106. COMPOSITIONS, COATING OR PLASTIC
84

CROSS REFERENCE

Examine

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MAGNETIC MATERIAL

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This invention relates to magnetic materials and more particularly to the magnetic cores made from finely divided and insulated magnetic particles and to methods for making such materials.

Objects of the invention are to provide magnetic materials having high permeabilities and low energy losses and efficient and effective methods of making such materials.

In accordance with one embodiment of the invention, finely divided magnetic particles are insulated and compressed into cores and the cores are then heat-treated in a nitrogenous atmosphere to anneal the magnetic particles.

In practicing the present invention, the magnetic material is preferably prepared from a brittle alloy containing nickel and iron, with or without the addition of other constituents, and commonly known as "permalloy". The alloy may be prepared in the manner described in Patent No. 1,669,649, issued May 15, 1928, to C. P. Beath and H. M. E. Heinicke, wherein approximately 81 parts of nickel and 19 parts of iron are melted together in an oxidizing atmosphere, the resulting alloy being poured into a mold. The alloy thus prepared is rolled while hot into relatively thin slabs which are quenched rapidly to produce a fine crystalline structure which is desirable since the disintegration of the material takes place at the crystal boundaries and, consequently, the smaller the size of the crystals the finer the dust which can be produced therefrom. The slabs are then reduced to a finely divided form in any suitable manner and the finely divided alloy is subsequently reduced to a dust by pulverizing it in an attrition or ball mill.

The dust from the attrition or ball mill is then sifted and the portion passing through a 120-mesh screen is placed in a closed container and annealed at a temperature of approximately 885° C. The annealed dust is removed from the container in the form of a cake, which is again reduced to a powder by crushing it in a rotary crusher and subsequently grinding it in an attrition mill, the ground dust is again sifted through a 120 mesh screen and the dust passing the screen is then mixed with the insulating composition as described hereinafter. It should be understood, however, that the present invention is independent of the particular magnetic metal or alloy employed, and of the manner of preparing the metal or alloy. The term "magnetic metal", as used herein, is therefore intended to include any magnetic metal or alloy of metals suitable for use in connection with the present invention, regardless of its composition or method of preparation.

As an example of an insulating composition suitable for the purposes of the present invention, the following formula is given:

	Pounds
Tartaric acid	.30
Sodium silicate	1.05
Powdered talc	.75
Kaolin	.75
Water	12.00

The permalloy dust thus obtained is thoroughly mixed with a portion of insulating material. It has been found that best results are obtained by applying the insulating material in two to five successive steps. This makes it possible to use a smaller amount of insulating material and still obtain a better insulation of the particles. The smaller amount of insulating material used also increases the permeability of the magnetic body because permeability is proportional to the amount of insulating material used. The total amount of insulating material may be as low as ½% of the amount of dust used according to the permeability desired.

After the dust has been insulated as described, the magnetic material is formed into cores by subjecting it to a pressure in the neighborhood of 200,000 pounds per square inch. During the application of this pressure, the magnetic particles are again subjected to strains which impair the magnetic properties thereof and, therefore, the cores are again subjected to an annealing heat-treatment.

In this second heat-treatment to which this invention particularly relates care must be taken to provide an atmosphere about the cores which will not tend to destroy or damage the insulation surrounding the compressed parts. This heat-treatment is, therefore, carried out by placing the cores in a sealed container in which approximately 5% of ammonium carbonate by weight of the cores has been placed. This amount is not critical and considerable variations may be made therein. The sealed container is then placed in a furnace and heated to a temperature of approximately 1000° to 1200° F. At these temperatures the ammonium carbonate appears to become disassociated to form a nitrogenous atmosphere containing enough free hydrogen to have a reducing effect to shield the cores from oxidation without deleteriously affecting the insulation surrounding the compressed magnetic particles. The nitrogenous atmosphere, in addition to being inert with respect to the insulation of the particles, is non-inflammable, which makes the operation free from the hazard of explosions. The heat-treatment of the cores with a nitrogenous atmosphere results in the reduction of the hysteresis losses in the cores of over 50% of that obtained in an open air heat-treatment, and also since the nitrogenous atmosphere does not attack the insulation strong cores will be obtained. If desired gaseous nitrogen may be used by itself as the annealing atmosphere. However, in that case the advantage of a reducing atmosphere is not obtained.

While the invention has been described particularly in connection with magnetic cores made from insulated dust particles, it will be evident that magnetic bodies in sheet, bar or other uninsulated forms may be annealed in accordance with the invention wherever it is desirable to provide a reducing, non-inflammable atmosphere during a heat-treatment thereof.

What is claimed is:

1. A method of making a compressed magnetic dust core, which comprises insulating magnetic dust particles, compressing the insulated particles to form a core, and heat-treating the core in a nascent nitrogenous atmosphere containing sufficient hydrogen to have a reducing effect.

2. A method of making a compressed magnetic dust core, which comprises insulating magnetic dust particles, compressing the insulated particles to form a core, and heating the core to the annealing temperature in the presence of ammonium carbonate.

3. A method of making a compressed magnetic dust core, which comprises insulating magnetic dust particles, compressing the insulated particles to form a core, and heat-treating the core in a nascent nitrogenous atmosphere in a sealed container said atmosphere containing sufficient free hydrogen to have a reducing effect.

4. A method of making a compressed magnetic dust core, which comprises insulating magnetic dust particles, compressing the insulated particles to form a core, and heating the core to the annealing temperature in the presence of ammonium carbonate in a sealed container.

5. A method of making a magnetic core, which comprises insulating particles of nickel-iron dust, compressing the insulated particles to form a core, and heating the core in a nascent nitrogenous atmosphere containing sufficient free hydrogen to have a reducing effect.

6. A method of making a magnetic dust core, which comprises coating magnetic dust particles with a mixture comprising sodium silicate and a filler, compressing the coated particles into a core, and heat treating the core in an atmosphere containing nascent nitrogen and hydrogen.

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