Design Data (14)

Resonant R.F. Chokes

AT high radio frequencies it is a common practice to employ resonant chokes to prevent R.F. currents from straying into unwanted paths. In the detector output circuit and in the heater leads of R.F. valves the use of such chokes is not uncommon.

A resonant choke is an inductance which resonates with its own self-capacitance at the radio-frequency concerned. It thus acts as a parallel-resonant circuit at this frequency, and offers a high impedance; because of this the choking action falls off as the frequency departs from resonance. It is, however, effective over a reasonably wide band, and the resonance frequency should be chosen to lie towards the middle of the band to be covered.

Chokes of this kind are not often used at the lower frequencies because the resonance tends to be too sharp in relation to the bandwidth. They could, however, be used in I.F. amplifiers, but they are rarely needed. They find most application at frequencies of 10 Mc/s and over, where it is possible to use a single-layer winding, and then the design of suitable chokes becomes amenable to simple calculation.

When the coil is wound with a large ratio of length to diameter the length of wire required is one-half wavelength. As the ratio is reduced, the length of wire needed is lessened also. This is easily understandable, for shortening a coil increases the coupling and capacitance between turns and so increases the inductance.

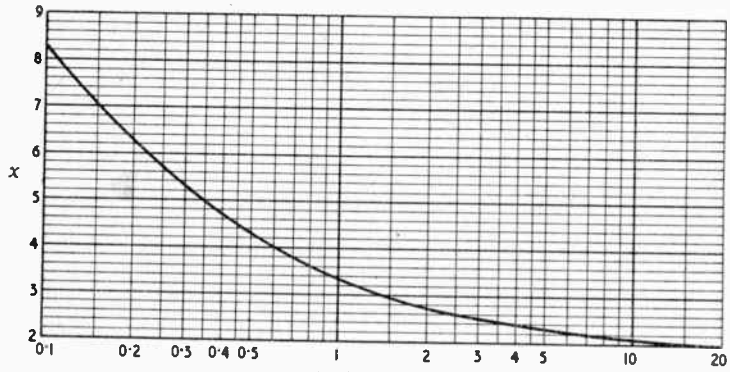

Fig. 1.

Fig. 1 gives a curve showing the value of x as a function of the ratio of length to diameter of the coil, where x is the number by which the wavelength must be divided to find the length of wire needed.[1]

As an example, suppose that length/diameter is 4 and that the choke is to resonate at 45 Mc/s. Fig. 1 gives $x=2.4$, and the wavelength corresponding to 45 Mc/s is 6.66 metres. The length of wire is thus $6.66/2.4=2.775$ m = 109in. If the diameter of the coil is ⅜in the length is 1½in, and the length of one turn is $\frac{3}{8}\times 3.14 =$ 1.18in, so that $109/1.18=92.5$ turns are needed. The turns per inch are $92.5/1.5=61.6$, and reference to wire tables shows that No. 28 enamelled wire can just be used with careful winding.

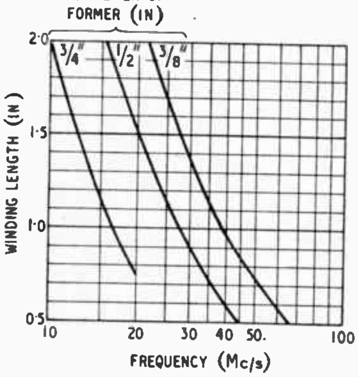

Fig. 2.

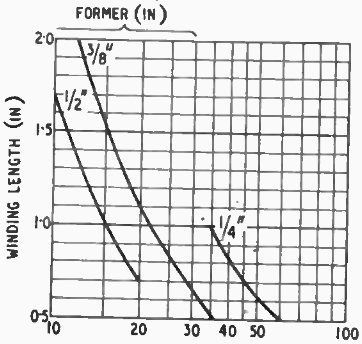

Fig. 3.

Figs. 2 and 3 show curves of winding length as a function of frequency for a number of different winding diameters, and for No. 36 and No. 41 gauges enamelled wire respectively. They are derived from Fig. 1, and are convenient in design, since they enable one to pick the most suitable dimensions very quickly, and it is usually sufficiently accurate to wind the coil to length without bothering about the actual number of turns.

For 13 Mc/s, for instance, with No. 36 wire one could hardly use anything less than ¾in diameter, since anything smaller would be inconveniently long. Fig. 2 gives the winding length as 1.4in. With No. 41 wire, however, one can well drop to ½in diameter and wind to 1.22in. One might not, of course, be able to stand for the higher D.C. resistance of No. 41 wire; one certainly could not in a heater circuit and, in fact, one would try not to drop below about No. 26 gauge for this purpose. Such chokes are not usually needed below about 30 Mc/s, and the dimensions are then so reduced that larger wire is not impracticable.

[1] "H.F. Resistance and Self-Capacitance of Single-Layer Solenoids," by R. G. Medhurst, *Wireless Engineer*, February and March, 1947, Vol. 24, pp. 35 and 80.