April 28, 1936. P. V. HUNTER ET AL 2,038,935

ELECTRIC CABLE

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Fig. 1.

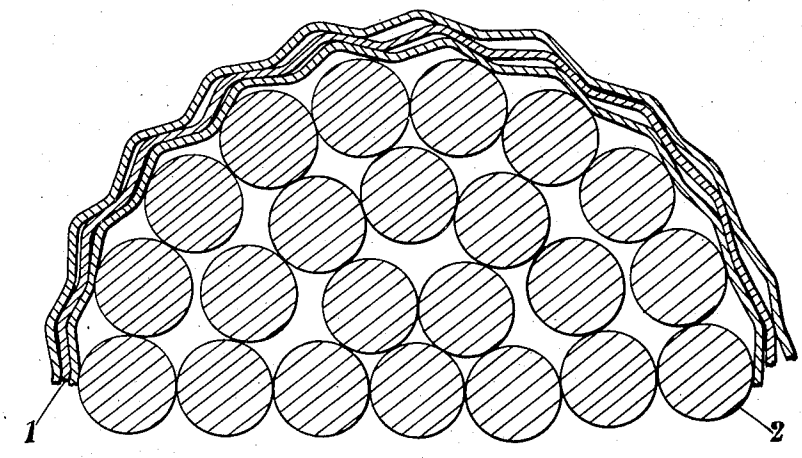

Fig. 2.

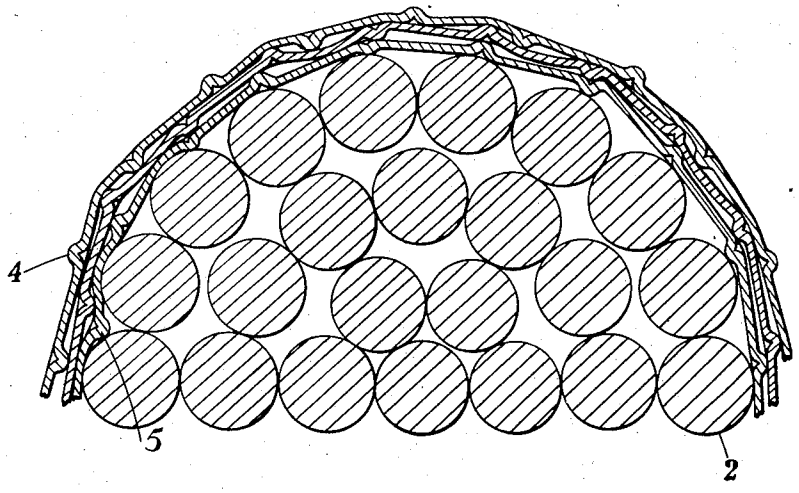

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Fig. 3.

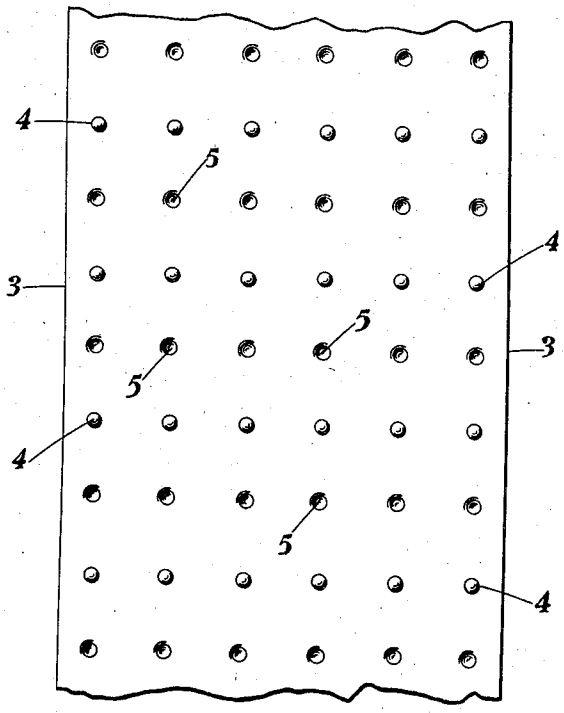
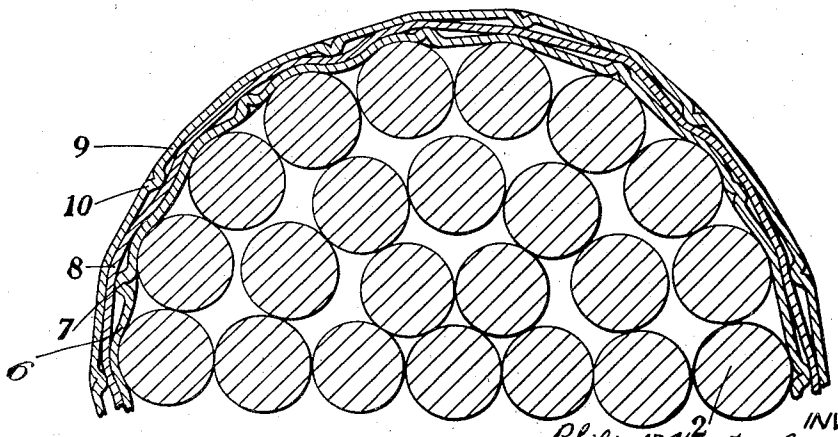


Fig. 4.



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2,038,935

ELECTRIC CABLE

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Application November 14, 1931, Serial No. 575,000
In Great Britain November 21, 1930

4 Claims. (Cl. 173—264)

This invention relates to electric cables either single core or multi-core of the kind having insulation formed by lapping on helically strips of paper to form a number of superposed layers, the insulation being impregnated with liquid or semi-liquid material (for instance oil or compound). In accordance with the invention the strip of paper before application to the conductor is treated in such a way as to be slightly deformed so that it takes a non-smooth line when wrapped on the conductor. This provides that the paper is capable of slight longitudinal extension without the production of high tensile stress in it. The advantage of this is that it permits the increase of the space occupied by the compound between the layers of the insulation and between the innermost layer and the conductor without producing a severe tensile stress in the material of the layers. Alternatively or simultaneously the impregnating or enclosed liquid or semi-liquid material may be allowed to expand with change of temperature without being forced to make its way through the layers in a generally radially outward direction. The advantage of the improved insulation is greatest when used on circular conductors since in these cases the form of the layers would not otherwise readily permit extension of the material without high tensile stress being produced.

In the usual case of circular conductors wrapped with smooth layers of paper, the stressing or penetration of the layers, when the impregnating and enclosed material expands with increase of temperature, and the corresponding difficulty of obtaining the return to the original conditions, when the change of temperature is reversed, appear to be inherent. To accommodate them or mitigate their effects it is necessary to use an insulating material for the layers which has a certain degree of permeability and to use an impregnating material which has a certain degree of fluidity so that penetration of the former by the latter may take place. In the improved arrangement of the present invention by producing layers of paper on the conductor in non-smooth lines, it is provided that a very considerable increase in the volume enclosed by each layer may take place without stretching of the material of the layer. Accordingly the danger of over-stressing does not arise and the necessity for penetration of the paper by the impregnating material, under changes of temperature in the working conditions of the cable, is removed. Apart, therefore, from the physical requirements of the initial impregnation, this permits of the choice of material for the layers and for the impregnation being made without regard to the possibility of obtaining cyclic penetration under operating conditions. Accordingly a more advantageous choice of the materials can be made than is possible under the conditions at present usual. The paper may, for instance, be given a treatment which raises its breakdown voltage, although at the same time it renders it relatively impermeable, and the range of permissible compounds may be extended even down to the relatively solid jellies.

The accompanying drawings illustrate examples of conductors having various forms of insulating material according to the invention. The insulating material has not been drawn to scale for the sake of convenience and clearness.

Figure 1 shows in section a portion of a stranded conductor having one form of insulating material.

Figure 2 is a diagrammatic section of a stranded conductor having another form of insulating material.

Figure 3 is a plan view of a portion of the insulating material shown in Figure 2, and

Figure 4 is a diagrammatic section of a further form of insulating material.

In Figure 1, the layers 1 have a slightly wavy form produced by crimping the strip of paper transversely before application to the conductor, the latter consisting of the wires 2 stranded together. The deformation of the paper need be only of a very small order. In the drawing the pitch of the waves in the paper and the amplitude of the waves have been exaggerated. In practice these dimensions would be considerably smaller than as actually shown. The paper however, does not take a smooth line around the conductor as in the case when the usual plain paper insulating material is used.

In Figure 2 the paper has been embossed to provide it with a number of small projections arranged in rows and running transversely to the strip. The rows of projections are arranged alternately on opposite sides of the paper. In Figure 3 the edges of the strip are shown at 3, the projections 4 standing up while those at 5 project downwards. The projections may be hemispherical, conical or other convenient shape. When the paper is wrapped around the conductor, the projections cause it to follow irregular slightly wavy lines as shown in Figure 2. The size and the distance apart of the projections have been enlarged in the drawings, these dimensions being in practice much smaller than as

shown. The degree of embossing need be only very small so that it can be carried out without perforating the paper.

The number of embossing processes may be reduced by adopting the form of insulating material shown in Figure 4 where groups of three strips of paper are employed. The drawings show the first group consisting of an inner layer 6 having a number of small projections 7 all directed outwards, a middle layer 8 of plain paper, and an outer layer 9 provided with projections 10 all directed inwards. When the strips are wound on the conductor the layers follow irregular and wavy lines as before. The three strips may be either applied individually to the conductor in their proper sequence or as a group. The same remarks as to the dimensions of the projections apply to Figure 4 as in the previous cases.

What we claim as our invention and desire to secure by Letters Patent is:—

1. An electric cable having a conductor and impregnated insulating material formed from strips of paper arranged in groups of three, the outer layers of each group having rows of small projections projecting inwards towards each other and alternating with each other, the centre layer of each group being plain, the strips being lapped on helically to form a number of superposed layers each of which has a slightly wavy disposition.

2. An electric cable comprising a conductor, a number of superposed layers of paper applied helically to the conductor and each having a slightly wavy disposition, and a material impregnating the paper and filling the spaces between the layers thereof, and remaining more or less liquid during the operation of the cable, the wavy disposition of the paper layers permitting the volume enclosed by each layer to increase, without stretching the material of the layer.

3. An electric cable comprising a conductor, a number of superposed layers of paper applied helically to the conductor and each having rows of small projections on its upper surface alternating with rows of small projections on its lower surface, the rows of projections being transversely arranged to the strips and each layer having a slightly wavy disposition, and a material impregnating the paper and filling the spaces between the layers thereof, and remaining more or less liquid during the operation of the cable.

4. An electric cable, comprising a conductor, a number of superposed transversely crimped layers of paper applied helically to the conductor, the said layers having a slightly wavy disposition and being capable of increasing their length by a small amount without the production of a large tensile stress in the layers, and a material impregnating the paper and filling the spaces between the layers thereof, and remaining more or less liquid during the operation of the cable.

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