

Description

The present invention relates to cable terminations and cable termination assemblies and a method of making the same.

In the art of electrical connectors for cables, the term cable termination typically means a connector that is or can be used at the end or at an intermediate portion of a cable to connect the conductors thereof to an external member, such as another connector, cable termination, printed circuit board or the like. A cable termination assembly is usually referred to as the combination of a cable termination with an electrical cable. Sometimes such terms are used interchangeably, depending on context.

Multiconductor electrical cable termination assemblies have been available to the electrical industry for a number of years. These cable termination assemblies have been available both in the unassembled form requiring mechanical assembly thereof which includes the mechanical clamping of the termination properly to secure the various elements of the termination and cable, and also as a permanent preassembled and molded integral structural combination. In both cases the junctions or connections of contacts with respective conductors are made by part of the contacts piercing through the cable insulation to engage a respective conductor; such connections are referred to as insulation displacement connections (IDC). Unfortunately, the mechanically assembled types of prior art cable terminations do not provide a hermetic seal which surrounds the junctions formed between the cable conductors and contacts of a termination so as to completely encapsulate the junctions and prevent the contamination thereof.

US Patent No. 4,030,799 discloses a multiconductor electrical cable termination in which a plurality of electric contacts each has cable-piercing terminals forming an electric junction with at least one of the conductors of the cable. A housing includes a base which directly holds the contacts and the cable in relatively fixed positions, and the protruding ends of the electrical contacts are for electrical connection to an external member placed in engagement therewith. The base may fully encapsulate the electrical junctions between the contacts and the conductors. However in this prior art document the form of the connection is such that openings or holes are formed in the base to allow portions of the ends of the electrical contacts to remain exposed.

This document, US 4,030,799, forms the preamble to independent claim 1.

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comprised in the state of the art insofar as the designated Contracting States DE, FR, GB, IT are concerned. discloses an electrical connector for a multiconductor cable in which an insert supports contacts in connection with the electrical conductors. A body is then molded around the insert and cable to form an integral structure. In this connector the ends of the contacts adjacent the electrical conductors remain exposed. This document also discloses a method of manufacturing an electric connector in which contacts and the electrical conductors are supported by a pre-molded insert and molding material is introduced into the cavity of molds to form a molded body about the contacts, cable, electric junction and insert. This method of manufacture requires the use of a pre-molded insert to support the contacts, and is not therefore capable of producing the electric connector in a single molding step.

This document also discloses a molding machine in which an anvil holds a contact and a conductor in their connected position against a pre-molded insert.

According to a first aspect of the invention there is provided a multiconductor electrical cable termination, comprising:

a flat multiconductor electrical cable including a plurality of conductors and electrical insulation about said conductors maintaining said conductors electrically insulated from each other;

a plurality of electrical contacts, each including terminal means penetrating through said insulation and forming an electrical junction with corresponding conductors, and contacting means for electrically connecting each of said electrical contacts to an external member placed to engagement therewith, said contacting means of said contacts being located on one side of said cable, said terminal means having cable insulation piercing end portions projecting beyond the opposite side of said cable;

a housing including base means for directly holding said electrical contacts and said cable in relatively fixed position, said base means comprising a body of insulating material integrally molded about at least a portion of each of said electrical contacts and a portion of said cable, said body including mold core openings, said electrical junctions being hermetically sealed by a molded portion of said base means characterised in that:

said end portions are surrounded by and fully encapsulated within said body of insulating material, and said mold core openings are proximate to but laterally spaced apart from said end portions.

The resulting multiconductor electrical cable termination assembly is formed as an integral structural combination of the multiconductor elec-

trical cable, a plurality of electrical contacts, and a housing part that is molded about at least a portion of each of the contacts and a portion of the cable. Each contact forms a junction with a respective conductor of the cable, and the integral housing part includes a molded junction zone that includes a substantial depth of molding material at each contact to assure encapsulation of the IDC junctions and of the entire IDC end of the contacts. Moreover, such housing part preferably is molded under elevated temperature and pressure conditions so that each of the junctions is fully encapsulated by the molded body part to create a hermetically sealed junction zone which is free of moisture, air, oxygen, and other like deleterious contaminants, and which helps to prevent the contamination of the junction when the termination is utilized in a hostile environment, for example, an environment which is either acidic or basic. The contacts and the conductors, therefore, may be of dissimilar metals, which will not corrode, oxidize or undergo any electrolysis-like activity due to the lack of moisture, oxygen, and the like, at the junctions. Furthermore, the molded housing part preferably is of a material compatible with that of the electrical insulation of the cable so as to bond chemically therewith to provide an effective strain relief for the termination and also to insure the integrity of the encapsulation of the junctions. It will be appreciated that the contacting portion of each electrical contact, i.e., the portion being intended for electrical connection to a device other than the cable of the termination, may be of various designs for connection, for example, with pin contacts, female contacts, e.g., fork contacts, conductive paths on a printed circuit board, etc.

The present invention provides encapsulation of the IDC ends of contacts in an IDC cable termination assembly. While the exposure of the IDC ends of the contacts can provide an advantage of probing the same, encapsulation of the IDC ends of the contacts can prevent inadvertent short circuit or incorrect connections to exposed IDC ends of the contacts, although the mentioned probability capability could be eliminated. Advantageously, though, such encapsulation further can eliminate the possibility that a probe inserted to the exposed IDC ends of the contacts might mechanically damage the IDC connection of a conductor and contact.

According to a second aspect of the invention there is provided a method of producing a multiconductor electrical cable termination having a plurality of electrical contacts mounted with respect to a base, each contact being connected at an electrical junction to a respective conductor of a flat multiconductor electrical cable, said method comprising the steps of:

placing the contacts into supporting engage-

ment with opened molds of a molding machine;

placing the electrical cable between the opened molds in proper alignment with the supported contacts;

5 closing the molds to form a closed mold cavity and simultaneously to urge terminal portions of the contacts through the insulation of the cable to engagement with respective conductors of the cable to form electrical junctions therewith, with end
10 portions of the terminal, portions being urged beyond the cable, said closing step including the step of using plural mold cores to engage the cable at opposite sides of the terminal portion of respective contacts, the mold cores each including an opening
15 formed between walls laterally spaced apart a distance greater than the thickness of the end portion of the respective contacts terminal portion; and

introducing molding material into the cavity of the closed molds to form a molded body about at least a part of each contact and portion of the
20 cable the molding material flowing between the end portion of each contacts terminal portion and the walls of the respective mold core to form with molding material otherwise flowing around the respective electrical junction a hermetic seal surrounding the electrical junction and to surround and
25 fully encapsulate the terminal end portions within said molded body upon subsequent solidifying of the molding material.

30 According to a further aspect of the invention there is provided a molding machine comprising two opposing molds which cooperate to define a mold cavity to containing therein contacts and a multiconductor electrical cable to form a multiconductor cable termination having a plurality of electrical junctions each surrounded and contained
35 within a hermetically sealed junction zone by molding a base about at least part of such contacts and cable and a mold core mounted within the sidewall of the injection mold, said mold core comprising a
40 plurality of protruding legs each having an inner, outer, and end surface which with the mold closed surround the ends of the contacts protruding beyond the insulation of the cable wherein during the injection process of the injection molding machine
45 the material being injected is allowed to flow freely above and about such electrical junctions to form such hermetically sealed junction zones and fully encapsulate said ends of the contacts.

50 The foregoing and other features of the invention are hereinafter fully described and particularly pointed out in the claims, the following description and the annexed drawings setting forth in detail certain illustrative embodiments of the invention.

55 In the annexed drawings:

Figure 1 is an exploded isometric view of the multiconductor electrical cable termination assembly in accordance with the invention;

Figure 2 is a bottom view of the molded housing part of Figure 1 looking in the direction of line 2-2 thereof;

Figure 3 is an end elevation view of the multiconductor electrical cable termination assembly of Figure 1 looking in the direction of line 3-3 thereof;

Figure 4 is a fragmentary cross-sectional view of the multiconductor electrical cable termination assembly of Figure 1 taken generally along line 4-4 thereof;

Figure 5 is a fragmentary cross-sectional view of the multiconductor electrical cable termination assembly of Figure 4 taken generally along line 5-5 thereof;

Figure 6 is a fragmentary cross-sectional view of the molds and core according to the present invention which may be used to produce the housing base of the multiconductor electrical cable termination assembly of Figure 1;

Figure 7 is a fragmentary cross-sectional view of one of the molds and the core of Figure 6 after the base of the multiconductor electrical cable termination assembly has been formed;

Figure 8 is a fragmentary end view of the core of Figure 7 looking generally in the direction of line 8-8 thereof;

Figure 9 is a fragmentary bottom view of the core of Figure 7 looking generally in the direction of line 9-9 thereof;

Figure 10 is a fragmentary elevational view of an alternate embodiment of a core according to the present invention which may be used to produce the base of the multiconductor electrical cable termination assembly of Figure 1; and

Figure 11 is a bottom view of the core of Figure 10 looking generally in the direction of line 11-11 thereof.

Referring to the drawings and initially to Figures 1-5 there is illustrated a multiconductor electrical cable termination assembly 20 made in accordance with the present invention. Cable termination assembly 20 includes a multiconductor electrical cable 22, a plurality of electrical contacts, one of which is indicated at 24, for connection at respective junctions to the respective conductors 26 of electrical cable 22, and a housing 28 having a base body part 30 molded about at least a portion of each of the contacts 24 and a portion of the electrical cable 22 to form an integral structure therewith.

As illustrated, the housing 28 also includes a cover 32 adapted to fit onto the base 30 at peripheral step 34 of the latter for appropriate containment of the contacting portions 36 of the electrical contacts 24; however, it will be appreciated that the form of the cover 32 and its possible elimination will depend on the particular style of the contacting

portions 36. For example, as the illustrated contacts 24 are female fork or wiping type, the cover 32 is needed to guide external pin contacts to engage such contacts 24; whereas if the contacts 24 and contacting portions 36 thereof were simply pin contacts to be soldered in plated through openings of a printed circuit board or the like rather than the illustrated fork-like style, the cover 32 can be eliminated from the cable termination 20.

The base may be of plastic or of other material that is able to be formed by plastic injection molding techniques. Such material may include a filler, such as fiberglass for strength or other characteristics. Preferably, the composition of the material of which the base 30 is formed and the composition of the electrical insulation 38, which separates and maintains the conductors 26 in parallel spaced-apart relation, are compatible or soluble in one another so that when the base 30 is molded it will chemically bond to the insulation 38 further to increase the integrity of the structure of the cable termination 20. The base 30 also provides a molded strain relief that precludes separation of the contact terminal portions 40 from their respective junctions 42 with the conductors 26, which are seen most clearly illustrated in Figure 4.

The terminal portion 40 of each electrical contact 24 preferably includes a pair of elongate prong-like arms 44 commonly supported from a base portion 46 and defining a relatively narrow slot 48 therebetween. The ends (47) of the arms 44 remote from the base portion 46 preferably are tapered or chamfered to define an entranceway into the narrow slot 48 and to form generally pointed tips (29) to pierce easily through the electrical insulation 38 to create the desired IDC (insulation displacement connection). The width of the narrow slot 48 is preferably narrower than the normal diameter of the conductor 26. Therefore, as a typical electrical contact 24 is joined with cable 22 by urging the two toward each other, the pointed tips 50 pierce through the insulation 38 while the wide chamfered entranceway guides the conductor 26 into the narrow slot 48. As the conductor 26 enters the slot 48, it is somewhat flattened to provide a relatively enlarged surface area of engagement or connection with the two arms 44.

The terminal portion 40 of each electrical contact 24 is in the same plane and is offset with respect to the contacting portion 36 thereof, as can be seen most clearly in Figures 1 and 4. As seen particularly in Figure 1, the electrical contacts 24 in the forward row 52 have their terminal portions offset to the left with respect to their contacting portions, and the electrical contacts in the rearward row 54 have their terminal portions offset to the right with respect to the contacting portions. This offset configuration of the electrical contacts 12

allows them to be of reasonable size and strength while the contacting portion of each contact in one row is directly aligned with the contacting portion of an opposite contact in the other row and with each of the relatively closely positioned parallel conductors 26 being connected to only a single respective contact 24. It will be appreciated that although the illustrated embodiment utilizes two rows of contacts, the principles of the invention may be, of course, employed in terminations having one row or more than two such rows of contacts or any other arrangement thereof.

As illustrated in Figure 1, each of the electrical contacts 24 is of the fork contact type whereby each of the contact portions 36 comprises a pair of generally elongate arms 60 adapted for electrical and mechanical connection with a pin contact, for example, inserted therebetween. The housing cover 32 is preferably separately produced from a dielectric material such as, for example, plastic and includes a plurality of chambers (not illustrated) therein for individual containment of the arms 60. The housing cover 32 has an outer wall 32 open at the bottom 66 to receive respective pairs of contact arms 60 within the chambers. The cover top 72 includes a plurality of apertures 74 for providing access to and guiding respective pin contacts or the like into the respective chambers surrounding the two arms 60 of the respective contacts 24 for mechanical and electrical engagement therewith. Preferably, the opening at the cover bottom 66 includes a step which forms an inverted image of the step 34 of base 30 so as to facilitate a stable and secure fit between the cover 32 and the base 30. Upon the assembly of the cover 32 to base 30 the two elements may be securely bonded to one another utilizing various techniques such as, for example, ultrasonic welding techniques.

Referring now to Figures 3-5 the details of the base 30 molded about at least a portion of each of the contacts 24 and a portion of the cable 22 are made more clearly evident. Specifically, the junctions 42 between the two arms 44 of the contact terminal portions 40 and the conductors 26 are illustrated as being totally surrounded and encapsulated by the plastic from which the base 30 is produced to form a hermetically sealed junction area or zone 76 completely free of any air pockets and gaps, moisture, or other like contamination.

The hermetically sealed junction zone 76 is assured not only by molding together the base 30, contacts 24, and cable 22 in an injection molding machine having elevated operating temperatures and pressures, but also by using an injection molding machine having molds equipped with a core 77 which allows the injected plastic to flow freely during the injection molding process around the two arms 44 and the conductors 26 to form the

hermetically sealed junction zone 76. Hermetically sealed junction zone 76 essentially eliminates the formation of corrosion, oxidation, or electrolysis-like activity at junction 42 regardless of the material from which the conductors 26 and contacts 24 may be produced and irrespective of the atmosphere to which the cable termination 10 may be subjected. Therefore, the relatively expensive or plated conductors 26 may be effectively terminated, for example, by less expensive aluminium electrical contacts 24. Similarly, cable termination 10 may be effectively utilized, for example, in basic, acidic, or similarly contaminated environments which prior art terminations are incapable of tolerating. During the molding process, the core produces the core openings 78 in the bottom 80 of the base 30, as is described further below.

Referring now to Figures 6-9 there is illustrated a portion of the core 77 suitable for use in producing the cable termination assembly 20 illustrated in Figures 1-5. The core 77, which is preferably mounted within the side wall of an injection mold 84, includes a plurality of protruding legs 86 each having straight inner 88, outer 90, and end 92 surfaces that cooperate to form rectangular-shape cavities 94 therebetween to surround the ends of the legs 44 protruding beyond the insulation 38.

In the process of forming the base 30, the contacts 24 are placed into openings 87 in matching mold 94 which mates with mold 84 and maintains the contacts 24 in their proper position during the IDC and injection molding processes. After the contacts 24 are inserted into the openings 87 in mold 96, the cable 22 is positioned relative to the IDC arms 44 of the contacts 24 to align the conductors 26 relative to the contacts. Then the opposing molds 84 and 96 are brought toward one another. Preferably, as the molds are being brought together and sealed, the end surfaces 92 of the legs 86 force the insulated conductors 26 between the respective legs 44 of the contacts 24 creating IDC junctions 42. The spacing of the two inner walls 88 on opposite sides of the cavity 94 preferably is small enough to assure that relative movement of the cable 22 and contacts 24 upon closure of the mold parts or halves 84, 96 will cause good IDC connections to be made between the respective cable conductors 26 and contacts 24.

When the molds 84 and 96 are properly mated and sealed the cavity formed therebetween is then injected with plastic or other suitable material. During injection the core 77 helps to support the cable 22 and conductors 26 in their proper position relative to respective contacts 24, as is seen in Figure 6, preventing the dislodgement of the junctions 46, which otherwise might too easily result due to the turbulence generated during injection. Core 77 further ensures that the injected plastic flows freely

above and about junctions 42 creating the hermetically sealed junction zones 76. The spacing between walls 88 on opposite sides of the cavity 94 is adequate to permit flow of plastic into such cavity above the cable (as is seen in Figures 6 and 7) to achieve good encapsulation of the IDC ends or arms 44. Finally, when the injected plastic has sufficiently solidified, the molds 84 and 96 may be separated and the newly formed base 30 with its integrally molded cable and contacts located therein may be removed from the mold cavity.

It will be appreciated that although in the previously illustrated embodiment of the invention the two arms 44 of the terminal portion 40 have been completely surrounded and encapsulated by the plastic, a cable termination may be produced in accordance with the present invention wherein the distal ends of the arms 44 including the pointed tips 50 are not fully encapsulated within the plastic, but are instead left open and exposed, possibly to facilitate the testing of each of the junctions while the termination is connected, for example, to another connector, computer, printed circuit board, or the like. Such exposure can be achieved by altering the shape of the cavity 94. Of course, in order to maximize hermetic sealing of the junction zone, the arms 44 should be completely surrounded by the plastic as illustrated.

Referring now to Figures 10 and 11, there is illustrated an alternative embodiment of a portion of a core 98 suitable for use in producing a cable termination assembly made in accordance with the present invention. Core 98 comprises a plurality of legs 100 having straight outer 102 and end 104 surfaces, and multifaced inner surfaces 106 which cooperate to form cavities 108 having wide mouths 110, narrowing midsections 112, and reduced end sections 114. Such a unique configuration has been found to minimize further the undesirable turbulent flow effects which manifest themselves during the injection process, thus further ensuring that the junctions are not dislodged or disturbed. For example, the wide mouth 110 assures adequate flow of plastic above the cable to seal the IDC junction zone 42. The narrow end section 114 of the core 98 provides alignment stability for the contact 24 IDC arms 44 during the molding process. Furthermore, the sloping, tapering or narrowing midsection 112 both helps guide the IDC arms 44 and tips 50 thereof properly into the narrow section 114 and a tapering down of the molded plastic to avoid sharp edges that could too easily break.

While the invention is illustrated and described above with reference to multiconductor electrical cable termination 20 located at an end of the multiconductor electrical conductor 11, it will be apparent that such a termination also may be pro-

vided in accordance with the invention at a location on a multiconductor electrical cable intermediate the ends thereof.

5 Claims

1. A multiconductor electrical cable termination, comprising:

a flat multiconductor electrical cable (22) including a plurality of conductors (26) and electrical insulation (38) about said conductors maintaining said conductors electrically insulated from each other;

a plurality of electrical contacts (24), each including terminal means (40) penetrating through said insulation and forming an electrical junction (42) with corresponding conductors, and contacting means (36) for electrically connecting each of said electrical contacts to an external member placed in engagement therewith, said contacting means of said contacts being located on one side of said cable, said terminal means (42) having cable insulation piercing end portions (47) projecting beyond the opposite side of said cable;

a housing (28) including base means (30) for directly holding said electrical contacts (24) and said cable (22) in relatively fixed position, said base means (30) comprising a body of insulating material integrally molded about at least a portion of each of said electrical contacts and a portion of said cable, said body including mold core openings (78), said electrical junctions being hermetically sealed by a molded portion of said base means characterized in that:

said end portions (47) are surrounded by and fully encapsulated within said body of insulating material, and said mold core openings (78) are proximate to but laterally spaced apart from said end portions (47).

2. A termination as set forth in claim 1, wherein said cable insulation piercing end portions (47) of each contact (24) includes generally pointed spaced tips (50) for piercing said insulation to engage a conductor therebetween.

3. A termination as set forth in claim 1 or 2, wherein each of said electrical junctions (42) is sealed in an airtight and relatively moisture-free and oxygen-free condition by hermetically sealed junction zones formed between respective pairs of said core openings, said mold core openings of each pair being laterally spaced apart from opposite sides of the corresponding cable piercing end portion.

above and about junctions 42 creating the hermetically sealed junction zones 76. The spacing between walls 88 on opposite sides of the cavity 94 is adequate to permit flow of plastic into such cavity above the cable (as is seen in Figures 6 and 7) to achieve good encapsulation of the IDC ends or arms 44. Finally, when the injected plastic has sufficiently solidified, the molds 84 and 96 may be separated and the newly formed base 30 with its integrally molded cable and contacts located therein may be removed from the mold cavity.

It will be appreciated that although in the previously illustrated embodiment of the invention the two arms 44 of the terminal portion 40 have been completely surrounded and encapsulated by the plastic, a cable termination may be produced in accordance with the present invention wherein the distal ends of the arms 44 including the pointed tips 50 are not fully encapsulated within the plastic, but are instead left open and exposed, possibly to facilitate the testing of each of the junctions while the termination is connected, for example, to another connector, computer, printed circuit board, or the like. Such exposure can be achieved by altering the shape of the cavity 94. Of course, in order to maximize hermetic sealing of the junction zone, the arms 44 should be completely surrounded by the plastic as illustrated.

Referring now to Figures 10 and 11, there is illustrated an alternative embodiment of a portion of a core 98 suitable for use in producing a cable termination assembly made in accordance with the present invention. Core 98 comprises a plurality of legs 100 having straight outer 102 and end 104 surfaces, and multifaced inner surfaces 106 which cooperate to form cavities 108 having wide mouths 110, narrowing midsections 112, and reduced end sections 114. Such a unique configuration has been found to minimize further the undesirable turbulent flow effects which manifest themselves during the injection process, thus further ensuring that the junctions are not dislodged or disturbed. For example, the wide mouth 110 assures adequate flow of plastic above the cable to seal the IDC junction zone 42. The narrow end section 114 of the core 98 provides alignment stability for the contact 24 IDC arms 44 during the molding process. Furthermore, the sloping, tapering or narrowing midsection 112 both helps guide the IDC arms 44 and tips 50 thereof properly into the narrow section 114 and a tapering down of the molded plastic to avoid sharp edges that could too easily break.

While the invention is illustrated and described above with reference to multiconductor electrical cable termination 20 located at an end of the multiconductor electrical conductor 11, it will be apparent that such a termination also may be pro-

vided in accordance with the invention at a location on a multiconductor electrical cable intermediate the ends thereof.

Claims

1. A multiconductor electrical cable termination, comprising:

a flat multiconductor electrical cable (22) including a plurality of conductors (26) and electrical insulation (38) about said conductors maintaining said conductors electrically insulated from each other;

a plurality of electrical contacts (24), each including terminal means (40) penetrating through said insulation and forming an electrical junction (42) with corresponding conductors, and contacting means (36) for electrically connecting each of said electrical contacts to an external member placed in engagement therewith, said contacting means of said contacts being located on one side of said cable, said terminal means (42) having cable insulation piercing end portions (47) projecting beyond the opposite side of said cable;

a housing (28) including base means (30) for directly holding said electrical contacts (24) and said cable (22) in relatively fixed position, said base means (30) comprising a body of insulating material integrally molded about at least a portion of each of said electrical contacts and a portion of said cable, said body including mold core openings (78), said electrical junctions being hermetically sealed by a molded portion of said base means characterised in that:

said end portions (47) are surrounded by and fully encapsulated within said body of insulating material, and said mold core openings (78) are proximate to but laterally spaced apart from said end portions (47).

2. A termination as set forth in claim 1, wherein said cable insulation piercing end portions (47) of each contact (24) includes generally pointed spaced tips (50) for piercing said insulation to engage a conductor therebetween.

3. A termination as set forth in claim 1 or 2, wherein each of said electrical junctions (42) is sealed in an airtight and relatively moisture-free and oxygen-free condition by hermetically sealed junction zones formed between respective pairs of said core openings, said mold core openings of each pair being laterally spaced apart from opposite sides of the corresponding cable piercing end portion.



4. A termination as set forth in any preceding claim, wherein said seal maintains said respective electrical junction in relatively moisture-free and oxygen-free condition.
5. A termination as set forth in claim 1 or 2 wherein said housing (28) includes a cover (32) adapted to fit said base means (30) for containing said contacting ends on each of said contacts.
6. A termination as set forth in claim 3, wherein said cable piercing end portions (47) are surrounded by and fully encapsulated within said hermetically sealed junction zones (76).
7. A termination as set forth in claim 6 wherein said housing includes a cover (32) adapted to fit said base means (30) for containing said contacting ends on each of said contacts.
8. A termination as set forth in claim 7 wherein said cover (32) is bonded to said molded body (30).
9. A termination according to claim 1, 2 or 6 wherein each mold core opening (73) has an inner side wall with at least a central portion thereof sloping towards the corresponding end portion.
10. A termination according to any preceding claim wherein the insulating material of said base means is compatible with the electrical insulation of the cable, so as to bond therewith.
11. A method of producing a multiconductor electrical cable termination having a plurality of electrical contacts mounted with respect to a base, each contact being connected at an electrical junction to a respective conductor of a flat multiconductor electrical cable, said method comprising the steps of:
 - placing the contacts (24) into supporting engagement with opened molds (84, 96) of a molding machine;
 - placing the electrical cable (22) between the opened molds in proper alignment with the supported contacts;
 - closing the molds to form a closed mold cavity and simultaneously to urge terminal portions of the contacts through the insulation of the cable to engagement with respective conductors of the cable to form electrical junctions therewith, with end portions of the terminal portions being urged beyond the cable, said closing step including the step of using plural mold cores (77) to engage the cable (22) at

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opposite sides of the terminal portion (40) of respective contacts (24), the mold cores each including an opening formed between walls laterally spaced apart a distance greater than the thickness of the end portion (47) of the respective contacts terminal portion; and introducing molding material into the cavity of the closed molds to form a molded body about at least a part of each contact (44) and portion of the cable (22), the molding material flowing between the end portion of each contacts terminal portion and the walls of the respective mold core to form with molding material otherwise flowing around the respective electrical junction a hermetic seal surrounding the electrical junction and to surround and fully encapsulate the terminal end portions within said molded body upon subsequent solidifying of the molding material.

12. A method as set forth in claim 11 including the step of fully encapsulating the end portion of each terminal portion within the molded body.

13. A molding machine comprising two opposing molds (84, 96) which cooperate to define a mold cavity for containing therein contacts (24) and a multiconductor electrical cable (22) to form a multiconductor cable termination having a plurality of electrical junctions each surrounded and contained with a hermetically sealed junction zone by molding a base (30) about at least part of such contacts and cable and a mold core (77) mounted within the sidewall of the injection mold, said mold core comprising a plurality of protruding legs each having an inner, outer, and end surface which with the mold closed surround the ends (44) of the contacts protruding beyond the insulation of the cable wherein during the injection process of the injection molding machine the material being injected is allowed to flow freely above and about such electrical junctions to form such hermetically sealed junction zones and fully encapsulate said ends of the contacts.

14. A molding machine as claimed in claim 13 wherein the legs of said mold core each have a straight inner, outer and end surfaces which, with the mold closed, form a plurality of rectangular shaped cavities.

15. A molding machine as claimed in claim 13 wherein the legs (100) of said mold core each have a straight outer (102) and a straight end (104) surface, and further have a multifaced inner surface (106) such that, with the mold closed, the legs form a plurality of cavities



(108) having wide mouths (110), narrowing midsections and reduced end sections (114).

Patentansprüche

1. Eine Mehrfachleiter-Kabelanschluß, der folgenden umfaßt:

ein Mehrfachleiter-Flachbandkabel (22) mit einer Mehrzahl von Stromleitern (26), und mit einer elektrischen Isolierung (38) um die genannten Stromleiter, um diese genannten Stromleiter voneinander elektrisch isoliert zu erhalten;

eine Mehrzahl von elektrischen Kontakten (24), von denen jeder eine Anschlußeinrichtung (40) aufweist, die durch die genannte Isolierung dringt, wobei jede der Anschlußeinrichtungen eine elektrische Verbindung (42) mit entsprechenden Stromleitern bildet, und eine Kontakteinrichtung (36) zur elektrischen Verbindung jedes genannten elektrischen Kontakts mit einem externen Element, welches sich im Eingriff mit der Kontakteinrichtung befindet, dadurch gekennzeichnet, daß sich die genannte Kontakteinrichtung der genannten Kontakte auf einer Seite des genannten Kabels befindet, wobei die genannten Anschlußeinrichtungen (40) die Kabelisolierung durchdringende Endteile (47) aufweisen, welche über die entgegengesetzte Seite des genannten Kabels vorstehen;

ein Gehäuse (28) mit einer Basiseinrichtung (30), um die genannten elektrischen Kontakte (24) und das genannte Kabel (22) direkt in verhältnismäßig fester Position zu halten, dadurch gekennzeichnet, daß die genannte Basiseinrichtung (30) einen Körper aus Isoliermaterial aufweist, der wenigstens integral um einen Teil jedes der genannten elektrischen Kontakte sowie um einen Teil des genannten Kabels geformt ist, wobei der genannte Körper Formkernöffnungen (78) aufweist, dadurch gekennzeichnet, daß die genannten elektrischen Verbindungen durch einen geformten Teil der genannten Basiseinrichtung luftdicht abgeschlossen sind, dadurch gekennzeichnet, daß:

die genannten Endteile (47) von dem genannten Körper eines Isoliermaterials umgeben werden und darin vollständig eingekapselt sind, und wobei sich die genannten Formkernöffnungen (78) nahe an den genannten Endteilen (47) befinden, sie jedoch seitlich mit Zwischenabstand zu den genannten Endteilen angeordnet sind.

2. Anschluß nach Anspruch 1, dadurch gekennzeichnet, daß die genannten die Isolierung durchdringenden Endteile (47) jedes Kontakts

(24) allgemein spitzzulaufende, mit Zwischenabstand angeordnete Spitzen (50) aufweisen, um die Isolierung zu durchdringen, um so dazwischen in Eingriff mit einem Stromleiter zu gelangen.

3. Anschluß nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß jede der elektrischen Verbindungen (42) in einem luftdichten, verhältnismäßig feuchtigkeitsfreien und sauerstofffreien Zustand abgeschlossen ist, und zwar durch luftdicht abgeschlossene Verbindungsbereiche, die zwischen entsprechenden Paaren der genannten Kernöffnungen ausgebildet sind, wobei die genannten Formkernöffnungen jedes Paares seitlich mit Zwischenabstand angeordnet sind, und zwar von entgegengesetzten Seiten des entsprechenden das Kabel durchdringenden Endteils.

4. Anschluß gemäß den vorstehenden Ansprüchen, dadurch gekennzeichnet, daß der genannte Abschluß die entsprechende elektrische Verbindung in einem verhältnismäßig feuchtigkeitsfreien und sauerstofffreien Zustand aufrecht erhält.

5. Anschluß nach Anspruch 1 oder 2, dadurch gekennzeichnet, daß das genannte Gehäuse (28) eine Abdeckung (32) aufweist, welche so adaptiert ist, daß sie mit der genannten Basiseinrichtung (30) zusammenpaßt, um die genannten, in Kontakt stehenden Enden auf jedem der genannten Kontakte einzuschließen.

6. Anschluß nach Anspruch 3, dadurch gekennzeichnet, daß die genannten das Kabel durchdringenden Endteile (47) von den genannten luftdicht abgeschlossenen Verbindungsbereichen (76) umgeben und in diesen vollständig eingekapselt sind.

7. Anschluß nach Anspruch 6, dadurch gekennzeichnet, daß das genannte Gehäuse eine Abdeckung (32) aufweist, die so adaptiert ist, daß sie mit der genannten Basiseinrichtung (30) zusammenpaßt, um die genannten in Kontakt stehenden Enden an jedem der genannten Kontakte einzuschließen.

8. Anschluß nach Anspruch 7, dadurch gekennzeichnet, daß die genannte Abdeckung (32) mit dem genannten geformten Körper (30) verbunden ist.

9. Anschluß nach Anspruch 1, 2 oder 6, dadurch gekennzeichnet, daß jede Formkernöffnung (78) eine innere Seitenwand aufweist, wobei



wenigstens ein zentraler Teil dieser Wand in Richtung des entsprechenden Endteils geneigt ist.

10. Anschluß gemäß den vorstehenden Ansprüchen, dadurch gekennzeichnet, daß das Isoliermaterial der genannten Basiseinrichtung zu der elektrischen Isolierung des Kabels kompatibel ist, um somit damit verbunden zu werden.

11. Ein Verfahren zur Erzeugung eines elektrischen Mehrfachleiter-Kabelanschlusses mit einer Mehrzahl von elektrischen Kontakten, die in bezug auf eine Basis angebracht sind, wobei jeder Kontakt an einer elektrischen Verbindung mit einem entsprechenden Stromleiter eines elektrischen Mehrfachleiter-Flachbandkabels verbunden ist, dadurch gekennzeichnet, daß das genannte Verfahren folgendes umfaßt:

Positionieren der Kontakte (24) in halten- den Eingriff mit offenen Formen (84, 96) einer Formmaschine;

Positionieren des elektrischen Kabels (22) zwischen den offenen Formen, in passender Ausrichtung mit den gehaltenen Kontakten;

Schließen der Formen, um so einen geschlossenen Hohlraum der Form zu bilden, und um gleichzeitig die Anschlußteile der Kontakte durch die Isolierung des Kabels zu drängen, und zwar in Eingriff mit den entsprechenden Stromleitern des Kabels, um so damit elektrische Verbindungen zu bilden, wobei die Endteile der Anschlußteile über das Kabel hinaus gedrängt werden, dadurch gekennzeichnet, daß der genannte Schließungsschritt den Schritt der Verwendung einer Mehrzahl von Formkernen (77) umfaßt, die sich an entgegengesetzten Seiten des Anschlußteils (40) der entsprechenden Kontakte (24) im Eingriff mit dem Kabel (22) befinden, wobei jeder der Formkerne eine Öffnung aufweist, die zwischen Wänden gebildet ist, die seitlich mit Zwischenabstand mit einer Entfernung angeordnet sind, die größer ist als die Dicke des Endteils des entsprechenden Kontaktanschlußteils; und

Einführen von Formmaterial in den Hohlraum der geschlossenen Formen, um so einen geformten Körper zu bilden, um wenigstens einen Teil jedes Kontakts (44) und einen Teil des Kabels (22), wobei das Formungsmaterial zwischen dem Endteil jedes Kontaktanschlußteils und den Wänden des entsprechenden Formkerns fließt, um so mit anders um die entsprechende elektrische Verbindung fließendem Formungsmaterial einen luftdichten Abschluß zu bilden, der die elektrische Verbindung umgibt, und um die Anschlußendteile (47) in dem genannten geformten Körper zu

umgeben und vollständig einzukapseln, nach späterem Festwerden des Formungsmaterials.

12. Verfahren nach Anspruch 11, ferner gekennzeichnet durch den Schritt der vollständigen Einkapselung des Endteils jedes Anschlußteils innerhalb des geformten Körpers.

13. Eine Formmaschine, die zwei gegenüberliegende Formen (84, 96) umfaßt, welche so zusammenwirken, daß sie einen Formhohlraum definieren, um darin Kontakte (24) und ein elektrisches Mehrfachleiterkabel (22) einzuschließen, um so einen Mehrfachleiter-Kabelanschluß mit einer Mehrzahl von elektrischen Verbindungen zu bilden, wobei jede der Verbindungen mit einem luftdicht abgeschlossenen Verbindungsbereich umgeben ist und darin eingekapselt wird, und zwar dadurch, daß eine Basis (30) um wenigstens einen Teil dieser Kontakte und des Kabels gebildet ist, und durch einen Formkern (77), der in der Seitenwand der Spritzgußform angebracht ist, wobei der genannte Formkern eine Mehrzahl von vorstehenden Füßen aufweist, die alle eine innere, eine äußere und eine Stirnoberfläche aufweisen, die, bei geschlossener Form, die Enden (44) der Kontakte umgeben, die über die Isolierung des Kabels vorstehen, wobei während des Spritzverfahrens der Spritzgußmaschine, das eingespritzte Material frei über und um diese elektrischen Verbindungen strömen kann, um so die luftdicht abgeschlossenen Verbindungsbereiche zu bilden, und um so die genannten Enden der Kontakte vollständig einzukapseln.

14. Formmaschine nach Anspruch 13, dadurch gekennzeichnet, daß alle Füße des genannten Formkerns eine gerade innere, äußere und Stirnoberfläche aufweisen, die, bei geschlossener Form, eine Mehrzahl von rechteckig geformten Hohlräumen bilden.

15. Formmaschine nach Anspruch 13, dadurch gekennzeichnet, daß alle Füße (100) des genannten Formkerns eine gerade äußere (102) und eine gerade Stirnoberfläche (104) aufweisen, sowie ferner eine innere Oberfläche (106) mit verschiedenen ebenen Flächen, so daß, bei geschlossener Form, die Füße eine Mehrzahl von Hohlräumen (108) bilden, welche breite Mündungen (110), enger werdende Mittelbereiche und verkleinerte Endbereiche (114) aufweisen.



Revendications

1. Agencement d'extrémité de câble électrique à conducteurs multiples, comprenant :

un câble électrique plat (22) à conducteurs multiples, comportant une pluralité de conducteurs (26) et un isolant électrique (38) autour des conducteurs et maintenant les conducteurs électriquement isolés l'un de l'autre,

une pluralité de contacts électriques (24), chacun comprenant des moyens de raccordement (40), qui pénètrent au travers de l'isolant et qui forment une jonction électrique (42) avec des conducteurs correspondants, et des moyens de mise en contact (36) pour connecter électriquement chacun des contacts électriques à un élément externe mis en prise avec eux, les moyens de mise en contact des contacts étant situés sur un côté du câble, les moyens de raccordement (40) ayant des parties d'extrémité (47) qui percent l'isolant du câble et qui font saillie au-delà du côté opposé du câble,

un boîtier (28) comportant des moyens de base (30) pour maintenir directement les contacts électriques (24) et le câble (22) dans une position relativement fixe, les moyens de base (30) comprenant un corps de matière isolante moulé d'une pièce autour d'au moins une partie de chacun des contacts électriques et d'une partie du câble, le corps comprenant des ouvertures de noyau de moulage (78), les jonctions électriques étant hermétiquement scellées par une partie moulée des moyens de base,

caractérisé en ce que les parties d'extrémité (47) sont entourées par et complètement enfermées dans le corps de matière isolante et en ce que les ouvertures de noyau de moulage (78) sont proches mais écartées latéralement des parties d'extrémité (47).

2. Agencement d'extrémité suivant la revendication 1, caractérisé en ce que les parties d'extrémité (47), de chaque contact (24), qui percent l'isolant du câble comportent généralement des bouts écartés pointus (50) pour percer l'isolant afin d'entrer en contact avec un conducteur situé entre eux.

3. Agencement d'extrémité suivant la revendication 1 ou 2, caractérisé en ce que chacune des jonctions électriques (42) est scellée, dans un état étanche à l'air et relativement sans humidité et sans oxygène, par des zones de jonction scellées hermétiquement formées entre des paires respectives des ouvertures susdites de noyau, les ouvertures de noyau de moulage

de chaque paire étant écartées latéralement de côtés opposés de la partie d'extrémité correspondante qui perce le câble.

4. Agencement d'extrémité suivant l'une quelconque des revendications précédentes, caractérisé en ce que le scellage susdit maintient la jonction électrique respective dans un état relativement sans humidité et sans oxygène.

5. Agencement d'extrémité suivant la revendication 1 ou 2, caractérisé en ce que le boîtier (28) comporte un couvercle (32) adapté pour s'agencer sur les moyens de base (30) afin de contenir les extrémités de contact de chacun desdits contacts.

6. Agencement d'extrémité suivant la revendication 3, caractérisé en ce que les parties d'extrémité (47) qui percent le câble sont entourées par et complètement enfermées dans lesdites zones de jonction (76) scellées hermétiquement.

7. Agencement d'extrémité suivant la revendication 6, caractérisé en ce que le boîtier comporte un couvercle (32) adapté pour s'agencer sur les moyens de base (30) afin de contenir les extrémités de contact de chacun desdits contacts.

8. Agencement d'extrémité suivant la revendication 7, caractérisé en ce que le couvercle (32) est fixé au corps moulé (30).

9. Agencement d'extrémité suivant la revendication 1 ou 2 ou 6, caractérisé en ce que chaque ouverture de noyau de moulage (73) présente une paroi latérale interne avec au moins une partie centrale de celle-ci en pente vers la partie d'extrémité correspondante.

10. Agencement d'extrémité suivant l'une quelconque des revendications précédentes, caractérisé en ce que la matière isolante des moyens de base est compatible avec l'isolant électrique du câble de façon à s'y fixer.

11. Procédé de production d'un agencement d'extrémité de câble électrique à conducteurs multiples qui a une pluralité de contacts électriques montés par rapport à une base, chaque contact étant connecté, à une jonction électrique, à un conducteur respectif d'un câble électrique plat à conducteurs multiples, le procédé comprenant :

un placement des contacts (24) dans un engagement porteur avec des moules ouverts



(84, 96) d'une machine de moulage,

un placement du câble électrique (22) entre les moules ouverts dans un alignement correct avec les contacts supportés,

une fermeture des moules pour former une cavité de moule fermée et simultanément pour presser les parties de raccordement des contacts au travers de l'isolant du câble pour entrer en contact avec les conducteurs respectifs du câble afin de former avec eux des jonctions électriques, avec des parties d'extrémité de la borne, parties qui sont poussées au-delà du câble, l'étape de fermeture comportant l'étape d'utiliser plusieurs noyaux de moulage (77) pour entrer en prise avec le câble (22) à des côtés opposés de la partie de raccordement (40) de contacts respectifs (24), les noyaux de moulage comportant chacun une ouverture formée entre des parois écartées latéralement d'une distance supérieure à l'épaisseur de la partie d'extrémité de la partie de raccordement de contacts respective, et

une introduction de la matière de moulage dans la cavité des moules fermés, afin de former un corps moulé autour d'au moins une partie de chaque contact (44) et d'une partie du câble (22), la matière de moulage s'écoulant entre la partie d'extrémité de chaque partie de raccordement de contacts et les parois du noyau de moulage respectif afin de former avec la matière de moulage qui s'écoule autrement autour de la jonction électrique respective un scellage hermétique entourant la jonction électrique et pour entourer et enfermer complètement les parties d'extrémité de raccordement (47) dans le corps moulé par une solidification subséquente de la matière de moulage.

12. Procédé suivant la revendication 11, comportant l'étape d'enfermer complètement la partie d'extrémité de chaque partie de raccordement dans le corps moulé.

13. Machine de moulage comprenant deux moules opposés (84, 96) qui coopèrent pour déterminer une cavité de moule pour y contenir des contacts (24) et un câble électrique à conducteurs multiples (22) afin de former un agencement d'extrémité, de câble à conducteurs multiples, qui a une pluralité de jonctions électriques, chacune étant entourée et contenue par une zone de jonction scellée hermétiquement, en moulant une base (30) autour d'au moins une partie de ces contacts et câble et d'un noyau de moulage (77) monté dans la paroi latérale du moule d'injection, le noyau de moulage comprenant une pluralité de branches en saillie qui ont chacune une surface interne,

externe et d'extrémité qui entourent, lorsque le moule est fermé, les extrémités (44) des contacts qui font saillie au-delà de l'isolant du câble, dans laquelle pendant le processus d'injection de la machine de moulage par injection la matière en cours d'injection est autorisée à s'écouler librement au-dessus et autour de ces jonctions électriques pour former ces zones de jonction scellées hermétiquement et pour complètement enfermer les extrémités des contacts.

14. Machine de moulage suivant la revendication 13, caractérisée en ce que les branches du noyau de moulage ont chacune des surfaces droites interne, externe et d'extrémité qui, lorsque le moule est fermé, forment une pluralité de cavités de section rectangulaire.

15. Machine de moulage suivant la revendication 13, caractérisée en ce que les branches (100) du noyau de moulage ont chacune une surface droite externe (102) et une surface droite d'extrémité (104) et ont de plus une surface interne (106) à faces multiples de sorte que, lorsque le moule est fermé, les branches forment une pluralité de cavités (108) qui ont des orifices larges (110), des sections médianes en diminution et des sections d'extrémité réduites (114).

