HUGO GERNSBACK, *Editor*

RADIO CRAFT

RADIO — ELECTRONICS

ELECTRONIC KISSMETER

SEE ELECTRONICS SECTION

SEPT
1948

30¢
U. S. and

RADIO-ELECTRONICS IN ALL ITS PHASES

Three Bug-Free Amplifiers

The author presents circuits and data for three straightforward amplifiers

By JOHN W. STRAEDE*

IN this article descriptions of three straightforward bug-free amplifiers are given. Their circuits are comparatively simple and do not include unnecessary parts. They deliver 9, 13 and 20 watts respectively.

The tubes used in the amplifier of Figs. 1 and 2 are a couple of voltage-amplifying pentodes in cascade followed by a 6L6-G developing 9 watts. The rectifier is either a 5Y3-G or 5V4-G depending upon the voltage of the transformer secondary. If the high-voltage winding gives about 375 volts per side a 5Y3-G (or an 80) can be used. If the voltage is lower, around 300 per side, the more efficient 5V4-G must be used to provide a sufficiently high d.c. output. As an alternative to the 5V4-G, a metal 5Z4 can be employed.

Parallel mixers are used with 270,000-ohm isolating resistors between the volume controls and the control grid of the second tube.

Unusual points in the circuit are the use of grid leak bias on the first 6J7, lack of a filter choke, use of a volume-expander lamp and a lamp as fuse.

Advantages of grid leak bias are the saving of a cathode resistor and a by-pass condenser and lower hum level (because cathode is grounded.)

No filter choke is necessary for ordinary PA use, because a beam tetrode or pentode output valve has a high plate resistance and the plate current is almost entirely unaffected by changes in plate voltage.

The pilot lamp connected across the voice coil winding of the speaker transformer gives a small amount of automatic volume expansion but its real use is to act as an output-level indicator.

Another 6-volt 0.3-amp lamp is connected in the negative side of the high-voltage supply to prevent damage to the power transformer if an electrolytic condenser should break down. The pilot light may have to be omitted if a 5V4-G or other low-impedance rectifier is used, because switching the set on and off when hot may cause the lamp to blow out.

One feature not at first noticeable is the way in which the circuit is designed to give a good frequency response. Although there are small plate bypass condensers to remove any r.f. that may be picked up, the plate load resistors are smaller than usual, resulting in an excellent high-frequency response. Bass response is also good because the decoupling network for the 6L6-G bias supply acts to a certain extent as a bass-booster.

A conventional high-cut tone control is connected between the plate of the second tube and ground.

A 47,000-ohm suppressor resistor is connected directly in series with the 6L6-G control grid to make the sound more tolerable when momentary overloads occur.

To eliminate the bass boost, reduce C to .01-μf and increase the suppressor resistor R to 270,000 ohms.

The sixth pin of each tube socket (except the rectifier) is used as a tie point. It is definitely not advisable to have parts rigidly mounted—a little slack in the wiring gives elasticity and minimizes the chances for resistors and condensers to break down.

Six tubes, thirteen watts

The second amplifier (Figs. 3 and 4) is quite orthodox, bearing some similarity to the smaller job in the use of shorting jacks, high-cut tone control and lack of a filter choke.

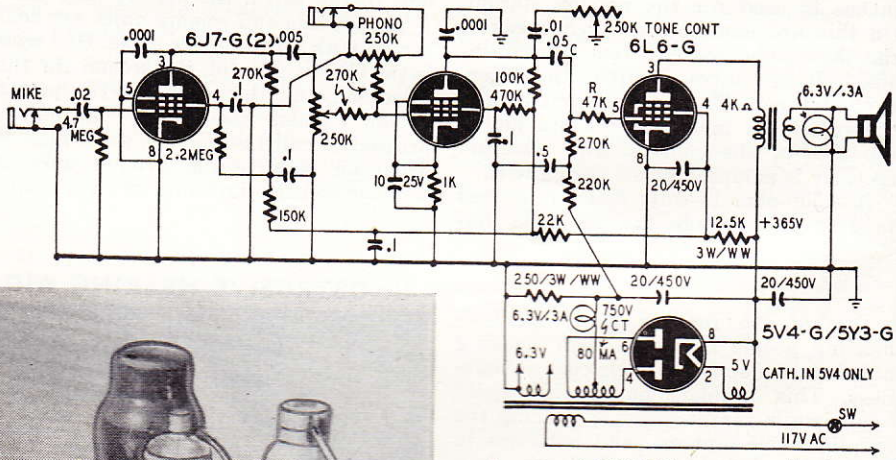
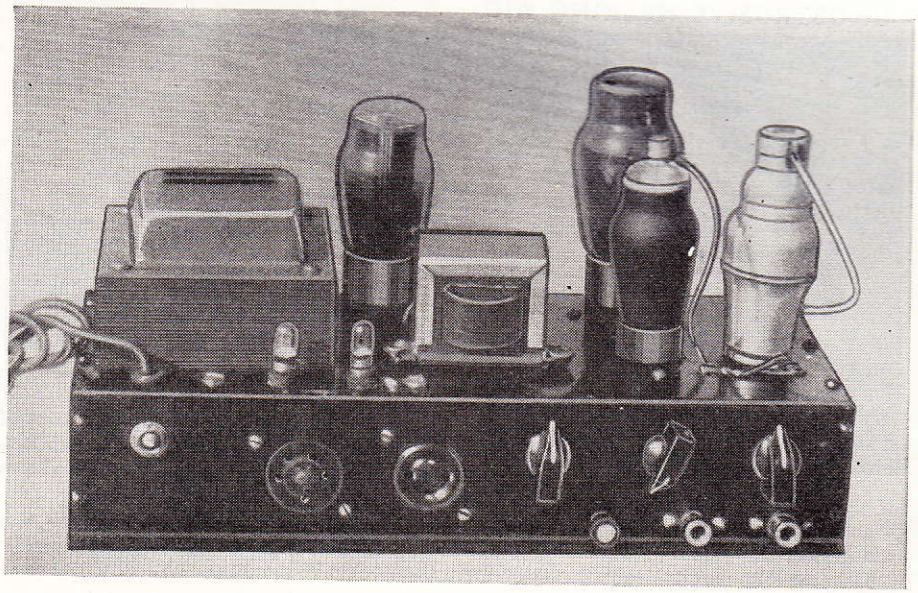


Fig. 1 (right)—Schematic of the 9-watt unit.
Fig. 2 (below)—Sockets are for speaker plugs.



A pair of 6V6-G beam tetrodes is used in class AB1. The operating conditions are such as to provide negative regulation (the total current drawn decreases at full volume).

Floating paraphase phase inversion is used—a system which gives an automatic near-balance. This system cannot give perfect balance, for if each 6V6-G grid had an equal signal, there would be no signal to drive the phase-inverter grid.

The common cathode resistor helps to bring the system nearer to perfect balance—these resistors have such an effect that if the 150,000-ohm resistor is shorted the drop in volume is negligible.

*Lecturer in electronics and electro-acoustics, Melbourne Technical College, Australia.

A 20 percent change in value has no perceptible effect. Most critical value is that of the 6,500-ohm dropping resistor for the 6V6-G screens. If no wire-wound resistor is available three 20,000-ohm, 1-watt carbon resistors can be connected in parallel.

Although a 3.9-megohm resistor is shown as an inverse feedback device, this is seldom used, as the presence of inverse feedback is apt to cause a rise in hum level when the output tubes do not have a well-filtered supply. (Feedback from the voice coil is less likely to produce a higher hum level but it is not easily applied in this circuit).

Decoupling is used for every stage. The filtering is comparatively poor for the output stage but is better for each preceding stage. The very best of filtering is necessary for the first tube because it is followed by a gain of something like 2,000.

Five tubes, twenty watts

This five-tube amplifier has a peculiar layout as Fig. 5 indicates. The power-pack section is spaced well away from the four amplifying tubes. This is to allow it to fit in a case with plenty of room in the center for a heavy-duty PM speaker. As in the previous amplifiers, grid-leak bias is used for the microphone preamplifier, but unlike the others, a filter choke is included so plenty of negative feedback can be used without excessive hum. The schematic appears in Fig. 6.

There are two negative feedback circuits. One is from an output tube plate to a 6SC7 plate. The other comes from the other 6L6-G plate to the 6SC7 input grid, helping to compensate for lack of coupling between halves of the output transformer primary.

Paraphase inversion is used and the 6SC7 works very well. Formerly a 6N7 was used, resulting in lower gain.

The cathode of the phase inverter is bypassed for high frequencies with a .05-μf condenser so that there is no common coupling at high frequencies. This allows more effective operation of the high-frequency tone control. The plate-to-plate feedback circuit is connected as a low-frequency tone control.

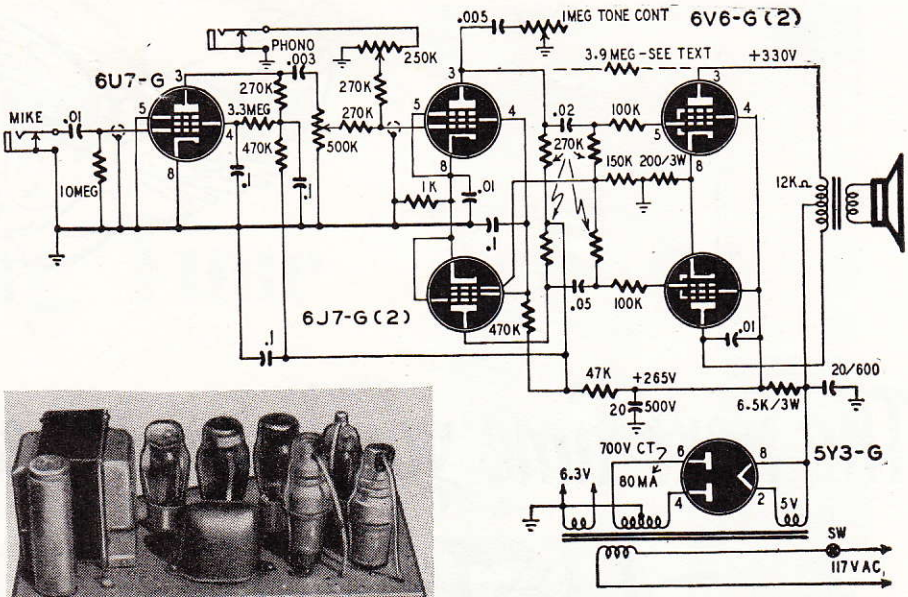


Fig. 3 (above)—The 6-tube, 13-watt amplifier.
Fig. 4 (left)—Chassis layout of this unit.

In the other feedback circuit there are two condensers. One of 500 μμf shunts some signal to ground to reduce the feedback at high frequencies and thus provide a high-frequency boost. The .001-μf condenser in series, provides a bass boost by reducing the feedback at low frequencies.

The gain from 6SC7 grid to 6L6-G anode is about 800 so the feedback voltage is reduced by two voltage dividers —one consisting of 3.9-megohm and 47,000-ohm resistors, and the other consisting of a 1-megohm resistor and the 270,000-ohm isolating resistors of the two volume controls.

If the amplifier is unstable because of too much gain or due to phase changes in the feedback circuit, it may be necessary to reduce the size of the 47,000-ohm resistor or to increase the 1-megohm resistor to around 4 megohms.

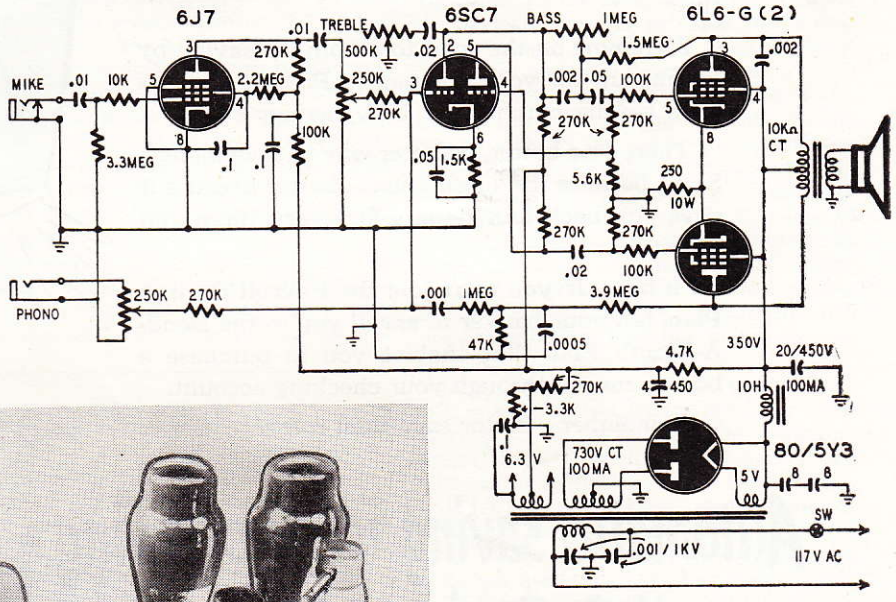
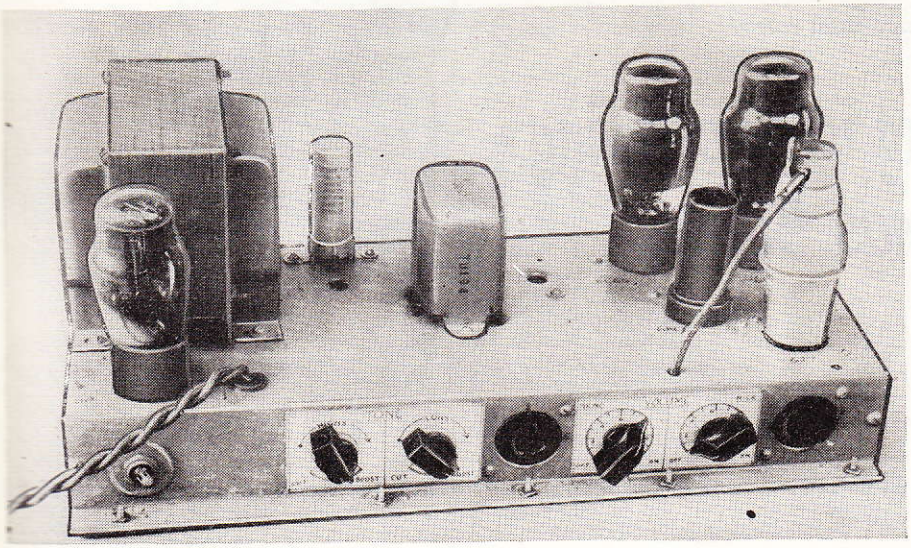


Fig. 5 (below)—Parts placement reduces hum.
Fig. 6 (right)—Amplifier output is 20 watts.



Two features not found in either of the other amplifiers are the use of an r.f. suppressor, a 10,000 ohm resistor in series with the grid of the 6J7-G, and the application of a positive voltage to the heaters of the tubes to reduce heater emission, a common cause of hum.

This amplifier is very suitable for recording.