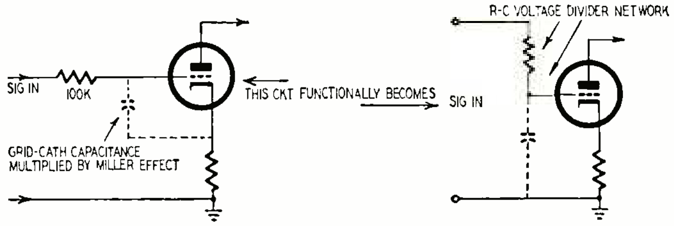

Fig. 2—How high frequencies are lost in mixer circuit.

The Miller effect increases interelectrode capacitance between the first 6SN7 grid and ground. This capacitance, together with the 100,000-ohm isolation resistors, forms a high-frequency shunt circuit (Fig. 2). Additional treble losses are introduced when the 1-megohm volume control is near mid-setting.

Fortunately, the .001-μf capacitor in the main feedback loop not only stabilizes the high-frequency response of the amplifier but compensates for the loss of highs in preceding stages. The value of this capacitor can be changed to compensate for wiring layouts, transformers variations or circuit changes. Once the response curve of the amplifier has been flattened, however, check for high-frequency instability.

All inexpensive feedback amplifiers, such as the Knight or Heathkit A-7D, have a tendency to ring when overdriven. This can be observed by running about 60 cycles into the amplifier and watching the output on a scope while the system is connected to a speaker load. Crank up the input signal until clipping is visble. If somewhere in the process a fuzzy shape (Fig. 3) appears on part of the waveform, it indicates high-frequency instability.

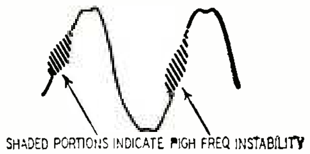

Fig. 3—Oscilloscope pattern shows ringing as amplifier is overdriven.

Changing the values of C10 and C13 will get rid of the ring but will also change the amplifier response curve. A small capacitor of 50 to 250 $\mu\mu$f across the phase-inverter plate resistor will often eliminate instability without seriously changing of characteristics.

The Knight kit, as furnished, also has a positive feedback loop to increase sensitivity, but it was impossible to retain this circuit and still keep the amplifier stable under all load conditions. Since the amplifier has plenty of gain as diagrammed, there is no reason to worry about loss of positive feedback.

Juggling capacitors and feedback loops, as mentioned, is necessary only if you are a perfectionist and have the necessary equipment. The amplifier will *sound* good if the diagram is followed exactly. Hum is a different sort of problem—it is something you can hear and consequently worth while getting rid of. The 50-ohm 2-watt hum-balancing pot and .01-μf capacitor from the ac line to chassis ground are both added to keep hum below audibility.

The balancing pot is a feature found in most commercial hi-fi amplifiers. The idea is that, by shifting the ground point of the filament system, a null can be found where hum introduced in the heater circuit cancels hum voltage picked up from other sources. Although this scheme lowers the hum level of the amplifier to insignificance if good wiring practice is followed, the input circuit is still sensitive to body capacitance unless the chassis is grounded. And most people don't have ground wires available for small record players.

Nonmetallic tone arms, such as that on the model T, provide no shielding for the pickup wires at the point where you handle the arm to put it on a record. Every time you put your fingers on the pickup head an annoying loud buzz is heard. A small capacitor from one side of the ac line to the chassis will stop this nuisance so long as the line plug is inserted the right way.

Any small amplifier circuit can easily be adapted to the upside-down type of construction. The Knight circuit described or the Heathkit mentioned are both excellent low-power amplifiers for small systems. The builder will find that one of these or a similar kit plus the additional chassis and other parts cost considerably less than purchasing individual components.

The cabinet can be made like the one shown here or designed to fit any standard manual player or record-changer assembly. Most companies furnish mounting templates with their phono units so that chassis and cabinet can be accurately laid out beforehand. If you don't have the tools or skill, any local cabinetmaker can do the job. END

BALANCING THE GOLDEN EAR

The long-term stability of the direct-coupled front end in Mr. Marshall's Golden Ear amplifiers is poor because of the severe requirements which it places on the stability of the B-plus and heater-voltage supplies. Since the B-plus supply to the inverter stage is regulated by a voltage-regulator tube, the primary cause of balance drift is probably line-voltage variations. For a particular 12AU7 selected at random, the cathode-to-cathode voltage of the cathode-follower input stage varies about .038 volt as the line voltage is varied from 105 to 125, with plates held at 150 volts.

This modification improves the balance and minimizes drift by applying negative feedback from the driver plates to the grids of the input stage as shown in dashed lines. To maintain gain within the loop, the feedback paths are designed as low-pass networks with the 3-db point at .04 cycle. For the values shown, the feedback amounts to around 27 db. The proper balance point is reached by controlling the resistance in one of the feedback legs with a variable resistor. The 330,000-ohm grid resistor for the lower half of the 12AU7 is shunted by 15 $\mu\mu$f for 90% compensation of the grid-to-plate capacitance.

No claim is made for originality in this design, although I have not seen a comparable feedback circuit described anywhere.—*Joseph J. Conradi*

(Mr. Marshall reports that this modification works fine and produces a very stable amplifier. He adds however that it is simpler and no more expensive to add another 150-volt voltage-regulator series with the one already in the Golden Ear amplifiers and apply 300 volts regulated to the driver—*Editor*)