

Dec. 6, 1927.

1,651,958

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INSULATION OF FINELY DIVIDED MAGNETIC MATERIAL

Filed Jan. 3, 1927

Fig. 1.

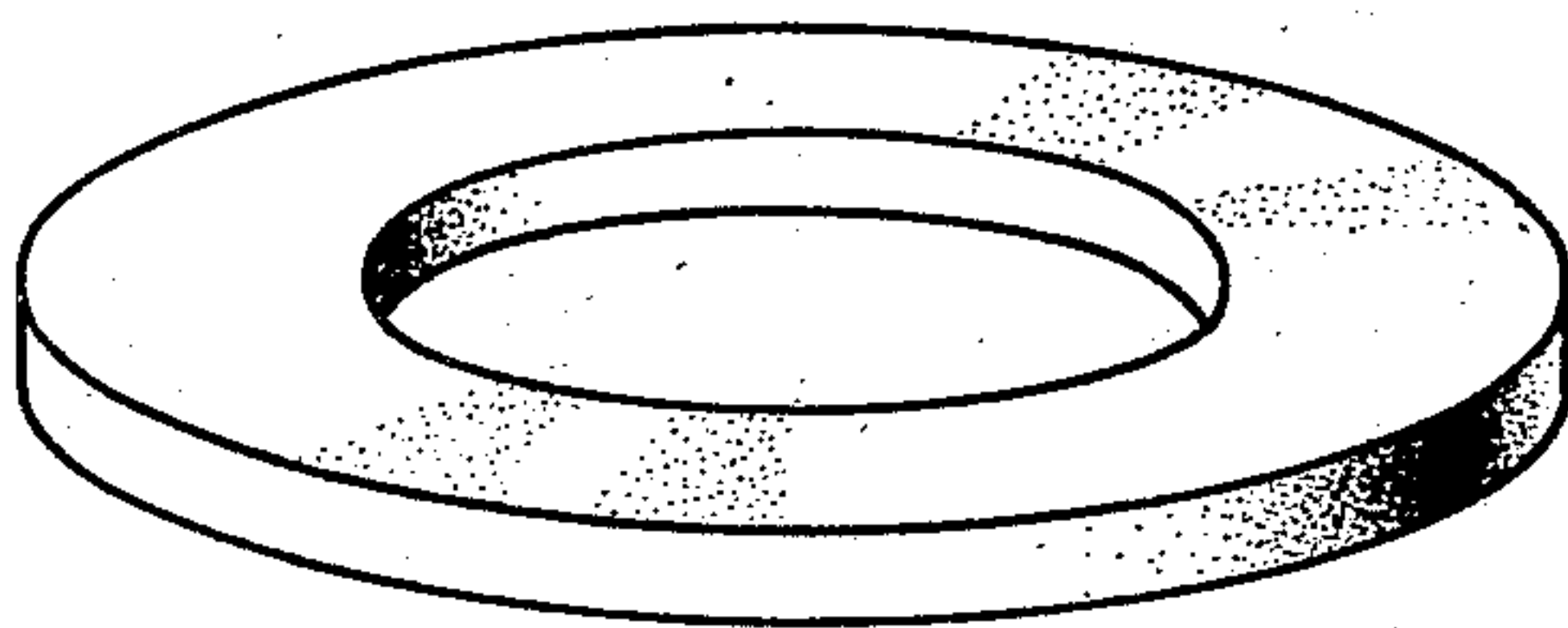
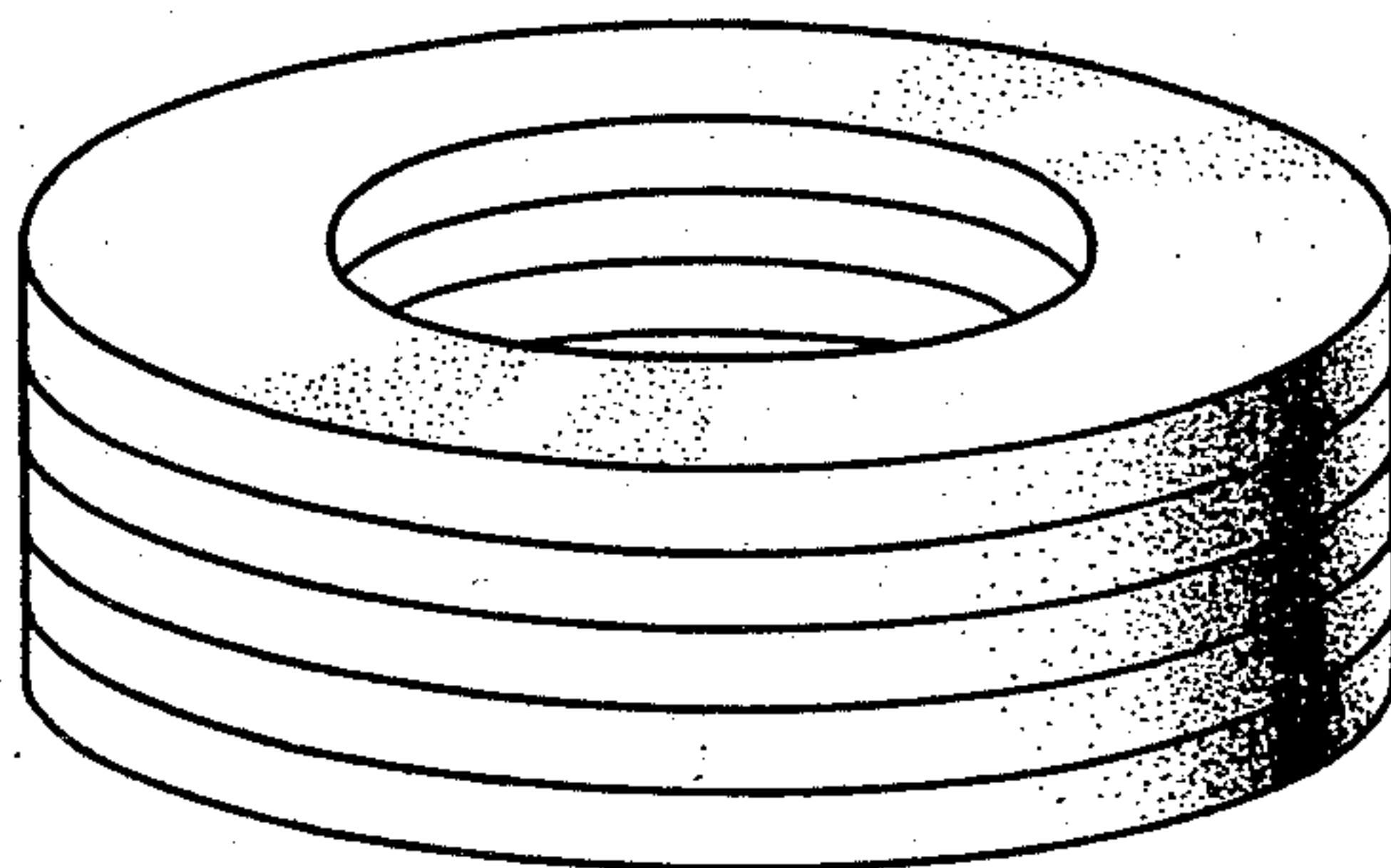


Fig. 2.



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INSULATION OF FINELY-DIVIDED MAGNETIC MATERIAL.

Application filed January 3, 1927. Serial No. 158,799.

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

5 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
10 a considerable extent for this purpose. These alloys in finely divided form, when formed into cores and properly heat treated, are peculiarly desirable for loading coil cores by virtue of properties, some of which vary
15 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 treating after the dust has been compressed into core
20 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
25 which will not deteriorate during the heat treatment.

In accordance with this invention the material used for the insulating coating on the magnetic dust is magnesium oxide and zinc
30 oxide.

In another aspect, the invention is a method of preparing magnetic structures, and particularly dust magnetic cores. As applied to cores, for example, this method
35 specifically stated, comprises mixing a mass of the magnetic dust particles with magnesium hydroxide and zinc hydroxide, heating the dust at a low temperature to change the hydroxides to oxides, compressing the
40 mass of oxide coated magnetic dust into a self-sustaining solid core, and heat treating the core to improve the magnetic properties of the magnetic material. This treatment forms an adherent insulating coating on the
45 individual alloy particles. This coating comprising magnesium oxide together with small amounts of zinc oxide and oxides of the magnetic material, will withstand without deterioration the maximum temperatures of
50 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 plu- 55
rality 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 60
preferred form of alloy contains $78\frac{1}{2}\%$ nickel and $21\frac{1}{2}\%$ 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 65
may be used. The magnetic alloy, which may be in slab form, is reduced to a finely divided form, such as dust, in any well known manner, as for example by crushing in a hammer mill or other suitable reducing 70
apparatus and subsequently rolling the crushed material in a ball mill. The resulting product is sieved, and the portion passing through a 120 mesh sieve is used for core material. This dust is mixed with an in- 75
sulating material to form an insulating coating on the particles and pressed into core form. The coating material is preferably formed by preparing a concentrated solution of zinc oxide in ammonia to which is 80
added an equal amount of magnesium oxide in finely divided form which is held in suspension. A small amount of the suspension containing zinc and magnesium hydroxide 85
formed by the interaction of the oxides with the ammonia and amounting to approximately 6% by volume of the magnetic dust to be insulated is mixed with the particles by stirring until the particles are thoroughly 90
coated. The coated particles are dried in air at a temperature of approximately 100°C . for one hour and then dried in vacuum at a temperature of 200°C . for two hours. This process insures an adherent 95
coating of magnesium oxide and zinc oxide on the particles since water is given off during the heating, thereby changing the hydroxides to oxides.

A mass of the oxidized particles is placed in a mold and compressed into core rings, 100
such as is shown in Fig. 1, with a pressure of approximately 200,000 pounds per square inch. The compressed core rings are placed in an electric furnace and given a suitable heat treatment therein to improve the mag- 105
netic 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. During this heat treatment the zinc oxide which is used as a flux for the magnesium oxide is partially dissociated and volatilized, the oxygen resulting from the dissociation combining with the magnetic particles to form a combination of nickel and iron oxide on the surfaces of the particles which further increases the insulation. The high temperatures of the heat treatment do not appreciably affect the insulating properties of the magnesium oxide coating, this being stable within the range of the heat treating temperatures. For a detailed account of heat treatments employed with nickel iron alloys, reference is made to patents to G. W. Elmen Nos. 1,586,884 and 1,586,889.

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 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 oxide-zinc oxide insulation may be employed in other forms of metallic structures which are subject to heat treatment after the insulation has been applied. Furthermore, the specific proportions of the oxides may be varied, depending on the properties of the metallic material which are to be attained by the heat treatment.

What is claimed is:

1. A magnetic structure which comprises magnetic material in a finely divided state and a coating of a mixture of magnesium oxide and zinc oxide on the magnetic particles.

2. A magnetic structure comprising an alloy including nickel and iron in finely divided form, compressed into a self-sustaining solid, the particles of which are insulated from each other by an adherent coating of magnesium oxide and zinc oxide.

3. A magnetic structure comprising an alloy including nickel-iron in finely divided form, said alloy requiring heat treatment at a high temperature to improve the magnetic properties of the core, and an adherent insulating coating on the particles consisting of magnesium oxide, zinc oxide and oxides of nickel and iron, said coating retaining its in-

insulating properties at the temperatures of the heat treatment.

4. A magnetic structure comprising an alloy containing nickel and iron in finely divided form, the particles being capable of passing through a sieve having 120 meshes per inch, and an adherent insulating coating on the particles comprising magnesium oxide and zinc oxide, the volume of the oxides being approximately 6% of the volume of the magnetic particles and the volumes of the two oxides being substantially equal.

5. The method of producing magnetic structures, which comprises coating magnetic particles with a composition containing magnesium hydroxide and zinc hydroxide and heating the coated particles to change the hydroxides to oxides.

6. The method of producing magnetic structures, which comprises coating magnetic particles with a mixture of magnesium hydroxide and zinc hydroxide, heating said particles to change the hydroxides to adherent oxides, and subjecting the oxide coated particles to high pressures to form a homogeneous solid.

7. The method of producing magnetic structures, which comprises coating particles of an alloy comprising nickel-iron with a mixture of magnesium hydroxide and zinc hydroxide, heating said particles to convert the hydroxides to oxides, and subjecting a mass of oxide-coated particles to high pressure to combine the coated particles into a homogeneous solid.

8. The method of insulating nickel-iron alloy in a finely divided state, which comprises mixing a mass of alloy particles with magnesium hydroxide and zinc hydroxide, the total volume of the hydroxide being approximately 6% of the volume of the alloy mass, to form a coating on the particles, and heating the mixture to change the hydroxides to oxides.

9. The method of producing a magnetic core, which comprises coating particles of an alloy comprising nickel and iron with a mixture of magnesium hydroxide and zinc hydroxide, heating said coated particles to form an adherent coating thereon of magnesium oxide and zinc oxide, forming a mass of said particles into a homogeneous solid under high pressure, and heat treating said solid to improve the magnetic properties of said nickel-iron alloy.

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

HOMER H. LOWRY.