Feb. 11, 1936. W. S. TITCOMB 2,030,160

METHOD OF COVERING ARTICLES

Filed April 4, 1934

S - Soluble derative of cellulose
i - Cotton, silk, linen or other natural or insoluble fibers

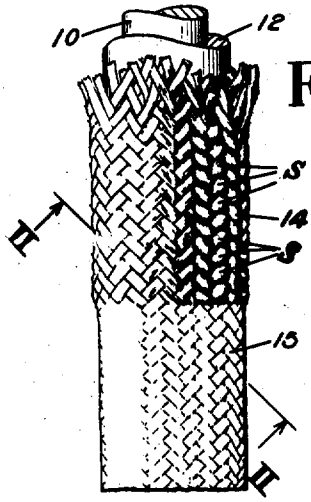

Fig.1.

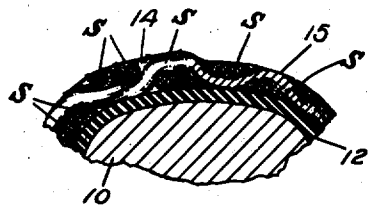

Fig.2.

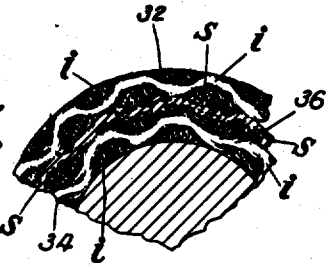

Fig.7.

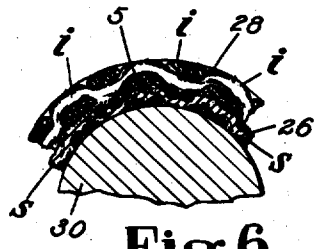

Fig.6.

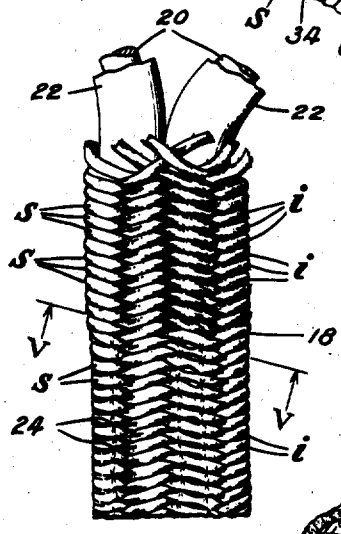

Fig. 4.

Fig.5.

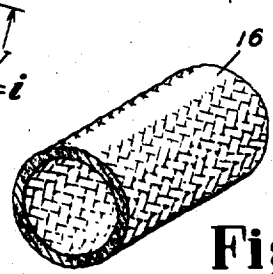

Fig.3.

INVENTOR
William S. Titcomb
By his attorney
Victor Cobb

Patented Feb. 11, 1936 2,030,160

UNITED STATES PATENT OFFICE

2,030,160

METHOD OF COVERING ARTICLES

William S. Titcomb, Andover, Mass., assignor to Shoe Lace Company, Boston, Mass., a corporation of Maine

Application April 4, 1934, Serial No. 719,030

2 Claims. (Cl. 96—26)

This invention relates to improvements in methods of covering rod-like articles, and is illustrated herein with reference to applying an insulating covering about an electric conductor.

Many uses for rod-like articles such as wires, for example, require that they shall be provided with a covering which is substantially impervious and has sufficient flexibility to permit of its being bent without breaking or cracking. Such covering may be made either separate from the article on which it is to be used but adapted to be put thereon, or it may be formed integrally with an indefinite length of the material from which the article is to be made.

The invention is concerned with the formation on a rod-like article such as an electric conductor, for example, of an insulating covering which not only meets the above-named prerequisites but also cannot readily, or will not in the normal use of such article or conductor, be removed from it. Accordingly, the invention contemplates that improvement in methods of covering rod-like articles which consists in first coating the article with a volatile solvent and then, before the coating of solvent has evaporated, applying a fabric covering to the coated article, some or all of the strands of which covering are soluble in the solvent with which the article has been coated. If desired, the step of coating the article may be carried out by applying thereto a solution of the material of which the soluble strands of the covering are composed. As a result of practising either of these methods, the solvent or solution permeates the covering as the latter is applied about the article and causes the soluble strands of the covering not only to dissolve, at least partially, and to coalesce, but also to be bound tenaciously to the article itself by a solidified solution of the dissolved strands.

I have discovered that strands made of cellulose derivative fibers such, for example, as cellulose acetate fibers, are suitable for making a covering such as that referred to above, this substance being readily soluble in acetone. It has been found desirable in some instances, moreover, to combine with strands of a cellulose derivative, strands of substantially insoluble fibers such, for example, as cotton or other cellulose fibers, which the cellulose derivative web in its dissolved state readily permeates and, when resolidified, completely encases.

Great strength and imperviousness may be obtained in a covering of the type under consideration by repetition of the above-mentioned methods and thereby superimposing a plurality of layers of covering, and causing the contiguous layers, as well as their strands, to be united to each other by a homogeneous web of the material of which the soluble strands are composed.

As mentioned above, an important application of the present invention is in connection with electric conductors having coverings of the type described above. Accordingly, the invention has been illustrated herein with reference to coverings for electric conductors but, as will be pointed out below, the invention may have other applications and is not to be limited to that referred to herein, which has been selected merely for illustrative purposes, and which will now be described with reference to the drawing, in which,—

Fig. 1 illustrates a fabric covered conductor a portion of the covering of which has been treated in accordance with the invention;

Fig. 2 is a sectional view of the covered conductor shown in Fig. 1 as taken along the line II—II of Fig. 1;

Fig. 3 is a view in perspective illustrating a covering alone of the type which is illustrated as applied about a conductor shown in Fig. 1;

Fig. 4 illustrates another form of fabric covering contemplated by the invention as applied about a pair of conductors;

Fig. 5 is a sectional view taken along the line V—V of Fig. 4; and

Figs. 6 and 7 are sectional views illustrating coverings comprising a plurality of layers of fabric.

Various uses of wire either in great lengths or in relatively short lengths, both of which are intended to be included by the term "rod-like article" as employed herein, require that the wire shall have a covering. This covering may be made separately as an article of manufacture and adapted to be applied about a rod-like article or wire (as in the case of the "spaghetti" used in some radio receiving apparatus) or it may be formed about the article.

Referring now to Fig. 1, a rod-like article or wire 10 has a covering consisting of rubber insulation 12 and a tubular fabric sheath 14, which preferably is braided about an indefinite length of the rubber insulated wire 10, or which, if desired, can be applied in relatively short lengths about short lengths of the wire. The sheath 14 may be a fabric of any appropriate form whether woven or braided, but as herein illustrated is a so-called "diamond" braid each strand of which passes first over and then under two other strands. The sheath 14 is composed entirely of strands *s* the fibres of which are readily soluble.

Such strands may be made from a cellulose derivative such as cellulose acetate, for example. This material can be readily dissolved in many volatile fluids such, for example, as acetone and diethylene oxide, which are suitable for use in carrying out the invention, as will be explained below.

The sheath 14 is next treated with a solvent of the type referred to, as by immersion or by being sprayed, sufficiently to cause the strands *s* to be at least partially dissolved. The material thus dissolved from the strands *s* thoroughly permeates them and fills the interstices between them, giving the sheath, as treated, a structure consisting of the remaining portion of the braid the strands of which are united by a homogeneous web formed of the material dissolved from the soluble strands *s*. As indicated in Fig. 2, the strands *s* when dissolved coalesce to a great extent, undergo a slight reduction in thickness owing to the leveling of the ridges of the fabric structure and the filling in of the interstices and, being thus united to each other by the solid material remaining when the volatile solvent has entirely evaporated, form a substantially homogeneous and impervious sheath 15. Such a sheath or covering 16, separate from and independent of a rod, wire or the like, is illustrated in Fig. 3 and may be made by treating a tubular fabric some or all of the strands of which are made of soluble fibers with a suitable solvent, as described above.

The strands of a covering treated in the above-described manner, after having been applied about a wire or rod-like article, are not only united with each other by the web of solid material derived from the soluble strands but are also bound by the web securely to the article or wire itself. The soluble strands can be dissolved to any desired degree by varying the extent of the solvent treatment, as by controlling the duration of the treatment, the quantity of solvent employed and the nature or condition of the solvent. The solvent may, if desired, contain a plasticizer, for example di-butyl phthalate or tri-cresyl phosphate, in order to toughen and improve the resiliency of the covering.

While Figs. 1 and 2 illustrate a covering all of the strands of which are composed of soluble fibers, it may be desired in some instances to employ both soluble and insoluble strands. Such a covering 18 is illustrated in Figs. 4 and 5 as being applied about a pair of conductors 20 having rubber insulating coverings 22. In Fig. 4 all of the strands which extend upwardly from right to left are made of soluble fibers *s* while the other strands *i* are made from fibers which are insoluble, or substantially so, in the solvent for the soluble strands; but it is to be understood that the particular proportion of strands having soluble fibers and other strands having insoluble fibers may be varied as desired. That is, if desired each set of strands may be composed partly of soluble and partly of insoluble strands instead of one set being composed of soluble strands and the other of insoluble strands, as in the case of the covering illustrated in Fig. 4.

The covering 18 responds to a treatment by solvent for the soluble strands in a similar manner but to a lesser extent than in the case of a covering all of the strands of which are soluble. As indicated in Fig. 4, the partially dissolved soluble strands coalesce to some extent, especially where they pass between the insoluble strands as at 24, and the material dissolved from them permeates and is absorbed by the insoluble strands which, when the solvent has evaporated, become substantially encased in the re-solidified material derived from the soluble strands. As the insoluble strands in this example are unaffected by the solvent, the treated covering retains more of its original fabric appearance than would be the case if all of the strands were soluble, as in the case of the coverings shown in Figs. 1 and 3.

While a covering consisting of a single layer of fabric is adequate for many purposes, it is desirable for others to provide a covering having a plurality of superimposed fabric layers whereby the strength and effectiveness of the covering is increased. Illustrative examples of such a covering are shown in Figs. 6 and 7, Fig. 6 representing a covering consisting of two fabric layers the inner one 26 of which is composed of strands of soluble fibers *s* and the outer one 28 of insoluble fibers *i*. These layers are illustrated in Fig. 6 as being formed about a rod-like article or a conductor 30 and as having been treated with a solvent for the soluble strands. Thus, the strands of the inner fabric layer 26, as a result of being treated with solvent, coalesce and are united with each other by a homogeneous web formed by solid material dissolved from these strands. The aforesaid solution, however, in its fluid state, permeates, to some extent if not completely, the outer fabric layer 28, thereby binding the two layers together when the solution solidifies. The resulting covering, therefore, retains substantially all of its original fabric appearance, the outer fabric layer 28 not having been changed much in appearance by the action of the solvent, and the inner layer 26 provides a substantially homogeneous, impervious sheath for the conductor 30 beneath it with which the inner layer 26 is also intimately connected by the aforesaid web.

Fig. 7 represents another multiple-layer fabric covering which is illustrative of coverings of a type having two or more layers of soluble or insoluble strands, successive layers of like strands being separated by a layer composed of strands of the other kind. In the covering illustrated in Fig. 7 the outer layer 32 and an inner layer 34 are both composed of strands of insoluble fibers *i* and an intermediate layer 36 is composed of strands of soluble fibers *s*. However, as indicated above, the positions of the layers of soluble and insoluble strands might be interchanged. As a result of treating a covering of the type illustrated in Fig. 7 with a solvent for the soluble strands *s* of the intermediate fabric layer 36, the inner and outer fabric layers 32 and 34 of insoluble strands are securely bound to the intermediate layer 36 by the web of material which is dissolved from the soluble strands by the solvent employed. All of the layers of this covering are thus united and the outer and inner layers are encased by the solid material derived from the soluble strands.

Although the solvent treatment given to the coverings described with reference to Figs. 1, 4, 6, and 7 has been referred to as being carried out after the covering has been formed about the article, wire or conductor to be covered, the invention in the method aspect also contemplates coating the member to be covered with a solvent and then applying the covering to the coated member while the solvent is in a fluid condition. This coating may include a plasticizer or may be constituted by a solution of the material of which the soluble strands of the covering are composed if the resulting covering is to be used in any application requiring great resiliency or toughness.

A covering made in accordance with this invention, whether distinct and separate from a rod, wire and the like, or whether treated by a solvent in either of the ways referred to above, possesses several qualities which are of especial value in connection with insulating electric conductors. The tendency of a braided fabric insulating covering on an electric wire or conductor to ravel is well known and should be avoided or prevented when such conductors are used for electric wiring purposes. A common method of overcoming this difficulty is applying about the conductor over the frayed edge of the insulation a piece of adhesive tape; but this or similar steps are unnecessary when wires or conductors covered in accordance with the invention are used as the material dissolved from the soluble strands in the covering, as described above, will bind all of the strands of the covering together, and also to the article or wire about which such a covering may have been made. Another valuable advantage of a covering of the type illustrated in Figs. 1 and 3 all of the strands of which are composed of soluble fibers results from its substantial imperviousness. A covering of this type affords substantial resistance against absorption of atmospheric dampness and thus insures against the difficulties which arise in the operation of electric apparatus which is sensitive to dampness.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent of the United States is:

1. That improvement in methods of covering a rod-like article which consists in first coating an article with a cellulose derivative dissolved in a volatile solvent, and then, before the solvent has evaporated, applying to the article a fabric covering comprising strands of a cellulose derivative which are soluble in the solvent employed.

2. That improvement in methods of covering a rod-like article which consists in first coating an article with a cellulose derivative dissolved in a volatile solvent, and, before the solvent has evaporated, braiding about said coated article a fabric covering some or all of the strands of which are soluble in said solvent.

WILLIAM S. TITCOMB.