Aug. 15, 1950 H. HARTMANN 2,519,133

CONDUCTOR INSULATION

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Fig. 2.

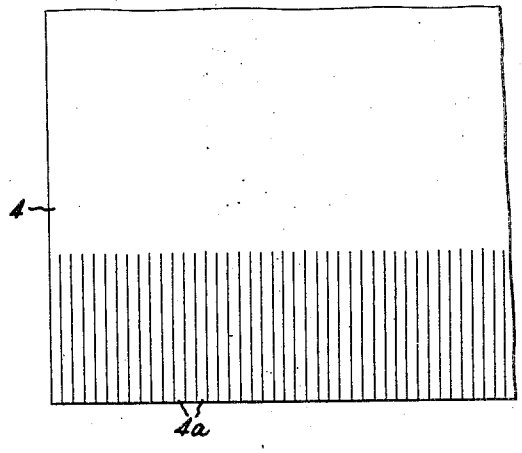
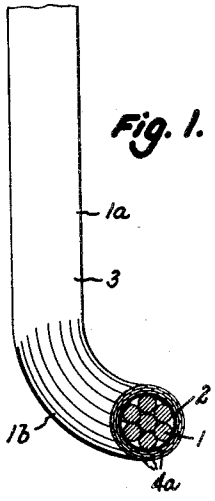


Fig. 1.



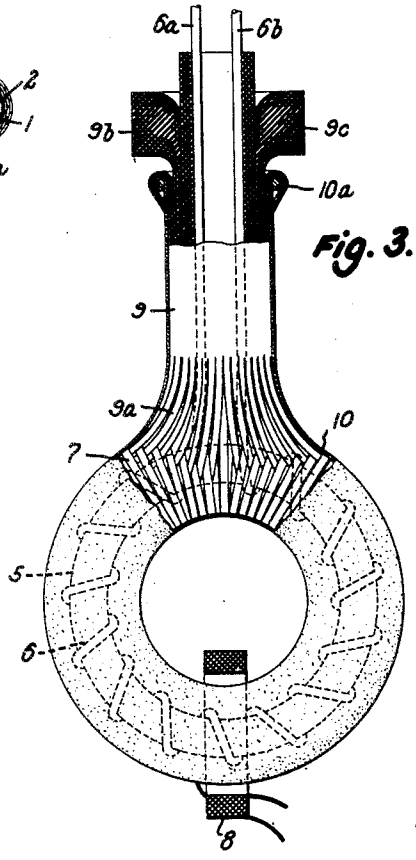


Fig. 3.

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CONDUCTOR INSULATION

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In high tension electrical systems, it frequently happens that a straight conductor section passes over into a curved section. Where the conductor is to be insulated sufficiently for use on high voltage, the only known way in the past for applying the insulation without interruption was to wind both the straight and curved sections on in the form of a narrow strip of insulating material such as paper. However this method was costly since it is far more economical to use wide paper sheeting for insulating the straight portions of the conductor. The use of wide paper sheeting on the straight portions and comparatively narrow winding strip on the curved portions has not been practical for the reason that it brought about highly difficult problems in satisfactorily insulating the conductor at the section where the winding strip on the curved portion of the conductor joined the end of the wide sheeting on the straight portion.

In current transformers of the annular type i. e. those having an annular core with the secondary winding wound on the core and the primary winding also annular and looped through the core and secondary winding, the problem of satisfactorily insulating the straight lead-off conductors at the point where they merge into the annular portion of the winding is particularly difficult and paper strip insulation could not be applied in the usual way. Complicated and time consuming methods must be used for putting on the strip insulation which increase the transformer cost materially.

One method already proposed for applying the insulation is to glue the insulation on the conductor (or upon the tube if the conductor is enclosed in one) and to glue the various insulating layers upon each other. Gluing however is detrimental to the quality of the insulation material and makes it most difficult to thoroughly dry the insulation which is essential. But even with the gluing method it is still necessary to provide special insulation at the junction of the strip insulation on the curved part of the conductor with the sheet insulation on the straight conductor part.

In accordance with this invention, the foregoing problems of insulating a conductor of the foregoing type are solved simply and economically by using sheet insulation on the straight part and slitting the edge of the insulation facing the curved conductor part inwardly to form tabs which can then be used for insulating the curved conductor section where it joins the straight section.

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In the accompanying drawings, Fig. 1 is a perspective view showing an application of the invention to a simple line conductor; Fig. 2 is a fragmentary view of the sheet material used for forming the insulating sheath; Fig. 3 is a longitudinal view partly in section of a current transformer illustrating an application of the invention to the secondary winding of the transformer.

Referring now to Fig. 1, the conductor structure is illustrated as being comprised of a plurality of conductors 1 which are enclosed within a tube 2 upon which the desired insulation is to be placed. The straight portion of the conductor group is designated by numeral 1*a* and the curved portion by 1*b*. The insulation 3 on the straight portion of the enclosing tube 2 is a cylinder comprised of a plurality of layers of a comparatively wide sheet of paper insulation 4. Before winding the sheet into the multi-layered cylinder, one edge of the paper sheet 4 is slit inwardly as shown in Fig. 2 to form a series of comparatively narrow tab portions 4*a*. After the insulation cylinder 3 has been wound, it is pushed over the straight conductor section 1*a* with the tab portions 4*a* facing the curved conductor section 1*b* until the tabs 4*a* extend along the curved conductor section. The tab portions of the several insulating layers may then easily be made to lie flat against the curved conductor section. If the curved portion is extensive, the arrangement offers a smooth and satisfactory transition from strip insulation which may be generally applied to the remainder of the curved portion of the conductor and the more economical wide sheet insulation used on the straight part.

It will be understood that the tabbed insulation cylinder 3 may if desired be applied directly to the conductor or conductors themselves in which case tube 2 would be eliminated. Also the insulating sleeve 3 may be first wound from plain wide sheeting and then slit afterwards to form the tab portions.

Referring now to Fig. 3, the annular current transformer there shown is comprised of an annular core 5 on which the secondary winding 6 of the transformer is wound. The lead-off conductors 6*a*, 6*b* of the secondary winding are straight and extend radially outward with reference to the center of the ring secondary winding. Paper strip 7 is applied in the known manner to the necessary thickness for insulating the core 5 and secondary winding 6 from the primary winding 8 of the transformer which is wound over the secondary winding 6 after the strip

insulation 7 has been applied. The insulation for the straight conductor portions 6a, 6b is comprised of a laminated tube 9 formed by winding from sheet insulating paper. Before tube 9 is wound the paper is slit inwardly along one of its side edges to form a series of comparatively narrow paper tabs 9a. The tube 9 is then applied over the conductors 6a, 6b and the tabs 9a are bound in by interlaying them with the several layers of the strip insulation 7.

A smoother transition between the sheet insulation on the conductor portions 6a, 6b and the strip insulation on the annular secondary winding 6 may be obtained by stepping down, in a lengthwise direction, the several layers of the paper tabs 9a which are formed as the tube 9 is wound to its required thickness from the sheet paper insulation and binding these layers in with the strip insulation 7 in step fashion. The insulation over the straight conductors 6a, 6b may also be constituted by a plurality of separate tubes each with tab portions the several tubes being pushed one over the other in telescoped fashion into place on the conductors, the paper tabs on each tube being bound in separately with the aid of the strip insulating material covering the core and secondary winding. In this way, the formation of a uniform transition of the insulation from the ring portion of the winding to the straight conductor lead-off is assured.

In the event that the paper tabs formed from the sheet insulation are not deemed sufficient for insulating the inner side of the annular secondary winding opposite the lead-off conductors 6a, 6b, additional insulation of laminated paper can be provided at such location. The supplementary insulation can be secured in place with the aid of the paper strip insulation 7.

If a conductive coating 10, for example of metal, is applied to the outer surface of the cylindrical insulation 9 and the toroidal winding strip insulation 7 and also to the interwoven tab portions 9a, such coating can be grounded in some cases, or as shown schematically in other cases, the coating may carry the high potential of the primary winding. In either case there will then be a difference in potential between the lead-off conductors 6a, 6b and the metal coating 10. To prevent flashovers between them, several of the intermediate layers of the laminated insulation cylinder 9 at the end opposite the tabs 9a may also be slit longitudinally to form a series of narrow tab portions 9b at this end and these are then turned outwardly to form a collar-like insulating barrier 9c extending cross-wise to the field of force. The metal coating 10 is provided with a thickened end 10a for reducing the rim stresses, the end 10a being preferably embedded in the insulation by turning back several of the outer layers of the insulating tube 9 over it.

I claim:

1. In a transformer of the type wherein one winding thereof is constituted by an annular

section and a lead-off conductor section extending substantially radially outward from said annular section, means for insulating said winding comprising a plurality of layers of strip insulation material embracing said annular section at the junction between said annular and lead-off sections, and a multi-layered insulating sleeve embracing said lead-off section and which terminates in tabs at the end adjacent said annular section, said tabs extending into cooperative proximity with the several layers of said strip material and interlayered with the latter.

2. The method of insulating a transformer winding of the type including annular section and a lead-off section extending substantially radially outward from said annular section which comprises the steps of applying to said annular section at the junction between said annular and lead-off sections a plurality of layers of strip insulation material, applying to said lead-off section a plurality of layers of sheet insulation material having tabs formed along the edge adjacent said annular section and extending into cooperative proximity therewith, and binding said tabs into place by interleaving the same with the several layers of strip insulation material.

3. The method of insulating a transformer winding of the type including an annular section and a lead-off section extending substantially radially outward from said annular section which comprises the steps of applying to said annular section at the junction between said annular and lead-off sections a plurality of layers of strip insulation material, applying to said lead-off section a multi-layered sleeve of sheet insulation material having tabs formed along the edge adjacent said annular section and extending into cooperative proximity therewith, and binding said tabs into place by interleaving the same with the several layers of said strip insulation material.

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