

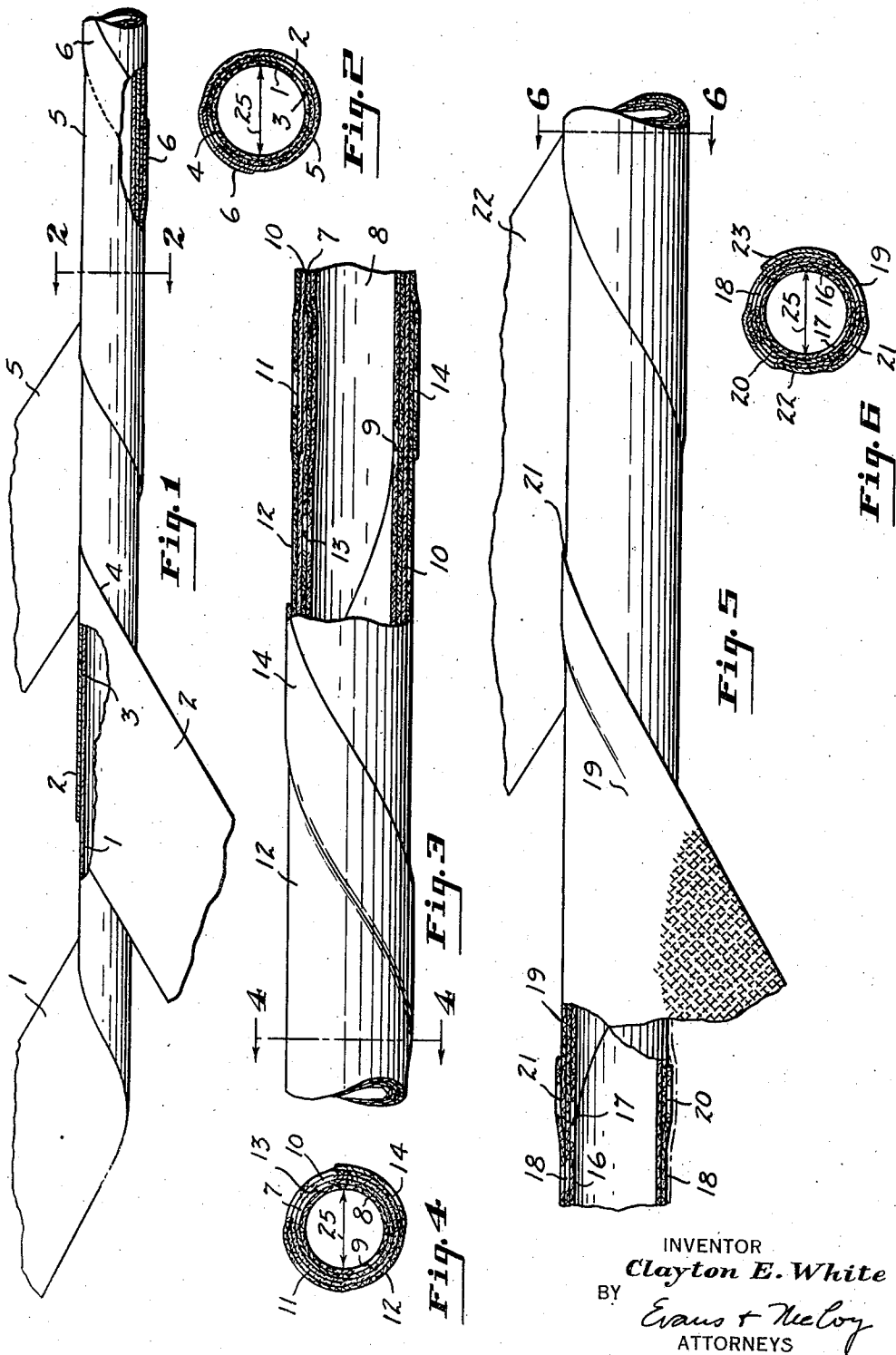
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TUBING AND METHOD OF MAKING THE SAME

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TUBING AND METHOD OF MAKING THE SAME

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This invention relates to laminated tubing construction, and more particularly to tubing of this character which is used in relatively short lengths over electrical conductors to insulate the same, commonly referred to as "spaghetti tubing", and the method of making the same.

It is an object of the invention to provide an improved tube having increased tensile strength, and which may be laterally bent or twisted, and even collapsed, without objectionable injury thereto.

Another object is to provide a tube of increased dielectric properties, and which has a free inside diameter, permitting it to be applied externally over an electrical conductor to insulate the same.

Another object is to provide a tube having increased resistance to tear and rupture, and which is relatively impervious to moisture.

A further object is to provide a tube of simple construction which may be economically manufactured, and which is formed of relatively neutral chemical activity materials to avoid corrosion and attack of objects with which the tubes come in contact.

It has been common practice to make tubes of various materials, such as paper, cloth and asbestos. These materials, when used either singly or in combination, have physical, electrical or chemical characteristics that limit their value and render them unfit for many applications. One of the chief objections to tubes of paper, cloth and the like is that they do not have sufficient strength and toughness to resist rupture or breakage of their walls. Additionally, such tubes have relatively low dielectric properties for their wall thickness and are not sufficiently impervious to moisture because of the fibrous character of the materials used throughout. Tubes constructed in accordance with the present invention have numerous physical, chemical and electrical characteristics which make them of particular utility in the art.

In carrying out the invention, one or more strips of flexible fibrous paper material are wound about a suitable core or mandrel and cooperate with one or more strips of clear, nonfibrous cellulose material which are also wound about the same core or mandrel to form a tube having the desired dimensions of length, outside diameter, and free inside diameter when removed from the core or mandrel.

The laminations of fibrous paper which are in contacting relation with one another are secured by an adhesion agent such as glue or mucilage and the cellulose material adheres to the fibrous

paper by reason of solvent or adhesive applied to the cellulose material.

In the accompanying drawing,

Figures 1, 3 and 5 are diagrammatic, fragmentary, longitudinal views, partly in section and with parts removed, showing the construction of tubes embodying the invention; and

Figs. 2, 4 and 6 are sections taken substantially on the lines 2-2, 4-4 and 6-6 respectively of Figs. 1, 3 and 5.

Referring to the embodiment illustrated in Figs. 1 and 2, the tube has an inner lamination 1 and an intermediate lamination 2 formed of spirally wound strips of relatively flexible, fibrous material, such as kraft paper and the like. These laminations of fibrous material give body and shape to the tube and are secured together by a coating of glue applied to the inside of the intermediate layer or the outside of the inner layer, or both. Successive turns of the strip material for the laminations 1 and 2 abut one another, as indicated at 3 and 4 respectively. Preferably, the spiral butt joint 3 of the inner lamination 1 is staggered longitudinally of the tube with respect to the butt joint 4 of the intermediate lamination 2, thus increasing the strength of the tube.

Around the intermediate lamination 2 is wound a spiral strip of relatively thin cellulose material to form outer lamination 5. Cellulose material of the character employed in carrying out the present invention may be one of a number of types now in common use. For example, a cellulose derivative, such as cellulose acetate, may be employed and is considered preferable because of its high dielectric strength and neutral chemical properties. In addition, however, regenerated cellulose, known in the trade as Cellophane, and various other cellulose derivatives may be used. The cellulose material is fibreless in the sense that no fibers may be discerned therein, and is preferably transparent.

The cellulose strip forming the outer lamination 5 is materially thinner than the strips of fibrous paper forming the laminations 1 and 2, and adjacent edges of successive turns of the spiral strip forming the outer lamination 5 are overlapped, as indicated at 6, to form a lapped joint. Preferably, a suitable solvent or adhesion agent, such as amyl-acetate, is first applied to the inner surface of the strip cellulose material forming the lamination 5 to secure the lapped portions of the joint 6 together.

The completed tube is, in effect, held together by the outer layer or lamination 5, which binds in the inner layers 1 and 2 formed of the fibrous

paper material. This outer layer is substantially impervious to moisture, and the tube has considerable longitudinal tensile strength on account of the lap joint 6 and the toughness of the cellulose sheet material forming the outer lamination 5. On account of the thinness of the cellulose material, the tube may be bent sideways or collapsed without rupturing the outer ply. Transverse flexibility is afforded by the thinness of the cellulose material which can be flexed or bent without cracking or splitting. For tubes used as insulation on electrical conductors I have found cellulose material having a thickness of from about .00088 in. to about .00152 in. to be preferable.

In Figs. 3 and 4 is illustrated a modified tube embodying the invention. This tube comprises an inner lamination 8 formed of a fibrous paper strip in a spiral formation and having a continuous spiral butt joint 9 formed by the engaged edges of successive turns of the strip.

A first intermediate lamination 7 is wrapped about the inner lamination 8 in spiral fashion and secured thereto by a coating of glue or mucilage applied to the outside of strip 8 or the inside of strip 7 or both. Adjoining edges of the strip 7 form a continuous spiral butt joint 13.

A second intermediate lamination 10 is formed by a continuous spiral strip of cellulose sheet material, which corresponds in composition to the outer lamination 5 described in connection with Figs. 1 and 2. The successive turns of this cellulose sheet material strip are lapped at 11 and secured together by a suitable solvent or adhesion agent, which may be amyl-acetate, as mentioned above.

An external lamination 12 is formed about the intermediate lamination 10 and consists of a spirally wound strip of fibrous paper material, the marginal edges of which are lapped, as indicated at 14, and secured by a suitable adhesion agent, such as glue or mucilage. The tube shown in Figs. 3 and 4 is made with laminations 7 and 8 of creped paper which imparts increased flexibility and toughness to the construction. The cellulose material lamination 10 is provided with a lap joint, which affords increased dielectric properties and considerable tensile strength. It is preferred that the paper strip forming the outer lamination 12 be of relatively strong and tough fibrous material, such as kraft paper, so that the tube may be subjected to transverse flexing without rupture of the outer paper layer.

On account of the outer lamination 12 being of fibrous paper material it may be printed or written upon, or otherwise coated by a pigment. Accordingly, this type of tube readily lends itself to applications in which it is desired to imprint the tubes with a legend or advertising material and the like. The outer lamination is, in this case, a matrix for the absorption of the pigment while the tube illustrated in Figs. 1 and 2 would be inapplicable for such use on account of the relatively impervious outer lamination 5 of cellulose material.

The modification illustrated in Figs. 5 and 6 comprises an inner lamination 16 formed by a helically wound strip of fibrous paper having a continuous butt joint 17. A pair of intermediate laminations 18 and 19 are formed of helically wound strips with lapped joints 20 and 21 and an outer lamination 22 is formed by a helically wound strip of cellulose material of the character previously described with a lapped joint 23. The lapped joints 20 and 21 may be secured by a suitable adhesion agent, such as casein glue,

and the lap 22 of the outer cellulose lamination may be secured by a solvent, such as amyl-acetate, previously mentioned.

The cellulose material employed in carrying out the invention is transparent tape, and the intermediate lamination 19 of Figs. 5 and 6 is of colored paper, which is visible through the transparent outer lamination 22. On account of the impervious character of the cellulose outer lamination, the colored lamination is protected and retains its color. This feature is of particular advantage when employing the tubes of the present invention for electrical conductors and it is desirable to distinguish the conductors one from another. It is contemplated for such application of the invention to supply the tubes with a colored paper lamination of fibrous character beneath an outer lamination of transparent cellulose material. Different colors are used to distinguish the several tubes used in any one application, and each colored paper layer is protected by a layer of transparent cellulose material.

An advantageous feature of the invention in employing a layer of colored fibrous paper under the outer layer of transparent cellulose material is in the variety of distinctive identifying colors that may be had by using colored cellulose material for the outer transparent layer. For example, a layer of blue fibrous paper covered by a layer of transparent, yellow tinted cellulose material, gives a green hue to the tube. The same yellow tinted cellulose material imparts a brown color to a tube having the next underlying lamination of red fibrous paper. Similarly, a purple tube can be produced by a layer of blue fibrous paper covered by a transparent red tinted cellulose material strip. Other combinations of colored fibrous paper layers with tinted transparent cellulose material layers, or white fibrous paper layers with color tinted cellulose material covering layers may be used. One advantage of this feature is that a multiplicity of identifying and ornamental colors for tubes may be produced from a minimum number of different colored fibrous paper strips and cellulose material strips.

In all of the embodiments of the invention illustrated a free inside diameter 25 is provided to receive the material or substance to be enclosed by the tube. This free inside diameter is maintained by the spiral character of the inner laminations and the butt joints thereof. Additionally, the adhesion agent securing adjacent layers of fibrous paper assists in maintaining the tube form. The cellulose material, such as cellulose acetate, which comprises one or more of the laminations which are wrapped about the inner lamination shrinks upon drying of the solvent or adhesive which was applied thereto prior to the winding of the cellulose material strip on the mandrel. The application of the liquid solvent or adhesive to the cellulose material enables the latter to stretch when the cellulose material strip is applied under tension. The shrinkage after drying is effective to hold the inner laminations in proper relative position and to retain the shape of the tube. In each instance at least two layers of fibrous material underlie the cellulose material layer. This construction affords a sufficient body to be compacted by the shrinkage of the cellulose material and results in a more rigid tube. Preferably, the spirally wound strips forming the individual laminations of the tubes are of greater

width than the diameter of the particular tube formed thereby, thus increasing the pitch of the helical curve described by the laminations and imparting increased tensile properties to the tube.

When utilizing the invention to manufacture tubes for electrical conductors it is preferable that one or more of the laminations be formed of a yieldable or expansible strip material, such as crepe paper, to impart increased yieldability to the tubing. The crepe paper lamination contacts the cellulose material lamination at a number of spaced apart regions or crests and permits an accoridian flexure of the crepe layer adjoining the cellulose material layer. For example, the embodiment shown in Figs. 5 and 6 has the inner lamination 16 formed of crepe paper, and the laminations 7 and 8 of the embodiment shown in Figs. 3 and 4 are of crepe paper.

Any suitable spiral tube-forming apparatus may be employed in making the tubes of the present invention or they may be wound by hand on a mandrel and subsequently removed therefrom in the usual manner. The removal of the tubes from a mandrel is facilitated by the novel construction which avoids the use of lap joints on the inner lamination, and which provides a tube of increased tensile properties to permit its being withdrawn from a mandrel without injury. The lamination or layer of spiral lapped cellulose material is disposed about a lamination or layer of spiral fibrous paper having abutting edges. After stripping of the tube from the mandrel on which it is formed, the shrinkage of the cellulose material causes the latter to tightly embrace the inner butt jointed fibrous lamination, so that the tube is compacted and increased strength imparted thereto. This shrinking of the outer lamination of cellulose material effects a slight reduction in diameter of the tube, which occurs after removal from the mandrel. Accordingly, it is necessary to remove the completed tube from the mandrel before the shrinkage of the cellulose material occurs in order to avoid difficulty in the removal, or even injury to the tubes.

Other modes of utilizing the principles of the invention may be employed. Various alterations and modifications of the particular construction shown may be resorted to, change being made as desired, the particular embodiment being given for purposes of explanation and illustration.

What I claim is:

1. As an article of manufacture, a composite tube of laminated construction, comprising a plurality of layers of spirally wound strips of fibrous paper in combination with a thin, homogeneous layer of spirally wound, fiberless, cellulose material, the cellulose material embracing at least one layer of fibrous paper and being in the form of a continuous strip having marginal edge portions in overlying relation and adhering to one another, the marginal edge portions of the strips in contacting laminations being staggered with respect to one another to distribute the regions of decreased strength in the tube, said strips being individually of greater width than the outside diameter of the tube to impart increased tensile strength to the tube, the tube having a free inside diameter throughout substantially its entire length to receive material to be enclosed by the tube, and an inner fibrous lamination being slightly reduced in diameter with respect to its original formed diameter.

2. The method of making tubing which comprises wrapping a layer of fibrous paper material on a mandrel in spiral formation and with a butt joint between adjacent edges of successive turns of the paper, wrapping a layer of stretched, liquid coated non-fibrous cellulose material having the property of shrinkage upon drying of the liquid coating over the said fibrous layer, the cellulose material being in spiral form and having adjacent edges of successive turns in overlapped adhering relation, stripping the assembled tube from the mandrel before shrinkage of cellulose material occurs, and allowing the cellulose material to shrink on the underlying layer of fibrous paper to tightly embrace and compact the latter.

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