April 5, 1966 E. B. TANNER 3,245,015

COVERINGS OF COIL WINDINGS OF ELECTRICAL APPARATUS

Filed July 23, 1962

FIG. 1.

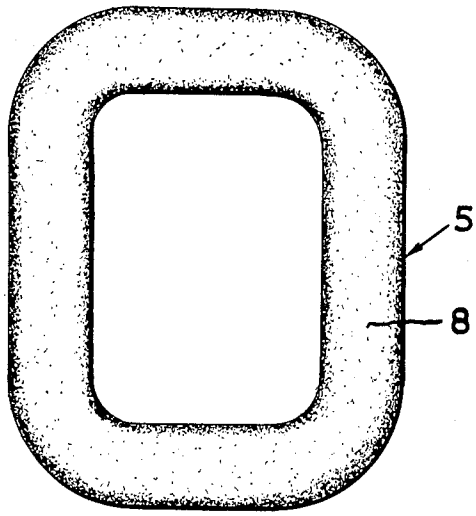


FIG. 2.

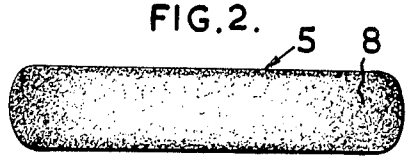


FIG. 3.

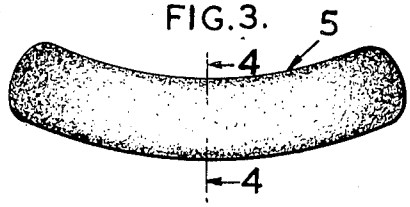
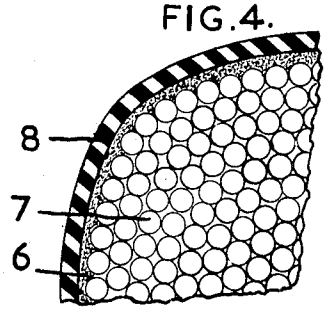


FIG. 4.



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3,245,015

COVERINGS OF COIL WINDINGS OF ELECTRICAL APPARATUS

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7 Claims. (Cl. 336—229)

This invention relates to the application of protective coverings to coil windings for electrical apparatus in which the coils after being wound and the protective coating applied have to be formed or shaped.

The invention is capable of wide application but is especially suitable for the covering of field coils of dynamos. The usual covering for such coils has long been helically wound tape. After taping, the coils are curved in a press to suit the contour of the dynamo yoke.

The present invention consists in a method of covering coil windings of electrical apparatus prior to forming or shaping the coils which comprises applying to the outside of the coil a slip coating and then applying over the slip coating an outer coating which provides a relatively strong flexible skin, the arrangement being such that during subsequent forming of the coil so covered the outer coating can move relatively to the turns of the coil.

The slip coating preferably comprises a soft filling composition which enters the interstices between at least the outside turns of the coil so as to reduce the surface irregularities of the coil surface over which the outer coating is applied.

The filling composition prevents partial penetration of the outer coating between the wires of the coil so that on forming of the coil the skin is not locally stressed by being forced to follow local movement among the wires nor is movement and re-arrangement of the wires within the coil hindered. The skin is of more uniform thickness resulting in economy of outer coating material and reducing stress concentration, which could be caused by local stretching of the skin. Residual stresses in the skin are thus minimised so reducing the risk that the skin might crack or split in service after losing some of its initial elasticity through ageing or heat.

By a filling composition which is "soft" is meant one which comprises pulverulent material and has a low degree of cohesion owing to its being substantially unbound or underbound that is to say the amount of binder present in the finished filling composition is substantially less than that needed to fill completely the interstices between the powder particles, without voids.

For the filling composition the powders should, in general, be cheap, fine and inert. A wide range of powders may be used, for example, powders generally used as paint extenders. For a coloured filling a coloured pigment in powder form may be included or constitute the pulverulent component of the filling composition. Powders having unsuitable properties such as volatility, low melting point, or chemical reactivity with the outer coating composition or the metal of the wire of the coil or its insulation should naturally be excluded. Electrically conductive powders would also normally not be used.

In general we prefer powders in which the particles have another than spheroidal shape, such as those which are lamellar, needle-like or irregular in shape, for example asbestine, diatomaceous earth, mica, talc and china clay. However other particles which are of less markedly lamellar, needle-like or irregular shape could be used, for example barytes, pumice, precipitated or natural calcium carbonate, magnesium carbonate and silica.

Some of these powders, talc for example, may be used as the filling composition without a binder. They may be rubbed into the interstices between the wires dry and will lodge there by their own natural cohesion. In general however a liquid vehicle is preferred. The filling composition may then be applied by dipping, brushing, spraying, wiping or in some other suitable manner.

Binders for the filling composition may be those which when dissolved or dispersed in volatile liquids give to the composition a consistency suited to the desired method of application when present in only minor proportions. One group of substances suitable as binders are these used as thickeners in emulsion paints such as cellulose ethers and the sodium salt of carboxymethyl cellulose. Examples of cellulose ethers are ethyl hydroxyethyl cellulose, methylcellulose and hydroxyethyl methyl cellulose and methyl ethyl cellulose. Examples of further substances suitable as binders are natural and synthetic rubbers, polyvinyl resins, polyacrylic and methacrylic resins and alginates, for example, sodium alginate.

The binder and the volatile liquid vehicle must be harmless to the metal of the wire of the coil or its insulation, and, when dry, to the outer coating composition.

The outer coating may be of any of a variety of compositions. It may, for example be

(1) A plastisol or organosol
(2) A rubber-resin composition
(3) A composition in which a vinyl resin emulsion is the binder.

The rubber-resin composition may be synthetic rubber, neoprene for example, with a phenolic resin.

Embodiments of the invention will now be particularly described with reference to the accompanying drawings and examples. In the drawings:

FIGURE 1 is a plan and FIGURE 2 an end elevation of a coil winding for electrical apparatus covered according to the invention, before forming.

FIGURE 3 is an end view similar to FIGURE 2 but after forming.

FIGURE 4 is a fragmentary cross-sectional view on line 4—4 of FIGURE 3.

A coil winding 5 of enamel insulated copper wire is wound in flat form as illustrated in FIGURES 1 and 2. After winding the coil, a slip coating 6 is applied over its outer turns 7 to reduce the surface irregularities of the coil and provide a smooth surface over which a relatively strong, flexible outer coating 8 is applied. After covering the coil it is formed or shaped in a press or by rollers to the curved form shown in FIGURE 3.

The slip coating is formed by a soft filling composition as previously defined. Specific examples of coverings applicable to such coils are:

Example 1

Soft filling composition:	Parts by weight
Mica powder, 200 mesh	437
Hydroxyethyl methyl cellulose (British Celanese: Celacol HEM 450)	13.9
Water	850
Sodium hexametaphosphate (Albright & Wilson: Calgon)	1.4
Polyethylene glycol 300 Monoleate (Union Carbide: Nonex 26)	14.8
A water-soluble fungicide (Ward Blenkinsop: RD113)	2.6

In the water-soluble fungicide (RD113) the phenyl mer-

curial radical is combined with dinaphthyl methane disulphonic acid.

The sodium hexametaphosphate is a water softener and the polyethylene glycol 300 monoleate a flow promoting agent.

A coil was dipped in this composition, allowed to dry in an oven at 150° F., and allowed to cool. It was then dipped in an organosol coating composition consisting of polyvinyl chloride dispersed in an epoxidised vegetable oil, together with minor proportions of lead stabiliser and an anti-oxidant. The coated coil was then stoved at 390° F. No splits developed in the top coating on forming, or on clamping under a pole piece within a yoke and heating in an oven for 64 hours at 302° F.

Example 2

A circular coil, of external diameter 3½ inches, internal diameter 2 inches, and thickness ½ inch, comprising some 500 turns of 24 gauge enamelled copper wire was dipped in the soft filling composition as described in Example 1, allowed to dry in an oven at 150° F. and allowed to cool. It was then dipped in a mixture of the following composition:

Propiofan 5D	500
Water	100

and allowed to dry for 16 hours in an oven at 150° F.

Propiofan 5D is an approximately 50% plasticiser-free dispersion of polyvinyl propionate manufactured by the Badische Anilin & Soda Fabrik A.G.

When cold the coil was formed by compressing it within a screw press having a fixed horizontal semi-cylindrical outer component of diameter 3¼ inches, and a moving cylindrical inner component of diameter 2⅜ inches. The coil was first gently squeezed by hand diametrically so as to fit within the jaws of the outer component.

No splits developed in the outer coating when the coil was screwed down tightly within the press as described.

A similar coil without the preliminary application of the soft filling composition was dipped in the Propiofan 5D composition and allowed to dry for 16 hours in an oven at 150° F. When this coil, after allowing to cool, was similarly formed in the screw press several splits developed in the coating.

Example 3

Micronised talc powder was rubbed by hand into the interstices between the outer turns of a coil similar to that described in Example 2. The powder lodged by its natural cohesion so as to present a smooth and geometrically regular outer surface.

The coil so prepared was dipped in the Propiofan 5D composition as described in Example 2. The coating was allowed to dry for 16 hours in the oven at 150° F. When cold the coil was formed in the screw press as described in Example 2. No splits developed in the outer coating.

I claim:

1. A curved electrical coil, the individual turns of which are enamel insulated having over the turns of the coil lining a slip coating consisting of the following ingredients in the parts by weight specified:

Mica powder, 200 mesh	437
Hydroxyethyl methyl cellulose	13.9
Water	850
Sodium hexametaphosphate	1.4
Polyethylene glycol monoleate	14.8
Water-soluble fungicide comprising a phenyl mercurial radical combined with dinaphthyl methane disulphonic acid group	2.6

and which enters the interstices between at least the outside turns of the coil so as to reduce the external surface irregularities of the coil and having over the slip coating an outer relatively strong flexible skin.

2. A curved electrical coil, the individual turns of which are enamel insulated having over the outer turns of the coil a slip coating comprising a powder selected from the group consisting of asbestine, diatomaceous earth, mica, talc, and china clay and a binder of cellulose ether selected from the groups consisting of ethyl hydroxyethyl cellulose, methyl cellulose, hydroxyethyl methyl cellulose and methyl ethyl cellulose, the slip coating entering the interstices between at least the outside turns of the coil so as to reduce the surface irregularities of the coil surface, and having over the slip coating an outer relatively strong, flexible skin.

3. A curved electrical coil according to claim 2 wherein the outer coating is a plastisol.

4. In the art of forming electrical windings wherein an enamel insulated wire is wound into a flat coil formed of a plurality of turns arranged in contiguous relation, the process of forming on the coil a protective covering which is capable of moving relative to the turns of the coil and which conforms with the shape of the coil during subsequent bending, which process comprises applying to the outer surface of the coil a layer of slip material completely covering the outer turns of the coil, and then applying over the layer of slip material, a coating of a material providing a relatively strong flexible skin and then bending the coil from the flat form into a curved form.

5. The method according to claim 4 in which said layer of slip material comprises a soft filling composition which includes a pulverulent material and has a low degree of cohesion and which enters the interstices between at least the outside turns of the coil so as to reduce the surface irregularities of the coil surface.

6. A method of covering coil windings of electrical apparatus according to claim 4 wherein the slip coating consists of:

	Parts by weight
Mica powder, 200 mesh	437
Hydroxyethyl methyl cellulose	13.9
Water	850
Sodium hexametaphosphate	1.4
Polyethylene glycol monoleate	14.8
A water-soluble fungicide	2.6

7. The method according to claim 4 in which said layer of slip material consists of a powder selected from the group consisting of asbestine, diatomaceous earth, mica, talc and china clay and a binder of cellulose ether selected from the group consisting of ethyl hydroxyethyl cellulose, methyl cellulose, hydroxyethyl methyl cellulose and methyl ethyl cellulose.

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