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- (54) **Title:** METHOD FOR CONNECTING FIRST AND SECOND OPTICAL AND ELECTRIC HYBRID CABLES

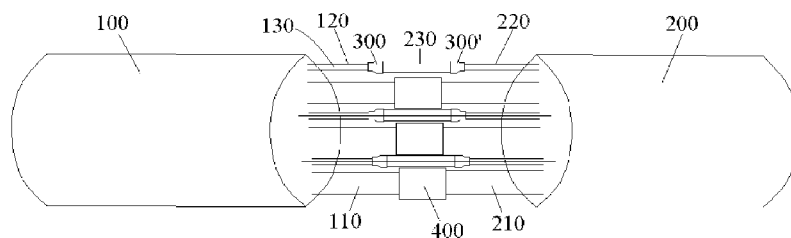


Fig. 1

(57) **Abstract:** A method for connecting a first and second optical and electric hybrid cables is disclosed. The first optical and electric hybrid cable has a first power cable and a first fiber tube for receiving a fiber therein, and the second optical and electric hybrid cable has a second power cable and a second fiber tube for receiving the fiber therein. The connection device comprises a fiber tube connection assembly for coupling the first and second fiber tubes. The method comprises steps of: blowing a fiber to pass through the first fiber tube of the first optical and electric hybrid cable by means of a compressor; blowing the fiber, which has passed through the first fiber tube, to pass through the second fiber tube of the second optical and electric hybrid cable by means of the compressor; removing the compressor; and coupling the first fiber tube and the second fiber tube by means of the fiber tube connection assembly. Based on the connection method disclosed, the optical splicing of two optical and electric hybrid cables is achieved conveniently and quickly only by a compressor and a fiber tube connection assembly.



METHOD FOR CONNECTING FIRST AND SECOND OPTICAL AND ELECTRIC HYBRID CABLES

5 CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of Chinese Patent Application No. 201410373744.8 filed on July 31, 2014 in the State Intellectual Property Office of China, the whole disclosure of which is incorporated herein by reference.

10

BACKGROUND OF THE INVENTION

Field of the Invention

15 The present disclosure relates to a method for connecting a first optical and electric hybrid cable and a second optical and electric hybrid cable.

Description of the Related Art

20 In some situations for special applications, there exists a need for an optical and electric hybrid cable, that is, a cable having both power cable and fiber. For the connection of such optical and electric hybrid cables, the applicant of the present application has proposed a technical solution previously, in which the electrical connection of the power cables contained in two optical and electric hybrid cables is achieved by means of a
25 conventional crimping method, and the optical splicing of the fibers contained in two optical and electric hybrid cables is achieved by means of a fiber optic splicing box. It is complicated to splice the fibers of two optical and electric hybrid cables, in particular, an end of each fiber of the optical and electric hybrid cables is firstly connected to a fiber optic connector, and then two fiber optic connectors with fibers are coupled with each other via a
30 fiber adapter, thus the optical splicing of the fibers in two optical and electric hybrid cables is achieved. Another technical solution is proposed prior to the above technical solution set forth by the applicant of the present application, in which the optical splicing of the fibers in two optical and electric hybrid cables is achieved by means of butt fusion. However, such butt fusion process encounters disadvantages such as process complexity and high cost,
35 since fiber-arranging tray, fiber-coiling tray, shrinkable tube, etc. are required.

In the technical solutions described above, it is necessary to adopt a special fiber optic splicing box to achieve the optical splicing of the fibers in two optical and electric hybrid cables, causing complicated structure, difficult operation, and high cost.

SUMMARY OF THE INVENTION

5 The purpose of the present disclosure is intended to solve at least one aspect of the above issues and faults in the prior art.

One object of the present disclosure is to provide a method for connecting a first optical and electric hybrid cable and a second optical and electric hybrid cable such that the optical connecting of two optical and electric hybrid cables is achieved conveniently and quickly.

10 According to an aspect of the present disclosure, there is provided a method for connecting a first optical and electric hybrid cable and a second optical and electric hybrid cable. The first optical and electric hybrid cable has a first power cable and a first fiber tube for receiving a fiber therein, and the second optical and electric hybrid cable has a second power cable and a second fiber tube for receiving the fiber therein. The method comprises
15 steps of optically connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable and electrically connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable, wherein the step of optically splicing the first optical and electric hybrid cable and the second optical and electric hybrid cable comprises steps of:

20 S110: blowing a continuous fiber to pass through one first fiber tube of the first optical and electric hybrid cable by a compressor;

S120: blowing the fiber, which has passed through the first fiber tube, to pass through one second fiber tube of the second optical and electric hybrid cable by the compressor;

S130: removing the compressor; and

25 S140: coupling the first fiber tube and the second fiber tube, through which the fiber has passed, by a fiber tube connection assembly.

According to an exemplary embodiment of the present invention, the fiber tube connection assembly comprises: an intermediate connecting tube having a diameter larger than that of the first fiber tube and the second fiber tube; a first tapered tube connector
30 having a first port with smaller diameter and a second port with larger diameter; and a second tapered tube connector having a first port with smaller diameter and a second port with larger diameter, wherein the first fiber tube is inserted into and connected to the first port of the first tapered tube connector, the second fiber tube is inserted into and connected to the first port of the second tapered tube connector, and two ends of the intermediate
35 connecting tube are inserted into and connected to the second ports of the first tapered tube connector and the second tapered tube connector, respectively.

According to another exemplary embodiment of the present invention, the method further comprises steps of:

before the step S120, inserting the first fiber tube from the first port of the first tapered tube connector to pass through the first tapered tube connector, inserting the second fiber tube from the first port of the second tapered tube connector to pass through the second tapered tube connector, and sleeving the intermediate connecting tube onto the first fiber tube, which has passed through the first tapered tube connector, or the second fiber tube, which has passed through the second tapered tube connector.

According to another aspect of the present disclosure, there is provided a method for connecting a first optical and electric hybrid cable and a second optical and electric hybrid cable. The first optical and electric hybrid cable has a first power cable and a first fiber tube for receiving a fiber therein, and the second optical and electric hybrid cable has a second power cable and a second fiber tube for receiving the fiber therein. The method comprises steps of optically connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable and electrically connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable, wherein the step of optically connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable comprises steps of:

S210: providing a fiber tube connection assembly comprising a first tapered tube connector, a second tapered tube connector and an intermediate connecting tube, each of the first tapered tube connector and the second tapered tube connector having a first port with smaller diameter and a second port with larger diameter, the intermediate connecting tube having a diameter larger than that of the first fiber tube and the second fiber tube;

S220: blowing a continuous fiber to pass through the first fiber tube of the first optical and electric hybrid cable by a compressor;

S230: inserting the first fiber tube, through which the fiber has passed, from the first port of the first tapered tube connector to pass through the first tapered tube connector, inserting one second fiber tube from the first port of the second tapered tube connector to pass through the second tapered tube connector, and sleeving the intermediate connecting tube onto the first fiber tube, which has passed through the first tapered tube connector, or the second fiber tube, which has passed through the second tapered tube connector;

S240: blowing the fiber, which has passed through the first fiber tube, to pass through the second fiber tube of the second optical and electric hybrid cable, which has passed through the second tapered tube connector by the compressor;

S250: removing the compressor; and

S260: moving the first tapered tube connector, the second tapered tube connector and the intermediate connecting tube such that the first fiber tube is connected to the first port of the first tapered tube connector, the second fiber tube is connected to the first port of the second tapered tube connector, and two ends of the intermediate connecting tube are connected to the second ports of the first tapered tube connector and the second tapered tube

connector, respectively.

According to another exemplary embodiment of the present invention, the step of electrically connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable comprises steps of:

- 5 electrically connecting the first power cable of the first optical and electric hybrid cable and the second power cable of the second optical and electric hybrid cable by a power cable connector.

According to another exemplary embodiment of the present invention, the first optical and electric hybrid cable and the second optical and electric hybrid cable comprise one or
10 more power cables, respectively; and said one or more power cables of the first optical and electric hybrid cable and the second optical and electric hybrid cable are electrically connected by means of one or more power cable connectors, respectively.

According to another exemplary embodiment of the present invention, the first optical and electric hybrid cable and the second optical and electric hybrid cable comprise one or
15 more fiber tubes, respectively; and said one or more fiber tubes of the first optical and electric hybrid cable and the second optical and electric hybrid cable are coupled by means of one or more fiber tube connection assembly, respectively.

According to another exemplary embodiment of the present invention, all power cables of the first optical and electric hybrid cable or the second optical and electric hybrid cable
20 are wrapped in a metal shielding layer, and insulation filling materials are filled into the gap between the metal shielding layer and the power cables; and the fiber tubes of the first optical and electric hybrid cable or the second optical and electric hybrid cable are embedded in the insulation filling materials.

According to another exemplary embodiment of the present invention, the first optical
25 and electric hybrid cable and the second optical and electric hybrid cable comprise three power cables and three fiber tubes, respectively; and the three power cables of the first optical and electric hybrid cable or the second optical and electric hybrid cable are intertwined with each other, and tangential to each other with peripheries thereof.

According to another exemplary embodiment of the present invention, the first tapered
30 tube connector comprises: a first body having a first port and a second port opposite to the first port; and a first resilient barb member provided on the inner wall of the first port of the first body; and a second resilient barb member provided on the inner wall of the second port of the first body. The first fiber tube and the intermediate connecting tube are inserted into the first port and the second port of the first body, respectively. The first resilient barb
35 member is configured to allow the first fiber tube to be inserted towards inside of the first body, and prevent the first fiber tube from being pulled out towards outside of the first body; and the second resilient barb member is configured to allow the intermediate connecting tube to be inserted towards inside of the first body, and prevent the intermediate connecting

tube from being pulled out towards outside of the first body.

According to another exemplary embodiment of the present invention, the second tapered tube connector comprises: a second body having a first port and a second port opposite to the first port; and a first resilient barb member provided on the inner wall of the first port of the second body; and a second resilient barb member provided on the inner wall of the second port of the second body. The second fiber tube and the intermediate connecting tube are inserted into the first port and the second port of the second body, respectively. The first resilient barb member of the second body is configured to allow the second fiber tube to be inserted towards inside of the second body, and prevent the second fiber tube from being pulled out towards outside of the second body; and the second resilient barb member of the second body is configured to allow the intermediate connecting tube to be inserted towards inside of the second body, and prevent the intermediate connecting tube from being pulled out towards outside of the second body.

According to another exemplary embodiment of the present invention, the first and second tapered tube connector each further comprises a first movable member mounted in the first port of the first/second body, wherein the first movable member has a first pressure portion extending toward the first resilient barb member, and the first movable member is movable from a first position for releasing the first resilient barb member to a second position for pressing the first resilient barb member. When the first movable member is located at the first position, the first resilient barb member is held in a first state which allows the first or second fiber tube to be inserted towards inside of the first or second body, and prevent the first or second fiber tube from being pulled out towards outside of the first or second body; and when the first movable member is located at the second position, the first resilient barb member is pressed by the first pressure portion and held in a second state which allows the first or second fiber tube to be pulled out towards outside of the first or second body. The first or second tapered tube connector further comprises a second movable member mounted in the second port of the first or second body, wherein the second movable member has a second pressure portion extending toward the second resilient barb member, and the second movable member is movable from a first position for releasing the second resilient barb member to a second position for pressing the second resilient barb member. When the second movable member is located at the first position, the second resilient barb member is held in a first state which allows the intermediate connecting tube to be inserted towards inside of the first or second body, and prevent the intermediate connecting tube from being pulled out towards outside of the first or second body; and when the second movable member is located at the second position, the second resilient barb member is pressed by the second pressure portion and held in a second state which allows the intermediate connecting tube to be pulled out towards outside of the first or second body.

According to another exemplary embodiment of the present invention, each of the first

second tapered tube connector further comprises: a first resilient seal ring provided on the inner wall of the first port of the first or second body for sealing an engagement interface between the first or second body and the first/second fiber tube inserted into the first or second body; and a second resilient seal ring provided on the inner wall of the second port of the first or second body for sealing an engagement interface between the first or second body and the intermediate connecting tube inserted into the first/second body.

According to another exemplary embodiment of the present invention, the first or second tapered tube connector further comprises: a first spacer provided on the inner wall of the first port of the first or second body and one side of the first resilient barb member facing to the inner wall of the first or second body to prevent the first resilient barb member from excessive deformation or damage; and a second spacer provided on the inner wall of the second port of the first or second body and one side of the second resilient barb member facing to the inner wall of the first/second body to prevent the second resilient barb member from excessive deformation or damage.

According to another exemplary embodiment of the present invention, the power cable connector comprises: a crimping tube constructed to crimp a conductor core of the first power cable of the first optical and electric hybrid cable with a conductor core of the second power cable of the second optical and electric hybrid cable; and an insulation sleeve constructed to be sleeved outside the crimping tube and insulation layers of the first and second power cables, so that the insulation sleeve is acted as sections of insulation layers of the first and second power cables which are stripped.

According to another exemplary embodiment of the present invention, the method further comprises a step of:

binding on a junction of the first optical and electric hybrid cable and the second optical and electric hybrid cable by means of a layer of waterproof band to wrap hermetically the fiber tube connection assembly and the power cable connector therein.

According to another exemplary embodiment of the present invention, the first tapered tube connector is constructed to be identical to the second tapered tube connector.

In the connection method according to various embodiments of the present invention, the first fiber tube of the first optical and electric hybrid cable and the second fiber tube of the second optical and electric hybrid cable are coupled with each other by means of fiber tube connection assembly, and a whole fiber is blown into the first fiber tube and the second fiber tube to be coupled with each other by the compressor, such that the whole fiber passes through the first fiber tube and the second fiber tube to be coupled with each other, continuously, thus the optical splicing of two optical and electric hybrid cables is achieved. Based on the connection method, the optical splicing of two optical and electric hybrid cables is achieved in a convenient and quick manner only using the compressor and the fiber tube connection assembly, instead of using a fiber optic splicing box having fiber connector,

fiber adapter, fiber-arranging tray, fiber-coiling tray, shrinkable tube, etc., and various fiber optic manufacturing devices, therefore, the connection method according to the embodiments of the present invention may achieve the optical splicing of two optical and electric hybrid cables conveniently and quickly.

5 Other characteristics and advantages of the present disclosure will be made clear by the following detailed description, the comprehension of which will be facilitated by reference to the attached drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

10

The present invention will be further described in detail with reference to the accompanying drawings, in which:

Fig.1 is a schematic view showing a first optical and electric hybrid cable, a second optical and electric hybrid cable and a connection device for connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable according to a first exemplary embodiment of the present invention;

Fig.2a is a cross-section view of the first optical and electric hybrid cable and the second optical and electric hybrid cable according to the first exemplary embodiment of the present invention, wherein fibers are not inserted into fiber tubes of the first optical and electric hybrid cable and the second optical and electric hybrid cable;

Fig.2b is a cross-section view of the first optical and electric hybrid cable and the second optical and electric hybrid cable according to the first exemplary embodiment of the present invention, wherein the fibers are inserted into fiber tubes of the first optical and electric hybrid cable and the second optical and electric hybrid cable;

Fig.3a is a schematic view showing a first tapered tube connector and a second tapered tube connector of a fiber tube connection assembly of the connection device as shown in Fig.1 for coupling a first fiber tube with a second fiber tube;

Fig.3b is a schematic view showing that the first fiber tube and the second fiber tube as shown in Fig.1 are coupled with each other via the fiber tube connection assembly;

Fig.4 is a schematic view showing a first optical and electric hybrid cable, a second optical and electric hybrid cable and a connection device for connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable according to a second exemplary embodiment of the present invention;

Fig.5 is a schematic view showing a first optical and electric hybrid cable, a second optical and electric hybrid cable and a connection device for connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable according to a third exemplary embodiment of the present invention;

Fig.6 is a schematic view showing a first optical and electric hybrid cable, a second

optical and electric hybrid cable and a connection device for connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable according to a fourth exemplary embodiment of the present invention; and

5 Figs. 7a-7f are schematic views showing each step for connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

10 Exemplary embodiments of the present disclosure will be described hereinafter in detail with reference to the attached drawings, wherein the like reference numerals refer to the like elements. The present disclosure may, however, be embodied in many different forms and should not be construed as being limited to the embodiment set forth herein; rather, these embodiments are provided so that the present disclosure will be thorough and
15 complete, and will fully convey the concept of the disclosure to those skilled in the art.

In the following detailed description, for purposes of explanation, numerous specific details are set forth in order to provide a thorough understanding of the disclosed embodiments. It will be apparent, however, that one or more embodiments may be practiced without these specific details. In other instances, well-known structures and devices are
20 schematically shown in order to simplify the drawing.

According to a general concept of the present disclosure, there is provided a method for connecting a first optical and electric hybrid cable and a second optical and electric hybrid cable. The first optical and electric hybrid cable has a first power cable and a first fiber tube for receiving a fiber therein, and the second optical and electric hybrid cable has a second
25 power cable and a second fiber tube for receiving the fiber therein. The method comprises steps of: optically connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable and electrically connecting the first optical and electric hybrid cable and the second optical and electric hybrid cable, wherein the step of optically
30 splicing the first optical and electric hybrid cable and the second optical and electric hybrid cable comprises steps of: blowing a continuous fiber to pass through one first fiber tube of the first optical and electric hybrid cable by a compressor; blowing the fiber, which has passed through the first fiber tube, to pass through one second fiber tube of the second
optical and electric hybrid cable by the compressor; removing the compressor; and coupling the first fiber tube and the second fiber tube, through which the fiber has passed, by a fiber
35 tube connection assembly.

Fig. 1 is a schematic view showing a first optical and electric hybrid cable 100, a second optical and electric hybrid cable 200 and a connection device for connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200

according to a first exemplary embodiment of the present invention; Fig.2a is a cross-section view of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 according to the first exemplary embodiment of the present invention, wherein fibers 130 are not inserted into fiber tubes 120, 220 of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200; and Fig.2b is a cross-section view of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 according to the first exemplary embodiment of the present invention, wherein the fibers 130 are inserted into fiber tubes 120, 220 of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200.

As shown in Figs.2a and 2b, in an exemplary embodiment of the present invention, the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 have the same internal structure, however, the present disclosure is not limited to the embodiments illustrated, the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 may have different internal structures.

Further referring to Figs.2a and 2b, in the embodiment illustrated, the first optical and electric hybrid cable 100 comprises three first power cables 110 and three first fiber tubes 120. As shown clearly in Fig.2a, three first power cables 110 are intertwined with each other, and three first power cables 110 are tangential to each other with peripheries thereof. Three first power cables 110 are wrapped by a layer of first metal shielding layer 102 outside three first power cables 110, and insulation filling materials 101 are filled into the gap between the first metal shielding layer 102 and three first power cables 110. As manufacturing the first optical and electric hybrid cable 100, three first fiber tubes 120 are embedded in the insulation filling materials 101.

In the embodiment shown in Fig.2a, the first optical and electric hybrid cable 100 further comprises a first insulation layer 103 wrapped outside the first metal shielding layer 102, a second metal shielding layer 104 wrapped outside the first insulation layer 103, and an outer sheath layer 105 wrapped outside the second metal shielding layer 104. As shown in Fig.2a, each first power cable 110 comprises a conductor cone 111, insulation material layer (not shown) wrapped outside the conductor cone 111, and a metal shielding layer wrapped outside the insulation material layer (not shown).

Similarly, in the embodiment shown in Figs.2a and 2b, the second optical and electric hybrid cable 200 comprises three second power cables 210 and three second fiber tubes 220. As shown clearly in Fig.2a, three second power cables 210 are intertwined with each other, and three second power cables 210 are tangential to each other with peripheries thereof. Three second power cables 210 are wrapped by a layer of first metal shielding layer 202 outside three second power cables 210, and insulation filling materials 201 are filled into the gap between the first metal shielding layer 202 and three second power cables 210. As manufacturing the second optical and electric hybrid cable 200, three second fiber tubes 220

are embedded in the insulation filling materials 201.

In the embodiment shown in Fig.2a, the second optical and electric hybrid cable 200 further comprises a first insulation layer 203 wrapped outside the first metal shielding layer 202, a second metal shielding layer 204 wrapped outside the first insulation layer 203, and a
5 outer sheath layer 205 wrapped outside the second metal shielding layer 204. As shown in Fig.2a, each second power cable 210 comprises a conductor cone 211, insulation material layer (not shown) wrapped outside the conductor cone 211, and a metal shielding layer wrapped outside the insulation material layer (not shown).

Further referring to Fig.1, in the embodiment illustrated, the connection device for
10 connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 primarily comprises three power cable connectors 400 and three fiber tube connection assemblies. Three power cable connectors 400 are constructed to electrically connect three first power cables 110 of the first optical and electric hybrid cable 100 and
15 three second power cables 210 of the second optical and electric hybrid cable 200, respectively. Three fiber tube connection assemblies are constructed to couple three first fiber tubes 120 of the first optical and electric hybrid cable 100 with three second fiber tubes 220 of the second optical and electric hybrid cable 200, respectively.

In an exemplary embodiment of the present invention, if a total length of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 is
20 less than or equal to a predetermined value (such predetermined value may be determined as necessary), for example, less than or equal to 500m, the fiber 130 may be inserted into the first fiber tube 120 and the second fiber tube 220 after the first fiber tube 120 and the second fiber tube 220 have been coupled with each other, it thereby achieves the optical connection of the first optical and electric hybrid cable 100 and the second optical and electric hybrid
25 cable 200. Thus, the connection device may achieve the optical connection of two cables 100, 200 without using a fiber optic splicing box. However, if the total length of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 is larger than the predetermined value, for example, larger than 500m, it is necessary to insert the fiber 130 into the first fiber tube 120 and the second fiber tube 220 in turn before the
30 first fiber tube 120 and the second fiber tube 220 have been coupled with each other, as will be described in more detail below.

Fig.3a is a schematic view showing a first tapered tube connector 300 and a second tapered tube connector 300' of the fiber tube connection assembly of the connection device as shown in Fig.1 for coupling the first fiber tube 110 with the second fiber tube 220; Fig.3b
35 is a schematic view showing that the first fiber tube 110 and the second fiber tube 220 as shown in Fig.1 are coupled with each other via the fiber tube connection assembly.

As shown in Figs.1, 3a and 3b, in an exemplary embodiment of the present invention, the fiber tube connection assembly primarily comprises: an intermediate connecting tube

230, a first tapered tube connector 300, and a second tapered tube connector 300'. The intermediate connecting tube 230 has a diameter larger than that of the first fiber tube 120 and the second fiber tube 220. The first tapered tube connector 300 has a first port with smaller diameter and a second port opposite to the first port and with larger diameter, and
5 the second tapered tube connector 300' has a first port with smaller diameter and a second port opposite to the first port and with larger diameter.

Further referring to Figs.1, 3a and 3b, in the embodiment illustrated, the first tapered tube connector 300 further comprises: a first body disposed between the first port and the second port; a first resilient barb member 311 provided on the inner wall of the first port;
10 and a second resilient barb member 312 provided on the inner wall of the second port.

In the embodiment illustrated, as shown in Figs.1, 3a and 3b, the first fiber tube 120 and the intermediate connecting tube 230 are inserted into the first body from the first port and the second port, respectively. The first resilient barb member 311 is configured to allow the first fiber tube 120 to be inserted towards inside of the first port of the first body, and
15 prevent the first fiber tube 120 from being pulled out towards outside of the first body; and similarly, the second resilient barb member 312 is configured to allow the intermediate connecting tube 230 to be inserted towards inside of the second port of the first body, and prevent the intermediate connecting tube 230 from being pulled out towards outside of the first body.

Further referring to Figs.3a and 3b, in the embodiment illustrated, the first tapered tube connector 300 further comprises a first resilient seal ring 321 provided on the inner wall of the first port of the first body and a second resilient seal ring 322 provided on the inner wall of the second port of the first body. The first resilient seal ring 321 is constructed to seal an engagement interface between the first body and the first fiber tube 120 inserted into the
20 first body. The second resilient seal ring 322 is constructed to seal an engagement interface between the first body and the intermediate connecting tube 230 inserted into the first body.

Further referring to Figs.3a and 3b, in the embodiment illustrated, the first tapered tube connector 300 further comprises a first spacer 331 provided on the inner wall of the first port of the first body and a second spacer 332 provided on the inner wall of the second port of the first body. The first spacer 331 is provided on one side of the first resilient barb member 311 facing to the inner wall of the first body to support the first resilient barb member 311 when being pressed outward radially, thereby preventing the first resilient barb member 311 from excessive deformation or damage. The second spacer 332 is provided on one side of the second resilient barb member 312 facing to the inner wall of the first body to support the second resilient barb member 312 when being pressed outward radially, thereby
30 preventing the second resilient barb member 312 from excessive deformation or damage.

Further referring to Figs.3a and 3b, in the embodiment illustrated, the first tapered tube connector 300 further comprises a first movable member 341 mounted in the first port of the

first body and a second movable member 342 mounted in the second port of the first body.

In an exemplary embodiment of the present invention, the first movable member 341 has a first pressure portion 3410 extending toward the first resilient barb member 311. The first movable member 341 is movable from a first position for releasing the first resilient
5 barb member 311 to a second position for pressing the first resilient barb member 311. When the first movable member 341 is located at the first position, the first resilient barb member 311 is not pressed by the first pressure portion 3410 of the first movable member 341 and held in a first state which allows the first fiber tube 120 to be inserted towards
10 inside of the first body, and prevent the first fiber tube 120 from being pulled out towards outside of the first body. When the first movable member 341 is located at the second position, the first resilient barb member 311 is pressed by the first pressure portion 3410 and held in a second state which allows the first fiber tube 120 to be pulled out towards outside of the first body.

Similarly, in an exemplary embodiment of the present invention, the second movable
15 member 342 has a second pressure portion 3420 extending toward the second resilient barb member 312. The second movable member 342 is movable from a first position for releasing the second resilient barb member 312 to a second position for pressing the second resilient barb member 312. When the second movable member 342 is located at the first position, the second resilient barb member 312 is not pressed by the second pressure portion
20 3420 of the second movable member 342 and held in a first state which allows the intermediate connecting tube 230 to be inserted towards inside of the first body, and prevent the intermediate connecting tube 230 from being pulled out towards outside of the first body. When the second movable member 342 is located at the second position, the second resilient
25 barb member 312 is pressed by the second pressure portion 3420 and held in a second state which allows the intermediate connecting tube 230 to be pulled out towards outside of the first body.

Further referring to Figs.1, 3a and 3b, in the embodiment illustrated, the second tapered tube connector 300' primarily comprises: a second body having a first port with smaller diameter and a second port opposite to the first port with larger diameter; and a first resilient
30 barb member 311' provided on the inner wall of the first port; and a second resilient barb member 312' provided on the inner wall of the second port.

In the embodiment illustrated, as shown in Figs.1, 3a and 3b, the second fiber tube 220 and the intermediate connecting tube 230 are inserted into the second body from the first port and the second port, respectively. The first resilient barb member 311' is configured to
35 allow the second fiber tube 220 to be inserted towards inside of the first port of the second body, and prevent the second fiber tube 220 from being pulled out towards outside of the second body; and similarly, the second resilient barb member 312' is configured to allow the intermediate connecting tube 230 to be inserted towards inside of the second port of the

second body, and prevent the intermediate connecting tube 230 from being pulled out towards outside of the second body.

Further referring to Figs.3a and 3b, in the embodiment illustrated, the second tapered tube connector 300' further comprises a first resilient seal ring 321' provided on the inner wall of the first port of the second body and a second resilient seal ring 322' provided on the inner wall of the second port of the second body. The first resilient seal ring 321' is constructed to seal an engagement interface between the second body and the second fiber tube 220 inserted into the second body. The second resilient seal ring 322' is constructed to seal an engagement interface between the second body and the intermediate connecting tube 230 inserted into the second body.

Further referring to Figs.3a and 3b, in the embodiment illustrated, the second tapered tube connector 300' further comprises a first spacer 331' provided on the inner wall of the first port of the second body and a second spacer 332' provided on the inner wall of the second port of the second body. The first spacer 331' is provided on one side of the first resilient barb member 311' facing to the inner wall of the second body to support the first resilient barb member 311' when being pressed outward radially, thereby preventing the first resilient barb member 311' from excessive deformation or damage. The second spacer 332' is provided on one side of the second resilient barb member 312' facing to the inner wall of the second body to support the second resilient barb member 312' when being pressed outward radially, thereby preventing the second resilient barb member 312' from excessive deformation or damage.

Further referring to Figs.3a and 3b, in the embodiment illustrated, the second tapered tube connector 300' further comprises a first movable member 341' mounted in the first port of the second body and a second movable member 342' mounted in the second port of the second body.

In an exemplary embodiment of the present invention, the first movable member 341' of the second tapered tube connector 300' has a first pressure portion 3410' extending toward the first resilient barb member 311'. The first movable member 341' of the second tapered tube connector 300' is movable from a first position for releasing the first resilient barb member 311' to a second position for pressing the first resilient barb member 311'. When the first movable member 341' is located at the first position, the first resilient barb member 311' is not pressed by the first pressure portion 3410' of the first movable member 341' and held in a first state which allows the second fiber tube 220 to be inserted towards inside of the second body, and prevent the second fiber tube 220 from being pulled out towards outside of the second body. When the first movable member 341' is located at the second position, the first resilient barb member 311' is pressed by the first pressure portion 3410' and held in a second state which allows the second fiber tube 220 to be pulled out towards outside of the second body.

Similarly, in an exemplary embodiment of the present invention, the second movable member 342' of the second tapered tube connector 300' has a second pressure portion 3420' extending toward the second resilient barb member 312'. The second movable member 342' is movable from a first position for releasing the second resilient barb member 312' to a second position for pressing the second resilient barb member 312'. When the second movable member 342' is located at the first position, the second resilient barb member 312' is not pressed by the second pressure portion 3420' of the second movable member 342' and held in a first state which allows the intermediate connecting tube 230 to be inserted towards inside of the second body, and prevent the intermediate connecting tube 230 from being pulled out towards outside of the second body. When the second movable member 342' is located at the second position, the second resilient barb member 312' is pressed by the second pressure portion 3420' and held in a second state which allows the intermediate connecting tube 230 to be pulled out towards outside of the second body.

It is noted that, in the present disclosure, the fiber tube connection assembly is not limited to the illustrated embodiment, it also may have any other structures as long as the first fiber tube 120 and the second fiber tube 220 may be coupled with each other.

As shown in Fig.1, in an exemplary embodiment of the present invention, the power cable connector 400 may comprise a crimping tube (not shown) and an insulation sleeve (not shown). The crimping tube is constructed to crimp the conductor core 111 (see Fig.2) of the first power cable 110 of the first optical and electric hybrid cable 100 with the conductor core 121 (see Fig.2) of the second power cable 120 of the second optical and electric hybrid cable 200. The insulation sleeve is constructed to be sleeved outside the crimping tube and insulation layers of the first and second power cables 110, 210 so as to be acted as sections of insulation layers of the first and second power cables 110, 210 which are stripped.

It is noted that, any types of power cable connectors in the prior art may be used as the power cable connector in the present disclosure, as long as two power cables may be connected electrically.

Although not shown, in an exemplary embodiment of the present invention, the connection device for connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 further comprises a layer of waterproof band bound on a junction of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 for wrapping hermetically the fiber tube connection assembly and the power cable connector 400 therein.

Fig.4 is a schematic view showing a first optical and electric hybrid cable 100, a second optical and electric hybrid cable 200 and a connection device for connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 according to a second exemplary embodiment of the present invention.

In the embodiment shown in Fig.4, each of the first optical and electric hybrid cable

100 and the second optical and electric hybrid cable 200 comprises three power cables 110 and two fiber tubes 120. Accordingly, in the embodiment shown in Fig.4, the connection device for connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 comprises three power cable connectors 400 and two fiber tube connection assemblies.

The main difference of the second embodiment shown in Fig.4 from the first embodiment shown in Fig.1 lies in that each of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 only comprises two fiber tubes 120, and the connection device for connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 only comprises two fiber tube connection assemblies. Except that, the second embodiment shown in Fig.4 is identical to the first embodiment shown in Fig.1.

Fig.5 is a schematic view showing a first optical and electric hybrid cable 100, a second optical and electric hybrid cable 200 and a connection device for connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 according to a third exemplary embodiment of the present invention.

In the embodiment shown in Fig.5, each of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 comprises three power cables 110 and one fiber tube 120. Accordingly, in the embodiment shown in Fig.5, the connection device for connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 comprises three power cable connectors 400 and one fiber tube connection assembly.

The main difference of the third embodiment shown in Fig.5 from the first embodiment shown in Fig.1 lies in that each of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 only comprises one fiber tube 120, and the connection device for connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 only comprises one fiber tube connection assembly. Except that, the third embodiment shown in Fig.5 is identical to the first embodiment shown in Fig.1.

Fig.6 is a schematic view showing a first optical and electric hybrid cable 100, a second optical and electric hybrid cable 200 and a connection device for connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 according to a fourth exemplary embodiment of the present invention.

In the embodiment shown in Fig.6, each of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 comprises one power cable 110 and one fiber tube 120. Accordingly, in the embodiment shown in Fig.6, the connection device for connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 comprises one power cable connector 400 and one fiber tube

connection assembly.

The main difference of the fourth embodiment shown in Fig.6 from the first embodiment shown in Fig.1 lies in that each of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 only comprises one power cable 110 and one fiber tube 120, and the connection device for connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 only comprises one power cable connector 400 and one fiber tube connection assembly. Except that, the fourth embodiment shown in Fig.6 is identical to the first embodiment shown in Fig.1.

It is noted that, the present disclosure is not limited to the embodiments as illustrated, each of the first optical and electric hybrid cable and the second optical and electric hybrid cable may comprise any number of power cables and any number of fiber tubes, accordingly, the connection device may comprise any number of power cable connectors and any number of fiber tube connection assemblies. In other words, the number of power cables and the number of fiber tubes accommodated in the first optical and electric hybrid cable and the second optical and electric hybrid cable, the number of power cable connectors and the number of fiber tube connection assemblies of the connection device may depend on requirements, rather than being limited to the embodiments shown in Figs.1-6. For example, each optical and electric hybrid cable may comprise two, four or more power cables, and each optical and electric hybrid cable may comprise four, five or more fiber tubes. Accordingly, the connection device may comprise two, four or more power cable connectors and four, five or more fiber tube connection assemblies.

As mentioned above, if the total length of the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 is larger than the predetermined value, for example, larger than 500m, it is necessary to insert the fiber 130 into the first fiber tube 120 and the second fiber tube 220 in turn before the first fiber tube 120 and the second fiber tube 220 have been coupled with each other. Now it will be further described in more detail with reference to Figs7a-7f below.

In a further exemplary embodiment of the present invention, there is provided a method for connecting a first optical and electric hybrid cable 100 and a second optical and electric hybrid cable 200, the method comprises steps of optically connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 and electrically connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200. In an exemplary embodiment of the present invention, the step of optically splicing the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 comprises steps of:

S110: blowing a continuous fiber 130 to pass through a first fiber tube 120 of the first optical and electric hybrid cable 100 by a compressor 500, as shown in Fig.7b;

S120: blowing the fiber 130, which has passed through the first fiber tube 120, to pass

through a second fiber tube 220 of the second optical and electric hybrid cable 200 by the compressor 500, as shown in Fig.7d;

S130: removing the compressor 500, as shown in Fig.7e; and

5 S140: coupling the first fiber tube 120 and the second fiber tube 220, through which the fiber 130 has passed, by a fiber tube connection assembly.

In an exemplary embodiment of the present invention, as shown in Fig.7c, before the step S120, inserting the first fiber tube 120 from a first port of a first tapered tube connector 300 to pass through the first tapered tube connector 300, inserting the second fiber tube 220 from a first port of a second tapered tube connector 300' to pass through the second tapered tube connector 300', and sleeving an intermediate connecting tube 230 onto the second fiber tube 220, which has passed through the second tapered tube connector 300'.

The present disclosure is not limited to the embodiments as illustrated, for example, in another exemplary embodiment of the present invention, before the step S120, the intermediate connecting tube 230 may be sleeved onto the first fiber tube 120, which has passed through the first tapered tube connector 300, rather than the second fiber tube 220, which has passed through the second tapered tube connector 300'.

In another exemplary embodiment of the present invention, the step of optically connecting the first optical and electric hybrid cable 100 and the second optical and electric hybrid cable 200 comprises steps of:

20 S210: providing a fiber tube connection assembly as shown in Fig.3a and 3b, the fiber tube connection assembly comprising a first tapered tube connector 300, a second tapered tube connector 300' and an intermediate connecting tube 230, each of the first tapered tube connector 300 and the second tapered tube connector 300' having a first port with smaller diameter and a second port with larger diameter, the intermediate connecting tube 230 having a diameter larger than that of the first fiber tube 120 and the second fiber tube 220;

S220: blowing the continuous fiber 130 to pass through the first fiber tube 120 of the first optical and electric hybrid cable 100 the compressor 500, as shown in Fig.7a and 7b;

30 S230: inserting the first fiber tube 120, through which the fiber 130 has passed, from the first port of the first tapered tube connector 300 to pass through the first tapered tube connector 300, inserting one second fiber tube 220 from the first port of the second tapered tube connector 300' to pass through the second tapered tube connector 300', and sleeving the intermediate connecting tube 230 onto the second fiber tube 220, which has passed through the second tapered tube connector 300', as shown in Fig.7c;

35 S240: blowing the fiber 130, which has passed through the first fiber tube 120, to pass through the second fiber tube 220 of the second optical and electric hybrid cable 200, which has passed through the second tapered tube connector 300', by the compressor 500, as shown in Fig.7d;

S250: removing the compressor 500, as shown in Fig.7e; and

S260: moving the first tapered tube connector 300, the second tapered tube connector 300' and the intermediate connecting tube 230, such that the first fiber tube 120 is connected to the first port of the first tapered tube connector 300, the second fiber tube 220 is connected to the first port of the second tapered tube connector 300', and two ends of the intermediate connecting tube 230 are connected to the second ports of the first tapered tube connector 300 and the second tapered tube connector 300', respectively, as shown in Fig. 7f.

It should be appreciated for those skilled in this art that the above embodiments are intended to be illustrated, and not restrictive. For example, many modifications may be made to the above embodiments by those skilled in this art, and various features described in different embodiments may be freely combined with each other without conflicting in configuration or principle.

Although several exemplary embodiments have been shown and described, it would be appreciated by those skilled in the art that various changes or modifications may be made in these embodiments without departing from the principles and spirit of the disclosure, the scope of which is defined in the claims and their equivalents.

As used herein, an element recited in the singular and proceeded with the word "a" or "an" should be understood as not excluding plural of said elements or steps, unless such exclusion is explicitly stated. Furthermore, references to "one embodiment" of the present invention are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Moreover, unless explicitly stated to the contrary, embodiments "comprising" or "having" an element or a plurality of elements having a particular property may include additional such elements not having that property.

What is claimed is,

1. A method for connecting a first optical and electric hybrid cable (100) and a second optical and electric hybrid cable (200), the first optical and electric hybrid cable (100) having a first power cable (110) and a first fiber tube (120) for receiving a fiber (130) therein, and the second optical and electric hybrid cable (200) having a second power cable (210) and a second fiber tube (220) for receiving the fiber (130) therein,

the method comprising steps of optically connecting the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200) and electrically connecting the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200),

wherein the step of optically connecting the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200) comprises steps of:

S110: blowing a continuous fiber (130) to pass through one first fiber tube (120) of the first optical and electric hybrid cable (100) by a compressor (500);

S120: blowing the fiber (130), which has passed through the first fiber tube (120), to pass through one second fiber tube (220) of the second optical and electric hybrid cable (200) by the compressor (500);

S130: removing the compressor (500); and

S140: coupling the first fiber tube (120) and the second fiber tube (220), through which the fiber (130) has passed, by a fiber tube connection assembly (300, 230, 330').

2. The method according to claim 1, wherein the fiber tube connection assembly (300, 230, 330') comprises:

an intermediate connecting tube (230) having a diameter larger than that of the first fiber tube (120) and the second fiber tube (220);

a first tapered tube connector (300) having a first port with smaller diameter and a second port with larger diameter; and

a second tapered tube connector (300') having a first port with smaller diameter and a second port with larger diameter,

wherein the first fiber tube (120) is inserted into and connected to the first port of the first tapered tube connector (300), the second fiber tube (220) is inserted into and connected to the first port of the second tapered tube connector (300'), and two ends of the intermediate connecting tube (230) are inserted into and connected to the second ports of the first tapered tube connector (300) and the second tapered tube connector (300'), respectively.

3. The method according to claim 2, further comprising steps of:

before the step S120, inserting the first fiber tube (120) from the first port of the first tapered tube connector (300) to pass through the first tapered tube connector (300), inserting the second fiber tube (220) from the first port of the second tapered tube connector (300') to pass through the second tapered tube connector (300'), and sleeving the intermediate connecting tube (230) onto the first fiber tube (120), which has passed through the first tapered tube connector (300), or the second fiber tube (220), which has passed through the second tapered tube connector (300').

4. A method for connecting a first optical and electric hybrid cable (100) and a second optical and electric hybrid cable (200), the first optical and electric hybrid cable (100) having a first power cable (110) and a first fiber tube (120) for receiving a fiber (130) therein, and the second optical and electric hybrid cable (200) having a second power cable (210) and a second fiber tube (220) for receiving the fiber (130) therein,

the method comprising steps of optically connecting the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200) and electrically connecting the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200),

wherein the step of optically connecting the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200) comprises steps of:

S210: providing a fiber tube connection assembly (300, 230, 330') comprising a first tapered tube connector (300), a second tapered tube connector (300') and an intermediate connecting tube (230), each of the first tapered tube connector (300) and the second tapered tube connector (300') having a first port with smaller diameter and a second port with larger diameter, the intermediate connecting tube (230) having a diameter larger than that of the first fiber tube (120) and the second fiber tube (220);

S220: blowing a continuous fiber (130) to pass through the first fiber tube (120) of the first optical and electric hybrid cable (100) by a compressor (500);

S230: inserting the first fiber tube (120), through which the fiber (130) has passed, from the first port of the first tapered tube connector (300) to pass through the first tapered tube connector (300), inserting one second fiber tube (220) from the first port of the second tapered tube connector (300') to pass through the second tapered tube connector (300'), and sleeving the intermediate connecting tube (230) onto the first fiber tube (120), which has passed through the first tapered tube connector (300), or the second fiber tube (220), which has passed through the second tapered tube connector (300');

S240: blowing the fiber (130), which has passed through the first fiber tube (120), to pass through the second fiber tube (220) of the second optical and electric hybrid cable (200), which has passed through the second tapered tube connector (300'), by the compressor (500);

S250: removing the compressor (500); and

S260: moving the first tapered tube connector (300), the second tapered tube connector (300') and the intermediate connecting tube (230), such that the first fiber tube (120) is connected to the first port of the first tapered tube connector (300), the second fiber tube (220) is connected to the first port of the second tapered tube connector (300'), and two ends of the intermediate connecting tube (230) are connected to the second ports of the first tapered tube connector (300) and the second tapered tube connector (300'), respectively.

5. The method according to claim 4, wherein the step of electrically connecting the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200) comprises steps of:

electrically connecting the first power cable (110) of the first optical and electric hybrid cable (100) and the second power cable (210) of the second optical and electric hybrid cable (200) by a power cable connector (400).

15

6. The method according to claim 5, wherein

the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200) comprise one or more power cables (110, 210), respectively; and

said one or more power cables (110, 210) of the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200) are electrically connected by one or more power cable connectors (400), respectively.

7. The method according to claim 6, wherein

the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200) comprise one or more fiber tubes (120, 220), respectively; and

said one or more fiber tubes (120, 220) of the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200) are coupled by one or more fiber tube connection assembly (300, 230, 330'), respectively.

8. The method according to claim 7, wherein

all power cables (110, 210) of the first optical and electric hybrid cable (100) or the second optical and electric hybrid cable (200) are wrapped in a metal shielding layer (102, 202), and insulation filling materials (101, 201) are filled into the gap between the metal shielding layer and the power cables (110, 210); and

the fiber tubes (120, 220) of the first optical and electric hybrid cable (100) or the second optical and electric hybrid cable (200) are embedded in the insulation filling materials (101, 201).

9. The method according to claim 8, wherein
the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200) comprise three power cables (110, 210) and three fiber tubes (120, 220), respectively; and

5 the three power cables (110, 210) of the first optical and electric hybrid cable (100) or the second optical and electric hybrid cable (200) are intertwined with each other, and tangential to each other with peripheries thereof.

10 10. The method according to claim 4, wherein the first tapered tube connector (300) comprises:

a first body having a first port and a second port opposite to the first port; and
a first resilient barb member (311) provided on the inner wall of the first port of the first body; and a second resilient barb member (312) provided on the inner wall of the second port of the first body, wherein

15 the first fiber tube (120) and the intermediate connecting tube (230) are inserted into the first port and the second port of the first body, respectively;

the first resilient barb member (311) is configured to allow the first fiber tube (120) to be inserted towards inside of the first body, and prevent the first fiber tube (120) from being pulled out towards outside of the first body; and

20 the second resilient barb member (312) is configured to allow the intermediate connecting tube (230) to be inserted towards inside of the first body, and prevent the intermediate connecting tube (230) from being pulled out towards outside of the first body.

25 11. The method according to claim 10, wherein the second tapered tube connector (300') comprises:

a second body having a first port and a second port opposite to the first port; and
a first resilient barb member (311') provided on the inner wall of the first port of the second body; and a second resilient barb member (312') provided on the inner wall of the second port of the second body, wherein

30 the second fiber tube (220) and the intermediate connecting tube (230) are inserted into the first port and the second port of the second body, respectively;

the first resilient barb member (311') of the second body is configured to allow the second fiber tube (220) to be inserted towards inside of the second body, and prevent the second fiber tube (220) from being pulled out towards outside of the second body; and

35 the second resilient barb member (312') of the second body is configured to allow the intermediate connecting tube (230) to be inserted towards inside of the second body, and prevent the intermediate connecting tube (230) from being pulled out towards outside of the second body.

12. The method according to claim 11, wherein the first and second tapered tube connector (300, 300') each further comprises:

a first movable member (341, 341') mounted in the first port of the first/second body, wherein the first movable member (341, 341') has a first pressure portion (3410, 3410') extending toward the first resilient barb member (311, 311'), and the first movable member (341, 341') is movable from a first position for releasing the first resilient barb member (311, 311') to a second position for pressing the first resilient barb member (311, 311'); when the first movable member (341, 341') is located at the first position, the first resilient barb member (311, 311') is held in a first state which allows the first or second fiber tube (120, 220) to be inserted towards inside of the first or second body, and prevent the first or second fiber tube (120, 220) from being pulled out towards outside of the first or second body; and when the first movable member (341, 341') is located at the second position, the first resilient barb member (311, 311') is pressed by the first pressure portion (3410, 3410') and held in a second state which allows the first or second fiber tube (120, 220) to be pulled out towards outside of the first or second body; and

a second movable member (342, 342') mounted in the second port of the first or second body, wherein the second movable member (342, 342') has a second pressure portion (3420, 3420') extending toward the second resilient barb member (312, 312'), and the second movable member (342, 342') is movable from a first position for releasing the second resilient barb member (312, 312') to a second position for pressing the second resilient barb member (312, 312'); when the second movable member (342, 342') is located at the first position, the second resilient barb member (312, 312') is held in a first state which allows the intermediate connecting tube (230) to be inserted towards inside of the first or second body, and prevent the intermediate connecting tube (230) from being pulled out towards outside of the first or second body; and when the second movable member (342, 342') is located at the second position, the second resilient barb member (312, 312') is pressed by the second pressure portion (3420, 3420') and held in a second state which allows the intermediate connecting tube (230) to be pulled out towards outside of the first or second body.

13. The method according to claim 12, wherein the first and second tapered tube connector (300, 300') each further comprises:

a first resilient seal ring (321, 321') provided on the inner wall of the first port of the first or second body for sealing an engagement interface between the first or second body and the first or second fiber tube (120, 220) inserted into the first or second body; and

a second resilient seal ring (322, 322') provided on the inner wall of the second port of the first or second body for sealing an engagement interface between the first or second

body and the intermediate connecting tube (230) inserted into the first or second body.

14. The method according to claim 13, wherein the first/second tapered tube connector (300, 300') each further comprises:

5 a first spacer (331, 331') provided on the inner wall of the first port of the first or second body and one side of the first resilient barb member (311, 311') facing to the inner wall of the first or second body to prevent the first resilient barb member (311, 311') from excessive deformation or damage; and

10 a second spacer (332, 332') provided on the inner wall of the second port of the first or second body and one side of the second resilient barb member (312, 312') facing to the inner wall of the first or second body to prevent the second resilient barb member (312, 312') from excessive deformation or damage.

15 15. The method according to claim 5, wherein the power cable connector (400) comprises:

 a crimping tube constructed to crimp a conductor core (111) of the first power cable (110) of the first optical and electric hybrid cable (100) with a conductor core (121) of the second power cable (120) of the second optical and electric hybrid cable (200); and

20 an insulation sleeve constructed to be sleeved outside the crimping tube and insulation layers of the first and second power cables (110, 210), so that the insulation sleeve is acted as sections of insulation layers of the first and second power cables (110, 210) which are stripped.

16. The method according to claim 4, further comprising a step of:

25 binding on a junction of the first optical and electric hybrid cable (100) and the second optical and electric hybrid cable (200) by a layer of waterproof band to wrap hermetically the fiber tube connection assembly (300, 230, 330') and the power cable connector (400) therein.

30 17. The method according to claim 16, wherein the first tapered tube connector (300) is constructed to be identical to the second tapered tube connector (300').

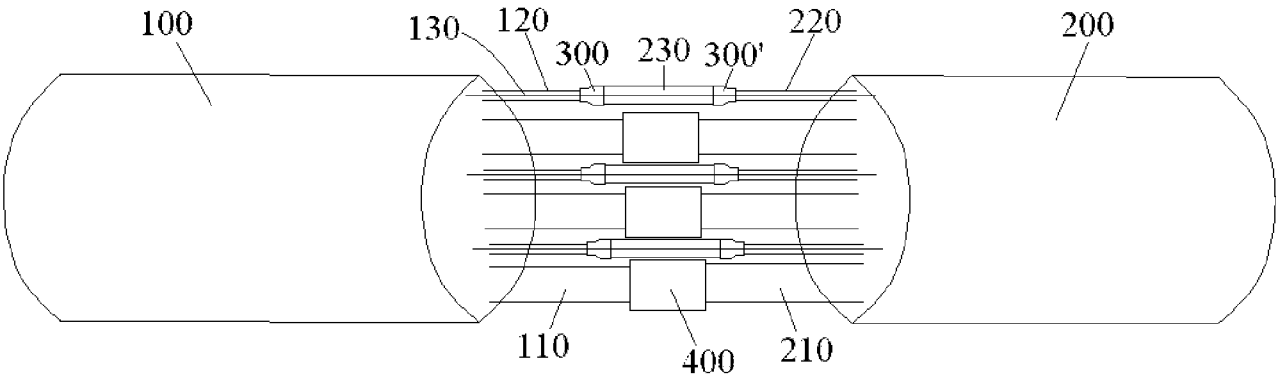


Fig. 1

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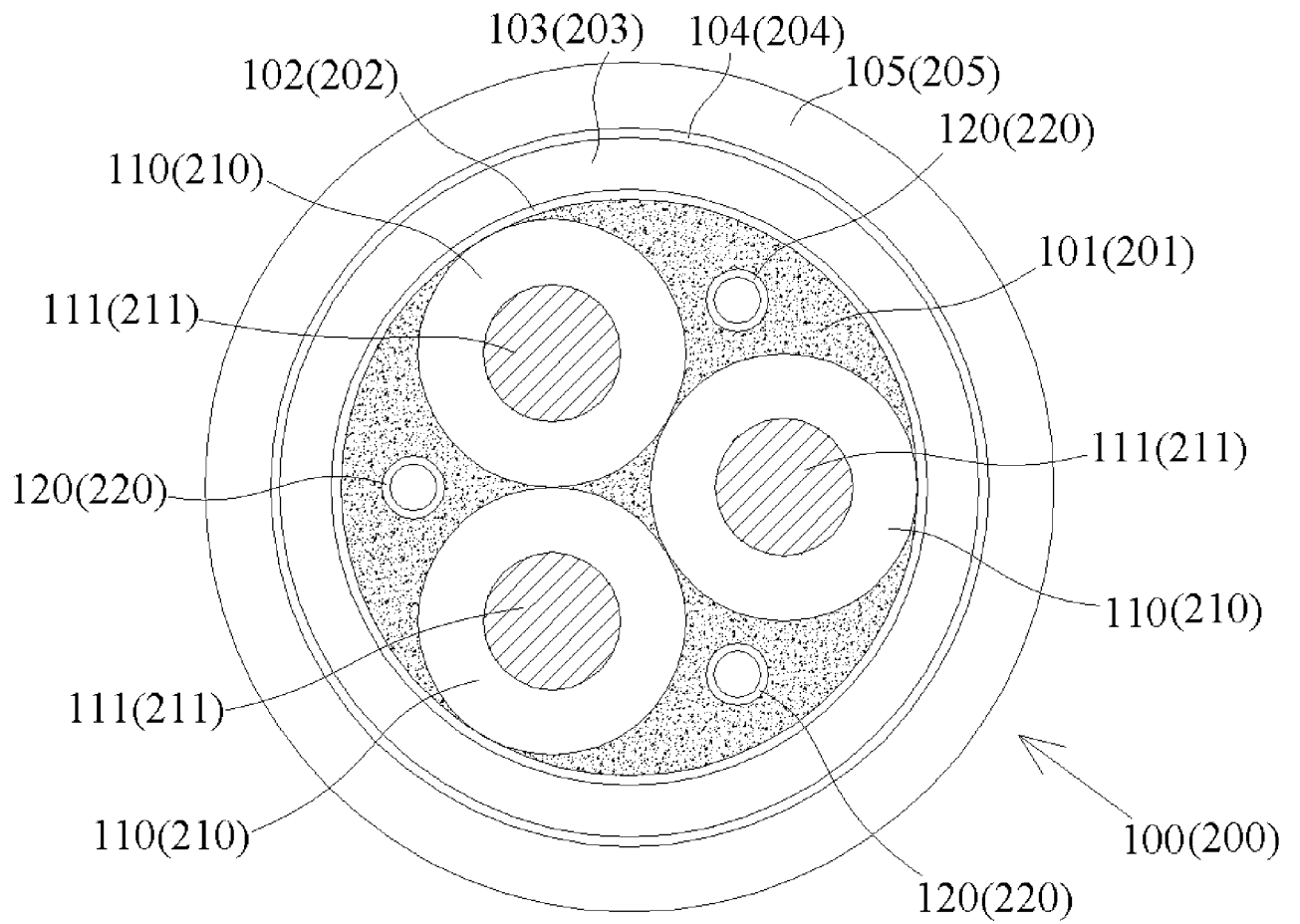


Fig. 2a

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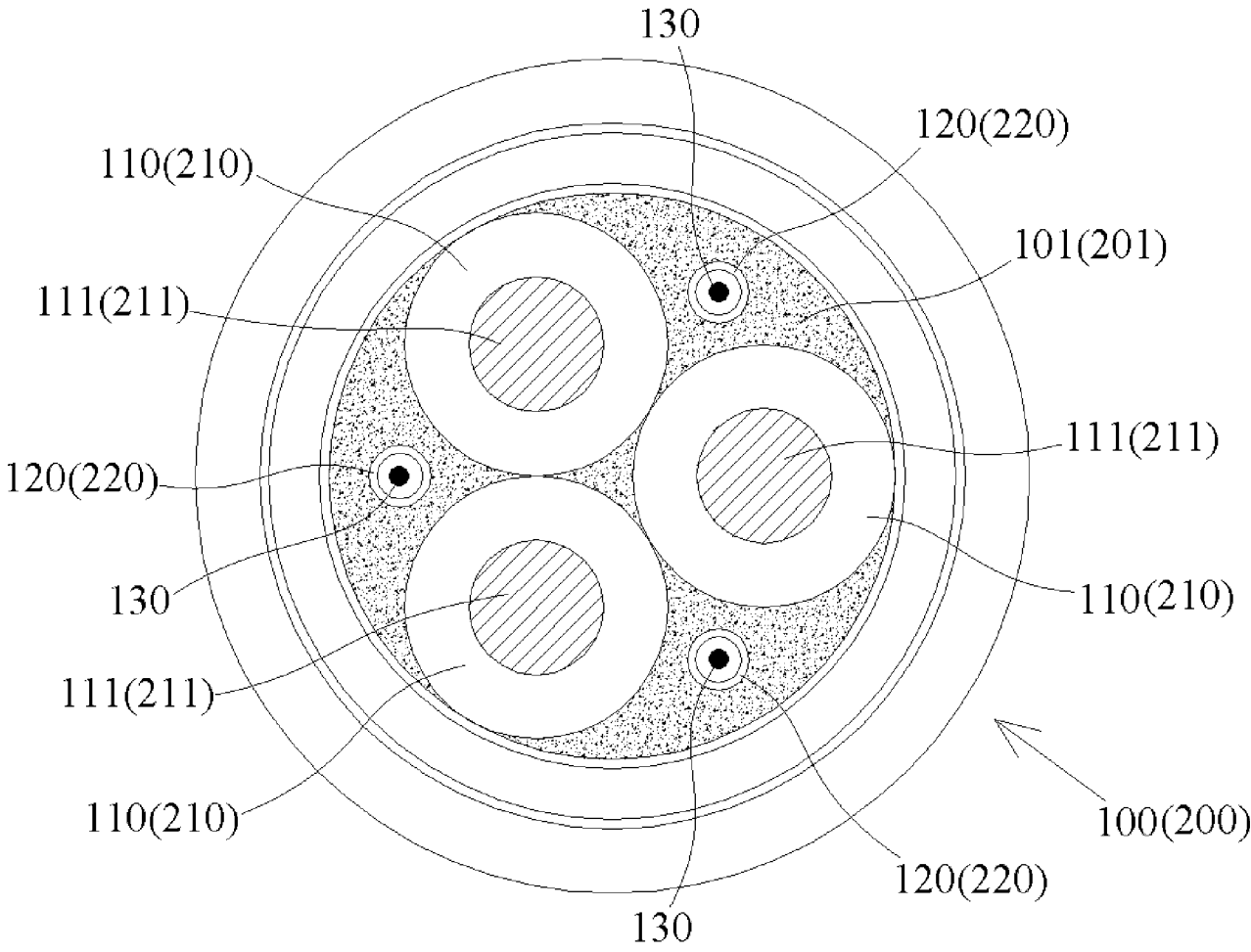


Fig. 2b

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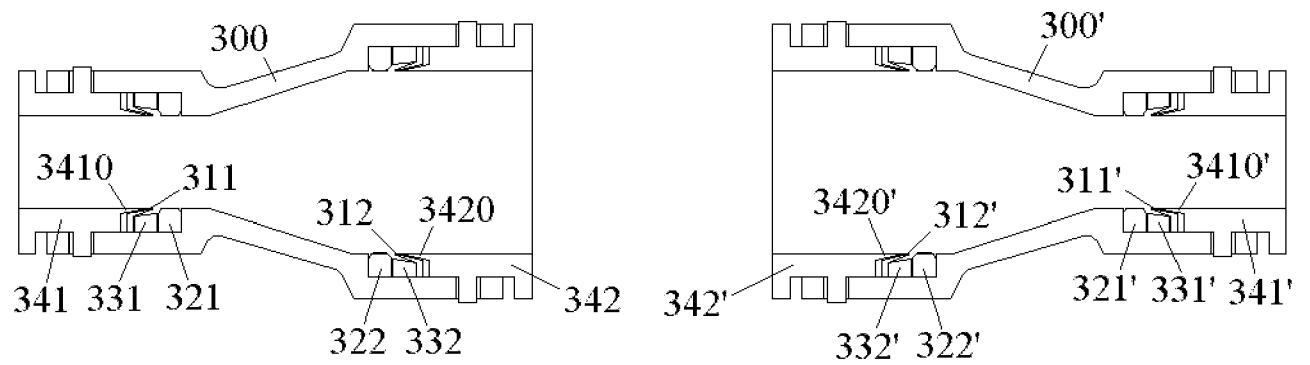


Fig. 3a

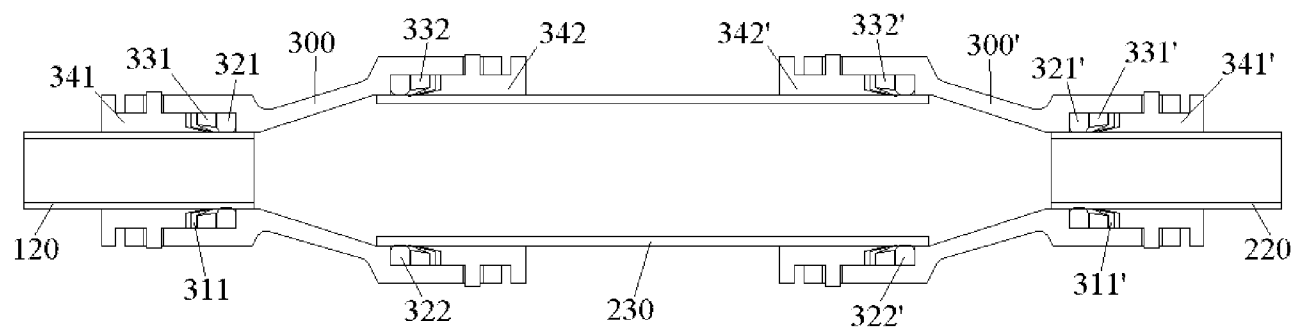


Fig. 3b

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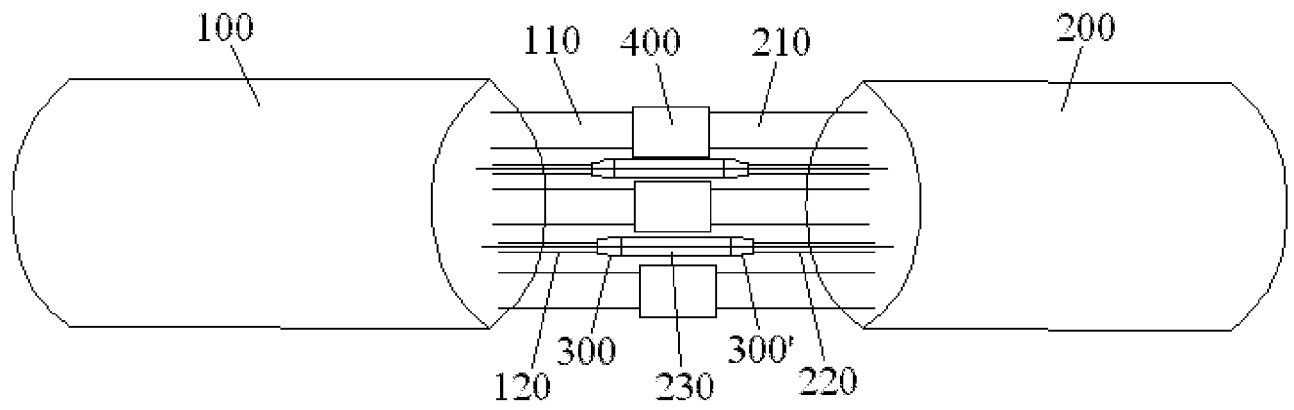


Fig. 4

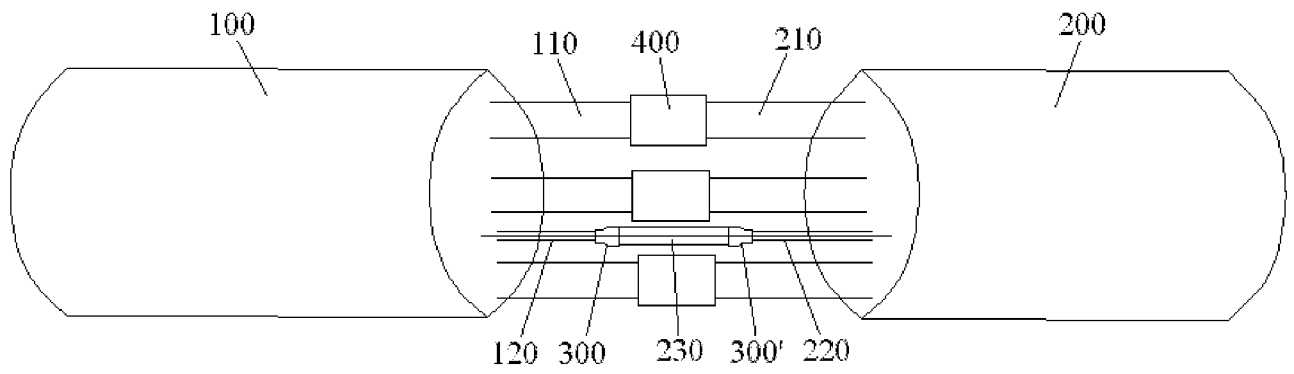


Fig. 5

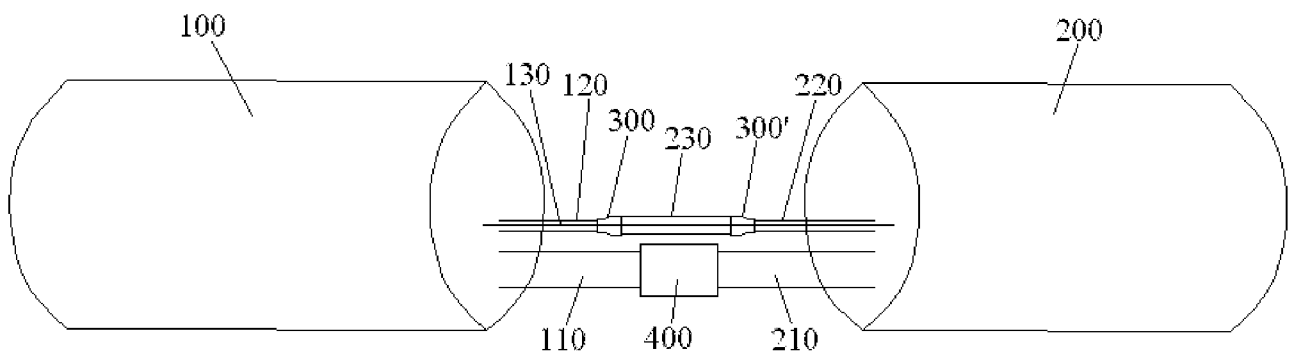


Fig. 6

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Fig. 7a

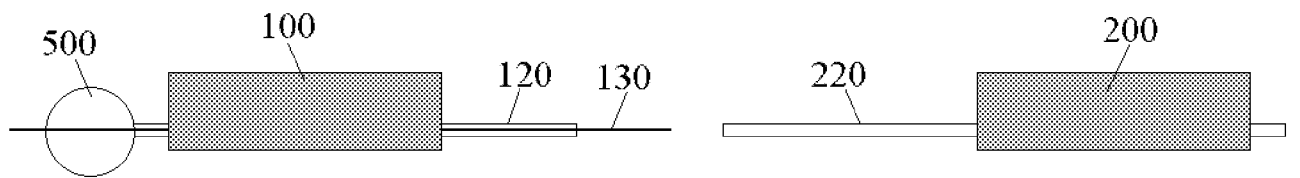


Fig. 7b

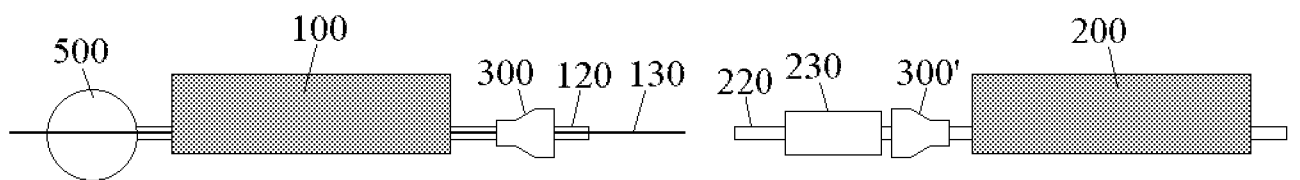


Fig. 7c

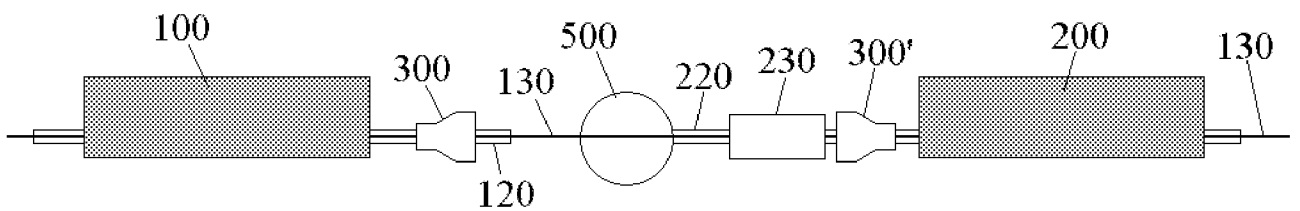


Fig. 7d

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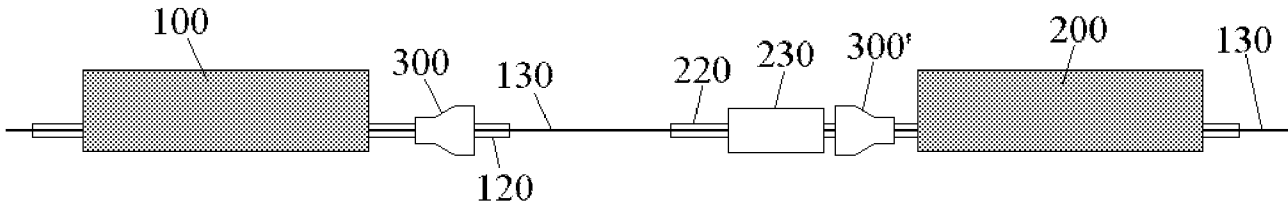


Fig. 7e

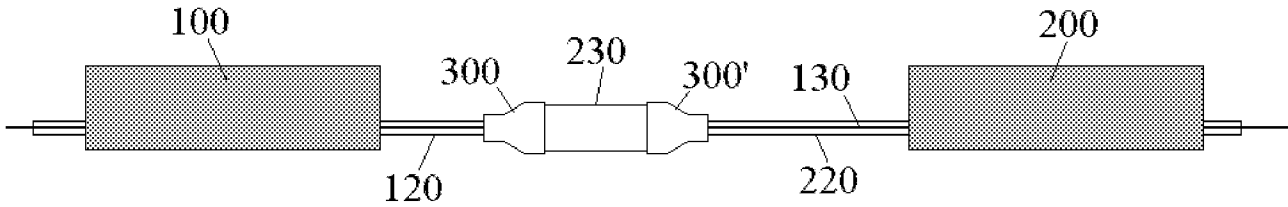


Fig. 7f

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2015/055435

A. CLASSIFICATION OF SUBJECT MATTER INV. G02B6/44 G02B6/46 ADD.		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) G02B		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EPO-Internal, WPI Data		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 03/044583 A1 (PIRELLI GENERAL PLC [GB]; SUTHELL RALPH [GB]; DAVIES MARTIN VINCENT []) 30 May 2003 (2003-05-30)	1-7,9-12
Y	page 5, line 9 - line 11; figures 3,6,7 page 5, line 15 - page 6, line 6 page 12, line 5 - line 18 page 9, line 8 - line 15 -----	8,9, 13-17
X	EP 0 410 735 A2 (BICC PLC [GB]) 30 January 1991 (1991-01-30)	1
Y	figures 1,2 -----	8,9, 13-17
Y	EP 0 780 713 A1 (PIRELLI GENERAL PLC [GB]) 25 June 1997 (1997-06-25) figure 4 -----	13
-/-		
☒ Further documents are listed in the continuation of Box C. ☒ See patent family annex.		
* Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search		Date of mailing of the international search report
29 October 2015		09/11/2015
Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016		Authorized officer Jones, Julian

INTERNATIONAL SEARCH REPORT

International application No

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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