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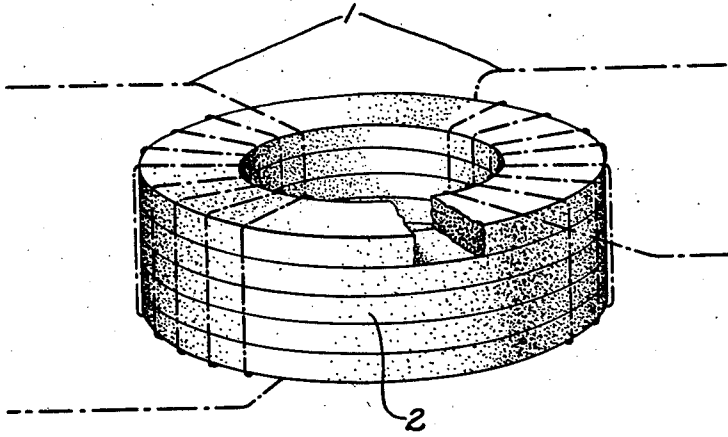
CROSS REFERENCE

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MAGNETIC BODY
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MAGNETIC BODY

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This invention relates to electrical insulation and particularly to the insulation of magnetic material in magnetic cores for loading coils and the like.

jected in service, so as to impair the magnetic, electrical or mechanical properties of said coils.

The U. S. patent to Andrews et al., No. 1,669,643, issued May 15, 1928, discloses a method of obtaining the above-mentioned desirable properties in a magnetic dust core by using as an insulating and binding material for the magnetic dust particles suitable proportions of sodium silicate (water glass), talc and chromic acid. The chromic acid is provided for the purpose of neutralizing the effects of the other components of the insulating material so as to eliminate to some extent the forming of undesired chemical combinations during the process of manufacture of the core which tend to impair the magnetic and electrical properties of the magnetic material. In the process of manufacture disclosed in the Andrews et al. patent, the magnetic cores in which the sodium silicate-talc-chromic acid insulation is used are boiled in water prior to the final annealing heat treatment in order to make them chemically stable and to remove substantially all soluble substances such as chromates.

As a result of considerable experimentation, applicant has discovered that magnetic dust cores having better magnetic and electrical properties at least as good as those employing the sodium silicate-talc-chromic acid insulation may be produced by using as the insulating and binding material between the magnetic dust particles, merely talc and sodium silicate (water glass) of a high silica to soda ratio, in suitable proportions. When the sodium silicate has a high silica to soda ratio, it was found unnecessary to use an additional chemical, such as chromic acid, for neutralizing the alkali. The elimination of the chromic acid in the insulation results also in a simplification of the process of manufacture of the magnetic dust cores for the step of washing the cores to remove water soluble salts of the chromic acid is unnecessary.

The proportions of the sodium silicate and talc to be used in a given case are determined by the amount of magnetic material

An object of the invention is to improve the magnetic, electrical and mechanical characteristic of magnetic bodies of the type employing magnetic material in finely divided form, for example, magnetic dust cores for loading coils.

Magnetic cores made from finely divided magnetic material, so called magnetic dust cores, are being extensively used for the loading coils which are inserted in telephone lines to improve their transmission characteristics. Such cores are usually constructed by subjecting the finely divided particles of the magnetic material and a non-magnetic, insulating and binding material between the magnetic particles, to extremely high pressures in the neighborhood of 200,000 pounds per square inch. The high pressures are utilized to form the component materials into a substantially homogeneous mass in the desired core form, and to give sufficient mechanical strength to the completed core. The non-magnetic material serves as a binder, and also as an insulation between the magnetic particles to reduce eddy current losses in the completed core.

In the case especially where the magnetic material in a core made in the above described manner is a magnetic alloy including nickel and iron, it has hitherto been found desirable to subject the core to a subsequent heat treatment at a high temperature to remove the strains introduced in the magnetic material by the pressing operation, which tend to impair the magnetic properties of the magnetic alloy in the core. It is desirable, therefore, that the insulating material used in the core be one which will bind the magnetic particles firmly together, and which will withstand without deterioration the high pressures and temperatures to which it will be subjected during the construction of the core. It is desirable also that the insulating material in the core be one which will not deteriorate under the conditions to which loading coils are sub-

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in the body, the constituents of the material and the magnetic and electrical properties desired in the final magnetic body or core.

Briefly, the preferable process of making magnetic bodies in accordance with the invention is as follows. The finely divided magnetic material and finely divided dry talc are first mixed together in the proper proportions, and then there is added thereto the proper amount of a water solution of the sodium silicate. The whole is then continuously stirred together with the application of heat thereto until the water is evaporated and insulating coatings containing sodium silicate and talc are formed on the magnetic particles. A mass of the insulated particles which are of the required degree of fineness to make them suitable for use as magnetic core material, are then subjected to high pressure to form them into a solid, substantially homogeneous mass of the desired form, which is subsequently annealed at a high temperature to improve the magnetic properties of the magnetic material therein.

The practical applications of the invention and the details thereof will be clear from the description when read in connection with the accompanying drawing, the single figure of which illustrates a magnetic device, such as a loading coil, comprising the toroidal windings 1 and a magnetic core 2 therefor composed of a plurality of stacked core rings made of compressed magnetic dust and insulating material in accordance with the invention.

In carrying out the present invention, the magnetic material is preferably prepared from a magnetic alloy including nickel and iron. A preferable form of alloy contains approximately 81 per cent nickel and approximately 19 per cent iron. For a description of this and other magnetic alloys which may be used in the magnetic bodies of the invention, reference is made to the U. S. patent of G. W. Elmen No. 1,586,884 issued June 1, 1926. Obviously magnetic alloys other than those described in that patent may also be used. The magnetic alloys used may be embrittled by the addition of an embrittling material or by subjecting it to a suitable preliminary metallurgical treatment such as disclosed, for example, in the U. S. patents to Zickrich No. 1,632,105 issued June 14, 1927, Beath et al. No. 1,669,649 issued May 15, 1928, White patent No. 1,739,052 and Harris patent No. 1,739,068 both issued December 10, 1929. After this it may be readily reduced to particles of the required degree of fineness, in any well known manner, for example, by crushing in a hammer mill and then subsequently rolling the crushed particles in a ball mill. The resulting product is then sieved, and the portion thereof passing

through a sieve of 120 meshes per inch is used as the magnetic core material. The magnetic dust particles are then insulated.

The material utilized for insulating the magnetic dust particles from each other in accordance with the invention comprises talc and sodium silicate only. The particular proportions of these materials used depend on the amount of magnetic material, the constituents thereof and the magnetic and electrical characteristics desired in the completed body. Where the alloy dust particles have the preferable combination of approximately 81 per cent nickel and 19 per cent iron and they are to be used for making magnetic cores for coils for loading telephone circuits, the magnetic dust particles are preferably insulated as follows.

Finely divided talc is first thoroughly mixed with the magnetic dust particles in proportions ranging from 1.0 to 2.5 grams, preferably 1.5 grams, talc to each 100 grams of the nickel-iron alloy dust. To this mixture is added a solution in about 20 C. C. of hot water of 0.5 to 2.0 grams preferably 1.5 grams, sodium silicate to each 100 grams of the magnetic alloy dust. For the best results, the talc and sodium silicate used should have a high degree of purity and the sodium silicate should have a high silica to soda ratio. The high ratio of silica to soda in the sodium silicate makes unnecessary the use of an additional material like chromic acid to neutralize the alkali in the sodium silicate and also makes unnecessary the later step of washing out undesired water soluble salts, such as sodium chromate, the presence of which in the complete cores would tend to make the magnetic and electrical properties thereof deteriorate in service. Sodium silicate is much less water soluble than sodium chromate. The elimination of the chromic acid has other advantages from the manufacturing point of view since chromic acid is a hygroscopic highly oxidizing substance.

The whole is then stirred continuously with the application of heat thereto until the temperature of the mass is about 120° C. in order to evaporate the water and to form on the magnetic dust particles adherent insulating coatings comprising talc and sodium silicate. The insulated dust is then sieved the portion passing through a 120 mesh sieve being suitable for use as a loading coil core material. A mass of the insulated magnetic particles is then placed in a mold and compressed under high pressure approximately 200,000 pounds per square inch, into core rings such as shown in the core 2 of the drawing. Following this step in the process, the core rings, without unduly exposing them to the air, are transferred to an annealing furnace where they are annealed at the optimum annealing

temperature of approximately 500° C., and are then cooled. A plurality of the rings thus formed are stacked coaxially to form a core, such as shown in the drawing, on which the usual loading coil core toroidal windings 1 are wound. The number of rings used in a given core will depend upon the existing electrical characteristics of the telephone circuit with which the loading coils are to be associated.

It has been found that the magnetic dust cores comprising magnetic alloy particles and the talc and sodium silicate insulation in the above mentioned proportions, made by the above mentioned process have for a given high permeability at least as good hysteresis and resistivity characteristics as similar cores employing the chromic acid-talc-sodium silicate insulation of the prior art making them particularly suitable for use as cores for loading telephone circuits. The insulation in these cores is a decided improvement over the insulation used hitherto in the prior art in that the required insulating and binding properties are obtained with a smaller number of chemical materials resulting in a more simplified and cheaper process. Moreover, as brought out above the materials used for insulating the magnetic dust particles in the cores of the invention do not form deleterious chemical combinations which tend to impair the magnetic electrical and mechanical characteristics of the cores under the conditions to which the loading coils are subjected in practice.

It is to be understood that the invention is not limited to magnetic bodies or cores made from magnetic materials having the particular constituents referred to nor to the particular proportions of the magnetic and insulating materials and to the particular heat treatments specified above, which have been given by way of example only, and that other magnetic alloys, other proportions of the insulating materials, and other heat treatments may be employed in making such cores without departing from the spirit and scope of the invention as defined in the appended claims.

What is claimed is:

1. A magnetic body consisting of finely divided nickel-iron alloy and an insulating and binding material comprising sodium silicate of high silica to soda ratio and talc only between the alloy particles.

2. A magnetic body comprising a magnetic alloy in finely divided form, including nickel and iron, and an insulating material between the particles of the alloy and consisting of sodium silicate having a high silica to soda ratio, and talc only, the whole compressed into a substantially homogeneous solid.

3. A magnetic body comprising finely

divided particles of a magnetic alloy including nickel and iron in approximate proportions of 81 per cent nickel and 19 per cent iron, and an insulating material between the particles comprising talc and sodium silicate, said insulating material constituting approximately three per cent by weight of the magnetic alloy, compressed into a substantially homogeneous mass of the desired form.

4. A magnetic body comprising an alloy including approximately 81 per cent nickel and 19 per cent iron, in finely divided form, and an insulating material between the particles comprising sodium silicate and talc in proportions of 0.5 to 2.0 per cent and 1.0 to 2.5 per cent, respectively, by weight of the magnetic material.

5. A magnetic body comprising an alloy including approximately 81 per cent nickel and 19 per cent iron, in finely divided form, and an insulating material between the particles comprising sodium silicate and talc in proportions of approximately 1.5 per cent and 1.5 per cent, respectively, by weight of the magnetic alloy material.

6. The process of making a magnetic body comprising finely divided magnetic particles and an insulation material consisting of talc and sodium silicate only, which process consists in continuously stirring together a mixture of the finely divided magnetic particles and finely divided talc in a solution of sodium silicate of high silica to soda ratio, while subjecting the whole to heat, to coat the magnetic particles with talc and sodium silicate, subjecting a mass of the coated particles to high pressure to form it into a substantially homogeneous solid of the desired form, and subsequently heat treating said solid at a high temperature to improve the magnetic properties of the magnetic material therein.

7. The process of making a magnetic body which consists in continuously stirring together a mixture of finely divided particles of iron-nickel alloy and finely divided talc in a water solution of sodium silicate while subjecting the whole to heat until the mixture reaches a temperature of approximately 120° C., to insulate the alloy particles, subjecting a mass of the insulated particles to high pressure to form it into a substantially homogeneous solid of the desired form, and then heat treating said solid to improve its magnetic properties.

8. The process of making a magnetic core having such magnetic, electrical and mechanical characteristic as to make it particularly adapted for use as a core for a telephone loading coil, from finely divided particles of a magnetic alloy containing approximately 81 per cent nickel and 19 per cent iron and an insulating material containing sodium silicate and talc only, which

method consists in thoroughly mixing with each 100 grams of the finely divided particles of said magnetic alloy approximately 1.5 grams of finely divided talc, adding the mixture to a water solution containing approximately 1.5 grams of sodium silicate, continuously stirring the whole together with the application of heat until it reaches a temperature of approximately 120° C., to form insulating coatings comprising talc and sodium silicate on the magnetic particles, subjecting a mass of the insulated particles to high pressure to form it into a substantially homogeneous solid of the desired form, and annealing said solid at a temperature of approximately 500° C. to improve the magnetic properties of the magnetic material therein.

In witness whereof, I hereunto subscribe my name this 5th day of June, 1930.

HUBBEL LATHROP.

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