INSTRUCTION BOOK

for

NAVY MODELS RAO-3 AND RAO-4 RADIO RECEIVING EQUIPMENT

NAVSHIPS-900, 359-1B

RESTRICTED

(*For Official Use Only*)

MANUFACTURED BY
WELLS-GARDNER & CO.
CHICAGO, ILLINOIS

FOR

U. S. NAVY DEPT. BUREAU OF SHIPS

Contract NXss-21446 *Approved 27, SEPTEMBER, 1944*

RESTRICTED

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RECORD OF CORRECTIONS MADE

CHANGE No.	DATE	SIGNATURE OF OFFICER MAKING CORRECTION

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GUARANTEE

The equipment including all parts and spare parts, except vacuum tubes, batteries, rubber and material normally consumed in operation, is guaranteed for a period of one year from the date of delivery of the equipment to and acceptance by the Government with the understanding that all such items found to be defective as to material, workmanship or manufacture will be repaired or replaced, f.o.b. any point within the continental limits of the United States designated by the Government, without delay and at no expense to the Government; provided that such guarantee will not obligate the Contractor to make repair or replacement of any such defective items unless the defect appears within the aforementioned period and the Contractor is notified thereof in writing within a reasonable time and the defect is not the result of normal expected shelf life deterioration.

To the extent the equipment, including all parts and spare parts, as defined above, is of the Contractor's design or is of a design selected by the Contractor, it is also guaranteed, subject to the foregoing conditions, against defects in design with the understanding that if ten per cent (10%) or more of any such said item, but not less than two of any such item, of the total quantity comprising such item furnished under the contract, are found to be defective as to design, such item will be conclusively presumed to be of defective design and subject to one hundred per cent (100%) correction or replacement by a suitably redesigned item.

All such defective items will be subject to ultimate return to the Contractor. In view of the fact that normal activities of the Naval Service may result in the use of equipment in such remote portions of the world or under such conditions as to preclude the return of the defective items for repair or replacement without jeopardizing the integrity of Naval communications, the exigencies of the Service, therefore, may necessitate expeditious repair of such items in order to prevent extended interruption of communications. In such cases the return of the defective items for examination by the Contractor prior to repair or replacement will not be mandatory. The report of a responsible authority, including details of the conditions surrounding the failure, will be acceptable as a basis for affecting expeditious adjustment under the provisions of this contractual guarantee.

The above one year period will not include any portion of time the equipment fails to perform satisfactorily due to any such defects, and any items repaired or replaced by the Contractor will be guaranteed anew under this provision.

REPORT OF FAILURE

Report of failure of any part of this equipment, during its service life, shall be made to the Bureau of Ships in accordance with current instructions. The report shall cover all details of the failure and give the date of installation of the equipment. For procedure in reporting failures see Chapter 67 of the "Bureau of Ships Manual," or superseding instructions.

PERTINENT DATES

Contract NXss 21446 Date of Contract, January 11, 1943

Serial number of equipment.....

Date of acceptance by the Navy.....

Date of delivery to contract destination.....

Date of completion of installation.....

Date placed in service.....

Blank spaces in this book shall be filled in at time of installation. Operating personnel shall also mark the "date placed in service" on the date of acceptance plate located below the model nameplate on the equipment, using suitable methods and care to avoid damaging the equipment.

REQUESTS FOR REPLACEMENT MATERIAL

All requests or requisitions for replacement material should include descriptive data covering the part desired, in the following form:

1. Name of part desired.

2. Federal Stock number (if assigned).

3. Navy Type number (if assigned) (including prefix and suffix as applicable).

4. Commercial designation.

5. Model designation (including suffix) of equipment in which used.

6. Navy Type designation (including prefix and suffix where applicable) of major unit in which part is used.

7. Contract, purchase order, requisition, etc., under which the equipment was procured.

8. Circuit symbol designation of part.

9. (a) Navy drawing and/or specification number (include part or group number)

   (b) Manufacturer's drawing or specification's number. (Include part or group number.)

10. Rating or other descriptive data.

WARNING

THIS EQUIPMENT EMPLOYS VOLTAGES WHICH ARE DANGEROUS AND MAY BE FATAL IF CONTACTED BY OPERATING PERSONNEL. EXTREME CAUTION SHOULD BE EXERCISED WHEN WORKING WITH THE EQUIPMENT.

THE ATTENTION OF OFFICERS AND OPERATING PERSONNEL IS DIRECTED TO CHAPTER 67 OF BUREAU OF SHIPS MANUAL OR SUPERSEDING INSTRUCTIONS ON THE SUBJECT OF "RADIO-SAFETY PRECAUTIONS TO BE OBSERVED."

AN APPROVED POSTER ILLUSTRATING THE RULES FOR RESUSCITATION BY THE PRONE PRESSURE METHOD SHALL BE PROMINENTLY DISPLAYED IN EACH RADIO, RADAR OR SONAR ENCLOSURE. POSTERS MAY BE OBTAINED UPON REQUEST TO THE BUREAU OF MEDICINE AND SURGERY.

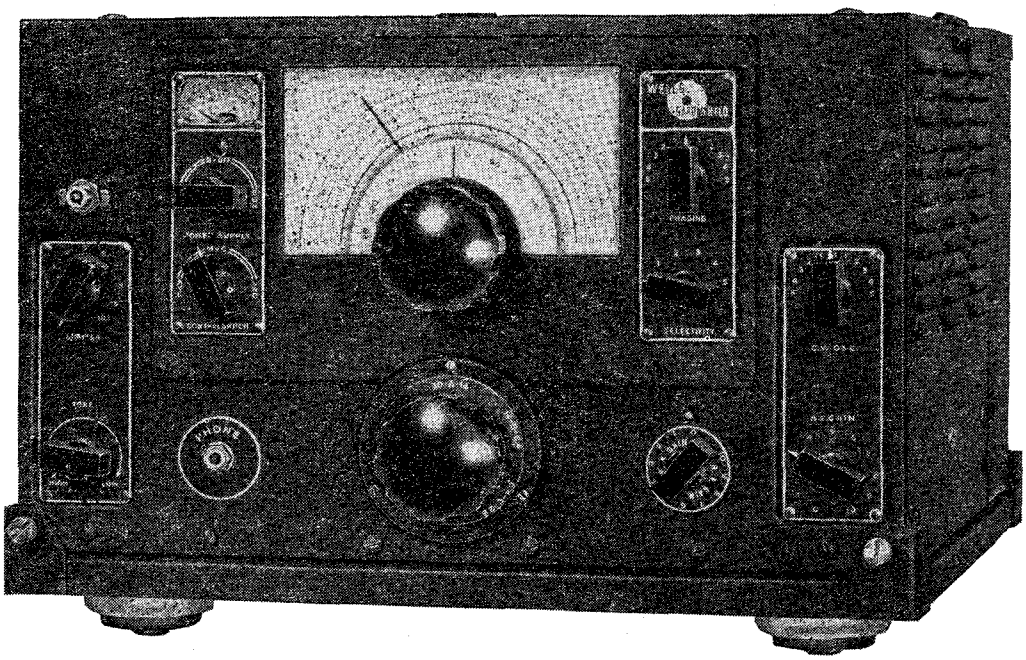


Fig. 1. The Model RAO-3 Radio Receiver

SECTION I
DESCRIPTION

SPECIAL NOTICE

The Model RAO-3 and RAO-4 Radio Receiving Equipments are essentially alike except for the required AC power supply voltages. The Model RAO-3 Radio Receiving equipment is intended for operation on a 115 volt, 50-60 cycle power supply and the Model RAO-4 Radio Receiving Equipment is intended for operation on either a 115 or 230 volt, 50-60 cycle power supply.

IMPORTANT

Do Not Attempt to Operate the Models RAO-3 and RAO-4 Radio Receiving Equipments Without First Reading the Following Instructions:

Power Supply Voltage and Frequency	105-115 Volts, 50-60 Cycles. See Par. 1, General (Page 1). The RAO-4 may also be operated on 230 volts.
Connections to Power Supply	See Par. 10a, Connections for AC Operation (Page 6) and Par. 10b, Connections for Battery Operation (Page 6).
Antenna and Ground Connections	See Par. 12a(2) Antenna and Ground Connections (Page 8).
Antenna Connector Plug Installation	See Par. 12a(2) Antenna and Ground Connections (Page 8).

1 GENERAL

The †Model RAO-3 Radio Receiving Equipment employs 11 tubes in a super-heterodyne circuit and covers in five bands the frequency range of 540-30,000 kc.

The receiver is suitable for the reception of MCW, CW or ICW signals. The receiving equipment is suitable for use either at Naval Shore Stations or aboard Naval vessels where the radiation of the high frequency oscillator must be less than 400 micro-micro watts as measured at the antenna terminal.

The Model RAO-3 Radio Receiver is intended to operate on a 115 volt, 50-60 cycle power supply. The Model RAO-4 Radio Receiver is intended to operate on a 115 or 230 volt, 50-60 cycle power supply. The power consumption of either receiver is approximately 60 watts when operating on the AC power supply. Connections are provided at the rear of the receivers for battery operation when necessary.

All controls, as well as a head phone jack, are located on the front panel. Power, antenna, ground, additional output connections and fuses are located at the rear of the receiver.

2 SHIPPING INFORMATION

a Model RAO-3

The Model RAO-3 Radio Receiving Equipment consists of the following:

1 Type CWQ-46187-A Radio Receiver
1 Type CWQ-10125-A Mounting Base
1 Set of Spare Parts and Tools
2 Preliminary Instruction Manuals

The equipment is packed and shipped in a single wooden packing crate as follows:

Size—28½"x21½"x17½" High
Cubic Volume—6.8 Cubic Feet
Shipping Weight—165 lbs.
Weight of Receiver—75 lbs.

Marking—
Contract NXss 21446
Model RAO-3
Radio Receiving Equipment
with
Equipment Spare Parts
Serial No.

Lot— Item— Pty.—
Equip. No.— Of Quan.—
Wt. 165 lbs. Cu. Ft. 6.8

b Model RAO-4

The Model RAO-4 Radio Receiving Equipment consists of the following:

1 Type CWQ-46187-B Radio Receiver
1 Type CWQ-10125-A Mounting Base
2 Type 49016 Headphones with Type 49034 Plug Attached
1 Set of Spare Parts and Tools
2 Preliminary Instruction Manuals

‡The Model RAO-4 Radio Receiving Equipment is essentially the same as the Model RAO-3, except where otherwise noted.

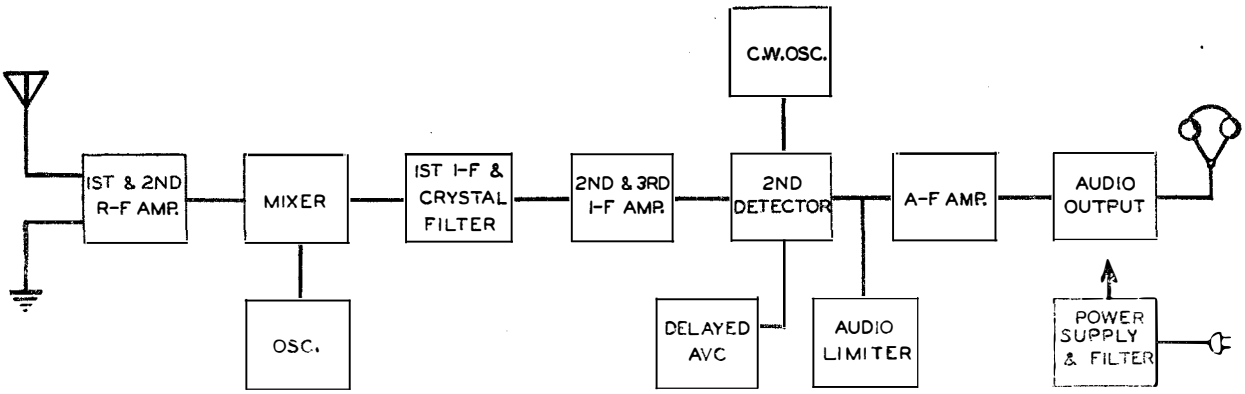


Fig. 2. Block Diagram of Models RAO-3 and RAO-4 Radio Receivers

The equipment is packed and shipped in a single wooden packing crate as follows:

Cubic Volume—6.8 Cubic Feet
Shipping Weight—165 lbs.
Weight of Receiver—75 lbs.
Size—28½"x21½"x17½" High

Marking— Contract NXss 21446
Model RAO-4
Radio Receiving Equipment
with
Equipment Spare Parts
Serial No.

Lot— Item— Pty.—
Equip. No.— Of Quan.—
Wt. 165 lbs. Cu. Ft. 6.8

3 CIRCUIT DESCRIPTION

a General

The Type *CWQ-46187-A Radio Receiver uses two stages of R-F amplification, a separate high frequency oscillator, a mixer stage, a crystal filter circuit and two stages of I-F amplification followed by a infinite impedance type detector. A single audio amplifier stage is followed by a single-ended output stage. A separate stage is provided for the C-W oscillator and separate circuits provide automatic volume control and limiting of the peak noise signals. A self-contained power supply provides the necessary DC voltages when the receiver is operated from an AC power line.

b Power Supply

Although primarily intended for operation on an AC power supply, provisions have been made for battery operation. For battery operation it is necessary to have a six volt A battery and a 180 volt B battery supply. The six volt battery must be capable of supplying 3.45 amperes and the B battery, 30 milliamperes. Connections for battery operation are given in Par. 10b, Connections for Battery Operation.

*Information concerning the Type CWQ-46187-A Radio Receiver is applicable also to the Type CWQ-46187-B Radio Receiver except where otherwise stated.

c Frequency Changes

The receiver covers the frequency range of 540-30,000 kc in five bands approximately as follows:

Band	Frequency Range
A	14,000-30,000 kilocycles
B	6,400-14,000 kilocycles
C	2,800- 6,400 kilocycles
D	1,300- 2,800 kilocycles
E	540- 1,300 kilocycles

d Tube Complement

The tubes used in the Type *CWQ-46187-A Radio Receiver and the circuit in which each is used are as follows:

6K7	1st R-F Amplifier
6K7	2nd R-F Amplifier
6J7	Mixer
6J5	H-F Oscillator
6K7	1st I-F Amplifier
6K7	2nd I-F Amplifier
6C8G	2nd Detector and Limiter
6J7	C-W Oscillator
6F8G	1st Audio Amplifier and Automatic Volume Control
6K6GT/G	Audio Output
5Z3	Rectifier

e *Output Connections*

A phone jack is provided on the front panel for connecting head phones to the receiver's output stage. A terminal at the rear of the receiver provides an additional output connection in parallel with the jack on the front panel. The correct impedance for the total output load is 600 ohms.

4 CABINET

A steel cabinet with a black wrinkle finish is used to house the Type *CWQ-46187-A Radio Receiver. The cabinet is 17⅝" wide, 10½" high and 16$\frac{1}{16}$" deep. The top of the cabinet is hinged to give access to the tubes for servicing. A removable bottom plate enables the service man to reach the under side of the chassis.

5 DIAL

The main tuning dial is of the fixed scale moving pointer type, calibrated in five frequency bands. At the bottom of the main tuning dial is an additional small rotating dial that is divided into 100 divisions. This dial is of value when tuning in a station accurately. The drive ratio is such that the small dial revolves ten times while the tuning capacitor travels thru the tuning range.

*Information concerning the Type CWQ-46187-A Radio Receiver is applicable also to the Type CWQ-46187-B Radio Receiver except where otherwise stated.

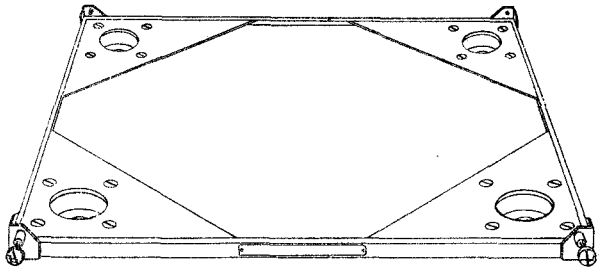


Fig. 3. The Type CWQ-10125-A Mounting Base

6 MOUNTING BASE

The Type CWQ-10125-A Mounting Base is a metal framework with four shock absorber feet. Holes in the shock absorbers allow the Mounting Base to be bolted securely to a table or bench.

At each corner of the Mounting Base are upright corner pieces. These corner pieces position the receiver and hold slotted, knurled thumb screws that are used to fasten the receiver to the base.

Fig. 28, Drilling Plan for Mounting Base Installation, shows the dimensions for a drilling template that may be made and used whenever a permanent receiver installation is to be made.

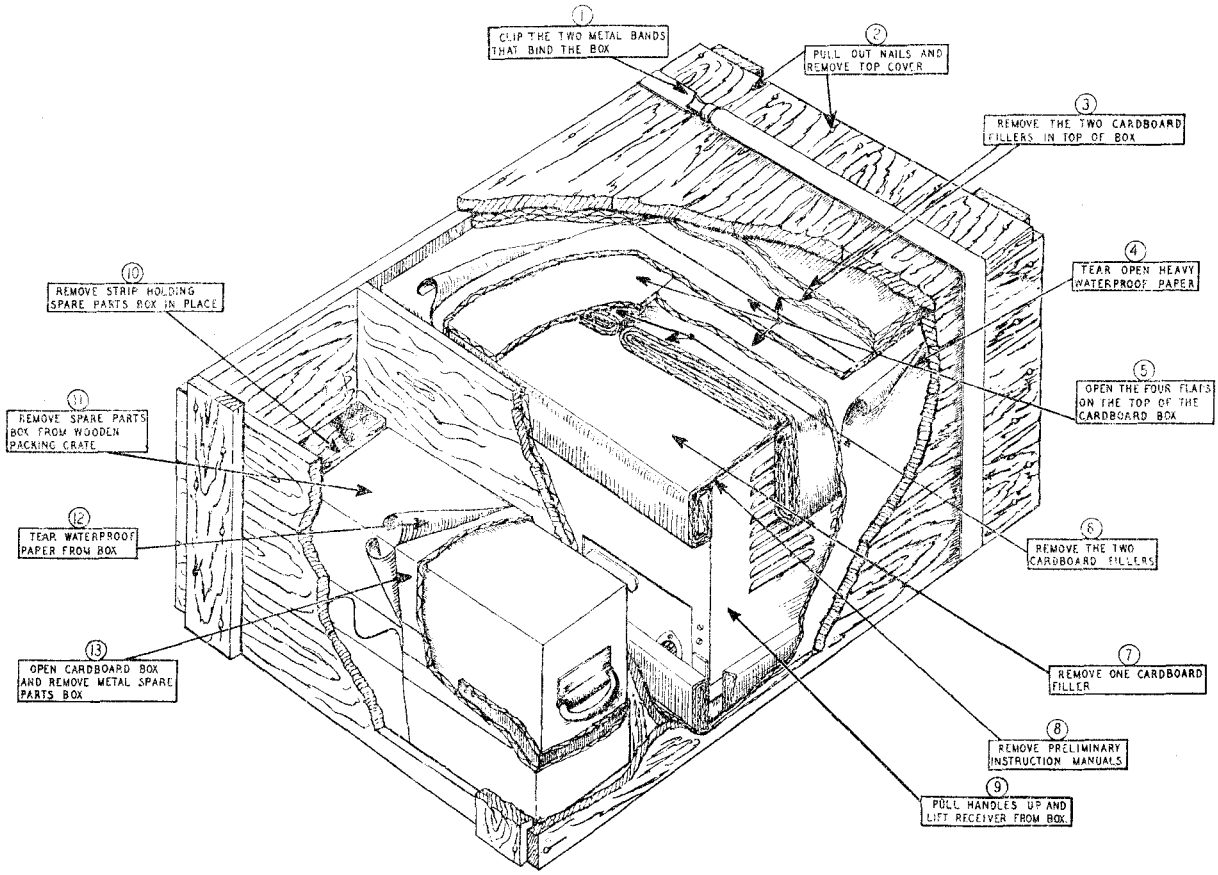


Fig. 4. Unpacking Procedure

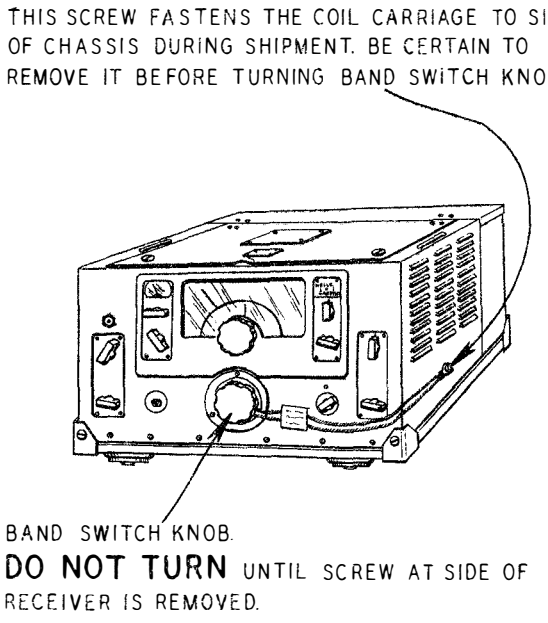


Fig. 5. Removal of Coil Carriage Screws

SECTION II
PREPARATION FOR USE AND OPERATION

7 UNPACKING THE EQUIPMENT

The Type *CWQ-46187-A Radio Receiving Equipment is packed in a wooden box with the Type CWQ-10125-A Mounting Base, spare parts and instruction manuals.

To unpack the equipment preparatory to installation, proceed as follows:

1. Clip the two metal bands binding the box.
2. Pull out the nails from the top of the box and remove the cover.
3. Remove two cardboard fillers in the top of packing box.
4. Tear open heavy waterproof paper.
5. Open the large cardboard box.
6. Remove the two fillers that will be seen in the top of the cardboard box.
7. Remove the one large cardboard filler.
8. Pull up the handles on the top of the cabinet near each end and lift the receiver from the carton.
9. Remove the strip holding the spare parts box in place.
10. Remove the spare parts box from the packing case.

*Information concerning the Type CWQ-46187-A Radio Receiver is applicable also to the Type CWQ-46187-B Radio Receiver except where otherwise stated.

8 PREPARATION OF EQUIPMENT

At the right side of the receiver is a screw that fastens the coil carriage to the side of the receiver. The purpose of this screw is to prevent movement of the carriage during shipment.

IMPORTANT

Before operating the Band Switch knob, remove this screw. The screw is located at the lower right side of the cabinet near the center and may be easily identified as it holds a lug that fastens a cord and warning card.

Operation of the Band Switch knob before the screw is removed may result in damage to the mechanism.

9 INSPECTION

After the receiver and spare parts have been uncrated and accounted for, check the receiver for broken dial glass, loose knobs, and other physical damage. Fig. 6, Tube Positions shows the positions of each tube as well as the dial lights. A check should be made to ascertain that each tube and fuse is in the proper position and that the dial lights are correctly inserted. The tubes and dial lights are accessible after opening the hinged lid on the top of the cabinet.

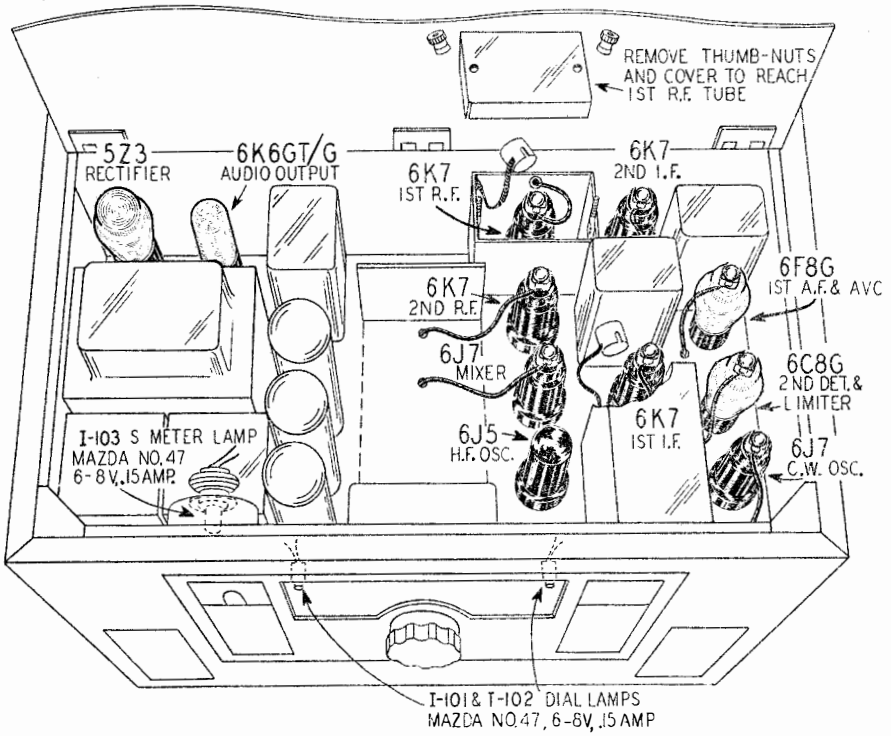


Fig. 6. Tube Positions

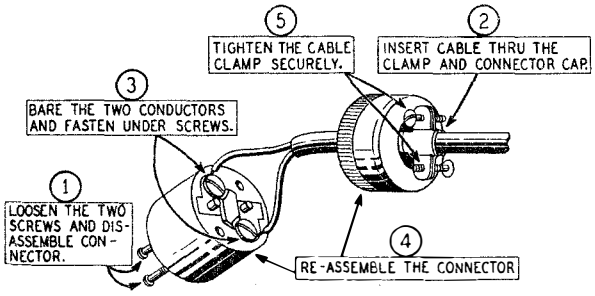


Fig. 7. AC Connector Plug Connections

10 CONNECTIONS TO POWER SUPPLY

a Connections for AC Operation

The Type CWQ-46187-A Radio Receiver is intended for operation on a power supply of 105-125 volts, 50-60 cycles.

The Type CWQ-46187-B Radio Receiver is intended for operation on a power supply of 115 or 230 volts, 50-60 cycles.

A jumper terminal board is used on the Power Transformer in the Type CWQ-46187-B Radio Receiver. Function of this terminal board is to connect the Transformer primaries for operation on either a 115 or 230 volt power supply. Fig. 27, Bottom Socket View of Type CWQ-46187-B Radio Receiver, shows how this terminal board must be mounted for either type of power supply.

For 115 Volt operation, the jumper terminal board must be mounted so that the 115 Volt marking is visible.

For 230 Volt operation, the jumper terminal board must be mounted so that the 230 Volt marking is visible.

Before plugging the receiver into a power supply outlet, make certain that the voltage and frequency available at the outlet is correct for the receiver.

An AC Connector Plug is supplied with the equipment. This plug is to be connected to a two-conductor cable as shown in Fig. 7, AC Connector Plug Connections. Each conductor in the cable should be of a size not smaller than #18 wire.

For AC operation, plug the AC Cord Connector Plug into the AC Power Socket, P-101, at the rear of the receiver.

Make certain that the AC Jumper Plug is inserted in the Battery Cable and Jumper Plug receptacle, J-103.

Insert the two-prong plug on the AC Cord into the AC power receptacle.

b Connections for Battery Operation

Connect a seven-prong Connector Plug to a 6 volt battery and a 180 volt B battery supply as follows:

Terminal No. 4, B—
Terminal No. 5, A+
Terminal No. 6, B+
Terminal No. 7, A—

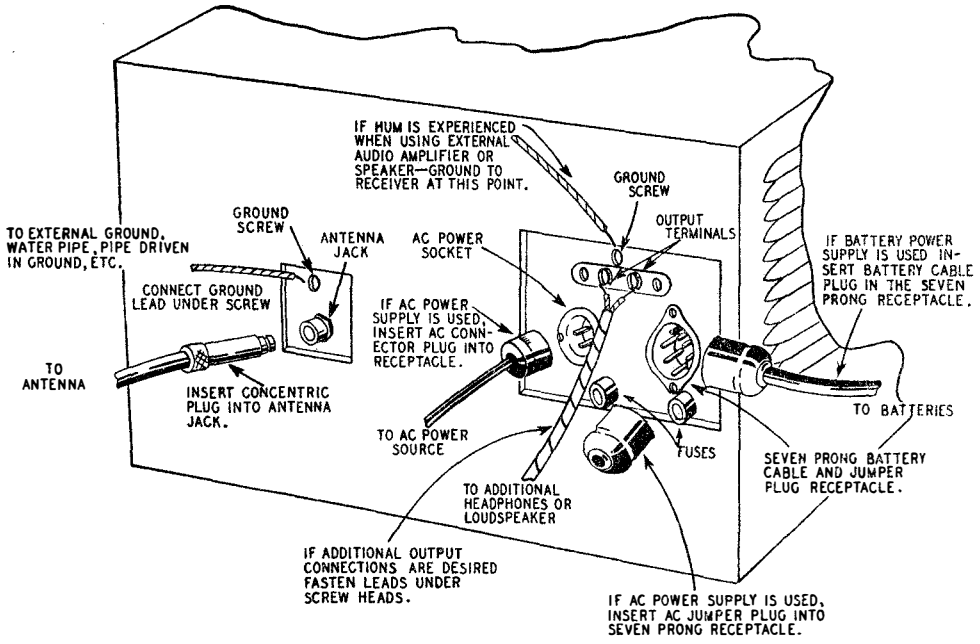


Fig. 8. Connections at Rear of Receiver

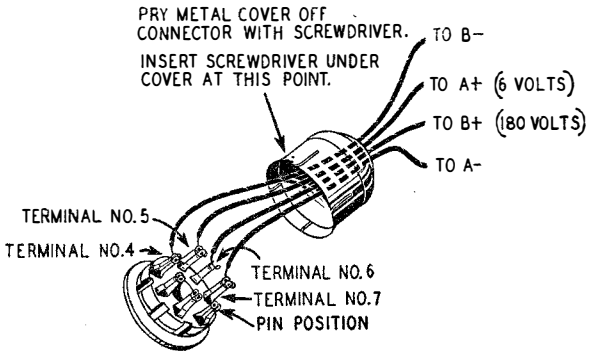


Fig. 9. Battery Cable Plug Connections

Terminals 1, 2 and 3 are to be left open. See Fig. 9, Battery Cable Plug Connections for a view of the Battery Cable Connector Plug showing the above connections.

To operate the receiver from a battery power supply, remove the AC Jumper Plug from the Battery Cable and Jumper Plug receptacle, J-103, and insert the Battery Cable Connector Plug.

If no seven-prong plug is available for the battery cable connection, remove the AC Jumper Plug; pry off the top, remove the jumper leads and rewire as instructed above. For AC operation, it will be necessary to disconnect the Jumper Plug from the Battery Cable and make the original connections as shown in Fig. 10, AC Jumper Plug Connections.

11 CONTROLS

After the equipment has been inspected, the operator should become familiar with the receiver controls. This step should be followed by a preliminary operating test.

a Power

The Power ON-OFF control is located near the left of the tuning dial. This control operates the switch that turns the receiver on or off. Although the receiver is primarily intended for operation on an AC supply, the function of the power switch will be the same when the receiver is operated from a battery power supply.

The switch has three positions—OFF, B+ OFF and B+ ON. The B+ OFF position may be used as a stand-by position during transmission periods.

b OFF-ON S-Meter Switch

Near the upper left corner of the front panel is a Toggle switch labeled OFF-ON. This control switches the S-Meter in and out of the circuit.

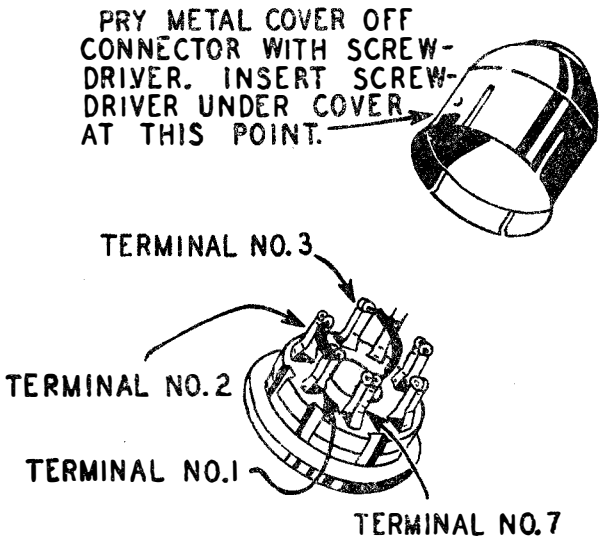


Fig. 10. AC Jumper Plug Connections

c Limiter Control

The Limiter control at the left of the front panel varies the DC potential applied to the Limiter tube. The position of the control determines the amplitude at which peak noise voltages will be cut off.

d Tone Control

The Tone control, near the lower left corner of the front panel, varies the audio band width passed by the audio amplifier. When turned to the position marked "N," the full range of the audio amplifier is utilized. In the high position, all audio frequencies above 100 cycles are amplified and those below, sharply attenuated. In the low position, audio frequencies under 1,000 cycles are amplified and those above, attenuated.

e Control Switch

The Control switch near the lower left corner of the receiver's dial selects the type of operation desired. It may be used to select AVC or MVC as well as to turn the C-W Oscillator on. When the C-W Oscillator is turned on, the automatic volume control circuit is automatically switched off.

f C-W Oscillator Control

The C-W Oscillator control may be used to vary the C-W Oscillator over a range of approximately 10,000 cycles. This enables the operator to select whatever audio tone is most suitable for the reception of the transmission.

g A-F Gain Control

The A-F Gain control regulates the amount of audio voltage fed into the audio amplifier and thus acts as a volume control.

h R-F Gain Control

The bias applied to the 1st and 2nd R-F stages is determined by the setting of the R-F Gain control. This enables the operator to adjust the sensitivity of the R-F stages to a level suitable for reception and also to prevent overload and distortion.

i Selectivity Control

The Selectivity control has six positions. When turned to the left to the OFF position, the crystal filter is cut out of the circuit. When the control is turned to any of the positions 1 through 5, the crystal filter is switched into the circuit and the selectivity increased as the knob is advanced towards the No. 5 position.

j Phasing Control

When using the crystal filter, interfering heterodyne signals may usually be eliminated by balancing the crystal circuit with the Phasing control.

k Tuning Knob

Reception may be accomplished by adjusting this knob until the desired signal is tuned in.

l Band Switch

The Band Switch knob permits the operator to select the desired frequency band in which the reception is to be accomplished. The knob must be turned approximately one and one-half turns to change from one band to the adjacent band. A positive detent mechanism positions the coil contact pins at each position of the Band Selector knob.

12 PRELIMINARY OPERATING TEST

A preliminary operating test should be made at the time the equipment is inspected in order to determine the condition of the receiving equipment.

a Electrical Connections

(1) POWER CONNECTIONS

Connections for AC or battery operation are to be made as instructed in Par. 10a, Connections for AC Operation, and Par. 10b, Connections for Battery Operation.

(2) ANTENNA AND GROUND CONNECTIONS

At the rear of the receiver is the antenna jack for the antenna connection and a flat head screw for the ground connection. No separate ground connection will be necessary if a concentric lead-in cable with grounded shield is used.

A Concentric Cable connector is to be attached to the Antenna Lead-in Cable as shown in Fig. 12, Concentric Plug Connections.

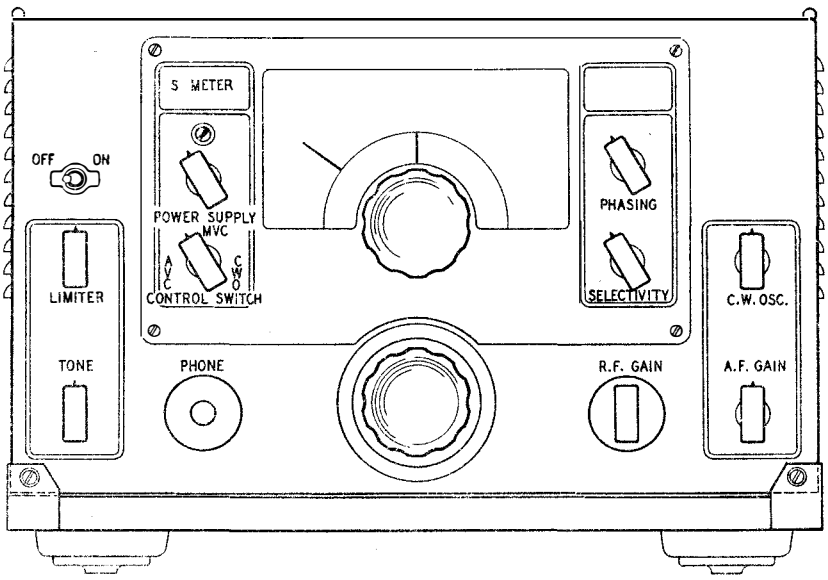


Fig. 11. Front Panel Controls

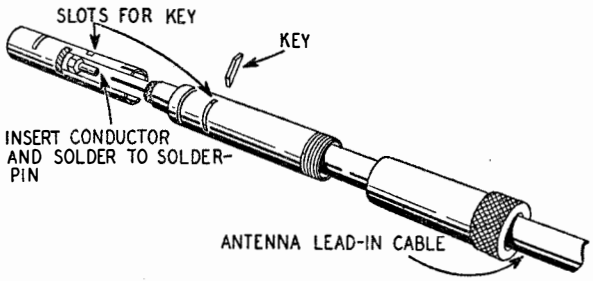


Fig. 12. Concentric Plug Connections

If necessary, connect the receiver to a good ground such as a cold water pipe or a pipe driven into the ground.

(3) OUTPUT CONNECTIONS

If headphones are to be used for the preliminary operating test they may be inserted into the phone jack on the front panel. An amplifier or additional sets of headphones may be connected to the output terminals at the rear of the receiver. The total output load impedance should be 600 ohms.

b Source of Test Signals and Procedure

The operating test should be made on each of the five frequency ranges. For this purpose both modulated and unmodulated signals should be used. Test signals may be derived from a signal generator or some station signal may be used.

If a station signal is used, connect the receiver to an antenna as mentioned in Par. 12a(2). If a signal generator is used as the source of the test signal, it may be connected through a capacitor, or a standard dummy antenna, to the antenna binding post.

c Test Procedure

The procedure for the operating test is as follows:

(1) Adjust the signal generator for a modulated signal at some frequency in the 540-1,300 kc band. If desired, a radio station transmitting a modulated signal in this frequency range may be used.

(2) Turn the Power ON-OFF switch to the B+ ON position. Allow about 30 seconds for the tubes to warm up.

(3) Adjust the controls on the receiver front panel as follows:

Controls	Position
OFF-ON S-Meter Switch	OFF
Limiter Control	Zero
Tone Control	N
Control Switch	MVC
C-W Oscillator	Zero
A-F Gain	Maximum
R-F Gain	Maximum
Phasing	Zero
Selectivity	OFF

(4) Turn the Band Selector knob to the E Band.

(5) Tune the receiver by means of the tuning knob and dial to the approximate test signal frequency. Slowly, rotate the tuning knob back and forth until the position is found at which the test signal comes in with maximum strength.

(6) Adjust the R-F Gain control to a position resulting in a suitable output level in the receiver's headphones. When the R-F Gain control is turned clockwise, the output level should increase.

(7) Vary the setting of the A-F Gain control and note result on the output signal level. The output signal should decrease when the control is turned in a counter-clockwise rotation.

(8) Turn the Control switch to the AVC position. The test signal should still be heard if correctly tuned in originally. The A-F Gain control should now be used to control the output signal level and the R-F Gain control should be set at maximum. When the receiver is tuned to a station frequency, the automatic volume control circuit will minimize fading effects. Changes of signal strength will not be as noticeable as when the Control switch is in the MVC position.

(9) De-tune the receiver from the test frequency to some position where only back-ground noise will be heard.

(10) Turn the Tone control clockwise from the "N" position. As the control is rotated, a lowering of the background noise should be noted. Return the Tone control to the "N" position.

(11) Turn the Limiter control in a clockwise direction. All peak audio voltages or noise signals will be limited to a level dependent upon the position of the Limiter control. Return the Limiter control to zero.

(12) Turn the signal generator modulation off or select a radio station transmitting an unmodulated signal.

(13) Turn the Control switch to the C-W Osc. position.

(14) Rotate the C-W Osc. control either side of the zero center position. An audio beat note should be heard if the receiver is accurately tuned to the test signal frequency. Leave the C-W Osc. control at a position producing a suitable audio note.

(15) Turn the Selectivity control to the No. 1 position. The receiver will now tune more sharply and the received signal may be tuned out with a much smaller movement of the tuning knob.

(16) Turn the Selectivity control step-by-step towards the No. 5 position. At each position, the receiver will tune more sharply.

(17) Turn the Control switch to the AVC position, the R-F Gain control to maximum and the Selectivity control to OFF. Tune in accurately either a modulated or unmodulated signal. Turn the Toggle switch at the upper left corner of the receiver front panel to the ON position. The signal strength of the test signal may now be read on the S-Meter.

(18) Repeat steps 3, 4, 5 and 6 on each frequency band.

SECTION III
INSTALLATION AND OPERATION

13 RECEIVER LOCATION

The Type *CWQ-46187-A Radio Receiver is to be fastened to the Type CWQ-10125-A Mounting Base at the time of installation. The mounting base may be mounted on any flat surface that is near the antenna lead-in and power supply outlet. If a permanent or secure mounting is desired, the mounting base may be bolted to the table or bench with four 3/8" bolts. The mounting base may be installed from the dimensions given in Fig. 28, Drilling Plan for Mounting Base Installation.

Sufficient clearance must be allowed between the rear of the receiver and the wall to allow for the Concentric Cable Connector and the curvature of the Antenna Lead-in Cable. The amount of space to be allowed will depend upon the type Antenna Lead-in Cable used.

The receiver is to be placed on the Mounting Base and then fastened securely by means of four slotted thumbscrews near the corners of the Mounting Base.

14 CONNECTIONS TO RECEIVER

a Power Connections

The Type CWQ-46187-A Radio Receiver may be operated from either a 105-125 volt 50-60 cycle (115 or 230 volts for Type CWQ-46187-B) AC supply, or from a battery power supply. Information concerning the proper connections at the receiver for either type power supply is given in Par. 10, Connections To Power Supply.

Do not connect the receiver to a power supply outlet unless certain that the voltage and frequency available are correct for the operation of the receiver.

*Information concerning the Type CWQ-46187-A Radio Receiver is applicable also to the Type CWQ-46187-B Radio Receiver except where otherwise stated.

b Antenna and Ground

At the rear of the receiver is the antenna jack for the antenna connection and a screw for the ground connection.

A Concentric Cable Connector is to be attached to the Antenna Lead-in Cable as shown in Fig. 12, Concentric Plug Connections.

Connect the receiver to a good ground such as a cold water pipe or a pipe driven into the ground if a concentric type lead-in with grounded shield is not used.

c Connections to Receiver's Output Stage

If headphones are to be used for the preliminary operating test, they may be inserted into the phone jack on the front panel. An amplifier or additional sets of headphones may be connected to the output terminals at the rear of the receiver. The total output load impedance should be 600 ohms.

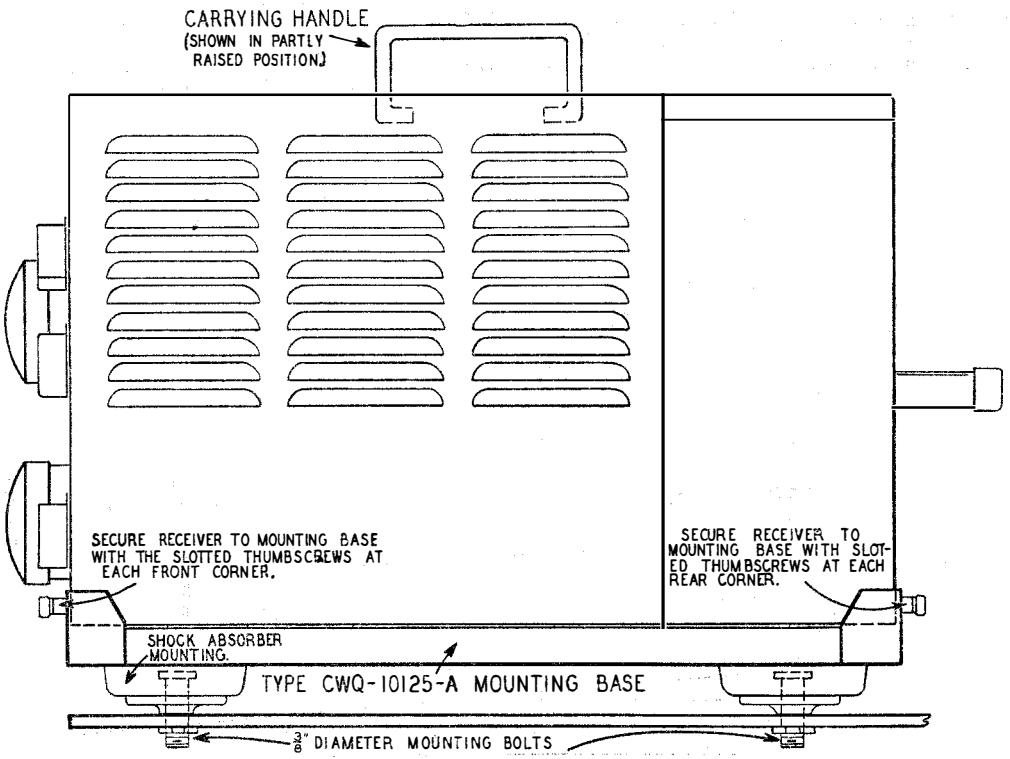


Fig. 13. Mounting the Model RAO-3 Radio Receiver

15 INSTALLATION INSPECTION

After the completion of the receiver and antenna installation, a thorough check of the installation should be made in order to insure the proper and secure fastening of the receiver and electrical connections.

16 OPERATION

a MCW Reception

For the reception of modulated signals, the operation of the Type *CWQ-46187-A Radio Receiver is as follows:

(1) Turn the Power control to the B+ ON position. Allow approximately 30 seconds for the tubes to warm up.

(2) Turn the Band Selector control to the band in which the signals to be received are transmitted.

(3) Turn the Control switch to the MVC position.

(4) Set the A-F Gain control to the maximum or No. 10 position.

(5) Adjust the R-F Gain control to a position that produces a suitable background noise level.

(6) Turn the Selectivity control to OFF.

(7) Turn the Limiter control to zero.

(8) Tune the receiver to the approximate station frequency by means of the tuning knob. Slowly rotate the tuning knob back and forth until the signal is received with maximum strength.

(9) Adjust the R-F Gain control for a suitable output level.

(10) Adjust the Tone control to the position that results in minimum background noise.

(11) After the receiver is tuned to the station, the Control switch may be turned to the AVC position if automatic volume control is desired.

(12) If AVC is used, turn the R-F Gain control to the maximum or No. 10 position and control the output level of the signal by means of the A-F Gain control.

(13) If interference is encountered, the selectivity of the receiver may be increased by turning the Selectivity control to one of the numbered positions. The selectivity of the receiver will increase as the control is turned towards the No. 5 position.

When receiving MCW signals, use the Selectivity control only when absolutely necessary as the increased selectivity will result in a loss in the quality of the received signal.

(14) Peak noise voltages of a level high enough to interfere with the received signal may often be limited by means of the Limiter control to a level that will permit reception of the desired signal.

(15) The strength of the received signal may be measured on the S-Meter. To make the signal strength reading, turn the Control switch to the AVC position, set the R-F Gain control at maximum or the No. 10 position.

*Information concerning the Type CWQ-46187-A Radio Receiver is applicable also to the Type CWQ-46187-B Radio Receiver except where otherwise stated.

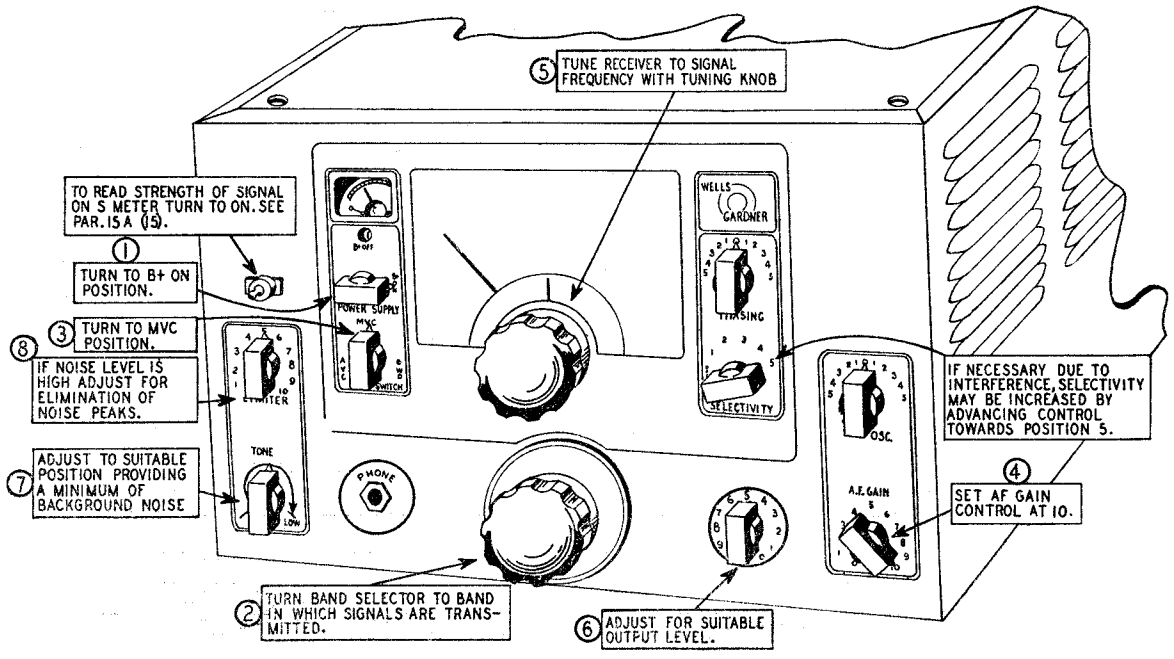


Fig. 14. General Operation of Controls for MCW Reception

Throw the Toggle switch at the upper left corner of the receiver front panel to the ON position. If the received signal is correctly tuned in, the strength may now be read on the S-Meter.

b C-W Reception

For the reception of C-W signals, proceed as follows:

(1) Turn the Power control to the B+ ON position. Allow approximately 30 seconds for the tubes to warm up.

(2) Turn the Band Selector control to the band in which the signals to be received are transmitted.

(3) Turn the Control switch to the CWO position.

(4) Set the A-F Gain control at the maximum or No. 10 position.

(5) Adjust the R-F Gain control to a position that produces a suitable background noise level.

(6) Turn the Selectivity control to OFF.

(7) Turn the Limiter control to zero.

(8) Turn the C-W Oscillator control away from the zero center position.

(9) Tune the receiver to the approximate frequency of the station by means of the tuning knob. An audio beat note will be heard when the station is tuned in. Slowly rotate the tuning knob back and forth until the signal is received with maximum volume.

(10) Adjust the R-F Gain control for a suitable output level.

(11) Adjust the C-W Oscillator control until a suitable beat note is obtained.

(12) If background noise is encountered, the Tone control may be turned clockwise in order that the noise may be minimized.

(13) Should a high background noise level or loud noise peaks be encountered, adjust the Limiter control to a position that will result in the leveling of the noise peaks to a level equal to that of the received signal.

(14) If interference is encountered, the selectivity of the receiver may be increased by turning the Selectivity control to one of the numbered positions. The selectivity of the receiver will increase as the control is turned towards the No. 5 position. Should interfering heterodyne signals still persist, the Phasing control may be adjusted to some position that will balance the interfering signal out.

(15) The strength of the received signal may be measured on the S-Meter. To make the signal strength reading, turn the Control switch to the AVC position, set the R-F Gain control at maximum or the No. 10 position.

Throw the Toggle switch at the upper left corner of the receiver front panel to the ON position. If the received signal is correctly tuned in, the strength may now be read on the S-Meter.

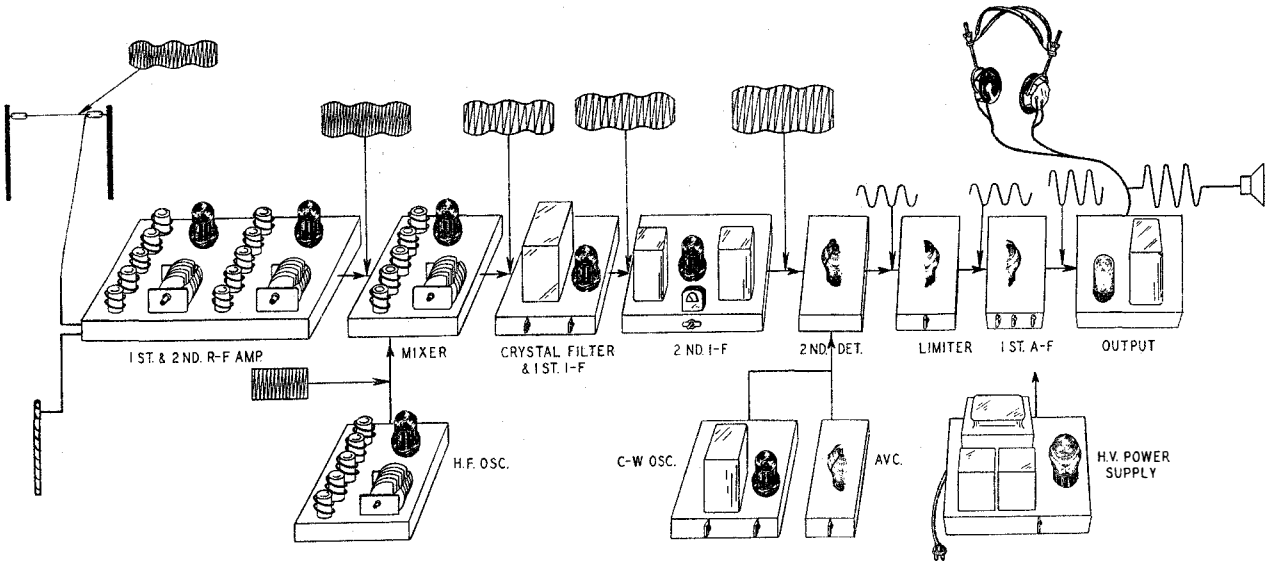


Fig. 15. Functional Diagram of Equipment

SECTION IV
CIRCUIT DESCRIPTION

17 RECEIVER OPERATION

In Fig. 15, is shown a block diagram of the receiver. The operation and function of each stage in the equipment when a modulated signal is received is as follows:

The transmitted signal is picked up by the antenna and transferred by means of the lead-in to the receiver. Here it is amplified in two amplifier stages. Next, it is passed on to the mixer stage where it is heterodyned with a signal from the local oscillator.

This results in a third signal at 455 kc that appears at the plate of the mixer tube. The 455 kc signal is then transferred through the 1st I-F transformer to the crystal filter. This filter is provided as a means of eliminating interferring signals that are close to the frequency of the signal that it is desired to receive. The selectivity of the receiver is controlled by the selectivity control on the front panel and may be set to a point that will permit optimum reception of the signal. The 455 kc signal after passing the crystal filter is further amplified by means of the two I-F stages. Then the signal is impressed upon the second detector where it is demodulated and the resultant audio signal passed to the limiter stage where the noise peaks are removed. In the A-F amplifier and output stages the audio signal is amplified further and fed to the receiver output terminals. Headphones or a speaker may be connected across the output terminals and the A-F signal will then be reproduced as sound.

If a C-W signal is received, the function of the R-F, Mixer, Oscillator, Crystal filter and I-F stages is the same as described above. However, to obtain an audio note suitable for reproduction in the headphones, the C-W signal is impressed upon the second detector together with the signal produced in the local C-W oscillator. This C-W oscillator signal is of a frequency close to the 455 kc I-F signal and may be varied above or below the I-F frequency by means of a front panel control. When the two signals are mixed in the detector, a beat note or audio signal results. The frequency of this beat note depends upon the adjustment of the C-W oscillator control. This control may be set to the position producing the note most pleasing to the operator. The resultant beat note or audio signal is then passed through the limiter stage, to the audio amplifier as previously described and then reproduced in the headphones or speaker.

The I-F frequency from the 2nd I-F amplifier stage in addition to being impressed upon the second detector, is also fed into the grid of the AVC tube. Here it is used to control the amount of AVC bias applied to the grid of the first and second R-F amplifier stages and the I-F amplifier stages. The AVC voltage controls the amplification of the R-F and I-F stages in accordance with the level of the signal received at the antenna terminals.

18 R-F AMPLIFIER

The R-F Amplifier in the Type *CWQ-46187-A Radio Receiver consists of two 6K7 amplifier stages. Individual coils for each band are connected into the circuit by means of the Band Selector knob on the front panel. AVC voltage is supplied to each stage. The gain of the stages is controlled by means of the R-F Gain control located on the front panel. All R-F coils are mounted on the two coil carriage assemblies. Each coil with associated trimmer condensers is located in a separate shielded compartment on the carriage. Operation of the Band Selector control on the front panel moves the coil carriage to a position where contacts on the receiver chassis will connect the coils to the proper stages.

19 MIXER STAGE

A 6J7 tube is used as a mixer. The signal from the local oscillator is coupled thru a .01 mf. capacitor to the screen of the mixer stage. Grid bias is obtained by means of a resistor connected between the cathode of the tube and ground. No AVC voltage is applied to this stage. Like the R-F and oscillator stages, individual coils are used for each frequency range. These are mounted in shielded compartments on the coil carriage.

*Information concerning the Type CWQ-46187-A Radio Receiver is applicable also to the Type CWQ-46187-B Radio Receiver except where otherwise stated.

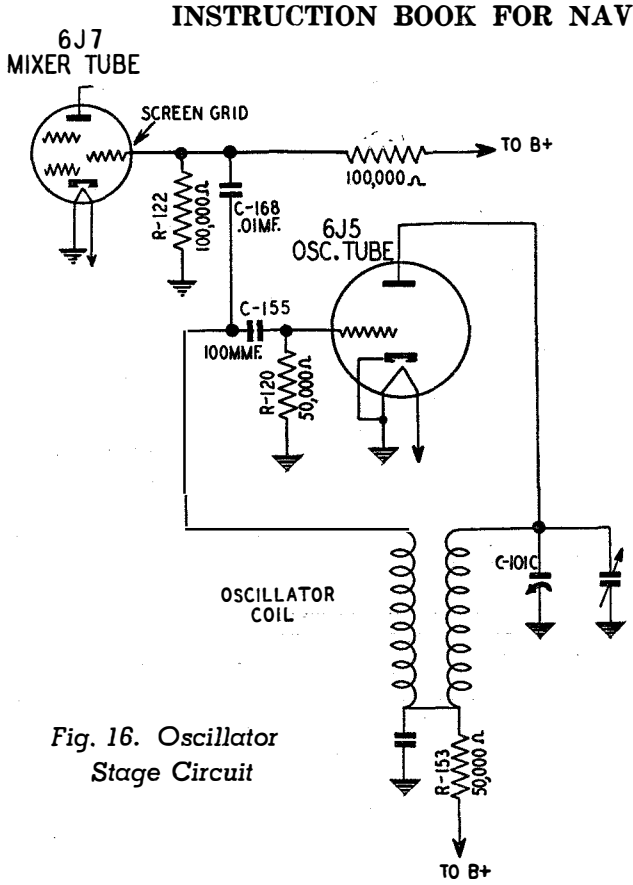


Fig. 16. Oscillator Stage Circuit

20 OSCILLATOR

A Type 6J5 tube is used in the oscillator stage. Individual coils and trimmer capacitors are employed for each frequency band. These coils are mounted on the large coil carriage assembly and each coil with its associated terminal capacitor is located in a separate shielded compartment. The circuit used in the oscillator stage is shown in Fig. 16.

21 CRYSTAL FILTER

A Crystal Filter with 5 degrees of selectivity is provided. This filter is connected between the 1st I-F transformer secondary and the grid of the first I-F tube. The 5 position switch enables the operator to select the degree of selectivity most suitable for reception. The phasing control is provided to permit sharp rejection of interferring signals that are close to the frequency of the desired signal.

22 I-F AMPLIFIER

Two I-F amplifier stages are used. Two Type 6K7 tubes are used in these stages. The I-F transformers are tuned by means of trimmer capacitors to a frequency of 455 kc. AVC voltage is supplied to each stage. Manual control of the gain in these stages is provided by the R-F Gain control on the front panel.

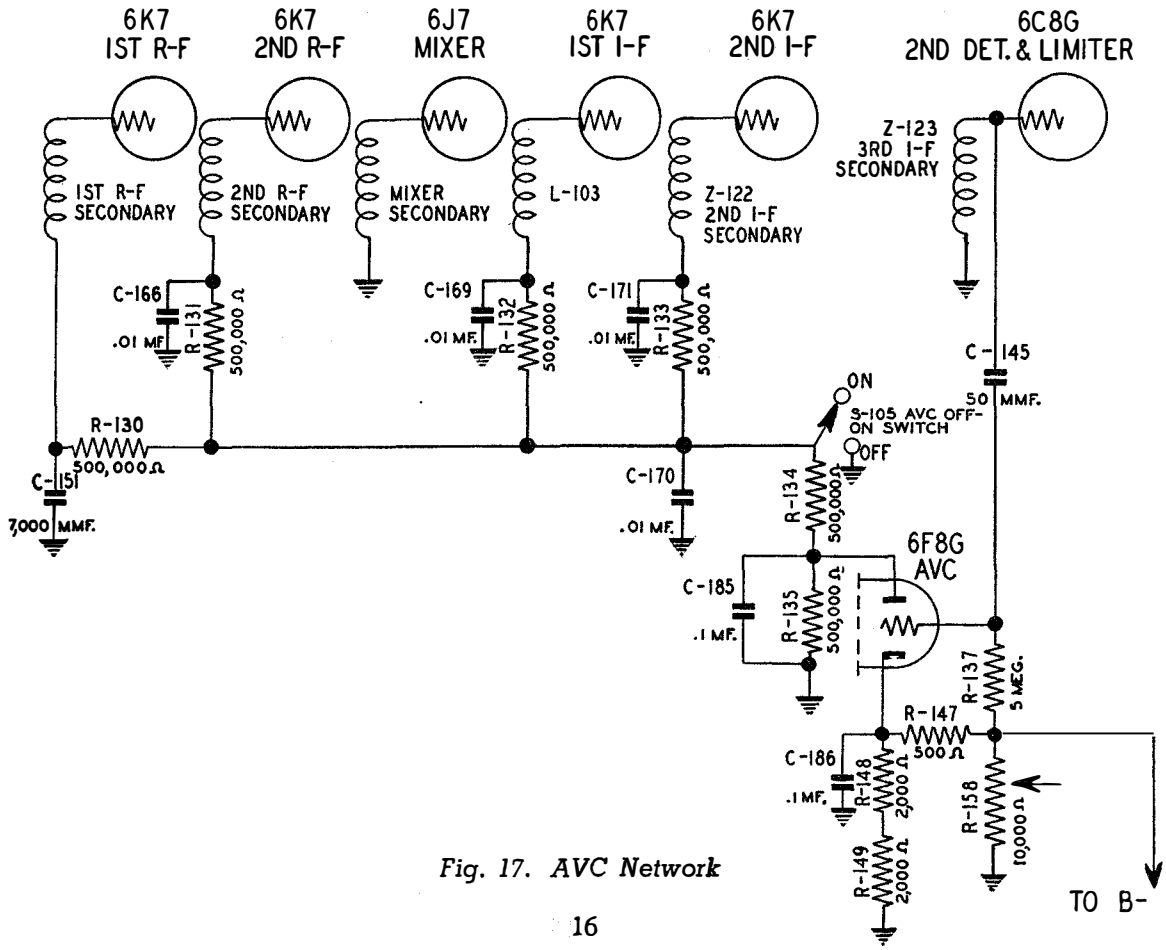


Fig. 17. AVC Network

23 C-W OSCILLATOR

The reception of the C-W signals may be accomplished by the use of the C-W or Beat Frequency Oscillator incorporated in the receiver. A 6J7 Tube is used in the C-W Oscillator circuit and a front panel control, identified as the C-W, Osc., varies the frequency at which the oscillator circuit operates, so as to provide a beat frequency with a range of approximately 10,000 cycles.

24 AUTOMATIC VOLUME CONTROL

A separate stage is used to provide delayed AVC. One section of a 6F8G twin-triode tube is used for this purpose. The I-F signal reaches the grid of this tube from the secondary of the 3rd I-F Transformer thru the coupling capacitor, C-145.

Rectification of the I-F signal in this stage, provides the controlling voltage for the AVC action. Proper delay voltage for the circuit is obtained from the B- network.

The switch, S-105, is incorporated for shorting the AVC network to ground whenever it is desired to use the receiver without automatic volume control. A control is provided on the front panel of the receiver for the operation of this switch.

25 2ND DETECTOR CIRCUIT

The detector circuit used is of the infinite impedance type, sometimes referred to as a reflex detector. This type detector will handle a high level input signal with low distortion. Also, the input impedance of the circuit is high enough so that it does not load the tuned circuit to which it is connected.

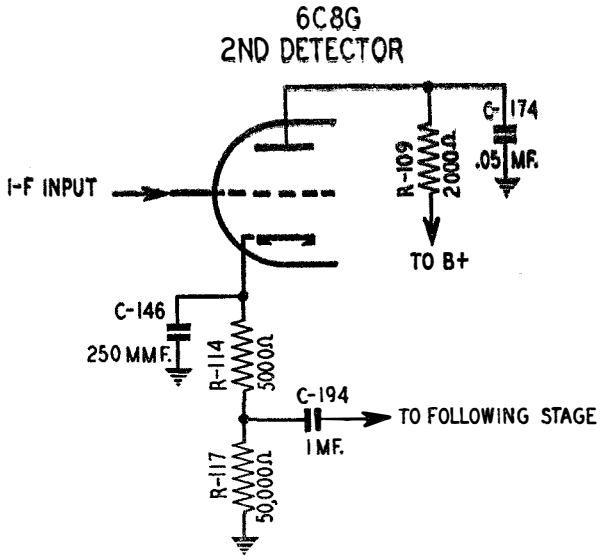


Fig. 18. 2nd Detector Circuit

Fig. 18 shows the actual circuit used. It will be noted, that this circuit is somewhat similar to that used for the plate detector. However, here the audio signal is developed across the high load resistance connected between the cathode and ground. Unlike the plate detector the infinite impedance detector does not amplify the audio signal. The inclusion of the high load resistance in the cathode leg of the circuit results in a degenerative circuit.

The resistor, R-109, connected between the B+ and the plate of the tube, serves as a filter for R-F and A-F in connection with the capacitor, C-174. The cathode load is made up of two resistors connected in series. The larger resistor, R-117, is the actual load that the signal is developed across. The signal is coupled from the high side of this resistor to the following circuits by means of the capacitor, C-194. The smaller resistor, R-114, is used with the capacitor, C-146 as a R-F filter.

Like the plate circuit detector, rectification of the R-F signal is accomplished by operating the tube near the point of the plate current cut-off. Thus, the negative portion of the incoming radio frequency signal is cut off, and the positive portion remains for amplification in the following audio stages.

The operation of the circuit is such that it minimizes the possibility of the grid driven positive with respect to cathode. This allows the tube to handle strong signals without overloading.

The high resistance between cathode and ground results in a low plate current and a high grid bias voltage with no signal at the grid. With a signal at the grid of the tube, the plate current will increase with the signal and consequently the voltage appearing across the load resistor will also increase. The high initial grid bias, plus the increase in bias due to the signal voltage at the grid, is sufficient to prevent even strong signals from overloading the tube and driving the grid positive.

Inasmuch as the cathode load resistor is not by-passed for the audio frequencies, a degenerative circuit results. This, of course, eliminates practically all gain in the stage.

26 LIMITER CIRCUIT

In Fig. 19, is shown both the second detector and limiter circuits used in the type *CWQ-46187-A Radio Receiver. It will be noted that a double triode tube 6C8G is used for these stages. The first triode section is used as an infinite impedance detector. The second section is connected to act as a series type diode limiter. Fig. 19B, is a simplified drawing of this

*Information concerning the Type CWQ-46187-A Radio Receiver is applicable also to the Type CWQ-46187-B Radio Receiver except where otherwise stated.

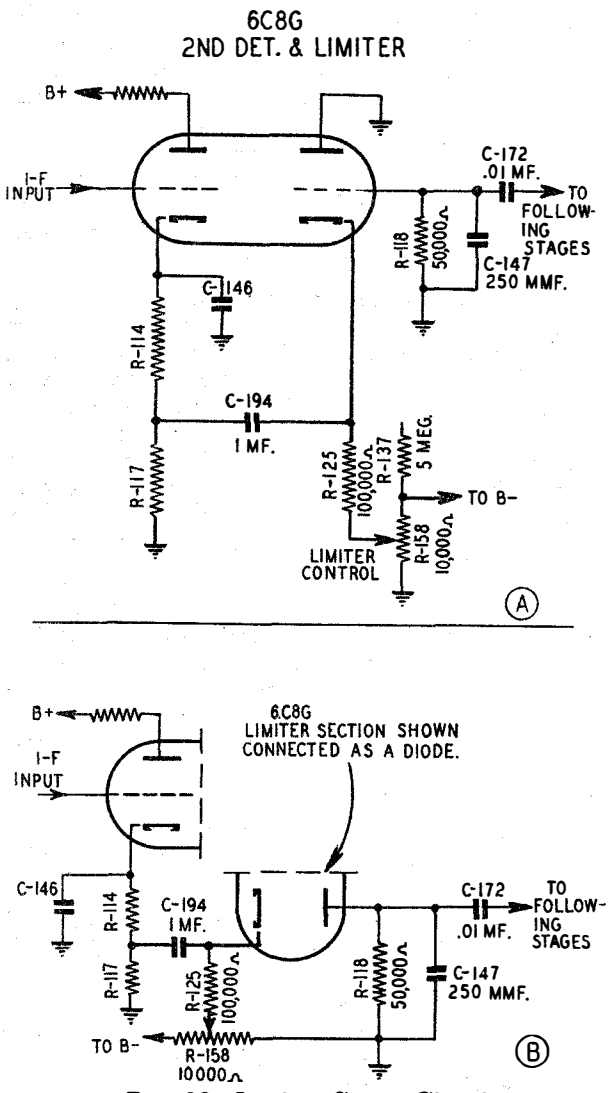


Fig. 19. Limiter Stage Circuit

circuit. Here the limiter section of the 6C8G tube is shown as a diode connected in series with the detector load resistor and the first A-F stage.

The limiter circuit consists of a biased diode through which the detector output passes to the first A-F stage. The cathode of the diode is biased sufficiently negative to cause conduction between it and the effective diode plate. In this case, the grid of the limiter section of the 6C8G tube is used as the diode plate.

The detected A-F signal is fed from the second detector cathode through capacitor, C-194, to the cathode of the limiter diode. This A-F signal in effect modulates the limiter diode current. This results in the A-F signal being developed across the limiter load resistor, R-118, from where it is coupled through, C-172, to the first A-F input circuit.

When a large A-F signal such as one due to noise, passes the second detector, the positive portion is sufficient to overcome the negative bias on the limiter cathode. The cathode is momentarily driven positive and conduction in the limiter tube ceases. The noise signal is thus prevented from passing through the limiter to the following stage.

The amplitude of the noise pulse necessary to drive the cathode positive and stop conduction is dependent on the setting of the Limiter Control, R-158. That is, the greater the negative bias applied to the limiter cathode by this control, the greater the signal that will be handled by the limiter before conduction ceases.

In operation, the limiter control is adjusted to some point that will just allow the normal A-F signal to pass through the limiter tube. With this setting, noise pulses higher in amplitude than the signal will be automatically cut off.

Noise pulses equal in amplitude to the desired signal or of lower amplitude, will not be eliminated by means of the limiter stage.

27 AUDIO STAGES

One section of a 6F8G twin-triode tube is used as an audio amplifier. This stage is self-biased by means of a 2000 ohm resistor by-passed with a 1 mf. capacitor.

A 500,000 ohm volume control is located in the grid circuit of this stage for control of the A-F gain.

A 6K6GT tube is used in the audio output stage. This tube is self-biased by two 250 ohm resistors. The output transformer, T-102, couples the tube to the phone jack on the front panel and the terminal strip at the rear of the receiver. These two output connections are in parallel and headphones or a speaker may be connected to them. The correct impedance for the total output load is 600 ohms. The overall audio response of the receiver is shown in Fig. 20.

28 POWER RECTIFIER

A 5Z3 full wave rectifier tube is used in the AC power supply to provide DC voltages for the operation of the receiver circuits. The Power Transformer, T-101, in the Type CWQ-46187-A Radio Receiver is designed for operation on only a 105-125 volt, 50-60 cycle power supply.

In the Type CWQ-46187-B Radio Receiver, a power transformer of the universal type is used. Jumper strips are provided on the transformer terminal board for changing the receiver to operate at either 115 or 230 Volts.

Whenever it is desired to change over the receiver from 115 to 230 volts operation, it will be necessary to remove the receiver from the mounting base and the bottom cover from the receiver cabinet. Reconnect the power transformer jumper strips as shown in Fig. 27, Bottom Socket View of Type CWQ-46187-B Radio Receiver.

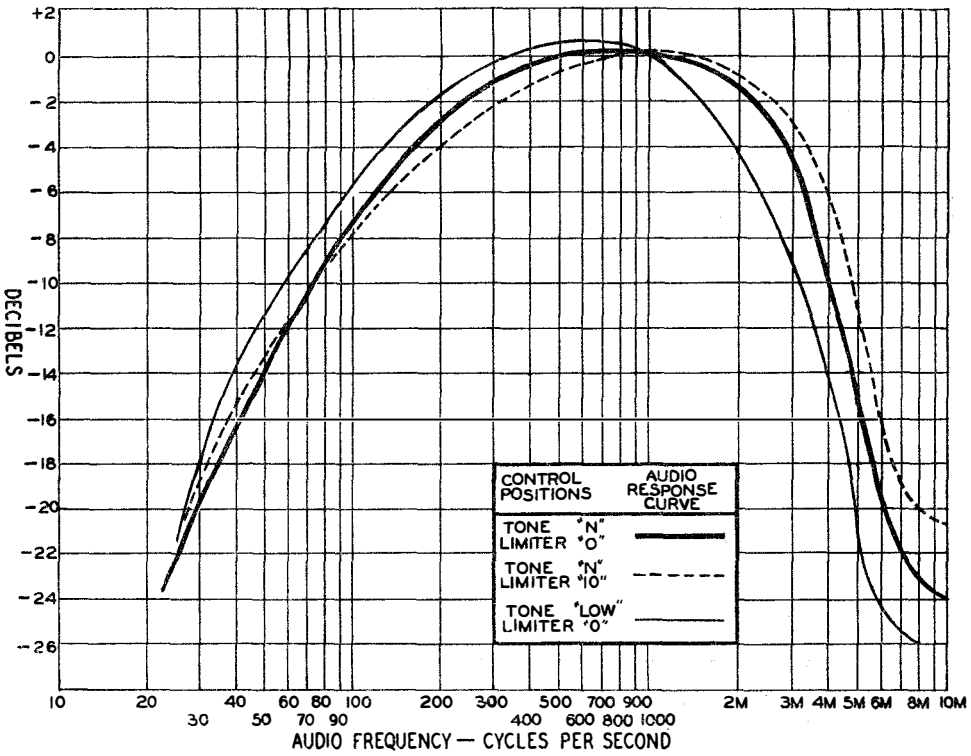


Fig. 20. Overall Audio Response

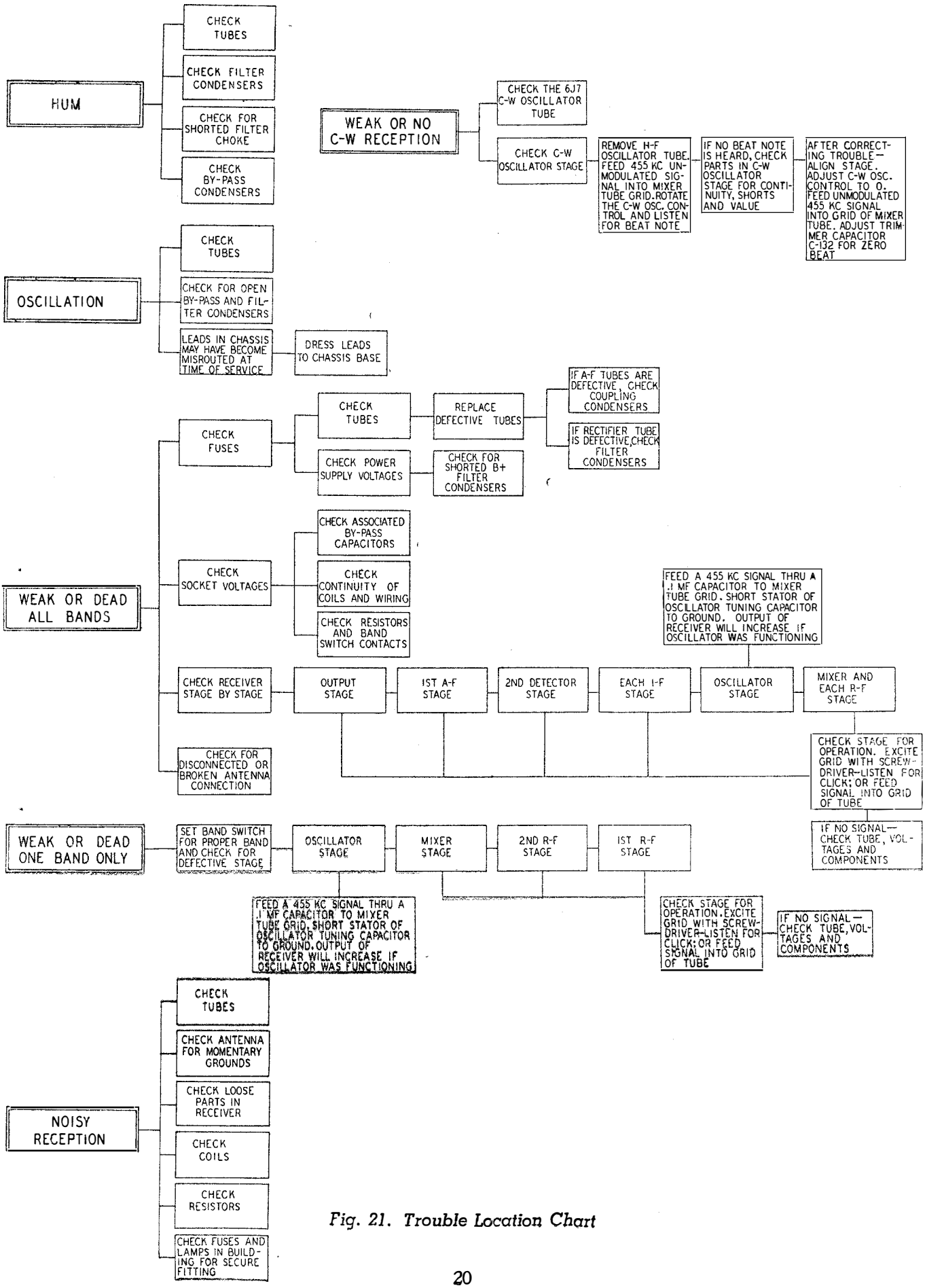


Fig. 21. Trouble Location Chart

SECTION V
MAINTENANCE

NOTE: Service, either electrical or mechanical, should be attempted only by qualified personnel authorized for such work.

Operation of this equipment involves the use of high voltages. Operating personnel must at all times observe all safety regulations.

Always disconnect equipment from power supply before changing tubes or attempting service.

29 PERIODIC INSPECTIONS

To insure the proper operation of the equipment, periodic inspections should be made as follows:

Daily; Check operation. Turn on the receiver and tune in a station on each frequency band.

Weekly; Repeat above. Check the antenna and power connections.

Tube Testing: The tubes should be removed for checking only when the operation of the receiver causes doubt concerning their condition. When replacing a tube that has been removed, be certain that it is reinserted in the socket in which it was originally. This will prevent possible mis-alignment and poor operation of the receiver.

30 FIELD TROUBLE SHOOTING

Trouble-free reception resulting from the proper installation and operation of the Type *CWQ-46187-A Radio Receiver will usually be insured by the periodic inspections detailed in Par. 29 Periodic Inspections. Troubles developing suddenly during operation are usually of a minor nature that may be corrected as follows.

a Set Dead—Dial and Panel Lights Out

(1) Check the power cord connections at the receiver and outlet box.

(2) Check the fuses located at the rear of the receiver.

b Set Dead—Dial Lights On

(1) Check for burned out tubes.
Live glass tubes will glow faintly and live metal tubes will be warm when touched.
If in doubt concerning the condition of a tube, replace it with a known good tube and note any change in the receiver's operation.

(2) Check headphone connections. Make certain that the headphone plug is properly inserted and that the leads in the flexible cord are unbroken. The headphone leads may be checked for continuity by momentarily touching the cord tips across a 1½ volt flashlight battery while listening for a click in the headphones.

*Information concerning the Type CWQ-46187-A Radio Receiver is applicable also to the Type CWQ-46187-B Radio Receiver except where otherwise stated.

c Set Dead or Noisy

(1) Check grid lead of 1st R-F tube. Remove the cover from R-F tube compartment. Make certain that the grid lead is not grounded against the metal grid shield. Pull the insulating tubing well up on the grid lead in order to prevent grounding.

31 TROUBLE LOCATION

a Tubes

When servicing a receiver, as a rule the first step should be a careful check for defective tubes. The common faults encountered with tubes are: low emission, leakage between cathode and heater or contact between two or more elements.

A simple but effective way to check suspected tubes is to turn the receiver on and replace them one at a time with known good tubes. However, before inserting the good tube in the socket, it is well to be reasonably certain that there is not some defect in the receiver that will damage the new tube. For example: If the power rectifier tube does not glow and the other tubes seem to be alive, it is probable that it is burned out. This may be due to a shorted filter capacitor in the B+ circuit. If so, the new tube would probably be burned out as soon as the receiver is turned on.

A good rule is never replace a burned out rectifier tube until after the B+ circuit is checked for shorts to ground. This will often prevent burning out a good tube or overloading the power transformer.

Be certain that all good tubes are returned to the sockets that they originally occupied.

b Bypass Capacitors

If no defective tubes are found, visual inspection of the parts or connections should follow.

Resistors or other parts with charred or discolored surfaces indicate a part that has been overheated due to excessive current passing through it. This condition is often caused by shorted bypass or filter capacitors. All associated capacitors should be checked for shorts or low resistance. An ohmmeter or capacitor analyzer may be used for this test after one lead of the suspected capacitor has been disconnected from the circuit.

Open filter or bypass capacitors will often cause oscillation, a loss of sensitivity or other troubles. Capacitors that are suspected of being open may be quickly checked by shunting them temporarily with a known good capacitor of the same size.

c Tuning Capacitor

Noise encountered only while tuning the receiver is generally due to intermittently shorting plates on the tuning capacitor. Should the plates be bent far enough to contact at all times, no noise will be present. Instead, the receiver will be dead on all bands.

Often the plates are shorted only over a portion of their travel, in such a case, the receiver will be dead or noisy, only over a portion of each of the bands.

A visual inspection will usually be sufficient to discover the faulty plates. A more positive check may be made with an ohmmeter after the capacitor has been disconnected from the circuit.

d Resistors

Trouble in resistors may usually be divided into three classifications, open, shorted and noisy.

Resistors that are suspected of being shorted or open may be conveniently checked with an ohmmeter. Noisy resistors may in some instances be located by tapping. However, the surest check is to first isolate the stage that the noise seems to originate in and then replace the suspected resistor. A quick way to isolate the troublesome stage is to start with the 1st R-F stage and work towards the output stage removing a tube at a time. The stage that the trouble is in will be the one where removal of the tube stops the noise.

e Coils

Trouble in coils will usually be open windings, shorted turns, or a high resistance winding. Coil trouble will usually cause a loss of sensitivity. Such trouble may be found as follows: Open or high resistances, check coil with an ohmmeter. Shorted turns, a measurement of inductance will usually be necessary to discover this fault.

f Switches

Switch trouble will usually be found to be dirty or weak contacts. The result of this will be noise, weak reception or possibly a dead receiver. As a rule, a slight pressure or tapping of the switch contacts will be all that will be required to determine which ones are at fault.

g Tube Socket Contacts

Weak or dirty tube socket contacts may cause noisy or weak reception or sometimes even a dead receiver. Pressure on the contacts will often locate the defective part. Ohmmeter readings between contact and tube prong may in some instances be of value.

h Power Transformer

Trouble in power transformers are usually an open winding or shorted turns. Open primary or high voltage secondary windings may be checked with an ohmmeter. It will be necessary to remove the tubes from the sockets to check the low voltage secondary windings.

Should one-half of the high voltage secondary be open, a lower B+ voltage will result and the hum level in the receiver will increase. Shorted turns will also cause low voltage output. This will also be accompanied by excessive heat.

i Output Transformer

Usual troubles are open windings, shorted turns or increased resistance of the windings. These troubles may be checked by means of an ohmmeter.

j General

Unsoldered terminals, loose wires or grounds caused by hidden solder may be found visually and quickly corrected.

Should such an inspection disclose no faults, the next step should be to tap the various parts, pull the wires at the connections, jar the chassis, etc. This procedure will often result in crackles, squeals, fading or distortion that will show in which circuit or part the trouble lies. If nothing is found by the procedure indicated in the preceding paragraphs, voltage and current measurements followed by resistance and continuity measurements should be made as described in the paragraphs that follow.

32 STAGE GAIN MEASUREMENTS

The approximate gain of each stage is shown in Table A, Stage Gain Measurements. To make measurements of this type, it will be necessary to have a signal generator and output meter. The signal generator must be accurately calibrated and must have an attenuator network capable of providing a signal of one microvolt.

33 VOLTAGE MEASUREMENTS

a General

Table B Socket Voltages, shows voltage measurements made from the chassis ground to the more important tube socket terminals. These measurements were made with a 1000 ohm per volt meter and are readings that will be obtained when using a similar meter on receivers in good condition.

b Procedure

(1) Remove the bottom plate from the cabinet. Supply power to the radio receiver and turn the radio receiver on. Place the controls in

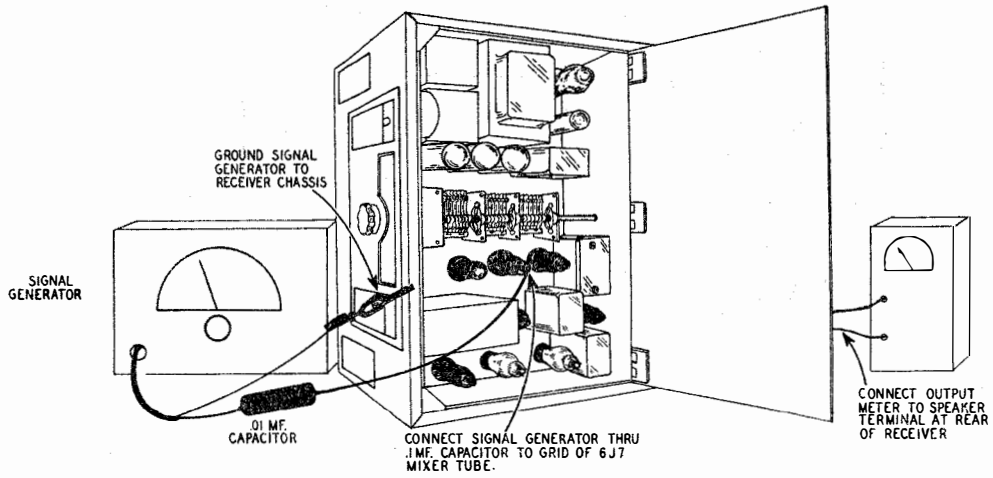


Fig. 22. Connections for I-F Alignment

the positions indicated in Table B, Socket Voltages.

(2) Use the voltmeter ranges indicated in the table and make the desired readings between the terminals shown on the voltage table and ground.

34 RESISTANCE AND CONTINUITY MEASUREMENTS

a General

In Table C, Coil Resistances, are shown the resistance readings of the coils and transformers. These measurements are to be made with test prods at the coil terminals or other points shown in the table. Whenever possible, use an ohmmeter range that will allow the readings to be made on the 0 to 50 portion of the ohmmeter scale.

b Procedure

(1) Remove the bottom plate from the cabinet and disconnect the power cord from the power supply.

(2) Use the proper ohmmeter scale and adjust the meter to zero ohms. Proceed to make the desired readings.

35 ALIGNMENT

a General

Correct alignment is extremely important for the proper operation of the *CWQ-46187-A Radio Receiver; however, re-alignment should not be attempted unless it is certain that the receiver is mis-aligned and then, only after all other possible causes of faulty operation have been fully investigated.

The correct step-by-step alignment procedure is given here and should be followed whenever aligning the receiver. Fig. 25, Trimmer Positions, shows the position of each Trimmer Capacitor.

b Equipment and Connections for Alignment

A standard 600 ohm output meter and a signal generator capable of producing both modulated and unmodulated signals between 455 kc and 28 megacycles is necessary for the alignment of the Type *CWQ-46187-A Radio Receiver. This test equipment is to be connected to the *CWQ-46187-A Radio Receiver as shown in the illustrations, and as instructed in the paragraphs that follow:

Unless otherwise directed, the positions of the controls while aligning the receiver are to be as follows:

Controls	Position
Power	B+ ON
S-Meter Switch	OFF
Limiter Control	Zero
Tone Control	N
Control Switch	MVC
C-W Oscillator	Zero
A-F Gain	Maximum
R-F Gain	Maximum
Phasing	Zero
Selectivity	OFF
Band Selector	To Desired Band
Tuning Knob	Adjust for Test Signal

*Information concerning the Type CWQ-46187-A Radio Receiver is applicable also to the Type CWQ-46187-B Radio Receiver except where otherwise stated.

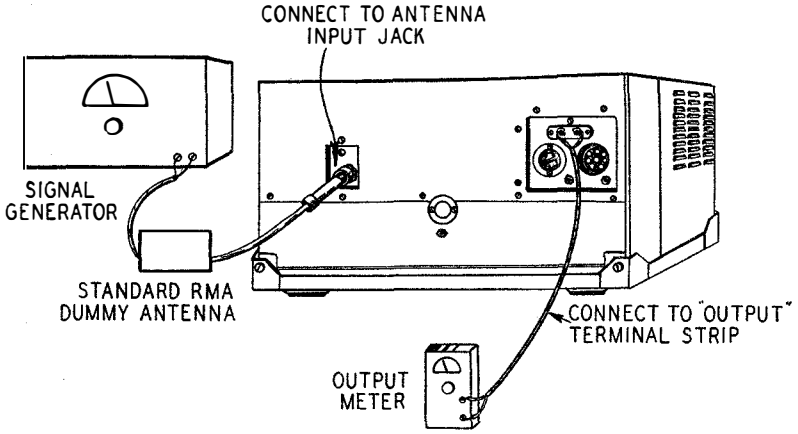


Fig. 23. Connections for R-F Alignment

c *Alignment Procedure*

(1) C-W OSCILLATOR ADJUSTMENT

Connect the output meter to the output terminals at the rear of the receiver and connect a signal generator through a .1 mf. capacitor to the grid of the 6J7 Mixer tube. Adjust the signal generator for a modulated output at approximately 455 kc. Begin with the 3rd I-F Transformer and work towards the Mixer tube. Adjust each I-F trimmer for a maximum output as indicated on the output meter.

Turn the signal generator modulation off. Turn the Control switch to the CWO position and with the C-W Osc. control set at zero, adjust the trimmer condenser, C-132, for zero beat.

(2) I-F ADJUSTMENT

Leave the controls in the position as last used for the C-W Oscillator adjustment. Turn the Selectivity control to the No. 5 position. Adjust the signal generator until a point of peak response, as indicated on the output meter, is found. This point will be the exact frequency of the crystal filter and the I-F trimmers are to be realigned at this frequency as follows:

Turn the signal generator modulation ON.

Turn the Selectivity control to OFF and the Control switch to the MVC position. Begin with the 3rd I-F Secondary trimmer, C-131, and work towards the Mixer tube, adjusting each trimmer for maximum output in the following sequence, C-131, C-130, C-129, C-128 and C-133. C-133 is adjusted from the underside of the chassis.

(3) CRYSTAL FILTER ADJUSTMENT

Turn the Selectivity switch to the No. 1 position. Leave the other controls as they were for the I-F alignment. De-tune the signal generator to 5 kc below the frequency at which the I-F trimmers were aligned. Adjust the trimmer condenser, C-134, for maximum output.

Turn the Selectivity control to the OFF position and re-tune the signal generator to the Crystal frequency. Adjust the trimmer condenser, C-125, for maximum output.

Adjust the Phasing control until the capacitor is at its mid position. This may be determined by observing the position of the capacitor plates thru the hole in the top of the Crystal Filter and 1st I-F assembly provided for the adjustment of C-126. De-tune the signal generator 10 kc from the alignment frequency and turn the modulation off. Turn the Control switch to the CWO position and the Selectivity switch to the No. 5 position. Adjust the Trimmer Capacitor, C-126, for minimum output.

Re-tune the signal generator to the alignment frequency and adjust the C-W Oscillator control until a zero beat condition is obtained. Loosen the set screw that holds the C-W Oscillator knob and adjust the knob until the pointer indicates zero.

Adjust the Phasing control until the tuning plates of the capacitor are at their mid position. Loosen the set screw that holds the Phasing control knob and adjust the knob until the pointer indicates zero.

The alignment at this point may be considered satisfactory if the input required at each stage to produce a 6-milliwatt output does not exceed the following values:

2nd I-F Grid	15,000 Microvolts
1st I-F Grid	250 Microvolts
Mixer Grid	25 Microvolts

These measurements are to be made with the signal generator modulation turned on.

(4) S-METER ADJUSTMENT

The S-Meter adjustment is to be made with the receiver turned on, the R-F Gain control set at maximum, no signal applied to the receiver

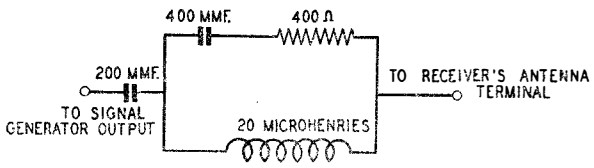


Fig. 24. Schematic Diagram, Standard RMA Dummy Antenna

and the S-Meter switch turned to ON. Adjust the S-Meter control, R-155, until the S-Meter reads zero.

(5) R-F AND OSCILLATOR STAGE ADJUSTMENTS

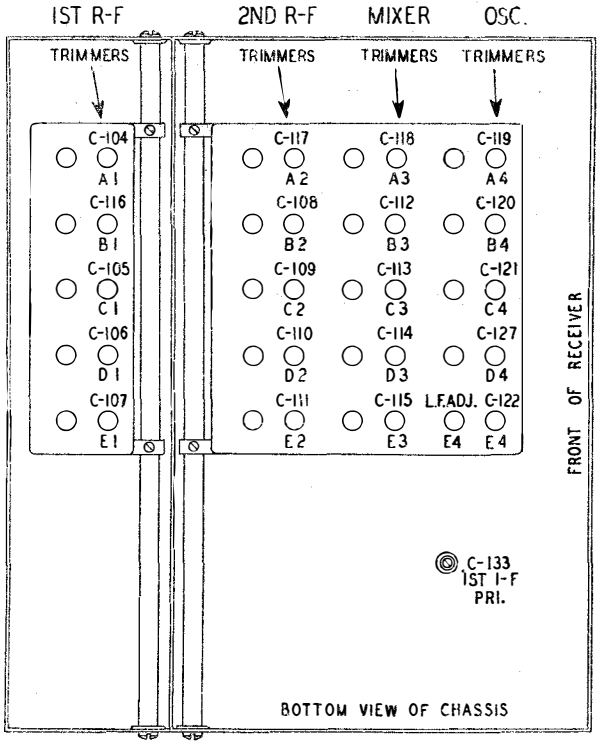
The table that follows gives the alignment frequency, trimmer adjustment and proper sensitivity for each of the five frequency bands.

The signal generator is to be connected through a standard RMA dummy antenna to the receiver's antenna terminal. A modulated signal is to be used. The receiver controls are to be positioned as originally specified for the alignment procedure. For the A, B, C and D bands, adjust the trimmers indicated in the table as follows:

Adjust the oscillator trimmer for maximum output. Adjust the Mixer, 2nd R-F and 1st R-F stages, in the order listed, for maximum output.

Adjustments for the E Band are as given for the other bands except that there is an additional oscillator stage adjustment at 600 kc. After this adjustment has been made, repeat the 1.2 Mc osc. adjustment. Readjust these two trimmers several times until the 600 kc adjustment does not effect the setting of the 1.2 Mc osc. trimmer. This will insure correct tracking and dial calibration.

The alignment of the R-F and Oscillator stages may be considered satisfactory if the input necessary to produce a 6-milliwatt output does not exceed the value shown in the right hand column of the table. Sensitivity measurements



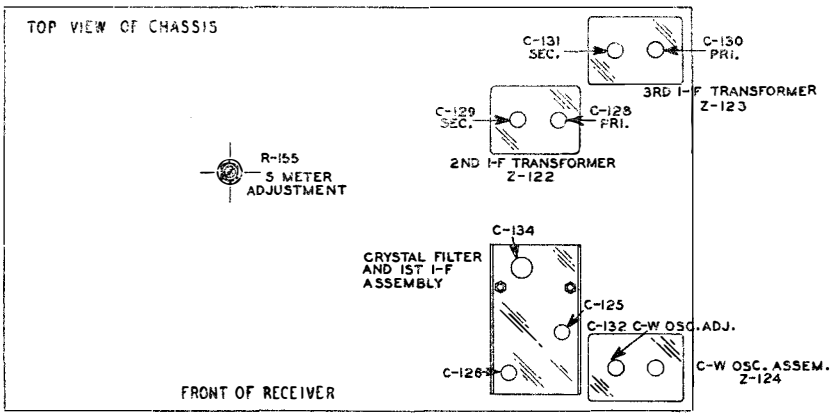


Fig. 25. Trimmer Positions

are to be made with a 10 to 1 noise ratio as follows:

Set the receiver to the signal generator frequency and turn the signal generator modulation off. Adjust the signal generator output level to the approximate sensitivity expected.

Adjust the R-F Gain control on the receiver until 600 microwatts of noise is indicated on the output meter. Turn the signal generator modulation on and adjust the signal generator level control to a position that will produce a 6-milliwatt output as read on the receiver's output meter. The strength of the signal supplied by the signal generator indicates the sensitivity of the receiver.

(6) R-F AND OSCILLATOR STAGE ALIGNMENT

All adjustments are to be made for maximum reading of the output meter.

Band	Freq. of Signal Generator and Receiver	Adjustment		Sensitivity (Microvolts)
A	28 Mc	1st R-F	C-104	14
		2nd R-F	C-117	
		Mixer	C-118	
		Osc.	C-119	
B	13.5 Mc	1st R-F	C-116	8
		2nd R-F	C-108	
		Mixer	C-112	
		Osc.	C-120	
C	6.0 Mc	1st R-F	C-105	16
		2nd R-F	C-109	
		Mixer	C-113	
		Osc.	C-121	
D	2.6 Mc	1st R-F	C-106	7
		2nd R-F	C-110	
		Mixer	C-114	
		Osc.	C-127	
E	1.2 Mc	1st R-F	C-107	3
		2nd R-F	C-111	
		Mixer	C-115	
		Osc. H-F	C-122	
	600 kc	Osc. L-F	(Core)	

TABLE A—STAGE GAIN MEASUREMENTS

A-F GAIN

Audio Oscillator—Frequency 600 Cycles

CONTROL POSITIONS

Power Control . . . . . ON
R-F Gain 0
A-F Gain 10
Control Switch . . . . . MVC
Limiter . . . . . OFF
Tone . . . . . N
C-W Osc. . . . . any position
Selectivity . . . . . any position
Phasing . . . . . any position
Band Selector . . . . . any position
Tuning Knob . . . . . any position

Audio Oscillator Connection at Receiver	Volts Input	Milliwatt Output
Across R-136, 500,000 Ohm Resistor at Output Tube Grid	.7	6
Across R-118, 50,000 Ohm Resistor at Limiter Grid	.04	6

R-F GAIN

Signal Generator Modulation—400 Cycles, 30%

CONTROL POSITIONS

Power Control . . . . . ON
R-F Gain . . . . . Adjust for 600 microwatt noise level See column "Approximate R-F Gain control setting for noise level."
A-F Gain 10
Control Switch . . . . . MVC
Limiter . . . . . OFF
Tone . . . . . N
Phasing 0
C-W Osc. 0
Selectivity . . . . . OFF
Band Selector . . . . . Band C
Tuning Knob . . . . . See Below

(Grid Caps may Be Left on Tubes)

Connection Between Signal Generator and Receiver	Signal Generator Connection to Receiver	Signal Generator Frequency	Receiver Dial Setting	Approximate R-F Gain Control Setting for Correct Noise Level	Noise Level Microwatts	Microvolt Input for Six Milliwatt Output
.1 mf	Detector Grid	456KC	. . . . .	Maximum	. . . . .	720,000
.1 mf	2nd I-F Grid	456KC	. . . . .	Maximum	. . . . .	10,300
.1 mf	1st I-F Grid	456KC	. . . . .	Maximum	. . . . .	150
.1 mf	Mixer Grid	456KC	. . . . .	Maximum	400	14
.1 mf	2nd R-F Grid	4 MC	4 MC	9.1	600	14
.1 mf	*1st R-F Grid	4 MC	4 MC	8.2	600	12
Standard RMA Dummy Antenna	Antenna Terminal	4 MC	4 MC	8	600	3.6

*Remove cover from 1st R-F tube box and grid shield

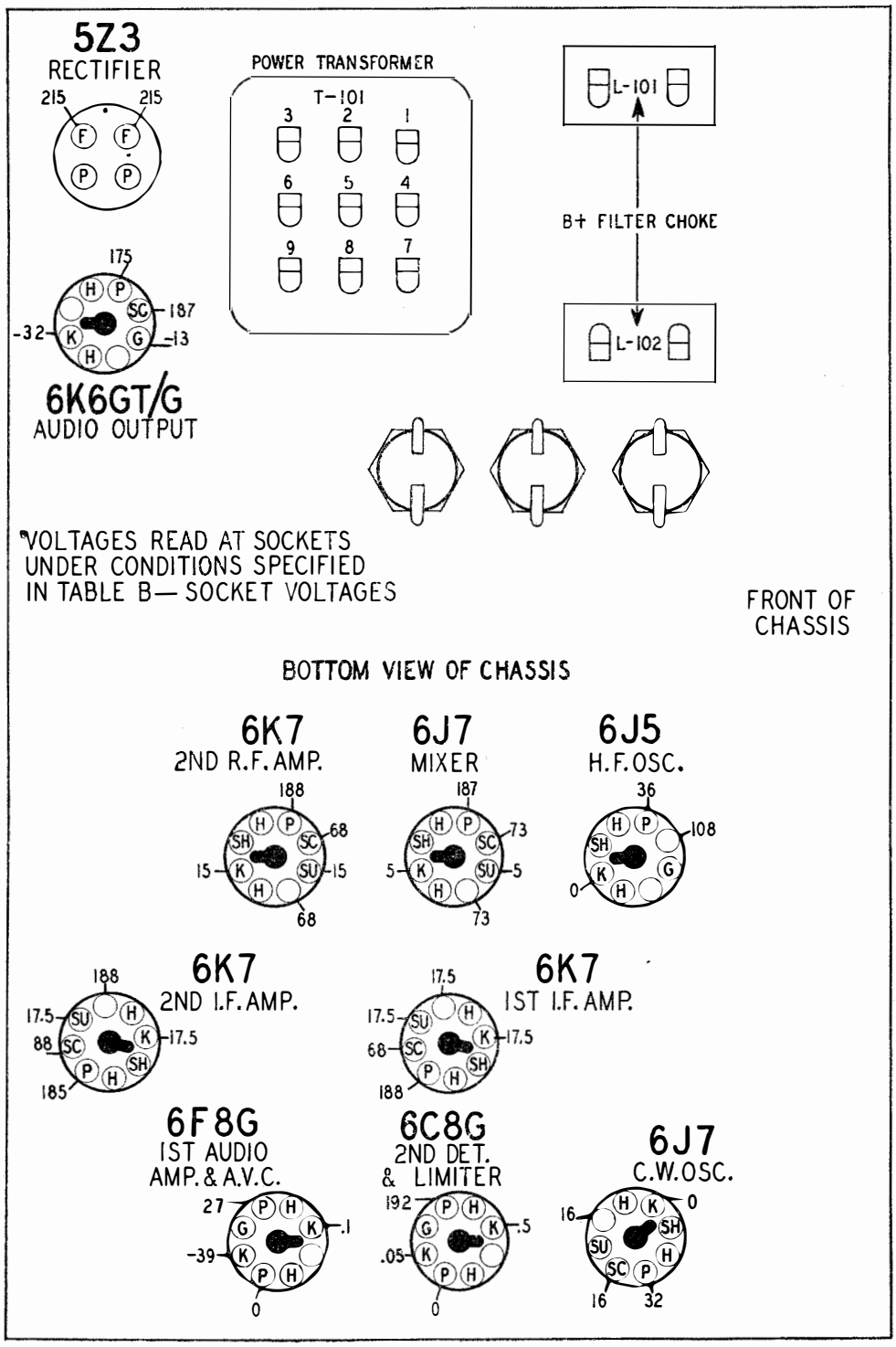
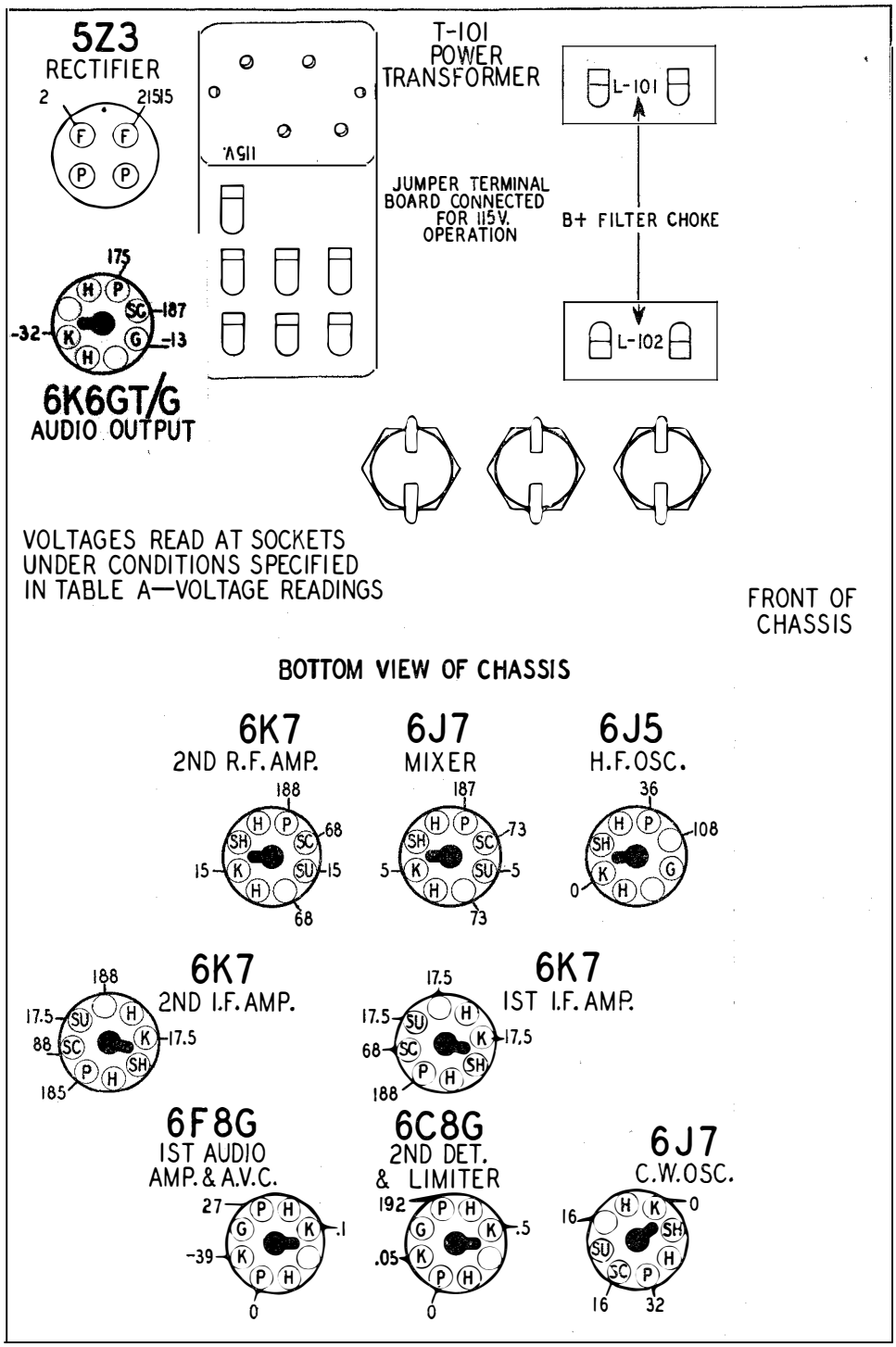
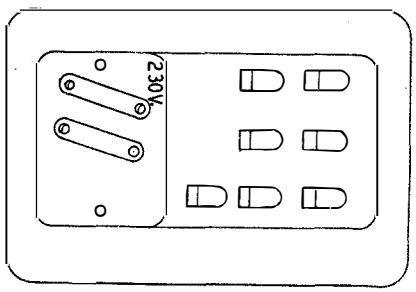


Fig. 26. Bottom Socket View of Type CWQ-46187-A Radio Receiver





JUMPER TERMINAL BOARD
CONNECTED FOR 230 V.
OPERATION.

Fig. 27. Bottom Socket View of Type CWQ-46187-B Radio Receiver

TABLE B—SOCKET VOLTAGES

All Voltages are approximate and are read between the socket terminals and chassis ground with a 1000 ohm-per-volt meter under the following conditions:

Line Voltage 115 Volts

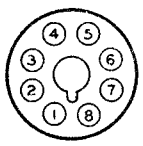
Plate and Screen Voltages Read on 250 Volt Scale

Cathode Voltages Read on Highest Scale That Permits Value To Be Read Easily

Power Control — B+ ON
R-F Gain — 0
Control Switch — MVC
Limiter Control — 0

Tube & Function	Plate Volts & Term. No.	Screen Volts & Term. No.	Cathode Volts & Term. No.
6K7 1st R-F	Tube prongs are not accessible for voltage measurements		
6K7 2nd R-F	188 No. 3	68 No. 4	15 No. 8
6J7 Mixer	187 No. 3	73 No. 4	5 No. 8
6J5 H-F Osc.	36 No. 3		0 No. 8
6K7 1st I-F	188 No. 3	68 No. 4	17.5 No. 8
6K7 2nd I-F	185 No. 3	88 No. 4	17.5 No. 8
6C8G 2nd Det. & Lim.	0 No. 3 192 No. 6		.05 No. 4 .5 No. 8
6J7 C-W Osc.	* 32 No. 3	* 16 No. 4	0 No. 8
6F8G 1st A-F & AVC	0 No. 3 27 No. 6		-39 No. 4 .1 No. 8
6K6GT/G Audio Outpuut	175 No. 3	185 No. 4	-32 No. 8
5Z3 Rectifier			215 Nos. 1 & 4

* Voltages read with Control switch tuned to the CWO position.



OCTAL SOCKET
BOTTOM TERMINAL NUMBERING

TABLE C—COIL RESISTANCES

Resistances shown are approximate resistance values of coils and transformers.
Colors shown for I-F transformer terminals are the colors of the wires soldered to the transformer terminals.

Symbol Desig.	Name of Part	Winding	Terminals Resistance is Measured Across	DC Resistance in Ohms
L-101	B+ Filter Choke			300
L-102	B+ Filter Choke			300
L-103	I-F Coil			9.5
*T-101	Power Transformer RAO-3	Primary H.V. Secondary 6.3 V. Secondary 5. V. Secondary	1-4 3 - 9 7 - 8 2-5	2.4 179 .051 .091
T-102	Output Transformer	Primary Secondary	Red—Blue Leads Green—Yellow Leads	350 32
T-103	1st I-F Transformer	Primary Secondary		7.12 2.57
*T-104	Power Transformer RAO-4	Primary No. 1 Primary No. 2	1 - 10 4 - 11	4.35 5.53
Z-101	1st R-F Transformer	Primary Secondary		.148 .029
Z-102	1st R-F Transformer	Primary Secondary		.18 .087
Z-103	1st R-F Transformer	Primary Secondary		.372 .46
Z-104	1st R-F Transformer	Primary Secondary		.486 1.335
Z-105	1st R-F Transformer	Primary Secondary		.811 .391
Z-106	2nd R-F Transformer	Primary Secondary		.812 .043
Z-107	2nd R-F Transformer	Primary Secondary		3.66 .09
Z-108	2nd R-F Transformer	Primary Secondary		13.95 .46
Z-109	2nd R-F Transformer	Primary Secondary		27.18 1.37
Z-110	2nd R-F Transformer	Primary Secondary		.83 4.05

*The information given on the secondary windings of the Power Transformer T-101 used in the RAO-3, also applies to the secondaries of the Transformer T-104 used in the RAO-4.

TABLE C—COIL RESISTANCES—Continued

Symbol Desig.	Name of Part	Winding	Terminals Resistance is Measured Across	DC Resistance in Ohms
Z-111	Mixer Transformer	Primary Secondary		.810 .043
Z-112	Mixer Transformer	Primary Secondary		3.655 .09
Z-113	Mixer Transformer	Primary Secondary		13.95 .46
Z-114	Mixer Transformer	Primary Secondary		27.0 1.37
Z-115	Mixer Transformer	Primary Secondary		.764 4.01
Z-116	Osc. Transformer	Grid Plate		.03 .068
Z-117	Osc. Transformer	Grid Plate		.07 .082
Z-118	Osc. Transformer	Grid Plate		.133 388
Z-119	Osc. Transformer	Grid Plate		.0913 .156
Z-120	Osc. Transformer	Grid Plate		.784 2.27
Z-121	Crystal Filter and I-F Assembly	See T-103 and L-103		
Z-122	2nd I-F Transformer	Primary Secondary	Red Tracer—Blue Tracer Black Tracer—Grid Clip	7.5 7.5
Z-123	3rd I-F Transformer	Primary Secondary	Red Tracer—Blue Tracer Black Tracer—Green Tracer	7.5 7.5
Z-124	C-W Oscillator Coil		Black Tracer—Green Tracer (Terminals Inside Can)	9.7

TABLE D—CATHODE CURRENTS

Measurements made under following conditions:

No signal received
Line Voltage.....115 Volts
Power Control.....B+ ON
R-F Gain.....5
A-F Gain.....10
Control Switch . .MVC except where otherwise noted
Limiter.....0
C-W Osc.....0
Selectivity.....OFF
Band Selector.....any position
Tuning Knob.....any position
Tone.....N

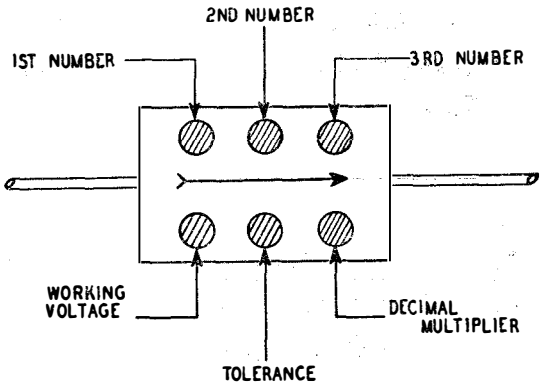
Tube	Function	Cathode Current	Tube	Function	Cathode Current
6K7	1st R-F.....	4.5 Ma	*6J7	C-W Osc.....	.4 Ma
6K7	2nd R-F.....	.7 Ma	6F8G	AVC and 1st A-F	
6J7	Mixer.....	14. Ma		AVC.....	.0 Ma
6J5	Oscillator.....	2. Ma		Audio.....	.5 Ma
6K7	1st I-F.....	.5 Ma	6K6GT	Output.....	30. Ma
6K7	2nd I-F.....	1. Ma	5Z3	Rectifier.....	54. Ma
6C8G	2nd Det. and Limiter				
	2nd Det.....	.1 Ma			
	Limiter.....	.4 Ma			

*Control Switch Turned to CWO Position.

TABLE E—COLOR CODING

COLOR CODE FOR CAPACITORS

Color	Numerals	Multiplier	Volts	Tolerance
Black	0	1		
Brown	1	10	100	1%
Red	2	100	200	2%
Orange	3	1,000	300	3%
Yellow	4	10,000	400	4%
Green	5	100,000	500	5%
Blue	6	1,000,000	600	6%
Violet	7	10,000,000	700	7%
Gray	8	100,000,000	800	8%
White	9	1,000,000,000	900	9%
Gold		0.1	1000	5%
Silver		0.01	2000	10%
No Color			500	20%

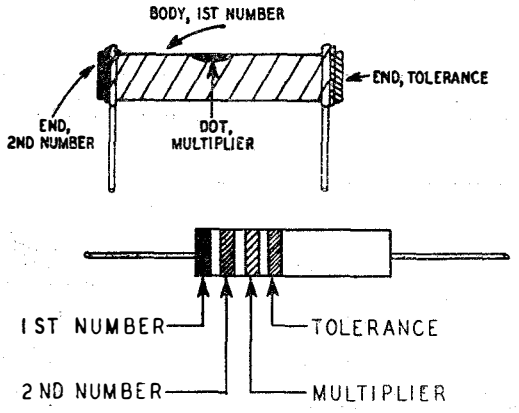


COLOR CODE FOR RESISTORS

Color	1st Number	2nd Number	Multiplier
Black		0	1
Brown	1	1	10
Red	2	2	100
Orange	3	3	1,000
Yellow	4	4	10,000
Green	5	5	100,000
Blue	6	6	1,000,000
Violet	7	7	
Gray	8	8	
White	9	9	

Tolerance Color Code Values

Gold 5% Silver 10% No Color 20%



AMERICAN WAR STANDARDS
COLOR CODE FOR FIXED MICA CAPACITORS
VALUES READ IN MMF

Color	1st, 2nd, 3rd No.	Decimal Multiplier	Tolerance	Characteristic
Black	0	1		A
Brown	1	10		B
Red	2	100	2%	C
Orange	3	1,000		D
Yellow	4			E
Green	5			F
Blue	6			G
Violet	7			
Gray	8			
White	9			
Gold		0.1	5%	
Silver		0.01	10%	
Black			20%	

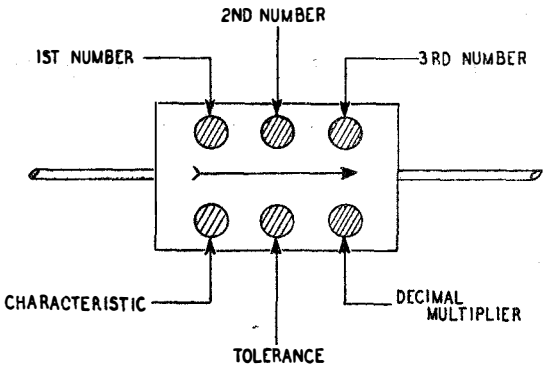


TABLE F—LIST OF MAJOR UNITS

QUANTITY		NAVY TYPE DESIGNATION	NAME OF MAJOR UNIT	SYMBOL GROUP	ASSEMBLY DRAWING NUMBER
MODEL RAO-3	MODEL RAO-4				
1	.....	CWQ-46187-A	Radio Receiver	101 and up	25A618
.....	1	CWQ-46187-B	Radio Receiver	101 and up	25A691
1	.....	CWQ-10125-A	Mounting Base	301 and up	25A634
.....	1	CWQ-10125-A	Mounting Base	301 and up	25A635
.....	2	49016	Headphones	.....	.....
.....	2	49034	Plug	.....	.....

TABLE G—PARTS LIST BY SYMBOL DESIGNATION

* One asterisk in the Symbol Designation column identifies parts NOT included in the Stock Spare Parts for the Models RAO-3 and RAO-4. The alphabetical portion of the symbol designations included in the parts list are assigned to cover certain classes of parts. The letter and the parts group to which each is assigned is as follows:

(A) Structural parts, panels, frames, castings, etc.

(C) Capacitors of all types.

(E) Miscellaneous electrical parts: Insulators, knobs, etc.

(F) Fuses.

(H) Hardware, screws, bolts, studs, pins, etc. (Also see "O" group.)

(I) Indicating devices (except meters and pilot lamps, etc.

(J) Jacks and receptacles (Stationary).

(L) Inductors, A-F.

(M) Meters.

(N) Nameplates, dials, charts, etc.

(O) Mechanical Parts and larger hardware.

(P) Plugs.

(R) Resistors, fixed and variable, potentiometers, etc.

(S) Switches.

(T) Transformers, A-F, power and R-F.

(V) Vacuum tubes.

(W) Wire and Cables

(X) Sockets

(Y) Crystals

(Z) Filters, I-F transformers, compound tuned circuit assemblies, etc., in a common container.

TABLE G—PARTS LIST BY SYMBOL DESIGNATION
FOR NAVY MODELS RAO-3 AND RAO-4 RADIO RECEIVING EQUIPMENT

*One asterisk in the Symbol Designation column identifies parts NOT included in the Stock Spare Parts. (The Stock Spare Parts are those supplied as spare parts but not shipped to the same destination as the receiving equipment.)

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*A-101	Dial Window	DIAL WINDOW, Cellulose Acetate, Water Clear. 7.000" x 4.000" x .093" Thick			7			17X79
*A-102	Rectifier Tube Clamping Ring	TUBE CLAMP, .015" High Carbon Tempered Steel. Overall 2.156" x 1.562" x .437" High. Cadmium Plated and Clear Lacquer Finish			11	8527		30X424
*A-103	Tuning Scale Mounting	TUNING SCALE BRACKET, .031" C.R. ¼ Hard Steel. Double Angle Type. Overall 3.062" x 1.718". Cadmium Plated and Clear Lacquer Finish			41			25X1273
*A-104	Receiver Bottom Cover	BOTTOM PLATE, C.R. Steel. 16.906" x 11.062" x .062" Thick; Cadmium Plated and Clear Lacquer Finish. Part of A-109			47			34X407
*A-105 and A-106	Receiver Bottom Rest	GLIDER, Stainless Steel, Overall .312" x .750" Dia., .109" x .275" Dia. Mtg. Stud, .562" R. Base. Part of A-109			44			20X1013
*A-107 and A-108	Same as A-105	GLIDER, Same as A-105, Except Part of A-117						
*A-109	Same as A-104 and A-105	BOTTOM PLATE ASSEMBLY, Consists of A-104, A-105 and A-106			47			25A679
*A-110	Chassis Mounting and Protection	CABINET, C.R. Steel, Overall, 17.532" x 11.516" x 10.468" High. Front and Side Panels. Black Wrinkle Finish			21			34X384
*A-111	Cabinet Top Cover Plate	TOP COVER, C.R. Steel, Overall 15.781" x 10.109" x .0475" Thick; with 3 Hinges Spotwelded to Rear of Plate. Black Wrinkle Finish			47			34X385
*A-112	Front Coil Carriage Guide	ROD, SAE 1112 Steel, 16.843" x .437" Dia. #10-32 Tap Hole Centered Each End, .500" Deep. Copper Plated			3			26X428
*A-113	Rear Coil Carriage Guide	ROD, Same as A-112						
*A-114	Shaft, O-108, Retainer	BUSHING, Brass. Overall Length .468" x .2515" I.D. Hex Shoulder .093" x .500" across Flats. .437"-27 Ext. Thd. to within .062" of Shoulder. Dull White Nickel Finish			31			29X436
*A-115	Shaft, O-107, Retainer	BUSHING, Brass. Overall Length 1.000" x .2515" I.D. Hex Shoulder .562" x .500" across Flats. .457"-27 Ext. Thd. to within .125" of Shoulder. Cutout in Shoulder Dull White Nickel Finish			31			29X435
*A-116	Shaft, O-107, Locking Spring	SHAFT RETAINING SPRING, .031" Music Wire. Semi-Hair Pin Type. Cadmium Plated			38			28X425
*A-117	Rear Channel Bottom Cover	BOTTOM PLATE AND GLIDER ASSEMBLY (Preselector). C.R. Steel. 17.095" x 4.125" x .062". Cadmium Plated and Clear Lacquer Finish. Includes A-107 and A-108			47			25A710

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*A-118	Gear Covering at Front Panel	GEAR CASE, .025" Brass, 3.562" O.D., 2.875" I.D. Circular Flange .250", Black Wrinkle Finish			47			4X790
*A-119	Jack, J-102, Mounting	JACK MOUNTING BRACKET, .062" C.R. Steel, L Shaped One Side, 1.812" x 1.500". Vertical Plate 2.250" x 1.812". Jack Mtg. Opening .765" Dia.; Cadmium Plated			47			25X1245
*A-120	Meter, M-101, Mounting	MOUNTING BRACKET, Overall Length 5.906", Meter Mtg. Opening 2.125", Two Flanges 1.000" x .593". Cadmium Plated and Clear Lacquer Finish			47			25X1227
*A-121	Coil Carriage Covering	COIL CARRIAGE COVER PLATE, Aluminum, 8.812" x 8.390" x .040". Thirty .500" Dia. Air Vents. Caustic Dip Finish			47			57X109
*A-122	Dial Opening Cover Plate	ESCUTCHEON, .032" C.R. Steel. Overall 11.750" x 6.687". Black Wrinkle Finish			47			4X770
A-301 thru A-304	Cradle Mounting	LORD MOUNT, C.R. Steel Frame, 3.000" Square, Cadmium Plated. Floating Rubber Mount with Metal Insert. Mtg. Opening .391" Dia.			33	200PH-20		8X145
*A-305	Receiver Mounting	CRADLE ASSEMBLY, Includes Symbol Designations A-301 thru A-304, A-306, H-301 thru H-304, and Hardware			47			25A634
*A-306	Same as A-305	CRADLE, C.R. Steel. Overall, 17.686" x 16.217", Corners, 1.687" High; With Four Radio Receiver Unit Mtg. Hubs. Black Wrinkle Finish			47			22X405
		CAPACITORS						
*C-101A	2nd R-F Tuning	CAPACITORS, Variable. Range 0.0 mmf. to 224.3 mmf. Effective			40	820-3-31		14A166
*C-101B	Mixer Tuning	CAPACITOR, Same as C-101A						
*C-101C	Osc. Tuning	CAPACITOR, Same as C-101A						
*C-102	1st R-F Tuning	CAPACITOR, Variable. Range 0.0 mmf. to 224.3 mmf. Effective			40	821-1-31		14A167
*C-103	Phasing Control	CAPACITOR, Trimmer. Range, 2.5 mmf. to 6.3 mmf.; Ceramic Base. Must Withstand Breakdown Test of 500 Volts R.M.S. 60 Cycle Knob Adjustment			46			17A211
*C-104	1st R-F Trimmer, A Band	CAPACITOR, Trimmer. Range, 2.7 mmf. to 14.0 mmf.; Ceramic Base. Must Withstand Breakdown Test of 500 Volts R.M.S. 60 Cycle and 200 Hr. Salt Spray Test. Screwdriver Adjustment			46			17A206
*C-105	1st R-F Trimmer, C Band	CAPACITOR, Same as C-104						
*C-106	1st R-F Trimmer, D Band	CAPACITOR, Same as C-104						

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*C-107	1st R-F Trimmer, E Band	CAPACITOR, Same as C-104						
*C-108	2nd R-F Trimmer, B Band	CAPACITOR, Same as C-104						
*C-109	2nd R-F Trimmer, C Band	CAPACITOR, Same as C-104						
*C-110	2nd R-F Trimmer, D Band	CAPACITOR, Same as C-104						
*C-111	2nd R-F Trimmer, E Band	CAPACITOR, Same as C-104						
*C-112	Mixer Stage Trimmer, B Band	CAPACITOR, Same as C-104						
*C-113	Mixer Stage Trimmer, C Band	CAPACITOR, Same as C-104						
*C-114	Mixer Stage Trimmer, D Band	CAPACITOR, Same as C-104						
*C-115	Mixer Stage Trimmer, E Band	CAPACITOR, Same as C-104						
*C-116	1st R-F Trimmer, B Band	CAPACITOR, Same as C-104, Except Range to 3.0 mmf. to 25.0 mmf.			46			17A205
*C-117	2nd R-F Trimmer, A Band	CAPACITOR, Same as C-116						
*C-118	Mixer Stage Trimmer, A Band	CAPACITOR, Same as C-116						
*C-119	Osc Trimmer, A Band	CAPACITOR, Same as C-116						
*C-120	Osc Trimmer, B Band	CAPACITOR, Same as C-116						
*C-121	Osc Trimmer, C Band	CAPACITOR, Same as C-116						
*C-122	Osc Trimmer, E Band	CAPACITOR, Same as C-116						
*C-123	C-W Osc Control	CAPACITOR, Trimmer. Range, 3.0 mmf. to 12.0 mmf.; Ceramic Base. Rotor and Stator Assemblies, Brass, Silver Plated. Must Withstand Breakdown Test of 500 Volts R.M.S. 60 Cycle and 200 Hr. Salt Spray Test. Knob Adjustment			46			17A220
*C-125	Selectivity Adjustment	CAPACITOR, Trimmer. Range, 3.0 mmf. to 35.0 mmf.; Ceramic Base. Test for Breakdown between Capacitor Elements at 350 Volts R.M.S. 60-600 Cycles for 3 Seconds			46			17A210
*C-126	1st I-F Secondary Trimmer	CAPACITOR, Same as C-125						
*C-127	Osc Trimmer, D Band	CAPACITOR, Same as C-104, Except Range to be 5.0 mmf. to 35.0 mmf.			46			17A207
*C-128	2nd I-F Primary Trimmer	CAPACITOR, Trimmer. Range, 4.5 mmf. to 80.0 mmf.; Ceramic Base. Must Withstand Breakdown Test of 500 Volts R.M.S. 60 Cycle and 200 Hr. Salt Spray Test			46			17A219
*C-129	2nd I-F Secondary Trimmer	CAPACITOR, Same as C-128						
*C-130	3rd I-F Primary Trimmer	CAPACITOR, Same as C-128						

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*C-131	3rd I-F Secondary Trimmer	CAPACITOR, Same as C-128						
*C-132	C-W Osc Trimmer	CAPACITOR, Same as C-128						
*C-133	1st I-F Primary Trimmer	CAPACITOR, Trimmer. Range 6.0 mmf. to 98.0 mmf., Ceramic Base. Must Withstand Breakdown Test of 500 Volts R.M.S. 60 Cycle and 200 Hr. Salt Spray Test. Screwdriver Adjustment			46			17A218
*C-134	1st I-F Output Coil Trimmer	CAPACITOR, Same as C-133						
*C-135	Selectivity Switch Series	CAPACITOR, Fixed, Ceramic, 5.0 mmf. ±20%	481576		8	809A115 811-154		47X332
*C-136	Same as C-135	CAPACITOR, Fixed, Ceramic, 10.0 mmf. ±10%	481577		8			47X333
*C-137	Same as C-135	CAPACITOR, Same as C-136						
*C-138 and C-139	1st I-F Secondary Compensating Capacitor	CAPACITOR, Fixed, Ceramic, 50.0 mmf. ±10%			8	813-161		47X355
*C-140	C-W Osc. Plate Coupling	CAPACITOR, Bakelite, 1.0 mmf. ±20%, 400 VDC Working			45	Type GA	A-7344	47X365
C-145	AVC Diode Coupling	CAPACITOR, Fixed, Molded Mica, 50.0 mmf. ±10%, 500 V DC Working	481279		42	K-1450		47X331
C-146	2nd Det. Cathode Bypass	CAPACITOR, Fixed, Molded Mica, 250 mmf. ±10%, 500 V DC Working	48690		42	K-1325		47X356
*C-147	2nd Det. Grid Bypass	CAPACITOR, Same as C-146						
*C-148	1st Audio Plate Bypass	CAPACITOR, Same as C-146						
C-149	Tone Control	CAPACITOR, Fixed, Molded Mica, 700 mmf. ±10%, 500 V DC Working	481016		42	C-1370		47X349
C-150	C-W Osc. Grid	CAPACITOR, Fixed, Molded Mica, 1000 mmf. ±10%, 500 V DC Working	48983		42	C-1210		47X340
C-151	1st R-F AVC Filter	CAPACITOR, Fixed, Molded Mica, 7000 mmf. ±10% V DC Working	481106		42	C-1270		47X348
*C-152	Hum Neutralizing	CAPACITOR, Same as C-146						
C-155	Osc. Grid Coupling	CAPACITOR, Fixed, Silvered Mica, 100 mmf. ±10%, 500 V DC Working	48843		42	K-1310		47X357
C-156	Osc. Series, E Band	CAPACITOR, Fixed, Silvered Mica, 300 mmf. ±5%, 500 V DC Working	48854		42	K-1330		47X353
C-157	Osc. Series, D Band	CAPACITOR, Fixed, Silvered Mica, 800 mmf. ±5%, 500 V DC Working	481428		42	C-1380		47X354
C-158	Ant. Series, A Band	CAPACITOR, Fixed, Silvered Mica, 980 mmf. ±5%, 500 V DC Working	481083		42	C-1398		47X352
*C-159	Osc. Series, A Band	CAPACITOR, Same as C-158						
C-160	Osc. Series, C Band	CAPACITOR, Fixed, Silvered Mica, 1360 mmf. ±5%, 500 V DC Working			42	C-12136		47X351

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
C-161	Osc. Series, B Band	CAPACITOR, Fixed, Silvered Mica, 3100 mmf. ±5%, 300 V DC Working			42	C-1310		47X350
*C-165	1st R-F Plate Bypass	CAPACITOR, Fixed, Tubular, Paper, .01 mf. ±10%, 600 V DC Working	481567		19	3412BB		46X360
*C-166	2nd R-F AVC Bypass	CAPACITOR, Same as C-165						
*C-167	2nd R-F Plate Bypass	CAPACITOR, Same as C-165						
*C-168	Osc. Mixer Coupling	CAPACITOR, Same as C-165						
*C-169	1st I-F AVC Bypass	CAPACITOR, Same as C-165						
*C-170	AVC Bypass	CAPACITOR, Same as C-165						
*C-171	2nd I-F AVC Bypass	CAPACITOR, Same as C-165						
*C-172	Grid Coupling, 1st Audio Stage	CAPACITOR, Same as C-165						
*C-173	Tone Control Capacitor	CAPACITOR, Same as C-165						
*C-174	2nd Det. Plate Bypass	CAPACITOR, Fixed, Tubular, Paper, .05 mf. ±10%, 600 V DC Working	481568		19	3483A		46X363
*C-175	B+ Bypass	CAPACITOR, Same as C-174						
*C-176	1st R-F Cathode Bypass	CAPACITOR, Fixed, Tubular, Paper, .01 mf. ±10%, 400 V DC Working	481569		19	A7830		46X371
*C-177	1st R-F Filament Filter	CAPACITOR, Same as C-176						
*C-178	1st R-F Screen Resistor Bypass	CAPACITOR, Same as C-176						
*C-179	2nd R-F Cathode Bypass	CAPACITOR, Same as C-176						
*C-180	1st R-F Screen Bypass	CAPACITOR, Same as C-176						
*C-181	1st I-F Cathode Bypass	CAPACITOR, Same as C-176						
*C-182	2nd I-F Cathode Bypass	CAPACITOR, Same as C-176						
*C-183	2nd I-F Screen Bypass	CAPACITOR, Same as C-176						
*C-184	Output Grid Coupling	CAPACITOR, Same as C-176						
*C-185	AVC Plate Bypass	CAPACITOR, Same as C-176						
*C-186	AVC Cathode Bypass	CAPACITOR, Same as C-176						
*C-187	C-W Osc. Screen Bypass	CAPACITOR, Same as C-176						
*C-188	Audio Output Cathode Bypass	CAPACITOR, Same as C-176						
*C-189	Mixer Cathode Bypass	CAPACITOR, Same as C-176, Except with Mounting Strap			19	A7654		46X372

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*C-190	Mixer Plate Bypass	CAPACITOR, Fixed, Tubular, Paper, 0.1 mf. ±10%, 600 V DC Working	481570		19	A3486		46X361
*C-191	1st I-F Plate Bypass	CAPACITOR, Same as C-190						
*C-192	2nd I-F Plate Bypass	CAPACITOR, Same as C-190						
*C-193	1st Audio Plate Bypass	CAPACITOR, Same as C-190						
*C-194	2nd Det. Cathode Coupling	CAPACITOR, Fixed, Tubular, Paper, 1.0 mf. ±10%, 200 V DC Working	481572		19	7652		46X362
*C-195	1st Audio Cathode Bypass	CAPACITOR, Same as C-194						
*C-196 and C-197	Negative Bias Supply Filter	CAPACITOR, Same as C-194						
*C-200 thruC-202	Power Supply Filter	CAPACITOR, Fixed, Oil Filled, Paper. 4.0 mf. ±10%, 600 V DC Working	481080		56			48X249
		MISCELLANEOUS ELECTRICAL PARTS						
*E-101	Meter Lamp Socket Spacer	GROMMET, Rubber, .250" x .625" O.D., .375" I.D. Groove: .062" x .500" O.D.			6	230		6X40
*E-102	1st R-F Tube Leads Insulator	GROMMET, Same as E-101						
*E-103	Rear of Tuning Capacitor Mtg. Cushion	GROMMET, Rubber, .312" x .625" O.D., .265" I.D. Groove: .062" x .468" O.D.			6	1240		6X41
*E-104 thru E-109	Coil Leads from Channel Insulator	GROMMET, Rubber, .250" x .437" O.D., .187" I.D. Groove: .062" x .312" O.D.			6	2286		6X47
*E-110	Tuning Meter Adj. Control, R-155, Mounting Insulator	WASHER, Hard Black Fibre, .032" x .625" O.D., .380" I.D.			30			2X395
*E-111	Same as E-110	SHOULDER WASHER, Hard Black Fibre. Washer: .042" x .495" O.D., .380" I.D.; Shoulder: .051" x .875" O.D.			30			2X394
*E-112 and E-113	Phone Jack, J-101, Mounting Insulator	SHOULDER WASHER, Hard Black Fibre. Washer: .031" x .437" O.D., .380" I.D.; Shoulder: .031" x .625" O.D.			30			2X392
*E-114 thru E-116	Coil Contacts Mounting	CONTACT PANEL, Bakelite. Overall, 2.500" x 1.250" x .250" Thick. Five Contact Slots .390" x .187" Tapering to .050"			9			1X224
*E-117	Speaker Connections	TERMINAL PANEL. Bakelite, Two Screw Terminals with Lugs. Panel Lettered, SPKR			11	1720	Marked SPKR	4A274
*E-118	Osc. Coil Section Contact Insulator	COIL CONTACT INSULATOR, Sheet Fibre. Overall, .875" x .562" x .007" Thick			28			16X82

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*E-119 thru E-122	Vacuum Tube Grid Cap	GRID CLIP, C.R. Steel, Hot Tin Dipped			11	6012		30X391
*E-123	1st R-F Tube Grid Shield	GRID SHIELD, .031" C.R. Steel, 1.000" x .781" O.D.; Cadmium Plated			11	6020		32X331
*E-124 and E-125	Receiver Circuit AC Connection	SOLDERING LUG, Brass, Hot Tin Dipped			49	147		30X346
*E-126	Limiter Control Knob	BAR KNOB AND POINTER. Knob: Black Bakelite, 1.250" x .500" x .625" High, with .375" R. at Long Side Centers. Two 6-32 Tap Mounting Holes. Pointer Plate Attached to Bottom			47			10A487
*E-127	Tone Control Knob	BAR KNOB AND POINTER, Same as E-126						
*E-128	Power Supply Control Knob	BAR KNOB AND POINTER, Same as E-126						
*E-129	AVC-MVC-CWO Control Knob	BAR KNOB AND POINTER, Same as E-126						
*E-130	Phasing Control Knob	BAR KNOB AND POINTER, Same as E-126						
*E-131	Selectivity Control Knob	BAR KNOB AND POINTER, Same as E-126						
*E-132	CWO Control Knob	BAR KNOB AND POINTER, Same as E-126						
*E-133	A-F Gain Control Knob	BAR KNOB AND POINTER, Same as E-126						
*E-134	R-F Gain Control Knob	KNOB AND DIAL ASSEMBLY. Knob, Black Bakelite, 1.250" x .500" x .625" High, with .375" R. at Long Side Centers. Two 6-32 Tap Mtg. Holes. Dial Plate: .030" Zinc 1.625" Dia. Calibrated 0 to 10 and Letetred R-F GAIN			17	17622		10A488
*E-135	Tuning Control	KNOB, Black Bakelite, Fluted Edge, Rounded Front. Overall Dia. 2.375" x 1.187" Thick. Two 8-32 Tap Mtg. Holes			9			10A485
*E-136	Frequency Range Change Control	KNOB, Same as E-135						
*E-137 thru E-146	Frequency Range Change Grounding Contacts	CONTACT ASSEMBLY. Brass Screw, .343" Long x .086" Dia., #2-56 Thd., .156" from End. Coin Silver Button, .016" x .180" Dia., Soldered to Hex Head of Screw			18			25A631
*E-147	H-F Osc. Coil Adjustment Band E	IRON CORE, Grade GIC Iron, .250" x .437" Dia. 6-32 Thread x .625" Brass Screw with Slot at End Embedded in Iron			45			5X409
*E-148 thru E-151	Connection Insulator	TERMINAL BOARD ASSEMBLY, Bakelite, Two Terminals. .750" x .375" x .062" Thick. Right Lug Mtg. Extension. Wax Impregnated. All Parts to Withstand 200 Hr. Salt Spray Test			11	6464W1		4A277
*E-152 thru E-155	Same as E-148	TERMINAL BOARD ASSEMBLY, Same as E-148, Except Left Lug Mtg. Extension			11	6465W1		4A278

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*E-155 thru E-168	Same as E-148	TERMINAL BOARD ASSEMBLY, Bakelite, Three Terminals. 1.125" x .375" x .062". Center Lug Mtg. Extension. Wax Impregnated. All Parts to Withstand 200 Hr. Salt Spray Test			11	6468W1		4A276
*E-169	Same as E-148	TERMINAL BOARD ASSEMBLY, Same as E-155, Except Right Lug Mtg. Extension			11			4A281
*E-170 thru E-173	Same as E-148	TERMINAL BOARD ASSEMBLY, Bakelite, Four Terminals, Third Lug Mtg. Extension. Wax Impregnated. All Parts to Withstand 200 Hr. Salt Spray Test			11			4A279
*E-174 and E-175	Same as E-148	TERMINAL BOARD ASSEMBLY, Same as E-170, Except Second Lug Mtg. Extension			11			4A280
*E-176	Same as E-148	TERMINAL BOARD ASSEMBLY, Same as E-170, Except Different Type Mtg. Lug Extension			11			4A283
*E-177	Coil Contacts Mounting	CONTACT PANEL, Same as E-115, Except One End, Ground Flush			9			1X225
*E-178 thru E-217	Coil Contact	COIL CONTACT, .020" Phosphor Bronze, Silver Plated			25			30X362
*E-218	1st R-F Coil Leads Insulator	GROMMET, Same as E-104						
*E-219	1st R-F Tube Shield Cover	1ST R-F TUBE COVER, C.R. Steel. 2.624" x 2.406" x .031" Thick. Three Sides, .406" High. Two .187" Dia. Mtg. Holes. Cadmium Plated and Clear Lacquer Finish			50			34X400
*E-220	1st R-F Tube Grid Shield	GRID SHIELD, Same as E-123						
E-221	Voltage Changeover Strip for Type CWQ-46187-B Radio Receiver	VOLTAGE CHANGEOVER BOARD, Bakelite, 2.125" x 1.375" x .062" Thick. 4 Terminals, Two Each Connected by .031" Thick Brass Strips. Wax Impregnated. Part of Power Transformer, T-104.			33			4A300
*E-222	Mixer Coil Section Insulator, Primary Winding	COIL CONTACT INSULATOR, .010" Black Fibre. Overall, 1.250" x .562"						16X101
*E-223 thru E-226	Same as E-119	GRID CLIP, Same as E-119						
*E-227	Capacitor, C-125, Mounting Insulator	INSULATOR, Low Loss Ceramic, 1.250" x .375" Dia. Two 6-32 Tap Holes, Each .375" Deep, One Each End			8			16X81
*E-228 and E-229	Rear Coil Carriage Grounding Spring Contact	CONTACT, Brass. Overall Length, .281". Staggered Dia. as Follows: .156" x .132" Dia., .062" x .210" Dia., .063" x .132" Dia.; Silver Plated			47			30X405
*E-230 and E-231	Rear Coil Carriage Grounding	GROUNDING ASSEMBLY, Contact Lug with Grounding Spring			47			25A632
*E-232 and E-233	Meter Switch, S-102, Contacts	TERMINAL, Brass, Overall Length, .937", Hot Tin Dipped.			53			30X316

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*E-236	Det. Section Coil Contact Panel	CONTACT PANEL ASSEMBLY, Includes E-177, E-178 and E-222			47			25A714
*E-237	1st R-F Section Coil Contact Panel	CONTACT PANEL ASSEMBLY, Includes E-114 and E-178			47			25A715
*E-238	2nd R-F Section Coil Contact Panel	CONTACT PANEL ASSEMBLY, Same as E-237						
*E-239	Osc. Section Coil Contact Panel	CONTACT PANEL ASSEMBLY, Includes E-114, E-118 and E-178			47			25A716
*E-240	Coil Assembly, T-103, Connections	TERMINAL BOARD ASSEMBLY, Bakelite, Two Terminals, 1.875" x .750" x .062" Thick. Wax Coating			11			4A292
*E-241	Coil Assembly, L-103, Connections	TERMINAL BOARD ASSEMBLY, Same as E-240						
*E-242	2nd I-F Transformer Assembly, Z-122, Connections	TERMINAL PANEL ASSEMBLY, Bakelite. Four Terminals. 2.375" x 1.906" x .062" Thick. Rounded Corners; Two .265" x .125" Deep Cutouts, One Each Long Side at Center. Wax Coating			11			4A293
*E-243	Det. Input Transformer Assembly, Z-123, Connections	TERMINAL PANEL ASSEMBLY, Same as E-242						
*E-244	C-W Osc. Assembly, Z-124, Connections	TERMINAL BOARD ASSEMBLY, Bakelite. Four Terminals, 1.750" x 1.125" x .062" Thick. .312" R. Cutout One Side at Center. Wax Coating			11			4A294
*E-245	Mounts Resistor, R-152, and Terminal Connections	TERMINAL BOARD ASSEMBLY, Bakelite. Five Terminals. Center Lug Mounting. Wax Impregnated. All Parts to Withstand 200 Hr. Salt Spray Test			11			4A316
*E-246	R-F Cable, W-103, Protection	CONDUIT, Spauldite, 3.500" x .425" O.D., .375" I.D.			58			32X332
		FUSES						
*F-101 and F-102	Receiver Protection	FUSE, Type 3AG, 2 Amps., 250 Volts. 1.187" x .250" Dia.; All Parts to Withstand 200 Hr. Salt Spray Test			32	1042		16X87
		MISCELLANEOUS HARDWARE						
*H-101	Gear, O-104, Staking	GROOV-PIN, C.R. Steel, .375" x .062". Cadmium Plated			22	Type #1		29X413
*H-102thru H-105	Collars, O-111, O-112, and Sleeve, O-110 to Shafts, O-108 and O-109, Staking	GROOV-PIN, C.R. Steel, .750" x .093". Cadmium Plated			22	Type #1		29X403
*H-106	Gear, O-103, to Shaft, O-108, Staking	GROOV-PIN, C.R. Steel, .500" x .093". Cadmium Plated			22	Type #1		29X373

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*H-107	Pinion, O-105, to Shaft, O-108, Staking	GROOV-PIN, Same as H-106						
*H-108	Gear, O-102, to Shaft, O-107, Staking	GROOV-PIN, Same as H-106						
*H-109 thru H-117	Bar Knobs and R-F Gain Control Knob Retainer	SET SCREW, Allen Hd., Steel, 6-32 x .187" (.062" across Flats of Hex)			43			20X903
*H-118	Same as H-109	SET SCREW, Same as H-109 Except .500" Length			43			20X1002
*H-119 thru H-122	Main Tuning and Range Change Knobs Retainer	SET SCREW, Allen Hd., Steel, 8-32 x .500" (.078" across Flats of Hex)			43			20X1003
H-125 and H-126	1st R-F Tube Shield Cover Mounting	LOCKWASHER, Steel. #6, External Teeth. Cadmium Plated			52			20X550
*H-127 thru H-134	Same as H-109	SET SCREW, Same as H-118						
*H-143	Meter, M-101, Mounting	METER CLAMP, C.R. Steel. Overall, 2.500" x 2.187" x .0475" Thick. Cutout One Side. 2.125" Dia. Center Cutout. Cadmium Plated and Clear Lacquer Finish			47			30X402
*H-144	Spring, H-161, Mounting	SET SCREW, Brass. Overall, .187" O.D. x .125" x .250"-32 Thd., Slotted Head. Dull White Nickel Finish			47			20X1025
*H-145	Spring, H-162, Mounting	SET SCREW, Same as H-144						
*H-146	Capacitors, C-180 and and C-182, Mounting	TWIN CONDENSER MOUNTING STRAP, .040" C.R. Steel. Overall Length, 1.250" x .375". Center Straight Portion, .312". Each Side of Center Section, .281" R. Arc.; Cadmium Plated			47			30X419
*H-147	Capacitors, C-187 and C-191, Mounting	TWIN CONDENSER MOUNTING STRAP, Same as H-146						
*H-148	Capacitors, C-179 and C-183, Mounting	TWIN CONDENSER MOUNTING STRAP, .050" C.R. Steel. Overall Length, 1.812" x .375". Center Straight Portion, .375". Each Side of Center Section, .406" R. Arc.; Cadmium Plated			47			30X420
*H-149	Tuning Capacitor, C-101, Rear Mounting	CONDENSER MOUNTING BRACKET, Overall Length, 1.187" x 1.375"; Width Tapering to .312" R.; Mtg. Flange, .500" Wide. Cadmium Plated			47			25X1214
*H-150 and H-151	Dial Escutcheon Spacer	SPACER, Cardboard. .375" x .250" x .125"			47			7X97
*H-152 and H-153	Receiver Unit Carrying Handle	HANDLE, .250" Dia., C.R. Steel. Straight C Shape. Overall, 4.000" x 1.750" High. Bending Point Stems at Open Side. .750" Long. Black Wrinkle Finish			47			4X786
*H-154 thru H-155	Holds Spur Gear, O-103, in Position	SPRING WASHER, .0045" Spring Steel. .437" O.D., .258" I.D.; .062" Straight Bulge across I.D.; Cadmium Plated			47			28X406

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*H-156 and H-157	Holds Drive Gear, O-102, in Position	SPRING WASHER, Same as H-154						
*H-158 and H-159	Holds Drive Pinion, O-105, in Position	SPRING WASHER, Same as H-154						
*H-160	Roller, O-113, Mounting	STUD, C.R. Steel. Overall, .546" Threaded Section, .281" x 10-32 Thd. to Within .062" Shoulder. Shoulder: .203" x .247" Dia.; Slotted Head: .062" x .312" Dia.; Copper Plated			47			20X845
*H-161 and H-162	1st R-F Section Coil Carriage Grounding Spring	COIL SPRING, .018" Music Wire. 5 Coils. Free Length, .250" x .187" O.D., ½ T. Lap on Both Ends. Compressed Length Not to Exceed .140". Cadmium Plated			47			20X418
*H-163 and H-164	1st R-F Tube Shield Cover Retainer	WING NUT, Steel. 6-32 Tap. Cadmium Plated			47			20X1083
H-165 thru H-168	Voltage Changeover Board, E-221, Mounting	MACHINE SCREW, B.H., Brass, .312" x 6-32. Dull White Nickel Finish			47			20X545
H-169 thru H-172	Same as H-165	LOCKWASHER, Same as H-125						
*H-301 thru H-304	Receiver to Cradle Mounting	SPECIAL SCREW, Stainless Steel. Overall Length, 1.062". .312" x 12-24 Thd. at End. Remainder of Stem, .500" x .162" .162" Dia.; Head, .250" x .500" Dia., Slotted, Knurled Edge			24			20X851
		INDICATING DEVICES						
*I-101 and I-102	Dial Illumination	DIAL LAMP, Bayonet Type. 6-8 Volts, .15 Amp.			48	Mazda 47		7A103
*I-103	Meter Illumination	DIAL LAMP, Same as I-101						
*I-104	Frequency Indicator	POINTER, .025" C.R. Steel, Overall Length 3.125". Mtg. Section .280" Dia. With .116" Dia. Mtg. Hole. .078" Width to 1.110" from Mtg. Section. Remainder 90° Twist Tapering to .046" Width at Tip. Smooth Black Finish			25			15X210
*I-105	Split Frequency Indicator	POINTER, .015" C.R. Steel. Overall Length 1.218". Pointer .562" x .062", 90° Twist from Mtg. Section. Mtg. Section .625" x .375" with One .098" and One .126" Dia. Mtg. Hole. Smooth Black Finish			14			15X209

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
		JACKS AND RECEPTACLES						
*J-101	Head Phones Connector	PHONE JACK, Circuit Reversing Switch Circuit. All Metal Parts to Withstand 200 Hr. Salt Spray Test	49200		34	B-116306 Type 705B		3A373
*J-102	Ant. Connector	CONCENTRIC JACK, Length 1.312". .500" x .875" O.D.; .812" x .750"-20 Thread. Single Pin Plug with Hex Nut	49120	RA-49F-215	39			3A375
*J-103	Power Supply Connector	SOCKET, Flush Mounting Type, 7 Prongs, (2 Large Prongs) Body: 1.375" Dia., 1.187" Deep, with Mtg. Plate. All Parts to Withstand 200 Hr. Salt Spray Test	49201		4	61CP75		3A363
*J-104	AC Power Cord Connector	CORD CONNECTOR, Bakelite, 1.187" x .968" Dia. with Steel Clamp Cord Grip			23	7464 Twist-lock		3A374
*J-105 and J-106	Fuse Receptacle	FUSE EXTRACTOR POST, For Type 3AG Fuse. All Parts to Withstand 200 Hr. Salt Spray Test. Screwdriver Operation			32	1075		16X84
		INDUCTORS						
L-101 and L-102	Power Supply Filter	FILTER CHOKE, Single Winding, Two Terminals. Inductance to Exceed 17 Henries at an Impressed Potential of 3.0 Volts R.M.S. 60 Cycles with 55 Ma. Through Winding. Must Withstand Breakdown Test of 2,000 Volts R.M.S. 60-500 Cycles from Winding to Core and between Winding Terminals	30931		36	C1955		52X62
*L-103	Crystal Filter Output	COIL ASSEMBLY, Single Winding. 297 T. #10-41 S.S.E. Litz Wire. Inductance in Air at 1,000 Cycles, 1.87 MH ±5%. DC Resistance 9.5 Ohms ±5%. The Q, at 455 Kc, 110 Min.; Wax Coating			47			9A1687
		METERS						
M-101	Signal Strength Indicator	METER. 50° Deflection Calibrated to 9 S Unit Divisions; Remainder: 4 Divisions, Range 0 to 40 Decibels. Current for Full Scale Deflection 1.0 MA. DC ±10%. All Parts to Withstand 200 Hr. Salt Spray Rest			35	Type 52RM		16A9
		NAME PLATES						
*N-101	Frequency Reading	MAIN TUNING SCALE, .028" Brass Plate, 6.868" x 4.931". Five Ranges. Full Range, 540 Kc to 30.0 Mc; Range E, 540 Kc to 1.3 Mc; Range D, 1.3 Mc to 2.8 Mc; Range C, 2.8 Mc to 6.4 Mc; Range B, 6.4 Mc to 14.0 Mc; Range A, 14 Mc to 30.0 Mc Approx. Calibrations and Characteristics Dull Black, Cream Colored Etched Background			14			58X580
*N-102	Fine Frequency Reading	VERNIER DIAL ASSEMBLY, Brass, 4.000" Dia., with Centered .500" Mtg. Opening, 100 Calibrations to 360°. Dull Black Calibrations and Characteristics, Cream Colored Background			14			25A607

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
		MECHANICAL PARTS						
*O-101	Range Drive	RANGE INDICATOR GEAR ASSEMBLY. Gear: ¼ Hard Brass, .023" Thick; 72 Teeth, 32 Pitch, 2.250" Pitch Dia., 14.5° Pressure Angle, Involute Tooth Form. With Hub and 3 Collets Staked Securely. Dull White Nickel Finish			47			25A678
*O-102	Main Drive Gear	DRIVE GEAR, Doler Zink #3, .250" Thick, 36 Teeth, 32 Pitch, 1.125" Pitch Dia., 14.5° Pressure Angle, Involute Tooth Form. Hub: .250" x .500" O.D., .251" I.D. Clear. Di-Chromate Dip Finish			15			24X521
O-103	Shafts, O-108 and O-109 Drive	SPUR GEAR, Doler Zink #3, .250" Thick, 48 Teeth, 32 Pitch, 1.500" Pitch Dia., 14.5° Pressure Angle, Involute Tooth Form. Hub: .187" x .500" O.D., .251" I.D. Clear. Di-Chromate Dip Finish			15			24X519
*O-104	Range Gear, O-101, Drive	PINION GEAR, Brass, .125" Thick, 12 Teeth, 32 Pitch, .375" Pitch Dia., 14.5° Pressure Angle, Involute Tooth Form. Hub: .250" x .297" O.D., .1875" I.D. Clear. .059" Dia. Mtg. Hole. Dull White Nickel Finish			20			24X518
*O-105	Front Coil Carriage Drive	DRIVE PINION, Brass, .250" Thick, 12 Teeth, 24 Pitch, .500" Pitch Dia., 14.5° Pressure Angle. Involute Tooth Form. Hub: .187" x .400" O.D., .251" I.D. Clear. Dull White Nickel Finish			20			24X520
*O-106	Rear Coil Carriage Drive	DRIVE PINION, Same as O-105						
*O-107	Range Change Knob Mounting	CONTROL SHAFT, Stainless Steel. Overall 2.875" x .249" Dia			31			26X447
*O-108	Mounts Gears O-103, O-104 and O-105	FRONT DRIVE SHAFT, Stainless Steel. Overall 11.500" x .249" Dia. with .375" x .1875" Dia. Section at One End			3			26X430
*O-109	Mounts Gear O-106	REAR DRIVE SHAFT, Stainless Steel. Overall 4.187" x .249" Dia.			37			26X433
O-110	Shafts O-108 and O-109, Coupling Sleeve	SLEEVE, Bakelite, 1.000" x .499" O.D., .250" I.D.			30			2X390
*O-111 and O-112	Shafts O-108 and O-109 Coupling	COLLAR, Brass, .375" x .750" O.D., .500" I.D. Dull White Nickel Finish			24	17290		29X359
*O-113	Rear Coil Carriage Rider	ROLLER, Bakelite, .250" x .750" O.D., .383" I.D.			28			2X391
*O-114	Roller, O-113, Insert	INSERT, Brass, .250" x .383" O.D., .062" x .320" and .188" x .250" I.D. Outer Surface. Medium Straight Knurl			24	17292		29X370
*O-115	Front Coil Carriage Rider	ROLLER, Bakelite, .312" x .625" O.D., .281" I.D.			28			2X406

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*O-116	Roller, O-115, Bushing	ROLLER BUSHING, Brass. Body: .281" x .285" O.D., .219" I.D. Straight Knurled Surface. Shoulder: .062" x .375" O.D. .219" I.D.			24			29X429
* O-117	Shaft, O-119, to Tuning Capacitor, C-101, Insulated Connector	COUPLING, .031" x 1.093" Dia. Bakelite Plate, One Brass Coupling Each Side; with Two 8-32 x .187" Allen Hd. Cup Point Set Screws in Each Coupling. Cadmium Plated			47			25A624
* O-118	Shaft, O-119, to 1st R-F Tuning Capacitor, C-102, Insulated Connector	COUPLING, Same as O-117						
*O-119	Tuning Capacitors, C-101 and C-102, Connecting Shaft	SHAFT, Steel. 2.375" x .249" Dia., .164" x .013" Deep Undercut Both Ends. .031" from End. Cadmium Plated			47			26X427
		PLUGS						
*P-101	AC Line Connector	FLUSH MOTOR PLUG, Twist Lock Type, Male Base, .875" Deep			23	7466 Twist-lock		6A266
*P-102	Ant. Connector	CONCENTRIC PLUG, Female Contact	49121	RA-49F-216	39			6A267
*P-103	AC Jumper Plug	PLUG, 7 Prong, Female Type. Bakelite. Two Large Prongs. Wired by W. G. & Co. as follows: Terms: 1 to 2 and 3 to 7 with #18 Bare Copper Wire. All Parts to Withstand 200 Hr. Salt Spray Test	49202		4	PF7S		3A369
		RESISTORS						
*R-101	2nd R-F Cathode	RESISTOR, Fixed, Carbon, Uninsulated. 350 Ohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94351
*R-102	1st R-F Cathode	RESISTOR, Fixed, Carbon, Uninsulated, 500 Ohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94501
*R-103	2nd I-F Plate Decoupling	RESISTOR, Fixed, Carbon, Uninsulated, 1000 Ohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94102
*R-104	1st R-F Screen	RESISTOR, Fixed, Carbon, Uninsulated. 2000 Ohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94202
*R-105	1st R-F Plate Isolating	RESISTOR, Same as R-104						
*R-106	2nd R-F Plate Isolating	RESISTOR, Same as R-104						

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*R-107	Mixer Plate Isolating	RESISTOR, Same as R-104						
*R-108	1st I-F Plate Isolating	RESISTOR, Same as R-104						
*R-109	2nd Det. Plate	RESISTOR, Same as R-104						
*R-110	1st Audio Cathode	RESISTOR, Same as R-104						
*R-111	1st I-F Cathode	RESISTOR, Fixed, Carbon, Uninsulated, 3000 Ohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94302
*R-112	2nd I-F Cathode	RESISTOR, Same as R-111						
*R-113	Mixer Cathode	RESISTOR, Fixed, Carbon, Uninsulated, 5000 Ohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94502
*R-114	2nd Det. Cathode	RESISTOR, Same as R-113						
*R-115	1st Audio Plate	RESISTOR, Fixed, Carbon, Uninsulated, 10,000 Ohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94103
*R-116	Screen Circuit Bleeder	RESISTOR, Fixed, Carbon, Uninsulated, 50,000 Ohms, ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94503
*R-117	2nd Det. Cathode	RESISTOR, Same as R-116						
*R-118	Limiter Grid	RESISTOR, Same as R-116						
*R-119	C-W Osc. Grid	RESISTOR, Same as R-116						
*R-120	Osc. Grid	RESISTOR, Same as R-116						
*R-121	2nd I-F Screen	RESISTOR, Fixed, Carbon, Uninsulated, 70,000 Ohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94703
*R-122	Mixer Screen Bleeder	RESISTOR, Fixed, Carbon, Uninsulated, 100,000 Ohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94104
*R-123	Mixer Screen	RESISTOR, Same as R-122						
*R-124	2nd I-F Screen Bleeder	RESISTOR, Same as R-122						
*R-125	2nd Det. Cathode	RESISTOR, Same as R-122						
*R-126	C-W Osc. Screen Resistor	RESISTOR, Same as R-122						
*R-127	C-W Osc. Screen Bleeder	RESISTOR, Same as R-122						

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*R-128	1st Audio Plate	RESISTOR, Fixed, Carbon, Uninsulated. 250,000 Ohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94254
*R-129	C-W Osc. Plate	RESISTOR, Same as R-128						
*R-130	1st R-F AVC Filter	RESISTOR, Fixed, Carbon, Uninsulated. 500,000 Ohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94504
*R-131	2nd R-F AVC Filter	RESISTOR, Same as R-130						
*R-132	1st I-F AVC Filter	RESISTOR, Same as R-130						
*R-133	2nd I-F AVC Filter	RESISTOR, Same as R-130						
*R-134 and R-135	AVC Plate	RESISTOR, Same as R-130						
*R-136	Audio Output Grid	RESISTOR, Same as R-130						
*R-137	AVC Grid	RESISTOR, Fixed, Carbon, Uninsulated, 5 Megohms ±10%, 0.5 W. Pigtail Type Terminals	63360		2	Type E		B94505
*R-145	Audio Output Cathode	RESISTOR, Fixed, Carbon, Uninsulated. 250 Ohms ±10%, 1.0 W. Pigtail Type Terminals	63288		2	Type G		C94251
*R-146	Same as R-145	RESISTOR, Same as R-145						
*R-147	AVC Bias Supply	RESISTOR, Fixed, Carbon, Uninsulated. 500 Ohms—0.0%, +10%, 1.0 W. Pigtail Type Terminals	63288		45			C96501
*R-148	AVC Cathode	RESISTOR, Fixed, Carbon, Uninsulated. 2000 Ohms —10%, +0.0%, 1.0 W. Pigtail Type Terminals	63288		45			C96202
*R-149	Same as R-148	RESISTOR, Same as R-148						
*R-150 and R-151	Screen Circuit Voltage Dropping	RESISTOR, Fixed, Carbon, Uninsulated, 10,000 Ohms ±10%, 1.0 W. Pigtail Type Terminals	63288		2	Type G		C94103
*R-152	R-F Screen Bleeder	RESISTOR, Fixed, Carbon, Uninsulated, 20,000 Ohms ±10%, 1.0 W. Pigtail Type Terminals	63288		2	Type G		C94203
*R-153	Osc. Plate Supply	RESISTOR, Fixed, Carbon, Uninsulated, 50,000 Ohms ±10%, 1.0 W. Pigtail Type Terminals	63288		2	Type G		C94503
*R-155	Tuning Meter Adjustment Control	POTENTIOMETER, W.W. Total Resistance 1000 Ohms, Screwdriver Slot Shaft .125" Long. All Parts to Withstand 200 Hr. Salt Spray Test	631288		12	E-9029A Type MH-1000		43X153
*R-157	R-F Gain Control	POTENTIOMETER, W. W. Total Resistance 10,000 Ohms ±10%. Split Winding, Each Section Linear. First 50% Clockwise Rotation 7,800 Ohms ±10%. Rating, 4 Watts Approx. Knob Control Shaft .500" Long. All Parts to Withstand 200 Hr. Salt Spray Test	631286	RE-13A-492	10	25, Wire Wound		43X157

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*R-158	Limiter Control	POTENTIOMETER, Same as R-157						
*R-159	Tone Control	POTENTIOMETER AND SWITCH, Composition. Total Resistance 500,000 Ohms ±20%. Switch S.P.S.T., 1 Amp., 250 V., 3 Amp. 125 V. Rating. Knob Control Shaft .500" Long. All Parts to Withstand 200 Hr. Salt Spray Test. Includes S-107.	631289		10	Series AC-35		40X273
*R-160	Volume Control	POTENTIOMETER, Composition. First 50% Clockwise Rotation 25,000 Ohms ±20%, Total Resistance 500,000 Ohms ±20%. Knob Control Shaft .500" Long. All Parts to Withstand 200 H.. Salt Spray Test	63757		10	Series No. 35		36X331
		SWITCHES						
*S-101A S-101B	Crystal Control Selectivity Control	SWITCH, Two Section, Rotary, D.P. Six Position. Shorting Contacts. One Break per Circuit			8	6803		2A271
S-102	Meter ON-OFF Control	SWITCH, Toggle, S.P.S.T., One Break Per Circuit. Rating, 3 Amps., 250 V.; All Finishes to Withstand 200 Hr. Salt Spray Test			5	80994		2A273
S-103	B+ Power OFF-ON Control	SWITCH, Toggle, S.P.S.T. One Break Per Circuit. Rating 3 Amps., 125 V. All Parts to Withstand 200 Hr. Salt Spray Test. Part of S-108	24146		5	80993	E	2A279
*S-104	C-W Osc. ON-OFF Control	SWITCH, Same as S-103. Part of S-109						
*S-105	AVC-OFF-ON Control	SWITCH, Same as S-104						
S-106A S-106B	AC Power OFF-ON Control DC Heater Supply OFF-ON Control	SWITCH, Toggle, D.P.S.T., Single Break Per Circuit. Rating 3 Amps., 125 V. All Parts to Withstand 200 Hr. Salt Spray Test. Part of S-108	24147		5	81009	AB	2A280
*S-107	High-Low Frequency Control	SWITCH, Part of Tone Control, R-159						
*S-108	Same as S-103 and S-106	POWER SWITCH ASSEMBLY, Includes Sym. Desigs. S-103 and S-106			5	1570NQ		2A282
*S-109	Same as S-104 and S-105	CONTROL SWITCH ASSEMBLY, Includes Sym. Desigs. S-104 and S-105			5	1570NR		2A283

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
		TRANSFORMERS						
T-101	Power Transformer, Type CWQ-46187-A Radio Rating	POWER TRANSFORMER, 4 Windings, 9 Terminals. Exciting Current .120 Amp., Exciting Power 4 Watts. Rating: Primary, 64 Watts; Secondary, 60 VA. Primary (Terms. 1-4) 115 V., 50-60 Cycles, 390 T. #20 E. Wire, DC Resistance 2.4 Ohms. ST. Shield, One T. .002" Cop. Secondary #1 (Terms. 3-9) 290 V.D.C., .055 Amp. with a 5Z3 Rectifier and a 4 mf. Capacitor; 1780 T. #31 E. Wire, DC Resistance 179 Ohms; Center Tapped (Term. 6). Secondary #2 (Terms. 7-8) 6.3 V., 3.85 Amps., 22 T. #14 E. Wire, DC Resistance .051 Ohms. Secondary #3 (Terms. 2-5) 5.0 V., 3.0 Amps., 18 T. #18 E. Wire, DC Resistance .091 Ohms	30883		36	P-1959		53X269
*T-102	Audio Output Transformer	AUDIO OUTPUT TRANSFORMER, Two Windings, 5 Leads. Source Imp. 36,000 Ohms, Load Imp. 600 Ohms. Turns Radio Full Primary to Secondary 7.9 to 1. Primary (Red-Blue): 3280 T. #36 E. Wire; DC Resistance 438 Ohms. Shield (Black) One Layer #36 E. Wire. Secondary: (Yellow to Green) 414 T. #30 E. Wire; DC Resistance 18 Ohms; Center Tapped (Connected to Shield Lead). Primary Impedance at 10 V., 60 Cycles, 28 MA. DC 5500 Ohms Min.	30884		36	A-1956		51X109
*T-103	1st I-F Input	COIL ASSEMBLY, Two Windings. Primary (Blue to Red Tracer): 239 T., Secondary (Green to Yellow Tracer): 97 T. #10-41 S.S.E. Litz Wire. .750" x .562" O.D., .437" I.D. Bakelite Form. Inductance in Air at 1,000 Cycles: Primary 1.15 MH ±5%, Secondary 180 MH ±5%. DC Resistance: Primary 7.12 Ohms ±5%, Secondary 2.57 Ohms ±5%. Wax Coated. Includes C-133, C-138, C-139.			47			9A1686
T-104	Power Transformer, Type CWQ-46187-B Radio Receiver	POWER TRANSFORMER, 11 Terminals, 5 Windings. 2 Primary Windings: Jumper Terminals for 115 V. (Terms.1-10 and 11-4) or 230 V. (Terms. 10-11), 50-60 Cycle Operation; Each Winding, 390 T. #23 Wire; DC Resistance: Primary #1, 4.35 Ohms; Primary #2, 5.53 Ohms. Secondary #1 (Terms. 3-9), Center Tapped (Term. 6), 494 V., 0.055 Amp.; 1780 T. #31 E. Wire; DC Resistance, 170 Ohms. Secondary #2 (Terms. 7-8) 6.3 V., 3.85 Amps.; 22 T. #14 Wire; DC Resistance, .051 Ohms. Secondary #3 (Terms. 2-5) 5.0 V., 3 Amps.; 18 T. #17 Wire; DC Resistance, .091 Ohms. Rating: Primary, 64 Watts; Secondary, 60 V. Amps. Exciting Power 4 Watts; Exciting Current, .120 Amps.			33	P-2006		53X273
		VACUUM TUBES						
*V-101	1st R-F Amplifier	VACUUM TUBE, Receiving Type, Metal, Super Control R-F Pentode Heater. 6.3 Volts, 0.30 Amps.	6K7	RE-13A-600E	27	6K7		6K7
*V-102	2nd R-F Amplifier	VACUUM TUBES, Same as V-101						

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
*V-103	Mixer	VACUUM TUBE, Receiving Type, Metal, Detector Amplifier Pentode. Heater 6.3 Volts, 0.30 Amps.	6J7	RE-13A-600E	27	6J7		6J7
*V-104	1st I-F Amplifier	VACUUM TUBE, Same as V-101						
*V-105	2nd I-F Amplifier	VACUUM TUBE, Same as V-101						
*V-106A *V-106B	Second Detector Limiter	VACUUM TUBE, Receiving Type, Glass, Double Triode. Heater 6.3 Volts, 0.30 Amp.	6C8G	RE-13A-600E	27	6C8G		6C8G
*V-107A *V-107B	1st Audio Amplifier Automatic Volume Control	VACUUM TUBE, Receiving Type, Glass, Double Triode. Heater 6.3 Volts, 0.60 Amp.	6F8G	RE-13A-600E	27	6F8G		6F8G
*V-108	Audio Output	VACUUM TUBE, Receiving Type, Glass. Power Amplifier. Pentode. Heater 6.3 Volts, 0.40 Amp.	6V6GT/G	RE-13A-600E	27	6V6GT/G		6V6GT/G
*V-109	H-F Oscillator	VACUUM TUBE, Receiving Type, Metal, General Purpose Triode. Heater 6.3 Volts, 0.40 Amp.	6J5	RE-13A-600E	27	6J5		6J5
*V-110	C-W Oscillator	VACUUM TUBE, Same as V-103						
*V-111	Power Rectifier	VACUUM TUBE, Receiving Type, Glass, Full Wave Rectifier. Heater 5.0 Volts, 3.0 Amp.	5Z3	RE-13A-600E	27	5Z3		5Z3
		WIRE AND CABLES						
*W-101	Jack, J-101, to 1st R-F Coil Section Lead	ANTENNA CABLE ASSEMBLY. 6.750" #20 Stranded, Tinned, Copper Wire. Double Butyrate Tape, Double Glass Braid, Flame Proof Lacquer Finish Insulation; Rating 1000 V. 4.500" Round Tinned Copper Braid Sheathing. Grounding Lug Connected to Braid			47			13X493
*W-102	Audio Circuit Connections	AUDIO CABLE ASSEMBLY. 21 Leads Stranded, Tinned, Copper Wire. Double Butyrate Tape. Double Glass Braid, Flame Proof Lacquer Finish Insulation; Rating 1000 V. 15 Leads #20 Wire; 5 Blue, 4 Red, 2 Red-Yellow, 2 Black, One Each Red-Green and Red-Blue Tracer. 6 Leads #18 Wire: 3 Each Orange and Gray Tracer. Bound with Lacing Cord			47			13X489
*W-103	R-F Circuit Connections	R-F CABLE ASSEMBLY, 15 Leads. Stranded, Tinned, Copper Wire. Double Butyrate Tape, Double Glass Braid, Flame Proof Lacquer Finish Insulation. Rating, 1000 V.; 12 Leads, #20 Wire; 3 Each Black, Red and Green, One Each Red-Green, Yellow and Brown Tracer. 3 Leads #18 Wire: One Each Orange and Gray and Black Tracer. Bound with Lacing Cord			47			13X490
*W-104	Power Leads Connections	POWER SUPPLY CABLE ASSEMBLY. 8 Leads Stranded, Tinned, Copper Wire. Double Butyrate Tape, Double Glass Braid, Flame Proof Lacquer Finish Insulation, Rating 1000 V. 6 Leads #20 Wire: 3 Red, 2 Black and 1 Yellow Tracer, 2 Leads #18 Wire: One Each, Orange and Gray Tracer, Bound with Lacing Cord			47			13X491

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
		SOCKETS						
X-101	1st R-F Tube Mounting	VACUUM TUBE SOCKET, Receiving Type, Octal, Assembled with Mounting Plate and Retainer Ring. Tube Locating Slot in Line with Mounting Holes. All Parts to Withstand 200 Hr. Salt Spray Test	49373	RE-49A-300B	4	RSS8M		3A364
*X-102	2nd R-F Tube Mounting	VACUUM TUBE SOCKET, Same as X-101						
*X-103	Mixer Tube Mounting	VACUUM TUBE SOCKET, Same as X-101						
*X-104	1st I-F Tube Mounting	VACUUM TUBE SOCKET, Same as X-101						
*X-105	2nd I-F Tube Mounting	VACUUM TUBE SOCKET, Same as X-101						
*X-106	2nd Det. and Limiter Tube Mounting	VACUUM TUBE SOCKET, Same as X-101						
*X-107	1st A-F and AVC Tube Mounting	VACUUM TUBE SOCKET, Same as X-101						
*X-108	Audio Output Tube Mounting	VACUUM TUBE SOCKET, Same as X-101						
*X-109	High Frequency Osc. Tube Mounting	VACUUM TUBE SOCKET, Same as X-101						
*X-110	C-W Osc. Tube Mounting	VACUUM TUBE SOCKET, Same as X-101						
X-111	Power Rectifier Tube Mounting	VACUUM TUBE SOCKET, Receiving Type, Ceramic. 4 Prong, Assembled with Mounting Plate and Retainer Ring. Silver Plated Phosphor Bronze Contacts. All Parts to Withstand 200 Hr. Salt Spray Test	49368	RE-49A-300B	4	RSS4M		3A372
*X-112	Dial Lamp Mounting	DIAL LAMP SOCKET ASSEMBLY, with Spring Mounting Clips. Cadmium Plated. Bayonet Type Socket with Exterior Fibre Insulation .875" Long. 12.250" #22 Stranded Insulated Yellow Tracer Lead to Center of Base. 12.750" #22 Stranded Insulated Black Tracer Lead to Socket Shell. All Parts to Withstand 200 Hr. Salt Spray Test			1	85UL		7A173
*X-113	Same as X-112	DIAL LAMP SOCKET ASSEMBLY, Same as X-112 Except Black Lead 11.250" and Yellow Lead 10.750"			1	85UL		7A174
*X-114	Meter Lamp Mounting	METER LIGHT SOCKET ASSEMBLY, Min. Bayonet Type. All Parts to Withstand 200 Hr. Salt Spray Test			16	217H		7A175
		CRYSTALS						
*Y-101	I-F Filter	CRYSTAL ASSEMBLY. Crystal Frequency 455 Kc ±0.5 Kc. Impedance, Less than 2,000 Ohms, at Resonance. Enclosed in Bakelite Covers. Assembly, Wax Coated.			47			30A2

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No
		INDUCTORS						
Z-101	Ant. to 1st R-F Tube Coupling, A Band	1ST R-F TRANSFORMER ASSEMBLY, Two Windings in Opposite Direction on .750" x .575" O.D. Bakelite Form. Primary: 3.875 T. #32 D.S. Wire, Close-wound, DC Resistance .148 Ohms ±5%, Q at 20 Mc 83. Secondary 5.875 T. #22 E. Wire, Space Wound; DC Resistance.029 Ohms ±5%, Q at 20 Mc 137. Wax Coated. Includes C-104			47			9A1625
Z-102	Ant. to 1st R-F Tube Coupling, B Band	1ST R-F TRANSFORMER ASSEMBLY, Two Windings in Same Direction on 1.500" x 1.005" O.D. Bakelite Form. Primary: 2.875 T. #32 D.S. Wire, Close-wound; DC Resistance 0.18 Ohms ±5%, Q at 20 Mc 83. Secondary: 9.4 T. #24 E. Wire; DC Resistance .087 Ohms ±5%, Q at 8 Mc 137. Wax Coated. Includes C-116			47			9A1624
Z-103	Ant. to 1st R-F Tube Coupling, C Band	1ST R-F TRANSFORMER ASSEMBLY, Two Windings in Same Direction on 1.500" x 1.005" O.D. Bakelite Form. Primary: 7.125 T. #32 D.S. Wire, Close-wound, DC Resistance .372 Ohms ±5%, Q at 8 Mc 80. Secondary: 23.5 T. #28 E. Wire, Space-wound; DC Resistance .46 Ohms ±5%, Q at 5 Mc 101. Wax Coated. Includes C-105			47			9A1623
Z-104	Ant. to 1st R-F Tube Coupling, D Band	1ST R-F TRANSFORMER ASSEMBLY, Two Windings, .750" x .562" O.D. Bakelite Form. Primary: 24 T. #30 D.S. Wire; Inductance at 1,000 Cycles in Air, 12 MH, DC Resistance .468 Ohms ±5%, Q at 3 Mc 50. Secondary: 56 T. #10-41 S.S.E. Wire; Inductance at 1,000 Cycles in Air 62.0 MH, DC Resistance 1.335 Ohms ±5%, Q at 1.5 Mc 65. Wax Coated. Includes C-106			47			9A1622
Z-105	Ant. to 1st R-F Tube Coupling, E Band	1ST R-F TRANSFORMER ASSEMBLY, Two Windings on 1.000" x .562" O.D. Bakelite Form. Primary: 39 T. #30 D.S. Wire; Inductance at 1,000 Cycles 30.0 MH, DC Resistance .811 Ohms ±5%, Q at 2,000 Kc 40. Secondary: Double-wound; Each 74 T. #10-41 S.S.E. Wire; Inductance at 1,000 Cycles 353 MH, DC Resistance 3.91 Ohms ±5%, Q at 600 Kc 97. Wax Coated. Includes C-107			47			9A1621
Z-106	1st R-F Tube to 2nd R-F Tube Coupling, A Band	2ND R-F TRANSFORMER ASSEMBLY, Three Windings. Primary: 9.5 T. #36 D S. Wire. Secondary: 9.875 T. #22 E. Wire. Both Wound on .750" x .575" O.D. Bakelite Form. Primary: DC Resistance .812 Ohms ±5%, Q at 20 Mc 28. Secondary: DC Resistance. 043 Ohms ±5%, Q at 20 Mc 40. Tertiary Winding 47 T. #38 E. Wire on .812" x .625" O.D. Bakelite Form; DC Resistance 5.98 Ohms ±5%, Q at 3 Mc 31; Inductance at 1000 Cycles in Air, 51.0 MH. Wax Coated. Includes C-117			47			9A1640
Z-107	1st R-F Tube to 2nd R-F Tube Coupling, B Band	2ND R-F TRANSFORMER ASSEMBLY, Two Windings Primary: 73 T. #36 S.S.E. Wire. .500" x .375" O.D. Bakelite Form; Inductance at 1,000 Cycles in Air 56.0 MH, DC Resistance 3.66 Ohms ±5%, Q at 2 Mc 30. Secondary: 9.4 T. #24 E. Wire. 1.500" x 1.005" O.D. Bakelite Form; DC Resistance .09 Ohms ±5%, Q at 8 Mc 95. Capacity Turn Interwound with Secondary 1 T. #28 D.S. Wire. Wax Coated. Includes C-108			47			9A1637

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
Z-108	1st R-F Tube to 2nd R-F Tube Coupling, C Band	2ND R-F TRANSFORMER ASSEMBLY, Two Windings, Primary: 252 T. #36 S.S.E. Wire on 1.500" x .375" O.D. Bakelite Form; Inductance at 1,000 Cycles in Air 690 MH, DC Resistance 13.95 Ohms ±5%, Q at 0.6 Mc 30. Secondary: 23.5 T. #28 E. Wire, Space-wound on 1.500" x .880" O.D. Bakelite Form; DC Resistance .46 Ohms ±5%, Q at 5 Mc 84. Capacity Turn, 1T. Wound Close to Secondary. #28 D.S. Wire. Wax Coated. Includes C-109			47			9A1636
Z-109	1st R-F Tube to 2nd R-F Tube Coupling, D Band	2ND TRANSFORMER ASSEMBLY, Two Windings. Primary: 347 T. #36 S.S.E. Wire; Inductance at 1,000 Cycles in Air 2,200 MH, DC Resistance 27.18 Ohms ±5%, Q at 0.2 Mc 63. Secondary: 58 T. #10-41 S.S.E. Wire; Inductance at 1,000 Cycles in Air 64.5 MH, DC Resistance 1.37 Ohms ±5%, Q at 1.5 Mc 51. Capacity Turn, 1 T. Wound Close to Secondary #28 D.S. Wire. 1.000" x .562" O.D. Bakelite Form. Wax Coated. Includes C-110			47			9A1634
Z-110	1st R-F Tube to 2nd R-F Tube Coupling, E Band	2ND R-F TRANSFORMER ASSEMBLY, Two Windings, Primary: 39 T. #30 D.S. Wire; Inductance at 1,000 Cycles in Air 30.0 MH, DC Resistance .83 Ohms ±5%, Q at 1,500 Kc 35. Secondary: 123 T. #10-41 S.S.E. Wire; Inductance at 1,000 Cycles in Air 353.5 MH, DC Resistance 4.05 Ohms ±5%, Q at 600 Kc 83. Wax Coated. Includes C-111			47			9A1631
Z-111	2nd R-F Tube to Mixer Tube Coupling, A Band	MIXER TRANSFORMER ASSEMBLY, Three Windings. Primary: 9.5 T. #36 D.S. Wire; DC Resistance .810 Ohms ±5%, Q at 27 Mc 25. Secondary: 9.875 T. #22 E. Wire; DC Resistance .043 Ohms ±5%, Q at 20 Mc 38. Both Windings on .750" x .575" O.D. Bakelite Form. Tertiary Winding 47 T. #38 E. Wire on .812" x .625" O.D. Bakelite Form; Inductance at 1,000 Cycles in Air 51 MH, DC Resistance 5.909 Ohms ±5%, Q at 3 Mc 32. Wax Coated. Includes C-118			47			9A1651
Z-112	2nd R-F Tube to Mixer Tube Coupling, B Band	MIXER TRANSFORMER ASSEMBLY, Two Windings. Primary: 73 T. #36 S.S.E. Wire on .500" x .375" O.D. Bakelite Form; Inductance at 1,000 Cycles in Air 56 MH, DC Resistance 3.655 Ohms ±5%, Q at 2 Mc 30. Secondary: 9.4 T. #24 E. Wire; DC Resistance .09 Ohms ±5%, Q at 8 Mc 100. Capacity Turn, 1 T. #28 D.S. Wire; Both on 1.500" x 1.005" O.D. Bakelite Form. Wax Coated. Includes C-112			47			9A1648
Z-113	2nd R-F Tube to Mixer Tube Coupling, C Band	MIXER TRANSFORMER ASSEMBLY, Two Windings. Primary: 252 T. #36 S.S.E. Wire on .500" x .375" O.D. Bakelite Form; Inductance at 1,000 Cycles in Air 690 MH, DC Resistance 13.95 Ohms ±5%, Q at 0.6 Mc 30. Secondary: 23.5 T. #28 E. Wire; DC Resistance .46 Ohms ±5%, Q at 5 Mc 84. Capacity Turn ⅛ T. #28 D.S. Wire; Both on 1.500" x 1.005" O.D. Bakelite Form. Wax Coated. Includes C-113			47			9A1646

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
Z-114	2nd R-F Tube to Mixer Tube Coupling, D Band	MIXER TRANSFORMER ASSEMBLY, Two Windings. Primary: 347 T. #36 S.S.E. Wire; Inductance at 1,000 Cycles in Air 2,200 MH, DC Resistance 27.0 Ohms ±5%, Q at 0.2 Mc 60. Secondary: 58 T. #10-41 S.S.E. Wire; Inductance at 1,000 Cycles in Air 64 MH, DC Resistance 1.37 Ohms ±5%, Q at 1.5 Mc 50. Capacity Turn 1 T. #28 D.S. Wire. Both on 1.000" x .562" O.D. Bakelite Form. Wax Coated. Includes C-114			47			9A1645
Z-115	2nd R-F Tube to Mixer Tube Coupling, E Band	MIXER TRANSFORMER ASSEMBLY, Two Windings. Primary: 39 T. #30 D.S. Wire; Inductance at 1,000 Cycles in Air 30 MH, DC Resistance .764 Ohms ±5%, Q at 1,500 Kc 35. Secondary: 123 T. #10-41 S.S.E. Wire; Inductance at 1,000 Cycles in Air 345 MH, DC Resistance 4.01 Ohms ±5%, Q at 600 Kc 85. Both on .750" x .562" O.D. Bakelite Form. Wax Coated. Includes C-115			47			9A1643
Z-116	Osc. Coupling, A Band	H-F OSC. TRANSFORMER ASSEMBLY, Two Windings. Grid Winding: 2.25 T. #30 D.S. Wire; DC Resistance .068 Ohms ±5%, Q at 20 Mc 76. Plate Winding: 5.25 T. #22 E. Wire; DC Resistance .03 Ohms ±5%, Q at 20 Mc 120. .750" x .575" O.D., .437" I.D. Bakelite Form. Wax Coated. Includes C-119 and C-159			47			9A1661
Z-117	Osc. Coupling, B Band	H-F OSC. TRANSFORMER ASSEMBLY, Two Windings. Grid Winding: 2.6 T. #28 D.S. Wire; DC Resistance .07 Ohms ±5%, Q at 14 Mc 68. Plate Winding: 8.75 T. #24 E. Wire; DC Resistance .082 Ohms ±5%, Q at 8 Mc 113. Wound on 1.500" x 1.005" O.D. Bakelite Form. Wax Coated. Includes C-120 and C-161			47			9A1659
Z-118	Osc. Coupling, C Band	H-F OSC. TRANSFORMER ASSEMBLY, Two Windings. Plate Windings: 20 T. #28 E. Wire; D.C. Resistance .388 Ohms ±5%, at 5 Mc 87. Grid Winding: 5.75 T. #28 E. Wire; DC Resistance .133 Ohms ±5%, Q at 8 Mc 73. 1.500" x 1.005" O.D. Bakelite Form. Wax Coated. Includes C-121 and C-160.			47			9A1657
Z-119	Osc. Coupling, D Band	H-F OSC. TRANSFORMER ASSEMBLY, Two Windings. Plate Winding: 48.25 T. #28 E. Wire; Inductance at 1,000 Cycles in Air 3.1 MH, DC Resistance 0.156 Ohms ±5%, Q at 10 Mc 51. Grid Winding: 7.2 T. #28 E. Wire; Inductance at 1,000 Cycles 48 MH, DC Resistance .0913 Ohms ±5%, Q at 1.5 Mc 80 1.500" x 1.005" O.D. Bakelite Form. Wax Coated. Includes C-127 and C-157			47			9A1655
Z-120	Osc. Coupling, E Band	H-F OSC. TRANSFORMER ASSEMBLY, Two Windings. Grid Winding: 39 T. #30 D.S. Wire; Inductance at 1,000 Cycles in Air 30 MH, DC Resistance .784 Ohms ±5%, Q at 1,500 Kc 26. Plate Winding: 93 T. #10-41 S.S.E. Wire; Inductance at 1,000 Cycles in Air 184 MH, DC Resistance 2.27 Ohms ±5%, Q at 600 Kc 50. 1.000" x .562" O.D. Bakelite Form. Wax Coated. Includes C-122 and E-147			47			9A1653

TABLE G — PARTS LIST BY SYMBOL DESIGNATION FOR NAVY MODELS RAO-3 AND RAO-4

Symbol Desig.	FUNCTION	DESCRIPTION	Navy Type Number	Navy Specification or Drawing Number	Mfr.	Mfr. Desig.	Special Tolerance Rating or Modification	Contractor's Drawing and Part No.
Z-121	Mixer Tube to 1st I-F Tube Coupling	CRYSTAL FILTER AND I-F ASSEMBLY. Includes Capacitors C-103, C-125, C-126, C-133, C-134, C-135, C-136, C-137, C-138 and C-139, Coil L-103, Switch S-101, 1st I-F Transformer T-103 and Crystal Assembly Y-101			47			25A547
Z-122	1st I-F Tube to 2nd I-F Tube Coupling	2ND I-F TRANSFORMER ASSEMBLY, Two Windings in Same Direction. Primary (Red to Blue Tracer Leads); Secondary (Black Tracer to Green Tracer, Grid Cap Lead); Each 260 T. #10-41 S.S.E. Litz Wire. 2,000" x .562" O.D. .437" I.D. Bakelite Form. Inductance in Air at 1,000 Cycles Each 1.40 MH ±5%. Wax Coated. Includes C-128 and C-129	47254		47			9A1619
Z-123	2nd I-F Tube to 2nd Det Tube Coupling	DETECTOR INPUT TRANSFORMER ASSEMBLY, Two Windings in Same Direction. Primary (Red to Blue Tracer Leads) Secondary (Green to Black Tracer Leads) Each 260 T. #10-41 S.S.E. Litz Wire. 2.000" x .562" O.D., .437" I.D. Bakelite Form. Inductance in Air at 1,000 Cycles Each Winding 1.40 MH Wax Coated Includes C-130 and C-131	47242		47			9A1688
Z-124	C-W Osc. Tube, Plate to Grid Coupling	C-W OSCILLATOR ASSEMBLY, Single Winding. 305 T. #32 S.S.E. Wire; Tapped at 57 T. .750" x .500" O.D., .375" I.D. Bakelite Form. Inductance in Air at 1,000 Cycles 1.5 MH ±5%. Wax Coated Includes C-123, C-132, C-150 and R-119	47253		47			9A1620
		MISCELLANEOUS						
*	Replacement Contact for All Tube Sockets Except X-111 Rectifier Socket	CONTACT LUG, Phosphor Bronze, Overall Length .750". Silver Plated to Withstand 200 Hr. Salt Spray Test			4	9-171		30X378
*	Replacement Contact for Rectifier Tube Socket	SOCKET CONTACT, Phosphor Bronze. Silver Plated			4			30X422
*	Maintenance Tool	WRENCH, Allen Type, Steel. 1.750" x .562" x .062" Across Hex Flats, to Fit Allen Hd. Set Screw #6. Cadmium Plated			43			77X8
*	Maintenance Tool	WRENCH, Allen Type, Steel, 2.125" x .750" x .078" Across Hex Flats, to Fit Allen Hd. Set Screw #8. Cadmium Plated			43			67X9
*	I-F Adjustment	I-F WRENCH, Plexiglas, Overall 6.000" x .500"; Socket Body 1.187" x .390" Dia. With .256" Across Flats Hex Socket 1.000" Deep			29			67X22
*	Equipment Spare Parts Container	METAL SPARE PARTS BOX			26			34X402
*	Equipment Spare Parts Listing Card Cover	WINDOW, Cellulose Acetate, Water Clear, 6.000" x 4.625" x .031"			7			17X81

TABLE H—EQUIPMENT SPARE PARTS LIST BY NAVY TYPE DESIGNATION

Box No.	Qty.	Navy Type Number	All Symbol Desigs. Involved	DESCRIPTION	Navy Drawing or Specification	Mfr.	Mfg. Desig.	Special Tolerance or Modification	Contractor's Drawing and Part Number
				CAPACITORS					
1	2	481080	C-200, C-201, C-202	CAPACITOR, Oil Filled, Paper, 4.0 mf. ±10%, 600 V.		19	7670		48X249
1	5	481567	C-165 to C-173, Incl.	CAPACITOR, Tubular, Paper, .01 mf. ±10%, 600 V.		19	3412BB		46X360
1	1	481568	C-174, C-175	CAPACITOR, Tubular, Paper, .05 mf. ±10%, 600 V.		19	3483A		46X363
1	7	481569	C-176 to C-188, Incl.	CAPACITOR, Tubular, Paper, 0.1 mf. ±10%, 400 V.		19	A7830		46X371
1	2	481570	C-190, C-191, C-192, C-193	CAPACITOR, Tubular, Paper, 0.1 mf. ±10%, 600 V.		19	3486A		46X361
1	2	481572	C-194, C-195, C-196	CAPACITOR, Tubular, Paper, 1.0 mf. ±10%, 200 V.		19	7652		46X362
1	1	481576	C-135	CAPACITOR, Ceramic, 5 mmf. ±20%		8	809A115		47X332
1	1	481577	C-136, C-137	CAPACITOR, Ceramic, 10 mmf. ±10%, 600 V.		8	811-154		47X333
1	1		C-138, C-139	CAPACITOR, Ceramic, 50 mmf. ±10%		8	813-161		47X355
1	1		C-140	CAPACITOR, Bakelite, 1 mmf. ±20%		45			47X365
1	1		C-189	CAPACITOR, Same as C-176 Except with Mounting Strap		19	A7654		46X372
				FUSES					
1	2		F-101, F-102	TYPE 3AG, 2 Amps., 250 V.		32	1042		16X87
				INDICATING DEVICES					
1	3		I-101, I-102, I-103	DIAL LAMP, Bayonet Type, 6-8 Volts, .15 Amp.		48	Mazda #47		7A103
				RESISTORS (CLASS 63)					
1	1	63360	R-101	RESISTOR, Carbon, 350 Ohms ±10%, 0.5 W.		2	Type E		B94351
1	1	63360	R-102	RESISTOR, Carbon, 500 Ohms ±10%, 0.5 W.		2	Type E		B94501
1	1	63360	R-103	RESISTOR, Carbon, 1,000 Ohms ±10%, 0.5 W.		2	Type E		B94102

TABLE H—EQUIPMENT SPARE PARTS LIST BY NAVY TYPE DESIGNATION

Box No.	Qty.	Navy Type Number	All Symbol Desigs. Involved	DESCRIPTION	Navy Drawing or Specification	Mfr.	Mfg. Desig.	Special Tolerance or Modification	Contractor's Drawing and Part Number
1	4	63360	R-104 to R-110	RESISTOR, Carbon, 2,000 Ohms ±10%, 0.5 W.		2	Type E		B94202
1	1	63360	R-111, R-112	RESISTOR, Carbon, 3,000 Ohms ±10%, 0.5 W.		2	Type E		B94302
1	1	63360	R-113, R-114	RESISTOR, Carbon, 5,000 Ohms ±10%, 0.5 W.		2	Type E		B94502
1	1	63360	R-115	RESISTOR, Carbon, 10,000 Ohms ±10%, 0.5 W.		2	Type E		B94103
1	3	63360	R-116 to R-120	RESISTOR, Carbon, 50,000 Ohms ±10%, 0.5 W.		2	Type E		B94503
1	1	63360	R-121	RESISTOR, Carbon, 70,000 Ohms ±10%, 0.5 W.		2	Type E		B94703
1	3	63360	R-122 to R-127	RESISTOR, Carbon, 100,000 Ohms ±10%, 0.5 W.		2	Type E		B94104
1	1	63360	R-128, R-129	RESISTOR, Carbon, 250,000 Ohms ±10%, 0.5 W.		2	Type E		B94254
1	4	63360	R-130 to R-136	RESISTOR, Carbon, 500,000 Ohms ±10%, 0.5 W.		2	Type E		B94504
1	1	63360	R-137	RESISTOR, Carbon, 5 Megohms ±10%, 0.5 W.		2	Type E		B94505
1	1	63288	R-145, R-146	RESISTOR, Carbon, 250 Ohms ±10%, 1.0 W.		2	Type G		C94251
1	1	63288	R-147	RESISTOR, Carbon, 500 Ohms —0% ±10%, 1.0 W.		2	Type G		C94501
1	1	63288	R-148, R-149	RESISTOR, Carbon, 2,000 Ohms ±10%, 1.0 W.		2	Type G		C94202
1	1	63288	R-150, R-151	RESISTOR, Carbon, 10,000 Ohms ±10%, 1.0 W.		2	Type G		C94103
1	1	63288	R-152	RESISTOR, Carbon, 20,000 Ohms ±10%, 1.0 W.		2	Type G		C94203
1	1	63288	R-153	RESISTOR, Carbon, 50,000 Ohms ±10%, 1.0 W.		2	Type G		C94503
1	1	63757	R-160	POTENTIOMETER, Variable, Comp., 500,000 Ohms ±20%		10	Series No. 35		36X331
1	1	631286	R-157, R-158	POTENTIOMETER, Variable, W.W., 10,000 Ohms ±10%, 4 W.	RE-13A-492	10	25 Wire Wound		43X157
1	1	631288	R-155	POTENTIOMETER, Variable, W.W., 1,000 Ohms		12	E-9029A Type MH-1000		43X153
1	1	631289	R-159	POTENTIOMETER AND SWITCH ASSEMBLY, Variable, Comp., 500,000 Ohms ±20%			Series AC-35		40X273
				TRANSFORMERS A. F. (CLASS 30)					
1	1	30884	T-102	AUDIO TRANSFORMER, Source Impedance 36,000 Ohms, Load Impedance 600 Ohms		36	A-1956		51X109

TABLE H—EQUIPMENT SPARE PARTS LIST BY NAVY TYPE DESIGNATION

Box No.	Qty.	Navy Type Number	All Symbol Desigs. Involved	DESCRIPTION	Navy Drawing or Specification	Mfr.	Mfg. Desig.	Special Tolerance or Modification	Contractor's Drawing and Part Number
				VACUUM TUBES					
1	4	6K7	V-101, V-102, V-104, V-105	VACUUM TUBE, R-F Amplifier, 2nd R-F Amplifier, 1st I-F Amplifier, 2nd I-F Amplifier	RE-13A-600E	27	6K7		6K7
1	2	6J7	V-103, V-110	VACUUM TUBE, Detector Amplifier, C-W Oscillator	RE-13A-600E	27	6J7		6J7
1	1	6C8G	V-106	VACUUM TUBE, Dual Triode	RE-13A-600E	27	6C8G		6C8G
1	1	6F8G	V-107	VACUUM TUBE, Dual Triode	RE-13A-600E	27	6F8G		6F8G
1	1	6K6GT/G	V-108	VACUUM TUBE, Power Amplifier Pentode	RE-13A-600E	27	6K6GT/G		6K6GT/G
1	1	6J5	V-109	VACUUM TUBE, General Purpose Triode	RE-13A-600E	27	6J5		6J5
1	1	5Z3	V-111	VACUUM TUBE, Rectifier	RE-13A-600E	27	5Z3		5Z3
				MISCELLANEOUS					
1	40			SOCKET CONTACTS		4	9-17F		30X378
1	2			SOCKET CONTACTS		4			30X422
1	1			I-F WRENCH		29			67X22
1	1			WRENCH, Allen Type #6		43			67X8
1	1			WRENCH, Allen Type #8		43			67X9
1	1			METAL SPARE PARTS BOX		26			34X402
1	1			WINDOW		7			17X81

TABLE I—PARTS LIST BY NAVY TYPE NUMBERS

Quantity	Navy Type Number	All Symbol Designations Involved
		STRUCTURAL PARTS
1		A-101
1		A-102
1		A-103
1		A-104
4		A-105 thru A-108
1		A-109
1		A-110
1		A-111
2		A-112, A-113
1		A-114
1		A-115
1		A-116
1		A-117
1		A-118
1		A-119
1		A-120
1		A-121
1		A-122
4		A-301 thru A-304
1		A-305
1		A-306
		CAPACITORS
4	48690	C-146, C-147, C-148, C-152
1	48843	C-155
1	48854	C-156
1	48893	C-150
1	481016	C-149
3	481080	C-200, C-201, C-202
2	481083	C-158, C-159
1	481106	C-151
1	481279	C-145
1	481428	C-157
1	481567	C-165 thru C-173
2	481568	C-174, C-175
13	481569	C-176 thru C-188
4	481570	C-190 thru C-193
4	481572	C-194 thru C-197
1	481576	C-135
2	481577	C-136, C-137
1		C-101A, C-101B, C-101C
1		C-102
1		C-103
12		C-104 thru C-115
7		C-116 thru C-122
1		C-123
2		C-125, C-126
1		C-127
5		C-128 thru C-132
2		C-133, C-134
2		C-138, C-139
1		C-140
1		C-160
1		C-161
1		C-189
		MISCELLANEOUS ELECTRICAL PARTS
2		E-101, E-102
1		E-103
7		E-104 thru E-109 and E-218
1		E-110
1		E-111
2		E-112, E-113
3		E-114, E-115, E-116
1		E-117
1		E-118
8		E-119 thru E-122, E-223 thru E-226
1		E-123
2		E-124, E-125
8		E-126 thru E-133
1		E-134
2		E-135, E-136
10		E-137 thru E-146
1		E-147
4		E-148 thru E-151
3		E-152 thru E-154
14		E-155 thru E-168
1		E-169
4		E-170 thru E-173
2		E-174, E-175
1		E-176
1		E-177
40		E-178 thru E-217
1		E-219
1		E-220
1		E-221
1		E-222
1		E-227
2		E-228, E-229
2		E-230, E-231
2		E-232, E-233
1		E-236
2		E-237, E-238
1		E-239
2		E-240, E-241
2		E-242, E-243
1		E-244
1		E-245
1		E-246
		FUSES
2		F-101, F-102
		MISCELLANEOUS HARDWARE
1		H-101
4		H-102 thru H-105
3		H-106 thru H-108
9		H-109 thru H-117
1		H-118, H-127 thru H-134
4		H-119 thru H-122
6		H-125, H-126, H-169 thru H-172
3		H-135 thru H-137
5		H-138 thru H-142
1		H-143
2		H-144, H-145
2		H-146, H-147
1		H-148
1		H-149
2		H-150, H-151
2		H-152, H-153
4		H-154 thru H-159
1		H-160
2		H-161, H-162
2		H-163, H-164
4		H-165 thru H-168
4		H-301 thru H-304
		INDICATING DEVICES
3		I-101 thru I-103
1		I-104
1		I-105
		JACKS AND RECEPTACLES
1	49120	J-102
1	49200	J-101
1	49201	J-103
1		J-104
2		J-105, J-106

TABLE I—PARTS LIST BY NAVY TYPE NUMBERS

Quantity	Navy Type Number	All Symbol Designations Involved
		INDUCTORS
2	30931	L-101, L-102
1		L-103
		METERS
1		M-101
		NAME PLATES
1		N-101
1		N-102
		MECHANICAL PARTS
1		O-101
1		O-102
1		O-103
1		O-104
2		O-105, O-106
1		O-107
1		O-108
1		O-109
1		O-110
2		O-111, O-112
1		O-113
1		O-114
1		O-115
1		O-116
2		O-117, O-118
1		O-119
		PLUGS
1	49121-A	P-102
1	49202	P-103
1		P-101
		RESISTORS
2	63288	R-145, R-146
1	63288	R-147
2	63288	R-148, R-149

Quantity	Navy Type Number	All Symbol Designations Involved
		RESISTORS—Continued
1	63288	R-150, R-151
1	63288	R-152
1	63288	R-153
1	63360	R-101
1	63360	R-102
1	63360	R-103
7	63360	R-104 thru R-110
2	63360	R-111, R-112
2	63360	R-113, R-114
1	63360	R-115
5	63360	R-116, R-117, R-118, R-119, R-120
1	63360	R-121
6	63360	R-122 thru R-127
2	63360	R-128, R-129
7	63360	R-130 thru R-136
1	63360	R-137
1	63757	R-160
2	631286	R-157, R-158
1	631288	R-155
1	631289	R-159
		SWITCHES
3	24146	S-103, S-104, S-105
1	24147	S-106A, S-106B,
1		S-101A, S-101B
1		S-102
1		S-108
1		S-109
		TRANSFORMERS
1	30883	T-101
1	30884	T-102
1		T-103
1		T-104
		VACUUM TUBES
1	5Z3	V-111
1	6C8G	V-106A, V-106B
1	6F8G	V-107A, V-107B
1	6K6G/TG	V-108
1	6J5	V-109
2	6J7	V-103, V-110
4	6K7	V-101, V-102, V-104, V-105

Quantity	Navy Number	All Symbol Designations Involved
		WIRES AND CABLES
1		W-101
1		W-102
1		W-103
1		W-104
		SOCKETS
1	49368	X-111
10	48373	X-101 thru X-110
1		X-112
1		X-113
1		X-114
		CRYSTALS
1		Y-101
		INDUCTORS
1	47242	Z-123
1	47253	Z-124
1	47254	Z-122
1		Z-101
1		Z-102
1		Z-103
1		Z-104
1		Z-105
1		Z-106
1		Z-107
1		Z-108
1		Z-109
1		Z-110
1		Z-111
1		Z-112
1		Z-113
1		Z-114
1		Z-115
1		Z-116
1		Z-117
1		Z-118
1		Z-119
1		Z-120
1		Z-121
		MISCELLANEOUS
80		30X378
4		30X422
1		67X8
1		77X9
1		67X22
1		34X402
1		17X81

TABLE J—LIST OF MANUFACTURERS

Code Number	Mfr. Prefix	Name	Address
1		Alden Products Co.	Brockton, Mass.
2	CBZ	Allen-Bradley Co.	Milwaukee, Wis.
3		American Metalcraft Co.	2144 N. Western Avenue, Chicago, Illinois.
4	CPH	American Phenolic Corporation	1830 S. 54th Avenue, (Cicero P.O.), Chicago, Illinois
5		Arrow Electric Division, The Arrow-Hart & Hegeman Electric Co	103 Hawthorn Street, Hartford, Conn.
6		Atlantic India Rubber Works, Inc.	1453 W. Van Buren Street, Chicago, Illinois
7		J. B. Carroll Co	Carroll & Albany Aves., Chicago, Illinois
8		Centralab	900 E. Keefe Avenue, Milwaukee, Wisconsin
9		Chicago Die Mold Mfg. Co.	4001 W. Wrightwood Avenue, Chicago, Illinois
10	CTC	Chicago Telephone Supply Co.	Elkhart, Indiana
11		Cinch Manufacturing Corporation	2335 W. Van Buren Street, Chicago, Illinois
12	CMC	Clarostat Manufacturing Company, Inc.	285 North Sixth Street, Brooklyn, N.Y.
13		Crescent Tool & Die Co.	4140-50 Belmont Avenue, Chicago, Illinois
14		Crowe Name Plate & Manufacturing Co.	3701 Ravenswood Avenue, Chicago, Illinois
15		Doehler Die Casting Co.	386 Fourth Avenue, New York, N.Y.
16		Drake Manufacturing Company	1713 W. Hubbard Street, Chicago, Illinois
17		Etching Company of America	1520 Montana Street, Chicago, Illinois
18		Fansteel Metallurgical Corporation	North Chicago, Illinois
19	CBV	John E. Fast & Co.	3123 N. Crawford Avenue, Chicago, Illinois
20		Franke Gear Works	3246 N. Hoyne Avenue, Chicago, Illinois
21		Grand Sheet Metal Works	2501 W. 24th Street, Chicago, Illinois
22		Groov-Pin Corporation	2017 Kerrigan Avenue, Union City, N. J.
23		Harvey Hubbell, Inc.	1930 Thomas Street, Bridgeport, Conn.
24		Hudson Screw Machine Products Co.	4500 W. Augusta Blvd., Chicago, Illinois
25		International Spring Company	222 N. Washtenaw Avenue, Chicago, Illinois
26		Invincible Metal Furniture Co.	Manitowoc, Wisconsin
27	CKR	Ken-Rad Tube & Lamp Corporation	Owensboro, Kentucky
28		The Kirby Company	13000 Athens Avenue, Cleveland, Ohio
29		Klise Mfg. Co., Inc.	Grand Rapids, Michigan
30		Lamicoid Fabricators, Inc.	3610 Potomac Avenue, Chicago, Illinois
31		Lemke Screw Products Company	1913 N. Le Claire Avenue, Chicago, Illinois
32	CLF	Littlefuse Incorporated	4757 Ravenswood Avenue, Chicago, Illinois
33		Lord Manufacturing Company	Erie, Pennsylvania
34		P. R. Mallory & Co., Inc.	3029 East Washington Street, Indianapolis, Indiana
35		Marion Electrical Instrument Co.	Stark Street Gate, Manchester, N.H.
36		Merit Coil & Transformer Corp.	311 N. Des Plaines Avenue, Chicago, Illinois
37		Metal & Glass Products Company	165 N. Morgan Street, Chicago, Illinois
38		Micro-Matic Spring Co., Not Inc.	1218 North 37th Street, Melrose Park, Illinois
39	CN	National Electrical Machine Shops, Inc.	2014 Fifth Street, N.E., Washington, D.C.
40	COC	Oak Manufacturing Company	1260 Clybourn Avenue, Chicago, Illinois
41		Olson Manufacturing Co.	1820-22 W. Grand Avenue, Chicago, Illinois
42	CAN	Sangamo Electric Company	Springfield, Illinois
43		Set Screw & Mfg. Co.	Bensenville, Illinois
44		Slingerland Banjo & Drum Co.	1325 Belden Avenue, Chicago, Illinois
45	CSA	Stackpole Carbon Company	St. Mary's, Pennsylvania
46		Underwood Electric & Mfg. Co., Inc.	3120 W. Grand Avenue, Chicago, Illinois
47	CWQ	Wells-Gardner & Co.	2701 N. Kildare Avenue, Chicago, Illinois
48	CAY	Westinghouse Electric Mfg. Co., Lamp Division	20 N. Wacker Drive, Chicago, Illinois
49		Zierick Manufacturing Corp.	Bronx Lehigh Building, 385 Gerard Ave., New York, N. Y.
50		A-AN-E Manufacturing Corp.	2110 Marshall Blvd., Chicago, Illinois
51		Manufacturers Screw Products	216-222 W. Hubbard St., Chicago, Illinois
52		Shakeproof, Inc.	2501 N. Keeler Ave., Chicago, Illinois
53		Rhopac, Inc.	168-72 North Clinton St., Chicago, Illinois

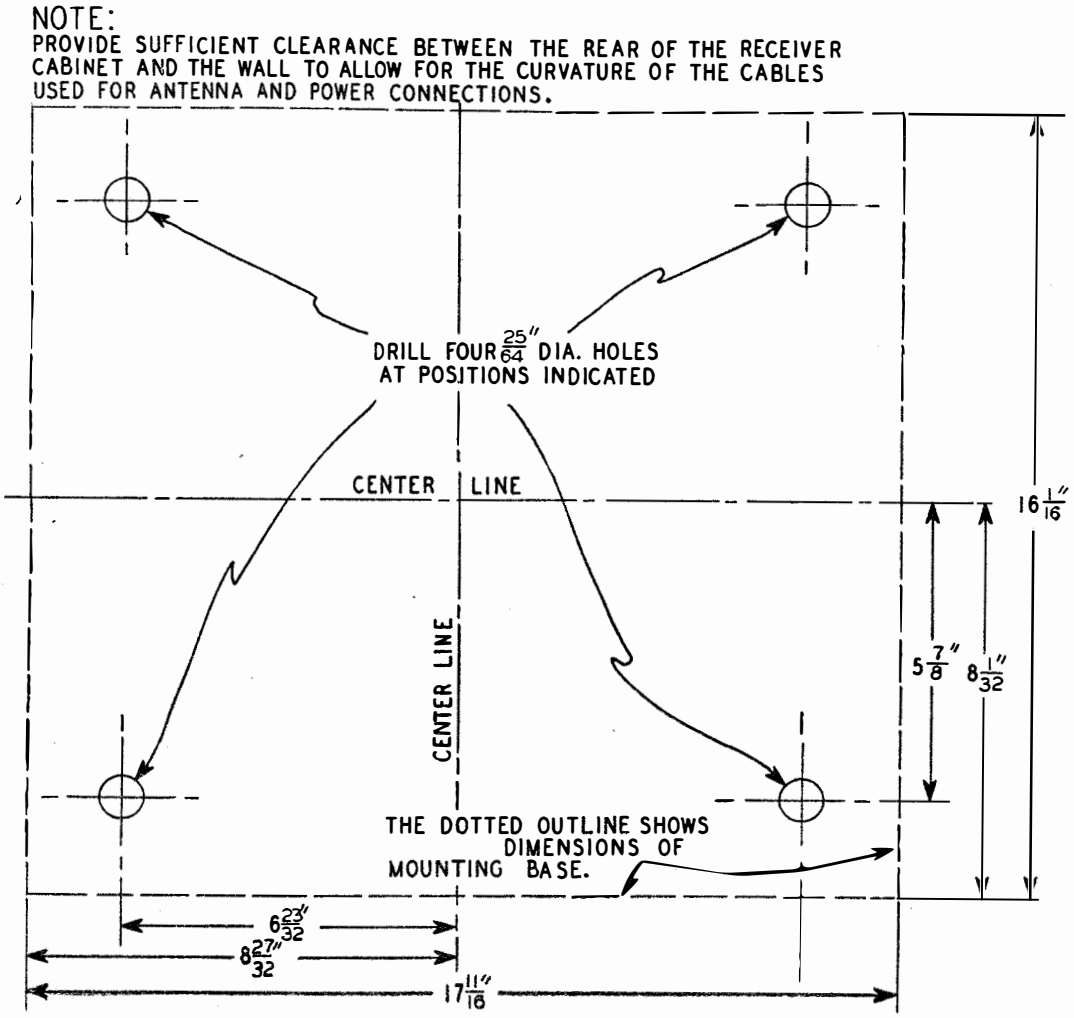


Fig. 28. Drilling Plan for Mounting Base Installation

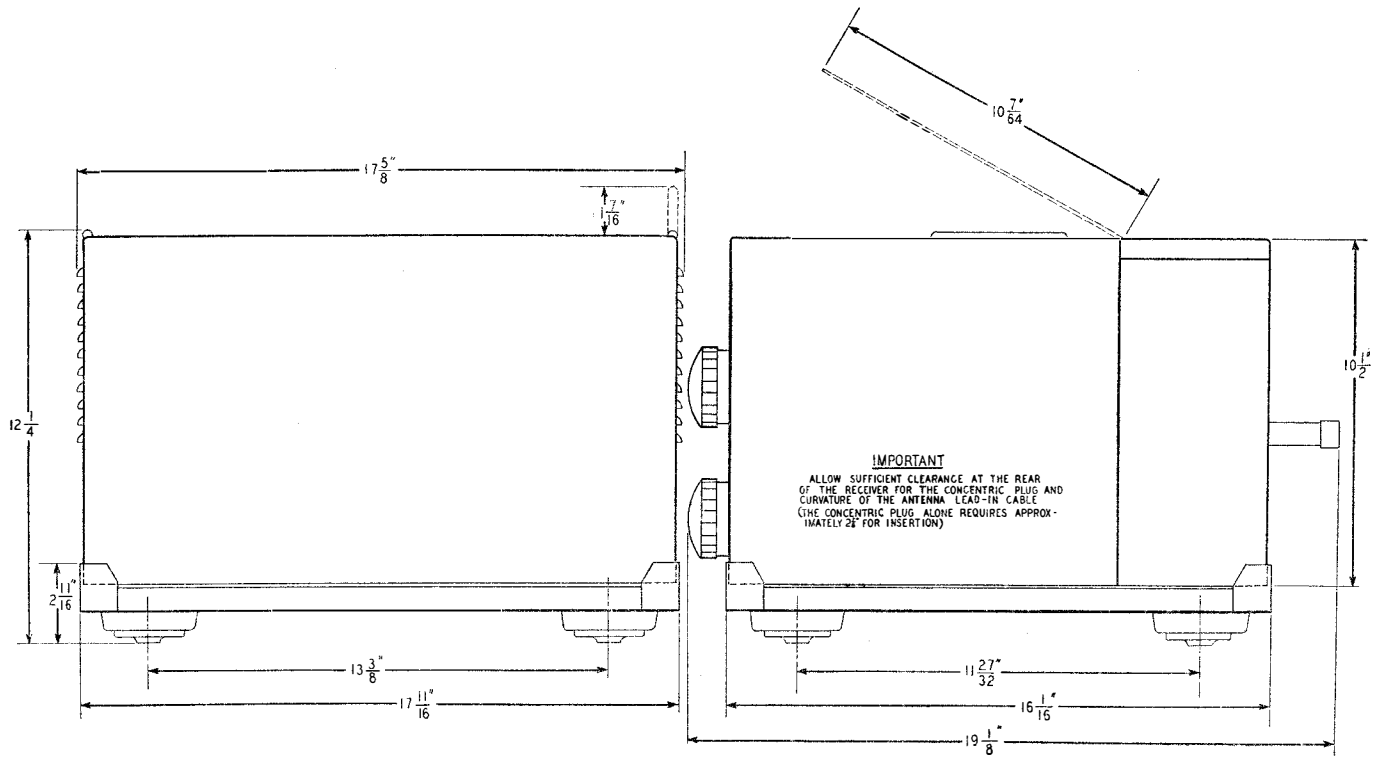


Fig. 29. Outline Dimensions

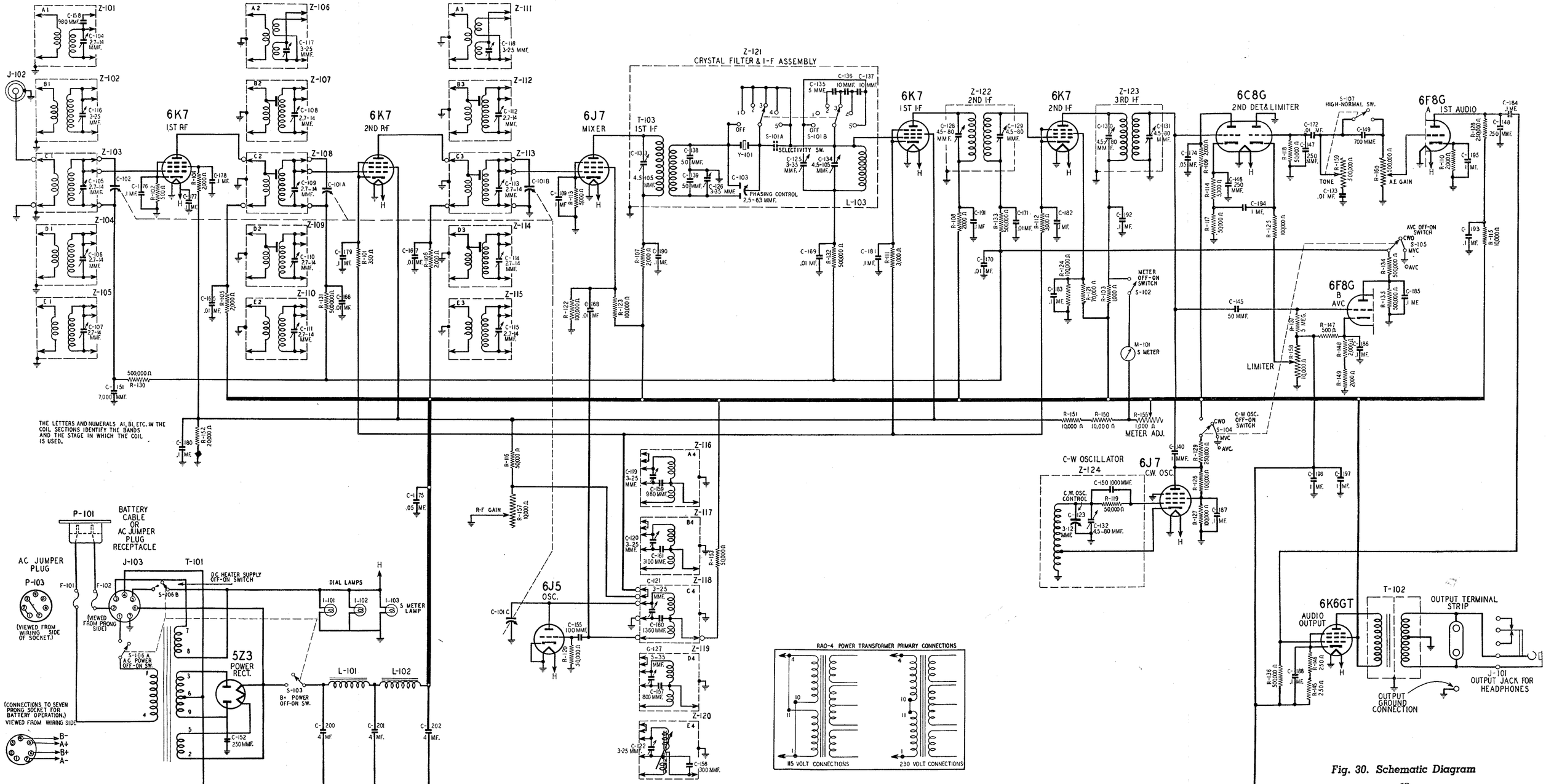


Fig. 30. Schematic Diagram

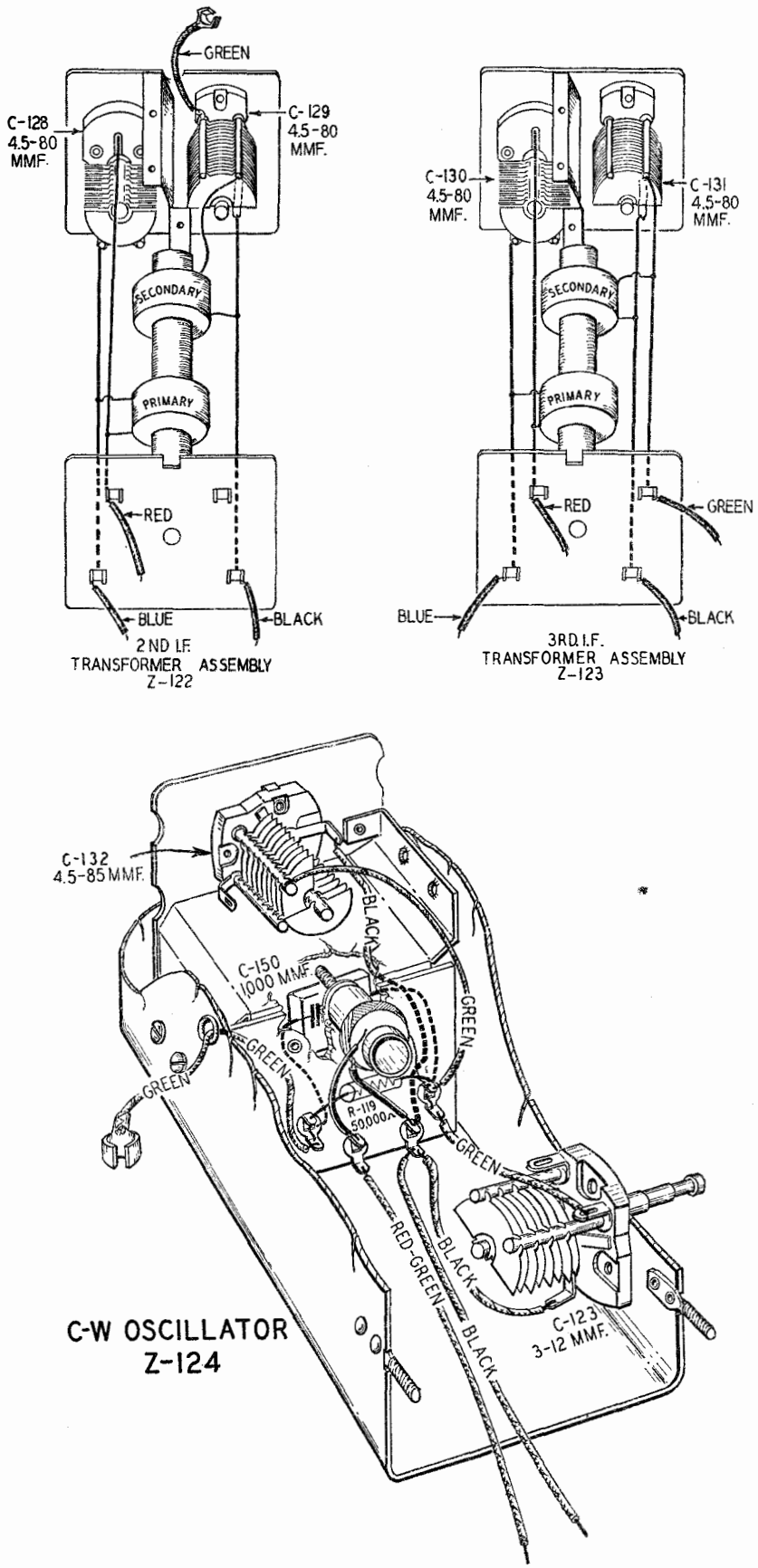


Fig. 31. Pictorial Diagram of I-F Transformer Assemblies

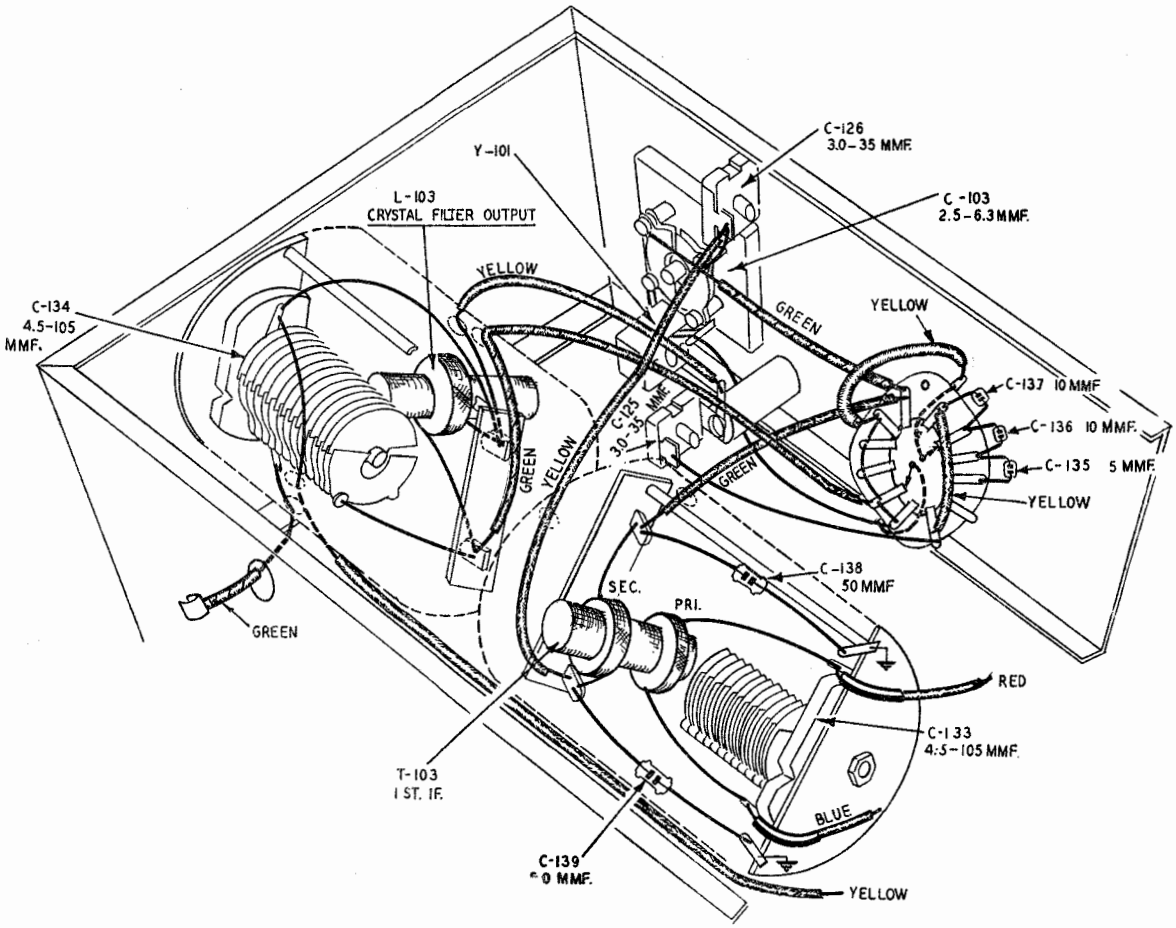


Fig. 32. Pictorial Wiring Diagram of Crystal Filter Assembly

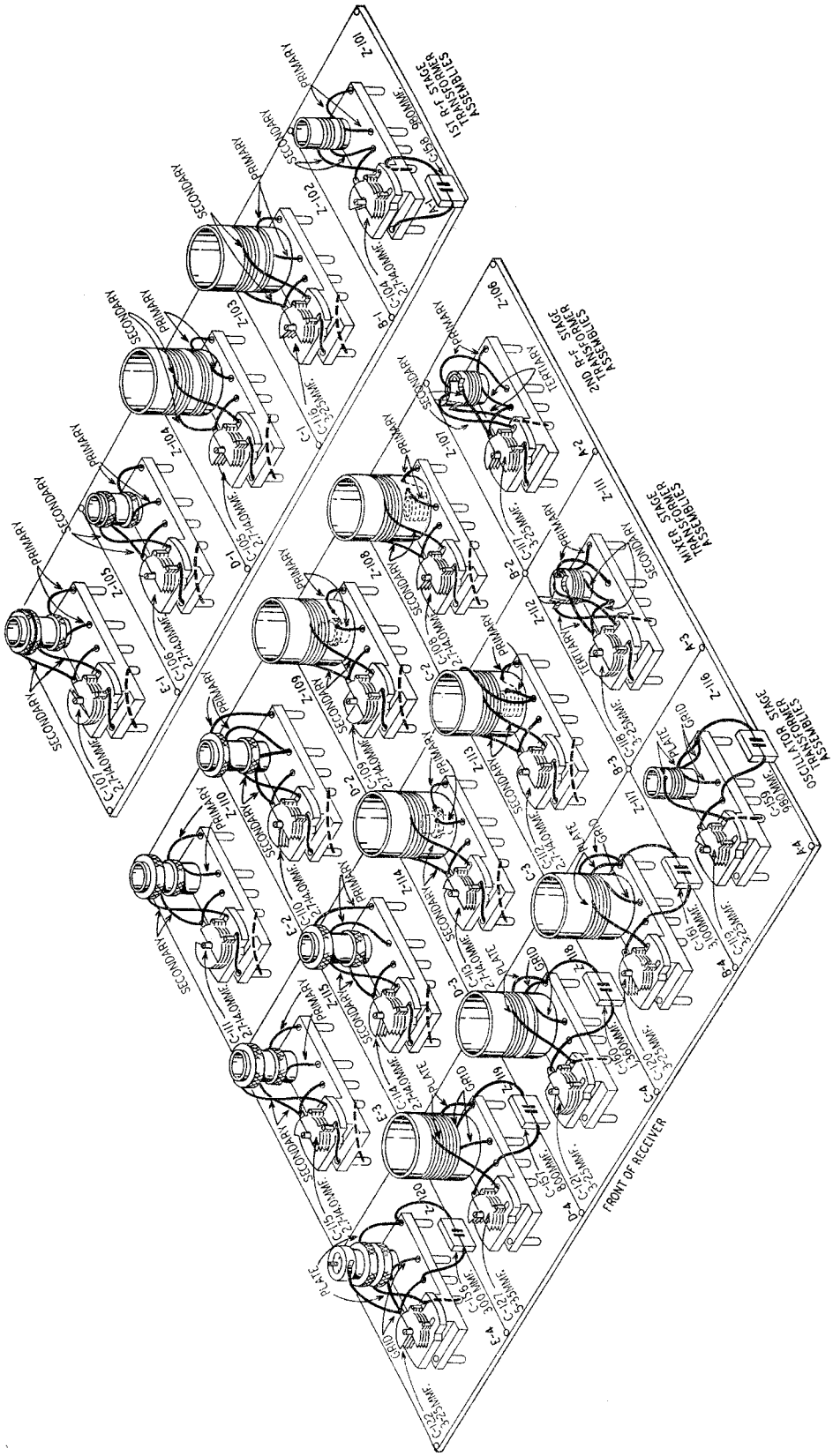


Fig. 33. Pictorial Wiring Diagram of Coil Carriage Assembly

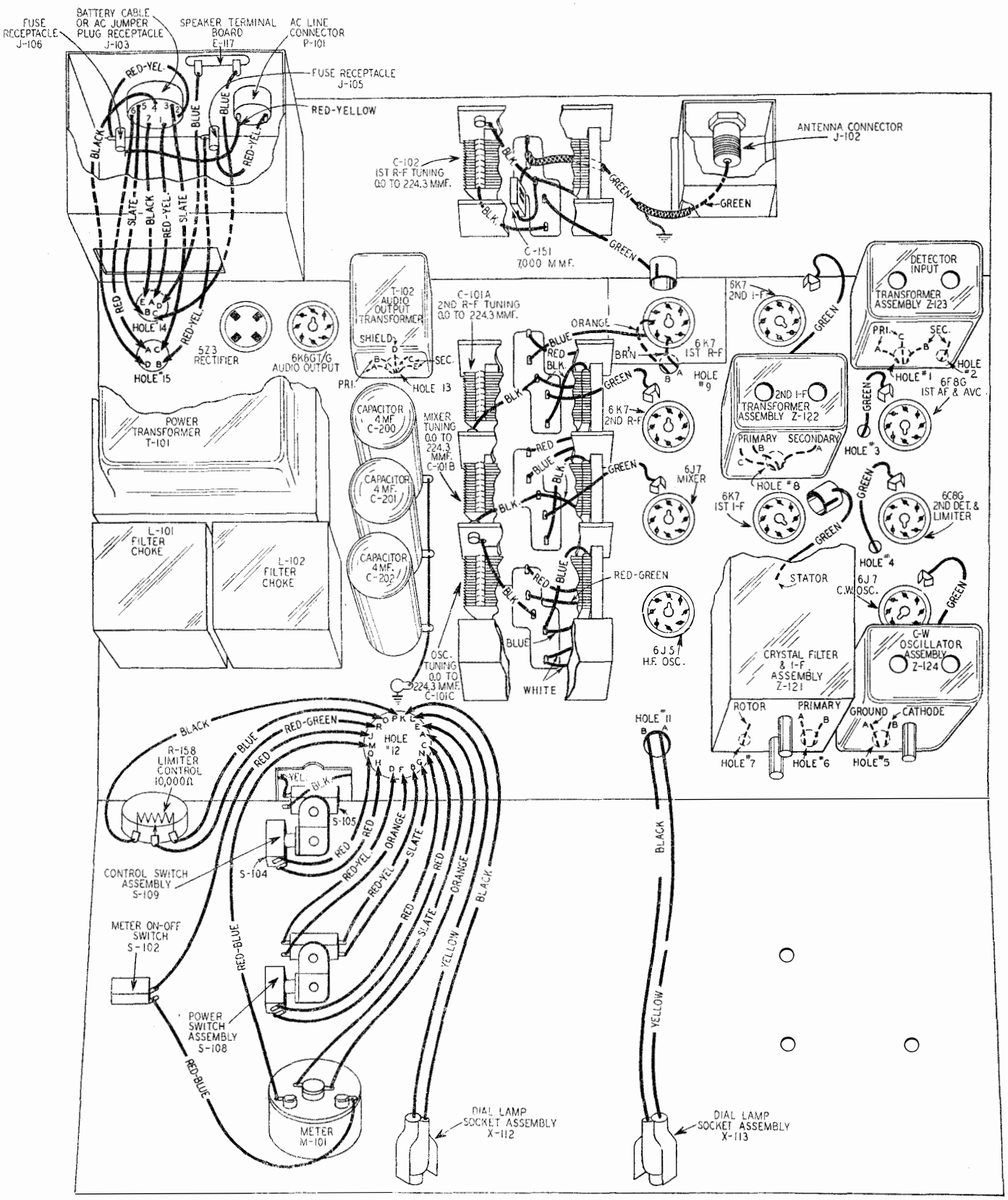


Fig. 34. Pictorial Wiring Diagram of Top of Receiver Chassis

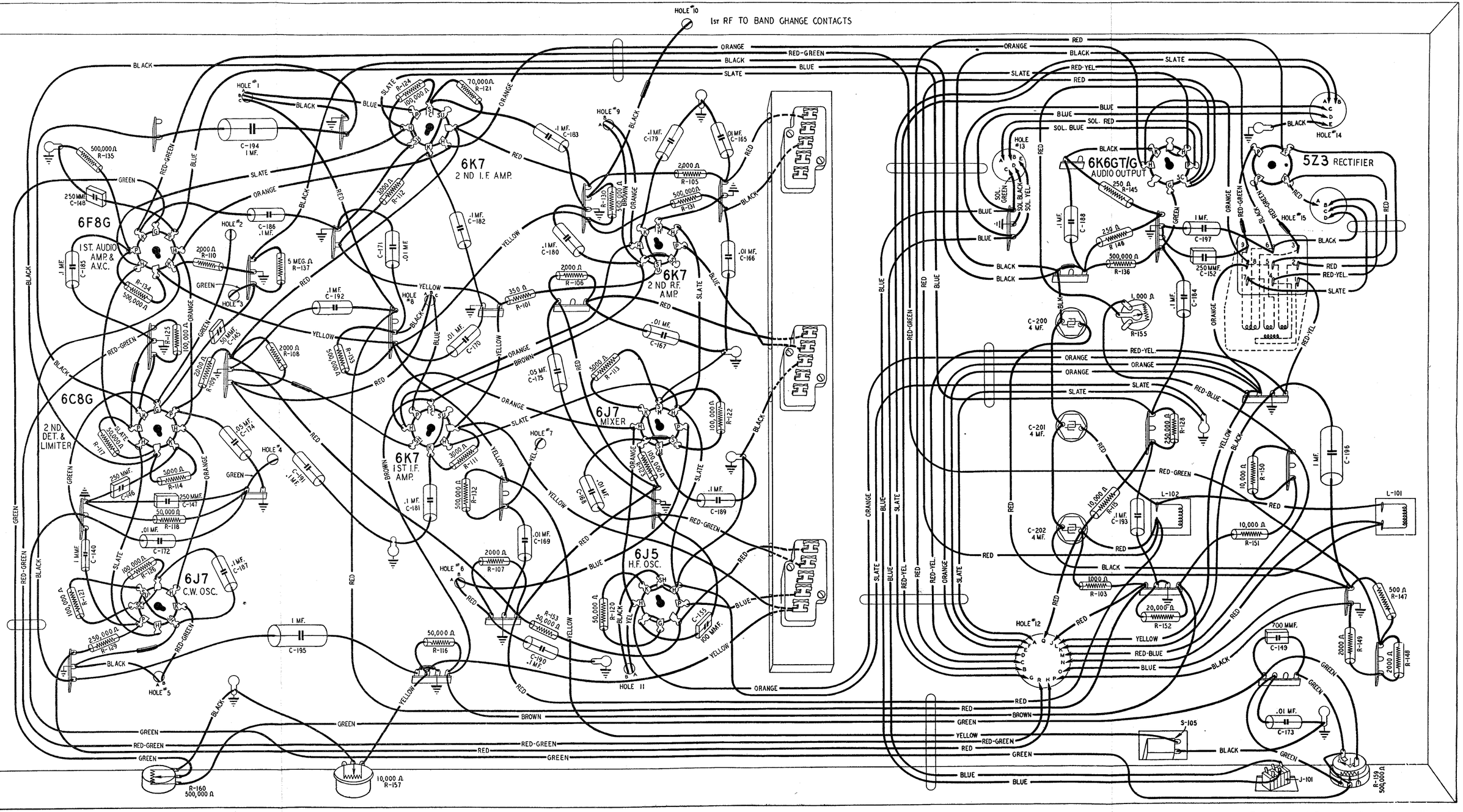


Fig. 35. Pictorial Wiring Diagram of Bottom of Receiver Chassis

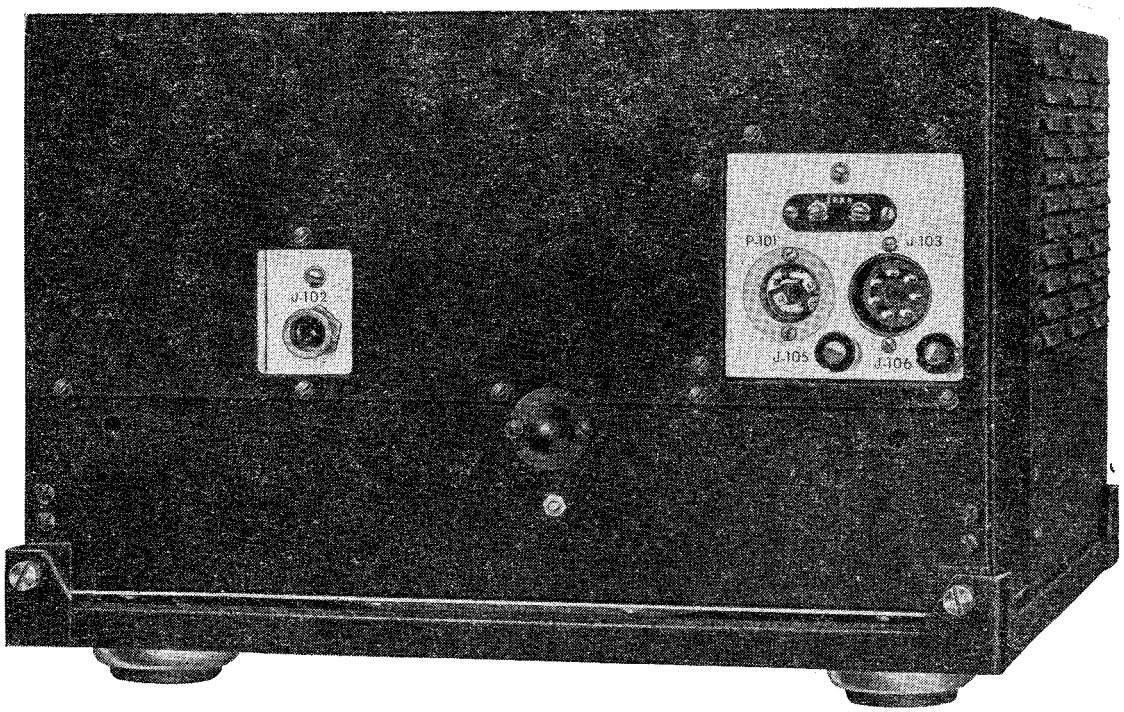


Fig. 36. Rear View of Model RAO-3 Radio Receiver

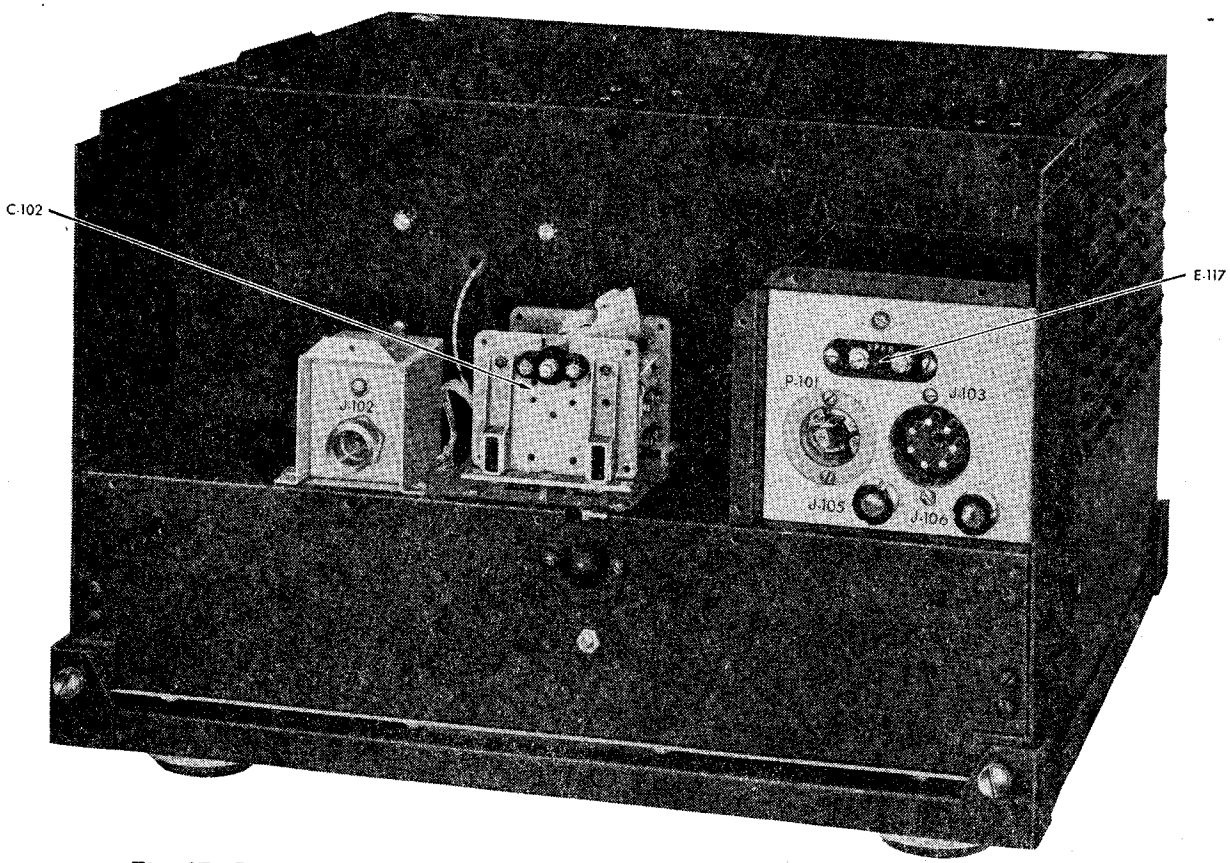


Fig. 37. Rear View of Model RAO-3 Radio Receiver with Rear Cover Removed

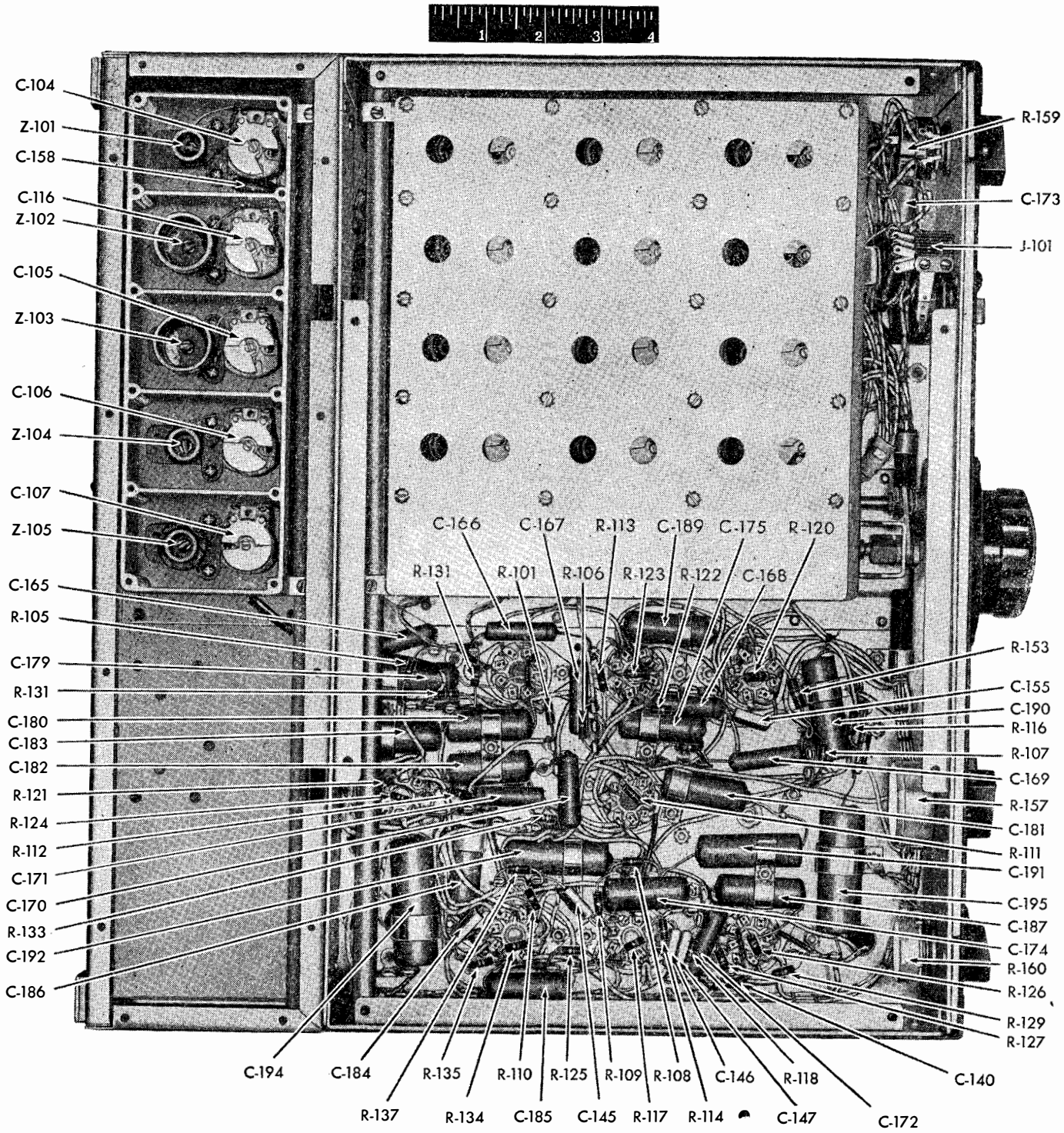


Fig. 38. Bottom View of RAO-3 Radio Receiver Showing 1st I-F and A-F Sections

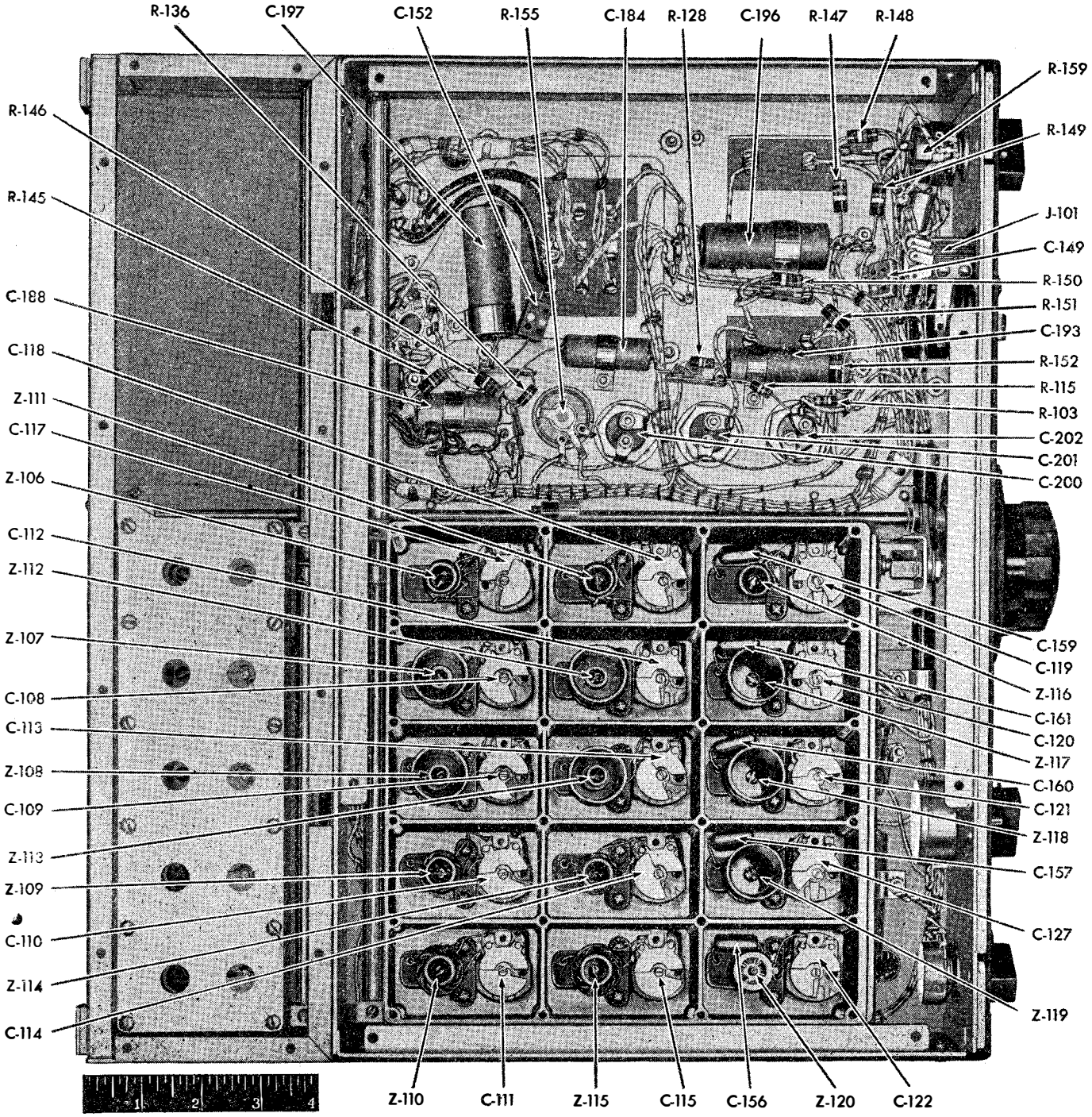


Fig. 39. Bottom View of RAO-3 Radio Receiver Showing Power Supply, Audio Output Stage and Coils

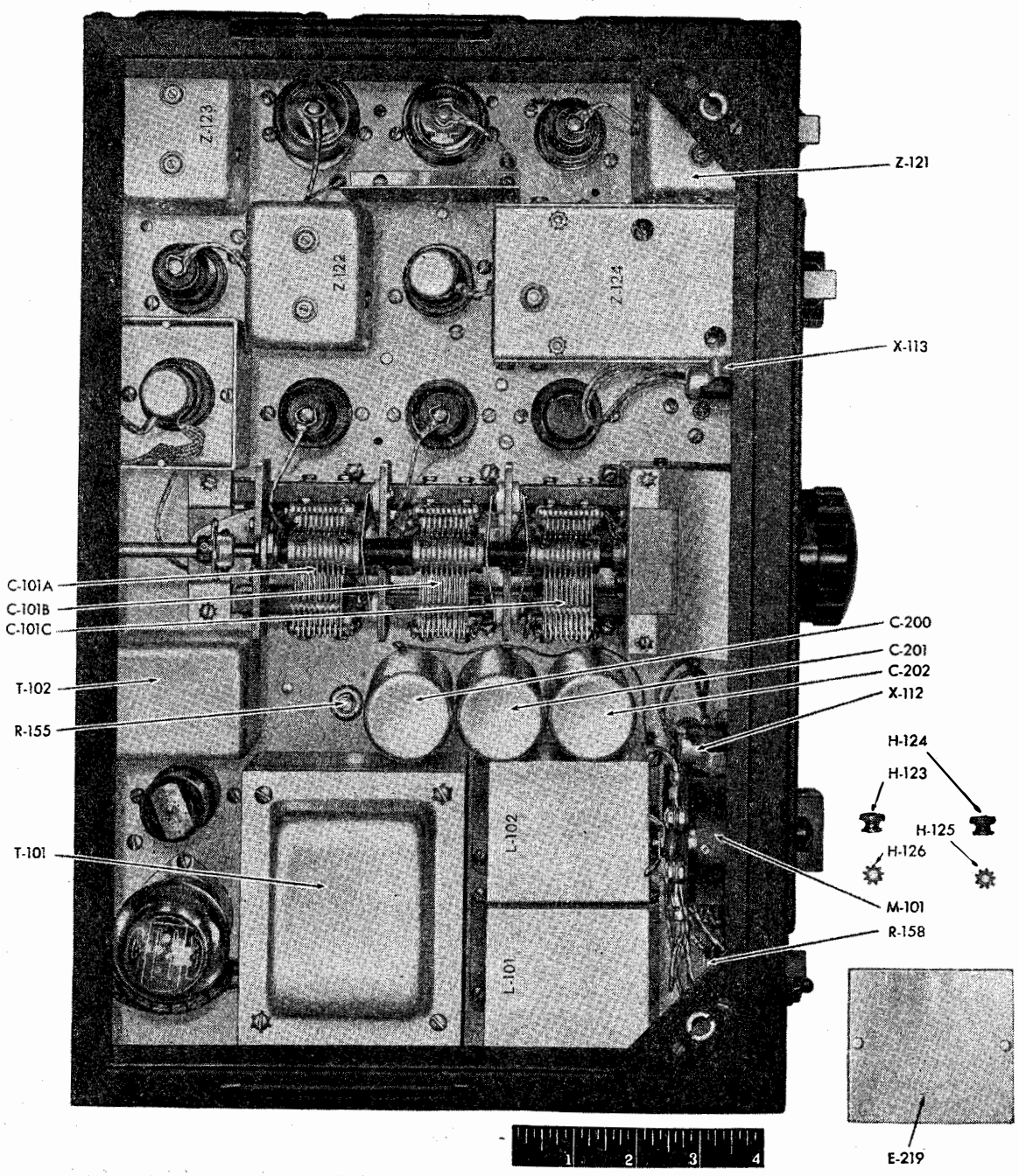


Fig. 40. Top View of Model RAO-3 Radio Receiver