

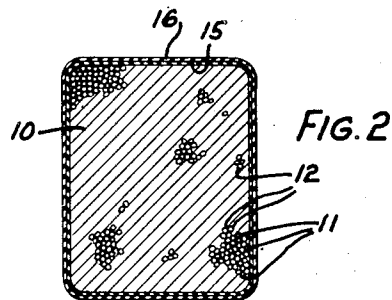
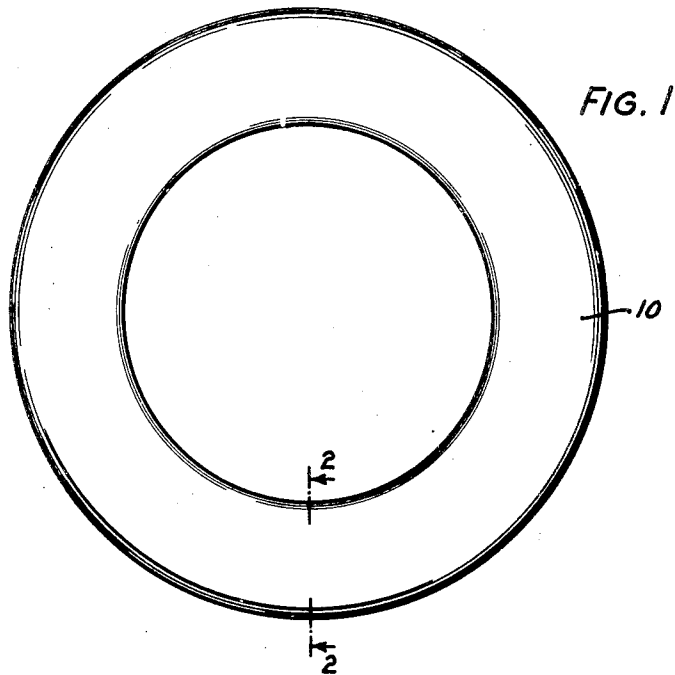
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MAGNETIC CORE

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MAGNETIC CORE

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10 Claims. (Cl. 175—21)

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This invention relates to magnetic cores, and more particularly to magnetic cores having an external protective coating, and is a division of my co-pending application, Serial No. 382,397, filed March 8, 1941, issued February 9, 1943, as Patent No. 2,310,820.

Various types of electrical apparatus include magnetic cores with a wire winding thereon and one type of magnetic core that is used extensively in such structures, particularly in communication equipment, comprises finely divided particles of magnetic material that are individually coated with a combination insulator and binder and then compressed into a core body of the desired shape. These magnetic dust cores, to which the present invention is especially adapted, are well known and are described in United States Patent 2,105,070 to A. F. Bandur. As described in this patent, an inorganic insulating material is used as a binder and the cores are first treated at a temperature high enough to cure the binder and thereafter are treated at a temperature high enough to anneal the metallic dust particles. These cores are usually provided with a wire winding and, although the coating on the core particles is an insulator, it is necessary to provide additional and substantial electrical insulation between the core and the winding. Also, because the core is made up of small particles, it is not particularly strong mechanically and in constructions where a heavy winding is applied, a supplementary support for the winding is required.

In order to provide the necessary insulating values, and a suitable foundation for the subsequently applied wire winding, it has been customary to apply a thick wrapping of paper or fabric on the core before the winding was applied. On cores of simple configuration, it was sometimes convenient to wrap paper or fabric strip around the core, but on cores having an irregular configuration, it was customary to use specially formed covers which were expansive and also cumbersome to apply. These prior procedures were primarily objectionable because it was necessary to use relatively heavy material to provide adequate insulation values and to protect the cores mechanically. In most of these constructions, it is desirable to position the winding as closely as possible to the core and the heavy wrapping material or the formed covers, which were usually .015" or more in thickness, occupied valuable winding space.

An object of this invention is the provision of an improved, efficient and particularly thin protective coating on magnetic cores and the like

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to provide a high degree of both mechanical and electrical protection for the cores and similar articles.

In accordance with one embodiment of the invention, a coating having a total thickness of less than .004" is applied on a core of the magnetic dust type to insulate the core and to protect the core mechanically when it is subsequently incorporated in an electrical coil. The core is first coated with a solution of alkyd resin having a high proportion of titanium dioxide particles dispersed therein, and then baked at a suitable temperature to mature the resin and convert the coating into a tough film. The coated cores are then tumbled with small steel balls, after which another coating of the alkyd resin-titanium dioxide composition is applied and the core is finally baked to mature the second coat and complete the protective envelope.

A more complete understanding of the invention may be had from the following detailed description taken in conjunction with the appended drawing, in which

Fig. 1 is a plan view of a magnetic core having an external coating of insulation produced in accordance with one embodiment of the invention, and

Fig. 2 is an enlarged sectional view of the core shown in Fig. 1 taken on the line 2—2 of Fig. 1.

As stated above, the present invention is particularly adapted for insulating cores of the magnetic dust type. As shown in the drawing, a core 10 of this type comprises small particles 11 of magnetic material enclosed in a combination insulation and binder 12 which coats the particles. As explained in the patent to A. F. Bandur, the magnetic particles may be made of a nickel-iron magnetic alloy and the insulation on the particles may comprise magnesium hydroxide, an alkali metal silicate and a filler, such as talc.

These cores are generally produced or pressed in the form of a toroidal ring with a body having a substantially rectangular cross-section. Because the core is made up of small particles, the core surface is often irregular and may contain sharp ridges, particularly at the corners of the rectangular section, or at the parting lines of the die in which the cores are formed. These projections tend to form electrical leakage or breakdown paths when the core is incorporated in a coil and also to damage the insulation on subsequently applied wire. These surface irregularities are difficult to remove because the core will not withstand any extensive machining and filing will

produce burrs that are often as objectionable as the original projections.

The coating composition or material employed in the present invention comprises essentially an oil modified alkyd resin and titanium dioxide particles dispersed therein. One resin which gives particularly good results is a reaction product of phthalic acid and glycerine but resins derived from other polybasic acids and alcohols can also be used for this purpose. The resin is modified with a fatty acid derived from a drying oil such as linseed oil or tung oil. The titanium dioxide particles should be 400 mesh or smaller in size.

To prepare the composition, the oil modified alkyd resin is first diluted with a suitable solvent, such as hydrogenated naphtha, and then mixed mechanically with the titanium dioxide particles. The proportions in which these ingredients are combined depends upon the desired composition of the formulated composition. Best results are obtained when the solids content of the composition consists of equal parts by weight of resin and titanium dioxide particles but these proportions can be varied to provide a titanium dioxide content ranging from 35% to 65% by weight of the total solids content of the final coating.

The composition ingredients are mixed in a ball mill and milling is continued until the particles are thoroughly incorporated and until the mixture attains a smooth pasty consistency. This paste is then further diluted to a suitable viscosity, depending upon the proposed method for applying the composition on the core, by further additions of hydrogenated naphtha.

The resultant composition is applied uniformly over the entire surface of the core in a thin coating, preferably by spraying, and the core is then baked to volatilize the solvent and mature the resin. The baking operation requires heating the coated core at a temperature around 400° F. for a period of about one hour, which provides sufficient heat to mature the enamel into a tough and strong film. The resultant coating 15 possesses high unit strength and toughness and, consequently, a film that is .002" or slightly less in thickness after baking is adequate. This composition has good bonding qualities, with the result that it adheres tenaciously to the core surface, and the composition also has the property of forming a uniform film which causes it to cover the core evenly, except at the sharp corners of the core section where the coating may be thinner than at other portions of the core surface.

Next, a quantity of the coated cores is placed in a conventional tumbling barrel together with hard metal balls or spheres of small diameter and the barrel is then rotated at a low speed for a limited period. In this operation, it is important to avoid the development of stresses within the cores because the presence of stresses detracts from the magnetic properties of the core. For best results, the tumbling barrel is filled about $\frac{3}{8}$ full of cores and metal, such as steel balls, which should be relatively small in comparison with the dimensions of the cores. One core size that is used extensively is a flat ring about $\frac{1}{2}$ " thick having an outside diameter around two inches and an internal diameter of one inch and with cores of this size steel balls or spheres $\frac{3}{8}$ " in diameter give the best results. For smaller cores, the sphere size should be reduced to insure uniform access to all portions of the core surface, including the inside face of the cut-out portion, by the

moving spheres. The tumbling operation is conducted at rotational speeds of 25 R. P. M. or less and the operation is continued until all ridges and rough areas on the core surface are smoothed down.

During the tumbling operation, the cores, which are fragile and normally tend to crumble readily, are protected by the coating which provides a tough and continuous envelope over the core. Due to the combined characteristics of the matured resin and the proper proportion and particle size of the finely dispersed titanium dioxide pigment therein, the coating substantially absorbs the stresses imposed by the impacting balls and cores and prevents the transmittal of these stresses to the core body. As a result, disintegration of the core portions adjacent to the core surface is prevented and the development of objectionable stresses within the core body is avoided.

As stated above, the preferred composition of this coating is about 50—50 resin and titanium dioxide on a weight basis but the titanium dioxide content may range from 35% to 65% of the coating weight. The size of the titanium dioxide particles is important as this factor influences the thickness of the coating and also the function of the coating in providing desired protection to the core during the tumbling operation and in service.

After the tumbling operation, a second coating of the above composition is applied over the first coating, also by spraying, after which the core is again baked at about 400° F. for a period of about one hour to mature the resin in the second coating. This outside layer 16 can be thinner than the first coating and a layer around .001" or slightly greater in thickness is satisfactory.

The resultant coating is tough, strong, smooth, bakes without wrinkling, and provides a smooth and uniform foundation for a subsequently applied wire winding. The coating has excellent insulating and mechanical properties, with the result that very thin coatings provide adequate protection to the core. The use of this coating, which is substantially thinner than the insulation formerly used on cores of this type, reduces the overall size of the completed coil to a minimum and also improves the properties of the coil by positioning the winding closer to the core surface.

What is claimed is:

1. In a magnetic core, a body portion formed of finely divided particles of magnetic material, and a protective envelope for said body portion, the protective envelope comprising a layer of an oil modified alkyd resin over the surface of the core and particles of titanium dioxide dispersed uniformly throughout the layer of resin.

2. In a magnetic core, a core body portion formed of finely divided particles of magnetic material individually insulated one from another, coated with a binder, and compressed into said body; and a protective envelope for the core body portion, the protective envelope comprising a layer of an oil modified alkyd resin over the core surface and particles of titanium dioxide dispersed in the resin layer, the titanium dioxide content of the envelope ranging from 35 to 65% of the total weight of the envelope.

3. In a magnetic core, a core body formed of finely divided particles of magnetic material individually coated with a binder, and a protective envelope enclosing the core body, said protective envelope comprising a layer of alkyd resin, and titanium dioxide particles smaller than 400 mesh

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in size dispersed in the resin layer, the total weight of the titanium dioxide particles in the envelope being substantially equal to the weight of the resin in the envelope.

4. In a magnetic core, a body portion formed of small magnetic particles coated with a binder, and a protective envelope enclosing the body, said protective envelope comprising a matured reaction product of phthalic acid and glycerine in a uniform layer over the core surface, and particles of titanium dioxide dispersed throughout said layer.

5. In a magnetic core, a core body formed of finely divided particles of magnetic material individually coated with a binder and compressed to a predetermined core shape, and a protective envelope enclosing the core body, said protective envelope comprising a layer of oil modified alkyd resin having titanium dioxide particles dispersed therein, said titanium dioxide particles being smaller than 400 mesh and constituting substantially one-half the total weight of the envelope comprised of resin and particles.

6. In a magnetic core, a core body of magnetic material, and a protective envelope enclosing said body, said protective envelope comprising a layer of oil modified alkyd resin and particles of titanium dioxide dispersed therein.

7. In a magnetic core, a core body of magnetic material, and a protective envelope enclosing said body, said envelope comprising a layer of a reaction product of phthalic acid and glycerine modified with a fatty acid derived from a drying oil and titanium dioxide particles dispersed throughout said layer.

8. In a magnetic core, a core body of magnetic material, and a protective envelope enclosing said body, said envelope comprising an oil modified reaction product of phthalic acid and glycerine

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and particles of titanium dioxide dispersed therein.

9. In a magnetic core, an annealed core body comprising magnetic particles bound together by an inorganic insulating binder, and a protective envelope enclosing said body, said envelope comprising an oil modified reaction product of phthalic acid and glycerine and having particles of titanium dioxide dispersed therein.

10. In a magnetic core, an annealed core body formed of finely divided particles of magnetic material individually coated with an inorganic insulating binder and compressed to a predetermined core shape, and a protective envelope enclosing the core body, said protective envelope comprising a layer of oil modified alkyd resin having titanium dioxide particles dispersed therein, said titanium dioxide particles being smaller than 400 mesh and constituting substantially one-half the total weight of the envelope comprised of resin and particles.

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