TAP CONNECTIONS FOR MULTI-CONDUCTOR CABLES

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References Cited
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ABSTRACT

A tap-type connection for a multi-conductor cable comprises a multi-contact connector disposed beside the cable. The wires from the cable extend laterally with respect to the cable axis and are connected to terminals on the rearward side of the connector. The wires extend from these terminals back to the axis of the cable and become part of the cable again. The tap is contained in a housing comprising two panel-like members hinged together clamshell fashion. The housing has inlet and outlet openings for the cable along one side and, in its closed condition, is assembled to the rearward side of the connector so that the laterally extending wires are contained in the housing.

16 Claims, 7 Drawing Figures
TAP CONNECTIONS FOR MULTI-CONDUCTOR CABLES

BACKGROUND OF THE INVENTION

The patent to Roberts et al. U.S. Pat. No. 3,824,530 discloses and claims a tap for a multi-conductor cable comprised of a plurality, for example fifty, individual wires. The term "tap connection", as used herein, denotes connections of branch wires to the individual wires in the cable, in other words, T connections involving a relatively large number of wires. The tap is made with a multi-contact connector, of the type fully disclosed in U.S. Pat. No. 3,760,335, which is located beside the cable. The wires in the cable extend to and from the connector without being cut. A strain relief and wire holding means is provided in accordance with the teachings of U.S. Pat. No. 3,824,530 which is assembled to the rearward side of the connector and which serves to guide the wires into and out of the connector. The portions of the wires extending from the cable to the connector are not, however, covered or otherwise enclosed. It is good practice to use a so-called back cover on electrical connectors of the type shown in U.S. Pat. No. 3,824,530 to enclose the portions of the wires which are immediately adjacent to the connector to which they extend. However, none of the presently available back covers are suitable for use with tap-type connections as disclosed in U.S. Pat. No. 3,824,530.

The instant invention is specifically addressed to the achievement of a cover means for tap-type connections for multi-conductor cables. An object of the invention is to provide a cover for a tap connection of the type comprising a multi-contact electrical connector having terminals to which cable wires are connected. A further object is to provide a cover or housing for a cable tap which will provide strain relief means for the cable and for the individual wires which extend from the cable to the terminals in the connector. A further object is to provide a cover or housing which can be produced as a one piece molding and which will completely enclose wires extending from the cable to the tap connector.

These and other objects of the invention are achieved in a preferred embodiment thereof which is briefly described in the foregoing abstract, which is described in detail below, and which is shown in the accompanying drawing in which:

FIG. 1 shows a perspective view of a cable tap in accordance with the invention.

FIG. 2 is a view similar to FIG. 1 but with the tap housing cover in its open position.

FIG. 3 is a perspective view illustrating the manner of connecting the wires in the cable to the terminals in a connector to form a tap in accordance with the invention, one part of the connector strain relief being exploded from the connector in this view.

FIG. 4 is a view similar to FIG. 3 but showing both parts of the connector strain relief assembled to the connector housing.

FIG. 5 is a view taken through the rear side of an open housing showing details of the hinge means and the backwall.

FIG. 6 is a perspective fragmentary view of a preferred type of connector for cable taps in accordance with the invention.

FIG. 7 is a fragmentary cross-sectional side view of the housing mounted on a connector.

Referring first to FIGS. 1 and 2, a cable tap in accordance with the invention is made by removing a portion of the sheath 44 of the cable 40 to expose the individual wires 42 thereof. Intermediate portions 2 of these wires are connected to the terminals on the rearward side of a connector 8 and a housing or cover in accordance with the invention, as will be described below, is then placed over the ends of the cable sheath 44 and the rearward side of the connector 8 so as to completely enclose the rearward side of the connector and the portions of the wires which extend to, and from, the connector.

The connector 8 is shown in FIG. 6 and is briefly described below for a better understanding of the invention. In accordance with the instant invention, intermediate portions 2 of the wires 2 are connected to the wire-receiving portions 4 of contact terminals 6 which are contained in the housing 10 of the connector 8. The housing has a mating face 12 and a rearward face 14. A central rib 16 extends from the rearward side or face and a plurality of side-by-side contact receiving cavities 18 extend through the housing on the upper and lower sides of the rib. Each cavity contains an individual terminal 6 and each terminal has a forward contact portion 20, and intermediate shank 22, and the previously identified wire receiving portion 4 which comprises two plate-like members 24, 26 which are connected at their upper ends by strap sections 28. The wire 2 is moved laterally of its axis into the gap between the strap members 28 and into slots 30 in the plate sections, the width of these slots being such that the insulation of the wire is penetrated and electrical contact is established with the conducting core. When the terminals are mounted in the cavities, the contact portions extend forwardly and into a trough-like recess 32 in the mating face 12 which is adapted to receive a complementary male connector.

Adjacent terminals in the two rows are separated from each other by barriers 36 and the end barriers 38 extend somewhat beyond the other barriers 36 as shown. The housing 10 is provided with a radially extending flange 34 by means of which it may be mounted in a panel or the like.

It will thus be apparent that after an intermediate portion 2 of each wire has been connected to one of the terminals 6, it will be possible to form tap connections to the cable by merely plugging a complementary connector into the trough-like recess 32 of the connector 8. It is desirable, however, to enclose the laterally extending portions of the wires 42a, 42b in a housing as will now be described.

A preferred form of housing in accordance with the invention comprises a clamshell like molding having a first or top section 46 and a second or bottom section 48, these two sections being hinged together on their lefthand ends as viewed in FIGS. 1 and 2, and as shown in FIG. 5. It will be understood that the terms "top" and "bottom" are used as a matter of convenience and that the housing may occupy any desired orientation. Top section 46 comprises a generally rectangular panel 50 having depending flanges 52 extending from its opposite side edges. The internal opposed surfaces 53 of these flanges are spaced apart by a distance equal to the distance between the ends of a bar-like connector strain relief 84 which is shown in FIGS. 3 and 4 so that the housing will snugly receive the rearward end or side of the connector 8. The external surfaces of the flanges 52 are recessed as shown at 54 adjacent to the forward.
edge 56 of panel section 50 and an ear 58 extends outwardly from the center of each recess, these ears providing upwardly facing shoulders for cooperation with latch arms 70 on the bottom section 48. The flanges 52 do not extend to the rearward side of the panel 50 so that openings remain for the cable 40 and clamping ears 60, comprising planar extensions of panel section 46, project laterally in opposite directions over these openings.

Top section 46 has a flange 62 extending from its rearward edge and this flange is connected by a thin flexible integral hinge 64 with a flange 65. The flange 65 extends from the panel portion 66 of the bottom part of the housing. Flanges 68 project upwardly from the side edges of the panel section 66 these flanges being opposed to, and in alignment with, the flanges 52. The opposed internal surfaces of flanges 68, like the opposed surfaces 53, conform to the rearward side of the connector 8 with the strain relief means assembled thereto. Integral latch arms 70 extend upwardly from the frontal portions of flanges 68 and these latch arms have centrally located slots 69 which receive the latching ears 58.

Three cable clamping ears 72, 74, 76 extend from each side of the bottom section, one of these ears extending from the flange 68, one of these ears 72 extending from the panel 66, and the remaining ear 76 being in alignment with the backwall 62. All of the ears 60, 72, 74, 76 are somewhat flexible so that they can be clamped to the cable sheath as shown in FIG. 1. Advantageously, the internal surfaces of the ears have transversely extending ribs 77 which bear against the cable sheath.

The top and bottom sections 46, 48 when closed, provide an enclosure which is open on its forwardly facing side to receive the connector 8. It is desirable to provide means in this enclosure to neatly dress the laterally extending portions 42a, 42b of the wires which extend to and from the connector. In the disclosed embodiment, a guide means is provided in the form of opposed U-shaped internal walls 80 which extend from the internal surface of panel section 66. The inner ends of these guide walls are spaced apart and define a restricted passageway 82 having curved surfaces against which the wires shown are positioned.

The ears 60, 72, 74, 76 provide first strain relief means for the cable and it is desirable to provide a second or additional strain relief means for the portions 2 of the wires which extend in the vicinity of the rearward side of the connector 8. This strain relief means as shown in FIGS. 3 and 4 comprises two identical bar members 86, each of which has a flexible latch arm 88 extending from one end thereof and a recess 90 on its opposite end. A shoulder 91 is provided in each of the recesses 90 for cooperation with a slot 94 in the latch arm 88 of the other clamping member so that these two clamping bars can be assembled to the rearward side of the connector as shown in FIG. 3. The opposed edges 93 of these two clamping members are spaced apart so that the wires can pass through the resulting slot as shown in FIG. 4 to the terminals in the connector. The wires extend from the terminals and between the clamping bar and the housing and are reversely bent over the outwardly facing surface of the clamping bar. Advantageously, this outwardly facing surface on each bar is provided with spaced apart grooves 100 which receive the wires. The clamping bars 84 are held on the rearward side of the connector by the latch arms 88 but it is desirable to provide additional latch arms 96 and additional latching ears 98 on each clamping bar to clamp the central portions of the bars to each other. This additional clamping means prevents bowing of the clamping bars in their central sections. The clamping bars shown in FIG. 3 are further described in the above identified U.S. Pat. No. 3,824,530 although the clamping bars shown here are modified in some respects.

While the connector with the clamping bars 84 assembled thereto has a snug fit in the open side of the housing and is frictionally held to some extent, it is desirable to provide a positive stop or holding means for the connector. Accordingly there are provided integral rectangular stop blocks 87 at the corners of the internal surfaces of the panel sections 50, 66. These stop blocks are received in complementary recesses 89 in the ends of the bar members 84. As shown in FIG. 7, the opposed surfaces of these stop blocks and the recesses in the bar members prevent the connector from moving out of the housing when the housing is closed onto the connector.

The clamshell housing and the clamping bars 84 are preferably manufactured by an injection molding process, any suitable molding material being used such as nylon or a polyphenylene oxide material or polypropylene.

In order to make a cable tap in accordance with the invention a portion of the b cable sheath is removed as previously explained to expose the wires 42. Intermediate portions of these wires are then inserted into the wire receiving portions 4 of the appropriate terminals in the connector. This wire inserting operation may be carried out by means of the apparatus disclosed in the above identified U.S. Pat. No. 3,824,530 or in any other manner as desired. The clamping bars 84 are then assembled to the rearward side of the connector and the wires in the ends of the cable sheath are placed in the lower section of the housing. The connector is located between the opposed surfaces 78 of the flanges 68 and the upper section 46 is swung downwardly until the ears 58 lodge in the slots 69 of latch arms 70. Finally, bundle tie devices 102 are placed around the ears 60, 72, 74, 76 and drawn taut so that the ears are firmly clamped to the cable sheath as shown in FIG. 2. By virtue of the clamping ears, the housing is firmly supported on the cable sheath and the connector, being snugly held in the open end of the housing, is also supported on the cable sheath. The portions of the wires which extend from the cable to the terminals are thus not subjected to any tensile forces which might be applied to the cable and the electrical connections of the conductors to these terminals will not be disturbed. The portions of the wires in the enclosure, and particularly those portions in the wire receiving slots in the terminals, are further protected by the clamping and strain relief bars 84, this second strain relief means for the individual wires being independent of the first strain relief formed by the means 84 and the bundle ties 102.

Additional protection for the electrical connections between the portions 2 of the wires and the contact terminals is achieved by virtue of the opposed curved surfaces of the walls 80 which define the constricted passageway 82. It will be noted from FIG. 2 that the wires 42a and 42b curve gently from the axis of the cable until they extend normally of the cable axis and they then diverge towards the connector in the front of the housing. It can be seen that if the wires in the cable should be subjected to tensile forces acting in the direc-
tion of the cable axis, these tensile forces would be disipated on the curved surfaces 82; in other words, the reaction forces to the tensile forces in the wire would arise in the portions of the wires extending through the constriction 82. The integrity of the electrical connections of the portions 2 of the wires to the terminals is further guaranteed by the fact that these electrical connections would be disturbed by moving the wires laterally of their axes and away from a connector to cause them to move out of the wire receiving slots in the terminals. It can be seen from FIG. 2 that any tensile forces imposed on the wires would not have any force components tending to move the wires laterally of their axes and out of the terminals.

Changes in construction will occur to those skilled in the art and various apparently different modifications and embodiments may be made without departing from the scope of the invention. The matter set forth in the foregoing description and accompanying drawings is offered by way of illustration only.

What is claimed is:
1. A housing in combination with an electrical cable comprising a plurality of wires and an electrical connector, said connector having a forward side and a rearward side, said connector having spaced-apart electrical contact terminals therein, said terminals having wire receiving portions at said rearward side, intermediate portion of said cable extending along a predetermined axis, said connector being disposed beside said axis, said wires having intermediate portions extending laterally from said axis to said rearward side along a portion of each of said wires being in said wire-receiving portion of one of said terminals, and said wires extending from said rearward side back to said axis, said housing comprising:
   first and second cover members, said cover members being hinged together by hinge means extending between said cover members and along said rearward side thereof, said cover members extending from said one side to said rearward side of said connector and over said terminals at said rearward side, said terminals being extended between said cover members, said covers and said cover members forming an enclosure surrounding said intermediate portions of said wires, and openings in said covers adjacent to said hinge means, said cable extending through said openings into, and from, said enclosure.
2. The combination as set forth in claim 1, said intermediate means having interengaging latch means for latching said cover members to each other.
3. The combination as set forth in claim 1, said intermediate means having ear means forming a latch means for latching said intermediate means of said cable to said intermediate portions of said cable, and said latching means forming an enclosure surrounding said intermediate portions of said cable, and openings in said covers adjacent to said hinge means, said cable extending through said openings into, and from, said enclosure.
4. The combination as set forth in claim 3 including clamping means on said ear means, said ear means being clamped to said portions of said cable to provide a first strain relief for said intermediate portions of said cable.
5. The combination as set forth in claim 1 including wire guide means in said enclosure, said wire guide means comprising a guide surface extending between said cover means and serving to guide said wires from said axis towards said rearward side of said connector.

6. The combination set forth in claim 1 including second strain relief means within said enclosure, said second strain relief means being mounted on said rearward side of said connector, said intermediate portions of said wires extending through said second strain relief means to said wire-receiving portions of said terminals then from said strain relief means.
7. The combination set forth in claim 6, said second strain relief means comprising holding means extending across said rearward side of said connector and over said wire-receiving portions of said terminals.
8. A housing for enclosing a tap on a multi-conductor cable said tap comprising an electrical connector having a mating side and a rearward side, a plurality of contact terminals in said connector, each of said terminals having a wire-receiving portion at said rearward side, the wires in said cable extending from said cable to said rearward side and being in said wire-receiving portions of said terminals, said wires extending from said terminals back to said cable, said housing comprising:
   first and second cover members, said cover members being connected to each other clamshell fashion along one side thereof, said side constituting a rear side and having hinge means whereby said cover members can be moved from an open position to a closed position,
   each of said cover members comprising a panel section extending from said rear side, each of said panel sections having flanges extending from opposite side edges thereof, said panel sections said flanges, and said rear side forming an enclosure when said cover members are closed, said enclosure having an open side which is opposite to said rearward side internal surface portions of said enclosure which are proximate to open side conforming to said rearward side of said connector,
   cable openings in said flanges adjacent to said rear side, said openings conforming in size to said cable, and means for latching said cover members to each other in said closed position whereby,
   portions of said cable adjacent to said connector can be positioned in said cable openings and said cover members can be closed onto said rearward side of said connector whereby said wires extending from said cable to said connector will be contained in said enclosure.
9. A housing as set forth in claim 8, said cover member having strain relief ears extending laterally in opposite directions from portions thereof which surround said openings, whereby said ears can be clamped to said cable to provide strain relief means therefore.
10. A housing as set forth in claim 9 including guide means in said enclosure for guiding wires extending between said cable and said connector.
11. A multi-contact electrical connector and a multi-conductor cable, said cable extending along a predetermined axis, said connector comprising an insulating housing having a mating side and a rearward side, a rib extending from said rearward side, a plurality of electrical contact terminals extending through said housing from said rearward side to said mating side, said terminals having wire-receiving portions arranged in two rows, said wire-receiving portions facing in opposite directions on oppositely directed surfaces of said rib, said connector being disposed beside said cable with said
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A pair of clamping bars disposed against said oppositely directed surfaces of said rib,
first portions of said conductors extending from said cable laterally of said axis and towards said rib,
each of said conductors being in said wire-receiving portion of one of said terminals, said conductors extending from said terminals in a reverse direction and being wrapped over said clamping bars,
second portions of said conductors extending from said clamping bars towards said axis and thence along said axis.

12. A connector and a cable as set forth in claim 11, and cover means on said cable, said cover means having openings at opposite ends thereof, said cable extending through said openings into, and from, the interior of said cover means, portions of said cover means being secured to said housing in surrounding relationship to said rib and said clamping bars.

13. The combination set forth in claim 12, said cover means comprising two opposed parts.

14. The combination set forth in claim 13, said parts of said cover means being hinged to each other.

15. The combination set forth in claim 12, said cover means having clamping means at said openings, said clamping means holding said cover means in clamping engagement with said cable.

16. The combination set forth in claim 11, said clamping bars having conductor-receiving grooves therein, said conductors being in said grooves.