Nov. 1, 1927. 1,647,738

V. E. LEGG

INSULATION OF MAGNETIC MATERIAL

Filed Jan. 5, 1927

Fig. 1.

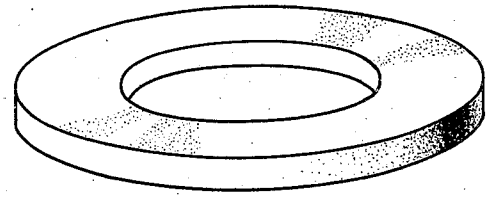
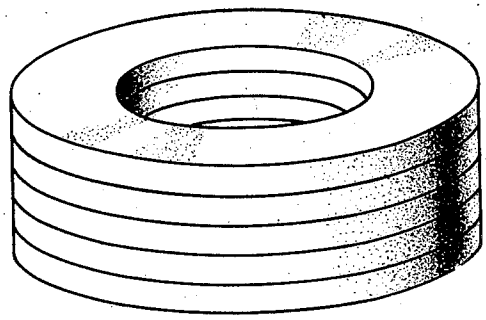


Fig. 2.



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INSULATION OF MAGNETIC MATERIAL.

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This invention relates to electrical insulation, and more particularly to the insulation of the particles used in the manufacture of magnetic dust cores.

Magnetic dust cores are being extensively used as cores for loading coils to improve the transmission characteristics of signaling lines. Certain magnetic alloys containing nickel and iron are now replacing iron to a considerable extent for this purpose. These alloys, when formed into cores and properly heat treated, are peculiarly desirable for loading coil cores by virtue of properties, some of which vary when the alloy material is strained, as is incidentally done by changing its form in compressing the dust into solid cores. It is, therefore, best to perform the heat treatment after the dust has been compressed into core form. Furthermore, it is necessary to insulate the individual particles prior to the core forming operation to reduce eddy current losses in the completed core. It is therefore necessary to provide an insulation which will not be affected by the temperatures used in the heat treatment.

In accordance with this invention the pores of a pervious insulating coating on the magnetic particles are partly or wholly filled with powdered quartz or similar inert insulating material.

In another aspect, the invention is a method of preparing magnetic structures and more particularly dust cores for loading coils, transformers and the like. As applied to cores, for example, this method, specifically stated, comprises the following steps. A pervious insulating surface is first produced on the magnetic particles, for example, by heating the particles in an oxidizing atmosphere to form a spongy oxide coating on the particles. The coated particles are then mixed with quartz powder. A mass of the double coated particles is then subjected to high pressures to combine the particles into a homogeneous solid core. The pervious nature of the coatings on the magnetic particles serves to hold the quartz powder in place thereon during the pressing operation, so that in the final compressed core the magnetic particles are properly insulated from each other. The core is then given a heat treatment to improve the magnetic properties of the core material, and since the quartz powder is highly refractory and chemically inert, the insulation will not be deleteriously affected by the heat treatment.

A more detailed description of the invention follows and the accompanying drawing illustrates one embodiment of the invention, Fig. 1 being a perspective view of a single magnetic ring and Fig. 2 illustrating a plurality of rings combined to form a magnetic core.

In carrying out the present invention the magnetic material is preferably prepared from an alloy containing nickel and iron. A preferred form of alloy contains 78½% nickel and 21½% iron. For a description of this and other alloys which may be used as core material see patent to G. W. Elmen, No. 1,586,884, issued June 1, 1926. Obviously other alloys may also be used. The magnetic alloy, which may be in slab form, is reduced to a fine dust in any well known manner, as for example by crushing in a hammer mill or other suitable reducing apparatus, and is subsequently rolled in a ball mill. The dust is sieved and the portion passing through a screen, which has 120 meshes per inch, is used for core material. A pervious insulating coating is then produced on the magnetic dust particles. The coating material is preferably formed by heating the magnetic particles in an oxidizing atmosphere to form insulating oxides of nickel and iron on the particles, in a manner similar to that used to form the insulating oxide coating on iron particles disclosed in G. W. Elmen Patent No. 1,286,965, issued December 10, 1918. The oxidized magnetic dust is then mixed with a small quantity of a highly refractory and chemically inert insulating material in powdered form, for instance, quartz powder, the proportion of insulating powder used being such as to provide the desired insulation without unduly reducing the permeability of the completed core. The pervious character of the primary insulating oxide causes the refractory quartz powder to be trapped in the pores thereof, thereby forming a secondary coating of the refractory powder around the individual particles.

A mass of the double coated particles is then placed in a mold and compressed into core rings, such as is shown in Fig. 1, with a pressure of approximately 200,000 pounds per square inch. The compressed core rings

are transferred to an electric oven and given a heat treatment to improve the magnetic properties of the magnetic material. This treatment is carried on at temperatures between approximately 450° C. and 550° C. and the rings are thereafter cooled. The refractory powdered insulating material is chemically inert and stable at the temperatures encountered during the heat treatment and is not harmfully affected by the high pressures employed in forming the core ring. No deleterious effects are caused in the magnetic material which would impair the permeability obtained by the heat treatment. For a detailed account of heat treatments employed with nickel iron alloys, reference is made to patents to G. W. Elmen No. 1,586,884 and No. 1,586,889, issued June 1, 1926. Furthermore, the insulating powder will not deteriorate in the subsequent use of the core ring, thereby preventing the breakdown of the insulation which would increase the eddy current losses in the core.

When a core is to be made, in accordance with this invention, for a telephone loading coil, a plurality of these rings are stacked coaxially to form a complete core as shown in Fig. 2, on which the usual toroidal winding is applied, the number of rings used depending upon the existing electrical characteristics of the telephone circuit with which the loading coils are to be associated.

While the specific method above described recites the use of quartz powder as the preferred refractory material, various other materials may be used, such as "alundum", "silo-cel", "magnesia" and other highly refractory insulating powders. The requisites of the refractory powders are: Their insulating properties must be high, they must not deleteriously affect the magnetic material or the primary insulating coating, and they must remain inert at the maximum temperature employed in the heat treatment.

What is claimed is:

1. A magnetic structure comprising magnetic dust, a property of which is improved by heat treatment at a temperature above 450° C., a pervious insulating material carried by the dust particles, and an insulating powder carried by said pervious material, said insulating powder being inert at the temperature of said heat treatment.

2. A magnetic structure comprising magnetic dust, a property of which is improved by heat treatment at a temperature above 450° C., a pervious coating of the oxide of said magnetic dust on said dust particles, and an insulating powder within the pores of said pervious coating, said insulating powder and said oxide being inert at the temperature of said heat treatment.

3. A magnetic structure comprising magnetic dust, a property of which is improved by heat treatment at a temperature above 450° C., a pervious coating of the oxide of said magnetic dust on said dust particles, and quartz powder within the pores of said pervious coating, said quartz powder and said oxide being inert at the temperature of said heat treatment.

4. A magnetic structure comprising an alloy dust consisting chiefly of nickel and iron, a property of which is improved by heat treatment, a pervious insulating coating on said dust particles and an insulating powder in the pores of said pervious coating, both said pervious coating and said insulating powder being inert at the temperature of the heat treatment.

5. A magnetic structure comprising a mixture of an alloy dust consisting chiefly of nickel and iron, a property of which is improved by heat treatment, oxides of nickel and iron, and quartz powder, said oxides and said powder being inert at the temperature of the heat treatment.

6. The method of producing a magnetic structure from magnetic dust, a property of which is improved by heat treatment, which method comprises treating said dust to produce a pervious coating thereon, introducing into the pores of said coating a powdered insulating material which is inert at the temperature of the heat treatment, compressing said dust into a self-sustaining solid, and subjecting said solid to said heat treatment, the temperature being raised to at least 450° C.

7. The method of producing a magnetic structure from a magnetic alloy dust consisting chiefly of nickel and iron, the property of which is improved by heat treatment, which method comprises oxidizing said dust to produce a pervious coating of nickel and iron oxides thereon, introducing into the pores of said coating a powdered insulating material which is inert at the temperature of said heat treatment, compressing said dust into a self-sustaining solid, and subjecting said solid to said heat treatment.

8. The method of producing a magnetic structure from magnetic alloy dust consisting chiefly of nickel and iron, a property of which is improved by heat treatment, which method comprises oxidizing said dust to form a pervious coating of nickel and iron oxides thereon, introducing powdered quartz into pores of said coating, compressing said dust into a self-sustaining solid, and subjecting said solid to said heat treatment at temperatures between 450° and 550° C.

In witness whereof, I hereunto subscribe my name this 31st day of December, A. D., 1926.

VICTOR E. LEGG.