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WOVEN GLASS ELECTRICAL INSULATING SHEET

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Fig. 1.

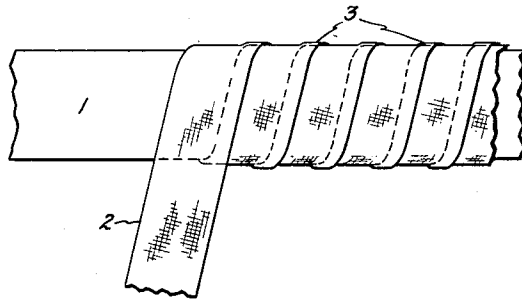


Fig. 2.

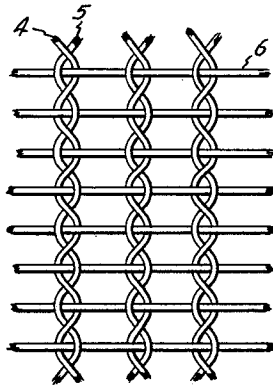
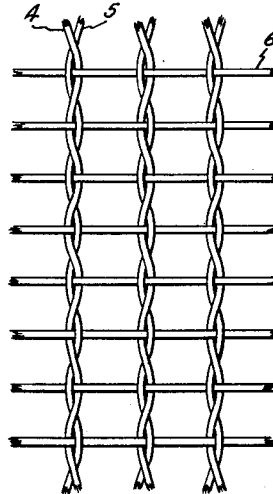


Fig. 3.



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## UNITED STATES PATENT OFFICE

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## WOVEN GLASS ELECTRICAL INSULATING SHEET

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This invention relates to insulating sheet material, more particularly to insulating tape of the type comprising a fabric impregnated or coated with an insulating varnish, such as varnished linen or cotton fabric and normally used by winding the tape helically on an electric conductor with the adjacent turns of the tape in overlapping relation.

Varnished cambric or varnished cloth is that particular type of electrical insulating material wherein the base fabric consists of fibers (usually cotton) which are woven in a square weave and subsequently coated and/or impregnated with a suitable electrical insulating varnish to fill the voids between crossing threads of the fabric thereby to form a composite sheet.

After varnish treating the full width base cotton fabric (normally 37 to 39 inches wide), the finished varnished cloth is subsequently slit into tape form of widths varying from one-fourth inch to three inches. The tape is wound helically around an electrical conductor such as a cable to form the required wall thickness of electrical insulation. Normal industry practice requires that cloth tape be applied with an overlap to insure the fact that the cable is completely covered. In this process it is obvious that the varnished cambric is being wound about two different diameters; that is, at one edge of the tape there is a lap over the contiguous tape, while at the opposite edge the tape is wrapped directly on the cable. In order to apply such a tape smoothly without producing wrinkles, voids or edge tears, which are detrimental to the quality of cable, it is necessary that the tape have the property of a certain percentage of elongation or stretch. This is an inherent property in a varnished cambric tape because the base cotton fabric has a natural resiliency giving it the property of a certain amount of elongation.

Cotton tape, however, while having the desirable stretching feature, does have a certain disadvantage in that it will absorb moisture and will deteriorate if subjected to long time high temperature aging. There is a need in the art, therefore, to replace the cotton with fibers which are not subject to moisture absorption and heat deterioration.

A further consideration is that, at times, the price of cotton becomes so high that it is economically necessary to have as an alternate a less expensive base material for electrical insulating tape.

While glass fibers for electrical insulation purposes with and without varnish have been known,

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for example see U. S. Patent No. 2,133,183, still the glass insulating material known heretofore would not fulfill the purpose intended by this improved invention since glass fibers do not have the natural elongation required for proper application about two different diameters. Consequently, voids, gaps and edge tears occurred in the prior art glass insulation whereby the dielectric strength of the electrical insulating material is reduced with production of a substandard grade of cable.

It has also been suggested that the lack of elongation of glass fibres might be circumvented by forming a yarn of a combination of glass fibres and asbestos fibres twisted together so that the glass fibres contribute strength to the yarn while the asbestos fibres contribute stretchability. Such yarns, it was proposed, could be woven into fabrics which could be treated with suitable insulating materials for electrical insulation purposes. This proposal, however, has not fulfilled the requirements of the industry for a varnished cloth for use in place of the conventional varnished cambric for several reasons. Not only is added cost and other disadvantages involved in combining several kinds of fibres into a yarn, but also by admixing other fibres with glass fibres, the desirable qualities of glass are lost to the extent of such admixing.

It is an object of this invention, therefore, to produce an electrical insulating material utilizing a base fabric of glass fiber yarn so woven that the finished product has the property of a certain percentage of elongation or stretch whereby the material is adapted for use in cable or other electrical wrappings where a lapped type of winding is required.

It is a further object of this invention to provide an electrical insulating material which is not subject to moisture absorption or heat deterioration.

It is a still further object of this invention to provide an improved electrical insulating material having greater insulating properties and flame resistance than heretofore known.

Further objects and advantages of this invention will become apparent and the invention will be more clearly understood from the following description, referring to the accompanying drawing, and the features of novelty which characterize this invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Briefly, this invention relates to an improved type of electrical insulating sheet material hav-

ing a base of a woven glass fabric wherein, while an individual glass fiber yarn will not permit elongation, the weaving is such that the fabric will exhibit a significant longitudinal elongation. The preferred weaving is a leno or gauze weave wherein the longitudinal or warp yarns are loosely twisted, so that when the fabric is longitudinally stretched the twist is tightened to give a certain degree of over-all elongation.

For clarification and ease of reference, conventional insulating material will be referred to by the usual industry term "varnished cambric," while my new material, which is the subject matter of this invention, will be designated as "varnished glass."

Referring to the drawing, Fig. 1 is a front elevation of a section of cable being wrapped with electrical insulating tape; Fig. 2 is a magnified front elevation of my improved varnished glass, showing the glass fabric in its normal position; while Fig. 3 is a magnified front elevation of the glass fabric in its stretched position.

Referring to the drawing, an electric cable 1 is shown in the process of being wrapped with an electrical insulating tape 2 wherein adjacent edges of the tape are overlapped on contiguous tape to provide overlapped portions 3. It is obvious that the overlapped portions 3 have a greater diameter than that of the cable itself. In order to compensate for this overlapping portion, it is necessary that a certain degree of elongation exist within the tape 2, whereby through such elongation a tight casing is produced without voids or tears as the tape is wrapped about the cable 1.

The varnished glass tape 2, which is the subject matter of this invention, is made from a base glass fabric having a leno or gauze weave pattern (hereinafter explained). The glass fabric is then coated and/or impregnated with an electrical insulating varnish to fill in all the gaps between the yarns of glass fibers thereby providing a continuous sheet of varnished glass. Preferably, as with the varnished cambric, tape 2 is formed as a sheet having any predetermined width which is later slit to desired widths, for example one-fourth inch to three inches. With such widths, the tape is adapted to be wrapped in rolls for easy application to a cable.

Leno weave, by definition, is of the genus called "crossed weaving." This group includes all fabrics such as gauzes, in which the warp threads or yarns 4, 5 intertwist amongst themselves while the weft yarns or threads are straight to give intermediate effects between ordinary weaving and lace. Plain gauze embodies the principles that underlie the construction of all crossed woven textiles; that is, the twisting of two warp threads together leaves large interstices between both warp and weft. But although light and open in texture, gauze fabrics are the firmest that can be made from a given quantity and quality of material. One warp thread 5 from each pair is made to cross the other between every pick, to the right and to the left alternately; therefore, the same threads 5 are above every weft thread 6. In crossing from side to side, warp threads 5 pass below the other warp threads 4, which in turn are below every weft thread 6; consequently, all are bound securely together as shown in Figs. 2, 3. Leno is heavier than gauze and it is composed of an odd number of picks of a plain weave followed by one pick of gauze.

It is important that the spacing of the longitudinal or warp threads 4, 5 and the cross or weft

threads 6 be so selected that when the glass fabric is varnish coated and/or impregnated with the electrical insulating varnish, there will not be so great a stress placed on the varnish film that it will break through the open mesh. Accordingly, the varnish used with this varnished glass must form a film which will withstand some elongation without failing electrically or mechanically. Ideally, such a varnish film would be a residue of one of the high grade electrical insulating varnishes available in the market wherein an unsupported film of varnish will withstand approximately 10% elongation without rupture or loss of electrical properties.

While it is not intended to be a limitation of the scope of this invention, it is to be noted that in one particular embodiment it has been found that glass is so much stronger than cotton that a 24 x 12 leno or gauze weave base glass fabric has adequate physical strength for cable application. However, tests on the finished varnished glass show that this particular weave is too open to adequately support the varnish film. The 32 x 16 leno or gauze weave base glass fabric has proven more satisfactory to this extent. However, other weaves, such as 32 x 20, etc., may be used. By 32 x 16 is meant 32 longitudinal or warp yarns and 16 cross or weft yarns per square inch. With this structure the area of the interstices between the glass yarns is such that it will support a varnish film wherein an unsupported film of varnish will withstand approximately 10% elongation without rupture or loss of electrical properties.

It is to be noted that, due to the high physical strength of the glass yarn, a more open weave base glass fabric may be used in the manufacture of varnished glass as compared to varnished cambric. This attractive physical property is of economic advantage in that the amount of thread used may be decreased as the weave is opened.

Preferably threads or yarns 4, 5 and 6 are of that yarn category known in industry as 150-1/0. The 150-1/0 indicates a single end glass yarn with approximately 15,000 yards per pound. This is a low cost material as compared to other types of glass yarn and it is particularly suited to the manufacture of a finished glass fabric of the required thickness—approximately 6 mils.

While glass fabric inherently has no elongation, and, therefore, while there would be no crosswise elongation due to the straight weft threads 6, yet there is some longitudinal elongation of the varnished glass (which is actually a false stretching) due to the particular positioning of the yarns 4, 5: i. e., when the varnished material is cut into tape it is cut lengthwise; i. e., parallel with the warp threads 4 and 5 so that the tape can stretch lengthwise. By false stretching is meant that as tension is produced on opposite ends of the warp yarns 4, 5, they tend to twist or tighten to the position shown in Fig. 3 whereby stretching of the varnished glass is produced even though there is no actual stretching of the individual threads of glass yarn.

It has been found that by using leno or gauze weave glass fabric such as that described, an elongation in the order of 4 to 6 per cent is obtained, which is more than satisfactory for the use of the varnished glass on cable or for other electrical wrappings where a lapped type of winding application is required. Tests have proven that this varnished glass will lie flat about the cable and that there will be no voids, gaps or

edge tears to destroy or lower the electrical or physical properties of the finished cable.

While in the above description reference has been made primarily to a lapped tape wound around two different diameters, it is to be understood that the varnished glass may be used for butt joint type of application where the elongation of the tape is not necessary for normal application. However, the elongation in the varnished glass is beneficial to the butt joint type of tape application, as the elongation of the tape allows bending of the cable without damage to the insulation.

Modifications of this invention will occur to those skilled in the art and it is desired to be understood, therefore, that this invention is not intended to be limited to the particular embodiment disclosed, but rather it is intended to cover all modifications which are within the true spirit and scope of this invention.

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

1. Insulating tape adapted for helical winding around a conductor with adjacent edges of successive turns overlapping comprising fabric of leno woven glass yarn wherein the warp threads are loosely looped around the weft threads and extend longitudinally of the tape, and a resilient electrical insulating varnish coating on the fabric capable of stretching without rupture an amount sufficient to permit of the tape being helically wound smoothly on a conductor with its edges overlapping whereby when the tape is helically wound on a conductor with the tape edges overlapping the overlapping tape edge can stretch sufficiently to compensate for the increased diameter due to the overlap.

2. Insulating tape adapted for helical winding around a conductor with adjacent edges of successive turns overlapping comprising fabric woven from glass yarn wherein the weft threads extend transversely of the tape, and the warp threads extend longitudinally of the tape and are

arranged in groups wherein all of the threads of each group are loosely looped across and are interlocked with the weft threads, each thread of each group crossing and recrossing at least one other thread in the same group, and a continuous film of resilient electrical insulating varnish filling the interstices between the threads, so that when the tape is helically wound on a conductor with the tape edges overlapping, the overlapping tape edge can stretch sufficiently to compensate for the increased diameter due to the overlap.

3. Insulating tape adapted for helical winding around a conductor with adjacent edges of successive turns overlapping comprising fabric woven from glass yarn wherein the weft threads extend transversely of the tape and the warp threads extend longitudinally of the tape and are arranged in spaced pairs and wherein all of the warp threads are loosely looped and are interlocked with the weft threads, the two threads in each pair crossing and recrossing each other, and a continuous film of resilient electrical insulating varnish on both sides of the fabric, so that when the tape is helically wound on a conductor with the tape edges overlapping, the overlapping tape edge can stretch sufficiently to compensate for the increased diameter due to the overlap.

#### References Cited in the file of this patent

##### UNITED STATES PATENTS

| Number    | Name         | Date          |
|-----------|--------------|---------------|
| 240,772   | Schinneller  | Apr. 26, 1881 |
| 702,725   | Hammesfahr   | June 12, 1902 |
| 2,133,183 | Baird et al. | Oct. 11, 1938 |
| 2,209,850 | Shand et al. | July 30, 1940 |
| 2,360,245 | McFarlane    | Oct. 10, 1944 |

##### FOREIGN PATENTS

| Number  | Country       | Date          |
|---------|---------------|---------------|
| 260,136 | Great Britain | Oct. 28, 1926 |