

[54] **INSULATED COIL FOR
ARRANGEMENT IN A SLOT IN THE
STATOR OR ROTOR OF AN
ELECTRICAL MACHINE**

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[51] Int. Cl.**H02k 1/00**

[58] Field of Search ...174/26, 117 R, 117 F, 117 FF, 174/110 N, 120, 120 R, 110 M, 127, 73, 73.1; 310/196; 336/223, 206; 156/52-54

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[57] **ABSTRACT**

A coil positioned in the slot of a stator or rotor in an electric machine is formed of a bundle of conductors arranged close together and insulated from each other and from the slot. The conductor insulation consists of a layer of enamel and a tape of corona resistant insulating material running longitudinally of the conductor is adhered to the enamel layer. The tape surrounds the parts of the conductor facing the main insulation which surrounds the bundle of conductors and furthermore overlies at least those parts of the sides of the conductor which face the adjacent conductors which parts are situated nearest the sides facing the main insulation.

15 Claims, 8 Drawing Figures

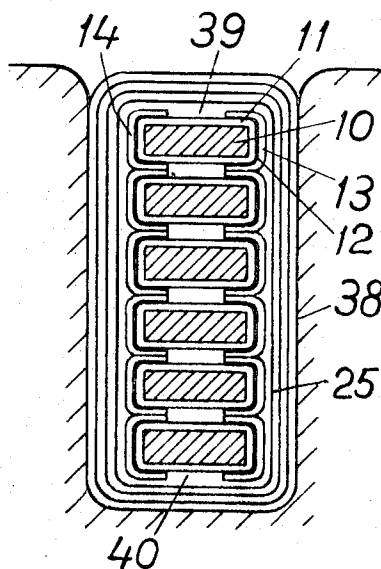


Fig. 1

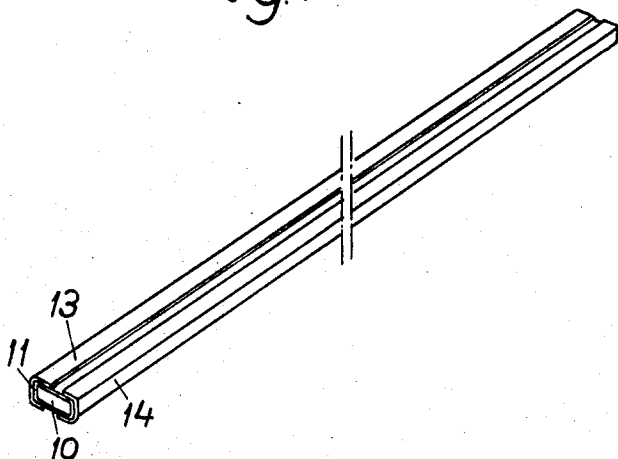


Fig. 2

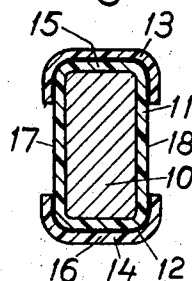


Fig. 3

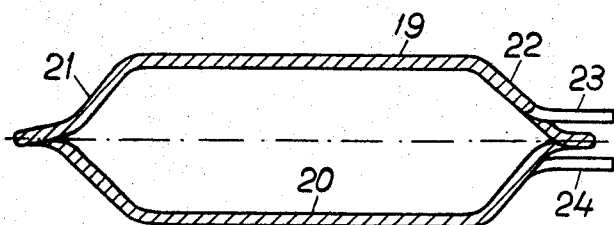


Fig. 4

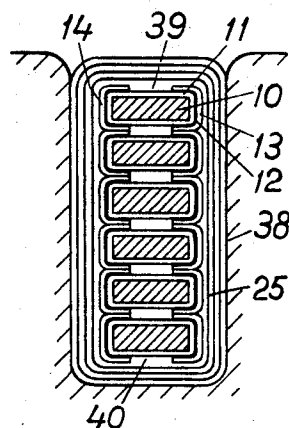


Fig. 5

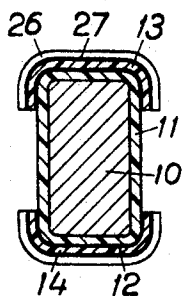


Fig. 6

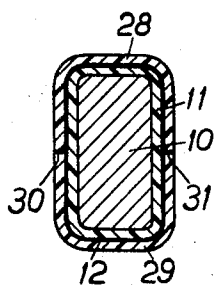


Fig. 7

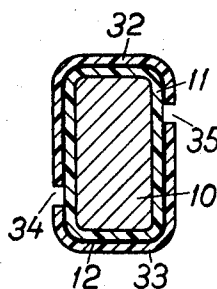
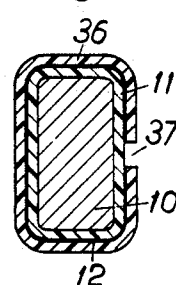


Fig. 8



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INSULATED COIL FOR ARRANGEMENT IN A SLOT IN THE STATOR OR ROTOR OF AN ELECTRICAL MACHINE

1. Field of the Invention

Background of the Invention

The invention relates to the insulation of a conductor arranged in a slot in the rotor or stator of an electric machine.

2. The Prior Art

A coil which is arranged in a slot in the stator or rotor of an electric machine often comprises a bundle of several conductors arranged close together and provided with a conductor insulation to insulate the conductors from each other. The bundle may consist of turns of a single insulated conductor. It may also consist of several separate insulated conductors, which are electrically connected, usually parallel-connected, to each other at the ends.

The conductor bundle is surrounded by a main insulation to insulate the bundle from the machine slot which has earth potential. The main insulation usually includes material which has strong resistance to corona attack, for example mica or silicone rubber and there are normally impregnating and pressing operations during its application around the bundle of conductors to obtain an insulation having no voids and tightly surrounding the conductor bundle.

In practice it has been impossible to ensure the manufacture of coil insulations which are permanently free from inner spaces where corona may occur. The occurrence of small gas-filled voids even during the manufacture of the insulation cannot be completely avoided. Furthermore, voids and gaps in the insulation may arise as a result of aging phenomena due to thermal and mechanical stresses during operation. In this case the boundary layer between the conductor insulation and main insulation is particularly subjected to stresses since the temperature is highest nearest the conductor and because of the mechanical stresses which arise upon temperature alterations since the coefficients of thermal expansion for the conductor and the insulation are different.

When corona arises which affects the conductor insulation there is great risk that this will be destroyed and weakened so that short-circuiting between adjacent turns of a single insulated conductor or short-circuiting between strands may occur. In order to avoid this risk, a conductor insulation is aimed at which has strong resistance to corona attack. A conventional embodiment of conductor insulation which also provides corona protection is one in which the conductor is wrapped with mica tape consisting of mica flakes attached to a carrier material of, for example, glass cloth. With respect to the occurrence of temporary steep over-voltages, for example connection over-voltages, which may cause great stress between adjacent turns in a coil, the requirements of the electrical strength of the conductor insulation are extremely high compared to the stress occurring during normal operation. A normal rule is that insulation between adjacent turns shall be dimensioned to withstand a voltage equal to the rated voltage of the machine. In order to achieve sufficient electrical strength with conductor insulation of mica tape, a relatively thick insulation is required which is effected by winding on several layers of tape. This con-

ductor insulation has several disadvantages. It requires considerable space, is expensive and the insulation is easily damaged by folds and cracks arising during the bending process or during other handling of the conductor while shaping the coil. Another type of conductor insulation where these disadvantages are less pronounced is an embodiment in which the insulation of the conductor consists of a layer of enamel of a type normally used for enameling conducting wire and a wrapping of mica tape applied outside the enamel layer as corona protection. Because of the high electrical strength of the wire enamel layer, the total thickness of the insulation can in this case be kept lower than when the conductor is only wrapped with mica tape. In order effectively to protect the enamel layer against corona and at the same time to contribute somewhat to the electrical strength, the outer wrapping of tape must be carried out with overlap between adjacent turns of the tape. In this case also the tape wrapping causes problems when the conductors are being bent. If the tape is loosely bound to the enamel layer below it, it has a tendency to slide apart when the conductor is bent. If, on the other hand, the tape is firmly attached to the layer of enamel, cracks may easily occur during the bending.

It is extremely desirable for the insulation and corona protection around the conductor to be as thin and take as little space as possible. In this way more conductor material can be incorporated in the coil and a greater effect is achieved for a given machine size or for a given effect the machine size can be reduced.

Summary of the Invention

According to the present invention, it has been discovered that it is possible to use considerably thinner conductor insulation in coils of the desired type than in previously known coils, and at the same time achieve equally good electrical qualities in the coils.

The present invention relates to a coil to be arranged in the slot of a stator or rotor in an electric machine, comprising a bundle of several conductors arranged close together and provided with conductor insulation to insulate the conductors from each other and a main insulation surrounding the bundle to insulate the bundle from the machine slot, the conductors having in cross-section main sides facing each other and end sides facing the main insulation, characterized in that the conductor has a conductor insulation in the form of a layer of enamel on the conductor and that a tape of corona-resistant insulating material running in the longitudinal direction of the conductor and attached to the enamel layer of the conductor is arranged to surround the end sides of the conductor and at least those parts of the main sides of the conductor facing adjacent conductors which are situated nearest the end sides.

The invention also relates to a method of manufacturing such a coil, the method being characterized in that a substantially straight conductor is coated with a layer of enamel acting as conductor insulation, after which a tape of corona-resistant insulating material is applied in the longitudinal direction of the conductor and attached to the enamel layer of the conductor in such a way that the tape surrounds the end sides of the conductor which are intended to face the main insulation of the coil and at least those parts of the main sides

of the conductor situated nearest the first sides, these main sides being those which are intended to face adjacent conductors in the coil and the conductor is then bent to provide end parts and slot parts of the coil, several bent conductors are arranged close to each other to form a bundle and the bundle is surrounded by the main insulation of the coil.

The explanation of the more effective use of the corona-resistant insulating material which is achieved according to the present invention is that joints and gaps are avoided between parts of this insulating material where the stresses are greatest. According to the present invention it is possible in this region, with only one layer of the corona-resistant insulating material, to achieve effective corona protection, whereas normally at least two layers must be used since the tape must be applied with overlap between adjacent turns. According to the invention therefore the outer dimensions of the conductor bundle are considerably less than for a corresponding conductor bundle in which an identical tape of insulating material is wound around the conductor with overlap in the conventional manner. The fact that joints or gaps may occur according to the present invention between the corona-resistant material along the sides of the conductors in the coil described which are facing each other has not proved to be any disadvantage. This is explained because the stresses between the conductors are low during normal operation and any over-voltages which arise are very brief, as mentioned previously.

The present invention is specifically intended for use in electric machines and apparatus for operational voltages above 3kV because of the problems arising with corona in such machines and apparatus.

The conductor bundle may consist of several turns of a single insulated conductor which is bent to give the final shape of the bundle. It may also consist of several separate insulated conductors, often called strands, which are electrically joined to each other, usually parallel-connected, at their ends. The invention is particularly advantageous for the first-mentioned type of conductor bundle, since the stresses between adjacent conductors in this case are greater and short-circuiting due to damaged conductor insulation is more serious.

The main insulation may be designed in various well known ways and its construction does not form any part of the present invention. It may, for example, consist of a bandage of mica tape or mica sheet. These may be made of large mica flakes of conventional type which, for example with a resinous binder such as an alkyd resin or a thin thermoplastic film, are attached to a carrier material of paper, glass cloth or the like. The mica material may also consist of self-carrying tape or sheets of small mica flakes overlapping each other, manufactured by splitting ordinary mica. In this case the mica material is usually attached to a carrier material as well.

A binder may be applied on said mica tapes or sheets which, when the material is later applied around the conductor bundle, binds the various layers of the conductor insulation to each other. However, such a binder may even be supplied after the insulating material has been applied around the conductor bundle by means of an impregnation. As examples of a suitable binder for the turns in the wrapping may be mentioned

solventless resins such as epoxy resins and unsaturated polyester resins.

The main insulation may alternatively consist of silicone rubber, for example, applied in the form of a strip or paste around the bundle of conductors.

The conductor insulation may consist of an enamel of a type normally used for enamelling conducting wires, such as terephthalic acid alkydes, polyester imides, polyamide imides, polyimides, polyurethanes, silicones and epoxy resins and other well-known resinous enamel compositions.

The thickness of the layer of varnish is suitably 10 - 200 μ .

The tape of corona-resistant material is preferably formed of a mixture of small mica flakes and short fibers of a linear polymer such as polyamide, aromatic polyamide, polyethylene glycol terephthalate, polyacrylate, polyurethane and polyacrylnitrile. It is also possible to use fibers of cellulose and glass instead of or as well as polymer fibers. The percentage of mica is suitably 10 - 90, preferably 30 - 70 percent, and the percentage of fibers suitably 90 - 10, preferably 70 - 30 percent, of the total weight of mica and fibers. Such mica flakes which have a size less than 5 mm², usually less than 2 mm² can be manufactured according to known methods by splitting ordinary mica, for example by first heating the mica and then subjecting it alternately to the action of two solutions which react with each other producing a gas. The split mica then has such properties that it can be mixed with water to form a pulp. Fibers can then be mixed into this pulp and the mixture of components can be shaped into a sheet of material according to methods similar to those used in the manufacture of paper. The fibers have suitably a length of 0.5 to 25, preferably 1 - 10 mm and a thickness of 1 - 50, preferably 5 - 25 μ . The tape may also consist of only small mica flakes of the type described. Instead of mica flakes it is also possible to use thin flakes of glass. It is also possible to reinforce the tape mechanically, for example with a thin cloth or mat of a fibrous material such as glass fiber, suitably applied on one side of the tape.

The thickness of the tape is suitably 10 - 200 μ , preferably 25 - 125 μ .

It is advantageous if the tape has a high elongation before rupture so that no damage occurs when the insulated conductor is bent. The elongation before rupture of the tape described can be increased by impregnating it with a flexible resin, such as a flexible polyurethane resin, a flexible alkyd resin, a flexible epoxy resin or a flexible silicon resin.

The resistance of the tape to rupture can also be increased by attaching it to the conductor insulation along its entire contact surface with this insulation. A resinous binder is preferably used for the attachment, which has high elongation before rupture and good stiffness. The resinous binder should be pore-free so that corona will not arise in it and should also have the ability to bind every point of the tape effectively to the conductor insulation so that any mechanical stress arising when the conductor is bent is distributed evenly along the entire length of the tape. As examples of suitable resinous binders may be mentioned flexible polyurethane resins, epoxy resins modified with polyamides, polyester resins modified with isocyanates,

epoxy resins modified with polyurethane resin and certain types of rubber.

Another way of increasing the strength of the tape against rupture is to apply a film of a flexible polymer or plastic along the entire outer surface of the tape. The purpose of the film is to act as a support for the tape during the bending and to distribute any mechanical stress arising in the tape during the bending evenly along the entire length of the tape. The film can be bound to the tape by a resinous binder of the type exemplified previously. As examples of suitable polymers in the film may be mentioned polyethylene glycol terephthalate, polycarbonate, polyamide, polypropene, polyphenylenoxide and polyacryl nitrile.

If the conductor has two end sides facing the main insulation, it may be advantageous to use one tape for each end side instead of using one tape which surrounds both end sides. Thus when the conductor is bent the tape on one of said end sides does not effect the tape on the other end side since there is no connecting part of tape. Mechanical stresses on one tape are therefore not transferred to the other tape.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in more detail by means of a number of examples with reference to the accompanying drawings in which FIG. 1 shows in perspective a conductor according to the invention provided with conductor insulation and tape of corona-resistant insulating material prior to bending; FIG. 2 the same conductor in cross-section on a larger scale; FIG. 3 a side view of a coil produced by bending the conductor according to FIGS. 1 and 2 and provided with main insulation; FIG. 4 the same coil in cross-section; and FIGS. 5 to 8 alternative embodiments of the conductor according to FIGS. 1 and 2 shown in cross-section.

EXAMPLE 1

A copper conductor 10 having the dimensions 3 × 8 mm and having bevelled edges is provided with conductor insulation 11 by enamelling with a terephthalic acid alkyd produced by condensation of dimethyl terephthalate (45 equivalents) and glycerol (22 equivalents) according to U.S. Pat. No. 2,936,296. When applying the enamel the alkyd is dissolved in cresol to a 35 percent solution. The thickness of the enamel layer may be 65 μ . Outside the cured layer of enamel a resinous binder 12 is applied (not shown in FIG. 1) consisting of a polyamide-modified epoxy resin, (for example "AF-42" from Minnesota Mining and Manufacturing Company). The resin is dissolved in a solvent, such as a mixture of equal parts by weight of methanol and trichloroethylene to a 30 percent by weight solution, and applied in a thin layer on the surface of the enamelled conductor where the tape of insulating material is to be applied. When the solvent has evaporated, a tape 13, 14, respectively, of the corona-resistant insulating material is applied along each of the short sides 15, 16, respectively of the conductor and the parts of the long sides 17, 18 respectively, situated nearest these short sides. The product thus formed is then placed in a mould and subjected to heating to 165°C for 30 minutes under pressure so that the tape is effectively attached to the conductor insulation by means of the resinous binder. The tape, which has a

width of 7 mm and a thickness of 17 μ , consists of a mat built up of a mixture of equal parts by weight of small mica flakes and short fibers of an aromatic polyamide (for example a web NOMEX M from DuPont, USA).

The conductor provided with corona-resistant insulating material is bent into a coil having several turns of the conductor lying close to each other as shown in FIGS. 3 and 4, respectively. (These figures show the coil when the main insulation has been applied). The turns of the conductor lying close together form the conductor bundle of the coil. As is clear from FIG. 3, the conductor is bent so that the coil had straight parts 19 and 20 intended to be placed in the machine slots and curved end parts 21 and 22 which extend outside the slots. The terminals of the coil are designated 23 and 24.

The conductor bundle is then wrapped by turns with, for example half overlap, with a 25 mm wide mica tape consisting of a 0.09 mm thick self-carrying layer of small mica flakes overlapping each other fixed to a 0.04 mm thick woven glass tape with 0.006 mm thick polyethylene glycol terephthalate foil. Such an insulating tape is described in British Pat. No. 939,747. When the bundle has been provided with a wrapping 25 of, for example, 30 layers of mica tape one on top of the other, the winding is dried first at a pressure of 0.1 mm Hg and a temperature of 40°C, after which an impregnating resin is supplied at the same pressure. When all the impregnating resin has been supplied, the pressure is raised to, for example 25 kg/cm². The impregnating resin may consist of an epoxy resin consisting, for example, of 85 parts "Araldit F", 100 parts "Curing agent 905" (both from Ciba AG, Switzerland) and 15 parts phenyl glycidyl ether. In order to prevent the impregnating resin from squeezing out the insulation during the subsequent curing process, the impregnated conductor bundle with the wrapping of mica tape may be surrounded with a sealing tape of polytetrafluoroethylene or the like. The coil is then placed in a moulding tool to cure the impregnating resin. Curing takes place at a temperature of about 160°C for 4 to 6 hours. The coil is applied with the straight slot parts in the machine slot 38 as shown in FIG. 4. No corona-resistant material is necessary on the sides 39 and 40 of the outer conductors facing outwardly in the bundle since short-circuiting between conductors cannot occur here.

EXAMPLE 2

A coil is manufactured in the manner indicated in Example 1 with the difference that a film 26 of a polymer is applied outside each tape of the corona-resistant material as shown in FIG. 5. The film consists of a 10 μ thick polyethylene glycol terephthalate foil which is bound to the tape below by insulating material with a layer 27 of the same resinous binder as that with which the tape is bound to the conductor insulation.

EXAMPLE 3

A coil is manufactured in the manner indicated in Example 1 with the difference that, instead of the tape of corona-resistant insulating material described therein, a similar tape is used which has been impregnated with an isocyanate-modified polyester resin. A solution of such resin can be manufactured by mixing

333 parts by weight Desmophen 1670 (Farbenfabriken Bayer, Germany) 167 parts by weight Desmodur CT Stabil, 275 parts by weight diacetone alcohol, 75 parts weight butyl acetate and 150 parts by weight xylene. When the tape has been impregnated it is dried at 180°C for 10 minutes.

EXAMPLE 4

A coil is manufactured in the manner indicated in Example 1. However, instead of the tape of corona-resistant insulating material described therein, a tape of the same width and thickness is used built up of only small mica flakes overlapping each other. Instead of the resinous binder mentioned to attach the tape to the conductor insulation, a resinous binder is used consisting of 65 parts by weight of a copolymerisate of equal parts polyhexamethylene adipamide and polycaprolactame having an average molecule weight of about 25,000, 3 parts by weight of an epoxy resin consisting of a diglycidyl ether of bisphenol A with an epoxy equivalent of 190 and 2 parts by weight dicyan diamide. During application the resinous binder is dissolved in a 25 percent solution in equal parts by weight methanol and trichlorethylene. The solution is applied in the manner indicated in Example 1.

Furthermore, as the impregnating resin in the main insulation an unsaturated polyester resin is used manufactured from adipic acid (11 mol percent), phthalic acid anhydride (11 mol percent) maleic acid anhydride (23 mol percent) and ethylene glycol (55 mol percent) and provided with diallyl phthalate in such a quantity that the diallyl phthalate comprises 40 percent of the total weight of polyester resin and diallyl phthalate and also with benzoyl peroxide in a quantity corresponding to 1 percent of the weight of the mixture. The polyester resin itself is manufactured by reaction of a mixture of said acids and the alcohol in an inert atmosphere by increasing the temperature to 220°C and maintaining this temperature until the acid number of the reaction product is about 30. The coil is dried prior to impregnation at a pressure of less than 1 mm Hg and the resin is cured after the impregnation at a temperature of 130°C for 1 hour.

EXAMPLE 5

A coil is manufactured in the manner indicated in Example 4. However, the mica tape used is impregnated in the manner described in Example 3 and a film of polymer is applied outside the tape in the manner indicated in Example 2.

EXAMPLE 6

A coil is manufactured in the manner indicated in Example 1 with the difference that, instead of the tape of corona-resistant insulating material described therein, an otherwise similar tape 11 mm wide is used. Thus, as can be seen in FIG. 6, the tape 28,29, respectively applied around each short side of the conductor will lie edge to edge with the tape applied around the opposite short side.

The parts where the edges of the tape meet each other on the long sides of the conductor are designated 30,31, respectively.

EXAMPLE 7

A coil is manufactured in the manner indicated in Example 1 with the difference that, instead of the tape of corona-resistant insulating material described therein, an otherwise similar tape 10 mm wide is used. Each tape 32,33, respectively, is applied, as shown in FIG. 7, displaced in relation to a plane through the middle of the short sides of the conductor so that the gaps 34 and 35 between the edges of the tape will be situated on opposite sides of a plane through the middle of the long sides of the conductor. In this way the gaps in two adjacent conductors will not match each other at any point. The corona-resistant material is thus also used as insulation between the conductors. Of course the gaps 34 and 35 may be zero as shown in FIG. 6, that is, the two edges of the tape may meet each other on both sides of the conductor, but on opposite sides of the plane through the middle of the long sides.

EXAMPLE 8

A coil is manufactured in the manner indicated in Example 1 with the difference that, instead of the tape described therein, a 20 mm wide tape 36 is used, which is in other respects the same. This tape surrounds both the sides of the conductor facing the main insulation, as seen in FIG. 8 and the neighboring parts of sides facing adjacent conductors. The gap between the edges of the tape is designated 37.

Instead of the terephthalic acid alkyd described as conductor insulation in the foregoing examples a polyester imide may be used which has been manufactured in the following way: 45.5 parts by weight diamino diphenylmethane, 59 parts by weight trimellitic acid anhydride and 358 parts by weight dimethyl terephthalate are first reacted at 170°C. 74.6 parts by weight glycerol, 78.2 parts by weight ethylene glycol and 1.2 parts by weight lead oxide (PbO) are then added and the temperature is gradually raised to 235°C. The temperature is maintained at 235° until the acid number of the reaction product is 3 and the viscosity of a 50 percent by weight solution of the reaction product in m-cresol is 6,700 centipois at 25°C. The polyester imide resin is applied on the conductor in the form of a 50 percent by weight solution in m-cresol and cured at a temperature above 300°C. Also a polyurethane resin manufactured as described below may be used in the examples instead of the terephthalic acid alkyd: 290 parts by weight Desmophen F 950 (Farbenfabriken Bayer, Germany) is dissolved in a solvent consisting of a mixture of cresol and xylene, 58 parts by weight Desmodur CT stabil (Farbenfabriken Bayer) is dissolved separately in the same solvent to form a second solution. The dissolution is effected by heating the two resin components in the solvent to at the most 80°C, after which the two solutions are cooled and mixed at room temperature. 1.75 parts by weight titanium butylate is dissolved in a small amount of the same solvent and added to the mixture. The total amount of solvent used is 650 parts by weight, of which 520 parts is cresol and 130 parts xylene. The polyurethane resin is then applied on the conductor in the form of this cresol-xylene solution and cured at a temperature above 300°C. Also a polyvinyl formal phenolic resin may be used in the foregoing examples instead of the

terephthalic acid alkyd. Such resin of a modified type may be produced from 100 parts by weight Formvar 5/95 E (a polyvinyl formal from Shawinigan Resins Co), 50 parts by weight Mondur S (a blocked isocyanate from Mobay Chemical Co), 45 parts by weight P.D. George Phenolic No. 5716 (a phenolic resin from the P. D. George Co) and 5 parts by weight Resimene 882 (a melamine resin from Monsanto Co). The solvent used consists of 231 parts by weight cresol and 369 parts by weight Solvesso 100 (a solvent naphta, a hydrogenated petroleum solvent of high aromatic value from Humble Oil and Refining Company).

Of course mica tape having large mica flakes or other commercially available completely polymerizable resins, and also inter alia asphalt, can be used for the main insulation in the coils described in the examples. Although many unsaturated polyester resins and epoxy resins suitable for impregnating electric insulations are known, a few more examples of such resins will be mentioned. For example, an impregnating resin consisting of 60 parts by weight of a reaction product of 3 mols maleic acid anhydride, 1 mol adipic acid, 4.4 mols ethylene glycol manufactured according to the process described earlier, with an acid number of 30, and of 40 parts by weight diallylphthalate containing 0.75 percent benzoyl peroxide may be used, or an impregnating resin consisting of 70 parts by weight of a reaction product of 1 mol fumaric acid, 1 mol phthalic acid and 2.2 mols propylene glycol reacted to an acid number of 25 and 30 parts by weight monostyrene containing 0.5 percent benzoyl peroxide. Among suitable epoxy resins may be mentioned a product consisting of 100 parts by weight "Epon 828" (Shell Chemical Co.) 65 parts by weight "Dow 331" (Dow Chemical Co.) and 65 parts by weight tetrahydrophthalic acid anhydride.

Thus the first and second opposite sides of the conductor, the vertical sides in FIG. 4, are surrounded by tape (either a single tape or two tapes) while tape overlies at least those parts of the third and fourth sides, the horizontal sides, adjacent the first and second sides.

It will also be apparent in FIG. 7 that the gap between the edges of the parts of the tapes overlying one of the third and fourth sides is located on the opposite side of the central longitudinal plane through the middle of the third and fourth sides from the gap between the edges of the parts of the tape overlying the other of the third and fourth sides. When assembling several such conductors on top of each other in the slot shown in FIG. 4, the gap on one of the third and fourth sides of a conductor will not cover the gap on the other of the third and fourth sides of the adjacent conductor, this last-mentioned side being adjacent said one side of the first-mentioned conductor. The corona-resistant material thus also acts as insulation between the conductors. This condition may also exist when the tapes completely surround the conductor, that is, the joints 30 and 31 in FIG. 6 may be displaced on opposite sides of such plane.

We claim:

1. Coil to be arranged in the slot of a stator or rotor in an electric machine, comprising a bundle of conductors arranged close together and provided with conductor insulation to insulate the conductors from each other and main insulation surrounding the bundle to insulate the bundle from the machine slot, the conduc-

tors having first sides facing each other and second sides facing the main insulation, the conductor having conductor insulation comprising a layer of enamel on the conductor and tape means of corona-resistant insulating material running in the longitudinal direction of the conductor and attached to the enamel layer, the tape means surrounding at least one second side of the conductor facing the main insulation and at least those parts of the first sides of the conductor which are situated nearest said second side.

2. Coil as claimed in claim 1, in which a resinous binder secures the tape means of insulating material to the enamel layer of the conductor along its entire area of contact therewith.

3. Coil as claimed in claim 1, having film of flexible plastic outside the tape means of insulating material.

4. Coil according to claim 1, said tape means comprising a tape of insulating material surrounding only one second side of the conductor facing the main insulation and at least those parts of the first sides of the conductor facing adjacent conductors situated nearest this second side, and a second tape of insulating material surrounding another second side of the said conductor facing the main insulation and at least those parts of the first sides of the conductor facing adjacent conductors nearest said other second side.

5. Coil according to claim 4, the edges of the two tapes terminating on one first side of the conductor being displaced laterally in relation to the edges of the two tapes on the other first side of the adjacent conductor facing the first conductor so that at least one layer of tape is present between the conductors.

6. Electrical machine having a stator or rotor with a slot therein, and having in said slot a coil as claimed in claim 1.

7. Coil as claimed in claim 1, in which said tape means comprises a material from the group of mica and glass.

8. Coil as claimed in claim 1, in which said tape means comprises a mixture of mica in the form of small flakes and fibers of a linear polymer.

9. Coil as claimed in claim 7, in which said polymer is a polyamide.

10. Coil as claimed in claim 1, in which the tape means surrounds the other second side of the conductor facing the main insulation and at least those parts of the first sides of the conductor which are situated nearest said second side.

11. Insulated electrical conductor having substantially rectangular cross-section, in which the insulation comprises a layer of enamel on the conductor and tape of corona-resistant insulating material attached to the enamel layer and running parallel to the longitudinal axis of the conductor, said tape surrounding first and second opposite sides of the conductor and overlying at least those parts of the third and fourth sides adjacent the first and second sides.

12. Conductor as claimed in claim 1, in which said tape comprises two tapes surrounding the first and second sides.

13. Conductor as claimed in claim 2, in which said two tapes overlie parts only of the third and fourth sides, leaving parts of said sides uncovered.

14. Conductor as claimed in claim 3, in which such uncovered parts lie on opposite sides of a plane extend-

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ing longitudinally of the conductor and perpendicular to the third and fourth sides.

15. Conductor as claimed in claim 2, in which the edges of the parts of the tapes overlying one of the third and fourth faces lie on the opposite side of a plane ex-

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tending longitudinally of the conductor and perpendicular to the third and fourth sides from the edges of the parts of the tapes overlying the other of the third and fourth sides.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 3,723,797

Dated March 27, 1973

Inventor(s) Anders Andersson and Anders Bjorklund

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 10, line 60, first line of claim 12, replace
"1" by -- 11 --.

Column 10, line 63, first line of claim 13, replace
"2" by -- 12 --.

Column 10, line 67, first line of claim 14, replace
"3" by -- 13 --.

Column 11, line 3, first line of claim 15, replace
"2" by -- 12 --.

Signed and Sealed this
eighteenth Day of May 1976

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks

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