Improved Circuit for Electrostatic Tweeters

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Build this simple "second channel" amplifier to provide a distortion-free driver for your inexpensive electrostatic tweeter and listen to the improvement in its performance.

RECENT NEW DEVELOPMENTS have made it possible to get performance from low-cost hi-fi systems which is often quite competitive with that which can be obtained from the more expensive outfits. One of the most important of these developments is the electrostatic tweeter, which enables the treble end of a set's spectrum to be extended out to the limit of audibility with very little cost. It is actually a condenser speaker, whose light cone facilitates the necessary response. Units have been brought out by several manufacturers, but one of the better ones presently available as a separate component is the Kingdom-Lorenz SKL-100, which sells for about $5.00.

The circuit recommended for use with this unit is shown in *Fig.* 1. In this arrangement the speaker signal is taken off the power amplifier plate, with RC coupling circuits inserted for application of polarization voltage and filtering out the lower frequencies. This arrangement is certainly simple, but it has certain advantages which might limit the effective use of the tweeter. First, it depends on the high-frequency response of the output transformer, which might drop off in cheaper units, keeping the highs away from the tweeter. Second, in this connection the tweeter is exposed to all the high-frequency distortion products developed in the power output stage. If the original speaker did not reproduce these sounds and they are then brought out in a tweeter, the net result might be just the opposite of the expected improvement.

With the cost of a tube and a few extra components, the above deficiencies can be remedied by use of the circuit shown in *Fig.* 2. This is essentially a separate output channel for the tweeter, an idea similar to the multichannel amplifiers which often appear in the literature. However, due to the liberal requirements of this application, the circuit can be considerably simpler than the usual multichannel design. For example, because of the relatively small proportion of signal power in the higher frequencies and the consequent small amount of power that must be fed to the tweeter, voltage amplifiers are quite adequate. The circuit of *Fig.* 2 uses a 6SN7 or similar dual medium-mu triode as a two-stage voltage amplifier taking a signal from the power-output-tube grid and feeding it to the tweeter.

Looking at the circuit in detail, the 250 μμf capacitor and 0.1-meg. resistor form a high-pass filter which transmits to the first section of the 6SN7 the signal at the grid of the power output tube, cutting off frequencies below about 5000 cps. If the main amplifier has a push-pull output stage, a similar dummy RC circuit should be connected to the grid of the other power tube to keep the two sides in balance. It might be thought that less effect on the main amplifier would be had by using a smaller capacitor and larger resistor, keeping the RC product constant; but if this is carried too far the Miller-effect input capacitance of the tube, which would run about 50 μμf or so, would begin to have a marked effect on the performance of the circuit. Actually, the values used would not have much effect at the lower frequencies where the main amplifier does its work.

Between the two amplifier stages is placed a similar RC circuit, with a pot used instead of a fixed resistor. This pot serves as a treble control to adjust the amount of signal going to the tweeter for the listener's taste. This is another advantage over the simple circuit of *Fig.* 1. The electrostatic tweeter is connected to the plate of the second tube, drawing both signal and polarizing voltage from this connection. The B+ return of this tube (shown as B++) should be connected to the highest-voltage well-filtered B+ point available in the set. However, the tweeter manufacturer's rating of 300 volts should not be exceeded. The B+ return of the first tube can go to any convenient source. Decoupling networks may be necessary in some cases to prevent interaction with other circuits in the set.

To get the most out of this tweeter and circuit, it will be necessary to see that the high frequencies are not getting lost in the early parts of the set. For example, the input capacitance of triodes, which due to Miller effect can run as

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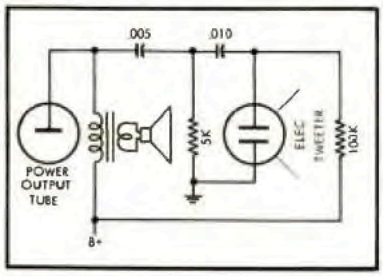

Fig. 1. Usual circuit recommended for connecting an electrostatic tweeter to the output stage of an amplifier.

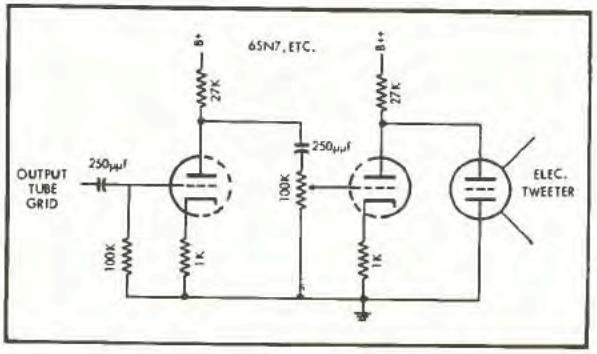

Fig. 2. With a separate amplifier for driving the tweeter, distortion of output stage is avoided

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ugh as 50 μμf for medium-mu and 150 μμf. for high-mu triodes, can cause trouble in some circuits, especially with volume controls, where these capacitances could result in considerable treble attenuation when the volume control is turned down. Thus, for maximum benefit from the tweeter, the set should be carefully checked for such bottlenecks.

Long cables in high-impedance circuits can also be troublesome.

If sensibly utilized, then, the electrostatic tweeter can add the treble end to a hi-fi set at very little cost. Now, if some way could be found to add the bass end at similarly small expense, every thing would be fine!