106. COMPOSITIONS,
COATING OR PLASTIC
84 -M
CROSS REFERENCE
Examiner

Patented July 19, 1932

1,868,327

UNITED STATES PATENT OFFICE

ERWIN KRAMER, OF BERLIN, GERMANY, ASSIGNOR TO FIRM HARTSTOFF-METALL AKTIEN-GESELLSCHAFT (HAMETAG), OF BERLIN, COPENICK, GERMANY

MASS CORE AND MEANS FOR, AND A METHOD OF MAKING IT

No Drawing. Application filed January 2, 1931, Serial No. 506,320, and in Germany January 2, 1930.

My invention relates to an insulated ferro-magnetic finely grained powder for the manufacture of mass cores, the individual particles of the powder being covered by an insulating substance consisting of a cementing medium and a very finely comminuted admixture. The invention also relates to a method of manufacturing this particular powder and to the mass core made from the powder. Such cores are intended for use in connection with induction coils, Pupin coils and other electrical parts, devices, apparatus etc., etc.

The powder is distinguished by certain excellent properties which make it especially suited for said coils and the like. I have found that the size of the grains or particles of a pulverized metal should not have a larger diameter than 0.2 millimeter in order to prevent eddy currents, it being assumed that the powder particles are globular. The present invention deals with particles of this minute size, but in most cases the particles actually used will be yet much smaller, having a diameter of only some thousandths of a millimeter.

The conditions to be fulfilled in order to attain a good insulation of the powder particles are those very small and smallest sizes particularly difficult, where such small sizes are concerned the more so, as the number of the particles increases very greatly with the diminution of their size. Furthermore, the total amount of the insulating substances relative to the ferro-magnetic powder must constitute only a fraction of the latter involving difficulties which are not met with if the particles of the ferro-magnetic substance have the size of scrap, granules, or the like.

A powder manufactured according to this invention can be subjected to considerable pressures, e. g. from 20000 to 25000 kg. per square centimeter, without any detrimental effect upon the insulation, even if the ferro-magnetic substance is very hard and the particles are only moderately rounded or smoothed. The thickness of the insulating coating upon the individual powder particles can be exceedingly thin so that it amounts only to from about 5 to 8% of the volume of the particles, or even less than 5%. The powder manufactured according to this invention is, thus, particularly suited for the manufacture of mass cores, especially such which if pure iron is used and with an insulation as responds to the most recent requirements possess a specific weight of over 7. If iron-nickel alloys are employed, the specific weight is still higher by reason of the greater specific weight of the nickel.

Researches of late made have shown that the hysteresis values have a certain relation to the magnitude of the eddy current losses. On this account the improved powder allows of the manufacture of cores distinguished by their slight hysteresis.

I am aware of the fact that various proposals for the insulation of ferro-magnetic powders intended for Pupin coil cores have already been made. The one most known consists in covering or coating the pulverulent particles with resins. The insulations made therewith necessitate however, particularly where higher pressures are concerned, an especially carefully smoothed surface, and as the compressive strength of the resins is only slight, the resin is liable to be pressed away when the particles are subjected to the pressing operation while the cores are being made. Because of these drawbacks, it had also been proposed to make use of more resistible covering or coating substances, such as glass, mica, alumina, and the like, the respective substance being also used in a finely disintegrated state. The results were, however, unsatisfactory, especially since the insulating layers had not the fineness desired or necessary. Besides, the insulating covering or coating was subject to being damaged because of displacements. Also mixtures of finely pulverized solid insulating substances have been proposed and tried, as well as mixtures of these substances with liquid insulating substances, but also these means have failed. Finally, the repeatedly tried surface oxidation of the pulverulent iron likewise has not produced a useful result.

Now, I have discovered that all those drawbacks can be overcome and a perfectly satisfying result can be obtained by the admixture

of exceedingly finely comminuted asbestos to the cementing medium for the insulating substance, the thickness of the asbestos particles amounting to less than one thousandth of a millimeter. It is, indeed, possible to grind down the asbestos to an extraordinary fineness even in large amounts, that is, to less than one thousandth of a millimeter, which practically means: between some ten-thousandths and one hundred thousandth of a millimeter. Even with this unimaginable degree of fineness it is possible to give the asbestos particles a longitudinal, that is to say, threadlike shape which is of useful effect for the subsequent insulation.

The fineness of the asbestos particles is chosen in relation to the size of the pulverulent metal used for the cores. If the metal particles are comparatively large, the number of the insulation places is correspondingly smaller, and it is thus possible to make the insulating coating correspondingly thicker without making use of a larger amount thereof, the above-mentioned percentage as regards the thickness of the insulating coating being, of course, taken into consideration, and likewise the size of the asbestos particles. Making use of asbestos particles larger than one thousandth of a millimeter would not be suited to the purpose in view, viz. the manufacture of mass cores, the less so, because it happens that the particles in some instances become superposed on each other. The result is by far more satisfying if the asbestos particles have, for instance, the medium size between the above-mentioned dimensions, it being understood, that thickness is meant, whereas the length may be greater. If the particles have thread-like shape this is, in fact, advantageous for the purpose in view.

The thin asbestos particles are bendable so that they accommodate themselves easily to the contours of the ferro-magnetic powder particles.

As there is silicic acid in asbestos, its threads are particularly resistible against compression, which proves useful as the powder is compressed and transformed into cores. In other words, the asbestos threads are particularly able to withstand a high pressure without being crushed. When the powder, the particles of which are covered or coated with the fine asbestos particles, is subjected to the high pressure required for converting it into cores, there remain no empty spaces whatever into which asbestos particles could be pressed, but a preliminary condition thereto is that the insulating layer upon the iron particles is exceedingly thin, as stated. If pulverulent glass is used as a covering substance, which is to be had in commerce only in the form of comparatively large grains, there are still spaces between the iron particles as they are pressed into cores, that is prior to the pressure becoming so great that the glass grains are crushed, and some of the crushed glass particles will enter then into those spaces which must be obviated.

Now, in order to prevent the fine asbestos particles from collecting already at the beginning of the procedure in and between the spaces between the iron particles which spaces are materially larger than said asbestos particles, the latter are intentionally connected with the iron particles by means of a cementing medium, preferably in a dissolved state, which thereafter is permitted to dry. There may be employed solutions of borax, resins, and the like. Also aqueous solutions may be used since the formation of a thin oxide skin that adheres firmly to the iron particle improves the insulation. Preferably, an insulating substance is used as cementing medium.

The use of borax and other salt-like substances, e. g. silicate of potassium, for insulating purposes is old, but an insulation of such a quality as requisite for magnetic cores is attainable only if the cementing medium is used in connection with the extraordinarily finely subdivided asbestos, as in accordance with the present invention. Only by this combination, the full utilization of the useful properties of the salt-like insulating and cementing substance is rendered possible. When this substance is used in a dissolved state, the very fine asbestos particles apply themselves extremely accurately to the surface of the particles of the ferro-magnetic substance or the iron respectively, the more and the better, because also capillary and surface forces act.

Under the effect of the high pressures used in connection with the method of manufacturing the cores, the powder shows a certain tendency to "flow" while being subjected to such a pressure; in other words, it is likely to be displaced, and because thereof the insulation at the boundary surfaces of cores is not so good as in the interior thereof, especially in the center. If, however, the insulation is effected in accordance with the present invention by means of the mixture forming also a part of this invention, said displacements are practically entirely obviated, and, therefore, also the detrimental drawbacks. This becomes obvious especially if the ferro-magnetic powder consists of foil-shaped particles, because particles of this shape have a greater tendency for shifting than particles of more or less globular shape.

That reduction of the tendency for displacements of the individual powder particles requires, on the other hand, a greater elongation or deformation of the metal particles, during the pressing operation. It has been found that just that deformation of pulverulent wrought-iron in the cold state is of useful effect upon the magnetic prop-

106. COMPOSITIONS, COATING OR PLASTIC
84
CROSS REFERENCE
Examiner

erties of the finished core, especially such used for Pupin coils. A condition that must be fulfilled at any rate, however, is that the insulation of the particles be carried out as above described, in which case the further advantage is attained that the powder is, and the cores are, resistible to a rather high temperature so that it is possible to expose the cores to such temperatures which may become necessary in certain cases. Finally, the powder presents also this advantage that it can be transported without any risk of the ferro-magnetic substance being separated from the insulating substance, or reversely. The latter adheres strongly and firmly to the ferro-magnetic material, and the powder does not undergo any change so that it can form an article of commerce irrespective of its subsequent use.

The following is an example of how the powder is made: 100 kg. of rounded pulverulent iron are intimately mixed with a solution of shellac which is strongly diluted with alcohol and contains 1 kg. of dry substance, as well as with 2 kg. of exceedingly finely disintegrated asbestos. The mixture is then dried in a furnace. If clods should have formed, they are again disintegrated, and the powder therefrom is admixed to the other powder. It is also possible to carry out the operation in stages, that is to say, to add the asbestos and the cementing solution in several parts, as will be clear without further details. In either case an insulated powder results having the above described excellent properties.

As the asbestos particles are so very exceedingly fine and thin, it does not matter if some are superposed upon one another. If the asbestos particles have thread-like shape, a sort of network is formed, the meshes of which enclose particles of the main substance, and which network at the same time acts as holding means for the cementing medium, e. g. shellac, while the cores are being pressed. Said network of asbestos threads prevents, furthermore, the shellac, or other cementing substance, from being displaced during the pressing operation. The asbestos and the cementing medium assist one another in remaining in the proper place and in intimate contact with the interior material.

I claim:

1. A pulverulent composition of matter to be used for the manufacture of mass cores, comprising a finely grained ferro-magnetic substance and a cementing medium containing as an admixture minutely disintegrated asbestos particles having a thickness of less than one thousandth of a millimeter.

2. A pulverulent composition of matter to be used for the manufacture of mass cores, comprising a finely grained ferro-magnetic substance and a cementing medium containing as an admixture minutely disintegated asbestos particles having a thickness of between some ten thousandths and one hundred thousandth of a millimeter.

3. A pulverulent composition of matter to be used for the manufacture of mass cores, comprising a finely grained ferro-magnetic substance and a cementing medium containing as an admixture minutely disintegrated thread-like asbestos particles having a thickness of less than one thousandth of a millimeter.

4. A pulverulent composition of matter to be used for the manufacture of mass cores, comprising a finely grained ferro-magnetic substance and a cementing medium containing as an admixture minutely disintegrated thread-like asbestos particles having a thickness of between some ten thousandths and one hundred thousandth of a millimeter.

5. The method of manufacturing a pulverulent composition of matter to be used for the manufacture of mass cores, consisting in intimately mixing a pulverulent finely grained ferro-magnetic substance, a cementing medium containing as an admixture minutely disintegrated asbestos particles having a thickness of less than one thousandth of a millimeter, and a diluent in such proportions that a pulp is attained, and drying this pulp to thereby convert it into powder.

6. The method of manufacturing a pulverulent composition of matter to be used for the manufacture of mass cores, consisting in intimately mixing a pulverulent finely grained ferro-magnetic substance, a cementing medium containing as an admixture minutely disintegrated asbestos particles having a thickness of less than one thousandth of a millimeter, borax, and a diluent, in such proportions that a pulp is attained, and drying this pulp to thereby convert it into powder.

7. The method of manufacturing a pulverulent composition of matter to be used for the manufacture of mass cores, consisting in intimately mixing a pulverulent finely grained ferro-magnetic substance, and a borax solution containing as an admixture minutely disintegrated asbestos particles having a thickness of less than one thousandth of a millimeter, the proportions of said substances, including the diluent, being so chosen that a pulp is attained, and drying the pulp to thereby convert it into powder.

8. A compressed mass core consisting of a mixture comprising a finely grained ferro-magnetic substance and a cementing medium containing as an admixture minutely disintegrated asbestos particles having a thickness of less than one thousandth of a millimeter.

9. A compressed mass core, consisting of a mixture comprising a finely grained ferro-magnetic substance and a cementing medium containing as an admixture minutely disintegrated asbestos particles having a thickness

of between some ten thousandths and one hundred thousandth millimeter.

10. A compressed mass core, consisting of a mixture comprising a finely grained ferro-magnetic substance and a cementing medium containing as an admixture minutely disintegrated asbestos particles of thread-like shape and having a thickness of less than one thousandth of a millimeter.

11. A compressed mass core, consisting of a mixture comprising a finely grained ferro-magnetic substance and a cementing medium containing as an admixture minutely disintegrated asbestos particles of threadlike shape and having a thickness of between some ten thousandths and one hundred thousandth of a millimeter.

12. The method of manufacturing a pulverulent composition of matter to be used for the manufacture of mass cores which consists in intimately mixing a pulverulent finely grained ferro-magnetic substance, a cementing medium containing as an admixture minutely disintegrated asbestos particles having a thickness of less than one thousandth of a millimeter, and a diluent in such proportions that a pulp is attained, drying this pulp to thereby convert it it into powder and clods, subdividing the clods formed during drying, disintegrating the clods into powder, and mixing the latter with the powder already obtained by the drying of the pulp.

In testimony whereof I affix my signature.

ERWIN KRAMER.