

# BROADCAST AUDIO EQUIPMENT

## Type BN-2A Portable Remote Amplifier



RADIO CORPORATION OF AMERICA  
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N. J.







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## INSTRUCTIONS

# Type BN-2A Portable Remote Amplifier

(MI-11230)

RADIO CORPORATION OF AMERICA  
ENGINEERING PRODUCTS DEPARTMENT, CAMDEN, N. J.

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Figure 1—Type BN-2A Portable Remote Amplifier, panel cover removed



## DESCRIPTION

### Application

The Type BN-2A Portable Remote Amplifier (MI-11230) is a high-fidelity unit for a-m and f-m broadcast audio applications. It is designed to amplify low-level signals for transmission over a telephone line to the studio. The amplifier provides complete pickup facilities for programs remote from the studio such as sports events, street programs, political and social meetings, park concerts and similar gatherings. It may also be employed for semi-permanent installations such as in department stores, night clubs and restaurants, or may be used in a small studio for regular use or as standby equipment.

### Components

The amplifier is a four-stage resistance-coupled unit including three preamplifiers in the first stage for separate microphone or turntable inputs. A switch is provided to permit switching a fourth input into channel three. Each preamplifier has its own mixer. A master

gain control is provided as part of the three-stage program amplifier section. Output terminals on the front panel may be used for simultaneously feeding the signal to a public address amplifier and a telephone line. The public address output has its own balanced volume control. Cueing and monitoring facilities are provided. A control permits switching the public address input to "cue", "amplifier output" or "off". A meter with an associated switch is used for checking level to the line and also for giving an indication of the condition of the amplifying tubes. A switch is provided for controlling the amount of meter illumination.

All electrical components in the amplifier are precision made with close tolerances. Step-type attenuators are used. The 1620 tubes are especially designed for broadcast applications where a minimum of noise and microphonics are required. The three preamplifier tubes and the first program amplifier tube are shock-mounted to insure low microphonics and maximum protection from vibrations which are often experienced during remote broadcasts.

## TECHNICAL DATA

### Power Required

#### A-C Operation

117 volts, 50 to 60 cps, 25 watts

#### D-C Operation

"A" Supply—6.3 volts, 2.1 amperes max.

"B" Supply—275 volts, 10 milliamperes

### Fuse

A-C line, 1 ampere

### Tube Kit (MI-11269)

4 RCA 1620

2 RCA 6J7\*

1 RCA 6X5GT

\*1620's may be used in place of 6J7's

### Optional Tube Kit (MI-11269-A)

6 RCA 6J7

1 RCA 6X5GT

Note: 6J7's may be substituted for RCA 1620's when maximum uniformity of characteristics and minimum of microphonics, hum and distortion are not required.

### Source Impedance

150 or 30 ohms balanced. May be used with 250-ohm microphones on 150-ohm tap. May also be used with an unbalanced source. See text.

### Input Impedance

Unloaded transformer

### Maximum Input Level

-30 dbm

### Mixing

High level, after preamplifier channels

### Load Impedance

500/600 ohms

### Power Output

+18 dbm for distortion of less than 1.0% at 50 to 15,000 cps

### Gain

92 db (150-ohm source on 150-ohm input to 600-ohm load)

### Frequency Response

±1 db from 30 to 15,000 cps (fig. 2)

### Noise Level

Single channel, gain maximum: -30 dbm

Single channel, gain 68 db (master gain control set at 12, mixer gain control set at 16): -52 dbm. This corresponds to a signal-to-noise ratio of 70 db at rated power output.

### Dimensions and Weight

Length—14½ inches

Depth—9½ inches

Height—10 inches

Weight—29 pounds

### Panel Slope

10 degrees



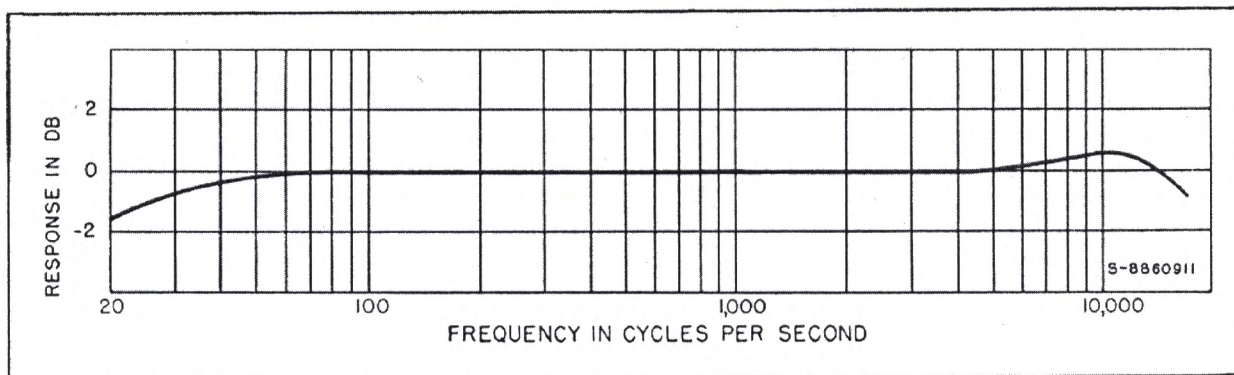


Figure 2—Frequency response

### Construction

The back and bottom cover of the amplifier is made removable for ease of servicing. The top cover, which is also removable for replacement of tubes, has a carrying strap which fits into a recess on the cover when not in use. If a screwdriver is not available, a coin may be used to loosen the twist-lock fasteners which hold the covers in place. Two tube sockets and a fuse clip are provided on the bottom side of the top for carrying spare tubes and a spare fuse. Only two spare tubes are required (6X5GT and 1620 or 6J7). The amplifier is designed with a sloping panel for maximum ease of operation. A removable panel cover protects the control knobs and meter. A protective cover, MI-11277, is available as an accessory for transporting the amplifier during inclement weather or to preserve its appearance.

### Power Requirements

The power cord and plug of the amplifier is intended to be connected to an a-c power line of the voltage and frequency specified under *Technical Data*. When desired, an MI-11214 Battery Box and MI-11255 Battery Kit may be used to furnish power. The batteries in this kit are described under *Battery Connections*. The power cord assembly for a-c line operation is supplied with the amplifier, and the power cord assembly for d-c operation is supplied with the MI-11214 Battery Box. Each of these power cords is equipped with a 12-terminal plug which mates with the power receptacle on the amplifier chassis.

## CIRCUIT

### Input

The input circuit to each of the three preamplifier channels consists of a transformer (T-1,2,3) normally connected for operation from a 150-ohm balanced source. Other possible input connections are described under *Installation*. An RCA 1620 (or 6J7) connected

as a triode (V-1,2,3) is used in each of the three preamplifier channels. Three step-type attenuators (R-5, 11,17) marked MIC-1, MIC-2, MIC-3 & 4, which are connected in the coupling circuits to the first program amplifier stage, serve as the mixers to control the levels in each of the preamplifier channels.

### First Stage of Program Amplifier

An RCA 1620 (or 6J7) is connected as a pentode (V-4) in the first program amplifier stage. The MASTER gain control (R-37) is a step type attenuator in the coupling circuit between the first and second program amplifier stages. Negative feedback is applied

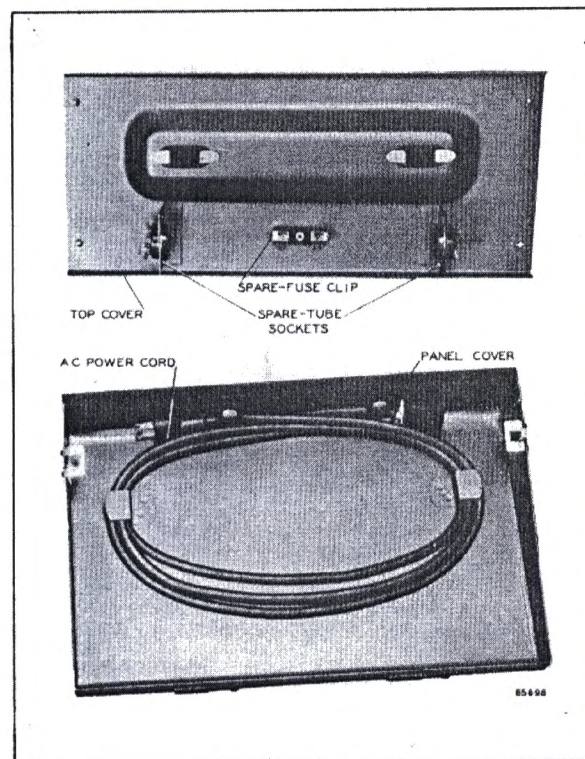


Figure 3—Panel and top covers



from this control through R-19 to the grid of the first program amplifier stage.

**Second and Third Stages of Program Amplifier**

The second and third stages of the program amplifier section use RCA 6J7 tubes connected as pentodes (V-5, 6). These stages are resistance coupled. A fixed feedback loop which includes R-28 and C-11 is connected around the two stages. This feedback reduces instability caused by variations in the tube characteristics, changes in the output load and fluctuations in the supply voltage. It also reduces distortion and improves the frequency response.

The output transformer (T-4) is designed to operate into a 500- to 600-ohm load. A 2-db pad (R-43, 44, 45, 46, 47) in the output partially isolates the output stage and the telephone line so that this stage and the output meter work into a nearly constant impedance.

**Meter Circuit**

A VU meter (M-1) is mounted on the front panel for measuring the output level and voltages in the cathode circuits of each of the amplifying tubes except V-5. Metering of V-5 is accomplished in its plate circuit. A panel-mounted selector switch (S-5) per-

mits selection of the various readings. A LIGHT switch (S-6) mounted in the upper right-hand section of the panel permits either high or low illumination from the meter lamps. If it should become necessary, checking of the tubes by the meter during a program is possible. The meter pad (R-52) is connected so that the meter will read "O" for an output level of +8 vu or +8 dbm. Terminals are provided on the pad so that it may be reconnected for other desired meter calibrations (see *Installation*).

**Interference Elimination**

The amplifier has been especially designed to eliminate stray r-f and a-c power line pick-up. For this purpose the transformers are electrostatically shielded, and capacitors C-21 and C-22 in the output circuit bypass radio frequencies to ground.

**Rectifier**

The self-contained rectifier comprises a power transformer (T-5) a one-ampere fuse (F-1) an RCA 6X5GT full-wave rectifier tube (V-7) and a resistance-capacity filter. A small d-c voltage is tapped off the voltage divider circuit comprising R-50 and R-51 for heater bias of the amplifier tubes.

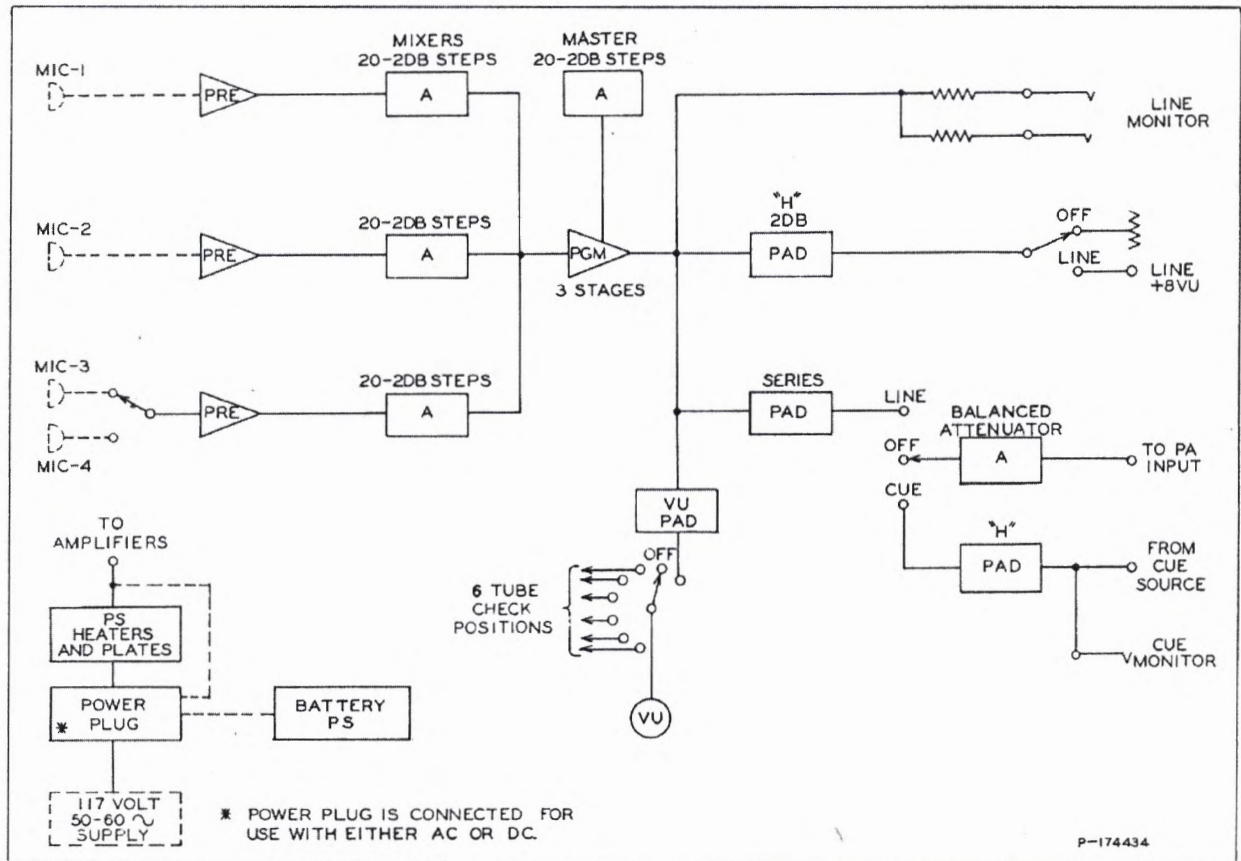


Figure 4—Block schematic diagram



## INSTALLATION

### Audio Input Connections

Audio input connections are made through four standard Cannon female receptacles marked MIC-1,2,3 and 4 at the rear of the amplifier. The mating plugs (RCA MI-4630-B or Cannon P3-CG-12S) are not furnished with the amplifier. The MIC-1 and MIC-2 receptacles are each connected to the input transformers T-1 and T-2 respectively. The MIC-3 and MIC-4 receptacles are connected through switch S-1 to input transformer T-3. Refer to figures 6 and 8. To change the wiring on the input transformers as described below, first remove the bottom and back cover assembly by loosening the eight twist-lock fasteners which hold it in place. Each fastener need only be turned  $\frac{1}{4}$  of a revolution with a coin or screwdriver.

### Connections to Balanced Source

Each of the amplifier input transformers is connected for operation from a 150-ohm balanced source. If desired, a 250-ohm balanced source may be connected to this tap.

If it is desired to use one or more 30-ohm sources, change the wiring to the taps on the primary windings of the associated input transformers as follows:

- a. Remove the black lead connected to terminal number 1 and connect it to terminal number 2.
- b. Remove the red lead connected to terminal number 4 and connect it to terminal number 3.

On all balanced inputs, connect the audio leads from the source to terminals number 2 and 3 on the input plug used and connect the shield lead to terminal number 1.

### Connections to Unbalanced Source

For connection to a 150-ohm or 250-ohm unbalanced source, first remove the jumper connecting terminal number 5 to terminal number 6 on the associated input transformers; then connect terminal number 5 to terminal number 1.

To connect a 30-ohm unbalanced source proceed as follows:

- a. Remove the jumper connecting terminal number 5 to terminal number 6 on the associated input transformers.
- b. Connect terminal number 5 to terminal number 2.
- c. Disconnect the black lead from terminal number 1 and connect it to terminal number 2.
- d. Disconnect the red lead from terminal number 4 and connect it to terminal number 3.

When connecting an unbalanced source which uses the shield as one of the audio leads, connect the shield lead

to terminal number 3 on the input plug and connect the other audio lead to terminal number 2.

For an unbalanced input having two audio leads and an electrostatic shield, connect the low side of the line to terminal number 3 on the input plug, the high side to terminal number 2, and the shield lead to terminal number 1.

### Output Connections

Remove the panel cover by pressing the two spring buttons on the sides of the amplifier. Output connections are made as follows:

- a. Connect the telephone line to the LINE binding posts.
- b. Connect the PA binding posts to the input of the public address amplifier.
- c. Connect the leads from the cue source to the CUE binding posts.

### Ground Connection

Connect the GND binding post to a suitable ground. The amplifier may be operated without an external ground when none is available, however best operation is obtained when the amplifier is grounded.

### Headphone Jacks

Headphones may be used for monitoring, however none are supplied with the amplifier. Insert the plug from the output monitoring headphones into one of the telephone-type jacks marked LINE MON (J-6 or J-7) on the right-hand side of the amplifier. Insert the plug from the cue-monitoring headphones into the jack marked CUE MON (J-5) on the same side.

### Meter Pad Connections

The meter pad R-52 and the associated meter circuit are connected so that the meter indicates 0 vu for a line level of +8 dbm or +8 vu when the meter switch is in the +8 VU position. To obtain a 0-vu indication for any other integral line level in the range of +2 to +18 dbm, it is necessary to reconnect the terminals on the meter pad for different amounts of attenuation. A convenient method of determining the amount of attenuation is as follows: The amount of attenuation in the pad is 2 db less (numerically) than the line level corresponding to 0-vu indication on the meter. For example, the pad has its 2-db and 4-db sections connected in series to give a 6-db attenuation, and thus the meter reads 0 vu for +8 dbm or +8 vu line level. The pad has sections for 1, 2, 4, 8 and 12 db of attenuation. The two terminals for each of these sections are clearly indicated by stencilled designations on the rear of the pad between each pair. If necessary to reconnect the pad, indicate in some manner near the meter-switch panel-marking the new value to be used instead of the +8 VU designation.



### A-C Power Connections

The amplifier is connected for a-c operation from a 115- to 125-volt, 50- to 60-cycle power line. For operation from a 105- to 115-volt line, it is necessary to disconnect the black/red lead from terminal number 12 of transformer T-5 and connect this lead to terminal number 11 of T-5.

The a-c power cord is clamped to the inside of the front panel cover for convenience in transporting. Remove this cord from beneath the clamps and insert the 12-terminal plug on one end of the cord into the receptacle on the rear of the amplifier. Insert the two-prong plug on the other end of the cord into a suitable a-c outlet.

### Tubes

Loosen the four twist-lock fasteners on the top cover and remove this cover. Markings on the chassis indicate the correct tube type for each socket. Place the tubes in the sockets. Place the grid caps and grid-cap shields on all of the amplifying tubes. Each shield must make a good electrical connection to the shell of the tube for noise-free operation.

### Battery Connections

Six RCA Type VS012 "B" Batteries or equivalent, and 10 RCA Type VS004 "A" Batteries or equivalent may be used to supply the d-c power requirements listed under *Technical Data*. A kit of the above listed batteries may be ordered as MI-11255. The use of 15 "A" batteries will increase the battery life. The MI-11214 Battery Box may be used with the Type BN-2A Amplifier. The battery box contains space for 15 "A" batteries and 6 "B" batteries of the types listed above.

The MI-11214 Battery Box is wired with plugs ready to be inserted into the batteries and is supplied with a power cord for direct connection to the receptacle on the amplifier. The battery connector plug is wired as shown in the lower-left corner of the schematic diagram, figure 8.

The expected battery life for an average amplifier operation of six hours per day is as per the table below. If the amplifier is used less than six hours per day, the expected life of the battery in hours will be increased. If the amplifier is to be used continuously the life of the battery will be materially decreased.

EXPECTED LIFE IN HOURS (APPROXIMATE)

Quantity	"A" or "B"	Type	Life in Hours
15	A	VS004	8.5
10	A	VS004	4
6	B	VS012	125

NOTE: For maximum battery life remove all battery plugs when the battery supply is not to be used for 24 hours or more.

## OPERATION

Set the LIGHT switch for the desired meter illumination (LO or HI). (The meter lamps also serve as power-on-off indicators.) Set this switch in "LO" position when using batteries to reduce drain on the batteries. Turn the POWER switch ON and allow about 30 seconds for tube warm-up. Before broadcasting has begun, turn all volume controls to maximum and check carefully for extraneous noises in the output which may be due to faulty location of the microphones and cables. When using the MIC-3 or MIC-4 input, set the MIC switch to the corresponding number. Rotate the METER switch to the "+8 VU" position. Output level to the telephone line should be +8 vu. Adjust the gain controls so that the peaks of modulation swing the needle of the meter to zero on the upper scale (for an average line level of +8 vu). This zero reading will represent a different line level if the connections to the meter pad have been changed as indicated under *Installation*. For the best signal-to-noise ratio the MASTER gain control should be set at a fixed position somewhere between number 10 and number 16 and the mixer controls (MIC 1, 2, 3 & 4) should be adjusted for the zero reading on the meter. This arrangement permits varying the mixers from number 0 to number 16 without adding more than 2 db to the noise level of the amplifier. The MASTER and MIC controls also control the level at the output-monitoring jacks.

### Switching to Telephone Line

To switch the output of the amplifier into the telephone line, turn the AMP OUTPUT control to LINE. To switch the output of the amplifier off the telephone line, turn the AMP OUTPUT control to OFF.

### Switching to PA Amplifier

To switch the output of the amplifier into the input of a connected public address amplifier, turn the PA INPUT switch to AMP. To switch the input at the CUE terminals to the input of the public address amplifier, set the PA INPUT switch to CUE. Adjust the PA VOLUME control for the desired output from the public address system. To switch both amplifier and cue inputs off the public address amplifier, turn the PA INPUT switch to OFF.

## SERVICE

### Tube Checking with VU Meter

To check the tubes, rotate the METER control through positions 1 through 6 and observe the VU meter at each step. These meter positions check V-1 through



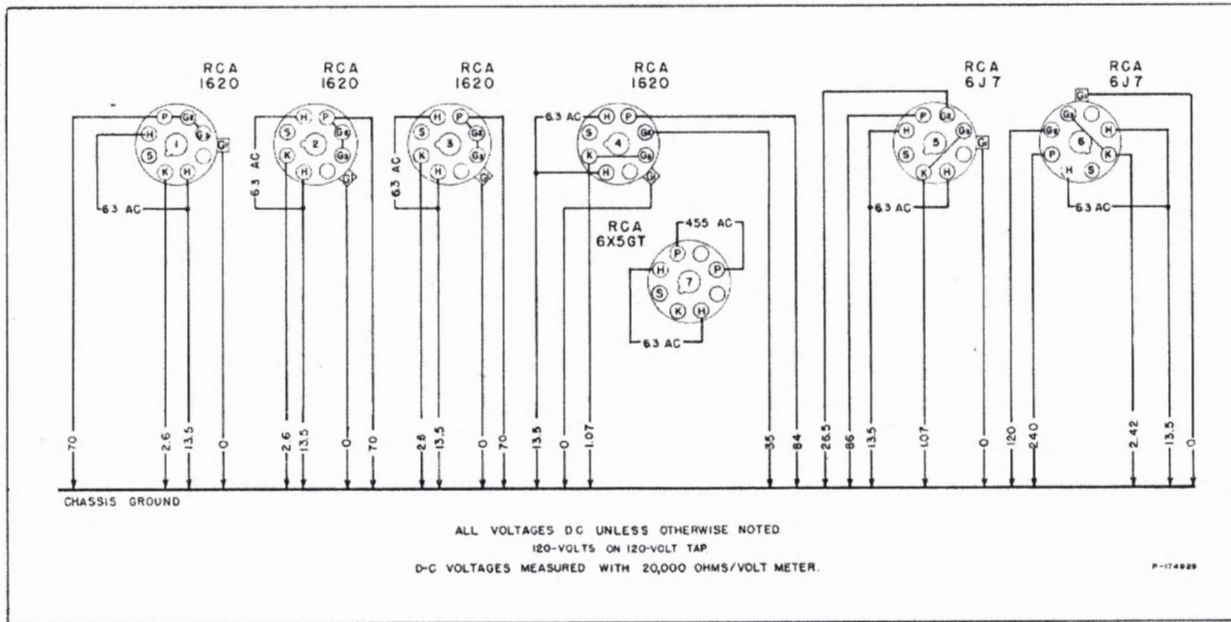


Figure 5—Tube socket voltages

V-6 respectively (fig. 8). The meter readings are each an indication of the emission of the tubes. The normal meter reading for each tube should be  $0 \pm 2$  (on VU scale). Note that two spare tube sockets are provided on the bottom side of the top cover for carrying spare tubes.

#### Cleaning Volume Controls

Remove the bottom and rear cover assembly of the amplifier. Press the spring fasteners on the rear covers of the volume controls and remove the covers. Apply Davenoil, which is furnished with the amplifier, to the contacts, and rotate the knobs. If any dark streaks appear, wipe off the contacts. Repeat this procedure until the contacts are clean, and then apply a thin film of Davenoil for lubrication. The Davenoil is provided for cleaning and lubricating the volume controls and no other cleaning agent should be used.

#### Operating Voltages

Refer to figure 5 for the tube operating voltages. The voltages listed are approximate, but readings should not vary more than about 20% of the values given. If

the voltmeter used has a meter resistance of less than 20,000 ohms-per-volt, most readings taken will vary accordingly, the amount of variation depending upon the circuit across which the meter is connected.

#### Fuse Replacement

When replacing a fuse, make sure that the replacement fuse is of the same type and rating (1 ampere) as the one furnished with the amplifier. To use a fuse of higher rating for replacement purposes will needlessly endanger the windings of the power transformer. Note that a spare fuse mounting is provided on the bottom side of the top cover for carrying a spare fuse.

#### Replacement Parts

The following parts list is included to provide identification when ordering replacement parts. Order from *RCA Replacement Parts Department, Camden, New Jersey*, giving the *Stock Number* and *Description* of the parts wanted. Replacement parts supplied may be slightly different in form or size from the original parts but will be completely interchangeable with them.

### LIST OF PARTS

Symbol No.	Description	Stock No.
C-1	Capacitor, elec, 3 sections: "A" 40 mf - 25 v, "B" & "C" 15 mf - 450 v	34150

Symbol No.	Description	Stock No.
C-2,3	Capacitor, oil filled, 0.25 mf $\pm 10\%$ , 400 v	55811
C-4	Same as C-1	



## LIST OF PARTS (Continued)

Symbol No.	Description	Stock No.
C-5	Same as C-2	
C-6,7	Same as C-1	
C-8	Capacitor, oil filled, 0.5 mf ±20%, 400 v	55812
C-9	Capacitor, paper, oil impreg- nated, 0.05 mf ±10%, 600 v	55813
C-10	Capacitor, mica, 2500 mmf C-16 ±10%, 500 v SAME AS	40122
C-11	Capacitor, oil filled, 0.05 mf ±10%, 400 v	55814
C-12	Same as C-2	
C-13	Same as C-9	
C-14	Same as C-2	
C-15	Capacitor, paper, oil impreg- nated, 0.5 mf ±10%, 400 v	55815
C-16,17	Capacitor, molded, paper, 0.0015 mf, 600 v	55816
C-18	Capacitor, metalized paper, 0.25 mf, 200 v	55817
C-19,20	Capacitor, elec, 40 mf, 450 v	37308
C-21,22	Same as C-16	
F-1	Fuse, 1 amp	14133
J-1,2,3,4	Connector, female, 3 contacts, chassis mounting	25598
J-5,6,7	Jack, open circuit phone jack	43921
M-1	Meter, VU volume level indi- cator, illuminated, scale "A" calibrated for .047" steel panel, panel angle 10 de- grees, black	55818
P-1	Connector, male, 12 contacts	19679
R-1	Resistor, comp, 1800 ohms ±5%, 1 w	
R-2	Resistor, comp, 680 ohms ±5%, 1 w	
R-3	Resistor, comp, 100,000 ohms ±10%, 1 w	
R-4	Resistor, comp, 27,000 ohms ±10%, 1 w	
R-5	Resistor, attenuator, carbon, 20 steps of 2 db each to infinity, 100,000 ohms	55819
R-6	Resistor, comp, 220,000 ohms ±10%, 1 w	
R-7	Same as R-1	
R-8	Same as R-2	
R-9	Same as R-3	
R-10	Same as R-4	
R-11	Same as R-5	
R-12	Same as R-6	
R-13	Same as R-1	
R-14	Same as R-2	
R-15	Same as R-3	
R-16	Same as R-4	
R-17	Same as R-5	
R-18	Same as R-6	

Symbol No.	Description	Stock No.
R-19	Resistor, comp, 1.2 meg ±10%, 1 w	
R-20	Resistor, comp, 1100 ohms ±5%, 1 w	
R-21	Resistor, comp, 56,000 ohms ±10%, 1 w	
R-22	Same as R-19	
R-23	Same as R-6	
R-24	Resistor, comp, 3300 ohms ±5%, 1 w	
R-25	Resistor, comp, 2700 ohms ±5%, 1 w	
R-26	Resistor, comp, 2.7 meg ±10%, 1 w	
R-27	Resistor, comp, 470,000 ohms ±10%, 1 w	
R-28	Resistor, comp, 560,000 ohms ±5%, 1 w	
R-29	Resistor, comp, 12,000 ohms ±10%, 1 w	
R-30	Resistor, comp, 1 meg ±10%, 1 w	
R-31	Resistor, comp, 130 ohms ±5%, 1 w	
R-32	Resistor, comp, 360 ohms ±5%, 1 w	
R-33	Resistor, comp, 120,000 ohms ±5%, 1 w	
R-34,35	Resistor, comp, 4700 ohms ±10%, 1 w	
R-36	Resistor, variable, dual, 300 ohms per section ±20%, shaft .249" diam x 3/4" in- cluding 1/4" bushing flat 1/8" body 1 1/8" diam x 1 1/8"	54667
R-37	Resistor, attenuator, ladder pad	43115
R-38,39	Same as R-34	
R-40	Resistor, comp, 560 ohms ±10%, 1 w	
R-41,42	Resistor, comp, 2200 ohms ±10%, 1 w	
R-43,44	Resistor, comp, 39 ohms ±10%, 1 w	
R-45	Same as R-25	
R-46,47	Same as R-43	
R-48	Same as R-40	
R-49	Resistor, comp, 3900 ohms ±10%, 1 w	
R-50	Same as R-27	
R-51	Resistor, comp, 22,000 ohms ±10%, 1 w	
R-52	Resistor, attenuator, multiple pad, impedance 7100/3900 ohms, maximum attenua- tion 27 db	19328



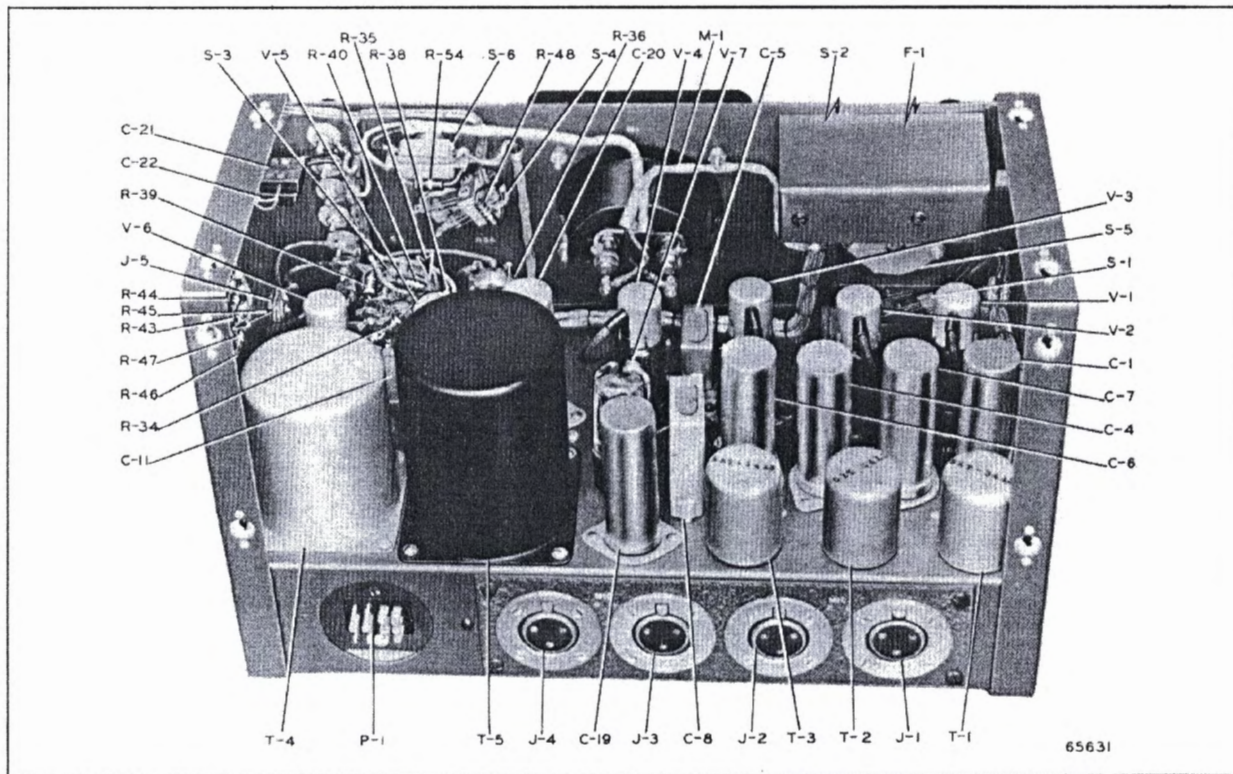


Figure 6—Location of parts, rear view

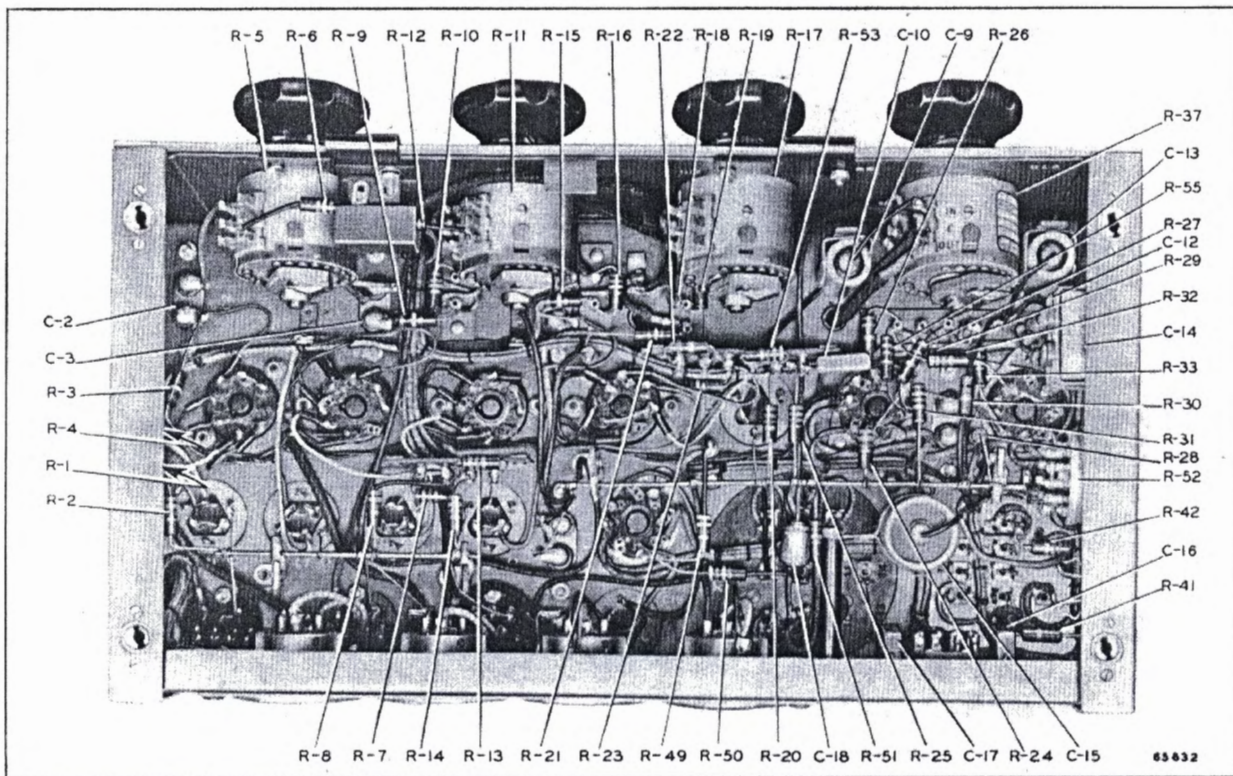
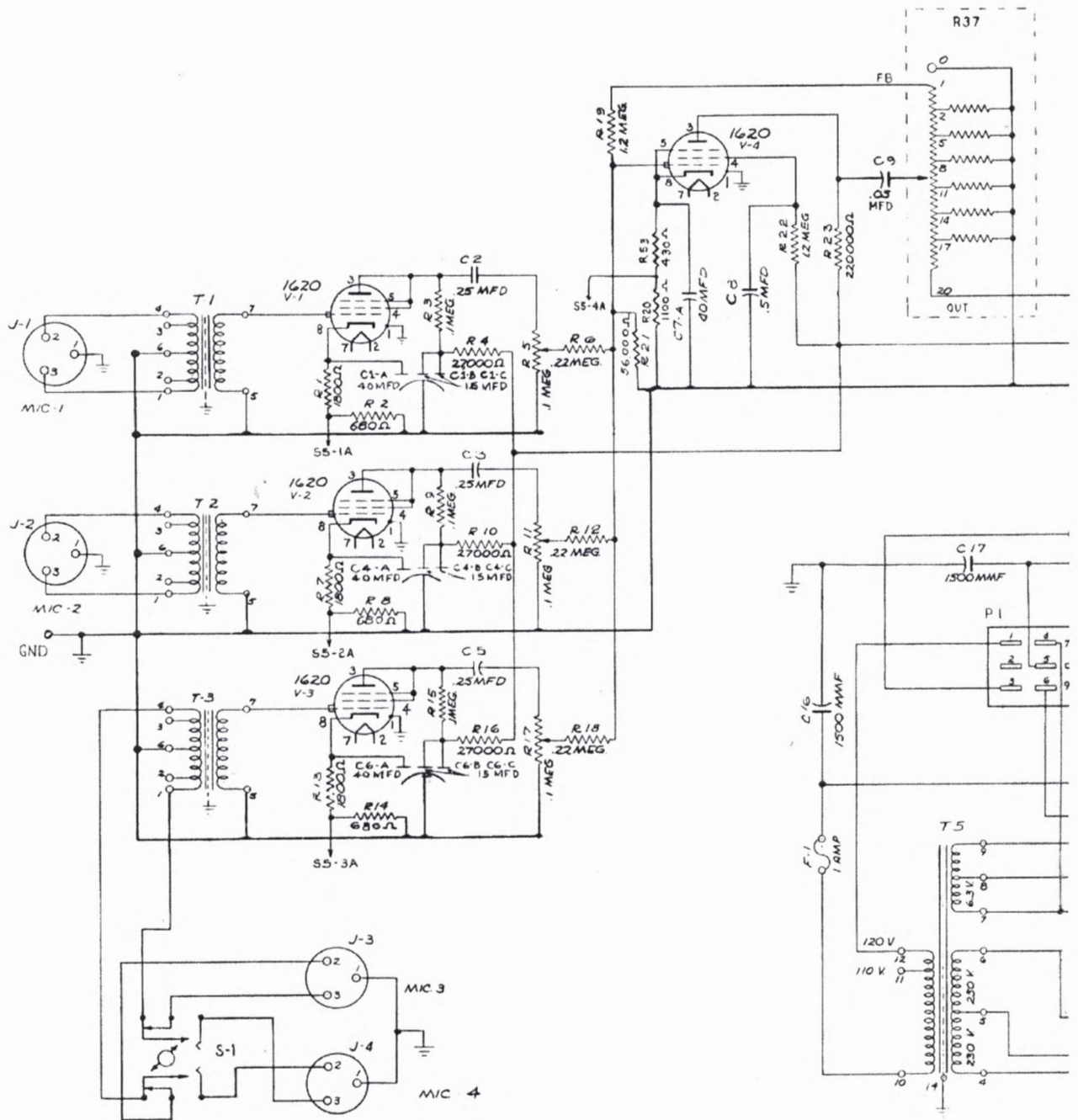


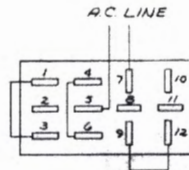
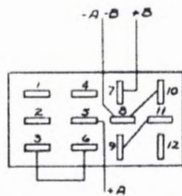
Figure 7—Location of parts, bottom view with attenuator caps removed





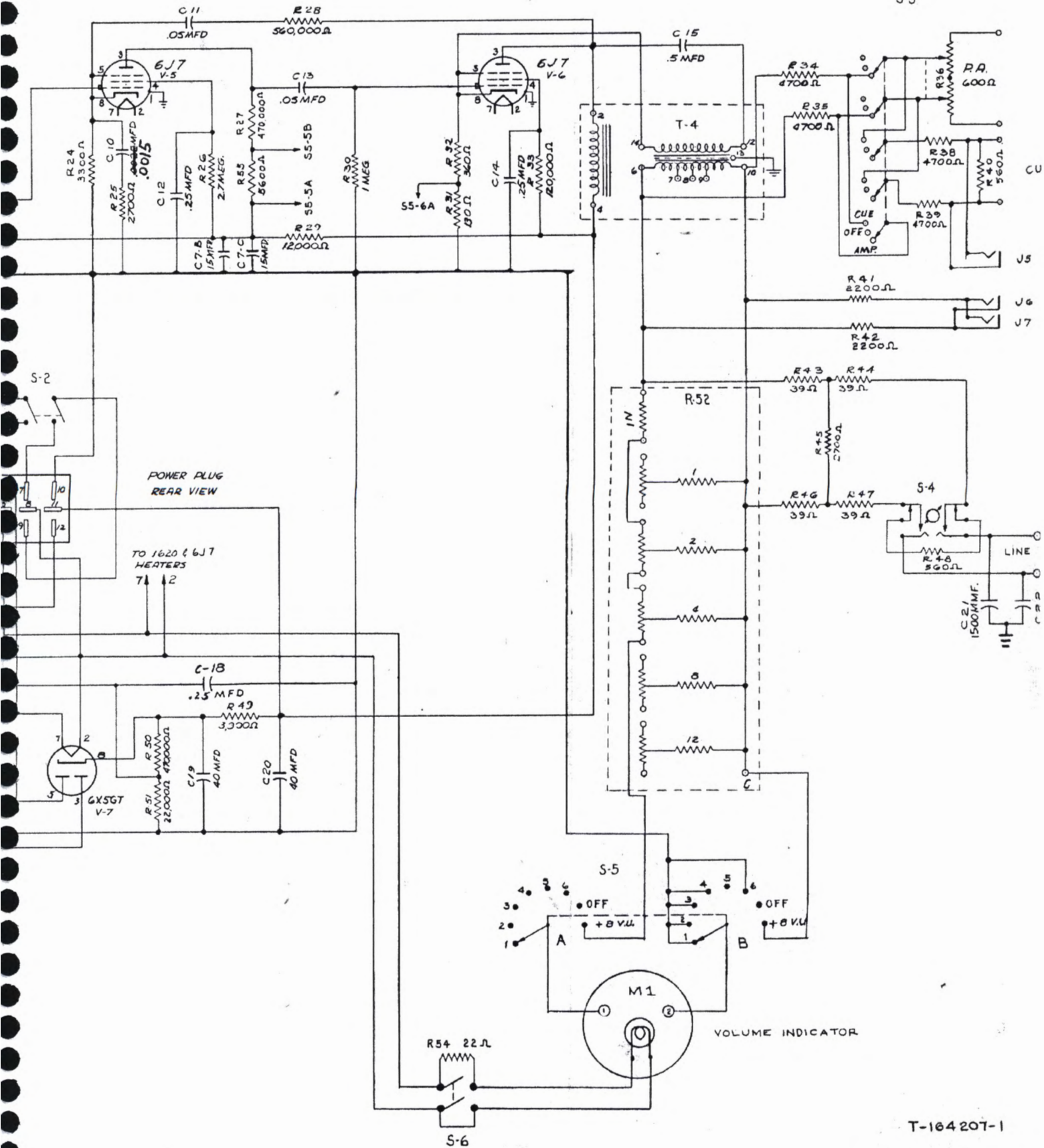
BATTERY CONNECTOR

A.C. CONNECTOR



FRONT VIEWS





T-164 207-1

Figure 8—Schematic diag



## LIST OF PARTS (Continued)

Symbol No.	Description	Stock No.
R-53	Resistor, comp, 430 ohms ±5%, 1 w	
R-54	Resistor, comp, 22 ohms ±10%, 1 w	
R-55	Resistor, comp, 5600 ohms ±5%, 1 w	
S-1	Switch, rotary, DPDT, locking	55820
S-2	Switch, toggle, DPST, rated 2 amp, 250 v	43281
S-3	Switch, rotary, 2 section, 3 position	55821
S-4	Same as S-1	
S-5	Switch, rotary, 2 section, 8 position	55822
S-6	Same as S-2	

Symbol No.	Description	Stock No.
T-1,2,3	Transformer, input, ratio full pri to sec 1:18.2, pri taps to sec 1:40.8	55823
T-4	Pack, comprising output trans- former ratio pri to sec 7-9 17.85:1, and reactor 200 h	55824
T-5	Transformer, power, pri 60 cyc 120/110 v, plate 230-0- 230 v .014 amp, filament 6.3 v, center tap, 2.7 amp	55834
X-1,2,3,4	Socket, tube, 8 contacts	28413
X-5,6,7	Socket, tube, 8 contacts	31319
X-8	Holder, fuse	48894
	Catch, front cover	28687
	Knob, for S-1,3,4,5 and R-36	30075
	Knob, for R-5,11,17 and 37	17269
	Mounting, fuse mounting clip	13526





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