Real Audio Selectivity Using Standard Parts

LAWRENCE FLEMING, QST August 1950

Although toroidal chokes and other esoteric components are nice to have when designing an audio filter, some of the lowly units to be found in almost any junk box can be pressed into service quite nicely.

While high-Q toroidal chokes make the best audio filters[1], they are by no means indispensable in obtaining effective audio selectivity for C.W. reception. The chokes from a surplus FL8A filter, having a Q of about 12, have been used successfully[2], but may not always be available. Most midget radio replacement-type filter chokes have a 1000-cycle inductance of 5 to 7 Henries, with a Q of 6 or 8. One such choke, Thordarson No. T20C52, measures 8.7 Henries, *Q* =7.5. An inductor such as this one, which has the further advantage of unusually small physical size, can be made the basis of a thoroughly satisfactory 1000-cycle low-pass network.

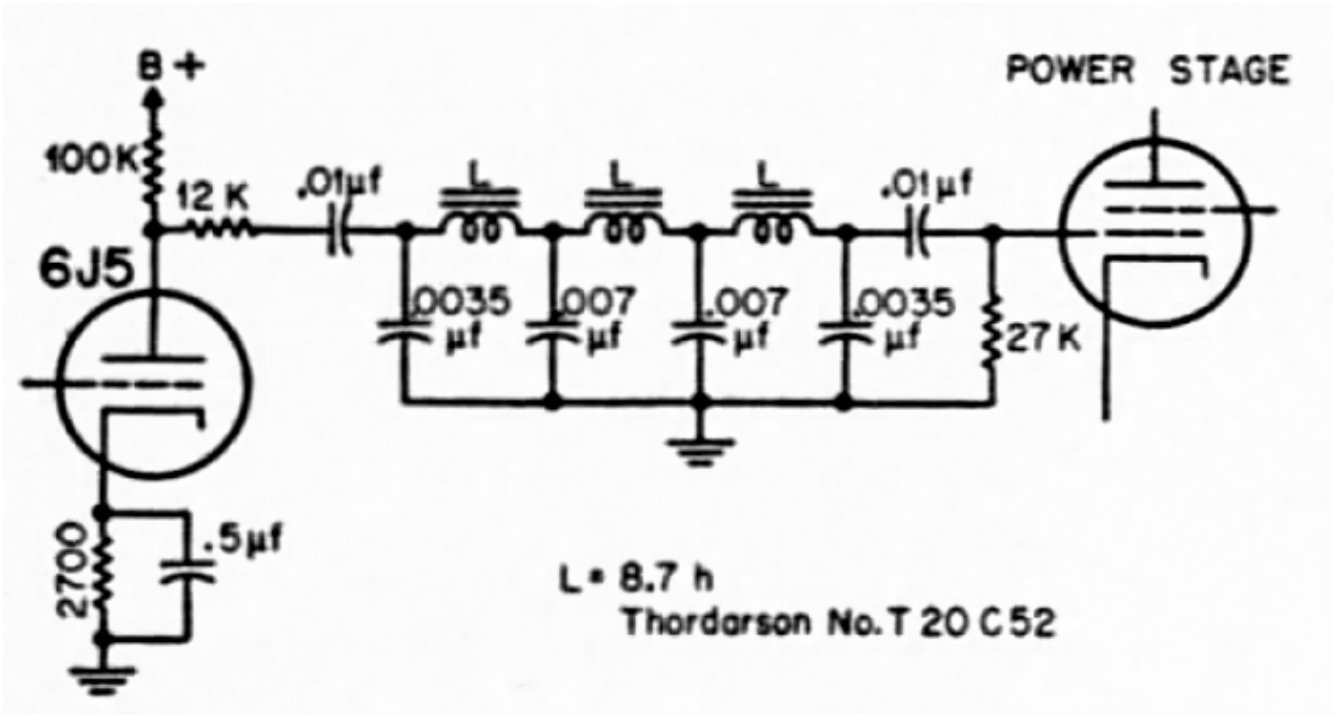

Fig. 1. The filter connected between the first and second audio stages of a receiver.

The filter is a three-section constant-k type which may be connected between the first and second audio stages of a receiver, as shown in *Fig.* 1 or between the plate of the output tube and a pair of headphones, as in *Fig.* 2. In either case, the measured response is as shown in *Fig.* 3. The transmission of the filter starts down at about 900 cycles, and has dropped 40 db at 2100 cycles. In a listening test, with a good strong signal in the phones from an oscillator at 1000 cycles, the signal was very weak at 2000 cycles, and inaudible above 2500. The characteristic impedance comes out 27,000 ohms, as is evident from the diagrams; in Fig, 2 the phones are partly isolated by means of two resistors so that the inductance of the phones does not upset the termination. The impedance of the source driving the filter in Fig. 1 is partly made up of the plate resistance of the 6J5 tube (15,000 ohms) and partly of an additional 12,000-ohm resistor. The Pentode in *Fig.* 2 has a high plate resistance so that the right

source impedance can be obtained with a shunt resistor a cross the output transformer primary. The low-frequency cut off below 300 cycles is due to the .01 uF condensers at the ends of the filter. These are not properly part of the filter but provide an easy way to help drop the lows.

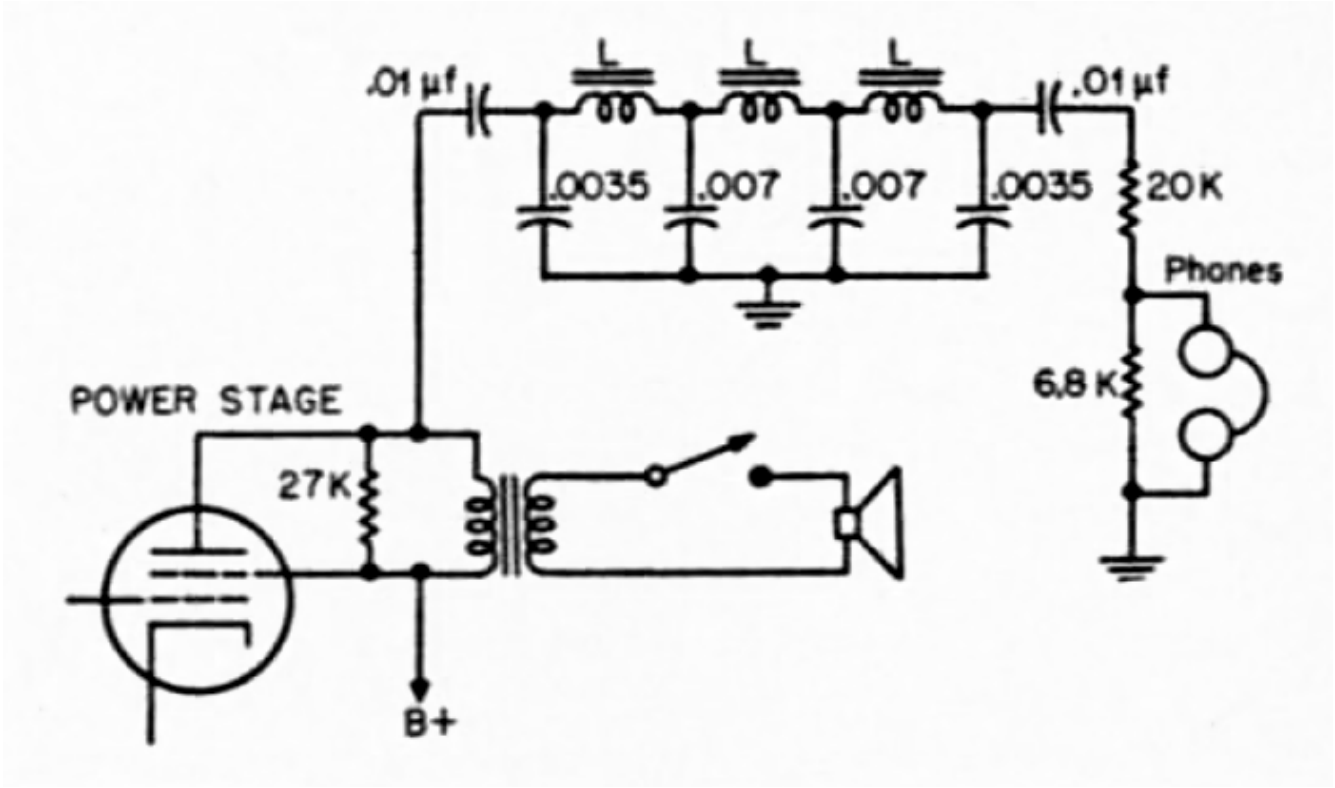

Fig. 2 Perhaps the simplest application is placing the filter between the last audio stage and a pair of cans.

Facts about Filters:

In any filter of the constant-k type, the rate of attenuation beyond the edge of the pass band is always 6 db per octave multiplied by the number of reactive elements in the circuit. In this particular case, there are 3 chokes and 4 condensers, so that the attenuation rate is 6*7=42 dB per octave. By using m-derived circuits, the attenuation curve can be made steeper near the edge of the pass band, but only at the expense of getting less attenuation at frequencies farther out. The rate of attenuation outside the pass band does not depend much on the *Q* of the chokes. The effect of low *Q* is to round off the curve at the point where it starts down. The rounding-off in the curve of *Fig.* 3 has no discernible effect on the ear; expensive high-Q inductances in this application[3] would be wasted. This filter was designed according to the regular formula:

$$L = \frac{R}{\pi f_c}$$

$$C = \frac{L}{R^2}$$

where *L* is inductance in Henries, *C* capacitance in farads, and *R* the terminating resistance in ohms. *The shunt condensers at the ends of the filter are made 1/2 C. the others C.* More sections can be added if desired. Power-supply type chokes such as are used here can be adjusted in inductance over

quite a wide range by changing the air gap. While it is not practicable to decrease the gap, the inductance is readily lowered (and the *Q* increased) by spacing the "I" laminations farther away from the "E" completely removed. In this condition the inductance is usually about *1070* of its original value, and the *Q* has increased to around 10 or 12. Further reduction in inductance On be effected by taking out some of the "E" laminations, but the Q begins to drop again as the choke begins to look too much like an air-core coil.

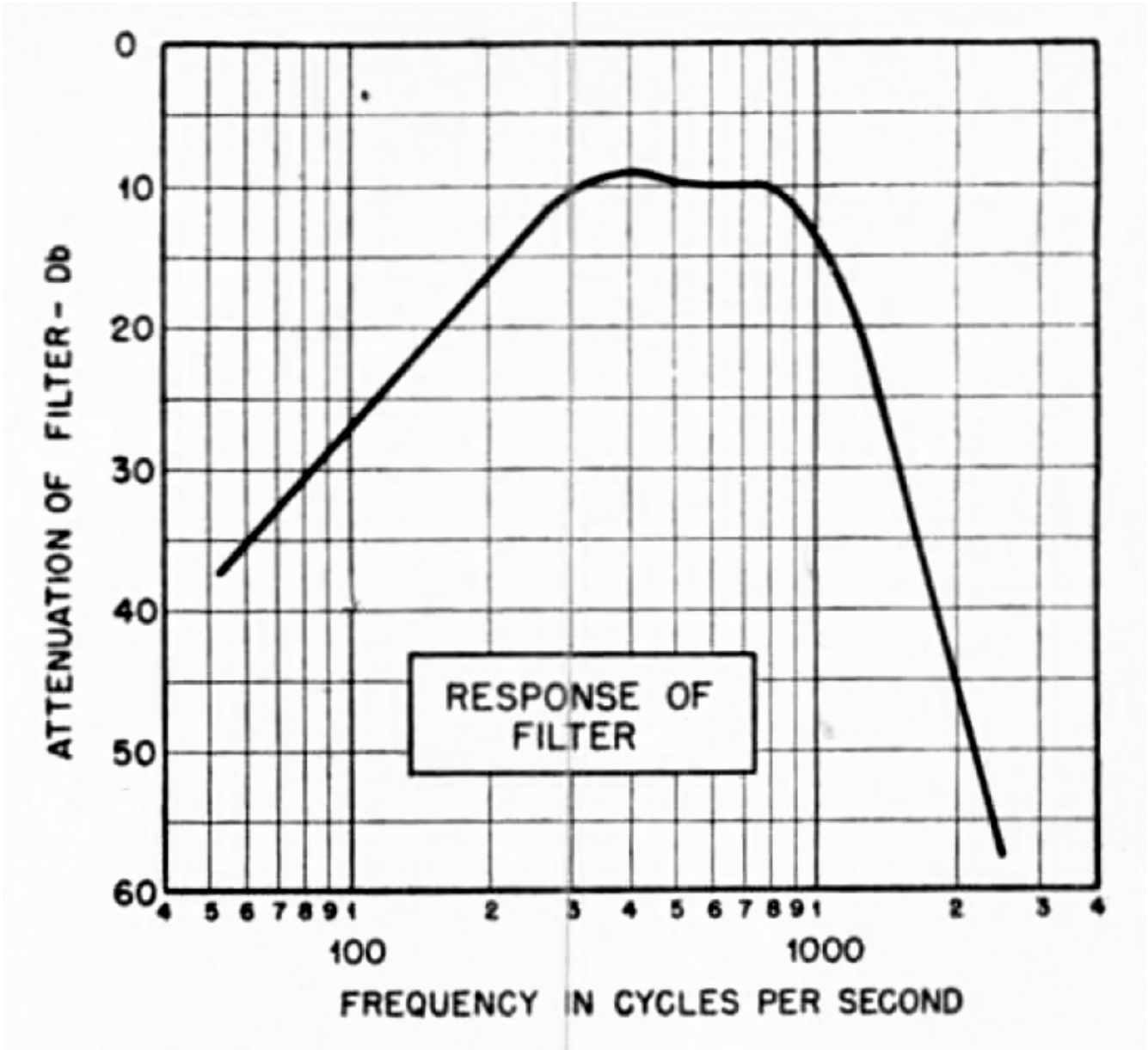

Fig. 3. The measured response of the filter.

1 Bane, "Band-pass Filters," *CQ,* June 1948, p. 15.
2 Tapley, "Low-Cost Audio Selectivity," *CQ,* September 1948, p. 21.
3 Narrow band receive filter.