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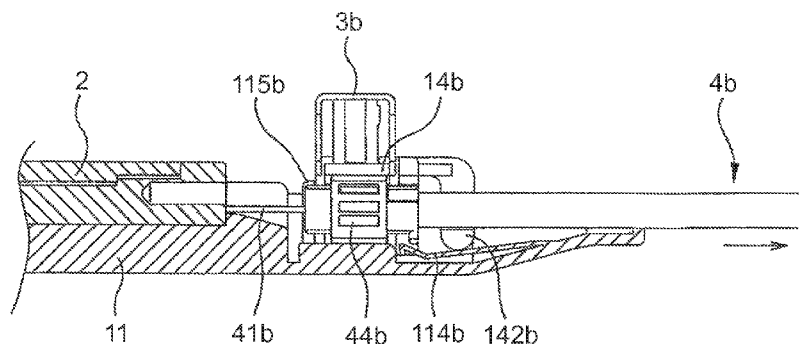


Fig. 10

(57) Abstract: A connecting structure for an optical cable by which connecting of the cable may be performed with few man-hours and without causing a mistake by an operator. A latch releasing member (142b) is integrally formed with a clip carrying member (14b). When clip carrying member (14b) is rotated so that a clip (3b) carried by clip carrying member (14b) is positioned close to a clip holder (44b) of a cable (4b), latch releasing member (142b) pushes down a latch (114b) of a base (11) in order to disengage the latch. As latch (114b) prevents cable holder (44b) from moving backward, by the operation to push down latch (114b), cable holder (44b) may be moved away from a mechanical splice (2) by a restoring force of a bent core fiber (41b).

CONNECTING STRUCTURE FOR OPTICAL CABLE

TECHNICAL FIELD

The present invention relates to a connecting structure for an optical cable including a mechanical splice therein.

BACKGROUND ART

5 In recent years, a connecting structure of a field mounting type including an optical fiber is used for constructing an optical fiber network such as a FFTH (Fiber to Home). The connecting structure has, for example, a so-called mechanical splice structure therein. (This structure may permanently connect ends of naked optical fibers to each other such
10 that the ends of the fibers abut each other, without welding or adhering.) For example, Japanese Unexamined Patent Publication (Kokai) No. 2003-322762 discloses a connecting jig for a mechanical splice-type connector used for inserting an optical fiber into a holding groove of a splice member.

Generally, in a connecting structure containing a mechanical splice the ends of
15 core fibers of two drop cables processed in the assembling field abut each other. At this point, in order to ensure the abutment state, the drop cables are biased toward the connecting structure such that the core fibers somewhat bend near the mechanical splice. The abutment state may maintained by a reaction force obtained by bending of the fibers. For example, it is described in Japanese Unexamined Patent Publication (Kokai) No.
20 2007-121878 disclosing a connecting tool for an optical connector, that "According to the connecting tool, a flexure or a bend of a fiber, desired when the fiber is connected in a mechanical splice, may be easily and quantitatively generated, whereby two fibers may be surely connected in the mechanical splice."

Further, Japanese Unexamined Patent Publication (Kokai) No. 2005-208496
25 discloses a closure 10 including a clamp part 4 for connecting two optical fibers 2 inserted into a closure sleeve 11 from opposing ends thereof; and a coupling platform 3 having a pair of holder ports 20 for gripping optical fibers 2, clamp part 4 being positioned between holder ports 20, holder parts 20 being configured to slidably move from both ends of platform 3 to clamp part 4 so that optical fibers 2 gripped by holder parts 20 may be
30 inserted into clamp part 4.

The optical cable or the drop cable, used in a FTTH application, is connected in a cabinet, arranged on an electric pole by using a mechanical splice or another connector and wired to each home. If at least a part of the drop cable between the electric pole and each home has trouble, such as breaking or being damaged, the cable between the electric pole and the home having the trouble is removed and wire distribution is restarted from the beginning again. Accordingly, it is desired to restore the drop cable by inserting another drop cable into the broken or damaged point of the cable, without restarting the wire distribution from the beginning.

When the connecting structure is used for the FTTH application, the connection of the structure is often done in a treacherous place in an unstable outdoor environment. Accordingly, a connecting structure is desired by which the connecting of the cable may be done with few man-hours, by bringing members required for the work together.

In a drop cable after the connection is completed, it is preferable that a core fiber of the cable does not have a flexure in the connecting structure so as to reduce optical loss. On the other hand, the cable is connected with a certain flexure, optical loss by which may be neglected or allowable, in order that disadvantageous tension is not applied to the core fiber due to a change in dimension by heat or the like. However, depending on the procedure of the connecting structure, an operator may forget to provide the flexure to the core fiber, or may purposely release the flexure. Therefore, a connecting structure, by which the operator may carry out the connection without forgetting to provide a certain flexure to the core fiber and the operator cannot purposely release the flexure, is desired.

Further, when the connecting structure is used indoors, a simple and compact connecting structure is desired.

The present invention thus provides a connecting structure for an optical cable by which connecting of the cable may be performed with few man-hours and without causing a mistake by an operator.

In order to achieve the object of the invention described above, one embodiment of the present invention provides a connecting structure comprising: a case containing a mechanical splice configured to connect two optical fibers of two cables; an engaging part arranged in the case and configured to engage with at least one cable such that the at least one cable is not separated from the mechanical splice by more than a predetermined distance in the longitudinal direction of the at least one cable; a releasing part configured

to release the engaging part from the at least one cable; a clip carrying member configured to carry a clip member for fixing the cable to the case and move relative to the case such that the clip member may be positioned close to the cable, wherein the releasing part is integrally formed with the clip carrying member and configured to release the engaging
5 part from the at least one cable when the clip member is positioned close to the cable.

Another embodiment of the present invention provides a connecting structure comprising: a case having a mechanical splice mounting part for containing a mechanical splice configured to connect two optical fibers of two cables; a clip for gripping and fixing the cable to the case; and a cover constituting a closure cooperatively with the base,
10 wherein the cover has a pushing member for contacting at least a part of the clip gripping the cable and pushing the clip in the direction along the longitudinal direction of the cable toward the mechanical splice mounting part, when the cover is attached to the base so as to form the closure.

Still another embodiment of the present invention provides a connecting structure
15 comprising: a housing containing a mechanical splice configured to connect two optical fibers of two cables; and an actuation member for closing the mechanical splice, the actuation member extending in the longitudinal direction of the housing, wherein at least one of both ends in the longitudinal direction of the housing of the actuation member is attached the housing, and an intermediate part of the actuation member between both ends
20 is configured to be displaced toward the mechanical splice and contact the mechanical splice.

According to one embodiment of the present invention, the operation for positioning the clip member close to the cable is combined with the operation for releasing the engaging part holding the cable from the cable, whereby the connection of the cable
25 may be performed with few man-hours and without causing a mistake by the operator. Further, by using the clip carrying member for carrying the clip member, the clip member cannot be lost and cannot be an obstacle to the operation.

According to another embodiment of the present invention, by inserting optical cables each having a predetermined length of exposed core fiber into a mechanical splice
30 of a connecting structure, the cables may be easily connected to each other without using another tool. In this connection, since clip gripping the cable is pushed toward the mechanical splice when a cover is attached to a base, a certain length of bend is formed in

the core fiber of the cable when the assembling operation of the connecting structure is completed. Therefore, an operator cannot purposely release the bend, whereby a stable operation may be performed regardless of the skill of the operator.

According to still another embodiment of the present invention, a compact and
5 simple connecting structure may be provided. Further, the connecting work of cables may be carried out with relatively few man-hours.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other objects, features and advantages of the present invention will be made more apparent by the following description of the preferred embodiments thereof,
10 with reference to the accompanying drawings, wherein:

Fig. 1 is a perspective view showing a connecting structure according to a first embodiment of the present invention.

Fig. 2 is a diagram showing a constitution of a drop cable which may be connected by using the connecting structure.

15 Fig. 3 is a perspective view showing the state that a first drop cable is positioned in the connecting structure.

Fig. 4 is a perspective view showing the state that a clip is positioned close to the first drop cable.

Fig. 5 is a perspective view showing the state that the clip is pushed down to fix
20 the first drop cable.

Fig. 6 is a perspective view showing the state that a second drop cable is positioned in the connecting structure.

Fig. 7a is an axial cross-sectional view showing the state before the second drop cable is fixed by a latch.

25 Fig. 7b is an axial cross-sectional view showing the state after the second drop cable is fixed by the latch.

Fig. 8 is a perspective view showing the state that a mechanical splice of the connecting structure is closed.

Fig. 9 is a perspective view showing the state that a clip is positioned close to the
30 second drop cable.

Fig. 10 is a perspective view showing the state that the latch is released by a latch releasing member of a clip carrying member.

Fig. 11 is a perspective view showing the state that the clip is pushed down to fix the second drop cable.

Fig. 12 is a perspective view showing the state that a cover is closed to complete the connecting structure.

5 Fig. 13 is a perspective view showing a connecting structure according to a second embodiment of the present invention.

Fig. 14 is an axial cross-sectional view showing the state that a latch is released by pushing down a lever.

10 Fig. 15 is a schematic view showing an example around a latch when a cable does not have a cable holder.

Fig. 16a is a schematic view showing another example around a latch when a cable does not have a cable holder.

Fig. 16b is a schematic view showing the state that a cable holder guide engaging with a cable is released by an engagement releasing member.

15 Fig. 17 is a perspective view showing a connecting structure according to a third embodiment of the present invention.

Fig. 18 is a diagram showing a constitution of a drop cable which may be connected by using the connecting structure.

20 Fig. 19 is a perspective view showing the state that a first drop cable is positioned in the connecting structure of Fig. 17.

Fig. 20 is a perspective view showing the state that the first drop cable is fixed to a base by means of a clip.

Fig. 21 is a perspective view showing the state that a second drop cable is positioned in the connecting structure.

25 Fig. 22 is a perspective view showing the state that a mechanical splice of the connecting structure is closed.

Fig. 23 is a perspective view showing the state that the second drop cable is fixed to the base by means of a clip.

30 Fig. 24 is a perspective view showing the state that a cover is closed to complete the connecting structure.

Fig. 25a is an axial cross-sectional view showing the state before the second drop cable is fixed by the clip.

Fig. 25b is an axial cross-sectional view showing the state that the clip is pushed toward the base.

Fig. 25c is an axial cross-sectional view showing the state after the second drop cable is fixed by the clip.

5 Fig. 25d is an axial cross-sectional view showing the state that the cover is positioned above the base.

Fig. 25e is an axial cross-sectional view showing the state that the cover is attached to the base and the clip is displaced toward the mechanical splice.

Fig. 26 is a partial enlarged view of Fig. 25c.

10 Fig. 27 is a partial enlarged view of Fig. 25e.

Fig. 28 is a perspective view showing a connecting structure according to a fourth embodiment of the present invention.

Fig. 29 is an exploded perspective view showing a connecting structure according to a fifth embodiment of the present invention.

15 Fig. 30 is a diagram showing a constitution of a drop cable which may be connected by using the connecting structure.

Fig. 31 is a diagram showing the state that a mechanical splice is positioned in a housing of the connecting structure of Fig. 29.

20 Fig. 32 is a diagram showing the state that first and second drop cables are positioned in the connecting structure of Fig. 29.

Fig. 33 is a cross-sectional view along XXXIII-XXXIII line of Fig. 32.

Fig. 34 is a diagram showing the state that the first and second drop cables are displaced away from the mechanical splice by a certain distance, from the state of Fig. 32.

Fig. 35 is a cross-sectional view along XXXV-XXXV line of Fig. 34.

25 Fig. 36 is a perspective view showing the state that the clip is pushed down to complete the connecting structure.

Fig. 37 is a perspective view showing a connecting structure according to a sixth embodiment of the present invention.

30 Fig. 38 is a diagram showing the state that a mechanical splice is positioned in a housing of the connecting structure of Fig. 37.

Fig. 39 is a diagram showing a constitution of a drop cable which may be connected by using the connecting structure.

Fig. 40 is a diagram showing the state that first and second drop cables are positioned in the connecting structure of Fig. 37.

Fig. 41 is a perspective view showing the state that the clip is rotated to complete the connecting structure.

5 Fig. 42 is a cross-sectional view along XXXXII-XXXXII line of Fig. 41.

Fig. 43 is a diagram showing the state that the connecting structure of the sixth embodiment is contained in a case.

DESCRIPTION OF EMBODIMENTS

Fig. 1 is a perspective view of a first embodiment of a connecting structure for
10 optical cables according to the present invention. A connecting structure 1 has a base member 11 for receiving two drop cables to be connected, and a cover member 12 pivotably connected to base member 11 by means of a hinge 121. In this embodiment, each of base 11 and cover 12 has a general shape of a halved cylinder formed by dividing a cylinder into two pieces along the longitudinal direction thereof. As described below,
15 base 11 and cover 12 cooperatively form a closure or a case. Connecting structure 1 also has a closing part or a lever member 13 pivotably connected to base 11 by means of a hinge 131 such that the lever member may close a mechanical splice 2 located at generally the center of base 11; and clip carrying members 14a, 14b for carrying fixing part or clip members 3a, 3b for fixing cable holder 44a, 44b (see Fig. 2) attached to drop cables 4a, 4b
20 to base 11. Clip carrying members 14a, 14b are pivotably connected to base 11 by means of hinges 141a, 141b, respectively.

Clip 3a is a member formed by machining a plate member and has a substrate 31a; two pairs of opposing fixed edges 32a extending in the direction perpendicular to the substrate, from both ends in the direction of insertion of the cable of substrate 31a toward
25 the base; and guides 33a extending in the same direction of edges 32a, from both ends in the direction generally perpendicular to the direction of insertion of the cable. Each pair of edges 32a grips the cable therebetween. Guides 33a attached to clip carrying member 14a such that the guides grips both ends of clip carrying member 14a in the direction generally perpendicular to the direction of insertion of the cable. Clip 3b may have the
30 same configuration as clip 3a.

Clip carrying member 14a is generally a flat plate member, having a slit 143a at an outside end in the direction of insertion of the cable for receiving a pair of fixed edges 32a

of clip 3a, and a recess 144a at an opposing inside end in the direction of insertion of the cable for guiding the lateral side of another pair of fixed edges 32a. On one lateral side of clip carrying member 14a contacting guide 33a of clip 3a, a recess 145a having the generally same width as guide 33a is formed. On the other lateral side (i.e., the side near
5 hinge 141a) of clip carrying member 14a, an opening 146a is formed. Recesses 144a and 146a, corresponding to fixed edges 32a and guide 33a, respectively, have side walls for guiding edges 32a and guide 33a such that clip 3a may be pushed in the direction generally perpendicular to the cable, as described below. In addition, clip carrying member 14b may have the same configuration as clip carrying member 14a, except for a
10 latch releasing member 142b as described below.

Lever member 13 is generally a flat plate member and has a splice contacting surface 132 capable of contacting mechanical splice 2 and an operation surface 133 opposed to splice contacting surface 132. The mechanical splice used in this embodiment is configured to close a core fiber holding member folded in V-shape (not shown)
15 contained therein by pushing a cap member 21 toward a main body 22, whereby two core fibers of the cables within the core fiber holding member may be aligned and fixed by means of an alignment groove (not shown) formed on the inner surface of the core fiber holding member.

Base 11, cover 12, lever 13 and clip carrying members 14a, 14b may be
20 individually formed or integrally formed by molding. Clips 3a, 3b may be formed by using arbitrary material having the required strength, such as a metal or a plastic.

Hereinafter, the procedure for connecting two drop cables using connecting structure 1 is explained with reference to Figs. 1 to 12. First, as shown in Fig. 1, mechanical splice 2 is located at generally the center of base 11. Mechanical splice 2 may
25 be gripped by splice guides 111a, 111b formed in base 11, so as to correctly position the mechanical splice. Next, as shown in Fig. 2, a drop cable 4a is provided, in which an optical fiber or a core fiber 41a constituted by silica glass and a UV-coating 42a of the cable is exposed by predetermined lengths from one end thereof, and a cable holder 44a is attached at or near the boundary between the UV-coating and a jacket 43a of the cable.
30 When the cable is processed, a known jacket removing tool and a core fiber (glass fiber) cutting tool may be used. Cable holder 44a has, as shown in Fig. 2, generally a rectangular solid shape when attached to cable 4a, with a body portion 441a and a lid

portion 442a connected to body portion 441a by means of a hinge (not shown). The body portion has a recess for receiving the drop cable and serrate projections (not shown) on opposing surfaces of the recess. When the drop cable is inserted into the recess, the serrate projections bite into jacket 43a of the cable so as to hold the cable. Body portion 441a also has a path (not shown) for the core fiber such that the core fiber exposed from the end of the jacket of the cable may extend generally along the longitudinal direction of the cable. Lid portion 442a is closed after insertion of the cable into the recess of body portion 441a, whereby the separation of drop cable 4a from cable holder 44a may be avoided.

Drop cable 4b may have the same configuration as drop cable 4a. In this connection, the term "drop cable" used herein means a cable used for wiring between a connection box arranged on an electric pole and each home of the user. The drop cable has a jacket such as PVC or PE containing a core fiber coated by arbitrary resin such as UV-resin, and one or more high tensile strength material such as FRP or metal. The drop cable generally has a rectangular cross section in the direction perpendicular to the longitudinal direction thereof. Generally, in such a drop cable, the jacket and the core fiber are substantially closely attached or integrally formed with other. Therefore, by fixing the jacket of the cable, the core fiber may be indirectly fixed. The connecting structure of the invention may be used for a cable other than the drop cable, as long as a core fiber and a jacket of the cable are substantially closely attached such that the core fiber cannot be substantially moved relative to the jacket. Further, even a cable having a core fiber which is not closely attached to a jacket may be used, if the jacket gripped by a cable holder is constricted and comes into contact with the core fiber, whereby the core fiber cannot be substantially moved relative to the jacket. Hereinafter, the term "core fiber" means a portion of the cable outwardly extending from cable holder 44a or 44b in Fig. 2, i.e., including core fiber portion 41a and UV-coating portion 42a.

Next, as shown in Fig. 3, first drop cable 4a is positioned in base 11 such that core fiber 41a of the cable is inserted into mechanical splice 2 in the longitudinal direction of the cable. At this point, the core fiber extending between the end of mechanical splice 2 and cable holder 44a is generally straight. The front end of core fiber 41a is positioned at a desired position (generally the center in the longitudinal direction) within mechanical splice 2. Base 11 has a core fiber guide 112a for guiding and inserting core fiber 41a into

mechanical splice 2, and a cable holder guide 113a for positioning cable holder 44a. Cable holder guide 113a has opposing surfaces, the distance of which is generally the same as or slightly greater than the width of cable holder 44a. Therefore, when cable holder 44a is moved along guide 113a, core fiber 41a is guided into mechanical splice 2, whereby the operator is not required to consciously insert the core fiber into a small hole of the mechanical splice.

Base 11 also has an engaging part or a latch 114a (see Fig. 1) for preventing the positioned cable holder 44a from moving backward, and a canopy member 115a (see Fig. 1) for preventing the cable holder from moving upward. Latch 114a is a flexible member and has an end 116a attached to base 11 which is the outside end in the direction of insertion of the cable, and an opposing end having a protrusion 117a on the upper surface thereof capable of engaging with cable holder 44a. Canopy member 115a has two members symmetrically arranged in relation to the longitudinal direction of the base, each extending upward (or toward a fitting surface between base 11 and cover 12) from the bottom of base 11 and having a canopy projection extending toward another opposing member. Cable holder guide 113a, latch 114a and canopy member 115a may be integrally with base 11, otherwise, may be partially or wholly formed as independent members as required.

Cable 4a is moved toward base 11 from above such that cable holder 44a is positioned at the end of base 11. Cable 4a is then moved toward the center of base 11 such that cable holder 44a slides along the bottom of the base. When cable holder 44a approaches protrusion 117a of latch 114a, cable holder 44a pushes down protrusion 117a so as to bend latch 114a, whereby cable holder 44a may be further moved toward the center of the base. The front end of core fiber 41a is guided into an insertion hole of mechanical splice 2 along an inner slope of core fiber guide 112a, toward the alignment member (not shown) within the mechanical splice. When cable 4a reaches a predetermined position, the lowered latch 114a is restored to its original shape by means of a restoring force thereof, whereby protrusion 117a engages with the rear end of the cable holder. In this position, as the upper surface of cable holder 44a is under the canopy projections of canopy member 115a, cable 4a cannot be moved upward from base 11 and away from mechanical splice 2.

Then, as shown in Fig. 4, clip carrying member 14a is rotated pivotably mounted to base 11 by hinge 141a such that clip 3a carried by clip carrying member 14a is positioned close to cable holder 44a. Next, as shown in Fig. 5, by pushing down clip 3a toward cable 4a, clip 3a may grip cable holder 44a so as to fix cable 4a to base 11. As described above, as clip 3a has two pairs of opposing fixed edges, each pair grips the side wall of cable holder 44a between the opposing edges thereof, whereby clip 3a may be integrated with cable 4a. In this connection, as clip carrying member 14a is positioned between substrate 31a of clip 3a and cable holder 44a, the clip carrying member may be fixed in relation to the direction of insertion of the cable, by means of the portions of the clip extending through the recess and the opening of the carrying member. Accordingly, cable 4a may be fixed to base 11 by means of clip 3a.

When the cable is fixed before the mechanical splice is closed, it may be avoided that the core fiber in the mechanical splice is unexpectedly deviated from the mechanical splice and/or an unexpected tension is applied to the connected core fiber. However, the above fixing operation of cable 4a using clip 3a may be performed after the mechanical splice is closed. If latch 114a may provide a desired engagement force, it is not necessary to fix cable holder 44a by clip 3a. Unlike in the case of another cable holder 44b as described below, cable holder 44a may be fixed at a desired position, whereby the cable holder may be fixed without using the clip member. On the other hand, cable holder 44b as described below, the fixed position thereof may somewhat varies depending on the difference between the cut lengths of the two core fibers. Therefore, in order to fix the cable holder without generating an excess length of a bend of the core fiber, it is preferable to use a fixing member such as a clip of the invention. Since the clip of the invention may be attached to the flat side surface of the cable holder, the clip may be fixed at a desired position within the flat surface, whereby the above difference between the cut lengths of the two core fibers may be absorbed by selecting the position of the clip relative to the cable holder.

Next as shown in Fig. 6, a second drop cable 4b similar to first drop cable 4a (see Fig. 2) is provided and positioned in base 11 such that a core fiber 41b of cable 4b may be inserted into the mechanical splice, in the longitudinal direction of the cable, at the opposing side in the case of core fiber 41a. Base 11 has a core fiber guide 112b for guiding and inserting core fiber 41b into mechanical splice 2, and a cable holder guide

113b for positioning a cable holder 44b attached to cable 4b. Therefore, similarly to the case of cable 4a, the operator can easily insert core fiber 41b into the mechanical splice, without consciously inserting core fiber 41b into a small hole of mechanical splice 2.

5 Figs. 7a and 7b are axial cross sections indicating the operation for inserting core fiber 41b of drop cable 4b into the mechanical splice. First, as shown in Fig. 7a, as core fiber 41b of cable 4b is inserted into the mechanical splice at the opposing side in the case of core fiber 41a, the front ends of core fibers 41a and 41b abut each other within mechanical splice 2. In this state, cable holder 44b of cable 4b does not contact core fiber guide 112b of base 11.

10 Then, as shown in Fig. 7b, cable holder 44b is further pushed toward mechanical splice 2 until the cable holder comes into contact with core fiber guide 112b, whereby core fiber 41b is bent like a bow having a predetermined length. At this point, base 11 has an engaging part or a latch 114b (see Fig. 1) for engaging with cable holder 44b and preventing the cable holder from moving backward. Therefore, by moving cable holder
15 44b toward mechanical splice 2 until cable holder 44b climbs over latch 114b and a rear end 443b of the cable holder engages with latch 114b, core fiber 41b is held while retaining the bow even when the operator release his/her hand from the cable.

In the state of Fig. 7b, within mechanical splice 2, the front end of core fiber 41b abuts the front end of core fiber 41a which is previously inserted into the mechanical
20 splice, whereby core fiber 41b may be kept having the bend like a bow. In other words, the bend of the core fiber is a sign for indicating that the two core fibers abut each other within the mechanical splice. Base 11 also has a canopy member 115b (see Fig. 1) for preventing cable holder 44b from moving upward. Therefore, even when the operator release the hand from the cable in the state of Fig. 7b that cable holder 44b engages with
25 latch 114b, cable 4b cannot be moved upward from base 11.

Next, as shown in Fig. 8, the operator rotates lever 13 pivotably mounted to base 11 by means of hinge 131, from the state of Fig. 7b, in order to close mechanical splice 2. Due to this, core fibers 41a and 41b are fixed in the mechanical splice while abutting each other, whereby the two cables are optically connected. In this embodiment, the
30 mechanical splice is explained as having a pair of alignment member folded in V-shape (not shown) which is closed by pushing main body 22 toward cap member 21 and then grips the optical fibers. However, a mechanical splice may be used in the invention is not

limited to the above constitution. For example, a mechanical splice including a pair of alignment member which is gripped by a leaf spring member having generally C-shaped cross section, may be used. When this type of mechanical splice is used, a wedge member (not shown) may be arranged on splice contacting surface 132 of lever 13. The wedge member may be inserted between each alignment member so as to make a gap between them for receiving fibers. When the fibers are inserted into the mechanical splice, the lever is rotated so as to insert the wedge member between each alignment member, and after the fibers are inserted, the lever is reversely rotated away from the mechanical splice so as to pull out the wedge member and fix the fibers. After the connecting operation of the fibers is completed, the wedge member may be removed or broken off from the lever, the lever may be positioned as shown in Fig. 8.

Next, as shown in Fig. 9, clip carrying member 14b pivotably mounted to base 11 by means of hinge 141b is rotated such that clip 3b carried by clip carrying member 14b is positioned close to cable holder 44b. As shown in Fig. 10, clip carrying holder 14b has an engagement releasing part or a latch releasing member 142b (see Fig. 1) integrally formed with the clip carrying member. Latch releasing member 142b, formed as a generally flat bar member, is arranged at an outside end of clip carrying member 14b in relation to the direction of insertion of the cable, and extends from the carrying member in the direction of insertion of clip 3b. In other words, releasing member 142b generally vertically extends away from clip 3b. When clip carrying member 14b is rotated so as to position clip 3b close to cable holder 44b, the front end of latch releasing member 142b may push down latch 114b of base 11 so as to disengage the latch from the cable holder. As latch 114b prevents cable holder 44b from moving backward as described above, by pushing down latch 114b, cable holder 44b may be moved away from mechanical splice 2 by a restoring force of the bent core fiber 41b, whereby bent core fiber 14b becomes generally straight. In this position, as the base has canopy member 115b, cable holder 44b cannot be moved in the direction other than the longitudinal direction of the cable by disengaging latch 114b, whereby the workability of this operation cannot be deteriorated.

If the optical fiber has an excess length of bend, a significant optical loss may occur at the bend, further, the mechanical reliability of the fiber may be deteriorated. Therefore, the excess length of bend is necessary to surely cleared before the cable is mechanically fixed. In the connecting structure of the invention, the operation for moving

the clip or the clip carrying member close to the cable holder is combined with the operation for releasing the latch, whereby the bend of the core fiber may be surely eliminated before the fixing operation using the clip, and the connecting work of the cable may be performed with few man-hours. Also, since the clip is attached to the clip carrying member, the clip cannot be lost. Further, the clip cannot be an obstacle to the operation. Still further, the bend of the core fiber does not need to be consciously cleared, since the bend is automatically cleared. By using such a connecting structure for the FTTH application, the broken cable may be easily spliced, whereby the cable may be utilized effectively.

When cable holder 44b is moved by the restoring force of core fiber 41b and the core fiber becomes generally straight, as shown in Fig. 11, clip 3b carried by clip carrying member 14b is pushed toward cable holder 44b so as to fix the cable holder to base 11. Finally, as shown in Fig. 12, cover 12 is rotated and fixed to base 11 such that the cover and the base cooperatively form a closure having a generally cylindrical shape. The connecting operation of the drop cables is then completed. In addition, on an inner surface of cover 12 facing base 11, protrusions 122a, 122b may be arranged configured to push clips 3a, 3b when cover 12 is rotated toward base 11. Due to this, the operations for pushing the clips and forming the closure may be performed simultaneously.

A waterproof means such as a packing may be arranged the fitting surface between base 11 and cover 12. Alternatively or additionally, a waterproof tape or tube such as a vinyl tape may be arranged to fully cover the closure.

In the above embodiment, when one drop cable (4b) is connected, the cable holder thereof is once fixed by the latch so as to make the bend of the core fiber of the cable, and then, the latch is released to allow the cable holder to move backward. However, the operations for fixing the cable holder by the latch and releasing the latch may be performed in relation to both cables. In other words, a latch releasing member similar to latch releasing member 142b may arranged on clip carrying member 14a carrying clip 3a, and the operation for moving clip 3a close to cable holder 44a may be combined with the operation for releasing latch 114a. In this case, however, the core fibers of the two drop cables should be inserted into the mechanical splice generally simultaneously such that the front ends of the core fibers of the two drop cables are positioned generally the center of the mechanical splice in relation the longitudinal direction thereof, and a predetermined

length of bend of the core fiber is formed at each side of the mechanical splice.

Alternatively, after the two core fibers are inserted, the position of each cable may be adjusted such that the bends of the core fibers at the both sides of the mechanical splice have generally the same length, whereby the front ends of the core fibers may be

5 positioned at generally the center of the mechanical splice. Also in this case, the operation for clearing an excess length of bend of the core fiber is performed.

In the above embodiment, the operation for positioning the clip close to the cable holder is combined with the operation for releasing the latch. In a second embodiment explained by using Figs. 13 and 14, the operation for moving a lever to close a mechanical
10 splice is also substantially combined with the operations for positioning a clip and releasing a latch.

A connecting structure 1', according to a second embodiment as shown in Figs. 13 and 14, has a base member 11' for receiving two drop cables 4a', 4b' to be connected, and a cover member 12' pivotably connected to base member 11' by means of a hinge 121'.
15 Connecting structure 1' also has a closure part or a lever member 13' pivotably connected to base 11' by means of a hinge 131' such that the lever member may close a mechanical splice 2' located at generally the center of base 11'. In the second embodiment, clip carrying members 14a', 14b', for carrying fixing part or clip members 3a', 3b' for fixing cable holders 44a', 44b' attached to drop cables 4a', 4b' to base 11', are integrally formed
20 with lever 13' at both ends of the lever in the longitudinal direction of the cable. Due to this, the operation for moving the lever is combined with the operation for positioning the clip.

Clip carrying members 14a', 14b' have protrusions 142a', 142b', respectively, capable of contacting core fiber guides 112a', 112b' for guiding core fibers 41a', 41b' of
25 cables 4a', 4b', when lever 13' is moved to the position where the lever closes a mechanical splice 2. Protrusions 142a', 142b' is positioned between lever 13' and carrying members 14a', 14b', and extend in the direction generally perpendicular to the longitudinal direction of the lever. As shown in Fig. 14, core fiber guides 112a', 112b' are connected to base 11' by means of connecting portions 1121a' 1121b', respectively, such that the core fiber
30 guides may be displaced in the direction generally perpendicular to the longitudinal direction of the cable. Latches 114a', 114b' for preventing cable holders 44a', 44b' from moving backward, respectively, are arranged on core fiber guides 112a', 112b' at the ends

thereof opposing the ends where the connecting portions are arranged. In other words, in this embodiment, the fixed ends of the latches are closest to the center of the base, and the core fiber guide and the latch may be integrally displaced.

Next, the function of lever 13' is explained. Also when connecting structure 1' is
5 used, the operations for inserting the core fiber in the mechanical splice and fixing the cable holder by using the latch may be performed similarly to the case using connecting structure 1. Then, lever 13' is rotated relative to base 11' to close mechanical splice 2', in order to fix core fibers 41a', 41b' while abutting each other within the mechanical splice. In this state, or in the state in which lever 13' is further pushed toward base 11', protrusions
10 142a', 142b' of clip carrying members 14a', 14b' push down core fiber guides 112a', 112b', respectively, whereby latches 114a', 114b' connected thereto are also displaced downward. In other words, protrusions 142a' 142b' indirectly displace the latches downward. Due to this, latches 114a', 114b' disengages from cable holders 44a', 44b', respectively, whereby the cable holders are moved by the restoring forces of core fibers 41a', 41b' away from
15 mechanical splice 2' in the longitudinal direction of the cable. By forming the latches integrally with the core fiber guides, the operation for releasing the latch may be automatically performed by the lever operation. As a modification of the second embodiment, the protrusions may be arranged on or near the outer ends of the clip carrying members. In this case, the protrusions may push down the outer ends of the cable
20 holder guides or the latches.

Then, clips 3a', 3b' are pushed toward cable holder 44a', 44b', respectively, whereby cables 4a', 4b' may be fixed to base 11'. In this embodiment, the lever operation is combined with the operations for positioning the clips and the releasing the latches. Therefore, the connecting work of the cable may be performed with few man-hours and
25 without causing a mistake regarding the work procedure of the operator. Finally, cover 12' is rotated and fixed to base 11', whereby the connecting structure or the closure is accomplished. In this case, on an inner surface of cover 12' facing base 11', protrusions (not shown) may be arranged configured to push clips 3a', 3b' when cover 12' is rotated toward base 11'. Due to this, the operations for pushing the clips and forming the closure
30 may be performed simultaneously.

In each embodiment as described above, the two drop cables are connected after the cable holder is attached to each drop cable. However, the cable holder is not necessary

when the jacket and the core fiber of the drop cable are integrally formed. For example, as schematically shown in Fig. 15, by contacting a canopy portion 115 and/or a protrusion 117 or the like with a drop cable 4, the drop cable is inclined relative to the longitudinal direction of a base (not shown). Accordingly, the cable may be held in the inclined state
5 by a friction force between the cable and the canopy portion or the protrusion, whereby a bend of a core fiber 41 of the cable may be retained. Alternatively, the tip of the latch may be formed with a sharp edge capable of contacting the jacket of the cable in order to hold the cable.

Alternatively, as shown in Fig. 16, in a pair of cable guide 113 having opposing
10 surfaces, one or more serrate projections 118 may be arranged on at least one of the opposing surfaces in order to elastically grip cable 4. In this case, a lower end or an inside or an outside end of cable guide 113 in relation to the direction of insertion of the core fiber may act a fulcrum point, whereby the cable guide may be elastically displaced. Then, when a clip carrying member (not shown) having a releasing member 142 is rotated, the
15 releasing member may enlarge the distance between the opposing surfaces of cable guide 113, whereby the bend of core fiber 41 may be cleared. In addition, if the cable does not have the cable holder, the distance between the opposing edges of the clip are determined such that the edges act on the jacket of the cable.

Fig. 17 is a perspective view of a third embodiment of a connecting structure for
20 optical cables according to the present invention. A connecting structure 1001 has a base 1011 for receiving two drop cables to be connected, and a cover 1012 configured to engage with base 1011. In this embodiment, each of base 1011 and cover 1012 has generally a rectangular box shape and cooperatively form a closure or a case. The connecting structure 1001 also has a closing part or a lever 1013 pivotably connected to
25 base 1011 by means of a hinge 1131 such that the lever may close a mechanical splice 1002 located a mechanical splice mounting part 1119 (at generally the center of base 11 in this embodiment); and cable gripping member or clips 1014a, 1014b for gripping and fixing drop cables 1003a, 1003b (see Fig. 18) to base 1011. Clips 1014a, 1014b are pivotably connected to base 1011 by means of hinges 1141a, 1141b, respectively.
30 Although base 1011, lever 1013 and clips 1014a, 1014b are integrally formed by resin molding in the embodiment, each member may be individually formed.

Clip 1014a has a substrate 1142a; a cable gripping part 1143a (a pair of opposing sawteeth) extending from substrate 1142a in the direction perpendicular to the substrate. Pair of sawteeth 1143a grips cable 1003a located on a cable supporting part 1111a of base 1011 when clip 1014a is rotated about hinge 1141a (see Fig. 20) in a connecting procedure
5 below. Clip 1014b may have the same configuration as clip 1014a. In other words, clip 1014b is a member integrally formed with base 1011 and has a substrate 1142b; a cable gripping part 1143b (a pairs of opposing sawteeth) extending from substrate 1142b in the direction perpendicular to the substrate. Pair of sawteeth 1143b grips cable 1003b located on a cable supporting part 1111b of base 1011 when clip 1014b is rotated about hinge
10 1141b (see Fig. 23) in a connecting procedure below.

Lever 1013 is generally a flat plate member and has a splice contacting surface 1132 (a surface of a groove in the embodiment) capable of contacting mechanical splice 1002 and an operation surface 1133 opposed to splice contacting surface 1132. Mechanical splice 1002 used in this embodiment is configured to close a core fiber
15 holding member folded in V-shape (not shown) contained therein by pushing a cap member 1021 toward a main body 1022, whereby two core fibers of the cables within the core fiber holding member may be aligned and fixed by means of an alignment groove (not shown) formed on the inner surface of the core fiber holding member.

Hereinafter, the procedure for connecting two drop cables using connecting
20 structure 1001 is explained with reference to Figs. 17 to 26. First, as shown in Fig. 17, mechanical splice 1002 is located in mechanical splice mounting part 1119 generally at the center of base 1011. Mechanical splice 1002 may be gripped by splice guides 1111a, 1111b formed in base 1011, so as to correctly position the mechanical splice. Next, as shown in Fig. 18, a drop cable 1003a is provided, in which an optical fiber or a core fiber
25 1031a constituted by silica glass and a UV-coating 1032a of the cable is exposed by predetermined lengths from a jacket 1033a of the cable. When the cable is processed, a known jacket removing tool and a core fiber (glass fiber) cutting tool may be used. A drop cable 1003b may have the same configuration as drop cable 1003a.

In this connection, the term "drop cable" used herein means a cable used for wiring
30 between a connection box arranged on an electric pole and each home of the user. The drop cable has a jacket such as PVC or PE containing a core fiber coated by arbitrary resin such as UV-resin, and one or more high tensile strength material such as FRP or metal.

The drop cable generally has a rectangular cross section in the direction perpendicular to the longitudinal direction thereof. Generally, in such a drop cable, the jacket and the core fiber are substantially closely attached or integrally formed with other. Therefore, by fixing the jacket of the cable, the core fiber may be indirectly fixed. The connecting
5 structure of the invention may be used for a cable other than the drop cable, as long as a core fiber and a jacket of the cable are substantially closely attached such that the core fiber cannot be substantially moved relative to the jacket. Further, even a cable, so-called an optical code, having a core fiber which is not closely attached to a jacket may be used, if a cable holder is attached to the cable and the jacket gripped by sawteeth is constricted
10 and comes into contact with the core fiber, whereby the core fiber cannot be substantially moved relative to the jacket. Hereinafter, the term "core fiber" means a portion of the cable outwardly extending from jacket 1033a in Fig. 18, i.e., including core fiber portion 1031a and UV-coating portion 1032a.

Next, as shown in Fig. 19, first drop cable 1003a is positioned in base 1011 such
15 that core fiber 1031a of the cable is inserted into mechanical splice 1002 in the longitudinal direction of the cable. At this point, core fiber 1031a is generally straight without a bend portion. The front end of core fiber 1031a is positioned at a desired position (generally the center in the longitudinal direction) within mechanical splice 1002. Base 1011 has a core fiber guide 1113a for guiding and inserting core fiber 1031a into
20 mechanical splice 1002, and a cable holder guide 1114a for positioning jacket 1033a of cable 1003a. Cable holder guide 1114a has opposing surfaces, the distance of which is generally the same as or slightly greater than the width of jacket 1033a. Therefore, when jacket 1033a is moved along guide 1114a, core fiber 1031a is guided into mechanical splice 1002, whereby the operator is not required to consciously insert the core fiber into a
25 small hole of the mechanical splice. Base 1011 further has a stopper 1115a configured to contact the end on jacket 1033a of cable 1003a at a predetermined position in order to avoid that the positioned cable 1003a is further moved toward the mechanical splice and the core fiber has an excess length of bend portion.

In the state of Fig. 19, the end of cable 1003a is spaced from stopper 1115a. Due
30 to this, when the cover is closed (described below), clip or cable gripping part 1143a may be displaced toward the mechanical splice. Alternatively, the end of cable 1003a may abut stopper 1115a, whereby the cable may be easily positioned.

Then, as shown in Fig. 20, clip 1014a pivotably mounted to base 1011 is rotated by hinge 1141a such that gripping part or pair sawteeth 1143a grips jacket 1033a of cable 1003a, whereby cable 1003a is fixed to base 1011.

Next, as shown in Fig. 21, a second drop cable 1003b (see Fig. 18) similar to drop
5 cable 1003a is provided and is positioned in base 1011 such that a core fiber 1031b of the cable is inserted into mechanical splice 1002 in the direction opposed to the insertion direction of first drop cable 1003a. Base 1011 has a core fiber guide 1113b for guiding and inserting core fiber 1031b into mechanical splice 1002, and a cable holder guide 1114b for positioning jacket 1033b of cable 1003b. Cable holder guide 1114b has
10 opposing surfaces, the distance of which is generally the same as or slightly greater than the width of jacket 1033b. Therefore, when jacket 1033b is moved along guide 1114b, core fiber 1031b is guided into mechanical splice 1002, whereby the operator is not required to consciously insert the core fiber into a small hole of the mechanical splice. Base 1011 further has a stopper 1115b configured to contact the end on jacket 1033b of
15 cable 1003b at a predetermined position in order to avoid that the positioned cable 1003b is further moved toward the mechanical splice and the core fiber has an excess length of bend portion. As described below, the positions of stoppers 1115a and 1115b in base 1011, in relation to the longitudinal direction of the cable, are determined such that the core fiber of each cable has a slight length of bend when the front ends of the cables abut
20 each other in mechanical splice 1002 and each jacket of the cables contacts each stopper.

In the state of Fig. 21, jacket 1033b of cable 1003b contact stopper 1115b and only core fiber 1031b has a bend portion. On the other hand, core fiber 1031a of cable 1003a does not have a bend portion, since the distance between the end of mechanical splice 1002 and jacket 1033a is relatively small and a buckling force is larger than a compression
25 force in the longitudinal direction of the cable. However, the present invention is not limited to such a configuration, for example, core fiber 1031a may have a bend portion by increasing the distance between the end of mechanical splice 1002 and jacket 1033a.

Next, as shown in Fig. 22, the operator rotates lever 1013 pivotably mounted to base 1011 by means of hinge 1131, from the state of Fig. 21, in order to close mechanical
30 splice 1002. Due to this, core fibers 1031a and 1031b are fixed in the mechanical splice while abutting each other, whereby the two cables are optically connected. In this connection, as shown in Fig. 17, by arranging a projection 1134 on lever 1013 and

forming a receiving hole 1116 in base 1011 such that projection 1134 may be press-fitted into hole 1116 in the state of Fig. 22, lever 1013 is not easily returned to the state of Fig. 21 from the state of Fig. 22 due to an external force or the like. Since it is necessary to vertically push cap 1021 of mechanical splice 1002 into main body 1022, it is preferable that lever 1013 also vertically approaches mechanical splice 1002. Due to projection 1134 and receiving hole 1116, lever 1013 may be guided such that lever 1013 is not inclined or offset relative to mechanical splice 1002. Of course, the projection may be arranged on the base and the receiving hole may be formed in the lever. Alternatively, another engaging means such as a latch and a latch hole may be arranged on the base and the lever.

In this embodiment, the mechanical splice is explained as having a pair of alignment member folded in V-shape (not shown) which is closed by pushing cap member 1021 toward main body 1022 and then grips the optical fibers, as shown in Fig. 17. However, a mechanical splice may be used in the invention is not limited to the above constitution. For example, a mechanical splice including a pair of alignment member which is gripped by a leaf spring member having generally C-shaped cross section, may be used. When this type of mechanical splice is used, a wedge member (not shown) may be arranged on a splice contacting surface 1132 of lever 1013. The wedge member may be inserted between each alignment member so as to make a gap between them for receiving fibers. When the fibers are inserted into the mechanical splice, the lever is rotated so as to insert the wedge member between each alignment member, and after the fibers are inserted, the lever is reversely rotated away from the mechanical splice so as to pull out the wedge member and fix the fibers. After the connecting operation of the fibers is completed, the wedge member may be removed or broken off from the lever, the lever may be positioned as shown in Fig. 22.

Then, before cable 1003b is fixed by using clip 1014b, cable 1003b is moved away from the mechanical splice so as to release the bend portion of core fiber 1031b of cable 1003b. Generally, by a restoring force of the bend portion of the core fiber, the cable automatically moves away from the mechanical splice when the operator releases his hand from the cable. From this state, as shown in Fig. 23, clip 1014b pivotably mounted to base 1011 by means of hinge 1141b is rotated such that gripping part or sawteeth 1143b grips jacket 1033b of cable 1003b. Due to this, cable 1003b is fixed to base 1011.

Finally, as shown in Fig. 24, cover 1012 is attached to base 1011 such that the cover and the base cooperatively form a closure having a generally rectangular box shape. The connecting operation of the drop cables is then completed. In this connection, as shown in Fig. 23, a latch (two latches 1117a, 1117b in the embodiment) may be arranged on a suitable peripheral part of base 1011 and a latch hole (two latch holes 1121a, 1121b in the embodiment) may be formed on a part of cover 1012 corresponding to the latch of the base, whereby cover 1012 is not unexpectedly separated from base 1011 after assembling. Of course, the cover may have the latch and the base may have the latch hole.

A waterproof means such as a packing may be arranged the fitting surface between base 1011 and cover 1012. Alternatively or additionally, a waterproof tape or tube such as a vinyl tape may be arranged to fully cover the closure.

In this connection, on an inner surface of cover 1012 facing base 1011, a pushing member may be arranged configured to push clips 1014a, 1014b toward the mechanical splice mounting part (or the center of the base along the longitudinal direction of the cable) when cover 1012 is attached to base 1011. Due to this, the core fiber of each cable may have a predetermined length of bend portion at generally the same time when the cover forms the closure with the base. In addition, although the pushing member in the embodiment is a protrusion, the invention is not limited such a configuration.

Figs. 25a to 25e explain the procedure regarding Figs. 23 and 24, showing the cross section of the connecting structure around drop cable 1003b, the cross section being perpendicular to the longitudinal direction of the cable. First, as shown in Fig. 25a, when clip 1014b does not fix drop cable 1003b to base 1011, the end of jacket 1033b of cable 1003b does not contact stopper 1115b, whereby a light length of gap is formed between the end of jacket 1033b and stopper 1115b.

From this state, as shown in Figs. 23 and 25b, clip 1014b is pushed toward base 1011 so as to grip jacket 1033b of cable 1003b. In this connection, the end surface of clip 1014b facing the mechanical splice has a step or uneven portion along the pushing direction of clip 1014b. In detail, clip 1014b has a convex or taller portion 1144b at the pushing side (or the lower side in Fig. 25a) thereof and a concave or smaller portion 1145b at the opposing side (or the upper side in Fig. 25a) thereof. On the other hand, the end surface of stopper 1115b opposing the mechanical splice has a step or uneven portion along the pushing direction of clip 1014b. In detail, stopper 1115b has a concave or

smaller portion 1151b at the pushing side (or the lower side in Fig. 25a) thereof and a convex or taller portion 1152b at the opposing side (or the upper side in Fig. 25a) thereof. In other words, the end surface of clip 1014b directed to the mechanical splice and the end surface of stopper 1115b facing the end surface of clip 1014b have complementary shapes to each other.

Due to such configurations of the clip and the stopper, as shown in Fig. 25b, convex portion 1144b of clip 1014b contacts convex portion 1152b of stopper 1115b while clip 1014b is being pushed toward base 1011. Then, when clip 1014b reaches a predetermined position, as shown in Fig. 25c, concave portion 1145b of clip 1014b faces convex portion 1152b of stopper 1115b, and convex portion 1144b of clip 1014b faces concave portion 1151b of stopper 1115b. As shown in Fig. 26 which is a partial enlarged view of Fig. 25c, a slight gap "d" (for example, $d = 0.1 - 0.5$ mm) is formed between the convex and concave portions facing each other.

Next, as shown in Fig. 25d, cover 1012 is positioned above base 1011, and then, as shown in Fig. 25e and Fig. 27 which is a partial enlarged view of Fig. 25e, cover 1012 is attached to base 1011 so as to form a closure (see Fig. 24). In this connection, as shown in Fig. 25d, the inner surface of cover 1012 has a protrusion (or a pushing member) 1122b configured to push clip 1014b in the longitudinal direction of the cable toward the mechanical splice mounting part when cover 1012 is attached to base 1011. In detail, protrusion 1122b is formed as a slant or round portion contacting a slant or round portion 1146b arranged on the upper surface of clip 1014b when cover 1012 is attached to base 1011. In other words, protrusion 1122b of cover 1012 and slant or round portion 1146b of clip 1014b cooperatively generate a biasing force for moving clip 1014b toward the mechanical splice in the longitudinal direction of the cable. In the embodiment, since hinge 1141b for connecting clip 1014b to base 1011 is a member with a short dimension in the longitudinal direction of the cable, clip 1014b may be displaced toward the mechanical splice by the biasing force.

On the other hand, on the side of clip 1014b near the mechanical splice, clip 1014b and 1115b are separated each other by a slight distance. Therefore, when the closure is assembled (see Fig. 25e), clip 1014b gripping cable 1003b is displaced by the distance toward the mechanical splice. Due to this, core fiber 1031b of cable 1003b may have a bend portion in response to change of temperature environment of the connecting

structure, and then the connecting procedure is completed. Further, an optical loss due to the bend portion is negligible. Therefore, the core fiber of the cable may have a predetermined length of bend portion generally at the same time when the cover forms the closure with the base, and further, the operator cannot purposely release or straighten the bend portion. The bend portion is formed by moving the cable toward the mechanical splice by a distance which is equal to or larger than a length corresponding to the difference between amounts of displacement of the base and the optical fiber, by which a tension is generated in the optical fiber, the difference being calculated by linear expansion coefficients of the core fiber and the material constituting the base, the distance between the clip and the fixed position of the core fiber to the mechanical splice, and the temperature range of the connecting structure during use. Further, the length of the bend portion does not generate an unacceptable optical loss (for example, 0.2 dB).

In the embodiment of Fig. 25a, slant or round portion 1146b is formed near the end of clip 1014b opposed to the mechanical splice. However, the slant or round portion may be arranged on the other part of the clip, in this case, the protrusion of cover 1012 is positioned at the position corresponding to the position of the slant or round portion. In addition, the clip may have a protrusion and the inner surface of the cover may have a protrusion or hole capable of contacting the protrusion of the clip.

The configurations of clip 1014a and cover 1012 near clip 1014b are omitted, since the configurations may be similar to the configurations explained with reference to Figs. 25a-25e (see a protrusion 1122a' of Fig. 28). According to the invention, the connecting structure may be assembled while both cables have bend portions. Even when the end of jacket 1033a of cable 1003a contacts stopper 1115a, since the end of the jacket generally has an uneven surface, the uneven surface may be deformed by contacting stopper 1115a. Therefore, cable 1003a may be moved by a desired distance toward the mechanical splice, similarly to the case that the end of jacket 1033a is separated from stopper 1115a. In addition, in case that core fiber 1031a already has a certain length of bend portion when the core fiber is fixed by the mechanical splice, it is not necessary to move clip 1014a toward the mechanical splice.

Fig. 28 shows a fourth embodiment of a connecting structure of the invention. A connecting structure 1001' according to the fourth embodiment may have a base 1011' and a cover 1012' similar to base 1011 and cover 1012 of the third embodiment, respectively,

except that cover 1012' may be pivotably moved relative to base 1011' by means of a hinge (hinges 1118a' and 1118b', in the embodiment). Other major elements of the second embodiment are indicated by the character (') attached to corresponding references of the third embodiment, and a detailed explanation thereof is omitted. In the fourth
5 embodiment, the number of parts of the connecting structure may be substantially one, whereby a maintenance thereof may be easy and the operation for attaching the cover to the base may be easier.

As shown in Fig. 28, water barriers 1123a' and 1123b' may be arranged on the inner surface of cover 1012'. Water barriers 1123a' and 1123b' are positioned so as to face
10 areas of base 1011' between a stopper 1115a' and a core fiber guide 1113a', and between a stopper 1115b' and a core fiber guide 1113b' of base 1011', respectively. Water barriers 1123a' and 1123b' have slits 1124a' and 1124b', respectively, each extending in the direction perpendicular to the longitudinal direction of the core fiber of the drop cable (not shown) when the connecting structure is assembled. The width of each slit is slightly
15 larger than the diameter of the core fiber. Due to such a configuration, when rainwater or the like enters the connecting structure from the ends in the longitudinal direction of the cable, at least a part of the rainwater flowing along the core fiber may then flow along the water barrier. Therefore, the amount of rainwater or the like entering the mechanical splice mounting part may be reduced.

Fig. 29 is an exploded perspective view showing a connecting structure according to a fifth embodiment of the present invention. A connecting structure 2001 of the fifth embodiment has a housing 2011 containing two drop cables to be connected, a mechanical splice 2002 positioned at generally the center of housing 2011, and clip members 2003a, 2003b which serve as fixing parts for fixing cable holders 2044a, 2044b attached to drop
25 cables 2004a, 2004b (see Fig. 30) to housing 2011, respectively. Although housing 2011 as illustrated has generally a rectangular parallelepiped shape, the housing may have a cylindrical shape, for example, insofar as the housing may contain the mechanical splice. Mechanical splice 2002 used in this embodiment is configured to close a core fiber holding member folded in V-shape (not shown) contained therein by pushing a cap
30 member 2021 toward a main body 2022, whereby two core fibers of the cables within the core fiber holding member may be aligned and fixed by means of an alignment groove (not shown) formed on the inner surface of the core fiber holding member.

To housing 2011, a closing part or an actuation member 2012 for closing mechanical splice 2002 is attached. For example, actuation member 2012 is a generally flat plate extending in the longitudinal direction of housing 2011, and has ends 2121 and 2122 opposing in the longitudinal direction. Actuation member 2012 is attached to housing 2011 at at least one of ends 2121 and 2122, and has an intermediate portion (for example, a center portion 2123) between both ends 2121 and 2122 configured to be displaced toward mechanical splice 2002 and contact the mechanical splice. Actuation member 2012 is constituted by flexible material at at least the end thereof attached to the housing. When actuation member 2012 is constituted by flexible material as a whole, cap 2021 of mechanical splice 2002 may be evenly pushed into main body 2022 in a closing operation of the mechanical splice as described below. Actuation member 2012 may constitute at least one lateral side of housing 2011, whereby the mechanical splice may be protected from external force or the like after the optical core fibers are connected in the mechanical splice.

In order to prevent actuation member 2012 from slipping on mechanical splice 2002 after contacting the mechanical splice during closing operation of the mechanical splice, center portion 2123 of actuation member 2012 preferably has protrusions 2124 and 2125 on a back side (or a side facing the mechanical splice) thereof. Protrusions 2124 and 2125 may contact two inclined surfaces 2211 and 2212 of cap member 2021 of mechanical splice 2002, respectively.

Housing 2011 and actuation member 2012 may be separately manufactured and connected each other, or may be integrally formed by resin molding or the like.

Clips 2003a and 2003b are made individually from housing 2011, by using arbitrary material having the required strength, such as a metal or a plastic. As clips 2003a and 2003b, clips 3a and 3b used in the first embodiment as described above may be used.

Hereinafter, the procedure for connecting two drop cables using the connecting structure 2001 with reference to Figs. 31 to 36. First, as shown in Fig. 31, mechanical splice 2002 is located at generally the center of housing 2011. Mechanical splice 2002 may be gripped by splice guides (not shown) formed in housing 2011, so as to correctly position the mechanical splice. Next, as shown in Fig. 30, a drop cable 2004a is provided, in which an optical fiber or a core fiber 2041a constituted by silica glass and a UV-coating 2042a of the cable is exposed by predetermined lengths from one end thereof, and a cable

holder 2044a is attached at or near the boundary between the UV-coating and a jacket 2043a of the cable. When the cable is processed, a known jacket removing tool and a core fiber (glass fiber) cutting tool may be used. Cable holder 2044a has, as shown in Fig. 30, generally a rectangular solid shape when attached to cable 2004a, with a recess for
5 receiving the drop cable and serrate projections (not shown) on opposing surfaces of the recess. When the drop cable is inserted into the recess, the serrate projections bite into jacket 2043a of the cable so as to hold the cable. A drop cable 2004b as described below may have the same configuration as drop cable 2004a.

Next, as shown in Fig. 32, first and second drop cables 2004a and 2004b are
10 positioned in housing 2011 such that the core fibers of the cables are inserted into mechanical splice 2002 from opposing ends the mechanical splice in the longitudinal direction of the cable. As shown in Fig. 29, housing 2011 has holder containing parts 2013a and 2013b containing cable holders 2044a and 2044b, respectively, whereby the cable holder contained in the holder containing part cannot be substantially moved in the
15 direction other than the axial direction of the cable. Housing 2011 also has guiding parts (in the drawing, inclined surfaces 2014a and 2014b) guiding core fibers 2041a and 2041b projecting the cable holders contained in the holder containing parts, whereby the core fiber of each cable may be smoothly guided into mechanical splice 2002.

As shown in Fig. 30, cable holders 2044a and 2044b of drop cables 2004a and
20 2004b have protrusions 2441a and 2441b, respectively, and as shown in Fig. 33 showing a cross-section of Fig. 32, housing 2011 has engaging holes or recesses 2111a and 2111b at the bottom part thereof, which may engage protrusions 2441a and 2441b, respectively. Due to this, each cable holder may be retained at a predetermined position in housing 2011 by inclining each cable relative to the longitudinal direction of housing 2011. The
25 predetermined position is determined so that each of the core fibers has a certain length of flexure so as to maintain the front ends of the core fibers abut each other in mechanical splice 2002.

Next, as shown in Fig. 32, the operator pushes actuation member 2012 in the direction of an arrow 2126 so as to displace the actuation member toward mechanical
30 splice 2002 and close the mechanical splice. Due to this, cables 2004a and 2004b are fixed in the state that the core fibers of the cables abut each other in mechanical splice 2002, whereby the cables are optically connected each other.

Then, as shown in Fig. 35 showing a cross-section of Fig. 34, cable holders 2044a and 2044b of drop cables 2004a and 2004b are displaced in the direction (upward in Fig. 34) generally perpendicular to the axial direction of the cables, so as to disengage protrusions 2441a and 2441b from recesses 2111a and 2111b, respectively. At this point, due to a restoring force of the bent core fiber, each cable holder is displaced away from mechanical splice 2002. By this displacement of each cable holder, the flexure of each core fiber is released.

Finally, as shown in Fig. 36, by pushing clips 2003a and 2003b toward housing 2011, clips 2003a and 2003b grip cable holders 2044a and 2044b, respectively, whereby both cables are fixed to housing 2011. Each clip has two pairs of opposing fixed teeth. By gripping the sides of each cable holder between the fixed opposing teeth, the clip and the cable may be substantially integrated, whereby the cable and the housing are integrated.

In the first and fifth embodiments of the invention, the cable holder may be displaced toward the mechanical splice when the clip is pushed down, whereby the core fiber between the cable holder and the mechanical splice has a certain length of flexure.

Fig. 37 is a perspective view showing a connecting structure according to a sixth embodiment of the present invention. A connecting structure 3001 of the sixth embodiment has a housing 3011 containing two drop cables to be connected, a mechanical splice 3002 positioned at generally the center of housing 3011, and clip members 3003a, 3003b for fixing cable holders 3044a, 3044b attached to drop cables 3004a, 3004b (see Fig. 39) to housing 3011, respectively. Although housing 3011 as illustrated has generally a rectangular parallelepiped shape, the housing may have a cylindrical shape, for example, insofar as the housing may contain the mechanical splice. Mechanical splice 3002 used in this embodiment is configured to close a core fiber holding member folded in V-shape (not shown) contained therein by pushing a cap member 3021 toward a main body 3022, whereby two core fibers of the cables within the core fiber holding member may be aligned and fixed by means of an alignment groove (not shown) formed on the inner surface of the core fiber holding member.

To housing 3011, a closing part or an actuation member 3012 for closing mechanical splice 3002 is attached. For example, actuation member 3012 is a generally flat plate extending in the longitudinal direction of housing 3011, and has ends 3121 and

3122 opposing in the longitudinal direction. Actuation member 3012 is attached to housing 3011 at at least one of ends 3121 and 3122, and has an intermediate portion (for example, a center portion 3123) between both ends 3121 and 3122 configured to be displaced toward mechanical splice 3002 and contact the mechanical splice. Actuation member 3012 is constituted by flexible material at at least the end thereof attached to the housing. When actuation member 3012 is constituted by flexible material as a whole, cap 3021 of mechanical splice 3002 may be evenly pushed into main body 3022 in a closing operation of the mechanical splice as described below. Actuation member 3012 may constitute at least one lateral side of housing 3011, whereby the mechanical splice may be protected from external force or the like after the optical core fibers are connected in the mechanical splice.

Housing 3011 and actuation member 3012 may be separately manufactured and connected each other, or, may be integrally formed by resin molding or the like.

Clips 3003a and 3003b are made by using arbitrary material having the required strength, such as a metal or a plastic. As shown in Fig. 38, clips 3003a and 3003b are pivotably mounted to housing 3011 by means of fulcrum shafts 3031a and 3031b, respectively, whereby each clip may be rotated about an axis generally perpendicular to the longitudinal direction of housing 3011.

Hereinafter, the procedure for connecting two drop cables using the connecting structure 3001 with reference to Figs. 38 to 42. First, as shown in Fig. 38, mechanical splice 3002 is located at generally the center of housing 3011. Mechanical splice 3002 may be gripped by splice guides (not shown) formed in housing 3011, so as to correctly position the mechanical splice. Next, as shown in Fig. 39, a drop cable 3004a is provided, in which an optical fiber or a core fiber 3041a constituted by silica glass and a UV-coating 3042a of the cable is exposed by predetermined lengths from one end thereof, and a cable holder 3044a is attached at or near the boundary between the UV-coating and a jacket 3043a of the cable. When the cable is processed, a known jacket removing tool and a core fiber (glass fiber) cutting tool may be used. Cable holder 3044a has, as shown in Fig. 39, generally a rectangular solid shape when attached to cable 3004a, with a recess for receiving the drop cable and serrate projections (not shown) on opposing surfaces of the recess. When the drop cable is inserted into the recess, the serrate projections bite into

jacket 3043a of the cable so as to hold the cable. A drop cable 3004b as described below may have the same configuration as drop cable 3004a.

Next, as shown in Fig. 40, first and second drop cables 3004a and 3004b are positioned in housing 3011 such that the core fibers the cables are inserted into mechanical splice 3002 from opposing ends the mechanical splice in the longitudinal direction of the cable. As shown in Fig. 37, housing 3011 has holder containing parts 3013a and 3013b containing cable holders 3044a and 3044b, respectively, whereby the cable holder contained in the holder containing part cannot be substantially moved. At this point, each holder containing part may have a protrusion (not shown) at the lateral side thereof capable of engaging the side of the cable holder, in order to prevent the cable holder from being disadvantageously separated from the holder containing part. Housing 3011 also has guiding parts (in the drawing, inclined through holes 3014a and 3014b) guiding core fibers 3041a and 3041b projecting the cable holders contained in the holder containing parts, whereby the core fiber of each cable may be smoothly guided into mechanical splice 3002. The shape of each holder containing part is determined so that each of the core fibers has a certain length of flexure so as to maintain the front ends of the core fibers abut each other in mechanical splice 3002, while the cable holders of the drop cables are contained in the holder containing parts. As shown in Fig. 37 or 38, each cable holder may engage protrusion (only a protrusion 3016b is illustrated) formed at the bottom surface of the holder containing part, whereby the flexure of the core fiber may be maintained. In this case, the flexure may be maintained even when the operator takes his hand off the cable.

Next, as shown in Fig. 40, the operator pushes actuation member 3012 in the direction of an arrow 3124 so as to displace the actuation member toward mechanical splice 3002 and close the mechanical splice. Due to this, cables 3004a and 3004b are fixed in the state that the core fibers of the cables abut each other in mechanical splice 3002, whereby the cables are optically connected each other.

Finally, as shown in Fig. 41, by rotating clips 3003a and 3003b toward housing 3011 so as to close holder containing parts 3013a and 3013b, respectively, the cable holders cannot be removed from housing 3011, whereby both cables are fixed to housing 3011. As shown in Fig. 40, protrusions 3015a and 3015b are formed on the outer side surfaces covered by the clips, and recesses 3032a and 3032b capable of respectively

engaging protrusions 3015a and 3015b are formed on the insides of clips 3003a and 3003b, respectively. Due to this, the cable holder is prevented from disadvantageously being separated from the housing, by the rotation of each clip from the state that the clip closes the holder containing part (Fig. 41).

5 In the sixth embodiment, as shown in Fig. 42 showing the cross-section of Fig. 41, the length of the once formed flexures of core fibers 3041a and 3041b of cables 3004a and 3004b are not changed. Therefore, connecting structure 3001 of the sixth embodiment may be assembled with few man-hours.

As shown in Figs. 39 and 42, cable holder 3044a has a space or cavity 3441a
10 extending from the end of jacket 3043a of cable 3004a to the front end of cable holder 3044a. In other words, the boundary position between jacket 3043a of cable 3004a and core fiber 3041a is away from mechanical splice 3002 than the front end of cable holder 3044a, in the axial direction of the cable. Due to this, the length of the flexure of core
15 fiber 3041a (i.e., the distance between the end of mechanical splice 3002 and the end of the cable jacket) may be relatively long, the optical loss of the cable may be reduced by decreasing the curvature of the core fiber. In addition, as shown in Fig. 39, since cavity 3441a is opened at the upper surface thereof, the length of the flexure of core fiber 3041a may be longer. In the other embodiments, the flexure of the core fiber is formed outside
20 the cable holder, on the other hand, in the sixth embodiment, the flexure is formed inside the cable holder. The same is also applicable to cable holder 3044b.

Regarding the fifth and sixth embodiments, the sealed structure including the cover and the base as in the first embodiment is not provided, and thus the connecting structure of the fifth or sixth embodiment is mainly used indoors. However, such a structure may be compact relative to the first to fourth embodiments, and the connecting operation of the
25 cables may be completed with relatively few man-hours. In addition, the actuation member may serve as a protecting member against external force.

The connecting structure of the fifth or sixth embodiment may be contained in a case if desired. For example, as shown in Fig. 43, connecting structure 3001 of the sixth embodiment may be contained in a case 3005 constituted by a base 3051 and a cover
30 3052, whereby the connecting structure may be used outdoors as well as indoors. Cover 3052 is pivotably attached to base 3051 by a hinge 3053, whereby the cover and the base may cooperatively form a closure.

Case 3005 may be watertight if desired. For example, a seal member 3511 is arranged along generally whole circumference of base 3051 of case 3005, on the other hand, a ridge-shaped pressing member 3521 is formed on a part of cover 3052 facing seal member 3511 when the closure is formed, whereby pressing member 3521 may compress seal member 3511 when the closure is assembled. Further, seal members 3522a and 3522b are arranged on parts of cover 3052 facing cables 3004a and 3004b, respectively, when the closure is formed. Due to this, when cover 3052 is rotated so as to form the closure cooperatively with base 3051, pressing member 3521 of cover 3052 compress seal member 3511 of base 3051 and seal members 3522a and 3522b closely contact cables 3004a and 3004b, respectively, whereby the watertight closure is constituted. As the seal member, elastic resin such as silicone or rubber is preferable. Further, in order to improve the sealing function, the seal member preferably has adhesive characteristic.

The connecting structure of the fifth embodiment may also be contained in a case similar to case 3005 as described above.

While the invention has been described with reference to specific embodiments chosen for the purpose of illustration, it should be apparent that numerous modifications could be made thereto, by one skilled in the art, without departing from the basic concept and scope of the invention.

CLAIMS

1. A connecting structure comprising:

a case containing a mechanical splice configured to connect two optical fibers of two cables;

5 an engaging part arranged in the case and configured to engage with at least one cable such that the at least one cable is not separated from the mechanical splice by more than a predetermined distance in the longitudinal direction of the at least one cable;

10 a releasing part configured to release the engaging part from the at least one cable;

a clip carrying member configured to carry a clip member for fixing the cable to the case and move relative to the case such that the clip member may be positioned close to the cable,

15 wherein the releasing part is integrally formed with the clip carrying member and configured to release the engaging part from the at least one cable when the clip member is positioned close to the cable.

2. The connecting structure according to claim 1, further comprising a lever member for closing the mechanical splice, the lever member being movably attached to the case.

20 3. The connecting structure according to claim 2, wherein the clip carrying member is integrally formed with the lever member.

4. The connecting structure according to any one of the preceding claims, wherein the case comprises a base member for receiving the mechanical splice and a cover member movably attached to the base member so as to constitute a closure cooperatively
25 with the base member.

5. The connecting structure according to claim 4, wherein the cover member comprises a protrusion configured to push the clip member toward the cable when the

cover member is moved toward the base member so as to constitute the closure cooperatively with the base member.

6. The connecting structure according to any one of the preceding claims, wherein the predetermined distance is determined such that the optical fiber of the at least one cable is held while having a predetermined length of a bend between the mechanical splice and the engaging part.

7. The connecting structure according to any one of the preceding claims, wherein the engaging part is configured to engage with a cable holder attached to the cable.

8. A connecting structure comprising:
a case having a mechanical splice mounting part for containing a mechanical splice configured to connect two optical fibers of two cables;
a clip for gripping and fixing the cable to the case; and
a cover constituting a closure cooperatively with the base,
wherein the cover has a pushing member for contacting at least a part of the clip gripping the cable and pushing the clip in the direction along the longitudinal direction of the cable toward the mechanical splice mounting part, when the cover is attached to the base so as to form the closure.

9. The connecting structure according to claim 8, therein the connecting structure has two clips and the cover has two pushing members each contacting the two clips.

10. The connecting structure according to claim 8 or 9, wherein the pushing member is a protrusion arranged on a surface of the cover facing the base.

11. The connecting structure according to any one of claims 8 to 10, wherein a pushing distance of the clip pushed by the pushing member is set such that a tension is not substantially generated in the optical fiber connected to the mechanical splice due to a change in temperature.

12. The connecting structure according to any one of claims 8 to 11, wherein the clip is connected to the base by means of a hinge.

13. A connecting structure comprising:

a housing containing a mechanical splice configured to connect two
5 optical fibers of two cables; and

an actuation member for closing the mechanical splice, the
actuation member extending in the longitudinal direction of the housing, wherein at least
one of both ends in the longitudinal direction of the housing of the actuation member is
attached the housing, and an intermediate part of the actuation member between the both
10 ends is configured to be displaced toward the mechanical splice and contact the
mechanical splice.

14. The connecting structure according to claim 13, wherein the actuation member constitutes a part of a lateral side of the housing in relation to the longitudinal direction of the housing.

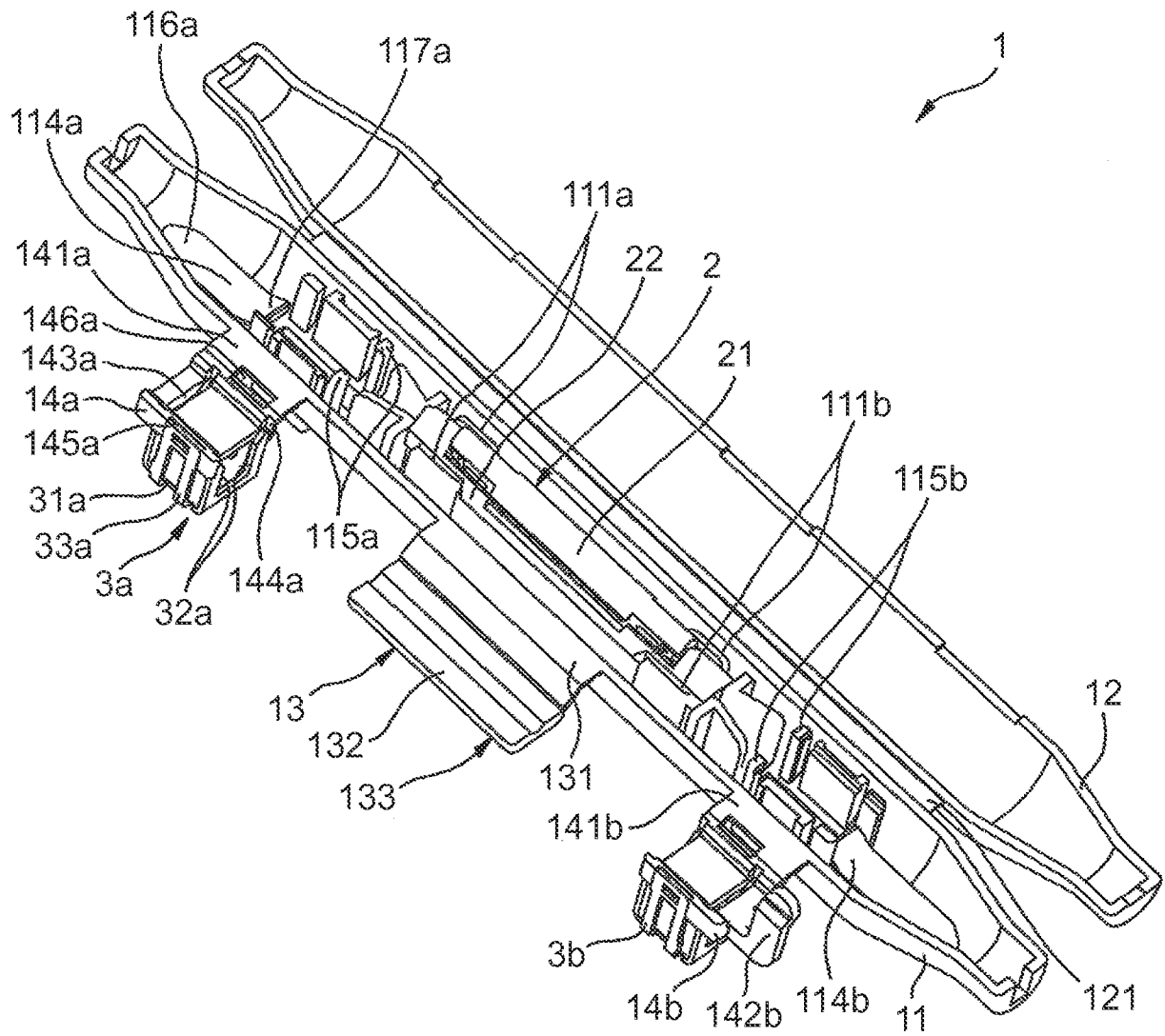


Fig. 1

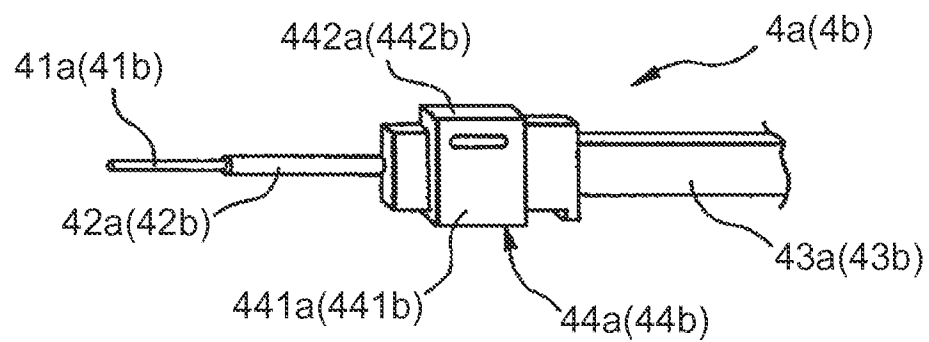


Fig. 2

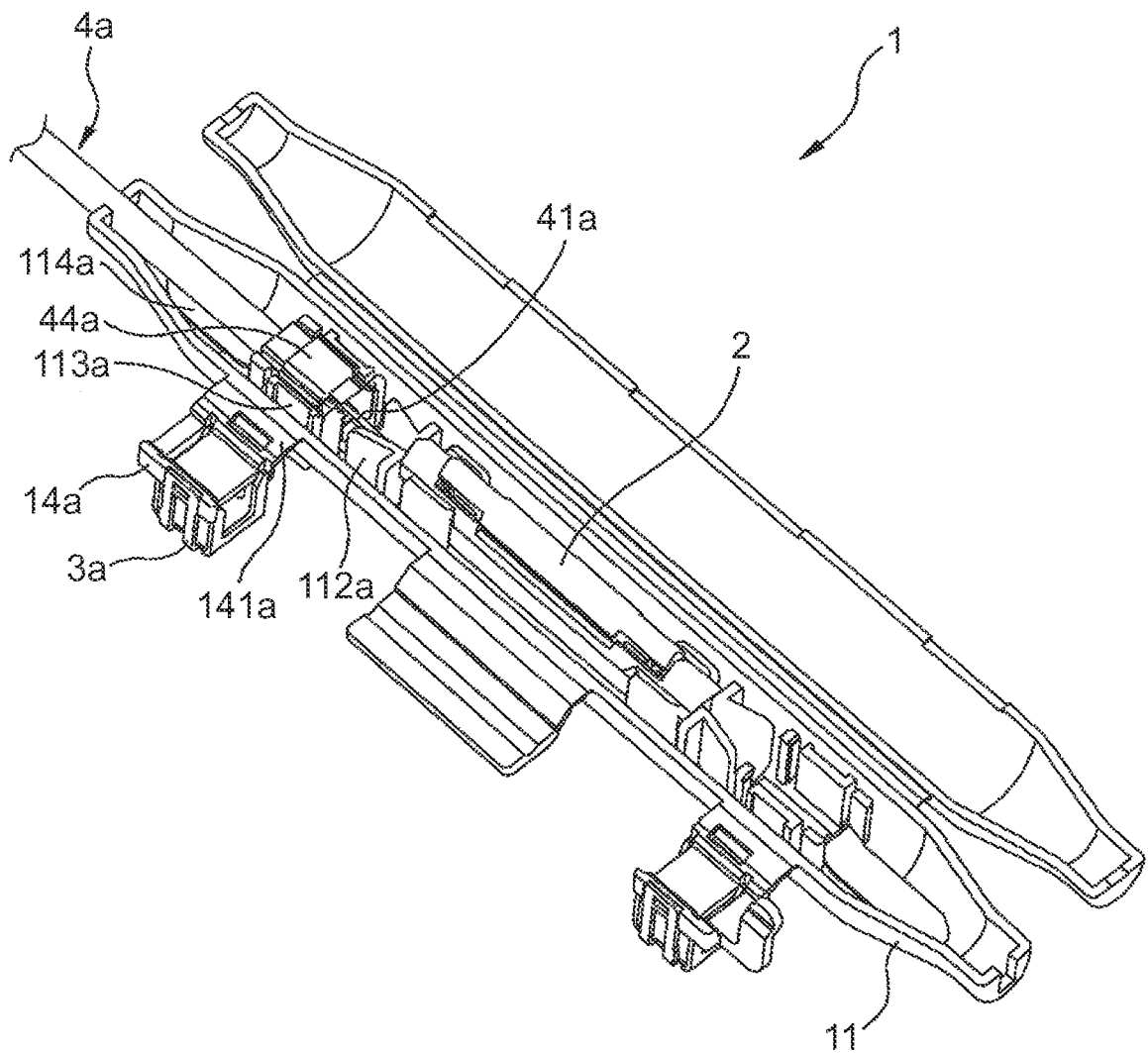


Fig. 3

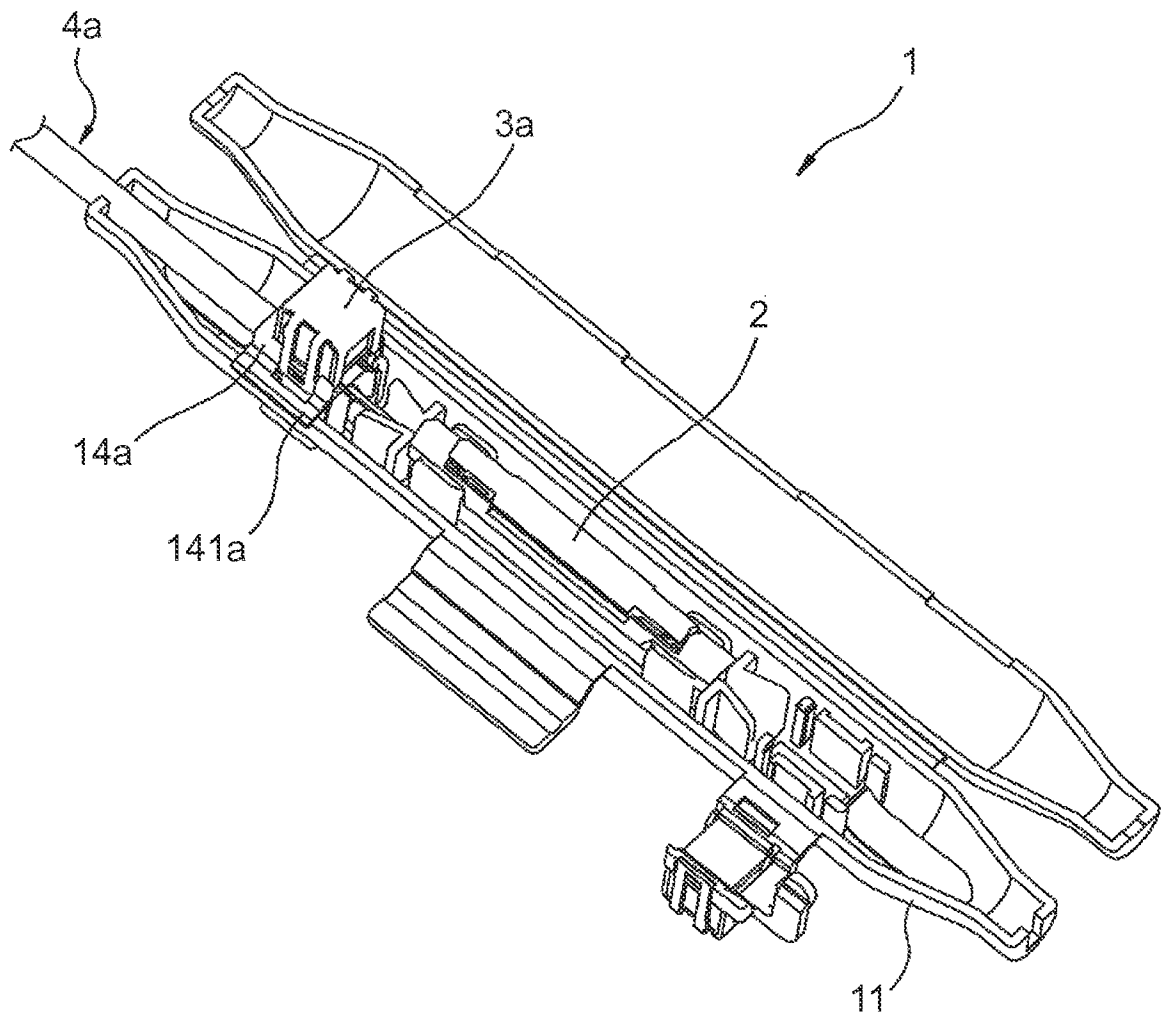
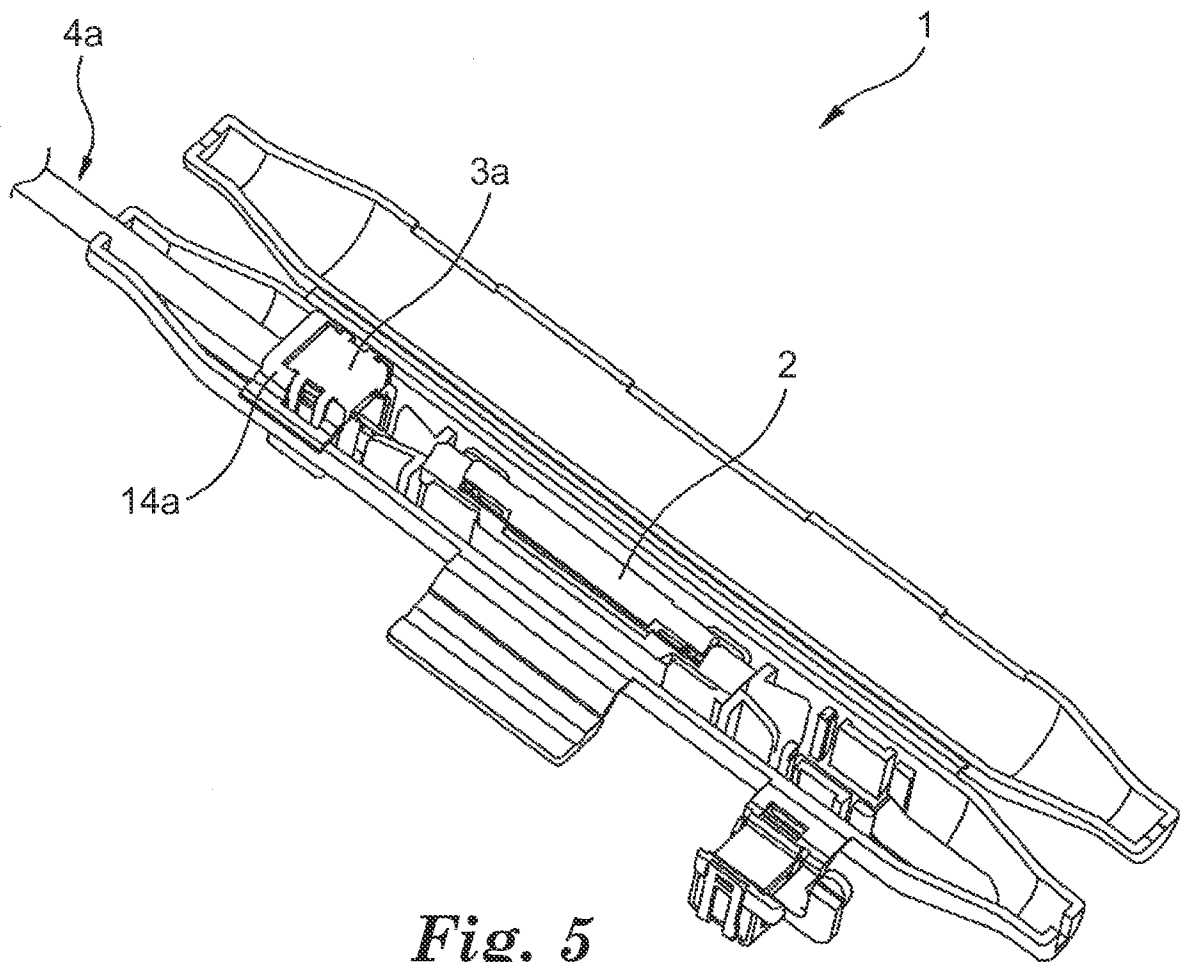


Fig. 4



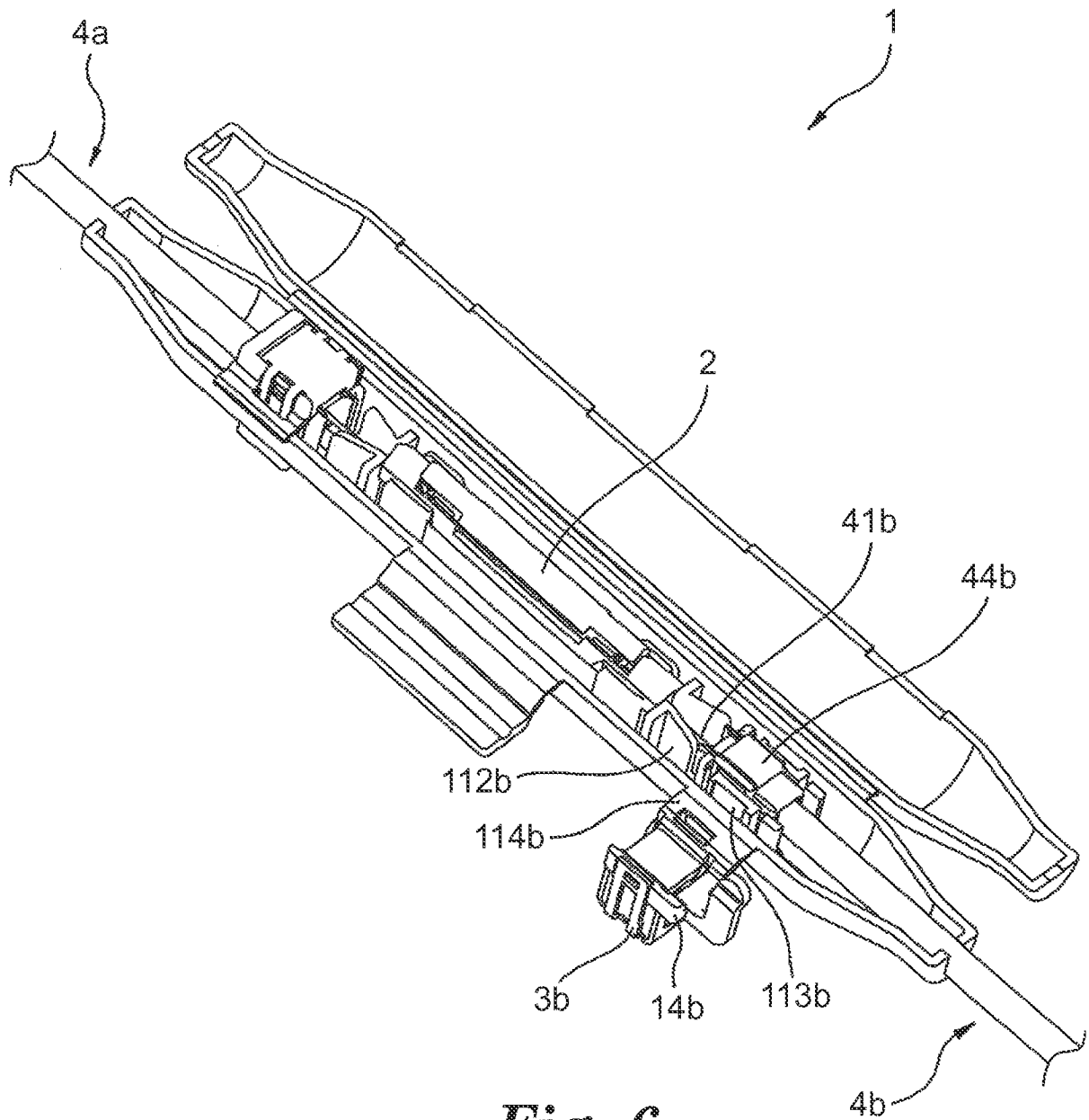


Fig. 6

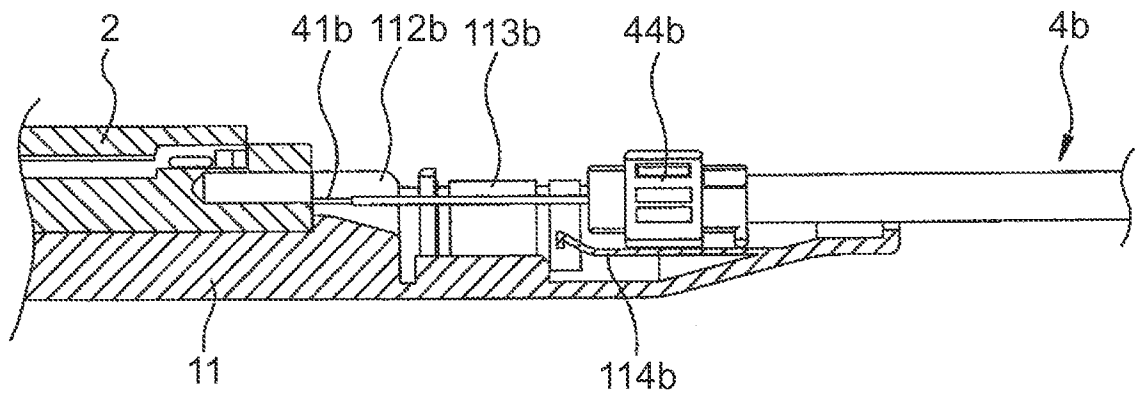


Fig. 7a

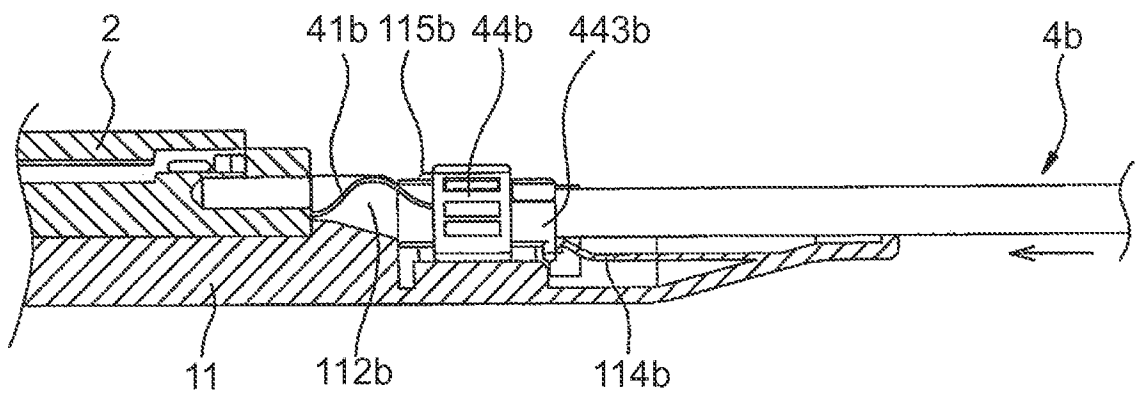


Fig. 7b

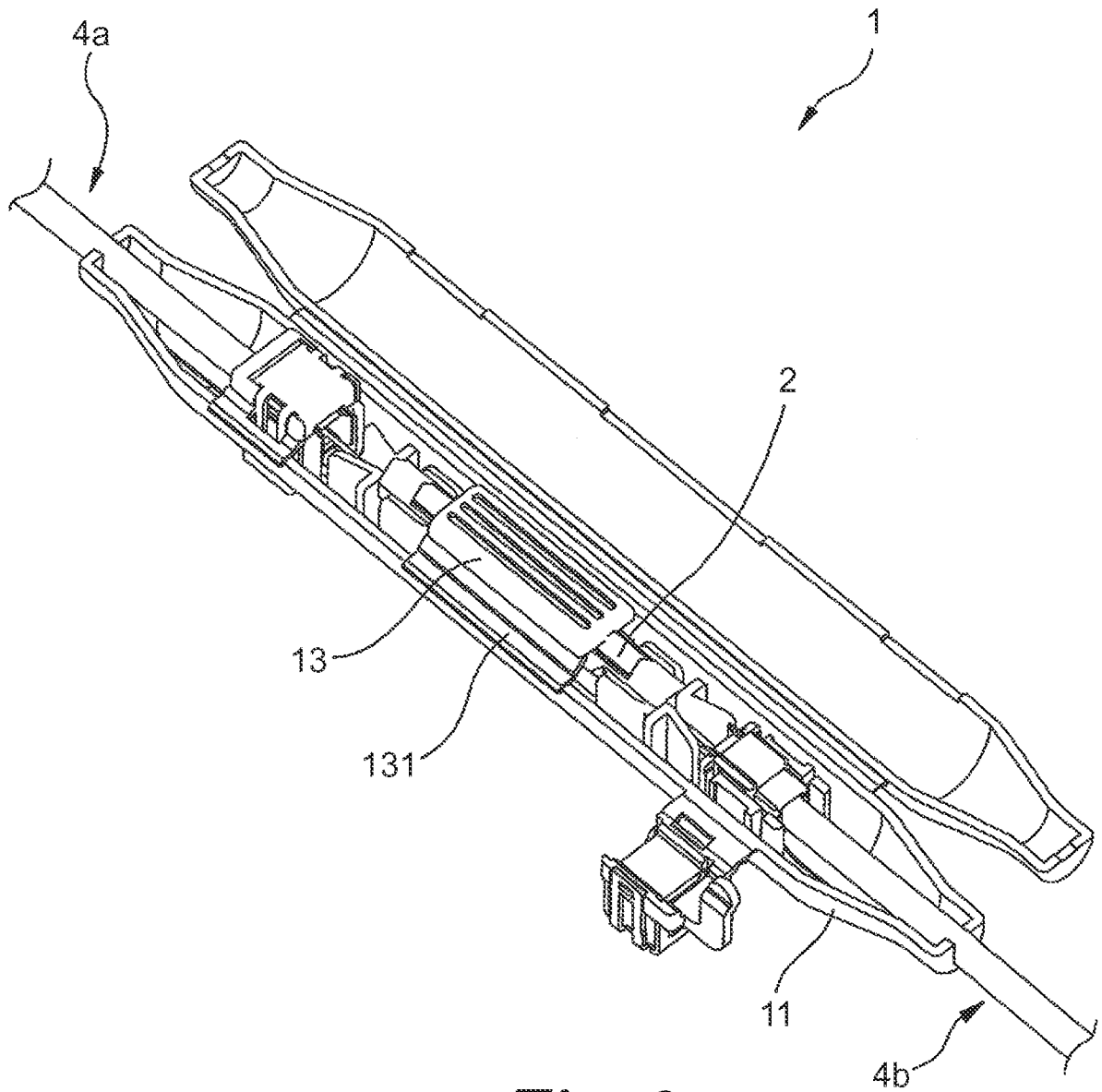


Fig. 8

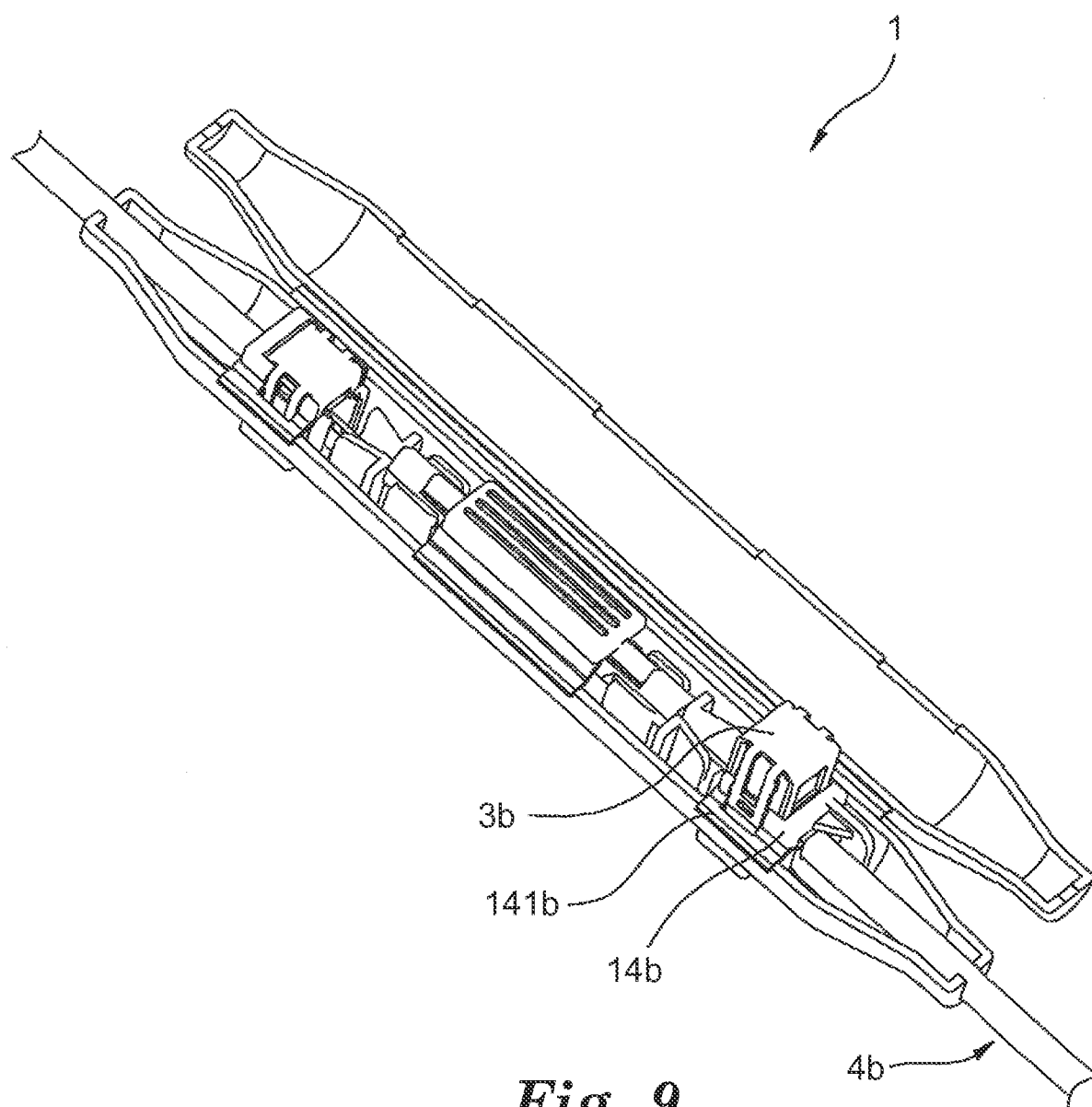


Fig. 9

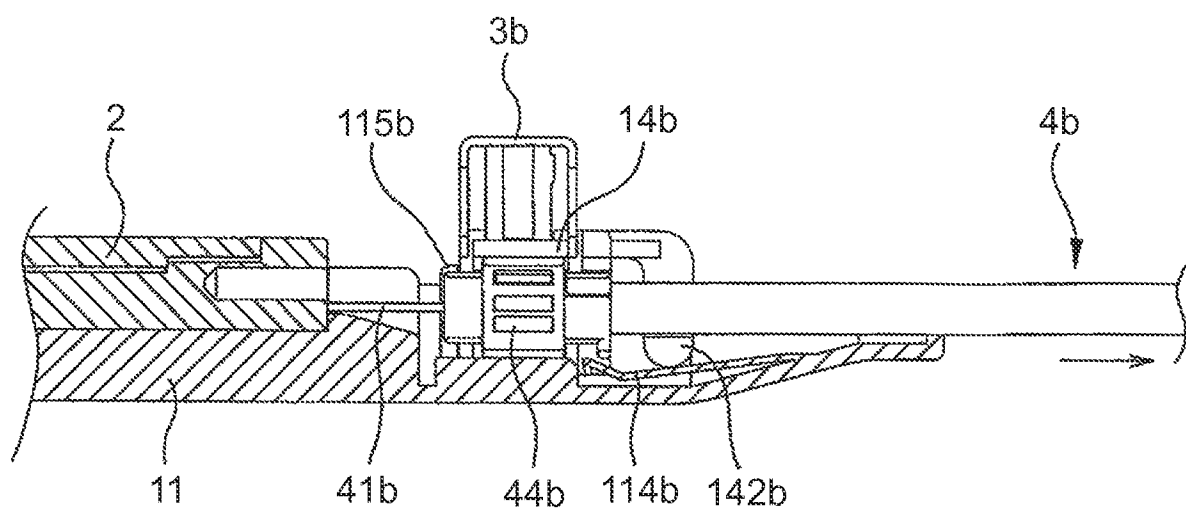
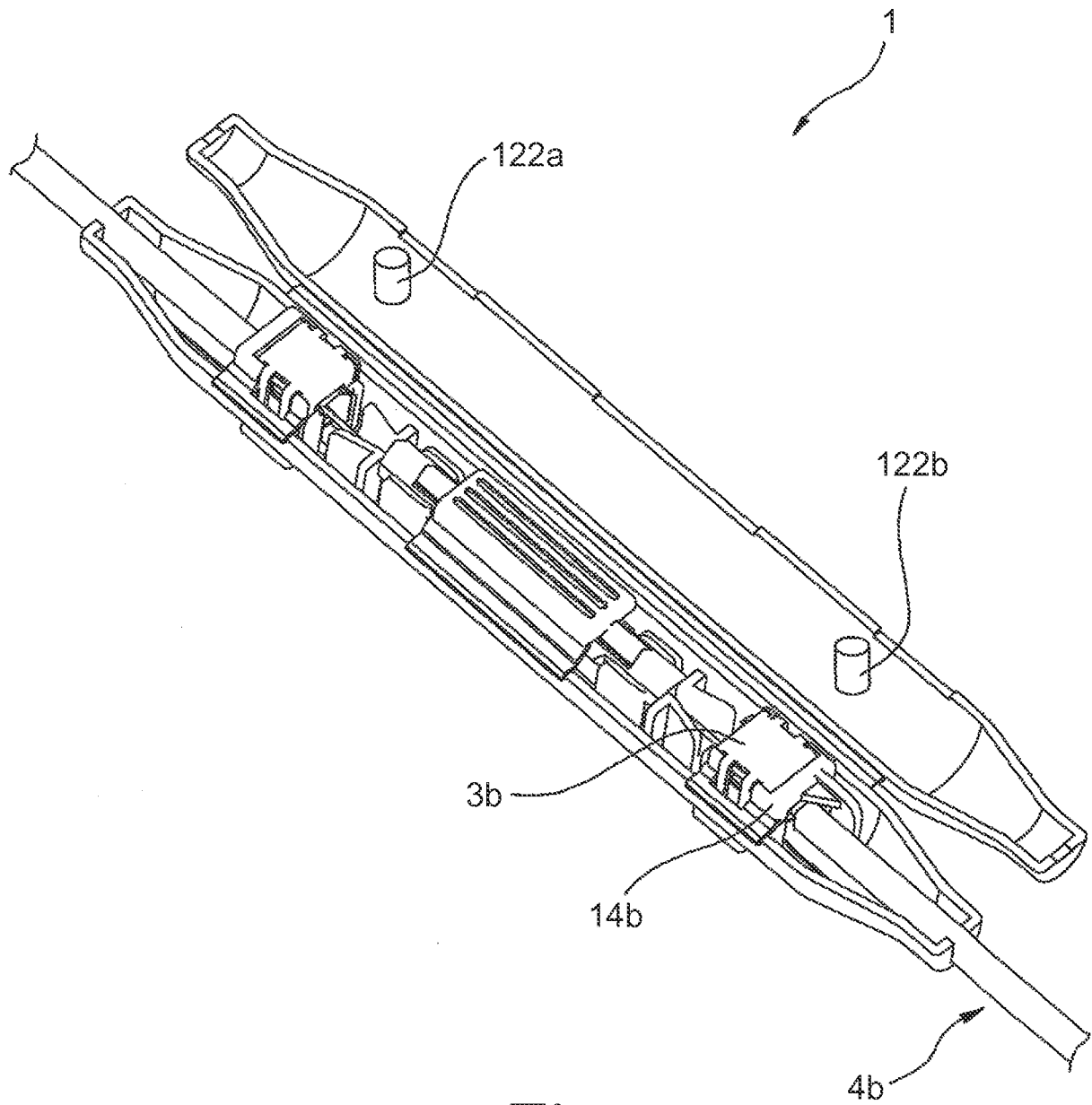


Fig. 10

*Fig. 11*

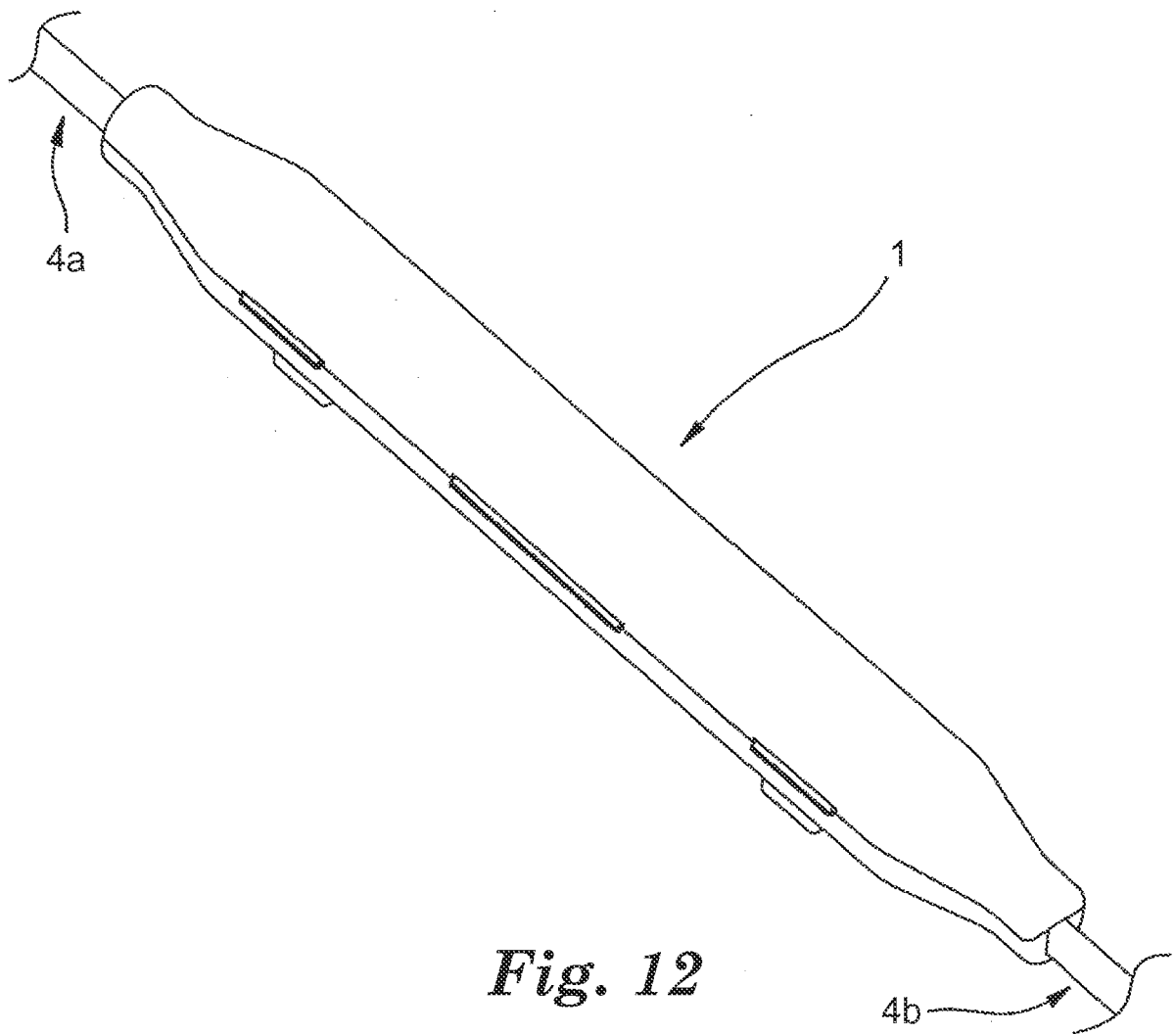
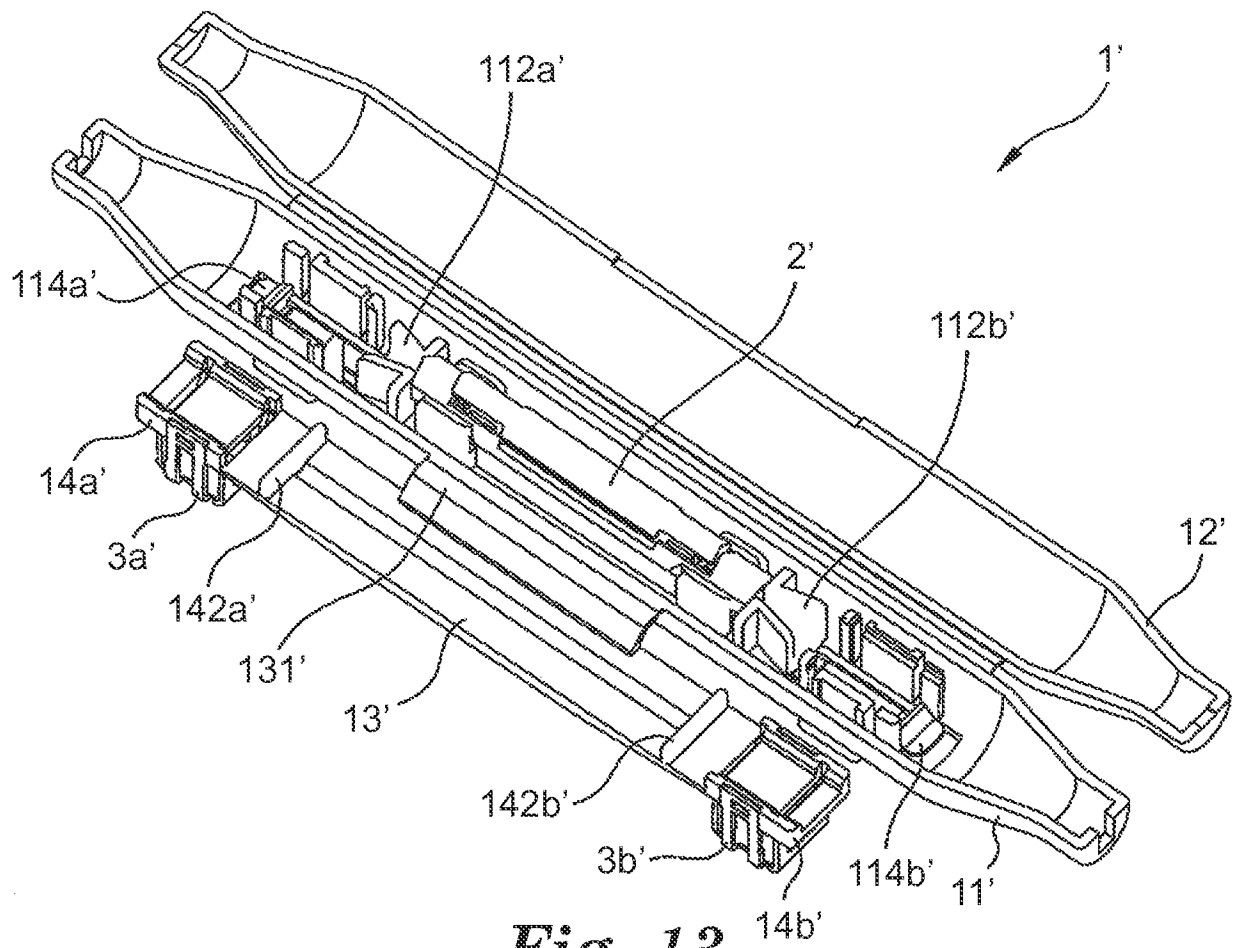
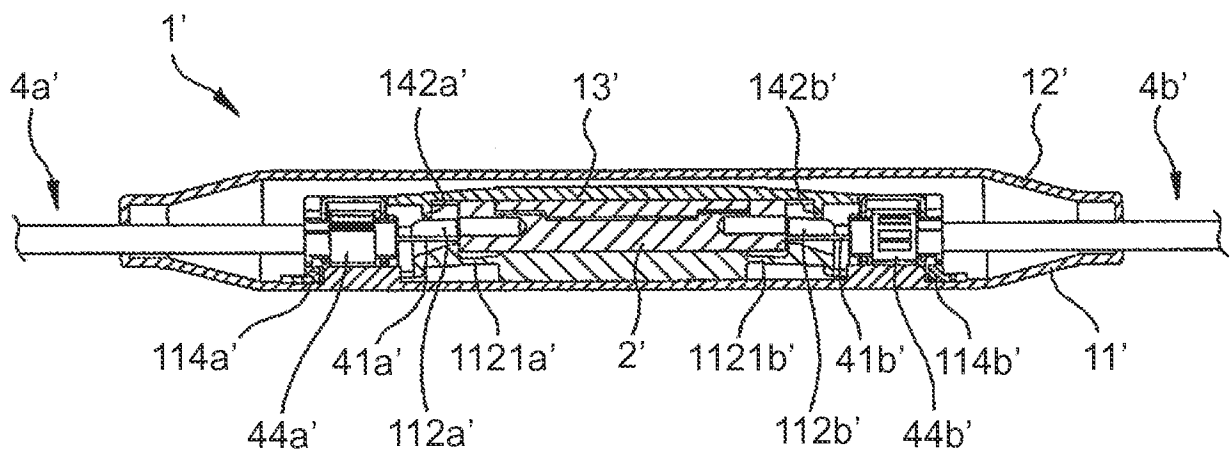
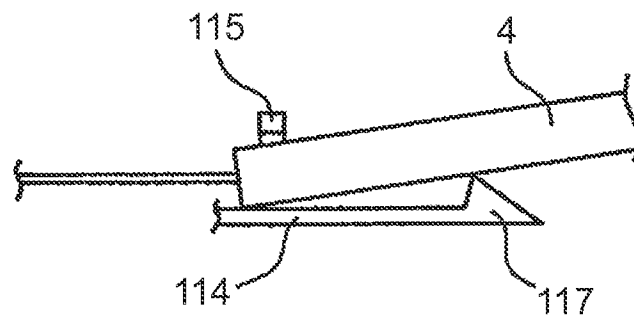
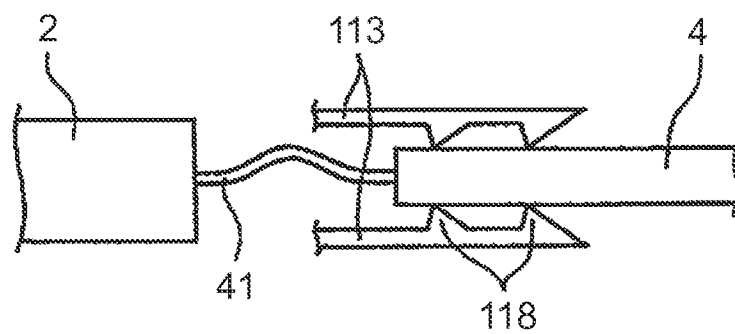
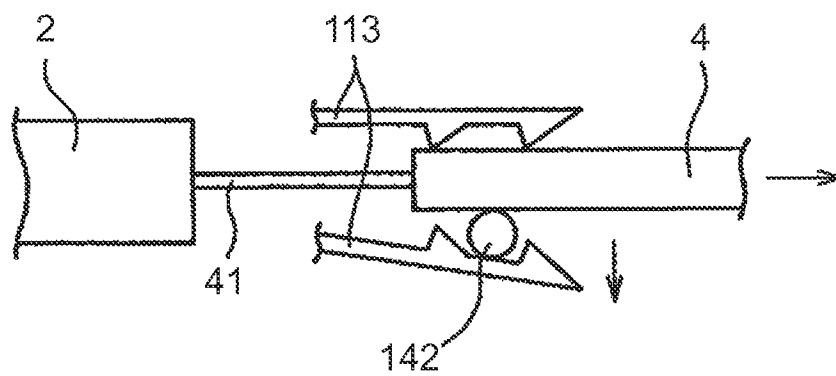


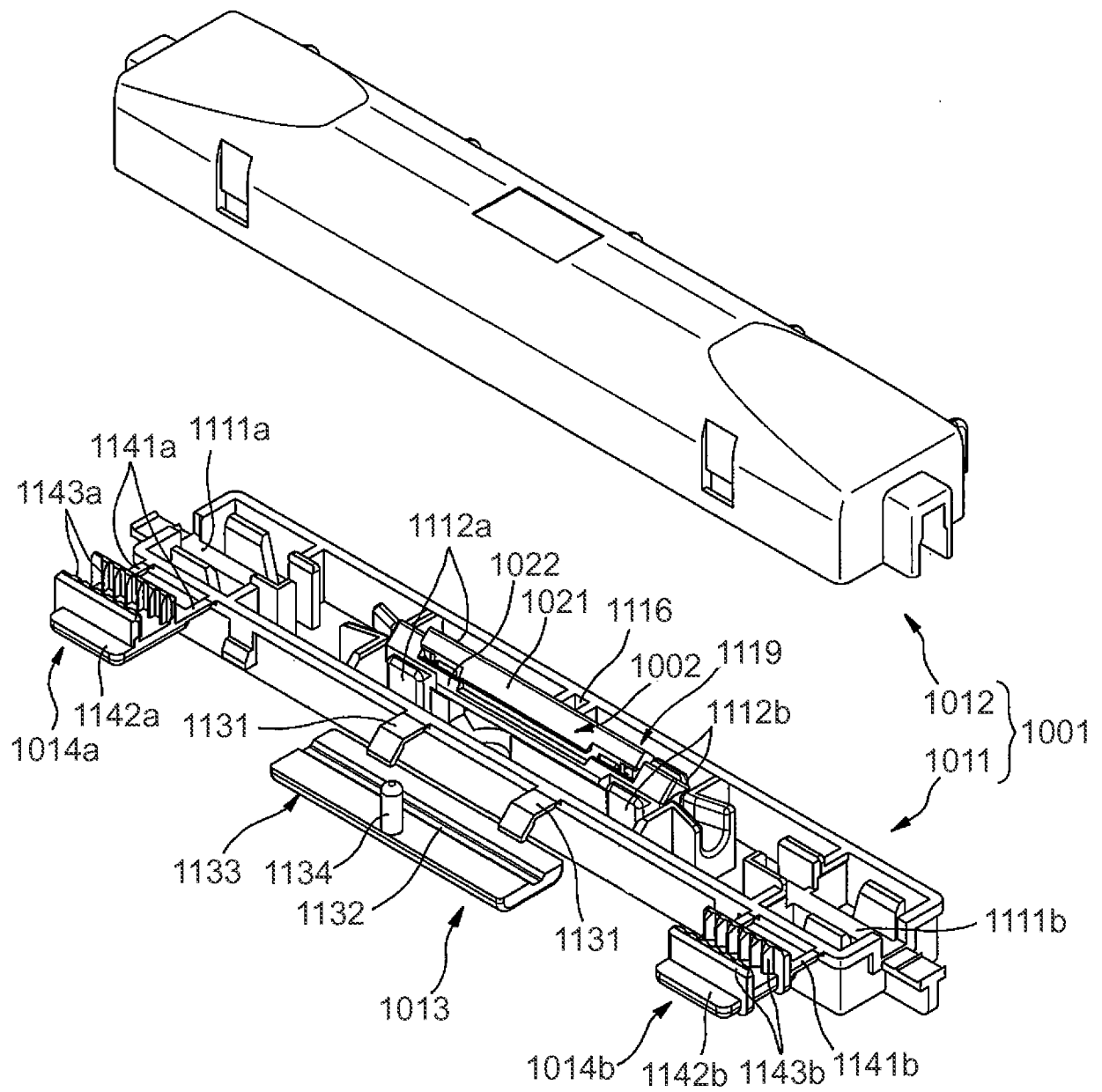
Fig. 12

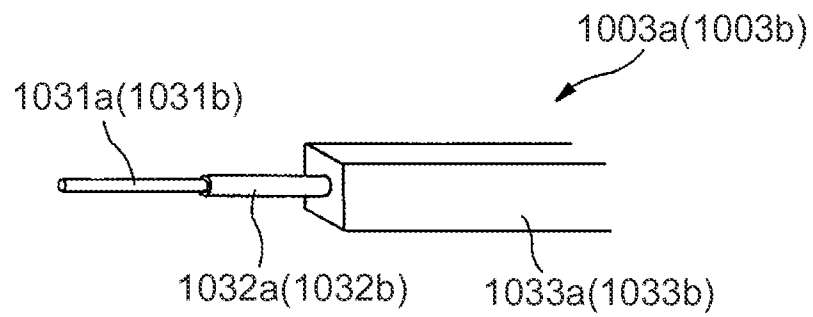
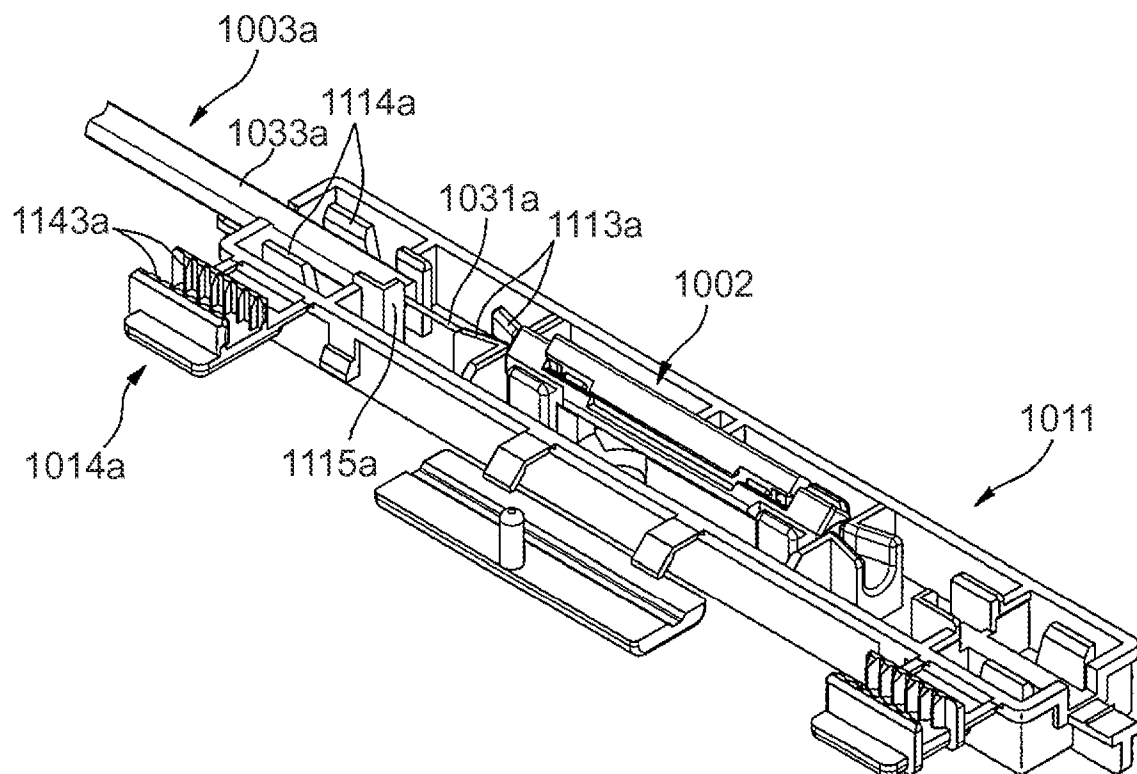
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**Fig. 13****Fig. 14**

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*Fig. 15**Fig. 16a**Fig. 16b*

*Fig. 17*

*Fig. 18**Fig. 19*

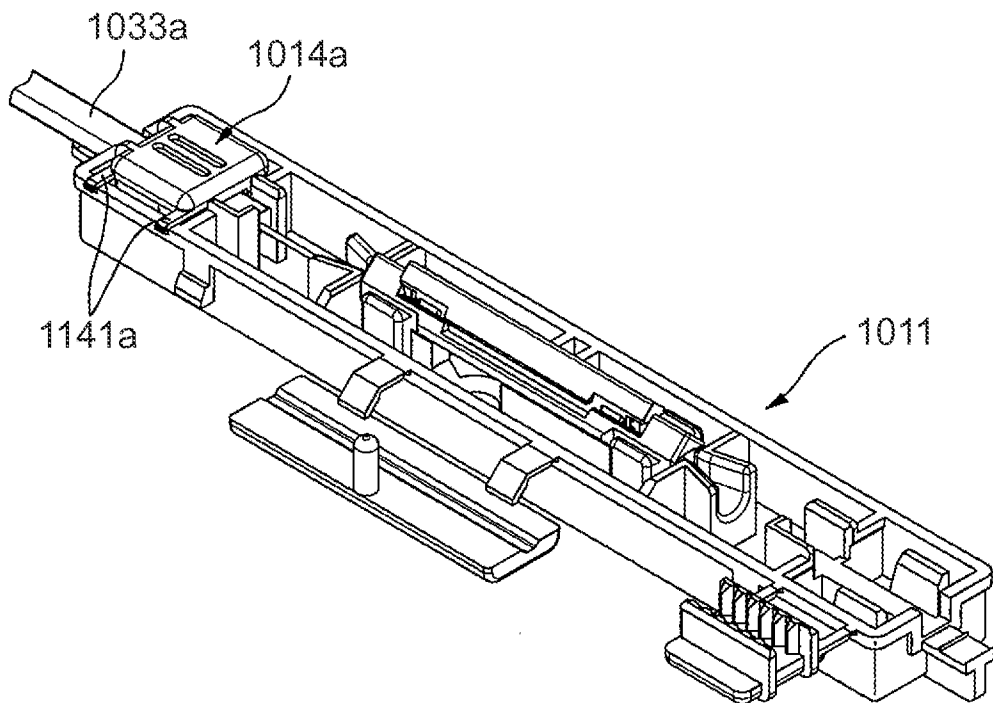


Fig. 20

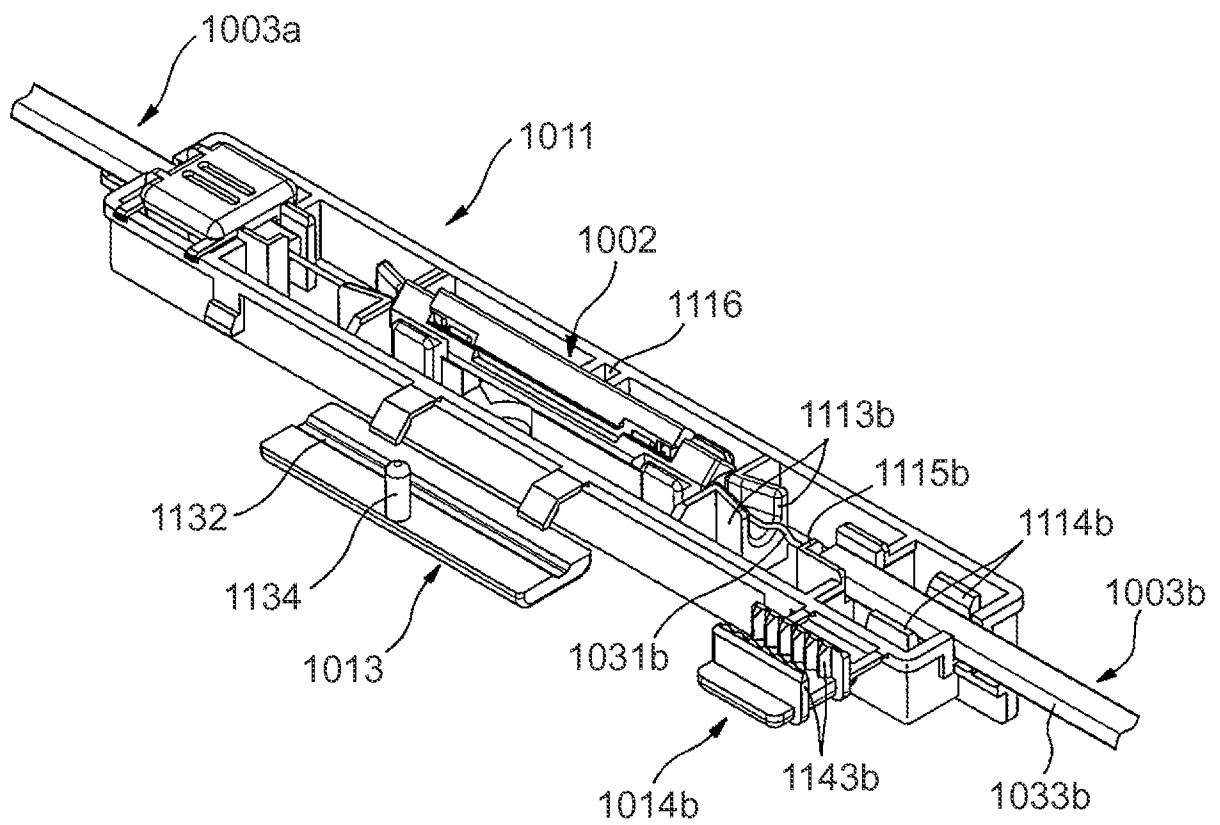


Fig. 21

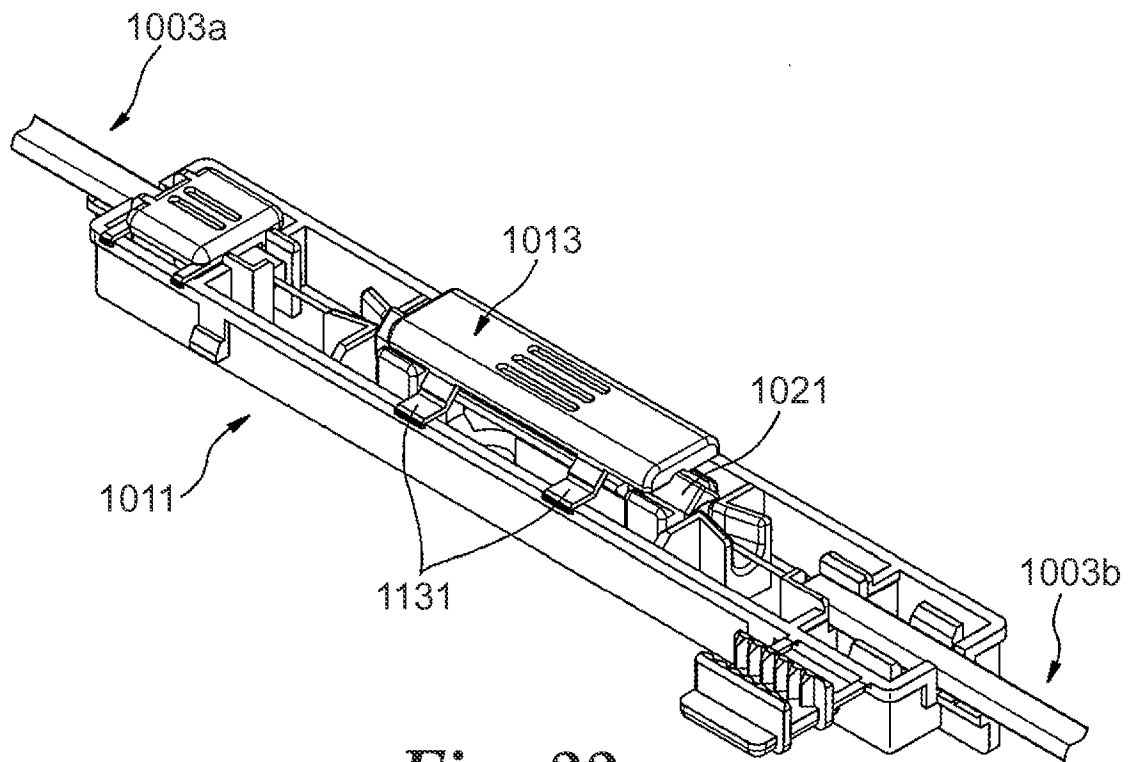


Fig. 22

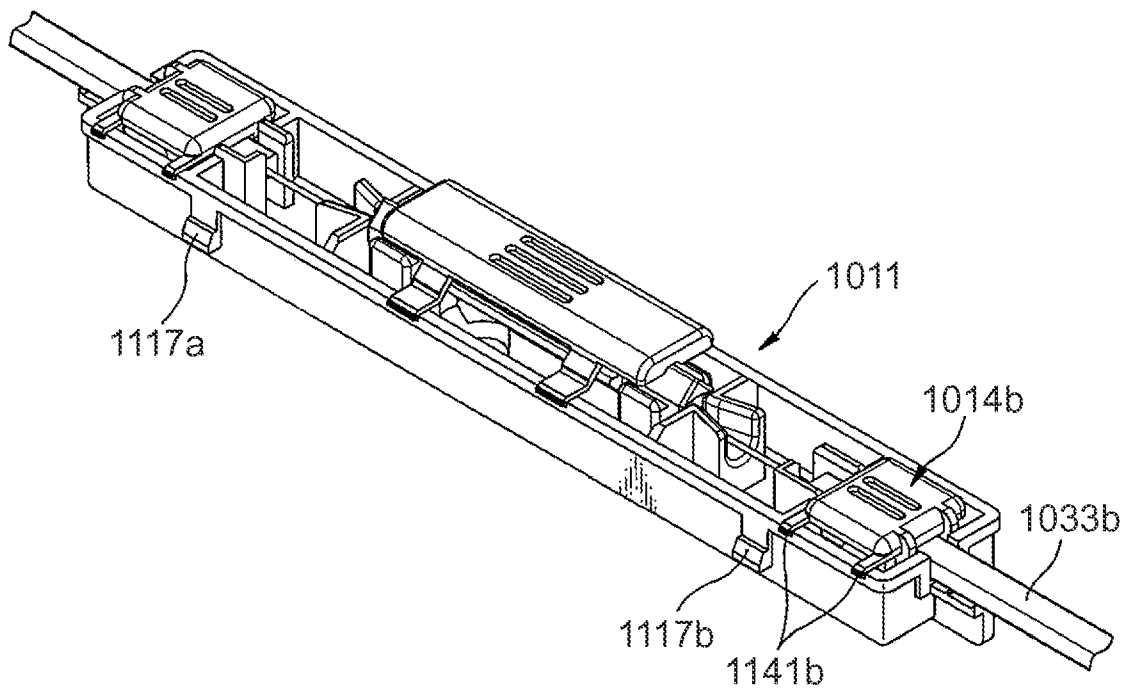


Fig. 23

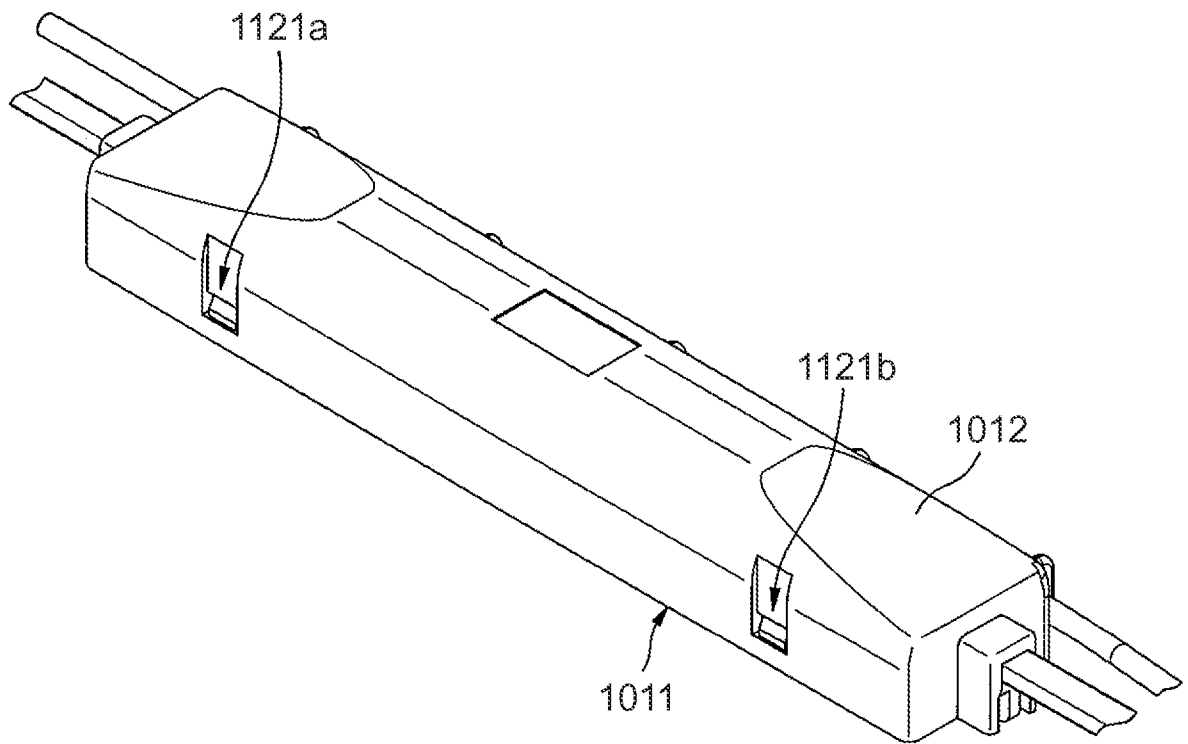


Fig. 24

Fig. 25a

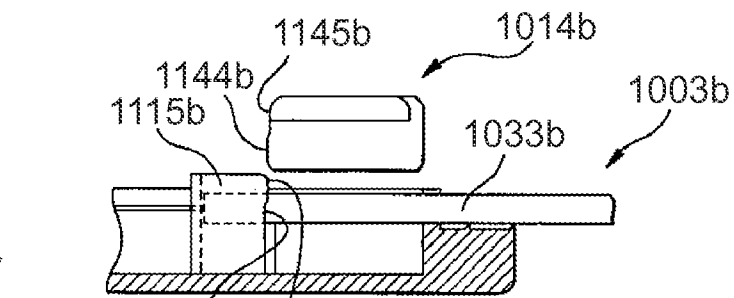


Fig. 25b

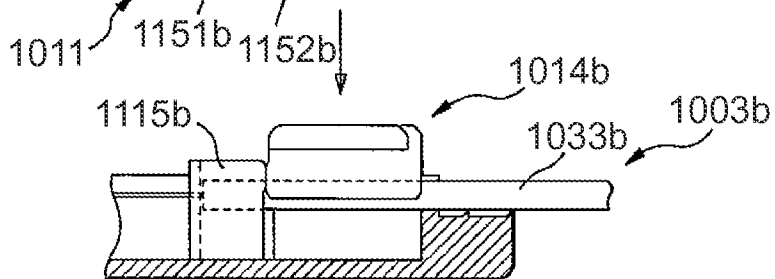


Fig. 25c

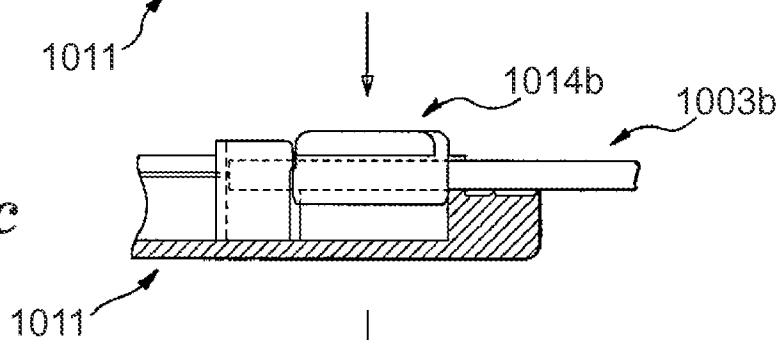


Fig. 25d

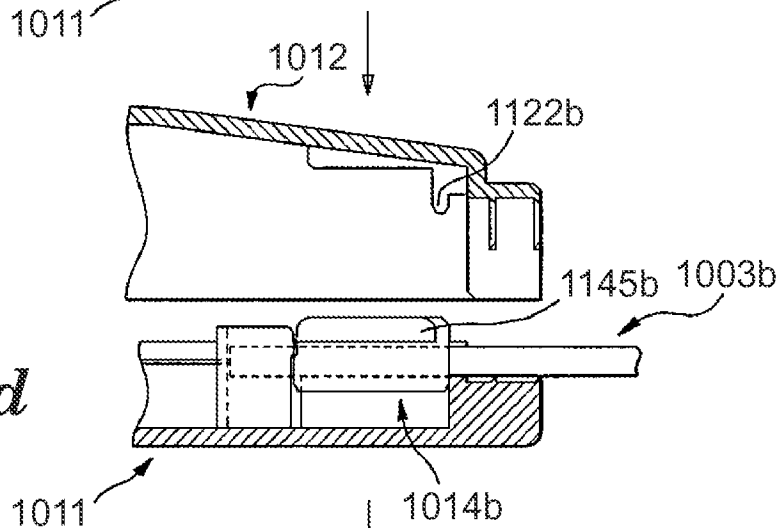
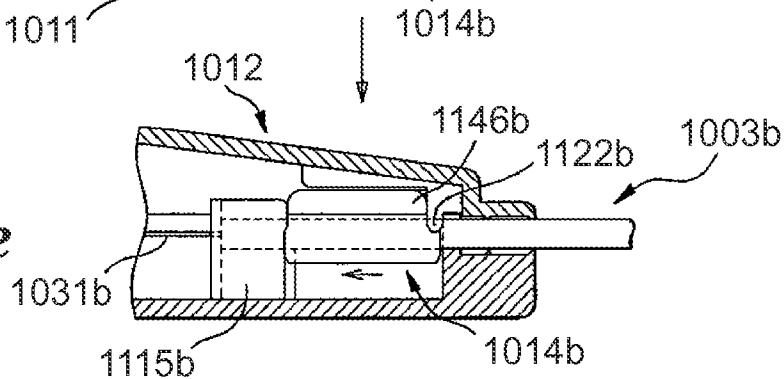
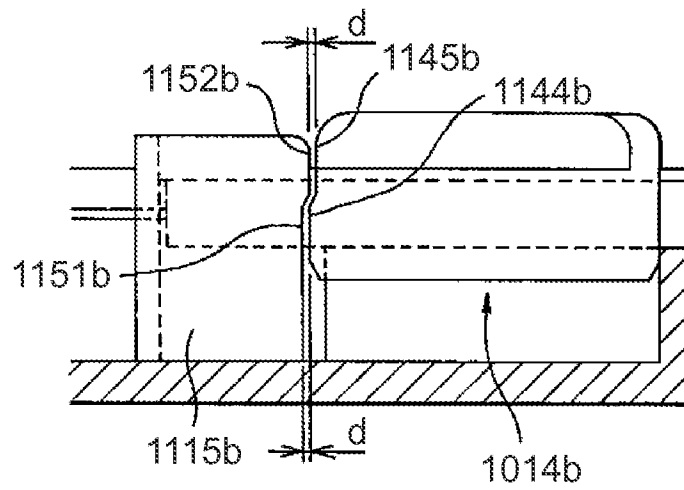
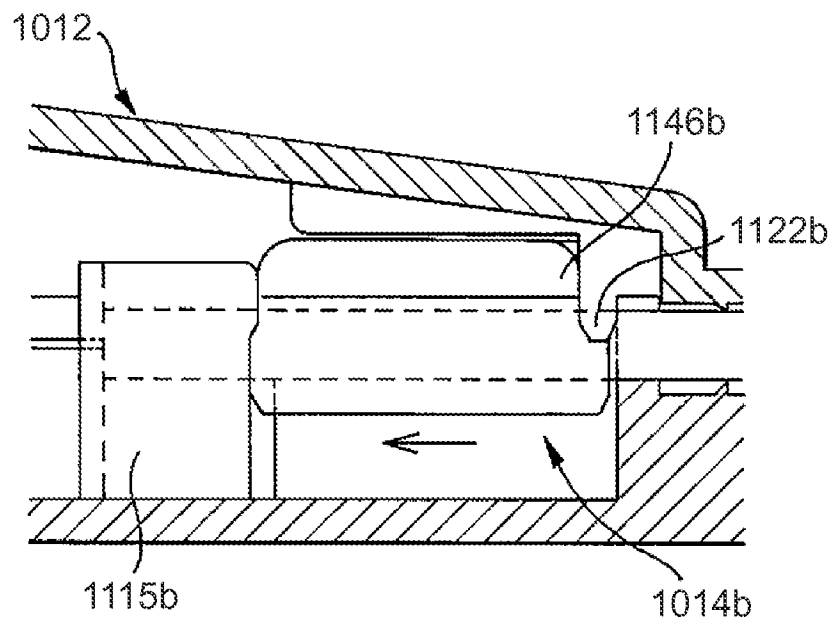
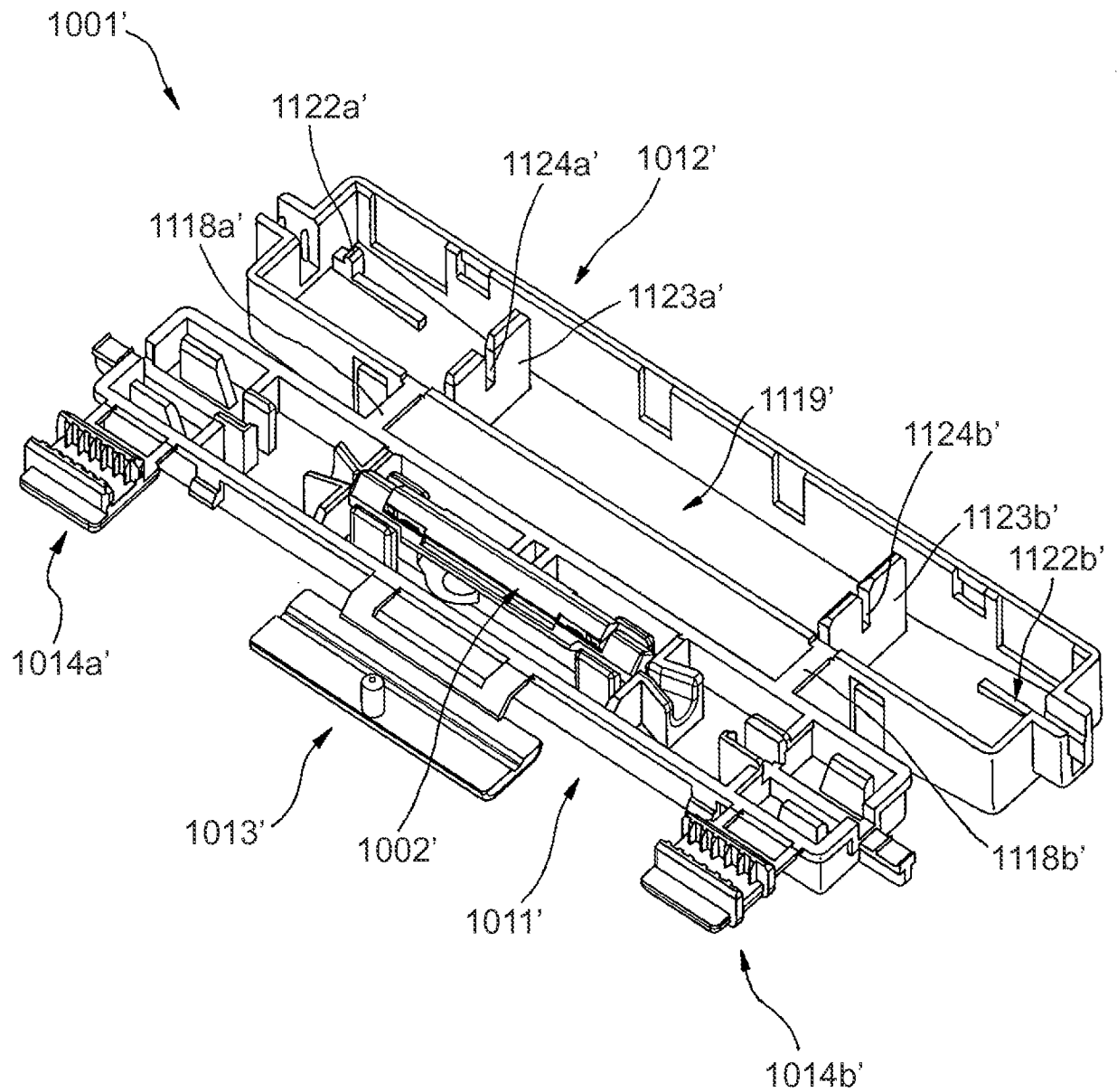


Fig. 25e



*Fig. 26**Fig. 27*

*Fig. 28*

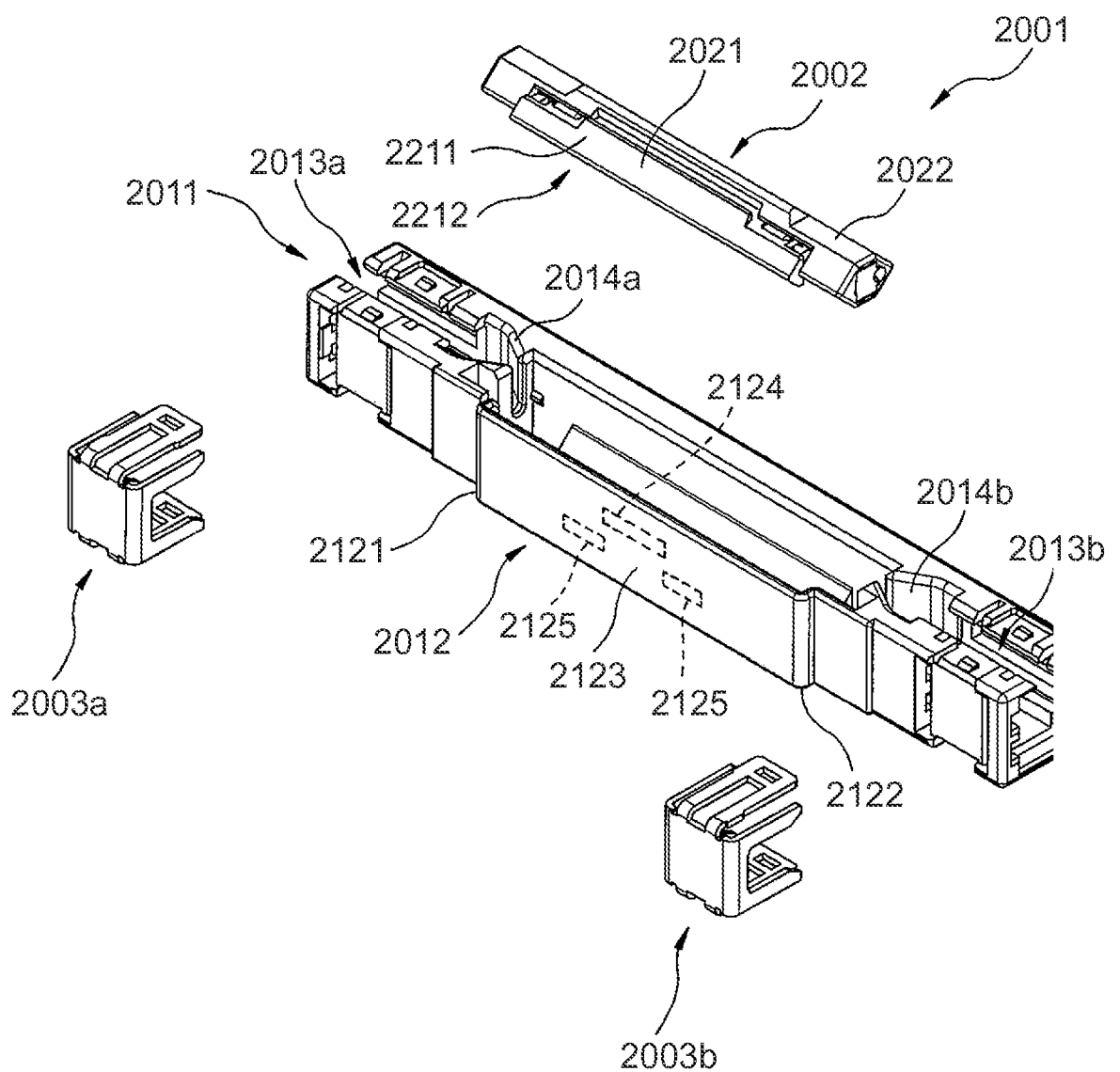
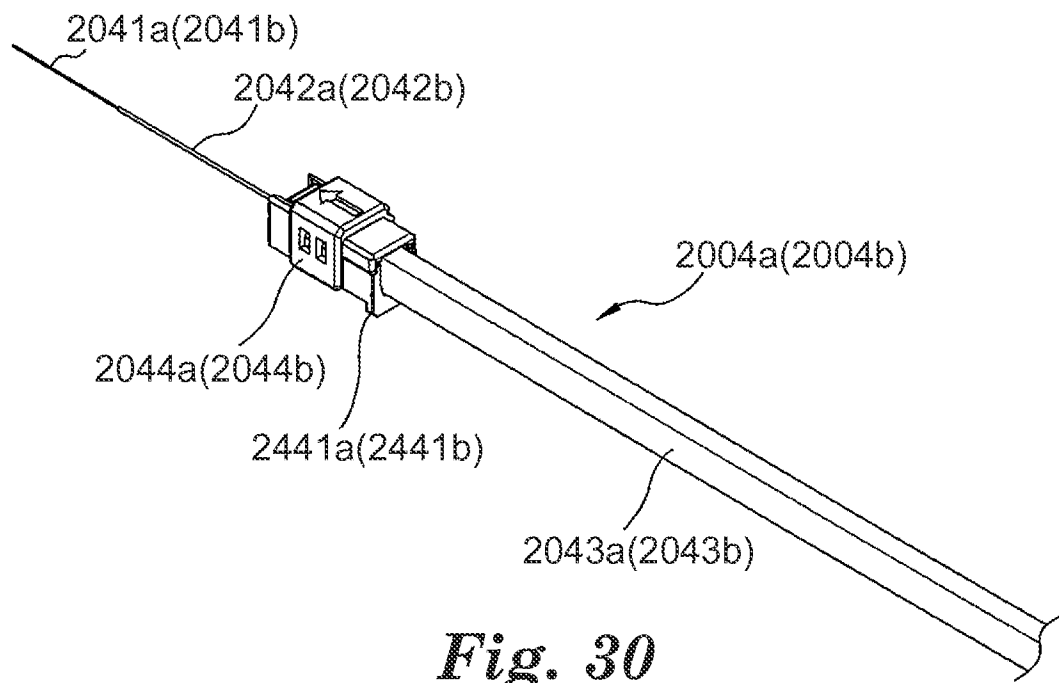
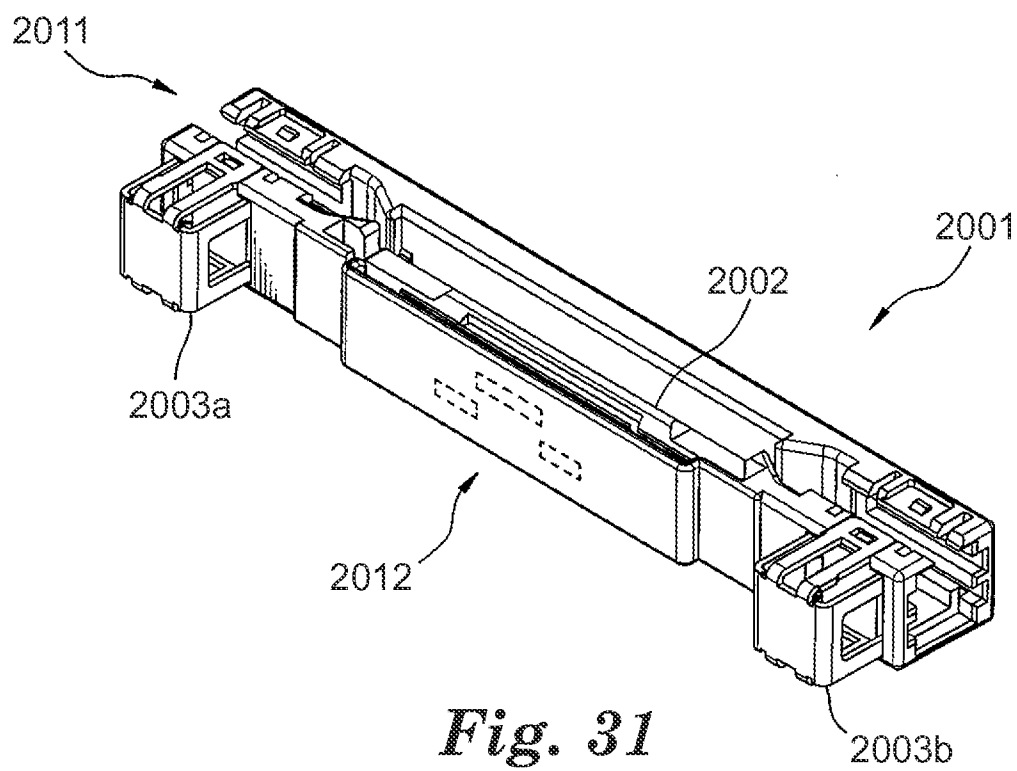


Fig. 29

*Fig. 30**Fig. 31*

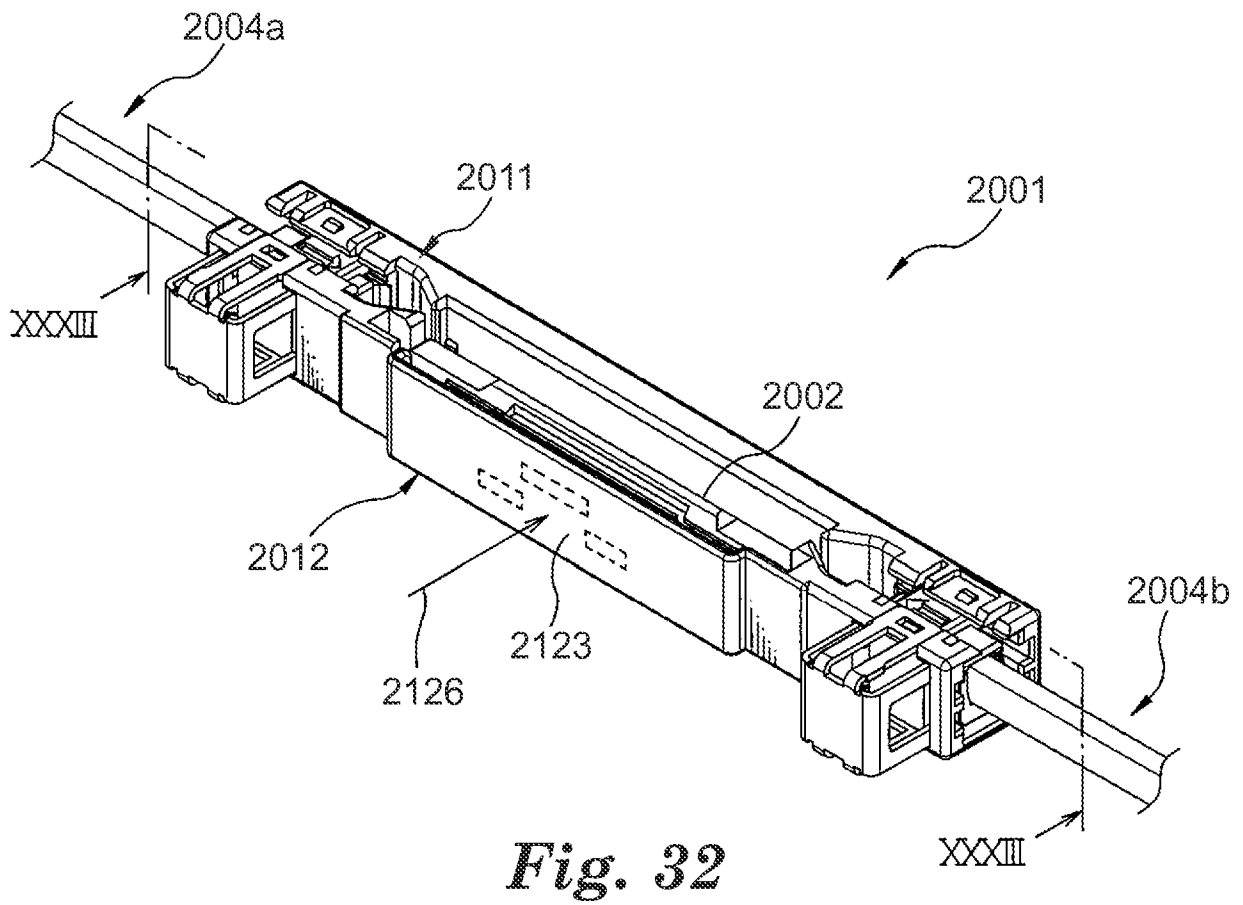


Fig. 32

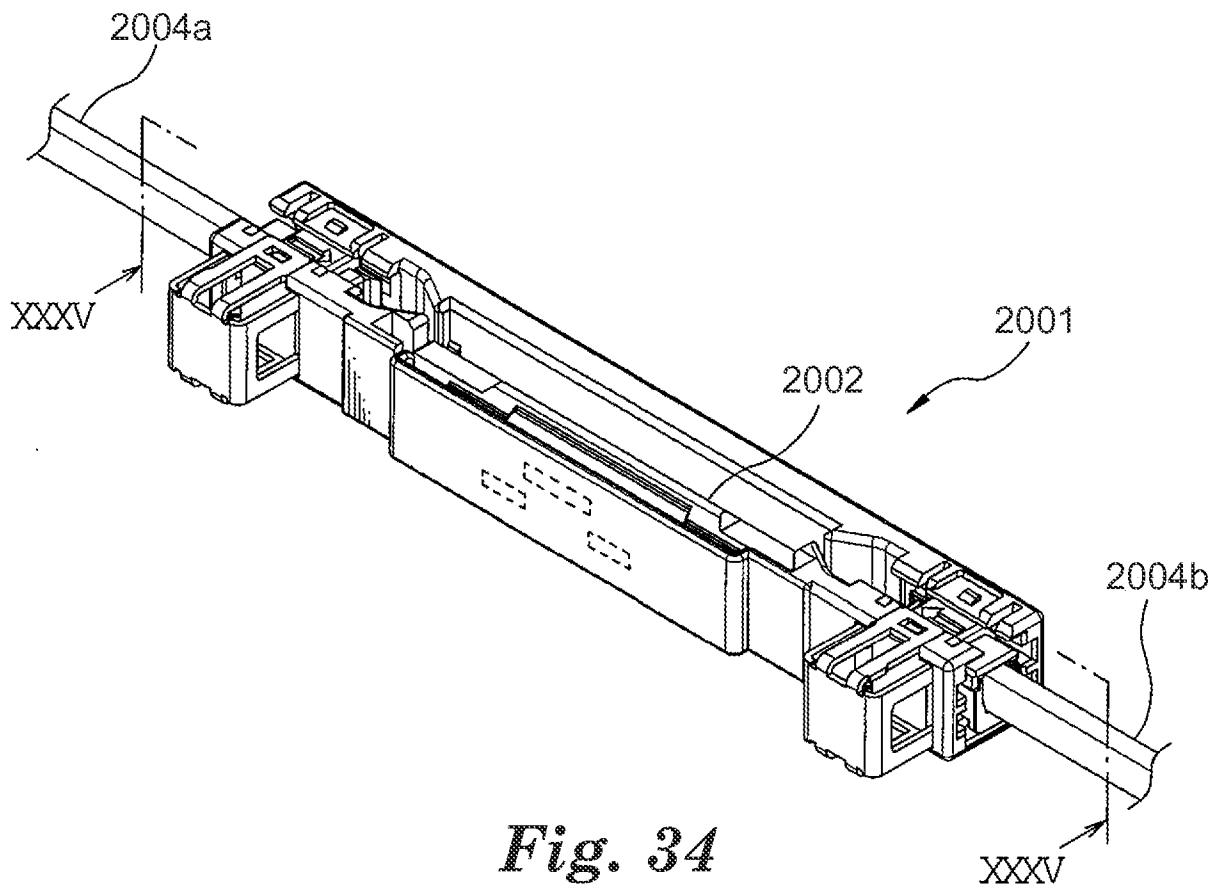
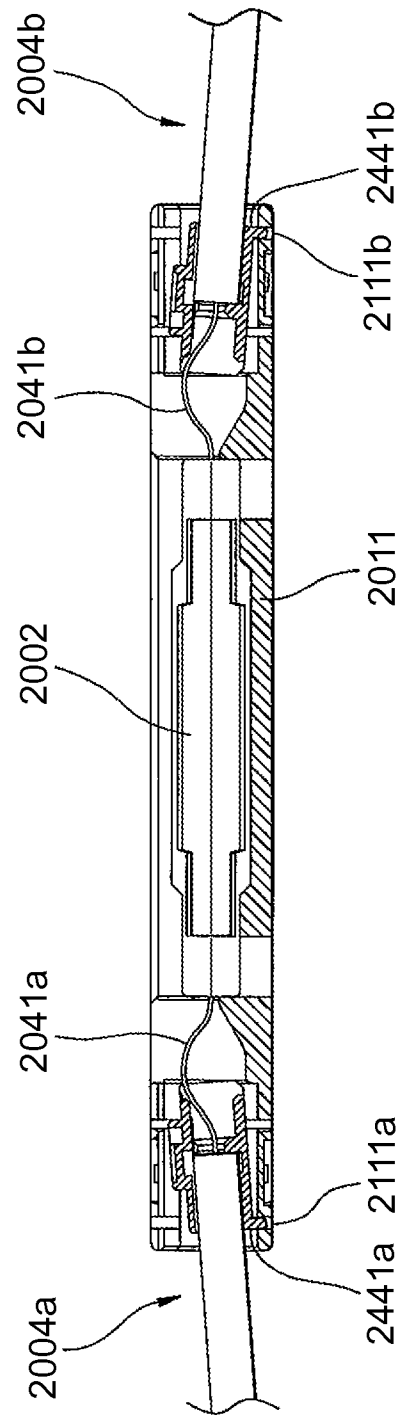
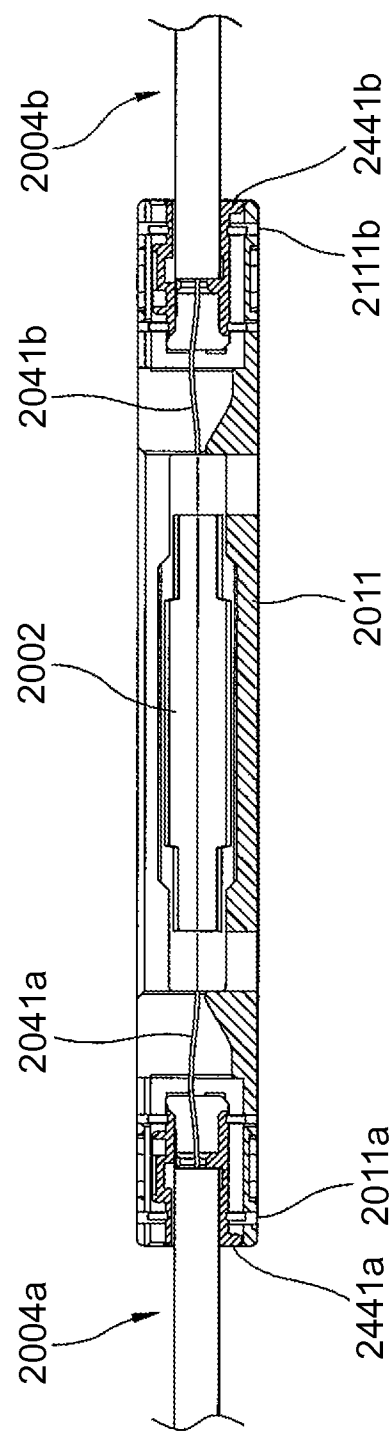


Fig. 34



XXXIII-XXXIII SECTION

Fig. 33



xxxv-xxxv SECTION

Fig. 35

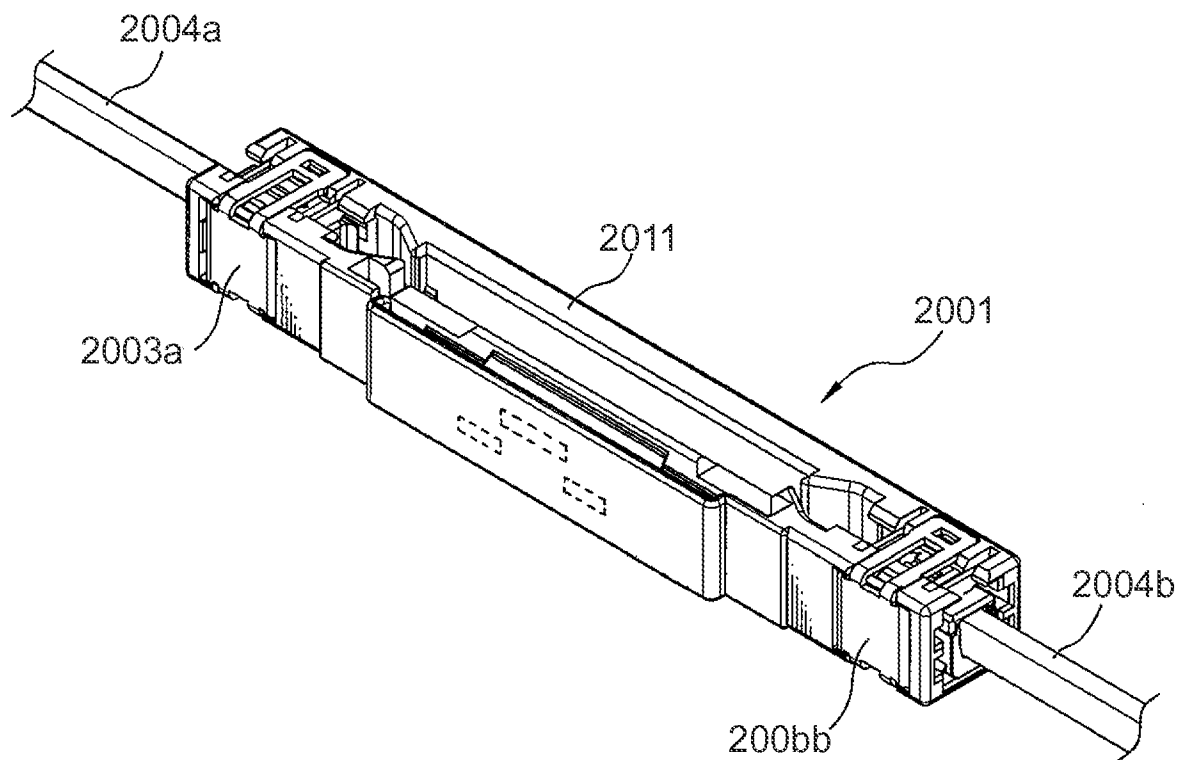


Fig. 36

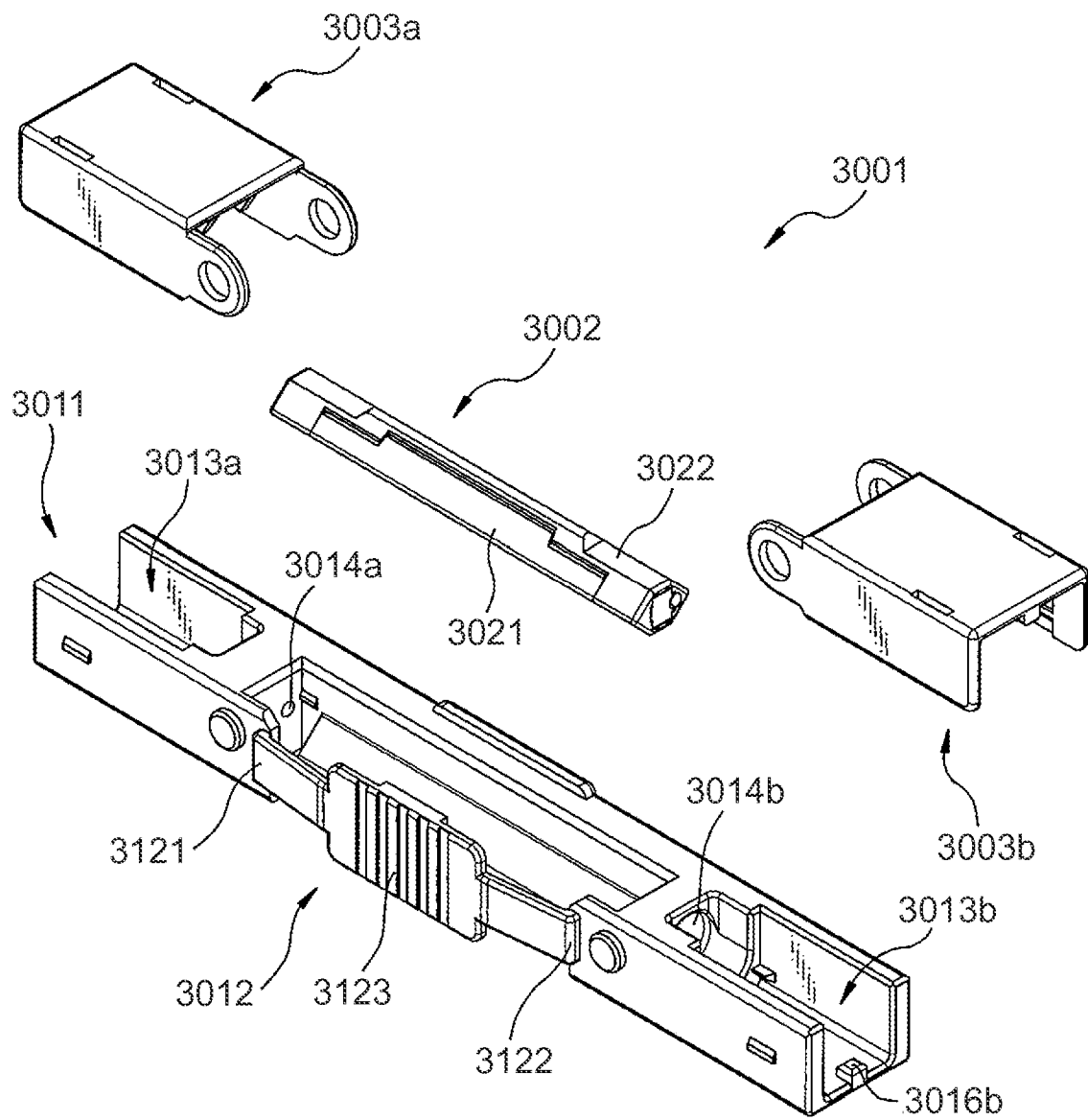
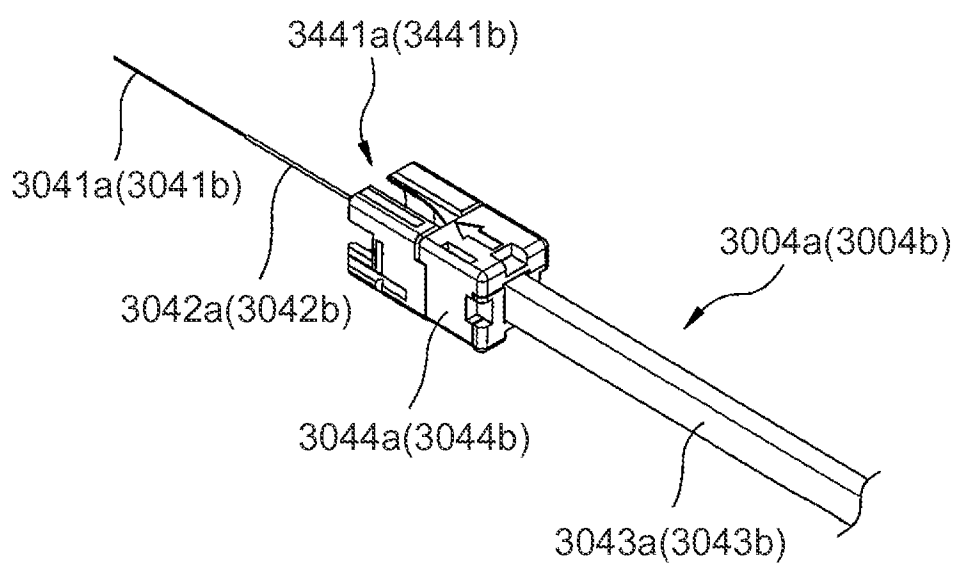
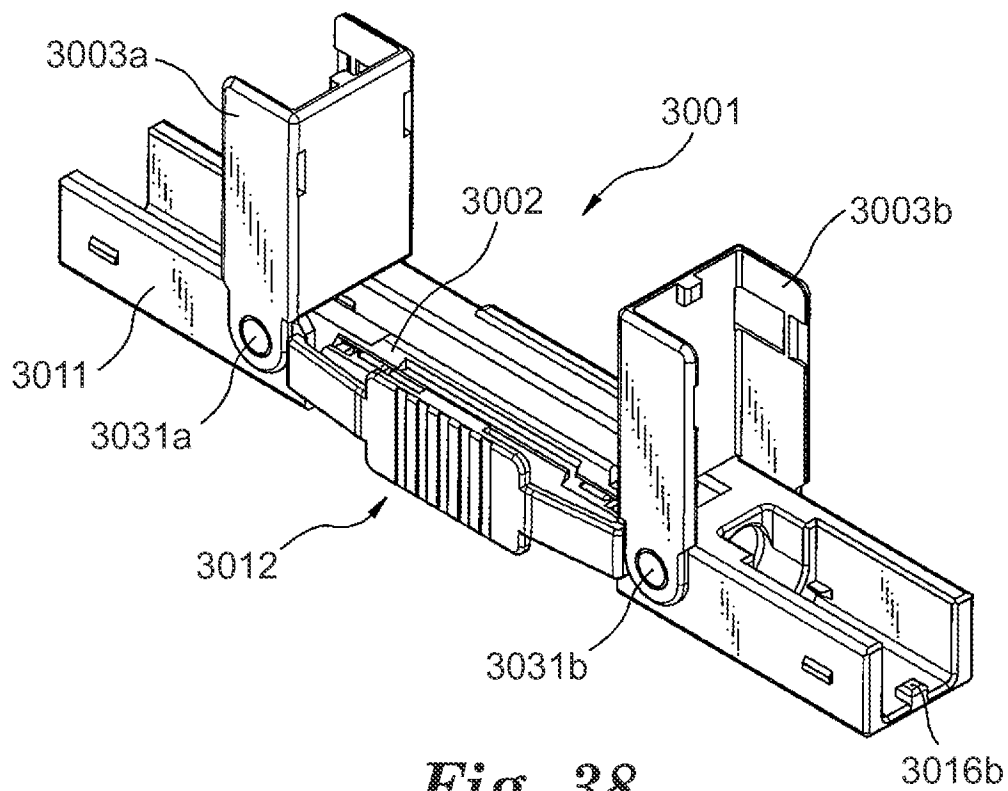
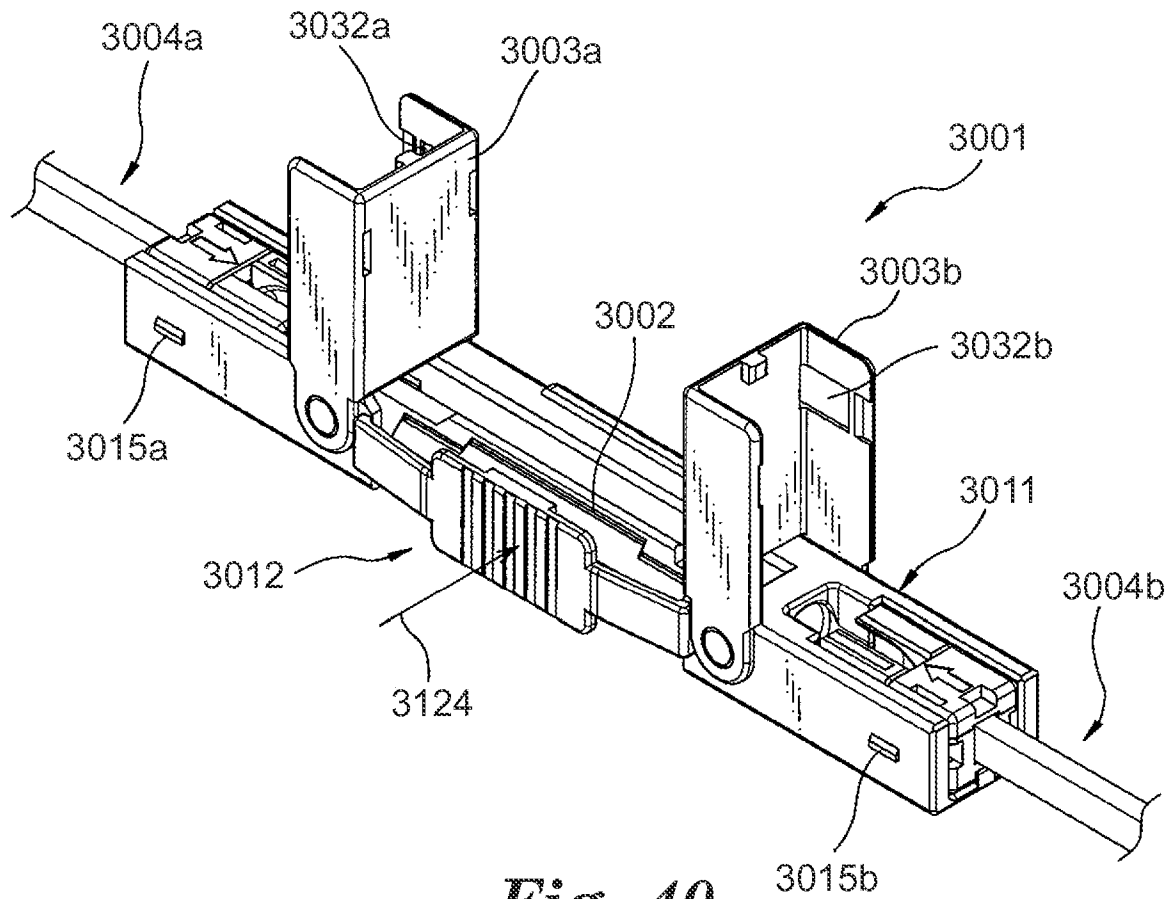
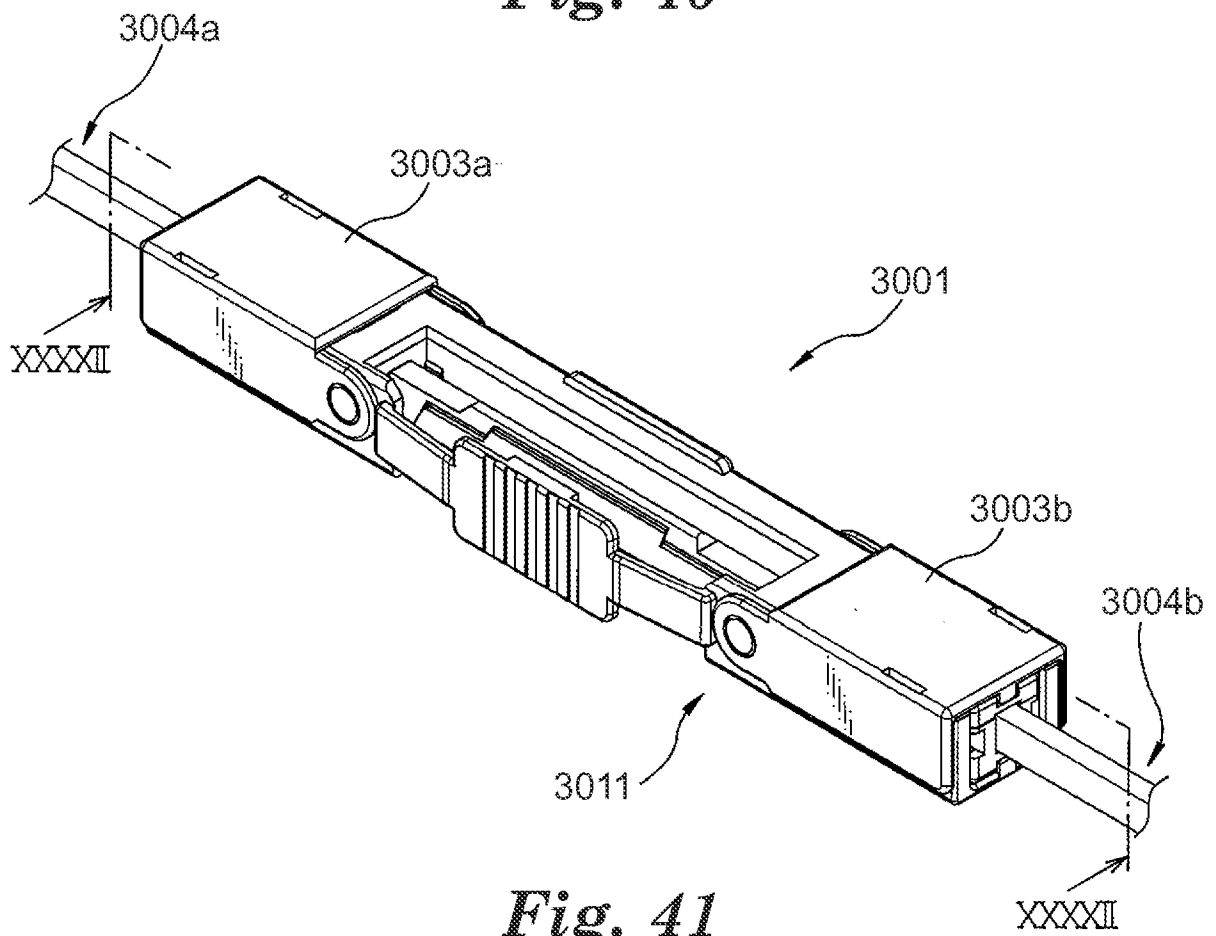
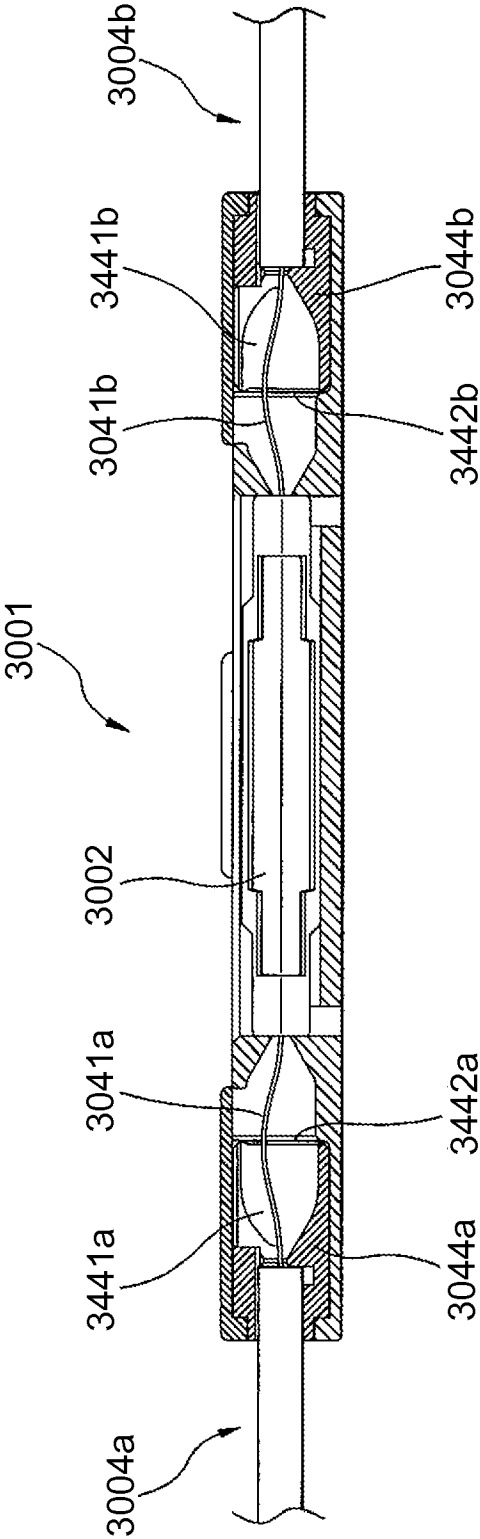


Fig. 37



*Fig. 40**Fig. 41*



XXXXII-XXXXII SECTION

Fig. 42

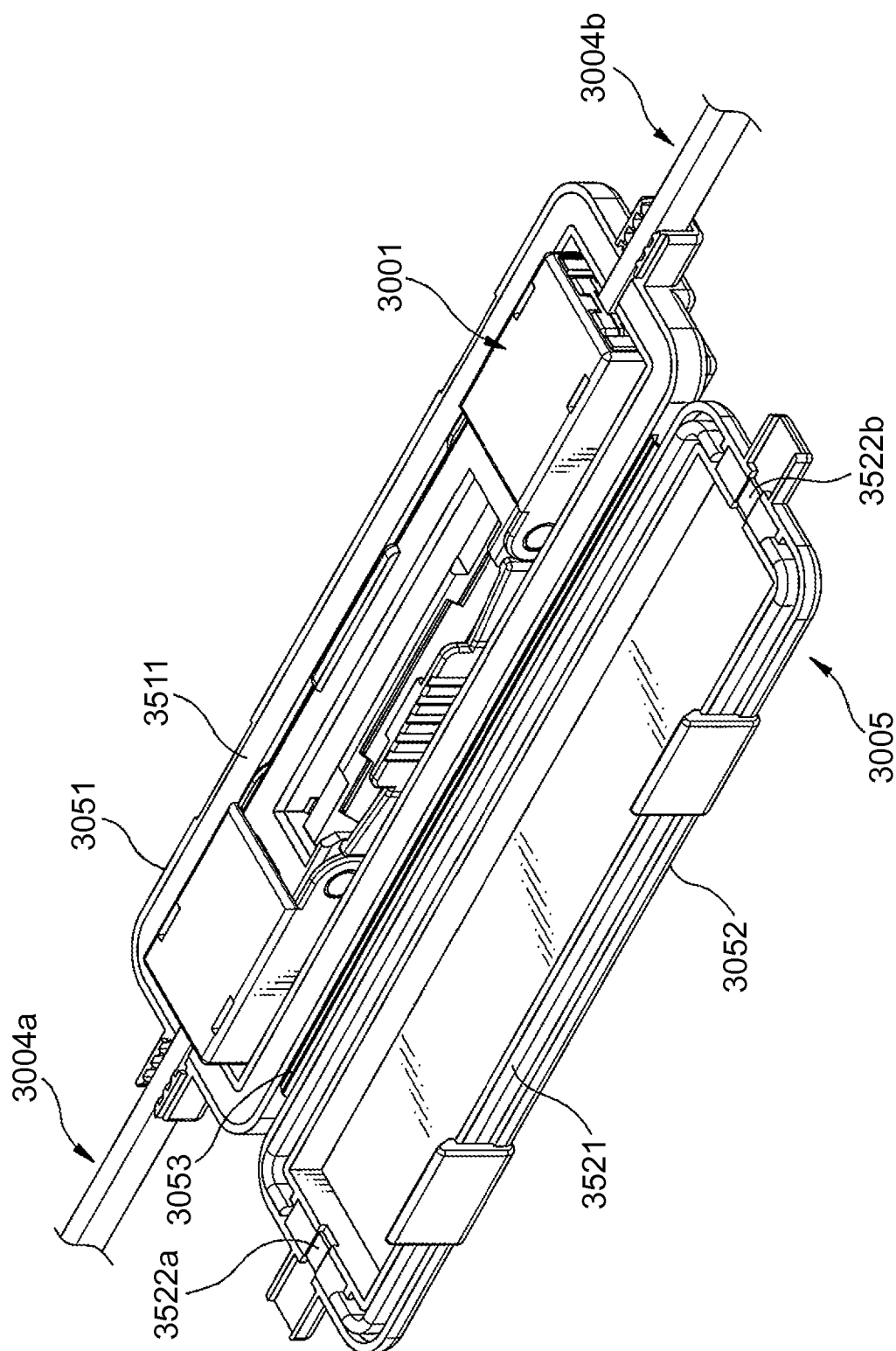


Fig. 43

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2009/034497**A. CLASSIFICATION OF SUBJECT MATTER****G02B 6/38(2006.01)i, G02B 6/36(2006.01)i**

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)

IPC 8: G02B 6/38

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Korean Utility models and applications for Utility models since 1975

Japanese Utility models and applications for Utility models since 1975

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

eKIPASS(KIPO internal)) & keywords : mechanical splice, connect, clip

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2006-0067637 A1 (CARPENTER, J. B. et al.) 30 March 2006	13-14
A	See the abstract; paragraphs [82]-[83]; figures 14 and 16.	1-5, 8-10
A	US 7234878 B2 (YAMAUCHI, T. et al.) 26 June 2007	1-5, 8-10, 13-14
	See the abstract; claims 1-7; figures 1-22.	
A	US 7140787 B2 (YAMAUCHI, T. et al.) 28 November 2006	1-5, 8-10, 13-14
	See the abstract; claims 1-7; figures 1-14.	
A	US 4629284 A (MALAVIEILLE, F. L.) 16 December 1986	1-5, 8-10, 13-14
	See the abstract; column 11, line 48 - column 12, line 35; figures 1 and 22.	



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 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

19 JUNE 2009 (19.06.2009)

Date of mailing of the international search report

19 JUNE 2009 (19.06.2009)

Name and mailing address of the ISA/KR

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Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☒ Claims Nos.: 6, 7, 11, 12
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

Group I, claims 1-7 relating to a connecting structure having a releasing part integrally formed with the clip carrying member.
Group II, claims 8-12 relating to a connecting structure having a cover with a pushing member.
Group III, claims 13-14 relating to a connecting structure having an actuating member for closing the mechanical splice.

The common technical feature between groups I, II and III is a case containing a mechanical splice. However, this feature lacks novelty and inventive step with respect to the following documents cited in this ISR: (a) US 2006-0067637 A1, (b) US 7234878 B2, (c) US 7140787 B2

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☒ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.
- ☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.
- ☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/US2009/034497

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2006-0067637 A1	30.03.2006	EP 1792220 A1 KR 10-2007-0064604 A US 7333709 B2 WO 2006-036676 A1	06.06.2007 21.06.2007 19.02.2008 06.04.2006
US 7234878 B2	26.06.2007	US 2006-0233500 A1	19.10.2006
US 7140787 B2	28.11.2006	US 2006-0072884 A1	06.04.2006
US 4629284 A	16.12.1986	CA 01241824 A1 DE 3482500 D1 EP 0122169 A2 EP 0122169 A3 EP 0122169 B1 ES 530378 D0 ES 8500662 A1 FR 2542458 A1 FR 2542458 B1 FR 2544876 A2 FR 2544876 B2 IN 162684 A1 JP 59-218415 A	13.09.1988 19.07.1990 17.10.1984 19.08.1987 13.06.1990 01.11.1984 16.01.1985 14.09.1984 25.07.1986 26.10.1984 17.06.1988 02.07.1988 08.12.1984