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FERROMAGNETIC CERAMIC INDUCTANCE CORE

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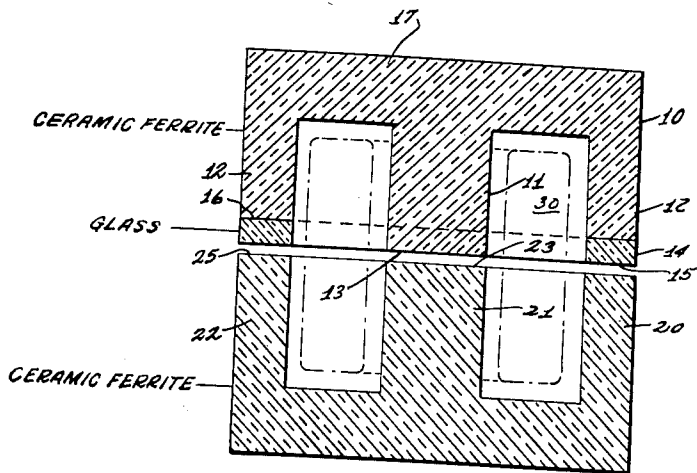


FIG. 1

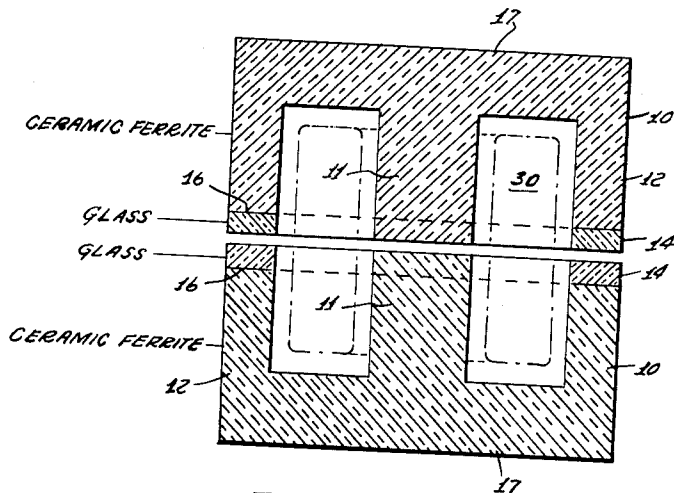


FIG. 2

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FERROMAGNETIC CERAMIC INDUCTANCE CORE

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3 Claims. (Cl. 336—83)

This invention relates to a ferromagnetic inductance core of the type having small non-ferromagnetic gaps.

Many electrical inductances are equipped with ferromagnetic cores which form an open magnetic circuit. The function of these coils depends on the ratio of air gap and mean magnetic path. Solenoidal cores (slugs) having an air gap of indefinite length form a class of their own. The present invention is concerned only with magnetic cores, where the width of the air gap is small compared with the magnetic path.

An object of this invention is to provide a ferromagnetic core with a very accurate stable and invariable air gap and process of making same.

It is quite evident that the electrical and mechanical properties of a coil of the described species depend very much on the accuracy and invariability of the air gap. Usually the two halves of such a core are separated by a washer of organic insulating material and clamped together with a spring. However, the insulating paper, cardboard, tape or whatever is being used, can either shrink or warp or expand, thus changing the size of the air gap and changing simultaneously the electrical data of the coil.

Another object of the invention therefore is to provide a gapped ferromagnetic core with a permanent and integral insulating spacer means at the gap.

These objects and others ancillary thereto are obtained by making the air-gap core of ceramic ferromagnetic materials and providing the air gap portion with a ceramic glaze or glass. Preferably the core is made in two or more parts. Two of said parts of the core have corresponding surfaces which are to form the air gap and one or both of the said corresponding surfaces are provided with a ceramic glaze or a glass which because of the ceramic nature of the ferromagnetic material can be firmly united thereto. The various interfitted parts of the core may then be ground and polished to form surfaces which fit together with exactitude and the core is then ready to be assembled with the coil.

The ceramic ferromagnetic materials have the general formula of $xM''O.yFe_2O_3$ in which M'' represents one or preferably two or more bivalent metal oxides comprising for example nickel oxide, cobalt oxide, magnesium oxide, manganous oxide, copper oxide, zinc oxide, etc., and in which $x:y$ is approximately 1:1.

The novel features characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and its method of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawings in which:

Figure 1 is a cross sectional view showing a two part cup core made according to the invention with the two parts slightly separated.

Figure 2 is a view similar to Figure 1 of a modified form of cup core.

In order to illustrate the invention a cup type of core

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has been shown but it will be obvious from a reading of the following description that the principle of the invention is of general application to any type of core with a gap of finite length. According to the embodiment shown in Figure 1 the complete core comprises two parts 10 and 20. The upper part 10 has a central leg 11 around which the coil 30 is to be wound or fitted and a peripheral flange 12 extending in the same direction as the central leg 11. The ferromagnetic material of the flange 12 ends at surface 16 the plane of which is closer to the base or top 17 of the cup than the plane of surface 13 of the central leg 11. A glaze 14 is united to the flange 12 at surface 16. The face 15 of the glaze or glass layer 14 is ground to provide a smooth fit with the corresponding cup part 20.

The coil part 20 is shown as made the usual way with a center leg 21 and peripheral flange 22 and with the flat surface 23 of the center leg 21 and the flat surface 25 of the flange 22 all being in the same plane. It is not necessary that the surfaces 13 and 15 on the one hand and the surfaces 23 and 25 on the other hand be in the same plane as long as the corresponding surfaces to the two parts fit closely together but it is convenient to make the core parts in this way.

In the modification shown in Figure 2 the two parts are made substantially identical. In this way it is easier to obtain a larger gap.

The following example illustrates how the cores are made.

Example

A zinc-nickel ferrite composition containing about 17% of zinc oxide, about 13% of nickel oxide, about 65% of ferric oxide and about 2% of manganese oxide is finely ground, plasticized with a wax emulsion and pressed to form (for example, the cup shape of part 10 of Figure 1 or 2). The pressed product is fired at approximately 2200° F. After cooling, the outer flange 12 of the cup is coated with a lead glaze made up from about 15% clay, about 20% flint, about 65% of a ground frit, (the latter made up from about 20% flint, 40% borax, 60% leadmonoxide). Other known ceramic glazes can be employed provided of course that the maturing temperature of the glaze is below the fusion temperature of the ferrite. After the slip has been applied the piece is refired at the maturing temperature of the glaze. If the resultant glaze is not of sufficient thickness an additional coating of the slip may be applied and the product refired, etc. After the final desired thickness is obtained the outer surface 15 of the glaze 14 is ground to produce a flat surface and the surface 13 of leg 11 may be ground simultaneously. The accurately ground surfaces of two parts 10 or of the part 10 and part 20 can be accurately fitted together to form the core with an accurate and invariable gap of the glaze 14.

Since the various parts of core have flat ground and polished contacting surfaces the resultant core produced by the union of the two parts is stable, the gap being of predetermined and accurate size. The glazed or glass gap does not deteriorate with age, by the presence of moisture, by elevated temperatures, etc. This principle of securing the accurate width of the gap can be applied to any shape of inductance inasmuch as the width of the air gap is an integral part of the core structure.

The essential feature of the invention is the idea of uniting a ceramic insulating material such as glass, to a ceramic ferromagnetic material. Instead of applying a glaze-slip, a washer of glass can be fitted onto the core surface and united or welded thereto by softening the glass under heat and pressing the glass against the contacting surface.

I claim:

1. A ferromagnetic inductance core of the type having

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a gap of finite length in the magnetic material thereof, said core being formed in at least two parts, the said two parts having at least two separate substantially planar contacting areas therebetween, a first one of said parts consisting essentially of a ceramic ferromagnetic ferrite, a first of said contacting areas of said first part making ferromagnetic contact with the corresponding contacting surfaces of a second of said parts when the parts are assembled with a coil thereon, a second of said contacting areas of said first part containing a ceramic glaze which contacts a corresponding area of said second part when the parts are assembled whereby the said glaze forms an accurate and invariable gap between the corresponding second contacting areas of the two parts.

2. The device of claim 1 in which said core consists of two parts, each consisting essentially of ceramic ferromagnetic material and each comprising a glaze coating on one contacting area.

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3. The device of claim 1 in which said core consists of two, similarly-formed, cup-shaped parts, each having the second of said contacting areas at the end of a continuous flange surrounding but spaced from the first pair of contacting areas.

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