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CONSTRUCTION OF THE INSULATION IN JOINTS FOR
HIGH TENSION ELECTRIC CABLES
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Fig. 1

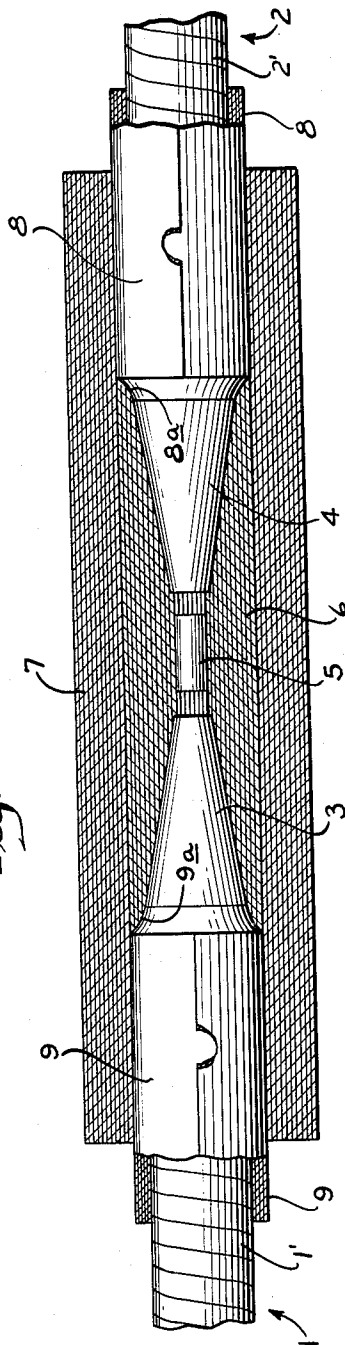
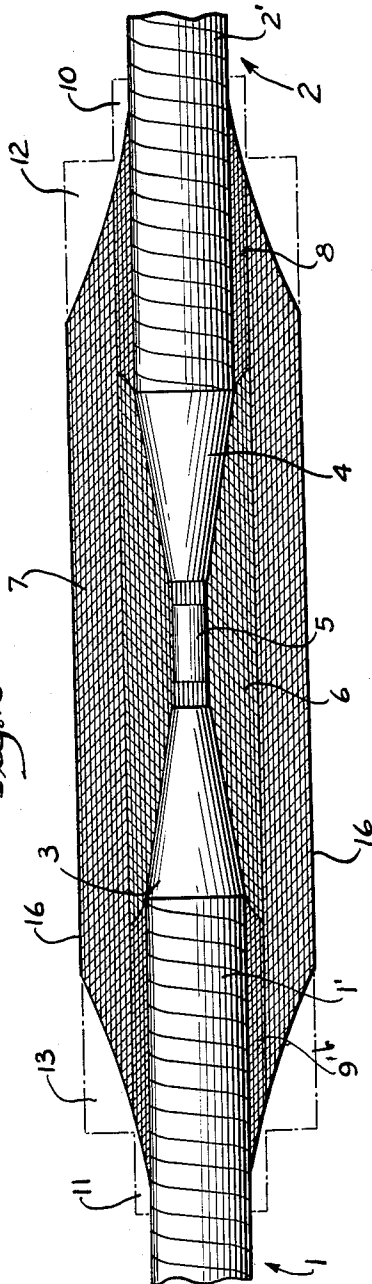


Fig. 2



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CONSTRUCTION OF THE INSULATION IN JOINTS FOR HIGH TENSION ELECTRIC CABLES

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This invention relates to an improvement in the technique of constructing of insulating layers at the joints of high tension electric cables that are insulated with impregnated wrappings of paper or the like.

It is known that the construction of a joint for electric cables insulated with impregnated paper generally requires the following operation: The bared conductors are mechanically and electrically connected by means of a ferrule; then, after having removed the desired length of metallic sheath from the cable ends to be jointed, a portion of the insulation is removed from the cable conductors so as to leave a pencilled-down or step-profile of insulation on the conductors, and then, finally, the insulation is rebuilt by means of paper tapes or tubes or with other insulating material.

As a result, a compact and uniform insulation is obtained around the ferrule, this insulation generally being built up to a diameter greater than that of the original cable insulation.

In the following description the word "inner" indicates the layers which are wrapped from the ferrule to reach the diameter of the cable core and the word "outer" indicates those layers constituting supplementary insulation and which have varying shape and thickness according to the particular features of each joint. As used in the cable terminology and in this application the phrase "paper tube" means a tube wrapped in situ and comprising a paper sheet of the necessary total width of the tube which sheet is unrolled from a roll and rolled up around a cable core in several superposed layers.

The construction of the insulation at the joint may be completely carried out by means of the taping closely wrapped about the connecting ferrule and filling the space between the tapered ends of the insulation on the cable conductors being joined, and then the lapping of the tape over the cable insulation is continued until the required thickness is obtained. This method of the prior art has the disadvantage in that considerable time is required for accomplishing the desired end.

Another method of the prior art which has proved more accurate and expeditious in practice comprises the reconstruction of the inner layers by means of tapes, or by means of a combination of paper tape and tubes and the construction of the outer layers by means of a single paper tube. This construction gives the joint greater compactness and solidity in comparison with the above described total taping operation. It is, however, subject to a serious objection that arises from the fact that the externally wound tapes on the original cable are helical. The preformed tube of insulation that is being slid or wound on the outermost helical winding of the cable core will aid in the tensioning of the external tape layers on the end of one of the cables being joined and will cause slackening on the outermost tape of the other cable core. This slackening and consequent loosening of the tape on the cable core begins at the point of interruption of the cable core tape and propagates along the outermost helical winding on the cable core.

It is one of the objects of the present invention to provide a method of and a means for completing the insulation on a high tension cable joint which retains the advantages of using the prefabricated outer insulator sleeve as in the prior art, and which avoids the slackening of

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the external tape of the cores during the construction of the insulation of a normal joint between high tension electric cables that are insulated with impregnated paper.

It is a further object of the present invention to provide an improvement in the technique of construction of the insulation in a high voltage joint. In accordance with the preferred exemplification of this object, there is wound, on the outer helical layer of each cable core to be joined, an auxiliary tube of paper or other suitable insulation and of small thickness. Each of these windings is intentionally made of a length somewhat greater than is necessary. The space between the auxiliary tubes that have been wound on the joined cable ends is then filled either with an auxiliary paper tube or with a series of paper tapes or tubes up to the external diameter of said auxiliary paper tube, so as to obtain a uniform cylindrical surface. On this surface a single preformed outer paper tube is assembled. Thereafter, the excess portions of the paper tubes are removed.

Reference may now be had more particularly to the drawings wherein:

FIG. 1 is a longitudinal sectional view, partially broken away, showing the insulation on a high voltage cable joint during one stage in the process of forming the joint;

and

FIG. 2 is a view similar to FIG. 1 showing the completed applied insulation on the joint of FIG. 1.

In the drawings there is shown the insulation at a joint between two similar high voltage cables the cores of which are indicated at 1 and 2. The insulation on the original cable conductors is impregnated paper and terminates on the outside of each cable in an external helically wound tape 1' and 2', respectively. The winding of the tapes 1' and 2' are, from the geometry of the helix, in the same direction. The insulation at the ends of the cable is tapered at 3 and 4, and the cable conductors are joined by a conducting ferrule 5 as is usual in the prior art. Auxiliary paper tubes 8 and 9 of small thickness are then formed on the respective ends of the cable cores 1 and 2 by winding paper tapes around the cable core. Each paper tube 8 and 9 may comprise a single continuous sheet of paper spirally wound in tube formation, the tube being wound as a spiral of a number of turns to bring it to its desired thickness. The innermost and outermost edges of the spirally wound paper tube could be a preformed tube which can be opened or uncurled and by turning of the same be positioned on the core, or it could be one directly wound on the core. The auxiliary tube 8 is spirally wound in one direction about its core and the auxiliary tube 9 is spirally wound in the opposite direction about its core so that the winding of each of them on its core aids the tension of the underlying external helical tape of the core. The auxiliary paper tubes 8 and 9 are made of an initial length greater than necessary so that each extends an excessive amount over the free length of the core end (not including the tapered ends 3 and 4), so that they may be held steady from the side thereof remote from the electrical connections in any convenient manner during the subsequent operation as, for instance, manually. By employing paper tubes 8 and 9, the outer diameter of the core end is in effect increased and consequently the space included between the opposite ends of the tubes 8 and 9 is increased. The end of each tube 8 and 9 adjacent to the corresponding tapered ends 3 or 4, as the case may be, is made tapered by tapers 8a and 9a that merge with and terminate at the tapers 4 and 3, respectively, as indicated.

The space between the ends of the paper tubes 8 and 9 is then filled with inner tape 6, that is, by spirally winding paper tape or a combination of tape and tube up to the outer diameter of the two paper tubes 8 and 9 in order to

obtain a uniform compact cylindrical surface having a diameter equal to the outside diameter of the tubes 8 and 9 and greater than the original core diameter of the cable cores 1 and 2.

A single paper tube 7 is now positioned on the outer cylindrical surface of the tape 6 and tubes 8 and 9. The paper tube 7 could be a preformed spirally wound tube that may be threaded onto the cylindrical surface formed by the parts 6, 8 and 9, or it may be a sheet that is directly wound onto that surface. The tube 7 is tightened on the cylindrical surface formed by the parts 6, 8 and 9 of insulation. During this tightening operation the ends of the auxiliary tubes 8 and 9 may be manually held against movement on the cable core. The outer paper tube 7 is then duly tapered at its ends by removing with a continuous cut its excessive portions 12 and 13 as well as the excessive portions 10 and 11 of the paper tubes 8 and 9, thus completing the insulation of the joint. A continuous electric screening 16 is, where desired or necessary, then applied on the outside of the tube 7 by winding thereon a wire or metal woven tape in close coil formation, which winding is then connected to the metal sheath of the cable as is conventional.

The above described improvement may be applied to any type of cable, particularly to high tension electric cables, and is especially applicable to such cables of the oil-filled type.

I claim:

1. The improvement in the method of construction of the insulation of normal joints for high tension electric cables insulated with impregnated paper, characterized by comprising the following operations: making a conductive connection between the conductors of the cable cores that are being joined and forming windings of auxiliary spaced apart paper tubes having small thickness surrounding the insulation on the adjacent cylindrical ends of the respective cable cores that are being joined, the two auxiliary tubes being wound in opposite directions on the core ends so that each of them aids in the tension of the underlying external tape of its core, then filling of the space included between the opposite ends of the paper tubes by winding on the conductive connection between the joined conductors solid insulation in an amount to obtain a uniform cylindrical surface having a diameter equal to the outside diameter of the auxiliary paper tubes, and then winding a single outer paper tube on the whole of said cylindrical surface.

2. An improvement in the method of claim 1 wherein the two auxiliary paper tubes wound on the cylindrical ends of the cable cores are made of an initial length greater than the necessary length in order to keep them laterally steady during the subsequent application of the outer paper tube, then tapering the outer paper tube and removing the excess portions of the auxiliary paper tubes that were first wound on the core end.

3. The improvement in the method of construction of the insulation of normal joints for high tension electric cables insulated with impregnated paper, characterized by comprising the following subsequent operations: First forming windings of auxiliary paper tubes having small thickness surrounding the insulation on the adjacent cylindrical ends of the respective cable cores that are being joined, the two auxiliary tubes being wound in opposite directions on the core ends so that each of them aids in the tension of the underlying external tape of its core, then applying a wrapping of insulation on the connected cable conductors and continuing said wrapping to fill the space included between the opposite ends of the paper tubes so as to obtain a uniform cylindrical surface having a diameter equal to the outside diameter of the auxiliary paper tubes, and then winding a single outer paper tube on the whole of said cylindrical surface.

4. An improvement in the method of claim 3 wherein the two auxiliary paper tubes wound on the cylindrical ends of the cable cores are made of an initial length greater

than the necessary length and with the excess extending beyond the subsequently applied outer paper tube and holding the excess extended parts of the auxiliary tubes in order to keep them laterally steady during the subsequent application of the outer paper tube, then tapering the outer paper tube and removing the excess portions of the auxiliary paper tubes that were first wound on the core end.

5. The improvement in the method of construction of the insulation of normal joints for high tension electric cables insulated with impregnated paper, characterized by comprising the following operations: forming windings of auxiliary paper tubes having small thickness and spaced apart and surrounding the insulation on the adjacent cylindrical ends of the respective cable cores and tapering the insulation at the ends of the respective cable cores, applying insulation to the tapered cable insulation to fill the space between the tubes, forming a surface continuous with the outside surface of said tubes and of the same outside diameter as the outside diameter of the tubes, the two auxiliary paper tubes being wound spirally in opposite directions, and then winding a single outer paper tube over said auxiliary paper tubes and the space between them.

6. The improvement in claim 5 wherein each outer paper tube is a sheet that is wound spirally to form the tube.

7. The improvement in the construction of the insulation of normal joints for high tension electric cables between cores that include insulation surrounded by an outer helical tape, characterized by the fact that the adjacent ends of the insulation of the connected cable cores are tapered towards the cable conductors and the provision of auxiliary insulating tubes having small thickness on the outer helical tapes at the adjacent ends of the respective cable cores, said tubes being spaced apart by the tapered portions of the cores, and said tubes being tapered by surfaces that terminate at the tapers of the insulation of the respective cores, insulation filling said space between the tubes and forming a surface continuous with the outside surface of the tubes, the auxiliary tubes comprising spirally wound insulation with the spiral windings being in opposite directions on the two tubes to aid the tension of the underlying external tapes of the respective cores, and a single outer paper tube tightly surrounding the two auxiliary tubes and spanning the space therebetween.

8. The improvement in the construction of the insulation at the cable conductor connection of normal joints for high tension electric cables between cores that include insulation of impregnated paper surrounded by an outer helical tape, characterized by the provision of spaced apart auxiliary paper tubes having small thickness on the outer helical tapes of adjacent ends of the respective cable cores that are being joined, the tubes comprising spirally wound insulation with the spiral windings in opposite directions on the two tubes so that each of them aids the tension of the underlying external tapes of the respective cores, the auxiliary tubes being on opposite sides of the connection between the cable core conductors, and the cable core insulation being tapered by one continuous taper extending from the auxiliary tubes to the cable conductor, the space included between the opposite ends of the paper tubes being filled by solid insulation to a uniform cylindrical surface having a diameter equal to the outside diameter of the auxiliary paper tubes, and a single outer paper tube on the whole of said cylindrical surface.

9. The improvement in the construction of the insulation at the cable conductor connection of normal joints for high tension electric cables between cores that include insulation of impregnated paper surrounded by an outer helical tape, characterized by the provision of spaced apart auxiliary paper tubes having small thickness on the outer helical tapes of adjacent ends of the respective cable cores that are being joined, the auxiliary tubes being on opposite sides of the connection between the cable core conductors, and each cable core insulation and its surround-

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ing auxiliary tube being tapered by one continuous taper extending from the auxiliary tube to the cable conductor, the space included between the opposite ends of the paper tubes being filled by solid insulation to a uniform cylindrical surface having a diameter equal to the outside diameter of the auxiliary paper tubes, and a single spirally wound outer paper tube on the whole of said cylindrical surface.

10. The improvement in the method of construction of insulation of normal joints for high tension electric cables insulated with impregnated paper, characterized by comprising the following operations: Forming windings of auxiliary paper tubes having small thickness and spaced apart and surrounding the insulation on the adjacent cylindrical ends of the cable cores, the auxiliary tubes being spirally wound with the spiral windings in opposite directions on the two tubes to aid the tension of the underlying external tapes of the respective cores, tapering the insulation at the ends of the cable being joined and the adjacent paper tubes by tapers extending from the cable conductors to the outside surfaces of the respective paper tubes, applying a single continuous roll of sheet insulation to the tapered cable insulation to fill the space between the tubes and to form a surface continuous with the outside surface of the tubes and of the same outside diameter as the outside diameter of the tubes, and then winding a single outer paper tube over the auxiliary paper tubes and the space between them.

11. The improvement in the construction of insulation at the cable conductor connection of normal joints for high tension electric cables between cores that comprise insulation of impregnated helically extending paper tape characterized by the provision of spaced apart auxiliary paper tubes having small thickness on the outer helical tapes at the adjacent ends of the respective cable cores that are being joined, the tubes comprising spirally wound

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insulation with the spiral windings in opposite directions on the two tapes so that each of them aids the tension of the underlying external tapes of the respective cores, the auxiliary tubes being on opposite sides of the connection between the cable core conductors, each cable core insulation and its surrounding auxiliary tube being tapered by a continuous taper extending from the outer surface of the auxiliary tube to the cable conductor, the space included between the opposite ends of the paper tubes being filled by solid insulation that includes a continuous wrapping of an insulating sheet around the connected cable conductors and covering also the tapered insulation and built up to a uniform cylindrical surface having a diameter equal to the outside diameter of the auxiliary paper tubes and bridging the space between the auxiliary paper tubes at their outside diameter; and a single outer paper tube on the whole of said cylindrical surface and extending over the outer surfaces of the auxiliary paper tubes.

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