

**RESTRICTED**

**TECHNICAL ORDER -**  
**No. 08-10-24**

**INSTRUCTION BOOK**  
**FOR**  
**RADIO RECEIVER BC-224-A**

**MANUFACTURED BY**

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

**RESTRICTED**

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## ERRATA SHEET

PAGE	PARAGRAPH	CORRECTIONS AND ADDITIONS																																
8	2-3	Line 3, add "and 6-2" in parentheses.																																
17	2-16b	Line 7, change "VT-68" to "VT-70"; line 8, change "VT-70" to "VT-68".																																
21	2-21	Line 2, after "primary supply." add "but are equally effective with either side of the line grounded."																																
23	2-25	Heading of the last column in the table should read "Micromhos" instead of "Microhms".																																
24	Fig. 14	To the note "15 MA(MAX)----" in the upper right hand corner add "Connect to TERM #2 for positive and to TERM #5 or GROUND for negative."																																
29	5-4b(1)	Line 8, change "3-1g" to "3-1k".																																
33	6-1a	Add a paragraph as follows: "(3) Dynamotor Rating.- The nominal rating of the dynamotor machine is; Input 1.75 amperes at 13.8 volts; Output 50 milliamperes at 225 volts; Regulation 15%. Average performance data on Dynamotor Unit BD-94-A is as follows: *																																
		<table border="0" style="margin-left: auto; margin-right: auto;"> <thead> <tr> <th colspan="2" style="text-align: center;">INPUT</th> <th colspan="2" style="text-align: center;">OUTPUT</th> </tr> <tr> <th style="text-align: center;">Volts</th> <th style="text-align: center;">Amperes</th> <th style="text-align: center;">Volts</th> <th style="text-align: center;">Milliamperes</th> </tr> </thead> <tbody> <tr> <td style="text-align: center;">12.0</td> <td style="text-align: center;">1.18</td> <td style="text-align: center;">217</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;">12.0</td> <td style="text-align: center;">1.46</td> <td style="text-align: center;">192</td> <td style="text-align: center;">25</td> </tr> <tr> <td style="text-align: center;">12.0</td> <td style="text-align: center;">1.86</td> <td style="text-align: center;">163</td> <td style="text-align: center;">50</td> </tr> <tr> <td style="text-align: center;">14.0</td> <td style="text-align: center;">1.10</td> <td style="text-align: center;">258</td> <td style="text-align: center;">0</td> </tr> <tr> <td style="text-align: center;">14.0</td> <td style="text-align: center;">1.45</td> <td style="text-align: center;">234</td> <td style="text-align: center;">25</td> </tr> <tr> <td style="text-align: center;">14.0</td> <td style="text-align: center;">1.89</td> <td style="text-align: center;">208</td> <td style="text-align: center;">50</td> </tr> </tbody> </table>	INPUT		OUTPUT		Volts	Amperes	Volts	Milliamperes	12.0	1.18	217	0	12.0	1.46	192	25	12.0	1.86	163	50	14.0	1.10	258	0	14.0	1.45	234	25	14.0	1.89	208	50
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		* Dynamotor unit disconnected from receiver and negative high voltage connection made to case of unit.																																
36	6-3c(1)	Add at end of paragraph "Refer to Fig. 26."																																
37	6-3c(2)(h)	Add at end of paragraph "Before replacing the expansion screw coat it with a locking compound such as Glyptal to prevent subsequent loosening."																																
39	6-4b	Add at end of paragraph "(7) Audio Frequency Oscillator."																																
39	Fig. 19	Add color code for terminals; Plus 206 volts is RED Plus 13.8 volts is YELLOW Minus 10 volts is GREEN Minus 13.8 volts is BLACK																																
40	Fig. 20	Add an asterisk (*) after "Measured on 100,000 ohm voltmeter."																																
41	6-4c(6)	Line 3, add "and ground" after "detector tube".																																
42	6-4c(9)	Lines 1 and 2, delete "at this time by switching it" and substitute "by coupling the the 915 KC signal input to the grid of the first detector tube and then switching the C-W Oscillator".																																
43	6-4c(12)	Line 5, change "R3-4" to "R7".																																
44	6-4c(15)	Line 3, change "is" to "are".																																
45	6-4e	Line 5, delete "s" from "paragraphs", delete "6-4c(8) and".																																
50	6-4g(2)	Delete "(2)" in page heading.																																
51	VII	Line C4-7, delete "T" in "3T".																																

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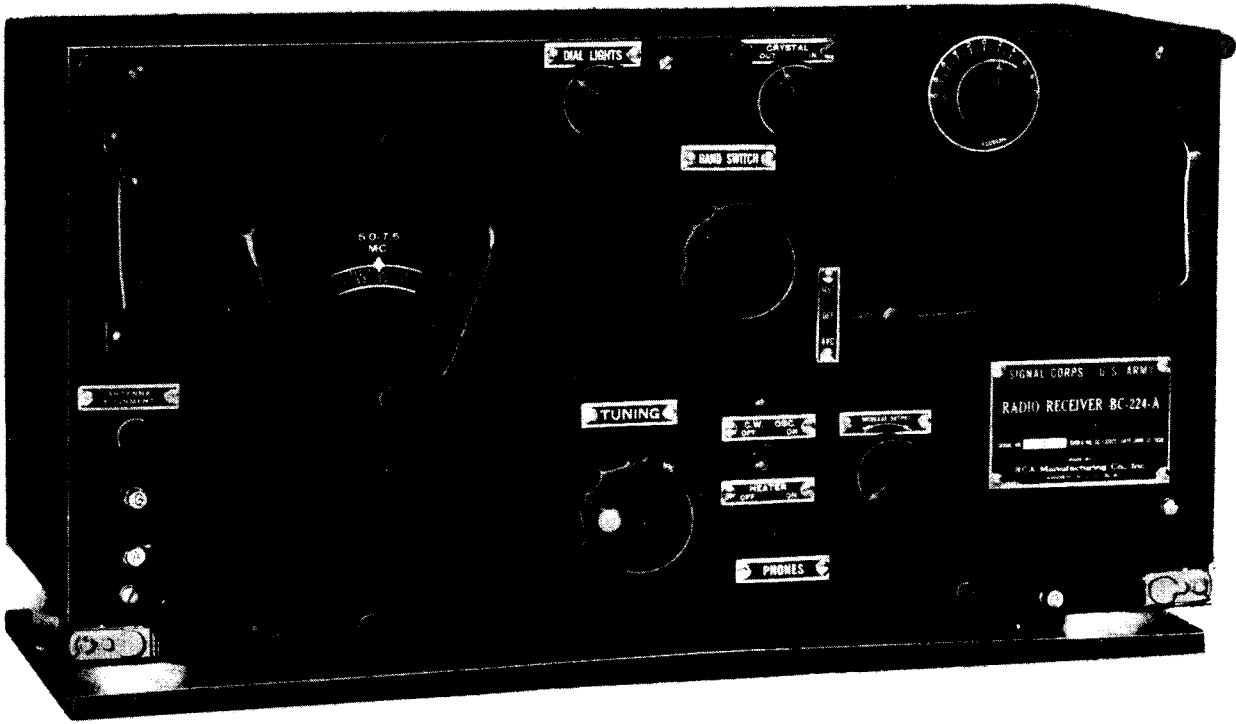


Fig. 1 - Radio Receiver BC-224-A

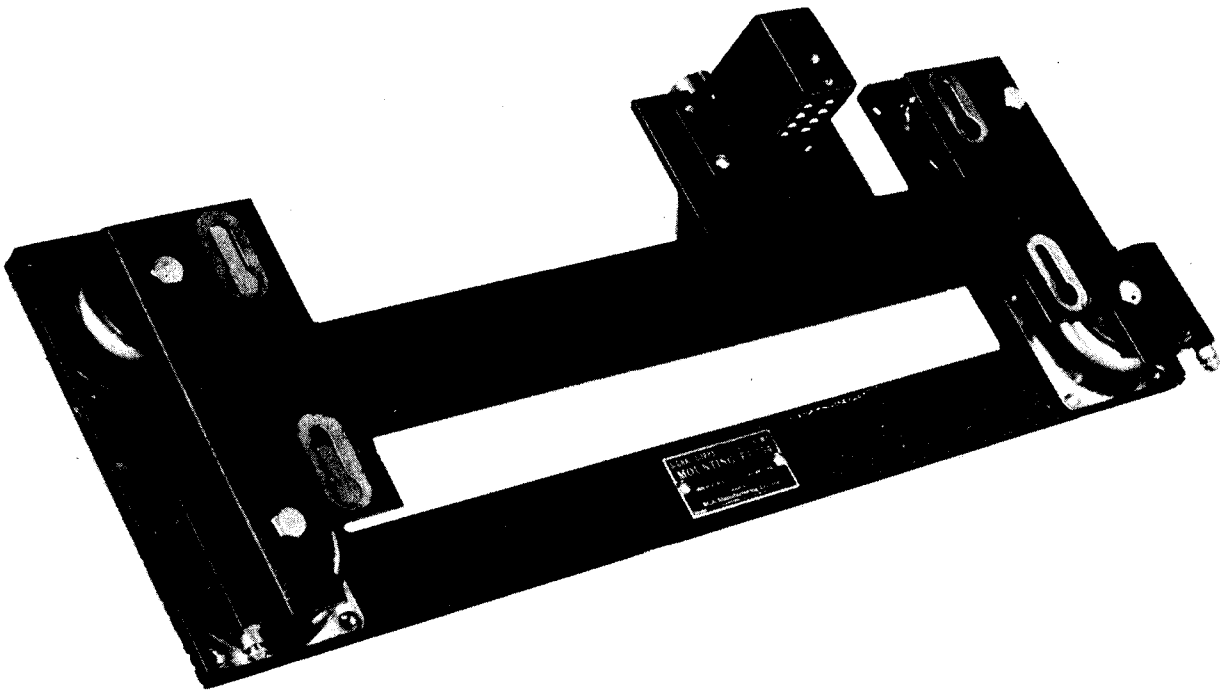


Fig. 2 - Mounting FT-154 with Plug PL-Q103 attached

## I. General Description

1-1 Radio Receiver BC-224-A is a locally controlled, 8 tube, 6 band super-heterodyne receiver for use in U.S. Army aircraft and covers the frequency range 1.5 to 18.0 megacycles. The receiver is not intended for remote control and no features or units have been provided for remote operation. This receiver is capable of voice, tone and c-w. reception with manual or automatic volume control. The receiver when equipped with tubes, dial lights and fuses, and with the antenna, ground, and 14 volt primary power source connections properly made becomes a complete and operative equipment by the addition of a headset, as all coils and the high voltage power supply unit are built into the receiver.

1-2 The following is a list of the component units which are described in detail under Section II:

	<u>Size</u>	<u>Weight</u>
Radio Receiver BC-224-A (includes Dynamotor Unit BD-94-A and Mounting FT-154)	18 x 6-1/2 x 10-1/16 inches	42 lbs.
Mounting FT-154 (does not include Plug PL-P103 or PL-Q103)	18 x 6-1/2 x 1-7/16 inches	3 lbs. 2 ozs.
Tube VT-48		
" VT-68		
" VT-69		
" VT-70		
" VT-76		
Lamp LM-27 (Pilot)		
Fuse FU-23		
Set-Screw Wrench		

## II. Detailed Description

2-1 The receiver cabinet is of welded aluminum construction, with black wrinkle finish and is provided with guides to facilitate the withdrawal and replacement of the chassis. Four studs are riveted to the bottom of the cabinet and serve to guide and secure the cabinet when placed on Mounting FT-154. In front, a portion of the cabinet projects downward, and serves to mount the snap-slides and the auxiliary antenna binding post. The disposition of these latter parts as well as the location of the five captive screws which secure the front panel to the cabinet can be identified in Figs. 1 & 3. The louvres and round holes in the cabinet provide the necessary ventilation for the dynamotor unit. The rectangular hole in the bottom back of the cabinet permits the entrance of the connecting plug into the cabinet.

2-2 The chassis is constructed of heavy aluminum and is provided with runners and guides of stainless steel that facilitate the sliding of the chassis into the cabinet. The handles on the front panel are for the manipulation of the chassis when removing or replacing it in the cabinet and for handling or carrying the complete receiver.

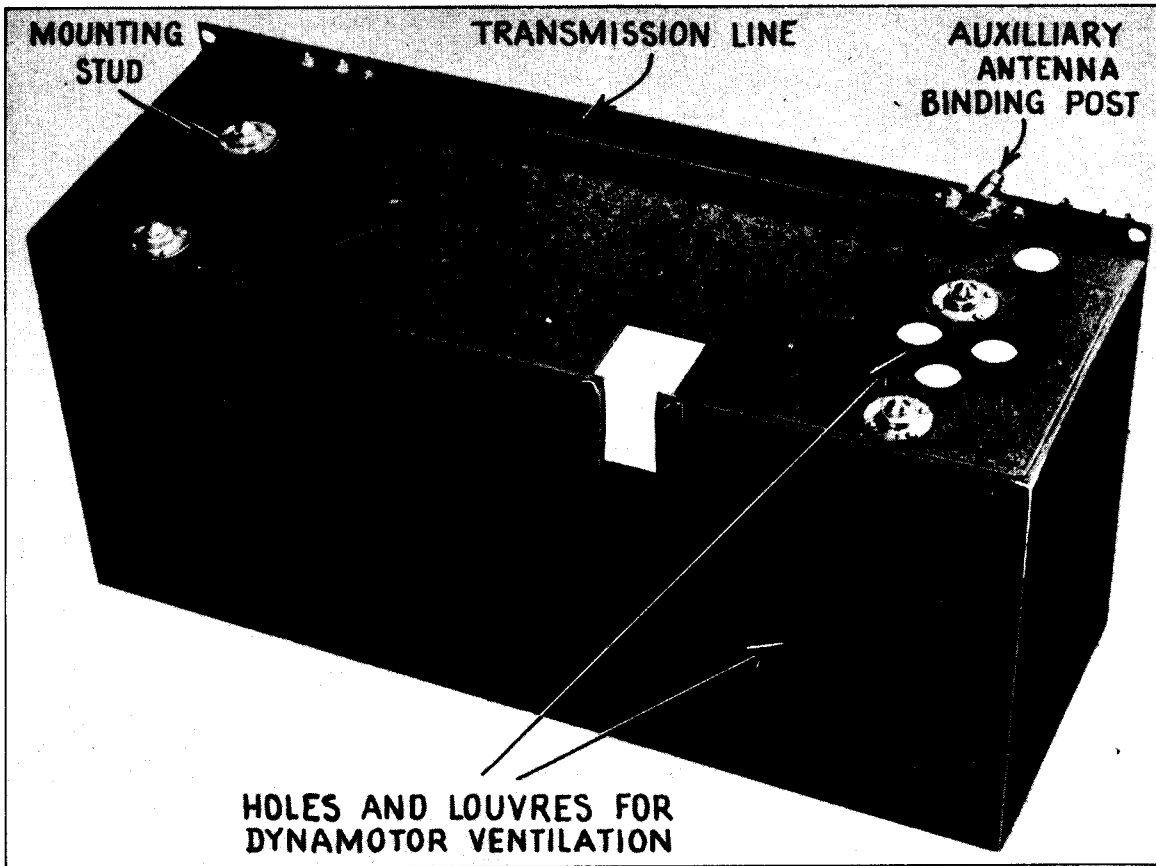


Fig. 3 - View of Cabinet Showing Bottom and Back

2-3 The front panel is attached to the chassis by the five bright nickel screws which should not be disturbed except when necessary to remove the panel for maintenance work (see 6-1).

2-4 Fig. 4 shows the front view of the chassis with panel removed. The location of the following parts is shown:

- Tube sockets
- Connector Socket for Dial Lights
- Bypass Condensers
- Resistor Racks (-1 & -2)
- Dial Light Rheostat (R27)
- Band Switch Drive
- Tuning Condenser and Gearing.
- Mask Positioning Mechanism
- Crystal Filter Switch (S2)
- Beat Frequency Adjustment (C12)
- Receiver "AVC - OFF - MVC" Switch (S4)
- C-W. Oscillator Switch (S3-1)
- Heater Switch for Heating Pads in Temperature Controlled Compartment (S3-2)

2-4 (Continued)

Headset Jack  
Volume Control (R28 and R29)  
Dynamotor Unit BD-94-A  
Antenna Alignment  
Binding Posts "A" and "G"  
Chassis

2-5 Fig. 5 shows the bottom view of the chassis and the location of the following parts:

Tuning Condenser C1  
Resistor Racks (-1 & -2)  
Fuse and Dynamotor Terminal Board  
First Preselector Coil Compartment (1st RF)  
Second " " " (2nd RF)  
Third " " " (1st Det)  
Temperature Controlled Oscillator Compartment (Osc.)  
Socket for Plug PL-P103 or PL-Q103  
Dynamotor Unit BD-94-A



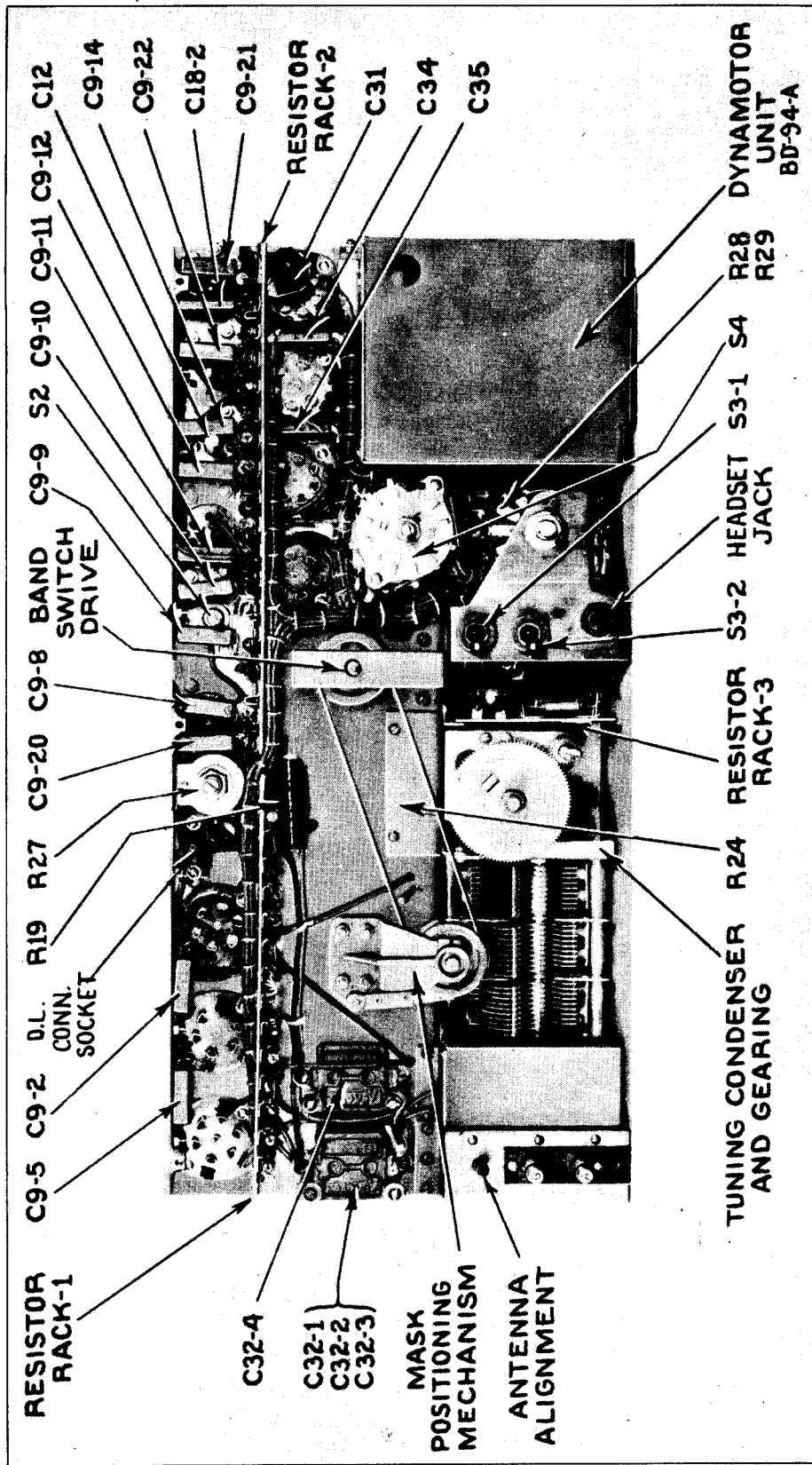


Fig. 4 - Front View of Chassis with Panel Removed

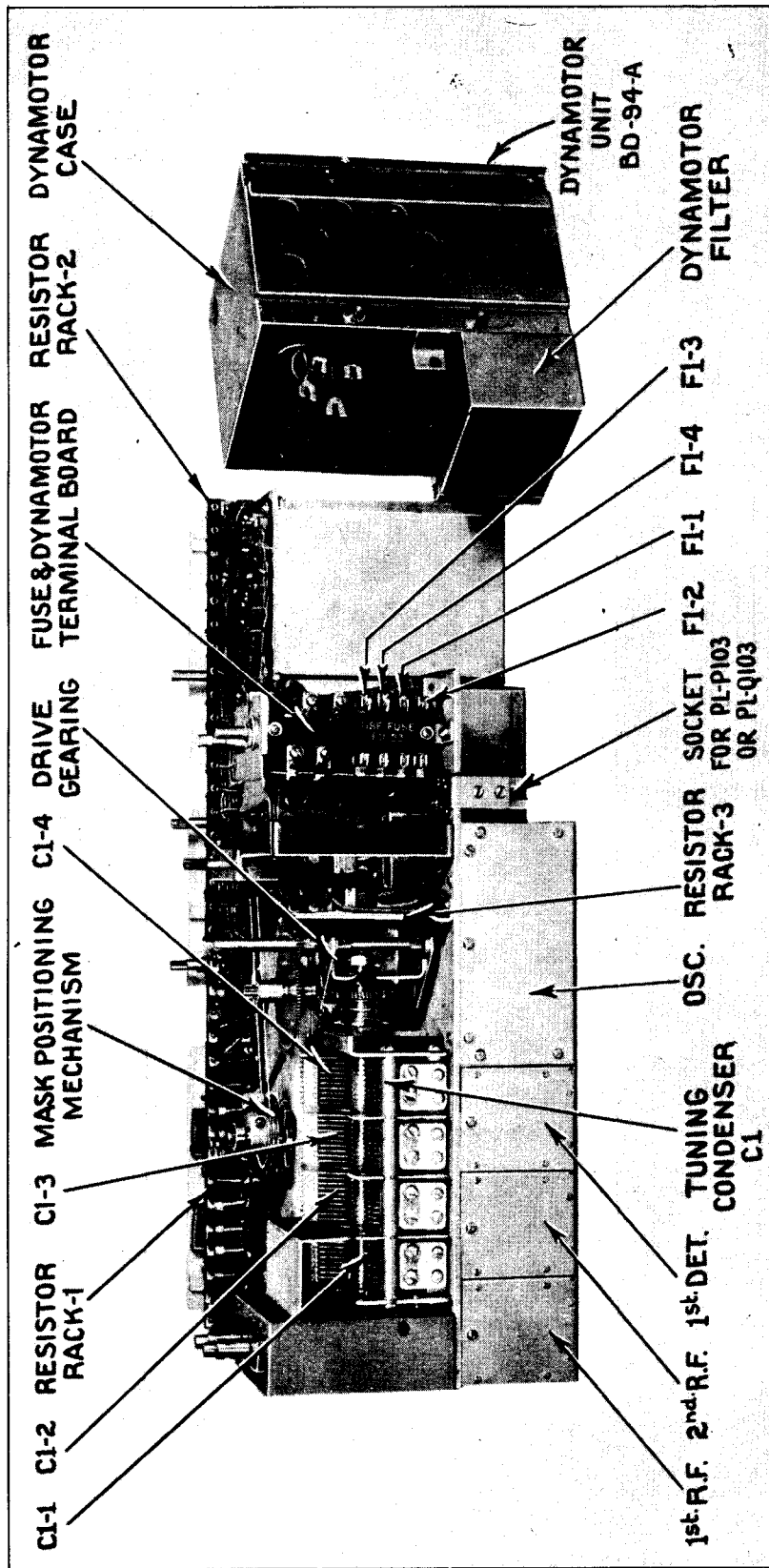


Fig. 5 - Bottom View of Chassis with Dynamotor Unit Disconnected

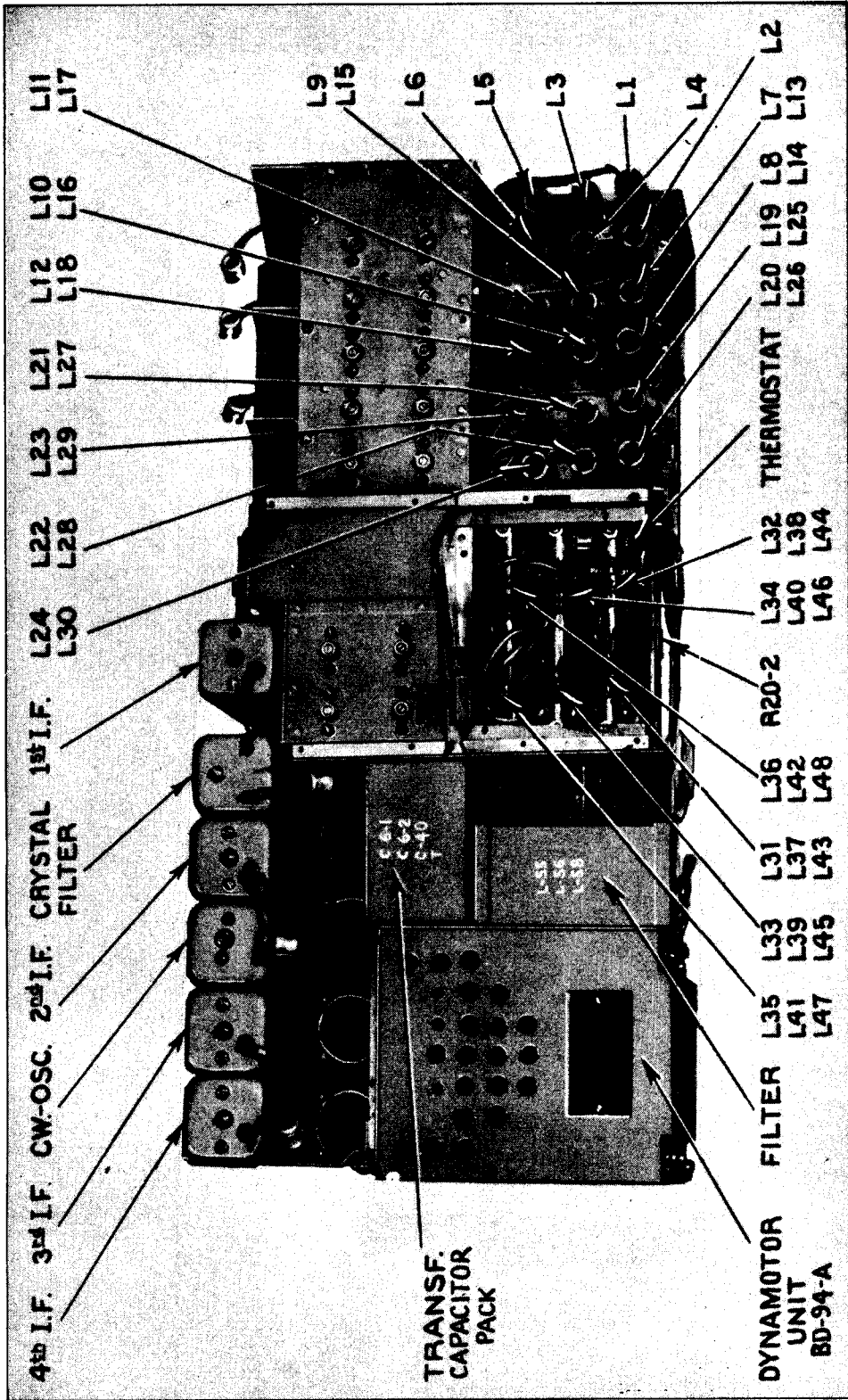


Fig. 6 - Rear View of Chassis

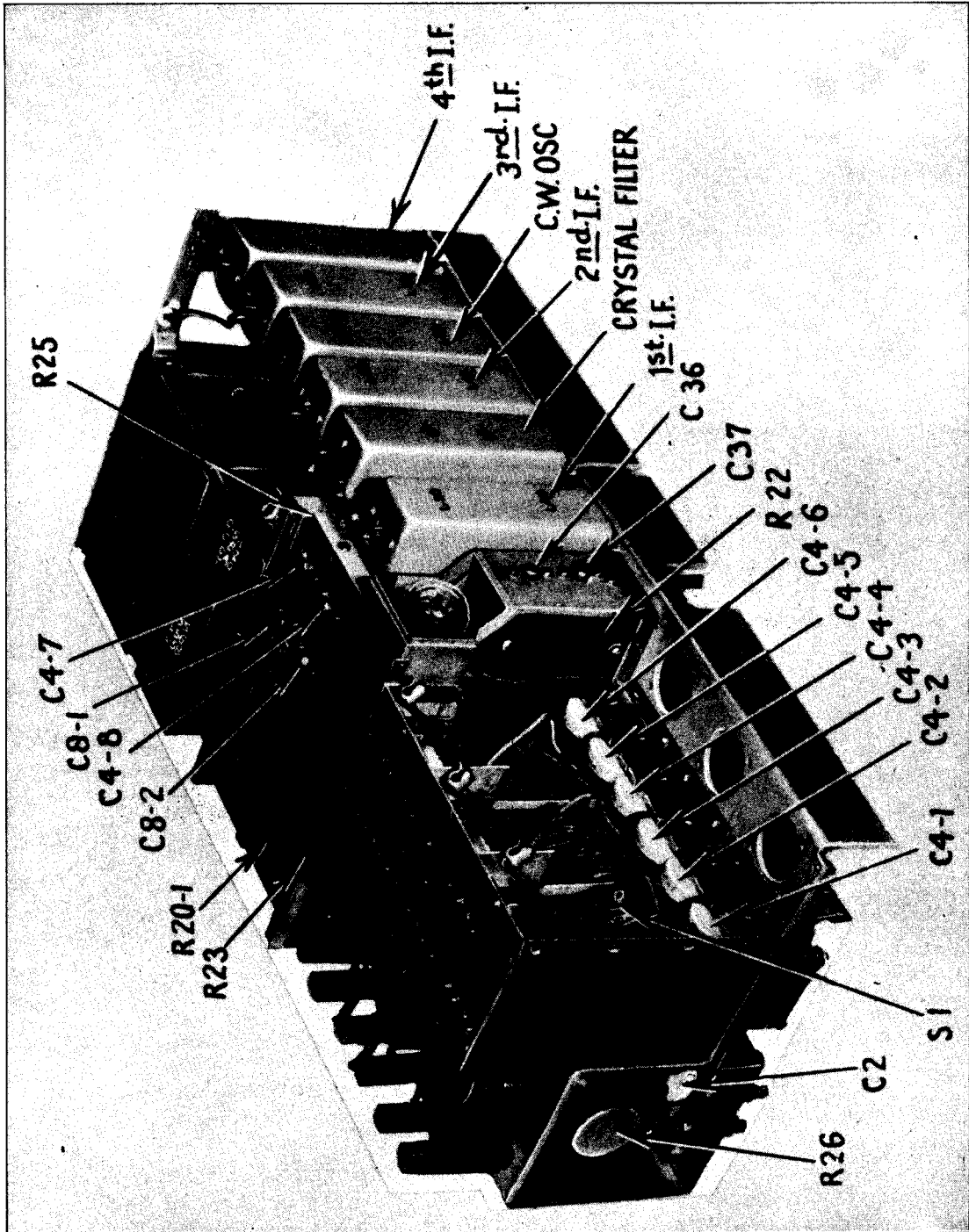


Fig. 7 - View of Chassis Showing Back, Top and End

2-6 The rear of the chassis provides access to r-f. coils, transformers, tubes, trimmers, tube shields, etc. Their locations including the parts listed below being shown on Figures 6, 7 and 8.

Tubes - 1st RF, VT-69; 2nd RF, VT-69; 1st Det., VT-69; Osc. VT-76

1st IF, VT-69; 2nd IF, VT-70; Det. VT-68; Output VT-48

Intermediate Frequency Transformer Compartments

Crystal Filter

C-W Osc.

Dynamotor Unit BD-94-A

Transformer - Capacitor Pack

Plug Socket

Temperature Controlled Oscillator Comp.

Detector

2nd RF

1st RF

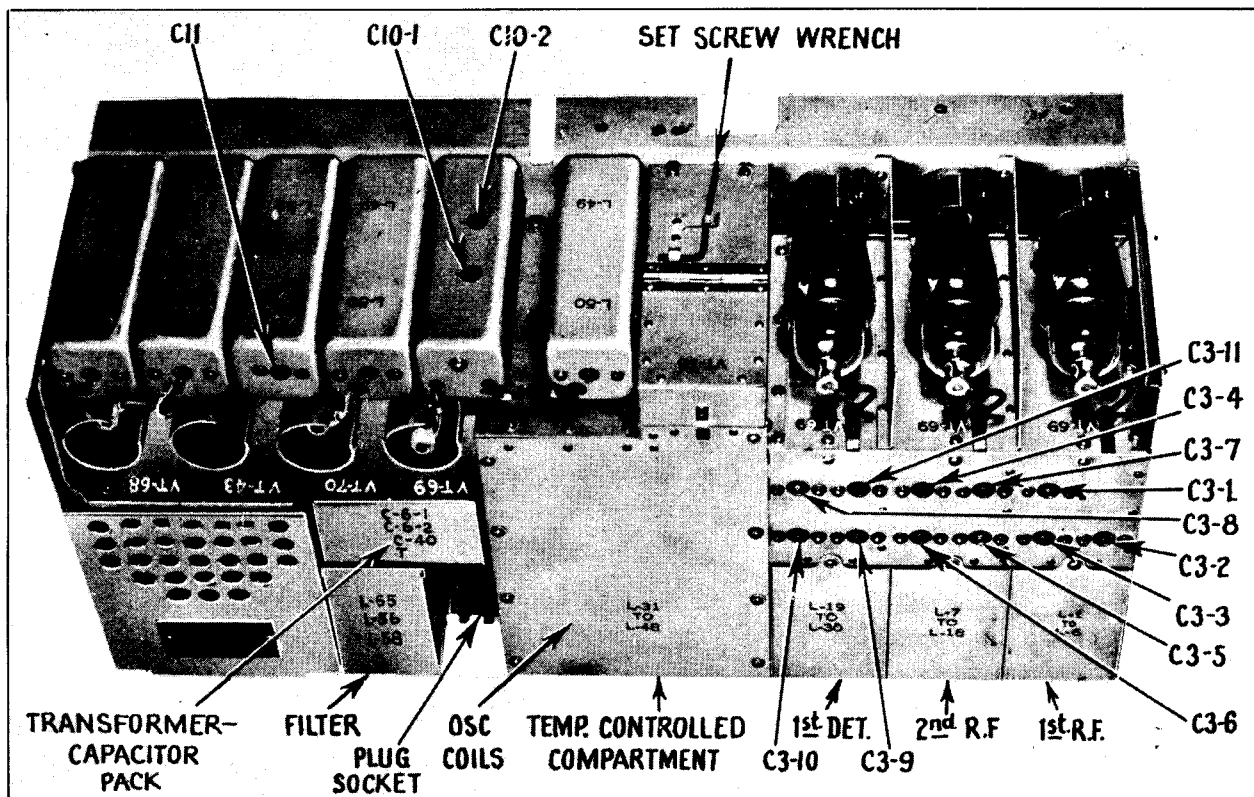


Fig. 8 - View of Chassis Showing Top and Back

2-7 All plug contacts are automatically disconnected when the receiver is removed from its mounting. The connections are also broken if the chassis is removed from the cabinet when it is in place on Mounting FT-154.

## 2-8 Circuits

Electrically the receiver comprises three stages of tuned radio frequency amplification preceding the first detector, a temperature controlled heterodyne oscillator, three intermediate frequency amplifier stages, a

## 2-8 (Continued)

second detector and one stage of audio-frequency amplification with a transformer output circuit. A crystal band-pass filter and beat-frequency oscillator are also included. The former is for increasing selectivity and the latter for receiving c-w. signals. The schematic and wiring diagrams are shown in the appendix.

## 2-9 Dial Assembly

a. The dial is divided into six frequency bands and the dial and tuning condenser are so geared to the tuning control shaft that the tuning condenser covers the frequency range indicated on the dial for each band in approximately 90 revolutions of the tuning knob. Split gearing is used throughout to minimize backlash. A positive stop is provided to prevent undue pressure on the gears and to limit the travel of the dial and the tuning condenser.

b. A mask, with suitably located and marked windows, is mounted before the dial. The mask is controlled by the band change switch and is connected thereto by means of pulleys and cables. The positioning mechanism for centering of the mask is shown in Figures 4, 16 and 17.

## 2-10 Frequency Range and Frequency Bands

The frequency range of 1.5 to 18.0 megacycles is covered in six bands which are under the control of a band change switch. The frequency range and approximate kilocycles per revolution of the tuning control for each of the six bands are given in the following table:

<u>Band</u>	<u>Frequency Range Megacycles</u>	<u>Freq. Coverage K.C.</u>	<u>Approximate K.C. per Rev. of Tuning Knob</u>
1	1.5-3.0	1500	15
2	3.0-5.0	2000	20
3	5.0-7.5	2500	25
4	7.5-10.5	3000	30
5	10.5-14.0	3500	35
6	14.0-18.0	4000	40

Removable shields give access to the coil compartments, trimmers, band switches and the terminal boards.

## 2-11 Input Coupling

The antenna input circuit is capacitatively coupled to the first tuned grid circuit by means of the antenna alignment capacitor. Sufficient range is available in this capacitor to permit alignment for antenna capacities within the limits of 50 to 200 micro microfarads. The antenna input circuit is designed for antennas whose resistance falls between 1 and 5 ohms. The same input coupling is suitable for use with a grounded transmission line of 30 to 100 ohms impedance.

## 2-12 Input Protection

The resistor R1-1 provides a leakage path for static charges which may be collected on the antenna. The input circuit will withstand the applica-

## 2-12 (Continued)

tion of 250 volts DC without damage. For protection against the application of radio frequency voltages up to 30 volts R.M.S., the input circuit provides for the overshooting of the grid of the first r-f. tube and the building up of a protective negative grid bias across the grid filter resistor R1-2.

## 2-13 Radio-Frequency Amplifier

The radio-frequency preselector comprises three ganged tuned circuits coupled by two Tubes VT-69 (super control pentode amplifier tubes). Separate inductances and trimmers are employed for each frequency band with the exception of Band 1. The r-f. gain of each of the six bands is kept uniform by selection of the turn ratio between the grid and plate circuit for each of the respective bands. A relatively low signal level is maintained at the grid of the first detector tube, thus insuring freedom from cross modulation interference.

## 2-14 First Detector

The first detector employs a Tube VT-69 which has a remote cutoff characteristic thus permitting the handling of signal voltages without cross modulation. The oscillator output is coupled into the cathode circuit of this tube and separate cathode coupling coils enable the individual adjustment of oscillator output for each frequency band.

## 2-15 Radio-Frequency Oscillator

a. The heterodyne oscillator employs a tuned plate, grid feed back circuit, utilizing a triode Tube VT-76. The effects on the oscillator frequency stability, of wide variations in ambient temperature under service conditions, have been reduced to a minimum by enclosing the oscillator tube and circuit components in a temperature controlled compartment. Individual inductances and trimmers are employed for each frequency band, and the low impedance coupling circuit to the cathode of the first detector insures a freedom from frequency instability with load variation or detector circuit tuning. On the four lower frequency tuning bands, the oscillator frequency is higher than the r-f. tuning by the intermediate frequency. On the two highest frequency ranges, Bands 5 and 6, the oscillator is on the low frequency side of the desired signal. This results in a more uniform tuning ratio over these bands and increases the image rejection ratio.

b. In the temperature controlled oscillator compartment, two bi-metallic thermostats are employed, one being placed in the oscillator coil compartment, while the other is in the switch section compartment. Each thermostat controls a separate heater circuit consisting of heating pads, so distributed about the oscillator compartments that each thermostat may independently control the temperature in both the coil and switch compartments. A heater "off" and "on" switch is provided on the front panel for independent control of the heater current through the "AVC - OFF - MVC" switch.

## 2-16 Intermediate-Frequency Amplifier

a. The intermediate-frequency amplifier comprises three low gain amplifying stages coupled by four highly selective, double tuned circuit transformers. The intermediate frequency employed is 915 kc.

b. The i-f. transformers are tuned by means of adjustable iron cores and fixed capacitors. The increased permeability resulting from the use of the iron cores contributes largely to the highly selective transformer characteristics while the lowered tuned circuit impedance, secured by the relatively large fixed tuning capacitors, provides an inherently stable amplifier. A Tube VT-69 functions as the first i-f. amplifier while the pentode section of a Tube VT-68 is employed as the second i-f. amplifier. A Tube VT-70 as the third i-f. amplifier supplies a relatively high level signal to the diodes of this same tube.

## 2-17 Crystal Band-Pass Filter

Additional selectivity is available by the use of the i-f. crystal filter preceding the first i-f. amplifier tube. This crystal filter comprises a balanced capacity bridge circuit which may be adjusted internally to provide a band width of 800 to 3,000 cycles at 20 decibels down from resonance.

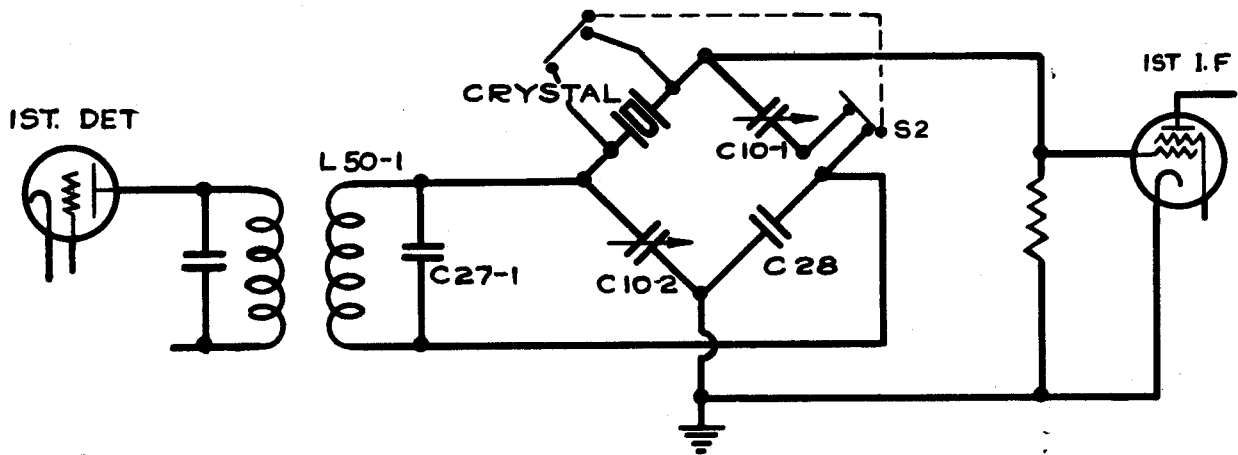


Fig. 9 - Details of Crystal Filter Circuit

The crystal filter may be switched in or out of the circuit by the "Crystal Out-In" switch, S2, located on the front panel. The filter band width is adjustable by the tuning of the input circuit, L50-1 and C27-1, and by the adjustment of C10-1. As delivered by the manufacturer the band width is set at approximately 2000 cycles. For adjustment see paragraph 6-4c(10).



## 2-18 C-W. Oscillator

a. The c-w. oscillator employs the triode section of the Tube VT-70 (second i-f. amplifier tube) in a tuned plate grid feedback circuit. A relatively large internally adjustable air dielectric, tank capacitor, C11, is employed for rough frequency alignment while a small panel-operated "Beat Frequency" control, C12, permits fine adjustment of the beat frequency within a range approximately 4,000 cycles each side of zero. The effects of ambient temperature variations are minimized by the use of a temperature compensated inductance L54 mounted on a bimetallic support. The c-w. Oscillator operates at an extremely low level minimizing harmonics and stray oscillator pickup. The output is coupled to the plate circuit of the second amplifier tube by the internal tube and socket capacity. Amplification by the third i-f. amplifier stage, the gain of which is not controlled either by manual or AVC, provides sufficient output from the c-w. Oscillator to the diode detector. This value of oscillator output is somewhat below the level at which the AVC operates, thus permitting the use of automatic volume control even for c-w. reception.

b. The c-w. oscillator switch S3-1 in the "ON" position supplies the oscillator plate voltage and increases the AVC time constant by connecting the additional capacitor C40. In order that the overall noise level may be maintained essentially constant with the c-w. oscillator switched on or off, the circuit arrangement simplified in Figure 10 is employed. Switch S3-1 supplies the oscillator plate voltage by connection to the screen grids of the first and second i-f. tubes. The same switching connects the loading resistor R6 which drops the screen voltage to the first and second i-f. and first r-f. tubes to a value that reduces the sensitivity by an amount sufficient to keep the overall set noise essentially constant. This arrangement for supplying the c-w. oscillator has added advantages which are not obvious.

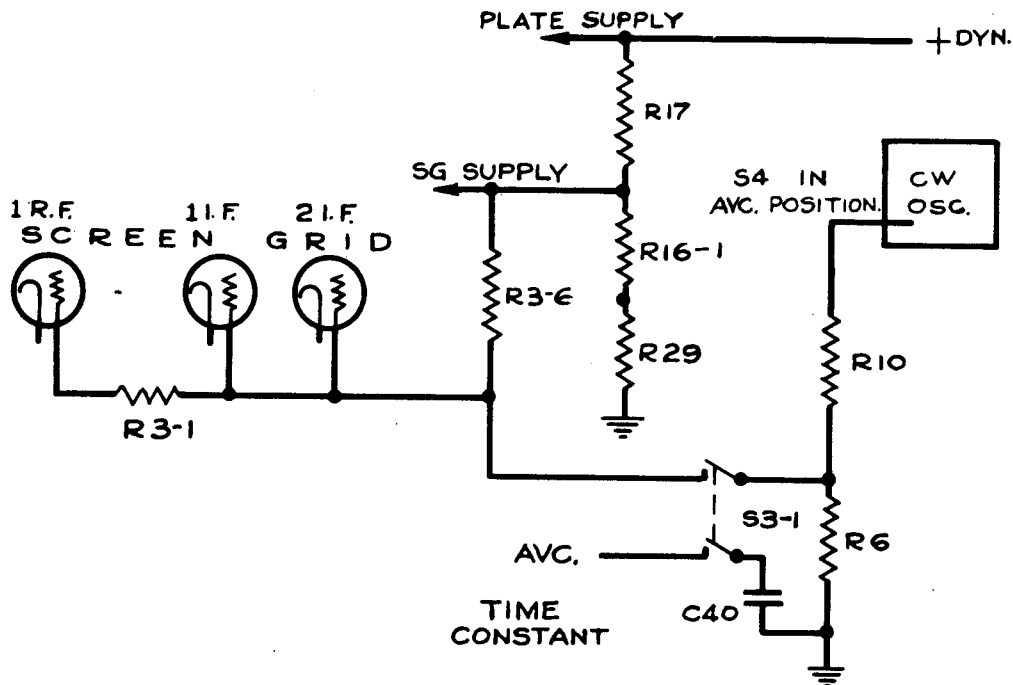


Fig. 10 - C-W. Oscillator Switching

## 2-18 b. (Continued)

In order to have sufficient oscillator excitation available to handle high detector levels encountered with AVC operation and strong signal inputs, while still keeping the no signal c-w. excitation below the AVC delay level, it is desirable to have the c-w. oscillator output increase as a strong signal input raises the AVC bias. This circuit arrangement, as shown in Figure 10, accomplishes this result, since with switch S4 in the AVC position, R16-1, R17, and R29 form a fixed bleeder supplying the screen grid voltage to r-f., 1st. detector and i-f. tubes. A strong input signal building up the AVC bias causes a considerable decrease in screen current and hence an increase in the screen supply voltage. This increases the voltage supplied to the c-w. oscillator and hence the excitation increases in proportion to signal level at the detector.

## 2-19 Second Detector

The Tube VT-68 also functions as the second detector. A relatively high level signal is supplied by the third i-f. amplifier to the diodes of this tube. One diode functions as the signal linear detector while the other diode is capacitively coupled and provides high level, delayed automatic volume control bias.

## 2-20 Output

a. The high level signal diode supplies audio output for driving the VT-48 output tube without additional audio amplification. The design choice of three i-f. amplifier stages and high level detection results in a number of operating advantages. The high level detection is relatively free from distortion due to the characteristic curvature at the lower end of the diode curve. The direct drive of the output tube from the diode detector simplifies the dynamotor ripple filtering and eliminates possible microphonics resulting from high audio amplification. The high diode level further provides relatively high bias voltage insuring an unusually flat automatic volume control characteristic with the desired time delay.

The dual volume control comprises potentiometers R28 and R29. The former R28 functions only with the switch S4 in the AVC position and in this condition it permits the desired adjustment of the audio level to the output tube and load. For manual volume control with switch S4 in the MVC position, the potentiometer R29 becomes the active control operating on the cathode bias of the r-f. and the 1st and 2nd i-f. amplifier tubes. This potentiometer has two linear resistance tapers providing a smooth variation of sensitivity.

Automatic load compensation is obtained by the method of biasing the output tube. Here, the grid bias is obtained from the resistance drop across the dynamotor filter reactor, thus, any tendency towards a decreasing load on the dynamotor results in a slight decrease in the bias of the output tube with a compensating increase in the load current. (See Figure 11).

b. The characteristic increase of internal receiver noise when tuning from the low to the high frequency end of a band has been corrected in this design by means of the potentiometer R26. The function of this potentiometer can be more clearly understood by reference to Figure 11. Here the noise compensator R26 is mechanically connected to the shaft of the ganged tuning capacitor with the electrical connections such as to give minimum resistance at the low frequency end of the band.

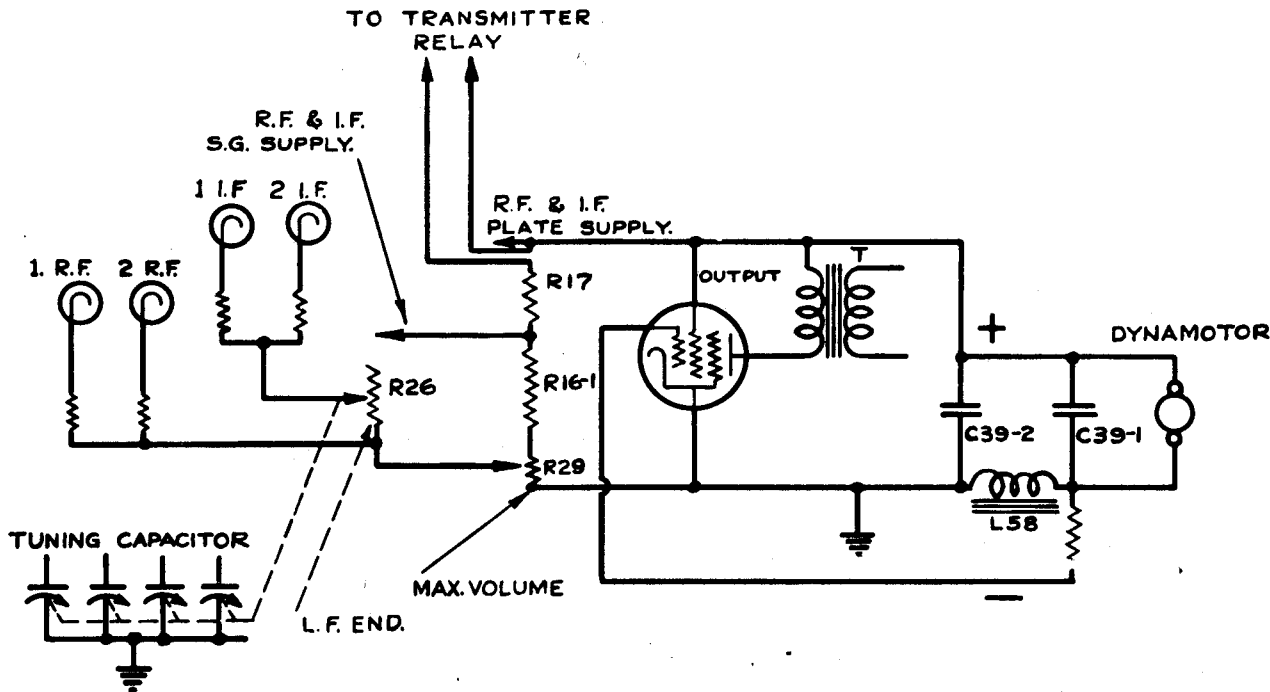


Fig. 11 - Load Compensator and Bleeder Circuit Details

The cathode return leads of both first and second i-f. amplifier tubes connect to the moving arm of R26 and hence the i-f. gain is decreased proportionally as the r-f. gain increases when tuning toward the high frequency end of the frequency band. This arrangement tends to maintain the noise level and receiver sensitivity essentially constant over the tuning ranges.

c. The Tube VT-48 provides a considerable margin of power capability above that necessary to operate a number of headsets in parallel.

2-21 Dynamotor Unit BD-94-A

The dynamotor and associated high and low voltage filter circuits are assembled in one unit. Removal and servicing of this unit is described under

2-21 (Continued)

Section VI Maintenance, paragraph 6-1. The r-f. and audio ripple filters are of the balanced type for an ungrounded primary supply. Adequate r-f. filtering is provided on each of the output leads to the receiver plug.

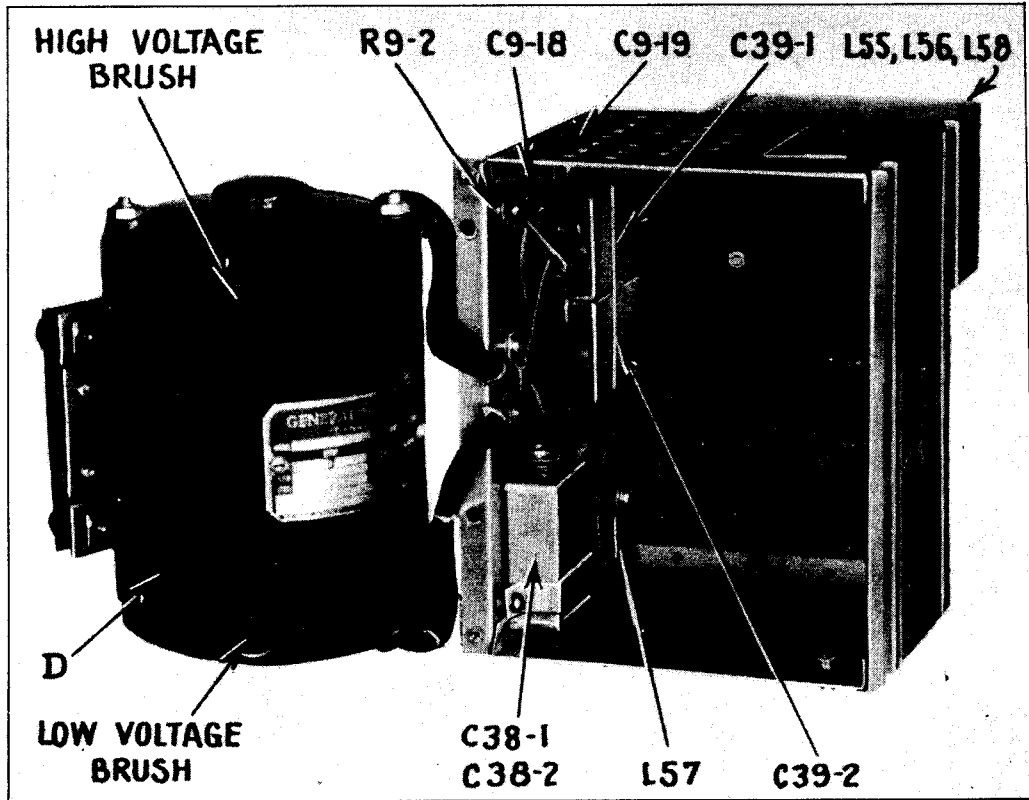


Fig. 12 - Dynamotor Unit BD-94-A, Showing Dynamotor Removed From Case.

#### 2-22 Illumination

The receiver tuning dial is illuminated by means of two dial lights (Lamps LM-27) controlled by the "Dial Lights" dual rheostat R27. This rheostat has an "off" position when the illumination is not desired. The dial lights are located beneath a readily removable housing which permits the easy replacement of a dial lamp during flight.

#### 2-23 Panel Items and Controls

The following items and controls are located on the front panel of the receiver. (See Figure 1).

Dial Lights, Housing and Window  
Tuning Control

2-23 (Continued)

Frequency Band Change Switch  
Volume Control "Increase Output"  
Receiver Switch "AVC" "OFF" "MVC"  
C-W. Oscillator Switch "OFF", "ON"  
Crystal Switch "OUT", "IN"  
Heater Switch "OFF", "ON"  
Phone Jack for Headset  
C-W. Oscillator Beat Frequency Adjustment  
Antenna and Ground Binding Posts  
Antenna Aligning Capacitor  
Dial Light Rheostat  
Handles for Removing Chassis from Cabinet  
Captive Screws for attaching Chassis to Cabinet

2-24 Mounting FT-154

a. The mounting shown in Figure 13 is constructed of stainless steel except for the aluminum base which carries 6 mounting holes and to which are

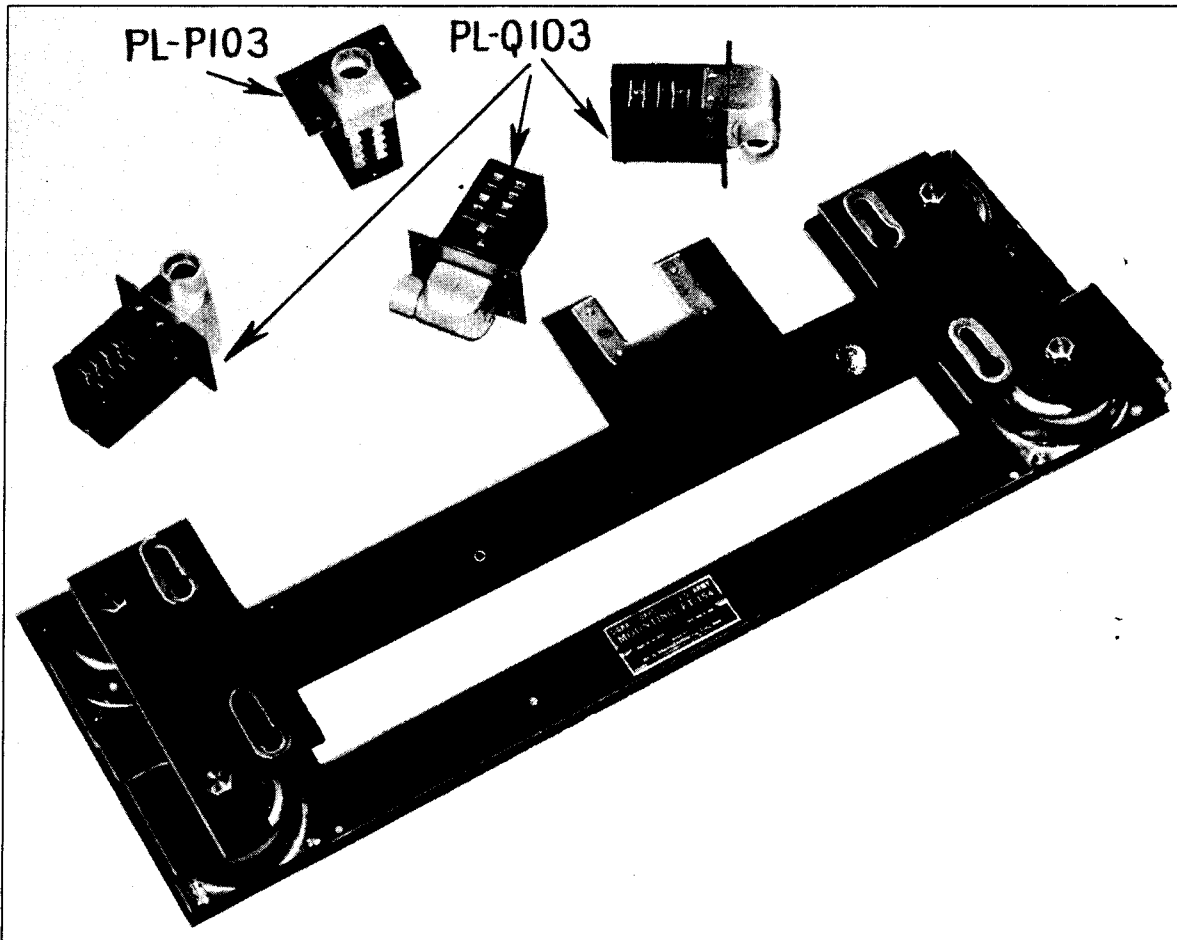


Fig. 13 - Mounting FT-154 and Plugs PL-P103 and PL-Q103  
attached the bases of 4 shock absorbers. To the top of the shock absorbers

2-24 a. (Continued)

is fastened the stainless steel support, which provides for the attachment of the receiver cabinet by means of studs and snapslides.

b. The plug, attached to the mounting by screws, is provided with eight terminals which are accessible upon removal of the rear cover of the plug housing. The plug, when provided with a straight outlet becomes Plug PL-P103. A right angle outlet which may be mounted in any of three positions, right, left or back may be used with the plug, making it Plug PL-Q103.

The positions and uses of these outlets with the plug are clearly shown on the outline dimensional sketch in the appendix.

## 2-25 Vacuum Tubes and Dial Lamps

The type and characteristics of the tubes and dial lamps are given below:

### Tube Characteristics

<u>Tube</u>	<u>Heater</u>		<u>Esg</u>	<u>Ep</u>	<u>Ecg</u>	<u>Ip</u>	<u>IsG.</u>	<u>Mu</u>	<u>RP</u>	<u>Gm</u>
	<u>Volts</u>	<u>Amps.</u>	<u>Volts</u>	<u>Volts</u>	<u>Volts</u>	<u>ma</u>	<u>ma</u>		<u>Ohms</u>	<u>Microhms</u>
VT-69	6.3	0.3	100	250	-3	8.2	2.0	1280	800,000	1600
VT-68	6.3	0.3	100	250	-3	6.0	1.5	800	800,000	1000
VT-70	6.3	0.3	Pen 100	250	-3	6.5	1.5	900	850,000	1100
			Tri -	100	-3	3.5	-	8	16,000	500
VT-76	6.3	0.3	-	250	-13.5	5	-	13.8	9,500	1450
VT-48	6.3	0.4	250	250	-18	32	5.5	150	68,000	2200

### Dial Lamps

<u>Type</u>	<u>Volts</u>	<u>Amps.</u>
LM-27	6.3	0.25

## 2-26 Fuses

Four 10 ampere glass cartridge fuses (Fuse FU-23) are used in each receiver. These fuses are specially designed to withstand the vibration encountered in aircraft.

## 2-27 Tools

Any small screw driver may be used in aligning the receiver as no undesirable tuning effects will be encountered.

A set screw wrench for use in removing the control knobs is attached to the cover of the heater compartment.

## III. Installation

3-1 The most important considerations necessary for the successful installation and operation of this receiver are as follows:-

### a. Mounting

The receiver should be mounted on a plane surface with sufficient clearance being allowed on all sides to permit free action of the shock absorber mounting. The mounting should be permanently attached to the rigid members of the plane. The drilling plan of the mounting is shown in the appendix.

### b. Power Connections

Separate pairs of leads to the 14 volt primary power source should be used for the dynamotor unit and filament circuit (plug terminals 3 and 8) and for the heater circuit (plug terminals 4 and 7). (See Figure 14). These leads should not be connected together at the receiver.

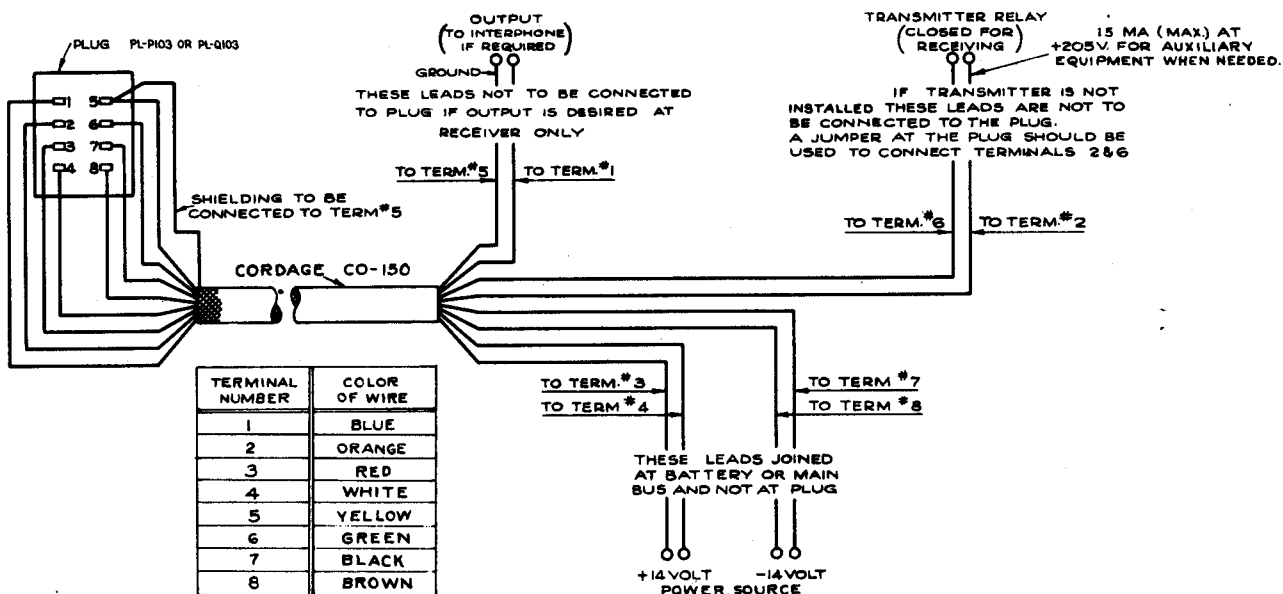


Fig. 14 - Plug Connections

### c. Transmitter Connections

Provisions have been made for the protection of this receiver when the associated transmitter is being used. Leads from plug terminals 2

### 3-1 c. (Continued)

and 6 should be wired to contacts on the transmitter relay. If the transmitter is removed from the installation the wires from plug terminals 2 and 6 must be connected together to have the receiver operate.

#### d. Output Connections

(1) The output of this receiver has been brought to plug terminals 1 and 5. Leads from these terminals should be wired to the Interphone System or as otherwise desired. If the output is desired only at the receiver, it should be taken directly from the phone jack and no connections made to plug terminals 1 and 5.

(2) In the design of the output transformer, a tap has been provided for use with a load impedance of approximately 500 ohms. This 500 ohm lead from the output transformer is color coded BROWN to distinguish it from the normal 3,500 ohm lead which is coded RED. Referring to the wiring diagram (Figure 23a) the location of these output transformer taps are shown on adjacent terminals of Resistor Rack #2 (nearest to the front panel). Normally the BLUE output lead connecting to the plug socket is soldered to the RED (3500 ohm) lead at the fifth terminal from the left on this Resistor Rack. When a 500 ohm output impedance is to be employed this BLUE lead should be unsoldered and connected to the adjacent terminal (sixth from the left on Resistor Rack #2).

#### e. Bonding and Shielding

At the time of installation of this equipment care should be taken to insure that the engine ignition system, generator, and other possible causes of disturbance are properly shielded and that bonding of metal parts is or has been carefully carried out.

#### f. Mounting of Receiver

When proper wiring connections have been made, place the receiver on Mounting FT-154 with the studs on the bottom of the cabinet entering the slots of the mounting. See that the cabinet is well down on the mounting and that all four studs are fully seated, then push the cabinet towards the rear and secure in place by the snapslides on the lower front corners of the cabinet.

#### g. Safety Wire

Safety wire should be passed through the holes of the snapslide assemblies, care being taken that the wires are not twisted too tightly.

#### h. Ground

The ground binding post "G" should be connected by a short, direct, low resistance lead to some grounded metal portion of the plane and soldered at that point if practicable. The lead should have enough slack to prevent vibration being transmitted to the receiver.



i. Antenna

This receiver is designed for an antenna system of which the capacity lies within the limits of 50 to 200 micro-microfarads, and resistance between 1 and 5 ohms. However, satisfactory performance will be obtained on practically any type of mast, fixed, or trailing wire antenna, altho in extreme cases, i.e., very short mast or very long trailing wire, optimum setting of the "Antenna Alignment" may not be obtained. In general, the most effective antenna is one whose length away from the grounded metal fuselage is the greatest. The receiver should be located as near as possible to the lead-in insulator and connected from the insulator to the antenna binding post by a copper wire. The lead should have enough slack to prevent vibration being transmitted to the receiver.

j. Transmission Line

Connections to a radio frequency transmission line may be made at the antenna and ground binding posts.

k. Adjustment of Input Alignment Condenser

With the receiver "AVC - OFF - MVC" switch, in the "MVC" position, the band switch on Band 1, and using the tuning control tune in a signal, at approximately 2.9 megacycles, to maximum signal strength. Reduce volume by means of volume control knob until signal is just audible. Adjust "Antenna Alignment" control to give maximum volume. This adjustment is correct for all frequencies covered by this receiver when using the particular antenna to which it is connected at the time the adjustment is made.

#### IV. Preparation for Use

4-1 This receiver is a self-contained unit, having its high voltage power supply and all coil sets built-in. Before installing the tubes, they should be checked with the tube checker of Test Set I-56-A.

4-2 Be sure that the proper tubes, well pushed down and firmly seated in their sockets, are installed, that tube shields are properly placed, and that grid caps fit tightly on the tubes.

Check dial lights and fuses and see that they are properly and securely placed.

4-3 Make sure that according to the color code, the leads from Dynamotor Unit BD-94-A are properly connected at the fuse and terminal panel and that the screws holding them in place are tight. No other precautions are necessary.

#### V. Operation

5-1 Power to the receiver is controlled by the receiver "AVC - OFF - MVC" switch. The following table shows the power connections in conjunction with this receiver switch.

5-1 (Continued)

Receiver Switch "OFF" )  
Heater Switch "OFF" or "ON" ) No power supplied to receiver  
Dial Light Rheostat "MIN." or "MAX.")

Receiver Switch "AVC" or "MVC" )  
Heater Switch "OFF" ) Filaments "ON"  
Dial Light Rheostat "MIN." (lights out) ) Dynamotor "ON"

Receiver Switch "AVC" or "MVC" ) Filaments "ON" Dynamotor "ON"  
Heater Switch "OFF" or "ON" ) Heater "OFF" or "ON"  
Dial Light Rheostat "MIN." or "MAX." ) Dial Lights "OUT" or "FULL ON"

5-2 The screen grid voltage supply leads are carried out of the receiver through Plug PL-( )103 to the keying relay of the associated transmitter where the circuit is opened when actually transmitting.

5-3 Operating Test

When the receiver has been completely installed an operating test should be made as follows:

a. Plug headset into the Phone Jack. Set Receiver Switch to "MVC". The dynamotor should start and after the tubes have warmed up (approximately 30 seconds), the volume control knob should be advanced until a slight background noise is heard. Set Band Switch to the frequency band in which test signals are available.

b. Using Tuning Knob and with reference to the calibrated scale on the dial, tune in the desired signal. Note: *All tuning should be done on "MVC" with the volume control advanced only enough to give the desired signal strength. In the absence of a signal the setting of the volume control can be judged by the loudness of the background noise. On "MVC", with the volume control set at maximum, very strong carrier waves will block the receiver and intelligible signals cannot be received.*

c. Set Receiver Switch to "AVC". The desired signal should still be heard.

d. With the Beat Frequency adjustment at zero setting, turn the c-w. Oscillator Switch to the position "ON". An audible beat note should be heard which should vary in pitch when the Beat Frequency adjustment is changed.

e. With the c-w. Oscillator still "ON", throw the Crystal Filter Switch to "IN". Noise should be greatly reduced and the signal can be tuned out by a much smaller movement of the tuning control knob than when the Crystal Filter Switch is in the "OUT" position.

f. With conditions the same as in Par. 5-3(d), throw Heater Switch to "ON". After a short time the pitch of the signal should automatically change due to the warming up of the temperature controlled oscillator compartment.

### 5-3 (Continued)

g. Turn the Dial Light Rheostat and observe if control of illumination is secured with both dial lights functioning.

h. A check should be made before flight and with the airplane engine running. An increase of background noise when the engine starts, indicates imperfect shielding, bonding, faulty generator regulator, faulty generator, open filter capacitors, or a combination of these faults.

i. Always turn the Receiver Switch to the "OFF" position when the receiver is not to be used.

### 5-4 Operating Routine

#### a. Controls

##### (1) Antenna and Ground Binding Posts

The antenna may be connected to either of the binding posts marked "A". If it is connected to the post in the lower right hand corner a jumper must be placed between the post marked "A" on the left side and the stud on the lower edge of the panel as shown in Figure 1. If the antenna is connected to the "A" post on the left side the jumper should be removed. A short, direct ground lead should connect to the ground post "G".

A grounded transmission line is similarly connected, with the ungrounded conductor to either antenna post "A" and with the grounded conductor to "G".

##### (2) "Antenna Alignment" Control

This control is a variable capacitor for aligning the input circuit to a given antenna. This adjustment should be made with the receiver tuned to approximately 2.9 megacycles.

##### (3) "Tuning" Control

This control varies the setting of the 4-gang variable tuning capacitor.

##### (4) "Band Switch" Control

This control selects the desired frequency band as indicated on the dial mask.

##### (5) "Dial Lights" Control

This knob controls the intensity of dial illumination and is provided with an "OFF" position.

##### (6) "C-W. Oscillator" Switch

This toggle switch controls the operation of the c-w. oscillator as well as the AVC time constant for c-w. reception.

5-4 a. (Continued)

(7) "Crystal" Switch

This control permits the insertion of an i-f. Crystal Filter when extreme selectivity is desired.

(8) "Beat Frequency" Control

This control permits vernier adjustment of the c-w. oscillator frequency and in tuning it should be set near the zero position.

(9) "Heater" Switch

This toggle switch controls the power supply to the heaters in the heterodyne oscillator compartment and should always be in the "ON" position except for emergency operation when reduced battery drain is desirable.

(10) "Increase Output"

This control is for sensitivity adjustment on "MVC" operation, and output level adjustment on "AVC" operation. When switching from "MVC" to "AVC" or vice versa it will generally be necessary to readjust this control to maintain a given volume level as only under certain conditions of signal strength will the volume level remain unchanged.

(11) "AVC - OFF- MVC" Switch

This three-position switch in the "OFF" position removes all power from the receiver. In the "MVC" position the receiver is operative with manual volume control while in the "AVC" position the automatic volume control is functioning.

(12) "Phones" Jack

This is an open circuit jack providing connections to the headset.

b. Modulated Signal Reception

(1) Throw the "AVC - OFF - MVC" switch to "MVC" and set other switches and controls as follows:

Heaters - "ON"

C-W.Osc. - "OFF"

Crystal Filter - "OUT"

Antenna alignment set as in the initial installation adjustment, paragraph 3-1g.

For stable operation, approximately 20 minutes should be allowed for the oscillator heat compartment to reach its operating temperature.

(2) Set the band switch to the desired frequency band and adjust the tuning control to the desired frequency with reference to the dial calibration. It is of greatest importance that this tuning be accomplished with the receiver switch in the "MVC" position.

5-4 b. (Continued)

(3) Increase the volume control until the desired signal is heard or the background noise attains a fair level.

(4) Adjust the tuning control until maximum output from the desired signal is obtained. This insures correct alignment or proper tuning of the receiver.

(5) If automatic volume control is desired, switch to the "AVC" position and readjust the volume control for the desired output level.

(6) Note:

*The "AVC" should not be employed while tuning in a signal. Tuning should always be done in the "MVC" position and with the volume control advanced only as far as required for a comfortable output level.*

c. C-W. Reception

(1) The procedure is the same as outlined above with the exceptions that the "c-w" oscillator switch is "ON" and tuning accomplished with the "Beat Frequency" control set near the zero or mid-position.

(2) After tuning in the desired signal the "Beat Frequency" control may be varied and the frequency of the beat note adjusted as desired.

(3) Automatic volume control may be employed for c-w. reception by switching to the "AVC" position and readjusting the volume control.

(4) When extreme selectivity is desired to minimize interference, the "Crystal" filter is switched "IN". A slight readjustment of the tuning and beat frequency controls may be required to secure the desired beat note frequency.

(5) Note:

*The Crystal Band Pass Filter is intended primarily for use in c-w. reception. However, the added selectivity may at times prove helpful in receiving modulated signals through heavy interference.*

## VI. Maintenance

*NOTE: No attempt at either mechanical or electrical servicing of this receiver should be made unless suitable shop and laboratory facilities are available. For example, a standard signal generator, a phantom antenna, a Test Set I-56-A, and other like equipment should be used for alignment purposes and the instructions in this book carefully followed.*

### 6-1 Inspection

#### a. Dynamotor Unit BD-94-A

(1) The dynamotor unit should be inspected at least once a year and after every 2000 hours of service. The complete dynamotor unit or the dynamotor machine alone is removable from the receiver chassis without disturbing other parts, provided the procedure outlined below is followed:

Loosen the five thumb screws on the receiver panel (3 at the top edge and 2 at the bottom), disconnect antenna and ground leads, then withdraw the chassis from the cabinet.

Lay the chassis with panel upwards on a smooth, flat surface with the bottom toward the operator.

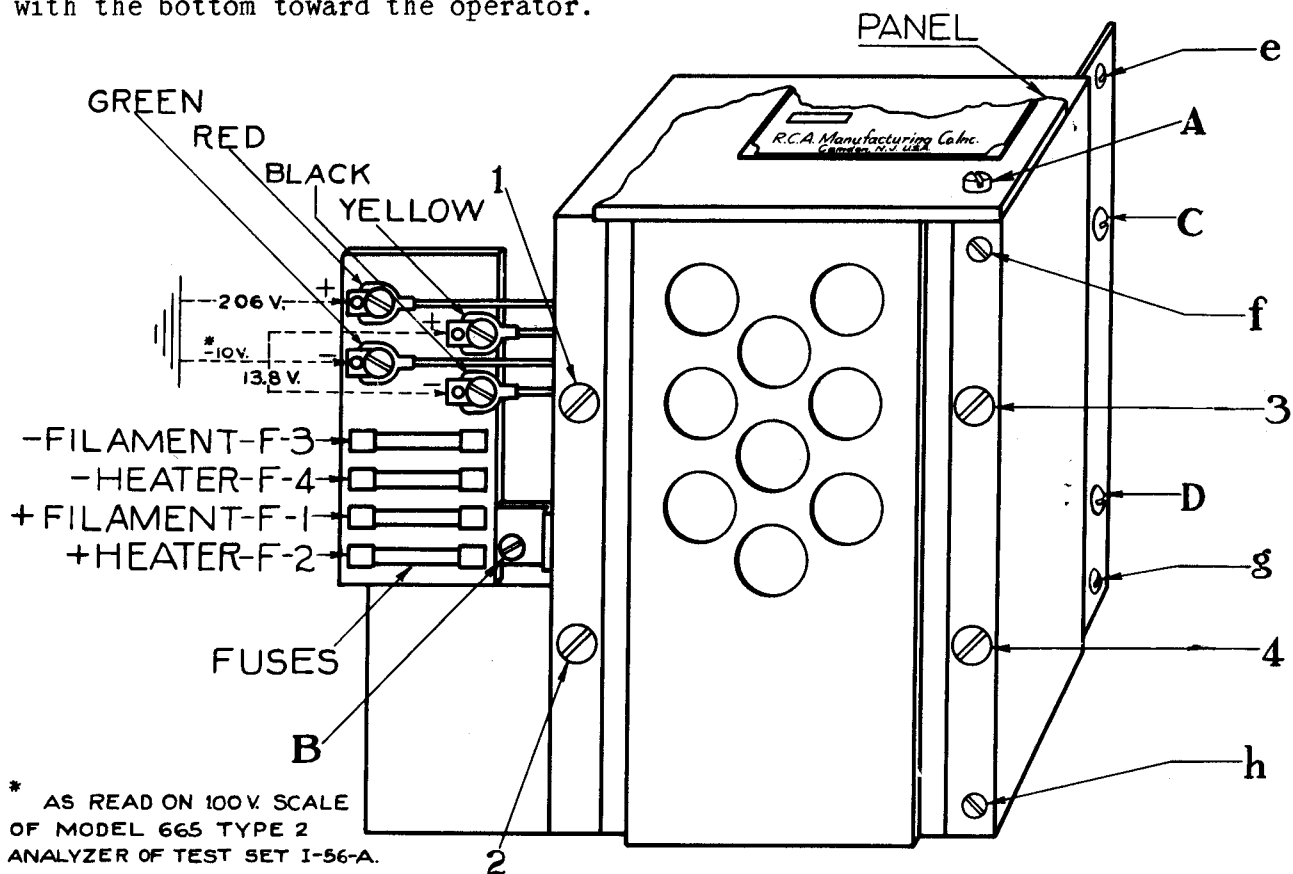


Fig. 15 - Dynamotor Unit BD-94-A - External Connections

6-1 a. (1) (Continued)

Loosen the four connector screws near the fuses and withdraw the spade terminals from beneath them. (See Fig. 15)

Remove the following screws:

One screw "B" (at the bottom of the chassis, located beside the fuse board).

Two screws "C" and "D" (at the end of the chassis which hold the top of dynamotor case).

One screw "A" (at the lower right corner of the front panel). The complete dynamotor unit may now be removed by sliding it sideways from under the panel.

*NOTE:- In replacing the unit on the chassis, care should be taken to make sure that the colors of the four leads with the spade terminals agree with the color coding of the terminals to which they are connected.*

(2) Removal of Dynamotor from Case

To remove the dynamotor from the high voltage supply unit case, the side cover should first be removed. (See Fig. 15). This is held in place by four machine screws, two "e" and "g" at the top corners and two "f" and "h" on the under side which engage angle brackets on the inside of the cover. After removing the cover, the four fillister head screws, 1, 2, 3 and 4 in the recesses in the bottom of the case should be taken out. The case can now be tilted toward the open side and the dynamotor rolled out. It should be noted that the dynamotor machine may be removed from the receiver without removing the entire Dynamotor Unit BD-94-A. With the leads still attached to the case, the brushes and end bells of the dynamotor may be removed for inspection in accordance with the instructions stenciled on the side of the frame. To do this remove the four brushes by unscrewing the bakelite cap screws and pull the brushes from their holders, being careful to note their original positions so that they can be replaced in exactly the same relation. Examine the brushes to see that they have worn properly and are free from hard spots. Should such spots be apparent the brush should be renewed. Spotted brushes may be isolated by inspecting the commutator for grooves. To do this remove the end bell from the high voltage end of the machine by first removing the nuts from the through bolts and then inserting a screw driver in the slot on the end bell and prying it off, and withdraw the armature assembly. Wipe the dust from the commutator being careful to prevent it from collecting in the ball bearing assembly. If the commutator does not have a smooth, even surface, the armature should be placed in a lathe, rotated and the commutator polished by holding a fine grade of sandpaper, not coarser than size 00, lightly against the commutator. All residue of dust, sand particles and dirt should be wiped away from the commutator after polishing. An ideal commutator is one that has a smooth,

#### 6-1 a. (2) (Continued)

glossy or polished surface, free of dirt, grease, ridges and the like. A commutator having a smooth or polished surface should not be sanded or turned down simply because it is discolored.

Under normal conditions, the commutators should not require turning down before the expiration of 5000 hours of service and can stand two turning-downs. After turning down the commutator should be carefully examined to see if undercutting of the mica is necessary. A toothbrush should be used to remove any foreign particles that remain between the commutator bars. The armature life should be approximately 10,000 hours.

After servicing the commutator, the ball bearings should be thoroughly cleaned and repacked with Keystone No.44 grease, as supplied by the Keystone Lubricating Company, Phila., Pa., or equivalent high-grade of ball bearing grease. (Air Corps grade No. 295)

#### b. Tubes

After every 300 hours of operation inspect all tubes with the Model 685 Type 2 Tube Checker of Test Set I-56-A and replace all tubes that do not check "Good".

#### 6-2 Removal of Front Panel

For adjustment of dial or mask, or for servicing of certain parts, it is necessary to remove the panel. The chassis, with panel attached, should be taken completely out of the cabinet and placed for inspection with the panel facing upwards.

The jumper for connecting the antenna posts, if in place, must first be removed. Then remove all the knobs, loosening the set screws with the special hexagonal wrench held in clips on the top of the chassis. Under these knobs will be found felt washers for the exclusion of dust. These should be collected to prevent their loss. Remove the five nickel plated screws which attach the panel to the chassis, and lift the panel off the chassis, at the same time pulling out the dial lamp connection plug which is visible through the cut-out at the top of the chassis. It is advisable to pry the plug upward with a screw driver in order to avoid severe strain on the connecting wires on the back of the panel.

In replacing the knobs on the shafts, it will be noted that flats on the shafts provide for proper location. All set screws must be securely tightened, and the set screw on the band switch knob in particular should be given a second tightening after the shaft has been rotated a few times.

#### 6-3 Dial and Mask

The construction of the dial and mask assembly is shown in Fig. 16, and the arrangement of the cord drive from the switch shaft is shown in Fig. 17.



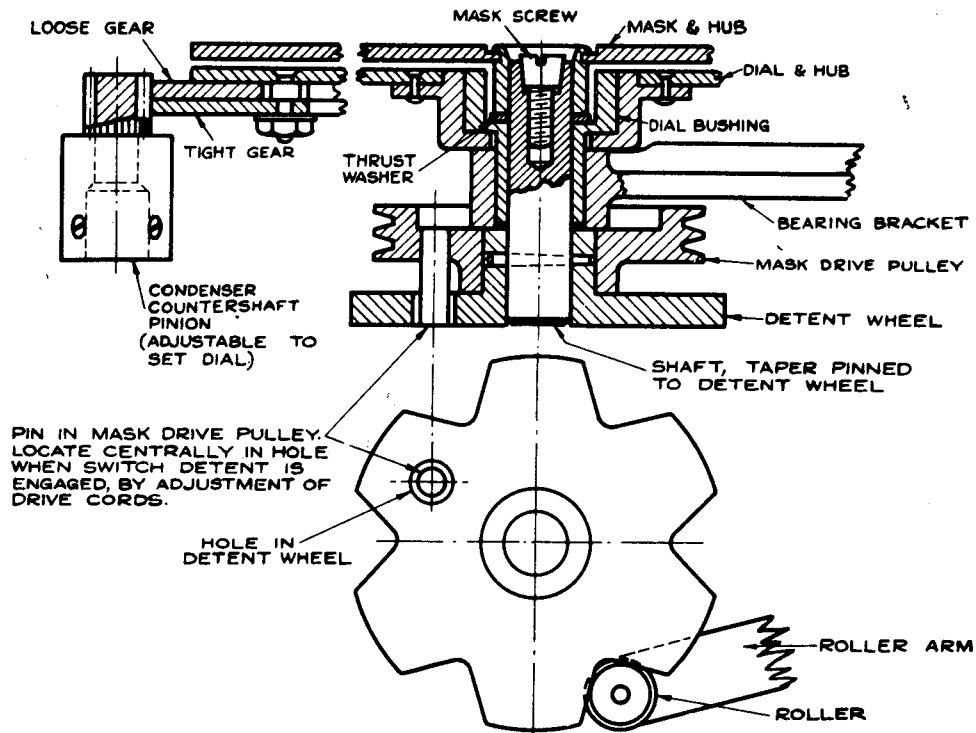


Fig. 16 - Dial and Mask Assembly

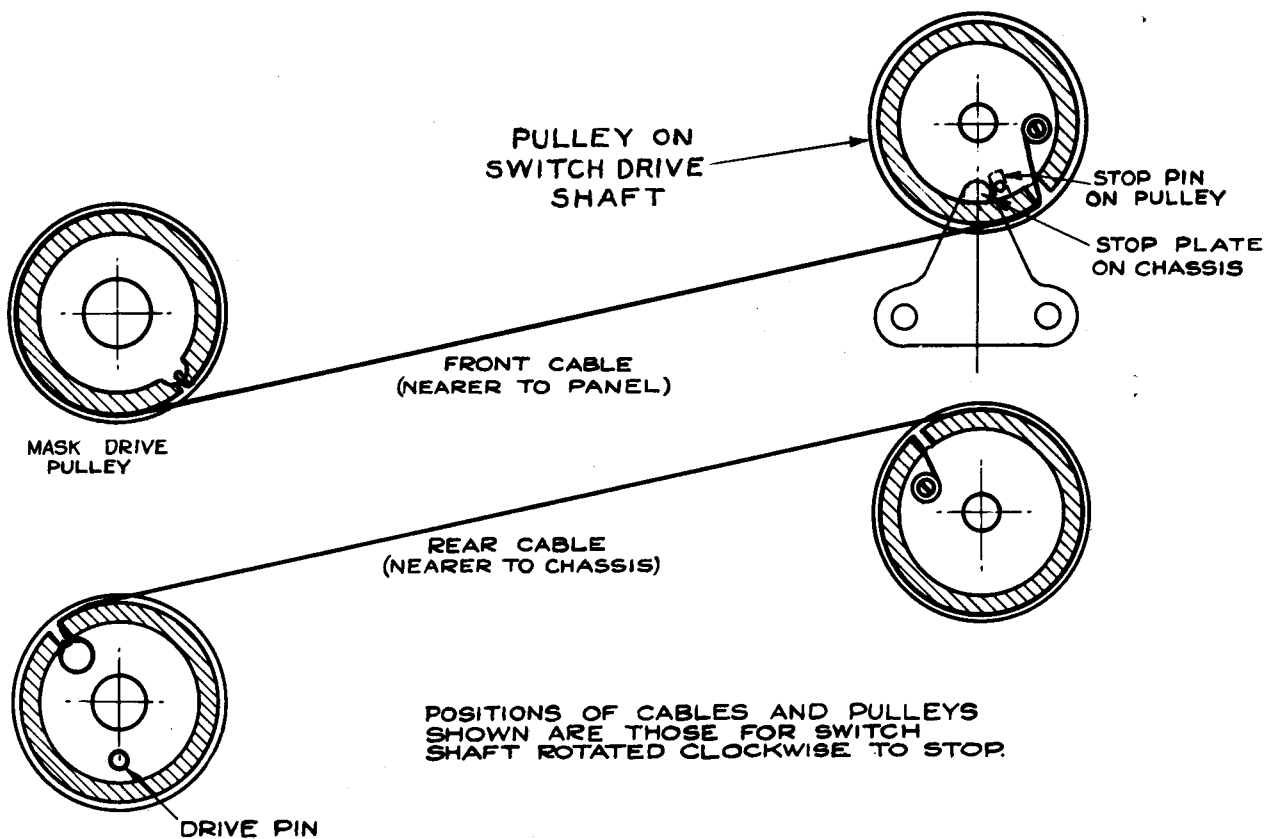


Fig. 17 - Cord Drive for Dial Mechanism

a. Mask

The switch drive shaft, which projects through the panel, operates the 6-position band switch through a pair of 2 to 1 bevel gears. By this means the  $150^{\circ}$  rotation of the switch itself is transformed to a  $300^{\circ}$  rotation of the switch drive shaft. This rotation is transferred without change in ratio to the pulley which drives the mask in front of the tuning dial by means of a pair of phosphor bronze cables. Thus the mask assumes one of six positions spaced  $60^{\circ}$  apart, corresponding to the particular switch position, and uncovering the appropriate tuning scale. Since the mask openings also have the index pointers integral with them, the positioning of the mask must be exact and independent of slight variations in switch shaft position or of discrepancies in the assembling of the drive cables and parts. Therefore a considerable amount of "lost motion" is deliberately incorporated in the mask drive, and the final position of the mask is determined by an arm and spring, attached to the dial supporting bracket and having a roller which engages notches in a detent wheel on the shaft carrying the mask. The mask pulley turns freely on the hub of this detent wheel and drives the wheel by means of a pin in a hole considerably larger than the pin. A separate detent on the switch itself serves to locate the switch in each of its six contact positions, and when the switch is in any one of these positions, the pin on the mask pulley is in the center of the hole in the detent wheel. When the switch shaft is rotated, it will be noticed that the mask does not immediately move, as it is necessary for this pin to reach the side of the hole before motion is transferred. Also, just before the switch reaches the next operating position, the spring roller arm carries the mask ahead to the new position.

Stops are provided on the switch shaft inside the chassis to permit travel to and slightly beyond the extreme contact positions. These are used only for setting the switch in a known position. A stop pin on the back of the pulley on the switch drive shaft engages a stop plate which is held to the chassis by the two screws which also hold the bottom of the switch shaft bearing bracket. These stops permit rotation to and also slightly beyond the extreme contact positions of the switch, but not as far as the inner stops. The outer stops, therefore, determine the angular movement of the switch drive shaft and protect the inner stops from undue strains through the reduction drive gears. Because of clearance in the holes in the stop-plate, adjustment is provided for securing equal over-travel at each end of the switch rotation.

b. Dial

While the tuning dial is concentric with the mask and supported by the same bracket, it is in no way connected to it, but rotates on the outside of the bushing in which the mask shaft runs. The dial has a split antibacklash gear at its periphery which is driven by a pinion on the countershaft of the tuning condenser. The ratio is such, that, while the tuning condenser rotates through  $180^{\circ}$  the dial rotates  $330^{\circ}$ . The pinion is adjustable on its shaft to permit setting the dial to its correct relation with the condenser.

c. Assembly and Disassembly of Dial and Mask

(1) Mechanism

At all times when working on the mask or dial mechanism, keep the tuning condenser plates fully meshed to prevent damage.

In order to remove the mask, the screw located in the center of the mask shaft should be loosened. In loosening this screw, which is set up tightly to prevent shifting of the mask, the mask detent wheel should be supported underneath to take the strain of the screw driver thrust. It should also be held from rotating so that the rotational strain will not be taken by the drive cables and the switch shaft pulley stops. This is important, both for dis-assembly and re-assembly.

With this screw loosened, the mask can be lifted off the shaft. Care must be used in handling the mask to avoid bending or springing it. It will be noticed that with the mask removed, the mask shaft may drop back through the bushing, but the chassis prevents it from coming out.

To remove the tuning dial, the clamp screw on the bracket underneath the dial (accessible from the bottom of the receiver) must first be loosened. The dial together with the bushing can then be withdrawn from the bracket. This should be removed by pressing from underneath, near the center of the dial and not by lifting at the edge of the dial. The bracket can then be removed from the chassis, by taking off four nuts, but in order to preserve the gear center distances it is advisable not to disturb the bracket unless absolutely necessary.

(2) Drive Cables

Removal of drive cables is possible only after the mask and dial have been removed. These cables are threaded through holes in the mask pulley, in which they are held by soldered "knots" at the ends, and then attached to the switch shaft pulley by screws.

If necessary to install new cables, the following procedure should be followed:

(a) Thread cords through the holes in the mask drive pulley.

(b) Put the bushing only in place in the bracket, leaving off the dial. This centers the mask shaft.

(c) Rotate the switch drive shaft to its clockwise position, making sure that the switch detent is centrally engaged.

(d) Thread cables over pulleys and through the holes at the bottom of the grooves in accordance with Fig. 17, keeping mask pulley in position shown.

(e) Draw up cords to take out slack and at the same time keep the driving pin of the mask pulley centered in the hole in the detent wheel. Since this cannot be readily seen, trial movements of the pulley will indicate when there is clearance on each side of the pin. Be sure that setting is correct and centered before tightening screws holding cables on switch drive shaft pulley.

(f) Remove bushing from bracket, place it in the dial hub and re-assemble in the bracket. As the gear teeth are ready to mesh with the teeth on the pinion on the condenser drive, move the loose gear approximately two or three teeth with respect to the fixed gear and push into place. Before tightening the clamp screw on the bracket which locks the bushing in place, press the bushing in so as to take out all end play.

(g) The tuning condenser should now be set to its maximum capacity with the stop pin against the stop. Loosen the two set screws on the hub of the pinion which drives the dial and rotate the dial until the setting mark beyond the low frequency end of the outer scale is vertically above the center of the bushing. A square against the top edge of the chassis will assist in this setting. Tighten the two set screws.

(h) Put the mask in place on the shaft, using the thrust washer between its hub and the inside of the bushing. Turn the switch shaft to the extreme clockwise position, and set the mask with the outer window at the top and with the index pointer in line with the setting mark referred to above (Par. 6-3 c (2) (g)). Support the detent wheel from beneath and hold it from turning, then press mask hub as far on as possible, to take out all end play, and very firmly tighten the expansion screw in the end of the shaft. This locks the mask to the shaft.

(i) Before replacing panel, check for proper operation of mask and tuning dial; also for alignment of mask index pointer with reference to mark on dial, being sure that tuning capacitor is against stop at maximum capacity.

#### 6-4 Trouble Location and Remedy

##### a. General

The normal sensitivity (number of microvolts input to produce 10 milliwatts output into a 3500 ohm resistance load) of the receiver is better than 3 microvolts when measured under the following conditions:

C-W. oscillator "ON"; Crystal Filter "OUT"; Output load 3500 ohms non-inductive resistance; pure c-w. input from signal generator applied between antenna-ground terminals through a 100 m.m.f. dummy antenna; Volume control set to produce 1 volt noise output.

6-4 a. (Continued)

This sensitivity will, of course, be subject to variation with time due to tube aging, etc. Therefore, it is recommended that no attempt be made to retrim or realign the equipment unless the sensitivity is found to be less than 7 microvolts with new, average tubes.

This receiving equipment has been carefully adjusted and aligned by the manufacturer before shipment and should maintain these adjustments over reasonably long periods of time. Every effort should be made to make any major adjustments and repairs in a laboratory well equipped with the necessary servicing tools and equipment and to refrain from changing any of the adjustments of the radio frequency circuits until it is ascertained that the difficulty being experienced is not the result of external or normal deteriorating influences, such as worn-out vacuum tubes, improper operating voltages, blown fuses, external noises, etc. However, in order to permit the servicing of this equipment, the following procedure should be followed in determining the sources of trouble and in their correction. This has been divided into the following major divisions, with respect to the nature of the troubles being experienced.

Equipment required - See Paragraph 6-4b.

Weak or No signals on all Bands - Modulated Reception - See Paragraph 6-4c.

Weak or No signals on any One Band - Modulated Reception - See Paragraph 6-4d.

Weak or No signals - C-W. Reception - Modulated Reception Normal - All Bands - See Paragraph 6-4e.

The following graphically outlines the procedure for trouble loca-

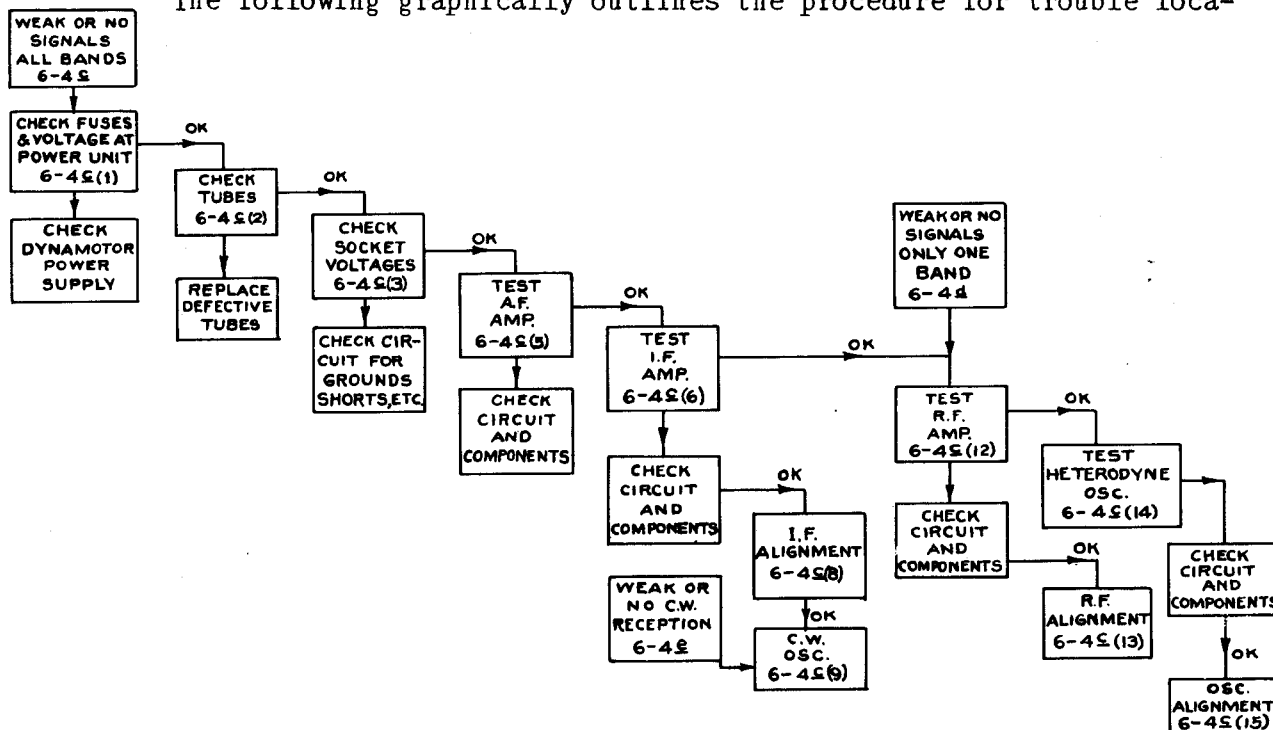


Fig. 18 - Trouble Location and Remedy Chart

6-4 a. (Continued)

tion, the numbers in each block referring to the paragraph numbering in the following discussion.

**b. Equipment Required**

(1) Few instruments other than those found on a standard set analyzer (Test Set I-56-A) are required in locating and correcting the most probable troubles on this receiver. These individual instruments are as follows:

(2) A modulated test oscillator (Standard Signal Generator) with a frequency range from 900 to 18,000 K.C. with provision for calibration accuracy better than 0.1% at aligning frequencies.

(3) Voltmeter - 1000 ohms per volt,  
Ranges: 0-10; 0-100; 0-250 volts.

(4) Continuity tester.

(5) Output meter, rectifier type, 0-10 volt,  
4000 ohms.

(6) Micro-ammeter, 0-200.

**c. Weak or No Signals on All Bands - Modulated Reception**

(1) Check of Dynamotor Voltages

When all signals on all bands are weak or no signals are heard even when known to be present, the procedure follows that shown in the chart. The voltages checked at the dynamotor terminal board should closely approximate the following values:

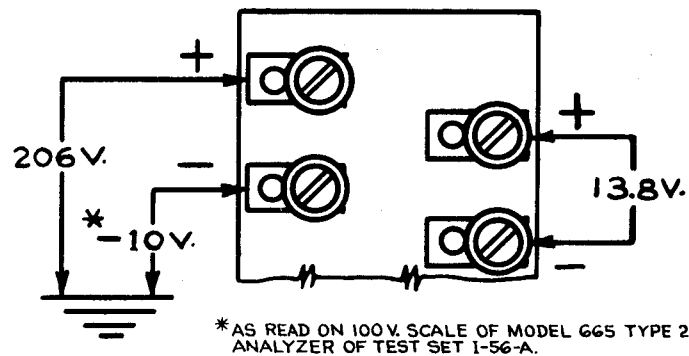


Fig. 19 - Dynamotor Voltages

If these voltage readings do not approximate the values shown, the fuses should be checked as well as the dynamotor and filter circuits, wiring and components.

6-4 c. (Continued)

(2) Tube Check

If the voltages at the dynamotor terminal board approximate the values given, proceed to check all tubes for emission and characteristics or replace all tubes with those of known average characteristics.

(3) Check of Socket Voltages

If tubes check satisfactorily, or if after replacing with tubes known to be good, the sensitivity is still low, proceed to check all tube socket voltages as outlined under Paragraph 6-4f with Test Set I-56-A. The average socket voltages are given in the following Figure 20. Conditions of measurement are as follows:

Input voltage 14V.; Crystal "Out"; "MVC"; Volume "Max."; C-W.Osc. "Off"; Heaters "On". Load - 3500 ohms resistance.

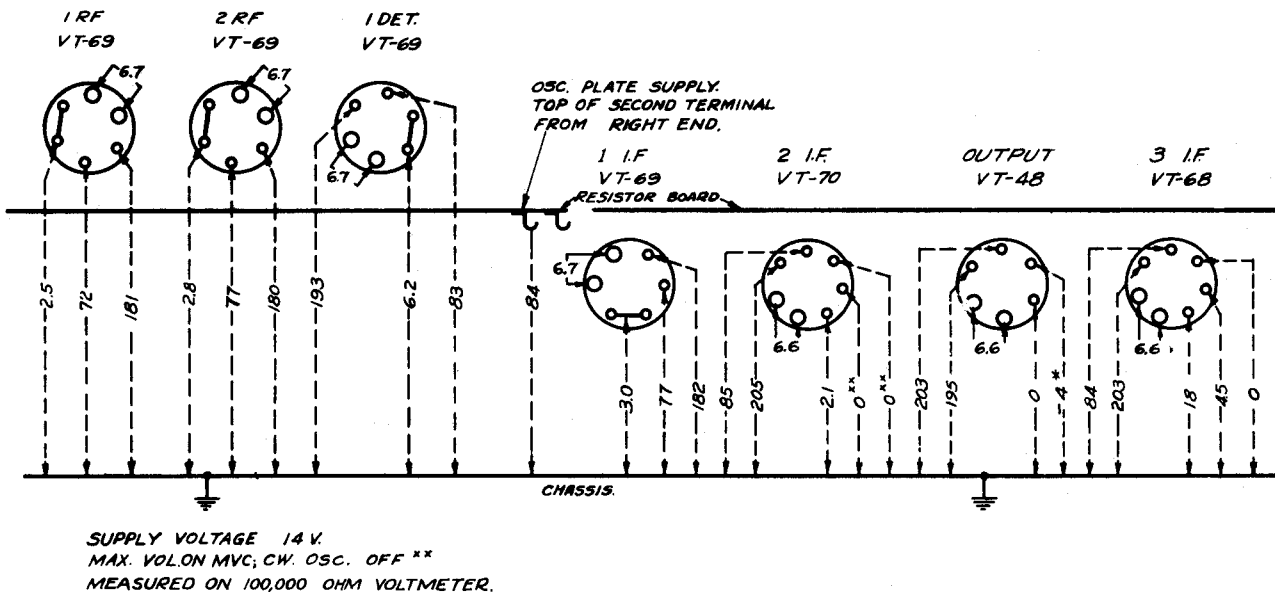


Fig. 20 - Tube Socket Voltages

(4) Check Circuit Wiring and Components

If the tube socket voltages do not approximate the values shown in Figure 20, the associated circuits and components should be checked for grounds, shorts and similar defects.

(5) Test of Audio Frequency Amplifier

Having checked all socket voltages and found the values to be correct, proceed to the test of the audio frequency amplifier. This can be checked by capacitively coupling a 400 cycle voltage of approximately 2 volts R.M.S. from ground to the audio diode socket prong. As an alternative,

6-4 c.(5) (Continued)

a 2 volt modulated 915 K.C. signal may be coupled at this point and to ground. Proper functioning of the audio amplifier will be indicated by an output well over 10 milliwatts for the 2 V. audio input. (Corresponding lower output for 915 K.C. input). Circuits, wiring and components should be checked if this order of response is not obtained.

(6) Test of Intermediate-Frequency Amplifier

Following a satisfactory test of the audio amplifier, check the intermediate frequency amplifier by capacitively coupling the modulated test oscillator to the grid cap of the first detector tube, the frequency being adjusted to 915 K.C.. A rough check of the proper functioning of the i-f. amplifier is indicated by a comfortable headphone output level with low input from the test oscillator. (Approximately 50 microvolts input for 10 milliwatts output).

(7) I-F. Amplifier Circuit Check

If the i-f. amplifier does not respond as above or lacks sensitivity, a progressive check, stage by stage, should be made. The test oscillator, 915 K.C. modulated input, is connected through a 0.1 mfd. capacitor to the detector diode socket prong and to ground. A signal response indicates proper functioning. Coupling the oscillator to the grid of the third i-f. should indicate a decided gain in sensitivity. Proceeding similarly towards the first detector, each stage should show a decided gain, and a faulty stage can be circuit checked for grounds, shorts, or defective components.

(8) Alignment of I-F. Amplifier

When all stages have been tested, the i-f. amplifier alignment is checked by coupling a low level input signal of 915 K.C. to the first detector grid and adjusting the i-f. tuning cores of both primary and secondary windings of the first, second and third i-f. transformers for maximum output. The fourth i-f. transformer is slightly over-coupled with the resultant double response peaks symmetrically located approximately 7 kilocycles each side of the 915 K.C. i-f. alignment frequency.

In general, it will not be necessary to realign this transformer because of its broad characteristic. However, if realignment becomes necessary the following procedure should be followed:

Connect the modulated test oscillator through a 0.1 mfd. capacitor to the grid of the Tube VT-68 (third i-f. amplifier tube) and to ground. Set the input frequency at 908 K.C. and adjust alternately first the primary tuning core, then the secondary tuning core of the fourth i-f. transformer until maximum output is obtained when both cores are turned in a right hand screw direction. The modulated test oscillator should then be tuned slowly through the 915 K.C. setting and to approximately 922 kilocycles when a second response peak of approximately equal amplitude as that at 908 K.C. should be obtained. This indicates correct alignment. Slight supplementary



adjustments of the primary and secondary tuning cores may be necessary to secure a symmetrical double peak response with the slight hollow between response peaks located at the 915 K.C. alignment frequency. If a sweep frequency modulated test oscillator is available, this fourth i-f. transformer can be conveniently aligned by visual observation on a cathode ray oscilloscope. In this case, the tuning core adjustments are made to obtain a double peak response pattern centered at 915 K.C.

#### (9) Alignment of C-W. Oscillator

The c-w. oscillator is checked and adjusted at this time by switching it "ON" and removing the modulation from the input signal. With the "Beat Frequency" Control set at mid-position, the main oscillator trimmer C11 is adjusted for zero beat.

If no c-w. beat can be heard, the oscillator circuit should be checked for grounds, shorts, or defective components. With the c-w. oscillator "ON" the screen voltage at the first and second i-f. sockets drops to approximately 45 volts (measured to ground).

#### (10) Test and Adjustment of Crystal Band Pass Filter

Normally the crystal band pass filter is adjusted at the factory for a band width of 1500 to 2000 cycles at 20 db. down from resonance. This filter can be tested by applying an unmodulated signal of approximately 915 kilocycles, connected through a 0.1 mfd. capacitor to the grid of the first detector tube and ground. With the crystal filter switch "IN", and a 200 microampere meter connected in the lead from the volume control R28 to the cathode of the third i-f. amplifier Tube VT-68 (available at the tube socket), the frequency of the test oscillator should be slowly varied until the response peak of the crystal filter is located. The signal input voltage or the volume control (MVC) should then be adjusted to give a reading of approximately 70 microamperes on the response peak. Switching the crystal filter "OUT" should not produce a reading of more than 110 microamperes. This test indicates the correct functioning of this filter.

To adjust the bandwidth of the crystal filter, a signal generator or microvolter having an expanded tuning scale in the vicinity of 915 K.C. and having also an attenuator with a multiplier of 10 times (20 db.) is required. The following procedure is recommended: With the signal input on the crystal filter response peak (Crystal "IN") and an output reading of 100 microamperes, the attenuator is set to multiply the input voltage by 10 times and the signal generator detuned either side of resonance, noting the frequency of the points where a reading of 100 microamperes is again obtained. From the difference of these frequency readings, the crystal filter bandwidth can be determined. The bandwidth can be increased (broadened) by increasing the capacity setting of C10-1, noting that maximum capacity is obtained when the two red markings coincide. For each setting of C10-1, the bandwidth at 10 times input should be checked as described above.

To decrease the bandwidth with C10-1 set at minimum capacity and the input frequency adjusted to the crystal filter response peak, the tuning core of the grid circuit of the first i-f. transformer (L50-1) is rotated slightly (either direction) until a maximum reading of the microammeter is obtained. The crystal band width for this setting should be checked as above and further adjustment of the tuning core (L50-1) or C10-1 made as required to secure the desired band width. C10-2 should be set to maximum capacity for all adjustments.

### (11) Check of Heterodyne Oscillator

Having checked the functioning of the i-f. amplifier, if signals are not heard on any band, the first oscillator should be checked for oscillation. This can be done by observing the plate voltage at the resistor terminal board when grounding the tube grid terminal. If no drop in voltage is noted with this test, the oscillator circuit should be checked for grounds, shorts or defective components.

### (12) Test of the R-F. Amplifier

Having completed the test and alignment of the i-f. amplifier, the r-f. amplifier is tested as follows:

Remove the heterodyne oscillator tube from its socket. Disconnect the first detector cathode return at resistor R3-4 and insert a 200 microampere meter in series with 50,000 ohm resistor. A type 6C6 tube is used in the detector socket for checking the alignment. With no signal input the 6C6 detector cathode current should be approximately 100 microamperes. With the band switch set on the band lacking sensitivity, a signal from the test oscillator is capacitively coupled through a 100 m.m.f. dummy antenna to the antenna post and to ground. This input signal frequency should be set quite accurately to the alignment frequency shown in the "Table of Alignment Data" for the band under test. With the tuning control set for this alignment frequency, an increase in detector cathode current should be noted. Capacitively coupling the test oscillator to the grid of the first r-f. and second r-f. tubes should show a progressive decrease in detector cathode current indicating the proper functioning of the particular r-f. stage or circuits preceding.

Table of Alignment Data

Band No.	Freq. Range MC	Alignment Frequency MC	Trimmers*			
			1 RF	2 RF	1 Det.	Osc.
1	1.5 - 3.0	2.9	C2**	C3-7	C3-11	C36
2	3.0 - 5.0	4.9	C3-1	C3-4	C3-8	C37
3	5.0 - 7.5	7.4	C4-1	C4-3	C4-5	C4-7
4	7.5 - 10.5	10.4	C4-2	C4-4	C4-6	C4-8
5	10.5 - 14	13.9	C3-2	C3-5	C3-9	C8-1
6	14 - 18	17.9	C3-3	C3-6	C3-10	C8-2

\* Refer to Schematic Diagram and marked photographs for location.

\*\* Antenna alignment control.

### (13) Alignment of R-F. Amplifier

If no increase in the first detector cathode current is noted when the receiver is tuned to resonance and with the signal input at the antenna post, the test oscillator should be capacitively coupled to the grid of the detector (approximately 2 volts required) and then progressively to the second and first r-f. grid caps. The stage which does not indicate a decided increase in detector cathode current should be checked for circuit, ground, shorts or defective components. In the r-f. alignment for any particular band (*Note: For a general alignment start with the 1.5 - 3.0 M.C. #1 Band*) the tuning control is adjusted for the alignment frequency (Table of Alignment Data) and the Test Signal at this alignment frequency is coupled from the test oscillator to the antenna post through the 100 m.m.f. dummy antenna. The three r-f. trimmers (1r-f.; 2r-f.; and 1 Det.) for this band, identified by means of the above table and the marked photographs, are then adjusted for maximum increase of detector cathode current. A similar procedure is followed in the alignment of each band.

### (14) Test of the Heterodyne Oscillator

Using the 6C6 detector tube and with the micro-ammeter in the cathode circuit, as employed for the test of the r-f. amplifier described above, and with the Band Switch on Band #1 (or defective band) the oscillator tube is replaced in its socket. When the tube heater has warmed sufficiently to permit oscillation, a rise of 20 to 60 micro-amperes in the detector cathode current should be noted. If there is no change in detector current, the oscillator circuit should be checked for shorts, ground or defective components.

### (15) Alignment of Heterodyne Oscillator

To align the oscillator follow the same general procedure as was followed for the alignment of the r-f. amplifier. The meter and added resistor in the first detector cathode circuit is removed and the circuit returned to normal after replacing the Tube VT-69 in the detector socket. With the Band Switch on Band #1 (1.5 - 3.0 MC) and the Tuning Control set to the alignment frequency, couple the output of the modulated test oscillator (set at the alignment frequency) to the antenna post through the 100 m.m.f. dummy antenna. The oscillator trimmer for this band is adjusted for maximum output, referring to the above table and the marked photographs, for the trimmer designation and location. In aligning the oscillator, the sections of the outer heat compartment shields are removed temporarily to permit access to the trimmer condensers. A similar procedure is followed in the alignment of each band.

*Note:*

*In a general alignment, start with the 1.5-3.0 MC Band.*

d. Weak or No Signals on Any One Band - Modulated Reception

The condition of satisfactory reception on several bands and weak or no signals on one or more bands, indicates the correct functioning of the i-f. and a-f. amplifier and requires checking only the r-f. amplifier and heterodyne oscillator for the defective band or bands. The procedure outlined in paragraphs 6-4c (12) to 6-4c (15) should be followed for the defective band or bands.

e. Weak or No Signals - C-W. Reception - Modulated Reception  
Normal - All Bands

Weak or no signals on all bands for c-w. reception with satisfactory modulated signal reception requires testing and alignment of the c-w. oscillator. Proceed as outlined in paragraphs 6-4c (8) and 6-4c (9).

f. Measurements with Test Set I-56-A

GENERAL - The following readings are typical values obtained on the Model 665-2 Selective Analyzer (Test Set I-56-A).

If all plugs seem to be securely in position with the dynamotor running and faulty or poor operation is obtained on the receiver, a careful check should first be made of the cables and plugs using the Model 564 Volt-ohmmeter as outlined under "Detailed Tests on Radio Sets - General", page 11 Instruction Book for Test Set I-56-A. If all plug-in cable connections seem to be functioning properly, a test should be made of the tubes in the receiver using the Model 685 tube tester as outlined in the same paragraphs as mentioned above. Should neither of these tests locate the difficulty, voltage and current or resistance measurements should be made as outlined in the following paragraphs.

(1) Voltage and Current Measurements

Set up the receiver and a Model 665 Analyzer for operation as outlined under general voltage and current measurements. To obtain the various readings, connect the jumper leads from the socket selector block to the analyzer pin jacks in accord with the instructions given below.

Procedure

1. Release the thumb screws and pull the complete chassis out of the case.
2. Power connections should be made to the plug socket at the rear of the receiver chassis.
3. Be sure the plug and tube top grid connections are secure when taking readings.
4. Keep the analyzer "AC-DC" switch on "DC".
5. Place the analyzer left-hand toggle switch in the "VOLTS-MA" position.
6. Connect the short jumper cables for the various tests as indicated below.
7. Connect jumper cable from black terminal "GND" to receiver chassis.

## Procedure (continued)

8. Set the receiver control switch to the "MVC" position unless otherwise specified.
9. Set the receiver with the volume control at the maximum position (extreme clockwise).
10. Set the tuning control to 1.5 MC. (LF end of Band 1); readings should deviate but slightly when switching to other bands with the tuning control remaining at the low frequency end of each band.
11. The c-w. oscillator should be "OFF" for the readings in Table A and "ON" for the readings in Table B.

<u>Test</u>	<u>Type VT</u>	<u>Function</u>	<u>Block Terminal Number</u>	<u>to</u>	<u>Analyzer Jacks</u>
Plate Voltage	All types		{ 2 gnd		250 volts +- volts
Screen Voltage	All types		{ 3 gnd		250 volts +- volts
Cathode Voltage	69 } 48 }		{ 5 gnd		10 volts +- volts
	76		{ 4 gnd		10 volts +- volts
	68 } 70 }		{ 6 gnd	10 & 25	volts +- volts
	Heater Voltage	69	{ 6 1		10 volts +- volts
	69	(1 RF)			
	48	(2 RF)	{ 1 6		10 volts +- volts
	76	(1 Det.)			
	76	1 IF	{ 5 1		10 volts +- volts
	70	Output			
	68	Osc.	{ 1 7		10 volts +- volts
	70	2 IF			
	68	3 IF			
Plate Voltage - Triode	70	C-W. Osc.	{ 4 gnd		250 volts +- volts
Diode Voltage	68	2 Det.	{ 5 gnd		100 volts +- volts

## 6-4 f. (1) (Continued)

<u>Test</u>	<u>Type VT</u>	<u>Function</u>	<u>Block Terminal Number</u>	<u>to</u>	<u>Analyzer Jacks</u>
Plate Current	All types		{ 2 Outside 2 Inside		10 m.a. - m.a.
Screen Current	All types		{ 3 Outside 3 Inside		5 m.a. - m.a.

*Note: The readings given below are average values taken on receivers of this type using a 14 volt power supply. Meter indications within  $\pm 10\%$  of these values will in most cases indicate correct operation.*

Table A. C-W. Osc. "OFF"

<u>Stage</u>	<u>VT</u>	<u>Plate V.</u>	<u>Screen V.</u>	<u>Cathode V.</u>	<u>Heater Volts</u>	<u>M.A. Plate Current</u>	<u>M.A. Screen Current</u>
1 RF.	69	181	72	* 2.5	6.7	4.5	1.1
2 RF.	69	180	77	* 2.8	6.7	4.7	1.3
1 Det.	69	193	83	* 6.2	6.7	2.4	0.6
Osc.	76	** 49	—	00	6.7	** 3.8	—
1 IF.	69	182	77	* 3.0	6.7	4.9	1.3
2 IF.	70	205	77	2.1	6.6	4.1	0.7
3 IF.	68	203	84	18	6.6	2.8	0.7
Output	48	195	203	0	6.6	11.6	2.0
2 Det.	68 Diode	4.5					

Table B. C-W. Osc. "ON"

<u>Stage</u>	<u>VT</u>	<u>Plate V.</u>	<u>Screen V.</u>	<u>Cathode V.</u>	<u>Heater Volts</u>	<u>M.A. Plate Current</u>	<u>M.A. Screen Current</u>
1 RF.	69	195	37	* 1.2	6.7	2.2	0.52
2 RF.	69	190	57	* 2.0	6.7	3.5	0.87
1 Det.	69	198	62	* 4.6	6.7	1.8	0.45
Osc.	76	** 50	—	0	6.7	** 3.8	—
1 IF.	69	195	42	* 1.5	6.7	2.5	0.58
2 IF.	70	207	42	1.0	6.6	1.8	0.25
3 IF.	68	207	86	19	6.6	2.85	0.7
Output	48	198	207	0	6.6	14.4	2.4
CW Osc.	70 Triode	13					

\*\* Not oscillating.

\* Suppressor connected to cathode.

## (2) Resistance and Continuity Measurements

Remove the chassis from the cabinet and do not make any connections to the plug socket at the rear of the chassis. This procedure permits the operation of all switches without running the dynamotor and causing voltages to be built up across the various resistors and condensers. Any voltages set up by the dynamotor in the receiver would cause serious errors in reading on the ohmmeter ranges or might possibly damage the test instruments.

### Procedure

1. Set the receiver control switch to "MVC" unless otherwise specified.
2. Set the receiver with the volume control at the maximum position (extreme clockwise).
3. Set the tuning control to 1.5 M.C. (L.F. end of Band 1); readings should not deviate when switching to other bands with the tuning control remaining at the low-frequency end of each band.
4. The c-w. oscillator should be "OFF" for the readings in Table C and "ON" for the readings in Table D.
5. Shift the analyzer left-hand toggle switch to the ohms position.

Set up the Model 665 Analyzer for resistance and continuity measurements as outlined under "General Resistance and Continuity Tests" in the Test Set instruction book. Before taking a resistance reading on any range, short the two jumper leads plugged into the ohmmeter pin jacks and rotate the "battery adjustment" knob until the instrument pointer reads exactly full scale. Should it be found impossible to bring the pointer up to the top mark, refer to the paragraphs on battery replacement under the heading "Maintenance" in the Test Set instruction book.

Plug the pin tip end of the 3 foot clip lead into the Block hole marked "GND" and clip the other end to the chassis. Connect one of the jumper leads between the remaining ground jack and one of the ohmmeter jacks on the required range. Connect the other jumper lead from the remaining ohmmeter range jack to the tube element under test. In general, ohmmeter readings will be most accurate when taken on the upper 2/3 of the scale, and wherever possible, the range should be chosen that will give indications in this area.

*Note: The readings tabulated below are average values taken on receivers of this type with the storage battery disconnected. Meter indications within  $\pm 10\%$  of these values will in most cases indicate correct operation.*

## Resistance to Ground (ohms)

Table C. C-W. Osc. "OFF"

Stage	VT	Cathode	Plate	Screen	"MVC" Grid	"AVC" Grid
1 RF.	-	* 480	5000	75000	500,000	4 meg.
2 RF.	-	* 480	5000	76000	500,000	4 meg.
1 Det.	-	*2200	5000	75000	0	0
Osc.	-	0	21000	-	330,000	
1 IF.	-	* 480	5000	70000	600,000	4 meg.
2 IF.	-	480	600	70000	500,000	4 meg.
3 IF.	-	5700	600	16000	4,700	4,700 ohms
Output	-	0	1200	600	700,000	

Table D. C-W. Osc. "ON"

1 RF.	-	* 480	5000	13000	500,000	4 meg.
2 RF.	-	* 480	5000	22500	500,000	4 meg.
1 Det.	-	*2200	5000	22000	0	0
Osc.	-	0	21000	-	330,000	
1 IF.	-	* 480	5000	8700	600,000	4 meg.
2 IF.	-	480	600	8700	500,000	4 meg.
3 IF.	-	5700	600	16000	4,700	4,700 ohms
Output	-	0	1200	600	700,000	
C-W. Osc.	-		85000		500,000	
Det. Diode	-		330,000			
AVC Diode	-			1.2 meg.		

Heaters of all tubes - not grounded

\* Suppressor connected to cathode

## g. Failure of Tube Heater

The circuit arrangement and the physical relation of the dial lights and the vacuum tubes may be used to indicate and help to locate a tube heater failure as indicated in functional diagram, Figure 21. In case



6-4 g. (2) (Continued)

of the failure of any one of the tube heaters of the four tubes located on the left side of the receiver, the dial lamp on the left side DL-1 becomes markedly dimmer than the other dial lamp DL-2. The opposite effect takes place for a tube heater burn-out in the group of four tubes on the right hand side of the receiver. The dial lamps thus give a selective indication in case of tube heater failure.

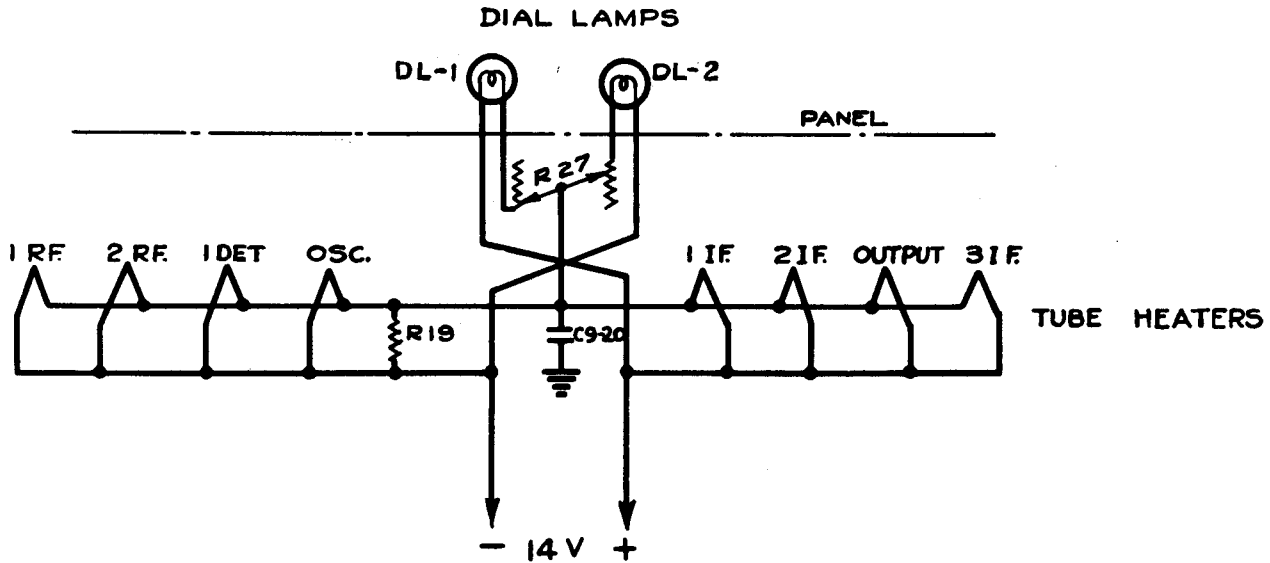


Fig. 21 - Tube Heater and Dial Lamp Arrangement

#### h. Failure of Dial Light

As the dial lamps are connected independently, a failure of one lamp indicates a burned out lamp or poor connection in the socket. Removal of the dial light housing gives ready access to the lamps.

VII - Appendix

REFERENCE LIST - UNITS AND PARTS OF UNITS - RADIO RECEIVER BC-224-A

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
CAPACITORS					
C1-1 -2 -3 -4	Tuning Capacitor	One Capacitor four-gang, spec. max. 230 mmf., min. less than 15 mmf. each section	RCA		M-407426-1
C2	Ant. Trimmer	Capac. 50 mmf. with insulated shaft & mtg. bracket	RCA		K-829964-501
C3-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11	1st RF Bnd. 2 Trimmer " " " 5 " " " " 6 " 2nd RF " 2 " " " " 5 " " " " 6 " " " " 1 " 1st Det. " 2 " " " " 5 " " " " 6 " " " " 1 "	Eleven Capacitors 50 mmf. each	RCA		M-413394-22
C4-1 -2 -3 -4 -5 -6 -7 -8	1st RF Bnd. 3 Trimmer " " " 4 " 2nd RF " 3 " " " " 4 " 1st Det. " 3 " " " " 4 " Osc. " 3 T " " " " 4 "	Eight Capacitors 25 mmf. each	RCA		M-413394-20
C5-1 -2 -3 -4 -5 -6 -7 -8	Filter Capacitor " " " " " " " " " " " "	Four Capacitors Oil Filled, each is two section 0.5 mf. per section $\pm 20\%$	RCA		K-829921-1
C6-1 -2	Filter Capacitor " "	Two Capacitors Oil Filled, 1 mf. $\pm 20\%$ each	RCA		M-68535-502

\* See footnote on page 57.

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
C8-1 -2	Osc. Bnd. 5 Trimmer } " " 6 " }	Two Capacitors 50 mmf. each	RCA		M-413394-21
C9-1 -2 -3 -4 -5 -6 -7 -8 -9 -10 -11 -12 -13 -14 -15 -16 -17 -18 -19 -20 -21 -22 -23	1st RF, G By-Pass } " Det, S.G. " " RF, P " 2nd RF, G " " " C " " " P " Osc. P " 1st Det. P " " IF, C " " " P " 2nd IF G " CW Osc. G " " " P " 3rd IF, G " O.T. Sec. " S.G. " Ther Y1-2 " Dyna. Arm " " " " Filament " Time Constant " 3rd IF, S.G. " Ther Y1-1 " }	Twenty-three Fixed Capacitors, mica, 0.01 mf. $\pm 10\%$ each	RCA		K-833452-1
C10-1 -2	Cry. Fil. Trimmer } " " " }	Two Capacitors 10 mmf. each	RCA		M-413394-19
C11	CW Osc. Trimmer	Capacitor 100 mmf.	RCA		K-829518-1
C12	CW Osc. BF Adj.	Capacitor 5 mmf. with shaft	RCA		K-829517-1
C13-1 -2 -3 -4	1st RF Bnd. 3 Pad } 2nd RF " 3 " 1st Det. " 3 " Osc. " 3 " }	Four Fixed Capacitors 70 mmf. $\pm 5\%$ each	RCA		K-35913-11
C14-1 -2 -3 -4	1st RF Bnd. 4 Pad } 2nd " " 4 " 1st Det. " 4 " Osc. " 4 " }	Four Fixed Capacitors 112 mmf. $\pm 5\%$ each	RCA		K-35913-13
C15-1 -2 -3	1st RF Bnd. 5 Ser. } 2nd RF " 5 " 1st Det. " 5 " }	Three Fixed Capacitors 155 mmf. $\pm 1.8\%$ each	RCA		K-35913-18

\* See footnote on page 57.

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
C16-1 -2 -3	1st RF Bnd. 6 Ser. 2nd RF " 6 " 1st Det." 6 " }	Three Fixed Capacitors 130 mmf. $\pm 2\%$ each	RCA		K-35913-14
C17	2nd RF Bnd. 1 Pad	Fixed Capacitor 155 mmf. $\pm 5\%$	RCA		K-35913-19
C18-1 -2	Osc. Grid 2nd Det. Diode }	Two Fixed Capacitors 250 mmf. $\pm 10\%$ each	RCA		K-833452-4
C19	Osc. Bnd. 1 Pad	Fixed Capacitor 8 mmf. $\pm 10\%$	RCA		K-35913-9
C20	" " 6 Ser.	Fixed Capacitor 137 mmf. $\pm 1.2\%$	RCA		K-35913-16
C21	" " 5 Ser.	Fixed Capacitor 172 mmf. $\pm 1.2\%$	RCA		K-35913-20
C22	" " 4 Ser.	Fixed Capacitor 2080 mmf. $\pm 5\%$	RCA		K-35913-25
C23	" " 3 Ser.	Fixed Capacitor 2200 mmf. $\pm 5\%$	RCA		K-35913-26
C24	" " 2 Ser.	Fixed Capacitor 1255 mmf. $\pm 3\%$	RCA		K-35913-24
C25	" " 1 Ser.	Fixed Capacitor 530 mmf. $\pm 1.5\%$	RCA		K-35913-23
C26-1 -2 -3	1st IF Tr. Pri. 2nd " " " 3rd " " " }	Three Fixed Capacitors 250 mmf. $\pm 5\%$ each	RCA		K-35913-21
C27-1 -2 -3	1st IF Tr. Sec. 2nd " " " 3rd " " " }	Three Fixed Capacitors 260 mmf. $\pm 5\%$ each	RCA		K-35913-22
C28	Cry. Filter	Fixed Capacitor 5 mmf. $\pm 10\%$	RCA		K-35913-8
C29	4th IF Tr. Sec.	Fixed Capacitor 150 mmf. $\pm 5\%$	RCA		K-35913-17
C30	4th IF Tr. Pri.	Fixed Capacitor 38 mmf. $\pm 5\%$	RCA		K-35913-10
C31	2nd Det. Diode	Fixed Capacitor 70 mmf. $\pm 10, -5\%$	RCA		K-35913-12
C32-1 -2 -3	1st RF Cath. 2nd RF S.G. 1st RF S.G. }	Three Fixed Capacitors 0.01 mf. $\pm 10\%$ each	Aerovox	1455	K-30090-11
C33	CW Osc. Grid	Fixed Capacitor 130 mmf. $\pm 20\%$	RCA		K-35913-15
C34	Output Grid	Fixed Capacitor 0.004 mf. $\pm 10\%$	RCA		K-833452-3
C35	Output Tr. Pri.	Fixed Capacitor 0.0035 mf. $\pm 15\%$	RCA		K-833452-2
C36	Osc. Bnd. 1 Trimmer	Capacitor 25 mmf. Invar.	RCA		M-413394-23
C37	" " 2 "	Capacitor 50 mmf. Invar.	RCA		M-413394-24
C38-1 -2	Dyn. Pri. Filter " " " }	One Capacitor, Oil Filled, two sections 0.5 mf. per section $\pm 20\%$	RCA		K-833292-501
C39-1 -2	Dyn. Sec. Filter " " " }	Two Capacitors, Oil Filled, 1 mmf. $\pm 20\%$ each	RCA		K-833194-501
C40	CW Osc. Time Constant	Fixed Capacitor 0.05 mf. paper special impreg.	RCA		P-72017-523

\* See footnote on page 57.

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
<b>RESISTORS</b>					
R1-1 -2 -3 -4 -5	Ant. Protect 1st RF Grid 2nd " " 2nd IF " CW Osc. "	Five Resistors 470,000 ohms $\pm 10\%$ $\frac{1}{2}$ Watt, each	IRC		K-78726-94
R2-1 -2 -3 -4	1st RF Cath 2nd RF Cath 2nd IF Cath 1st IF Cath				
R3-1 -2 -3 -4 -5 -6 -7 -8	1st RF, S.G. " " P 2nd RF, P Osc. P 1st Det. P 1st IF, S.G. " " P 3 IF Grid				
R4-1 -2	2nd RF, S.G. 1st Det, S.G.				
R5	CW Osc. P.				
R6	CW Osc. P.	10,000 ohms, carbon $\pm 20\%$ $\frac{1}{10}$ Watt	RCA		K-78720-19
R7	1st Det. Cath	10,000 ohms, carbon $\pm 10\%$ $\frac{1}{2}$ Watt	RCA		K-78722-74
R8	Osc. Grid	2,200 ohms $\pm 10\%$ $\frac{1}{2}$ Watt	IRC		K-78726-66
R9-1 -2	1st IF Grid Output Grid	330,000 ohms, carbon $\pm 10\%$ $\frac{1}{2}$ Watt	RCA		K-78721-92
R10	CW Osc. P.	Two Resistors 100,000 ohms $\pm 10\%$ $\frac{1}{2}$ Watt, each	IRC		K-78726-86
R11	3rd IF, S.G.	68,000 ohms $\pm 10\%$ $\frac{1}{2}$ Watt	IRC		K-78726-84
R12	2nd Det Diode	1,000 ohms $\pm 10\%$ $\frac{1}{2}$ Watt	IRC		K-78726-62
R13	2nd Det Diode	2.2 megohms $\pm 10\%$ $\frac{1}{2}$ Watt	IRC		K-78726-102
R14	Output Grid	1.5 " $\pm 10\%$ $\frac{1}{2}$ Watt	IRC		K-78726-100
R15	Output P	560,000 ohms $\pm 10\%$ $\frac{1}{2}$ Watt	IRC		K-78726-95
R16-1 -2	Bleeder 3rd IF, S.G.	56,000 ohms $\pm 10\%$ $\frac{1}{2}$ Watt	IRC		K-78726-83
R17	Bleeder	Two Resistors 47,000 ohms, carbon $\pm 10\%$ $\frac{1}{2}$ Watt, each	RCA		K-78722-82
		18,000 ohms, carbon $\pm 10\%$ 1 Watt	RCA		K-78723-77

\* See footnote on page 57.

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
R18	Bleeder	22,000 ohms, carbon $\pm 10\%$ 1 Watt	RCA		K-78723-78
R19	Filament Bal.	68 ohms, carbon $\pm 10\%$ 1 Watt	RCA		K-78723-48
R20-1 -2	Heating Pad " " }	Two Resistors 2.7 ohms $\pm 20\%$ 50 Watt each	RCA		K-829977-501
R22	Heating Pad	1.2 ohms $\pm 20\%$ 20 Watt	RCA		K-833092-501
R23	" "	1.4 " $\pm 20\%$ 25 Watt	RCA		K-829971-501
R24	" "	1.5 " " " "	RCA		K-829975-501
R25	" "	1.9 " " " "	RCA		K-829969-501
R26	Noise Compensator	1000 ohms Potentiometer 10 ma.	RCA		K-826434-1
R27	Dial Light Control	60 ohms per sec. 2 sec. Rheostat	RCA		K-833271-1
R28 R29	Volume Control " " }	330,000 ohms AVC Level 23,000 " Vol. Control }	RCA		K-826433-1
INDUCTANCES					
L1	1st RF Bnd.   Grid		RCA		See Ref.No 20
L2	" " " 2 "		RCA		" " " 21
L3	" " " 3 "		RCA		" " " 22
L4	" " " 4 "		RCA		" " " 23
L5	" " " 5 "		RCA		" " " 24
L6	" " " 6 "		RCA		" " " 25
L7	" " "   Plate		RCA		" " " 26
L8	" " " 2 "		RCA		" " " 27
L9	" " " 3 "		RCA		" " " 28
L10	" " " 4 "		RCA		" " " 29
L11	" " " 5 "		RCA		" " " 30
L12	" " " 6 "		RCA		" " " 31
L13	2nd " "   Grid		RCA		" " " 26
L14	" " " 2 "		RCA		" " " 27
L15	" " " 3 "		RCA		" " " 28
L16	" " " 4 "		RCA		" " " 29
L17	" " " 5 "		RCA		" " " 30
L18	" " " 6 "		RCA		" " " 31
L19	" " "   Plate		RCA		" " " 32
L20	" " " 2 "		RCA		" " " 33
L21	" " " 3 "		RCA		" " " 34
L22	" " " 4 "		RCA		" " " 35
L23	" " " 5 "		RCA		" " " 36
L24	" " " 6 "		RCA		" " " 37
L25	1st Det."   Grid		RCA		" " " 32
L26	" " " 2 "		RCA		" " " 33
L27	" " " 3 "		RCA		" " " 34
L28	" " " 4 "		RCA		" " " 35

\* See footnote on page 57.

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
L29	1st Det. Bnd. 5 Grid		RCA		See Ref.No.36
L30	" " " 6 "		RCA		" " " 37
L31	" " " 1 Cath.		RCA		" " " 38
L32	" " " 2 "		RCA		" " " 38
L33	" " " 3 "		RCA		" " " 39
L34	" " " 4 "		RCA		" " " 39
L35	" " " 5 "		RCA		" " " 40
L36	" " " 6 "		RCA		" " " 40
L37	Osc. Bnd. 1 Plate		RCA		" " " 38
L38	" " 2 "		RCA		" " " 38
L39	" " 3 "		RCA		" " " 39
L40	" " 4 "		RCA		" " " 39
L41	" " 5 "		RCA		" " " 40
L42	" " 6 "		RCA		" " " 40
L43	" " 1 Grid		RCA		" " " 38
L44	" " 2 "		RCA		" " " 38
L45	" " 3 "		RCA		" " " 39
L46	" " 4 "		RCA		" " " 39
L47	" " 5 "		RCA		" " " 40
L48	" " 6 "		RCA		" " " 40
L49-1	1st IF Tr. Pri.		RCA	}	K-829416-501
-2	2nd " " "				
-3	3rd " " "				
L50-1	1st " " Sec.		RCA	}	K-829416-502
-2	2nd " " "				
-3	3rd " " "				
L51	4th " " Pri.		RCA	}	K-829416-502
L52	" " " Sec.		RCA		
L53	CW Osc. Grid		RCA		K-829519-501
L54	" " Plate		RCA		K-829489-501
L55	RF Filter Choke	500 turns #30 SSE	RCA		K-833027-501
L56	" " "	500 turns #30 SSE	RCA		M-66347-501
L57	" " "		RCA		M-413422-501
L58	Filter Reactor	10H -50 ma. - 400 ohms	RCA		K-77658-512
<b>SWITCHES</b>					
S1-1	1st RF Grid Ind.	One 12 pole, 6 position Band Switch, rotary	RCA		P-701742-1
-2	" " Tuning Cap.				
-3	" " Plate Ind.				
-4	2nd RF Grid Ind.				
-5	" " Tuning Cap.				
-6	" " Plate Ind.				
-7	1st Det. Grid Ind.				
-8	" " Tuning Cap.				
-9	" " Cath Ind.				
-10	Osc. Grid Ind.				
-11	" " Plate Ind.				
-12	" " Tuning Cap.				

\* See footnote on page 57.

Reference	Name or Function	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
S2	Cry. Filter	Rotary Toggle 2-line, 2-circuit	RCA		K-833005-1
S3-1	CW Osc.	Two Switches Toggle DPST	GECo	MI-2387-12	K-30066-12
-2	Heater				
S4-1	AVC Level Cont.	One 7 pole, 3 position switch "AVC - OFF - MVC" rotary	RCA		K-833420-1
-2	MVC Vol. Cont.				
-3	AVC Cut-out				
-4	Main Power				
-5	" "				
-6	Heater Power				
-7	" "				
	MISCELLANEOUS				
D	Dynamotor	14 V - 220 V - 50 ma	GECo		SeeRef.No.11
DL-1	Lamp LM-27 (Dial)	6.3 Volt	GECo	Mazda #44	K-61114-15
-2	" " "				
F1-1	Main Fuse +	Four Fuses 10 Amp. 25 V. Vibration Proof Glass Enclosed Fuse Size 4AG (1-1/4" x 9/32")	Littelfuse	1095	
-2	Heater Fuse +				
-3	Main Fuse -				
-4	Heater Fuse -				
T	Output Transformer		RCA		K-77658-513
X	IF Crystal	Crystal with holder 915 KC	RCA		K-829601-501
Y1-1	Thermostat	Two Thermostats 55°C.--2.5 Amps. 12 Amp. full load, each	RCA		SeeRef.No.42
-2	" "				
J	Phone Jack	Short type	Carter	No.1	K-30019-1

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

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

Aerovox = Aerovox Corporation, 70 Washington St., Brooklyn, N.Y.

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

GECo = General Electric Company, Schenectady, N.Y.

Littelfuse = Littelfuse Laboratories, 4238 Lincoln Ave., Chicago, Ill.

Carter = Carter Radio Company, Div. of

Utah Radio Products Company, 820 Orleans St., Chicago, Ill.

Lord = Lord Manufacturing Company, Erie, Pa.



Reference No.	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
1	4-gang tuning condenser complete with drive bracket and gearing but less dial. Includes C1-1, C1-2, C1-3, C1-4 and R26.	RCA		P-701996-501
2	Crystal filter assembly complete with shield. Includes C10-1, C10-2, C28, R9-1, S2 and X.	RCA		M-413317-501 K-829415-502
3	Beat oscillator assembly complete with shield. Includes C9-13, C11, C12, C33, R5, L53 and L54.	RCA		M-413230-501 K-829415-503
4	1st I.F. transformer assembly complete with shield. Includes L49-1, L50-1, C26-1 and C27-1. (See Note)	RCA		M-413359-501 K-829415-501
5	2nd I.F. transformer assembly complete with shield. Includes L49-2, L50-2, C26-2 and C27-2. (See Note)	RCA		M-413359-503 K-829415-501
6	3rd I.F. transformer assembly complete with shield. Includes L49-3, L50-3, C26-3 and C27-3. (See Note)	RCA		M-413359-504 K-829415-501
7	4th I.F. transformer assembly complete with shield. Includes L51, L52, C29 and C30.	RCA		M-413359-502 K-829415-501
8	Output transformer and capacitor pack. Includes T, C6-1, C6-2 and C40.	RCA	RT-448	M-81079-501
9	Dynamotor unit filter assembly. (Reactor pack for Ref. No. 10) Includes L55, L56 and L58.	RCA	RT-447	M-81078-501
10	Dynamotor Unit BD-94-A (High Voltage Supply) complete in case and with filter assembly and dynamotor machine. Includes C9-18, C9-19, C38-1, C38-2, C39-1, C39-2, L57 and R9-2.	RCA		T-601614-501
11	Dynamotor Machine for Ref. No. 10	GECo	BY-42-A 12/200	M-413327-1

\* See footnote on page 57.

NOTE: Ref. Nos. 4, 5 and 6 differ only in wiring leads.

Reference No.	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
12	Armature for Ref. No. 11.	GECo	5039027-G2	K-850342-1
13	Bearing for Ref. No. 11.	GECo	5075480	K-850342-2
14	L.V. brush for Ref. No. 11.	GECo	5075355	K-850342-3
15	H.V. brush for Ref. No. 11.	GECo	4215385	K-850342-4
16	Cap for L.V. brush for Ref. No. 11.	GECo	5088036-G1	K-850342-5
17	Cap for H.V. brush for Ref. No. 11.	GECo	5047525-G2	K-850342-6
18	Field coil for Ref. No. 11.	GECo	5019440-G5	K-850342-7
19	Rubber Grommets for Ref. No. 10.	GECo	4226607-AA	K-850342-8
20	1st RF transformer for Band 1, complete with mounting washers. Consists of L1.	RCA		K-833047-502 K-833261-1 K-833262-1
21	1st RF transformer for Band 2, complete with mounting washers. Consists of L2.	RCA		K-833048-502 K-833261-1 K-833262-1
22	1st RF transformer for Band 3, complete with mounting washer. Consists of L3.	RCA		K-833049-502 K-833261-1 K-833262-1
23	1st RF transformer for Band 4, complete with mounting washer. Consists of L4.	RCA		K-833050-502 K-833261-1 K-833262-1
24	1st RF transformer for Band 5, complete with mounting washers. Consists of L5.	RCA		K-833051-502 K-833261-1 K-833262-1
25	1st RF transformer for Band 6, complete with mounting washers. Consists of L6.	RCA		K-833052-502 K-833261-1 K-833262-1
26	2nd RF transformer for Band 1, complete with mounting washers. Consists of L7 and L13.	RCA		K-833047-501 K-833261-1 K-833262-1
27	2nd RF transformer for Band 2, complete with mounting washers. Consists of L8 and L14.	RCA		K-833048-501 K-833261-1 K-833262-1

\* See footnote on page 57

Reference No.	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
28	2nd RF transformer for Band 3, complete with mounting washers. Consists of L9 and L15.	RCA		K-833049-501 K-833261-1 K-833262-1
29	2nd RF transformer for Band 4, complete with mounting washers. Consists of L10 and L16.	RCA		K-833050-501 K-833261-1 K-833262-1
30	2nd RF transformer for Band 5, complete with mounting washers. Consists of L11 and L17.	RCA		K-833051-501 K-833261-1 K-833262-1
31	2nd RF transformer for Band 6, complete with mounting washers. Consists of L12 and L18.	RCA		K-833052-501 K-833261-1 K-833262-1
32	1st detector transformer for Band 1, complete with mounting washers. Consists of L19 and L25.	RCA		K-833046-501
33	1st detector transformer for Band 2, complete with mounting washers. Consists of L20 and L26.	RCA		K-833048-503 K-833261-1 K-833262-1
34	1st detector transformer for Band 3, complete with mounting washers. Consists of L21 and L27.	RCA		K-833049-503 K-833261-1 K-833262-1
35	1st detector transformer for Band 4, complete with mounting washers. Consists of L22 and L28.	RCA		K-833050-503 K-833261-1 K-833262-1
36	1st detector transformer for Band 5, complete with mounting washers. Consists of L23 and L29.	RCA		K-833051-503 K-833261-1 K-833262-1
37	1st detector transformer for Band 6, complete with mounting washers. Consists of L24 and L30.	RCA		K-833052-503 K-833261-1 K-833262-1
38	RF oscillator transformer for Bands 1 and 2. Consists of L31, L37, L43, L32, L38 and L44.	RCA		M-413324-501
39	RF oscillator transformer for Bands 3 and 4. Consists of L33, L39, L45, L34, L40 and L46.	RCA		M-413325-501
40	RF oscillator transformer for Bands 5 and 6. Consists of L35, L41, L47, L36, L42 and L48.	RCA		M-413326-501

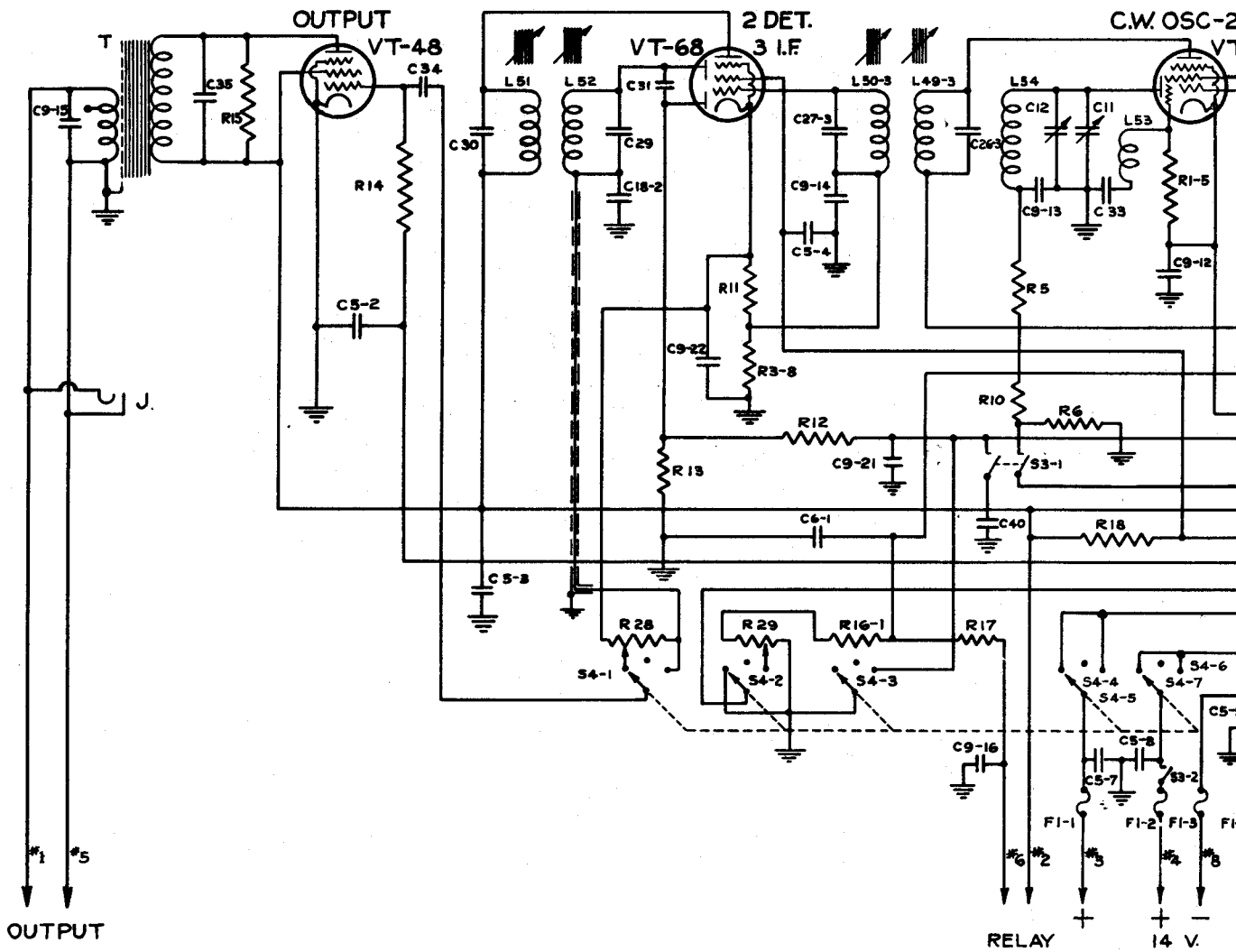
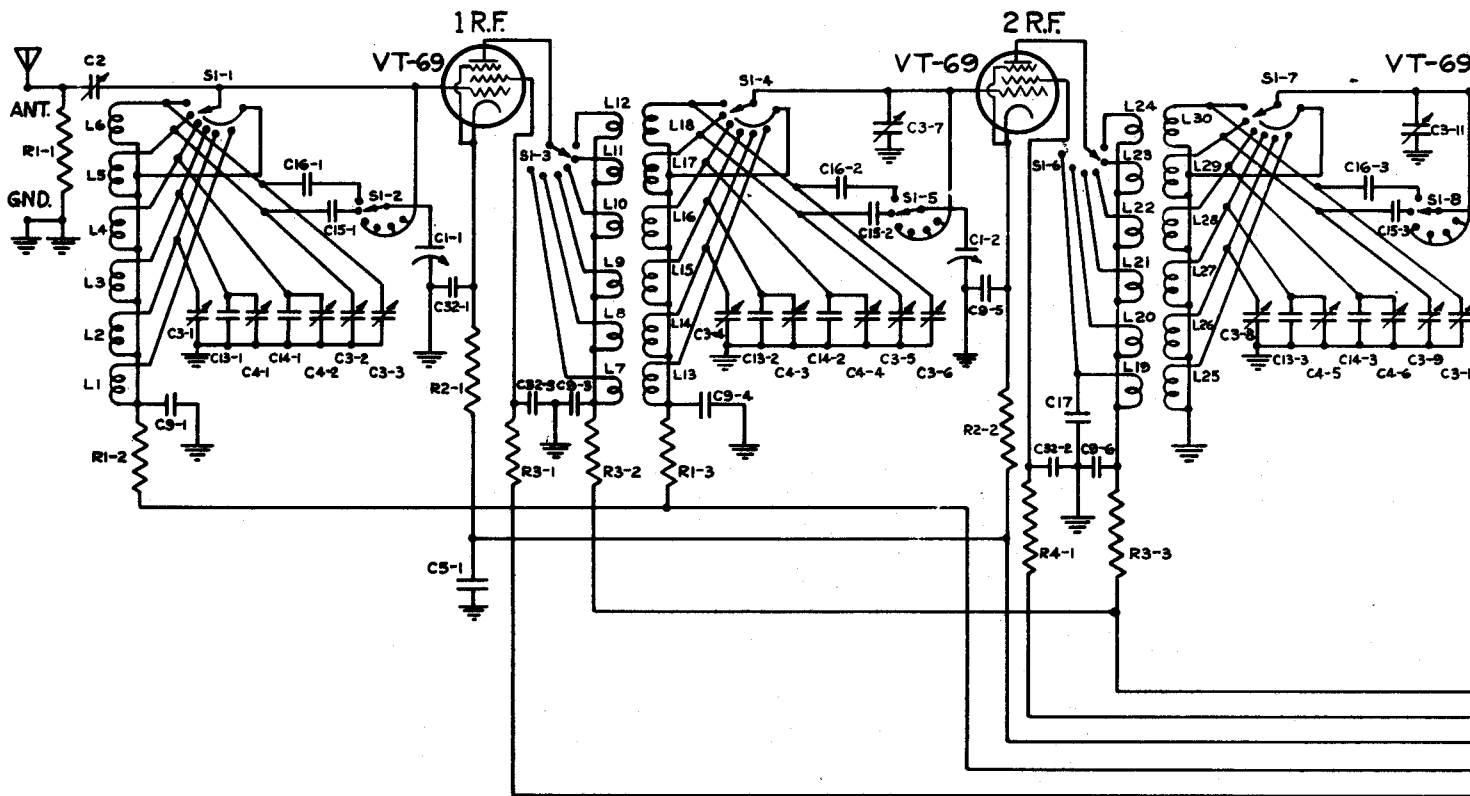
\* See footnote on page 57

Reference No.	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
41	Band change switch assembly, complete with mounting brackets, drive shaft, gear and pulley. Includes S1-1 to S1-12 inclusive, with 4 terminal boards and wiring from switch to terminal boards.	RCA		M-403407-501 K-833272-501 (3) K-833279-501
42	Thermostat, with shielding and lead wires. Consists of Y1-1 and Y1-2.	RCA		K-833612-501
43	Socket, vacuum tube, 5-prong.	RCA		M-413408-501
44	Socket, vacuum tube, 6-prong.	RCA		M-413408-502
45	Socket, vacuum tube, 7-prong.	RCA		M-413408-503
46	Post, binding, antenna.	RCA		K-829928-1
47	Post, binding, ground.	RCA		K-829928-2
48	Belt, phosphor bronze cable. (Band change mask drive)	RCA		K-833416-1
49	Connector plug, dial lamp, 4 prong.	RCA		K-833233-2
50	Connector socket, dial lamp.	RCA		K-833233-1
51	Connector SO-83; plug, power, male section (attaches to receiver chassis and fits Ref. No. 52).	RCA		K-833068-501
52	Plug, power, female (attaches to mounting base). Complete with housing, cover, straight or right angle fitting, also includes 4 special mounting screws to base. When equipped with straight cord fitting it is "Plug PL-P103" and when equipped with the right angle cord fitting it is "Plug PL-Q103".	RCA		K-829765-501 K-829771-1 K-829771-2 K-829037-501 K-829856-501 K-833568-1 K-833569-1 K-833515-1 (6) K-59048-30 (6) K-833571-1 (4)
53	Shield, vacuum tube.	RCA		K-833406-1
54	Board, fuse clip and terminal assembly.	RCA		M-413381-501
55	Grommet, rubber, main tuning condenser and dynamotor mountings.	RCA		K-65415-2

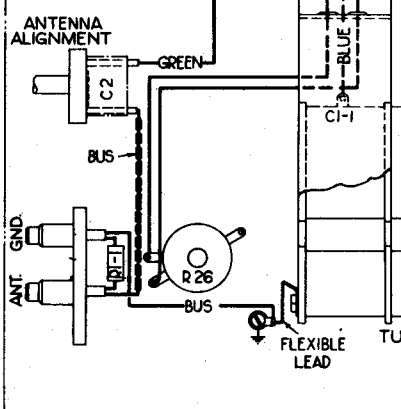
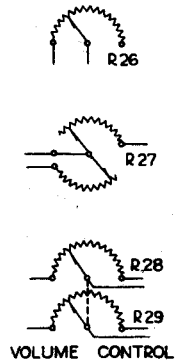
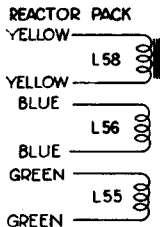
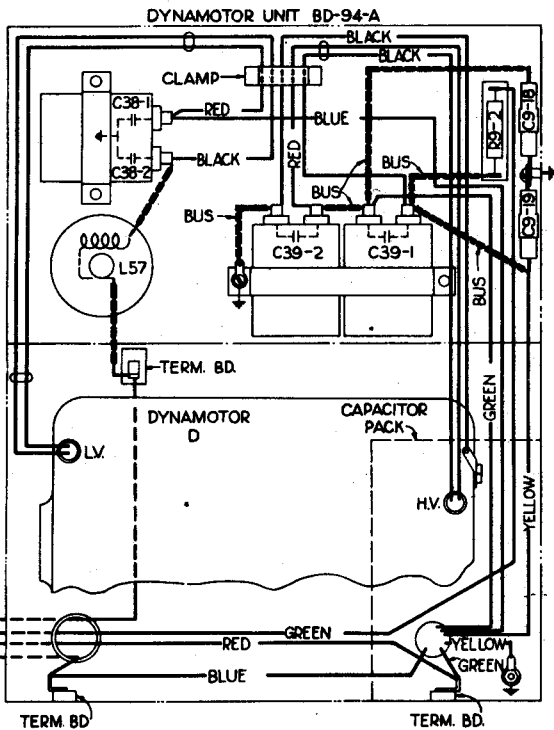
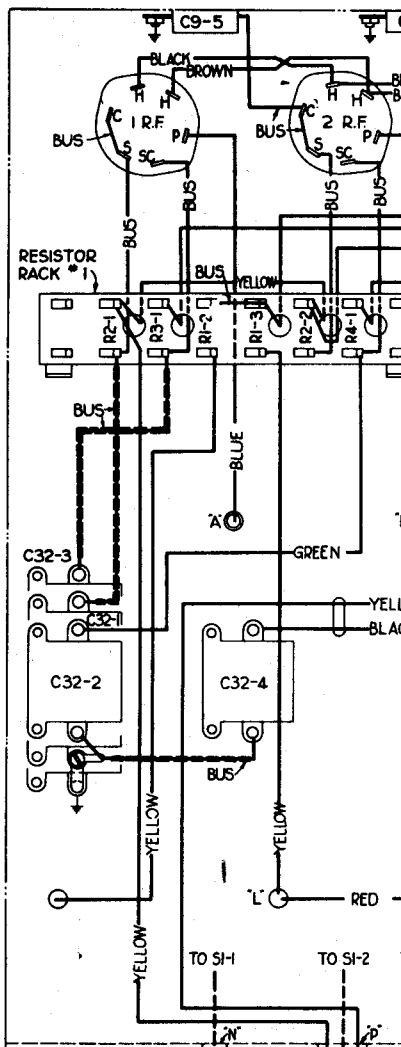
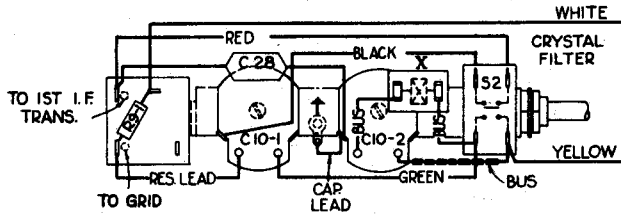
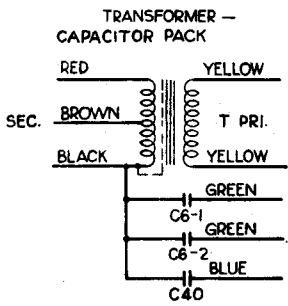
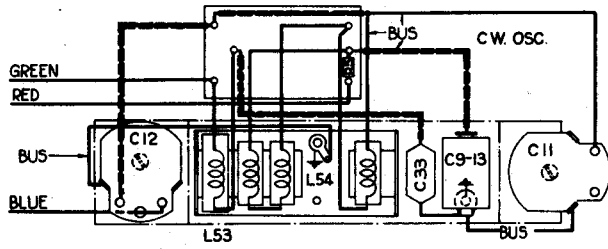
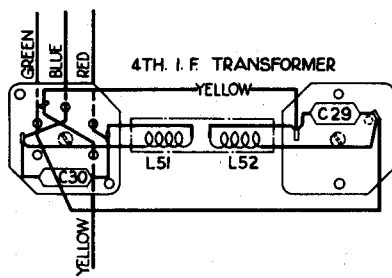
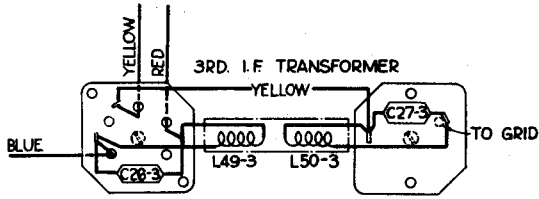
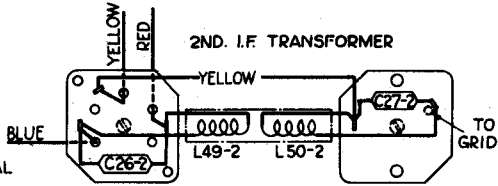
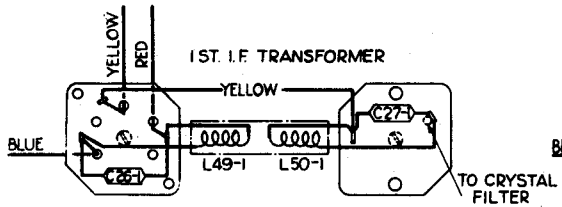
\*See footnote on page 57.

Reference No.	Description	Manufacturer*	Manufacturer's Type	RCA Dwg. No.
56	Calibrated dial and band change mask assembly, completely assembled with mounting bracket, shaft and detent mechanism.	RCA		M-413397-501 M-413403-501 K-833400-501 K-829420-1 K-833295-501 K-833296-501 K-833403-1 K-850244-1 K-833416-1(2)
57	Socket, dial lamp.	RCA		K-833553-1
58	Knob, main tuning.	RCA		K-833518-501
59	Knob, control of volume, beat frequency, etc.	RCA		K-833259-2
60	Knob, band change switch.	RCA		M-413420-2
61	Knob, antenna alignment.	RCA		K-833260-1
62	Lever, AVC-OFF-MVC Switch.	RCA		K-829329-1
63	Drag, friction, for control knobs, with rivets.	RCA		K-833277-1 K-57492-53(2)
64	Mounting FT-154 for receiver, includes upper and lower plates and shock absorbers, but does not include Plug PL-P103 or PL-Q103.	RCA		P-701998-501 and P-701967-501 except less Parts 5, 6, 7, 12, 13, 14, 15, 16, 17, and 18 of the latter drawing
65	Mounting plate assembly, lower, complete with shock absorbers for Ref. No. 64.	RCA		P-701998-501
66	Shock absorbers for Ref. Nos. 64 and 65.	Lord	150PH12	P-412755-29
67	Glass window, for dial lamp housing.	RCA		K-833029-1
68	Fitting, right angle, power plug to flexible conduit.	RCA		K-833568-1
69	Fitting, straight, power plug to flexible conduit.	RCA		K-833569-1

\* See footnote on page 57.









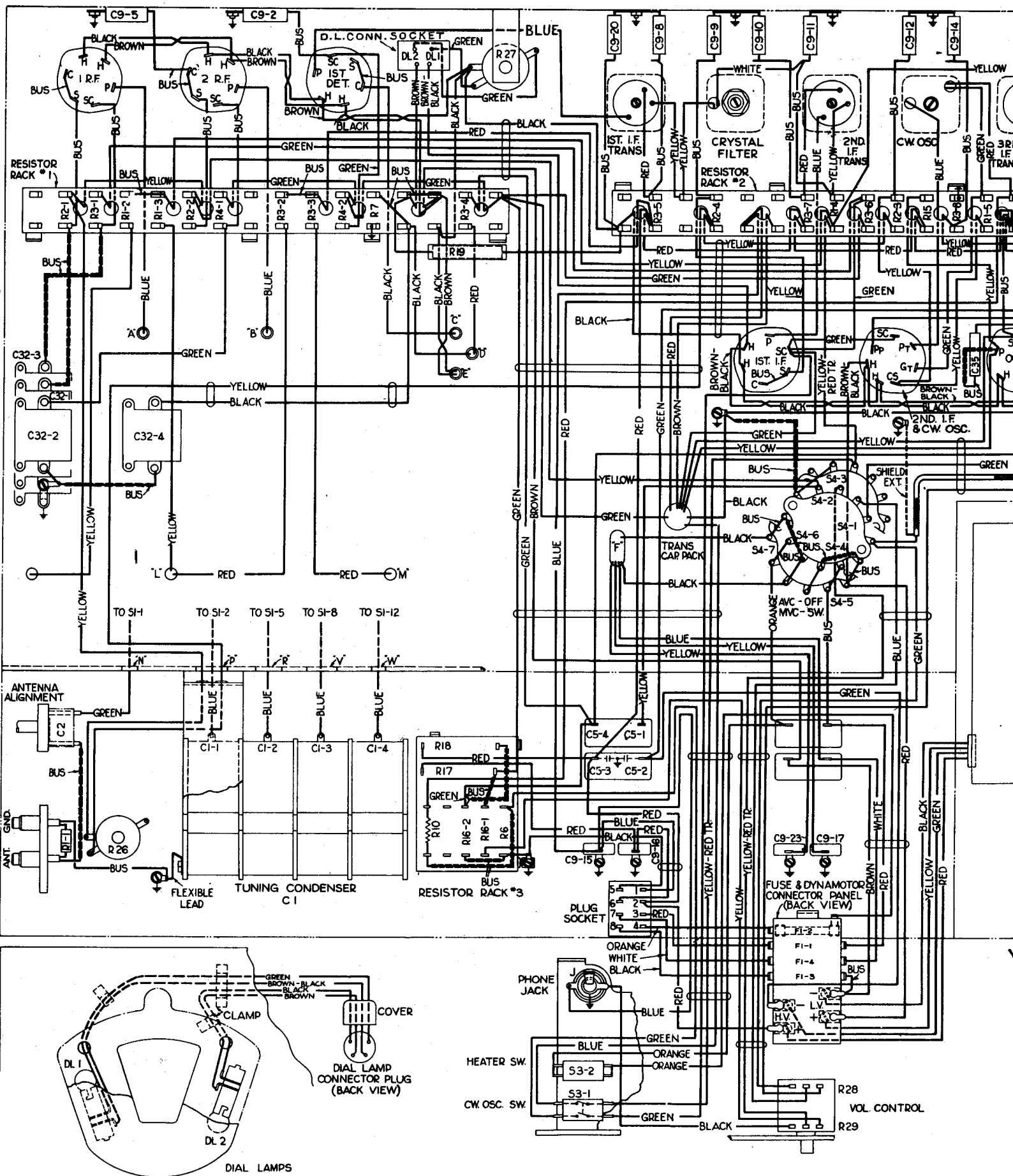


Fig. 23a - Wiring Diagram, I

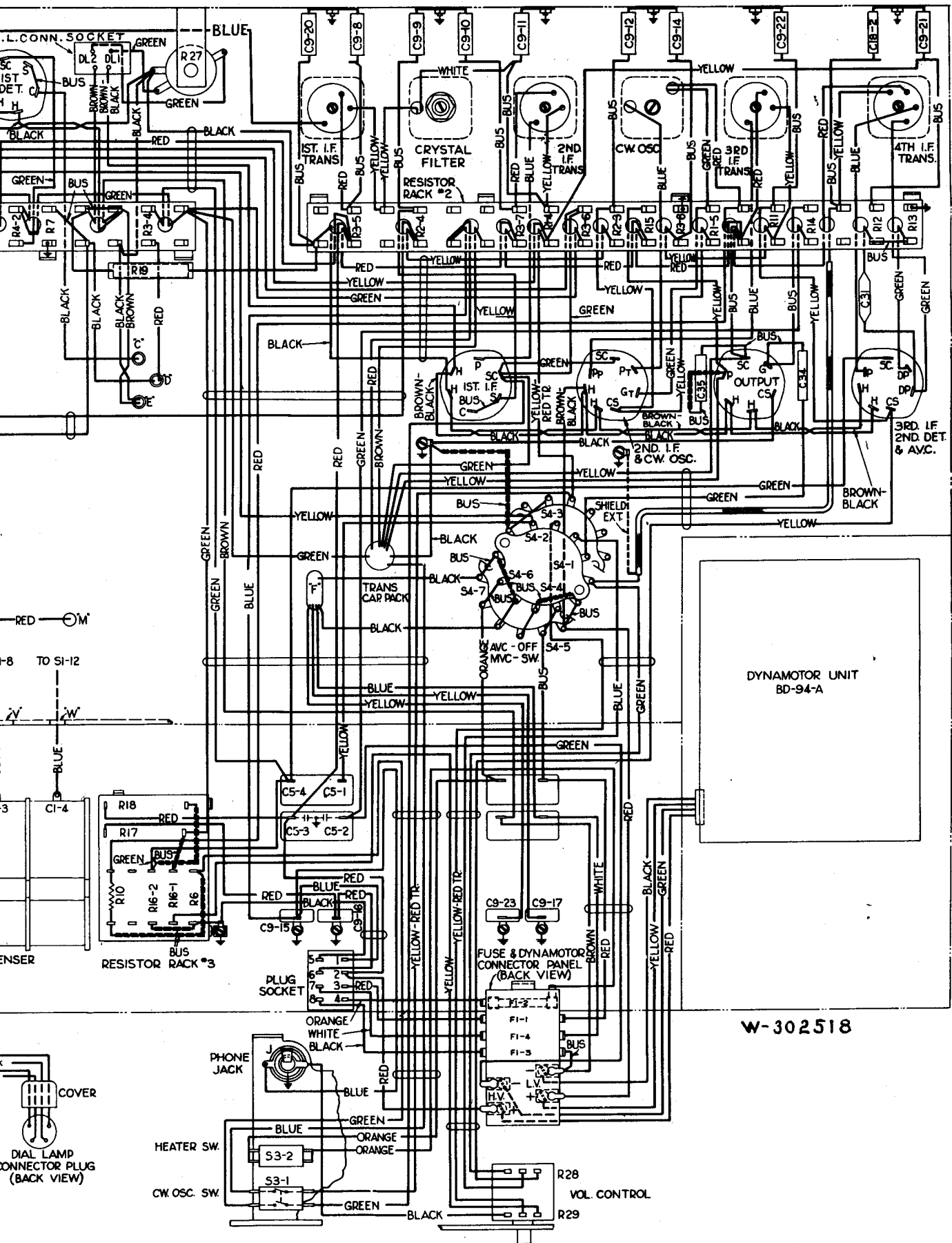
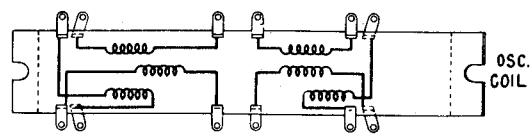
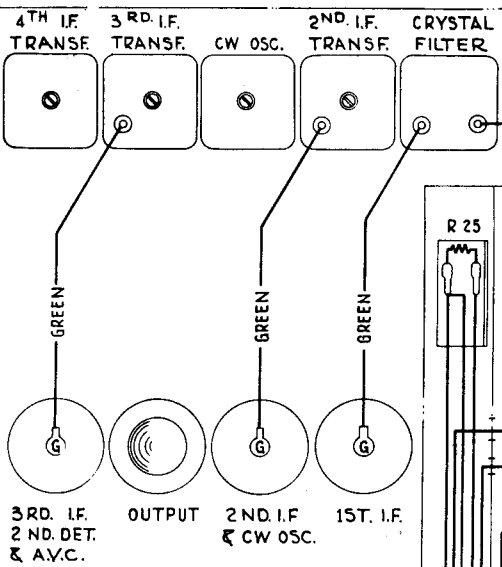
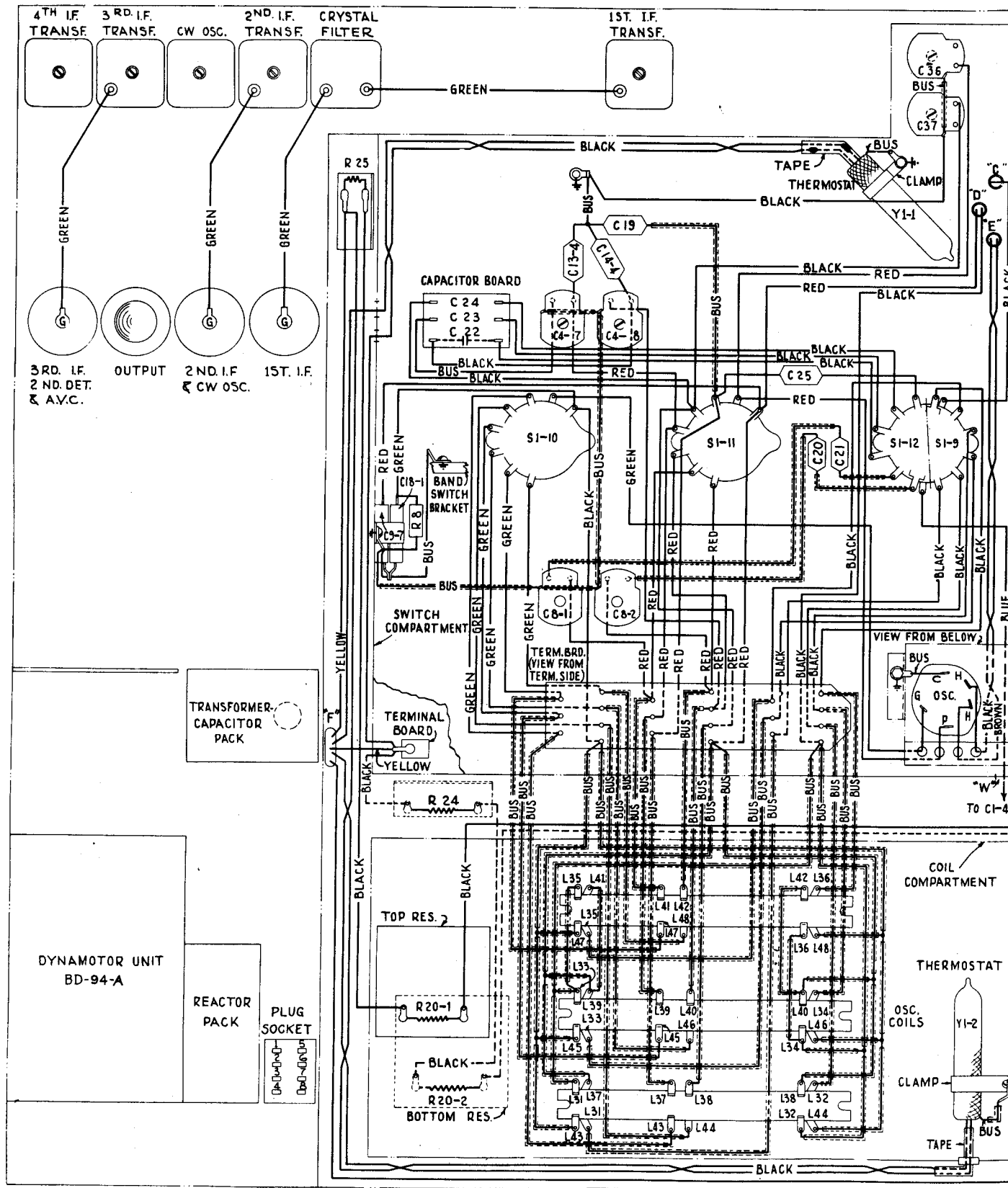


Fig. 23a - Wiring Diagram, Front of Chassis



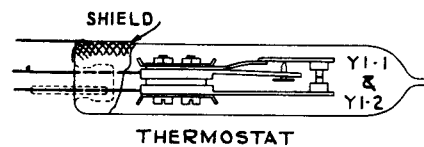
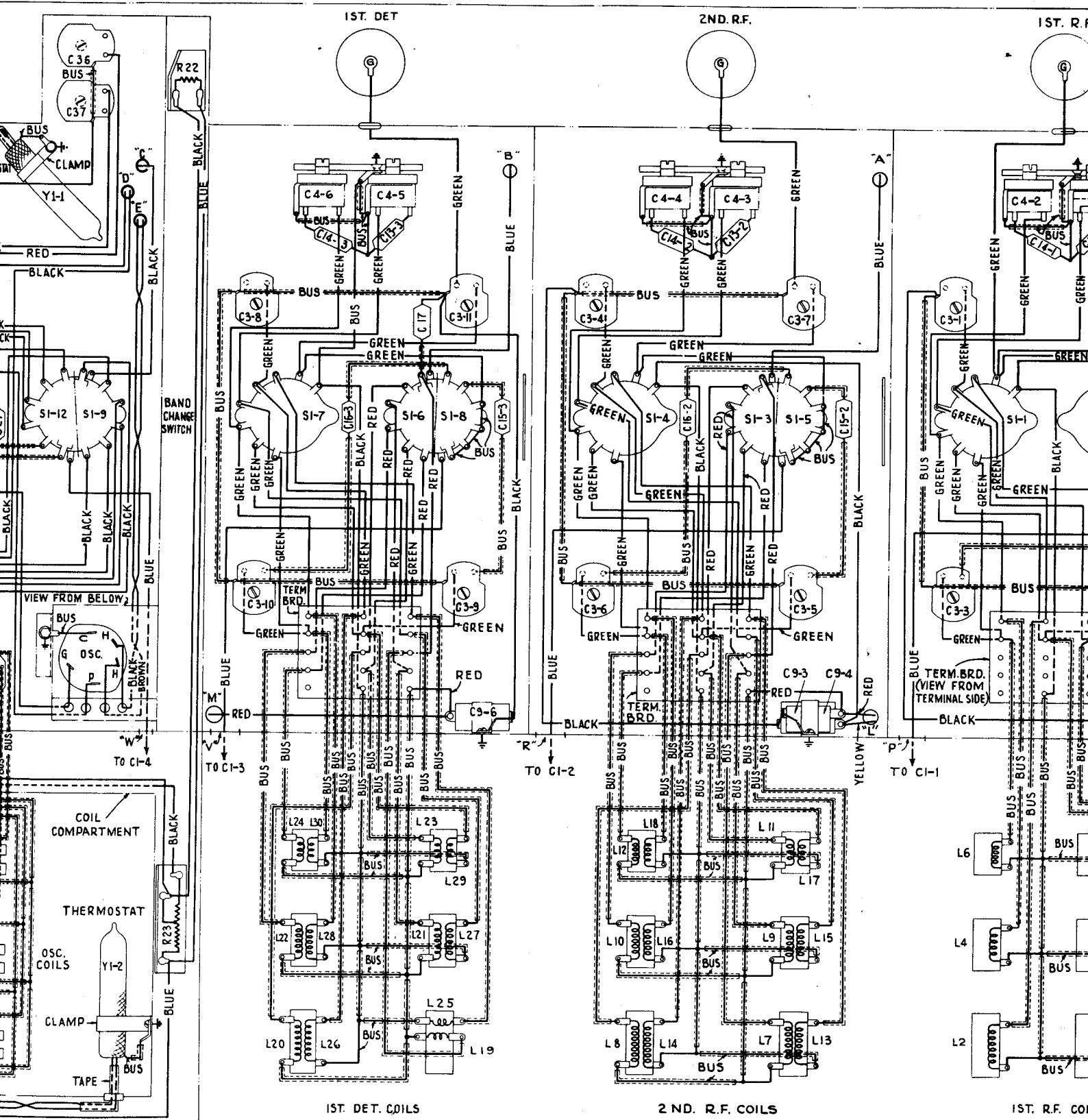
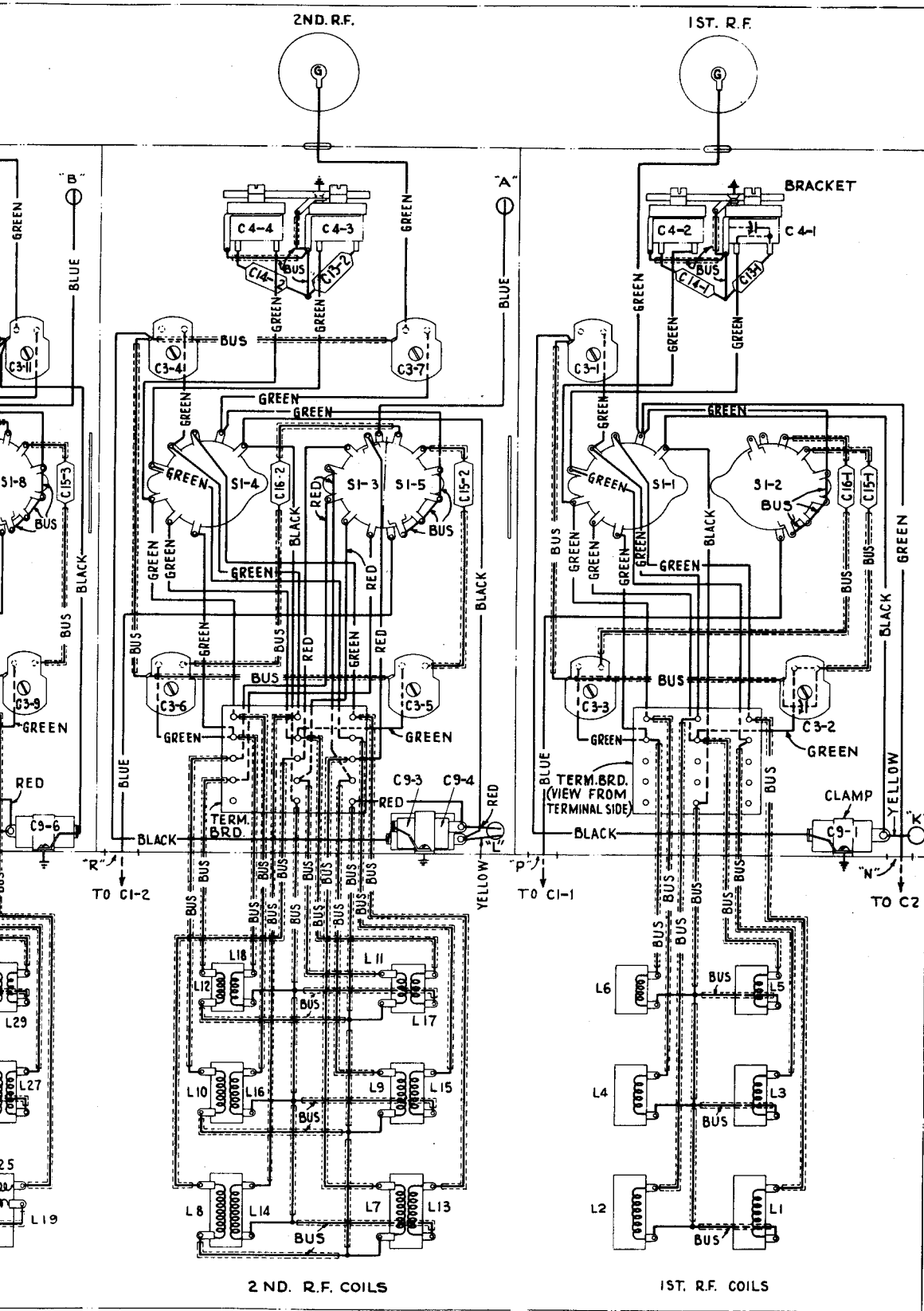
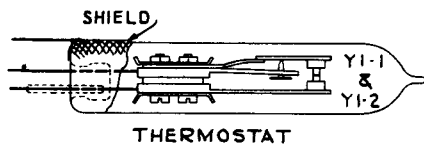


Fig. 23b - Wiring Diagram, Back



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Fig. 23b - Wiring Diagram, Back of Chassis

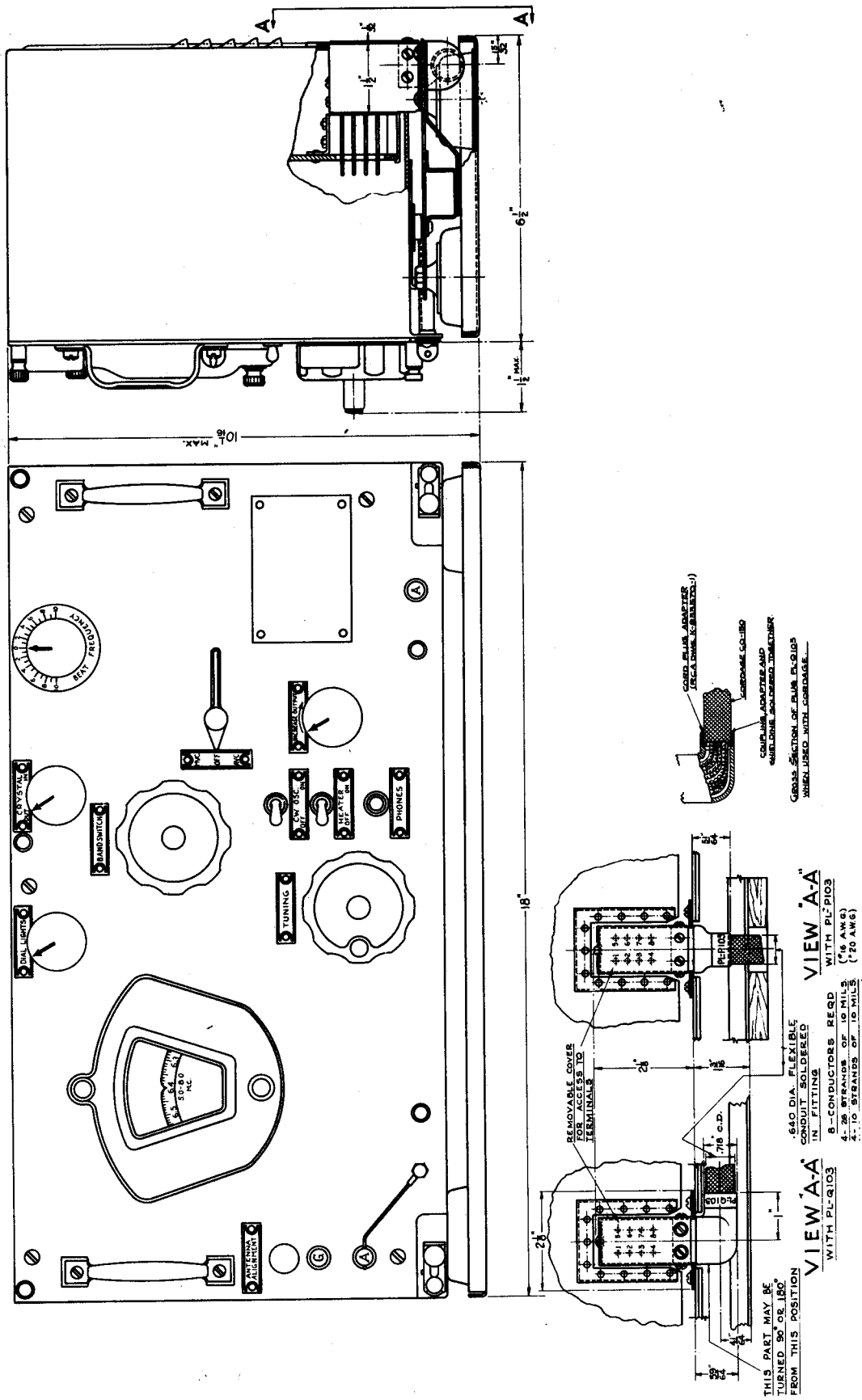


Fig. 24 - Outline Dimensional Sketch