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(54) **Powder composite magnetic core and method of manufacturing the same**

(57) Method comprises the die being filled with magnetic powder composite, with at least one electromagnetic element (3) being placed within the die during pouring of the powder, following which procedure magnetic powder composites are being bounded with elec-

trotechnical elements (3) through compacting.

Magnetic core is characterized by the presence of at least one electrotechnical element (3) within the element made of compacted dielectromagnetic powder (1).

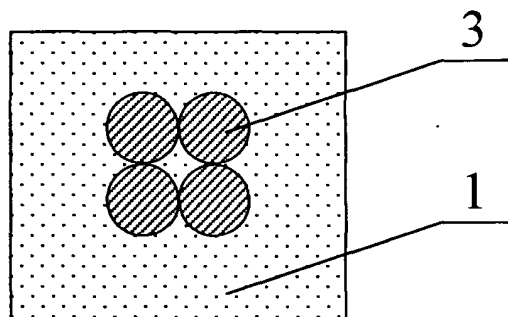


Fig. 1

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Description

[0001] The invention concerns method for manufacturing powder composite magnetic core and powder composite magnetic core designed for use in electro-technical appliances, and especially in electrical machines.

[0002] Inductive element and method for producing the same are already known from international patent application WO02/101763. Said powder composite is produced by mixing a ferromagnetic amorphous or nanocrystalline alloy powder with a ferromagnetic dielectric powder and a thermoplastic or duroplastic polymer, with dielectric ferromagnetic powder alloy equaling more than 55% by volume. Inductive element produced of dielectric ferromagnetic powder is characteristic in that in the mixture of powders, ribbons of ferromagnetic alloy are placed in the mixture of powders.

[0003] Known from their employment are magnetic cores or powder composite magnetic cores, which are manufactured as components from homogenous mass of compressed powder, wherein the compacted magnetic cores are annealed or sintered following their compacting.

[0004] According to the invention method for manufacturing comprises the die being filled with magnetic powder composite, with at least one electromagnetic element being placed within the die during pouring of the powder, following which procedure magnetic powder composites are being bounded with inductive electro-technical elements through compacting. As electro-technical elements, sheets wires and bars of magnetically soft metal are located in the die.

[0005] Favourably, the electro-technical elements are coated with thin gluing layer. According to this invention, the essence of the method of manufacturing comprises inserting at least one electro-technical element into the element mad of compacted magnetic composite.

[0006] As the electro-technical element, steel or magnetically soft wire can be employed, favourably manufactured of magnetically soft material.

[0007] What is also favourable is the employment of gluing layer between the electro-technical element and the compacted powder composite.

[0008] Powder composite magnetic cores manufactured using this innovative method is characterized by increased mechanical strength. Electromagnetic circuits with new magnetic cores are characterized by improved magnetic properties. In these new magnetic cores higher values of magnetic induction are obtained at the same values of magnetic field intensity and magnetic permeability increases.

[0009] According to the invention, powder composite magnetic cores are manufactured as hybrid magnetic cores of reinforced structures, with powder magnetic composites being used as the basis of the hybrid arrangement and electrical sheets, bars and wires are made of soft magnetic materials. Hybrid arrangement is

shaped in the process of the die being filled with magnetic powder composite. Electrical sheets on top and bottom surface of the magnetic powder which fills the die; within the magnetic core or in all these places. Following the compaction of the prepared arrangement, a magnetic core of reinforced top and bottom surfaces, or of reinforced inside, or of reinforced top and bottom surfaces and reinforced inside, is obtained, depending on the arrangement of components prepared earlier. Soft magnetic wires are inserted in the die during pouring of the powder into the die as bundles, single wire vain along whole length of the prepared magnetic core, along the predicted magnetic flux flow path. Following compaction of the prepared arrangement, reinforced magnetic core is obtained. All the elements of bundle of wires or elements of electrical sheet, before they are placed in the die, are being coated with a thin layer of thermosetting resin in order to obtain better bounding with the powder structure during compacting. Compacting of the hybrid arrangement is conducted in standard conditions typical for obtaining of composite magnetic cores.

[0010] Embodiment of the invention w is presented in the drawing, in which Fig. 1 illustrates cross-sectional view of the magnetic core of compressed magnetic composite with four bars made of soft magnetic material; Fig. 2 - longitudinal section of magnetic core with two steels made of soft magnetic material, Fig. 3 - cross-sectional view of a cubicoïd magnetic core with nine bars made of soft magnetic material, Fig. 4 - cross-sectional view of a magnetic core with four bars made of soft magnetic material and coated with gluing layer, Fig. 5 - axial view of a cylindrical magnetic core with two sheets made of soft magnetic material and coated with gluing layer, Fig. 6 - axial view of a magnetic cores with wires made of soft magnetic material arranged symmetrically to the axis on external diameter of the core, Fig. 7 - axial view of a cylindrical magnetic core with wires made of soft magnetic material arranged symmetrically and parallel to the axis of the magnetic core and on its external diameter, Fig. 8 - longitudinal section of magnetic core with two steels made of soft magnetic material, coated with gluing layer, Fig. 9 - magnetization characteristics for both the hybrid and the homogenous magnetic cores, and Fig. 11 presents mechanical properties of both the hybrid and the homogenous magnetic cores.

Example 1.

[0011] Method for manufacturing powder composite hybrid magnetic core comprises the cylindrical die being filled with magnetic powder composite. During compacting, four electro-technical elements 3 in the form of soft magnetic material are being inserted into it. Subsequently, powder composite material is being bounded with wires 3 through the process of compaction.

Example 2.

[0012] Method for manufacturing powder composite hybrid magnetic core proceeds as in example 1, the difference being that two electrotechnical elements 3 in the form of electrical steel sheets material are inserted into cubicoid die.

Example 3

[0013] Method for manufacturing powder composite hybrid magnetic core proceeds as in example 1, the difference being that nine electrotechnical elements 3 made of soft magnetic material are inserted into cubicoid die.

Example 4.

[0014] Method for manufacturing powder composite hybrid magnetic core proceeds as in example 1 or 2, the difference being that electrotechnical elements 3 are coated with thin gluing layer of thermosetting resin.

Example 5.

[0015] Magnetic core manufactured as cylindrical hybrid core with two electrotechnical elements made of soft magnetic sheet within the compacted magnetic powder composite 1.

Example 6.

[0016] Magnetic core manufactured as in example 5, the difference being that the magnetic core is cylindrically shaped and has eight electrotechnical elements 3 which are made of soft magnetic material. Wires 3 are arranged symmetrically to the axis of cylindrical hybrid magnetic core on its external diameter.

Example 7.

[0017] Magnetic core manufactured as in example 5, the difference being that twelve electrotechnical elements 3 are bars made of soft magnetic material. Bars 3 are arranged symmetrically to the axis of cylindrical hybrid magnetic core on its external diameter.

Example 8.

[0018] Magnetic core manufactured as in example 5, or 6, or 7 the difference being that a layer of thermosetting resin 2 is placed between each electrotechnical element 3 and compacted powder composite material 1.

[0019] Magnetic properties of new powder composite magnetic cores are presented in diagrams of magnetization characteristics, magnetic permeability and mechanical properties of hybrid magnetic core toroidal samples A and B and of homogenous sample C. The

first hybrid magnetic core - A - has centrally located bundle of wires being electrotechnical elements 2 on external diameter of the core, inside the compacted magnetic powder composite. These wires are made of soft magnetic material. The second hybrid magnetic core B has electrotechnical elements 2 in the form of soft magnetic wires placed on its external diameter, with the wires being located in corners of the cross-section of compacted powder composite material 1. The third magnetic core is manufactured of compacted powder composite material 1 only. The above magnetic cores are made of identical powder composite material 1 and the electrotechnical elements 2 in the form of wires are manufactured of the same soft magnetic material.

Claims

1. Method for manufacturing powder composite magnetic core comprising magnetic powder composites being bounded through compacting, wherein the die is being filled with magnetic powder composite, with at least one electrotechnical element (3) being placed within the die during pouring of the powder, following which procedure magnetic powder composite is being bounded with electrotechnical elements (3) through compacting.
2. Method according to Claim 1, wherein soft magnetic electrical sheet is inserted into the die as the electrotechnical element (3).
3. Method according to Claim 1, wherein soft magnetic wires are inserted into the die as the electrotechnical elements (3).
4. Method according to Claim 1, wherein bars made of soft magnetic material are inserted into the die as the electrotechnical elements (3).
5. Method according to Claim 1, wherein the electrotechnical elements (3) are coated with thin gluing layer (2).
6. Powder composite magnetic core of any shape is manufactured as an element made of compacted dielectromagnetic powder, wherein at least one electrotechnical element (3) is placed inside the compacted dielectromagnetic powder (1).
7. Magnetic core as claimed in claim 6, the difference being that a gluing layer (2) is placed between the electrotechnical element (3) and the compacted dielectromagnetic powder (1).
8. Magnetic core as claimed in claim 6, the difference being that soft magnetic electrical sheet serves as the electrotechnical element (3).

9. Magnetic core as claimed in claim 6, the difference being a wire made of soft magnetic material is as the electrotechnical element (3).

10. Magnetic core as claimed in claim 6, the difference being a rod made of soft magnetic material is as the electrotechnical element (3).

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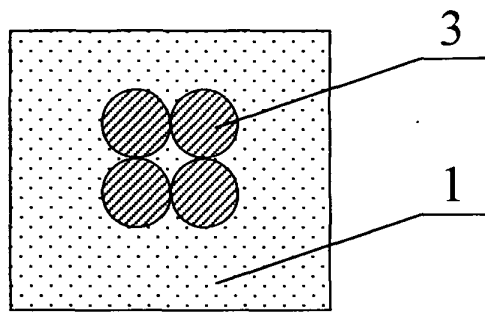


Fig. 1

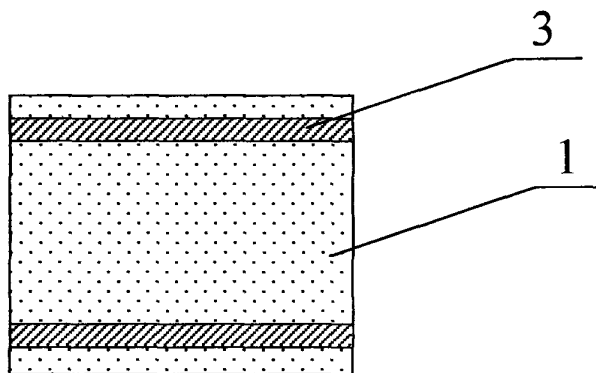


Fig. 2

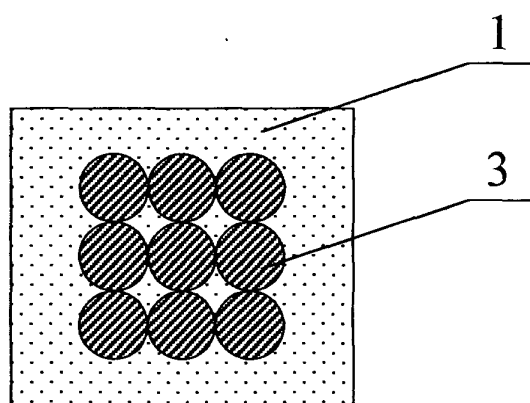


Fig. 3

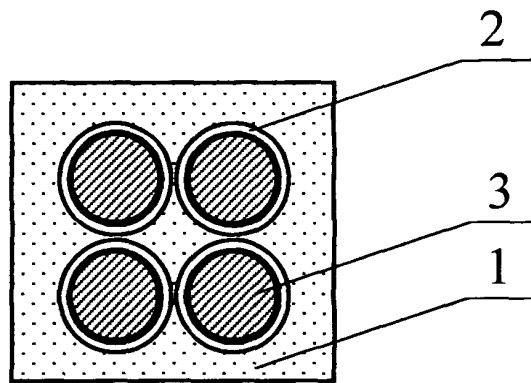


Fig. 4

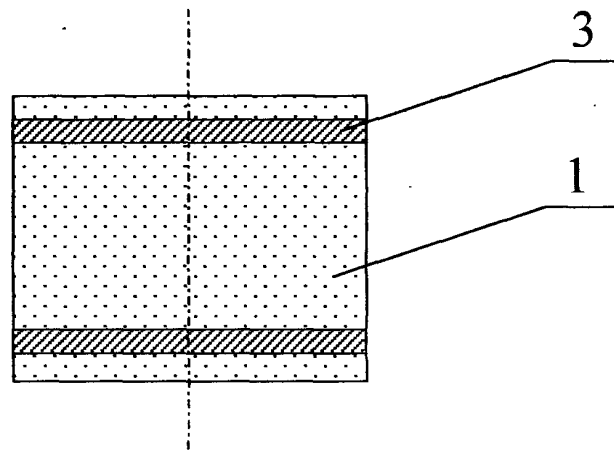


Fig. 5

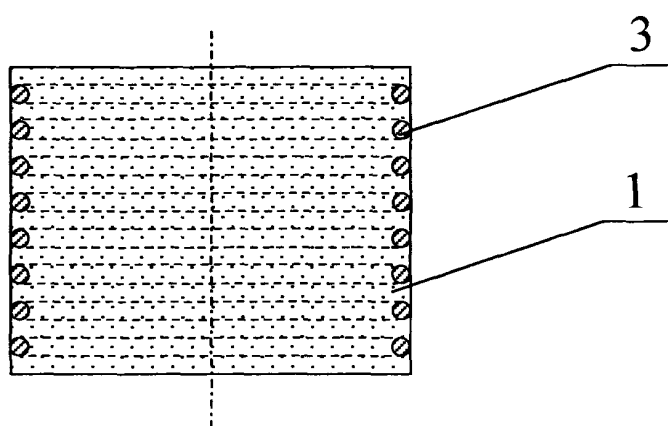


Fig. 6

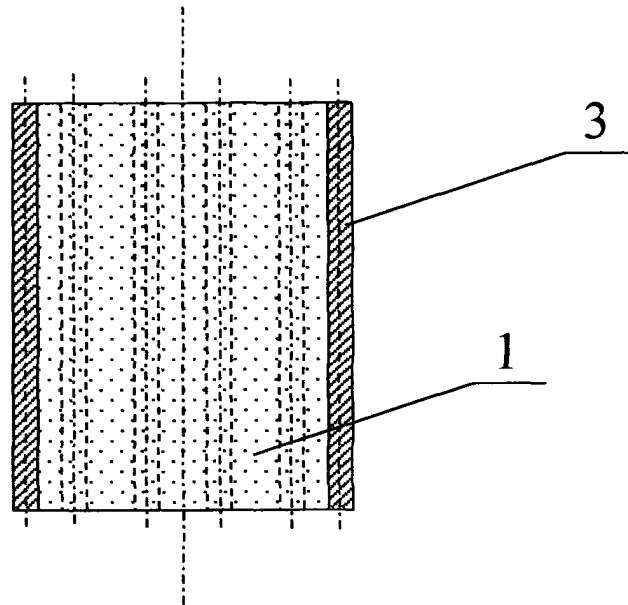


Fig. 7

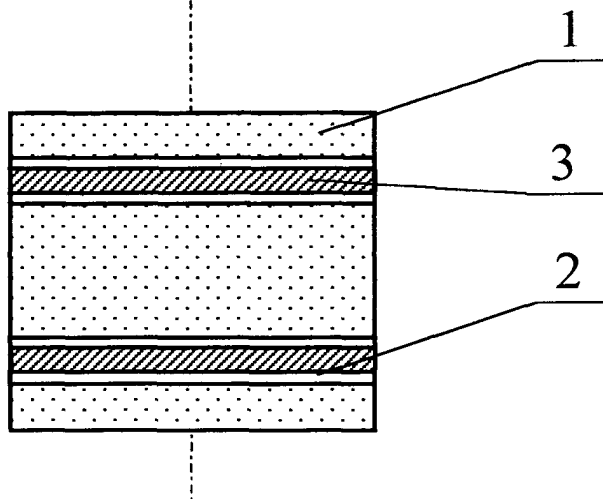


Fig. 8

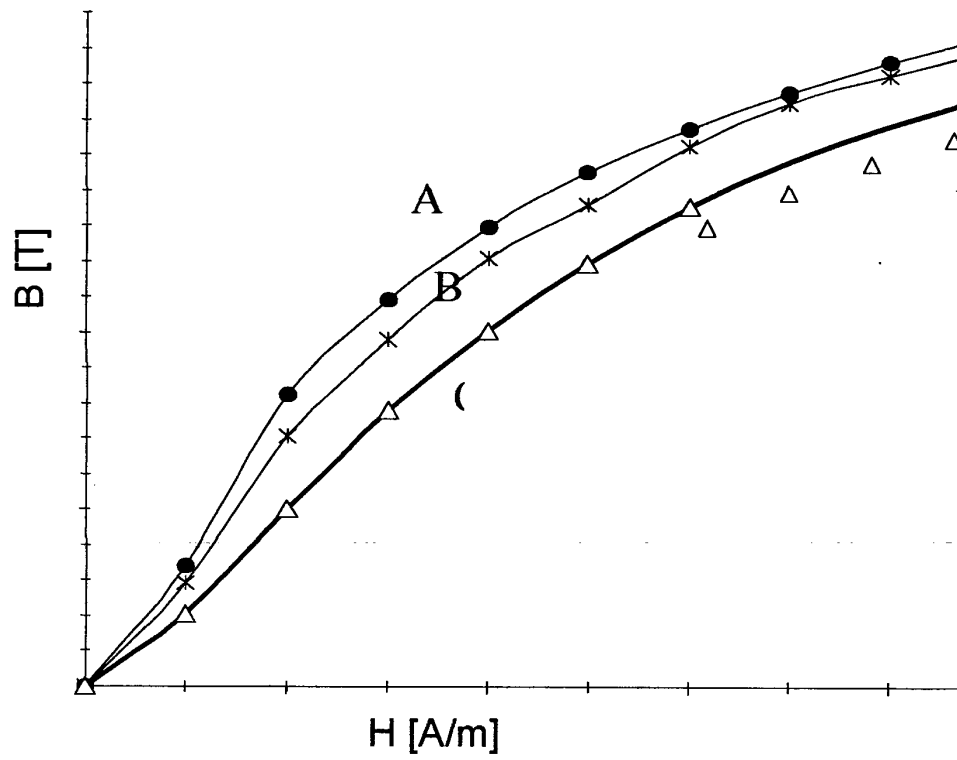


Fig. 9

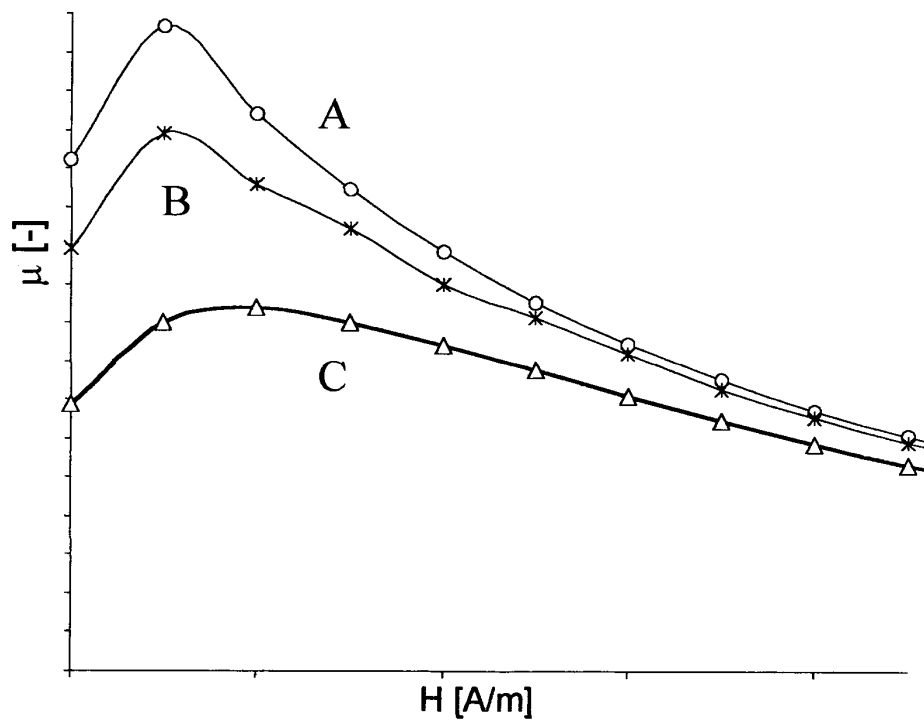


Fig. 10

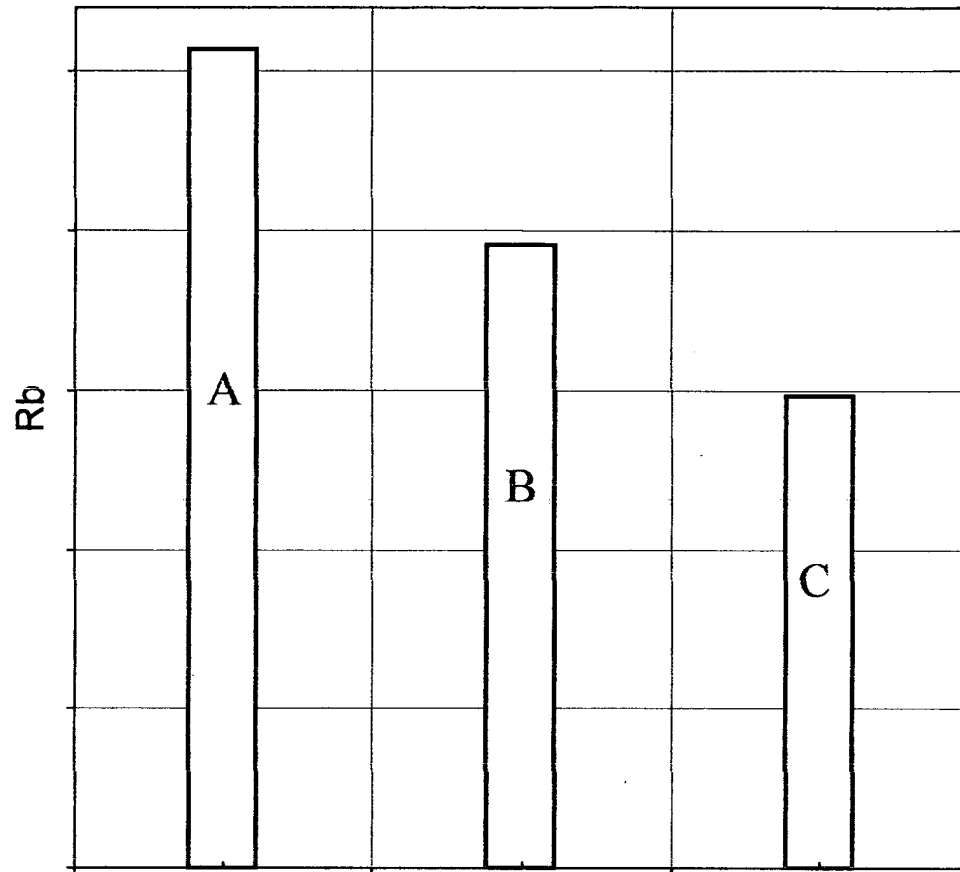


Fig. 11