# The Effects of Screening on Coils

MATERIALS AND TEMPERATURE AFFECT THE "Q" OF A COIL AS EXPLAINED HERE

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IN the early days of radio the tuning coils were mounted in the open for easy access, but with the evolution of the multi-electrode valve increasing sensitivity and circuit complexity it was soon found essential substantially to confine all electromagnetic and electrostatic flux by screening coils from each other and from neighbouring components to prevent instability from feedback due to stray coupling.

Today the screening of coils is inclined to be taken for granted, but it is both useful and interesting to know just why this has to be done and what is the effect of placing a coil inside a screening can, not only on the coil but on the circuit in which it is functioning.

In general, coils may be divided into two main categories, high frequency and low frequency, but as may be expected the material for shielding an L.F. coil would not be suitable for an H.F. coil.

### Electromagnetic Screening

Screening cans of high permeability are used when the magnetic flux is unidirectional or from a low-frequency source. The magnetic flux lines are prevented from extending beyond the container by such materials which act as a virtual magnetic short circuit, giving an effect analogous to that which a Faraday cage has on electrostatic flux. Fig. 1 (a) and (b) illustrates the disposition of magnetic flux when a solenoid is placed inside a container made of magnetic material of high permeability at low flux densities such as mu-metal.

In general, electromagnetic shielding extends over the audio frequency range up to about 10 Kc/s, though depending upon requirements it may be found necessary to use a combination of both electromagnetic and electrostatic shielding. Such circumstances may occur in a screened and balanced transformer where, to preserve balance, the different sections of the windings may need to be shielded from capacity effects as well as inductive. Such transformers usually employ electrostatic shielding between primary and secondary consisting of metal foil arranged so that its surface is approximately parallel with the magnetic field, but provided with an insulated gap to prevent it becoming a short circuited turn. This method of screening is used on transformers which range from mains frequencies up to radio frequencies in Band II.

### Electrostatic Shielding

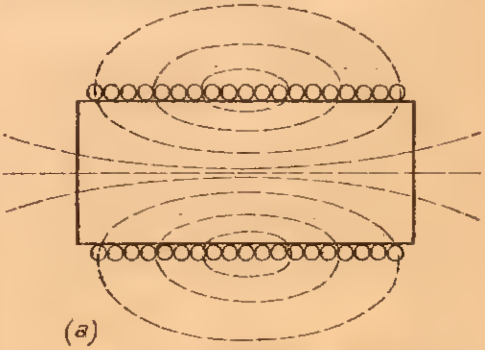
This form of shielding extends from the frequency where the electromagnetic ceases, that is from about 10 Kc/s upwards.

The distribution of electrostatic flux for a coil both outside and inside an aluminium can is shown at Fig. 2 (a) and (b).

It is difficult to assign a transitional point where the shielding ceases to be efficient as magnetic shielding and becomes more efficient as electrostatic shielding, because as the frequency of a magnetic field becomes higher, more satisfactory shielding is obtained by the use of shielding material having high electrical conductivity, as already mentioned.

The magnetic flux in attempting to pass through such a shield induces voltages that set up eddy currents which assist in blocking the magnetic flux and prevent it penetrating the shield. This eddy current effect increases with frequency and with the conductivity of the material. Therefore the best metals are found to be silver, copper, aluminium, etc., and effectively form a Farady cage by screening the parts external to the shield from electrostatic effects within. The exact nature of the shielding material is not important, but aluminium is popular on account of its lightness, ease of working and high conductivity. Its relative resistivity to copper is 1.64 to 1, and although copper has largely been superseded by the latter metal, it is still used occasionally with silver plating for high efficiency standard coils associated with special test gear such as Q-meters.

The eddy currents just referred to do not penetrate the screen material deeply so the thickness of the can is determined more by mechanical considerations. For instance, the minimum thickness for adequate shielding at 100 Kc/s is 0.0325in. Coil cans are invariably not thinner than 20 s.w.g. or 0.036in., which is greater than that required for minimum shielding. At higher frequencies, of course, the required thickness decreases.


(a)

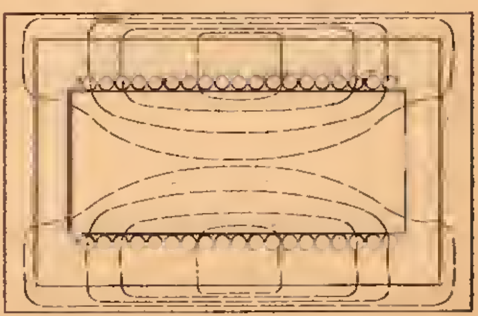

(b)

*Fig. 1.—Disposition of electromagnetic flux (a) outside and (b) inside a screening can.*