

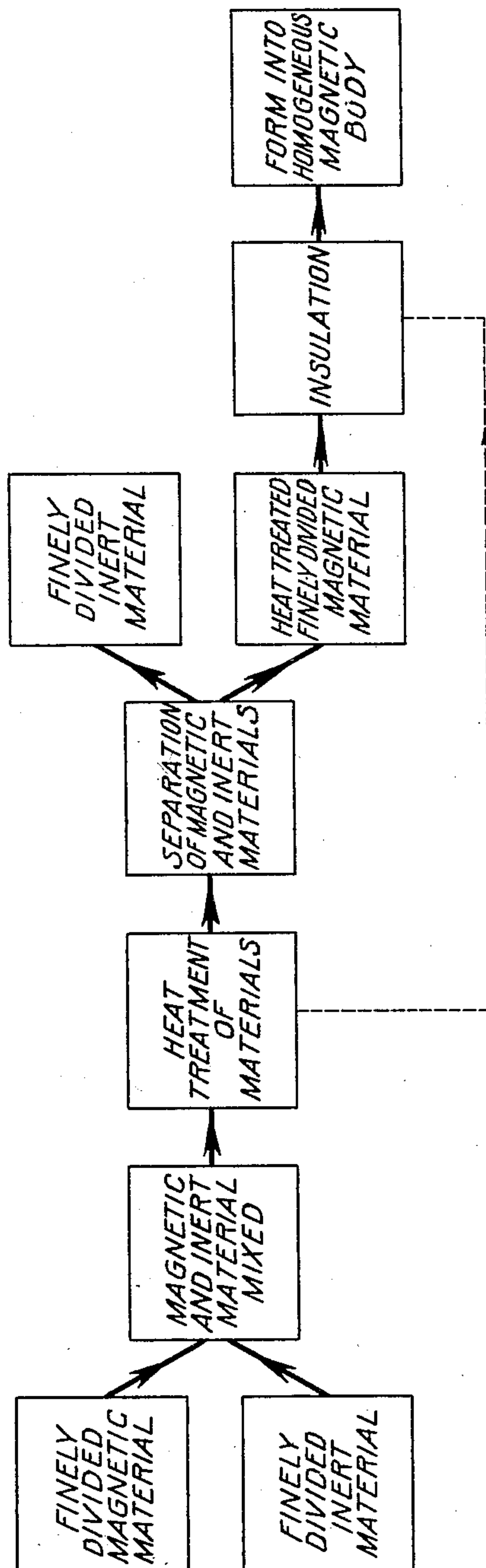
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MAGNETIC STRUCTURE

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MAGNETIC STRUCTURE

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This invention relates to magnetic structures and particularly to a process of treating magnetic material for producing such structures.

5 The invention has reference to magnetic material in finely divided condition. Material in this condition is commonly used in structures of the so-called compressed "dust" type, that is, the type formed by compressing finely divided magnetic material and insulating material under high pressure to form a homogeneous structure, such as is commonly used for cores for loading coils and the like, and especially to such structures in which the magnetic material requires heat treatment to improve its magnetic properties. So far as this invention is concerned, in its broader aspects it is not necessary that the material be actually compressed although in most usages the material will be compressed or otherwise formed into the required structures.

10 An object of the invention is to improve the magnetic properties of finely divided magnetic material such as may be used in structures of the above described type.

15 Another and more specific object is to improve the magnetic properties of such structures by improving the process for making the same.

20 Heretofore, it has been found desirable in the process of producing commercially magnetic structures of the compressed dust type in which the magnetic material requires heat treatment to improve its magnetic properties, such as nickel-iron alloy material, to subject the magnetic dust particles to heat treatment at high temperatures after they have been insulated and compressed into a homogeneous structure in order to improve the magnetic properties which have deteriorated due to the high pressures to which the particles have been subjected, for example, in the manner disclosed and claimed in the United States patent to Elmen 1,669,658, issued May 15, 1928.

25 It has also been found desirable in order to obtain the best magnetic properties in completed structures of the type described above to subject the magnetic particles to a preliminary

nary annealing heat treatment at a high temperature prior to their insulation and compression, for example, in the manner disclosed and claimed in the United States patent to Karcher No. 1,669,665, issued May 15, 1928. At the high temperatures of the last mentioned annealing treatment, the magnetic particles will often sinter together and form a hard cake, which must be broken and pulverized by machinery in order that the particles may be properly insulated prior to pressing them to form a homogeneous body. Applicant has found that this process of breaking up and pulverizing the sintered particles results in sufficient mechanical working to harden the magnetic particles to some extent, resulting in a loss of a part, at least, of the beneficial effects of this preliminary heat treatment on the magnetic characteristics of the completed structure.

30 In accordance with the invention, this sintering of the magnetic particles during the preliminary heat treatment with its resultant bad effect on the magnetic properties of the completed structure is prevented by utilizing a finely divided material inert at the temperature of the annealing heat treatment, such as silica dust, to separate the particles from each other during their heat treatment.

35 For a better understanding of the invention and its advantages, reference is made to the following detailed description and the accompanying drawing, the single figure of which shows in diagrammatic form the various steps in one embodiment of the process of the invention.

40 As indicated in the drawing, the process of the invention comprises, first, mixing with finely divided magnetic particles, which may be obtained by grinding or other methods, prior to their insulation and compression, a finely divided material which will not combine chemically with, or adhere firmly to the magnetic particles when subjected to heat of high temperature. The mixture is then subjected to the annealing heat treatment necessary to improve the magnetic properties of the magnetic material, the inert material serving to separate the magnetic dust particles from each other so as to prevent

their sintering during this heat treatment. A suitable inert material is silica dust, which is preferably subdivided to a greater degree of fineness than the magnetic dust.

5 After the heat treatment of the mixture, the particles of magnetic material may be easily separated from the inert material without employing methods which will tend to reduce the beneficial effects of the anneal-
10 ing treatment, as by water elutriation or other suitable means, and subsequently insulted and formed into a homogeneous structure. The removal of the silica is not necessary, however, but the mixture of silica and
15 magnetic dust, with or without the addition of a binding medium or other insulting material, or both, may be formed by suitable means into a homogeneous magnetic structure. The silica in this case will serve as
20 an insulator, or a partial insulator between the magnetic particles.

Comparative measurements on magnetic structures made by the method described above and on structures made from the same
25 magnetic material but without using any means for preventing sintering of the magnetic dust particles during the annealing heat treatment indicate that the former have much improved magnetic properties over
30 those of the latter. In particular cases in which loading coil cores made from finely divided (200 mesh) particles of nickel-iron alloy material comprising about 81 per cent nickel and 19 per cent iron mixed with about
35 3 per cent by weight of finely divided (400 mesh) silica and subjected to a preliminary annealing treatment at a temperature of approximately 900° C. for one hour, were compared with cores made of magnetic particles
40 of the same composition taken from the same lot and subjected to similar treatment except that silica was not used, a permeability of 118, hysteresis coefficient of 2.5 and eddy current coefficient of 1.7 was obtained for the
45 former as compared with a permeability of 87, hysteresis coefficient of 3.9 and eddy current coefficient of 1.7 for the latter. In both cases the magnetic particles were insulated with the chromic acid-water glass-talc type
50 of insulation in the manner described in the patent to Andrews et al. No. 1,669,643, issued May 15, 1928, and the insulated particles were subsequently compressed under a pressure of about 200,000 lbs. per square inch
55 into a homogeneous core, the completed core being given a further annealing heat treatment at a temperature of 500° C. for one hour to give the required magnetic characteristics thereto.

60 It is to be understood that the the composition of the inert material used for separating the magnetic particles during the annealing heat treatment specified above, and the particular heat treatments mentioned above, are
65 only by way of example and do not limit the

invention, the scope of which is defined by the appended claims.

What is claimed is:

1. The method of improving the magnetic properties of the individual particles of a mass of finely divided particles of magnetic material by heat treatment at a high temperature while preventing sintering of the particles, which comprises mixing said particles with a finely divided material which is inert
70 when subjected to heat at a high temperature, subjecting the mixture to heat treatment at a high temperature to effect the desired change in the properties of the magnetic particles, and then removing said magnetic particles
75 from said mixture. 80

2. The method of producing a magnetic structure from finely divided particles of magnetic material requiring heat treatment at an elevated temperature to fully develop
85 its magnetic properties, which method comprises mixing said magnetic particles with finely divided material which is inert at said elevated temperature, to effectively separate
90 said magnetic particles from each other, heat treating the mixture at an elevated temperature, removing said finely divided inert material, insulating the heat treated magnetic particles, and forming the insulated particles
95 into a homogeneous structure. 100

3. In a process for producing magnetic structures comprising finely divided particles of magnetic material insulated from each other and compressed into a homogeneous mass, said magnetic particles requiring annealing at an elevated temperature prior to their insulation and compression in order to fully develop the magnetic properties of the completed structure, the method of annealing
105 said magnetic particles so as to prevent sintering during the annealing treatment, which method comprises mixing the magnetic particles prior to said annealing treatment with a finely divided material inert at said elevated temperature and subjecting the mixture to
110 said annealing treatment, the annealed magnetic particles being separated from said inert material prior to their insulation and compression into a magnetic structure.

4. The method of producing magnetic structures having a high permeability, low hysteresis losses and low eddy current losses, which comprises mixing finely divided particles of a magnetic material having an initial permeability higher than that of iron with
120 a finely divided material which is inert when subjected to heat at a high temperature, subjecting the mixture to heat treatment at a high temperature to improve the magnetic properties of said magnetic particles, separating
125 the heat-treated magnetic particles from the finely divided inert material, insulating said heat treated magnetic particles, and forming the insulated particles into a homogeneous structure. 130

5. A method in accordance with that of claim 4, and in which said finely divided inert material comprises silica.

6. A method in accordance with that of claim 4, and in which said finely divided inert material comprises silica, the particles of which are at least as small as said magnetic particles.

7. The method of producing a magnetic structure which comprises mixing a mass of finely divided particles of a magnetic material comprising an alloy including nickel and iron, with finely divided silica to effectively separate the magnetic particles from each other, subjecting the mixture to a heat treatment at an elevated temperature to improve the magnetic characteristics of the magnetic particles, separating the heat treated magnetic particles from the finely divided silica, insulating the heat treated magnetic particles and forming the insulated magnetic particles into a homogeneous structure.

8. The method of producing a magnetic body having a high permeability, low hysteresis losses, and low eddy current losses, which consists in mixing finely divided particles of a magnetic alloy including nickel and iron with finely divided silica, subjecting the mixture to heat treatment at a high temperature to improve the magnetic properties of the magnetic particles, applying an insulating material between the magnetic particles after said heat treatment, and forming the insulated magnetic particles into a homogeneous structure.

In witness whereof, I hereunto subscribe my name this 29th day of June, 1928.

RICHARD M. BOZORTH.

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