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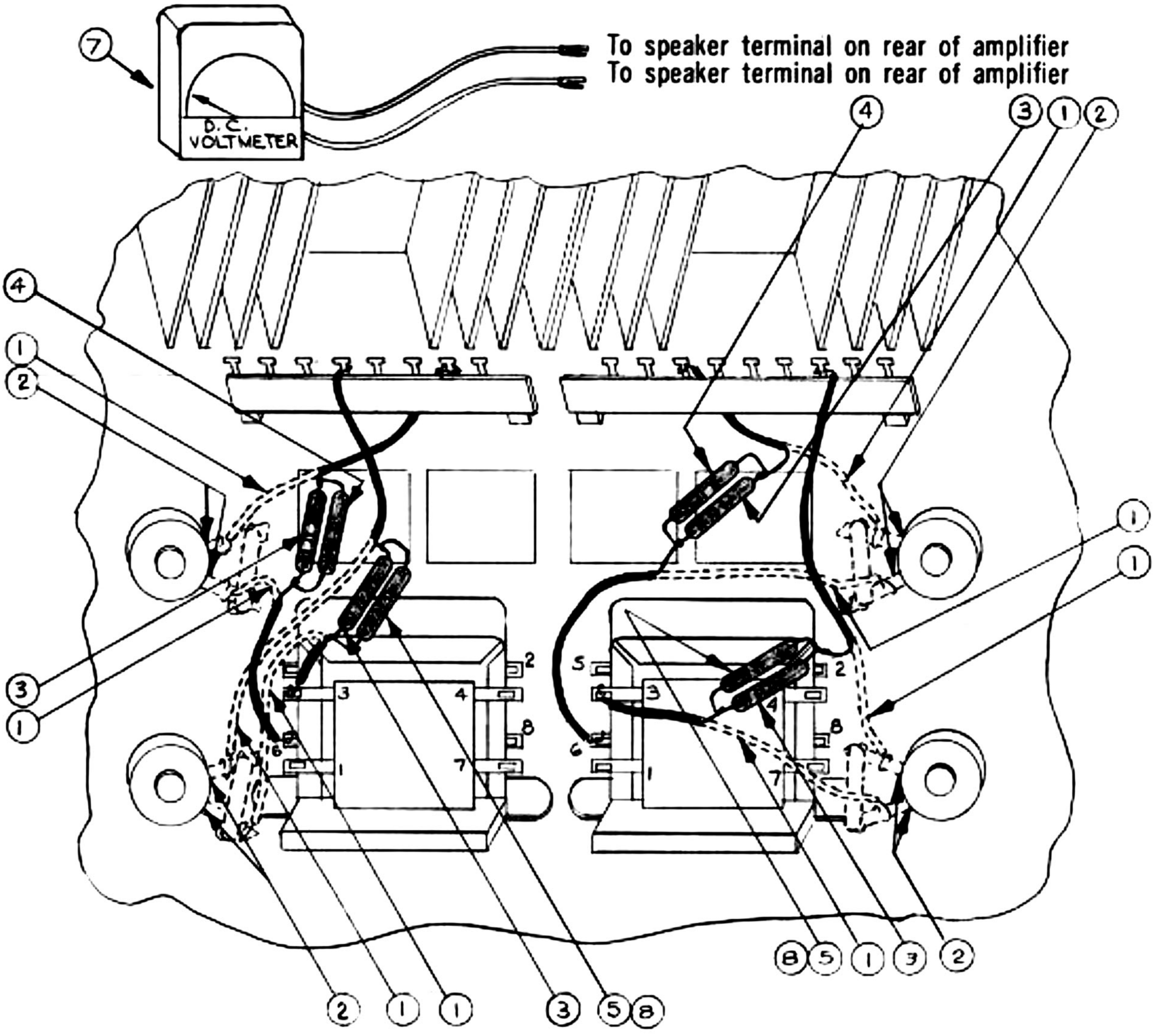
SERVICE BULLETIN:

REPLACING BIAS POTENTIOMETERS IN AR AMPLIFIER AND RECEIVER

A troublesome area in the AR amplifier and first production receivers has been the bias pots. A malfunction can lead to overheating of the output stages. Acoustic Research has developed a circuit modification that replaces the bias pot with a fixed resistance value. The actual resistance required will vary slightly from unit to unit but can easily be determined by the method described below. All amplifiers (and receivers) in production are being modified to eliminate the bias pots. This service bulletin describes how units in the field can be altered. AR recommends that any amplifier brought in for service should have this modification *even if the bias pots are functioning normally.*

Only amplifiers with serial numbers below 15,800, and receivers with serial numbers below 475, need to be modified. Units with serial numbers above these have fixed bias installed at the factory.

AMPLIFIERS SERIAL NO'S BELOW 8,760



1 Remove dotted section of wire from each bias pot (8 places).

2 Clip terminals off the bias pots (8 places).

3 Solder a 13 ohm 5% ½ watt resistor to solid wires between terminal strip and driver transformer (4 places).

4 Solder **one** correct parallel resistor* across **one** 13 ohm resistor in each channel.

5 Tightly wrap **one** correct parallel resistor across the **other** 13 ohm resistor in each channel **but do not solder.**

6 Turn the unit on with all controls set for normal stereo operation in the tuner position. Turn volume control all the way down and load the unit with 4 ohms.

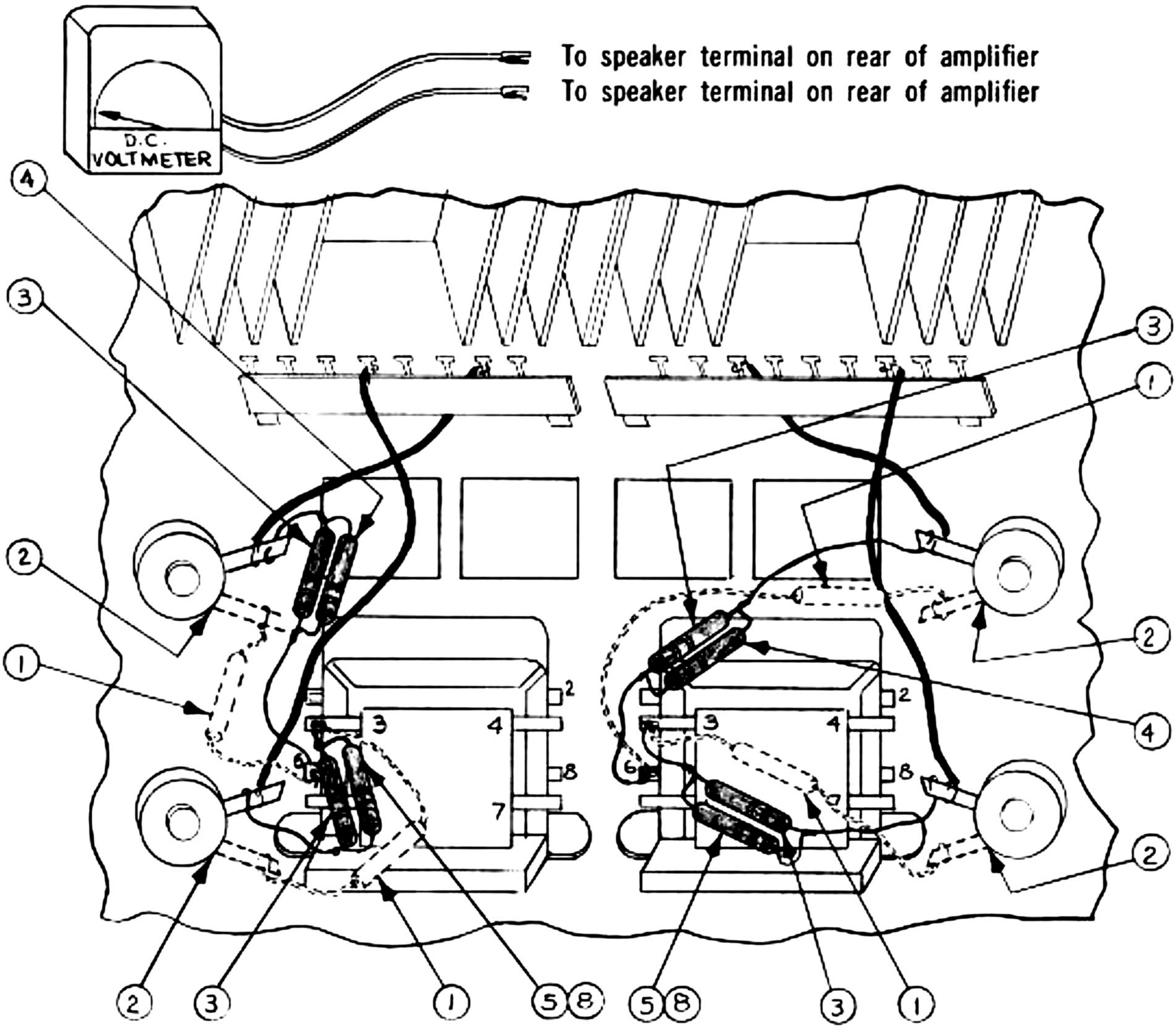
7 Use an accurate D.C. voltmeter with a full scale sensitivity of around 1 volt. Measure the D.C. leakage at the speaker terminals. If voltage exceeds ±250 MV in either channel — raise or lower (in small steps) the size of **5** parallel resistor in the affected channel until the D.C. leakage is very close to zero.

8 Solder the **5** resistors in each channel. Cover all four pairs of resistors with electrical tape (if necessary).

*Remove driver transistor cover (bottom of amplifier) and note color coding of drivers. For correct parallel resistor, see chart below.

DRIVER COLOR CODE	CORRECT PARALLEL RESISTOR
YELLOW	51 OHM 5% ½ WATT
GREEN	43 OHM 5% ½ WATT
BLUE	36 OHM 5% ½ WATT
VIOLET	33 OHM 5% ½ WATT
BLACK	22 OHM 5% ½ WATT

AMPLIFIERS SERIAL NO'S BETWEEN 8,760 AND 15,800



1 Remove the 9.1 ohm resistor between the driver transformer and the 5 ohm bias pot (the 9.1 ohm resistor is shown dotted) 4 places.

2 Clip the empty terminal (shown dotted) off the bias pot (4 places). Leave the other terminal (with green or/and brown wires) connected as is. 4 places.

3 Solder a 13 ohm 5% ½ watt resistor between the point on the driver transformer (formerly occupied by the 9.1 ohm resistor) and the remaining terminal on the 5 ohm bias pot. 4 places.

4 Solder **one** correct parallel resistor across **one** 13 ohm resistor in each channel.

5 Tightly wrap **one** correct parallel resistor* across the **other** 13 ohm resistor in each channel **but do not solder.**

6 Turn the unit on with all controls set for normal stereo operation in the tuner position. Turn volume control all the way down and load the unit with 4 ohms.

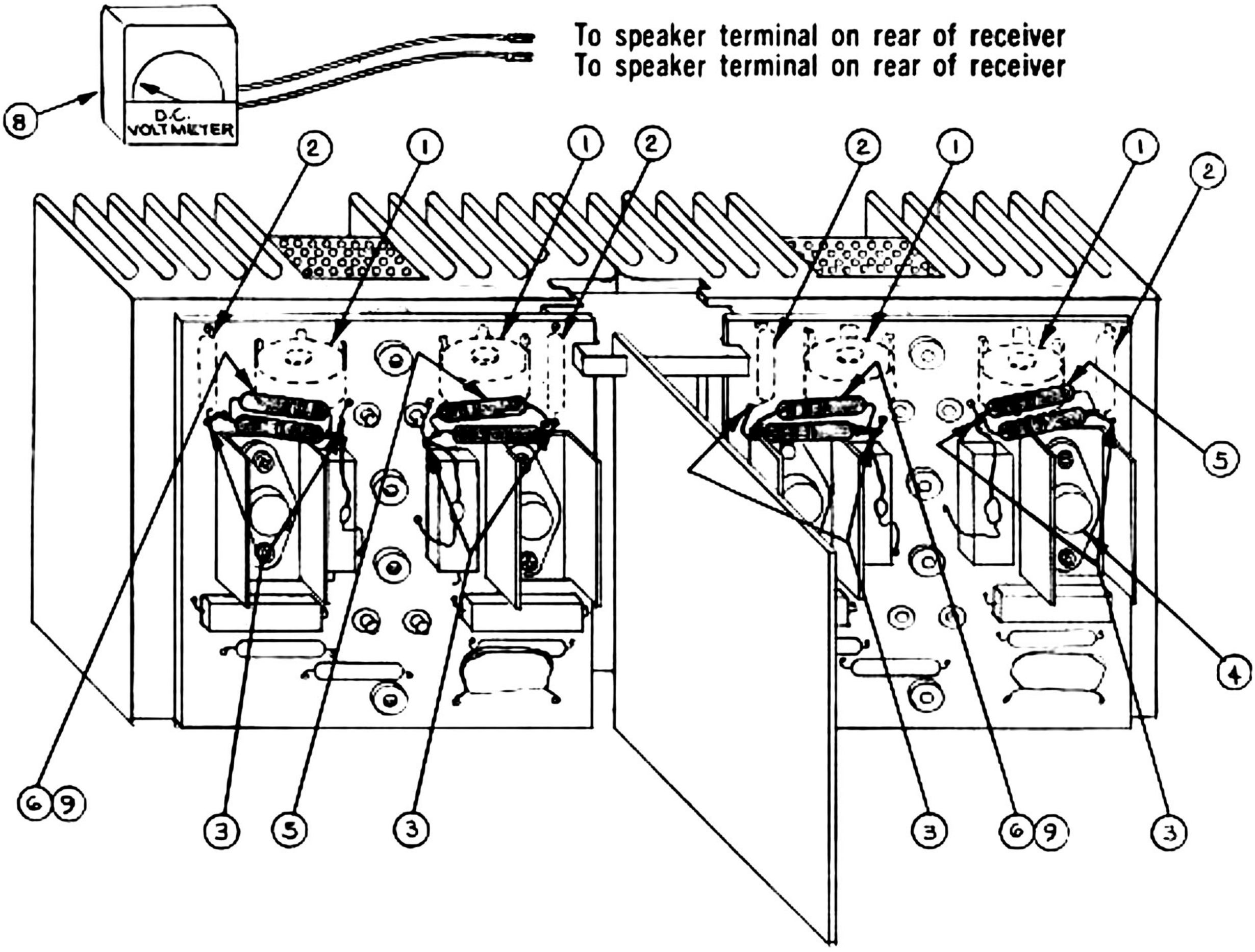
7 Use an accurate D.C. voltmeter with a full scale sensitivity of around 1 volt. Measure the D.C. leakage at the speaker terminals. If voltage exceeds ±250 MV in either channel — raise or lower (in small steps) the size of **5** parallel resistor in the affected channel until the D.C. leakage is very close to zero.

8 Solder the **5** resistors in each channel. Cover all four pairs of resistors with electrical tape (if necessary).

*Remove driver transistor cover (bottom of amplifier) and note color coding of drivers. For correct parallel resistor, see chart below.

DRIVER COLOR CODE	CORRECT PARALLEL RESISTOR
YELLOW	51 OHM 5% ½ WATT
GREEN	43 OHM 5% ½ WATT
BLUE	36 OHM 5% ½ WATT
VIOLET	33 OHM 5% ½ WATT
BLACK	22 OHM 5% ½ WATT

RECEIVERS SERIAL NO'S BELOW 475



1 Remove both 5 ohm bias pots (shown dotted) from each driver board (4 places)

2 Remove both 9.1 ohm resistors (shown dotted) from each driver board (4 places)

3 Insert a 13 ohm, 5%, ½ watt resistor into the hole formerly occupied by the bottom lead of the 9.1 ohm resistor, (resistor to stand off board about ¼") solder. Connect the other lead of 13 ohm resistor directly to the top lead (anode) of the temperature compensating diode attached to the .33 ohm, 5 watt resistor (4 places)

4 Note the color code of the driver transistors.

5 Solder one correct parallel resistor* across one 13 ohm resistor in each channel.

6 Tightly wrap one correct parallel resistor across the other 13 ohm resistor in each channel but do not solder.

7 Turn the unit on with all controls set for normal stereo operation. Turn volume control all the way down and load the unit with 4 ohms. Place the selector switch in the "special" position (be certain that the "speaker" and "tape" switch are in "normal" position).

8 Use an accurate D.C. voltmeter with a full scale sensitivity of around 1 volt. Measure the D.C. leakage at the speaker terminals. If voltage exceeds ±250 MV in either channel, raise or lower (in small steps) the size of 6 parallel resistors in the affected channel until the D.C. leakage is very close to zero.

9 Solder the 6 resistors in each channel. Cover all four pairs of resistors with electrical tape (if necessary).

*DRIVER COLOR CODE	CORRECT PARALLEL RESISTOR
YELLOW	51 OHM 5% ½ WATT
GREEN	43 OHM 5% ½ WATT
BLUE	36 OHM 5% ½ WATT
VIOLET	33 OHM 5% ½ WATT
BLACK	22 OHM 5% ½ WATT

B. Biasing Procedure

The quiescent collector currents in the output transistors Q23 and Q25 are determined by the voltage dividers R87/R91 and R83/R89. The 13 ohm portions of these dividers are shunted by fixed resistors whose values are selected so that the amplifier has low IM distortion and reasonable operating temperature. If the amplifier has pots in place of these 13 ohm resistors, update the amp following instructions in Part I.C.2.

1. Initial Adjustment

Make sure that the diodes D1 and D3 are secured to the 0.33 ohm power resistors R97 and R99. If loose, the bias will drift, causing thermal runaway. Check the silicone grease on the driver and output transistors for a thin, even coat on both sides of the mica or anodized aluminum insulators. Also check the mounting screws for tightness. Tack-solder four 0.5 watt resistors across the four 13 ohm resistors. These can be any value between 33 and 51 ohms, but should be the same value within a channel. These resistors, as well as the 13 ohm ones, should be carbon or metal film types for temperature stability. However, common carbon composition types can be used. AR used Corning glass-coated metal film resistors in production.

The initial DC offset adjustment requires the use of an audio test rack, which has switches to disconnect the dummy loads while retaining all other test equipment connections. Also it should have a left-right monitor switch which feeds the equipment. Either a DC-coupled oscilloscope or sensitive DC voltmeter is required for this test, having a 250 mV full-scale range or less. A zero-center type is most convenient.

Connect the amp to the rack, leaving the loads off. Turn the amp on, keeping the volume fully down. Touch the leads of a 150 to 200 ohm resistor across each of the four parallel resistor combinations and note which ones thus shunted tend to reduce the offset in each channel. Turn the amp off. Replace the 33 to 51 ohm shunt resistors, noted above (one in each channel), with one or two values smaller. For example, if a 47 ohm resistor was initially chosen, replace it with a 43 or 39 ohm resistor. Another way to reduce the offset is to <u>increase</u> the <u>other</u> shunt resistor. Turn the amp on and recheck the offset. If it is 100 mV DC or less, proceed with distortion measurements.

2. Distortion Measurements

Having achieved DC offsets of less than 100 mV DC in both channels, connect resistive dummy loads of 4 ohm, 100 watts. Note that the offset decreases considerably; this is normal. If a voltmeter was used to measure offset, disconnect it or it will be damaged in the following test. Replace the standard AGC-3 speaker fuses with 4-amp slowblow fuses. Connect a SMPTE-type IM distortion analyzer across the dummy loads and to the amplifier's tuner input jacks. Turn the volume control to the 3 o'clock position, and increase the IM analyzer's generator output until the output is just below clipping. The IM distortion must be 0.25% or less. Reduce the amplifier's volume until 3 V RMS output is obtained. The IM distortion must be 0.25% or less at this level also.

With the simple output stage circuitry, there is a tradeoff between distortion and quiescent current. As the adjustable shunt resistors R81 and R85 are made smaller, the quiescent current (and therefore the temperature) in the output transistors is decreased, but the crossover-notch distortion increases. This affects the IM distortion, especially at low levels. If the resistors are increased, the distortion decreases, but the temperature increases.

It has been determined from production experience that the shunt resistors should be between 30 and 62 ohms, if R89 and R91 are 13 ohms. Some amplifiers were built with 12 ohm resistors, and for these the suggested shunt range is 36 to 82 ohms.

After the amp has achieved the IM distortion specification, recheck the DC offset with dummy loads disconnected. This will drift somewhat with temperature, but the final shunt adjustment should be made when the heat sinks are moderately warm, not hot. The harmonic distortion must be 0.5% or less at clipping and at 3 V RMS output, but typically will be 0.1%. Both IM and THD will be somewhat lower with 8 and 16 ohm loads. Return the standard AGC-3 fuses to the speaker fuseholders.

C. Modifications and Updates

1. +20 Volt Regulator

Early production amplifiers used S2108 (2N3567) transistors for Q28 and these often failed. Replace it with RCA #40311, a metal TO-5 style. Also change collector resistor R113 to 270 ohm, 1 watt; and zener series resistor R114 to 820 ohm, 0.5 watt.

2. Biasing Update

Early production amps and receivers used carbon pots to adjust the bias. These became intermittent with use and also had a considerable temperature coefficient. Two circuits were employed: a 50 ohm pot across a 33 ohm resistor, and a 5 ohm pot with a 9.1 ohm series resistor.

For more stable bias, update the circuit as follows:

- Using a 1/8" to 1/4" drill, remove the rivets which fasten the pots, working inside the chassis. Shake out any metal particles which remain inside; these could cause short circuits. Clip the leads connected to the pots, leaving as much wire remaining in the amp as possible. Discard the pots.

- Install four terminal strips on the chassis, using any of the rivet holes which allow the clipped leads to reach the terminal strip lugs. Each strip should have two lugs insulated from the mounting foot. Connect one 12 or 13 ohm, 1/2 watt resistor to each strip, leaving room for the shunt resistors which will be connected later.

- To update a receiver, remove the bias pots from the power amp boards. If one is careful this can be done without removing the boards from the heat sinks. Install jumper wires and 12 or 13 ohm, 1/2 watt resistors, as shown in Figure 11.

3. +39 Volt Lead Dress

To prevent buzz in the output, especially with low AC line voltages, change the +39 V wiring to the driver/output stages. The red wire from C50 (5,000 μF), goes to terminal #7 (below terminal #4) of the left-channel driver transformer T3. It then goes to the collector of Q19, then to the collector of Q20, and finally to terminal #7 of the right-channel driver transformer T2. T3 and Q19 are closest to the power transformer. The #7 terminals serve only to support R87 and R88, the 1k resistors in the bias divider, but do not connect internally to the transformer windings.