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INSULATED MATERIAL AND METHOD OF MAKING THE SAME

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Fig. 1.

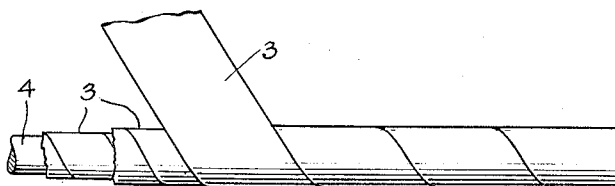
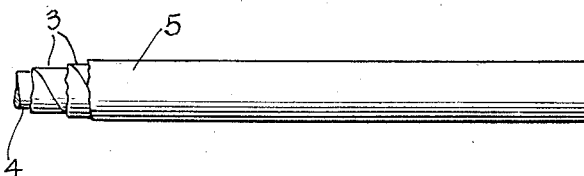


Fig. 2.



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INSULATED MATERIAL AND METHOD OF
MAKING THE SAME

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8 Claims. (Cl. 173-264)

This invention relates to the electrical insulation of wires, coils or other electrical devices and relates more particularly to a method of insulating such material by the use of bands or ribbons of organic derivatives of cellulose.

An object of my invention is to insulate electrical wires, coils or other devices in a cheap and expeditious manner. A further object of my invention is to employ strips, bands or ribbons of foil containing cellulose acetate or other organic derivatives of cellulose as an electrical insulating medium. Further objects of this invention will appear from the following detailed description.

Heretofore, Tussah silk or cotton has been employed for the electrical insulation of wires and the like. Tussah silk is relatively expensive and cotton has such relatively low dielectric strength that a large amount must be used whereby the final covered wire has a large diameter and is therefore bulky. I have found that strips or bands of foil made of cellulose acetate or other organic derivatives of cellulose have an extremely high dielectric strength, which is many times that of natural silk and vastly many times that of cotton, and therefore when such cellulose acetate strips are employed to cover wires and the like, a relatively small amount is required to obtain the desired degree of insulation. Wires covered by cellulose acetate strips in accordance with this invention not only have a smaller diameter than those wrapped with Tussah silk or cotton, but they are also insulated better and at a much lower cost.

In accordance with my invention I insulate electrical devices by covering the same with strips, ribbons or bands of foil or films made of organic derivatives of cellulose. In order to impart a continuous relatively waterproof surface to the layer of the strips or bands, at least the outer layer of such strips or bands, after they have been wound on the electrical devices, is partially or completely coalesced by the application of heat and pressure, a solvent, a swelling agent, and/or a softening agent or plasticizer.

In order to illustrate my invention reference is had to the accompanying drawing in which

Fig. 1 is a plan view, partly broken away, of a portion of an electrical conductor in process of preparation in accordance with the present invention; and

Fig. 2 is a plan view, partly broken away, of a portion of a finished electrical conductor, with the outer strips of the foil coalesced.

In the drawing, 3 indicates strips or bands of foil of cellulose acetate or other organic derivatives of cellulose which are spirally wrapped around the wire or conductor 4. Several layers of wrappings may be wound around the conductor and at least the top layer is coalesced so as

to form a continuous, water-proof coating 5 for the inner wrappings or layers of foil.

Any suitable electrical device may be insulated by my invention. For instance individual wires may be insulated with the cellulose acetate strips or bands, as may also be cables comprising a plurality of individual wires, which individual wires may be insulated with cellulose acetate strips or bands or with any other insulating material. Coils, such as induction coils, transformer coils, relay coils or other magnetic coils such as those employed in telephone receivers, may be covered with the cellulose acetate strips or bands, and the individual wires may be insulated with such cellulose acetate strips or in any other manner. Windings, such as those of motors or dynamos, may be insulated by this invention, as may also be the electrical condensers by wrapping the plates with the strips of cellulose acetate. The wires may be first covered with another insulator such as enamel or even silk, and then be given a final wrapping with the cellulose acetate strips or bands.

For covering electrical devices, I employ tapes, strips, bands or ribbons of foils of organic derivative of cellulose, which may vary in thickness from less than $\frac{1}{32}$ to $\frac{1}{2}$ " or more in width. These may have a thickness of less than 0.0005 to 0.003" or more and may be formed by cutting wider pieces of foil, which may be made by casting a solution of the organic derivative of cellulose in a volatile solvent upon a smooth surface which may be either stationary or moving such as that of moving bands or wheels.

While this invention is described more specifically in connection with the use of strips or bands of cellulose acetate, such strips or bands may be made of other organic derivatives of cellulose such as organic esters of cellulose and cellulose ethers. Examples of such organic esters of cellulose are cellulose formate, cellulose propionate, and cellulose butyrate, while examples of cellulose ethers are ethyl cellulose, methyl cellulose and benzyl cellulose. If desired, plasticizers such as triacetin, diethyl phthalate, dibutyl phthalate, diethyl tartrate, triphenyl phosphate, etc. may also be incorporated in the strips or bands.

After strips or bands of cellulose have been wound around the electrical device, in order to prevent ravelling of the same and also to obtain a more or less continuous impervious surface, at least the outer surface of such strips or bands is coalesced by the application of one or more of the following expedients: heat, heat and pressure, a solvent, a swelling agent and a softening agent.

In order to coalesce the strips of cellulose acetate by means of heat, any suitable expedient may be used. Thus the wire that is wrapped with the cellulose acetate strips or bands may be passed

between rollers or through openings or dies in plates and the like which are heated sufficiently to cause the cellulose acetate to at least partially melt and coalesce by pressure. Wires, coils and the like covered with the cellulose acetate strips may be placed in heated molds to cause the desired degree of coalescence.

Another expedient for causing coalescence is the use of a solvent for the cellulose acetate or other organic derivative of cellulose. Examples of such solvents are acetone, tetrachlorethane or mixtures of methylene chloride with ethyl or methyl alcohol. The choice of the solvent will depend on the solubility characteristics of the particular organic derivative of cellulose present in the strips or bands. To cause coalescence by means of solvent, the electrical device wrapped with the strips of cellulose acetate may be sprayed with a solvent or immersed in a solvent bath for a relatively short time and then withdrawn from the bath, whereupon after evaporation of the solvent a coalesced layer is formed. Wire covered with the cellulose acetate strips may be passed through a bath of solvent, or the solvent may be applied to such wire by spraying, by means of wicks or rollers while they are in transit to a winding device, or the wire may merely be exposed to the vapors of such solvent. If desired the action of the solvent may be aided by the application of heat.

Another method of causing coalescence is by the application of a swelling agent for the organic derivative of cellulose. Examples of swelling agents for acetone-soluble cellulose acetate are ethyl alcohol, methyl alcohol, diacetone alcohol, monoethyl ether of ethylene glycol, or a mixture of a solvent such as acetone with a diluent such as benzene, the amount of diluent present being such that the mixture has only a swelling action on the cellulose acetate. The swelling agent may be applied to the covered electrical device in the same manner as that described in connection with a solvent. After the application of a swelling agent, I prefer to apply heat to aid the action of the swelling agent to cause coalescence.

Another manner of causing coalescence is by the use of a softening agent or plasticizer for the cellulose acetate. Examples of such plasticizers are triphenyl phosphate, tricresyl phosphate, triacetin, diethyl phthalate, dibutyl phthalate, diethyl tartrate, dibutyl tartrate or mono methyl xylene sulfonamid. If the plasticizer is a liquid it may be applied alone to the cellulose acetate strips, either before they are wound on the device or after they have been so wound. If the plasticizer is a solid, or even in the case of liquid plasticizers, the same may be dissolved in a liquid which is a solvent for the softening agent or plasticizer. This solvent for the softening agent may be a non-solvent, a solvent or a swelling agent for the cellulose acetate. If further coalescence is desired, heat or heat and pressure may be applied as described above.

The use of a softening agent or plasticizer is very advantageous, since its presence imparts a softness and pliability to the coalesced strips or bands and therefore the coalesced layer is not so likely to crack or peel as in the case when no softening agent is used or is present.

By this invention electrical devices such as wires, coils, windings, condensers, etc., may be produced which have an insulation of very high

dielectric strength. Because of the high dielectric strength of the cellulose acetate material, only a relatively small amount is required for the coverings so that such electrical devices when finished have a small bulk. Moreover the insulation costs are lower than that of previous methods. Because of the coalescence, the wrappings do not tend to ravel and the outer layer presents a smooth continuous surface which is relatively waterproof.

It is to be understood that the foregoing detailed description is given merely by way of illustration and that many variations may be made therein without departing from the spirit of my invention.

Having described my invention, what I claim and desire to secure by Letters Patent is:

1. Articles comprising an electric conductor having a covering of an insulator which comprises an impervious outer layer, consisting solely of an organic derivative of cellulose composition, enclosing separable windings consisting solely of strips of foil of the same composition.

2. Articles comprising an electric conductor having a covering of an insulator which comprises an impervious outer layer, consisting solely of a cellulose acetate composition, enclosing separable windings consisting solely of strips of foil of the same composition.

3. Method of insulating articles comprising an electric conductor, which comprises applying to the conductor strips of an organic derivative of cellulose foil to form a plurality of layers of foil, and at least partially coalescing at least the outermost layer, leaving at least the innermost layer in its original form.

4. Method of insulating articles comprising an electric conductor, which comprises applying to the conductor strips of cellulose acetate foil to form a plurality of layers of foil, and at least partially coalescing at least the outermost layer, leaving at least the innermost layer in its original form.

5. Method of insulating articles comprising an electric conductor, which comprises applying to the conductor strips of cellulose acetate foil to form a plurality of layers of foil, and at least partially coalescing at least the outermost layer by the application of heat and pressure, leaving at least the innermost layer in its original form.

6. Method of insulating articles comprising an electric conductor, which comprises applying to the conductor strips of cellulose acetate foil to form a plurality of layers of foil, and at least partially coalescing at least the outermost layer by the application of a solvent, leaving at least the innermost layer in its original form.

7. Method of insulating articles comprising an electric conductor, which comprises applying to the conductor strips of cellulose acetate foil to form a plurality of layers of foil, and at least partially coalescing at least the outermost layer by the application of a swelling agent, leaving at least the innermost layer in its original form.

8. Method of insulating articles comprising an electric conductor, which comprises applying to the conductor strips of cellulose acetate foil to form a plurality of layers of foil, and at least partially coalescing at least the outermost layer by the application of a softening agent, leaving at least the innermost layer in its original form.

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