

SPECIFICATION

Insulator for covering electrical cables

The present invention relates to insulators for covering electric cables and, more particularly, to such insulators which are especially adapted for use in connection with flat multiconductor cables.

In the copending U.K Patent Application 8017084 there is disclosed a technique for connecting flat multiconductor cables. Briefly described, the method disclosed in that Application involves overlapping a pair of flat multiconductor cables and then mechanically and electrically connecting the overlapping portions of the cables using metallic connectors which extend beyond the surface of at least one of the cables. Any connector which electrically connects two "hot", i.e. electrically energised, conductors also becomes electrically energised and therefore potentially dangerous, inasmuch as an individual who touches the connector, either directly or indirectly, could receive a serious electric shock.

In order to electrically insulate the connectors, it has been proposed to cover them with a flat sheet of relatively flexible electric insulation. Because the cable is designed preferably for undercarpet installation, it is undesirable to use a thick sheet of insulation which might, due to its thickness, create bulges in the carpet. Should the thickness of such insulation be decreased in an effort to prevent the formation of unsightly bulges in the overlying carpet, the insulation becomes more susceptible to puncture or piercing by the relatively sharp edges of the connectors when the carpet above is walked on. Pierced or punctured insulation results in the same potentially hazardous condition that exists when the connectors are not covered by any insulation whatsoever. Moreover, the piercing or puncturing of the insulation increases the possibility of eventual electrical "tracking" or arcing between the partially exposed connectors.

In addition, the flat multiconductor cable, as described in the above mentioned copending UK Patent application, has a series of parallel flat, insulated conductors separated from adjacent conductors by flattened depressed regions of insulation which, when scored, lend themselves to tearing should it be desired to separate the conductors from one another. These flattened, depressed regions are significantly thinner than the adjacent conductor insulation portions of the cable. As a result, insulating spacers placed on such cable insulation would fail to conform to the depressed regions leaving pathways between the cable surface and the insulating spacers where moisture, dirt or other contaminants can enter. Thus, improper sealing of the connectors from these depressed regions can cause the connectors to be subjected to moisture, dirt or contaminants contained therein, leading to a shorting of or other injury to the joints and cables.

It is an object of the present invention to provide an improved cable assembly including an insulator for use with multiconductor cables.

In accordance with the invention, there is provided a cable assembly comprising a first cable and a second cable each having one or more conductors, said cables having common overlapping portions, a selected conductor of said first cable being joined to a selected conductor of said second cable by an electrical connector having a portion extending beyond an exterior surface of the joined cables by a predetermined height; and a pair of insulators positioned so as to sandwich and envelop the overlapping portions of said joined first and second cables therebetween, at least one of the insulators having an electrically non-conductive spacer member having a height greater than said predetermined height of such connector, said spacer member defining an opening to at least partially surround said connector, each of said insulators including an insulating member of continuous, solid expanse of size and configuration so as to completely cover said connector joining said first and second cables, one of said insulating members engaging a surface of said at least one spacer member and extending over said opening thereby covering said connector.

In one particular embodiment the assembly comprises a spacer adapted to insulate joined cables that have a central portion of predetermined thickness and at the marginal edges thereof, flat depressed regions of thickness less than the central portions. Electric conductors extend within the central portions and the connectors joining such cables extend beyond the exterior surface of the central portion. The spacer is made from a relatively non-compressible, non-conductive material having a plurality of openings therein. The spacer is located on the central portions of the cable with the openings being arranged to completely surround the connectors. Thus, barriers between the flat depressed regions and the connectors are formed, sealing the connectors from any moisture, dirt or contaminants that may be contained in the depressed regions.

Fig. 1 is a plan view of an insulator for covering electric cables constructed in accordance with the concepts of this invention.

Fig. 2 is a side elevational view, in section of the insulator of Fig. 1 taken along the lines 2—2 in Fig. 1.

Fig. 3 is a plan view of two overlapping flat multi-conductor cables coupled to one another by a series of connectors.

Fig. 4 is a side elevation, in section, of one of the flat multi-conductor cables of Fig. 3 taken along the lines 4—4.

Fig. 5 is a side elevation, in section, of a flat multiconductor cable with an insulator adhered thereto useful in describing a preferred embodiment of the invention.

Fig. 6 is a side elevation, in section of a flat multiconductor cable with an insulator constructed in accordance with the invention adhered thereto.

Fig. 7 is a side elevation, in section, of a joint

between two flat multiconductor cables insulated on both sides with insulators in accordance with the invention.

Turning now to Figs. 3 and 4, a first flat multiconductor cable 110 has its individual conductors 112, 114, 116 and 118 joined to like individual conductors 122, 124, 126 and 128, respectively, of a second flat multiconductor cable 120 by connectors 132, 134, 136 and 138, respectively. Connectors 132, 134, 136 and 138 may be any suitable connectors such as are disclosed, for example, in the copending UK Patent Application (ref. T & B 829F) 8017082 claiming priority from U.S. Patent Application, Serial No. 042,441 by T.L.C. Kuo, filed on May 25, 1979 and entitled "Self-Locking Clamp Member." As is best seen in FIG. 4, the conductors are generally rectangular and are covered on both long sides by layers of insulation 130 and 140. The layers of insulation 130 and 140 are adhered to themselves in the interstices between adjacent conductors as at 142, 144, 146 and at the cable ends at 148 and 150. In that there is no conductor at such locations, a flattened, depressed region is created having a width significantly less than the adjacent areas where a conductor is located resulting in a natural trough or passage along the longitudinal axis of the cable 110. Similar depressed regions are found in cable 120 as at 152, 154 and 156 and at the cable ends 158 and 160. A score line, such as 162 in depressed region 142, may extend down the center at each of the depressed regions to permit the individual conductors to be separated from the full cable. Thus, conductor 112 can be removed from cable 110 by tearing along score line 162 in the depressed region 142.

As stated above, the presence of a bare metallic connector such as 132, 134, 136 or 138 engaging an energized conductor such as 112, 114, 116, 118, 122, 124, 126 or 128 itself becomes electrically "hot" so that one contacting such a connector could receive a severe electrical shock. To prevent this from happening, an insulator constructed in accordance with the present invention is provided. As shown in Figures 1 and 2, an insulator 164 comprises a spacer 166, preferably made from a noncompressible, electrically insulating material, such as polyvinylchloride. Spacer 166 is sized and shaped so as to completely cover and preferably overhang overlapping portions of the flat multiconductor cables 110 and 120 respectively (see Figure 3). Although the spacer 166 is illustrated as being square in Figure 1, it may have any other suitable shape depending upon the configuration of the overlapping portions of the cables 110 and 120, respectively.

A plurality of holes 168 extend through the spacer 166, the holes 168 being sized to receive therein the arms of the connectors 132, 134, 136 and 138 joining the overlapping cables 110 and 120, respectively. As will be described, the holes 168 are suitably formed to inhibit tracking between the connectors as well as to seal these

connectors from the environment. Preferably, for manufacturing purposes, the holes 168 are circular, although they may have other geometric shapes.

Included on the spacer 166, is a thin film of electric insulation 170, preferably clear for alignment purposes and laminated to one of the faces of the spacer 166. On the opposite surface of the spacer 166 is a layer of pressure-sensitive adhesive 172 that is protected until use by a layer of removable release material 174. The insulator 164 preferably includes a circular aperture 176 and an elongated slot 178 through the spacer 166 to enable the insulator 164 to be positioned upon a suitable tool for aligning the insulator 164 with the cables it is to insulate.

The liner 174 prevents the inadvertent sticking of the pressure-sensitive adhesive 172 to the cables 110 and 120 or other objects. Preferably, the liner 22 is made from clear plastic so that the aperture 176 and slot 178 may be easily observed therethrough.

The film 170 of electric insulation can be made from any suitable material, such as a laminate of polyvinyl-chloride and polyester adapted for lamination to the spacer 166. Alternately, the film 170 may be formed monolithically with the spacer 166.

In order to prevent the film 170 from being pierced or punctured by the arms (see Fig. 3) of the connectors 132, 134, 136 and 138, the film 170 is supported a predetermined, substantially fixed distance from the arms of these connectors by the spacer 166. The thickness of the spacer 166 may be varied to vary the distance between the connector arms and the film 14, as long as the spacer 166 is thicker than the distance the connector arms project above the exterior surface of the joined cables 110 and 120, respectively.

In the preferred embodiment, the spacer 166 is formed to seal the connectors from each other and from any contaminants that may be contained within the depressed regions of the cables. To effect such a seal, the holes 168, as shown in Figure 6, are formed large enough to closely accept and fully surround the connectors and are spaced from each to lie in substantial registry with the thicker, central portions of the cable 110 within which the conductors 112, 114, 116 and 118 extend. The diameters of the holes 168, centered over the respective conductors, are formed to be less than the lateral distance between the depressed regions that extend along the marginal edges of each of the central portions containing the conductors, so that the holes 168 do not extend over any of the depressed regions, 142, 144 and 146. Thus, the portions of the spacer 166 on the central cable portions extending from the walls of the holes 168 establish an insulative barrier between the connectors 132, 134, 136 and 138 and the flat, depressed regions 142, 144 and 146.

The significance of the preferred sealing structure can be more fully understood by reference to Figure 5. In this arrangement, an

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insulator 10 comprising an insulative spacer 12 with an insulation layer 14 and an adhesive film 18 thereon, includes a plurality of apertures 32. The apertures 32 are formed to receive connectors therein, the diameters being larger than the lateral distance between depressed regions, whereby portions of the holes 32 overlies the recessed regions 142, 144 and 146. In such a structure an undesirable passageway is created from the depressed regions 142, 144 and 146 to the connectors that extend into the holes 32, resulting potentially in short circuits or electrical arcing.

While the insulator 164 of the present invention is preferably configured to seal the connectors joining multiconductor cables with recessed portions, it should be understood that the present insulator is not limited thereto. The present insulator may also be readily used with multiconductor cable wherein the exterior surfaces are substantially flat thereacross. With such flat cable, the insulator configuration shown in Figure 5 would not present the potential tracking problems as the depressed portions 142, 144 and 146 would not be present. Furthermore, with flat cable, the connectors may be only partially surrounded and barriers between connectors would not be necessary where no troughs or depressions are present to carry or otherwise contain contaminants. Moreover, the spacing between the insulation 170 and the arms of the connectors 132, 134, 136 and 138 may also be effected by separate spacer elements positioned on the cables at a distance to sufficiently receive the connectors therebetween.

Referring back to Figure 3, a typical splice is shown in which the cables 110 and 120 are perpendicular to each other. The four conductors 112, 114, 116 and 118 of the cable 110 are electrically and mechanically connected to the corresponding four conductors 122, 124, 126 and 128 of the cable 120 by the connectors 132, 134, 136 and 138, respectively. The four connectors extend diagonally across the overlapping portions of the spliced cables 110 and 120.

When applying the insulator 164 to the overlapping cable 110, the liner 174 is removed in a suitable manner to expose the pressure-sensitive adhesive 172. Upon proper installation of the insulator 164, the arms of the connectors 132, 134, 136 and 138 will register with four of the holes 168 which are aligned diagonally across the face of the spacer 166 (see Figure 1). The other diagonal hole may be used when insulating a tap splice between five-conductor cables. The two longitudinally aligned holes together with the middle one of the five diagonal holes may be used to selectively connect one conductor of a cable to three corresponding cables of an overlapping cable. Of course, the number and arrangement of the holes may be varied depending upon the configuration of the connectors.

In Figure 7, there is shown a completed splice of flat multiconductor cables 110 and 120 with spacers 166 positioned above and below a joint formed, for example, by the connector 132. It is

preferable to form the insulators for such applications such that the spacers 166 overhang the overlapping region of the joined cables 110 and 120. The overhanging spacer portions (not shown) may be adhered to each other by means of the pressure-sensitive adhesive on each spacer so as to completely envelop the joining connectors and joined overlapping portions of the cables 110 and 120. To further assure a seal from the environment, the interior surfaces of the overlapping portions of the cables 110 and 120 may be coated with a filler material such as a mastic.

It should be appreciated that the embodiments described herein are merely exemplary and that a person skilled in the art may make variations and modifications without departing from the spirit and scope of the invention. For instance, the insulator of the present invention may be applied to round electric cable as well as to flat multiconductor cable. Also, the insulator is equally suitable for use in converging any overlapped portions of a pair of cables which are spliced together by, for example, a butt splice or any other type of splice. All such modifications and variations are intended to be included within the scope of the invention as defined in the appended claims.

CLAIMS

1. A cable assembly comprising a first cable and a second cable each having one or more conductors, said cables having common overlapping portions, a selected conductor of said first cable being joined to a selected conductor of said second cable by an electrical connector having a portion extending beyond an exterior surface of the joined cables by a predetermined height; and a pair of insulators positioned so as to sandwich and envelope the overlapping portions of said joined first and second cables therebetween, at least one of the insulators having an electrically non-conductive spacer member having a height greater than said predetermined height of such connector, said spacer member defining an opening to at least partially surround said connector, each of said insulators including an insulating member of continuous, solid expanse of size and configuration so as to completely cover said connector joining said first and second cables, one of said insulating members engaging a surface of said at least one spacer member and extending over said opening thereby covering said connector.

2. A cable assembly according to claim 1, wherein each of said cables has a central portion of predetermined thickness and at the marginal edges thereof, flat depressed regions of thickness less than the thickness of the central portion, the conductor being disposed at said central portion the connector portion extending beyond the exterior surface of the central portion, said spacer members being located on the central portions to form a barrier between said flat depressed regions and said connector.



insulator 10 comprising an insulative spacer 12 with an insulation layer 14 and an adhesive film 18 thereon, includes a plurality of apertures 32. The apertures 32 are formed to receive connectors therein, the diameters being larger than the lateral distance between depressed regions, whereby portions of the holes 32 overlie the recessed regions 142, 144 and 146. In such a structure an undesirable passageway is created from the depressed regions 142, 144 and 146 to the connectors that extend into the holes 32, resulting potentially in short circuits or electrical arcing.

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It should be appreciated that the embodiments described herein are merely exemplary and that a person skilled in the art may make variations and modifications without departing from the spirit and scope of the invention. For instance, the insulator of the present invention may be applied to round electric cable as well as to flat multiconductor cable. Also, the insulator is equally suitable for use in converging any overlapped portions of a pair of cables which are spliced together by, for example, a butt splice or any other type of splice. All such modifications and variations are intended to be included within the scope of the invention as defined in the appended claims.

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2. A cable assembly according to claim 1, wherein each of said cables has a central portion of predetermined thickness and at the marginal edges thereof, flat depressed regions of thickness less than the thickness of the central portion, the conductor being disposed at said central portion the connector portion extending beyond the exterior surface of the central portion, said spacer members being located on the central portions to form a barrier between said flat depressed regions and said connector.

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3. A cable assembly according to claim 2, said at least one spacer member having an aperture disposed in registry with said central portion, the walls of said aperture being spaced apart in a direction transversely to said depressed regions less than the lateral spacing of said central portion, to thereby define said barrier between the flat depressed regions and said connector.
4. A cable assembly according to claim 1 or claim 2 wherein said cables are each multiconductor cables, and wherein there is a predetermined pattern of individual joints formed by a plurality of electrical connectors between prescribed conductors of such cables and wherein said at least one spacer member has a plurality of apertures at least equal in number to said joining connectors.
5. A cable assembly according to claim 4, wherein said apertures are circular for receiving said joining connectors.
6. A cable assembly according to claim 1, further including means for locating said insulator with respect to said joints, said locating means including an opening extending through said member to permit positioning said apertures over said connectors.
7. A cable assembly according to claim 3, wherein a plurality of apertures lie along a diagonal line so as to overlie the joints of the conductors of a first cable individually with an associated conductor of a second cable placed substantially orthogonally to said first cable.
8. A cable assembly according to any preceding claim wherein an adhesive layer is placed on the lower surface of said spacer member to adhere said spacer member to the central portions of a cable adjacent a connector.
9. A cable assembly according to claim 8, wherein liner means is removably attached to said adhesive layer prior to adhering said spacer member to said cable.
10. An insulator for a cable assembly substantially as herein described with reference to Figs. 1 and 2 of the accompanying drawings.