July 1, 1952 G. CAMILLI ET AL 2,602,035

PAPER PULP COATING OF COILS

Filed Sept. 8, 1949

Fig. 1.

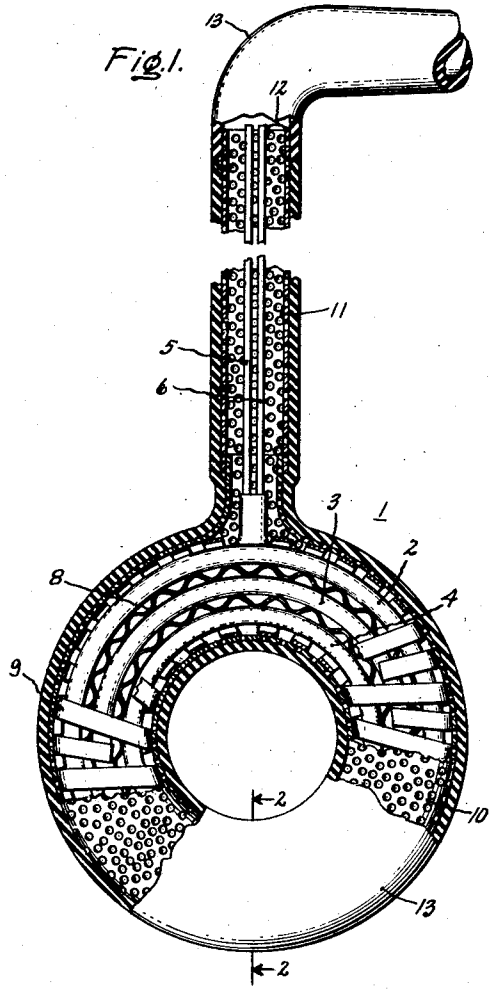


Fig. 3.

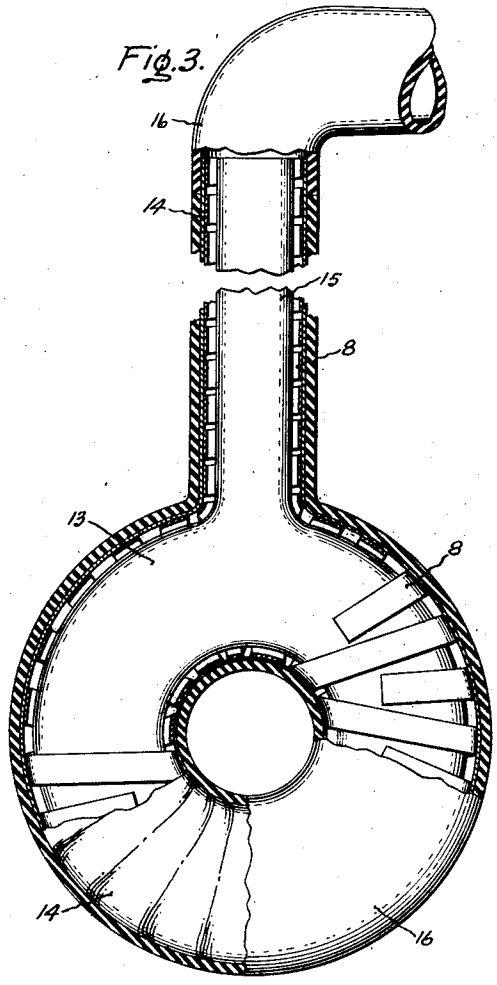


Fig. 2.

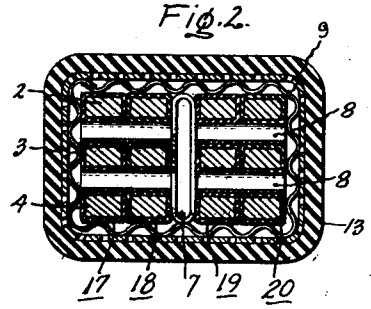


Fig. 5.

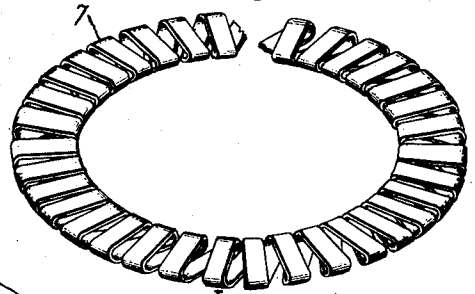
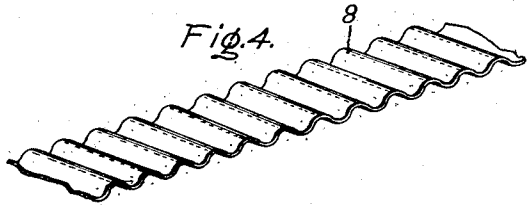


Fig. 4.



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PAPER PULP COATING OF COILS

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2 Claims. (Cl. 154—80)

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This invention relates to electrical insulation and more particularly to an improved method of applying an insulating material to an electrical conductor.

In Patent 2,290,671 to Guglielmo Camilli, Raymond J. Hemphill, and Harold S. Endicott, assigned to the same assignee as the present application, there is disclosed a method for hydraulically applying insulation to an electrically conducting article. In this method, the insulating material, such as paper pulp, which is to be coated on the article to be insulated, is suitably beaten or broken into finely divided particles of proper size and is then mixed with any suitable liquid, such as water. The article to be insulated may be perforated or a suitable screening or liquid-permeable material may be placed around the article, and the article is then immersed in the liquid. The perforations or screening are necessary in order to allow the liquid adjacent the outside surface of the perforated member or screen to pass through the perforations and deposit its suspension on the outside surface of the screen member when a difference of pressure between the liquid inside the perforated member or screen and the liquid surrounding the perforated member or screen is created. If this movement of the liquid takes place at a sufficiently fast rate, the liquid passing through the perforations will deposit its suspension on the outside surface thereof. In this manner, insulation may be hydraulically applied to any suitable member, such as a coil, it being only necessary to use insulating material which, when beaten, will have particles of fibers of sufficiently large size so that they will not pass through the permeable wrapping or screen with the liquid.

One limitation which occurs in connection with the hereinbefore described method, as disclosed in Patent 2,290,671, is that when a relatively thin layer of the insulating coating has been applied on the perforated or permeable screening material, the differential in pressure between the liquid inside the screen and the liquid outside the screen is not sufficient to draw additional liquid through the perforations of the screen. As a result, only relatively thin coatings of insulation may be applied in accordance with the method just described.

Another problem which is encountered when insulating by the hydraulic method described hereinbefore is that of providing suitable ducts for the passage of liquid about the coil inside the screening or permeable wrapping, since satisfactory deposition of the suspended insulating

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material requires a relatively fast flow of liquid through the screening surrounding the coil.

It is an object of our invention to provide a new and improved method for hydraulically applying insulation to an electrical conducting member, such as a coil.

It is a further object of our invention to provide a method for applying a plurality of layers of insulating material hydraulically.

It is a still further object of our invention to provide an improvement over the hydraulic insulating method disclosed in Patent 2,290,671, mentioned hereinbefore.

Another object of our invention is to provide an improved duct system within the screening or permeable wrapping about the coil winding in order to promote more rapid fluid flow therethrough.

In accordance with the objectives hereinbefore outlined, this invention provides a method for applying a plurality of layers of insulating material by a hydraulic method, wherein after one insulating coating has been applied in accordance with the method described in Patent 2,290,671, spacer members and a permeable wrapping are applied over the initial coating, and the channel so provided is connected to a vacuum source in order to draw more liquid through the permeable wrapping, thereby causing the deposition of an additional coating of insulating material.

Also, this invention provides pressboard spacer members between the concentric turns of a disc coil and also between the coil layers comprised of a plurality of such concentric turns, in order to provide ducts for the free flow of liquid after it has passed through the screening or permeable wrapping surrounding the coil.

The features of this invention which we believe to be novel are set forth with particularity in the appended claims. Our invention itself, however, both as to its organization and use, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing in which Fig. 1 represents a view, partly in section, of a coil being insulated in accordance with our invention; Fig. 2 is a cross-sectional view along line 2—2 of Fig. 1; Fig. 3 is a view of the coil of Figs. 1 and 2 with an additional layer of insulation applied thereto; Figs. 4 and 5 are views of spacer members used to provide the liquid-flow ducts shown in Figs. 1, 2, and 3.

Referring now to the drawing, there is shown in Figs. 1 and 2 a coil 1 which is to be insulated,

comprised of a plurality of concentric turns 2, 3, and 4, and provided with terminal leads 5 and 6. In the embodiment illustrated in the drawing, coil 1 is annular shaped and comprises a plurality of superposed winding layers 17, 18, 19 and 20. Each winding layer is annular shaped and formed by spirally winding a plurality of insulated conductor turns such as 2, 3, 4 in a radial plane. While in the embodiment shown in the drawing, each conductor 2, 3, 4 is represented as a single conductor turn, it will be understood that each conductor 2, 3, 4 could also represent a plurality of successive spirally-wound turns lying in the same radial plane. Also, each of the layers 17, 18, 19 and 20 could represent a plurality of superposed layers. The winding layers are arranged in two axially-extending sections which are axially separated by a spacer member 7 comprised of some material such as cardboard or pressboard spirally wound to form a generally annular figure, shown separately in Fig. 5. The resultant spacer member 7 is then placed between the two sections of the coil, as will best be seen in Fig. 2. In order to maintain ducts between the concentric winding turns 2, 3, and 4, corrugated strips 8 made of pressboard or some similar material are placed between these turns. Separate corrugated strips 8 are used on each side of spacer 7 which, as has been mentioned, is placed between the two winding sections of coil 1. A separate view of the corrugated strip 8 is shown in Fig. 4.

A further layer of the corrugated strip 8 may be wound around the complete coil assembly, as shown at 9 in Figs. 1 and 2, in order to space the coil assembly from the perforated container or permeable wrapping to be subsequently applied, as will be described hereinafter.

After the coil 1 has been provided with ducts by means of spacer members 7 and 8, and spacer 8 has also been wound around the coil assembly, as shown at 9, the entire assembly is then surrounded by a suitable permeable wrapping or perforated container through which the treating liquid may pass to cause the deposition of insulating material.

In the construction illustrated in Fig. 1, a perforated metal shield is used as the means for filtering the liquid. This shield is in the form of a split ring 10 having connected to it a perforated metal tube 11 through which terminal leads 5 and 6 pass. A shield of this type is described in more detail in Patent 2,280,625 to Camilli, assigned to the same assignee as the present application. Perforated metal ring 10 and its associated connected metal tube 11 serve the dual function of providing an electrostatic shield for the coil 1, and leads 5 and 6, which may be necessary if the coil is operated at a high potential above ground, and also as a filtering member upon which the suspended insulating material may be deposited.

The shield is connected to one of the leads 5 or 6 by a conductor 12 so that the shield and the lead to which it is connected will have a definite voltage relationship. If this connection is not made, the shield may assume an indefinite voltage which depends upon the electrostatic capacity between the leads and the shield, and also upon the capacity between the shield and ground. The shield is formed with a smoothly curved outer surface, with the radius of curvature of each part of the shield being sufficient to prevent corona between the coil 1 and ground.

After the coil 1 has been provided with suitable ducts by means of spacer members 7 and 8, as shown in Figs. 1 through 4, and has been placed in a permeable container, such as the perforated metal shield hereinbefore described, the whole assembly is then placed in a tank filled with liquid having insulating material, such as paper pulp or asbestos, in suspension, and this suspended material is deposited on the coil assembly in accordance with the previously mentioned Patent 2,290,671 to Camilli, Hemphill, and Endicott, assigned to the same assignee as the present application. As disclosed in the patent just mentioned, the tube 11 is connected to a source of vacuum, causing a pressure differential on the interior and exterior of the coil assembly, thereby causing a flow of water through the permeable container such as the perforated metal shield 10 and through the ducts formed by spacers 7 and 8. As the water flows through the perforated metal shield 10, it deposits its suspension of insulating material, such as paper pulp or asbestos, on the outer surface of the shield, thereby building up an insulating coating 13 about the shield and winding.

However, as has been stated hereinbefore, only a relatively thin layer of insulating coating can be built up in this manner, due to the fact that once such a relatively light coat has been deposited, the vacuum suction will not be sufficient to draw any more liquid or water through the already deposited coating. Therefore, in accordance with our invention, we provide a construction which permits the depositing of thicker layers of insulating material hydraulically than can be obtained using only the method disclosed in the previously-mentioned Patent 2,290,671 to Camilli, Hemphill and Endicott.

Referring to Fig. 3, there is shown the same coil 1 as that shown in Figs. 1 and 2, having a layer 13 of insulating coating of paper pulp or other similar material applied thereto in accordance with the method hereinbefore described. In order to add another layer of insulating material, we provide a new system of ducts above the first layer 13 of insulating material. As will be seen in Fig. 3, we spirally wind corrugated spacers 8 over layer 13 of insulating material, and over corrugated spacers 8, we wind a layer of some suitable permeable material such as cotton tape 14, for example. The spacers 8 may be cut into short lengths of slightly more than one turn, as shown in Fig. 3, rather than attempting to wind a continuous spiral around the entire circumference of the coil structure. Spacers 8 and cotton tape winding 14 are also placed around the neck portion 15 which projects from the circular coil assembly, and which contains leads 5 and 6.

In depositing the additional coat of paper pulp or other insulating material, the neck 15 is connected to a vacuum source and the liquid is sucked through the cotton tape 14 and through the ducts formed by spacers 8, into the vacuum line, as was done when the first coat was deposited. The suspension of paper pulp or other insulating material will be deposited on the cotton tape wrapping and will build up another insulating coat 16. However, just as in the case of the first coat, a point will be reached where the vacuum will not exert sufficient suction to draw any more water through the cotton tape wrapping 14. If it is desired to further increase the thickness of the insulating coating, it will then be necessary to apply another layer of spacers 8 and permeable wrapping 14 around the circumference of the coil assembly on top of the second layer of insulation 16 and also around the second layer of insulation on the projecting neck portion 15. This process can be carried on indefinitely, until

the thickness of the paper pulp coating around the coil has been built up to the desired thickness.

In the event that the coil which is being insulated is for use with low voltages and does not require a thick coating of insulation or the use of a metal shield member 10, as shown in Fig. 1, the structure of Fig. 1 may be modified by omitting the metal shield 10 which is primarily used for electrostatic shielding purposes and is not necessary when the coil is only subjected to low voltages above ground. In the event that the metal shield 10 is omitted, the first layer of insulating material would be applied over a wrapping of cotton tape 14, which would be used in place of the metal shield 10 as the surface upon which the suspended material would be deposited. In other words, a layer of cotton tape 14 would be substituted for the metal shield 10 in applying the first layer of insulation, and would serve as the filtering medium for the application of the first layer of insulation in place of the metal shield 10.

It can be seen that our invention provides an improved method of depositing insulation hydraulically, since we provide an improved duct system for permitting rapid flow of fluid through the coil body itself, and also provide a simple and effective method for increasing the thickness of the insulating coating, where that is desired.

While there have been shown and described particular embodiments of our invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and, therefore, it is aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. The method of insulating an electrical winding of the type having a plurality of superposed coaxial winding layers, each of said layers having a plurality of spirally-wound conductor turns in the same radially-extending plane, which includes beating a solid insulating material into bits, introducing the beaten material into a liquid, positioning corrugated axially-extending spacer members between successive turns of said winding, wrapping a corrugated spacer member around the outer surface of said winding, afterwards surrounding said winding with a covering permeable to said liquid, then immersing said winding in said liquid having said insulating material in suspension, and creating a difference in the relative pressures inside and outside said permeable covering so that the liquid adjacent the outside surface of said permeable covering will pass therethrough and deposit its suspension on the outside surface of said permeable covering.

2. The method of insulating an electrical winding of the type having a plurality of superposed coaxial winding layers, each of said layers having a plurality of spirally-wound conductor turns in the same radially-extending plane, which includes introducing a finely-divided insulating material into a liquid, said liquid holding said insulating material in suspension, positioning corrugated axially-extending spacer members between successive turns of said winding, wrapping a corrugated spacer member around the outer surface of said winding, afterwards surrounding said winding with a covering permeable to said liquid, then immersing said winding in said liquid having said insulating material in suspension, and creating a difference in the relative pressures inside and outside said permeable covering so that the liquid adjacent the outside surface of said permeable covering will pass therethrough and deposit its suspension on the outside surface of said permeable covering.

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LEO MULLIGAN.

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