary.*

(1) Interior of rack cabinet and Junction Box J–93/CRD–2, exterior of all chassis, and all parts mounted on top of chassis.

(2) All capacitors, for leakage of oil or dielectric, for bulging and for signs of overheating.

(3) All power transformers, for signs of overheating.

(4) Fuses and fuse holders, for corrosion, cracks, and lack of tension sufficient to insure good contact.

(5) Tube sockets and pins, for loose contacts, dirt, and corrosion. Check tubes; replace if necessary.

(6) All resistors, for blistering, discolora-

tion, and other evidence of over-heating.

(7) Switches, for dirt, corrosion, loose contacts, and unsatisfactory mechanical action.

(8) Antenna masts, for corrosion and loose coupling rings and loose skirt elements.

(9) Wires, cords, and cables, for cracked, cut, and frayed insulation.

(10) Terminal boards, for cracks, dirt, and loose connections.

(11) Front panel controls, for unsatisfactory mechanical operation.

(12) Mountings, machine screws, and nuts, for mechanical looseness.

(13) All visible terminals and connections, for loose connections and corrosion.

(14) MFP coatings, for breaks. (Retouch with a brush, if necessary.)

(15) Finish, for scratches and bare spots. (Retouch, if necessary.)

(16) Unshielded variable capacitors, for dirt, corrosion, and bent plates.

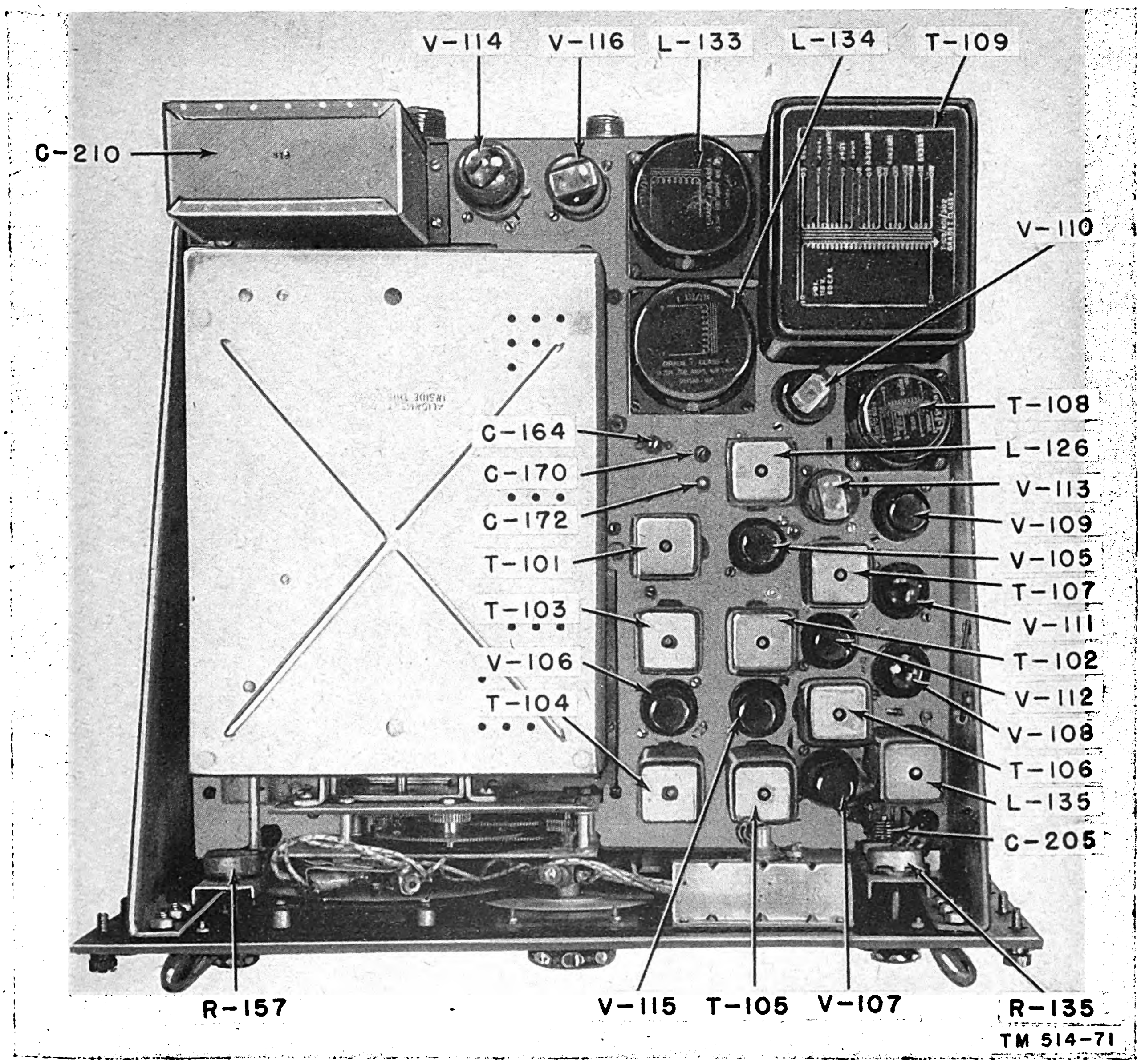


Figure 50. Radio Receiver R-127/CRD-2, top view of chassis, parts location.

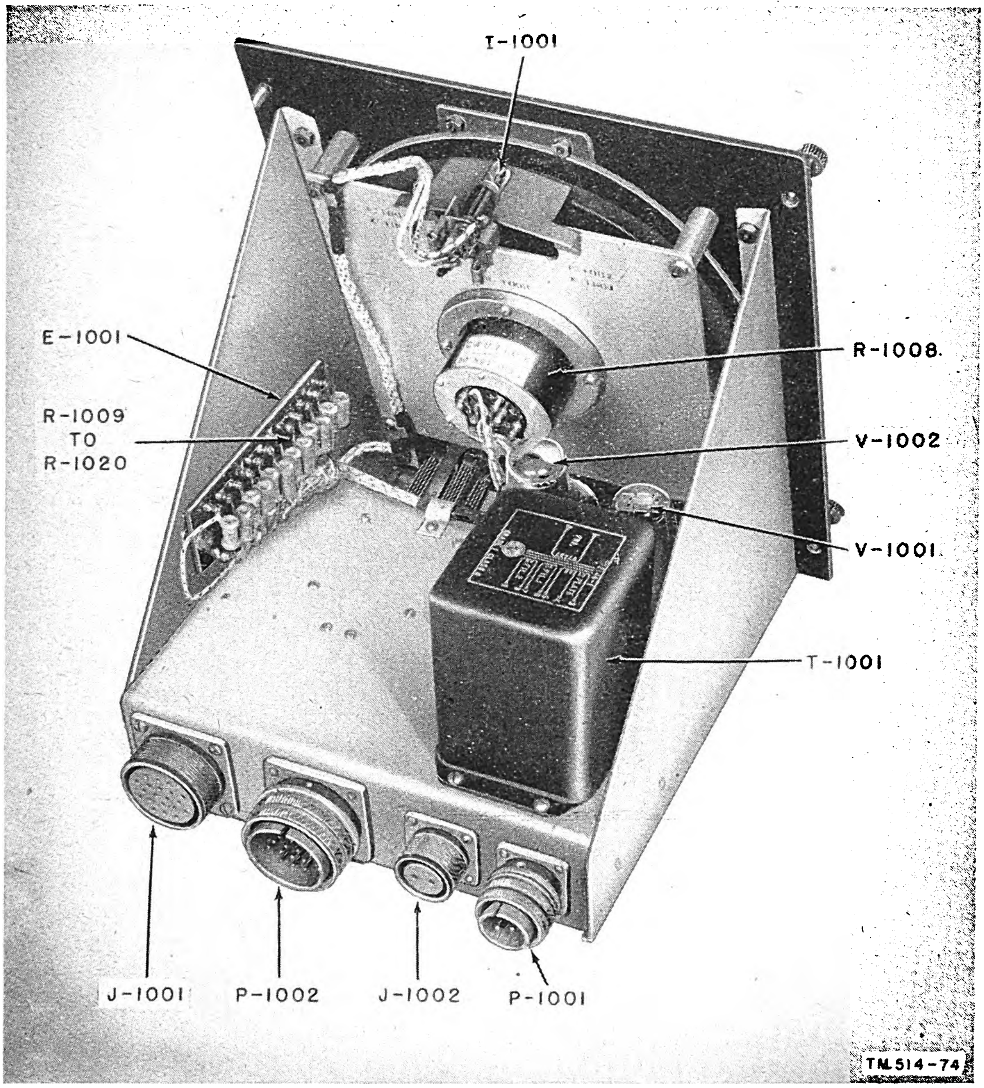


Figure 52. Azimuth Indicator ID–240/CRD–2, top view of chassis, parts location.

Section III. LUBRICATION AND WEATHERPROOFING

55. Lubrication Instructions

The only parts of Radio Set AN/CRD–2 which require periodic lubrication are the control bearing surfaces and the guide rails in the rack. Lubricate these parts every six months as follows:

a. Remove old lubrication.

b. Apply Oil, lubricating, preservative, medium (PL-MEDIUM) sparingly to all control shaft friction points.

c. Apply oil (PL-MEDIUM) sparingly to the guide rails in the rack.

56. Weatherproofing

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

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

c. WINTER MAINTENANCE. Special precautions necessary to prevent poor performance or total operational failure of equipment in extremely low temperatures are explained fully in TB SIG 66.

d. DESERT MAINTENANCE. Special precautions necessary to prevent equipment failure in areas subject to extremely high temperatures, low humidity, and excessive sand and dust are explained fully in TB SIG 75.

e. LUBRICATION. The effects of extreme cold and heat on materials and lubricants are explained in TB SIG 69. Observe all precautions outlined in TB SIG 69 and pay strict attention to all lubrication orders when operating equipment under conditions of extreme cold or heat. Refer to paragraph 55 for detailed instructions.

57. Rustproofing and Painting

a. When the finish on the rack, cabinets, junction boxes, antenna supports, or other external surfaces of the radio set has been scarred badly or damaged, rust and corrosion can be prevented by touching up bared surfaces. Use No. 00 or No. 000 sandpaper to clean the surface down to the bare metal; obtain a bright smooth finish.

Caution: Do not use steel wool. Minute particles 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. Remove rust from the case by cleaning corroded metal with solvent (SD). In severe cases it may be necessary to use solvent (SD) to soften the rust and to use sandpaper to complete the preparation for painting. Paint used will be authorized and consistent with existing regulations.

Section IV. TROUBLE SHOOTING AT ORGANIZATIONAL MAINTENANCE LEVEL

58. Scope

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

b. The paragraphs which follow in this section help in determining which of the components, such as the radio receiver or bearing indicator, is at fault and in localizing the fault in that component to the defective stage or item, such as a tube or fuse.

59. Visual Inspection

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

(1) Improperly connected cords or cables.

(2) Worn, broken, or disconnected cords, plugs, or receptacles.

(3) Burned-out fuses.

(4) Defective tubes.

b. When failure is encountered and the cause is not immediately apparent, obtain information from the operator of the equipment regarding performance at the time trouble occurred, visually inspect the radio set for obvious abnormalities, and use the procedures given in paragraphs 60 and 61.

60. Trouble Shooting by Using Equipment Performance Checklist

a. GENERAL. The equipment performance checklist (par. 61) will help the operator to sectionalize the trouble to a major component, such as the radio receiver or the junction box. Also, the checklist will help the operator to locate many troubles, such as burned-out fuses, poor tubes, etc., in the defective major component. The list gives the item to be checked, the conditions under which the item is checked, the normal indications and tolerances of correct operation, and the corrective measures the operator can take. *To use this list, follow the items in numerical sequence.*

b. ACTION OR CONDITION. For some items, the information given in the action or condition column consists of various switch and control settings 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. If the indications are not normal, the operator should apply the recommended corrective measures.

Note. The normal indications given in the checklist will not be obtained if the items are not followed from 1 to 36 in numerical sequence and in the exact manner described.

d. CORRECTIVE MEASURES. The corrective measures listed are those the operator can make without turning in the equipment for repairs. A reference in the table to chapter 5 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 results, trouble shooting is necessary. However, if the tactical situation requires that operation 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.

61. Equipment Performance Checklist

	Item No.	Action or condition	Normal indications	Corrective measures
PREPARATORY		On Junction Box J-95/CRD-2, set OUTPUT LOAD switch at OFF, LINE INPUT switch at OFF, and OUTPUT VOLTAGE CONTROL at 1.	None.	
		On azimuth indicator, set VISUAL-AURAL switch at VISUAL and MODULATING LEVEL control at midposition.	None.	
		On modulating voltage generator, set MASTER POWER switch at OFF, POWER switch at OFF, MOD VOL switch at VISUAL, STAND-BY - OPERATE - SPLIT switch at OPERATE, E_b IND - E_b GEN - I_k ANT MOD at E_b GEN, MOD VOLTAGE LEVEL switch at OFF, and NORTH, EAST, SOUTH, and WEST switches at OFF.	None.	
		On bearing indicator, set POWER switch at OFF, rotate INTENSITY and FOCUS controls fully counterclockwise, set H and V CENTERING controls at midposition, set H and V BEARING SPLITTERS at midposition, set PATTERN	None.	

	Item No.	Action or condition	Normal indications	Corrective measures
		SHAPE control at midposition, and rotate PATTERN SIZE control fully counterclockwise.		
		On radio receiver, set OFF - TRANS - REC MOD - REC CW switch at OFF, RANGE switch at 4 if h-f antenna combination is in use or 2 if l-f antenna combination is in use, rotate RF GAIN and AF GAIN controls fully counter-clockwise, set SELECTIVITY switch at D/F-2, set MAN - MAN NL - AVC NL - AVC switch at MAN, rotate BFO ADJ and ANT ADJ controls until the pointers are straight up, and set NOISE LIMITER and HF TONE controls at midposition.	None.	
START	1	On Junction Box J-95/CRD-2, throw OUTPUT LOAD switch to DUMMY.	None.	
	2	On Junction Box J-95/CRD-2, throw LINE INPUT switch to position which corresponds to voltage of a-c power source. For example, if voltage of a-c power source is between 100 and 120 volts, throw switch to 115V.	*a.* OUTPUT VOLTAGE meter will indicate less than 115 volts.	*a.* If *no* reading is obtained, depress circuit breaker which corresponds to setting of LINE INPUT switch. If reading still is not obtained, check Cord CX-639/CRD-2 which connects junction box to a-c power source. Also check a-c power source for normal reading. If cord and power source are not cause of abnormal reading, see section VIII of chapter 5 for information on repair of junction box.
			b. LINE FREQUENCY meter will indicate approximately 60 cycles.	*b.* If OUTPUT VOLTAGE meter does show a reading but LINE FREQUENCY meter does not, check frequency of output voltage of power unit (if used). *Note.* Operation of radio set from an a-c power source having a frequency less than 50 cycles or more than 60 cycles may cause damage to equipment or impair its operating efficiency.
			c. Meter readings should not fluctuate.	*c.* If readings are obtained on both meters but pointer of LINE VOLTAGE meter fluctuates, check a-c power line for excessive, intermittent loading of power source. If LINE FREQUENCY meter indication fluctuates over wide limits, check output frequency of power unit (if used).
	3	On Junction Box J-95/CRD-2, rotate OUTPUT VOLTAGE CONTROL	Meter reading will increase to approximately 115 volts.	If meter reading does not increase to 115 volts, check a-c power source for low input voltage. If power source is normal

Item No.	Action or condition	Normal indications	Corrective measures
	clockwise until OUTPUT VOLTAGE meter indicates approximately 115 volts.		see section VIII of chapter 5 for repair instructions on junction box.
4	On Junction Box J-95/CRD-2, throw OUTPUT LOAD switch to EQUIPMENT.	There may or may not be a change in OUTPUT VOLTAGE meter reading, depending on regulation of a-c power source.	None.
5	On modulating voltage generator, throw MASTER POWER switch to ON.	Pilot light adjacent to this switch will light.	If pilot light does not light, replace it. If replacement light also fails to light, check Cord CX-1115/U and its connectors. This cord connects 115-volt output of junction box to a plug on rear apron of rack. Also check cord between plug P-402 on modulating voltage generator and rear apron of rack. If these cords and their connectors are not shorted or open-circuited, see section III of chapter 5 for repair information on modulating voltage generator.
6	On modulating voltage generator, throw POWER switch ON.	*a.* Pilot light adjacent to this switch will light.	*a.* If pilot light does not light, replace fuse F-401 located at rear of chassis. If fuse is not at fault, replace pilot light. If replacement of pilot light does not correct abnormal condition, see section III of chapter 5 for information on repair of modulating voltage generator.
		b. The IND-GEN-ANT VOLT - MILLIAMMETER will indicate 300 volts.	*b.* If pilot light does light and a meter reading is obtained, but this reading is other than 300 volts, adjust B + LEVEL control (screw-driver adjustment) on subpanel of modulating voltage generator. If adjustment of this control fails to correct abnormal meter reading, check tubes V-409 and V-410. If tubes are normal, trouble is in modulating voltage generator. If so, see section III of chapter 5 .
7	On modulating voltage generator, throw E_b IND - E_b GEN - I_k ANT MOD switch to I_k ANT MOD, throw NORTH switch to TEST, observe reading of IND-GEN-ANT-VOLT - MILLIAMMETER, and then throw NORTH switch to OFF.	With NORTH switch in TEST position, meter reading will be between 7 and 13 ma.	If *no* meter reading is obtained, replace fuse F-404 on rear of chassis. If fuse is not cause of abnormal meter reading, measure a-c voltage at receptacle J-505 in voltage distribution unit. (1) If a 115-volt a-c measurement is not obtained, check cord between receptacle J-403 on modulating voltage generator and rear apron of rack. (See fig. 39.) Also, check Cords CX-1116/CRD-2 and CX-452/CRD-2. *Note.* After disconnecting the cords, check them and their connectors for an open- or short-circuited condition.

Item No.	Action or condition	Normal indications	Corrective measures
			(2) If a 115-volt measurement is obtained at receptacle J–505, check cord between receptacle J–404 on modulating voltage generator and rear apron, Cord CX–1114/CRD–2, CX–454/CRD–2, and north Cord CX–455/CRD–2. (See note above.) If these cords are normal, remove north Antenna Coupling Unit CU–34/CRD–2 and replace it with another coupling unit known to be in good operating condition. If still no meter reading is obtained, trouble is in modulating voltage generator. If so, see Section III of chapter 5. However, if replacement of coupling unit produces normal meter reading, see section IV of chapter 5 for repair instructions on defective Antenna Coupling Unit CU–34/CRD–2. *Note.* After an Antenna Coupling Unit CU–34/CRD–2 is replaced permanently, the system balancing procedure given in paragraph 45 must be performed. If a meter reading is obtained but the reading is abnormal, perform the checks given in (2) above. Also check continuity of Coupling Unit CU–68/CRD–2 (or CU-69/CRD–2).
8	Repeat operations given in step 7 for EAST, SOUTH, and WEST switches successively.	When any one of these switches is at TEST, the IND-GEN-ANT VOLT-MILLIAMMETER will indicate between 7 and 13 ma.	If *no* meter reading is obtained when one of the switches is in TEST position, check Cord CX–455/CRD–2 associated with switch giving the abnormal reading. For example, if a zero reading is obtained when WEST switch is at TEST, check CORD CX–455/CRD–2 which connects to west Antenna Coupling Unit CU–34/CRD–2. If this cord is not the fault, perform the other corrective measures given in step 7.
9	On modulating voltage generator, rotate MOD-VOLTAGE LEVEL switch to OVERALL.	IND-ANT MODULATING VOLTAGE meter will read 3 volts.	If a reading of 3 volts is not obtained, adjust OVER-ALL control. If this adjustment does not correct abnormal condition, check tubes V–401, V–402, V–405. If tubes are normal, disconnect cord from receptacle J–404 at rear of chassis. Then check meter reading. (1) If meter reading then can be brought to 3 volts after readjustment of OVER-ALL control, trouble is in circuits associated with distribution of modulating voltage to antenna system. If so, check for shorted condition in cord between rear apron of rack and receptacle J–404, Cord CX–1114/CRD–2, Cord CX–454/CRD–2, and north and south Cords CX–455/CRD–2. If these cords are normal, look for a shorted condition in VISUAL-AURAL switch in azimuth indicator, in voltage distribution unit, or in grid input circuits of north and south Antenna Coupling Units CU–34/

Item No.	Action or condition	Normal indications	Corrective measures
			CRD–2. See chapter 5 for repair instructions on these components. (2) However, if normal meter reading was not obtained when plug was removed from receptacle J–404, trouble is in modulating voltage generator. If so, see section III of chapter 5.
10	On modulating voltage generator, rotate MOD VOLTAGE LEVEL switch to E–W.	The IND-ANT MODULATING VOLTAGE meter will read 3 volts.	If a meter reading of 3 volts is not obtained, adjust E–W control. If this adjustment fails to produce 3-volt reading, check tube V–403. If tube is normal, disconnect cord from receptacle J–404 at rear of chassis. (1) If meter reading then can be obtained after readjustment of E–W control, trouble is in circuits associated with distribution of modulating voltage to east and west Antenna Coupling Units CU–34/CRD–2. If so, check for a shorted condition in cord between rear apron of rack and receptacle J–404, Cord CX–1114/CRD–2, Cord CX–454/CRD–2, and east and west Cords CX–455/CRD–2. If these cords are normal, check for a shorted condition in VISUAL-AURAL switch circuit of azimuth indicator, or in voltage distribution unit, or in grid input circuit of east and west Antenna Coupling Units CU–34/CRD–2. See chapter 5 for repair instructions for these components. (2) However, if 3-volt reading still was not obtained when cord was removed from receptacle J–404, trouble is in east and west modulating voltage output circuit of modulating voltage generator. If so, see section III of chapter 5.
11	On bearing indicator, throw POWER switch to ON. Then allow 15 minutes for equipment to warm up.	Dial lights on azimuth scale will light.	If pilot lights do not light, check fuse F–402 on rear chassis of modulating voltage generator. If fuse is not at fault, check Cord CX–1115/U. If cord also is normal, see section VI of chapter 5 for repair data on bearing indicator.
12	On modulating voltage generator, rotate E_b IND - E_b GEN - I_k ANT MOD switch to E_b IND position.	IND-GEN-ANT VOLT-MILLIAMMETER will indicate 300 volts.	(1) If no meter reading is obtained, check tubes V–318, V–317, and V–316. If these tubes are normal, check Cord CG–237/CRD–2 and its connectors. If cord is normal, trouble is either in bearing indicator or in metering circuit of modulating voltage generator. If so, see section VI or III in chapter 5 for repair data on these components. (2) If a meter reading is obtained but this reading is other than 300 volts, adjust control R–377 located on rear of chassis of bearing indicator. If adjustment fails to correct abnormal reading, check tubes

Item No.	Normal indications	Action or condition	Corrective measures
			V–315 and V–314. If tubes are normal, trouble is in either metering circuit of modulating voltage generator or bearing indicator. If so, see sections III and VI of chapter 5 for repair data on these components.
13	On modulating voltage generator, rotate MOD VOLTAGE LEVEL switch to IND.	IND-ANT MODULATING VOLTAGE meter will read 1.5 volts.	(1) If *no* meter reading is obtained, check tube V–402 in modulating voltage generator and tubes V–310 and V–312 in bearing indicator. If these tubes are normal, check Cord CG–237/CRD–2 for a short or open-circuited condition. If cord is normal, trouble is in either bearing indicator or metering circuit (tube V–402) of modulating voltage generator. If so, see sections III and VI of chapter 5 for repair data on these components. (2) If a meter reading is obtained but this reading is other than 1.5 volts, adjust AUDIO INPUT control (R–344) at rear of chassis of bearing indicator. If adjustment of this control fails to correct abnormal reading, follow corrections in step (1) above.
14	On bearing indicator, rotate INTENSITY control clockwise until illumination is observed on screen of cathode-ray tube.	Illumination will appear on screen.	If no illumination is obtained, test tubes V–301 and V–303. If these tubes are normal, replace cathode-ray tube V–305. If replacement of this tube does not correct abnormal condition, see section VI of chapter 5 for repair data on bearing indicator.
15	On bearing indicator, rotate FOCUS control clockwise until illumination appears as a sharply defined, small spot.	Illumination will change to a small spot.	If a sharply defined, small spot of illumination cannot be obtained, see section VI of chapter 5 for repair data on bearing indicator.
16	On bearing indicator, adjust H and V CENTERING controls until spot of illumination is centered on screen.	(1) Spot of illumination will move vertically as V control is rotated. (2) Spot of illumination will move horizontally as H control is rotated.	If adjustment of controls fails to center spot of illumination on screen, try replacing cathode-ray tube V–305. If tube replacement does not correct abnormal condition, see section VI of chapter 5 for repair data on bearing indicator.
17	On bearing indicator, rotate PATTERN SIZE control clockwise until extremities of illuminated area are just within inner diameter of azimuth scale.	Size of illuminated area will vary with setting of SIZE control. Illuminated area consists of two circular or elliptical patterns not necessarily superimposed.	(1) If size of illuminated area does not change, check tube V–302. If tube is normal, see section VI of chapter 5 for repair data on bearing indicator. (2) If a vertical line is obtained instead of circular or elliptical patterns, check tubes V–308 and V–309. If these tubes are normal, check their circuits, as explained in section VI of chapter 5. (3) If only a horizontal line is observed, check tubes V–306, V–307, and V–311. If these tubes are normal, check their circuits as explained in section VI of chapter 5.

Item No.	Action or condition	Normal indications	Corrective measures
18	On bearing indicator, adjust H and V BEARING SPLITTERS until elliptical or circular patterns are superimposed.	*a.* H BEARING SPLITTER control will superimpose patterns in horizontal plane. *b.* V BEARING SPLITTER control will superimpose patterns in vertical plane.	*a.* If H BEARING SPLITTER control fails to superimpose patterns in horizontal plane, check tubes V–308 and V–309. See note below. *b.* If V BEARING SPLITTER fails to superimpose patterns in vertical plane, check tubes V–306 and V–307. See note below. *Note.* Transconductances of tubes V–306 through V–309 should be very nearly the same. Replacement or rearrangement of the tubes may necessitate re-adjustment of output tuning and balancing controls of balanced modulator stages. Paragraph 45 gives instructions for performing these adjustments. If these tubes are normal, check balanced modulator circuit at fault as explained in section VI of chapter 5.
19	On bearing indicator, rotate PATTERN SHAPE control until a circular pattern is obtained. Readjust SIZE control as necessary (step 17).	Shape of pattern will change to circular. This pattern should be stationary.	(1) If pattern cannot be made circular by adjustment of control, check tube V–311. If this tube is normal, check transconductances of tubes V–306 through V–309. All four tubes should have nearly the same transconductances. See note under corrections for step 18. If all tubes are normal, see section VI of chapter 5 for repair data on bearing indicator. (2) If circular pattern is not stationary, check tube V–313. If this tube is normal, see section VI of chapter 5 for repair data on bearing indicator.
20	On bearing indicator, rotate one of BEARING SPLITTER controls until two circular patterns are not superimposed. Then depress SENSE SWITCH.	One of circular patterns will appear faint or will disappear when SENSE SWITCH is pressed.	If one pattern does not disappear or become faint, check tube V–304. If this tube is normal, check blanking adjustment as explained in paragraph 168, check SENSE SWITCH S–301, the circuits associated with this switch and tube V–304, as explained in section VI of chapter 5.
21.	Repeat step 18.		
22	On radio receiver, rotate OFF - TRANS - REC MOD - REC CW switch to REC MOD.	Dial lights will light------	If dial lights do not light, check fuse F–403 on rear chassis of modulating voltage generator. If fuse is normal, check Cord CX–1115/U and its connectors. If cord is normal, check pilot lights I–101 through I–104. If these lights also are normal, see section V chapter 5 for repair data on radio receiver.
23	On radio receiver rotate RF GAIN and AF GAIN controls fully clockwise and rotate ANT ADJ control for maximum noise output from speaker. Then adjust AF GAIN control for a desirable audio output.	*a.* A noise output will be heard from speaker. *b.* Circular pattern on screen of cathode-ray tube will be noise-modulated.	*a.* If no noise is heard, check Cord CX–638/CRD–2 and its associated connectors and, if these are normal, check tubes in radio receiver excepting tubes V–111, and V–112, V–113, and V–115. If tubes are normal, see section V of chapter 5 for repair data on radio receiver. *b.* If pattern is not noise-modulated, check tubes V–112 and V–113 in radio receiver. If these tubes are normal, check Cord CG–238/CRD–2 and, if cord is normal, check

Item No.	Action or condition	Normal indications	Corrective measures
			tube V–302 in bearing indicator. If this tube is also normal, see section V of chapter 5 for repair information on radio receiver and section VI of chapter 5 for repair information on bearing indicator.
24	On modulating voltage generator, throw NORTH switch to TEST. Then tune in a strong, steady signal of known azimuth by rotating TUNING CONTROL and ANT ADJ control on radio receiver. Next, rotate RF GAIN and AF GAIN controls, as necessary, until a propeller-shaped pattern (or two propeller-shaped patterns not superimposed) is observed on screen and a desirable audio output is obtained from speaker. Finally, throw NORTH switch to OFF.	When NORTH switch is at TEST, pattern on screen will change from circular to propeller-shaped, and a signal will be heard from speaker.	If propeller-shaped pattern is not obtained, take following steps: (1) Throw the NORTH switch to OFF and EAST switch to TEST. If pattern then can be obtained after readjustment of radio receiver controls named in action column for this step, trouble has been localized to north Antenna Coupling Unit CU–34/CRD–2 and its associated cords, Cords CG–240/CRD–2 and CX–455/CRD–2. If so, check these cords and their connectors for a short or open-circuited condition after disconnecting cords. If cords are normal, trouble is in north coupling unit. See section IV of chapter 5 for repair data. (2) However, if no pattern is obtained after EAST switch is thrown to TEST, then throw EAST switch to OFF and NORTH switch to TEST. Then check cord between receptacle J–101 on radio receiver and rear apron of rack and Cord CG–239/CRD–2. If these cords are normal, check cord between plug P–601 (or P–701) on Coupling Unit CU–68/CRD–2 (or CU–69/CRD–2) and receptacle J–506 on voltage distribution unit. If these cords also are normal, substitute coupling unit not in use for one in use (Coupling Units CU–68/CRD–2 and CU–69/CRD–2). If substitution of coupling unit makes it possible for a propeller-shaped pattern to be obtained after again adjusting radio receiver controls named under "Action" column for this step, trouble is in original coupling unit. If so, see section IV of chapter 5 for repair data.
25	Repeat actions given in step 24 for EAST, SOUTH, and WEST switches successively.	Same as for step 24 *Note.* Angular position of pattern will be the same for north and south checks but will be displaced 90° for east and west checks.	If propeller-shaped pattern is not obtained when EAST, SOUTH, or WEST switch is thrown to TEST, repeat checks given under corrections in step 24, substituting cords for Antenna Coupling Unit CU–34/CRD–2 in use. For example, if patterns are not observed when SOUTH switch is at TEST, check Cords CX–455/CRD–2 and CG–240/CRD–2 associated with south Antenna Coupling Unit CU–34/CRD–2.
26	Repeat actions given for	Positions of patterns will	(1) If it is impossible to superimpose the

Item No.	Action or condition	Normal indications	Corrective measures
	step 24 to obtain propeller-shaped pattern when NORTH switch is at TEST. Then if two patterns not superimposed are observed on the screen, adjust BALANCE control located above NORTH switch until patterns are superimposed. Then throw NORTH switch to OFF.	change with rotation of BALANCE control and, at one setting of control, patterns will be superimposed.	two patterns, the tubes in north Antenna Coupling Unit CU-34/CRD-2 probably are not matched. *Note.* When replacing a tube in Antenna Coupling Unit CU-34/CRD-2, perform the system balancing procedure explained in paragraph 45. (2) If the tubes are normal, see section IV of chapter 5 for repair data on coupling unit.
27	Repeat actions given in step 26 except use, in turn, EAST, SOUTH, and WEST switches instead of NORTH switch. Also, use BALANCE control above switch in use.	Same as for step 26	Same as for step 26, except that east, south, or west Antenna Coupling Unit CU-34/CRD-2 is checked.
28	Throw NORTH, EAST, SOUTH, and WEST switches to OPER and obtain a propeller-shaped bearing pattern from a known azimuth by adjusting controls of radio receiver.	One tip of propeller-shaped pattern will indicate direct azimuth of received signal. Other tip of pattern will indicate reciprocal azimuth.	If tips of pattern do not indicate direct and reciprocal azimuths of received signal, follow orientation procedure explained in paragraph 46.
29	While observing propeller-shaped pattern, depress SENSE SWITCH on bearing indicator.	A sense pattern similar to one of those shown in figure 46 will be observed on screen. Direct azimuth of received signal will be indicated by angular position of pattern. The frequency of the audio output will become lower.	(1) If a sense pattern is obtained but pattern is not similar to one of those shown in figure 46, adjust SENSE GAIN control on subpanel of modulating voltage generator. If this adjustment fails to obtain sense pattern, see section VI of chapter 5 for repair data on bearing indicator. (2) If a sense pattern is not obtained, check position of SENSE H-L switch in all four Antenna Coupling Units CU-34/CRD-2. Each of these switches should be in position which corresponds to antenna array in use. For example, if l-f antenna combination is in use, all four switches should be in L position. If switches are properly positioned, check the four sense tubes in coupling units. If these tubes are normal, trouble is probably in sense-switching and sense phase-rotation circuits. If so, see section VI of chapter 5 for repair data on bearing indicator.
30	Obtain bearing pattern by performing actions given in step 28. Then move STAND-BY - OPERATE - SPLIT switch to SPLIT.	Bearing pattern will split. Intersection of split will indicate same azimuth as did tip of single, propeller-shaped pattern.	If split pattern is not obtained, check circuits associated with STAND-BY - OPERATE - SPLIT switch. See section III of chapter 5 for repair data.

Item No.	Action or condition	Normal indications	Corrective measures
31	While observing bearing pattern, move STAND-BY-OPERATE-SPLIT switch to STAND-BY.	Bearing pattern will be replaced by a circular pattern, diameter of which will change with setting of RF GAIN control, and audio output will not be modulated by the 2 x 147-cps component of signal.	If circular pattern is not obtained, and audio output still is modulated, check circuits associated with STAND-BY - OPERATE - SPLIT switch as explained in section III of chapter 5.
32	With STAND-BY - OPERATE - SPLIT switch at OPERATE, and OFF - TRANS - REC MOD - REC CW switch at REC CW, adjust BFO ADJ control to obtain any desired audio pitch or tone.	An audible beat note will be heard, and frequency of note will vary with rotation of BFO ADJ control. *Note 1.* After completing this step, rotate OFF - TRANS - REC MOD - REC CW switch to REC MOD. *Note 2.* A beat note will be obtained for any position of STAND-BY - OPERATE - SPLIT switch. However, the 2 x 147-cps, modulating component in audio signal will not be heard when switch is in STAND-BY position.	If beat note is not obtained, check tube V-115 in radio receiver. If tube is normal, check bfo circuit of radio receiver, as explained in section V of chapter 5.
33	On azimuth indicator throw VISUAL-AURAL switch to AURAL, and on modulating voltage generator throw MOD VOL switch to AURAL and STAND-BY-OPERATE-SPLIT switch to OPERATE.	*a.* Lights for red and white scales of dial light will light.	*a.* If both dial lights do not light, check fuse F-404 on rear chassis of modulating voltage generator. If fuse is normal, check pilot lights I-1001 and I-1002. If these pilot lights are also normal, see section VII of chapter 5 for repair data on azimuth indicator.
		b. IND-ANT MODULATING VOLTAGE meter will read 3 volts.	*b.* If pilot lights do light, and if a meter reading is obtained but reading is other than 3 volts, adjust MODULATING LEVEL control on azimuth indicator. If adjustment fails to correct meter reading, follow corrections given below for a condition of no meter reading. If *no* meter reading is obtained when dial lights are lighted, check tubes V-1001 and V-1002. If tubes are normal, check Cord CX-1114/CRD-2 and cord between rear apron of rack and receptacle J-404 on modulating voltage generator. If cords are normal, see section VII of chapter 5 for repair data on azimuth indicator.
		c. Pattern will change from propeller-shaped to circular, and diameter of pattern will change with setting of azimuth indicator dial knob and RF GAIN control. Also, aural output of speaker will vary with setting of these controls, and the 2 x 147-cps modulating component of audio signal will not be heard.	*c.* If circular pattern and audio output are not obtained as stated under normal condition *c*, see section VII of chapter 5 for repair data on switching and sinusoidal potentiometer circuits of azimuth indicator.

Item No.	Action or condition	Normal indications	Corrective measures
34	Rotate azimuth indicator dial knob to obtain a null or minimum output from speaker.	Speaker output will vary as control is rotated. At aural-null position, bearing indicated on dial of azimuth indicator will be the same as visual bearing observed in step 28.	If aural-null and visual bearing indications are not the same, orient dial of azimuth indicator as explained in paragraph 48.
35	With azimuth indicator dial knob rotated to aural-null position, throw SENSE switch on azimuth indicator first to RED and then to WHITE.	*a.* With switch at RED, only red scale of dial will be illuminated. With switch at WHITE, only white scale of dial will be illuminated.	*a.* If pilot light fails to operate normally, trouble is in SENSE switch of azimuth indicator. If so, see section VII of chapter 5.
		b. In one position of switch, signal will be louder than in other position. At louder position, direct azimuth will be indicated on illuminated dial and this azimuth will be the same as direct azimuth observed during visual operation (steps 28 and 29).	*b.* If aural-null and visual sense indications of the direct azimuth are not the same, check azimuth scale orientation as explained in paragraph 48 and check switching circuits in azimuth indicator as explained in section VII of chapter 5.
36	Upon completion of step 35, radio set is ready for aural-null operation. If visual operation is desired, throw VISUAL-AURAL switch on azimuth indicator to VISUAL and throw MOD VOL switch on modulating voltage generator to VISUAL.		

CHAPTER 4

THEORY OF EQUIPMENT

Section I. FUNDAMENTAL PRINCIPLES

62. Determination of Direction

The fundamental problem of radio direction finding is that of determining the *direction* in which a distant radio transmitter lies with respect to the radio direction finder. This direction usually is expressed in degrees, with either true north or magnetic north being used as the 0° reference direction.

a. Experience shows that radio waves almost always follow the shortest distance on the surface of the earth, the great circle path, as they travel at the speed of light from a radio transmitter to a radio receiver. Thus, the problem of radio direction finding is reduced to that of determining the direction of arrival of the radio wave at the location of the radio direction finder.

b. A radio direction finder consists essentially of three basic units: a directional antenna, a radio receiver, and an indicating device (fig. 53). The antenna determines the direction of arrival of the radio wave, the radio receiver detects and amplifies the signal picked up by the antenna, and the indicating device presents the results for interpretation by the human senses.

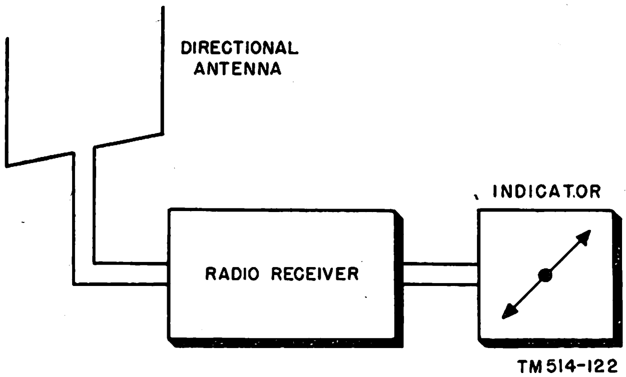


Figure 53. Elementary radio direction finder.

63. Monopole Antenna

A simple form of antenna is a single vertical wire, or monopole. When used as a receiving antenna, it responds equally well to signals from any direction in the horizontal plane. Thus, if a small transmitter is moved about the antenna, identical responses will be obtained at equal transmitter distance. In other words, the monopole has no directional properties in the horizontal plane. A polar diagram of reception for a monopole showing responses plotted against angle of arrival of waves is shown in figure 54.

64. Directional Antennas

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

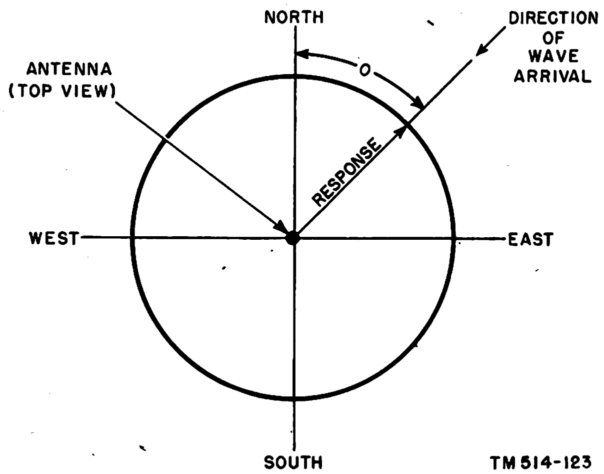


Figure 54. Polar response pattern for monopole antenna.

b. The simple loop and U antennas shown in A and B, figure 55 comply with this requirement. Such antennas have the directional figure-8 response characteristic shown in C of figure 55. Thus, if a small transmitter is moved about a loop or U receiving antenna, unequal

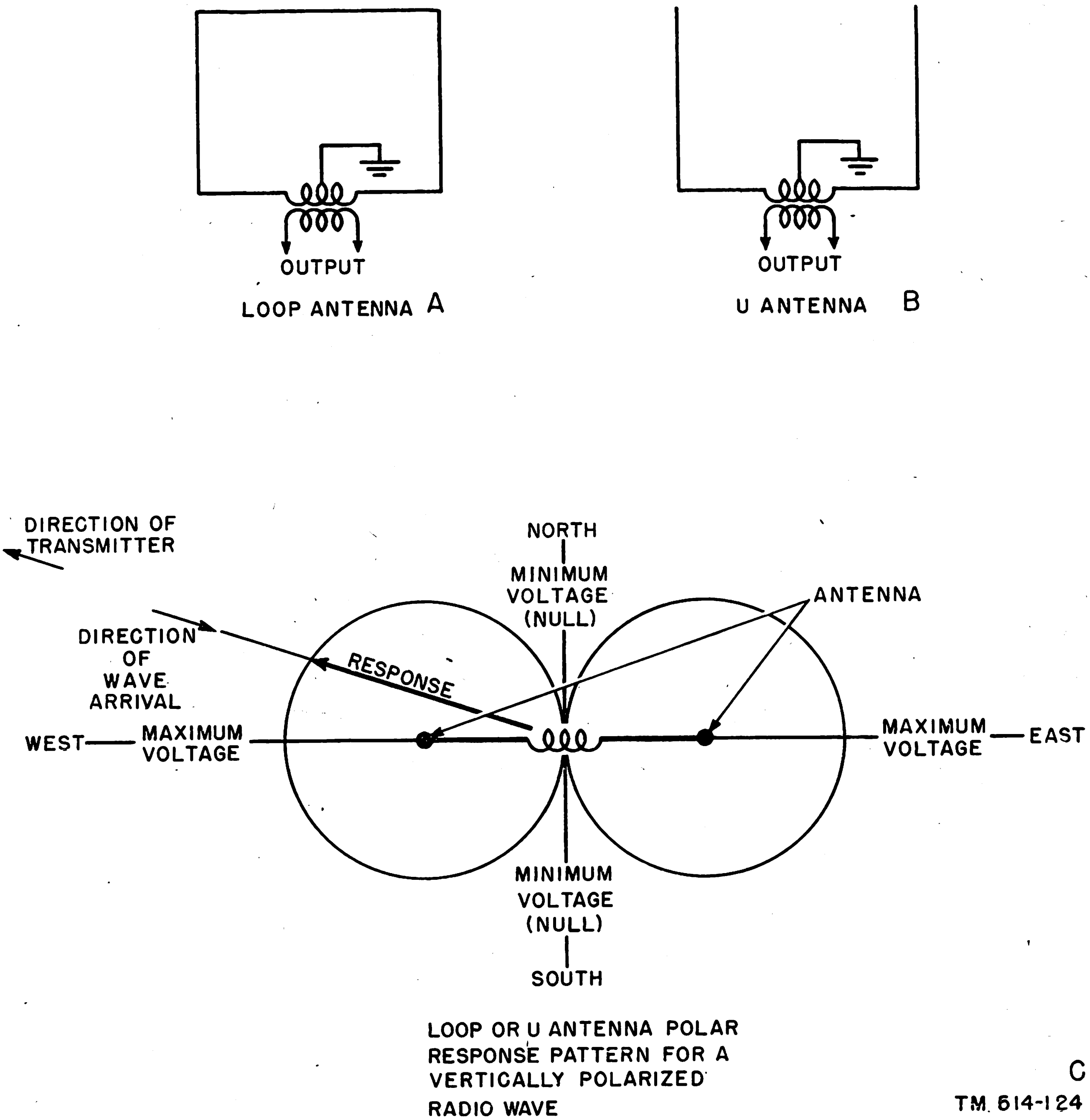


Figure 55. Figure–8 response pattern for loop or U antenna.

responses will be obtained at equal transmitter distances.

(1) The output voltage of these antennas is the result of phase differences between the voltages induced in opposite sides of the antenna. Consider the case of the U antenna placed in the path of a vertically polarized radio wave. When the plane of the U antenna is perpendicular to the direction of wave travel, the wave front reaches the two sides of the U at the same time, the voltages induced in the two sides are of equal magnitude and the same phase, and, being directed in opposition through the coupling impedance,

cancel each other, thus resulting in a null or zero output.

(2) As the plane of the U antenna is rotated about a central vertical axis and brought nearer to parallel with the direction of wave travel, the wave front reaches the two sides of the U at slightly different times, causing a phase difference between the voltages induced in the two sides and giving rise to a resultant voltage that is maximum when the plane of the U antenna is parallel to the direction of wave travel.

(3) The output voltage changes polarity as the angle of arrival of the radio wave passes through the angle of null response. In C, figure 55, the polarity of the output voltage for signals arriving west of the N–S line is just the reverse of the polarity for signals arriving east of the N–S line.

c. Since the response of the U antenna depends upon the direction of arrival of the wave with respect to the plane of the array, the antenna may be used to determine the azimuth of a transmitter; to do this, rotate the antenna to the null or zero position. A pointer set perpendicular to the array and located at its center will point along the line of arrival of the radio wave. Observe, however, that there are two null positions, 180° apart. Either null gives the line of arrival of the wave but does not distinguish between two possible directions along the line, leaving a 180° ambiguity in the azimuth of the transmitter. This ambiguity may be eliminated by taking advantage of the polarity reversing property at the nulls of the U antenna and combining its output with the output of a single monopole (sense) antenna so phased that the relationship between the response diagram of the combined antennas and that of the U antenna alone shows which U antenna null corresponds to the transmitter azimuth.

d. (See figs. 54 and 55.) The output of a single monopole is a circular or omnidirectional pattern, and the output of the U antenna is a figure-8 pattern. If the voltage from the sense monopole is in phase, or 180° out of phase, with the resultant U antenna voltage, and the amplitude of the sense monopole voltage is equal to the amplitude of the maximum U antenna voltage, the combining of these voltages will produce the cardioid response pattern shown by the solid curve in figure 56. The solid curve is the algebraic sum of the two dotted curves. The polarity of the lobes of the figure-8 pattern is determined by the direction of arrival of the signal, whereas the polarity of the sense monopole is independent of the direction of arrival of the signal. Therefore, a reversal of the polarity of the figure-8 pattern will result in a reversal of the cardioid pattern. The orientation of the cardioid pattern with respect to the U antenna null, clockwise or counterclockwise, determines which U antenna null to read for the direct azimuth. The other null indicates the reciprocal azimuth.

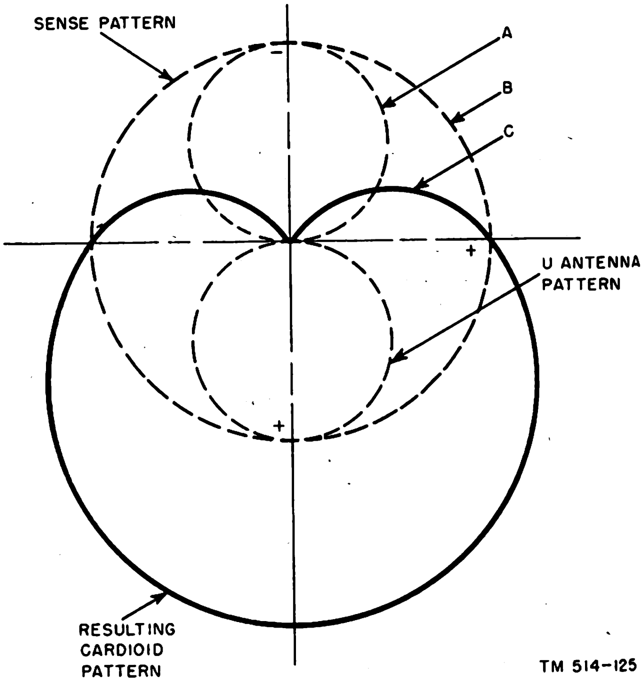


Figure 56. Development of cardioid response pattern.

65. Goniometer Systems

Rotating a U antenna is frequently impractical because of the physical size of the array. This is particularly true of the instantaneous type of indicating systems where a high rotation rate is required. The same effect may be obtained by using two identical fixed-position U antenna arrays set at right angles to each other and combining their output in a *goniometer*. Heretofore, the type of goniometer most commonly used in the frequency range of this

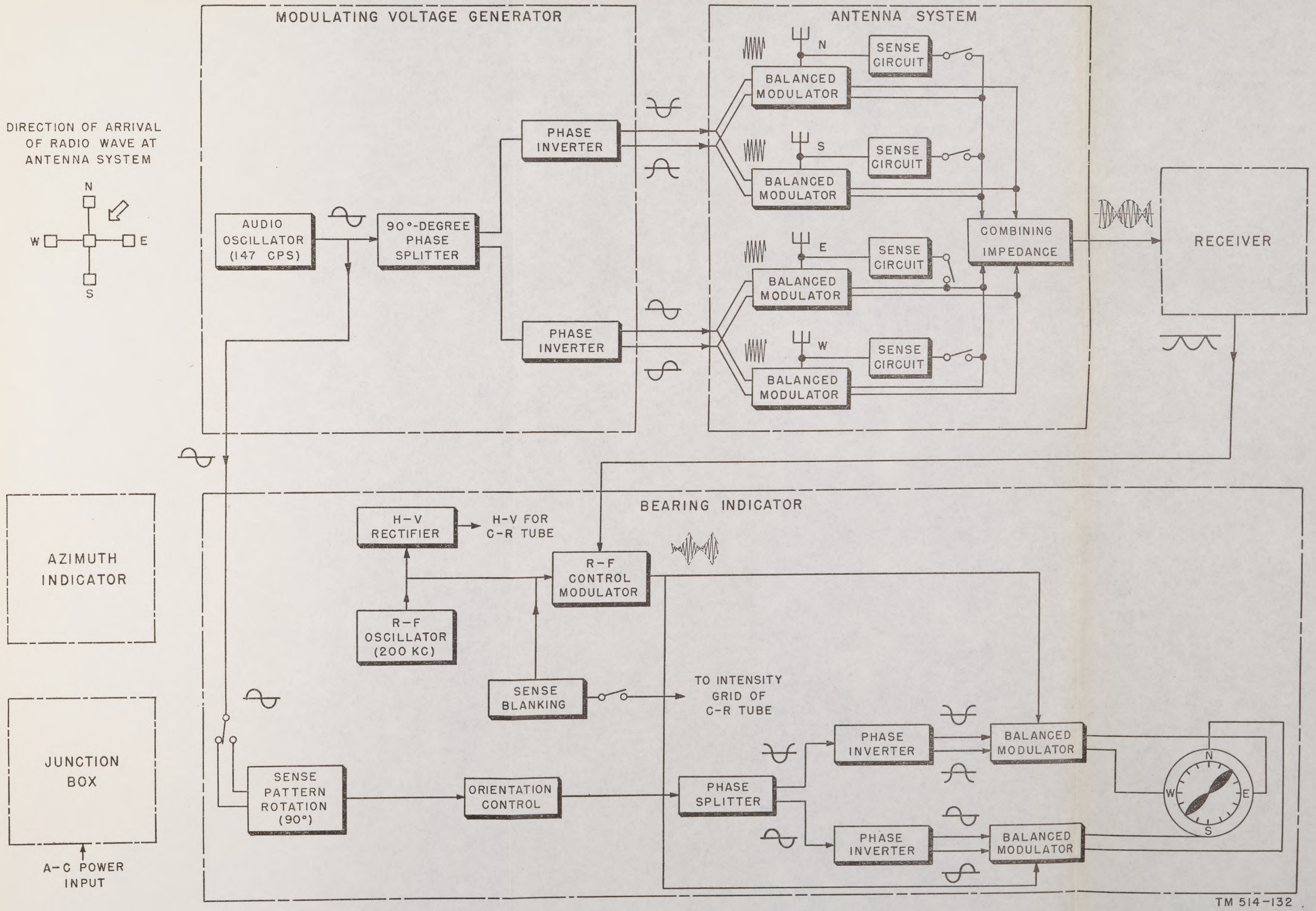


Figure 57. Radio Set AN/CRD-2, functional block diagram.

radio set was the mechanical inductive goniometer. Briefly, it consisted of two stator primary coils (one pair for each antenna array) arranged at right angles to each other and coupled to a movable secondary coil. The response characteristic obtained by rotating the movable coil within the field of the stator coils is identical in form to the response characteristic of a single rotating U antenna. Now, developments in electronics have produced circuits whereby the functions of the mechanical goniometer can be performed by electronic means.

Section II. BLOCK DIAGRAM

66. General

a. Radio Set AN/CRD–2 is a radio direction finder using a fixed oriented antenna array and an electronic goniometer in order to develop, for each r-f signal induced in the antenna array, a sinusoidally modulated r-f wave having an envelope phase which is dependent upon the angle of arrival of the radio wave. For example, if a portable radio transmitter were emitting a signal while being carried through a complete circle (360°) around the antenna array, the envelope phase of the modulated r-f wave appearing at the output of the electronic goniometer would vary through 360 electrical degrees, or a complete cycle.

b. This bearing-dependent wave, after amplification and demodulation in the radio receiver, is applied to circuits in the bearing indicator. This indicator translates the bearing intelligence carried by the wave and displays the bearing information in the form of a propeller-shaped area of light (fig. 45) on the screen of a cathode-ray tube, around which is placed a fixed oriented azimuth scale graduated from 0° to 360°. Thus, for the case of the portable radio transmitter above, the propeller-shaped pattern would revolve in synchronism with the movement of the transmitter.

c. For sense determination, the radio set contains special circuits by means of which the propeller-shaped pattern can be replaced by a sense pattern similar to one of those shown in figure 46.

d. To accomplish its purpose, the radio set uses several major components, including a modulating voltage generator, an antenna system (see note below), a radio receiver, a bearing indicator, an azimuth indicator, and a junction box (a-c power distribution). Paragraphs 67 through 71 present the over-all functioning of these major components in terms of the block diagram of figure 57, and paragraphs 72 through 118 present the theory in detail.

Note. For purposes of presenting the theory of operation, several major components have been grouped together and called the antenna system.

67. Modulating Voltage Generator

A 147-cps sinusoidal voltage is generated in the audio oscillator of the modulating voltage generator. This voltage is fed to a phase-splitting circuit where it is converted into two sinusoidal voltages displaced in phase from each other by 90°. Each of these voltages is, in turn, passed through a phase inverter stage, the output of which consists of two voltages displaced in phase from each other by 180°. Thus, four sinusoidal voltages are developed which are applied as modulating voltages to the antenna system; and, if an arbitrary phase of 0° were to be assigned to one of these voltages, the other three voltages would bear phase relationships of 90°, 180°, and 270°. The modulating voltage generator also supplies a 147-cps sinusoidal reference voltage to the bearing indicator.

68. Antenna System

The antenna system is stationary and uses four spaced monopoles (fig. 6) oriented to the north, south, east, and west of the center of the antenna array. When a radio wave sweeps across the antenna system, it does not arrive at all four monopoles at the same time. For this reason, the relative phase of the r-f signals induced in each of the monopoles is dependent upon the direction of arrival of the radio wave. R-f signals picked up by each monopole are fed to a two-tube *balanced modulator* which is contained in a metal box (Antenna Support AB–64/CRD–2) located at the base of each monopole.

a. The four 147-cps sinusoidal voltages developed in the modulating voltage generator also are fed to these balanced modulators.

b. The outputs of all four balanced modulators (fig. 57) are connected to a common load, the combining impedance, across which is developed a single, modulated, r-f wave. The envelope phase of this wave, explained in section IV, this chapter, is dependent upon the direction of arrival of the radio wave at the antenna system.

c. For sense operation, a portion of the r-f output of each monopole is applied to a sense differentiating circuit and then recombined with the modulated r-f wave at the outputs of the balanced modulators. In this way, sense operation is obtained without the use of an additional monopole or sense antenna.

69. Radio Receiver

The radio receiver is a modified communications receiver which selects, amplifies, and detects the modulated r-f wave which appears at the output of the combining impedance in the antenna system.

a. The radio receiver has two outputs: an audio signal which actuates a speaker (physically located in the modulating voltage generator) and a video signal which is fed to the bearing indicator.

b. Because the video output signal of the receiver is developed from the modulated r-f wave at the input to the receiver, the phase of the video signal is dependent upon the envelope phase of the modulated r-f wave which, in turn, is dependent upon the direction of arrival of the radio wave at the antenna array.

c. All the usual features of a communications receiver also are found on the radio receiver for Radio Set AN/CRD–2, including r-f and a-f gain controls, a beat-frequency oscillator, a noise limiter, continuous tuning from 0.54 to 30 mc, etc.

70. Bearing Indicator

The 147-cps sinusoidal voltage generated in the audio oscillator of the modulating voltage generator is fed to the bearing indicator to act as a synchronizing voltage.

a. This 147-cps voltage, after passing through the sense pattern rotation and orientation circuits, is fed to a phase splitter which divides the voltage into two voltages displaced in phase from each other by 90°. These two voltages then are passed through a pair of phase inverters. The operation and function of the phase splitter and phase inverters are the same as those of the corresponding circuits in the modulating voltage generator. Likewise, the four voltages produced by the phase inverters have the same phase relationship as those produced in the modulating voltage generator, that is, 90°, 270°, 0°, and 180°. These four voltages are applied to two balanced modulators.

b. A 200-kc signal is generated in the oscillator of the bearing indicator. This 200-kc signal is used to power the h-v (high-voltage) rectifier which develops the high d-c potentials required for the cathode-ray tube. The 200-kc signal also is fed to an r-f control modulator.

c. In the absence of a video signal from the receiver, the output of the r-f control modulator is an unmodulated, 200-kc signal. This signal is fed, in phase, to each of the balanced modulator tubes. In each balanced modulator, the 200-kc signal is combined with the 147-cps signal to produce the output voltage which is applied to deflection plates of the cathode-ray tube. Under excitation, the balanced modulators cause the electron beam in the cathode-ray tube to trace a pattern on the screen. This pattern appears as a circular area of illumination.

d. In the presence of the video signal from the receiver, the output of the r-f control modulator is a modulated, 200-kc wave which is applied to each of the balance modulator tubes. In this case, the illuminated circular pattern on the screen of the cathode-ray tube is changed to a propeller pattern (A, fig. 3). The angular position of the propeller depends on the direction or angle of arrival of the radio wave at the antenna system. During sense operation, the propeller pattern is changed to a sense pattern. (B, fig. 3).

71. Azimuth Indicator

The azimuth indicator can be switched into operation when aural-null operation is desired. Section VII of this chapter explains the theory of the azimuth indicator.

72. Junction Box J-95/CRD-2

This junction box, connected between the a-c power source and the modulating voltage generator supplies 115-volt, 60-cycle power to the modulating voltage generator which, in turn, distributes the power to all other major components. The unit contains input and output connectors, an autotransformer for adjusting the output to 115 volts, overload circuit breakers, a voltmeter, a frequency meter, and dummy load resistors.

Section III. THEORY OF MODULATING VOLTAGE GENERATOR

73. Block Diagram

A block diagram showing each stage or circuit in the modulating voltage generator is shown in figure 58. (Figure 119 is the complete schematic diagram.)

a. A 147-cps voltage is generated in the oscillator stage (one section of tube V-401), the master audio oscillator for Radio Set AN/CRD-2. The oscillator output voltage is sinusoidal and its frequency stability is good.

b. The buffer stage (the other section of tube V-401) isolates the oscillator circuit from the amplifier so that variations in the load circuit will not affect the frequency of the oscillator.

c. The output of the buffer is parallel-fed to two amplifier stages. One of these stages, the sync voltage amplifier, uses one section of tube V-402 to amplify the 147-cps signal, which then is fed to the bearing indicator. The other amplifier uses the other section of tube V-402 to raise the level of the 147-cps signal before its application to the 90° phase shifter and high-level amplifiers (tube V-403).

d. The 90° phase shifter converts its 147-cps input signal into two output signals which differ in phase by 90°. The output signals then are fed to separate amplifier stages. After amplification, these quadrature signals are applied to the phase inverter stages.

e. Each phase inverter stage converts its input signal into two equal-amplitude and oppositely phased voltages. Thus, four 147-cps signals, having phase relationships of 0°, 180°, 90°, and 270°, appear at the outputs of the phase inverter stages. These four voltages are fed to the balanced modulator stages in the antenna system.

f. The power supply converts the 115-volt, a-c input to the low a-c voltages required for heating the filaments of the tubes and to the high d-c voltages required for operation of the voltage regulating circuit. The voltage regulator tubes, V-407 through V-411, and their associated circuits stabilize the B+ voltages which supply the d-c operating potentials for the plates of the tubes in the modulating voltage generator. In addition, the voltage regulating circuit furnishes B+ voltage for the screen and plate circuits of the tubes in the antenna system.

g. The metering circuit associated with V-405 enables the operator to check the voltage levels of the 147-cps signals developed at the outputs of the phase inverter stages and also the level of the 147-cps synchronizing voltage which appears at the input of the horizontal balance modulator stage in the bearing indicator. To prevent the metering circuit from loading the circuit under test, a VTVM (vacuum-tube voltmeter) arrangement is used. In addition to the above measurements, another metering circuit provides for checking the regulated outputs of the voltage regulating circuits of the modulating voltage generator and the bearing indicator and also the cathode currents of the balanced modulator tubes in the antenna system. A third metering circuit arrangement provides for checking the d-c level (modulating voltage) in the azimuth indicator.

h. The speaker used for aural monitoring of output signals of the radio receiver is located in the modulating voltage generator.

i. Also located in this component are various level and balance control circuits which are, electrically, a part of the antenna system.

74. Oscillator and Buffer Stages

a. OSCILLATOR STAGE. The 147-cps master audio oscillator (fig. 59) uses section 1 of tube V-401 in an R-C (resistance-capacitance) phase shift type of oscillator circuit.

(1) The network consisting of capacitors C-401, C-402, and C-403, in combination with resistors R-401, R-402,

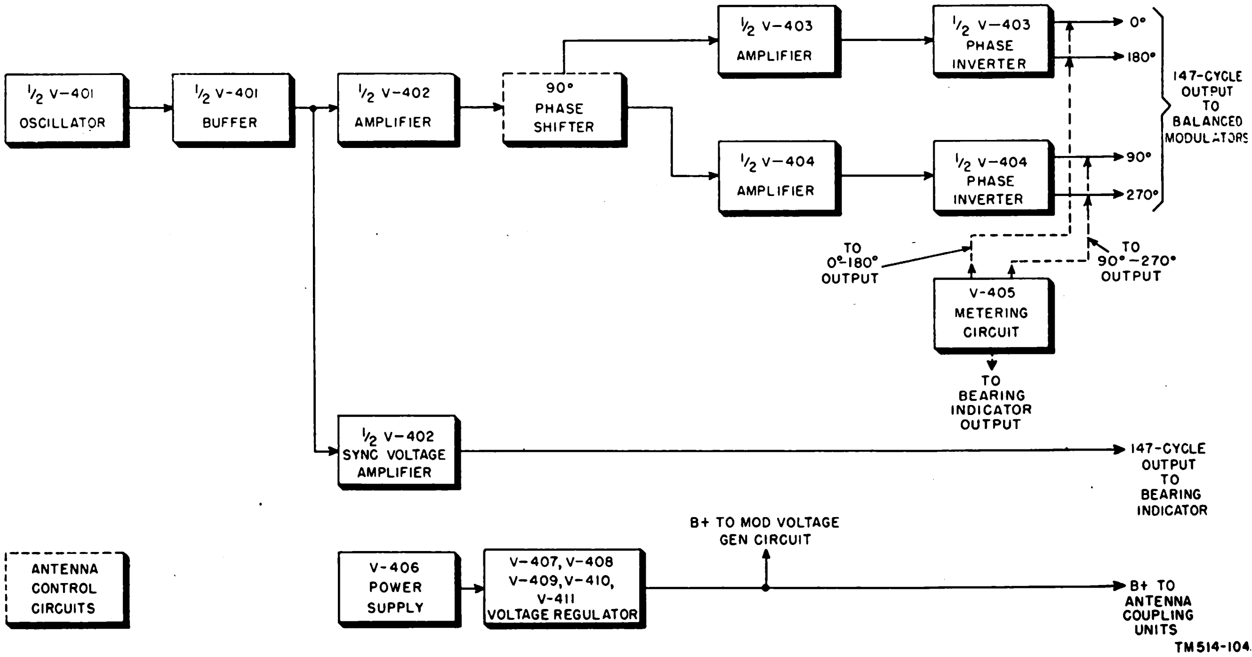


Figure 58. Modulating Voltage Generator O–15/CRD–2, block diagram.

and R–403, provides the feedback coupling between the plate and grid circuits of the tube. This feedback is necessary to maintain oscillation. The values of capacitance and resistance have been so selected that only at the frequency of 147 cps is the phase shift of the feedback voltage at the correct angle for oscillation to be sustained.

(2) R–404 is the cathode bias voltage resistor, and C–404 is the cathode a-f bypass capacitor. R–410 is the plate load resistance. Capacitor C–408 in combination with resistance R–409 form a decoupling network to prevent a-f energy from entering the power supply circuits.

(3) The oscillator output voltage is coupled to the input circuit of the buffer stage by means of capacitor C–407.

b. BUFFER STAGE. Section 2 of tube V–401 is a buffer amplifier (fig. 59) which is used to isolate the oscillator from variations occurring in following stages. This isolation prevents load changes from causing distortion of the oscillator output voltage and shifts in the frequency of the oscillator. The buffer uses a conventional amplifier circuit except for the inclusion of a low-pass filter in the grid circuit.

(1) Resistors R–407 and R–408 in combination with capacitors C–405 and C–406 form a low-pass filter which discriminates against undesired harmonic energy in the 147-cps signal. Elimination of the harmonic content in this signal prevents distortion of the sinusoidal waveform desired for the output signal.

(2) R–406 is the grid resistor, and R–405 is the cathode bias resistor. R–412 is the plate load resistance, and capacitor C–410 with resistor R–411 comprise another decoupling network.

75. Amplifier and Sync Voltage Amplifier (fig. 60)

The 147-cps output signal is fed from the buffer stage through coupling capacitor C–409 and passes through another low-pass filter (R–413, R–414, C–411, and C–412) before being parallel-fed to two amplifiers, each of which uses one triode section of tube V–402. The low-pass filter further attenuates harmonic content in the 147-cps signal.

a. AMPLIFIER. The output of the filter

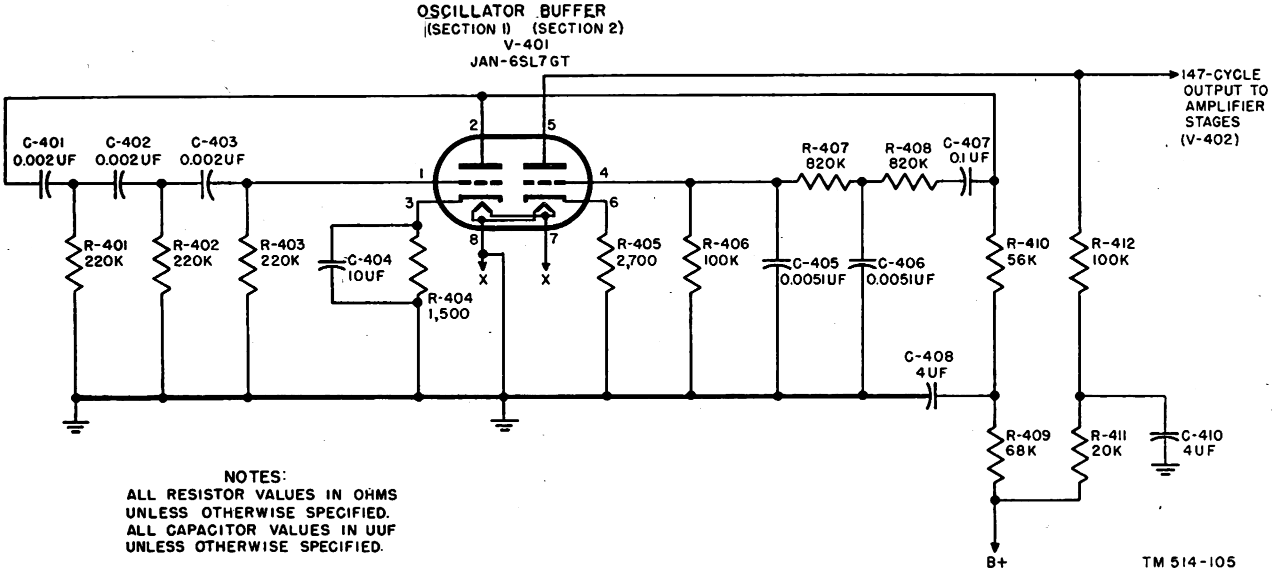


Figure 59. Modulating Voltage Generator O–15/CRD–2, oscillator and buffer stages, schematic diagram.

reaches the grid of the first section of the tube through potentiometer R–416, the OVER-ALL control. The amplified output signal which appears across plate load resistor R–421 is coupled to the 90° phase shifter and high-level amplifiers through the R-C network which consists of resistors R–422 and R–423 and capacitors C–414 and C–415. This network comprises a highpass filter which is used to attenuate any 60-cps hum which might have been picked up in preceding circuits. R–417 is the cathode bias resistor.

b. SYNC VOLTAGE AMPLIFIER. The 147-cps input to the sync voltage amplifier is taken from the common low-pass filter network and is coupled through isolating resistor R–145 to the grid of the second section of tube V–402. R–419 is the grid resistor, and R–418 is the cathode bias resistor for this stage. The amplified output signal appears across R–420, the plate load resistance. This output signal is the synchronizing voltage which is fed to the bearing indicator through C–413, the output coupling capacitor.

76. Phase Shifter, Amplifiers, and Phase Inverters (fig. 61)

a. PHASE SHIFTER. As previously explained, the 147-cps signal developed in section 1 of tube V–402 is coupled through a phase-shifting network before it reaches the amplifier sections of tubes V–403 and V–404. The purpose of the phase shifter is to divide the input signal into two voltages displaced in phase by exactly 90° with respect to each other.

(1) Before the 147-cps signal reaches the grid of the amplifier portion (section 1) of tube V–404, it passes through one arm of the phase shifter consisting of resistor R–425 and capacitor C–417, with the grid voltage appearing across the capacitor.

(2) The grid voltage for the amplifier portion (section 1) of tube V–403 passes through the other arm of the phase shifter which is comprised of capacitor C–416, resistors R–424 and R–246, and potentiometer R–427, the E-W control, with the grid voltage being taken from the potentiometer.

(3) Each of the two arms of the phase shifter causes a phase shift to occur between its input and output voltages with the total phase shift of both arms amounting to 90°. Thus, the 147-cps signals at the grids of the two amplifiers are 90° out of phase with each other.

(4) The purpose of the E-W control is to permit adjustment of the amplitude of the signal at the grid of section 1 of tube V–403 to the same value as that applied to section 1 of tube V–404.

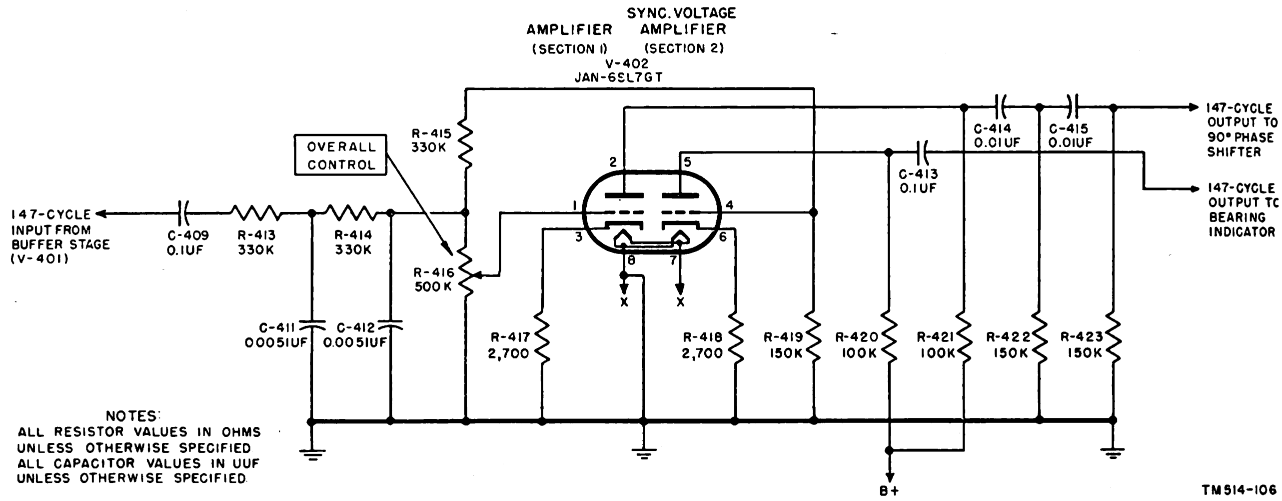


Figure 60. Modulating Voltage Generator O–15/CRD–2, amplifier and sync voltage amplifier stages, schematic diagram.

b. AMPLIFIERS. The two amplifiers are identical and use a conventional circuit. R–428 and R–435 are the cathode bias resistors, R–433 and R–440 are the plate load resistors, and C–418 and C–422 are the output coupling capacitors. Resistor R–432 with capacitor C–419 and resistor R–439 with capacitor C–423 comprise two decoupling networks for the plate circuits of tubes V–403 and V–404.

c. PHASE INVERTERS. The output signal of the amplifier section of tube V–403 is coupled to the grid of the second section of the tube, a phase inverter stage.

(1) In the phase inverter, R–430 is the cathode bias resistor and R–431 is the grid resistor. As the 147-cps sinusoidal input signal swings through its positive and negative alternations, the tube current increases and decreases in unison. This tube current is common to both the cathode resistance and the plate resistance. As a result, the a-f signals appearing across resistors R–429 and R–434 are of equal amplitude (the values of the resistors are equal). One output voltage is taken across the cathode resistor through capacitor C–421, and the other output voltage is taken across the plate resistor through capacitor C–420. These voltages are in phase opposition, however, because increases in tube current cause a rise in cathode potential and a fall in plate potential while decreases in tube current have the opposite effect. Thus, two output voltages are developed which are equal in amplitude but shifted in phase by 180°

(2) The phase inverter section of tube V–404 functions in exactly the same manner as the phase inverter section of tube V–403. However, because the input signal to tube V–404 differs in phase by 90° from the input signal to tube V–403, the two output signals are displaced in phase by the same amount. Thus, the four output signals of the phase inverters are of equal amplitude but of different phase. If one of these signals is considered to have a phase angle of 0°, then the other three signals will bear phase relationships of 180°, 90°, and 270°. These four signals are the modulating voltages fed to the balanced modulators in the antenna system.

77. Power Supply and Voltage Regulators (fig. 62)

a. POWER SUPPLY. The power supply converts the 115-volt, a-c input to the low a-c voltages required for heating the filaments of the various tubes and the high d-c voltage required for operation of the voltage regulator circuit.

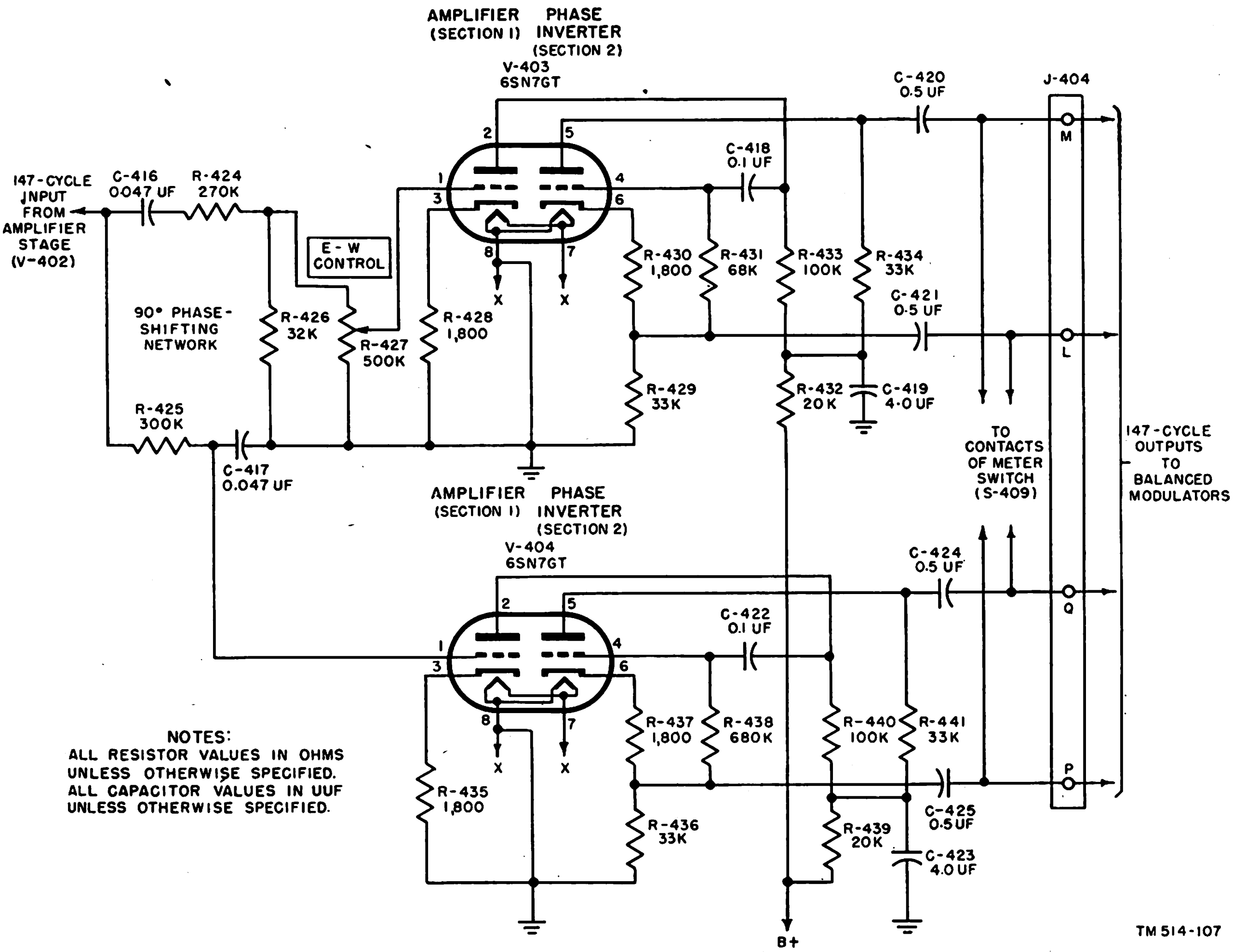


Figure 61. Modulating Voltage Generator O–15/CRD–2, phase shifter, amplifiers, and phase inverters, schematic diagram.

(1) The 115-volt, a-c input reaches the primary of power transformer T–401 through receptacle P–402 and switches S–401 and S–402, the power OFF-ON and MASTER POWER OFF-ON switches. Pilot lights I–401 and I–402 glow when these switches are turned on and power is applied. Fuse F–401 protects the primary circuit of the transformer from overload. Receptacles J–401, J–402, and J–403 make the 115-volt, a-c power available to other circuits in the equipment, as shown on the cording diagram in figure 39. Fuses F–402, F–403, and F–404 protect these outlets from overload.

(2) One of the three low-voltage secondary windings provides the filament voltage for rectifier tube V–406, a second winding furnishes filament voltage for regulator tubes V–407 and V–408, and the third winding furnishes the filament voltage for the other tubes in the modulating voltage generator.

(3) The h-v secondary winding of transformer T–401 is connected to the plates of full-wave rectifier tube V–406. The B+ output of the rectifier is taken from the center tap of the filament winding for the rectifier tube and is passed through a smoothing filter comprised of choke L–401 and capacitor C–429. This filter eliminates much of the ripple from the d-c output voltage of the rectifier.

b. VOLTAGE REGULATORS. The voltage regulator circuit furnishes a stable d-c output voltage over a wide range of operating conditions despite changes in the output load, or changes in the a-c line voltage.

(1) The h-v output of the power supply is connected to the load through the series current path which consists of choke L–401, parallel-connected voltage regulator tubes V–407 and V–408, and the secondary winding (terminals 8, 9, and 10) of transformer T–401 (fig. 62).

(2) Across the output circuit is connected the series combination of resistors R–466 and R–464 and potentiometer R–465, the B+ level control. This combination acts as a voltage divider for the output voltage. The adjustable arm of the potentiometer connects to the grid of voltage control tube V–409, thus applying a portion of the output voltage to the grid of this tube. The cathode of tube V–409 is held at a constant voltage level by action of the gas voltage regulator tube, V–410, and its series resistor R–467. Capacitor C–428 prevents self-oscillation in this circuit. Because the cathode voltage is constant, the tube current is determined only by the grid voltage. The plate of this tube is connected to the B+ line through resistor R–462 and to the grids of tubes V–407 and V–408. Thus, any changes in plate potential for tube V–409 produce corresponding changes in the grid voltage of the two voltage regulator tubes.

(3) Resistors R–460 and R–461 and potentiometer R–463, the HUM control, feed a portion of the unregulated voltage back into the grid of the tube V–409. When this control is adjusted properly, power supply hum is eliminated because of the out-of-phase feedback voltage.

(4) To follow the regulating action of this circuit assume that the output voltage starts to increase as a result of a change in line voltage increasing the h-v output of the rectifier tube. When this occurs, the grid voltage of tube V–409 also will rise and the tube will conduct more current, producing a larger voltage drop across resistor R–462 and a lower voltage at the plate of the tube. The voltage at the grids of tubes V–407 and V–408 (connected to the plate of tube V–409) also will be lower; that is, the voltage will become more negative with respect to cathodes of the tubes. This action results in an increase in the plate resistance of the parallel-connected tubes. As the plate resistance increases, the voltage drop across the tubes also increases and, because these tubes are connected in series between the rectifier output and the load ((1) above), the output voltage decreases to its original value.

(5) Additional regulation is provided for the 150-volt output to the tubes in the antenna system. This regulation is obtained by the use of gas voltage regulator tube V–411 and its series resistor, R–468.

78. Metering Circuits (fig. 63)

The metering circuits used two O–1 milliammeters and their associated circuits, which include the two selector switches (S–408, the E_B IND - E_B GEN - I_K ANT MOD switch, and S–409, the MOD VOLTAGE LEVEL switch).

a. Meter M–401 is connected in a vacuum-tube voltmeter circuit and indicates the amplitude of any one of three different pairs of 147-cps signals. In the IND position of switch S–409, the meter measures the level of the 147-cps voltage which appears across the input of the horizontal balanced modulator in the bearing indicator. In the OVER-ALL position of the switch, the level of the 147-cps voltage at the output of phase inverter tube V–404 is measured. In the E-W position of the switch, measurement is transferred to the output voltage of phase inverter tube V–403.

(1) As shown in figure 63, switch S–409 selects the particular voltage which is to be measured and applies it to the grids of the vacuum-tube voltmeter tube V–405. R–446A and R–446B are ganged, cathode bias potentiometers

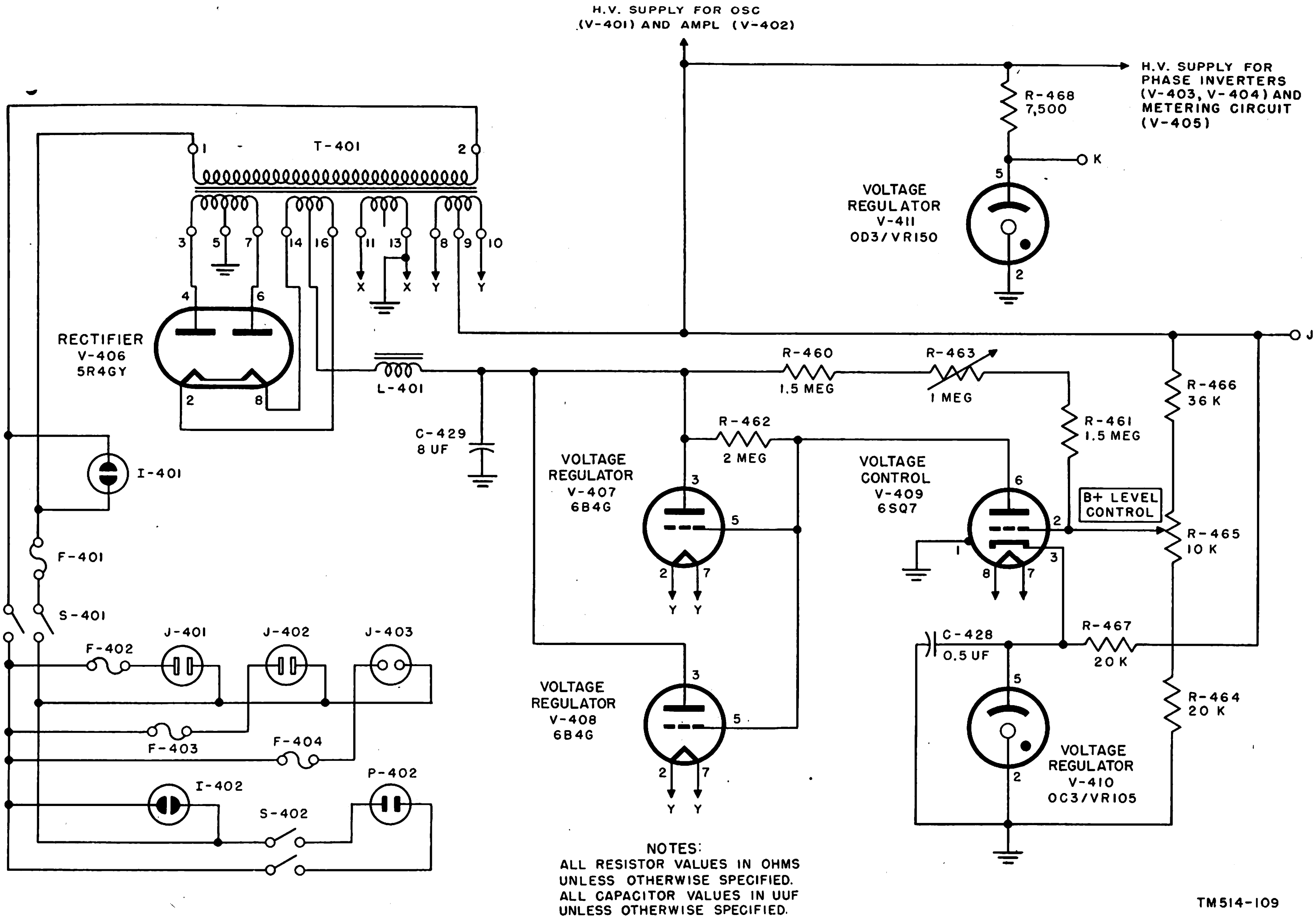


Figure 62. Modulating Voltage Generator O-15/CRD-2, power supply and voltage regulators, schematic diagram.

and can be adjusted during meter calibration to provide a proper bias voltage to the two triode amplifier sections of the tube. R–442 and R–443 are the grid resistors. R–444 and R–445 are the plate load resistances across which the amplified 147-cps voltage appears.

(2) The 147-cps voltage appearing at the output of the metering tube is connected to the input terminals of the full-wave, selinium rectifier CR–401 through capacitors C–426 and C–427. These capacitors also prevent the d-c component of plate voltage from reaching the rectifier. Resistor R–469 dissipates any charge present across the retcifier input. The bridge-type rectifier converts its alternating input potential to a d-c voltage, the amplitude of which varies directly with the amplitude of the 147-cps signals. This d-c voltage then is applied to the meter and produces a d-c current flow through the meter.

(3) Switch S–410 disconnects the meter from the vacuum-tube voltmeter circuit and connects it into a d-c circuit in the azimuth indicator. When so connected, resistor R–1005 (in the azimuth indicator) is used as a meter shunt in a conventional d-c milliammeter circuit.

b. Meter M–402 can be used for any one of three different measurements. In the E_B IND position of switch S–408, the meter is connected in series with meter multiplier resistor R–447 and the switch to the B+ output of the voltage regulator in the bearing indicator. In the E_B GEN position of this switch, the meter is connected in a series with the resistor (R–447) and the switch to the B+ output of the voltage regulator in the modulating voltage generator. In the I_K ANT MOD position of this switch, the meter is connected across shunt resistor R–457 and to a common circuit for the cathodes of the balanced modulator tubes in the antenna system. By means of the OPER-OFF-TEST switches, the cathode current of any one of these tubes can be measured by throwing its corresponding switch to the TEST position (par. 79).

79. Antenna System Control Circuits

In order to permit certain adjustments of the antenna system at the operator's position, a number of anetnna system controls are located physically in the modulating voltage generator and are connected electrically to the antenna system by means of connecting cables. Figure 64 shows those antenna system circuits which are in the modulating voltage generator. In the following explanation, it is assumed that the controls are located at the antenna system. Section IV of this chapter contains the theory of operation for the antenna system.

a. As shown in A of figure 65, potentiometers R–448 through R–451 (BALANCE controls) are differential cathode bias controls which are used to balance the current flow in each pair of balanced modulator tubes in the antenna system. For example, potentiometer R–451 is used to balance the west balanced modulator tubes. Potentiometers R–453 through R–456 (LEVEL controls) are used to adjust the level of cathode currents for each pair of tubes. Switches S–404 through S–407 (OPER-OFF-TEST switches) return the cathode circuits to ground when the switches are in the OPER position, open the cathode circuits when in the OFF position, and connect meter M–402 in series with the cathode ground return circuit when in the TEST position. These four switches are not ganged and may be operated independently of each other.

b. The cathodes of four of the balanced modulator tubes are connected together and returned to ground through resistor R–458 when the STAND-BY - OPERATE - SPLIT switch is in the STAND-BY position (B, fig. 65). Because the current drawn by the four tubes flows through a common resistor (R–458), the voltage drop across this resistor is high. As a result, a high bias voltage is applied to the tubes and reduces their amplification. The cathode circuits of the other four balanced modulator tubes remain unchanged (connected to ground through OPER-OFF-TEST switches which are not shown in B of figure 65), but the 147-cps modulating voltage which normally is fed the balanced modulator tubes by the modulating voltage generator is shorted out by the action of one set of contacts on switch S–403. As a result, the operation of each balanced modulator is unbalanced and its output is an un-

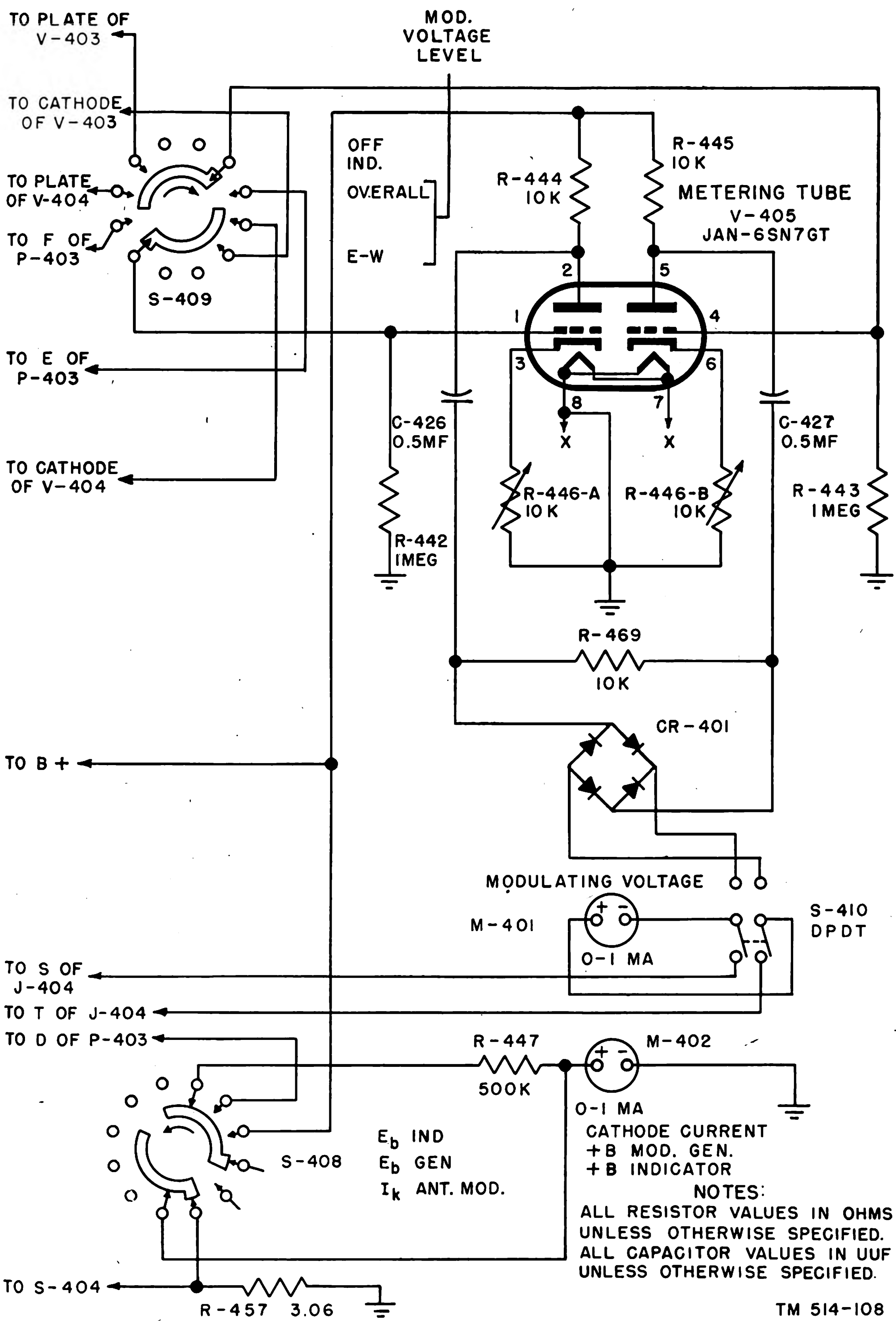


Figure 63. Modulating Voltage Generator O–15/CRD–2, metering circuits schematic diagram.

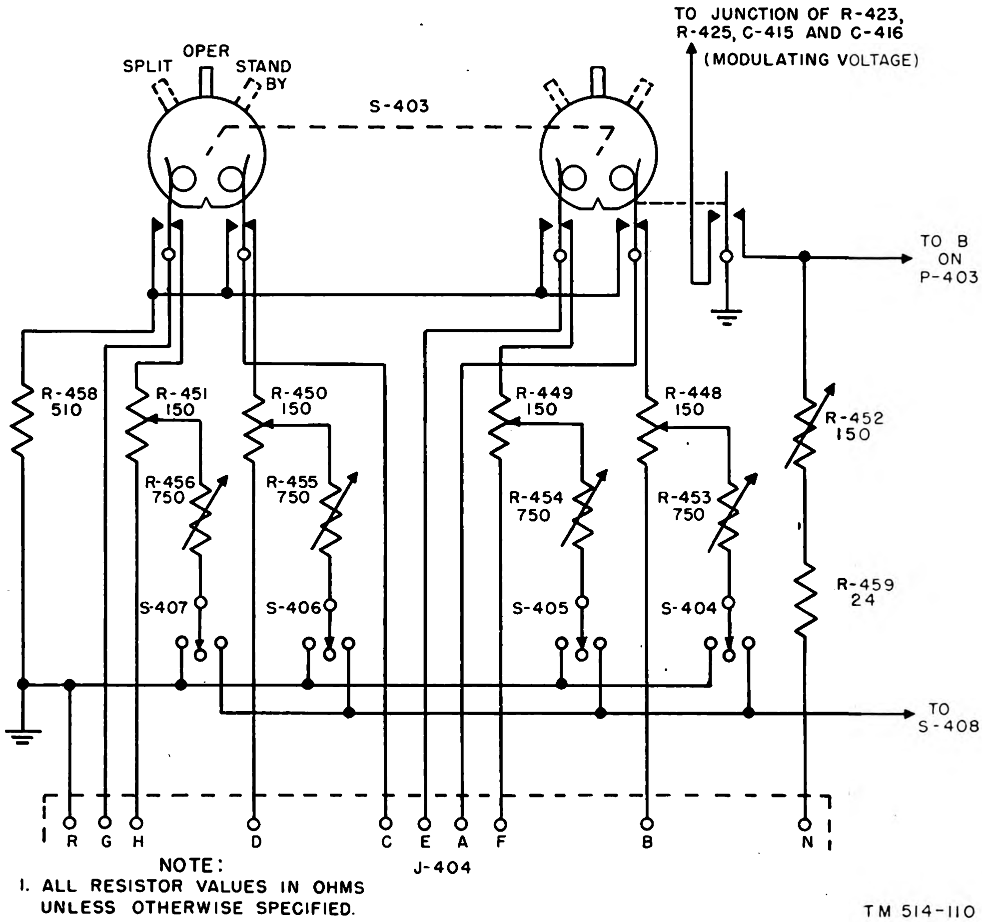


Figure 64. Modulating Voltage Generator O–15/CRD–2, antenna system control circuits, schematic diagram.

modulated signal. This condition is desirable when the radio set is used for aural monitoring.

c. When switch S–403 is in the SPLIT position, the sense tube in each antenna coupling unit is made operative by returning its cathode to ground through resistors R–459 and R–452, the SENSE GAIN control. R–452 is used to adjust the bias voltage for the sense tubes during split or sense operation, and resistor R–459 provides a minimum bias voltage for the tubes if R–452 is adjusted to a zero resistance setting.

Section IV. THEORY OF ANTENNA SYSTEM

80. General

The antenna system of Radio Set AN/CRD–2 consists of four vertical antennas (monopoles), four balanced modulator and sense circuits (Antenna Coupling Units CU–34/CRD–2), a combining impedance (Coupling Unit CU–68/CRD–2 or CU–69/CRD–2), plus a number of coaxial lines, interconnecting cables, control circuits, and other associated equipment.

a. R-f signals induced in the monopoles are fed to the balanced modulator and sense tubes which are contained in the metal case located at the base of each monopole.

b. In each of the balanced modulators, the r-f signals are combined with the 147-cps voltages generated in the modulating voltage generator. After combination, a single modulated r-f wave appears across the combining impedance located in the junction box at the center of the antenna array. Coaxial lines are used to carry the r-f energy from the balanced modulator tubes to the combining impedance. Other lines bring the 147-cps voltages from the modu-

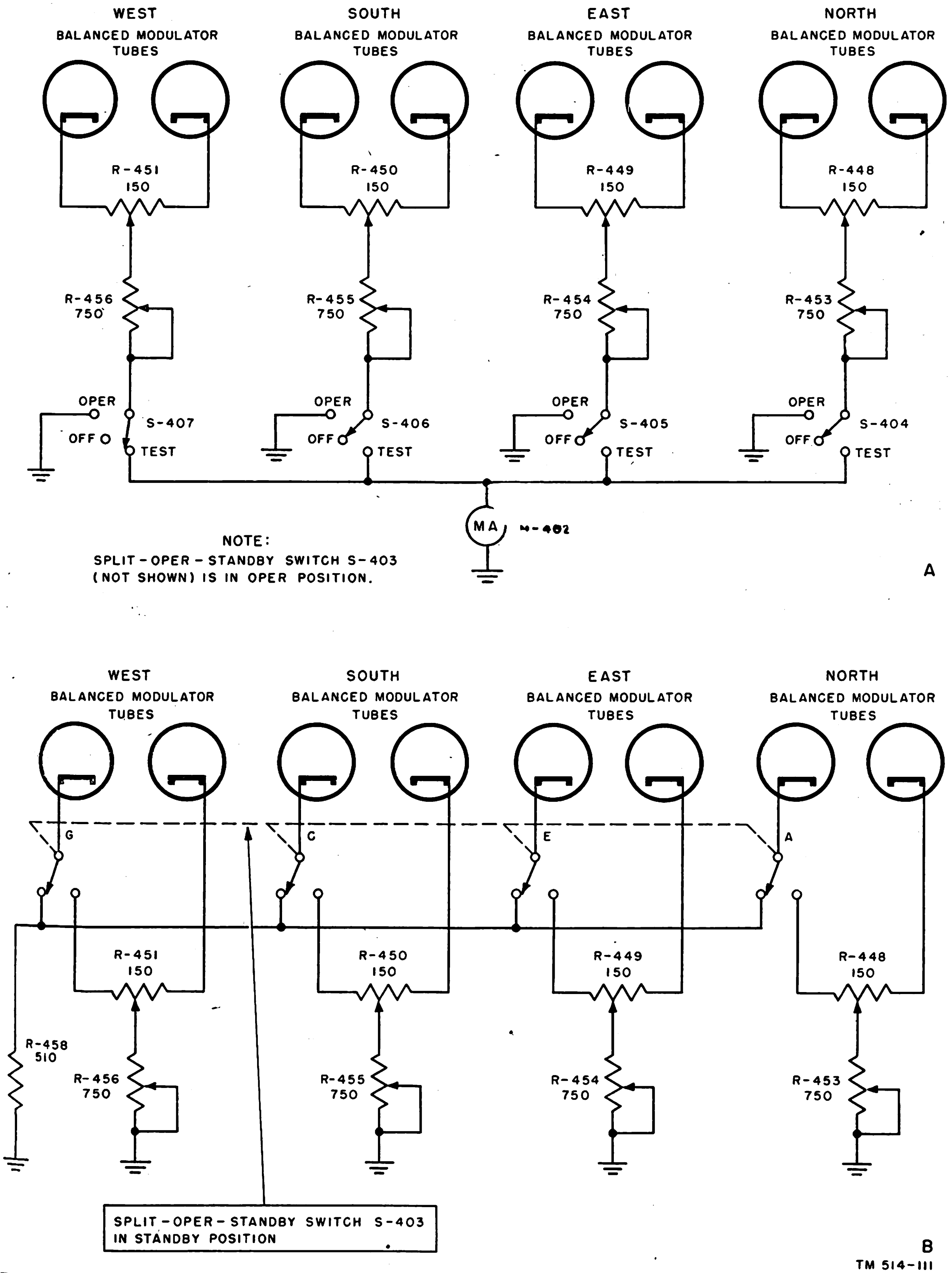


Figure 65. Modulating Voltage Generator O-15/CRD-2, functional diagrams showing connections of control circuits in modulating voltage generator to the balanced modulator circuits in the antenna system.

lating voltage generator to the balanced modulator tubes.

c. The modulated r-f outputs of the four balanced modulators appear across a common primary winding in the combining impedance. The signal induced in the secondary winding is the resultant voltage produced by the primary signals. The secondary voltage is a modulated r-f wave and is fed to the radio receiver by means of a shielded twin coaxial transmission line. The envelope phase of the input wave to the radio receiver is dependent on the direction of arrival of the r-f wave at the antenna system.

d. During sense operation, four sense tubes are connected into the circuit and operate in conjunction with the balanced modulator tubes to produce a radio receiver input wave which can be used for sense indication.

e. Figure 66, a functional schematic diagram of the antenna system, shows some control circuit parts for the antenna system which are located physically in the modulating voltage generator. *For purposes of clarifying the following explanation of its operation, the parts designations on this drawing do not agree with the designations of corresponding parts on the equipment, nor are the circuits identical. For details of this equipment, see figures 39, 119, 122, 123, and 124.*

81. Functioning of Parts (fig. 66)

a. BEARING OPERATION. During bearing operation, the four cathode circuits of the sense tubes are open and the sense tubes are inoperative. The equipment then can be used for bearing operation with the circuits functioning as follows:

(1) The r-f signal induced in each of the monopoles is applied, in phase, to the grids of its corresponding balanced modulator tubes. For example, the r-f signal induced in the north monopole is coupled through capacitors C–1 and C–2 to the grids of the north balanced modulator tubes, V–1 and V–2.

(2) In the absence of the 147-cps, out-of-phase or push-pull audio modulating voltage at the input to these tubes, and assuming that all circuits are balanced perfectly, the r-f signals that are applied in phase to the grids produce r-f changes in the current through the tubes and through their plate load, the primary winding of the combining impedance. However, because the r-f grid voltages are applied in phase, the r-f plate currents of the tubes are also in phase with each other. Also, the plate of each tube is connected to opposite ends of the combining impedance, causing cancellation to take place in the induction field about this winding. As a result, no voltage appears across the secondary or output winding of the combining impedance.

(3) However, when the 147-cps audio modulating voltage and the r-f monopole signals are applied simultaneously to the grids of the balanced modulator tubes, there is an output voltage across the secondary winding of the combining impedance. As the push-pull (180° out-of-phase) audio voltages reach the grids of the tubes, the current through the tubes and their load impedance varies in response to the instantaneous values of these audio signals in addition to the changes of current produced by the r-f signals. The application of the push-pull audio voltages causes the plate current in one balanced modulator tube to be out of phase with the plate current of the other tube. For example, when the audio signal applied to the grid of tube V–1 is passing through its positive half-cycle, the plate current through this tube is high. Simultaneously, the out-of-phase audio signal at the grid of tube V–2 is passing through its negative half-cycle, and the current through tube V–2 is low. Conversely, on the following half-cycle of applied audio energy, the audio signal at the grid of tube V–1 is negative and the current through tube V–1 is low. Simultaneously, the audio grid signal of tube V–2 is positive, and the plate current of this tube is high. Thus, the push-pull audio grid signals cause the tube currents and the currents through the primary winding of the combining impedance to be 180° out

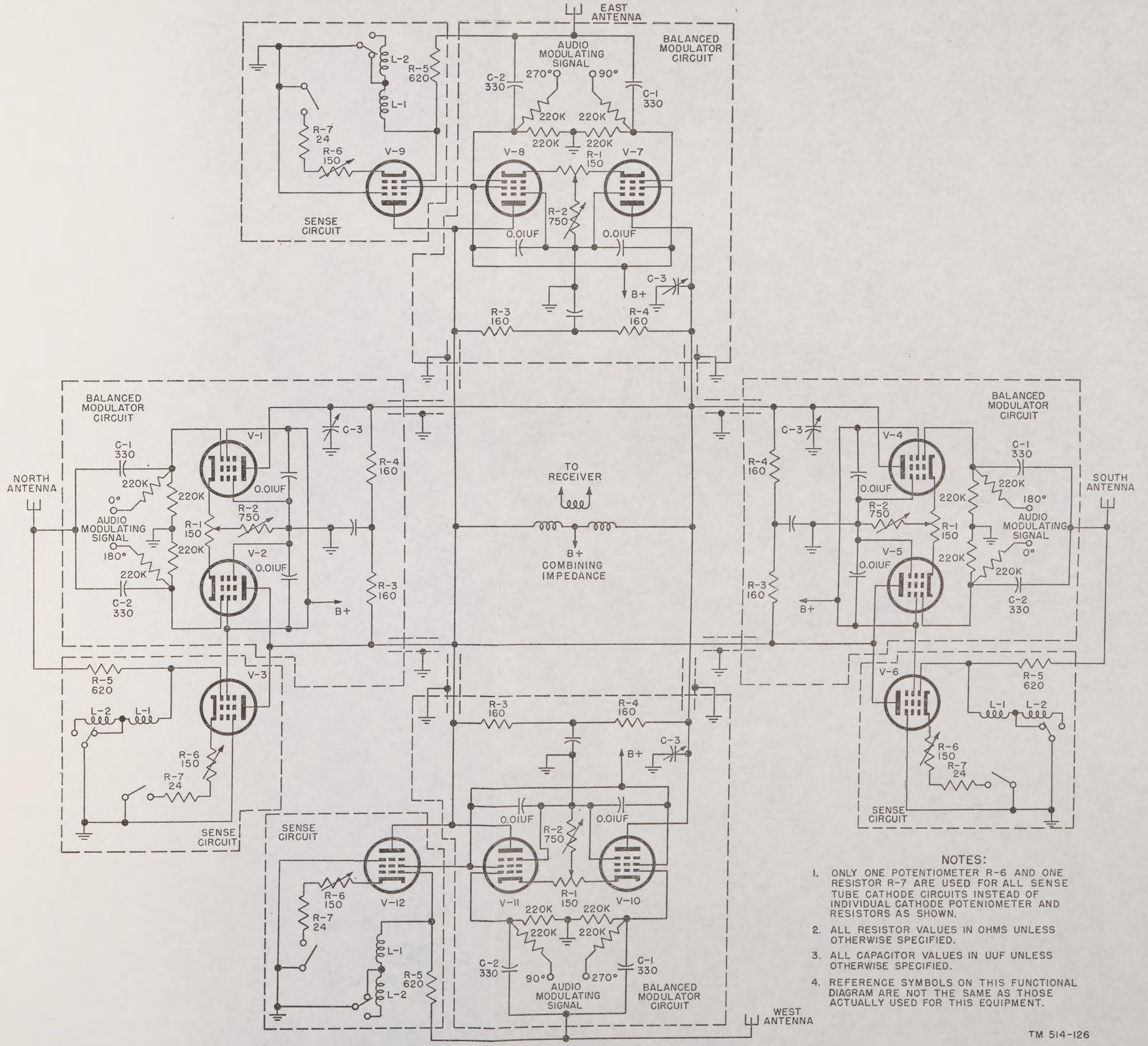


Figure 66. Antenna system, functional schematic diagram.

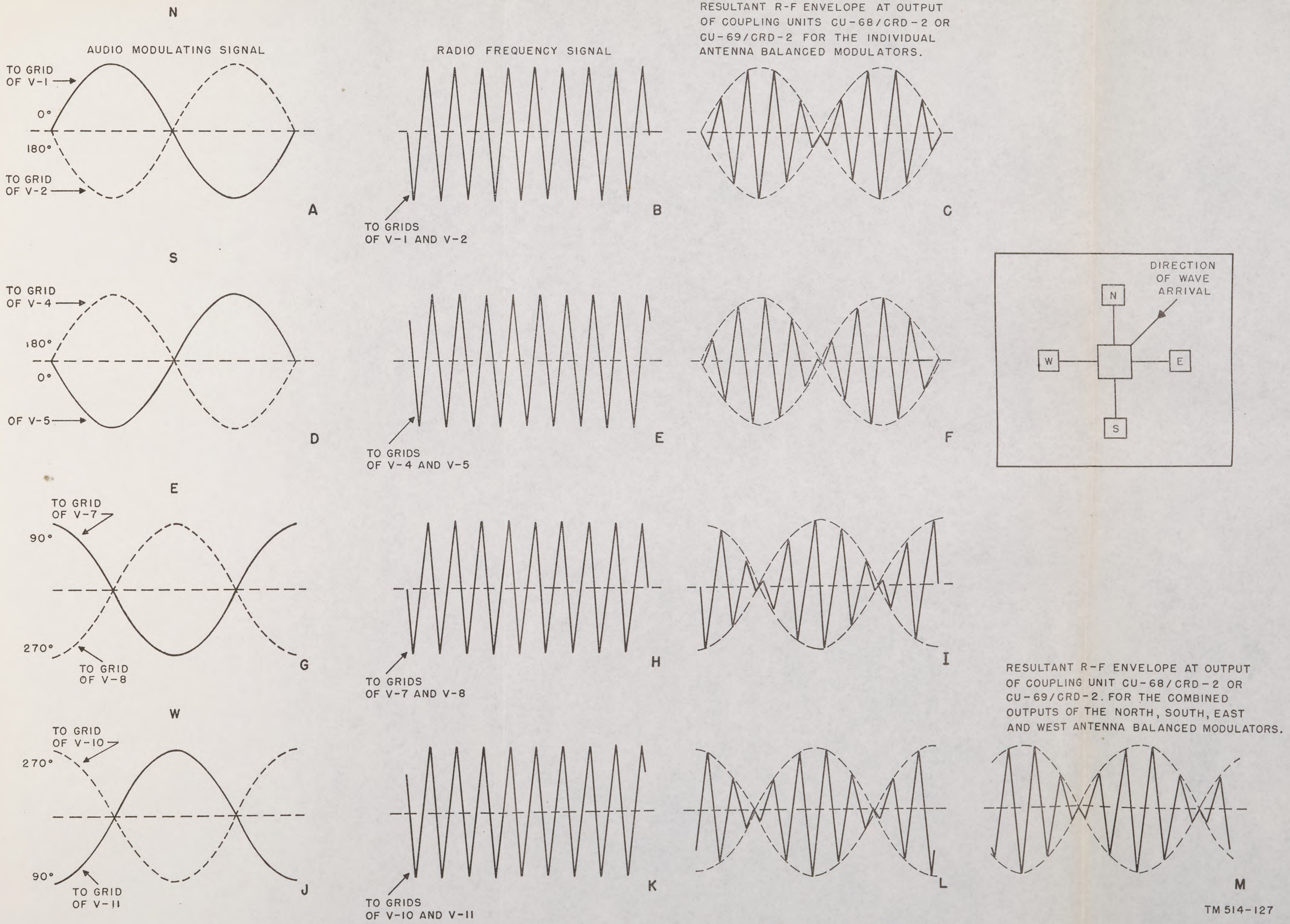


Figure 67. Theoretical waveforms showing development of resultant r-f signal at output of combining impedance, when direction of arrival of r-f wave at the antenna system is 45°.

of phase. As a result, cancellation of induction fields does not occur about the primary winding, and an output voltage is induced in the secondary winding.

(4) The output of each balanced modulator consists of a modulated r-f wave from which the carrier component has been removed. This r-f wave has the same envelope phase as the audio modulating voltage but reverses in phase for every half-cycle of modulating voltage. Because of this phase-reversing characteristic, when this wave is detected in the radio receiver, an audio signal is recovered which has a frequency double that of the audio modulating signal; that is, the 147-cps modulating component of the output signal for the combining impedance appears as a 294-cps audio signal at the output of the radio receiver (par. 82).

(5) In operation, all four balanced modulators function in the same manner, and their combined outputs appear across the primary winding of the combining impedance. There is induced into the secondary winding the differential voltage of all four balanced modulator outputs to produce a resultant wave. The envelope of this wave is the same as the envelope of any single balanced modulator output wave but with an envelope phase which depends upon the angle of arrival of the r-f wave at the antenna system (par. 82).

(6) In the balanced modulators, potentiometer R–1 (BALANCE control) is used to equalize the gain of the two balanced modulator tubes, and variable resistor R–2 (LEVEL control) is used to adjust the operating level of both tubes. (These two controls are located in the modulating voltage generator.) Variable capacitor C–3 is used to compensate for the capacity added to one of the balanced modulator tubes by its connection to the sense tube, V–3. This capacitor also compensates for slight capacitive unbalances in the coaxial lines used to connect the balance modulator tubes to the combining impedance. Resistors R–3 and R–4 are terminating resistors for the coaxial lines.

b. SENSE OPERATION. During sense operation, the SENSE SWITCH (on the bearing indicator) is pressed and the sections of the SENSE SWITCH in the cathode circuits of the four sense tubes are closed. The sense circuit then functions as follows:

(1) A portion of the output of one of the monopoles (for example, the north monopole) is passed through a differentiating circuit consisting of resistor R–5 and either coil L–1 alone or the series combination of coils L–1 and L–2. This circuit shifts the phase of the r-f signal approximately 90° before it is applied to the grid of sense tube V–3. This r-f grid signal produces corresponding changes in the current through the tube.

(2) As a result, an amplified r-f signal appears at the plate of this tube and at the plate of the balanced modulator tube to which it is directly coupled. Sense indication is obtained when the resultant output of all four sense tubes is combined with the resultant output of the four balanced modulators. Also, the resultant sense signals must be approximately in phase or 180° out-of-phase with the resultant output signal of the four balanced modulators.

82. Waveform Analysis, Bearing Operation

Waveforms showing the operation of the electronic goniometer system for an r-f signal arriving at an azimuth angle of 45° with respect to the antenna array are presented in figure 67.

a. Sketch A, figure 67 shows the audio modulating signal applied 180° out of phase with the grids of the north balanced modulator tubes, V–1 and V–2. The r-f signal (B, fig. 67) is applied in phase to the grids of tubes V–1 and V–2. The resultant waveform at the output of the combining impedance (Coupling Unit CU–68/CRD–2 or CU–69/CRD–2) for only the north balanced modulator is shown in C, figure 67. Note that the r-f envelope is the same as the modulating wave and that the r-f voltage reverses at the start of the second half-cycle of the modulating wave.

b. Sketch D, figure 67 shows the audio modulating signal applied 180° out of phase to the grids of the south balanced modulator tubes, V–4 and V–5. The circuits are arranged so that the modulating voltage applied to the south balanced modulator is in opposition to the modulating voltage applied to the north balanced modulator. This in effect provides a differential connection between the north and south antennas. The r-f signal (E, fig. 67) is applied in phase to the grids of balanced modulator tubes V–4 and V–5. However, the angle of arrival of the signal with respect to the spaced monopole antennas is such that the r-f signal arrives at the north antenna before it arrives at the south antenna. Therefore, a phase difference exists between the r-f voltage applied to the south balanced modulator and the r-f voltage applied to the north balanced modulator. The resultant r-f output for the south balanced modulator is shown in F, figure 67. The r-f output is reversed in phase with respect to the north balanced modulator because of the reversal of the modulating voltage between the north and south balanced modulators. Also, the south balanced modulator r-f voltage is displaced in phase with respect to the north balanced modulator r-f voltage because of the difference in time of arrival of the r-f wave at the south antenna with respect to the north antenna.

c. Sketch G, figure 67 shows the audio modulating signal applied 180° out of phase to the grids of the east balanced modulator tubes, V–7 and V–8. This modulating voltage is displaced 90° from the modulating voltages applied to the north and south balanced modulators. The r-f voltage (H, fig. 67) is applied in phase to the grids of tubes V–7 and V–8. The phase of the r-f voltage induced in the east antenna is the same as the phase of the r-f voltage induced in the north antenna because the r-f signal arrives at the north and east antennas at the same time. The resultant r-f output for the east balanced modulator is shown in I, figure 67. Again it can be seen that the r-f envelope phase is a function of the audio modulating voltage.

d. Sketch J, figure 67, shows the audio modulating signal applied 180° out of phase to the grid of the west balanced modulator tubes, V–10 and V–11. This signal is reversed 180° from the audio modulating signal applied to the grid of the east balanced modulator, thereby effectively providing a differential connection between the east and west balanced modulators. The r-f voltage (K, fig. 67) is applied in phase to the grids of tubes V–10 and V–11. This r-f voltage is displaced in phase with respect to the r-f voltage applied to the east balanced modulator as a result of the difference in the time of arrival of the r-f signal between the east and west antennas. The resultant r-f output envelope for the west balanced modulator is shown in L, figure 67. This resultant r-f signal is reversed in phase with respect to the r-f signal at the output of the east balanced modulator because of the reversal of the audio modulating voltage and also is displaced in phase because of the difference in time of arrival of the r-f wave at the east and west antennas.

e. The resultant r-f envelope at the output of the combining impedance for the combined outputs of the north, south, east, and west antenna balanced modulators is shown in M, figure 67. The instantaneous amplitude at any point on this combined, resultant r-f envelope is the algebraic sum of the instantaneous amplitudes at corresponding points on the r-f output envelopes of the four individual balanced modulators. The envelope phase, therefore, is a function of the phase of the r-f output of the individual balance modulators, which in turn is a function of the direction of arrival of the r-f signal at the antenna system. Thus, it can be seen that for different horizontal directions of arrival of the r-f signal, the envelope phase of the combined output of the balanced modulators will also be different (fig. 85). Likewise, the amplification and detection of this signal by the radio receiver will produce a rectified envelope having a direction-dependent phase. By comparing the phase of the rectified envelope with the phase of a reference audio signal on a cathode-ray tube phase meter (Bearing Indicator ID–64/CRD–2), a bearing indication having a 180° ambiguity can be obtained (A, fig. 3). This ambiguity can be resolved by combining sense voltage (an in-phase or 180° out-of-phase r-f signal) with the combined outputs of the antenna balance modulators (par. 83).

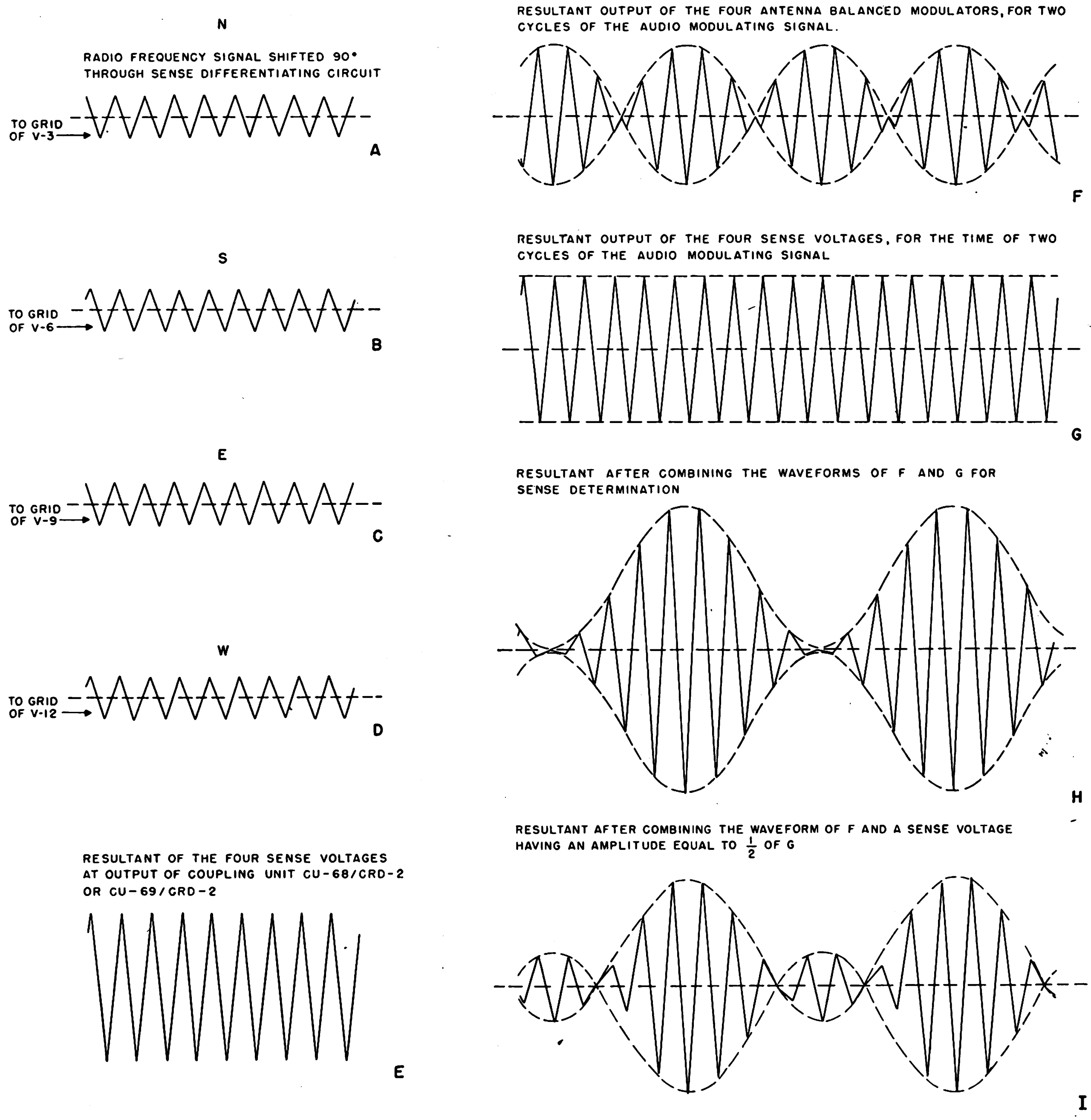


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Figure 68. Theoretical waveforms showing development of resultant sense signal for an r-f wave arriving at an azimuth angle of 45° at antenna system.

83. Waveform Analysis, Sense Operation

Waveforms showing the operation of the sense circuits are presented in figure 68.

a. A portion of the output of each antenna is passed through a differentiating circuit which shifts the phase of the signal approximately 90°. The r-f signal in A through D, figure 68 is shown displaced 90° with respect to the r-f signals shown in B, E, H, and K, figure 67. The four differentiated sense signals are fed through coupling tubes V–3, V–6, V–9, and V–12 to the plate of one tube of each balanced modulator. The signals are combined additively, resulting in the waveform shown in E, figure 68. The phase of this resultant r-f sense signal with respect to the phase of the resultant r-f envelope output of the four antenna balanced modulators is such that, for alternate half-cycles of the r-f envelope voltage, the sense voltage is either in phase or 180° out of phase.

b. Sketches F and G, figure 68 show the r-f envelope for the combined output of the antenna balanced modulators and the resultant output of the combined sense voltages for two cycles of the audio modulating voltage. The algebraic sum of these two waveforms results in the waveform shown in H, figure 68. The r-f envelope has two minimums per audio modulating cycle (F, fig. 68). However, after combination with the sense signal (G, fig. 68), the resultant waveform (H, fig. 68) has only one minimum per audio modulating cycle. This is due to the fact that the phase of the r-f signal in F, figure 68, is reversed for each half-cycle of the audio modulating voltage, whereas the phase of the r-f signal in G, figure 68, is not so influenced. The combining of the r-f waves of F and G, figure 68 is equivalent to combining a figure-8 pattern with an omnidirectional sense pattern (fig. 56), and the resulting r-f envelope (H, fig. 68) is equivalent to the resultant cardioid pattern. In this manner, the 180° ambiguity of the bearing pattern can be resolved.

c. The amplitude of the r-f wave in G, figure 68, is equal to the maximum amplitude of the r-f envelope in F, figure 68. However, it is not necessary to maintain this exact amplitude relationship to obtain sense indications. Sketch I, figure 68, shows the resultant sense waveform when the amplitude of the r-f wave in G, figure 68, is reduced to half its original value.

84. Voltage Distribution Unit J-59/CRD-2, Functioning of Parts (fig. 122)

a. The voltage distribution unit is located inside Junction Box J-96/CRD-2 at the center of the antenna array and has the following uses:

(1) Acts as a physical support for Coupling Unit CU-68/CRD-2 (or CU-69/CRD-2), and its associated connectors which terminate r-f coaxial lines to the radio receiver and Antenna Coupling Units CU-34/CRD-2.

(2) Serves as an electrical terminal for the power cable which connects the 147-cps voltages developed in the modulating voltage generator to Antenna Coupling Units CU-34/CRD-2, connects the B+ voltages developed in the modulating voltage generator to Coupling Unit CU-68/CRD-2 (or CU-69/CRD-2), and connects the antenna system control circuits in the modulating voltage generator to Antenna Coupling Units CU-34/CRD-2.

(3) Contains a 115-volt a-c auxiliary outlet.

(4) Contains a transformer which lowers the 115-volt ac to 6.3-volt ac for the heaters of the tubes in Antenna Coupling Unit CU-34/CRD-2.

b. P-506 is the plug for the power cable which connects the modulating voltage generator to the voltage distribution unit. J-507 through J-510 are receptacles for power cables which connect Antenna Coupling Units CU-34/CRD-2 to the voltage distribution unit. Plug J-506 supplies B+ voltage to Coupling Unit CU-68/CRD-2 (or CU-69/CRD-2). R-509 through R-512 are resistors connected across the filaments and cathodes of the west balanced modulator and sense tubes. Resistors R-505 through R-508 are connected across the filaments and cathodes of the north tubes, and resistors R-501 through R-504 and R-513 through R-516 are connected across the filaments and cathodes of the east and south tubes, respectively. C-502A is the cathode bypass capacitor for the sense tubes, and C-502B is a screen bypass capacitor. Coil L-501 and capacitor C-503 comprise a filter which prevents stray r-f energy from appearing on the B+ line to Coupling Unit CU-68/CRD-2 (or CU-69/CRD-2).

c. Transformer T-501 supplies filament voltages to the tubes in Antenna Coupling Units CU-34/CRD-2. C-501A and C-501B are line filter capacitors. J-505 is the auxiliary outlet for 115-volt ac. Receptacle P-505 is the 115-volt input receptacle.

d. Jacks J-501 through J-504 and plugs P-501 through P-504 are the grounding connectors for the voltage distribution unit. Jack J-511 is the grounding connector for Coupling Unit CU-68/CRD-2 (or CU-69/CRD-2).

85. Coupling Units CU–68/CRD–2 and CU–69/CRD–2, Functioning of Parts

When maximum performance is to be obtained during operation of the radio set in the frequency range of 0.55 mc to 8.0 mc, Coupling Unit CU–68/CRD–2 is used; for the 4.0-mc to 30-mc range, Coupling Unit CU–69/CRD–2 is used (fig. 124).

a. Each coupling unit contains a highly balanced transformer (L–601 or L–701) which acts as the common plate impedance for the tubes in Antenna Coupling Units CU–34/CRD–2 and as the coupling medium for r-f energy between Antenna Coupling Units CU–34/CRD–2 and the radio receiver.

b. The plates of all tubes in Antenna Coupling Units CU–34/CRD–2 are connected to the primary of the transformer by means of coaxial lines which terminate at receptacles J–601 through J–608 when Coupling Unit CU–68/CRD–2 is in use, or at receptacles J–701 through J–708 when Coupling Unit CU–69/CRD–2 is in use. The secondary winding of the transformer is connected through receptacle P–603 (or P–703) to the twin-coaxial line which goes to the radio receiver.

c. The B+ power developed in the modulating voltage generator, and coupled to the voltage distribution unit by means of the power cable, is fed through the primary winding of the transformer (L–601 or L–701) before reaching the tubes in Antenna Coupling Units CU–34/CRD–2. C–601A, B, and C (or C–701A, B, and C) are bypass capacitors in the plate circuit. P–602 (or P–702) is a grounding plug.

86. Antenna Coupling Unit CU–34/CRD–2, Functioning of Parts (fig. 123)

a. R-f signals induced in a monopole are fed to the coupling unit through plug P–801 and jack J–801. At the jack, three parallel connections are made: one for the sense tube circuit which uses tube V–803 and the other two for the balanced modulator circuit which uses tubes V–801 and V–802.

b. Capacitors C–801 and C–804 couple the r-f signals to the grids of the balanced modulator tubes, and resistors R–805 and R–806 suppress parasitic oscillation. R–803 and R–804 are the grid resistors.

c. Two of the 147-cps audio modulating signals developed in the modulating voltage generator are applied to points B and I (fig. 123). These two voltages are 180° out of phase, as explained in section III of this chapter.

d. L–801 and L–802 are r-f choke coils which, in combination with resistors R–801 and R–802 and capacitors C–802 and C–803, form a filter which prevents any radio signals that might be picked up on the audio cables from being coupled into the tube grids.

e. Capacitors C–801 through C–804, although offering negligible impedance to r-f signals, are a high impedance for the 147-cps audio signals. Therefore, the 147-cps signals are not shorted out at this point.

f. L–803 and L–804 are r-f choke coils, which prevent any stray r-f energy appearing on the long cathode lines from being coupled into the balanced modulator tubes. C–805 and C–806 are r-f bypass capacitors in the cathode circuit.

g. C–807 and C–808 are the r-f bypass capacitors for the screen grids of tubes V–801, V–802, and V–803.

h. The plate inductance (combining impedance of Coupling Unit CU–68/CRD–2 or CU–69/CRD–2) for the balanced modulator tubes located in Voltage Distribution Unit J–59/CRD–2 is connected by means of coaxial lines to receptacles J–803 and J–804 which are, in turn, connected to the plates of tubes V–801 and V–802. Resistors R–807 and R–808 are chosen to match the plate impedance to that of the coaxial lines and comprise part of the plate load. Capacitor C–810 is the plate circuit r-f bypass. Jack J–802 is the antenna coupling unit grounding connection.

i. R-f energy also is coupled to the control grid of sense tube V–803, through resistor R–809. This resistor, in combination with coils L–805 and L–806, comprise a 90° phase-shifting network for the r-f signals. Switch S–801, the SENSE H-L switch, removes coil L–806 from the circuit during h-f operation in order to maintain a 90° phase shift at these frequencies.

j. C–811 is an r-f cathode bypass capacitor and, in combination with r-f choke coil L–807, prevents r-f energy picked up on the cathode line which goes to the modulating voltage generator from being introduced into the sense circuit.

k. The plate of tube V–803 is coupled directly to the plate of tube V–802. Capacitor C–809 in the plate circuit of tube V–801 compensates for the capacitive unbalance of the output circuit of the balanced modulator introduced by the plate connection of tube V–803 to tube V–802.

l. C–812 and C–813 are r-f bypass capacitors for the filaments of tubes V–801 and V–802. Receptacle J–805 provides connections for power and audio voltages.

Section V. THEORY OF RADIO RECEIVER

87. General

Each r-f wave which sweeps across the antenna array induces r-f voltages in the individual antenna elements. These r-f voltages are passed through the electronic circuits in the antenna system and are combined in a common impedance before being sent to the radio receiver as a single, modulated r-f signal.

a. In radio communications, there are always hundreds of transmitters radiating energy and, as a result, a large number of waves are sweeping the antenna array simultaneously. Also, over a wide band of frequencies, the antenna system offers little discrimination against signals of different frequencies. Consequently, the input to the receiver consists of a large number of r-f signals, each of which represents the transmissions of a single radio transmitter.

b. The function of the receiver is to select one of the signals and, ideally, to reject all others, to amplify the selected signal to a level which permits efficient detection to take place, and to detect or rectify the amplified signal in order to produce an l-f video signal suitable for bearing indicator operation.

c. The receiver also has an aural channel which terminates in a speaker, thus providing a means of monitoring the signal sent to the bearing indicator.

88. Block Diagram (fig. 69)

The receiver uses a superheterodyne circuit.

a. R-F AMPLIFIERS. Input signals are passed through two stages of r-f amplification (V–101 and V–102). These stages contain three tuned circuits having good selectivity characteristics, thus providing a high signal-to-image ratio. The r-f stages also have sufficient gain for a favorable signal-to-noise ratio, although this gain is not so great as to cause undesirable cross-modulation in the mixer tube.

b. MIXER AND H-F OSCILLATOR. The amplified signals leaving the r-f amplifiers are fed to the mixer tube (V–104) where they are combined with the output of the h-f oscillator (V–103) to produce difference frequencies in the resonant plate circuit of the mixer tube. This circuit is resonant at 455 kc. Thus, any signals at the imput of the mixer stage which beat with the h-f oscillator to produce difference frequencies which fall within a few kilocycles on either side of 455 kc pass through to the first i-f amplifier tube with little attenuation. Signals at the input of the mixer tube which beat with the h-f oscillator to produce difference frequencies outside the narrow frequency band about 455 kc are attenuated (A, fig. 73).

c. FIRST AND SECOND I-F AMPLIFIERS.

(1) When the SELECTIVITY switch of

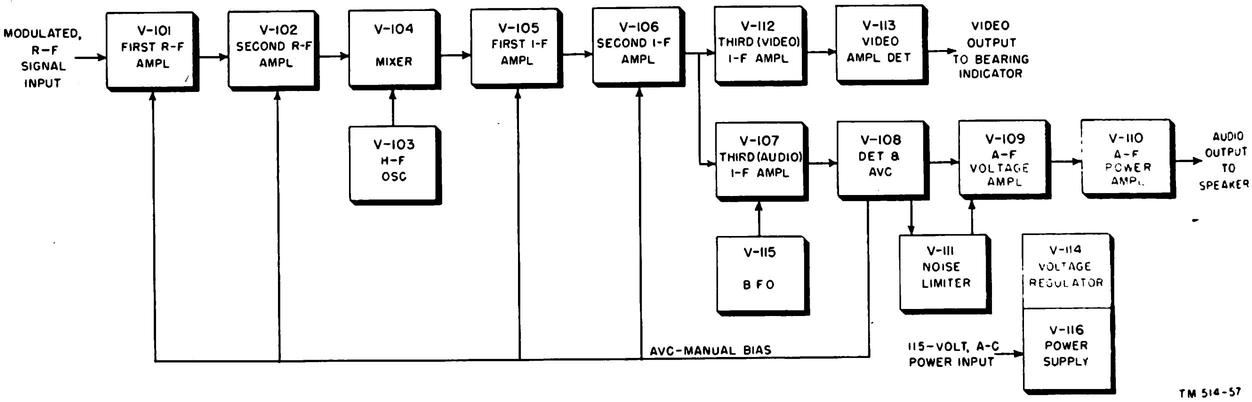

Figure 69. Radio Receiver R–127/CRD–2, block diagram.

the receiver is in position 1 or position D/F–2, the mixer output signals are fed to the cascade i-f amplifier stages (V–105 and V–106), and the crystal filter circuit is not used. These two i-f amplifiers provide high gain for signals which fall within the limits of the i-f bandpass and high rejection for signals at frequencies outside this bandpass. In position 1 of the SELECTIVITY switch, the bandpass for the first and second i-f stages is approximately 15 kc; and for position D/F–2, it is approximately 9 kc (fig. 73C).

(2) When the SELECTIVITY switch is in position 3, 4, or 5, the 455-kc output signals of the mixer tube are fed to the crystal filter circuit before reaching the first i-f amplifier tube. In any of the crystal positions, a high degree of selectivity is obtained (narrow bandpass), with the selectivity being sharpest in position 5, which corresponds to so-called reception.

(3) For direction finding purposes, the SELECTIVITY switch always is left in the D/F–2 position.

d. THIRD I-F AMPLIFIERS. The output of the second i-f amplifier is parallel-fed to the third video i-f amplifier (V–112) and the third audio i-f amplifier (V–107). Each of these amplifiers increases the gain of the signals and improves the over-all bandpass characteristics of the i-f amplifier section.

e. VIDEO CHANNEL. The output of the third (video) i-f amplifier (V–112) then is passed through another amplifier (video amplifier, one section of tube V–113) before being sent to the detector (other section of tube V–113). The detector output consists of a series of negative pulses which conform, in waveshape, to the negative portions of the modulated wave. The i-f components are filtered from the detector voltage before the remaining l-f video signal is sent to the bearing indicator.

f. AUDIO CHANNEL. The audio channel is comprised of the third (audio) i-f amplifier, a detector, an avc rectifier, an a-f voltage amplifier, an a-f power amplifier, a bfo, and a noise limiter. Tubes V–107 through V–111 and tube V–115 are used in this channel.

(1) The third (audio) i-f amplifier (V–107) performs the same function for the audio channel as the third (video) i-f amplifier does for the video channel.

(2) In the detector stage (one section of tube V–108), demodulation takes place and an audio signal conforming in waveshape to the modulation component of the i-f signal is produced. The second section of tube V–108 controls the d-c voltage required for avc action. The avc voltage provides automatic bias voltage for the r-f amplifiers and the first two i-f amplifiers, a bias voltage which varies with the strength of received signals.

(3) The audio signals produced in the detector stage are sent through an a-f voltage amplifier (V–109)and an a-f power amplifier (V–110) before being supplied to a speaker voice coil.

(4) For purposes of developing an audible signal during c-w reception, the output of the bfo (V–115) is mixed with the i-f signals at the input of the detector stage.

(5) Some kinds of noise interference, such as that created by automobile ignition systems, are reduced greatly by action of the noise limiter circuit (V–111) in the audiochannel. This kind of noise interference consists of transient voltage peaks of high amplitude and short time duration and is most bothersome at the higher radio frequencies.

g. POWER SUPPLY. Tubes V–114 and V–116 are used in the combination rectifier-voltage regulator circuits of the power supply to furnish d-c operating potentials for the various receiver circuits. The power supply also furnishes the low a-c voltages required for the filaments of the tubes and pilot lights.

89. First and Second R–f Amplifiers

The first and second r-f amplifiers V–101 and V–102 are Tubes JAN–6SG7, semiremote cut-off pentodes (fig. 70).

a. When the RANGE switch of the receiver (S–101) is set on band 1, transformer L–101 provides coupling of r-f input signals to the grid of the first r-f amplifier tube; r-f transformer L–107 couples the first and second amplifier tubes and R–F transformer L–119

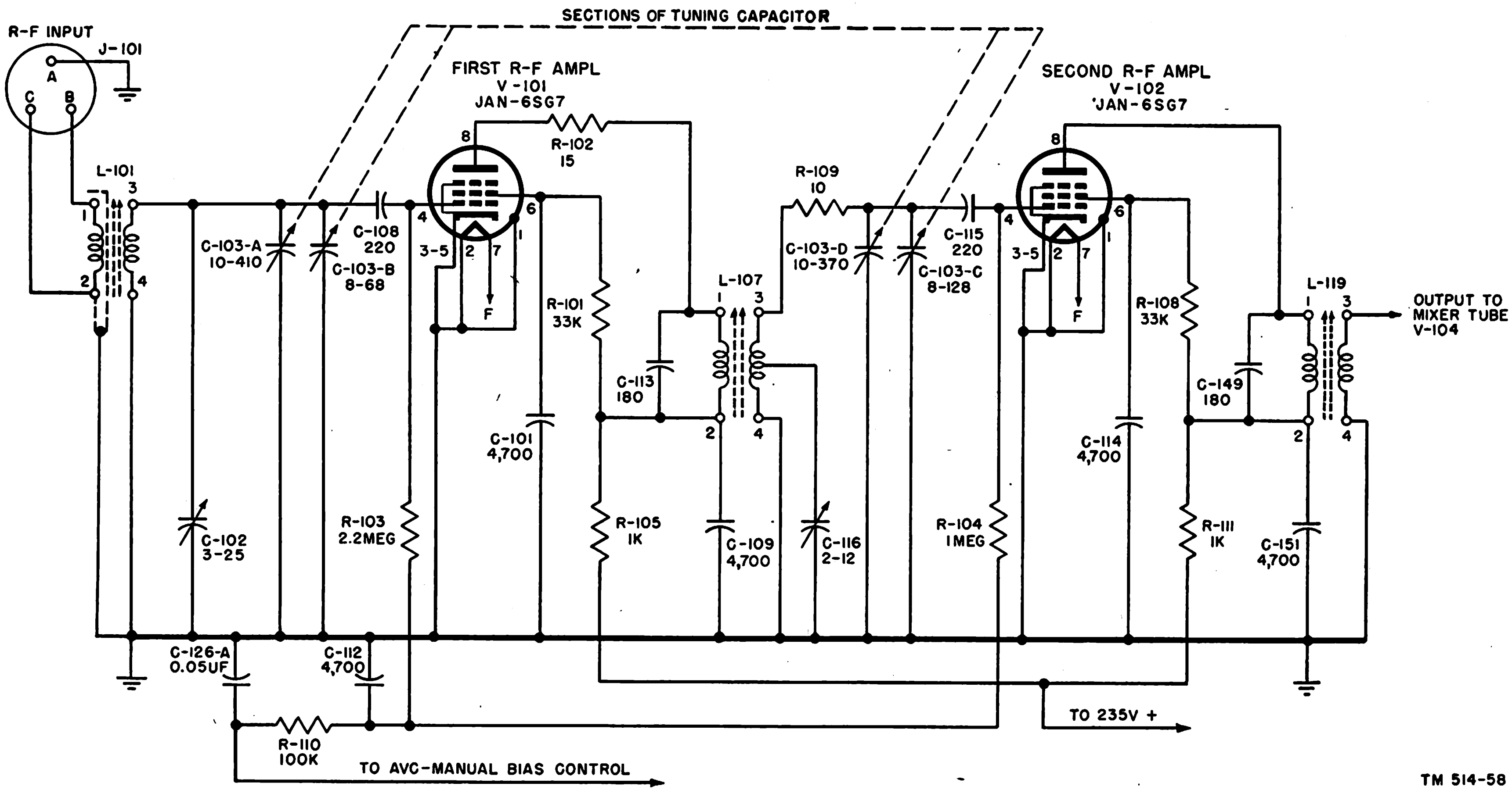

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Figure 70. Radio Receiver R–127/CRD–2, r-f amplifiers, simplified schematic diagram.

couples the second r-f amplifier tube to the mixer tube. For purpose of alinement, all r-f transformers are permeability tuned by means of powdered-iron slugs.

b. Capacitors C–103A, C–103B, C–103C, and C–103D are ganged, variable tuning capacitors in the tuned grid circuits. Capacitors C–102 and C–116 are variable trimmer capacitors.

c. Resistors R–103 and R–104, in combination with capacitor C–112, comprise a grid circuit decoupling net work while resistor R–110 and capacitor C–126A provide avc filtering. R-f coupling capacitors C–108 and C–115 block the d-c bias voltage from the L-C (inductance-capacitance) circuits.

d. Capacitors C–113 and C–149 resonate their respective plate coils at the low-frequency end of the band in order to equalize the gain of the stages over the entire band. Resistor R–109 eliminates regeneration. R–101 and R–108 are the screen-grid voltage-dropping resistors, and capacitors C–101 and C–114 are screen-grid r-f bypass capacitors. Resistors R–105 and R–111, in combination with capacitors C–109 and C–151, make up the plate circuit decoupling networks.

e. As the RANGE switch (S–101) of the receiver is switched from band 1 to the other bands, the following changes take place:

(1) The primary coil of L–101 is replaced by the primary coil of L–102, L–103, L–104, L–105, or L–106 for band 2, 3, 4, 5, or 6, respectively. Both ends of the coil in use are brought out to terminals B and C of the r-f input jack (J–101).

(2) The secondary coil of L–101 is replaced by the secondary coil of L–102, L–103, L–104, L–105, or L–106 for the various bands.

(3 Tuning capacitors C–103A, C–103B. C–103C, and C–103D, which are used in band 1, are used also in band 2. Only capacitors C–103A and C–103D are used in band 3, and only C–103B and C–103C are used in bands 4, 5, and 6.

(4) Additional fixed capacitors (fig. 120), C–104 on band 3, C–105 and C–120 on band 4, C–106 and C–122 on band 5, and C–107 and C–124 on band 6, are placed across the grid circuits.

(5) The primary coil of L–107 and capacitor C–113 (first r-f output) are replaced by the primary coil of L–108 in parallel with resistor R–107 on band 2, and by the primary coil of L–109 on band 3.

(6) The secondary coil of L–107 (second r-f input) is replaced by L–108, L–109, L–110, L–111, or L–112 for the various bands.

(7) The coupling system used between the first and second r-f amplifiers is transformer coupling on bands 1, 2, and 3 and capacitive coupling on bands 4, 5, and 6. On bands 4 and 5, the coupling is through capacitors C–110 and C–111, and C–115; on band 6, the coupling is through capacitors C–110 and C–115.

(8) Capacitor C–116 (second r-f input trimmer) is replaced by capacitor C–117, C–118, C–119, C–121, or C–123 for the various bands.

(9) The primary coil of L–119A and capacitor C–149 (second r-f output) are replaced by the primary coil of L–120 in parallel with resistor R–114 on band 2 and by the primary coil of L–121 on band 3.

(10) The coupling system used between the second r-f amplifier and mixer tubes is transformer coupling on bands 1, 2, and 3 and capacitive coupling on bands 4, 5, and 6. On band 4, the coupling is through capacitors C–148 and C–150; on bands 5 and 6, the coupling is through capacitor C–148.

(11) When secondary coils of L–101, L–102, L–103, L–104, L–105, L–106, L–107, L–108, L–109, L–110, L–111, and L–112 (first and second r-f inputs) are not in use, they are shorted to ground.

(12) When primary of coils L–107, L–108, L–109, L–119, L–120, and L–121 (first and second r-f outputs)are not in use they are shorted out of the circuit.

90. Mixer and H–f Oscillator

The oscillator of the receiver uses a triode Tube JAN–6J5 (V–103), and the mixer uses

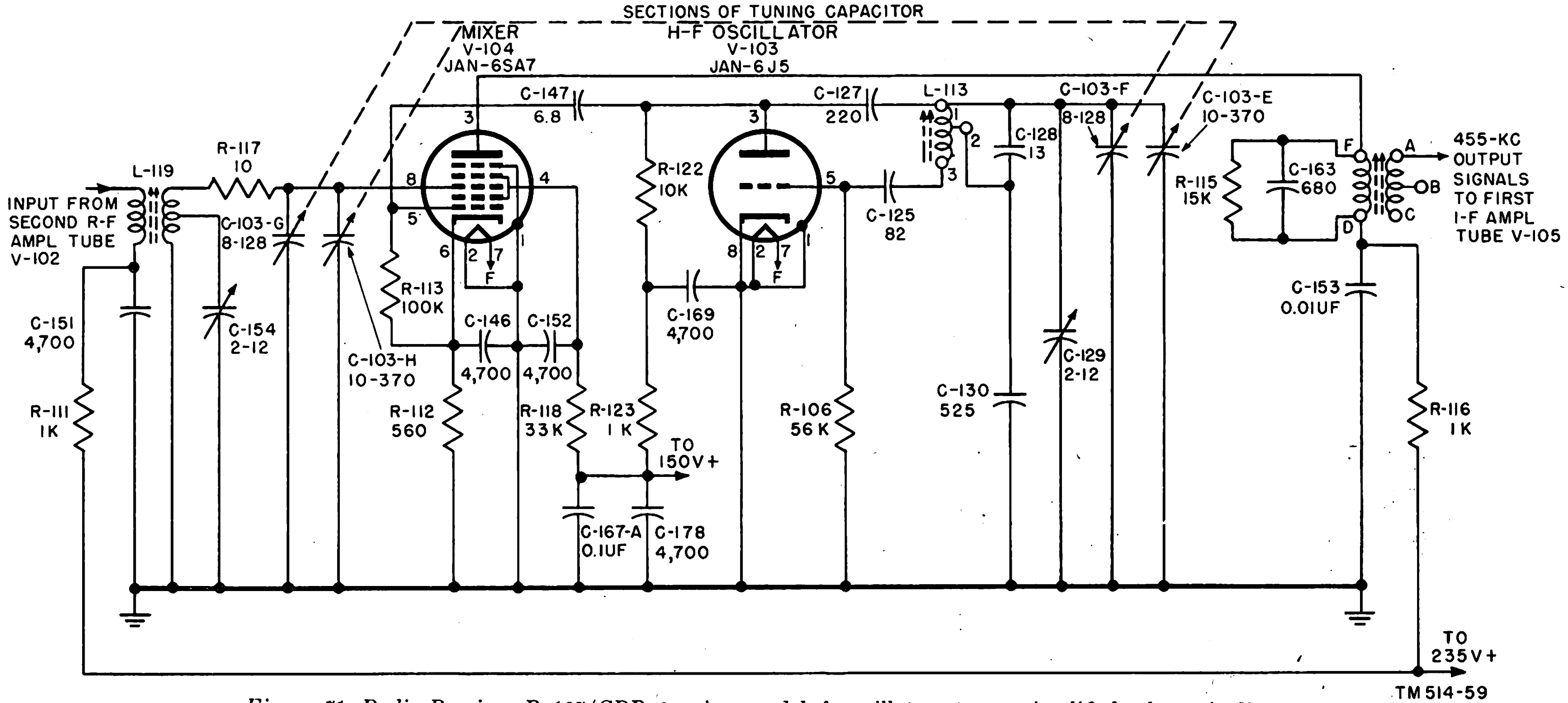


Figure 71. Radio Receiver R-127/CRD-2, mixer and h-f oscillator stages, simplified schematic diagram.

a pentagrid converter Tube JAN-6SA7 (V-104) (fig. 71).

a. When the RANGE switch (S-101) is set on band 1, coil L-113 provides coupling between the grid and plate circuits of the modified Hartley oscillator circuit, the output of which is coupled through capacitor C-147 to the oscillator injection grid of the mixer tube.

b. R-f transformer L-119 provides coupling of the second r-f amplifier output to the signal grid of the mixer tube, and i-f transformer T-101 provides coupling of the resultant 455-kc i-f signals either to the first i-f amplifier or to the crystal-filter circuit preceding the first i-f amplifier, depending on the setting of the SELECTIVITY switch.

c. Capacitors C-103E, F, G, and H are variable tuning capacitors which are ganged with the four tuning capacitors in the r-f amplifier stages. Capacitors C-129 and C-154 are variable trimmer capacitors in the tuned circuits. Capacitor C-128, which has a negative temperature coefficient, is used to compensate for oscillator frequency variations caused by temperature changes. Capacitor C-130 serves as a series padder to reduce the total ganged tuning capacity of the h-f oscillator.

d. C-125 is the grid blocking capacitor, and R-106 is the bias resistor for the grid circuit of the h-f oscillator tube. Capacitor C-147 and resistor R-113 serve similar purposes for the oscillator injection grid of the mixer tube. Resistor R-112, bypassed by capacitor C-146, provides cathode bias for the signal grid of the mixer tube. Resistor R-117 eliminates regeneration.

e. Capacitor C-163 is used to resonate the plate coil of the mixer tube at 455 kc. Resistor R-115 is used across the mixer plate load to broaden the frequency response of this circuit. C-152 is the r-f bypass capacitor for the screen of the mixer tube, and R-118 is the screen-grid voltage-dropping resistor for the mixer tube. R-122 is the plate voltage-dropping resistor, and C-127 is the d-c blocking capacitor for the shunt-fed oscillator plate circuit. Resistors R-123 and R-116, with capacitors C-169 and C-153, make up the plate circuit decoupling networks. C-178 is a bypass capacitor for the + 150-volt line.

f. As the RANGE switch of the receiver is switched from band 1 to the other bands, the following changes take place:

(1) Resistor R-117 (mixer signal grid circuit) is left out of the circuit.

(2) The secondary coil of L-119 is replaced by the secondary coil of L-120, L-121, L-122, L-123, or L-124 for band 2, 3, 4, 5, or 6, respectively.

(3) Tuning capacitors C-103E, F, G, and H, which are used in band 1, also are used in band 2. Only capacitors C-103F and H are used in band 3; only capacitors C-103E and G are used in bands 4, 5, and 6.

(4) Additional fixed capacitors, C-158 on band 4, C-160 on band 5, and C-162 on band 6, are placed across the grid circuit of the mixer tube.

(5) Additional fixed capacitors, C-139 on band 4, C-142 on band 5, and C-145 on band 6, are placed across the tuned circuit of the oscillator.

(6) Coil L-113 (oscillator coupling) is replaced by coils L-114 through L-118 on the other bands.

(7) Capacitor C-128 (oscillator temperature compensating) is replaced by capacitor C-131 on band 2 or by C-134 on band 3. No temperature compensating capacitor is used on bands 4, 5, and 6.

(8) Capacitor C-130 (oscillator padding) is replaced by capacitors C-133, C-136, C-137, C-140, and C-143 on the other bands.

(9) Capacitors C-129 (oscillator trimmer) and C-154 (mixer trimmer) are replaced by capacitors C-132, C-135, C-138, C-141, and C-144 for the oscillator and by capacitors C-155, C-156, C-157, C-159, and C-151 for the mixer stage.

(10) When coils L-113 through L-118 (oscillator coupling) are not in use, either one end or both ends of the coils are shorted to ground.

(11) When coils L-119, L-120, L-121, L-122, L-123, and L-124 (mixer input) are not in use, they are shorted to ground.

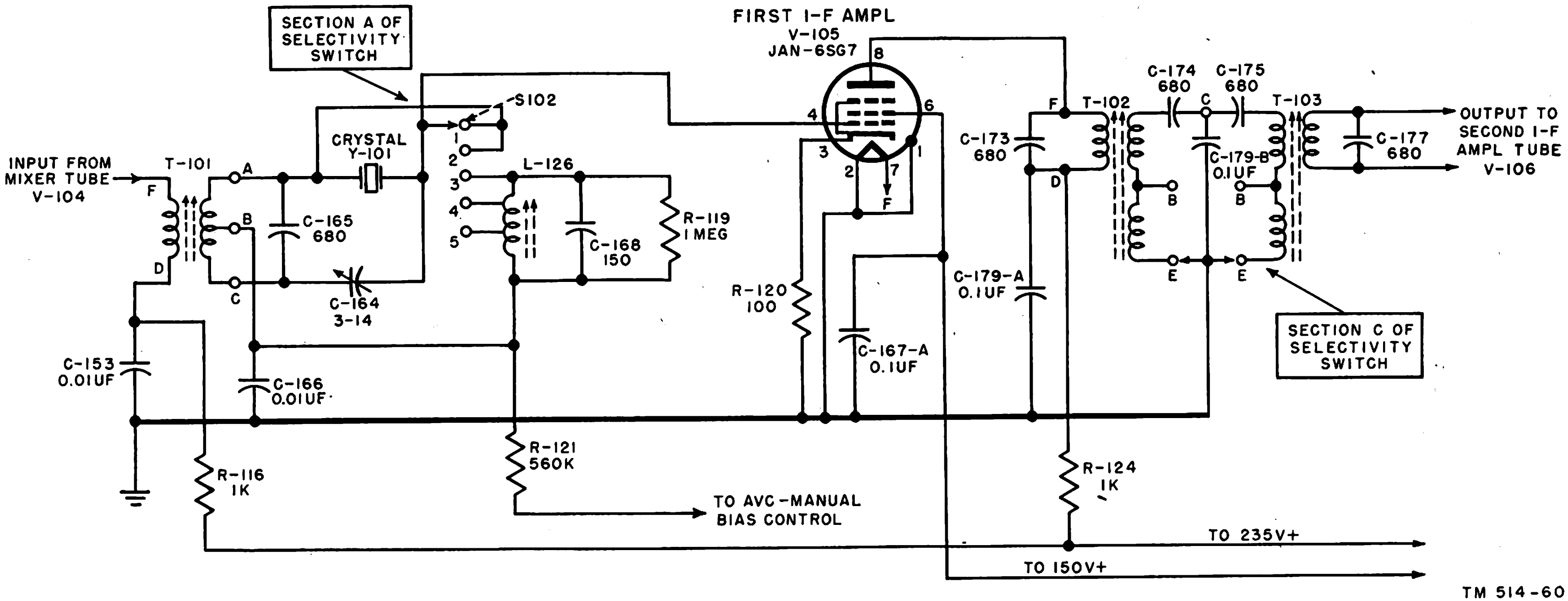


Figure 72. Radio Receiver R-127/CRD-2, crystal filter and first i-f amplifier stage, simplified schematic diagram.

91. General Data on Band-Switching System of R–f Amplifiers, Mixer and H–f Oscillator Circuits

The band-switching system uses a 16-gang switch (S–101), the RANGE switch, which makes all necessary circuit changes when switching from one band to another (fig. 120).

a. CAPACITORS.

(1) On bands 1 and 2, both sections of the ganged variable tuning capacitors are used for the two r-f amplifiers, the mixer, and the oscillator tuning circuits.

(2) On band 3, only the large section of the variable tuning capacitor is used for each of the four tuned circuits.

(3) On bands 4, 5, and 6, only the small section of the variable tuning capacitor is used for each of the four tuned circuits.

(4) To prevent dead spots in the tuning range, all secondary coils either are shorted or grounded when not in use.

b. INDUCTORS. On bands 1, 2, and 3, individual plate coils are coupled to their individual tuned secondaries in the r-f amplifier and mixer circuits. On bands 4, 5, and 6, the plate coils of band 3 are used as r-f chokes, and the signal is coupled capacitively to the tuned grid circuit of the following stage. Separate antenna coils are used, however, to couple the antenna to the first r-f stage on each band.

92. Crystal Filter and First I–f Amplifier

The first i-f amplifier of the receiver uses a semiremote cut-off, pentode Tube JAN–6SG7 (V–105) (fig. 72).

a. The i-f signal from the plate circuit of the mixer tube is transformer-coupled through i-f transformer T–101 to the input circuit of the first i-f amplifier stage. When the equipment is operating at positions 1 and 2 of the SELECTIVITY switch (S–102), this i-f signal is coupled directly to the grid of the first i-f amplifier tube, V–105. When the equipment is operating at positions 3, 4, and 5 of the SELECTIVITY switch, the i-f signal is coupled to the first i-f amplifier tube through a crystal-filter bridge circuit.

b. For the three most selective types of operation, the crystal-filter circuit is connected in series with a tapped tuned circuit, peaked at the intermediate frequency (455 kc). This tuned circuit consists of coil L–126 and capacitor C–168 shunted by resistor R–119. Connecting the crystal to various taps on coil L–126 presents varying load impedance to the crystal, thereby varying its selectivity. Tapping full across the coil presents the greatest load impedance and thereby provides the least selective operation of the three crystal positions. Capacitor C–164 is used to balance out the crystal holder capacity and thus effect a capacitance balance for the crystal filter circuit.

c. The output of the first i-f amplifier is coupled to the grid circuit of the second i-f amplifier tube by means of an inductance-capacitance bandpass network comprised of transformers T–102 and T–103 and capacitors C–173, C–174, C–175, C–179B, and C–177. The bandpass characteristics of the network for positions 1 and 2 of the SELECTIVITY switch are shown in B, figure 73. Note that the bandpass of transformer T–101 (A, fig. 73) combines with that of the inductance-capacitance network to provide a uniform bandpass curve at the input to the second i-f amplifier tube (C, fig. 73).

(1) The primary winding of transformer T–102 is tuned to resonance by fixed capacitor C–173. Signal voltages in the primary winding are coupled inductively to the secondary winding which in turn, is resonated by the series combination of capacitors C–174 and C–179B. A second tuned circuit, comprised of one winding of transformer T–103 and capacitors C–175 and C–179B completes the bandpass network.

(2) Note that capacitor C–179B is common to both tuned circuits and acts as a coupling between the two circuits. The valve of this capacitor effects the percentage of coupling for the network and, in this circuit, the value selected provides overcoupling, as evidenced by the double-humped resonance curves of B, figure 73.

(3) In positions DF/2, 3, 4, and 5 of the SELECTIVITY switch, only the upper coils shown in figure 72 are used. For position 1 of this switch, the lower coils are added in series with the up-

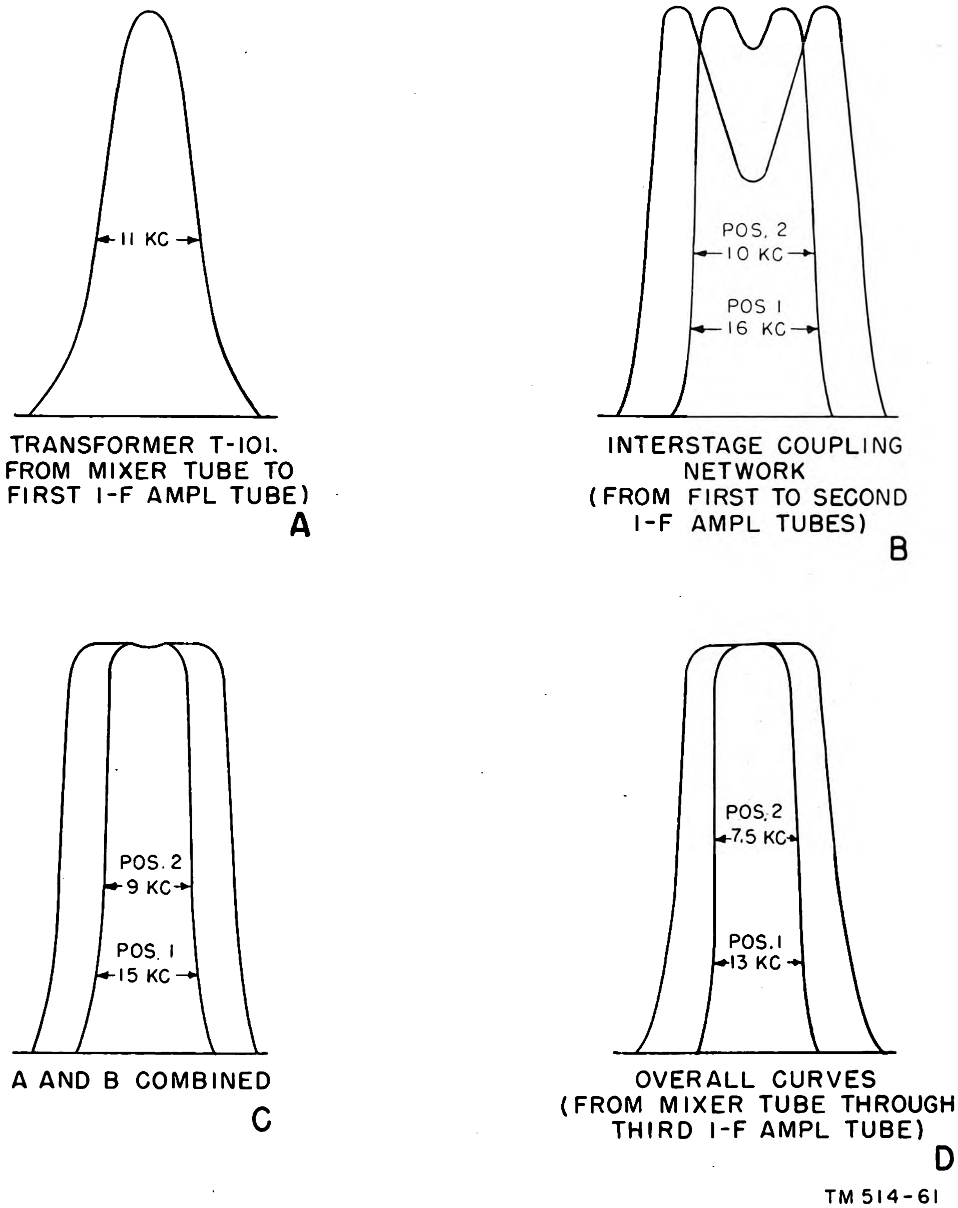


Figure 73. Bandpass curves.

per coils in order to increase the overall bandpass.

(4) Signal voltages which pass through the network are coupled inductively to the secondary of transformer T–103 and then are connected to the grid of the second i-f amplifier tube.

d. C–165, C–168, and C–179B are fixed capacitors used to tune their respective circuits to the intermediate frequency. R–120 is a cathode bias resistor. Resistor R–121, in combination with bypass capacitor C–166, decouples the i-f voltage in the grid circuit from the avc line. C–167A is the screen bypass capacitor. Capacitor C–179A and resistor R–124 make up the plate decoupling network.

93. Selectivity Switching System

The SELECTIVITY switch (S–102) is a five-position, four-gang switch (fig. 120).

a. In position 1, the i-f bandwidths are sufficiently broad for high-fidelity reception (curve 1 of fig. 74). In this position, the interstage coupling networks between the first and second

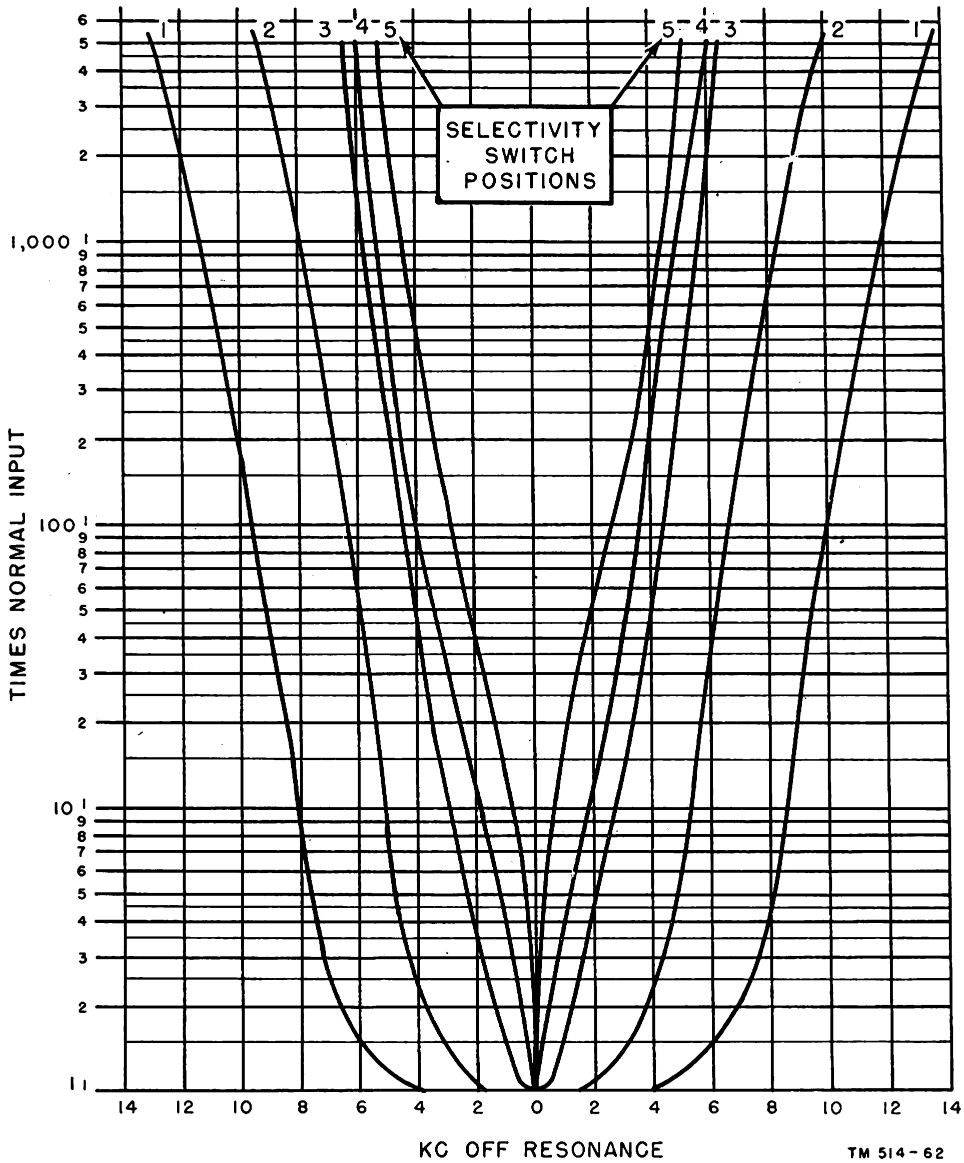


Figure 74. Radio Receiver R–127/CRD–2, selectivity curves for five positions of the SELECTIVITY switch.

i-f stages and between the second and third i-f stages are adjusted for broad bandwidth by connecting all E points of transformers T–102, T–103, T–104, and T–105 to ground (figs. 72 and 75). This adds some inductance to 4 of the 12 i-f tuned circuits, thereby adjusting the i-f channel for a broad bandpass. However, the added inductance does not shift the center frequency to any appreciable extent.

b. Position D/F–2 always is used when taking visual bearings with Radio Set AN/CRD–2 (curve 2 of fig. 74). In this position, all B points of the same four transformers are connected to ground. This tunes the circuits to provide the sharpest i-f channel possible without crystal filtering.

c. Crystal Y–101 is used in a bridge circuit connected to the first i-f amplifier for crystal filtering in positions 3, 4, and 5 (fig. 120). Selectivity in these positions is varied by changing the impedance which is in series with the crystal. This is done by switching to different taps on coil L–126 and by switching capacitors C–170, C–171, and C–172, as required, to maintain resonance.

d. Position 3 connects the crystal and the

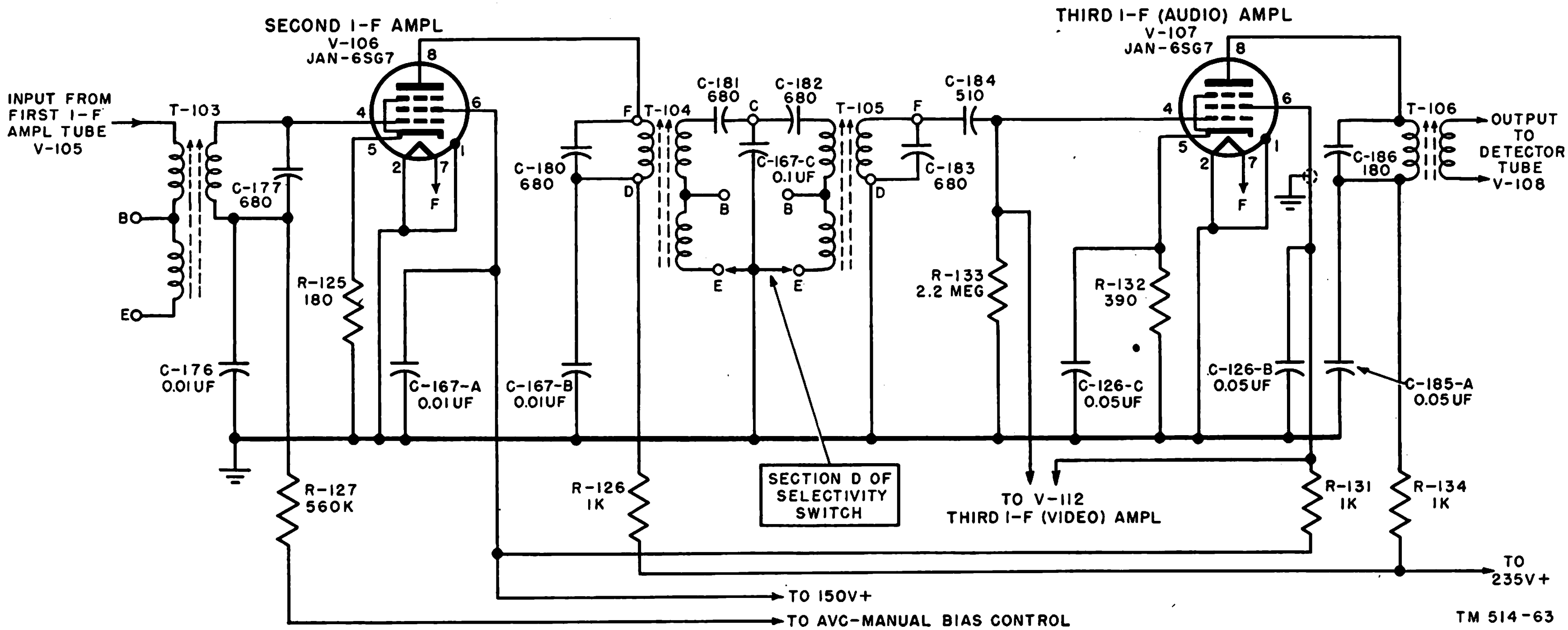


Figure 75. Radio Receiver R-127/CRD-2, second and third (audio) i-f amplifier stages, schematic diagram.

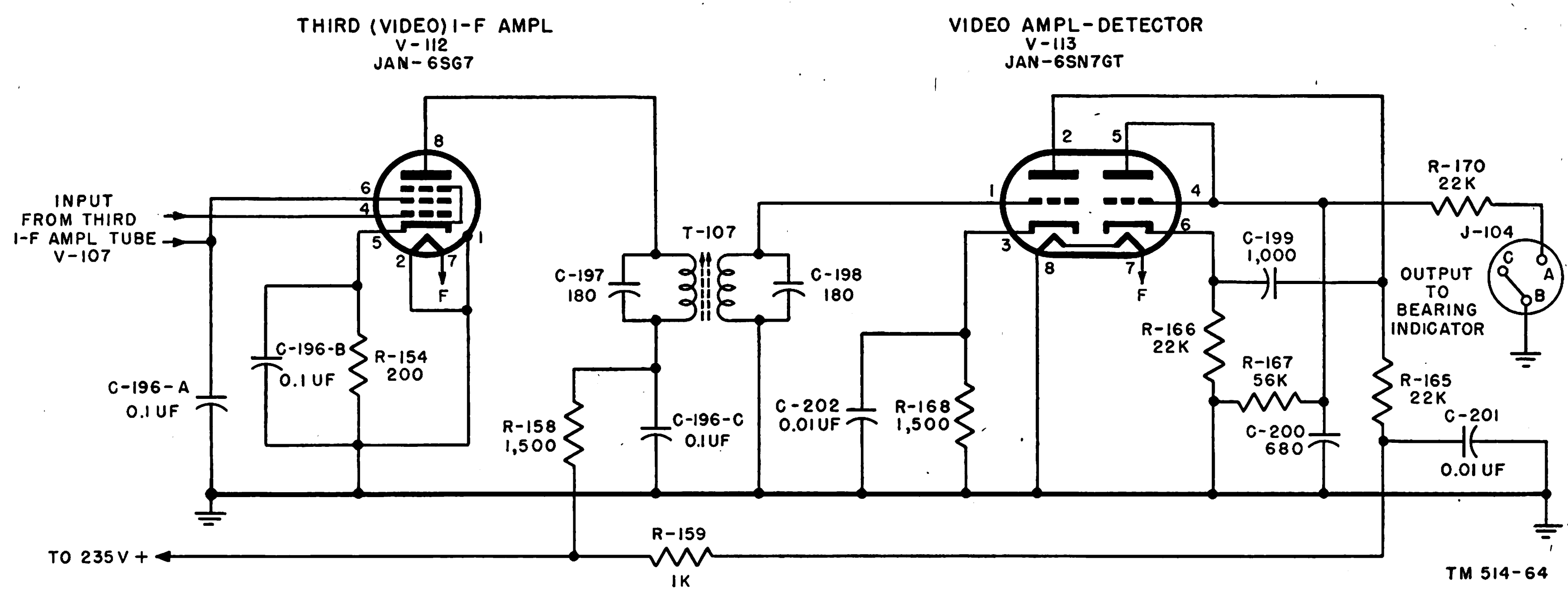


Figure 76. Radio Receiver R-127/CRD-2, third (video) i-f amplifier, video amplifier, and detector stages, schematic diagram.

grid of the first i-f amplifier tube to the top of coil L–126, providing the least selectivity (with crystal). This position is useful for c-w, aural-null, or very sharp modulated signal reception (curve 3 of fig. 74).

e. In position 4, coil L–126 is tapped down and a high degree of selectivity is provided for c-w reception (curve 4 of fig. 74).

f. Position 5 connects the crystal and the grid of the tube to another tap on coil L–126, providing extreme selectively (curve 5 of fig. 74). This position is useful for aural-null reception of c-w signals through extreme interference.

94. Second and Third (Audio) I–f Amplifiers

The second and third (audio) i-f amplifiers also use Tubes JAN–6SG7 (V–106 and V–107) (fig. 75).

a. The output signal from the second i-f amplifier tube, V–106, is coupled to the grid of the third (audio) i-f amplifier tube by means of another inductance-capacitance, bandpass network which is similar to that used between the first and second i-f amplifier tubes. The output of the third (audio) i-f amplifier is, in turn, coupled to the detector stage (one section of tube V–108) through interstage i-f transformer T–106.

b. Capacitors C–177, C–180, C–181, C–182, C–183, and C–186 are fixed capacitors used to tune their respective circuits to the intermediate frequency. Capacitor C–167C is the common impedance used for coupling purposes. R–125 and R–132 are cathode bias resistors, and C–126C is the cathode bypass capacitor for the third (audio) i-f amplifier. Resistor R–127 and capacitor C–176 decouple the grid circuit of the second i-f amplifier from the avc line. Screen bypassing and decoupling is obtained by capacitors C–167A and C–126B and resistor R–131. Resistors R–126 and R–134 and capacitors C–167B and C–185A accomplish plate decoupling for the two stages.

95. Third (Video) I–f Amplifier, Video Amplifier, and Detector

The third (video) i-f amplifier and the video amplifier-detector use one Tube JAN–6SG7 (V–112) and one twin-triode Tube JAN–6SN 7GT (V–113) (fig. 76).

a. The signal voltage on the grid of the third (video) i-f amplifier tube V–112 is obtained from the same point as the input to the grid of the third (audio) i-f amplifier tube, V–107. The output of the third (video) i-f amplifier is coupled through transformer T–107 to the input of one triode section of tube V–113, which functions as a video amplifier. The output of the video amplifier is, in turn, coupled to the cathode of the second triode section of tube V–113, which is connected in the diode detector circuit.

b. Resistors R–154 and R–168 with capacitors C–196B and C–202 provide cathode bias for the third (video) i-f amplifier and video amplifier stages. Resistors R–158 and R–159 in combination with capacitors C–196C and C–201 are plate circuit decoupling networks. C–196A is the screen bypass capacitor for tube V–112. Capacitors C–197 and C–198 tune the coils of transformer T–107 to 455 kc. The output voltage of the video amplifier stage (triode section of tube V–113) is developed across plate load resistor R–165 and is coupled to the cathode of the detector (triode section of tube V–113) by the combination of capacitor C–199 and resistor R–166.

c. Resistor R–167 forms the output (plate and grid) load of the detector. The i-f component of the rectified voltage is bypassed to ground through capacitor C–200, leaving the low-frequency component of the i-f wave to form the video output at jack J–104.

96. Detector, Automatic Volume Control, and Noise Limiter

The detector, automatic volume control, and noise limiter use two twin-diode Tubes JAN–6H6 (V–108 and V–111) (fig. 77). The front panel switch marked MAN - MAN NL - AVC NL - AVC (S–103A and S–103B) controls the type of operation which may be obtained in the detector, avc, and noise limiter circuits.

a. MAN OPERATION.

(1) *Bias voltage.* During manual operation (A, fig. 78), the RF GAIN control is used to vary the level of negative d-c bias voltage applied to the grids of the r-f and i-f amplifier tubes. As shown in the diagram, a negative d-c voltage is obtained from the power supply and is passed through the volt-

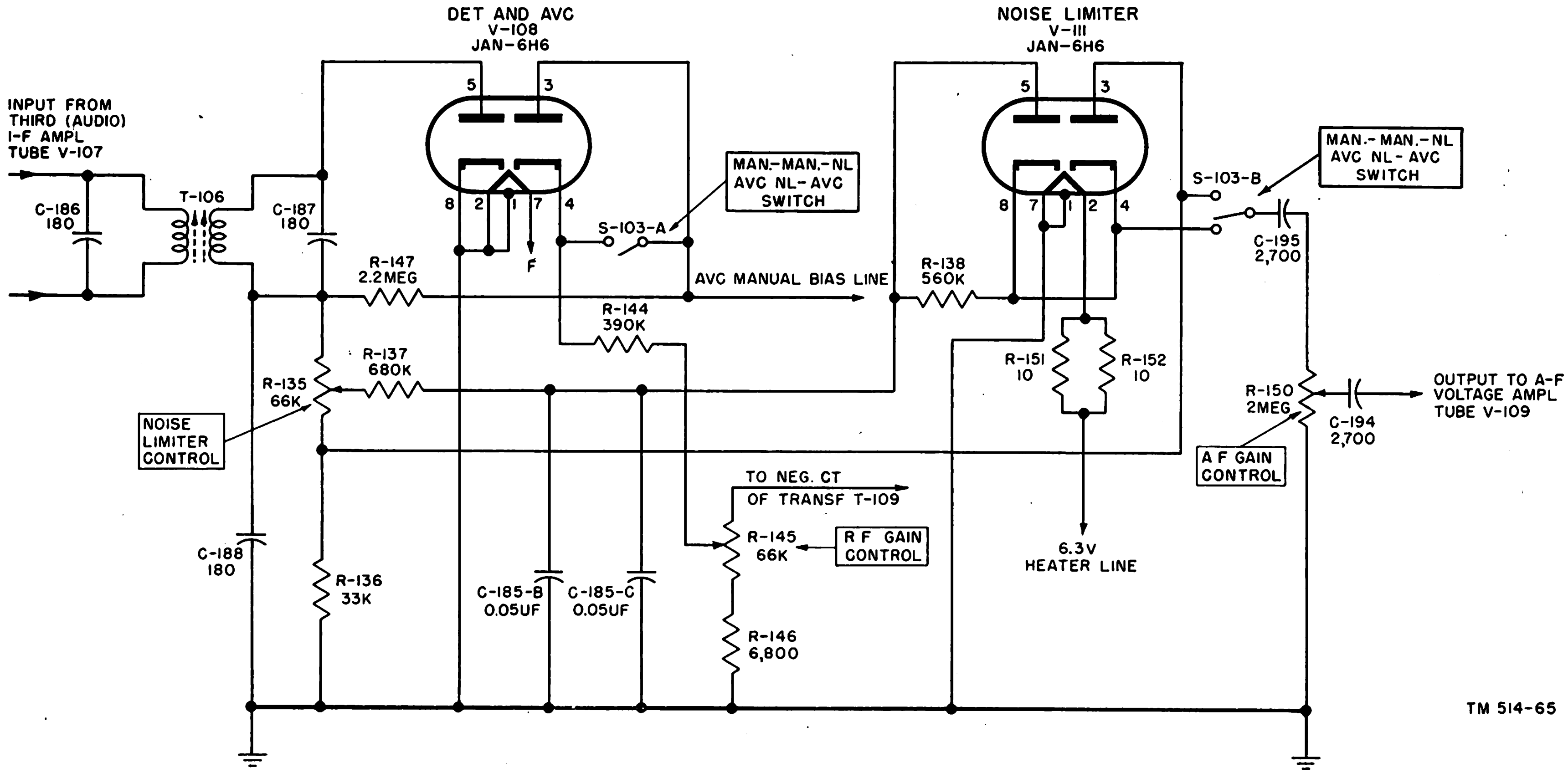


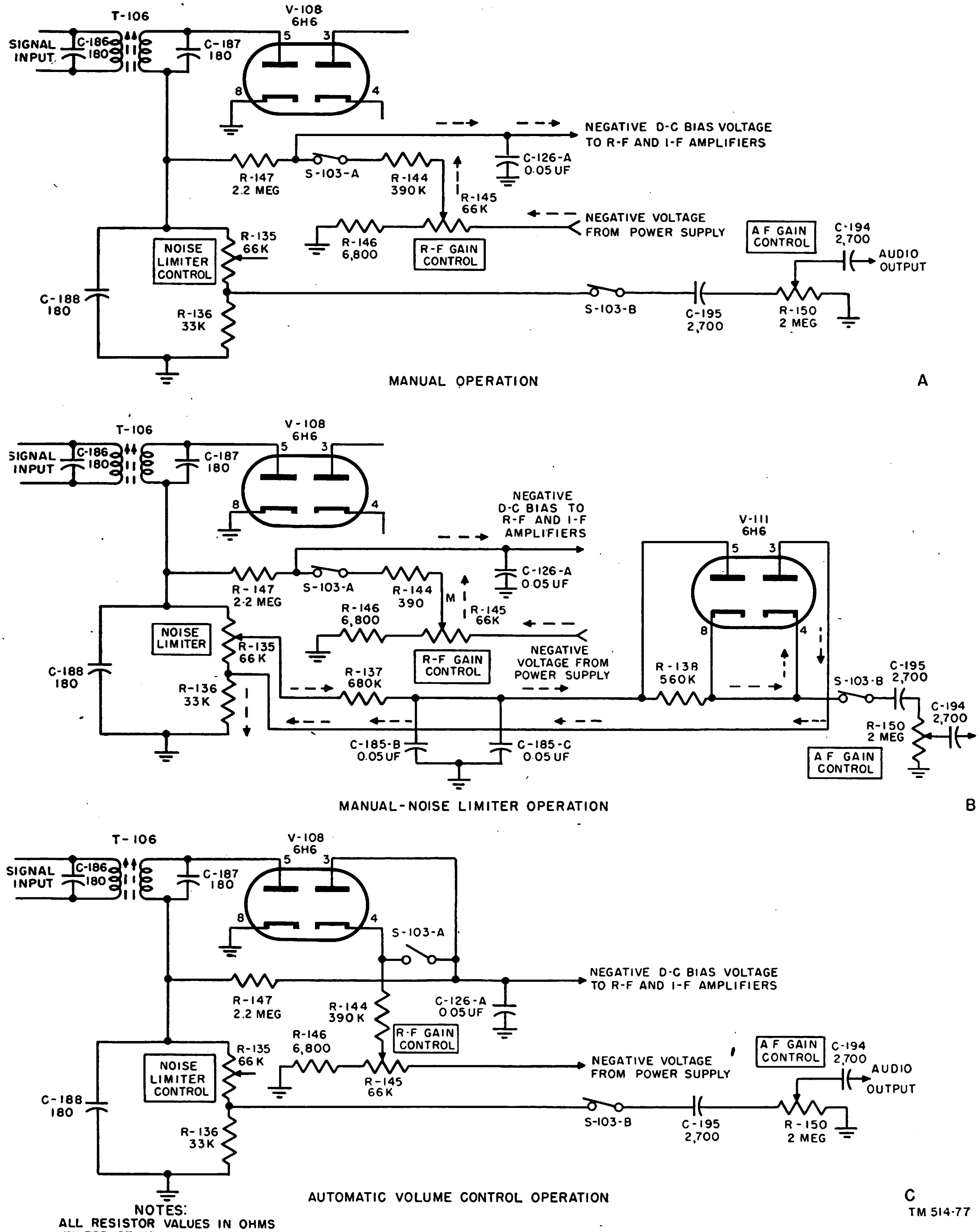
Figure 77. Radio Receiver R-127/CRD-2, detector, noise-limiter, and avc stages, schematic diagram.

age divider comprised of potentiometer R–145 and resistor R–146. The variable arm of R–145 selects the level of d-c voltage which is fed to the resistance network comprised of resistors R–144, R–147, R–135, and R–136. Because of the high-resistance value of this series combination, direct current is limited to a low level and only a small d-c voltage drop occurs across resistor R–144. Therefore, the negative d-c bias line to the r-f and a-f amplifier tubes has a level which approaches that at the variable arm of R–145. The amplifier line itself draws negligible current and does not load the resistance network.

(2) *Detector circuit, no signal input.* In the absence of an i-f signal input to the detector stage, there is a small current flow through resistor R–136, potentiometer R–135, the secondary winding of transformer T–106, and the detector diode section of tube V–108. This current is called zero-signal plate current and is produced by emission of free electrons by the cathode of the detector diode (with no plate potential applied), some of which reach the plate of the tube and complete the external circuit. The direction of this current flow causes a small negative voltage (less than 1 volt) to be developed across resistors R–135 and R–136.

(3) *Detector action, unmodulated signal.* Signals are coupled to the detector circuit through transformer T–106. Capacitors C–186 and C–187 resonate the primary and secondary windings of this transformer to 455 kc. On alternate half-cycles of an unmodulated i-f signal, the upper or plate end of the secondary winding is positive and the lower end of this winding is negative. During these half-cycles, the detector diode section of tube V–108 conducts and current flows through resistor R–136, potentiometer R–135, the secondary winding, and the diode. Each time this conduction takes place, a charge is built up across capacitor C–188. On the other alternate half-cycles of the impressed i-f signal the plate end of the secondary winding becomes negative and the tube stops conducting. During this nonconduction period, the charge which previously had built up across the capacitor starts to leak off through resistors R–135 and R–136. No appreciable discharge is able to occur, however, because the R-C time constant for the combination is long, in comparison with the period of the i-f cycle. Before the capacitor can lose much of its charge, the diode again conducts as the i-f signal causes the plate of the tube to become positive again. When conduction again occurs, the capacitor then regains that part of its charge which was lost during the nonconduction period. Thus, the diode current consists of a series of bursts, or pulses, of current and the capacitor charge varies only slightly around a level which is proportional to the peak amplitude of the i-f signal. Also, during the reception of an unmodulated signal, there is negligible change in the flow of current through resistors R–135 and R–136. The voltage developed across resistor R–136 is practically constant, and no a-f signal is developed in the a-f output line, which is comprised of one section of switch S–103B, capacitor C–195, potentiometer R–150 (AF GAIN control), and capacitor C–194.

(4) *Detector action, modulated signal.* When the i-f signal is being modulated at an a-f rate, the amplitude of the i-f wave rises and falls in response to the a-f or modulating component of the wave. During the detection of such a wave, the detector circuit functions in exactly the same manner as described above except that the capacitor (C–188) charge varies in response to variations in the peak amplitude of the i-f wave, causing an a-f signal to be recovered and to appear across the AF GAIN control in the a-f output circuit. The charge across capacitor C–188 varies because the R-C time constant of



NOTES:
ALL RESISTOR VALUES IN OHMS UNLESS OTHERWISE SPECIFIED.
ALL CAPACITOR VALUES IN UUF UNLESS OTHERWISE SPECIFIED.

Figure 78. Radio Receiver R–127/CRD–2, detector, automatic volume control, and noise limiter, schematic diagrams for three positions of MAN - MAN NL - AVC NL - AVC switch.

this capacitor and resistors R–135 and R–136 is short in comparison with the period of an a-f cycle, thus permitting the capacitor charge to *follow* the rises and falls in the peak amplitude of the modulated i-f wave. In short, the capacitor voltage is an a-f signal with a waveshape which corresponds to the a-f modulation component of the i-f wave. As the capacitor voltage swings at the a-f rate, the current through resistors R–135 and R–136 swings in unison, and the a-f output potential is developed across resistor R–136. Also, because of the direction of current flow through the resistors, the upper end of R–135 is negative in polarity with respect to ground.

b. MAN NL OPERATION. When switch S–103 is thrown to the MAN NL position, the noise limiter circuit is added to the MAN operation circuit explained in *a* above (B, fig. 78)

(1) With no signal input to the detector stage and with the NOISE LIMITER control, R–135, set at the center of its range, there is a flow of current from the variable arm of potentiometer R–135 through the circuit comprised of resistors R–137 and R–138, the noise limiter diode (pins 3 and 4 of tube V–111), and resistor R–136, as shown by the dotted arrows in B, figure 78. This current is produced by the flow of zero-signal plate current in the noise limiter diode. Current flow in the diode also is increased because of the small current which flows through resistors R–136 and R–135 as the result of zero-signal plate current in the detector diode circuit as explained in *a*(1) above. These currents cause the voltage at the upper end of R–135 to be more negative than ground. Likewise, the voltage at the junction of R–135 and R–136 which connects to the plate of the noise limiter diode is more positive than the voltage at the variable arm of R–135 which connects through resistors R–137 and R–138 to the cathode of the tube. As long as the noise limiter diode conducts, there is an output path for signals from resistor R–136 through the noise limiter diode, one section of switch S–103B, capacitor C–195, AF GAIN control R–150, and capacitor C–194. When the NOISE LIMITER control is set at maximum, the variable arm of this control is made more negative with respect to ground and conduction though the noise limiter diode is maximum. Conversely, when the control is at minimum, the variable arm is less negative and is at the same potential as the plate of the noise limiter diode. At minimum position, the noise limiter diode current is also at a minimum.

(2) When a modulated wave containing no noise peaks is being received, and R–135 is at its center setting, detection takes place as explained in *a* above and an a-f signal of negative polarity appears across resistors R–135 and R–136. That portion of the a-f signal which appears across resistor R–136 is connected to the a-f output circuit through the noise limiter diode path. An a-f signal also appears at the variable arm of potentiometer R–135 but does not reach the cathode of this diode through resistors R–137 and R–138 because of the presence of capacitors C–185B and C–185C. These capacitors offer a low-impedance path for the a-f signal and cause the a-f signal to appear across resistor R–137. However, these capacitors do charge to the level of the d-c component of the signal voltage, and a d-c voltage appears at the junction of resistors R–137 and R–138. This d-c voltage changes slowly with the average level of the d-c component of the a-f signal.

(3) When a noise peak occurs, a large negative voltage instantaneously appears in the detector circuit and across its output resistors, R–135 and R–136. As a result, a large negative voltage also appears across resistor R–136 and at the plate of the noise limiter diode. This sudden negative plate voltage makes the tube stop conducting as its plate becomes more negative than its cathode. The cathode voltage

cannot shift immediately in response to the noise peak voltage because of the presence of capacitors C–185B and C–185C. These capacitors must change their d-c level through resistor R–137, and the time constant of the combination is very long in comparison with the duration of most noise peak voltages. When the noise limiter diode stops conducting, the a-f output circuit opens and the signal does not reach the output terminals. As the noise peak disappears, the circuit returns to its normal operation and a-f signals again reach the output circuit. In this way, the noise limiter circuit causes the a-f output circuit to open each time a noise peak occurs and thus prevents the noise voltage from appearing in the a-f output. The NOISE LIMITER control can be used to increase or decrease the potential at which noise (or a-f signal) clipping occurs.

(4) The second section of tube V–111 (pins 5 and 8) prevents the generation of a small noise voltage as a result of noise limiter action.

(*a*) When a signal without noise peaks is being received and the noise limiter section of tube V–111 is conducting, the current flow through resistor R–138 produces a voltage drop which prevents the other section of tube V–111 from conducting (pin 5 negative with respect to pin 8).

(*b*) When a noise peak arrives with the signal and causes the noise limiter section (pins 3 and 4) to become nonconductive, the circuit for current flow through resistor R–138 (B, fig. 78) is opened. If the shunting diode (pins 5 and 8) were not present, current flow through resistor R–138 would cease abruptly and the end of this resistor attached to the cathode of the noise limiter diode would change abruptly in potential to the level existing at the other end of the resistor. This abrupt change in potential would be carried directly to the audio output circuit and would be heard as a small noise pulse.

(*c*) The shunting diode acts to maintain the original voltage drop across resistor R–138 and to prevent the generation of such a noise pulse. As the current through resistor R–138 decreases, the cause of nonconduction in the shunting diode is removed and the diode produces zero-signal plate current of approximately the same magnitude and direction as that originally produced by the signal. In short, the shunting diode produces a sustaining current. As long as the noise limiter diode is nonconducting, the shunting diode is conducting. But as soon as the noise pulse ends and the noise limiter diode again conducts, the shunting diode becomes nonconductive because of the voltage drop across resistor R–138.

(*d*) This cycle of operation repeats each time a noise pulse occurs.

(5) The above explanation of the functioning of the noise limiter circuit holds true for most noise peaks which consist of short time duration voltage peaks. If, however, a noise peak of long time duration occurs, the circuit acts as it does when no noise peak is present, and the noise limiter does not function effectively.

c. AVC OPERATION. When switch S–103 is thrown to the AVC position, the automatic volume control circuit is completed and the noise limiter does not function (C, fig. 78).

(1) With a weak signal input to the detector stage, only a small d-c negative voltage (d-c component of signal voltage) is developed across capacitor C–188, as explained in *a* above. This small d-c voltage also appears across capacitor C–126A and at the plate of the avc section (pins 3 and 4) of tube V–108. (The d-c voltage across capacitor C–126A cannot swing in unison with the a-f changes of signal because of the long R-C time constant of resistor R–147 and capacitor C–126A.

However, the capacitor voltage will follow average shifts in the level of an i-f signal.)

(2) Only a small d-c voltage appears across capacitor C–126A during the reception of a weak signal and, as a result, the potential at the plate of the avc diode is only slightly negative with respect to ground. At the same time, the cathode of this tube is more negative because of its connection through resistor R–144 to the d-c bias voltage supply. As a result, the diode conducts and d-c current flows from the variable arm of R–145 through the combination of resistors R–144, R–147, R–135, and R–136, and a certain minimum level of bias voltage is developed for the r-f and i-f amplifier tubes. The exact level of minimum bias voltage so developed is largely dependent upon the setting of the RF GAIN control, R–145.

(3) When the i-f input signal shifts to a high level, a large negative d-c component appears across capacitor C–188 and the negative voltage across capacitor C–126A gradually drifts to a higher level. As this occurs, the plate of the avc diode becomes more negative than its cathode, and conduction through the diode ceases. Consequently, for strong signals, the bias for the amplifier tubes is controlled entirely by the strength of received signals. As the signals reach a very high level, the bias voltage increases. Conversely, as the signals reach a lower level, the bias voltage decreases. In this manner, avc action on strong signals is obtained.

(4) Thus, for all normal levels of signal input, the avc circuit functions to give a comparatively equal a-f output voltage.

d. AVC NL OPERATION. This type of operation combines the avc circuit with the noise limiter circuit as explained above and allows noise limiting during avc operation.

97. Beat-Frequency Oscillator

The bfo uses a Tube JAN–6J5 (V–115) and a conventional Colpitts circuit (fig. 79).

a. Coil L–135 and capacitors C–204, C–205, and C–206 comprise the major lumped constants which determine the frequency of oscillation. One of the capacitors, C–205, is variable (BFO ADJ control) and can be adjusted in order to obtain the desired beat-note tone. These capaci-

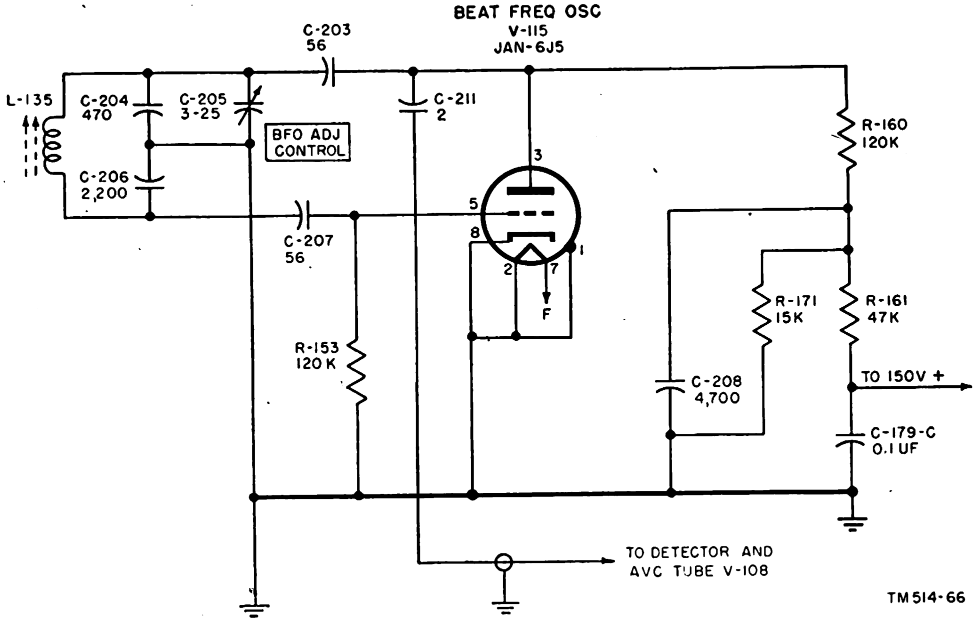


Figure 79. Radio Receiver R–127/CRD–2, beat-frequency oscillator, schematic diagram.

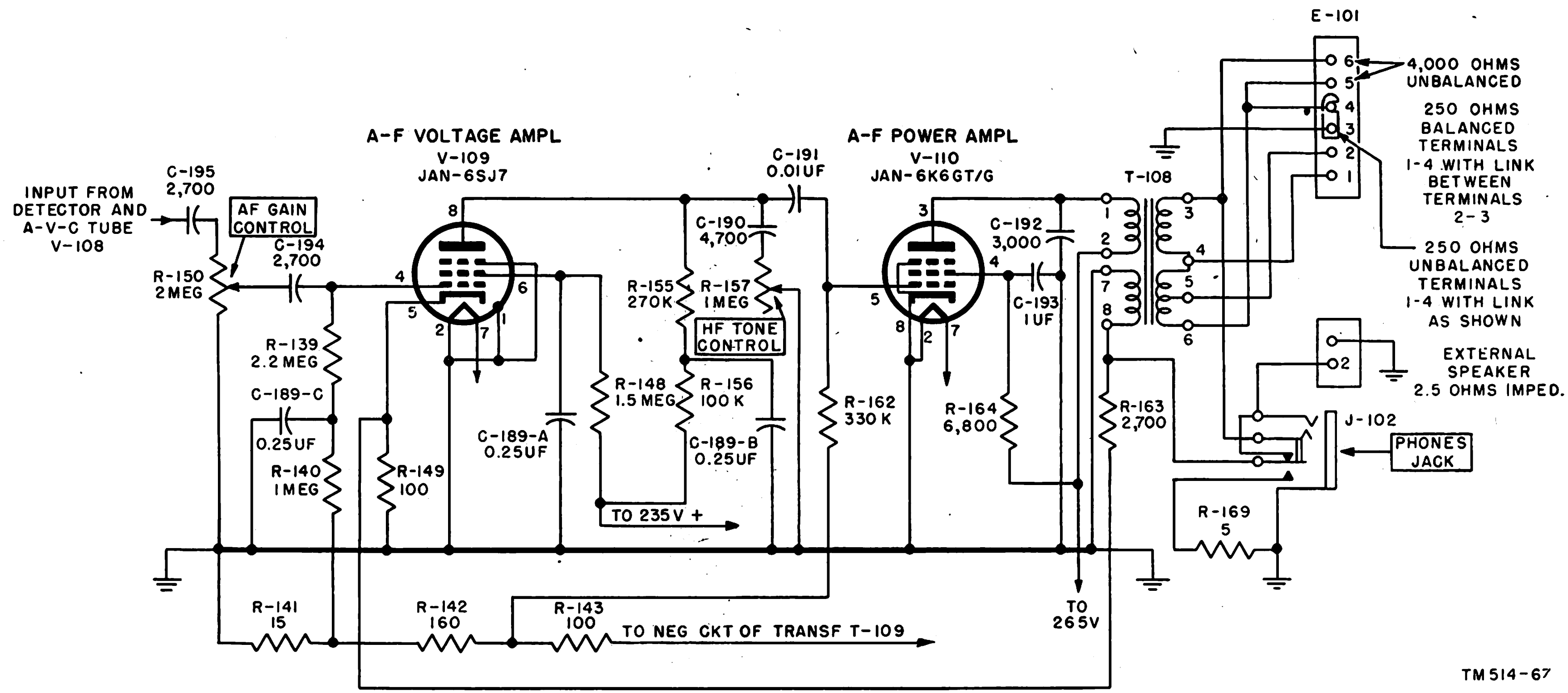


Figure 80. Radio Receiver R-127/CRD-2, a-f voltage and power amplifier stages, schematic diagram.

tors also control the plate-to-grid feedback by means of which oscillations are built up and sustained.

b. D-c blocking capacitor C–207, in combination with grid bias resistor R-153, provides bias voltage. C–203 is a d-c blocking capacitor. Resistors R–160 and R–161 and capacitors C–208 and C–179C provide voltage dropping and decoupling in the plate circuit.

c. The output of the bfo is coupled to the plate of the detector tube through capacitor C–211.

98. A–f Voltage and Power Amplifiers

The a-f voltage amplifier uses a sharp cut-off pentode Tube JAN–6SJ7 (V–109). The power amplifier uses a power pentode Tube JAN–6K6GT/G (V–110) (fig. 80).

a. The audio signal from the detector is fed through blocking capacitor C–195, AF GAIN control R–150, and blocking capacitor C–194 before reaching the grid of tube V–109. The output of the amplifier is developed across plate load resistor R–155 and fed through blocking capacitor C–191 to the grid of power amplifier tube V–110. The plate of the power amplifier tube connects to transformer T–108, which provides output power at 250 ohms balanced, 250 ohms unbalanced, or 4,000 ohms unbalanced. A PHONES jack and a 2.5-ohm outlet for an external speaker also are provided.

b. Bias voltage for these two amplifiers is obtained from a voltage divider network consisting of resistors R–141, R–142, and R–143 connected from the negative center tap of power transformer T–109 to ground. Additional bias for the a-f voltage amplifier is developed across cathode bias resistor R–149. R–139, R–140, and R–162 are grid return resistors with the combination of resistor R–140 and capacitor C–189C acting as a grid decoupling circuit. Capacitor C–190 and resistor R–157 comprise the tone control circuit. C–189A and C–193 are the screen bypass capacitors; R–164, R–148, and R–156 are the screen and plate voltage-dropping resistors for their respective circuits. Capacitor C–189B in combination with resistor R–156 provides plate decoupling. Capacitor C–192 is shunted across the plate circuit of the power amplifier tube to bypass undesirable high-frequency components from the audio output. Inverse feedback voltage is obtained from the 2.5-ohm tap of the output transformer and applied to the cathode of the first amplifier tube. This feedback circuit tends to cancel out any distortion produced in the a-f amplifier stages.

99. Power Supply

The power supply uses two tubes, a full-wave rectifier Tube JAN–5Y3GT/G and gas regulator Tube JAN–OD3/VR150 (fig. 81).

a. The primary of power transformer T–109 is designed for a 115-volt, 50/60-cycle, a-c input. There are four secondary windings for supplying 5 volts to the filament of the rectifier tube, 345 volts to each of the rectifier plates, and 6.3 volts for the filaments of tubes V–101 through V–113 and tube V–115. Capacitors C–209A and C–209B are line filters.

b. The rectified output of tube V–116 is passed through an L-C filter consisting of chokes L–133 and L–134 and capacitors C–210A, C–210B, and C–210C. R–129 and R–130 are bleeder resistors. The filter circuit provides two d-c output voltages for the receiver circuits and for the voltage regulator circuit consisting of resistor R–128 and tube V–114.

c. Resistors R–141, R–142, and R–143 form a voltage divider from which two negative voltages are obtained. These two voltages provide bias voltages for the a-f amplifier tubes.

d. Switch S–104 controls the application of 115-volt, a-c power to transformer T–109 and also controls the application of d-c potentials to various circuits of the radio receiver.

(1) In the OFF position of this switch, the 115-volt a-c power is disconnected and the radio receiver is inoperative.

(2) In the TRANS position, filament voltages are applied to all tubes in the radio receiver and plate voltages are applied to rectifier tube V–116 and a-f amplifier tube V–110.

(3) In the REC MOD position, all the receiver circuits are energized except the plate circuit of the bfo (tube V–115).

(4) In the REC CW position, all circuits in the radio receiver, including the plate circuit of the bfo, are energized.

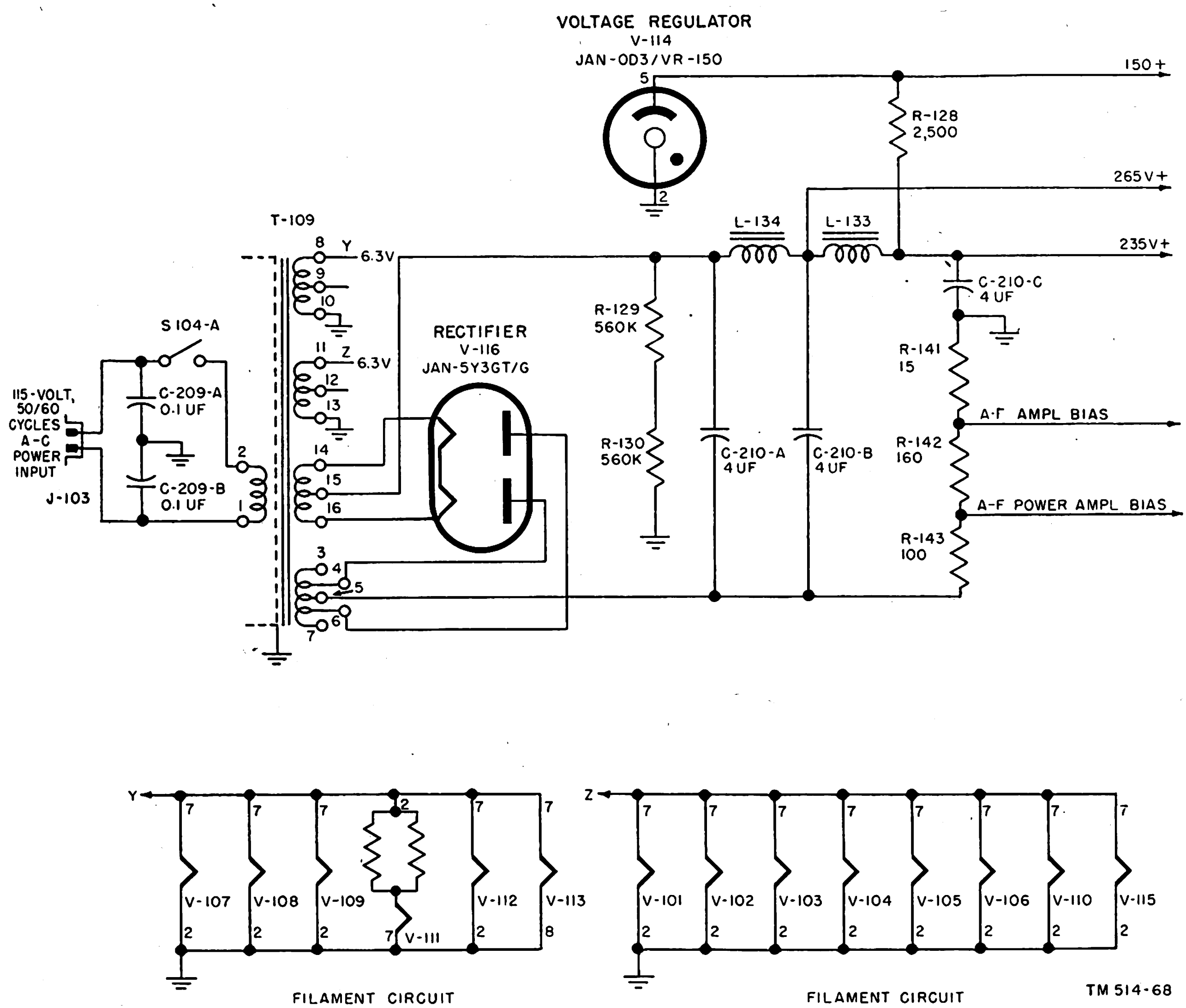


Figure 81. Radio Receiver R–127/CRD–2, power supply, schematic diagram.

Section VI. THEORY OF BEARING INDICATOR

100. General

The bearing indicator has two input signals, the 147-cps sinusoidal reference voltage from the modulating voltage generator and the video signal from the radio receiver. Under excitation of these two signals, the bearing indicator develops complex voltages which, when applied to the cathode-ray tube indicator, produce the bearing (or sense) pattern on the screen of the tube, with the angular position of this pattern being dependent upon the phase relationship of the two input signals. For this reason, the bearing indicator sometimes is referred to as a *phase meter.*

101. Block Diagram (fig. 82)

a. The 147-cps sinusoidal reference voltage is fed directly to the orientation stage of the bearing indicator during *bearing* operation of the radio set when the propeller-shaped pattern is observed on the cathode-ray tube. The purpose of the orientation stage is to provide a means of adjusting the phase of the 147-cps reference voltage. This adjustment permits

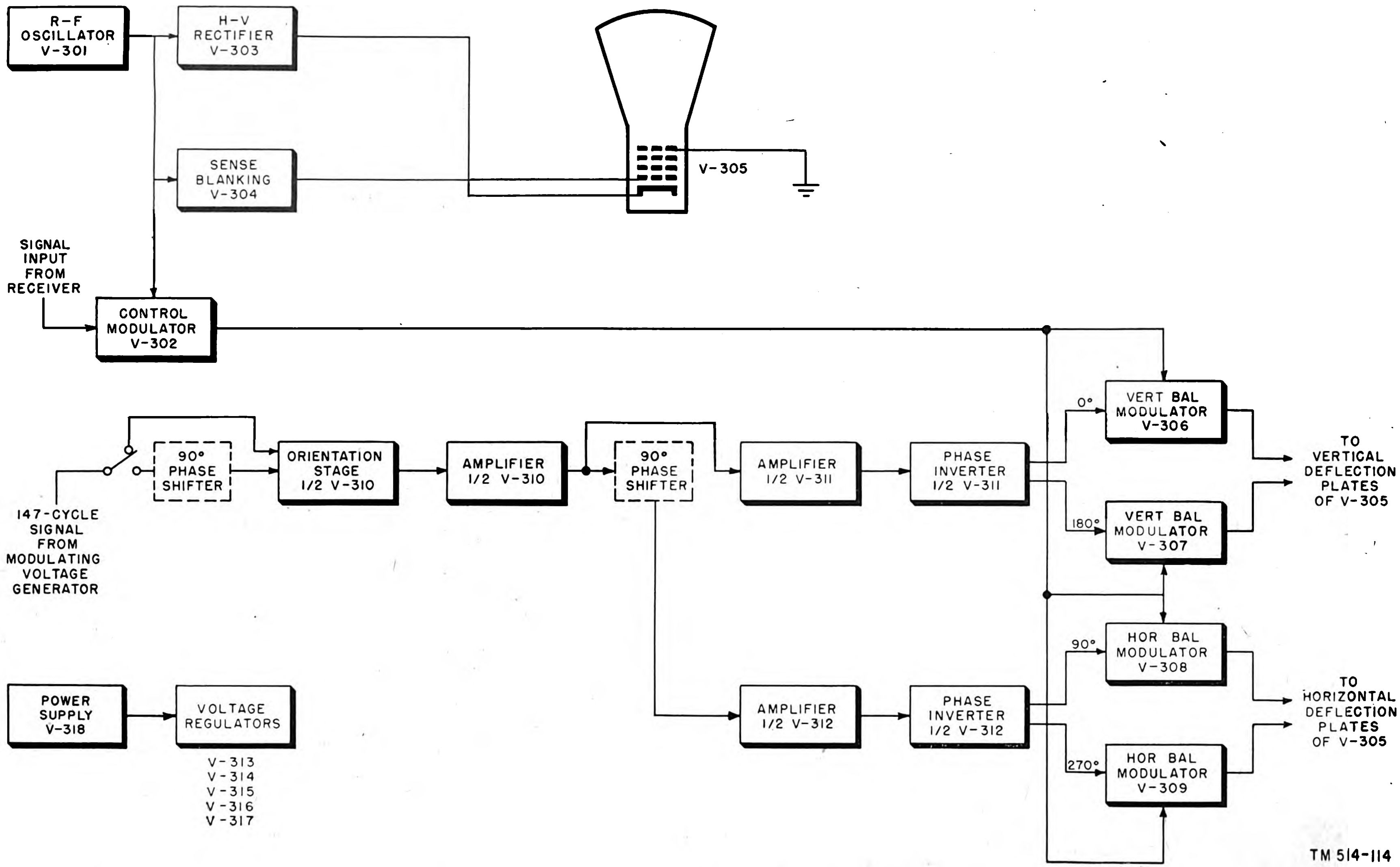


Figure 82. Bearing Indicator ID–64/CRD–2, block diagram.

electronic orientation of the antenna because, as the control is turned, the angular position of the propeller-shaped pattern on the screen of the bearing indicator also rotates. In this way, the control can be adjusted to the setting which causes the angular position of the pattern to coincide with the angle of arrival of a radio wave of known azimuth at the antenna array. Thus, the control can be used to compensate for physical misorientation of the antenna system.

b. During *sense* operation, the phase of the 147-cps reference signal is shifted 90° in the sense rotation circuit before it reaches the orientation stage. This 90° phase shift is required in order to obtain correct sense indication.

c. After the 147-cps signal passes through the orientation stage, it is amplified and then sent to the 90° phase splitter which develops two 147-cps voltages displaced in phase by 90°. This circuit is similar to the phase splitter in the modulating voltage generator. Also, as in the modulating voltage generator, the two 90° phase-displaced voltages are amplified and sent to phase inverter stages which generate four 147-cps voltages having phase relationships of 0°, 180°, 90°, and 270°. These four voltages are then applied to a pair of balanced modulators (fig. 82).

d. The 200-kc oscillator generates an unmodulated, 200-kc voltage which is fed to the r-f control modulator. With no video input to the bearing indicator from the radio receiver, the output of the r-f control modulated is also an unmodulated 200-kc voltage which is parallel-fed to all four tubes of the balanced modulators. Because of the symmetry of the parallel-fed circuit, the 200-kc voltages at the grids of all balanced modulator tubes are in phase.

e. Upon application of the unmodulated 200-kc voltage and the 147-cps reference voltage, but with no video signal from the radio receiver, the balanced modulators develop voltages for the deflection plates of the cathode-ray tube which cause a circular area of light to appear on the screen of the tube.

f. The video output signal of the radio receiver is fed to the r-f control modulator. In the presence of this video signal, the output of the r-f control modulator is a 200-kc signal which is modulated at the video rate. This signal causes the circular pattern on the cathode-ray tube to change into a propeller-shaped pattern (or sense pattern).

g. In addition to feeding a voltage to the r-f control modulator, the 200-kc oscillator stage furnishes a high, 200-kc voltage to rectifier tube V–303. This rectifier provides the high d-c operating voltages for the cathode-ray tube.

h. The sense blanking stage is operative only during sense operation. When in use, it uses the 200-kc voltage to blank out the illumination on the screen of the cathode-ray tube during alternate half-cycles.

i. The power supply and voltage regulator circuits are similar to those in the modulating voltage generator and are used to supply filament, plate, and screen potentials for the various tubes in the bearing indicator.

102. Development of the Circular Pattern

In the absence of a video signal from the radio receiver, a 147-cps sinusoidal voltage and an unmodulated 200-kc voltage appears at the grid of each balanced modulator tube (fig. 83).

a. In this diagram, the 147-cps voltages at the grids of tubes V–1 through V–4 have the same amplitude but differ in phase and, if an arbitrary phase angle of 0° were to be assigned to the 147-cps voltage at the grid of tube V–1, then the 147-cps voltages at the grids of tubes V–2, V–3, and V–4 would bear phase angles of 180°, 90°, and 270°, respectively.

b. In the *absence* of the 200-kc voltage at the grids of these tubes, it would appear that the 147-cps voltages would be amplified by the tubes and would appear across the plate load inductances and at the deflection plates of the cathode-ray tube to produce a circular pattern (not filled in). Such is not actually the case, however, because the plate inductances have a low impedance at a frequency of 147 cps, and no appreciable 147-cps voltage appears at the plates of the balanced modulator tubes or at the deflection plates of the cathode-ray tube.

c. In the *absence* of the 147-cps audio voltage and with the application of the 200-kc signal at the grids of the tubes, it also would appear that 200-kc amplified signals would appear at the plates of the balanced modulator tubes and at the deflection plates of the cathode-ray tube to produce a line trace on the screen of the tube.

However, because the 200-kc signals are in phase at the grids and are in phase with each other at the plates of the balanced modulator tubes, the voltages acting on the deflection plates are in opposition and no line trace is obtained.

d. When *both* the 147-cps audio voltages and the 200-kc voltages are applied simultaneously to the grids of the tube V–1 through V–4, a 200-kc signal modulated at a frequency corresponding to that of the audio voltage appears across the output of each balanced modulator and at each set of deflection plates in the cathode-ray tube. The envelope phases of the modulated waves appearing at the deflection plates bear the same quadrature relationships as do the four 147-cps voltages at the grids of the balanced modulator tubes. In response to these voltages, a pattern is formed on the screen which consists of a 200-kc line trace rotating at an audio rate. However, because of the persistence of human vision, this pattern appears as a "filled-in" circle, or circular area of illumination.

e. Actually, under normal operating conditions, *two* superimposed circular patterns are formed during each audio cycle. Two superimposed patterns are formed because the line trace is a diametral line which creates one solid circle of illumination during each 180° rotation. A radial line, on the other hand, must rotate 360° to create a solid circle and would create only one circular pattern during each audio cycle. This latter action is an important factor in sense operation as will be explained in this section of the manual.

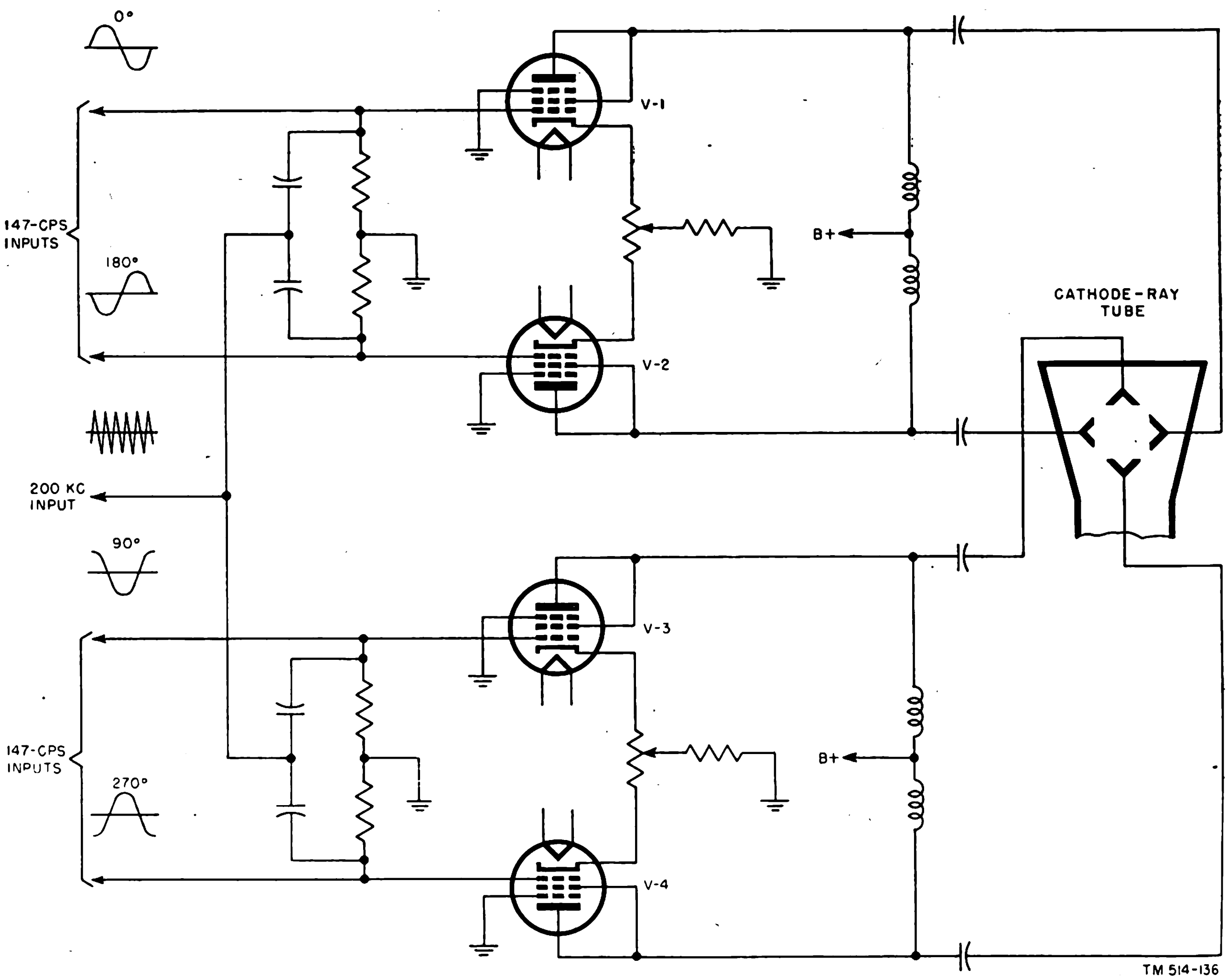


Figure 83. Bearing Indicator ID–64/CRD–2, functional schematic diagram of balanced modulators.

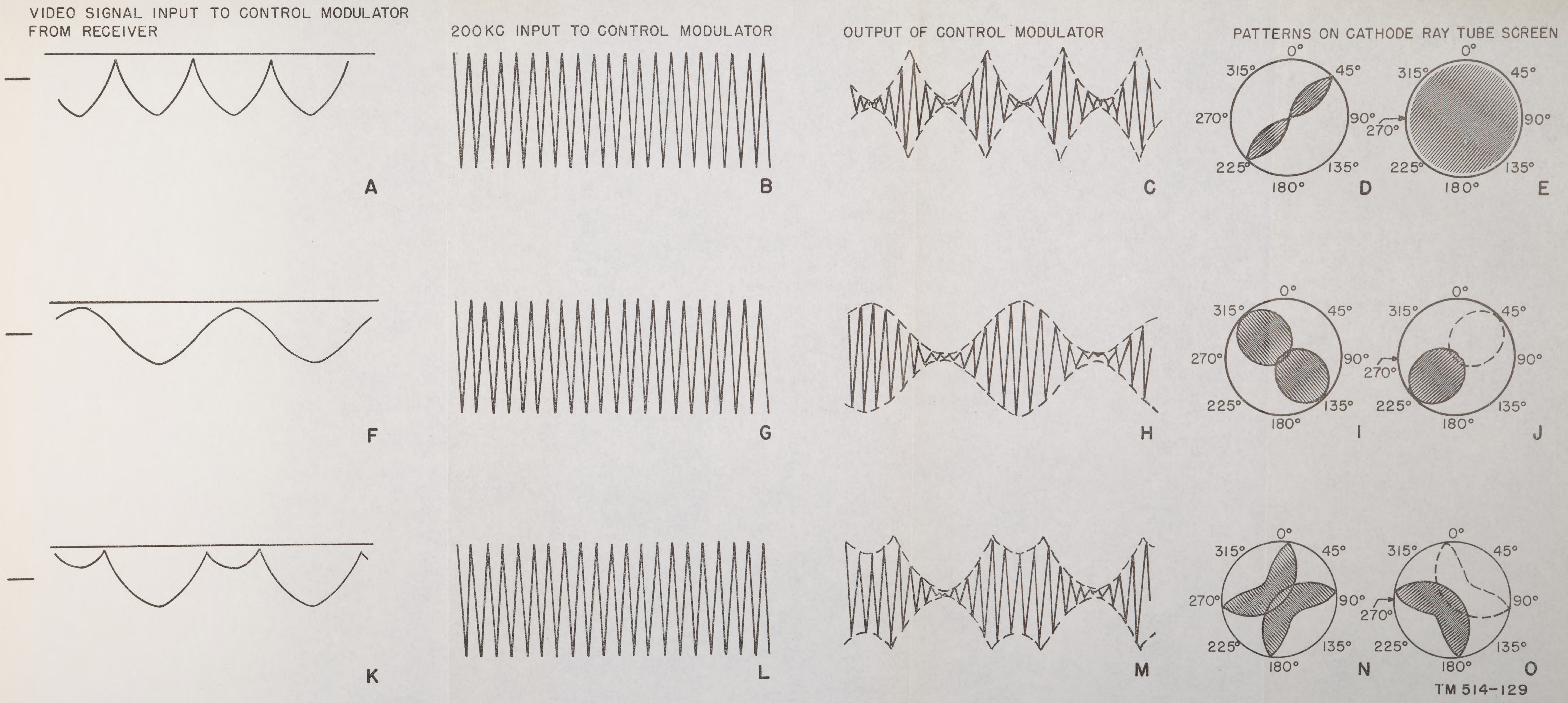


Figure 84. Theoretical waveforms showing development of patterns on screen of cathode-ray tube.

f. Thus, in the *absence* of a video signal at the input of the r-f control modulator (such as would be the case when no r-f signal was being received at the frequency to which the radio receiver was tuned or when the RF GAIN control of the receiver was turned counterclockwise) the output of the r-f control modulator will be a 200-kc unmodulated wave (B, fig. 84), and the presentation on the screen of the cathode-ray tube will be two superimposed circular patterns (E, fig. 84).

103. Development of Bearing Pattern

For a radio wave which is arriving at the antenna array at an azimuth of 45°, the output of the combining impedance (Coupling Unit CU–68/CRD–2 or CU–69/CRD–2) is a modulated r-f wave as shown in F, figure 68. This r-f wave is amplified and demodulated in the radio receiver and appears at the grid of the r-f control modulator in the bearing indicator as d-c pulses, a video signal of *negative polarity* (A, fig. 84).

a. The 200-kc signal (B, fig. 84) also passes through the r-f control modulator and, as a result, the output of this stage consists of a 200-kc voltage which varies at the frequency of the video signal, as shown in C, figure 84. Because the video signal applied to the r-f control modulator has negative polarity, maximum output of the r-f control modulator corresponds to the minimum of the video signal.

b. Previously, it was shown that the 200-kc voltage was responsible for the rotating line trace on the screen of the cathode-ray tube. The effect of the video signal, then, is to reduce the amplitude of the 200-kc voltage at intervals corresponding to the maximums of the video wave (which shortens the length of the line trace on the screen at these intervals) and to allow the 200-kc voltage to remain at maximum at intervals corresponding to the minimums of the video wave (which returns the length of the line trace to maximum). As a result, two superimposed propeller-shaped patterns are traced during each revolution of the line trace (fig. 84). There will be two superimposed propeller-shaped patterns during each revolution for the same reason that there were two superimposed circular areas (par. 102*e*).

c. In this way, the propeller-shaped pattern or bearing pattern is formed, with the tips of the propeller corresponding to the nulls of the figure-8 antenna response pattern and the center of the propeller-pattern corresponding to the maximums of the figure-8 pattern.

d. The approximate waveforms developed and the bearing indication obtained for signals arriving at various azimuth angles are shown in figure 85.

104. Development of Sense Pattern

The bearing pattern shown in D, figure 84, has 180° ambiguity. However, when the SENSE SWITCH is pressed, sense voltage (G, fig. 68) is combined with the r-f envelope (F, fig. 68) to produce the sense waveform of H, figure 68. When this sense waveform is fed to the radio recevier, the video output signal is negative in polarity and similar to that shown in F, figure 84.

a. The video signal is fed to the r-f control modulator where it is combined with the 200-kc voltage (G, fig. 84) to produce the output waveform shown in H, figure 84. When this signal is applied in phase and the 147-cps reference voltage is applied in phase quadrature to the balanced modulators, two displaced elliptical patterns on the screen (I, fig. 84) normally would be produced. However, depressing the SENSE SWITCH not only introduces the sense voltage in the antenna system as previously explained but also shifts the phase of the 147-cps reference signal by 90° before it enters the orientation stage of the bearing indicator. Also, depressing the SENSE SWITCH blanks out alternate half-cycles of the 200-kc signal applied to the deflection plates. Therefore, the pattern actually appearing on the screen of the cathode-ray tube is a single elliptical pattern as shown in J, figure 84, the dotted lines indicating the position of the blanked-out portion. Thus, the 180° ambiguity of the bearing pattern (D, fig. 84) is resolved by arbitrarily reading as the direct azimuth the null of the bearing pattern which corresponds in position to the blanked-out portion of J, figure 84. In this case, the bearing would be 45°.

b. Sketch K of figure 84 is the waveform of the video signal at the input of the r-f control modulator for a sense voltage of one-half the amplitude shown in G, figure 68. Sketches L and

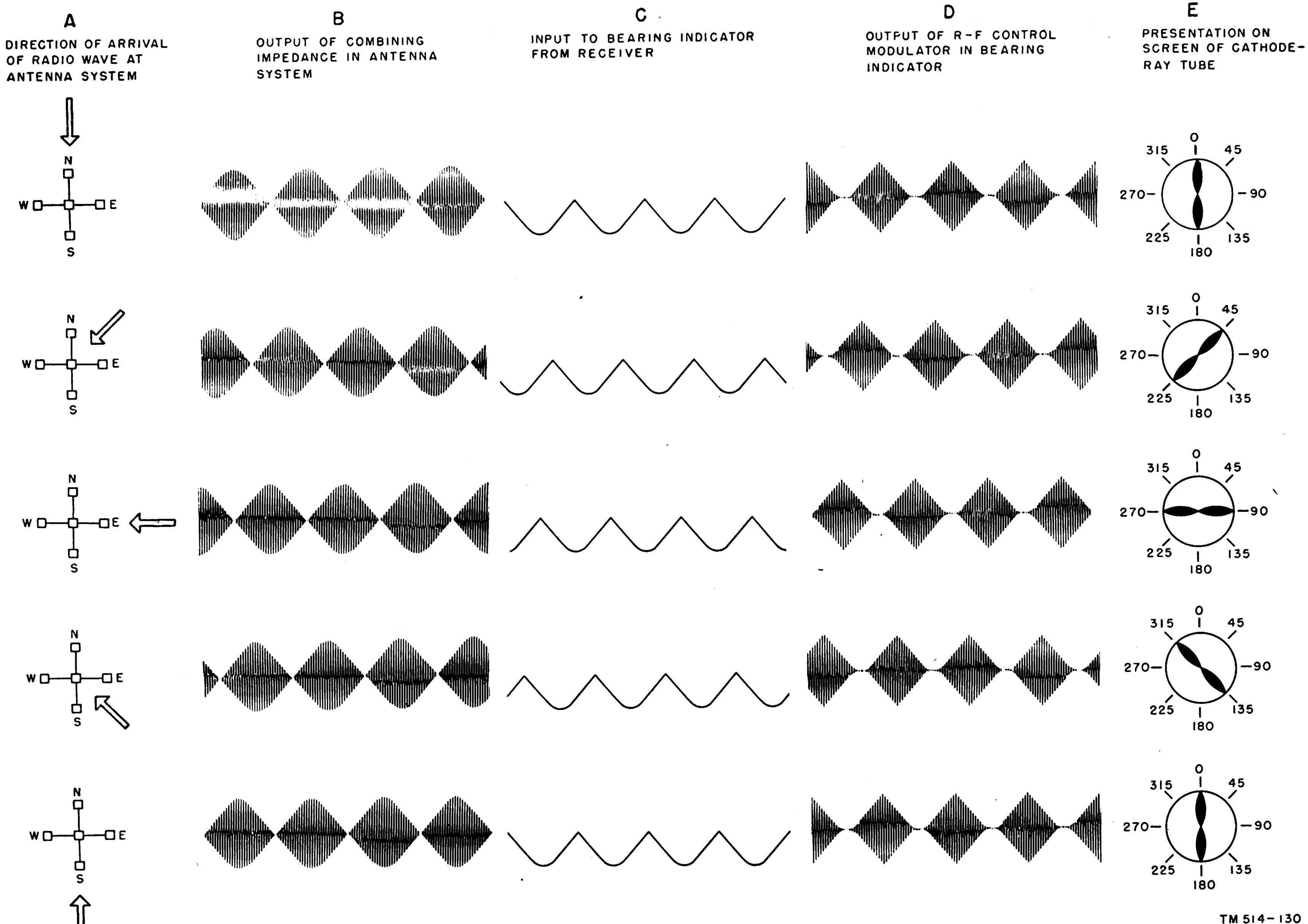


Figure 85. Relationship between direction of arrival of an r-f signal at antenna array, approximate bearing waveforms at various points in radio set, and bearing indication on cathode-ray tube.

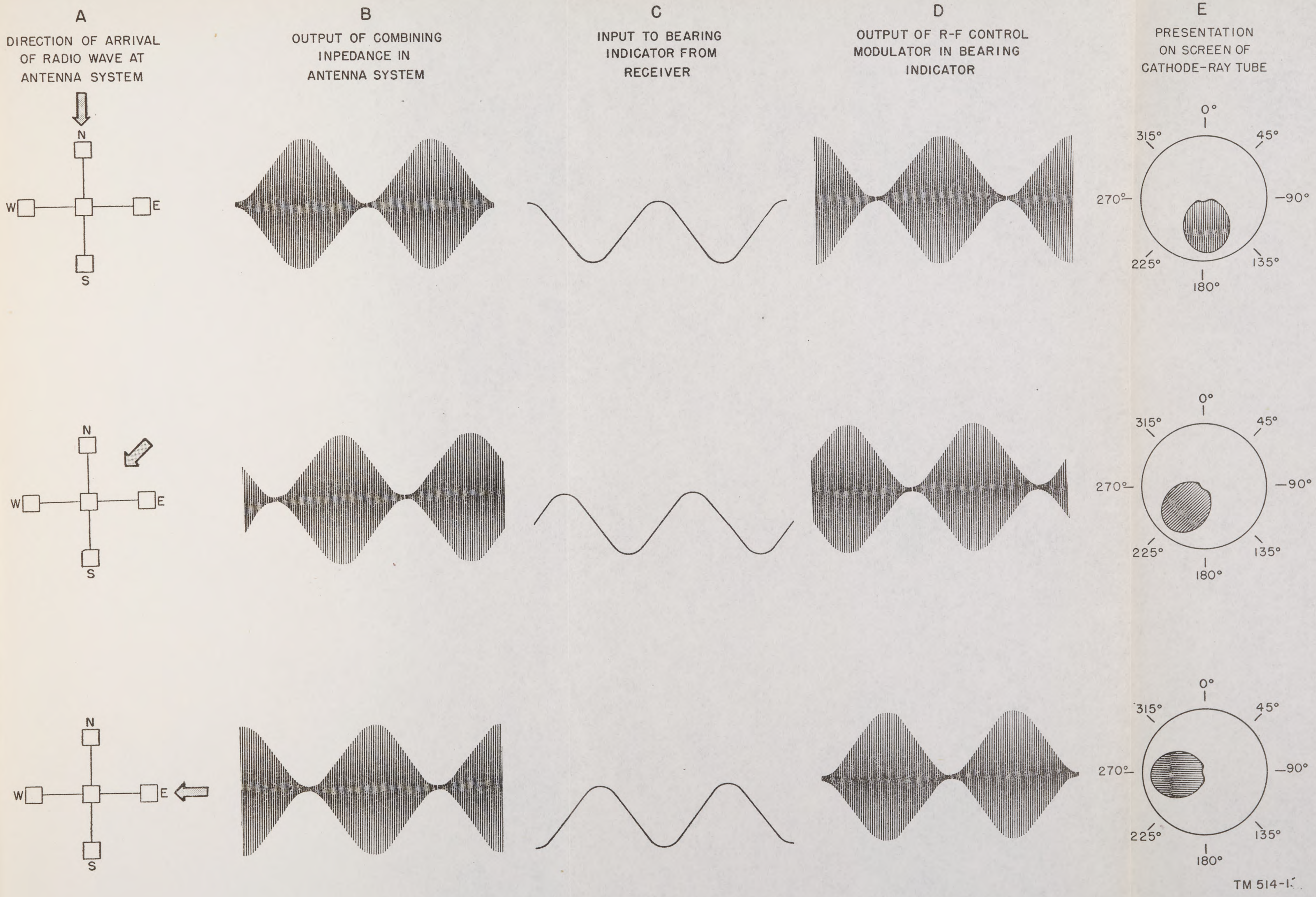


Figure 86. Relationship between direction of arrival of an r-f signal at antenna array, approximate sense wave-forms at various points in radio set, and sense indication on cathode-ray tube.

M, figure 84 are the 200-kc input and output waveforms, respectively, of the r-f control modulator. For a signal such as shown in M, figure 84, applied in phase and the 147-cps voltages applied in phase quadrature to the balanced modulator tubes, a split pattern (N, fig. 84) would appear on the screen of the cathode-ray tube. However, because of the 90° phase shift of the 147-cps reference signal in the circuit preceding the orientation stage, and because of the blanking action, the pattern actually appearing on the screen will be that shown in O, figure 84. This pattern is the type most commonly obtained in actual operation of the radio set.

c. Split patterns such as shown in I and N, figure 84, when caused by reasons other than operation of the sense or split circuits, are not normal indications but instead indicate unbalances in the antenna system or the indicating system, for which corrective measures must be applied.

d. The sense waveforms and the sense indications obtained for signals arriving at various azimuth angles are shown in figure 86.

105. Sense Rotation Circuit, Orientation Stage and Amplifier Stage (fig. 87)

a. SENSE ROTATION CIRCUIT. The 147-cps sinusoidal reference voltage from the modulation voltage generator enters the bearing indicator and appears across control R–344. This control provides a means of adjusting the 147-cps voltage to the proper operating level. The two arms of switch S–301 (SENSE SWITCH) rotate the phase of the 147-cps voltage by 90° in the following manner:

(1) Capacitor C–341 and resistor R–345 comprise a phase-shifting network with values selected to give a 45° phase shift between the input and output voltages of the network.

(2) In one position of the SENSE SWITCH, capacitor C–341 is connected in series with the 147-cps signal, and resistor R–345 is connected in shunt with the signal. This circuit arrangement provides a lagging 45° phase displacement.

(3) In the other position of the SENSE SWITCH, resistor R–345 is connected in series with the 147-cps signal, and capacitor C–341 is connected in shunt with the signal. With this circuit arrangement, a leading 45° phase displacement occurs.

(4) Thus, a total of 90° shift occurs when the SENSE SWITCH is changed from one position to another. Such a 90° phase shift is necessary in order to accomplish the 90° rotation of the pattern necessary for sense operation.

b. ORIENTATION STAGE. This stage uses the first section of twin-triode tube V–310. Capacitor C–340 couples the 147-cps signal from the sense rotation network to the grid of the triode. R–346 is the grid resistor, and R–347 is the cathode bias voltage resistor. R–348 is the cathode load resistor, and R–352 is the plate load resistor. C–343 provides cathode output coupling, and R–351, the ORIENTATION control, is a potentiometer which can be rotated to select either the phase-inverted plate voltage, the in-phase cathode voltage, or some combination of plate and cathode voltages. In this way, a continuously variable phase change can be obtained. The circuits constants in the orientation circuits have been selected to give a constant-amplitude output with rotation of the control. However, only approximately 120° of phase rotation of the 147-cps signal is obtained instead of 180° because of the limitations of the components selected.

c. AMPLIFIER STAGE. Section 2 of tube V–310 is a conventional, resistance-coupled amplifier which raises the level of the 147-cps signal before its application to subsequent circuits. C–342 couples the output of the orientation stage to the grid of the amplifier tube. R–350 is the grid resistor, and R–349 is the cathode bias voltage resistor. The amplified output is taken from the plate circuit across load resistor R–354 and fed to the phase-shifting network in the phase inverter stages through a double-section, high-pass filter network. This filter network consists of capacitors C–345 and C–346 in combination with resistors R–355 and R–356. This network attenuates any undesired hum which might have been picked up in preceding circuits.

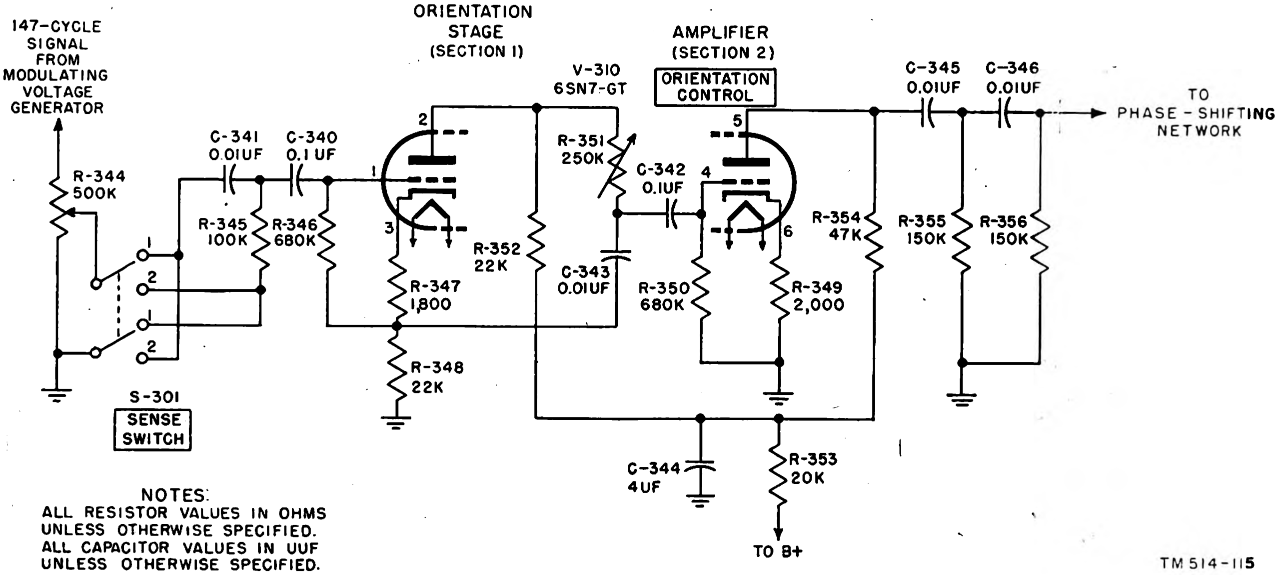


Figure 87. Bearing Indicator ID-64/CRD-2, sense rotation circuit, orientation and amplifier stages, simplified schematic diagram.

106. Phase Splitter, Amplifiers, and Phase Inverters (fig. 88)

The 90° phase splitter, amplifiers, and phase inverters are similar to those in the modulating voltage generator.

a. 90° PHASE SPLITTER. One arm of this phase splitter consists of resistor R–358 and capacitor C–352 with the phase-shifted output being taken from across the capacitor and fed to the amplifier section of tube V–312. The other arm of the phase splitter consists of capacitor C–347, resistors R–357 and R–359, and potentiometer R–360 (SHAPE control). The control allows manual adjustment of the amplitude of the phase-shifted voltage which is fed to the amplifier section of tube V–311. During operation, the setting of this control affects the relative amplitudes of the voltages which eventually are fed to the balanced modulators and to the deflection plates of the cathode-ray tube. As the amplitudes of these voltages are varied, the shape of the pattern on the screen of the cathode-ray tube also varies.

b. AMPLIFIER STAGES. The first section of tube V–311 is a conventional resistance-coupled amplifier which raises the level of the 147-cps voltage fed to the phase inverter section of this tube. The first section of tube V–312 is used in another amplifier circuit which is identical to that of tube V–311. However, the output of the amplifier section of tube V–312 is fed to the phase inverter section of tube V–312.

(1) For the amplifier section of tube V–311, R–361 is the cathode bias voltage resistor and R–365 is the plate load resistor. Capacitor C–350 in combination with resistor R–367 form a plate circuit decoupling network used to isolate the 147-cps audio voltage from the power supply and other circuits in the bearing indicator. The amplified 147-cps output voltage of the amplifier is coupled to the grid of the phase inverter by means of capacitor C–348.

(2) For the amplifier section of tube V–312, R–368 is the cathode bias voltage resistor and R–372 is the plate load resistor. Plate circuit decoupling is accomplished by means of capacitor C–355 and resistor R–374. Amplified output is coupled through capacitor C–353 to the grid of the phase inverter section of this tube.

c. PHASE INVERTERS. The phase inverter sections of tubes V–311 and V–312 are identical.

(1) For the phase inverter section of tube V–311, R–362 is the cathode bias voltage resistor and R–363 is the cathode load resistor across which the 147-cps output voltage is developed. This volt-

age is in phase with the grid voltage. R–364 is a grid resistor. The phase-inverted plate voltage (180° out of phase with the grid voltage) appears across plate load resistor R–366 and is coupled to one of the vertical balanced modulator tubes by means of capacitor C–349. Cathode output, on the other hand, is coupled to the other vertical balanced modulator tube by means of capacitor C–351. Because the resistance values of the cathode and plate load resistors are identical, the amplitude of the cathode and plate output signals are also identical.

(2) For the phase inverter section of tube

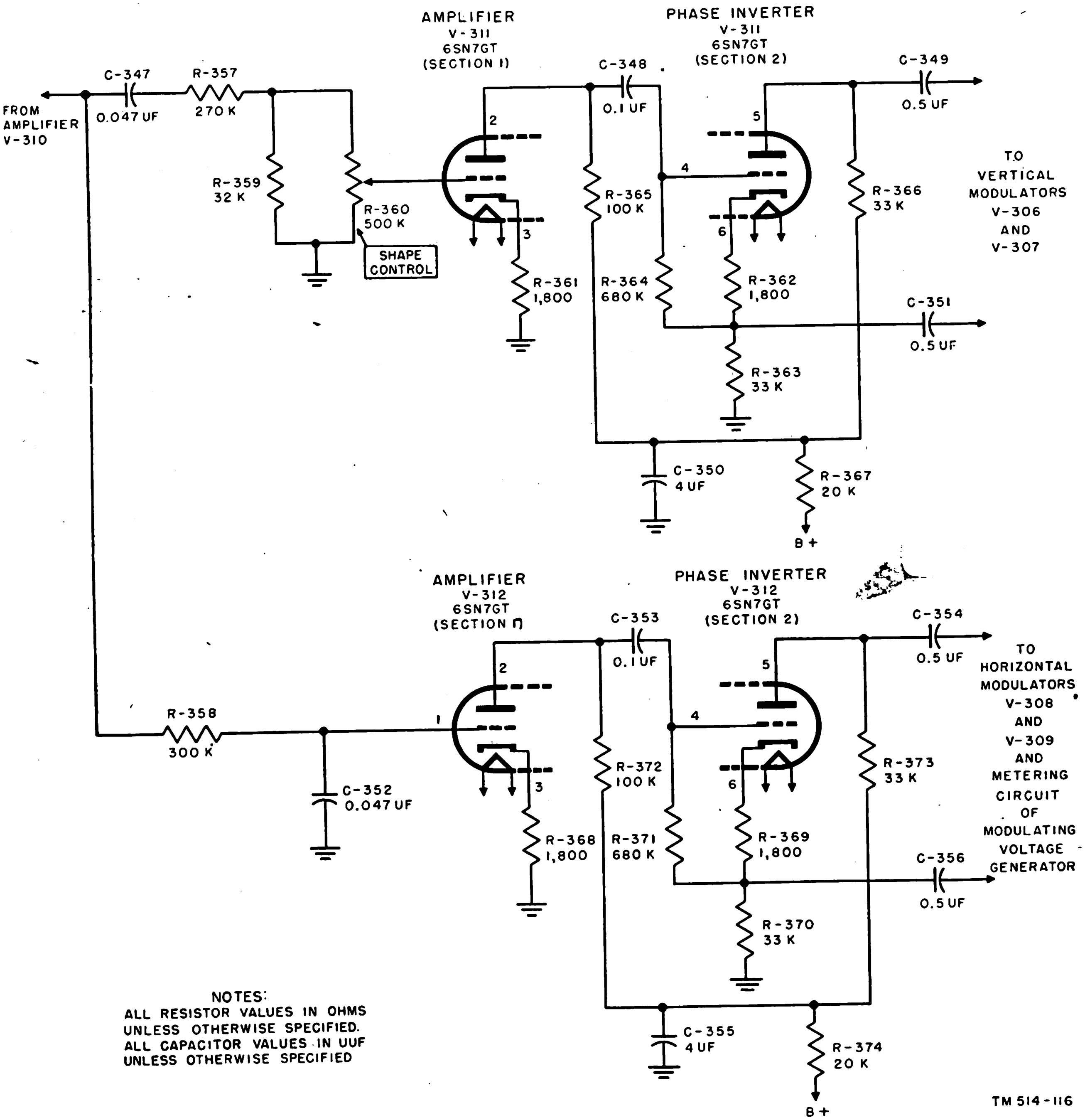


Figure 88. Bearing Indicator ID–64/CRD–2, amplifier and phase inverter stages, simplified schematic diagram.

V–312, R–369 is the cathode bias voltage resistor, R–370 is the cathode load resistor, R–371 is the grid resistor, and R–373 is the plate load resistor. The equal-amplitude plate and cathode output voltages are coupled to the tubes in the horizontal balanced modulator by means of capacitors C–354 and C–356.

d. PHASE RELATIONSHIP OF OUTPUT VOLTAGES OF PHASE INVERTERS. As previously explained, the plate and cathode output potentials of the phase inverter section of tube V–311 bear relative phase relationships of 0° and 180°. Likewise, the plate and output voltages of the phase inverter section of tube V–312 bear the same 0° and 180° phase relationship. However, because the voltages applied to the grids of these two tubes are 90° out of phase because of the action of the 90° phase splitter network, the plate and cathode outputs of the two phase inverters do not bear identical phase relationships. Instead, the output voltages of one phase inverter are displaced 90° in phase with respect to the outputs of the other phase inverter. Thus, four 147-cps voltages appear at the outputs of the two phase inverters and, if one of these is assigned a phase angle of 0°, then the other three voltages will bear phase angles of 180°, 90°, and 270°.

107. Balanced Modulator Stages (fig. 89)

Each balanced modulator stage uses two pentode Tubes JAN–6AC7, the vertical balanced modulator using tubes V–306 and V–307 and the horizontal balanced modulator using tubes V–308 and V–309. The circuits for the two balanced modulators are identical. The input to each of the balanced modulator tubes is a 147-cps voltage and a 200-kc voltage. The 200-kc voltage is obtained from the output of the r-f control modulator and is fed to the grid circuits of all four balanced modulator tubes in phase (parallel connection). The 147-cps voltages, on the other hand, reach the grid circuits with relative phase relationships of 0°, 180°. 90°, and 270°. The resultant output of the balanced modulators is fed to the deflection plates of the cathode-ray tube to produce the patterns on the screen of the tube, as explained in paragraphs 102, 103, and 104.

a. In the vertical modulator, the 147-cps input voltages and the 200-kc voltage reach the grids of the vertical balanced modulator tubes V–306 and V–307 through a capacitance-resistance network.

(1) In this network, the values of capacitors C–320 and 323 are chosen to provide parallel coupling for the 200-kc voltage while not shorting out the 147-cps voltage. The combination of resistors R–322 and R–325 and capacitors C–321 and C–322 forms a filter circuit to prevent the 200-kc signal from feeding back into the phase inverter circuits. Resistors R–323 and R–327 suppress undesired parasitic oscillations. R–324 and R–326 are grid resistors, R–329 is the cathode bias voltage resistor, and R–328 (V BEARING SPLITTER) is a balancing control used to superimpose the circular patterns in the vertical plane by balancing the two modulator tubes. C–324A and C–324B are cathode r-f bypass capacitors, and C–324C is the screen bypass capacitor.

(2) The output of the vertical balanced modulator appears across coil L–304, which is resonated to a frequency of 200 kc by capacitors C–325A, C–325B, and C–326. R–330 is a loading resistor which lowers the Q of the tuned circuit in order to prevent critical tuning. In this resonant circuit, C–325B is a differential capacitor that can be adjusted to compensate for unequal stray capacitances in the plate circuits of the two tubes. C–328A is the plate circuit bypass capacitor. Capacitors C–327 and C–329 couple the balanced modulator output to the vertical deflection plates.

(3) D-c centering voltage is applied to one of the vertical deflection plates through isolating resistor R–331 with capacitor C–328B placing the d-c input line at ground potential for ac. R–332 is inserted in the other side of the circuit to prevent loss of circuit symmetry as a result of the inclusion of resistor R–331.

b. The functionings of the parts in the hori-

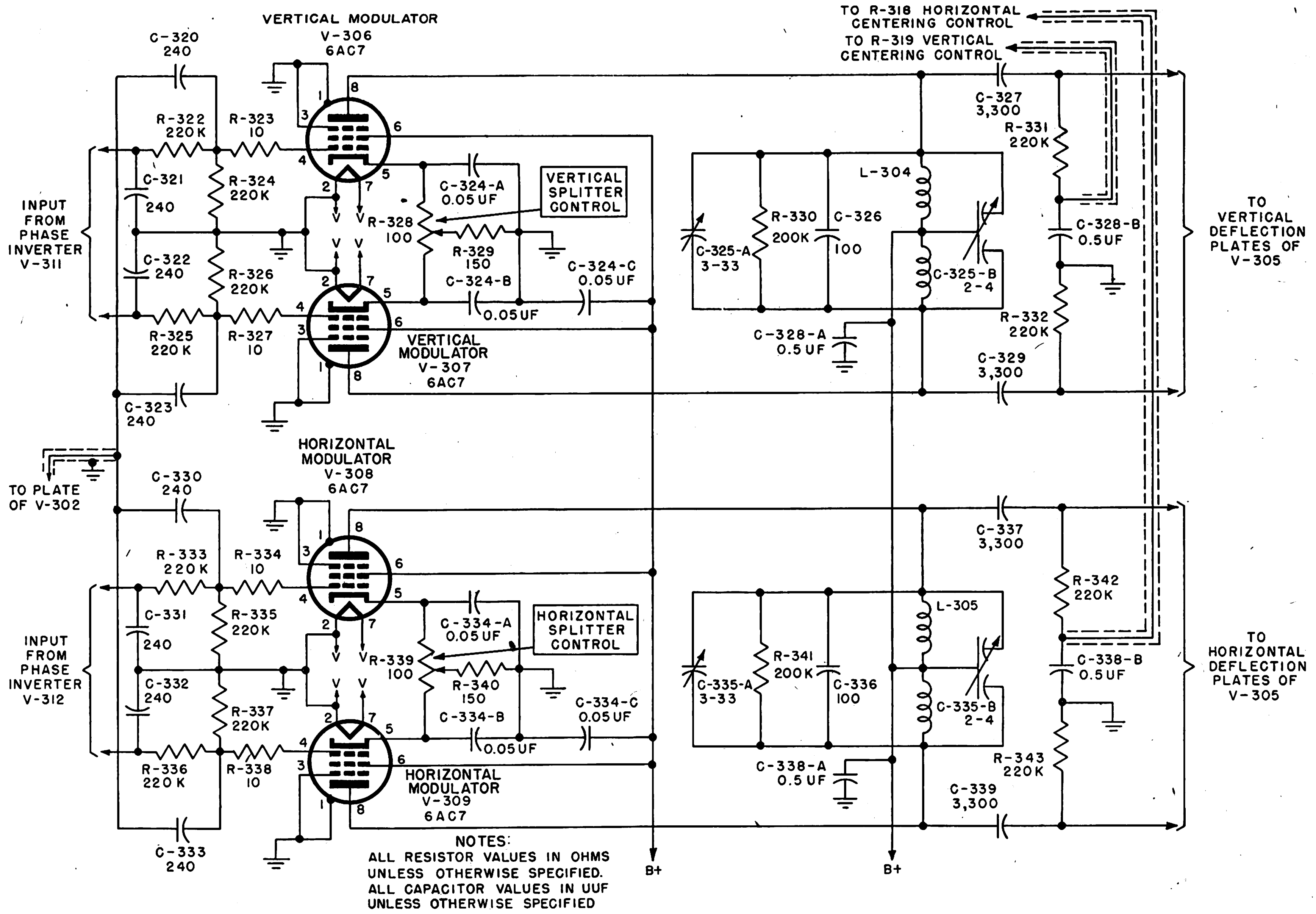


Figure 89. Bearing Indicator ID-64/CRD-2, balanced modulator stages, simplified schematic diagram.

zontal balanced modulator is the same as corresponding parts in the vertical balanced modulator.

108. 200-kc Oscillator and H-v Power Supply (fig. 90)

a. 200-KC OSCILLATOR.

(1) The r-f oscillator uses a triode-connected, beam power tube (V-301) in a Hartley circuit to generate 200-kc output energy. In this circuit, resistor R-301 is a grid leak used in conjunction with capacitor C-301 to provide operating bias voltage for the tube. Resistor R-302 is a parasitic suppressor that prevents oscillation on frequencies other than 200 kc. L-301B is the oscillator tank coil which is resonated at a frequency of 200 kc by fixed capacitor C-302 and trimmer capacitor C-303. Capacitor C-308 is the feedback capacitor. L-302 is a choke coil which prevents 200-kc energy from appearing in the B+ line.

(2) Coil L-301C is coupled inductively to the tank coil, L-301B, and provides a means of feeding a portion of oscillator output to the r-f control modulator stage.

(3) Coil L-301A also is coupled inductively to coil L-301B and provides a stepped-up, 200-kc voltage for h-v rectifier tube V-303. Capacitor C-307 resonates coil L-301A to 200 kc in order to obtain a high voltage for the h-v rectifier. This capacitor is variable and can be used for adjusting the voltage output of the oscillator before it is applied to the h-v rectifier tube.

b. H-V POWER SUPPLY. Tube V-303 is used in a half-wave, high-voltage rectifier circuit which develops the high d-c potentials necessary for operation of the cathode-ray tube.

(1) In this circuit, the high-voltage, 200-kc energy is applied to the rectifier tube. This tube conducts on alternate half-cycles, producing a fluctuating d-c output which is applied to the filter network consisting of capacitors C-306 and C-311 and resistor R-310. The output of the filter is a d-c voltage substantially free from any high-frequency ripple component.

(2) The d-c output of the filter appears across the series resistance voltage divider comprised of resistors R-312 (INTENSITY control), R-315, R-316 (FOCUS control), R-317, R-320, and R-321. The d-c potentials required for operation of cathode-ray tube V-305 are tapped off this voltage divider.

(3) The variable arm of potentiometer R-312, the INTENSITY control, connects to the grid of tube V-305 through resistor R-313, thus permitting a variable level of negative voltage (with respect to the cathode of tube V-305) to be applied to the grid of the tube. Resistor R-313 in combination with capacitor C-315 isolates the h-v power supply from the sense blanking voltage present on the grid during sense operation. C-316 is the cathode bypass capacitor for tube V-305.

(4) The variable arm of the FOCUS control R-316 connects to the focusing anode of tube V-305, thus permitting a variable level of positive voltage (with respect to the cathode of tube V-305) to be applied to this anode. C-317 is an a-c filter for the FOCUS control.

(5) Resistor R-321 is the only resistor in the voltage divider for the h-v output voltage across which a positive voltage (with respect to ground) appears. This resistor is connected between the cathode of the h-v rectifier tube and ground and is the same value as R-320. For this reason, the common current which flows through the voltage divider ((2) above) produces the same voltage drop across resistors R-320 and R-321. However, the voltage across resistor R-320 is negative with respect to ground. Therefore, the voltage applied to one side of centering controls R-318 and R-319 is equal to but of opposite polarity to the voltage applied to the other side of these potentiometers. When the variable arms

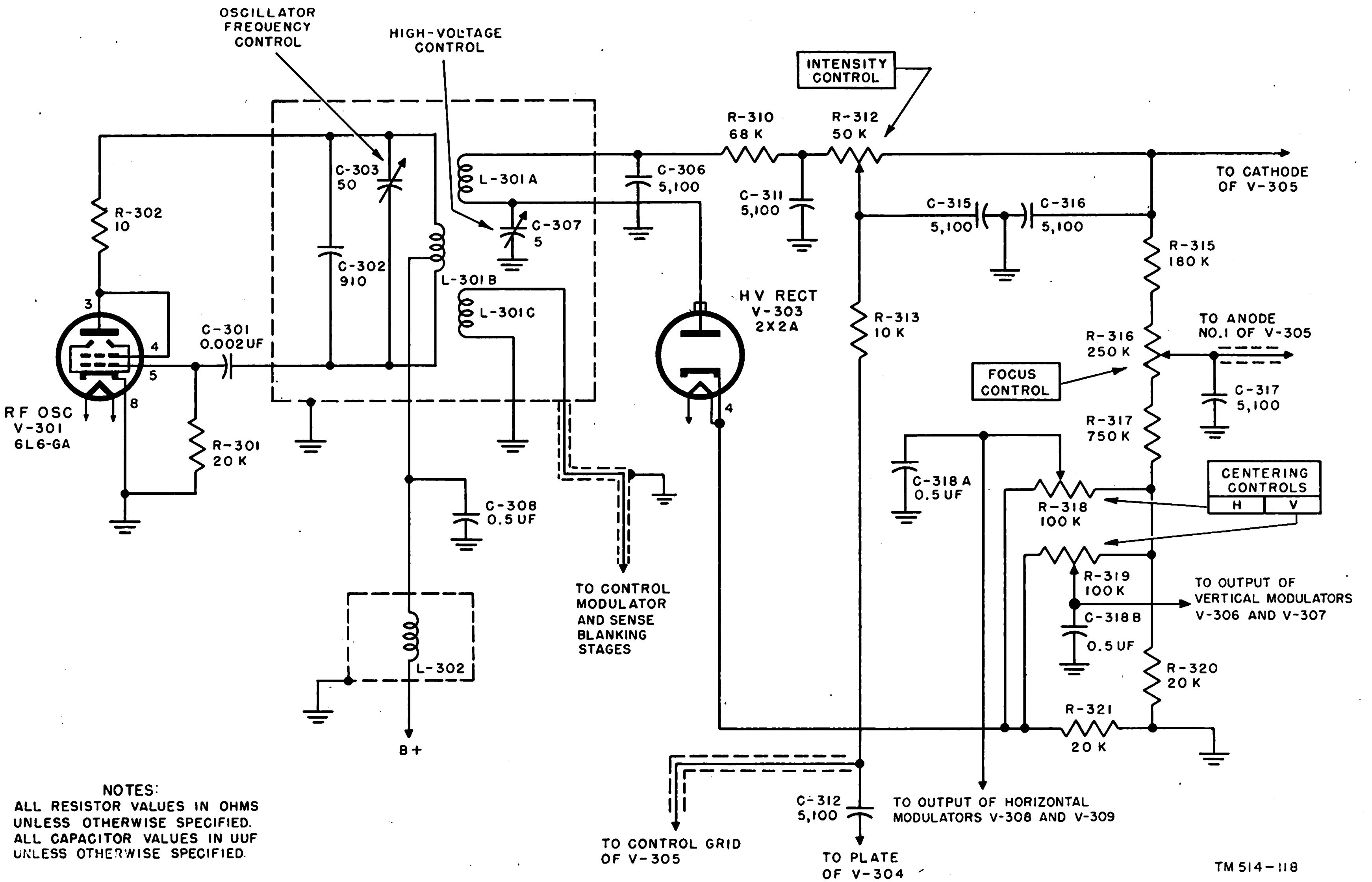


Figure 90. Bearing Indicator ID-64/CRD-2, 200-kc oscillator and h-v power supply, simplified schematic diagram.

of these controls are set at midpoint, the voltage present between the arms and ground is zero. As the controls are rotated from one side of their midpoint positions to the other, the voltage at the arms will vary in level and polarity. The arm of the vertical CENTERING control is connected to one of the vertical deflection plates of tube V–305 through isolating resistor R–331 in the vertical balanced modulator circuit. Likewise, the arm of the horizontal CENTERING control is connected to one of the horizontal deflection plates of tube V–305 through isolating resistor R–342 in the horizontal balanced modulator circuit. As the d-c ouptut voltages at the arms of these controls are varied by rotation of the controls, the vertical and horizontal positions of the illumination on the screen of the cathode-ray tube will vary also, thus permitting the illumination to be centered on the screen prior to operation of the equipment.

109. R–f Control Modulator (fig. 91)

a. A portion of the 200-kc output of oscillator tube V–301 is applied to the injection grid of the r-f control modulator tube V–302, a pentagrid converter tube. Potentiometer R–306, the PATTERN SIZE control, varies the level of the 200-kc voltage applied to this grid. In the absence of a video signal from the radio receiver at the control grid of this tube, the tube acts as a conventional amplifier and only the 200-kc signal appears at the plate of the tube.

b. When a video bearing signal from the receiver is present at the control grid of the tube, the current through the tube varies in response to the video signal, and the 200-kc plate output voltage has an amplitude which varies in accordance with the video signal.

c. R–303 is the grid resistor and C–304 is the screen bypass capacitor. Resistors R–307, R–305, and R–304 comprise a voltage divider, with

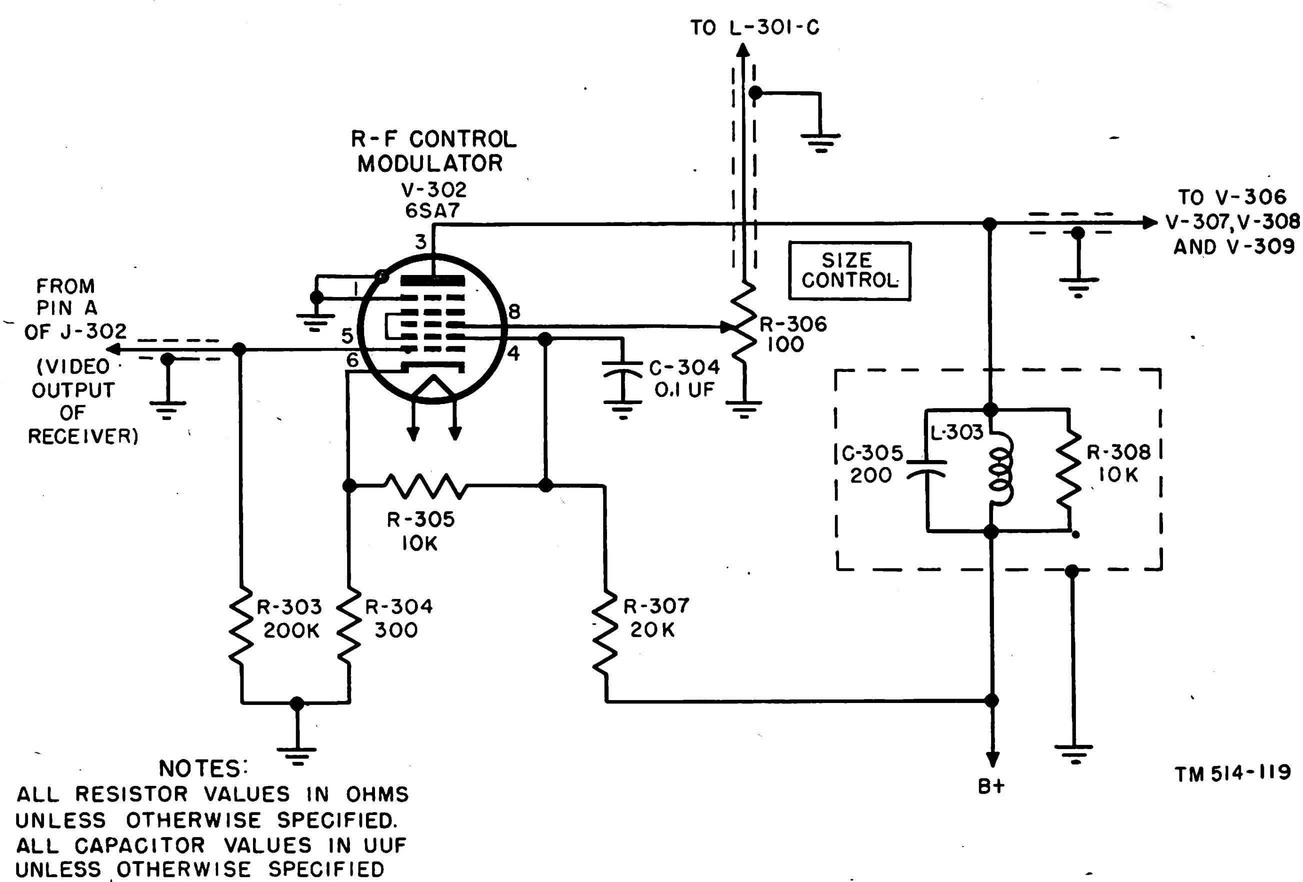


Figure 91. Bearing Indicator ID–64/CRD–2, r-f control modulator, simplified schematic diagram.

the screen voltage being taken from the junction of resistors R–307 and R–305, and the cathode voltage being taken from the junction of resistors R–305 and R–304. Coil L–303 is the plate load impedance for the tube, and this coil is resonated to 200 kc by capacitor C–305. A loading resistor (R–308) is used to prevent sharp resonance in the tuned circuit.

110. Sense Blanking Amplifier (fig. 92)

a. A portion of the 200-kc voltage from the 200-kc oscillator also is fed to the control grid of the sense blanking amplifier tube, V–304, through capacitor C–309. This capacitor, in conjunction with resistor R–309, makes up a variable phase-shifting network that is adjusted to compensate for the difference between the phase of the blanking voltage and the 200-kc voltage appearing on the deflection plates of the cathode-ray tube.

b. When SENSE SWITCH S–301C is depressed, the cathode return circuit of tube V–304 is completed and the sense blanking circuit is operative.

c. C–310A is the cathode bypass capacitor. R–311 is the screen voltage-dropping resistor, and C–310B and C–310C form the screen bypass capacitor. R–314 is the plate load resistor, and C–313A and C–313B are the plate circuit bypass capacitors. The 200-kc output of the sense blanking amplifier stage is coupled to the control grid of cathode-ray tube V–305 through coupling capacitor C–312.

111. Power Supply and Voltage Regulator Circuits (fig. 93)

a. The 115-volt a-c input power is obtained from the modulating voltage generator and enters the bearing indicator through plug P–301. Switch S–302, the POWER ON-OFF switch, controls the application of power to transformers T–301 and T–302 which, in turn, supply the high and low a-c voltages, required for operation of the bearing indicator.

b. One low-voltage secondary winding of transformer T–301 furnishes power for the filament of tubes V–301, V–302, V–310, V–311, V–312, and V–315 and dial lamps I–301 through I–306 of the alidade assembly. A second secondary winding on this transformer furnishes power to the filament of tube V–303, and the third winding furnishes power to the filament of tube V–305.

c. The high-voltage secondary winding of

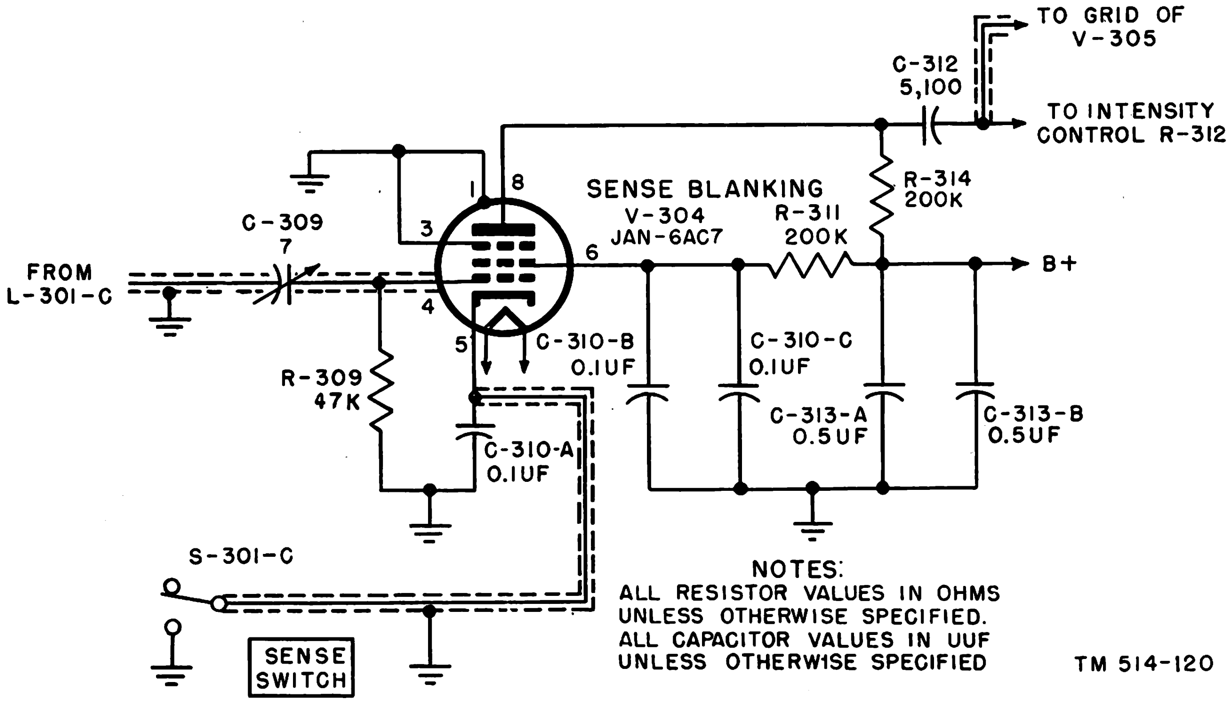


Figure 92. Bearing Indicator ID–64/CRD–2, sense blanking stage, simplified schematic diagram.

transformer T–302 is connected to the plates of rectifier tube V–318, and one of the low-voltage windings furnishes filament power for this tube. Another low-voltage secondary winding supplies power for the filaments of the four balanced modulator tubes, V–306 through V–309, and the fourth secondary winding furnishes power to the filaments of tubes V–304, V–316, and V–317.

d. The rectifier and voltage regulating circuits of the modulating voltage generator and the bearing indicator are almost identical. In the bearing indicator, tube V–318 is a full-wave rectifier tube used to supply a high-voltage, pulsating, d-c voltage to the voltage regulator circuits. Resistor R–383 and capacitor C–358 comprise an R-C filter to remove much of the ripple component from the d-c output of the rectifier.

e. Resistors R–376, R–377, and R–378 are in series with voltage regulator tubes V–316 and V–317, this whole combination acting as a voltage divider. Regulator tube V–314 holds the cathode of tube V–315 at a constant potential. R–386 is the regulating and limiting resistor for tube V–314. Capacitor C–357B reduces any tendency of tube V–314 to oscillate. R–377, the regulated output voltage control, adjusts the d-c level at the grid of tube V–315. R–379 is the grid bias resistor for the grid voltage of tubes V–316 and V–317. R–380, R–381, and R–382 are series resistors which comprise the hum-bucking feedback circuit. The gas voltage regulator tube, V–313, holds the voltage developed for the screens of the tubes in the bearing indicator at a constant level. Resistor R–385, in combination with capacitor C–375A, reduces the tendency of this tube to oscillate. R–375 is the current limiting resistor for tube V–313.

f. Lamps I–301 through I–306 provide illumination of the scale in the alidade assembly. The DIM control, R–384, allows variation of the amount of illumination produced by these lamps.

Section VII. THEORY OF AZIMUTH INDICATOR

112. Aural Indication

Radio set AN/CRD–2 provides aural-null indication through the use of a sinusoidal potentiometer and its associated circuit in the azimuth indicator (fig. 125). The sinusoidal potentiometer is a variable resistance across which a d-c potential is applied. This d-c potential is supplied by the rectifier and filter circuit in the azimuth indicator. The potentiometer has four output arms coupled to a common rotatable shaft, with an azimuth scale affixed to this shaft. If the shaft were to be rotated at a constant rate of 147 rotations per second, the four output arms would produce four 147-cps sinusoidal voltages having the same frequency and phase relationships as the four outputs of the modulating voltage generator which are applied to the balanced modulators in the antenna system. In actual use, however, such high-speed rotation is not possible nor desirable. Instead, the shaft is rotated by hand, clockwise or counterclockwise, and can be stopped at any position in its 360° excursion. When the shaft is stopped at a position, a d-c output voltage appears at each of the four arms of the potentiometer, and these four d-c output voltages still maintain the relationship in magnitude and polarity of the instantaneous values of voltages spaced 90° apart along a sinusoidal curve. For example, the d-c voltages for different settings of the potentiometer are shown in figure 94.

a. In this illustration, A shows a setting which is referred to as the 0° position. In the 0° position, the d-c voltages at arms 1 and 3 are zero, the voltage at arm 2 is maximum positive, and the voltage at arm 4 is maximum negative. In figure 94, a sinusoidal curve is drawn between these four d-c voltages which appear at the arms of the potentiometer in order to show the relationship of these d-c voltages to a sinusoidal voltage.

b. When the shaft then is rotated 45° from the 0° position, each d-c voltage can be considered as having advanced 45° along a sinusoidal curve (B, fig. 94). At the 45° position, the voltages of arms 1 and 2 are equal, and those of arms 3 and 4 are equal. However, the voltages at arms 1 and 2 are positive, and the voltages at arms 3 and 4 are negative.

c. When the potentiometer is rotated 90°

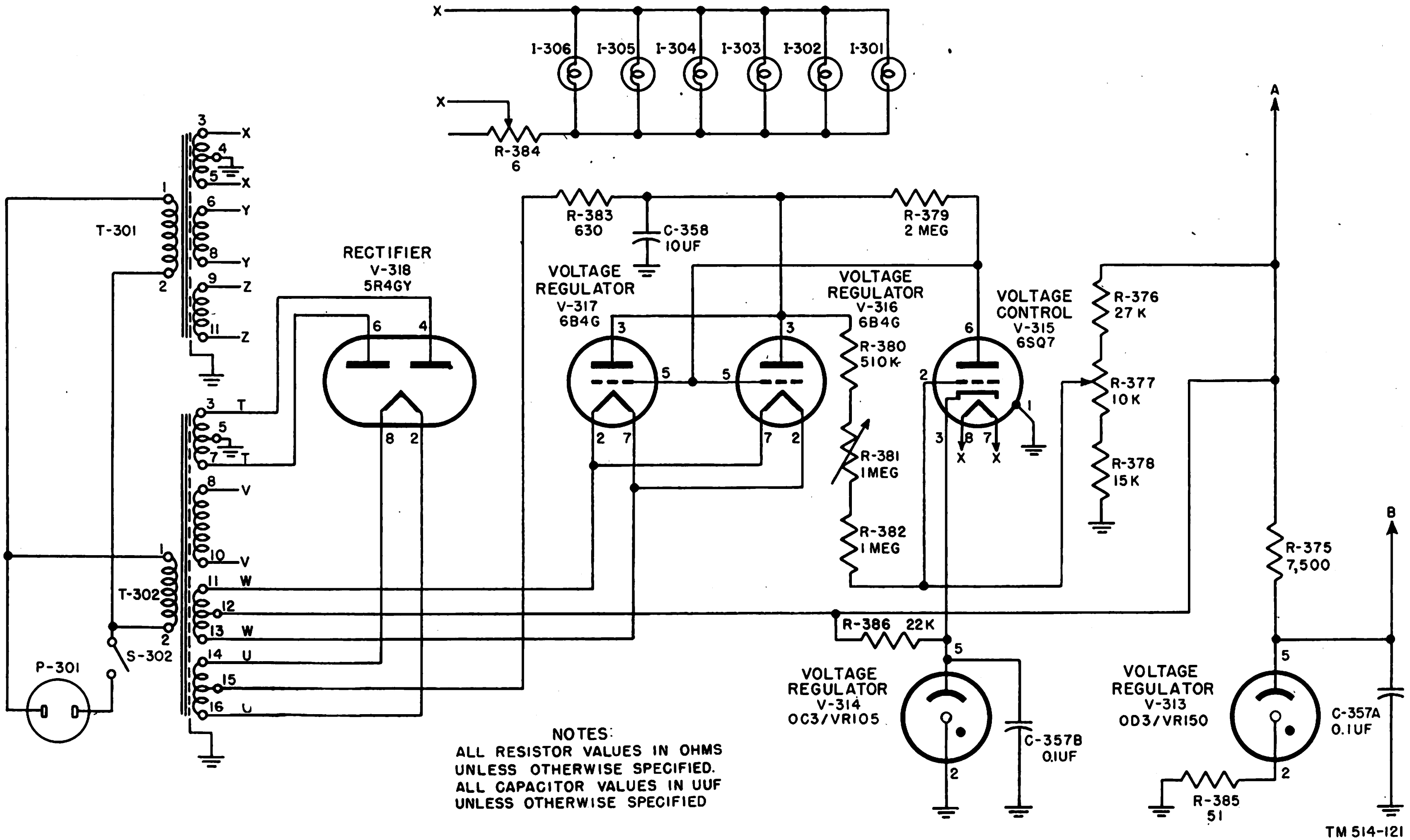


Figure 93. Bearing Indicator ID-64/CRD-2, power supply and voltage regulator circuit, schematic diagram.

from its 0° position, arm 1 is maximum positive, arm 3 is maximum negative, and arms 2 and 4 are at zero potential (C, fig. 94).

d. For 135° rotation, the voltages at arms 1 and 4 are equal and positive while those at arms 2 and 3 are equal and negative (D, fig. 94).

e. If the shaft is rotated a total of 180°, the voltages at arms 1 and 3 again go to zero. However, in this case, arm 4 is maximum positive and arm 2 is maximum negative (E, fig. 94).

f. For intermediate positions of the shaft of the sinusoidal potentiometer, other d-c output voltages appear at the four arms of the potentiometer. In any position, however, a 90° sinusoidal displacement of the d-c voltages between successive arms is maintained.

g. During aural-null operation, the 147-cps voltages from the modulating voltage generator are disconnected from the antenna balanced modulators, and the four d-c voltages of the azimuth indicator are connected in their place, by means of the VISUAL-AURAL switch on the azimuth indicator. During aural-null operation, the balanced modulators no longer function as such but may be considered as special type amplifiers to which variable d-c bias voltages are applied. These d-c bias voltages are the four outputs of the azimuth indicator.

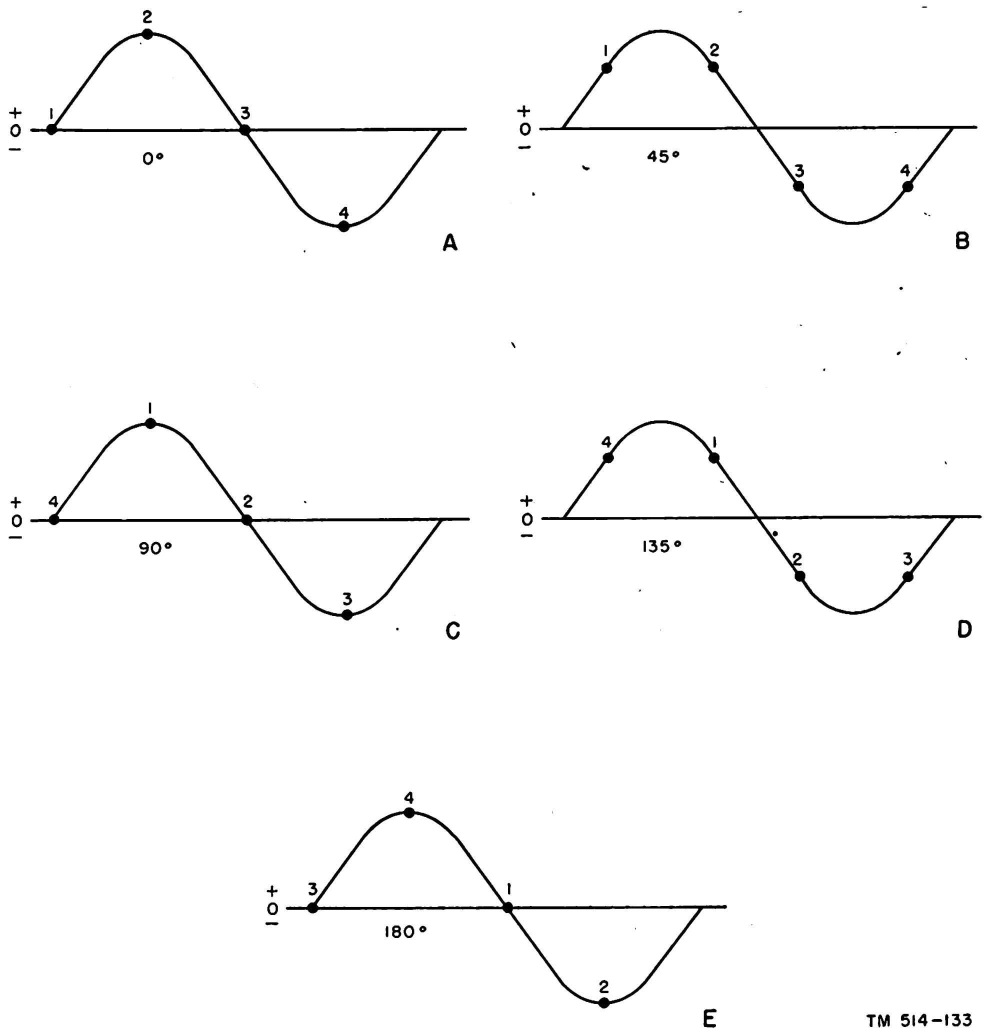


Figure 94. Azimuth Indicator ID–240/CRD–2, curves showing sinusoidal relationships between four d-c output voltages of sinusoidal potentiometer.

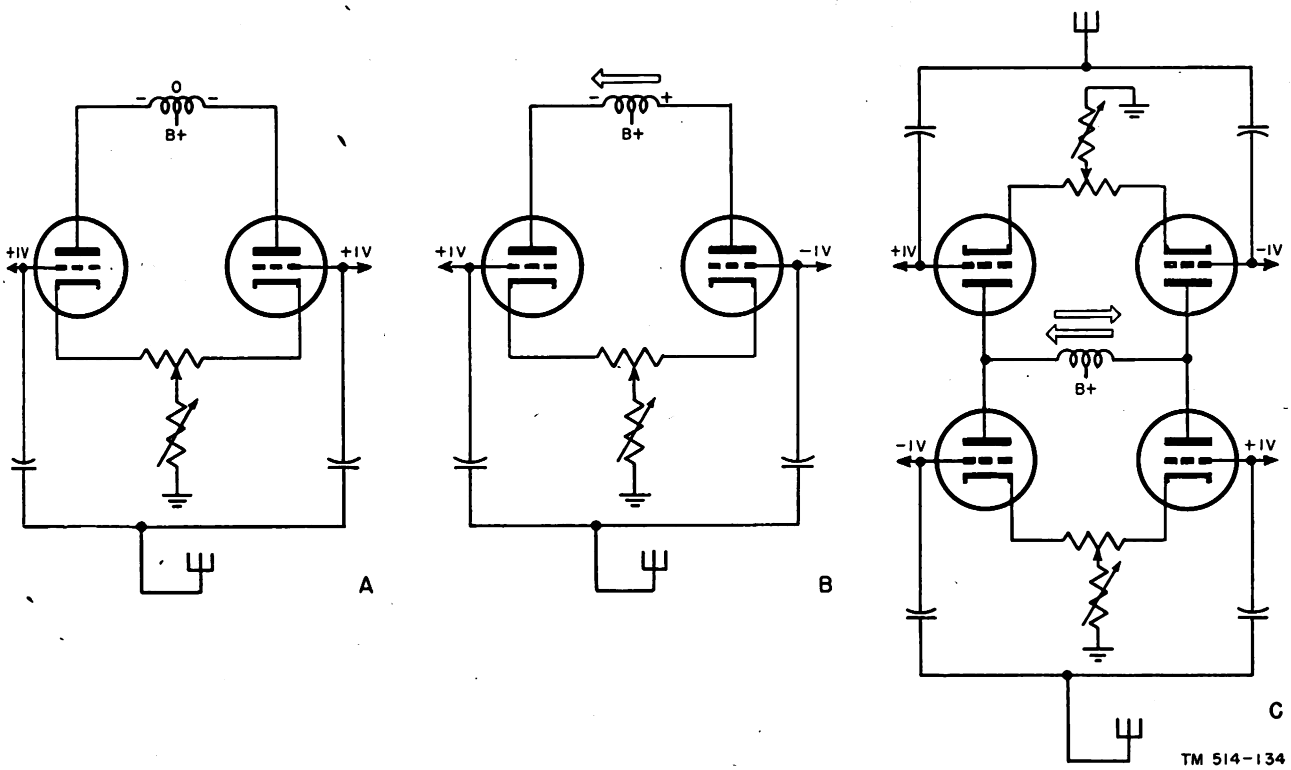


Figure 95. Functional schematic diagrams of balanced modulators for aural-null operation.

113. Functioning of Balanced Modulators During Aural-Null Operation (fig. 95)

a. In A, figure 95, the r-f signal from an antenna is applied in phase to each of the grids of one pair of balanced modulator tubes. Simultaneously, these grids receive a potential of 1 volt positive from the azimuth indicator. In this case, no output is obtained in the plate circuit because the currents are equal and in phase and cancel across the load impedance.

b. In B, figure 95, the r-f signal also is applied in phase to the grids of the tubes. In this case, however, the d-c bias from the azimuth indicator places one of the grids at a potential of 1 volt positive and the other grid at a potential of 1 volt negative. As a result, the plate currents are unequal, cancellation does not occur across the load impedance, and output is obtained.

c. In C, figure 95, two circuits with oppositely polarized d-c grid bias voltages are shown. In addition, the plate circuits are connected in opposition.

(1) When the r-f signal induced in one of the antennas is equal to and in phase with the r-f signal induced in the second antenna (when the r-f signal arrives at both antennas simultaneously), each pair of tubes provides output across the load impedance; but, because the circuits are connected in opposition, the resultant output across the load impedance is zero.

(2) When the r-f signal induced in one of the antennas is out of phase with the r-f signal induced in the second antenna (r-f signal arrives at one of the antennas before it arrives at the other antenna), the output of each pair of tubes is out of phase by an angle corresponding to the difference in time of arrival of the r-f signals at the antennas. As a result, complete cancellation of the output across the load impedance does not occur.

(3) If the d-c bias voltages of the four tubes shown in C, figure 95, were changed so that the voltages on all four tubes were equal and of the same polarity, no signal would be developed in the output because neither pair of tubes would have an output.

114. Aural-Null Operation

The antenna system includes four pairs of balanced modulator tubes having a common load impedance (sec. IV of this ch.) During aural-null operation, the control grid of each of these tubes receives a d-c voltage from the sinusoidal potentiometer instead of a 147-cps audio signal from the modulating voltage generator.

a. When the sinusoidal potentiometer is set at the position which develops the four d-c voltages shown in A of figure 94, the d-c bias voltage relationships at the tubes in the antenna system will be the same as those shown in A of figure 96. In this position of the potentiometer, and assuming the arrival of an r-f signal from north of the antenna system, no output is obtained from the N and S tubes because equal bias is applied to the grids of these tubes. Also, no signal will be obtained at the output of the E and W tubes because the r-f signal reaches the E and W antennas simultaneously and reaches the grids of the E and W tubes in phase. Because of this condition, the currents in the plate circuits of the E and W tubes cancel across the common load impedance. Therefore, the condition shown in A, figure 96, corresponds to a null during aural-null operation.

b. If the potentiometer is rotated 90° from the 0° position, the d-c voltages developed at the output of the azimuth indicator will be those shown in C, figure 94, and the d-c bias voltages applied to the tubes in the antenna system will be the same as those shown in C, figure 96. In this position of the potentiometer, and assuming the arrival of a north signal at the antenna system, the N and S tubes will be operative and, because the r-f signal arrives at the N antenna before it arrives at the S antenna, maximum output will be developed across the load impedance. The E and W tubes contribute nothing to this output, which corresponds to a *maximun* for aural-null operation.

c. When the potentiometer is rotated 45° from its 0° position, the d-c voltages developed at the azimuth indicator for the tubes in the antenna system will correspond to those shown in B, figure 94 and E, figure 96. If, in this position of the potentiometer, the signal arrives from the north, the outputs of the E and W tubes cancel across the load impedance (the r-f signal strikes the E and W antennas simultaneously). However, the N and S tubes will provide 0.707 times the maximum output obtained in the 90° position (*b* above).

d. If, however, the signal is arriving from the northeast direction (45°) when the potentiometer is set at the 45° position, a null output will be obtained. For this condition, d-c azimuth indicator output voltages and the d-c bias voltages will be as shown in B, figure 94 and B, figure 96, respectively. The r-f signal will arrive at the N and E antennas simultaneously and, although the N and E tubes are operative, their plate currents will cancel across the output impedance. Similarly, the outputs of the S and W tubes will cancel, and a zero output will be obtained. For this condition, another null is obtained.

e. If the potentiometer is rotated, then rotated 90° farther to the 135° position, the azimuth indicator output voltages will be as shown in D, figure 94, and the d-c bias voltages at the tubes will be the same as those shown in D, figure 96. In this case, the bias voltage polarities on the N and S tubes will remain the same but the E and W relationship will be inverted. Thus, the N and E outputs add to each other as do the S and W outputs. Therefore, maximum output is obtained.

f. For other azimuth settings and other directions of arrival of an r-f wave at the antenna system, various plate currents of the tubes combine to produce zero outputs or nulls at settings of the sinusoidal potentiometer which correspond to the angles of arrival of the r-f signals at the antenna system. Points of maximum signals always are removed 90° from the null positions.

115. Sense Indication During Aural-Null Operation

The azimuth indicator can be used also to obtain sense indication during aural-null operation. For this purpose, a SENSE switch is placed on the front panel of the azimuth indicator.

a. During aural-null *bearing* operation, two nulls will be obtained during a 360° rotation of the shaft of the sinusoidal potentiometer. These two nulls are displaced 180° from each other. For example, if the r-f signal were ar-

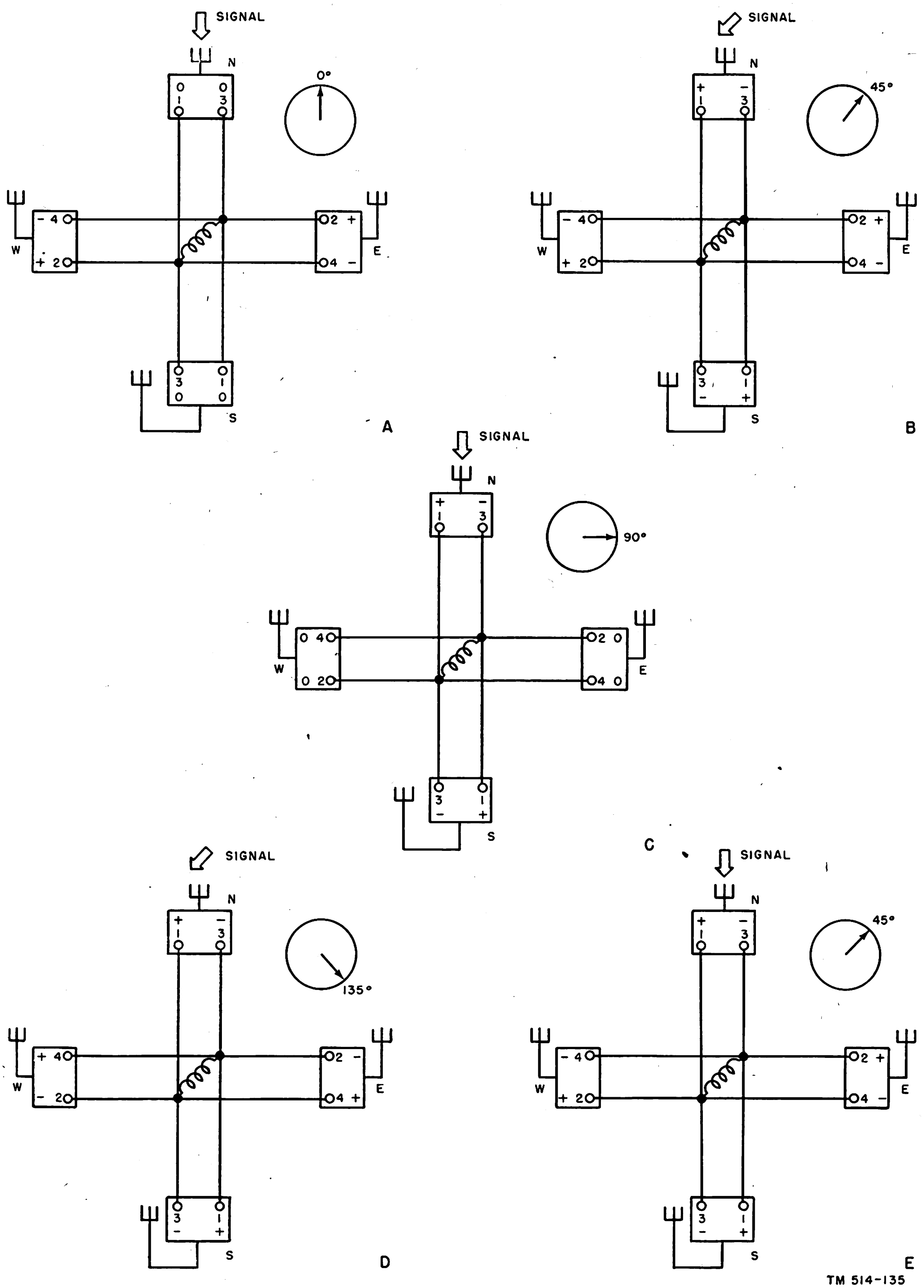


Figure 96. Functional diagram showing polarities of d-c voltages supplied to antenna system balanced modulator tubes by azimuth indicator, for various operating conditions.

riving from the north direction when the potentiometer was set at the 0° position, a null is obtained (A, fig. 96). Another null also would be obtained if the potentiometer were rotated to the 180° position. Obviously, this 180° is a false, or reciprocal, azimuth indication. During *bearing* operation, a reciprocal azimuth indication can be obtained for any received signal, and the reciprocal azimuth null should be 180° displaced from the true azimuth null. Likewise, if the direction of arrival of a radio wave were unknown, an operator would have no way of distinguishing between the true and false nulls if no sense indication could be obtained.

b. During *visual* operation of the equipment, this 180° ambiguity is resolved by introducing properly phased r-f signals to the sense tubes in the antenna system and by combining the output of the sense tubes with the outputs of the balanced modulator tubes to obtain a receiver input signal which will cause a sense pattern to appear on the screen of the cathode-ray tube in the bearing indicator. During *aural-null* operation, it is also necessary to add a sense signal in the same manner as for visual operation in order to obtain an aural output which will resolve the 180° ambiguity.

c. In any radio direction finding system, sense indication is obtained by combining a nondirectional sense signal with a directional (figure-8) bearing signal in such a way that one of the lobes of the figure-8 antenna response pattern is enlarged and the other lobe is made smaller or eliminated. The resultant ideal sense pattern is the cardioid (fig. 56).

d. The SENSE switch in the azimuth indicator, when thrown to either sensing position (RED or WHITE), connects the sense tubes of the antenna system into the circuit. This switch also shifts the four d-c voltages on the arms of the sinusoidal potentiometer by plus or minus 90° along the sinusoidal curve, depending on the position of the SENSE switch (RED or WHITE).

e. The azimuth dial consists of two scales (red and white) calibrated in degrees (0 to 360) and displaced 180° from each other. In operation, the azimuth dial is rotated to either of the two null positions, and the SENSE switch then is thrown to either the RED or WHITE position. In one position, the aural signal will be louder than in the other position. The direct or true azimuth will be indicated on the azimuth scale that corresponds in color to the SENSE switch position which produced the louder signal.

116. Azimuth Indicator ID–240/CRD–2, Functioning of Parts (fig. 125)

Power of 115-volt, 50/60-cycle a-c enters the azimuth indicator at receptacle P–1001. Receptacle J–1002 is connected in parallel with the 115-volt input and is used to connect the 115-volt power to the antenna system. Capacitors C–1005A and C–1005B are line filters.

a. Transformer T–1001 converts the 115-volt input power to the low and high a-c voltages necessary for operation of the tubes and dial lights in the azimuth indicator. When the VISUAL-AURAL switch S–1002 is in the AURAL position, a pair of contacts on this switch is closed and the 115-volt a-c input is connected across the primary of the transformer.

b. Rectifier tube V–1001 converts the a-c voltage of the high-voltage secondary winding to a d-c voltage. The combination of resistor R–1001, capacitor C–1001, and tube V–1002 removes the ripple from the rectifier output and maintains the output voltage to the azimuth indicator circuits at a constant level of 105 volts.

c. Filament voltage for tube V–1001 is obtained from one secondary winding on the transformer, and another winding supplies the a-c voltage required for dial lights I–1001 and I–1002.

d. Resistors R–1004, R–1003, R–1002, R–1006, R–1007, and R–1005 are connected in series, and the combination is connected across the 105-volt, d-c output of the rectifier and voltage regulating circuit. The common terminals of resistors R–1006 and R–1007 are connected to the chassis and thus produce two equal voltages of opposite polarity (with respect to the chassis) across these resistors. That is, the level of positive d-c voltage between point E (fig. 125) and the chassis is the same as the level of negative d-c voltage between point F and the chassis. These two equal-amplitude, oppositely polarized d-c voltages are the two input voltages of the sinusoidal potentiometer, R–1008.

e. Resistor R–1005, in the series combination, is used as a meter shunt, and the voltage appearing across this resistor in indicated by a meter in the modulating voltage generator. Potentiometer R–1002, the MODULATING LEVEL control, can be adjusted to the setting which produces the correct meter indication.

f. The four d-c voltages appearing at the arms of the potentiometer (points A, B, C, and D in fig. 125) have amplitudes and polarities which depend on the position of the rotatable shaft of the potentiometer.

g. Resistors R–1009, R–1010, and R–1011 comprise a voltage divider for the voltage at arm A, with the d-c output voltage for this arm being taken across resistor R–1011. Resistors R–1012 through R–1020 serve the same function for arms B, C, and D.

h. The VISUAL-AURAL switch S–1002 (fig. 125) has two functions—

(1) One section of the switch opens and closes the primary circuit of transformer T–1001 and thus acts as the power on-off switch.

(2) The other four sections of the switch connect either the four quadrature-phased, 147-cps voltages to the balanced modulator tubes in the antenna system (VISUAL position of switch) or connect the four d-c output voltages of the azimuth indicator to the balanced modulator tubes in the antenna system (AURAL position of switch).

i. The SENSE switch S–1001 has three positions:

(1) In the normal position of the switch (bearing operation), the switch contacts are in the positions shown in figure 125. In this position, the four d-c voltage outputs of the azimuth indicator are connected to the balanced modulator tubes in the antenna system (switch S–1002 in AURAL position) for bearing operation. The contact of the switch which connects to resistor R–1021 is open and causes the sense tubes in the antenna system to be inoperative (cathode circuits of these tubes ungrounded). Also, the switch sections which are connected in the dial light circuits are closed (grounded) and cause both dial lights I–1001 and I–1002 to light.

(2) When the SENSE switch is thrown to RED, all the switch sections shown on the right side of the switch in figure 125 break the lower contacts and make the upper contacts. At the same time, the switch sections shown on the left side of the switch remain as they were for bearing operation. As a result of this switching action, the light behind the red scale of the dial remains lighted and illuminates this scale, and the other dial light goes out. Secondly, one side of resistor R–1021 is grounded, thus causing the sense tubes in the antenna system to become operative. Also, the four d-c output voltages of the azimuth indicator are shifted 90° with respect to their positions along a sinusoidal curve.

(3) When the SENSE switch is thrown to WHITE, the right side sections of the switch remain in their bearing positions and the left side sections of the switch break the upper and make the lower contacts. As a result, the sense tubes are operative, the white dial light goes on and the red dial light goes off, and the four d-c output voltages are shifted 90° with respect to their positions along the sinusoidal curve but in the opposite direction from the 90° shift which accompanied the movement of this switch to the RED position.

Section VIII. THEORY OF POWER CONTROL CIRCUITS

117. Junction Box J–95/CRD–2, Functioning of Parts

Radio Set AN/CRD–2 can be powered by any source of 50/60-cycle, 115- or 230-volt ac capable of supplying 500 watts of power. Input from the power supply is fed to Junction Box J–95/CRD–2 (figs. 39 and 126).

a. When a *230-volt* power source is used, the input is made to plug P–901 which, in turn, is connected to the LINE INPUT 115V-OFF-230V switch. With this switch in the 230V position, input power is applied across the entire winding of autotransformer T–901. Circuit breaker K901 is connected in series with one side of this winding to protect the circuit from overload.

b. During *115-volt* operation, the input is connected through plug P–902 which, in turn, is connected to the LINE INPUT 115V-OFF-230V switch. With this switch in the 115V position, input power is connected through circuit breaker K–902 and appears across one half of the entire winding.

c. Output of the autotransformer is taken across part of the winding, with the output voltage being adjusted to 115 volts by means of the OUTPUT VOLTAGE CONTROL (switch S–902), which connects to various taps on the winding. Output voltage and frequency are measured by meters M–901 and M–902, respectively.

d. Output power is taken from the junction box circuit when the OUTPUT LOAD EQUIPMENT-OFF-DUMMY Switch S–903 is thrown to either the EQUIPMENT or DUMMY position. In the EQUIPMENT position, the output power is applied to parallel-connected receptacles J–901 through J–905. One of these receptacles is used to feed the output power to the rear apron of the operating rack. The others are utility receptacles. When switch S–903 is in the DUMMY position, resistors R–901 through R–904 are connected as a substitute load, and the power output of the unit can be checked under conditions which simulate equipment operation. The use of the dummy load protects the equipment during adjustment of the line voltage.

118. Distribution of Power (fig. 39)

All a-c power passes through the modulating voltage generator before being applied to the other components of the equipment.

a. Power from Junction Box J–95/CRD–2 enters the modulating voltage generator through plug P–402. As shown in figure 119, this plug connects to the MASTER POWER OFF-ON switch, S–402, before power reaches the circuits in the modulating voltage generator and the outlets for other components. Therefore, the MASTER POWER switch controls the application of power to all components of the radio set except Junction Box J–95/CRD–2.

b. With the MASTER POWER switch in the ON position, power is applied to receptacles J–401, J–402, and J–403, each of which is protected from an overload current by fuses F–402, F–403, and F–404. Power also is applied to POWER switch S–401 and, when this switch is thrown to the ON position, the primary of transformer T–401 is energized. Fuse F–401 protects this transformer from overload. Pilot lights I–401 and I–402 indicate when the switches are on and power is applied.

c. Transformer T–401 supplies all a-c operating potentials to the circuits of the modulating voltage generator.

d. Receptacle J–401 of the modulating voltage generator supplies 115 volts ac to the bearing indicator receptacle, P–301 (fig. 121) through Cord CX–1115/U. This receptacle connects to the parallel-connected primaries of transformers T–301 and T–302 through the POWER OFF-ON switch, S–302. These two transformers power the bearing indicator circuits.

e. Receptacle J–402 in the modulating voltage generator connects to receptacle J–103 in the radio receiver (fig. 120) through Cord CX–1115/U. This receptacle connects to the primary of transformer T–109 through switch S–104A. This transformer powers all circuits in the radio receiver.

f. Receptacle J–403 in the modulating voltage generator connects to plug P–1001 in the azimuth indicator (fig. 125) through Cord CX–1116/CRD–2. This latter receptacle, in turn, connects to the primary of transformer T–1001, when the VISUAL-AURAL switch is in the AURAL position. (One of the switch sections is in series with the primary circuit of the transformer.) Receptacle P–1001 also connects to receptacle J–1002 which, in turn, connects to receptacle P–505 in Voltage Distribution Unit J–59/CRD–2 (fig. 122) through Cord CX–452/CRD–2. Receptacle P–505 connects to the primary of transformer T–501, which supplies a-c power to the heaters of the tubes in the antenna system. Receptacle P–505 also is connected to receptacle J–505 and serves as a

115-volt auxiliary outlet on the voltage distribution unit.

g. To summarize, input power is applied to Junction Box J–95/CRD–2 before being fed to the modulating voltage generator. The modulating voltage generator then distributes the power to the various other components of the radio set. Protective fuses for these components are located in the modulating voltage generator. Circuit breakers for the primary power line are located in the junction box. Master control switches are located on the junction box and on the modulating voltage generator. Component switches are located on the radio receiver, the bearing indicator, and the azimuth indicator.

CHAPTER 5

FIELD AND DEPOT MAINTENANCE INSTRUCTIONS

Note. This chapter contains information for field and depot maintenance. The amount of repair that can be performed by units having field and depot maintenance responsibility is limited only by the tools and test equipment available and by the skill of the repairmen.

Section I. PREREPAIR PROCEDURES

119. Tools, Materials, and Test Equipment

Tools, materials, and test equipment needed for performing the prerepair procedures in this section are listed below:

SCREW DRIVER: 6 inches long, ½-inch blade.

TUBE PULLER TL–201: tongs (pair), 8 inches long with specially shaped neoprene covered lips curved the contour of radio tubes.

CLOTH, textile: 16.3 yards per pound; 36 inches wide.

CLEANING FLUID: Solvent, dry-cleaning (SD); Federal specification P–S–661a.

TUBE TESTER I–177.

TEST SET I–176: test meter; 0 to 1,000 volts ac; 0 to 5,000 volts dc; 0 to 10 amperes ac; 0 to 5 amperes dc; 0 to 10 megohms.

120. Removal of Pluck-Out Parts

a. REMOVING TUBES.

(1) *General.* Using Tube Puller TL–201, remove the tubes from their sockets. If the space around the tube is so limited that the tube puller cannot be used, make sure that the tubes have cooled sufficiently; then, with the fingers, pull up the tubes. Do not rock the tube or jiggle it in its socket if it can be extracted by a direct upward pull. Rock it gently if it does not release easily. Jiggling a tube in its socket during removal spreads the socket contacts. *Label each tube as soon as it is removed so that it can be replaced later in the socket from which it was removed.*

(2) *Modulating voltage generator.* All tubes in this component are located on top of the chassis and are readily accessible (fig. 49).

(3) *Antenna Coupling Unit CU–34/CRD–2.* There are three tubes in each coupling unit. Before these tubes can be removed from their sockets, it is necessary to release the clamp which holds the tubes in place (fig. 8). To release the clamps, loosen the screws on the clamps and rotate the clamp bars.

(4) *Radio receiver.* All tubes in the radio receiver are located on the chassis. (figs. 50 and 106). However, four of these tubes are not accessible until the shield which houses the r-f components is removed from the top of the chassis.

(5) *Bearing indicator.* All tubes in this component also are accessible from the top of the chassis (fig. 51). However, before the cathode-ray tube can be removed, it is necessary to remove the alidade assembly. For instructions on removing the cathode-ray tube, see section IX of this chapter.

(6) *Azimuth indicator.* Only two tubes are used in the azimuth indicator (fig. 52). Both tubes are located on the chassis and are easily accessible.

b. REMOVING FUSES. Four fuses are located on the modulating voltage generator and are accessible at the rear of the chassis. To remove the fuse, press it in and turn it counterclockwise. The fuses then can be extracted from their holding sleeves.

c. REMOVING PILOT LIGHTS.

(1) *Modulating voltage generator.* Unscrew the two jewel guards of the

pilot lights which are located adjacent to the MASTER POWER and POWER switches. Then remove the bayonet-base lamps by pushing in and turning counterclockwise.

(2) *Radio receiver.* There are four pilot lights in the radio receiver. All are located behind the front panel and are accessible from the top of the chassis. Remove each lamp by pressing in and turning counterclockwise.

(3) *Bearing indicator.* There are six pilot lights located behind the azimuth dial in the alidade assembly. To remove these lights, remove the three screws which hold the alidade scale assembly to the front panel, and remove the asssembly. Then release the lights by pressing in and turning counterclockwise.

(4) *Azimuth indicator.* The two dial lights for this component are located behind the front panel and are accessible from the top of the chassis. Remove the lights by pressing in and turning counterclockwise.

121. Cleaning, Inspecting, and Testing Tubes

a. CLEANING. Clean the tubes with a cloth moistened with solvent (SD); if necessary, clean the grid caps and prongs with crocus cloth.

b. INSPECTING. Inspect the tubes for cracks in glass and base and for bent and broken prongs.

c. TESTING. Test the tubes for proper emission, leakage, and short circuits; use a tube tester or place doubtful tubes in a radio receiver known to be operating normally.

122. Inspecting, Cleaning, and Testing Fuses

a. INSPECTING. Inspect fuse ends for evidence of burning, corrosion, and looseness.

b. CLEANING. Clean fuse ends with emery cloth and wipe with a clean cloth. If a file is used to remove deep pits, use crocus cloth to leave a smooth contact surface and then wipe dry with a clean cloth.

c. TESTING. Check fuse for continuity.

123. Inspecting Pilot Lamps

Inspect the lamp for continuity of filament and make sure that the lamp base is not loose.

124. Cleaning and Inspecting Chassis Assemblies

a. CLEANING. Thorough cleaning of the components is necessary to insure optimum performance by preventing corrosion, rust, and dust from damaging parts or causing arc-over or low-resistance leakage between high-voltage points and ground. Remove loose dust and dirt with a brush or blower. With a brush or cloth and solvent (SD), remove dirt and grease which adheres to the chassis and parts. On the radio receiver, remove the shield covers from the r-f amplifier, mixer, and oscillator sections; clean the waveband switches with a small brush or pipe cleaner and solvent (SD). Clean the tuning capacitor bearings and rotor grounding springs with solvent (SD).

b. INSPECTING. After a component has been thoroughly and carefully cleaned, make a visual inspection of the parts and wiring for rust, corrosion, loose connections, frayed and burned insulation, loose screws, and burned and charred resistors and coils. Carefully inspect tube sockets for broken contacts, switches for loose and bent contacts and broken insulation, and terminal boards for broken lugs and signs of burning. Inspect and tighten all loose tuning dial gears and setscrews.

125. Reassembling Components

Replace the tubes, fuses, and pilot lights in their respective components. When replacing the tubes, make certain that they are returned to the sockets from which they were removed. If it is necessary to replace tube V–801 or V–802 in Antenna Coupling Unit CU–34/CRD–2 or tube V–306, V–307, V–308, or V–309 in the Bearing Indicator ID–64/CRD–2, make certain that the replacement tube is matched to the other tubes in the circuit. For example, if tube V–801 is replaced, make certain that its transconductance is the same as that of the tube V–802; if tube V–306 is replaced, make certain that its transconductance is the same as that of tubes V–307, V–308, and V–309.

Warning: When servicing the equipment, be extremely careful because of the high voltages exposed.

126. Trouble-Shooting Procedures

The first step in servicing a defective radio set is to sectionalize the fault. Sectionalization means tracing the fault to the *major 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 often can be located by sight, smell, and hearing. The majority of faults, however, must be localized by *checking voltage and resistance.*

a. SYSTEM SECTIONALIZATION. System sectionalization is discussed in paragraphs 60 and 61.

b. COMPONENT SECTIONALIZATION AND LOCALIZATION. The tests listed in paragraph 127 aid in isolating the source of the trouble. To be effective, the procedure should be followed in the order given. Remember that servicing procedures should cause no further damage to the equipment. First, trouble should be localized to a single stage or circuit. Then, the trouble may be isolated within the stage or circuit by appropriate voltage, resistance, and continuity measurements.

127. Summary of Service Procedures Used in Isolating Trouble

a. VISUAL INSPECTION. The purpose of visual inspection is to locate any visible trouble. Through this inspection alone, the repairman frequently may discover the trouble or determine the stage in which the trouble exists.

b. PRELIMINARY MEASUREMENTS. These measurements (pars. 131, 142, 151, and 156) are resistance checks of key circuits which are made before power is applied to the circuits. By means of these checks, shorts or heavy overloading of a circuit can be discovered and a correction applied before the power is turned on, thus avoiding further damage to the equipment.

c. OPERATIONAL TEST. The operational tests (pars. 132, 143, 152, 157, and 161) are important because they frequently indicate the general location of trouble. In many instances the information gained will determine the exact nature of the fault. In order for this information to be utilized fully, all symptoms must be interpreted in relation to one another.

d. TROUBLE-SHOOTING CHARTS. The trouble symptoms listed in these charts (pars. 132, 143, 152, 157, and 161) will aid greatly in localizing trouble.

e. SIGNAL SUBSTITUTION. The principal advantage of the signal substitution method (par. 144) is that it usually enables the repairman to localize a trouble accurately and quickly to a given stage when the general location of the trouble is not immediately evident from the above tests.

f. INTERMITTENTS. In all these tests, the possibility of intermittents should not be overlooked. If present, an intermittent often can be made to appear by tapping or jarring the set. It is possible that the trouble is not in the components but in their installation, or the trouble may be due to external conditions.

128. General Precautions

Whenever the equipment is serviced, observe the following precautions very carefully:

a. Be careful when servicing; high a-c and d-c voltages are exposed.

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

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

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

(3) Do not allow drops of solder to fall into the equipment; this condition may cause short circuits.

(4) A carelessly soldered connection may

create a new fault. It is very important to make well-soldered joints, since a poorly soldered joint is one of the most difficult faults to find.

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

Section III. TROUBLE SHOOTING IN MODULATING VOLTAGE GENERATOR

129. Trouble-Shooting Data

The illustrations listed below are useful to the repairman when he is trouble shooting in the modulating voltage generator. Refer to the text and illustrations of section III in chapter 4 during trouble-shooting work.

Figure No.	*Title*
41	Modulating Voltage Generator O–15/CRD–2, front panel controls.
49	Modulating Voltage Generator O–15/CRD–2, top view of chassis, tube and parts location.
97 and 98	Modulating Voltage Generator O–15/CRD–2, bottom view of chassis, parts location.
99	Modulating Voltage Generator O–15/CRD–2, normal voltage measurements at tube socket contacts.
100	Modulating Voltage Generator O–15/CRD–2, normal resistance measurements at tube socket contacts.
119	Modulating Voltage Generator O–15/CRD–2, complete schematic diagram.

130. Test Equipment Required

The test equipment required for trouble shooting in the modulating voltage generator is listed below. The technical manuals associated with this test equipment are listed also.

Test equipment	*Technical manual*
Tube Tester I–177, or equal	11–2627
Test Unit I–176, or equal	11–2626
Electronic Multimeter TS–505/U, or equal.	
Analyzer TS–415( )/U, or equal.	

131. Preliminary Measurements

Place the modulating voltage generator on the test bench and make the following checks before applying power:

a. Measure the resistance between the terminals of capacitor C–429. This resistance normally is higher than 4 megohms (switch S–409 rotated to the E_B IND or I_K ANT MOD position). The cause of the low resistance reading may be a leaky or shorted capacitor C–429. Also, the trouble may be caused by the h-v secondary winding of transformer T–401 or coil L–401 being shorted to the case (grounded winding) or by some other abnormal condition in the rectifier, filter, or voltage regulator circuit.

b. Measure the resistance between terminal J or receptacle J–404 and the chassis. This resistance normally is about 75,000 ohms. If the reading is low, the trouble may be a leaky or shorted capacitor C–428, C–408, C–410, C–419, or C–423. Also, the low-voltage secondary winding (terminals 8, 9, and 10) of transformer T–401 may be shorted to the case, or some other abnormal condition may exist in the rectifier, voltage regulator, or B+ line to the individual stages in the modulating voltage generator.

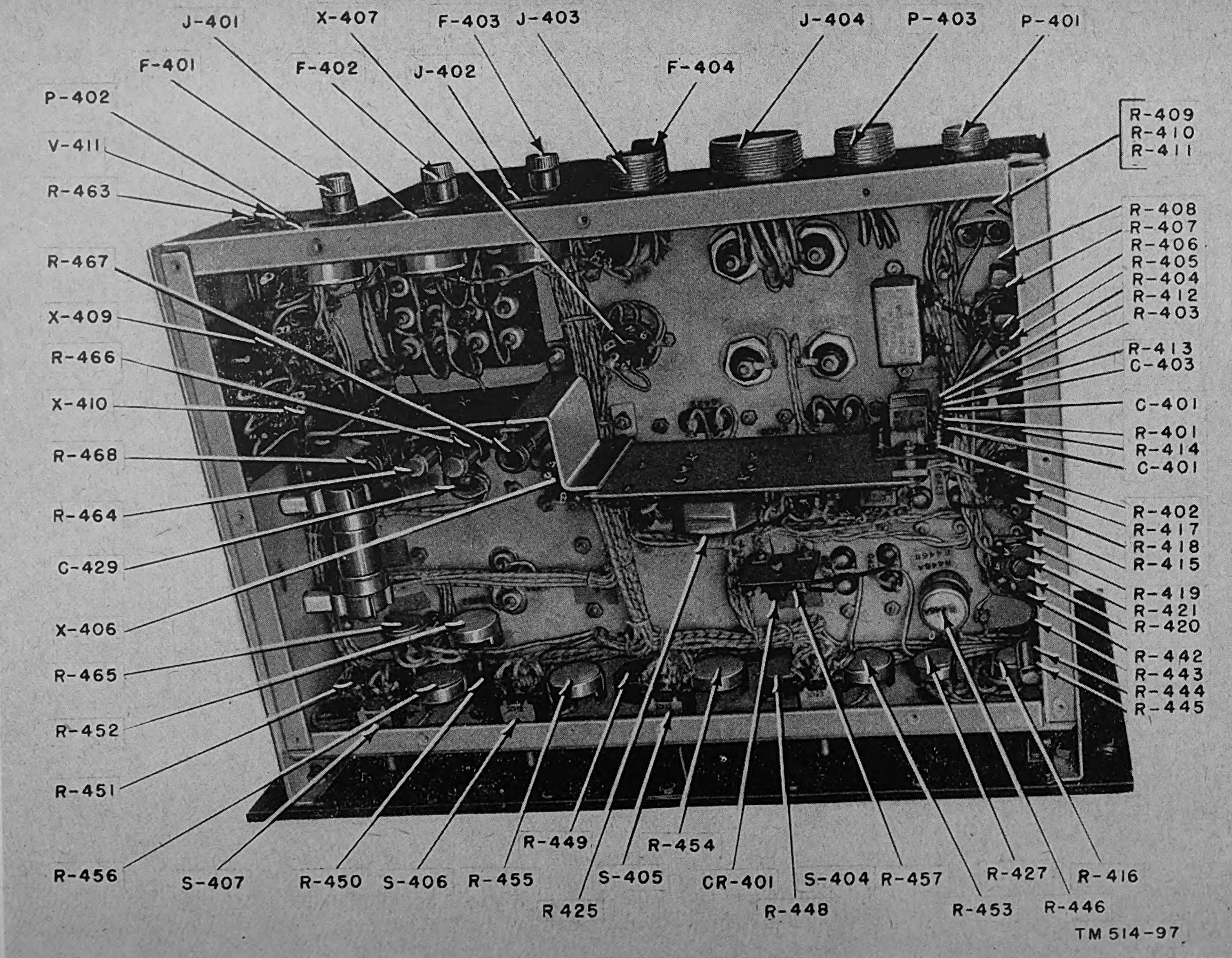


Figure 97. Modulating Voltage Generator O-15/CRD-2, bottom view of chassis, parts location.

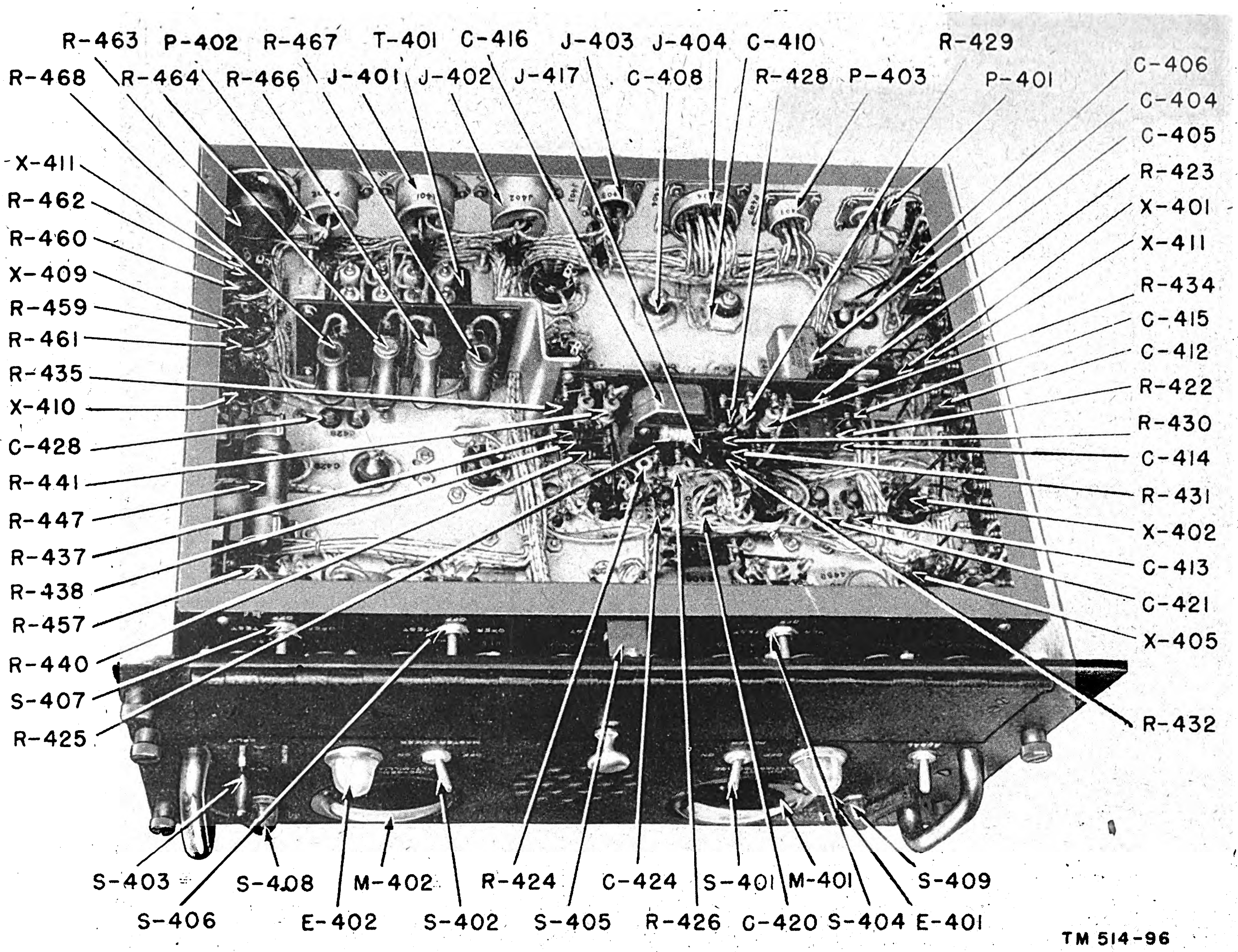


Figure 98. Modulating Voltage Generator O-15/CRD-2, bottom view of chassis, parts location.

NOTES:

1. ALL READINGS TAKEN FROM TUBE PINS TO GROUND WITH EQUIPMENT IN NORMAL OPERATING CONDITION
2. STAND BY-OPERATE-SPLIT SWITCH IN OPERATE POSITION
3. VOLTAGE READINGS TAKEN WITH A 1,000-OHMS-PER-VOLT TEST INSTRUMENT EXCEPT THOSE SHOWN IN BOXES, WHICH WERE TAKEN WITH A 20,000-OHMS-PER-VOLT TEST INSTRUMENT.
4. LINE VOLTAGE=115 VOLTS
5. B+LEVEL CONTROL SET FOR 300-VOLT READING ON METER M-402.
6. ALL MEASUREMENTS ARE DC UNLESS OTHERWISE NOTED

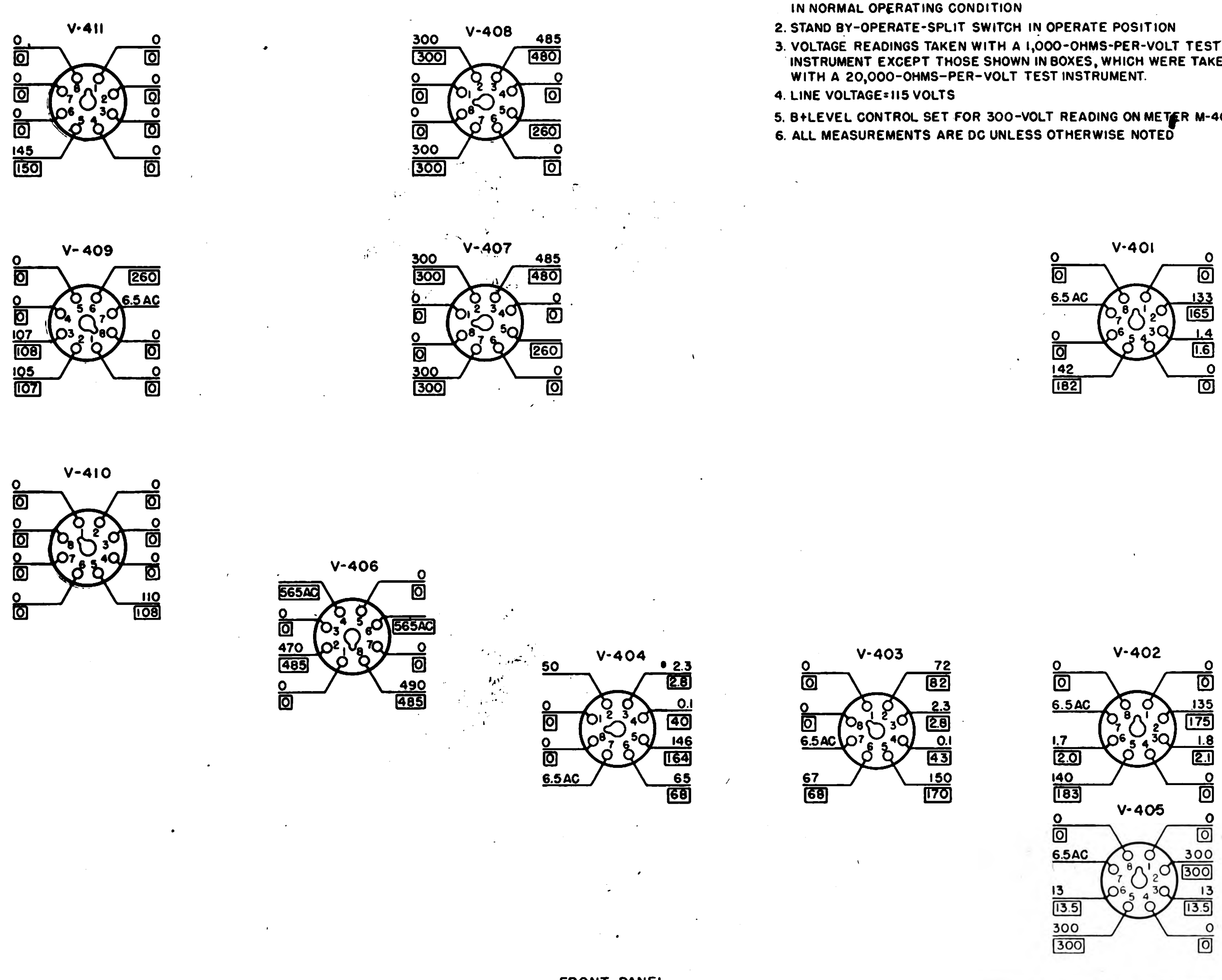


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Figure 99. Modulating Voltage Generator O–15/CRD–2, normal voltage measurements at tube socket contacts.

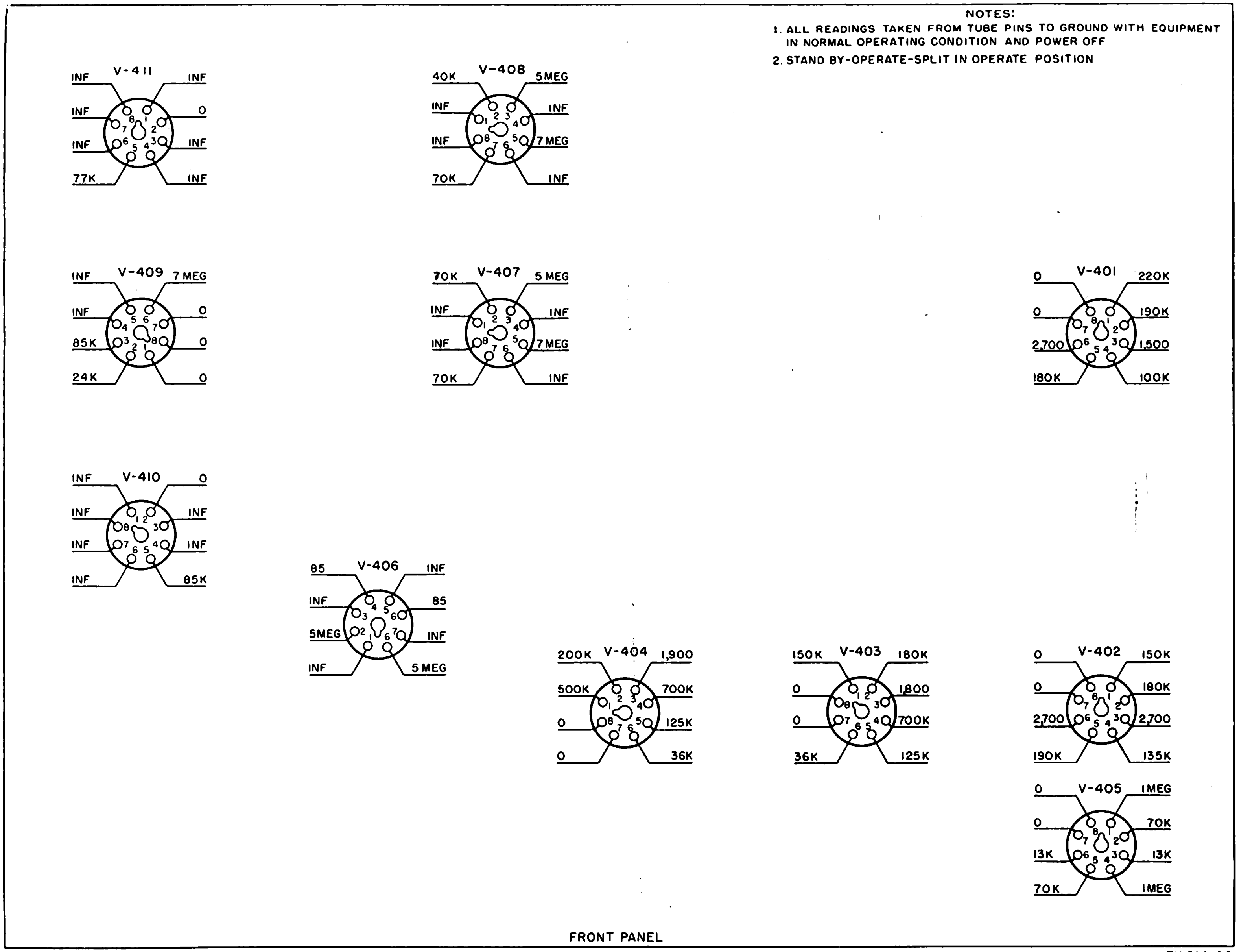


Figure 100. Modulating Voltage Generator O–15/CRD–2, normal resistance measurements at tube socket contacts.

132. Trouble-Shooting Chart

Connect a source of 115-volt, 50/60-cycle a-c power to receptacle P–402 at the rear of the chassis. Then check the modulating voltage generator in accordance with the chart which follows. *Make checks in numerical sequence.*

Symptom	Probable trouble	Correction
1. Pilot light I–402 does not light when MASTER POWER switch is ON.	1. Burned-out pilot lamp I–402	1. Replace lamp.
	Open switch S–402	Repair or replace switch.
2. Pilot lamp I–401 does not light when POWER switch is ON.	2. Burned-out pilot lamp I–401	2. Replace lamp.
	Burned-out fuse F–401	Replace fuse.
	Open switch S–401	Repair or replace switch.
3. No tubes light when power is applied.	3. Open primary transformer T–401.	3. Repair or replace defective transformer.
4. Some tubes light but other tubes fail to light.	4. Open secondary filament winding on transformer T–401.	4. Check continuity of secondary windings.
		Repair or replace defective transformer.
5. Meter M–402 does not indicate 300 volts when switch S–408 is set at E_b GEN position.	5. B+ LEVEL control out of adjustment.	5. Adjust control.
	Abnormal voltage output from regulated circuits in power supply.	Check d-c voltage between terminal J of receptacle J–404 and chassis. Voltage should be 300 volts when R–465 is adjusted properly. If d-c voltage is normal, trouble is in switch S–408, resistor R–447, or meter M–402 or in wiring associated with these parts. However, if d-c voltage is abnormal, trouble is in either power supply or voltage regulator circuit. If so, check for normal voltage and resistance measurements at tube socket contacts (figs. 99 and 100).
6. A 3-volt, a-c (rms) (root mean square) reading is not obtained when a vacuum-tube voltmeter is connected between terminals P and Q of receptacle J–404.	6. OVER-ALL control R–416 out of adjustment.	6. Adjust control.
	Poor tube V–401, V–402, or V–404.	Replace poor tube.
	Abnormal condition in circuits associated with these tubes.	Check for an abnormal voltage or resistance measurement at tube socket contacts of these tubes (figs. 99 and 100). Also, check for a capacitor of abnormal value.
7. A 3-volt, a-c (rms) reading is not obtained when a vacuum-tube voltmeter is connected be-	7. E–W control R–427 out of adjustment.	7. Adjust control.

Symptom	Probable trouble	Corrections
tween terminals L and M of receptacle J–404.	Defective tube V–403	Replace poor tube.
	Abnormal condition in circuits associated with these tubes.	Check for an abnormal voltage or resistance measurement at socket contacts of this tube (figs. 99 and 100). Also, check for a capacitor of wrong value.
8. With switch S–410 at VISUAL, switch S–409 at E–W, and a 3-volt a-c (rms) reading on a vacuum-tube voltmeter connected between terminals L and M of receptacle J–404, a reading of 3 volts is not indicated by meter M–401.	8. Calibrating control R–446A and B out of adjustment.	8. Adjust control.
	Poor tube V–405	Replace poor tube.
	Abnormal condition in metering tube circuit.	Check for an abnormal voltage of resistance measurement at socket contacts for tube V–405 (figs. 99 and 100). If measurements are normal, check rectifier CR–401, switch S–410, and meter M–401.
9. Abnormal condition in antenna system control circuits associated with switch S–403.	9. Defective part or connection in antenna system control circuits.	9. Check continuity of all sections of switches S–403, S–404, S–405, S–406, and S–407. Check controls associated with these switches. Check resistors R–457, R–458, and R–459.
10. Speaker LS–401 inoperative when an audio signal of low impedance is applied to terminals A and B of receptacle P–401.	10. Defective speaker	10. Repair or replace defective speaker.

Section IV. TROUBLE SHOOTING IN VOLTAGE DISTRIBUTION UNIT, ANTENNA COUPLING UNIT CU–34/CRD–2, AND COUPLING UNIT CU–68/CRD–2 OR CU–69/CRD–2

133. Trouble-Shooting Data

The illustrations listed below are useful to the repairman when he is trouble shooting in Voltage Distribution Unit J–59/CRD–2. Antenna Coupling Unit CU–34/CRD–2, and Coupling Unit CU–68/CRD–2 or CU–69/CRD–2. Refer to the text and illustrations of section IV in chapter 4 during trouble-shooting work.

Figure No.	*Title*
101	Voltage Distribution Unit J–59/CRD–2, bottom view of chassis.
102	Antenna Coupling Unit CU–34/CRD–2, inside views.
103	Coupling Unit CU–68/CRD–2 (or CU–69/CRD–2), inside view, top and bottom cover plates removed.
104	Antenna Coupling Unit CU–34/CRD–2, normal voltage measurements at tube socket contacts when coupling unit is connected for use as part of Radio Set AN/CRD–2.
105	Antenna Coupling Unit CU–34/CRD–2, normal resistance measurements at tube socket contacts when coupling unit is connected for use as part of Radio Set AN/CRD–2.
122	Voltage Distribution Unit J–59/CRD–2, complete schematic diagram.
123	Antenna Coupling Unit CU–34/CRD–2, complete schematic diagram.
124	A. Coupling Unit CU–68/CRD–2, complete schematic diagram.
	B. Coupling Unit CU–69/CRD–2, complete schematic diagram.

134. Test Equipment Required for Trouble Shooting

The test equipment required for trouble shooting Voltage Distribution Unit J–59/CRD–2, Antenna Coupling Unit CU–34/CRD–2, and and Coupling Unit CU–68/CRD–2 or CU–69/CRD–2 is listed below. The technical manuals associated with this test equipment are listed also.

Test equipment	*Technical manual*
Tube Tester I–177, or equal	11–2627
Test Unit I–176, or equal	11–2626
Analyzer TS–415( )/U, or equal.	

135. Precautions

a. Antenna Coupling Unit CU–34/CRD–2. Do not disturb the position of capacitor C–809. This capacitor is adjusted during the balancing procedure for the radio set (par. 45). Also, tubes V–801 and V–802 normally are a balanced pair. Label these tubes before removing them from their sockets. If it is necessary to replace either tube, make certain that the transconductances of the two tubes are equal.

b. Coupling Units CU–68/CRD–2 and CU–69/CRD–2. Do not attempt to disturb the windings or leads inside the cases on these coupling units. The windings are balanced and adjusted at the time of manufacture and cannot be rebalanced or repaired satisfactorily in the field.

136. Trouble-Shooting Procedures for Voltage Distribution Unit J–59/CRD–2

a. Place the unit on the test bench and make a complete set of continuity checks in order to

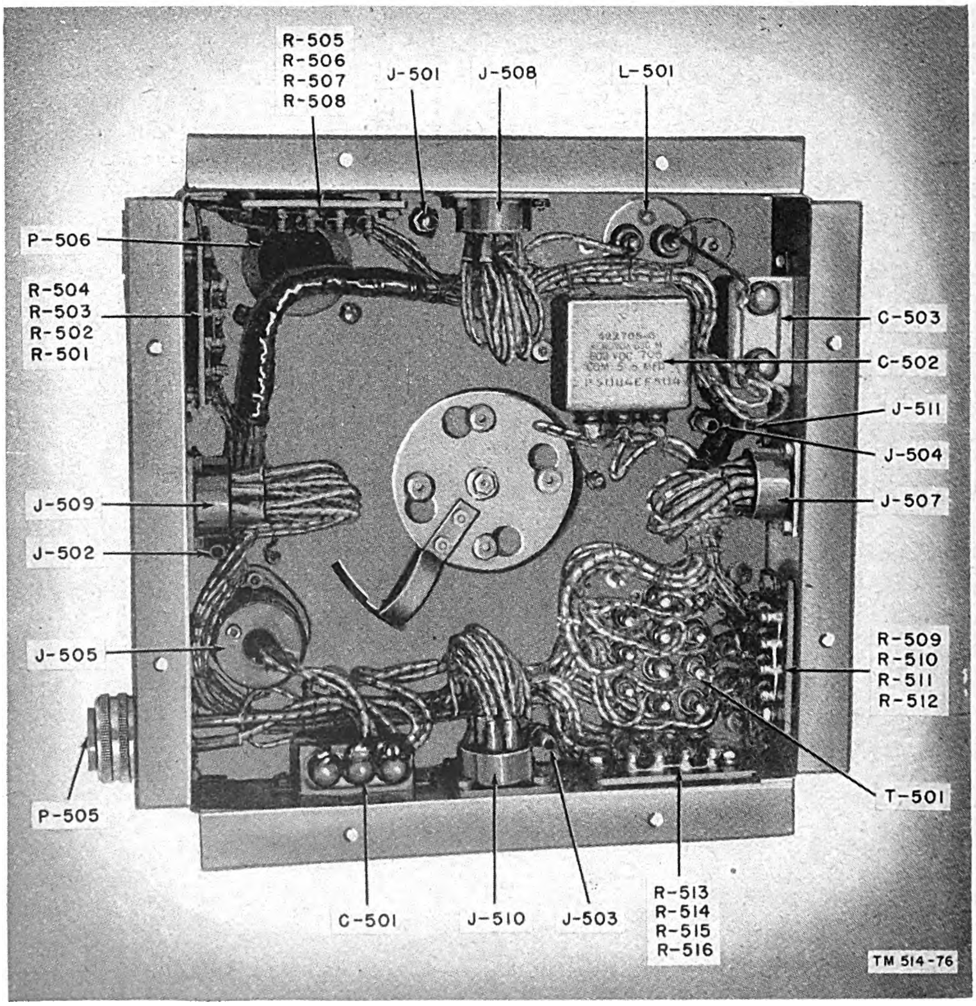


Figure 101. Voltage Distribution Unit J–59/CRD–2, bottom view of chassis.

test receptacles, plugs, and wiring. Use figure 122 as the basis for these checks. Repair or replace defective parts, as necessary.

b. Check the values of the resistors and replace all defective resistors.

c. Check for a shorted or open capacitor C–501A, C–501B, C–502A, C–502B, or C–503.

d. Apply a source of 115-volt, 50/60-cycle a-c power to receptacle P–505 and then check the output voltage across each of the five secondary windings on transformer T–501. Each secondary voltage should be approximately 6.3 volts ac. Replace transformer if defective.

137. Trouble-Shooting Procedures for Antenna Coupling Unit CU–34/CRD–2

a. Check tubes V–801 and V–802. If tubes are defective, replace them with tubes having the same transconductances.

b. Check tube V–803 and replace if defective.

c. Place the unit on the test bench and make a complete set of continuity checks against the circuit shown on figure 123. Repair or replace defective parts, as necessary.

d. Check the values of the resistors and capacitors and replace all defective parts.

e. Check for abnormally low resistance measurements at all points in the circuit.

138. Trouble-Shooting Procedures for Coupling Units CU–68/CRD–2 and CU–69/CRD–2

a. Place the unit on a test bench and make a complete set of continuity checks against the circuit shown in figure 124. Make repairs or replacement of parts, as necessary.

b. Check for an open or shorted capacitor C–601A, B, C (or C–701A, B, C). Replace defective capacitors.

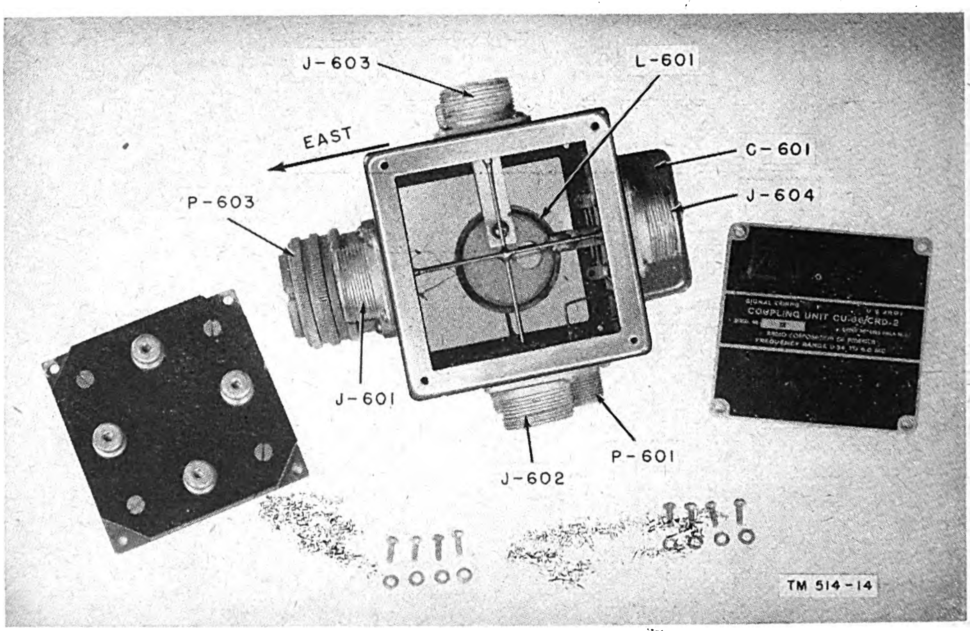


Figure 103. Coupling Unit CU–68/CRD–2 (or CU–69/CRD–2), inside view, top and bottom cover plates removed.

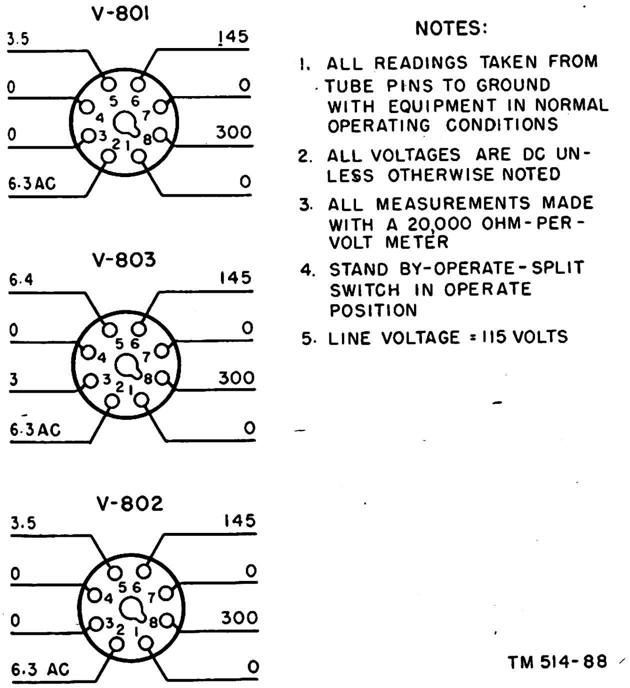


Figure 104. Antenna Coupling Unit CU–34/CRD–2, normal voltage measurements at tube socket contacts when coupling unit is connected for use as part of Radio Set AN/CRD–2.

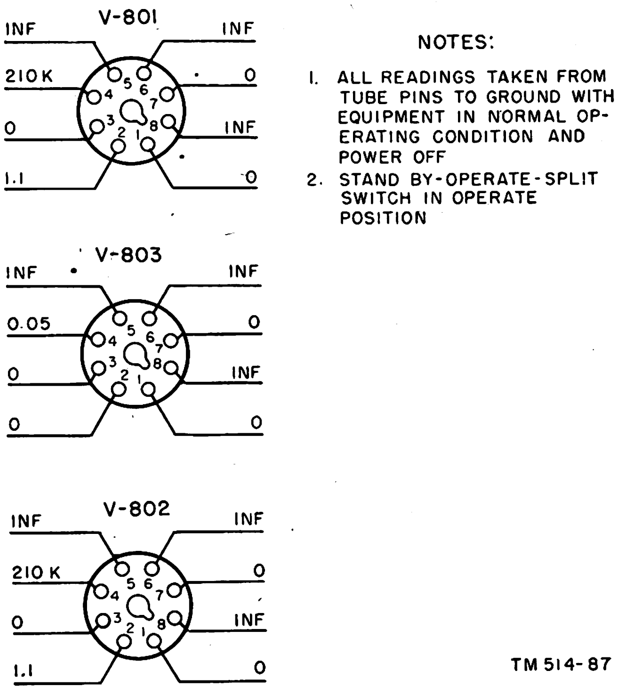


Figure 105. Antenna Coupling Unit CU–34/CRD–2, normal resistance measurements at tube socket contacts when coupling unit is connected for use as part of Radio Set AN/CRD–2.

Section V. TROUBLE SHOOTING IN RADIO RECEIVING

139. Trouble-Shooting Data

The illustrations listed below are useful to the repairman when he is trouble shooting in the radio receiver. Refer to the text and illustrations of section V in chapter 4 during trouble-shooting work.

Figure No.	*Title*
43	Radio Receiver R–127/CRD–2, front panel controls.
106	Radio Receiver R–127/CRD–2, top of chassis with shield removed, showing h-f section.
50	Radio Receiver R–127/CRD–2, top view of chassis, parts location.
107	Radio Receiver R–127/CRD–2, bottom of chassis with shield plates removed, showing h-f sections.
108	Radio Receiver R–127/CRD–2, normal voltage measurements at tube socket contacts.
109	Radio Receiver R–127/CRD–2, normal resistance measurements at tube socket contacts.
120	Radio Receiver R–127/CRD–2, complete schematic diagram.

140. Test Equipment Required

The test equipment required for trouble shooting in the radio receiver is listed below. The technical manuals associated with this test equipment are listed also.

Test equipment	*Technical manual*
Tube Tester I–177, or equal	11–2627
Test Unit I–176, or equal	11–2626
Oscilloscope BC–1060, or equal	11–2526
Oscillator I–151, or equal	11–2524
Signal Generator I–72–( ), or equal	11–307

141. Precautions

For precautionary measures to be observed during trouble shooting, see paragraph 128.

142. Preliminary Measurements

See paragraph 127*b*, then make the following checks before applying power to the radio receiver:

a. Check the resistance between pin 8 of tube V–116 and the chassis. The normal resistance is approximately 1.1 megohms. If the measurement shows an abnormally low resistance, check capacitors C–210A, C–210B, and C–210C for leaks or shorts. If the capacitors are not the cause of the low resistance measurement, check the windings of coils L–133 and L–134 and the rectifier filament winding of transformer T–109 for a short to the case or chassis. Replace defective parts.

b. Turn switch S–104 to the OFF position and check the resistance between each input terminal on receptacle J–103 and the chassis. An infinitely high resistance should be indicated. If the resistance measurement does not indicate infinity, check capacitors C–209A and C–209B for shorts or leaks. Replace defective capacitor.

143. Trouble-Shooting Chart

Place the radio receiver on a test bench and connect a source of 115-volt, 50/60-cycle a-c power to the a-c power receptacle, J–103. Then proceed with the checks given in the trouble-shooting chart. Following the items of this chart in numerical sequence.

Symptom	Probable trouble	Correction
1. Dial lights and tubes with glass envelopes do not light when switch S–104 is rotated to REC MOD position.	1. Open contacts on switch S–104	1. Repair or replace defective switch.
	Open primary winding on transformer T–109.	Replace defective transformer.
2. Tubes with glass envelopes do light but dial lights do not go on.	2. Open or shorted secondary winding (terminals 8, 9, and 10) of transformer T–109.	2. Replace defective transformer.
	Burned-out dial lights	Replace dial lights.
3. Dial lights do light but tubes with glass envelopes do not light.	3. Open secondary winding on transformer T–109.	3. Replace defective transformer.
4. No noise output or a very low noise output is obtained from speaker when switch S–103 is at Man, switch S–102 is at D/F–2, and RF GAIN controls are rotated fully clockwise.	4. ANT ADJ control out of adjustment.	4. Try rotating control for noise output.
	Abnormal condition in receiver circuits.	Follow signal substitution procedures explained in paragraph 144.
5. When an antenna is connected to antenna terminal (receptacle J–101), signals can be tuned in but audio output is distorted badly.	5. Trouble in audio stages	5. Make voltage and resistance measurements at tube socket contacts in audio section of receiver (figs. 108 and 109).
6. A loud hum is heard at all times	6. D-c output voltage of power supply contains a ripple component.	6. Check filter capacitors C–210A, C–210B, and C–210C.
7. Receiver has normal audio response but reception is noisy where RF GAIN and AF GAIN controls are rotated.	7. Faulty controls	7. Replace defective controls R–145 and R–150.
8. Oscillation (indicated by a whistle or howl).	8. Defective part or connection	8. Ground grid of first r-f amplifier tube through a 0.1-uf (micro-

Symptom	Probable trouble	Correction
		farad) capacitor, then grid of second r-f amplifier, then grid of mixer, etc., until grounding of one of the grids causes oscillation to disappear. When this happens, cause of trouble most likely has been isolated to that stage or to a preceding stage. Check suspected stages for an open bypass capacitor or poor ground connection.
9. Rotation of SELECTIVITY switch S–102 does not change selectivity characteristics in a normal manner for positions 3, 4, and 5.	9. Crystal Y–101 defective Abnormal condition in crystal selectivity circuits.	9. Replace defective crystal. Check circuits for defective part or connection.
10. Reception is normal on all except one of the positions of RANGE switch.	10. Abnormal condition in circuits associated with abnormal position of switch S–101.	10. Check parts and connections in circuits.
11. Aural output is normal but output at video output receptacle J–104 is abnormal.	11. Trouble in third (video) i-f amplifier or in video detector or video amplifier stage.	11. Make voltage and resistance checks at tube socket contacts of tubes V–112 and V–113 (figs. 108 and 109).
12. Reception is normal for MAN position of switch S–103 but abnormal for one or more of other positions.	12. Trouble in detector, avc, and noise-limiter circuit.	12. Make voltage and resistance checks at tube socket contacts of tubes V–108 and V–111 (figs. 108 and 109).

144. Signal Substitution Notes

a. Signal substitution requires a source of audio, i-f, and r-f signals. Signal Generator I–72–(*) is suitable for this purpose.

b. In addition, a headset or permanent magnet loudspeaker such as Headset HS–30–(*) or Loudspeaker LS–3, respectively, is necessary.

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

d. In all tests indicated in the paragraphs which follow, ground one lead from the signal generator to the receiver chassis and connect the other lead to the point indicated through a 0.1-uf capacitor.

e. Note the volume and listen for serious distortion from the loudspeaker or headset at the various points during the signal substitution procedure. If possible, compare the result with a receiver known to be in good condition.

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

Note. Do not remove the shield or can of a tuned unit until the trouble has been traced to that unit. Do not damage the wiring by pushing it back and forth during inspection. Be careful not to damage the receiver in any other way.

g. Misalinement of one or more stages of the receiver will cause reduced output. Misalinement of the h-f oscillator will cause inaccurate dial readings. However, do not touch any alinement control unless it has been established definitely that realinement is necessary. See section X of this chapter for alinement procedures.

h. When trouble has been localized to a given stage, first test the tube if such a test is indicated, then measure the voltage, and finally measure the resistance at the tube socket of that stage.

the plate (pin 3) of tube V–110 and listen for a low signal in the headset or loudspeaker, whichever is used. If no signal is heard, check transformer T–108, capacitor C–192, and jack J–102 and the wiring in the audio output circuit.

b. TERMINAL 5 OF TUBE V–110 (GRID OF POWER AMPLIFIER). Apply the audio signal to pin 5 of tube V–110 and listen for an improved signal. This output should be greater than the signal applied to the plate (pin 8) of this tube. If an amplified output is not obtained, make voltage and resistance measurements at the tube socket contacts of tube V–110 (figs. 108 and 109).

c. TERMINAL 8 OF TUBE V–109 (PLATE OF FIRST AUDIO AMPLIFIER). Apply an audio signal to pin 8 of this tube. If there is no audio output, check capacitor C–191. If this capacitor is not defective, make voltage and resistance measurements at the tube socket contacts (figs. 108 and 109).

d. TERMINAL 4 OF TUBE V–109 (GRID OF FIRST AUDIO AMPLIFIER). Apply an audio signal to pin 4 of this tube and listen for an output tone. If there is no tone, check the voltage on pin 4. Low voltage or no voltage may indicate a short in capacitor C–194 or C–189C. Check resistors R–139 through R–146. If voltage at pin 4 is normal, check the voltage and resistance at the other tube socket terminals (figs 108 and 109).

146. I–f Tests

Set the controls as listed below for all i-f testing. Adjust the signal generator attenuator for a usable signal output level.

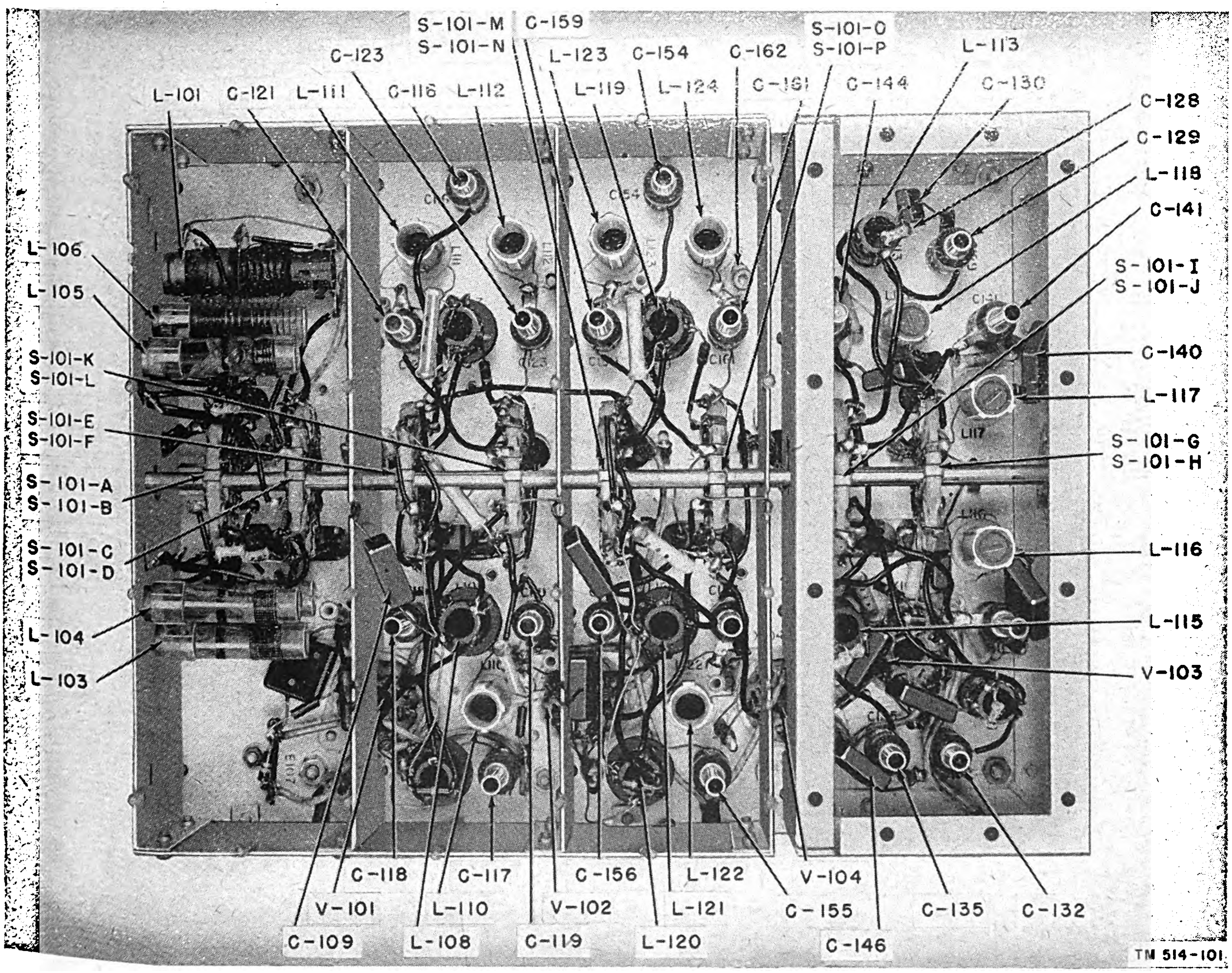


Figure 107. Radio Receiver R–127/CRD–2, bottom of chassis with shield plates removed, showing h-f sections.

NOTES:

1. ALL READINGS TAKEN FROM TUBE PINS TO GROUND WITH EQUIPMENT IN NORMAL OPERATING CONDITION.
2. LINE VOLTAGE = 120 VOLTS.
3. RF GAIN CONTROL IN MAXIMUM POSITION.
4. AF GAIN CONTROL IN MAXIMUM POSITION.
5. RANGE SWITCH IN NO. 1 POSITION.
6. MAN-MAN. NL-AVC NL-AVC SWITCH IN MAN. POSITION.
7. ALL MEASUREMENTS MADE WITH A 1,000-OHMS-PER-VOLT METER EXCEPT THOSE IN BOXES WHICH WERE MADE WITH A 20,000-OHMS-PER-VOLT METER.

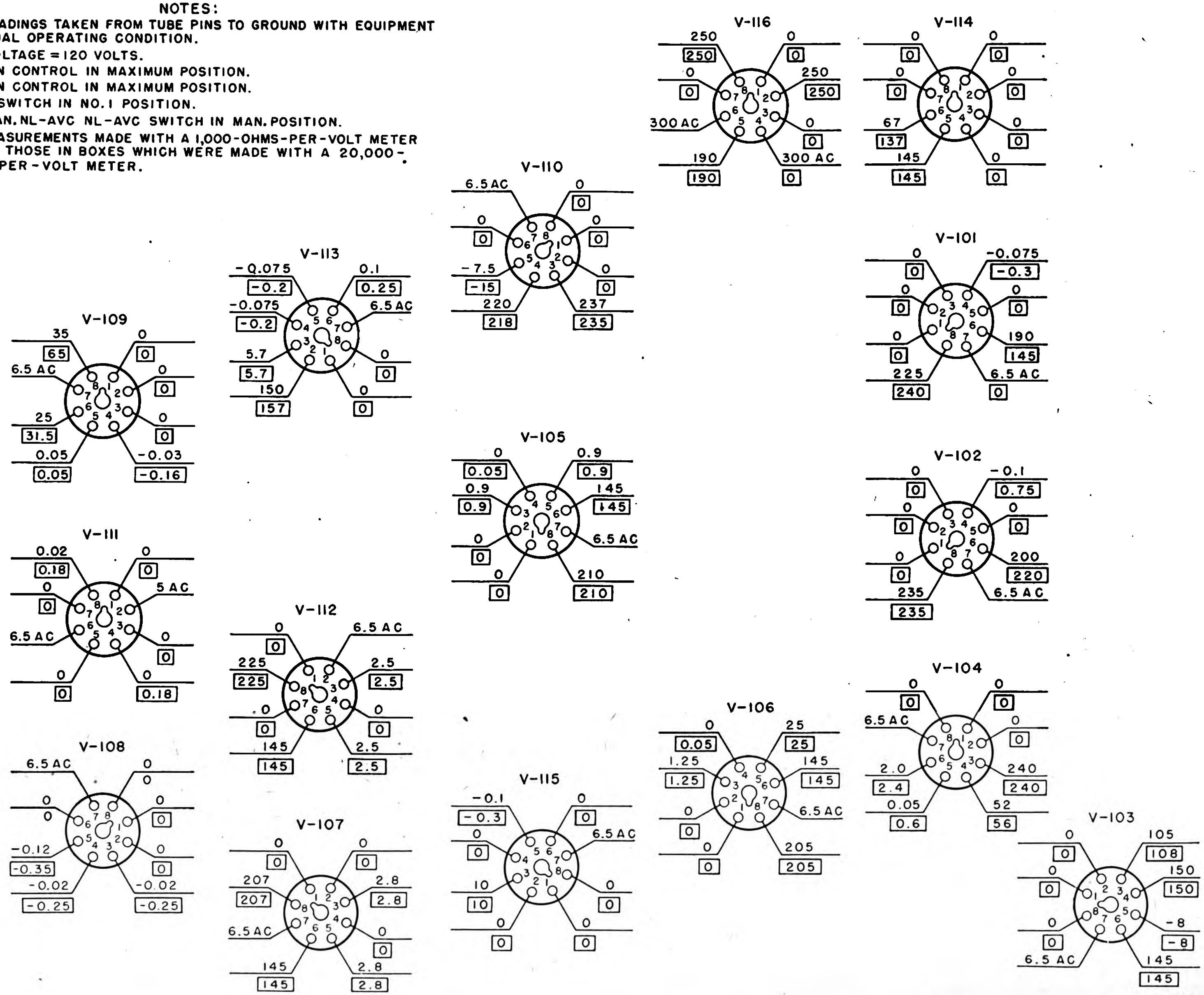


Figure 108. Radio Receiver R-127/CRD-2, normal voltage measurements at tube socket contacts.

NOTES:
1. ALL READINGS TAKEN FROM TUBE PINS TO GROUND WITH EQUIPMENT IN NORMAL OPERATING POSITION AND POWER OFF
2. RF GAIN IN MAXIMUM POSITION
3. AF GAIN CONTROL IN MAXIMUM POSITION
4. RANGE SWITCH IN NO. 1 POSITION
5. MAN.-MAN. NL-AVC SWITCH IN MAN. POSITION

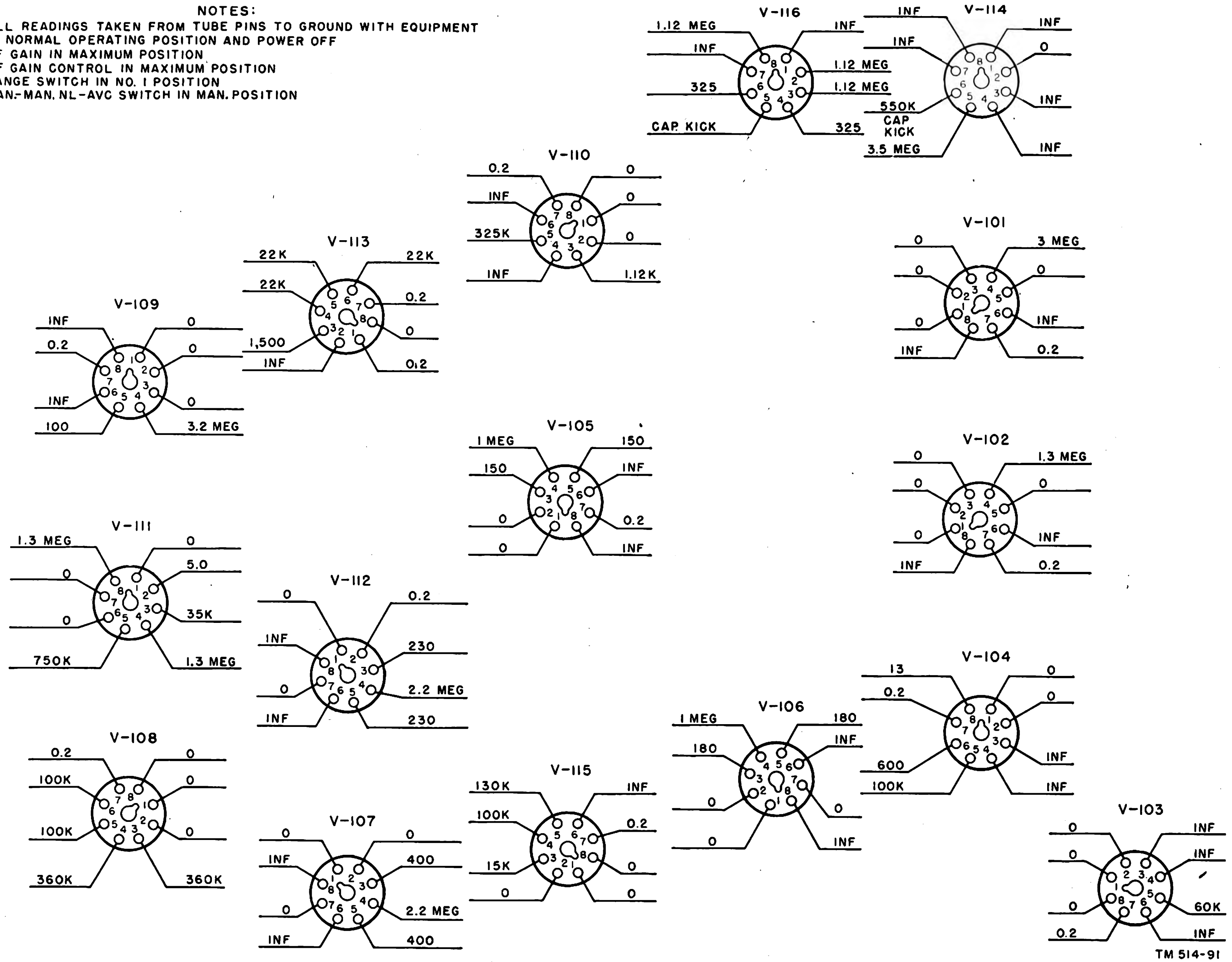


Figure 109. Radio Receiver R-127/CRD-2, normal resistance measurements at tube socket contacts.

Control	Setting
RANGE switch	Band 1.
AF GAIN control	Maximum.
RF GAIN control	Maximum.
MAN - MAN NL - AVC NL - AVC switch	MAN.
SELECTIVITY switch	Position D/F-2.
OFF - TRANS - REC MOD - REC CW switch	REC MOD.
Signal generator output	455 kc (400 cycles, 30 percent modulated). Apply the signal through a capacitor (0.1 uf) in series with the output lead.

a. TERMINAL 5 OF TUBE V-108 (DETECTOR DIODE PLATE). Apply the i-f signal to pin 5 of this tube and check for an audio output. If there is no signal, make voltage and resistance checks in the detector circuit (figs. 77, 108, and 109).

b. TERMINAL 8 OF TUBE V-107 (THIRD (AUDIO) I-F PLATE). Connect the generator to pin 8 and test for an audio output. The signal should be stronger at the output terminals with each succeeding step in the signal substitution through the i-f stages after this point. (For approximate gain of each i-f stage, refer to paragraph 171.) If this point gives an audio output signal, use it as an index of signal strength (volume level) for further testing. If there is no audio output at this point, take tube socket voltage and resistance measurements for this stage (figs. 108 and 109).

c. TERMINAL 4 OF TUBE V-107 (THIRD (AUDIO) I-F GRID). Apply the i-f signal to pin 4 and check for audio output. The output level should be higher than at the plate of the tube. If the output is abnormal, check for a defective part in the circuits associated with this tube. Make voltage and resistance measurements (figs. 108 and 109).

d. TERMINAL 4 OF TUBE V-106 (SECOND I-F GRID). Apply the i-f signal to pin 4 of this tube and check for audio output. The output should be stronger than in the previous test (*c* above). If the output is abnormal, take voltage and resistance measurements to locate the faulty part (figs. 108 and 109).

e. TERMINAL 4 OF TUBE V-105 (FIRST I-F GRID). Apply the i-f signal on pin 4 and listen for an audio output. This output level should be higher than it was from the second i-f stage (*d* above). If the output is abnormal, take voltage and resistance measurements at the tube socket (figs. 108 and 109).

f. TERMINAL 3 OF TUBE V-104 (MIXER PLATE). Injection of an i-f signal on pin 3 of this tube should result in a somewhat increased audio output over that obtained at the first i-f grid. If no output is obtained, make voltage and resistance measurements for this stage, omitting the input circuit (figs. 108 and 109).

147. R-f Tests

The control settings for r-f testing are the same as the settings used for testing the i-f stages. For r-f tests, connect a 180-uuf (micromicrofarad) capacitor in series with the generator output lead. The signal will be of radio frequency, with the generator modulation on. Each step of testing after the mixer grid should give an increased output over the stage before.

a. TERMINAL 5 OF TUBE V-104 (MIXER GRID). Set the RANGE switch to band 1, and tune the receiver to 1,000 kc. Apply a modulated 1,000-kc signal to the grid of the mixer tube and listen for an audio output. If there is no audio response, check the output of the h-f oscillator. Make voltage and resistance measurements at the tube socket contacts of tubes V-103 and V-104 (figs. 108 and 109).

b. TERMINAL 4 OF TUBE V-102 (SECOND R-F GRID).

(1) Apply the signals listed below to pin 4 of this tube and tune the receiver to the frequency of the signal generator in each case. Check for an audio output signal at each setting.

Range switch setting	Signal frequency
Band 1	1,000 kc.
Band 2	2.9 mc.
Band 3	8.0 mc.
Band 4	15.0 mc.
Band 5	21.0 mc.
Band 6	28.0 mc.

(2) If there is no signal on one or more bands but the stage proves operative, check the individual band coils and components. Examine the wafer contacts on the RANGE switch for proper make. If the stage is not operative on any band, check the tube and if the tube is good, take tube socket voltage and resistance measurements (figs. 108 and 109) to help isolate the trouble.

c. TERMINAL 4 OF TUBE V–101 (FIRST R-F GRID). Apply the signal generator output lead to pin 4 of this tube and follow the procedure outlined in *b* above.

d. ANTENNA TERMINALS. Apply the r-f signal to the antenna terminals (receptacle J–101) and follow the procedure given in *b* above. To isolate a defective part, check tube socket voltage and resistance on first r-f stage and test the individual parts in the antenna circuit.

Section VI. TROUBLE SHOOTING IN BEARING INDICATOR

Caution: High voltages are used in the bearing indicator circuits. Be careful when performing service work.

148. Trouble-Shooting Data

The illustrations listed below are useful to the repairman when he is trouble shooting in the bearing indicator. Refer to the text and illustrations of second VI in chapter 4 during trouble-shooting work.

Figure No.	*Title*
42	Bearing Indicator ID–64/CRD–2, front panel controls.
51	Bearing Indicator ID–64/CRD–2, top view of chassis, parts location.
110	Bearing Indicator ID–64/CRD–2, bottom view of chassis, showing location of resistances.
111	Bearing Indicator ID–64/CRD–2, normal voltage measurements at tube socket contacts.
112	Bearing Indicator ID–64/CRD–2, normal resistance measurements at tube socket contacts.
113	Bearing Indicator ID–64/CRD–2, bottom of chassis showing location of parts other than resistances.
121	Bearing Indicator ID–64/CRD–2, complete schematic diagram.

149. Test Equipment Required

The test equipment required for trouble shooting in the bearing indicator is listed below. The technical manuals associated with the test equipment are listed also.

Test equipment	*Technical manual*
Tube Tester I–177, or equal	11–2627
Test Unit I–176, or equal	11–2626
Oscillator I–151, or equal	11–2524
Analyzer TS–415( )/U, or equal.	
Frequency Meter Set SCR–211, or equal	11–300
Electronic Multimeter TS–505/U, or equal.	

150. Precautions

a. For precautionary measures to be observed during trouble shooting, see paragraph 168.

b. Tubes V–306 through V–309 are matched in transconductance and were balanced when the bearing indicator was installed as part of Radio Set AN/CRD–2 in accordance with the instructions given in paragraph 45. Therefore, if these tubes are removed from their sockets, make certain that they are returned to their original positions. If it is necessary to replace one of these tubes, select a replacement which has the same transconductance as the other tubes in this matched set.

c. Do not touch the controls in the output circuits of the balanced modulators unless one of the controls is defective and must be replaced. Paragraph 168 describes the method of adjusting these controls.

151. Preliminary Measurements

See paragraph 127*b*, then check the B+ circuits for a shorted condition as follows:

a. Measure the resistance between pin 5 of tube V–313 and the chassis. The resistance should be approximately 28,000 ohms. If the resistance is much less, check capacitor C–357A. Also check capacitor C–328A and C–338A, C–313A and C–313B, and C–308. If these capacitors are not leaky or shorted, check the secondary winding (terminals 11, 12, and 13) of transformer T–302 for a short to the case.

b. Measure the resistance across capacitor C–358. The resistance should be approximately 3 megohms. If the resistance is much less, check capacitor C–358. Also check the secondary winding (terminals 14, 15, and 16) of transformer T–302 for a short to the case.

152. Trouble-Shooting Chart

Place the bearing indicator on the test bench and connect a source of 115-volt, 50/60-cycle. a-c power to receptable P–301. Then proceed with the checks given in the following trouble-shooting chart. Follow the items of this chart in numerical sequence.

Symptom	Probable trouble	Correction
1. Azimuth scale is not illuminated when POWER switch S–302 is ON.	1. DIM control R–384 out of adjustment.	1. Rotate control clockwise.
	DIM control R–384 burned out.	Replace defective control.
	Low secondary voltage between terminals 3 and 5 of transformer T–301.	Check for a normal 6.3-volt reading. If voltage is low, check secondary winding (terminals 3, 4, and 5) of transformer T–301 for a short to case. Also check this transformer for a short or open primary winding. Replace if defective.
2. Dial lights go on but tube V–303 does not light.	2. Defective secondary winding on transformer T–301.	2. Check for an open or shorted winding (terminals 6 and 8) on transformer T–301. Replace defective transformer.
3. Tubes V–316, V–317, V–318, and V–306 through V–309 fail to light.	3. Defective transformer T–302	3. Check for an open or shorted winding on transformer. Replace defective transformer.
4. No d-c voltage can be measured between terminal D of receptacle J–303 and chassis.	4. Open or shorted h-v winding on transformer T–302.	4. Replace defective transformer.
	Open resistor R–383.	Replace defective resistor.
5. D-c measurement is obtained between terminal D of receptacle J–303 and chassis, but this voltage is not 300 volts.	5. Control R–377 out of adjustment.	5. Adjust control.
	Defective component in voltage regulator circuit.	Check voltage and resistances at tube socket contacts in power supply and voltage regulator circuits (figs. 111 and 112).
6. 300 volts is obtained between terminal D of receptacle J–303 and chassis, but approximately 150 volts cannot be measured between pin 5 of tube V–313 and chassis.	6. Open resistor R–375	6. Replace resistor if it is defective.
	Shorted capacitor C–334C or C–324C.	Replace defective capacitor.

Symptom	Probable trouble	Correction
7. Approximately 1,750 volts is not indicated when a high-resistance voltmeter is connected between junction of resistor R–310 and capacitor C–311 and chassis.	7. Incorrect oscillator frequency.	7. See paragraph 168.
	Capacitor C–307 out of adjustment.	See paragraph 168.
	Abnormal condition in oscillator, h-v rectifier, or h-v control circuit.	Check continuity of coils in oscillator stage. Check for normal voltage and resistance measurements at tube socket contacts of tubes V–301 and V–303 (figs. 111 and 112).
8. Approximately 1,750 volts is obtained across capacitor C–311, but no illumination appears on cathode-ray tube when INTENSITY control is advanced fully clockwise.	8. Poor control R–312	8. Replace defective control.
	Poor centering control R–318 or R–319.	Replace defective control.
	Shorted capacitor C–316, C–317, C–318A, or C–318B.	Replace defective capacitor.
	Open resistor R–315, R–316, R–317, R–320, or R–321.	Replace defective resistor.
	Shorted capacitor C–327, C–329, C–337, or C–339.	Replace defective capacitor.
	Shorted or open filament winding on transformer T–301.	Check winding (terminals 9 and 11) on this transformer and replace transformer if it is defective.
9. Approximately 1.5 volts (rms) is not indicated by a VTVM when VTVM is connected between terminals E and F on receptacle J–303 when a 7-volt (rms) audio signal is fed between terminal A of receptacle J–303 and chassis. See paragraph 168.	9. Control R–344 out of adjustment.	9. Adjust control.
	Abnormal condition in circuits associated with tubes V–310 and V–312.	Check for an abnormal voltage or resistance measurement at the socket contacts of tubes V–310 and V–312 (figs. 111 and 112). Check the individual parts in these circuits, including SENSE SWITCH S–301. Also check for a shorted capacitor C–331 or C–332.
10. Approximately 1.5 volts is not indicated by a VTVM when VTVM is connected across ungrounded terminals of capacitors C–321 and C–322. (Input between terminal A on receptacle J–303 and chassis must be kept at 7 volts (rms) for this test.)	10. Control R–360 out of adjustment.	10. Adjust control.
	Abnormal condition in circuits associated with tube V–311.	Check for an abnormal voltage or resistance at socket contacts of tube V–311 (figs. 111 and 112). Check individual parts in these circuits. Also check for shorted capacitor C–321 or C–322.
11. A circular pattern (or two circular patterns not superimposed) is not observed on screen of cathode-ray tube when items 9 and 10 above are normal.	11. No 200-kc output from r-f control modulator tube V–302.	11. Check adjustment of SIZE control R–306. Check continuity of coil L–301C. Check for an abnormal voltage or resistance measurement at socket contacts of tube V–302 (figs. 111 and 112).

Symptom	Probable trouble	Correction
	Abnormal condition in circuits associated with tubes V–306 through V–309.	Check for abnormal voltage or resistance measurement at socket contacts of tubes V–306 through V–309 (figs. 111 and 112). Check these circuits for open capacitors.
12. Two circular patterns are observed, and these patterns cannot be superimposed by adjustment of the H and V BEARING SPLITTERS (R–328 and R–339).	12. Unequal transconductance for tubes V–306 through V–309.	12. Use four tubes having equal transconductances.
	Output circuits of these tubes out of adjustment.	See paragraph 168.
13. One of the two circular patterns (see note below) observed on screen does not disappear when SENSE SWITCH is depressed. *Note.* To obtain the two circular patterns, rotate either the H or V BEARING SPLITTER control.	13. Control C–309 out of adjustment.	13. Adjust control.
	Abnormal condition in circuits associated with tube V–304.	Check for an abnormal voltage or resistance measurement at socket contacts of tube V–304. Check for a shorted or open capacitor in these circuits.

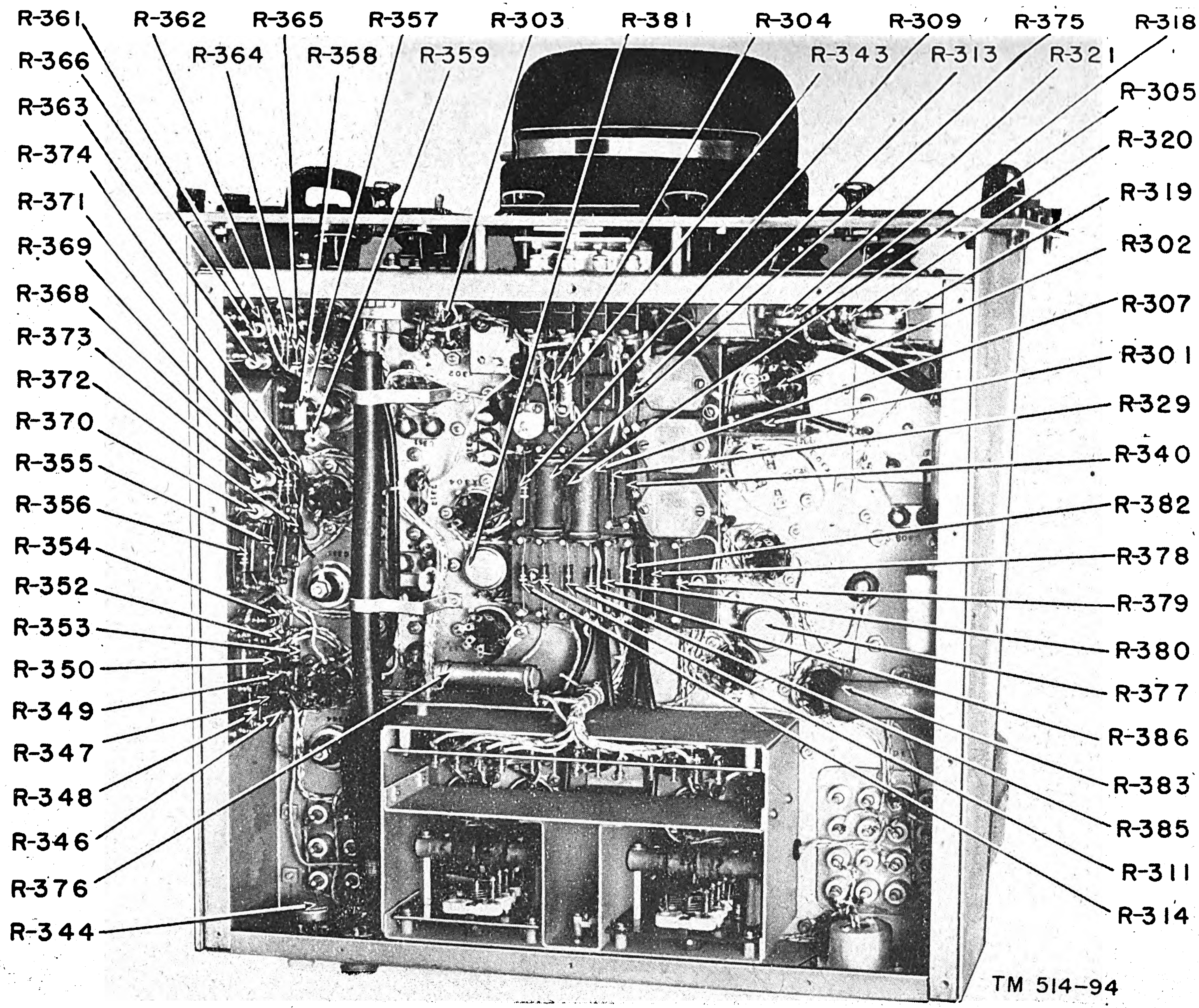
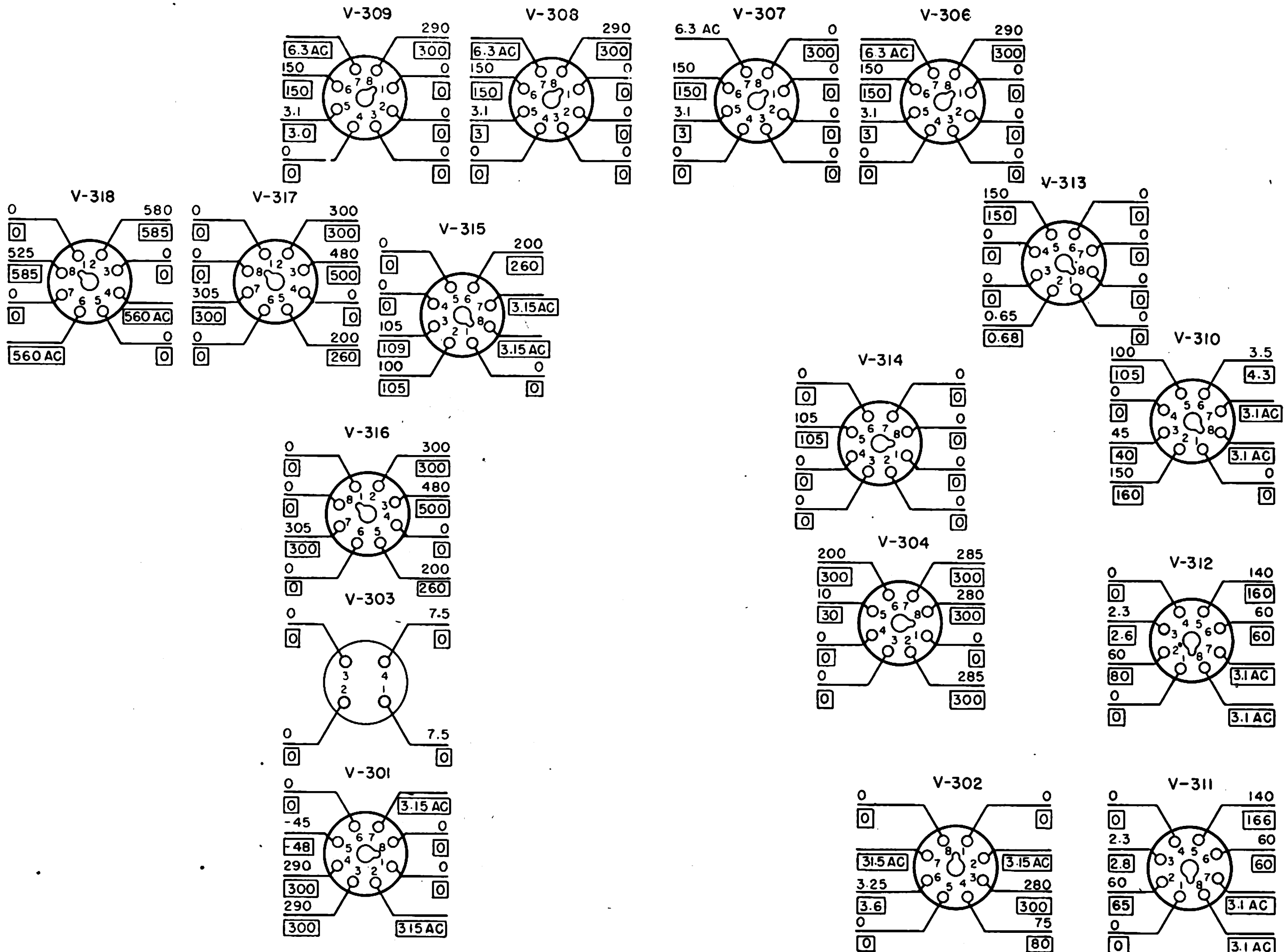


Figure 110. Bearing Indicator ID-64/CRD-2, bottom view of chassis, showing location of resistances.

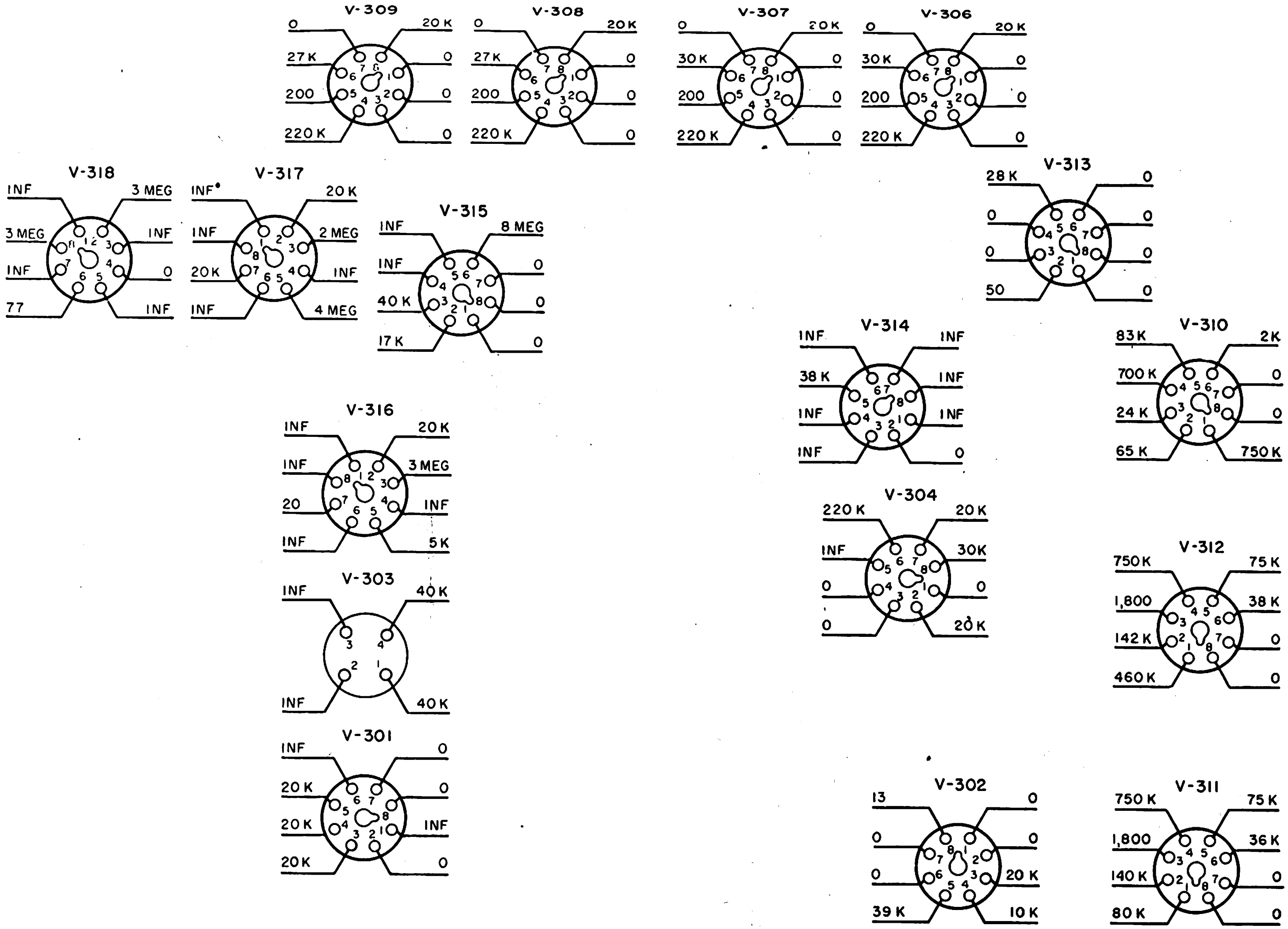


NOTES.

1. ALL READINGS TAKEN FROM TUBE PINS TO GROUND WITH EQUIPMENT IN NORMAL OPERATING CONDITION
2. ALL MEASUREMENTS TAKEN WITH A 1,000-OHMS-PER-VOLT TEST INSTRUMENT EXCEPT THOSE IN BOXES WHICH WERE TAKEN WITH A 20,000-OHMS-PER-VOLT TEST INSTRUMENT
3. LINE VOLTAGE = 115 VOLTS
4. STAND BY-OPERATE-SPLIT SWITCH IN OPERATE POSITION
5. ALL VOLTAGES ARE DC UNLESS OTHERWISE NOTED

TM 514-89

Figure 111. Bearing Indicator ID-64/CRD-2, normal voltage measurements at tube socket contacts.



NOTES:

1. ALL READINGS TAKEN FROM TUBE PINS TO GROUND WITH EQUIPMENT NORMAL OPERATING CONDITION AND POWER OFF
2. STAND BY-OPERATE-SPLIT SWITCH IN OPERATE POSITION

TM 514-90

Figure 112. Bearing Indicator ID-64/CRD-2, normal resistance measurements at tube socket contacts.

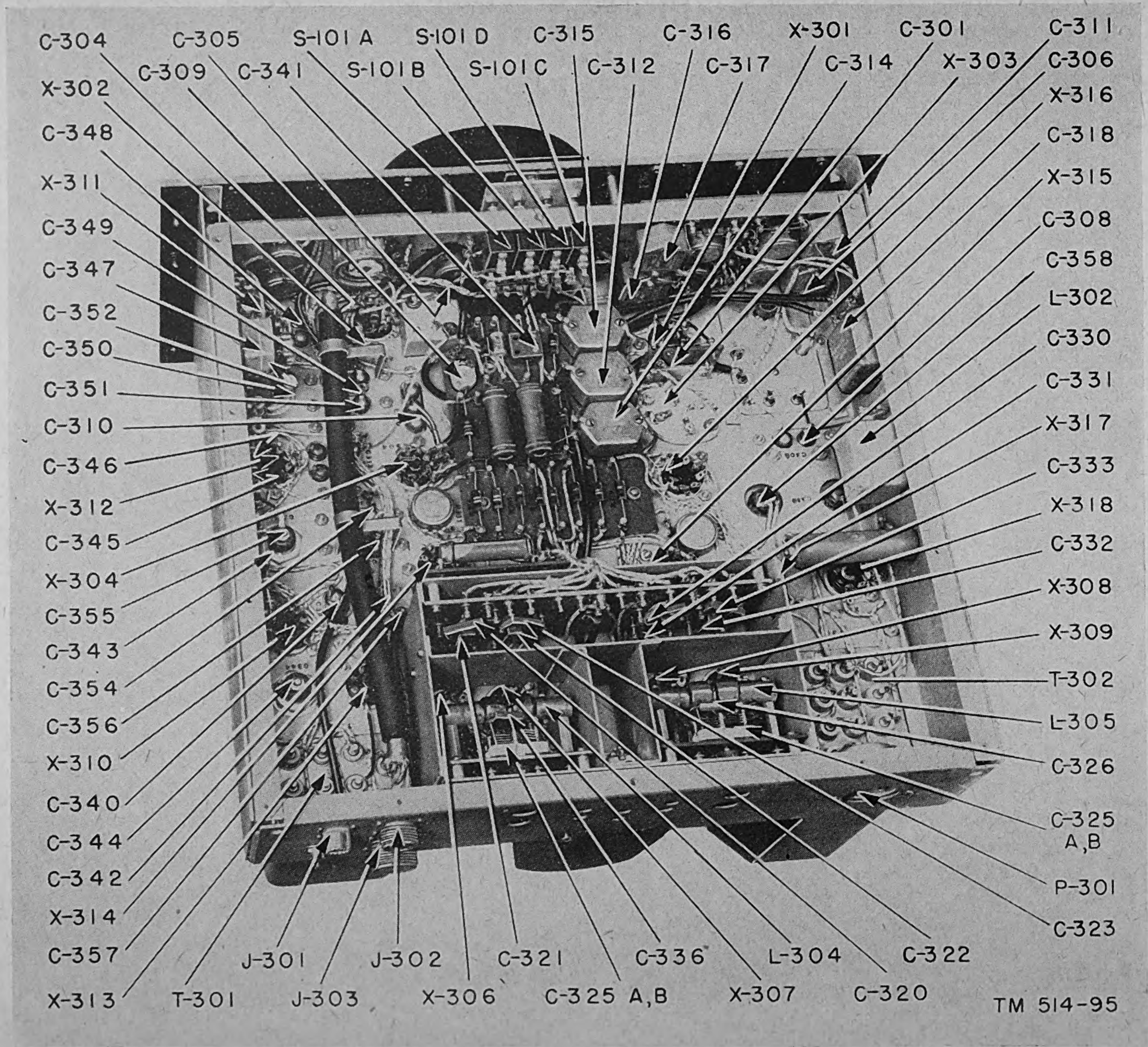


Figure 113. Bearing Indicator ID–64/CRD–2, bottom of chassis, showing location of parts other than resistances.

Section VII. TROUBLE SHOOTING IN AZIMUTH INDICATOR

153. Trouble-Shooting Data

The illustrations listed below are useful to the repairman when he is trouble shooting in the azimuth indicator. Refer to the text and illustrations of section VII in chapter 4 during trouble shooting.

Figure No.	*Title*
44	Azimuth Indicator ID–240/CRD–2, front panel controls.
52	Azimuth Indicator ID–240/CRD–2, top view of chassis, parts location.
114	Azimuth Indicator ID–240/CRD–2, bottom view of chassis.
125	Azimuth Indicator ID–240/CRD–2, complete schematic diagram.

154. Test Equipment Required

The test equipment required for trouble shooting in the azimuth indicator is listed below. The technical manuals associated with the test equipment also are listed.

Test equipment	*Technical manual*
Tube Tester I–177, or equal	11–2627
Test Unit I–176, or equal	11–2626

155. Precautions

For precautionary measures to be observed during trouble shooting, see paragraph 128.

156. Preliminary Measurements

See paragraph 127*b*, then check the B+ circuits for a shorted condition as follows:

a. Measure the resistance across capacitor C–1001. The resistance should not be less than approximately 20,000 ohms. If the resistance is low, check capacitors C–1001 and C–1002. Replace defective capacitors.

b. Measure the resistance between the terminals of receptacle P–1001 when switch S–1002 is set at the VISUAL position. The resistance should be infinite. If the resistance is low, check capacitors C–1005A and C–1005B. Replace defective capacitor.

c. Set the VISUAL-AURAL switch at VISUAL. Then check the continuity between the terminals of receptacles P–1002 and J–1001. The resistance between terminals A, B, C, D, etc., on P–1002 and corresponding terminals, A, B, C, D, etc., on J–1001 should be zero (a fraction of 1 ohm). If an abnormal condition is discovered, check for a poor connection or for poor contact on switch S–1002 (fig. 125).

d. Check for an abnormally shorted circuit between the terminals of P–1002 and J–1001 (fig. 125). Repair or make part replacements as necessary to correct the abnormal condition.

157. Trouble-Shooting Chart

Place the azimuth indicator on the test bench and connect a source of 115-volt, 50/60-cycle a-c power to receptacle P–1001. Then proceed with the checks given in the following trouble-shooting chart. Follow the items of this chart in numerical sequence.

Symptom	Probable trouble	Corrections
1. Dial lights and tube V–1001 fails to light when switch S–1002 is set at AURAL.	1. Open contacts on switch S–1002 (circuit for primary of transformer T–1001).	1. Repair or replace switch S–1002.
	Shorted capacitor C–1005A, B	Replace defective capacitor.
	Defective transformer T–1001	Replace defective transformer.
2. Dial lights do not go on when switch S–1002 is set at AURAL but tube V–1001 lights.	2. Open secondary winding (terminals 7 and 9) on transformer T–1001.	2. Replace defective transformer.
	Open contacts on switch S–1001 (pilot light circuit).	Repair or replace switch S–1001.
	Burned-out pilot lamps	Replace pilot lamps.

Symptom	Probable trouble	Corrections
3. Approximately 100 volts dc cannot be measured across capacitor C–1001.	3. Open resistor R–1001	3. Replace defective resistor.
	Open or shorted h-v winding (terminals 3, 4, and 5) on transformer T–1001.	Replace defective transformer.
4. Approximately 50 volts dc cannot be measured between terminals E and F of potentiometer R–1008 when potentiometer R–1002 is rotated completely clockwise.	4. Shorted capacitor C–1003 or C–1004.	4. Replace defective capacitor.
	Open resistor R–1004, R–1003, R–1002, or R–1005.	Replace defective resistor.
	Wrong value for resistor R–1006 or R–1007.	Replace resistor if its value is incorrect.
5. Voltage measured between terminal L, M, P, or Q of receptacle P–1002 and chassis does not vary from approximately +6 volts to −6 volts with rotation of azimuth dial. *Note.* Rotate potentiometer R–1002 fully clockwise before making this check.	5. Open potentiometer R–1008	5. Replace defective potentiometer.
	Open resistor R–1009 through R–1020.	Replace all defective resistors.
	Open connection	Repair any abnormal connection on switch S–1001 or S–1002 or on receptacle P–1002 or J–1001.
	Open contacts on switch S–1001 or S–1002.	Repair or replace defective switch.
6. Red dial is not lighted when SENSE switch is held at RED position.	6. Open switch contact (red pilot lamp section) on switch S–1001.	6. Repair or replace defective switch.
7. White dial is not lighted when SENSE switch is held at WHITE position.	7. Open switch contact (white pilot lamp section) on switch S–1001.	7. Repair or replace defective switch.
8. A resistance of approximately 47 ohms cannot be measured between terminal N of receptacle P–1002 and chassis when SENSE switch is held at RED or WHITE position.	8. Open resistor R–1021	8. Replace defective resistor.
	Open switch contacts on switch S–1001.	Repair or replace defective switch.

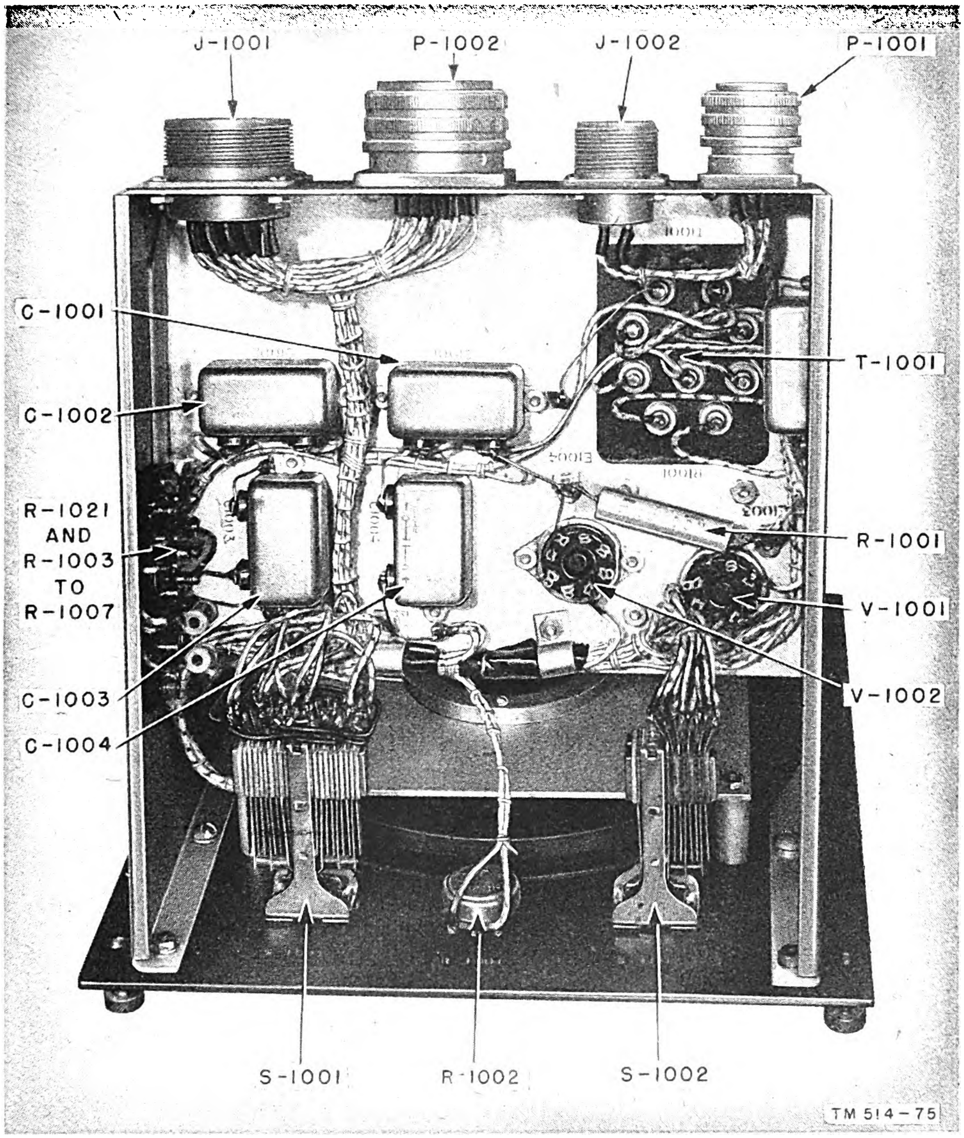


Figure 114. Azimuth Indicator ID–240/CRD–2, bottom view of chassis.

Section VIII. TROUBLE SHOOTING IN JUNCTION BOX

158. Trouble-Shooting Data

The illustrations listed below are useful to the repairman when he is trouble shooting in Junction Box J–95/CRD–2. Refer to the text and illustrations of section VIII in chapter 4 during trouble-shooting work.

Figure No.	*Title*
115	Junction Box J–95/CRD–2, bottom view of chassis.
126	Junction Box J–95/CRD–2, complete schematic diagram.

159. Test Equipment Required

The test equipment required for trouble shooting in the junction box is listed below with the associated technical manual.

Test equipment	*Technical manual*
Test Unit I–176, or equal	11–2626

160. Precautions

For precautionary measures to be observed during trouble shooting, see paragraph 128.

161. Trouble-Shooting Chart

Place the junction box on the test bench and connect a source of 115-volt, a-c power of known frequency between 50 and 60 cps to receptacle P–902. Then proceed with the checks given in the following trouble-shooting chart. Follow the items of this chart in numerical sequence.

Symptom	Probable trouble	Corrections
1. Meters M–901 and M–902 do not indicate voltage and frequency of power source when switch S–903 is set at DUMMY and switch S–901 is set at 115V.	1. Circuit breaker K–902 is out	1. Press button marked 115V. See note below.
	Switch S–902 out of adjustment	Adjust switch.
	Defective meter	Replace defective meter.
	Defective transformer T–901	Replace defective transformer.

Note. If circuit breaker does not remain closed after it is pressed, an overload is indicated. If so, check transformer T–901 for a shorted winding, check dummy load resistors R–901 through R–904 for a shorted condition or for an incorrect resistance value, and check wiring in junction box for a short circuit.

Symptom	Probable trouble	Corrections
2. Meters indicate normally when S–903 is set at DUMMY but no voltage can be measured at receptacles J–901 through J–905 when this switch is set at EQUIPMENT position.	2. Open switch S–903	2. Repair or replace defective switch.
	Open connection	Check continuity of connections to receptacles.
3. Normal meter readings are obtained with a 115-volt, a-c power input to receptacle P–902, but no voltage is indicated when a 230-volt, a-c power input is connected to receptacle P–901 (switch S–901 set at the 230V position).	3. Circuit breaker K–901 is out	3. Press reset button marked 230V. See note above.
	Open switch S–901	Repair or replace switch.
	Open transformer T–901	Repair or replace T–901.

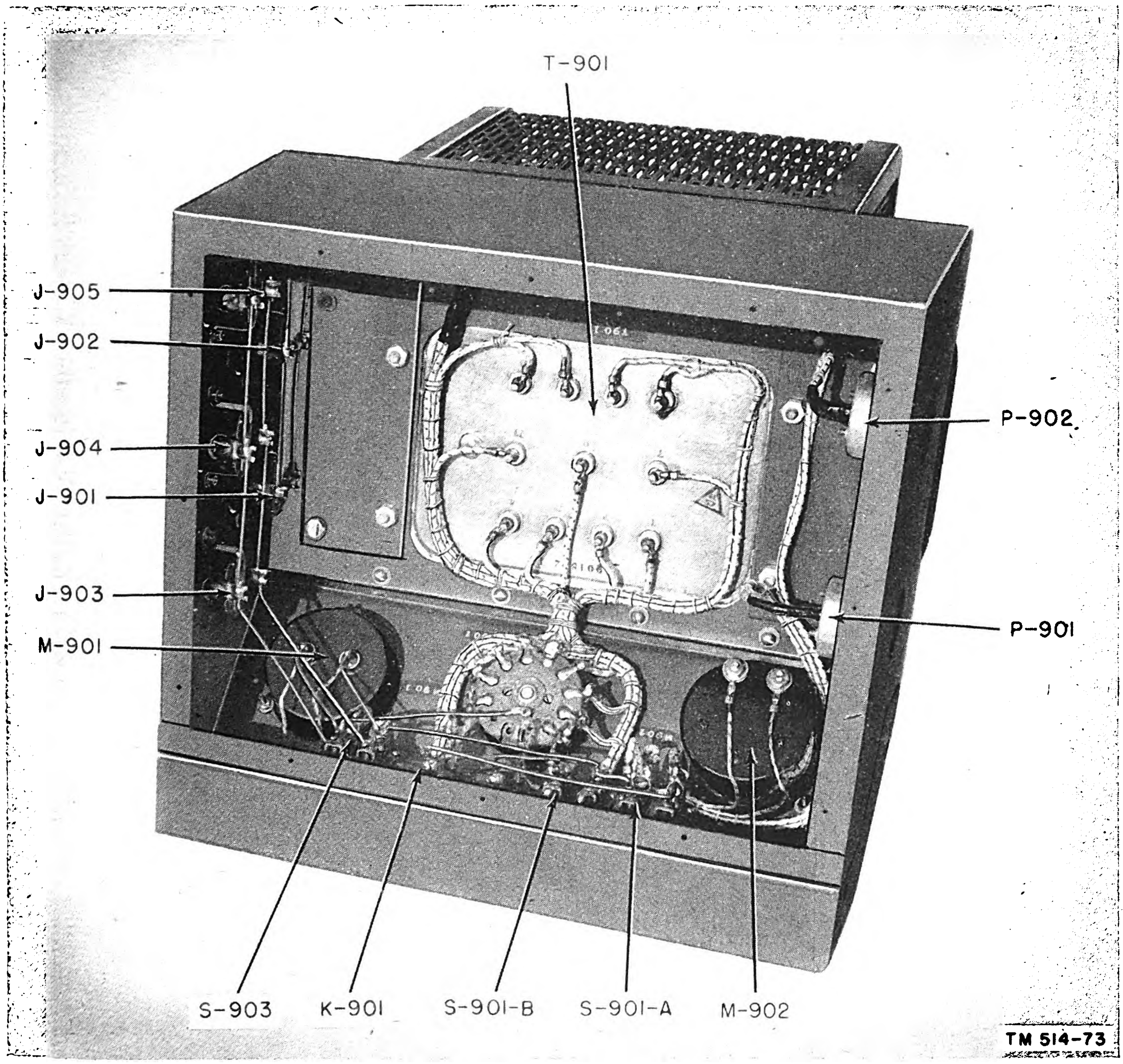


Figure 115. Junction Box J–95/CRD–2, bottom view of chassis.

Section IX. REPAIRS

162. Replacement of Parts

Most of the parts in Radio Set AN/CRD–2 are readily accessible and are replaced easily if found to be faulty. When replacing cathode-ray tube V–305 or the alidade scale assembly dial lamps, follow the instructions given in *a* and *b* below.

a. REPLACEMENT OF CATHODE-RAY TUBE.

(1) Remove the screws which hold the alidade scale assembly to the front panel and remove the assembly.

(2) While supporting the cathode-ray tube from the front, push the base of the tube out of its socket by pressing on the key which fits into the center of the socket.

(3) Pull the tube out slowly until the cap on the side of the tube is accessible. Remove the cap, then slide the tube out of the bearing indicator.

b. REPLACEMENT OF ALIDADE SCALE ASSEMBLY DIAL LAMPS.

(1) Remove the alidade scale assembly after taking out the screws which hold the assembly to the front panel.
(2) Remove the lamps by pressing in and rotating counterclockwise.

163. Refinishing

Instructions for refinishing badly marred panels on the exterior of cabinets are given in TM 9–2851.

Section X. ALINEMENT PROCEDURES

164. Test Equipment Required for Alinement of Radio Receiver

a. GENERAL. Parts requiring alinement are located on the top and bottom of the receiver chassis (figs. 50 and 106).

b. SIGNAL GENERATOR. The signal generator should be an accurately calibrated instrument capable of producing f-m signals at 455 kc with a sweep range of at least 10 kc. The generator also must have provisions for producing a-m signals from 535 kc to 32 mc. It should have an output of approximately 100 microvolts and an output impedance of approximately 100 ohms for best results when alining the r-f amplifier and h-f oscillator circuits. For i-f alinement, these values are not critical. Accurate frequency calibration of the sweep generator is of great importance since any variation of the generator will result in a corresponding misalinement of the radio receiver circuits.

c. OSCILLOSCOPE. An oscilloscope having a vertical amplifier with a uniform response to at least 600 kc is required. Oscilloscope BC–1060–(*) or equivalent is suitable for this purpose.

d. VACUUM-TUBE VOLTMETER. A VTVM with flat response in the audio range, with a-c, d-c, and a-f scales covering the 0–5/10/100 ranges, is required. Electronic Multimeter TS–505/U or an aquivalent meter is suitable for this purpose.

e. ALINEMENT TOOLS. A suitable alinement tool is supplied with the radio receiver and is mounted with clips inside the large r-f unit cover. This tool is for the adjustment of all r-f and i-f coils.

165. Test Equipment Required for Alinement of Bearing Indicator

a. VACUUM-TUBE VOLTMETER. The same type VTVM is required as that described in paragraph 164*d*.

b. FREQUENCY METER OR WAVEMETER. A wavemeter or frequency meter capable of operation at 200 kc is required. The accuracy of the instrument should be good. Frequency Meter Set SCR–211–(*) or an equivalent instrument is suitable.

c. OSCILLOSCOPE. An oscilloscope of the same type as that described in paragraph 164c is required.

d. AUDIO OSCILLATOR. Any audio oscillator capable of supplying a 147-cps sinusoidal signal at a 7-volt (rms) level will be satisfactory, provided the output waveform has a low percentage of distortion. Oscillator I–151–(*) or equal is satisfactory.

166. Test Equipment Required for Alinement of Modulating Voltage Generator

a. OSCILLOSCOPE. An oscilloscope of the same type as that described in paragraph 164*c* is required.

b. VACUUM-TUBE VOLTMETER. A VTVM of the same type as that described in paragraph 164*d* is required.

167. Alinement of Modulating Voltage Generator

Place the modulating voltage generator on the test bench and connect a source of 115-volt, 50/60-cycle a-c power to the terminals of receptacle P–402, then turn on switches S–402 and S–401.

a. VOLTAGE ADJUSTMENT. Connect the d-c prods of the VTVM between pin J of receptacle J–404 and the chassis. Then adjust the voltage control potentiometer R–465 for a 300-volt reading on the d-c scale of the voltmeter.

b. HUM ADJUSTMENT. Connect the vertical amplifier input terminals of the oscilloscope between pin J of receptacle J–404 and the chassis of the modulating voltage generator. Adjust the oscilloscope at a low sweep frequency and look for an indication of the presence of ripple (ac) on the oscilloscope screen. If necessary, adjust hum control R–463 until the ripple is reduced to a minimum.

c. METERING TUBE ADJUSTMENT. Connect the a-c probe of the VTVM between terminals L and M of receptacle J–404. Then adjust potentiometer R–427 (E–W control) for a meter reading of 3 volts (rms). Turn switch S–409 (MOD VOLTAGE LEVEL) to the E–W position and adjust dual rheostat R–446A and R–446B until meter M–401 on the modulating voltage generator also reads 3 volts.

168. Alinement of Bearing Indicator ID–64/CRD–2

The bearing indicator is alined properly at the factory and normally will not require realinement. If faulty operation of the direction finder definitely is traced to misalinement of the bearing indicator, the realinement procedure given below may be used.

Caution: High voltages are exposed during alinement of the bearing indicator.

Note. Realinement should be made by experienced repair personnel only.

a. Connect a 115-volt, 50/60-cycle a-c power source to receptacle P–301 on the rear of the chassis and turn on the bearing indicator.

b. Connect a high-resistance volmeter between ground and the junction of resistors R–375 and R–376. Adjust potentiometer R–377 (voltage control) until the voltmeter indicates 300 volts. Disconnect the voltmeter.

c. Loosely couple a wavemeter or frequency meter to the 200-kc oscillator circuit and adjust capacitor C–303 until coil L–301B resonates at 200 kc, then disconnect the frequency measuring device.

d. Connect a 0 to 5,000-volt, high-resistance voltmeter between ground and the junction of resistor R–310 and capacitor C–311. Adjust capacitor C–307 for maximum indication (about 1,750 volts). Readjust capacitor C–303 and then C–307 for maximum voltage indication. Disconnect the voltmeter.

e. Connect the vertical amplifier input terminals of the test oscilloscope between pin D of receptacle J–303 and the chassis. Adjust the oscilloscope to a low sweep frequency and look for indication of the presence of ripple (ac) on the oscilloscope screen. If necessary, adjust the HUM control, R–381, until the ripple is reduced to a minimum.

f. Center and focus the spot on the screen of the bearing indicator by using panel controls.

g. Connect a source of 7-volt (rms), 147-cps voltage between pin A of receptacle J–303 and the chassis. Connect the a-c probe of a vacuum-tube voltmeter between terminals E and F of receptacle J–303. Then adjust potentiometer R–344 to obtain a reading of 1.5 volts (rms) on the vacuum-tube voltmeter.

h. Adjust the SHAPE (R–360) and SIZE (R–306) controls until the the patterns are as nearly circular as possible and are approximately one quarter inch within the inner diameter of the azimuth scale.

i. Adjust capacitor C–325A for maximum vertical deflection of the patterns and C–335A for maximum horizontal deflection. Superimpose the star-shaped figures that appear in the center of the pattern by adjusting capacitors C–325B and C–335B.

j. To adjust the phase of the blanking voltage used in the sense circuit, split the circular pattern by means of the H or V BEARING SPLITTERS. Then depress the SENSE switch and adjust capacitor C–309 (sense blanking phasing control) until one of the circular patterns disappears or becomes as dim as possible. Release the SENSE switch and again superimpose the circular patterns.

169. Adjustment of Sweep Signal Generator Prior to Alinement of Radio Receiver

Before attempting to aline the i-f stages of the radio receiver, it is necessary to set the main tuning dial of the signal generator to a position which will produce an output signal of exactly 455 kc. This adjustment may be accomplished in the following manner:

a. Turn switch S–104 on the radio receiver to REC MOD, and turn the power on-off switch of the signal generator to on. *Allow both equipments to warm up for about an hour before making any adjustments.*

b. Place SELECTIVITY switch S–102 on the radio receiver to position 3.

c. Connect the output leads of the signal generator between terminal A of transformer T–101 and the chassis of the receiver.

d. Connect the sweep frequency output terminals of the signal generator to the horizontal amplifier terminals of the oscilloscope.

e. Connect the high lead of the vertical amplifier on the oscilloscope to pin 4 of tube V–105, and connect the low lead to the chassis of the receiver.

f. Adjust the signal generator to produce a carrier signal of approximately 455 kc with a bandwidth of zero.

g. Vary the main tuning dial of the signal generator to obtain the maximum vertical trace on the screen of the oscilloscope. At maximum trace, the signal generator is set at exactly 455 kc.

Note. After making this 455-kc adjustment, do not touch the main tuning dial of the signal generator until otherwise noted in the alinement instructions.

170. Preliminary Alinement of I-f Amplifier Stages in Radio Receiver

After completing the signal generator adjustments explained in paragraph 169, make the following connections and adjustments before beginning the actual alinement of the i-f amplifier stages.

a. Rotate the OFF - TRANS - REC MOD - REC CW switch on the radio receiver to REC MOD.

b. Rotate the RF GAIN control on the radio receiver fully clockwise.

c. Rotate the SELECTIVITY switch on the radio receiver to position D/F–2.

d. Rotate the MAN - MAN NL - AVC NL - AVC switch on the radio receiver to AVC.

e. Connect the high vertical amplifier terminal on the oscilloscope to terminal C on transformer T–106 (junction of C–188, R–135, and R–147). Connect the low vertical amplifier terminal on the oscilloscope to the chassis of the radio receiver.

171. Alinement of I–f Amplifier Stages in Radio Receiver

a. THIRD (AUDIO) I-F AMPLIFIER ALINEMENT. With the oscilloscope connected to the diode output as explained in paragraph 170*e*, connect the output leads of the signal generator between the control grid (pin 4) of third i-f (audio) amplifier tube V–107 and the chassis (fig. 50). Then adjust the top and bottom tuning slugs of the fourth i-f transformer, T–106, until a single-peaked trace is obtained on the screen of the oscilloscope. This curve should have a bandwidth of approximately 10 kc at two times down (A, fig. 116). The gain of the third i-f (audio) amplifier stage is approximately 100.

Note. In order to produce the resonant curve on the screen of the oscilloscope (A, fig. 116), it is necessary to adjust the sweep control on the signal generator to a width greater than 20 kc.

b. SECOND I-F AMPLIFIER ALINEMENT. Remove the lead from the control grid of the third i-f (audio) amplifier tube and then connect it to the control grid (pin 4) of the second i-f amplifier tube, V–106. The stages under test are now the second and third i-f amplifiers (transformers T–104, T–105, and T–106); but because transformer T–106 already has been adjusted, only the top and bottom tuning slugs of transformers T–104 and T–105 are to be adjusted at this time.

(1) The position of the SELECTIVITY switch will affect the bandpass curve, because the switch changes the inductance of transformers T–104 and T–105. Therefore, the adjustments should be made first in position 1 of the switch and checked for a symmetrical curve in position 1 (B, fig. 116).

(2) In position 1 of the switch, the response of transformers T–104 and T–105 are double-peaked but the combination of transformers T–104, T–105, and T–106 (as indicated by the curve on the oscilloscope) will be broad and flat-topped (B, fig. 116).

(3) In position D/F–2 of the SELECTIVITY switch, the curve will be somewhat sharper and more rounded (B, fig. 116).

(4) The bandwidth should be about 8.5 kc in position D/F–2 and 15 kc in position 1.

(5) The gain of the second i-f amplifier stage alone is about 3.5 and 6 for positions 1 and D/F–2 of the SELECTIVITY switch, respectively. The gain of the combination of the second and third i-f amplifier stages as checked

in this test should be approximately 350 and 600 for positions 1 and D/F–2 of the switch.

c. FIRST I-F AMPLIFIER ALINEMENT. Remove the lead from the control grid of the second i-f amplifier tube and connect it to the control grid (pin 4) of the first i-f amplifier tube, V–105. The stages under test are now the first, second, and third i-f ampliers (transformers T–102 through T–106), but only transformers T–102 and T–103 are to be adjusted. Each of these transformers has a top and bottom tuning slug. The inductances of transformers T–102 and T–103 are changed with the position of the SELECTIVITY switch in exactly the same manner as for transformers T–104 and T–105. Also, the bandpass for the two sets of transformers is the same. Therefore, the combination of transformers T–102 through T–106 should produce a curve on the oscilloscope which is double-peaked in position 1 of the switch (C, fig. 116) and flat-topped in position D/F–2 of the switch (C, fig. 116). Adjustments of transformers T–102 and T–103 should be made first for position 1 of the switch and checked for symmetrical response in position 1. The bandwidth will be somewhat sharper than for the curve obtained in *b* above. The gain of the first stage alone is approximately 5 and 8 for positions 1 and D/F–2, respectively, and the gain of the combination under test is approximately 1,750 and 4,800.

d. FIRST I-F INPUT CIRCUIT ALINEMENT. Remove the lead of the signal generator from the control grid of the first i-f amplifier tube and connect it to pin 8 of the mixer tube, V–104. Transformer T–101, like transformer T–106, is sharply peaked and is not affected by the setting of the SELECTIVITY switch. This input circuit will transform the double-peaked curve of transformers T–102 through T–106 (*c* above) to a flat-topped curve (D, fig. 116). The gain of the mixer stage alone is approximately 2, and the over-all gain of the mixer and i-f stages is approximately 3,500 and 9,600 for positions 1 and D/F–2, respectively, of the SELECTIVITY switch. The following procedure is used for alinement:

(1) Set the crystal phasing capacitor, C–164, at approximately one-half of its maximum capacity. (This is approximately its final setting, and changing it appreciably will detune transformer T–101 and coil L–126 slightly.)

(2) Adjust the top and bottom tuning slugs of transformer T–101 for maximum deflection on the oscilloscope with the SELECTIVITY switch in position D/F–2.

(3) Switch to position 1 and check the curve for symmetry.

(4) Adjust the phasing control, C–164, to obtain the narrowest bandwidth on the oscilloscope.

e. CRYSTAL LOAD CIRCUIT ADJUSTMENT.

(1) All connections remain as described in *d* above.

(2) Turn the SELECTIVITY switch to position 3.

(3) Adjust the crystal load circuit trimmer (trimmer for coil L–126) for a symmetrical round-topped curve.

(4) Place the SELECTIVITY switch at position 4.

(5) Adjust trimmer capacitor C–172 for a symmetrical curve.

(6) Place the SELECTIVITY switch at position 5.

(7) Adjust capacitor C–170 for a symmetrical curve.

Note. The adjustments explained above are very critical and must be made carefully to obtain symmetrical results.

172. Alinement of Third (Video) I–f Amplifier in Radio Receiver

The third (video) i-f amplifier is alined at 455 kc and the signal generator is kept at exactly the same frequency which was used for alinement of the other i-f amplifiers (pars. 170 and 171). Use the following procedure:

a. Connect the output leads of the signal generator between the control grid (pin 4) of the third (video) i-f amplifier tube, V–112, and the chassis of the radio receiver.

Note. Use a 0.01-uf capacitor in series with the lead of the signal generator which connects to the grid of the tube.

b. Connect a VTVM across resister R–166.

c. Set the OFF - TRANS - REC MOD - REC CW switch to REC MOD.

d. Set the RF GAIN control fully clockwise.

e. Set the SELECTIVITY switch to position D/F–2.

f. Set the MAN - MAN NL - AVC NL - AVC switch to AVC.

g. Adjust the tuning slugs of transformer T–107 for maximum output as indicated on the VTVM. This stage is sharply tuned and has a bandwidth of approximately 10 kc at two times down. The voltage gain is approximately 300.

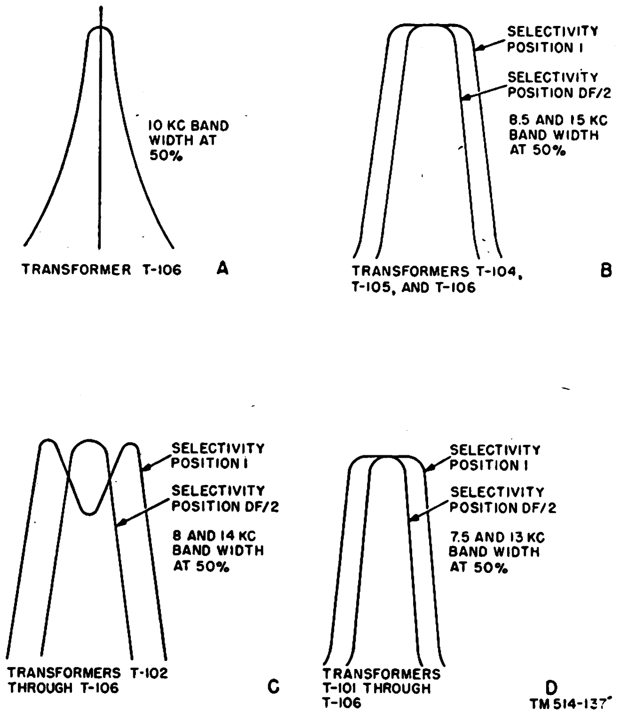


Figure 116. Alinement data.

173. Alinement of H-f Section of Radio Receiver

a. GENERAL. The h-f section (r-f amplifiers, mixer, and h-f oscillator) alinement requires a signal generator capable of furnishing a modulated r-f signal with a frequency range of 535 kc to 32 mc and an output meter. It is desirable to use a loudspeaker in conjunction with the output meter. This speaker should have a voice coil of 2.5 to 3.2 ohms impedance. Connect the meter across the voice coil.

(1) Adjust the signal generator to give the least signal which will produce usable readings on the output indicator.

(2) On the higher frequencies, be sure that the oscillator is alined for tracking on the high-frequency side of the signal.

(3) Use the table in *b* below for all alinement operations. Follow the steps in the order given.

(4) Set the signal generator for a modulated output, and feed the signal to terminals A and B of receptacle J–101 on the rear of the chassis.

(5) Turn the AF GAIN control to full clockwise position.

(6) Turn the RF GAIN control to full clockwise position.

(7) Set the MAN - MAN NL - AVC NL - AVC switch to MAN.

(8) Set the SELECTIVITY switch at position D/F–2.

(9) Turn the OFF - TRANS - REC MOD - REC CW switch to REC MOD.

(10) See the table below for RANGE switch settings.

(11) All r-f alinement adjustments are located on the top of the chassis (fig. 106).

(12) The oscillator should track above the signal frequency on all bands. If more than one peak is obtainable on the oscillator, use the higher frequency peak.

b. ALINEMENT PROCEDURE. The following table lists the alinement procedures in the order that the operations are to be performed.

Note. On band 1, use a 200-uuf capacitor across the antenna input during alinement.

Operation No.	*RANGE switch pos*	*Position of dial*	*Gen freq in kc*	*Position of ANT ADJ control*	*Part adjusted for max. peak output*	*Purpose of adjustment*
1	1	Extreme low end	535	--------	L–113	Low end oscillator
2	1	Extreme high end	1,600	--------	C–129	High end oscillator
3	Repeat 1 and 2 until extreme end frequencies are as indicated.					
4	1	1,500 kc	1,500	Max output	C–116, C–154	1st and 2d r-f

Operation No.	RANGE switch pos	Position of dial	Gen freq in kc	Position of ANT ADJ control	Part adjusted for max. peak output	Purpose of adjustment
5	1	600 kc	600	Untouched	L–101 secondary L–107 secondary L–119 secondary	Antenna and 1st and 2d r-f
6	Repeat 4 and 5 until circuits remain in alinement over the band.					
7	2	Extreme low end	1,570	--------	L–114	Low end oscillator
8	2	Extreme high end	4,550	--------	C–132	High end oscillator
9	Repeat 7 and 8 until extreme end frequencies are as indicated.					
10	2	4,300 kc	4,300	Max output	C–117, C–155	1st and 2d r-f
11	2	1,700 kc	1,700	Untouched	L–102 secondary L–108 secondary L–120 secondary	Antenna and 1st and 2d r-f
12	Repeat 10 and 11 until circuits remain in alinement over the band.					
13	3	Extreme low end	4,450	--------	L–115	Low end oscillator
14	3	Extreme high end	12,150	--------	C–135	High end oscillator
15	Repeat 13 and 14 until extreme end frequencies are as indicated.					
16	3	11,500 kc	11,500	Max output	C–118, C–156	1st and 2d r-f
17	3	4,600 kc	4,600	Untouched	L–103 secondary L–109 secondary L–121 secondary	Antenna and 1st and 2d r-f
18	Repeat 16 and 17 until circuits remain in alinement over the band.					
*19	4	Extreme low end	11,900	--------	L–116	Low end oscillator
20	4	Extreme high end	16,600	--------	C–138	High end oscillator
21	Repeat 19 and 20 until extreme end frequencies are as indicated.					
22	4	16,400 kc	16,400	Max output	C–119, C–157	1st and 2d r-f
23	4	12,100 kc	12,100	Untouched	L–104, L–110, L–122	Antenna and 1st and 2d r-f
24	Repeat 22 and 23 until circuits remain in alinement over the band.					
*25	5	Extreme low end	16,100	--------	L–117	Low end oscillator
26	5	Extreme high end	22,700	--------	C–141	High end oscillator
27	Repeat 25 and 26 until extreme frequencies are as listed.					
28	5	22,500 kc	22,500	Max output	C–121, C–159	1st and 2d r-f
29	5	16,400 kc	16,400	Untouched	L–105, L–111, L–123	Antenna and 1st and 2d r-f
30	Repeat 28 and 29 until circuits remain in alinement over the band.					
*31	6	Extreme low end	22,000	--------	L–118	Low end oscillator
32	6	Extreme high end	32,000	--------	C–144	High end oscillator
33	Repeat 31 and 32 until extreme end frequencies are as indicated.					
34	6	31,500 kc	31,500	Max output	C–123, C–161	1st and 2d r-f
35	6	22,500 kc	22,500	Untouched	L–106, L–112, L–124	Antenna and 1st and 2d r-f
36	Repeat 34 and 35 until circuits remain in alinement over the band.					

* On all coils except L–116, L–117, and L–118, bands 4, 5, and 6 oscillator coils, respectively, turning the core clockwise increases the inductance. On the three above-mentioned coils, turning the core clockwise decreases the inductance.

174. Adjustment of Beat-Frequency Oscillator in Radio Receiver

a. On the radio receiver, set the OFF-TRANS-REC MOD-REC CW switch to REC MOD and the SELECTIVITY switch to position D/F–2.

b. Turn on the signal generator.

c. Allow about an hour for both equipments to warm up.

d. Connect the output leads of the signal generator to terminals A and B of receptacle J–101 of the radio receiver and feed a modulated signal into the radio receiver.

e. Tune the radio receiver to the frequency of the output signal of the signal generator and rock the tuning dial of the receiver until the signal is tuned to exact resonance.

f. Remove the modulation from the output of the signal generator and set the OFF-TRANS-REC MOD- REC CW switch on the radio receiver to REC CW. The latter action turns on the bfo in the radio receiver.

g. Rotate the pointer of the BFO ADJ control until the pointer on the knob is straight up.

h. Adjust the tuning slug of coil L–135, if necessary, to produce a zero beat (no audio output from speaker). Zero beat is obtained if further rotation of the tuning slug (or BFO ADJ control), in either direction, produces an audio tone.

Section XI. FINAL TESTING

Note. Final testing should be performed by personnel who are familiar with the operation of this radio set.

175. Over-All Performance Tests for Radio Set AN/CRD–2

a. The over-all performance tests described in this section require the use of the following components of Radio Set AN/CRD–2:

Quantity	*Name of component*
1	Junction Box J–95/CRD–2
1	Voltage Distribution Unit J–59/CRD–2
1	Coupling Unit CU–68/CRD–2
1	Coupling Unit CU–69/CRD–2
4	Antenna Coupling Unit CU–34/CRD–2
1	Radio Receiver R–127/CRD–2
1	Bearing Indicator ID–64/CRD–2
1	Modulating Voltage Generator O–15/CRD–2
1	Azimuth Indicator ID–240/CRD–2
4	Cord CG–240/CRD–2 (9 ft, 8 in. lg, color-coded green)
4	Cord CG–240/CRD–2 (9 ft, 8 in. lg, color-coded red)
4	Cord CG–240/CRD–2 (17 ft, 2 in. lg, color-coded green)
4	Cord CG–240/CRD–2 (17 ft, 2 in. lg, color-coded red)
4	Cord CX–455/CRD–2 (9 ft, 8 in. lg, no color code)
4	Cord CX–455/CRD–2 (17 ft, 2 in. lg, no color code)
1	Cord CG–239/CRD–2
1	Cord CX–454/CRD–2 (150 ft lg)
1	Cord CX–1114/CRD–2 (6 ft lg)
1	Cord CX–452/CRD–2 (150 ft lg)
1	Cord CX–1116/CRD–2 (6 ft lg)
1	Cord CX–1115/W (10 ft lg)
1	Cord CX–639/CRD–2
1	Set of interconnecting cables for rack
1	Complete set of spare r-f, power, and control cables

b. Connect the components for operation in accordance with the installation instructions given in section I of chapter 2 of this manual, except that the installation can be made indoors (if desired) and Antenna Supports AB–64/CRD–2, horizontal Supports MT–333/CRD–2, Counterpoise MX–313/CRD–2 and the monopole antennas are omitted.

176. Test Equipment Required for Final Testing

Use a standard signal generator of known accuracy and good stability and a VTVM. Signal Generator TS–588/U and Electronic Multimeter TS–505/U are suitable instruments.

177. Measurements in Frequency Range of 4 to 30 Mc

Use the components associated for operation in this frequency range; that is, Coupling Unit CU–69/CRD–2, 8 Cords CG–240/CRD–2 (9 feet, 8 inches long, 4 color-coded green and 4 color-coded red), and 4 Cords CX–455/CRD–2 (9 feet, 8 inches long).

a. PRELIMINARY ADJUSTMENTS. After installation, turn the test equipment and the radio set on and allow them to warm up for approximately 15 minutes.

b. RADIO RECEIVER R–127/CRD–2 ADJUSTMENTS.

(1) Set the SELECTIVITY control at the D/F–2 position.
(2) Set the MAN - MAN NL - AVC NL - AVC switch at the MAN position.
(3) Set the OFF - TRANS - REC MOD - REC CW switch at the REC MOD position.

c. BEARING INDICATOR ID–64/CRD–2 ADJUSTMENTS.

(1) Adjust the INTENSITY and FOCUS controls to produce a clear, well-defined pattern.
(2) Superimpose the patterns by means of the H and V BEARING SPLITTER controls.
(3) Adjust the PATTERN SHAPE control to produce a circular pattern.
(4) Reduce the size of the pattern to a dot by means of the PATTERN SIZE control.
(5) Center the dot by means of the H and V CENTERING controls.
(6) Increase the size of the dot until the circular pattern coincides with the inner diameter of the azimuth scale.

Note. Rotation of the PATTERN SIZE control will not cause the pattern to split.

d. AZIMUTH INDICATOR ID–240/CRD–2 ADJUSTMENTS.

(1) Set the VISUAL-AURAL switch to the AURAL position, and adjust the MODULATING LEVEL control to produce a 3-volt indication. The indication will appear on the IND-ANT MODULATING VOLTAGE meter on the modulating voltage generator when the MOD VOL switch is thrown to AURAL.
(2) Return the VISUAL-AURAL switch to the VISUAL position. Also return the MOD VOL switch on the modulating voltage generator to VISUAL.

e. ANTENNA COUPLING UNITS CU–34/CRD–2 ADJUSTMENTS. Set the SENSE switch at the H position.

f. MODULATING VOLTAGE GENERATOR O–15/CRD–2.

(1) Set the STAND-BY - OPERATE - SPLIT switch at OPERATE.
(2) A reading of 300 volts should be obtained when the E_B IND - E_B GEN - I_K ANT MOD switch is set at either the E_B IND OR E_B GEN position. Adjust to 300 volts, if necessary, by adjustment of voltage controls R–465 and R–377.
(3) Adjust the MODULATING VOLTAGE LEVEL OVER-ALL control to bring the reading of the IND-ANT MODULATING VOLTAGE meter to 3 volts when the MOD VOLTAGE LEVEL switch is at the OVER-ALL position.
(4) Adjust the MODULATING VOLTAGE LEVEL E–W control to bring the reading of the IND-ANT MODULATING VOLTAGE meter to 3 volts when the MOD VOLTAGE LEVEL switch is at the E–W position.
(5) With the NORTH switch in the TEST position and the EAST, SOUTH, and WEST switches at OFF, adjust the LEVEL control above the NORTH switch to bring the reading of the IND-GEN-ANT VOLT-MILLIAMMETER to 10 ma.
(6) Repeat the operation of (5) above for the EAST, SOUTH, and WEST switches.
(7) Feed a 13-mc 1,000-microvolt signal from a standard signal generator to the input of the north Antenna Coupling Unit CU–34/CRD–2, and connect a VTVM to the output of the video channel of the radio receiver (receptacle J–104). Tune the radio receiver to the frequency of the signal generator, and adjust the RF GAIN control on the radio receiver to produce a bearing pattern (A, fig 3). If the pattern is split, superimpose the pattern by means of the NORTH BALANCE control. Repeat the above operations for the east, south, and west

antenna coupling units, using the EAST, SOUTH, and WEST BALANCE controls, respectively. With the equipment adjusted for normal operation, these controls will have sufficient additional range to permit compensation for variations occurring during field use.

178. Sensitivity Tests

The sensitivity should not exceed the limits indicated below when measured in accordance with the instructions given in *a* and *b* below. Make the measurements at the following frequencies:

Test frequency (mc)	Limits (approx.)	
	D/F sensitivity (microvolts)	Stand-by sensitivity (microvolts)
4	8.0	----
6	8.0	----
10	9.0	----
13	9.0	12
16	9.0	----
18	8.0	----
22	8.0	----
24	7.5	----
30	7.5	----

a. Rotate the NORTH, EAST, SOUTH, and WEST switches on the modulating voltage generator to the OPER position. Then connect the output of the signal generator to the input of the north Antenna Coupling Unit CU–34/CRD–2. Ground the inputs of the other three Antenna Coupling Units CU–34/CRD–2. Tune the signal generator to the test frequency, and tune the radio receiver to resonance with the frequency of the signal generator, as indicated by maximum indication on the VTVM. Then complete the following tests:

(1) Adjust the signal generator for zero output. Then adjust the RF GAIN control on the radio receiver for a 1-volt noise output as indicated by the VTVM.

(2) Without changing the position of the RF GAIN control, increase the output of the signal generator to produce a 3-volt indication on the VTVM. Record the microvolt output of the signal generator (input to the coupling unit) as the D/F (direction finding) sensitivity.

Note. At 24 mc, use a 0.5-volt noise to 1.5-volt signal-plus-noise reference.

b. Rotate the STAND-BY - OPERATE - SPLIT switch on the modulating voltage generator to the STAND-BY position and repeat the operations of *a* above to obtain the stand-by sensitivity (only at 13 mc).

179. Balance Tests

The ratios obtained in the balance test described in *a* and *b* below should not be less than the following values:

Test frequency (mc)	Balance ratio limits (approx.)	
	North-South	East-West
4	40 to 1	40 to 1
6	40 to 1	40 to 1
10	40 to 1	40 to 1
13	40 to 1	40 to 1
16	35 to 1	35 to 1
18	35 to 1	35 to 1
22	20 to 1	20 to 1
24	20 to 1	20 to 1
30	10 to 1	10 to 1

a. Balance Adjustment.

(1) Set the STAND-BY - OPERATE - SPLIT switch on the modulating voltage generator at OPERATE.

(2) Set the EAST and WEST switches on the modulating voltage generator at OFF.

(3) Set the NORTH and SOUTH switches at TEST.

(4) Connect the antenna inputs of the north and south Antenna Coupling Units CU–34/CRD–2 in parallel, and connect the output of the signal generator between the exact center of the parallel connection and ground.

(5) Adjust the signal generator to 13 mc at an output level of 2,000 microvolts. Tune the radio receiver to resonance at 13 mc, as indicated by maximum deflection of the VTVM.

(6) Adjust the tube currents of the north and south antenna coupling units to 10 ma each by means of the LEVEL controls on the modulating voltage generator. The current is indicated on the IND-GEN-ANT VOLT-MILLIAMMETER when the NORTH (or SOUTH) switch is at TEST and the other three switches are at OFF.

(7) The BALANCE and LEVEL controls above the NORTH and SOUTH switches, should be adjusted as necessary until the indication of the VTVM is minimum. Adjust capacitor C–809 on the antenna coupling units for minimum indication on the VTVM.

(8) After performing the balance adjustment, the difference in the tube corrent for the north antenna coupling unit and the south antenna coupling unit should not be greater than 4 ma at a mean level of approximately 10 ma.

b. Balance Ratio Test.

(1) After completing the adjustment of *a* above, disconnect the signal generator from the south antenna coupling unit and adjust the output of the signal generator to 100 microvolts at the test frequency.

(2) Tune the radio receiver to resonance with the signal generator output, and adjust the RF GAIN control for a 4-volt output, as indicated by the VTVM.

(3) Reconnect the signal generator in parallel with the north and south antenna coupling units as explained in *a* above, set the NORTH and SOUTH switches at TEST, and, without changing any radio receiver control, increase the signal generator output level until the VTVM again indicates 4 volts. Record the output of the signal generator at this time. Obtain the ratio of this output to 100 microvolts, and record this ratio. Then repeat the operations explained in this subparagraph for each of the other test frequencies.

(4) Repeat the operations of *a* and *b*(1) through (3) above, using the east and west antenna coupling units.

180. Visual Bearing Check

a. Throw the NORTH, EAST, SOUTH, and WEST switches to OPER. Then feed a 13-mc, 1,000-microvolt signal to the north antenna coupling unit. Tune the radio receiver to resonance at 13 mc and adjust the RF GAIN control to obtain a 4-volt indication on the VTVM. By means of the ORIENTATION control on the bearing indicator, orient the bearing pattern to read 0°. Record the reading of the VTVM and, without changing any control on the radio receiver or signal generator, successively connect the output of the signal generator to the inputs of the east, south, and west antenna coupling units. Adjust the LEVEL controls as necessary to provide the same VTVM indication for all four antenna coupling units. Also, superimpose any pattern which might be split.

b. Reconnect the output of the signal generator to the north antenna coupling unit and record the north bearings at the following test frequencies: 4, 6, 10, 13, 16, 18, 22, 24, and 30 mc.

c. Connect the signal generator successively to the north and east, east, east and south, south, south and west, west, and west and north antenna coupling units. Record the bearings for each azimuth position at the test frequencies listed in *b* above.

d. There should be no bearing shift in azimuth with radio receiver tuning. The bearings recorded at 0°, 45°, 90°, 135°, 180°, 225°, 270°, and, 315° positions (*c* above) should not vary by more than plus or minus 2° from the true direction indicated above.

e. After the patterns are initially superimposed at 13 mc, the patterns obtained in *b* and *c* above at the frequencies indicated in *b* above should not be split by more than 2° from tip to tip.

181. Aural-Null Bearing Check

a. Feed a 13-mc, 1,000-microvolt signal to the north antenna coupling unit. (The north bearing should be 0°.) Record the direct and reciprocal visual bearings obtained. Set the VISUAL-AURAL switch on the azimuth indicator at AURAL. Orient the azimuth scale with respect to the sinusoidal potentiometer to produce a null at 0°. Then rotate the azimuth scale approximately 180° and record the reciprocal null obtained.

b. Return the VISUAL-AURAL switch to the VISUAL position. Connect the signal generator, in turn, to the north and east, east, east and south, south, south and west, west, and west and north antenna coupling units. For each of the above azimuth positions, record the visual bearings (direct and reciprocal) and the aural-null direct and reciprocal bearings after setting the VISUAL-AURAL switch to AURAL.

c. The error between the direct and reciprocal aural-null bearings when checked against an unsplit visual bearing should not be more than plus or minus 3° (approx.) Where a direct and reciprocal error exists, correct each bearing to produce a 180° difference by applying one-half of the error to the direct and one-half of the error to the reciprocal bearing. After applying the above correction, the bearings should conform to the plus and minus 2° accuracy specified in paragraph 180*d*.

182. Measurements in the Frequency Range of 0.55 to 6 Mc

Use Coupling Unit CU–68/CRD–2, 8 Cords CG–240/CRD–2 (17 feet, 2 inches long, 4 color-coded red and 4 color-coded green), and 4 Cords CX–455/CRD–2 (17 feet, 2 inches long).

a. Use the same adjustments as described in paragraph 177 with the following exceptions: Throw the SENSE switch on the Antenna Coupling Units CU–34/CRD–2 to the L position, use the frequency of 2.5 mc instead of 13 mc as given in paragraph 177*f*(7).

b. Measure the sensitivity as described in paragraph 178, using the test frequencies and limits that follow:

Frequency (mc)	Limits	
	D/F sensitivity (microvolts)	Stand-by sensitivity (microvolts)
0.55	8.5	----
0.75	7.5	----
1.0	7.5	----
2.0	9.5	----
2.5	9.5	10.0
4.0	9.5	----
6.0	13.0	----

c. Conduct the balance test as described in paragraph 179; however, perform the balance adjustment at 2.5 mc and use the balance ratio given below:

Frequency (mc)	Balance ratio limits	
	North-South	East-West
0.55	35 to 1	35 to 1
0.75	40 to 1	40 to 1
1.0	40 to 1	40 to 1
2.0	40 to 1	40 to 1
2.5	40 to 1	40 to 1
4.0	40 to 1	40 to 1
6.0	30 to 1	30 to 1

d. Perform the visual bearing check as explained in paragraph 180; however, use the frequency of 2.5 mc instead of 13 mc (par. 180*a*), and use the test frequencies of 0.55 mc, 0.75 mc, 1.0 mc, 2.0 mc, 2.5 mc, 4.0 mc, and 6.0 mc in place of those given in paragraph 180*b*. The limits should be the same as those indicated in paragraphs 180*d* and 180*e*.

e. Perform the aural-null bearing check as outlined in paragraph 181, using the signal frequency of 2.5 mc. The limits should be the same as those specified in paragraph 181*c*.

CHAPTER 6

SHIPMENT AND LIMITED STORAGE AND DEMOLITION TO PREVENT ENEMY USE

Section I. SHIPMENT AND LIMITED STORAGE

183. Disassembly

Disassemble the radio set by reversing the applicable procedures for its installation given in chapter 2 of this manual. The disassembly procedure is outlined below:

a. Remove cords from Junction Box J–95/CRD–2.

b. Remove all cords from Azimuth Indicator ID–240/CRD–2.

c. Remove the cords which connect Rack MT–332/CRD–2 to other components not contained in the rack.

d. Remove all ground connections for the radio set.

e. Lower the monopoles and disassemble them.

f. Remove all interconnecting cords and cables from the antenna system.

g. Disassemble the antenna support structure.

h. Fold the counterpoise.

i. Roll cables on reels.

j. Disassemble the tripod assembly for the target transmitter.

184. Repacking for Shipment or Limited Storage

a. After disassembling the radio set, take inventory of all equipment to make sure that no parts are missing. Check completeness of parts against the table of components (par. 7).

b. Using the table of components as a guide, repack all components in their respective chests or crates.

c. After all components have been replaced in accordance with the instructions given above, the crates and chests are, in turn, prepared for shipment or limited storage. The exact method which will be used depends upon the material available and the conditions under which the equipment is to be shipped or stored. Figures 4 and 5 show typical packaging methods.

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

Section II. DEMOLITION OF MATÉRIEL TO PREVENT ENEMY USE

185. General

The demolition procedures outlined in paragraph 186 and 187 will be used to prevent the enemy from using or salvaging this equipment. Demolition of the equipment will be accomplished *only* upon order of the commander.

186. Methods of Destruction

a. SMASH. Use sledges, axes, handaxes, pickaxes, hammers, crowbars, and heavy tools.

b. CUT. Use axes, handaxes, and machetes.

c. BURN. Use gasoline, kerosene, oil, flame throwers, and incendiary grenades.

d. EXPLOSIVES. Use firearms, grenades, and TNT.

e. OTHER. *Use anything immediately available for destruction of this equipment.*

f. DISPOSAL. Bury in slit trenches, fox holes. and other holes. Throw in streams. Scatter.

187. Destruction of Components

a. *Smash* meters, controls, tubes, switches, capacitors, coupling units, panels, and chassis.

b. *Cut* cords and wiring.

c. *Burn* cords, technical manuals, coupling units, wiring and spare parts.

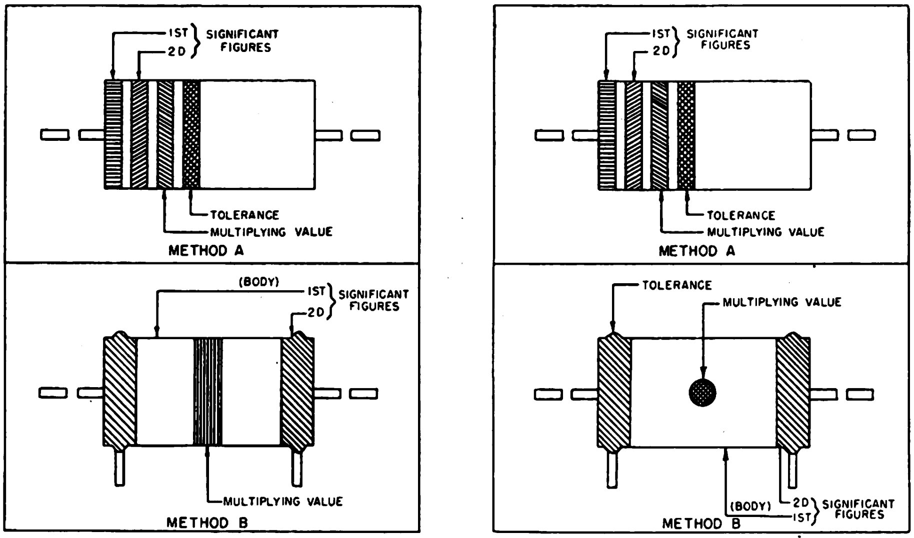
d. *Bury or scatter* all the destroyed parts.

e. *Destroy* everything.

RESISTOR COLOR CODES

RMA COLOR CODE FOR FIXED COMPOSITION RESISTORS*

JAN COLOR CODE FOR FIXED COMPOSITION RESISTORS†



A B

COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE	TOLERANCE (%)
BLACK	0	1	± –
BROWN	1	10	± 1
RED	2	100	± 2
ORANGE	3	1,000	± 3
YELLOW	4	10,000	± 4
GREEN	5	100,000	± 5
BLUE	6	1,000,000	± 6
VIOLET	7	10,000,000	± 7
GRAY	8	100,000,000	± 8
WHITE	9	1,000,000,000	± 9
GOLD	–	0.1	± 5
SILVER	–	0.01	± 10
NO COLOR	–	–	± 20

NOTES

* INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A NATURAL TAN BACKGROUND COLOR. NON-INSULATED FIXED COMPOSITION RESISTORS WITH AXIAL LEADS ARE DESIGNATED BY A BLACK BACKGROUND.

† RESISTORS WITH AXIAL LEADS ARE INSULATED. RESISTORS WITH RADIAL LEADS ARE NON-INSULATED.

RMA RADIO MANUFACTURERS ASSOCIATION

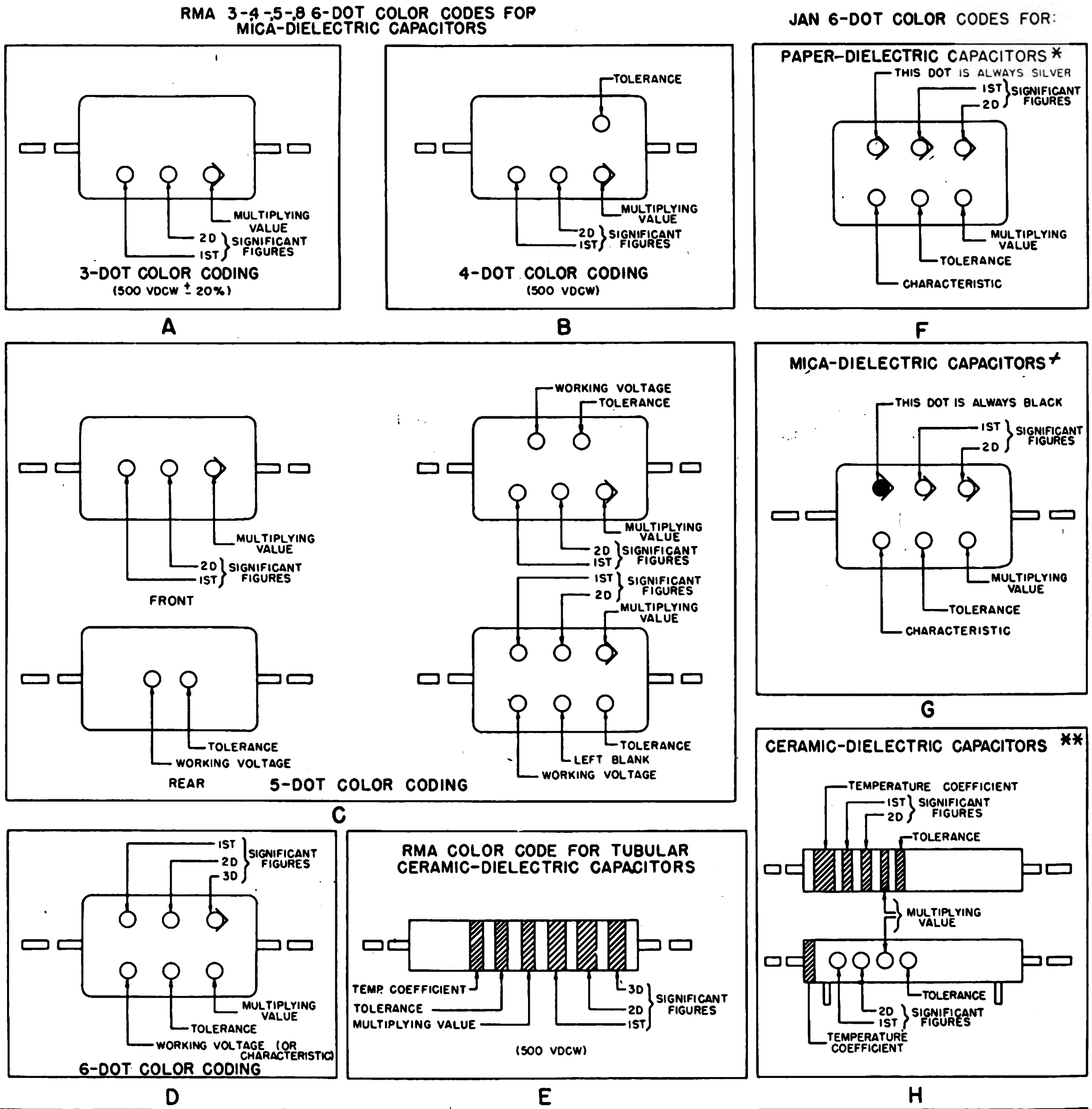
JAN JOINT ARMY-NAVY

THESE COLOR CODES GIVE ALL RESISTANCE VALUES IN OHMS

TL 32454S

Figure 117. Resistor color codes.

CAPACITOR COLOR CODES



COLOR	SIGNIFICANT FIGURE	MULTIPLYING VALUE			RMA VOLTAGE RATING
		RMA MICA-AND CERAMIC-DIELECTRIC	JAN MICA-AND PAPER-DIELECTRIC	JAN CERAMIC-DIELECTRIC	
BLACK	0	1	1	1	-
BROWN	1	10	10	10	100
RED	2	100	100	100	200
ORANGE	3	1,000	1,000	1,000	300
YELLOW	4	10,000	10,000		400
GREEN	5	100,000			500
BLUE	6	1,000,000			600
VIOLET	7	10,000,000			700
GRAY	8	100,000,000		0.01	800
WHITE	9	1,000,000,000		0.1	900
GOLD	-	0.1	0.1		1,000
SILVER	-	0.01	0.01		2,000
NO COLOR	-				500

NOTES

* THE SILVER DOT IDENTIFIES THIS MARKING FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

✝ THE BLACK DOT IDENTIFIES THIS MARKING. FOR WORKING VOLTAGES SEE JAN TYPE DESIGNATION CODE.

** CAPACITORS MARKED WITH THIS CODE HAVE A VOLTAGE RATING OF 500 VDCW. EITHER THE BAND OR DOT CODE MAY BE USED FOR BOTH INSULATED (AXIAL-LEAD) OR UNINSULATED (RADIAL-LEAD) CAPACITORS.

RMA RADIO MANUFACTURERS ASSOCIATION

JAN: JOINT ARMY-NAVY

THESE COLOR CODES GIVE CAPACITANCES IN MICROMICROFARADS.

TL 32453S

Figure 118. Capacitor color codes.

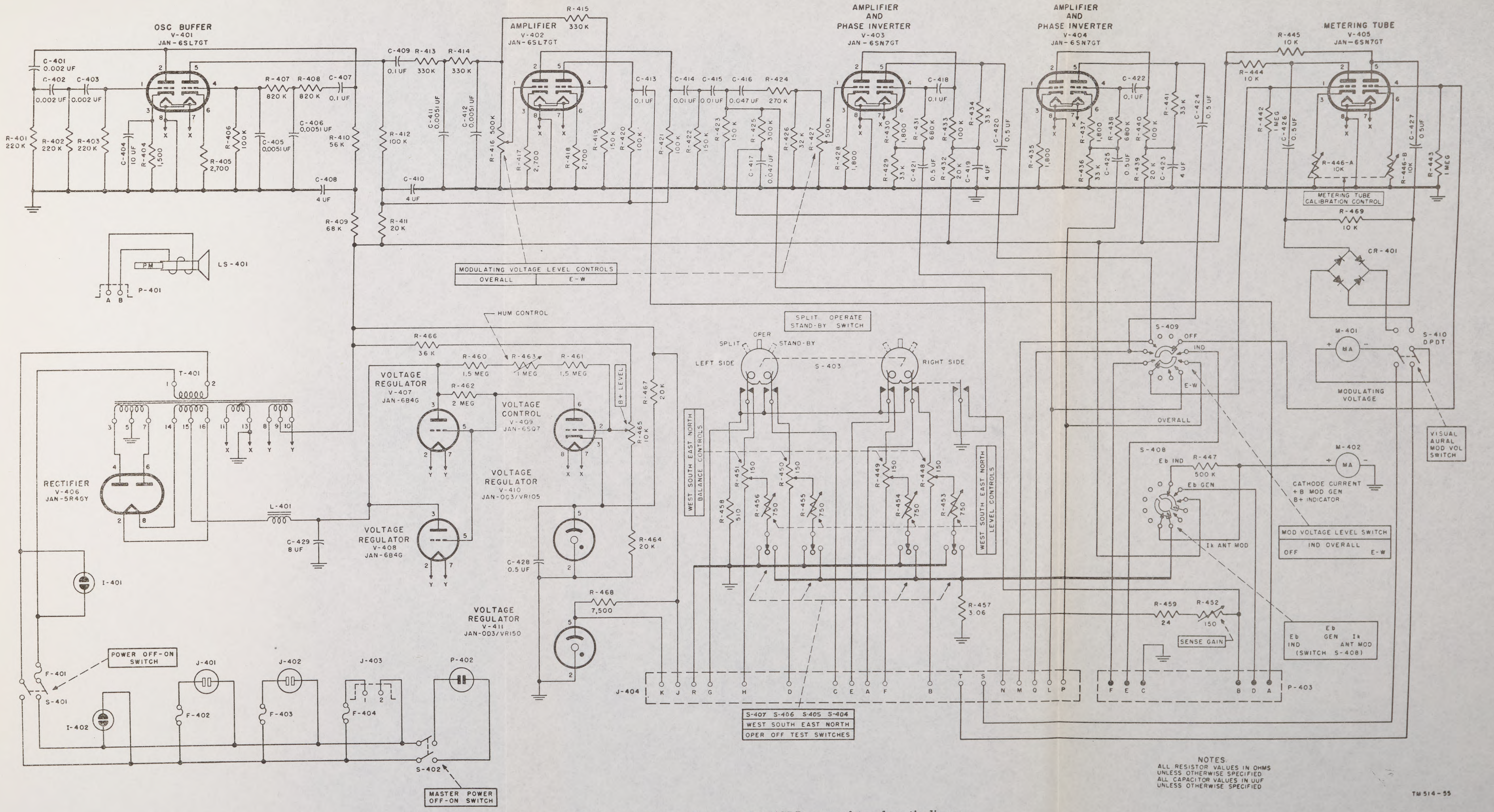


Figure 119. Modulating Voltage Generator O-15/CRD-2, complete schematic diagram.

NOTES

RANGE SWITCH SHOWN IN MAXIMUM COUNTER-CLOCKWISE POSITION (BAND 1) AS VIEWED FROM FRONT OR KNOB END OF SWITCH --

BAND	RANGE
1	535–1,600 KC
2	1,570–4,550 KC
3	4,450–12,150 KC
4	11,900–16,600 KC
5	16,100–22,700 KC
6	22,000–32,000 KC

2 RANGE SWITCH SHOWN IN POSITION 1 (BAND 1) SELECTIVITY SWITCH (S-102A, S-102B, S-102C, S-102D) SHOWN IN POSITION 1 (BROAD)

3 AVC NOISE LIMITER SWITCH (S-103A, S-103B) SHOWN IN MANUAL POSITION WITHOUT NOISE LIMITER

4 OFF-TRANSM-REC SWITCH (S-104A, S-104B) SHOWN IN "OFF" POSITION

5 ALL RESISTOR VALUES IN OHMS UNLESS OTHERWISE SPECIFIED.

6 ALL CAPACITOR VALUES IN UUF UNLESS OTHERWISE SPECIFIED

* TERMINALS SHOWN UNWIRED, BUT WITH CONTACTS, ARE ACTUALLY WIRED TO SIMILARLY NUMBERED TERMINALS ON OTHER SECTIONS OF THIS SWITCH AS FOLLOWS: TERMINALS OF SECTION B TO TERMINALS OF SECTION A, SECTION F TO SECTION E, H TO G, J TO I, L TO K, N TO M AND P TO O.

Figure 120. Radio Receiver R-127/CRD-2, complete schematic diagram.

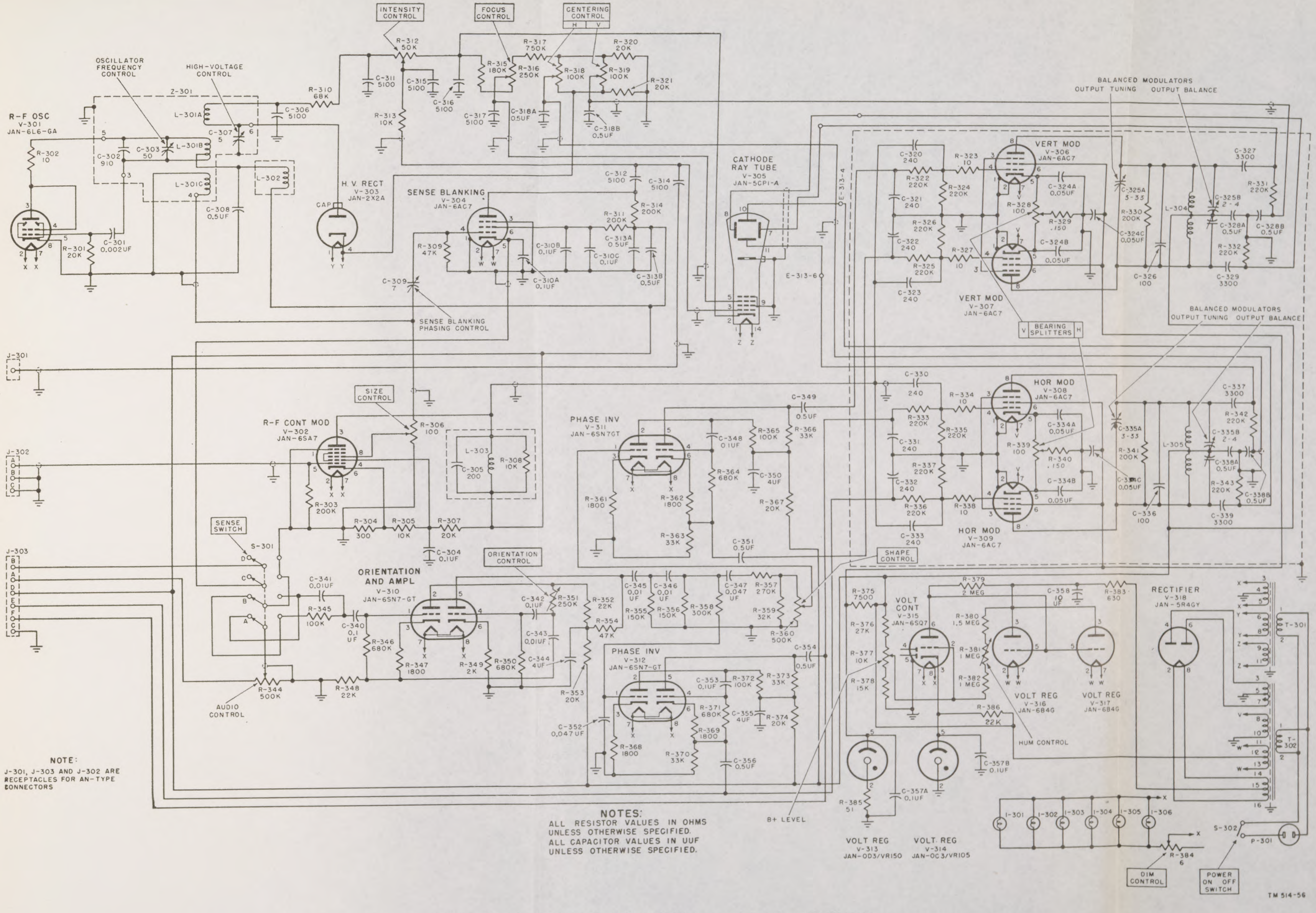


Figure 121. Bearing Indicator ID–64/CRD–2, complete schematic diagram.

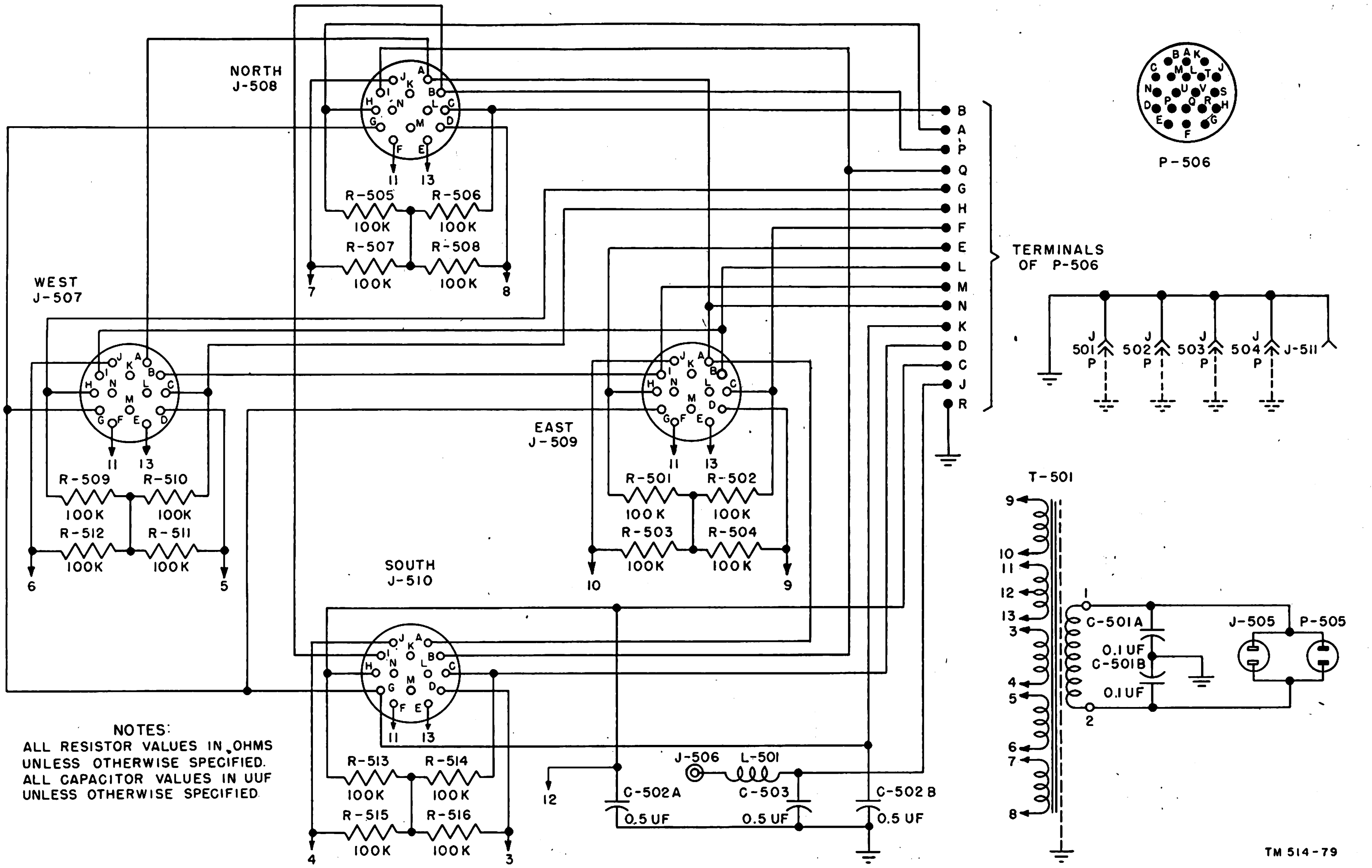


Figure 122. Voltage Distribution Unit J–59/CRD–2, complete schematic diagram.

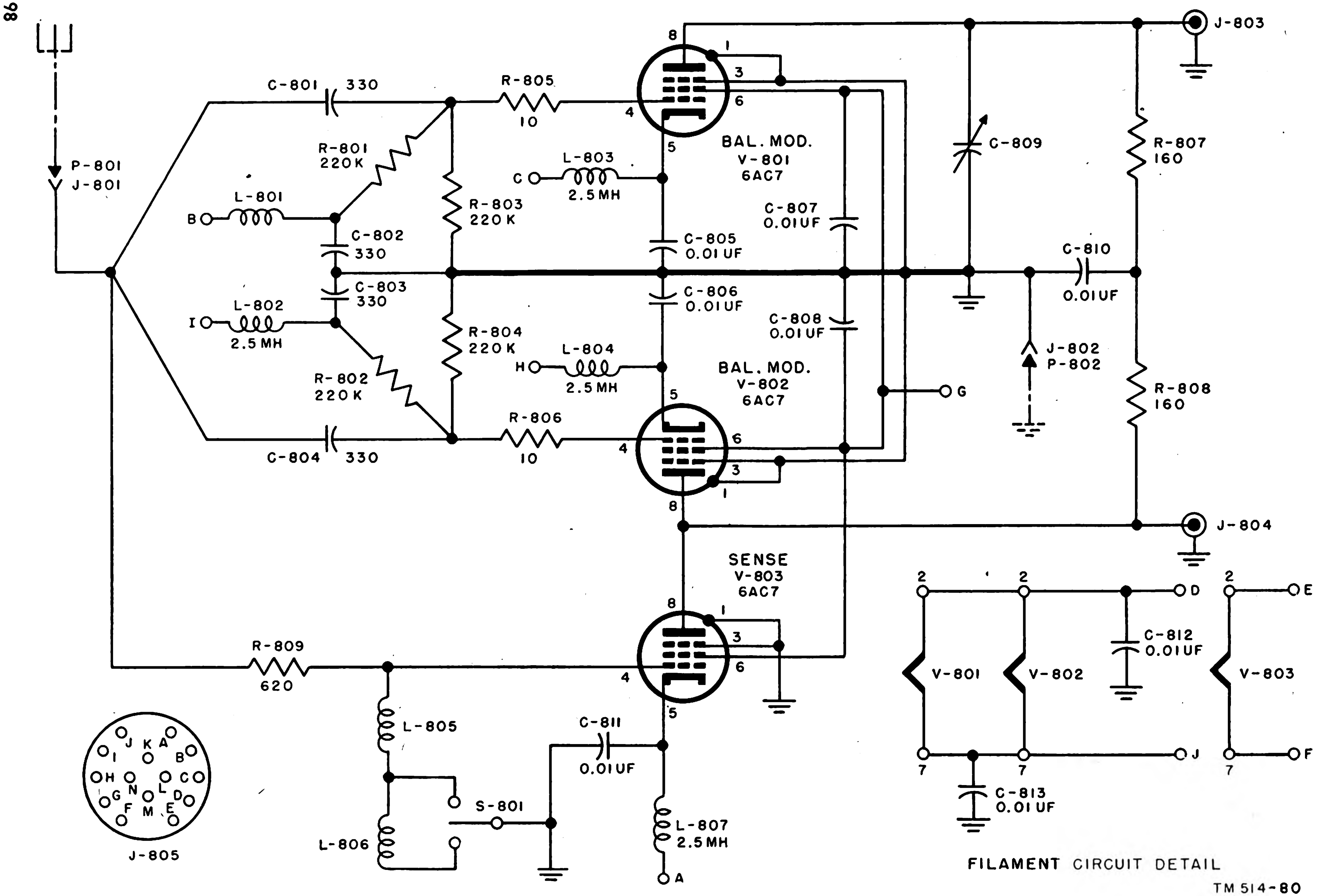
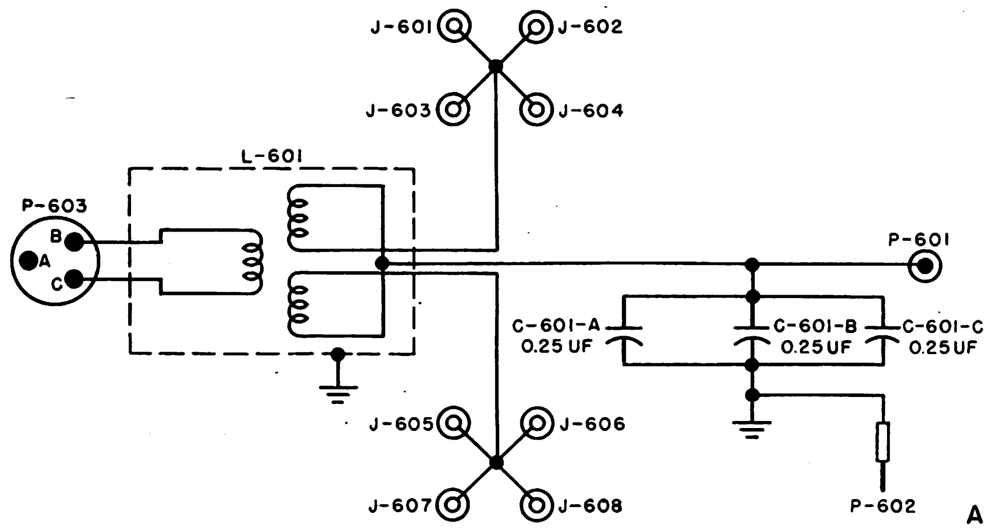
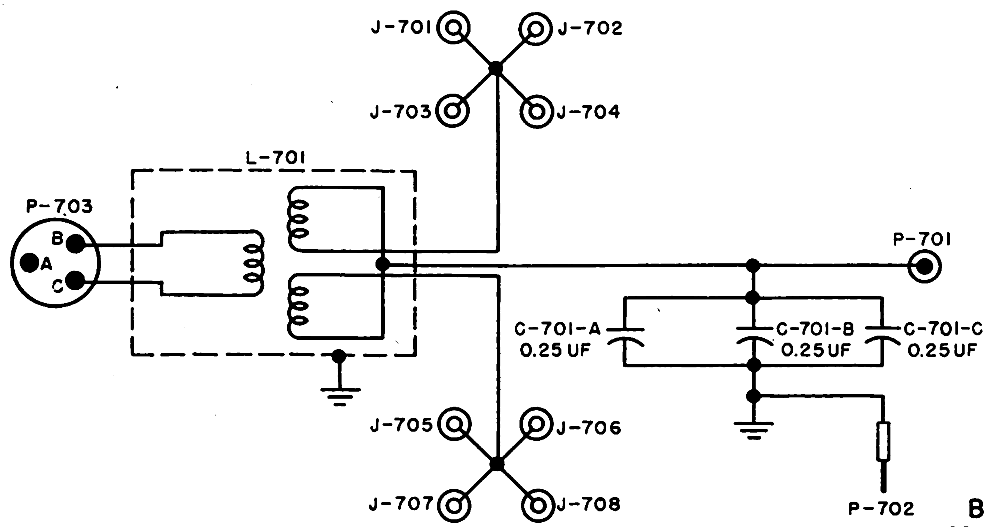


Figure 123. Antenna Coupling Unit CU-34/CRD-2, complete schematic diagram.





A. Coupling Unit CU–68/CRD–2, complete schematic diagram.
B. Coupling Unit CU–69/CRD–2, complete schematic diagram.

Figure 124.

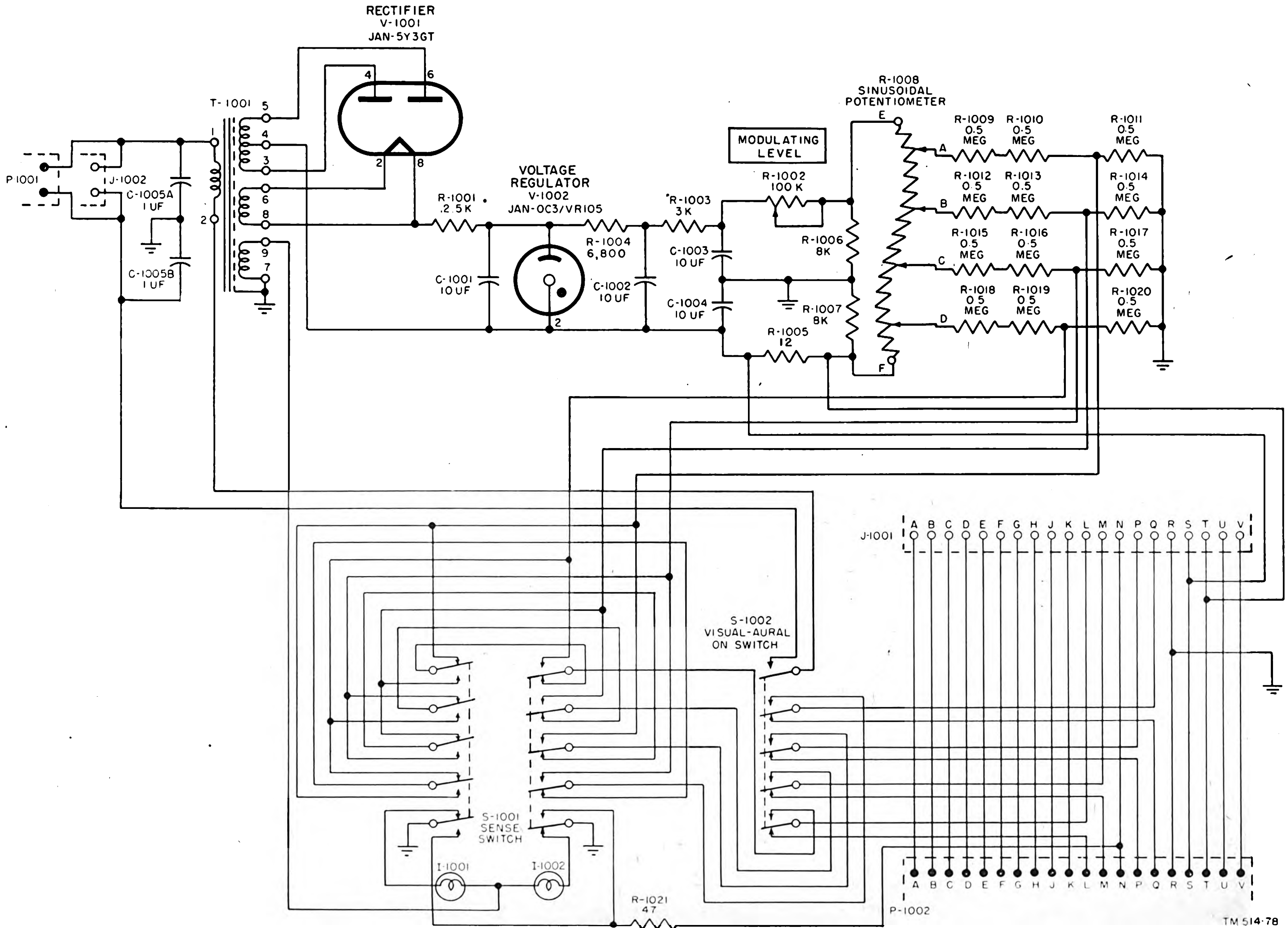


Figure 125. Azimuth Indicator ID–240/CRD–2, complete schematic diagram.

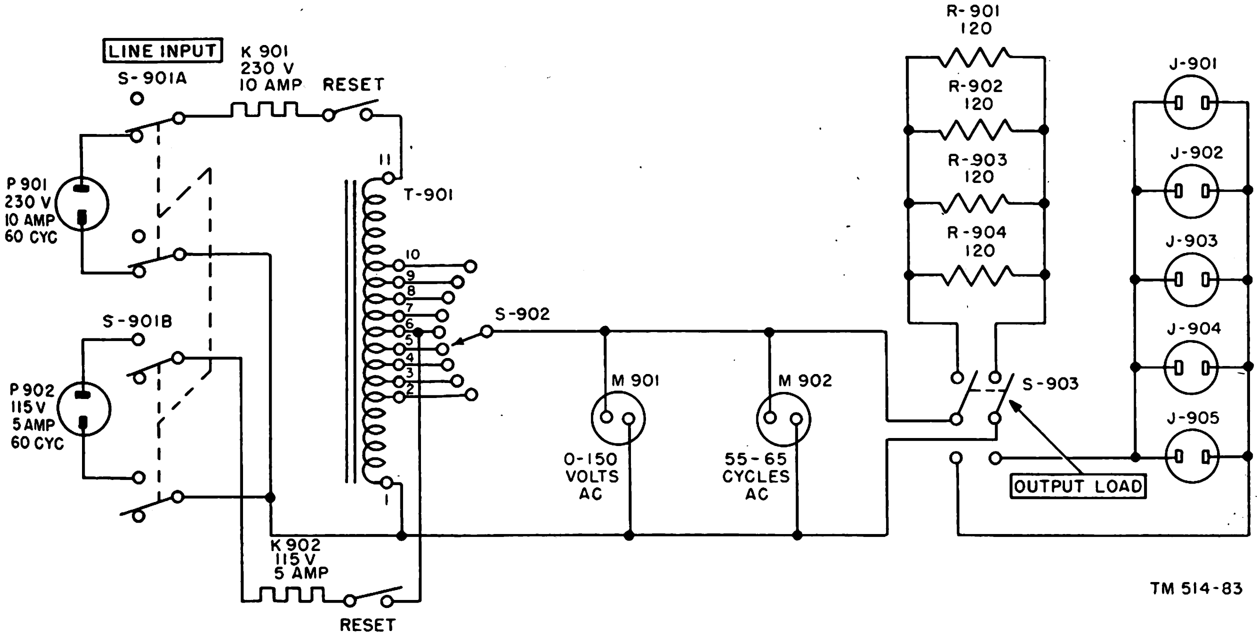


Figure 126. Junction Box J–95/CRD–2, complete schematic diagram.

APPENDIX I

REFERENCES

Note. For availability of items listed, consult FM 21–6 and DA Supply Catalog SIG 1. See also 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 4–2 ------ Allowances of Expendable Supplies for Schools, Training Centers, Boards, and Fixed Installations.
SIG 10 ------- Fixed Plant Maintenance Lists.
SB 11–17 ----- Electron Tube Supply and Reference Data.
SB 11–76 ----- Signal Corps Kit and Materials for Moisture- and Fungi-Resistant Treatment.

3. Technical Manuals on Auxiliary Equipment and Test Equipment

TM 11–300 ---- Frequency Meter Sets SCR–211–(*).
TM 11–303 ---- Test Sets I–56C, –D, –H, and –J.
TM 11–307 ---- Signal Generators I–72–G, H, J, and K.
TM 11–849 ---- Radio Transmitter BC–1149–A.
TM 11–2524 --- Oscillator I–151–A.
TM 11–2526 --- Oscilloscope BC–1060–A.
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.
TM 9–2851 ---- Painting Instructions for Field Use.

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–P–100 --- General Specifications.
JAN–P–116 --- Preservation, Methods of.

b. SIGNAL CORPS INSTRUCTIONS.

720–7 -------- Standard Pack.
726–15 ------- Interior Marking.

9. Other Publications

FM 24–18 ----- Radio Communication
TB SIG 25 ---- Preventive Maintenance of Power Cords.
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.
TB 11–499–(*) - Basic Radio Propagation Predictions.

(A new TB in this series is issued monthly and gives propagation predictions 3 months in advance.)

TM 1–455	Electrical Fundamentals.
TM 11–314	Antennas and Antenna Systems.
TM 11–455	Radio Fundamentals.
TM 11–466	Radar Electronic Fundamentals.
TM 11–476	Radio Direction Finding.
TM 11–483	Suppression of Radio Noises.
TM 11–499	Radio Propagation Handbook.
TM 11–660	Introduction to Electronics.
TM 11–4000	Trouble Shooting and Repair of Radio Equipment.
TM 38–650	Basic Maintenance Manual.

10. Forms

NME Form 6 (Report of Damaged or Improper Shipment).

DA AGO Form 468 (Unsatisfactory Equipment Report).

AF Form 54 (Unsatisfactory Report).

11. Abbreviations

a-c	alternating-current
a-f	audio-frequency
a-m	amplitude-modulated
amp	ampere
avc	automatic volume control
bfo	beat-frequency oscillator
cps	cycles per second
c-w	continuous-wave
d-c	direct-current
D/F	direction finding
f-m	frequency-modulated
h-f	high-frequency
h-v	high-voltage
icw	interrupted continuous wave
i-f	intermediate-frequency
kc	kilocycle
L–C	inductance-capacitance
l-f	low-frequency
ma	milliampere
mc	megacycle
meg	megohm
mf, uf	microfarad
mmf, uuf	micromicrofarad
mw	milliwatt
PM	preventive maintenance
R-C	resistance-capacitance
r-f	radio-frequency
rms	root mean square
v	volt
VTVM	vacuum-tube voltmeter

12. Glossary

For explanation of the terms used in this manual, refer to TM 11–455 and TM 11–476.

APPENDIX II

IDENTIFICATION TABLE OF PARTS

Note. The fact that a part is listed in this table is not sufficient basis for requisitioning the item. Requisitions must cite an authorized basis, such as T/O&E, T/A, T/BA, SIG 7-8-10, SIG 10, list of allowances of expendable material, or another authorized supply basis. The Department of the Army Supply Catalog applicable to the equipment covered in this manual is SIG 7 & 8 AN/CRD-2. For an index of available supply catalogs in the Signal portion of the Department of the Army Supply Catalog, see the latest issue of SIG 1, Introduction and Index.

1. Identification Table of Parts for Radio Set AN/CRD-2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	RADIO SET AN/CRD-2: AM, FM or CW signal; freq range 0.54 mc to 30 mc; input 115/230 v, 50/60 cyc, 500 w.	Ground station, air transportable radio direction finder.	2S1515-2
	TECHNICAL MANUAL: TM 11-514	Instruction book	(Order through AGO channels.)
	ADAPTER, tripod head: brass, olive drab finish; disk shape; 3⅜" ID, 4$\frac{7}{16}$" OD x ⅝" wd w/tube 1¼" diam x 8$\frac{15}{16}$" lg; 3½"-8 female thd on bottom; RCA part/dwg #728191-1.	For mounting transmitter on tripod.	2Z306-20
	ANTENNA COUPLING UNIT CU-34/CRD-2: 4 mtg posts w/90 deg spacing on 4½" diam circle w/diam bisecting sides of housing; RCA part/dwg #618999-501.	For impedance matching and signal modulating.	2A745-34
	ANTENNA SUPPORT AB-64/CRD-2: sq box shape mtg, cone shape ins w/vert round stud on top; 17¼" lg x 11¾" wd x 21$\frac{13}{16}$" h o/a; RCA part/dwg #727390-501.	For holding Antenna Coupling Unit CU-34/CRD-2.	2A248-64
	ANTENNA SYSTEM AS-87/CRD-2: 4 element spaced collector system for receiving; 0.54 mc to 30 mc.	For receiving signals and developing a bearing-dependent r-f wave.	2A249-87
	AZIMUTH INDICATOR ID-240/CRD-2: 8" diam scale, red and white marking readings; input 115 v, 60 cyc, single ph, self-contained power supply; approx 14" h x 12" wd x 12" d not incl handles; front panel contains sense switch and switch for aural or visual indications; RCA part/dwg #8885383-501.	Radio station locator by use of a sinusoidal potentiometer to give aural-null readings of station location.	2C5390-240
	BAG: cable ends; duck, olive drab; 8¼" lg x 4½" wd; strap and buckle closing; no supporting framework; eyelet in closed end of bag; RCA part/dwg #728136-1.	Protective coverings for cable connectors.	6Z474
	CASE: compass; brown leather; 6$\frac{1}{16}$" lg x 2" d x 4⅞" h o/a; snap fastener closing; sewn leather construction; leather shoulder strap; RCA part/dwg #728754-3.	Compass carrying case	6Z1743-1

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	BEARING INDICATOR ID-64/CRD-2: radio station locator; CR tube, 5" diam, cross propeller type signal, green med persistence screen; input 105 v, 60 cyc. single ph, 146 w, or 115 v, 60 cyc, single ph, 171 w; 21 13/16" lg x 19" wd x 10½" h; incl oper cables; RCA part/dwg #308178-1.	Visual indicating system for RDF.	2C1565-64
	BULB, rubber: egg shape approx 2" diam x 3¼" lg; tube 4" lg; Fisher Scientific cat. #14-075.	For removal of dust.	
	BRUSH: flat; hair bristles; approx 7¾" lg x 1" wd; Fed spec #H-B-701 and #E-H-B-701.	For varnishing	6Z1581
	BRUSH: flat; hair bristles 1½" lg; approx 7¼" lg x ½" wd.	For painting	6Z1550
	CABLE ASSEMBLY, power: 2 #12 AWG stranded copper cond ea comprising 65 #30 AWG strands, rubber ins; 600 v working; neoprene outer jacket 0.605" OD; 25" lg excluding term; AN type AN-3106-18-3P two-cont male connector w/Amphenol type AN-3057-10 cable clamp one end, AN type AN-3102-18-3S two-cont female connector w/ Cannon elec #2245-6 junction shell and Amphenol type AN-3057-10 cable clamp other end; RCA part/dwg #446643-501.	Connects Modulating Voltage Generator 0-15/CRD-2 to rear apron.	3E7350.1-25.1
	CABLE ASSEMBLY, power: 2 #12 AWG stranded copper cond ea comprising 65 #30 AWG strands, rubber ins; 600 v working; neoprene outer jacket 0.605" OD; 27" lg excluding term; Hubbell #7357 female connector one end, Hubbell #6808 male connector other end; RCA part/dwg #447317-501.	Connects Modulating Voltage Generator 0-15/CRD-2 to rear apron.	E7350.1-27
	CABLE ASSEMBLY, power: Cord CX-1115/U; 2 #12 AWG stranded copper cond ea comprising 84 #31 AWG strands, rubber ins; 600 v working; neoprene jacket 0.610" OD; 30" lg excluding term; Hubbell #7257 two-cont female connector one end, Hubbell #7357 two-cont male connector other end; RCA part/dwg #442706-501.	Connects Modulating Voltage Generator 0-15/CRD-2 to Bearing Indicator ID-64/CRD-2, or Receiver R127/CRD-2 to Modulating Voltage Generator 0-15/CRD-2.	3E6000-452-30
	CABLE ASSEMBLY, power: Cord CX-1115/U; 2 #12 AWG stranded copper cond ea comprising 84 #31 AWG strands, rubber ins; 600 v working; neoprene jacket 0.610" OD; 10 ft lg excluding term; Hubbell #7257 two-cont female connector one end, Hubbell #7357 two-cont male connector other end.	Connects Junction Box J-95/CRD-2 to rear apron.	3E6000-452-120

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	CABLE ASSEMBLY, power: Cord CX-452/CRD-2 (150 ft 0"); 2 cond, 2 #12 AWG stranded copper cond ea comprising 65 #30 AWG strands, rubber ins; 600 v working; neoprene jacket 0.605" OD; 150 ft lg excluding term; AN type AN-3101-18-3S two-cont female connector w/Amphenol type AN-3057-10 cable clamp and RCA gland #894981-501 one end, AN type AN-3106-18-3P two-cont male connector w/Amphenol type AN-3057-10 cable clamp other end, w/metal tag ea end marked CX-452/CRD-2 (150 ft 0"); RCA part/dwg #442709-501.	Connects Azimuth Indicator ID-240/CRD-2 to Voltage Distribution Unit J-59/CRD-2.	3E6000-452-1800
	CABLE ASSEMBLY, spcl purpose: Cord CX-639/CRD-2; 2 cond, 2 #12 AWG stranded copper cond ea comprising 65 #30 AWG strands, rubber ins; 600 v working; neoprene jacket 0.605" OD; 150 ft lg excluding term; Hubbell #7224 two-cont female connector one end, 2 spade lug term RCA dwg #61580-1 other end; RCA part/dwg #442702-501; metal tag ea end marked CX-639/CRD-2.	Connects Junction Box J-95/CRD-2 to power source.	3E6000-639
	CABLE ASSEMBLY, power: Cord CX-638/CRD-2; uses UL, cord type SJ, 2 #18 AWG stranded copper cond ea comprising 41 #34 AWG strands; 300 v working; neoprene jacket 0.390" OD; 28½" lg excluding term; AN type AN-3106-14S-9S w/Amphenol type AN-3057-6 cable clamp one end, 2 spade lug term other end; RCA part/dwg #441386-501; metal tag ea end marked CX-638/CRD-2.	Connects Modulating Voltage Generator 0-15/CRD-2 to Radio Receiver R-127/CRD-2.	3E6000-638
	CABLE ASSEMBLY: Sig C Cord CD-201; uses Sig C Cordage CO-144, 2 cond, rubber jacket; 5 ft lg excluding term; PL-55 male connector one end, 2 spade lug terminals TM-29 other end.	Telephone	3E1201
	CABLE ASSEMBLY, RF: Cord CG-238/CRD-2; Amphenol type #72-26 PBI-CXBBV coax cable; 125 ohms impedance; flex; single #26 AWG phosphor bronze wire; vinyl ins; polystyrene bead dielectric; celanese covering; tinned copper braid; double cotton braid; vinyl outer jacket 0.617" OD, 12½ lg excluding term; 14" lg o/a; AN type AN-3108-14S-1P, single cont male connector w/Amphenol type AN-3057-8 cable clamp and adapter RCA #8893564 ea end; RCA part/dwg #442704-501; metal tag ea end marked CG-238/CRD-2.	Connects Bearing Indicator ID-64/CRD-2 to Radio Receiver R-127/CRD-2.	3E6015-238

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	CABLE ASSEMBLY, RF: Cord CG-239/CRD-2; uses AN RF Cable RG-23/U; 125 ohms impedance; 150 ft lg excluding terms; 150 ft 2" lg o/a; AN type AN-3101-22-2S three-cont female connector w/adpt RCA dwg #897871-1 and Amphenol type AN-3057-20 cable clamp one end w/gland RCA #441654-501 approx 10" from end; AN type AN-3106-22-2P three-cont male connector w/adpt RCA dwg #897871-1 and Amphenol type AN-3057-20 cable clamp other end; copper wire braided grounding lead 12" lg soldered to cable shield 12" from gland end w/spade term lug other end.	Connects Coupling Unit CU-68/CRD-2 or CU-69/CRD-2 to rear apron.	1F430-239
	CABLE ASSEMBLY, RF: Cord CG-240/CRD-2 (9 ft 9"); Amphenol type #72-26 PBI-CXBBV coax cable; 125 ohms impedance; flex; single #26 AWG phosphor bronze wire; vinyl ins; polystyrene bead dielectric; celanese covering; tinned copper braid; double cotton braid; vinyl outer jacket 0.617" OD; 9 ft 9" lg o/a; Amphenol type #83-21SP, single cont male connector ea end; no color code metal tag ea end marked CG-240/CRD-2 (9 ft 9 in).	Connects Coupling Unit CU-69/CRD-2 to Antenna Coupling Unit CU-34/CRD-2.	3E6015-240.117
	CABLE ASSEMBLY, RF: Cord CG-240/CRD-2 (17 ft 5"); Amphenol type #72-26 PBI: CXBBV coax cable; 125 ohms impedance; flex; single #26 AWG phosphor bronze wire; vinyl ins; polystyrene bead dielectric, celanese covering; tinned copper braid; double cotton braid; vinyl outer jacket 0.617" OD; 17 ft 5" lg o/a; Amphenol type #83-21SP, single cont male connector ea end; no color code; metal tag ea end marked CG-240/CRD-2 (17 ft 5 in).	Connects Coupling Unit CU-68/CRD-2 to Antenna Coupling Unit CU-34/CRD-2.	3E6015-240.209
	CABLE ASSEMBLY RF: AN RF Cable RG-54A/U coax cable; 58 ohms impedance; 2 parallel lengths ea 15" lg excluding term; 18" lg o/a; AN type AN-3108-22-2P three-cont male connector w/Amphenol type AN-3057-12 cable clamp one end, AN type AN-3102-22-2S three-cont female connector w/Cannonelec #2245-8 junction shell other end; RCA part/dwg #447316-501.	Connects Radio Receiver R-127/CRD-2 to rear apron.	3E7350-2.15
	CABLE ASSEMBLY, spcl purpose: AN Cord CG-237/CRD-2; 6 cond; 2 cond AN RF Cable RG-58/U; 52 ohms impedance, 4 #18 AWG stranded copper cond ea comprising 16 #30 AWG strands; rubber ins; varglas jacket ½" diam; 18¾" lg excluding term; AN type AN-3106-18-12S, 6 cont female connector w/Amphenol type AN-3057-10 cable clamp one end, AN type AN-3108-18-12P, 6 cont male connector w/Amphenol type AN-3057-10 cable clamp other end; RCA part/dwg #442775-501; metal tag ea end marked CG-237/CRD-2.	Connects Bearing Indicator ID-64/CRD-2 to Modulating Voltage Generator 0-15/CRD-2.	1F430-237

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	CABLE ASSEMBLY, spcl purpose: Cord CX-455/CRD-2; 10 cond; #12 AWG stranded copper cond ea comprising 65 #30 AWG strands, 8 #18 AWG stranded copper cond ea comprising 41 #34 AWG strands; rubber ins. 600 v working; neoprene jacket 0.735" OD; 17 ft 2" lg including term; AN type AN-3106-20-1P, 14 cont male connector w/ Amphenol type AN-3057-12 cable clamp ea end; RCA part/dwg #442705-502; metal tag ea end marked CX-455/CRD-2 (17 ft 2").	Connects Voltage Distribution Unit J-59/CRD-2 to Antenna Coupling Unit CU-34/CRD-2.	3E6000-455.206
	CABLE ASSEMBLY, Cord CX-455/CRD-2; spcl purpose: 10 cond; 2 #12 AWG stranded copper cond ea comprising 65 #30 AWG strands, 8 #18 AWG stranded copper cond ea comprising 41 #34 AWG strands; rubber ins, 600 v working; neoprene jacket 0.735" OD; 9 ft 8" lg inc term; AN type AN-3106-20-1P, 14 cont male connector clamp ea end; RCA part/dwg #442705-501; metal tag ea end marked CX-455/CRD-2 (9 ft 8").	Connects Voltage Distribution Unit J-59/CRD-2 to Antenna Coupling Unit CU-34/CRD-2.	3E6000-455.116
	CABLE ASSEMBLY, spcl purpose: 20 cond; 2 #12 AWG stranded copper cond ea comprising 65 #30 AWG strands, 18 #18 AWG stranded copper cond ea comprising 41 #34 AWG strands; rubber ins, 600 v working; color-coded; outer covering double face tape; tinned copper shield braid; neoprene jacket 1.028" OD; 22" lg excluding term; AN type AN-3108-28-16P, 20 cont male connector w/Amphenol type AN-3057-16 cable clamp one end, AN type AN-3102-28-16S female connector w/Amphenol type AN-3057-16 cable clamp and Cannonelec #2245-10.	Connects Modulating Voltage Generator 0-15/CRD-2 to rear apron.	3E7350-1.32
	CABLE ASSEMBLY, spcl purpose: AN Cord CX-454/CRD-2; 20 cont; 2 #12 stranded copper cond, 18 #18 AWG stranded copper cond; rubber ins; 600 v working; color-coded; neoprene jacket 1.028" OD; 150 ft lg incl term; AN type AN-3101-28-16S, 20 cont female connector w/Amphenol type AN-3057-16 cable clamp and RCA gland #441654-502 one end, AN type AN-3106-28-16P, 20 cont male connector w/Amphenol type AN-3057-16 cable clamp other end; RCA part/dwg #442708-501; metal tag ea end marked CX-454/CRD-2.	Connects Azimuth Indicator ID-240/CRD-2 to Voltage Distribution Unit J-59/CRD-2.	3E600-454
	CHEST SET H-18/GT: 4.036" h x 2.8125" wd x 1" thk; incl 2 straps and Y cord 11⅛" lg o/a; w/Plug PL-291-A on main leg, 2 term TM-30 on short legs; Sig C dwg #SC-D-17105B.	For aural-null operation__	4B422-18
	CLAMP: cold finish steel bar; hot galv; 11" lg x 1⅞" wd x ¼" thk o/a; U shape w/one leg 2½" lg, other leg 11" lg; RCA part/dwg #897832-1.	Counterpoise ____________	2A478.13

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	COMPASS, magnetic: moving needle type; 1 deg scale division from 0 to 360 deg counterclockwise, w/zero point at north position; brass case, black enamel finish; 4 13/16" diam x 4 1/8" h w/sights in open position, 7/8" h w/sights closed; mtg bushing tapped w/5/8"-24 thd; jewel bearing; equipped w/2 levels, hinged sight and needle lock stop; incl ball and socket adpt w/flex coupling; K&ECo #5334; RCA part/dwg #728754-2.	For orientation of radio-direction finder.	3F2660-1
	COUNTERPOISE MX-313/CRD-2: mesh type; 75 ft 1" wd; 108 uninsulated wires, 75 ft 1" lg ea, #12 AWG stranded tinned copper wire; soldered junctions; no lead-in; RCA part/dwg #309005-1.	Ground screen	2A722-313
	COUPLING, flexible: c/o brass ball w/2 thd sleeves; 2 1/2" lg x 1 3/8" d o/a; mts by 5/8"-24 male thd one end, 7/8"-27 female thd other end; RCA part/dwg #728754-4.	For leveling compass	2Z306-19
	COUPLING UNIT CU-68/CRD-2: freq range 0.54 to 6.0 mc; pri impedance 80 ohms w/secd terminated by 125-ohm load; rectangular; 6 1/16" lg x 5 3/8" h x 6 1/4" d o/a; RCA part/dwg #618995-501.	Common coupling impedance.	2Z3265-68
	COUPLING UNIT CU-69/CRD-2: freq range #4 to 30 mc; pri impedance 80 ohms w/secd terminated by 125-ohm load; rectangular; 6 1/16" lg x 5 3/8" h x 6 1/4" d o/a; RCA part/dwg #618955-502.	Common coupling impedance.	2Z3265-69
	COVER BC-170-A: canvas; olive drab; 13 3/4" lg x 7 5/8" wd x 11 3/4" d o/a; snap fastening; no supporting framework; cotton webbing adj shoulder strap.	For target transmitter	2Z34400-170A
	CRANK ASSEMBLY, hand: c/o steel crank w/brass handle at 90 deg at one end of crank, other end of crank bent 90 deg and away from handle, 10 3/8" lg x 6 3/8" wd x 1" thk o/a; opposite end from handle machined 0.700" sq x 1 3/8" lg to engage reel shaft; RCA part/dwg #443038-501.	For cable reel	6H904-1
	GLAND: cable; irregular shape; 2 7/8" lg x 2 1/2" diam 0-a; 2 3/8"-16 female thd one end, 1 1/2"-16 female thd other end; RCA part/dwg #441654-501.	Seal	6Z4552
	GLAND: cable; irregular shape; 2 7/8" lg x 3 1/4" diam o/a; 2 3/4"-16 female thd one end, 1 1/2"-16 female thd other end; RCA part/dwg #441654-502.	Seal	6Z4552-1
	GROUND ROD GP-26: galv steel; conepoint; 1/2" diam x 6 ft lg w/5/32" diam; radial hole 1" ctr to top end of rod.	Grounding	5B4426

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	HEADSET HS-29: magnetic; total impedance 250 ohms; c/o 4 receivers, ea 125 ohms impedance connected series-parallel; ea receiver 0.090" max diam x 0.79" max d; w/75" lg Cord CD-656, 2 Headbands HB-30, and 4 Inserts M-300.	For aural-null operation__	2B829
	JACK JK-39: for 2 cont plug ¼" diam; 2¼" lg x 11/16" diam o/a; J1 cont arrangement.	Plug receptacle __________	2Z5539
	JUNCTION BOX J-95/CRD-2: 14" wd 14⅝" h x 13" d o/a; RCA part/dwg #619336-501.	Houses step-down transformer, meters, and switches.	2Z5600-95
	LEVEL, spirit: iron plumb; 12" lg; smooth bottom; Stanley Tools #36.	For leveling antenna system.	6Q63012
	MODULATING VOLTAGE GENERATOR 0-15/CRD-2: approx 19" wd x 14" d x 10½" h o/a; RCA part/dwg #308161-1.	Fixed frequency oscillator and phase-splitting device for antenna-system.	3F3582-15
	MOUNT: sq base, cup type; 50 to 60 lb load rating; 3" sq x 1½" h o/a; rubber cushion, steel cup 3" diam; steel ctr sleeve w/0.380" diam hole; LN Barry #C-2060.	Vibration ________________	2Z8405-23
	MOUNT: sq base, cup type; 35 to 40 lb load rating; 3" sq x 1½" h o/a; rubber cushion, steel cup 3" diam; steel ctr sleeve w/0.380" diam hole; LN Barry #C-2040.	Vibration ________________	2Z8405-27
	OIL, lubricating: preservative, spcl PS; 4 oz; screw top can; Fed stock #14-0-2833-994.	Lubricant ________________	6G-1007
	PAINT: lacquer; nitrocellulose base; olive drab; lustreless; 1 pt cont.	Retouching ______________	6G1005.9
	PAINT: lacquer; quick drying; glossy; synthetic clear; 1 pt cont.	Retouching ______________	6G1005-3.3
	PAINT: lacquer; cellulose acetate base; carmine; ½ pt can; Sherwin-Williams RBL #16.	Retouching ______________	6G1003-7
	RADIO RECEIVER R-127/CRD-2: 0.54 mc to 32 mc in 6 bands; input 110 v, 60 cyc, single ph, 87 w, or 115 v, 60 cyc, single ph, 95 w; 19" wd x 19 1/16" d x 10½" h o/a; RCA part/dwg #897700-501.	A-m, c-w, or mcw reception; communications receiver w/video stage for direction finder use.	2C4180-127
	RADIO TRANSMITTER BC-1149-A _________	Transmits low-power signals for use in orienting and calibrating radio direction finder.	2C6596-1149
	SIGNAL GENERATOR I-72: range 100 kc to 32 mc w/400 cyc modulation; operates on 110-125 v AC; metal portable case w/leather handle; 15⅛" lg x 6¾" wd x 9 7/16" h o/a.	R-f signal _______________	3F3852
	STRAP, wrench: cotton webbing; olive drab; 12" lg x 1⅛" wd x 3/16" thk; RCA part/dwg #442798-13.	Pipe wrench _____________	6R41385-1
	STRAP, wrench: cotton webbing; olive drab; 18" lg x 1¾" wd x 3/16" thk; RCA part/ #442798-14.	Pipe wrench _____________	6R41385

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	TELEPHONE EE-8: portable; can be used on common-battery lines by setting screw switch to common battery position.	Local battery telephone for general field purposes.	4B5008
	TEST SET I-56-K: Universal radio test set; consists of Test Unit I-176, Voltohmmeter I-166 and Tube Tester I-177.	Test set	3F4056K
	WRENCH: pipe; strap; adj opening 1" to 5" straight flat handle; Warnock Mfg Co #1-5.	Tool	6R57714-1
	WRENCH: Allen type hex key; L shape; 1/16" across flat; for Allen type #5 and #6 setscrews; Allen Mfg 1/16" short arm series.	Tool	6R57400-6
	WRENCH: strap; flexible woven strap; steel handle Warnock Mfg Co #12".	For use on pipe 1/8" to 2"	6R59349
	WRENCH KIT TL-569/U: for hex socket head screws; 9 wrenches in metal box; L shape; 5/64", 3/32", 1/8", 5/32", 3/16", 7/32", 1/4" 5/16", and 3/8" across flats; 5½" lg x 4⅛" wd x ¾" d.	Tools	6R57670
	TRIPOD: extension leg type 77¼" h extended, 56½" h collapsed; wooden legs, metal head, feet, and clamps; olive drab finish; pan head w/3½"-8 NS 2 male thd; Brunson Instr #B-799.	For compass and target transmitter.	3F5310
	VASELINE: petrolatum; yellow; 4-oz jar	Lubricant	6G2205.2
	TAPE: measuring; steel; 3/8" wd; 50 ft lg; K&ECo #7372T.	General use	6R36032T
	VOLTAGE DISTRIBUTION UNIT J-59/CRD-2: steel chassis; w/o cover; rectangular, 10½" lg x 10½" wd x 2" h incl mtg flange; RCA part/dwg #619318-501.	Provides filament voltage to antenna coupling units.	2Z5600-59

2. Identification Table of Parts for Antenna System AS-87/CRD-2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	ANTENNA SYSTEM AS-87/CRD-2: four-element spaced collector system type; for receiving; 0.54 mc to 30 mc.	For receiving signals	2A249-87
	TECHNICAL MANUAL: TM 11-514		(Order through AGO channels.)
	ANTENNA COUPLING UNIT CU-34/CRD-2: 5 7/16" lg x 5 7/16 wd x 5⅜" h o/a; 4 mtg posts w/90 deg spacing on 4½" diam circle w/diam bisecting sides of housing; RCA part/dwg #618999-501.	Signal modulating and impedance matching.	2C472-34
	ANTENNA SKIRT MX-849/CRD-2: 8 SS rods 5/16" diam x 34 3/16" lg, 1 brass hub and 1 copper tube 7/8" diam x 5½" lg; umbrella shaped open, cylindrical when closed; approx 3½" diam x 3 ft lg closed; SS rods screw into brass hub, tube mts on antenna mast by force fit; RCA part/dwg #736978-501.	Antenna top loading	2A3235-849

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	ANTENNA SUPPORT AB-64/CRD-2: sq box shape mtg cone shape ins w/vert round stud on top; 17¼" lg x 11¾" wd x 21 13/16" h overall; RCA part/dwg #727390-501.	Housing for Antenna Coupling Unit CU-34/CRD-2 and support for antenna mast.	2A248-64
	COLLAR, mast: steel, olive drab E; approx 2½" h x 2½" wd x ⅝" thk o/a; 3 clamping lugs ⅜" diam holes spaced 120 deg apart; RCA part/dwg #896330-501.	Antenna guy wire clamping collar.	2A492.2-3
	COUPLING UNIT CU-68/CRD-2: freq range 0.54 to 6.0 mc; pri impedance 80 ohms w/secd terminated by 125-ohm load; rectangular; 6 1/16" lg x 5⅜" h x 6¼" d o/a; RCA part/dwg #618995-501.	Common coupling impedance.	2Z3265-68
	COUPLING UNIT CU-69/CRD-2: freq range 4 to 30 mc; pri impedance 80 ohms w/secd terminated by 125-ohm load; rectangular; 6 1/16" lg x 5⅜" h x 6¼" d o/a; RCA part/dwg #618995-502.	Common coupling impedance.	2Z3265-69
	GUY: antenna mast; c/o 18 ft nylon cord 3 ply 3/16" diam w/2 boat snaps, 2 thimbles, 3 ins, and 2 tighteners; approx 32" lg x 4½" wd x 1⅛" d o/a; RCA part/dwg #443039-501.	For supporting masts ----	2A1344-68
	INSULATOR: oval-shaped; white glazed porcelain; 1½" lg; approx ¾" diam through ctr; two ¼" diam radial holes on ⅝" ctr; Birnbach cat. #474.	Strain ------------------	3G1250-24.2
	JUNCTION BOX J-96/CRD-2: weatherproof container; zinc-plated steel; box 28¼" sq x 9⅛" h incl 5" pipe extensions on ea side.	Housing for Voltage Distribution Unit J-59/CRD-2 and Coupling Unit CU-68/CRD-2 or CU-69/CRD-2.	2Z5600-96
	LEAD, electrical: ¼" flat, copper braid, 240 #36 AWG strands; 6" lg excluding term; RCA part/dwg #897822-1 plug at one end and RCA part/dwg #818337-9 ring type term at other end; RCA part/dwg #898170-501.	Grounding strap ---------	3E4400-15
	LEAD, electrical: ⅜" flat, copper braid, 320 #36 AWG strands; 15" lg excluding term; ea end term in a spade type term 1⅝" lg x ⅝" wd x 1/16" thk; RCA part/dwg #897829-2.	Grounding strap ---------	3E4400-16
	LEAD, electrical: ¼" flat, copper braid, 240 #36 AWG strands; 7" lg excluding term; RCA part/dwg #99025-10.	Grounding strap ---------	3E4400-14
	LEG, support: antenna leveling leg; steel; olive drab finish; 12" lg x 4" wd x 9¼" h o/a; RCA part/dwg #727353-501.	For Antenna Support AB-64/CRD-2.	2A1825-2
	LEG, support: junction box leveling leg; steel; olive drab finish; 4⅞" lg x 4" wd x 9¼" h o/a; RCA part/dwg #727353-502.	Antenna support leveling -	2Z6120.6

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	MAST SECTION AB-60/CRD-2: SS tube w/ SS collar 4" from one end; phosphor bronze knob at top end; 76" lg x 1¼" OD o/a; mts by telescoping collar end; RCA part/dwg #622948-504.	Antenna mast	2A2450-60
	MAST SECTION AB-61/CRD-2: SS tube w/ clamp and collar attached 5³⁄₁₆" from one end; phosphor bronze knob at top; 94³¹⁄₃₂" lg x 2⁹⁄₁₆" OD o/a; mts by telescoping collar end; RCA part/dwg #622948-503.	Antenna mast	2A2450-61
	MAST SECTION AB-62/CRD-2: SS tube w/ one SS collar attached approx 5³⁄₁₆" from one end, phosphor bronze knob other end; 94³¹⁄₃₂" lg x 1⅜" OD o/a; mts by telescoping collar end; RCA part/dwg #622948-502.	Antenna mast	2A2450-62
	MAST SECTION AB-63/CRD-2: SS tube w/ one phosphor bronze knob attached to ea end; 96³⁄₃₂" lg x 1⅞" OD o/a; mts by 1⅝"-10 thd coupling at base; RCA part/dwg #622948-501.	Antenna mast	2A2450-63
	ROPE, nylon: twist, 3 ply; ³⁄₁₆" diam; olive drab; 580 lb breaking strength; 32 ft lg, plain ends; RCA part/dwg #443039-6; Sig C spec JQD-310.	Spare guy line	6Z7919
	STAKE GP-2, guy: wrought steel, galv; spike shape w/point at one end, rounded head at other end and tying loop 1¼" from head; 16" lg x 1¹¹⁄₁₆" wd x 1⁹⁄₁₆" d; o/a; RCA part/dwg #896329-1.	Guy anchor	2A3302
	SUPPORT, MT-333/CRD-2: steel tube, olive drab finish; 8 ft lg x 3⅞" diam o/a; RCA part/dwg #441662-501.	Mechanical coupling and conduit between antenna support and junction box.	2Z9057MT-333
	VOLTAGE DISTRIBUTION UNIT J-59/CRD-2: w/o cover; rectangular, 10½" lg x 10½" wd x 2" h incl mtg flange; RCA part/dwg #619318-501.	Electrical terminal for antenna conductors.	2Z5600-59

3. Identification Table of Parts for Antenna Support AB-64/CRD-2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	ANTENNA SUPPORT AB-64/CRD-2: for holding Antenna Coupling Unit CU-34/CRD-2; sq box shape mtg cone shape ins w/vert round stud on top; 17¼" lg x 11¾" wd x 21¹³⁄₁₆" h o/a; RCA part/dwg #727390-501.	Housing for Antenna Coupling Unit CU-34/CRD-2 and support for Antenna Mast.	2A248-64
	GASKET: neoprene; ring shape, 3¾" ID, 4¼" OD x ¼" thk; RCA part/dwg #887824-19.	Insulating	2Z4868.585
	GASKET: neoprene; sq shape, 7³⁄₁₆" lg, x 7³⁄₁₆" wd x ¼" thk; RCA part/dwg #43538-14.	Antenna base	2Z4868.586

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	GASKET: neoprene; sq shape; 9¼" lg x 9¼" wd x 1/16" thk; RCA part/dwg #894983-1.	Base to box	2Z4868.587
	INSULATOR: conical shape; phenolic; bottom 5" OD, top 1½" OD x ¾" ID x 2" h; RCA part/dwg #441901-1.	Bushing	3G100-6
	PLATE: mounting: antenna; steel; 5⅝" lg x 5⅝" wd x approx ½" thk w/3" diam hole in ctr; 4 pear shape slots on 4½" diam spaced 90 deg apart, four 0.281" diam mtg holes on 4½" x 4½" mtg/c; RCA part/dwg #727392-501.	Mounting plate for Antenna Coupling Unit CU-34/CRD-2.	2A2822-9

4. Identification Table of Parts for Antenna Coupling Unit CU-34/CRD-2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	ANTENNA COUPLING UNIT CU-34/CRD-2: 5 7/16" lg x 5 7/16" wd x 5⅜" h o/a; 4 mtg posts w/90 deg spacing on 4½" diam circle w/diam bisecting sides of housing; RCA part/dwg #618999-501.	Impedance match between antenna and output cables; also contains antenna balanced modulator circuits.	2C472-34
	BOARD, terminal: 3 brass tin pl term; 5½" lg x 1¾" wd x 27/32" h o/a; RCA part/dwg #896332-501.	For mounting resistors and capacitors.	3Z770-3.1
	BOARD, terminal: 5 brass tin pl term; ½" between ctr; brass, silver pl; 2¼" lg x ⅜" d o/a; RCA part/dwg #896350-501.	General purpose	3Z770-5.2
C-801 through C-804.	CAPACITOR, fixed: mica; 330 mmf ± 2%; 500 vdcw; max body dimen 51/64" lg x 15/32" wd x 7/32" thk; JAN type CM20D331G.	R-f coupling	3K2033143
C-805 through C-808, C-810 through C-813.	CAPACITOR, fixed: silver mica; 10,000 mmf ± 2%; 300 vdcw; max body dimen 53/64" sq x 11/32" thk; JAN type CM35E103G.	R-f bypass	3K3510353
C-809	CAPACITOR, variable: air; 3 to 14 mmf; SLC characteristics; 0.030" air gap; 27/32" lg x 15/16" wd x 1 7/32" h excluding shaft; shaft ¼" diam x 1 3/16" lg; 5 plates; RCA part/dwg #253132-10.	Balancing	3D9014V-14
L-806	COIL, RF: choke; single winding, single layer wound; unshielded; 13½" turns #22 AWG wire; ⅝" diam x 1⅜" lg; RCA part/dwg #898224-501.	R-f sense coil	3C370-78
L-805	COIL, RF: choke; single winding, single layer wound; unshielded; 8½ turns #22 AWG wire; ⅝" diam x 1⅜" lg; RCA part/dwg #898224-502.	R-f sense coil	3C370-80
L-801 through L-804, L-807.	COIL, RF: choke; single winding, 3 pie universal wound; unshielded; 160 turns #36 wire ea pie; ½" diam x ⅞" lg; RCA part/dwg #897895-501.	R-f choke coil for cathode and modulation voltage lines.	3C370-79

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
J-801, J-802	CONNECTOR, receptacle: female; single cont; straight; 1" lg x ⅝" across flats; ½"-20 thd for mtg; RCA part/dwg #881457-1.	J-801: Antenna input terminal. J-802: Ground terminal.	2Z3062-134
J-803, J-804	CONNECTOR, receptacle: female; single cont; straight; 1¹⁄₁₆" lg x approx ¾" diam w/1⁹⁄₃₂" sq flange; Amphenol type #83-21R.	R-f output	2Z3062-131
J-805	CONNECTOR, receptacle: female; 14 cont; straight; 1¹¹⁄₃₂" lg w/1½" sq flange; AN type AN-3102-20-18.	Audio and filament voltage input.	2Z8684-5
P-801	CONTACT, connector: banana type; single male cont; straight; 2¼" lg x ⅝" across flats of hex body o/a; RCA #897206-1.	Antenna	2Z3021-144
P-802	CONTACT, connector: banana type; single male cont; straight; 1¾" lg x ½" across flats of hex body o/a; Johnson EF #77 less nuts and term.	Ground	2Z7249.12
	GASKET: neoprene; cir shape, 3⅜" diam x ¹⁄₃₂" thk; RCA part/dwg #894992-1.	Antenna coupling unit	2Z4868.584
	KNOB: round; aluminum, olive drab finish; for ¼" shaft; single #8-32 setscrew; marked C809 ¹⁵⁄₁₆" diam x ¹¹⁄₁₆" h o/a; RCA part/dwg #897767-501.	For capacitor C-809	2Z5822-212
	KNOB: round; aluminum, olive drab finish; for ¼" diam shaft #8-32 setscrew; ⅝" h x 1" wd x 1⅛" d o/a; RCA part/dwg #8892353-1.	For switch S-801	2Z5822-210
R-805, R-806	RESISTOR, fixed: composition; 10 ohms ± 1%; ½ w; ⅝" lg x ⁹⁄₃₂" diam; Concarbon type #X-½.	Parasitic suppressors	3Z6001-115
R-807, R-808	RESISTOR, fixed: composition 160 ohms ± 1%; ½ w; ⅝" lg x ⁹⁄₃₂" diam; Concarbon type #X-½.	R-f cable terminating resistors.	3Z6016-19
R-809	RESISTOR, fixed: composition; 1500 ohms ± 1%; ½ w; ⅝" lg x ⁹⁄₃₂" diam; Concarbon type #X-½.	Part of sense phase-shifting circuit.	3Z6150-122
R-801 through R-804.	RESISTOR, fixed: composition; 220,000 ohms ± 1%; ½ w; ⅝" lg x ⁹⁄₃₂" diam; Concarbon type #X-½.	R-801 and R-802: Series grid. R-803 and R-804: Grid.	3Z6722-36
X-801, X-802, X-803.	SOCKET, tube: octal; retainer ring mtg; for 1⅛" diam chassis cut-out; bakelite body 1¼" diam x ³¹⁄₆₄" h excluding term; Cinch #9610.	For tubes V-801, V-802, and V-803, respectively.	2Z8654.7
S-801	SWITCH, rotary: SPDT; silver pl brass cont; phenolic body; ²⁷⁄₃₂" wd x 1¹⁹⁄₆₄" h x 1⅛" o/a; 3 solder lug term; ¼" diam x ⅝" lg; Oak type #23.	Sense circuit	3Z9825-82.30
V-801, V-802, V-803.	TUBE, electron: JAN-6AC7	V-801 and V-802: Balanced modulators. V-803: Sense.	2J6AC7

5. Identification Table of Parts for Voltage Distribution Unit J-59/CRD-2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	VOLTAGE DISTRIBUTION UNIT J-59/CRD-2: steel chassis; w/o cover; rectangular, 10½" lg x 10½" wd x 2" h incl mtg flange; RCA part/dwg #619318-501.	Electrical terminal for antenna conductors.	2Z5600-59
	BOARD, terminal: 8 post type term; lam phenolic 3/32" thk; 2 11/32" lg x 1½" wd x 27/64" h incl term; RCA part/dwg #451401-501 (marked R-501, 502, 503, 504).	For mounting resistors	3Z770-8.2
	BOARD, terminal: 8 post type term; lam phenolic ¼" thk; 2 11/32 lg x 1½" wd x 27/64" h incl term; RCA part/dwg #451401-502 (marked R-505, 506, 507, 508).	For mounting resistors	3Z770-8.3
	BOARD, terminal: 8 post type term; lam phenolic 3/32" thk; 2 11/32" lg x 1½" wd x 27/64" h incl term o/a; RCA part/dwg #451401-503 (marked R-509, 510, 511, 512).	For mounting resistors	3Z770-8.4
	BOARD, terminal: 8 post type terms; lam phenolic 3/32" thk; 2 11/32" lg x 1½" wd x 27/64" h incl term o/a; RCA part/dwg #451401-504 (marked R-513, 514, 515, 516).	For mounting resistors	3Z770-8.5
C-501-A, C-501-B.	CAPACITOR, fixed: paper; 2 sect; 100,000-100,000 mmf + 20% — 10%; 600 vdcw; 1 13/16" wd x 1" d x ¾" h; 3 solder lug term on side; JAN type CP53B4EF104V.	115-volt, a-c line filters	3DA100-770
C-503	CAPACITOR, fixed: paper; 500,000 mmf + 20% — 10%; 600 vdcw; 1 13/16" wd x 1" d x 1" h; 2 solder lug term on side; JAN type CP53B1EF504V.	R-f bypass	3DA500-451
C-502-A, C-502-B.	CAPACITOR, fixed: paper; 2 sect; 500,000-500,000 mmf ± 15%; 600 vdcw; 2" wd x 1¾" d x 1" h; 3 solder lug term on side; JAN type CP53B4EF504L.	R-f bypass	3DA500-537
	CLAMP: cable; aluminum; 2 bolts used; 1" lg x ⅝" diam o/a w/½"-28 thd; for ¼" max OD cable; Amphenol #AN-3057-3.	Cable clamp	2Z2638-11
L-501	COIL, RF: choke; integral type; single winding, 4 pie universal wound; shielded; 5.5 mh at 1000 cps w/1 v, 15 ohms DC resistance; 1 51/64" lg x 1½" wd x 1¾" h; RCA part/dwg #443034-501.	R-f choke for d-c plate supply.	3C370-77
J-501 through J-504, J-511.	CONNECTOR, receptacle: female; single cont; straight; 19/32" lg x ⅜" across hex flats; body ¼"-18 thd; RCA part/dwg #99015-6.	Ground receptacles	2Z3062-133
J-505	CONNECTOR, receptacle: female; 2 cont; straight; 10 amp, 250 v, 15 amp, 115 v; 2 1/32" lg x 1¾" wd x approx 1⅛" d o/a; Hubbell #9819.	115-volt, a-c line receptacle.	6Z7785-1
J-507 through J-510.	CONNECTOR, receptacle: female; 14 cont; straight; 1 11/32" lg w/1½" sq flange; AN type AN-3102-20-18.	For cable to Antenna Coupling Unit CU-34/CRD-2.	2Z8684-5

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
J-506	CONNECTOR, plug: male; single cont; 90 deg angle type; 1½" lg x 25/32" diam AN type AN-3108-10-2P.	For B+ voltage	2Z3021-171
P-501 through P-504.	CONNECTOR, plug: male; single cont; straight; 1" lg x 7/32" diam o/a; RCA part/dwg #897822-1.	Grounds	2Z3021-172
P-505	CONNECTOR, receptacle: male; 2 cont; straight; 1 13/32" lg w/1 5/16" sq flange; Amphenol AN-97-5105-1-3P.	Line voltage input connector.	2Z3022-91
P-506	CONNECTOR, receptacle: male; 20 cont; 90 deg angle type; 3 15/32" lg x 2 7/16" wd x 2" d; 4 mtg holes on 1 9/16 x 1 9/16" mtg/c; Amphenol AN-97-5117-28-16P.	Power and control cable receptacle.	2Z3021-143
R-501 through R-516.	RESISTOR, fixed: composition; 100,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF104J.	Filament and cathode	3RC30BF104J
T-501	TRANSFORMER: fil type; input 115 v, 60 cyc, single ph; 5 output windings; secd #1, 6.3 v at 2 amp CT; secd #2, 3, 4, 5, ea 6.3 v at 1 amp; HS metal case; 3 1/16" lg x 2½" wd x 4¼" h; RCA part/dwg #901881-501.	Power	2Z9606-23

6. Identification Table of Parts for Coupling Unit CU-68/CRD-2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	COUPLING UNIT CU-68/CRD-2: freq range 0.54 to 6.0 mc; pri impedance 80 ohms w/secd terminated by 125-ohm load; rectangular; 6 1/16" lg x 5⅜" h x 6¼" d o/a; RCA part/dwg #618995-501.	Common coupling impedance.	2Z3265-68
C-601-A, C-601-B, C-601-C.	CAPACITOR, fixed: paper; 3 sect; 250,000-250,000-250,000 mmf ± 20%; 600 vdcw; 2" wd x 1¾" d x ⅞" h; 3 solder lug term on bottom; JAN type CP55B5EF254M.	B+ filter	3DA250-412
L-601-B	COIL, RF: integral type; single winding, single layer wound; unshielded; 18 turns #36 AWG single nylon covered enamel wire; 1 15/32" OD x ½" lg o/a; RCA part/dwg #443046-501.	R-f impedance	3C302F-3
L-601-A	COIL RF: integral type; 2 windings, single layer wound; unshielded; ea winding 5 turns #36 AWG single nylon covered enamel wire; 1.249" OD x 1½" lg o/a; RCA part/dwg #443045-501.	R-f impedance	3C302F-2
P-602	CONNECTOR, plug: male; single cont; straight; 1" lg x 7/32" diam o/a; RCA part/dwg #897822-1.	For ground line	2Z3021-170
J-601 through J-608.	CONNECTOR, receptacle: female; single cont; straight; 1 1/16" lg x approx ¾" diam w/ 1 9/32" sq flange; Amphenol type #83-31R.	For r-f cables	2Z3062-131

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
P-601	CONNECTOR, receptacle: male; single cont; straight; 59/64" lg x ½" diam w/1" sq flange; AN type AN-3102-10S-2P.	For B+ line	2Z3021-34
P-603	CONNECTOR, receptacle: male; 3 cont; straight; 1 13/32" lg x 1 19/32" diam w/1⅝" sq flange; AN type AN-97-5105-22-2P.	For r-f output line to receiver.	2Z3023-40
	INSULATOR, plate: octagonal; black phenolic; 3 1/16" lg x 3 1/16" wd x 3/16" thk; o/a w/four 0.173" diam holes on 2" x 2" mtg/c; RCA part/dwg #896398-1.	Bottom plate	3G320-1

7. Identification Table of Parts for Coupling Unit CU-69/CRD-2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	COUPLING UNIT CU-69/CRD-2: freq range 4 to 30 mc; pri impedance 80 ohms w/secd terminated by 125-ohm load; rectangular; 6 1/16" lg x 5⅜" h x 6¼" d o/a; RCA part/dwg #618995-502.	Common coupling impedance.	2Z3265-69
C-701-A, C-701-B, C-701-C.	CAPACITOR, fixed: paper; 3 sect; 250,000-250,000-250,000 mmf ± 20%; 600 vdcw; 2" wd x 1¾" d x ⅞" h; 3 solder lug term on bottom; JAN type CP55B5EF254M.	B+ filter	3DA250-412
L-701-B	COIL, RF: antenna coupling; integral type; single winding, single layer wound; unshielded; 10 turns #28 AWG single nylon covered enamel wire; 1 15/32" OD x ½" lg o/a; RCA part/dwg #443046-502.	R-f impedance	3C302F-1
L-701-A	COIL, RF: antenna coupling; integral type; 2 windings, single layer wound; unshielded; ea winding 3 turns #36 AWG single nylon covered enamel wire; 1.249" OD x 1½" lg o/a; RCA part/dwg #443045-502.	R-f impedance	3C302F-4
J-701 through J-708.	CONNECTOR, receptacle: female; single cont; straight; 1 1/16" lg x approx ¾" diam w/ 1 9/32" sq flange; Amphenol type #83-21R.	For r-f cables	2Z3062-131
P-701	CONNECTOR, receptacle: male; single cont; straight; 59/64" lg x ½" diam w/1" sq flange; AN type AN-3102-10S-2P.	For B+ line	2Z3021-34
P-702	CONNECTOR, plug: male; single cont; straight; 1" lg x 7/32" diam o/a; RCA part/dwg #897822-1.	For ground line	2Z3021-170
P-703	CONNECTOR, receptacle: male; 3 cont; straight; 1 13/32" lg x 19/32" diam w/1⅝" sq flange; AN type AN-97-5105-22-2P.	For r-f output line to receiver.	2Z3023-40
	INSULATOR, plate: octagonal; black phenolic; 3 1/16" lg x 3 1/16" wd x 3/16" thk o/a w/four 0.173" diam holes on 2" x 2" mtg/c; RCA part/dwg #896398-1.	Bottom plate	3G320-1

8. Identification Table of Parts for Radio Receiver R–127/CRD–2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	RADIO RECEIVER R–127/CRD–2: AM, CW, and MCW reception; com rec w/video stage for direction finder use; 0.54 to 30 mc in 6 bands; input 100 v, 60 cyc, single ph, 87 w or 115 v, 60 cyc, single ph, 95 w; 19" wd x 19 1/16" d x 10 1/2" h o/a; RCA part/dwg #897700–501.	For RDF operation	2C4180–127
	BOARD, terminal: 1 solder lug term; lam phenolic; 25/32" lg x 21/32" wd x 33/64" thk; RCA part/dwg #897192–2.	General purpose	3Z770–1.2
	BOARD, terminal: 1 solder lug term; lam phenolic; 25/32" lg x 13/32" wd x 33/64" thk; RCA part/dwg #897192–3.	General purpose	3Z770–1.3
	BOARD, terminal: 2 brass screw term; lam phenolic; 1 11/16" lg x 5/8" wd x 3/32" thk; RCA part/dwg #422719–1.	General purpose	3Z770–2.4
	BOARD, terminal: 2 solder lug term; lam phenolic; 1 1/8" lg x 11/16" wd x 33/64" thk; RCA part/dwg #897193–1.	General purpose	3Z770–2.5
	BOARD, terminal: 6 solder lug term; lam thermosetting plastic; 2 1/2" lg x 1 11/16" wd x 1/16" thk; RCA part/dwg #897792–501.	General purpose	2Z9406.242
	BOARD, terminal: 6 brass screw term; lam phenolic; 3 7/16" lg x 5/8" wd x 3/32" thk; RCA part/dwg #442719–2.	General purpose	3Z770–6.2
	BOARD, terminal: 15 solder lug term; lam phenolic; 4 7/8" lg x 2 13/16" wd x 1/16" thk; RCA part/dwg #442724–501.	General purpose	2Z9415.36
C–211	CAPACITOR, fixed: ceramic; 2.0 mmf ± 1%; 500 vdcw; 0.562" lg x 0.250" diam; JAN type CC21CK020F.	Coupling, output of tube V–115.	3D9002–40
C–147	CAPACITOR, fixed :ceramic; 7 mmf ± 0.5 mmf; 500 vdcw; 0.460" lg x 0.240" diam; JAN type CC30UJ070D.	Coupling, cathode of tube V–104.	3D9007–26
C–171	CAPACITOR, fixed: ceramic; 10 mmf ± 1%; 500 vdcw; 0.460" lg x 0.240" diam; JAN type CC30UJ100F.	Loading, across coil L–126	3D9010–124
C–128, C–131, C–134.	CAPACITOR, fixed: ceramic; 7 mmf ± 0.5 500 vdcw; 0.460" lg x 0.240" diam; JAN type CC30TH120J.	C–128: Resonating across part of coil L–113. C–131: Resonating across part of coil L–114. C–134: Resonating across part of coil L–115.	3D9012–53
C–107, C–150	CAPACITOR, fixed: ceramic; 15 mmf ± 10%; 500 vdcw; 0.460" lg x 0.250" diam; JAN type CC30UJ150K.	C–107: Fixed trimmer across coil L–106. C–150: Fixed padder for V–104 mixer circuit.	3D9015–76

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
C-104	CAPACITOR, fixed: ceramic; 18mmf ± 10%; 500 vdcw; 0.460" lg x 0.240" diam; JAN type CC30UJ180K.	Fixed trimmer across coil L-103.	3D9018-18
C-105, C-106	CAPACITOR, fixed: ceramic; 22 mmf ± 10%; 500 vdcw; 0.460" lg x 0.240" diam; JAN type CC30UJ220K.	C-105: Fixed trimmer across coil L-104. C-106: Fixed trimmer across coil L-105.	3D9022-25
C-111	CAPACITOR, fixed: ceramic; 33 mmf ± 10%; 500 vdcw; 0.460" lg x 0.240" diam; JAN type CC30UJ330K.	Series Coupling when coil L-109 is in use.	3D9035-19
C-203	CAPACITOR, fixed: silver mica; 56 mmf ± 5%; 500 vdcw; 1 1/16" lg x 15/32" wd x 7/32" thk; JAN type CM25D560J.	Coupling to plate of tube V-115.	3K2556042
C-207	CAPACITOR, fixed: silver mica; 56 mmf ± 5%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" thk; JAN type CM20C560J.	Coupling grid of tube V-115.	3K2056032
C-145	CAPACITOR, fixed: ceramic; 75 mmf ± 5%; 500 vdcw; 1.165" lg x 0.315" diam; JAN type CC35PG750J.	Resonating for coil L-118	3D9075-25
C-120, C-125, C-139, C-142, C-158, C-160, C-162.	CAPACITOR, fixed: ceramic; 82 mmf ± 5%; 500 vdcw; 1.165" lg x 0.315" diam; JAN type CC35RH820J.	C-120: Resonating for coil L-110. C-125: Coupling to grid of tube V-103. C-139: Resonating for coil L-116. C-142: Resonating for coil L-117. C-158: Resonating for coil L-122. C-160: Resonating for coil L-123. C-162: Resonating for coil L-124.	3D9082-15
C-124	CAPACITOR, fixed: ceramic; 82 mmf ± 2%; 500 vdcw; 1.165" lg x 0.315" diam; JAN type CC35CH820G.	Resonating for coil L-112	3D9082-20
C-122	CAPACITOR, fixed: ceramic: 91 mmf ± 5%; 500 vdcw; 1.165" lg x 0.315" diam; JAN type CC35CG910J.	Resonating for coil L-111	3D9091-10
C-168	CAPACITOR, fixed: silver mica; 150 mmf ± 5%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" thk; JAN type CM20C151J.	Fixed trimmer for crysstal filter coil L-126.	3K2015132
C-113, C-149	CAPACITOR, fixed: ceramic; 180 mmf ± 5%; 500 vdcw; 0.640" lg x 0.250" diam; Centralab type C.	C-113: Resonating for primary of transformer L-107. C-149: Resonating for coil L-119.	3D9180-19

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
C-186, C-187, C-188, C-197, C-198.	CAPACITOR, fixed: silver mica; 180 mmf ± 5%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" thk; JAN type CM20C181J.	C-186 and 187: Resonating for transformer T-106. C-188: R-f bypass (V-108). C-197 and C-198: Resonating for windings of transformer T-107.	3K2018132
C-108, C-110, C-115, C-127, C-148.	CAPACITOR, fixed: ceramic; 220 mmf ± 10%; 500 vdcw; 0.460" lg x 0.240" diam; JAN type CC35UJ221K.	C-108 and C-110: Grid coupling for tube V-101. C-115: Grid coupling for tube V-102. C-127: R-f coupling for tube V-103. C-148: Coupling to injection grid of tube V-104.	3D9220-14
C-204	CAPACITOR, fixed: silver mica; 470 mmf ± 10%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" thk; JAN type CM20D471K.	Feedback in bfo circuit	3K2047141
C-184	CAPACITOR, fixed: silver mica; 510 mmf ± 5%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" thk; JAN type CM20D511J.	Grid coupling for tube V-107.	3K2051142
C-130	CAPACITOR, fixed: mica; 525 mmf ± 1%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" thk; RCA part/dwg #72081-36.	R-f bypass capacitor for tube V-103.	3D9525-2
C-163, C-165, C-173, through C-175, C-177, C-180, through C-183, C-200.	CAPACITOR, fixed: silver mica; 680 mmf ± 5%; 500 vdcw; 1 1/16" lg x 15/32" wd x 7/32" thk; JAN type CM25D681J.	C-163: Resonating for primary of transformer T-101. C-165: Resonating for secondary of transformer T-101. C-173 through C-175 and C-177: Resonating for windings of transformers T-102 and T-103. C-180 through C-183: Resonating for windings of transformers T-104 and T-105. C-200: I-f bypass for tube V-113.	3K2568142
C-199	CAPACITOR, fixed: silver mica; 1000 mmf ± 10%; 500 vdcw; 1 1/16" lg x 15/32" wd x 7/32" thk; JAN type CM25D102K.	I-f bypass for tube V-113	3K2510241
C-133	CAPACITOR, fixed: mica; 1550 mmf ± 2%; 500 vdcw; 53/64" lg x 53/64" wd x 9/32" thk; RCA part/dwg #72081-39.	R-f bypass for tube V-103	3DA1.550-2
C-206	CAPACITOR, fixed: silver mica; 2200 mmf ± 10%; 500 vdcw; 53/64" lg x 53/64 wd x 9/32" thk; JAN type CM30D222K.	Feedback for bfo circuit	3K3022241
C-137	CAPACITOR, fixed: silver mica; 2700 mmf ± 5%; 500 vdcw; 53/64" lg x 53/64" wd x 9/32" thk; JAN type CM30E272J.	Fixed padder for h-f oscillator tank (L-116).	3K3027252

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
C–194, C–195	CAPACITOR, fixed: mica; 2700 mmf ± 10%; 500 vdcw; 53/64" lg x 53/64" wd x 9/32" thk; JAN type CM30B272K.	A-f coupling capacitors for tube V–109.	3K3027221
C–136, C–140	CAPACITOR, fixed: silver mica; 3000 mmf ± 5%; 500 vdcw; 53/64" lg x 53/64" wd x 9/32" thk; JAN type CM30E302J.	C–136: R-f bypass for tube V103. C–140: Fixed padder for h-f oscillator tank (L–117).	3K3030252
C–192	CAPACITOR, fixed: paper; 3000 mmf ± 20%; 1000 vdcw; HS metal case; 1 5/16" lg x 11/16" diam; JAN type CP26A1EG302M.	H-f attenuator for a-f amplifier tube V–110.	3DA3–108
C–143	CAPACITOR, fixed: silver mica; 3900 mmf ± 5%; 500 vdcw; 53/64" lg x 53/64" wd x 11/32" thk; JAN type CM35E392J.	Fixed padder for h-f oscillator tank (L–118).	3K3539252
C–101, C–109, C–112, C–114, C–146, C–151, C–152, C–169, C–178, C–190, C–208.	CAPACITOR, fixed: silver mica; 4700 mmf ± 10%; 500 vdcw; 53/64" lg x 53/64" wd x 11/32" thk; JAN type CM35D472K.	C–101: Screen r-f bypass for tube V–101. C–109: Screen and plate circuit decoupling for tube V–101. C–112: Avc circuit decoupling for tubes V–101 and V–102. C–114: Screen r-f bypass for tube V–102. C–146: Cathode bypass for tube V–104. C–151: Plate circuit decoupling for tube V–102. C–152: Screen r-f bypass for tube V–104. C–169: Plate circuit decoupling for tube V–103. C–178: R-f bypass for V–104 and V–103 stages. C–190: Tone control. C–208: Plate circuit decoupling for tube V–115.	3K3547241
C–201, C–202	CAPACITOR, fixed: paper; 10,000 mmf ± 10%; 600 vdcw; 53/64" lg x 53/64" wd x 11/32" thk; JAN type CN35A103K.	C–201: Plate circuit decoupling for tube V–113. C–202: Cathode bypass for tube V–113.	3DA10–218
C–191	CAPACITOR, fixed: silver mica; 10,000 mmf ± 10%; 300 vdcw; 1 1/32" lg x 41/64" wd x 11/32" thk; JAN type CM40E103K.	A-f coupling (V–110).	3K4010351
C–153, C–166, C–176	CAPACITOR, fixed: paper; 10,000 mmf ± 20%; 600 vdcw; HS metal case; 1 5/16" lg x 1/2" diam; JAN type CP26A1EF103M.	C–153: Plate circuit decoupling for tube V–104. C–166: R-f bypass for coil L–126 and secondary of transformer T–101. C–176: Grid circuit decoupling for tube (V–106).	3DA10–388

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
C-193	CAPACITOR, fixed: paper; 1 mf ± 20% −10%; 600 vdcw; HS metal case; 2" wd x 1¾" d x 1" h; 2 solder lug term on side; JAN type CP53B1EF105V.	Screen a-f bypass for tube V-110.	3DB1-83
C-209	CAPACITOR, fixed: paper; 2 sect; 100,000-100,000 mmf + 40% − 15%; 600 vdcw; HS metal case; 1$^{11}/_{16}$" wd x 1" d x ¾" h; 3 solder lug term on top; JAN type CP54B4EF104X.	Line filters	3DA100-783
C-126, C-185	CAPACITOR, fixed: paper; 3 sect; 50,000-50,000-50,000 mmf + 20% − 10% 600 vdcw HS metal case; 1$^{13}/_{16}$" wd x 1" d x ¾" h; 3 solder lug term on side; JAN type CP53B5EF503V.	C-126-A: Avc line. C-126-B: Screen r-f bypass for tube V-107. C-126-C: Cathode bypass for tube V-107. C-185-A: Plate circuit decoupling for tube V-107. C-185-B: Bias level for noise limiter (V-111). C-185-C: Bias level for a noise limiter (V-111).	3DA50-279
C-167, C-179, C-196.	CAPACITOR, fixed: paper; 3 sect; 100,000-100,000-100,000 mmf + 20% − 10%; 600 vdcw; HS metal case; 1$^{13}/_{16}$" lg x 1" d x ⅞" h; 3 solder lug term on side; JAN type CP53B5EF104V.	C-167-C: Common coupling for transformers T-104 and T-105. C-167-B: Plate circuit decoupling for tube V-106. C-167-A: Screen r-f bypass for tubes V-105 and V-106. C-179-A: Plate circuit decoupling for tube V-105. C-179-B: Common coupling for transformers T-102 and T-103. C-179-C: Plate circuit decoupling for tube V-115. C-196-A: Screen r-f bypass for tube V-112. C-196-B: Cathode bypass for tube V-112. C-196-C: Plate circuit decoupling for tube V-112.	3DA100-748
C-189	CAPACITOR, fixed: paper; 3 sect; 250,000-250,000-250,000 mmf + 20% − 10%; 600 vdcw; HS metal case; 2" wd x 1¾" d x ⅞" h; 3 solder lug term on side; JAN type CP53B5EF254V.	C-189-A: Screen a-f bypass for tube V-109. C-189-B: Plate circuit decoupling for tube V-109. C-189-C: Grid circuit decoupling for tube V-109.	3DA250-346
C-210	CAPACITOR, fixed: paper; 3 sect; 4-4-4 mf + 20% − 10%; 500 vdcw; HS metal case; 5$^{9}/_{16}$" wd x 2¼" d x 5$^{5}/_{16}$" h; 5 solder lug term on bottom; RCA part/dwg #72026-515.	Filters for rectifier (V-116).	3DB4-162

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
C–116, C–129, C–132, C–135, C–154.	CAPACITOR, variable: air; plunger type; 2 to 12 mmf; 0.027" air gap; 2⅞" lg x 0.515" diam; wrench adj; bus wire term; RCA part/dwg #95534–508.	C–116: Trimmer across coil L–107. C–129: Trimmer across coil L–113. C–132: Trimmer across coil L–114. C–135: Trimmer across coil L–115. C–154: Trimmer across coil L–119.	3D9012V–12
C–117, C–118, C–155, C–156, C–170, C–172.	CAPACITOR, variable: air; plunger type; 2 to 20 mmf; 0.027" air gap; 3⅝" lg x 0.515" diam; wrench adj; bus wire term; RCA part/dwg #95534–507.	C–117: Trimmer across coil L–108. C–118: Trimmer across coil L–109. C–155: Trimmer across coil L–120. C–156: Trimmer across coil L–121. C–170: Trimmer across capacitor C–171. C–172: Trimmer across coil L–126.	3D9020V–34
C–119, C–121, C–123, C–138, C–141, C–144, C–157, C–159, C–161.	CAPACITOR, variable: air; plunger type; 2 to 20 mmf; 0.027" air gap; 3⅝" lg x 0.515" diam; wrench adj; bus wire and solder lug term; RCA part/dwg #95534–506.	C–119: Trimmer across coil L–110. C–121: Trimmer across coil L–111. C–123: Trimmer across coil L–112. C–138: Trimmer across coil L–116. C–141: Trimmer across coil L–117. C–144: Trimmer across coil L–118. C–157: Trimmer across coil L–122. C–159: Trimmer across coil L–123. C–161: Trimmer across coil L–124.	3D9020V–35
C–164	CAPACITOR, variable: air; plate meshing type; 3 to 14 mmf; SLC characteristic; 500 v RMS test; 27/32" lg x 15/16" wd x 17/32" h excluding shaft; bakelite shaft ¼" diam x 13/16" lg from mtg surface, screwdriver adj; solder lug term; RCA part/dwg #442716–3.	Crystal circuit balancing (Y–101).	3D9014–6
C–102	CAPACITOR, variable: air; plate meshing type; 3 to 25 mmf; SLC characteristics; 500 v RMS test; 13/32" lg x 15/16" wd x 17/32" h excluding shaft; shaft ¼" diam x 227/32" lg from mtg surface, extension shaft adj; solder lug term; Hammarlund type #APC.	Trimmer across secondary of L–101.	3D9025V–58

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
C-205	CAPACITOR, variable: air; plate meshing type; 3 to 25 mmf; SLC characteristics; 500 v RMS test; 1 3/32" lg x 15/16" wd x 1 7/32" h excluding shaft; shaft ¼" diam x 1¾" lg from mtg surface, extension shaft adj; solder lug term; Hammarlund type #APC.	Bfo tuning	3D9025V-57
C-103	CAPACITOR, variable: air; plate meshing type; 8 sect: sect A, 10 to 410 mmf; sect B, 8 to 68 mmf; sect C, 8 to 128 mmf; sect D, 10 to 370 mmf; Sect E, 8 to 128 mmf; sect F, 10 to 370 mmf; sect G, 8 to 128 mmf; sect H, 10 to 370 mmf; SLC characteristics; 11 31/32" lg x 4⅛" wd x 4" h; shaft ¼" diam x 25/32" lg, extension shaft adj; lug and screw term; RCA part/dwg #92444-503.	Tuning	3D9410V-1
	CLAMP: tube mtg; SS; 1 5/32" ID x ¾" h excluding clip; for 1 5/32" diam tube base; buckle type lock; Birtcher #926A.	Tube mounting	2Z2636-28
L-101	COIL, RF: ant, #1 band; integral type; 2 wnd, 1 wnd 6 pie universal wnd; ea pie 20 turns of 15 strands #43 AWG single glass braid E wire, other wnd universal wnd 25 turns #36 AWG single glass braid E wire; split copper shield between pri and secd; 1¼" diam x 2¾" lg o/a incl mtg bushing; RCA part/dwg #442723-502.	Antenna coil, band 1	3C1084H-36
L-102	COIL, RF: ant, #2 band; 2 wnd, single layer wnd; pri 40 turns #30 AWG E wire, secd 19 turns #30 AWG E wire; unshielded; ¾" diam x 2⅝" lg o/a; RCA part/dwg #95521-501.	Antenna coil, band 2	3C1084H-37
L-103	COIL, RF: ant, #3 band; 2 wnd single layer wnd; pri 15 turns #26 AWG E wire, secd 10 turns #30 AWG E wire; unshielded; ¾" diam x 2⅝" lg o/a; RCA part/dwg #95521-502.	Antenna coil, band 3	3C1084H-38
L-104	COIL, RF: ant, #4 band; 2 wnd, single layer wnd; pri 10 turns #26 AWG E wire, secd 10 turns #30 AWG E wire; unshielded; ¾" diam x 2⅝" lg o/a; RCA part/dwg #95521-503.	Antenna coil, band 4	3C1084H-39
L-105	COIL, RF: ant, #5 band; 2 wnd, single layer wnd; pri 7 turns #30 AWG E wire, secd 7 turns #24 AWG E wire; unshielded; ¾" diam x 2⅝" lg o/a; RCA part/dwg #95521-504.	Antenna coil, band 5	3C1084H-40
L-106	COIL, RF: ant, #6 band; 2 wnd, single layer wnd; pri 3⅛ turns #22 AWG tinned wire, secd 5⅛ turns #22 AWG tinned wire, unshielded; ¾" diam x 2 9/16" lg o/a; RCA part/dwg #95519-507.	Antenna coil, band 6	3C1084H-41

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
L-107, L-119	COIL, RF: RF transf #1 band; integral type; 2 wnd, 1 wnd 5 pie universal wnd w/tap between 4th and 5th pie; ea pie 24 turns of 10 strands #42 AWG single glass braid E wire; other wnd universal wnd 400-½ turns #38 AWG single glass braid E wire, unshielded; ⅞" diam x 2¾" lg o/a; RCA part/dwg #442723-501.	L107: R-f interstage, band 1. L119: R-f output, band 1	3C1084H-48
L-108, L-120	COIL, RF: RF transf #2 band; integral type; 2 wnd, pri single layer wnd, secd universal wnd; pri 37 turns #30 AWG E wire, secd 200 turns #36 AWG single glass braid E wire; unshielded; ⅞" diam x 2¾" lg o/a; RCA part/dwg #442723-503.	L108: R-f interstage, band 2. L120: R-f output, band 2	3C1084H-50
L-109, L-121	COIL, RF: RF transf #3 band; integral type; 2 wnd, pri single layer wnd, secd universal wnd; pri 15½ turns #26 AWG E wire, secd 90 turns #36 AWG double glass braid E wire; unshielded; ⅞" diam x 2¾" lg o/a; RCA part/dwg #442723-504.	L109: R-f interstage, band 3. L121: R-f output, band 3	3C1084H-51
L-110, L-122	COIL, RF: amplr, #4 band; single wnd, single layer wnd; 8⁹⁄₁₆" turns #22 AWG tinned wire; unshielded; ¾" diam x 2⁹⁄₁₆" lg o/a; RCA part/dwg #95519-501.	L110: R-f interstage, band 4. L122: R-f output, band 4	3C1084H-33
L-111, L-123	COIL, RF: amplr #5 band; single wnd, single layer wnd; 4⁹⁄₁₆" turns # 22 AWG tinned wire; unshielded; ¾" diam x 2⁹⁄₁₆" lg o/a; RCA part/dwg #95519-502.	L111: R-f interstage, band 5. L123: R-f output, band 5	3C1084H-34
L-112, L-124	COIL, RF: amplr #6 band; single wnd, single layer wnd; 2⁹⁄₁₆" turns # 22 AWG tinned wire; unshielded; ¾" diam x 2⁹⁄₁₆" lg o/a; RCA part/dwg #95519-503.	L112: R-f interstage, band 6. L124: R-f output, band 6	3C1084H-35
L-135	COIL, RF: BFO; single wnd, 4 pie universal wnd; rectangular aluminum shielded can; 1.375" sq x 3.385" h excluding mtg bolts; marked "L-135, ITEMS C-203, C-204, C-206, C-207, R-153, R-160, R-161, R-171, INSIDE"; RCA part/dwg #727692-9.	Oscillator coil for tube V-115.	3C1084Z6-37
L-126	COIL, RF: crystal load; single wnd, 6 pie universal wnd; rectangular aluminum shielded can; 1.375" sq x 3.385" h excluding mtg bolts; marked "L-126, ITEM C-168, R-119, INSIDE"; RCA part/dwg #727692-7.	Load for crystal Y-101	3C1084Z6-36
L-113	COIL, RF: osc, #1 band: integral type; single wnd, combination bank-universal wnd; 95¼ turns #36 AWG single glass braid E wire tapped at 74¾ turns; unshielded; ¾" diam x 2¾" lg o/a; RCA part/dwg #442723-505.	Oscillator, band 1	3C1084H-42
L-114	COIL, RF: osc, #2 band; integral type; single wnd, single layer wnd; 45¼ turns #30 AWG E wire tapped at 33¾ turns; unshielded; ¾" diam x 2¾" lg o/a; RCA part/dwg #442723-506.	Oscillator, band 2	3C1084H-52

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
L-115	COIL, RF: osc, #3 band; integral type; single wnd, single layer wnd; 17¼ turns #26 AWG E wire tapped at 13¾ turns; unshielded; ¾" diam x 2¾" lg o/a; RCA part/dwg #442723-507.	Oscillator, band 3	3C1084H-44
L-116	COIL, RF: osc, #4 band; single wnd, single layer wnd; 10⁵⁄₁₆ turns #22 AWG tinned wire tapped at 6³⁄₁₆ turns; unshielded; ¾" diam x 2⁹⁄₁₆" lg o/a; RCA part/dwg #95519-504.	Oscillator, band 4	3C1084H-43
L-117	COIL, RF: osc, #5 band; single wnd, single layer wnd; 7¹³⁄₁₆ turns #22 AWG tinned wire tapped at 4⁷⁄₁₆ turns; unshielded; ¾" diam x 2⁹⁄₁₆" lg o/a; RCA part/dwg #95519-505.	Oscillator, band 5	3C1084H-49
L-118	COIL, RF: osc, #6 band; single wnd, single layer wnd; 5¹⁄₁₆ turns #22 AWG tinned wire tapped at 2³⁄₁₆ turns; unshielded ¾" diam x 2⁹⁄₁₆" lg o/a; RCA part/dwg #95519-506.	Oscillator, band 6	3C1084H-45
J-101	CONNECTOR, receptacle: female; 3 cont; straight; 1¹¹⁄₃₂" lg w/ 1⅝" sq flange; AN type #AN-3102-22-2S.	Antenna input	2Z8673.1
J-104	CONNECTOR, receptacle: female; 3 cont; straight; ²⁹⁄₃₂" lg w/ 1³⁄₁₆" sq flange; AN type #AN-3102-14S-1S.	Video input	2Z8673.20
J-103	CONNECTOR, receptacle: male, 2 flat parallel cont; straight; 1¼" lg x 1¼" diam w/2.031" lg x 1²¹⁄₃₂" wd mtg flange; Hubbell #6808.	A-c power input	
	COUPLING, flexible: phophor-bronze rings, nickel pl brass hubs; 1³⁄₃₂" diam x ⅝" lg o/a w/hub on ea side for ¼" diam shaft; RCA part/dwg #98950-3.	Extends shaft	3H1290-37
	COUPLING, flexible: phosphor-bronze springs and brass hubs, nickel pl, ceramic ins; 1¼" diam x ¹¹⁄₁₆" lg o/a w/hub on ea side for ¼" diam shaft; RCA part/dwg #897704-1.	Extends shaft	3H1290-38
Y-101	CRYSTAL UNIT, quartz: 455 kc −40° C to +70° C temp range; 2 copper wire leads; rectangular phenolic body ²⁵⁄₃₂" lg x ²⁵⁄₃₂" wd x ³¹⁄₆₄" thk; RCA part/dwg #MI-19454-1.	Crystal filter circuit	2X115-455
	DETENT: 6 positions, 30° apart; approx 2²⁹⁄₃₂" lg x ¹⁵⁄₁₆" wd x 2¼" h o/a; 2 mtg holes 0.228" diam on 1⅝" x ½" mtg/c; RCA part/dwg #442721-501.	Band change	2Z3613-4
	DIAL: c/o white translucent lamicoid dial, black finished steel mask and brass gear mtd on SS bushing; 5¾" diam x ⅞" thk o/a; mts on ¼" diam shaft by dual #8-32 set screw; RCA part/dwg #442722-501.	Tuning	2Z3718.82
	DIAL: white translucent lamicoid; 3⅝" diam x 0.040" thk; mts on ¼" diam shaft w/two #8 set screws; RCA part/dwg #98947-502.	Vernier disk	2Z3718.81

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	DRIVE, tuning: main and vernier dials; c/o gears and 4 shafts ¼" diam; approx 6⅝" lg x 4 1/32" wd x 4¼" h o/a; four # 8–32 mtg studs on bottom of rear plate; RCA part/dwg #92417–2.	For gauged capacitor	2Z3876.102
	GEAR: spur, idler; brass gear, 80 straight teeth; 2.562" OD x 0.375" ID x 3/32" thk; fastened to steel bracket approx 3¼" lg x 29/32" wd x 3¼" h; RCA part/dwg #897852–501.	Part of gear assembly	2Z4875–156
	GEAR ASSEMBLY: c/o SS gear 0.875" PD, 32 diam pitch, 28 teeth, ⅛" face, RCA part/dwg #897849–1 w/brass gear 1.500" PD, 32 diam pitch, 48 teeth, 0.93" face, RCA part/dwg #897850–1; approx 1⅝" diam x 45/64" lg o/a; mts on ¼" diam shaft by dual #8–32 set screws; RCA part/dwg #897851–501.	Band change	2Z4870–82
J–102	JACK, telephone: for 2 cond ¼" diam plug 2⅝" lg x 15/16" h x ⅝" wd o/a; mtg bushing ⅜"–32 thd x ⅜" lg; RCA part/dwg #897702–1.	Phones	2Z5531.53
	KNOB: round; black molded compound; for ¼" diam shaft; double #10–32 set screw; 2" diam x 1¼" h o/a; brass insert; shaft hole ⅝" d; 8 indents; RCA part/dwg #712336–503.	Control	2Z5842–10
	KNOB: round; black molded compound; for ¼" diam shaft; double #8–32 set screw 1⅝" lg x 1½" wd x ⅞" h o/a; brass insert; shaft hole 9/16" d; 8 indents and pointer; RCA part/dwg #712336–505.	Control	2ZK5788–18
	KNOB: round; black molded compound; for ¼" diam shaft; single #8–32 set screw ⅝" h x 1" wd x 1⅛" d o/a; brass insert; shaft hole ½" d; RCA part/dwg #712336–507.	Control	2Z5842–9
I–101 through I–104.	LAMP LM–27: incandescent; 6.3 v, 0.25 amp; 1 3/16" lg o/a; miniature bayonet base.	Dial lights	2Z5927
X–117, X–118, X–120.	LAMPHOLDER: miniature bayonet; brass body 6–8 v; 27/32" lg x 7/16" wd x 13/16" h; Amer Rad Hdwe type #1540.	For panel lights	2Z5883–59
X–119	LAMPHOLDER: miniature bayonet brass cad pl body; 6–8 v; approx 31/32" lg x 13/16" diam o/a; mts in ⅝" diam hole by snap springs; Cinch type #⅝ plug button.	For panel light	2Z5956.7
	PLATE, friction: c/o phosphor-bronze strip, steel plate and bracket; approx 3 11/32" lg x ⅞" wd x 23/32" d o/a; 2 mtg holes on 0.203" diam spaced ½" c to c, ¼" from 1 end; RCA part/dwg #99819–502.	Friction dial lock	2Z2639–81

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
L-133, L-134	REACTOR: 13.25 hy, 90 ma; 400 ohms DC resistance; HS metal case; $2\frac{13}{16}$" lg x $2\frac{13}{16}$" wd x $3\frac{1}{4}$" h less term; four 0.180" diam holes on $2\frac{7}{16}$" x $2\frac{7}{16}$" mtg/c; 2 ins solder lug term $\frac{41}{64}$" h on top; RCA part/dwg #901589-501.	Filter chokes	3C555-14
R-169	RESISTOR, fixed: WW; 5 ohms ± 5%; 9 w; 2" lg x $\frac{5}{8}$" max diam; 2 axial wire leads; JAN type RW56J5RO.	Impedance matching, power amplifier circuit (V-110).	3RW10510
R-109, R-117, R-151, R-152.	RESISTOR, fixed: composition; 10 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF100K.	R-109 and R-117: parasitic suppressors. R-151 and R-152: Voltage dropping, filament of tube V-111.	3RC20BF100K
R-102, R-141	RESISTOR, fixed: composition; 15 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF150K.	R102: Parasitic suppressor, plate circuit of tube V-101. R-141: Part of voltage divider in bias supply.	3RC20BF150K
R-143	RESISTOR, fixed: WW; 100 ohms ± 5%; 9 w; 2" lg x $\frac{5}{8}$" max diam; 2 axial wire leads; JAN type RW56J101.	Part of voltage divider in bias supply.	3RW18324
R-120, R-149	RESISTOR, fixed: composition; 100 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF101K.	R-120: cathode bias for tube V-105. R-149: Cathode bias for tube V-109.	3RC20BF101K
R-142	RESISTOR, fixed: WW; 160 ohms ± 5%; 9 w; 2" lg x $\frac{5}{8}$" max diam; 2 axial wire leads; JAN type RW56J161.	Part of voltage divider in bias supply.	3RW19518
R-125	RESISTOR, fixed: composition; 180 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF181K.	Cathode bias for tube V-106	3RC20BF181K
R-154	RESISTOR, fixed: composition; 200 ohms ± 5%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF201J.	Cathode bias for tube V-112	3RC20BF201J
R-132	RESISTOR, fixed: composition; 390 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF391K.	Cathode bias for tube V-107	3RC20BF391K
R-112	RESISTOR, fixed: composition; 560 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF561K.	Cathode bias for tube V-104	3RC20BF561K

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
R–105, R–111, R–116, R–123, R–124, R–126, R–131, R–134, R–159.	RESISTOR, fixed: composition; 1000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF102K.	R–105: Decoupling, plate circuit of tube V–101. R–111: Decoupling, plate circuit of tube V–102. R–116: Decoupling, plate circuit of tube V–104. R–123: Decoupling, plate circuit of tube V–103. R–124: Decoupling, plate circuit of tube V–105. R–126: Decoupling, plate circuit of tube V–106. R–131: Dropping, screen circuit of tube V–107. R–134: Decoupling, plate circuit of tube V–107. R–159: Decoupling, plate circuit of tube V–113.	3RC20BF102K
R–158, R–168	RESISTOR, fixed composition; 1500 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF152K.	R–158: Decoupling, plate circuit of tube V–112. R–168: Cathode bias for tube V–113.	3RC20BF152K
R–128	RESISTOR, fixed: WW; 2500 ohms ± 5%; 9 w; 2″ lg x ⅝″ max diam; 2 axial wire leads; JAN type RW56J252.	Regulating for tube V–114	3RW26728
R–163	RESISTOR, fixed: composition; 2700 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF272K.	Feedback, a-f amplifier circuit.	3RC20BF272K
R–107, R–114	RESISTOR, fixed: composition; 5600 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF562K.	R–107: Loading across coil L–108. R–114: Loading across coil L–120.	3RC20BF562K
R–146, R–164	RESISTOR, fixed: composition; 6800 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF682K.	R–146: Part of voltage divider for bias voltage to r-f and i-f amplifiers. R–164: Voltage dropping, screen circuit of tube V–110.	3RC20BF682K
R–122	RESISTOR, fixed: composition; 10,000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF103K.	Plate load for tube V–103	3RC20BF103K
R–115, R–171	RESISTOR, fixed: composition; 15,000 ohms ± 10%; ½ w; 0.468″ lg x 0.249″ diam; JAN type RC20BF153K.	R–115: Loading across primary winding of transformer T–101. R–171: Voltage divider in plate circuit of tube V–115.	3RC20BF153K

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
R–165, R–166, R–167, R–170.	RESISTOR, fixed: composition; 22,000 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF223K.	R–165: Plate load for triode section of tube V–113. R–166: Cathode bias for tube V–113. R–167: Grid resistor for tube V–113. R–170: Series output, tube V–113.	3RC20BF223K
R–101, R–108, R–118, R–136.	RESISTOR, fixed: composition; 33,000 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF333K.	R–101: Voltage dropping, screen circuit of tube V–101. R–108: Voltage dropping, screen circuit of tube V–102. R–118: Screen dropping for tube V–104. R–136: Load, tube V–108.	3RC20BF333K
R–161	RESISTOR, fixed: composition; 47,000 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF473K.	Voltage divider in plate circuit of tube V–115.	3RC20BF473K
R–106	RESISTOR, fixed: composition; 56,000 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF563K.	Grid resistor for tube V–103.	3RC20BF563K
R–110, R–113, R–156.	RESISTOR, fixed: composition; 100,000 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF104K.	R–110: Filter, Avc circuit. R–113: Grid resistor for tube V–104. R156: Decoupling, plate circuit of tube V109.	3RC20BF104K
R–153, R–160	RESISTOR, fixed: composition; 120,000 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF124K.	R–153: Grid resistor for tube V–115. R–160: Voltage dropping, plate circuit of tube V–115.	3RC20BF124K
R–155	RESISTOR, fixed: composition; 270,000 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF274K.	Plate load for tube V–109	3RC20BF274K
R–162	RESISTOR, fixed: composition; 330,000 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF334K.	Grid resistor for tube V–110.	3RC20BF334K
R–144	RESISTOR, fixed: composition; 390,000 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF394K.	Isolating, bias voltage circuit for r-f and i-f amplifier.	3RC20BF394K
R–121, R–127, R–129, R–130, R–138.	RESISTOR, fixed: composition; 560,000 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF564K.	R–121: Decoupling in avc circuit. R–127: Decoupling in avc circuit. R–129: Bleeder in power supply. R–130: Bleeder in power supply. R–138: Load, diode tube V–111.	3RC20BF564K

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
R-137	RESISTOR, fixed: composition; 680,000 ohms ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF684K.	Filter, noise limiter circuit.	3RC20BF684K
R-104, R-119, R-140.	RESISTOR, fixed: composition; 1 meg ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF105K.	R-104: Grid resistor for tube V-102. R-119: Loading in crystal circuit (Y-101). R-140: Decoupling, avc circuit.	3RC20BF105K
R-148	RESISTOR, fixed: composition; 1.5 meg ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF155K.	Voltage dropping, screen circuit of tube V-109.	3RC20BF155K
R-103, R-133, R-139, R-147.	RESISTOR, fixed: composition; 2.2 meg ± 10%; ½ w; 0.468" lg x 0.249" diam; JAN type RC20BF225K.	R-103: Grid resistor for tube V-101. R-133: Grid resistor for tube V-107. R-139: Grid, tube V-109. R-147: Voltage divider.	3RC20BF225K
R-135, R-145	RESISTOR, variable: composition; 66,000 ohms ± 10%; ½ w; 3 solder lug term; end metal case 1⅛" diam x 9/16" d max; round metal shaft ¼" diam x 1¾" lg FMS; RCA part/dwg #441392-4 (no marking).	R-135: NOISE LIMITER control. R-145: RF GAIN control.	3Z7466
R-157	RESISTOR, variable: comp; 1 meg ± 20%; ½ w; 3 solder lug term; encl metal case 1⅛" diam x 9/16" d max; round metal shaft ¼" diam x 1¾" lg FMS; RCA part/dwg #441392-1.	HF-tone control	3Z7499-1.73
R-150	RESISTOR, variable: composition; 2 meg ± 20%; ½ w; 3 solder lug term; encl metal case 1⅛" diam x 9/16" d max; round metal shaft ¼" diam x 1¾" lg FMS; RCA part/dwg #441392-5.	AF GAIN control	3Z7499-2.24
	SHAFT: steel, cad pl; 0.249" diam x 9 21/32" lg; turned to ⅛" diam for 7/16" lg, 1" from 1 end; RCA part/dwg #897857-1.	Extension for trimmer capacitor.	2Z8204-12
X-101 through X-116.	SOCKET, tube: octal; isolantite, 1⅞" x 1½" wd x ¾" thk; Natl Co #CIR-8.	For octal tubes	2Z8678.53
S-103	SWITCH, rotary: 2 pole, 4 position; single sect; silver cont; phenolic body; 17/32" lg x 1 33/64" wd x 1⅞" h; bushing ⅜"-32 thd x ⅜" lg, shaft ¼" diam x 1 13/16" lg FMS; RCA part/dwg #442717-1.	MAN - MAN NL - AVC NL - AVC switch.	3Z9825-82.41
S-102	SWITCH, rotary: 4 pole, 5 position; 2 sect; silver cont; ceramic body; approx 9 7/32" lg x 3 7/16" wd x 3½" h; bushing ⅜"-32 thd x ⅜" lg, shaft ¼" diam x 1 13/16" lg FMS; RCA part/dwg #442718-1.	SELECTIVITY switch	3Z9825-82.40

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
S-101	SWITCH, rotary: 16 pole, 6 position; 8 sect; silver cont; ceramic body; approx $11\frac{7}{8}''$ lg x $8\frac{3}{4}''$ wd x $3\frac{7}{8}''$ h; bushing $\frac{3}{8}''$-32 thd x $\frac{3}{8}''$ lg, shaft $\frac{1}{4}''$ diam x $3\frac{7}{16}''$ lg FMS; RCA part/dwg #727690-2.	RANGE switch	3Z9825-82.38
S-104	SWITCH, rotary: 3 pole, 4 position and SPST; single sect and power switch; silver cont; phenolic body; approx $1\frac{3}{8}''$ lg x $1\frac{33}{64}''$ wd x $1\frac{7}{8}''$ h; bushing $\frac{3}{8}''$-32 thd x $\frac{3}{8}''$ lg, shaft $\frac{1}{4}''$ diam x $1\frac{13}{16}''$ lg FMS; RCA part/dwg #442715-1.	OFF - TRANS - REC MOD - REC CW switch.	3Z9825-82.39
	TOOL, alinement: fiber; 8" lg x $\frac{3}{8}''$ diam; hex socket wrench at 1 end, steel hook at other end; RCA part/dwg #81059-502.	Alinement	6R38476
	TOOL, alinement: laminated plastic; $6\frac{3}{16}''$ lg x $\frac{1}{4}''$ diam; $\frac{3}{16}''$ wd x 0.015" thk ext metal screwdriver 1 end, 0.125" wd x 0.015" thk recessed screw driver in other end; RCA part/dwg #897847-501.	Alinement	6R38433
T-108	TRANSFORMER, AF: pri 7000 ohms impedance; secd #1, 5 ohms; secd #2, 250 ohms CT; secd #3, 4000 ohms; HS metal case, iron core; case $2\frac{5}{64}''$ diam x $2\frac{3}{4}''$ h; 8 pillar type term $\frac{9}{16}''$ h, on bottom; RCA type XT-4937.	Plate coupling.	
T-109	TRANSFORMER: fil and plate type; input 115 v, 60 cyc, single ph; four output wnd; 590 v ea side CT at 0.212 amp w/tap at 340 v ea side CT, fil #1-6.3 v at 3 amp CT, fil #2-6.3 v at 3 amp CT, fil #3-5 v at 3 amp CT; compound and castor oil filled; HS metal case; case excluding term $4\frac{29}{32}''$ lg x $4\frac{29}{32}''$ wd x $6\frac{1}{32}''$ h; 16 ceramic ins solder lug term $\frac{13}{16}''$ h on top; four #10-32 studs on top on 3" x $4\frac{1}{8}''$ mtg/c; RCA part/dwg #901883-501.	Power	2Z960884
T-101	TRANSFORMER, IF: 455 kc; shielded; 1.375" sq x 3.385" h less mtg bolts; powdered iron core; tuned pri and secd; adj core tuning; 2 spade bolts on $1\frac{5}{16}''$ mtg/c; 6 solder lug term; contains two 680-mmf fixed capacitors; RCA part/dwg #727692-1, less ref symbols.	I-f interstage	2Z9641-276
T-102 through T-105.	TRANSFORMER, IF: 455 kc; shielded; $1\frac{7}{16}''$ sq x $3\frac{15}{16}''$ h less mtg bolts; powdered iron core; tuned pri and secd; adj core tuning; 2 spade bolts on $1\frac{5}{16}''$ mtg/c; 4 solder lug term; contains two 680-mmf fixed capacitors; RCA part/dwg #P92430-503, less ref symbols.	I-f interstage	2Z9641-132
T-106	TRANSFORMER, IF: 455 kc; shielded; 1.375" sq x 3.385" h less mtg bolts; powdered iron core; tuned pri and secd; adj core tuning; 2 spade bolts on $1\frac{5}{16}''$ mtg/c; 6 solder lug term; contains three 180-mmf fixed capacitors; RCA part/dwg #727692-8, less ref symbols.	I-f interstage	2Z9641-131

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
T-107	TRANSFORMER, IF: 455 kc; shielded; 1.375" sq x 3.385" h less mtg bolts; powdered iron core; tuned pri and secd; adj core tuning; 2 spade bolts on 1$\frac{5}{16}$" mtg/c; 6 solder lug term; contains two 180-mmf fixed capacitors; RCA part/dwg #727692-6.	I-f interstage.	
V-114	TUBE, electron: JAN-OD3/VR150	Voltage regulator	2JOD/VR150
V-116	TUBE, electron: JAN-5Y3GT/G	Rectifier	2J5Y3GT/G
V-108, V-111	TUBE, electron: JAN-6H6	V-108: Detector and avc V-111: Noise limiter.	2J6H6
V-103, V-115	TUBE, electron: JAN-6J5	V-103: H-f oscillator V-115: Beat-frequency oscillator.	2J6J5
V-110	TUBE, electron: JAN-6K6GT/G	A-f power amplifier	2J6K6GT/G
V-104	TUBE, electron: JAN-6SA7	Mixer	2J6SA7Y
V-101, V-102, V-105, V-106, V-107, V-112.	TUBE, electron: JAN-6SG7	V-101: 1st r-f amplifier V-102: 2d r-f amplifier. V-105: 1st i-f amplifier. V-106: 2d i-f amplifier. V-107: 3d i-f amplifier (audio). V-112: 3d i-f amplifier (video).	2J6SG7Y
V-109	TUBE, electron: JAN-6SJ7Y	1st audio amplifier	2J6SJ7Y
V-113	TUBE, electron: JAN-6SN7/GT	Video amplifier-detector	2J6SN7GT
	WRENCH: Allen set screw; $\frac{5}{64}$" across flat; 1$\frac{7}{8}$" lg x $\frac{39}{64}$" wd; steel, parkerized; L-shape; for Allen #8 set screw and #4 cap screw; Allen #8.	Tool	6R57400
	WRENCH: Allen set screw, short series type; $\frac{3}{32}$" across flats; 2" lg x $\frac{21}{36}$" wd; steel, parkerized; L-shape; for Allen #10 and #12 set screw and #6 cap screw; RCA part/dwg #828505-1.	Tool	6R55496

9. Identification Table for Modulating Voltage Generator O-15/CRD-2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No
	MODULATING VOLTAGE GENERATOR O-15/CRD-2: fixed freq osc and ph splitting device; approx 19" wd x 14" d x 10½" h o/a; RCA part/dwg #308161-1.	Furnishes modulating voltage to antenna system and synchronizing voltage to bearing indicator.	3F3582-15
	TECHNICAL MANUAL: TM 11-514	Instruction book	(Order through AGO channels.)
	BOARD, terminal: lam phenolic; 2¾" lg x 1¾" wd x $\frac{3}{32}$" thk o/a; RCA part/dwg #897520-1.	General purpose	2Z6820.150

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	BOARD, terminal: 4 brass tin pl term; $\frac{1}{2}''$ x $1\frac{1}{4}''$ between ctrs; lam phenolic; 2" lg x $\frac{3}{4}''$ x $\frac{3}{32}''$ thk; RCA part/dwg #441647-501, less marking.	Resistor mounting	2Z770-4.4
	BOARD, terminal: 5 post type term; 4 term on $\frac{3}{4}''$ x $\frac{1}{2}''$ mtg/c, other term forms triangle w/ctr term; lam phenolic; $1\frac{3}{4}''$ lg x $1\frac{5}{8}''$ wd x $\frac{11}{32}''$ thk o/a; RCA part/dwg #441999-501.	Resistor mounting	3Z770-5.1
	BOARD, terminal: 6 post type term; lam phenolic; $2\frac{1}{16}''$ lg x $1\frac{7}{8}''$ wd x $\frac{3}{32}''$ thk; RCA part/dwg #8890519-501.	Resistor and rectifier mounting.	3Z770-6.1
	BOARD, terminal: 8 brass post type term; 4 term on $1\frac{1}{2}''$ x $2\frac{3}{4}''$ ctr, 4 term on $\frac{7}{8}''$ x $2\frac{1}{8}''$ ctr; lam phenolic; board $4\frac{3}{4}''$ lg x 3" wd x $\frac{3}{32}''$ thk; RCA part/ dwg #443303-501.	Resistor mounting	3Z770-8.7
	BOARD, terminal: 8 brass post type term; 4 term on 1" x $\frac{1}{2}''$ ctr, 4 term on 1" x $\frac{1}{2}''$ ctr w/$\frac{11}{16}''$ space between sets; lam phenolic; board $3\frac{7}{16}''$ lg x $1\frac{1}{2}''$ wd x $\frac{3}{32}''$ thk; RCA part/dwg #443303-502.	Resistor mounting	3Z770-8.6
	BOARD, terminal: 14 brass tin pl term; $\frac{3}{8}''$ x $1\frac{1}{8}''$ between term ctrs; lam phenolic; board $3\frac{1}{4}''$ lg x $1\frac{1}{2}''$ wd x $\frac{3}{16}''$ thk; RCA part/dwg #897259-501.	Resistor mounting	3Z770-14.1
	BOARD, terminal: 25 brass tin pl term; lam phenolic; board $6\frac{11}{16}''$ lg x $3\frac{1}{2}''$ wd x $\frac{3}{32}''$ thk; RCA part/dwg #441939-501.	Resistor and capacitor mounting.	3Z770-2S
	BOARD, terminal: 48 brass tin pl term; lam phenolic; board 11" lg x $1\frac{1}{2}''$ wd x $\frac{3}{32}''$ thk; RCA part/dwg #441958-501.	Resistor and capacitor mounting.	3Z770-48
C-401, C-402, C-403.	CAPACITOR, fixed: mica; 2000 mmf $\pm$ 2%; 500 vdcw $\frac{53}{64}''$ lg x $\frac{53}{64}''$ wd x $\frac{11}{32}''$ h; JAN type CM30E202G.	Part of phasing network in oscillator stage (V-401).	3K3020253
C-405, C-406, C-411, C-412.	CAPACITOR, fixed: mica; 5100 mmf $\pm$ 5%; 500 vdcw; $\frac{53}{64}''$ lg x $\frac{53}{64}''$ wd x $\frac{11}{32}''$ h; JAN type CM35E512J.	C-405 and C-406: Part of low-pass filter network (tube V-401 circuit). C-411 and C-412: Part of low-pass filter network (tube V-402 circuit).	3K3551252
C-414, C-415	CAPACITOR, fixed: mica; 10,000 mmf $\pm$ 2%; 300 vdcw; $\frac{53}{64}''$ lg x $\frac{53}{64}''$ wd x $\frac{11}{32}''$ h; JAN type CM35E103G.	Part of high-pass filter network (tube V-403 circuit).	3K3510353
C-416, C-417	CAPACITOR, fixed: mica; 47,000 mmf $\pm$ 2%; 600 vdcw; $1\frac{25}{32}''$ lg x $1\frac{11}{32}''$ wd x $\frac{3}{4}''$ h; JAN type CM61D473G.	Part of phase-shifting network.	3K6147343

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
C-407, C-409, C-413, C-418, C-422.	CAPACITOR, fixed: paper; 100,000 mmf ± 10%; 600 vdcw; HS metal case; 1 5/16 lg x 49/64" wd x 2" h; 2 solder lug term; JAN type CP65B1EF104K.	C-407: Part of low-pass filter network (tube V-401 circuit). C-409: Coupling from tube V-401 to tube V-402. C-413: Coupling of bearing indicator output voltage. C-418 and C-422: Coupling, phase inverter circuit.	3DA100-665
C-420, C-421, C-424 through C-428.	CAPACITOR, fixed: paper; 500,000 mmf ± 10%; 600 vdcw; HS metal case; 1 5/16" lg x 49/64" wd x 2" h; 2 solder lug term; JAN type CP65B1EF504K.	C-420, C-421, C-424, and C-425: Coupling of antenna system output voltages. C-426 and C-427: Coupling to metering circuit rectifier. C-428: Filter across tube V-410.	3DA500-479
C-408, C-410, C-419, C-423.	CAPACITOR, fixed: paper; 4 mf ± 10%; 600 vdcw; HS metal case; 4½" lg x 1½" diam; palnut mtg; JAN type CP40C2EF405K.	C-408: Part of low-pass filter network (tube V-401 network). C-410: Decoupling plate circuit of tube V-401. C-419: Grid resistor for tube V-402. C-423: Part of filter network (tube V-403).	3DB4-259
C-429	CAPACITOR, fixed: paper; 8 mf + 20% — 10%; 1000 vdcw; HS metal case; 3¾" lg x 1¾" wd x 4¾" h; 2 solder lug term; Jan type CP70B1EG805V.	Ripple filter	3DB8-187
C-404	CAPACITOR, fixed: electrolytic; 10 mf; 100 vdcw; 1 13/16" lg x 1" wd x 15/16" h; HS metal case; 2 solder lug term; JAN type CE63C100H.	Cathode a-f bypass for tube V-401.	3DB10-165
	CLAMP: SS; 1½" OD x 1⅜" ID x 1" h o/a; Birtcher clamp type #926C.	Electron tube mounting	2Z2636-26
	CLIP: phosphor-bronze, nickel pl; 11/16" lg x 15/16" wd x 1⅛" h o/a; RCA part/dwg #7862770-2.	Fuse clip	3Z1029-10.4
	CLIP: phosphor-bronze, nickel pl; ½" lg x ⅝" wd x 27/32" h o/a; RCA part/dwg #7862770-7.	Fuse clip	3Z1033
J-403	CONNECTOR, receptacle: female; 2 round cont; straight; 1 11/32" lg x 1⅜" sq flange; AN type #AN-3102-18-3S.	A-c output to azimuth-indicator.	2ZK3096-20
J-404	CONNECTOR, receptacle: female; 20 round cont; straight; 1 11/32" lg w/2" sq flange; AN type #AN-3102-28-168.	Output to azimuth indicator	2Z3081
J-401, J-402	CONNECTOR, receptacle: female; 2 flat cont; straight; 2.031" lg x 1¾" wd x 1⅛" d approx o/a; Hubbell cat. #9813.	A-c output	6Z7785-1

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
P-401	CONNECTOR, receptacle: male; 2 round cont; straight; 1 3/16" wd x 1 3/16" d x 29/32" lg less cont; AN type #AN-3102-14S-9P.	Speaker input from receiver	2Z7112.30
P-402	CONNECTOR, receptacle: male; 2 flat cont; straight; flange 2.31" lg; body 1.375" OD x 1.062" d; Hubbell cat. #6808.	A-c output to antenna assembly.	6Z7589
P-403	CONNECTOR. receptacle: male; 6 round cont; straight; 1⅜" sq x 1 11/32" lg less cont and term; AN type #AN-3102-18-12P.	Output to bearing indicator	2Z7116.27
F-401 through F-404.	FUSE FU-50: cartridge; 3 amp. 250 v; one-time; glass body; ferrule term; 1¼" lg x ¼" diam; Littel fuse cat. #1043.	Protect circuits from overload.	3Z1950
	HOLDER. fuse: extractor post type; for single 3 AG cartridge fuse; black bakelite body; 7/16" diam x 2" lg; panel hole mtg; 2 solder lug term; Buss type HKM.	For F-401, F-402, F-403, and F-404.	3Z3285-2
	INSULATOR. standoff: sq pillar shape; white glazed steatite: 0.625" lg; ⅜" sq w/mtg holes 3/16" lg x 6-32 thd at ea end; JAN type NS4W1005.	Insulator.	3G3510-05.1
	KNOB: door knob, round; nickel pl brass; single #8-32 tapped hole ½" d; ⅞" diam x 13/16" d; Natl Lock cat. #0489.	Control	2Z5822-214
	KNOB: bar; aluminum alloy, black finish; for ¼" diam shaft; two #8-32 set screws; 2⅝" lg x ¾" wd x ⅝" h o/a; RCA part/dwg #871292-1.	Control	2Z5821-127
	KNOB: round; black composition; for ¼" diam shaft; single #8-32 set screw; line marking; ⅝" h x 1" wd x 1⅛" d o/a; RCA part/dwg #712336-507.	Control	2Z5842-9
E-401, E-402	LAMP, glow: 65 v AC striking voltage, ¼ w; candelabra screw base; neon; 30,000-ohm resistor in base; GE Mazda neon lamp type #NE45.	A-c indicators	3F4056A/L2
I-401, I-402	LIGHT, indicator: w/lens; 1" diam clear lens candelabra screw base; 115 v, ¼ w; 2 13/16 lg x 1⅛" wd across hex flats; Gothard cat. #1216.	Holders for E-401 and E-402.	2Z5991-96
M-402	METER, multi-scale: DC; 0-50 ma, 0-500 v; round metal HS flush mtg case; bbl 2.80" diam x 1 21/32" lg w/round fl 3½" diam; 1.0 ma full-scale deflection, 1000 ohms per v; RCA part/dwg #442387-2.	Indicator	3F886-50
M-401	METER, voltmeter: AC, rect type; 0 to 5 v; round metal HS flush mtg case; bbl 2.80" diam x 1 21/32" lg w/round fl 3½" diam; 1.0 ma full-scale deflection, 1000 ohms per v; RCA part/dwg #442387-1.	Indicator	3F8005-7

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
L-401	REACTOR: single sect; 31 hy, 0.02 amp at 60 cyc; 12 ohms impedance at 60 cyc; 3 11/32" lg x 3" wd x 4 51/64" h excluding term; RCA type #XT-4932.	Filter choke	3C370-83
CR-401	RECTIFIER, metallic: selenium; input, 10 v AC, 1-1000 cyc; output 6.5 v DC, 0.010 amp max; rectangular 3/8" wd x 15/32" h x 21/32" lg o/a; potted in plastic case; Selen Corp type #DS-8F.	Rectifies a-f current for metering purposes.	3H4858-17.1
R-457	RESISTOR. fixed: WW; 3.06 ohms ± 0.5%; 1/2 w; 27/32" diam x 1" lg; JAN type RB12B-3R060D.	Meter shunt	3RB2-3060
R-459	RESISTOR, fixed: composition; 24 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF240J.	Minimum bias voltage for balanced modulator tubes during SPLIT operation.	3RC30BF240J
R-458	RESISTOR, fixed: composition; 510 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF511J.	Common cathode bias for four of balanced modulator tubes in antenna system during STAND-BY operation.	3RC30BF511J
R-404	RESISTOR, fixed: composition; 1500 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF152J.	Cathode bias for tube V-401.	3RC30BF152J
R-428, R-430, R-435, R-437.	RESISTOR, fixed: composition; 1800 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF182J.	R-428: Cathode bias for tube V-403. R-430: Cathode bias for tube V-403. R-435: Cathode bias for tube V-404. R-437: Cathode bias for tube V-404.	3RC30BF182J
R-405, R-417, R-418.	RESISTOR, fixed: composition; 2700 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF272J.	R-405: Cathode bias for tube V-401. R-417 and R-418: Cathode bias for tube V-402.	3RC30BF272J
R-468	RESISTOR, fixed: WW; 7500 ohms ± 5%; 8 w; 2" lg x 9/16" diam; IRC type DG.	Voltage regulating for tube V-411.	3Z6575-81
R-411, R-432, R-439.	RESISTOR, fixed: composition; 20,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF203J.	R-411: Decoupling, plate circuit of tube V-401. R-432: Decoupling, plate circuit of tube V-403. R-439: Decoupling, plate circuit of tube V-404.	3RC30BF203J
R-464	RESISTOR, fixed: composition; 20,000 ohms ± 5%; 4 w; 2.66" lg x 0.730" diam; JAN type RC65CF203J.	Part of voltage divider in power supply.	3RC65CF203J
R-467	RESISTOR, fixed: WW; 20,000 ohms ± 5%; 8 w; 2" lg x 9/16" diam; IRC type DG.	Voltage regulating for tube V-410.	3Z6620-155
R-426	RESISTOR, fixed: composition; 32,000 ohms ± 1%; 1/2 w; 5/8" lg x 3/8" diam; Concarbon type X 1/2.	Part of Phase-shifting network.	3Z6632-1

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
R-429, R-434, R-436, R-441.	RESISTOR, fixed: composition; 33,000 ohms ± 10%; ½ w; ⅝" lg x ⅜" diam; Concarbon type X ½.	R-429: Cathode output for tube V-403. R-434: Plate load for tube V-403. R-436: Cathode output for tube V-404. R-441: Plate load for tube V-404.	3Z6633-29
R-466	RESISTOR, fixed: composition; 36,000 ohms ± 5%; 4 w; 2.66" lg x 0.730" diam; JAN type RC65CF363J.	Part of voltage divider in power supply.	3RC65CF363J
R-410	RESISTOR, fixed: composition; 56,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF563J.	Plate load for tube V-401	3RC30BF563J
R-409	RESISTOR, fixed: composition; 68,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF683J.	Decoupling, plate circuit of tube V-401.	3RC30BF683J
R-406, R-412, R-420, R-421, R-433, R-440.	RESISTOR, fixed: composition; 100,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF104J.	R-406: Grid for tube V-401 R-412: Plate load for tube V-401. R-420: Plate load for tube V-402. R-421: Plate load for tube V-402. R-433: Plate load for tube V-403. R-440: Plate load for tube V-404.	3RC30BF104J
R-419, R-422, R423.	RESISTOR, fixed: composition; 150,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF104J.	R-419: Grid resistor for tube V-402. R-422 and R-423: Part of high-pass filter network.	3RC30BF154J
R-401, R-402, R-403.	RESISTOR, fixed: composition; 220,000 ohms ± 1%; ½ w; ⅝" lg x $\frac{9}{32}$" diam; Concarbon type x ½.	Part of phasing network in oscillator circuit.	3Z6722-36
R-424	RESISTOR, fixed: composition; 270,000 ohms ± 1%; ½ w; ⅝" lg x $\frac{9}{32}$" diam; Concarbon type x ½.	Part of phase-shifting network.	3Z6727-35
R-425	RESISTOR, fixed: composition; 300,000 ohms ± 1%; ½ w; ⅝" lg x $\frac{9}{32}$" diam; Concarbon type x ½.	Part of phase-shifting network.	3Z6730-40
R-413, R-414, R-415.	RESISTOR, fixed: composition; 330,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF334J.	R-413 and R-414: Part of low-pass filter network (tube V-402). R-415: Isolating.	3RC30BF334J
R-447	RESISTOR, fixed: WW; 500,000 ohms; 2$\frac{15}{16}$" lg x 1" diam; 2 ferrule type term $\frac{33}{64}$" lg x $\frac{13}{16}$" diam; voltage rating 500 v; JAN type MFC504.	Meter multiplier	3F3795-504
R-431, R-438	RESISTOR, fixed: composition; 680,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF684J.	R-431: Grid resistor for tube V-403. R-438: Grid resistor for tube V-404.	3RC30BF684J

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
R-407, R-408	RESISTOR, fixed: composition; 820,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF824J.	Part of low-pass filter network (tube V-401).	3RC30BF824J
R-442, R-443	RESISTOR, fixed: composition; 1 meg ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF105J.	Grid resistors for tube V-405.	3RC30BF105J
R-460, R-461	RESISTOR, fixed: composition; 1.5 meg ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF155J.	Feedback resistor in power supply.	3RC30BF155J
R-462	RESISTOR, fixed: composition; 2 meg ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF205J.	Regulating resistor for power supply.	3RC30BF205J
R-452	RESISTOR, variable: WW; 150 ohms ± 10%; 2 w; 3 term; 1.28" diam x 0.62" d; slotted shaft ¼" diam x 1¼" lg; JAN type RA20A2-SG151AH.	SENSE GAIN control	3RA3903
R-448 through R-451.	RESISTOR, variable: WW; 150 ohms ± 10%; 2 w; 3 term; 1.28" diam x 0.62" d; round shaft ¼" diam x 1¼" lg; JAN type RA20A2-RD151AK.	BALANCE controls for balanced modulator tubes in antenna system.	3RA3905
R-453 through R-456.	RESISTOR, variable: WW; 750 ohms ± 10%; 2 w; 3 term; 1.28" diam x 0.62" d; round shaft ¼" diam x 1¼" lg; JAN type RA20A2-RD751AK.	LEVEL controls for balanced modulator tubes in antenna system.	3RA5407
R-465	RESISTOR, variable: WW; 10,000 ohms ± 10%; 2 w; 3 solder lug term; enclosed body 1.28" diam x 0.62" d; shaft ¼" diam x 1¼" lg from mtg surface, screwdriver slot; JAN type RA20A2SG103AK.	B+ LEVEL control	3RA7525
R-416, R-427	RESISTOR, variable: composition; 500,000 ohms ± 10%; 2 w; 3 solder lug term; enclosed metal body 1¹⁄₁₆" diam x ⁹⁄₁₆" d; shaft ¼" diam x ⅞" lg from mtg surface, slotted end; AB type J.	R-416: Controls input to grid of tube V-402. R-427: Controls input to grid of tube V-403.	2Z7272-161
R-463	RESISTOR, variable: composition; 1 meg ± 20%; 2 w; 3 solder lug terms; enclosed metal body 1¹⁄₁₆" diam x ⁹⁄₁₆" d; shaft ¼" diam x ½" lg from mtg surface, slotted end; AB type J.	HUM control	2Z7273-104
R-446A, R-446B	RESISTOR, variable: composition; 2 sect, ea 10,000 ohms ± 10%; 2 w, 85° C max continuous oper; 3 solder lug term ea sect; enclosed metal bodies in tandem 1¹⁄₁₆" diam x 1³⁄₁₆" d; shaft ¼" diam x ½" lg from mtg surface, screwdriver slot; AB type JW.	Cathode resistor for tube V-405.	3Z7410-94
X-401 through X-411.	SOCKET, tube: octal; 1 piece saddle mtg; two 0.143" diam mtg holes on 1½" mtg/c; plastic body 1⅛" diam x ½" h excluding term; Cinch type #9977.	Tube sockets	2Z8678.26

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
LS-401	SPEAKER, magnetic: 4" diam cone; PM; 2½ w normal; voice coil impedance 3.8 ohms at 400 cyc; 5 1/32" diam x 2⅜" d o/a; Jensrad Model #PM5-FS, stock #ST-443.	Monitor speaker	6C35-6
S-403	SWITCH, lever: 5 pole, 3 position, locking action; position #1-1A, position #2-1B, position #3-5A; cont rated 5 amp, 110 v AC; open body 3½" lg x 1⅛" wd x 2" h o/a; lever 1 3/16" lg x 7/16" diam; Mossman DP type 0-42.	SPLIT-OPERATE-STAND-BY switch.	3Z9580-32.1
S-408	SWITCH, rotary: 1 pole, 2 position and 1 pole, 3 position; open steel frame, phenolic ins; 1⅞" lg x 1⅝" wd x 2" d o/a; flatted shaft ¼" diam x ⅞" lg; RCA part/dwg #447728-1.	Meter selector switch	3Z9825-82.32
S-409	SWITCH, rotary: 2 pole, 4 position; open steel frame, phenolic ins; 1⅞" lg x 1⅝" wd x 2" d o/a; flatted shaft ¼" diam x ⅞" lg; RCA part/dwg #447729-1.	Meter selector switch	3Z9825-82.33
S-401, S-402	SWITCH, toggle: DPST; 25 amp, 125 v, 9 amp, 250 v; bakelite body; 1 21/64 lg x 49/64" wd x 1 1/16" h; 4 term; JAN type ST52K.	S-401: POWER OFF-ON switch. S-402: MASTER POWER OFF-ON switch.	3Z9863-52K
S-404 through S-407.	SWITCH, toggle: SPDT; 20 amp, 24 v; bakelite body; 1 9/64" lg x 41/64" wd x 1⅛" h; 3 term; JAN type ST42E.	OPER-OFF-TEST switch	3Z9849.53-1
S-410	SWITCH, toggle: DPDT; 5 amp, 125 v, 2 amp, 250 v; bakelite body; 1 9/32" lg x 23/32" wd x 23/32" h; 4 term; JAN type ST22N.	MOD VOL AURAL-VISUAL switch.	3Z9849.135
T-401	TRANSFORMER, power: fil and plate type; input 115 v, 60 cyc, single ph; 4 output windings; plate 590 v ea side CT at 0.212 amp w/tap also at 340 v ea side CT, fil #1, 6.3 v at 3 amp CT, fil #2, 6.3 v at 3 amp CT, fil #3, 5 v at 3 amp CT; HS metal case; 4 29/32" lg x 4 3/32" wd x 6 1/32" h excluding term; 16 term; RCA part/dwg #901883-501.	Power	2Z9608-84
V-410	TUBE, electron: JAN-OC3/VR105	Voltage regulator	2JOC3/VR105
V-411	TUBE, electron: JAN-OD3/VR150	Voltage regulator	2JOD3/VR150
V-406	TUBE, electron: JAN-5R4GY	Rectifier	2J5R4GY
V-407, V-408.	TUBE, electron: JAN-6B4G	Voltage regulators	2J6B4G
V-401, V-402.	TUBE, electron: JAN-6SL7GT	V-401: Oscillator V-402: Buffer amplifier.	2J6SL7GT
V-403, V-404, V-405.	TUBE, electron: JAN-6SN7GT	V-403 and V-404: Phase inverters. V-405: Metering.	2J6SN7GT
V-409	TUBE, electron: JAN-6SQ7	Voltage control	2J6SQ7

10. Identification Table of Parts for Bearing Indicator ID-64/CRD-2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	BEARING INDICATOR ID-64/CRD-2: radio station locator; CR tube, 5" diam, cross propeller type signal, green med persistence screen; input 105 v, 60 cyc, single ph, 146 w, or 115 v, 60 cyc, single ph, 171 w; 21 13/16" lg x 19" wd x 10½" h; incl oper cables; RCA part/dwg #308178-1.	Indicates azimuth of arrival of r-f signals at the antenna system.	2C1565-64
	TECHNICAL MANUAL: TM 11-514	Instruction book	(Order through AGO channels.)
	BAR, switch actuator: aluminum alloy, black enamel; T-shape; 3" lg x 15/32" wd x ½" thk o/a; RCA part/dwg #898149-1.	For SENSE SWITCH	2Z558-27
	BOARD, terminal: 2 brass solder lug term, solder coated; lam phenolic; 3⅝" lg x 1½" wd x 3/32" thk; RCA part/dwg #898189-501 (marked R-376).	Resistor mounting	3Z770-2.3
	BOARD, terminal: two 0.173" diam term holes; lam phenolic; 1¾" lg x 1¾" wd x 3/32" thk; RCA part/dwg #898168-1 (marked C-302).	General purpose	3Z770-2.2
	BOARD, terminal: 2 post type term and 2 elastic stop nuts; lam phenolic; 1⅝" lg x 1⅝" wd x 3/32" thk o/a; RCA part/dwg #898133-501.	Special purpose	3Z770-4
	BOARD, terminal: 4 post type term; lam phenolic; 2" lg x 1½" wd x 21/32" thk o/a; RCA part/dwg #441967-502.	For mounting resistor and capacitor.	3Z770-4.2
	BOARD, terminal: 4 elastic stop nuts; lam phenolic; 2¾" lg x 1¾" wd x 0.391" thk o/a; RCA part/dwg #897220-501.	For mounting capacitors	3Z770-4.1
	BOARD, terminal: 4 brass, tin pl term; lam phenolic; 2" lg x ¾" wd x 3/32" thk x 15/32" h incl term o/a; RCA part/dwg #441647-504, less marking.	For mounting resistor	3Z770-4.3
	BOARD, terminal: 5 post type term; lam phenolic; 1¾" lg x 1⅝" wd x 11/32" thk o/a; RCA part/dwg #441999-502.	For mounting resistors	3Z770-5
	BOARD, terminal: 6 post type term; lam phenolic; 2½" lg x 15/16" wd x 7/16" thk o/a; RCA part/dwg #897519-501.	General purpose	3Z770-6
	BOARD. terminal: 7 post type term; lam phenolic; 3⅜" lg x 3" wd x 11/32" thk o/a; RCA part/dwg #441970-502, less marking.	For mounting resistors and capacitors.	3Z770-7
	BOARD. terminal: 10 post type term w/8 elastic stop nuts; lam phenolic; 5⅝" lg x 3 7/16" wd x 13/16" thk o/a; RCA part/dwg #441969-501.	For mounting resistors and capacitors.	3Z770-18
	BOARD, terminal: 17 post type term: lam phenolic; 3½" lg x 2⅞" wd x 11/32" thk o/a; RCA part/dwg #441967-501	For mounting resistors and capacitors.	3Z770-17

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	BOARD, terminal: 25 post type term w/6 elastic stop nuts; lam phenolic; 6 1/16" lg x 3 1/2" wd x 39/64" thk; RCA part/dwg #441968-501	For mounting resistors and capacitors.	3Z770-31
	BOARD, terminal: 32 post type term; lam phenolic; 8 1/4" lg x 3" wd x 21/32" thk o/a; RCA part/dwg #441966-501	For mounting resistors and capacitors.	3Z770-32
	BOARD, terminal: 35 post type term; lam phenolic; 6 11/16" lg x 4 7/8" wd x 3/4" thk o/a; RCA part/dwg #441971-501 (marked R-304, R-305, R-307, R-309, R-311, R-313, R-314, R-329, R-340, R-345, R-375, R-378, R-379, R-380, R-382, R-385, R-386, C-309, C-312, C-314, C-315, C-341).	For mounting resistors and capacitors.	3Z770-43
C-326, C-336	CAPACITOR, fixed: silver mica; 100 mmf ± 2%; 500 vdcw; 51/64" lg x 15/32" wd x 7/32" thk; JAN type CM20C101G.	C-326: Resonating in output circuit of tubes V-306 and V-307. C-336: Resonating in output circuit of tubes V-307 and V-308.	3K2010133
C-305	CAPACITOR, fixed: silver mica; 220 mmf ± 2%; 500 vdcw; 1 1/16" lg x 15/32" wd x 7/32" thk; JAN type CM25E221G.	Resonating across coil L-303.	3K2520153
C-320 through C-323, C-330 through C-333.	CAPACITOR, fixed: silver mica: 240 mmf + 2%; 500 vdcw; 1 1/16" lg x 15/32" wd x 7/32" thk; JAN type CM25E241G.	C-320 and C-323: Coupling in input circuits of tubes V-306 and V-307. C-321 and C-322: 200-kc bypass in grid circuits of tubes V-306 and V-307. C-330 and C-333: Coupling in input circuits of tubes V-308 and V-309. C-331 and C-332; 200-kc bypass in grid circuits of tubes V-308 and V-309.	3K2524153
C-302	CAPACITOR, fixed: mica; 910 mmf ± 2%; 2500 vdcw; 1 25/32" lg x 1 11/32" wd x 15/32" thk; JAN type CM55B911G.	Resonating across coil L-301B.	3K5591123
C-301	CAPACITOR, fixed: silver mica; 2000 mmf ± 5%; 500 vdcw; 53/64" lg x 53/64" wd x 9/32" thk; JAN type CM30E202J.	Grid capacitor for tube V-301.	3K3020252
C-327, C-329, C-337, C-339.	CAPACITOR, fixed: silver mica; 3300 mmf ± 2%; 500 vdcw; 53/64" lg x 53/64" wd x 9/32" thk; JAN type CM30E332G.	Coupling, outputs of tubes V-306 through V-309.	3K3033253

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
C–306, C–311, C–312, C–314, through C–317.	CAPACITOR, fixed: mica 5100 mmf ± 5%; 2500 vdcw; 1 25/32" lg x 1 11/32" wd x ¾" thk; JAN type CM61D512J.	C–306 and C–311: Part of smoothing filter in oscillator output circuit (V–301). C–312: Coupling, output circuit of tube V–304. C–314: Coupling to grid of tube V–305. C–315: Filter in output circuit of tube V-301. C–316: Cathode bypass for tube V–305. C–317: Bypass, focusing grid of tube V–305.	3K6151242
C–341, C–343, C–345, C–346.	CAPACITOR, fixed: silver mica; 10,000 mmf ± 2%; 300 vdcw; 53/64" lg x 53/64" wd x 11/32" thk; JAN type CM35E103G.	C–341: Phase shifting C–343: Coupling, cathode output of tube V–310. C–345 and C–346: Part of high-pass filter network.	3K3510353
C–347, C–352	CAPACITOR, fixed: mica 47,000 mmf ± 2%; 600 vdcw; 1 25/32" lg x 1 11/32" wd x ¾" thk; JAN type CM61D473G.	Part of phase-shifting networks.	3K6147343
C–304, C–340, C–342, C–348, C–353.	CAPACITOR, fixed: paper; 100,000 mmf ± 10%; 600 vdcw; 1 5/16" wd x 49/64" d x 1⅜" h; 2 solder lug term on bottom; JAN type CP65B1EF104K.	C–304: Screen bypass for tube V–302. C–340: Coupling in grid circuit of V–310. C–342: Coupling in grid circuit of tube V–310. C–348: Coupling in grid circuit of tube V–311. C–353: Coupling in grid circuit of tube V–312.	3DA100–665
C–357	CAPACITOR, fixed: paper; 2 sect; 100,000–100,000 mmf + 20% – 10%; 600 vdcw; 1¾" wd x 41/64" d x 1½" h; 3 solder lug term on bottom; JAN type CP69B4EF104V.	Prevents oscillation of tubes V–313 and V–314.	3DA100–533
C–308, C–349, C–351, C–354, C–356.	CAPACITOR, fixed: paper; 500,000 mmf ± 10%; 600 vdcw; 1 5/16" wd x 49/64" d x 2" h; 2 solder lug term on bottom; JAN type CP65B1-EF504K.	C–308: Feedback in oscillator circuit (V–301). C–349 and C–351: Coupling in output circuits of tube V–311. C–354 and C–356: Coupling in output circuits of tube V–312.	3DA500–479
C–318	CAPACITOR, fixed: paper; 2 sect; 500,000–500,000 mmf + 20% — 10%; 600 vdcw; 2" wd x 1¾" d x 1" h; 3 solder lug term on side; JAN type CP53B4EF504V.	A-f bypass for potentiometers R–318 and R–319.	3DA600–576

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
C-313, C-328, C-338.	CAPACITOR, fixed: paper; 2 sect; 500,000-500,000 mmf + 20% — 10%; 600 vdcw; 1 5/16" wd x 49/64" d x 2 3/4" h; 3 solder lug term on bottom; JAN type CP65B6EF504V.	R-313: Decoupling, plate circuit of tube V-304. C-328A: Decoupling, plate circuit of tubes V-306 and V-307. C-328B: R-f bypass for centering voltage to V-305. C-338A: Decoupling, plate circuit of tubes V-308 and V-309. C-338B: R-f bypass for centering voltage to V-305.	3DA500-577
C-324, C-334	CAPACITOR, fixed: paper; 3 sect; 50,000-50,000-50,000 mmf + 20% — 10%; 600 vdcw; 1 3/4" wd x 41/64" d x 1 1/2" h; 3 solder lug term on bottom; JAN type CP69B5EF503V.	C-324A, C-324B: Cathode bypass for tubes V-306 and V-307. C-324C: Screen r-f bypass for tubes V-306 and V-307. C-334A, C-334B: Cathode bypass for tubes V-308 and V-309. C-334C: Screen r-f bypass for tubes V-308 and V-309.	3DA50-209
C-310	CAPACITOR, fixed: paper; 3 sect; 100,000-100,000-100,000 mmf + 20% — 10%; 600 vdcw; 1 3/4" wd x 41/64" d x 1 1/2" h; 3 solder lug term on bottom; JAN type CP69B5EF104V.	C-310A: Cathode bypass for tube V-304. C-310B: Screen bypass for tube V-304.	3DA100-673
C-344, C-350, C-355.	CAPACITOR, fixed: paper; 4 mf ± 10%; 600 vdcw; 4 1/2" lg x 1 1/2" diam; one #10-32 stud w/nut and solder lug; JAN type CP40C2-EF405K.	C-344: Decoupling, plate circuit of tube V-310. C-350: Decoupling, plate circuit of tube V-311. C-355: Decoupling, plate circuit of tube V-312.	3DB4-259
C-358	CAPACITOR, fixed: paper; 10 mf ± 10%; 1000 vdcw; 3 3/4" wd x 2 1/4" d x 4 3/4" h; 2 solder lug term on top; JAN type CP70B1-EG106K.	Filter in power supply	3DB10-188
	CAPACITOR, variable: ceramic; rotary type; 1.5 to 7 mmf; 500 vdcw; 41/64" wd x 13/32" d x 27/32" h; screwdriver adj; JAN type CV11A070.	Coupling to grid of tube V-304.	3D9007V-17
C-307	CAPACITOR, variable: air; 2.7 to 5.0 mmf; 0.109" air gap; 1" lg x 1 13/32" wd x 1 5/16" h excluding shaft; shaft 1/4" diam x 5/8" lg, screwdriver slot; Cardwell type ZR-10 modified per RCA part/dwg #442778-3.	Resonating in oscillator output circuit (V-301).	3D9005V-11
C-303	CAPACITOR, variable: air; 2.8 to 50 mmf; 0.030" air gap; 1 3/8" lg x 1 13/32" wd x 1 3/4" h excluding shaft; shaft 1/4" diam x 1/2" lg, extension adj; Cardwell type ZR-50-AS stub shaft.	Oscillator tuning	3D9050V-61

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
C–325, C–335	CAPACITOR, variable: air; 2 sect, 1st sect 3 to 33 mmf, 2d sect 2 to 4 mmf; 1 29/32" lg x 1 11/32" wd x 3/4" d excluding shaft; shaft 1/4" diam x 1/2" lg, extension shaft adj; Hammerlund type #HF modified per RCA part/dwg #898645-1.	C–325: Balancing in output circuit of tubes V–306 and V–307. C–335: Balancing in output circuit of tubes V–308 and V–309.	3D9033V–2
	CLAMP: SS; 2 11/16" lg x 1 3/8" wd x 1" h o/a; one mtg hole 3/16" wd x 5/16" lg; accommodates tube base approx 1 3/8" diam; Birtcher #926C.	Tube mounting	2Z2636–26
	CLIP: fuse; phosphor-bronze, nickel pl; 0.30 amp, 600 v; 1/2" lg x 5/8" wd x 27/32" h o/a; RCA part/dwg #7862770-7.	Holds fuse	3Z1033
L–303	COIL, RF: choke; single wnd, 1 pie universal wnd; unshielded; 1.72 mh inductance; 470 turns #36 B&S wire; 3/4" diam x 7/8" lg o/a; RCA part/dwg #898890-501.	Part of resonant circuit, plate load for tube V–302.	3C370–93
L–302	COIL, RF: choke; single wnd, 5 pie universal wd; shielded; 9 mh min at 1000 cps w/1 v, 20 ohms DC resistance; ea pie 115 turn #5–40 Litz wire; 1 51/64" lg x 1 1/2" wd x 1 7/8" h o/a; HS, castor oil impr; RCA part/dwg #443035-501.	R-f choke in oscillator circuit.	3C370–94
L–301	COIL, RF: osc; 3 windings, 2 universal wnd, 1 single layer wnd; unshielded; OSC pri 6.96 mh+ 1%, HV secd ind 45.5 mh ± 1%; OSC pri 148 turns #15–38 DSE Litz wire universal wnd, OSC secd 20 turns #36 DSC wire single layer wnd, HV secd 4 pies ea 452 turns #7–40 DSE Litz wire universal wnd; 1 3/8" diam x 4 1/4" lg o/a; RCA part/dwg #443054-501.	L–301A: Oscillator output to h-v rectifier. L–301B: Oscillator tank. L–301C: Oscillator output to r-f control modulator.	3C370–92
L–304, L–305	COIL, RF: plate; single winding, universal wnd, 2 pie; unshielded; 1.9 mh inductance ea pie w/combined total 4.2 mh; ea pie 435 turns 0.005" diam DSE magnet wire; 7/8" diam x 3" lg o/a; RCA part/dwg #898646-501.	Part of resonant circuits, plate load for tubes V–306 through V–309.	3C370–95
J–301	CONNECTOR, receptacle: Sig C Socket SO-239; female; single coax cont; straight; 1 1/16" lg x 5/8" diam w/ 1" sq flange; Amphenol type #83–1R.	Auxiliary	2Z8799–239
J–302	CONNECTOR, receptacle: female; 3 cont; straight; 29/32" lg x 3/4" diam w/1 3/16" sq flange; AN type #AN-3102-14S-1S.	Video input	2Z8673.20
J–303	CONNECTOR, receptacle: female; 6 cont; straight; 1 11/32" lg w/ 1 3/8" sq flange; AN type #AN-3102-18-12S.	147-cycle input and metering circuits.	2Z8676.48
P–301	CONNECTOR, receptacle: male; 2 flat parallel cont; straight; 1 3/8" diam x 1 1/16" h w/ 2 1/32" mtg flange; Hubbell #6808.	A-c power input	6Z7589

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	HINGE: door type; steel, cad pl; 2½" lg x 1⅞" wd o/a; removable pin; RCA part/dwg #898109-501.	For panel doors	2Z5038-3
	KNOB: door, round; brass, nickel pl; single #8-32 tapped hole ½" d; ⅞" diam x 13/16" d; Natl Lock #0489.	For panel doors	2Z5822-214
	KNOB: round; black molded bakelite; for ¼" diam shaft; single #8-32 set screw; 1⅛" diam x ⅝" d o/a; RCA part/dwg #712336-507.	Control	2Z5842-9
I-301 through I-306.	LAMP IM-52: incandescent; 6.3 v, 0.15 amp; T-3¼ clear; 1⅛" lg o/a; miniature bayonet base; GE type Mazda #47.	Dial lamps	2Z5952
	LAMPHOLDER: miniature bayonet; 6-8 v, 2.8 v; 1 15/16" lg x ½" wd x 7/16" d o/a; RCA part/dwg #897243-1.	For lamps I-301 through I-306.	2Z5883-326
	PLATE, back: brass, nickel pl; 1½" lg x ¾" wd x 0.0907" thk; RCA part/dwg #897273-1.	SENSE SWITCH retaining	2Z7093-112
R-302, R-323, R-327, R-334, R-338.	RESISTOR, fixed: composition; 10 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF100J.	R-302: Parasitic suppressor in plate circuit of tube V-301. R-323, R-327, R-334, and R-338: Parasitic suppressors for tubes V-306 through V-309.	3RC30BF100J
R-385	RESISTOR, fixed: composition; 51 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF510J.	Parasitic suppressor for tube V-313.	3RC30BF510J
R-329, R-340	RESISTOR, fixed: composition; 150 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF151J.	Cathode bias, tubes V-306 through V-309.	3RC30BF151J
R-304	RESISTOR, fixed: composition; 300 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF301J.	Part of voltage divider in screen-cathode circuit of tube V-302.	3RC30BF301J
R-383	RESISTOR, fixed: WW; 630 ohms ± 5%; 30 w; 3" lg x 29/32" diam; JAN type RW34G631.	Filter, in regulated power supply.	3RW23121
R-347, R-361, R-362, R-368, R-369.	RESISTOR, fixed: composition; 1800 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF182J.	R-347: Cathode bias for tube V-310. R-361, and R-362: Cathode bias for tube V-311. R-368 and R-369: Cathode bias for tube V-312.	3RC30BF182J
R-349	RESISTOR, fixed: composition; 2000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF202J.	Cathode bias for tube V-310.	3RC30BF202J
R-375	RESISTOR, fixed: WW; 7500 ohms ± 5% 8 w; 2" lg x 9/16" diam; IRC type #DG.	Regulating for tube V-313	3Z6575-81

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
R-305, R-308, R-313, R-314.	RESISTOR, fixed: composition; 10,000 ohms ± 5%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF103J.	R-305: Part of voltage divider in screen-cathode circuit of tube V-302. R-308: Loading across coil L-303. R-313: Isolating for grid circuit of tube V-305. R-314: Plate load for tube V-304.	3RC30BF103J
R-378	RESISTOR, fixed: composition; 15,000 ohms ± 5%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF153J.	Part of voltage divider in power supply.	3RC30BF153J
R-301, R-320, R-321, R-353, R-367, R-374, R-386.	RESISTOR, fixed: composition; 20,000 ohms ± 5%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF203J.	R-301: Grid resistor for tube V-301. R-320: Part of voltage divider in h-v power supply. R-321: Cathode for tube V-303. R-353: Decoupling for plate circuit of tube V-310. R-367: Decoupling for plate circuit of tube V-311. R-374: Decoupling for plate circuit of tube V-312. R-386: Voltage regulating for tube V-314.	3RC30BF203J
R-307	RESISTOR, fixed: WW; 20,000 ohms ± 5%; 8 w; 2″ lg x $^{9}/_{16}$″ diam; IRC type #DG.	Part of voltage divider in screen-cathode circuit of tube V-302.	3Z6620-155
R-348, R-352	RESISTOR, fixed: composition; 22,000 ohms ± 5%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF223J.	R-348: Cathode load for tube V-310. R-352: Plate load for tube V-310.	3RC30BF223J
R-376	RESISTOR, fixed: composition; 27,000 ohms ± 5%; 4 w; 2.66″ lg x 0.730″ diam; JAN type RC65CF273J.	Part of voltage divider in power supply.	3RC65CF273J
R-359	RESISTOR, fixed: composition; 32,000 ohms ± 1%; ½ w; ⅝″ lg x $^{9}/_{32}$″ diam; Concarbon type X-½.	Part of 90-degree phase-shifting network.	3Z6632-1
R-363, R-366, R-370, R-373.	RESISTOR, fixed: composition; 33,000 ohms ± 1%; ½ w; ⅝″ lg x $^{9}/_{32}$″ diam; Concarbon type X-½.	R-363 and R-366: Cathode load for tube V-311. R-370: Cathode load for tube V-312. R-373: Plate load for tube V-312.	3Z6633-29
R-309, R-354	RESISTOR, fixed: composition; 47,000 ohms ± 5%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF473J.	R-309: Part of phase-shifting circuit for tube V-304. R-354: Plate load for tube V-310.	3RC30BF473J
R-310	RESISTOR, fixed: composition; 68,000 ohms ± 5%; 1 w; 0.750″ lg x 0.280″ diam; JAN type RC30BF683J.	Filter, oscillator output (tube V-301).	3RC30BF683J

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
R-345	RESISTOR, fixed: composition; 100,000 ohms ± 1%; ½ w; ⅝" lg x ⅜" diam; Concarbon type X-½.	Part of phase-shifting network.	3Z6700-176
R-365, R-372	RESISTOR, fixed: composition; 100,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF104J.	R-365: Plate load for tube V-311. R-372: Plate load for tube V-312.	3RC30BF104J
R-355, R-356	RESISTOR, fixed: composition; 150,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF154J.	Part of high-pass filter in output circuit of tube V-310.	3RC30BF154J
R-315	RESISTOR, fixed: composition; 180,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF184J.	Part of voltage divider in h-v power supply.	3RC30BF184J
R-303, R-311, R-330, R-341.	RESISTOR, fixed: composition; 200,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF204J.	R-303: Grid resistor for tube V-302. R-311: Voltage dropping, screen circuit of tube V-304. R-330: Loading across coil L-304. R-341: Loading across coil L-305.	3RC30BF204J
R-322, R-324, R-325, R-326, R-331, R-332, R-333, R-335, R-336, R-337, R-342, R-343.	RESISTOR, fixed: composition; 220,000 ohms ± 1%; ½ w; ⅝" lg x 9/32" diam; Concarbon type X-½.	R-322 and R-325: Part of 200-kc filter at input of tubes V-306 and V-307. R-324 and R-326: Grid resistor for tubes V-306 and V-307. R-331 and R-342: Isolating for centering voltages of tube V-305. R-332 and R-343: Circuit balancing. R-333 and R-336: Part of 200-kc filter at input of tubes V-308 and V-309. R-335 and R-337: Grid resistor for tubes V-308 and V-309.	3Z6722-36
R-357	RESISTOR, fixed: composition; 270,000 ohms ± 1%; ½ w; ⅝" lg x 9/32" diam; Concarbon type X-½.	Part of 90-degree phase-shifting network.	3Z6727-35
R-358	RESISTOR, fixed: composition; 300,000 ohms ± 1%; ½ w; ⅝" lg x 9/32" diam; Concarbon type X-½.	Part of phase-shifting network.	3Z6730-40
R-346, R-350, R-364, R-371.	RESISTOR, fixed: composition; 680,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF684J.	R-346 and R-350: Grid resistor for tube V-310. R-364: Grid resistor for tube V-311. R-371: Grid resistor for tube V-312.	3RC30BF684J

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
R-317	RESISTOR, fixed: composition; 750,000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF754J.	Part of voltage divider in h-v power supply.	3RC30BF754J
R-382	RESISTOR, fixed: composition; 1 meg ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF105J.	Part of hum-bucking feedback circuit in regulated power supply.	3RC30BF105J
R-380	RESISTOR, fixed: composition; 1.5 meg ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF155J.	Part of hum-bucking feedback circuit in regulated power supply.	3RC30BF155J
R-379	RESISTOR, fixed: composition; 2 meg ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF205J.	Regulating in regulated power supply.	3RC30BF205J
R-384	RESISTOR, variable: WW; 6 ohms ± 10%; 25 w; 3 term; open body 1.68" diam x 1.41" d; shaft ¼" diam x ½" lg, screw driver slot; JAN type RP101SA6ROKK.	DIM control	3RP2104
R-328, R-339	RESISTOR, variable: composition; 100 ohms ± 10%; 2 w; 3 term; enclosed body 1$\frac{1}{16}$" diam x $\frac{9}{16}$" d; shaft ¼" diam x 1¾" lg, screw driver slot; AB type J.	Cathode balance for tubes V-306 through V-309.	3Z7100-37
R-306	RESISTOR, variable: composition; 100 ohms ± 10%; 2 w; 3 term; enclosed body 1$\frac{1}{16}$" diam x $\frac{9}{16}$" d; shaft ¼" diam x ⅞" lg, screw driver slot; AB type J.	SIZE control	3Z7100-36
R-377	RESISTOR, variable: composition; 10,000 ohms ± 10%; 2 w; 3 term; enclosed body 1$\frac{1}{16}$" diam x $\frac{9}{16}$" d; shaft ¼" diam x ½" lg, screw driver slot; AB type J.	Output voltage control for regulated voltage.	2Z7269-172
R-312	RESISTOR, variable: composition; 50,000 ohms ± 20%; 2 w; 3 term; enclosed body 1$\frac{1}{16}$" diam x $\frac{9}{16}$" d; shaft ¼" diam x ¾" lg, screw driver slot; AB type J.	INTENSITY control	2Z7270-102
R-318, R-319	RESISTOR, variable: composition; 100,000 ohms ± 10%; 2 w; 3 term; enclosed body 1$\frac{1}{16}$" diam x $\frac{9}{16}$" d; shaft ¼" diam x ¾" lg, screw driver slot; AB type J.	CENTERING controls	3Z7480-91
R-316, R-351	RESISTOR, variable: composition; 250,000 ohms ± 10%; 2 w; 3 term; enclosed body 1$\frac{1}{16}$" diam x $\frac{9}{16}$" d; shaft ¼" diam x ¾" lg, screw driver slot; AB type J.	R-316: FOCUS control R-351: ORIENTATION control.	3Z7498-25.48
R-344, R-360	RESISTOR, variable: composition; 500,000 ohms ± 10%; 2 w; 3 term; enclosed body 1$\frac{1}{16}$" diam x $\frac{9}{16}$" d; shaft ¼" diam x ⅞" lg, screw driver slot; AB type J.	R-344: Input level control for tube V-310. R-360: Output level control for tube V-310.	2Z7272-161
R-381	RESISTOR, variable: composition; 1 meg ± 20%; 2 w; 3 term; enclosed body 1$\frac{1}{16}$" diam x $\frac{9}{16}$" d; shaft ¼" diam x ½" lg, screw driver slot; AB type J.	HUM control	2Z7273-104

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	SCALE: Sig C Alidade Scale Assembly MX-316/CRD-2; 7½" OD x 4" lg w/inside dimen to fit 5" CR tube; 360 deg scale range 1 deg graduation w/numerical characters for ea 10 deg; RCA part/dwg #619321-501.	Azimuth scale	2Z8077-316
	SHAFT: extension; phenolic; 0.248" for ½", ½" diam for ⅜", ⅞" lg o/a; RCA part/dwg #898150-2.	Extends shaft	2Z8204-10
	SHAFT: extension; phenolic; 0.248" diam for $\frac{5}{32}$", ½" diam for ⅜", $\frac{17}{32}$" lg o/a; RCA part/dwg #898150-1.	Extends shaft	2Z8204-11
	SHIELD, light: aluminum; 4⅝" OD x 3½" lg o/a; RCA part/dwg #441933-1.	For CR tube	2Z8304-128
X-303	SOCKET, tube: Sig C Socket SO-62 4 cont; oval ceramic body $2\frac{15}{16}$" lg x $1\frac{11}{16}$" wd x $\frac{9}{32}$" thk o/a; 2 slotted holes $\frac{17}{64}$" lg x $\frac{11}{64}$" wd on $1\frac{27}{32}$" mtg/c; Johnson EF type #224.	Tube socket	2Z8762
X-301, X-302, X-304, X-306, through X-318.	SOCKET, tube: octal; plastic body 1⅛" diam x ½" h excluding term; two 0.143" diam mtg holes on 1½" mtg/c; Cinch type #9977.	Tube sockets	2Z8678.26
X-305	SOCKET, tube: 14 cont; #6 and #13 cont missing; phenolic body 2.219" OD x 1⅜" h o/a; mts into ring w/4 slots; Cinch type #9450.	Tube socket	2ZK8684-5
S-301A, S-301B, S-301C, S-301D.	SWITCH, sensitive: SPDT; 10 amp, 125 v; phenolic body; 1.937" lg x 0.687" wd x 2.187" h o/a; panel mount ¼" over-travel; 1 circuit normally open, 1 normally closed; 3 screw term; JAN type SS03B20.	SENSE	3Z9558-39.5
S-302	SWITCH, toggle: SPST; 6 amp, 125 v; phenolic body; $1\frac{9}{32}$" lg x $\frac{23}{32}$" wd x $\frac{23}{32}$" d; JAN type ST12A.	Power	3Z9863-12A
T-301	TRANSFORMER, power: fil type; pri 115 v, 60 cyc, single ph; secd #1, 6.3 v at 6 amp CT; secd #2, 2.5 v at 2 amp CT; secd #3, 6.3 v at 1 amp CT; 11 term; HS metal case; $3\frac{25}{64}$" lg x 3" wd x $4\frac{51}{64}$" h excluding term; RCA part/dwg #901880-501.	Power	2Z9606-24
T-302	TRANSFORMER, power: fil and plate type; pri 115 v, 60 cyc, single ph; plate 590 v ea side CT at 0.212 amp w/tap also at 340 v ea side CT; secd #1, 6.3 v at 3 amp CT; secd #2, 6.3 v at 3 amp CT; secd #3, 5 v at 3 amp CT; 16 term; HS metal case; $4\frac{29}{32}$" lg x $4\frac{3}{32}$" wd x $6\frac{1}{32}$" h excluding term; RCA part/dwg #901883-501.	Power	2Z9608-84
V-314	TUBE, electron: JAN-OC3/VR105	Voltage regulator	2JOC3/VR105
V-313	TUBE, electron: JAN-OD3/VR150	Voltage regulator	2JOD3/VR150
V-303	TUBE, electron: JAN-2X2A	H-v rectifier	2J2X2A
V-305	TUBE, electron: JAN-5CP1A	Cathode-ray tube	2J5CP1A
V-318	TUBE, electron: JAN-3R4GY	Rectifier	2J5R4GY

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
V-304, V-306, through V-309.	TUBE, electron: JAN-6AC7Y	V-304: Sense blanking V-306 and V-307: Vertical modulators. V-308 and V-309: Horizontal modulators.	2J6AC7Y
V-316, V-317	TUBE, electron: JAN-6B4G	Voltage regulators	2J6B4G
V-301	TUBE, electron: JAN-616GAY	R-f oscillator	2J6L6GAY
V-302	TUBE, electron: JAN-6SA7	R-f control modulator	2J6SA7
V-310, V-311, V-312.	TUBE, electron: JAN-6SN7GT	V-310: Phase rotation V-311: Phase inverter. V-312: Phase inverter.	2JSN7GT
V-315	TUBE, electron: JAN-6SQ7	Voltage control	2J6SQ7

11. Identification Table of Parts for Junction Box J-95/CRD-2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	JUNCTION BOX J-95/CRD-2: 14" wd x $14\frac{5}{8}$" h x 13" d o/a; RCA part/dwg #619336-501.	Power control box	2Z5600-95
K-901	CIRCUIT BREAKER: Navy type #NAF 1131-5; thermal; single pole; 115 v AC, 5 amp; bakelite case; time delay, 10 sec; manual reset; $2\frac{3}{16}$" lg x $\frac{3}{4}$" wd x $1\frac{9}{16}$" h o/a; Spencer Thermo #PM-5.	230-volt line circuit breaker	3H900-5-16
K-902	CIRCUIT BREAKER: Navy type #NAF 1131-10; thermal; single pole; 230 v AC, 10 amp; bakelite case; time delay, 10 sec; manual reset; $2\frac{3}{16}$" lg x $\frac{3}{4}$" wd x $1\frac{9}{16}$" h o/a; Spencer Thermo #PM-10.	115-volt line	3H900-10-19
J-901 through J-905	CONNECTOR, receptacle: female; 2 T-shape cont; straight; 10 amp, 250 v, 15 amp, 125 v; round bakelite body; $2\frac{1}{8}$" lg x $1\frac{7}{16}$" wd x $\frac{21}{32}$" d o/a; 2 mtg ears on $1\frac{3}{4}$" c to c; Hubbell #7331.	Power output	6Z7811
P-901, P-902	CONNECTOR, receptacle: male; 2 rectangular pol cont; straight; 20 amp, 250 v; cylindrical steel body; bakelite insert; $1\frac{19}{32}$" diam x $1\frac{9}{32}$" h; mtg flange w/2 holes on $2\frac{1}{16}$" c to c; Hubbell #9105.	P-901: 230-volt line input P-902: 115-volt line input.	6Z7813
	KNOB: bar; olive green wrinkle; cast aluminum; for $\frac{1}{4}$" diam shaft; single $\frac{1}{4}$" -20 thd cap screw; 2" lg x $\frac{5}{8}$" wd $\frac{3}{4}$" h o/a; RCA part/dwg #898292-501.	------------------------	2Z5821-126
M-902	METER, frequency indicator: AC, 55 to 65 cyc; 100-150 v; round flange $3\frac{1}{4}$" diam x $2\frac{9}{16}$" diam body x $2\frac{3}{16}$" d; 10 scale div, black numerals on white background; RCA part/dwg #443087-1.	LINE FREQUENCY	3F2745-9

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
M-901	METER, voltmeter: AC, 25 to 125 cyc; 0–150 v; round flange 3½" diam x 2.80" diam body x 1.80" d; black numerals on white background; RCA part/dwg #442387-3.	OUTPUT VOLTAGE	3F8150-125
R-901 through R-904.	RESISTOR, fixed: WW; 120 ohms ± 5%; 100 w; 8" lg x 1$\frac{5}{16}$" diam JAN type RW38G121.	Dummy load	3RW18911
S-902	SWITCH, rotary: 1 pole, 9 position; single sect; ceramic body; 2¼" diam x 2⅝" o/a; Ohmite #212-9.	OUTPUT VOLTAGE	3Z9826-89
S-901-A, S-901-B, S-903.	SWITCH, toggle: DPDT; 20 amp, 125 v; phenolic body; 2$\frac{5}{32}$" lg x 1$\frac{33}{64}$" wd x 1⅜" d o/a; JAN type #ST55P.	S-901-A and S-901-B: 115 V - OFF - 230V switch. S-903: OUTPUT LOAD EQUIPMENT - OFF - DUMMY switch.	3Z9863-55P
T-901	TRANSFORMER, power: fixed autotransformer; input 115/230 v, 60 cyc, single ph; output in 10 steps, 96, 101, 106, 112, 117, 122, 125, 132, 137, 240, v; 1 kw; HS metal case; 7$\frac{7}{16}$" lg x 5$\frac{9}{16}$" wd x 7$\frac{7}{16}$" h; RCA type XT-4935, part/dwg #901882-501.	Power	2Z9621-127

12. Identification Table of Parts for Azimuth Indicator ID-240/CRD-2

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	AZIMUTH INDICATOR ID-240/CRD-2: radio station locator by use of a sinusoidal pot to give aural null readings of station location; 8" diam scale, red and white marking readings; input 115 v, 60 cyc, single ph, self-contained power supply; approx 12" h x 10¾" wd x 11" d not incl handles; front panel contains sense switch and switch for aural or visual indications; RCA part/dwg #8885383-501.	Aural-null bearing indicator.	2C5390-240
	ADAPTER, dial: SS; 1¾" diam x $\frac{57}{64}$" d; 4 holes #4-40 tapped equally spaced on 1.437" diam one end, ⅝"-32 thd other end; RCA part/dwg #8888182-1.		2Z307-68
	BOARD, terminal: 1 solder lug term; lam phenolic; $\frac{25}{32}$" lg x ⅜" wd o/a; RCA part/dwg #897192-1.	General purpose	3Z770-1.1
E-1001	BOARD, terminal: 14 post type solder lug term; lam phenolic; 3¼" lg x 1½" wd x $\frac{3}{32}$" thk; RCA part/dwg #897529-502.	For mounting resistors	3Z770-14
	CABLE ASSEMBLY, power: Cord CX-1116/CRD-2; 2 #12 AWG cond ea comprising 84 #31 AWG strands, RC; 6 ft lg incl term; AN type #AN-97-5103-18-3S, 2 cont female connector w/Amphenol type #AN-3057 cable clamp one end, AN type #AN-3106-18-3P, 2 cont male connector w/Amphenol type #AN-3057-10 cable clamp other end; RCA part/dwg #442709-502.	Interconnecting	3E6000-452-72

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	CABLE ASSEMBLY, power: Cord CX-1114/CRD-2; 20 cond, 2 #12 AWG cond ea comprising 84 #31 AWG strands, 18 #18 AWG cond ea comprising 41 #34 AWG strands, RC; 6 ft incl term; AN type #AN-5103-28-16S, 20 cont female connector w/Amphenol type #AN-3057-16 cable clamp one end, AN type #AN-3106-28-16P, 20 cont male connector w/Amphenol #AN-3057-16 cable clamp other end; RCA part/dwg #442708-502.	Interconnecting	3E6000-454-72
C-1001 through C-1004.	CAPACITOR, fixed: electrolytic; 10 mf; 100 vdcw; $1\frac{13}{16}$" lg x 1" wd x $\frac{15}{16}$" h; HS metal case; 2 solder lug term; JAN type CE63-C100H.	Filters	3DB-165
C-1005A, C-1005B.	CAPACITOR, fixed: paper; 2 sec; 100,000-100,000 mmf + 20% — 10%; 600 vdcw; HS metal case; $1\frac{13}{16}$" wd x 1" d x $\frac{3}{4}$" h; 3 solder lug term on side; JAN type CP53B4EF104V.	Line filters	3DA100-770
	CLAMP: tube; SS; natural finish; $2\frac{25}{32}$" lg w/clip extended x $1\frac{3}{8}$" wd across extension loop x $\frac{19}{32}$" h, closed approx $1\frac{5}{32}$" ID; right angle mtg bracket w/hole for #10 machine screw; fits small shell octal tube base; Birtcher type #926A modified per RCA part/dwg #438114-7.	Holds tube in place	2Z2636-28
	CLAMP: tube; SS natural finish; approx $2\frac{9}{16}$" lg w/clip extended x $1\frac{1}{2}$" wd across extension loop x $\frac{3}{4}$" h, closed approx $1\frac{1}{4}$" ID; right angle mtg bracket w/mtg slot $\frac{5}{16}$" x $\frac{3}{16}$"; fits intermediate shell octal tube base; Birtcher type #926B.	Holds tube in place	2Z5042-4
J-1002	CONNECTOR, receptacle: female; 2 cont; straight; $1\frac{11}{32}$" lg w $1\frac{3}{8}$" sq flange; AN type #AN-3102-18-3S.	Power	2ZK3096-20
J-1001	CONNECTOR, receptacle: female; 20 cont; straight; $1\frac{11}{32}$" lg w/2" sq flange; AN type #AN-3102-28-16S.	Power and control cable	2Z3081
P-1001	CONNECTOR, receptacle: male; 2 cont; straight; $1\frac{13}{32}$" lg w/$1\frac{5}{16}$" sq flange; AN type #AN-97-5105-18-3P.	Power	2Z3022-107
P-1002	CONNECTOR, receptacle: male; 20 cont; straight; $1\frac{13}{32}$" lg x $1\frac{31}{32}$" diam w/2" sq flange; AN type #AN-97-5105-28-16P.	Power and control cable	2Z3040-6
	DIAL: clear plexiglas; 9" diam x 0.125" thk o/a w/0.875" diam shaft hole and four 0.147" diam centering holes equally spaced on 1.437" diam circle; marked in 1 deg graduations for full circle, 1 row of figures on ea side of markings reading clockwise in tens and 180 deg out of phase w/ea other; RCA part/dwg #447321-1.	Bearing indicator	2Z3714-145

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	KNOB: round; black molded bakelite; for ¼" diam shaft; double #10-32 set screw; 2" diam x 1¼" h o/a; RCA part/dwg #712336-503.	Control	2Z5842-10
	KNOB: round; brass, black finish; ⅝"-32 tapped hole in ctr; 3¼" diam x 21/64" h o/a; RCA part/dwg #8888183-1.	Control	2Z5822-211
I-1001, I-1002	LAMP LM-52: incandescent; 6-8 v, 0.15 amp; T-3-¼ clear; 1⅛" max lg o/a; miniature bayonet base; GE type Mazda #47.	Dial lamps	2Z5952
X-1003, X-1004	LAMPHOLDER: miniature bayonet base; steel body; 6-28 v, 1¼ amp; 15/16" lg x ⅜" diam; Dialco #704.	Dial lamp receptacles	2Z5883-155
	MOUNT, vibration: sq mtg; 2⅜" sq x 11/16" h o/a; cushion rubber 1½" diam x ⅝" thk; Lord type #150PH8.	Shock mountings	2Z8401-5PH8
R-1005	RESISTOR, fixed: composition; 10 ohms ± 1%; ½ w; ⅝" lg x 9/32" diam; Concarbon type X-½.	Meter shunt	3Z6001-115
R-1021	RESISTOR, fixed: composition; 47 ohms ± 5%; ½ w; 0.655" lg x 0.249" diam; JAN type RC21BF470J.	Cathode bias for sense tubes in antenna system.	3RC21BF470J
R-1001	RESISTOR, fixed: WW; 2500 ohms ± 5%; 10 w; 2" lg x 7/16" diam; JAN type RW56F252.	Voltage regulating	3RW26723
R-1006, R-1007.	RESISTOR, fixed: composition; 8000 ohms ± 1%; ½ w; ⅝" lg x ⅜" diam; Concarbon type X-½.	Voltage divider	3Z6580-43
R-1009 through R-1020.	RESISTOR, fixed: composition; 500,000 ohms ± 1%; ½ w; ⅝" lg x ⅜" diam; Concarbon type X-½.	Voltage dividers	3Z6750-94
R-1008	RESISTOR, variable: WW; 16,000 ohms ± 10%; 6 solder lug term; enclosed phenolic case 2⅝" diam x 1½" d; flatted shaft 1" lg from mtg surface; Rawson Elect Instr type #RL-11-C; RCA part/dwg #885346-1.	Sinusoidal	3Z7416-1
R-1003	RESISTOR, fixed: composition; 3000 ohms ± 5%; 1 w; 0.750" lg x 0.280" diam; JAN type RC30BF302J.	Filter	3RC30BF302J
R-1004	RESISTOR, fixed: composition; 6800 ohms ± 10%; ½ w; 0.468" lg x 0.429" diam; JAN type RC20BF682K.	Filter	3RC20BF682K
R-1002	RESISTOR, variable: composition; 100,000 ohms ± 10%; 2 w; 3 solder lug term; enclosed body 1 3/32" diam x 9/16" d; shaft 13/16" lg x ¼" diam, screw driver slot; AB type J.	MODULATING LEVEL control.	3Z7480-24
X-1001, X-1002.	SOCKET, tube: octal; 1 piece saddle mtg; for 1⅛" diam chassis cutout; bakelite body approx 1¼" diam x ½" h excluding term; Cinch #9977.	Tube sockets	2Z8678.26

Ref Symbol	Name of part and description	Function of part	Signal Corps stock No.
	SPRING: helical compression type; 0.054" diam music wire; ⅝" max free lg x 15/32" min ID; 3 turns; squared ends; RCA part/dwg #145187-17.	For dial	2Z8879-226
S-1002	SWITCH, lever: 2 position (off-on) nonlocking; position #1-4C1A; cont rated 110 v, 60 cyc (noninductive) 3 amp, 150 v; 49/16" lg o/a; RCA part/dwg #8854080-25.	VISUAL-AURAL	3Z9580-35
S-1001	SWITCH, lever: 2 position nonlocking; position #1-5C, position #2-5C; cont rated 3 amp, 110 v AC (noninductive); 3¼" lg x ⅞" wd x 1⅞" h; Mossman DP #4803; RCA part/dwg #8854080-31.	SENSE WHITE-RED	3Z9580-35.1
T-1001	TRANSFORMER, power: fil and plate type; pri 110 v, 60 cyc, single ph; secd #1, 5.45 v ± 3%; at 2 amp; secd #2, 6.81 v ± 3% at 1 amp; secd #3, 352 v ± 3% at 0.025 amp CT; HS metal case; 4¼" lg x 3" wd x 359/64" h excluding term; 9 solder lug term ⅝" h on top of case; RCA part/dwg #902144-1.	Power	2Z9613-547
V-1002	TUBE, electron: JAN-OC3/VR105	Voltage regulator	2JOC3/VR105
V-1001	TUBE, electron: JAN-5Y3GT/G	Rectifier	2J5Y3GT/G
	WASHER, flat: neoprene and cork; 1¼" ID, 115/16" OD x 3/16" thk; RCA part/dwg #8888180-1.		6L54020

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