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(54) [Title of the Invention] Method for molding cable branch portion

(57) [Patent Claims]

5 [Claim 1]

A method for molding a cable branch portion, which is a method for molding a section where a conductor of a branch cable is connected to a conductor of a trunk cable,

10 characterized in that, using a forming die provided with protrusions for forming positioning holes, this forming die is arranged at the section where the conductor of the branch cable is connected to the conductor of the trunk cable, a resin is injected into
15 the forming die in that state, and an inside molded portion comprising the positioning holes is molded, then, using a forming die for an outside molded portion provided with positioning pins, the positioning pins are inserted into the positioning holes in the inside
20 molded portion so as to position the forming die for the outside molded portion in relation to the inside molded portion, a resin is injected into the forming die for the outside molded portion in that state, and the outside molded portion covering the inside molded
25 portion is molded.

[Detailed Description of the Invention]

[0001]

[Technical Field of the Invention]

30 The present invention relates to a method for molding a cable branch portion of a CV cable (crosslinked polyethylene insulated vinyl sheath cable), etc., for example.

35 [0002]

[Prior Art]

Recent years have seen the development of various types of solar systems for general domestic or commercial use. Solar systems are constructed by arranging multiple solar battery modules comprising a plurality of solar battery cells on a roof or on top of a building, and connecting the solar battery modules by means of cables.

[0003]

A power cable such as a CV cable is used to connect such solar battery modules or to connect electrical devices including modules for snow melting purposes and modules for tape heaters. In a CV cable, an insulator covering a conductor (stranded wire) is formed by PE (polyethylene) and a sheath material is formed by PVC.

15

[0004]

If there is a branch wire branching from a trunk wire when a CV cable is laid, it is generally the case that a conductor 2a of a branch cable 2 is connected to a conductor 1a of a trunk cable 1, after which a cable branch portion is molded from PVC (polyvinyl chloride) in order to ensure insulation of the conductor connecting section (branch portion), as shown in fig. 11.

25

[0005]

[Problems to be Solved by the Invention]

There are problems with a structure in which the branch portion of the CV cable is molded from PVC (fig. 11) in that high waterproofing performance is not achieved because of poor adhesion between the PVC and the cable conductors.

[0006]

The present invention has been devised in light of this situation, and the objective thereof lies in providing a molding method suitable for molding a molded

structure for a cable branch portion having excellent waterproofing performance.

[0007]

5 [Means for Solving the Problems]

A molded structure for a branch portion formed by means of the molding method according to the present invention is characterized in that a molded portion for insulating/protecting a section where a conductor of a
10 branch cable is connected to a conductor of a trunk cable constitutes a double molded structure comprising an inside molded portion which is resin molded so as to cover the conductor connecting section, and an outside molded portion which is resin molded so as to cover the
15 inside molded portion.

[0008]

More specifically, said molded structure is characterized in that a molded portion for
20 insulating/protecting a branch portion of a CV cable in which an insulator is formed by PE and a sheath material is formed by PVC constitutes a double structure comprising the inside molded portion and the outside molded portion, the inside molded portion being
25 molded from PE, the outside molded portion being molded from PVC.

[0009]

According to the abovementioned molded structure, the
30 molded portion for insulating/protecting the cable branch portion constitutes a double molded structure, so PE which has good adhesion with the cable conductors can be used for a resin of the inside molded portion, and waterproofing performance can be enhanced.

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[0010]

Here, when the molded portion has a double molded structure, this requires molding to be performed twice, in order to mold the inside molded portion and to mold the outside molded portion, and there is a possibility of misalignment occurring between the inside molded portion and the outside molded portion when the outside molded portion is molded. If such misalignment occurs, a thin section is formed in the wall thickness of the outside molded portion, and it may no longer be possible to achieve the intended waterproofing performance.

[0011]

The molding method of the present invention has been devised in order to solve such a problem, and is characterized in that positioning holes are formed during molding of the inside molded portion which covers the connecting section of the cable conductors, then, using a forming die provided with positioning pins, the positioning pins are inserted into the positioning holes in the inside molded portion so as to correctly position the forming die in relation to the inside molded portion, a resin is injected into the forming die in that state, and the outside molded portion covering the inside molded portion is molded.

[0012]

[Embodiment of the Invention]

An embodiment of the present invention will be described below with reference to the drawings.

[0013]

As shown in fig. 5, the procedure for branching a CV cable first comprises stripping a sheath material (PVC) 1c and an insulator (PE) 1b of a trunk cable 1 to expose a conductor 1a. A sheath material (PVC) 2c and an insulator (PE) 2b at an end portion of a branch

cable 2 are then stripped to expose a conductor 2a, and this conductor 2a is connected to the conductor 1a of the trunk cable 1. It should be noted that, in the example depicted in fig. 5, a portion of the sheath materials 1c, 2c of the trunk cable 1 and the branch cable 2 has been stripped at the branch portion so as to expose a portion of the insulators 1b, 2b.

[0014]

10 This embodiment constitutes the abovementioned molded structure for a branch portion of a CV cable, and, as shown in fig. 1-4, an inside molded portion 11 is resin molded so as to cover a connecting section of the conductors 1a, 2a of the trunk cable 1 and the branch cable 2. An outside molded portion 12 is further resin molded so as to cover the inside molded portion 11, and the entirety of a molded portion 10 constitutes a double molded structure.

20 [0015]

PE is used for the resin of the inside molded portion 11. The inside molded portion 11 adheres to outer circumferential surfaces of the conductors 1a, 2a of the trunk cable 1 and the branch cable 2, and the insulators 1b, 2b (also including a portion of the sheath materials 1c, 2c) of the cables.

[0016]

PVC is used for the resin of the outside molded portion 12. The outside molded portion 12 adheres to the outer circumferential surfaces of the sheath materials 1c, 2c of the trunk cable 1 and the branch cable 2.

[0017]

35 According to this embodiment, the same resin (PE) as that of the insulators 1b, 2b of the CV cable is thus used as the resin of the inside molded portion 11,

which therefore improves adhesion between the inside molded portion 11 and the insulators 1b, 2b. Additionally, the same resin (PVC) as that of the sheath materials 1c, 2c of the CV cable is used as the resin of the outside molded portion, which therefore also improves adhesion between the outside molded portion 12 and the sheath materials 1c, 2c. This makes it possible to achieve high waterproofing performance by virtue of a double waterproofing effect.

[0018]

The method for molding the molded structure shown in fig. 1-4 will be described next with reference to fig. 6-10.

[0019]

The conductor 1a of the trunk cable 1 and the conductor 2a of the branch cable 2 are first of all connected by the procedure shown in fig. 5.

[0020]

As shown in fig. 6(A) and (B), the connecting section of the conductors 1a, 2a is arranged inside a cavity 101b of a forming die 101, and a molten resin (PE) is injected into the cavity 101b in order to mold the inside molded portion 11 (fig. 7(A) and (B)).

[0021]

The forming die 101 for the inside molded portion 11 is provided with protrusions 101a..101a at four locations on upper and lower dies, and positioning holes 11a..11a are formed in the inside molded portion 11 after molding (after opening of the die) (fig. 8(A) and (B)).

[0022]

After molding of the inside molded portion 11 has been completed, a forming die 102 having positioning pins

102a..102a provided in a positional relationship corresponding to the positioning holes 11a..11a is placed so that the positioning pins 102a thereof are inserted into each of the corresponding positioning
5 holes 11a, whereby the forming die 102 is correctly positioned in relation to the inside molded portion 11, as shown in fig. 9(A) and (B).

[0023]

10 In that state, a molten resin (PVC) is injected into a cavity 102b of the forming die 102 to mold the outside molded portion 12, after which the forming die 102 is opened. This makes it possible to obtain the molded portion 10 having the structure shown in fig. 1-4, in
15 other words, a double molded structure comprising the inside molded portion 11 and the outside molded portion 12.

[0024]

20 It should be noted that the embodiment above constitutes a double molded structure combining PE for the inside molded portion 11 and PVC for the outside molded portion 12, but this is an arbitrary combination of those two types of resins, and the resins may be
25 appropriately selected according to conditions such as the type of cable for which the molding is performed.

[0025]

In addition to molding of a branch portion of a CV
30 cable used for connecting solar battery modules, the present invention may also be applied to molding of branch portions for various types of cables used for connecting electrical devices such as modules for snow melting purposes and modules for tape heaters.

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[0026]

[Advantage of the Invention]

As described above, the molded structure for a cable branch portion constitutes a double molded structure comprising the inside molded portion and the outside molded portion, so PE which has good adhesion with the cable conductors can be used for the resin of the inside molded portion, and excellent waterproofing performance can be ensured.

[0027]

According to the molding method of the present invention, the forming die for the outside molded portion can be correctly positioned in relation to the inside molded portion when the abovementioned double molded structure is molded, so a partial thinning in the wall thickness of the outside molded portion no longer occurs. As a result, stable waterproofing performance can always be achieved.

[Brief Description of the Drawings]

[Fig. 1] is a view in horizontal section showing the structure of an embodiment of the present invention.

[Fig. 2] is a plan view of the embodiment in fig. 1.

[Fig. 3] is a view in the cross section X-X of fig. 2.

[Fig. 4] is a view in the cross section Y-Y of fig. 3.

[Fig. 5] schematically shows an example of the branch portion of the CV cable.

[Fig. 6] is an illustrative diagram of the molding method for the embodiment shown in fig. 1-4.

[Fig. 7] is an illustrative diagram of the molding method for the same.

[Fig. 8] is an illustrative diagram of the molding method for the same.

[Fig. 9] is an illustrative diagram of the molding method for the same.

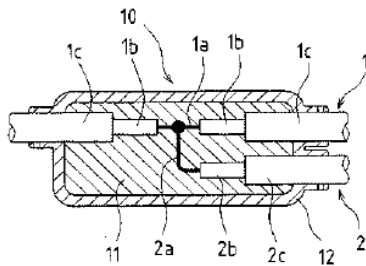
[Fig. 10] is an illustrative diagram of the molding method for the same.

[Fig. 11] schematically shows a conventional example of a molded structure for a cable branch portion.

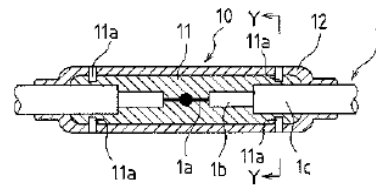
[Key to Symbols]

- 5 1 Trunk cable (CV cable)
 - 1a Conductor
 - 1b Insulator
 - 1c Sheath material
- 2 Branch cable (CV cable)
 - 2a Conductor
 - 2b Insulator
 - 2c Sheath material
- 10 Molded portion
 - 11 Inside molded portion
 - 11a Positioning hole
 - 12 Outside molded portion
 - 101 Forming die (for molding inside molded portion)
 - 101a Protrusion
 - 102 Forming die (for molding outside molded portion)
 - 102a Positioning pin

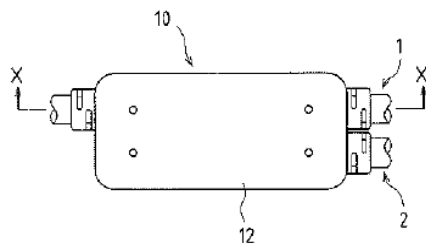
[Fig. 1]



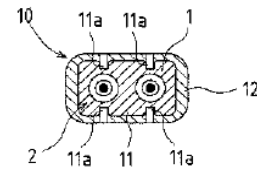
[Fig. 3]



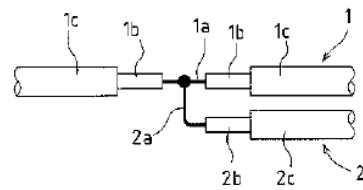
[Fig. 2]



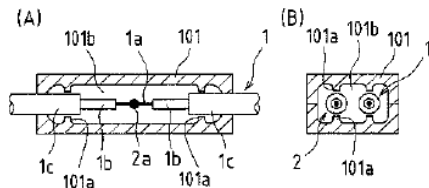
[Fig. 4]



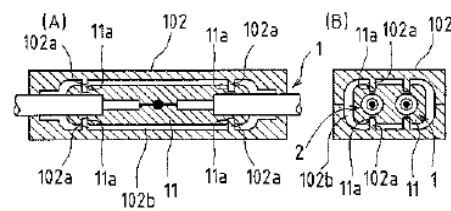
[Fig. 5]



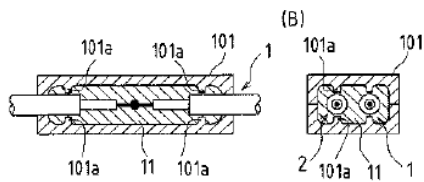
[Fig. 6]



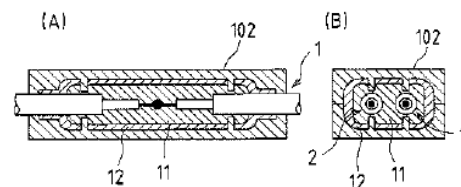
[Fig. 9]



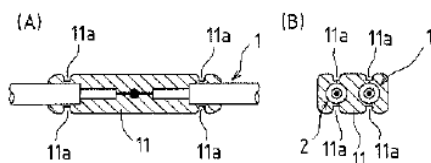
[Fig. 7]



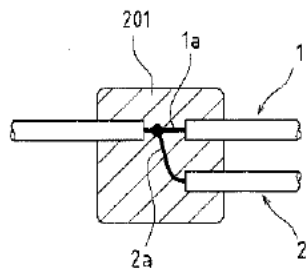
[Fig. 10]



[Fig. 8]



[Fig. 11]



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I, Roland Piers LEVAN BA (Joint Hons),
translator to RWS Group Ltd, of Europa House, Chiltern Park, Chiltern Hill, Chalfont St
Peter, Buckinghamshire, United Kingdom, hereby declare that I am conversant with the
English and Japanese languages and am a competent translator thereof. I declare further that
to the best of my knowledge and belief the following is a true and correct translation of the
accompanying document in the Japanese language.

Signed this 13th day of November 2023



R. P. LEVAN
For and on behalf of RWS Group Ltd