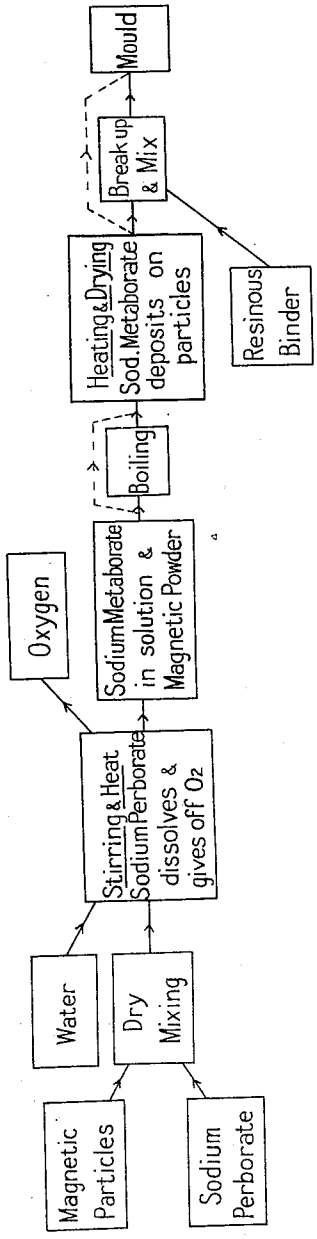
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METHOD OF MOLDING MAGNETIC POWDER

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METHOD OF MOLDING MAGNETIC POWDER

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This invention relates to the manufacture of moulded magnetic cores for inductances, and more particularly to the treating of magnetic powder prior to the moulding process.

In the manufacture of moulded magnetic cores, it is customary to insulate the magnetic particles one from the other, since otherwise the core losses are excessive. The methods of particle insulation practised hitherto have been found to be troublesome to control, and are also expensive. Difficulties have arisen in particular due to variations which occur in the magnetic powder itself. For example, in the process of insulating hydrogen reduced iron powder by applying a coating of zinc phosphate, little or no difficulty is experienced. When, however, carbonyl iron has to be insulated by this process, some batches are found to give trouble which is thought to be due to varying particle size. Powder with smaller than average particle diameter has been found to give trouble—satisfactory coatings being difficult to obtain and the core losses being excessive.

The objects of the invention are to obviate the foregoing difficulties and to provide a method of insulating magnetic particles which is reliable in production and is both cheap and easy to carry out.

This invention consists in applying to individual magnetic particles a coating of an alkali metal metaborate derived from a water soluble alkali metal perborate, such for example as sodium perborate.

The following examples read in connection with the accompanying drawing, the single figure of which shows schematically an application of the invention, illustrate the preferred procedure for making moulded magnetic cores in accordance with the invention:

Example

To each kilogram of magnetic powder (e. g., carbonyl iron or hydrogen reduced iron) is added 30 to 40 grams of sodium perborate, i. e., according to the degree of permeability required, followed by mixing in a dry state sufficiently to disperse the sodium perborate uniformly throughout the iron powder. Sufficient water is then added, for example, 250 cc. per kilogram of the magnetic powder, to make a thin soupy mixture, which is thereupon thoroughly stirred, and the resulting admixture dried out slowly by heating in a revolving mixer. In some instances, for example, with carbonyl iron powder, this aqueous mixture may be boiled for 15 minutes, before subjecting to the drying operation in the revolving

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mixer. Upon the addition of water with subsequent stirring as aforesaid, and also during the boiling operation, if employed, at least a portion of the sodium perborate dissolves and in giving off oxygen is reduced to metaborate. The oxygen tends to break up aggregations of iron particles, and the metaborate during the subsequent drying operation in the revolving mixer, precipitates out on the individual particles of magnetic material, to form insulating coatings thereon. When the powder has thus been thoroughly dried out and allowed to cool, there is added about 30 grams of a synthetic resin per kilogram of iron powder, for example, a thermo-setting synthetic resin, such as a phenol-formaldehyde resin, in a fine state of sub-division, and the resulting mixture is then treated in a ball mill to break up aggregates of magnetic particles and also thoroughly to mix the resinous binder therewith. At this stage, the resulting admixture is ready to be loaded into a heated mould, of the appropriate magnetic core shape desired, and is thereupon subjected to combined heat and pressure until the mixture is integrally consolidated and the resinous binder converted to the thermoset condition. For this purpose, pressures of about 6,000 to 15,000 kilograms per square centimeter, and temperatures of about 100 to 170° C., may be employed, the hot-pressing operation being ordinarily carried out for about 2 to 4 minutes.

A principal advantage of the aforesaid procedure for treating magnetic powders prior to moulding, is that the process is very simple and therefore very economical to apply. Similar results can be obtained with a variety of raw materials, for example potassium, slight variations in which do not affect the final result.

In a modification of the procedure for making moulded magnetic cores as described above, no binding resin is used and the moulding process is carried out at room temperature. To produce cores of the same permeability a higher percentage of water-soluble alkali metal perborate replaces the binding resin used in the procedure described above.

The modified procedure is now described in detail by way of example:

Example

To each kilogram of magnetic powder (e. g. carbonyl iron or hydrogen reduced iron) is added 30 to 100 grams of sodium perborate, i. e. according to the degree of permeability required in the finished core. The magnetic powder and the sodium perborate are then mixed in a dry state

sufficiently to disperse the sodium perborate uniformly throughout the iron powder. Sufficient water is then added, for example, 250 cc. per kilogram of the magnetic powder to make a thin soupy mixture, which is thereupon stirred and the resulting admixture dried out in a revolving mixer at a temperature of approximately 100° C. During this process a portion of the sodium perborate dissolves and in giving off oxygen is reduced to metaborate. The oxygen tends to break up aggregations of iron particles, and the metaborate during the drying operation precipitates out on the individual particles of magnetic material to form insulating coatings thereon.

After the drying out of the admixture as described above the quantity of the resultant powder required for moulding a particular sized or shaped core is then weighed out and placed in a mould. Pressure for moulding of about 6,000 to 15,000 kilograms per square centimeter is applied at room temperature depending on the desired compression which is judged by the density of the finished core. After ejection from the mould the cores are placed in an oven and are heated at a temperature of between 120° and 180° C. for a period from 12 to 24 hours in order to dry out water of crystallisation.

Removed from the oven the cores are allowed to cool to a temperature of approximately 60° C. and are then coated with lacquer to prevent subsequent absorption of water by the mouldings.

The above procedure provides a simplification over the procedure described before in which a bonding material was required, and the particles had to be broken up after insulation. Moulding the cores without applying heat is very much cheaper, because the power consumption of moulding presses is rather considerable. For example, a press manufacturing a toroidal core approximately 5 centimetres diameter by approximately 2 centimeters height consumes approximately 5–10 kilowatts and produces one core every five to seven minutes; whereas the modified procedure enables cores to be produced once per minute from the same press with no consumption of power at all for heating the press. The moulded core itself of course has to be heated, but this requires relatively little heat since the process can be carried out in an oven with good thermal insulation. The turning out of one moulding per minute in place of one moulding per five minutes enables very much greater output to be obtained from the same capital expenditure in moulding presses, which are far more expensive than the necessary oven for the heat treatment of the cores after moulding. An additional factor is that when moulding can be done at room temperature the workmen operating the moulding machines can work for more efficiently because no awkward gloves are required to protect their hands from heat. There is a further advantage in using the modified procedure outlined above in preferance to a procedure in which bonding material of the synthetic resin type is employed, namely that heat treatment after moulding becomes possible without destroying the bonding material and/or distorting the shape.

I claim:

1. A process for applying insulating coatings of an alkali metaborate derived from a water soluble alkali metal perborate to magnetic particles, which comprises: dry mixing said particles and the perborate in a finely divided state, adding a solvent for the perborate with agitation and at a temperature sufficiently high to dissolve at least a portion of said perborate, and thereupon thoroughly drying the resulting product while continuously admixing the same.

2. A process for applying insulating coatings of sodium metaborate derived from sodium perborate to magnetic particles, which comprises: dry mixing said particles and perborate in a finely divided state, adding sufficient water with agitation and at a temperature sufficiently high to dissolve and reduce to metaborate at least a portion of the perborate, and thereupon thoroughly drying the resulting product while continuously admixing the same.

3. A process for applying insulating coatings of sodium metaborate derived from sodium perborate to magnetic particles, which comprises; dry mixing said particles and perborate in a finely divided state, adding sufficient water with agitation to dissolve at least a portion of the perborate, boiling the resulting mixture to reduce the dissolved perborate to metaborate, and thereupon thoroughly drying the same while subjecting to a continuously admixing operation.

4. A process for forming magnetic cores of powdered magnetic material, the particles of which are insulated by coatings of sodium metaborate derived from sodium perborate, and bonded together with a thermosetting synthetic resin, which comprises: dry mixing said magnetic particles and sodium perborate in a finely divided state, adding sufficient water with agitation and at a temperature sufficiently high to dissolve and reduce to metaborate at least a portion of the perborate, thereupon thoroughly drying the resulting admixture while subjecting to a continuous admixing operation adding sufficient of said resin in a finely divided state to bond the so-coated particles and thoroughly admixing therewith, and moulding the resulting admixture with combined heat and pressure into the configuration of said core, until the mixture is integrally consolidated and the resin converted from thermosetting to the thermoset condition.

5. A process for forming magnetic cores of powdered magnetic material, the particles of which are coated with an alkali metal metaborate derived from a water-soluble alkali metal perborate, which comprises: dry mixing said particles and perborate in a finely divided state; adding a solvent for the perborate with agitation and at a temperature sufficiently high to dissolve said perborate; thoroughly drying the resulting product while continuously admixing the same; moulding the resulting product, under pressure, to the shape of said core; and subjecting the moulded core to a baking operation for removing water of crystallization.

6. A process for forming magnetic cores of powdered magnetic material, the particles of which are coated with an alkali metal metaborate derived from a water-soluble alkali metal perborate, which comprises: dry mixing said particles and perborate in a finely divided state; adding a solvent for the perborate with agitation and at a temperature sufficiently high to dissolve said perborate; thoroughly drying the resulting product while continuously admixing the same; moulding the resulting product, under pressure, to the shape of said core; subjecting the moulded core to a baking operation for removing water of crystallization; and lacquering the moulded core while at elevated temperature resulting from said baking operation.

7. A process for forming magnetic cores of a powdered magnetic material, the particles of

which are coated with an alkali metal metaborate derived from a water-soluble alkali metal perborate, which comprises: dry mixing said particles and perborate in a finely divided state; adding sufficient water with agitation and at a temperature sufficiently high to dissolve the perborate; thoroughly drying the resulting product at elevated temperature while continuously admixing the same; moulding the product, under pressure, to the shape of said core; and subjecting the core to a baking operation for removing water of crystallization.

8. A process for forming magnetic cores of powdered magnetic material, the particles of which are coated with an alkali metal metaborate derived from a water soluble alkali metal perborate, which comprises: dry mixing said particles and said perborate in a finely divided state; adding sufficient water with agitation and at a temperature sufficiently high to dissolve the perborate; thereupon thoroughly drying the resulting product, at elevated temperature, while continuously admixing the same; moulding the resulting product, under pressure, to the shape of said core; baking the resulting core to remove water of crystallization; and lacquering the core, while at elevated temperature, resulting from said baking operation.

9. A process for forming magnetic cores of

powdered magnetic material, the particles of which are coated with sodium metaborate, derived from sodium perborate, which comprises: dry mixing said particles and said perborate in a finely divided state; adding sufficient water with agitation and at a temperature sufficiently high to dissolve the perborate and reduce it to metaborate; thereupon thoroughly drying the resulting product, at elevated temperature, while continuously admixing the same; moulding the resulting product, under pressure, to the shape of said core; baking the resulting core to remove water of crystallization; and lacquering the core, while at elevated temperature, resulting from said baking operation.

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