INSTRUCTION BOOK

FOR

RADIO COMPASS SCR-242-A

MANUFACTURED BY

RCA MANUFACTURING CO., INC.
CAMDEN, N. J., U. S. A.

RESTRICTED

PUBLISHED BY AUTHORITY
OF
THE CHIEF SIGNAL OFFICER

ORDER NO. SC-132376 DATE—MARCH 19, 1937

Copy 1 19 March 1937

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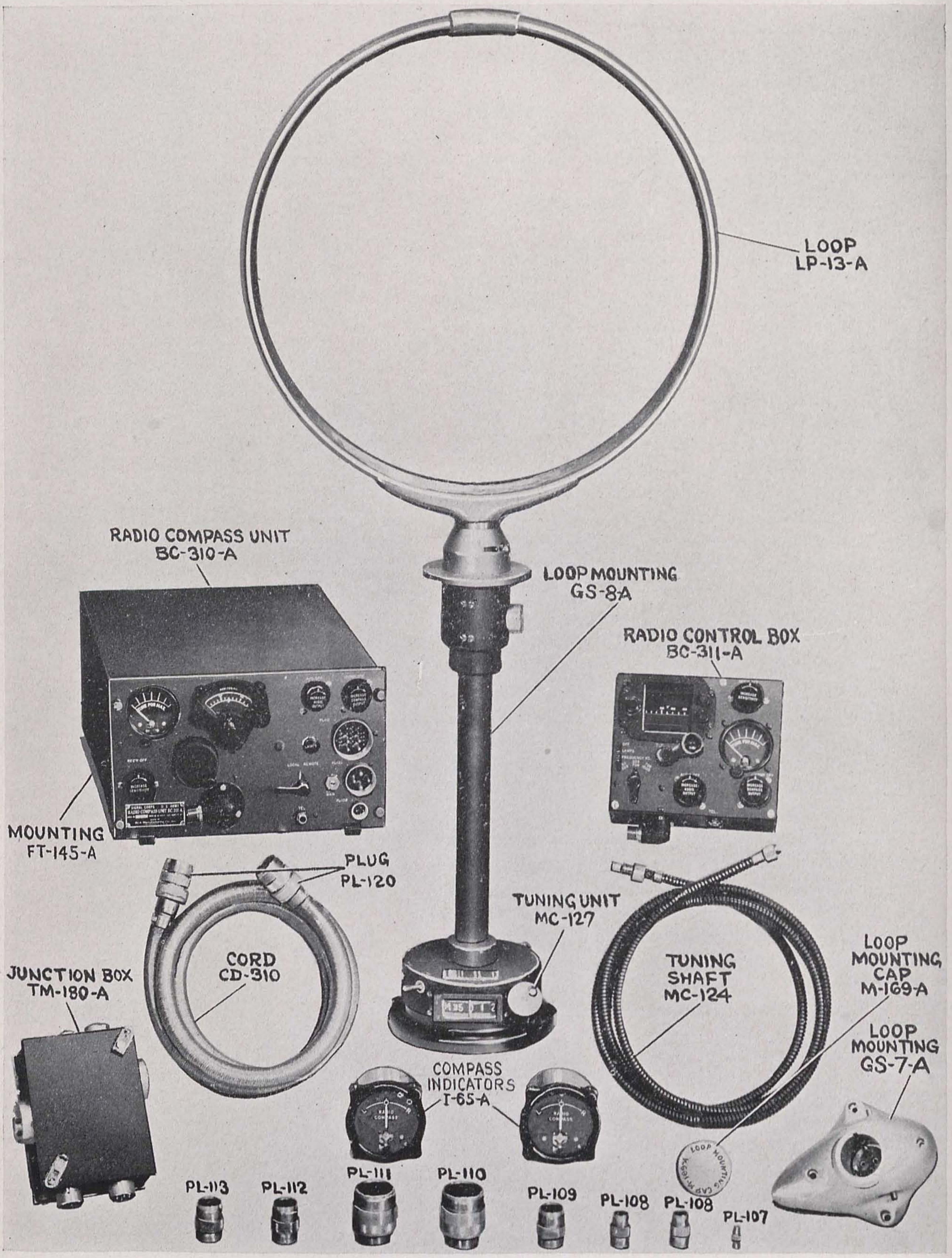


Figure 1—Radio Compass SCR-242-A

I

GENERAL DESCRIPTION OF COMPLETE EQUIPMENT

1-1 RADIO COMPASS SCR-242-A

Radio Compass SCR-242-A was designed primarily for use in U. S. Army aircraft. When used in conjunction with a suitable vertical antenna, one or two headsets and a 14.25-volt direct current power supply, this radio compass is a complete operable unit capable of providing aural reception of modulated radio frequency energy or visual, unidirectional, right-left indication of the direction of arrival of radio frequency energy with respect to the plane of the loop and simultaneous "on course," aural reception of modulated radio frequency energy. This equipment is a 15-tube, 112.5 kc i-f, superheterodyne, capable of being locally or remotely controlled (at the option of the local operator) throughout the frequency range of 150 to 1,500 kc. The frequency range is divided into three bands electrically switched from either the local or remote position. The equipment is manually tuned from either position. The tuning dials are calibrated directly in kilocycles and only the calibration of the band in use is visible. A fixed loop mounting is supplied for "homing" use only, or a rotatable loop mounting is supplied for both "homing" and radio direction finding purposes. This equipment is primarily intended for use in aircraft with built-in connector panels but junction boxes and plug connectors can be included for aircraft without built-in connector panels. All component parts of this equipment bearing the same type number are interchangeable, viz., radio compass units, loops, loop mountings, indicators and control boxes. Radio Compass SCR-242-A was designed and built to U. S. Army specification 71-849, dated May 15, 1936, by RCA Manufacturing Company, Inc., Camden, New Jersey, on order No. SC-132376, dated March 19, 1937.

1-2 COMPONENTS FOR AIRCRAFT WITH BUILT-IN CONNECTOR PANEL

The following components are required to provide a radio compass installation in aircraft having a built-in radio compass connector panel or junction box:

Components	Overall Size, in Inches Including Projections	Weight, Lbs.
1 Radio Compass Unit BC-310-A includes:†	18½ x 11⅝ x 7⅛*	42.1*
1 Alignment Tool TL-138-A		
1 Dynamotor DM-18		
4 Lamps LM-32 (2 in use, 2 mounted spares)		
1 Mounting FT-145-A		
1 Wrench, set screw, No. 8		
1 Radio Control Box BC-311-A includes:. .	7 x 7 x 3¾	5.2
4 Lamps LM-32 (2 in use, 2 spare)		
1 Wrench, set screw, No. 8		
1 Loop LP-13-A	23¾ x 20¾ x 2¼	3.5
1 Loop Mounting GS-8-A (Rotatable Loop)‡ includes:	22⅞ x 7½ dia.	9.2
1 Lamp LM-32		
1 Loop Mounting Cap M-169-A	2¼ dia. x 1⅝	0.2
1 or 2 Compass Indicators I-65-A, each includes:	3¼ dia x 3	1.3 ea.
1 Lamp LM-32		
1 Tuning Shaft MC-124	¾ dia. x 120	1.8
1 Tuning Unit MC-127‡	1½ x 1½ x 1¼	0.1
1 Set of Vacuum Tubes includes:	—	1.3
2 Tubes VT-65		
6 Tubes VT-86		
1 Tube VT-87		
1 Tube VT-90		
4 Tubes VT-91		
1 Tube VT-92		
1 Cord CD-310 (includes 2 Plugs PL-120 and 1 flexible conduit assembly)	⅞ dia. x 72	1.8
2 Cords CD-307§ includes:	½ dia. and variable length	—
1 Jack JK-26 (includes terminals) . . .	½ dia. x 2⅞	0.06
1 Plug PL-55 (includes terminals) . . .	½ dia. x 2⅞	0.06
Cordage CO-119 (length as required) .	9/32 dia.	0.05 per ft.

1-2 (Continued)

Components	Overall Size, in Inches Including Projections	Weight, Lbs.
1, 2 or 3 Plugs PL-107 (one for each indicator and rotatable loop mounting)	3/8 dia. x 7/8	0.02 ea.
2 or 3 Plugs PL-108 (one for radio compass unit and one for each indicator) ...	3/4 dia. x 1 3/8	0.05 ea.
1 Plug PL-110 (includes Conduit Adapter M-187)	1 5/8 dia. x 2 1/8	0.25
1 Insulator IN-79 (lead-in)	1 1/4 dia. x 3 1/8	0.25
Insulator IN-81 (stand-off 1 1/2 inches), (number required as specified for each type of airplane)	1 1/4 dia. x 1 1/2	0.06 ea.
Insulator IN-88 (strain), (number required as specified for each type of airplane)	1 1/2 dia. x 2 3/4	0.13 ea.
Wire W-106 (antenna wire, length required as specified for each type of airplane)	—	.0045 per ft.

*When less Mounting FT-145-A, size is 18 1/2 x 11-7/16 x 5/8 inches and weight is 40.7 pounds.

† Requires but does not include, 1 set of vacuum tubes.

‡ When "homing" feature only is required (for attack, basic training and army and corps observation type aircraft) 1 Loop Mounting GS-7-A (fixed loop) having the dimensions of 6-11/16 x 4-7/32 x 5-1/16 inches and weighing 1.2 pounds is furnished in lieu of 1 Loop Mounting GS-8-A (rotatable loop) 1 Plug PL-107 and 1 Tuning Unit MC-127.

§ One Cord CD-307 may be omitted for each aircraft position where the headset extension cord of the radio set or interphone equipment is conveniently located for use also with the radio compass.

1-3 ADDITIONAL COMPONENTS FOR AIRCRAFT WITHOUT BUILT-IN CONNECTOR PANEL

For installations in aircraft which do not contain a built-in radio compass connector panel or junction box, the components listed under paragraph 1-2 above and the following additional components are required.

Components	Overall Size, in Inches Including Projections	Weight, Lbs.
1 Junction Box TM-180-A, includes 4 Fuses FU-24 (2 in use, 2 spare)	6 3/4 x 5 3/8 x 2-13/16	1.7
1 or 2 Plugs PL-108 (one per indicator for junction box)	3/4 dia. x 1 3/8	0.05 ea.
1 Plug PL-109 (furnished only when using with marker beacon receiving equipment) .	1 dia. x 1 1/2	0.06
1 Plug PL-110 (includes Conduit Adapter M-187)	1 5/8 dia. x 2 1/8	0.25
1 Plug PL-111 (includes Conduit Adapter M-187)	1 5/8 dia. x 2 1/8	0.25
1 Plug PL-112 (furnished only when using with marker beacon receiving equipment) .	1 dia. x 1 1/2	0.06
1 Plug PL-113	3/4 dia. x 1 1/2	0.06

II

DETAILED DESCRIPTION OF PRINCIPAL COMPONENT UNITS

2-1 RADIO COMPASS UNIT BC-310-A

Radio Compass Unit BC-310-A consists of a cabinet and chassis and includes Mounting FT-145-A, Dynamotor DM-18, 4 Lamps LM-32 (2 in use, 2 mounted spares), Alignment Tool TL-138-A and a No. 8 set screw wrench. This unit requires but does not include 1 set of vacuum tubes. Radio Compass Unit BC-310-A contains the compass circuit elements, the superheterodyne receiver circuit elements, the local controls and the high voltage power supply. (See Figure 2.)

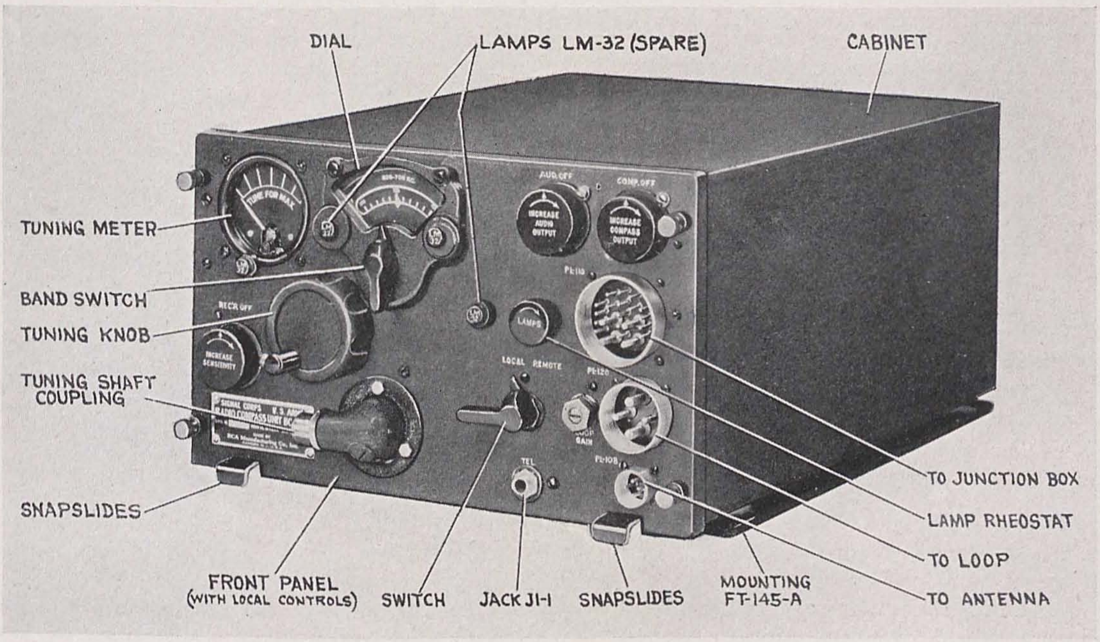


Figure 2—Radio Compass Unit BC-310-A, Assembly View

a **Cabinet.**—The cabinet is of welded aluminum construction with black wrinkle finish. The panel (front) end allows the removal of the radio compass unit chassis. Runners are provided on each side of the cabinet for guiding and holding the chassis in place. Tapped studs are provided near each corner of the panel end, for four captive thumbscrews on the chassis panel, which secure the chassis in the cabinet. Mounted in the bottom of the cabinet are ganged snapslides for securing the cabinet to Mounting FT-145-A. The front and back snapslides on each side of the cabinet are ganged and a spring release is provided so that the snapslides can not be closed unless the cabinet is properly seated on all four studs of Mounting FT-145-A. An Alignment Tool TL-138-A (for aligning all r-f and i-f circuits) and set screw wrench (for removing control knobs) are mounted on clips on the inside bottom of the cabinet back of the front mounting cups. A view of the cabinet is shown in Figure 3.

b. **Mounting FT-145-A.**—This shock mounting for Radio Compass Unit BC-310-A is shown in Figure 4. The aluminum base has four shock absorbers, carrying snapslides studs, mounted in each corner. For Outline Dimensional Drawing and Drilling Diagram see Figure 36, Appendix.

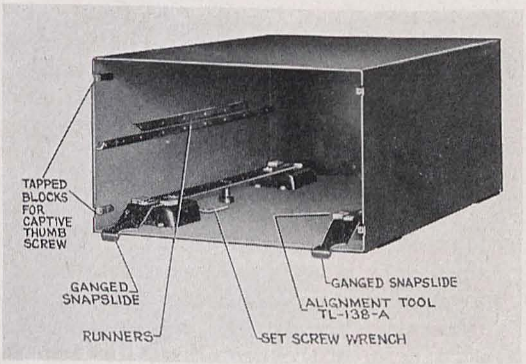


Figure 3—Radio Compass Unit BC-310-A, Cabinet

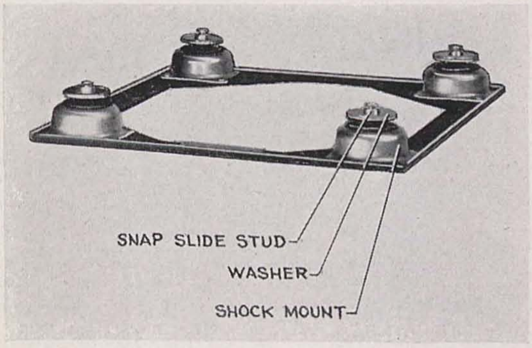


Figure 4—Mounting FT-145-A

c. **Chassis.**—The chassis is of aluminum with the panel and rear plate attached to opposite ends, enabling the chassis to be placed on any one of its five sides for servicing without damaging any of the parts. The panel is mounted on the front end of the chassis and contains all local controls. The chassis is arranged to fit into runners provided in the cabinet and is held

2-1 c. (Continued)

in place by four captive thumbscrews provided on the front panel. When the thumbscrews are tightened, the cabinet is spray and dust-proof. All necessary circuits are so shielded that when the equipment is aligned on the bench the chassis may be placed in the cabinet without changing the alignment. The chassis is shown in Figures 5 to 9 inclusive.

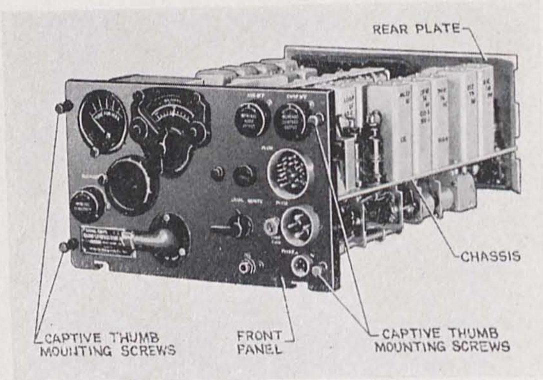


Figure 5—Radio Compass Unit BC-310-A, Chassis, Front View

d. **Local Panel Items and Controls.**—This equipment is completely controlled either locally or remotely; the Local-Remote switch at the local position determines which position has control. The remote controls are discussed under paragraph 2-2. All local controls and installation adjustments are contained on the panel mounted on the front of the radio compass unit chassis. The following items appear on the front panel. (See Figures 2 and 5.)

(1) Tuning Control.—The local tuning knob drives the tuning condenser through a train of gears. The remote tuning knob drives the tuning condenser through Tuning Shaft MC-124. The tuning shaft coupling to the chassis is a swivel joint capable of being rotated and locked in any angle in the plane of the panel. The gear ratio between the tuning knob and tuning condenser is approximately 60 to 1. The gear ratio between the flexible Tuning Shaft MC-124 and the tuning condenser is 120 to 1. The local and remote controls are interconnected by rotating both local dial and remote dials to points on the dials marked ALIGN and then connecting Tuning Shaft MC-124.

(2) Dial.—A disc type dial is used and is calibrated directly in kilocycles for each of the three bands. A mark with the word ALIGN is placed on the dial for aligning local and remote dials when interconnecting them with Tuning Shaft MC-124. Only the frequency band on which the equipment is operating is visible. The dial is illuminated by one Lamp LM-32.

(3) Tuning Meter I-69.—A tuning meter indicates when the Radio Compass Unit BC-310-A is tuned to the center of the pass band. The meter is provided with Lamp LM-32 and rim type illumination. Luminous paint is applied to the pointer and scale divisions as an aid in night flying.

(4) Band Switch.—The frequency band switch is a lever operated switch capable of electrically selecting any one of the three bands. The frequency range on which the receiver is operating is marked on the dial mask and only that particular frequency range marking is visible.

(5) Local-Remote Switch.—When this switch is in the Local position, all controls function when operated at the Local position, but the remote headset and remote Compass Indicator I-65-A remain connected and are subject only to their respective level controls. When this switch is in the Remote position, all controls function when operated at the Remote position, but the local headset and local Compass Indicator I-65-A remain connected and are subject only to their respective level controls. In both the Local and Remote positions of the switch, the interphone connection located at Junction Box TM-180-A or connector panel is available for either compass or receiver operation, when both local and remote headset jacks are free of plugs. The interphone connection is opened when a plug is inserted in the headset jack at either the local or remote positions.

(6) Increase Sensitivity and Rec'r.-Off Switch.—This control is provided to control the overall gain of the receiver and has the effect of setting the threshold value below which the audio output of the receiver is negligible. A switch is ganged with this control to turn the receiver off when the knob is rotated completely counterclockwise to the Rec'r.-

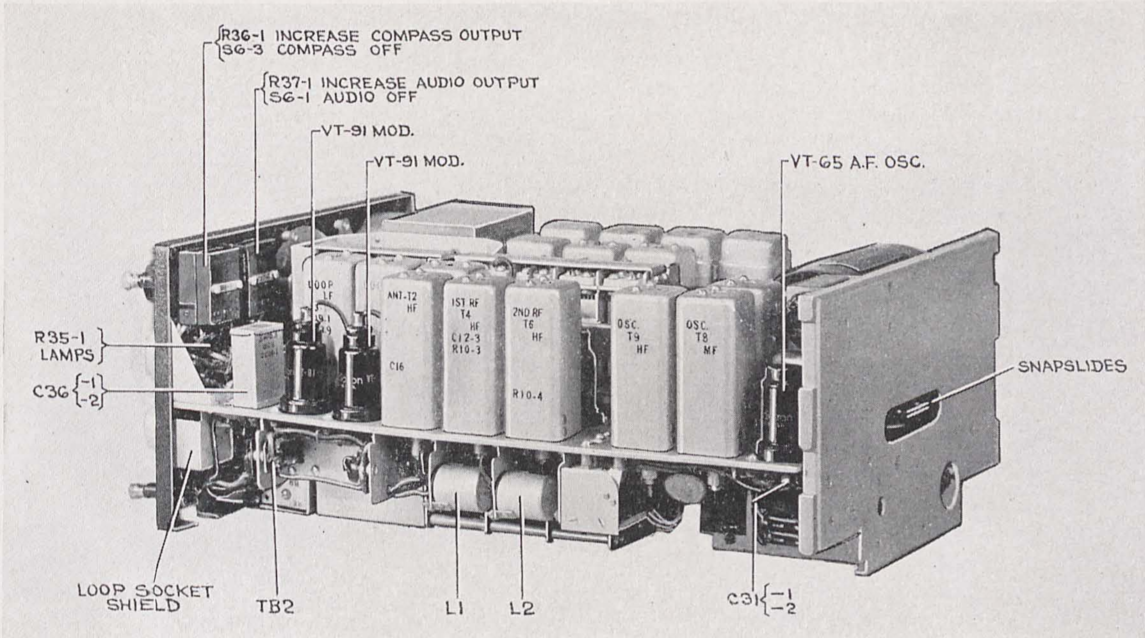


Figure 6—Radio Compass Unit BC-310-A, Chassis, Right Side View

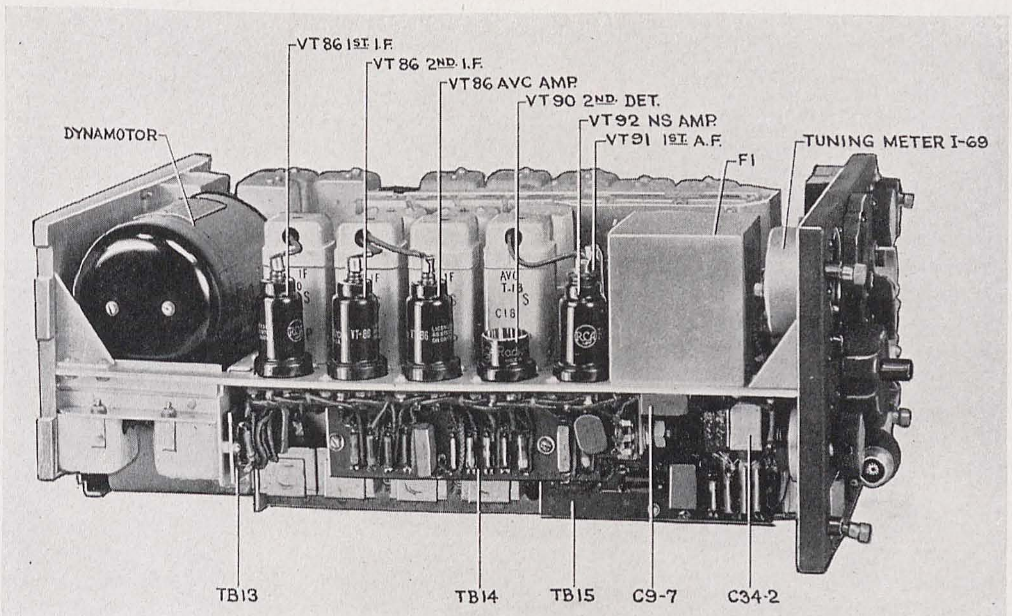


Figure 7—Radio Compass Unit BC-310-A, Chassis, Left Side View

2-1 d. (Continued)

Off position. An adjustable detent is provided near the extreme clockwise rotation of the control and this is to be set at a threshold value which corresponds to the maximum sensitivity compatible with local noise conditions.

(7) Increase Audio Output and Audio Off Switch.—This control adjusts the audio level into the associated headset, whether the equipment is operating as a radio compass or as a radio receiver, and affects the local position only. A switch is ganged with this control to disconnect the headset from the circuit when the knob is turned completely counterclockwise to the Audio Off position. An adjustable detent is provided to set this control at a normally comfortable audio output level.

(8) Increase Compass Output and Compass Off Switch.—This control determines only the response of the Compass Indicator I-65-A associated with the Local position and does not affect the communication reception. A switch is ganged with this control to deenergize the compass circuits when its knob is turned completely counterclockwise to the Compass Off position. An adjustable detent is provided to be set at the point where a nominal loop rotation of 15 degrees gives full scale deflection on Compass Indicator I-65-A.

(9) Lamp LM-32 (2 in use, 2 spares).—The dial and tuning meter lamps (Lamp LM-32) are under control of the lamp rheostat knob, marked Lamps, which has an Off position. Two spare lamps are provided, one mounted on the left of the dial window housing and one on the panel near the lamp control. The lamps are connected in a series arrangement and will light only when the Local-Remote switch is in the Local position.

(10) Headset Jack.—This jack marked Tel. receives Plug PL-55.

(11) Loop Gain.—This screwdriver control is an installation adjustment and permits the adjustment of the loop gain to provide for proper functioning of the equipment with vertical antennae of different effective heights. The control is provided with a locking nut to prevent creeping under vibration.

(12) Sockets.—Mounted on the right of the panel are sockets for the three plugs, Plug PL-108 (antenna connection), Plug PL-110 (junction box connections), and Plug PL-120 (loop connections). All plugs are discussed under paragraph 2-13.

e. **Dynamotor DM-18.**—The dynamotor is mounted in the chassis and secured to shock absorbers by ganged snapslides which are provided for safety wiring. Removal and servicing of this unit is described under Section VI, Maintenance, paragraph 6-3 a. (1). The r-f and audio ripple filters (not a part of the dynamotor) are of the balanced type for an ungrounded primary supply. This dynamotor also supplies 0.015 amperes at 200 volts to the marker beacon receiving equipment. There is no difference in the performance of this equipment whether or not this power is taken by the marker beacon receiving equipment.

f. **Circuits**

(1) General.—Electrically, Radio Compass Unit BC-310-A comprises a compass circuit and a receiver circuit. The frequency range of 150 to 1,500 kilocycles is covered in three bands as follows:

Band	**Frequency Range Kilocycles**	**Approximate KC per Rev. of Tuning Knob**
1	150- 329	6.0
2	329- 708	12.8
3	708-1,500	26.4

(2) Compass Circuit.—The compass circuit contained in the Radio Compass Unit BC-310-A consists of the loop circuit, the loop modulating tubes, the audio oscillator, the superheterodyne receiver, and the indicator and headset circuit. (Refer to Schematic Functional Diagram, Figure 29.) The loop circuit consists of a loop winding of eight turns with center point tapped. The outer ends of the winding are brought out to terminals at the base of the loop. The center tap is connected to the middle terminal and grounded at the loop mounting. A thermal compensating capacitor, used to maintain constant frequency regardless of temperature, is mounted within the loop above the terminals. The loop is connected to the variable tuning capacitor C1-A through the fixed or rotatable loop mountings and Cord CD-310. The grids of the loop modulating tubes (VT-91) are connected across the tuning capacitor C1-A. The plates of these tubes are connected in parallel and to the input of the superheterodyne receiver through the blocking capacitor

2-1 f. (2) (Continued)

C20. A variable resistor R31 is connected in the common cathode circuit of the loop modulating tubes and provides a means for varying the amplification to compensate for various lengths or effective heights of antenna. This is an installation adjustment mounted on the local control panel and marked, Loop Gain.

A Tube VT-65 connected to transformer T14 provides a 109 cycle audio frequency voltage which is applied to the grids of the loop modulating tubes (VT-91) through resistors. This audio voltage biases the loop modulating tube grids to cut-off on alternate half cycles, thus adding or subtracting the loop voltage and antenna voltage. This same audio frequency voltage is applied to the tuned indicator field coils. The plate supply for the audio oscillator and loop modulating tubes is through switch S6 of the Increase Compass Output control. This control is turned ON (clockwise rotation) when radio compass

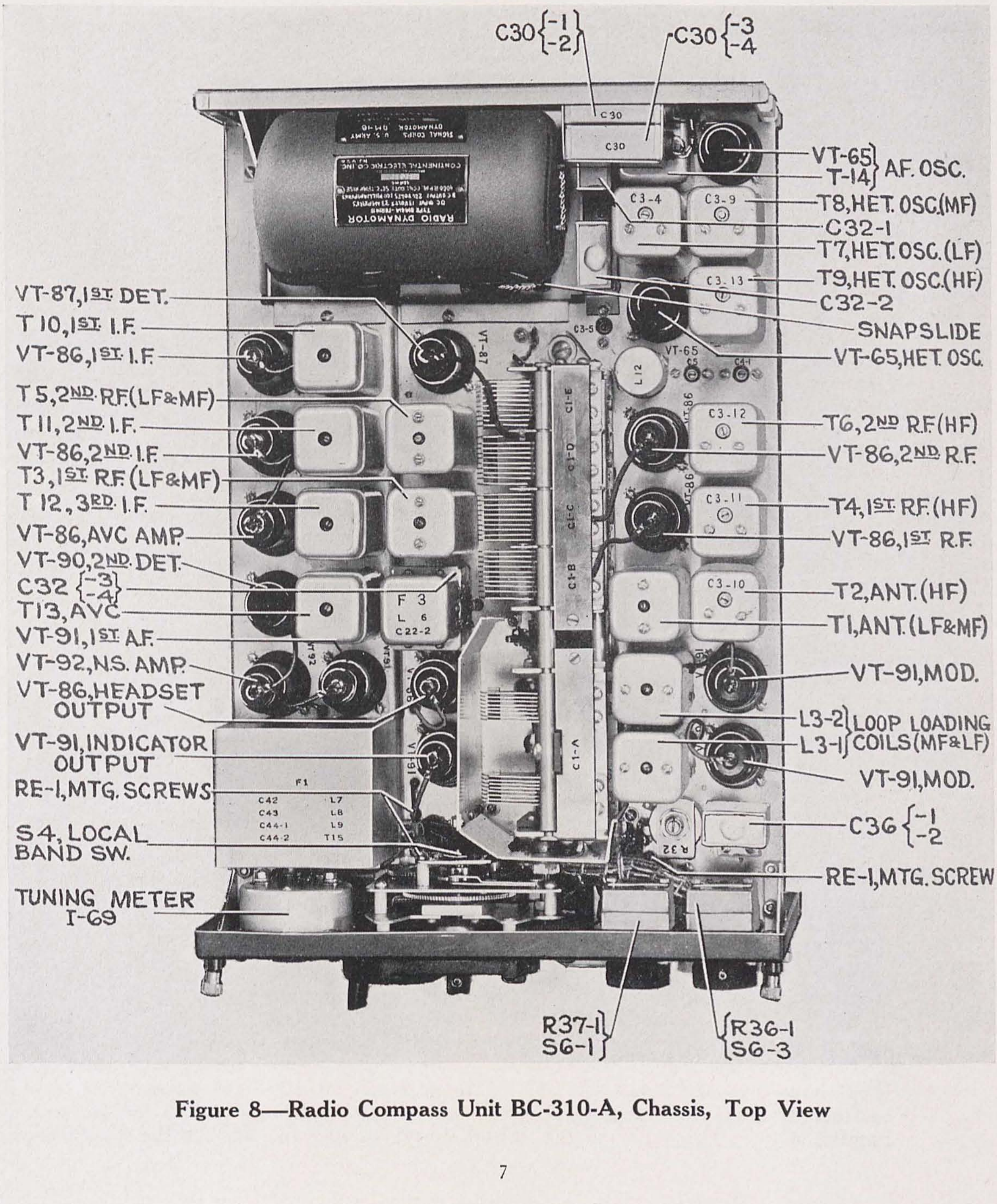


Figure 8—Radio Compass Unit BC-310-A, Chassis, Top View

 f. (2) (Continued)

operation is desired and OFF (counterclockwise rotation) when receiver operation is desired. The loop signal applied through capacitor C20 is combined with the antenna voltage and amplified and detected by the superheterodyne receiver circuit. This amplified and detected output is supplied to the indicators and headsets through separate output tubes. The output of the compass output tube (VT-91) passes through a band-pass filter adjusted to 109 cycles which is the loop tube modulating frequency. The output of this filter is then coupled through parallel L pads to separate indicators. The headset output is discussed in paragraph 2-1 f. (3).

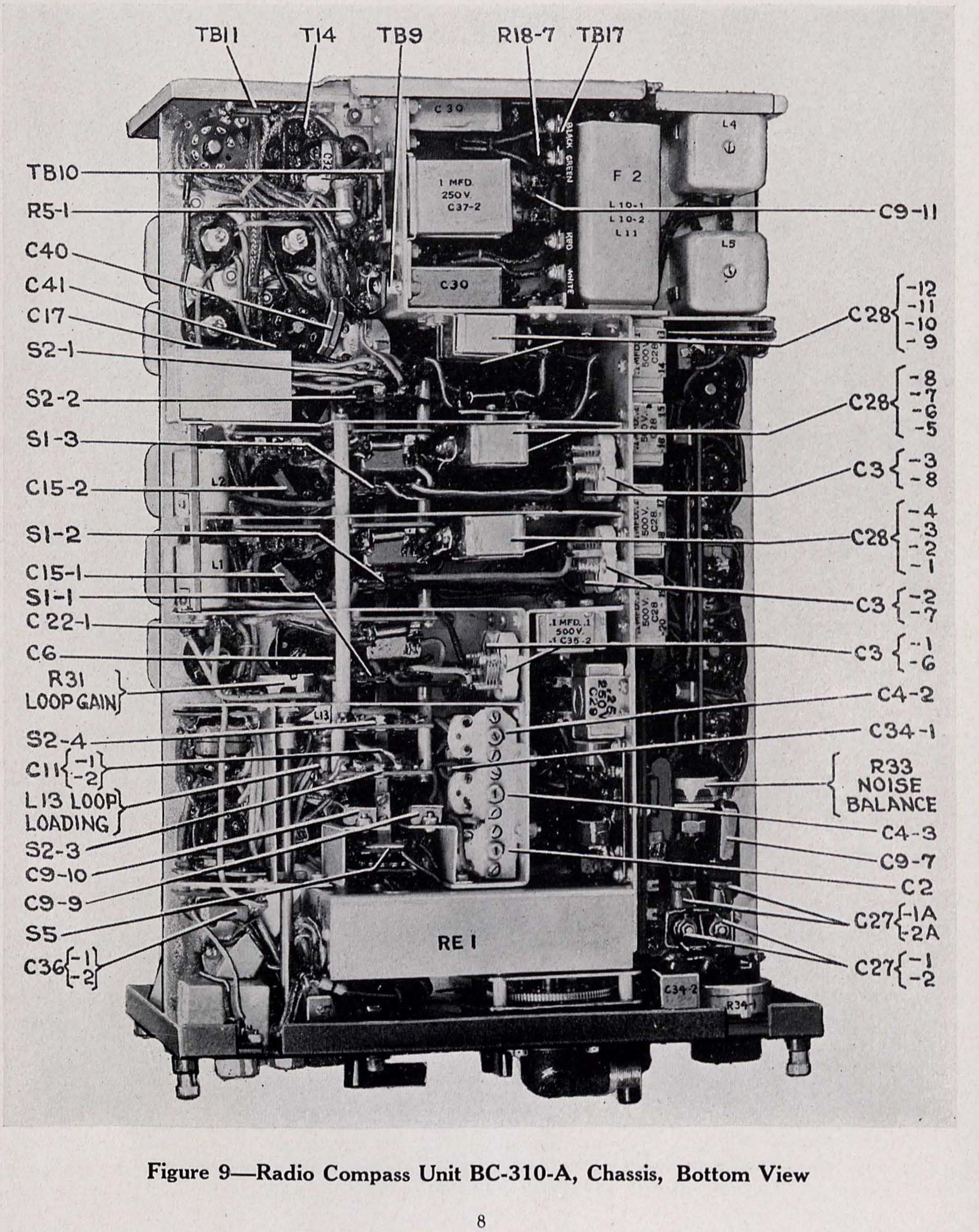


Figure 9—Radio Compass Unit BC-310-A, Chassis, Bottom View

2-1 f. (Continued)

(3) Receiver Circuit

(a) General.—The receiver circuit is of the superheterodyne type and consists of:

Three stages of tuned radio frequency amplification (includes first detector stage).
A radio frequency oscillator.
Two 112.5 kc intermediate frequency amplifier stages.
A second detector and noise suppressor.
An AVC amplifier circuit.
A noise suppressor amplifier and tuning meter circuit.
A first audio frequency amplifier.
Two separate output amplifier circuits:
Headset output amplifier circuit.
Indicator output amplifier circuit.

(b) Input Coupling.—The antenna input circuit is designed to operate over a range of input capacities from 50 to 200 mmfd without undue misalignment of the antenna stage. Adjustment for various antenna capacities is not required.

(c) Input Protection.—The antenna circuit is protected from accumulation of static charges by the input resistor R22-1. The loop is electrostatically shielded and large static charges can not build up on the internal wiring. The size of the loop wire and the spacing of the tuning capacitor plates is sufficient to take care of normal voltages encountered from nearby transmitters.

(d) R-F Amplifier.—The r-f amplifier and first detector consists of three tuned stages. The antenna and r-f stages utilize two Tubes VT-86 and the first detector stage one Tube VT-87. Each of the three bands uses separate r-f transformers. The inductance of the secondary winding of each transformer is adjustable by means of an iron core. Band 1 (L.F) and Band 2 (M.F.) r-f stages are contained in single shielded assemblies. Band 3 (H.F.) r-f stages are contained in assemblies for this band only.

(1) I-F Rejection Circuits.—The r-f amplifier includes four trap circuits, adjusted to reject a frequency band corresponding to the band passed by the i-f amplifier, in order to minimize response to frequencies near the intermediate frequency (112.5 kc). In series with the antenna, the circuit composed of L1 and C22-1 offers a high impedance to frequencies near 112.5 kc. Similar circuits L2, C15-1 and L12, C15-2 are connected in the screen circuits of the first and second r-f amplifier tubes respectively. When the band switch is set for the low frequency band, an additional rejection circuit is thrown into operation. This circuit, consisting of the M.F. primary of the antenna transformer (T1) and the H.F. primary and C16 on the H.F. antenna transformer assembly (T2) is inductively coupled to the L.F. antenna transformer (T1) and absorbs energy at frequencies near the intermediate frequency by virtue of the impedance reflected into the L.F. antenna transformer circuits. The four trap circuits mentioned above are tuned to different frequencies slightly separated from 112.5 kc in order to provide a relatively wide rejection frequency band.

(e) R-F Oscillator.—The r-f oscillator consists of Tube VT-65 with separate shielded assemblies, T7, T8 and T9 containing the coils for each band. The circuit arrangement is such that the grid is untuned and the plate tuned by Section C1-E of the ganged tuning capacitor. Capacitor C19-4 couples the oscillator mixer tube.

(f) First Detector.—The first detector tube circuit utilizes Tube VT-87 and in conjunction with the oscillator Tube VT-65 provides the means of converting the r-f signal to a lower frequency of 112.5 kc.

(g) I-F Amplifier.—Three transformers T10, T11, T12 and two Tubes VT-86 are used at an i-f of 112.5 kc to provide the necessary gain and selectivity for the desired operation of the receiver and compass circuits. Adjustment of the i-f transformers to the resonating frequency is accomplished by means of screws on the iron cores. These screws are brought out at top and bottom of the shielded assemblies and turning clockwise or counterclockwise varies the position of the core in or out to make the required adjustment. Fixed sealed mica type capacitors are used for resonating the inductances.

(h) AVC Amplifier and Tuning Meter.—A second channel, coupled to the input of the last i-f tube operates the AVC amplifier, Tube VT-86. This is followed by an additional i-f transformer T13 which is tuned to a frequency of 112.5 kc. This operates into the AVC diode of the Tube VT-92, which obtains a fixed delay of 43 volts bias from the bleeder circuit

2-1 f. (3) (h) (Continued)

so that the AVC is inoperative at low output levels. For signal levels which exceed the delay bias, the d-c voltage developed is utilized to bias off the r-f and i-f amplifiers and maintain a relatively constant output for large variations of input signal voltages. The remaining diode of the Tube VT-92 is coupled to the last i-f plate through capacitor C13-2, and supplies a delay bias to one of the tube VT-90 diodes, just equal to the peak voltage of a normal signal.

(i) Second Detector and Noise Suppressor.—The transformer T12 feeds a bridge circuit which performs the functions of detection and noise suppression. The detector diode of Tube VT-90, R18-1, R18-11, and R10-9 form one arm of the bridge and the noise suppressor diode of Tube VT-90, R18-10 and R33 form the other arm. The output of T12 is applied between the cathode of Tube VT-90 and the common connection of R33 and R10-9. Thus, if the bridge is balanced for a signal, detection occurs in both arms of the bridge and equal and opposite audio voltages are set up across R33 and R10-9. The sum of these voltages is applied to the audio amplifier so that when balanced, no output is obtained. The constants of the bridge circuit are such as to provide a low time constant so that the bridge balance is maintained for sharp impulses. In order to unbalance the bridge and allow signal output, bias is applied to the noise suppressor diode of Tube VT-90 through a slow time constant circuit (R18-5, C34-1 and R13-3). This bias voltage is the voltage set up across R18-12 by the signal voltage applied to a third diode (located in Tube VT-92) through the coupling capacitor C13-2 and is thus dependent on the signal voltage. By means of C13-2 and R15, the bias voltage is adjusted so that the noise suppressor diode of VT-90 is biased off just below the peak signal. Thus, normally, the noise suppressor diode of Tube VT-90 is inoperative, the detector diode performs its function of detection, and the audio voltage set up across R10-9 is fed to the audio amplifier, the voltage across R33 being zero. The majority of noise disturbances obtained in radio reception (as for example ignition interference) consists of sharp impulses of extremely short duration and of amplitudes greatly exceeding normal operating signal amplitudes. When such an impulse is applied to the circuit described, the time duration is too short to cause any appreciable change in the bias voltage applied to the noise suppressor diode of Tube VT-90 due to the slow time constant circuit (R18-5, C34-1, R13-3) mentioned above. Since the amplitude of the noise impulse exceeds the signal level, detection of the noise impulse occurs in both diodes of Tube VT-90 and approximately equal and opposite surges are set up in R33 and R10-9 and balance out.

(j) First A-F Amplifier.—The first a-f amplifier Tube VT-91 is resistance coupled to both the indicator tube output and headset tube output stages. A resonant circuit F3 (L6, C22-2), in series with the plate resistor R16-2, provides the necessary fidelity on the higher audio frequencies.

(k) A-F Output.—The a-f output for the indicator has been discussed in paragraph 2-1 f. (2). The a-f output stage for the headsets consists of Tube VT-86, which connects to the output transformer, T15. The output of transformer T15 connects to parallel T pads R37-1 and R37-2, which independently control the volume at the Local and Remote positions. The load into which the transformer is designed to work for maximum efficiency is 4,000 ohms.

(l) Output Jacks.—Three output phone jacks are provided. J1-1 is the Local jack mounted on the front panel of the radio compass unit. J1-2 is the Remote jack located on the radio control box. A third jack J2 is supplied in Junction Box TM-180-A and is used for interphone connection. Resistors R9-1 and R9-2 are wired into the jacks to provide the proper load when either headset is removed. When both headsets are removed, the full audio output is connected through to the interphone jack J2, located in the junction box. The output from J2 should be fed into a voltage amplifying type of interphone although at least two pairs of headsets may be operated from a direct line connected to this output jack. On aircraft with built-in connector panels, J2 may be replaced by a terminal. *Plugs should always be removed from headset jacks J1-1 or J1-2 when headsets are disconnected from Cord CD-307.*

2-2 RADIO CONTROL BOX BC-311-A

a. **General.**—This box contains all remotely operated controls of Radio Compass Unit BC-310-A and is constructed for mounting in a rigid conduit system. (See Figure 10.) This box is in two sections. The panel containing the controls is a complete unit and is attached to the back mounting plate by means of three captive screws indicated in Figure 10. The rigid conduit is attached to the back mounting plate and electrical connections are made to the panel by means of a plug-in arrangement. (See Figure 11.)

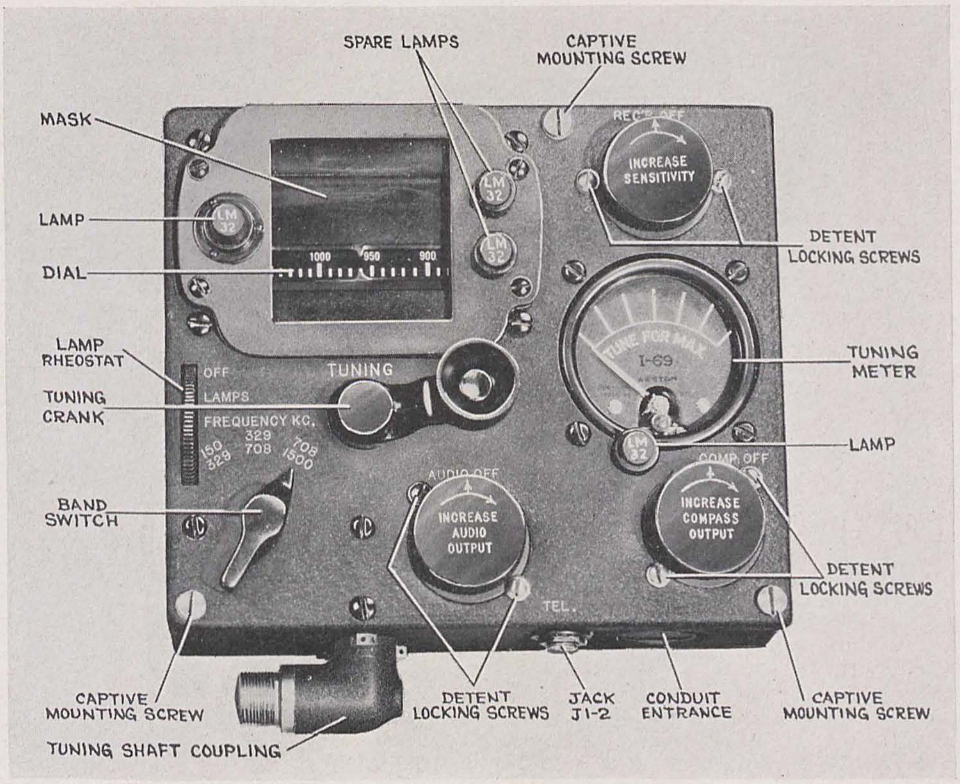


Figure 10—Radio Control Box BC-311-A, Exterior

b. **Dial.**—A tape or ribbon type dial is used and is calibrated directly in kilocycles for each of the three bands. A mark with the word ALIGN is placed on the high frequency end of the dial for aligning the remote dial with the local dial when connecting Tuning Shaft MC-124. Only the frequency band on which the equipment is operating is visible.

c. **Tuning Control.**—A tuning crank operates the remote dial and is connected through gears and a right angle gear coupling to Tuning Shaft MC-124 to drive the dial and tuning condenser of Radio Compass Unit BC-310-A.

d. **Tuning Meter I-69.**—A tuning meter indicates when Radio Compass Unit BC-310-A is tuned to the center of the pass-band. The meter is provided with Lamp LM-32 and rim type illumination. Luminous paint is applied to the pointer and scale divisions as an aid in night flying.

e. **Band Switch.**—The frequency band switch is a lever operated switch capable of electrically selecting any one of the three bands. The frequency range on which the receiver is operating is marked on the panel of the control box opposite the lever position.

f. **Increase Sensitivity and Rec'r.-Off Switch.**—This control is provided to control the overall gain of the receiver and has the effect of setting the threshold value below which the noise output of the receiver is negligible. A switch is ganged with this control to turn the receiver off when the knob is rotated completely counterclockwise to the Rec'r.-Off position. An adjustable detent is provided near the extreme clockwise rotation of the control and this is to be set at a threshold value which corresponds to the maximum sensitivity compatible with local noise conditions.

g. **Increase Audio Output and Audio Off Switch.**—This control adjusts the audio level into the associated headset, whether the equipment is operating as a radio compass or as a radio receiver, and affects the remote position only. A switch is ganged with this control to disconnect the headset from the circuit when the knob is turned completely counterclockwise to the Audio Off position. An adjustable detent is provided to set this control at a normally comfortable audio output.

h. **Increase Compass Output and Comp. Off Switch.**—This control determines only the response of the Compass Indicator I-65-A associated with the remote position and does not affect the communication reception. A switch is ganged with this control to de-energize the compass cir-

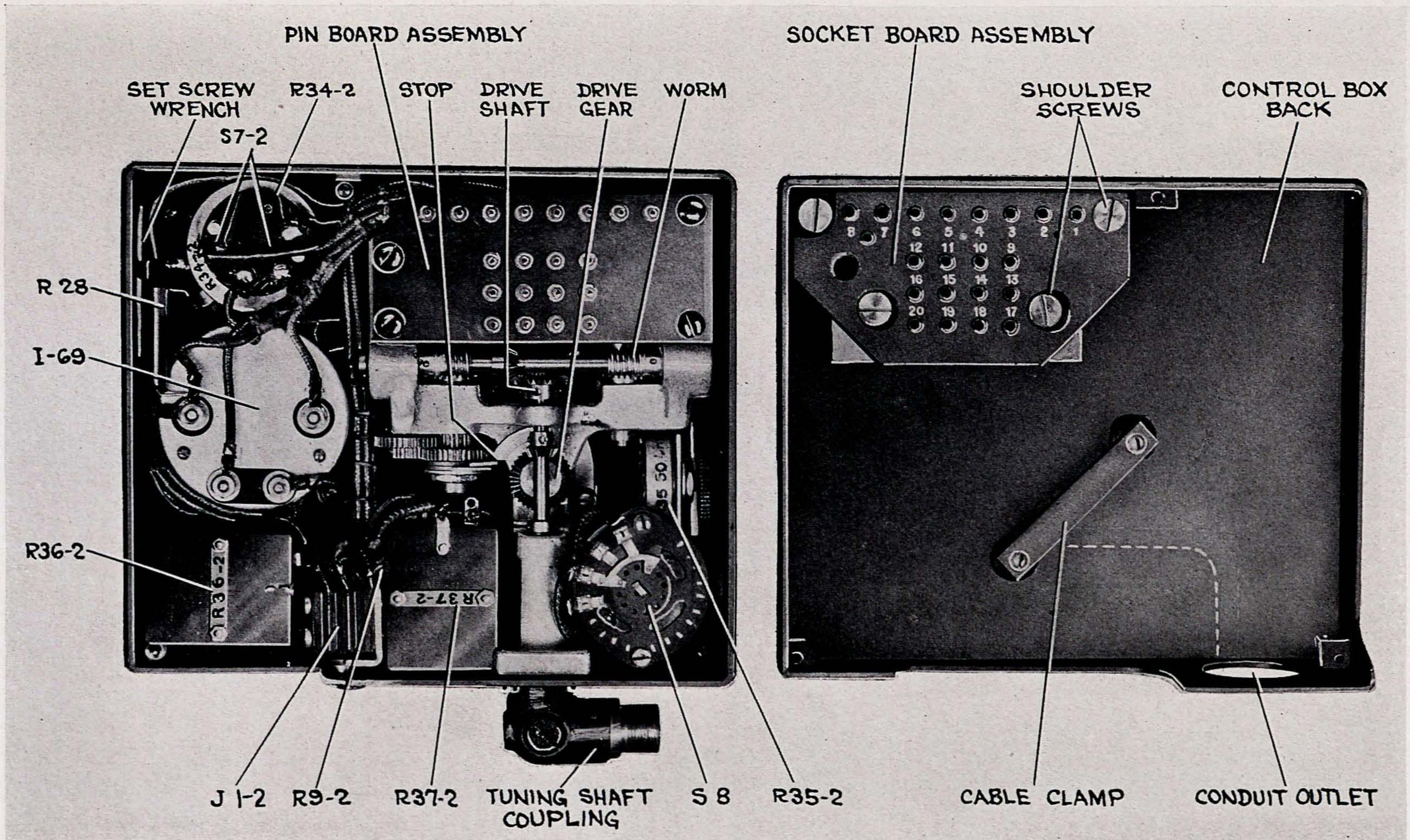


Figure 11—Radio Control Box BC-311-A, Interior

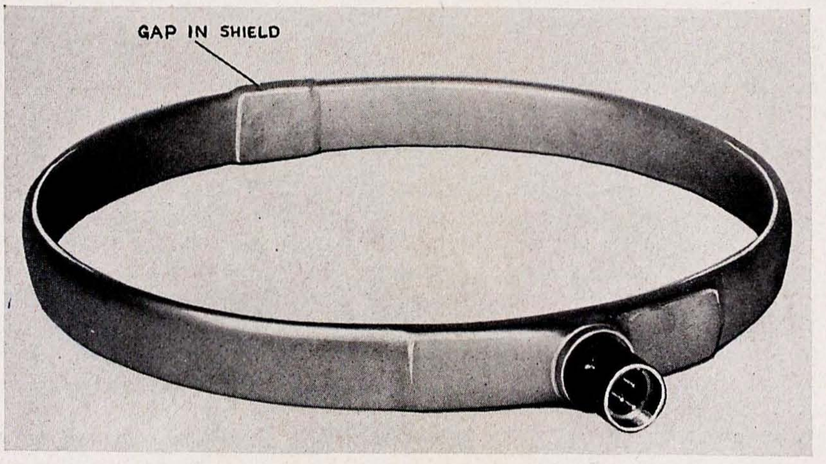


Figure 12—Loop LP-13-A

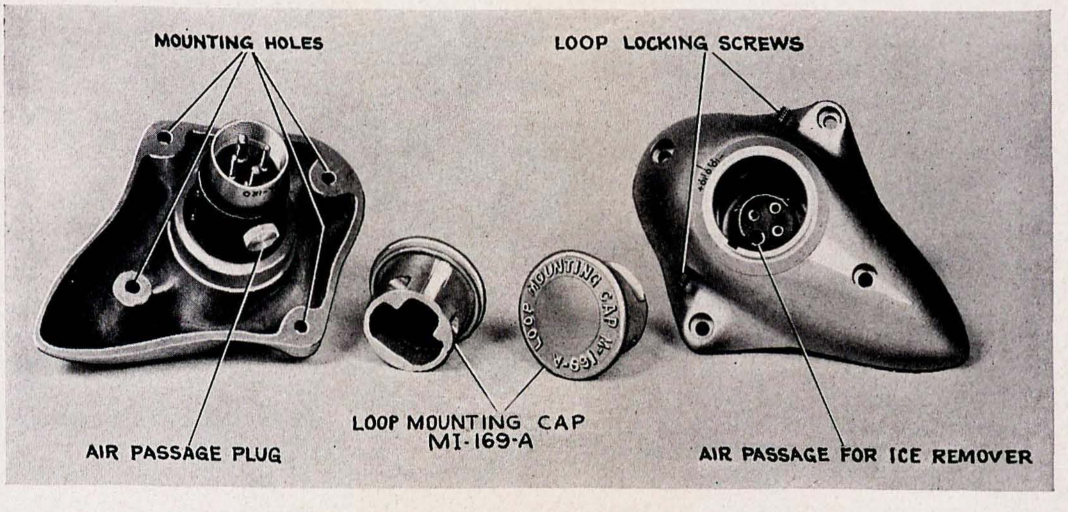


Figure 13—Loop Mounting GS-7-A (Fixed Loop) and Loop Mounting Cap M-169-A

2-2 h. (Continued)

cuits when its knob is turned completely counterclockwise to the Compass Off position. An adjustable detent is provided to be set at the point where a nominal loop rotation of 15 degrees gives full scale deflection on Compass Indicator I-65-A.

i. **Lamp LM-32.**—The dial and the tuning meter lamps, Lamp LM-32, are under control of a lamp rheostat thumb wheel which has an Off position. Two spare lamps are mounted at the right of the dial window frame.

j. **Headset Jack.**—This jack marked Tel. receives Plug PL-55.

2-3 **LOOP LP-13-A.**—The loop consists of an 8 turn coil with center tap, enclosed in a toroidal electrostatic shield of streamline cross-section. The shield has a gap at the top of the loop and this gap is insulated, weatherproofed and waterproofed with vulcanized rubber tubing. (See Figure 12.) A temperature operated compensating capacitor, C38, is contained within the lower part of the mounting section to compensate against any frequency change due to varying temperature. Electrical connection is provided through three contact type terminals which fit both Loop Mountings GS-7-A and GS-8-A. A keyed locating device is attached to the loop to direct the proper positioning of the loop on the mountings. Loop LP-13-A will fit either Loop Mounting GS-7-A or GS-8-A.

2-4 **LOOP MOUNTING GS-7-A (FIXED LOOP).**—This mounting is provided for installing Loop LP-13-A in the homing position for use on aircraft. Two locking screws in the streamline housing serve to rotate the loop over a range of ±10 degrees with respect to the mounting proper. A scale calibrated at the 5 and 10 degree points is marked on the rotatable part of the mounting and a fiducial mark on the fixed part. (See Figure 13.) The mounting flange dimensions of GS-7-A are the same as those of GS-8-A. A socket is provided for Plug PL-120 of Cord CD-310 for connection to Radio Compass Unit BC-310-A. A fixed capacitor, C-39, is mounted inside the loop mounting to make the capacity of the mounting the same as that of Loop Mounting GS-8-A. A hole, normally plugged, is placed in the base of the mounting and serves for connection of an air hose when loops equipped with ice removers are used.

2-5 **LOOP MOUNTING GS-8-A (ROTATABLE LOOP).**—This mounting includes Lamp LM-32 and Tuning Unit MC-127. This mounting permits continuous rotation of the loop and determination of its angular position with respect to the center line of the aircraft fuselage. (See Figures 14 and 15.) The mounting is interchangeable with Loop Mounting GS-7-A (fixed loop). A brake mechanism, lever operated, is proved for locking the loop in any position and may be conveniently operated from any position of the handwheel which rotates the loop. A vernier adjustment is also provided for rotating the loop and is engaged when the brake lever is in the On position. This vernier adjustment has a gear ratio of approximately 120 to 1 and is provided with a fitting at each end for the attachment of Tuning Unit MC-127 to operate the vernier. An adjustable click mechanism prevents drift of the vernier control under vibration. (See Figure 15.) The azimuth scale is graduated in 1 degree steps from 0 to 360 degrees with the 10-degree graduations numerically marked from 0 to 350 degrees. When installed, rotation of the left side of the handwheel away from the operator causes an increase in scale readings. The azimuth scale and brake assembly are enclosed in a protective housing containing a glass window through which the index and scale are visible. A Lamp LM-32, under control of a toggle switch and connected by Plug PL-107 to a 14.25-volt power source, provides the illumination for the scale. The index and azimuth scale are adjustable to any one of four equally spaced positions with respect to the loop to compensate for variations in installations. These four positions are so spaced that the scale may be set at zero with the plane of the loop perpendicular to the axis of the fuselage. In addition to this quadrature adjustment, the scale is capable of fine adjustment with respect to the loop for ±15 degrees. When Loop LP-13-A is in place, it is secured by a lock which may be operated by a screwdriver. The lock is turned to the left to insert the loop and locks when turned one-half revolution to the right. The lock is prevented from creeping under vibration by means of a spring-actuated pin which fits into the screwdriver slot in the head of the lock pin. A hole, normally plugged, is placed in the base of the mounting and serves for connection of an air hose when loops equipped with ice removers are used.

2-6 **LOOP MOUNTING CAP M-169-A.**—A cap fitting either Loop Mounting GS-7-A or GS-8-A is provided and should be inserted in the mountings whenever Loop LP-13-A is removed, to protect them from entrance of water, dirt, etc. (See Figure 13.)

2-7 **COMPASS INDICATOR I-65-A.**—Two Compass Indicators I-65-A are normally used with Radio Compass SCR-242-A, one for local operation and one for remote operation; however, no degradation in performance results if one of these indicators is not connected. These instruments are designed for instrument panel mounting and neither Local nor Remote Indicators should be used in aircraft without proper shock mountings. (See Figure 16.) The movement

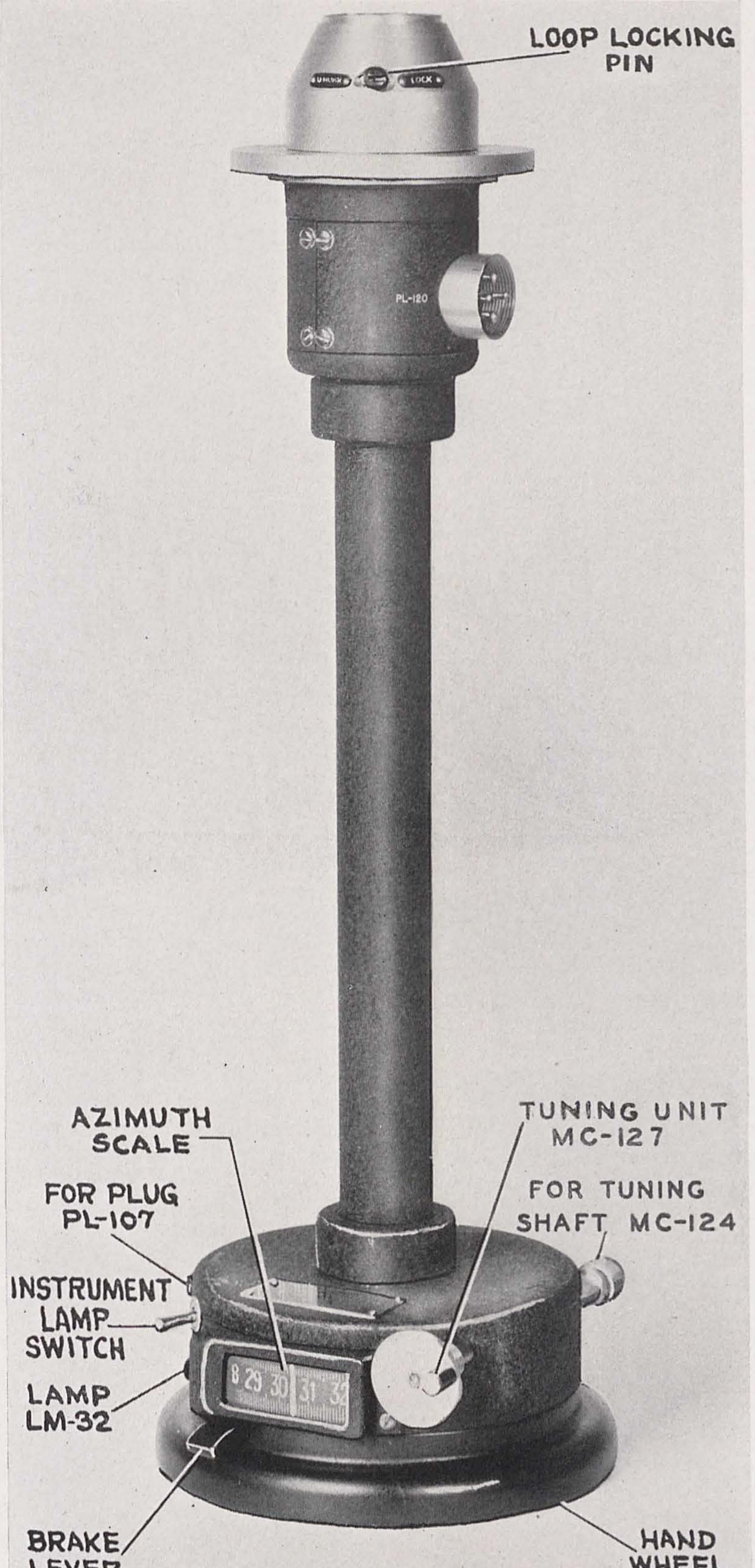


Figure 14—Loop Mounting GS-8-A (Rotatable Loop) Assembly View

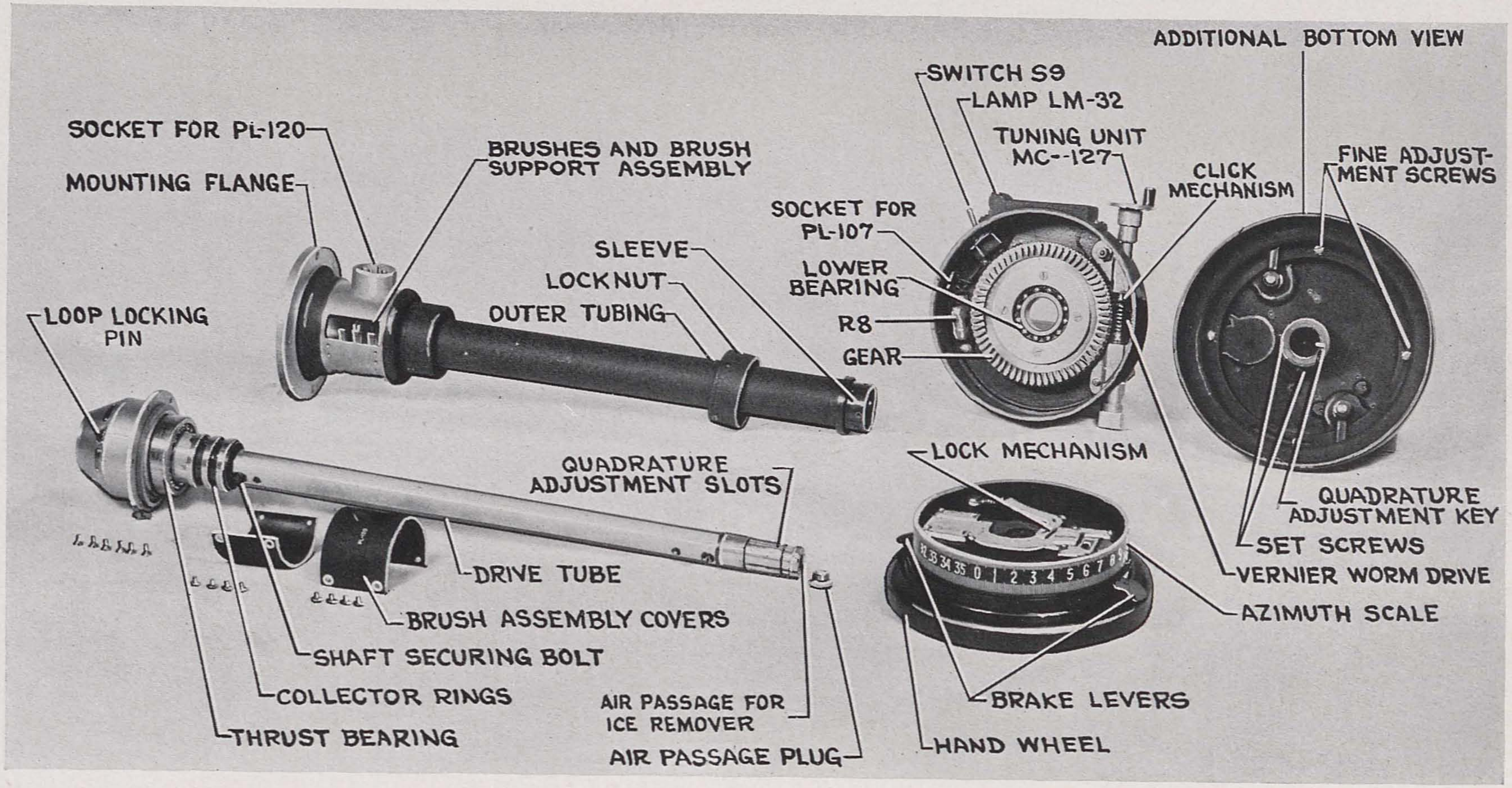


Figure 15—Loop Mounting GS-8-A (Rotatable Loop) Disassembly View

2-7 (Continued)

is of the iron core dynamometer type and the pointer and "L-⏀-R" marks are coated with luminous paint for visibility during night flying. Rim lighting is provided by Lamp LM-32 located in the upper right hand mounting ear. The lamp is connected internally to the socket marked PL-107 on the rear. No internal resistance is provided when the socket is connected to the instrument panel lamp rheostat of the aircraft. If the lamp circuit of either local or remote indicator cannot be conveniently connected into the aircraft instrument panel, instructions given in Section 3-4 should be followed. Terminals 1 and 3 of the socket marked PL-108 connect to the moving coil, terminals 2 and 4 to the field winding. (See Diagram Figure 28 Appendix.)

Figure 16—Compass Indicator I-65-A

2-8 **TUNING SHAFT MC-124.**—This consists of a laterally flexible steel shaft enclosed in a hose-type metal housing. It is used to couple the tuning control of Radio Control Box BC-311-A to the tuning drive mechanism of Radio Compass Unit BC-310-A. (See Figure 19.)

2-9 **JUNCTION BOX TM-180-A (INCLUDING 4 FUSES, 2 IN USE, 2 MOUNTED SPARES).**—The junction box is furnished primarily for use as test equipment but is adaptable to aircraft installations not supplied with built-in connector panels or junction boxes. The cover is completely removable and is normally secured in place by snapslides which should be safety wired when installed in aircraft. The box contains four 15-ampere, 25-volt glass cartridge type Fuses FU-24. Two are used, one in each side of the low voltage supply line and two spare fuses are mounted in clips. These fuses are specially designed to withstand the vibration encountered in aircraft. A jack J2, for Plug PL-55 provides the interphone connection. The box is provided with all the sockets necessary for interconnection with the components of Radio Compass SCR-242-A, the primary source of power supply, the marker beacon receiver and the marker beacon indicator. (See Figure 17 and Diagram, Figure 28.)

2-10 **TEST BOX BX-18-A.**—This box is the back section of Radio Control Box BC-311-A with a socket assembly to take Plug PL-111, instead of conduit entrance. The socket assembly is wired to the terminal board inside of the box for proper connection through Plug PL-111 to Junction Box TM-180-A. This test box plus the front operating panel of Radio Control Box BC-311-A functions therefore the same as a normal complete Radio Control Box BC-311-A and is used for test purposes. (See Figure 18.)

2-11 **VACUUM TUBES**

a. **General.**—A complement of 15 tubes is required for Radio Compass SCR-242-A and all are used in Radio Compass Unit BC-310-A. Tubes may be replaced by removing the radio compass unit chassis from its cabinet. The following tubes are required:

Tube VT-65	2
Tube VT-90	1
Tube VT-91	4
Tube VT-86	6
Tube VT-87	1
Tube VT-92	1
Total	15

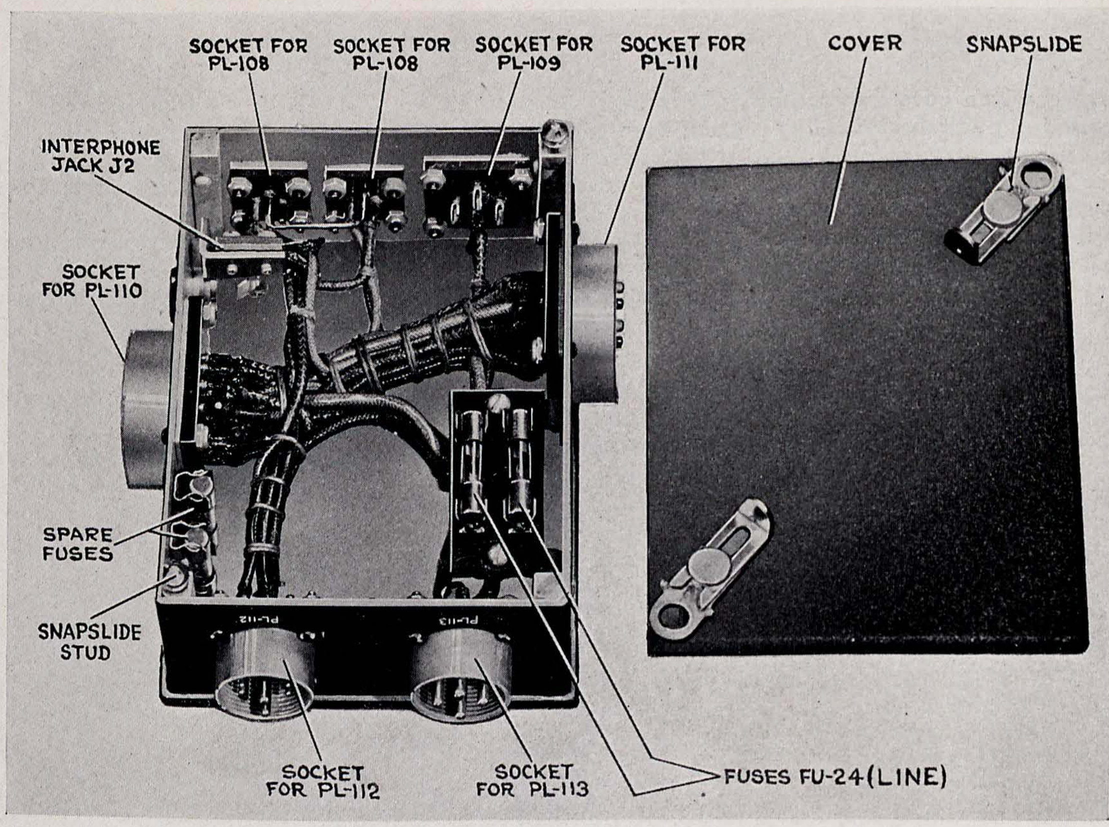


Figure 17—Junction Box TM-180-A, Interior

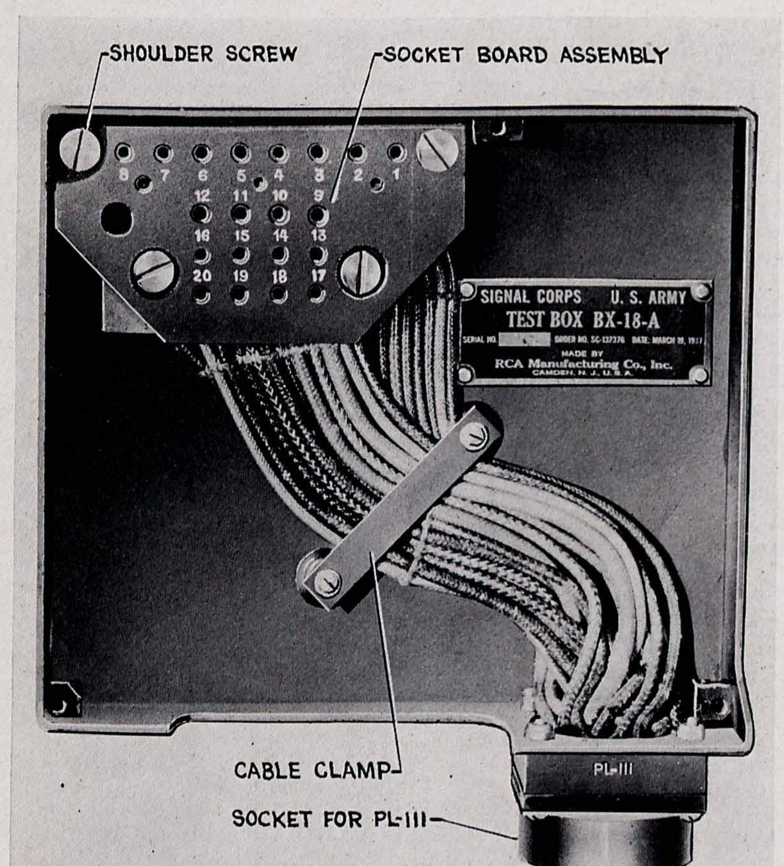


Figure 18—Test Box BX-18-A

2-11 (Continued)

b. **Tube Characteristics**

Tube	Heater Volts	Heater Amps.	Esg. Volts	Ep Volts Max.	Ecg Volts	Ip M.A.	Isg M.A.	Mu	Rp Ohms	Gm Micromhos
VT-65	6.3	0.3	—	250	—8	8.	—	20	10,000	2,000
VT-86	6.3	0.3	100	250	—3	7.	1.7	1,160	800,000	1,450
VT-87	6.3	0.3	100	250	—3*	5.3	5.5	880	800,000	1,100
VT-90	6.3	0.3	—	100	—	4. max.	—	—	—	—
VT-91	6.3	0.3	100	250	—3	2.	0.5	1,500	1,500,000	1,225
VT-92	6.3	0.3	—	250	—3	1.1	—	70	58,000	1,200

* NOTE:—Voltage on control grid No. 1 and control grid No. 3.

2-12 LAMP LM-32

a. A total of 11 lamps are required for Radio Compass SCR-242-A as follows:

Radio Compass Unit BC-310-A .... 4 (2 spare)
Radio Control Box BC-311-A .... 4 (2 spare)
Compass Indicator I-65-A (Local) 1
Compass Indicator I-65-A (Remote) 1
Loop Mounting GS-8-A (Rotatable Loop) 1

b. **Lamp Characteristics.**—Lamp LM-32 requires 3 volts and 0.18 ± 0.02 amperes.

2-13 PLUGS AND CORD

a. **Plugs PL-107, PL-108, PL-109, PL-110, PL-111, PL-112, PL-113 and PL-120.**—Radio Compass SCR-242 is equipped with 8 types of plugs. (See Figure 19.) Their types, description, and use (see Diagram Figure 28, Appendix), are as follows:

Plug PL-107, 2-connector. One used at Loop Mounting GS-8-A and one at each Compass Indicator I-65-A for scale illumination.

Plug PL-108, 4 connectors, 10-ampere. One used at Radio Compass Unit BC-310-A (antenna), two at Junction Box TM-180-A and one at each Compass Indicator I-65-A.

Plug PL-109. 5 connectors, two 25-ampere and three 10-ampere. One used at Junction Box TM-180-A for marker beacon indicator.

Plug PL-110, 21 connectors, four 25-ampere and seventeen 10-ampere (J contact omitted). One used at Radio Compass Unit BC-310-A and one at Junction Box TM-180-A. Includes Conduit Adapter M-187 for connecting to conduit.

Plug PL-111, 21 connectors, four 25-ampere and seventeen 10-ampere (P contact omitted). One used at Junction Box TM-180-A and one at Test Box BX-18-A. Includes Conduit Adapter M-187 for connecting to conduit.

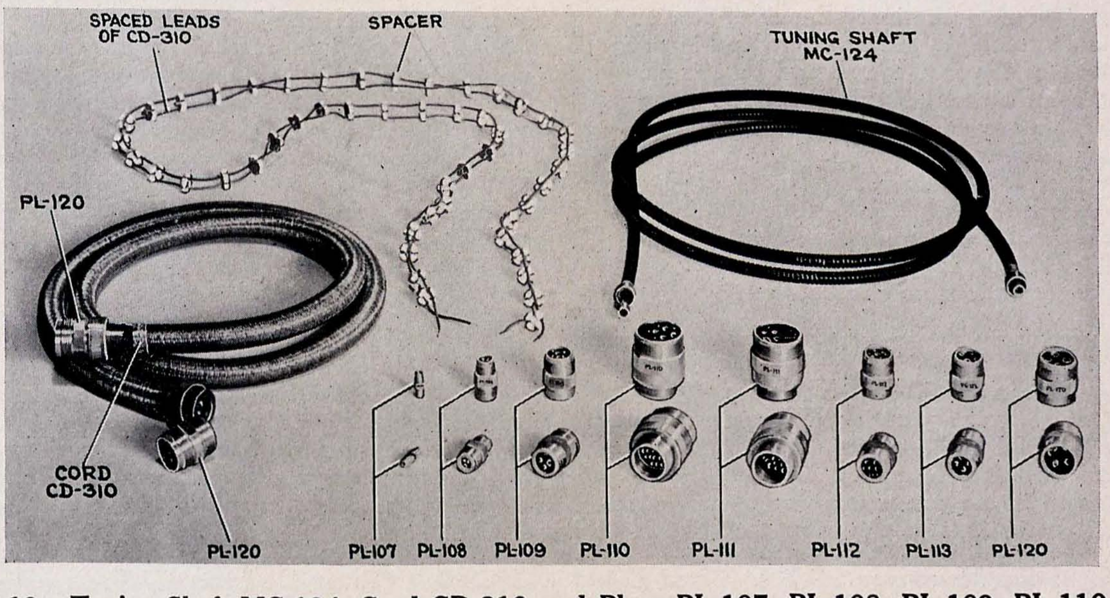


Figure 19—Tuning Shaft MC-124, Cord CD-310 and Plugs PL-107, PL-108, PL-109, PL-110, PL-111, PL-112, PL-113 and PL-120

2-13 a. (Continued)

Plug PL-112, 9 connectors, two 25-ampere and seven 10-ampere. One used at Junction Box TM-180-A for marker beacon receiving equipment.

Plug PL-113, 4 connectors, 25-ampere. One used at Junction Box TM-180-A for primary power source of supply.

Plug PL-120, 4 connectors, two 50-ampere and two 25-ampere. Part of Cord CD-310 (see paragraph 2-13 b below.)

The above plugs are not interchangeable. Plug PL-108 is a triple function plug and may be inadvertently inserted in the wrong socket, however, no damage will result to the equipment.

b. **Cord CD-310.**—A loop connecting cord is used to couple Radio Compass Unit BC-310-A to Loop Mounting GS-7-A or GS-8-A. The cord consists of flexible conduit fitted at each end with Plug PL-120. (See Figure 19.) The shield which is used as a ground return contains two spaced rubber covered flexible leads having a low minimum capacity. *The length of this cord is 6 feet and it is important that this length should remain 6 feet.* If the cord is too long, it may be coiled. Right angle fittings may be attached to the plugs provided the length of the lead is not increased over two inches per plug.

III
INSTALLATION

3-1 **BONDING AND SHIELDING.**—Satisfactory operation of radio compass equipment in aircraft is dependent upon the efficiency of the shielding and bonding of the ignition, generator and associated electrical distributing system. Before installation is made, the aircraft should comply with the requirements for shielding and bonding as set forth in Air Corps Technical Orders.

3-2 **ANTENNA EQUIPMENT.**—In general, two types of antenna are used with the radio compass. Figure 48 shows the approximate location, dimensions and placement of suitable antenna installations. In some instances the standard mast (A.C. Dwg. 31-189) may be used, in others it may be necessary to use stub masts and a T type antenna. The actual type and location of the antenna are dependent on the type and size of aircraft and are specified in detail on applicable Air Corps drawings for the aircraft.

Radio Compass SCR-242-A is designed for use with an antenna with vertical characteristics having an effective height of 0.3 to 0.6 meters, capacity of 50 to 200 micro-microfarads and a resistance of 1 to 10 ohms. While it is desirable to use an antenna whose characteristics are within the above limits, satisfactory performance will often be obtained with other antennæ. In order to eliminate the reception of local disturbances that may be present within the aircraft fuselage, the antenna lead-in must be shielded. That portion of the lead-in insulator inside of the fuselage should be completely enclosed in a metallic box permanently grounded to the structure. Flexible conduit or rigid and flexible conduit ⅜ inch in diameter terminating at this box on one end and at Plug PL-108 on the other end, should be used to shield the remainder of the lead-in. A No. 20 AWG, flexible, varnished cambric insulated wire should be soldered from terminal No. 2 of Plug PL-108 to flexible conduit shield. A hole should be drilled through the flexible conduit shield about one inch from the plug, and the ground wire soldered onto the outside of the shield. Varnished cambric insulated wire No. 20 AWG, flexible, should be used for the antenna lead-in. The wire should terminate in a lug which clamps the insulation, or else be securely supported to prevent vibration and breakage.

3-3 **INSTALLATION OF COMPONENTS**

a. **Loop LP-13-A.**—The loop should be located on the center line of the fuselage in a position as far as practicable from sources of engine interference, metal masses and conductors. In determining the actual location of the loop, consideration must be given the space available for both the loop and loop mounting, structural requirements, length of Cord CD-310, the location of the compass unit and other factors incident to the normal use of the aircraft. The overall dimensions of the loop are shown in Figure 39.

b. **Loop Mountings GS-7-A (Fixed Loop) and GS-8-A (Rotatable Loop).**—The type of loop mounting used will be determined by the requirements of the aircraft in which the radio compass is to be installed. The mountings are interchangeable electrically, and mechanically with

3-3 b. (Continued)

respect to the mounting holes; a fixed loop mounting may be substituted for a rotatable loop mounting and, conversely, if sufficient space is available a rotatable loop mounting may be substituted for a fixed loop mounting. The fixed loop mounting may be installed in a position normally inaccessible in flight since there are no operable controls on this unit. The rotatable loop mounting should be installed in such a position that the index and azimuthal scale are easily readable from the operator's position. Controls at the base of the rotatable loop mounting must be accessible. Areas affecting safety in flight, operation of the aircraft and maintenance shall not be obstructed by the mountings and associated equipment. It will be necessary to provide a suitable mounting plate securely attached to the structure of the aircraft to support either type of mounting. An additional support attached to the rotatable loop mounting at a convenient point near the center of the outer tube must be used to eliminate vibration. The assembly of the mounting and support should be made in such a manner that water, oil, dirt, etc., will not enter the fuselage at this point when the aircraft is in a normal position.

The mounting dimensions, for the fixed and rotatable loop mountings, are shown in Figure 40 and Figure 41, respectively. In locating the mounting holes for either the fixed or rotatable loop mounting, two of the holes diametrically opposite should coincide with the center line of the fuselage or a line parallel thereto. The streamlined fixed loop mounting must be installed in the normal position with the fiducial mark nearest the front of the aircraft. The rotatable loop mounting may be installed in any one of the four positions, since it is possible to rotate the assembly on the base of the mounting 90, 180 or 270 degrees relative to collector ring housing and the loop. This is accomplished as follows:

(1) Remove handwheel after unscrewing the two set screws located in the hub.

(2) Loosen the nut that secures the outer tubing to the lower housing.

(3) Back out the locating set screw below the nut.

(4) Rotate the housing to the desired positioning hole (90, 180 or 270 degrees).

(5) Tighten set screw and nut and reassemble handwheel to give desired reading on scale.

The length of Loop Mounting GS-8-A may be decreased if necessary, by shortening the inner and outer tubing. The minimum possible length from top of mounting flange to the lowest part of loop mounting is 9¼ inches. Such alterations, however, are not authorized by personnel other than those of the Signal Corps repair shops and of the Signal Corps Sections of Air Depots.

A lathe is required to insure that the cut-off is perpendicular with the axis of the tubing. The disassembly of Loop Mounting GS-8-A, for alteration may be accomplished in the following manner:

(1) Remove handwheel (see 1 above).

(2) Remove lower housing after holding nut and set screw have been removed.

(3) Remove the collector ring covers and the six screws holding the bearing cover to the collector ring housing. Carefully lift the brushes over the collector rings as the entire rotating assembly and ball bearings are withdrawn from the mounting and outer tube.

(4) Unscrew the outer tubing from the collector ring housing after removing the locking screw.

(5) Remove the drive tube from the collector ring assembly by taking out one bolt and a taper pin.

(6) Decrease the length of the drive tube the desired amount and drill holes for the bolt (No. 19 drill) and the taper pin (No. 32 drill).

(7) Decrease the length of the outer tubing.

(8) Slip nut over outer tubing and tighten to collector housing, and drill ⅛-inch hole for holding screw.

(9) Assemble lower housing to outer tube. Before fully tightening the nut, adjust lower housing to the desired quadrantal position and drill ⅛-inch hole for positioning screw.

(10) Assemble drive tube to collector ring spindle and arbor. Slide assembly in the mounting, being careful not to injure the brushes. Replace and stake the six screws in the top of the mounting. Assemble the collector ring cover plates.

3-3 b. (Continued)

(11) Assemble the handwheel on the spindle.
Tuning Unit MC-127 should be screwed in place on the vernier fitting on Loop Mounting GS-8-A after the mounting is installed.

The loop may be installed on the fixed mounting by loosening the mounting adjusting screws sufficiently to allow the insertion of the loop. See that the loop is in place before tightening the adjusting screws. Since these screws provide the adjustment for the On Course setting of the loop, final adjustment cannot be made until the installation is completed. To install the loop in the rotatable loop mounting, turn the locking pin in the top of the housing to the OPEN position, insert the loop and lock in place by turning the locking pin to the LOCK position. If, at any time, the loop is removed, Loop Mounting Cap M-169-A must be installed and locked in place to prevent water and dirt from entering the loop mounting.

c. **Radio Compass Unit BC-310-A (includes Mounting FT-145-A).**—The compass unit should be installed in such a manner that the local controls on the panel can be conveniently operated from the operator's position. The location of this unit is to a certain extent dependent upon the length of Cord CD-310. Consideration must also be given the location of the interconnecting cables or conduit, the antenna lead-in, the tuning shaft, structural requirements and other factors that may influence the performance of the aircraft in flight. Sufficient clearance must be available to permit the removal of the unit from its mounting. The unit is designed for mounting on a plane surface with approximately ¾-inch clearance on all sides to permit free action of the shock absorber mounting. Mounting FT-145-A should be bolted to the structure of the aircraft through the mounting holes provided using the eight mounting holes extending through the Lord mounting brackets. In cases where other mounting holes are necessary, they must be backed up with a metal plate or strip to provide additional strength to the mounting plates. Mounting dimensions are shown in Figures 35 and 36.

d. **Radio Control Box BC-311-A.**—This unit should be mounted in a position convenient for operation of the various controls on the face of the unit. The exact location will be determined by the requirements for the type of aircraft. Consideration must be given to ease of operation, visibility, location of the interconnecting cables or conduit and the tuning shaft. The unit is designed for use with either flexible or rigid conduit. Mounting holes are not provided in this unit. The panel should be removed from the base and the base bolted to the structure of the aircraft after the holes are drilled. The location of the mounting bolts and the number used will be determined by the area available. It is desirable to use four bolts located one near each corner of the box. However, if conditions of mounting prohibit the use of four bolts, three may be used.

After the back of Radio Control Box BC-311-A is mounted rigidly in place, wires from the conduit entrance to the terminal board must be carefully placed and dressed so that sufficient clearance is provided for compass control R36-2 and jack J1-2 at the rear of the front panel of Radio Control Box BC-311-A. The wiring should be dressed along the bottom of the back of the control box directly at the point where wires emerge from rigid conduit and should be free from kinks and have a minimum number of cross-overs to provide clearance required. Wires may be dressed as shown in Figure 18 for Test Box BX-18-A or within dotted line shown in Figure 11.

e. **Compass Indicator I-65-A.**—The compass indicator is designed for panel mounting. The mounting dimensions shown in Figure 42 are standard for aircraft instruments, panel mounting, having 3¼-inch face. Space is normally available on the instrument board near the other flight instruments for the front indicator. Clearance must be provided in the rear of the instrument panel for installing the interconnecting cables.

When two indicators are required, the rear one should be located in a position readily visible to the observer. If a rotatable loop is used, this indicator should be mounted near the rotatable loop mounting. Where shock mounting is not provided, it will be necessary to shock mount the indicator mounting assembly. It is not necessary to shock mount an indicator installed on a shock mounted instrument board.

f. **Tuning Shaft MC-124.**—In installing the tuning shaft, sharp bends should be avoided. Where bends are necessary, they should be of as large a radius as practicable and in no case should the radius be less than 6 inches. The right angle couplings provided on the radio compass unit and radio control box can be adjusted to the desired angle for connecting the tuning shaft. Three screws, mounted on the locking ring of the coupling unit, control this adjust-

3-3 f. (Continued)

ment. After final adjustment they should be safety wired. Before the tuning shaft is connected, the dials on the respective units should be set at the mark ALIGN which is located at the high frequency end of Band 3.

g. **Junction Box TM-180-A.**—This unit is primarily designed to be used as test equipment. However, the unit can be installed in aircraft in lieu of a built-in junction box or connector panel. Four fuses (Fuse FU-24) should be in the box (2 in use, 2 spare).

h. **Cord CD-310.**—*Do not alter the length of this cord as this will prevent interchangeability of Radio Compass Units BC-310-A.*

This cord should be bonded to the structure. Either end of this cord which carries Plug PL-120 should be screwed into the loop mounting socket and the other into the radio compass unit socket. Excess cordage may be coiled if necessary.
Right angle fittings may be attached to the plugs provided the length of the leads is not increased over two inches per plug.

3-4 **CONDUIT AND WIRING.**—The conduit dimensions, wire size, number of conductors and wiring data for the interconnecting cables are shown in Figure 28. Where conduit and wiring has been installed by the aircraft manufacturer, the applicable A.C. drawing should be used in conjunction with the above figure. The illumination circuit of the Compass Indicator I-65-A is designed for a terminal supply not exceeding 3 volts. When the indicator is installed on the instrument board of the aircraft, the lighting circuit leads should be attached to the instrument lighting system. When an indicator is installed in a position where it is not practicable to attach the leads from Plug PL-107 to the instrument lighting system, illumination may be provided externally or by the insertion of a 5-watt 60-ohm resistor and control switch in series with the positive lead and the primary power supply. The leads from the Plug PL-107 on Loop Mounting GS-8-A should be attached directly to the primary power supply, no resistor being necessary.

3-5 **CO-OPERATION WITH OTHER EQUIPMENTS**

a. **Marker Beacon Receiving Equipment.**—Provision has been made to supply high and low D.C. voltages for the operation of the above receiving equipment. See Figure 28.

b. **Interphone.**—The audio output of Radio Compass SCR-242-A may be connected to a two-place interphone circuit without amplification; if more than two headsets are used, amplification will be required. Plugs must be removed from the jacks in the radio compass unit and remote control box when the audio output of the radio compass is attached to the interphone circuit.

3-6 **ADJUSTMENT AND CHECK.**—Before installation of the complete radio compass equipment in aircraft it should be tested as outlined in paragraph 4-1. After the units have been safety wired, final adjustment of loop gain, loop setting and compass indicator sensing should be made in accordance with paragraph 4-2.

IV

PREPARATION FOR USE

4-1 PREPARATION FOR USE PRIOR TO INSTALLATION IN AIRCRAFT

After unpacking and checking the list of parts of the radio compass equipment, the following checks should be made:

a. Test tubes in Test Set I-56-A securely insert them in the radio compass unit sockets and fit grid caps firmly. The tubes may be easily removed by pushing up on the aligning plug beneath the tube socket.

b. Check safety wiring on dynamotor snap slides.

c. Test active and spare lamps for burn-outs at local and remote positions in the indicators and in Loop Mounting GS-8-A.

d. Check active and spare fuses in the junction box. *FUSES MUST BE 15 AMPERE SIZE.* The use of larger size fuses may cause damage to the equipment and smaller size fuses will burn out.

e. Make the standard compass test set-up (see Figure 24) using as far as possible all the radio compass components intended for aircraft installation. (Refer to Typical Conduit Wiring Diagram, Figure 28.)

4-1 e (Continued)

(1) With Local-Remote switch on Remote, set remote sensitivity, audio and compass controls, on maximum, and allow the equipment to operate for one-half hour.

(2) Listen with remote headset throughout each frequency band while equipment is being jarred or vibrated. Any evidence of noise or clicks will require a thorough investigation and removal of the cause.

(3) Using a 20 uv/m field strength, the on-course accuracy over the frequency range should not change more than ±1 degree and the loop should not require more than 45 degrees rotation for full scale indicator deflection.

(4) The correct sensing of the remote indicator is checked by noting that the indicator reads LEFT when the leading edge of the loop is nearest the signal generator and the longitudinal axis of the loop points to the RIGHT of the signal generator. This sense *MUST NOT REVERSE* as the signal generator and the compass unit are tuned from 150-1,500 kc.

(5) With Local-Remote switch on Local, set local sensitivity, audio and compass controls to maximum and repeat paragraphs 2, 3 and 4.

f. If a standard compass test set-up is not available, a partial preliminary operation test should be performed by interconnecting the radio compass elements (refer to Typical Conduit Wiring Diagram, Figure 28) utilizing as far as possible all radio compass components intended for aircraft installation and a vertical antenna approximately 6 feet long.

(1) Repeat paragraphs e. (1), e. (2) and e. (5).

(2) Tune in several stations, preferably one in each band. Swing the loop right and left and take full scale indicator deflections and on-course bearings on the stations tuned in. From a knowledge of the distance, power and direction of the stations, a rough check may be obtained of the performance of the radio compass equipment. No sensing or bearing accuracy check can be relied upon if made inside or close to buildings or large electrically conductive objects unless radio compass bearings check actual geographical bearings for each desired station. The sensing of the radio compass shall be such that when installed on an aircraft with the leading edge of the loop towards the front of the aircraft, the indicator pointer will indicate to the right when the aircraft heads to the left of the station and to the left when the aircraft heads to the right of the station. In fewer words, the indicator pointer should point to the station.

g. **Adjustment of Loop Gain Control.**—This control adjusts the gain of the loop modulation tubes to produce a voltage comparable with that at the vertical antenna. Before setting this control, first check the match of the loop tubes on a tube tester. A satisfactory match is indicated by the following additional test:

Advance the Loop Gain control to its maximum clockwise position and obtain a bearing on a signal at a frequency of approximately 175 kc. Then slowly rotate the Loop Gain control counterclockwise and at the same time observe any azimuth bearing shift. If any shift occurs, substitute different Tubes VT-91 until the error is reduced to one degree or less.

To set the Loop Gain control:
Advance the Increase Sensitivity control to maximum and tune in a signal at or near the high frequency end of Band 3.
Advance the Increase Compass Output control to give approxmiately full scale deflection at the maximum or ninety degree position of the loop from the On-Course reading on the azimuth scale. Loosen the locknut and adjust the Loop Gain control with a screwdriver, at the same time rotating the loop through ninety degrees from the On-Course position, and observe the compass indicator. The final position of the control is found by turning it to the maximum clockwise position and then carefully turning back until the point is found at which the compass indicator progresses to its maximum deflection as the loop is rotated to its ninety-degree position. The maximum deflection of the indicator must only occur with the loop at ninety degrees. Improper adjustment causes the indicator pointer to reach its maximum deflection before the ninety-degree loop position is reached, to move back as the loop is further rotated to ninety degrees, and to move forward again after the ninety-degree point is passed. After the adjustment is completed tighten the locknut.

4-2 PREPARATION FOR USE AFTER INSTALLATION IN AIRCRAFT

a. Preliminary Checks

(1) Check active and spare radio compass unit fuses in aircraft connector panel. *FUSES MUST BE 15 AMPERE SIZE.* Check the battery supply voltage. The voltage must be between 11 and 15 volts or the equipment will not operate satisfactorily.

(2) Check to see that all plugs are properly placed and tightened. Tighten the plug collars at the flexible conduit end of the plugs.

(3) Test the operation of Tuning Shaft MC-124, and the connections at both local and remote positions. When properly connected, the ALIGN marks on both local and remote dials are in the same relative positions and the frequency calibrations coincide.

(4) Check Loop LP-13-A for proper position and locking. (See paragraph 4-2 b.) The loop mounting and mounting screws must be water-proofed with Permatex No. 1 sealing compound, or equal. The screw holes of the loop mounting must be properly filled to provide optimum streamlining. Check Loop LP-13-A for cracks or damage which may admit moisture and thus impair the compass operation.

(5) Check the Mounting FT-145-A base screws. Safety wire the ganged snapslides of Radio Compass Unit BC-310-A. Tighten the thumbscrews holding the front panel in place.

(6) Check Radio Control Box BC-311-A for tightness of mounting to aircraft's structure, and check mounting screws on panel for tightness.

(7) Check the vertical antenna and see that the connections are properly and securely made.

(8) Be sure that Cord CD-310 is supported, taped, and bonded to avoid noise in the loop circuit.

(9) Check for MC-127 on GS-8-A to allow vernier operation of the loop mounting.

(10) Check for the presence and operation of instrument lights. Also check the lamp controls.

(11) Using a Headset HS-18 check receiver operation on all three bands, then check compass operation and indicator response. Jar the compass unit to check for possible sources of noise.

(12) Switch the compass ON and OFF and note whether or not the magnetic compass is affected.

(13) Check for effects of other radio equipment in the aircraft upon the communication and navigational performance of the radio compass. Also determine the extent of any interference produced by the radio compass in other radio equipment in the aircraft.

(14) Start the aircraft's motors and check for interference with radio compass operation. Check ignition noise, taking necessary action to eliminate it especially if the level is high enough to affect the automatic volume control action of the radio compass, thus reducing its sensitivity. Note whether any of the aircraft's flying equipment, such as electrical generators, motors, or other radio equipment cause interference in the radio compass.

(15) Adjust the Loop Gain control by the method described under paragraph 4-1 g.

(16) With the aircraft's motors off, tune in on compass a weak station noting its bearings and intelligibility of signals. Start aircraft's motors and taxi aircraft about field noting any decrease in sensitivity, less intelligibility and increase in noise level. If the increase in noise causes unsatisfactory operation, take necessary action to eliminate the cause.

(17) Take a trial flight, check compass sensitivity, stability and accuracy.

b. Method of Aligning Loop LP-13-A With Respect to the Axis of the Aircraft

(1) Fixed Loop Installation.—With an installation using Loop Mounting GS-7-A it is necessary to position the aircraft on the reference lines (Ref. 4-2 e.), and take a compass bearing on the reference station. Adjust the loop for zero indicator deflection, and lock it in place with both loop locking screws. To check the alignment, turn the aircraft 180 degrees so that it points directly away from the station. When the loop is properly placed,

4-2 b. (1) (Continued)

and the loop circuit is properly functioning; the forward and the reverse bearings should each produce zero indicator deflection within 1 degree.

(2) Rotatable Loop Installation.—With the GS-8-A installation the same procedure is followed, as for the GS-7-A installation, except that an additional loop circuit check is provided by rotating the loop. With Loop Mounting GS-8-A adjusted to zero degrees, and zero indicator deflection, the 180-degree position should also produce zero indicator deflection. Set the azimuth scale to zero by aid of fine adjustment arrangement beneath handwheel. See Figure 15.

c. **Method of Checking Compass Sensitivity and Accuracy**

(1) Fixed Loop Mounting Installation.—Position the aircraft on reference lines, and tune in reference station. Start the aircraft's directional gyro, allow the necessary time for the gyro to reach constant speed and cage it to zero. Adjust the compass sensitivity control to maximum and rotate the aircraft to get exactly full scale indicator deflection. Read the gyro, and compare the angle with the reference data. This test may be made on any station of sufficient field strength without the aid of the reference lines. However, this requires tedious manœuvering of the aircraft to obtain zero indicator deflection. If the compass lacks sensitivity, adjust Loop Gain for maximum deflection of indicator. See paragraph 4-1 g. Check for correct sensing of indicators.

(2) Rotatable Loop Mounting Installation.—In this type of installation, it is not necessary to make use of the directional gyro for sensitivity and accuracy checks. With aircraft in position on the reference lines and the radio compass sensitivity control at maximum tune in the reference station, and record the loop rotation necessary to produce full scale indicator deflection. Compare the data with that obtained as in paragraph 4-2 e. to ascertain the approximate compass sensitivity. The radio compass on-course accuracy can be checked on the reference station, precaution being taken to properly locate the aircraft upon the reference lines before attempting any correction of the loop position.
If stations are available in the on-course position which have frequencies in other radio compass bands, it is desirable to make use of them. If the compass lacks sensitivity adjust the Loop Gain adjustment for maximum deflection of indicator. See paragraph 4-1 g. Check for correct sensing of indicators.

d. **Calibration for Quadrantal Error.**—(Quadrantal error calibration is not necessary for a fixed loop installation.)

(1) On the Ground.—For installations including Loop Mounting GS-8-A, it is important to ascertain the nature and magnitude of the quadrantal error resulting from distortion of the radio wave front by the aircraft fuselage and wing. Position the ship on the reference lines and take bearings on known stations in all four quadrants. Since the quadrantal error varies with frequency, it is desirable to group the data to determine the error in the upper and lower halves of each frequency band. The difference between the bearings taken and those of the standard reference data (4-2 e.) is the quadrantal error.

(2) In the Air.—For installations using Loop Mounting GS-8-A, quadrantal error in the air may be determined for any given frequency in the following manner:
Home on a station which is at least 100 miles distant, and cage the directional gyro to zero. Keeping the aircraft approximately horizontal, fly in a circle of from one to one and one-half miles in diameter, and at given intervals simultaneously record directional gyro and loop azimuth readings for zero indicator deflection. The difference between the recorded readings at each interval is the quadrantal error.

e. **Method of Laying Out Reference Lines and Taking Reference Data**

(1) Select a radio compass test area about 100 feet square, and at least 200 feet from the nearest hangars, fences, wires or other metal objects. Although a concrete surface is most desirable, any level surface upon which lines can be permanently made will suffice. Place Radio Compass SCR-242-A with Loop Mounting GS-8-A, known to be in operating condition and of at least average sensitivity on a table near the center of the test area. Select a radio station to be used as the on-course reference. This station should be chosen with care after the following considerations:

(a) Station should be in a clear channel between 550 and 1,000 kc.

(b) It should be located more than five miles from the field.

(c) It should operate on an unlimited time basis, all day, every day in the year.

4-2 e. (1) (Continued)

(d) It should provide a good ground wave, with little sky wave and fading.

(e) The signal should be strong, averaging around 1,000 uv/m if possible.

(f) A vertical radiator is more desirable than other types of antenna, because of its ground or direct wave characteristics, and greater distance to the fading wall.

(g) Stations of the previously stated general types whose frequencies lie in compass band 1 or band 2, and which have their antennæ located in the general vicinity of the reference station are desirable, since they can be used as on-course reference in their respective bands.

(2) To establish the on-course reference line, tune in the reference station and take a bearing on it. Then rotate the loop 90 degrees, and sight across it to a stadia rod about 50 to 100 feet away. Continue this procedure, fixing a point 50 to 100 feet in the opposite direction. Permanent lines can be painted on the ramp or apron through these fixed points, a reference arrow head being made to show the direction toward the station. Before making the permanent lines, the reference line should be checked against actual geographical bearings. Any wide deviations between radio bearings and magnetic or geographical bearings will require the selection of another reference station.

(3) Set the Loop Mounting GS-8-A to read zero when taking a bearing on the reference station. Then, for stations in all quadrants, all frequency bands and including the reference station, record the following information:

(a) On-course and reciprocal bearings.

(b) Degrees plus and minus on-course for full scale indicator deflections with sensitivity control on maximum.

(c) The call letters, frequency, power, location of the station, the date and the hour of the day. Avoid taking bearings at sun-up and sunset.

(d) These recorded data should be arranged systematically and kept permanently as standard reference information to which all compass installations can be compared.

(e) To facilitate locating the aircraft properly with respect to the reference lines, it is useful to extend lines at ± 30 degrees to the reference, forming an X with the compass table position as its center. The legs of this X should be about 50 feet in length. This permits accurate alignment of the aircraft by placing its two wheels on the X lines, and the tail wheel, in a fore and aft position on the reference line.

(f) The differences between the standard reference information, and that obtained using the aircraft's radio compass, will show the quality of the installation as well as the nature and magnitude of wave distortion produced by the plane itself.

V

OPERATION

5-1 **Theory of Operation.**—In actual operation of an aircraft, the pilot selects a radio transmitter located near the airport to which he is going, tunes the radio compass to the frequency of the transmitter, adjusts the headset volume and indicator response and turns the aircraft until the indicator points to zero. As long as he keeps the indicator on zero he knows that he is in line with the radio transmitter.

If the heading of the aircraft should vary from its course, the indicator will point toward the radio transmitter. That is, if the aircraft heads left of the course, the indicator will point to the right. If the aircraft heads to the right of the course the indicator will point to the left.

This type of radio compass will also point zero when the radio transmitter is either directly in front or behind the aircraft. If the pilot wants to know whether he is flying toward or away from the transmitter, he turns the aircraft slightly. If the indicator pointer moves opposite to the way the aircraft is turned, the pilot knows that the transmitter is in front of him. If the indicator pointer moves in the same direction the aircraft is turned, then the transmitter is to the rear.

While the pilot is navigating with the equipment, he can also hear the station signals and in this manner he can obtain weather reports and other flight information.

This type of radio compass merely indicates zero heading of the aircraft and does not give directly the angular deviation from true bearing in degrees. In some cases, the pilot is only

5-1 (Continued)

interested in knowing whether he is flying toward the station. In these cases the loop is mounted rigidly to the aircraft and the aircraft is turned left or right as required to keep the indicator pointing to zero. When the equipment is mounted in this manner, it is called a homing radio compass.

In other cases, the navigator on the aircraft wishes to take bearings on several stations and thereby establish his definite location. In these cases the loop can be rotated from the inside of the aircraft and the angles between stations read from the azimuth scale on the rotatable mounting for the loop. Where angles can be read, the loop is known as a radio direction finder.

This type of radio compass employs a very sensitive and highly selective radio receiver, a vertical antenna, a loop, a 90 degree loop phase shifting circuit, an indicator, and a loop and indicator reversing circuit. (See Figure 20a.)

The vertical antenna is non-directional, that is, if the vertical antenna is rotated, the amplitude and phase of the induced voltage remain the same. The induced voltage is also in phase with the flux of the radio wave. (See Figure 20e.)

The loop is directional, that is, if the loop is rotated, the induced voltage is zero when the plane of the loop is perpendicular to the direction of travel of the radio wave. The induced voltage is 90 degrees out of phase with the flux of the radio wave and the phase of the induced voltage changes abruptly 180 degrees as the loop is rotated left or right of zero heading. (See Figure 20b.)

By shifting the loop voltage approximately 90 degrees, the loop voltage can be combined with the vertical antenna voltage and it will add to or subtract from the vertical antenna voltage depending on whether the loop is rotated left or right of zero heading. This 90 degree phase shift is obtained by partially detuning the loop circuit and partially through capacitor C19-1. (See Figures 20c and 20d.)

The loop and indicator reversing circuit is a continuous comparing circuit. It is continually adding and subtracting the loop and antenna voltages.
If the radio wave is coming from the right side of the loop, the loop and antenna voltages will add when the reversing switch is to the right (see Figure 20, c, e and f) and subtract when the reversing switch is to the left (see Figure 20, d, e and g) so the average right output will be greater than the average left output and the indicator will point right.

If the radio wave is coming from the left side of the loop, the loop and antenna voltages will add when the switch is to the left and subtract when the switch is to the right, so the average left output will be greater than the average right output and the indicator will point left.

The reversing switch moves so fast that the indicator cannot follow each reversal, but the pointer takes up a position depending on whether the average outputs to the right are greater than the average outputs to the left or vice versa.

In the actual circuit (see Figure 29) the reversing switch function is performed by two modulators (Tubes VT-91) which are alternately keyed ON and OFF by the audio voltage fed to the grids through resistors R18-8 an R18-9. Loop LP-13-A is tuned by means of capacitor C1-A, off resonance so that the voltage set up across C1-A is approximately in phase with the loop induced voltage (or 180 degrees out of phase, depending on the loop polarity or orientation).

The voltage across C1-A is fed to the modulator grids through coupling capacitors C19-1 and C19-2 which have negligible reactance. The modulator plates are coupled through C20 to the antenna circuit which presents a capacitive load on the modulator tube plates. The capacitive reactance is small in comparison with the plate resistance so that the voltage set up across the plate load is approximately 90 degrees out of phase with the grid voltage or the loop induced voltage.

The voltage induced in the antenna is set up across the same capacitive reactance, and since as stated above, the loop and antenna induced voltages were 90 degrees out of phase, the voltages from these two sources set up in the antenna circuit are in phase or 180 degrees out of phase depending on the loop orientation.

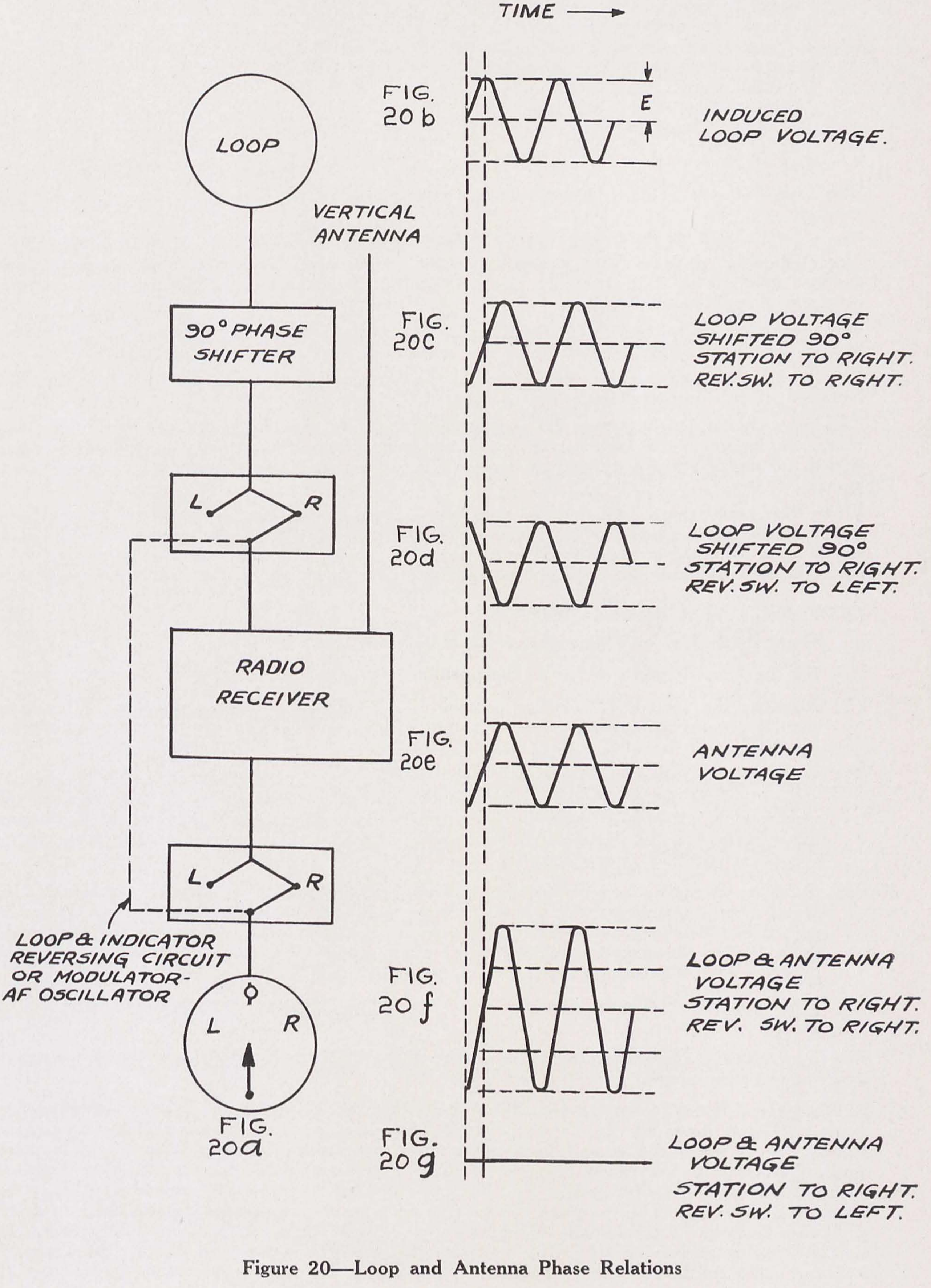


Figure 20—Loop and Antenna Phase Relations

5-2 **Controls.**—Refer to Figures 2 and 10. The following operating controls are duplicated on both the radio compass unit and the radio control box:

Increase Sensitivity (combined with Rec'r-Off switch)
Increase Audio Output (combined with Audio-Off switch)
Increase Compass Output (combined with Comp.-Off switch)
Tuning Control
Band Switch
Instrument Lamp Control
Tuning Meter
Tel. Jack

The Local-Remote switch is located at the local position and determines which position has control.

The audio output and compass output controls function independently of the position of the "Local-Remote" switch. The proper levels for operation of the two compass indicators and the two headsets at their particular positions are set individually by their respective compass output and audio output controls.

The sensitivity control and the instrument lamps function only at the position having control of operation, this being determined by the position of the Local-Remote switch.

The local and remote tuning controls are ganged by mechanical cable, Tuning Shaft MC-124. Rotation of either control tunes the equipment.

The local and remote frequency dial masks, however, are operated independently of each other, and therefore the frequency band visible at the position not having control is no indication of the signal frequency being received. The instrument lamps indicate which position has control.

When the Local-Remote switch is operated, the equipment will electrically switch to the band set up by the band change switch in the position having control. If the control of a particular signal being received is to be transferred from one position to the other, it is necessary to ascertain by interphone the correct band setting before operation of the Local-Remote switch.

5-3 **OPERATION AS A RADIO COMPASS**

a. **Visual Indication for Flying Broadcast or Radio Range Signals**

(1) Set the Local-Remote switch to the position from which it is desired to operate.

(2) Advance the Increase Sensitivity control to the extreme clockwise position. This turns on the primary power for tubes, dynamotor, etc., and adjusts equipment for maximum sensitivity.

(3) Set the Band Switch to the desired band and with the Tuning Control tune in the desired station. Tune in the signal carefully until the tuning meter gives an indication of the maximum, i. e., the greatest deflection towards the right or clockwise end of the tuning meter scale. Adjust Increase Audio Output control clockwise until comfortable audio volume is obtained in the headset.

(4) Turn the Increase Compass Output control clockwise and adjust to a level at which it is found most convenient to fly by the compass indicator. A detent or clicking device is provided which may be set at this point. Usually, this detent is set so that full scale deflection of the compass indicator is obtained when 15 degrees off-course for a signal intensity of 1000 microvolts per meter.

(5) The equipment will now give true flight indications towards the station to which it is tuned.

The Increase Sensitivity control should be in the MAXIMUM or clockwise position for compass flying as described above.

b. **Combined Aural Reception and Visual Indication for Flying Radio Range Signals.**—For flying a beacon range by the combined aural and visual method, perform all the operations indicate in paragraph 5-3 a. and, in addition, turn the Increase Compass Output and Increase Audio Output to the maximum (extreme clockwise) position. *Reduce Increase Sensitivity control by counterclockwise rotation until a level has been reached where the A and N signal may be clearly distinguished.* The need for this is evident from discussion in paragraph 5-4 b.

c. **Cross Bearing Triangulation.**—When used as a radio compass, bearings with respect to aircraft heading may be obtained by orienting the loop on a station and holding the Compass Indicator I-65-A to the center "⏀" position. The reading may then be added to the heading of

5-3 c. (Continued)

the aircraft, as determined from the magnetic or gyro compass. The exact position of the aircraft may be determined by taking bearings on several stations and plotting them in conjunction with a map on which the position of each station is given. A certain correction must be made for the different loop readings and for different frequencies. This correction is obtained on the ground by plotting actual bearings to a radio station against loop indicated bearings as the aircraft is rotated through 360 degrees. This calibration is known as a quadrantal error curve. (See paragraph 4-2 d.)

5-4 OPERATION AS A RADIO RECEIVER

a. Aural Reception of Broadcast Signals

(1) Set the Local-Remote switch to the position for which it is desired to operate.

(2) Turn Increase Compass Output to the Comp.-Off position. This operation turns off the compass circuits.

(3) Advance the Increase Sensitivity control to the extreme clockwise position. This operation turns on the primary power for tubes and dynamotor and adjusts equipment for maximum sensitivity.

(4) Set the Band Switch to the desired band and with the Tuning Control tune in the desired station. Tune in the signal carefully until the tuning meter gives an indication of the maximum, i. e., the greatest deflection towards the right or clockwise end of the tuning meter scale.

For reception of very strong signals, the Increase Sensitivity control may have to be retarded somewhat to keep the tuning meter needle within the scale limits while tuning the receiver.

(5) Adjust Increase Audio Output control clockwise until comfortable audio volume is obtained in the headset.

b. Aural Reception of Radio Range Signals

(1) Perform all operations indicated in paragraph 5-4 a. until signal is tuned in.

(2) After signal is tuned in, advance Increase Audio Output control to maximum.

(3) Reduce the Increase Sensitivity Control until a level is reached where the A or N signal is clearly distinguishable.

NOTE—With the signal properly tuned in it is *essential that the Increase Audio Output be operated on maximum and the sensitivity be reduced* by turning the Increase Sensitivity control counterclockwise until a level has been reached where the A or N signal may be clearly distinguished. If the sensitivity is not reduced, the A and N tend to fill in and form the T zone. When the sensitivity is properly adjusted, the difference between the On-Course and Off-Course A or N signals may be clearly distinguished to a degree which is actually greater than exists in the transmitted pattern. The explanation is that the AVC action tends to hold down the loud signal and pull up the weak signal which results in producing one signal of nearly constant level. By reducing the sensitivity, a point is reached where the AVC no longer has control, and since this point is at a non-linear position of amplification it results in exaggerating the desired keyed signal and reducing the undesired signal. This results in a more clearly defined A or N signal and therefore in a sharpening of the course indication.

5-5 PRECAUTIONS DURING OPERATION

a. Set Local-Remote switch to position desiring control. *WHERE ONLY ONE OPERATOR IS PRESENT IN THE AIRCRAFT, THIS MUST BE CHECKED BEFORE TAKE-OFF.*

b. Set Increase Audio Output to maximum and adjust Increase Sensitivity control when flying aural A or N signals.

c. Tune equipment carefully. If an interfering signal is heard in the headset it is probably causing an error in bearing. To check, tune a few kilocycles either side of maximum. A change in bearing with tuning indicates an interfering signal. The indicator pointer must be held on center during this test and any change in bearing noted on the directional gyro. If station interference exists, select another station or proceed by dead reckoning until closer to the desired station. Care must be exercised when taking bearings on stations which are netted or which

5-5 c. (Continued)

are synchronized to the same frequency. If the desired station fades or stops transmitting, bearings will be taken on other stations on the same frequency thus causing apparent instability or errors.

d. Night effect, or reflection from the sky is always present. It may be recognized by a slow periodic fluctuation in bearing. The remedy is to take an average of the fluctuations or select a lower frequency station.

e. When close to a station, accurate bearings cannot be obtained with the aircraft in a steep bank.

f. If a particular motor speed causes interference, avoid that speed.

g. Do not depend upon bearings on two stations for a fix of location; at least three station bearings should be used which will plot as a triangle to give an average.

h. Only Head-On or Directly-Aft bearings are entirely dependable. If side bearings are necessary keep the wings horizontal, and refer to correction for quadrantal error.

i. Bearings should not be taken with a partially discharged battery or before the radio tubes have warmed up properly (at least 2 minutes).

j. This equipment will not operate during bad conditions of rain or snow static, especially when discharges occur from parts of the aircraft's surfaces. If discharge occurs from certain parts, these parts should be noted and necessary action taken to eliminate them. The type of rain and snow static, existing in thunderheads can be avoided by increasing or decreasing altitude or flying around the cloud. The type of rain or snow static existing in air mass fronts at at different temperatures can be avoided by flying at right angles to the air mass front. In bad cases of rain and snow static some improvement can be obtained by removing the antenna Plug PL-108 and then operating equipment on compass as a null type receiver.

k. Do not disturb Loop Gain adjustment.

l. Do not disturb any adjustments inside radio compass unit.

m. Do not depend on tuning meter as a distance or signal intensity indicator.

n. The compass indicator deflection bears no relation to the degrees off-course. *Fly aircraft with indicator pointer on zero.*

o. Do not operate equipment as a compass with all controls on maximum as it will be very sensitive and appear unstable. Reduce compass output control until pointer is fairly steady.

p. Check dial calibrations against actual station frequencies. If the calibration is wrong, report the equipment in trouble.

q. Information concerning the location of radio transmitting stations with respect to airports or cities has been published and is available from several sources.

VI

MAINTENANCE

NOTE.—Repair of major components of this equipment shall not be attempted in the field. Defective units should be returned to the Signal Corps Radio Section at the proper Air Depot. The indicators should not be opened. Repair and adjustment of circuits in Radio Compass Unit BC-310-A should not be attempted unless suitable laboratory equipment is available, for example, signal generators, Test Set I-56-A, shielded room and standard compass test set-up. DO NOT OPERATE EQUIPMENT WITHOUT THE RADIO CONTROL BOX UNLESS LOCAL TUNING INDICATOR IS SHUNTED WITH 125 OHMS.

6-1 **DAILY FLIGHT INSPECTION.**—The inspection prior to the first flight of each day shall be sufficiently thorough to determine whether the equipment is in working order. This inspection should be made with the airplane at least 200 feet distant from hills, buildings, towers, telephone lines, power lines, and other large conductive objects which are likely to distort the radio frequency field.

6-1 (Continued)

a. Check mounting and safetying of Radio Compass Unit BC-310-A and Radio Control Box BC-311-A.

b. Check all plugs and mechanical couplings. See that they are secure in sockets and that the outer collar is sufficiently tight to prevent movement of the flexible conduit or mechanical cable in the couplings. Check phone cords.

c. Check that loop is locked securely in its mounting.

d. Check all instrument lamps.

e. Operate equipment as a receiver. Tune in different stations in each band. Select stations providing weak signals and check receiver sensitivity. Check the operation of all controls. Check noise in equipment. Check frequency calibration on local and remote dials.

f. Operate equipment as a compass. Check bearings of stations in each band against known bearings. Select stations providing weak signals and left and right bearings. Check both indicators for correct sensing (indicator pointer points to station). Check deflection of indicator pointers against previously observed deflections.

g. Start aircraft motors. Repeat procedure of paragraph f above. Check for any increase in noise and indicator pointer instability.

6-2 FORTY HOUR INSPECTION

a. Remove Radio Compass Unit BC-310-A from its cabinet. (See paragraph 6-3 a.) Inspect all internal connections, screws, nuts, etc., for looseness and corrosion. *Do not disturb alignment adjustments or location of any radio frequency wiring.*

b. Check all tubes. Check loop modulator tubes for proper match. If tube plate current is less than 80% of normal plate current (with 6.3 volts on heater), replace tube. Tubes may be easily removed by pushing on the aligning plug beneath the tube socket.

c. Remove Radio Control Box BC-311-A from its panel. Inspect all internal connections, screws, nuts, etc., for looseness and corrosion. Clean pin contactors, if necessary.

d. Remove Loop LP-13-A from Loop Mounting GS-7-A or GS-8-A. Inspect pins and sockets for corrosion. Clean, if necessary.

e. Inspect collectors and collector rings in Loop Mounting GS-8-A for corrosion. Clean, if necessary.

f. Inspect all bonding.

g. Clean all headset plugs. A long pencil eraser provides a simple means for cleaning these plugs.

h. **Lubrication.**—The following parts require lubrication after hours of service indicated below:

Part	Time	Lubrication
Dynamotor DM-18	1000 hrs.	A.C. Grade 375
Loop Mounting GS-8-A Bearings	1000 hrs.	A.C. Grade 375
Loop Mounting GS-8-A Worm Gear	1000 hrs.	A.C. Grade 375
Loop Mounting GS-8-A Collector Rings	1000 hrs.	A.C. Grade 375
Dial Gear Mechanisms (Local)	1000 hrs.	Univis #60
Dial Gear Mechanisms (Remote)	1000 hrs.	Univis #60
Band Change Relay	1000 hrs.	Univis #60
Tuning Shaft MC-124	As req'd.	A.C. Grade 375
Mounting FT-145-A Plate Studs	As req'd.	Fibre Grease
Dynamotor DM-18 Mounting Studs	As req'd.	Fibre Grease

DO NOT LUBRICATE variable tuning condensers, volume controls, or dynamotor commutator.

i. Replace equipment and check operation as outlined in paragraphs 6-1.

6-3 REMOVAL AND MAINTENANCE OF PARTS

a. **Radio Compass Unit BC-310-A.**—After disconnecting plugs and Tuning Shaft MC-124 from the front panel, the cabinet may be removed from Mounting FT-145-A by pulling out the snapslides (after cutting the safety wire) and lifting the cabinet upwards. The chassis may be removed from the cabinet by merely loosening the four captive thumbscrews located at the corners of the front panel and sliding the chassis forward.

NOTE: Extreme care should be exercised in removing and also in replacing the chassis in the cabinet to prevent damaging of parts, as cabinet clearances are very small. Under no conditions should the chassis be transported except when mounted in the cabinet. Plug PL-110 may be inserted as an aid in removing the chassis from the cabinet. As chassis is removed, the right hand should grasp the bottom right side of the front panel and the left hand should support the bottom at the rear of the left side.

(1) Dynamotor DM-18.—If Radio Compass Unit BC-310-A is operating satisfactorily, with the dynamotor noise at a suitably low level, the dynamotor unit should not be disturbed as unnecessary manipulation of the brushes, bearings or commutators is apt to do more harm than good. If, however, it becomes necessary to remove Dynamotor DM-18 from Radio Compass Unit BC-310-A, this can be accomplished by first inverting the unit (without cabinet) and loosening the four terminals on terminal board TB17. Then turn the chassis over, cut the dynamotor snapslide safety wire and disengage the snapslides. The dynamotor may now be lifted out vertically, carefully slipping the cable wires up through the hole in the chassis.

This dynamotor requires lubricating after 1,000 hours or approximately 6 months of ordinary service and should be lubricated with none other than Air Corps Grade 375 grease. The directions for lubrication are stamped on the inside of the end-bell dust covers. Access to the bearings of the dynamotor is obtained by first removing the dust covers after cutting the safety wires and removing the retaining screws, then unscrewing the bearing end-plugs. *Do not PACK the lubricant in these bearings.* Figure 45 is a drawing of the dynamotor.

When necessary to replace the ballbearings or turn down the commutators, first remove the brushes from their cartridges. Remove the nuts from the tie rods which hold the bearing end-bells and pull the end-bells away from the field coil assembly. The armature can now be taken out. Examine the brushes to see that they have worn properly and are free from hard spots. Should such spots be apparent (they generally cause grooves in the commutator surface), the brush should be replaced and the commutator smoothed down. The ballbearing retainers and the shaft are machined for very snug fits, but a slight tapping will loosen them. To remove the bearing retainers from the end-bells use two small screwdrivers as wedges between the outer ball race and the end-bell. Care must be exercised to avoid marring the grease plug threads during this operation. If the grease slinger becomes bent during removal, it should be straightened and replaced on the shaft before replacing the bearing.

To smooth down the commutator rotate it in a lathe holding a fine grade of sandpaper, not coarser than size 00, lightly against the commutator surface. *Do not use emery cloth.* All residue of dust, sand and dirt should be wiped away to leave a clean, smooth, polished commutator surface. A commutator having a smooth or polished surface should never be sanded or turned down simply because it is discolored. If the commutator is turned down in a lathe, the mica segment separators must be undercut.

Re-assembly of the dynamotor is accomplished in substantially the reverse of the disassembly procedure except that the use of the screwdrivers as wedges is not necessary. In replacing the brushes check to see that the + and — markings on the brushes correspond with those on the brush holder supports. The cotter pins, after bending, are clipped close to prevent grounding on the dust covers. Care should be taken to have the four dynamotor leads tightly connected to their corresponding terminals on TB17. (See Figures 25 and 30.)

The commutator must be given a final inspection for free running, cleanliness and absence of grease or oil. The endbells should be wiped clean and dry before replacing them on the dynamotor.

(2) Removal of Front Panel.—For the servicing of the dial mechanism and certain parts, it is necessary to partly remove the panel. The chassis should be taken out of the cabinet and placed bottom upwards. The shield in the rear of the receptacle for Plug PL-120 is held in place by two screws to the chassis and should be removed. It may be neces-

6-3 a. (2) (Continued)

sary in some cases to unsolder the two wires attached to the receptacle for Plug PL-108 to allow removal of this shield. The screw holding the ground connection from PL-120 should then be removed from the chassis. Withdraw the right angle tuning shaft coupling after removing the safety wire and taking out the three screws holding it in place. Remove the Increase Audio Output knob, the Tuning knob, the Band Switch lever and the Local-Remote lever, using the set screw wrench held in clips in the bottom of the cabinet, and take off the nuts and lockwashers holding the Increase Audio Output and Local-Remote controls.

Remove the dial lamp escutcheon assembly held in place by three screws and unsolder the connections to the lamp sockets. Then remove the four screws holding the panel to the corner gusset plates, the screw under the words Local-Remote, the screw under the caption PL-120, the two screws under the words Rec'r.-Off and the holding nut and locking nut on the loop gain control. The positions of the screws are given when viewing the chassis in the upright position. With the chassis bottom upwards the screw will appear above the inverted words. Next remove the screw below the remote control gear (viewed with chassis bottom upwards) which holds the gear assembly in place on the panel.

Turn chassis right side up and place on a block so that the front panel is free. Then, from behind the front panel, proceed to remove screws and parts in the following sequence:

Three screws attaching the shield, around the main tuning capacitor, to the chassis. Then lift out shield.

The two Allen set screws nearest to the panel, holding the coupling on the main tuning shaft to the gear assembly. This releases the gear assembly from the main tuning capacitor.

Two screws holding the wafer on the band change switch to the gear assembly. Then slide the wafer back off its shaft.

Now grasp the panel at the top left-hand corner and at top center and carefully pull it out from the chassis. The panel slides out at an angle towards the operator, the top left-hand corner moving the greatest distance. Check to see that the tuning condenser drive shaft slides out to clear its coupling and that the band change switch shaft and the tuning shaft slide out of the bearings in the panel to give sufficient clearance at the back.

The dial mechanism assembly may now be removed and access to controls, sockets and other parts for servicing, is possible.

The reverse sequence should be followed in replacing the front panel.

(3) Dial and Mask Assembly.—To remove the dial and mask assembly follow the instructions given in paragraph 6-3 a. (2) for removal of front panel. Then press the remote control gear to clear through the hole in the front panel and carefully lift out the assembly at the top of the panel.

The mask may be removed by driving out the taper pin in the detent hub and pulling the mask and shaft out enabling the removal of the dial.

The stop on the main tuning shaft is controlled by the cutout section of the dial and should operate when the last calibrated line on the dial scale reaches the index pointer on the mask. When coupling the tuning mechanism to the tuning capacitor during reassembly, the dial should be set to the low frequency stop mark at the extreme counterclockwise position of any band and should lock at this setting. Turn the tuning capacitor to its maximum capacity position and tighten the insulating coupling set screws.

In replacing the mask, the index pointer corresponding to its particular detent is placed in the mid-position of the window opening and care should be taken to place the taper pin from the proper side so that the detent arm roller is in the center cutout of the detent cam when the mask is in position for Band 2.

(4) Band Change Relay

Removal.—Place the chassis upon its left side with panel to the left and remove the loop section shield. Disconnect the band change switch shaft at the relay shaft coupling by removing the front screw and loosening the rear screws. Unsolder the five leads connected to the relay terminal board. The color coding of the leads should correspond to that stamped on the relay opposite the terminals to which the leads are connected. Remove the three screws securing the relay frame to the chassis. As viewed from top front of

6-3 a. (4) (Continued)

chassis, two of these screws are located to the right of F1 between the tuning mechanism and the socket for Tube VT-91, and one screw to the left of the mounting bracket for R32. The relay can then be lifted out.

Check the contact pressure of the relay switch wafer contacts. No adjustment should be necessary other than to clean and square the silver contacts with a fine contact file and to check the contact pressure with a Western Electric Company No. 70G relay gauge or the equivalent. Oil, free flowing at low temperatures, should be lightly applied to the plungers and other moving parts, care being taken to keep the electrical contacts free from oil. A recommended lubricant is Univis No. 60, manufactured by the Standard Oil Company of New Jersey.

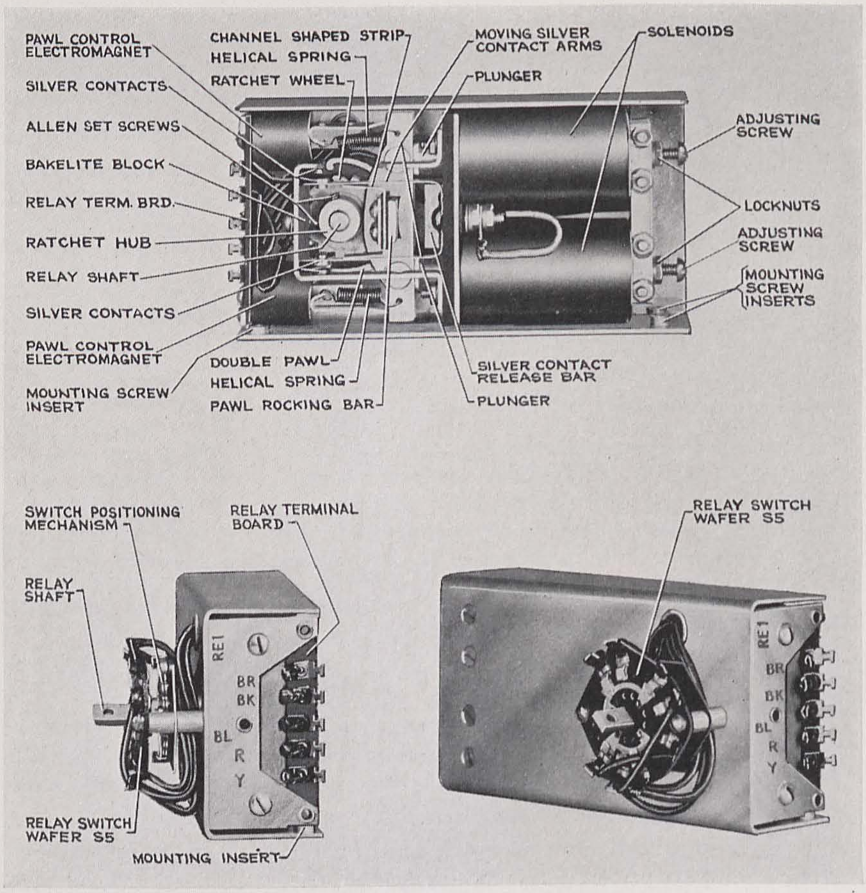


Figure 21—Band Change Relay; Back, Front and End Views

The operation of the relay is as follows:

Manual operation of either band switch lever closes a circuit through the relay switch wafer to energize one of the pawl control electromagnets which attracts one pawl, thus engaging the other pawl in a tooth on the ratchet wheel and closing one set of silver contacts. This energizes the solenoids at the bottom of the relay assembly, and pulls down the complete movable mechanism, rotating the band change switch to its new position. The pawl rocking bar strikes the silver contact release block between the solenoid plungers, opening the contacts, breaking the solenoid circuit and allowing the helical springs to pull the movable mechanism back into its original position.

If additional adjustment should be necessary, the procedure should be as follows:

Adjust the moving silver contact arms by bending each at the fixed end until the contact pressure to close the contacts is 35 to 40 grams, as measured at the shank of each of the movable silver contacts, using a Western Electric Company No. 70G relay gauge or equivalent. Keep the movable contact arms straight. Rotate the relay shaft to its central

6-3 a. (4) (Continued)

position. The double pawl and ratchet wheel assembly should now appear symmetrically placed in the relay housing, the two pawls being equi-distant from the ratchet wheel. If this is not the case, bend the channel shaped strip attached to the pawl rocking bar, at the angles of bend. The tips only of this strip should touch the contact arms, and when one tip is touching, the other one should clear its adjacent contact arm by 0.002 to 0.020 inch. The pawl positions are determined by these angles of bend. In addition, the angles of bend must be such as to allow the movable contact arms to press against the ends of the bakelite block adjacent to the contacts. The distance between the engaging surfaces of each pawl and the adjacent ratchet tooth should be the same. If not, loosen the two Allen set screws on the ratchet hub, turn the hub to equalize the spaces and retighten the screws.

If further adjustment is necessary, the relay should be separately tested. Connect a battery supply to the terminals BR and BK. The polarity is not important. The battery voltage for no load operation should be between 8 and 12 volts, and for operation on a mechanical load equivalent to that produced by the band change switch should be between 10 and 14 volts. The relay shaft should be in its central position. To cause the relay to operate connect terminal BR to either terminal BL or terminal Y. This completes a circuit through one of the pawl control magnet coils and the relay switch wafer contacts.

Should the movable mechanism not spring back but remain down, either stationary or chattering, power should be disconected and the following adjustments made:

Re-inspect contact and pawl adjustments as already explained. If the silver contacts remain closed with the movable mechanism down and stationary, loosen the lock nuts on the bottom of the solenoids and turn each adjusting screw one-quarter to one-half turn to the left or out. Tighten the lock nuts and test the relay again. These adjusting screws control the plunger travel and therefore the pawl movement as the pawl rocking bar strikes the block and causes the silver contacts to break the circuit.

If the movable mechanism remains down and chatters, it will be found that the movement occurs mostly on one side. Turn the solenoid adjusting screw on that side, one-quarter turn out, as explained in the previous paragraph. Then retest. If similar chattering still occurs, make a solenoid screw adjustment on the other side of the relay, turning the screw in (clockwise) and again retest. The proper adjustment of these two solenoid screws should give correct relay operation.

Should the above adjustments fail to remedy the trouble, loosen the locknuts on the bottom of the solenoid coils and unscrew the two adjusting screws several turns. Then press down one plunger to its lowest limit and turn in the adjusting screw on that side until the plunger is pushed out one-half a screw turn from its lowest position. Tighten the locknut and proceed to make a similar adjustment on the other solenoid. This should reset the solenoid plungers for correct operation.

(5) Removal of Band Change Wafer Switch Sections.—Disconnect the band change switch shaft as explained in 6-3 a. (4), first paragraph. The shaft may now be pulled entirely clear of the chassis through the hole provided in the rear panel. The placement and forming of the wires should be carefully noted before unsoldering the switch wafer which is held in place by two supporting screws and spacers to the shield. In replacing a switch wafer, make sure that the rotors of all wafers are placed alike as it is possible to reverse any wafer and still pass the shaft through the wafers. The rotatable member of each wafer is marked with a cutout and this should appear in the same relative position on the replaced wafer as on the other units. After replacing switch wafers, see that the shaft and coupling work freely and without binding, after connection to RE1.

b. **Radio Control Box BC-311-A**

(1) Removal of Dial Mechanism.—This mechanism may be removed for servicing or replacement of the dial scale as follows:

Withdraw the right angle coupling for Tuning Shaft MC-124 after removing the safety wire and the three holding screws.

Remove the dial window housing after unscrewing the four screws holding the frame to the panel and unsoldering the connections to the dial lamp socket.

Remove the tuning crank and unscrew all screws holding the dial mechanism to the panel.

6-3 b. (1) (Continued)

Turn the panel over and remove the screw holding the mask drive arm to the band change switch.

The terminal board mounted on the rear of the gear mechanism should be raised after removing the four holding screws, and bent back so that the gear mechanism may be lifted out.

The screws holding the band change switch wafer should be loosened as this wafer interferes with the removal of the dial mechanism which may now be lifted clear of the control box.

(2) Replacement of Dial Scale.—Should it become necessary to replace the dial scale, proceed as follows:

Remove the upper and lower shields and lift out the mask assembly and shutter guides.

Loosen the nut locking the stop and turn the scale to the extreme high frequency end exposing the slot into which the end of the scale is secured. Lift out the scale and unwind from the other spool by turning the gearing until the slot in the spool is exposed. Remove the scale.

Dial scales are formed at each end to fit the slot in the spools and in assembly the inside corner of the scale should be flat against the outside of the spools. First assemble the scale onto the drive spool (one furthest from stop) with the edges of the scale overhanging the ends of spool equally and assemble free end (low frequency end) in the tension spool slot, pulling the tape flat across the gap between spools. Before placing the scale in the tension spool slot, the tension spool should be wound so that the full tension of the spring will keep the scale taut.

The mask, guides, and shields should now be assembled. Turn the scale to the stop appearing on all bands and adjust the stop mechanism to operate at this point. Turn the crank shaft 29¾ revolutions and adjust the stop to operate at the stop mark at the other end of the scale and securely tighten the stop locking nut.

Re-assemble the gear mechanism on the control box panel in the reverse order as explained under paragraph 6-3 b. (1).

c. **Loop Mounting GS-8-A Disassembly.**—Remove the handwheel after loosening the two set screws opposite the round holes. The adjustable click and clutch mechanism in the top of the handwheel is now exposed for servicing.

Loosen the nut that secures the outer tubing to the lower housing and back out the locating set screw below the nut. The lower housing may now be removed from the outer tube and the vernier drive and other parts in the housing are exposed for servicing.

Remove the collector ring covers and the six screws holding the bearing cover to the collector ring housing. Carefully lift the brushes over the collector rings as the entire rotating assembly and ballbearing are withdrawn from the mounting and outer tube.

Remove the drive tube from the collector ring assembly and from the bottom arbor by taking out one bolt and two screws.

Unscrew the outer tubing from the collector ring housing after removing the locking screw.

6-4 TROUBLE LOCATION AND REMEDY

a. **General.**—This equipment has been carefully adjusted and aligned by the manufacturer before shipment and is designed to maintain these adjustments over long periods of time. Major adjustments and repairs must be made only where the necessary tools and measuring instruments are available.

Before changing adjustments of any of the circuits, it must be ascertained that the difficul[ty] being experienced is not the result of normal deteriorating influences, such as worn out vacu[um] tubes, blown fuses, improper operating voltages, broken cords, external noises, etc. It is a[lso] recommended that any questionable performance characteristics be actually measured before a[nd] after adjustment or repairs. Make repairs in the radio compass unit only as a last resort a[nd] after it has been definitely determined that the trouble exists in the unit.

In order to expedite the locating of troubles, the procedure indicated graphically in Figure should be followed, and the special precautions applying to particular portions of the circ[uit] should be carefully observed.

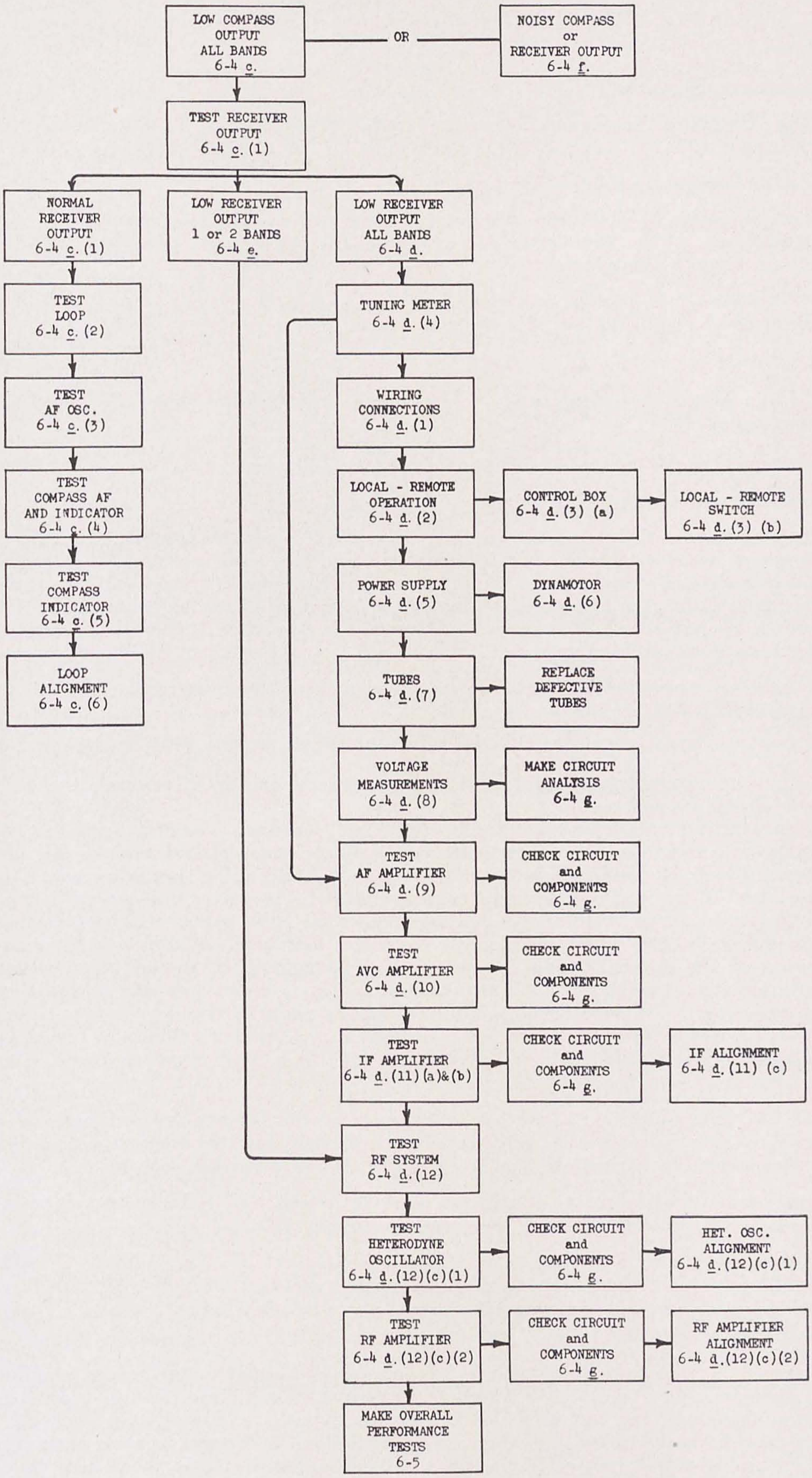


Figure 22—Trouble Location and Remedy Chart

6-4 Continued

b. Equipment Required

(1) Test Oscillator or Signal Generator—range 100-2,000 kc, modulated 30%, 400 cycles, with provision for calibration accuracy of 0.1% at aligning frequencies.

(2) Audio Oscillator—100-4,000 kc.

(3) Test Set I-56-A—This set contains all necessary meters required for normal circuit test procedure. If the test set is not available, the instruments (4), (5), (6) and (7) may be used for making tests.

(4) Voltmeter—1,000 ohms per volt.
Ranges—0-10, 0-100, 0-250 volts.

(5) Continuity Tester.

(6) Output Meter—Rectifier type, 4,000 ohms, with voltage ranges 0-1.5, 0-6, 0-15, 0-60 approximately.

(7) Vacuum Tube Voltmeter—GR type 726-A or equivalent.

c. Low Compass Output—All Bands

(1) Normal Receiver Output.—If compass operation is unsatisfactory, it should first be determined whether the trouble is associated with the receiver circuits or compass circuits. An experienced operator can check the receiver operation by noting if normal noise level is obtained and that normal signal outputs and tuning meter indications are obtained from known transmitters. If receiver performance is doubtful, it may be definitely checked by the tests outlined in section 6-5.

If receiver operation is found defective as well as compass operation, the procedure of paragraph 6-4 d. should be followed.

If receiver operation is normal, the procedure of paragraph 6-4 c. (2) should be followed.

(2) Loop.—If no bearings are obtained and receiver operation is normal, the following loop tests should be made:
With compass output switch turned on at Local position, tune in a signal, remove antenna, rotate loop and listen for a tone which will indicate audio modulation of the carrier. If no tone is obtained, the loop connections, loop tubes and audio oscillator tube should be first checked. If no faults are found, measure the audio oscillator voltages with a vacuum tube voltmeter or an a-c rectifier type output meter (the latter meter readings are not exact and will be lower than VTM readings). If correct oscillator voltages and loop continuity are indicated the setting of the Loop Gain adjustment R31 should be checked. The adjustment should be at a point about one-fifth of the distance from the extreme counterclockwise position. All loop, tube, plate and screen resistors should then be checked. With PL-120 removed from loop socket a resistance measurement between Terminals V and Z of loop socket should indicate an open circuit. A closed circuit indicates a short circuit in trimming or tuning capacitors.

(3) A-F Oscillator Test.—The a-f oscillator is set at the factory for a frequency of 109 ±2 cycles. The coil and core assemblies are adjusted for this frequency and faults located in this assembly necessitate the replacement of the defective part or unit.

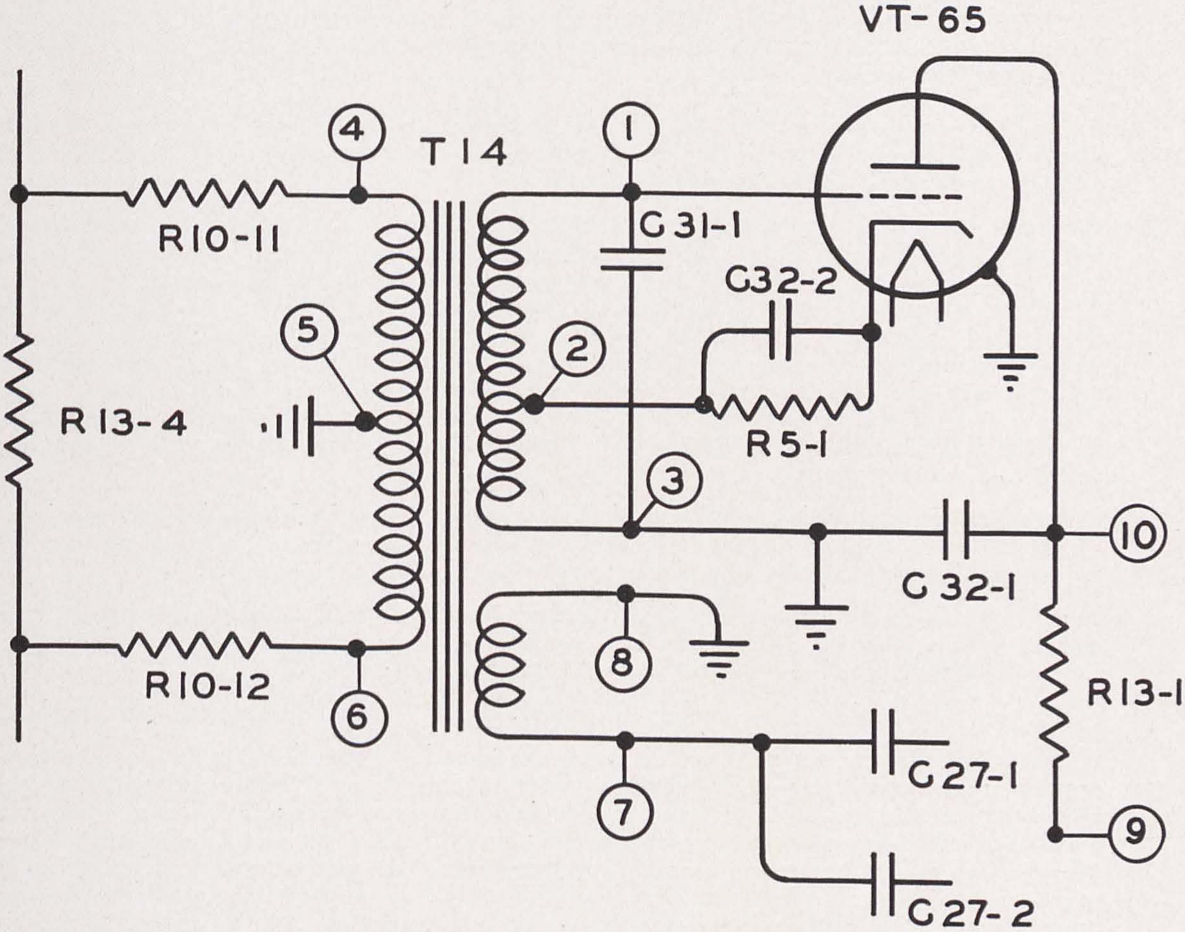
A vacuum tube voltmeter should be used to check the voltages developed by the a-f oscillator, in accordance with the table in Figure 23.

Winding 4, 5 and 6 is used to modulate the grids of the loop tubes. Winding 7 and 8 supplies the field excitation of the Compass Indicators I-65-A. If a VT voltmeter is not available, an approximate measurement can be obtained with the 665 Type 2 Analyzer or any high impedance a-c voltmeter.

(4) Compass A-F Output Test.—Place headphones or output meter across terminals 5 and 6 of filter pack F1 (see Figures 29 and 31), and check for modulating tone. If it is present at this point but not at the secondary terminals 7 and 8 of filter pack F1, check output from L pad onward for short circuit. If none is located remove L pad from output of F1 and check output of F1 for tone. Lack of tone at this point and its presence at the primary would indicate a faulty transformer and the entire filter unit should be replaced.

6-4 c. (4) (Continued)

The compass a-f output is measured by applying a 109-cycle signal between grid of first a-f tube and ground. Then open terminal 3 of F1 and connect a 1,000-ohm output meter across terminals 3 and 4. An input of 0.22 volts ±10% at first a-f grid or 1.8 volts ±10% at second a-f grid should produce an output of 100 milliwatts. Maximum out put should be 450 milliwatts.



A-F Oscillator Transformer Voltages

Terminals of T14	Volts A.C. (Test Set I-56-A)	Volts A.C. (Vacuum Tube Voltmeter)
1-3	29	47 ±15%
2-3	26	33 ±15%
4-3 or 5	2.7	3.4 ±15%
6-3 or 5	2.7	3.4 ±15%
7-3 or 8 (with both indicators connected)	4.0	4.7 ±15%

A.C. measurements using Test Set I-56-A are made with Model 665 Type 2 Analyzer on the 50-volt A.C. range.

Figure 23—Audio Oscillator Voltages

(5) Compass Indicator Test.—If the loop tubes are working normally, a tone is audible as the loop is turned from the null position with antenna removed, and the a-f oscillator voltages are normal but still no bearings are obtained, the compass indicator output circuit should be investigated.

Measure voltage across the field winding of the indicator with a vacuum tube voltmeter. This should be approximately 24 volts A.C. (indicator terminals 1-4). If no voltage is present remove Plug PL-108 and check across the leads supplying the field. The reading should be approximately 5.8 volts with field removed. The higher voltage with the field

6-4 c. (5) (Continued)

in the circuit is due to the building up of voltage due to resonance. If the field voltage is measured without the indicator attached, and drops when indicator is connected, examine meter and C27 for shorts. If the field circuit is functioning normally, the moving coil (indicator terminals 2 and 3) should be examined. Replace the antenna and measure the output at the moving coil. This will vary depending on the angular position of the loop in respect to the signal path. Full scale deflection requires approximately 1.2 volts under normal conditions. If no voltage is present, check back through the L pads, R36 and filter F1 for open circuits.

(6) Loop Alignment.—The alignment of the loop circuit should only be attempted with adequate checking equipment including a transmission line test setup. The alignment affects the sensitivity and the uniformity of response.

(a) Standard Method.—(Refer to Radio Compass SCR-242-A Alignment, paragraph 6-6.) Use the Standard Test Set-up (Figure 24) and the Standard Test Conditions of paragraph 6-5. Set sensitivity control at maximum and tune the radio compass unit to a 1,475-kc, 1,000-uv/m, 400-cycle, 30% modulated signal. Turn the loop to 15 degrees off-course and lock in position. Adjust the compass output control for approximately half-scale indictator deflection. Tune in on 800-kc, 1,000-uv/m, 400-cycle, 30% modulated signal and observe the indicator pointer deflection. Continue the procedure of tuning back and forth several times between 800 kc and 1,475 kc, each time readjusting C2 at 1,475 kc until the indicator pointer deflections obtained at 1,475 kc and 800 kc are of equal amplitudes and correct sensing.

Proceed to Band 2, using a 690-kc, 1,000-uv/m signal, and adjust C4-3 until the indicator deflection is of the same amplitude and sensing as that obtained with a 330-kc, 1,000-uv/m signal. Repeat this procedure until correct results are obtained.

Proceed to Band 1, using a 320-kc, 1,000-uv/m signal and adjust C4-2 until indicator deflection is of the same amplitude and sensing as that obtained with a 155-kc, 1,000-uv/m signal. Repeat this procedure until correct results are obtained.

After the above alignment, make an overall check in accordance with paragraph 6-5 c.

If the sensitivity is low on Band 1 or 2, the coils L3-1 and L3-2 may be defective and require replacement or readjustment. In that case it may be necessary to adjust the inductance of the coils. For Band 2 this is done as follows: Tune the equipment to a 330-kc, 1,000-uv/m signal, adjust the iron cores of coils L3-1 and L3-2 (located beneath the chassis) and observe the indicator-pointer deflection and sensing. Then tune equipment to a 690-kc, 1,000-uv/m signal and adjust C4-3. Repeat this procedure until maximum sensitivity is obtained and the indicator deflections at 690 kc and 330 kc are of equal amplitudes and correct sensing.

For Band 1, tune the equipment to a 155-kc, 1,000-uv/m signal, adjust the iron cores of coils L3-1 and L3-2 (located on top of the chassis) and observe the indicator-pointer deflection and sensing. Then tune the equipment to a 320-kc, 1,000-uv/m signal, and adjust C4-2. Repeat this procedure until maximum sensitivity is obtained and the indicator deflection at 320 kc and 155 kc are of equal amplitude and correct sensing.

It is important that all condenser adjustments be made at the high frequency end of the band and all coil adjustments at the low frequency end of the band. When adjusting the coils, turn each core screw in or out approximately the same number of turns until the indicator produces maximum deflection. Always start the adjustment by decreasing the inductance of the loop load coils (counterclockwise rotation of adjusting screws). *DO NOT DISTURB THE COIL ADJUSTMENTS UNTIL IT HAS BEEN DEFINITELY ESTABLISHED THAT THE COILS ARE AT FAULT.* After the above alignment, make an overall check in accordance with paragraph 6-5 c.

It should be noted that, in making either a capacitor or inductance setting, the correct approach to the final setting should be made from the high frequency or minimum settings. This is important because it is possible to obtain the same compass sensitivity at two settings. For example, a given setting with the trimmer adjusted to an initial value may give full scale indicator deflections under standard test conditions (1,000 microvolts per meter at 800 kc). Then increasing the capacitance of the trimmer may give improved compass sensitivity until a point is reached where further increase results in a decrease of sensitivity to the original desired value. This last setting might cause errors at other dial settings and should not be used.

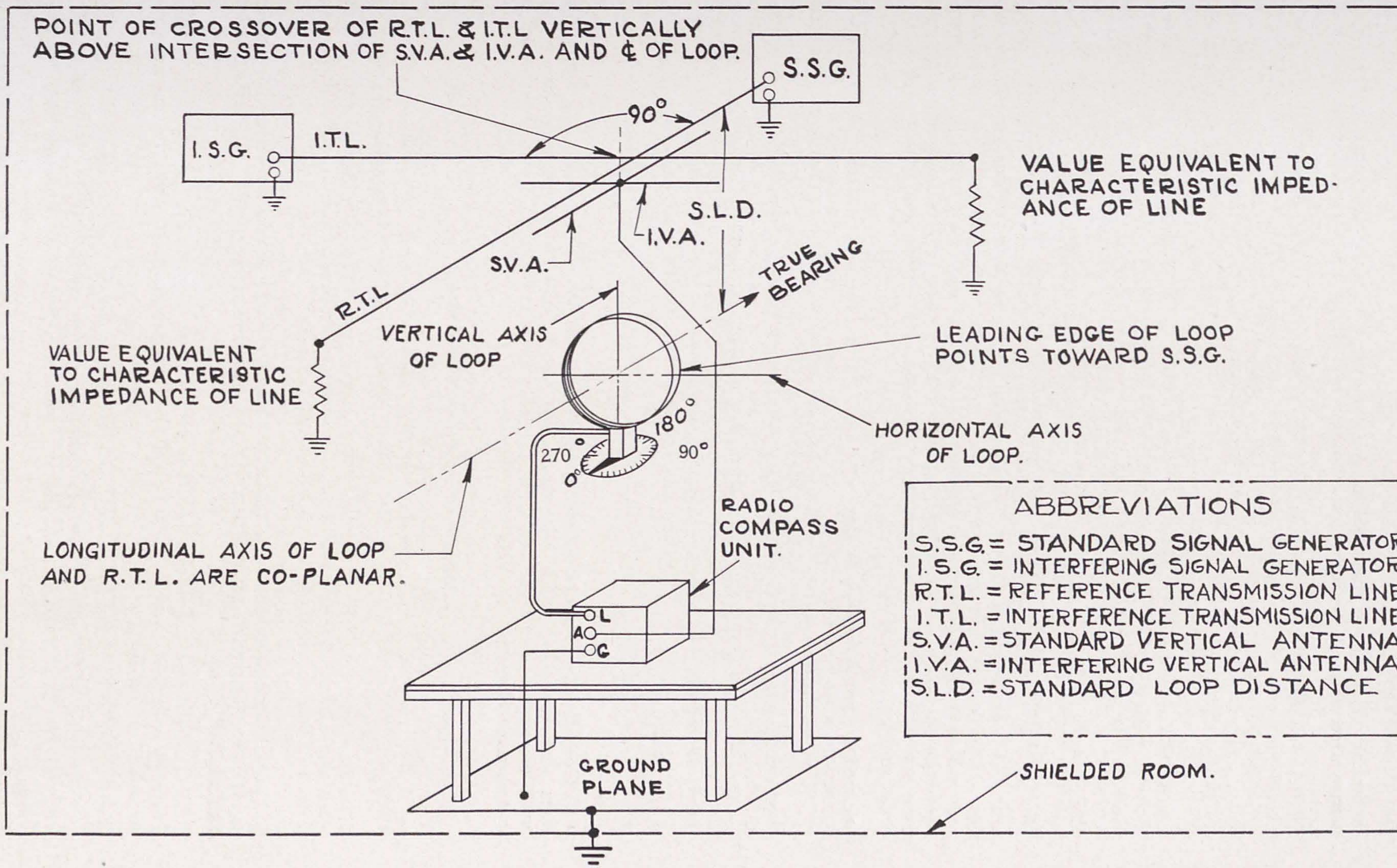


Figure 24—Standard Test Set-up for Radio Compass

6-4 c. (6) (Continued)

(b) Emergency Method.—Should it become necessary to align the loop in the field the procedure should be as follows:

Tune in a station at a frequency between 1,470 and 1,500 kc. Remove chassis from cabinet and stand it on its side. Remove antenna, turn loop to position for maximum signal and reduce sensitivity control until tuning meter reads approximately 2 scale divisions. Using Alignment Tool TL-138-A, turn trimmer C2 in both directions and note which causes an increase in tuning meter reading. Continue to turn in the direction of increased meter reading until tuning meter reads maximum. Next reduce sensitivity control until tuning meter again reads 2 divisions. Now turn back trimmer C2 toward the minimum capacity position until the tuning meter drops to a reading of 1½ scale divisions.
Turn to Band 2 and tune in a station within approximately 30 kc of the highest tunable frequency. Repeat trimmer adjustments, using C4-3 trimmer.

Follow the same procedure on Band 1 using C4-2 trimmer.

Replace antenna and check L & R position of stations.

IMPORTANT NOTE:—*The loop must always be tuned to a frequency higher than resonance. That is, the trimmers must be set for a lower capacity value than the maximum signal response obtainable without the antenna. If the trimmer is set to the low frequency side of resonance (higher value of capacity) bearings will be reversed over a portion of the band, will drop to zero over a lower frequency position, and will finally be correct at the low end only of the band.*

d. **Lower Receiver Output—All Bands**

(1) Cable Connections.—If both signal and noise output is low or absent, an inspection should be made of all external cable connections (see Figure 28), including antenna connections, power supply connections, fuses in junction box, and headphone connections.

(2) Local-Remote Operation.—The operation should be tested with the Local-Remote switch thrown to each of its positions in turn. Both local and remote output circuits are normally in operation independent of the setting of the Local-Remote switch. If trouble is experienced with the Local-Remote switch in Remote position only, the control box should be tested with particular regard to sensitivity control and power supply circuits. Be sure that the remote band switch, sensitivity control and audio level control are properly operated.

(3) (a) Control Box.—Remove control box from mounting, shunt terminals 1 and 2 in control box connector block with 125 ohms and test voltages at terminal board, in accordance with the following table: Set Local-Remote switch to Local, Local Sensitivity control to maximum, Compass to Off.

Control Box Terminal Voltages

Terminals	Voltages
1-ground	225
2-ground	220 (DO NOT GROUND THIS TERMINAL. USE 250-VOLT SCALE, OR Rx1,000-OHM SCALE, OF ANALYZER)
17-20	14

If these voltages are correct, the control box circuits should be tested for continuity and resistance. The tuning meter is a 1.5 D.C. milliammeter, *DO NOT APPLY VOLTAGE DIRECT.*

(b) Local-Remote Switch.—If the control box circuits are correct and trouble is still present with the Local-Remote switch in Remote position, test the connections to this switch.

(4) Tuning Meter.—If receiver output is low or absent, in certain cases the trouble may be localized by observing the tuning meter operation. If the tuning meter operates normally and the output is low, the trouble may be localized in the AVC, second detector or audio circuits.

(5) Power Supply.—Failure of the primary power supply circuit may be detected by instrument lamp operation. The primary voltage should be checked at the main feeders from

6-4 d. (5) (Continued)

the battery, at the junction box, and at the receiver. Normal voltages with equipment interconnected and sensitivity control ON are as follows:

Terminals	Local-Remote Switch Setting	
	Local	Remote
Primary Power Supply	14.25 V.	14.25 V.
Junction Box		
Plug PL-113 U&S to R&T	14	14
Plug PL-111 F-R	14	14
E-Q	14	13.5
Plug PL-110 F-R	14	14
E-Q	14	13.5

(6) Dynamotor.—Test dynamotor terminal voltages in accordance with Figure 25, using voltmeter of Model 665 Type 2 Analyzer or equivalent. The voltage range to be used is in all cases the lowest range which includes the indicated voltage.

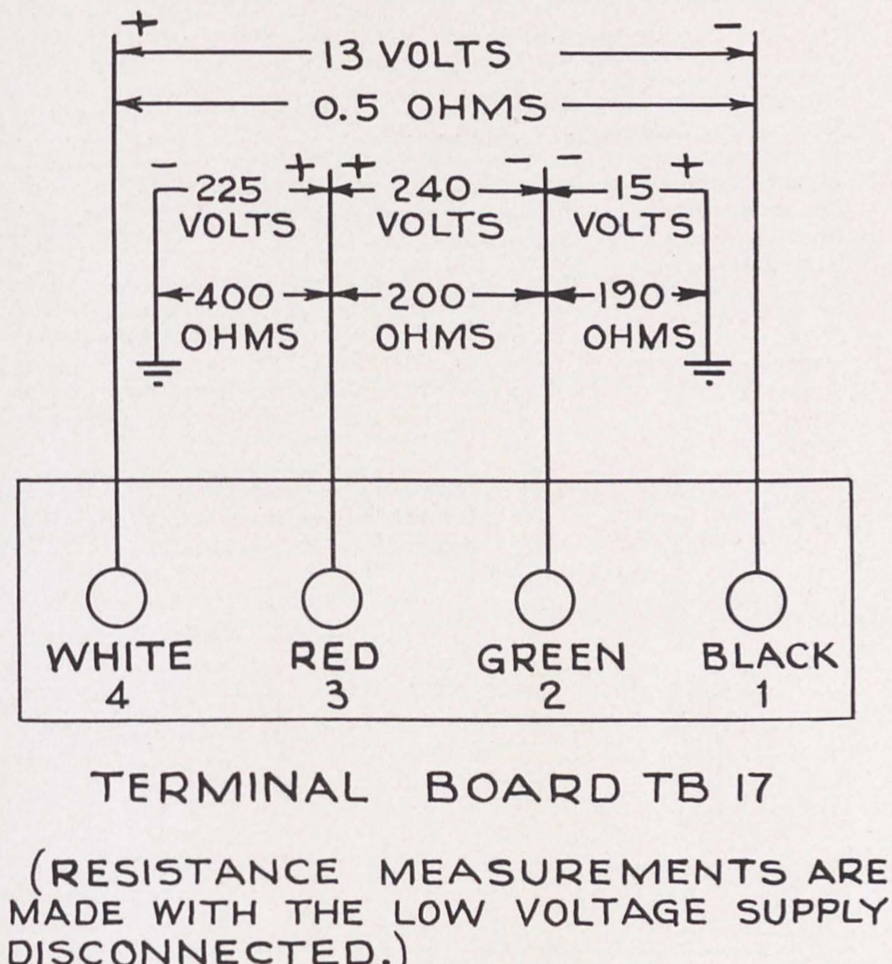


Figure 25—Dynamotor Voltages

The above values apply for 14-volt supply, Local-Remote switch on Local on. Sensitivity control at maximum, and Compass off.

If proper dynamotor secondary voltages are not obtained with the specified primary voltage, test the filter and receiver circuits for opens and grounds, also inspect dynamotor (see paragraph 6-3 a. (1)).

6-4 d. (Continued)

(7) Tubes.—Test the tubes for emission and other characteristics or replace all tubes with tubes having characteristics within standard limits. (See paragraph 2-11.)

(8) Voltage Measurements.—Voltages given in the following tables apply for the following conditions. If values do not check within ± 10% of those given, the associated circuits and components should be tested. The measurements should be made with Model 665 Type 2 Analyzer using the following scales:

For plate, screen and dynamotor secondary voltages use 250-volt scale; for cathode voltages use 50-volt scale.

Supply voltage—14.25 volts at battery end of 10-foot battery cable.
Local-Remote switch at Local.

All tubes in sockets.

Sensitivity control Maximum.

Compass Off—except for compass tube and a-f oscillator measurements.

(a) Overall Voltage Measurements. (See Figure 26.)

Measurement Points	Voltage
Supply	14.25
Primary choke drop L4 or L5	0.16
Dynamotor Primary	13.0
Dynamotor Secondary (see pagraph 6-4 d. (6))	240
Dynamotor (+) to ground	225
Secondary choke drop F2—terminals 1-2	7.5
Secondary choke drop F2—terminals 2-3	7.5
Secondary choke drop F2—terminals 1-3	15
Bleeder circuit (see Figure 26)—	
terminal 1—ground	225
terminal 2—ground	150
terminal 3—ground	90
terminal 4—ground	43
terminal 5—ground	39
terminal 6—ground	22
terminal 7—ground	22 Sens. Min.
terminal 7—ground	0 Sens. Max.
terminal 4—5	4

(b) Tube Socket Voltages

Stage	Tube	Heater	Plate to Ground	Screen to Ground	Cathode to Ground
Modulator tube (1)	VT-91	6.5	60*	125	10*
Modulator tube (2)	VT-91	6.5	60*	125	10*
A-F Oscillator	VT-65	6.5	100	—	9.0
1st R-F	VT-86	6.5	210	75	4.0
2nd R-F	VT-86	6.5	210	75	4.0 (22 Sens. Min.)
Het. Osc.	VT-65	6.5	165†	—	0
1st Det.	VT-87	6.5	220	65	3.5
1st I-F	VT-86	6.5	210	115	3.0
2nd I-F	VT-86	6.5	190	150	4.5
AVC Amp.	VT-86	6.5	210	125	13
2nd Detector	VT-90	6.5	—	—	27
N.S. Amp.	VT-92	6.5	220‡	—	43
1st A-F	VT-91	6.5	75	80	45
Headset Output	VT-86	6.5	210	225	0
Indicator Output	VT-91	6.5	220	225	0

* Reading depends on Loop Gain setting.
† Reading with tube oscillating. If oscillation is stopped reading is 115.
‡ *DO NOT GROUND THIS TERMINAL. USE 250-VOLT SCALE OF ANALYZER.*

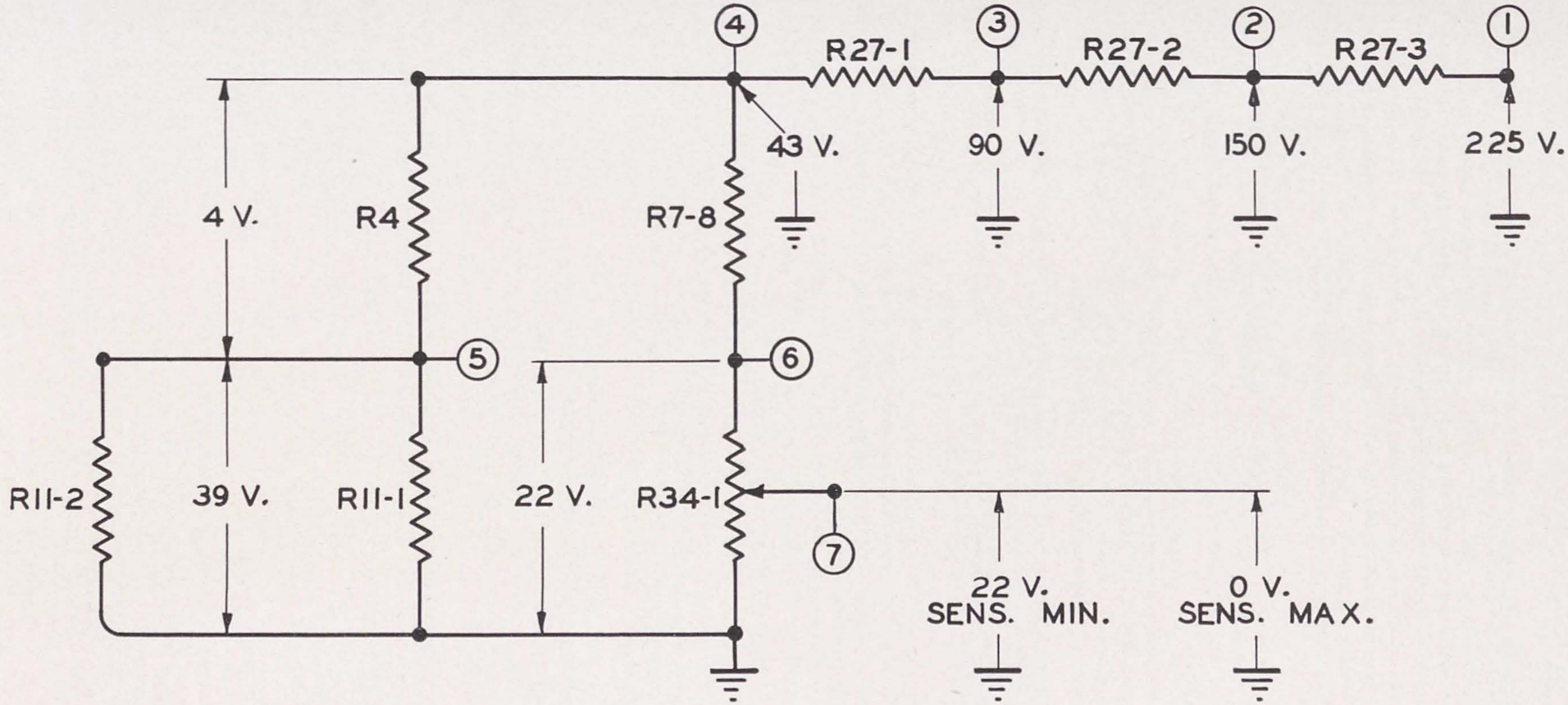


Figure 26—Bleeder Circuit Voltages

6-4 d. (Continued)

(9) A-F Amplifier Circuit

(a) Operation of the a-f amplifier may be tested by applying 400-cycle audio input to the grids of the 1st a-f and output tubes and measuring the input for 50 mw output. Remove lead connected to terminal 7 of F1, Figure 31, and connect 4,000-ohm load or 4,000-ohm output meter from terminal 7 to ground. Connect the low side of the output of an a-f oscillator to receiver chassis and couple high side, through a 0.5 mfd capacitor (approximately), to grid of 1st a-f or output tube. The normal input voltages required to produce 50 mw output at 400 cycles are as follows:

Input to 1st a-f . . . . 0.063 volt
Input to output stage 1.25 volt

Maximum audio output (with increased input) should be approximately 800 milliwatts.

The audio system in this equipment has a peaked characteristic. As the frequency of the input to 1st a-f is increased, the output should increase to a maximum of approximately 9 db above the output for 400-cycle input, the maximum point occurring at approximately 2,500 cycles.

Failure of the peaked characteristic indicates a defective audio tuning reactor, L6, or a defect in the associated circuit.

Failure of overload characteristic is usually due to trouble in tubes, tube voltages, coupling circuits, or circuit elements.

(b) A-F Amplifier Circuit Test.—The tests outlined in the preceding paragraph should indicate the position of the circuit at fault. A systematic check of all circuit elements of the faulty portion should be made by means of voltage, resistance, and continuity measurements.

(10) AVC Amplifier Circuit

(a) The AVC amplifier affects the audio and compass outputs by its automatic adjustment of overall receiver gain, dependent on the input signal strength. Thus, for a given input, the audio output will be decreased if the AVC amplifier gain increases, or increased if the AVC amplifier gain decreases. A condition of low output may be caused by a defective AVC amplifier and this circuit should, therefore, be checked before proceeding with i-f or r-f circuit adjustments.

To test the AVC circuit, operate the receiver under conditions specified for r-f alignment sensitivity measurements. (See paragraph 6-4 d. (12) (c) (2).) Apply the Band 2H alignment frequency and tune receiver to resonance, with sensitivity control at maximum. Adjust input to produce approximately 100 milliwatts output. For inputs lower than this value, the output should decrease approximately in proportion to the input.

For inputs greater than this value the output should increase gradually to approximately 400 milliwatts, as the input is increased to 0.5 volts.

(b) AVC Amplifier Circuit Test.—For AVC amplifier alignment, refer to paragraph 6-4 d. (11) (c) (3). If the AVC circuit is found to be causing trouble the voltages and circuit components associated with Tube VT-86 (AVC amplifier) and Tube VT-92 (N.S. amplifier) should be tested.

(11) I-F Amplifier Circuit

(a) General.—Remove chassis from cabinet.

Connect Plug PL-110 and set up radio compass unit in accordance with Radio Compass SCR-242-A Typical Conduit Wiring Diagram, Figure 28, except that a Test Box BX-18-A is used instead of the control box back. Plugs PL-120 and PL-108 may be disconnected from front panel. Set radio compass unit controls as follows: Local-Remote switch at Local, Compass Off, Sensitivity maximum. Use standard output (meter) load (see paragraph 6-5 a.).

(b) Test for Normal Operation.—Apply 112.5 kc, 400-cycle 30% modulated signal from grids of the i-f amplifier tubes to ground. A blocking capacitor of 0.1 mfd

6-4 d. (11) (b) (Continued)

capacity or larger should be used in series with the grid connection to protect the attenuator of the signal generator.

The normal inputs required for 50 milliwatts output (14.1 volts) at a frequency of 112.5 volts kc ±0.1%, are as follows:

Input to:	Input microvolts
2nd I-F grid	330,000
1st I-F grid	5,000
1st Detector grid	160

The above tests will indicate the portion of the circuit which is at fault. The faulty portion of the circuit should be thoroughly tested by making voltage, resistance and continuity tests.

(c) I-F Amplifier Alignment.—The circuit elements are designed to maintain alignment over long periods of time and should seldom require readjustment. Should readjustment become necessary due to replacement of tuned circuit components, etc., the procedure should be as follows: (See Alignment Chart, paragraph 6-6, and Figure 27.)

(1) 3rd I-F Transformer Adjustment.—Using conditions of test as outlined in paragraph 6-4 d. (11) (a) and (b), apply input to 2nd i-f grid. Tune 3rd i-f transformer (T12) for maximum audio output by adjusting screws at top and bottom of transformer assembly. During alignment, maintain output at 50 milliwatts approximately.

(2) Noise Suppressor (N.S.) Adjustment.—Remove Tube VT-92 from its socket. With normal input to 2nd i-f grid (330,000 microvolts) adjust R33 for minimum output (0.02 milliwatt approximately). Replace Tube VT-92.

(3) AVC Tuning Transformer Adjustment.—With normal input (330,000 microvols) applied to 2nd i-f grid, adjust screws at top and bottom of AVC tuning transformer T13 for maximum deflection of tuning meter. This deflection for the normal input specified should be approximately 1 division.

If the desired deflection cannot be obtained in this manner, it may be necessary to make a slight change in the position of the short circuiting ring between the primary and secondary of T13. This is done by melting the wax and prying the free side of the ring with a screwdriver.

(4) 2nd I-F Transformer Adjustment.—Apply 5,000 microvolts to grid of 1st i-f amplifier tube and adjust screws at top and bottom of 2nd i-f transformer, T11, for maximum audio output.

(5) 1st I-F Transformer Adjustment.—Apply 160 microvolts to grid of 1st detector and adjust screws at top and bottom of 1st i-f transformer T10 for maximum audio output.

(6) Selectivity Test.—The accuracy of alignment should be checked by measurement of the selectivity characteristic. This is done by application of input to the grid of the first detector and adjustment of input to produce 50 milliwatts output at resonance. The input should then be increased in the ratios indicated below and the band widths in kilocycles for 50 mw output measured for the various inputs.

I-F Overall Selectivity

Ratio	Band Width kc
2	3.6 to 2.8
10	6.4 to 5.4
100	10.4 to 9
1,000	15.4 to 14

The alignment should be rechecked until the band widths fall within the stated limits. If the band widths are too narrow, the adjustments of T10 and T11 should be staggered. This is accomplished by turning the bottom adjustments of T10 and T11 to the right and the top adjustments to the left, one at a time, in such a manner that the output is decreased by the same percentage (approximately 10%) for each adjustment.

6-4 d. (Continued)

(12) R-F Amplifier and Heterodyne Oscillator Circuit Tests

(a) General.—Perform the 6-4 d. (11) (a) procedure.

(b) Test for Normal Operation.—Apply 400-cycle 30% modulated signal at the frequencies listed in paragraph 6-4 d. (12) (c) (1) and tune receiver to resonance. Adjust input until 50 mw output is obtained.

The normal inputs at each stage of the r-f system are as follows:

	Microvolts					
	Band 1		Band 2		Band 3	
	"L"	"H"	"L"	"H"	"L"	"H"
Ant.*	5	2.3	2.3	1.4	2.2	3.1
1st r-f	13	12	10.8	10.1	13	24
2nd r-f	45	39	47	50	21	49
1st det.	215	205	233	225	235	220

* Use a 100 mmfd condenser in series with signal generator to antenna terminal.

Low sensitivity of any portion of the circuit will be indicated by a high input requirement at the preceding stage.

When the defective portion of the circuit is ascertained by the above tests the circuits may be investigated by voltage, resistance, and continuity measurements.

CAUTION.—The rigid bus wiring in the r-f and heterodyne oscillator circuits is somewhat critical as to position. In testing or replacement of r-f components the wiring should not be disarranged any more than is required, in order to avoid unnecessary realignment.

(c) R-F Amplifier and Heterodyne Oscillator Alignment.—This equipment is designed to maintain accurate alignment over long periods of time and should seldom require realignment unless it has been necessary to replace tuned circuit components. Complete alignment procedure is given below, but in many cases alignment of only those portions of the circuit which have been repaired will be required. In all cases complete overall tests (see section 6-5) should be made to insure that the readjustments have been accurately made. The alignment procedure is as follows (see Alignment Chart, paragraph 6-6 and Figure 27):

(1) Heterodyne Oscillator Tests and Alignment.—The heterodyne oscillator may be tested for oscillation by grounding the grid and noting the decrease in noise level at the receiver output. Oscillation may be more definitely tested by measurement of oscillator plate supply voltage at the common terminals of T7, T8 and T9 as shown in Figures 29 and 31.

The voltage should be 107 volts non-oscillating and 165 volts oscillating. Alignment of the oscillator is most readily checked by testing the calibration. For this test a frequency source with accuracy of about ±0.1% is required. The procedure is:

Follow test conditions outlined in paragraph 6-4 d. (12) (a) and (b).

Apply signal to grid of 1st detector, tune radio compass unit to resonance. Note that when signal is applied to 1st detector grid, several responses are obtained at different settings of the tuning control. Unless the circuit is badly out of line, the correct response will be found near the correct calibration mark. Note calibration error at the three test points in each band, L, M and H, and calculate the average error.

The average errors should not be in excess of the following:

Band	Average Error Kilocycles
1	1.9
2	3.4
3	9.4

If the calibration is appreciably in error, the oscillator should be realigned. The procedure for alignment of any one band is as follows:

6-4 d. (12) (c) (1) (Continued)

Use test conditions outlined in paragraph 6-4 d. (12) (a) and (b). Keep input adjusted to the value which produces approximately 50 milliwatts output.

Apply the H test frequency (see following table) to the 1st detector grid and turn the radio compass unit dial to the corresponding dial reading. Adjust the trimmer indicated in the table below for maximum output.

Apply the L test frequency and turn the radio compass unit dial to the corresponding dial reading and adjust the indicated trimmer for maximum output.

Apply the M test frequency and check calibration. If calibration at this point is appreciably in error, adjust the inductance screw, at bottom of the indicated transformer, for maximum output. This adjustment is permanently set at the factory and should seldom need alteration in the field.

Repeat the above H, L and M procedures until calibration checks at all three points.

Oscillator Alignment Table

Band	Test Point	Frequency	Tune Adjustment for Max. Output
1	L	155	C3-5
	M	240	T7 (bottom)
	H	320	C3-4
2	L	330	C4-1
	M	510	T8 (bottom)
	H	690	C3-9
3	L	720	C5
	M	1,100	T9 (bottom)
	H	1,460	C3-13

(2) R-F Amplifier Tests and Alignment.—The test outlined in paragraphs 6-4 d. (12) (a) and (b) will indicate major troubles in the r-f amplifier. For r-f alignment of each band, the following procedure applies (see Alignment Chart, paragraph 6-6, and Figures 22 and 27).

Use test conditions outlined in paragraph 6-4 d. (12) (a) and (b) except that the sensitivity control should be retarded if the antenna input for 50 milliwatts output falls below 3 microvolts.

Keep input adjusted to the value which produces approximately 50 mw output. Apply H test frequency (see table below) to grid of the 2nd r-f tube. Tune compass unit to resonance. Adjust the trimmer indicated in the table for maximum output. Retune to resonance and readjust trimmer until the maximum output is obtained.

Apply H test frequency to the grid of the 1st r-f tube and then to the antenna terminal in series with 100 mmfd artificial antenna and adjust the indicated trimmers (see table below) as described above.

The sensitivity should be tested, see paragraph 6-5 b. (2) or the input test of paragraph 6-4 d. (12) (b) applied.

If sensitivity is low at the low frequency ends of the bands, the inductances should be adjusted. The procedure for this adjustment is similar to that outlined for the trimmer adjustments above, except that the inductances are adjusted at the M test frequencies. After adjusting an inductance, the trimmer must be readjusted at the H test point and the process repeated, until the alignment checks at both points. These inductance adjustments are permanently set at the factory and should seldom require alteration in the field.

6-4 d. (12) (c) (2) (Continued)

			R-F Alignment Table	Tune Adjustment for Max. Output	
Band	**Test Point**	**Freq.**	**Ant.***	**1st R-F**	**2nd R-F**
1	H	320	C3-1	C3-2	C3-3
	M	240	T1 (bottom)	T3 (bottom)	T5 (bottom)
2	H	690	C3-6	C3-7	C3-8
	M	510	T1 (top)	T3 (top)	T5 (top)
3	H	1,460	C3-10	C3-11	C3-12
	M	1,100	T2	T4	T6

* Use a 100 mmfd condenser in series with signal generator to antenna terminal.

(3) Image Suppressor Adjustment.—Set compass unit dial at 1,500 kc. Apply 1,725 kc signal (image frequency) to antenna terminals through 100 mmfd capacity (artificial antenna), with input approximately 0.1 volts. Adjust spacing between plate and grid wires (blue and green) in 2nd r-f compartment for minimum output.

(4) I-F Rejection Trap Adjustment.—Apply 150 kc signal to antenna terminal through 100 mmfd capacity (artificial antenna), tune to resonance, and set sensitivity control so that 50 milliwatts output is obtained with approximately 5 microvolts input.

Change input frequency to 112.5 kc (approximately). Increase input until approximately 50 milliwatts output is obtained (requires about 1 volt input). Adjust inductance screws of wave traps L1, L2 and L12, for minimum output at 112.5 kc and lower frequencies. The second harmonic response of 75 kc should be disregarded.

(5) Maximum Noise Adjustment.—Set radio compass unit dial at 280 kc. Connect compass unit antenna terminal to ground through 100 mmfd capacitor. Set sensitivity control at maximum. Adjust R32 to obtain 10 mw (6.5 volts) noise output.

e. **Low Receiver Output on One or Two Bands Only.**—If unsatisfactory operation is experienced on only one or two bands with the remaining band or bands operating normally, the difficulty is localized in circuits associated with the band switch in r-f amplifier, or in heterodyne oscillator system. The procedure of paragraph 6-4 d. (12) should be observed with particular attention to the portions of circuits between the band switch and coils. The circuits associated with r-f and oscillator tubes, power supply and tuning capacitor are common to all bands.

If low sensitivity or dead spots should be noted covering a small portion of one band, the band switch shorting circuits should be investigated. A portion of the band switch is utilized to short out unused coils and circuits which would otherwise resonate and absorb energy at particular frequencies.

f. **Noisy Compass or Receiver Output.**—Radio Compass Unit BC-310-A is electrically a very complicated device depending on a precise and intricate correlation and adjustment of its circuits for successful operation. The following general rules must be strictly observed before proceeding to make tests or repairs on the various components of this compass unit.

(1) When checking for noisy output or intermittent noises, a process of elimination should be be followed, proceeding from the most obvious possible causes to those less likely to occur in practice. The compass unit should be checked only after it has been established that the fault cannot be found outside the compass unit.

(2) Electrical noise of local and atmospheric origin will always be present to some extent in the operation of this radio equipment in aircraft, particularly when controls are set for maximum sensitivity. The radio man can distinguish atmospheric noises and those produced by the various electrical equipments on the plane, such as the ignition system, lighting (loose lamps and noisy switches) voltage regulators, charging generators, relays and electrical switches and wiring in general. Such electrical noises can be identified by disconnecting the loop and antenna at the main panel. Location of the source will have to be determined by examining the wiring, switches and any make-break contacts associated with the equipment suspected to be at fault while monitoring the noise with headset.

6-4 f. (Continued)

(3) Dynamotor Noise.—There are two types of dynamotor noise, ripple and hash. Dynamotor ripple can be identified by listening to the receiver with Increase Sensitivity control set at minimum and Increase Audio Output set at maximum. Hash is a radio frequency form of interference and can best be detected by setting the Increase Sensitivity Control at maximum and disconnecting the antenna and loop plugs. If hash exists, it will be just as audible as before. For maintenance and repair of dynamotor, see paragraph 6-3 a. (1).

(4) Ignition and generator noises can be identified by varying the speed of the engine or engines, switching off magnetos in turn to determine which may be noisy. Generators can be checked by slowing up the engine to the point where the generator cuts out. If noise is due to generator it will cut out or become intermittent at this point. Do not operate radio compass unit in this manner for longer than necessary as the battery drain may be excessive and its voltage drop below 12 volts. Generator and voltage regulator noise is frequently a more elusive fault than ignition interference. If interference is caused by equipment within the aircraft, take the necessary action to have it eliminated.

(5) The next points to undergo inspection for probable sources of noise are the plugs and interconnecting cables, the headset cords and plugs and all bonding connections. They should be examined for clean tight connections. This is a very common, but easily remedied cause of complete interruption of service, because of the severe wear to which these items are subjected.

(6) Vacuum tube noise should be identified on ground, engine running, as a crackling or ringing sound. It will sometimes appear under sustained vibration and never be heard at all when the compass unit is jarred intermittently by hand. An intermittent contact inside a tube is sometimes the first indication that its useful life is over. Noises originating in the tubes are greatly accentuated by the presence of a strong incoming radio signal, particularly an unmodulated signal, and this may be used as a means of identifying such a noise. The faulty tube must be isolated by replacing the tubes one by one with new ones and observing when the disturbance vanishes.

(7) Intermittent contact in an internal circuit of the compass unit may be identified with the engine running or by jarring the unit by hand. Disconnecting the antenna and loop and vibrating the unit is only a partial test because noises of this character may be increased to audibility by a strong incoming signal. If the trouble is due to the compass unit, it must be removed from its cabinet and inspected internally for loose connections. Operating the compass unit at excessively high voltage tends to make it noisy during operation and to increase the residual causes of noise. Never allow the compass unit to be operated at a supply voltage greater than 14.25 volts. Operation at less than 12 volts will not damage the equipment, but the performance will be unsatisfactory.

g. **Circuit Analysis Using Test Set I-56-A**

(1) General.—Before attempting to use Test Set I-56-A, the instructions should be carefully studied in the first five paragraphs of Detailed Tests on Radio Sets, Section III of the Instruction Book for Test Set I-56-A.

(2) Cable Tests.—If poor or erratic operation of the radio compass unit is noted, a continuity check on all plugs and connecting cables should first be made in accordance with paragraph 2 of the above reference.

(3) Tube Testing.—If all cable connections seem to be in good condition, the tubes should be tested on the Model 685 tube checker in accordance with paragraph 3 of the above reference and the following chart:

Tube Type	Filament Selector	Tube Selector	"N" Position	2nd Plate
VT-86	6	40	BCDE	—
VT-91	6	40	BCDE	—
VT-65	6	40	BD	—
VT-90	6	0	B	D
VT-87	6	44	BCDE	—
VT-92	6	41	BE	—(Triode Sec.)
VT-92	6	0	C	D(Diode Sec.)

6-4 g. (Continued)

(4) Voltage, Current and Resistance Measurements.

(a) If a test on all the tubes does not clear the trouble, voltage and current measurements should be made on the radio compass unit, using the Model 665 Analyzer and the Model 666 Socket Selector Unit. Set up the analyzer and socket selector block as indicated under paragraphs 3 and 4 of Section III of the Instruction Book for Test Set I-56-A. The voltage, current and resistance values should check within 10% of those given in table 6-4 g. (4) (c), provided the following rules are observed:

Test Set I-56-A.—Place Model 666 Type 1B Socket Selector Block in pin jacks above the meter.

Keep AC-DC toggle switch on DC.

Place the other analyzer toggle switch on the "Volts-MA" position.

Connect short jumper cables from the selector block to the analyzer as indicated by chart 6-4 g. (4) (b).

Select proper meter scale, and read scale accurately.

Make all voltage measurements using the *outside* pin jacks of the selector block.

Insertion of a cable pin at the *inside* position produces an open circuit to provide for current measurements.

In general, it is more convenient to measure resistance values at the tube sockets. Resistance measurements are always made with the low voltage supply disconnected and the analyzer toggle switch in the Ohms position. Use the Rx1000 scale setting to avoid burning out the tuning meter by applying the analyzer battery voltage across it when measuring the plate to ground resistance of Tube VT-92.

Radio Compass Unit.—Set up the radio compass unit without a vertical antenna.

Use a supply voltage of 14.25 volts.

Set Local-Remote switch in Local position.

Set Increase Sensitivity control to the maximum clockwise position.

Set Increase Audio Output control to the maximum clockwise position.

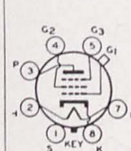
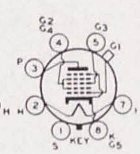
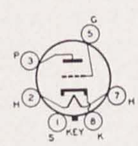
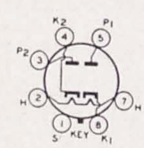
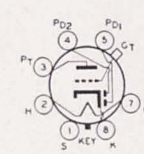
Set Increase Compass Output control to Off position, except when measuring the compass modulator or a-f oscillator tube values, at which time set to maximum clockwise position.

Set tuning control at 150 kc; readings should deviate slightly when switching to other bands.

Slightly lower voltage values will be obtained with the Local-Remote switch in the Remote position.

6-4 g. (4) (Continued)

(b) Tube Circuit Analysis Using Test Set I-56-A.

Tube Type	**VT-86, VT-87 and VT-91**		**VT-65**		**VT-90**		**VT-92**	
	Block Terminal Number	Connects to Analyzer Jacks	Block Terminal Number	Connects to Analyzer Jacks	Block Terminal Number	Connects to Analyzer Jacks	Block Terminal Number	Connects to Analyzer Jacks
Plate Voltage ..	3 Gnd.	250 V. ± V.	3 Gnd.	250 V. ± V.	— —	— —	3 Gnd.	250 V. ± V.
Plate Current ...	3 outside 3 inside	25 Ma. – Ma.	3 outside 3 inside	10 Ma. – Ma.	— —	— —	3 outside 3 inside	10 Ma. – Ma.
Screen Voltage..	4 Gnd.	250 V. ± V.	— —	— —	— —	— —	— —	— —
Screen Current ..	4 outside 4 inside	5 Ma. – Ma.	— —	— —	— —	— —	— —	— —
Cathode Voltage.	8 Gnd.	50 V. ± V.	8 Gnd.	50 V. ± V.	4 or 8 Gnd.	50 V. ± V.	8 Gnd.	50 V. ± V.
Diode Voltage ..	— —	— —	— —	— —	3 Gnd.	50 V. ± V.	4 Gnd.	50 V. ± V.
Diode Current ..	— —	— —	— —	— —	3 outside 3 inside	5 Ma. – Ma.	4 outside 4 inside	5 Ma. – Ma.
Diode Voltage ..	— —	— —	— —	— —	5 Gnd.	50 V. ± V.	5 Gnd.	50 V. ± V.
Diode Current ..	— —	— —	— —	— —	5 outside 5 inside	5 Ma. – Ma.	4 outside 4 inside	5 Ma. – Ma.
Base Diagram ..	 VT-86, VT-91	 VT-87	 VT-65		 VT-90		 VT-92	

(1) All plate and screen voltages are measured on the 250 volt scale.

(2) All cathode voltages are measured on the 50 volt scale.

(3) All current measurements are made on the lowest usable scale.

(4) Voltages on the heterodyne oscillator Tube VT-65 are about 50% lower when measured through the Test Set I-56-A block terminal than when measured at the set socket terminals. In the block terminal socket the tube is not oscillating.

6-4 g. (4) (Continued)

(c) Voltage, Current and Resistance Values Using Model 666 Type 1B Socket Selector Block.

Tube Function	Type	Plate			Screen			Heater	Control Grid	Suppressor Grid		Cathode	
		Volts	MA	Ohms	Volts	MA	Ohms	Volts	Ohms	Volts	Ohms	Volts	Ohms
Compass Modulator	VT-91	*	.35	150,000	125	.13	150,000	6.5	110,000	10.0	6,000–15,000	10.0	6,000–15,000
Compass Modulator	VT-91	*	.35	150,000	125	.13	150,000	6.5	110,000	10.0	6,000–15,000	10.0	6,000–15,000
A-F. Osc.	VT-65	100	.37	33,000	—	—	—	6.5	315	—	—	9.0	2,500
1st R-F.	VT-86	210	3.2	4,900	75	.77	24,000	6.5	1.5 meg.	4.0	650	4.0	650
2nd R-F.	VT-86	210	3.1	4,900	75	.75	24,000	6.5	1.5 meg.	4.0	650	4.0	650
Het. Osc.	VT-65	165	10.0	11,000	—	—	—	6.5	350,000	—	—	0	0
Not Oscillating		115			—	—	—			—	—		
1st Det.	VT-87	220	1.4	4,900	65	3.2	18,500	6.5	1.0 meg.	3.5	47,000 Mixer Grid	3.5	490–550
1st I-F.	VT-86	210	2.7	5,000	115	1.2	23,500	6.9	1.0 meg.	3.0	660	3.0	660
2nd I F.	VT-86	190	6.7	5,000	150	2.1	3,500	6.9	1.0 meg.	4.5	550	4.5	550
AVC Amp.	VT-86	210	1.5	5,000	125	.33	14,000	6.9	1.0 meg.	13.0	8,000	13.0	8,000
2nd Det.	VT-90		(Diode # 1 16 volts, 350,000 ohms) (Diode # 2 26 volts 130,000 ohms)					6.9	—	—	—	27.0	47,000
N.S. Tube	VT-92	220	**	(Diode #1 110,000 ohms) (Diode #2 1.0 megohm)				6.9	3,500	—	—	43.0	3,400
1st A-F.	VT-91	75	.52	75,000	80	.14	32,000	6.9	1.0 meg.	45.0	6,000	45.0	6,000
Headset Output	VT-86	210	18.0	750	225	5.0	375	6.9	0.5 meg.	0	0	0	0
Indicator Output	VT-91	220	4.0	950	225	1.2	375	6.9	0.5 meg.	0	0	0	0

* Determined by loop gain adjustment.

** Note: Do not ground this terminal, or damage to the tuning meter will result.

6-5 Overall Performance Tests

a. **Standard Test Conditions.**—For these tests Standard Test Conditions should be maintained unless otherwise stated.

Standard output load of 4,000 ohms may be obtained by either of the following two methods:

(1) Use open circuited dummy Plug PL-55 in control box jack J1-2. Use another Plug PL-55 wired to a 4,000 ohm output meter of the milliwatt or voltmeter type in front panel jack J1-1. Set both Increase Audio Output controls at maximum, Model 571 output meter in the Test Set I-56-A should be used if available.

(2) Set both Increase Audio Output controls at Off. Remove plugs from jacks J1-1 and J1-2. Plug Model 665 Type 2 analyzer (used as high impedance voltmeter) in interphone jack J2.

Signal modulated 30% at 400 cycles.

Artificial antenna 100 mmfd.

Compass Off.

Temperature 20°–30° C.

Warm up period not less than 20 minutes.

Humidity, 80% or less.

Average set of tubes.

Standard signal to noise ratio (4:1 in power).

Standard output 50 milliwatts or 14.1 volts (signal and noise).

Standard noise output (carrier on) 12.5 mw or 7.07 volts.

Low voltage supply = 14.25 volts.

b. **Overall Receiver Performance Tests**

(1) General.—If at any time the operation of the equipment is questionable, performance tests should be applied to determine the actual condition of the equipment before any major adjustments or repairs are made.
After making any major repairs or adjustments, performance should be checked to insure that the adjustments have been properly made.

(2) Sensitivity.—For sensitivity measurement apply signal to antenna terminal through artificial antenna (see Standard Test Conditions, paragraph 6-5 a.). Tune compass unit to resonance. Set input at approximately 5 microvolts. Cut off modulation leaving carrier on and set sensitivity control to obtain 12.5 milliwatts noise output. With modulation On, adjust input to obtain 50 milliwatts signal plus noise output. Repeat until both readings check. The sensitivity at any frequency between 150 and 1,500 kc should be better than 5 microvolts.

Considerable deviation from the value stated may be permitted without serious reduction in actual serviceability. Unless wide discrepancies are noted, readjustments should not be attempted.

(3) Receiver Maximum Noise.—Measurement of maximum noise provides a simple means of testing overall gain with a minimum of required measuring equipment. The procedure is to follow standard test conditions, paragraph 6-5 a., except set Sensitivity control at maximum and short the antenna terminal to ground through the standard artificial antenna (100 mmfd). Care should be taken to shield the compass unit and antenna circuit from external noise pickup. The normal noise voltages at receiver output are as follows

Band 1		Band 2		Band 3	
Freq. kc	**Noise Volts**	**Freq. kc**	**Noise Volts**	**Freq. kc**	**Noise Volts**
155	1.6	330	2.5	710	5.0
200	4.6	420	4.4	900	5.2
240	6.0	510	5.5	1,100	4.2
280	6.5	600	5.3	1,300	2.3
320	5.8	655	5.0	1,475	0.5

6-5 b. (3) (Continued)

The noise voltage will normally vary over quite wide limits, not greater than 10 volts, under different operating conditions, different tubes, etc., without appreciably affecting service performance. The noise output may be readily readjusted by means of R32. (See paragraph 6-4 d. (12) (c) (5).)

(4) Receiver AVC Action.—For measurement of AVC action, follow standard test conditions, paragraph 6-5 a. except set Senstivity control to maximum and make the measurement on Band 2 at 690 kc. The characteristic is approximately the same at all frequencies. Normal values are:

Input Microvolts	Output Volts
1	11 (5 to 15)
10	28
100	33
1,000	37
10,000	39
100,000	41
500,000	43 (35 to 55)
2,000,000	56 (50 to 70)

(5) Receiver Selectivity.—Overall selectivity measurements will indicate accuracy of alignment. Overall selectivity is affected to a greater degree by i-f alignment than by r-f alignment (see also paragraph 6-4 d. (11) (c)). For measurement of overall selectivity adjust the compass unit under standard test conditions as for sensitivity measurement, paragraph (1) above, with normal input signal and 50 milliwatts output. Increase the input in the ratios indicated below and measure the frequency above and below resonance at which 50 milliwatts output is again obtained. The difference between these two frequencies is the band width. It is important that the generator used for this test be free from frequency modulation. As an alternative the output reading may be taken in terms of i-f voltage between Tube VT-90 (second detector) cathode and ground, measured with a high impedance vacuum tube voltmeter. Normal selectivity values are as follows:

Signal Ratio	Band 1, 320 kc Band Width	Band 2, 690 kc Band Width	Band 3, 1,450 kc Band Width
10	4.8 kc	5.0 kc	5.2 kc
100	7.5	7.8	9.1
1,000	10.9	11.8	13.8
10,000	14.8	17.1	20.0

(6) Receiver Image Response.—Measurement of image response will indicate accuracy of i-f alignment. This measurement is made under standard test conditions (paragraph 6-5 a.)

The receiver is first adjusted as for sensitivity measurements (paragraph 6-5 b. (2)) and the input noted for 50 milliwatts output. The signal generator frequency is then increased by 225 kc, the input being increased and the frequency varied again slightly until peak output is obtained at this image frequency. The input is finally adjusted to obtain 50 milliwatts output. The image ratio is defined as the ratio of input at the image frequency (for 50 milliwatts output) to the input at resonance for the same output. The normal ratios should not be less than those stated below:

Band No.	Resonance Frequency kc	Image Freq. kc	Image Ratio
1	320	545	100,000
2	690	915	20,000
3	1,300	1,525	13,690

NOTE: The ratio at 1,300 kc is critically dependent upon the image suppressor adjustment, see paragraph 6-4 d. (12) (c) (3).

6-5 (Continued)

c. **Overall Compass Performance Tests**

(1) Compass Sensitivity, Uniformity and Absolute Accuracy.—Using the Standard Compass Test Set Up (Figure 24) and the Standard Test Conditions of paragraph 6-5 a. with sensitivity control at maximum tune the radio compass unit to a 800-kc, 1,000-uv/m, 400-cycle 30% modulated signal. Turn the loop to 15 degrees off-course and adjust the compass output control to give full scale indicator deflection (do not disturb this adjustment after the setting). The following table gives the nominal values and the variations to be expected in the performance of the radio compass unit, throughout 150 to 1,500 kc.

	Loop Degrees for	
Field Strength uv/m	**Full Scale Ind. Def. Left or Right**	**On-Course Accuracy**
20	25 ± 20	0 ± 1
100	15 ± 10	0 ± 1
1,000	15 ± 10	0 ± 1
100,000	15 ± 10	0 ± 1

NOTE: With the loop locked on 15 degrees from On-Course position, check at least three points in each frequency band of the radio compass unit for absence of indicator reversals.

6-6 Radio Compass SCR-242-A, Alignment

THIS PROCEDURE SHOULD ONLY BE USED TO ALIGN THAT SECTION OR SECTIONS IN WHICH MAL-ALIGNMENT IS KNOWN TO EXIST.

a. **Standard Receiver Alignment Procedure** (Refer to section 6-5).

(1) A standard signal generator (SSG) calibrated to an accuracy of $\pm$ 0.1% should be coupled to the indicated circuit through a 0.1 mfd condenser in the live side.
(2) Turn remote controls off; adjust local sensitivity and audio output controls to maximum.
(3) If no remote control box is connected shunt the local tuning meter with 125 ohms.
(4) The indicated SSG settings give the approximate values that yield 50 milliwatts audio output for 400 cycle 30% modulation.

Circuit Function	Standard Freq. KC	Signal Microvolts	Generator Applied at	Adjust for Max. Output	Remarks	Trouble Ref. Par.
I-F — 3rd I-F Trans.	112.5	330,000	2nd I-F CG	T12 (T & B)	T = Top Adj. B = Bot-	6-4 d. (11) (c) (1)
I-F — Noise Suppres.	112.5	330,000	2nd I-F CG	R33	tom Adj.	6-4 d. (11) (c) (2)
I-F — AVC Trans.	112.5	330,000	2nd I-F CG	T13 (T & B)	Adjust R33 for min. out-	6-4 d. (11) (c) (3)
I-F — 2nd I-F Trans.	112.5	5,000	1st I-F CG	T11 (T & B)	put with VT-92 removed	6-4 d. (11) (c) (4)
I-F — 1st I-F Trans.	112.5	160	1st Det. CG	T10 (T & B)		6-4 d. (11) (c) (5)
Het. Osc. — Band 1 H	320	205	1st Det. CG	C3-4	Repeat until required dial	6-4 d. (12) (c) (1)
Het. Osc. — Band 1 L	155	215	1st Det. CG	C3-5	calibration and sensitivity	6-4 d. (12) (c) (1)
Het. Osc. — Band 1 M	240	210	1st Det. CG	T7(B)**	are obtained	6-4 d. (12) (c) (1)
Het. Osc. — Band 2 H	690	225	1st Det. CG	C3-9	Repeat until required dial	6-4 d. (12) (c) (1)
Het. Osc. — Band 2 L	330	233	1st Det. CG	C4-1	calibration and sensitivity	6-4 d. (12) (c) (1)
Het. Osc. — Band 2 M	510	229	1st Det. CG	T8(B)**	are obtained	6-4 d. (12) (c) (1)
Het. Osc. — Band 3 H	1460	220	1st Det. CG	C3-13	Repeat until required dial	6-4 d. (12) (c) (1)
Het. Osc. — Band 3 L	720	235	1st Det. CG	C5	calibration and sensitivity	6-4 d. (12) (c) (1)
Het. Osc. — Band 3 M	1100	228	1st Det. CG	T9(B)**	are obtained	6-4 d. (12) (c) (1)
2nd R-F Trans. — Band 1 H	320	39	2nd R-F CG	C3-3		6-4 d. (12) (c) (2)
2nd R-F Trans. — Band 1 M	240	41	2nd R-F CG	T5(B)**		6-4 d. (12) (c) (2)
2nd R-F Trans. — Band 2 H	690	50	2nd R-F CG	C3-8		6-4 d. (12) (c) (2)
2nd R-F Trans. — Band 2 M	519	48	2nd R-F CG	T5(T)**		6-4 d. (12) (c) (2)
2nd R-F Trans. — Band 3 H	1460	49	2nd R-F CG	C3-12		6-4 d. (12) (c) (2)
2nd R-F Trans. — Band 3 M	1100	35	2nd R-F CG	T6(B)**		6-4 d. (12) (c) (2)
1st. R-F Trans. — Band 1 H	320	12	1st R-F CG	C3-2		6-4 d. (12) (c) (2)
1st. R-F Trans. — Band 1 M	240	13	1st R-F CG	T3(B)**		6-4 d. (12) (c) (2)
1st. R-F Trans. — Band 2 H	690	10	1st R-F CG	C3-7		6-4 d. (12) (c) (2)
1st. R-F Trans. — Band 2 M	510	11	1st R-F CG	T3(T)**		6-4 d. (12) (c) (2)
1st. R-F Trans. — Band 3 H	1460	24	1st R-F CG	C3-11		6-4 d. (12) (c) (2)
1st. R-F Trans. — Band 3 M	1100	18	1st R-F CG	T4(B)**		6-4 d. (12) (c) (2)
Ant. R-F Trans. — Band 1 H	320	2.3	Ant. Ter.*	C3-1		6-4 d. (12) (c) (2)
Ant. R-F Trans. — Band 1 M	240	3.5	Ant. Ter.*	T1(B)**		6-4 d. (12) (c) (2)
Ant. R-F Trans. — Band 2 H	690	1.4	Ant. Ter.*	C3-6		6-4 d. (12) (c) (2)
Ant. R-F Trans. — Band 2 M	510	2.0	Ant. Ter.*	T1(T)**		6-4 d. (12) (c) (2)
Ant. R-F Trans. — Band 3 H	1460	3.1	Ant. Ter.*	C3-10		6-4 d. (12) (c) (2)
Ant. R-F Trans. — Band 3 M	1100	2.7	Ant. Ter.*	T2(B)**		6-4 d. (12) (c) (2)
Image Suppression	1725	100,000	Ant. Ter.*	Tune set to 1500 kc. Adjust plate and grid wires in 2nd R-F compartment for minimum output		6-4 d. (12) (c) (3)
I-F Rejection (1)	150	5	Ant. Ter.*	Set sens. control for 50 mw output		6-4 d. (12) (c) (4)
I-F Rejection (2)	112.5	1 volt	Ant. Ter.*	L1, L2 & L12 Adj. for minimum output		6-4 d. (12) (c) (4)
Maximum Noise	(Tune set to 280 kc)		Gnd. Ant. thru 100 mmfd	R32	Adjust for 10 milliwatts output noise	6-4 d. (12) (c) (5)

b. **Standard Loop Alignment Procedure:**
(1) Make the Standard Compass Test Setup (see Figure 24).
(2) Turn Remote Controls off; adjust Local Sensitivity control to maximum.
(3) Rotate the loop 15 degrees from true bearing (on-course position) and lock.
(4) If no remote control box is used, shunt the local tuning meter with 125 ohms.

Circuit Function	Standard Freq. KC	Signal uv/m	Generator Applied at	Adjust for F.S.Ind. Defl.***	Remarks	Trouble Ref. Par.
Loop Sect. — Band 3 L	800	1,000	RTL	Comp. Output Control	Repeat until sensitivities are equal***	6-4 c. (6)
Loop Sect. — Band 3 H	1475	1,000	RTL	C2		
Loop Sect. — Band 2 H	690	1,000	RTL	C4-3	Repeat until sensitivities are equal***	6-4 c. (6)
Loop Sect. — Band 2 L	330	1,000	RTL	L3-1(B)** L3-2(B)**		6-4 c. (6)
Loop Sect. — Band 1 H	320	1,000	RTL	C4-2	Repeat until sensitivities are equal***	6-4 c. (6)
Loop Sect. — Band 1 L	135	1,000	RTL	L3-1(T)** L3-2(T)**		

* Through a 100 mmfd condenser connected to antenna terminal.
** Factory adjustments (purple glyptal seal) not to be altered unless absolutely necessary.
*** 1. In loop circuit alignment, the correct approach to the final setting of a capacitance *MUST BE* made from its minimum setting, until the desired compass indicator deflection is obtained. Approaches from the maximum setting will give the same deflection but should *NEVER* be used since course reversals may occur at other dial settings.
2. Full scale indicator deflection (F.S.Ind. Defl.) is defined as the deflection that just makes the pointer move to the end of the scale line. If full scale deflection is unobtainable on Bands 1 or 2, align for the maximum sensitivity which will still maintain equal indicator amplitude and sensing at the two test frequencies.
3. After the loop alignment has been performed the radio compass unit should be tested for absence of course reversals throughout the frequency range (150-1500 kc) using the fixed 15 degree loop rotation and the 1000 uv/m field strength.
4. Minimum inductance settings are obtained by turning screws to extreme counterclockwise position.

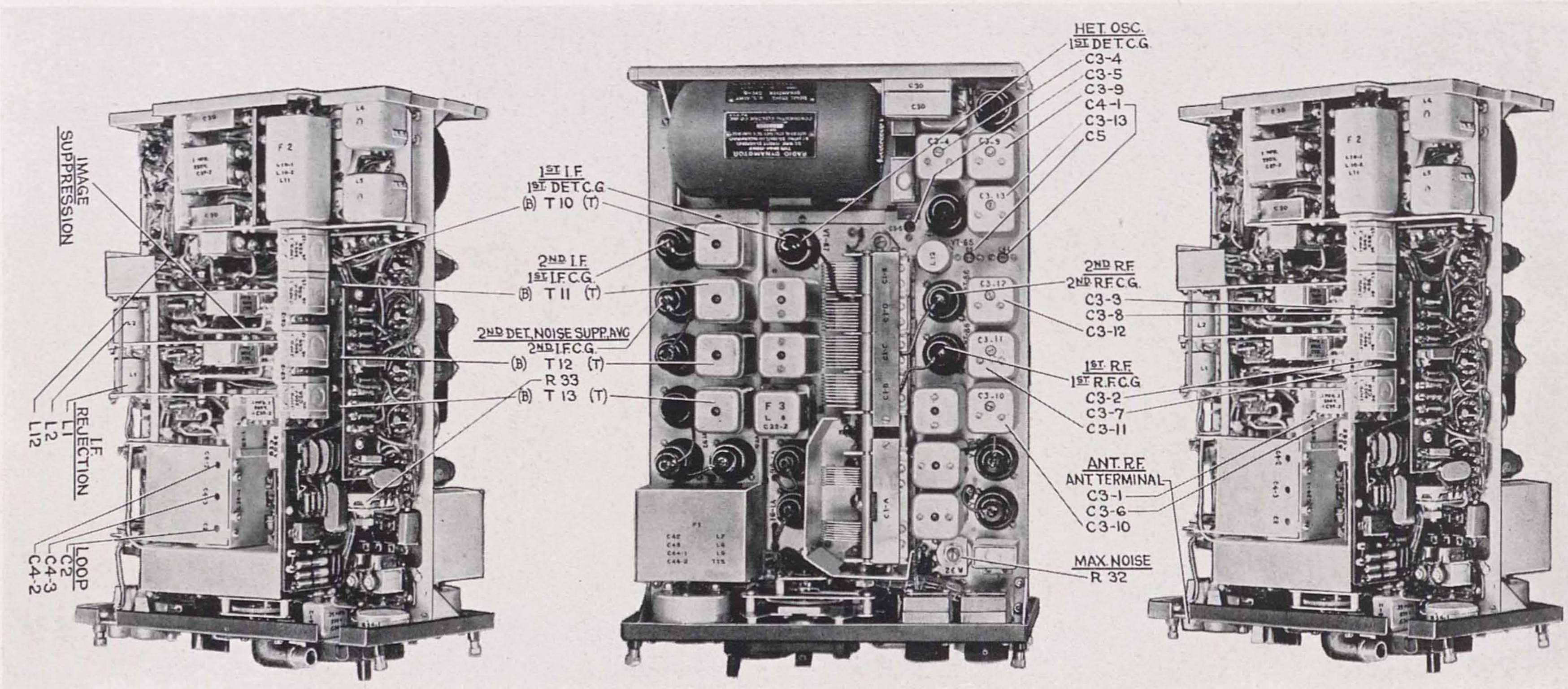


Figure 27—Radio Compass Unit BC-310-A, Order of Alignment

VII. APPENDIX

7-1 REFERENCE LIST—UNITS AND PARTS OF UNITS

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
7-1 a.	**Radio Compass Unit BC-310-A less Mounting FT-145-A**				T-601632 and W-302231
	(1) CAPACITORS				
C1-A	Loop Tuning	28 to 579 mmfd ±10% (One capacitor, five gang special)	RCA		P-720038-501
-B	Ant. Tuning	22 to 287 mmfd ±10%			
-C	1st R-F Tuning	22 to 287 mmfd ±10%			
-D	2nd R-F Tuning	22 to 287 mmfd ±10%			
-E	Het. Osc. Tuning	22 to 287 mmfd ±10%			
C2	Loop Trimmer H.F.	5.5 to 75 mmfd ±10%	RCA		M-413394-16
C3-1	Ant. Trimmer L.F.	Thirteen capacitors 4 to 25 mmfd ±10% each	RCA		M-413394-11
-2	1st R-F Tmr. L.F.				
-3	2nd R-F Tmr. L.F.				
-4	Het. Osc. Par. Tmr. L.F.				
-5	Het. Osc. Ser. Tmr. L.F.				
-6	Ant. Trimmer M.F.				
-7	1st R-F Tmr. M.F.				
-8	2nd R-F Tmr. M.F.				
-9	Het. Osc. Par. Tmr. M.F.				
-10	Ant. Trimmer H.F.				
-11	1st R-F Tmr. H.F.				
-12	2nd R-F Tmr. H.F.				
-13	Het. Osc. Par. Tmr. H.F.				
C4-1	Osc. Ser. Tmr. M.F.	Three capacitors 4.5 to 50 mmfd ±10% each	RCA		M-413394-12
-2	Loop Tmr. L.F.				
-3	Loop Tmr. M.F.				
C5	Het. Osc. Tmr. H.F.	Capacitor 5.5 to 75 mmfd ±10%	RCA		M-413394-13
C6	Ant. Coupling	Fixed capacitor 5.6 mmfd ±10%	RCA		K-850402-12
C7	Ant. Prim. Tuning	Fixed capacitor, 22 mmfd ±10%	RCA		K-850402-14
C8	AVC Prim. Tuning	Fixed capacitor, 39 mmfd ±5%	RCA		K-850402-9
C9-1	1st R-F Grid Bypass	Eleven fixed capacitors, 0.01 mfd ±10% each	RCA		K-833452-1
-2	2nd R-F Grid Bypass				
-3	1st Det. Grid Bypass				
-4	1st I-F Grid Bypass				

* See footnote on page 78.

7-1 a. (1) (Continued)

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
-5	2nd I-F Grid Bypass				
-6	AVC Grid Bypass				
-7	Tuning Meter Bypass				
-8	Ind. Tube Grid Coupling				
-9	Loop Mod. Gr. Filter				
-10	Loop Mod. Gr. Filter				
-11	Dynamotor Bypass				
C10-1	Det. Diode Bypass	Two fixed capacitors, 47 mmfd ±10% each	RCA		K-850402-1
-2	N. S. Diode Bypass				
C11-1	Loop Pad M.F.	Two fixed capacitors, 82 mmfd ±10% each	RCA		K-850402-2
-2	Loop Pad L.F.				
C12-1	Does not exist	Two fixed capacitors, 100 mmfd ±10% each	RCA		K-850402-3
C12-2	AVC Diode Coupling				
-3	1st R-F Prim. Tuning H.F.				
C13-1	2nd R-F Prim. Tuning M. F.	Three fixed capacitors, 270 mmfd ±10% each	RCA		K-850402-5
-2	N. S. Delay Diode Coupling				
-3	1st R-F Prim. Tuning M.F.				
C14-1	1st I-F Prim. Tuning	Six fixed capacitors, 330 mmfd ±5% each	RCA		K-850402-10
-2	1st I-F Sec. Tuning				
-3	2nd I-F Prim. Tuning				
-4	2nd I-F Sec. Tuning				
-5	Diode Prim. Tuning				
-6	Diode Sec. Tuning				
C15-1	I-F Trap Tuning (1st R-F)	Two fixed capacitors, 220 mmfd ±5% each	RCA		K-850402-15
-2	I-F Trap Tuning (2nd R-F)				
C16	Ant. Prim. Ser. Tuning H.F.	Fixed capacitor, 390 mmfd ±5%	RCA		K-850402-16
C17	Het. Osc. Ser. Pad. M.F.	Fixed capacitor, 746 mmfd ±2%	RCA		K-850402-17
C18	AVC Sec. Tuning	Fixed capacitor, 1,500 mmfd ±5%	RCA		K-850402-11

* See footnote on page 78.

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
C19-1	Loop Mod. Grid Coupling	Seven fixed capacitors, 470 mmfd ±10% each	RCA		K-850402-6
-2	Loop Mod. Grid Coupling				
-3	Het. Osc. Grid Bypass				
-4	Het. Osc. Coupling				
-5	AVC Coupling				
-6	N. S. Diode Bypass				
-7	2nd Det. Diode Bypass				
C20	Loop Mod. Coupling	Fixed capacitor, 560 mmfd ±10%	RCA		K-850402-7
C21-1	1st R-F Prim. Tuning L.F.	Four fixed capacitors, 1,000 mmfd ±10% each	RCA		K-850402-8
-2	2nd R-F Prim. Tuning L.F.				
-3	Antenna Blocking				
-4	Loop Mod. Plate Bypass				
C22-1	I-F Trap Tuning (Ant.)	Two fixed capacitors, 1,000 mmfd ±5% each	RCA		K-850402-18
-2	A-F Tuning				
C23	Output Grid Coupling	Fixed capacitor, 2,200 mmfd ±10%	RCA		K-850403-1
C24	Det. Plate Bypass	Fixed capacitor, 2,700 mmfd ±10%	RCA		K-850403-3
C25-1	A-F Grid Coupling	Two fixed capacitors, 4,700 mmfd ±10% each	RCA		K-850403-2
-2	Output Plate Bypass				
C26	Does not exist				
C27	Ind. Field Tuning	One capacitor, oil filled, two section, 0.0495 mfd +5–0% each, padded with sub sections 0.002 mfd (approx.) each until capacity of each section is 0.0515 mfd ±1%. DO NOT REPLACE SECTIONS, BUT ONLY THE COMPLETE UNIT C27	RCA		K-850409-1
C27-1	Section of C27				
-2	Section of C27				
-1A	Pad. Sub Section				
-2A	Pad. Sub Section				

* See footnote on page 78.

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
C28-1	1st R-F Cath. Bypass	Ten capacitors, oil filled, each is two sections, 0.1 mfd ±20% per section	RCA		K-850406-1
-2	1st R-F Screen Bypass				
-3	1st R-F Plate Bypass				
-4	2nd R-F Heater Bypass				
-5	2nd R-F Cath. Bypass				
-6	2nd R-F Screen Bypass				
-7	2nd R-F Plate Bypass				
-8	Heater C. T. Bypass				
-9	1st Det. Cath. Bypass				
-10	1st Det. Screen Bypass				
-11	1st Det. Plate Bypass				
-12	Het. Osc. Plate Bypass				
-13	1st I-F Cath. Bypass				
-14	1st I-F Screen Bypass				
-15	1st I-F Plate Bypass				
-16	2nd I-F Cath. Bypass				
-17	2nd I-F Screen Bypass				
-18	2nd I-F Plate Bypass				
-19	AVC Cathode Bypass				
-20	AVC Screen Bypass				
C29	N. S. Diode Coupling	Capacitor, oil filled, 0.25 mfd ±20%	RCA		K-850406-2
C30-1	A-F Plate Bypass	Four capacitors, oil filled, each is two sections, 0.5 mfd ±15% per section	RCA		K-850408-2
-2	H.V. Supply Bypass				
-3	H.V. Supply Bypass				
-4	H.V. Supply Bypass				
-5	Dynamotor Input Bypass				
-6	Dynamotor Input Bypass				
-7	Dynamotor Output Bypass				
-8	Output Tube Bias				

* See footnote on page 78.

7-1 a. (1) (Continued)

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
C31-1 -2	A-F Osc. Tuning A-F Osc. Plate Filter	One capacitor, oil filled, two section, one section (C31-2) 0.5 mfd ±15% and one section (C31-1) 0.48 mfd ±2%	RCA		K-850408-3
C32-1 -2 -3 -4	A-F Osc. Pl. Bypass A-F Osc. Cath. Bypass N. S. Tube Cath. Bypass 1st A-F Tube Cathode Bypass	Four capacitors, oil filled, 1 mfd ±15% each	RCA		K-850408-1
C33	Does not exist				
C34-1 -2	N. S. Delay Filter Sens. Contr. Bypass	Two capacitors, oil filled, 0.25 mfd ±20% each	RCA		K-850407-1
C35-1 -2	N. S. Tube Grid Bypass AVC Plate Bypass	One capacitor, oil filled, two section, 0.1 mfd ±20% per section	RCA		K-850406-3
C36-1 -2	Loop Mod. Cath. Bypass Loop Mod. Screen Bypass	One capacitor, oil filled, two section, 0.5 mfd ±15% per section	RCA		K-850405-1
C37-1 -2	Dynamotor Filter Dynamotor Filter	Two capacitors, oil filled, 1 mfd ±15% each	RCA		K-850404-1
C40	Het. Osc. Ser. Pdg. L.F.	Capacitor, 419 mmfd ±2%	RCA		K-850402-19
C41	Het. Osc. Ser. Pdg. H.F.	Capacitor, 1,340 mmfd ±2%	RCA		K-850402-20
C42	Ind. Filter Tuning	Capacitor, 0.015 mfd ±10%. Part of F1	RCA		
C43	Ind. Filter Tuning	Capacitor, 0.05 mfd ±10%. Part of F1	RCA		
C44-1 -2	Ind. Filter Tuning Ind. Filter Tuning	Capacitor, two-section, 0.10 mfd ±20% per section. Part of F1	RCA		

(2) DYNAMOTOR

DM-18	Dynamotor (includes snapslide mounting)	Input, 13V, 3.3 amps., 4,000 r.p.m. Output 220V, 100 ma. (see Miscellaneous for list of parts)	RCA		M-420002-501

* See footnote on page 78.

7-1 a. (Continued)

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
	(3) FILTER PACKS				
F1	Output Filter Pack	Contains C42, C43, C44-1, C44-2, L7, L8, L9 and T15	RCA		M-420123-1
F2	Dynamotor Filter Pack	Contains L10-1, L10-2, L11	RCA		K-850400-1
F3	Audio Tuning Pack	Contains L6, C22-2	RCA		K-850398-1
	(4) INDICATING METER				
I-69	Tuning Meter (Local)	1 ma full scale—125 ohms	RCA		K-850122-1
	(5) JACK				
J1-1	Output Jack (Local)	Double circuit	RCA		K-833759-1
	(6) INDUCTANCES				
L1	I-F Trap Antenna	See Figure 31	RCA		M-420058-502
L2	I-F Trap 1st R-F	See Figure 31	RCA		M-420058-501
L3-1	Loop Load	See Figure 31 for Bands 1 and 2	RCA		P-714050-502
-2	Loop Load	See Figure 31 for Bands 1 and 2			
L4	Dynamotor Prim. Filter	See Figure 31	RCA		K-833916-502
L5	Dynamotor Prim. Filter	See Figure 31	RCA		K-833916-501
L6	Audio Tuning React.	See Figure 31, part of F3	RCA		
L7	Output Filter React.	See Figure 31, part of F1	RCA		
L8	Output Filter React.	See Figure 31, part of F1	RCA		
L9	Output Filter React.	See Figure 31, part of F1	RCA		
L10-1	Dyn. Filter React. A-F	See Figure 31, part of F2	RCA		
-2	Dyn. Filter React. A-F	See Figure 31, part of F2	RCA		
L11	Dyn. Filter React. R-F	See Figure 31, part of F2	RCA		
L12	I-F Trap 2nd R-F	See Figure 31	RCA		M-420058-503
L13	Loop Load	See Figure 31 for all bands	RCA		K-850377-501
	(7) LAMPS				
LM-32	Dial Lamp (Local)	3 volts, 0.180 ±0.020 amperes	RCA		K-850338-1
LM-32	Tng. Meter Lamp (Local)	3 volts, 0.180 ±0.020 amperes	RCA		K-850338-1
LM-32	Spare Lamp Mounted	3 volts, 0.180 ±0.020 amperes, two lamps	RCA		K-850338-1

* See footnote on page 78.

7-1 a. (Continued)

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
	(8) RESISTORS				
R1	1st Det. Cathode	390 ohms ±5%, ½ watt	IRC		K-78726
R2-1 -2 -3 -4	1st R-F Cathode 2nd R-F Cathode 1st I-F Cathode 2nd I-F Cathode	Four resistors, 560 ohms ±5%, ½ watt each	IRC		K-78726
R3-1 -2 -3	Het. Osc. Plate 1st R-F Prim. L.F. 2nd R-F Prim. L.F.	Three resistors, 680 ohms ±5%, ½ watt each	IRC		K-78726
R4	N. S. Stage Bias	820 ohms, ±5%, ½ watt	IRC		K-78726
R5-1 -2 -3	A-F Osc. Cathode 1st R-F Pl. Loading M.F. 2nd R-F Pl. Loading M.F.	Three resistors, 2,200 ohms, ±5%, ½ watt each	IRC		K-78726
R6	A-F Cathode	2,700 ohms, ±5%, ½ watt	IRC		K-78726
R7-1 -2 -3 -4 -5 -6 -7 -8	1st R-F Pl. Filter 2nd R-F Pl. Filter 1st Det. Scr. Filter 1st Det. Pl. Filter 1st I-F Pl. Filter 2nd I-F Pl. Filter AVC Amp. Pl. Filter Sens. Contr. Bleeder (Local)	Eight resistors, 4,700 ohms, ±5%, ½ watt each	IRC		K-78726
R9-1 -3	Output Load (Local) AVC Cathode	Two resistors, 8,200 ohms, ±5%, ½ watt each	IRC		K-78726
R10-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11 -12	1st R-F Scr. Fil. 2nd R-F Scr. Fil. 1st R-F Pl. Loading H.F. 2nd R-F Pl. Loading H.F. Het. Osc. Filter 1st I-F Screen Filter 2nd I-F Screen Filter AVC Screen Filter Diode Load A-F Osc. Plate Filter Loop Mod. Grid Filter Loop Mod. Grid Filter	Twelve resistors, 10,000 ohms, ±5%, ½ watt each	IRC		K-78726

* See footnote on page 78.

7-1 a. (8) (Continued)

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
R11-1 -2	Voltage Divider Voltage Divider	Two resistors, 15,000 ohms, ±5%, ½ watt each	IRC		K-78726
R12	Loop Mod. Cathode	5,600 ohms, ±5%, ½ watt	IRC		K-78726
R13-1 -2 -3 -4	A-F Osc. Plate A-F Amp. Filter N. S. Diode Filter A-F Osc. Filter	Four resistors, 22,000 ohms, ±5%, ½ watt each	IRC		K-78726
R14	A-F Screen	27,000 ohms, ±5%, ½ watt	IRC		K-78726
R15	2nd Det. Cathode	33,000 ohms, ±5%, ½ watt	IRC		K-78726
R16-1	1st Det. Gr. Leak	47,000 ohms, ±5%, ½ watt	IRC		K-78726
-2	A-F Plate Load	47,000 ohms, ±5%, ½ watt	IRC		K-78726
R17	Does not exist				
R18-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11 -12	1st R-F Grid Fil. 2nd R-F Grid Fil. 1st Det. Grid Fil. 1st I-F Grid Fil. N. S. Grid Fil. Bias Voltage Divider Bias Voltage Divider Loop Mod. Grid. Loop Mod. Grid. N. S. Load Det. Diode Load N. S. Delay Diode Load	Twelve resistors, 0.1 megohm ±5%, ½ watt each	IRC		K-78726
R19-1 -2	Loop Mod. Plate Loop Mod. Screen	Two resistors, 0.15 megohm ±5%, ½ watt each	IRC		K-78726
R20	AVC Load	0.22 megohms, ±5%, ½ watt	IRC		K-78726
R21	Het. Osc. Grid	0.33 megohms, ±5%, ½ watt	IRC		K-78726
R22-1 -2 -3	Static Leak Output Grid Leak Ind. Grid Leak	Three resistors, 0.47 megohms, ±5%, ½ watt each	IRC		K-78726
R23	AVC Load	0.56 megohms, ±5%, ½ watt	IRC		K-78726

* See footnote on page 78.

7-1 a. (8) (Continued)

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
R24-1 -2	AVC Grid Leak 1st A-F Grid Leak	Two resistors, 1 megohm, ±5%, ½ watt	IRC		K-78726
R25	AVC Filter	2.2 megohms, ±5%, ½ watt	IRC		K-78726
R26	2nd I-F Grid Filter	3.3 megohms, ±5%, ½ watt	IRC		K-78726
R27-1 -2 -3	Voltage Divider Voltage Divider Voltage Divider	Three resistors, 4,700 ohms each, 1 watt ±5%	IRC		K-78728
R29	Heater Balance	30 ohms, ±10%, 5 watt	IRC		K-850046-6
R30	Does not exist				
R31	Loop Mod. Cathode	Potentiometer, 0.25 megohm, ±15%	RCA		K-850217-1
R32	Max. Noise Adj.	Potentiometer, 200 ohms, ±15%	RCA		K-850207-1
R33	N. S. Bal. Adj.	Potentiometer, 20,000 ohms, ±15%	RCA		K-850218-1
R34-1	Sens. Control (Local)	Potentiometer, 5,000 ohms, ±10% (contains S7-1)	RCA		K-850316-1
R35-1	Inst. Lamp (Local)	Rheostat, 50 ohms, ±15%	RCA		K-850192-1
R36-1	Compass Ind. L Pad (Local)	Potentionmeter, 0 to 7,700 and 2,000 to 412 ohms, Special (contains S6-3)	RCA		K-850035-1
R37-1	Headset Output T Pad (Local)	Potentiometer, 0.1 meg. to 640 ohms and 640 ohms to 0.1 meg., Special (contains S6-1)	RCA		K-850037-1

(9) RELAY

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
RE1	Band Change Relay	Plunger, ratchet type, for band change switch	RCA		M-413513-1

* See footnote on page 78.

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
	(10) SWITCHES				
S1-1	Ant. Band Section	Band change switch wafer, 2 pole, 3 pos.	RCA		P-714057-4
-2	1st R-F Band Sec.	Band change switch wafer, 2 pole, 3 pos.	RCA		P-714057-4
-3	2nd R-F Band Sec.	Band change switch wafer, 2 pole, 3 pos.	RCA		P-714057-4
S2-1	Het. Osc. Band Sec.	Band change switch wafer, 2 pole, 3 pos.	RCA		P-714057-3
-2	Does not exist				
-3	Loop Mod. Section	Band change switch wafer, 2 pole, 3 pos.	RCA		P-714057-3
-4	Loop Mod. Section	Band change switch wafer, 2 pole, 3 pos.	RCA		P-714057-3
S3-1 -2	Local-Remote Sec. Local-Remote Sec.	Local-Remote switch, 6-pole, 2-position, 2-wafer rotary	RCA		K-850072-1
S4	Band Selector (Local)	Switch, single pole, 3-position, single wafer, rotary	RCA		P-714057-11
S5	Relay Positioning	Switch, 2-pole, 3-position, rotary, single wafer, ganged with band change switch	RCA		P-714057-2
S6-1	Audio Output Control (Local)	"Audio-Off" switch, ganged with R37-1	RCA		K-850037-1
-3	Compass Output Loop Control (Local)	"Compass-Off" switch, ganged with R36-1	RCA		K-850035-1
S7-1	Power (Local)	"Rec'r.-Off" switch, ganged with R34-1	RCA		K-850316-1
S10	Het. Osc. Band Sec.	Band change switch wafer, 1 pole, 3 pos.	RCA		P-714057-12
	(11) TRANSFORMERS				
T1	Ant. L.F. and M.F.	See Figure 31	RCA		P-714050-501
T2	Ant. H.F.	See Figure 31	RCA		P-720000-501
T3	1st R-F, L.F. and M.F.	See Figure 31	RCA		P-714046-501
T4	1st R-F, H.F.	See Figure 31	RCA		P-720000-502
T5	2nd R-F, L.F. and M.F.	See Figure 31	RCA		P-714046-502
T6	2nd R-F, H.F.	See Figure 31	RCA		P-720000-503
T7	Het. Osc. L.F.	See Figure 31	RCA		P-720001-503
T8	Het. Osc. M.F.	See Figure 31	RCA		P-720001-501
T9	Het. Osc. H.F.	See Figure 31	RCA		P-720001-502
T10	1st I-F	See Figure 31	RCA		P-714045-501
T11	2nd I-F	See Figure 31	RCA		P-714045-502

* See footnote on page 78.

7-1 a. (11) (Continued)

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
T12	3rd I-F Diode	See Figure 31	RCA		P-714051-501
T13	AVC Tuning	See Figure 31	RCA		P-714047-501
T14	A-F Osc.	See Figure 31	RCA		K-850399-1
T15	Headset Output	See Figure 31, part of F1	RCA		

(12) TERMINAL BOARDS

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
TB-1	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-833913-504
-2	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-833911-501
-3	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-833913-501
-4	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-833829-501
-5	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-833829-502
-6	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-833827-501
-7	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-833829-503
-8	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-833827-502
-9	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-833913-503
-10	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-850046-501
-11	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-833911-502
-12	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-837096-501
-13	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-850001-501
-14	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-850003-501
-15	Term. Bd. Assembly	Less capacitors and resistors	RCA		M-420003-501
-16	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-850019-501
-17	Term. Bd. Assembly	Dynamotor term. bd. less capacitor	RCA		K-833900-501
-18	Term. Bd. Assembly	Less capacitors and resistors	RCA		K-850195-501

(13) MISCELLANEOUS

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
1	Dynamotor Armature		RCA		K-850362-1
2	Dynamotor Bearing		RCA		K-850362-2
3	Dynamotor H.V. Brush	Assembly	RCA		K-850362-3
4	Dynamotor L.V. Brush	Assembly	RCA		K-850362-4

* See footnote on page 78.

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
5	Dynamotor Dust Cover		RCA		K-850362-5
6	Dynamotor End Bell	Assembly, less brush assembly	RCA		K-850362-6
7	Dynamotor Field Coils	Assembly	RCA		K-850362-7
8	Dynamotor Pole Piece		RCA		K-850362-8
9	Dynamotor Bushing	Insulated brush holder assembly	RCA		K-850362-9
10	Gear Drive	Right angle, for flexible shaft	RCA		K-833769-501
11	Coupling	For band change shaft	RCA		K-850015-1 and 2
12	Coupling	Insulated, for tuning capacitor	RCA		K-850214-501
13	Dial	Calibrated	RCA		K-833771-501
14	Hub and Detent	Cam assembly for mask and hub	RCA		K-833720-501
15	Detent Arm Spring	For mask and hub	RCA		K-833402-2
16	Gear Assembly	Tuning dial drive	RCA		P-714039-501
17	Glass	Dial window	RCA		K-833699-1
18	Insulator	Part of C1	RCA		
19	Knob	Tuning	RCA		K-833518-502
20	Knob	"Increase Audio Output"	RCA		K-833752-501
21	Knob	"Increase Compass Output"	RCA		K-833752-502
22	Knob	"Increase Sensitivity"	RCA		K-833752-503
23	Knob	Band selector switch	RCA		K-833700-1
24	Knob	Lamp rheostat (Local)	RCA		K-837088-2
25	Knob	"Local-Remote"	RCA		K-850121-1
26	Mask and Hub	Assembly	RCA		K-833702-501
27	Socket	For PL-108	RCA		T-601638-20
28	Socket	For PL-110	RCA		T-601638-18
29	Socket	For PL-120	RCA		T-601638-19
30	Tool, TL-138-A	For circuit alignment	RCA		K-837017-503
31	Wrench, Set Screw	For knobs	RCA		K-828505-12
32	Terminal	Condenser grounding	RCA		K-67592-8
33	Terminal	Dynamotor frame grounding	RCA		K-65989-1
34	Terminal	Circuit Grounding	RCA		K-67592-8
35	Cabinet, complete	For radio compass unit BC-310-A	RCA		T-601632-501
36	Sockets	For vacuum tubes	RCA		K-850372-1
37	Screws	For right angled flexible shaft drive	RCA		K-850074-1
38	Plug	For right angled flexible shaft drive	RCA		K-837049-1
39	Locknut	For loop gain control	RCA		K-850014-1

* See footnote on page 78.

7-1 (Continued)

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
7-1 b.	**Mounting FT-145-A**				T-601633
40	Shock Mount		RCA		K-833544-2
41	Washer	Aluminum, for shock mounts	RCA		K-833864-2
42	Washer	Stainless steel, for shock mounts	RCA		K-833864-4
43	Snapslide Stud		RCA		K-833894-1
7-1 c.	**Radio Control Box BC-311-A**				T-601639
	(1) INDICATING METER				
I-69-2	Tuning Meter, Remote	1 ma, full scale, 125 ohms	RCA		K-850122-1
	(2) JACK				
J1-2	Output Jack, Remote	Double circuit	RCA		K-833759-1
	(3) LAMPS				
LM-32-3	Dial Lamp, Remote	3 volts, 0.180 ±0.020 amperes	RCA		K-850338-1
-4	Tng. Metr. Lamp, Remote	3 volts, 0.180 ±0.020 amperes	RCA		K-850338-1
LM-32	Spare Lamps, Mounted	3 volts, 0.180 ±0.020 amperes, 2 lamps	RCA		K-850338-1
	(4) RESISTORS				
R9-2	Output Load, Remote	8,200 ohms, ±5%, ½ watt	IRC		K-78726-181
R28	Voltage Divider, Remote	56,000 ohms, ±5%, 1 watt	IRC		K-78728-201
R34-2	Sens. Control, Remote	Potentiometer, 5,000 ohms, ±10% (contains S7-2)	RCA		K-850316-2
R35-2	Pilot Lamp, Remote	Rheostat, 50 ohms, ±15%	RCA		K-850192-2
R36-2	Compass Ind. L. Pad, Remote	Potentiometer Special, 0 to 7,700 and 2,000 to 412 ohms (contains S6-4)	RCA		K-850035-2
R37-2	Output T Pad, Remote, Headset	Potentiometer, Special, 0.1 meg. to 640 ohms and 640 ohms to 0.1 meg. (contains S6-2)	RCA		K-850037-2

* See footnote on page 78.

7-1 c. (Continued)

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
	(5) SWITCHES				
S6-2	Output Control, Remote	"Audio Off" switch, ganged with R37-2	RCA		K-850035-2
-4	Compass Output Control, Remote	"Compass Off" switch, ganged with R36-2	RCA		K-850035-2
S7-2	Power, Remote	"Rec-r.-Off" switch, ganged with R34-2	RCA		K-850316-2
S8	Band Selec. Remote	Switch, single-pole, 3-position, single wafer, rotary	RCA		M-420021-1
	(6) MISCELLANEOUS				
44	Gear Drive	Right angle assembly for flexible shaft	RCA		K-833769-502
45	Glass	Dial window	RCA		K-837033-1
46	Scale Calibrated	For dial	RCA		M-27363-1
47	Tng. Drive and Mask	Assembly	RCA		T-620001-501
48	Mask	Assembly	RCA		M-413488-501
49	Socket Board	Assembly	RCA		K-833992-502
50	Pin Board	Assembly	RCA		K-833993-501
51	Tuning Crank	Assembly	RCA		K-837030-501
52	Set Screw Wrench		RCA		K-828505-12
53	Thumb Wheel	For pilot lamp control	RCA		K-850186-1
54	Back Cover		RCA		P-714063-502
55	Shoulder Screw	For terminal board assembly	RCA		K-850105-1
56	Screw	For right angled gear drive	RCA		K-833728-1
57	Plug	For right angled gear drive	RCA		K-850216-1
7-1 d.	**Loop LP-13-A**				AS-535-4-D
	(1) CAPACITOR				
C38	Compensating	Bi-metallic	RCA		AS-518-1-D
	(2) MISCELLANEOUS				
58	Pin Support		RCA		AS-488-1-D
7-1 e.	**Loop Mounting GS-7-A (Fixed Loop)**				AS-543-1-C
	(1) CAPACITOR				
C39	Padding	Fixed capacitor, 10 mmfd, ±10%	RCA		K-850402-13

* See footnote on page 78.

7-1 e. (Continued)

Refer-ence	Name or Function	Description	Manu-fac-turer*	Manu-fac-turer's Type	RCA Drawing No.
	(2) MISCELLANEOUS				
					U. S. Air Corps. Dwg. No.
59	Socket Insert	For Loop LP-13-A	RCA		A.C. 35A 5242
					RCA Dwg. No.
60	Socket Support	For Loop LP-13-A	RCA		AS-405-1-C
61	Socket Retainer	For Loop LP-13-A	RCA		AS-409-1-B
62	Socket Pin Assembly	For Plug PL-120	RCA		AS-421-1-C
63	Socket Housing	For Plug PL-120	RCA		AS-551-1-B
7-1 f.	**Loop Mounting GS-8-A (Rotatable Loop)**				AS-532-4-D
	(1) RESISTOR				
R8	Scale Lamp	48 ohms, ±5%, ½ watt	RCA		AS-553-1
	(2) SWITCH				
S9	Lamp Switch	Toggle type	RCA		AS-552-1
	(3) TUNING UNIT				
					U. S. Signal Corps. Dwg. No.
MC-127	Tuning Unit	Assembly and details	RCA		SC-D-2036-A
	(4) MISCELLANEOUS				
					U. S. Air Corps. Dwg. No.
64	Socket	For Loop LP-13-A	RCA		A.C. 35A 5242
					RCA Dwg. No.
65	Socket Support	For Loop LP-13-A	RCA		AS-405-1-C
66	Socket Retainer	For Loop LP-13-A	RCA		AS-409-1-B
67	Socket Pin Assembly	For Plug PL-120	RCA		AS-421-1-C
68	Socket Housing	For Plug PL-120	RCA		AS-401-1-B
69	Brush Support	Assembly	RCA		AS-531-1-A
70	Collector Ring	Assembly, double	RCA		AS-490-1-C
71	Collector Ring	Assembly, single	RCA		AS-411-1-C

* See footnote on page 78.

7-1 (Continued)

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
7-1 g.	**Loop Mounting Cap M-169-A**				
M-169-A	Cap	Loop Mounting Cap	RCA		AS-540-1-A
7-1 h.	**Compass Indicator I-65-A**				M-420076
	(1) INDICATING METER				
I-65-A	Compass Indicator	Sensitivity 35 degrees defl. at 700 microamperes Field coil ind. 39± 5% henries at 100 cycles, 24 V., d-c res. 2,700 ±10% ohms Moving coil ind. 0.175 ±5% henries at 100 cycles, 3 V., d-c res. 2,200 ±10% ohms.	RCA		M-420076-1
	(2) INSTRUMENT LAMP				
LM-32	Lamp	3-volt, 0.180 ±0.020 ampere	RCA		K-850338-1
7-1 i	**Tuning Shaft MC-124**				U. S. Signal Corps. Dwg. No.
	(1) TUNING SHAFT				
MC-124	Tuning Shaft	Assembly and details	RCA		SC-D-2035-A
	(2) MISCELLANEOUS				
72	Nut		RCA		SC-D-2035-A-1
73	Spline		RCA		SC-D-2035-A-2
74	Sleeve		RCA		SC-D-2035-A-3
75	Hub		RCA		SC-D-2035-A-4
76	Tag		RCA		SC-D-2035-A-5
77	Taper Pin		RCA		SC-D-2035-A-6
78	Shaft		RCA		SC-D-2035-A-7
79	Casing		RCA		SC-D-2035-A-8
					RCA Dwg. No.
7-1 j.	**Junction Box TM-180-A**				P-720044
	(1) FUSE				
FU-24	Fuse	15 amperes, input line	RCA		K-850339-1

* See footnote on page 78.

7-1. j. (Continued)

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
	(2) JACK				
J2	Interphone	Single circuit	RCA		K-833759-2
	(3) MISCELLANEOUS				
80	Clip	For fuse	RCA		K-60938-1
81	Socket	For Plug PL-108	RCA		P-720044-11
82	Socket	For Plug PL-109	RCA		P-720044-23
83	Socket	For Plug PL-110	RCA		P-720044-24
84	Socket	For Plug PL-111	RCA		P-720044-14
85	Socket	For Plug PL-112	RCA		P 720044-12
86	Socket	For Plug PL-113	RCA		P-720044-13
87	Fuse Board	Assembly	RCA		K-850288-501

7-1 k. **Cord CD-310**

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Drawing No.
	(1) CORD				
CD-310	Cord	Loop cord assembly and details	RCA		M-413511-501
	(2) MISCELLANEOUS				
88	Spacers	For leads, ceramic	RCA		K-829781-1
89	Plug	PL-120	RCA		M-413511-3
90	Flexible Conduit		RCA		K-837126-501

* In the column headed "Manufacturer" the following abbreviations are used:

RCA—RCA Manufacturing Co., Inc., Camden, New Jersey.

IRC—International Resistance Company, 401 N. Broad St., Philadelphia, Pa.

NOTE: For ease in service and repair, all radio compass components and parts are marked to accord with a standard system. This system is designed to give all the necessary information in the simplest manner. For example, the first letter tells the electrical nature of the part.

C—Capacitor	J—Jack
R—Resistor	RE—Relay
L—Inductor	LM—Lamp
T—Transformer	I—Indicating Meter
DM—Dynamotor	S—Switch
F—Filter-pack	TB—Terminal Board

The number following the letter indicates the physical and electrical characteristics and size of component or part. All parts with the same letter and number are interchangeable. Following the letter and number is a dash and an additional number which serves to show the exact (1) physical and electrical position, (2) use in the equipment, and (3) location on drawings and diagrams. In all cases when replacing a defective component or part the marking, including the dash number, must agree exactly with that of the replaced part. This means that the radio repairman must stencil the dash number on all new replacement parts.

It should also be noted that the largest dash number following a specific letter and number indicates the number of those identical parts which are contained in the radio compass, except where the part is a multiple unit. Hence C9-12 indicates that there are at least twelve C9 capacitors in the equipment, since C9 is a single section capacitor. C28-20 indicates that there are at least twenty sections, or ten dual units, since C28 is a two-section capacitor.

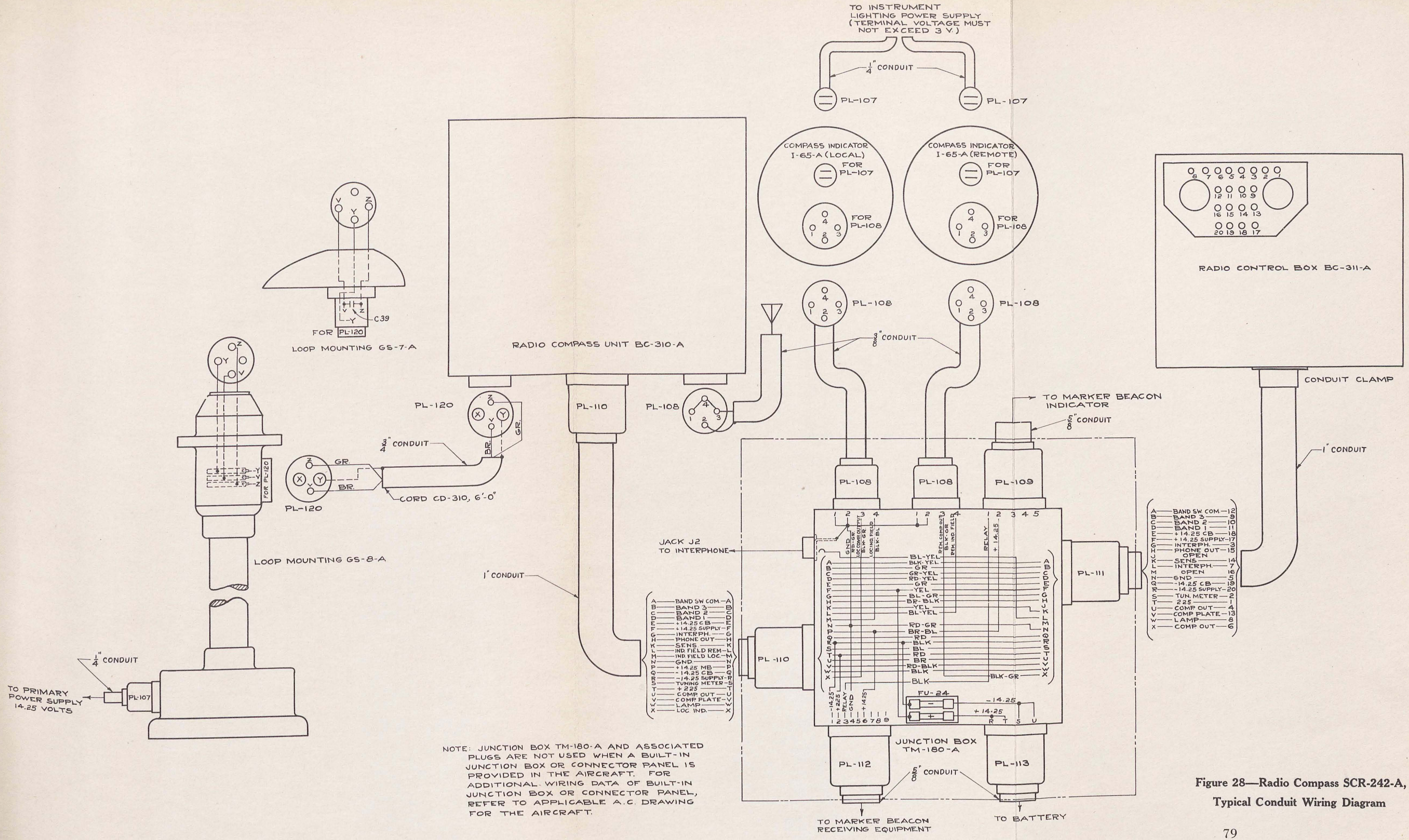
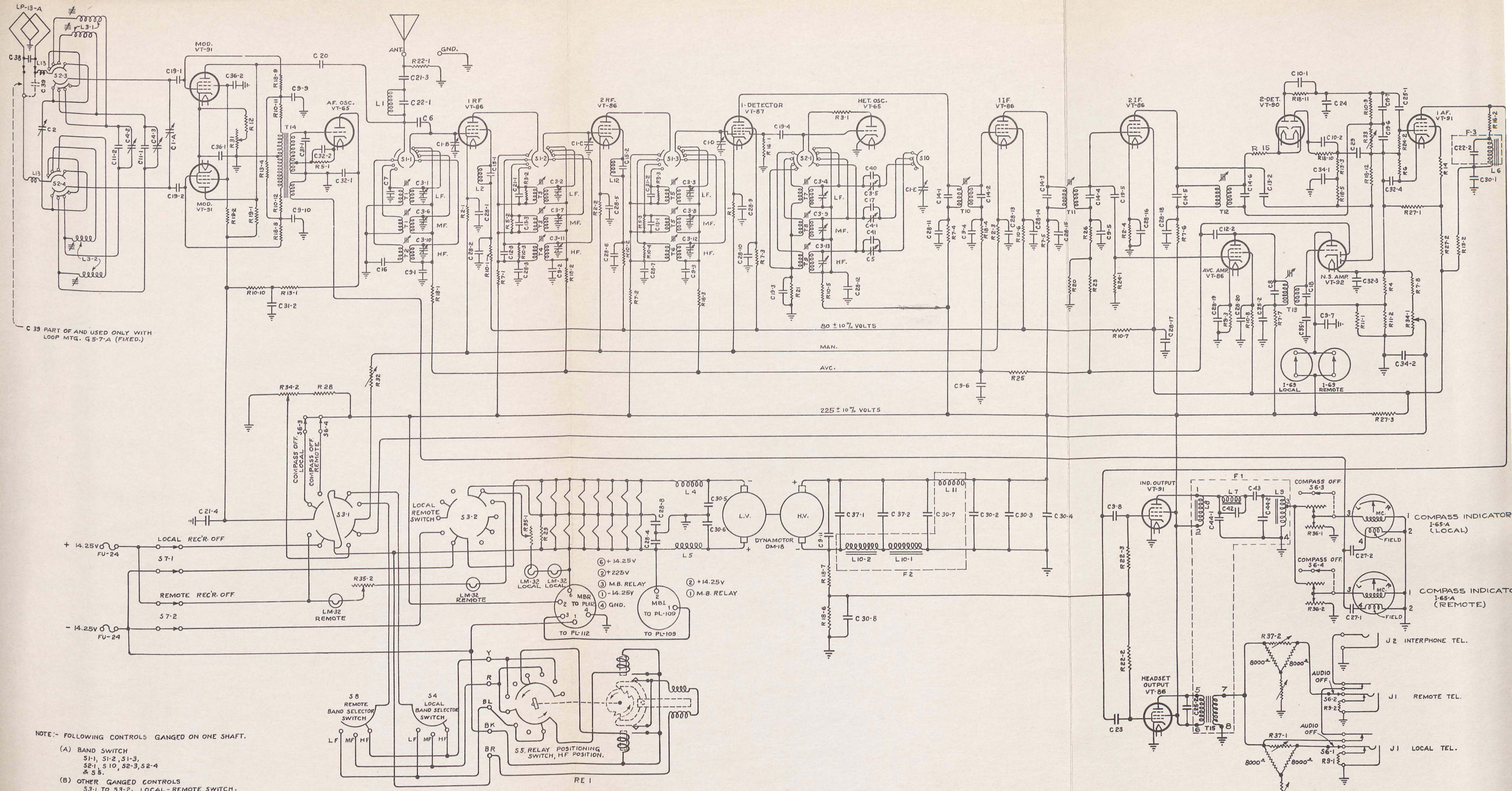


Figure 28—Radio Compass SCR-242-A, Typical Conduit Wiring Diagram



NOTE:- FOLLOWING CONTROLS GANGED ON ONE SHAFT.

(A) BAND SWITCH
S1-1, S1-2, S1-3,
S2-1, S10, S2-3, S2-4
& S5.

(B) OTHER GANGED CONTROLS
S3-1 TO S3-2. LOCAL-REMOTE SWITCH.
R34-2 TO S7-2. REMOTE "REC'R. OFF" SWITCH.
R34-1 TO S7-1. LOCAL "REC'R. OFF" SWITCH.
R36-1 TO S6-3. LOCAL "COMP. OFF" SWITCH.
R36-2 TO S6-4. REMOTE "COMP. OFF" SWITCH.
R37-1 TO S6-1. LOCAL "AUDIO OFF" SWITCH.
R37-2 TO S6-2. REMOTE "AUDIO OFF" SWITCH.

Figure 29—Radio Compass SCR-242-A
Schematic Functional Diagram

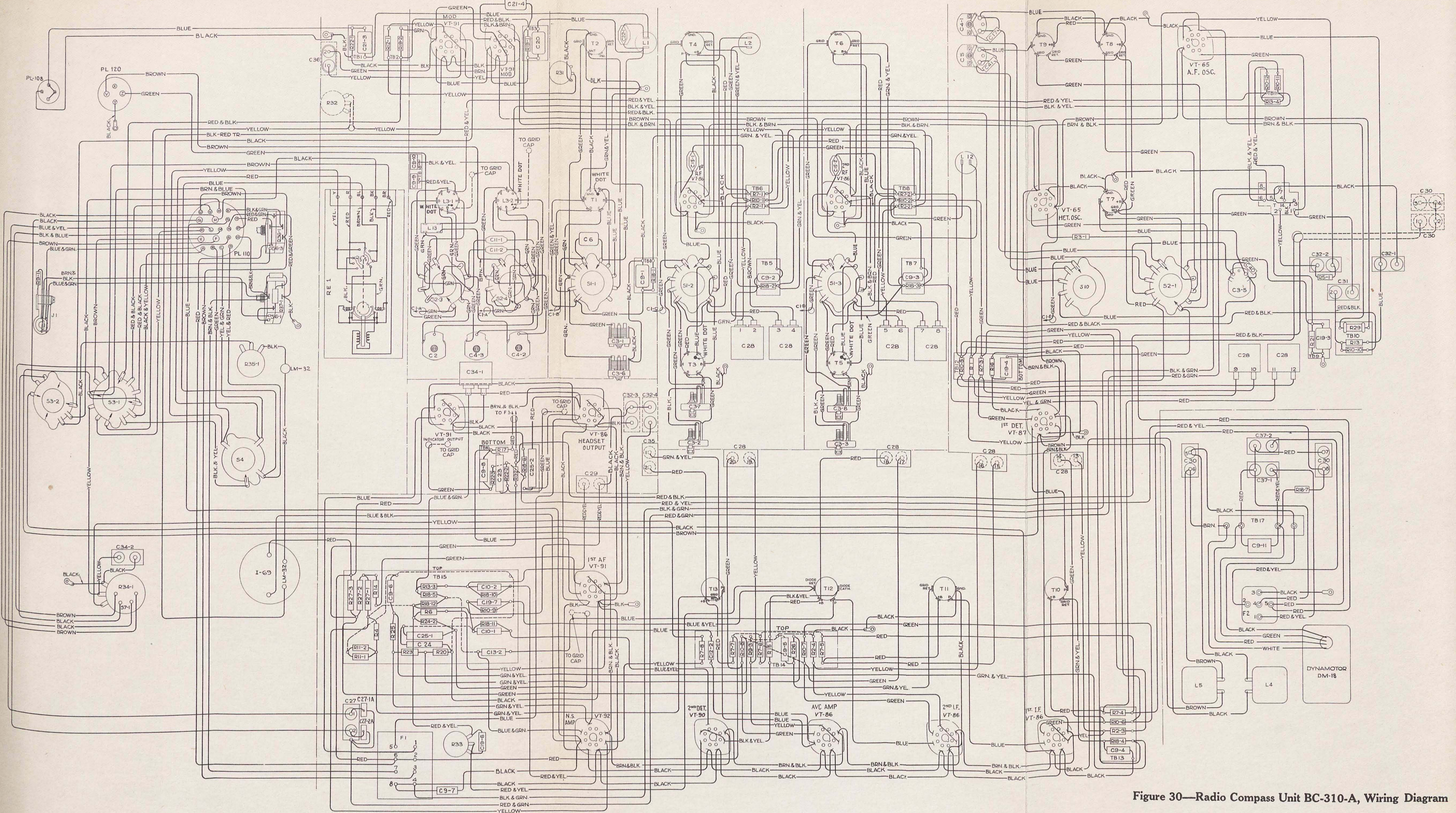


Figure 30—Radio Compass Unit BC-310-A, Wiring Diagram

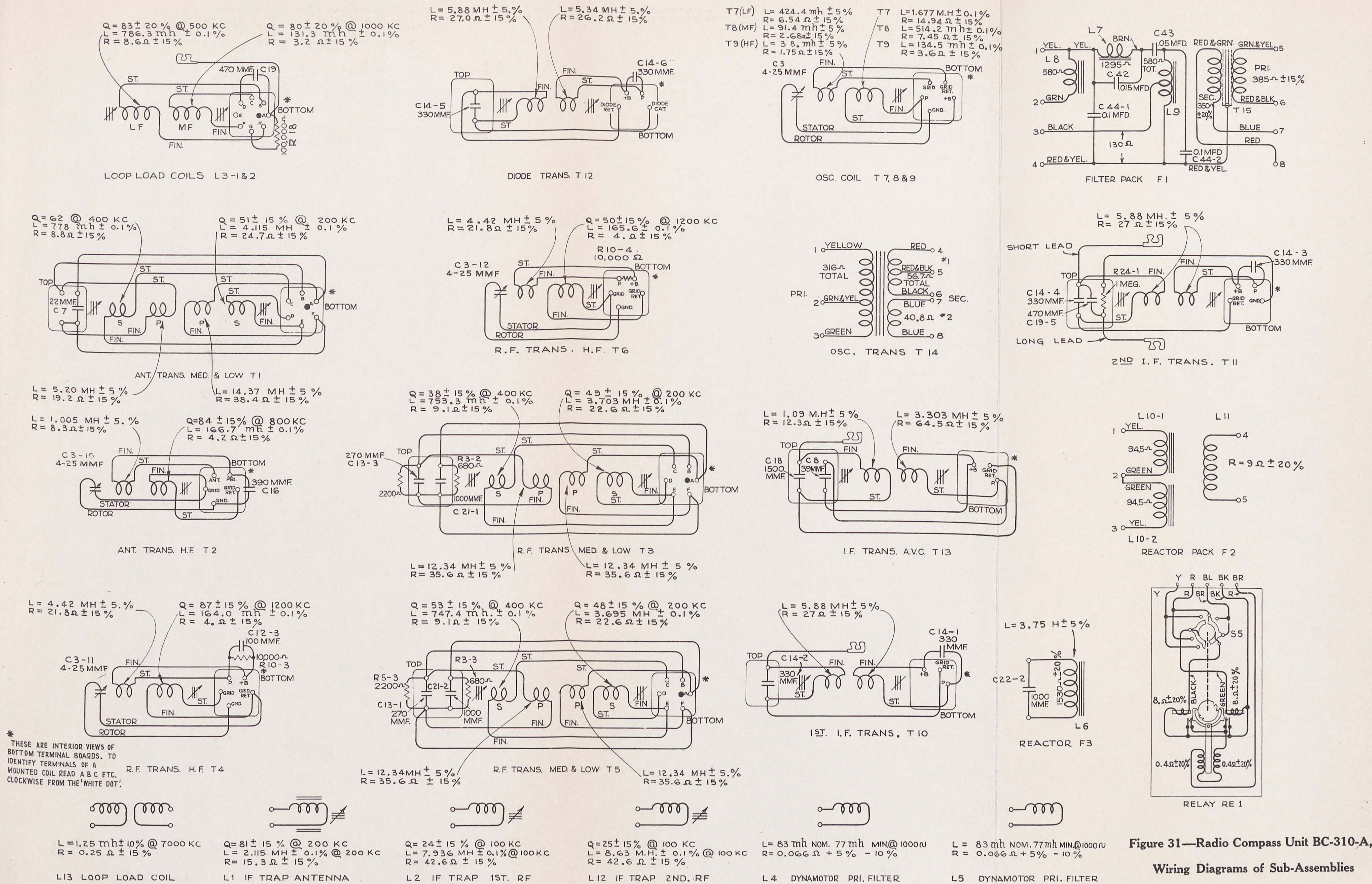


Figure 31—Radio Compass Unit BC-310-A, Wiring Diagrams of Sub-Assemblies

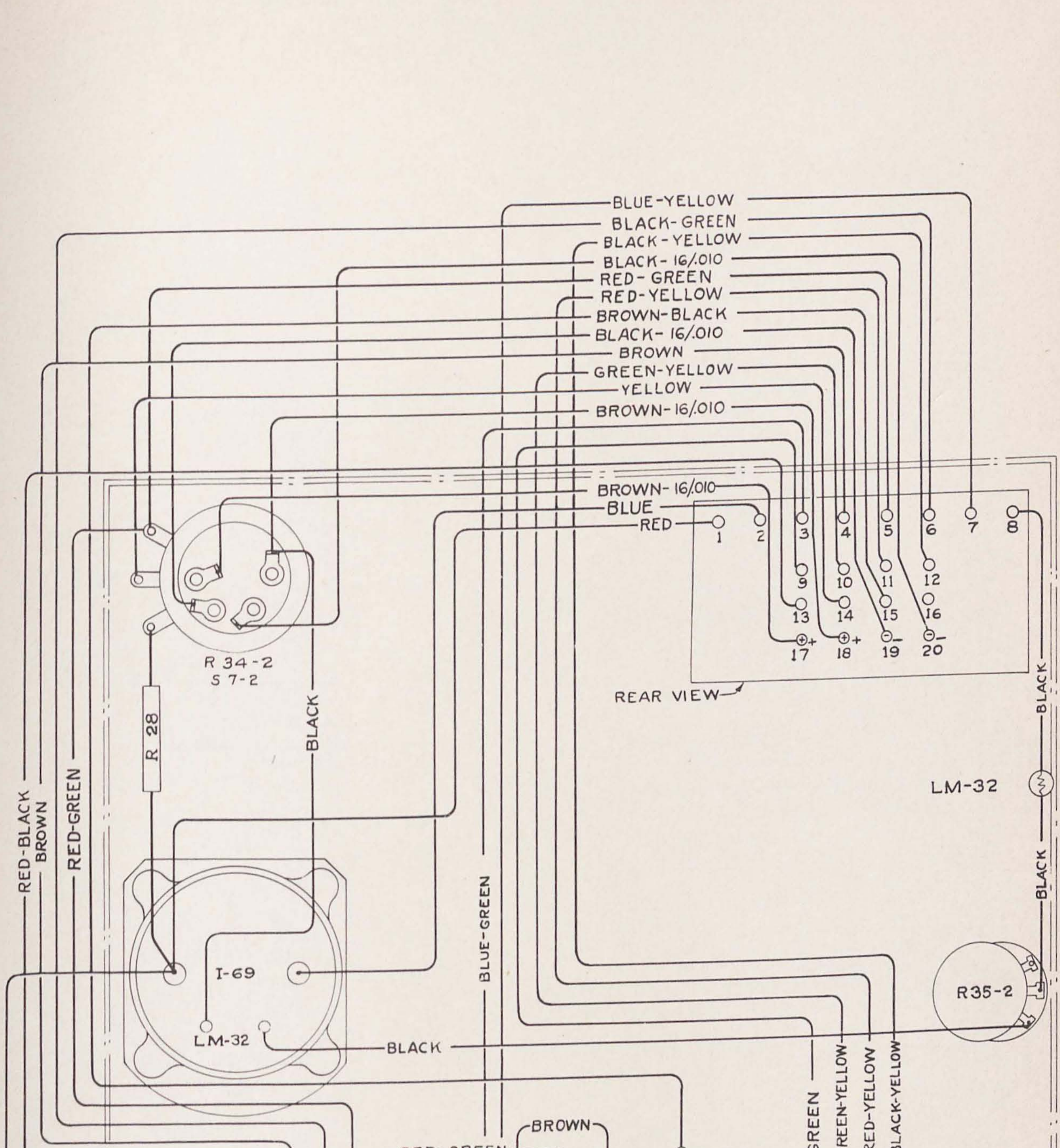


Figure 32—Radio Control Box BC-311-A, Wiring Diagram

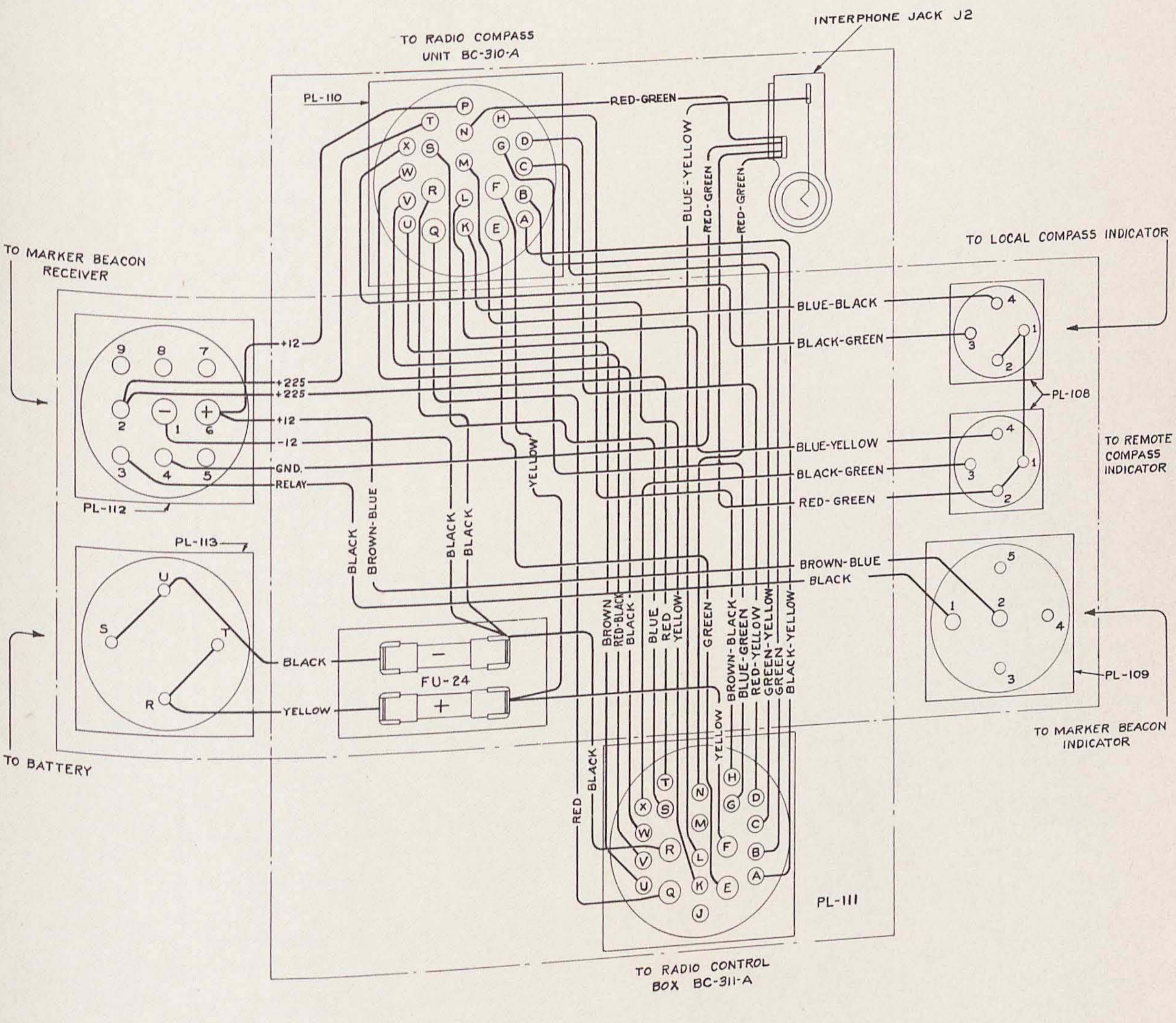


Figure 33—Junction Box TM-180-A, Wiring Diagram

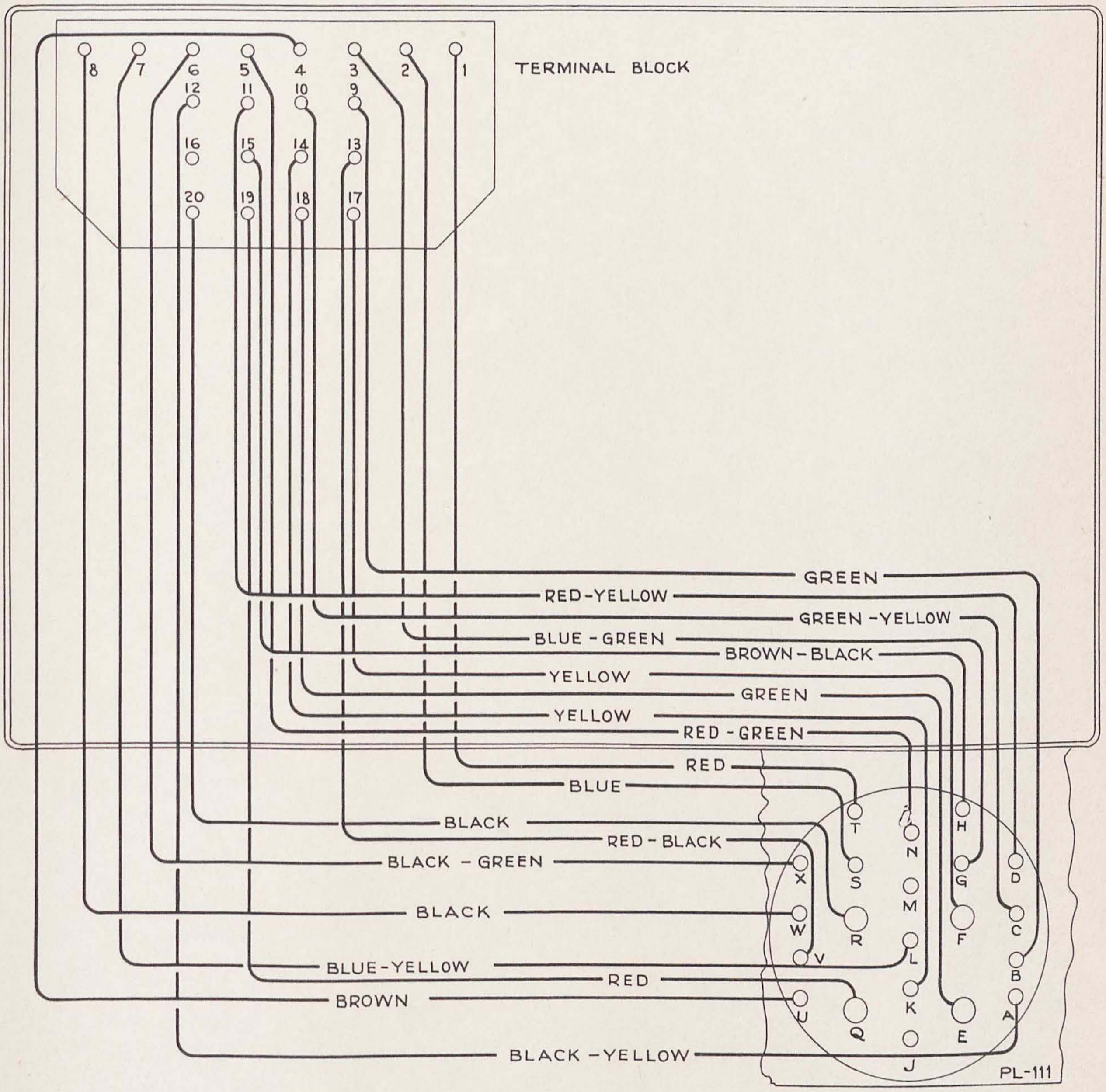


Figure 34—Test Box BX-18-A, Wiring Diagram

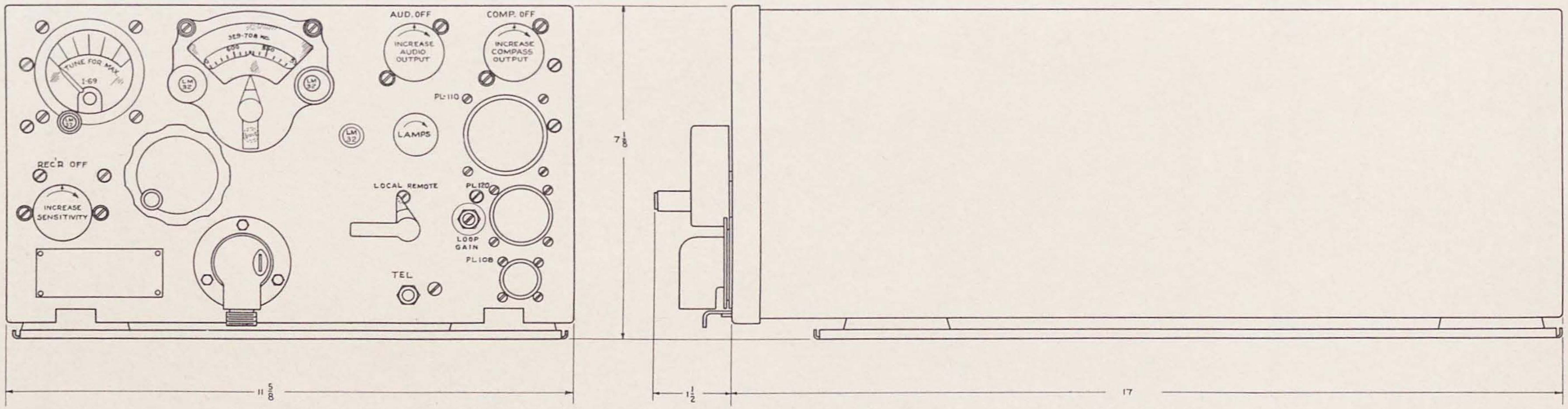


Figure 35—Radio Compass Unit BC-310-A, Outline Dimensional Drawing

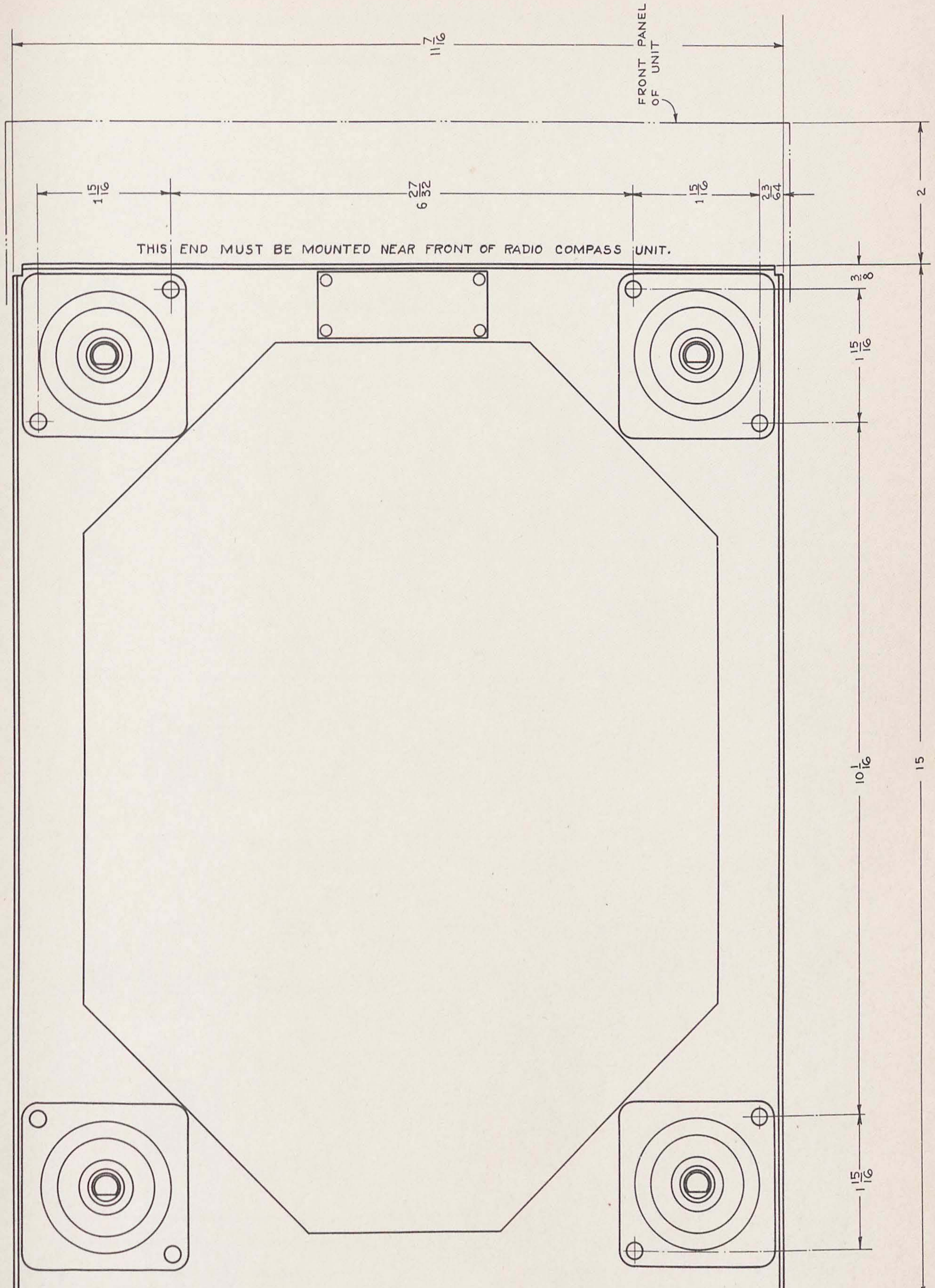


Figure 36—Mounting FT-145-A, Outline Dimensional Drawing and Drilling Diagram

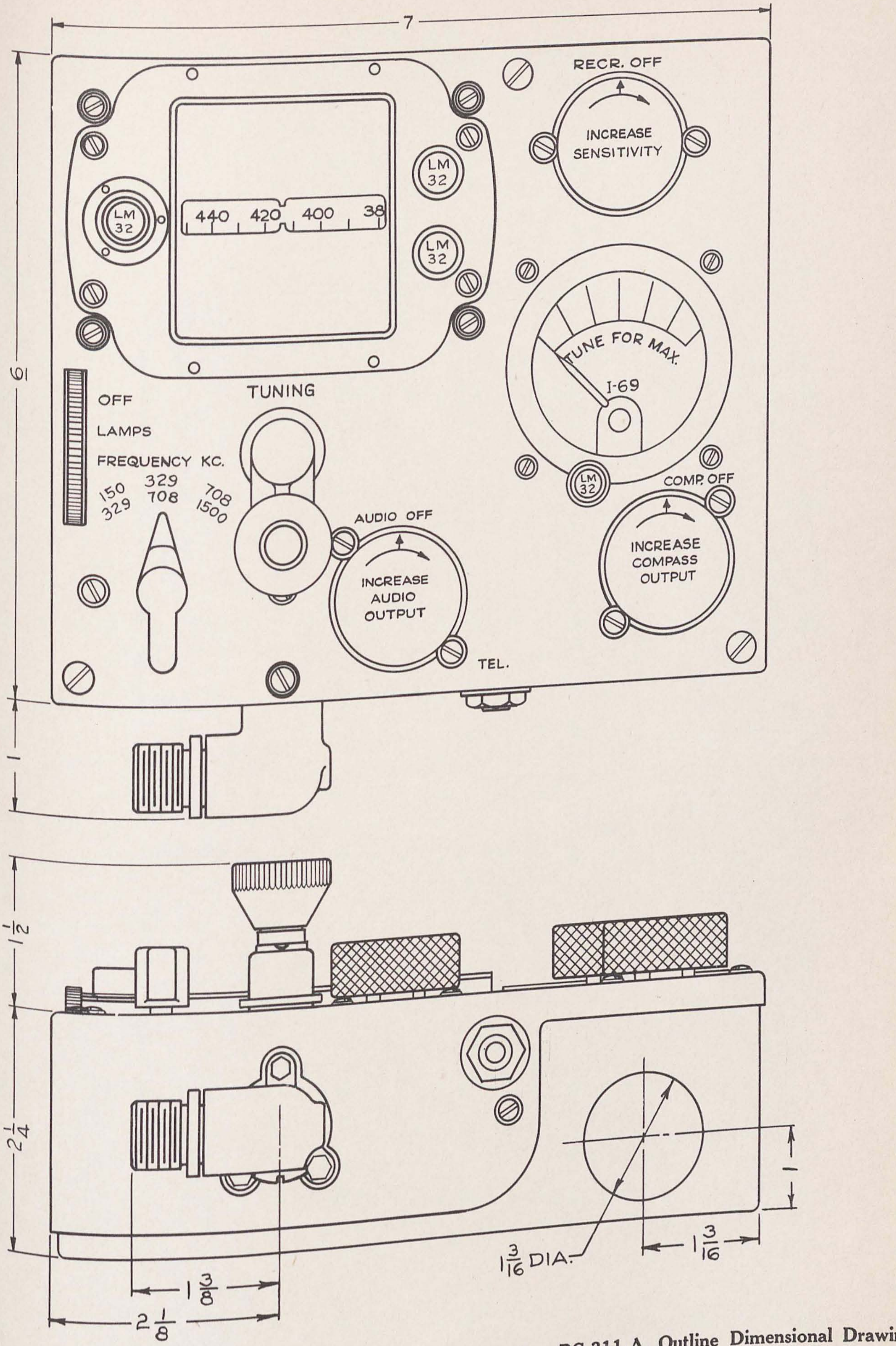


Figure 37—Radio Control Box BC-311-A, Outline Dimensional Drawing

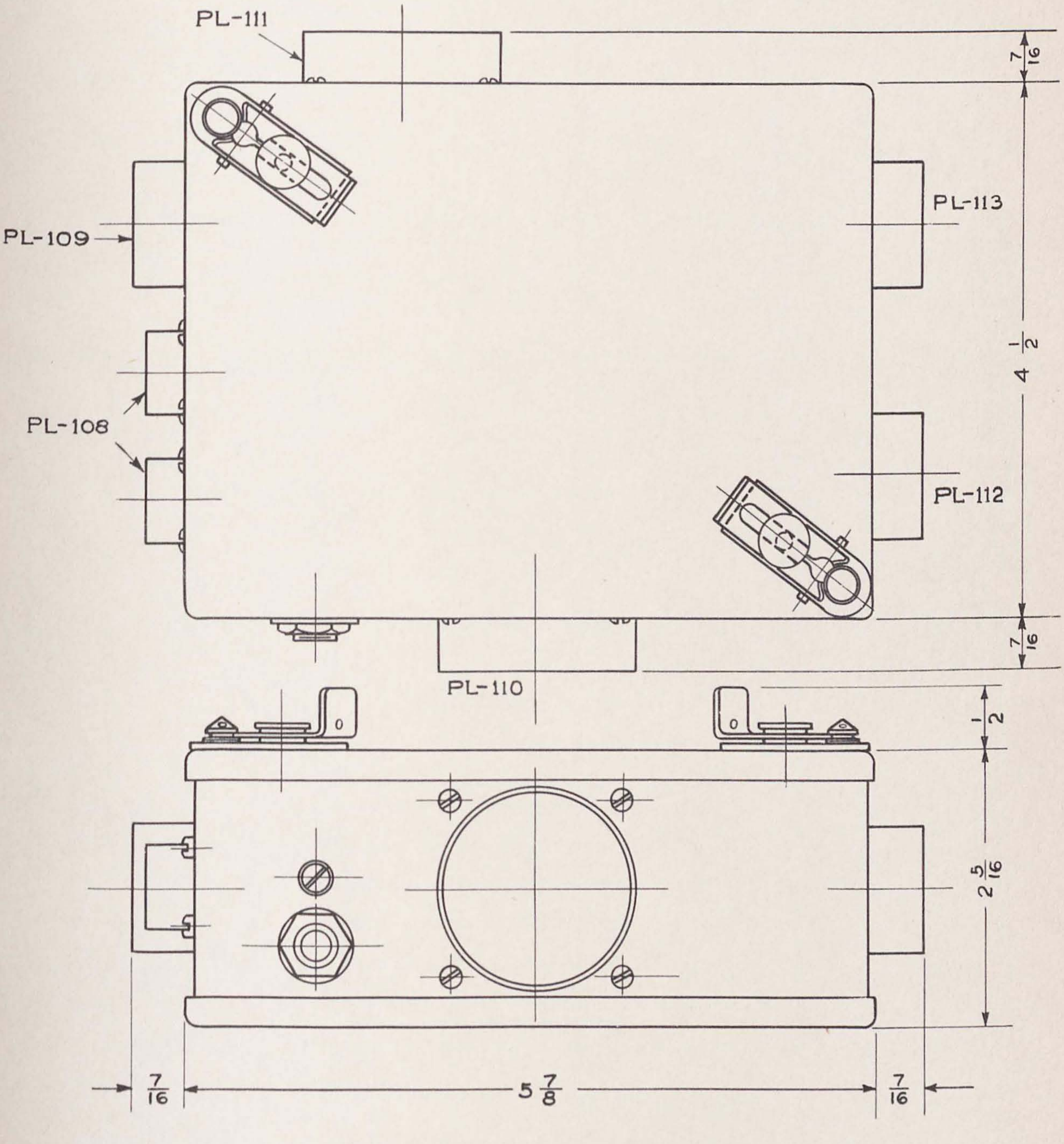


Figure 38—Junction Box TM-180-A, Outline Dimensional Drawing

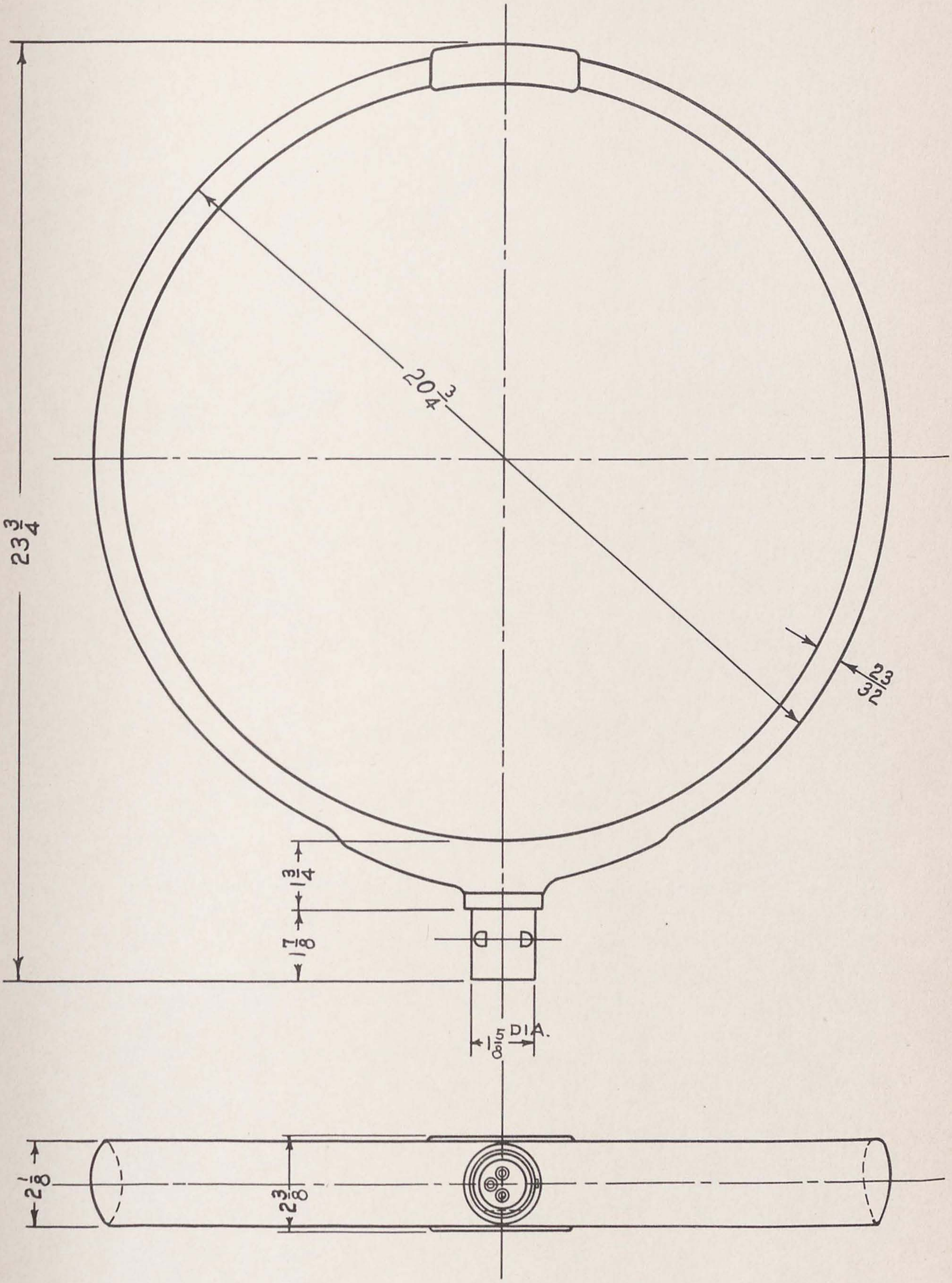


Figure 39—Loop LP-13-A, Outline Dimensional Drawing

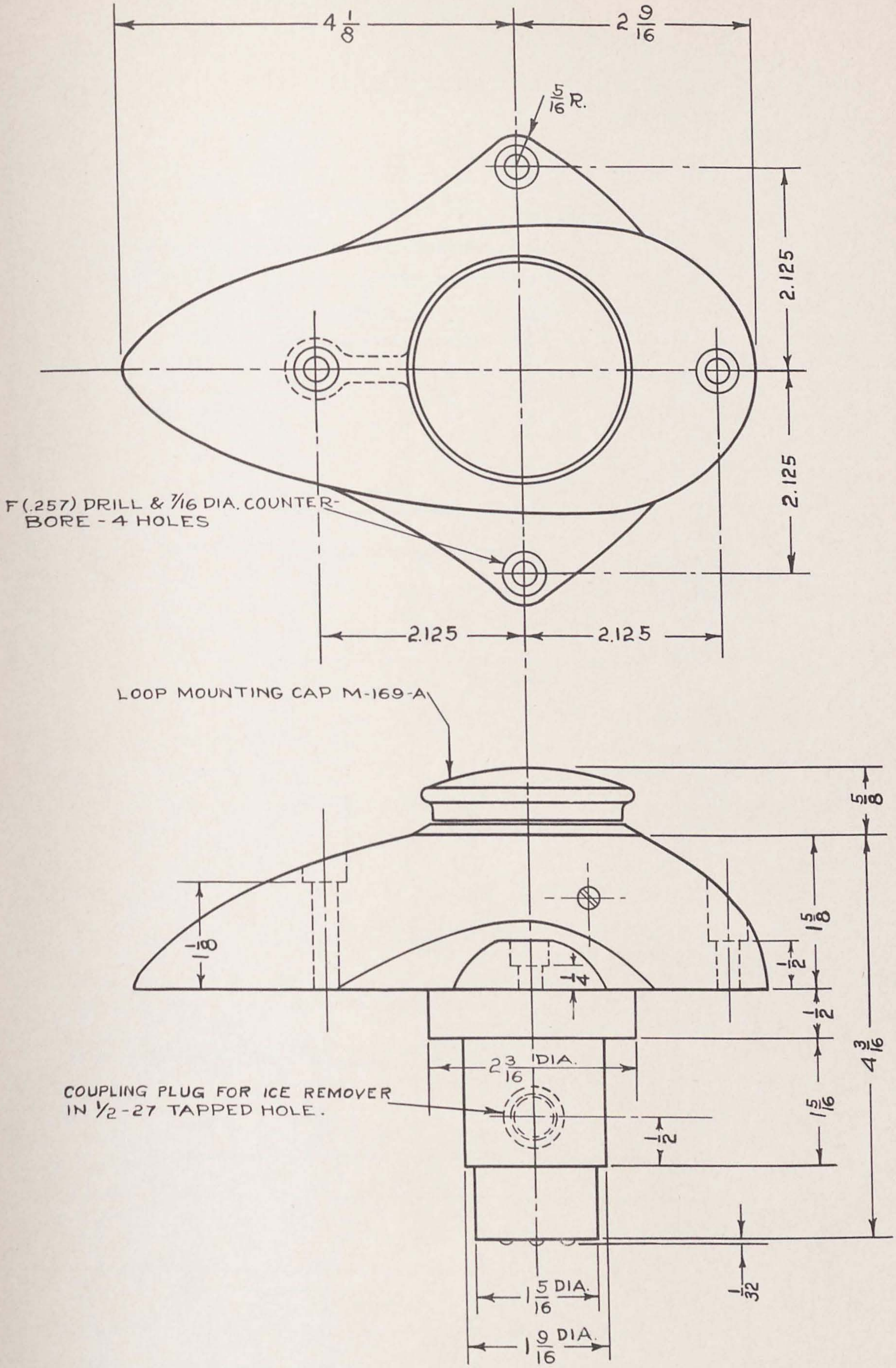


Figure 40—Loop Mounting GS-7-A, Outline Dimensional Drawing

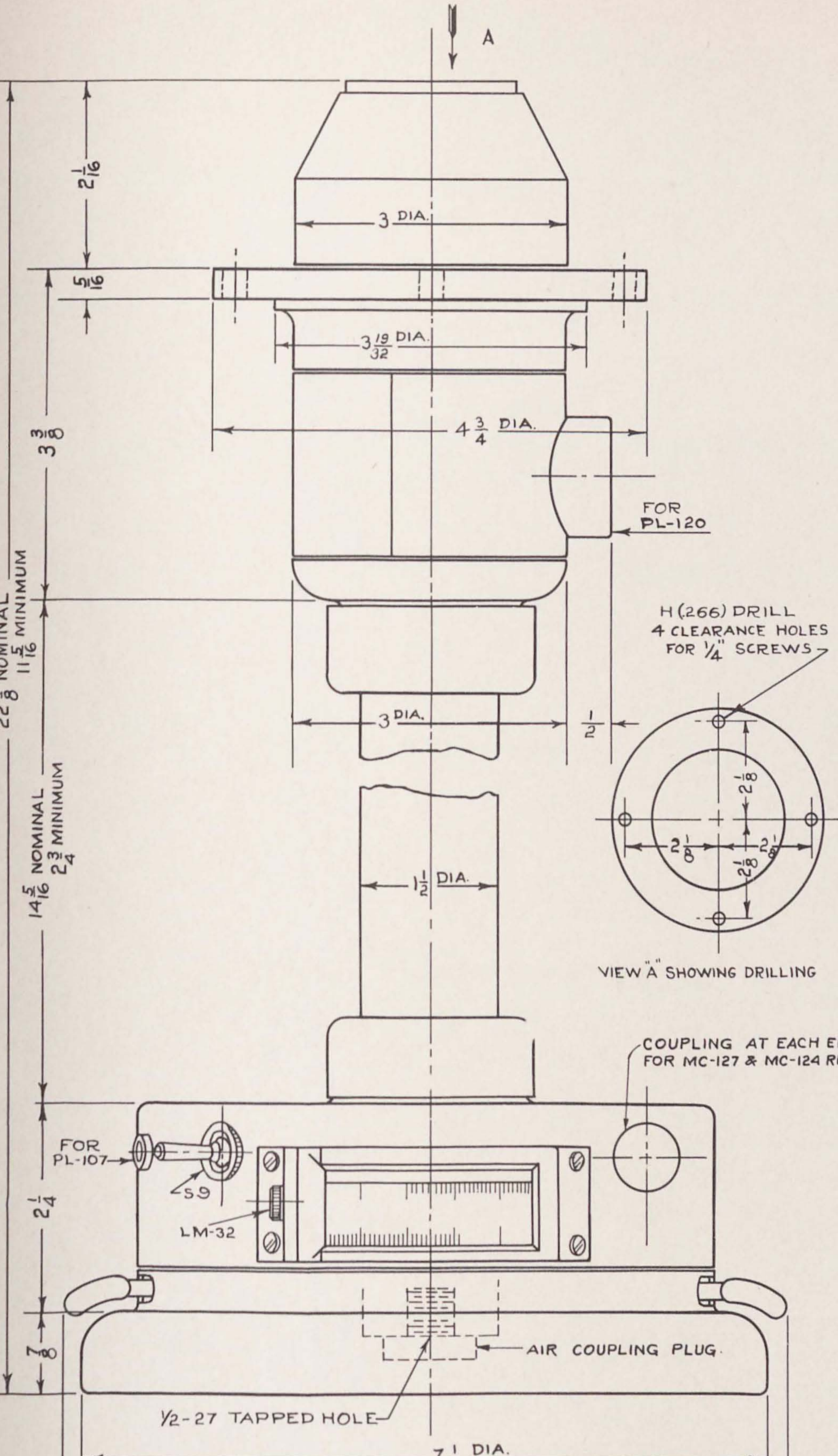


Figure 41—Loop Mounting GS-8-A, Outline Dimensional Drawing

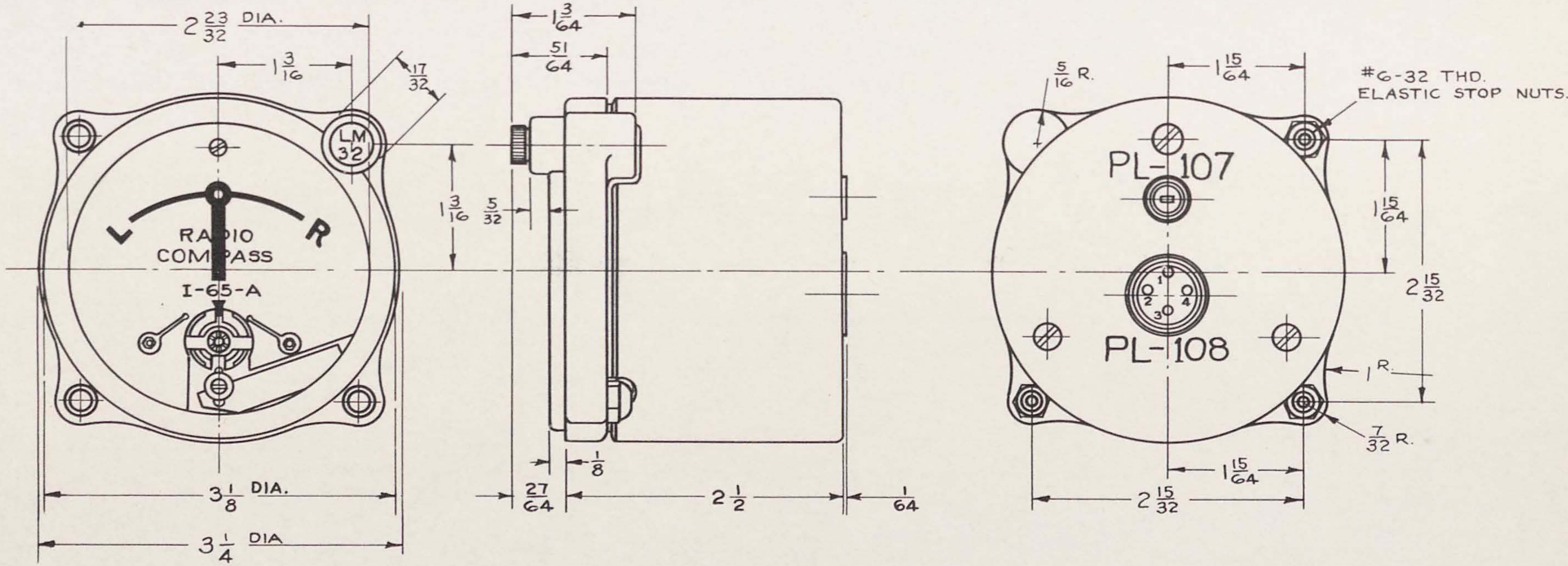


Figure 42—Compass Indicator I-65-A, Outline Dimensional Drawing

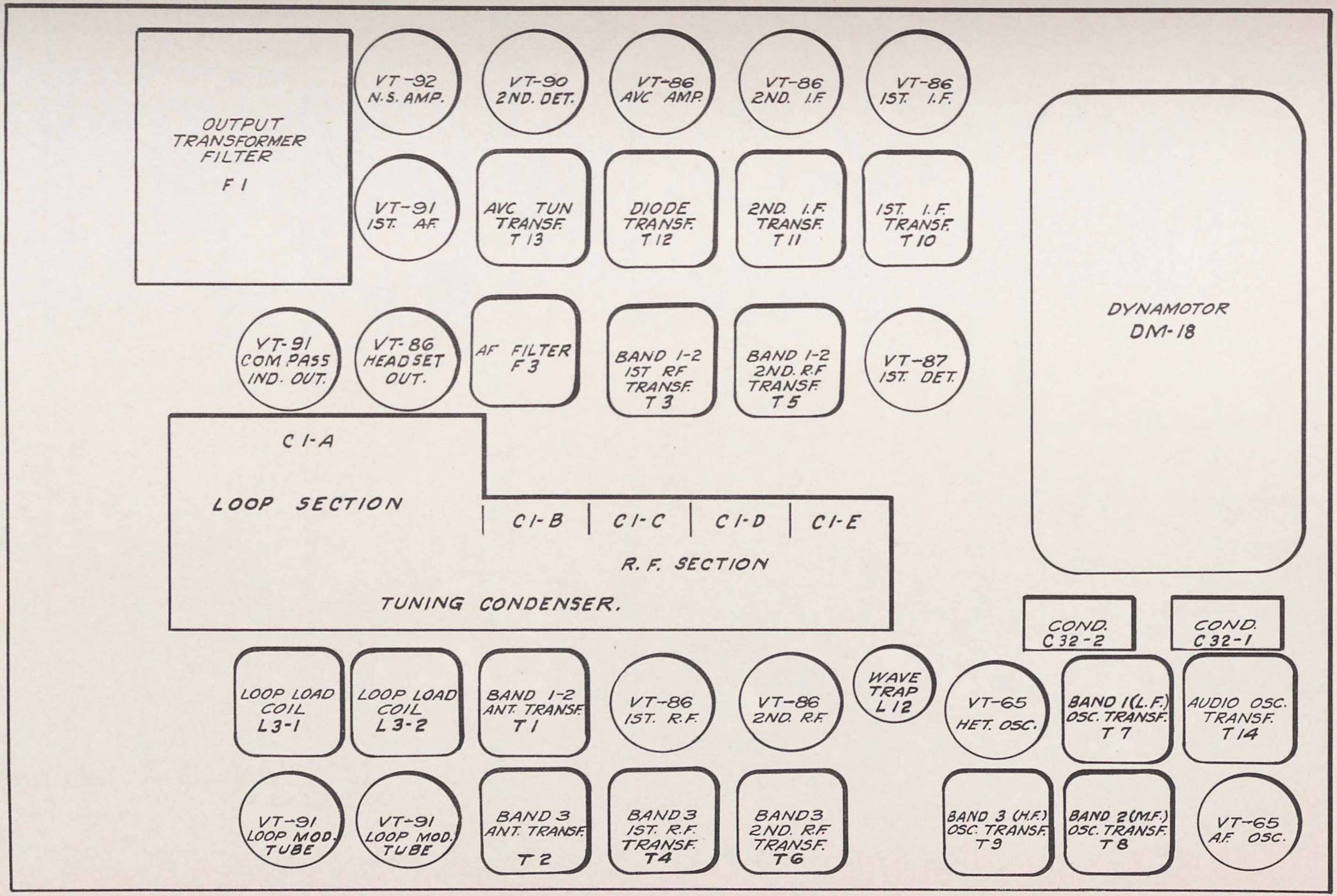


Figure 43—Chassis Location Chart

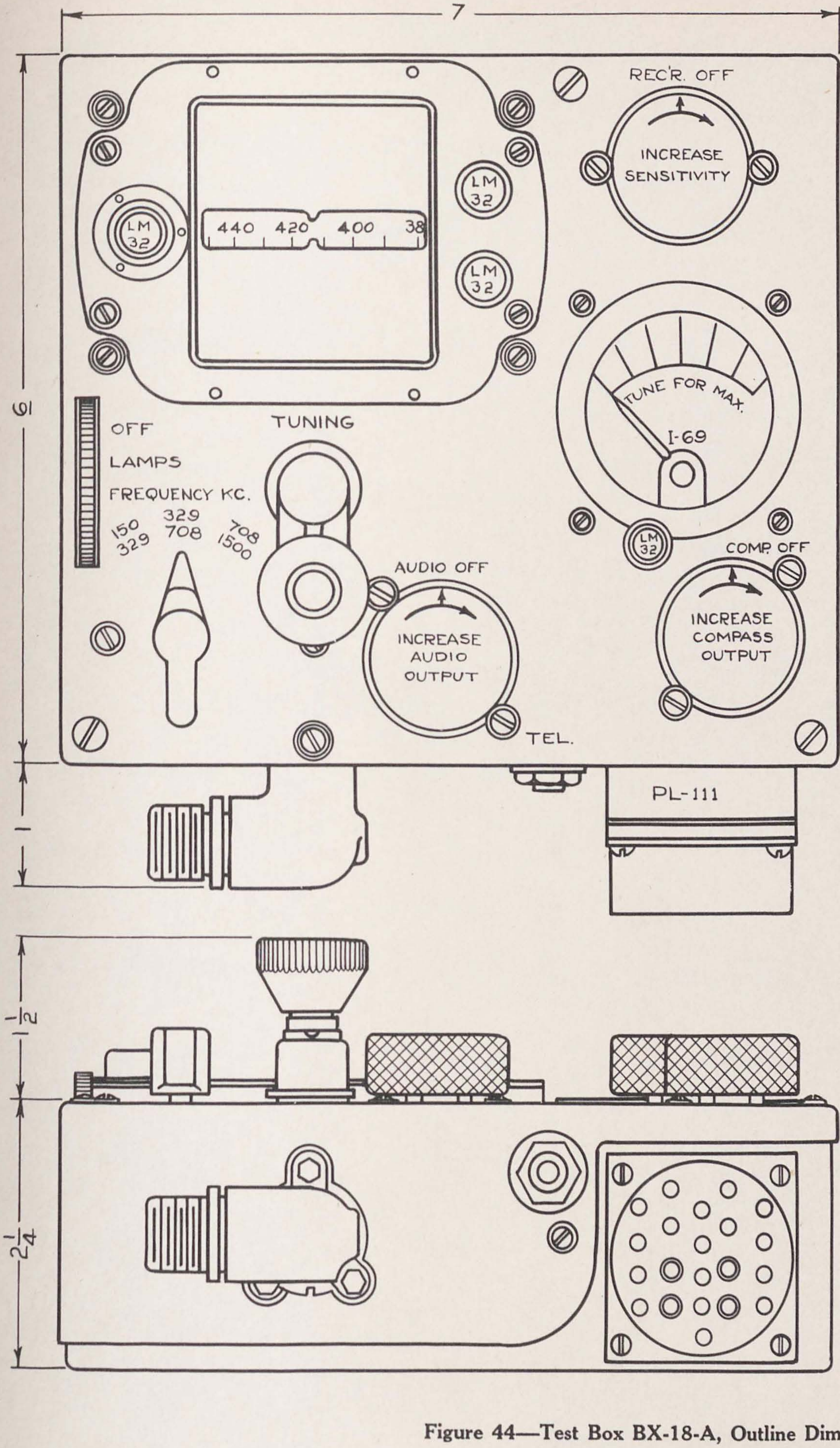


Figure 44—Test Box BX-18-A, Outline Dimensional Drawing

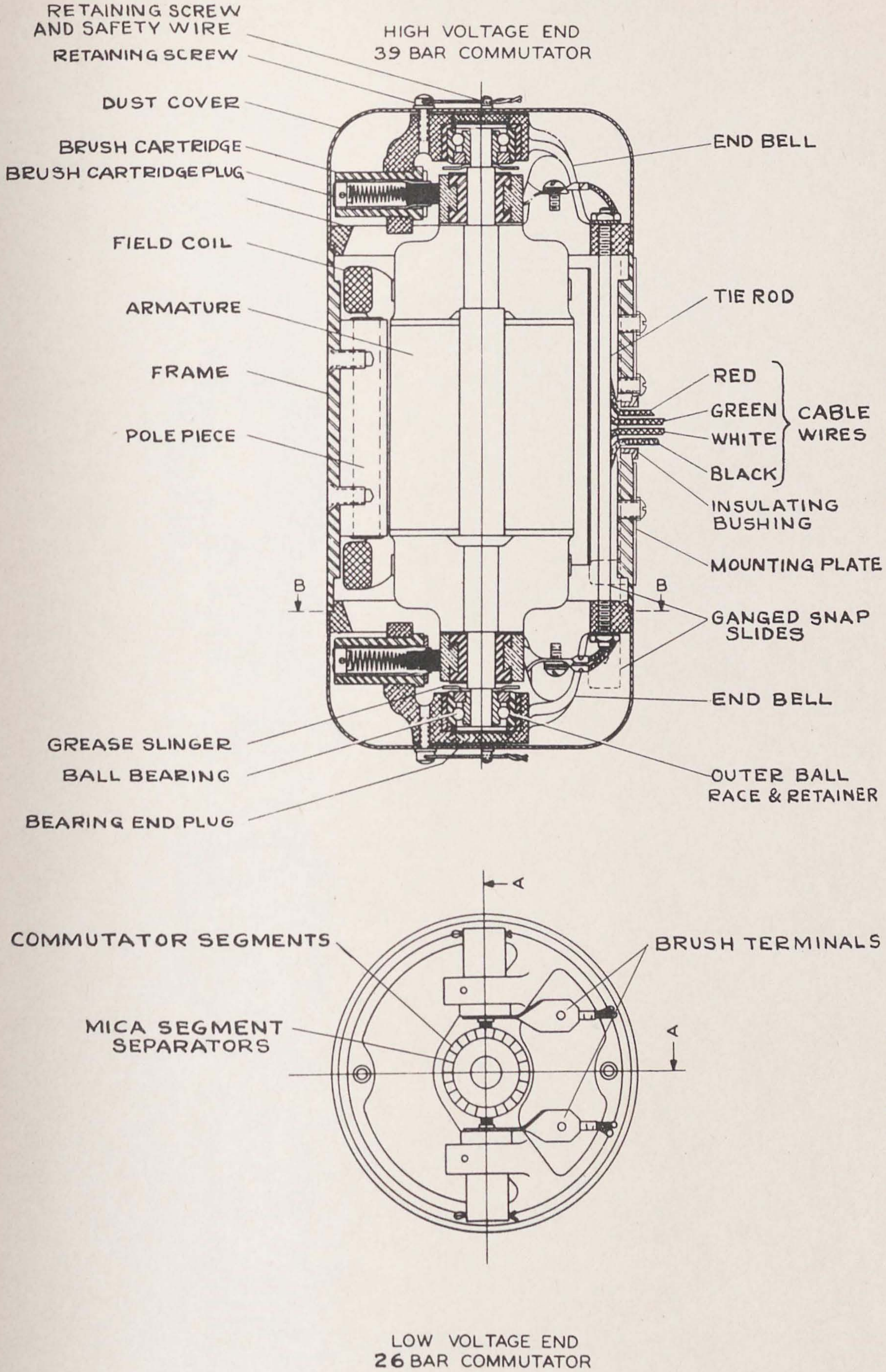


Figure 45—Dynamotor DM-18, Assembly Drawing

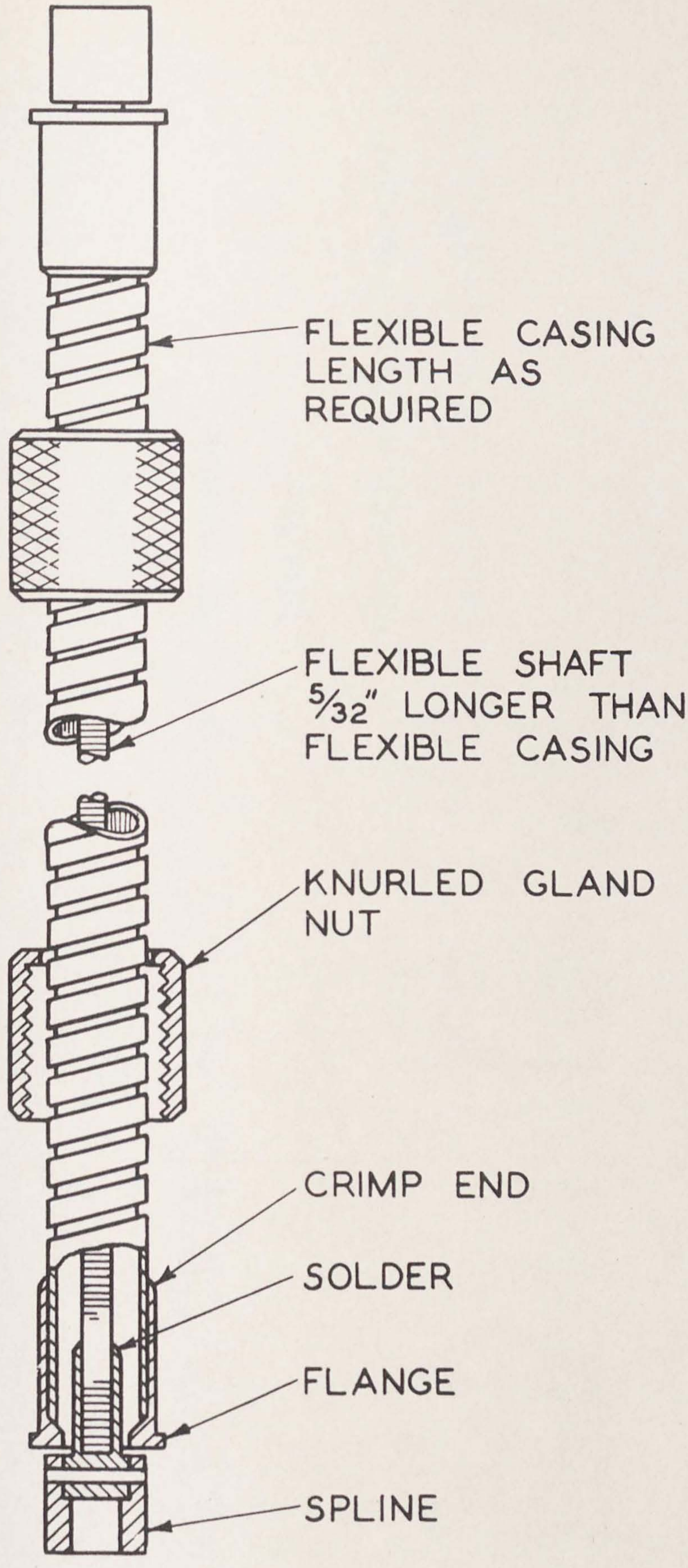


Figure 46—Tuning Shaft MC-124, Assembly Drawing

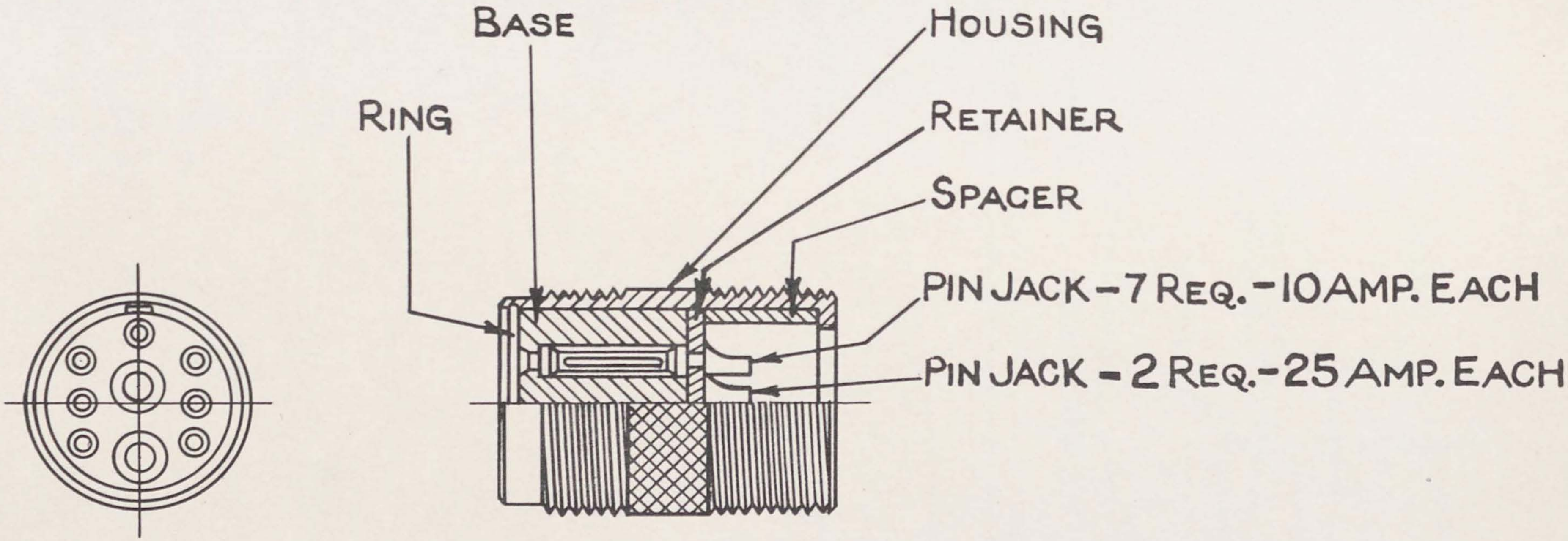


Figure 47—Plug PL-112, Assembly Drawing