

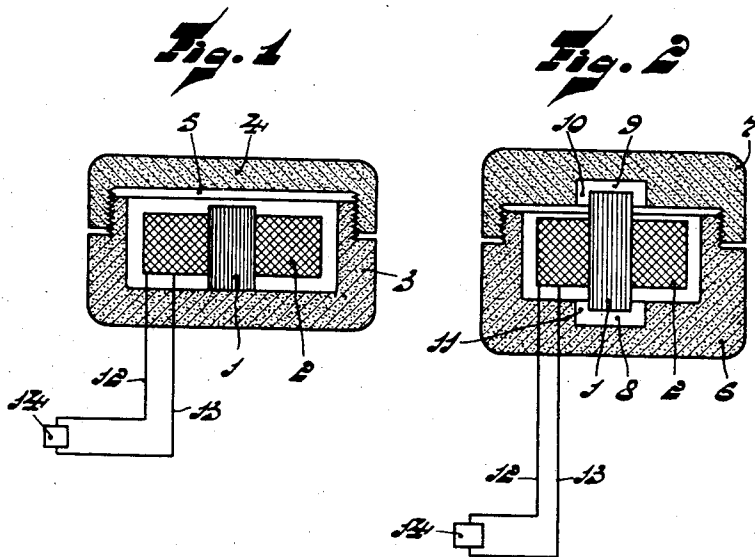
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INDUCTANCE COIL

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INDUCTANCE COIL

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Our invention relates to inductance coils whose inductance varies only slightly with the temperature, and more particularly to inductance coils having a core and a sheath of magnetic material.

Such coils are particularly useful in case where a constant inductance is desired, for example in electric high-frequency filters. However, present high-frequency coils usually have cores made from iron powder and an insulating binder, and their temperature coefficient of inductance is too high to make them suitable for the above purpose. This is apparently due to the high coefficient of expansion of the insulating binder.

The object of our invention is to provide an inductance coil having a very low temperature coefficient of inductance.

The coil according to the invention comprises a sheath of magnetically-subdivided material, and a core of magnetic material which is not subdivided in the direction of the lines of force and has a high effective permeability. We separate the core and the sheath by an air gap of such size that the magnetic leakage flux, which is substantially independent of variations in length of the air gap due to thermal expansion of the core and the sheath, is at least as high as the flux passing through the air gap.

In order that the invention may be more clearly understood and readily carried into effect, we shall describe the same in more detail with reference to the accompanying drawing, in which:

Figure 1 is a sectionized side view of an inductance coil according to the invention, and

Fig. 2 is a sectionized side view of an inductance coil according to another embodiment of the invention.

The inductance coil illustrated in Fig. 1 comprises a core 1 which is magnetically subdivided laterally, and may consist, for example, of mutually insulated metal wires of an Fe-Ni alloy of high permeability. Core 1 is secured at its lower end to a cup-shaped member 3 having an externally threaded end to which is secured a second cup-shaped member 4. Members 3 and 4 form the sheath of the coil and are of a magnetic material, such as iron powder compressed with a suitable insulating binder such as an artificial resin. Surrounding core 1 is a coil 2 having leads 12 and 13 connected to a suitable source of voltage 14. After assembly the space between the member 3 and the coil 2 is filled with an insulating compound which secures the parts in position.

The upper end of core 1 is separated from

member 4 by an air gap 5, and as the core has a high permeability, i. e. from 200 to 300, this air gap can be given a considerable length without unduly decreasing the permeability of the magnetic circuit as a whole. This would not be the case if core 1 were made of a material having a low effective permeability, i. e. from compressed iron powder.

By making an air gap 5 of considerable length, a comparatively large portion of the total flux forms leakage flux around air gap 5 between the core and the sheath. We have found that if this leakage flux is made at least as high as and preferably higher than that portion of the flux which passes directly through the air gap, a low temperature coefficient of the inductance is obtained. Tests have shown that a temperature coefficient of about 0.005% per degree centigrade could be readily obtained. This is due to the fact that the variation in length of the air gap due to the thermal expansion and contraction of the core and the sheath, influences only the flux that passes directly through the air gap, whereas the leakage flux remains substantially constant.

Due to the high effective permeability of the material of core 1, only a small number of lines of force will intersect coil 2, and as a result the eddy current losses in this coil will remain low, which results in a low loss-resistance of the coil.

Although a construction such as shown in Fig. 1 gives very good results, we have found that there is a concentration of the lines of force at the area where the flux passes directly through the air gap to the sheath, and as a result the magnetic field at this point has a comparatively high intensity. This is undesirable because it produces high hysteresis and eddy-current losses.

The above is avoided in the construction illustrated in Fig. 2, in which the sheath comprises two cup-shaped members 6 and 7, which are similar to members 3 and 4 of Fig. 1, but are provided with cylindrical cavities 8 and 9 respectively. The ends of core 1 extend slightly into cavities 8 and 9 to form air gaps 10 and 11 which are of large cross-sectional area. The position of the core 1 is determined by means of a small ebonite spacer filling the cavity 8 and the assembly is then fixed by filling by an insulating compound.

It will be noted that the portions of the sheath are screwed together in order that the length of the air gap, and hence the inductance of the coils, may be adjusted to the desired value. In addition, the sheath portions are preferably shaped as solids of revolution to provide good

screening, and to increase their magnetic cross section. Because of the large cross section the sheath may be readily manufactured by compressing insulated iron powder. This reduces the cost of manufacture, and in addition the magnetic flux becomes low and the hysteresis and eddy-current losses remain within the desired limits.

While we have described our invention with reference to specific examples and applications, we do not wish to be limited thereto, but desire the appended claims to be construed as broadly as permissible in view of the prior art.

What we claim is:

1. An inductance coil having a low temperature coefficient of inductance comprising a core of magnetic material, said core being magnetically subdivided only in a direction normal to the direction of the magnetic lines of force to obtain a high effective permeability, a coil surrounding said core, and a sheath of magnetic material subdivided in the direction of the magnetic lines of force to obtain an effective permeability which is low relatively to that of the core, said sheath completely surrounding the core and the coil with the portion of said sheath overlying one of the ends of said core spaced from said core end to form therebetween an air gap of such size that during operation the magnetic leakage flux passing through the core but not through the air gap is at least equal to the flux passing from the core end to the sheath through the air gap.

2. An inductance coil having a low temperature coefficient of inductance comprising a core of

longitudinally - extending mutually - insulated wires of magnetic material of high effective permeability, a coil surrounding said core, and a sheath of low effective permeability comprising compressed and mutually-insulated iron particles, said sheath completely surrounding the core and the coil with the portion of the sheath overlying one of the ends of said core spaced from said core end to form therebetween an air gap of such size that during operation the magnetic leakage flux passing through the core but not through the air gap is at least equal to the flux passing from the core end to the sheath through the air gap.

3. An inductance coil having a low temperature coefficient of inductance comprising a core of longitudinally - extending mutually - insulated wires of magnetic material of high effective permeability, a coil surrounding said core, and a sheath of low effective permeability comprising compressed and mutually-insulated iron particles, said sheath wholly surrounding the core and the coil and being provided with a cavity, an end of said core extending into said cavity to form between the surface of said cavity and the surface of said core end an air gap of such size that during operation of the coil the magnetic leakage flux passing through the core but not through the air gap is at least equal to the flux passing from the core end to the sheath through the air gap.

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