ARMY AIR FORCES
TECHNICAL ORDER No. 08-10-50

INSTRUCTION BOOK
FOR
OPERATION AND MAINTENANCE
OF
RADIO SET SCR-274-N

RESTRICTED

PUBLISHED BY AUTHORITY
OF
THE CHIEF SIGNAL OFFICER

FOR AIRPLANE TYPE C-64A
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Revised: February 15, 1943

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RADIO SET SCR-274-N

This publication replaces *Instruction Book for Radio Set SCR-274-N* (Technical Order No. 08-10-50), dated 11-41, and *Preliminary Instructions for Radio Set SCR-274-N* (Technical Order No. 08-10-75).

RESTRICTED

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ADDENDUM

RADIO RECEIVER BC-946-B

SAFETY NOTICE

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DYNAMOTOR DM-33-A, ON THE MODULATOR UNIT OF THIS RADIO SET, GENERATES 600 VOLTS, D. C. THIS IS SUFFICIENT TO CAUSE SEVERE SHOCK, OR EVEN DEATH. MAKE ABSOLUTELY CERTAIN THAT THE DYNAMOTOR IS NOT RUNNING BEFORE MAKING ANY ADJUSTMENT WHATEVER WITH THE EXCEPTION OF TUNING UP THE TRANSMITTERS.

Opening up the tube covers on the transmitters and modulator unit exposes the high voltage plate connections to the top caps of Tubes VT-136. These covers should be safety-wired in place at the time of installation. *Do not attempt to connect or disconnect a transmitter or a power plug while Dynamotor DM-33-A is running.* Do not depend alone upon hearing the dynamotor or upon observing the several switch positions to determine whether the dynamotor is running—feel it.

In tuning up the antenna circuit of the transmitters, be careful to avoid touching the antenna when the power is on as severe, irritating burns will result. Warn anyone who may be working near the antenna of your intention to turn on the power.

FIRE: If the radio compartment has been exposed to gasoline vapor, make certain that it is aired out well before turning on the power. The antenna must be installed as far as possible from any inflammable material such as fabric covering, canvas baggage compartments, etc., because of the possibility of sparking through this material to a grounded metal member beyond and setting fire to the material.

Dynamotor DM-32-A, on each of the receivers, generates 250 volts d.c. The danger of exposure to this voltage must not be ignored. Make certain that all control switches are OFF before performing any adjustment to the equipment other than antenna alignment.

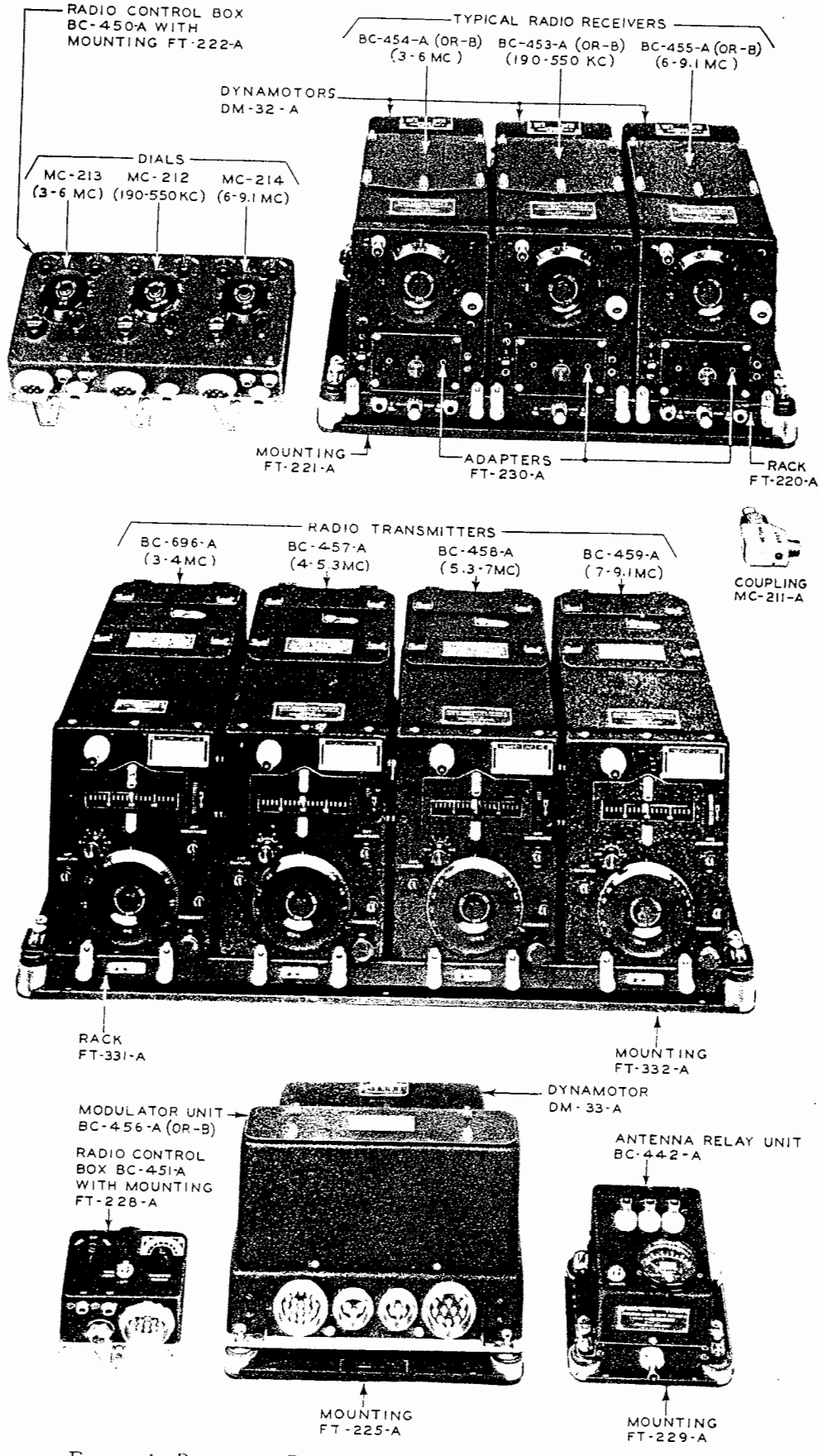

FIGURE 1—PRINCIPAL COMPONENTS OF RADIO SET SCR-274-N

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SECTION I
GENERAL DESCRIPTION

1. INTRODUCTION

Radio Set SCR-274-N is a multi-channel aircraft radio receiving and transmitting equipment, the major components of which are identified in Figure 1. Although some of these components are not furnished on each order of equipment, similar units are operatively interchangeable regardless of order number. Table I, Paragraph 8, lists components furnished.

2. RECEIVING EQUIPMENT

a. Components

The receiving equipment consists of Radio Receivers BC-453-A (or -B) (190-550 kc), BC-454-A (or -B) (3.0-6.0 mc) and BC-455-A (or -B) (6.0-9.1 mc), three Dynamotors DM-32-A, and either Radio Control Box BC-450-A (for three receivers) or Radio Control Boxes BC-473-A (or -B) (for one receiver) and BC-496-A (for two receivers). In addition, there are the racks, mountings, plugs and cordage listed in Table 1, Paragraph 8.

b. Antenna Requirements

A single antenna may be used for all receivers and transmitters, providing it is suitable for each unit. It may be desirable to use a long fore and aft inverted L or T antenna for all receivers and transmitters.

c. Power

Primary power is obtained from the 24-28 volt d-c supply on the airplane. The current drain is 1.6 amperes per receiver for a normal input of 28 volts. (See Table 2, SECTION V, for further details on current drain.) The receiver is designed for satisfactory operation over a range of 22 to 30 volts.

d. Tuning

The receiving equipment may be installed for either local or remote control by the use of suitable adapters and tuning controls which are supplied as parts of this radio set. All tuning dials are calibrated in kilocycles (kc) or megacycles (mc).

e. Receiver Outputs

The output of each receiver may be paralleled on one line to a single headset or separated and fed to two lines for reception by more than one operator. Several Headsets HS-23 (8000 ohms impedance per headset) may be used with either -A or -B type radio receivers. The -B type radio receivers may be converted to supply low impedance (600 ohms) headsets by changing taps on the output transformers.

f. Sensitivity Control

Continuous wave (CW) or amplitude modulated (MCW) radio signals may be received. Manual control of sensitivity is employed, aided by a built-in auxiliary control circuit which prevents strong radio signals from blocking reception. No provision is made for complete automatic gain control.

g. Electrical Circuits

The electrical circuits of the receiving equipment are shown in Figure 26. All the receivers are of the superheterodyne type and, except for elements form-

ing the r-f and i-f tuned circuits, they are essentially alike, electrically and physically. Each receiver employs six 12-volt tubes performing the following functions: r-f amplifier, mixer, first i-f amplifier, second i-f amplifier, diode detector—CW heterodyne oscillator and audio amplifier.

h. Weights and Dimensions

The weight of the receiving equipment, comprising the component units required for a three-receiver installation but not including control boxes, cords or external wiring, is 35.3 pounds. Figure 28 shows the overall dimensions and lists the weights of the component units. Figure 30 shows similar information on the radio control boxes and associated mountings.

3. TRANSMITTING EQUIPMENT

a. Apparatus

The transmitting equipment consists of Radio Transmitters BC-696-A (3.0-4.0 mc), BC-457-A (4.0-5.3 mc), BC-458-A (5.3-7.0 mc) and BC-459-A (7.0-9.1 mc) (certain installations use only one or two of these transmitters while others use three or four); Dynamotor DM-33-A and Modulator Unit BC-456-A (or -B) which supply the high voltage d-c and the modulating power for the transmitters; Radio Control Box BC-451-A for remote control of the transmitting equipment and Antenna Relay Unit BC-442-A for switching a single antenna between the receivers and the transmitters. In addition, there are the racks, mountings, cords, etc., listed in Table 1, Paragraph 8.

b. Antennas

A single antenna may be used for all transmitters, providing it has characteristics at each operating frequency within the following limits:

(1) A reactance not greater than that of 50 micromicrofarads or of 4.5 microhenries.

(2) A resistance up to 12 ohms.

The peak power output of each transmitter under optimum antenna loading conditions exceeds 40 watts (on CW) for 28 volts input to the equipment. Considerably less power will be obtained when using short built-on antennas whose capacitance may be as low as 50 micromicrofarads and whose total resistance may be one ohm or less. Under these conditions a reduction of as much as 10 to 1 in power may be expected. Typical test data on the transmitters are given in Table 8, SECTION V.

c. Power

Primary power is obtained from the 24-28 volt d-c supply on the airplane. The current drain in a two-transmitter installation, at 28 volts input is 9 amperes at maximum power output, and 2.5 amperes when not transmitting (vacuum tube heater current). (The primary supply current for various conditions of operation is shown in Table 2, SECTION V.) Satisfactory operation will be obtained if the d-c input voltage lies within a range of 22 to 30 volts.

d. Control Box

The position of the TONE-CW-VOICE switch on Radio Control Box BC-451-A determines the type of emission, and the four-position switch on the same box selects a pretuned transmitter.

e. Frequency Calibration

A piezo-electric crystal and an electron resonance indicator are provided in each transmitter to check the accuracy of the calibration at one frequency. The transmitter dials are calibrated in megacycles (mc).

f. Sidetone

Sidetone is furnished to the headsets from the modulator unit to permit listening to the transmission on the interphone system. Either Modulator Unit BC-456-A or BC-456-B may be used with high impedance headsets. Modulator Unit BC-456-B may be converted for use with low impedance headsets.

g. Electrical Circuits

The electrical circuits are shown in Figure 27. A master-oscillator excites a pair of beam tetrode power amplifier tubes connected in parallel. The master-oscillator and the r-f power amplifier tuning capacitors are ganged for simplification of controls. Continuously variable magnetic coupling between the power amplifier tank circuit and the antenna circuit is controlled by the ANT. COUPLING knob on the front panel. The antenna circuit is tuned by a continuously adjustable series inductor. Two Tubes VT-136 in parallel are used as r-f power amplifiers and are screen-grid modulated by audio voltage from Modulator Unit BC-456-A (or -B). The modulation capability exceeds 85 per cent.

h. Weights and Dimensions

The weight of the transmitting equipment with two transmitters, less cords, is 41.2 pounds. Figure 29 lists the weights of the transmitter and its associated racks and mountings, and shows the overall dimensions of the equipment. Figure 30 contains similar information on the radio control boxes and antenna relay unit and associated mountings.

4. SERIAL NUMBERS

a. Application

Serial numbers appear on all major units of Radio Set SCR-274-N.

b. Dynamotors

A nameplate bearing Signal Corps nomenclature is located on the base of each Dynamotor DM-32-A and Dynamotor DM-33-A and is hidden from view when the dynamotor is mounted on the equipment. In order to aid in checking the serial number without dismounting the dynamotor, an additional serial-number plate has been provided on the top of the dynamotor. This plate is of the write-in type, so that the proper number may be recorded if a new dynamotor is mounted on the dynamotor base. The number engraved on the nameplate is the permanent serial number of that unit.

c. Radio Receiver

A serial number on the rear of the receiver chassis corresponds to the serial number appearing on the receiver nameplate on the outer shield. Certain receivers have the nameplate on the side of the chassis. Serial numbers for manufacturing records only are rubber-stamped on each gang capacitor, and are steel-stamped on the side of each dynamotor. These apply to the gang capacitor and dynamotor and not to the receiver.

5. REFERENCE AND PART NUMBERS

a. Reference Numbers

The reference numbers used in the following discussion refer to parts shown in the photographs and drawings and are referenced in the Table of Replaceable Parts in SECTION V of this book.

b. Part Numbers

A reference number has been assigned to each component. For example, "Z-5" is the r-f coil set assembly. This assembly is different for each of the three receivers in this equipment, hence, three "Western Electric Company Drawing Numbers" will be found for Z-5. These numbers are also Western Electric Company "Part Numbers." Many parts will be found common to all three receivers or to all four transmitters, but wherever this is not true, a separate listing for each unit will indicate the correct number.

6. BRIEF DESCRIPTION OF THE PRINCIPAL COMPONENTS OF THE RECEIVING EQUIPMENT

(See Figure 1 and outline drawings in Figures 28 and 30.)

a. Radio Receivers

This item includes Radio Receivers BC-453-A (or -B), BC-454-A (or -B) and BC-455-A (or -B), with Dynamotors DM-32-A, Adapters FT-230-A, Couplings MC-211-A, Rack FT-220-A and Mounting FT-221-A (for three receivers). Other racks and mountings are also available as follows: Rack FT-233-A with Mounting FT-231-A (for one receiver), Rack FT-277-A with Mounting FT-279-A (for two receivers) and Rack FT-264-* with Mounting FT-278-* (for four receivers).

For the 3-receiver arrangement the weight and dimensions are as follows:

Weight: 32.6 pounds.

Overall Dimensions: $16\frac{9}{16}$ inches wide, $7\frac{1}{32}$ inches high and $13\frac{1}{8}$ inches deep.

This group of components comprises three complete radio receivers, each with its own high-voltage dynamotor, adapter and coupling, and Rack FT-220-A with three stalls for the three radio receivers and shock-proof Mounting FT-221-A for vibration protection of all of these units.

The weight of a single receiver with its rack and mounting and with Dynamotor DM-32-A is 11.2 pounds. The overall dimensions are $6\frac{1}{16}$ inches wide, $7\frac{1}{32}$ inches high and $13\frac{1}{8}$ inches deep.

* Mountings and racks with no letter suffix were not manufactured at the time of publication of this instruction book.

b. Radio Control Boxes

This item includes Radio Control Boxes BC-450-A, BC-496-A and BC-473-A (or -B) with Mounting FT-222-A, FT-240-A and FT-235-A (or -B) respectively.

The overall dimensions of Radio Control Box BC-450-A with Mounting FT-222-A are 9½ inches wide, $5\frac{3}{32}$ inches high and $2\frac{3}{16}$ inches deep. The weight of this unit, including Mounting FT-222-A, is 2.7 pounds.

Radio Control Box BC-450-A contains three completely independent groups of controls for remote control of the three radio receivers. It is equipped with Dials MC-212 (190-550 kc), MC-213 (3-6 mc) and MC-214 (6-9.1 mc) which are mechanically interchangeable.

The overall dimensions of Radio Control Box BC-496-A with Mounting FT-240-A are 6⅜ inches wide, $5\frac{3}{32}$ inches high and $2\frac{3}{16}$ inches deep. The weight of this unit, including its mounting, is 1.7 pounds.

Radio Control Box BC-496-A differs from Radio Control Box BC-450-A in that there are only two sets of controls. This box is normally equipped with Dials MC-213 (3-6 mc) and MC-214 (6-9.1 mc).

The overall dimensions of Radio Control Box BC-473-A (or -B) with Mounting FT-235-A (or -B) are 3¼ inches wide, $5\frac{3}{32}$ inches high and $2\frac{3}{16}$ inches deep. The weight of this unit, including its mounting, is 0.9 pound.

Radio Control Box BC-473-A (or -B) differs from Radio Control Box BC-450-A in that there is but one set of controls. This box is normally equipped with Dial MC-212 (190-550 kc).

A one-section and a two-section control box may be used instead of the three-section control box described above whenever it is desired to split the controls between two operators.

c. Adapter FT-260-A and Control Unit MC-237-A

Adapter FT-260-A, containing local control for one receiver, fits into the same socket on the receiver as Adapter FT-230-A and adds 0.1 pound to the weight of each receiver so equipped above the weight including Adapter FT-230-A.

Control Unit MC-237-A is a crank used to replace the tuning shaft when local tuning of the receiver is desired. To install Control Unit MC-237-A proceed as follows: Remove the tuning shaft by unscrewing the knurled nut which holds the shaft to the sleeve on the front of the receiver. Press Control Unit MC-237-A on the sleeve, making sure that the spline shaft on the adapter slides into the spline socket. Secure in place by screwing the rear flange of the adapter on the sleeve.

Control Unit MC-237-A, when attached to a receiver, adds 0.1 pound to the weight and 1.0 inch to the depth.

7. BRIEF DESCRIPTION OF THE PRINCIPAL COMPONENTS OF THE TRANSMITTING EQUIPMENT

(See Figure 1 and outline drawings in Figures 29 and 30.)

a. Radio Transmitters

This item includes Radio Transmitters BC-696-A, BC-457-A, BC-458-A and BC-459-A; Rack FT-234-A and Mounting FT-232-A (for one transmitter); Rack FT-226-A and Mounting FT-227-A (for two transmitters), Rack FT-276-* and Mounting FT-262-* (for three transmitters) and Rack FT-331-A and Mounting FT-332-A (for four transmitters).

This group of components comprises the four transmitters, racks with stalls for any one, two, three or all four transmitters and shock-proof mountings for vibration protection of these units. Each of the transmitters contains a master-oscillator and the r-f power-amplifier components of the transmitting equipment.

Weight: 10.5 pounds (one transmitter, Rack FT-234-A and Mounting FT-232-A).

Dimensions: 7¼ inches wide, $8\frac{3}{16}$ inches high and $15\frac{1}{32}$ inches deep (one transmitter, Rack FT-234-A and Mounting FT-232-A).

Weight: 20.4 pounds (two transmitters, Rack FT-226-A and Mounting FT-227-A).

Dimensions: 12¾ inches wide, $8\frac{3}{16}$ inches high and $15\frac{1}{32}$ inches deep (two transmitters, Rack FT-226-A and Mounting FT-227-A).

Weight: 30.3 pounds (three transmitters, Rack FT-276- and Mounting FT-262-).

Dimensions: 18¼ inches wide, $8\frac{3}{16}$ inches high and $15\frac{1}{32}$ inches deep (three transmitters, Rack FT-276- and Mounting FT-262-).

* Mountings and racks with no letter suffix were not manufactured at the time of publication of this instruction book.

Weight: 40.2 pounds (four transmitters, Rack FT-331-A and Mounting FT-332-A).

Dimensions: 23¾ inches wide, 8 1/16 inches high and 15 1/2 inches deep (four transmitters, Rack FT-331-A and Mounting FT-332-A).

b. Control Box

This item includes Radio Control Box BC-451-A and Mounting FT-228-A.

Weight: 0.9 pound.

Dimensions: 4⅛ inches wide, 4⅜ inches high and 2¾ inches deep.

Radio Control Box BC-451-A contains all controls for the operation of any of one to four transmitters. (Tuning controls on the front of each transmitter are differentiated from operating controls.) This box contains a built-in telegraph key, a jack for connection to an external key, a microphone jack, an emission selector switch, a transmitter selection switch, a primary power source switch and a switch (inside the box) for short-circuiting a microphone series resistor. This resistor normally is short-circuited.

c. Modulator Unit

This item includes Modulator Unit BC-456-A (or -B), Dynamotor DM-33-A and Mounting FT-225-A.

Weight: 18 pounds.

Dimensions: 10 3/16 inches wide (facing receptacles), 7 11/16 inches high and 8⅞ inches deep.

This group of components comprises the high-voltage d-c power supply, all of the voice and tone modulating circuit components and a shock-proof mounting for vibration protection of these units.

d. Antenna Relay Unit

This item includes Antenna Relay Unit BC-442-A and Mounting FT-229-A.

Weight: 2.2 pounds.

Dimensions: 5⅝ inches wide (facing the unit so that the meter reads right side up), 4 1/32 inches high and 6 9/16 inches deep.

This unit consists of a switching relay, an antenna current indicator (with current transformer and thermocouple), a REMOTE-LOCAL antenna current indicator switch*, a 50 micromicrofarad antenna series condenser and a shock-proof mounting for vibration protection of the unit.

*Discontinued on the later model of Radio Set SCR-274-N.

8. APPARATUS UNITS WHICH MAY BE USED AS COMPONENT PARTS OF RADIO SET SCR-274-N

The first column of the following table assumes that the radio set may include any number of transmitters from one to four but that it will include three receivers.

TABLE 1

PRINCIPAL COMPONENTS OF RADIO SET SCR-274-N

Quantity Per Radio Set	*Name of Major Unit or Accessory*	*Western Electric Co. Dwg. No.*
3	Adapter FT-230-A (receiver, remote control)	6433
*	Adapter FT-260-A (receiver, local control)	6434
1	Antenna Relay Unit BC-442-A	5017
1	Instruction Book for Radio Set SCR-274-N	—
*	Control Unit MC-237-A (Local, Tuning) (formerly coded MC-236)	6743
3	Coupling MC-211-A (right angle, for tuning shaft)	6357
3	Dynamotor DM-32-A (receiver)	7351
1	Dynamotor DM-33-A (modulator unit)	5168
2	Ferrule M-231 (used on primary power supply cords)	6780
1	Modulator Unit BC-456-A (or -B)	7591
1	Mounting FT-225-A (for Modulator Unit BC-456-A or BC-456-B)	7058
1	Mounting FT-229-A (for Antenna Relay Unit BC-442-A)	7056
*	Mounting FT-235-A (or -B) (for one-receiver Radio Control Box BC-473-A (or -B)	7053
*	Mounting FT-240-A (for two-receiver Radio Control Box BC-496-A)	6831

*Variable, depending upon operating requirements.

TABLE 1—(*Continued*)
PRINCIPAL COMPONENTS OF RADIO SET SCR-274-N

Quantity Per Radio Set	*Name of Major Unit or Accessory*	*Western Electric Co. Dwg. No.*
1	Mounting FT-222-A (for three-receiver Radio Control Box BC-450-A)	7054
1	Mounting FT-228-A (for transmitter Radio Control Box BC-451-A)	7083
*	Mounting FT-231-A (for one-receiver Rack FT-233-A)	7059
*	Mounting FT-279-A (for two-receiver Rack FT-277-A)	5694
1	Mounting FT-221-A (for three-receiver Rack FT-220-A)	7060
*	Mounting FT-278- (for four-receiver Rack FT-264-)***	5696
*	Mounting FT-232-A (for one-transmitter Rack FT-234-A)	7061
*	Mounting FT-227-A (for two-transmitter Rack FT-226-A)	7062
*	Mounting FT-262- (for three-transmitter Rack FT-276-)***	7063
*	Mounting FT-332-A (for four-transmitter FT-331-A)	7064
2	Nut M-232 (used on primary power supply cords)	7546
1	Plug PL-147 (2-contact, for cable) or	6578
	Plug PL-147-A (2-contact, for open wire)	9127
1	Plug PL-148 (3-contact, for cable) or	6965
	Plug PL-148-A (3-contact, for open wire)	9126
2	Plug PL-151 (6-contact, for cable) or	6784
	Plug PL-151-A (6-contact, for open wire)	9123
6	Plug PL-152 (8-contact, for cable) or	6577
	Plug PL-152-A (8-contact, for open wire)	9125
2	Plug PL-153 (18-contact, for cable) or	6963
	Plug PL-153-A (18-contact, for open wire)	9121
2	Plug PL-154 (12-contact, for cable) or	6964
	Plug PL-154-A (12-contact, for open wire)	9122
2	Plug PL-156 (5-contact, for cable) or	6967
	Plug PL-156-A (5-contact, for open wire)	9124
*	Plug PL-157 (2-contact) (discontinued in later models)	3146
*	Plug PL-158 (2-contact) (discontinued in later models)	7543
*	Plug PL-192 (used in receiver rack when receiver is equipped with Adapter FT-260-A for local control)	6787
*	Rack FT-233-A (for one receiver)	7509
*	Rack FT-277-A (for two receivers)	5018
1	Rack FT-220-A (for three receivers)	7537
*	Rack FT-264- (for four receivers)***	5019
*	Rack FT-234-A (for one transmitter)	7507
*	Rack FT-226-A (for two transmitters)	5020
*	Rack FT-276- (for three transmitters)***	7638
*	Rack FT-331-A (for four transmitters)	6090
*	Radio Control Box BC-473-A (or -B) (for one receiver) Includes:	7043
	Dial MC-212 (190-550 kc)	

*Variable, depending upon operating requirements.
***Mountings and racks with no letter suffix were not manufactured at the time of publication of this instruction book.

TABLE 1–(*Continued*)
PRINCIPAL COMPONENTS OF RADIO SET SCR-274-N

Quantity Per Radio Set	*Name of Major Unit or Accessory*	*Western Electric Co. Dwg. No.*
*	Radio Control Box BC-496-A (for two receivers) Includes: Dial MC-213 (3.0-6.0 mc) Dial MC-214 (6.0-9.1 mc)	6546
1	Radio Control Box BC-450-A (for three receivers) Includes: 1 Dial MC-212 (190-550 kc) 1 Dial MC-213 (3.0-6.0 mc) 1 Dial MC-214 (6.0-9.1 mc)	5014
1	Radio Control Box BC-451-A (one to four transmitters)	7095
1	Radio Receiver BC-453-A (or -B) (190-550 kc) Includes: 1 Adapter FT-230-A (for remote control)	7594
1	Radio Receiver BC-454-A (or -B) (3.0-6.0 mc) Includes: 1 Adapter FT-230-A (for remote control)	7595
1	Radio Receiver BC-455-A (or -B) (6.0-9.1 mc) Includes: 1 Adapter FT-230-A (for remote control)	7596
*	Radio Transmitter BC-696-A (3.0-4.0 mc)	ESR-681991
*	Radio Transmitter BC-457-A (4.0-5.3 mc)	7632
*	Radio Transmitter BC-458-A (5.3-7.0 mc)	7633
*	Radio Transmitter BC-459-A (7.0-9.1 mc)	7634
1	Tube Set (for Modulator Unit BC-456-A or BC-456-B) Includes: 1 Tube VT-135 (RMA type 12J5-GT) 1 Tube VT-136 (RMA type 1625) 1 Tube VT-139 (RMA type VR-150-30)	
3	Tube Set (for a receiver) Includes: 3 Tube VT-131 (RMA type 12SK7) 1 Tube VT-132 (RMA type 12K8) 1 Tube VT-133 (RMA type 12SR7) 1 Tube VT-134 (RMA type 12A6)	
*	Tube Set (for a transmitter) Includes: 2 Tube VT-136 (RMA type 1625) 1 Tube VT-137 (RMA type 1626) 1 Tube VT-138 (RMA type 1629)	
**	Tuning Shaft MC-215	6151
	Test Set RC-54-A (for receiver testing). This is used with, but is not a part of, Radio Set SCR-274-N. See Figure 33.	
	Test Set RC-55-A (for transmitter testing). This is used with, but is not a part of, Radio Set SCR-274-N. See Figures 34 and 35.	

* Variable, depending upon operating requirements.
** Cordage and Tuning Shaft are supplied in bulk.
*** Mountings and Racks with no letter suffix were not manufactured at the time of publication of this instruction book.

SECTION II

EMPLOYMENT

9. INITIAL PROCEDURE

a. Preliminary Check

Check the supply of component units against the list in Table I, aided by the group photograph in Figure 1 and, if necessary, by the cording diagram, Figure 31. It is advisable to make a visual inspection of each component to determine that no obvious mechanical fault exists. Such an examination should include checking the operation of controls and dials, checking the threads of receptacles and plugs, examination of pin plug assemblies for bent or otherwise unserviceable units, and other components. Remove the dust covers which are attached by means of snapslides. Proper fuses should be in place in the modulator unit and receiver rack. Vacuum tubes should be inserted firmly in the sockets identified for the particular type of tube. The type designations will be found marked on the edges of the case nearest the socket in which that particular type of tube should be placed or on a chart on the under side of the tube compartment cover. Grid clips should be firmly attached.

b. Bench Test

It is strongly recommended that an electrical "bench test" be made of each component item before it is installed in an airplane. This will insure normal operation of the equipment after installation with the minimum number of man-hours of work in and about the airplane. Trouble-shooting on installed radio equipment is difficult and should be avoided. Where a considerable amount of installation work is to be done, it is recommended that a permanent bench test installation be made, consisting of:

(1) 1 Test Set RC-54-A (for tests on receiving equipment). See Figure 33 for information regarding the use of this test set. Control Unit MC-237-A may be used for local tuning of the receiver.

(2) 1 Test Set RC-55-A (for tests on transmitting equipment). See Figures 34 and 35 for information regarding the use of this test set.

(3) 1 Storage battery, 28 volts, preferably at least 100 ampere-hour capacity.

(4) 1 Headset HS-23 or equal.

(5) 1 Microphone T-17 or equal.

c. A TEL.-B TEL. Switch

The functional diagram, Figure 8, indicates that each A TEL.-B TEL. toggle switch, directly under the front of each receiver, must be in its center position, covered by a screw cap. These switches are never operated when the receivers are remotely controlled. If one of these switches is thrown to A or B, the A-B switch on the control box corresponding to this receiver will not function properly.

d. Use of A TEL. Line

Normally all receivers will be connected to the A TEL. line; if an interphone is used, it will be connected to the "Command" channel thereof. When the receiver controls are split, as mentioned in Paragraph 6b, and two interphone channels are available, as in airplanes without a liaison set or compass or both, the A TEL. outlet can be connected to one interphone channel and the B TEL. outlet to the other channel.

e. Sidetone Relay

A relay behind each receiver in Rack FT-220-A operates with the transmitter keying relay to switch the headset circuit of that receiver to the transmitter sidetone circuit. If one receiver is connected to a separate antenna, it may be desirable to disconnect the sidetone relay associated with this receiver so that reception on it will not be interrupted during keying of one of the transmitters. If this is necessary, the proper relay may be made inoperative by placing a wedge under the armature. If Plug PL-151 is disconnected from Rack FT-220-A, sidetone is removed from all receivers.

f. Resistor in Radio Control Box BC-451-A

The toggle switch, S-53 (Figure 27), inside Radio Control Box BC-451-A, should be in the R-OUT

position. This short-circuits a 510-ohm resistor in the microphone line. To gain access to the toggle switch, use a screwdriver to pry off the snap cap near the red designation plate. The same screwdriver may be used to check the position of the toggle switch. Radio Control Box BC-451-A is set at the factory with the resistor short-circuited by the switch, but a check as just indicated should be made to insure this fact. Microphone T-17 will not operate satisfactorily with the resistor in the circuit.

g. Microphone Control

If the transmitters are to be controlled by the button on Microphone T-17, or equal, turn the knurled nut on the microphone jack as far counter-clockwise as possible. If "throttle-switch" control is required, turn the knurled nut as far clockwise as possible, and permanently close the press-to-talk switch on Microphone T-17.

10. INSTALLATION

a. Antenna

The antenna will vary in length with the airplane and frequency range employed. The longest antenna will be approximately 50 feet and the shortest approximately 18 feet, both lengths including the external and internal lead-in wire. The external part of the antenna should be placed as far away from the fuselage as possible. Transverse antennas are to be avoided because of the increased drag they cause and the possibility of failure due to icing. The exact layout of the antenna is dictated by the design of the airplane. The lead-in inside the fuselage shall be kept as short as possible, especially the one to the transmitter. Antenna Wire W-106-A provides the best internal lead-in connector. When internal antenna leads require support, ceramic stand-off insulators should be used, and when protection against accidental contact with the aircraft structure is necessary, ceramic beads should be strung on the wire. If necessary, insulated stranded wire such as is used in the airplane wiring may be used for the antenna lead to the receiver, but the use of this wire is not recommended.

b. Location of Receivers and Transmitters

The radio set consists basically of a group of three receivers and a group of two or four transmitters, each group with its special rack and mounting. This apparatus, together with an antenna relay unit, should be located near the antenna lead-in bushing in order to keep the interior portion of the antenna lead-in as short as possible. Since it will be necessary to change the receivers and transmitters occasionally and to tune the transmitters, the chosen location should facilitate these operations. The location for the transmitters must permit a view of the reflection, seen in the mirror on the under side of the hinged rear cover on each unit, of the entire electron resonance indicator screen in tube V-53 (Tube VT-138). This view is essential in checking the calibration of each transmitter. Allow enough clearance around the units so that under the maximum amplitude of vibration they will not strike against anything.

c. Location of Other Equipment

In addition to the apparatus mentioned in the preceding paragraph, there is a modulator unit (with a high-voltage dynamotor) and separate control boxes for the group of receivers and group of transmitters. The modulator unit should be located near the 24-28 volt d-c supply in order to reduce the voltage drop in the battery cable and it should also be near the radio equipment in order to reduce the weight of the interconnecting cables. The radio control boxes should be installed near the pilot or operator. The location of the receiver radio control box (or boxes) should be such that the dials may be easily read day or night. (All dials are etched or engraved in aluminum and have a black background.) The location of the transmitter radio control box should be such that the three switches and built-in key can be easily operated. Space must be left under this box and the receiver radio control box for inserting the plugs.

d. Weights and Dimensions

Figures 28, 29 and 30 show the installation dimensions and weights of all units of Radio Set SCR-274-N. The weight of the cables may be kept low by a careful grouping of the units. A cording diagram showing the interconnection of units is shown in Figure 31 and notes associated with this illustration are included in Paragraph 10m.

e. Ground Connections

In order to secure a good ground connection to the receivers and transmitters, connect a short flexible lead from the airplane frame to one of the G binding posts on each of the racks. If open-wire cables are employed, it may be necessary also to ground the case of Antenna Relay Unit BC-442-A in order to eliminate circulating radio frequency currents. The knurled nuts which clamp the receivers and transmitters in the racks must be securely hand-tightened and safety-wired. This holds the units solidly in place and at the same time provides an electrical connection between the chassis and racks. Noisy receivers and reduced antenna current from the transmitters will result if this precaution is not observed.

f. Vacuum Tubes

See that all tubes are securely in place in their proper sockets and that the tube compartment covers are in place and locked before the power is turned on. The following vacuum tube sets are required:

Set of tubes for each receiver

3 Tube VT-131
1 Tube VT-132
1 Tube VT-133
1 Tube VT-134

Set of tubes for the modulator unit

1 Tube VT-135
1 Tube VT-136
1 Tube VT-139

Set of tubes for each transmitter

2 Tube VT-136
1 Tube VT-137
1 Tube VT-138

The location of each type of tube is indicated by the Signal Corps type number engraved on the outer dust cover adjacent to the tube or is shown on a chart attached to the under side of the tube compartment cover.

g. Mounting of Receivers and Transmitters

Each of the receivers and transmitters must be carefully slid as far as it will go into its proper rack compartment. When this is done, it will be possible to slip the locking lugs, located on the rack below the front of each unit over the conical studs on the receivers and transmitters. Radio Receiver BC-453-A (or -B) (190-550 kc) should be installed in the center compartment of Rack FT-220-A. This will physically separate Radio Receivers BC-454-A (or -B) (3.0-6.0 mc) and BC-455-A (or -B) (6.0-9.1 mc) and reduce electrical interference between them. The knurled nuts which hold the locking lugs in place should be hand-tightened and then safety-wired. A safety wire, not larger than 0.032 inch diameter, may be threaded through one of the four holes on the front of the nut and out through one of the three holes near the knurling. It is essential that these instructions be followed carefully in order that the several units will be held securely in place and that a good electrical connection will exist between these units and the racks on which the ground binding posts are located.

h. Tuning Shafts

Flexible tuning shafts should be kept short and have as few sharp bends as possible. Additional length and sharp bends increase the friction and consequent backlash in tuning. Also, since the only mechanical stop on the receiver tuning control consists of the tie plates on the receiver gang condenser rotors, it is possible to turn the tuning crank at the low-frequency end of the range with sufficient force to spring the stators from their ball-type supporting insulators. The likelihood of this mechanical damage increases with increased intricacy of tuning shaft layout, since increased friction gives less "feel" of the stop points. In this connection, it is well to observe the tuning dial of the receiver control box or boxes and not to tune beyond the end calibration marks on the dials.

i. Slack in Connectors

Allow plenty of slack in all connectors near the points of attachment to the units. Reduction in the shock-proofing of the units and, at the same time, damage to the connectors and tuning shafts may result if this precaution is not observed.

j. Safety Wiring on Snapslides

Refer to Air Corps instructions relative to safety wiring of snapslides on radio equipment. Safety-wire the snapslides which lock the several units to their mountings. Safety-wire the snapslides which hold the tube covers on the transmitters and modulator unit; this makes access to the tube compartments more difficult and minimizes the possibility of accidental contact with the high-voltage plate leads connected to the tops of Tubes VT-136.

k. Receiver Control Box Dial

Set each control box dial to correspond with the dial of the receiver to which it is connected. Each radio control box dial may be adjusted to a predetermined position by first loosening the knurled screw in the center and then rotating the dial to the desired reading. The knurled screw must then be hand-tightened. Do not use pliers for this operation.

l. Attachment of Plugs

To attach plugs, "feel" for the proper orientation before using any considerable pressure on the plugs. The locking rings must be hand-tightened.

m. Special Notes to Be Read in Connection with the Cording Diagram, Figure 31

Interconnection of units can be accomplished by any one of three methods of wiring. First, by use of plugs and shielded cordage as shown on Figure 31 (use for temporary installation). Second, by use of plugs and individual wires run in rigid and/or flexible conduit. Third, by the use of plugs and individual wires without shielding. The second and third methods shall be accomplished in accordance with Air Corps Specifications 32300-A, 32310-A and other Air Corps instructions, including wiring diagrams, that may be issued from time to time. If it becomes necessary to alter or fabricate a cord, refer to the illustrations on Figure 32. The following notes are to be read in connection with the cording diagram, Figure 31:

(1) Radio Control Box BC-473-A (or -B) (for one receiver) and Radio Control Box BC-496-A (for two receivers) may be substituted for Radio Control Box BC-450-A (for three receivers).

(2) Radio Receiver BC-453-A (or -B) (190-550 kc) should be in the middle section. The relative location of the others is immaterial, but unless otherwise indicated by special instructions, install them as shown in Figure 31.

(3) Coupling MC-211-A (right angle) may be used as a link between Tuning Shaft MC-215 and a receiver if necessary. This coupling can be used within certain limits at the control-box end of the tuning shaft but it should be omitted altogether if a satisfactory installation can be made without it.

(4) Plug PL-151 may be plugged into either one of the side receptacles on the receiver racks.

(5) The ground leads should be as short as possible.

(6) Use W-106-A Antenna Wire for antenna leads. Support on high quality ceramic insulators. All transmitter antenna leads must be carefully spaced away from grounded surfaces, and the ends of the wires must be bent in close to the metal shells of the binding posts. If any sharp wire ends are allowed to project away from the binding post surface, corona and spark breakdown will occur, particularly at high altitude. There may be occasions when the liaison transmitter frequency is very near one of the command receiver listening frequencies or when atmospherics are exceptionally strong. Therefore, it is recommended that an International Resistance Company Type F-2, 5 megohm, 2 watt, metallized resistor, or equal, be connected between the antenna and ground at some convenient point between the antenna binding posts on the receivers and Antenna Relay Unit BC-442-A. This prevents the building up of extremely high voltages which might damage the antenna series capacitor. This high shunt impedance will have no perceptible effect on the sensitivity of the receivers.

(7) Radio Transmitter BC-457-A, BC-458-A or BC-696-A may be installed here instead of Radio Transmitter BC-459-A. The 50 micromicrofarad series capacitor, connected between posts C on Antenna Relay Unit BC-442-A, is supplied for use when the antenna capacitance is so large that a transmitter cannot be properly tuned. The capacitor may be connected in series with any one or all of the transmitters as necessary. It may not be necessary to use the antenna series capacitor with the lower-frequency transmitters. If it is possible to resonate the antenna circuit of a transmitter, without the use of the antenna series capacitor, this should be done in order to avoid increased circuit losses.

(8) The antenna lead of Radio Receiver BC-453-A (or -B) may be permanently connected to a separate antenna for reception of airways radio range signals.

n. Shielding, Filtering and Bonding

The airplanes in which Radio Sets SCR-274-N are to be installed must be suitably prepared for radio use by shielding the ignition system and the generator voltage regulator circuit, installing radio frequency filters and by bonding the airplane structure in accordance with Air Corps instructions (Handbook of Instructions for Airplane Designers, Air Corps Specifications 32300-A, 32310-A, etc.). When the radio shielding, filtering and bonding are properly accomplished, the radio frequency noise voltage at the receiver end of the antenna will not exceed 2½ microvolts, and the noise voltage on the battery cables will not exceed 50 microvolts.

11. PREPARATION FOR USE

a. Precautions and Preliminary Procedure

Precautions preparatory to turning on the power to this equipment have been covered in the Safety Notice on page xvii of this book and in Paragraphs 9 and 10 of SECTION II. The final adjustments to the equipment prior to normal use are: (1) antenna circuit alignment of the receivers and (2) tuning up the transmitters. Before making these adjustments, read carefully SECTION III, FUNCTIONING OF PARTS, and make certain that the functions of the controls are thoroughly understood. All receivers and transmitters should be connected, as indicated in Figure 31, to the antenna through Antenna Relay Unit BC-442-A before making the following tuning adjustments.

b. Antenna Circuit Alignment of the Receivers

(All receivers must be connected to the antenna or antennas with which they are to be used.)

(1) Set the CW-OFF-MCW power switch controlling the first receiver to CW.
(2) Set the A TEL.-B TEL. switch of the same control box section to A TEL.
(3) Connect a headset into any A TEL. jack or into a corresponding interphone jack box.
(4) Set the INCREASE OUTPUT knob for maximum output.
(5) Rotate the TUNING knob until the dial indicates the highest frequency. Do not attempt to rotate the dial beyond the boundary calibration marks.
(6) Align the antenna circuit for maximum background noise, using the ALIGN INPUT knob on the front of the receiver.
(7) Switch this receiver OFF.
(8) Perform a similar operation with each of the other receivers in turn.
(9) It is good practice to repeat the alignment operation on all receivers for optimum results, even though the improvement may seem small.

c. Transmitter Tuning Controls

There are three controls on the front of each transmitter: (1) the frequency control knob in the lower right corner marked FREQUENCY, (2) the antenna tuning inductance control in the upper right section marked ANT. INDUCTANCE and (3) the coupling control in the middle left section marked ANT. COUPLING. Each transmitter is supplied with a special frequency checking circuit which includes a plug-in crystal resonator. This crystal circuit is used for checking the frequency at one point on the dial; it does not control the frequency. The frequencies of the crystals supplied with the different transmitters are as follows:

Radio Transmitter	*Crystal Frequency*
BC-696-A (3-4 mc)	3.5 mc
BC-457-A (4-5.3 mc)	4.6 mc
BC-458-A (5-7.3 mc)	6.2 mc
BC-459-A (7-9.1 mc)	8.0 mc

d. Tuning the Transmitters

Transmitters must be tuned up with the emission switch on Radio Control Box BC-451-A in the CW position and must not be readjusted in any way after switching to TONE or VOICE. Such retrimming will result in greater antenna current in either position, but the transmitter cannot be properly modulated. To tune up a transmitter:

(1) Set the calibrated dial to the desired transmitting frequency.
(2) Set the ANT. COUPLING control to about 3 on its scale.
(3) Operate the toggle switch on Antenna Relay Unit BC-442-A to LOCAL.
(4) Set emission switch, S-50, on Radio Control Box BC-451-A to CW.

(5) Set the TRANSMITTER SELECTION switch on Radio Control Box BC-451-A to the number corresponding to the rack position of the transmitter which is being tuned.

(6) After making sure that neither the microphone button nor the key is closed, operate the TRANS. POWER switch to ON. Dynamotor DM-33-A should start.

(7) Allow a minimum of 15 seconds for the tubes to heat up.

(8) Lock the "built-in" telegraph key on top of Radio Control Box BC-451-A by rotating it clockwise.

(9) Resonate the antenna circuit by adjusting the ANT. INDUCTANCE for maximum antenna current. (Maximum inductance is in series with the antenna when the contact button behind the transparent window is in the extreme righthand position.) This adjustment should be made with the ANT. COUPLING at a lower setting than that which gives highest antenna current.

(10) Vary the ANT. COUPLING until the maximum CW antenna current reading is obtained on the r-f current indicator on Antenna Relay Unit BC-442-A (switch S-54 in the LOCAL position). This setting must be carefully made.

(11) Retrim the ANT. INDUCTANCE tuning for maximum CW antenna current.

(12) Observe the antenna current on VOICE and TONE. Antenna current readings will vary widely with the antenna and the choice of frequency. For a short "built-on" fore and aft antenna, the reading on CW probably will be greater than half scale. On VOICE it will be considerably less than for CW, and for TONE it will be between the values for CW and VOICE.

(13) The other transmitters in the rack should be tuned up, following the same routine as for the first. It is then good practice to return to the first transmitter and retrim the ANT. INDUCTANCE control on CW.

(14) Lock the three controls of each transmitter by rotating the LOCK knobs one-half turn clockwise to a stop, in which position the engraving, "LOCK," on the knob will read right side up.

(15) Mark the frequency to which each transmitter has been tuned in soft pencil in the appropriate blank space on the plate above the TRANSMITTER SELECTION switch. Record the transmitter data on the "write-in" plate on the front of each transmitter.

e. Transmitter Resonance Indicator

Tube V-53 (Tube VT-138) in each transmitter is used as an indicator of resonance between the frequency calibration crystal and the transmitting frequency. When a transmitter is operated at or near the frequency of the crystal in that transmitter, a dark three-cornered shadow appears in the round spot of green light on the screen of tube V-53 (Tube VT-138). This shadow "opens" as the transmitting frequency approaches the frequency of the crystal; operation at exact resonance with the crystal frequency is indicated by a sharp maximum in the width of this shadow. When properly calibrated, the transmitter carrier-frequency output will be within ± 0.05% of the frequency indicated on the dial.

f. Calibrating the Transmitters

Always recheck the frequency calibration in the following manner after any tube is replaced in the transmitter. This is particularly important when a new master-oscillator tube V-54 (Tube VT-137) is installed:

(1) Open the hinged cover (at top rear of transmitter) to such an angle that the reflection of the entire resonance indicator screen of tube V-53 (Tube VT-138) may be seen.

(2) Tune the transmitter to the lowest frequency which will open the shadow on the resonance indicator. (Spurious responses will sometimes be observed but they are always higher than the nominal frequency of the crystal; the low-

est response frequency can be most easily found by approaching the calibration point on the dial from the low frequency direction.) The indicated dial frequency should now correspond with that of the crystal. If it does not, set the dial exactly on the nominal frequency of the crystal and trim the master-oscillator capacitor to make it so. This trimmer may be adjusted with a small metal screwdriver inserted through the hole, covered by snapslide H-52 (Figure 11), in the top of the transmitter. A clockwise rotation of this trimming control lowers the transmitter frequency. Adjust the FREQUENCY control again to make certain that no "opening" of the resonance indicator is observed for any indicated dial frequency below the one corresponding to the value shown on the crystal holder. The calibration engraved on the frequency dial of the transmitter will then be correct at other parts of the dial.

12. OPERATION

a. Remote Operation of the Receivers

(1) Accessories are provided as a part of this radio set for remote control of the three receivers. One, two and three-unit receiver radio control boxes are listed in Table 1. The three-unit Radio Control Box BC-450-A is shown in Figure 1, and the one and two-unit Radio Control Boxes BC-473-A (or -B) and BC-496-A are shown in Figure 10. These radio control boxes provide for control in one location of all three receivers or for control in one location of two receivers and in another of the third receiver. When the remote control boxes are used, each receiver so controlled must be equipped with an Adapter FT-230-A.

(2) Each receiver radio control box contains one, two or three of the following groups of controls: (a) CW-OFF-MCW switch, (b) TUNING knob, (c) gain control marked INCREASE OUTPUT and (d) A-B switch. Each group of controls is used to control one receiver independently of the other receivers. Receiver control boxes of all types contain headset jacks marked A TEL. and B TEL. These jacks are connected to two separate headset lines for use by two operators, if desired. The audio signal output from any receiver is switched either to the A TEL. jacks or to the B TEL. jacks throughout the radio set by means of the A-B switch which is in the control group operating that particular receiver. The signals from any receiver may be cut off from the headset lines by operating the A-B switch of that particular receiver to its mid-position. For example, if the pilot is given Radio Control Box BC-473-A (or -B), connected to Radio Receiver BC-453-A (or -B), he may operate its A-B switch to A and turn his interphone switch to the corresponding position, set the CW-OFF-MCW switch to MCW and tune in a radio range signal, using the INCREASE OUTPUT control to adjust the volume. If, at the same time, the radio operator or observer is given Radio Control Box BC-496-A, connected to Radio Receivers BC-454-A (or -B) and BC-455-A (or -B), he may switch each of his A-B switches to B, set the CW-OFF-MCW switches to CW or MCW and tune in signals on both receivers simultaneously. The gain controls of these two receivers may be used to fade the signal from one, in or out, with respect to the signal from the other. When two or more receiving frequencies are to be guarded simultaneously, the receivers which are tuned to these frequencies should be "opened up" by advancing their gain controls. If the pilot wishes to receive the signals being heard by the operator, he must turn his interphone switch to the position connected to the B TEL. output circuit, and vice versa for the operator. When the radio set is operated by one individual only, all receivers shall be switched to A TEL. Other combinations will suggest themselves in practice. In a single-place airplane, the pilot's headset will be plugged into the A TEL. jack (through the radio range filter, if used). In all other airplanes, the headset connections will be made through the interphone system.

(3) In each group of controls, the CW-OFF-

MCW switch performs the functions of: (1) battery power switch and (2) a heterodyne oscillator switch (for the reception of CW signals) in the receiver which is controlled by that particular group. Remote tuning is accomplished for each receiver by Tuning Shaft MC-215. Tuning dials on both the receivers and the radio control boxes are calibrated in kilocycles or megacycles. The gain control (with knob marked INCREASE OUTPUT) is a variable resistor in the cathode-to-ground circuits of the r-f and first i-f amplifier tubes of each receiver; its setting determines the sensitivity of the receiver. The design of the receivers is such that a 2-volt signal in the antenna circuit will not overload the r-f or i-f amplifiers. For reception of airways radio range signals, it is important that the volume be kept well below the maximum; this avoids overloading the receiver which would give incorrect indications of the off-course signals.

b. Local Operation of Receivers

(1) The accessories necessary for local control of the receivers are: (*a*) Adapter FT-260-A which takes the place of Adapter FT-230-A and supplies facilities for control of vacuum tube heaters, output volume and the CW oscillator, (*b*) Control Unit MC-237-A which is a tuning crank and spline assembly and attaches to the condenser drive spline in the same manner as does the flexible shaft used for remote tuning and (*c*) Plug PL-192 which must be inserted in the receiver rack instead of Plug PL-152 which is used for remote control.

c. Operation of the Transmitters

Facilities are provided for the operation of one, two, three or four transmitters as a part of this radio set. Each transmitter is preset on a particular frequency. Transmission is possible on any of the preset frequencies but on only one at a time. The operator has a choice of TONE, CW and VOICE types of emission on each of the frequencies. All transmitter controls are associated with Radio Control Box BC-451-A. Assuming that the equipment has been installed, tested and tuned according to instructions in previous parts of the book, the operator need learn only the following few directions:

(1) Set the TRANSMITTER SELECTION switch to the desired preset transmitting frequency indicated on the write-in plate.

(2) Set the emission switch to TONE, CW or VOICE, as required.

(3) Operate the TRANS. POWER toggle switch to ON and wait 15 seconds to allow all the transmitter tube filaments to reach their operating temperature.

(4) If on VOICE, press the press-to-talk button on the microphone and talk clearly and distinctly into the microphone. In the VOICE position, the transmitting dynamotor will not start until the press-to-talk button has been closed. Antenna current will be indicated by the ammeter on Antenna Relay Unit BC-442-A whenever the press-to-talk button is closed. Sidetone should be heard distinctly whenever transmitting.

NOTE: When transmitting voice with a microphone which does not have a keying switch, the equipment must be switched between "receive" and "transmit" by means of the built-in telegraph key (K-56 in Figure 19) on Radio Control Box BC-451-A or by a remote switch plugged into the KEY jack.

(5) The TRANS. POWER toggle switch should be left ON throughout the flight in order to avoid repetition of the 15 second warm-up time.

(6) To transmit on TONE or CW, turn the emission switch to the appropriate position. Dynamotor DM-33-A will start and continue to run as long as this switch is in either of these positions, but the transmitter will not be "on the air" until either the built-in key or the external key is pressed. Antenna current will be indicated by the ammeter on Antenna Relay Unit BC-442-A. A tone of approximately 1000 cycles per second should be heard while transmitting on either TONE or CW.

(7) To reduce battery drain and to increase dynamotor life, the emission selector switch should be left on VOICE unless continued use on TONE or CW is expected.

13. PRECAUTIONS

CAUTION: VOLTAGES GENERATED IN THIS RADIO SET ARE DANGEROUS. READ THE SAFETY NOTICE ON PAGE xvii OF THIS BOOK.

a. Primary Voltage Limits

The equipment should not be operated when the primary source voltage is outside the limits of 22-30 volts. Lower voltages will result in improper functioning of the circuit components (such as poor sensitivity of the receivers and improper modulation of the transmitters, or even failure to oscillate on the part of the r-f and CW oscillators of the receivers and of the master-oscillator of the transmitters). Higher voltages may cause damage to the tubes or dynamotors or may cause voltage breakdowns within the equipment.

b. Transmitter Tuning

Under Paragraph 11, Preparation for Use, it was directed that tuning of the transmitters must be done with the emission selector switch of Radio Control Box BC-451-A on CW and that the ANT. TUNING must not be retrimmed after switching to TONE or VOICE, even though it results in higher antenna current. This precaution must be observed or considerable distortion on VOICE will result.

c. Transmitter Calibration

In tuning up a transmitter for the first time to check the calibration accuracy against the built-in piezo-electric crystal, the operator must make certain that he is resonating the lowest frequency to which the crystal will respond. A spurious resonance will often be found but it will be higher in frequency than the nominal frequency of the crystal.

d. Transmitter Keying

Do not key the transmitter with the controls in the VOICE position with the built-in key, an external key or the microphone switch, because the dynamotor is started and stopped with such keying. The heavy starting current involved will reduce the life of the dynamotor and starting relay K-50 in Modulator Unit BC-456-A (or -B). In the CW and TONE positions, the dynamotor is constantly running, and the effect of pressing the key is to operate relays controlling the transmission of telegraph signals (see Figure 24).

e. Switching of Transmitters

Do not switch from one transmitter to another while transmitting as there is a possibility of an arc being formed across the contacts of selector relay K-53 (see Figure 24).

f. Limit on Range of Antenna Tuning Control

Do not rotate the ANT. INDUCTANCE control (with transmitter power on) so near to either end of L-52 that there is danger of the contactor slipping off the coil and causing an arc.

g. Overloading of Dynamotors

Dynamotor DM-33-A has a continuous duty as well as an intermittent duty rating (see Table 18). It is essential that no operating requirement be placed on the transmitting equipment which exceeds these ratings. There is no time limit to operation on CW so long as the transmitter is being keyed for the ordinary transmission of messages. The dynamotor high-voltage load current in the TONE and VOICE positions is low enough to be drawn continuously without fear of damage to the equipment.

h. Adjustment of R-F Coils in Receiver

Tuned coils in the r-f coil set in each receiver contain small iron cores which are used to adjust each of these coils to a precise value of inductance. This is a laboratory adjustment and alterations in the settings of any of these should not be attempted without proper equipment and authority. The result may be mistracking of the r-f circuits.

i. Adjustment of R-F Coils in Transmitter

The master-oscillator and power-amplifier coils in the transmitters are also adjusted to a predetermined value of inductance at the factory by means of adjustable iron cores. The screw, E-58 in Figure 13, controlling the location of the iron core in the master-oscillator coil, is located over master-oscillator coil T-53. The screw, E-59 in Figure 13, controlling the location of the iron core in power-amplifier coil T-54, is mounted on a bracket attached to the top of the isolantite coil form of T-54. After proper adjustment

of the inductance of each of these coils, the screws are sealed and the tops painted blue. Subsequent alteration in the setting of these screws will affect the calibration precision and the tracking of the two ganged tuned circuits of the transmitter. The adjustment should be carried out only under controlled laboratory conditions.

j. Electrical Interference Within the Airplane

It will be useless to attempt to receive radio signals unless the r-f disturbances set up within the airplane, due to an imperfectly shielded ignition system, generator system, motors, or other equipment on the airplane, have been reduced to a reasonable level. Refer to Paragraph 10*n*.

k. Limit on Range of Tuning Dials

The receivers and transmitters are calibrated directly on the tuning dials. Operators should be careful not to tune beyond the normal end-frequencies in such a manner as to strain the gears or capacitors. End stops are provided, but if an unreasonable amount of force is applied, damage can be done to the equipment.

l. Switch in Thermocouple Circuit

Switch S-54 in the antenna relay unit is in a low resistance thermocouple circuit. It is recommended that this switch be thrown back and forth several times if trouble is experienced in obtaining a stable reading on M-50.

SECTION III

FUNCTIONING OF PARTS

14. RECEIVING EQUIPMENT

a. Radio Receivers BC-453-A (or -B), BC-454-A (or -B) and BC-455-A (or -B) with Dynamotors DM-32-A, Adapters FT-230-A and FT-260-A and Racks FT-233-A, FT-277-A, FT-220-A and FT-264- ***

(1) Radio Receivers BC-453-A (or -B), BC-454-A (or -B) and BC-455-A (or -B) are basically alike, as may be seen in the schematic wiring diagrams of Figures 37, 38 and 39 and each has the same complement of tubes performing identical functions. Any one of these receivers may be installed on Rack FT-233-A, any two on Rack FT-277-A or all three on Rack FT-220-A. Rack FT-264- ** provides for the installation of four receivers. Figure 26 is a schematic diagram of the receiving equipment of Radio Set SCR-274-N, including only Radio Receiver BC-455-B, Adapters FT-230-A and FT-260-A, Dynamotor DM-32-A, Rack FT-220-A and a cord for attachment to the primary source. The schematic circuit diagrams of Radio Receivers BC-453-B and BC-454-B (with adapters and dynamotors) were not included on this diagram because all circuits connecting with the rack are identical in all three units. For completeness, however, Figures 37, 38 and 39 show the schematic circuits and the practical wiring diagrams of the three receivers. Photographs of a typical receiver may be seen in Figures 2, 3 and 4.

(2) The radio frequency (r-f) part of these radio receivers consists of the following circuits and vacuum tubes, starting at the antenna: a tuned antenna input circuit, an r-f amplifier tube V-3 (Tube VT-131), a tuned r-f amplifier circuit, a mixer tube V-4 (Tube VT-132), and an r-f oscillator circuit. The antenna, the r-f amplifier and the r-f oscillator circuits are tuned by equal sections of a three-section gang capacitor C-4 (A, B, C). The plate current of mixer tube V-4 contains a frequency component which is equal to the difference between the frequency of the applied signal and that of the r-f oscillator voltage.

(3) Antenna coil L-1 is contained in Z-5A which is a unit of plug-in r-f coil set assembly Z-5 (Figure 4). Z-5B contains the r-f amplifier coils L-2 and L-3. Z-5C contains L-4, L-5, R-3 and R-6 of the r-f oscillator. L-1 of Z-5A, L-3 of Z-5B and L-5 of Z-5C contain iron cores which are used to adjust each coil to a particular value of inductance. After this adjustment at the factory, the iron cores are sealed in position. A subsequent change in the setting of any of these will upset the tracking of that circuit.

(4) C-1 is a small fixed capacitor which couples the antenna to the input tuned circuit. The capacitances of C-1 and C-2 are so designed that for any capacitive antenna it is possible to resonate the antenna circuit by tuning C-2.

(5) C-39 (across L-2 in Radio Receiver BC-453-A (or -B only) serves to tune L-2 to a frequency lower than 190 kc, and by so doing, to increase the amplification of signals at the low frequency end of the tuning range. This assists in producing a reasonably uniform receiver sensitivity over the tuning range. The plate-to-screen capacitance of r-f amplifier tube V-3 (Tube VT-131) and the capacitance of the wiring to L-2, perform a corresponding function in Radio Receivers BC-454-A (or -B) and BC-455-A (or -B).

(6) L-5 of the r-f oscillator has a lower inductance than L-3 of the r-f amplifier circuit. This lower value of L-5, aided by the insertion of C-10 between L-5 and ground, results in an r-f oscillation which is higher in frequency than the signal frequency. By design, this difference is equal to the intermediate frequency throughout the tuning range of the receiver. L-4 and L-5 are the grid and plate coils of the r-f oscillator. C-4C, with trimmers C-4E and C-4G, and C-10, with trimmer C-9, together determine the tuning capacitance across L-5. C-8 is a grid blocking capacitor, and R-3 is a grid resistor. R-6 is a series resistor in the plate circuit which not only serves to

* See Paragraph 14*a*(11) for differences between Radio Receivers BC-453-A and BC-453-B, etc.

** Rack FT-264- was not manufactured at the time of publication of this instruction book.

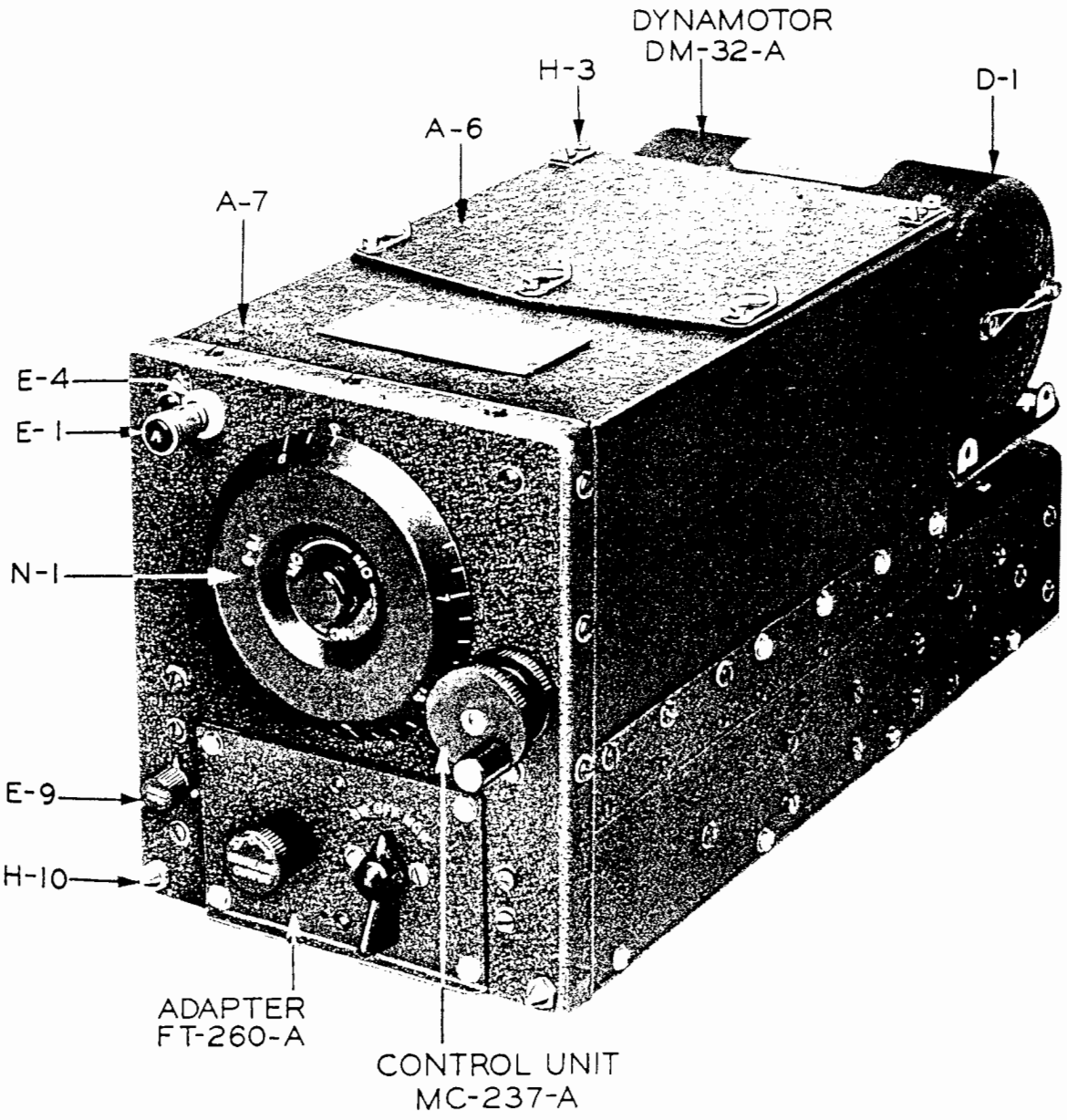


FIGURE 2—TYPICAL RADIO RECEIVER WITH ADAPTER FOR LOCAL CONTROL

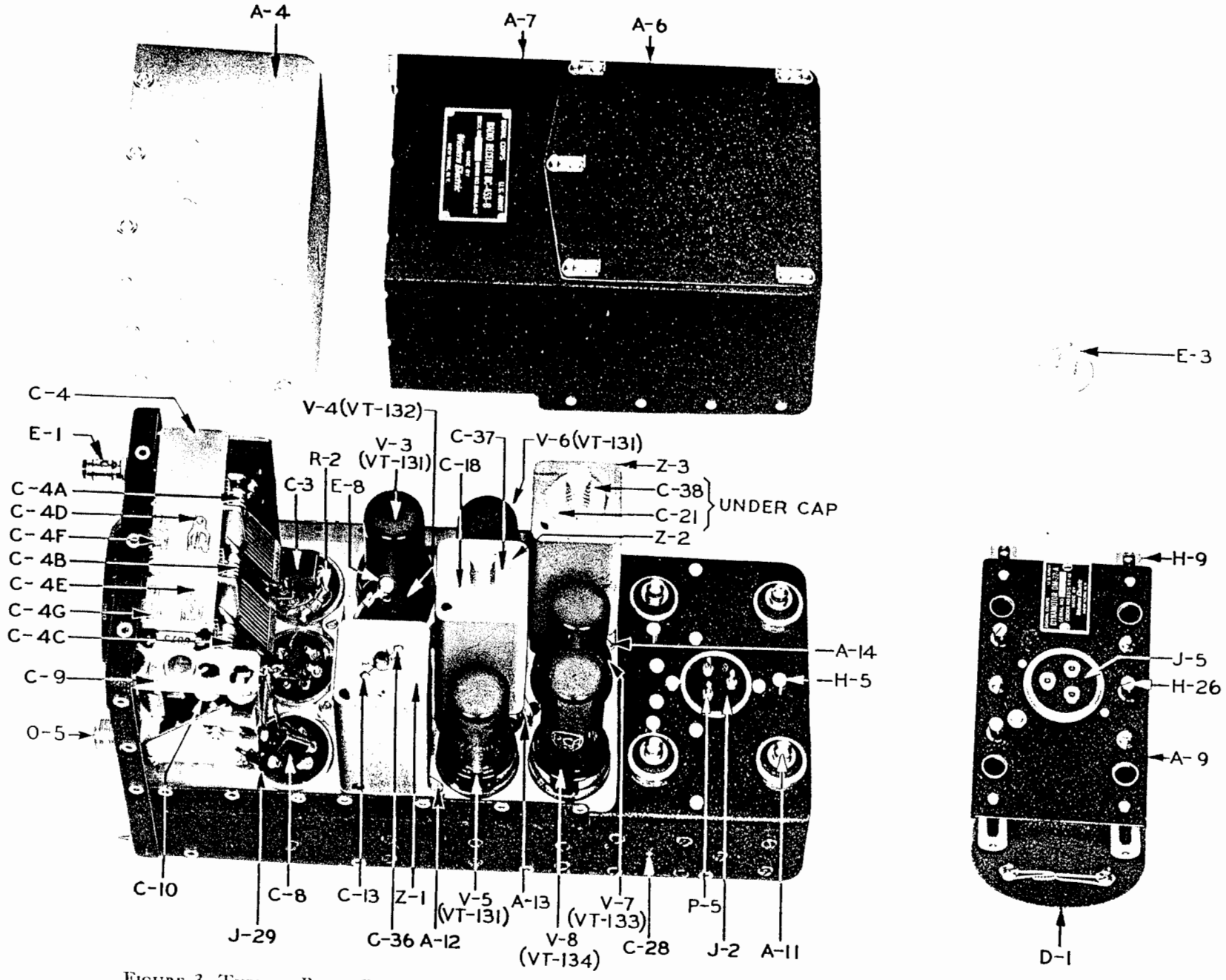


FIGURE 3—TYPICAL RADIO RECEIVER, TOP INSIDE VIEW, AND BOTTOM VIEW OF DYNAMOTOR DM-32-A

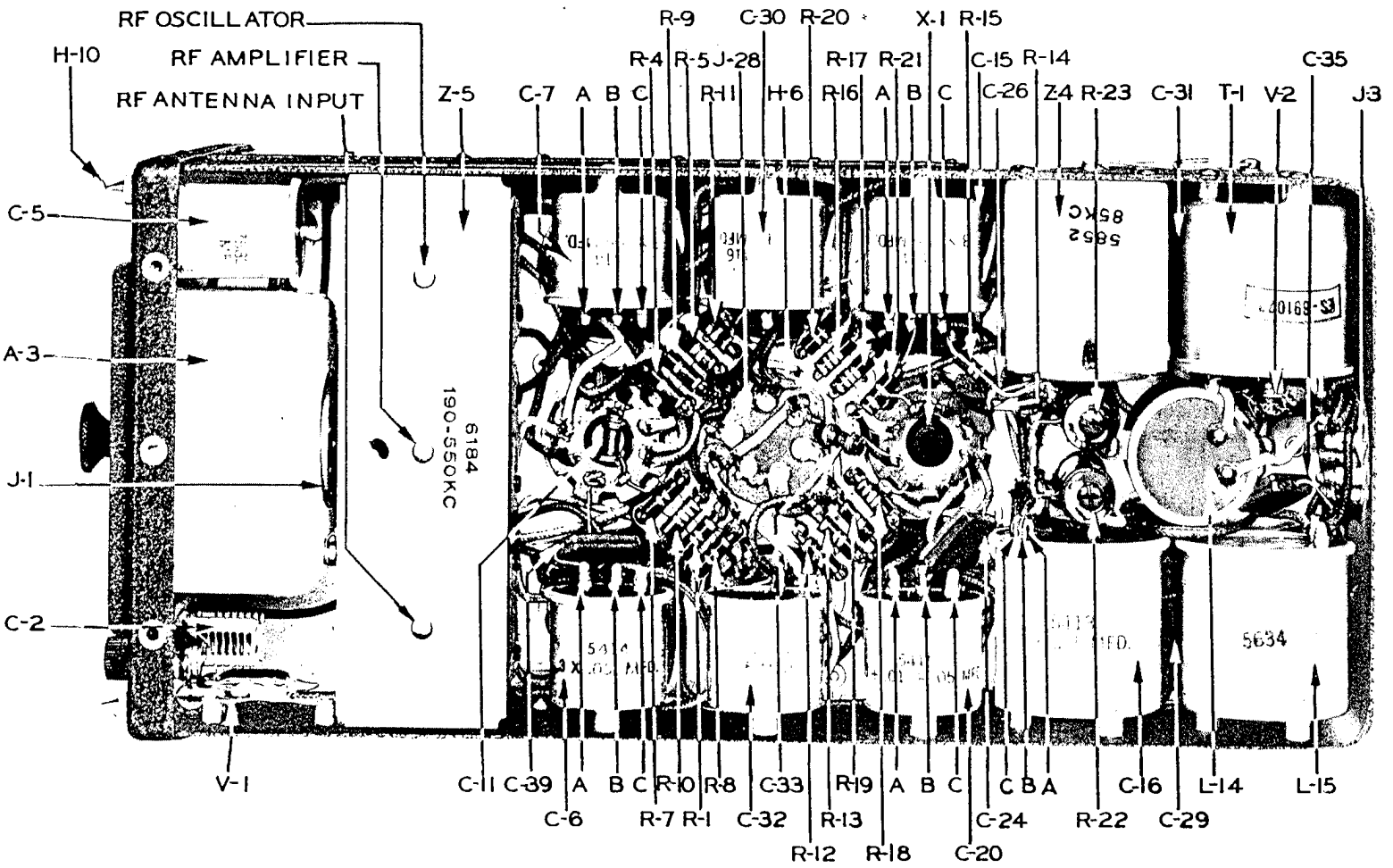


FIGURE 4—TYPICAL RADIO RECEIVER, BOTTOM INSIDE VIEW

drop the dynamotor voltage to the proper value for the r-f oscillator, but also acts as an r-f filter in conjunction with C-10 to isolate this circuit from others connected to the high-voltage supply line. C-11 is a compensating capacitor connected across the r-f oscillator tuning capacitor to reduce the frequency drift during the first half hour of operation.

(7) The intermediate frequency (i-f) part of these receivers consists of three i-f coupling units, Z-1, Z-2 and Z-3 (Figure 3), following the V-4 (Tube VT-132) mixer tube, V-5 (Tube VT-131) first i-f amplifier tube and the V-6 (Tube VT-131) second i-f amplifier tube, respectively. In Radio Receivers BC-453-A (or -B) and BC-454-A (or -B), each i-f coupling unit contains two tuned circuits which are magnetically coupled. Z-1 which is representative of the three coupling units consists of coils L-6 and L-7, fixed tuning capacitors C-12 and C-14 and trimming tuning capacitors C-13 and C-36. The coils and capacitors are designed so that each circuit may be tuned precisely to the intermediate frequency. In Radio Receiver BC-453-A (or -B), the magnetic coupling between the coils in each i-f coupling unit is adjustable to either of two values, namely, an over-coupled value (bakelite rod, protruding through the top of the i-f coupling unit, "down") or an under-coupled value (bakelite rod up). The position for these rods during alignment is up, but for operation, the rod of the second i-f coupling unit Z-2 remains up while those of Z-1 and Z-3 must be down. With the couplings so adjusted, a flat-top selectivity curve is obtained, accompanied by better audio fidelity up to 2000 cycles per second. The selectivity 10 kilocycles or more away from resonance is little affected by the position of these rods. The magnetic coupling between coils in Z-1, Z-2 and Z-3 of Radio Receiver BC-454-A (or -B) is fixed.

(8) There is but one tuned circuit in each of the i-f coupling units of Radio Receiver BC-455-A (or -B). Each of these tuned circuits consists of a coil (for example L-6 in Z-1) with fixed tuning capacitor C-12 and trimming tuning capacitor C-13. The single i-f tuned circuit is capacitively coupled (for example C-14 in Z-1) to the following vacuum tube input circuit. L-7, L-9 and L-11 act only as r-f chokes.

(9) The rotors of trimming capacitors C-13, C-18 and C-21 are grounded, but the rotors of trimming capacitors C-36, C-37 and C-38 (reached through the holes numbered "2" in Z-1, Z-2 and Z-3 of Radio Receivers BC-453-A (or -B) and BC-454-A (or -B)) are not grounded, hence it is necessary to use a screwdriver with an insulated shank to adjust them. Figure 25 shows an external view of three i-f coupling units.

(10) The detector and audio frequency (a-f) parts of these radio receivers consist of a diode section of tube V-7 (Tube VT-133) acting as a detector, resistance coupled to the input of tube V-8 (Tube VT-134), and a 2.2 to 1 step-down output transformer. C-24 is an r-f by-pass capacitor and R-18 is the diode load resistor across which the rectified audio voltage is developed. R-19 and C-24 act to prevent the intermediate frequency from appearing across the input to the audio amplifier tube. C-29 is a blocking capacitor, and R-20 is the audio grid resistor. C-31, across the primary of T-1, assists C-35, across the secondary, in reducing the output of high audio frequencies. The design of transformer T-1 is such that the leakage reactance, with the aid of C-31 and C-35, attenuates frequencies above 3000 cycles per second.

(11) Radio Receivers BC-453-B, BC-454-B and BC-455-B are exactly like Radio Receivers BC-453-A, BC-454-A and BC-455-A except that the secondary winding of T-1 has a tap to which the output wire may be connected, thereby converting the sets for use with low impedance (600 ohms) headsets. If it is desired to make this change, remove the two wires on terminal 3 and connect them to terminal 6.

(12) V-1 and V-2 are small neon lamps acting to protect the equipment when exceptionally strong signals are received. These lamps glow at approximately 80 volts. As soon as the glow starts, any increase in voltage across the lamp terminals causes a relatively large increase in current. In this manner, the voltage is limited to 80 volts across L-1 and likewise across half of the primary winding of T-1.

(13) Gain or volume is manually controlled by a 0-50,000-ohm variable resistor located in Radio Control Box BC-450-A. (This may be R-25, R-26 or R-27, depending upon which control section is being considered.) The cathode circuits of the r-f amplifier and first i-f amplifier are completed to ground through R-25. As this resistor is increased from 0 to 50,000 ohms, the voltage between ground and each cathode increases, and since the grids of these tubes are at ground potential for direct current, the grids be-

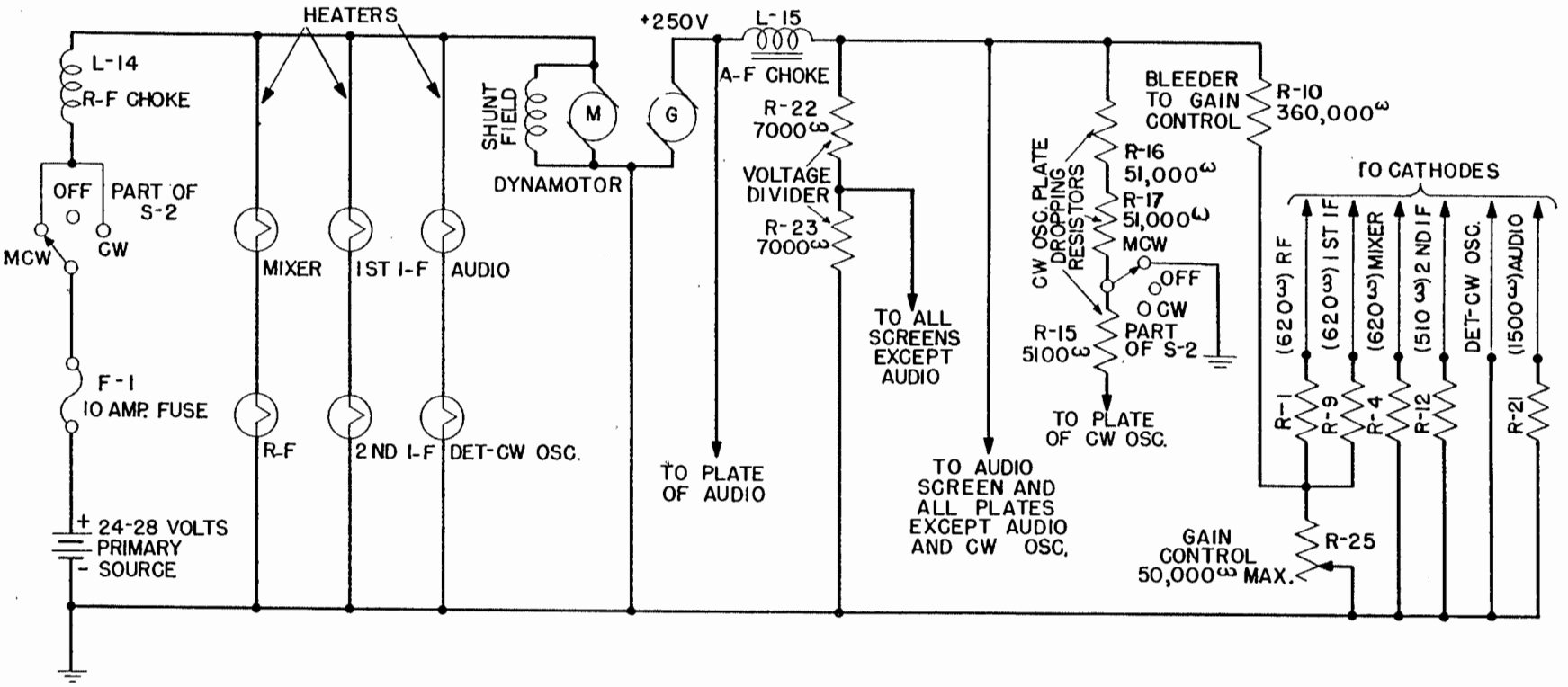


FIGURE 5—FUNCTIONAL DIAGRAM OF THE D-C CIRCUITS OF A TYPICAL RADIO RECEIVER

come increasingly negative with respect to the cathodes. This results in a reduction of amplification in each of the controlled tubes, and in an overall reduction in the gain of the receiver by a factor exceeding 50,000 to 1 as R-25 reaches its maximum resistance. About 0.6 of a milliampere of direct current is conducted from the +250-volt dynamotor line through R-10 and R-25 to ground. The voltage across R-25 is thus greater than it would be if only cathode current flowed through it. In the minimum gain position of R-25 (50,000 ohms), there is a difference of potential of approximately 30 volts even though the cathode current is negligible. From this, it may be seen that R-10 acts to make the control voltage developed across R-25 less dependent upon the cathode current of the tubes being controlled.

(14) The control grid of r-f amplifier tube V-3 (Tube VT-131) and of the first i-f amplifier tube V-5 (Tube VT-131) are returned to ground through a common resistor, R-11, in the control grid circuit of the second i-f amplifier tube V-6 (Tube VT-131). The object of this auxiliary gain control circuit is to prevent overload of the r-f or i-f amplifier by signals producing as much as 2 volts in the antenna circuit. In effect, it is an automatic gain control which is operative only on signals so strong that they would otherwise overload the receiver. When an overload condition arises, the second i-f amplifier grid current flows through R-11, making the grid side of R-11 negative with respect to ground. By connecting the grid circuits of the r-f and first i-f amplifier to this potential, the gain of these tubes will be reduced to the point where overload in these stages is prevented. This circuit does not limit the maximum volume that can be obtained from the receiver. The output will be essentially uniform for r-f input signals stronger than 100 microvolts (and up to 2 volts). *Manual gain control resistor R-25 (marked INCREASE VOLUME) should always be adjusted to a value such that the receiver output is well below the maximum, to avoid spurious effects such as an apparent reversal of course on the airways radio range signals.*

(15) Current from the primary source enters Rack FT-220-A at J-24 (Figure 26), passes through fuse F-1 (or F-2 or F-3) to switch S-2 (or S-4 or S-6) in Radio Control Box BC-450-A, back to the rack and thence to the +L.V. line of the receiver. Adapter FT-230-A completes the circuit to terminal 2 on J-2 and to the vacuum tube heater circuits. The negative side of the dynamotor and of the primary source is grounded. The dynamotor frame, receiver chassis, framework of the rack, all covers and shielding are carefully bonded to insure good ground connections. When local control of the receivers is required, it is necessary only to replace Adapter FT-230-A with Adapter FT-260-A, which contains the equivalent of S-2 and R-25, and to insert Plug PL-192 in J-21 (or J-22 or J-23) of the receiver rack. The operation of all controls may then be accomplished locally. Control Unit MC-237-A, when substituted for the flexible shaft, permits local tuning of the receiver.

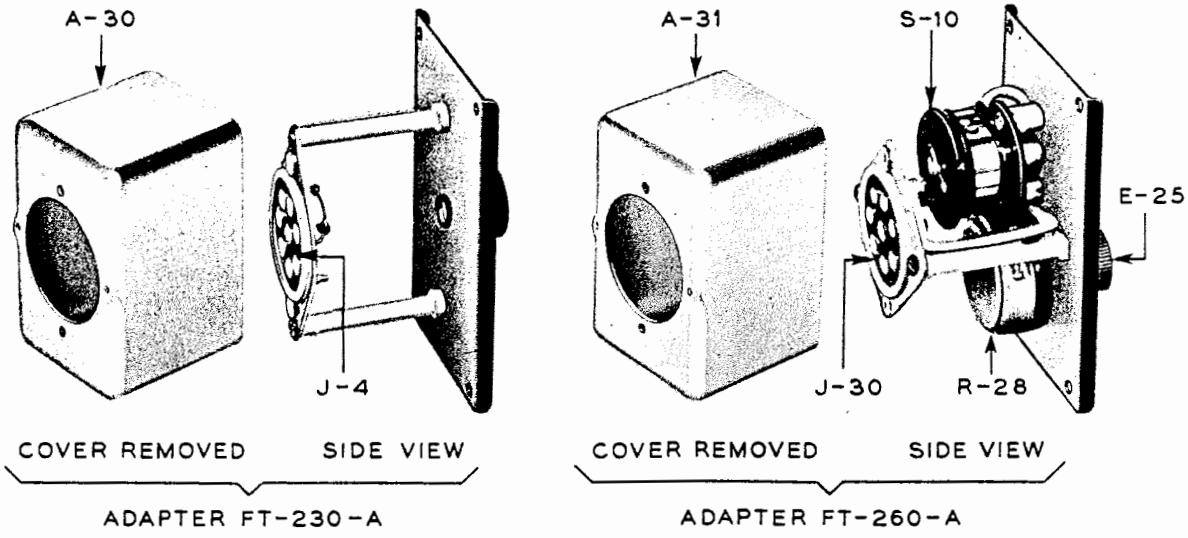


FIGURE 6—ADAPTERS FT-230-A AND FT-260-A

(16) The cathode of detector-CW oscillator tube V-7 (Tube VT-133) is connected directly to ground, and capacitors C-6C, C-7B, C-15B, C-20A and C-30 are cathode resistor by-pass capacitors for the r-f and audio amplifier tubes. All of these capacitors are of the foil-paper type except C-30 (a 15-microfarad electrolytic unit) which must possess high capacitance in order to prevent audio degeneration in the output amplifier.

(17) All control grids have a d-c path to ground. R-2 and R-20 are each 2 megohms, but the resistance to ground of all other control grids is 100,000 ohms or less.

(18) The screen grid circuits of tubes V-3, V-4, V-5 and V-6 connect to the junction of a voltage divider, formed by R-22 and R-23 across the high-voltage side of the dynamotor. Resistor R-8, with capacitors C-7A and C-16A, act as a filter to isolate r-f and i-f tube screen circuits. The screen grid of audio amplifier tube V-8 connects to the high voltage filtered plate supply line.

(19) The suppressor-grids of tubes V-3, V-5 and V-6 are connected to their respective cathodes at the tube sockets.

(20) The plates of all tubes connect either direct or through decoupling resistors to the high-voltage dynamotor line. R-7 with C-6A and R-13 with C-20C act as r-f filters. C-10 is the fixed series capacitance in r-f oscillator circuit and with R-6 it serves, incidentally, as an r-f filter. R-15, R-16 and R-17 act in the dual capacity of reducing the plate supply voltage for tube V-7 to the proper value and, with C-15C and C-25, as a filter. The plate of the output tube is connected through the primary of T-1 to the dynamotor side of L-15 which isolates this circuit from the other high-voltage circuits and reduces the possibility of "motorboating." "Motorboating" results when two circuits are coupled by a common impedance, and condenser C-32 would function in that manner if the plate of tube V-8 were connected to it.

(21) The CW heterodyne oscillator circuit is composed of a tuned-plate oscillator using the triode section of tube V-7. L-12 and L-13 are the grid and plate coils. C-27 and trimmer C-28 are tuning capacitors. C-26 and R-14 are the oscillator grid capacitor and resistor. C-33 is connected between the plate of the CW oscillator and the control grid of second i-f amplifier tube V-6. In the 190-550 kc receiver, C-33 is a 3 mmf capacitor outwardly resembling a small composition resistor. In other receivers, C-33 is a capacitance, formed by the proximity of pin plugs in the second i-f receptacle, and has a capacitance of less than 2 micromicrofarads. The amplitude of oscillation in the CW oscillator and the capacitance of C-33 are designed to produce the correct heterodyne voltage at the control grid of the second i-f amplifier for reception of CW signals. A connection at the junction of R-15 and R-17 goes to a contact on switch S-2. The MCW position of S-2 connects this line to ground, thus cutting off the CW oscillator plate supply. In the CW position, the ground is removed, and normal plate supply for the CW oscillator is obtained from the dynamotor through dropping resistors R-16, R-17 and R-15.

(22) The audio frequency filter circuit in the high-voltage supply consists of C-16B, a 0.22 microfarad foil-paper capacitor; C-32, a 5-microfarad electrolytic capacitor; and L-15, a 3-henry choke. This circuit suppresses all but a negligible audio frequency ripple on the high-voltage supply.

(23) C-16C is an r-f filter capacitor designed to reduce r-f dynamotor disturbances. (C-34 is a 0.001 microfarad capacitor which is connected across the dynamotor low-voltage brushes as an additional suppressor of r-f disturbances.)

(24) L-14 is an r-f choke designed to prevent r-f disturbances of any type from getting out of the receiver onto the primary source line where it might radiate enough energy to be picked up by a receiving antenna.

(25) Rack FT-220-A (shown in Figure 7) fulfills three functions: (1) it provides compartments into which the receivers may be slid and locked in place; (2) it provides a convenient electrical junction box for essential interconnections and (3) it contains a "sidetone-receiver output" relay, an A TEL.-B TEL. toggle switch, a fuse and set of A TEL.-B TEL. headset jacks for each of three receivers. The three receivers connect to receptacles J-18, J-19 and J-20, and the three cords to Radio Control Box BC-450-A connect to J-21, J-22 and J-23. A cord from the primary source connects to J-24, and a cord from Modulator Unit BC-456-A* connects to J-6 or to J-7.

* See Paragraph 15*d* for difference between Modulator Units BC-456-A and BC-456-B.

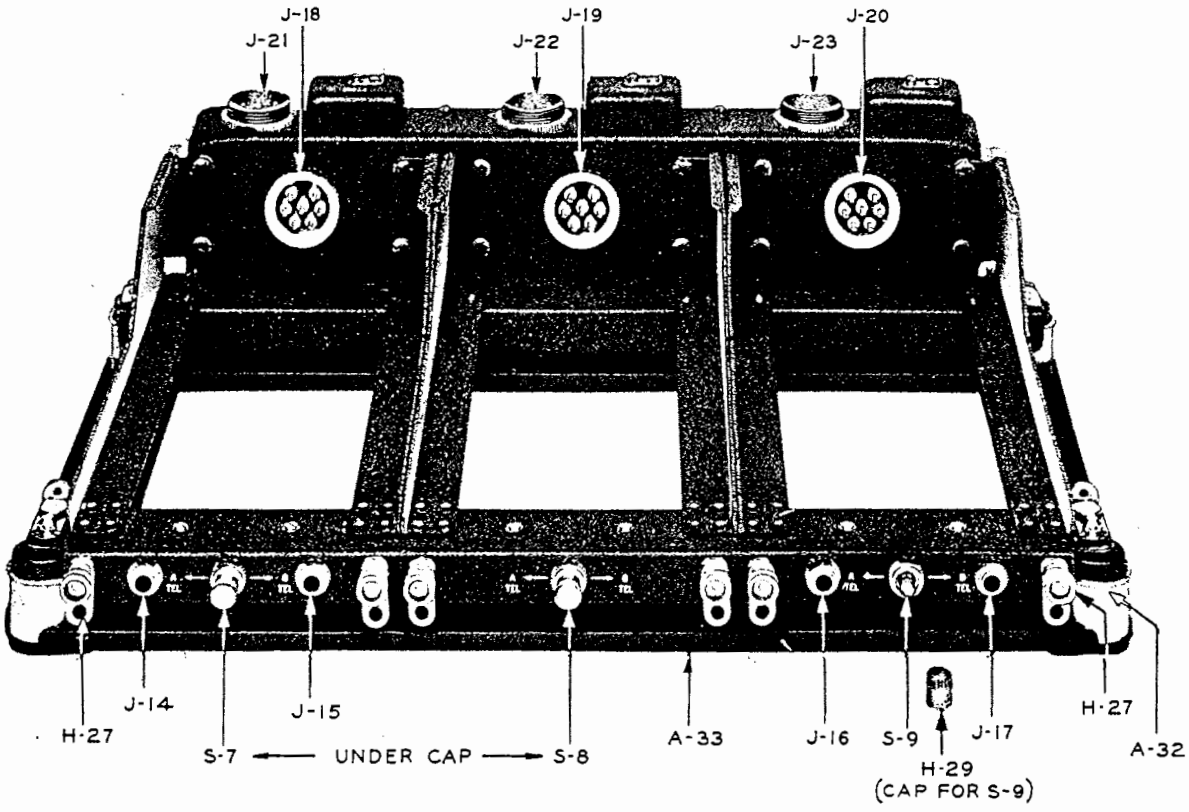


FIGURE 7A—RACK FT-220-A AND MOUNTING FT-221-A, FRONT VIEW

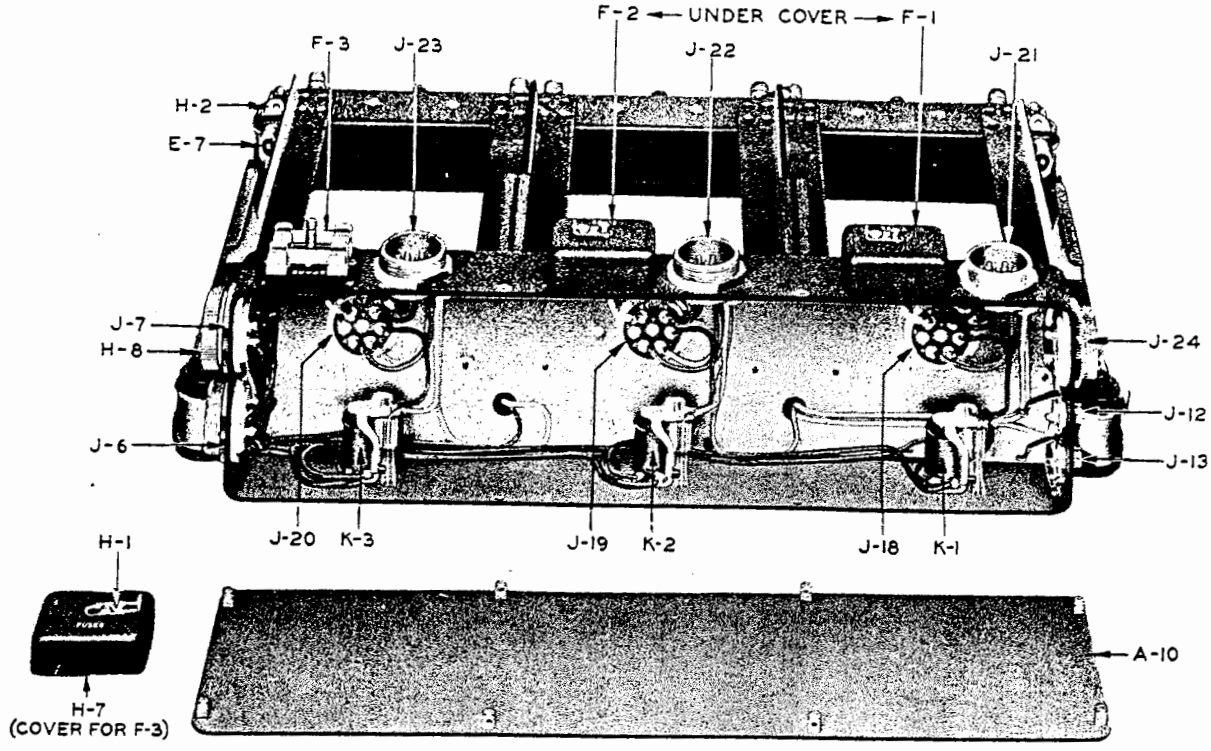


FIGURE 7B—RACK FT-220-A AND MOUNTING FT-221-A,
REAR VIEW WITH COVER OF RACK REMOVED

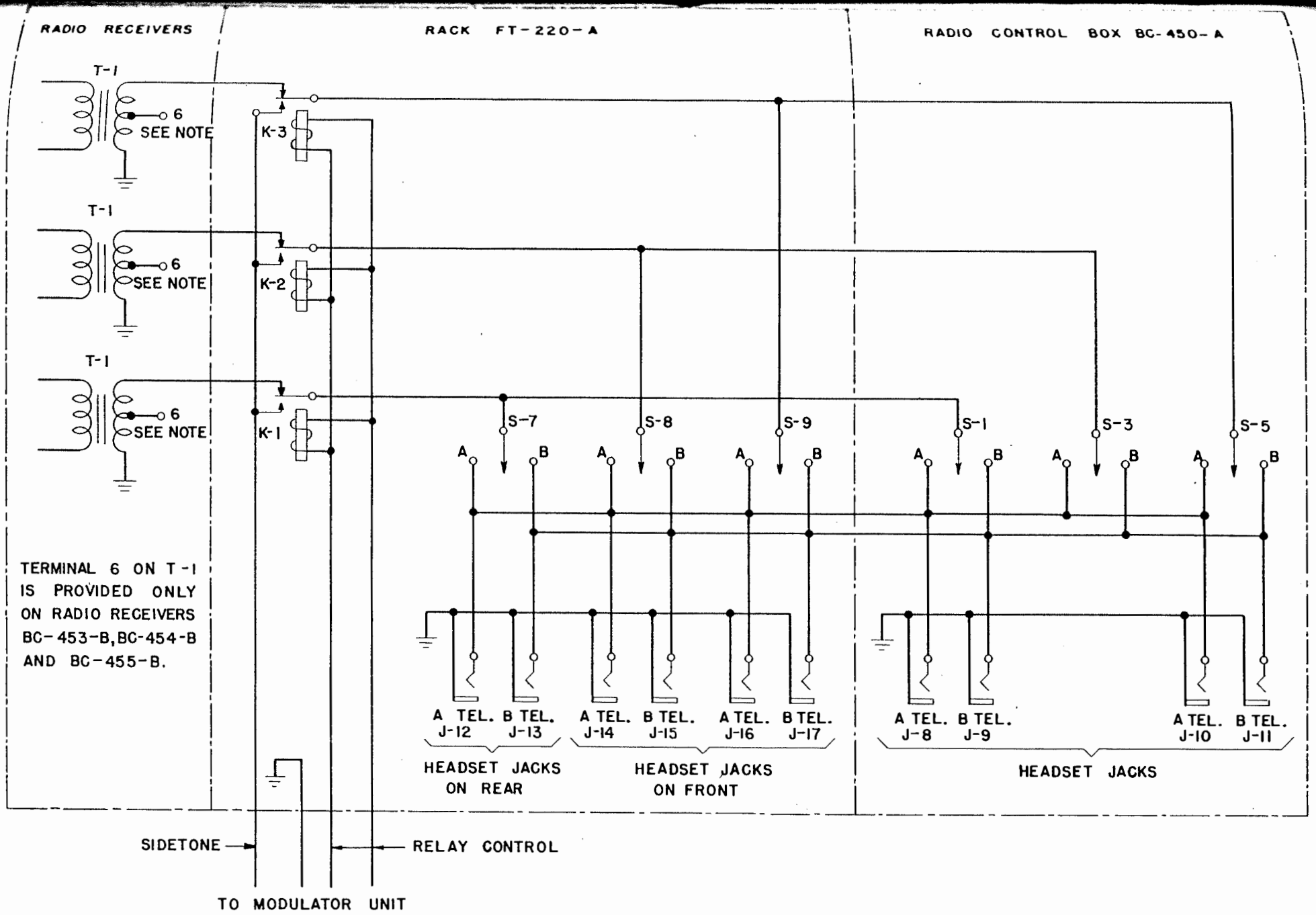


FIGURE 8—FUNCTIONAL DIAGRAM OF RECEIVER OUTPUT CONNECTIONS

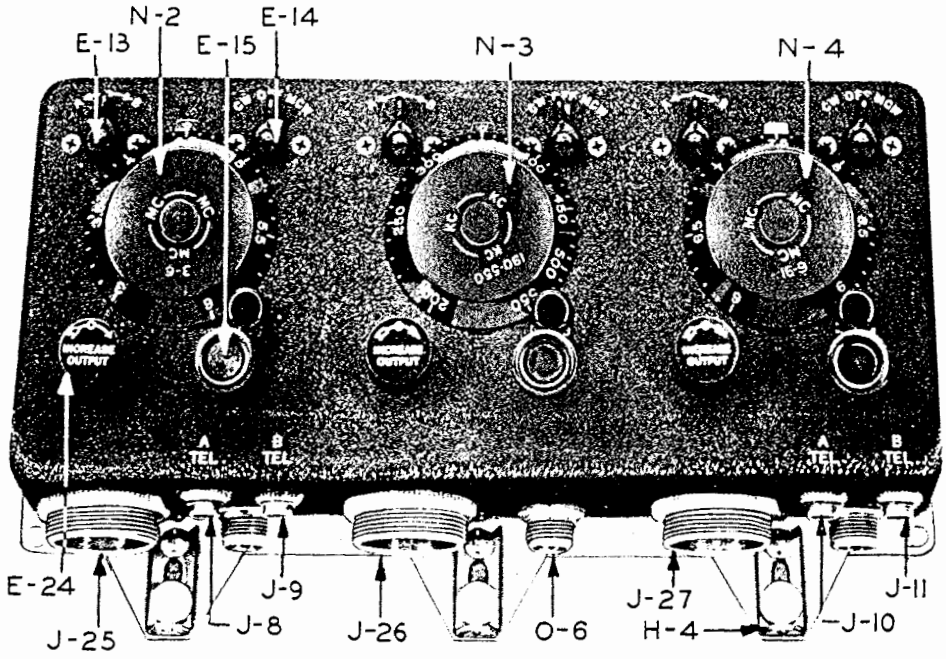


FIGURE 9A—RADIO CONTROL BOX BC-450-A, FRONT VIEW

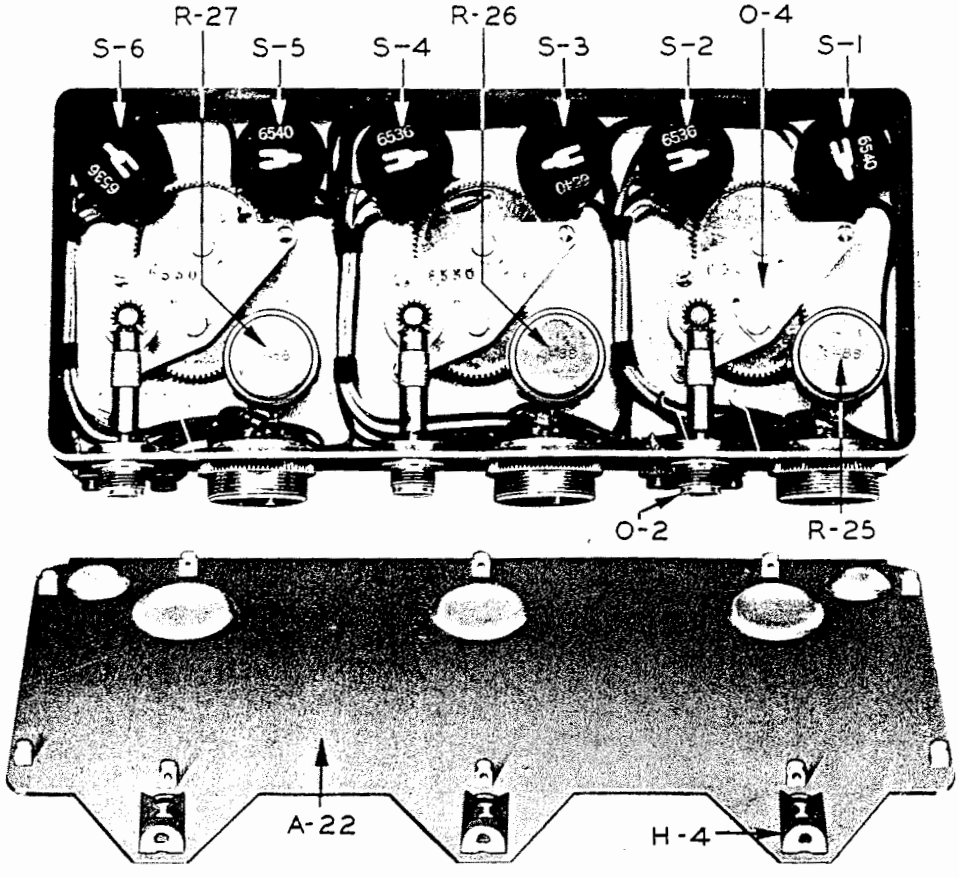


FIGURE 9B—RADIO CONTROL BOX BC-450-A, REAR VIEW WITH COVER REMOVED

b. Radio Control Boxes BC-473-A (or -B), BC-496-A and BC-450-A

(1) Radio Control Box BC-450-A provides for three radio receivers. It is shown in Figures 1 and 9, and a schematic circuit diagram of the electrical connections is shown in Figure 26. Radio Control Boxes BC-496-A and BC-473-A (or -B) provide for two and one receivers, respectively. They are shown in Figure 10. Practical wiring diagrams for the three units are shown in Figure 45. Electrically and mechanically, except for the calibration markings on the dials, each section of these radio control boxes is like every other section. Each section is used independently to tune and control one receiver.

(2) Refer to Figure 26 in connection with the following: When S-2 is turned to MCW, primary voltage is applied to one receiver and 7 on J-25 is connected to ground in order to disable the heterodyne oscillator in that receiver. With S-2 on CW the heterodyne oscillator is used for the reception of unmodulated signals. R-25 is a 0-50,000-ohm (variable) gain control resistor in the r-f and first i-f amplifier cathode circuits. S-1 is a three-position switch which isolates the receiver output or connects it to either of the headset lines A and B. Figure 8 is a functional diagram showing the receiver output connections. An examination of this will show that when S-1 is thrown to A, the output of the receiver connected thereto is connected to line A, providing that switch S-7 on Rack FT-220-A is in the center position. S-1 may be switched to B if desired or it may be left in the center as a stand-by position. The output of all receivers may be switched to A or to B, or one may be on A while the others are on B. The object of the A TEL.-B TEL. system is to provide two separate listening channels which may be reduced to one when the occasion demands.

15. TRANSMITTING EQUIPMENT

a. Radio Transmitters BC-457-A, BC-458-A, BC-459-A and BC-696-A with Racks FT-234-A, FT-226-A, FT-276- and FT-331-A*

(1) Four transmitters are available for use as parts of Radio Set SCR-274-N. Any one of these transmitters may be installed on Rack FT-234-A, any two on Rack FT-226-A, any three on Rack FT-276-* or

* Rack FT-276- was not manufactured at the time of publication of this instruction book.

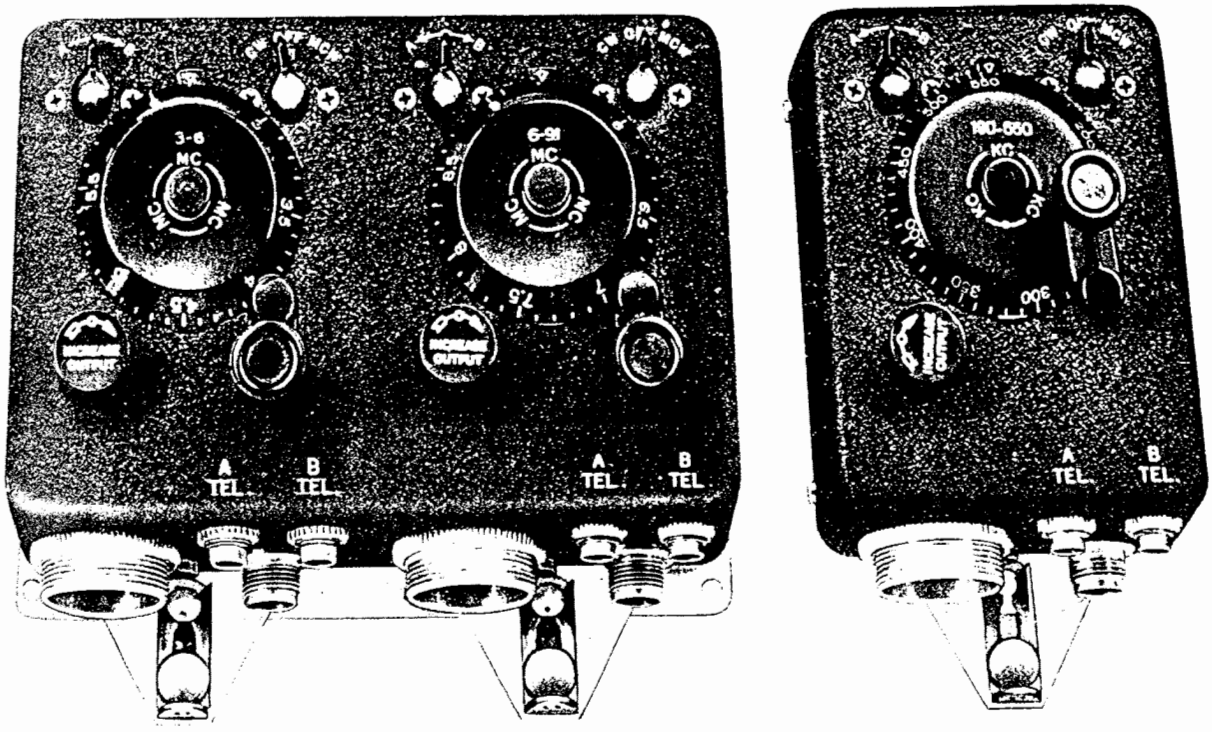


FIGURE 10—LEFT, RADIO CONTROL BOX BC-496-A (FOR TWO RECEIVERS); RIGHT, RADIO CONTROL BOX BC-473-A (OR -B) (FOR ONE RECEIVER)

all four on Rack FT-331-A. Each of the transmitters contains a separate set of master-oscillator, r-f power-amplifier and resonance indicator tubes with their associated circuits. However, each transmitter obtains its d-c high voltage from a common Dynamotor DM-33-A and the proper modulating voltages from a common Modulator Unit BC-456-A (or -B)**. The necessary remote controls are provided by a common Radio Control Box BC-451-A.

(2) Figure 27 shows the schematic circuit diagram of a typical transmitter. Schematically, the four units are alike, although they differ in the inductance and capacitance values in the r-f circuits and in the values of R-70 and R-73 which are associated with resonance indicator tube V-53 (Tube VT-138). Figure 47 shows the practical wiring diagram of the four trans-

**The difference between Modulator Units BC-456-A and BC-456-B is described in Paragraph 15*d*.

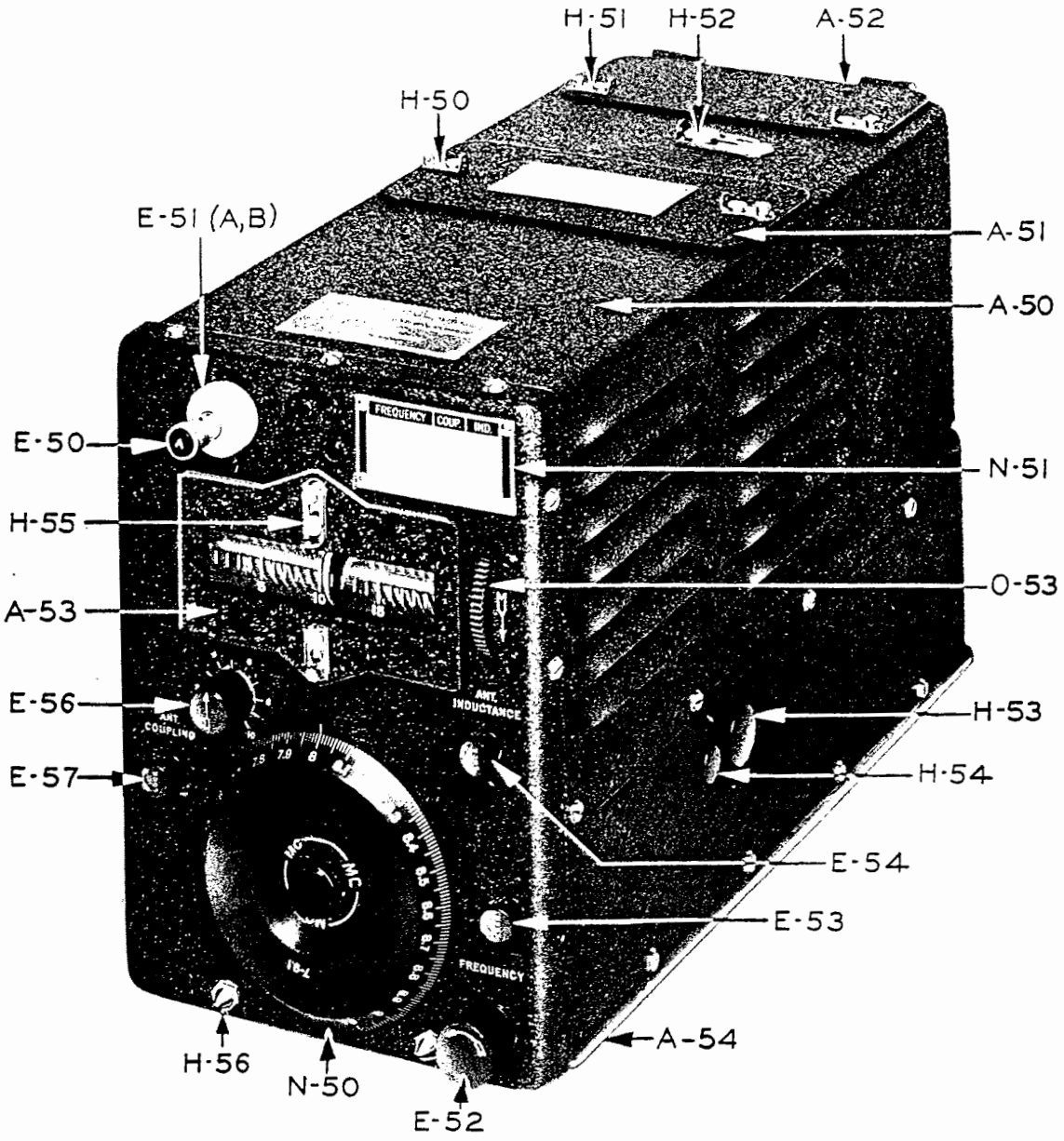


FIGURE 11—TYPICAL RADIO TRANSMITTER

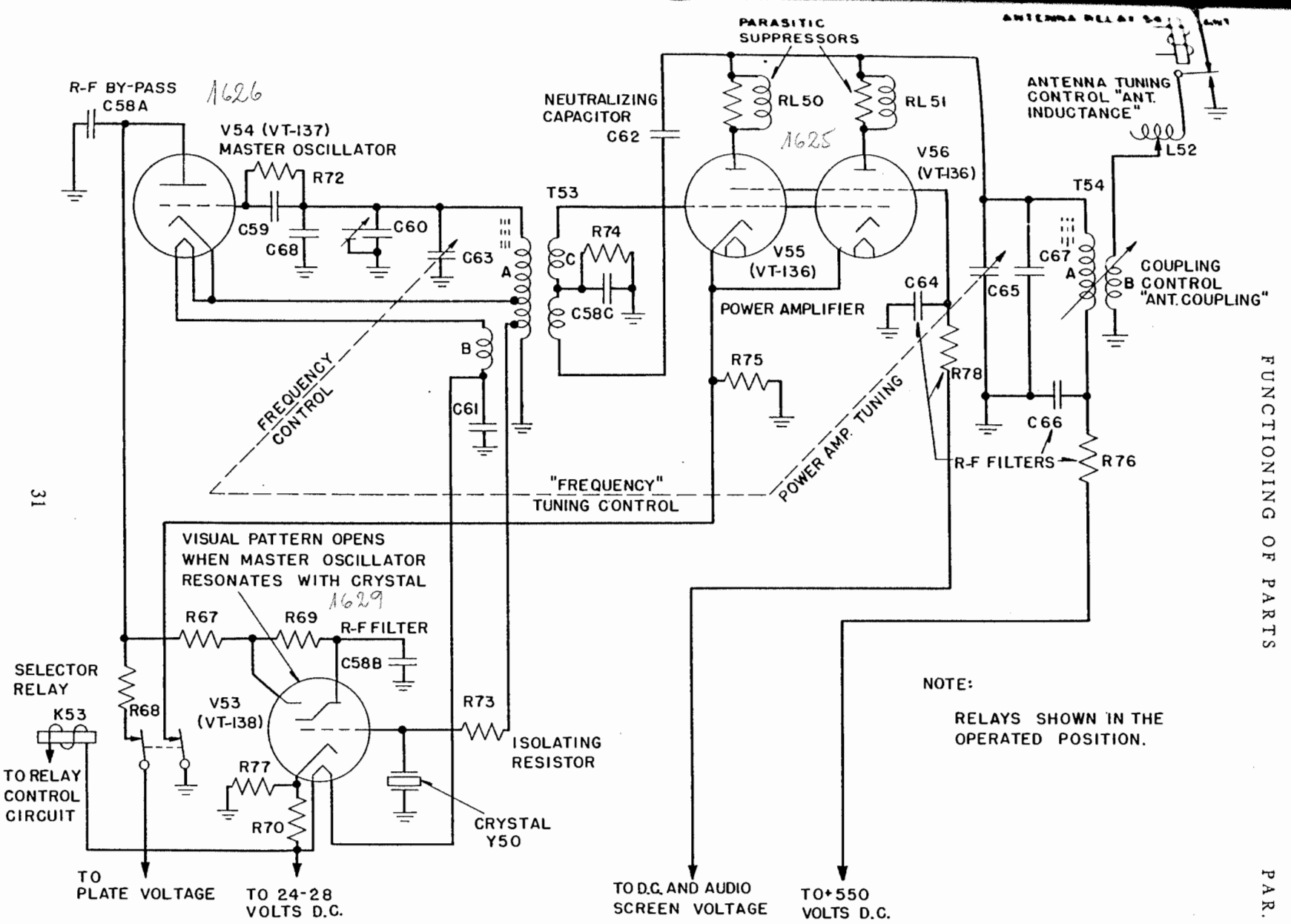


FIGURE 12—FUNCTIONAL DIAGRAM OF THE R-F CIRCUITS OF A TYPICAL RADIO TRANSMITTER

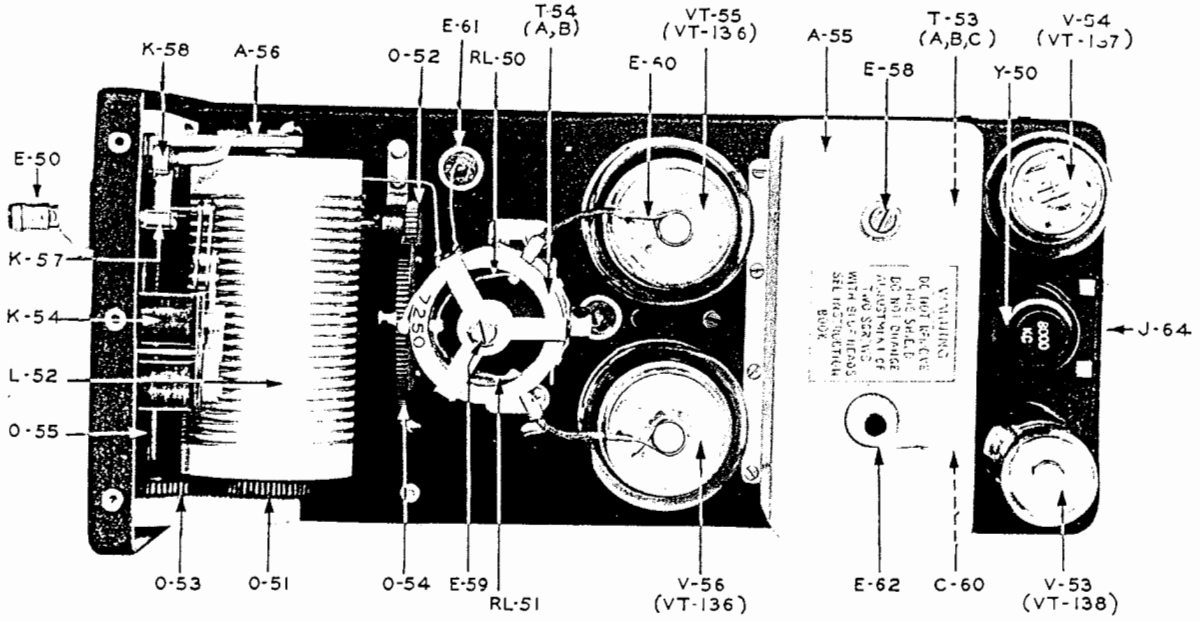


FIGURE 13–TYPICAL RADIO TRANSMITTER, TOP VIEW WITH SHIELD REMOVED

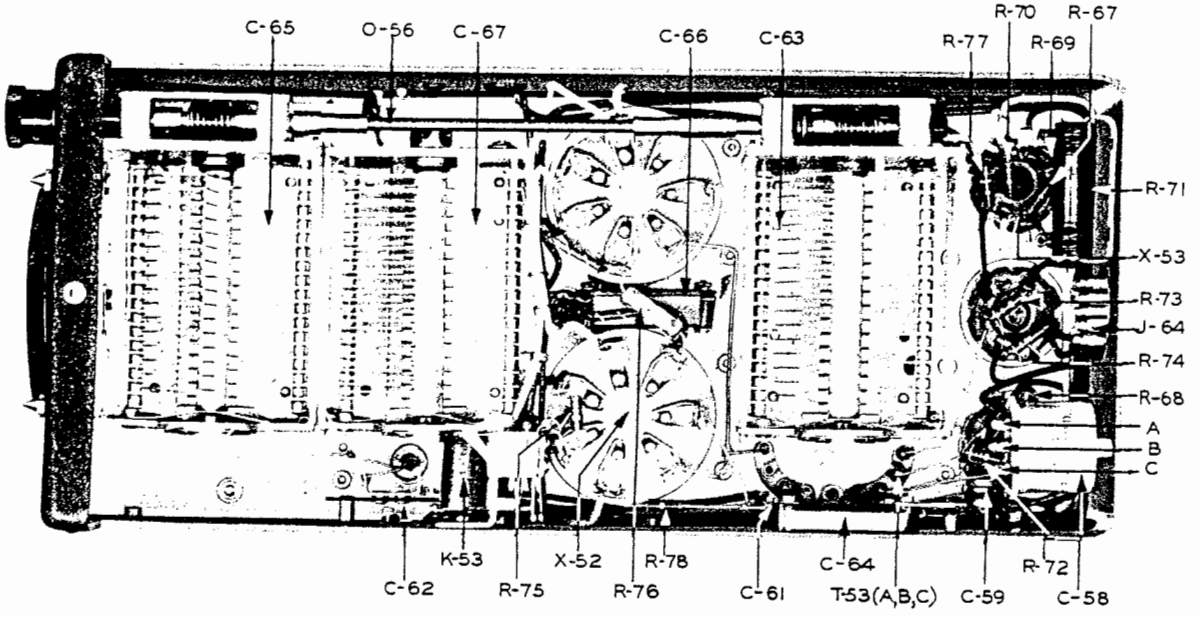


FIGURE 14–TYPICAL RADIO TRANSMITTER, BOTTOM VIEW WITH COVER REMOVED

mitters. Symbol numbers and terminal numbers shown on this drawing correspond with those on the schematic circuit diagram of Figure 27.

(3) Tube V-53 (Tube VT-138) is the resonance indicator, and tube V-54 (Tube VT-137) is the master oscillator. Tubes V-55 and V-56 (both Tube VT-136) are r-f power amplifiers connected in parallel. The electrical characteristic ratings of each of these tubes are given in Table 16.

(4) T-53A is the master-oscillator coil which is tuned by capacitor C-63. Fixed capacitor and trimmer C-60 and compensating capacitor C-68 are connected in parallel with C-63. R-72 and C-59 are the grid-leak and grid capacitor elements of the master-oscillator circuit. T-53B is a bifilar winding wound with the master-oscillator coil from the ground to the cathode tap in order that variations of cathode-to-heater capacitance within the tube will not affect the frequency of oscillation. It is essentially an r-f choke. The plate of tube V-54 (VT-137) is grounded for r-f by capacitor C-58A, hence the plate is essentially connected to the ground end of T-53A. The cathode is connected several turns above ground, and the grid is connected to the top of the coil. T-53C has a dual function: (*a*) it excites the grids of the r-f power amplifier tubes and (*b*) it provides a neutralizing voltage which is applied to the high voltage side of C-65 through the fixed neutralizing capacitor C-62. R-68 is a filter resistor which, with the aid of C-58A, isolates the plate circuit of tube V-54 (Tube VT-137) from other r-f circuits. C-61 and C-58C are r-f bypass capacitors designed to keep the low side of T-53B and the tapped point of T-53C at ground potential for radio frequency. R-74 is a resistor in the grid circuit of the r-f power amplifier tubes. Grid current in these tubes (which increases with greater excitation from the master-oscillator) flows through R-74. The sense of the grid current flow is such as to make the grids of the r-f power amplifier tubes more negative with respect to ground as the grid current increases. The high-voltage side of R-74 is connected to terminal 2 on receptacle J-64 to provide a convenient point in Racks FT-234-A, FT-226-A, FT-276-* and FT-331-A (terminal 2 on J-62) where the d-c grid bias, or excitation, may be measured.

(5) The two r-f power amplifier Tubes VT-136 are connected in parallel (except for an isolation of the two plates by separate parasitic suppressors RL-50 and RL-51). The power amplifier tuned circuit consists of coil T-54A shunted by fixed capacitor C-67 and tuning capacitor C-65. R-76, together with C-66, and R-78 with C-64, isolate the plates and screens of the amplifier tubes. T-54B is an antenna coupling coil mounted within T-54A. The amount of coupling to T-54A is controlled from the front of the radio transmitter by the ANT. COUPLING knob. L-52 is a continously adjustable inductor in the antenna circuit; its inductance is adjusted from the front of the radio transmitter by the ANT. INDUCTANCE knob. This is the only antenna tuning control.

(6) Y-50 is a piezo-electric crystal mounted in a metal-tube envelope having a standard octal base. The crystal may be reached through an opening, having a hinged cover, in the top-rear of the radio transmitter. If desired, a similar crystal, but of a different nominal frequency, may be substituted for the crystal normally supplied, if for any reason that is desired. The electrical circuits associated with tube V-53 (Tube VT-138) are such that any crystal whose nominal frequency falls within the range of the radio transmitter may be used. R-77 and R-70 are bias resistors for tube V-53. R-73 is an isolating resistor which separates Y-50 from the tap on the master-oscillator tuning coil, T-53A. (This prevents an interaction between the crystal and master-oscillator which would affect the frequency of the master-oscillator.) R-F voltage at this tap is applied through R-73 to Y-50 and to the grid of tube V-53. This tube acts as a grid circuit detector whose plate current increases as its grid voltage becomes more positive. When the crystal and master-oscillator frequencies differ appreciably, the impedance of the crystal is negligible as compared with the resistance of R-73, and practically all of the r-f voltage from T-53A appears across R-73. As the master-oscillator frequency approaches that of the crystal (within 200-300 cycles), the r-f voltage on the grid of tube V-53 increases, because the impedance of Y-50 increases with respect to R-73. The resulting plate current flowing through R-69 produces a difference in potential between the target and plate, and a shadow appears on the target. The shadow angle is greatest when the master-oscillator and crystal frequencies are exactly equal since this is the condition

* Mountings and racks with no letter suffix were not manufactured at the time of publication of this instruction book.

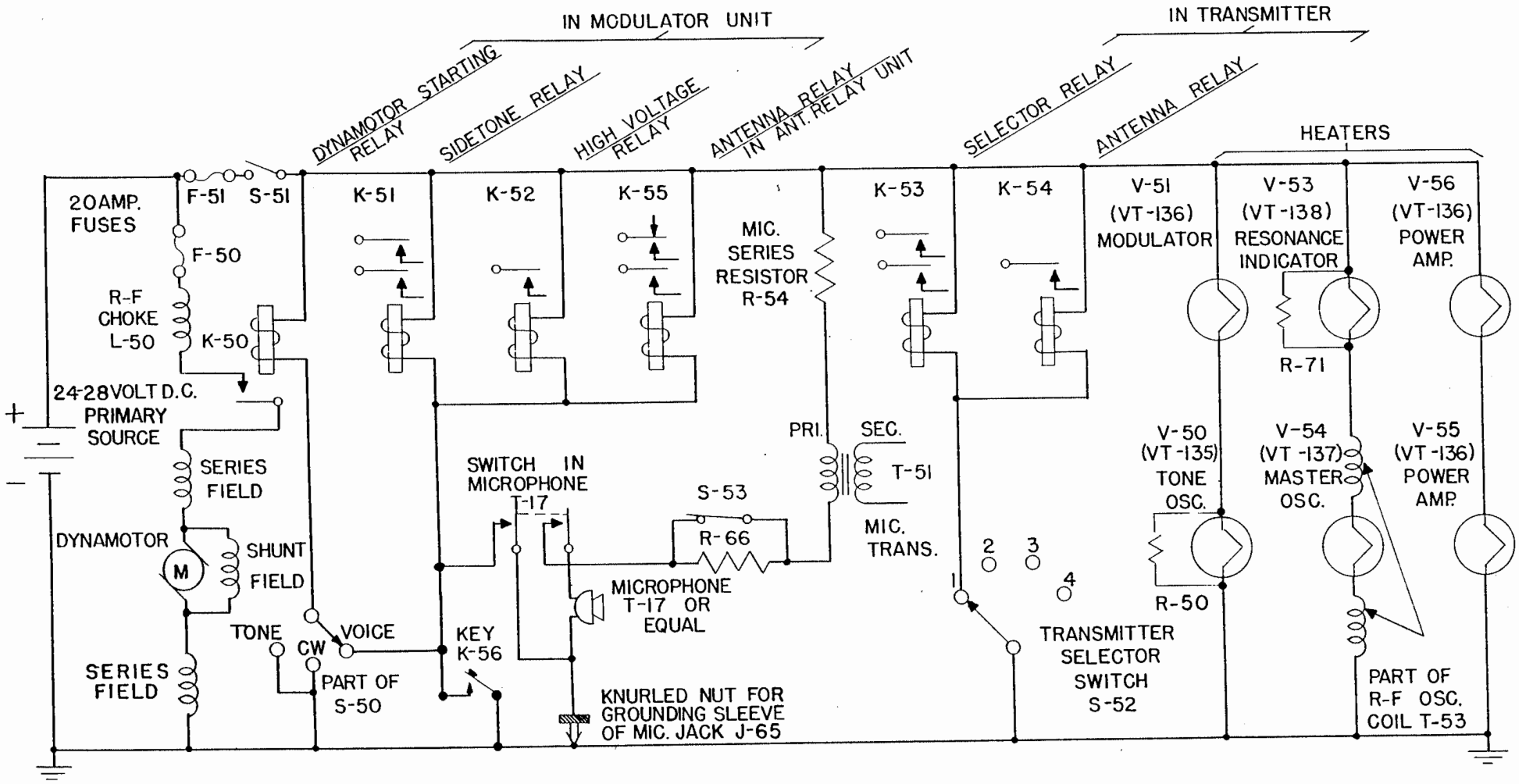


FIGURE 15—FUNCTIONAL DIAGRAM OF THE LOW VOLTAGE D-C CIRCUITS OF THE TRANSMITTING EQUIPMENT

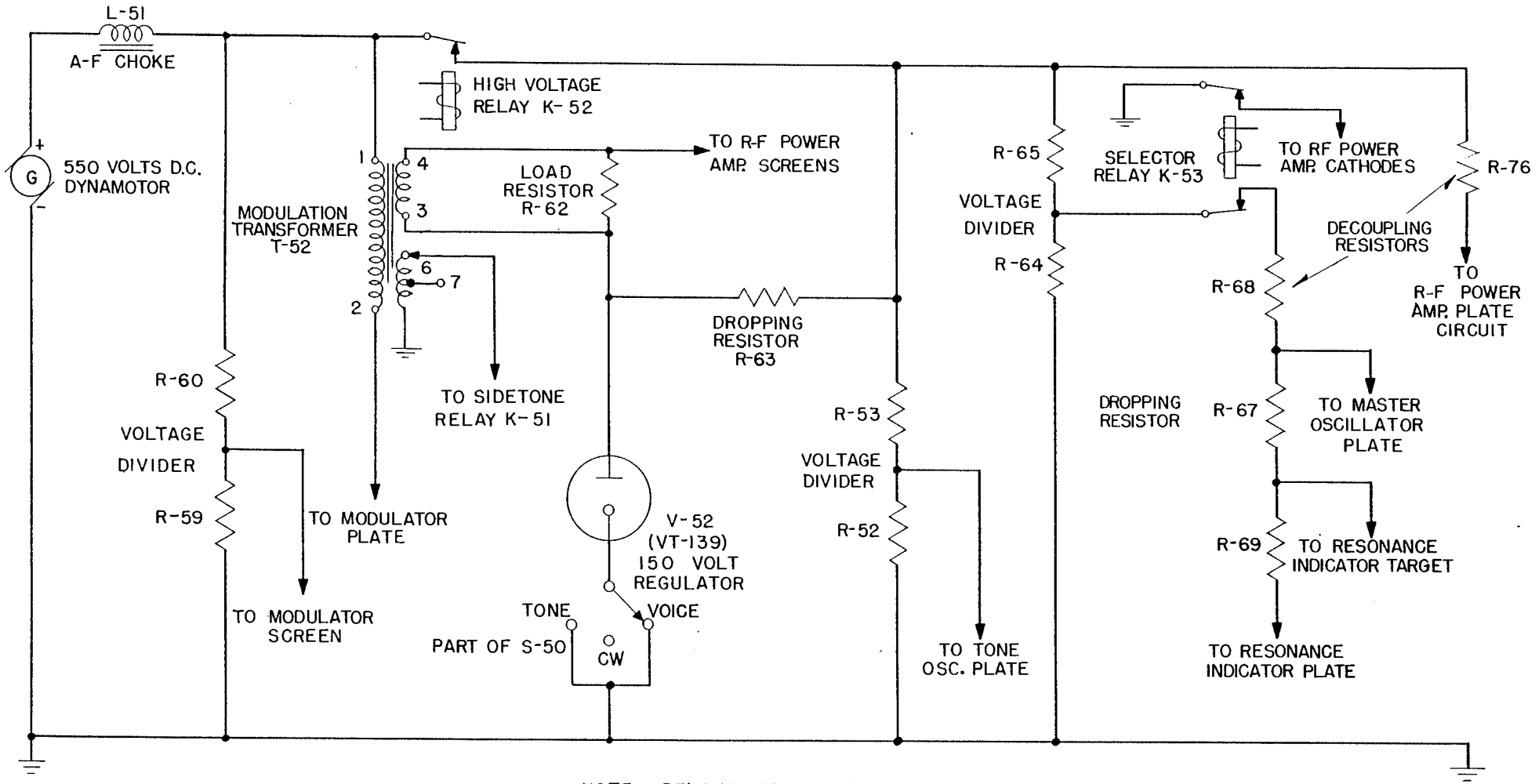


FIGURE 16—FUNCTIONAL DIAGRAM OF THE HIGH-VOLTAGE D-C CIRCUITS OF THE TRANSMITTING EQUIPMENT

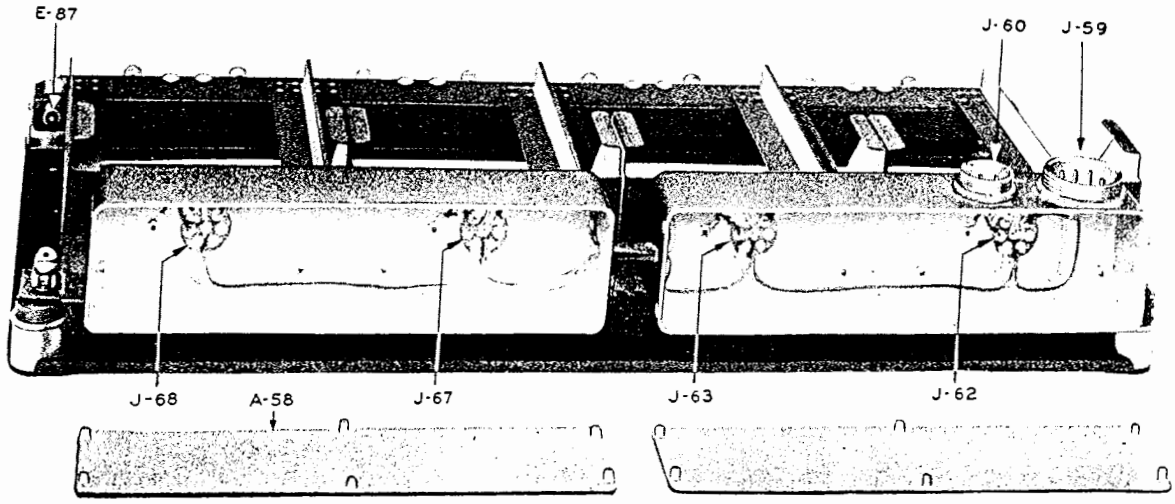


FIGURE 17A—RACK FT-331-A AND MOUNTING FT-332-A, REAR VIEW WITH COVER OF RACK REMOVED

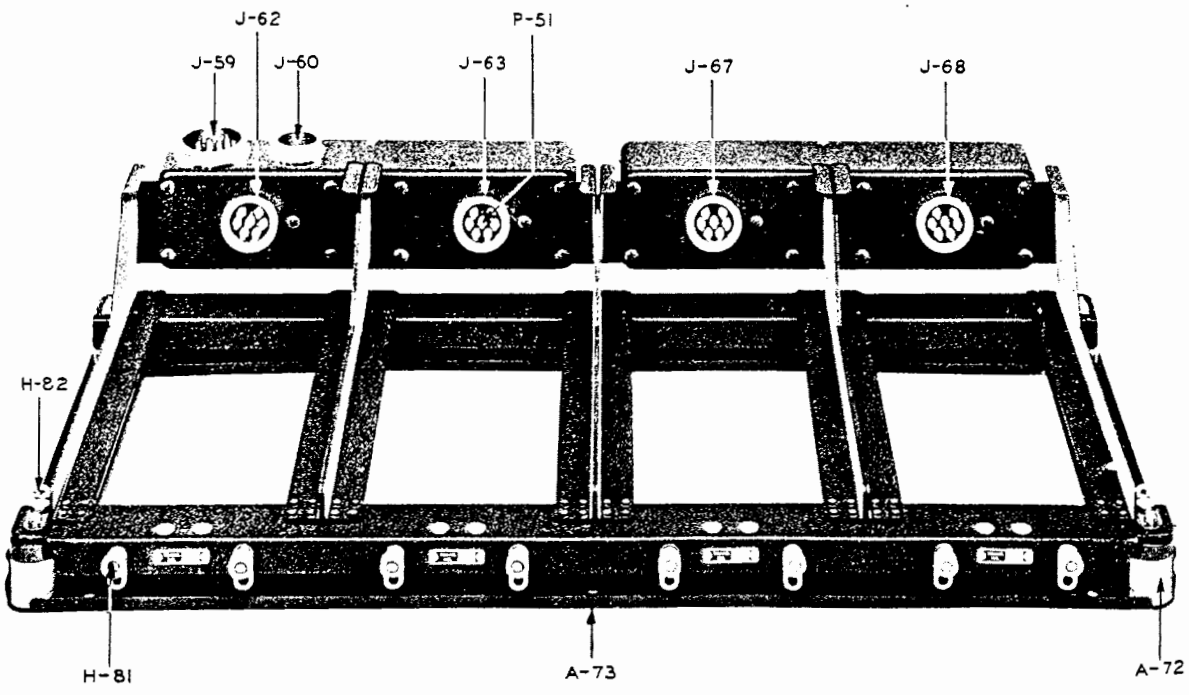


FIGURE 17B—RACK FT-331-A AND MOUNTING FT-332-A, FRONT VIEW

where the crystal impedance is highest and, therefore, the r-f voltage from T-53A impressed on the grid of tube V-53 is maximum. R-67 is used to decrease the plate voltage for tube V-53 and C-58B is an r-f by-pass capacitor connected to the plate of that tube.

(7) Relays K-53 and K-54 are closed in one of the transmitters when switch S-52 on Radio Control Box BC-451-A is set for that transmitter and TRANS. POWER switch S-51 in the same box is ON. (The transmitters are numbered from left to right in Racks FT-226-A, FT-276-* and FT-331-A. These numbers correspond to the numbers on switch S-52). K-53 closes the plate supply to the master-oscillator and resonance indicator tubes and also short-circuits R-75, a 51,000-ohm resistor in the cathode-to-ground circuit of the r-f power amplifier tubes. Plate and screen voltages are constantly supplied to power amplifier tubes V-55 and V-56 (both Tube VT-136) in all transmitters, but only one transmitter, whose R-75 is short-circuited, is operative. The bias voltage developed across R-75, when it is not short-circuited, is sufficient to reduce the plate and screen current nearly to zero. There is no excitation on the grids of the power amplifier tubes except in the *one* transmitter selected, because the plate supply to the master-oscillator tube V-54 (Tube VT-137) is closed only for that unit.

(8) Relay K-54 transfers the high potential end of the antenna tuning inductor L-52 from ground to the antenna binding post.

(9) The vacuum tube heater circuits are connected in series-parallel and remain energized as long as TRANS. POWER switch S-51 is ON. The arrangement may be seen best in Figure 15.

(10) Racks FT-234-A, FT-226-A, FT-276-* and FT-331-A each contain two ground binding posts and circuits interconnecting Modulator Unit BC-456-A (or -B) with the transmitters and with Antenna Relay Unit BC-442-A.

b. Radio Control Box BC-451-A

(1) Radio Control Box BC-451-A contains a three-position switch S-50 which controls the circuits determining the type of emission, a four-position switch S-52 which controls the circuits determining the choice of transmitter, microphone jack J-65, external key jack J-66, built-in key K-56, microphone series resistor R-66 (shunted by a switch S-53) and toggle switch, S-51, in the line direct from the primary source. This box contains receptacle J-55 for connection to Modulator Unit BC-456-A (or -B).

* Mountings and racks with no letter suffix were not manufactured at the time of publication of this instruction book.

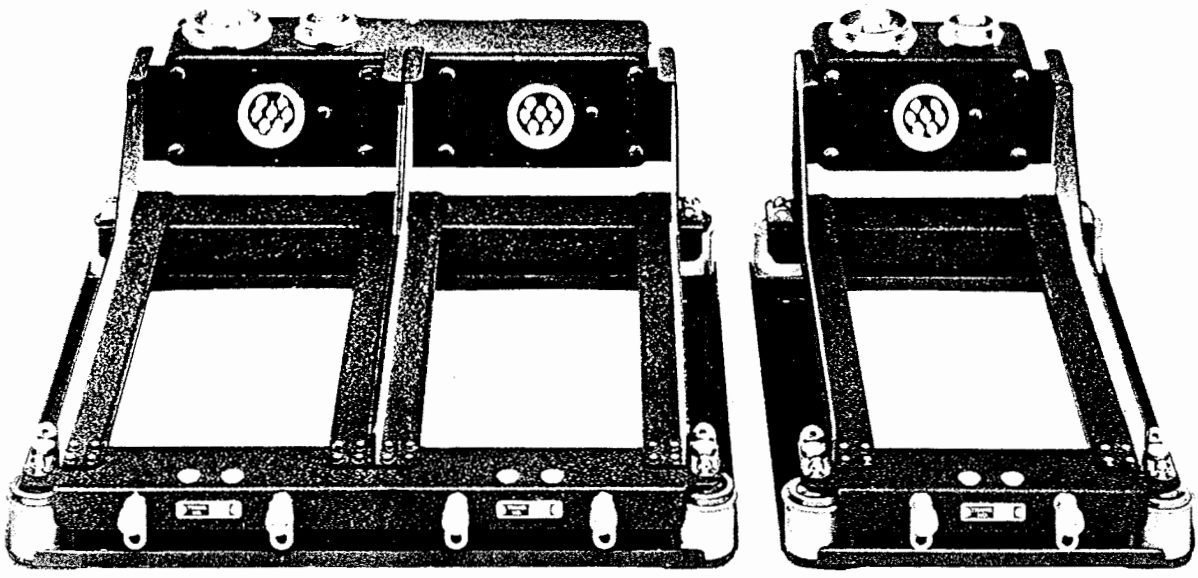


FIGURE 18—LEFT, RACK FT-226-A (FOR TWO TRANSMITTERS), RIGHT, RACK FT-234-A (FOR ONE TRANSMITTER)

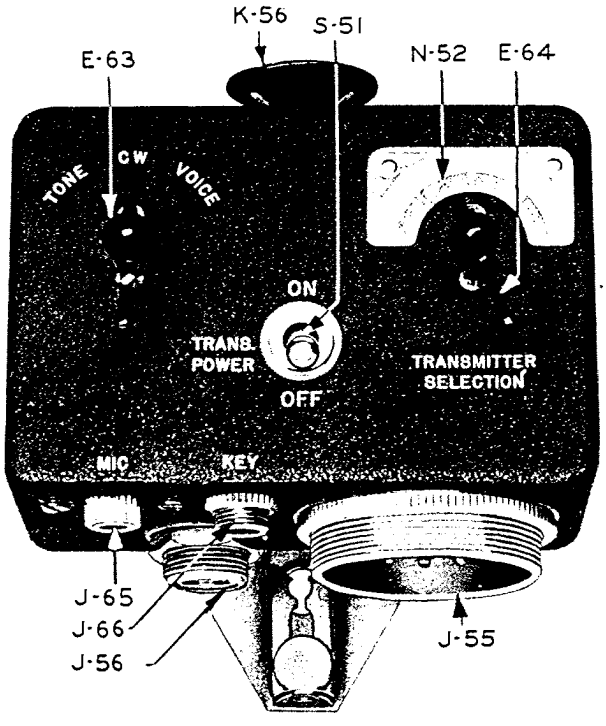


FIGURE 19A—RADIO CONTROL BOX BC-451-A, FRONT VIEW

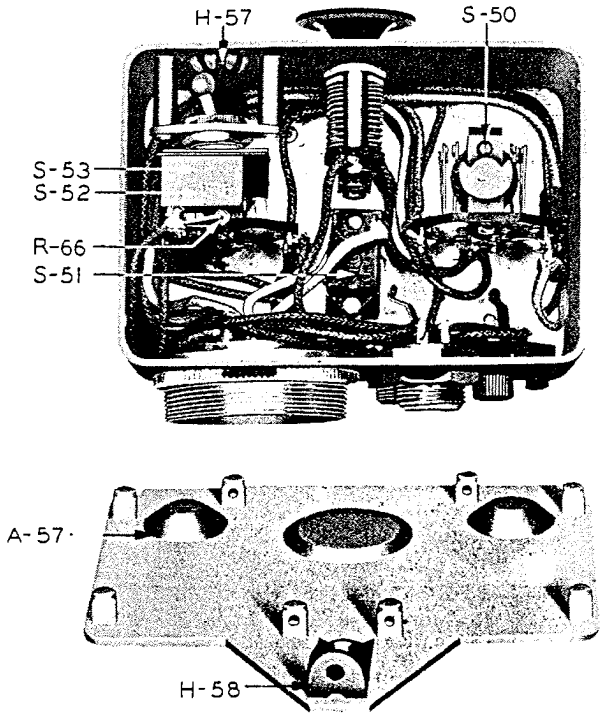


FIGURE 19B—RADIO CONTROL BOX BC-451-A, REAR VIEW WITH COVER REMOVED

(2) Microphone jack J-65 is constructed in such a manner that the sleeve may or may not be grounded to the box by turning the protruding knurled nut counter-clockwise or clockwise, respectively, as far as it will go by hand. In the counter-clockwise position, the sleeve is grounded and the push-to-talk button on the microphone will close the microphone and relay circuits to ground. With the nut in the maximum clockwise sense, the push-to-talk button may be permanently closed, and the pressing of the built-in key, external key or throttle switch will perform the functions of the press-to-talk button.

(3) Although S-52 on Radio Control Box BC-451-A is a four-position switch designed to select one of four transmitters, only position 1 is used with Rack FT-234-A. Positions 1 and 2 are used with Rack FT-226-A and positions 1, 2 and 3 with Rack FT-276-*. Positions 3 and 4 are used if a second modified FT-226-A is installed or if Rack FT-331-A is used. The modification of Rack FT-226-A consists of transferring the connections that go to terminals 8 and 9 on receptacle J-59 to terminals 6 and 7. It will then be necessary to add a junction box into which the cord from Modulator Unit BC-456-A (or -B) connects with two identical cords, one going to each of the racks.

c. Modulator Unit BC-456-A with Dynamotor DM-33-A

(1) Modulator Unit BC-456-A contains tone oscillator tube V-50 (Tube VT-135), speech-amplifying and modulator tube V-51 (Tube VT-136), a 150-volt voltage regulator tube V-52 (Tube VT-139), transformers, relays, chokes and other elements, to be described later, which are necessary to provide the audio-frequency power requirements of the transmitters. Dynamotor DM-33-A, mounted on the modulator unit, supplies the d-c high voltage requirements of the transmitters and the modulator unit. A schematic circuit diagram is shown in Figure 27.

*Mountings and racks with no letter suffix were not manufactured at the time of publication of this instruction book.

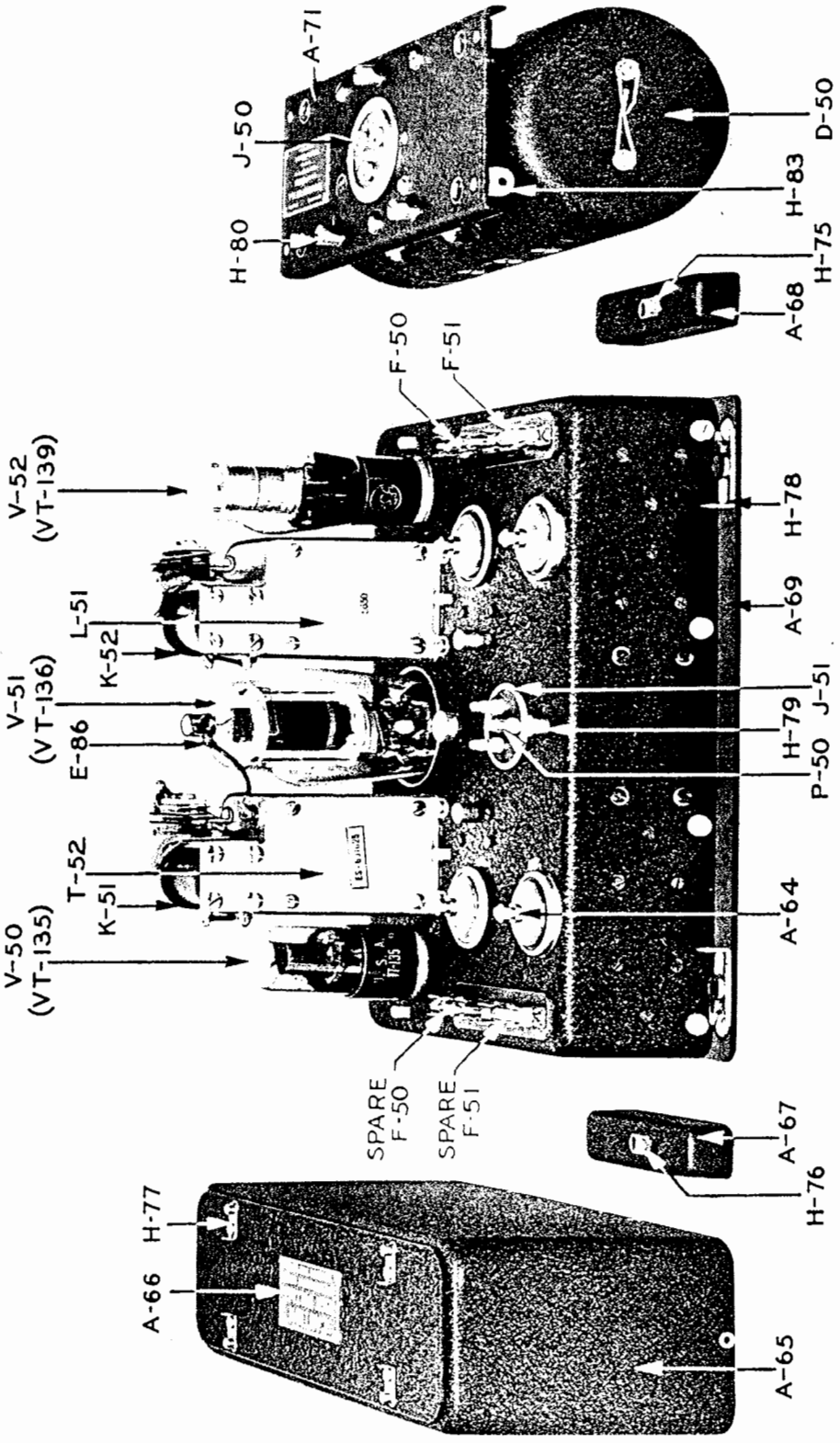
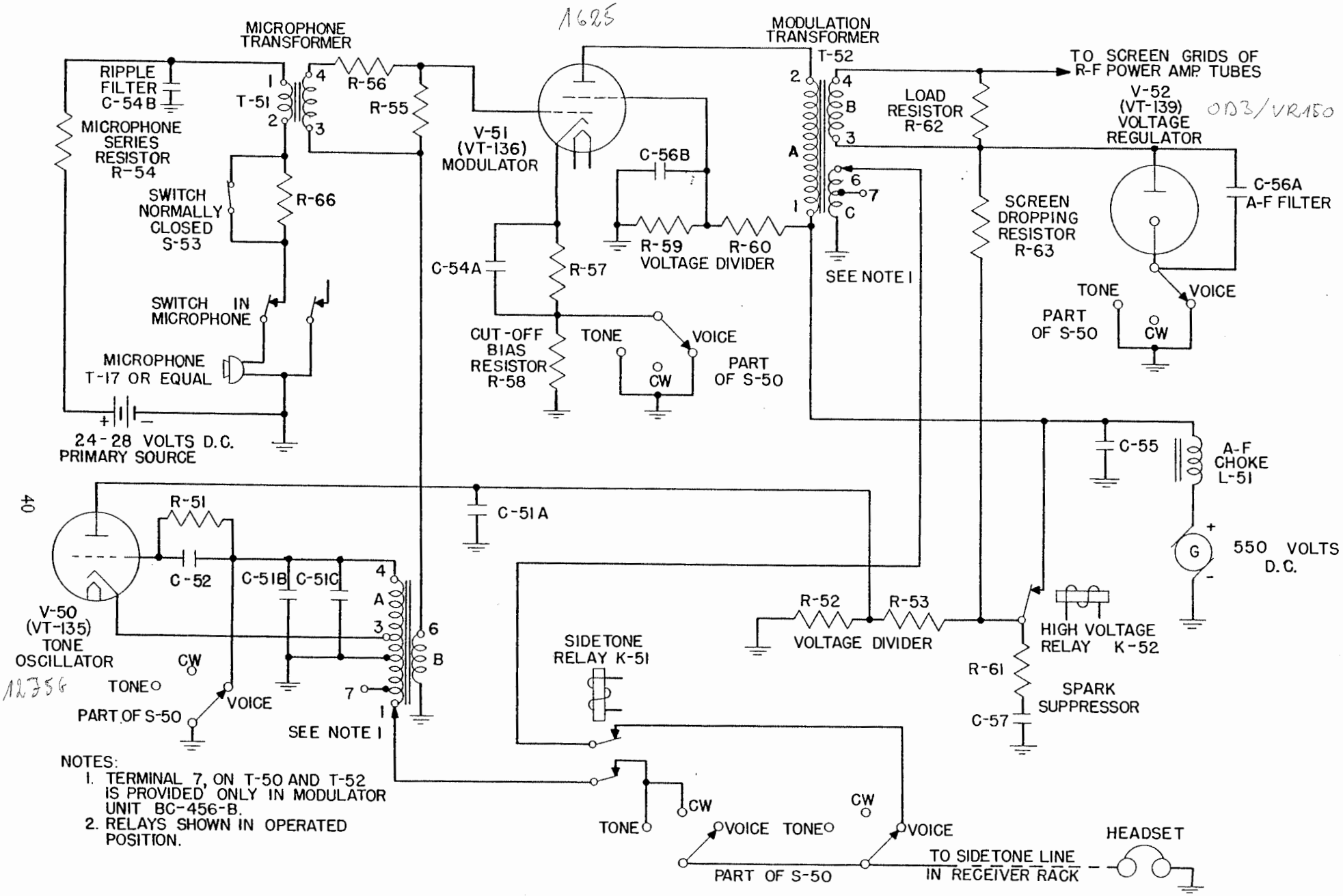
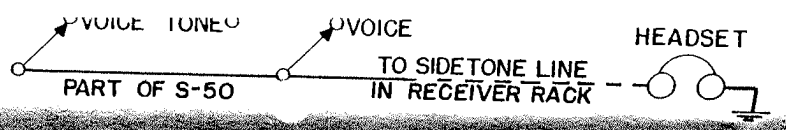


FIGURE 20—MODULATOR UNIT BC-456-B, TOP VIEW WITH SHIELD REMOVED, AND BOTTOM VIEW OF DYNAMOTOR DM-33-A


MICROPHONE TRANSFORMER
T-51
RIPPLE FILTER C-54B
MICROPHONE SERIES RESISTOR R-54
SWITCH NORMALLY CLOSED S-53
R-66
SWITCH IN MICROPHONE
MICROPHONE T-17 OR EQUAL
24-28 VOLTS D.C. PRIMARY SOURCE
R-56
R-55
V-51 (VT-136) MODULATOR
C-56B
C-54A
R-57
CUT-OFF BIAS RESISTOR R-58
TONE
VOICE
CW
PART OF S-50
R-59
R-60
VOLTAGE DIVIDER
MODULATION TRANSFORMER T-52
SEE NOTE 1
LOAD RESISTOR R-62
TO SCREEN GRIDS OF R-F POWER AMP. TUBES
V-52 (VT-139) VOLTAGE REGULATOR
SCREEN DROPPING RESISTOR R-63
C-56A A-F FILTER
C-55
A-F CHOKE L-51
G
550 VOLTS D.C.
C-51A
R-51
C-52
C-51B
C-51C
V-50 (VT-135) TONE OSCILLATOR
R-52
R-53
VOLTAGE DIVIDER
HIGH VOLTAGE RELAY K-52
R-61
SPARK SUPPRESSOR
C-57
SIDETONE RELAY K-51
HEADSET
TO SIDETONE LINE IN RECEIVER RACK
NOTES:
1. TERMINAL 7, ON T-50 AND T-52 IS PROVIDED ONLY IN MODULATOR UNIT BC-456-B.
2. RELAYS SHOWN IN OPERATED POSITION.

POSITION.



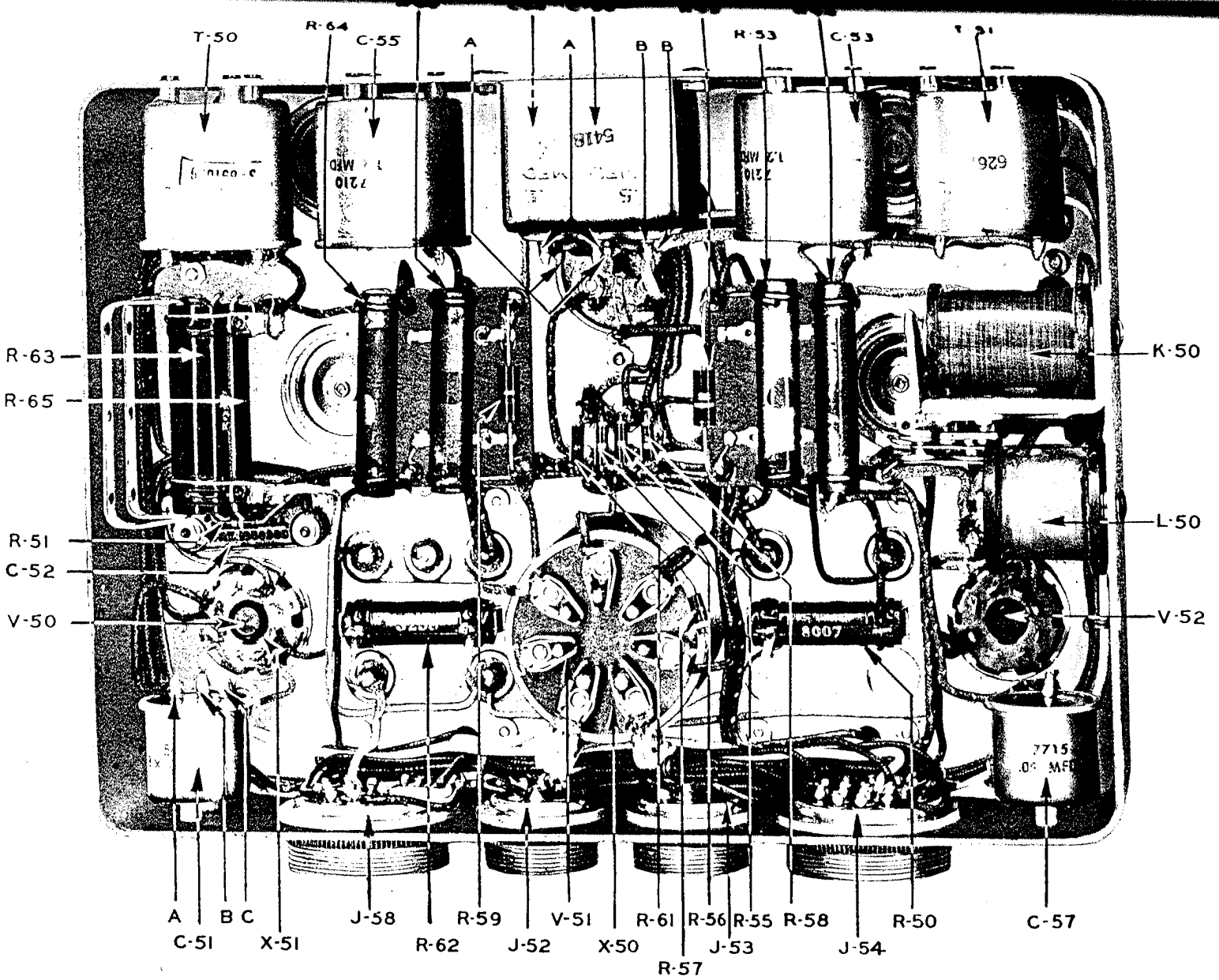


FIGURE 22—MODULATOR UNIT BC-456-B, BOTTOM VIEW WITH COVER REMOVED

(2) Tube V-50 (Tube VT-135) is the tone oscillator tube. T-50A with capacitors C-51B and C-51C in parallel form the tuned circuit of this oscillator. R-51 and C-52 are the grid leak and grid capacitor. R-53 and R-52 form a voltage divider across the high-voltage dynamotor supply line; they determine the plate voltage on the tube V-50 (Tube VT-135). T-50A is an auto-transformer with the section from the ground tap to the bottom acting as the secondary winding. When switch S-50 on Radio Control Box BC-451-A is set to either CW or MCW, this winding has a side-tone output of about 7 volts. Refer to Table 8 for further details. The audio-frequency voltage developed across the second winding T-50B is applied to the grid of modulator tube V-51 (Tube VT-136). The magnitude of this voltage is such that under average conditions, the resulting modulation will be about 90 per cent.

(3) T-51 is a transformer, the primary of which is in the microphone circuit. The control grid of tube V-51 (Tube VT-136) is connected to the junction of R-55 and R-56 which, together, act as a voltage divider and as a load across the secondary of the microphone transformer. These resistors are so chosen that the voltage applied to the modulator tube while transmitting on VOICE is sufficient to produce 85% average modulation with from 1.2 to 1.7 volts rms input. Circuit elements throughout the voice modulation circuits have been designed on the basis of the maximum output from an average Microphone T-17. The direct current through Microphone T-17 is approximately 62 milliamperes (assuming that R-66 is short-circuited by S-53 in Radio Control Box BC-451-A). Switch S-53 is opened only when using microphones not now supplied to the United States Army Air Corps.

(4) The screen grid supply to the modulator tube V-51 (Tube VT-136) is obtained through voltage dividers R-59 and R-60. C-56B is a by-pass capacitor to reduce the a-f impedance from screen-grid to ground. R-57 and R-58 are bias resistors in the cathode circuit of modulator tube V-51 (Tube VT-136). While transmitting TONE or VOICE, the junction of these resistors is grounded, leaving only R-57 (390 ohms) as a cathode bias resistor. In the CW position, cathode current flows through R-57 (390 ohms) and R-58 (51,000 ohms) to ground, producing a bias which reduces the plate current of V-51 to less than 1 milliampere. In this way, the modulator tube V-51 is effectively shut off in the CW position, and power is conserved at a time when the functioning of the modulator tube is not required.

(5) T-52 (A, B, C) is the modulation transformer, the primary winding of which is in the plate circuit of modulator tube V-51 (Tube VT-136). Two secondary windings are provided, T-52C providing about 15 volts of VOICE sidetone (refer to Table 8 for further details) and T-52B providing the modulating voltages. The latter is in series with the high voltage screen-grid supply to r-f power amplifier tubes V-55 and V-56 (both Tube VT-136) in the transmitters. R-62 is a load resistor designed to keep the load impedance of tetrode modulator tube V-51 (Tube VT-136) reasonably constant. R-63 is a series voltage dropping resistor in the screen-grid circuit of the r-f power amplifier tubes.

(6) Tube V-52 (Tube VT-139) is a gaseous voltage-regulator tube designed to maintain the d-c voltage between its plate and ground at 150 volts; this is the normal d-c voltage applied to the screen-grid of the r-f power amplifier in the TONE and VOICE positions. C-56A, across the voltage regulator tube, acts as an a-f by-pass capacitor.

(7) R-64 and R-65 together act as a voltage-divider for the master-oscillator d-c plate supply.

(8) F-50 and L-50 are a fuse and r-f choke respectively, in the input circuit to Dynamotor DM-33-A. This circuit is closed by the contacts on relay K-50 whenever the push-to-talk button on the microphone is closed (or a similar operation by the throttle switch or special switch) in the VOICE position. Relay K-50 is also actuated, and the dynamotor starts when switch S-50 in Radio Control Box BC-451-A is thrown to the TONE or CW position. The dynamotor will continue to run as long as S-50 remains in either of these positions, but the high-voltage keying relay, K-52, will not close until the built-in key, external key, microphone button or the throttle switch is closed. Relay K-51 closes the sidetone circuits from the TONE and VOICE sidetone windings to the emission switch, S-50. (The setting of S-50 determines which of these circuits is connected to the headsets.) The coils of K-51 and K-52 are in parallel and the relays operate together.

(9) R-50 is a 42-ohm resistor connected across the heater terminals of tube V-50 (Tube VT-135) so

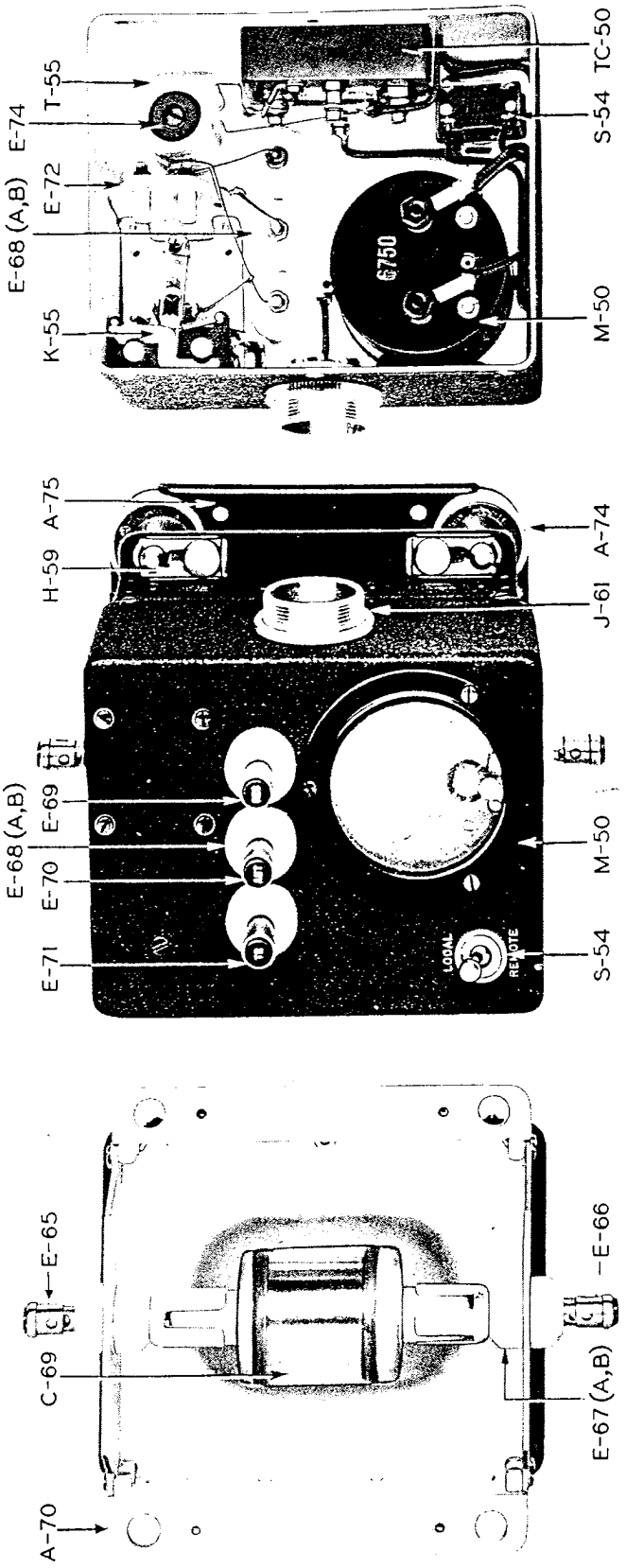


FIGURE 23—ANTENNA RELAY UNIT BC-442A

that the heater of this tube can be connected in series with the heater of tube V-51 (Tube VT-136) across the 28-volt primary source. The heater current is 0.45 ampere.

(10) Dynamotor DM-33-A generates the high voltage d-c for the transmitting equipment. Connections from the dynamotor to the modulator unit are made through couplings J-51 and J-50. The plate in J-50 is designed to be loose in order to reduce the strain on the pin plugs of J-51 during vibration of the units. The motor is compound wound. C-50, across the motor brush terminals, attenuates r-f disturbances set up at the brushes. C-53 is a filter capacitor, across the 28-volt line to the motor, performing a function similar to C-50.

(11) Dynamotor DM-33-A has a continous duty and an intermittent duty rating which may be found in Table 18.

(12) The four cords entering the Modulator Unit BC-456-A are the primary source voltage at J-53, the connections to Radio Control Box BC-451-A at J-54, the connections to Rack FT-234-A (or Rack FT-226-A, Rack FT-276-* or Rack FT-331-A) at J-58 and the connections to Rack FT-220-A (or other radio receiver racks) at J-52. The last of these connections is not essential to the operation of the transmitting equipment; it exists to control the three relays in Rack FT-220-A and to complete the sidetone circuit from the modulator unit to the headset lines in Rack FT-220-A and Radio Control Box BC-450-A.

d. Modulator Unit BC-456-B

Modulator Unit BC-456-B is exactly like Modulator Unit BC-456-A except that the sidetone windings on T-50 and T-52 have an additional tap to which the sidetone leads may be connected if the radio equipment is to be used with low impedance headsets.

e. Antenna Relay Unit BC-442-A

(1) Antenna Relay Unit BC-442-A consists of an antenna switching relay K-55 designed to switch a single antenna either to the radio transmitters or to the receivers of this equipment. This relay is operated simultaneously with the high-voltage keying relay in Modulator Unit BC-456-A (or -B). In addition to switching the antenna, relay K-55 connects to ground the antenna lead to the receivers during transmission. T-55 is an r-f current-transformer whose primary is in the antenna circuit and whose secondary is connected to a thermocouple TC-50. Switch S-54 has two positions, LOCAL and REMOTE, and it connects the output of thermocouple TC-50 to meter M-50. A schematic circuit diagram is shown in Figure 27.

(2) C-69, connected between terminals C, is a high-voltage vacuum capacitor of 50 micromicrofarads capacitance. C-69 may be connected in series with the antenna lead to any transmitter (or transmitters) in installations where it is found impossible to resonate the antenna circuit because of the great length of the antenna. (See Figure 31.)

* Mountings and racks with no letter suffix were not manufactured at the time of publication of this instruction book.

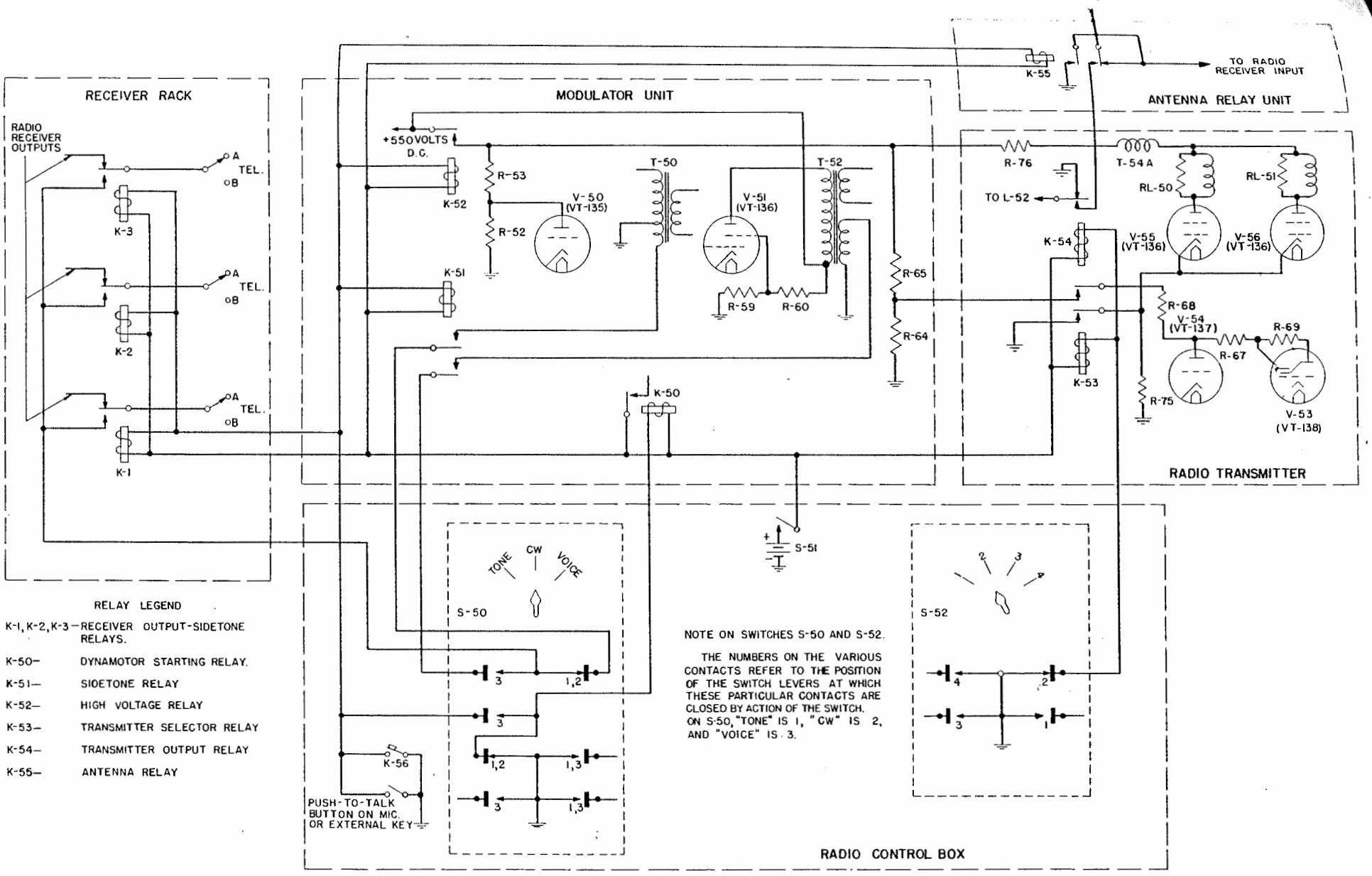


FIGURE 24—FUNCTIONAL DIAGRAM OF RELAY CONTROL CIRCUITS

SECTION IV

MAINTENANCE

16. PRE-FLIGHT INSPECTION

a. Procedure

The radio set should be given an inspection before each flight in accordance with the following:

(1) See that the proper receivers and transmitters are installed for operation on the scheduled frequencies.

(2) Check the operation of all receiver controls and make certain that the receivers are operating. An aural check on the operation of each receiver should be made by listening to signals on CW at maximum gain while tuning through the entire band. All receivers except the one being tested should be turned off.

(3) Check the input alignment of each receiver by readjusting knob E-9 for maximum receiver output while listening to a weak signal.

(4) Advance each INCREASE OUTPUT control to maximum and listen for electrical noise produced by each receiver dynamotor. The noise should be negligible.

(5) Turn up the airplane engine past the speed at which the battery charging generator cuts in and listen for electrical noises produced by the engine ignition system, generator or voltage regulator.

(6) Check each headset cord and plug for open or intermittent contacts. Check each headset.

(7) Check the operation of all transmitter controls and note the antenna current. The antenna currents on MCW and VOICE should be approximately equal, and a higher current should be obtained on CW. A sidetone signal of about 1000 cycles should be heard on CW and MCW. With switch S-50 on VOICE, speech signals impressed on the microphone should be heard in the headset.

b. Caution

Never operate the equipment on the ground longer than is necessary to complete the above inspection. Never leave the airplane without setting the TRANS. POWER and all CW-OFF-MCW switches at their OFF positions.

17. SERVICE INSPECTION

A detailed inspection of the equipment should be made at periods set up by the Army Air Forces for inspection and overhaul of the airplane. The following points should be covered in addition to those which experience and local conditions indicate to be necessary or desirable:

(1) Check all tubes on a tube checker.

(2) Measure the voltages tabulated in Tables 9 and 10. Use a high resistance voltmeter for the measurements.

18. ISOLATION OF FAULTY UNITS

a. Preliminary Check

During the preceding operating checks on the equipment, if any receiver or transmitter fails to perform in a normal manner, proceed as follows to discover the faulty part of the equipment.

LOOK FOR SIMPLE CAUSES OF FAILURE FIRST

Check to see that (1) all switches are in their proper positions, (2) all plugs are attached and all cords appear to be in good condition, (3) battery voltage is satisfactory, (4) dynamotors operate properly, (5) antenna is in good condition and properly connected and (6) ground connections are properly made to the receiver and transmitter racks.

b. Substitution Methods

After making the foregoing checks, if improper operation is still present, proceed to isolate it by substituting units known to be in operating condition for those whose operation is in doubt. For example, if one of the receivers does not operate properly while the other two are normal, interchange Plugs PL-152 connecting the receivers to their respective control units, and see whether the fault is in the receiver or in the control unit. In like manner, proper operation of one transmitter but abnormal operation of another indicates a fault in that transmitter or its control cir-

cuit; proper operation of one transmitter is sufficient evidence that the modulator and power supply circuits are in good condition. Interchange the two transmitters on the rack to determine whether the fault is in the control circuits, rack connections or in the transmitter itself. If neither transmitter performs properly, it is quite possible that the fault may lie in the modulator unit. Interchange this with one that is known to be good to prove whether or not this is so.

19. SERVICING FAULTY RECEIVERS

a. Disassembly of Such Parts as May be Required for Servicing Faulty Receivers

(1) *Receiver from Rack*

Disconnect the antenna lead from the receiver antenna binding post, remove the safety wires and unscrew the two knurled nuts far enough to allow the lugs to be disengaged from the pointed studs. Slide the receiver out of the rack.

(2) *Cover from Bottom of Chassis*

Remove the fourteen bright screws around the bottom edge of the chassis and front panel.

(3) *R-F Coil Set Assembly*

After removing the bottom cover of chassis, as indicated above, remove the two black screws (one at each side of the chassis) at approximately the center of the r-f coil set assembly and then lift the coil set assembly out squarely so as not to damage the pin plugs.

(4) *Receiver Outer Shield*

First unfasten the four dynamotor snapslides and lift out the dynamotor. Remove the eight bright screws (four rear-most screws along the top edge of the tie strap on each side of the chassis) and slide the outer shield back and off. This outer shield is NOT fastened by the three foremost black screws along the top edge of the tie strap on each side of the chassis, nor by the black screws around the outer edge of the front panel.

(5) *I-F Coupling Unit Assemblies and Tubes*

These components may be removed without taking off the outer receiver shield. Each i-f coupling unit assembly is secured by two bright screws at its base. Remove these screws and pull the assembly out squarely so as not to damage the pin plugs.

b. Location of Faults in the Receiving Equipment

One or both of the following methods may be used to locate trouble in a receiver after a failure has been definitely traced to a particular unit by the method outlined in Paragraph 18.

(1) First method

After removal of the chassis bottom cover, connect the receiver to Test Set RC-54-A as shown in Figure 33. Meters should read as indicated in the table on this figure. Following this, a systematic measurement of the voltages at each of the tube terminals listed in Table 9 will determine which of the d-c circuits, if any, is defective. This measurement will also check continuity or short circuit in the r-f and i-f plate circuits. If the trouble is not located at the conclusion of the above tests, use an ohmmeter to check the continuity of all circuits (see Table 11).

(2) Second method

A second method of locating faults in a receiver is to measure the microvolts required at each of several points to produce a receiver output of 10 milliwatts (6.3 volts across 4000 ohms). (The output of a receiver will decrease to almost half of its maximum value when connected in parallel with two other receivers in Rack FT-220-A.) Table 6 lists the test points and shows a value in microvolts which may be considered normal at each of these points. By systematically applying a signal generator to the points indicated, the stage in which the fault lies may be quickly determined. Specific instructions follow: Note the general precautions to observe in the application of Table 6. This table is meant merely as a guide, and departures of 2 to 1 from these figures do not necessarily indicate a fault. Even though the antenna trimmer was adjusted when using Test Set RC-54-A, it must be readjusted when the receiver is installed in the airplane due to the effect of different antenna characteristics.

(3) Equipment Required For Test

(*a*) A standard signal generator which covers the tuning range of the receivers and which may be modulated 30% at 400 cps.

(*b*) An output meter of the copper oxide rectifier type such as "Output Meter Weston Model 571 Type 3A", part of Test Set I-56-A, or a vacuum tube voltmeter.

(*c*) A resistor of such value that when combined with the headset and the voltage measuring instrument across it, the effective load resistance will be close to 4000 ohms.

(*d*) Test Set RC-54-A consisting of necessary cables, meter, jacks, gain control and power switch.

(*e*) A crystal-controlled frequency standard for accurately determining test frequencies. (The variable portion of the alignment tuning capacitors in this equipment is so small that unless the signal generator frequency is precise it may not be possible to find a resonant point within the range of the aligning capacitor.) The receiver may be connected to this equipment in any position for convenient inspection and adjustment. In place of this special equipment, a bench test of a receiver may be made by connecting the positive terminal of the battery to terminal 6 (see Figure 26) and the negative terminal to the chassis. The battery voltage should be close to that indicated in Table 9. The headset, output meter and load resistor may be connected in parallel to terminal 2 and the chassis. It is not necessary to remove the outer receiver shield for these tests. See Table 6 for the intermediate frequency and normal sensitivity values for all receivers.

(4) Test Procedure

(*a*) Connect the ground lead from the signal generator output to the receiver chassis and connect the other lead from the signal generator output direct to the antenna binding post. See that both leads from the signal generator are no longer than necessary (less than one foot) and that these leads are kept close together (twisted).

(*b*) Set the signal generator for an output of 200 microvolts, modulated 30 per cent at 400 cycles. Set the receiver frequency dial to the highest calibrated value and set the CW-OFF-MCW switch to the MCW position and turn the INCREASE OUTPUT control to maximum.

(*c*) Vary the signal generator frequency through the indicated receiver frequency and far enough on either side to avoid errors in signal generator frequency calibration. Use a headset in the receiver output circuit. If a 400 cycle output is heard, retune the signal generator through this frequency. Keep the signal generator output adjusted for a receiver output of not more than 10 milliwatts while adjusting the signal generator frequency and the ALIGN INPUT knob for maximum receiver output. The receiver sensitivity for MCW operation may be considered satisfactory, provided the r-f input required to produce 10 milliwatts output does not exceed twice the tabulated value (see Table 6) and any serious defect apparent in MCW operation must be found elsewhere. If the MCW sensitivity is satisfactory, check the sensitivity with the CW-OFF-MCW switch on the CW position. Consider the CW sensitivity satisfactory if the unmodulated r-f input required to produce an audio output of 10 milliwatts is one-half the tabulated value or less.

(*d*) If the receiver sensitivity on the MCW is abnormally low when measured at the antenna post, determine whether the fault lies ahead of, within or following the mixer stage by checking the sensitivity at the grid (top cap) of mixer tube V-4 (Tube VT-132). Do not remove the grid clip.

(*e*) Set the signal generator modulation to 30% at 400 cps, and adjust the generator frequency for the indicated receiver frequency as before. If the r-f input required to obtain 10 milliwatts is less than twice the tabulated value, the fault lies between the antenna binding post and the output of the r-f amplifier stage. If three or four times the number of microvolts indicated in the table is required in this r-f test, change the signal generator frequency to the intermediate frequency for this receiver and progressively vary the generator frequency and r-f output to obtain a maximum receiver output of 10 milliwatts. If the normal number of microvolts is now required, the fault lies in the oscillator tube elements or oscillator circuit of the mixer stage. Check the mixer tube voltages and if these are normal, replace the mixer tube with one known to be satisfactory.

(*f*) If an intermediate frequency input considerably greater than normal is required on the mixer grid, the fault lies in the i-f amplifier or in the hexode elements of the mixer tube. With the signal generator frequency set at the receiver intermediate frequency, connect the generator to the control grid of the first i-f tube. Wrap a wire around the control grid terminal (fourth terminal clockwise from the locating pin, as viewed from the bottom) for connection to the signal generator. Determine the r-f input required for a receiver output of 10 milliwatts.

(*g*) If this test shows faulty sensitivity, repeat the measurement in a similar manner on the control grid of the second i-f tube. Abnormally low sensitivity at the second i-f grid indicates trouble between this point and the audio output circuit. The signal generator is not useful beyond the second i-f grid.

(*h*) Using this test procedure, the source of the trouble may be quickly narrowed down. It is then possible to use an ohmmeter to check the components between the tube which was found to give correct

sensitivity, and the first one toward the antenna which failed to do so.

(*i*) After the fault has been removed, recheck the CW operation at the intermediate frequency with the signal generator (unmodulated) connected to the mixer grid (top cap). Determine whether the r-f input required to produce 10 milliwatts audio output is less than one-half the tabulated value. The signal generator frequency which produces zero beat on CW should agree closely with the frequency required to produce maximum MCW output.

(*j*) An ohmmeter, part of Test Set I-56-A, is the only equipment necessary to locate faults in the radio control boxes, dynamotors, racks and adapters. Refer to the schematic diagram of these units, Figure 26, for the circuits of this equipment.

c. Alignment of Receiver R-F and I-F Circuits

NOTE:—THIS OPERATION SHOULD NOT BE ATTEMPTED WITHOUT PROPER EQUIPMENT AND AUTHORITY.

If the sensitivity of a receiver is found to be low, and the tubes, dynamotor and circuit elements are normal, it may be necessary to realign the r-f and i-f amplifiers. The test equipment required is the same as indicated in Paragraph 19*b* (3) plus a small screw driver. If a screw driver having a metal shank is used, cover the shank with "spaghetti" tubing, or with a tough coating of lacquer. The maximum diameter of the shank and width of the blade must not exceed $\frac{3}{32}$ inch. Insulation is required to avoid accidental short-circuits on resistors R-11 and R-18 while aligning the secondary circuits of the i-f coupling units in Radio Receivers BC-453-A (or -B) and BC-454-A (or -B).

There are two holes (numbered 1 and 2) in the top of each i-f coupling unit in Radio Receivers BC-453-A (or -B) and BC-454-A (or -B) and one hole (numbered 1) per unit in Radio Receivers BC-455-A (or -B) (see Figure 25). A variable capacitor under hole 1 tunes the input (plate) circuit and the capacitor under hole 2 (when provided) tunes the output (grid or diode input) circuit. A small rod actuator, as shown in the views of the coupling unit assemblies in Figure 25, protrudes through the top of the shield on each i-f coupling unit in Radio Receiver BC-453-A (or -B). These rods control the coupling between the input and output circuits in each unit. Normally, the rods in the first and third units are pushed down (over-coupled position), and the rod in the second i-f unit is left in its upper (loose-coupled) position. A strong detent action indicates the two positions which are about ¼ inch apart. These coupling controls are omitted in Radio Receivers BC-454-A (or -B) and BC-455-A (or -B). Figures 40, 41 and 42 show the details of the construction of the i-f coupling units.

Each variable capacitor (except padding capacitors C-4F and C-4G under the gang capacitor shield) in the equipment is set at maximum capacitance when the top of the cross mark on the rotor shaft is lined up with the reference mark on the dust shield or chassis. The capacitance is reduced to minimum by a 180 degree rotation in either direction. When a circuit requires readjustment, turn the rotor in a counter-clockwise direction from the maximum capacitance setting. This will always result in a setting of the trimmer such that a clockwise rotation increases the capacitance. Uniform practice in this operation is desirable.

Padding capacitors C-4F and C-4G may be tuned only after removal of the gang capacitor shield. They are adjusted at the factory to maximum, half or minimum capacitance, depending upon the receiver and capacitor, and they should not be changed. The correct settings of these capacitors for each receiver are shown below.

Radio Receiver	*Settings of cross-marks on padding capacitors as seen from front of receiver*	
	C-4F	*C-4G*
BC-453-A (or -B) 190-550 kc	Min. †	Half —+
BC-454-A (or -B) 3-6 mc	Half —+	Max. ┼
BC-455-A (or -B) 6-9.1 mc	Half —+	Max. ┼

Table 6 shows average values of r-f input, in microvolts, for each receiver to obtain an output of 10 milliwatts with a 4,000-ohm load (two 8,000-ohm headsets in parallel). These values are to be used as a guide in determining the condition of the receiver under test.

Alignment of the receivers must not be attempted without using a standard signal generator and crystal-controlled frequency standard except in a real emergency and providing a modulated signal is available. The operations listed below shall be followed in the order given when a receiver is to be aligned:

(1) Connect the signal generator to the chassis and hexode grid (top cap) of the mixer tube V-4 (Tube VT-132). Do not remove the grid clip. Set the generator frequency for the intermediate frequency of the receiver, using a crystal-controlled frequency standard to obtain a precise adjustment, with 30 per cent modulation at 400 cycles per second. Set the CW-OFF-MCW switch to MCW and set the INCREASE OUTPUT control for maximum receiver output.

If Radio Receiver BC-453-A (or -B) (190-550 kc) is being aligned, *reduce the magnetic coupling in each i-f coupling unit assembly by raising the protruding rod (see Figure 25) until it snaps into its upper (loose-coupled) position.*

(2) Adjust the r-f output of the signal generator to obtain a convenient reading on the output meter; for example, 10 milliwatts or 6.3 volts across 4,000 ohms.

(3) Adjust the capacitor under hole 1 on the third (Z-3) i-f coupling unit and the capacitor under hole 2 (if it is provided) for maximum receiver output.

(4) Reduce the signal generator output until the receiver output is the same as in (2) above and then adjust the capacitors under holes 1 and 2 on the second (Z-2) i-f coupling unit for maximum receiver output.

(5) Reduce the signal generator output again and adjust the capacitors in the first (Z-1) i-f coupling unit for maximum receiver output.

(6) Reduce the signal generator output until the receiver output is the same as in (2) above and then readjust the capacitors in Z-3, Z-2 and Z-1 in that order for maximum receiver output.

(7) Operate the CW-OFF-MCW switch to CW and turn off the signal generator audio-frequency modulation. Do not change the frequency of the signal generator. Adjust the CW oscillator trimmer capacitor C-28 for zero beat, as indicated by listening with a headset, to the receiver output. This capacitor is accessible through the hole in the right rear side of the chassis.

(8) If the r-f circuits require realignment, remove the outer shield on the receiver to gain access to capacitors C-4D, C-4E and C-9. Refer to Paragraph 19*a* (4). Capacitor C-4D is accessible through the left hole in the gang capacitor shield (as viewed from the front of the receiver). Capacitor C-4E is accessible through the center hole, and C-9 through the remaining hole.

(9) Transfer the signal generator output to the antenna post and ground. Set the generator frequency for the high-end alignment frequency as indicated in the table below, using a crystal-controlled frequency standard to obtain a precise adjustment with 30 per cent modulation at 400 cycles per second. Operate the CW-OFF-MCW switch to MCW, set the INCREASE OUTPUT control for maximum receiver output and set the receiver tuning dial at the high-end alignment frequency.

R-F ALIGNMENT FREQUENCIES

Radio Receiver	*High-End Alignment Frequency*	*Low-End Alignment Frequency*
	Align C-4D C-4E and C-2 at	*Align C-9 at*
BC-453-A (or -B), 190-550 kc	520 kc	210 kc
BC-454-A (or -B), 3-6 mc	5.8 mc	3.1 mc
BC-455-A (or -B), 6-9.1 mc	8.9 mc	6.1 mc

INTERMEDIATE FREQUENCIES

Radio Receiver	*Frequency*
BC-453-A	85 kc
BC-454-A	1415 kc
BC-455-A	2830 kc

(10) Adjust the r-f output of the signal generator as in (2), and then adjust r-f oscillator trimmer capacitor C-4E for maximum receiver output.

If two different settings of C-4E are found at which maximum output is obtained, be sure to use the setting corresponding to the higher capacitance.

(11) Reduce the generator output until the receiver output is the same as in (2) above and then adjust capacitors C-4D and C-2 (ALIGN INPUT knob) for maximum receiver output.

(12) Operate the CW-OFF-MCW switch to CW, turn off the signal generator modulation and

adjust capacitor C-4E for zero beat (determined by listening with a headset to the receiver output). Only a small change in the setting of C-4E should be required.

(13) Set the generator frequency for the low-end alignment frequency (see Table, page 50) using a crystal-controlled frequency standard to obtain a precise adjustment with 30 per cent modulation at 400 cycles per second. Operate the CW-OFF-MCW switch to MCW, set the receiver tuning dial at the low-end alignment frequency and adjust the generator output as in (2) above. Make alternate adjustments in the settings of capacitor C-9 and the receiver tuning dial until maximum receiver output is obtained.

(14) Set the generator frequency for the high-end alignment, using a crystal-controlled frequency standard to obtain a precise adjustment without modulation. Operate the CW-OFF-MCW switch to CW, set the receiver tuning dial for the high-end alignment frequency and adjust capacitor C-4E for zero beat (determined by listening with a headset to the receiver output). The change in the setting of C-4E should be very small.

(15) The operations described in the preceding 14 paragraphs complete the alignment of Radio Receivers BC-454-A (or -B) and BC-455-A (or -B).

The final operation on Radio Receiver BC-453-A (or -B) is to return the first (Z-1) and third (Z-3) i-f coupling units to their overcoupled condition by pushing down the protruding rod on each of these units. When the rods are all up, the receiver selectivity is increased to such an extent that the audio response is penalized for frequencies as low as 1500 cycles per second.

Replace and securely tighten all screws holding shields, covers, etc. These screws serve to reduce undesired electrical currents as well as to assemble the units.

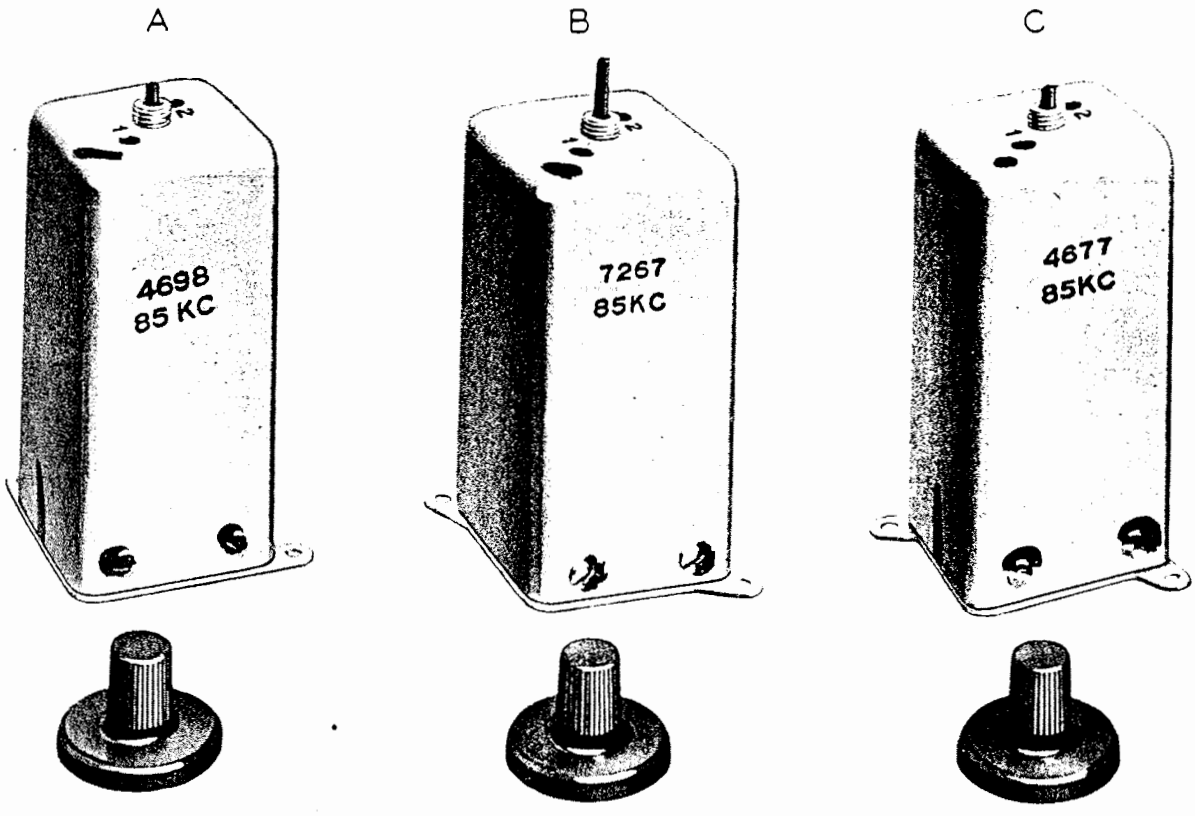


FIGURE 25—TYPICAL I-F COUPLING UNIT ASSEMBLIES

20. SERVICING FAULTY TRANSMITTERS

a. Disassembly of Such Parts as May be Required for Servicing Faulty Transmitters

(1) *Transmitter from Rack*

Disconnect the antenna lead from the transmitter antenna binding post and unscrew the two knurled nuts far enough to allow the lugs to be disengaged from the pointed studs. Slide the transmitter out of the rack.

(2) *Cover from Bottom of Chassis*

Remove the twelve bright screws around the bottom edge of the chassis and front panel.

(3) *Outer Shield*

Remove the nineteen bright screws around the edge of the shield. Lift the rear end up and slide it backward and off.

(4) *Shield over Master Oscillator Coil T-53 and Capacitor C-60*

The serial number and frequency range of the transmitter should be marked on the shield before it is removed. This is to make certain that it goes back onto the same unit, because the position of the screw on the left side (with blue paint) determines the inductance of the master-oscillator coil. The shield may be lifted off after the removal of twelve bright screws.

b. Location of Faults in Transmitting Equipment

(See Tables 8, 10, 12, 13 and 14 for normal conditions.)

After an operational failure has been traced to a particular transmitter or modulator unit, it should be removed from the equipment and given a bench test to discover the reason for failure. Test Set RC-55-A, shown on Figures 34 and 35, is very useful in servicing faulty transmitters, modulator units or other components of the radio set. The faulty unit and the test equipment should be connected as shown on Figures 34 and 35 and to a power supply which can be regulated to 28 volts ± 0.1 volt under the normal load conditions.

c. Modulator Unit Faults

Use a transmitter that is known to be in good condition. Tune it to one of the frequencies listed in Table 8 and attempt to obtain proper adjustments of the antenna inductance and coupling in the manner prescribed in Paragraph 11*d*. If it is impossible to obtain normal antenna current, look for the following indications of fault: (1) Subnormal input voltage. (2) Dynamotor not operating or running slowly. (3) Subnormal plate voltage. (4) Subnormal screen voltage. (5) Unusual oscillator plate current.

(1) If there is no input voltage, check the position of switch S-51 and test fuse F-51. If the input voltage is low, check the condition of the power source.

(2) If the dynamotor fails to run, test its supply circuit fuse F-50. If this is found to be good, exchange the dynamotor for one known to be in good condition. If it still does not operate, remove the bottom plate of the modulator unit and examine the contacts on relay K-50. If the dynamotor runs at low speed, try exchanging it with one known to be in good condition.

(3) If the plate voltage is low, it is possible that the dynamotor is at fault even though it appeared satisfactory in the foregoing tests. Try exchanging it with one known to be good. If plate voltage is entirely absent while the dynamotor runs in a normal manner, the fault may be due to an open plate supply circuit. Remove the dynamotor, close the telegraph key and check the continuity of the circuit between 3 on dynamotor receptacle J-51 and 10 on receptacle J-58. Check the operation of high-voltage relay K-52.

(4) Zero screen voltage indicates the necessity of a continuity check between terminals 10 and 12 on jack J-58.

(5) Unusual oscillator plate current may be due to faults in the voltage divider made up of resistors R-64 and R-65. A continuity check on J-58 between terminals 10 and 11 and between ground and terminal 11 will test these elements.

If normal voltages and currents and normal operation of the transmitter are found when operating on CW, try switching to TONE as a further check of the condition of the modulator unit. If normal sidetone is observed on TONE operation but the antenna current is below normal, the trouble is probably due to a fault in the modulator tube or its associated circuits made up of T-52, R-59, R-60, C-54A, C-56A and C-56B. Try a new modulator tube and, if trouble still exists, make a continuity check of the modulator circuit elements.

If the transmitter operates normally on TONE

but the voice sidetone is weak or absent and the antenna current on VOICE does not increase during speech, investigate the microphone circuit including T-51, R-54, R-55 and R-56. Check for a short-circuit in the sidetone circuit including sidetone winding T-52C.

d. Transmitter Faults

Test a faulty transmitter with Test Circuit RC-55-A shown in Figure 34, using dynamotor and modulator units known to be in good condition. Normal voltages but low plate currents probably indicate faulty transmitter tubes. If the oscillator plate current is low, it is probable that the amplifier plate current will also be low. Replace the oscillator tube before doing anything to the amplifier tubes.

CAUTION: DO NOT OPEN THE COVER ABOVE THE AMPLIFER TUBES WITHOUT FIRST SHUTTING DOWN THE EQUIPMENT. BE CERTAIN THAT THE DYNAMOTOR HAS STOPPED RUNNING. LOOK AT THE PLATE AND SCREEN VOLTMETERS.

If the antenna and plate currents are still low with a new oscillator tube and the amplifier tube voltages are normal, it is possible that one or both of the amplifier tubes is faulty. After shutting down the equipment, exchange these tubes for new ones. If the trouble still persists, remove the external connections to the transmitter and test the circuits for continuity in accordance with Table 12. Also check the continuity from terminal 7 of J-64 to the plate caps on tubes V-55 and 56 (Tube VT-136) and the circuit from terminal 4 of J-64 to the screen terminals of these same tubes.

e. Transmitter Alignment Procedure

The frequency dial of each transmitter is geared to both the oscillator variable capacitor and the power amplifier tank capacitor. The oscillator and amplifier circuits must therefore have exactly the proper inductance and capacitance for each frequency indicated by the dial. When the transmitters are manufactured, each of the inductances is properly adjusted by means of a movable iron dust core, and each of the capacitors is adjusted by means of a variable trimmer. An additional small trimmer capacitor, in parallel with the oscillator circuit, is available for service adjustment whenever new vacuum tubes are installed in the equipment. When such tube changes are made, the transmitter frequency dial should be set at its calibration frequency point, and this trimmer capacitor varied until the resonance indicator shows that the transmitter is in resonance with the calibration crystal.

After this procedure has been completed, if precision measurements indicate that certain transmitter frequencies are not within the limits of ± 0.05% of their indicated values, it may be necessary to realign the transmitter. There is little likelihood that this condition will arise unless a major replacement of transmitter parts has been necessary.

(1) *Adjusting the Master-Oscillator Circuit*

This adjustment can only be made in a properly equipped laboratory provided with precision frequency measuring equipment (such as a crystal oscillator and multivibrator coupled with a selective receiver, the output frequency of which will be the difference frequency between the transmitter and one of the multivibrator harmonics). In addition to the measuring equipment, a test circuit similar to that shown on Figure 34 should be employed for operating the transmitter.

First, remove outer shield A-50. Next, remove the oscillator shield A-55. Inspect the position of the rotor of capacitor C-60 and be sure that it is in the angular position indicated on the Practical Wiring Diagram for the transmitter in question when the adjusting arm is in its mid-position. With this capacitor rotor properly positioned, replace shield A-55.

CAUTION: BEFORE APPLYING POWER TO THE TRANSMITTER, OBSERVE EXTREME CAUTION AS THE VOLTAGE BETWEEN THE PLATE CAPS OF TUBES VT-136 AND GROUND IS APPROXIMATELY 600 VOLTS. TO INSURE SAFETY, PROVIDE A SPECIAL SHIELD SIMILAR TO A-50 BUT WITH HOLES FOR ADJUSTING INDUCTANCE SCREWS E-58 AND E-59 AND ALSO FOR ADJUSTING THE ROTOR AND TRIMMER OF C-60.

Tune the transmitter at its highest indicated frequency and operate on CW for a warmup period of 5 minutes.

To align the oscillator circuit, proceed as follows:

(*a*) Be certain that the dial is set exactly on the highest operating frequency.

(*b*) Adjust the oscillator trimmer through guide E-62 to produce zero beat between the transmitter frequency and the appropriate multivibrator harmonic.

(*c*) If zero beat cannot be obtained in this manner, reset this trimmer to its mid-position and adjust the main rotor of C-60 until approximately zero beat is obtained. This may be done by loosening the screw in the slotted hole at the end of the adjusting arm and by carefully turning the rotor by means of a screwdriver inserted thru the hole in shield A-55. This must be very carefully done as only a slight movement of the rotor is sufficient to cause a relatively large frequency change.

(*d*) If necessary, readjust the trimmer to obtain zero beat.

(*e*) Set the transmitter dial near the low frequency end of the scale and tune it until zero beat is obtained with the standard frequency harmonic corresponding to the lowest dial frequency. Adjust the antenna to resonance.

(*f*) Observe the *exact* dial reading for this zero beat position.

(*g*) Change the position of the dial to the other side of the lowest frequency mark at a point about 1½ times as far from that mark as the position observed in step (*f*).

(*h*) Readjust *inductance* adjustment E-58 to obtain zero beat between the transmitter and the standard frequency.

(*i*) Reset the dial to the lowest frequency mark and restore zero beat by adjusting the trimmer portion of capacitor C-60.

(*j*) Retune the transmitter to the highest frequency and see if the beat note between the transmitter and the standard is less than 200 to 300 cycles.

(*k*) If this beat frequency exceeds the above limit, reset to zero beat by varying the trimmer portion of capacitor C-60 and proceed as before, using steps (*b*), (*e*), (*f*), (*g*), (*h*), (*i*) and (*j*).

(*l*) When the end frequencies have been adjusted in the above manner, set the dial at the calibration frequency and adjust to the calibration crystal as indicated by resonance indicator V-53 (Tube VT-138). (See Paragraph 11*f* (2).)

(2) *Alignment of the Power Amplifier Circuit*

With the oscillator properly aligned with the dial, check the oscillator and the amplifier tuned circuits for tracking in the following manner:

(*a*) Remove phantom Antenna A-61-A.

(*b*) Tune the transmitter on CW to the highest frequency indicated on the dial and adjust C-67 (accessible under snap covers H-53 and H-54) until the amplifier plate current reaches its minimum value.

(*c*) Tune the transmitter to the low frequency end of the dial and note whether the amplifier plate current increases appreciably.

(*d*) If this current has risen more than 2 or 3 milliamperes, try adjusting the inductance of T-54A by means of screw E-59 to find the position which provides minimum amplifier plate current.

(*e*) If the minimum current is within 5 milliamperes of the current first observed in step (*d*), reset the iron core (E-59) to its first position.

(*f*) If the amplifier plate current is decreased more than 5 or 6 milliamperes as the minimum is approached, continue moving the iron core in the same direction to a point the other side of the minimum, using about 1½ times as many turns of the adjusting screw as were necessary to obtain the minimum plate current.

(*g*) Readjust capacitor C-67 for minimum plate current.

(*h*) Return to the high frequency end of the dial and repeat step (*b*). This procedure should cause the plate current to be within 3 or 4 milliamperes of its minimum value at both ends of the frequency band.

21. MAINTENANCE OF DYNAMOTORS

a. General

(1) The dynamotors used in the transmitters and receivers of Radio Set SCR-274-N are manufactured by the General Electric Co., the Westinghouse Electric and Manufacturing Co. or by the Continental Electric Co. These machines are of the two bearing type and are totally enclosed. Ball bearings of the single shielded type are used which contain enough

lubricant for long periods of operation. Each machine is electrically and dynamically balanced and is therefore quiet in operation. The weights of the dynamotors are given in Figures 28 and 30 and the ratings are given in Table 18.

(2) No special tools are required for ordinary care of the dynamotors. A 3½ inch cabinet screw driver and small pliers are enough for most maintenance or repair. Machines should be removed from service before attempting any maintenance.

b. Routine Inspection

If the equipment is operating satisfactorily, the dynamotor should rarely be touched. (In the case of the receiving equipment, one indication of unsatisfactory operation would be a high level of dynamotor noise.) Frequent sanding of commutators, manipulation of brushes, or excessive greasing is likely to do more harm than good. A uniform band of brown discoloration is an indication of normal operation and should not be removed. The dynamotors supplied with this equipment are provided with sealed ball bearings containing sufficient lubricant for 1,000 hours of operation. Hence, the routine inspection should consist of a check as to whether or not the brushes are free in their holders and of the removal of carbon or copper dust which may have accumulated in the vicinity of the commutators. For the receiving equipment, the inspection should include a check on the r-f and a-f noise attributable to the dynamotor.

c. Transmitter Voltage Below Normal

If the voltage of the transmitter dynamotor is below normal (see Table 10) remove the brushes and check each coil winding of the armature for an open circuit. This is accomplished by placing the prods of an ohmmeter on adjacent high-voltage commutator bars and continuing the test around the commutator. Ohmmeter prods must not be applied to that section of the commutator which normally comes in contact with the brushes. Similarly the field winding should be tested for a possible open circuit. Also tests should be made between the commutator and frame to be sure no grounds exist.

d. Noise From Receiver Dynamotor

The test for radio-frequency noise may be made by listening to the output of a receiver operated at maximum gain and comparing the noise output with that obtained with a dynamotor known to be satisfactory. After a little experience, it will be possible to distinguish dynamotor noise from other types, and a comparison dynamotor will not be necessary. If the equipment is not properly grounded to the metal fuselage, noise may be experienced even when the dynamotor is operating satisfactorily. The test for audio-frequency noise may be made by operating the receiver at a minimum gain. If a loud low pitched tone is heard, it is indicative of commutator or armature trouble. In a normal dynamotor, the ripple will be so low that it can barely be noticed when a small amount of radio frequency noise is present. If the audio-frequency noise is loud, make certain that all brushes make good contact with the commutators and that the brushes slide easily in their slots. If the noise still persists, remove the brushes and check each coil winding of the armature for an open circuit. This is accomplished by placing the terminals of an ohmmeter on adjacent high-voltage commutator bars and continuing the test around the commutator. Ohmmeter prods must not be applied to that section of the commutator which ordinarily comes in contact with the brushes.

e. Bearings and Lubrication

(1) The single shielded bearings (O-1 on Figure 46 or O-50 on Figure 51) are designed for long life but should be replaced if excessively noisy, loose on the shaft or not giving satisfactory operation. If the machines are normally overhauled after each 300 hours of operation, no lubrication should be required between overhauls.

(2) To lubricate bearings remove the end cover (A-17 or A-62) by cutting the safety wire on the end of the machine and removing two screws (H-19 or H-72), being careful not to lose the washers (H-21 or H-73). With the cover removed, first blow out loose dust and dirt and then take out the screws (H-11 or H-61) holding the end shield bearing retainer (H-12 or H-60). Remove the retainer, being careful not to lose any washers from the end of the shaft. Wipe out all available old and hardened grease with a toothbrush or other similar small brush and a clean cloth. Apply three or four drops of a light machine oil to the balls and repack the outer side of the bearing with a small amount of Navy Aero Spec. M-372, Air Corps Grease 375 or Lubrico M-6 Grease. Add only enough grease to cover the bearing. Do not pack the bearing full. Keep dirt from entering

the housing and do not allow grease or oil to get on the commutators. Replace any washers and then the end shield bearing retainer and cover. (Lubrication instructions are also printed on the inside of each end cover of the dynamotors.)

(3) If there is grit in the bearings and immediate replacement of the bearing is impracticable, the bearing may be left on the shaft and cleaned temporarily by removing the armature as outlined in Paragraph 21*g* under "Removal of Armature," which follows, and swishing the bearing back and forth in cleaning fluid, such as petroleum spirits, kerosene, gasoline or carbon tetrachloride, being careful not to insert the armature far enough into the fluid to permit the windings to become wet. After cleaning in this manner shake off as much cleaning fluid as possible and then insert the bearing into a bath of light machine oil, remove and allow to drain before repacking with grease as outlined above. Where this temporary cleaning method is employed the bearing should be replaced as soon as practicable thereafter.

CAUTION: FUMES FROM GASOLINE AND CARBON TETRACHLORIDE ARE HARMFUL WHEN BREATHED. OBSERVE THE USUAL PRECAUTIONS AGAINST FIRE IF GASOLINE IS USED.

(4) If bearings are to be replaced it will be necessary to remove the armature assembly (E-2 or E-85) as outlined in Paragraph 21*g* under "Removal of Armature." If a puller is not available to remove the bearing assembly (O-1 or O-50), clamp the outer race firmly in a vice and drive the bearing off by holding a nail set or similar tool against the end of the shaft and tapping lightly with a hammer. Do not reuse a bearing that has been removed from the shaft. Note the position of the oil thrower (H-25 or H-70) and washers. If washers or oil thrower are in bad condition, replace, omitting all washers behind the bearing. Place a spring washer (H-27 or H-86, neither shown) between bearing and bearing retainer at the H.V. end of the machine. Take up excessive end play by using the larger diameter washers (H-26 or H-85, furnished with all replacing bearings) between the outer ball race and retainer. Any shimming should be done by using washer shims in both ends and not putting all washer shims in one end. End play of approximately 0.015 inch maximum is permissible. Whenever a bearing is removed from its housing the housing should be wiped with a clean dry cloth, the housing lubricated sparingly with light machine oil or ball bearing grease and both the housing and the bearing kept clean. The inner race goes on the shaft with a light press fit and some selection of bearings may be necessary to find one that is not loose on the shaft. The outer race should have a sliding fit in its housing. A small piece of pipe whose end is smooth and slightly larger than the shaft is useful in pressing a new inner race onto the shaft. In pressing the inner race on the shaft, be sure the race goes on the shaft squarely and does not bind. Do not exert pressure on the outer race of a bearing that is being put on the shaft. After replacing a bearing, reassemble and note that the armature revolves readily without binding.

f. Commutator

(1) A highly polished commutator surface is very desirable and a dark color should not be mistaken for a burned condition. If the surface is smooth and polished and the commutation satisfactory, it should be left alone. Slight sparking is not necessarily evidence of poor commutation. If the surface of a commutator becomes dirty, wipe with a clean cloth. If necessary, wipe with a cloth moistened with cleaning fluid such as petroleum spirits, kerosene or gasoline, followed by a dry cloth. Keep bearings and housing clean. It is recommended that the covers be removed and the dust and dirt blown out for each 300 hours of operation. This cleaning should include removing the brushes and wiping the inside of the brush holders (E-17, E-22 or E-76, E-77) and the external surfaces of the brushes (E-18, E-19, E-20, E-21 or E-29, E-80, E-81, E-82).

(2) If any mica of the undercut commutators extends up to the commutating surface it should again be undercut. For turning down the commutator in a lathe or for extensive undercutting, the armature must be removed from the machine as outlined below.

g. Removal of Armature

Removal of the armature is accomplished as follows: Remove covers (A-17 or A-62) on both ends. Remove the brush holder caps E-16, E-75 or E-78), and brushes (E-18, E-19, E-20, E-21 or E-79, E-80, E-81, E-82) on both the high voltage and low voltage ends of the machine, noting that each brush is marked so that it may be replaced in the same holder and in the same position in the holder. Blow loose dust and

dirt from end brackets and windings. Disconnect the leads from the field coils (L-16, L-53A, or L-53B) to the brush holders on the high voltage end at the brush holder terminal (E-22 or E-77). Remove the nuts (H-17 or H-63) on the clamp bolts (H-15 or H-65) at the high voltage end and remove the end bracket (A-15 or A-61) from that end. The armature (E-2 or E-85) may now be removed, if desired, after removing connections from the brush holder terminals. The end brackets are so arranged that they cannot be interchanged or replaced incorrectly.

h. Brushes

(1) Each brush is equipped with a flexible pigtail and spring of such design as to limit the rotation of the spring and pigtail to a minimum when replacing a brush cap. Brushes should be replaced when less than ¼ inch long, measured to the spring. The brush pressure is considered satisfactory if ¼ inch or more of the spring extends out of the holder when the brush holder screw cap is removed and the end of the brush is touching the commutator. If the commutator is not too badly grooved, new brushes may be sanded in with a small strip of 4/0 sand paper slipped under the brush and pulled back and forth over a suitable arc of the commutator. The under surface of the paper should be in contact with one end of the brush. To obtain proper fit, new brushes should be run in for several hours at no load or, preferably, at light load in the neighborhood of quarter load before the machine is required to carry full load. It is desirable that the brushes be so seated that they have a 100% arc and at least 75% of their area in contact with the commutator. This requirement will be considered met if the electrical requirements are met.

(2) When brushes are removed for any reason they should be put back in the same holder and in the same position in the holder. Brushes with polarity marks should be replaced so that polarity mark faces upward. Brushes may be removed or replaced by removing the cover and brush holder caps.

(3) It is very important that brush resistance be kept as low as possible and in this connection it is necessary that the brush pigtails be in good condition and that the brushes be of the grade recommended by the manufacturer. If a brush pigtail is broken or loose in the brush or end cap, the current will have a tendency to go through the brush spring which will cause the spring to overheat, lose its temper and not give the proper brush pressure. A voltage drop due to resistance in the input side will result in a proportional voltage drop in the output of the machine.

i. Tests of the Armature Windings

A short circuit or open in the armature windings may be indicated in a number of different ways, such as the dynamotor not operating or operating at reduced speed, low output voltage, overheating, excessive arcing at the brushes, rapid wearing of the brushes or noise in the receiver. If facilities are available for making resistance measurements, a comparison of readings of the resistance between pairs of adjacent commutator bars, particularly on the high voltage end, would be of advantage. A reading between one pair of bars which is more than 7% higher or lower than the average of readings between other pairs of bars would indicate an open or short respectively.

TROUBLE LOCATION AND REMEDY

Possible Cause	*Correction*
DYNAMOTOR STOPS OR FAILS TO START	
No D-C supply: Open or loose connection, condenser shorted.	Tighten connections, replace shorted condenser.
Brushes not seating properly: Dirty, sticking, worn.	Remove brushes from holders and clean thoroughly. Seat brushes with 4/0 sandpaper, replace worn brushes.
Poor commutation: Dirty commutator, oily, rough, high mica.	Clean commutator and brushes; if rough, turn commutator and undercut mica.
Worn bearings: Armature strikes pole faces, or connections.	Replace bearings.
Defective armature: Short, or open. (See Paragraph 21*i*.)	Replace defective armature.
EXCESSIVE ARCING AT BRUSHES	
Poor commutation: Rough, worn commutator, high mica.	Clean commutator and brushes; if rough, turn commutator and undercut mica.
Brushes not seating properly: Dirty, sticking, worn, twisted pigtail.	Remove brushes from holder, clean, untwist pigtail or replace brush assembly.
Brush spring defective: Weak.	Replace brush assembly.
Short between bars: Dirty. (See Paragraph 21*i*.)	Clean slots or replace armature.
Open in armature coil. (See Paragraph 21*i*.)	Replace armature.
RAPID WEARING OF BRUSHES	
Excessive arcing:	See "Excessive Arcing at Brushes" above.
High mica:	Turn commutator and undercut mica.
Dirty commutator: Grit.	Clean commutator and brushes.
ELECTRICAL NOISE IN RECEIVER	
Sparking at commutator:	See "Excessive Arcing at Brushes" above.
Loose connections:	Tighten connections.
Condenser shorted:	Replace condenser.
EXCESSIVE NOISE AND VIBRATION	
Armature striking internal wiring:	Rearrange internal wiring.
Armature striking pole faces:	Replace bearings.
Worn bearings:	Replace bearings.

SECTION V

SUPPLEMENTARY DATA

TABLE 2

PRIMARY SUPPLY CURRENT

(Connect equipment as shown in cording diagram on Figure 31)

	Amperes at 24 Volts	*Amperes at 28 Volts*
(1) Four transmitters and three receivers energized, one transmitter operating on TONE	13.2	14.7
(2) Same as (1) except one transmitter operating on CW	13.7	15.6
(3) Same as (1) except with emission switch on VOICE (Dynamotor DM-33-A not running)	8.0	8.8
(4) Two transmitters and three receivers energized, one transmitter operating on TONE	11.8	13.1
(5) Same as (4) except one transmitter operating on CW	12.3	14.0
(6) Same as (4) except with emission switch on VOICE (Dynamotor DM-33-A not running)	6.6	7.2
(7) Same as (4) but with telegraph key open	8.0	8.8
(8) Three receivers only, all energized	4.5	5.0
(9) Four transmitters only, all energized and one operating on TONE	8.6	9.7
(10) Same as (9) but with one operating on CW	9.1	10.4
(11) Heater current of four transmitters and modulator unit	3.6	4.1
(12) Two transmitters only, all energized and one operating on TONE	7.2	8.1
(13) Same as (12) but with one operating on CW	7.7	8.8
(14) Heater current of two transmitters and modulator unit	2.2	2.5

A variation of ± 10% in the above values may be expected due to differences in dynamotors, vacuum tubes, relay resistances and measuring equipment. See Table 18 for ratings of Dynamotors DM-32-A and DM-33-A.

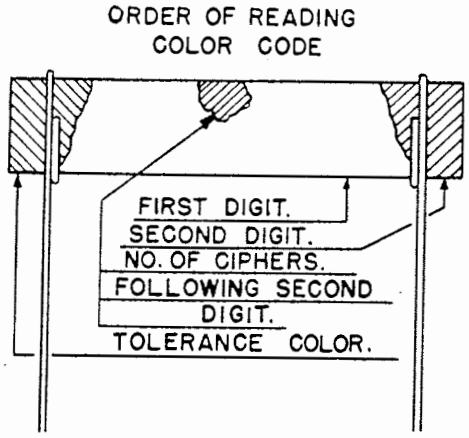
TABLE 3
RESISTOR COLOR CODE

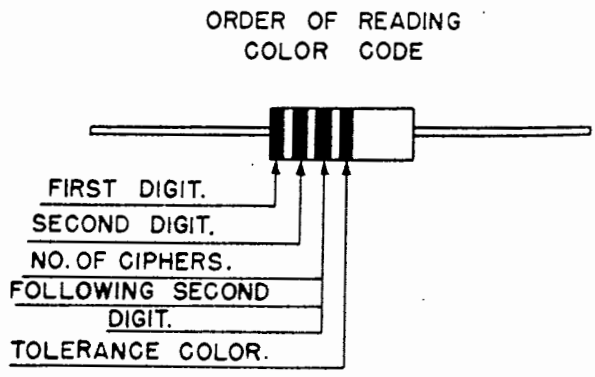
Carbon resistors are color coded by one of two methods to indicate the nominal resistance in ohms and the tolerance.

The first method is as follows: first digit is indicated by the body color, second digit by tip color, and the number of ciphers after the second digit by a dot painted on the body. A gold or silver colored tip, when used, indicates a tolerance of ± 5% and ± 10%, respectively.

The second method is as follows: four narrow rings are painted around the body, starting at one end. The color of the ring at the end represents the first digit, the second ring the second digit, the third ring the number of ciphers after the second digit. The fourth ring indicates the tolerance, gold for ± 5% and silver for ± 10%.

0—Black	3—Orange	6—Blue
1—Brown	4—Yellow	7—Violet
2—Red	5—Green	8—Gray
		9—White





EXAMPLE: 360,000 ohms ±5%: First method: orange body, blue tip, yellow dot, and a gold colored tip to represent the tolerance. Second method: orange, blue, yellow, and gold rings, starting at one end.

NOTE: These resistors increase in resistance with time and with the application of heat. Table 4 gives the acceptable operating tolerances for the carbon resistors used in this equipment.

TABLE 4
OPERATING TOLERANCES FOR CARBON RESISTORS

These resistors increase in resistance with time and temperature rise. The equipment will operate satisfactorily if the resistors are within the following tolerance ranges.

± 20%	R-1, R-3, R-4, R-6, R-9, R-12, R-15, R-16, R-17, R-21, R-52, R-53, R-54, R-55, R-56, R-57, R-58, R-59, R-60, R-64, R-66, R-67, R-68, R-69, R-70, R-72, R-73, R-74, R-75, R-77
± 30%	R-5, R-10, R-11, R-14, R-18, R-51, R-61, R-76, R-78
± 50%	R-2, R-7, R-8, R-13, R-19, R-20

TABLE 5
CAPACITOR COLOR CODE

Molded mica capacitors of fixed capacitance which are too small to be conveniently marked with capacitance values, are color coded by the use of three dots. The colors represent the numbers listed below. Reading from left to right in the direction of the arrow, the capacitance in micromicrofarads is indicated by the following: first color, first digit; second color, second digit; third color, the number of ciphers after the second digit.

0—Black	3—Orange	6—Blue
1—Brown	4—Yellow	7—Violet
2—Red	5—Green	8—Gray
		9—White

EXAMPLE: 200 micromicrofarads: a red dot, a black dot and a brown dot, reading from left to right.

When a tolerance is indicated, it is done by means of a fourth colored dot, gold for ± 5% and silver for ± 10%.

Mica capacitors C-10, C-12, C-14, C-17, C-19, C-22, C-23, C-27, C-36, C-37, C-38 and C-59 are coded by means of colored lacquer to show their nominal capacitance. One long colored line or spot followed by two small colored lines or spots, arranged clockwise as seen from the top of the nut, indicate the nominal capacitance in micromicrofarads. Colors represent the numbers listed above except that the third line or spot represents the third digit instead of the number of ciphers after the second digit.

EXAMPLE: 180 micromicrofarads: a long brown line or spot followed clockwise on the nut by a gray line and a black line or spot. Each of these capacitors is subject to a manufacturing tolerance of ± 2.5 micromicrofarads; a capacitor coded as 180 may have any value between 177.5 and 182.5 micromicrofarads.

Silvered mica fixed capacitors enclosed in a small bell-shaped housing are used in many of the units in place of the assembled condensers described above. On these units, the color code consists of three paint spots arranged about 45° apart on the periphery of the housing on the side opposite the mounting screw. The significance of these spots is the same as those just described when read in the clockwise direction.

TABLE 6

SENSITIVITY

The r-f input required from a direct connected signal generator to obtain 10 milliwatts output (6.3 volts) with a 4,000 ohm resistive load is shown for six points in each of the radio receivers. The load resistance shall be connected to the test receiver only and the output circuit of this receiver shall be isolated from the head sets and output circuits of other receivers. The frequencies at which the measurements must be made are in parentheses. Input voltage, 28 volts. Sensitivity values are in microvolts, modulated 30 per cent at 400 cps.

Radio Receiver	*Ant. Bind. Post*	*R-F Control Grid, Socket Term. #4*	*Mixer Control Grid, Top cap*	*Mixer Control Grid, Top cap*	*First I-F Control Grid, Socket Term. #4*	*Second I-F Control Grid, Socket Term. #4*
BC-453-A (or -B)	7	90	600	470	11,000	117,000
(190-550 kc)	(550 kc)	(550 kc)	(550 kc)	(85 kc)	(85 kc)	(85 kc)
BC-454-A (or -B)	7	140	550	430	3,000	110,000
(3-6 mc)	(6 mc)	(6 mc)	(6 mc)	(1415 kc)	(1415 kc)	(1415 kc)
BC-455-A (or -B)	8	180	670	550	3,000	88,000
(6-9.1 mc)	(9.1 mc)	(9.1 mc)	(9.1 mc)	(2830 kc)	(2830 kc)	(2830 kc)

This table of sensitivities is for use as a guide in servicing the receivers. It applies to undamaged and perfectly aligned receivers under reasonable climatic conditions. Microvolt values shown are to be regarded as average; they are to be approximated when adjusting the equipment after overhaul or long service. Departures from these values are not necessarily cause for major operations on the equipment. The values should be employed with caution and discretion, particularly in the case of measurements carried out under extreme conditions of temperature or humidity. A signal generator whose accuracy is not definitely known and a set of vacuum tubes which are not average may produce results varying considerably from those shown in the table.

TABLE 7
SELECTIVITY

The selectivity of a radio receiver is that characteristic which determines the extent to which it is capable of differentiating between the desired signal and disturbances of other frequencies. To measure this characteristic, proceed as follows:

1—With Radio Receiver BC-453-A (or -B) and a signal generator, both tuned to 190 kc, adjust the generator output to obtain a receiver output of 10 milliwatts into a 4000-ohm resistive load. Use 30 percent modulation, 400 cycles.

2—Increase the voltage of the signal generator to twice (2X) the value obtained above.

3—Increase the generator frequency until the receiver output decreases to 10 milliwatts. Record the frequency change.

4—Without changing the generator output, decrease the generator frequency, passing through 190 kc, until the receiver output is again 10 milliwatts. Record the difference between this frequency and 190 kc.

5—The average value of the two values obtained in steps 3 and 4 should approximate 1.7 kc, as indicated in the following table. Additional data on the selectivity characteristic of Radio Receiver BC-453-A (or -B) may be obtained by using generator outputs of 10 times (10X), 100 times (100X), 1000 times (1000X), etc., the value obtained in step 1 and repeating steps 3, 4 and 5.

Data on Radio Receivers BC-454-A (or -B) and BC-455-A (or -B) are obtained as outlined above, using the proper reference frequencies as given below.

Radio Receiver	*Reference Frequency*	*MCW Selectivity*			
		2X	*10X*	*100X*	*1000X*
BC-453-A (or -B) (190-550 kc)	190 kc	1.7 kc	3.1 kc	4.3 kc	5.5 kc
BC-454-A (or -B) (3-6 mc)	3 mc	7.5	12.5	18.6	25.8
BC-455-A (or -B) (6-9.1 mc)	6 mc	9.8	24.2	42.2	70.6

The above table is presented for use as a guide in servicing receivers. It applies to undamaged and perfectly aligned receivers, under reasonable climatic conditions. These values are to be regarded as average, to be approximated when adjusting the equipment after overhaul or long service. Departures from these values are not necessarily cause for major operations on the equipment. The values should be employed with caution and discretion, particularly in the case of measurements carried out under extreme conditions of temperature or humidity, or with a signal generator whose accuracy is not definitely known.

TABLE 8

TYPICAL TEST DATA ON TRANSMITTERS

Input voltage 28.0 volts, Antenna A-61-A (5 ohms, 100 mmf), transmitter tuning and coupling adjusted for maximum antenna current on CW. The transmitter must not be readjusted for TONE or VOICE measurements:

Transmitter	*Frequency (mc)*	*Emission*	*Plate Voltage to R-F Power Amp. Tubes*	*Screen Voltage to R-F Power Amp. Tubes*	*Plate Current to R-F Power Amp. Tubes*	*Plate Current to M. O. Tube*	*Antenna Current Into Antenna A-61-A*	*Setting of ANT. INDUCTANCE Control*	*Setting of ANT. COUPLING Control*
	3.0	CW	518	265	165	19.5	2.2	11.4	5.7
	3.0	TONE	535	150	95	20.5	1.5	11.4	5.7
BC-696-A	3.0	VOICE	535	150	92	20.5	1.1	11.4	5.7
	4.0	CW	515	262	175	17.8	2.5	7.0	6.0
	4.0	TONE	530	150	102	18.5	1.6	7.0	6.0
	4.0	VOICE	530	160	100	18.5	1.4	7.0	6.0
	4.0	CW	530	267	165	20	2.5	10.8	5.8
	4.0	TONE	547	154	95	21	1.8	10.8	5.8
BC-457-A	4.0	VOICE	547	154	91	21	1.4	10.8	5.8
	5.3	CW	520	262	170	18	2.8	6.8	6.0
	5.3	TONE	545	154	98	19	2.0	6.8	6.0
	5.3	VOICE	545	154	98	19	1.6	6.8	6.0
	5.3	CW	530	275	167	20	2.7	10.7	3.8
	5.3	TONE	552	154	94	21	1.9	10.7	3.8
BC-458-A	5.3	VOICE	552	154	91	21	1.5	10.7	3.8
	7.0	CW	522	270	177	18	3.0	6.1	3.9
	7.0	TONE	545	154	103	19	2.2	6.1	3.9
	7.0	VOICE	545	154	100	19	1.8	6.1	3.9
	7.0	CW	525	273	167	19	2.8	6.5	4.5
	7.0	TONE	547	154	97	20	2.0	6.5	4.5
BC-459-A	7.0	VOICE	547	154	94	20	1.6	6.5	4.5
	9.1	CW	520	274	179	18	3.1	3.4	4.6
	9.1	TONE	545	154	102	19	2.2	3.4	4.6
	9.1	VOICE	545	154	98	19	1.8	3.4	4.6

9.1	TONE	545	154	102	19	2.2	3.4	4.6
	VOICE	545	154	98	19	1.8	3.4	4.6

TABLE 8 (Continued)
TYPICAL TEST DATA ON TRANSMITTERS

Transmitter sidetone voltage across 4,000 ohms (Use Output Meter Model 571, Type 3A, part of Test Set I-56-A)

TONE and CW: 7 to 9 volts.

VOICE: 15 volts for loud sustained tone in Microphone T-17 or approximately 20 volts with maximum modulation at 1,000 cycles per second.

Microphone T-17 current: 60 to 62 milliamperes dc.

If the test conditions specified above this table are followed precisely, variations of ± 5% in voltages and ± 10% in currents may be considered satisfactory. If the test conditions have been carefully met and the results fall outside of these limits, important consideration should be given to the seriousness of the discrepancy or discrepancies before the equipment is considered unsatisfactory.

It is recommended that one or more sets of tubes, specially marked "average" or "standard," be set aside for checking units found to be outside the specified limits.

An example of the results of testing a normal Radio Transmitter BC-459-A under a different set of conditions follows: Input voltage 27.6, frequency 8 mc, antenna resistance 1 ohm, antenna capacitance 108 mmf, the transmitter tuning and coupling adjusted for maximum antenna current on CW and not readjusted for TONE or VOICE measurements. Antenna current in CW, TONE and VOICE positions 4.8, 3.4 and 2.8 amperes, respectively. The r-f power amplifier plate current is 212, 122 and 118 milliamperes, respectively, for the three positions. A comparison of these figures with those in the above table will demonstrate the importance of observing standard test conditions.

TABLE 9

VACUUM TUBE TERMINAL VOLTAGES IN THE RECEIVERS

(Use Test Set RC-54-A and d-c Voltmeter from Test Set I-56-A)

Input voltage, 28 volts. Receiver operating on CW, maximum gain condition. Variations of ± 10% from the following values may be expected due to differences in tubes, resistors, dynamotors and measuring equipment. Some terminals are accessible only with a bent voltmeter prod. Points which connect directly to inaccessible terminals may be located by referring to the wiring diagrams, Figures 37, 38 and 39. Plate and screen voltages in the following table must be measured with a voltmeter having a resistance of 600,000 ohms. The voltage at terminal 6 on tube V-7 (Tube VT-133) is zero while operating on MCW; all other voltages remain the same.

*Terminal	V-3 (Tube VT-131) R-F Amp.	V-4 (Tube VT-132) Mixer	V-5 (Tube VT-131) First I.F.	V-6 (Tube VT-131) Second I.F.	V-7 (Tube VT-133) Detector-CW Osc.	V-8 (Tube VT-134) Audio Amp.
1	0	0	0	0	0	0
2	0	14	14	0	**No Test	28
3	4	240	4	3.7	0	240
4	0	85	0	0	0	240
5	4	**No Test	4	3.7	0	0
6	85	***30-50	85	85	***50-80	—
7	14	28	28	14	14	14
8	240	4	240	240	0	17
Top Cap	—	0	—	—	—	—

*The tube terminals are numbered clockwise when viewed from the bottom, beginning with the locating pin.
**A small d-c voltage exists between this terminal and ground under oscillating conditions, but application of the voltmeter may stop oscillations, resulting in unreliable voltmeter readings.
***The voltage between this terminal and ground will vary with the frequency range of the receiver.

TABLE 10

VACUUM TUBE TERMINAL VOLTAGES IN THE MODULATOR UNIT AND TRANSMITTERS

(Use Test Set RC-55-A and d-c Voltmeter from Test Set I-56-A)

Input voltage, 28 volts. Variations of ± 10% from the following values may be obtained due to differences in tubes, transmitters, dynamotors and measuring equipment. Transmitter connected to Antenna A-61-A and tuned according to instructions on Figure 34.

*Socket Terminal	V-50 (Tube VT-135) Tone Osc.			V-51 (Tube VT-136) Modulator			V-52 (Tube VT-139) Voltage Regulator			Crystal			***V-53 (Tube VT-138) Resonance Indicator			V-54 (Tube VT-137) Master Osc.			V-55 (Tube VT-136) R-F Amp.			V-56 (Tube VT-136) R-F Amp.		
	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice	Tone	CW	Voice
1	—	—	—	28	28	28	—	—	—	0	0	0	0	0	0	—	—	—	14	14	14	28	28	28
2	14	14	14	—	—	—	0	0	0	—	—	—	28	28	28	14	14	14	545	525	545	—	—	—
3	115	115	55	124	137	130	—	125	—	0	0	0	50	50	50	193	190	193	150	270	150	150	270	150
4	—	—	—	0	0	0	—	—	—	—	—	—	128	128	128	193	190	193	–50	–50	–50	–50	–50	–50
5	**	**	0	0	23	0	150	270	150	–50	–50	–50	0	0	0	**	**	**	150	270	150	545	525	545
6	—	—	—	10	25	10	—	—	—	—	—	—	193	190	193	—	—	—	0	0	0	0	0	0
7	0	0	0	14	14	14	—	—	—	0	0	0	14	14	14	0	0	0	0	0	0	14	14	14
8	0	0	0	—	—	—	—	—	—	0	0	0	****	****	****	0	0	0	—	—	—	—	—	—
Top Cap	—	—	—	520	525	520	—	—	—	—	—	—	—	—	—	—	—	—	545	525	545	545	525	545

*The tube terminals on all tubes except V-51, V-55 and V-56 (Tube VT-136) are numbered clockwise when viewed from the bottom, beginning with the locating pin. Base connections on tubes V-51, V-55 and V-56 (Tube VT-136) are numbered clockwise when viewed from the bottom, beginning with the more clockwise of the two large pins.

**A small d-c voltage exists between terminal 5 and ground under oscillating conditions. The application of the voltmeter may stop oscillations, resulting in unreliable voltmeter readings. The application of the voltmeter to either heater terminal (2 and 7) on tube V-54 (Tube VT-137) may stop oscillations; the test should be made quickly to avoid damage to the equipment.

***Plate voltage (terminal 3) measured on 600 volt scale of the 600,000-ohm voltmeter. Master-oscillator frequency is not equal to crystal frequency for these measurements; when it is, the voltage at terminal 3 is approximately 20 volts.

****8 volts for Radio Transmitters BC-457-A and BC-458-A; 6.2 volts for Radio Transmitters BC-459-A and BC-696-A.

TABLE 11

RESISTANCE TO GROUND FROM RECEIVER TERMINALS

Resistance to ground in ohms from all socket and receptacle terminals in the receivers. Use ohmmeter in Selective Analyzer Model 665, Type 2, part of Test Set I-56-A. Disconnect the receiver from the rack. Remove adapter and dynamotor.

Terminal	*V-3 (Tube VT-131) RF-Amp.*	*V-4 (Tube VT-132) Mixer*	*V-5 (Tube VT-131) 1st I.F.*	*V-6 (Tube VT-131) 2nd I.F.*	*V-7 (Tube VT-133) Det.-CW Osc.*	*V-8 (Tube VT-134) Audio Amp.*	*J-1*	*J-2*	*J-3*
1	0	0	0	0	0	0	300,000	0	0
2	0	8	8	0	51,000)* 100,000)	8	0	8	330
3	300,000	14,000	300,000	510	0	15,000	H	14,000	300,000
4	H	7,000	100,000	100,000	510,000	14,000	330	—	314,000)* 116,000)
5	300,000	52,000	300,000	510	0	2,000,000	314,000)* 116,000)	—	7,000
6	7,000	520,000)* 210,000)	7,000	7,000	334,000)* 121,000)	H	8	—	H
7	8	8	8	8	8	8	H	—	14,000
8	14,000	620	14,000	14,000	0	1,500	H	—	—
Top Cap	—	**	—	—	—	—	—	—	—

*Upper value is for Radio Receiver BC-453-A (or -B), and lower is for Radio Receivers BC-454-A (or -B) and BC-455-A (or -B).
**Not over 20 ohms (the resistance of L-3).

NOTES: H signifies over 2 megohms, the practical limit of the ohmmeter. The value of 300,000 appears in several places; this is the leakage resistance of C-5. Apply positive lead of ohmmeter to C-5 and negative to ground for consistent results.

The resistance to ground from each terminal in Radio Control boxes BC-450-A, BC-496-A and BC-473-A (or -B) (all switches in mid-position), the receiver rack, and Adapter FT-230-A is either 0 or H as follows:

J-4, all H; J-6, J-7, all H except 3; J-18, J-19, J-20, all H except 1; J-21, J-22, J-23, all H except 4; J-24, all H except 2 and J-25, J-26, J-27, all H except 3 and 4 (INCREASE OUTPUT control at maximum).

TABLE 12

RESISTANCE TO GROUND FROM TRANSMITTER TERMINALS

Resistance to ground in ohms from all socket and receptacle terminals in the transmitters. Use ohmmeter in Selective Analyzer Model 665, Type 2, part of Test Set I-56-A. Remove transmitter from rack.

Terminal	*Crystal*	*V-53 (Tube VT-138) Res. Ind.*	*V-54 (Tube VT-137) Master Osc.*	*V-55 (Tube VT-136) R-F Amp.*	*V-56 (Tube VT-136) R-F Amp.*	*J-64*
1	0	0	H	4.7	7	0
2	H	7	7	H	H	15,000
3	(5,100 (10,000 * (15,000	H	H	H	H	H
4	(5,100 H	H	H	15,000	15,000	H
5	15,000	(5,100 (10,000 * (15,000	51,000	H	H	119
6	H	(5,100 H	H	51,000	51,000	7
7	0	7	0	0	4.7	H
8	0	300	0	—	—	—
Top Cap	—	—	—	H	H	—

*Values shown correspond to Radio Transmitters BC-696-A, BC-457-A, BC-458-A and BC-459-A, respectively.

NOTES: H signifies over 2 megohms, the practical limit of the ohmmeter. The resistance to ground from each terminal in Radio Control Box BC-451-A, Antenna Relay Unit BC-442-A and the transmitter rack is either 0 or H as follows:

J-55, all H except 2, 7, 12; J-56, both H; J-59, all H except 5; J-60, all H except 3; J-61 all H except 3; J-62, all H except 1; J-63, all H except 1.

J-25, J-26, J-27, all H except 3 and 4 (INCREASE OUTPUT control at maximum).

TABLE 13

RESISTANCE TO GROUND FROM MODULATOR UNIT TERMINALS

Resistance to ground in ohms from all socket and receptacle terminals in the modulator unit. Use ohmmeter in Selective Analyzer Model 665, Type 2, part of Test Set I-56-A. Remove dynamotor and all plugs before testing.

Terminal	*V-50 (Tube VT-135) Tone Osc.*	*V-51 (Tube VT-136 Mod.*	*V-52 (Tube VT-139) Volt. Reg.*	*J-51*	*J-52*	*J-53*	*J-54*	*J-58*
1	H	17	H	0	H	H	H	H
2	12	H	H	H	H	0	H	H
3	125,000	30,000	H	105,000	0	H	H	220
4	H	900	H	—	H	—	H	17
5	100,000	52,000	120,000	—	200	—	H	0
6	H	52,000	H	—	17	—	H	H
7	0	12	H	—	—	—	0	H
8	23	—	H	—	—	—	400	H
9	—	—	—	—	—	—	220	H
10	—	—	—	—	—	—	H	90,000
11	—	—	—	—	—	—	H	82,000
12	—	—	—	—	—	—	212	110,000
13	—	—	—	—	—	—	51,000	—
14	—	—	—	—	—	—	50	—
15	—	—	—	—	—	—	17	—
16	—	—	—	—	—	—	H	—
17	—	—	—	—	—	—	H	—
18	—	—	—	—	—	—	H	—
Top Cap	—	106,000	—	—	—	—	—	—

NOTE: H signifies over 2 megohms, the practical limit of the ohmmeter.

TABLE 14

CONTINUITY TESTS
Dynamotors, Relays, Chokes and Transformers

Use ohmmeter in Selective Analyzer Model 665, Type 2, part of Test Set I-56-A. Disconnect each major unit under test from the remaining equipment before making the following continuity tests.

Continuity Through	*Approximate Resistance in ohms*
Adjacent commutator segments, L.V. side of Dynamotor DM-32-A	0.3
Adjacent commutator segments, H.V. side of Dynamotor DM-32-A	22
Shunt field coil of Dynamotor DM-32-A	200
Adjacent commutator segments, L.V. side of Dynamotor DM-33-A	0.04
Adjacent commutator segments, H.V. side of Dynamotor DM-33-A	10
Shunt field coil of Dynamotor DM-33-A	80
Series field coil, L.V. side of Dynamotor DM-33-A	less than 0.1
K-1, K-2, K-3 in parallel, as measured between terminals 5 and 6 on J-6 or J-7, is 107 ohms	321, each coil
K-50, terminals 12 to 15 on J-54	200
K-51, K-52 in parallel, as measured between terminals 9 and 15 on J-54, is 200 ohms	400 each coil
K-53, K-54 in parallel, as measured between terminals 5 and 6 on J-64, is 112 ohms	(300 for K-53 coil (180 for K-54 coil
K-55, terminals 1 to 4 on J-61	180
L-14, terminal 7 on J-1 to 6 on J-3	less than 0.1
L-15, terminal 3 on J-2 to 7 on J-3	325
L-50, terminal 1 or 3 on J-53 to 2 on J-51 (hold K-50 closed)	less than 0.1
L-51, terminal 3 on J-51 to terminal on C-55	67
RL-50, RL-51, across each unit	less than 1
T-1, primary, terminals 1 to 2 on T-1	1200
T-1, secondary, terminal 3 on T-1 to ground	330
T-50, terminals 1 to 4 on T-50. Same as C-51A to terminal 11 on J-54 with K-51 closed	70
T-50, terminal 6 to ground	5.5
T-51, terminals 1 to 2 on T-51. Same as C-54B to terminal 8 on J-54	25
T-51, terminals 3 to 4 on T-51. R-56 must be disconnected or test will show 300 ohms	327
T-52, terminals 1 to 2 on T-52	1000
T-52, terminals 3 to 4 on T-52 (R-62 may be left across this coil with little effect)	208
*T-52, terminal 6 to ground (the resistance of this winding was altered during production from 70 ohms to 48 ohms)	48 or 70

*In Modulator Unit BC-456-B, the resistance is 60 ohms.

TABLE 15
CAPACITOR TESTS

Use Capacity Unit Model 666, Type 2, with Selective Analyzer Model 665, Type 2, from Test Set I-56-A. Disconnect major unit (receiver, transmitter, etc.) under test from remaining equipment. The following table gives the normal apparent capacitance of each paper or electrolytic capacitor in the equipment. The apparent capacitance will be different from the nominal in those cases where the capacitor is shunted by a resistor or inductor. To obtain the true capacitance, it will be necessary to disconnect all leads to the capacitor. The values shown must be considered as approximations only because of production variations in the elements, and line voltage variations which affect the measuring equipment.

Capacitor	*Apparent Capacitance (mf)*	*Capacitor*	*Apparent Capacitance (mf)*	*Capacitor*	*Apparent Capacitance (mf)*
C-5	3.0	C-16B	2.0	C-53	1.2
C-6A	3.3	C-16C	greater than 10	C-54A	4.2
C-6B	3.0	C-20A	2.3	C-54B	greater than 10
C-6C	1.8	C-20B	0.01	C-55	1.3
C-7A	0.7	C-20C	3.1	C-56A	0.6
C-7B	2.3	C-30	greater than 10	C-56B	0.6
C-7C	0.06	C-32	3.0	C-57	0.08
C-15A	0.08	C-51A	0.07	C-58A	0.05
C-15B	1.8	C-51B	greater than 10	C-58B	0.05
C-15C	0.07	C-51C	greater than 10	C-58C	0.15
C-16A	0.4				

TABLE 16

VACUUM TUBE DATA

Values shown are "Characteristic Ratings" for the type of tube; these are not necessarily the values used in this equipment.

Type	*VT-131*	*VT-132*	*VT-133*	*VT-134*	*VT-135*	*VT-136*	*VT-137*	*VT-138*	*VT-139*
Function in this equipment	R-F & I-F amp.	Mixer	Det. & CW osc.	Audio amp.	Tone osc.	Mod. & r-f power amplifier	Master osc.	Resonance indicator	Voltage regulator
Heater voltage	12.6	12.6	12.6	12.6	12.6	12.6	12.6	12.6	—
Heater current	0.15	0.15	0.15	0.15	0.15	0.45	0.25	0.15	—
Control grid voltage	−3.0	−3.0	−9.0	−12.5	−8.0	−29.0	−32.0	—	—
Plate voltage	250	250	250	250	250	600	250	200	—
Screen grid voltage	100	100	—	250	—	300	—	—	—
Plate current	9.2	2.5	9.5	30	9.0	42	25	—	—
Screen grid current	2.4	6.0	—	3.5	—	Approx. 1.0	—	—	—
Transconductance (micromhos)	2000	3000 (triode)	1900	3000	2600	—	2000	—	—
Plate resistance	0.8 megohm	0.6 megohm (hexode)	—	70,000	7700	—	2500	—	—
Amplification factor	1600	Conversion conductance, 350 micromhos	16	210 2.8 watts power output into 7500 ohms, 7% total harmonic distortion	20	8 (G-Gs) 25 watts on plate and 3.5 watts on screen grid, max. allowable dissipation	5	0.19 ma with target-to-plate resistor of one megohm, 3 ma to target. Shadow angle 90° for grid bias of 0 volts and 0° for grid bias of −6.5 volts	Starting voltage 180 dc. volts, operating 150 dc volts (approximately). Operating current 5 ma dc. min. and 30 ma dc. max.

TABLE 16 (Continued)
VACUUM TUBE DATA

Type	*VT-131*	*VT-132*	*VT-133*	*VT-134*	*VT-135*	*VT-136*	*VT-137*	*VT-138*	*VT-139*
*Base connections									
No. 1	Shell (S)	Shell (S)	Shell (S)	Shell (S)	—	Heater (H)	—	—	—
No. 2	Heater (H)	Heater (H)	Control grid (G)	Heater (H)	Heater (H)	—	Heater (H)	Heater (H)	Cold cathode (K)
No. 3	Suppressor grid (Su)	Plate (hexode) (P)	Cathode (K)	Plate (P)	Plate (P)	Screen grid (Gs)	Plate (P)	Plate (P)	Jumper to 7
No. 4	Control grid (G)	Screen grid (hexode) (Gs)	Diode plate (2) (Dp2)	Screen grid (Gs)	—	Control grid (G)	—	Target (TA)	—
No. 5	Cathode (K)	Control grid (osc) and grid No. 1 hexode (Go)	Diode plate (1) (Dp1)	Control grid (G)	Control grid (G)	—	Control grid (G)	Control grid (G)	Anode (AN)
No. 6	Screen grid (Gs)	Plate (osc) (Po)	Plate (triode) (P)	—	—	Cathode (K)	—	—	—
No. 7	Heater (H)	Heater (H)	Heater (H)	Heater (H)	Heater (H)	Heater (H)	Heater (H)	Heater (H)	Jumper to 3
No. 8	Plate (P)	Cathode (K)	Heater (H)	Cathode (K)	Cathode (K)	—	Cathode (K)	Cathode (K)	—
Top cap	—	Control grid (hexode) (G)	—	—	—	Plate (P)	—	—	—
**R.M.A. Type	12SK7	12K8	12SR7	12A6	12J5-GT	1625	1626	1629	VR-150-30
**Bulb	Metal shell MT-8	Metal shell MT-8	Metal shell MT-8	Metal shell MT-8	T-9	ST-16	ST-12	T-9	ST-12
**Cap	—	Miniature	—	—	—	Small metal	—	—	—
**Base	Small wafer octal 8-pin	Small wafer octal 8-pin	Small wafer octal 8-pin	Small wafer octal 7-pin	Intermediate shell octal 6-pin	Medium 7-pin	Small shell octal 8-pin	Small shell octal 7-pin	Small shell octal 6-pin

*Base connections are numbered clockwise when viewed from the bottom, beginning with the locating pin, except for Tube VT-136. This tube has a medium 7-pin base on which the numbering proceeds clockwise from the embossed arrow (clockwise from the more clockwise of the two large pins when viewed from the bottom).
**Radio Manufacturer's Association standard designation.

NOTE: Keys on the tube bases vary somewhat in size, with the result that occasionally a tube may be found which can be jammed part way down into the socket with incorrect pin orientation. Line up, visually or by feel, the key on the tube base with the keyway of the socket before exerting any considerable pressure on the tube.

TABLE 17
EMISSION TESTS ON VACUUM TUBES

An emission test may be made on all tubes in Radio Set SCR-274-N, except Tube VT-139, with Tube Checker Model 685, Type 2, part of Test Set I-56-A.

Tube	*Filament Selector*	*Tube Selector*	*IN Position*
VT-131	8	42	B, C, F, G
VT-132	8	44	B, C, D, E, F
VT-133 Triode	8	41	B, F Use Adapter D-70180
Diode	8	0	C, D Use Adapter D-70180
VT-134	8	42	B, C, D
VT-135	8	42	B, D
VT-136	8	43	C, D, E
VT-137	8	41	B, D
VT-138	8	37	B, C, D. Screen will not light
VT-139	Cannot be tested on this tube checker. An operating test would consist of measuring the screen grid voltage on r-f power amplifier Tubes VT-136 with VOICE emission. It should be 150 plus 10 volts or minus 5 volts.		

NOTE: All tubes should be given an operating test under working conditions in Radio Set SCR-274-N. There are many possible faults in tubes which a simple emission test will not discover.

TABLE 18
DYNAMOTOR RATINGS

Dynamotor	*Duty*	*Input*		*Output*	
		Amperes	*Volts*	*Milliamperes*	*Volts*
DM-32-A	*Continuous	1.1	28	60	250
DM-33-A	*Continuous	5.0	28	160	575
DM-33-A	**Intermittent	7.0	28	250	540

*60°C temperature rise by change-in-resistance method.
**40 seconds on and 20 seconds off.

the socket with incorrect pin orientation. Line up, visually or by feel, the key on the tube base with the keyway of the socket before exerting any considerable pressure on the

TABLE 19

PLUGS AND CORDAGES REQUIRED TO ASSEMBLE CORDS FOR RADIO SET SCR-274-N

(See Figure 31 for Cording Diagram and Figure 32 for Drawings of Cord Assemblies.)

Cord		*Plugs*			*Cordage*		*W.E. Co. Assembly Dwg. No.**
Use	*Stock Number*	*Designation*	*Stock Number*	*W.E. Co. Part No.*	*Designation*	*W.E. Co. Part No.*	
Primary power supply to receiver Racks FT-233-A, FT-227-A, FT-220-A or FT-264- (1 req'd.)	3E2204	PL-147 or PL-147-A Nut M-232 Ferrule M-231 (1 each req'd. per cord)	2Z7226-147 2Z3261-232 2Z3259-231	6578 9127 7546 6780	CO-204	6712	7547
Primary power supply to Modulator Unit BC-456-A (or -B) (1 req'd.)	3E2204	PL-148 or PL-148-A Nut M-232 Ferrule M-231 (1 each req'd. per cord)	2Z7226-148 2Z3259-232 2Z3259-231	6965 9126 7546 6780	CO-204	6712	7548
Modulator Unit BC-456-A (or -B) to receiver Racks FT-233-A, FT-227-A, FT-220-A or FT-264- (1 req'd.)	3E2205	PL-151 or PL-151-A (2 req'd. per cord)	2Z7226-151	6784 9123	CO-205	6794	5808
Receiver radio control box to Racks FT-233-A (1 req'd.), FT-227-A (2 req'd.), FT-220-A (3 req'd.) or FT-264- (4 req'd.)	3E2206	PL-152 or PL-152-A (2 req'd. per cord)	2Z7226-152	6577 9125	CO-206	6711	6693
Modulator Unit BC-456-A (or -B) to transmitter Radio Control Box BC-451-A (1 req'd.)	3E2207	PL-153 or PL-153-A (2 req'd. per cord)	2Z7226-153	6963 9121	CO-207	6796	7538

BC-451-A (1 req'd.)		(2 req'd. per cord)		9121

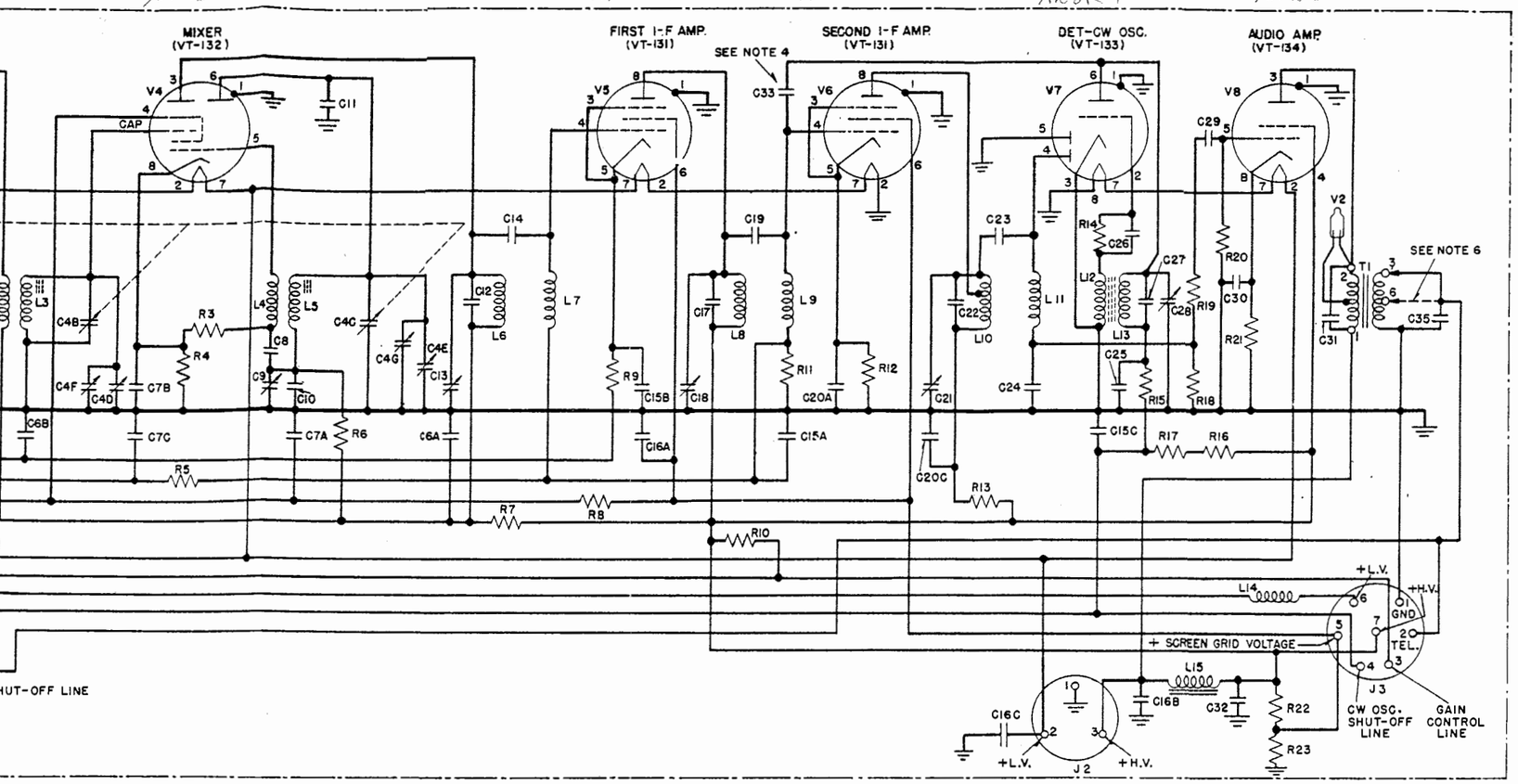
TABLE 19 (Continued)

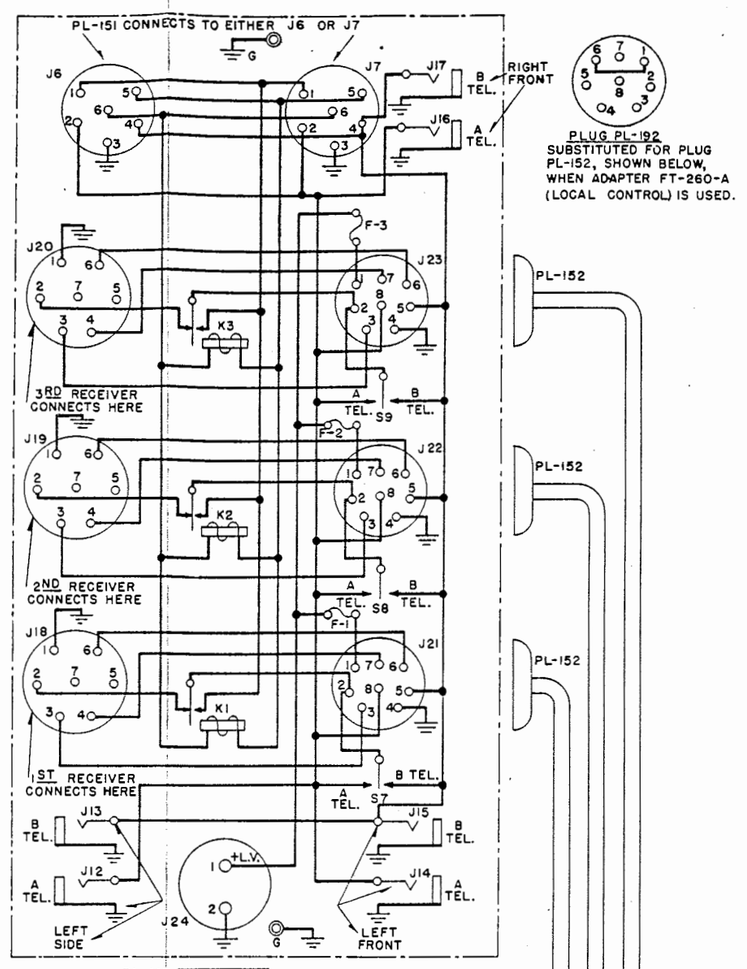
PLUGS AND CORDAGES REQUIRED TO ASSEMBLE CORDS FOR RADIO SET SCR-274-N

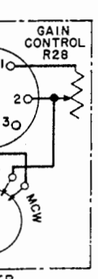
Cord		*Plugs*			*Cordage*		*W.E. Co. Assembly Dwg. No.**
Use	*Stock Number*	*Designation*	*Stock Number*	*W.E. Co. Part No.*	*Designation*	*W.E. Co. Part No.*	
Modulator Unit BC-456-A (or -B) to transmitter Racks FT-234-A, FT-226-A, FT-276- or FT-331-A (1 req'd.)	3E2210	PL-154 or PL-154-A (2 req'd. per cord)	2Z7226-154	6964 9122	CO-210	6795	5804
Antenna Relay Unit BC-442-A to Racks FT-234-A, FT-226-A, FT-276- or FT-331-A (1 req'd.)	3E2205	PL-156 or PL-156-A (2 req'd. per cord)	2Z7226-156	6967 9124	CO-205	6794	5810
Radio Control Box BC-451-A to Ammeter I-71-B** (1 req'd.)	3E2211	PL-157** (1 req'd. per cord) and PL-158** (1 req'd. per cord) PL-192***	2Z7226-157 2Z7226-158	3146 7545 and 7639	CO-211	3251	7543 6787

*Figure 32 shows the details of assembly of the cords and plugs.
**Discontinued in later models.
***One as required per receiver when Adapter FT-260-A for local control is used.

NOTE: An assembly (W.E. Co. Drawing No. 6151) of Tuning Shaft MC-215 is shown on Figure 32. One tuning shaft per receiver is required for remote control.



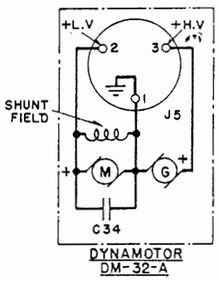




TYPICAL RADIO RECEIVER BC-455-B (6-9.1 MC). I-F = 2830KC

NOTES:

1. CAPACITOR ABBREVIATIONS:
   MMF - MICROMICROFARADS
   MF - MICROFARADS
2. ALL PLUGS AND RECEPTACLES ARE SHOWN AS VIEWED FROM THE OUTSIDE.
3. ALL RELAYS ARE SHOWN IN THE NON-ENERGIZED POSITION.
4. THE CAPACITANCE BETWEEN PIN PLUGS IN THE 2ND I-F RECEPTACLE CONSTITUTES C-33.
5. TERMINAL NUMBERS APPEARING ON RECEPTACLES OF JACKS IN RECEIVERS AND ADAPTERS AND ALL CIRCUIT SYMBOLS ARE FOR REFERENCE PURPOSES ONLY. THEY DO NOT APPEAR ON THE EQUIPMENT.
6. TRANSFORMER T1 IN BC-453-B, BC-454-B AND BC-455-B RECEIVERS IS PROVIDED WITH A TAP (TERM.6) FOR LOW IMPEDANCE HEADSETS. THESE THREE RECEIVERS AND RADIO RECEIVERS BC-453-A, BC-454-A AND BC-455-A ARE NORMALLY FURNISHED WITH CONNECTION SHOWN IN SOLID LINES FOR USE WITH HIGH IMPEDANCE (8000 OHMS) HEADSETS. RADIO RECEIVERS BC-453-B, BC-454-B, AND BC-455-B CAN BE CHANGED FOR USE WITH LOW IMPEDANCE HEADSETS BY REMOVING THE TWO WIRES ON TERMINAL 3 AND CONNECTING THEM TO TERMINAL 6 AS SHOWN IN DASHED LINES. (SEE FIGURE 39)



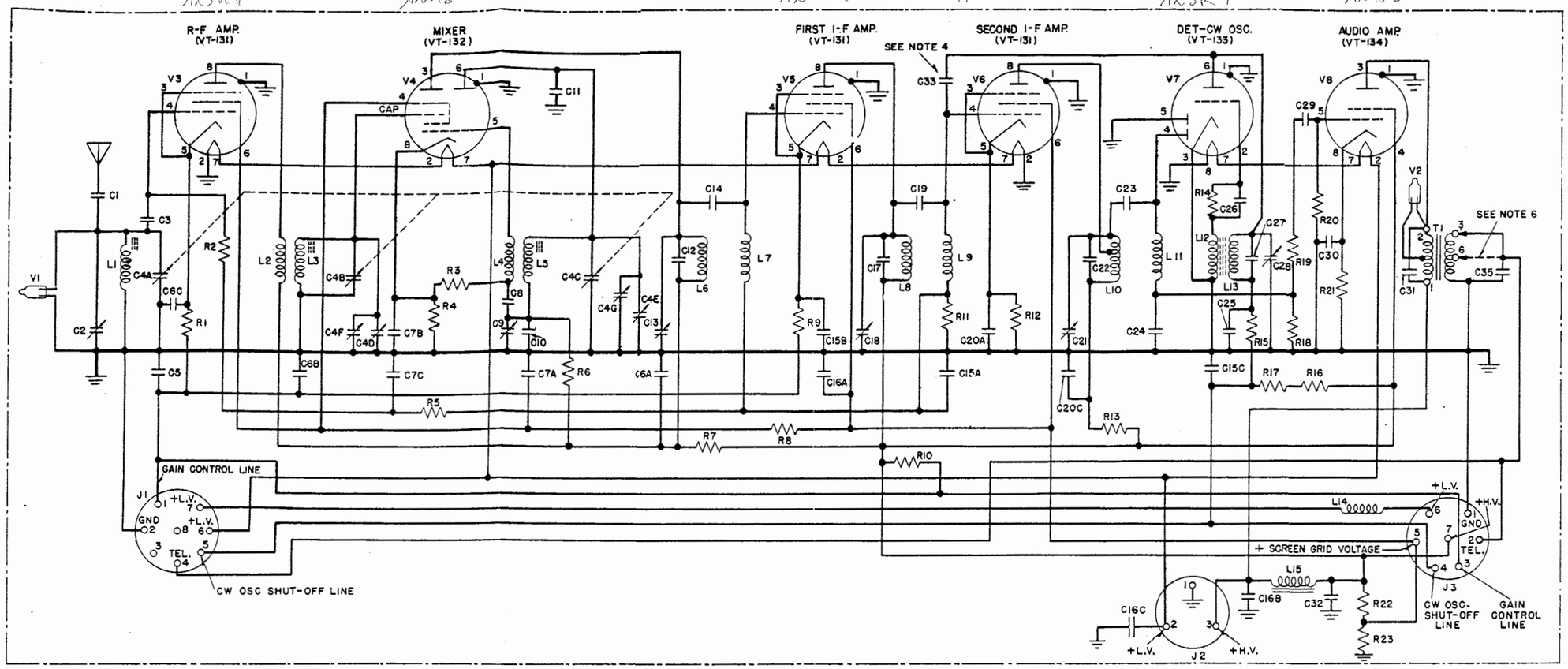
DYNAMOTOR DM-32-A

			INDUCTORS		RESISTORS				MISCELLANEOUS	
TION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS	SYMBOL	OHMS	SYMBOL	DESCRIPTION
05MF	C-29	.006MF	L-1	ANT. INPUT	R-1	620	* R-15	5,100	T-1	OUTPUT TRANSFORMER
2MF	C-30	15MF	L-2,L-3	RF AMP	R-2	2,000,000	* R-16	51,000		
MF	C-31	.001MF	L-4,L-5	RF OSC	R-3	51,000	* R-17	51,000	V-1, V-2	NEON TUBES
MF	C-32	5 MF	L-6,L-7	IN 1ST IF	R-4	620	R-18	510,000	K-1,K-2,K-3	REC.OUTPUT-TRANS.SIDE-TONE RELAYS
MF	*C-33	LESS THAN 2 MMF	L-8,L-9	IN 2ND IF	R-5	150,000	R-19	100,000		
5MF			L-10,L-11	IN 3RD IF	* R-6	150,000	R-20	2,000,000		
MF	C-34	.001MF	L-12,L-13	CW OSC	R-7	200	R-21	1,500	F-1,F-2,F-3	10 AMP FUSES
MF	C-35	750MMF	L-14	RF CHOKE 112μH	R-8	200	R-22	7,000		
MF					R-9	620	R-23	7,000		
MF			L-15	AF CHOKE 3H	R-10	360,000				
F					R-11	100,000	R-25	0-50,000		
MF					R-12	510	R-26	0-50,000		
MF					R-13	200	R-27	0-50,000		
MF					* R-14	100,000	R-28	0-50,000		

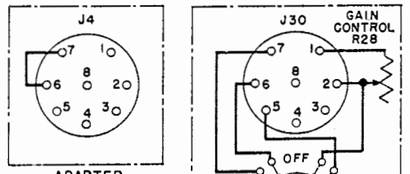
WITH THE RADIO RECEIVER. THOSE SHOWN IN THIS TABLE AIPPLY TO RADIO RECEIVER
ELEMENTS WHICH MAY BE REQUIRED IN THE OTHER RADIO RECEIVERS ARE NOT
CHEMATIC CIRCUIT OF RADIO RECEIVER BC-455-B.

FIGURE 26—RADIO SET SCR-274-N RECEIVING EQUIPMENT, SCHEMATIC CIRCUIT DIAGRAM

12SH7 12H8 12SH7 12SH7 12SR7 12A6



TYPICAL RADIO RECEIVER BC-455-B (6-9.1 MC). I-F = 2830 KC

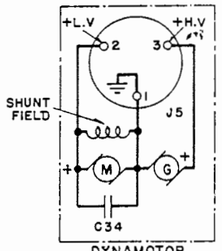


ADAPTER FT-230-A (REMOTE CONTROL)

ADAPTER FT-260-A (LOCAL CONTROL)

NOTES:

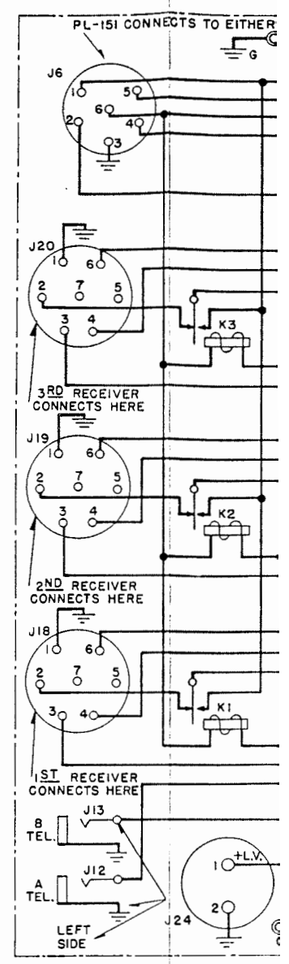
1. CAPACITOR ABBREVIATIONS:
   MMF - MICROMICROFARADS
   MF - MICROFARADS
2. ALL PLUGS AND RECEPTACLES ARE SHOWN AS VIEWED FROM THE OUTSIDE.
3. ALL RELAYS ARE SHOWN IN THE NON-ENERGIZED POSITION.
4. THE CAPACITANCE BETWEEN PIN PLUGS IN THE 2ND I-F RECEPTACLE CONSTITUTES C-33.
5. TERMINAL NUMBERS APPEARING ON RECEPTACLES OF JACKS IN RECEIVERS AND ADAPTERS AND ALL CIRCUIT SYMBOLS ARE FOR REFERENCE PURPOSES ONLY. THEY DO NOT APPEAR ON THE EQUIPMENT.
6. TRANSFORMER T1 IN BC-453-B, BC-454-B AND BC-455-B RECEIVERS IS PROVIDED WITH A TAP (TERM.6) FOR LOW IMPEDANCE HEADSETS. THESE THREE RECEIVERS AND RADIO RECEIVERS BC-453-A, BC-454-A AND BC-455-A ARE NORMALLY FURNISHED WITH CONNECTION SHOWN IN SOLID LINES FOR USE WITH HIGH IMPEDANCE (8000 OHMS) HEADSETS. RADIO RECEIVERS BC-453-B, BC-454-B, AND BC-455-B CAN BE CHANGED FOR USE WITH LOW IMPEDANCE HEADSETS BY REMOVING THE TWO WIRES ON TERMINAL 3 AND CONNECTING THEM TO TERMINAL 6 AS SHOWN IN DASHED LINES. (SEE FIGURE 39)

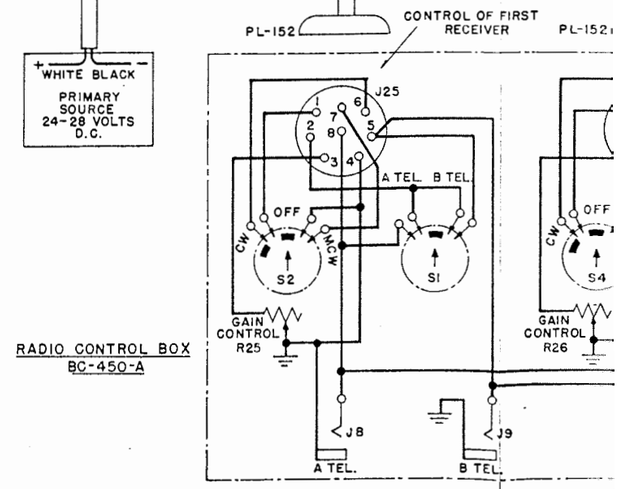


DYNAMOTOR DM-32-A

CAPACITORS						INDUCTORS		RESISTORS				MISCELLANEOUS	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS	SYMBOL	OHMS	SYMBOL	DESCRIPTION
* C-1	8.5 MMF	C-15(ABC)	.05/.05/.05 MF	C-29	.006 MF	L-1	ANT. INPUT	R-1	620	* R-15	5,100	T-1	OUTPUT TRANSFORMER
C-2	15 MMF	C-16(ABC)	.22/.22/.22 MF	C-30	15 MF	L-2, L-3	RF AMP	R-2	2,000,000	* R-16	51,000		
C-3	100 MMF	C-17	180 MMF	C-31	.001 MF	L-4, L-5	RF OSC	R-3	51,000	* R-17	51,000	V-1, V-2	NEON TUBES
C-4 (A TO G)	GANG 62 MMF	C-18	17 MMF	C-32	5 MF	L-6, L-7	IN 1ST IF	R-4	620	R-18	510,000	K-1, K-2, K-3	REC. OUTPUT-TRANS. SIDE-TONE RELAYS
C-5	3 MF	C-19	180 MMF	* C-33	LESS THAN 2 MMF	L-8, L-9	IN 2ND IF	R-5	150,000	R-19	100,000		
C-6 (ABC)	.05/.05/.05 MF	C-20(ABC)	.05/.01/.05 MF			L-10, L-11	IN 3RD IF	* R-6	150,000	R-20	2,000,000		
C-7 (ABC)	.05/.05/.05 MF	C-21	17 MMF	C-34	.001 MF	L-12, L-13	CW OSC	R-7	200	R-21	1,500	F-1, F-2, F-3	10 AMP FUSES
C-8	200 MMF	C-22	180 MMF	C-35	750 MMF	L-14	RF CHOKE 112 μH	R-8	200	R-22	7,000		
C-9	40 MMF	C-23	180 MMF					R-9	620	R-23	7,000		
* C-10	240 MMF	C-24	200 MMF			L-15	AF CHOKE 3H	R-10	360,000				
C-11	3 MMF	C-25	.001 MF					R-11	100,000	R-25	0-50,000		
C-12	180 MMF	* C-26	100 MMF					R-12	510	R-26	0-50,000		
C-13	17 MMF	* C-27	185 MMF					R-13	200	R-27	0-50,000		
C-14	180 MMF	C-28	34 MMF					* R-14	100,000	R-28	0-50,000		

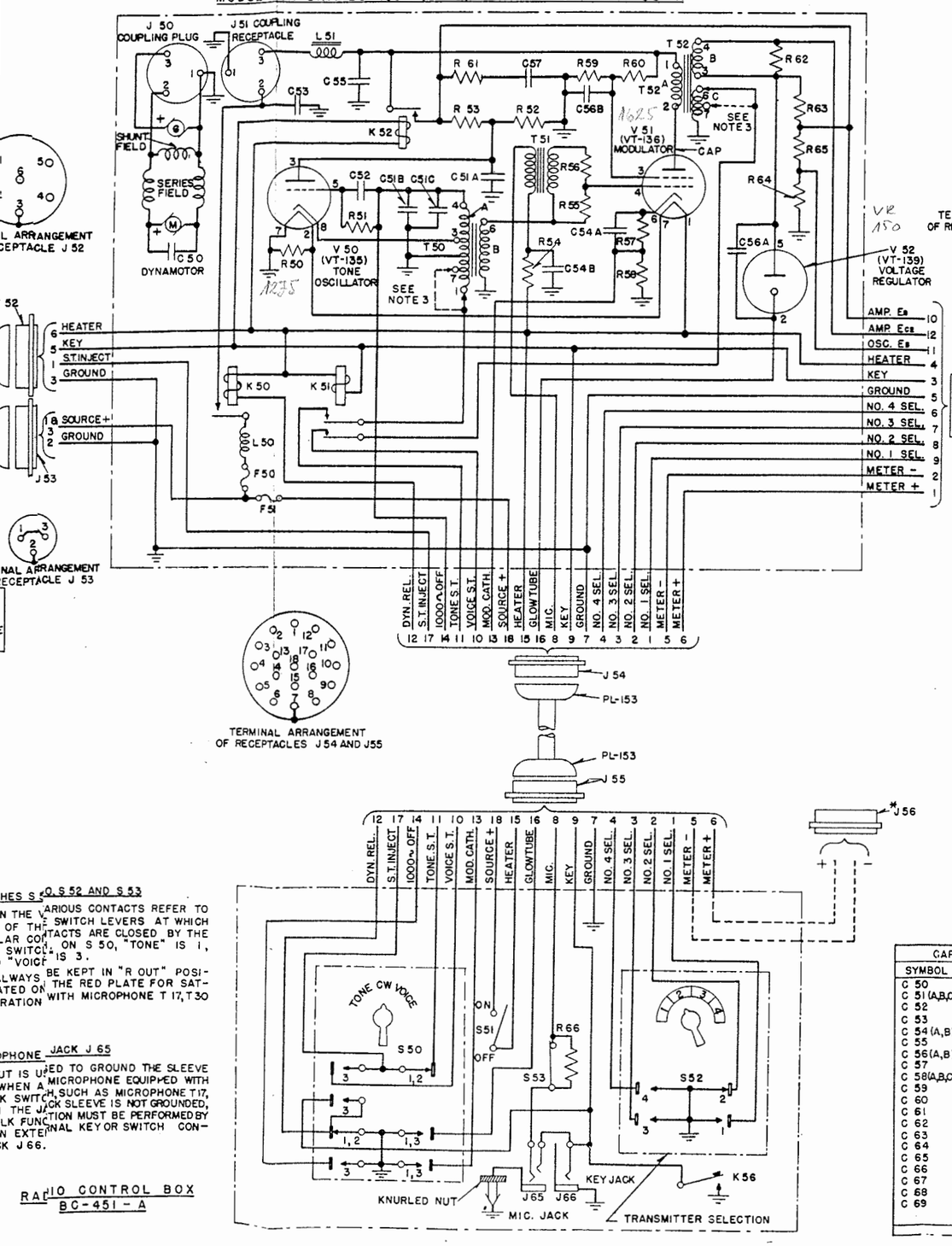
* VALUES SHOWN WITH AN ASTERISK VARY WITH THE RADIO RECEIVER. THOSE SHOWN IN THIS TABLE APPLY TO RADIO RECEIVER BC-455-B (6-9.1 MC) ONLY. ADDITIONAL CIRCUIT ELEMENTS WHICH MAY BE REQUIRED IN THE OTHER RADIO RECEIVERS ARE NOT SHOWN IN THE TABLE OR IN THE ABOVE SCHEMATIC CIRCUIT OF RADIO RECEIVER BC-455-B.





RADIO CONTROL BOX BC-450-A

MODULATOR UNIT BC-456-A(OR-B) WITH DYNAMOTOR DM-33-A

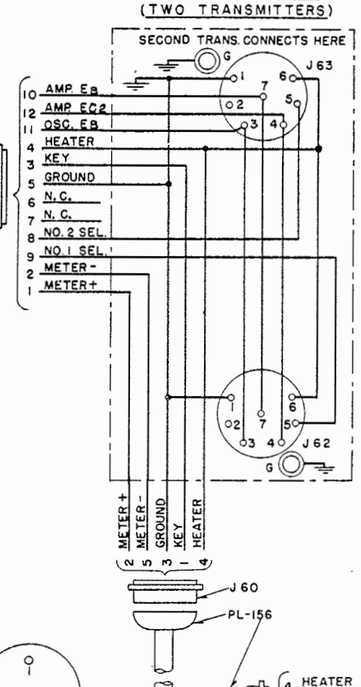


TERMINAL ARRANGEMENT OF RECEPTACLE J 52

TERMINAL ARRANGEMENT OF RECEPTACLE J 53

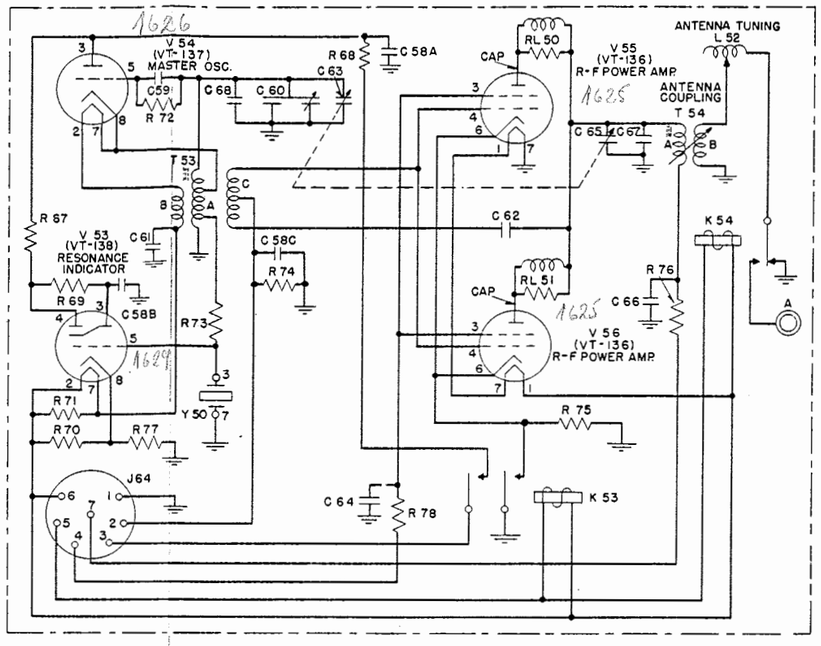
TERMINAL ARRANGEMENT OF RECEPTACLES J 54 AND J55

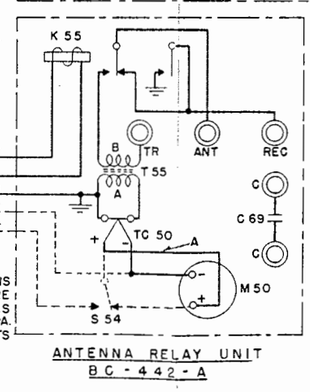
RACK FT-226-A (TWO TRANSMITTERS)



TYPICAL RADIO TRANSMITTER

BC-696-A(3-4 MC), BC-457-A(4-5.3 MC), BC-458-A(5.3-7 MC) OR BC-459-A(7-9.1 MC)





ANTENNA RELAY UNIT BC-442-A

NOTES

1. ALL RELAYS ARE SHOWN IN THE NON-ENERGIZED POSITION.
2. ALL COUPLING PLUGS AND RECEPTACLES SHOWN AS VIEWED FROM THE OUTSIDE. ALL PLUGS AS VIEWED FROM THE CORDAGE END HAVE THE SAME ORIENTATION OF CONDUCTORS AS THAT SHOWN HERE FOR THEIR RESPECTIVE RECEPTACLES.
3. TRANSFORMERS T 50 AND T 52 IN MODULATOR UNIT BC-456-B ARE PROVIDED WITH SIDETONE TAPS FOR LOW IMPEDANCE HEADSETS(7 ON T 50 AND 7 ON T 52). MODULATOR UNITS BC-456-A AND BC-456-B ARE NORMALLY FURNISHED WITH CONNECTIONS SHOWN IN SOLID LINES FOR USE WITH HIGH IMPEDANCE (8000 OHMS) HEADSETS. MODULATOR UNIT BC-456-B CAN BE CHANGED FOR USE WITH LOW IMPEDANCE (600 OHMS) HEADSETS BY SUBSTITUTING CONNECTIONS SHOWN IN DASHED LINES.
4. TERMINAL NUMBERS APPEARING ON RECEPTACLES OF JACK J 51 IN MODULATOR UNIT AND J 64 IN TRANSMITTER AND ALL CIRCUIT SYMBOLS ARE FOR REFERENCE PURPOSES ONLY. THEY DO NOT APPEAR ON THE EQUIPMENT.
5. * DISCONTINUED ON LATER EQUIPMENTS.

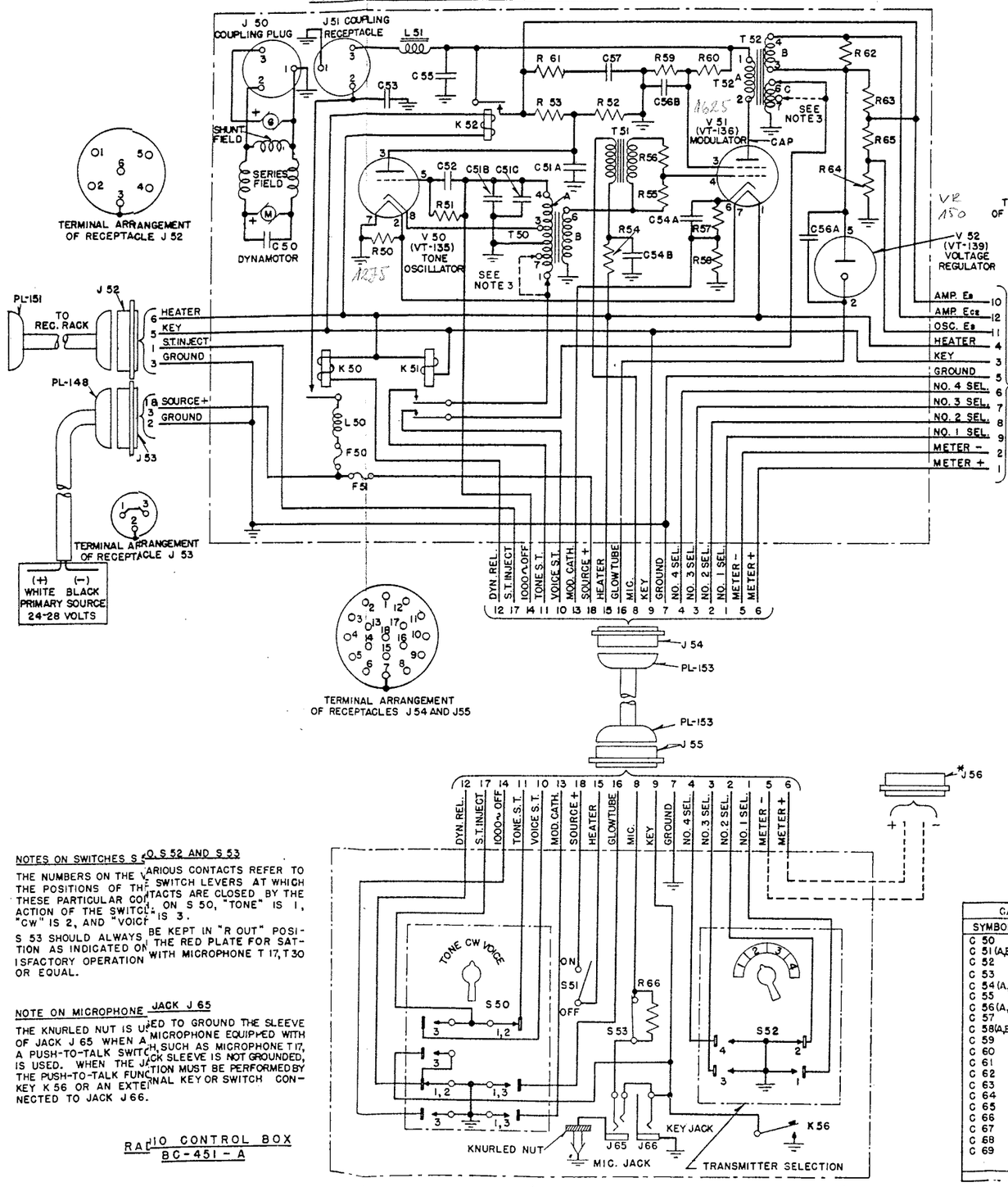
HES S
O. S 52 AND S 53
N THE V
ARIOUS CONTACTS REFER TO
OF TH
SWITCH LEVERS AT WHICH
AR CO
TACTS ARE CLOSED BY THE
SWITCH
ON S 50, "TONE" IS 1,
"VOICE
IS 3.
LWAYS
BE KEPT IN "R OUT" POSI-
TED ON
THE RED PLATE FOR SAT-
RATION
WITH MICROPHONE T 17, T 30

PHONE JACK J 65
UT IS U
ED TO GROUND THE SLEEVE
WHEN A
MICROPHONE EQUIPPED WITH
K SWITCH
SUCH AS MICROPHONE T 17,
THE JA
JACK SLEEVE IS NOT GROUNDED,
LK FUNC
THE JACK MUST BE PERFORMED BY
N EXTE
NAL KEY OR SWITCH CON-
K J 66.

RADIO CONTROL BOX BC-451-A

CAPACITORS		INDUCTORS		RELAYS & KEYS		RESISTORS				SWITCHES		TRANSFORMERS		MISCELLANEOUS	
SYMBOL	MICROFARADS	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS	SYMBOL	OHMS	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION
C 50	.006	L 50	RF CHOKE APPR. 15 MICROHENRIES	K 50	DYNAMOTOR INPUT	R 50	42	R 70	1000 FOR BC-457-A	S 50	CHOICE OF EMISSION	T 50	TONE OSC.	TC 50	THERMOCOUPLE
C 51(A,B,C)	.05/.05/.05	L 51	1.7 HENRIES	K 51	SIDETONE, VOICE AND TONE	R 51	100,000	R 70	1000 FOR BC-458-A	S 51	MAIN "ON-OFF"	T 51	MICROPHONE	M 50	ANT. CURRENT INDICATOR(LOCAL)
C 52	.006	L 52	ANT. TUNING INDUCTOR	K 52	DYNAMOTOR HIGH VOLTAGE(KEYING)	R 52	300,000	R 70	1500 FOR BC-459-A	S 52	TRANSMITTER SELECTION	T 52	MODULATION		
C 53	1.2			K 53	TRANSMITTER SELECTOR	R 53	91,000	R 70	1500 FOR BC-696-A	S 53	SHUNTS MIC. SERIES RESISTOR	T 53	BATTERY LINE	Y 50	CRYSTAL UNIT
C 54(A,B)	5/20.			K 54	TRANSMITTER OUTPUT	R 54	360	R 71	126	*S 54	ANT.CURRENT METER SWITCHING	T 54	TRANS. OUTPUT	F 50	20 AMP. FUSE
C 55	1.2			K 55	ANTENNA SWITCHING REC. TO TRANS.	R 55	2000	R 72	51,000			T 55	ANT. CURRENT	F 51	20 AMP. FUSE
C 56(A,B)	.5/.5			K 56	BUILT-IN KEY	R 56	1300	R 73	10,000 FOR BC-457-A					RL 50	PARASITIC SUPPRESSOR
C 57	.05					R 57	390	R 73	15,000 FOR BC-458-A					RL 51	PARASITIC SUPPRESSOR
C 58(A,B,C)	.05/.05/.05					R 58	51,000	R 73	5100 FOR BC-459-A						
C 59	.00018					R 59	30,000	R 73	5100 FOR BC-696-A						
C 60	MO. PADDING					R 60	75,000	R 74	15,000						
C 61	.006					R 61	20	R 75	51,000						
C 62	FIXED NEUTR.					R 62	10,000	R 76	20						
C 63	MO. TUNING					R 63	20,000	R 77	390						
C 64	.002					R 64	100,000	R 78	51						
C 65	PA. TUNING					R 65	15,000								
C 66	.01					R 66	510								
C 67	PA. PADDING					R 67	51,000								
C 68	.000003					R 68	20								
C 69	.00005					R 69	1,000,000								

MODULATOR UNIT BC-456-A(OR-B) WITH DYNAMOTOR DM-33-A



NOTES ON SWITCHES S 50, S 52 AND S 53

THE NUMBERS ON THE VARIOUS CONTACTS REFER TO THE POSITIONS OF THE SWITCH LEVERS AT WHICH THESE PARTICULAR CONTACTS ARE CLOSED BY THE ACTION OF THE SWITCH. ON S 50, "TONE" IS 1, "CW" IS 2, AND "VOICE" IS 3.

S 53 SHOULD ALWAYS BE KEPT IN "R OUT" POSITION AS INDICATED ON THE RED PLATE FOR SATISFACTORY OPERATION WITH MICROPHONE T 17, T 30 OR EQUAL.

NOTE ON MICROPHONE JACK J 65

THE KNURLED NUT IS USED TO GROUND THE SLEEVE OF JACK J 65 WHEN A MICROPHONE EQUIPPED WITH A PUSH-TO-TALK SWITCH, SUCH AS MICROPHONE T17, IS USED. WHEN THE JACK SLEEVE IS NOT GROUNDED, THE PUSH-TO-TALK FUNCTION MUST BE PERFORMED BY KEY K 56 OR AN EXTERNAL KEY OR SWITCH CONNECTED TO JACK J 66.

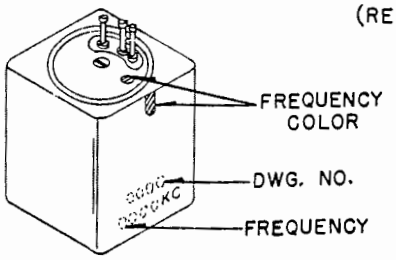
RADIO CONTROL BOX BC-451-A

CAPACITORS		INDUCTORS		RELAYS & KEYS			
SYMBOL	MICROFARADS	SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	O
C 50	.006	L 50	RF CHOKE APPR.	K 50	DYNAMOTOR INPUT	R 50	42
C 51 (A,B,C)	.05/.05/.05		15 MICROHENRIES	K 51	SIDETONE, VOICE AND TONE	R 51	10(
C 52	.006	L 51	1.7 HENRIES			R 52	30
C 53	1.2	L 52	ANT. TUNING INDUCTOR	K 52	DYNAMOTOR HIGH VOLTAGE (KEYING)	R 53	91,
C 54 (A,B)	5/20.			K 53	TRANSMITTER SELECTOR	R 54	36
C 55	1.2			K 54	TRANSMITTER OUTPUT	R 55	2(
C 56 (A,B)	.5/.5			K 55	ANTENNA SWITCHING REC. TO TRANS.	R 56	13
C 57	.05			K 56	BUILT-IN KEY	R 57	38
C 58 (A,B,C)	.05/.05/.05					R 58	5(
C 59	.00018					R 59	30
C 60	MO. PADDING					R 60	75
C 61	.006					R 61	2(
C 62	FIXED NEUTR.					R 62	10,
C 63	MO. TUNING					R 63	20
C 64	.002					R 64	10(
C 65	PA. TUNING					R 65	15,
C 66	.01					R 66	5(
C 67	PA. PADDING					R 67	5(
C 68	.000003					R 68	2(
C 69	.00005					R 69	10(

NOTE ON SWITCH S 54

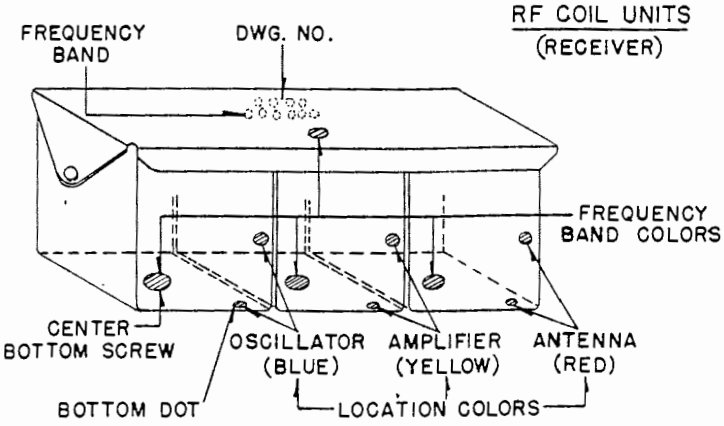
SWITCH S 54 AND CONNECTION SHOWN IN DASHED LINES WERE PROVIDED IN EARLIER MODELS OF ANTENNA RELAY UNIT BC-442-A. LEAD "A" WAS LEFT OUT IN UNIT WHERE S 54 WAS USED.

CW OSCILLATOR
(RECEIVER)



FREQUENCY COLOR CODE		
COLOR	FREQUENCY	CW OSCILLATOR DWG. NO.
BROWN	85 KC	5852
YELLOW	1415 KC	5855
GREEN	2830 KC	5856

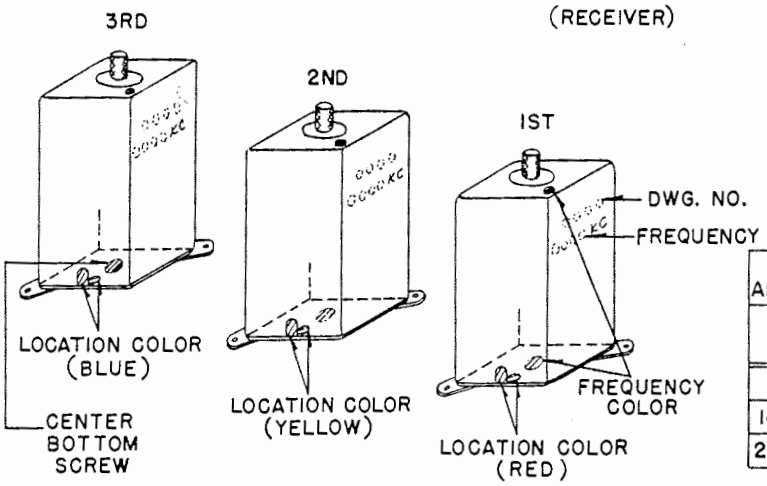
RF COIL UNITS
(RECEIVER)



LOCATION COLOR CODE	
RED	ANTENNA
YELLOW	AMPLIFIER
BLUE	OSCILLATOR

FREQUENCY BAND COLOR CODE		
COLOR	BAND	COIL SET DWG. NO.
BROWN	190-550 KC	6184
YELLOW	3-6 MC	6227
GREEN	6-9.1 MC	6234

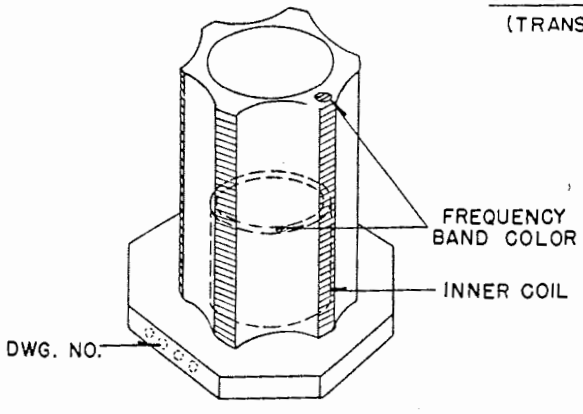
IF COUPLING UNITS
(RECEIVER)



FREQUENCY COLOR CODE	
I.F.	COLOR
85 KC	BROWN
1415 KC	YELLOW
2830 KC	GREEN

LOCATION COLOR CODE AND COUPLING UNIT DRAWING NUMBERS			
I.F.	1ST (RED)	2ND (YELLOW)	3RD (BLUE)
85 KC	4698	7267	4677
1415 KC	7274	7275	7276
2830 KC	7277	7278	7279

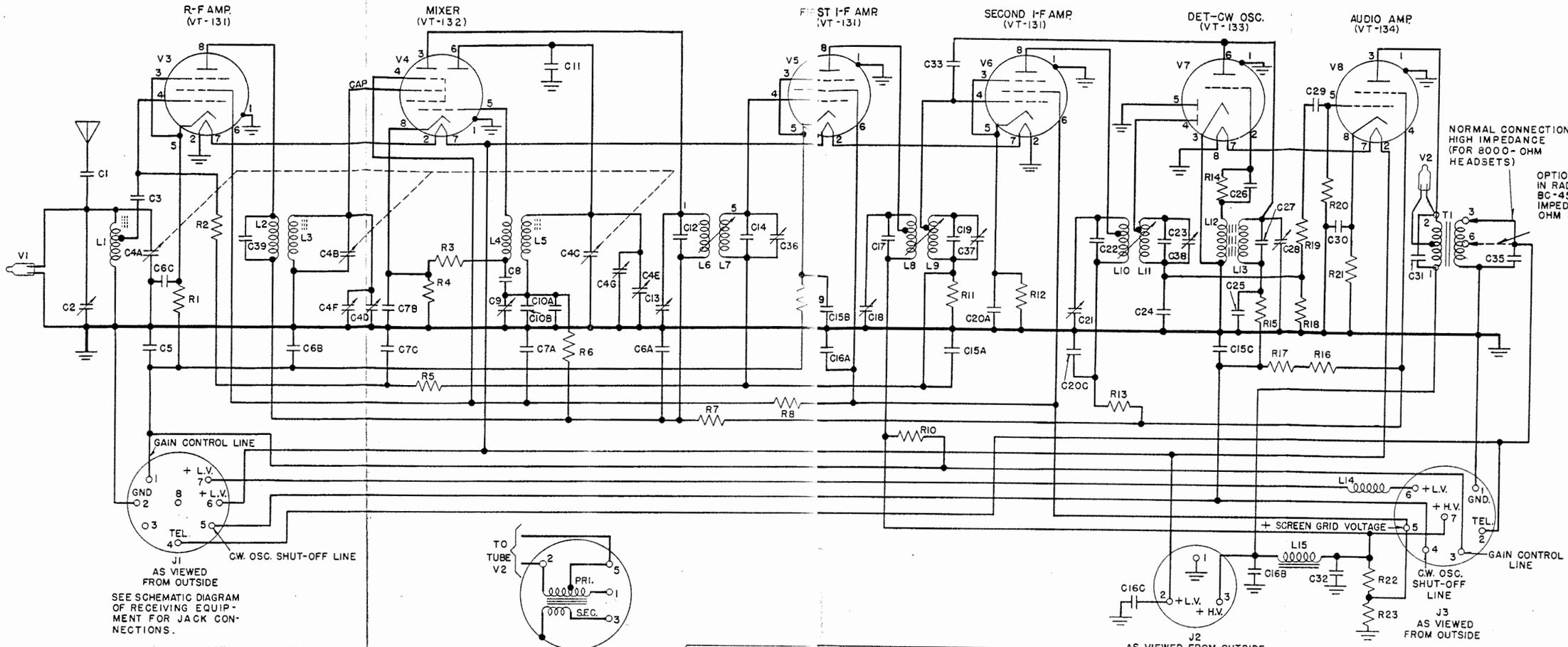
OSCILLATOR COIL
(TRANSMITTER)



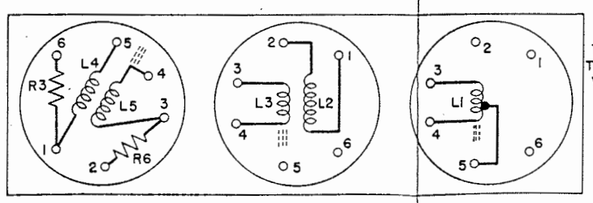
COLOR	BAND	OSCILLATOR COIL DWG. NO.
BROWN	3-4 MC	6029
RED	4-5.3 MC	6030
ORANGE	5.3-7 MC	6031
YELLOW	7-9.1 MC	6032

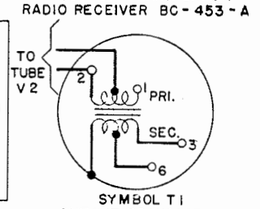
NOTE:
INNER COILS MARKED WITH TWO COLORS MAY BE USED IN EITHER OF THE TWO BANDS REPRESENTED.

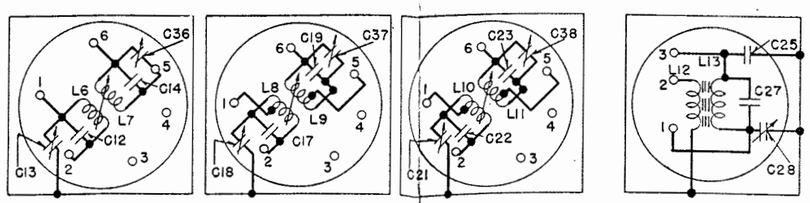
FIGURE 36—COLOR CODE FOR RECEIVER AND TRANSMITTER COILS



DETAIL SCHEMATIC DIAGRAMS
COIL ASSEMBLIES AND TRANSFORMERS

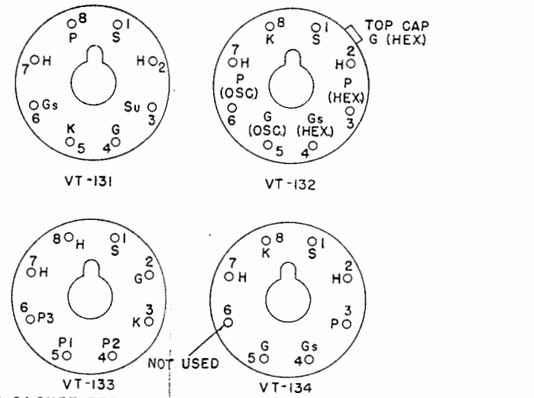






CIRCUITS IN R-F COIL SET, I-F COUPLING UNITS, CW OSCILLATOR, AND OUTPUT TRANSFORMER. THE TERMINAL NUMBERS ON THESE UNITS AGREE WITH THOSE SHOWN AT THE CORRESPONDING LOCATIONS ON THE PRACTICAL WIRING DIAGRAM.

CAPACITORS		INDUCTORS		RESISTORS	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C1	11 MMF.	L1	ANT. INPUT	R1	620
C2	15 MMF.	L2, L3	RF AMP.	R2	2,000,000
C3	100 MMF.	L4, L5	RF OSC.	R3	51,000
C4 (A TO G)	GANG (345 MMF.)	L6, L7	IN 1ST IF	R4	620
C5	3 MFD.	L8, L9	IN 2ND IF	R5	150,000
C6 (A,B,C)	.05/.05/.05 MF.	L10, L11	IN 3RD IF	R6	510,000
C7 (A,B,C)	.05/.05/.05 MF.	L12, L13	CW OSC.	R7	200
C8	200 MMF.	L14	RF CHOKE, 112 MICRO-HENRIES	R8	200
C9	40 MMF.	L15	AF CHOKE 3 HENRIES	R9	620
C10 (A,B)	690 MMF. ITAL			R10	360,000
C11	3 MMF.			R11	100,000
C12	180 MMF.			R12	510
C13	17 MMF.			R13	200
C14	180 MMF.			R14	51,000
C15 (A,B,C)	.05/.05/.05 F.			R15	20,000
C16 (A,B,C)	.22/.22/.22 F.			R16	150,000
C17	180 MMF.			R17	150,000
C18	17 MMF.			R18	510,000
C19	180 MMF.			R19	100,000
C20 (A,B,C)	.05/.01/.05 V.			R20	2,000,000
C21	17 MMF.			R21	1500
C22	180 MMF.			R22	7000
C23	180 MMF.			R23	7000
C24	200 MMF.				
C25	.001 MF.				
C26	200 MMF.				
C27	345 MMF.				
C28	34 MMF.				
C29	.006 MF.				
C30	15 MF.				
C31	.001 MF.				
C32	5 MF.				
C33	3 MMF.				
C35	750 MMF.				
C36	17 MMF.				
C37	17 MMF.				
C38	17 MMF.				
C39	120 MMF.				



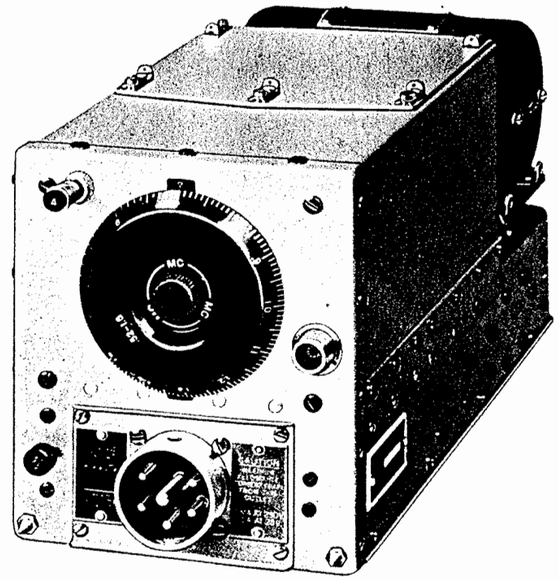
TUBE SOCKET TERMINALS-AS VIEWED FROM BOTTOM

G=CONTROL GRID
G (HEX.)=CONTROL GRID, HEXODE SECTION
G (OSC)=CONTROL GRID, OSC SECTION
Gs=SCREEN GRID
Gs (HEX)=SCREEN GRID, HEXODE SECTION
H=HEATER
K=CATHODE
P=PLATE
P (HEX)=PLATE, HEXODE SECTION
P (OSC)=PLATE, OSC. SECTION
P1=FIRST DIODE PLATE
P2=SECOND DIODE PLATE
P3=TRIODE PLATE ON TUBE VT-133
S=SHELL
Su=SUPPRESSOR GRID

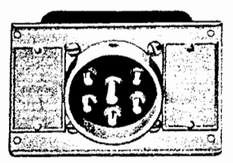
FIGURE 37A—RADIO RECEIVER BC-453-A (OR -B) (190-550 KC), SCHEMATIC

ADDENDUM

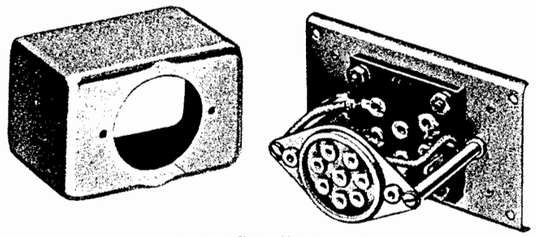
RADIO RECEIVER BC-946-B



RADIO RECEIVER
BC-946-B



ADAPTER FT-310-A
FRONT VIEW



ADAPTER FT-310-A
INTERIOR VIEW

FIGURE A1—RADIO RECEIVER BC-946-B

RADIO RECEIVER BC-946-B

1. DESCRIPTION

a. General

Radio Receiver BC-946-B is identical in mechanical design with other receivers, such as Radio Receiver BC-453-B, of Radio Set SCR-274-N, and uses the same tube complement, variable condenser, control box, etc. The radio frequency coil units are externally the same, although the coil details are different internally. Adapter FT-310-A may be used with Radio Receiver BC-453-B and other receivers of Radio Set SCR-274-N. The following instructions will cover the differences between Radio Receiver BC-946-B and Radio Receiver BC-453-B.

b. Frequency Range

The frequency range of Radio Receiver BC-946-B is .52 mc to 1.5 mc.

c. Intermediate Amplifier Frequency

The intermediate frequency of Radio Receiver BC-946-B is 239 kc.

d. Dial MC-415

Dial MC-415 is interchangeable with any of the other dials used on Radio Control Box BC-450-A. The calibration is identical with that of the dial for Radio Receiver BC-946-B.

e. Adapter FT-310-A

Adapter FT-310-A, which is a part of Radio Receiver BC-946-B, provides both high and low voltage outlet. It is mechanically interchangeable with Adapter FT-230-A.

CAUTION:—The current drawn by equipment connected to Adapter FT-310-A must not exceed 15 milliamperes at 250 volts and .5 ampere at 28 volts, because the performance of the radio receiver will be adversely affected and the life of the dynamotor reduced.

2. INSTALLATION

a. Radio Receiver BC-946-B

The receiver may be used interchangeably with any of the other receivers of Radio Set SCR-274-N by following instructions given for them.

b. Dial MC-415

Dial MC-415 is used on the radio control box.

3. OPERATION

The operation of Radio Receiver BC-946-B is the same as that given for Radio Receiver BC-453-B.

4. PEFORMANCE

The performance of the receiver is the same as that for Radio Receiver BC-453-B except as tabulated below. (For test conditions see Instruction Book for Operation and Maintenance of Radio Set SCR-274-N.)

SENSITIVITY

Circuits	*Locations*	*Micro-volts*	*KC*
Antenna	Antenna Binding Post	8	1500
R-F	R-F Control Grid at Terminal 4	120	1500
Mixer	R-F Control Grid at Top Cap	600	1500
Mixer	I-F Control Grid at Top Cap	470	239
1st I-F	I-F Control Grid at Terminal 4	8600	239
2nd I-F	I-F Control Grid at Terminal 4	100,000	239

SELECTIVITY (520 KC)

MCW Selectivity Factor

2X	10X	100X	1000X
4.5	14.0	20.0	30.0

5. ALIGNMENT

a. Procedure

The alignment procedure, symbol numbers and trimmer position views are the same as those given for Radio Receiver BC-453-B.

b. Alignment Frequencies

Intermediate Frequency .....239 kc
High-end alignment frequency for
C4E, C4D, and C2.....1.40 mc
Low-end alignment frequency for C9.....57 mc

c. Setting of Cross Mark

The setting of cross mark on auxiliary gang trimmers is indicated below:

C4F	C4G
Min ┼	Half ─┼─

6. OUTPUT IMPEDANCE

To change from a 4,000 ohm output connection to 300 ohms, proceed as follows:

(1) Remove capacitor C35
(2) Disconnect the black lead from terminal 3 on output transformer T-1 and connect it to terminal 6
(3) Connect a new lead from X on C20B to terminal 6 on output transformer, or to the same terminal from which C35 was disconnected on the power plug.

7. SCHEMATIC DIAGRAM

The schematic diagram (Figure A2) is similar to the one for Radio Receiver BC-453-B, and the same symbol numbers are used. The principal differences between the two receivers are as follows:

C 10A and C 10B.....slightly different capacity
C 33.....is capacitance of wiring only instead of 3 mmf
R 16 and R 17.....are 100,000 ohms instead of 150,000 ohms
C 39.....is omitted

An additional connection is made from high side of R 10 to terminal 8 on J-1.

TABLE 1

DIFFERENCES IN REPLACEABLE PARTS BETWEEN RADIO RECEIVER BC-453-B AND RADIO RECEIVER BC-946-B

Ref. No.	*Name of Part*	*Stock No.*	*Description*	*Function*	*Drawing Numbers* BC-453-B	BC-946-B
C-9	Capacitor		Variable, air, △ C approx. 40 mmfd. and fixed			
C-10			mica 400 v, 690 ± 5 mmfd.	R-F osc. series capacitor.	6075	.....
	Capacitor		Variable, air, △ C approx. 40 mmfd. and fixed			
			mica 400 v, 670 ± 5 mmfd.	R-F osc. series capacitor.	.....	6076
C-26	Capacitor	3B9100-59	Fixed 400 volts mica			
			200 mmfd. ± 5%	CW osc. blocking.	4513	.....
			100 mmfd. ± 5%	CW osc. blocking.	.....	4520
C-27	Capacitor		Fixed, 400 v, mica ± 2.5 mmfd. from nominal. Part of CW osc. assembly Z-4	Fixed capacitor part of CW osc. tuning		
			Nominal 345 mmfd.		6701	.....
			335 mmfd.		.....	49143
C-33	Capacitor		Fixed, 3 mmfd. ± ½ mmfd. (Wiring capacity	CW osc. coupling.	7020	.....
			only for BC-946-B)		.....	None
C-39	Capacitor		Fixed, 120 mmf., 2½% 400 v mica	Across pri. of R-F	8013	None
J-1	Receptacle		Coupling receptacle assembly; 7 circuit.	To adapter.	4724	49129
J-3	Plug	2Z7251	Plug assembly; 4 circuit.	Adapter to receiver.	.....	48930
J-3	Receptacle		Receptacle plate assembly.	Adapter receptacle.	.....	2226
N-1	Dial		Dial.	Receiver tuning dial.	5613	5610
R-6	Resistor		510000 ohms ± 10% ⅓w carbon.	R-F osc. series.	4570	.....
	Resistor		300000 ohms ± 10% ⅓w carbon.	R-F osc. series.	.....	4530
R-14	Resistor		51000 ohms ± 10% ⅓w carbon.	CW osc. grid.	4569	.....
	Resistor	3Z6700-48	100000 ohms ± 10% ⅓w carbon.	CW osc. grid.	.....	4501
R-16	Resistor		150000 ohms ± 10% ⅓w carbon.	CW osc. plate dropping.	4571	.....
	Resistor	3Z6700-48	100000 ohms ± 10% ⅓w carbon.	CW osc. plate dropping.	.....	4501

TABLE 1 (Continued)

DIFFERENCES IN REPLACEABLE PARTS BETWEEN
RADIO RECEIVER BC-453-B AND RADIO RECEIVER BC-946-B

Ref. No.	*Name of Part*	*Stock No.*	*Description*	*Function*	*Drawing Numbers* *BC-453-B*	*BC-946-B*
R-17	Resistor	3Z6700-48	Same as R-16.	CW osc. plate dropping.		
R-28	Resistor	3Z6651-3	51000 ohms ± 10% ⅓w carbon.	R-F primary load.	None	4569
Z-1	Coupling unit		1st i-f coupling unit, complete assembly including shield can and mtg. plate.	1st i.f.	4698	7268
Z-2	Coupling unit		2nd i-f coupling unit, complete.	2nd i.f.	7267	7269
Z-3	Coupling unit		3rd i-f coupling unit, complete.	3rd i.f.	4677	7270
Z-4	CW osc.		CW osc. complete assembly.	CW osc.	5852	5853
Z-5	R-F coil set		R-F coil set assembly including ant. Z-5A, r-f Amp. Z-5B, r-f osc. Z-5C in shield cans mounted on a cover.	R-F coil set.	6184	7975

TABLE 2

REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref. No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
2	C1	3D9011-1	Capacitor	Ceramic—11 mmf ± ½ mmf.	Ant. series.	A, B,	9046
2	C-2	3D9015V-6	Capacitor-shunt	Variable, air, △C. Approxiately 15 mmf.	Input alignment.	C	5676
2	C-3	3D9100-59	Capacitor	Fixed mica—.0001 mfd. ± 5% 400 v—C D Type 5 or equivalent.	R-F amp. grid blocking.	D, E, F,	4520
1	C-4	3D9346	Capacitor	Three equal—section gang with trimmers.	Preselector and r-f oscillator.	G	3936
3	C-5	3DB3.4	Capacitor	3 mfd dry electrolytic. Impedance at 60 cycles not over 1750 ohms.	Gain control. Line filter.	F, H, D,	7582 or ESL692651
2	C-6	3DA50-32	Capacitor	.05/.05/.05 mfd ± 15%. 300 volts paper.		F, H, D,	5414 or ESL692644
				A section.	Mixer plate by-pass.		
				B section.	Gain control line by-pass.		
				C section.	1st r-f cathode by-pass.		
2	C-7	3DA50-32	Capacitor	Same as C-6.		F, H, D,	
				A section.	Mixer screen by-pass		
				B section.	Mixer cathode by-pass.		
				C section.	AGC line by-pass.		
2	C-8	3D9200-29	Capacitor	Fixed mica—.0002 mfd. ± 5%, 400 v C D Type 5 or equivalent.	R-F osc. grid blocking.	D, E, F,	4513
2	C-9&C-10	2S274N/C6	Capacitor	Variable, air △ C Approximately 40 mmf—and Fixed mica 400 volts 670 ± 5 mmf.	R-F osc. series capacitor.	C	6076
2	C-11	3D9003-9	Capacitor	Ceramic—compensator, 3 mmf ± ½ mmf with temperature coefficient of —.00075 mmf per mmf per degree centigrade ± 15%, Centralab Co., Type 807 or equivalent.	R-F osc. temperature compensation.	A, B,	7020

*See Table 3, Index To Manufacturers.

TABLE 2 (Continued)

REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref. No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
2	C-15	3DA50-32	Capacitor	Same as C-6.	Grid return by-pass.		
				A section.	1st & 2nd i-f.		
				B section.	1st i-f cathode by-pass.		
				C section.	CW osc. plate line filter.		
2	C-16	3DA220	Capacitor	.22/.22/.22 mfd ± 20%, 300 volts, paper.		F, H, D,	5413 or ESL692643
				A section.	2nd i-f screen by-pass.		
				B section.	Dyn. H.V. filter.		
				C section.	Dyn. L.V. filter.		
2	C-20	3DA50-33	Capacitor	.05/.01/.05 mfd ± 15%, 300 volts, paper.		F, H, D,	5415
				A section.	2nd i-f amp. cathode by-pass.		
				B section.	Not used.		
				C section.	2nd i-f amp. plate by-pass.		
1	C-29	3DA6-29	Capacitor	Fixed mica—.006 mfd ± 5%, 400 volts, Aerovox type 1461 or equivalent.	Audio coupling.	D, E, F,	4091
3	C-30	3DB15-7	Capacitor	15 mfd., dry electrolytic impedance at 60 cycles not greater than 350 ohms.	Audio amp. cathode by-pass.	F, H, D,	5416 or ESL692646
1	C-31	3DA1-61	Capacitor	Fixed mica—.001 mfd ± 5%, 400 volts, Aerovox 1461 or equivalent.	Output filter.	D, E, F,	4114
3	C-32	3DB5-7	Capacitor	5 mfd, dry electrolytic. Impedance at 60 cycles not greater than 1050 ohms.	Dyn. H.V. filter.	F, H, D,	6350 or ESL692649
1	C-35	3D9750-4	Capacitor	Fixed mica—750 mmf ± 5% 400 volts.	Rec. output audio filter.	D, E, F,	4522
2	E-1	3Z509	Binding post	Antenna binding post "A."	Ant. binding post.		4667
2		2S274N/C7	Clip	Neon lamp.	Mounting for neon lamp.	J	ESA691038
1	E-8	2C4373A/C3	Clip	Grid.	Connects to mixer control grid.	J	4754

* See Table 1, Index To Manufacturers.

TABLE 2 (Continued)

TABLE 2 (Continued)
REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref.No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
1	E-4	2C4373A/J1	Insulator	Insulators for antenna.	Insulation.		
				Binding post.			
				A section, outside.			3485
				B section, inside.			6597
				1 washer 6481, and 1 washer 5727 req'd. to complete assembly.			
1	E-9	2Z5853	Knob	Input alignment control knob.	Ant. input alignment.	J	ESA690856
5	H-3	2Z8609-4	Snapslide	Formed snapslide, parts of the mechanism includes:	Fastener.		
		2Z8609-3/S1		Snapslide (on cover).		J	3888
		2Z8609-3/G1		Snapslide guide (on cover).		J	3887
		2Z8609-3/S3		Snapslide button (on cover).		J	3890
		2Z8609-4/S1		Snapslide stud (on shield).		J	4708
		2Z8609-3/W1		Washers (on cover).		J	3889
4	H-6		Panel	Typical resistor panel assembly.	For carbon resistors.	J	Col. 48861
2	H-10	2C4373A/S5	Stud	Conical stud.	For rec. locking.	J	4710
1	J-1		Receptacle	Coupling receptacle assembly, 7 circuit.	To adapter.	J	Col. 49129
1	J-2	2Z7412-1	Receptacle	Coupling receptacle assembly, 3 circuit.	To dynamotor.	J	4718
1	J-3	2Z7251	Plug	Plug assembly, 7 circuit.	To rec. rack.	J	5488
1			Plug	Plug assembly, 4 circuit.	Aadapter to rec.	J	Col. 48930
1			Receptacle	Receptacle plate assembly.	Adapter to rec.	J	2226
3	J-28	2Z7412-3	Receptacle	Typical i-f coupling unit receptacle assembly.	To i-f coupling unit.	J	4723
3	J-29	2Z7412-2	Receptacle	Typical r-f coil receptacle assembly.	To r-f coil.	J	4722
7		2S274N/J3	Jack				5228
1	L-14	3F2997-2	Inductor	R-F choke, 112 microhenries ± 10%, d-c resistance not over .15 ohms.	R-F choke.	C	5546
1	L-15	3F2997-2	Inductor	A-F choke, 3 henries with .05 amperes d.c., d-c resistance 325 ohms, ± 15%.	A-F choke.	K	5634
1	N-1		Dial	Dial.	Rec. tuning dial.		5610
23	P-5	2S274N/P4	Plug	Pin plug assembly (on dyn. receptacle assembly).	Connector.		7949

*See Table 3, Index To Manufacturers.

TABLE 2 (Continued)

REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref. No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
2	R-1	3Z6062-1	Resistor	620 ohms ± 10%, ⅓ w carbon, A-B Type E.	1st r-f cathode auto-bias.	L	6004
2	R-2	3Z6802-7	Resistor	2 megohms ± 10%, ⅓ w, metalized, Int. Resistance Co., Type F ⅓.	R-F amp. grid.	M	4439
2	R-4	3Z6062-1	Resistor	Same as R-1.	Mixer cathode auto-bias.	L	
2	R-5	3Z6715-16	Resistor	150M ohms ± 10%, ⅓ w carbon, A-B Type E.	AGC line decoupling.	L	4571
2	R-7	3Z6020-21	Resistor	200 ohms ± 10%, ⅓ w carbon, A-B Type E.	Mixer plate decoupling.	L	4497
2	R-8	3Z6020-21	Resistor	Same as R-7.	R-F amp. and mixer screen decoupling.	L	
2	R-9	3Z6062-1	Resistor	Same as R-1.	1st i-f cathode auto-bias.	L	
2	R-10	3Z6736	Resistor	360M ohms ± 10%, ⅓ w carbon, A-B Type E.	H.V. bleeder to gain control.	L	8032
2	R-11	3Z6700-48	Resistor	100M ohms ± 10%, ⅓ w carbon, A-B Type E.	AGC resistor.	L	4501
2	R-12	2Z6051-1	Resistor	510 ohms ± 10%, ⅓ w carbon, A-B Type E.	2nd i-f cathode auto-bias.	L	6005
2	R-13	3Z6020-21	Resistor	Same as R-7.	2nd i-f plate decoupling.	L	
2	R-14	3Z6700-48	Resistor	Same as R-11.	CW osc. grid.	L	
2	R-15	3Z6620-45	Resistor	20M ohms ± 10%, ⅓ w carbon, A-B Type E.	CW osc. plate decoupling and dropping.	L	4510
2	R-16	3Z6700-48	Resistor	Same as R-11.	CW osc. plate dropping.	L	
2	R-17	3Z6700-48	Resistor	Same as R-11.	Same as R-16.	L	
2	R-18	3Z6751-1	Resistor	510M ohms ± 10%, ⅓ w carbon, A-B Type E.	Diode series.	L	4570
2	R-19	3Z6700-48	Resistor	Same as R-11.	R-F decoupling.	L	
2	R-20	3Z6802-8	Resistor	2 megohms ± 10%, ⅓ w carbon, A-B Type E.	Grid resistor audio amp.	L	4503
2	R-21	3Z6150-24	Resistor	1500 ohms ± 10%, ⅓ w carbon, A-B Type E.	Audio amp. cathode auto-bias.	L	4506

*See Table 3, Index To Manufacturers.

TABLE 2 (Continued)
REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref.No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
2	R-22	3Z6570-9	Resistor	7M ohms ± 2%, 7 w wire wound, vitreous.	High voltage bleeder.	N, O,	5895
2	R-23	3Z6570-9	Resistor	Same as R-22	Same as R-22.	N, O,	
2	T-1	2Z9947-4.1	Transformer	Primary, 4000 turns #40 E. wire, secondary, 1800 turns #38 E. wire, primary d-c resistance 1028-1300 ohms, secondary d-c resistance 272-350 ohms.	Rec. output.	K	ESL691027
3	V-1	2Z5889	Neon lamp	Neon lamp, G.E. Co., Type T-2, modified.	R-F input voltage limiter.	I	5913
3	V-2	2Z5889	Neon lamp	Same as V-1.	A-F output voltage limiter.	I	
6	X-1	2C2500 456A.1/S1	Socket	Octal base tube socket. Does not include bakelite washer 6566 which should be specified if required. American Phenolic Corp., Type S-8, modified, or equivalent. Amphenol #4 retainer ring is part of assembly.	For all octal-base tubes in rec.	P, R,	6559
2	Z-1		Coupling unit	1st i-f coupling unit, complete assembly, including shield can and mounting plate.	1st I.F.	C	7268
2	Z-2		Coupling unit	2nd i-f coupling unit, complete assembly, including shield can and mounting plate.	2nd I.F.	C	7269
2	Z-3		Coupling unit	3rd i-f coupling unit, complete assembly, including shield can and mounting plate.	3rd I.F.	C	7270
1	Z-4		CW osc.	CW osc. complete assembly, including shield can.	CW osc.	C	5853
1	Z-5 (A, B, C,)		R-F coil set	R-F coil set assembly, complete including ant. coil Z-5A, R-F Amp. Z-5B, and R-F Osc. Z-5C, in shield cans, mounted on a cover.	R-F coil set.	C	7975

*See Table 3, Index To Manufacturers.

TABLE 2 (Continued)

REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref. No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
1			Groov-pin	Groov-pin 3/64 x 1/8		S	4160
2		6L3903-3	Groov-pin	Groov-pin 3/64 x 3/16		S	4166
13		2S274N/P2	Pin—plug			G	4628
5			Pin—plug			G	9081

*See Table 3, Index To Manufacturers.

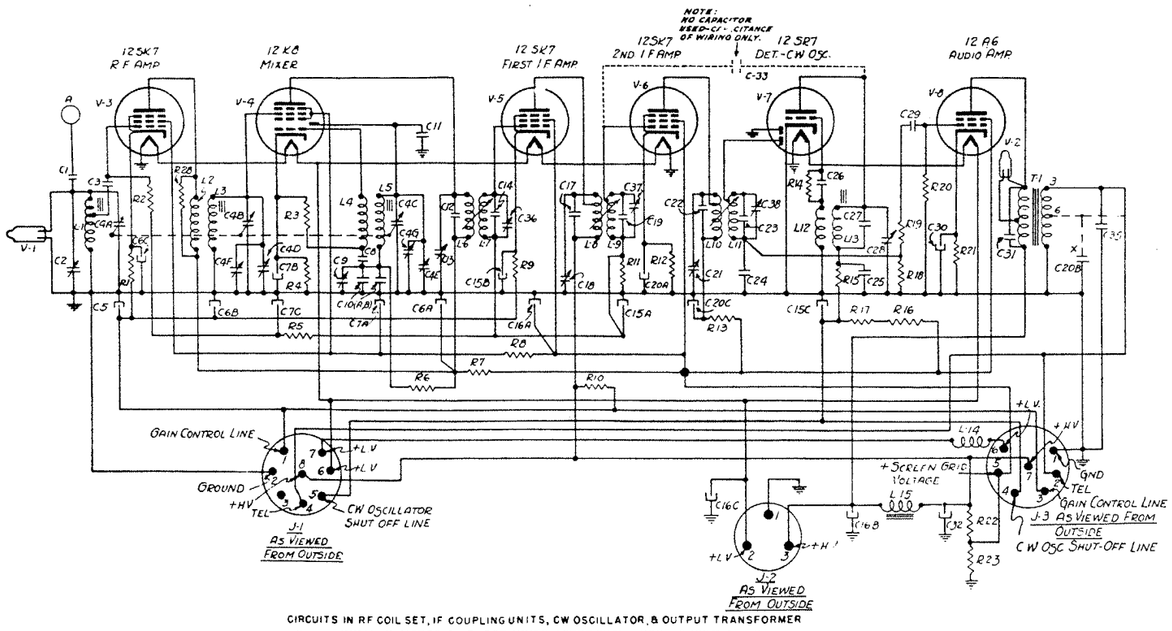
*See Table 3, Index To Manufacturers.

TABLE 2 (Continued)

REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Miscellaneous Parts Apt To Be required In Servicing Receiver BC-946-B

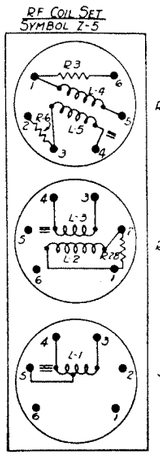
Quant.	*Stock Number*	*Description*	*Dwg. No.*
26	6L6348-3.9	Screw, binding head, #3-48 x 3/16 nickle plated	4058
2	6L6348-2.9	Screw, binding head, #3-48 x 1/8 nickle plated	4134
4	6LF1002	Screw, fillister head, #6-32 x 3/8 black nickle plated	4138
16	6L6348-4.9	Screw, binding head, #3-48 x 1/4 nickle plated	4168
2	6L6440-49	Screw, binding head, #4-40 x 1/4 nickle plated	6008
2	6L6348-3.P59	Screw, Phillips flat head, #3-48 x 3/16 black nickle plated	6010
19	6L6348-1.57	Screw, binding head, #3-48 x 7/32 black nickle plated	6017
4	6L6348-7.9	Screw, binding head, #3-48 x 7/16 nickle plated	6018
4	6L6440-3.57	Screw, binding head, #4-40 x 3/16 black nickle plated	6019
33	6L6348-2-1.57	Screw, binding head, #3-48 x 5/32 black nickle plated	6020
2	6LF1003	Screw, binding head, #3-48 x 5/32 nickle plated	7002
6	6LF1004	Screw, binding head, #3-48 x 3/16 black nickle plated	Col. 48920
2	6LF3102	Washer—flat	5402
7	2S274N/W1	Washer—flat	5520
6	6LF3103	Washer—flat (bakelite)	6566
2	6L72906	Washer—shakeproof #6 int. tooth	4042
100	6L72903	Washer—shakeproof #3 int. tooth	4558
4	6L72904	Washer—shakeproof #4 int. tooth	4242
1	2S274N/W4	Washer—special (hard rubber)	6481
1	2S274N/W3	Washer—spring	5727
2	6L3106-32.4	Nut—hex.—#6-32 x 5/64 nickle plated	4041
1	6L3508-27.11	Nut—hex.—1/2-27 x 1/8 cadmium plated	1285
1	2S274N/N1	Nut—hex.—1/2 x 27	5863
4	6L3103-48.3	Nut—hex.—3-48 x 1/16 nickle plated	4561
1	6L3104-40-3.1	Nut—hex.—4-40 x 5/64 nickle plated	6009
1	2S274N/S2	Sleeve	6397



CAPACITANCES		INDUCTANCES		RESISTANCES	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C-1	11 MMF	L-1	ANT INPUT	R-1	620
C-2	15 MMF	L-2, L-3	R F AMP	R-2	2,000,000
C-3	100 MMF	L-4, L-5	R F OSC	R-3	51,000
C-4 (A TOG)	GANG (346 MMF)	L-6, L-7	IN FIRST IF	R-4	620
C-5	3 MFD	L-8, L-9	IN 2ND I F	R-5	150,000
C-6 (A,B,C)	.05/.05/.05 MFD.	L-10, L-11	IN 3RD I F	R-6	300,000
C-7 (A,B,C)	.05/.05/.05 MFD	L-12, L-13	CW OSC	R-7	200
C-8	200 MMF	L-14	R F CHOKE	R-8	200
C-9	40 MMF		112 MICRO-	R-9	620
C-10 (A B)	670 MMF TOTAL		HENRIES	R-10	360,000
C-11	3 MMF	L-15	A F CHOKE	R-11	100,000
C-12	180 MMF		3 HENRIES	R-12	510
C-13	17 MMF			R-13	200
C-14	180 MMF			R-14	100,000
C-15 (A,B,C)	.05/.05/.05 MFD			R-15	20,000
C-16 (A,B,C)	.22/.22/.22 MFD			R-16	100,000
C-17	180 MMF			R-17	100,000
C-18	17 MMF			R-18	510,000
C-19	180 MMF			R-19	100,000
C-20 (A,B,C)	.05/.01/.05 MFD			R-20	2,000,000
C-21	17 MMF			R-21	1500
C-22	180 MMF			R-22	7000
C-23	180 MMF			R-23	7000
C-24	200 MMF			R-28	51,000
C-25	.001 MFD				
C-26	100 MMF				
C-27	335 MMF				
C-28	34 MMF				
C-29	.006 MFD				
C-30	15 MFD				
C-31	.001 MFD				
C-32	5 MFD				
C-33	WIRING CAPACITANCE LESS THAN 2 MMF				
C-35	750 MMFD (SEE NOTE BELOW)				
C-36	17 MMF				
C-37	17 MMF				
C-38	17 MMF				

CIRCUITS IN RF COIL SET, IF COUPLING UNITS, CW OSCILLATOR, & OUTPUT TRANSFORMER THE TERMINAL NUMBERS ON THESE UNITS AGREE WITH THOSE SHOWN AT THE CORRESPONDING LOCATIONS ON THE WIRING DIAGRAM

RF COIL SET SYMBOL Z-5

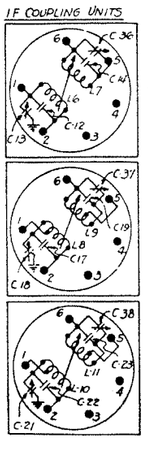


SYMBOL Z-5C RF OSCILLATOR

SYMBOL Z-5B RF AMPLIFIER

SYMBOL Z-5A RF ANTENNA

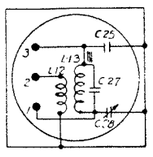
IF COUPLING UNITS



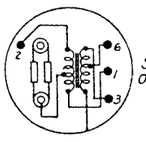
SYMBOL Z-1 1ST I F (239 KC)

SYMBOL Z-2 2ND I F (239 KC)

SYMBOL Z-3 3RD I F (239 KC)



SYMBOL Z-4 CW OSCILLATOR (239 KC)

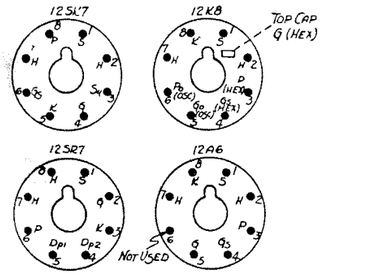


SYMBOL T-1 OUTPUT TRANSFORMER

@ C35 & TERMINAL 3 TO BE USED FOR 4000 OHM OUTPUT
C20B & TERMINAL 6 TO BE USED FOR 500 OHM OUTPUT

FIG. 1

TUBE SOCKET TERMINALS AS VIEWED FROM BOTTOM



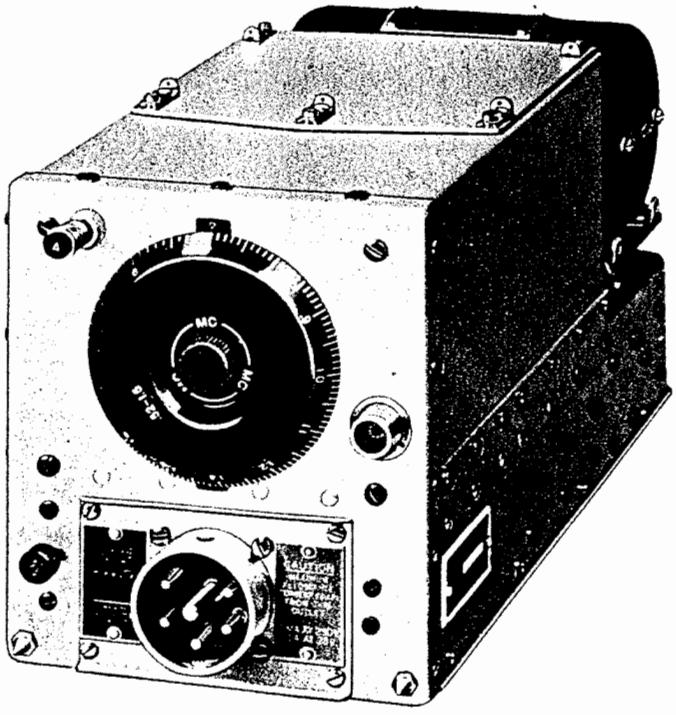
TUBE TERMINAL CODE

S = SHELL
H = HEATER
K = CATHODE
S_{up} = SUPPRESSOR GRID
D_{p1} = FIRST DIODE PLATE
D_{p2} = SECOND DIODE PLATE
G = CONTROL GRID
G_5 = SCREEN GRID
G_5 (HEX) = SCREEN GRID, HEXODE SECTION
G_0 (OSC) = CONTROL GRID, OSC. SECTION.
P = PLATE
P (HEX) = PLATE, HEXODE SECTION
P_0 (OSC) = PLATE, OSC. SECTION.
G (HEX) = CONTROL GRID, (HEXODE SECTION)

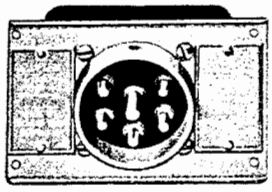
Radio Receiver BC-454 - Schematic Wiring Diagram

ADDENDUM

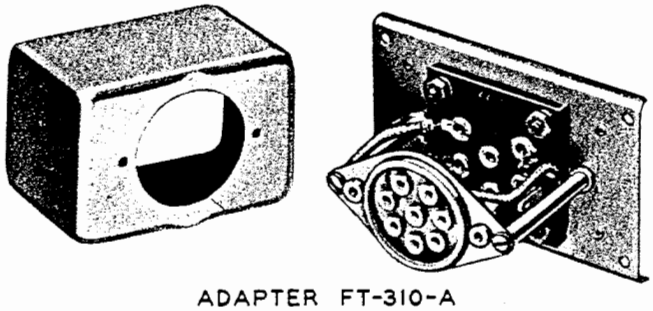
RADIO RECEIVER BC-946-B



RADIO RECEIVER
BC-946-B



ADAPTER FT-310-A
FRONT VIEW



ADAPTER FT-310-A
INTERIOR VIEW

FIGURE A1—RADIO RECEIVER BC-946-B

ADDENDUM

RADIO RECEIVER BC-946-B

1. DESCRIPTION

a. General

Radio Receiver BC-946-B is identical in mechanical design with other receivers, such as Radio Receiver BC-453-B, of Radio Set SCR-274-N, and uses the same tube complement, variable condenser, control box, etc. The radio frequency coil units are externally the same, although the coil details are different internally. Adapter FT-310-A may be used with Radio Receiver BC-453-B and other receivers of Radio Set SCR-274-N. The following instructions will cover the differences between Radio Receiver BC-946-B and Radio Receiver BC-453-B.

b. Frequency Range

The frequency range of Radio Receiver BC-946-B is .52 mc to 1.5 mc.

c. Intermediate Amplifier Frequency

The intermediate frequency of Radio Receiver BC-946-B is 239 kc.

d. Dial MC-415

Dial MC-415 is interchangeable with any of the other dials used on Radio Control Box BC-450-A. The calibration is identical with that of the dial for Radio Receiver BC-946-B.

e. Adapter FT-310-A

Adapter FT-310-A, which is a part of Radio Receiver BC-946-B, provides both high and low voltage outlet. It is mechanically interchangeable with Adapter FT-230-A.

CAUTION:—The current drawn by equipment connected to Adapter FT-310-A must not exceed 15 milliamperes at 250 volts and .5 ampere at 28 volts, because the performance of the radio receiver will be adversely affected and the life of the dynamotor reduced.

2. INSTALLATION

a. Radio Receiver BC-946-B

The receiver may be used interchangeably with any of the other receivers of Radio Set SCR-274-N by following instructions given for them.

b. Dial MC-415

Dial MC-415 is used on the radio control box.

3. OPERATION

The operation of Radio Receiver BC-946-B is the same as that given for Radio Receiver BC-453-B.

4. PEFORMANCE

The performance of the receiver is the same as that for Radio Receiver BC-453-B except as tabulated below. (For test conditions see Instruction Book for Operation and Maintenance of Radio Set SCR-274-N.)

SENSITIVITY

Circuits	*Locations*	*Micro-volts*	*KC*
Antenna	Antenna Binding Post	8	1500
R-F	R-F Control Grid at Terminal +	120	1500
Mixer	R-F Control Grid at Top Cap	600	1500
Mixer	I-F Control Grid at Top Cap	470	239
1st I-F	I-F Control Grid at Terminal +	8600	239
2nd I-F	I-F Control Grid at Terminal +	100,000	239

SELECTIVITY (520 KC)

MCW Selectivity Factor

2X	10X	100X	1000X
4.5	14.0	20.0	30.0

5. ALIGNMENT

a. Procedure

The alignment procedure, symbol numbers and trimmer position views are the same as those given for Radio Receiver BC-453-B.

b. Alignment Frequencies

Intermediate Frequency .....239 kc
High-end alignment frequency for
C4E, C4D, and C2.....1.40 mc
Low-end alignment frequency for C9.....57 mc

c. Setting of Cross Mark

The setting of cross mark on auxiliary gang trimmers is indicated below:

C4F	C4G
Min †	Half ⊣+

6. OUTPUT IMPEDANCE

To change from a 4,000 ohm output connection to 300 ohms, proceed as follows:

(1) Remove capacitor C35
(2) Disconnect the black lead from terminal 3 on output transformer T-1 and connect it to terminal 6
(3) Connect a new lead from X on C20B to terminal 6 on output transformer, or to the same terminal from which C35 was disconnected on the power plug.

7. SCHEMATIC DIAGRAM

The schematic diagram (Figure A2) is similar to the one for Radio Receiver BC-453-B, and the same symbol numbers are used. The principal differences between the two receivers are as follows:

C 10A and C 10B.....slightly different capacity
C 33.....is capacitance of wiring only instead of 3 mmf
R 16 and R 17.....are 100,000 ohms instead of 150,000 ohms
C 39.....is omitted

An additional connection is made from high side of R 10 to terminal 8 on J-1.

TABLE 1

DIFFERENCES IN REPLACEABLE PARTS BETWEEN RADIO RECEIVER BC-453-B AND RADIO RECEIVER BC-946-B

Ref. No.	*Name of Part*	*Stock No.*	*Description*	*Function*	*Drawing Numbers* BC-453-B	BC-946-B
C-9	Capacitor		Variable, air, △ C approx. 40 mmfd. and fixed mica 400 v, 690 ± 5 mmfd.	R-F osc. series capacitor.	6075	.....
C-10	Capacitor		Variable, air, △ C approx. 40 mmfd. and fixed mica 400 v, 670 ± 5 mmfd.	R-F osc. series capacitor.	.....	6076
C-26	Capacitor	3B9100-59	Fixed 400 volts mica			
			200 mmfd. ± 5%	CW osc. blocking.	4513	.....
			100 mmfd. ± 5%	CW osc. blocking.	.....	4520
C-27	Capacitor		Fixed, 400 v, mica ± 2.5 mmfd. from nominal. Part of CW osc. assembly Z-4	Fixed capacitor part of CW osc. tuning		
			Nominal 345 mmfd.		6701	.....
			335 mmfd.		.....	49143
C-33	Capacitor		Fixed, 3 mmfd. ± ½ mmfd. (Wiring capacity only for BC-946-B)	CW osc. coupling.	7020	.....
					.....	None
C-39	Capacitor		Fixed, 120 mmf., 2½% 400 v mica	Across pri. of R-F	8013	None
J-1	Receptacle		Coupling receptacle assembly; 7 circuit.	To adapter.	4724	49129
J-3	Plug	2Z7251	Plug assembly; 4 circuit.	Adapter to receiver.	.....	48930
J-3	Receptacle		Receptacle plate assembly.	Adapter receptacle.	.....	2226
N-1	Dial		Dial.	Receiver tuning dial.	5613	5610
R-6	Resistor		510000 ohms ± 10% ⅓w carbon.	R-F osc. series.	4570	.....
	Resistor		300000 ohms ± 10% ⅓w carbon.	R-F osc. series.	.....	4530
R-14	Resistor		51000 ohms ± 10% ⅓w carbon.	CW osc. grid.	4569	.....
	Resistor	3Z6700-48	100000 ohms ± 10% ⅓w carbon.	CW osc. grid.	.....	4501
R-16	Resistor		150000 ohms ± 10% ⅓w carbon.	CW osc. plate dropping.	4571	.....
	Resistor	3Z6700-48	100000 ohms ± 10% ⅓w carbon.	CW osc. plate dropping.	.....	4501

TABLE 1 (Continued)

DIFFERENCES IN REPLACEABLE PARTS BETWEEN
RADIO RECEIVER BC-453-B AND RADIO RECEIVER BC-946-B

Ref. No.	*Name of Part*	*Stock No.*	*Description*	*Function*	*Drawing Numbers* *BC-453-B*	*BC-946-B*
R-17	Resistor	3Z6700-48	Same as R-16.	CW osc. plate dropping.		
R-28	Resistor	3Z6651-3	51000 ohms ± 10% ⅓w carbon.	R-F primary load.	None	4569
Z-1	Coupling unit		1st i-f coupling unit, complete assembly including shield can and mtg. plate.	1st i.f.	4698	7268
Z-2	Coupling unit		2nd i-f coupling unit, complete.	2nd i.f.	7267	7269
Z-3	Coupling unit		3rd i-f coupling unit, complete.	3rd i.f.	4677	7270
Z-4	CW osc.		CW osc. complete assembly.	CW osc.	5852	5853
Z-5	R-F coil set		R-F coil set assembly including ant. Z-5A, r-f Amp. Z-5B, r-f osc. Z-5C in shield cans mounted on a cover.	R-F coil set.	6184	7975

TABLE 2

REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref. No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
2	C1	3D9011-1	Capacitor	Ceramic—11 mmf ± ½ mmf.	Ant. series.	A, B,	9046
2	C-2	3D9015V-6	Capacitor-shunt	Variable, air, △C. Approxiately 15 mmf.	Input alignment.	C	5676
2	C-3	3D9100-59	Capacitor	Fixed mica—.0001 mfd. ± 5% 400 v—C D Type 5 or equivalent.	R-F amp. grid blocking.	D, E, F,	4520
1	C-4	3D9346	Capacitor	Three equal—section gang with trimmers.	Preselector and r-f oscillator.	G	3936
3	C-5	3DB3.4	Capacitor	3 mfd dry electrolytic. Impedance at 60 cycles not over 1750 ohms.	Gain control. Line filter.	F, H, D,	7582 or ESL692651
2	C-6	3DA50-32	Capacitor	.05/.05/.05 mfd ± 15%. 300 volts paper.		F, H, D,	5414 or ESL692644
				A section.	Mixer plate by-pass.		
				B section.	Gain control line by-pass.		
				C section.	1st r-f cathode by-pass.		
2	C-7	3DA50-32	Capacitor	Same as C-6.		F, H, D,	
				A section.	Mixer screen by-pass		
				B section.	Mixer cathode by-pass.		
				C section.	AGC line by-pass.		
2	C-8	3D9200-29	Capacitor	Fixed mica—.0002 mfd. ± 5%, 400 v C D Type 5 or equivalent.	R-F osc. grid blocking.	D, E, F,	4513
2	C-9&C-10	2S274N/C6	Capacitor	Variable, air △ C Approximately 40 mmf—and Fixed mica 400 volts 670 ± 5 mmf.	R-F osc. series capacitor.	C	6076
2	C-11	3D9003-9	Capacitor	Ceramic—compensator, 3 mmf ± ½ mmf with temperature coefficient of —.00075 mmf per mmf per degree centigrade ± 15%, Centralab Co., Type 807 or equivalent.	R-F osc. temperature compensation.	A, B,	7020

*See Table 3, Index To Manufacturers.

TABLE 2 (Continued)

REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref. No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
2	C-15	3DA50-32	Capacitor	Same as C-6.	Grid return by-pass.		
				A section.	1st & 2nd i-f.		
				B section.	1st i-f cathode by-pass.		
				C section.	CW osc. plate line filter.		
2	C-16	3DA220	Capacitor	.22/.22/.22 mfd ± 20%, 300 volts, paper.		F, H, D,	5413 or ESL692643
				A section.	2nd i-f screen by-pass.		
				B section.	Dyn. H.V. filter.		
				C section.	Dyn. L.V. filter.		
2	C-20	3DA50-33	Capacitor	.05/.01/.05 mfd ± 15%, 300 volts, paper.		F, H, D,	5415
				A section.	2nd i-f amp. cathode by-pass.		
				B section.	Not used.		
				C section.	2nd i-f amp. plate by-pass.		
1	C-29	3DA6-29	Capacitor	Fixed mica—.006 mfd ± 5%, 400 volts, Aerovox type 1461 or equivalent.	Audio coupling.	D, E, F,	4091
3	C-30	3DB15-7	Capacitor	15 mfd., dry electrolytic impedance at 60 cycles not greater than 350 ohms.	Audio amp. cathode by-pass.	F, H, D,	5416 or ESL692646
1	C-31	3DA1-61	Capacitor	Fixed mica—.001 mfd ± 5%, 400 volts, Aerovox 1461 or equivalent.	Output filter.	D, E, F,	4114
3	C-32	3DB5-7	Capacitor	5 mfd, dry electrolytic. Impedance at 60 cycles not greater than 1050 ohms.	Dyn. H.V. filter.	F, H, D,	6350 or ESL692649
1	C-35	3D9750-4	Capacitor	Fixed mica—750 mmf ± 5% 400 volts.	Rec. output audio filter.	D, E, F,	4522
2	E-1	3Z509	Binding post	Antenna binding post "A."	Ant. binding post.		4667
2		2S274N/C7	Clip	Neon lamp.	Mounting for neon lamp.	J	ESA691038
1	E-8	2C4373A/C3	Clip	Grid.	Connects to mixer control grid.	J	4754

* See Table 1, Index To Manufacturers.

TABLE 2 (Continued)
REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref. No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
1	E-4	2C4373A/J1	Insulator	Insulators for antenna.	Insulation.		
				Binding post.			
				A section, outside.			3485
				B section, inside.			6597
				1 washer 6481, and 1 washer 5727 req'd. to complete assembly.			
1	E-9	2Z5853	Knob	Input alignment control knob.	Ant. input alignment.	J	ESA690856
5	H-3	2Z8609-4	Snapslide	Formed snapslide, parts of the mechanism includes:	Fastener.		
		2Z8609-3/S1		Snapslide (on cover).		J	3888
		2Z8609-3/G1		Snapslide guide (on cover).		J	3887
		2Z8609-3/S3		Snapslide button (on cover).		J	3890
		2Z8609-4/S1		Snapslide stud (on shield).		J	4708
		2Z8609-3/W1		Washers (on cover).		J	3889
4	H-6		Panel	Typical resistor panel assembly.	For carbon resistors.	J	Col. 48861
2	H-10	2C4373A/S5	Stud	Conical stud.	For rec. locking.	J	4710
1	J-1		Receptacle	Coupling receptacle assembly, 7 circuit.	To adapter.	J	Col. 49129
1	J-2	2Z7412-1	Receptacle	Coupling receptacle assembly, 3 circuit.	To dynamotor.	J	4718
1	J-3	2Z7251	Plug	Plug assembly, 7 circuit.	To rec. rack.	J	5488
1			Plug	Plug assembly, 4 circuit.	Aadapter to rec.	J	Col. 48930
1			Receptacle	Receptacle plate assembly.	Adapter to rec.	J	2226
3	J-28	2Z7412-3	Receptacle	Typical i-f coupling unit receptacle assembly.	To i-f coupling unit.	J	4723
3	J-29	2Z7412-2	Receptacle	Typical r-f coil receptacle assembly.	To r-f coil.	J	4722
7		2S274N/J3	Jack				5228
1	L-14	3F2997-2	Inductor	R-F choke, 112 microhenries ± 10%, d-c resistance not over .15 ohms.	R-F choke.	C	5546
1	L-15	3F2997-2	Inductor	A-F choke, 3 henries with .05 amperes d.c., d-c resistance 325 ohms, ± 15%.	A-F choke.	K	5634
1	N-1		Dial	Dial.	Rec. tuning dial.		5610
23	P-5	2S274N/P4	Plug	Pin plug assembly (on dyn. receptacle assembly).	Connector.		7949

*See Table 3, Index To Manufacturers.

TABLE 2 (Continued)

REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref. No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
2	R-1	3Z6062-1	Resistor	620 ohms ± 10%, ⅓ w carbon, A-B Type E.	1st r-f cathode auto-bias.	L	6004
2	R-2	3Z6802-7	Resistor	2 megohms ± 10%, ⅓ w, metalized, Int. Resistance Co., Type F ⅓.	R-F amp. grid.	M	4439
2	R-4	3Z6062-1	Resistor	Same as R-1.	Mixer cathode auto-bias.	L	
2	R-5	3Z6715-16	Resistor	150M ohms ± 10%, ⅓ w carbon, A-B Type E.	AGC line decoupling.	L	4571
2	R-7	3Z6020-21	Resistor	200 ohms ± 10%, ⅓ w carbon, A-B Type E.	Mixer plate decoupling.	L	4497
2	R-8	3Z6020-21	Resistor	Same as R-7.	R-F amp. and mixer screen decoupling.	L	
2	R-9	3Z6062-1	Resistor	Same as R-1.	1st i-f cathode auto-bias.	L	
2	R-10	3Z6736	Resistor	360M ohms ± 10%, ⅓ w carbon, A-B Type E.	H.V. bleeder to gain control.	L	8032
2	R-11	3Z6700-48	Resistor	100M ohms ± 10%, ⅓ w carbon, A-B Type E.	AGC resistor.	L	4501
2	R-12	2Z6051-1	Resistor	510 ohms ± 10%, ⅓ w carbon, A-B Type E.	2nd i-f cathode auto-bias.	L	6005
2	R-13	3Z6020-21	Resistor	Same as R-7.	2nd i-f plate decoupling.	L	
2	R-14	3Z6700-48	Resistor	Same as R-11.	CW osc. grid.	L	
2	R-15	3Z6620-45	Resistor	20M ohms ± 10%, ⅓ w carbon, A-B Type E.	CW osc. plate decoupling and dropping.	L	4510
2	R-16	3Z6700-48	Resistor	Same as R-11.	CW osc. plate dropping.	L	
2	R-17	3Z6700-48	Resistor	Same as R-11.	Same as R-16.	L	
2	R-18	3Z6751-1	Resistor	510M ohms ± 10%, ⅓ w carbon, A-B Type E.	Diode series.	L	4570
2	R-19	3Z6700-48	Resistor	Same as R-11.	R-F decoupling.	L	
2	R-20	3Z6802-8	Resistor	2 megohms ± 10%, ⅓ w carbon, A-B Type E.	Grid resistor audio amp.	L	4503
2	R-21	3Z6150-24	Resistor	1500 ohms ± 10%, ⅓ w carbon, A-B Type E.	Audio amp. cathode auto-bias.	L	4506

*See Table 3, Index To Manufacturers.

TABLE 2 (Continued)
REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref. No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
2	R-22	3Z6570-9	Resistor	7M ohms ± 2%, 7 w wire wound, vitreous.	High voltage bleeder.	N, O,	5895
2	R-23	3Z6570-9	Resistor	Same as R-22	Same as R-22.	N, O,	
2	T-1	2Z9947-4.1	Transformer	Primary, 4000 turns #40 E. wire, secondary, 1800 turns #38 E. wire, primary d-c resistance 1028-1300 ohms, secondary d-c resistance 272-350 ohms.	Rec. output.	K	ESL691027
3	V-1	2Z5889	Neon lamp	Neon lamp, G.E. Co., Type T-2, modified.	R-F input voltage limiter.	I	5913
3	V-2	2Z5889	Neon lamp	Same as V-1.	A-F output voltage limiter.	I	
6	X-1	2C2500 456A.1/S1	Socket	Octal base tube socket. Does not include bakelite washer 6566 which should be specified if required. American Phenolic Corp., Type S-8, modified, or equivalent. Amphenol #4 retainer ring is part of assembly.	For all octal-base tubes in rec.	P, R,	6559
2	Z-1		Coupling unit	1st i-f coupling unit, complete assembly, including shield can and mounting plate.	1st I.F.	C	7268
2	Z-2		Coupling unit	2nd i-f coupling unit, complete assembly, including shield can and mounting plate.	2nd I.F.	C	7269
2	Z-3		Coupling unit	3rd i-f coupling unit, complete assembly, including shield can and mounting plate.	3rd I.F.	C	7270
1	Z-4		CW osc.	CW osc. complete assembly, including shield can.	CW osc.	C	5853
1	Z-5 (A, B, C,)		R-F coil set	R-F coil set assembly, complete including ant. coil Z-5A, R-F Amp. Z-5B, and R-F Osc. Z-5C, in shield cans, mounted on a cover.	R-F coil set.	C	7975

*See Table 3, Index To Manufacturers.

TABLE 2 (Continued)

REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Quant.	*Ref. No.*	*Stock No.*	*Name of Part*	*Description*	*Function*	**Mfr.*	*Dwg. No.*
1			Groov-pin	Groov-pin 3/64 x 1/8		S	4160
2		6L3903-3	Groov-pin	Groov-pin 3/64 x 3/16		S	4166
13		2S274N/P2	Pin—plug			G	4628
5			Pin—plug			G	9081

*See Table 3, Index To Manufacturers.

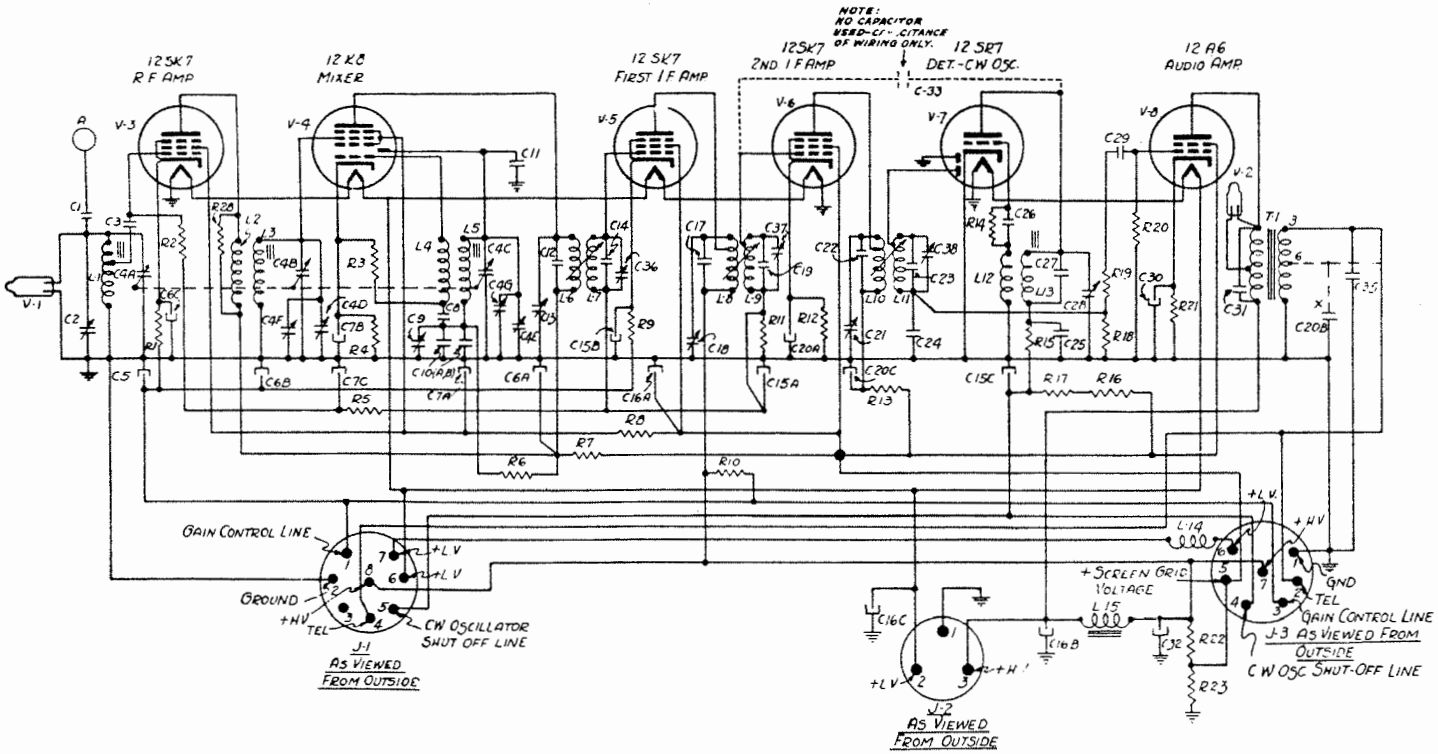
*See Table 3, Index To Manufacturers.

TABLE 2 (Continued)

REPLACEABLE PARTS FOR RADIO RECEIVER BC-946-B

Miscellaneous Parts Apt To Be required In Servicing Receiver BC-946-B

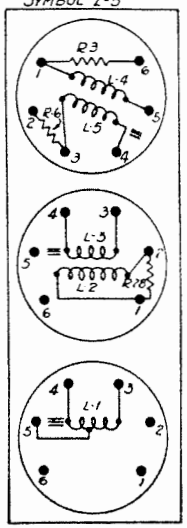
Quant.	*Stock Number*	*Description*	*Dwg. No.*
26	6L6348-3.9	Screw, binding head, #3-48 x 3/16 nickle plated	4058
2	6L6348-2.9	Screw, binding head, #3-48 x 1/8 nickle plated	4134
4	6LF1002	Screw, fillister head, #6-32 x 3/8 black nickle plated	4138
16	6L6348-4.9	Screw, binding head, #3-48 x 1/4 nickle plated	4168
2	6L6440-49	Screw, binding head, #4-40 x 1/4 nickle plated	6008
2	6L6348-3.P59	Screw, Phillips flat head, #3-48 x 3/16 black nickle plated	6010
19	6L6348-1.57	Screw, binding head, #3-48 x 7/32 black nickle plated	6017
4	6L6348-7.9	Screw, binding head, #3-48 x 7/16 nickle plated	6018
4	6L6440-3.57	Screw, binding head, #4-40 x 3/16 black nickle plated	6019
33	6L6348-2-1.57	Screw, binding head, #3-48 x 5/32 black nickle plated	6020
2	6LF1003	Screw, binding head, #3-48 x 5/32 nickle plated	7002
6	6LF1004	Screw, binding head, #3-48 x 3/16 black nickle plated	Col. 48920
2	6LF3102	Washer—flat	5402
7	2S274N/W1	Washer—flat	5520
6	6LF3103	Washer—flat (bakelite)	6566
2	6L72906	Washer—shakeproof #6 int. tooth	4042
100	6L72903	Washer—shakeproof #3 int. tooth	4558
4	6L72904	Washer—shakeproof #4 int. tooth	4242
1	2S274N/W4	Washer—special (hard rubber)	6481
1	2S274N/W3	Washer—spring	5727
2	6L3106-32.4	Nut—hex.—#6-32 x 5/64 nickle plated	4041
1	6L3508-27.11	Nut—hex.—1/2-27 x 1/8 cadmium plated	1285
1	2S274N/N1	Nut—hex.—1/2 x 27	5863
4	6L3103-48.3	Nut—hex.—3-48 x 1/16 nickle plated	4561
1	6L3104-40-3.1	Nut—hex.—4-40 x 5/64 nickle plated	6009
1	2S274N/S2	Sleeve	6397



CAPACITANCES		INDUCTANCES		RESISTANCES	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C-1	11 MMF	L-1	ANT. INPUT	R-1	620
C-2	18 MMF	L-2, L-3	R F AMP	R-2	2,000,000
C-3	100 MMF	L-4, L-5	R F OSC	R-3	51,000
C-4(A TO G)	GANG (346 MMF)	L-6, L-7	IN FIRST IF	R-4	620
C-5	3 MFD	L-8, L-9	IN 2ND IF	R-5	150,000
C-6(A,B,C)	.05/05/05 MFD.	L-10, L-11	IN 3RD IF	R-6	300,000
C-7(A,B,C)	05/05/05 MFD	L-12, L-13	CW OSC	R-7	200
C-8	200 MMF	L-14	RF CHOKE	R-8	200
C-9	40 MMF		112 MICRO-	R-9	620
C-10 (AB)	670MMF TOTAL		HENRIES	R-10	360,000
C-11	3 MMF	L-15	AF CHOKE	R-11	100,000
C-12	180 MMF		3 HENRIES	R-12	510
C-13	17 MMF			R-13	200
C-14	180 MMF			R-14	100,000
C-15(A,B,C)	05/05/05 MFD			R-15	20,000
C-16(A,B,C)	.22/22/22 MFD			R-16	100,000
C-17	180 MMF			R-17	100,000
C-18	17 MMF			R-18	510,000
C-19	180 MMF			R-19	100,000
C-20(A,B,C)	05/01/05 MFD			R-20	2,000,000
C-21	17 MMF			R-21	1500
C-22	180 MMF			R-22	7000
C-23	180 MMF			R-23	7000
C-24	200 MMF			R-28	51,000
C-25	.001 MFD				
C-26	100 MMF				
C-27	335 MMF				
C-28	34 MMF				
C-29	.006 MFD				
C-30	15 MFD				
C-31	.001 MFD				
C-32	5 MFD				
C-33	WIRING CAPACITANCE LESS THAN 2 MMF				
C-35	750 MMFD (SEE NOTE BELOW)				
C-36	17 MMF				
C-37	17 MMF				
C-38	17 MMF				

CIRCUITS IN RF COIL SET, IF COUPLING UNITS, CW OSCILLATOR, & OUTPUT TRANSFORMER THE TERMINAL NUMBERS ON THESE UNITS AGREE WITH THOSE SHOWN AT THE CORRESPONDING LOCATIONS ON THE WIRING DIAGRAM

RF COIL SET
SYMBOL Z-5

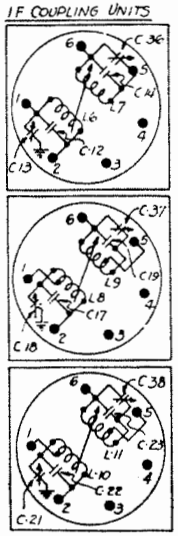


SYMBOL Z-5C
RF OSCILLATOR

SYMBOL Z-5B
RF AMPLIFIER

SYMBOL Z-5A
RF ANTENNA

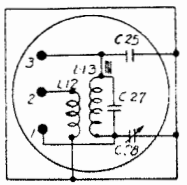
IF COUPLING UNITS



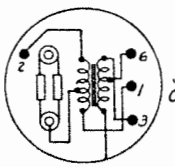
SYMBOL Z-1
1ST IF
(239 KC)

SYMBOL Z-2
2ND IF
(239 KC)

SYMBOL Z-3
3RD IF
(239 KC)



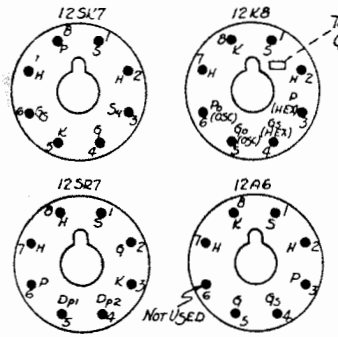
SYMBOL Z-4
CW OSCILLATOR
(239 KC)



SYMBOL T-1
OUTPUT TRANSFORMER

@ C35 & TERMINAL 3 TO BE USED FOR 4000 OHM OUTPUT
C20B & TERMINAL 6 TO BE USED FOR 300 OHM OUTPUT

TUBE SOCKET TERMINALS
AS VIEWED FROM BOTTOM

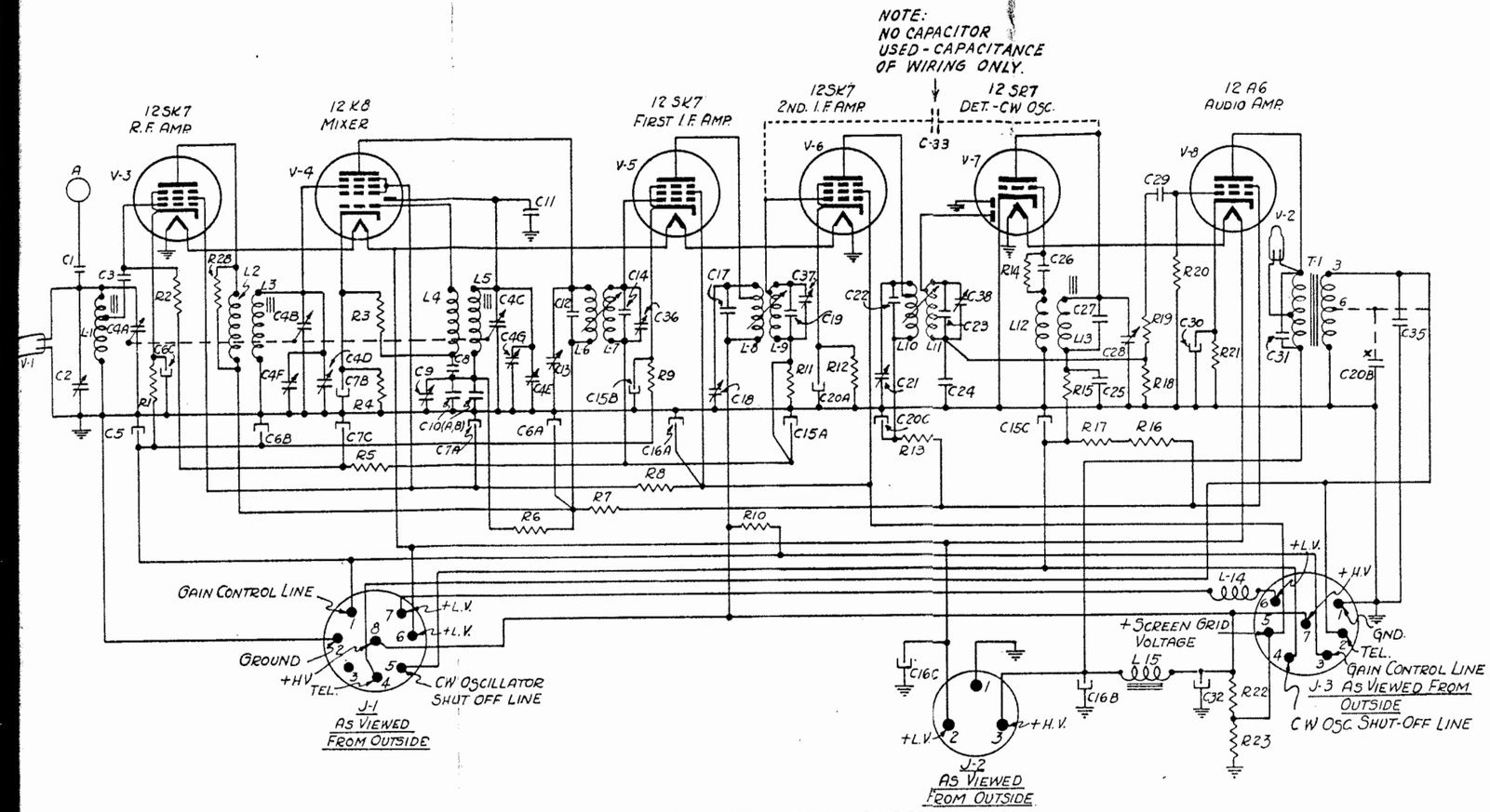


TUBE TERMINAL CODE

S = SHELL
H = HEATER
K = CATHODE
S_w = SUPPRESSOR GRID
D_{P1} = FIRST DIODE PLATE
D_{P2} = SECOND DIODE PLATE
G = CONTROL GRID
G_S = SCREEN GRID
G_S (HEX) = SCREEN GRID, HEXODE SECTION
G_O (OSC) = CONTROL GRID, OSC. SECTION.
P = PLATE
P(HEX) = PLATE, HEXODE SECTION
P_O (OSC) = PLATE, OSC. SECTION.
G (HEX) = CONTROL GRID, (HEXODE SECTION)

FIG. 1

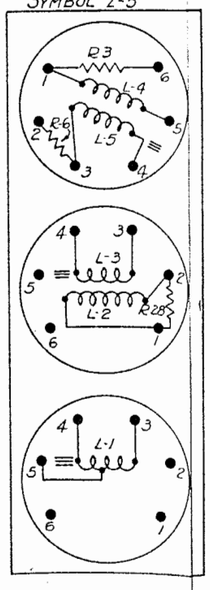
Radio Receiver BC-454 - Schematic Wiring Diagram



CAPACITANCES		INDUCTANCES		RESISTANCES	
SYMBOL	DESCRIPTION	SYMBOL	DESCRIPTION	SYMBOL	OHMS
C-1	11 MMF	L-1	ANT. INPUT	R-1	620
C-2	15 MMF	L-2, L-3	RF AMP	R-2	2,000,000
C-3	100 MMF	L-4, L-5	RF OSC	R-3	51,000
C-4(A TO G)	GANG(346 MMF)	L-6, L-7	IN FIRST IF	R-4	620
C-5	3 MFD	L-8, L-9	IN 2ND IF	R-5	150,000
C-6(A,B,C)	.05/.05/.05 MFD.	L-10, L-11	IN 3RD IF	R-6	300,000
C-7(A,B,C)	.05/.05/.05 MFD	L-12, L-13	CW OSC	R-7	200
C-8	200 MMF	L-14	RF CHOKE	R-8	200
C-9	40 MMF		112 MICRO-	R-9	620
C-10 (A B)	670MMF TOTAL		HENRIES	R-10	360,000
C-11	3 MMF	L-15	AF CHOKE	R-11	100,000
C-12	180 MMF		3 HENRIES	R-12	510
C-13	17 MMF			R-13	200
C-14	180 MMF			R-14	100,000
C-15(A,B,C)	.05/.05/.05 MFD			R-15	20,000
C-16(A,B,C)	.22/.22/.22 MFD			R-16	100,000
C-17	180 MMF			R-17	100,000
C-18	17 MMF			R-18	510,000
C-19	180 MMF			R-19	100,000
C-20(A,B,C)	.05/.01/.05 MFD			R-20	2,000,000
C-21	17 MMF			R-21	1500
C-22	180 MMF			R-22	7000
C-23	180 MMF			R-23	7000
C-24	200 MMF			R-28	51,000
C-25	.001 MFD				
C-26	100 MMF				
C-27	335 MMF				
C-28	34 MMF				
C-29	.006 MFD				
C-30	15 MFD				
C-31	.001 MFD				
C-32	5 MFD				
C-33	WIRING CAPAC-ITANCE LESS THAN 2 MMF				
C-35	750 MMFD (SEE NOTE BELOW) Ⓐ				
C-36	17 MMF				
C-37	17 MMF				
C-38	17 MMF				

CIRCUITS IN RF COIL SET, IF COUPLING UNITS, CW OSCILLATOR, & OUTPUT TRANSFORMER. THE TERMINAL NUMBERS ON THESE UNITS AGREE WITH THOSE SHOWN AT THE CORRESPONDING LOCATIONS ON THE WIRING DIAGRAM

RF COIL SET
SYMBOL Z-5

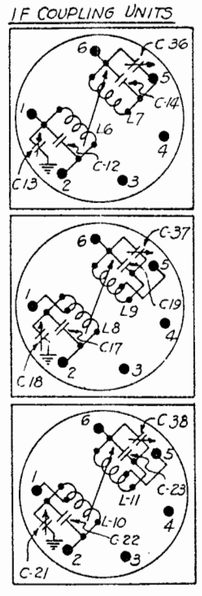


SYMBOL Z-5C
R.F. OSCILLATOR

SYMBOL Z-5B
R.F. AMPLIFIER

SYMBOL Z-5A
R.F. ANTENNA

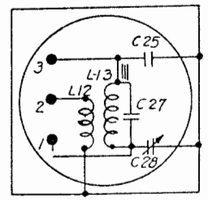
IF COUPLING UNITS



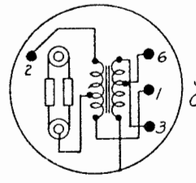
SYMBOL Z-1
1ST I.F.
(239 KC)

SYMBOL Z-2
2ND I.F.
(239 KC)

SYMBOL Z-3
3RD I.F.
(239 KC)



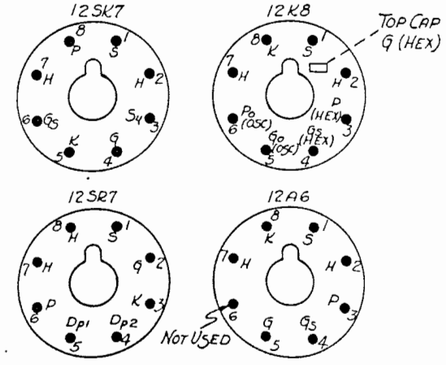
SYMBOL Z-4
CW OSCILLATOR
(239 KC)



SYMBOL T-1
OUTPUT TRANSFORMER

Ⓐ C 35 & TERMINAL 3 TO BE USED FOR 4000 OHM OUTPUT
C 20B & TERMINAL 6 TO BE USED FOR 300 OHM OUTPUT

TUBE SOCKET TERMINALS
AS VIEWED FROM BOTTOM



TUBE TERMINAL CODE

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S_4 = SUPPRESSOR GRID
D_{P1} = FIRST DIODE PLATE
D_{P2} = SECOND DIODE PLATE
G = CONTROL GRID
G_5 = SCREEN GRID
G_5 (HEX) = SCREEN GRID, HEXODE SECTION
G_0 (OSC) = CONTROL GRID, OSC. SECTION
P = PLATE
P(HEX) = PLATE, HEXODE SECTION
P_0 (OSC) = PLATE, OSC. SECTION
G (HEX) = CONTROL GRID, (HEXODE SECTION)