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1,647,737

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MAGNETIC CORE

Filed Jan. 3, 1927

Fig. 1.

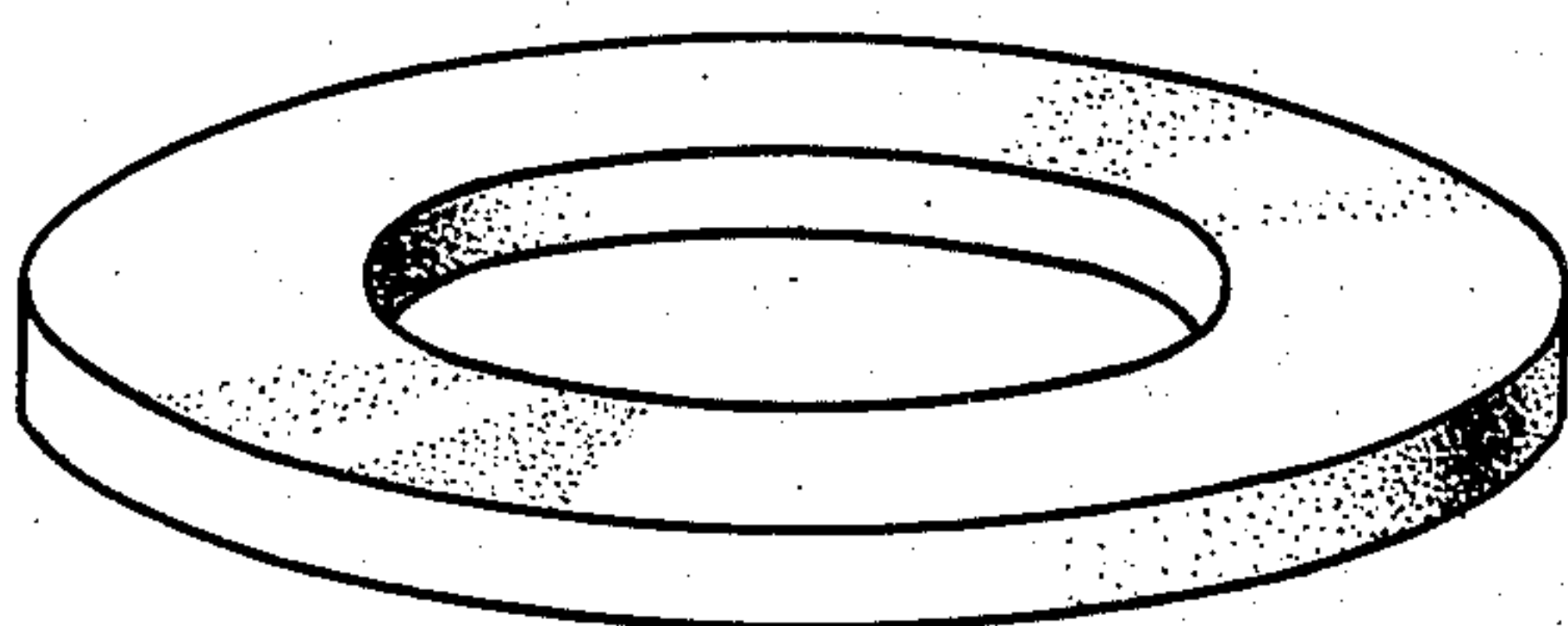
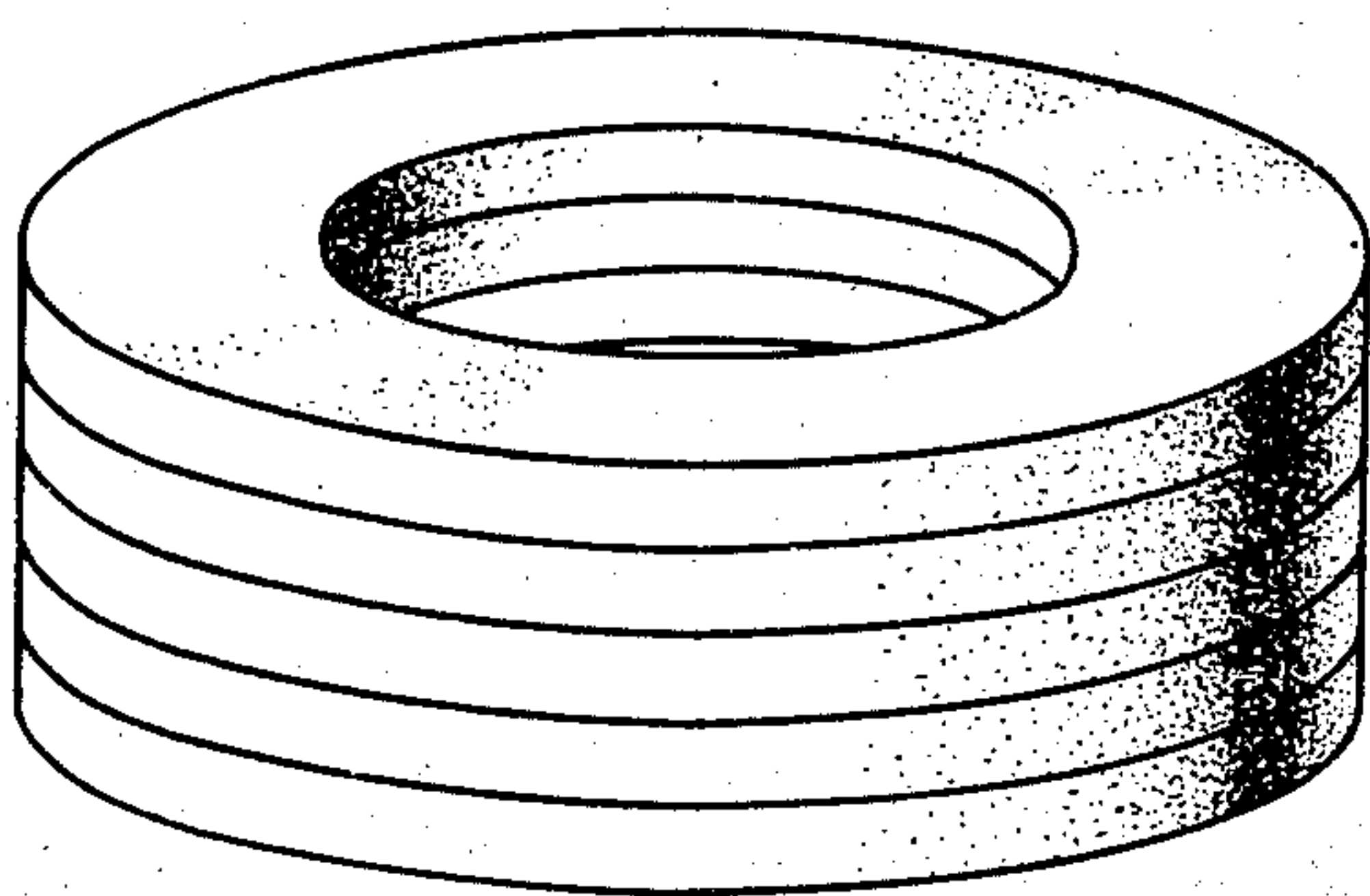


Fig. 2.



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MAGNETIC CORE.

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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.

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
10 nickle 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,
15 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
20 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
25 mechanical pressures used in forming the core and the high temperature employed in the heat treatment.

In accordance with this invention the material used to produce the insulating coating
30 on the magnetic dust is lead sesqui-oxide Pb_2O_3 , or other oxygen bearing material which will liberate some of its oxygen at or somewhat below the temperatures employed in the heat treatment of the cores.
35 During the heat treatment oxygen is released and combines with the magnetic material to produce an oxide thereof in the form of a coating on the particles, the residue of the oxygen bearing material being another form
40 of lead oxide, or other non-conducting substance if the original material is other than a higher oxide of lead.

In another aspect the invention is a method of preparing magnetic structures and
45 more particularly magnetic dust cores. As applied to cores, for example, this method, specifically stated, comprises coating each particle of a mass of the magnetic dust with an oxygen bearing insulating substance
50 which will release part of its oxygen at a definite temperature, preferably an oxide, for instance, lead sesqui-oxide Pb_2O_3 , compressing the coated particles into a solid core, and heat treating the core to improve the
55 magnetic properties of the core material.

An advantage of this method is that only a single heat treatment is necessary to form the double insulating coating on the particles and to improve the magnetic properties of the magnetic alloy material.

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-
60 rality of rings combined to form a magnetic core. 65

In carrying out the present invention the magnetic material is preferably prepared from an alloy containing nickel and iron. 70 A 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, issued June 1, 1926. Obvi- 75 ously other alloys may also be used. The magnetic alloy, which may be in slab form is reduced to a finely divided form, such as a fine dust, in any well known manner, as for example by crushing in a hammer mill or 80 other suitable reducing apparatus, and is subsequently rolled in a ball mill. The dust is sieved and the portion passing through a 120 mesh sieve is used for core material. This dust is mixed with a material to coat 85 the particles and pressed into core form. The coating material preferably consists of a higher oxide, for instance, lead sesqui-oxide, Pb_2O_3 , which is mixed with the dust, the weight of the oxide being approximately 90 5% of that of the alloy dust. Other materials may be used instead of lead sesqui-oxide with equally good results. Such materials may consist of manganese dioxide, MnO_2 ; nickel sesqui-oxide, Ni_2O_3 ; antimony 95 pentoxide, Sb_2O_5 ; or bismuth oxide, Bi_2O_5 . The magnetic dust is mixed with the lead sesqui-oxide to insure a thorough coating on the individual particles. A mass of the coated particles is then placed in a mold and 100 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 then transferred to an electric oven and given a heat 105 treatment to increase the permeability of the magnetic material or otherwise improve its magnetic properties. This treatment is carried on at temperatures between approximately 450° C. and 550° C. and the rings are 110

thereafter cooled. During the heat treatment the lead sesqui-oxide liberates oxygen at approximately 370° C. and at somewhat higher temperatures this oxygen combines with the nickel and iron to form an insulating coating of nickel and iron oxides on the individual particles and there is left a lead oxide residue, which is also non-conducting, as a secondary coating on the insulated particles of the mass. Such an insulating coating is chemically inert and stable at the maximum temperature of the heat treatment and will not break down to cause deleterious changes in the permeability of the magnetic material obtained by the heat treatment. For a detailed account of heat treatments employed with nickel iron alloys, reference is made to patents of G. W. Elmen, No. 1,586,884 and No. 1,586,889, issued June 1, 1926.

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.

Although the above described method is preferred in forming the core rings, due to the advantage of forming the double coating of insulating material during the heat treating process, it is within the scope of this invention to subject the coated particles to heat treatment prior to forming the core rings, to change the nature of the insulating coating on the particles. Metallic structures other than magnetic cores are also within the scope of the invention.

What is claimed is:

1. A metallic structure comprising magnetic material in the form of dust, a property of said material being improved by heat treatment, and an insulating coating on the dust particles comprising an oxide of said material and a lower oxide of another material which forms a higher oxide, which latter is reducible to the lower form of oxide at a temperature at least as low as that employed in said heat treatment.

2. A magnetic structure comprising magnetic dust of an alloy consisting chiefly of nickel and iron, a property of which is improved by heat treating at a temperature in the range between 450° C. and 550° C., and an insulating coating on said dust particles comprising oxides of nickel, iron and lead.

3. A magnetic structure comprising elements of magnetic material, a property of which is improved by heat treatment and which oxidizes at the temperature of said heat treatment, and an oxygen bearing substance separating said elements which releases oxygen at a temperature at least as

low as that employed in said heat treatment, whereby when the structure is heat treated oxygen will be released and an insulating oxide of the magnetic material will be formed between the elements.

4. A magnetic structure comprising a mixture of particles of magnetic material, properties of which are improved by heat treatment and which oxidize at the temperature of said heat treatment, and an oxygen bearing substance which releases oxygen at the temperature employed in said heat treatment, whereby when the structure is heat treated oxygen will be released and an oxide of the magnetic material formed.

5. A magnetic structure comprising a mixture of particles of an alloy containing nickel and iron, properties of which are improved by heat treatment and which oxidize at the temperature of said heat treatment and an oxygen bearing substance which releases oxygen at the temperature employed in said heat treatment, whereby when the structure is heat treated oxygen is released and nickel and iron oxides are formed.

6. The method of producing a magnetic structure from magnetic dust, a property of which is improved by heat treatment, which method comprises mixing the dust with a substance which liberates oxygen when heated at a temperature at least as low as that employed in said heat treatment and subsequently subjecting the mixture to said heat treatment.

7. The method of producing a magnetic structure from magnetic dust, a property of which is improved by heat treatment, which method comprises mixing the dust with a substance which liberates oxygen when heated at a temperature at least as low as that employed in 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 elements which comprises assembling said elements into the desired structural form with an oxide therebetween, causing said oxide to release oxygen and leave a non-conducting residue and causing said oxygen to unite with the magnetic material to form a non-conducting oxide.

9. The method of producing a magnetic structure from elements of an alloy consisting chiefly of nickel and iron, a property of which is improved by heat treatment, which method comprises assembling the elements with an oxide therebetween and subjecting the structure to said heat treatment, thereby causing said oxide to liberate oxygen, leaving a non-conducting residue, and causing said liberated oxygen to unite with the magnetic material to form a non-conducting oxide.

10. The method of producing a magnetic

structure from magnetic dust of an alloy consisting chiefly of nickel and iron, a property of which is improved by heat treatment, which method comprises mixing the dust with an oxide, compressing said dust into a self-sustaining solid and subjecting said solid to said heat treatment, thereby causing said oxide to liberate oxygen, leaving a residue of non-conducting substance, and causing said liberated oxygen to unite with the magnetic dust to form a non-conducting oxide on said dust.

11. The method of producing a magnetic structure from magnetic dust of an alloy consisting chiefly of nickel and iron, a property of which is improved by heat treating

at a temperature in the range between 450° C. and 550° C. which method comprises mixing said dust with lead sesqui-oxide, the weight of the oxide being approximately 5% of the weight of the dust, subjecting the mixture to high pressure to form a homogeneous solid, and heating said solid at a temperature within said range whereby said lead sesqui-oxide is changed to lead oxide and the released oxygen is caused to unite with the nickel and iron to form oxides thereof.

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

VICTOR E. LEGG.