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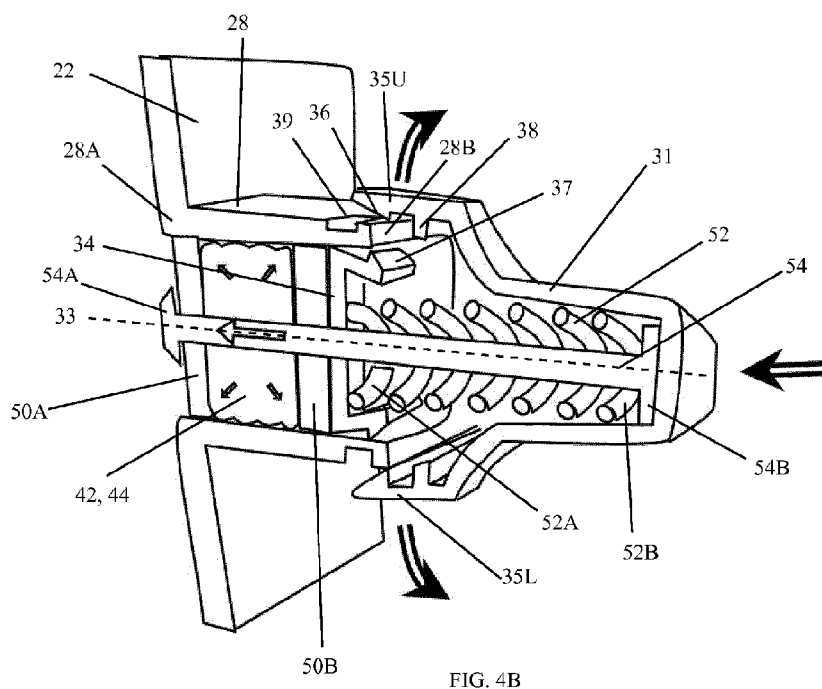
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[Continued on next page]

(54) Title: CABLE SEALING DEVICE



(57) Abstract: A cable sealing unit (30) is disclosed. The cable sealing unit includes a sealant (42, 44) and a spring (52) for pressurizing the sealant (42, 44). The spring is retained in a pre-loaded state by a spring retention mechanism (120). The sealing unit includes a release mechanism (122) for releasing the spring retention mechanism (120) once the cable sealing unit (30) has been inserted in a port (28) thereby allowing the spring (52) to pressurize the sealant (42, 44) within the port (28).

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CABLE SEALING DEVICE

BACKGROUND

Telecommunications systems typically employ a network of telecommunications cables capable of transmitting large volumes of data and voice signals over relatively long distances. The telecommunications cables can include fiber optic cables, electrical cables, or combinations of electrical and fiber optic cables. A typical telecommunications network also includes a plurality of telecommunications enclosures integrated throughout the network of telecommunications cables. The telecommunications enclosures are adapted to house and protect telecommunications components such as splices, termination panels, power splitters and wavelength division multiplexers. It is often preferred for the telecommunications enclosures to be re-enterable. The term "re-enterable" means that the telecommunications enclosures can be reopened to allow access to the telecommunications components housed therein without requiring the removal and destruction of the telecommunications enclosures. For example, certain telecommunications enclosures can include separate access panels that can be opened to access the interiors of the enclosures, and then closed to re-seal the enclosures. Other telecommunications enclosures take the form of elongated sleeves formed by wrap-around covers or half-shells having longitudinal edges that are joined by clamps or other retainers. Still other telecommunications enclosures include two half-pieces that are joined together through clamps, wedges or other structures.

Telecommunications enclosures are typically sealed to inhibit the intrusion of moisture or other contaminants. Pressurized gel-type seals have been used to effectively seal the locations where telecommunications cables enter and exit telecommunications enclosures. Example pressurized gel-type seals are disclosed by document EP 0442941 B1 and document EP 0587616 B1. Both of these documents disclose gel-type cable seals that are pressurized through the use of threaded actuators. Document US 6,046,406 discloses a cable seal that is pressurized through the use of an actuator including a cam lever. While pressurized cable seals have generally proven to be effective, improvements in this area are still needed.

SUMMARY

One aspect of the present disclosure relates to a cable sealing unit including a sealant a spring for pressurizing the sealant and a spring retention mechanism that retains the spring in a pre-loaded state. The pre-load can be a tensile pre-load or a compressive pre-load. The sealing unit also includes a release mechanism for releasing the spring retention

mechanism once the cable sealing unit has been inserted in a port thereby allowing the spring to pressurize the sealant within the port. The release mechanism can be manual or automatic. Manual release mechanisms can include release buttons, release arms, release levers, cam releases or other type of release arrangements. Automatic release mechanisms can be automatically triggered during the cable sealing unit insertion process when cable sealing unit reaches a predetermined location within the port (e.g., when the cable sealing unit has been fully inserted in the port). The port can be a cable pass-through port provided in a telecommunications housing (e.g., closure, enclosure, cabinet, box, etc.) in a wall, in a panel, or in any other type of structure where cable sealing is desirable. The retention and release mechanisms can include any number of different latch configurations, cam configurations, retention configurations, catch configurations, latches, linkages, or other arrangements. In a preferred embodiment the spring is pre-loaded with a pre-load force suitable for fully pressurizing the sealant upon actuation of the release mechanism.

Another aspect of the present disclosure relates to a cable sealing unit including a sealant and a spring for pressurizing the sealant. The spring is retained in a pre-loaded state by a spring retention mechanism. The spring is pre-loaded with a pre-load force suitable for fully pressurizing the sealant.

BRIEF DESCRIPTION OF THE DRAWINGS

FIGURE 1 is a perspective view of a telecommunications enclosure according to an embodiment.

FIGURE 2 is a perspective view of a cable sealing device according to an embodiment.

FIGURE 3 is a cross-sectional view of the cable sealing device according to an embodiment.

FIGURES 4A through 4C are cross-sectional views of the cable sealing device showing the actuation of the device according to an embodiment.

FIGURE 5 shows an alternative sealing device that can be actuated as part of an insertion action.

DETAILED DESCRIPTION

Existing cable sealing devices do not always produce an adequate seal at the locations where telecommunications cables enter and exit telecommunications enclosures. The

devices may be difficult to operate, requiring the use of both hands, and verification of the formation of an adequate seal may be challenging or impossible. It would therefore be desirable to provide for a mechanism that allows for an easy and reliable way to seal the entry/exit locations of cables. It would further be desirable to provide for a mechanism that allows for the insertion and sealing of a cable sealing device in a single motion. It is also desirable to provide for a mechanism that ensures that sufficient spring pressure is always applied to the sealant upon installation. It is also desirable to provide for a mechanism having a spring for pressurizing a cable sealant, wherein the spring is pre-loaded with a sufficient pre-load force to pressurize the sealant such that an effective cable seal is formed. It is also desirable to provide a mechanism with a manual or automatic release for releasing a pre-loaded spring to cause pressurization of a sealant.

FIGURE 1 shows a telecommunications enclosure 20 in accordance with the principles of the present disclosure. The telecommunications enclosure 20 is adapted for housing and protecting telecommunications optical and/or electrical components such as splices (e.g., mechanical splices, fusion splices, etc.), power splitters, multiplexing components (e.g., wavelength division multiplexers (WDM's)) or other components. The telecommunications enclosure 20 is preferably environmentally sealed to inhibit the intrusion of moisture, dust or other contaminants. Sealed cable entry/exit locations are preferably provided for allowing telecommunications cables (e.g., fiberoptic cables, electrical cables, etc.) to be routed into and out of the telecommunications enclosure 20 without compromising the overall environmentally sealed nature of the telecommunications enclosure 20.

Referring still to FIGURE 1, the telecommunications enclosure 20 includes a main housing 22 and a port 28 in which a cable sealing device 30 is mounted. The cable sealing device 30 includes cable ports 32 that allow fiberoptic cables 40 to be routed into and/or out of the main housing 22. The cable sealing device 30 provides an environmental seal about each of the cables routed through the cable sealing device 30 and also provides a peripheral/radial seal within the cable port and about the cable sealing device 30.

Referring to FIGURE 2, the cable sealing device 30 includes cable ports 32 that allow cables to be routed through the cable sealing device 30. According to an embodiment, the cable sealing device 30 also includes a cap 31 that can be used for inserting the cable sealing device 30 into the port 28 of the telecommunications enclosure 20 and for securing the cable sealing device 30 into place, protecting the interior of the telecommunications enclosure 20 from moisture, dust and other contaminants. The cap 31 can be configured to have any shape and the shape shown in FIGURE 2 should not be considered to be limiting, and other types of insertion structures can be used. The cap 31 can be configured to house, for

example, a central shaft 54, a spring 52 and a pre-load member 34, as seen in FIGURE 4A. It will be appreciated that the cable sealing unit 30 has a wrap-around cable sealing configuration that allows cables 40 to be radially/laterally inserted into the cable ports 32. Thus, it is not required for cables to be axially threaded through the cable ports 32 during installation of the cables. Non-wrap around embodiments are also included within the scope of the present disclosure. FIGURE 2 shows cables 40 routed through the cable ports 32 of the cable sealing device 30. The cables 40 can include jackets 41 enclosing one or more buffer tubes 43. The buffer tubes 43 can contain one or more optical fibers 45. The cables can also include strength members (e.g., aramid yarn, fiber reinforced epoxy rods, etc.) for reinforcing the cables.

FIGURE 3 shows a cross section of a cable sealing arrangement of the cable sealing device 30 secured into place in the port 28 of the telecommunications enclosure 20. According to an embodiment, when the cable sealing device 30 is in an actuated position (i.e., secured into place), the jackets 41 of the cables 40 are surrounded by one or more sealing members 42, 44 comprised of sealing material (e.g., gel) that presses against the jackets 41 of the cables 40 and a port-defining surface 53 of the port 28 of the telecommunications enclosure 20, substantially sealing the telecommunications enclosure 20 from the environment. The cable sealing device 30 may include a central shaft 54, which may also be surrounded by the sealing members 42, 44. It is preferred for each of the sealing members to have a flowable or resilient construction that allows the sealing members to flow and/or deform when pressurized so as to fill any void areas within the volume defined by the port 28 of the telecommunications enclosure 20. When the sealing members 42, 44 are pressurized, the sealing members 42, 44 form a peripheral seal 51 against the port-defining surface 53 of the port 28. The peripheral seal 51 surrounds a periphery of the cable sealing device 30 and prevents moisture from passing between the housing 22 and the sealing device 30.

The sealing members 42, 44 may be molded to approximate the shape and size of the inside of the port 28 of the telecommunications enclosure 20 with passages for the cables 40 and the central shaft 54. A side of one sealing member 42 cooperates with a side of the other sealing member 44 to provide circumferential seals about the peripheries (e.g., outer diameters) of cables 40 routed through the cable ports 32, and the central shaft 54. More specifically, one sealing member 42 defines half-openings 46 that align with corresponding half-openings 48 defined by the other sealing member 44. The half-openings 46, 48 cooperate to define the cable ports 32 and the opening for the central shaft. When the sealing members 42, 44 are pressurized within the port 28 of the telecommunications enclosure 20 while cables 40 and the central shaft 54 are routed through, the sealing members

42, 44 deform and/or flow about the cables 40 and the central shaft 54 to effectively provide circumferential sealing about the outer diameters (e.g., the jackets 41) of the cables 40 and the central shaft 54. When cables are not routed through the cable ports 32, it will be appreciated that the cable ports 32 can be closed by temporary plugs. In other embodiments, the cable ports 32 can have different shapes. For example, to accommodate flat drop cables, the cable ports 32 can have elongated, oval or obround configurations.

It will be appreciated that sealing members 42, 44 of the present disclosure may be formed of any one or more of a variety of sealing materials. Elastomers, including natural or synthetic rubbers (e.g., EPDM rubber or silicone rubber) can be used. In other embodiments, polymeric foam (e.g., open cell or closed cell) such as silicone foam can be used. In still other embodiments, the sealing members may comprise gel and/or gel combined with another material such as an elastomer. The gel may comprise, for example, silicone gel, urea gel, urethane gel, thermoplastic gel, or any suitable gel or geloid sealing material. Gels are normally substantially incompressible; when placed under a compressive force and normally flow and conform to their surroundings thereby forming sealed contact with other surfaces. Example gels include oil-extended polymers. The polymer may, for example, comprise an elastomer, or a block copolymer having relatively hard blocks and relatively elastomeric blocks. Example copolymers include styrene-butadiene or styrene-isoprene di-block or tri-block copolymers. In still other embodiments, the polymer of the gel may include one or more styrene-ethylene-propylene-styrene block copolymers. Extender oils used in example gels may, for example, be hydrocarbon oils (e.g., paraffinic or naphthenic oils or polypropylene oils, or mixtures thereof). The sealing members can also include additives such as moisture scavengers, antioxidants, tackifiers, pigments and/or fungicides. In certain embodiments, sealing members in accordance with the principles of the present disclosure have ultimate elongations greater than 100 percent with substantially elastic deformation to an elongation of at least 100 percent. In other embodiments, sealing members in accordance with the principles of the present disclosure have ultimate elongations of at least 200 percent, or at least 500 percent, or at least 1000 percent. Ultimate elongation can be determined by the testing protocol set forth at ASTM D412.

Referring to FIGURES 4A and 4B, a cross section and the actuating of the cable sealing device 30 is shown. As seen in FIGURE 4A, the cable sealing device 30 includes a first end plate 50A and a second end plate 50B, the end plates defining a space between them wherein the sealing members 42, 44 fit. According to an embodiment, the cable sealing device 30 may function as an enclosure for containing a spring 52 that can be pre-loaded (e.g., pre-compressed or pre-tensioned) with a substantial pre-load to provide pressurization

to the sealing members 42, 44 when released. The cable sealing device 30 may also include a spring retention mechanism 120 including pre-load member 34 that can be used to pre-load the spring 52 and hold the spring 52 in its pre-loaded position. The pre-load member 34 may be held in the pre-load position by a first interlock 37 that operatively connects the pre-load member 34 to the cap 31. The pre-load member 34 may be connected to the second end plate 50B or may be configured to be an integral part of the second end plate 50B, or can be a separate piece as depicted. The cable sealing device 30 may further include a central shaft 54 aligned along an insertion axis 33 of the cable sealing device 30 having a first end 54A coupled with the first end plate 50A and a second end 54B coupled with the cap 31. The spring 52, having first end 52A and a second end 52 B, is captured between the pre-load member 34 and the second end of the shaft 54B such that the first end of the spring 52A bears against the pre-load member 34 and the second end of the spring 52B bears against the second end of the shaft 54B. The central shaft 54 extends through the cap 31, the spring 52, the second end plate 50B, and the sealing members 42, 44, maintaining a fixed spacing between the first end plate 50A and the second end 52B of the spring.

According to an embodiment, the cap has a spring release mechanism 122 having upper and lower cantilevers 35U, 35 L, each cantilever including a ramped surface 36 adjacent an end of the cantilever. The cantilevers 35U, 35 L may also include a pre-load member retainer 38 that engages the corresponding first interlock 37 of the pre-load member 34. As seen in FIGURE 4B, when manual insertion pressure is applied axially to the cap 31 (i.e., when the sealing portion of the cable sealing device 30 is pushed into the port 28 of the telecommunications enclosure 20), engagement of the ramped surface 36 with the port 28 of the telecommunications enclosure 20 causes the upper and lower cantilevers 35U, 35 L to expand radially. The expansion of the cantilevers 35U, 35 L causes the pre-load member retainer 38 to disengage from the first interlock 37 that is holding the pre-load member 34 in the pre-load position, thus releasing the pre-loaded spring 52 to exert a force axially on the second end plate 50B. Releasing the pre-loaded spring pushes the second end plate 50B toward the first end plate 50A that is held in place by the central shaft 54, pressurizing the sealing members 42, 44 and causing the sealing members 42, 44 to flow about the cables 40 and the central shaft 54 and fill any void areas within the volume defined by the port 28 of the telecommunications enclosure 20. The cap 31 is moved axially along the insertion axis 33 until the first interlock 37 interlocks with the second interlock 39. The interlock between the interlocks 37, 39 axially retains the cable sealing device 30 within the port 28. The cable sealing device 30 can be inserted into the port 28 of the telecommunications enclosure 20 in a single motion, simultaneously sealing the port 28. The cap 31 may also be secured into place by some other suitable mechanism, such as a latch (e.g., snap fit latches) or hook

mechanism. The interlocking action between the first and second interlocks 37, 39 may cause an audible “click” sound when it locks into place indicating that the cable sealing unit 30 is properly sealed. FIGURE 4C shows the cap 31 in its secured (i.e., actuated/sealed) position.

5 It will be appreciated that the spring 52 is preferably pre-loaded with a pre-load force that is sufficiently large to fully pressurize the sealant of the sealing device 30 when the spring 52 is released. The sealant is fully pressurized when enough pressure is provided for the sealant to form effective circumferential seals about the cables 40 and to also form an effective peripheral seal with the housing 22. The amount of pre-load required is dependent
10 upon the mechanical characteristics (e.g., hardness, flowability) of the sealant. A variety of advantages are achieved by substantially pre-loading the spring as described above. First, pre-loading the spring 52 ensures that adequate pressure is provided for effectively sealing the port 28 and around the cables 40. The device is not dependent on an operator to set the degree of compression applied to the spring and ensures that adequate sealing pressure is
15 provided. Also, preloading the spring provides for greater design flexibility in selecting the spring utilized (e.g., a spring having a relatively low spring constant can be used). When the cable sealing unit 30 is exposed to compressive load over extended periods of time, it can slightly reduce in volume due to creep, leakage or other causes. To account for seal shrinkage over time, the spring 52 can be configured to over-compress the sealing members 42,
20 44. Therefore, sufficient compressive load continues to be applied to the cable sealing unit 30 even when the volume reduces thereby reducing the compressive load applied to the sealing members 42, 44. Preloading the spring 52 as described above also allows the cable sealing device 30 to effectively be designed to account for the effects of seal shrinkage that may occur over time.

25 In alternative embodiments, a manual release mechanism (e.g., a button, lever, or other type of actuator) can be provided for allowing a technician to manually release the pre-loaded spring 52 once the sealing device 30 has been inserted in a corresponding port 28. When the spring retention mechanism 120 is actuated to release the spring 52, the spring 52 pressurizes the sealant using stored energy from the pre-load and does not use or re-
30 quire any additional energy/force to fully pressurize the sealant.

FIGURE 5 shows an alternative cable sealing device 130 that can be actuated in a single motion with the insertion of the cable sealing device 130 in a port 28. The device 130 may include a ratchet assembly 155 comprising a ratcheting interlock 156, as shown in FIG-
35 URE 5. The ratchet assembly 155 may include a first end plate 150A and a second end plate 150B, the end plates defining a space between them wherein sealing members 42, 44 (not

shown) fit. Each end plate 150A, 150B may be constructed of two pieces that may be separable to allow for insertion of cables 40 without threading. The ratchet assembly 155 may also have a central shaft 154 that may include a first shaft element 154A and a second shaft element 154B, the first shaft element 154A being connected to the first end plate 150A and the second shaft element 154B being connected to the second end plate 150B. The first and second shaft elements 154A, 154B may be able to telescope relative to one another such that one element slidably fits inside the other. According to an embodiment, the ratchet assembly may also include first and second ratchet arms 156A, 156B that cooperate to define the ratcheting interlock 156. When manual insertion pressure is applied axially to the ratchet assembly 155, the ratchet assembly 155 moves axially into the port 28 of the telecommunications enclosure 20 until the first end plate 150A engages a positive stop at an inner end 28A of the port 28. Once the first end plate 150A stops at the inner end 28A of the port 28, the second end plate 150B is pushed toward the first end plate 150A, pressurizing the sealing members 42, 44 and causing the sealing members 42, 44 to flow about the cables 40 and the central shaft 154 and to fill any void areas within the volume defined by the port 28 of the telecommunications enclosure 20. As the first and second end plates 150A, 150B move closer together, the interlocks on the ratchet arms 156A, 156B engage, locking the plates 150A, 150B of the cable sealing device 130 into place and securely sealing the port 28 of the telecommunications enclosure 20, protecting the telecommunications enclosure 20 from moisture, dust and other contaminants. The second end plate 150B may be moved toward the first end plate 150A until the second end plate 150B is flush with an outer end 28B of the port 28 of the telecommunications enclosure 20. The ratchet arms 156A, 156B may have a certain amount of elasticity which maintains spring pressure on the sealing members 42, 44 over time. Alternatively, the ratchet assembly 155 may also include a spring (e.g., a coil spring leaf spring, spring washer, etc.) that functions to hold/maintain the sealing members 42, 44 under pressure and that is pressurized/compressed during the action of inserting the cable sealing device 130 in a port. In certain embodiments, the spring can be positioned axially between the sealing gel and one of the end plates 150A, 150B.

The telecommunications enclosure 20, cap 31, and the end plates 50A, 50B, 150A, 150B can be formed of one or more of a variety of materials capable of constraining the cable sealing arrangement while the cable sealing arrangement is loaded under pressure in the secured position. Example materials include one or more plastic materials such as polypropylene, polyamide, polycarbonate, acrylobutadiene-styrene (ABS) or the like. Additionally or alternatively, such members may be formed from one or more metals such as aluminum or steel.

PARTS LIST

20	telecommunications enclosure
22	main housing
28	port
30	cable sealing device
31	cap
32	cable port
33	insertion axis
34	pre-load member
35U	upper cantilever
35L	lower cantilever
36	ramped surface
37	first interlock
38	pre-load member retainer
39	second interlock
40	cable
41	jacket
42	sealing member
43	buffer tube
44	sealing member
45	optical fiber
46	half-opening
48	half-opening
50A	first end plate
50B	second end plate
51	peripheral seal
52	spring
52A	first end of the spring
52B	second end of the spring
53	port-defining surface
54	central shaft
54A	first end of the central shaft
54B	second end of the central shaft
120	spring retention mechanism
122	spring release mechanism
150A	first end plate
150B	second end plate
154	central shaft
154A	first shaft element
154B	second shaft element
155	ratchet assembly
156	ratcheting interlock
156A	first ratchet arm
156B	second ratchet arm

WHAT IS CLAIMED IS:

1. A cable sealing unit comprising:

a sealant (42, 44);

a spring (52) for pressurizing the sealant (42, 44), the spring being retained in a pre-loaded state by a spring retention mechanism (120);

characterized in that the sealing unit includes a release mechanism (122) for releasing the spring retention mechanism (120) once the cable sealing unit (30) has been inserted in a port (28) thereby allowing the spring (52) to pressurize the sealant (42, 44) within the port (28).
2. The cable sealing unit of claim 1, wherein the spring (52) is pre-loaded with a compressive pre-load force.
3. The cable sealing unit of claim 1, wherein the spring (52) is pre-loaded with a pre-load force suitable for fully pressurizing the sealant (42, 44) upon actuation of the release mechanism.
4. The cable sealing unit of claim 3, wherein the pre-load force is a compressive pre-load.
5. The cable sealing unit of claim 1, wherein the release mechanism is automatically actuated when the cable sealing unit is fully inserted in the port (28).
6. The cable sealing unit of claim 1, wherein the sealant is a sealing gel (42, 44), wherein the cable sealing unit (30) includes first and second end plates (50A, 50B), wherein the sealing gel (42, 44) is positioned between the first and second end plates (50A, 50B), wherein the cable sealing unit (30) includes an insertion axis (33) that aligns with an axis of the port (28) when the cable sealing unit (30) is inserted in the port (28), the first and second end plates (50A, 50B) being separated from one another along the insertion axis (33), the cable sealing unit (30) defining a cable passage that extends along the insertion axis (33) through the first and second end plates (50A, 50B) and the sealing gel (42, 44), the first and second end plates (50A, 50B) being movable relative to one another in an orientation along the insertion axis (33), wherein the spring (52) forces the first and second end plates (50A, 50B) to-

gether along the insertion axis to pressurize the sealing gel when the spring retention mechanism is released.

7. A cable sealing unit comprising:

a sealant (42, 44);

a spring (52) for pressurizing the sealant (42, 44), the spring being retained in a pre-loaded state by a spring retention mechanism (120);

characterized in that the spring (52) is pre-loaded with a pre-load force suitable for fully pressurizing the sealant (42, 44).

8. A cable sealing unit configured for insertion in a port (28) of an enclosure (20), the cable sealing unit (30) including a sealing gel (42, 44) positioned between first and second end plates (50A, 50B), the cable sealing unit (30) including an insertion axis (33) that aligns with an axis of the port when the cable sealing unit is inserted in the port, the first and second end plates (50A, 50B) being separated from one another along the insertion axis (33), the cable sealing unit (30) defining a cable passage that extends along the insertion axis (33) through the first and second end plates (50A, 50B) and the sealing gel (42, 44), the first and second end plates (50A, 50B) being movable relative to one another in an orientation along the insertion axis (33), characterized in that the cable sealing (30) unit has a gel pressurization arrangement including a spring that applies spring pressure for pressurizing the sealing gel (42, 44) in a single action with the insertion of the cable sealing unit (30) in the port (28).
9. The cable sealing unit of claim 8, wherein upon full insertion of the cable sealing unit (30) in the port (28), manual insertion pressure applied to the second end plate (50B) of the cable sealing unit (30) along the insertion axis (33) causes compression of the sealing gel (42, 44).
10. The cable sealing unit of claim 9, wherein the manual insertion pressure causes a spacing along the insertion axis (33) between the first and second plates (50A, 50B) to be reduced to a reduced spacing in which the sealing gel (42, 44) is pressurized between the first and second plates (50A, 50B).

11. The cable sealing unit of claim 10, wherein the gel compression arrangement includes a ratcheting interlock (156) between first and second end plates (50A, 50B) for retaining the first and second plates (50A, 50B) at the reduced spacing in which the sealing gel (42, 44) is pressurized between the first and second end plates (50A, 50B).
12. The cable sealing unit of claim 8, wherein insertion of the cable sealing unit (30) in the port (28) automatically releases a pre-compressed spring (52) that forces the first and second end plates (50A, 50B) together to pressurize the sealing gel (42, 44).

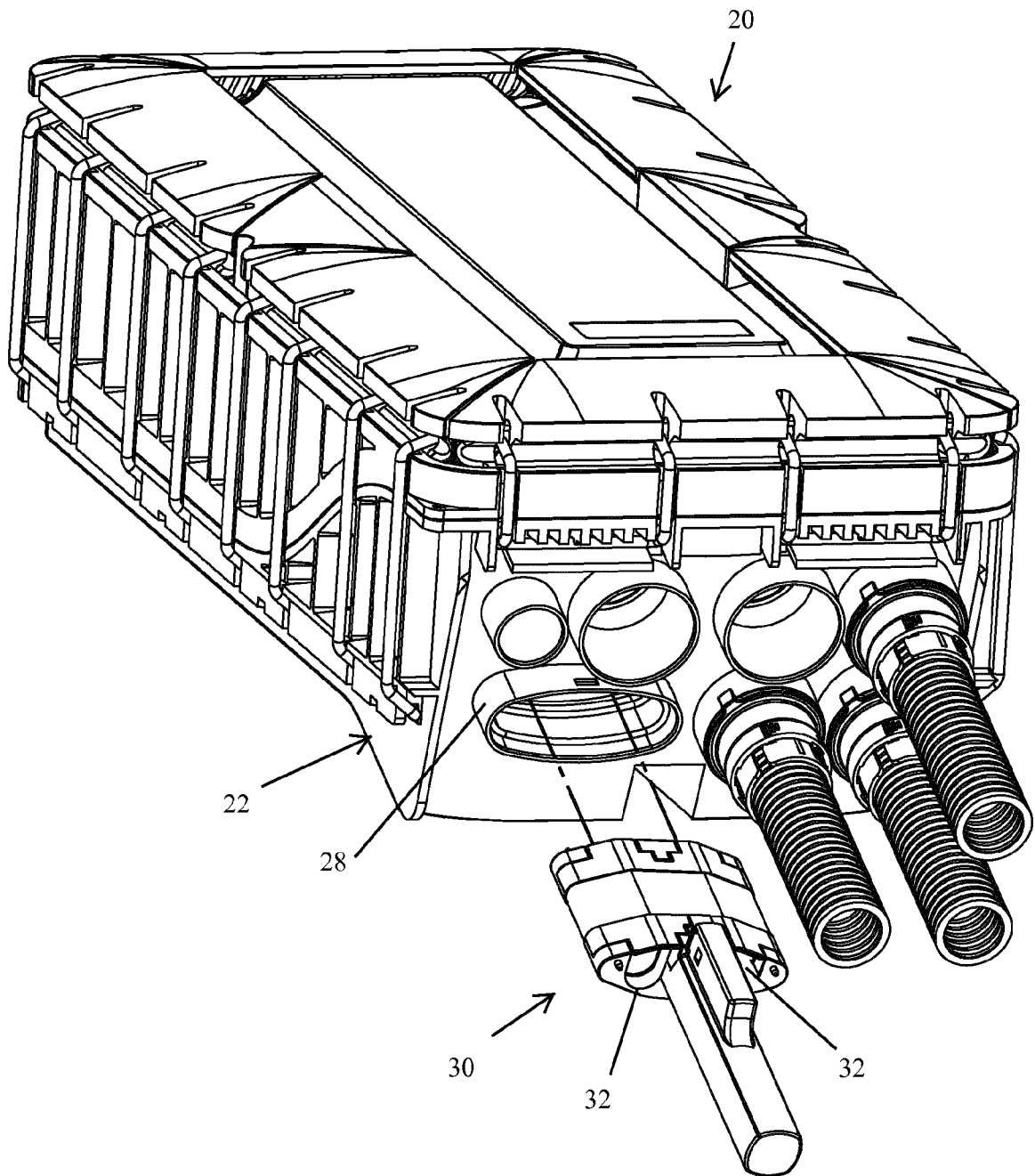


FIG. 1

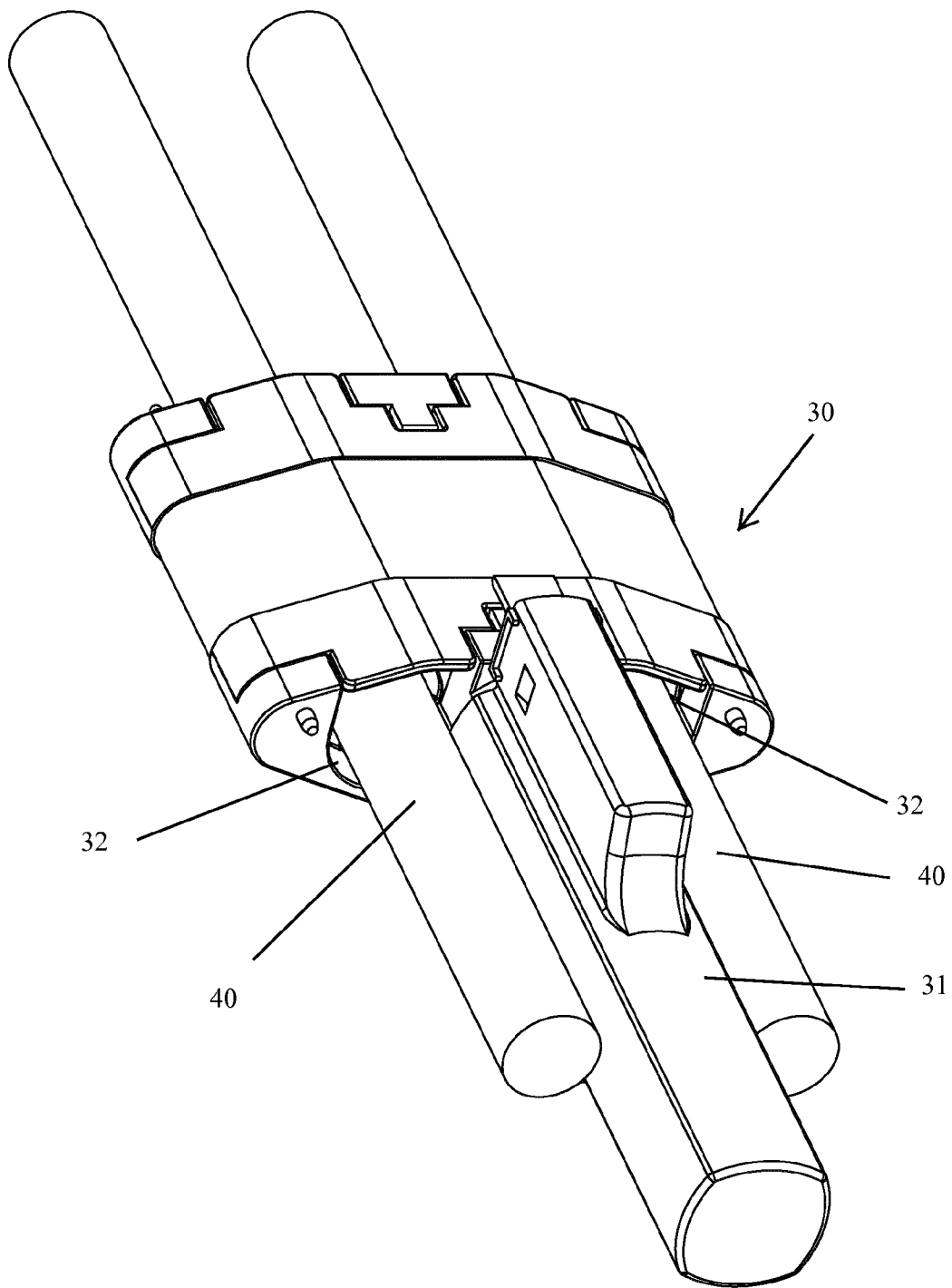


FIG. 2

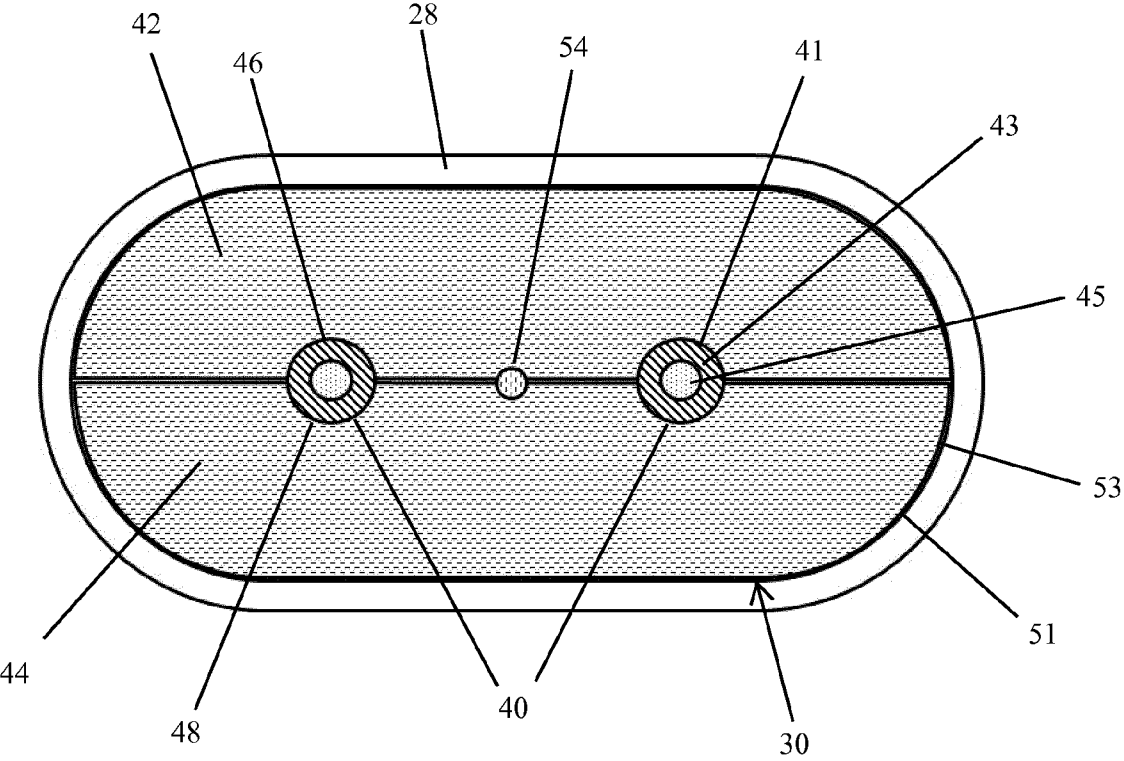


FIG. 3

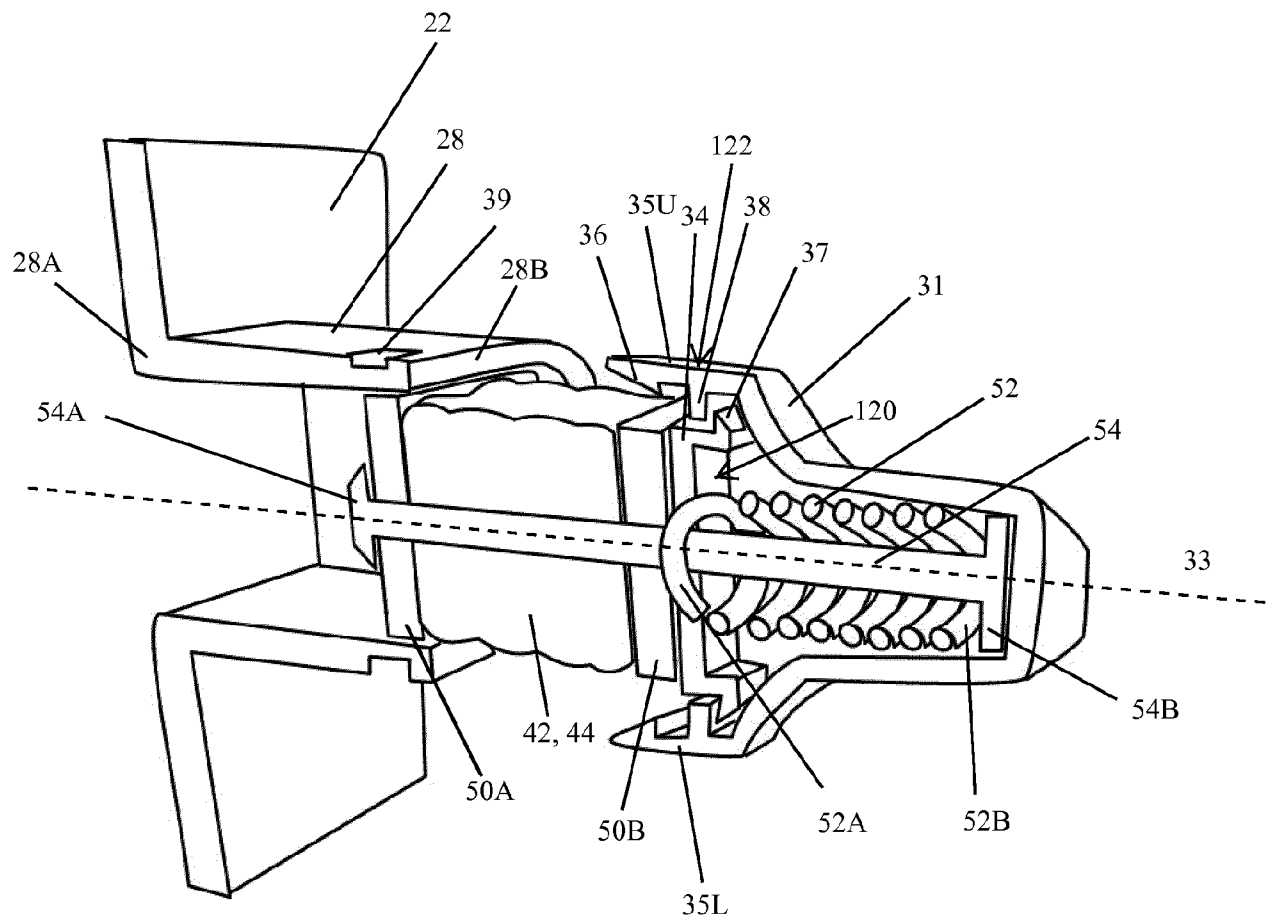


FIG. 4A

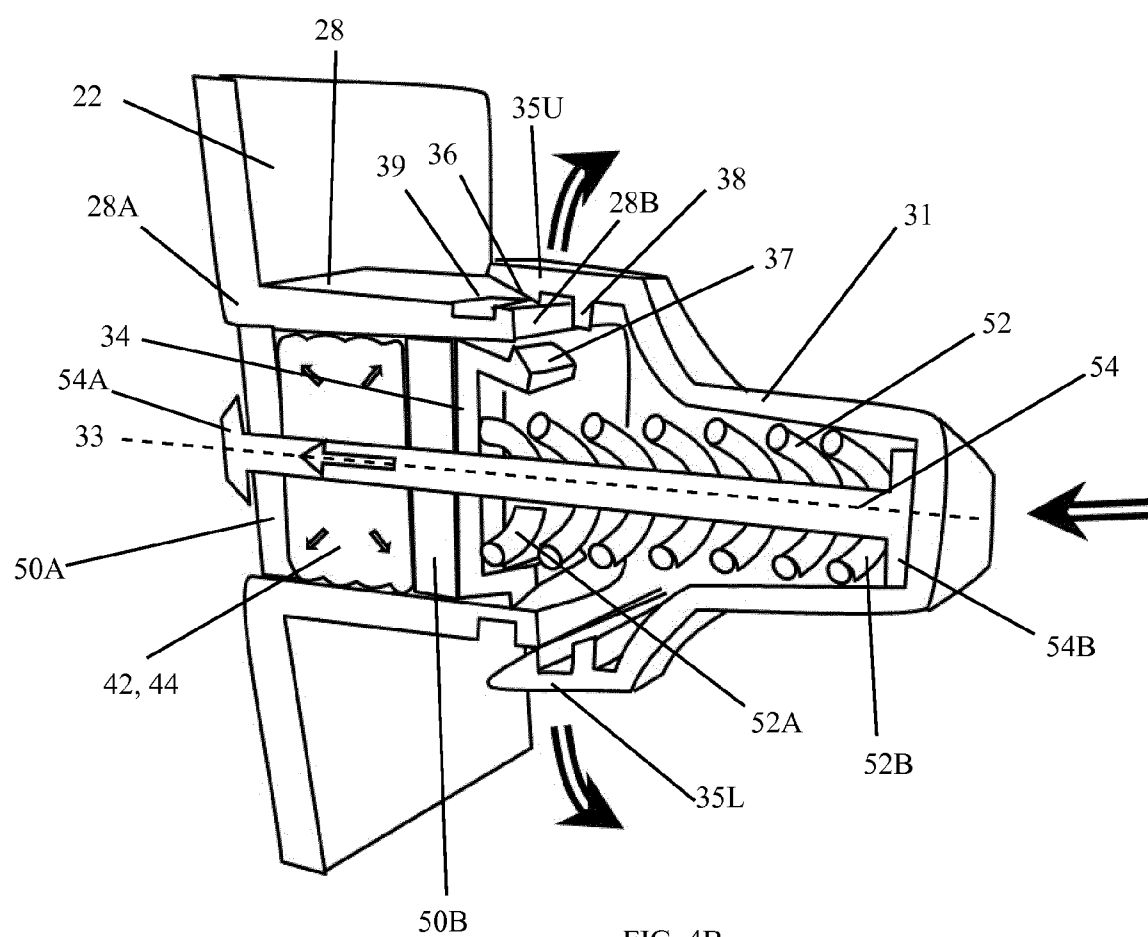
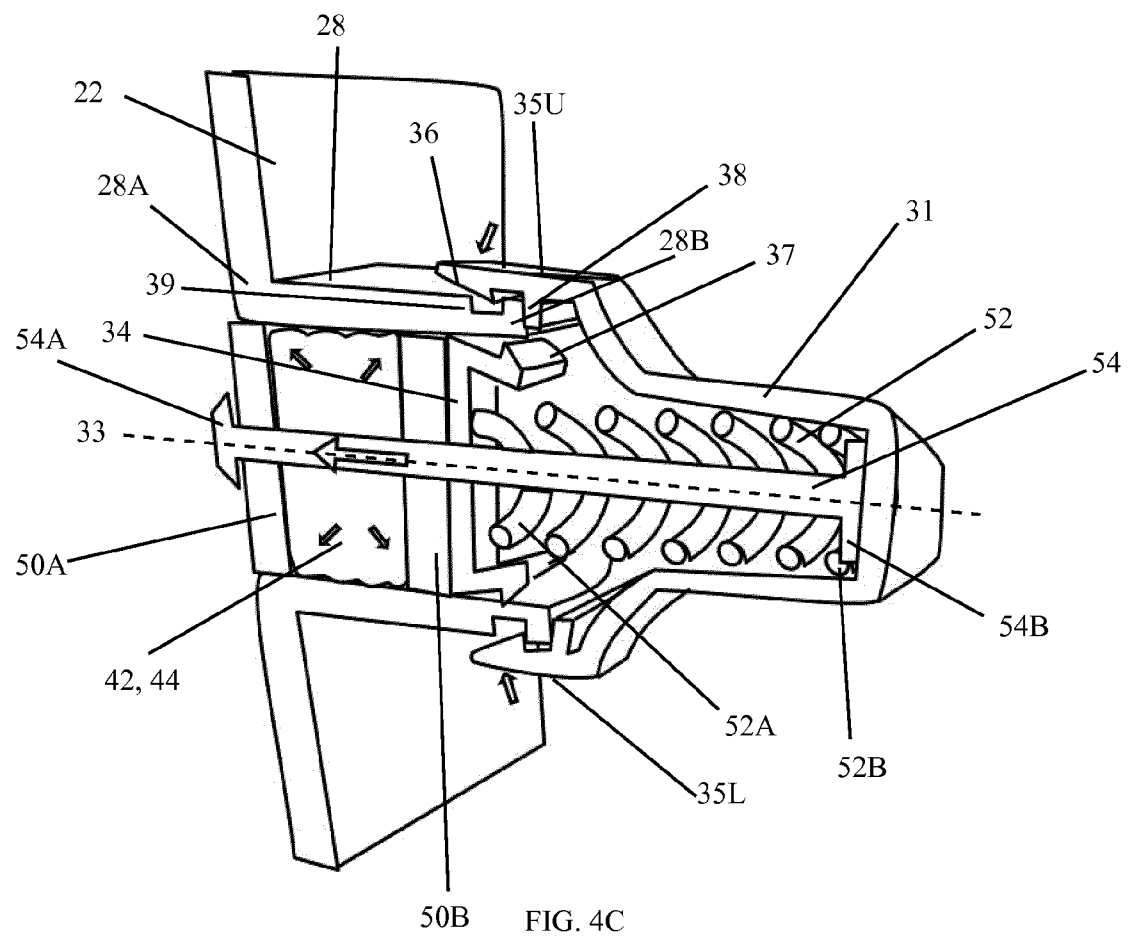


FIG. 4B



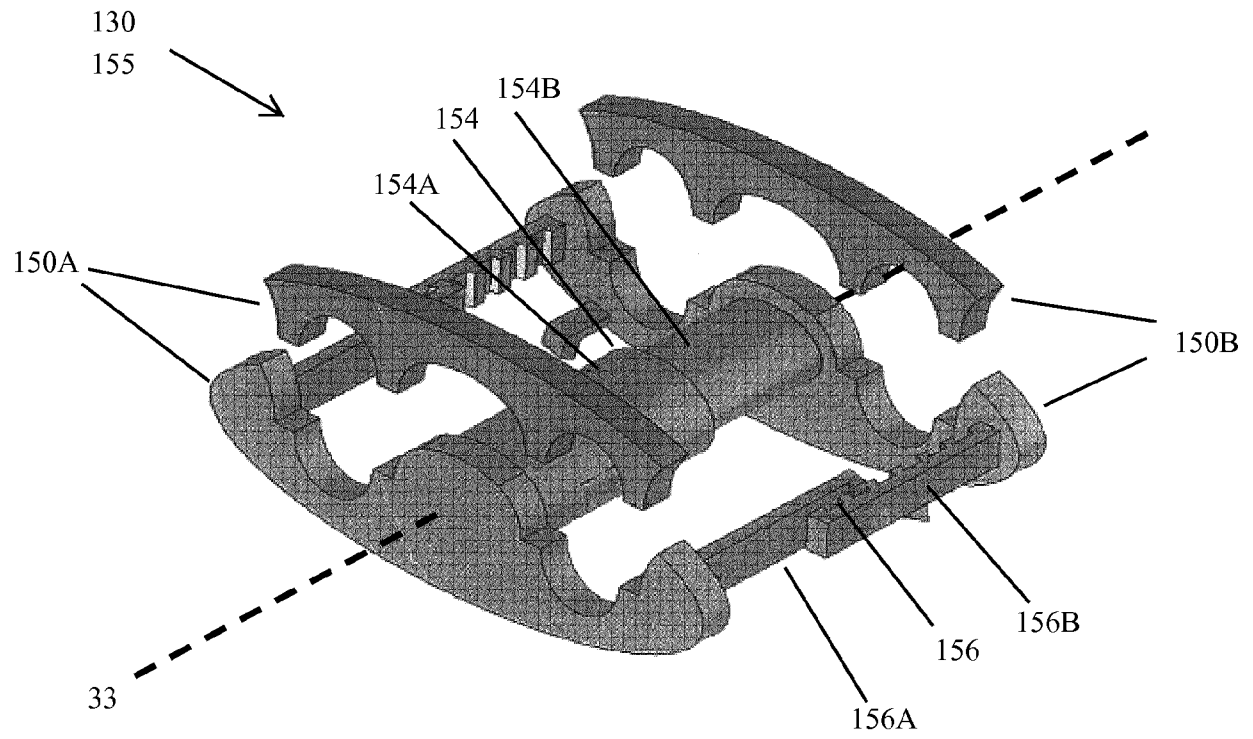


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2013/076597

A. CLASSIFICATION OF SUBJECT MATTER
INV. H02G15/013
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
H02G F16L

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 36 23 552 C1 (STEWING NACHRICHTEN) 15 October 1987 (1987-10-15) column 3, line 51 - column 4, line 38 figures 1-2	1-12
X	----- EP 0 652 619 A1 (RXS SCHRUMPFTECH GARNITUREN [DE]) 10 May 1995 (1995-05-10) figure 2	1,3,5,7
A	----- WO 2009/148604 A2 (CHANNELL COMMERCIAL CORP [US]; SHIMIRAK GERALD L [US]; SHEALS DEREC [G]) 10 December 2009 (2009-12-10) figures 4-9	1,7,8



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

28 March 2014

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Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2013/076597

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