HUM IN AUDIO AMPLIFIERS

Much has been written in the past on the subject of hum in audio amplifiers, and there is consequently a large bibliography available to those who wish to make a study of the subject. The average constructor or audiophile needs only a basic knowledge of the subject however, sufficient to put him on his guard in constructing and using hifi amplifiers. Let us start by listing the major causes of hum.

Induced hum. This heading covers hum due to leakage flux from the power transformer, filter chokes and other iron-cored components handling 50 cps power. It could include the turntable motor if placed sufficiently close to the amplifier. Poor layout can be the trouble here. Hum can be induced into just about any part of the circuit.

Hum due to lack of filtering. This is possibly the type of hum with which we are most familiar. It is due to unfiltered ripple on the B+ supply line, and is due to either insufficient filtering or the failure of one of the filter capacitors. In new equipment it may be due to poor design in the power pack. Ample design data is given in the "Radiotron Designer's Handbook."

Electrostatically-coupled hum. This arises from electrostatic coupling between points carrying ac potentials and low-signal-level portions of the amplifier circuit. Here again poor layout can be the cause.

Valve hum. This is generally referred to as heater hum, and is caused by ac voltages induced into the signal circuits from the valve heaters. This problem arises as a rule only in the low-level stages of the amplifier, usually only the first stage.

Before going on to mention a few of the ways of reducing hum, it is assumed that the ac leads to the heaters and pilot lamp are twisted and that the wiring for low level points is kept as far as possible away from them. If no centre-tap is available on the heater winding of the transformer, two half-watt 68-ohm resistors may be connected in series across the heater circuit, the centre point being earthed.

Of course it is necessary to observe all the rules of good wiring practice, using shielded wiring when necessary, with the shield earthed to the chassis. The chassis itself and any associated equipment such as record changer or record player should be thoroughly earthed. If a pre-amplifier is mounted on the same chassis as a main amplifier and power transformer, the problem is much the same but intensified.

The procedure which has been found helpful in reducing hum to low levels is to begin by reducing leakage-flux hum from the power transformer. This is mainly 50 and 150 cps hum. The effects of transformer leakage flux are usually negligible except when a steel chassis is used. In the latter case a simple cure is to isolate the transformer magnetically from the steel chassis, using brass bolts and spacers to lift the transformer at least ¼" above the chassis. This device is inexpensive, and there are good reasons for adopting it in all cases.

When the power transformer is isolated from the chassis, if the hum does not decrease to a sufficiently low level, it might sometimes be beneficial to re-orient the transformer with respect to the choke and other components, using the position giving least hum.

In most cases it is not necessary to isolate the filter choke magnetically from the chassis, although this should be beneficial. In the case of both transformer and chokes, screening may be employed using such materials as mumetal, but this should only be necessary in exceptional cases.

Having reduced the hum due to leakage flux to a satisfactory low level, the next approach is to make a large improvement in the filtering by connecting a large capacitor, of say 250μf, between B+ and ground. If this makes a substantial improvement better filtering is called for. In most cases the effect will be slight, and nothing need be done in this direction. This hum is almost entirely 100 cps when the rectification is full-wave.