Dec. 6, 1927. 1,651,957

H. H. LOWRY

INSULATION OF FINELY DIVIDED MAGNETIC MATERIAL

Filed Jan. 3, 1927

Fig. 1.

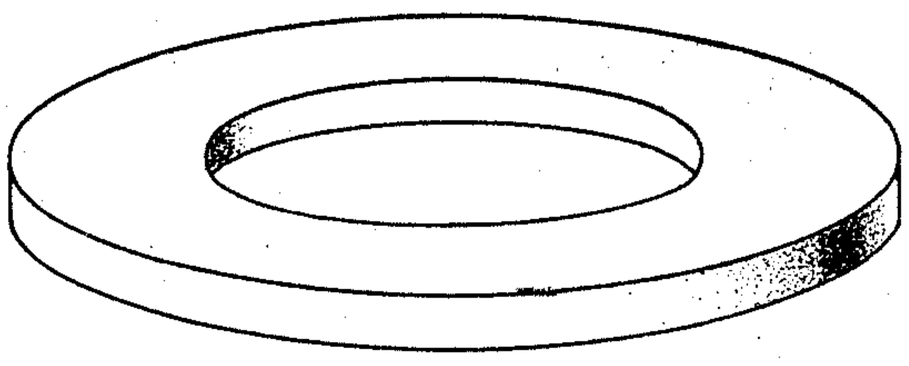
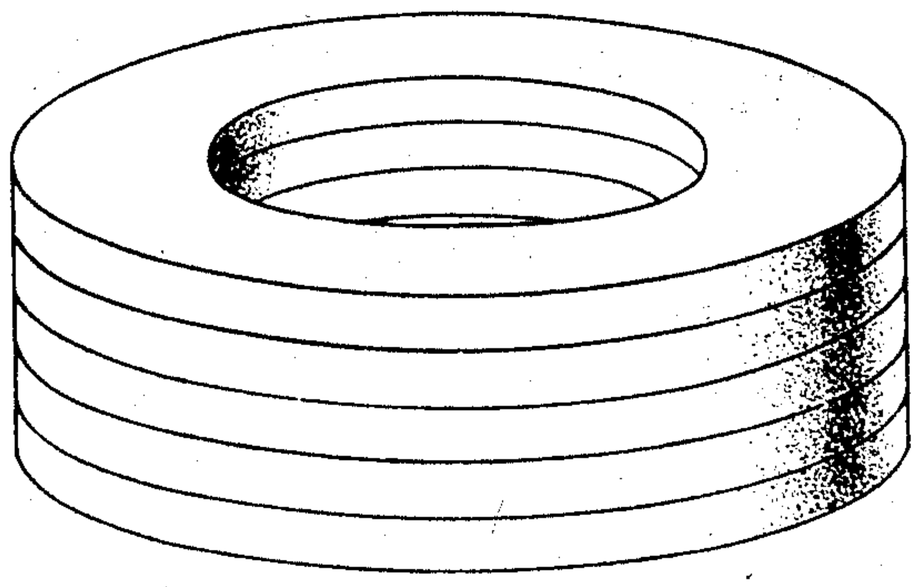


Fig. 2.



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# UNITED STATES PATENT OFFICE.

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## INSULATION OF FINELY-DIVIDED MAGNETIC MATERIAL.

Application filed January 3, 1927. Serial No. 158,798.

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

Magnetic dust cores are being extensively used as the 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 withstand the high temperatures of the heat treatment.

In accordance with this invention, the material used for insulating the finely divided magnetic material is a mixture of magnesium borate and silica.

In another aspect, the invention is a method of preparing magnetic structures and more particularly magnetic dust cores. As applied to cores, for example, this method, specifically stated, comprises mixing a mass of the magnetic material in finely divided form such as dust, dust with magnesium borate and silica to form an insulating coating on the particles, compressing the coated particles under high pressure to form a homogeneous mass, and heat treating the core to improve the magnetic properties of the magnetic material.

A more detailed description of the invention follows, and the accompanying drawing illustrates one embodiment, 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. Obviously, other alloys also may be used. The magnetic alloy, which may be in slab form, is reduced to a finely divided state, such as dust, in any well known manner, as by crushing in a hammer mill or other suitable reducing apparatus and is subsequently rolled in a ball mill. The dust is passed through a sieve and the portion of dust passing through a 120 mesh sieve is suitable for magnetic core purposes. The dust is mixed with an insulator and pressed into core form.

The insulator for the magnetic dust comprises magnesium borate and silica. One method of securing a definite refractory insulating coating on the particles comprises dissolving magnesium oxide in a concentrated solution of boric acid. For example, the boric acid solution may consist of approximately 150 grams of boric acid in 500 cc. of water to which is added 16 grams of magnesium oxide. This mixture is stirred while being heated at a temperature of approximately 90° C. until the oxide is dissolved. A suitable mixture for a core mass comprises 2000 grams of magnetic dust of nickel and iron alloy mixed with the boric acid solution of the magnesium oxide and 2% by volume of ground silica, the amount of the solution comprising approximately 4% of the mixture. The mixture is dried in an open vessel by stirring at a temperature of approximately 100° C. for one hour and then dried in an evacuated vessel at a temperature of 200° C. for two hours. The resulting material contains the nickel-iron alloy particles thoroughly coated with dry magnesium borate and silica dust.

A mass of the coated particles is then placed in a mold and compressed into a core ring such as is shown in Fig. 1, with a pressure of approximately 200,000 pounds per square inch. The compression of the particles into a homogeneous solid core, necessarily produces strains in the magnetic dust and also causes the magnesium borate and silica insulating coating to be strained at the contact points of adjacent particles while the insulating coating on the flat surfaces of the particles is not subject to the same de-

gree of strain. The compressed core rings are then transferred to an electric furnace and given a heat treatment to improve the magnetic properties of the magnetic material. This treatment is carried on at temperatures between approximately 500° C. and 600° C. and the rings are thereafter cooled. For a detailed account of heat treatments employed with nickel-iron alloy structures reference is made to patents to G. W. Elmen, Nos. 1,586,884 and 1,586,889;

A plurality of rings thus formed 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 depending upon the existing electrical characteristics of the telephone circuit with which the loading coils are to be associated.

While the invention has been described with respect to the insulation of magnetic dust which is subject to a heat treatment to improve the magnetic properties of the magnetic material, the invention is not limited to this particular aspect. The magnesium borate and silica insulation may be employed in other forms of metallic structures which are subject to compression and heat treatment and the invention is only to be limited within the scope of the appended claims.

What is claimed is:

1. A magnetic structure comprising magnetic material in a finely divided state, and an insulating coating on the particles of said material comprising magnesium borate and silica.

2. A magnetic structure comprising magnetic material, an alloy in a finely divided state, said alloy including nickel and iron, and an insulating coating on the alloy particles comprising magnesium borate and silica.

3. A magnetic structure comprising an alloy in finely divided form, said alloy inculding nickel and iron, and an insulating coating on the particles consisting of magnesium borate and silica, the entire mass being pressed into a homogeneous solid.

4. A magnetic structure comprising an alloy containing nickel and iron, in finely divided form, the division of the particles being such that they are capable of passing through a sieve having 120 meshes per inch, and an adherent insulating coating on the particles comprising magnesium borate and silica, the volume of the magnesium borate being approximately 4% of the volume of the magnetic structure and the volume of the silica being approximately 2% of the volume of the magnetic structure.

5. The method of making magnetic dust structures which comprises mixing a mass of magnetic dust particles with a boric acid solution containing magnesium oxide and silica dust, drying the mixture, and heat treating the mass to improve the magnetic properties.

6. The method of making magnetic dust structures which comprises mixing magnetic dust with a boric acid solution containing magnesium oxide and silica dust, drying the mixture, subjecting the mass to high pressure to form a homogeneous solid, and heat treating said solid to improve its magnetic properties.

In witness whereof, I hereunto subscribe my name this 30th day of December, A. D., 1926.

HOMER H. LOWRY.