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METHOD OF PRODUCING MATERIALS IN FINELY DIVIDED FORM

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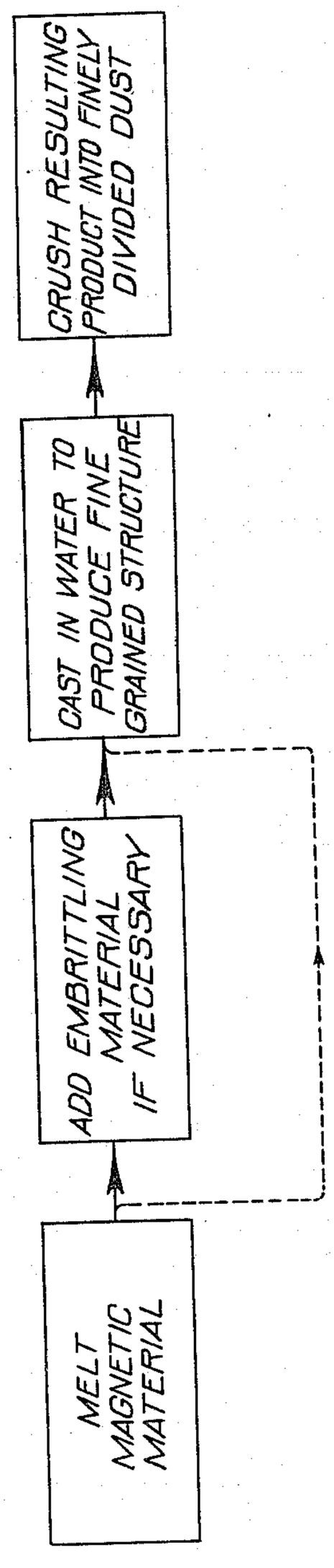

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UNITED STATES PATENT OFFICE

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METHOD OF PRODUCING MATERIALS IN FINELY-DIVIDED FORM

Application filed January 31, 1929. Serial No. 336,418.

This invention relates to methods of producing materials in finely divided form and particularly to methods of producing finely divided magnetic materials.

The invention has special reference to methods of manufacturing finely divided magnetic material for use in magnetic cores of the so-called "dust" type, particularly dust cores for loading coils and the like formed from a mixture of finely divided magnetic material and insulating material, such as described in U. S. patent to G. W. Elmen, No. 1,297,126, issued March 11, 1919. In magnetic cores of the type referred to above, it is desirable that the magnetic material be in sufficiently fine sub-division so that eddy currents are reduced to a minimum. Alloys of magnetic materials, such as nickel, iron and cobalt, because of their good electrical and magnetic characteristics, have been found to be particularly suitable as the magnetic material in such cores. In order to produce finely divided magnetic dust from such alloys in some cases it has been found to be desirable to incorporate in the magnetic alloy a small percentage of an additional material, for example, iron oxide, to embrittle the alloy so that it may be easily broken up mechanically into dust, and in addition to subject the material while it is hot to mechanical working, such as rolling, to reduce the size of its crystals so that sufficiently fine dust may be obtained by the subsequent crushing processes. Such a process is described in the U. S. patent to Beath and Heinicke, No. 1,669,649, issued May 15, 1928.

The object of this invention is to facilitate the reduction of metallic materials, such as magnetic alloys, to very finely divided form.

It has been found that the process of the prior art described above is not particularly suitable for reducing certain magnetic materials, for example, alloys including certain proportions of nickel, iron and cobalt, to dust, inasmuch as the crystals of these materials cannot be sufficiently reduced in size by the hot rolling process so as to enable dust of the desired degree of fineness to be produced. In accordance with this invention, the above described process has been improved in the case of said certain materials by substituting for the step of hot rolling in the process, the step of casting the molten magnetic material, or the molten magnetic material and the incorporated embrittling material, if an embrittling material is used, in water to solidify it, and to produce a crystalline structure therein which is sufficiently fine to enable the reduction of the material into very fine particles by the subsequent mechanical treatment.

The exact nature of the invention will be understood from the following detailed description thereof when read in connection with the accompanying drawing, the single figure of which shows in schematic form a process for producing finely divided material in accordance with the principles of the invention.

The invention will be described as applied to the production of finely divided magnetic material, but is not limited to magnetic material, but is of advantage in connection with the reduction to very finely divided form of metallic materials in general. The various steps in the process of the invention are indicated in the drawing. A preferable detailed method of practicing the invention will now be described.

The magnetic material in solid form is placed in a suitable container and heated until it becomes molten. A small quantity of embrittling material, such as iron oxide or iron sulphide, is then added to the molten material and mixed thoroughly therewith. This step in the process may, of course, be omitted if the magnetic material is inherently of the required brittleness so that it may be readily reduced to finely divided form by the usual mechanical processes. The molten material is then poured into water in a suitable container, the water being preferably continuously stirred during the pouring. The material will solidify in the water in the form of brittle aggregates of fine grained crystalline structure. These aggregates are then readily broken up into fine dust by mechanical processes, such as crushing and rolling. In these aggregates the fracture will take place principally along the crystal boundaries, and thus,

the fine grained structure of the material will enable the material to be reduced to very finely divided form approximating the size of a single crystal.

The process of the invention which has been described may be used for reducing metallic materials in general to finelv divided form, but it is especially applicable to magnetic alloys such as are used in magnetic dust cores for loading coils, transformers and the like. Its use has been found to be especially desirable in connection with the reduction to finely divided form of a magnetic alloy containing about 45 per cent nickel, 30 per cent cobalt and the rest iron, an alloy which has been found especially suitable as a magnetic material for loading signaling lines because of its desirable magnetic and electrical characteristics. This particular alloy does not lend itself readily to the processes of the prior art for making magnetic dust because the hot rolling step in such processes in this case will not sufficiently reduce the size of the crystals to enable subdivision of the material into verv finelv divided form.

The fine-grained, brittle magnetic material made by the process of the invention is then mechanically broken up into fine dust, as by crushing and rolling in a ball mill. The material thus treated will yield a large percentage of particles small enough to pass through a 120 mesh sieve, particles of such fineness being particularly suitable for either continuous or lump loading of telephone circuits. This very finely divided material is particularly well adapted to be formed into rings or cores for loading coils by a method similar to that described in U. S. patent to Andrews et al., No. 1,669,643, issued May 15, 1928. The method described in that patent consists in first annealing the magnetic particles, coating the annealed particles with a suitable insulating material, and then forming the coated particles into rings or cores by the application of high pressure thereto, the resulting rings or cores being given a subsequent annealing heat treatment to produce the desired stable magnetic properties therein. A plurality of rings thus formed are then stacked coaxially to form a core on which the usual toroidal winding is mounted, the number of such rings used depending upon the existing electrical characteristics of the telephone circuit with which the loading coils are to be associated.

The invention is not limited in its application to particular materials mentioned above which are given by way of example only, nor to the details in the process described, but only by the scope of the appended claims.

What is claimed is:

1. The method of reducing metallic material to very finely divided form which consists in melting the metallic material, casting the molten material in water to solidify it, and to produce a fine-grained crystalline structure therein, and breaking up the resulting product into finely divided form.

2. The method of reducing metallic material to very finely divided form which consists in melting the magnetic material, adding an embrittling agent to the molten material, casting the molten mixture in water to solidify it, and to produce a fine-grained crystalline structure therein, and thereafter mechanically breaking up the resulting product into particles of the desired fineness.

3. The method of reducing a magnetic material to a finely divided form suitable for use in low loss magnetic dust cores for induction coils, which method consists in melting the magnetic material, incorporating an embrittling material in the molten material, casting the molten mixture in water to solidify it, and to produce a fine-grained crystalline structure therein, and mechanically breaking up the resulting product into small particles.

4. The method of reducing an alloy including nickel, iron and cobalt to finely divided form suitable for use in low loss magnetic dust cores for induction coils, which method consists in melting the alloy, incorporating an embrittling material in the molten alloy, pouring the molten material into water to solidify it, and to produce a fine-grained crystalline structure therein, and mechanically breaking up the resulting product into small particles.

5. The method of making a magnetic body having high permeability and low hysteresis and eddy current losses, which method consists in melting a magnetic material including nickel and iron, incorporating an embrittling material in the molten material, pouring the molten mixture into water to solidify it, and to produce a fine-grained crystalline structure therein, mechanically breaking up the resulting product into fine dust, insulating the particles of dust, and forming the insulated dust into a homogeneous solid body.

In witness whereof, I hereunto subscribe my name this 30th day of January, 1929.

JAMES E. HARRIS.