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(54) **Furcation kit for optical fiber cable**

(57) A furcation kit utilizes the strength aramid fibers from the multiple fiber cable to form the mechanical connection between the cable and the furcation unit. This furcation kit has at least one and preferably two crimping surfaces where the strength fibers can be affixed. This furcation kit is usable with a variety of cables, including cables with two sets of strength fibers, cables with one set of strength fibers, and cables with an oval or a rectangular profile, among others. In accordance to one aspect, the furcation kit also allows the multiple fiber cable to be separated into single fibers or into smaller multiple fiber cables. In accordance to another aspect, the kit resists relative rotational movement between the housing of the kit and a fanout body contained therein. In accordance to another aspect, the furcation kit can be stacked or bundled with one another.

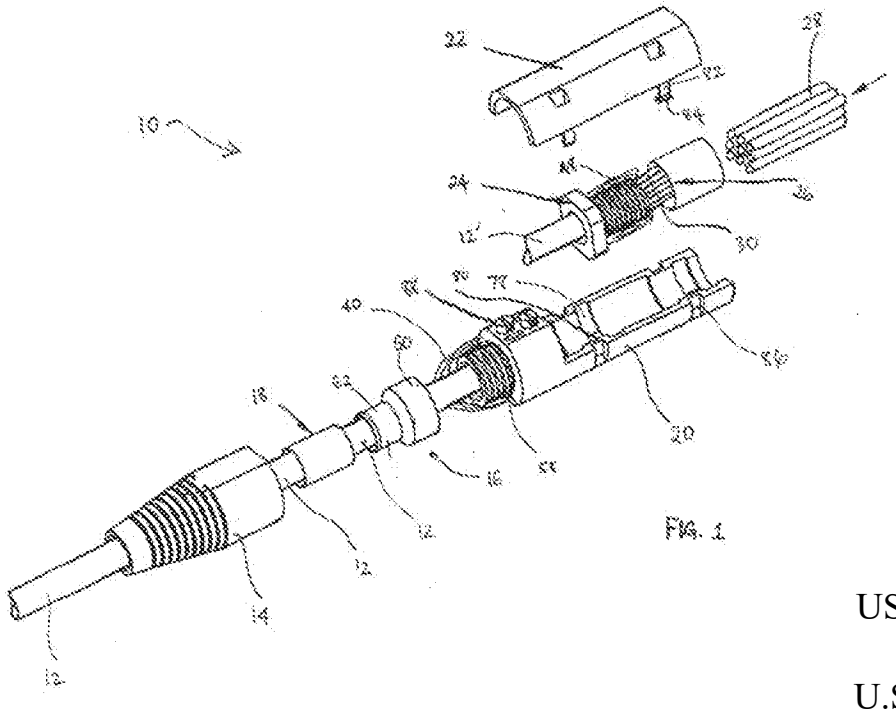


FIG. 1

EP 1 245 980 A2

US Conec EX1002 (Part 2)
IPR2024-00120
U.S. Patent No. 10,191,230

Description

FIELD OF THE INVENTION

[0001] The present invention generally relates to optical fiber connectors, and more particularly to furcation kits for the breakout of multi-fiber optical fiber cables.

BACKGROUND OF THE INVENTION

[0002] It is necessary to divide multi-fiber optical cables from main or trunk lines into smaller cables to reach the end-users. Typically, multi-fiber cables are terminated with single fiber connectors that are then individually connected into optical hardware or apparatus. U.S. patent No. 5,231,688 to Zimmer discloses a furcation kit, which segregates a multi-fiber optical cable into single optical fibers. Each separated fiber is then inserted into an individual furcation tube or terminated leg for connection to a terminal connector. While the '688 patent provides a workable solution for furcating multi-fiber cables, the strain relief disclosed in this reference does not take advantage of the aramid strength fibers present in the cables. This reference also does not provide for stacking or bundling of the furcation kits to organize the connection inside the optical hardware or apparatus, and does not provide for the furcation of oval or rectangular profiled cables and ribbons.

[0003] U.S. patent No. 5,970,195 to Brown discloses another furcation kit, which comprises housing and a plurality of single loose furcation tubes positioned inside the kit housing. Each single loose furcation tube comprises an inner tube adapted to receive a bare optical fiber and an outer protective jacket disposed concentrically around the inner tube. Aramid strength fibers are provided in the annular space between the inner tube and the outer protective pocket. The fibers are dimensioned to protrude beyond the end of the protective jacket and are folded backward around the protective jacket to be captured within the housing of the furcation kit. The captured strength fibers are then affixed to the housing of the furcation kit with adhesives. The captured strength fibers disclosed in this reference protect the single loose tubes against being accidentally pulled out of the furcation kit, but does not provide any protection for the optical cable.

[0004] Hence, there remains a need for a furcation kit that overcomes these and other known drawbacks of conventional furcation kits.

SUMMARY OF THE INVENTION

[0005] Accordingly, it is an object of the present invention to provide a furcation kit that relieves the strain exerted on the furcation kit using the available strength fibers from the optical cables.

[0006] Another object of the invention is to provide a furcation kit capable of being stacked or bundled within the optical hardware or apparatus.

[0007] Another object of the present invention is to provide a furcation kit that does not require furcation tubes or terminated legs.

[0008] Another object of the present invention is to provide a furcation kit that resists relative rotational movement between the kit housing and an internal fanout body.

[0009] Another object of the present invention is to provide a furcation kit that terminates a multi-fiber cable into single fibers and multiple fibers.

[0010] These and other objects of the present invention are realized by a furcation device comprising, among other things, a housing member adapted to receive a fanout body. The fanout body comprises a plurality of passageways, and each passageway receives at least one individual fiber from the multiple fiber cable. The housing member may also have at one end a cable crimp body. At least some of the strength members from the multiple fiber cable are crimped between the cable crimp body and a first crimp band to affix the multiple fiber cable to the furcation device. The fanout body may also have an exterior fanout crimp surface, and at least some of the strength members from the multiple fiber cable are crimped between the fanout crimp surface and a second crimp band to affix the multiple fiber cable to the furcation device.

[0011] In accordance to one aspect of the invention, the strength members from the multiple fiber cable comprise outer strength members and inner strength members, which are disposed inside the outer strength members. Some of the outer strength members are crimped between the cable crimp body and the first crimp band, and some of the inner strength members are crimped between a fanout crimp surface and a second crimp band. On the other hand, some of the outer strength members can also crimped between the fanout crimp surface and the second crimp band, and some of the inner strength members can also be crimped between the cable crimp body and the first crimp band.

[0012] In accordance to another aspect of the invention, the plurality of passageways comprises at least one passageway adapted to receive one individual fiber and at least one passageway adapted to receive one multiple fiber cable.

[0013] In another aspect of the invention, the housing member further comprises a first and second interlocking member. The first interlocking member is adapted to interlock with the second interlocking member disposed on an adjacent furcation device. The first interlocking member can be a knob disposed on the surface of the housing member, and the second interlocking member is a hole adapted to receive the knob. The knob may be tapered and defines a slit to facilitate the entry of the knob into the hole. The knob and hole may be positioned on the top and bottom surfaces of the housing, respectively, or on opposite side surfaces.

[0014] In another aspect of the invention, the fanout

body comprises at least one substantially flat surface thereon. This substantially flat surface cooperates with a corresponding substantially flat surface defined on the housing to resist relative rotational movement between the fanout body and the housing member.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015] In the accompanying drawings which form a part of the specification and are to be read in conjunction therewith and in which like reference numerals are used to indicate like parts in the various views:

FIG. 1 is an exploded view of one embodiment of a preferred furcation kit in accordance to the present invention;

FIG. 2 is a cross sectional view of the assembled furcation kit shown in FIG. 1 without the optical cable for clarity purpose;

FIG. 3A is a perspective partial cut-away view of an optical cable usable with the furcation kit in accordance to the present invention with two sets of strength fibers; FIG. 3B is a perspective partial cut away view of another optical cable with two sets of strength fibers;

FIG. 4A is a perspective partial cut-away view of an optical cable usable with the furcation kit in accordance to the present invention with one set of strength fibers; FIG. 4B is a perspective partial cut away view of another optical cable with one set of strength fibers;

FIGS. 5A and 5B are perspective partial cut-away view of optical cables comprising loose tubes of fibers usable with the furcation kit in accordance to the present invention;

FIG. 6 is a perspective partial cut-away view of an optical ribbon with an oval or rectangular shape usable with the furcation kit in accordance to the present invention; and

FIG. 7 is an enlarged view of the fanout crimp body; and FIGS. 7A-7E show some of the preferred embodiments of the fanout crimp body of FIG. 7.

DETAILED DESCRIPTION OF THE INVENTION

[0016] As shown generally in FIGS. 1 and 2 where like numbers designate like parts, reference number 10 broadly designates the furcation kit in accordance to the present invention. Furcation kit 10 is adapted to furcate an optical cable generically designated as 12 in FIG. 1. Many different types of optical cables can be used with furcation kit 10. Some of the examples of these cables are illustrated in FIGS. 3A, 3B, 4A, 4B, 5A, 5B and 6. Other optical cables can also be used with the present invention, and the present invention is not limited to the types of optical cables illustrated herein.

[0017] Furcation kit 10 comprises a segmented boot 14, a cable crimp band 16 and a heat shrinkable jacket 18 connecting the optical cable 12 to the furcation kit 10. Furcation kit 10 further comprises a housing member 20 and a removable top member 22. Housing member 20 and top member 22 cooperate to encapsulate a fanout crimp body 24 and a fanout crimp band 26, as best shown in FIG. 2. The bare optical fibers, generically designated as reference number 30 in FIG. 1, contained within optical cable 12 are separated within fanout crimp body 24, as discussed in detail below. A plurality of furcation tubes or terminated legs 28 may optionally be provided to conduct the segregated bare optical fibers 30 away from the furcation kit. As discussed below, the furcation kit in accordance to the present invention may be used without furcation tubes.

[0018] The optical cables 32 and 34, shown in FIGS. 3A and 3B, respectively, are two of the preferred optical cables usable with furcation kit 10. Each cable advantageously has two separate sets of strength fibers, which are preferably made from aramid yarns such as Kevlar™ fibers. Each cable has an outer jacket 36 covering and protecting the cable from environmental contaminations. Each cable also has one or more ripcords 38 disposed immediately below outer jacket 36. The ripcord facilitates the stripping of the outer jacket of the optical cables to prepare the cables for attachment to furcation kits or to connectors. Cables 32, 34 also have first set of outer strength fibers 40.

[0019] Cable 32, shown in FIG. 3A, also contains a plurality of buffered optical fibers 42. Each of the buffered optical fiber 42 generally comprises a bare fiber 44 disposed inside a protective acrylate buffer 46. Cable 32 also has second set of inner strength fibers 48, which are preferably disposed concentrically between the two rings of buffered optical fibers 42. Cable 32 further comprises an optional central member 50, which is preferably made from a dielectric material to provide an electrical ground for the cable 32.

[0020] Similarly, cable 34, shown in FIG. 3B, also contains second set of inner strength fibers 48 separated from outer strength fibers 40 by a protective layer 52. A buffer tube 54 is protected by inner strength fibers 48 and encloses a plurality of optical fiber ribbons 56.

[0021] To connect cables 32, 34 or another cable 12 to furcation kit 10, the cable is preferably inserted first through boot 14, jacket retention 18 and crimp band 16. The ripcord 38 is then pulled backward to strip away outer jacket 36 to expose the outer strength fibers 40. At least some of the outer strength fibers 40 are then trimmed and positioned on top of crimp body 58 of bottom housing 20, as best shown in FIG. 1, while the remaining core of the cable, generically designated as 12', is passed through the crimp body 58 to enter the interior of bottom housing 20. Outer strength fibers 40 are affixed to crimp body 58 by crimping end 60 of cable crimp band 16 over strength fibers 40 and crimp body 58. Preferably, the crimp body 48 has a plurality of exterior ridges and end 60 is made from a pliable metallic material. The crimping operation is known in the art, as shown for

example in U.S. patent No. 5,806,175 to Underwood. The '175 patent is hereby incorporated by reference in its entirety.

[0022] Heat shrinkable jacket 18 is then disposed partially over end 62 of cable crimp band 16 and partially over a section of cable 12, and is then shrunk with heat to affix a section of cable 12 to cable crimp band 16. The segmented boot 14 is then coupled to (by friction fit, adhesives, etc.) cable crimp band 16 and a portion of housing member 20, covering jacket retention 18 and a portion of cable 12, as best shown in FIG. 2, to protect against environmental contamination and to control the bend radius of the cable 12.

[0023] As most clearly shown in FIG. 1, remaining core 12' enters the housing member 20 through the hole defined in the crimp body 58. Preferably at or prior to this juncture, optical fibers 44 of cable 32 or optical ribbons 56 of cable 34 are stripped away from their buffer tubes 46 and 54, respectively. Inner strength fibers 48 are folded over the ridged end of the fanout crimp body 24 and are positioned over the exterior ridges of the fanout crimp body. Fanout crimp band 26 is then placed over second strength fibers 48, and is crimped to secure the inner strength fibers 48 to the fanout crimp body to enhance the mechanical connection between the cable 12 and the furcation kit 10. Additionally, some of the outer strength members 40 may also enter inside housing member 20 and be crimped along with inner strength fibers 48 to the fanout crimp body 24. Alternatively, some of the inner strength members 48 may also be crimped along with the outer strength members 40 between crimp body 58 on housing member 20 and crimp ring 16.

[0024] With respect to cable 32, bare fibers 44 are then inserted into fanout crimp body 24, where each fiber is inserted into a furcation tube 28 to be conducted to a terminal connector or directly to an optical apparatus or hardware. The length of the furcation tubes may be of any appropriate length, but preferably range from 6 inches to 200 inches, and the diameter of the furcation tubes may be of any appropriate size, but preferably range from 900 microns to 3.0 mm. Furcation tubes 28 can be affixed to the fanout crimp body by known processes, such as those described in U.S. patent No. 5,231,688. FIG. 7 shows the fanout crimp body 24 (without exterior ridges for clarity) with receiving end 64 and end face 66 defined thereon. While receiving end 64 has four substantially straight edges 68 illustrated, at least one edge 68 must have a configuration that assists with the orientation of the fanout crimp body 24 within body member 20 and at least one edge 68 to resist relative movement between the fanout crimp body 24 and housing member 20.

[0025] End face 66 may have one of a number of profiles 66A-66E, shown in FIGS. 7A-7E respectively, depending on the configuration of the optical cable 12. Specifically, end face 66D defines a number of fiber holes 70, sized and dimensioned to receive bare fibers 44 from cable 32 and furcation tubes 28 are received at the opposite end face. End face 66D may also define a central hole 72 to receive dielectric central member 50. Alternatively, holes 70 can be sized and dimensioned to receive both buffer tubes 46 and fibers 44. Buffer tubes 46 may act as a protective sheath to shield and protect fibers 44 from bending when inserted through the fiber holes in the endfaces 66A-66E, thereby rendering the use of furcation tubes unnecessary in this alternative embodiment.

[0026] End face 66A defines a number of slots 74 sized and dimensioned to receive the substantially flat optical ribbons 56 of cable 34. Furcation tubes 28 may also have a similar profile as the ribbons 56 to conduct the ribbons to terminal connectors or optical hardware. Alternatively, the fibers in ribbons 56 may also have individual, protective sheaths, thereby rendering the use of furcation tubes unnecessary.

[0027] After the fanout crimp ring 26 is crimped around the crimp body 24, this subassembly is placed in housing member 20, as illustrated in FIGS. 1 and 2. Preferably, housing 20 defines a channel 78 adapted to receive the receiving end 64 of the fanout crimp body 24. Channel 78 corresponds to the configuration of receiving end 64, which in the preferred embodiment has at least one substantial straight edge 80 to receive the straight edge 68 on receiving end 64. Straight edges 80 cooperate with straight edges 68 to resist relative rotational movement between housing member 20 and fanout crimp body 24. After the fanout crimp body and fanout crimp band subassembly is placed within the housing member 20, the top member 22 is snapped on to the housing member 20 to secure the subassembly therein. Top member 22, as shown in FIG. 1, has a number of legs 82 with a hook 84 disposed at the end of each leg 82. Each leg 82 is received in a groove 86 shaped to removably receive and securely retain leg 82 and hook 84. Alternatively, the top member 22 can be attached in an manner, including for example, through an interference fit, adhesive, tongue and groove, etc.

[0028] In accordance to another aspect of the invention, furcation kit 10 also has a stacking or bundling feature to allow the organization of multiple furcation kits within optical apparatus or hardware, such as the trays in the optical connection cabinets located within the distribution network described in U.S. patent No. 6,061,492. To this purpose, housing member 20 has number of knobs 88 disposed on the top of the housing member and a corresponding number of holes 90 disposed on the bottom of the housing. Preferably, knob 88 is tapered at the top end and has a slit 92 defined therein, and the outer diameter of the knob 88 is slightly larger than the inner diameter of the corresponding hole 90. When one furcation kit 10 is stacked to an adjacent kit, the tapered top end of knob 88 of one kit guides the knob into the hole 90 of the adjacent kit. The slit 92 allows the two halves to knob 88 to resiliently come together as the knob is inserted into hole 90. Due to the resiliency of the

knob 88, it exerts a pressure on the wall of hole 90 to hold securely one furcation kit to another. This construction also allows the connected furcation kits 10 to be pulled apart when necessary. Also, knobs 88 and holes 90 may be positioned on the opposite sides of furcation kit 10, so that the furcation kits may be stacked side-by-side in addition to top-to-bottom.

[0029] In accordance to another aspect of the present invention, optical cables with only the outer strength fibers 40 are also usable with the furcation kit 10. As shown in FIGS. 4A and 4B, cables 94, 96 have outer strength members 40 protecting buffer tube 54, which surround a number of ribbons 56 or buffered fibers 42, respectively. In this scenario, some of the outer strength members 40 are crimped between cable crimp band 16 and crimp body 58 of housing member 20, as described above. The remaining strength members 40 then are passed through fanout crimp body 24 and are crimped between fanout crimp body 24 and fanout crimp ring 26.

[0030] Furthermore, optical cables with individual sets of inner strength members 48, such as optical cable 98 shown in FIG. 5A, are also usable with furcation kit 10. Cable 98 has an outer jacket surrounding a plurality of buffered tubes 54. Each tube 54 surrounds a buffer fiber 42, which also contains inner strength members 48. Each buffer fiber may contain one or more bare optical fibers. In this situation, some of the inner strength members 48 are crimped between cable crimp band 16 and crimp body 58 of housing member 20, and the remaining strength members are crimped between fanout crimp body 24 and fanout crimp ring 26.

[0031] Additionally, optical cables with outer strength members 40 and individual sets of inner strength members 48, such as optical cable 100 shown in FIG. 5B, are also usable with furcation kit 10. Cable 100 has outer strength members 40 covering two separate protective layers 52,53. Layer 52 is typically a metal protective layer or a layer of water-swellable tape, and layer 53 is a core tube that surrounds dielectric rods 102 and a plurality of tubes 104 containing optical ribbons 56. Each of these tubes is preferably covered by inner strength members 48. In this situation, some of the outer strength members 40 are crimped between cable crimp band 16 and crimp body 58 of housing member 20, as described above. The remaining strength members 40 then are optionally passed through fanout crimp body 24 and are crimped between fanout crimp body 24 and fanout crimp ring 26, along with individual inner strength members 48. Alternatively, furcation kit 10 can be sized and dimensioned to be usable individually with each buffered tube 54 of cable 98 or with each tube 104 of cable 100.

[0032] Furcation kit 10 is also usable with substantially oval or rectangular profiled cables, such as ribbon cable 106 shown in FIG. 6. Ribbon cable 106 has an outer protective jacket 107 surrounding strength members 108, which protect optical ribbon 56. In this situation, some strength members 108 are crimped between cable crimp band 16 and crimp body 58 of housing member 20, while the remaining strength members are crimped between fanout crimp body 24 and fanout crimp band 26. The ribbon fibers 56 are separated and the individual fibers are then inserted into and conducted away from furcation kit 10 by furcation tubes 28, as described above. Advantageously, optical ribbon 56 may be separated into individual fibers and smaller multiple fiber ribbons. End face 86E, as shown in FIG. 7E, illustrates an embodiment that is adapted to receive individual fibers in holes 70, while receiving multiple fiber ribbon in slots 74.

[0033] While various descriptions of the present invention are described above, it is understood that the various features of the present invention can be used singly or in combination thereof. Therefore, this invention is not to be limited to the specifically preferred embodiments depicted therein.

Claims

1. A furcation device for furcating a multiple fiber cable having strength members, said furcation device comprises:

   a housing member adapted to receive a fanout body, wherein the fanout body comprises a plurality of passageways and wherein each passageway receives at least one individual fiber from the multiple fiber cable;

   wherein said housing member has at one end a cable crimp body, wherein at least some of the strength members from the multiple fiber cable are crimped between the cable crimp body and a first crimp band to affix the multiple fiber cable to the furcation device.

2. The furcation device of claim 1 wherein at least some of the strength members from the multiple fiber cable are crimped between a fanout crimp surface defined on the fanout body and a second crimp band.

3. The furcation device of claim 1 wherein the strength members from the multiple fiber cable comprise outer strength members and inner strength members disposed inside the outer strength members, and wherein some of the outer strength members are crimped between the cable crimp body and the first crimp band.

4. The furcation device of claim 3 wherein some of the inner strength members are crimped between a fanout crimp surface and a second crimp band.

5. The furcation device of claim 1 wherein the plurality of passageways comprises at least one passage-

way adapted to receive one individual fiber and at least one passageway adapted to receive one multiple fiber cable.

6. The furcation device of claim 1 wherein the fanout body comprises at least one surface thereon, said surface cooperates with a corresponding surface defined on the housing to resist relative rotational movement between the fanout body and the housing member.

7. The furcation device of claim 1 wherein a plurality of furcation tubes corresponding to the plurality of passageways on the fanout body is insertable into said passageways to conduct the at least one individual fiber to an optical apparatus.

8. The furcation device of claim 1 further comprises a top member removably connected to the housing member to hold the fanout body securely within the furcation device.

9. A furcation device for furcating a multiple fiber cable having strength members, said furcation device comprises:

a housing member adapted to receive a fanout body, wherein the fanout body comprises a plurality of passageways and wherein each passageway receives at least one individual fiber from the multiple fiber cable;

wherein said fanout body has an exterior fanout crimp surface, and wherein at least some of the strength members from the multiple fiber cable are crimped between the fanout crimp surface and a second crimp band to affix the multiple fiber cable to the furcation device.

10. The furcation device of claim 9 wherein at least some of the strength members from the multiple fiber cable are crimped between a cable crimp body located at one end of the housing member and a first crimp band.

11. The furcation device of claim 9 wherein the strength members from the multiple fiber cable comprise outer strength members and inner strength members disposed inside the outer strength members, and wherein some of the inner strength members are crimped between a cable crimp body located at one end of the housing member and a first crimp band.

12. The furcation device of claim 10 wherein some of the outer strength members are crimped between the fanout crimp surface and the second crimp band.

13. The furcation device of claim 9 wherein the plurality of passageways comprises at least one passageway adapted to receive one individual fiber and at least one passageway adapted to receive one multiple fiber cable.

14. The furcation device of claim 9 wherein the fanout body comprises at least one substantially flat surface thereon, said substantially flat surface cooperates with a corresponding at least one substantially flat surface defined on the housing to resist relative rotational movement between the fanout body and the housing member.

15. The furcation device of claim 9 wherein a plurality of furcation tubes corresponding to the plurality of passageways on the fanout body is insertable into said passageways to conduct the at least one individual fiber to an optical apparatus.

16. The furcation device of claim 9 further comprises a top member removably connected to the housing member to hold the fanout body securely within the furcation device.

17. A furcation device for furcating a multiple fiber cable comprising:

a housing member adapted to receive a fanout body, wherein the fanout body comprises a plurality of passageways and wherein each passageway receives at least one individual fiber from the multiple fiber cable;

wherein the housing member further comprises a first interlocking member and a second interlocking member, wherein the first interlocking member is adapted to interlock with the second interlocking member disposed on an adjacent furcation device.

18. The furcation device of claim 17 wherein the first interlocking member is a knob disposed on the surface of the housing member.

19. The furcation device of claim 18 wherein the knob is tapered and defines a slit.

20. The furcation device of claim 18 wherein the second interlocking member is a recess hole adapted to receive the knob.

21. The furcation device of claim 19 wherein the second interlocking member is a hole adapted to receive the knob.

22. The furcation device of claim 17 wherein the first interlocking member is disposed on a top surface of the housing member and the second interlocking

member is disposed on the bottom end of the housing member.

23. The furcation device of claim 17 wherein the first interlocking member is disposed on a first side surface of the housing member and the second interlocking surface is disposed on a second side surface, and wherein said first side surface is opposite to said second side surface.

24. The furcation device of claim 17 wherein the fanout body comprises at least one surface thereon, said surface cooperates with a corresponding at least one surface defined on the housing to resist relative rotational movement between the fanout body and the housing member.

25. A furcation device for furcating a multiple fiber cable comprising:

a housing member adapted to receive a fanout body, wherein the fanout body comprises a plurality of passageways and wherein each passageway receives at least one individual fiber from the multiple fiber cable;

wherein the fanout body comprises at least one surface thereon, said surface cooperates with a corresponding at least one surface defined on the housing to resist relative rotational movement between the fanout body and the housing member.

26. The furcation device of claim 25 wherein the fanout body comprises a receiving end and said at least one substantially straight edge is defined on said receiving end.

27. A furcation device for furcating a multiple fiber cable comprising:

a housing member adapted to receive a fanout body, wherein the fanout body comprises a plurality of passageways and wherein each passageway receives at least one individual fiber from the multiple fiber cable;

wherein the plurality of passageways comprises at least one passageway adapted to receive one individual fiber and at least one passageway adapted to receive one multiple fiber cable.

28. The furcation device of claim 27 wherein the fanout body comprises at least one surface thereon, said surface cooperates with a corresponding at least one surface defined on the housing to resist relative rotational movement between the fanout body and the housing member.

29. The furcation device of claim 27 wherein a plurality of furcation tubes corresponding to the plurality of passageways on the fanout body is insertable into said passageways to conduct the at least one individual fiber to an optical apparatus.

30. The furcation device of claim 27 further comprises a top member removably connected to the housing member to hold the fanout body securely within the furcation device.

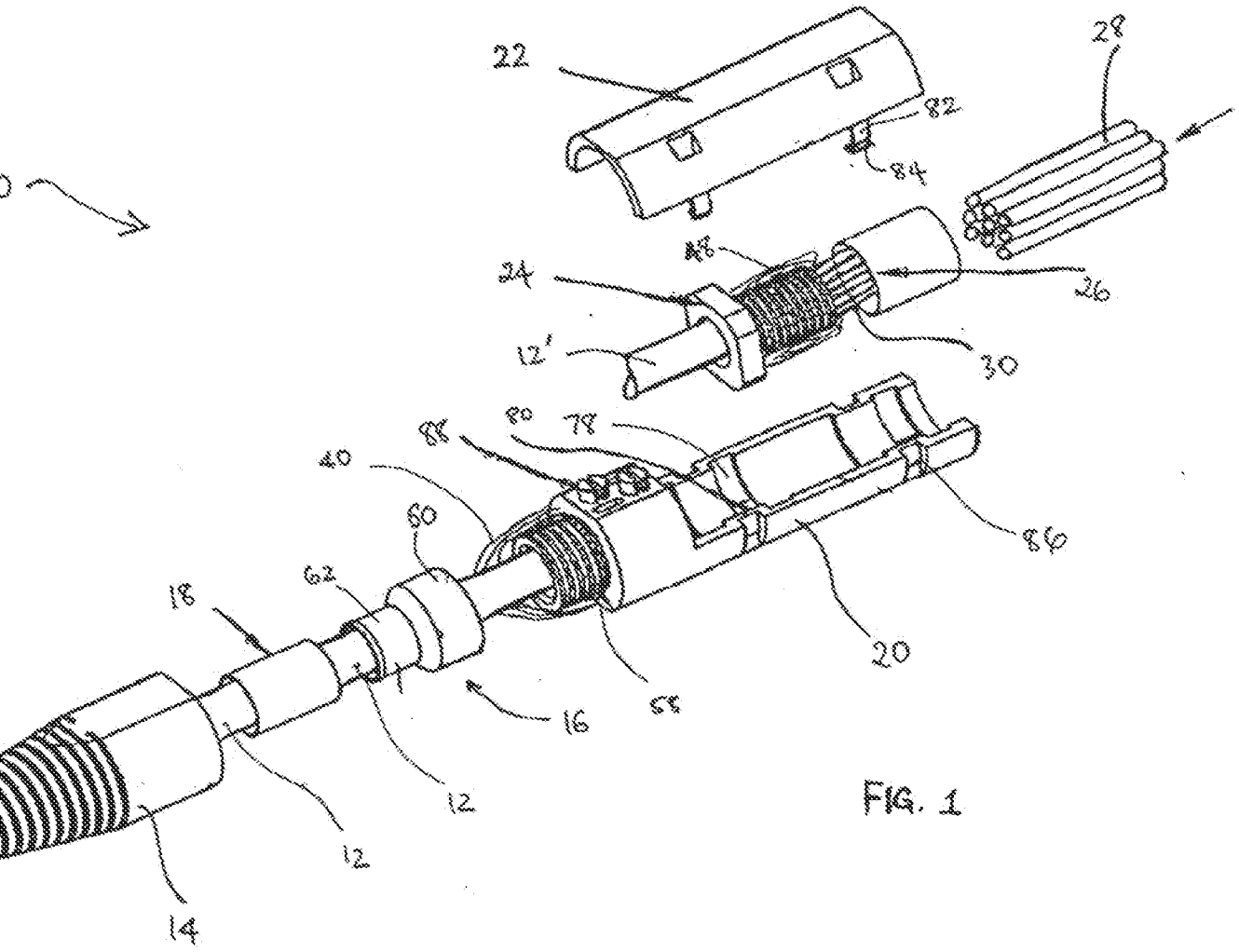


FIG. 1

EP 1 245 960 A2

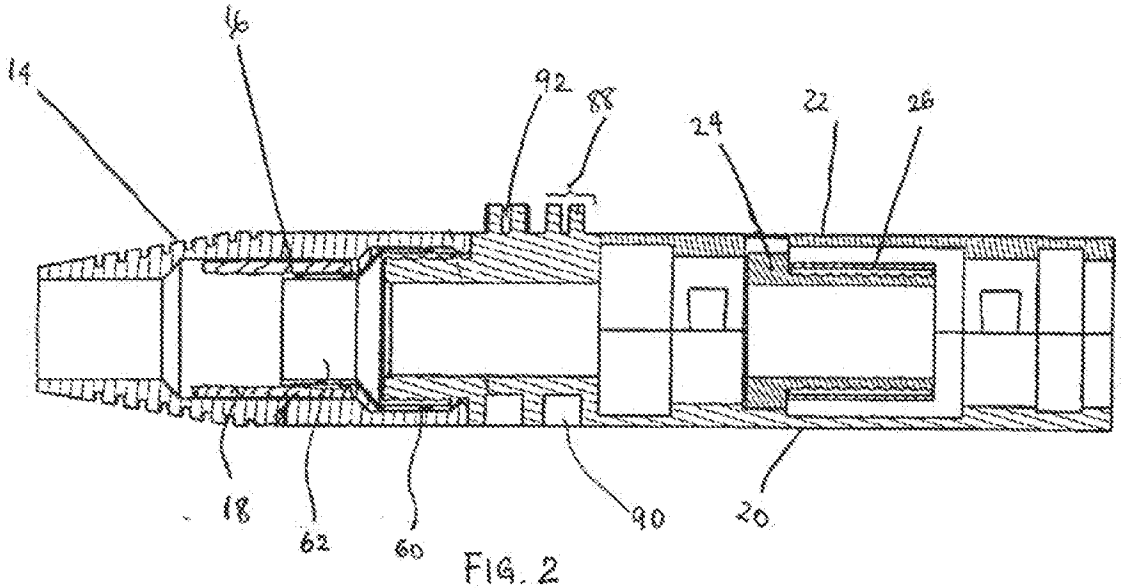


FIG. 2

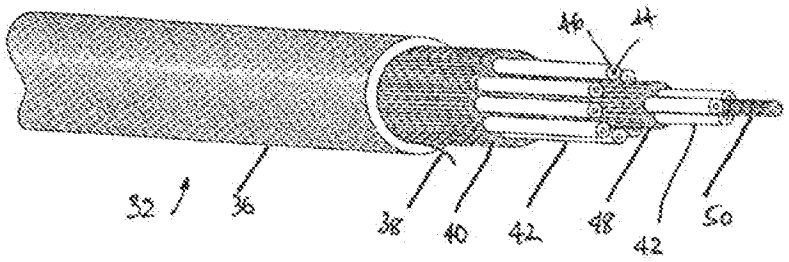


FIG. 3A

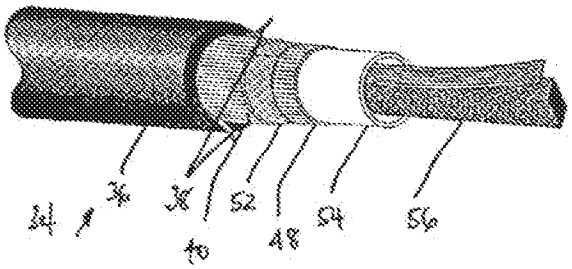


FIG. 3B

FIG. 4A

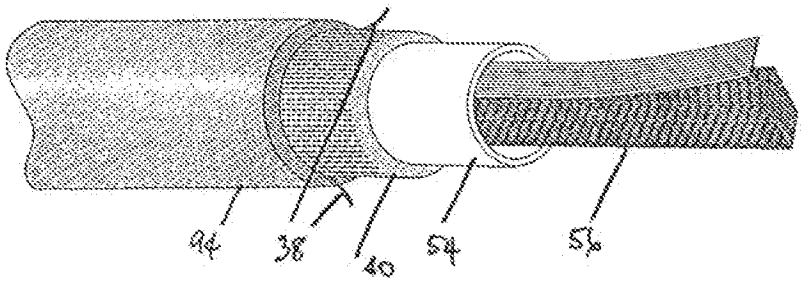


FIG. 4B

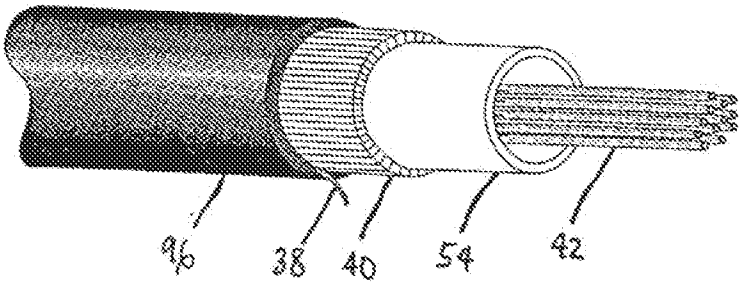


FIG. 5A

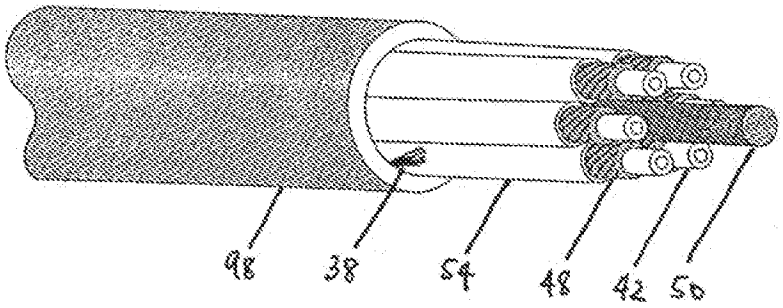
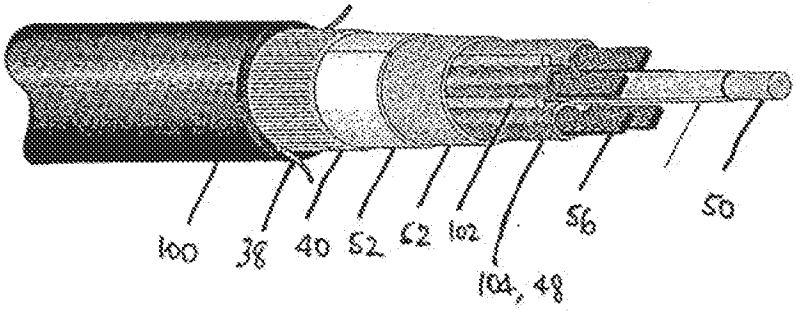


FIG. 5B



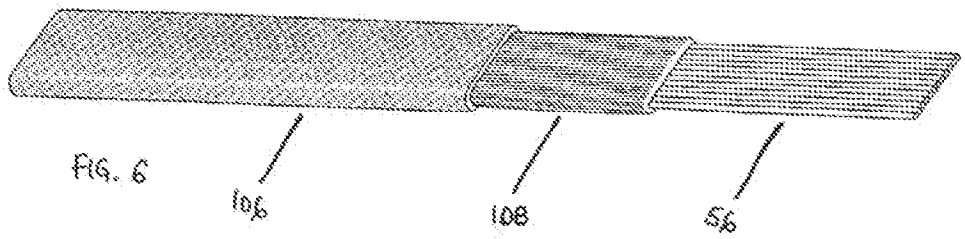


FIG. 6

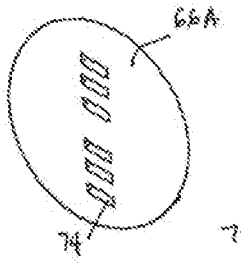


FIG. 7A

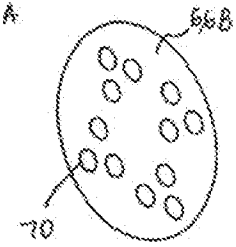


FIG. 7B

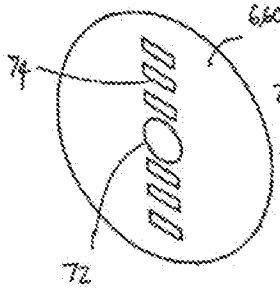


FIG. 7C

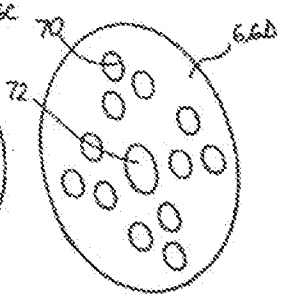


FIG. 7D

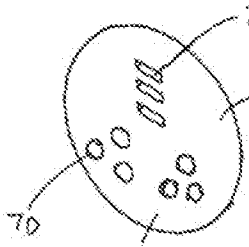


FIG. 7E

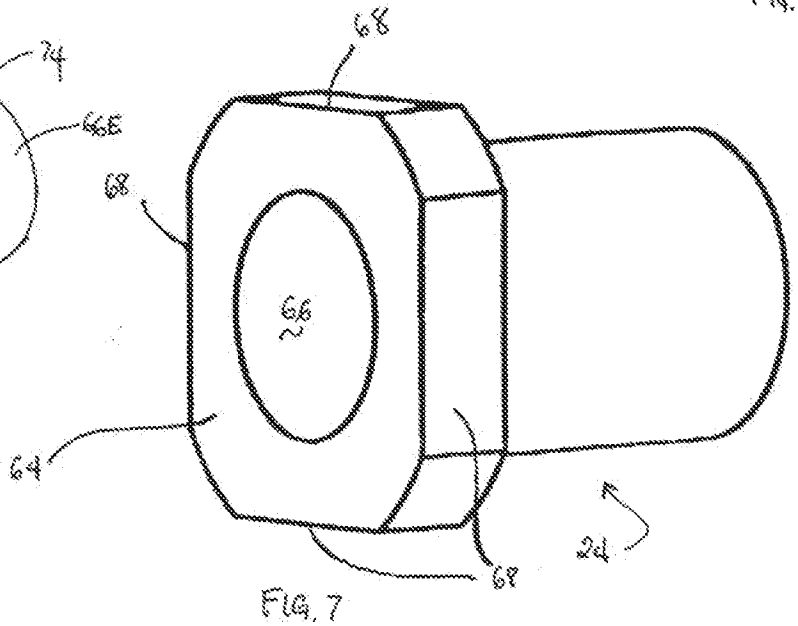


FIG. 7

B3

Plug housing of an optical plug connector for industrial environment

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EP0581527
US5971626
US6612750
US6318904
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Abstract of **EP1566674**

A plug housing of an optical pluggable connector (11), especially a SC-RJ plug, for receiving at least one ferrule housing (6a, 6b). The plug housing (10) has first fixture devices for releasable fixture with the pluggable connector capsule (7). - An INDEPENDENT CLAIM is included for a pluggable-connector capsule for receiving a plug housing.



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(54) Industrie-Steckergehäuse eines optischen Steckverbinders

(57) Ein Steckergehäuse (10) für einen optischen Steckverbinder (11), wie er für optische Steckeranordnungen (15) zur Verwendung kommt, weist erste Befestigungsmittell (16) auf, mit welchen das Steckergehäuse (10) mit einer Steckverbinderkapsel (7) verbunden werden kann. Diese ersten Befestigungsmittel (16) sind vorteilhafterweise für eine lösbare Befestigung ausgelegt und weisen Rastelemente (24, 24', 24") auf, um mit der Steckverbinderkapsel (7) in Art eines Schnappverschlusses wirkungskomplementär zusammen zu wirken. Eine besondere Ausführungsform sieht vor, diese ersten Befestigungsmittel (16) derart zu gestalten, dass ein Dreh-Schnappverschluss realisiert werden kann. Die Steckverbinderkapsel (7) weist zweite Befestigungsmittel auf, welche wirkungskomplementär zu den ersten Befestigungsmittel (24, 24', 24") des Steckergehäuses (10) zusammenwirken.

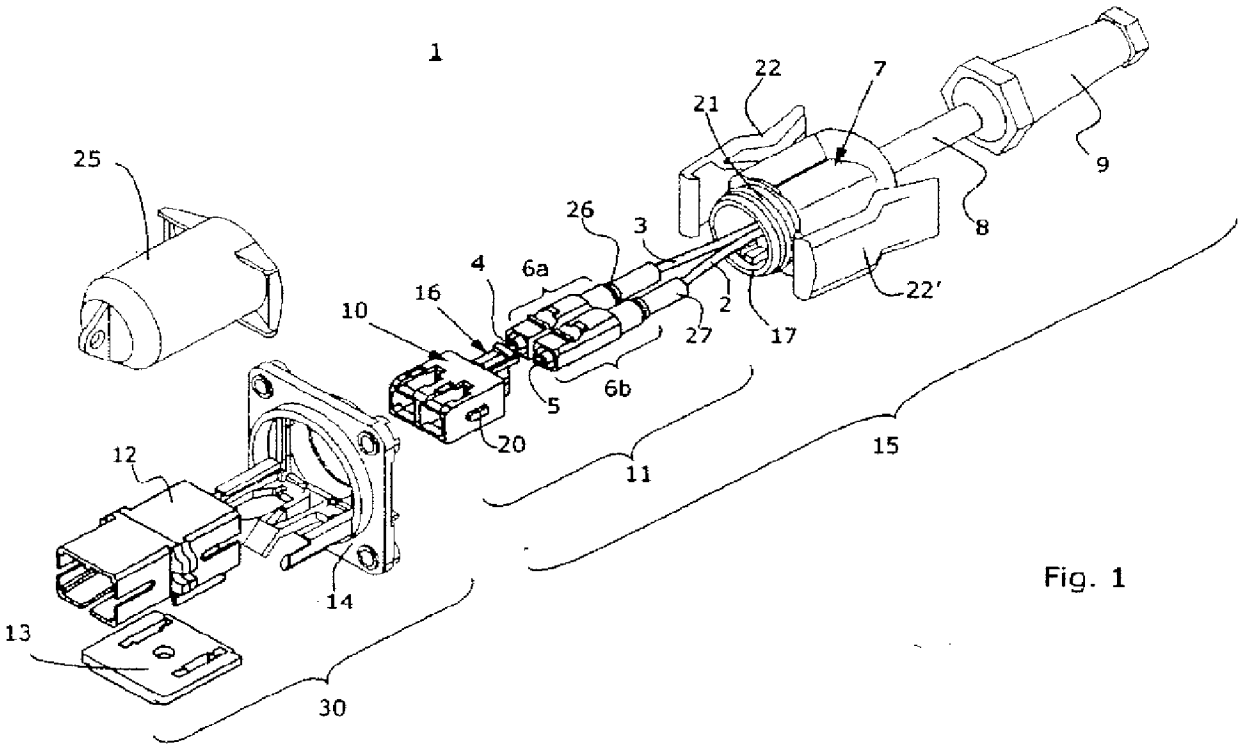


Fig. 1

EP 1 566 674 A1

Beschreibung

[0001] Die vorliegende Erfindung betrifft ein Steckergehäuse eines optischen Steckverbinders, insbesondere eines SC-RJ Steckers, für die Aufnahme mindestens eines Ferrulengehäuses, gemäss Oberbegriff des Anspruchs 1 sowie eine Steckverbinderkapsel für die Aufnahme dieses Steckergehäuses gemäss Oberbegriff des Anspruchs 8.

[0002] Steckergehäuse zum Einstecken in eine korrespondierende Steckerbuchse dienen ganz allgemein der Halterung und gezielten Führung von elektrischen oder optischen Kabeln, insbesondere um eine elektrische oder optische Verbindung von Kabelenden in einfacher Weise bewerkstelligen zu können. Derartige Verbindungen für die moderne Daten- und Kommunikationsübertragung werden im Aussenbereich ebenso verwendet, wie im Wohnbereich, Büro- oder Geschäftsbereich und in der Industrie. So haben sich zum Beispiel sogenannte RJ45-Stecker für die elektrische Signalübertragung auf dem Markt durchgesetzt. Für die Geometrie von sogenannten SC-RJ Steckern, respektive SC-RJ Steckverbinderanordnungen (Stecker/Adapter/Stecker) für optische Kabel bestehen bereits detaillierte Normvorschriften (EN 50377-6-1).

[0003] Bei der Verwendung derartiger Steckverbinderanordnungen in industrieller Umgebung erweisen sich diese jedoch als äusserst störanfällig. Insbesondere führen die mechanischen Belastungen, d.h. starken Vibrationen, und Kontaminationen der Luft, d.h. Oeldämpfe, Staub und/oder Feuchtigkeit, zu unerwünschten Beeinträchtigungen dieser empfindlichen Kontaktstellen.

[0004] Es bestehen deshalb Normen für die Ausgestaltung von industrietaulichen RJ45-Steckern, insbesondere die Norm IEC 61076-3-106 (International Electrotechnical Commission), und wird beispielsweise in der DE-100'31'341 ein Gehäusekörper für die Aufnahme eines RJ45-Steckers beschrieben, welcher sich für die Verwendung bei Steckkontakten eignet, wie sie unter industriellen Umgebungsbedingungen erforderlich sind. Der in dieser Druckschrift offenbarte Gehäusekörper ist mit einem abnehmbaren Klappdeckel versehen und derart gestaltet, dass ein normierter RJ45-Stecker in diesen Gehäusekörper eingelegt werden kann. Dieser Gehäusekörper weist darüber hinaus ein seitlich angeordnetes Klinkenpaar auf, mit dessen Hilfe der montierte Stecker an einer Steckerbuchse gesichert werden kann. Der mehrteilige Aufbau dieses Gehäusekörpers schützt die innenliegenden, elektrischen Kontaktstellen langfristig nur ungenügend und vermag den hohen Anforderungen für faseroptische Kontakte in einer industriellen Umgebung nicht mehr zu genügen.

[0005] So wird beispielsweise in der US 5,725,963 eine elektrische Steckverbindung beschrieben, welche für die Verwendung in einer industriellen Umgebung besonders ausgestaltet ist. Diese Anordnung umfasst ebenfalls einen mehrteiligen Gehäusekörper mit einem beidseitig angeordneten Klinkenpaar. Leider sind auch bei dieser Anordnung keine besonderen Massnahmen vorgesehen, um den Kontaktbereicht langfristig vor Feuchtigkeit, Staub oder anderen Kontaminationen zu schützen. Darüberhinaus werden Vibrationen ungedämpft auf die Kontaktstellen übertragen.

[0006] Es besteht heute das Bedürfnis, optische Steckverbindungen, wie sie beispielsweise in der WO 99/42877 beschrieben werden, vermehrt auch im Industriebereich verwenden zu können. Um derartige optische Steckeranordnungen im industriellen Bereich langfristig verwenden zu können, sind besondere Vorkehrungen zum Schutz der empfindlichen optischen Kabelenden erforderlich. Leider eignen sich keine der für elektrische Kabel bekannten Steckeranordnungen für die Verwendung mit optischen Kabeln. So wird beispielsweise in der US 6'648'520 eine Steckeranordnung für optische Kabel beschrieben, welche eine robuste Steckverbinderkapsel für ein Kabelendstück aufweist. Diese Steckverbinderkapsel wird mit Hilfe einer Überwurfmutter an einem am optischen Kabel befestigten Haltestück festgeklemmt. Leider löst sich eine derartige Befestigung wegen der permanenten Vibrationen im industriellen Umfeld mit der Zeit und lässt sich eine derartige Steckeranordnung nicht in einfacher Weise vor Ort konfektionieren.

[0007] Es ist deshalb Ziel der vorliegenden Erfindung, eine Steckeranordnung für einen optischen Steckverbinder zu schaffen, welche im industriellen Umfeld längerfristig verwendbar ist und sich vor Ort und in einfacher Weise zusammenbauen lässt. Vorzugsweise soll diese Steckeranordnung zerstörungsfrei demontierbar sein.

[0008] Insbesondere ist es Aufgabe der vorliegenden Erfindung ein Steckergehäuse für einen optischen Steckverbinder zu schaffen, welcher die Nachteile der bekannten Steckverbinder nicht aufweist, sowie eine Steckverbinderkapsel zu schaffen, welche für die sichere Aufnahme eines derartigen Steckergehäuses geeignet ist.

[0009] Diese Aufgabe wird erfindungsgemäss durch ein Steckergehäuse mit den Merkmalen des Anspruchs 1 gelöst, und insbesondere durch ein Steckergehäuse eines optischen Steckverbinders bekannter Art, welcher für die Aufnahme mindestens eines Ferrulengehäuses geeignet ist, wobei dieses Steckergehäuse erste Befestigungsmittel für eine langfristig sichere Befestigung mit einer Steckverbinderkapsel aufweist, um eine industrietaugliche Steckverbindung zu erzeugen.

[0010] Bevorzugte Weiterbildungen des erfindungsgemässen Steckergehäuses weisen die Merkmale der Unteransprüche 2 bis 5 auf.

[0011] So weist das erfindungsgemässe Steckergehäuse vorteilhafterweise erste Befestigungsmittel auf, welche sich für eine lösbare Befestigung mit einer Steckverbinderkapsel eignen. Diese ersten Befestigungsmittel umfassen mindestens ein Rastelement für die Bildung eines mit der Steckverbinderkapsel wir-

kungskomplemetär zusammenwirkenden Schnappverschlusses. Vorzugsweise umfassen die ersten Befestigungsmittel (16) mindestens ein Rastelement für die Bildung eines mit der Steckverbinderkapsel wirkungskomplementär zusammenwirkenden Dreh-Schnappverschlusses. Das Rastelement kann in einer ersten Ausführungsform eine einfache Rastnut oder in einer anderen Ausführungsform eine Rastnase aufweisen. In einer bevorzugten Weiterbildung der erfindungsgemässen ersten Befestigungsmittel weist das Rastelement eine Rastnase auf, welche quer zur Steckrichtung (R) kreissegmentförmig geformt ist, um in einer Führungsnut im Innern der Steckverbinderkapsel spielfrei geführt werden zu können.

[0012] Die gestellte Aufgabe wird weiter durch eine Steckverbinderkapsel gelöst, welche das oben beschriebene Steckergehäuse aufnehmen kann und mit diesem in geeigneter Weise zusammenwirkt. Diese Steckverbinderkapsel weist die Merkmale des vorliegenden Anspruchs 6 auf. Insbesondere sind zweite Befestigungsmittel für eine lösbare Befestigung mit dem erfindungsgemässen Steckergehäuse vorgesehen, welche zweiten Befestigungsmittel wirkungskomplementär mit den ersten Befestigungsmitteln des Steckergehäuses zusammenwirken. In einer Weiterbildung dieser Steckverbinderkapsel sind dritte Befestigungsmittel vorgesehen, mit welchen die Steckverbinderkapsel an einem Anbaurahmen oder einem Gerätegehäuse lösbar befestigt werden kann. Diese dritten Befestigungsmittel können als Klinke, resp. Klinkenpaar ausgebildet sein und wirkungskomplementäre Gegenelemente am Anbaurahmen oder am Gerätegehäuse hintergreifen. Ebenso einfach lässt sich für die Ausgestaltung dieser dritten Befestigungsmittel auch eine Überwurfmutter vorsehen.

[0013] Die Vorteile der vorliegenden Erfindung sind dem Fachmann unmittelbar ersichtlich und liegen in der Schaffung einer unter industriellen Verhältnissen auch langfristig sicheren und funktionstüchtigen Steckeranordnung, in deren einfachen Handhabung und kosten günstigen Herstellung. Insbesondere lässt sich diese Steckeranordnung mit Hilfe des erfindungsgemäss ausgebildeten Steckergehäuses in einfacher Weise zusammenbauen und vorzugsweise auch zerstörungsfrei demontieren.

[0014] Im Folgenden soll die Erfindung anhand eines Ausführungsbeispiels und mit Hilfe der Figuren näher beschrieben werden. Es zeigen:

Fig. 1 eine Explosionsdarstellung einer Steckverbindungsanordnung für optische Kabel mit einem erfindungsgemässen Steckergehäuse und einer dazu passenden Steckverbinderkapsel;

Fig. 2a - 2c räumliche Darstellungen zum Montageablauf des erfindungsgemässen Steckergehäuses mit der erfindungsgemässen Steckverbinderkapsel.

Fig. 3a - 3c detaillierte Darstellungen des erfindungsgemässen Steckergehäuses;

Fig. 4 eine Aufsicht der erfindungsgemäss ausgerüsteten Steckeranordnung, und

Fig. 5 eine räumliche Ansicht einer Buchse für die Aufnahme der erfindungsgemässen Steckeranordnung gemäss Fig. 4.

[0015] Figur 1 zeigt eine Steckverbindungsanordnung 1 für zwei optische Kabel 2, 3, auch Lichtwellenleiter genannt, deren Enden je mit einer Ferrule 4, 5 versehen sind. Diese Ferrulen 4, 5 werden in genormten Ferrulengehäusen 6a, 6b in bekannter Weise, d.h. mit Hilfe von Ferrulenhaltern 26 und Crimphülsen 27 gehalten. Die beiden optischen Kabel 2, 3 sind durch eine Steckverbinderkapsel 7 geführt und durch einen Kabelmantel 8 geschützt. Diese Steckverbindungsanordnung 1 weist zudem einen Knickschutz 9 bekannter Art auf, um die optischen Kabel 2, 3 vor einem ungewünschten Abknicken zu schützen. Darüber hinaus ist ein Steckergehäuse 10 vorgesehen, welches die Ferrulengehäuse 6a, 6b aufnimmt und so einen Steckverbinder 11, insbesondere einen SC-RJ Steckverbinder, bildet. Die derart zusammengesetzte Steckeranordnung 15 kann in einen Adapter 12 eingesteckt werden, welcher mit Hilfe einer Trägerplatte 13 an einem Anbaurahmen 14 befestigt ist. Es versteht sich, dass für derartige Steckverbindungsanordnungen auch eine Schutzkappe 25 vorgesehen wird, welche über die Steckeranordnung 15 gesteckt werden kann, um die Enden der optischen Kabel 2, 3 zu schützen.

[0016] Das erfindungsgemässe Steckergehäuse 10 weist erste Befestigungsmittel 16 auf, welche eine Schnappverbindung mit der Steckverbinderkapsel 7 erlauben. In einer bevorzugten Ausführungsform sind diese ersten Befestigungsmittel 16 als Teil eines Dreh-Rast-Verschlusses ausgebildet. Ein derartiger Dreh-Rast-Verschluss verhindert, dass beim Ausziehen der Steckeranordnung 15 aus der Buchsenanordnung 30 sich das Steckergehäuse 10 aus der Steckverbinderkapsel 7 löst und damit Zugkräfte auf die optischen Kabel 2, 3 ausgeübt werden. Bei der gezeigten Anordnung liegt das Steckergehäuse 10 mit seiner Rückseite am Öffnungsrand 17 der Steckverbinderkapsel 7 an. Dies führt dazu, dass im gesteckten Zustand das Steckergehäuse 10 vollständig in den Anbaurahmen 14 hineinragt und die Steckverbinderkapsel 7 dichtend am Anbaurahmen 14 anliegt. Die Steckverbinderkapsel 7 ist dazu mit einem O-Ring 21 versehen. Die erfindungsgemässe Steckverbinderkapsel 7 weist ein seitlich angeordnetes Klinkenpaar 22, 22' auf, um die Steckverbinderkapsel 7 am Anbaurahmen 14 zu sichern.

[0017] Die Figuren 2a bis 2c zeigen einige Montageschritte für das Zusammenbauen einer erfindungsge-

EPODOC <EP 1566674A1 >

mässen Steckeranordnung 15. Vorerst wird ein Dichtungselement, vorzugsweise ein Kabelmantel 8 und ein Knickschutz 9 über die Kabel 2, 3 geschoben. In diesem Zustand werden die Kabel 2, 3 in bekannter Weise ca. 7 cm abisoliert und die einzelnen Fasern konfektioniert, d.h. insbesondere mit einer Ferrule 4, 5 versehen und eventuell geklebt und geschliffen. Nach dem Konfektionieren der Kabel 2, 3 wird eine Steckverbinderkapsel 7 über die derart vorbereiteten Kabel 2, 3 geschoben. Jede der Ferrulen 4, 5 wird vorgängig in einem der Ferrulengehäuse 6a, 6b befestigt. Diese Ferrulengehäuse 6a, 6b werden anschliessend in das erfindungsgemässe Steckergehäuse 10 eingesetzt. In einem nächsten Schritt wird dieses Steckergehäuse 10 in die Steckverbinderkapsel 7 eingeführt, wie aus den Figuren 2a bis 2c ersichtlich, und wird der Knickschutz 9 an der Steckverbinderkapsel 7 und dem Kabelmantel 8 dichtend angebracht. Der Vorgang, mit welchem das Steckergehäuse 10 an der Steckverbinderkapsel 7 befestigt wird, wird in den Figuren 2a bis 2c deutlich gemacht. Vorerst werden die ersten Befestigungsmittel 16 des Steckergehäuses 10 in einer um die Steckrichtung R verdrehten Lage in die Steckverbinderkapsel 7 eingeführt. Figur 2b zeigt das bis zum Anschlag in die Steckverbinderkapsel 7 eingeführte Steckergehäuse 10. Die Rückwand dieses Steckergehäuses 10 liegt in dieser Position am Öffnungsrand 17 der Steckverbinderkapsel 7 an. Ein Teil der ersten Befestigungsmittel 16, insbesondere ein Rastelement 24 liegt nun in einem zweiten Befestigungsmittel, insbesondere in einer inneren Rastnut (nicht dargestellt) der Steckverbinderkapsel 7. Um das Steckergehäuse 10 daran zu hindern, dass dieses beim Ausziehen der Steckverbindung aus der Steckverbinderkapsel 7 herausrutscht, wird das Steckergehäuse 10 mit einer Drehung φ um die Steckrichtung R und mit Hilfe von zweiten Befestigungsmitteln in eine lösbare Dreh-Schnappverbindung mit der Steckverbinderkapsel 7 gebracht. Diese zweiten Befestigungsmittel umfassen bei dieser Ausführungsform zusätzlich eine auf der Rastnut angebrachte Rastkerbe, in welche eine Rastrippe 29 des Rastelementes 24 einrastet. Die Anordnung gemäss Figur 2c kann nun als erfindungsgemäss montierte Steckeranordnung 15 verwendet werden.

[0018] Figuren 3a bis 3c zeigen das erfindungsgemässe Steckergehäuse 10 und die erfindungsgemässen ersten Befestigungsmittel 16 im Detail. Dieses Steckergehäuse 10 weist zwei Steckplätze 18, 19 auf, in welche die Ferrulengehäuse 6a, 6b eingesetzt werden können. Seitliche Nocken 20, sowie ein Codiernocken (nicht ersichtlich) an der Unterseite des Steckergehäuses 10, gewährleisten das korrekte Einführen des Steckergehäuses 10 in eine Buchsenanordnung 30. Die in Fig. 3b im Detail gezeigten ersten Befestigungsmittel 16 umfassen einen Steg 23, welcher vom rückseitigen Ende des Steckergehäuses 10 in Steckgegenrichtung, d. h. in Richtung der Steckverbinderkapsel 7 zeigt. Dieser Steg 23 ist derart dimensioniert, dass die Ferrulengehäuse 6a, 6b in die Steckplätze 18, 19 des Steckergehäuse 10, auch Schlittengehäuse genannt, geführt werden können. Nach dem Einsetzen des Steckergehäuses 10 in die Steckverbinderkapsel 7, können die ersten Befestigungsmittel 16 in wirkungskomplementäre zweite Befestigungsmittel (nicht dargestellt) innerhalb der Steckverbinderkapsel 7 eingreifen.

[0019] Figuren 3a bis 3c machen die Geometrie bevorzugter erfindungsgemässer erster Befestigungsmittel 16 deutlich. Der Steg 23 umfasst bei dieser Ausführungsform mindestens ein Kopfteil 24 oder 24', welches quer zur Steckrichtung R kreissegmentförmig geformt ist. In den Figuren 3a bis 3b weisen die ersten Befestigungsmittel 16 einen Steg 23 mit zwei derartigen Kopfteilen 24, 24' auf. Im montierten Zustand liegt mindestens ein Kopfteil 24 in einer im Innern der Steckverbinderkapsel 7 vorgesehenen umlaufenden Nut (nicht dargestellt). Diese Nut weist an geeigneter Stelle eine Schwelle auf, in welche das Kopfteil 24 lösbar einrasten kann. Derart ist gewährleistet, dass das Steckergehäuse 10 nicht mehr in Steckgegenrichtung aus der Steckverbinderkapsel 7 ausziehbar ist, sondern nur über eine Drehbewegung $-\varphi$ aus seiner Raststellung gelöst werden kann.

[0020] Figur 4 zeigt den montierten Stecker und macht deutlich, dass das erfindungsgemässe Steckergehäuse 10 mit seiner Rückseite am Öffnungsrand der Steckverbinderkapsel 7 anliegt und vollständig in eine Buchsenanordnung 30 gemäss Figur 5 eingeführt werden kann.

[0021] Die in den Figuren 4 und 5 dargestellte Steckeranordnung 15 und Buchsenanordnung 30 macht deutlich, dass die Kontaktstelle für die optische Verbindung durch die erfindungsgemässe Steckverbindungsanordnung 1 vollumfänglich geschützt ist, insbesondere also mit Hilfe der einstückigen Steckverbinderkapsel 7 vollständig abkapselbar ist und somit auch bei erschwerten, industriellen Umweltbedingungen langfristig einwandfrei und sicher funktioniert. Im gesteckten Zustand legt sich der O-Ring 21 dichtend an eine Anschlagfläche 26 eines Öffnungskragens 27 des Anbaurahmens 14. Dieser Öffnungskragen 27 ist hinterschnitten, derart, dass dritte Befestigungsmittel, insbesondere mindestens eine der Klinken 22, 22' diesen Öffnungskragen 27 hintergreifen kann und damit die Steckeranordnung 15 sicher an der Buchsenanordnung 30 halten kann.

[0022] Es versteht sich, dass die hier dargestellten Ausführungsformen für alle Arten optischer Steckverbinder, insbesondere aber für SC-RJ Steckverbinder, anwendbar ist. Dabei ist es unerheblich, ob damit nur eine oder ob mehrere optische Kabel gleichzeitig verbunden werden sollen. Natürlich können auch andere geometrische Gestaltungen vorgesehen werden, insbesondere kann das erfindungsgemässe Steckergehäuse 10 im montierten Zustand vollständig oder nur teilweise im Innern der Steckverbinderkapsel 7 liegen. Das Steckergehäuse 10 oder die einzelnen Ferrulengehäuse 6a, 6b können mit selbsttätigen Schliessklappen versehen

BNSDOCID <EP 1566674A1 >

sein, um die optischen Fasern im ungesteckten Zustand vor Verschmutzung zu schützen.

[0023] Es versteht sich ebenfalls, dass der Fachmann ohne erfinderisches Dazutun die Steckerkapsel 7 anstelle mit Hilfe von Klinken 22 mit Hilfe einer Überwurfmutter am Anbaurahmen 14 oder an einem Gerätegehäuse befestigen kann. Andere Mittel zur sicheren Befestigung der erfindungsgemässen Steckeranordnung 15 liegen im gewöhnlichen Handeln des Fachmanns. So versteht es sich ebenfalls von selbst, dass die erfindungsgemäss ausgerüstete Steckeranordnung 15 auch selbsttätige Schliessklappen oder eine manuell aufsetzbare Schutzkappe 25 aufweisen kann.

Patentansprüche

1. Steckergehäuse (10) eines optischen Steckverbinders (11), insbesondere eines SC-RJ Steckers, für die Aufnahme mindestens eines Ferrulengehäuses (6a, 6b), **dadurch gekennzeichnet, dass** dieses Steckergehäuse (10) erste Befestigungsmittel (16) für eine Befestigung mit einer Steckverbinderkapsel (7) aufweist.

2. Steckergehäuse (10) nach Anspruch 1, **dadurch gekennzeichnet, dass** dieses erste Befestigungsmittel (16) für eine lösbare Befestigung mit der Steckverbinderkapsel (7) aufweist.

3. Steckergehäuse (10) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die ersten Befestigungsmittel (16) mindestens ein Rastelement (24, 24', 24") für die Bildung eines mit der Steckverbinderkapsel (7) wirkungskomplementär zusammenwirkenden Schnappverschlusses umfassen.

4. Steckergehäuse (10) nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die ersten Befestigungsmittel (16) mindestens ein Rastelement (24, 24', 24") für die Bildung eines mit der Steckverbinderkapsel (7) wirkungskomplementär zusammenwirkenden Dreh-Schnappverschlusses umfassen.

5. Steckergehäuse (10) nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass** das Rastelement (24, 24', 24") eine Rastnut aufweist.

6. Steckergehäuse (10) nach Anspruch 3 oder 4, **dadurch gekennzeichnet, dass** das Rastelement (24, 24', 24") eine Rastnase aufweist.

7. Steckergehäuse (10) nach Anspruch 6, **dadurch gekennzeichnet, dass** die Rastnase quer zur Steckrichtung (R) kreissegmentförmig geformt ist.

8. Steckverbinderkapsel (7) für die Aufnahme eines Steckergehäuses (10) gemäss Anspruch 1, **dadurch gekennzeichnet, dass** diese Steckverbinderkapsel (7) zweite Befestigungsmittel für eine Befestigung mit diesem Steckergehäuse (10) aufweist, welche zweite Befestigungsmittel wirkungskomplementär zu den ersten Befestigungsmitteln (24, 24',24") des Steckergehäuses (10) ausgebildet sind.

9. Steckverbinderkapsel (7) nach Anspruch 8, **dadurch gekennzeichnet, dass** diese dritte Befestigungsmittel, insbesondere mindestens eine Klinke (22 oder 22'), zur Befestigung an einen Anbaurahmen (14) oder einem Gerätegehäuse, aufweist.

10. Steckverbinderkapsel (7) nach Anspruch 8, **dadurch gekennzeichnet, dass** als dritte Befestigungsmittel eine Überwurfmutter vorgesehen ist.

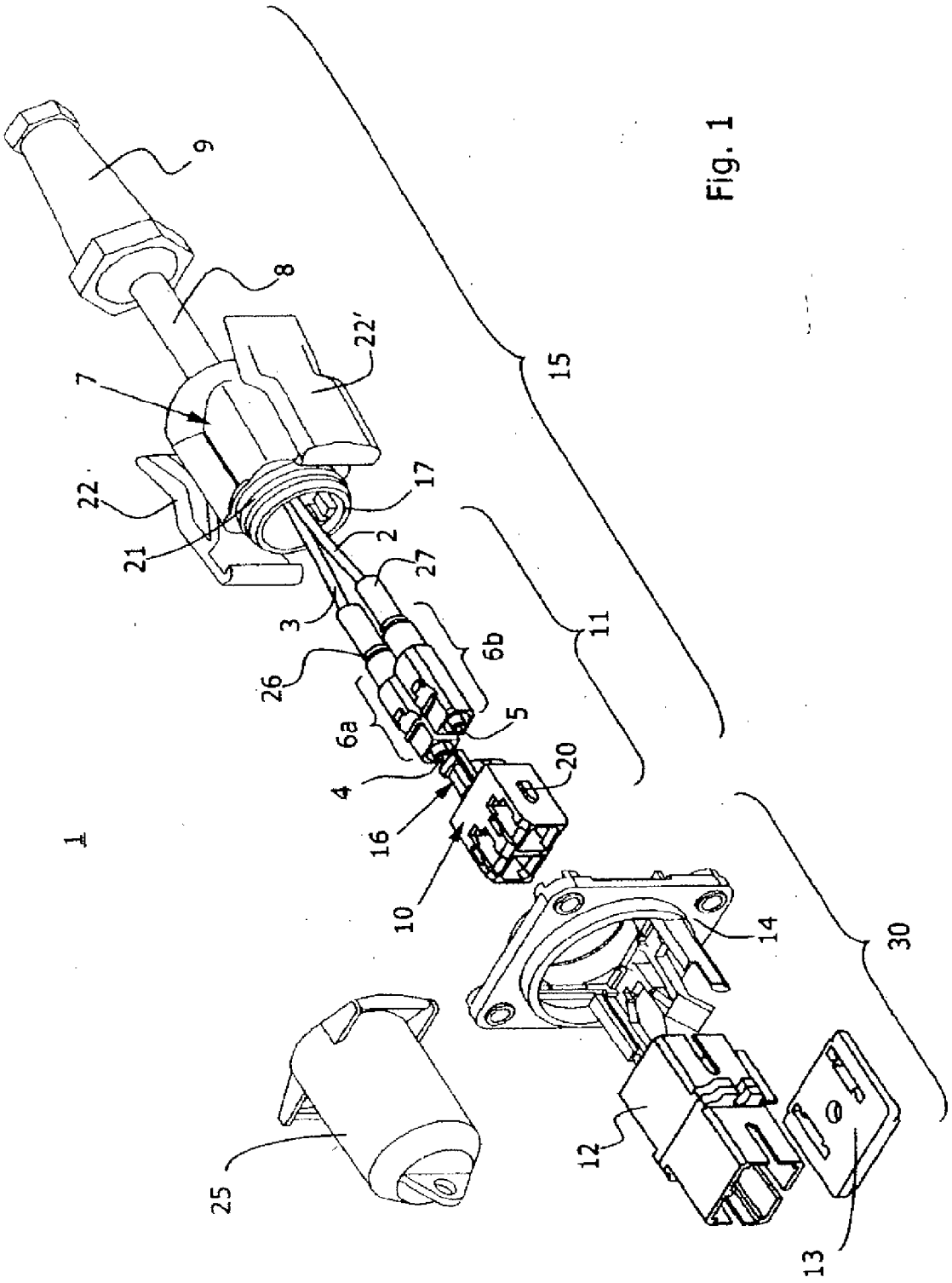


Fig. 1

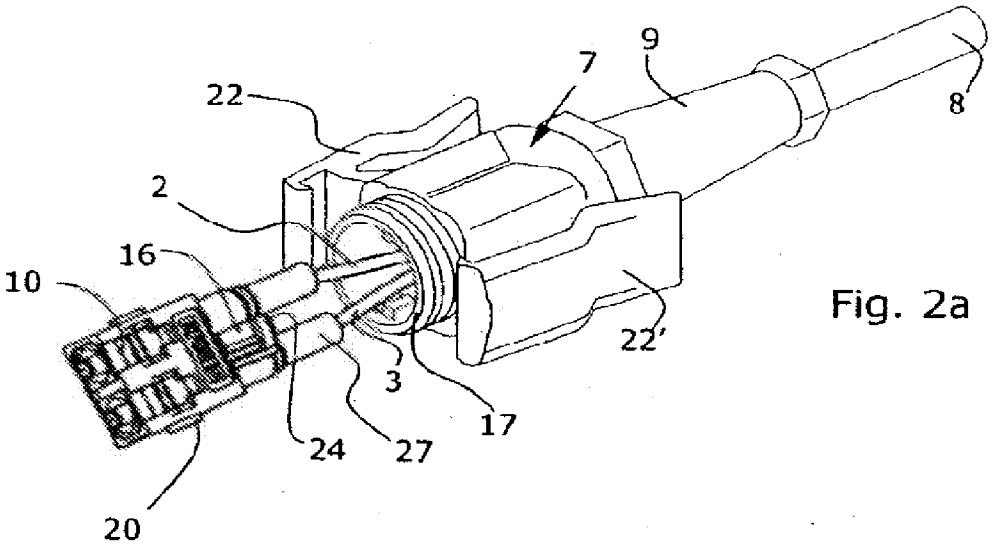


Fig. 2a

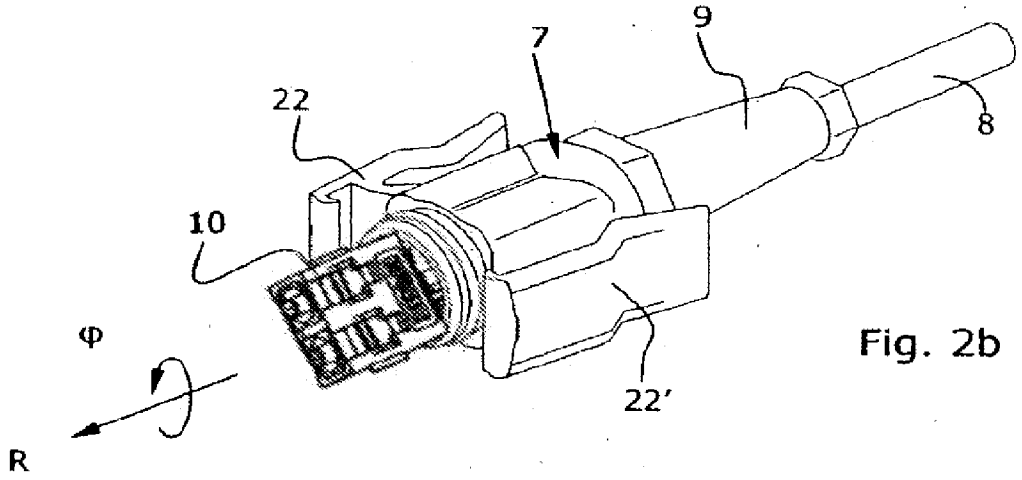


Fig. 2b

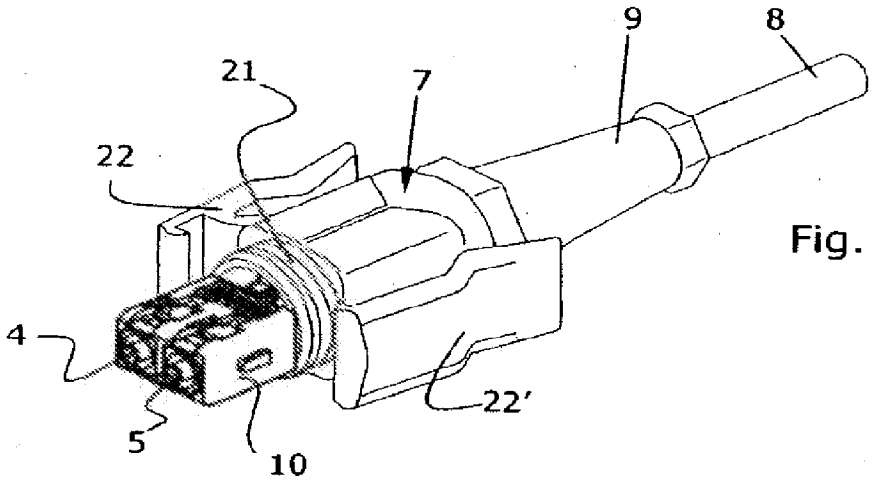


Fig. 2c

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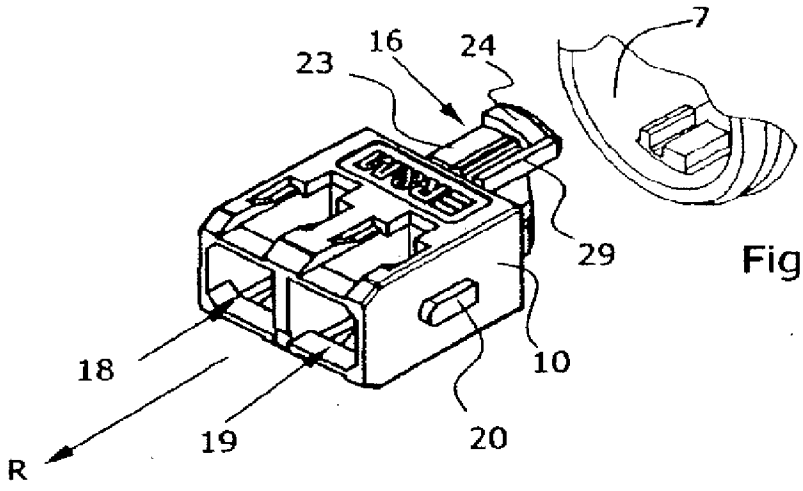


Fig. 3a

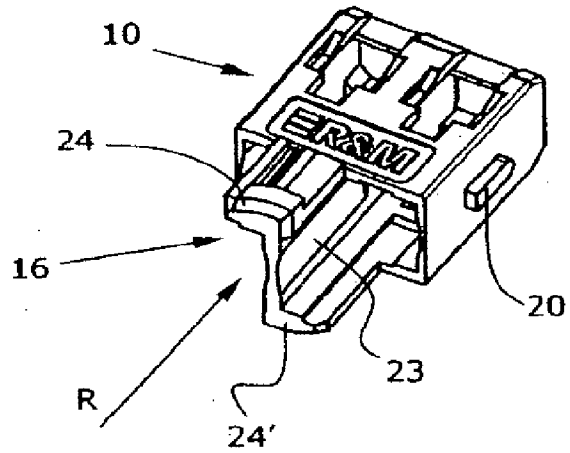


Fig. 3b

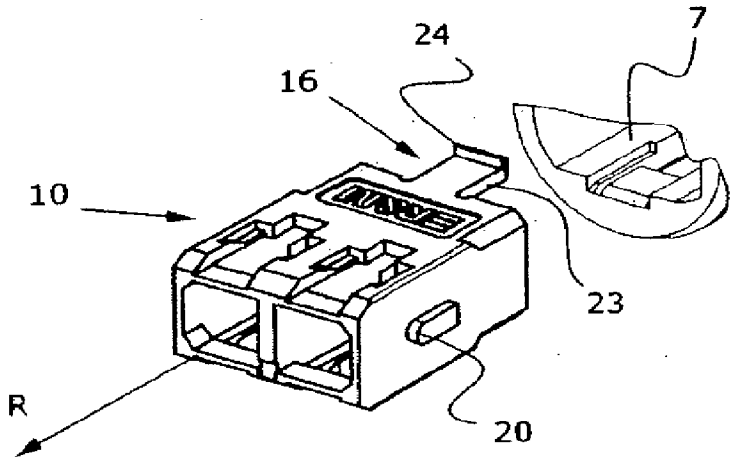


Fig. 3c

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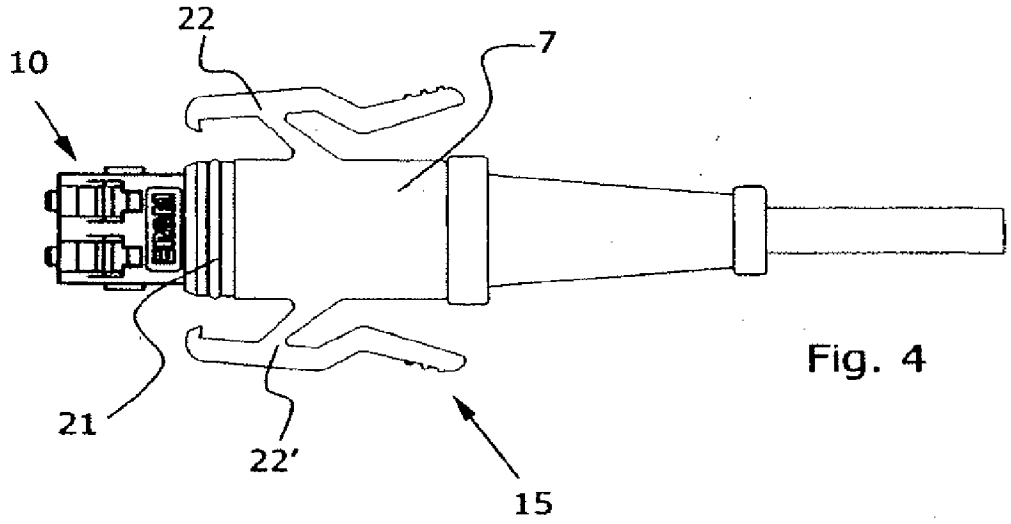


Fig. 4

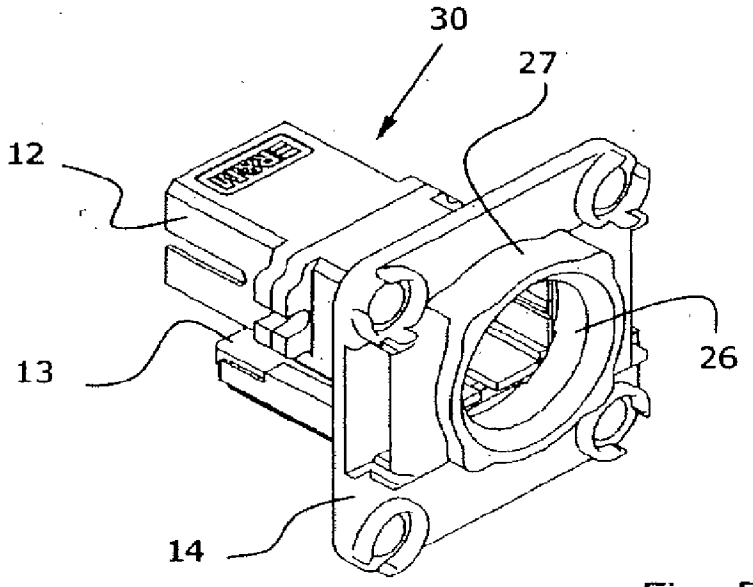


Fig. 5

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Europäisches Patentamt

EUROPÄISCHER RECHERCHENBERICHT

Nummer der Anmeldung
EP 04 00 3701

EINSCHLÄGIGE DOKUMENTE

Kategorie	Kennzeichnung des Dokuments mit Angabe, soweit erforderlich, der maßgeblichen Teile	Betrifft Anspruch	KLASSIFIKATION DER ANMELDUNG (Int.Cl.7)
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Y	* Spalte 8, Zeile 40 - Zeile 45 *	10	
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Y	* Spalte 9, Zeile 6 - Zeile 11 *	10	
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X	US 6 612 750 B1 (POTVIN STEEVE ET AL) 2. September 2003 (2003-09-02) * Zusammenfassung; Abbildungen 3,4,9 *	1-4,6-8	RECHERCHIERTE SACHGEBIETE (Int.Cl.7) G02B H01R
X	US 6 318 904 B1 (REICHLE HANS) 20. November 2001 (2001-11-20) * Zusammenfassung; Abbildung 2 * * Spalte 1, Zeile 4 - Spalte 2, Zeile 32 *	1-3,5,8	
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Der vorliegende Recherchenbericht wurde für alle Patentansprüche erstellt

Recherchenort	Abschlußdatum der Recherche	Prüfer
MÜNCHEN	28. Mai 2004	Blau, G

KATEGORIE DER GENANNTEN DOKUMENTE

X von besonderer Bedeutung allein betrachtet
Y von besonderer Bedeutung in Verbindung mit einer anderen Veröffentlichung derselben Kategorie
A technologischer Hintergrund
O nichtschriftliche Offenbarung
P Zwischenliteratur

T der Erfindung zugrunde liegende Theorien oder Grundsätze
E älteres Patentdokument, das jedoch erst am oder nach dem Anmeldedatum veröffentlicht worden ist
D in der Anmeldung angeführtes Dokument
L aus anderen Gründen angeführtes Dokument

& Mitglied der gleichen Patentfamilie, übereinstimmendes Dokument

1 EPO - FORM 1503 03.82 (P04C03)

ANHANG ZUM EUROPÄISCHEN RECHERCHENBERICHT ÜBER DIE EUROPÄISCHE PATENTANMELDUNG NR. EP 04 00 3701

In diesem Anhang sind die Mitglieder der Patentfamilien der im obengenannten europäischen Recherchenbericht angeführten Patentdokumente angegeben.
Die Angaben über die Familienmitglieder entsprechen dem Stand der Datei des Europäischen Patentamts am
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28-05-2004

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Für nähere Einzelheiten zu diesem Anhang : siehe Amtsblatt des Europäischen Patentamts, Nr 12/82

0375

(12) UK Patent Application (19) GB (11) 2 111 240 A

(21) Application No **8232452**
(22) Date of filing **12 Nov 1982**
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(33) **Fed. Rep. of Germany (DE)**
(43) Application published
29 Jun 1983
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G2J GEA
(56) Documents cited
GBA 2069170
GB 1549928
GB 1448975
GB 1149679
(58) Field of search
G2J
(71) Applicant
Allied Corporation (USA—New York), Morris County, New Jersey, United States of America
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(54) Connector for an optical fiber

(57) A connector (10) for an optical fiber (20) is provided with a fastening device (56) to hold the fiber in place. The fastening device is a sleeve (57) formed of soft metal which is crimped directly onto the fiber without damaging it. The soft metal is preferably formed of a soldering tin alloy of lead, or of another material of equivalent hardness. With this arrangement the optical fiber is not damaged even when very large crimping pressure is applied, as the soft metal will yield laterally, enabling secure fastening onto the fiber. This type of connector is especially suitable for plastic clad silicone (PCS) fibres.

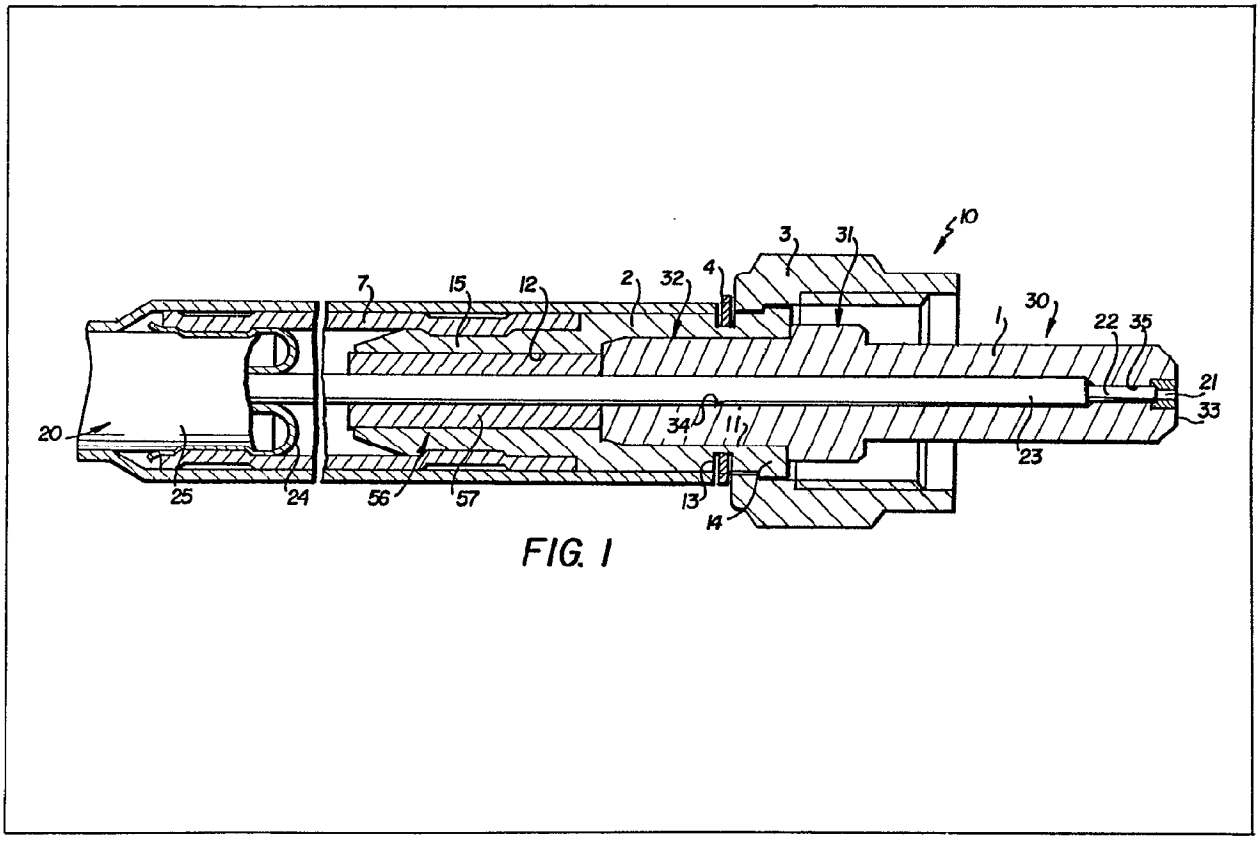


FIG. 1

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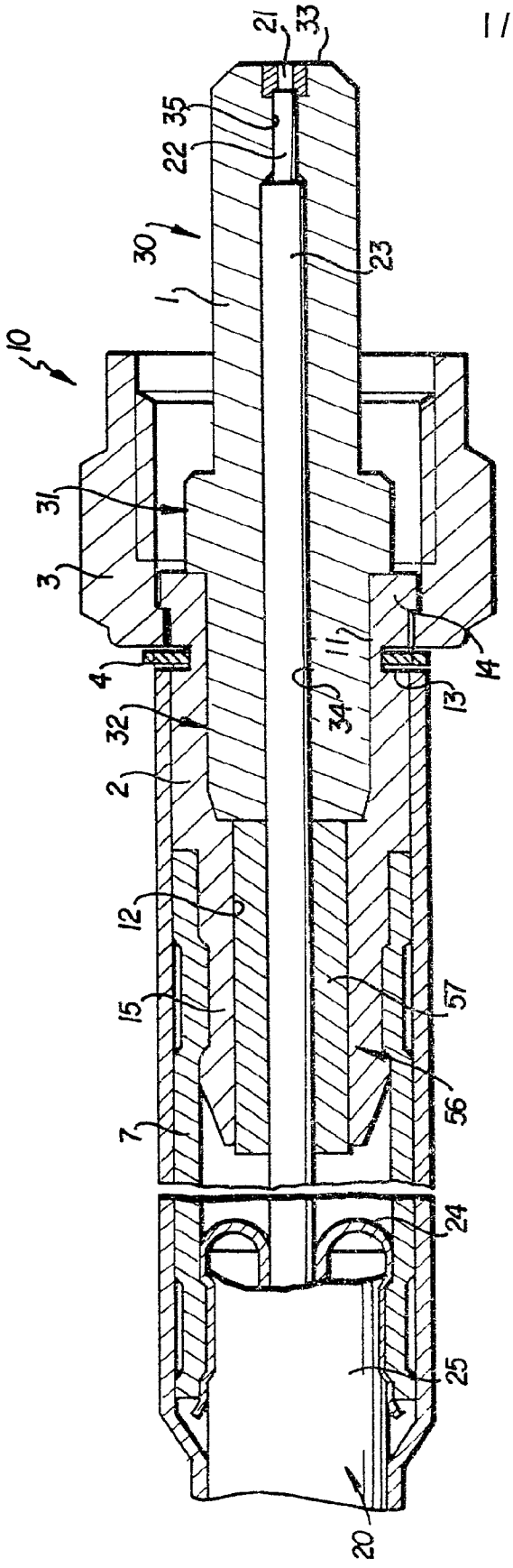


FIG. 1

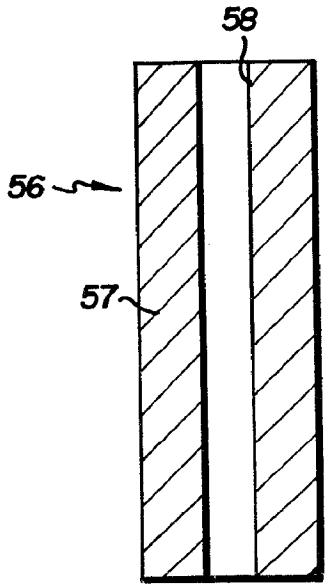


FIG. 2

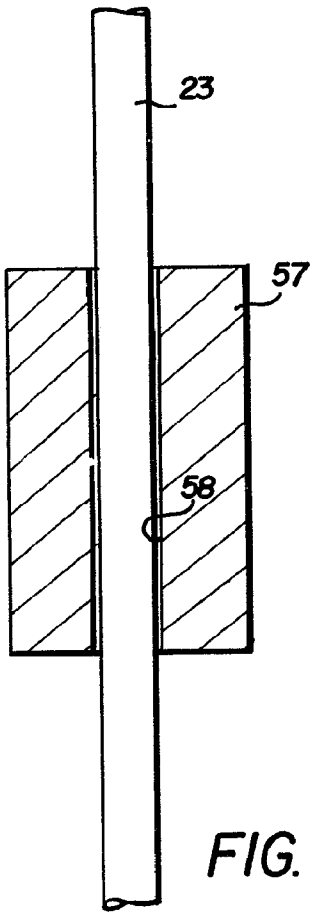


FIG. 3

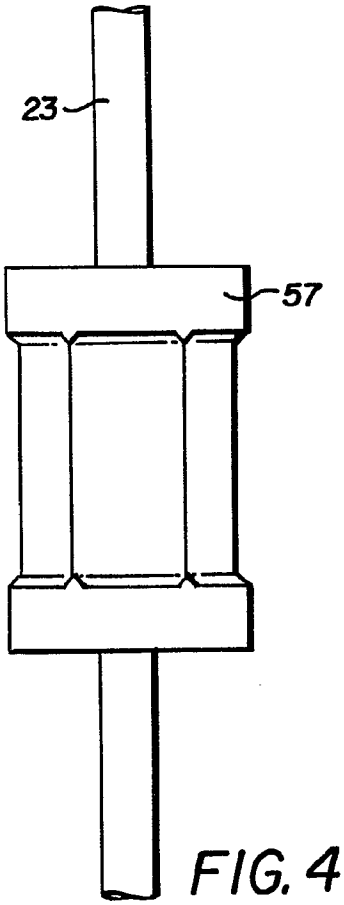


FIG. 4

SPECIFICATION

Connector for an optical fiber background of the invention

The invention concerns a connector for an optical fiber which is provided with a fastening device to hold the optical fiber in place and to prevent undesirable movement by the optical fiber.

The invention is particularly concerned with a connector for an optical fiber preferably made up of a core made of glass with a silicone coating as well as a plastic protective layer on the silicone coating with a guide element accommodating the optical fiber and a fastening device holding the core, the coating and the plastic protective layer of the optical layer in place by its clamping action, which in turn can be connected to the guide element.

West German Patent Application 29 43 180 describes an optical fiber connector using a fastening device made up of a collet and a clamping sleeve. The clamping sleeve and the collet form a so-called clamping cone connection with pressure applied primarily in a vertical direction on the longitudinal axis of the collet, thus pressing the collet somewhat together and holding the optical fiber sleeve against a plastic coating, since the clamping sleeve is set at the same time in a bore of the rear part of the guide element.

The arrangement and design of this already known fastening device is somewhat complicated. Particularly in the case of optical fibers with smaller diameters, in the range of 200 micrometers, this already known fastening device is difficult to use.

In the use of a connector pin that is already known, an optical fiber is centered and retained by clamping the fiber tight by means of crimping a crimp zone along an elastic clamping sleeve. Moreover, the optical fiber is centered by deforming the front end of the clamping sleeve. Specifically, there is either a light compression provided on the plastic coating or pressure into the plastic coating is used. Two parts are required for this already known connector pin arrangement in order to prevent damage to the optical fiber. Besides the elastic clamping sleeve, the external plastic, pliable crimp zone must be provided to assure lasting cohesive forces.

It would be desirable to provide a connector for an optical fiber which avoids the drawbacks of the present state of the art. In particular, it would be desirable to provide a connector for an optical fiber in such a way that retention of the optical fiber can be guaranteed with a minimum of components and to provide a fastening device that can be assembled at minimum costs.

Summary of the Invention

In accordance with this invention, there is provided a connector for an optical fiber having a core, a coating over the core and a protective layer over the coating, the connector comprising a guide element to receive the optical fiber which is held in place by the clamping effect of a fastening device, characterized in that the fastening device is formed of a sleeve made of soft metal which is crimped directly onto the optical fiber without damaging it.

Preferably the fastening device of this invention will be used with optical fibers having rigid cores, for example, out of glass, with a coating of softer material, for example, silicone, surrounding them. The use of the fastening device of this invention is especially preferred for an optical fiber with a glass core, a silicone coating and a protective layer, preferably of plastic, surrounding it, with the fastening device of this invention mounted on the aforementioned protective layer and compressed onto it so that any shifting or movement, particularly between the protective layer and the coated glass core, will be prevented.

According to the invention, the fastening device for an optical fiber in a connector is designed in such a way that an element having an axial bore and made of soft metal is provided, which after it is slipped onto the optical fiber, is crimped onto it without damaging it.

Brief Description of the Drawings

Fig. 1 shows a cross-section of a connector in accordance with the invention;

Fig. 2 shows a cross-section of the fastening device in accordance with the invention;

Fig. 3 shows a cross-section of the fastening device of this invention of the optical fiber before the crimping process;

Fig. 4 shows a view of the fastening device crimped onto the optical fiber.

Description of the Preferred Embodiments

Fig. 1 shows a connector 10 for an optical fiber 20. The optical fiber 20 includes the following: a core 21 of glass, for example, a coating 22 of silicone, for example, a protective layer 23 made of fluorocarbon resin, for example, a cover 24 made of a meshed material to relieve tensile pressure, with the cover 24 surrounded by an outer cover 25.

The connector 10 also has a connector element (guide element) made up of a front part 1 and a rear part 2. Starting from a flat polished front surface 33, the front part 1 has a bore 35 with a diameter equal to or somewhat smaller than the outer diameter of the coating 22. The bore 35 is connected to an additional bore 34 with a diameter equal to the outer diameter of the protective layer 23. The core 21 is pressed with the coating 22 into the bore 35 while in the area of the bore 34 a retention of the protective layer 23 with the bore is achieved by adhesion. The front part 1 is basically cylindrical in design and includes a forward plug area 30, a central impact or contact area of a larger diameter 31 and an area 32 with an intermediate diameter.

The rear part (hereinafter called back portion) 2 accommodates the front part 1 (hereinafter called front portion) in a bore 11 inserted into the back

portion 2. Bore 11 has a diameter equal to that of area 32. The bore 11 continues along the longitudinal axis of the back portion 2 in a bore 12 having a smaller diameter which equals the outer diameter of the fastening device 56 (hereinafter called mounting device) described below. On its outer surface the back portion 2 has a groove 13 which accommodates a locking ring. A coupling nut 3, used for connection with a matching connector (not shown), is retained by the locking ring 4 and the rim area 14 with a larger diameter on the back portion 2. The front portion 1, the back portion 2, the locking ring 4 and the coupling nut 3 can be manufactured in advance as a single unit or can be assembled in its individual parts with the front portion 1 being pressed tightly into the back portion 2 of the connector element. Primarily in the area of the bore 12, the back portion 2 has a cylindrical area 15 which has a smaller diameter equal to that of the crimp sleeve 7 described below and is beveled down at its open end. Details regarding the crimp sleeve 7 and its arrangement are described in the aforementioned German Patent Application 29 43 180.

The mounting device 56 provided as per the invention is made up of a mounting sleeve 57 of soft metal which is depicted in Figs. 2 to 4. By way of example, soldering tin or lead may be considered as the soft metal. It is also possible to use, for example, a plastic as long as it possesses the characteristics of a soft metal such as, for example, lead or soldering tin. The mounting sleeve 57 is preferably circular and cylindrical in design and has a bore 58 going in the longitudinal direction through which the optical fiber can pass. Preferably the soft metal sleeve 57 is slipped onto the protective layer 23 and then crimped; this can be done with a tool such as a crimper, for example. Preferably it is crimped in the middle area of the sleeve 57, so that it is possible for the soft metal to yield without difficulty on both sides in an axial direction. By using a mounting device as per the invention, an extraordinarily uniform pressure is applied onto the optical fiber so that the optical fiber is not damaged even when relatively enormous crimping pressure is applied since the soft metal will consistently yield laterally.

Since the mounting sleeve 57 preferably should be made to adhere on its outer surface to the surface of the bore 12, the outer surface of the mounting sleeve 57 is preferably smooth and cylindrical in its crimped state, as shown in Fig. 4, and not deformed with edges.

In Fig. 3 the mounting sleeve 57 is shown positioned on the optical fiber before crimping pressure is applied while in Fig. 4 the crimping process has been carried out and the mounting sleeve 57 makes it impossible from this point on for the optical fiber core 21, the optical fiber coating 22 and the optical fiber protective layer 23 to shift or move with relation to each other. By using a single mounting sleeve 57 of soft metal it is thus possible to assure a principal retention of the optical fiber. For that matter, the protective layer 23, frequently made of a fluorocarbon polymer, is roughened and is made to adhere to the front portion so that a sure retention results; however, despite this, the coating 22 made of silicone continues to provide the protective layer 23 with a sliding capacity.

The mounting device of this invention is especially advantageous when used in conjunction with the so-called PCS (plastic clad silicone) fibers, but it can also be used as a supplementary retaining element with other optical fibers and/or glass fibers.

According to the invention the mounting sleeve 57 is made of soft metal, e.g. a soldering tin alloy or lead. Pure aluminum and copper are not acceptable as the material for the mounting sleeve. As will be explained below, the material for the mounting sleeve 57 must be selected, taking into account its softness (physical adaptability in shape), in such a way that the maximum compression strength of the protective layer of the optical fiber, made for example out of fluorocarbon resin, is not exceeded during the crimping process. The softness of the material used in the mounting sleeve 57 makes it possible to crimp a large range of fiber diameters. Accordingly, only one single mounting sleeve size is necessary for a variety of fiber strengths. In contrast to this, the design described in the aforementioned application uses various models of clamping sleeves and collets.

Preferably, the mounting sleeve 57 is crimped using standard hexagonal wedges, but it can also be done with other crimpers that are conventionally used. The softness of the material for the mounting sleeve 57 prevents damage to the optical fiber, particularly a PCS fiber. With regard to the softness or hardness of the material used for the mounting sleeve 57 a compromise is provided insofar as the PCS fibers in particular and the optical fibers in general are not damaged, but on the other hand, the cohesive forces are so great that they are limited by the tearing strength of the protective layer, made of fluorocarbon resin for example, and not by the mounting sleeve per se.

The mounting sleeve can be used effectively and inexpensively not only with PCS fibers but also with all covered optical fibers in order to improve the tensile strengths of the fibers compared to the pure adherence (mounting) used conventionally otherwise.

Moreover, the mounting sleeve is also suitable for solving mounting and retaining problems in other technical equipment, for example in spliced connections.

The invention not only makes possible saving in parts but also a low-cost, problem-free assembly and relatively greater safety, even when assembled by non-professionals.

According to the invention, the mounting sleeve 57 is made of a soft metal. The concept of soft metal for the purpose of this invention is defined as follows:

Most metals have the capacity of permanent plastic deformation when forces are applied to them. Metals are designated as "soft" when the

shaping force required to shape the metal is slight. The present invention uses such soft metals to mount or fasten optical fibers, particularly optical fibers with a protective layer 23, with the soft metal used in such a way, moreover, that it does not damage, but rather compresses the optical fiber and its protective layer 23 during its plastic cold forming (and even afterwards).

Of the pure metals, lead with a hardness (HB/HV of 1.5 kg/mm^2) and an elasticity value (E equals 1600 kg/mm^2) is especially taken into consideration. According to the invention, in particular alloys of lead and tin can also be used, such as for example the soldering tin alloys commercially available. Preferably the hardness, (HB/HV) in kg/mm^2, should be in the hardness range of lead. But is is also possible to use hardnesses of higher values as long as the optical fiber and/or its protective layer 23 and/or its coating 24 are not damaged.

According to the invention, the reshaping process brought about by crimpoing is the result of cold forming with the mounting sleeve 57 being stressed beyond its elasticity limit, which flows and thus surrounds and retains the optical fiber uniformly without damaging it. Thus, in general the invention provides for the use of a soft metal alloy, particularly of lead and tin. But other alloys can also be used, such as for example alloys of copper and aluminum, as long as their hardness is of a sufficiently low value so there is no possibility of damaging the optical fiber. The following approximate ranges of hardness, given in HB/HV kg/mm^2, are preferred: 1.5 to 2.0; 1.5 to 5.0; 1.5 to 10; 1.5 to 20. During the crimping process the mounting sleeve 57 can penetrate the protective layer without destroying it. Preferably the mounting sleeve 57 will penetrate both into the protective layer 23 and into the coating 22 for the purpose of retaining or fastening the optical fiber, without destroying in any way the coating or protective layer, i.e. disrupting them.

As was already mentioned, the measures provided for in the invention are especially advantageous in the case of optical fibers with small diameters, for example in the diameter range of 200 micrometers to 600 micrometers, and here again preferably for PCS fibers. A typical example of PCS fiber has, for example, a core diameter of 400 micrometers, a core plus coating diameter of 560 micrometers and a core plus coating plus protective layer diameter of 900 micrometers.

CLAIMS

1. A connector for an optical fiber having a core, a coating over the core and a protective layer over the coating, the connector comprising a guide element to receive the optical fiber which is held in place by the clamping effect of a fastening device, characterized in that the fastening device is formed of a sleeve made of soft metal which is crimped directly onto the optical fiber without damaging it.

2. A connector in accordance with claim 1 wherein said soft metal is selected in such a way that it is deformed primarily in the plastic range so that damage to the optical fiber during the crimping process is prevented.

3. A connector in accordance with claim 2, wherein the optical fiber is made of glass.

4. A connector in accordance with claim 3 wherein the coating is made of a silicone material and the protective layer is made of a plastic material.

5. A connector in accordance with claim 4 wherein the sleeve is pressed directly onto the protective layer of the optical fiber.

6. A connector in accordance with claim 1 wherein said soft metal comprises a soldering tin alloy.

7. A connector in accordance with claim 1 wherein said soft metal comprises lead.

8. A connector in accordance with claim 1 wherein said soft metal comprises a lead-tin alloy.

9. A connector in accordance with claim 1 wherein said soft metal is a copper alloy.

10. A connector in accordance with claim 1 wherein said soft metal is an aluminum alloy.

11. A connector in accordance with claim 1 wherein the hardness of the soft metal (HB/HV) is in the range of 1.5 to 20 kg/mm^2.

12. A connector in accordance with claim 1 wherein the sleeve is crimped along its entire length onto the optical fiber.

13. A connector in accordance with claim 4 wherein the sleeve is crimped along its entire length onto the optical fiber and, once it is crimped, penetrates into the coating and/or protective layer without disrupting the coating and/or protective layer.

14. A connector in accordance with claim 4 wherein said protective layer is formed of a fluorocarbon resin.

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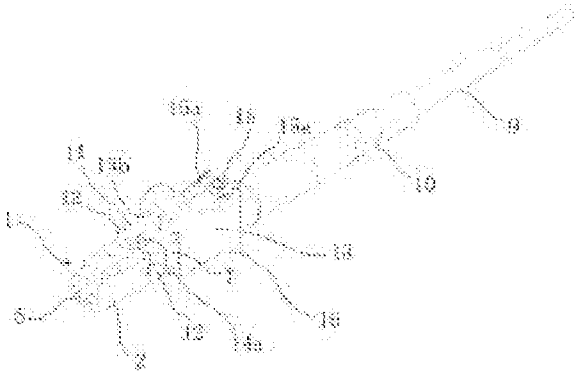
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OPTICAL CONNECTOR PLUG

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Abstract of JP2009229545 (A)

PROBLEM TO BE SOLVED: To provide an optical connector plug in which a release lever is easily operated, without using a tool even when it is mounted at a high density. ; SOLUTION: The optical connector plug comprises a release lever 11 which is furnished with an engaging piece 12 for engaging with an adapter P; a slider 13 mounted movably in a regulated range in the axial direction of the plug main body 1, wherein the slider 13 is pressurized to and engaged with the rear end of the release lever 11. The plug body 1 is mounted on the adapter P, by moving the slider 13 in the direction of the adapter P, wherein the release lever 11 is moved downward by the guide of the adapter P together with the engaging piece 12, and the engaging piece 12 and the adapter P are engaged. Furthermore, the plug body 1 is pulled out of the adapter P by moving the slider 13 in the pulling-out direction, wherein a release piece 11a of the rear end part of the release lever 11 is pressed down against the tapered face 13a of the slider 13 so that thus the engaging piece 12 and the adapter P are disengaged. ; COPYRIGHT: (C) 2010,JPO&INPIT



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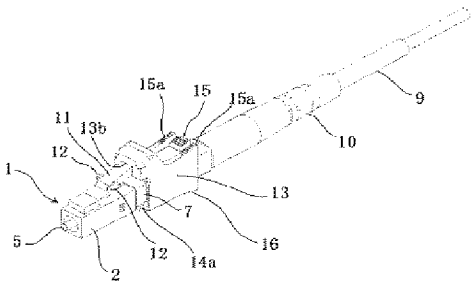
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(54)【発明の名称】光コネクタプラグ

(57)【要約】
【課題】高密度実装時にも工具を使用せずに、解除レバーを容易に操作することができる光コネクタプラグを提供する。
【解決手段】アダプタＰと係合するための係止片１２を具備して成る解除レバー１１と、プラグ本体１の軸方向の規制範囲に移動可能に装着したスライダ１３とを備え、該スライダ１３は解除レバー１１の後端部に押圧可能に係合して成る。プラグ本体１は、アダプタＰへの装着時にスライダ１３をアダプタＰ方向に移動することで、解除レバー１１は、係止片１２と共にアダプタＰのガイドによって下方へ変位し、係止片１２とアダプタＰが係合可能となる。また、プラグ本体１は、アダプタＰからの抜脱時にスライダ１３を抜脱方向に移動することで、スライダ１３のテーパー面１３ａで解除レバー１１の後端部の解除片１１ａを押し下げ、係止片１２とアダプタＰの係合を解除する。
【選択図】図２



【特許請求の範囲】
【請求項1】
プラグ本体の長手方向の一面に前方から後方に向かって形成され、アダプタと係合するための略中央に係止片を備え、且つ後端部に解除片を備えて成る解除レバーと、ストッパによってプラグ本体の軸方向の規制範囲に移動可能に装着されたスライダとを備え、該スライダは解除レバーの解除片に押圧可能に係合するテーパー面を有していることを特徴とした光コネクタプラグ。
【請求項2】
解除レバーは、プラグ本体のアダプタへの装着時に係止片と共にアダプタのガイドによって下方へ変位し、係止片とアダプタが係合可能となるものとし、アダプタからの抜脱時にスライダを抜脱方向に移動させることでスライダのテーパー面で解除レバーの解除片を押し下げ、係止片とアダプタの係合が解除された後、ストッパに移動が規制され、スライダがアダプタから抜脱されると同時に解除レバーの弾性力によりプラグ本体および解除レバーは初期位置に復帰するものとした請求項１記載の光コネクタプラグ。
【請求項3】
ストッパの位置は、スライダの移動により、係止片とアダプタとの係合が外れた位置よりも少なくとも後方に配置させるものとし、スライダを後方の抜脱方向に移動操作した際には、スライダは後側に位置するストッパに移動が規制され、プラグ本体を後方へ作用させる力が発生して、アダプタからのプラグ本体の抜脱を可能にし、スライダを前方の装着方向に移動操作した際には、スライダは前側に位置するストッパに移動が規制され、プラグ本体を前方へ作用させる力が発生して、アダプタへのプラグ本体の装着を可能にした請求項１記載の光コネクタプラグ。
【請求項4】
スライダの後方端の少なくとも上下いずれかには、操作時に把持するための凸形状の操作部を備えている請求項１乃至３のいずれか記載の光コネクタプラグ。
【請求項5】
スライダの操作部には、当該スライダを後方のコード側で操作可能とする引抜タブが着脱可能に装着されるものとした請求項４記載の光コネクタプラグ。
【請求項6】
引抜タブは、スライダの操作部にセットするための大径のセット穴と、当該操作部に固定するための小径の固定穴と、凹凸状の把持部とを備えて成る請求項５記載の光コネクタプラグ。

【発明の詳細な説明】
【技術分野】
【0001】
本発明は、光ファイバを接続するときに用いられる解除レバー付の光コネクタプラグに係り、アダプタに対する装着および抜脱の操作性を向上させた光コネクタプラグに関する。
【背景技術】
【0002】
従来、この種の光コネクタプラグは、そのプラグハウジングの外周面に、アダプタとの係合およびその解除を行うためのラッチが一体的に設けられている。このラッチは、プラグハウジングの先端部から後端部に向かって徐々にプラグハウジング外表面から離れるように傾斜して延設されている。この光コネクタプラグがアダプタに装着されている場合、当該アダプタの後端にラッチが僅かに突出する。そして、アダプタから光コネクタプラグを抜脱する際には、このラッチを指先で直接押し下げて係合を解除する。
【0003】
また、光コネクタプラグは、その本体フレーム側に、ラッチの後端部に係合させたラッチ解除部材を別個に設け、このラッチ解除部材を介して間接的にラッチを押し下げてアダプタに対する係合を解除することもある。

【0004】
さらに、特許文献１に開示されているように、光コネクタプラグを保持するハウジング内に軸方向移動自在に設けられたラッチ解除部材を具備し、ハウジングをアダプタ側に移動することにより光コネクタプラグをアダプタに挿入してラッチをアダプタに係合することができ、一方、ハウジングを逆方向に移動することにより、ラッチ解除部材がハウジングに対して前方側に相対移動してラッチの後端部を押圧してアダプタとの係合を解除できるものとした光コネクタ組立体なる技術が存在する。
【特許文献1】特開２００１－１４１９６１号公報
【発明の開示】
【発明が解決しようとする課題】
【0005】
近年においては、光コネクタの高密度実装が求められることから、アダプタからの光コネクタプラグの抜脱時にラッチ解除部材でアダプタに対するラッチの係合を解除する小型の光コネクタプラグが出現している。しかしながら、小型故にラッチ解除部材の操作が困難になり、工具を使用しないと光コネクタプラグの抜脱ができない状況が発生している。
【0006】
すなわち、上記した従来技術で示したように、アダプタの後端に僅かに突出している光コネクタプラグのラッチを指先で直接押し下げて係合を解除するか、あるいはラッチ解除部材を介して間接的にラッチを押し下げて係合を解除しなければならないため、特に高密度実装では操作性が悪いものとなる。
【0007】
また、特許文献１による技術では、ハウジングの部材だけ部品点数が多くなることから、構造が複雑となり、また大型且つ高コストとなる。したがって、これも高密度実装には適さないものである。
【0008】
そこで、本発明は、叙上のような従来存した諸事情に鑑み創出されたもので、高密度実装時にも特別な工具を使用せずに、解除レバーを容易に操作することができる小型の光コネクタプラグを提供することを目的とする。
【課題を解決するための手段】
【0009】
上述した課題を解決するため、本発明にあっては、プラグ本体の長手方向の一面に前方から後方に向かって形成され、アダプタと係合するための略中央に係止片を備え、且つ後端部に解除片を備えて成る解除レバーと、ストッパによってプラグ本体の軸方向の規制範囲に移動可能に装着されたスライダとを備え、該スライダは解除レバーの解除片に押圧可能に係合するテーパー面を有していることを特徴としている。
【0010】
解除レバーは、プラグ本体のアダプタへの装着時に係止片と共にアダプタのガイドによって下方へ変位し、係止片とアダプタが係合可能となるものとし、アダプタからの抜脱時にスライダを抜脱方向に移動させることでスライダのテーパー面で解除レバーの解除片を押し下げ、係止片とアダプタの係合が解除された後、ストッパに移動が規制され、スライダがアダプタから抜脱されると同時に解除レバーの弾性力によりプラグ本体および解除レバーは初期位置に復帰するものとなっている。
【0011】
ストッパの位置は、スライダの移動により、係止片とアダプタとの係合が外れた位置よりも少なくとも後方に配置させるものとし、スライダを後方の抜脱方向に移動操作した際には、スライダは後側に位置するストッパに移動が規制され、プラグ本体を後方へ作用させる力が発生して、アダプタからのプラグ本体の抜脱を可能にし、スライダを前方の装着方向に移動操作した際には、スライダは前側に位置するストッパに移動が規制され、プラグ本体を前方へ作用させる力が発生して、アダプタへのプラグ本体の装着を可能となっている。

【0012】
スライダの後方端の少なくとも上下いずれかには、操作時に把持するための凸形状の操作部を備えている。
【0013】
スライダの操作部には、当該スライダを後方のコード側で操作可能とする引抜タブが着脱可能に装着されるものとなっている。
【0014】
引抜タブは、スライダの操作部にセットするための大径のセット穴と、当該操作部に固定するための小径の固定穴と、凹凸状の把持部とを備えて成るものとなっている。
【発明の効果】
【0015】
本発明によれば、高密度実装時にも工具を使用せずに、解除レバーを容易に操作することができる。
【0016】
すなわち、本発明は、プラグ本体の長手方向の一面に前方から後方に向かって形成され、アダプタと係合するための略中央に係止片を備え、且つ後端部に解除片を備えて成る解除レバーと、ストッパによってプラグ本体の軸方向の規制範囲に移動可能に装着されたスライダとを備え、該スライダは解除レバーの解除片に押圧可能に係合するテーパー面を有しているので、スライダの前後方向への移動操作のみによって解除レバーを容易に操作することができる。したがって、小型高密度実装による光コネクタプラグであってもその操作性が著しく向上するものとなる。
【0017】
解除レバーは、プラグ本体のアダプタへの装着時に係止片と共にアダプタのガイドによって下方へ変位し、係止片とアダプタが係合可能となるものとし、アダプタからの抜脱時にスライダを抜脱方向に移動させることでスライダのテーパー面で解除レバーの解除片を押し下げ、係止片とアダプタの係合が解除された後、ストッパに移動が規制され、スライダがアダプタから抜脱されると同時に解除レバーの弾性力によりプラグ本体および解除レバーは初期位置に復帰するものとしたので、小型高密度実装による光コネクタプラグのアダプタに対し、プラグ本体を容易且つ確実に装着させることができる。
【0018】
ストッパの位置は、スライダの移動により、係止片とアダプタとの係合が外れた位置よりも少なくとも後方に配置させるものとし、スライダを後方の抜脱方向に移動操作した際には、スライダは後方に位置するストッパに移動が規制され、プラグ本体を後方へ作用させる力が発生して、アダプタからのプラグ本体の抜脱を可能にし、スライダを前方の装着方向に移動操作した際には、スライダは前側に位置するストッパに移動が規制され、プラグ本体を前方へ作用させる力が発生して、アダプタへのプラグ本体の装着を可能にしたので、小型高密度実装による光コネクタプラグのアダプタに対し、プラグ本体をワンタッチで且つスムーズに抜脱させることができる。
【0019】
スライダの後方端の少なくとも上下いずれかには、操作時に把持するための凸形状の操作部を備えているので、該操作部を指先で操作するだけで、スライダの前後方向への移動がスムーズに行える。したがって、小型高密度実装時における光コネクタプラグであっても、その操作性が著しく向上するものとなる。
【0020】
スライダの操作部には、当該スライダを後方のコード側で操作可能とする引抜タブが着脱可能に装着されるものとしたので、該引抜タブを指先で操作するだけで、スライダの後方向への移動がスムーズに行える。したがって、小型高密度実装による光コネクタプラグであっても、その操作性が著しく向上するものとなる。
【0021】
引抜タブは、スライダの操作部にセットするための大径のセット穴と、当該操作部に固

定するための小径の固定穴と、凹凸状の把持部とを備えて成るので、スライダの操作部に対する引抜タブの取り付けまたは取り外しが容易に行える。

【発明を実施するための最良の形態】

【0022】

以下、図面を参照して本発明に係る光コネクタプラグを実施するための最良の一形態について詳細に説明する。

【0023】

本発明に係る光コネクタプラグは、例えばＬＣ型のプラグ本体１によって構成されており、該プラグ本体１は、図１、図５（ａ）、図５（ｂ）に示すように、比較的高強度なプラスチックから成るカップリングスリーブ２と、このカップリングスリーブ２内にフェルール用チューブ３およびフェルールフレーム４から成るフェルール５と、フェルールフレーム４の後端部外周に装着されるスプリング６と、このスプリング６を介してフェルールフレーム４の後端部に嵌合するプラスチック製の本体フレーム７とを具備する。

【0024】

プラグ本体１を組み立てる場合には、図１に示すように、このカップリングスリーブ２に、フェルール５、スプリング６、本体フレーム７それぞれを順次挿入し、本体フレーム７の係止爪をカップリングスリーブ２の係止穴に係合することによって本体フレーム７がカップリングスリーブ２に固定され、フェルール５はカップリングスリーブ２内にスプリング６を介して軸方向前方に付勢保持される。また、本体フレーム７の後方には、光ファイバを保護して変形による断線等を防止するためのカシメリング８を備えた熱収縮チューブ９とブーツ１０が取り付けられる。

【0025】

また、図２、図３、図４（ａ）乃至（ｅ）、図５（ａ）、図５（ｂ）に示すように、カップリングスリーブ２の外周面には、アダプタＰとの係合およびその解除を行うための、幅方向両側面の略中央に係止片１２を備え、且つ後端の左右対称位置に軸方向に対して横向きに突出した一対の解除片１１ａを備えた解除レバー１１がカップリングスリーブ２上部に一体的に設けられている。

【0026】

この解除レバー１１は、プラグ本体１のカップリングスリーブ２の長手方向の一面において、先端部から後端部に向かって徐々にカップリングスリーブ２外表面から離れるように傾斜して延設されており、その後端部の左右一対の解除片１１ａは、後述するようにスライダ１３の開口部１３ｂ内側の左右対称位置にあるテーパー面１３ａに当接するよう当該テーパー面１３ａとは相補的な関係となっている。

【0027】

また、本体フレーム７の外周面にはハウジング状のスライダ１３が装着され、図２および図３に示すように、本体フレーム７の両側面における前側に設けたストッパ１４ａと後側に所定の間隔を置いて設けたストッパ１４ｂとによってスライダ１３の軸方向移動が規制されている。

【0028】

このスライダ１３は、図４（ａ）乃至（ｅ）、図５（ａ）に示すように、上面の前端側が若干斜め前方に向けて隆起され、この隆起した内側が本体フレーム７に面する上側において、解除レバー１１が軸方向に対して略直角方向に変位可能とする空間を形成すべく略コ字形アーチ状となった開口部１３ｂが前後方向に貫設され、該開口部１３ｂ内側の左右対称部分は本体フレーム７先端側に向けて傾斜したテーパー面１３ａとなっている。このテーパー面１３ａに前記解除レバー１１の傾斜した後端部における左右一対の解除片１１ａが係合される。尚、図示例では、スライダ１３上部の開口部１３ｂは前後方向に貫設されているが、後側を閉塞する構成を採用することもできる。

【0029】

また、図２、図３、図４（ｄ）、図５（ａ）、図５（ｂ）に示すように、スライダ１３の開口部１３ｂ後側には隆起位置から後方に向かって末広がりとなった左右一対の突壁面

状の把持部１５ａが延設され、且つ、左右の把持部１５ａの間には、スライダ１３操作時に指先で把持するための凸形状の操作部１５を備えている。これら操作部１５および把持部１５ａの上面には滑り止め用のローレット目が形成されている。尚、これら操作部１５および把持部１５ａは、スライダ１３の上方側のみに形成されているが、下方側のみ、もしくは上下両側に形成されていても良い。

【0030】

この操作部１５は、上部である頭部が幅広であって、下部である根元部分が前方および側面が括れており、この操作部１５には、後述する引抜タブ１７がセット穴１８を介して、前方括れ部分に引っ掛けるようにして装着される（図１０（ａ）、図１０（ｂ）、図１１（ａ）、図１１（ｂ）参照）のであるが、このとき、左右一対の把持部１５ａによって引抜タブ１７の左右両側縁が挟み込まれることで当該引抜タブ１７の回転が規制されるものとなっている。また、この操作部１５に対応してスライダ１３下面の後端部には、図４（ｅ）に示すように、若干小さな傾斜をもって断面略スカート形の突起状となった下側操作部１６が形成されている。

【0031】

そして、図８（ｂ）に示すように、プラグ本体１はアダプタＰに装着されるものであるが、この装着時には、図８（ａ）に示すように、上記した解除レバー１１の係止片１２によってプラグ本体１とアダプタＰとが係合されるようになっている。

【0032】

すなわち、解除レバー１１は、プラグ本体１のアダプタＰへの装着時には、図９（ａ）乃至（ｄ）に示すように、係止片１２がアダプタＰのプラグ挿入孔のガイドによって押圧され、当該係止片１２と共に下方へ変位しながら装着される。そして、アダプタＰのガイド奥側に上方に向けて形成されている段差に係止片１２が弾性的に係止されることで、係止片１２とアダプタＰが係合可能となる。

【0033】

また、このアダプタＰへの装着に際し、プラグ本体１を直接操作する替わりに、スライダ１３を介して間接的に操作しても良い。この場合、スライダ１３をアダプタＰ方向に移動するとストッパ１４ａに移動が規制されてプラグ本体１はアダプタＰに装着可能となり、係止片１２と解除レバー１１はアダプタＰのガイドにより下方へ変位し、係止片１２とアダプタＰが係合する。このとき、図８（ａ）、図８（ｂ）、図９に示すように、アダプタＰのプラグ挿入孔には、内側に向けて前記段差を有するガイドが形成されており、このガイドの段差に係止片１２が係入される。

【0034】

一方、プラグ本体１のアダプタＰからの抜脱時には、図９（ｅ）乃至（ｇ）に示すように、スライダ１３を抜脱方向に移動するとスライダ１３のテーパー面１３ａで解除レバー１１の前記解除片１１ａを押し下げることで、係止片１２とアダプタＰの係合が解除される。

【0035】

このとき、ストッパ１４ｂの位置は、スライダ１３の移動により、係止片１２とアダプタＰとの係合が外れた位置よりも少なくとも後方にあるため、スライダ１３を後方の抜脱方向に移動操作した際には、スライダ１３はストッパ１４ｂに移動が規制され、プラグ本体１を後方へ作用させる力が発生し、したがって、アダプタＰからのプラグ本体１の抜脱が可能となる。

【0036】

一方、スライダ１３を前方の装着方向に移動操作した際には、スライダ１３はストッパ１４ａに移動が規制され、プラグ本体１を前方へ作用させる力が発生し、したがって、アダプタＰへのプラグ本体１の装着が可能となる。

【0037】

また、図９（ｇ）、図７（ａ）、図７（ｂ）に示すように、スライダ１３はアダプタＰから抜脱されると同時に解除レバー１１の弾性力により初期位置に復帰する。

【0038】
図６（ａ）に示すように、係止片１２と解除レバー１１はカップリングスリーブ２上面の前端側に形成され、一方のストッパ１４ａは本体フレーム７両側面の前端側下縁部に各形成され、他方のストッパ１４ｂは本体フレーム７両側面の後端側中央部に各形成されている。
【0039】
あるいは、図６（ｂ）に示すように、プラグ本体１として、本体フレーム７を使用せずに、カップリングスリーブ２を後方に向けて延長させることで、係止片１２と解除レバー１１はカップリングスリーブ２上面の前端側に形成され、一方のストッパ１４ａは同じくカップリングスリーブ２両側面の略中央側下縁部に各形成され、他方のストッパ１４ｂは同じくカップリングスリーブ２両側面の後端側中央部に各形成されていても良い。
【0040】
また、図１０（ａ）、図１０（ｂ）、図１１（ａ）、図１１（ｂ）に示すように、スライダ１３の操作部１５には、当該スライダ１３を後方のコード側で操作可能とする帯板状の引抜タブ１７を装着可能にしてあり、この引抜タブ１７を抜脱方向に移動させることでスライダ１３が連動して抜脱方向に移動するようにしてある。
【0041】
すなわち、図１０（ａ）、図１０（ｂ）に示すように、引抜タブ１７の一端側には、スライダ１３の操作部１５の頭部を挿入するためのセット穴１８と、操作部１５の括れた前方根元部分を中央のスリット部２０を介して挿入し引っ掛けるようにして固定するための固定穴１９とが形成され、両穴１８、１９は当該スリット部２０を介して連設されている。この場合、操作部１５の頭部下側の括れ部分に対して固定穴１９の方が若干大きな形状となっており、且つ操作部１５の頭部に対してセット穴１８の方が若干大きな形状となっており、したがって固定穴１９と頭部下側の括れた部分とが嵌合する。
【0042】
また、図１０（ａ）、図１０（ｂ）に示すように、引抜タブ１７の他端側上面には凹凸状のローレット目による把持部２１を形成してある。さらに、引抜タブ１７の下面略中央には、Ｃリング状のフック２２が形成され、引抜タブ１７自体が光コードの曲がりに追従して当該光コードに取り付けられるようにしてある。なお、引抜タブ１７の上面略中央には、対象となるプラグ本体１の種別を明記したラベルを貼付するためのラベル貼付エリア２３を備えている。
【0043】
次に、以上のように構成された本発明・光コネクタプラグの最良の形態についての使用の一例について詳細に説明する。
【0044】
プラグ本体１のアダプタＰへの装着時には、図９（ａ）乃至（ｄ）に示すように、スライダ１３の操作部１５を指先でもってアダプタＰ装着方向に移動する。このとき、操作部１５はストッパ１４ａによって移動が規制され、アダプタＰ内にプラグ本体１が移動する。これと同時に、解除レバー１１は係止片１２と共にアダプタＰのガイドによって下方へ変位して係止片１２とアダプタＰが係合されることでプラグ本体１がアダプタＰに装着される。
【0045】
一方、プラグ本体１のアダプタＰからの抜脱時には、図９（ｅ）乃至（ｇ）に示すように、スライダ１３の操作部１５を指先でもって抜脱方向に移動する。このとき、スライダ１３のテーパー面１３ａで解除レバー１１の後端部における解除片１１ａを押し下げることで、係止片１２とアダプタＰの係合が解除される。さらにスライダ１３を抜脱方向に移動するとストッパ１４ｂに移動が規制され、アダプタＰからのプラグ本体１の抜脱が可能となる。また、図９（ｇ）に示すように、スライダ１３はアダプタＰから抜脱されると同時に解除レバー１１の弾性力により当該スライダ１３自体は初期位置に復帰する。
【0046】

また、図１０（ａ）、図１０（ｂ）、図１１（ａ）、図１１（ｂ）に示すように、スライダ１３を後方のコード側で操作できるようにするためには、スライダ１３の操作部１５に引抜タブ１７を装着する。そして、プラグ本体１のアダプタＰからの抜脱時には、この引抜タブ１７を指先でもって抜脱方向に移動させることでスライダ１３は連動して同じ抜脱方向に移動され、スライダ１３のテーパー面１３ａで解除レバー１１の後端部における解除片１１ａを押し下げることで、係止片１２とアダプタＰの係合が解除される。

【図面の簡単な説明】

【0047】

【図1】本発明を実施するための最良の形態における光コネクタプラグの分解斜視図である。

【図2】同じく組立後の光コネクタプラグの斜視図である。

【図3】同じく組立後の光コネクタプラグにおいてスライダを後方に移動させた状態の斜視図である。

【図4】同じく組立後の光コネクタプラグを示し、（ａ）は側面図、（ｂ）は正面図、（ｃ）は背面図、（ｄ）は斜上方向から見た斜視図、（ｅ）は斜下方向から見た斜視図である。

【図5】同じく組立後の光コネクタプラグを示し、（ａ）は図４（ｃ）中のＸ－Ｘ断面図、（ｂ）は解除レバーを押し下げた状態の断面図である。

【図6】同じく組立後の光コネクタプラグを示し、（ａ）は係止片と解除レバーがカップリングスリーブに具備され、２個一対のストッパがフレームに具備されている場合の斜視図、（ｂ）は係止片と解除レバーと２個一対のストッパがカップリングスリーブに具備されている場合の斜視図である。

【図7】同じく組立後の光コネクタプラグを示し、（ａ）は光コネクタプラグのセンター断面図、（ｂ）は光コネクタプラグの片側断面図である。

【図8】同じくアダプタから光コネクタプラグを抜脱する一例を説明するものであり、（ａ）はアダプタに光コネクタプラグが装着されている状態の斜視図、（ｂ）はアダプタから光コネクタプラグを抜脱した状態の斜視図である。

【図9.1】図中（ａ）乃至（ｄ）はアダプタに対する光コネクタプラグの装着の手順を断面図で示した説明図である。

【図9.2】図中（ｅ）乃至（ｇ）はアダプタに対する光コネクタプラグの抜脱の手順を断面図で示した説明図である。

【図10】引抜タブを使用した一例を示し、（ａ）は引抜タブを操作部に装着する前状態の斜視図、（ｂ）は引抜タブを操作部に装着した後状態の斜視図である。

【図11】同じく引抜タブを使用した一例を示し、（ａ）は引抜タブを操作部に装着する前状態の断面図、（ｂ）は引抜タブを操作部に装着した後状態の断面図である。

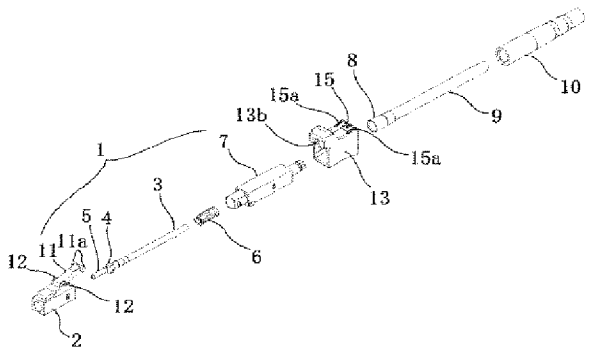
【符号の説明】

【0048】

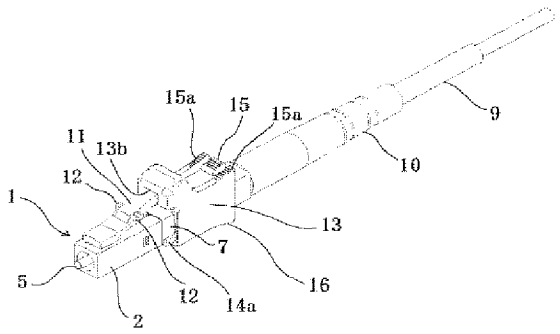
Ｐ　　アダプタ
１　　プラグ本体
２　　カップリングスリーブ
３　　フェルール用チューブ
４　　フェルールフレーム
５　　フェルール
６　　スプリング
７　　本体フレーム
８　　カシメリング
９　　熱収縮チューブ
１０　　ブーツ
１１　　解除レバー
１１ａ　解除片

１２　係止片
１３　スライダ
１３ａ　テーパー面
１３ｂ　開口部
１４ａ　ストッパ
１４ｂ　ストッパ
１５　操作部
１５ａ　把持部
１６　下側操作部
１７　引抜タブ
１８　セット穴
１９　固定穴
２０　スリット部
２１　把持部
２２　フック
２３　ラベル貼付エリア

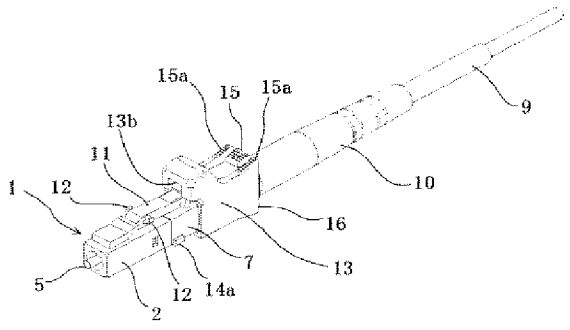
【図1】



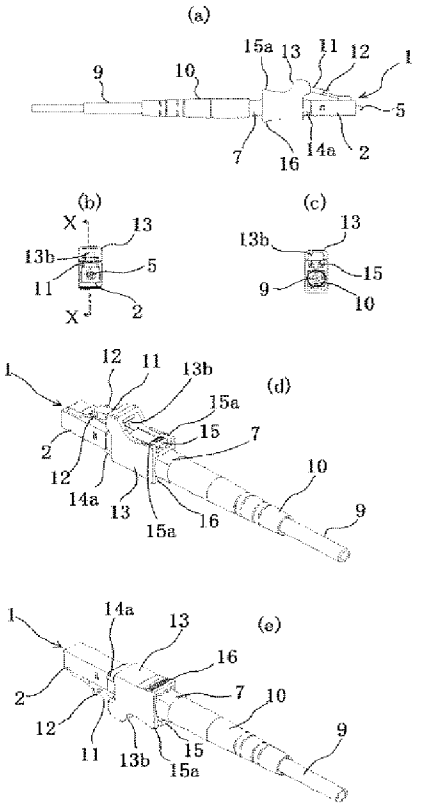
【図2】



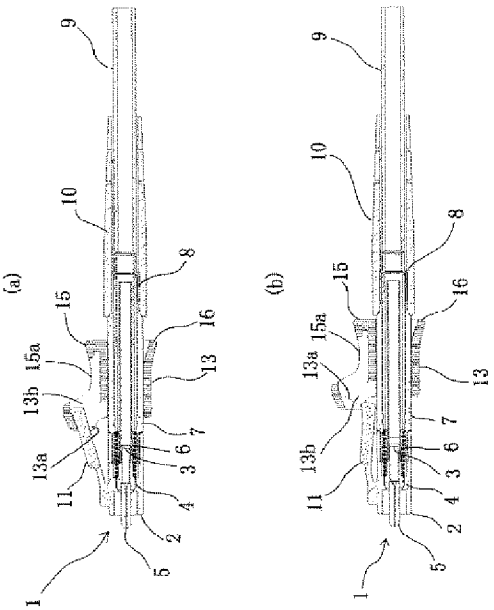
【図3】



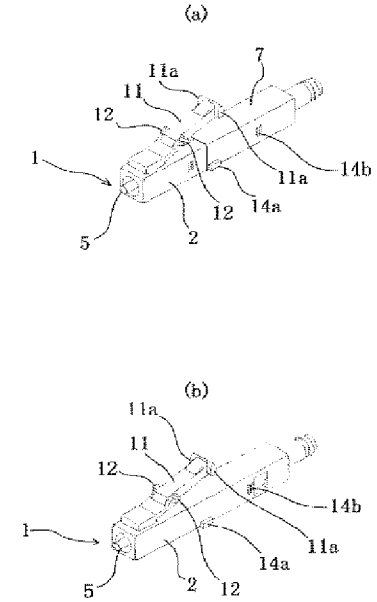
【図4】



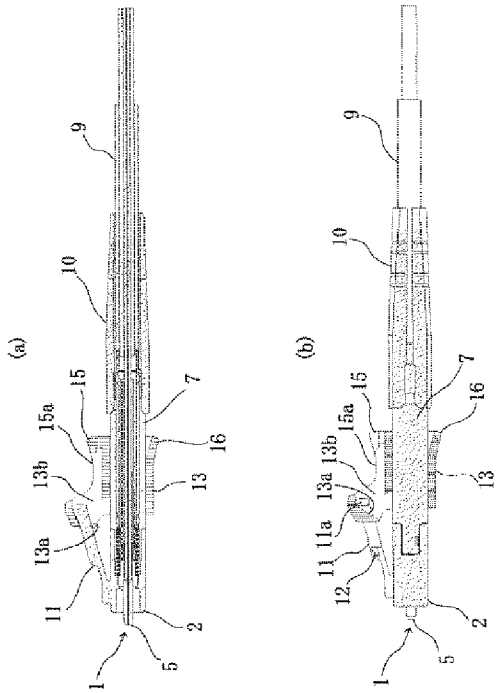
【図5】



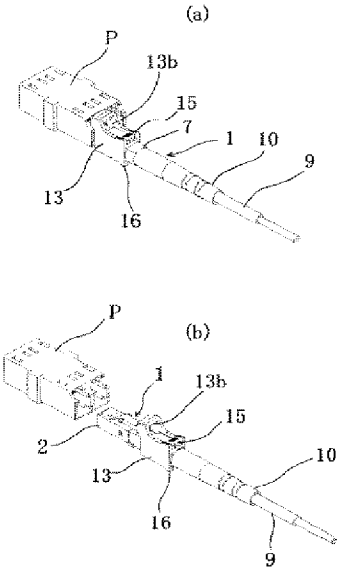
【図6】



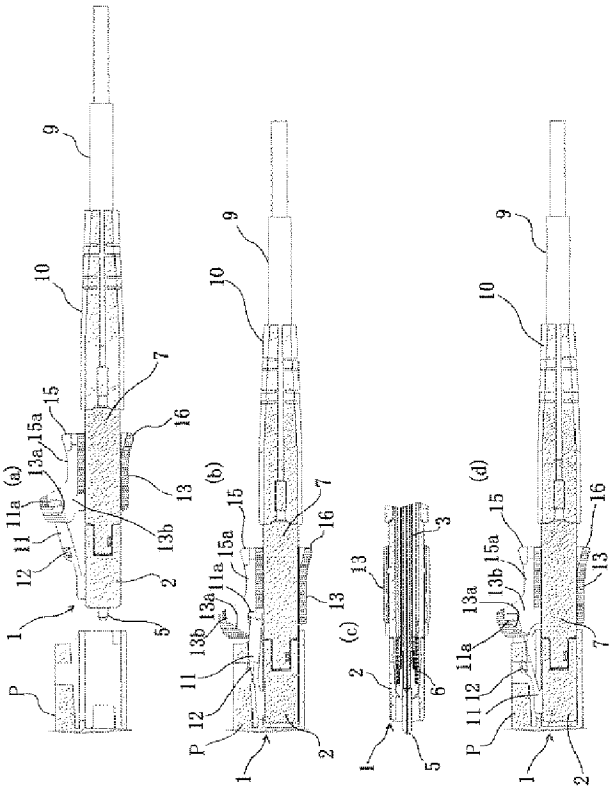
【図7】



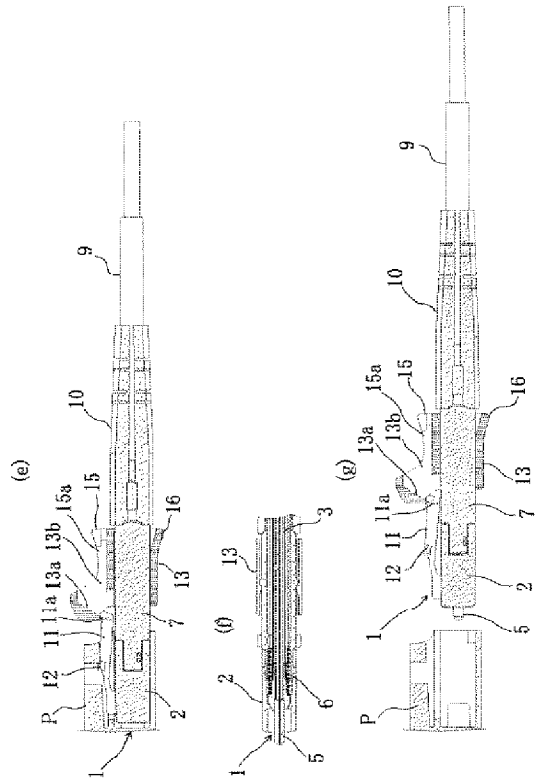
【図8】



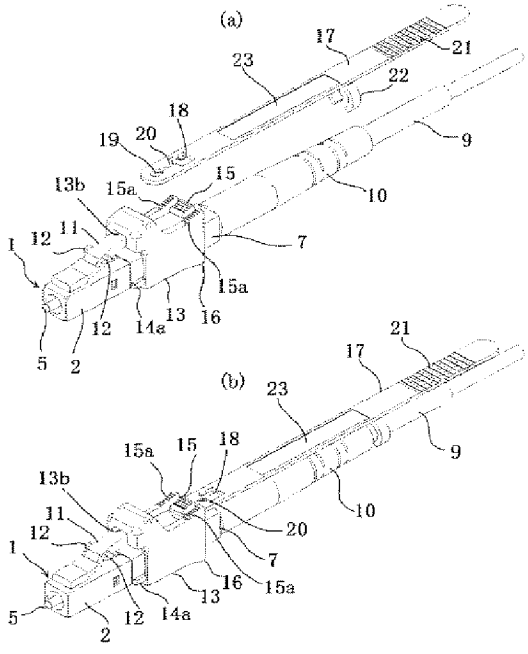
【図9.1】



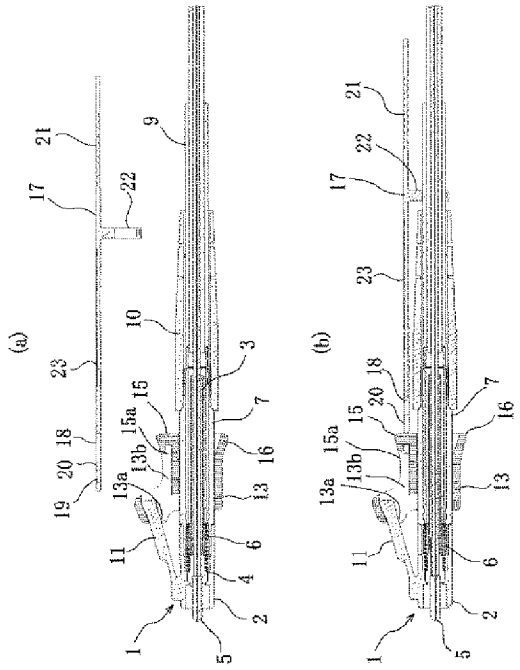
【図9.2】



【図10】



【図11】



Espacenet

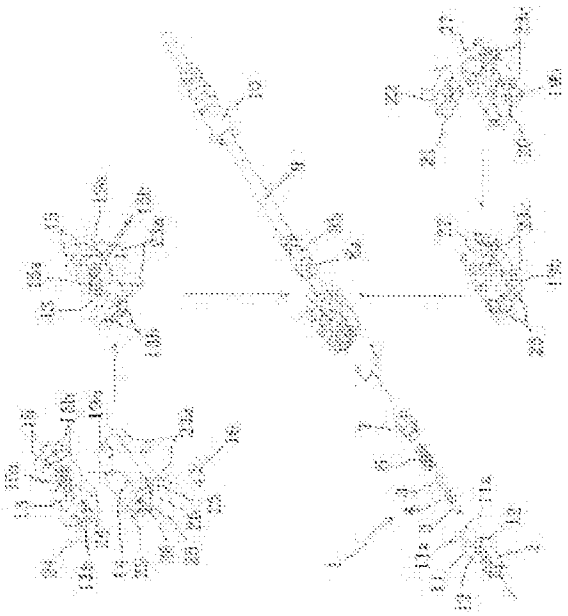
Bibliographic data: JP2009276493 (A) — 2009-11-26

OPTICAL CONNECTOR PLUG

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Applicant(s):	SANWA DENKI KOGYO CO LTD ±
Classification:	**- international:** ***G02B6/40***
	- European:
Application number:	JP20080126796 20080514
Priority number(s):	JP20080126796 20080514

Abstract of JP2009276493 (A)

PROBLEM TO BE SOLVED: To provide a small-sized multiple optical connector plug with which a release lever can be easily operated without any special tool even during high-density packaging. ; SOLUTION: The optical connector plug by a multiple type is constituted such that the optical adapter formed via partition disposed in a module of a plurality of branch structures is insertable and removable into/from respective insertion sections. A plug body 1 has a release lever 11 provided with a locking piece 12 for locking to the adapter before backward on one surface in a longitudinal direction of the plug body 1 and a release piece 11a at a rear end, and a slider 13 mounted movably in a regulation region in an axial direction of the plug body 1 via holder sections 19a, 19b vertically halved to incorporate a plurality of plug bodies 1. The slider 13 has a plurality of cam sections 13a pressably engaging the release piece 11a of each release lever 11 of the plurality of the plug bodies 1. ; COPYRIGHT: (C)2010,JPO&INPIT



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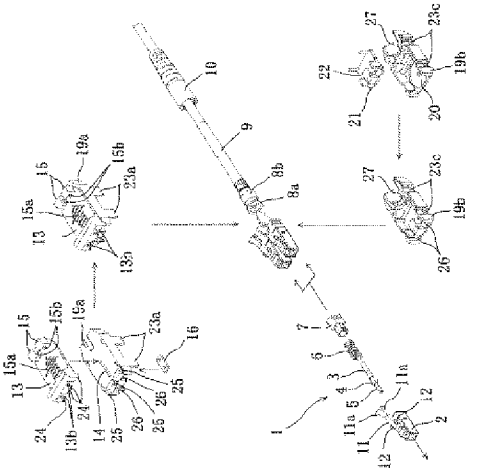
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(54)【発明の名称】光コネクタプラグ

(57)【要約】
【課題】高密度実装時にも特別な工具を使用せずに、解除レバーを容易に操作することができる小型の多連式光コネクタプラグを提供する。
【解決手段】複数分岐構造によるモジュールに設けられた隔壁を介して形成された光アダプタの各挿入部へ挿・抜可能とする多連式による光コネクタプラグを構成する。このプラグ本体１の長手方向の一面に前方から後方に向かって、アダプタと係合するための係止片１２を備え、且つ後端部に解除片１１ａを備えて成る解除レバー１１と、複数のプラグ本体１を組み込むための上下二分割したホルダー部１９ａ、１９ｂを介して、プラグ本体１の軸方向の規制範囲に移動可能に装着したスライダ１３とを備え、該スライダ１３は複数のプラグ本体１の各解除レバー１１の解除片１１ａに押圧可能に係合する複数のカム部１３ａを有して成る。
【選択図】図１



【特許請求の範囲】
【請求項1】
隔壁を介して形成された光アダプタの各挿入部へ挿・抜可能とした多連式による光コネクタプラグにおいて、プラグ本体の長手方向の一面に前方から後方に向かって形成され、アダプタと係合するための略中央に係止片を備え、且つ後端部に解除片を備えて成る解除レバーと、複数のプラグ本体が組み込まれるホルダー部を介して、プラグ本体の軸方向の規制範囲に移動可能に装着されたスライダとを備え、該スライダは複数のプラグ本体の各解除レバーの解除片に押圧可能に係合する複数のカム部を有して成ることを特徴とした光コネクタプラグ。
【請求項2】
解除レバーは、プラグ本体のアダプタへの装着時に係止片と共にアダプタのガイドによって下方へ変位し、係止片とアダプタが係合可能となるものとし、アダプタからの抜脱時にホルダー部に対しスライダを抜脱方向に移動させることでスライダのカム部で解除レバーの解除片を押し下げ、係止片とアダプタの係合が解除された後、ストッパに移動が規制され、スライダがアダプタから抜脱されると同時に解除レバーの弾性力によりプラグ本体および解除レバーは初期位置に復帰するものとなっている請求項１記載の光コネクタプラグ。
【請求項3】
スライダの移動規制範囲は、当該スライダ下面に突設した脚部が挿入されて前後スライド可能に保持されるようホルダー部上面に形成されたスライド用長孔の長さによって設定されているものとなっている請求項１または２記載の光コネクタプラグ。
【請求項4】
スライダの後方端上面には、操作時に把持するための凸形状の操作部を備えてなる請求項１乃至３のいずれか記載の光コネクタプラグ。
【請求項5】
スライダの操作部には、当該スライダを後方のコード側で操作可能とする引抜タブのフック部を着脱可能とするフック装着部を備えてなる請求項４記載の光コネクタプラグ。

【発明の詳細な説明】
【技術分野】
【0001】
本発明は、光ファイバを接続するときに用いられる解除レバー付の光コネクタプラグに係わり、アダプタに対する装着および抜脱の操作性を向上させた多連式の光コネクタプラグに関する。
【背景技術】
【0002】
従来、この種の光コネクタプラグは、そのプラグハウジングの外周面に、アダプタとの係合およびその解除を行うためのラッチが一体的に設けられている。このラッチは、プラグハウジングの先端部から後端部に向かって徐々にプラグハウジング外表面から離れるように傾斜して延設されている。この光コネクタプラグがアダプタに装着されている場合、当該アダプタの後端にラッチが僅かに突出する。そして、アダプタから光コネクタプラグを抜脱する際には、このラッチを指先で直接押し下げて係合を解除する。
【0003】
また、光コネクタプラグは、その本体フレーム側に、ラッチの後端部に係合させたラッチ解除部材を別個に設け、このラッチ解除部材を介して間接的にラッチを押し下げてアダプタに対する係合を解除することもある。
【特許文献1】特になし
【発明の開示】
【発明が解決しようとする課題】
【0004】
近年においては、光コネクタの高密度実装が求められることから、アダプタからの光コ

ネクタプラグの抜脱時にラッチ解除部材でアダプタに対するラッチの係合を解除する小型の光コネクタプラグが出現している。しかしながら、小型故にラッチ解除部材の操作が困難になり、工具を使用しないと光コネクタプラグの抜脱ができない状況が発生している。

【0005】

すなわち、上記した従来技術で示したように、アダプタの後端に僅かに突出している光コネクタプラグのラッチを指先で直接押し下げて係合を解除するか、あるいはラッチ解除部材を介して間接的にラッチを押し下げて係合を解除しなければならないため、特に高密度実装では操作性が悪いものとなる。

【0006】

そこで、本発明は、叙上のような従来存した諸事情に鑑み案出されたもので、高密度実装時にも特別な工具を使用せずに、解除レバーを容易に操作することができる小型の多連式光コネクタプラグを提供することを目的とする。

【課題を解決するための手段】

【0007】

上述した課題を解決するため、本発明にあっては、隔壁を介して形成された光アダプタの各挿入部へ挿・抜可能とした多連式による光コネクタプラグにおいて、プラグ本体の長手方向の一面に前方から後方に向かって形成され、アダプタと係合するための略中央に係止片を備え、且つ後端部に解除片を備えて成る解除レバーと、複数のプラグ本体が組み込まれるホルダー部を介して、プラグ本体の軸方向の規制範囲に移動可能に装着されたスライダとを備え、該スライダは複数のプラグ本体の各解除レバーの解除片に押圧可能に係合する複数のカム部を有して成ることを特徴とした。

【0008】

解除レバーは、プラグ本体のアダプタへの装着時に係止片と共にアダプタのガイドによって下方へ変位し、係止片とアダプタが係合可能となるものとし、アダプタからの抜脱時にホルダー部に対しスライダを抜脱方向に移動させることでスライダのカム部で解除レバーの解除片を押し下げ、係止片とアダプタの係合が解除された後、ストッパに移動が規制され、スライダがアダプタから抜脱されると同時に解除レバーの弾性力によりプラグ本体および解除レバーは初期位置に復帰するものとなっている。

【0009】

スライダの移動規制範囲は、当該スライダ下面に突設した脚部が挿入されて前後スライド可能に保持されるようホルダー部上面に形成されたスライド用長孔の長さによって設定されているものとなっている。

【0010】

スライダの後方端上面には、操作時に把持するための凸形状の操作部を備えてなる。

【0011】

スライダの操作部には、当該スライダを後方のコード側で操作可能とする引抜タブのフック部を着脱可能とするフック装着部を備えて成る。

【発明の効果】

【0012】

本発明によれば、高密度実装時にも工具を使用せずに、解除レバーを容易に操作することができる。すなわち、本発明は、隔壁を介して形成された多連式光アダプタの各挿入部へ挿・抜可能とした多連式による光コネクタプラグにおいて、プラグ本体の長手方向の一面に前方から後方に向かって形成され、アダプタと係合するための略中央に係止片を備え、且つ後端部に解除片を備えて成る解除レバーと、複数のプラグ本体が組み込まれるホルダー部を介して、プラグ本体の軸方向の規制範囲に移動可能に装着されたスライダとを備え、該スライダは複数のプラグ本体の各解除レバーの解除片に押圧可能に係合する複数のカム部を有して成るので、スライダの前後方向への移動操作のみによって解除レバーを容易に操作することができる。したがって、小型高密度実装による光コネクタプラグであってもその操作性が著しく向上するものとなる。

【0013】

解除レバーは、プラグ本体のアダプタへの装着時に係止片と共にアダプタのガイドによって下方へ変位し、係止片とアダプタが係合可能となるものとし、アダプタからの抜脱時にホルダー部に対しスライダを抜脱方向に移動させることでスライダのカム部で解除レバーの解除片を押し下げ、係止片とアダプタの係合が解除された後、ストッパに移動が規制され、スライダがアダプタから抜脱されると同時に解除レバーの弾性力によりプラグ本体および解除レバーは初期位置に復帰するものとしたので、小型高密度実装による多連式の光コネクタプラグによるアダプタに対し、プラグ本体を容易且つ確実に装着させることができる。

【0014】

スライダの移動規制範囲は、当該スライダ下面に突設した脚部が挿入されて前後スライド可能に保持されるようホルダー部上面に形成されたスライド用長孔の長さによって設定されているので、例えばスライド用長孔の後端縁側位置を、スライダの移動により、係止片とアダプタとの係合が外れた位置よりも少なくとも後方に配置させるものとし、スライダを後方の抜脱方向に移動操作した際には、スライダはスライド用長孔の後端縁によって移動が規制され、プラグ本体を後方へ作用させる力が発生して、アダプタからのプラグ本体の抜脱を可能にし、スライダを前方の装着方向に移動操作した際には、スライダはスライド用長孔の前端縁によって移動が規制され、プラグ本体を前方へ作用させる力が発生して、アダプタへのプラグ本体の装着を可能にする。したがって、小型高密度実装による多連式の光コネクタプラグのアダプタに対し、プラグ本体をワンタッチで且つスムーズに抜脱させることができる。

【0015】

スライダの後方端上面には、操作時に把持するための凸形状の操作部を備えているので、該操作部を指先で操作するだけで、スライダの前後方向への移動がスムーズに行える。したがって、小型高密度実装時における光コネクタプラグであっても、その操作性が著しく向上するものとなる。

【0016】

スライダの操作部には、当該スライダを後方のコード側で操作可能とする引抜タブのフック部を着脱可能とするフック装着部を備えて成るので、該引抜タブを指先で操作するだけで、ホルダ部に対するスライダの後方向への移動がスムーズに行える。したがって、小型高密度実装による多連式の光コネクタプラグであっても、その操作性が著しく向上するものとなる。

【発明を実施するための最良の形態】

【0017】

以下、図面を参照して本発明に係る光コネクタプラグを実施するための最良の一形態について詳細に説明する。

【0018】

本発明は、例えば高密度構内成端用光キャビネット内において、その複数分岐構造によるモジュールに設けられた隔壁を介して形成された多連式光アダプタの各挿入部へ挿・抜可能とした多連式による光コネクタプラグに係わるものである。

【0019】

この光コネクタプラグとしては、例えばＬＣ型の二つのプラグ本体１を並置させ、両プラグ本体１に、二分岐された両ファイバーを両プラグ本体１にそれぞれ接着固定して端面を研磨し、研磨後の両プラグ本体１を後述するホルダ部に組み込むことで二連式に構成される。尚、本発明は、二連式の光コネクタプラグに限定されるものではなく、三連あるいは四連以上の光コネクタプラグとしても良いことは勿論である。

【0020】

そして、このプラグ本体１は、図１に示すように、比較的高強度なプラスチックから成るカップリングスリーブ２と、このカップリングスリーブ２内にフェルール用チューブ３およびフェルールホルダー４によって組み込まれたフェルール５と、フェルール用チューブ３外周に巻装されるスプリング６と、このスプリング６を介してカップリングスリーブ

２の後端部に嵌合するプラスチック製のエクステンダーキャップ７とを具備する。

【0021】

プラグ本体１を組み立てる場合には、図１に示すように、このカップリングスリーブ２に、フェルール５、スプリング６、エクステンダーキャップ７それぞれを順次挿入し、エクステンダーキャップ７の係止爪をカップリングスリーブ２の係止穴に係合することによってエクステンダーキャップ７がカップリングスリーブ２に固定され、フェルール５はカップリングスリーブ２内にスプリング６を介して軸方向前方に付勢保持される。また、エクステンダーキャップ７の後方には、光ファイバを保護して変形による断線等を防止するためのカシメホルダ８ａ、カシメリング８ｂを備えた熱収縮チューブ９とブーツ１０がそれぞれ取り付けられる。

【0022】

また、図１、図８．１、図８．２、図１０．１、図１０．２に示すように、カップリングスリーブ２の外周面には、アダプタＰとの係合およびその解除を行うための、幅方向両側面の略中央に係止片１２を備え、且つ後端の左右対称位置に軸方向に対して横向きに突出した一対の解除片１１ａを備えた解除レバー１１がカップリングスリーブ２上部に一体的に設けられている。

【0023】

この解除レバー１１は、プラグ本体１のカップリングスリーブ２の長手方向の一面において、先端部から後端部に向かって徐々にカップリングスリーブ２外表面から離れるように傾斜して延設されており、その後端部の左右一対の解除片１１ａは、後述するようにスライダ１３の開口部１３ｂ内側の左右対称位置にあるカム部１３ａに当接するよう当該カム部１３ａとは相補的な関係となっている。

【0024】

また、二つのプラグ本体１は、上下二分割されたホルダー部１９ａ、１９ｂに、互いに隣接した状態に組み込まれ、上側ホルダー部１９ａの上面には、各プラグ本体１の軸方向の規制範囲に移動可能に装着されたスライダ１３を備えている。

【0025】

すなわち、ホルダー部１９ａ、１９ｂは、図３（ａ）、図３（ｂ）に示す上側ホルダー部１９ａと、図４（ａ）、図４（ｂ）に示す下側ホルダー部１９ｂとから構成され、上側ホルダー部１９ａの上面略中央には前後方向に長いスライド用長孔１４が設けられている。このスライド用長孔１４には、スライダ１３の下面に突設した前後一対の脚部１３ｃが挿入され、下方側から装着された長方形のストッパー板１６の前後一対の孔に当該両脚部１３ｃを挿入して反対側からカシメることでスライダ１３自体が上側ホルダー部１９ａ上面に沿って前後スライド可能に保持されている。このとき、スライダの移動規制範囲は、上側ホルダー部１９ａ上面に形成されたスライド用長孔１４の前後方向の長さによって設定されている。

【0026】

一方、下側ホルダー部１９ｂには、内底面にＩＣチップ１８を収容する凹部２０が設けられ、該凹部２０にＩＣチップ１８を収容して上側から押さえ板２１によって挟み込んで固定できるようにしてある。さらに、押さえ板２１上面には左右一対の互いに連通したプラグ収容凹部２２が形成されており、そこに二つのプラグ本体１を隣接した状態となって収容できるようにしてある。

【0027】

また、上側ホルダー部１９ａの左右両側には下方に向けて前後一対のアーム２３ａが設けられると共に、アーム２３ａの下端内側に係止爪２３ｂが突設されており、下側ホルダー部１９ｂの左右両側に設けられた前後一対の係止凹部２３ｃそれぞれに各係止爪２３ｂが係合されることで両ホルダー部１９ａ、１９ｂが一体となって組み付けられる（図１参照）。このとき、両ホルダー部１９ａ、１９ｂ同士の合体によって、その前側面には左右一対の矩形開口状となったプラグ側開口部２６が形成され、この両プラグ側開口部２６から両プラグ本体１の各カップリングスリーブ２が突出した状態となって、各々のエクステ

ンダーキャップ７、カシメホルダ８ａ、カシメリング８ｂが係止保持される。また、その後側面中央には円形開口状となったブーツ側開口部２７が形成され、このブーツ側開口部２７によってカシメリング８ｂに圧入されたブーツ１０が後側へ延出される（図１、図４、図８参照）。

【0028】

スライダ１３はプラグ本体１の解除レバー１１の解除片１１ａに押圧可能に係合するカム部１３ａを備えている。すなわち、カム部１３ａは、スライダ１３の前端側に形成した開口部１３ｂ内側の左右対称位置に略円弧状テーパー面となってそれぞれ形成され、このカム部１３ａに前記解除レバー１１の傾斜した後端部における左右一対の解除片１１ａがそれぞれ係合される。

【0029】

具体的には、図２（ｆ）、図３（ａ）、図３（ｂ）、図６に示すように、スライダ１３は、その上面の前端側が若干斜め前方に向けて隆起され、この隆起した内側がエクステンダーキャップ７に面する上側において、解除レバー１１が軸方向に対して略直角方向に変位可能とする空間を形成すべく略コ字形アーチ状となった隣接する２個の開口部１３ｂが前後方向にそれぞれ貫設され、該各開口部１３ｂ内側の左右対称部分はエクステンダーキャップ７先端側に向けて傾斜したカム部１３ａとなっている。このカム部１３ａに前記解除レバー１１の傾斜した後端部における左右一対の解除片１１ａが係合される。

【0030】

また、図５、図６、図７（ａ）、図７（ｂ）に示すように、このスライダ１３の前端側下縁部には、左右両端と中央にＬ字型突片状の係合突起２４が互いに開口部１３ｂ側に向けて突設されており、この係合突起２４に対応して上側ホルダー部１９ａの前端側上縁部に略コ字型長溝状となって形成された被係合部２５に当該係合突起２４が前方側から後方に向けて嵌り込むようにしてある。これによって、プラグ本体１の解除レバー１１によりカム部１３ａに対して押圧力が加わってもスライダ１３はホルダー部１９から上方へ浮き上がるのを阻止される。

【0031】

このスライダ１３の中央上面は、滑り止め用のローレット目が形成された把持面部１５ａとなっており、スライダ１３の後方端上面には、操作時に把持するための凸形状の操作部１５を備えている。この操作部１５は、図６、図７（ａ）、図７（ｂ）に示すように、単なる横長状の突起であっても良い。

【0032】

あるいは、操作部１５は、図１、図２（ａ）、図２（ｂ）、図２（ｃ）、図２（ｆ）、図３（ａ）、図３（ｂ）に示すような中間のスリットを介して左右に一対となったＬ字枠状のフック装着部１５ｂによって形成し、このフック装着部１５ｂには、図９に示すように、当該スライダ１３を後方のコード側で操作可能とするための帯板状の引抜タブ１７の括れ部分を介して形成されたフック部１７ａが着脱可能となるようにしても良い。この引抜タブ１７を抜脱方向に移動させることでスライダ１３が連動して抜脱方向に移動する。

【0033】

そして、プラグ本体１はアダプタＰに装着されるものであるが、この装着時には、図８．１に示すように、上記した解除レバー１１の係止片１２によってプラグ本体１とアダプタＰとが係合されるようになっている。

【0034】

すなわち、解除レバー１１は、プラグ本体１のアダプタＰへの装着時には、図８．１（ａ）乃至（ｃ）に示すように、係止片１２がアダプタＰのプラグ挿入孔のガイドによって押圧され、当該係止片１２と共に下方へ変位しながら装着される。そして、アダプタＰのガイド奥側に上方に向けて形成されている段差に係止片１２が弾性的に係止されることで、係止片１２とアダプタＰが係合可能となる。

【0035】

また、このアダプタＰへの装着に際し、プラグ本体１を直接操作する替わりに、スライ

ダ１３を介して間接的に操作しても良い。この場合、スライダ１３をアダプタＰ方向に移動すると上側ホルダー部１９ａのスライド用長孔１４によってスライダ１３の移動が規制されてプラグ本体１はアダプタＰに装着可能となり、係止片１２と解除レバー１１はアダプタＰのガイドにより下方へ変位し、係止片１２とアダプタＰが係合する。このとき、図８．１（ａ）乃至（ｃ）、図８．２（ｄ）乃至（ｆ）に示すように、アダプタＰのプラグ挿入孔には、内側に向けて前記段差を有するガイドが形成されており、このガイドの段差に係止片１２が係入される。

【0036】

一方、プラグ本体１のアダプタＰからの抜脱時には、図８．２（ｄ）乃至（ｆ）に示すように、上側ホルダー部１９ａ上面でスライダ１３を抜脱方向に移動するとスライダ１３のカム部１３ａで解除レバー１１の前記解除片１１ａを押し下げることから、係止片１２とアダプタＰの係合が容易に解除される。

【0037】

このとき、図８．１（ａ）乃至（ｃ）、図８．２（ｄ）乃至（ｆ）に示すように、スライド用長孔１４の後端縁側位置を、スライダ１３の移動により、係止片１２とアダプタＰとの係合が外れた位置よりも少なくとも後方に配置させてあることから、スライダ１３を後方の抜脱方向に移動操作した際には、図８．２（ｄ）乃至（ｆ）に示すようにスライダ１３はスライド用長孔１４の後端縁によって移動が規制され、プラグ本体１を後方へ作用させる力が発生して、アダプタＰからのプラグ本体１の抜脱が可能となる。このとき、スライダ１３はアダプタＰから抜脱されると同時に解除レバー１１の弾性力により初期位置に復帰する。

【0038】

また、スライダ１３を前方の装着方向に移動操作した際には、図８．１（ａ）乃至（ｃ）に示すように、スライダ１３はスライド用長孔１４の前端縁によって移動が規制され、プラグ本体１を前方へ作用させる力が発生して、アダプタＰへのプラグ本体１の装着を可能にする。

【0039】

次に、以上のように構成された本発明・光コネクタプラグの最良の形態についての使用の一例について詳細に説明する。

【0040】

プラグ本体１のアダプタＰへの装着時には、図８．１（ａ）乃至（ｃ）に示すように、スライダ１３の操作部１５または把持面部１５ａと下側ホルダー部１９ｂを指先でもってアダプタＰ装着方向に移動する。このとき、スライダ１３はスライド用長孔１４の前端縁によって移動が規制されているので、アダプタＰ内にプラグ本体１が移動可能となる。これと同時に、解除レバー１１は係止片１２と共にアダプタＰのガイドによって下方へ変位して係止片１２とアダプタＰが係合されることでプラグ本体１がアダプタＰに装着される。

【0041】

一方、プラグ本体１のアダプタＰからの抜脱時には、図８．２（ｄ）乃至（ｆ）に示すように、スライダ１３の操作部１５または把持面部１５ａを指先でもって抜脱方向に移動する。このとき、スライダ１３のカム部１３ａによって解除レバー１１の後端部における解除片１１ａが押し下げられることで係止片１２とアダプタＰの係合が解除される。

【0042】

さらにスライダ１３が抜脱方向に移動すると当該スライダ１３はスライド用長孔１４の後端縁によって移動が規制されていることから、アダプタＰからのプラグ本体１の抜脱が可能となる。また、図８．２（ｆ）に示すように、スライダ１３はアダプタＰから抜脱されると同時に解除レバー１１の弾性力により当該スライダ１３自体は初期位置に復帰する。

【0043】

また、スライダ１３を後方のコード側で操作できるようにするためには、図９、図１０

．１（ａ）に示すように、スライダ１３の操作部１５のフック装着部１５ｂに引抜タブ１７のフック部１７ａを装着する。

【0044】

そして、プラグ本体１のアダプタＰからの抜脱時には、図１０．１（ｂ）、図１０．１（ｃ）に示すように、この引抜タブ１７を指先でもって抜脱方向に移動させることでスライダ１３は連動して同じ抜脱方向に移動され、スライダ１３のカム部１３ａで解除レバー１１の後端部における解除片１１ａを押し下げることで、係止片１２とアダプタＰの係合が解除される。

【0045】

図１０．２（ｄ）に示すように、引抜タブ１７をさらに抜脱方向に移動させるとアダプタＰからプラグ本体１が抜脱される。そして、引抜タブ１７から指先を離すと、解除レバー１１の弾性力により当該スライダ１３自体は初期位置に復帰する。最後に、図１０．２（ｅ）に示すように、引抜タブ１７を前方に若干移動させてから、図１０．２（ｆ）に示すように、スライダ１３の操作部１５のフック装着部１５ｂから引抜タブ１７のフック部１７ａを持ち上げて外す。

【図面の簡単な説明】

【0046】

【図1】本発明を実施するための最良の形態における光コネクタプラグの分解斜視図である。

【図2】同じくスライダの一例を示すもので、（ａ）は平面図、（ｂ）は側面図、（ｃ）は底面図、（ｄ）は背面図、（ｅ）は正面図、（ｆ）は（ａ）のＡ－Ａ断面図である。

【図3】同じくスライダを上側ホルダー部に組み付ける状態を示し、（ａ）は組み付け前の分解断面図、（ｂ）は組み付け後の断面図である。

【図4】同じく下側ホルダー部にＩＣチップと押さえ板を組み込む状態を示し、（ａ）は組み込み前の分解断面図、（ｂ）は組み込み後の断面図である。

【図5】同じくスライダ、上下ホルダー部の組み込み後の状態を示す正面図である。

【図6】同じくスライダと上側ホルダー部との分解斜視図である。

【図7】同じくスライダの動作を説明するもので、（ａ）は上側ホルダー部に対してスライダを前方に移動させた状態の側面図、（ｂ）は上側ホルダー部に対してスライダを後方に移動させた状態の側面図である。

【図8.1】図中（ａ）乃至（ｃ）はアダプタに対する光コネクタプラグの装着の手順を断面図で示した説明図である。

【図8.2】図中（ｄ）乃至（ｆ）はアダプタに対する光コネクタプラグの抜脱の手順を断面図で示した説明図である。

【図9】引抜タブをスライダに装着する前状態の斜視図である。

【図10.1】図中（ａ）乃至（ｃ）は引抜タブを使ってのアダプタに対する光コネクタプラグの抜脱の手順を断面図で示した説明図である。

【図10.2】同じく図中（ｄ）乃至（ｆ）は引抜タブを使ってのアダプタに対する光コネクタプラグの抜脱の手順を断面図で示した説明図である。

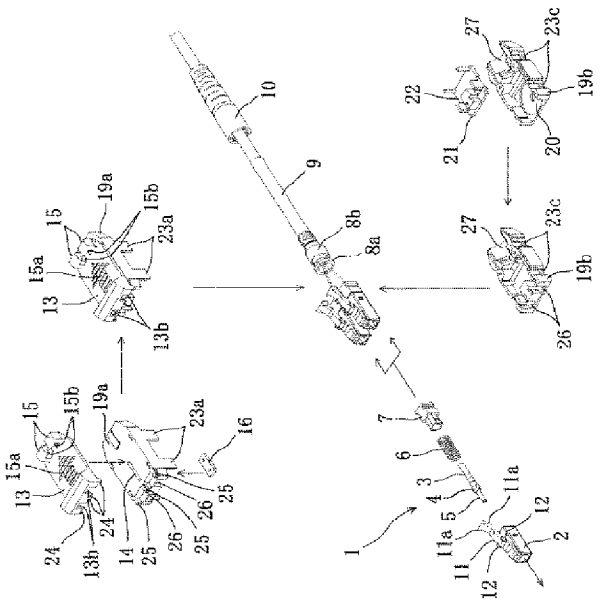
【符号の説明】

【0047】

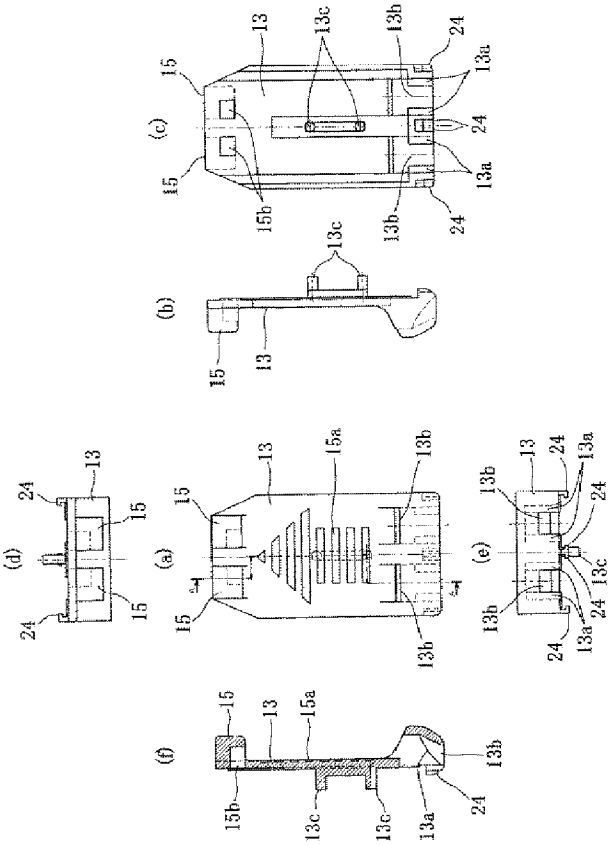
Ｐ　　アダプタ
１　　プラグ本体
２　　カップリングスリーブ
３　　フェルール用チューブ
４　　フェルールホルダー
５　　フェルール
６　　スプリング
７　　エクステンダーキャップ
８ａ　　カシメホルダ

８ｂ　カシメリング
９　熱収縮チューブ
１０　ブーツ
１１　解除レバー
１１ａ　解除片
１２　係止片
１３　スライダ
１３ａ　カム部
１３ｂ　開口部
１３ｃ　脚部
１４　スライド用長孔
１５　操作部
１５ａ　把持面部
１５ｂ　フック装着部
１６　ストッパー板
１７　引抜タブ
１７ａ　フック部
１８　ＩＣチップ
１９ａ　上側ホルダー部
１９ｂ　下側ホルダー部
２０　凹部
２１　押さえ板
２２　プラグ収容凹部
２３ａ　アーム
２３ｂ　係止爪
２３ｃ　係止凹部
２４　係合突起
２５　被係合部
２６　プラグ側開口部
２７　ブーツ側開口部

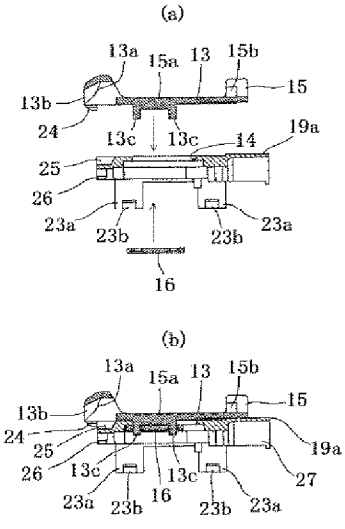
【図1】



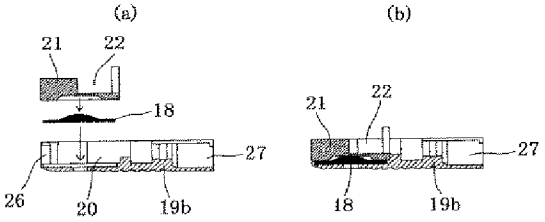
【図2】



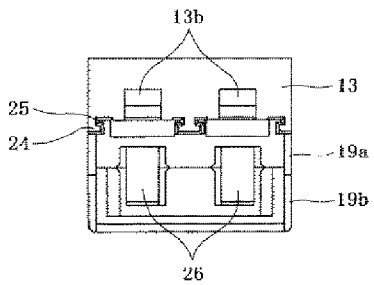
【図3】



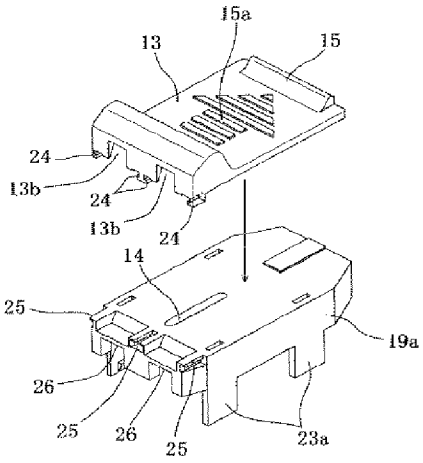
【図4】



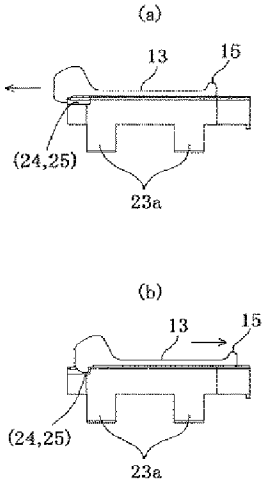
【図5】



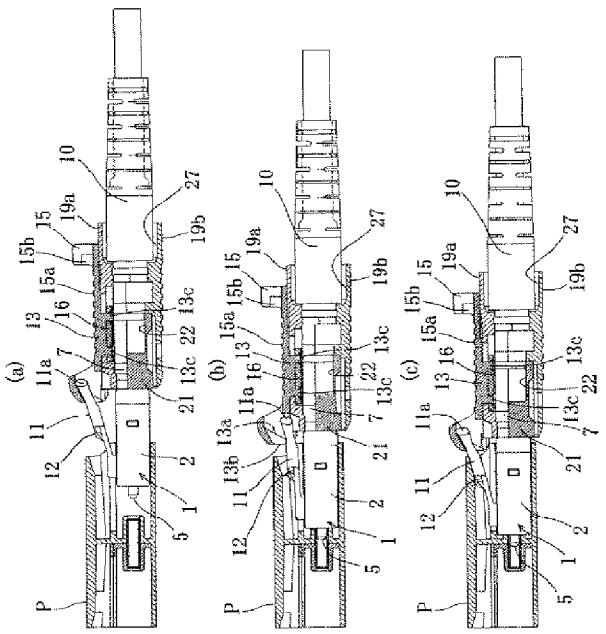
【図6】


15a
13
15
24
13b
24
13b
24
14
25
19a
26
25
26
25
23a

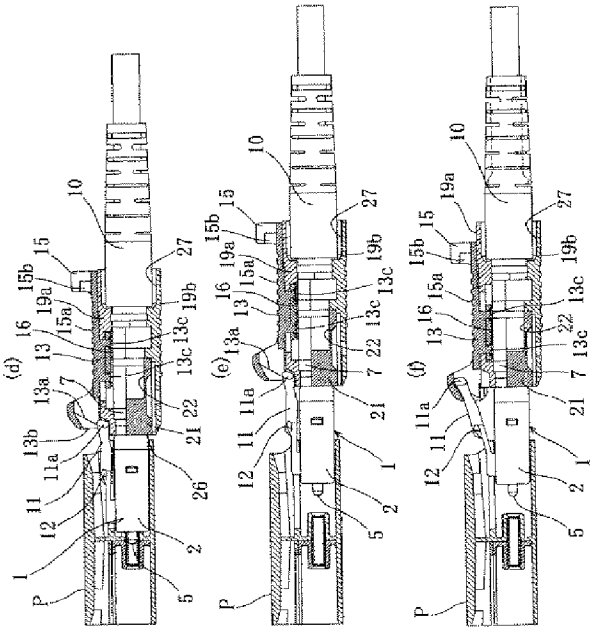
【図7】


(a)
13
15
(24,25)
23a
(b)
13
15
(24,25)
23a

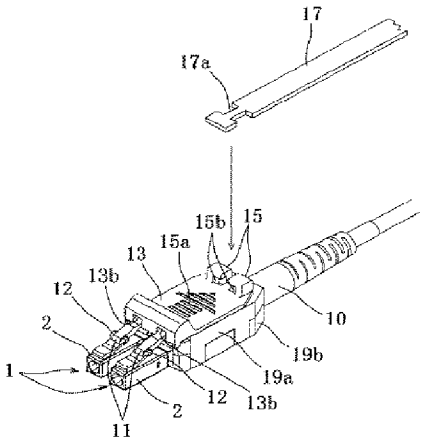
【図8.1】


(a)
(b)
(c)

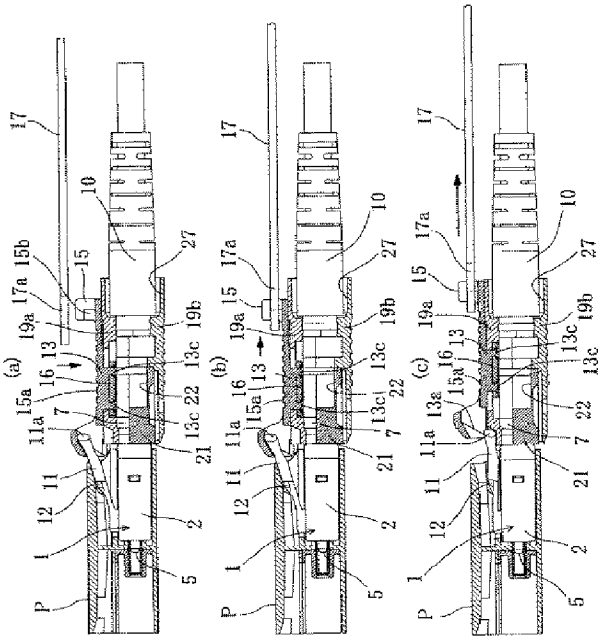
【図8.2】


(d)
(e)
(f)

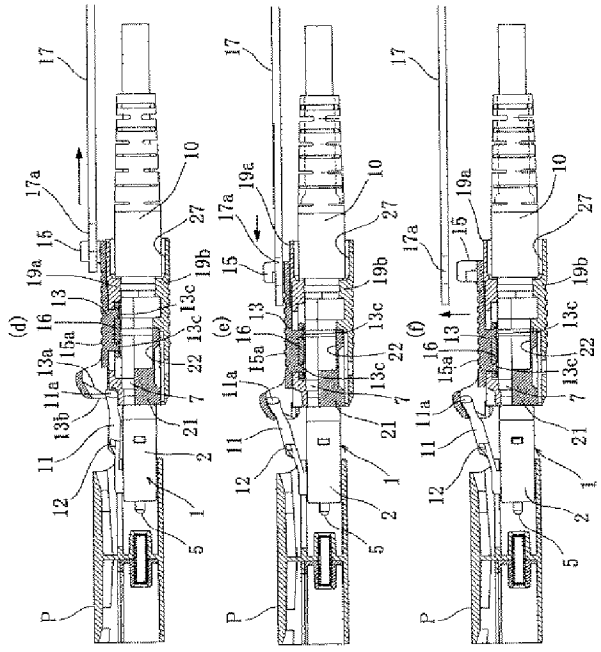
【図9】


17
17a
15b
15
15a
13
13b
12
2
10
19b
19a
1
12
13b
2
11

【図10.1】


(a)
(b)
(c)
17
10
27
15b
15
17a
19a
19b
13
13c
16
15a
22
11a
7
21
11
12
2
1
5
P

【図10.2】


(d)
(e)
(f)
17
17a
10
27
15
19a
19b
13
13c
16
15a
13a
22
11a
13b
7
21
11
12
2
1
5
P

200821653

發明專利說明書

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SC 型單件式光纖轉接器

SC type simplex one-piece optical adapter

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2. 日本/ JAPAN

四、聲明事項：

☐ 主張專利法第二十二條第二項☐第一款或☐第二款規定之事實，其事實發生日期為：　年　月　日。

☐ 申請前已向下列國家（地區）申請專利：

【格式請依：受理國家（地區）、申請日、申請案號　順序註記】

☐ 有主張專利法第二十七條第一項國際優先權：

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☐ 主張專利法第二十九條第一項國內優先權：

【格式請依：申請日、申請案號　順序註記】

☐ 主張專利法第三十條生物材料：

☐ 須寄存生物材料者：

國內生物材料 【格式請依：寄存機構、日期、號碼　順序註記】

國外生物材料 【格式請依：寄存國家、機構、日期、號碼　順序註記】

☐ 不須寄存生物材料者：

所屬技術領域中具有通常知識者易於獲得時，不須寄存。

2. 日本/ JAPAN

四、聲明事項：

☐ 主張專利法第二十二條第二項☐第一款或☐第二款規定之事實，其事實發生日期為：　年　月　日。

☐ 申請前已向下列國家（地區）申請專利：

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☐ 無主張專利法第二十七條第一項國際優先權：

☐ 主張專利法第二十九條第一項國內優先權：

【格式請依：申請日、申請案號　順序註記】

☐ 主張專利法第三十條生物材料：

☐ 須寄存生物材料者：

國內生物材料 【格式請依：寄存機構、日期、號碼　順序註記】

國外生物材料 【格式請依：寄存國家、機構、日期、號碼　順序註記】

☐ 不須寄存生物材料者：

所屬技術領域中具有通常知識者易於獲得時，不須寄存。

九、發明說明：

【發明所屬之技術領域】

本發明係有關一種SC型單件式光纖轉接器，更特別有關一種較習知轉接器具有更少組件的SC型單件式光纖轉接器。

【先前技術】

參考第1圖，習知SC型單件式光纖轉接器(fiber adapter)10具有一本體11，本體11設有被複數個側壁60所環繞的容室32，可分別與對接之光纖連接器(fiber connector)90連接。當光纖連接器90插入光纖轉接器10之容室32時，光纖轉接器10之側壁60上開設有缺口30，藉由缺口30可與光纖連接器90上的突起92卡接，具有對位的功能。再者，光纖轉接器10設有固定夾54及袖管52，藉由固定夾54可與光纖連接器90的凹處34卡接，以使袖管52對接於光纖連接器90的套管(ferrule)96。

參考第2圖，習知光纖轉接器200包含一第一殼體210a、一第二殼體210b、一第一內殼體220a、一第二內殼體220b以及一袖管230。上述第一殼體210a與第二殼體210b具有相同的結構；而第一內殼體220a與第二內殼體220b則具有相同的結構。

外殼體210a、210b具有由四個連續側壁211、212、213與214所環繞而成的矩形容室215，可與對接之光纖連接器90連接。一對突耳216分別由側壁212、214的外側相對延伸而出，方便將外殼體210a、210b固定於平坦的表

面。此外，側壁 211、213 的內側皆具有一狹長的突起 217，其長度方向係平行側壁 211、213 的周緣，且離開周緣一段距離。內殼體 220a、220b 具有一中空的圓柱體 221，以及在圓柱體 221 一端的矩形凸緣 222，凸緣 222 的大小恰好可容納於外殼體 210a、210b 的矩形容室 215 中，且其厚度剛好為突起 217 離開側壁 211、213 周緣的距離。此外，內殼體 220a、220b 還具有一對由凸緣 222 延伸而出且位在圓柱體 221 兩側的固定夾 223。

上述外殼體 210a、210b、內殼體 220a、220b 以及袖管 230 組裝成如第 1 圖之光纖轉接器 10 時，係分別將內殼體 220a、220b 的圓柱體 221 與固定夾 223 套入外殼體 220a、220b 內，外殼體 220a、220b 的狹長突起 217 則作為擋件，使內殼體 220a、220b 的凸緣 222 能夠卡在側壁 211、212、213、214 周緣與突起 217 之間。接著，將袖管 230 套入內殼體 220a、220b 的圓柱體 221 內，並將兩外殼體 210a、210b 的突耳 216 以超音波融接的方式融接在一起，使兩外殼體 210a、210b 相互連接。

上述光纖轉接器 200 由於需要超音波融接，因此兩外殼體 210a、210b 的相接處會有融接的痕跡，視覺上較不美觀；此外，光纖轉接器 200 具有較多的組件，在組裝上較為麻煩。

有鑑於此，便有需要提供一種 SC 型單件式光纖轉接器，以解決上述問題。

【發明內容】

本發明之目的在於提供一種SC型單件式光纖轉接器，其具有較少的組件，在組裝上較為簡易；此外，其外殼體係一體形成，外觀上沒有融接的痕跡，因此視覺上較為美觀。

為達上述目的，本發明之SC型單件式光纖轉接器包含一外殼體、一中空圓柱體及一夾持組件。外殼體由第一側壁、第二側壁、第三側壁與第四側壁所圍繞形成，其中第一側壁與第三側壁相對，並與第二及第四側壁相連。第一、第二、第三與第四側壁的一半部共同圍繞形成第一殼體，另一半部則共同圍繞形成第二殼體，第一殼體具有一具開口的第一容室，第二殼體則具有一具開口的第二容室。第一中空圓柱體設於第一殼體內，其軸向方向係與第一、第二、第三與第四側壁平行。夾持組件設於外殼體內，其包含一第二凸緣，第二凸緣的一表面設有一對第一固定夾，另一相對之表面則設有一對第二固定夾及位在兩第二固定夾之間的第二中空圓柱體，第二中空圓柱體的兩端具有開口，且其軸向方向垂直於第二凸緣。

上述之兩第一固定夾位於第一圓柱體的兩側，且第二圓柱體與兩第二固定夾位於第二殼體內，第一圓柱體的軸向與第二圓柱體的軸向對準。

為了讓本發明之上述和其他目的、特徵、和優點能更明顯，下文特舉本發明實施例，並配合所附圖示，作詳細說明如下。

【實施方式】

參考第3與4圖，本發明之SC型單件式光纖轉接器300包含一外殼體310及一夾持組件320。外殼體310包含一第一殼體310a與一第二殼體310b，其中第一殼體310a具有由四個連續側壁311a、312a、313a與314a所圍繞形成且具開口的第一容室315a，而第二殼體310a具有由四個連續側壁311b、312b、313b與314b所圍繞形成的第二容室315b。上述之側壁311b係由側壁311a平行延伸而出，並與側壁311a共同形成側壁311；側壁312b係由側壁312a平行延伸而出，並與側壁312a共同形成側壁312；側壁313b係由側壁313a平行延伸而出，並與側壁313a共同形成側壁313；側壁314b則由側壁314a平行延伸而出，且與側壁314a共同形成側壁314。此外，側壁311a與311b各開設有缺口317a、317b，使得當光纖連接器90插入容室315a、315b內時，可與光纖連接器90上的突起92卡接，具有對位的功能。

此外，側壁312與314的外側上各設有一突耳316，方便將外殼體310固定於平坦的表面。第一容室315a內設有一中空的圓柱體318，固定於外殼體310內，其軸向方向係與側壁311、312、313及314平行；圓柱體318的前端開口318a係朝向缺口317a、後端開口318b則朝向缺口317b，前端開口318a的內徑小於後端開口318b的內徑。當一袖管330由圓柱體的後端318b插入圓柱體318內時，袖管330無法由圓柱體的前端開口318a穿出，且部分長度會露出圓柱體318外。此外，為使圓柱體318固定於外殼體310內，其後端開口318b的外表面連接有一凸緣319，

凸緣 319 係固定於例如側壁 311 與 313 上，或者於側壁 312 與 314 上。

夾持組件 320 則包含一大致呈矩形之凸緣 322，其具有兩相對之表面 326a 及 326b，以及四個與表面 326a 及 326b 相連的連續的側面 328a、328b、328c、328d。凸緣 322 的表面 326a 上設有一對固定夾 324a、另一相對之表面 326b 上設有另一對固定夾 324b 以及位在兩固定夾 324b 之間的中空圓柱體 328；中空圓柱體 328 的軸向方向垂直於凸緣 322，且其兩端具有開口。凸緣 322 的側面 328a 上設有一凹槽 329a，另一側面 328c 則設有另一凹槽（圖未示）。

參考第 5 及 6 圖，欲將外殼體 310 及夾持組件 320 組裝成本發明之 SC 型單件式光纖轉接器 300 時，先將袖管 330 由圓柱體的後端 318b 插入圓柱體 318 內，由於袖管 330 的長度大於圓柱體 318 的軸向長度，因此袖管 330 會有部分長度露出於圓柱體的後端 318b。接著將夾持組件 320 由第二容室 315b 的開口套入外殼體 310 內並固定於其中，使兩固定夾 324a 位於圓柱體 318 兩側，且圓柱體 328 與兩固定夾 324a 位於第二殼體 310b 內，圓柱體 328 的軸向與圓柱體 318 的軸向對準，並套在袖管 330 外側。為使夾持組件 320 能夠牢固的固定於外殼體 310 內，圓柱體後端 318b 兩側的側壁 311 的內側上，分別設有成一直線的凸線 341a、341b，其長度方向垂直於側壁 312 與 314；而圓柱體後端 318b 兩側的側壁 313 的內側上，則各設有一成一直線的凸線（圖未示），其長度方向垂直於側壁 312 與 314。當夾持組件 320 置入外殼體 310 內時，側壁 311 上的凸線 341a、

314b卡在凸緣側面328a的凹槽329a內，而側壁313上的凸線則卡在凸緣側面328c的凹槽內，使得夾持組件320不會由外殼體310中脫落。

當兩光纖連接器90分別由容室315a、315b的開口插入外殼體310內以實行對接時，兩連接器90的套管96係分別由袖管330的兩端插入袖管300內，此時夾持組件320的兩對固定夾324a及324b則分別卡接於兩連接器90的凹處34，且兩套管96的端面相互接觸，藉此達到兩光纖連接器90對接的目的。

上述外殼體310較佳係一體形成，亦即以塑膠射出成型的方式，同時形成側壁311、312、313、314、兩突耳316以及圓柱體318；同樣地，夾持組件320亦可以塑膠射出成型的方式一體形成。

本發明SC型單件式光纖轉接器300之外殼體310，由於係一體形成，因此外觀上沒有融接的痕跡；再者，由於本發明SC型單件式光纖轉接器300具有較少的組件，在組裝上亦較為簡易。

雖然本發明已以前述實施例揭示，然其並非用以限定本發明，任何本發明所屬技術領域中具有通常知識者，在不脫離本發明之精神和範圍內，當可作各種之更動與修改。因此本發明之保護範圍當視後附之申請專利範圍所界定者為準。

【圖式簡單說明】

第1圖：為習知SC型單件式光纖轉接器與光纖連接器之立體圖。

第2圖：為習知之SC型單件式光纖轉接器之立體圖。

第3圖：為本發明之SC型單件式光纖轉接器之剖面分解圖。

第3a圖：為本發明之SC型單件式光纖轉接器之夾持組件之立體圖。

第4圖：為本發明之SC型單件式光纖轉接器之立體圖。

第5及6圖：顯示本發明之SC型單件式光纖轉接器各部組件組裝成SC型單件式光纖轉接器之步驟。

【圖號說明】

10	光纖轉接器	11	本體
30	缺口	32	容室
34	凹處	52	袖管
54	固定夾	60	側壁
90	光纖連接器	92	突起
96	套管	200	光纖轉接器
210a	外殼體	210b	外殼體
211	側壁	212	側壁
213	側壁	214	側壁
215	容室	216	突耳
217	突起	220a	內殼體
220b	內殼體	221	圓柱體
222	凸緣	223	固定夾
230	袖管	300	光纖轉接器
310	外殼體	310a	殼體
310b	殼體	311	側壁
311a	側壁	311b	側壁
312	側壁	312a	側壁
312b	側壁	313	側壁
313a	側壁	313b	側壁

314 側壁	314a 側壁
314b 側壁	315a 容室
315b 容室	316 突耳
317a 缺口	317b 缺口
318 圓柱體	318a 開口
318b 開口	320 夾持組件
322 凸緣	324a 固定夾
324b 固定夾	326a 表面
326b 表面	328 圓柱體
328a 側面	328b 側面
328c 側面	328d 側面
329a 凹槽	330 袖管
341a 凸緣	341b 凸緣

五、中文發明摘要：

一種SC型單件式光纖轉接器，其具有較少之零組件，因此組裝較為簡易；此外，其外殼體係一體形成，外觀上沒有融接的痕跡，視覺上較為美觀。

六、英文發明摘要：

An SC type simplex one-piece optical adapter is provided. The SC type adapter of the present invention has fewer parts than a conventional one. Therefore, it is simpler and easier to assemble the SC type adapter. In addition, because the housing of the SC type adapter is not required to be ultrasonically welded, there is not any welding line on the SC type adapter.

十、申請專利範圍：

1、一種SC型單件式光纖轉接器，用以使兩光纖連接器對接，該光纖轉接器包含：

一外殼體，係由一第一側壁、一第二側壁、一第三側壁與一第四側壁所圍繞形成，其中該第一側壁與該第三側壁相對，並與該第二及第四側壁相連，該第一、第二、第三與第四側壁的一半部共同圍繞形成一第一殼體，另一半部則共同圍繞形成一第二殼體，該第一殼體具有一具開口的第一容室，該第二殼體具有一具開口的第二容室；

一第一中空圓柱體，設於該第一殼體內，該第一中空圓柱體的軸向方向係與該第一、第二、第三與第四側壁平行；及

一夾持組件，設於該外殼體內，該夾持組件包含一大致呈矩形之第二凸緣，該第二凸緣具有兩相對之第一表面與第二表面，以及與該第一、第二表面相連的一第一側面、一第二側面、一第三側面與一第四側面，其中該第一側面與該第三側面相對，並與該第二及第四側面相連，該第一表面設有一對第一固定夾，該第二表面設有一對第二固定夾與位在該兩第二固定夾之間的第二中空圓柱體，該第二中空圓柱體的兩端具有開口，且其軸向方向垂直於該第二凸緣，

其中該兩第一固定夾位於該第一圓柱體的兩側，且該第二圓柱體與該兩第二固定夾位於該第二殼體內，該第

一圓柱體的軸向與第二圓柱體的軸向對準。

2、如申請專利範圍第1項之SC型單件式光纖轉接器，其中該第二凸緣之第一側面設有第一凹槽，該凸緣之第三側面設有第二凹槽，該外殼體之第一側壁的內側設有至少一第一凸線，該外殼體之第三側壁的內側設有至少一第二凸線，該第一與第二凸線係分別設於該第一凹槽與第二凹槽內。

3、如申請專利範圍第2項之SC型單件式光纖轉接器，其中該外殼體之第一側壁的內側設有兩第一凸線，分別位於該第一圓柱體的兩側，且該兩第一凸線成一直線，該外殼體之第三側壁的內側設有兩第二凸線，分別位於該第一圓柱體的兩側，且該兩第二凸線成一直線。

4、如申請專利範圍第1項之SC型單件式光纖轉接器，其中該外殼體另包含：

一第一凸緣，固定於該外殼體內，該第一中空圓柱體固定於該第一凸緣上。

5、如申請專利範圍第4項之SC型單件式光纖轉接器，其中該第一凸緣係固定於該第一及第三側壁上。

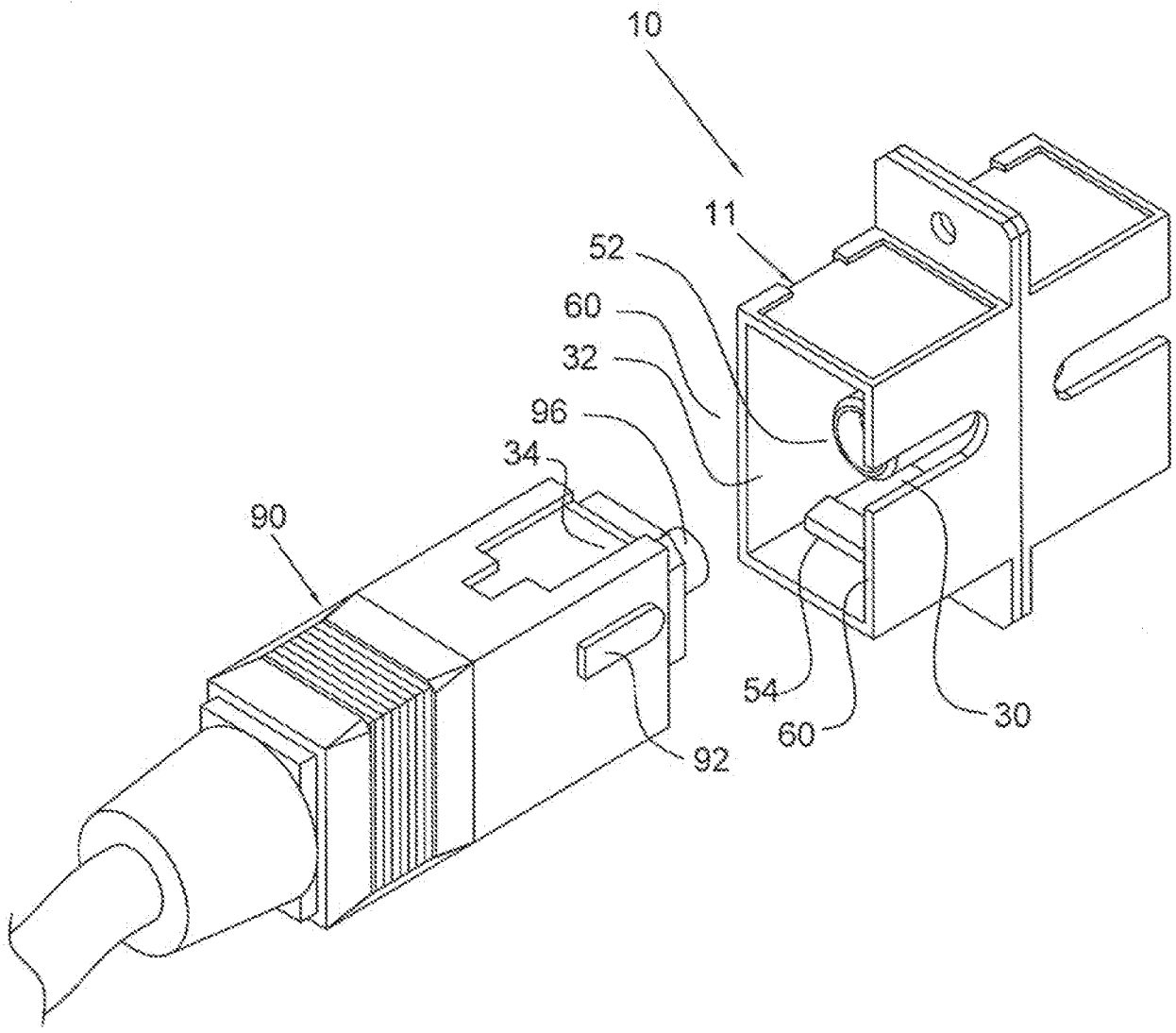
6、如申請專利範圍第1項之SC型單件式光纖轉接器，另包含：

一袖管，設於該第一及第二圓柱體內。

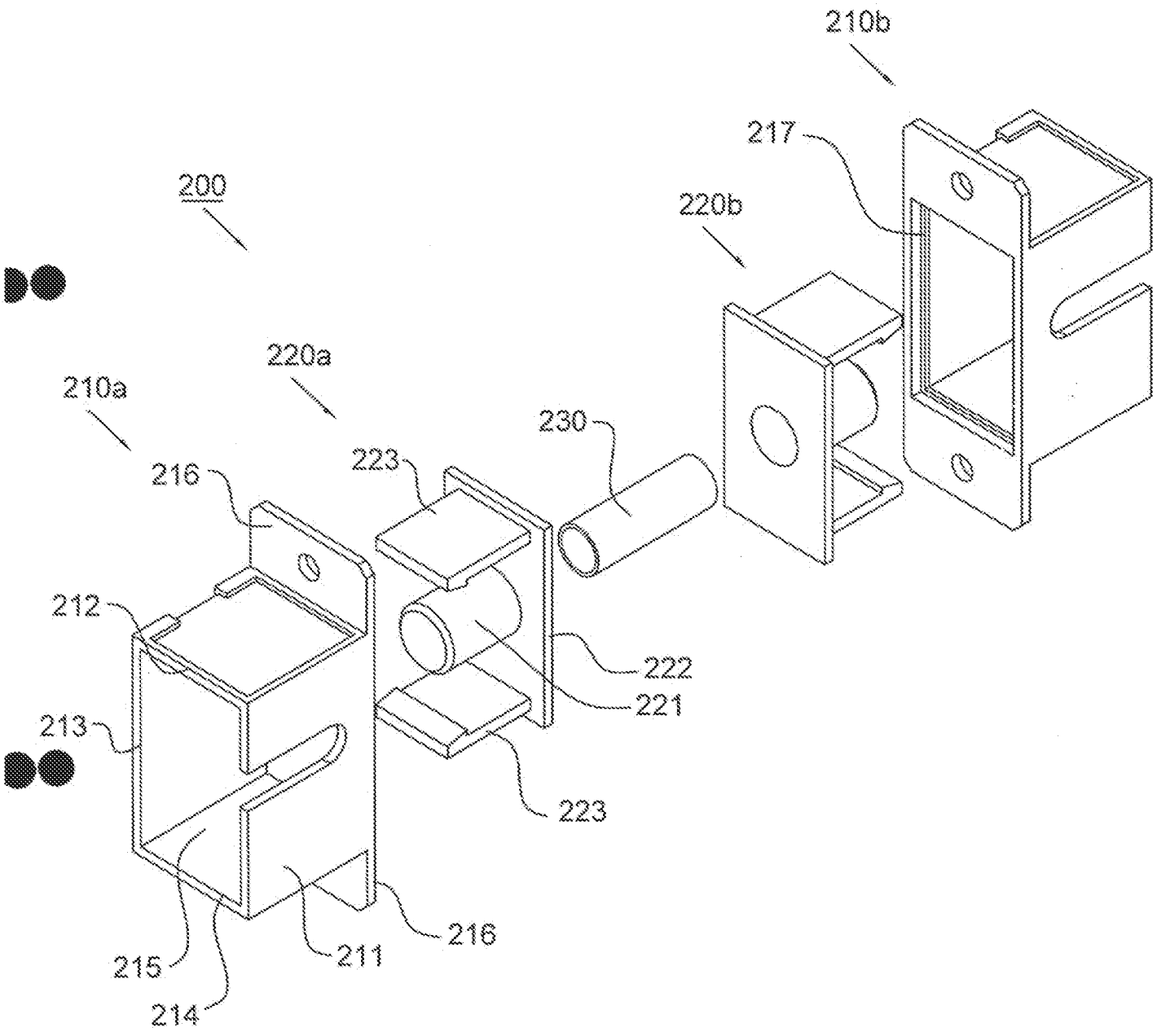
7、如申請專利範圍第1至6項中任一項之SC型單件式光纖轉接器，其中該第一、第二、第三與第四側壁以及該

第一圓柱體係一體形成。

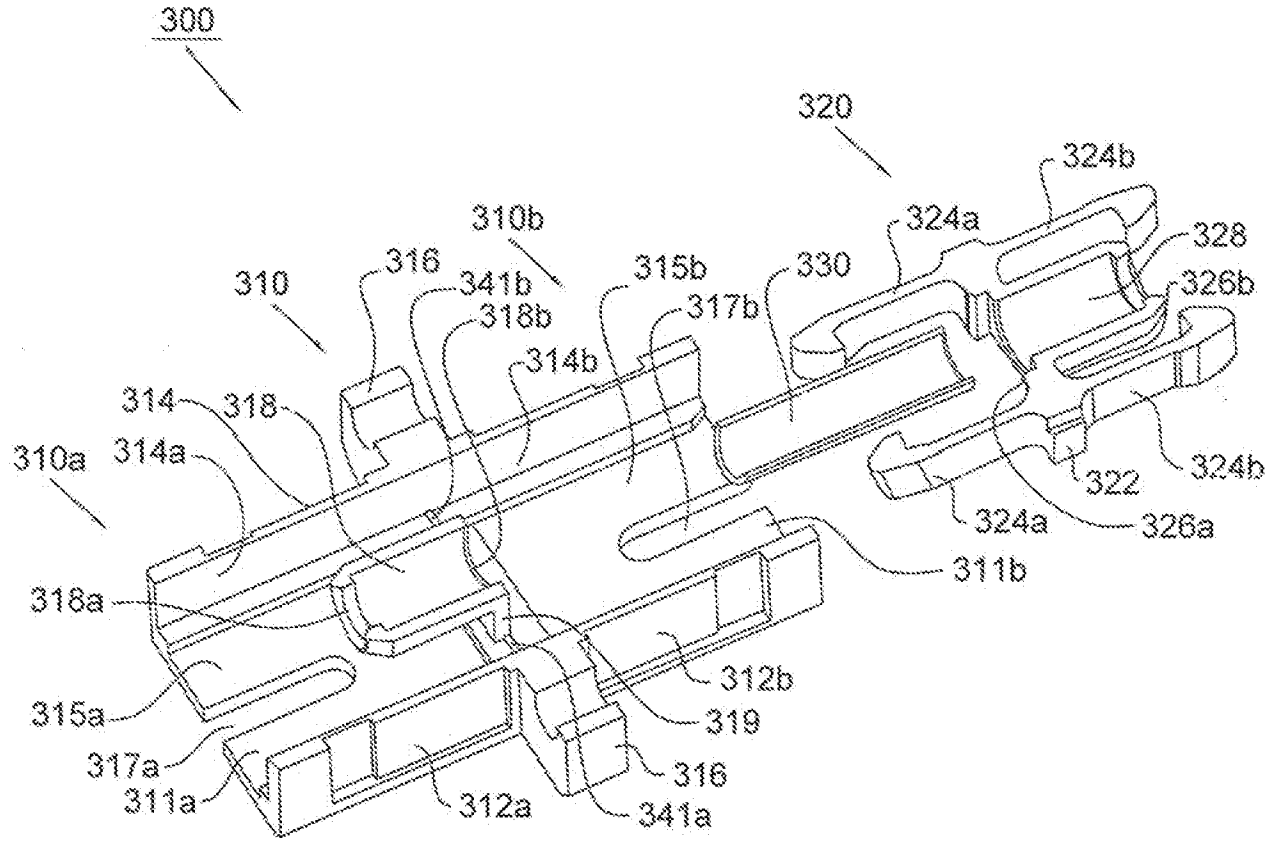
8、如申請專利範圍第7項之SC型單件式光纖轉接器，其中該夾持組件係一體形成。



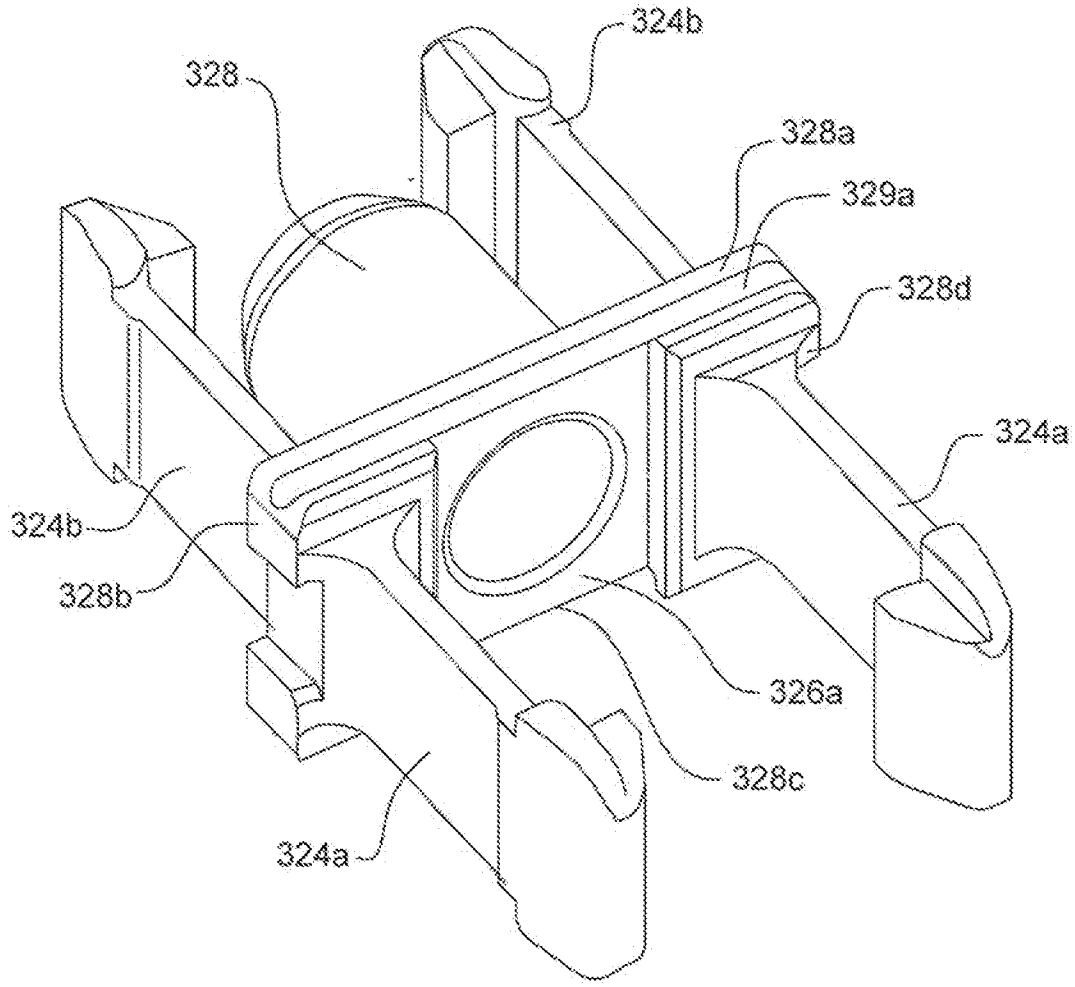
第 1 圖 (先前技術)


210b
217
200
220b
220a
210a
230
216
223
212
222
221
213
223
215
211
216
214

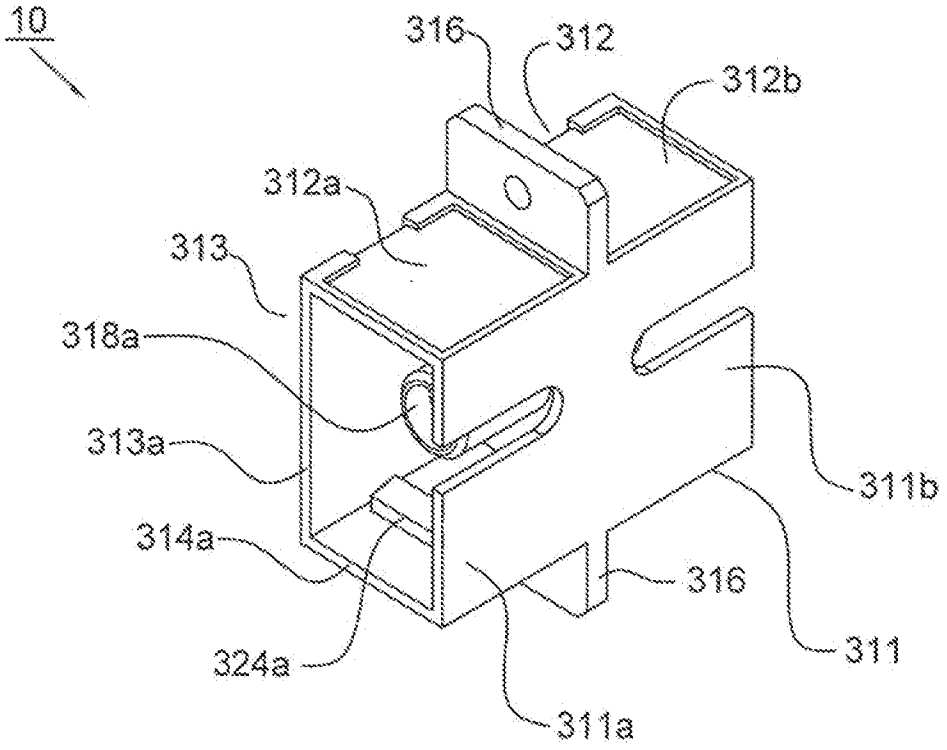
第 2 圖 (先前技術)


300
320
324b
310b
324a
328
316
310
341b
315b
330
326b
318b
317b
314b
314
318
310a
314a
322
324b
324a
326a
311b
318a
312b
315a
319
317a
316
311a
312a
341a

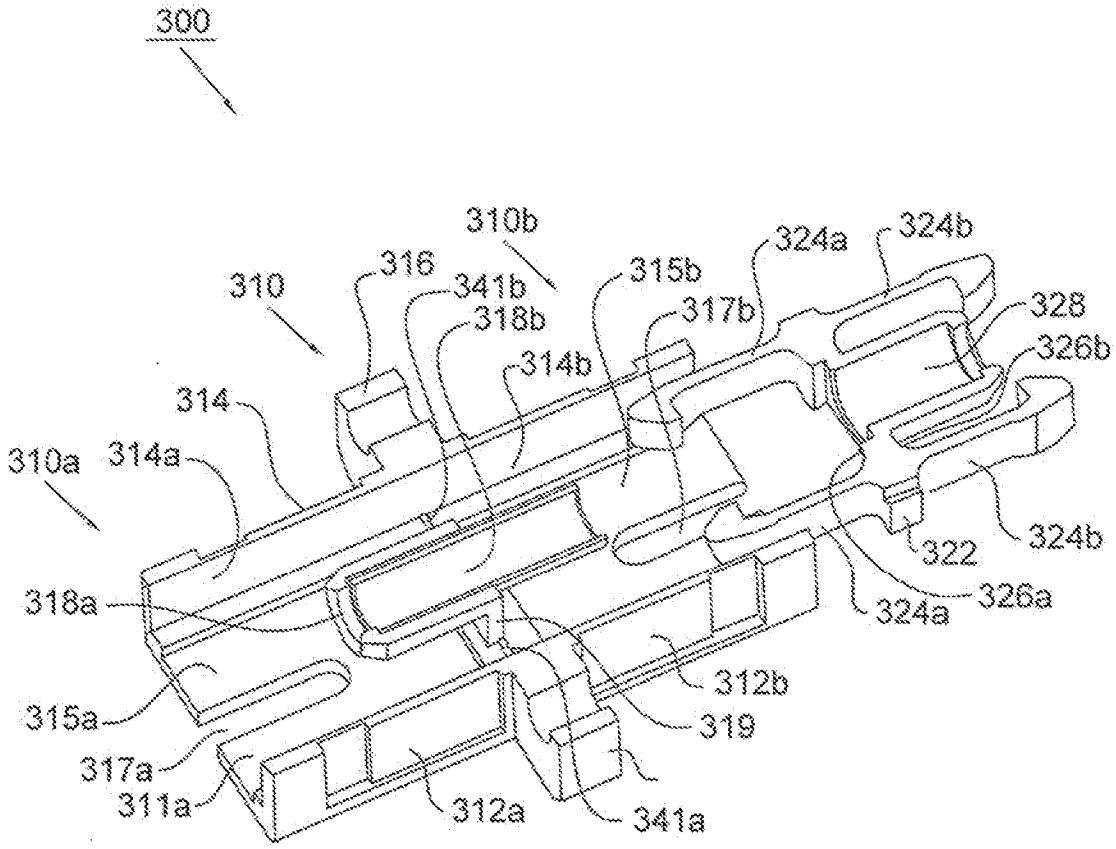
第 3 圖



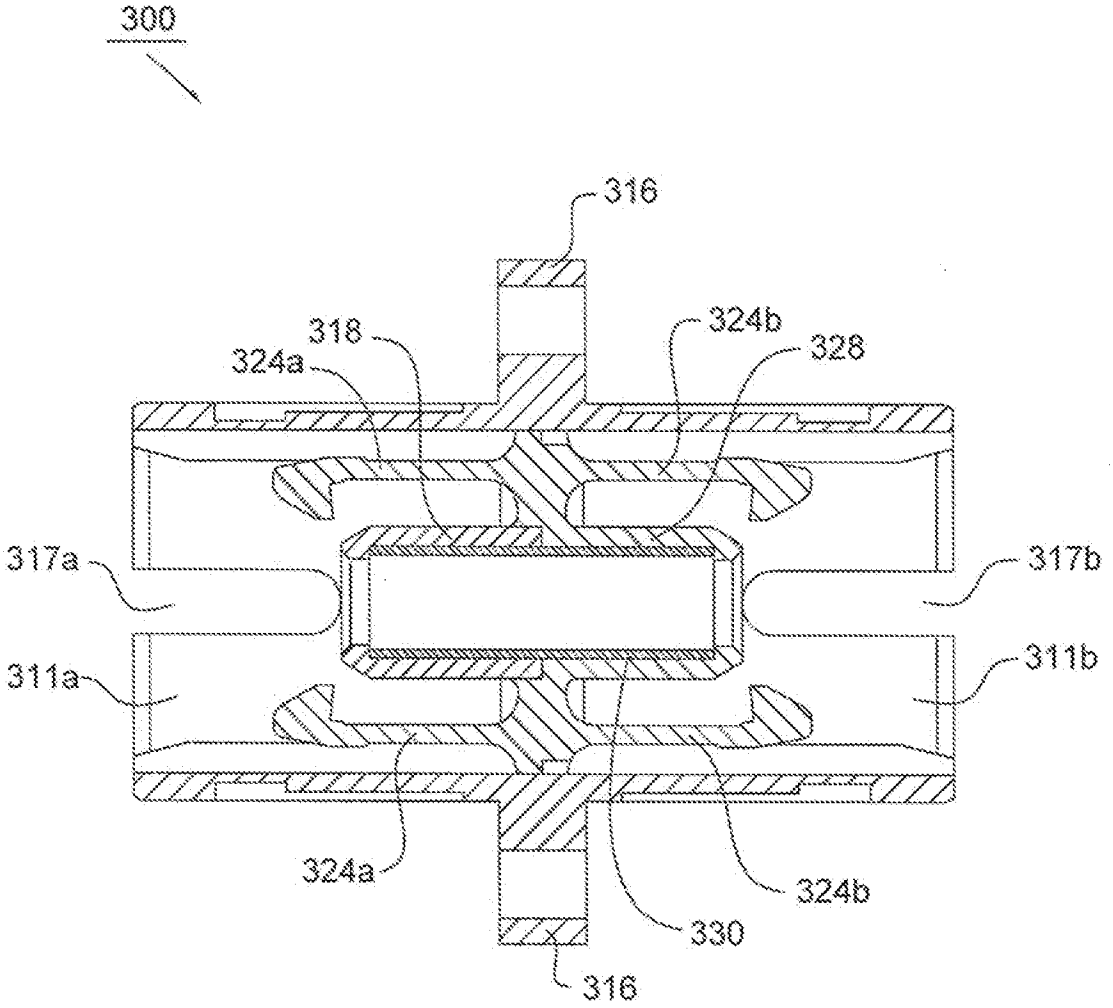
第 3a 圖



第 4 圖


300
310b
316
310
341b
315b
324a
324b
318b
317b
328
326b
314b
314
310a
314a
322
324b
318a
326a
324a
312b
315a
319
317a
311a
312a
341a

第 5 圖


300
316
318
324a
324b
328
317a
317b
311a
311b
324a
324b
330
316

第 6 圖

七、指定代表圖：

(一)本案指定代表圖為：第（3）圖。

(二)本代表圖之元件符號簡單說明：

300	光纖轉接器	310	外殼體
310a	殼體	310b	殼體
311	側壁	311a	側壁
311b	側壁	312	側壁
312a	側壁	312b	側壁
314	側壁	314a	側壁
314b	側壁	315a	容室
315b	容室	316	突耳
317a	缺口	317b	缺口
318	圓柱體	318a	開口
318b	開口	320	夾持組件
322	凸緣	324a	固定夾
324b	固定夾	326a	表面
326b	表面	328	圓柱體
330	袖管	341a	凸線
341b	凸線		

八、本案若有化學式時，請揭示最能顯示發明特徵的化學式：

(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

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(30) Angaben zur Priorität:
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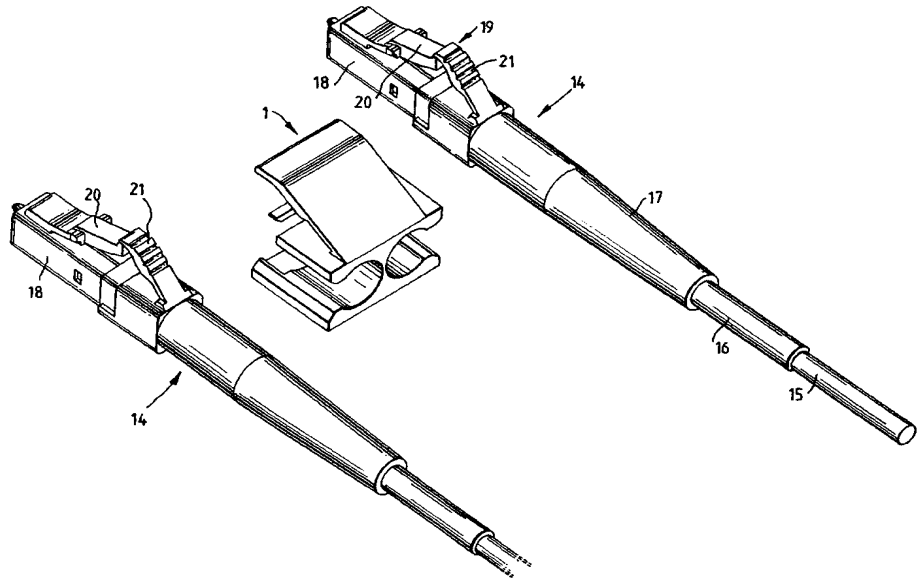
(81) Bestimmungsstaaten *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Bestimmungsstaaten *(regional)*: ARIPO-Patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), eurasisches Patent (AM, AZ, BY, KG, KZ, MD, RU, TJ,

[Fortsetzung auf der nächsten Seite]

(54) Title: DUPLEX CONNECTORS FOR OPTICAL FIBRE PLUG CONNECTORS

(54) Bezeichnung: DUPLEXVERBINDER FÜR GLASFASERSTECKVERBINDER



(57) Abstract: The invention relates to duplex connectors for optical fibre connectors, comprising two fixing devices for two simple plug connectors (14), for the formation of a duplex plug connector (22), whereby the fixing device is formed such that the above at least partly encloses the plug housing (18) or a kink preventer (17) on a plug connector to be fixed.

(57) Zusammenfassung: Die Erfindung betrifft Duplexverbinder für Glasfaserverbinder, umfassend zwei Befestigungseinrichtungen zur Aufnahme zweier Simplex-Steckverbinder (14) zur Bildung eines Duplex-Steckverbinders (22), wobei die Befestigungseinrichtungen derart ausgebildet sind, dass diese das Steckergehäuse (18) und/oder einen Knickschutz (17) eines aufzunehmenden Steckverbinders (14) mindestens teilweise umschliessen.

WO 01/79904 A2

TM), europäisches Patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI-Patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Veröffentlicht:

— *ohne internationalen Recherchenbericht und erneut zu veröffentlichen nach Erhalt des Berichts*

Zur Erklärung der Zweibuchstaben-Codes, und der anderen Abkürzungen wird auf die Erklärungen ("Guidance Notes on Codes and Abbreviations") am Anfang jeder regulären Ausgabe der PCT-Gazette verwiesen.

Duplexverbinder für Glasfasersteckverbinder

Die Erfindung betrifft einen Duplexverbinder, umfassend zwei Befestigungseinrichtungen zur Aufnahme zweier Simplex-Steckverbinder zur Bildung eines Duplex-Steckverbinders.

Ein derartiger gattungsgemäßer Duplexverbinder ist aus der US-579,425 bekannt. Der Duplexverbinder umfasst ein plattenförmiges Element, an dessen Seitenwänden jeweils zwei unterschiedlich ausgebildete zylindrische Stifte angeordnet sind, die in korrespondierende Löcher in einem Steckergehäuse eines Simplexsteckers steckbar sind. Auf der Oberseite des plattenförmigen Elementes ist ein bügelförmiges Element angeordnet, das im zusammengesetzten Zustand die Rastbügel der Simplexsteckverbinder umgreift, so dass durch Betätigung des bügelförmigen Elementes die beiden Rastbügel der Simplex-Steckverbinder simultan lösbar sind. Die Simplex-Steckverbinder sind an beiden Seiten ihres Gehäuses mit Löchern ausgebildet, so dass jeder Simplex-Steckverbinder an einer beliebigen Seite des Duplexverbinders anordenbar ist. Dadurch ist beispielsweise eine nachträgliche Vertauschung der Kanäle durch Austausch bzw. Wechsel der Simplex-Steckverbinder möglich. Mittels des Duplexverbinders lässt sich somit aus zwei Simplex-Steckverbindern ein Duplex-Steckverbinder herstellen. Ein weiterer Vorteil ist, dass bei Defekt eines Simplex-Steckverbinders nur dieser defekte Steckverbinder ausgetauscht werden muss. Nachteilig an dem bekannten Duplexverbinder ist die mangelnde Qualität der mechanischen Verbindung sowie deren beschränkte Verwendbarkeit.

Der Erfindung liegt daher das technische Problem zugrunde, einen Duplexverbinder für Glasfasersteckverbinder zu schaffen, der universell einsetzbar ist und eine verbesserte mechanische Verbindung zwischen Duplexverbinder und Steckverbinder realisiert.

Die Lösung des technischen Problems ergibt sich durch den Gegenstand mit den Merkmalen des Patentanspruchs 1. Weitere vorteilhafte Ausgestaltungen der Erfindung ergeben sich aus den Unteransprüchen.

Hierzu sind die Befestigungseinrichtungen derart ausgebildet, dass diese das Steckergehäuse und/oder den Knickschutz eines aufzunehmenden Steckverbinders mindestens teilweise umschließen. Dadurch wird der aufzunehmende Steckverbinder von der Befestigungseinrichtung festgeklemmt, wobei die Klemmkräfte sich entsprechend der Ausbildung der Befestigungseinrichtung um das Steckergehäuse bzw. die verteilen. Ein weiterer Vorteil des erfindungsgemäßen Duplexverbinders ist, dass dieser keinerlei mechanische Vorhaltungen am Steckverbinder selbst benötigt. Dadurch ist der Duplexverbinder universell für Steckverbinder verschiedener Hersteller verwendbar.

In einer bevorzugten Ausführungsform sind die Befestigungseinrichtungen als C-förmige Aufnahmen ausgebildet, so dass diese den jeweiligen Knickschutz federnd festklemmen. Dabei sind die offenen Schenkel der C-förmigen Aufnahme vorzugsweise mit einer Fase ausgebildet, um das Einführen des Steckverbinders zu erleichtern.

In einer weiteren bevorzugten Ausführungsform schließt sich in Längsrichtung des Duplexverbinders an die C-förmige Aufnahme eine rechtwinklige Aufnahme an. Diese rechtwinklige Aufnahme dient zum Festklemmen eines Teils des Steckergehäuses. Somit wird der Steckverbinder gleichzeitig an dem Knickschutz und dem Steckergehäuse von dem Duplexverbinder festgeklemmt, was eine besonders feste mechanische Verbindung bewirkt.

Die rechtwinklige Aufnahme ist vorzugweise im Wesentlichen L-förmig ausgebildet, wobei die offenen Schenkel vorzugsweise mit einer Fase ausgebildet sind. Weiter ist die L-förmige Aufnahme mit einem Steg

ausgebildet, der über die Oberseite des Steckergehäuses ragt.

In einer weiteren bevorzugten Ausführungsform ist auf der Oberseite ein bügelförmiges Element so angeordnet, dass im befestigten Zustand der Simplex-Steckverbinder deren Bügel übergreift, so dass durch Betätigung des bügelförmigen Elementes die beiden Bügel der Simplex-Steckverbinder simultan betätigt werden.

Die Erfindung wird nachfolgend anhand eines bevorzugten Ausführungsbeispiels näher erläutert. Die Fig. zeigen:

Fig. 1 eine perspektivische Rückansicht eines Duplexverbinders,
Fig, 2 eine perspektivische Vorderansicht des Duplexverbinders,
Fig. 3 eine Seitenansicht des Duplexverbinders,
Fig. 4 eine Explosionsdarstellung des Duplexverbinders mit zwei Simplex-Steckverbindern,
Fig. 5 eine Duplex-Steckverbindung aus einem Duplexverbinder und zwei Simplex-Steckverbindern im zusammengesetzten Zustand und
Fig. 6 eine Seitenansicht der Duplex-Steckverbindung.

Der Duplexverbinder 1 umfasst eine Oberseite 2 und eine Unterseite 3, zwischen denen mittig ein stegförmiges Wandelement 4 angeordnet ist. An jeder Seite des Wandelementes 4 ist eine C-förmige Aufnahme 5 und eine L-förmige Aufnahme 6 angeordnet. Die C-förmigen Aufnahmen 5 erstrecken sich über die volle Breite 3 des Duplexverbinders 1. Die Stirnseiten 7 der oberen Schenkel sind mit einer Fase 8 und die Stirnseiten 9 der unteren Schenkel sind mit einer Fase 10 ausgebildet. Die Stirnseite 9 des unteren Schenkels erstreckt sich über die volle Länge L des Duplexverbinders 1, wohingegen die Stirnseite 7 sich nur bis zur L-förmigen Aufnahme 6 erstreckt. Parallel zur Oberseite 2 des Duplexverbinders 1 ist im

Bereich der L-förmigen Aufnahme 6 ein Steg 11 angeordnet, der etwas schmaler als die Breite B des Duplexverbinders 1 ist. Der Steg 11 ist ebenfalls mit einer Fase 12 ausgebildet. Die Länge der C-förmigen Aufnahme 5 ist dabei etwas mehr als doppelt so groß wie Länge der L-förmigen Aufnahme 6. An der Oberseite 2 ist ein bügelförmiges Element 13 angeordnet, das sich in einem Winkel von der Vorderseite zur Rückseite erstreckt und in einen zur Oberseite 2 parallelen Teil übergeht.

In der Fig. 4 ist der Duplexverbinder 1 aus den Fig. 1-3 mit zwei Simplex-Steckverbindern 14 dargestellt. Die beiden Simplex-Steckverbinder 14 sind vollkommen identisch aufgebaut. Jeder Simplex-Steckverbinder 14 umfasst das eigentliche Glasfaserkabel 15, eine Kabelmantelfixierung 16, einen Knickschutz 17 und das Steckergehäuse 18. Der Knickschutz 17 setzt sich zusammen aus einem konischen und einem zylindrischen Teil, wobei der zylindrische Teil dem Steckergehäuse 18 zugewandt ist. An dem Steckergehäuse 18 ist ein Schnapp-Bügel 19 angeordnet, der zum Verrasten und Lösen des Steckverbinders 14 in einer entsprechenden Aufnahme dient. Das Steckergehäuse 18 selbst ist im Westentlichen quaderförmig ausgebildet. Der Schnapp-Bügel 19 setzt sich aus einem Rastbügel 20 und einem Lösebügel 21 zusammen, was anhand Fig. 6 näher erläutert wird.

In der Fig. 5 ist der komplette Duplex-Steckverbinder 22 dargestellt. Dabei ist der zylindrische Teil des Knickschutzes 17 in der C-förmigen Aufnahme 5 und ein Teil des Steckergehäuses 18 in der L-förmigen Aufnahme 6 festgeklemmt. Durch das seitliche Umgreifen der Aufnahmen 5,6 durch die Stirnseiten 7,9 mit ihren Fasen 8,10 ist die Klemmverbindung mechanisch sehr stabil. Das bügelförmige Element 13 steht dabei über beiden Bügeln 19 der beiden Simplex-Steckverbinder 14, so dass diese simultan gelöst werden können.

Wie aus Fig. 6 ersichtlich, stehen die Lösebügel 21 über den Rastbügeln 20

und das bügelförmige Element 13 über den Lösebügeln 21. Wird nun der Duplex-Steckverbinder 22 in eine entsprechende Aufnahme gesteckt, so rasten die Rastbügel 20 in der Aufnahme ein. Durch Druck auf den schrägen Teil des bügelförmigen Elementes 13 werden die Lösebügel 21 ebenfalls nach unten gedrückt. Diese wiederum drücken die Rastbügel 20 nach unten, so dass alle Bügel entrastet werden und der Duplex-Steckverbinder 22 gelöst werden kann.

Bezugszeichenliste

1) Duplexverbinder
2) Oberseite
3) Unterseite
4) Wandelement
5) C-förmige Aufnahme
6) L-förmige Aufnahme
7) Stirnseite des oberen Schenkels
8) Fase
9) Stirnseite des unteren Schenkels
10) Fase
11) Steg
12) Fase
13) bügelförmiges Element
14) Simplex-Steckverbinder
15) Glasfaserkabel
16) Kabelmantelfixierung
17) Knickschutz
18) Steckergehäuse
19) Schnapp-Bügel
20) Rastbügel
21) Lösebügel
22) Duplex-Steckverbinder

Patentansprüche

1) Duplexverbinder für Glasfaserverbinder, umfassend zwei Befestigungseinrichtungen zur Aufnahme zweier Simplex-Steckverbinder zur Bildung eines Duplex-Steckverbinders, **dadurch gekennzeichnet, dass** die Befestigungseinrichtungen derart ausgebildet sind, dass diese das Steckergehäuse (18) und/oder einen Knickschutz (17) eines aufzunehmenden Steckverbinders (14) mindestens teilweise umschließen.

2) Duplexverbinder nach Anspruch 1, dadurch gekennzeichnet, dass die Befestigungseinrichtungen als C-förmige Aufnahmen (5) ausgebildet sind.

3) Duplexverbinder nach Anspruch 2, dadurch gekennzeichnet, dass sich an die C-förmige Aufnahme (5) eine rechtwinklige (6) Aufnahme anschließt.

4) Duplexverbinder nach Anspruch 3, dadurch gekennzeichnet, dass die rechtwinklige Aufnahme (6) im Wesentlichen L-förmig ausgebildet ist.

5) Duplexverbinder nach einem der vorangegangenen Ansprüche, dadurch gekennzeichnet, dass auf der Oberseite (2) ein bügelförmiges Element (13) angeordnet ist, dass im befestigten Zustand der Simplex-Steckverbinder (14) deren Bügel (19) übergreift.

6) Duplex-Steckverbinder, umfassend einen Duplexverbinder (1) nach einem der vorangegangenen Ansprüche und zwei Simplex-Steckverbinder (14).

FIG.1

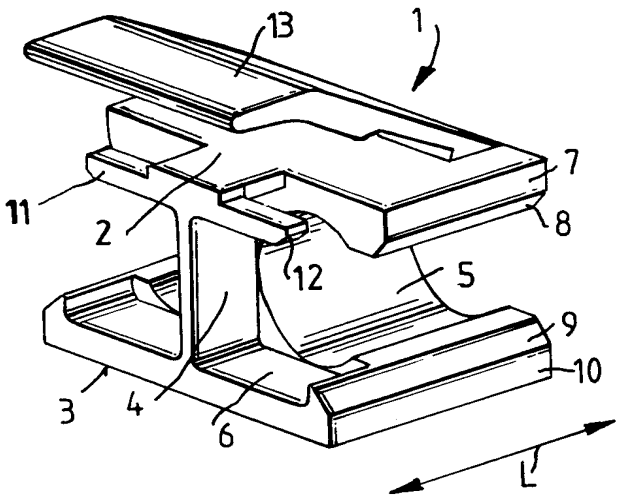


FIG.2

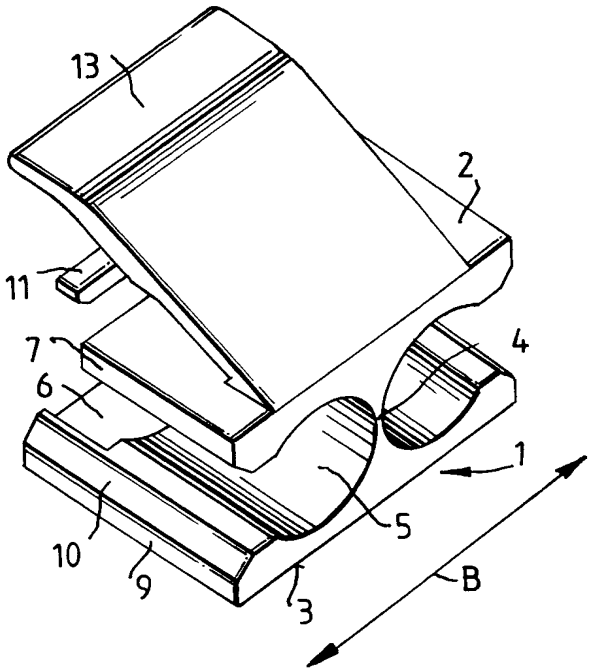
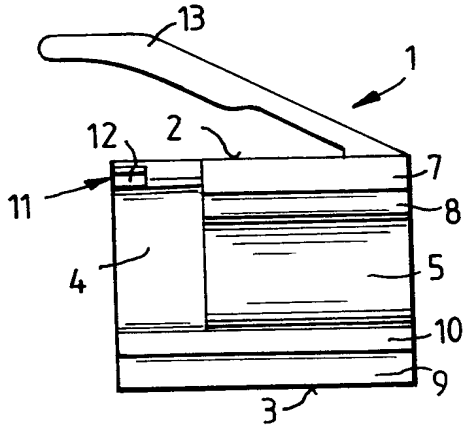


FIG.3



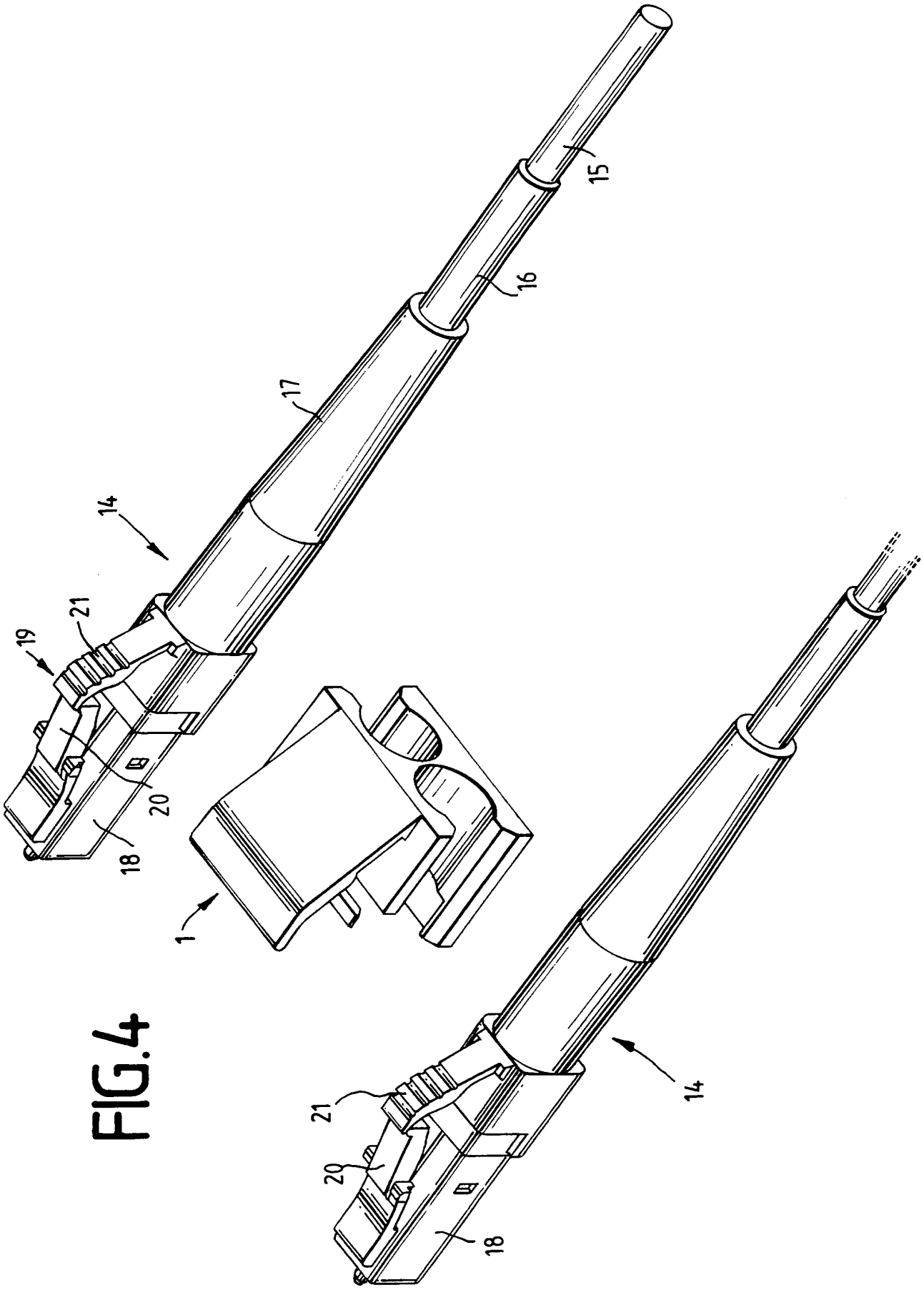


FIG.4

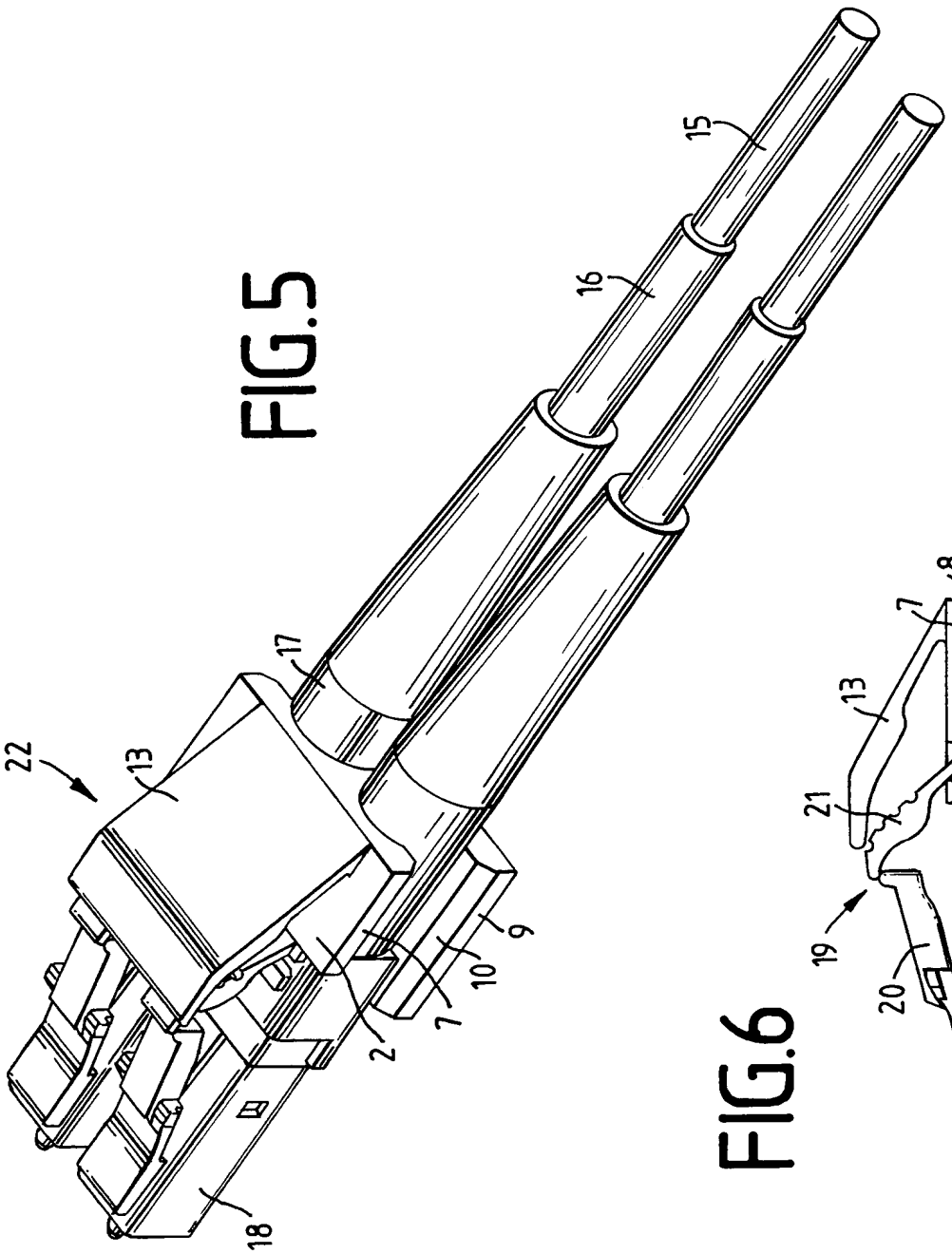


FIG.5

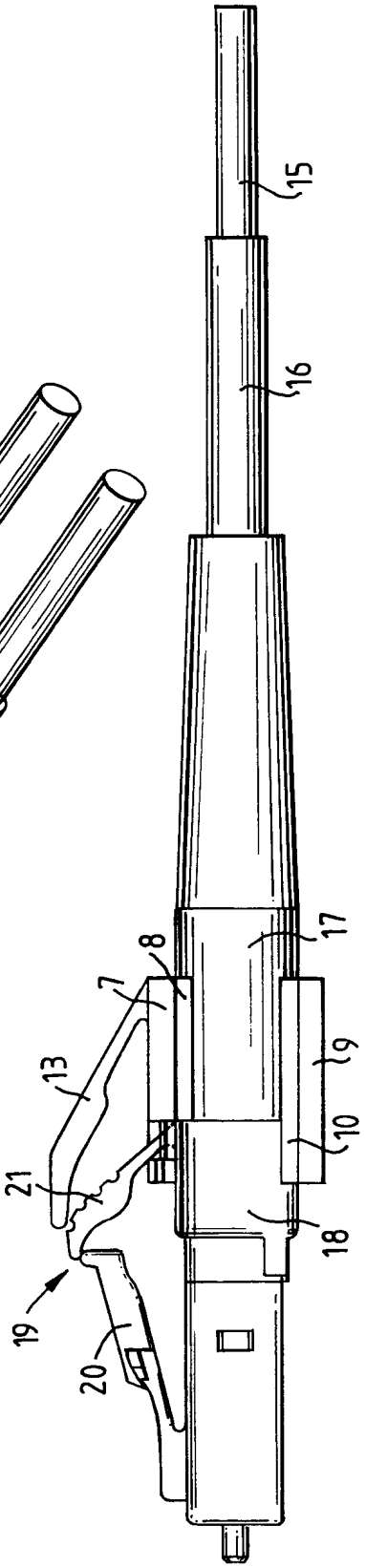


FIG.6

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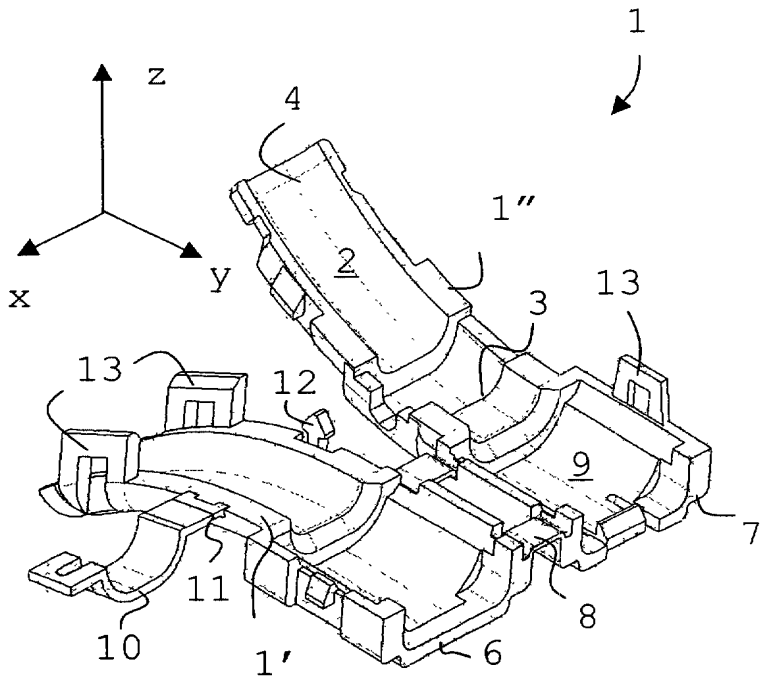
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[Continued on next page]

(54) Title: CABLE GUIDE



(57) Abstract: The invention relates to a cable guide comprising a passage (2) for guiding at least a portion of at least one cable (15) between a proximal end (3) and a distal end (4) of the passage (2) and at least one cable tie (10,1) for mounting the cable (15) to the cable guide (1,1″). The cable tie (10,1) is movable with respect to the cable guide (1,1″) for releasably attaching the cable (15) to the cable guide (1,1″). Preferably the cable tie comprises a hinged member or a releasable member or a rotating member, which member can be moved or replaced, with respect to the cable guide. By providing such a cable tie (10) the passage of the cable guide (1) can be made available for accommodating or releasing a cable, such as a flat fibre optical cable.

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Cable guide

The invention relates to a cable guide comprising:

- a passage for guiding at least a portion of at least one cable between a proximal end and a distal end of said passage, and
- at least one cable tie for mounting said cable to said cable guide.

US 6,134,370 discloses a fibre optical cable guide for removable placement on a fibre optical cable. The cable guide comprises extensions configured to wrap around at least a portion of the cable. The cable can be released from the cable guide by pulling the cable such that it is freed from the extensions. The cable guide has a first end with a hook portion for attaching the cable guide to a boot of the fibre optical cable.

However, the cable guide according to the prior art comprises several limitations with regard to installability in the field, such as a significant danger of damage or breakage of the optical fibres when pulling the cable out of the rigid extensions of the cable guide and limited flexibility with regard to flat fibre optical cables.

It is an object of the invention to provide a cable guide with an improved field installability.

This object is achieved by providing a cable guide characterised in that said at least one cable tie is movable with respect to said cable guide for releasably attaching said cable to said cable guide. Preferably the cable tie comprises a hinged member or a releasable member or a rotating member, which member can be moved or replaced, with respect to the cable guide. By providing such a cable tie the passage of the cable guide can be made available for accommodating or releasing a cable, such as a flat fibre optical cable. During such an operation, no substantial pulling forces have to be applied to the cable and therefore chances of damage or breakage of the optical fibres of the cable are substantially reduced.

In a preferred embodiment of the invention the passage of the cable guide is curved. Such a cable guide may e.g. be used for routing or re-routing of the cable. It is well known that fibre optical cables are susceptible to mechanical stress in that the signal transmission quality may significantly decrease if these stresses are too high. However, optical cables need to be guided or routed in various directions in spaces that are often severely limited or restricted, such as behind a backpanel. As a result significant curvature or bending of these optical cables is often unavoidable. The curve of the passage thus may not have a curvature beneath the minimum bend radius resulting in significant degradation of the cable.

In a preferred embodiment the cable guide comprises a housing at the proximal end providing a further passage for the cable that is substantially aligned with the passage of the cable guide. This housing may be adapted to be mounted to a connector. The housing and/or cable guide may comprise hinging means for making available the passage or passage and further passage for said cable.

It should be appreciated that the embodiments, or aspects thereof, may be combined.

The invention also relates to a cable comprising a cable guide as described above. Cables may be provided with cable guides that are releasably mounted to these cables by the cable tie means, as a result of which a guide or routing direction does not have to be decided upon prior to installing the cable. Moreover, re-routing of cables is less complex. These cables may e.g. be flat fibre optical cables.

The invention also relates to a method for guiding a cable using a cable guide as described above.

The invention also relates to a method for guiding a cable from a first direction to a second direction using a cable guide as described above, comprising the steps of:

- releasing said cable pointing in said first direction from said cable tie;
- orienting said cable guide or a second cable guide such that said distal end points in said second direction;

- attaching said cable by said cable tie in accordance with said passage.

The embodiments of the invention will be described into more detail below with reference to the attached drawing of which

Figs. 1A-H show a cable guide according to an embodiment of the invention in various stages of use;

Fig. 2 shows a backpanel wherein various cable guides are employed;

Figs. 1A-H show a cable guide 1 according to an embodiment of the invention in various stages of use.

As shown in Fig. 1A a cable guide 1, that may comprise parts 1' and 1", comprises a passage 2 extending between a proximal end 3 and a distal end 4, and a housing 5 (see Fig. 1C). Housing 5 is located at the proximal end 3 of the passage 2. Housing 5 comprises a first part 6 and a second part 7 that are connected via hinging means 8. In Fig. 1A housing 5 is shown in an opened state. Housing 5 provides a further passage 9 substantially aligned to the passage 2. The cable guide 1 comprises a cable tie 10 connected via a hinge 11. It is noted that the cable tie 10 can alternatively be connected to the cable guide 1 as a rotating member, wherein the passage 2 can be made accessible or available by first moving cable tie 10 in the z-direction and afterwards e.g. rotate the cable tie 10 substantially in the x-y plane. In yet another alternative the cable tie 10 is adapted to be entirely released from the cable guide 1. The cable tie 10 may be closed by applying locking means 12, such as a pin adapted to co-operate with the cable tie 10. The entire cable guide 1 may be closed and locked by employing the locking means 13.

It is noted that alternatively the part 1" may alone constitute the cable guide and that the cable tie function is performed by the part 1' for releasably attaching a cable. In such a case the cable tie 1' is movable via the hinging means 8 with regard to the cable guide 1" providing the passage 2. The cable tie 1' can be locked by employing the locking means 13.

In Fig. 1B a cable guide 1 is shown, wherein the hinging means 8 are located in a different position compared to the embodiment shown in Fig. 1A. Fig. 1C shows a closed cable guide 1. The handling member 14 can be used for e.g. pushing the cable guide during installation.

Fig. 1D shows a cable guide 1 as shown already in Fig. 1A, but yet with a cable 15 attached. Cable tie 10 is employed to attach the cable 15 to the cable guide 1. According to an aspect of the invention the cable 15 can be attached to the cable guide 1 without prior knowledge of the preferred direction, for cable tie 10 is adapted to easily release and subsequently attach again the cable 15 to the cable guide 1 in the preferred direction.

Fig. 1E shows the situation wherein the cable guide 1 is closed by employing the hinging means 8 while having a cable 15 attached. The curve of the passage 2 is such that it does not have a curvature beneath the minimum bend radius that results in significant degradation of the cable 15. Cable 15 is represented here as a flat fibre optical cable.

In Fig. 1F housing 5 is shown in abutting position against a connector 16 of cable 15. The connector 16 comprises a body 17 containing a ferrule with guide pins 18. Housing 6 is adapted to be mounted to the connector 15, by e.g. closing housing 5 using the hinging means 8 and subsequent mechanical locking to the connector 16.

In Figs. 1G and 1H the situation is shown wherein the bent cable guide 1 is employed to guide the cable 15 in a first direction 19 and a second direction 20. According to an aspect of the invention the cable 15 can be easily re-routed from the first direction 19 to the second direction 20 by releasing the cable 15 from the cable guide 1 by employing the cable tie 10.

In Fig. 2 a backpanel 21 is shown with MPO connectors comprising coupling sleeve means 22. The coupling sleeve means 22 have been provided with a plurality of cable guides 1, none of them comprising a cable 15 here. The distal ends 4 of the cable guides 1 point in various directions. As a result, cables 15 may be guided or routed in these various directions

by employing these bent cable guides 1 without degradation of the cable caused by severe bending. Note that in Fig. 2 only the passages 2 of the cable guides 1 are visibly and that other cables guides are shown on the backpanel 21 as well. MPO connectors (not visible) with mounted cable guides 1 are inserted into the housings 23 of the back panel 21, wherein the handling means 14 can be used.

For the purpose of teaching the invention, preferred embodiments of the cable guide have been described above. It will be apparent for the person skilled in the art that other alternative and equivalent embodiments of the invention can be conceived and reduced to practice without departing from the true spirit of the invention, the scope of the invention being only limited by the claims.

Claims

1. Cable guide (1;1") comprising:
- a passage (2) for guiding at least a portion of at least one cable (15) between a proximal end (3) and a distal end (4) of said passage (2), and
- at least one cable tie (10;1') for mounting said cable (15) to said cable guide (1;1")

characterised in that
said at least one cable tie (10;1') is movable with respect to said cable guide (1;1") for releasably attaching said cable (15) to said cable guide (1;1").

2. Cable guide (1) according to claim 1, wherein said at least one cable tie (10) comprises a hinged member or a releasable member or a rotating member.

3. Cable guide (1) according to claim 1 or 2, wherein said passage (2) is curved between said proximal end (3) and said distal end (4).

4. Cable guide (1) according to any of the preceding claims, wherein said cable (15) is a flat fibre optical cable.

5. Cable guide (1) according to any of the preceding claims, wherein said cable guide (1) substantially encapsulates said cable (15) from said proximal end (3) to said distal end (4).

6. Cable guide (1) according to any of the preceding claims, wherein said cable guide (1) comprises a housing (5) at said proximal end (3) providing a further passage (9) for said cable (15) substantially aligned to said passage (2).

7. Cable guide (1) according to claim 6, wherein said housing (5) or said cable guide (1) is adapted to be mounted to a connector (16).

8. Cable guide according to any of the preceding claims, wherein said housing (5) and/or said cable guide (1) comprises hinging means (8) for making available said passage (2) or said passage (2) and said further passage (9) for said cable (15).

9. Fibre optical cable (15) comprising at least one cable guide (1) according to any of the preceding claims.

10. Method for guiding a cable (15) using a cable guide (1) according to any of the claims 1-8.

11. Method for guiding a cable (15) from a first direction (19) to a second direction (20) using a cable guide (1) according to any one of the claims 1-8, comprising the steps of:

- releasing said cable (15) pointing in said first direction (19) from said cable tie (10);
- orienting said cable guide (1) or a second cable guide (1) such that said distal end (4) points in said second direction (20);
- attaching said cable (15) by said cable tie (10) in accordance with said passage.
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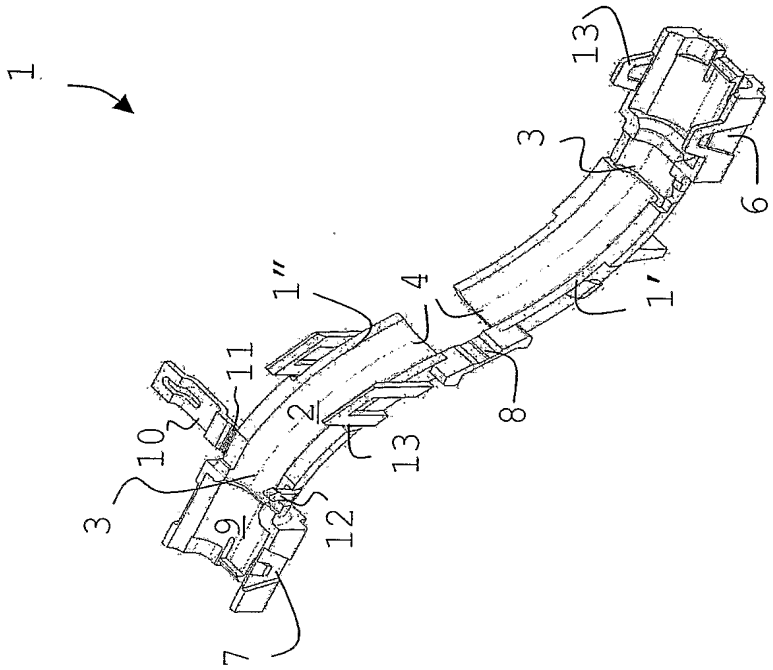


Fig. 1B

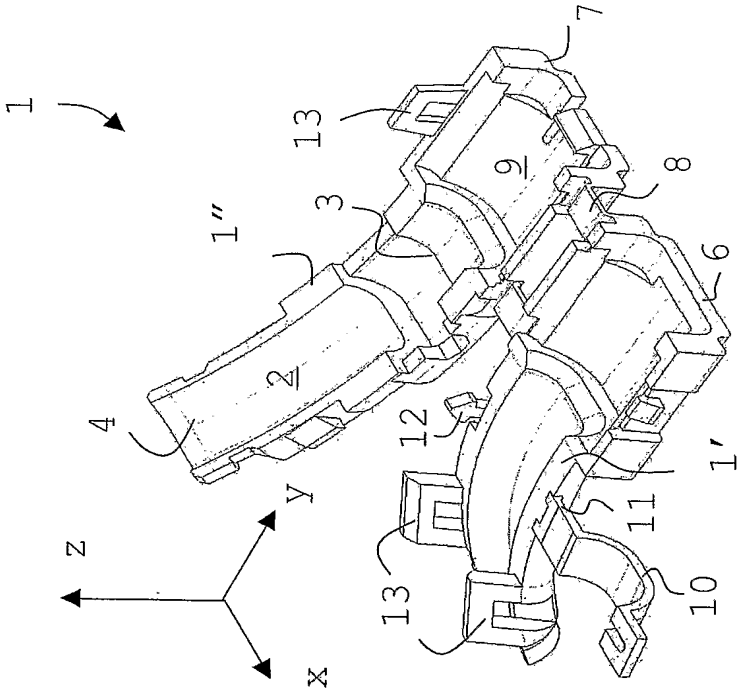


Fig. 1A

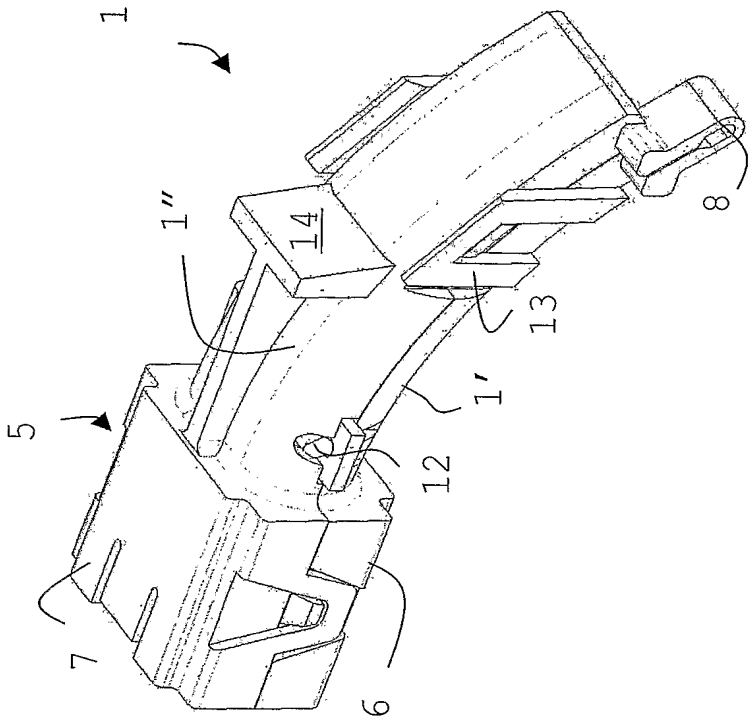


Fig. 1C

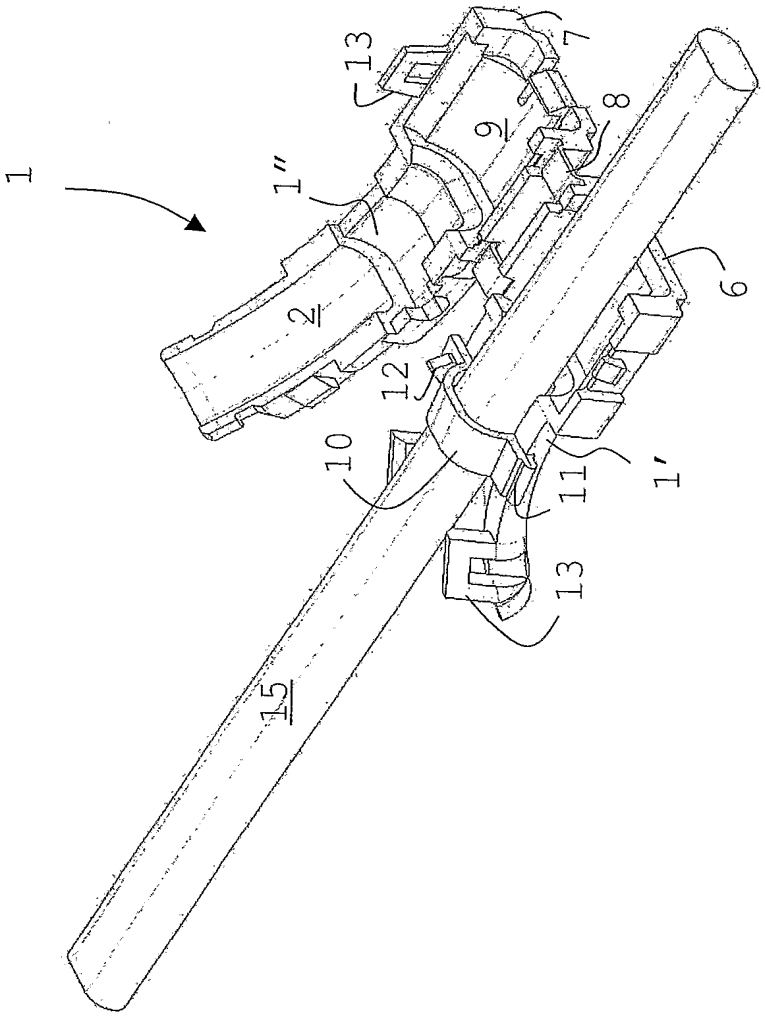


Fig. 1D

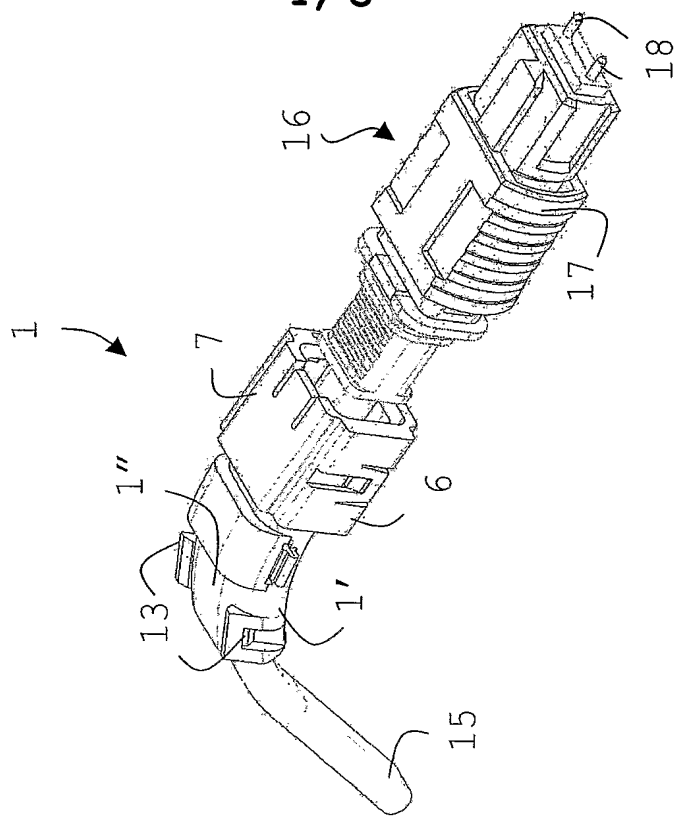


Fig. 1F

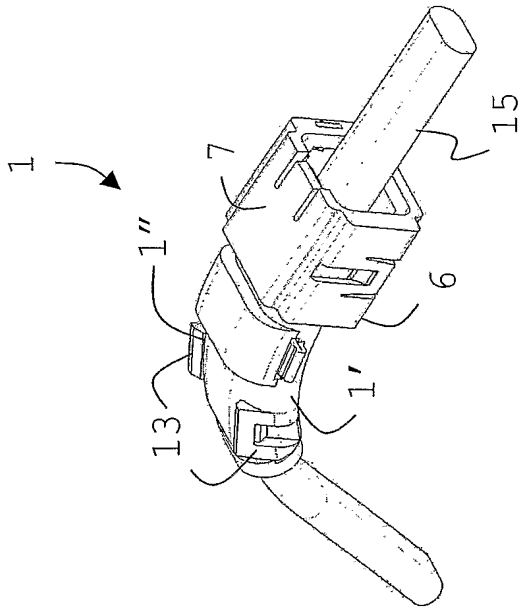


Fig. 1E

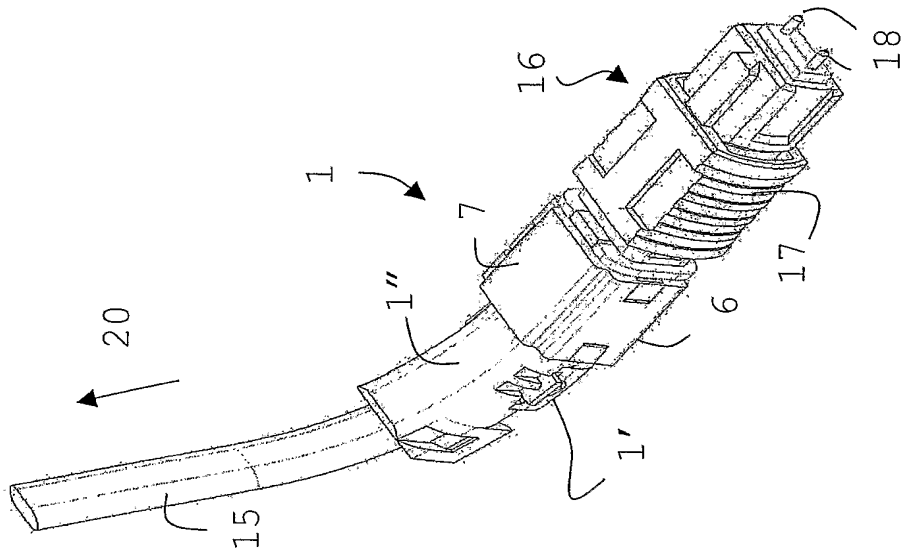


Fig. 1H

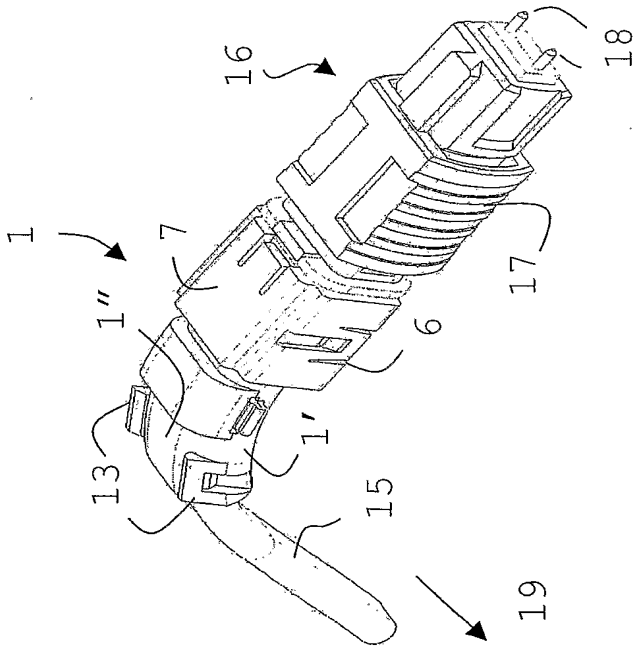


Fig. 1G

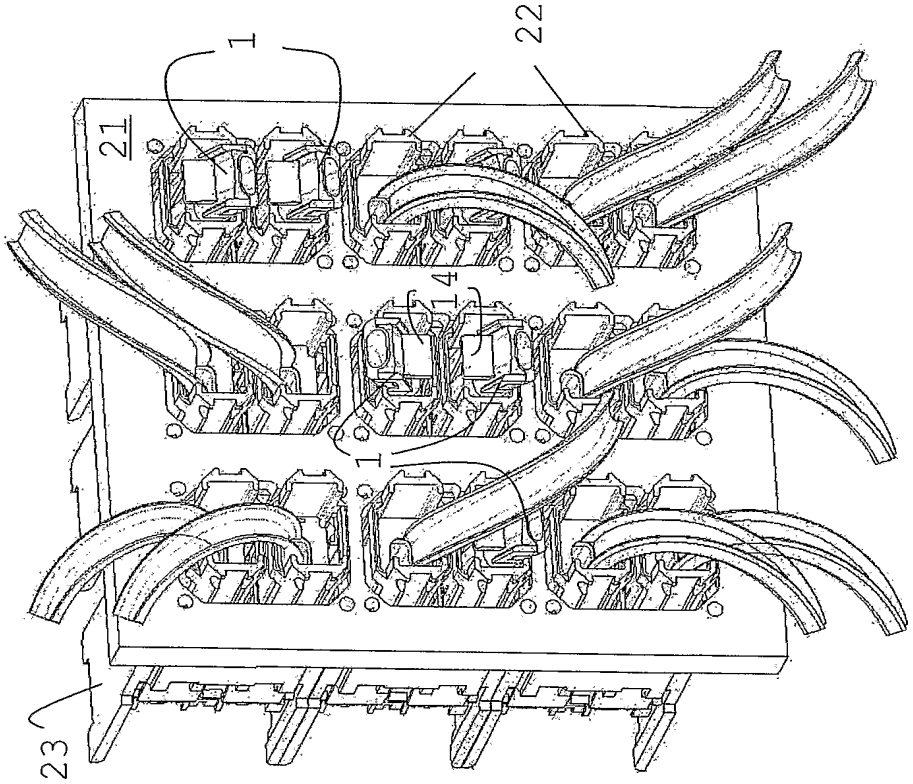


Fig. 2

INTERNATIONAL SEARCH REPORT

International Application No
PCT/EP 03/50637

A. CLASSIFICATION OF SUBJECT MATTER
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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 7 G02B

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

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

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	EP 0 997 756 A (SIECOR OPERATIONS LLC) 3 May 2000 (2000-05-03) cited in the application abstract; figure 15	1
A	FR 2 402 883 A (LUCAS INDUSTRIES LTD) 6 April 1979 (1979-04-06) page 3; figures 1,2	1

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in 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 document but published on or after the international filing date

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"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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
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Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016	Malic, K

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0997756 A	03-05-2000	US 6134370 A EP 0997756 A2	17-10-2000 03-05-2000
FR 2402883 A	06-04-1979	FR 2402883 A1	06-04-1979

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(54) **Title:** SINGLE BOOT FOR DUPLEX FIBER OPTIC CONNECTORS

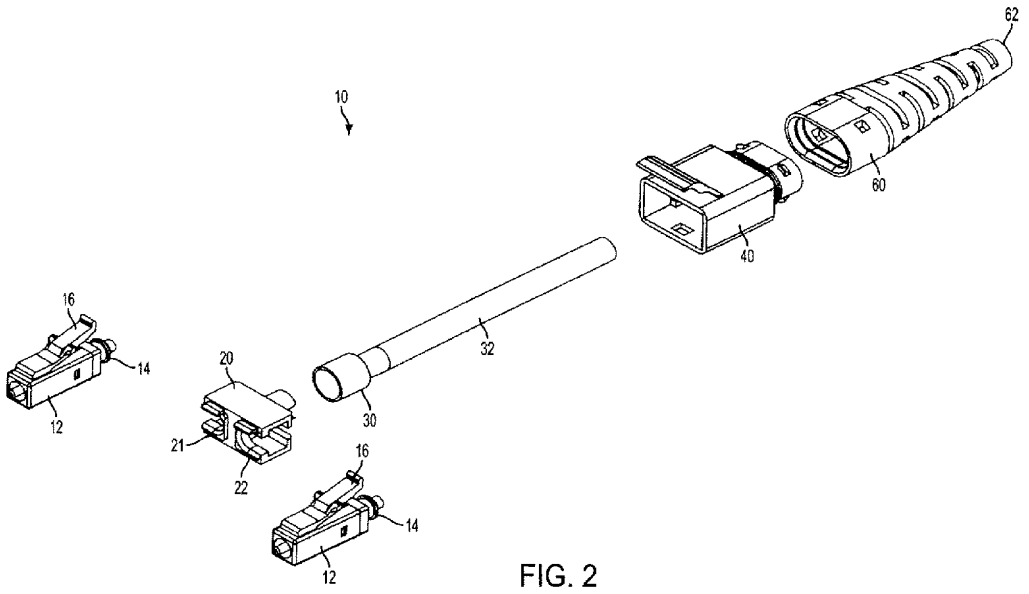


FIG. 2

(57) **Abstract:** An apparatus for holding a first fiber optic connector and a second fiber optic connector includes a housing (40) configured to secure the first fiber optic connector and the second fiber optic connector at a first end and a strain relief boot (60) connected to a second end of the housing. The housing and the strain relief boot are configured to form a passageway to receive a fiber optic cable that is connected to both the first fiber optic connector and the second fiber optic connector.

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— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments*

SINGLE BOOT FOR DUPLEX FIBER OPTIC CONNECTORS

BACKGROUND

This application discloses an invention that is related, generally and in various embodiments, to an apparatus for use with a fiber optic retaining system. Fiber optic cable systems provide a large bandwidth capacity for the transmission of voice and data. In order to extend such systems closer and closer to the premises of the end subscribers, more and more fiber optic connections are required, which often necessitates duplex cable connectors. Such connections are typically made by highly skilled field personnel utilizing specialized tools and equipment.

A conventional way of pairing two connectors to accommodate increased transmission capacity requires many parts, and can make connection to an adapter a difficult task. Often, the connectors can rotate before connection to the adapters, which can cause damage to the hardware. Further, generally, a duplex LC connector includes two cables: one attached to each of the connectors, and these two connectors are held together by a clip. Multiple cables require multiple crimp rings, multiple heat shrink tubes, and multiple boots to attach. This can create a need for more space in order to secure attachment to fiber optic adapters.

SUMMARY OF THE INVENTION

In general, in an aspect, the invention is directed to an apparatus for holding a first fiber optic connector and a second fiber optic connector. The apparatus includes a housing configured to secure a first fiber optic connector and a second fiber optic connector at a first end and a strain relief boot connected to a second end of the housing, wherein the housing and the strain relief boot are configured to form a

passageway to receive a fiber optic cable that is connected to the first fiber optic connector and the second fiber optic connector.

Aspects of the invention may include one or more of the following features. The apparatus can include a back post configured to secure the first fiber optic connector and the second fiber optic connector in a substantially fixed position. The back post can be configured to reside inside the housing. The housing and the back post can be integrally formed. The back post can include a first arcuate chamber to hold the first fiber optic connector and a second arcuate chamber to hold the second fiber optic connector. The apparatus can include a heat shrink tube configured to contain the fiber optic cable in the passageway. The apparatus can include a crimp ring configured to connect the heat shrink tube to the housing. The housing can include a thumb latch configured to release the first fiber optic connector and the second fiber optic connector.

In general, in another aspect, the invention is directed to a duplex fiber optic connector comprising a first fiber optic cable connector, a second fiber optic cable connector, a back post configured to secure the first fiber optic cable connector and the second fiber optic cable connector in a position adjacent one another, and a strain relief boot in connection with the back post and configured to receive a fiber optic cable that connects with the first and second fiber optic cable connectors.

Aspects of the invention may include one or more of the following features. The connector can include a housing configured to encapsulate the back post and connect with the strain relief boot. The connector can include a heat shrink tube configured to create a conduit within the strain relief boot to hold the fiber optic cable. The heat shrink tube can be connected to the back post via a crimp ring. The back

post can include a first arcuate chamber to secure the first fiber optic connector and a second arcuate chamber to secure the second fiber optic connector.

The invention is directed to a connection system by which two fiber optic cable connectors are positioned together for connection to a duplex adapter. The invention includes a single back post, housing and a strain relief boot by which the fiber optic connectors are securely positioned in proximity to one another. The invention may exhibit one or more of the following capabilities. The housing and back post can improve the ease with which a duplex LC connector is received by a duplex LC adapter. For example, the back post can prevent rotation of the duplex LC connector before the connector is connected to the adapter. The invention can decrease the amount of space required for a duplex LC connector or other duplex connectors in order to achieve connection to an adapter.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a duplex fiber optic cable connector and a strain relief boot and crimp ring with a heat shrink tube.

FIG. 2 is an assembly perspective view of a duplex fiber optic cable connector and the strain relief boot.

FIG. 3 is a perspective view of a duplex fiber optic cable connector back post.

FIG. 4 is a perspective view of a duplex fiber optic cable connector housing.

FIG. 5 is a perspective view of a strain relief boot for a duplex fiber optic cable connector.

DETAILED DESCRIPTION

It is to be understood that at least some of the figures and descriptions of the invention have been simplified to focus on elements that are relevant for a clear understanding of the invention, while eliminating, for purposes of clarity, other elements that those of ordinary skill in the art will appreciate may also comprise a portion of the invention. However, because such elements are well known in the art, and because they do not necessarily facilitate a better understanding of the invention, a description of such elements is not provided herein.

The invention is directed to a connection system by which two fiber optic cable connectors are positioned together for connection to a duplex adapter. Embodiments of the invention include a single back post, housing and a strain relief boot by which the fiber optic connectors are positioned in proximity to one another. Embodiments of the invention can be used for connecting two LC style connectors side-by-side. Embodiments of the back post and housing of the invention can accommodate LC connectors that are available on the market without the need for substantial alterations to the LC connectors themselves. The invention can be used to connect two connectors other than LC connectors, such as SC connectors. Other embodiments of the invention are possible and envisioned.

Referring to FIG. 1 and FIG. 2, a duplex fiber optic cable connector apparatus 10 includes LC connectors 12, a back post 20, a crimp ring 30, a shrink tube 32, a housing 40 and a strain relief boot 60. The LC connectors 12 are connected to be positioned side-by-side. The connectors 12 include a thumb latch 16. The fiber optic connectors 12 may be any suitable type of connector (e.g., SC, LC, MT, ST, etc.). The back post 20 is configured to accept the connectors 12. A first connector 12 is inserted into a first side 21 of the back post 20 and a second connector 12 is inserted

into a second side 22 of the back post 20. The crimp ring 30 connects the back post 30 to the shrink tube 32. The shrink tube 32 is inserted through the housing 40 and the boot 60. The shrink tube extends through the distal end 62 of the boot 60. When assembled, as shown in FIG. 1, the back post 20 is positioned inside the housing 40. The connectors 12 extend outside of the housing 40 on an end opposite the position of the boot 60. The apparatus 10 may be fabricated from any suitable material. For example, according to various embodiments, the portions of the apparatus 10, such as the back post 20 and the housing 40, are fabricated from plastic (e.g., a thermoplastic).

Referring also to FIG. 3, the back post 20 includes an arcuate receptacle 26 on each of the sides 21 and 22. The back post 20 is substantially rectangular and is configured to receive the first LC connector 12 in a first arcuate opening 26 on the first side 21, and the second LC connector 12 in a second arcuate opening 26 on the second side 22. The connectors 12 are positioned to rest in the receptacle 26 such that the connectors 12 are substantially parallel to one another and contained within the back post 20 (i.e., such that the connectors 12 do not substantially extend outside of the sides 21, 22 of the back post 20). The connectors 12 are secured in the arcuate receptacles 26. The back post 20 secures the LC connectors 12 in a duplex configuration such that the LC connectors 12 are connected into LC duplex adapters. Preferably, the LC duplex adapters are industry standard adapters. The back post 20 includes a lip 28 configured above the top flat of the connector body. The lip 28 is configured to substantially prevent the connectors 12 from rotating before positioning in the connection system.

The back post 20 includes a cylindrical connection port 24. The port 24 is configured to connect to the crimp ring 30. For example, the port 24 forms a male

connection with the crimp ring 30 and allows for passage of a fiber optic cable into the back post 20 for connection to the connectors 12. The crimp ring 30 is connected to the shrink tube 32. The shrink tube 32 is configured to provide a conduit, or passageway, through which the fiber optic cable passes to the connectors 12 for connection. A fiber optic cable is fastened to the back post 20, for example, using the crimp ring 30, although other fasteners are possible and envisioned.

Referring also to FIG. 4, the housing 40 comprises a first end 41 that inserts into to the back post 20 and a second end 43 that connects to the boot 60. The housing 40 includes a body 44 having an opening 42, a duplex thumb latch 50, and a boot connector 46 having hooks 48. The thumb latch 50 is positioned on the housing 40 such that individual thumb latches 16 for each of the respective LC connectors 12 are triggered by a single thumb latch 50 on the housing 40. The duplex thumb latch 50 is configured to depress the thumb latch 16 of the first LC connector 12 and the thumb latch 16 of the second LC connector 12, preferably at substantially the same time. The thumb latch 50 is configured to improve the efficiency in connection between the duplex LC connectors 12 and adapters (not shown). The LC connectors 12 and back post 20 are secured into the housing 40. The back post 20 is substantially encapsulated within the housing 40.

Referring also to FIG. 5, the strain relief boot 60 is affixed to the housing 40 on an end opposite to the position of the back post 20. The strain relief boot 60 is configured to reduce strain upon the cable inserted into the LC connectors 12. The strain relief boot 60 includes a tapered body 61. The body 61 includes slots 66 and snap holes 64. The snap holes 64 are configured to accept the hooks 48 of the housing 40 such that the housing is secured into position with the boot 60. The slots

66 are positioned along the length of the body 61 and provide flexibility to the boot 60.

The connection system of the duplex connector apparatus 10 operates to couple a fiber optic cable LC connector 12 with a second fiber optic cable LC connector 12 using the single housing 40, the back post 20 and the strain relief boot 60. In general, standard fiber optic connectors 12, such as LC connectors 12, are secured together side-by-side in a duplex configuration. The back post 20 and the housing 40 are configured to secure the connectors 12 in position for efficient connection to an adapter. The boot 60 is configured to secure the fiber optic cables in position such that the cables are not kinked or crimped. The apparatus 10 is configured to improve the ease with which the connectors 12 are connected to an adapter. The apparatus 10 is configured to allow for the reduction of two fiber optic cables to a single cable method. The single cable method used in the apparatus 10 is configured to increase the efficiency in assembling the connector by reducing the parts required for the connection system. The back post 20 and the housing 40 can be comprised of an integrated part. The heat shrink tube 32 and the boot 60 can be comprised of an integrated part.

The foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.

CLAIMS

1. An apparatus for holding a first fiber optic connector and a second fiber optic connector comprising:

a housing configured to secure a first fiber optic connector and a second fiber optic connector at a first end; and

a strain relief boot connected to a second end of the housing,

wherein the housing and the strain relief boot are configured to form a passageway to receive a fiber optic cable that is connected to the first fiber optic connector and the second fiber optic connector.

2. The apparatus of claim 1 further comprising a back post configured to secure the first fiber optic connector and the second fiber optic connector in a substantially fixed position.

3. The apparatus of claim 2 wherein the back post is configured to reside inside the housing.

4. The apparatus of claim 2 wherein the housing and the back post are integrally formed.

5. The apparatus of claim 2 wherein the back post includes a first arcuate chamber to hold the first fiber optic connector and a second arcuate chamber to hold the second fiber optic connector.

6. The apparatus of claim 1 further comprising a heat shrink tube configured to contain the fiber optic cable in the passageway.

7. The apparatus of claim 6 further comprising a crimp ring configured to connect the heat shrink tube to the housing.

8. The apparatus of claim 1 wherein the housing comprises a thumb latch configured to release the first fiber optic connector and the second fiber optic connector.

9. A duplex fiber optic connector comprising:

a first fiber optic cable connector;

a second fiber optic cable connector;

a back post configured to secure the first fiber optic cable connector and the second fiber optic cable connector in a position adjacent one another; and

a strain relief boot in connection with the back post and configured to receive a fiber optic cable that connects with the first and second fiber optic cable connectors.

10. The connector of claim 9 further comprising a housing configured to encapsulate the back post and connect with the strain relief boot.

11. The connector of claim 9 further comprising a heat shrink tube configured to create a conduit within the strain relief boot to hold the fiber optic cable.

12. The connector of claim 11 wherein the heat shrink tube is connected to the back post via a crimp ring.

13. The apparatus of claim 9 wherein the back post includes a first arcuate chamber to secure the first fiber optic connector and a second arcuate chamber to secure the second fiber optic connector.

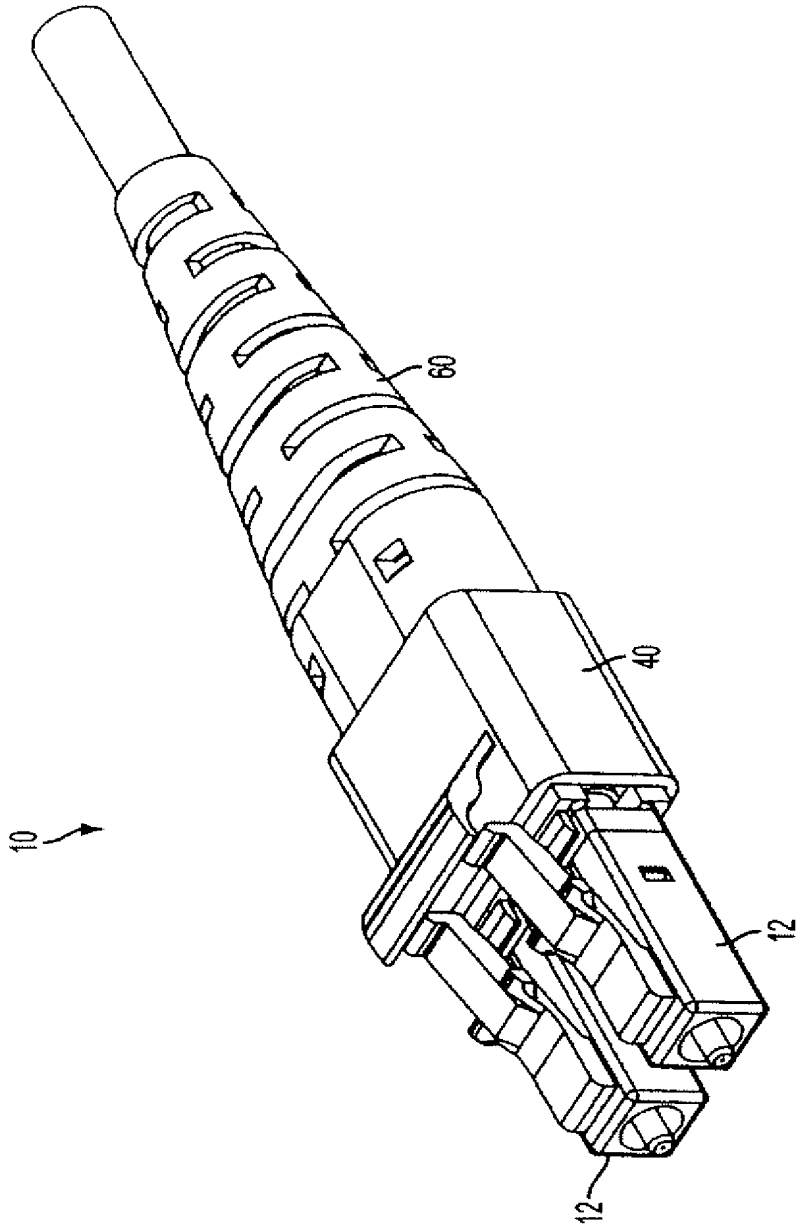


FIG. 1

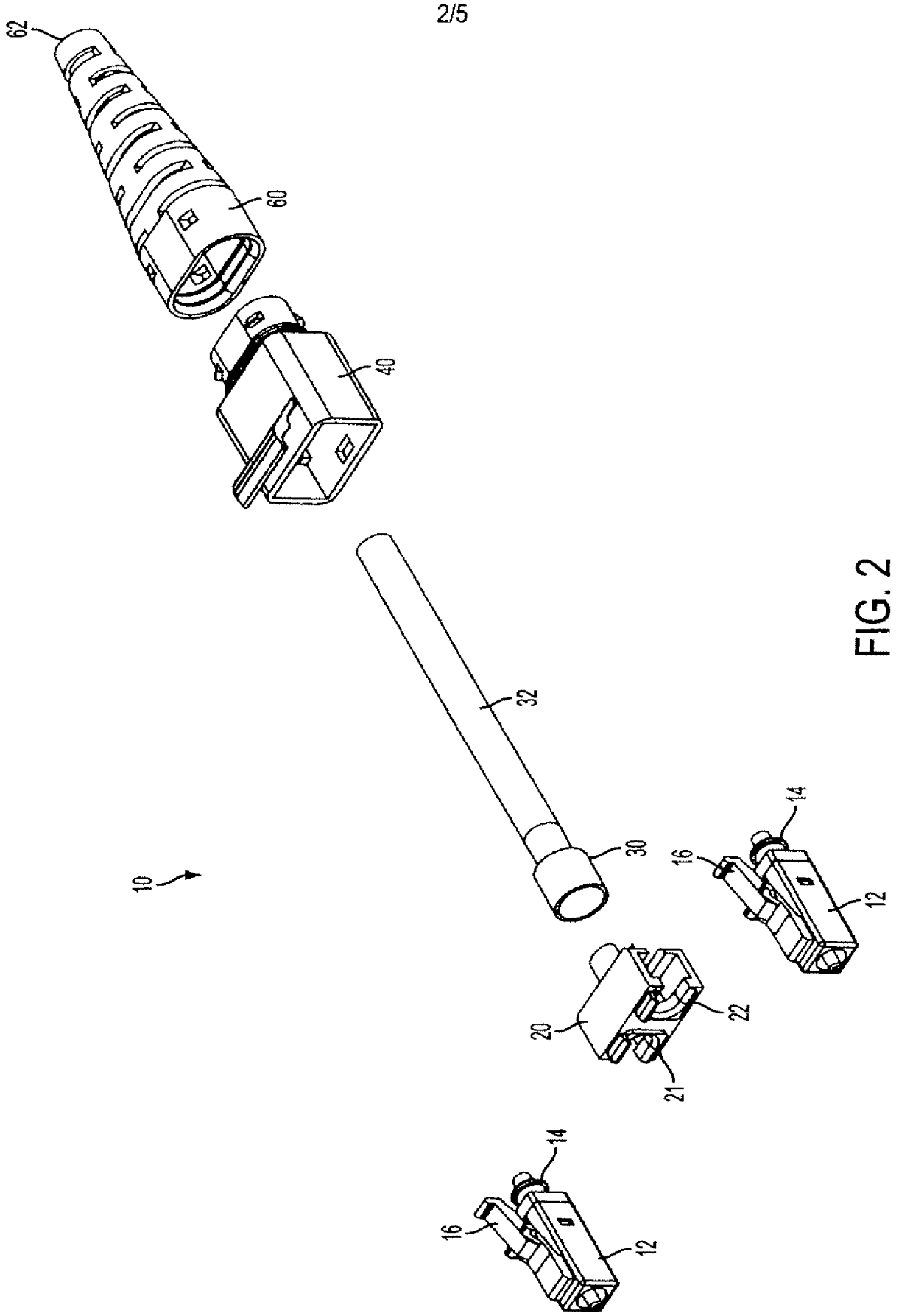


FIG. 2

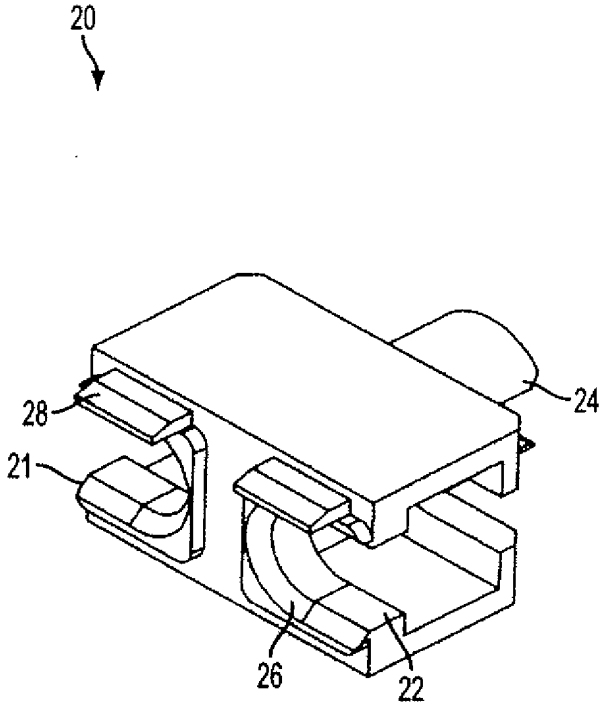


FIG. 3

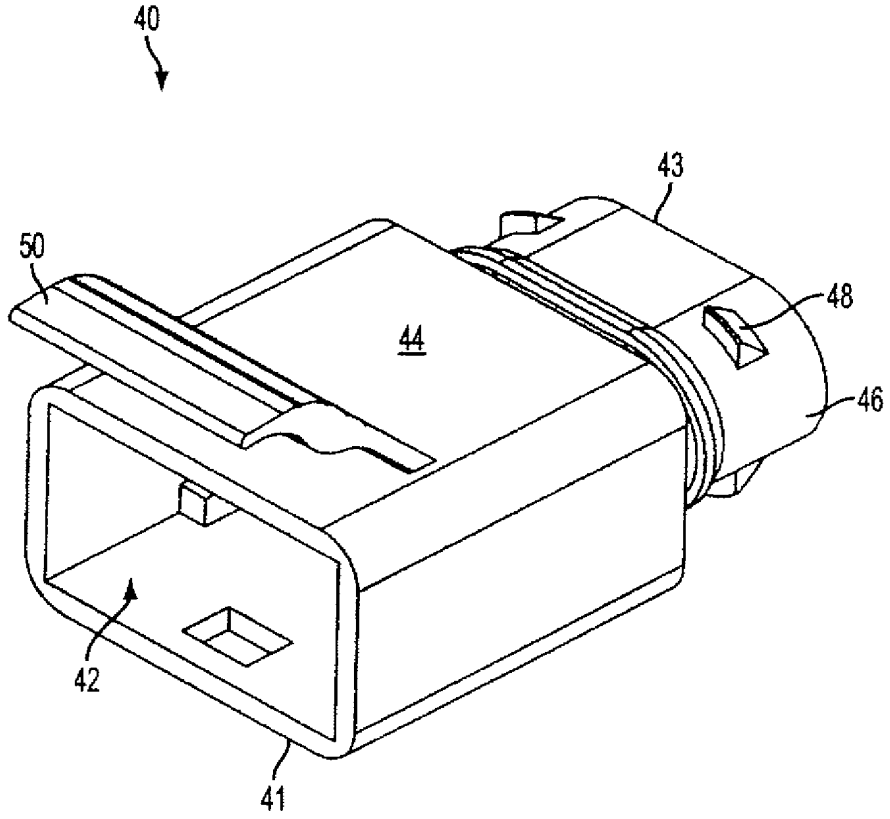


FIG. 4

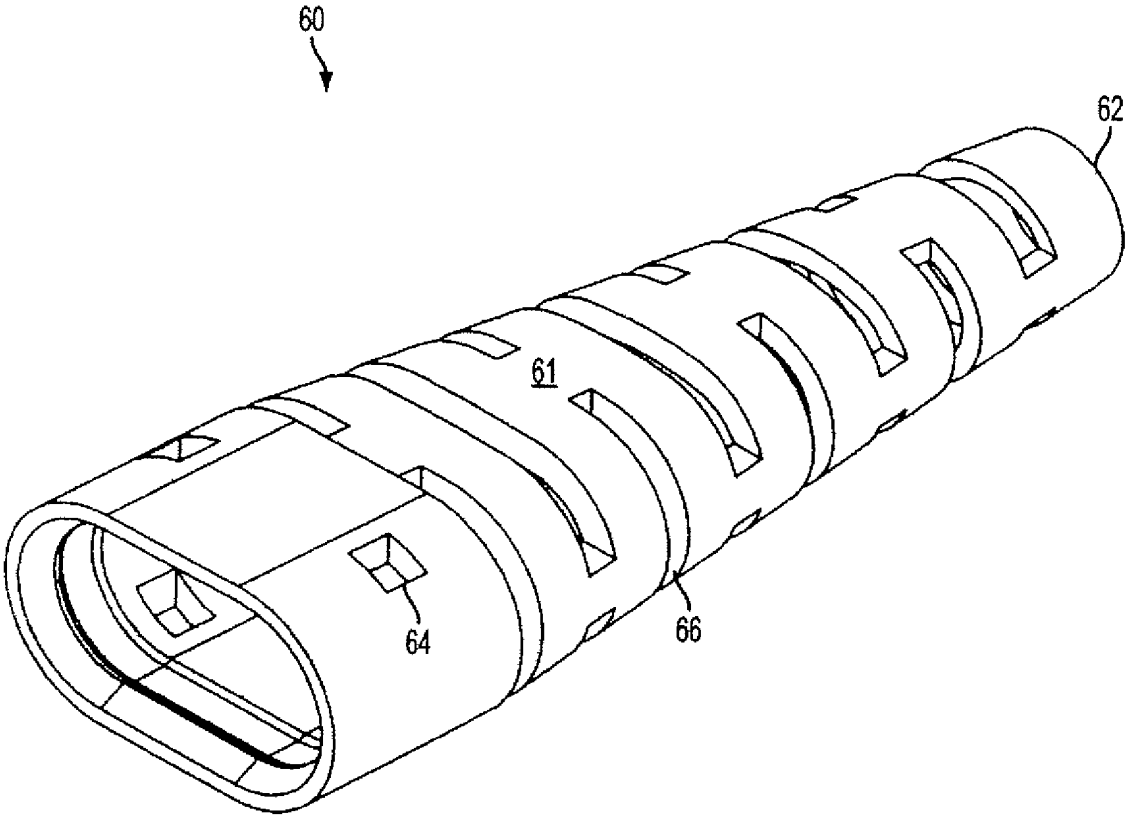


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2008/057023

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/38

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G02B H01R

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 practical, 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	US 2006/089049 A1 (SEDOR THOMAS M [US]) 27 April 2006 (2006-04-27) figures 3-7,10,11,15,20,21	1-5, 8-10,13
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-/--

[X] Further documents are listed in the continuation of Box C.

[X] 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 document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
12 August 2008	21/08/2008

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Bourhis, J

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2008/057023

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/US2008/057023

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(12) NACH DEM VERTRAG ÜBER DIE INTERNATIONALE ZUSAMMENARBEIT AUF DEM GEBIET DES PATENTWESENS (PCT) VERÖFFENTLICHTE INTERNATIONALE ANMELDUNG

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Internationales Büro

(43) Internationales Veröffentlichungsdatum
12. November 2009 (12.11.2009)

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H01R 13/627 (2006.01)

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28. April 2009 (28.04.2009)

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(26) Veröffentlichungssprache: Deutsch

(30) Angaben zur Priorität:
00707/08 7. Mai 2008 (07.05.2008) CH

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(81) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare nationale Schutzrechtsart)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PG, PH, PL, PT, RO, RS, RU, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Bestimmungsstaaten *(soweit nicht anders angegeben, für jede verfügbare regionale Schutzrechtsart)*: ARIPO (BW, GH, GM, KE, LS, MW, MZ, NA, SD, SL, SZ, TZ, UG, ZM, ZW), eurasisches (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), europäisches (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, SE, SI, SK, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Veröffentlicht:

— *mit internationalem Recherchenbericht (Artikel 21 Absatz 3)*

— *vor Ablauf der für Änderungen der Ansprüche geltenden Frist; Veröffentlichung wird wiederholt, falls Änderungen eingehen (Regel 48 Absatz 2 Buchstabe h)*

(54) Title: PLUG CONNECTOR HAVING UNLOCKING MECHANISM

(54) Bezeichnung: STECKVERBINDER MIT ENTRIEGELUNG

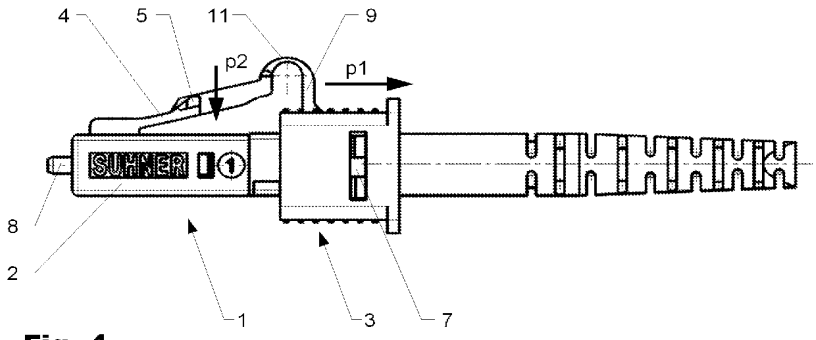


Fig. 4

(57) Abstract: The invention relates to an optical plug connector (1) having an improved unlocking mechanism. A locking arm (4), which protrudes toward the back in a slanted manner, is operatively connected to a collar (7) by way of a bracket (9). By displacing the collar (7) in an unlocking direction (-x), the connector (1) can be unlocked and removed from a sleeve.

(57) Zusammenfassung: Beansprucht wird ein optischer Steckverbinder (1) mit einem verbesserten Verriegelungsmechanismus. Ein schräg nach hinten abstehender Verriegelungsarm (4) ist über einen Bügel (9) mit einer Manschette (7) wirkverbunden. Indem die Manschette (7) in einer Entriegelungsrichtung (-x) verschoben wird, wird der Verbinder (1) entriegelt und kann aus einer Buchse entnommen werden.

WO 2009/135787 A1

STECKVERBINDER MIT ENTRIEGELUNG

Die Erfindung liegt auf dem Gebiet der Steckverbinder, insbesondere Steckverbinder für optische Kabel.

Aus dem Stand der Technik sind Steckverbinder für optische Kabel bekannt. Ebenfalls bekannt sind so genannte LC-Verbinder. Es handelt sich dabei im weiteren Sinn um Push-Pull-Verbinder, die eine hohe Packungsdichte aufweisen. Entsprechende Verbinder werden von der Anmelderin hergestellt, sind aber auch von diversen anderen Herstellern bekannt.

Die europäischen Patente EP 0 762 558 B1 (EP'558) und EP 0 768 547 B1 (EP'547) beschreiben einen optischen Steckverbinder. Der Steckverbinder weist einen Grundkörper zur Aufnahme des optischen Leiters auf. An die Aussenseite des Steckverbinders ist ein elastisch federnd ausgebildetes Auslegerbauglied (auch als Rastverriegelungsglied oder Verriegelungsglied bezeichnet) mit Verriegelungsschultern angeformt, dessen freies Ende gegen das hintere Ende des Steckverbinders gerichtet ist. An der Aussenseite des Steckverbinders ist weiter ein Flansch bzw. Auslöser angeformt, dessen freies Ende schräg nach oben abstehend gegen das vordere Ende des Steckverbinders zeigt und mit dem freien Ende des Verriegelungsglieds wechselwirkt. Wenn das freie Ende des ortsfest angeordneten Auslösers elastisch federnd niedergedrückt wird, wird das freie Ende des Verriegelungsglieds gegen die zentrale Achse gedrückt und der Steckverbinder kann durch ein nach hinten Ziehen am Grundkörper aus der Buchse gezogen werden, wenn bzw. solange der Auslöser hierbei gleichzeitig niedergedrückt wird. Ein Nachteil besteht in der ungünstigen Führung der Kräfte: Da für das Niederdrücken des Auslösers eine nach vorne gerichtete, aber für die Entnahme des Verbinders aus einer Buchse eine nach hinten gerichtete Kraft erforderlich ist, lässt sich der Verbinder nur vergleichsweise schwierig entriegeln.

Das europäische Patent EP 1 091 227 B1 (EP'227) offenbart eine weitere Ausführungsvariante eines Steckverbinders mit einem fix positionierten Auslöser. Am Grundkörper ist ein Verriegelungsglied angeformt. Der Steckverbinder umfasst weiter ein manschettenartiges Verstärkungselement (als Joch bezeichnet) mit quadratischem Querschnitt, welches einen Teilbereich des Grundkörpers senkrecht zur zentralen Achse des Steckverbinders vollständig umschliesst. Am Verstärkungselement ist weiter ein elastisch federnd ausgebildeter Auslöser angeformt, dessen freies Ende – analog wie bei EP'588 und EP'547– mit dem freien Ende des am Grundkörper angeformten Verriegelungsglieds zusammen wirkt. Bei der Herstellung bzw. dem Zusammenbau des Steckverbinders wird das Verstärkungselement entlang der zentralen Achse auf den Grundkörper geschoben und in einer definierten Position fixiert. Wie bei EP'588 und EP'547 kann der Steckverbinder aus der Buchse gezogen werden, wenn der Auslöser auf das Verriegelungsglied niedergedrückt und gleichzeitig der Steckverbinder bzw. Grundkörper nach hinten gezogen wird.

Das US-Patent US 6,565,262 B2 zeigt eine weitere Aufführungsvariante eines Steckverbinders mit einem fix positionierten Auslöser. Wie bei EP'277 ist an einem Grundkörper des Steckverbinders ein schräg nach hinten abstehendes Verriegelungsglied angeformt, welches ebenfalls durch einen Auslöser betätigt werden kann. Der Auslöser ist an einer in axialer Richtung fix angeordneten Schutzmanschette mit im Wesentlichen C-förmigem Querschnitt angeformt. Die Schutzmanschette kann sowohl in einer von der zentralen Achse abweichenden Richtung auf den Grundkörper oder den Leiter aufgeschnappt werden wie auch in Richtung der zentralen Achse gegen und auf den Grundkörper geschoben werden. In der bestimmungsgemässen Funktionsposition ist die Schutzmanschette fix am Grundkörper befestigt bzw. positioniert; Vorsprünge der Schutzmanschette greifen in korrespondiere Aussparungen des Grundkörpers. Der Steckverbinder kann aus der Buchse entfernt werden, wenn – wie beim vorangehenden Stand der Technik - der Auslöser nach unten gedrückt und der Steckverbinder gleichzeitig nach hinten gezogen wird. Hierbei erfolgt keine Verschiebung der Schutzmanschette auf bzw. gegenüber dem Grundkörper.

In der US-Patentanmeldung US 2004/ 0247252 A1 (US252) ist ein Steckverbinder offenbart, welcher aus einem Grundkörper und einem Entriegelungselement besteht. Der Grundkörper und das Entriegelungselement werden formschlüssig aneinander gekoppelt und sind derart ausgebildet, dass in Richtung der zentralen Achse ein optischer Leiter aufgenommen werden kann. Über ein Scharnier ist auf der Aussenseite des Grundkörpers ein schräg nach hinten abstehendes Verriegelungsglied angebracht. Der Grundkörper weist seitlich weiter eine durchgehende Ausnehmung auf, welche mit einer Zunge des Entriegelungselements wechselwirkt und den Hub der Verschiebung zwischen dem Grundkörper und dem Entriegelungselement entlang der zentralen Achse bestimmt. Das Entriegelungselement umfasst einen von der zentralen Achse abstehenden, formfesten Aufbau mit einem Schacht, welcher das freie Ende des Verriegelungsglieds aufnimmt. Beim nach hinten Ziehen des Entriegelungselements entlang der zentralen Achse wird das Verriegelungsglied gegen den Grundkörper gedrückt und hierbei der Steckverbinder entriegelt, so dass der Steckverbinder aus der Buchse gezogen werden kann. Im Vergleich zum vorangehend gewürdigten Stand der Technik muss hier der Auslöser während dem nach hinten Ziehen nicht niedergedrückt gehalten werden während das Entriegelungselement – und nicht das Grundgehäuse –nach hinten gezogen wird. Ein Nachteil besteht darin, dass das Entriegelungselement einen sehr komplizierten Aufbau aufweist.

Die US-Patente US 6,752,538 B1, US 6,821,024 B2 und US 7,052,186 B1 zeigen jeweils einen Steckverbinder oder ein Paar gekoppelter Steckverbinder mit einer Vorrichtung, welche ein ungewolltes Entriegeln verhindern sollen. Um ein ungewolltes Entriegeln des Verriegelungsglied zu verhindern, ist auf dem Grundkörper eine in Richtung der zentralen Achse verschiebbare Sicherheitsmanschette angebracht. Mit dem hinteren Ende des Betätigungselements kann die Sicherheitsmanschette einerseits nach vorne geschoben werden, so dass das vordere Ende des Betätigungselements unter das Verriegelungsglied greift, dieses hiermit nach oben drückt und zusätzlich arretiert, d.h. gegen ein unbeabsichtigtes Lösen schützt. Wird die Sicherheitsmanschette nach hinten geschoben, liegt das vordere Ende des Betäti-

gungselements nicht mehr unter dem Verriegelungsglied, welches somit zum Entriegeln des Verbinders wie gewohnt nach unten gedrückt werden kann.

Aus US 5,984,531 ist eine optischer Verbinder bekannt, der eine integrierte Abdeckung aufweist, welche beim Einstecken des Verbinders selbsttätig öffnet und beim Ausstecken wieder verschliesst. Ein am hinteren Ende des Gehäuses angebrachter und nach schräg vorne abstehender Arm dient als Verriegelungsglied. Ein von hinten bis zu einem Anschlag in das Gehäuse eingepresste Hülse mit einem angeformten Crimphals schliesst den Verbinder nach hinten ab. Die Hülse dient gleichzeitig als Widerlager zur Abstützung einer im Innern angeordneten Feder welche zwischen der Hülse und einem Ferrulenhalter eingespannt ist und diese aktiv nach vorne drückt.

US 6,206,581 ist auf einen optischen Verbinder mit einem einteilig ausgebildeten Gehäuse gerichtet. Ein Verriegelungsglied ist im vorderen Bereich des Gehäuses an einer Seitenwand angeformt und steht nach schräg hinten oben ab. Es ist federnd ausgebildet und kann in seinem hinteren Bereich zur Entriegelung elastisch gegen die Seitenwand des Gehäuses gedrückt werden. Um das Gehäuse zu verschliessen wird von hinten eine mit seitlich abstehenden Verriegelungselementen versehene Hülse in eine Längsöffnung des Gehäuses eingesetzt bis die Verriegelungselemente der Hülse in entsprechend vorgesehenen seitlichen Öffnungen des Gehäuses einrasten. Der Querschnitt der Längsöffnung ist zumindest am hinteren Ende rechteckig oder polygonal ausgestaltet. Das Gehäuse weist im hinteren Bereich in Längsrichtung verlaufende Schlitze auf, die ein nach aussen Biegen der Gehäuseseiten beim Einrasten der Verriegelungselemente ermöglichen. Der Querschnitt der Hülse ist so ausgestaltet, dass die Hülse im eingerasteten Zustand aufgrund ihrer formschlüssigen Ausgestaltung nicht um ihre Längsachse drehen kann. Ein von hinten auf das Verbindergehäuse aufgestecktes Entriegelungselement weist eine nach schräg vorne und oben abstehende Entriegelungslasche auf, die nach vorne unten auf das hintere Ende des Verriegelungselementes gedrückt werden kann, so dass dieses entriegelt. Je nach Ausgestaltung kann so mehr als

ein Verbinder gleichzeitig entriegelt werden. Weitere Verbinder ähnlicher Natur sind aus US 5,481,634, respektive US 5,579,425 bekannt. Die Gehäuse dieser Verbinder werden am hinteren Ende durch einen entsprechend ausgestalteten durch Spritzgiessen hergestellten Deckel verschlossen.

Ein Nachteil der aus dem Stand der Technik bekannten Lösungen besteht in der ungünstigen Führung der Kräfte beim Entriegeln, beziehungsweise dem komplizierten Aufbau. Viele der bekannten Verbindern erfordern dass beim Lösen von der Buchse zwei Bewegungen – das nach unten Drücken des Auslösers und das nach hinten Ziehen des Steckverbinders - annähernd synchron erfolgen müssen. Andere Steckverbinder zeichnen sich durch einen komplizierten Aufbau auf, der sich nachteilig auf die Herstellkosten niederschlägt.

Eine Aufgabe der Erfindung besteht darin, die Nachteile der aus dem Stand der Technik bekannten Verbinder zu überwinden. Eine weitere Aufgabe der Erfindung besteht darin, einen optischen Verbinder zu zeigen, der sich durch eine vereinfachte Bedienbarkeit auszeichnet.

Die Aufgabe wird durch den in den unabhängigen Patentansprüchen definierten Verbinder gelöst.

Im Unterschied zu den aus dem Stand der Technik bekannten Verbindern weist ein erfindungsgemässer Verbinder einen einfach herzustellenden Aufbau auf. Ausserdem werden die für die Entriegelung und die Entnahme notwendigen Kräfte so aufeinander abgestimmt, dass die Bedienung merklich erleichtert wird.

Weitere Vorteile bestehen in der im Vergleich zu den aus dem Stand der Technik bekannten Verbindern höherer Packungsdichte, welche sich vorteilhaft auf die Anordnung auswirkt. Es können mehrere Verbinder, resp. Verbinderpaare auf engeren Raum übereinander und/ oder

nebeneinander angeordnet werden. Die Verbinder weisen eine geringere Bauhöhe auf. Andererseits ist die Entriegelung bei hohen Packungsdichten dennoch unproblematisch, da es nicht erforderlich ist den Entriegelungshebel wie üblich von oben her nach unten zu drücken. Einfach gesagt, sind die Finger beim Entriegeln ausserhalb des Bereichs der Verriegelungsarme.

Verbinder der gattungsgemässen Art weisen einen weitgehend normierten Aufbau mit einem ein- oder mehrteiligen Grundkörper und einem daran angebrachten nach schräg hinten abstehenden Verriegelungsarm auf. Die Verbinder sind derart ausgestaltet, dass sie in dafür vorgesehene Buchsen eingeklinkt werden können. Seitlich am Verriegelungsarm vorstehende Verriegelungsschultern werden dabei in einen Hintergriff der Buchse eingeschnappt und verhindern damit ein ungewolltes Herausrutschen des Verbinders aus der Buchse. Der Verriegelungsarm kann zum Entriegeln gegen den Grundkörper gedrückt werden, derart, dass die Verriegelungsschultern aus dem Hintergriff bewegt werden und so den Verbinder zur Entnahme aus der Buchse freigeben. Der Grundkörper weist eine durchgehende Öffnung auf, in der eine optische Faser angeordnet ist. Am vorderen Ende mündet die optische Faser in eine in Längsrichtung federnd gelagerte Ferrule, üblicher Weise aus Keramik. Am hinteren Ende weisen die Verbinder in der Regel einen Crimphals auf, der zum Anschluss eines Kabelmantels des optischen Kabels dient. Im Innern des Verbinders ist in der Regel eine Feder angeordnet, welche gegen einen im Bereich des hinteren Endes der Ferrule angebrachten Blocks drückt. Die Gehäuse der Verbinder werden typischer Weise aus spritzgegossenem Kunststoff hergestellt.

Bei den aus dem Stand der Technik bekannten Verbindern muss in der Regel zum Entriegeln ein Bügel nach vorne unten gedrückt werden, bevor der Verbinder in entgegen gesetzter Richtung nach hinten aus einer Buchse entnommen werden kann. Diese Kräfteverhältnisse sind ungünstig, da während dem eine Kraft nach vorne unten, eine grössere Gegenkraft nach hinten überlagert werden muss um den Verbinder zu entriegeln und zu entnehmen.

Bei einer Ausführungsform der Erfindung wird dieser Nachteil vermieden, indem zum Entriegeln primär eine Kraft nach hinten - also in Entnahmerichtung - erforderlich ist. Durch diese vektorielle Gleichschaltung der Kräfte wird die Bedienung merklich vereinfacht. Konstruktiv wird dies erreicht, indem auf einem Grundkörper des Verbinders ein gegenüber diesem verschiebbares Entriegelungselement angeordnet ist, welches mit einem Verriegelungsarm wirkverbunden ist.

Das Entriegelungselement weist in der Regel ein Verschiebeelement auf, das Gegenüber dem Grundkörper verschiebbar ist. Ein am Verschiebeelement angeformter oder mit diesem wirkverbundener Bügel dient zur Transformation der Bewegung des Verschiebeelementes in eine Kraft, welche zum Entriegeln des Verriegelungsbügels dient. Der Bügel ist dabei derart ausgestaltet, respektive mit dem Verriegelungsarm wirkverbunden, dass der Verbinder problemlos in eine Buchse eingeschnappt werden kann, d.h. der Verriegelungsarm kann die für die Verriegelung notwendige Bewegung in Richtung des Grundkörpers ohne grossen Aufwand und Behinderung ausführen.

Eine Ausführungsform der Erfindung betrifft einen Steckverbinder mit einem Grundkörper und einem im Bereich des vorderen Endes des Grundkörpers angeformten, nach hinten schräg abstehenden, gelenkigen Verriegelungsarm. Ein manschettenartiges Verschiebeelement umgibt den hinteren Bereich des Grundkörpers zumindest bereichsweise und ist gegenüber diesem in Längsrichtung verschiebbar. Das Entriegelungselement ist mit dem Verriegelungsarm über einen Bügel wirkverbunden. Durch Verschieben des Entriegelungselementes in eine Entriegelungsrichtung wird, der wirkverbundene Verriegelungsarm entriegelt. Je nach Ausgestaltung und Anwendungsgebiet können der Bügel und der Verriegelungsarm und/ oder der Bügel und das Verschiebeelement einteilig ausgebildet sind. Dünnstellen, z.B. in Form von Filmscharnieren, garantieren dabei die erforderliche Beweglichkeit. Je nach Ausgestaltung kann das Verschiebeelement fest oder lösbar mit dem Grundkörper wirkverbunden sein. Bei einer lösbaren Ausgestaltung kann das Verschiebeelement einen C- oder U-

förmigen Querschnitt aufweist, welcher den Grundkörper teilweise umschliesst. Das Verschiebeelement kann derart ausgestaltet sein, dass es auf einem oder mehrere Verbinder gleichzeitig aufgeschnappt werden kann. Bei einer nicht lösbaren Ausgestaltung kann das Verschiebeelement einen ringförmig geschlossenen Querschnitt aufweisen, welcher den Grundkörper umgibt.

Die Entriegelungskräfte, sowie die für die Entnahme aus der Buchse erforderlichen Entnahmekräfte werden normaler Weise vom Verschiebelement über den Bügel auf den Verriegelungsarm und von da auf den Grundkörper übertragen. Durch Ziehen am Verschiebeelement wird zuerst der Verriegelungsarm entriegelt und dann der Grundkörper des Verbinders aus der Buchse gezogen. Bei Bedarf können das Verschiebeelement und/ oder der Grundkörper Mittel zur Begrenzung der Verschiebung, z.B. in Form von mechanischen Anschlägen aufweisen.

Bei Bedarf weist der Steckverbinder Kopplungsmittel auf, die zum seitlichen Wirkverbinden mit einem weiteren Steckverbinder dienen. Je nach Anwendungsgebiet können die Kopplungsmittel am Grundkörper und/ oder dem Verschiebeelement angeordnet sein. In einer Ausführungsform handelt es sich bei den Kopplungsmitteln um vorstehende Zapfen und mit ihnen korrespondierend ausgebildete Vertiefungen, die ein gegenseitiges Verdrehen der Steckverbinder verhindern.

Die Kopplungsmittel können so ausgestaltet sein, dass durch sie zwei Verbinder fest miteinander verbunden werden können. Alternativ oder in Ergänzung kann eine Halteklammer (Verbinderklammer) vorgesehen werden, die zur Aufnahme von zwei oder mehreren Verbindern geeignet ist. Die Halteklammer kann zum gemeinsamen Entriegeln der Verbinder geeignet sein.

Wie schon oben erwähnt ist aus US2004/ 0247252 (US252) ein Verbinder mit einem sehr komplizierten Aufbau bekannt. Obschon auch dieser Verbinder einen verschiebbaren Teil aufweist, kann er bezüglich dem Aufbau und der Funktionsweise nicht mit einem Verbinder gemäss der hier offenbarten Erfindung verglichen werden, der sich unter anderem wesentlich einfacher herstellen lässt. Der aus US252 bekannte Verbinder weist einen verschiebbaren Hinterteil auf, der den gesamten hinteren Bereich des Verbinders bildet. Der verschiebbare Teil wirkt je nach Ausführungsform mit dem Verriegelungsarm über eine oder mehrere kurze, steile im Innern des Gehäuses angeordnete Rampen zusammen. Die Rampen sind an einem starren, nicht deformierbaren Aufbau angeordnet. Durch Verschieben des Hinterteils gegenüber einem Vorderteil des Verbinders wird der Verriegelungsarm durch Rutschen entlang der Rampe nach unten gedrückt und der Verriegelungsarm dadurch entriegelt. Nachteile dieser Ausgestaltung sind neben der auftretenden, konstruktionsbedingten Gleitreibung, der komplizierte Aufbau, der sich negativ auf die Herstellkosten des Verbinders auswirkt. Ein weiterer Nachteil besteht darin, dass die Rampe aufgrund ihrer Ausgestaltung und Anordnung und Neigung ungünstige Kräfteverhältnisse ergibt. Ein weiterer Nachteil besteht darin, dass aufgrund der Ausgestaltung nicht klar definiert ist, wann der Verbinder entriegelt ist. Ausserdem ist nicht ersichtlich ob überhaupt durch ein Ziehen am hinteren Teil der Verbinder nicht nur entriegelt, sondern auch entnommen werden kann. Diese Nachteile werden durch die erfindungsgemässen Verbinder vermieden.

Die Erfindung soll anhand der in den nachfolgenden Figuren gezeigten Ausführungsbeispiele näher erläutert werden. Es zeigen

Fig. 1 zwei Exemplare einer ersten Ausführungsform eines Steckverbinders in einer perspektivischen Darstellung von schräg vorne und oben;

Fig. 2 zwei neben einander angeordnete Steckverbinder gemäss Figur 1 und eine Verbindeklammer in einer perspektivischen Ansicht von schräg vorne und oben;

Fig. 3 die Steckverbinder gemäss Figur 2 mit wirkverbundener Verbindeklammer in einer perspektivischen Ansicht von schräg vorne und oben;

Fig. 4 die Steckverbinder gemäss Figur 3 in einer Seitenansicht;

Fig. 5 eine zweite Ausführungsform eines Steckverbinders in einer perspektivischen Ansicht von schräg hinten;

Fig. 6 den Steckverbinder gemäss Figur 5 von der Seite;

Fig. 7 den Steckverbinder gemäss Figur 5 von hinten;

Fig. 8 zwei weitere Steckverbinder von schräg oben und miteinander wirkverbunden;

Fig. 9 die beiden Steckverbinder gemäss Figur 8 in getrennter Darstellung und teilweise geschnitten;

Fig. 10 einen Steckverbinder gemäss Figur 8 ohne Entriegelungselement;

Fig. 11 einen Steckverbinder gemäss Figur 8 in einer Explosionsdarstellung;

Fig. 12 ein Entriegelungselement für einen Verbinder und ein Entriegelungselement für zwei Verbinder;

Fig. 13 die beiden Verbinder gemäss Figur 8 in einer Draufsicht;

Fig. 14 eine Schnittdarstellung entlang der Schnittlinie AA gemäss Figur 13.

Sich entsprechende Elemente sind in den Figuren mit identischen Bezugszeichen versehen.

Figur 1 zeigt zwei Verbinder 1 in einer ersten Ausführungsform seitlich neben einander. **Figur 2** zeigt die Verbinder 1 gemäss Figur 1 seitlich zusammengefügt, zusammen mit einer noch nicht wirkverbundenen Verbinderklammer 3. **Figur 3** zeigt die beiden Verbinder 1 gemäss Figur 1 in einer perspektivischen Darstellung von schräg vorne und oben. Die Verbinder 1 sind seitlich nebeneinander und mittels der Verbinderklammer 3 wirkverbunden. **Figur 4** zeigt die Verbinder gemäss Figur 3 von der Seite.

Die Verbinder 1 weisen einen Grundkörper 2 und einen am vorderen Ende des Grundkörpers 1 schräg nach hinten elastisch federnd abstehenden Verriegelungsarm 4 auf. Am Verriegelungsarm 4 sind seitlich vorstehende Verriegelungsschultern 5 angeordnet die zum Einschnappen in entsprechende Ausnehmungen einer korrespondierend ausgebildeten Buchse (nicht dargestellt) dienen. Am vorderen Ende des Grundkörpers 2 ist eine Ferrule 8 zur Aufnahme und zum Verbinden eines optischen Leiters (nicht näher dargestellt) zu erkennen.

Ein Entriegelungselement 6 ist auf dem Grundkörper 2 angeordnet. Es weist eine Manschette (Verschiebelement) 7 auf, welche den Gründkörper 2 zumindest teilweise umgibt und gegenüber diesem in Längsrichtung (x-Richtung) verschiebbar ist. Das Entriegelungselement 6 ist in axialer Richtung vor einer Knickschutzhülle 19 angeordnet.

An der Manschette 7 ist ein Bügel 9 vorstehend angeordnet, der mit dem Verriegelungsarm 4 gelenkig wirkverbunden ist. In der gezeigten Ausführungsform ist die gelenkige Wirkverbindung durch eine oder mehrere Dünnstellen 10 gegeben. Je nach Ausführungsform kann der Bügel 9 elastisch federnd oder starr ausgebildet sein. Die Dünnstellen 10 können als Filmscharniere ausgebildet sein.

Durch Verschieben der Manschette 7 in Richtung des hinteren Endes (-x-Richtung) des Verbinders 1 wirkt der Bügel 9 eine Kraft auf den Verriegelungsarm 4 aus und zieht diesen nach unten in Richtung des Grundkörpers 2. Die Verriegelungsschultern 5 werden dadurch ebenfalls nach unten verschoben, so dass sie entriegelt werden und den Verbinder 1 freigeben. Die auf die Manschette 1 ausgeübten Kräfte dienen gleichzeitig zur Entnahme des Verbinders 1 aus einer Buchse.

Beide Verbinder 1 weisen im Bereich der Manschetten 7 Kopplungsmittel in Form von vorstehenden Elemente 12 auf, die – wie in **Figur 2** dargestellt - in entsprechend ausgestaltete Vertiefungen 13 eines benachbarten Verbinders 1 eingreifen können. Die vorstehenden Elemente 12 und die Vertiefungen 13 dienen zum Wirkverbinden von zwei Verbindern 1 miteinander. Sie verhindern gleichzeitig ein ungewolltes relatives Verdrehen oder Verschieben der Verbinder 1. Die Verbinderklammer 3 weist in der gezeigten Ausführungsform einen im Wesentlichen C-förmigen Querschnitt auf, der die Verbinder 1 auf drei Seiten umgibt. Andere ein oder mehrteilige Ausgestaltungen sind möglich. Die Verbinderklammer 3 kann – wie in **Figur 3** dargestellt – in der gezeigten Ausführungsform von hinten über die Manschetten 7 der beiden Verbinder 1 geschnappt werden, so dass diese fest miteinander und der Verbinderklammer 3 verbunden sind. Die Wirkverbindung wird in gezeigten Ausführungsform durch entsprechende Schnappverbindungsmittel in Form von vorstehenden Elementen 12 und korrespondierend ausgebildeten Ausnehmungen 14.

In dem die Verbinderklammer 3, wie in Figur 4 schematisch angedeutet (Pfeil p1) in Richtung des hinteren Endes des Verbinders 1 gezogen wird (vgl. **Figur 4**), werden die Bügel 9 gestreckt und damit die mit diesen Wirkverbundenen Verriegelungsarme 4 zusammen mit den Verriegelungsschultern 5 in Richtung des Grundkörpers 2 gezogen (Pfeil p2).

Figur 5 zeigt einen erfindungsgemässen Steckverbinder 1 in einer Ansicht von schräg hinten und oben. **Figur 6** zeigt den Verbinder 1 gemäss Figur 4 in einer Seitenansicht. **Figur 7** zeigt den Verbinder in einer Ansicht von hinten.

Der Steckverbinder 1 weist einen Grundkörper 2, einen Verriegelungsarm 4 und ein Entriegelungselement 6 auf. Am hinteren Ende ist ein Crimphals 16 zu erkennen der zum Anschliessen eine optischen Kabels (nicht näher dargestellt) dient.

Der Verriegelungsarm 4 ist am vorderen Ende des Grundkörpers 2 schräg nach hinten oben abstehend angeordnet und elastisch federnd ausgeführt. Der Verriegelungsarm 4 weist beidseits eine Verriegelungsschulter 5 auf, die zur Verriegelung des Steckverbinders 1 in einer korrespondierend ausgebildeten Buchse bekannter Art und Weise dient.

Das Entriegelungselement 6 weist in der gezeigten Ausführungsform ein auf dem Grundkörper 2 verschiebbares, manschettenartiges Verschiebelement 15 mit einem daran angeformten hier in Richtung des Verriegelungsarmes 4 schrägt nach vorne vorstehenden Bügel 17 auf, welcher den Verriegelungsarm 4 im Bereich des hinteren Endes umgibt. Durch das Zusammenwirken mit dem im hinteren Bereich rampenartig (Rampe 11) schräg nach oben verlaufenden Verriegelungsarm 4 wird dieser beim Zurückziehen der Manschette 15 des Entriegelungselementes 5 (Pfeil p1) durch den Bügel 17 in einem definierten Mass nach unten gedrückt. Indem dadurch die Verriegelungsschultern nach unten bewegt werden (Pfeil p2) erfolgt eine Entriegelung des Verbinders. In der gezeigten Ausführungsform verhindert ein mechanischer Anschlag 18 ein Abrutschen des Bügels 17 vom Verriegelungsarm 4. Gleichzeitig kann der Anschlag 18 dazu dienen, für die Entnahme des Verbinders notwendigen Kräfte auf den Verriegelungsarm 4 zu übertragen.

Der Bügel 17 ist in der gezeigten Ausführungsform derart ausgestaltet, dass das hintere Ende 18 des Bügel 4 von aussen bedienbar bleibt und bei Bedarf von Hand niedergedrückt werden kann.

Wie in **Figur 7** zu erkennen ist, ist das Entriegelungselement 6 in der gezeigten Ausführungsform als Schnappelement ausgestaltet, welches nachträglich auf den Verbinder 1 aufgeschnappt werden kann.

Zu diesem Zweck ist die Manschette (Verschiebeelement) 15 im unteren Bereich offen ausgestaltet. Der Querschnitt ist im Wesentlichen C-förmig ausgestaltet. Andere Ausgestaltungen sind möglich. Die Manschette kann aber auch, z.B. durch eine über ein Scharnier angeformte Klappe oder ein Gegenelement geschlossen ausgestaltet sein. Der Bügel 17 kann so ausgestaltet sein, dass er den Verriegelungsarm 4 in einer vorderen Position aktiv nach oben drückt und damit gegen ungewolltes Entriegeln sichert. Bei Bedarf kann der Bügel 17 derart ausgestaltet sein, dass er in einer hinteren Position einrastet und damit den Verriegelungsarm 4 in einer entriegelten Position festhält.

Bei Bedarf kann das Entriegelungselement 6 so ausgestaltet sein, dass es zur Aufnahme und Koordination von mehr als einem Verbinder geeignet ist. In diesem Fall ist das Verschiebeelement 15 so ausgestaltet, dass mehr als ein Grundkörper 1 damit wirkverbunden werden können. In einer Ausführungsform weist der Querschnitt eine doppel-C-förmige Ausgestaltung auf, bei dem die beiden im Wesentlichen C-förmigen Querschnitte Rücken an Rücken oder seitlich aneinander liegen. Andere Ausgestaltungen sind möglich. Das Entriegelungselement dient in diesem Fall zur Halterung und zur Koordination der Bewegungen der beiden Verbinder. Das Entriegelungselement übernimmt in diesem Fall die Funktion der Verbinderklammer 3 des Ausführungsbeispiels aus den Figuren 1 bis 4.

Figur 8 zeigt zwei Verbinder 1 einer dritten Ausführungsform in einer perspektivischen Darstellung von schräg oben. **Figur 13** zeigt die Verbinder 1 gemäss Figur 8 in einer Draufsicht. Figur 14 zeigt einen Schnitt durch die Anordnung von Figur 13 entlang der Schnittlinie AA. Die in den Figuren 8 und 13 dargestellten beiden Verbinder 1 sind mittels einer Verbinderklammer 20, die gleichzeitig als Entriegelungselement 6 dient, miteinander wirkverbunden.

Figur 9 zeigt zwei Verbinder 1 gemäss Figur 8 seitlich nebeneinander. Der vom Betrachter aus gesehen vordere Verbinder 1 ist bereichsweise geschnitten dargestellt, damit der innere Aufbau besser ersichtlich wird. Im Unterschied zur Anordnung gemäss Figur 8 weist jeder Verbinder 1 ein eigenes Entriegelungselement 6 auf. Bei Bedarf können die Entriegelungselemente Wirverbindungsmittel aufweisen (nicht weiter dargestellt), mittels denen zwei Entriegelungselemente zusätzlich miteinander wirkverbunden werden können.

Die Steckverbinder 1 weisen je einen Grundkörper 2, einen Verriegelungsarm 4 und ein Entriegelungselement 6 auf. Der Verriegelungsarm 4 ist am vorderen Ende des Grundkörpers 2 schräg nach hinten oben abstehend angeordnet und in der gezeigten Ausführungsform elastisch federnd ausgebildet (andere Ausgestaltungen sind möglich). Der Verriegelungsarm 4 weist beidseits eine Verriegelungsschulter 5 auf, die zur Verriegelung des Steckverbinders 1 in einer korrespondierend ausgebildeten Buchse bekannter Art und Weise dient. Das Entriegelungselement 6 weist ein gegenüber dem Grundkörper 2 verschiebbares, manschettenartiges Verschiebelement 15 mit einem daran angeformten hier in Richtung des Verriegelungsarmes 4 schrägt nach vorne vorstehenden Bügel 17 auf. Am hinteren Ende weist der Verriegelungsarm 4 eine Verdickung 21 auf, die hier auf jeder Seite des Verriegelungsarmes 4 eine Rampe 22 bildet, welche vom Bügel 17 umgriffen wird. Der Bügel weist dazu pro Seite einen nach innen vorstehenden Zapfen 35 auf. Zum Entriegeln wird das Entriegelungselement 6 auf dem Grundkörper 2, z.B. mit Daumen und Zeigefinger, nach hinten (-x-Richtung) gezogen. Dadurch tritt der Bügel 17, respektive die Zapfen 35 mit den Rampen 22 in Wirkverbindung und drücken dadurch den hinteren Teil des Verriegelungsarmes 4

aufgrund der Neigung der Rampe 22 nach unten gegen den Grundkörper 2. Dadurch werden die Verriegelungsschultern 5 ebenfalls nach unten gezogen, was zu einer Entriegelung des Verbinders 1 führt. Durch die gewählte Anordnung und Ausgestaltung ist eine niedere Bauform mit präziser Führung möglich.

In den **Figuren 9** (vorderer Verbinder), sowie **Figur 14** (Schnittdarstellung entlang Schnittlinie AA gemäss Figur 13, sowie der Explosionsdarstellung gemäss **Figur 11** ist das Innenleben des Verbinders ersichtlich. In **Figur 10** ist der Verbinder gemäss Figur 11 zusammengebaut dargestellt. Der Verbinder gemäss Figur 10 kann bei Bedarf auch ohne Entriegelungselement 6 verwendet werden. In diesem Fall ist auch die Verdickung 21 am Ende des Verriegelungsarmes 4 nicht zwingend erforderlich.

Wie in den **Figuren 9** und **14** zu erkennen ist, weist der Grundkörper 2 in Längsrichtung eine durchgehende Öffnung 23 auf. In diese wird vom hinteren Ende her ein Ferrulenhalter 24 mit einer Ferrule 25 eingeschoben, die zur Aufnahme einer nicht weiter dargestellten Glasfaser dienen. Der Ferrulenhalter 24 wird durch eine vorgespannte Feder 26 gegen eine im Innern der Öffnung 23 ausgebildete Schulter 27 gepresst. Der Ferrulenhalter weist einen polygonalen Querschnitt auf, der mit einer korrespondierend ausgebildeten Vertiefung der Schulter 27 formschlüssig zusammenwirkt. Durch diese Ausgestaltung kann der Ferrulenhalter zur Feineinstellung um seine Achse positioniert werden. Gegen hinten stützt sich die Feder 26 auf einer in den Grundkörper 2 eingepressten Einpresshülse 28 ab, die in der gezeigten Ausführungsform über den Grundkörper 2 vorsteht und gleichzeitig als Crimphals dient. Ähnliche Verbinderkonstruktionen sind von anderen Verbindern aus dem Stand der Technik bekannt (vgl. z.B. US 5,984,531), allerdings gehören diese Verbinder einer anderen Gattung an und bauen wesentlich grösser, so dass sie eine wesentlich grössere Wandstärke im Bereich der Hülse aufweisen. Die Packungsdichte ist entsprechend schlechter im Vergleich zum hier offenbarten erfindungsgemässen Verbinder. Vergleichbare Konstruktionen wurden bis heute bei der hier diskutierten Verbinderklasse von LC-Verbindern als nicht möglich erachtet

und waren daher auch nicht bekannt. Durch die spezielle Ausgestaltung und Abstimmung der Einpresshülse 28 werden die erforderlichen Auszugswerte bei Kabelzug in Längsrichtung des Verbinders und quer dazu erreicht.

Wie in den **Figuren 11** und **13** besonders gut zu erkennen ist, weist die Einpresshülse 28 einen Anschlagrand 29 auf, der die Einpresstiefe der Einpresshülse 28 in die Öffnung 23 des Grundkörpers 2 bestimmt. Im hinteren Bereich weist die Einpresshülse einen Crimphals 16 auf. Bei der Montage des Verbinders 1 an einem Kabel (nicht weiter dargestellt), wird der Kabelmantel auf den Crimphals 16 aufgeschoben und mit einer verpressten Crimphülse 30 fixiert. Ein für die eigentliche Funktion des Verbinders 1 nicht zwingend notwendiger Knickschutz 19 kann als Abschluss auf die Crimphülse 30 aufgeschoben werden.

In der Schnittdarstellung gemäss **Figur 13** ist der Aufbau und das Innenleben des Verbinders 1 in montiertem Zustand zu erkennen. Der Verriegelungsarm 4 weist im Bereich seiner Anbindung am Grundkörper 2 eine Dünnstelle 31 auf, welche das elastische Federverhalten beim Entriegeln verbessert.

Der Ferrulenhalter 24 geht am hinteren Ende in ein flexibel ausgestaltetes Rohr 32 über, welches in montiertem Zustand durch die Feder 26 hindurch bis in die Einpresshülse 28 hineinragt. Durch diese Ausgestaltung wird die erforderliche seitliche Beweglichkeit des Ferrulenhalters 24 im Innern des Grundkörpers 2 nicht behindert. Dennoch wird das Kabel gegenüber der Feder 26 geschützt. Des Weiteren dient das flexible Rohr 29 bei Bedarf als Montagehilfe. Ein weiterer Vorteil besteht darin, dass beim Verkleben des Verbinders verhindert wird, dass Klebstoff mit der Feder 26 und der Einpresshülse 28 ungewollt in Verbindung kommt.

Wie in **Figur 11** zu erkennen ist, weist der Ferrulenhalter 24 am hinteren Ende einen Anschlussbereich 33 auf, auf den das Rohr 32 aufgeschoben und verklebt werden kann. Ande-

re Befestigungsarten sind möglich. Die Einpresshülse 28 weist in der gezeigten Ausführungsform zwei zueinander beabstandete radial vorstehende Zähne 34, die sich beim Einpressen in die Öffnung 23 im Material des Grundkörpers 2 verzahnen. Die Zähne 34 können unterschiedliche Durchmesser aufweisen, was die Wirkung erhöhen kann. Die Länge des aktiven Bereichs (Bereich der eingepresst wird) der Einpresshülse 28 entspricht dem zwei- bis dreifachen des Durchmessers. Im Unterschied zum Stand der Technik sind beim hier offenbarten Verbinder keine Längsverlaufenden Entlastungschlitze im Grundkörper 2 erforderlich. Infolge der Relaxation des Materials werden die Zähne auszugsicher im Material des Grundkörpers eingebettet.

In **Figur 14** sind ein einfaches (a) und das doppeltes (b) Entriegelungselement 6 in einer perspektivischen Darstellung von schräg unten dargestellt. Beide Entriegelungselemente 6 sind als Schnappelement ausgestaltet, welche auf einen (a) oder zwei (b) Verbinder 1 gemäss Figur 10 aufgeschnappt werden können. Zu diesem Zweck ist die Manschette (Verschiebeelement) 15 im unteren Bereich offen ausgestaltet. Der Querschnitt ist im Wesentlichen C-förmig, resp. Doppel-C-förmig ausgestaltet. Andere Ausgestaltungen sind möglich. Die Manschette kann aber auch, z.B. durch eine über ein Scharnier angeformte Klappe oder ein Gegenelement geschlossen ausgestaltet sein. Der Bügel 17 kann so ausgestaltet sein, dass er den Verriegelungsarm 4 in einer vorderen Position aktiv nach oben drückt und damit gegen ungewolltes Entriegeln sichert. Bei Bedarf kann der Bügel 17 derart ausgestaltet sein, dass er in einer hinteren Position einrastet und damit den Verriegelungsarm 4 in einer entriegelten Position festhält.

In **Figur 12 (b)** ist das Entriegelungselement 6 so ausgestaltet sein, dass es zur Aufnahme und Koordination von mehr als einem Verbinder geeignet ist. In diesem Fall ist das Verschiebeelement 15 so ausgestaltet, dass mehr als ein Grundkörper 1 damit wirkverbunden werden können. In einer Ausführungsform weist der Querschnitt eine doppel-C-förmige Ausgestaltung auf, bei dem die beiden im Wesentlichen C-förmigen Querschnitte Rücken an

Rücken oder seitlich aneinander liegen. Andere Ausgestaltungen sind möglich. Das Entriegelungselement dient in diesem Fall zur Halterung und zur Koordination der Bewegungen der beiden Verbinder.

Die Verbinder 1 gemäss den Figuren 8 bis 14 ermöglichen einen besonders niederen Aufbau. Durch die offene (nicht durchgehende) Ausgestaltung des Bügels 17 kann zudem der Verriegelungsbügel 4 von Hand oder mit einem Werkzeug bedient werden.

BEZUGSZEICHENLISTE

1	Verbinder
2	Grundkörper
3	Verbinderklammer
4	Verriegelungsarm
5	Verriegelungsschulter
6	Entriegelungselement
7	Verschiebeelement (Manschette)
8	Ferrule
9	Bügel
10	Gelenk
11	Rampe
12	Vorstehendes Element
13	Vertiefung
14	Ausnehmung
15	Verschiebelement
16	Crimphals
17	Bügel
18	Mechanischer Anschlag
19	Knickschutz
20	Verbinderklammer
21	Verdickung
22	Rampe
23	Durchgehende Öffnung
24	Ferrulenhalter
25	Ferrule
26	Feder
27	Schulter
28	Einpresshülse
29	Anschlagrand
30	Crimphülse
31	Dünnstelle
32	Rohr
33	Anschlussbereich
34	Zahn
35	Zapfen

PATENTANSPRÜCHE

1. Steckverbinder (1) mit einem Grundkörper (2) und einem am vorderen Ende des Grundkörpers (2) angeformten, nach hinten schräg abstehenden, gelenkigen Verriegelungsarm (4) und einem Entriegelungselement (6) das mit dem Verriegelungsarm (4) wirkverbunden und gegenüber dem Grundkörper (2) derart in eine Entriegelungsrichtung (-x) verschiebbar ist, dass der Verriegelungsarm (4) entriegelt wird, **dadurch gekennzeichnet, dass** das Entriegelungselement (6) ein in Entriegelungsrichtung verschiebbares, mit dem Grundkörper (2) wirkverbundenes Verschiebeelement (7, 15) aufweist, wobei das Verschiebelement (7, 15) und der Verriegelungsarm (4) über einen Bügel (9, 17) wirkverbunden sind.

2. Steckverbinder (1) gemäss Anspruch 1, **dadurch gekennzeichnet, dass** der Bügel (9) gelenkig angeordnet ist.

3. Steckverbinder (1) gemäss Anspruch 2, **dadurch gekennzeichnet, dass** der Bügel (9) und der Verriegelungsarm (4) einteilig ausgebildet sind.

4. Steckverbinder (1) gemäss Anspruch 2, **dadurch gekennzeichnet, dass** der Bügel (9) und das Verschiebeelement (7, 15) einteilig ausgebildet sind.

5. Steckverbinder (1) gemäss einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** das Verschiebeelement (7, 15) lösbar mit dem Grundkörper (2) wirkverbunden ist.

6. Steckverbinder (1) gemäss einem der vorangehenden Patentansprüche, **dadurch gekennzeichnet, dass** das Verschiebeelement (7, 15) einen C- oder U-förmigen Querschnitt aufweist, welcher den Grundkörper (2) teilweise umschliesst oder auf diesen

aufgeschnappt ist, oder einen ringförmigen Querschnitt aufweist, welcher den Grundkörper (2) ganz umgibt.

7. Steckverbinder (1) gemäss einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** das Verschiebeelement (7, 15) und/ oder der Grundkörper (2) Mittel zur Begrenzung der Verschiebung in und/ oder entgegen der Entriegelungsrichtung aufweisen.

8. Steckverbinder (1) gemäss einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der Bügel (9, 17) mit dem Verschiebeelement (7, 15) und/ oder dem Verriegelungsarm (4) durch ein Filmscharnier oder ein mechanisches Scharnier wirkverbunden ist.

9. Steckverbinder (1) gemäss einem der Patentansprüche 1 bis 7, **dadurch gekennzeichnet, dass** der Bügel (17) mit dem Verriegelungsarm (4) über eine Rampe (11) zusammenwirkt.

10. Steckverbinder (1) gemäss Patentanspruch 9, **dadurch gekennzeichnet, dass** der Verriegelungsarm (4) eine Rampe (22) aufweist.

11. Steckverbinder (1) gemäss Patentanspruch 10, **dadurch gekennzeichnet, dass** der Verriegelungsarm (22) eine Verdickung aufweist an der seitlich eine Rampe (22) ausgebildet ist.

12. Steckverbinder (1) gemäss Patentanspruch 10, **dadurch gekennzeichnet, dass** das Entriegelungselement (6) einen Bügel (17) mit einem seitlich nach innen vorstehenden Zapfen aufweist, der beim Entriegeln mit der Rampe (22) zusammenwirkt.

13. Steckverbinder (1) gemäss einem der vorangehenden Ansprüche, **dadurch gekennzeichnet, dass** der Steckverbinder (1) Kopplungsmittel (12, 13) zum seitlichen Wirkverbinden mit einem weiteren Steckverbinder (1) aufweist.

14. Steckverbinder (1) gemäss Anspruch 13, **dadurch gekennzeichnet, dass** die Kopplungsmittel (12, 13) auf dem Grundkörper (2) und/ oder dem Verschiebeelement (7, 15) angeordnet sind.

15. Steckverbinder (1) gemäss Anspruch 13 oder 14, **dadurch gekennzeichnet, dass** die Kopplungsmittel (12, 13) aus vorstehenden Zapfen (12) und mit ihnen korrespondierenden Vertiefungen (13) bestehen, die ein gegenseitiges Verdrehen der Steckverbinder (1) verhindern.

16. Steckverbinder (1) gemäss Patentanspruch 10, **dadurch gekennzeichnet, dass** der Grundkörper (2) eine durchgehende Öffnung (23) aufweist, in deren hinteres Endes eine Einpresshülse (28) eingepresst ist.

17. Steckverbinder (1) gemäss Patentanspruch 16, **dadurch gekennzeichnet, dass** die Einpresshülse zwei konzentrisch angeordnete umlaufende Zähne aufweist.

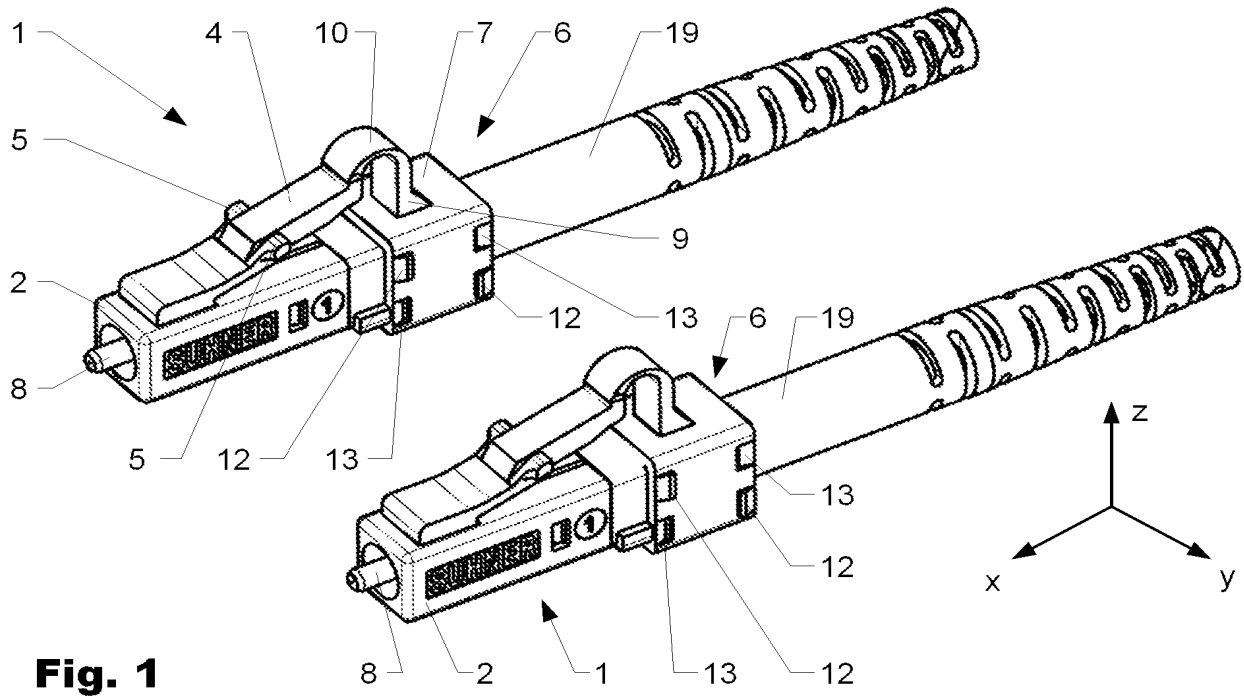

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Fig. 1

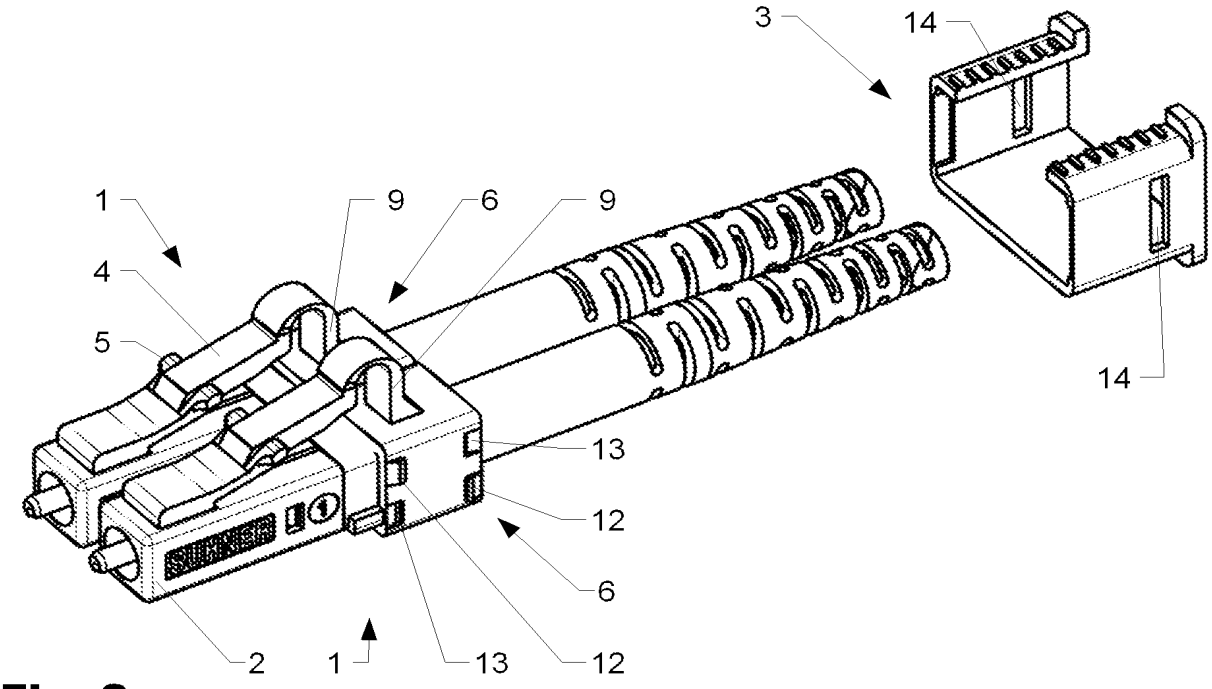

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Fig. 2

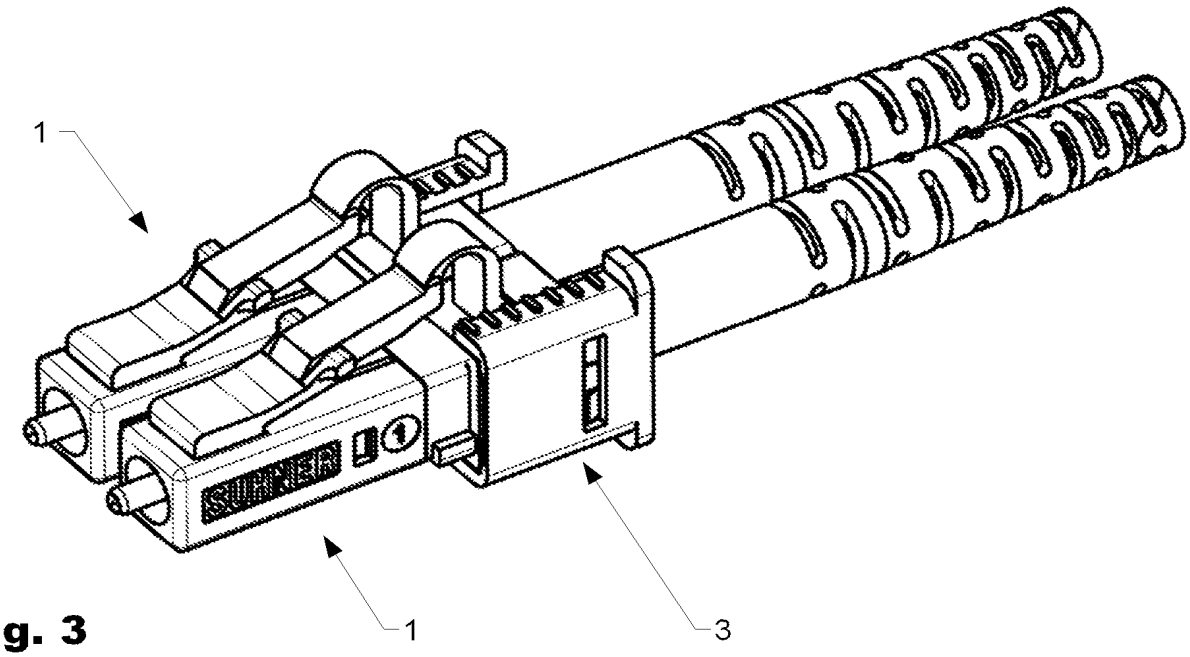


Fig. 3

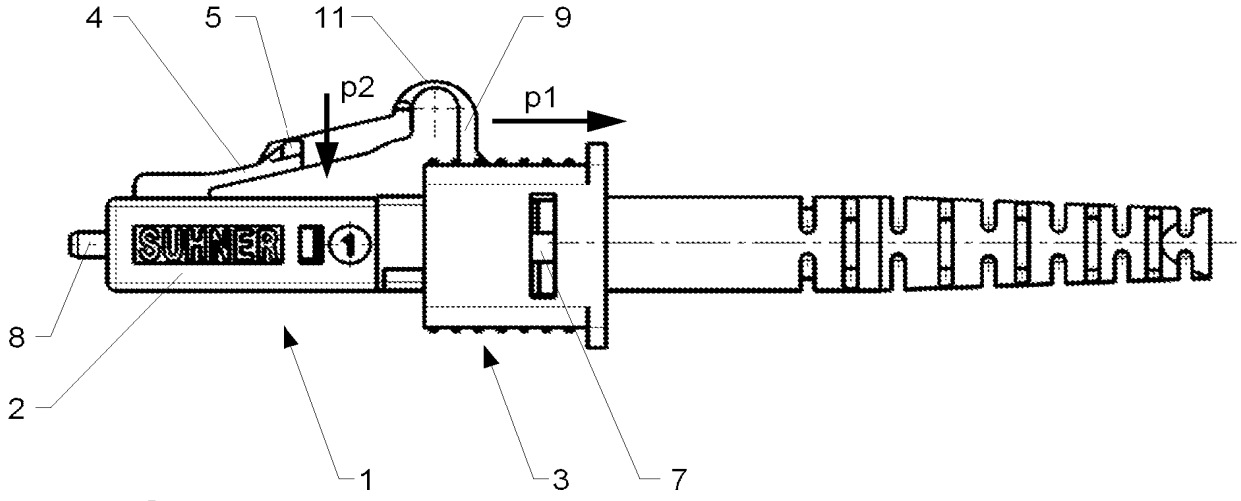


Fig. 4

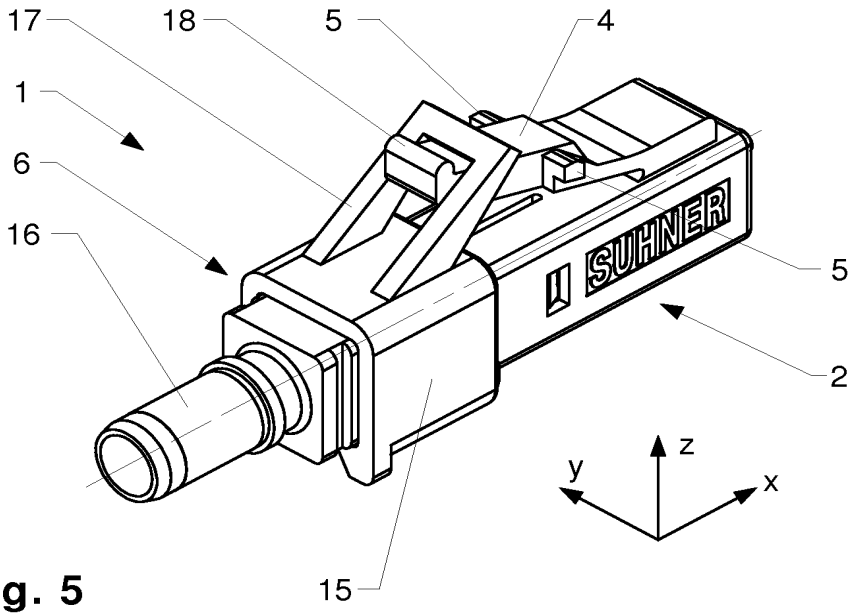


Fig. 5

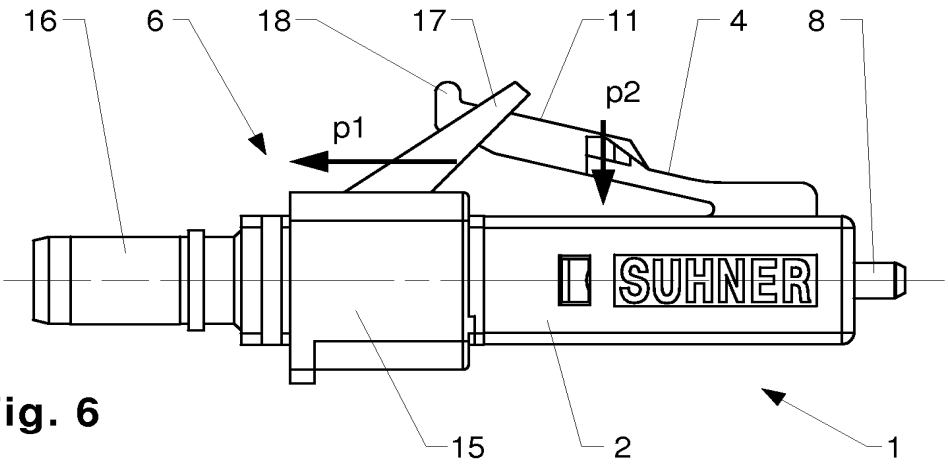


Fig. 6

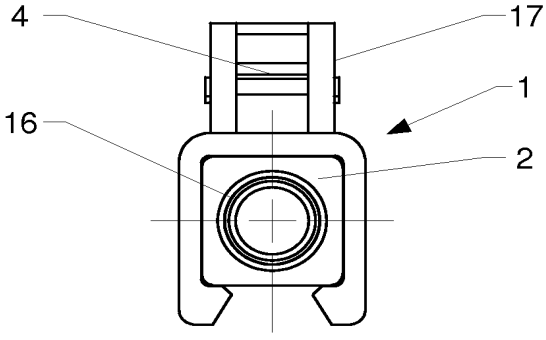


Fig. 7

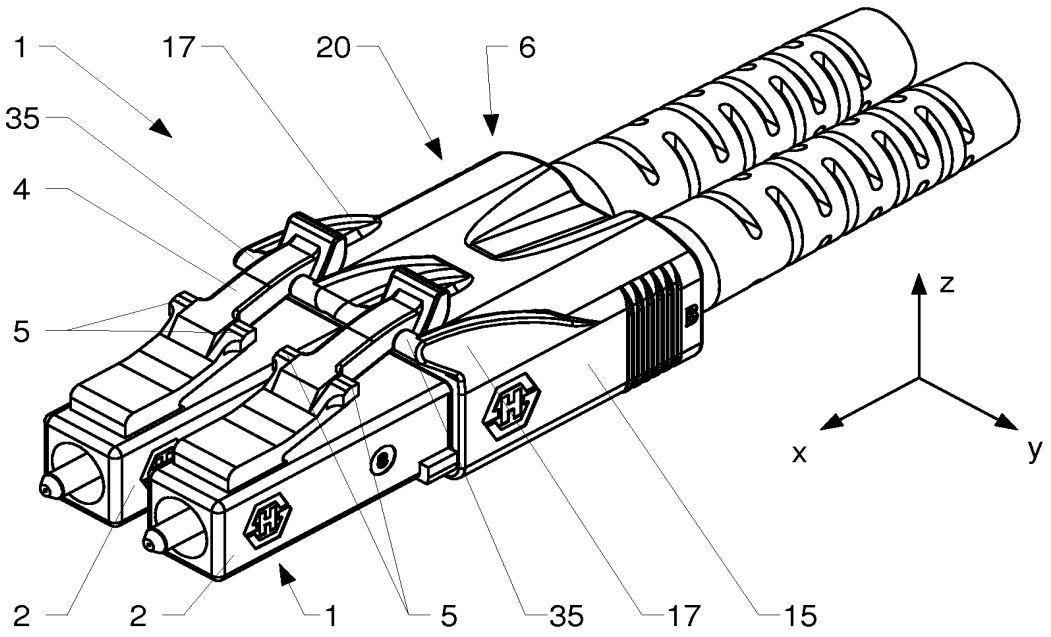

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Fig. 8

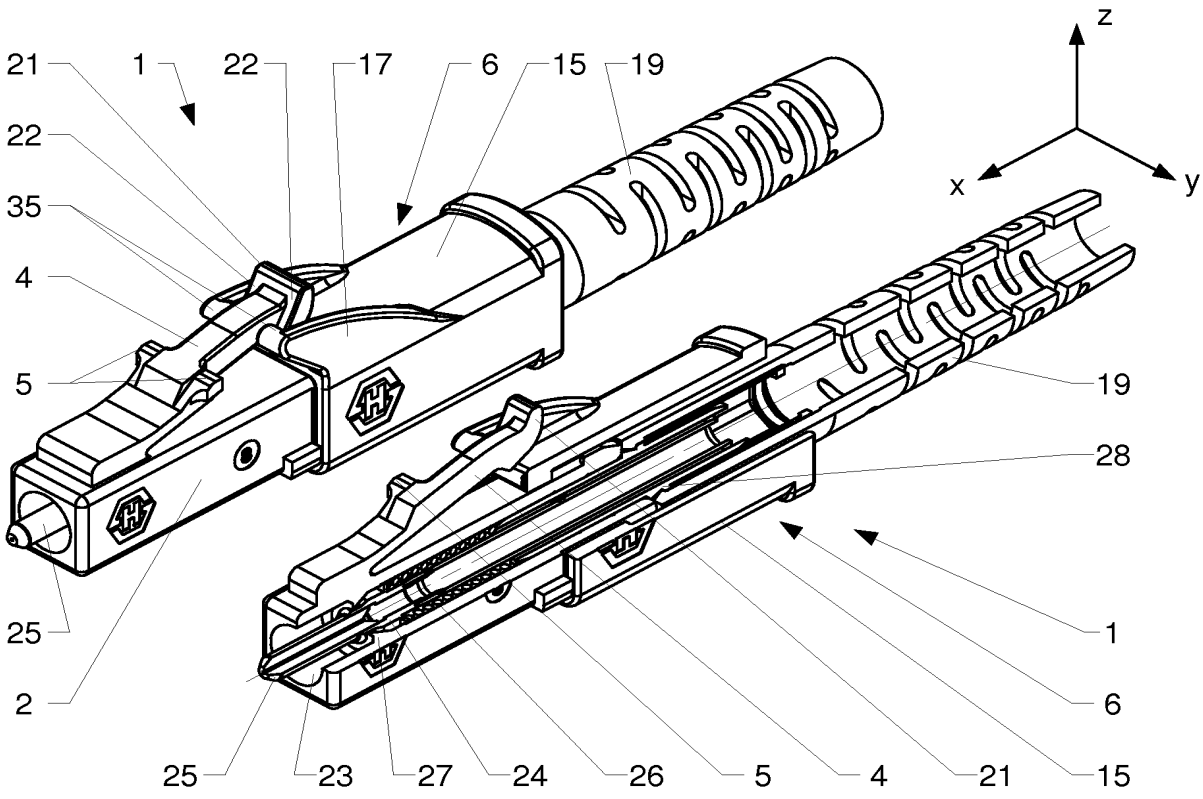

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Fig. 9

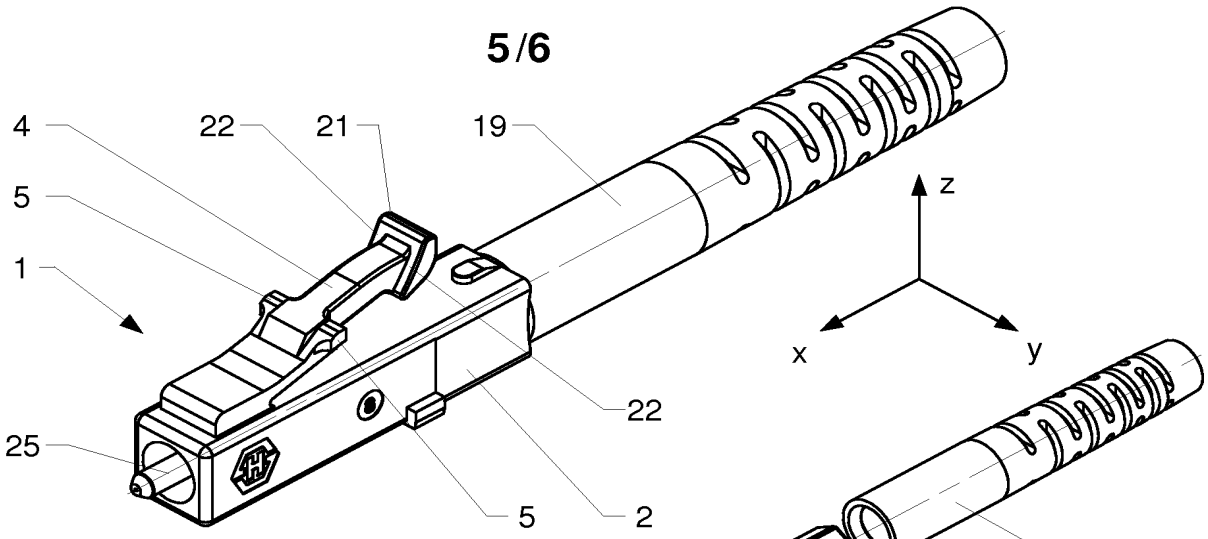


Fig. 10

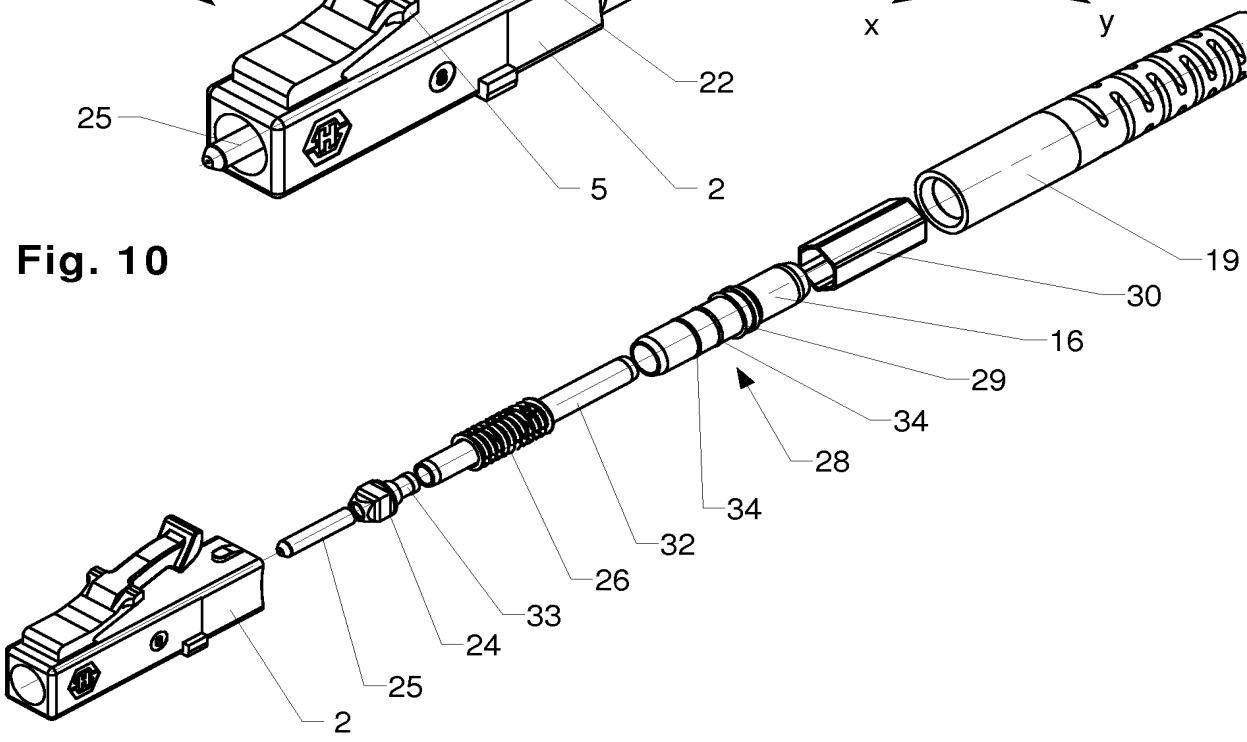


Fig. 11

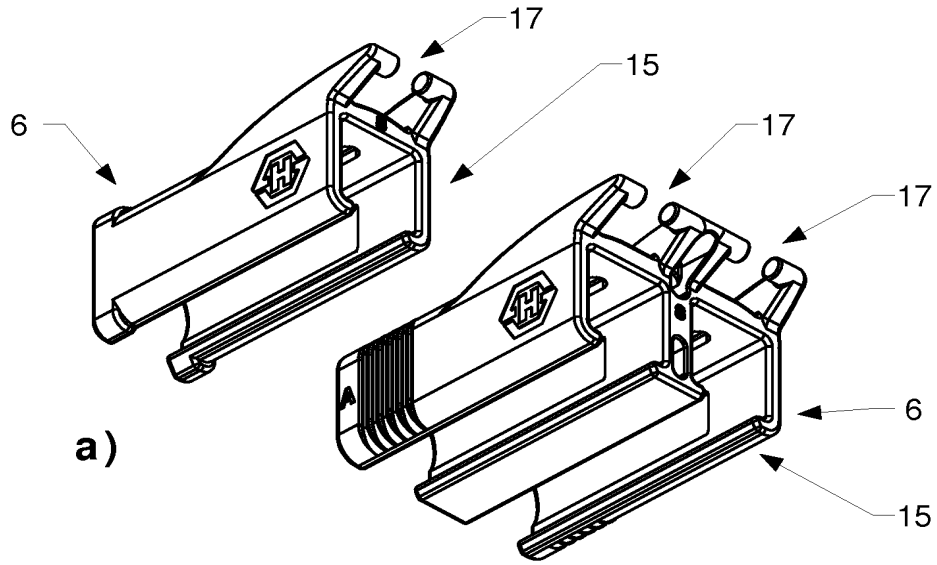


Fig. 12 b)

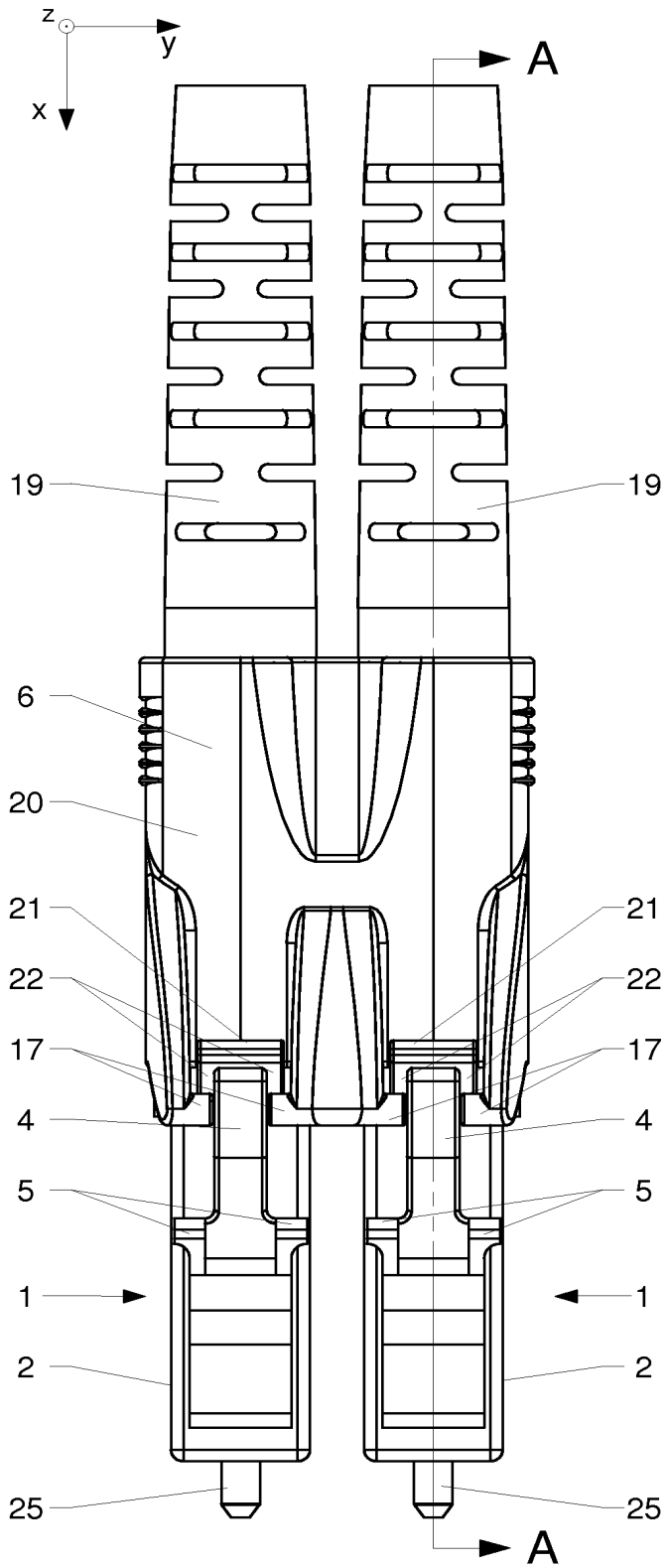

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Fig. 13

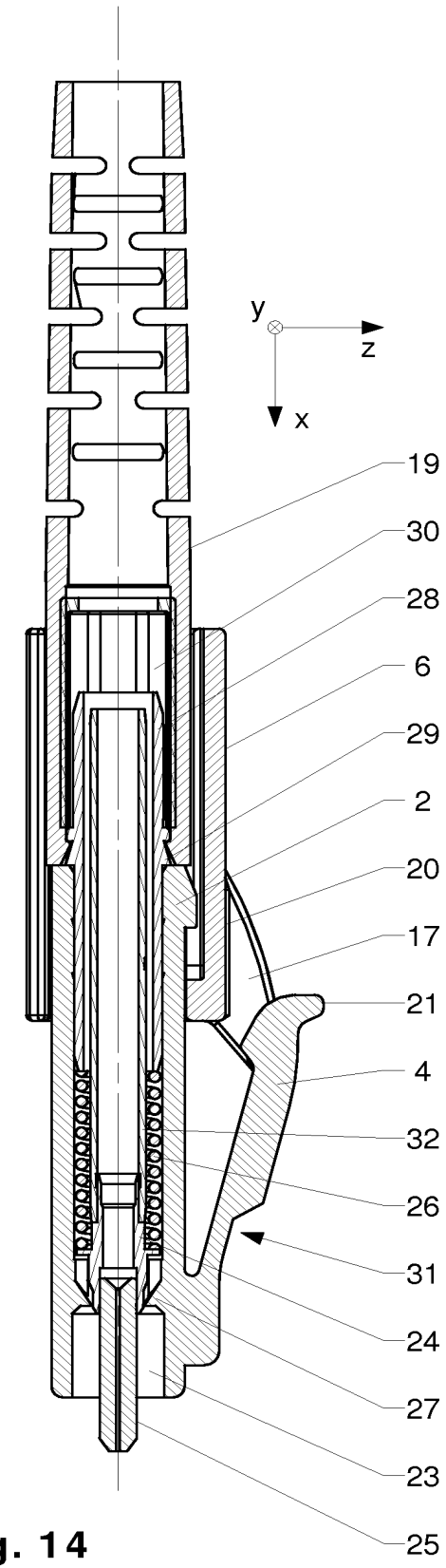

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Fig. 14

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/055161

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/38 H01R13/627 H01R13/633

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G02B H01R

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 practical, 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 Y	JP 63 184271 A (MATSUSHITA ELECTRIC WORKS LTD) 29 July 1988 (1988-07-29) figures	1,4-7, 9-10 2-3,8
X	US 2006/089039 A1 (CAVENEY JACK E [US] ET AL) 27 April 2006 (2006-04-27) abstract figures 1-9	1,4-7, 9-12
X	US 2003/220008 A1 (VIKLUND MARK [US] ET AL) 27 November 2003 (2003-11-27) paragraphs [0062], [0063] figures 35,36	1,4-7, 9-10
Y	US 7 326 075 B1 (ARMSTRONG MICHAEL [US] ET AL) 5 February 2008 (2008-02-05) column 6, lines 21-30 figures 5A,5B	2-3,8

-/--

[X] Further documents are listed in the continuation of Box C. [X] 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 document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 Juli 2009	15/10/2009

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Kloppenburg, Martin

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2009/055161

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E	EP 2 063 497 A1 (REICHLE & DE MASSARI FA [CH]) 27 May 2009 (2009-05-27) paragraphs [0025] - [0029] figure 2	1

Form PCT/ISA/210 (continuation of second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2009/055161

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.:
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:

see additional sheet

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 additional fees, this Authority did not invite payment of additional fees.

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.:
1-12

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.

Form PCT/ISA/210 (continuation of first sheet (2)) (April 2005)

International application No.
PCT/EP2009/055161

The International Searching Authority has found that the international application contains multiple (groups of) inventions, as follows:

1. **Claims 1-12**

   Details of an unlocking mechanism of a plug connector.

   ---

2. **Claims 13-15**

   Plug connector comprising an unlocking mechanism and coupling means for the lateral connection to another plug connector.

   ---

3. **Claims 16-17**

   Plug connector comprising an unlocking mechanism and a press-in sleeve pressed into the base body of the plug.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2009/055161

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 63184271 A	29-07-1988	NONE	
US 2006089039 A1	27-04-2006	CN 101065888 A	31-10-2007
		EP 1810378 A1	25-07-2007
		JP 2008518402 T	29-05-2008
		WO 2006047258 A1	04-05-2006
US 2003220008 A1	27-11-2003	NONE	
US 7326075 B1	05-02-2008	US 7549888 B1	23-06-2009
EP 2063497 A1	27-05-2009	NONE	

INTERNATIONALER RECHERCHENBERICHT

Internationales Aktenzeichen
PCT/EP2009/055161

A. KLASSIFIZIERUNG DES ANMELDUNGSGEGENSTANDES
INV. G02B6/38 H01R13/627 H01R13/633

Nach der Internationalen Patentklassifikation (IPC) oder nach der nationalen Klassifikation und der IPC

B. RECHERCHIERTE GEBIETE

Recherchierter Mindestprüfstoff (Klassifikationssystem und Klassifikationssymbole)
G02B H01R

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C. ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
X Y	JP 63 184271 A (MATSUSHITA ELECTRIC WORKS LTD) 29. Juli 1988 (1988-07-29) Abbildungen	1,4-7, 9-10 2-3,8
X	US 2006/089039 A1 (CAVENEY JACK E [US] ET AL) 27. April 2006 (2006-04-27) Zusammenfassung Abbildungen 1-9	1,4-7, 9-12
X	US 2003/220008 A1 (VIKLUND MARK [US] ET AL) 27. November 2003 (2003-11-27) Absätze [0062], [0063] Abbildungen 35,36	1,4-7, 9-10
Y	US 7 326 075 B1 (ARMSTRONG MICHAEL [US] ET AL) 5. Februar 2008 (2008-02-05) Spalte 6, Zeilen 21-30 Abbildungen 5A,5B	2-3,8

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[X] Weitere Veröffentlichungen sind der Fortsetzung von Feld C zu entnehmen [X] Siehe Anhang Patentfamilie

* Besondere Kategorien von angegebenen Veröffentlichungen :
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Datum des Abschlusses der internationalen Recherche	Absendedatum des internationalen Recherchenberichts
29. Juli 2009	15/10/2009

Name und Postanschrift der Internationalen Recherchenbehörde	Bevollmächtigter Bediensteter
Europäisches Patentamt, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Fax: (+31–70) 340–3016	Kloppenburg, Martin

Formblatt PCT/ISA/210 (Blatt 2) (April 2005)

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C. (Fortsetzung) ALS WESENTLICH ANGESEHENE UNTERLAGEN

Kategorie*	Bezeichnung der Veröffentlichung, soweit erforderlich unter Angabe der in Betracht kommenden Teile	Betr. Anspruch Nr.
E	EP 2 063 497 A1 (REICHLE & DE MASSARI FA [CH]) 27. Mai 2009 (2009-05-27) Absätze [0025] - [0029] Abbildung 2	1

Formblatt PCT/ISA/210 (Fortsetzung von Blatt 2) (April 2005)

INTERNATIONALER RECHERCHENBERICHT

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Feld Nr. II Bemerkungen zu den Ansprüchen, die sich als nicht recherchierbar erwiesen haben (Fortsetzung von Punkt 2 auf Blatt 1)

Gemäß Artikel 17(2)a) wurde aus folgenden Gründen für bestimmte Ansprüche kein internationaler Recherchenbericht erstellt:

1. ☐ Ansprüche Nr.
weil sie sich auf Gegenstände beziehen, zu deren Recherche diese Behörde nicht verpflichtet ist, nämlich

2. ☐ Ansprüche Nr.
weil sie sich auf Teile der internationalen Anmeldung beziehen, die den vorgeschriebenen Anforderungen so wenig entsprechen, dass eine sinnvolle internationale Recherche nicht durchgeführt werden kann, nämlich

3. ☐ Ansprüche Nr.
weil es sich dabei um abhängige Ansprüche handelt, die nicht entsprechend Satz 2 und 3 der Regel 6.4 a) abgefasst sind.

Feld Nr. III Bemerkungen bei mangelnder Einheitlichkeit der Erfindung (Fortsetzung von Punkt 3 auf Blatt 1)

Diese Internationale Recherchenbehörde hat festgestellt, dass diese internationale Anmeldung mehrere Erfindungen enthält:

siehe Zusatzblatt

1. ☐ Da der Anmelder alle erforderlichen zusätzlichen Recherchengebühren rechtzeitig entrichtet hat, erstreckt sich dieser Internationale Recherchenbericht auf alle recherchierbaren Ansprüche.

2. ☐ Da für alle recherchierbaren Ansprüche die Recherche ohne einen Arbeitsaufwand durchgeführt werden konnte, der zusätzliche Recherchengebühr gerechtfertigt hätte, hat die Behörde nicht zur Zahlung solcher Gebühren aufgefordert.

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1-12

Bemerkungen hinsichtlich eines Widerspruchs

☐ Der Anmelder hat die zusätzlichen Recherchengebühren unter Widerspruch entrichtet und die gegebenenfalls erforderliche Widerspruchsgebühr gezahlt.

☐ Die zusätzlichen Recherchengebühren wurden vom Anmelder unter Widerspruch gezahlt, jedoch wurde die entsprechende Widerspruchsgebühr nicht innerhalb der in der Aufforderung angegebenen Frist entrichtet.

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Die internationale Recherchenbehörde hat festgestellt, dass diese internationale Anmeldung mehrere (Gruppen von) Erfindungen enthält, nämlich:

1. Ansprüche: 1-12

   Details eines Entriegelungsmechanismus eines Steckverbinders

   ---

2. Ansprüche: 13-15

   Steckverbinder mit einem Entriegelungsmechanismus und Kopplungsmitteln zu seitlichen Verbinden mit einem weiteren Steckverbinder

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3. Ansprüche: 16-17

   Steckverbinder mit einem Entriegelungsmechanismus und einer in den Grundkörper des Steckers eingepressten Einpresshülse

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INTERNATIONALER RECHERCHENBERICHT

Angaben zu Veröffentlichungen, die zur selben Patentfamilie gehören

Internationales Aktenzeichen
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Im Recherchenbericht angeführtes Patentdokument	Datum der Veröffentlichung	Mitglied(er) der Patentfamilie	Datum der Veröffentlichung
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		JP 2008518402 T	29-05-2008
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US 7326075 B1	05-02-2008	US 7549888 B1	23-06-2009
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(54) **Title**: FIBER OPTIC FURCATION ASSEMBLY HAVING FEATURE(S) FOR CABLE MANAGEMENT

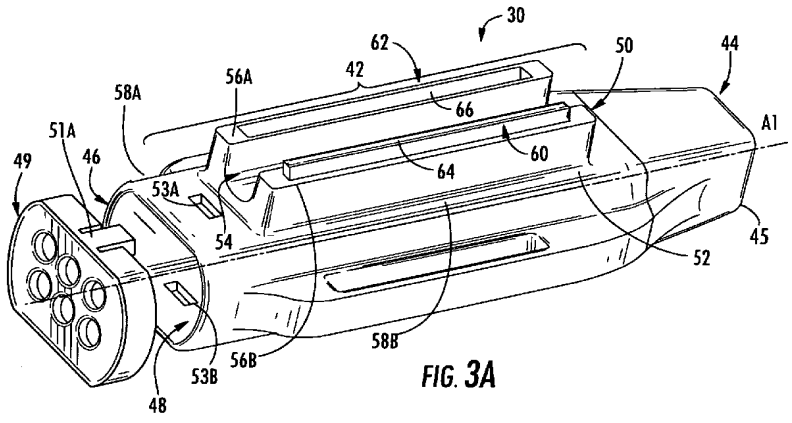


FIG. 3A

(57) **Abstract**: Fiber optic cable assemblies having a fiber optic cable, a furcation body, and one or more furcated legs are disclosed herein. In embodiments disclosed herein, the furcation body comprises a first end and a second end opposite the first end, the first end having the fiber optic cable extending therefrom, and the second end having one or more furcated legs extending therefrom. The furcation body can include one or more features that facilitate cable management by supporting cabling components used in making fiber optic interconnections. The cable management features of the fiber optic cable assemblies advantageously inhibit sagging, facilitate access to fiber optic interconnections, and/or improve air flow paths between fiber optic interconnections.

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FIBER OPTIC FURCATION ASSEMBLY HAVING FEATURE(S) FOR CABLE MANAGEMENT

RELATED APPLICATIONS

[0001] The present application claims priority to U.S. Provisional Patent Application Serial No. 61/197,068 titled "High Density Data Center Hardware Assemblies, and Components," which is incorporated herein by reference in its entirety.

[0002] The present application also claims priority to U.S. Provisional Patent Application Serial No. 61/190,538 titled "High Density Data Center Hardware Assemblies, and Components," which is incorporated herein by reference in its entirety.

[0003] The present application also claims priority to U.S. Patent Application Serial No. 12/394,140 titled "Fiber Optic Furcation Assembly Having Feature(s) for Cable Management," which is incorporated herein by reference in its entirety.

BACKGROUND

Field of the Disclosure

[0004] The technology of the disclosure relates to fiber optic cable management. More specifically, the disclosure relates to fiber optic cable assemblies for fiber optic cable management.

Technical Background

[0005] Benefits of optical fiber use include extremely wide bandwidth and low noise operation. Because of these advantages, optical fiber is increasingly being used for a variety of applications, including but not limited to broadband voice, video, and data transmission. Fiber optic communications networks include a number of interconnection points and related equipment such as in data centers, patch panels, and the like. By way of example, interconnections points in the data center occur between truck cables and distribution cables in an equipment rack or the like.

[0006] Due to increasing demand for fiber optic networks, data centers are increasingly being provided and upgraded to support higher densities of interconnection points. The higher densities reduce the amount of floor space, rack space, and the routing

pathways, etc. However, while use of higher density cabling components allows a larger number of interconnections to be made within a given space or area complications result. For instance, the increased number of interconnections in the given space or area leads to an increase in cable congestion and heat per unit area due to the increased heat from fiber optic equipment and the increased cable congestion. Thus, maintaining airflow is a consideration for maintaining data centers and the like. Moreover, the higher densities complicate cable routing and management to inhibit tangling of fiber optic cable assemblies and the like.

[0007] For example, fiber optic equipment is typically configured to support rows or columns of fiber optic interconnections where air can flow between the adjacent rows or columns to dissipate heat. However, the higher density cabling components often sag into adjacent rows or columns. Sagging cabling components can potentially adversely affect air flow, because sagging cabling components can invade air flow paths around fiber optic interconnections and thus reduce or block the air flow path. Reducing or blocking air flow paths around fiber optic interconnections can decrease the dissipation rate of heat, which may already be at increased levels in fiber optic equipment supporting high density interconnections. Also sagging cabling components also make it more difficult for an installer to access an adjacent row or column of fiber optic connectors and can create tangling issues that may disrupt the system.

[0008] **FIG. 1** illustrates a front view of an exemplary fiber optic equipment rack and fiber optic patch panel having conventional fiber optic cable **12**. As illustrated in **FIG. 1**, fiber optic equipment rack **10** has a vertical orientation for establishing fiber optic connections. Specifically, connectorized fiber optic cables **12** are routed vertically to fiber optic equipment **14** installed in the fiber optic equipment rack **10** and arranged in vertical blades **16**. Each blade **16** occupies a vertical plane and it may be necessary to access a single blade with out disturbing the interconnections of other blades. Typically, the fiber optic cables **12** are connected to connectors with interface with adapters **18** provided on the fiber optic equipment **14**. As shown, straps **20** are disposed around subsets of the fiber optic cables **12** to form fiber bundles **22** of fiber optic cables **12** to provide cable management. The fiber bundles **22** are routed through routing guides **24** extending vertically along a side **26** of the fiber optic equipment rack **10**. However, fiber

optic cables **12** from one vertical blade **16** extend and/or sag into the column of space **19** between an adjacent vertical blade(s) **16** as shown. Moreover, the problem can be worse with horizontal arrangements.

[0009] This sagging and congestion creates access and airflow issues. As shown, when installed the fiber optic cables **12** (left-side) create congestion since the columns of space **19** between the blades **16** is blocked. This creates issues for providing finger access to connectors on the fiber optic cables **12** and connectors or adapters **18** on the fiber optic equipment **14**, and also restricts air flow causing heat generation issues. Thus, there is a need for fiber optic assemblies with improved cable management features.

SUMMARY OF THE DETAILED DESCRIPTION

[0010] Embodiments disclosed in the detailed description include fiber optic cable assemblies having a fiber optic cable, a furcation body, and one or more furcated legs. In embodiments disclosed herein, the furcation body comprises a first end and a second end opposite the first end, the first end having the fiber optic cable extending therefrom, and the second end having one or more furcated legs extending therefrom. The furcation body can include one or more features that facilitate fiber optic cable management. These disclosed features of fiber optic cable assemblies may advantageously inhibit fiber optic cable assemblies from sagging (i.e., provide support), facilitate access to fiber optic interconnections, prevent or reduce obstruction of air flow paths between fiber optic interconnections, and/or inhibit tangling among fiber optic assemblies.

[0011] Additional features and advantages will be set forth in the detailed description which follows, and in part will be readily apparent to those skilled in the art from that description or recognized by practicing the invention as described herein, including the detailed description that follows, the claims, as well as the appended drawings.

[0012] It is to be understood that both the foregoing general description and the following detailed description present embodiments, and are intended to provide an overview or framework for understanding the nature and character of the disclosure. The accompanying drawings are included to provide a further understanding, and are incorporated into and constitute a part of this specification. The drawings illustrate various embodiments, and together with the description serve to explain the principles and operation of the concepts disclosed.

BRIEF DESCRIPTION OF THE FIGURES

[0013] **FIG. 1** is a front view of an exemplary fiber optic equipment rack and fiber optic patch panel having conventional fiber optic cables;

[0014] **FIG. 2A** is a front view of an exemplary fiber optic equipment rack and fiber optic patch panel having supported fiber optic cable assemblies;

[0015] **FIG. 2B** is a close-up view of the fiber optic cable assemblies interconnected to the fiber optic patch panel illustrated in **FIG. 2A**;

[0016] **FIGS. 3A and 3B** are perspective side and top views of a furcation body according to an embodiment;

[0017] **FIG. 4** illustrates an exemplary fiber optic cable assembly employing the furcation body of **FIGS. 3A and 3B**;

[0018] **FIG. 5** illustrates a side view of the furcated leg side of the fiber optic cable assembly of **FIG. 4**, which includes a cross section of furcated legs within the furcation body;

[0019] **FIG. 6** illustrates a furcated leg side end cap for the furcation body of **FIGS. 3A and 3B**;

[0020] **FIG. 7** illustrates a partially assembled view of the furcation of the fiber optic cable assembly of **FIGS. 3A and 3B**;

[0021] **FIGS. 8A and 8B** illustrate side perspective and top views, respectively, of two furcation bodies of **FIGS. 3A and 3B** cooperatively connected to provide support;

[0022] **FIG. 9** illustrates a side view of fiber optic cable assemblies whose furcation bodies are cooperatively connected according to the configuration illustrated in **FIGS. 8A and 8B**;

[0023] **FIGS. 9A-9D** illustrates a side profiles of furcation bodies having alternative attachment features;

[0024] **FIGS. 10A and 10B** illustrate side and bottom views, respectively, of the furcation body of **FIGS. 3A and 3B**;

[0025] **FIG. 10C** illustrates a fiber cable side boot for the furcation body of **FIGS. 3A and 3B**;

[0026] **FIGS. 11A-11C** illustrate an alternative furcation body and boot structure to receive a fiber optic cable;

[0027] **FIGS. 12A and 12B** illustrate side perspective and front views, respectively, of an alternate embodiment of a furcation body having one or more support features;

[0028] **FIGS. 13A and 13B** illustrate side perspective and front views, respectively, of another alternate embodiment of a furcation body having one or more support features;

[0029] **FIGS. 14A and 14B** illustrate side perspective and front views, respectively, of another alternate embodiment of a furcation body having one or more support features;

[0030] **FIGS. 15A and 15B** illustrate side and front views, respectively, of another alternate embodiment of a furcation body having one or more support features;

[0031] **FIG. 16** illustrates a side perspective view of another alternate embodiment of a furcation body having one or more support features;

[0032] **FIGS. 17A and 17B** illustrate a side perspective and side views, respectively, of a furcation body having one or more support features according to another alternate embodiment;

[0033] **FIGS. 18A-18C** illustrate side perspective, side, and front views, respectively, of a furcation body having one or more support features according to another alternate embodiment;

[0034] **FIGS. 19A-19B** illustrate a furcated leg side end cap and furcation body, respectively, having one or more support features according to another alternate embodiment;

[0035] **FIG. 20A** is a front view of storage area network (SAN) equipment distribution area (EDA) and main distribution area (MDA) cabinets;

[0036] **FIG. 20B** is a partial elevation view of the EDA cable assemblies routed to the SAN equipment of **FIG. 20A** employing furcations having at least one support feature supported by a support rod;

[0037] **FIG. 20C** is a front elevation of the EDA cable assemblies routed to the SAN equipment in **FIG. 20B**; and

[0038] **FIG. 21** is a partial side elevation view of an EDA cable assembly routed to SAN equipment employing furcations having at least one support feature supported by a support rod.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0039] Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings, in which some, but not all embodiments are shown. Indeed, the concepts may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Whenever possible, like reference numbers will be used to refer to like components or parts.

[0040] Embodiments disclosed in the detailed description include fiber optic cable assemblies having a fiber optic cable, a furcation body, and one or more furcated legs. In embodiments disclosed herein, the furcation body comprises a first end and a second end opposite the first end, the first end having the fiber optic cable extending therefrom, and the second end having one or more furcated legs extending therefrom. The furcation body can include one or more support features that facilitate supporting cabling components of adjacent fiber optic cable assemblies when making fiber optic interconnections. Consequently, the fiber optic cable assemblies disclosed are advantageous since they may reduce or prevent the cabling components in the cabling assemblies from sagging and tangling, facilitate access to fiber optic interconnections, and/or prevent or reduce obstruction of air flow paths between fiber optic interconnections.

[0041] **FIGS. 2A and 2B** depict fiber optic cable assemblies **28** that include furcation bodies **30** employing one or more features for cable management. As shown, the support feature(s) of the furcation bodies **30** support adjacent fiber optic cable assemblies **28** to prevent or reduce sagging into adjacent areas, thus blocking or reducing air flow. Simply stated, the fiber optic cables and/or furcated legs of adjacent fiber optic cable assemblies are supported by the furcation body **30**. As illustrated, an equipment rack **34** receives fiber optic cable assemblies **28** to support interconnections with fiber optic equipment **32** contained therein having one or more fiber optic patch panels. In this example, the fiber optic equipment **32** is arranged horizontally with horizontally-arranged blades **36**. Even though arranged horizontally, fiber optic cable assemblies **28** still provide horizontal

columns of space **37** between the blades **36** and fiber optic equipment **32** to allow access to the fiber optic equipment **32** and to provide an air flow path between adjacent fiber optic equipment **32**.

[0042] As will be discussed in more detail below, the furcation bodies **30** of fiber optic cable assemblies **28** include one or more support features that inhibit adjacent fiber optic assemblies **28** (i.e., its furcated legs **38** and/or fiber optic cable **40**) from sagging and extending into an adjacent column of space **37**. **FIG. 2B** illustrates a close-up view of **FIG. 2A**, showing upper and lower furcation bodies **30A**, **30B** that are cooperatively secured to each other for supporting a fiber optic cable **40** and/or one or more furcated legs **38A**, **38B** having a fiber optic connector of adjacent upper and lower fiber optic cable assemblies **28A**, **28B**. Specifically, the upper and lower furcation bodies **30A**, **30B** contain one or more support features that facilitate securing the upper furcation body **30A** to the lower furcation body **30B** to support adjacent fiber optic cable assemblies **28A**, **28B** and inhibit sag into adjacent columns of space **37** and tangling of cable assemblies.

[0043] As shown in **FIG. 2B**, the upper furcation body **30A** allows the upper fiber optic cable assemblies **28A** to support the lower fiber optic cable assemblies **28B**. Otherwise, gravity would tend to pull the lower fiber optic cable assemblies **28B** into the adjacent column of space **37**, thereby affecting access and reducing air flow. The upper fiber optic cable assembly **28A** is supported by the furcated leg **38** connections to the fiber optic equipment **32**. Also, by securing the lower furcation bodies **30B** to the upper furcation bodies **30A**, the lower furcation bodies **30B** pull the upper fiber optic cable assemblies **28A** toward the lower furcation bodies **30B**, which may be useful in the event that the upper furcated legs **38A** contain slack. The connections of the furcated legs **38A**, **38B** of the fiber optic cable assemblies **28A**, **28B** may be pulled tight to further increase support. The forces applied by the upper and lower furcation bodies **30A**, **30B** reach an equilibrium to secure the fiber optic cable assemblies **28A**, **28B** in place after the upper and lower furcation bodies **30A**, **30B** are attached to each other during installation. As shown, one or more of the furcated legs can have different lengths for tailoring the fit to the equipment and eliminating the need for storing excess slack, but in other variations the furcated legs may have lengths that are essentially the same.

[0044] The upper and lower furcation bodies **30A, 30B** can be used in a different configuration rather than an upper and lower arrangement. For example, if the fiber optic cable assemblies **28A, 28B** were arranged vertically like in **FIG. 1**, instead of horizontally as provided in **FIGS. 2A and 2B**, the furcation bodies **30A, 30B** would be arranged in a vertical plane with the respective furcation bodies **30** having a side-to-side orientation instead of top and bottom. Furcation bodies **30A, 30B** may have any suitable design as will be discussed in more detail below along with variations. For example, as illustrated in **FIG. 2B**, the upper and lower furcation bodies **30A, 30B** may contain attachment features that support an attachment device **41**, such as a strap or other binding, such as a Velcro® strip or Ty-rap®, a string, an adhesive strip, and a clamp, as examples, to secure the furcation bodies **30A, 30B** to each other or to secure fiber optic cables/fucated legs. More detail regarding the attachment device **41** and attachment features for use with a furcation body for supporting and allowing the attachment device **41** to secure and support a furcation body and one or more fiber optic cable assemblies is discussed in detail below.

[0045] **FIGS. 3A and 3B** respectively illustrate detailed side perspective and top views of a first embodiment of the furcation body **30** shown as the upper and lower furcation bodies **30A, 30B** in **FIGS. 2A and 2B**. Furcation body **30** consists of a main body **42** having a first end **44** and a second end **46** opposite the first end **44**. The furcation body **30** defines a passage **48** through the furcation body **30** extending from the first end **44** to receive a fiber optic cable and provide a furcation with one or more furcated legs from a fiber optic cable extending through the second end **46**. The first end **44** may include a boot **45** which is connected to the main body **42** and forms part of the passage **48** through the main body **42**, which will be discussed in more detail. The furcation body **30** may be constructed out of any type of suitable material desired, including but not limited to Ultem, Lexan, Valox, etc. Likewise, furcation bodies can have any suitable shape. As illustrated in **FIG. 4**, the first end **44** is configured to receive and furcate a fiber optic cable containing one or more optical fibers, such as the fiber optic cable **40** illustrated in **FIGS. 2A and 2B**. Fiber optic cable **40** may have any size, construction, fiber count, etc. By way of example, fiber optic cable may have a round profile with a diameter such as a 1.6 millimeter, 2.0 millimeter, or 2.9 millimeter with

any suitable fiber count. Of course, other variartions of the furcation body and/or fiber optic cable assembly are possible.

[0046] As also illustrated in **FIG. 4**, one or more furcated legs **38** furcated inside the passage **48** from the fiber optic cable **40** extend from the second end **46** of the furcation body **30**. The furcated legs **38** may extend through an end cap **49** that attaches to the second end **46** of the main body **42** to separate out the furcated legs **38** and to conceal the passage **48** and/or any epoxy, adhesive, or the like placed therein to secure the furcation. However, other embodiments can eliminate the end cap. Further, as illustrated in **FIG. 3A**, the end cap **49** contains latches **51A, 51B** (latch **51B** is visible in **FIGS. 8A, 8B**) configured to engage with latch orifice **53A, 53B**, respectively, disposed on opposing sides in the main body **42** to attach the end cap **49** to the main body **42**. By way of example, end cap **49** has apertures for six furcated legs **38** such as sized for 2.0 millimeter legs, but any suitable aperture size, shape, or arrangement is possible. After the furcated legs **38** are prepared, they are inserted into the second end **46** with epoxy, adhesive, or the like placed inside the furcation body **30** and cured to secure the furcated legs **38** therein.

[0047] Furcation body **30** includes several support features that may be employed to support one or more adjacent fiber optic cable assembly **28**. A first support feature that can be provided is an offset structure **50**, which is illustrated in **FIGS. 3A and 3B**. As used herein, "offset structure" means a portion of a furcation body that protrudes beyond a surface of the furcation body and has geometry that cooperates with a similar feature on another furcation body when the two furcation bodies are adjacently aligned together. As illustrated in **FIGS. 3A and 3B**, the offset structure **50** extends beyond a first surface **52** of the furcation body **30**. The offset structure contains a U-shaped channel **54** disposed between first and second offset structures **56A, 56B** that extend longitudinally down the longitudinal axis A_1 of the furcation body **30**. The U-shaped channel **54** defines at least a portion of a fiber routing guide to support a fiber optic cable **40** and/or furcated leg routed adjacent the furcation body **30**, as illustrated in **FIGS. 2A and 2B** for example. The first and second offset structures **56A, 56B** are disposed on the same side of the furcation body **30** in this embodiment on sides **58A, 58B** of the furcation body **30**. However, the offset structure **50**, including first and second offset structures **56A, 56B** could also be located on one or more side(s) of the furcation body **30** such that additional fiber optic

cable routing guides are formed. So that the offset structure **50** of the furcation body **30** can cooperate with a similar feature on another furcation body **30** to support adjacent fiber optic cable assembly **28**, the first offset structure **56A** in this embodiment contains a female portion **62**, and the second offset member **56B** contains a male portion **60**. In this embodiment, the male portion **60** is provided in the form of a protrusion **64** that extends longitudinally along the second offset structure **56B**. The female portion **62** is provided in the form of a channel **66** that also extends longitudinally along the first offset structure **56A**. Other variations of offset structure can eliminate the snap-fit male and female feature and instead use an attachment device such as a Velcro® strap hold or attach adjacent furcation bodies together.

[0048] To further illustrate the offset structure **50**, **FIG. 5** illustrates a front view of the furcation body **30** as part of a fiber optic cable assembly **28** from the second end **46** of the furcation body **30**. As shown therein, the offset structure **50** sits atop the first surface **52** of the furcation body **30**. The offset structure **50** may be a separate structure attached to the furcation body **30** or may be an integrated part of the furcation body **30** formed by a one-piece mold, as provided in this example. A cross-section of the furcated legs **38** disposed inside the passage **48** is also shown.

[0049] End cap **49** illustrated in **FIG. 6** can be used to receive and spread out the furcated legs **38** from each other and to cap off the passage **48** on the second end **46** of the furcation body **30** to limit access and/or hide epoxy, adhesive or other bonding material contained inside the passage **48**. Moreover, the end cap keeps the furcation within the furcation body **30**. The furcated legs **38** each extended through respective orifices **70** disposed in an end face **72** of the end cap **49**. The end cap **49** can then be slipped over the second end **46** of the furcation body **30** and secured via latches **51A, 51B** (shown in **FIGS. 8A and 8B)** to the latch orifices **53A, 53B**, respectively (see **FIG. 3A**), or in any other appropriate manner desired. The outer dimensions of the second end **46** are smaller than the inner dimensions of the end cap **49** so that the end cap **49** can be slipped over the top of the second end **46** of the furcation body **30**, but other variations are possible. An epoxy or other adhesive may be employed to secure the end cap **49** to the second end **46**, or the end cap **49** may be secured through tension or friction fit with the second end **46**. In a similar manner, the first end **44** of the furcation body **30** may

have an end piece such as illustrated and discussed in **FIG. 10C**. **FIG. 7** shows a partially assembled view of fiber optic cable assembly **28** with the fiber optic cable **40** extending through a boot **45** and into the passage **48** of the furcation body **30**, and a furcation **73** of the optical fibers in the fiber optic cable **40** into one or more furcated legs **38**.

[0050] **FIGS. 8A and 8B** respectively illustrate side perspective and top views of two adjacent furcation bodies **30** whose offset structures **50** are connected together to support fiber optic cable assemblies. The structure of the attached furcation bodies **30** is like that illustrated in **FIGS. 2A and 2B**. In this example, 'A' and 'B' designations are made to element numbers in **FIGS. 8A and 8B** to signify the two different furcation bodies **30A**, **30B**, but note that each furcation body **30A**, **30B** is the same structure in this embodiment, although not required, and their offset structures **50A**, **50B** cooperate with each other when the two furcation bodies **30A**, **30B** are adjacently aligned together.

[0051] As illustrated in **FIGS. 8A and 8B**, two furcation bodies **30A** cooperate and are aligned together with their offset structures **50A**, **50B** connected together. It is noted that portions of the cable assemblies are not illustrated in **FIGS. 8A and 8B** for the sake of simplicity and clarity, but they are illustrated in other figures. Specifically, the respective fiber optic cables and furcation legs attached to the furcation bodies of the fiber optic cable assemblies are not illustrated in **FIGS. 8A and 8B**. Specifically, the male portions **60A**, **60B** (not shown) of the offset structures **56A**, **56B** are inserted into the female portions **62B**, **62A** of the offset structures **56A**, **56B**. When the furcation bodies **30A**, **30B** are aligned with each other, as illustrated in **FIGS. 8A and 8B**, each protrusion **64A**, **64B** aligns with its corresponding channels **66B**, **66A** (see **FIG. 9**). Further, both U-shaped channels **54A**, **54B** are aligned with each other to provide an enclosed passage, which forms an area suitable for routing at least one fiber optic cable and/or furcated leg and thus forms a fiber routing guide **74** that is enclosed. As illustrated in **FIG. 2B**, some of the fiber optic cables **40** are routed from fiber optic cable assemblies **28** downstream into the fiber routing guide **74** formed when the furcation bodies **30A**, **30B** are connected to each other. This provides additional support for fiber optic cables **40** that are routed to inhibit cable sag.

[0052] **FIG. 9** illustrates a side view of furcation bodies **30A, 30B** illustrated in **FIGS. 8A and 8B** when supporting the fiber optic cable assemblies **28A, 28B** to further illustrate features when installed. As shown therein, two fiber optic cables **40A, 40B** are routed through the fiber routing guide **74** formed when the two furcation bodies **30A, 30B** are abutted to each other. The furcation bodies **30A, 30B** also contain additional, optional support structures in the form of attachment features **76A, 76B** that can also be provided in the furcation bodies **30A, 30B** and assist in supporting fiber optic cable assemblies **28A, 28B**. In this embodiment, a first attachment feature **76A** and a second attachment feature **76B** are disposed on the opposite sides of the furcation body **30**. Attachment device **41** illustrated in **FIGS. 2A and 2B** and previously discussed above is shown inserted through the attachment features **76A, 76B** to further support holding the furcation bodies **30A, 30B** and their offset structures **56A, 56B** to each other and to provide additional cable management routing for one or more fiber optic cables **40** and/or furcation legs for one or more fiber optic cable assemblies **28**.

[0053] In other words, **FIGS. 8A, 8B, and 9** illustrate a method for installing fiber optic cable assemblies disclosed herein. The method includes the steps of providing a first fiber optic cable assembly having a first furcation body **30A** with one or more furcated legs extending therefrom. As shown, the first furcation body **30A** has at least one first offset structure disposed thereon **56A**. Likewise, the method includes providing a second fiber optic cable assembly having a second furcation body **30B** with one or more furcated legs extending therefrom where the second furcation body has at least one second offset structure disposed thereon **56B**. Thereafter, the method includes attaching the at least one first offset structure **56A** of the first furcation body **30A** to the at least one offset structure **56B** of the second furcation body **30B** as shown. The method can include other steps such as routing one or more furcated legs or cables within a routing guide **74** or placing one or more attachment devices **41** about one or more furcation bodies **30A, 30B** of the fiber optic cables assemblies such as shown in **FIG. 9**. Additionally, the methods may be further duplicated to create larger assemblies such as shown in **FIGS. 2A and 2B**.

[0054] **FIGS. 10A and 10B** provide more detail regarding the attachment features **76A, 76B**. Attachment features **76** are disposed in the furcation body **30** in the form of a

first attachment feature **76A** on the first side **58A** of the furcation body **30** and a second attachment feature **76B** on the opposite, second side **58B** of the furcation body **30**. The first and second attachment features **76A, 76B** are integrated into the furcation body **30** in a one-piece mold in this example, but could be provided as a separate, connected structure. In this embodiment, the first and second attachment features **76A, 76B** are provided in the form of first and second wing structures **80A, 80B** that extend from the sides **58A, 58B** from the furcation body **30** in an axis substantially orthogonal to the longitudinal axis A_1 of the furcation body **30**. Loops are formed in the first and second wing structures **80A, 80B** by a channel orifice **82A, 82B** being disposed within the first and second wing structures **80A, 80B**, such as through an extrusion process. In this manner, the attachment device **41** or other attachment device can be routed through the channel orifices **82A, 82B** to further secure and/or support the furcation body **30**, and as a result, the fiber optic cable assembly **28** of which the furcating body **30** is a part. When two furcation bodies **30A, 30B** are connected to each other, as illustrated in **FIG. 9** as an example, the space **84** formed between the attachment device **41** and the furcation bodies **30** provides additional cable management routing guides that can be used to guide and support fiber optic cables **40** and/or furcation legs and in turn support the fiber optic cable assemblies **28** of which fiber optic cables **40C** are a part. In other words, all of the fiber optic cables and/or furcation legs are neatly routed adjacent to the furcation bodies to inhibit sag and thereby stiffening all of the fiber optic cable assemblies being routed to the blade, module, or the like. This also provides improve access, airflow, and inhibits tangling of cable assemblies. Additionally, as illustrated in **FIG. 9**, fiber optic cables **40D** can be disposed against the furcation bodies **30A, 30B** with the attachment device **41** attached to the attachment features **76A, 76B** such that the fiber optic cables **40D** are held secured to the furcation bodies **30A, 30B**. Other variations of attachment features **76** are possible as shown **FIGS. 9A-9C**, which respectively depict side views of attachment features a slip-loop (i.e., one side of the loop is a flap that is not attached to the furcation body), one or more hooks, a recessed region, and/or a loop attached or provided as part of the furcation body **30**. Of course, other features are possible for attachment features **76**. Moreover, the attachment device can be used without having attachment features.

[0055] **FIG. 10C** along with **FIGS. 8A and 8B** illustrate a boot **45** that may be placed about the first end **44** of the furcation body **30** to receive the fiber optic cable **40** and to cap off the passage **48** on the first end **44** of the furcation body **30** to prevent access and/or hide epoxy or other bonding material contained inside the passage **48**. During manufacture of the fiber optic cable assembly **28**, the fiber optic cable **40** is extended through an orifice **88** disposed in an end face **90** of the boot **45** as illustrated in **FIG. 7**. The boot **45** can then be slipped over the first end **44** of the furcation body **30** and secured in an appropriate manner. In this example, the outer dimensions of the first end **44** are smaller than the inner dimensions of the boot **45** that the boot **45** can be slipped over the top of the first end **44**. The boot could have other variations such as being integrated into the furcation body or eliminated.

[0056] An epoxy or other adhesive may be employed to secure the boot **45** to the first end **44** or may be secured through tension fit between the two. The boot **45** also contains protrusion structures **92** on each side of the boot **45** that extend over the back portions **94A, 94B** (see **FIG. 8A**) of the first and second winged structures **80A, 80B** to provide a contiguous other surface of the first and second winged structures **80A, 80B** when the boot **45** is placed over the top of the first end **44**.

[0057] **FIGS. 11A-11C** illustrate a furcation body **81** that is a variant of furcation body **30**. As shown, an external flange **85** is provided as part of the furcation body **81** that extends from a rear section **87** of the furcation body **81** to receive a boot **83**. The external flange **85** contains two latches **89A, 89B** that are received into latch orifices **91A, 91B** disposed in the boot **83** to secure the boot **83** to the furcation body **81**. A fiber optic cable **40** can be inserted into a first end **93** and passage **95** and into the external flange **85** to prepare the fiber optic cable **40** for furcation. The external flange **85** provides a guide for inserting the fiber optic cable **40** and may make manufacturing of the fiber optic cable assembly **28** efficient and convenient. The external flange **85** contains one or more shoulders **97** that may be used to provide a clamp or crimp body to secure the fiber optic cable **40** within the external flange **85** and in the furcation body **81**, although the fiber optic cable **40** may be secured within the external flange **85** and furcation body **81** via other means, including but not limited to an epoxy or adhesive. The boot **83** may be constructed out of any type of material, including but not limited to

Ultem, Lexan®, Valox®, Nylon, and Santoprene. Other features and variations discussed with respect to furcation body **30** are applicable for the furcation body **81** and the other furcation bodies disclosed herein.

[0058] Other embodiments and variations of fiber optic cable assemblies are possible. For example, **FIGS. 12A and 12B** illustrate another furcation body **30** similar to the furcation body of **FIGS. 2A-10C**, but without the U-shaped channel **54** disposed between the offset structures **56A, 56B**. This furcation body **30** does not contain latch orifices **53A, 53B** for an end cap to be secured onto the second end **46** of the furcation body **30**. Instead, the end cap **49** fits onto the furcation body **30** via a friction fit. Also, the offset structure **50** is provided as one solid member with extrusions for channels, other than the channels **66** of the offset structure **50** as part of the attachment feature of the furcation body **30A** to align and attaché to another furcation body **30B**, as illustrated in **FIG. 12B**. Other features and variations for this furcation body **30** are also possible as discussed.

[0059] **FIGS. 13A and 13B** illustrate still another variation for furcation body **30**. In this variation, the attachment features **76** and latch orifices **53A, 53B** are not included. The offset structure **50** is relied on solely to secure the furcation bodies **30A, 30B** together in this embodiment. The U-shaped channel **54** is included, but could also be not included like provided in the variation of the furcation body **30** in **FIGS. 12A-12B**.

[0060] **FIGS. 14A and 14B** illustrate yet another variation of the furcation body **30**. In this variation, an additional third attachment feature **76** in the form of a bottom winged structure **80C** is additionally included. The winged structure **80C** has the same attributes as the winged structures **80A, 80B** disposed on the sides **58A, 58B** of the furcation body **30** in this example, but such is not a requirement. The additional winged structure **80C** could be of different dimensions, for example. As illustrated in **FIG. 14B**, when two of these furcation bodies **30** are aligned and attached to each other, the additional winged structures **80C** appear on the top and bottom to provide additional routing guides for the attachment device **41** or other attachment device that may be disposed through the channel orifices **82A-82C** of the winged structures **80A-80C**. In still further embodiments of the fiber optic assemblies, the furcation body 30 could have a singe attachment feature.

[0061] **FIGS. 15A and 15B** illustrate yet another variation of the furcation body **30**. In this variation, an only one winged structure **80A** is provided for the attachment feature **76**. As illustrated in **FIG. 15B**, when two of these furcation bodies **30** are aligned and attached to each other, the winged structures **80A** are disposed on opposite sides from each other . Two winged structures **80A** may provide a sufficient routing guide to allow the attachment device **41** or other attachment device to secure the two furcation bodies **30A, 30B** to each other and to provide fiber optic cable management like that illustrated in **FIG. 9**. Of course, the attachment feature could be located on any side, have any suitable shape, etc. Additionally the furcation bodies could have a labeling scheme for the craft.

[0062] **FIG. 16** is another variation of the furcation body **30** for fiber optic assemblies disclosed herein. In this variation, the protrusions **64** and orifice channel **66** of the offset structure **50** are not provided as single elongated protrusions and channels and exclusively provided on either the first or second offset structures **56A, 56B**. Rather, the protrusions **64A, 64B** and orifice channels **66A, 66B** are disposed between the first and second offset structures **56A, 56B** on opposite corners from each other as illustrated in **FIG. 16**. In this manner, the protrusions **64A, 64B** and cooperative channels **66A, 66B** cooperate with each other to provide anti-rotation of one furcation body **30A** about the other furcation body **30B** when aligned and attached to each other. Further, less material is expended providing the protrusions **64A, 64B** which may reduce the costs of manufacture of the furcation body **30**.

[0063] **FIGS. 17A and 17B** illustrate another variation of the furcation body **30** having protrusions **64A, 64B** and channels **66A, 66B** disposed between the first and second offset structures **56A, 56B** on opposite corners from each other. However, in this variation, the offset structure **50** is provided as two separate offset structures **50A, 50B** instead of one offset structure **50** like shown by **FIG. 16**, wherein two U-shaped channels **54A, 54B** are provided in each offset structure **50A, 50B**. This may save material used to provide the offset structures **50A, 50B** in the furcation body **30** and also provide additional space **96** (**FIG. 17B**) in routing fiber optic cables **40** along both the longitudinal axis A_1 of the furcation body **30** as well as a latitudinal axis A_2 of the furcation body **30** as illustrated in **FIG. 17A**.

[0064] If it is desired to route fiber optic cables **40** adjacent the furcation body **30** along latitudinal axis A_2 of the furcation body A_1, the offset structure **50** could be rotated ninety (90) degrees from the embodiments disclosed above to align the U-shaped channel **54** along the latitudinal axis A_2, like illustrated in **FIGS. 18A-18C**. Moreover, a plurality of offset structures could be provided in this axis if desired. Again, other features and variations are also possible.

[0065] **FIGS. 19A and 19B** illustrate another variation of the end cap **49** for the second end **46** of the furcation body **30**, wherein a U-shaped groove **98** is disposed on a top side **99** of the end cap **49** to provide a resting channel for a fiber optic cable **40** routed through the offset structure **50** to rest within. **FIG. 19B** shows this variation of the end cap **49** installed on the second end **46** of the furcation body **30**. Otherwise the top side **99** of the end cap **49** may invade a portion of the space formed by the U-shaped channel **54** such that a fiber optic cable **40** routed through the offset structure **50** and the U-shaped channel **54** may not be able to lay flat without incurring a change in disposition when disposed across the top side **99** of the end cap **49**. In this manner, the fiber optic cable **40** is less susceptible to attenuation that may come from bending of the fiber optic cable **40** although an end cap like that described previously above should not adversely attenuate the fiber optic cable **40**.

[0066] **FIGS. 20A-20C** illustrate another embodiment whereby fiber optic cable assemblies **28** are provided that include furcation bodies **30** for cable management and support. In this example, a storage area network (SAN) is provided wherein fiber optic equipment **100** is arranged horizontally in an equipment distribution area (EDA) in a fiber optic equipment rack **102** horizontally similar to that provided in **FIGS. 2A and 2B**. However, as illustrated in **FIG. 20B and 20C**, furcation bodies **30** are not attached to each other. Instead, to support the EDA fiber optic cable assemblies **28** of which the furcation bodies **30** are a part, the furcation bodies **30** are secured to a support rod **104** that extends horizontally across the front of the fiber optic equipment **100**. More specifically, as illustrated in **FIG. 20C**, the U-shaped channel **54** provided in the offset structure **50** of the furcation body **30** receives the support rod **104**. The support rod **104** is fixedly attached to the fiber optic equipment rack **102** via support arms **106**. In this manner, the fiber optic cable assemblies **28** and their fiber optic cables **40** are supported

and reduced or prevented from sagging into adjacent columns of space or other fiber optic interconnections. Because the furcation bodies **30** in this embodiment do not attach to each other, the protrusions **64** and channels **66** do not have to be provided in the offset structure **50**, although such is not prohibited. For example, it may be desirable to manufacture one type of furcation body that can be attached to a support rod as well as another furcation body, thereby increasing the different types of installation deployments.

[0067] **FIG. 21** illustrates a partial side elevation view of an EDA fiber optic cable assembly routed to the SAN fiber optic equipment **100** employing a support rod **104** structure also provided to support fiber optic cable assemblies **28**, but in a vertical arrangement instead of the horizontal arrangement in **FIGS. 20A-20C**. The same concepts still apply. The U-shaped channel **54** of the furcation body **30** can be disposed around and secured to the support rod **104** to prevent the fiber optic cable assemblies **28** and their fiber optic cables **40** from sagging into adjacent rows. Any of the variations of the furcation body 30 previously described above are also possible for the support rod embodiments of **FIGS. 20A-21**. For example, one or more attachment features **76** may still be provided in the furcation body **30** for cable management or for further support and attachment, via an attachment device **41**, to the support rod(s) **104**.

[0068] Many modifications and other embodiments of the invention set forth herein will come to mind to one skilled in the art to which the invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. These modifications include, but are not limited to, type or size of fiber optic cable or furcated legs; size, dimensions, and materials of the furcation body; the type of fiber optic equipment or fiber optic patch panel supporting interconnections with fiber optic cable assemblies supported by the furcation body and one or more support features provided therein; and the dimensions of any support features, including the offset structure, the attachment feature, and/or the cable routing guides. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. It is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the

appended claims and their equivalents. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:

1. A fiber optic cable assembly having a fiber optic cable, a furcation body, and one or more furcated legs, the furcation body comprising:

a first end and a second end opposite the first end, the first end having the fiber optic cable extending therefrom, and the second end having one or more furcation legs extending therefrom; and

at least one offset structure disposed on the furcation body, wherein the at least one offset structure is adapted to cooperate with at least one offset structure on an adjacent furcation body.

2. The fiber optic cable assembly of claim 1, further including at least one attachment feature on the furcation body.

3. A fiber optic cable assembly having a fiber optic cable, a furcation body, and one or more furcated legs, the furcation body comprising:

a first end and a second end opposite the first end, the first end having the fiber optic cable extending therefrom, and the second end having one or more furcated legs extending therefrom; and

at least one attachment feature, wherein the attachment feature is configured to cooperatively receive an attachment device.

4. The fiber optic cable assembly of claim 3, further including at least one offset structure, wherein the at least one offset structure is adapted to cooperate with the at least one offset structure on an adjacent furcation body.

5. The fiber optic cable assembly of claims 1, 2, 3 or 4, further including a fiber optic cable routing guide on the furcation body.

6. The fiber optic cable assembly of claims 1, 2, 4 or 5, wherein the at least one offset structure is comprised of a first offset structure and a second offset structure on the same side of the furcation body.

7. The fiber optic cable assembly of claims 1, 2 or 4-6, wherein the at least one offset structure is comprised of at least one male portion and at least one female portion for attaching the furcation body with another furcation body.

8. The fiber optic cable assembly of claims 1, 2 or 4-7, wherein the at least one offset structure cooperates with the at least one offset structure on an adjacent furcation body, thereby defining at least one area suitable for routing at least one fiber optic cable.

9. The fiber optic cable assembly of claims 2 or 4-7, wherein the at least one attachment feature is comprised of a first attachment feature on a side of the furcation body and a second attachment feature on a second side of the furcation body.

10. The fiber optic cable assembly of claims 1-9, further including an attachment device for cable routing management.

11. A fiber optic assembly, comprising:

a fiber optic patch panel;

a fiber optic cable assembly having a fiber optic cable, a furcation body, and one or more furcated legs, the furcation body comprising:

a first end and a second end opposite the first end, the first end having the fiber optic cable extending therefrom, and the second end having one or more furcated legs extending therefrom, wherein at least one furcation leg is routed and optically connected to the fiber optic patch panel;

at least one offset structure disposed on a side of the furcation body, wherein the at least one offset structure is adapted to cooperate with at least one offset structure on an adjacent furcation body;

at least one attachment feature on the furcation body, and

an attachment device, wherein the attachment device engages the at least one attachment feature.

12. The fiber optic assembly of claim 11, wherein the furcation body is secured to an adjacent furcation body.

13. The fiber optic assembly of claims 11 or 12, further including at least one fiber optic cable routing guide on the furcation body.

14. The fiber optic assembly of claims 11-13, wherein the attachment device secures a plurality of fiber optic cables to the furcation body for cable routing management.

15. A method for installing fiber optic cable assemblies, the method comprising:

providing a first fiber optic cable assembly having a first furcation body with one or more furcated legs extending therefrom and an at least one first offset structure disposed on the first furcation body;

providing a second fiber optic cable assembly having a second furcation body with one or more furcated legs extending therefrom and an at least one second offset structure disposed on the second furcation body; and

attaching the at least one first offset structure of the first furcation body to the at least one offset structure of the second furcation body.

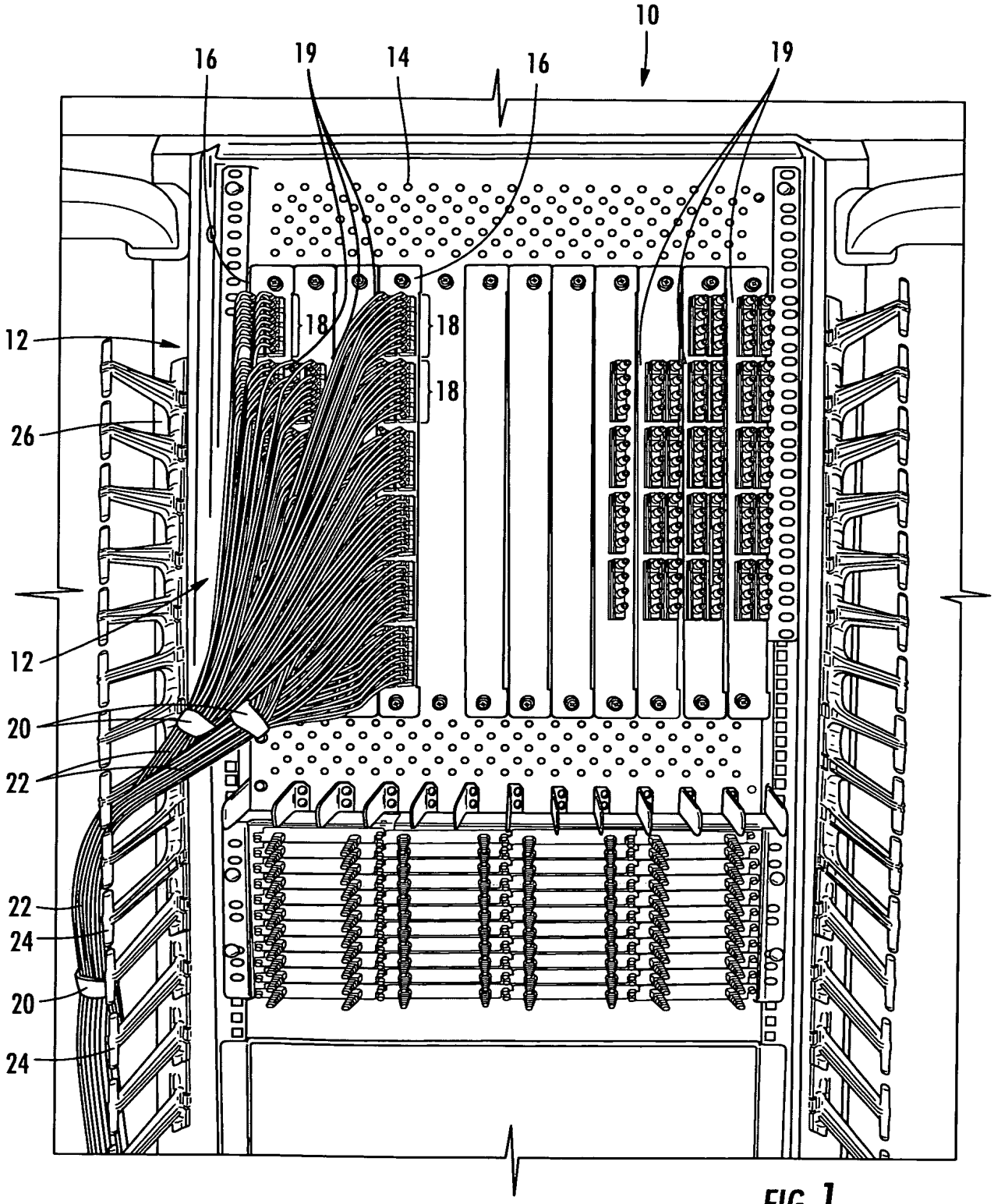


FIG. 1

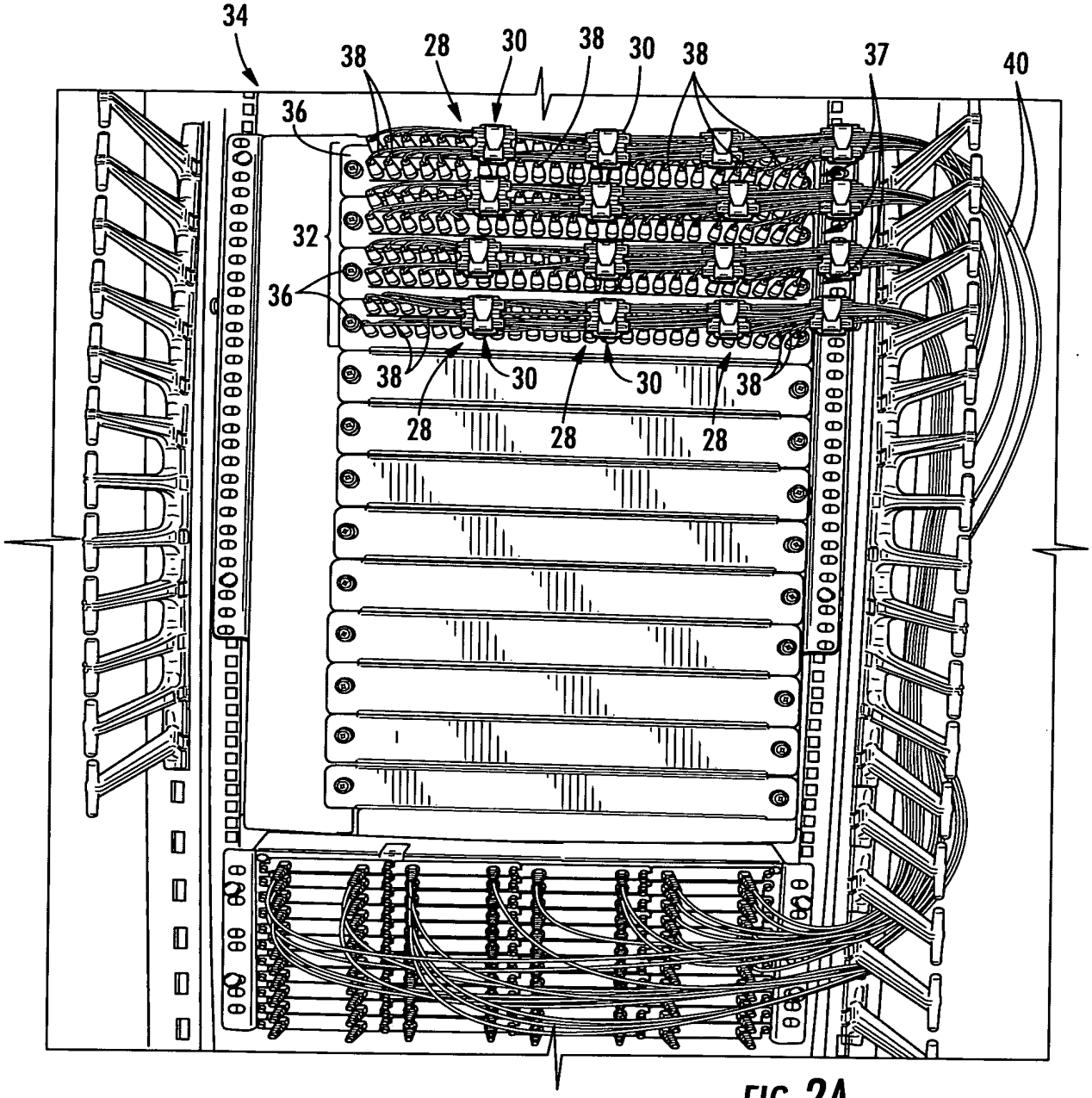

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FIG. 2A

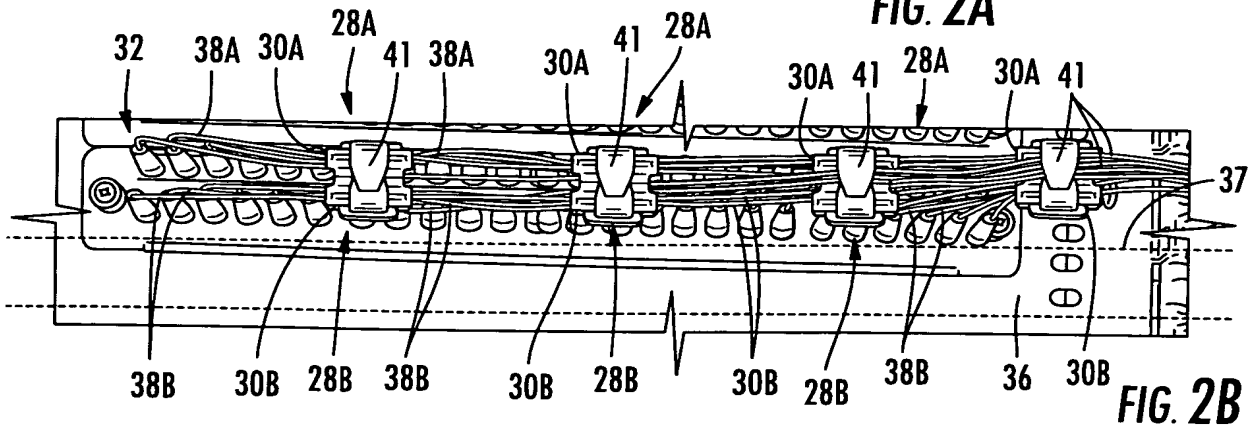

32
38A
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38A
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28A
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41
28A
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28B
38B
36
30B

FIG. 2B

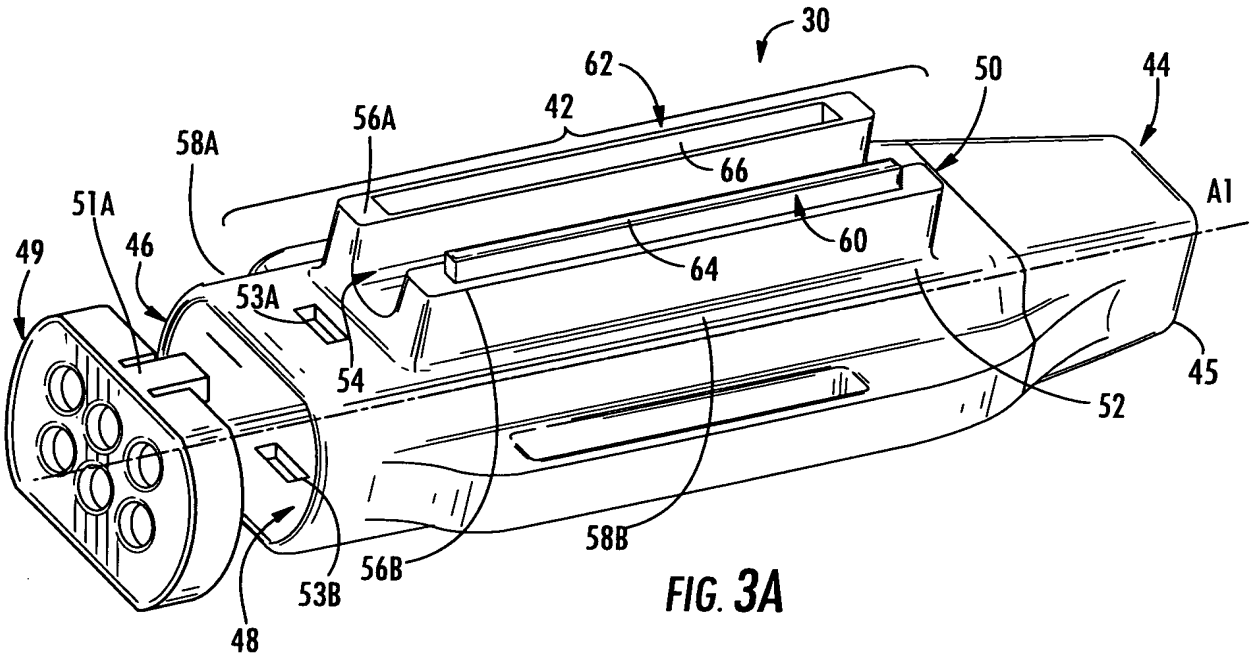

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56A
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51A
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58B
56B
53B
48

FIG. 3A

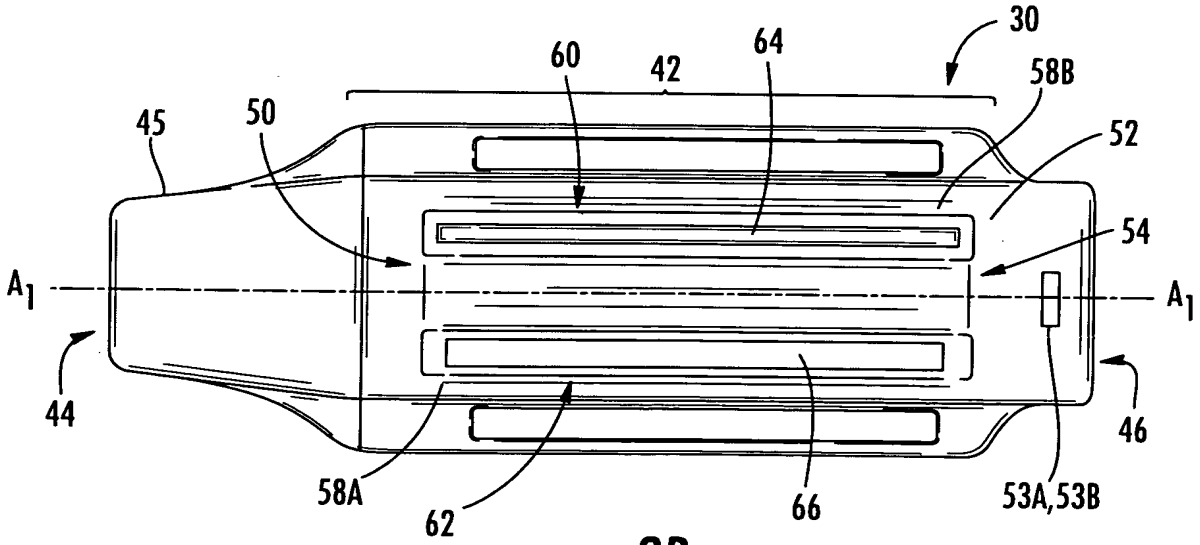

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58A
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53A,53B

FIG. 3B

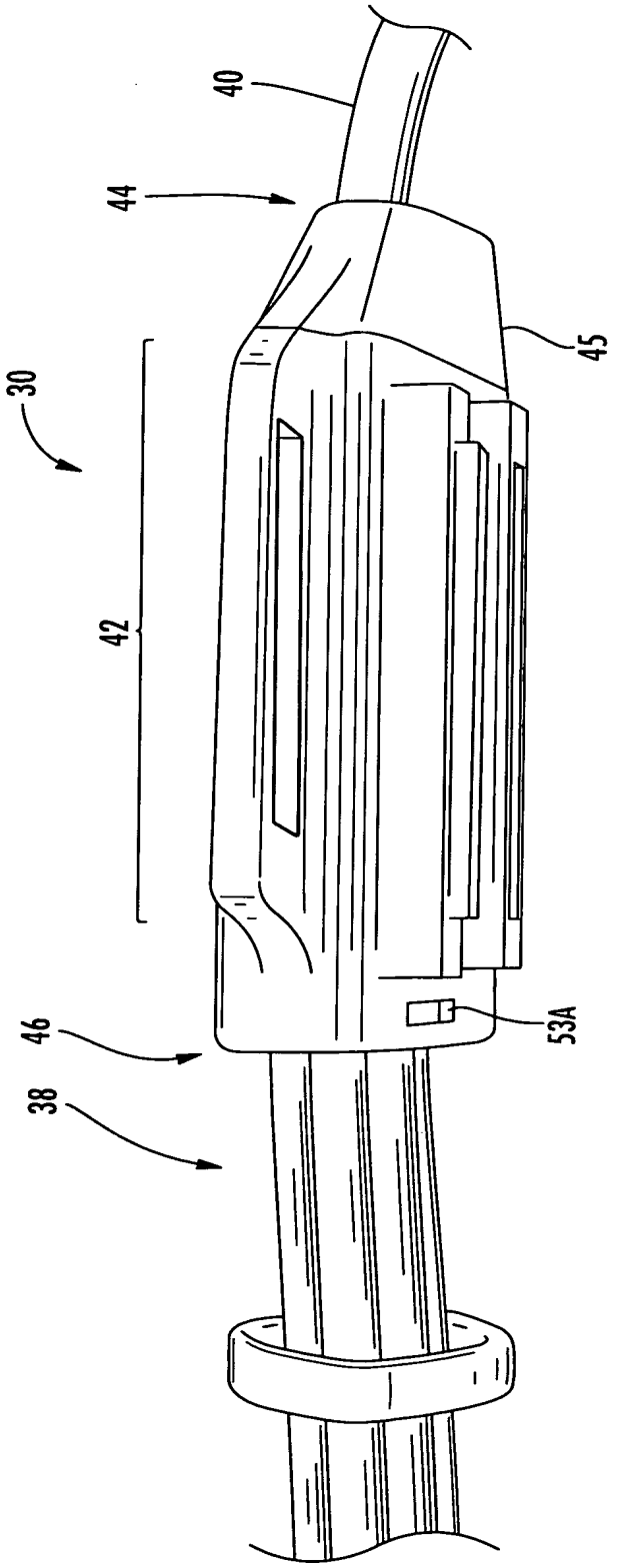


FIG. 4

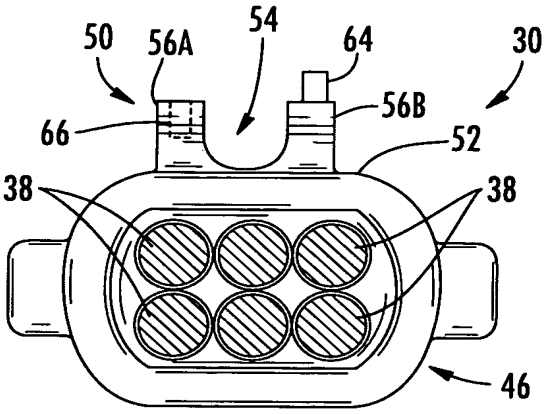


FIG. 5

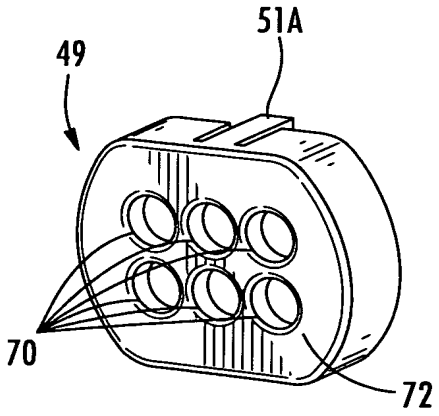


FIG. 6

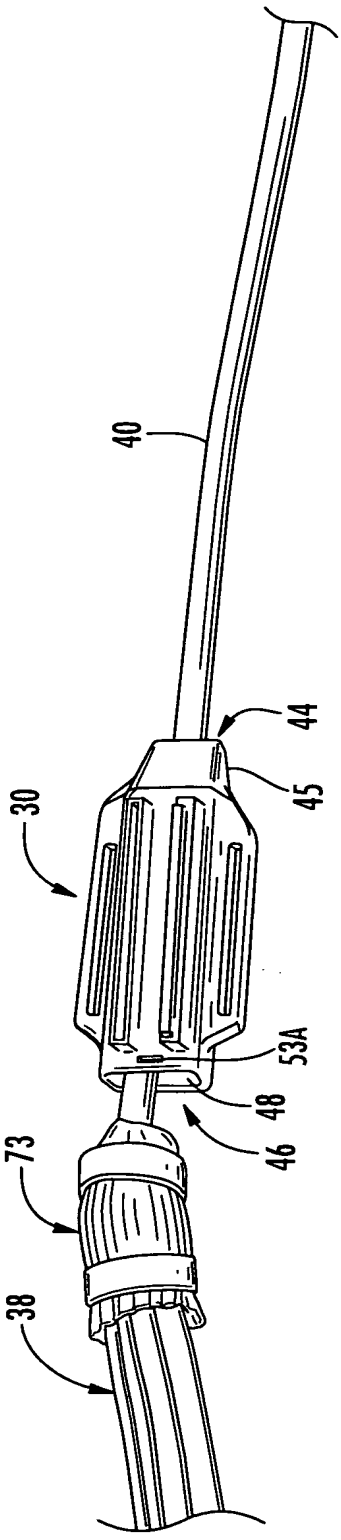


FIG. 7

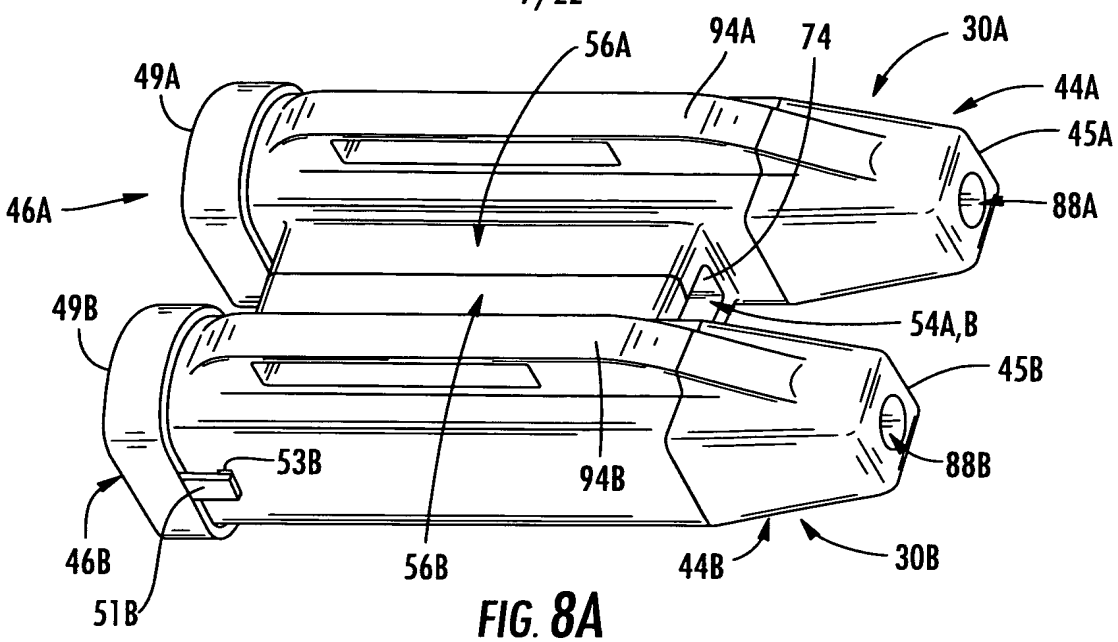

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88B
46B
56B
44B
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51B

FIG. 8A

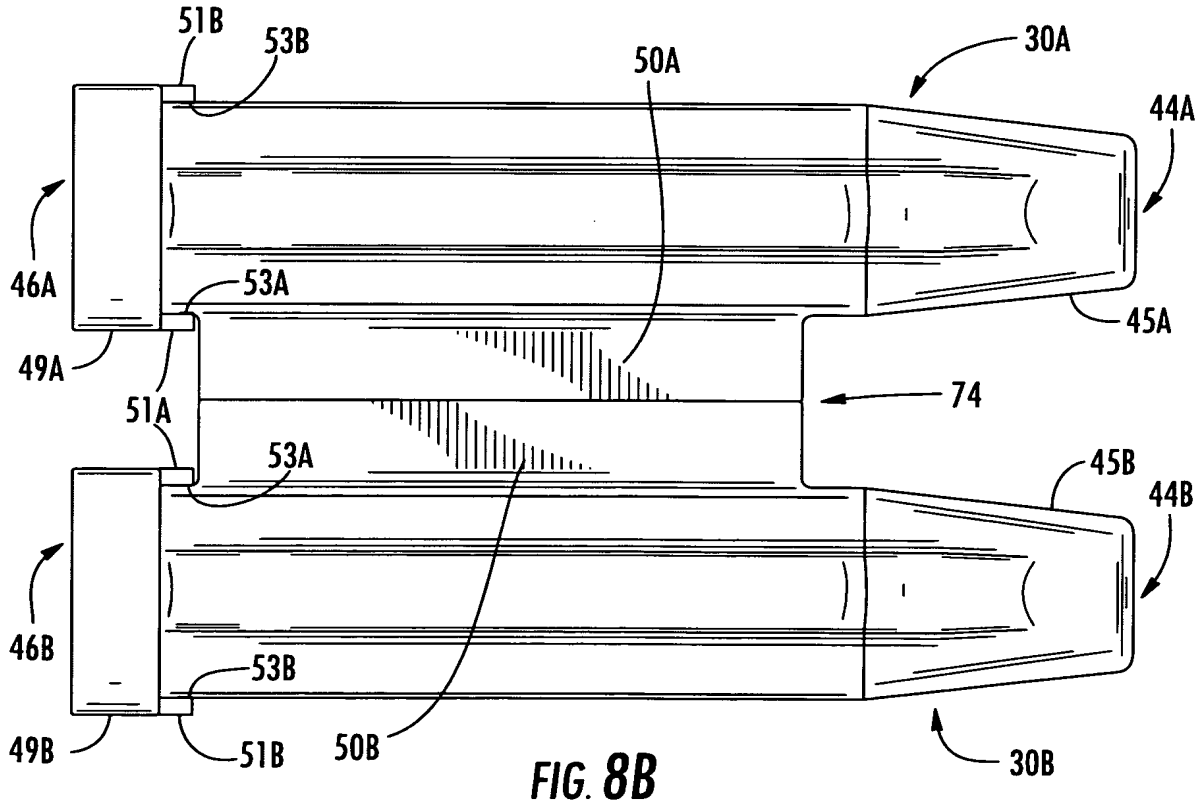

51B
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FIG. 8B

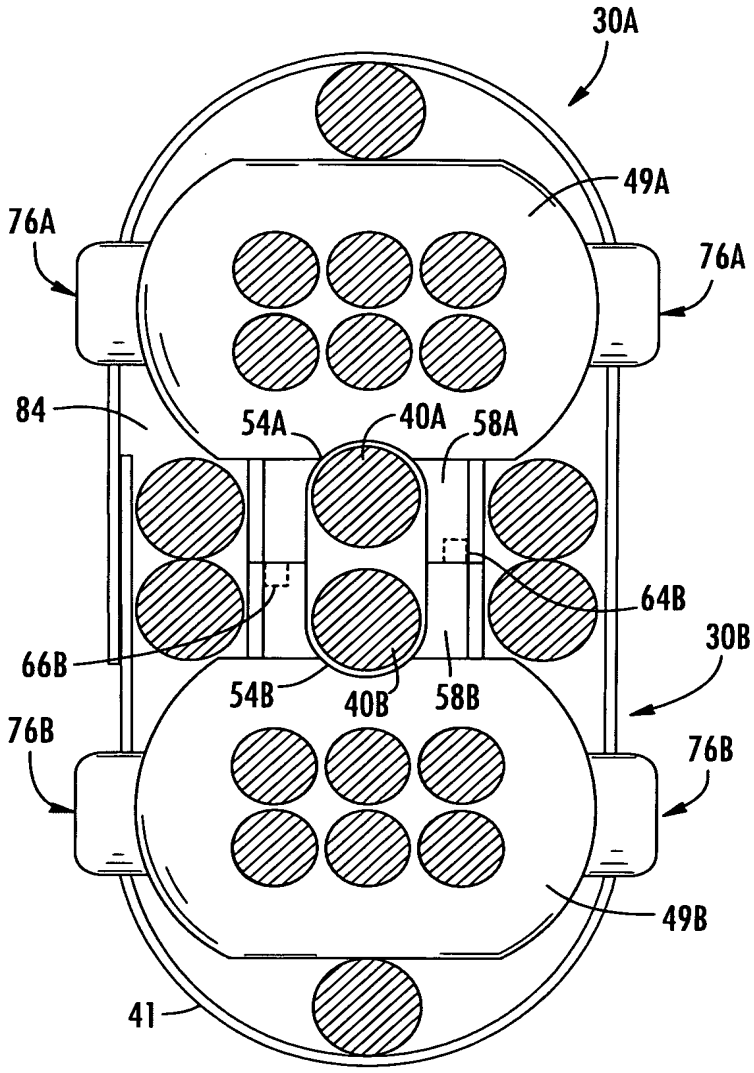


FIG. 9

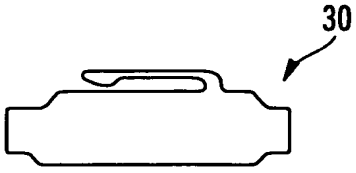


FIG. 9A

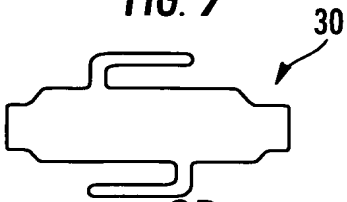


FIG. 9B

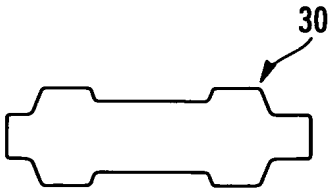


FIG. 9C

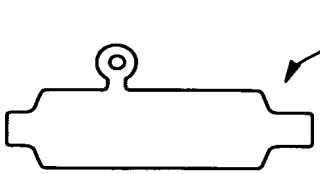


FIG. 9D

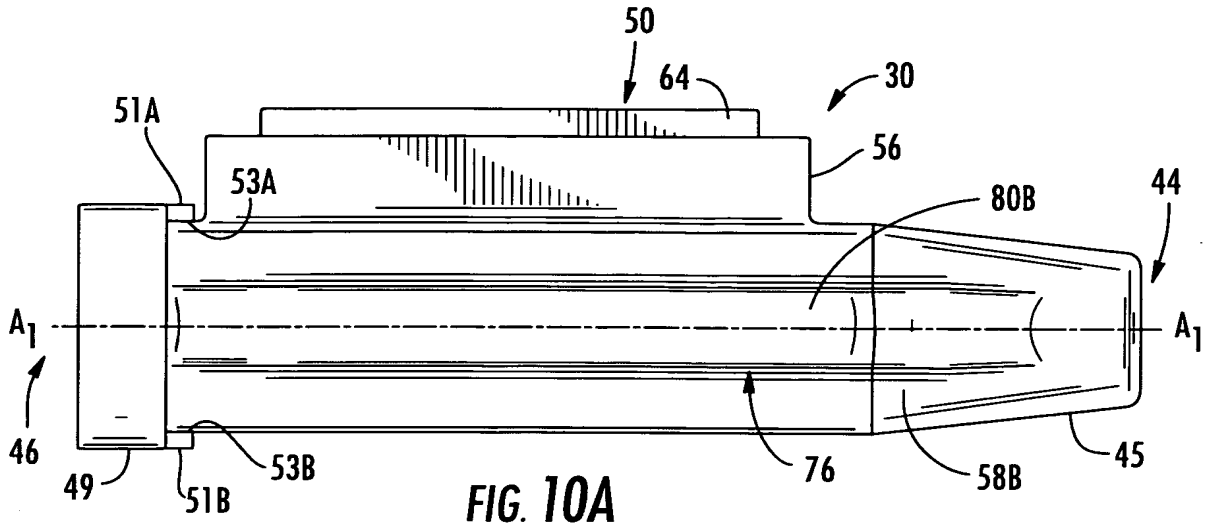


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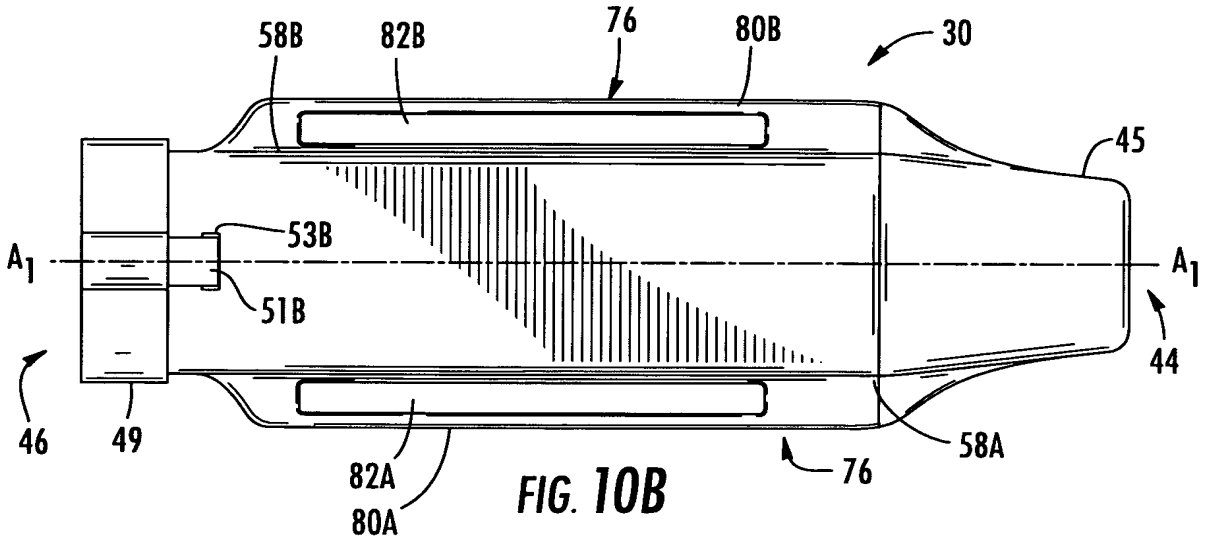


FIG. 10B

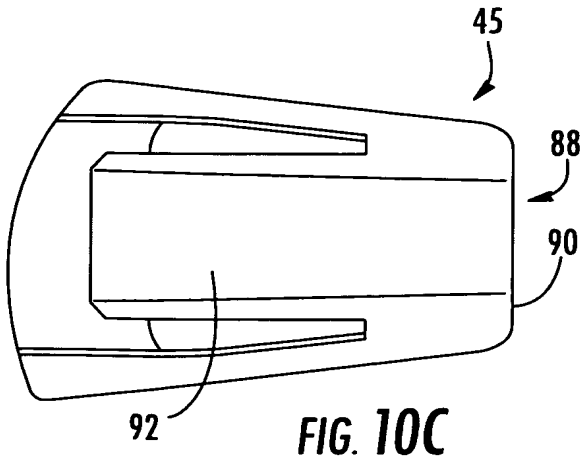


FIG. 10C

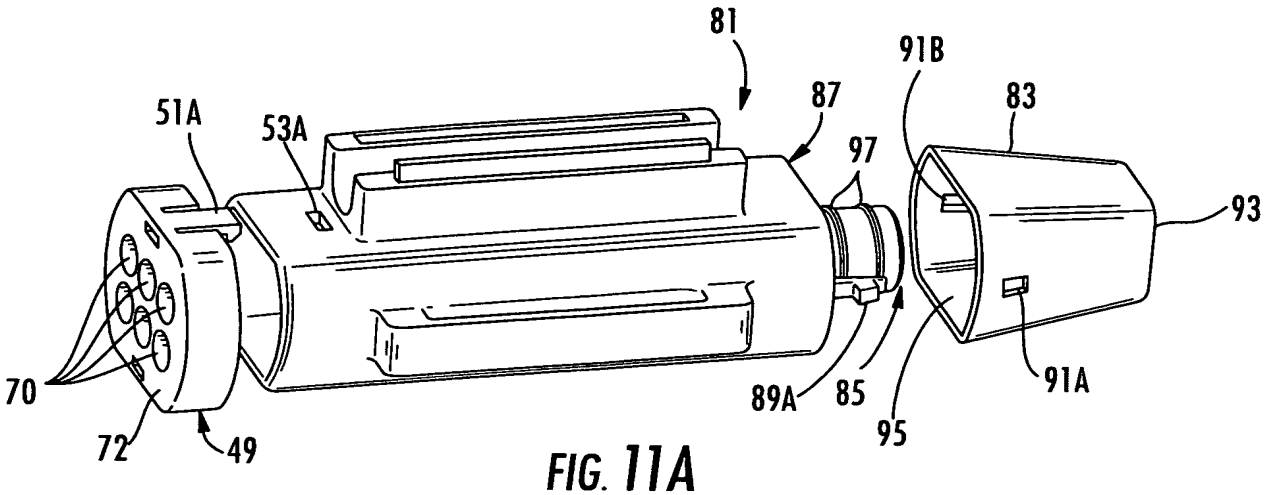


FIG. 11A

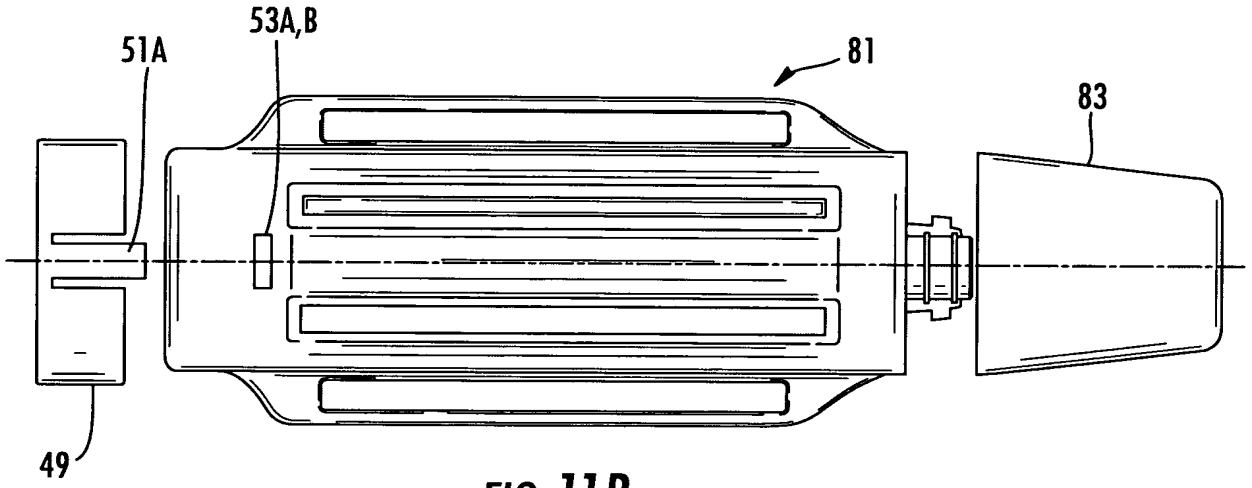


FIG. 11B

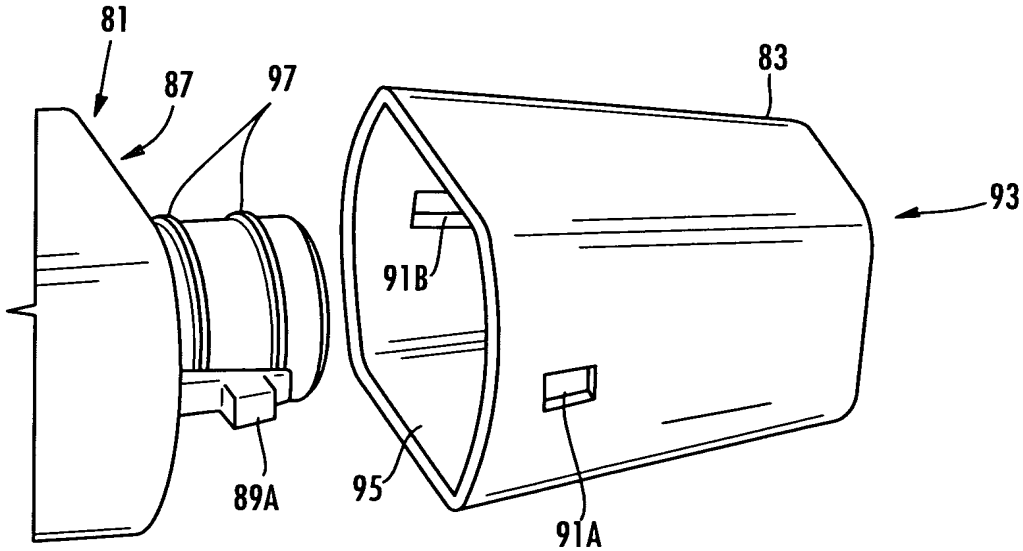


FIG. 11C

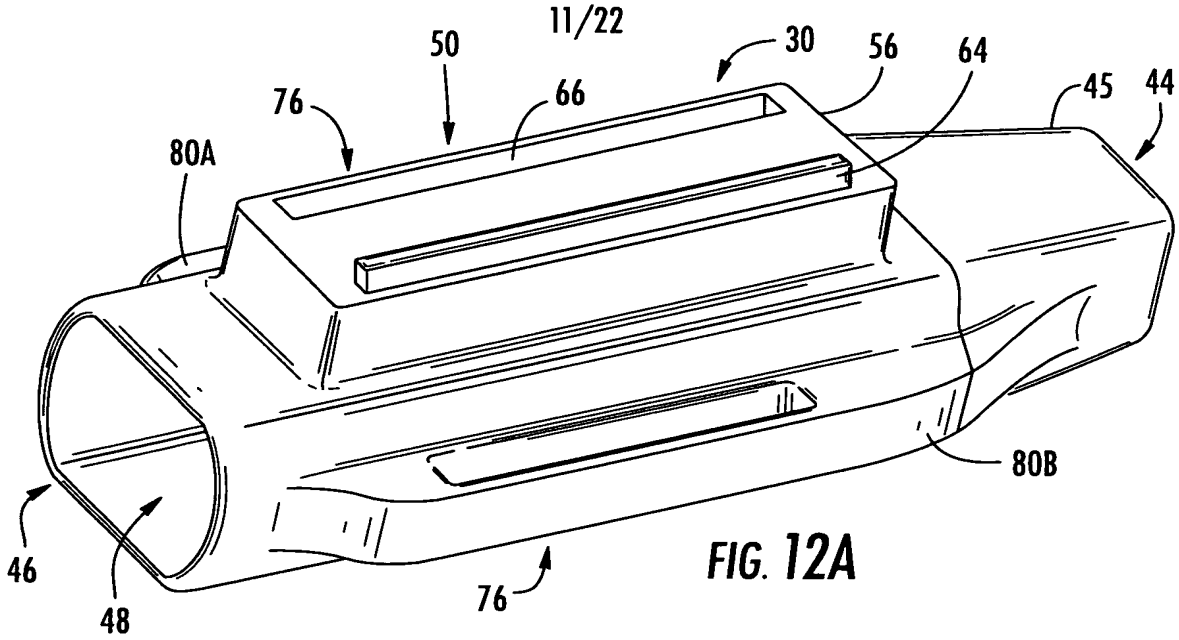


FIG. 12A

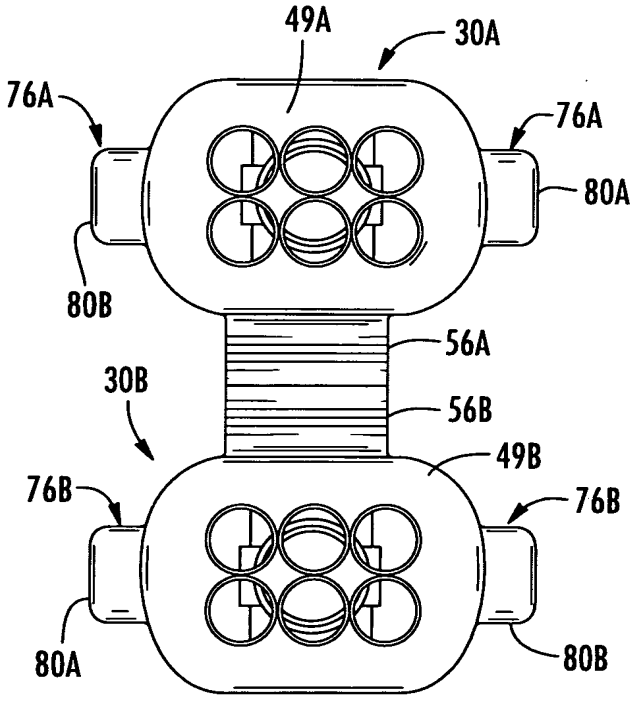


FIG. 12B

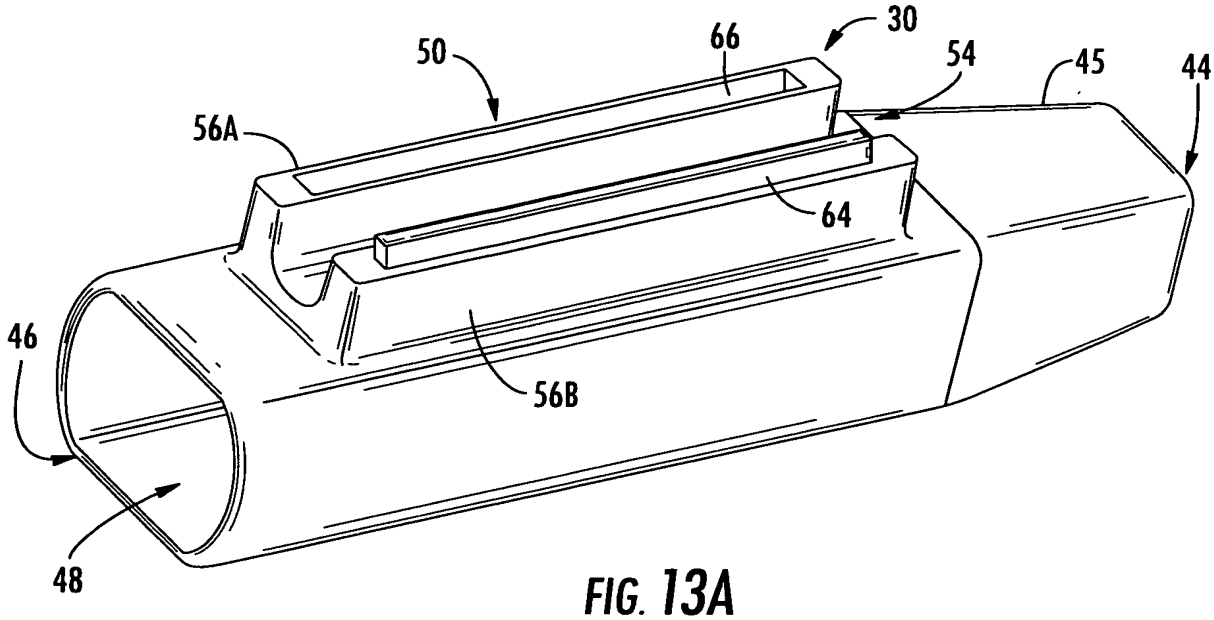


FIG. 13A

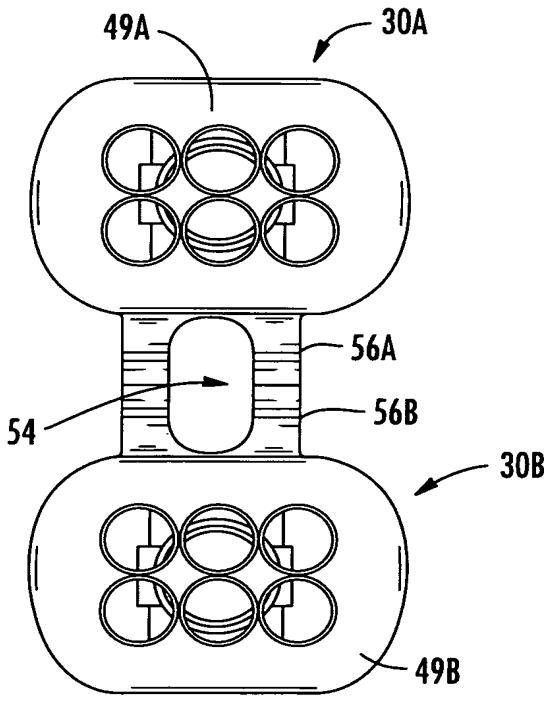


FIG. 13B

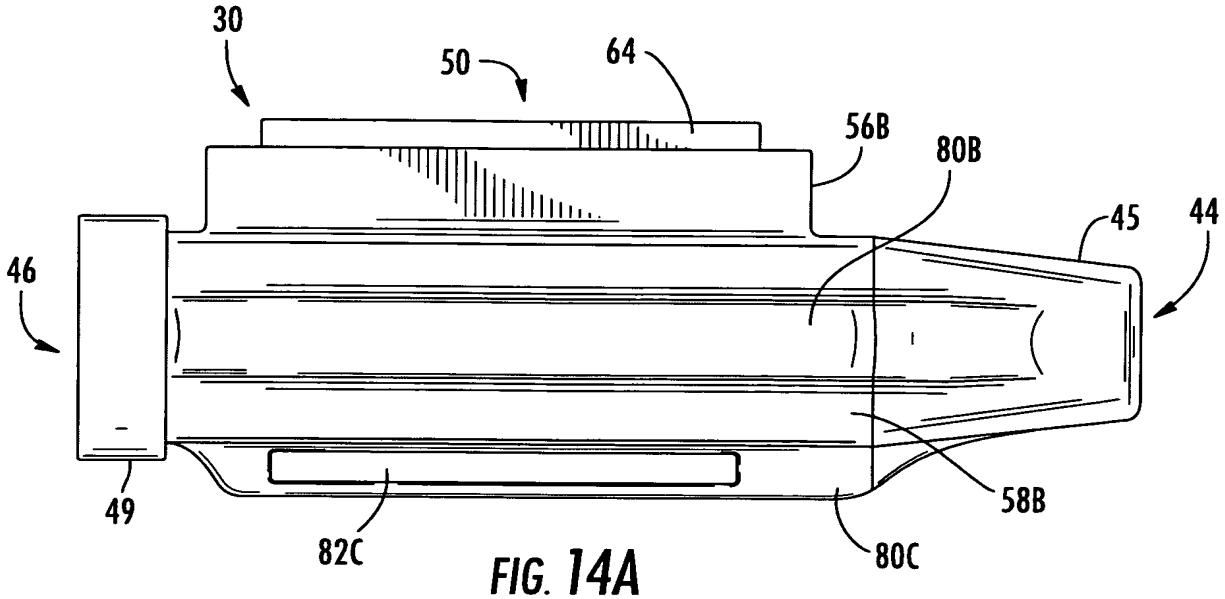


FIG. 14A

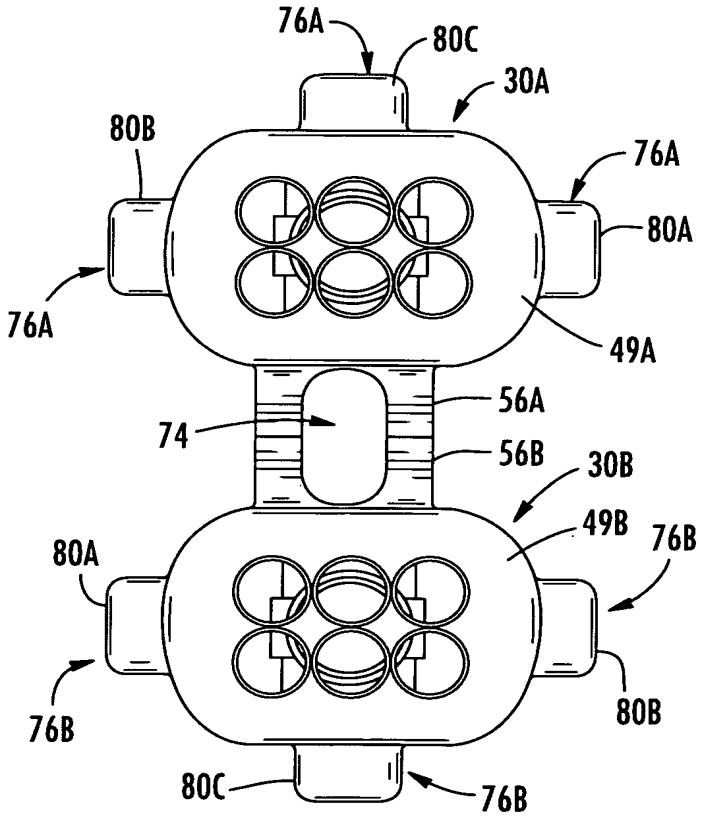


FIG. 14B

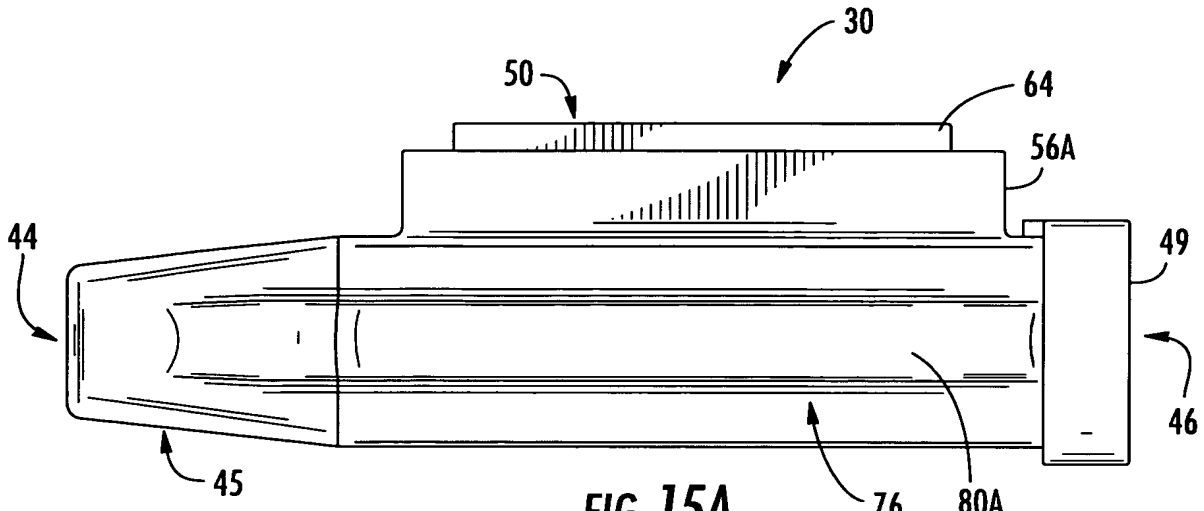


FIG. 15A

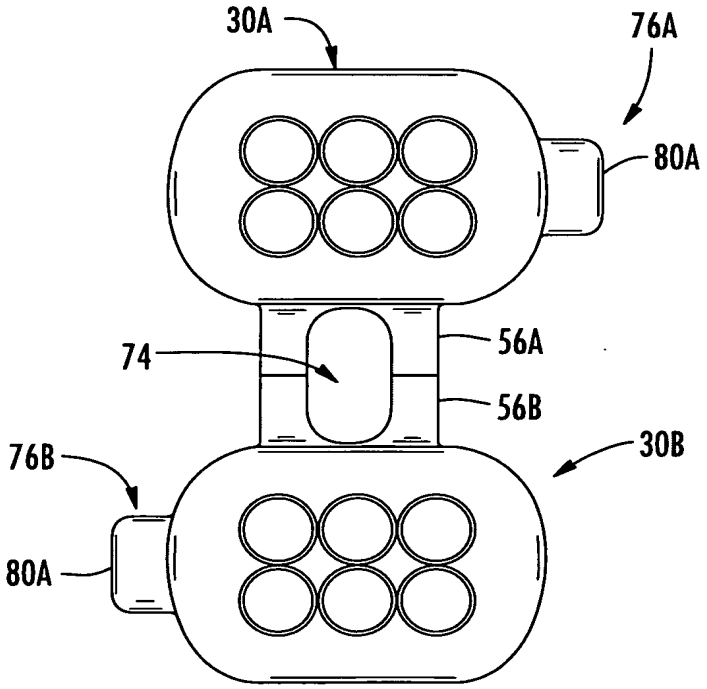


FIG. 15B

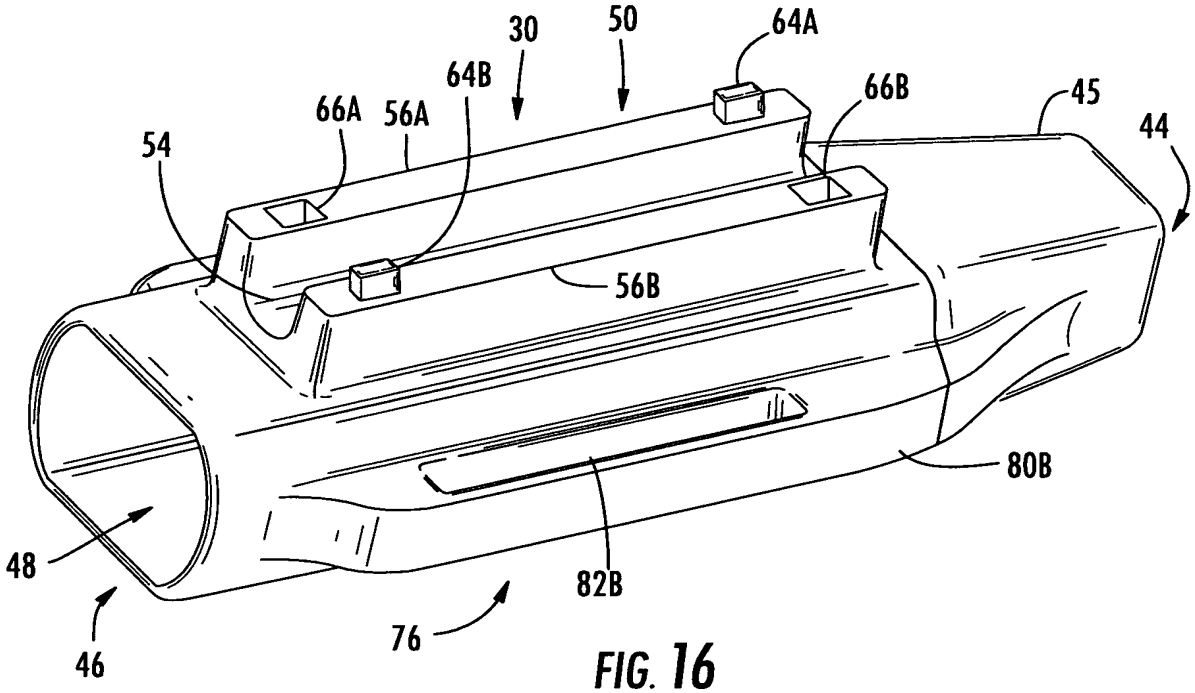


FIG. 16

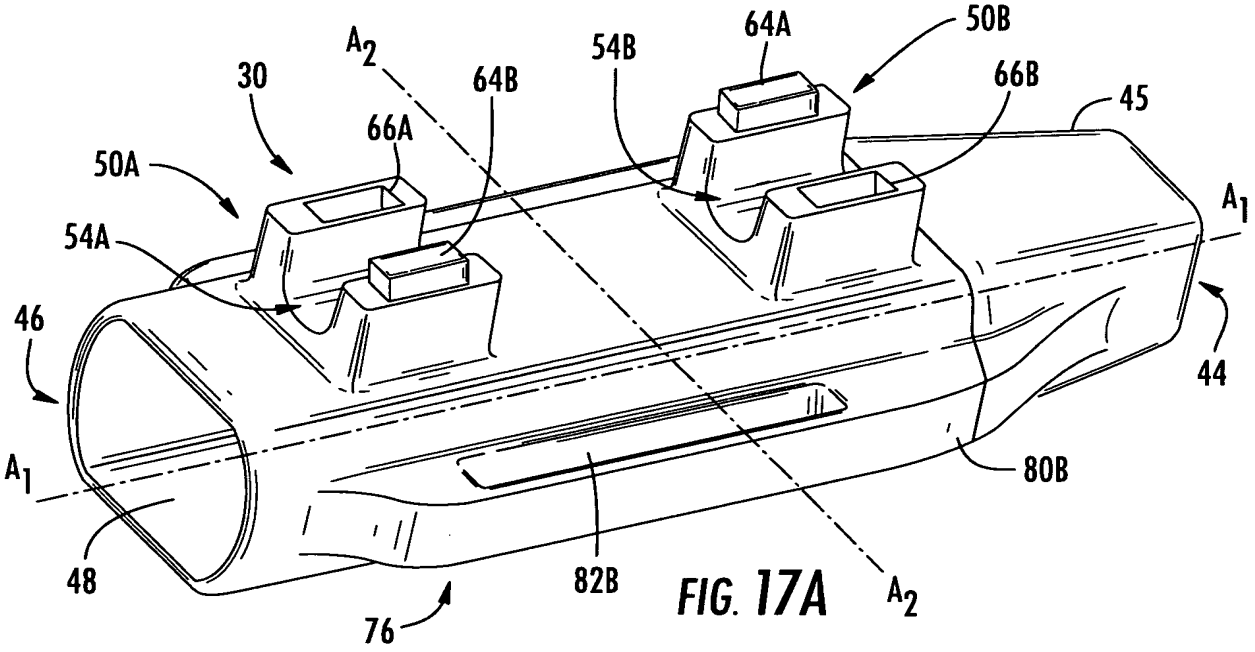


FIG. 17A

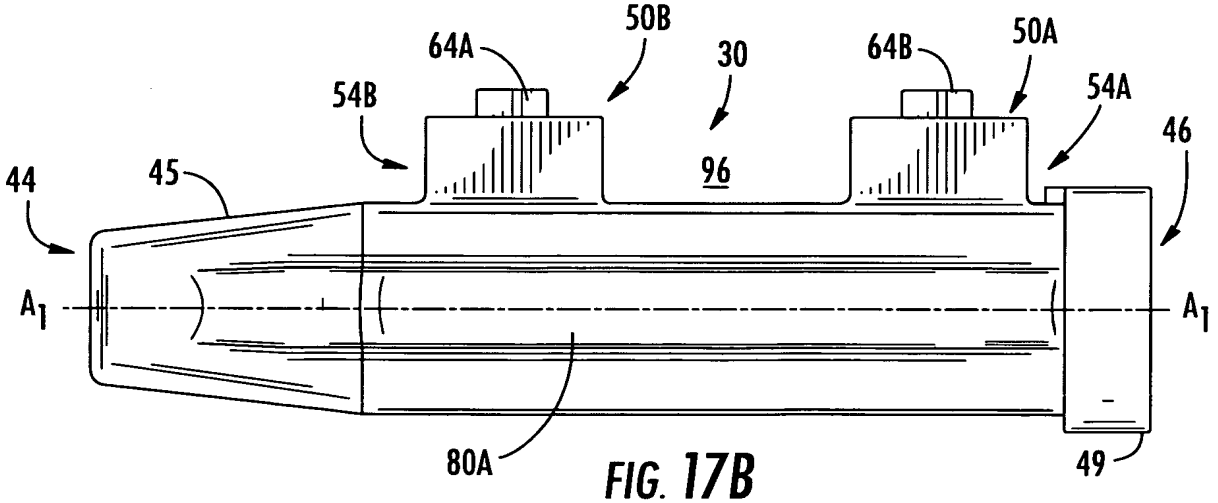


FIG. 17B

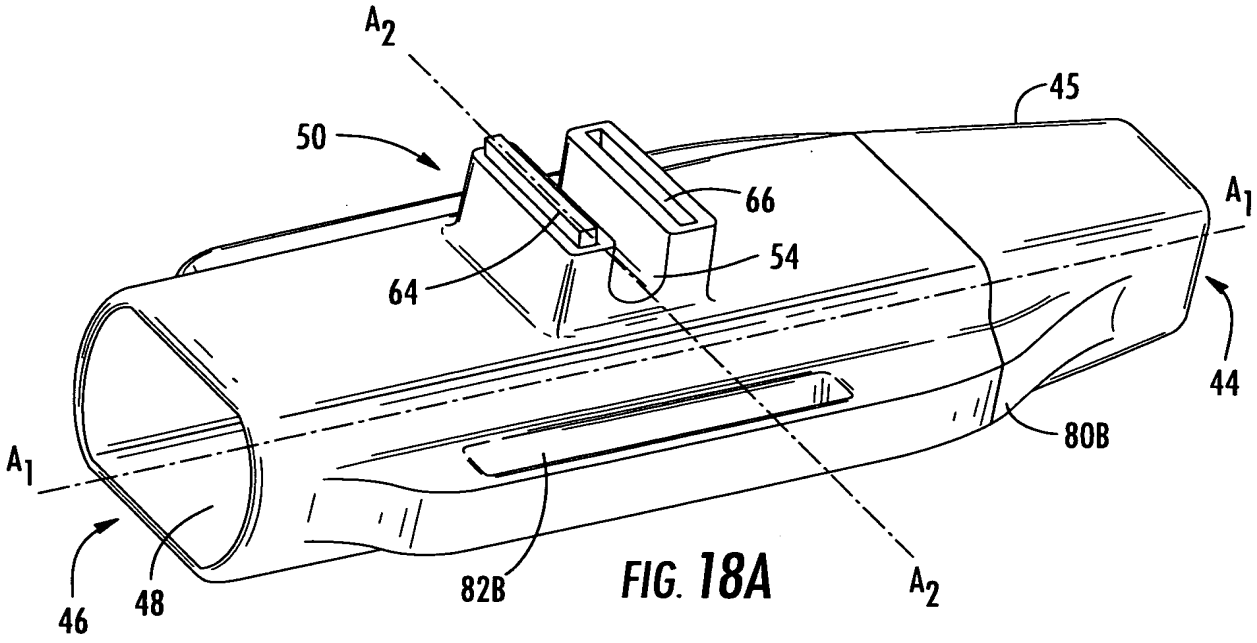


FIG. 18A

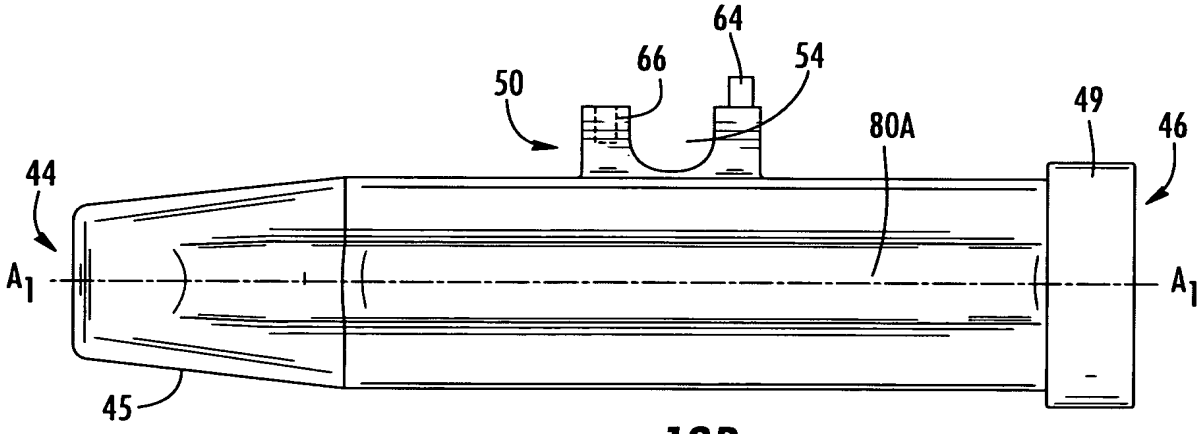


FIG. 18B

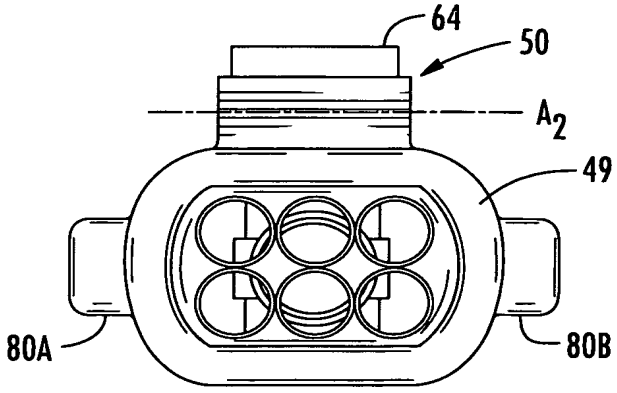


FIG. 18C

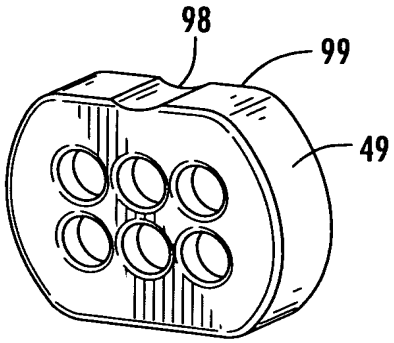


FIG. 19A

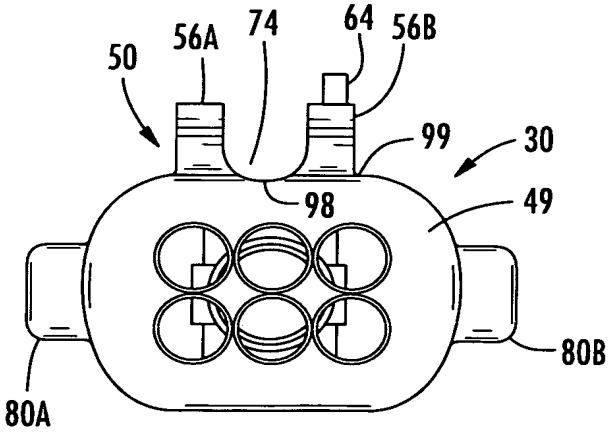


FIG. 19B

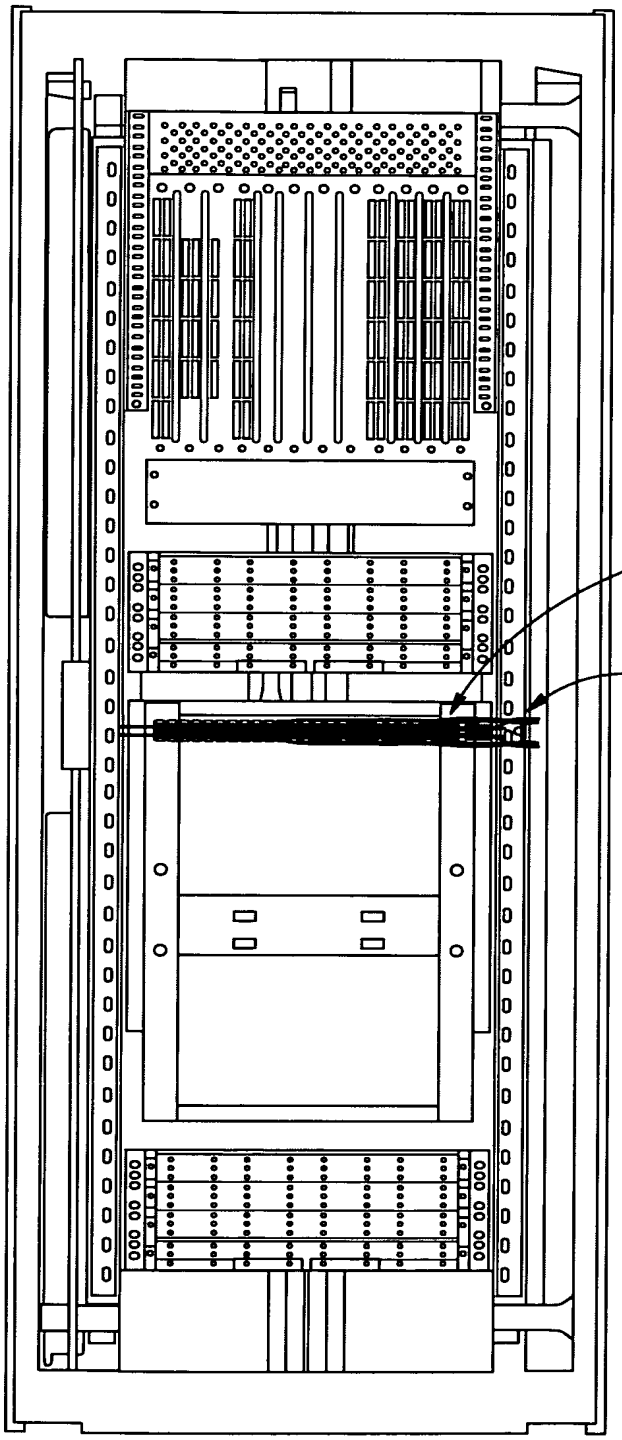


FIG. 20A

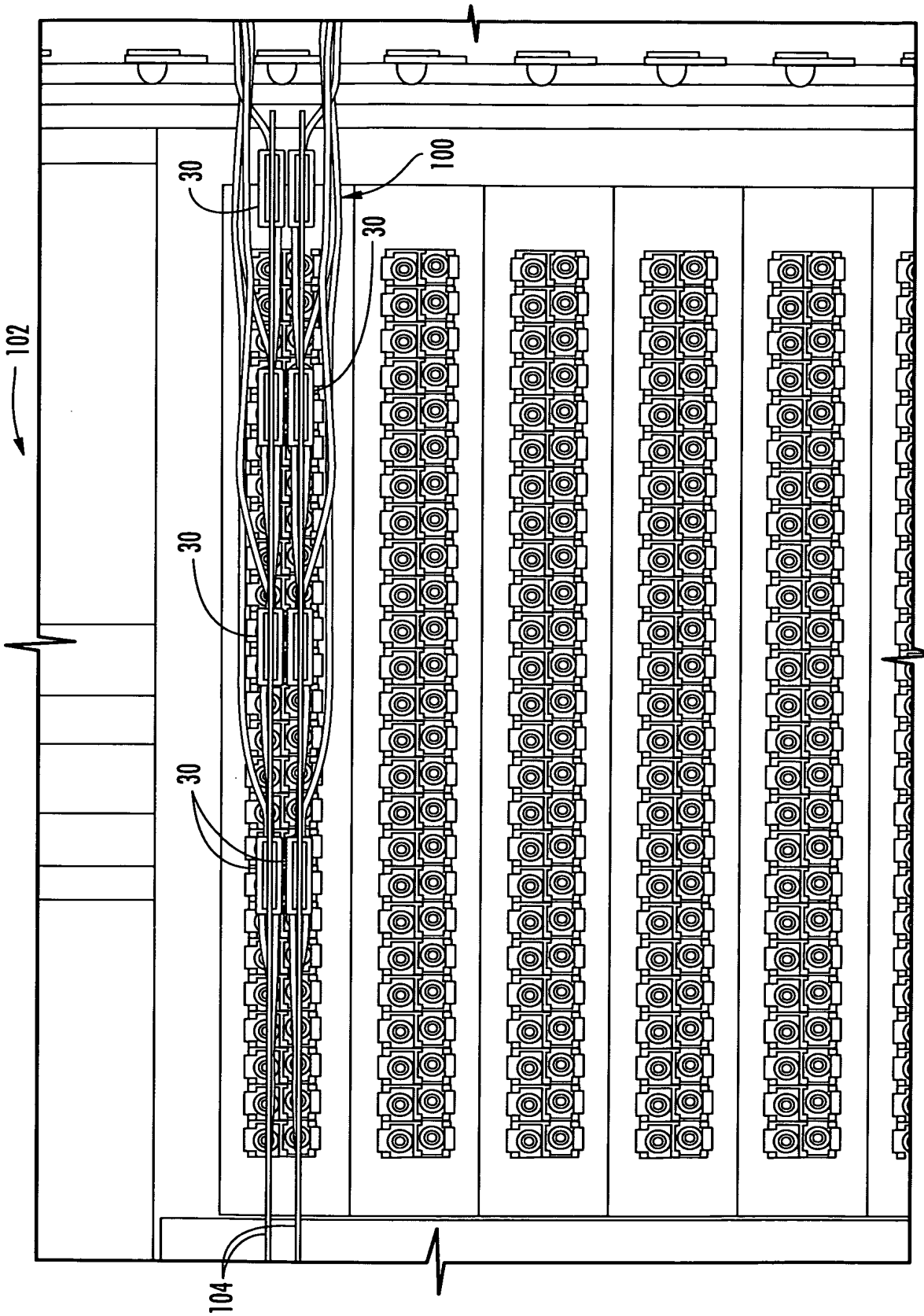


FIG. 20B

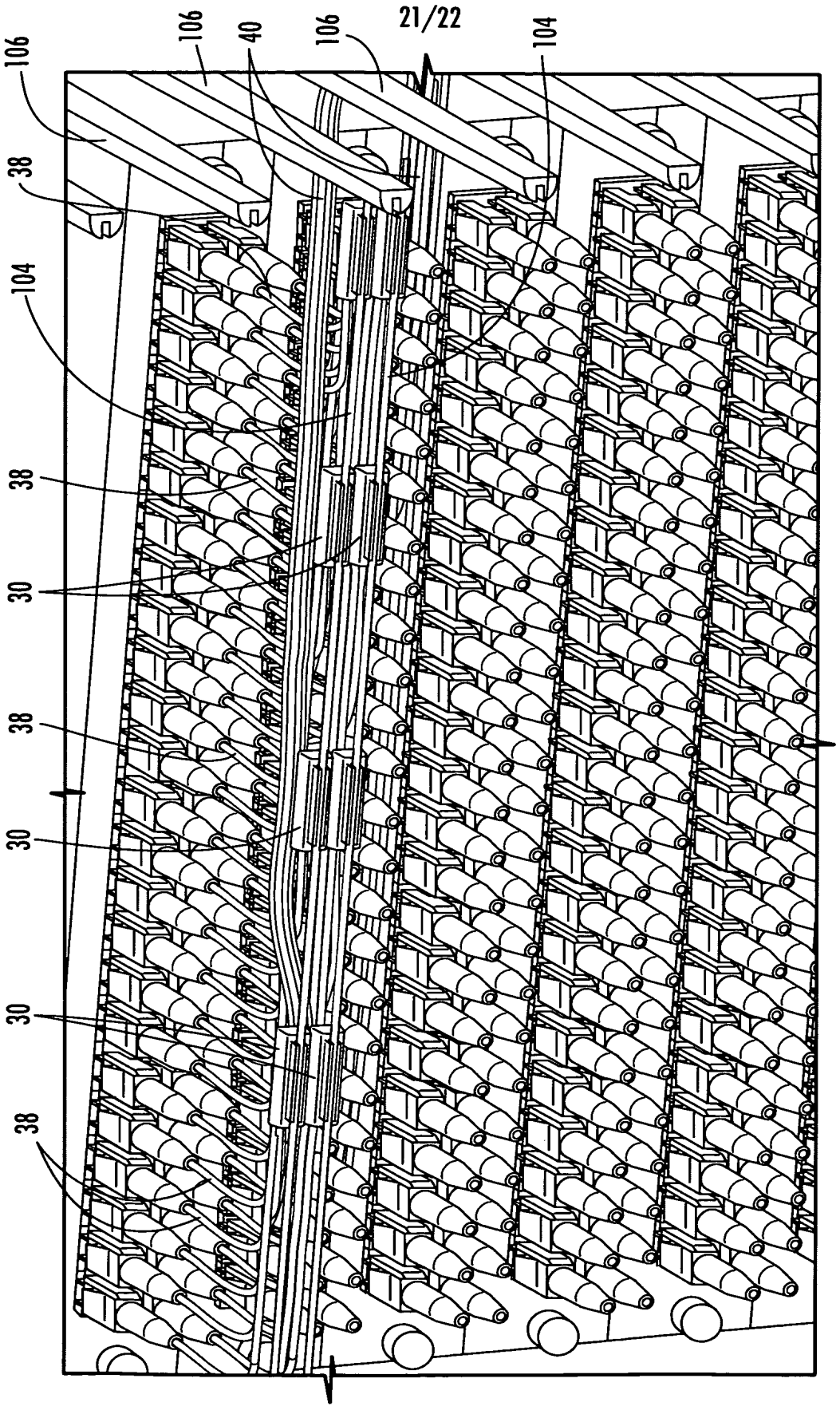
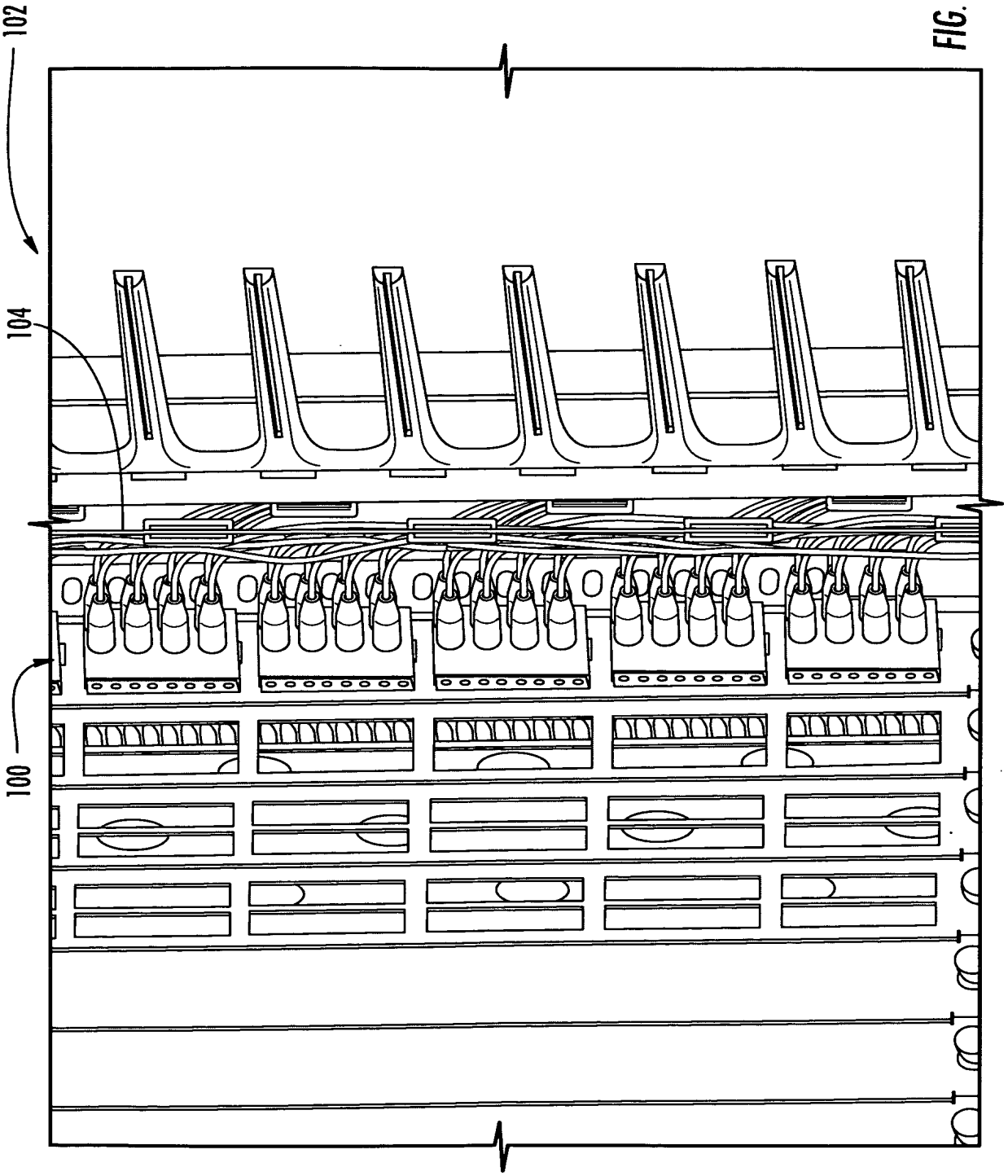


FIG. 20C

FIG. 21



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(72) Inventors; and

(75) Inventors/Applicants *(for US only)*: **DROESBEKE, Gert** [BE/BE]; Pallo 15, B-2440 Geel (BE). **PAULPANDIAN, Sivakumar** [IN/IN]; House No. 25 - 119, A -141, N.G.O. Colony, Gandhi Nager, Nagercoil, Kanyakumari District, Tamilnadu 629002 (IN).

(74) Agent: **FEENSTRA, L.**; De Vries & Metman, Overschiestraat 180, NL-1062 XK Amsterdam (NL).

(81) Designated States *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

Published:

— *with international search report (Art. 21(3))*

[Continued on next page]

(54) Title: CABLE GUIDE BOOT ASSEMBLY

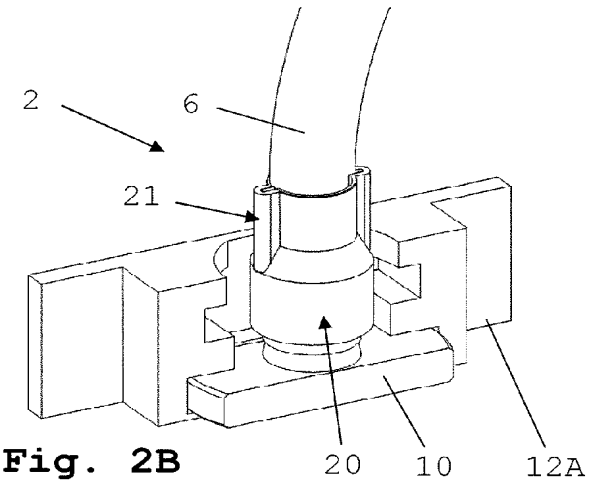


Fig. 2B

(57) Abstract: A cable guide boot assembly (2) for attachment to a connector (4) and guiding a cable (6) is provided, comprising a boot portion (22) and a connector portion (32). The connector portion is configured to be non-rotary fixed to the connector and to extend from the connector in a first direction (Z) relative to a mating direction of the connector, and comprises a first connection portion (34) having a non-circular circumferential shape relative to the first direction. The boot portion comprises a second connection portion (22A) mated to the first connection portion. The second connection portion is configured to receive the first connection portion, such that the boot portion is attachable to the connector portion in a discrete number of twisting angles (φ) with respect to the first relative direction.

WO 2012/136702 A1

— *before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))*

Cable guide boot assembly

TECHNICAL FIELD

The present disclosure relates to a cable guide boot assembly, in particular for guiding a cable in a desired direction with respect to a connector. A method is also provided.

BACKGROUND

Signal cables, in particular optical cables and/or flat cables having plural electrically conductive and/or optical signal strands adjacent each other, may be delicate and may require protection against kinks, sharp bends and/or twists which could reduce signal quality and/or even damage the strands. The risk of such kinks, sharp bends and/or twists in a cable is generally highest at or near the connection of the cable to a (cable) connector.

It is known to protect such cables by (semi-)rigid cable guide boots, which define a channel for guiding a cable in a bending and/or twisting angle that is considered acceptably safe for the cable. A particular example is use of guide boots in junction boxes where plural cable connectors are connected adjacent each other and where the cables are guided over about 90 degrees bending angle, so that space between a panel carrying plural connectors and another object, e.g. a wall or a door, may safely be reduced to a minimum.

To allow connecting and disconnecting cable connectors in a crowded junction box, it is desired that guide boots are provided which are adjustable and/or removable.

Thus, a desire exists for a guide boot that on the hand can provide adequate protection for a cable and on the other hand provide flexibility for granting access to the cable that is guided, a connector associated with the cable and/or adjacent equipment such as further cables, connectors etc.

SUMMARY

In a first aspect, a cable guide boot assembly is herewith provided for attachment to a connector and guiding a cable. The guide boot assembly comprises a first boot portion and a second boot portion. The first and second boot portions are attachable and/or attached to each other with a first coupling and a second coupling. When coupled with both first and second couplings, at least in the first coupling a portion of the first boot portion is received in a portion of the second boot portion and a curved channel portion is provided for guiding the cable with a predetermined bending radius through the cable guide boot assembly.

The first and second couplings may be arranged remote from each other along the first and/or second boot portions, in particular towards opposite ends of the first and/or second boot portions. Due to the first and second couplings, a particular relationship between the first and second boot portions with respect to their relative position and their direction of extension may be reliably established, and thus the bending radius of the channel portion defined by the boot assembly may be reliably established by attaching the first and second boot portions together.

The first and/or second boot portions and/or the first and second boot portions together may define an enclosed channel portion, to provide protection to the cable on all sides thereof along at least a portion of the cable.

The bending radius may be selected to suit one or more types of cables.

In an embodiment, at least one of the first and second couplings comprises a snap-fit coupling. Such assembly facilitates arranging the boot in the predetermined bending radius. The snap-fit coupling may provide an audible and/or tactile detectable click to indicate correct coupling.

In an embodiment, at least one of the first and second couplings is decouplable. Such assembly facilitates adjustment to the boot assembly, to the cable that is guided, to a

connector associated with the cable and/or to adjacent equipment.

In an embodiment, the first and second boot portions are detachably coupled to each other. Such assembly facilitates (partial) disassembling of the guide boot, improving access equipment associated with the assembly. Further, the assembly may be generally modular, which facilitates optimising the first and second boot portions to particular desires, e.g. manufacture from different materials and/or with different manufacturing techniques.

In an embodiment, the first and second boot portions are an integrated object. Such assembly facilitates use, since losing one portion of the guide boot assembly is prevented, also the first and second portions may be pre-aligned for appropriate coupling. The first and second boot portions may be manufactured as separate objects that are (semi-)permanently coupled and/or integrated afterward, e.g. with a hinge and/or by measures such as by gluing, welding, overmoulding, etc.

In another assembly the first and second boot portion may be unitary, which may facilitate manufacturing, e.g. by moulding techniques.

In an embodiment, at least the first boot portion (40) is relatively flexible and the second boot portion (48) is relatively rigid. In such an assembly the relatively flexible first boot allows moving the cable when the first and/or second coupling are uncoupled while at the same time providing some protection for the cable by the first guide boot portion. The relative rigidity of the second boot portion increases the protection to the level desired for the boot assembly in the coupled state of the first and second couplings.

In an embodiment, at least a portion of the channel extends along at least the first boot portion and the first and second couplings are arranged at or near opposite ends of the channel in the first boot portion. Such assembly facilitates accurately defining the bending radius of the channel of the first boot portion.

In an embodiment, in the coupled situation of the second coupling at least a portion of the first boot portion is received in a portion of the second boot portion. In such an assembly the portion of the first coupling in which a portion of the first boot portion is received in a portion of the second boot portion provides additional fortification of the first boot portion. Further, accessing the coupling from the outside of the guide boot is facilitated. Also, changes in the shape, strength and/or flexibility of the first boot along its length may be reduced or prevented, which may in particular be desirable in a boot assembly in which at least the first boot portion is relatively flexible and the second boot portion is relatively rigid.

A method of orienting a cable may, in accordance with the first aspect above, comprise the steps of

connecting a cable to a connector, such that the cable extends from the connector in a first relative direction;

providing a guide boot assembly of any one of the preceding claims;

accommodating at least a portion of the cable in at least a portion of the channel of the first boot portion;

coupling the first and second couplings of the guide boot assembly and therewith providing a curved channel through the cable guide boot assembly and bending the cable in a predetermined bending angle.

In a further aspect, a cable guide boot assembly is provided, which comprises a boot portion and a connector portion. Such cable guide boot assembly may comprise a cable guide boot assembly as described above. The connector portion is non-rotary fixed to the connector and extends from the connector in a first direction relative to a mating direction of the connector and comprises a first connection portion having a non-circular circumferential shape relative to the first direction. The boot portion, e.g. at least one of the first and second boot portions of a cable guide boot assembly as described above, comprises a second connection portion mated to the first connection portion, the second connection portion being

configured to receive the first connection portion, such that the boot portion is attachable to the connector portion in a discrete number of twisting angles with respect to the first relative direction.

In such cable guide boot assembly, the cable to be guided may be guided in a number of predetermined twisting angles, e.g. in steps of 30 or 45 degrees around the first direction. Predetermined twisting angles facilitate providing a predictable and reliable layout of the cables and assist preventing accidental twisting to a potentially unacceptable twisting angle, e.g. in view of signal quality and/or cable damage.

To define the twisting angles the first and second connection portions may comprise mated shapes comprising, e.g. a plurality of protrusions and/or recesses such as bumps, ribs, keys and/or regular or irregular polygonal shapes in cross section perpendicular to the first direction.

The boot portion receiving the connector portion provides a relatively cost-efficient assembly, since the connector portion may be a single-walled object, e.g. a tubular extension and/or a portion of a connector housing.

Further, the assembly may be relatively robust, since the assembly may be generally massive, since in the connector portion, hollow portions between wall portions for receiving the boot portion are obviated. Also, a connector provided with the connector portion of the assembly may be smaller and/or more accessible when the boot portion is not (yet) attached, compared to a connector having a connector portion for receiving a boot portion.

The connector portion may comprise a sleeve portion such as an overmoulded extension or a tubular extension of a connector housing or a connector shield, facilitating manufacture and design of the assembly.

Such sleeve portion may be a separate object. This facilitates providing the connector, the connector portion and the boot portion as an assembly of separate modules wherein each module may be optimised for different purposes. E.g., the

connector portion may comprise a crimping portion, e.g. a crimping ferrule. The crimping method may define a portion of the non-circular cross section of the first connection portion. Crimping also is an effective way of connecting the shield of a shielded cable to a connector shield.

Advantageously, the first and second connection portions are detachably connectable. This allows adjustment of the twisting angle by (partial) disconnecting the boot portion from the connector portion and reconnecting in another twisting angle.

The cable guide boot assembly may be of the above-described type having a first and a second guide boot portion, wherein the connector portion may be integrated in the first boot portion as a single object, e.g. a unitary object. In such case the second boot portion may comprise the second connection portion.

A method of orienting a cable may comprise the steps of providing a guide boot assembly according to the description of the further aspect above, fitting the boot portions over the connector portion in one of a discrete number of twisting angles with respect to the first direction thereby arranging the channel for receiving and guiding the cable in a predetermined twisting angle.

Where the cable guide boot assembly comprises a connector portion in the form of a sleeve portion, the method may comprise fixing the connector portion to a connector.

A cable guide boot may comprise one or more portions for defining a twisting angle of the cable to be guided relative to at least one portion of the guide boot assembly, e.g. comprising one or more portions of the channel with a narrow and/or non-circular cross section to determine an orientation of the cable within at least such portion of the channel.

BRIEF DESCRIPTION OF THE DRAWINGS

The above-described aspects will hereafter be more explained with further details and benefits with reference to

the drawings showing an embodiment of the invention by way of example.

Fig. 1 shows a reference coordinate system;

Figs. 2A-2F are various views of a first assembly comprising a guide boot assembly and a cable connector, Figs. 2C and 2D only showing a cable guide boot portion;

Figs. 3A-3B show a fiber patch cable comprising on opposite sides assemblies comprising a guide boot assembly and a cable connector;

Fig. 3C shows a cable guide boot portion of Figs. 3A-3B;

Fig. 4A shows a cable guide boot portion;

Figs. 4B-4C are different cross-section views of the boot portion of Fig. 4A, as indicated in Fig. 4A;

Figs. 4D-4E show two forms of a cable guide boot portion for use with the a cable guide boot portion of Fig. 4A;

Fig. 4F shows an assembly of the boot portions of Figs. 4A and 4E;

Fig. 5A shows a cable guide boot portion;

Fig. 5B is a cross-section view of the boot portion of Fig. 5A, as indicated in Fig. 5A;

Figs. 5C-5D show two forms of a cable guide boot portion for use with the a cable guide boot portion of Fig. 5A;

Figs. 5E-5F show an assembly of the boot portions of Figs. 5A and 5D in two arrangements;

Fig. 6A is an exploded view of a cable guide boot assembly;

Fig. 6B shows a cable guide boot of the assembly of Fig. 6A;

Figs. 6C-6D show the cable guide boot of Fig. 6A in perspective view and cross-section view, respectively;

Figs. 7A-7E, 8A-8C and 9A-9D, respectively, show various views of further embodiments in different arrangements.

DETAILED DESCRIPTION OF EMBODIMENTS

It is noted that the drawings are schematic, not necessarily to scale and that details that are not required for

understanding the present invention may have been omitted. The terms "upward", "downward", "below", "above", "front" and "rear" and the like relate to the embodiments as oriented in the drawings, and are for clarification purposes only without implications to a particular direction or orientation, unless otherwise specified. Further, elements that are at least substantially identical or that perform an at least substantially identical function are denoted by the same numeral, where useful further individualised with alphabetic suffixes.

Fig. 1 shows a reference coordinate system which will be adhered to in this disclosure. The position of any point P may be defined in Cartesian coordinates X, Y, Z, in cylindrical coordinates r, ϕ, Z, and/or in spherical coordinates r, ϕ, θ.

Fig. 1 shows a reference plane 1 corresponding with an XY plane, which may correspond to a panel into which a connector is to be plugged. The angle θ indicates a bending direction and the angle ϕ indicates a twisting angle.

A cable may be both twisted and bent. In case of a bent cable, twisting of a cable refers to a rotation about the longitudinal direction of the cable and bending refers to a deflection from a straight cable in a direction perpendicular to the longitudinal direction of the cable.

Figs. 2A-2F show (details of) a connector assembly 2 comprising a connector 4, attached to a cable 6 and further comprising a cable guide boot assembly 8.

The connector 4 is a cable connector and comprises a connector body 10 (partly shown) and a connector housing 12A-12B. Here, the connector body 10 comprises a barrel 14 for receiving at least a portion of the cable 6 and defining an initial direction of extension (Z) of the cable 6 from the connector 4.

The cable 6 comprises one or more leads (not shown in Figs. 2A-2F) e.g. for power or data transmission, which here extend through the barrel 14 and which are connected to one or more suitable terminals (not shown in Figs. 2A-2F) of the connector 4. Best seen in Fig. 2A, the cable 6 comprises an

optional shielding 16, e.g. a braid, and a cladding or sheath 18. The cable 6 is non-rotary fixed to the connector body 10.

A crimping ferrule 20 is arranged over the cable (shielding 16 and sheath 18) and is crimped to the barrel 14 (Fig. 2B). This fixes the cable 6 to the connector body 10 and prevents (twisting) rotation of the cable 6 about the barrel 14. The crimped ferrule 20 is provided with a connection portion 21 having a non-circular circumferential shape relative to the direction of extension (Z) of the barrel 14 and the cable 6, here being due to the crimping. In Fig. 2B the ferrule 20 is crimped in a so-called "ear-crimp" or "wing crimp", providing the connection portion 21 with a number of protruding ribs, but a star crimp, a hexagonal crimp, a line crimp or any other technique for and/or providing a connection portion having a non-circular cross circumferential shape in cross section may be employed.

Figs. 2C-2D show a cable guide boot portion 22 of the boot assembly 8. The boot portion 22 is generally hollow, having a lumen defining a channel 24 for receiving and guiding a portion of the cable 6 through it. The boot portion 22 is generally curved in a predetermined arc, here extending over about 90 degrees bending angle, and is substantially rigid, semi-rigid or somewhat flexible, e.g. metallic, plastic, artificial rubber, etc, to prevent sharp bends or kinks of a cable portion received in the boot portion 22. A semi-rigid and resilient boot portion 22 may deform slightly under force and veer back upon removal of the force. This extends life time and general robustness of the boot. Also, it prevents potentially damaging forces on (a barrel 14 of) a connector 4 to which the boot portion 22 is attached.

The boot portion 22 comprises a front section 22A, a middle section 22B and a rear section 22C. In the shown embodiment, the front end 22A is tubular with a closed circumferential wall, the middle section 22B and the rear section 22C have a generally C-shaped wall, providing openings 26B, 26C through the wall. The opening 26B in the middle section 22B is larger than the opening in the rear section 22C,

providing a window in the middle section 22B, as it were. A stiffening rib 27 extends along the boot portion 22, here only along the middle section 22B. The stiffening rib 27 extends radially inward with respect to the bending curvature of the boot portion 22 (Figs. 2D-2F).

The front section 22A has an exterior circumferential rib 28. The front section 22A has a non-circular interior shape in cross section perpendicular to the (local) direction of extension of the boot section 22, due to a plurality of structures protruding into the lumen. Here, best seen in Fig. 2D, the structures are ribs 30 arranged on an inner wall of the boot section and extending substantially axially along the boot section 22.

The boot 22 is attachable to the connector 4, with the front section 22A being configured to receive the cable 6 and to receive the crimping ferrule 20 (Figs. 2E-2F). In such attached situation, the outward extending ribs 21 of the ferrule 22 and the interior ribs 30 of the boot section 22 mate and interfere, preventing twisting of the boot portion 22 with respect to the connector body 10 when attached together. Due to the arrangement of interior ribs 30, the boot portion 22 is attachable to the ferrule 20, and thus to the connector body 10, in a discrete number of twisting angles ϕ with respect to (the direction of extension Z of the cable 6 from) the connector 4. As shown in Figs. 2E-2F, the (front section 22A of the) boot 22 may fit in a portion of the connector 4. In an embodiment, not shown, the boot portion 22 may be secured to the connector 4, e.g. one or more optional securing features of the connector housing portions 12A, 12B, may be provided, e.g. gripping onto the circumferential rib 28 (not shown).

Advantageously, the interior size and shape of the channel 24 in the boot section 22, at least in the front section 22A, and the exterior size and shape of the cable 6 are chosen such that at least a portion of the boot 22 and the cable 6 are freely rotatable about each other in the twisting direction. Thus, the boot 22 may be attached to the connector 4 in a

desired twisting position, without exerting a torsion force onto at least a portion of the cable 6.

The width of the openings of the middle and rear sections 22B, 22C, may be chosen. Preferably, the cable fits easily through the window 26B in the middle section 22B but may be held by the C-shaped wall of the rear section 22C. The cable 6 can, before, or in particular after attaching the boot 22 to the connector 4, be arranged into the channel 24 via the openings 26B, 26C, of the middle and rear sections 22B, 22C, of the boot portion 22. When the cable 6 is held to extend substantially straight from the connector 4, and is not retained in the rear section 22C of the boot portion 22, the boot 22 may be detached from (the ferrule 20 of) the connector and may be freely rotated and re-attached to the connector 4 in another predetermined twisting angle, without torsion of the cable 6. The cable 6 can then be arranged back into the channel 24 by fitting it into the rear portion 22C via the opening 26C with only a bend or with a desired amount of twisting. The rear section 22C and rear opening 26C may be formed such that the cable may be snapped into the rear portion 22C, e.g. by providing the rear portion 22C with suitably shaped lead-in bevels, chamfers and/or arms for guiding the cable 6 into the rear opening 26C and the rear portion 22C.

Figs. 3A-3B are explosion views of an embodiment of a substantially symmetric fiberoptic patch cable 6, the cable having fiberoptic leads 31 and having two substantially identical connector assemblies 4 on its opposite ends. Each connector 4 comprises a connector body 10. A strain relief portion 32 is fixed non-rotary to the connector body 10 and extends rearward from it along (the direction Z of extension of) the cable 6, opposite from the respective connecting directions C of the respective connector assemblies 4. The strain relief portion 32 has a connection portion 34 having a non-circular circumferential shape relative to the direction of extension Z of the cable 6 at the connector body 10 due to a plurality of facets, e.g. four, six (shown), eight or twelve. A rear portion 36 of the strain relief portion 32 is substantially flexible.

Fig. 3C is a perspective view of the cable guide boot portion 22 of Fig. 3B. Similar to the boot portion 22 of Figs. 2A-2F, this boot 22 is generally rigid and curved, providing a curved channel 24 that is bent over about 90 degrees. Different from the guide boot 22 of Figs. 2A-2F, the boot portion 22 of Figs. 3B-3C the middle section 22B comprises two generally C-shaped portions that are open to opposite lateral sides (best seen in Fig. 3B). This facilitates manufacture of an open construction by moulding, reduces material consumption and allows access to the channel 24 and a cable 6 received in it. Further, the rear portion 22C is tubular having a closed wall without an opening 26C. This boot portion 22 is provided with two stiffening ribs 27 extending along the middle section 22B, one extending radially inward and one extending radially outward with respect to the bending curvature of the boot portion 22 (Fig. 3B).

Like the boot portion 22 of Figs. 2A-2F, the front portion 22A of Figs. 3B-3C is tubular and comprises inward protruding interior ribs 30. Thus, the front section 22A is mated to (the exterior shape of) the connection portion 34 of the strain relief portion 32. In particular, the front section 22A is configured to receive and be detachably attachable to the connection portion 34 of the strain relief portion 32 in a discrete number of twisting angles ϕ with respect to the connector 4 and the cable 6 extending therefrom (direction Z). The different selectable twisting angles ϕ are determined by interplay of the interior ribs 30 and the facets of the connection portion 34 of the strain relief portion 32.

The cable 6 is freely rotatable about its longitudinal axis inside (the channel 24 of) the boot portion 22 so that, when detached from the connector 4, the boot portion 22 may be arranged in a different predetermined twisting angle with respect to the connector 4 without forcing torsion of the cable 6. Thus, an effective twisting angle ϕ, and a resulting effective direction of extension of the cable 6 from the connector 4 rearward from each boot portion 22, may reliably be defined without risking harm to the cable 6.

As indicated, the boot portions 22 of Figs 2A-3C are (semi-)rigid having a substantially fixed bending radius and angle, forceful deformation not considered. Such predetermined bending angle may not be desired in some applications, e.g. where a straight cable is preferred, where there is little room for twisting a bent boot 22, and/or where a bent boot 22 may interfere with connecting and/or assembling a connector 4 and/or an assembly of a connector 4 and an associated guide boot 22. The cable guide boot assembly 8 of Figs. 4A-4F addresses such problems.

This boot assembly 8 comprises a first boot portion 40 (Figs. 4A-4C) and a second boot portion 42 in the form of a stiffener or stay 42 (Figs. 4D-4E). The boot portion 40 is a generally tubular object which defines a channel 24 for receiving and guiding a cable 6 (not shown). The boot portion 40 comprises a front section 40A, a middle section 40B and a rear section 40C. As before, the front section 40A is configured to be attached to a mated non-circular connecting portion (not shown) of a connector and/or of another portion of the guide boot assembly 8 (both not shown) and it comprises interior ribs 30, visible in Fig. 4B, for defining twisting angles ϕ. The middle section 40B is generally flexible and comprises a plurality of optional radial cuts 44 to increase the flexibility. A sleeve 46 extends along the middle section 40B.

The stay 42 comprises an elongated body portion 42A and an optional gripping portion 42B, which here is formed disk-or spoon-like tab, but any other form e.g. a ring shaped is conceivable. The stay 42 is a substantially shape retaining object, which may be deformable or rigid e.g. metal, hard plastic or composite material.

The body portion 42A of the stay 42 and the sleeve 46 of the boot portion 40 are formed such that the stay may be inserted and maintained in the sleeve 46 (Fig. 4F) to provide an assembled boot assembly 8. The gripping portion 42B facilitates removal of the stay from the boot portion 40.

The stay 42 may be manufactured in straight form, as shown in Fig. 4D, but in use is preferably curved to define a

bending angle of the boot assembly 8. In an embodiment, the stay 42 is deformable by moderate force so as to define varying curvatures of the boot assembly 8, e.g. being bendable by hand without tools, but resisting bending under the influence of resiliency of the boot portion 40, such that a desired bending angle may be set and maintained thereafter. However, it is preferred that the stay 42 be substantially rigid to define a predetermined bending angle. In such case, for different bending angles, a stay 42 of one predetermined bending angle may be replaced with a stay 42 defining another predetermined bending angle.

Figs. 5A-5F show another boot assembly 8 comprising a first boot portion 40 and a second boot portion 48. The first boot portion 40 is similar to the first boot portion of Figs. 4A-4F, however lacking a sleeve 46 and having optional radial cuts 44 on two opposite sides. The second boot portion 48 is of similar construction to the stay 42 of Figs. 4A-4F, being a substantially shape retaining object, which may be deformable by a force larger than resiliency of the first boot portion or rigid e.g. metal, hard plastic or composite material. The second boot portion 48 comprises a front section 48A, a middle section 48B and a rear section 48C, which here is substantially identical to the front section 48A.

The front and rear sections 40A, 40B and 48A, 48B of the first and second boot portions 40, 48, respectively are arranged as first and second couplings for attaching the boot portions 40, 48, wherein the front and rear sections 48A, 48C of the second boot section 48 receive the front and rear sections 40A, 40B of the first boot section 40 by being bent around them (Figs. 5D-5F). The resulting shape of the second boot portion 48 is shown most clearly in Figs. 5D-5F. The front and rear sections 48A, 48B, may be formed differently, to facilitate coupling of the first boot section 40 therein.

When assembled and coupled with both couplings at the front and rear sections 40A, 48A; 40C, 48C, the guide boot assembly 8 provides a curved channel 24 for guiding the cable with a bending radius and bending angle that is defined by the

second boot portions 48. Upon decoupling one coupling, e.g. at the front sections as shown in Fig. 5E, the first boot portion 40 may be bent straight and thus be arranged in another twisting angle ϕ with little or no twisting stress on a cable and/or with reduced interference with nearby objects.

The second boot portion 48 need not be curved and may be substantially straight, but having a shorter length than the middle section of the first boot portion 40, pulling the front and rear sections 40A, 40C, together like a bow and a bowstring.

Figs. 6A-6D show another guide boot assembly 8. This assembly also comprises a first boot portion 40 and a second boot portion 48. The first boot portion 40 here is a generally flexible tubular object with a closed wall, but it may comprise cuts and/or windows. The second boot portion 48 is a substantially (semi-)rigid object resembling the boot portion 22 of Figs. 2A-2D and having a tubular front section 48A, a generally C-shaped middle section 48B with a relatively wide opening 26C and a generally C-shaped rear section 48C with a relatively narrow opening 26C. The second boot portion 48 also comprises a stiffening rib 27 and it may comprise a non-circular interior circumference, e.g. interior ribs 30 to define distinct twisting angles ϕ (not shown).

For assembling this assembly 8 and defining a predetermined bending angle, the first boot portion 40 is inserted from the rear into the front section 48A of the second boot portion 48 to provide a first coupling of the boot portions 40, 48 (Fig. 6A). To establish a bending radius and -angle defined by the second boot portion 48, (the rear section 40C of) the first boot portion 40 is also coupled with the rear section 48C of the second boot portion 48. The rear section 48C comprises outward extending arms 50 for guiding the first boot section 40 into the rear portion 48C so as to provide an easy snap-coupling, which is detachable (Figs. 6C-6D).

The C-shaped middle section 48B provides a sideways stability to (the middle section 40B of) the first boot section 40.

Figs. 7A-7E show a guide boot assembly 8 comprising a first boot portion 40 and a second boot portion 48, which are attached together, here being integrated into a unitary object.

The first boot portion 40 comprises a front section 40A, which may comprise interior ribs and/or other means to provide a non-circular interior cross sectional shape, and it comprises a middle section 40B which in turn comprises a plurality of optional radial cuts 44 and is flexible.

The second boot portion 48 comprises a front section 48A having a generally C-shaped wall providing a snap-coupling to the front section 40A of the first boot section 40. The second boot portion 48 further comprises a C-shaped middle section comprising a stiffening rib 27 which is enlarged to provide a gripping portion. In the shown boot assembly the rear sections of both boot portions 40, 48 coincide.

In use, to facilitate defining a twisting angle of the boot assembly 8 and a cable received in the boot assembly 8 and/or to facilitate access to one or more objects adjacent the assembly, the coupling between (the front sections 40A, 48A of) the first and second boot portions 40, 48, towards the front side of the assembly 8 may be detached. The first boot portion 40 may be bent over a bending angle defined by the second boot portion 48 by (re-)attaching the coupling of the front sections 40A, 48A.

Figs. 8A-8C show another guide boot assembly 8, comprising a first boot portion 40 and a second boot portion 48, which are hingingly attached to each other near the front side of the boot assembly 8. Here, the hinge 52 is formed by a flexible portion and the first and second boot portions 40, 48, are an integrated object, possibly unitary. The front section of second boot portion 48 comprises a tubular portion 48A, which is configured for attachment to a connection portion of a further object, e.g. a connector portion or a further portion of the guide boot assembly 8 (not shown), and which may comprise a non-circular interior circumferential shape preventing rotation between predetermined twisting angles. Here, both first and second boot sections comprise a generally C-shaped middle

section 40B, 48B. The rear section 40C of the first boot portion 40 is also generally C-shaped. The rear section 48C of the second boot portion 48, however, comprises an elongated flexible strap 54 having a first fastener 56. The rear portion 48C also comprises a second fastener 58 mated to the first fastener 56. The rear sections 40C and 48C are couplable together by arranging the respective rear sections 40C, 48C against each other and fastening the strap 54 around both of them, such that the first boot portion 40 is received by and attached to the second boor portion 48 (Figs. 8B-8C). The first and second fasteners here comprise a protrusion (58) and a matching recess (56), but other fasteners, e.g. a snap fastener, a hook-and-loop type fastener (e.g. Velcro ®), may be employed.

Different from the other boot assemblies shown, when the coupling at the rear is decoupled (Fig. 8A), this boot assembly 8 only forms an enclosed channel portion at the front side of the boot assembly 8. Towards the rear side of the guide boot a channel is absent, both first and second boot portions merely forming half-shells to provide an enclosed curved channel 24 upon coupling of the rear portions 40C, 48C.

The wall thicknesses of the first and second boot portions 40, 48, may vary along the boot assembly. E.g., the rear section 40C of the first boot portion 40 may be reduced such that the combined thickness of the first boot portion 40 and the strap 54 at that point are substantially equal to the wall thickness of an adjacent section of the first and/or second boot portions 40, 48.

Figs. 9A-9D show another cable guide boot assembly 8, comprising a plurality of boot portions 60 adjacent each other along the direction of extension of the boot assembly 8, which are separated by radial cuts , providing the boot portions with a tapering shape. Each boot portion comprises a lumen 61 for receiving and guiding a cable portion. The boot portions 60 are attached to a longitudinal rib 27 or spine, which is somewhat flexible such that adjacent boot portions 60 are hingingly coupled together and together form a channel 24 for receiving and guiding a portion of a cable.

Each boot portion 60 comprises at least a second coupling portion, here in the form of a latching barb 62 and a mated receptacle 64 with a latching edge 66 on an opposite side of the boot portion 60 with respect to the spine 27. Two adjacent boot portions 60 may be coupled together opposite the spine 27 by rotating the boot portions 60 towards each other about the hinge. Then, the latching barb 62 of the one boot portion 60 is received in the mated receptacle 64 of the adjacent boot portion 69 and engages the latching edge 66, e.g. snapping behind it, therewith establishing a second coupling between the adjacent boot portions 60 (best seen in Fig. 9D). Thus coupled together, adjacent boot portions 60 define a portion of a curved channel 24 for receiving and guiding a cable (not shown). In the shown embodiment, when all boot portions 60 are coupled with their respective adjacent boot portions 60 the boot assembly 8 defines a channel 24 that is curved in a bending angle over about 90 degrees (Figs. 9C, 9D). It is noted that the boot assemblies 8 of Figs. 9A-9B and 9C-9B have slightly different coupling members 62-66. In Figs. 9A-9B the coupled boot portions 60 would provide a saw-tooth-shaped edge on its radial inside edge with respect to the bending angle (not shown) whereas the boot portion of Figs. 9C-9D provides a smooth radial inside edge 68.

Decoupling of adjacent boot portion in the shown embodiment may readily be performed by lateral squeezing a boot portion 60 on opposite sides, substantially perpendicular to the plane of the Figures 9A-9D, between the rib portion 27 and the snap-coupling portion 62-66. Thus, the squeezed boot portion 60 is deformed whereby receptacle 64 is pushed away from the spine portion 27 and the latching edge 66 is pushed away from the barb 62, such that the two are disengaged from each other. The latched coupling between a number of boot portions 60 may thus be decoupled by successive pinching of the boot portions 60, which may be done in a single swiping motion along the desired section of the boot assembly 8.

It is noted that the boot assemblies of the Figures7A-7E and 9A-9D may be arranged in a curved state to a

predetermined bending radius through the cable guide boot assembly, by coupling the respective first and/or second couplings. However, when decoupled, at least the first boot portion of each assembly may provide a substantially straight strain relief and/or guide boot. Similar holds for the assemblies of Figs. 4A-4F when (at least partly) disassembled.

The invention is not restricted to the above described embodiments which can be varied in a number of ways within the scope of the claims. For instance, different bending radii may be employed. Different lengths may be used. The channel may be shaped differently, e.g. for receiving a flat cable. A guide boot may comprise plural coupling portions for providing different predetermined bending angles.

Elements and aspects discussed for or in relation with a particular embodiment may be suitably combined with elements and aspects of other embodiments, unless explicitly stated otherwise.

CLAIMS

1. A cable guide boot assembly (2) for attachment to a connector (4) and guiding a cable (6) comprising a boot portion (22, 8) and a connector portion (20, 32),

wherein the connector portion (20, 32) is configured to be non-rotary fixed to the connector and to extend from the connector in a first direction (Z) relative to a mating direction of the connector, and comprises a first connection portion (21, 34) having a non-circular circumferential shape relative to the first direction;

wherein the boot portion comprises a second connection portion (22A, 40A, 48A) mated to the first connection portion, and

wherein the second connection portion is configured to receive the first connection portion, such that the boot portion is attachable to the connector portion in a discrete number of twisting angles (ϕ) with respect to the first relative direction.

2. The cable guide boot assembly (2) according claim 1, wherein the boot portion (22, 8) provides a curved channel portion (24) for guiding the cable with a predetermined bending radius through the cable guide boot assembly.

3. The cable guide boot assembly (2) according to any preceding claim, wherein the first connection portion (21, 34) and the second connection portion (22A, 40A, 48A) comprise mated shapes in cross section perpendicular to the first direction.

4. The cable guide boot assembly (2) according to any preceding claim, wherein the first connection portion (21, 34) and the second connection portion (22A, 40A, 48A) are detachably connectable.

5. The cable guide boot assembly (2) according to any preceding claim, wherein the connector portion (20, 32) comprises a sleeve portion such as a crimping portion (20) for crimping onto a corresponding portion (14) of the connector (4), an overmoulded extension or a tubular extension of a connector housing or a connector shield.

6. The cable guide boot assembly (2) according to claim 5, wherein the connector portion (32) comprises a strain relief portion (36).

7. The cable guide boot assembly (2) according to any preceding claim, wherein at least a portion (36) of the connector portion (30, 32) is relatively flexible and the boot portion (22) is relatively rigid.

8. The cable guide boot assembly according to any one of claims 2-7, wherein the boot portion (8) comprises a first boot portion (40, 60) and a second boot portion (48, 60),

wherein the first and second boot portions are at least one of attachable and attached to each other with a first coupling (40A, 48A, 50, 27) and a second coupling (40C, 48C, 50, 54-58, 62-66), and wherein preferably the first and second couplings are at or near opposite ends of the channel in the first boot portion.

9. Cable guide boot assembly according to claim 8, wherein at least one of the first and second couplings (40A, 48A, 40C, 48C, 50, 54-58, 62-66) is decouplable.

10. Cable guide boot assembly according to claim 8 or 9, wherein at least the first boot portion (40) is relatively flexible and the second boot portion (48) is relatively rigid.

11. Cable connector assembly comprising a connector (4), in particular an optical connector, and a cable guide boot assembly (8) according to any one of the preceding claims.

12. Cable (6) having substantially identical connector assemblies (4) and cable guide boot assemblies (2) according to any one of the preceding claims on its opposite ends.

13. A method of orienting a cable (6) comprising the steps of connecting a cable to a connector (4), such that the cable extends from the connector in a first relative direction (Z);

providing a guide boot assembly (2) according to any preceding claim,

fitting at least the boot portion (22, 8) over the connector portion (20, 32) in one of a discrete number of twisting angles (ϕ) with respect to the first direction (Z)

thereby arranging a channel (24) for receiving and guiding the cable in a predetermined twisting angle.

14. A method of orienting a cable (6), in particular the method according to claim 13, comprising the steps of providing the guide boot assembly of any one of the preceding claims 8-10;

accommodating at least a portion of the cable in at least a portion of the channel (24) of the first boot portion (40, 60);

coupling the first and second couplings (27, 40A, 48A, 40C, 48C, 50, 54-58, 62-66) of the guide boot assembly and therewith providing a curved channel through the cable guide boot assembly and bending the cable in a predetermined bending angle.

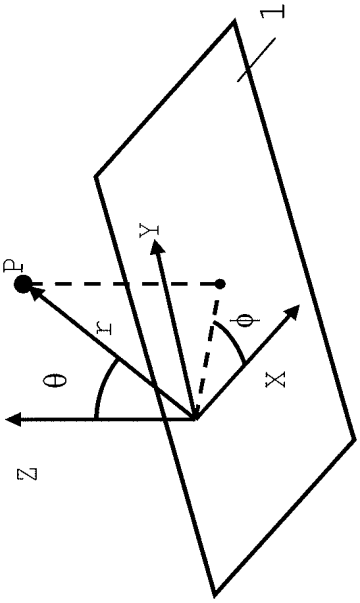


Fig. 1

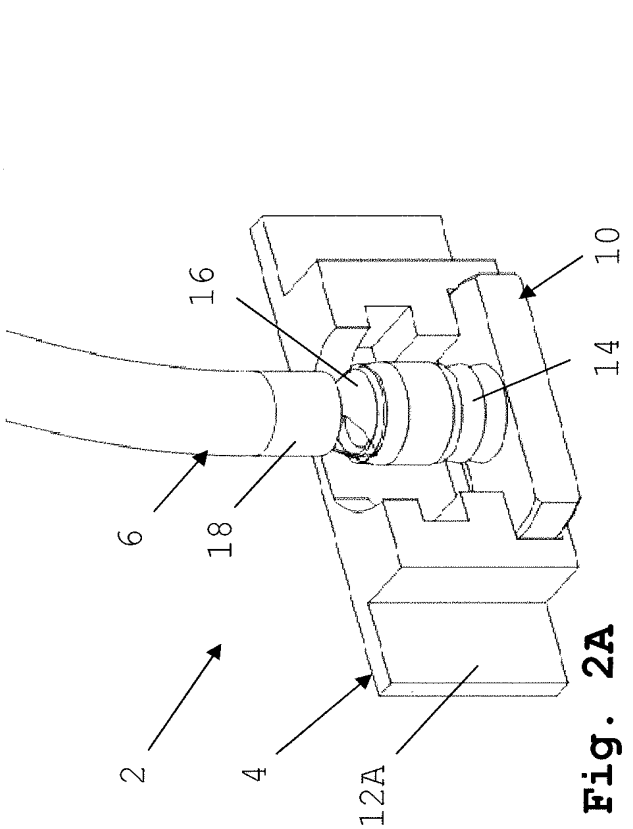


Fig. 2A

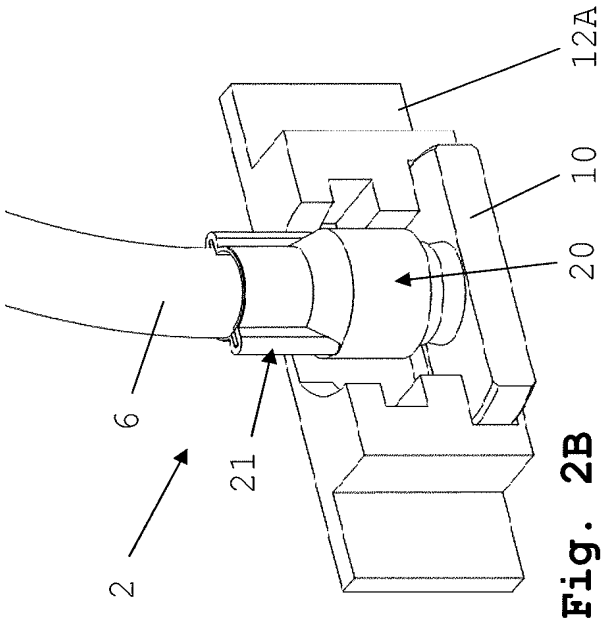


Fig. 2B

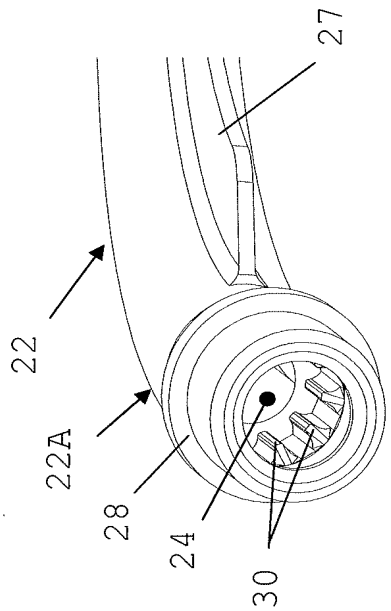


Fig. 2D

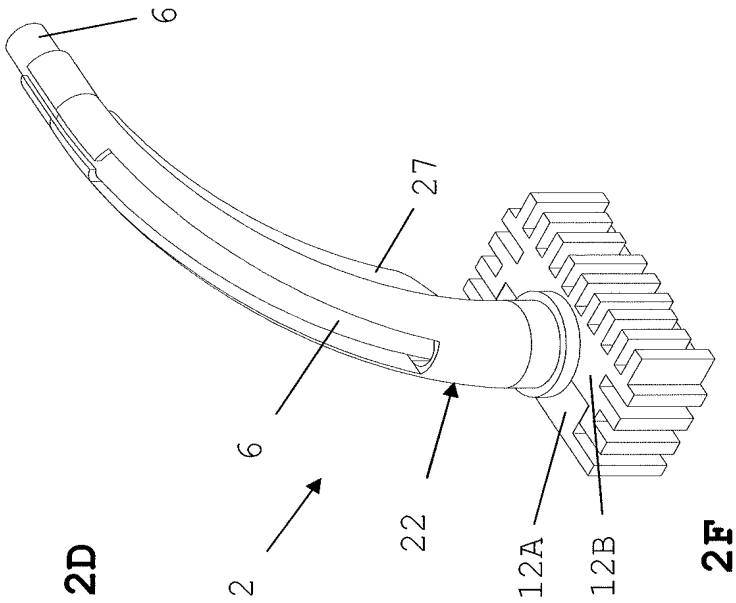


Fig. 2F

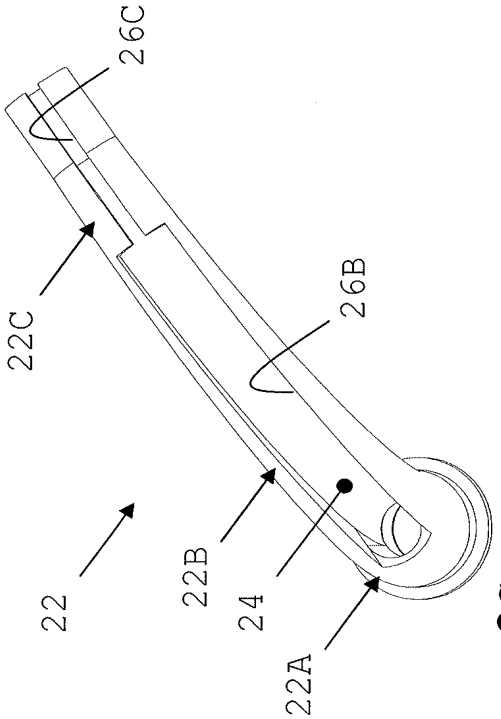


Fig. 2C

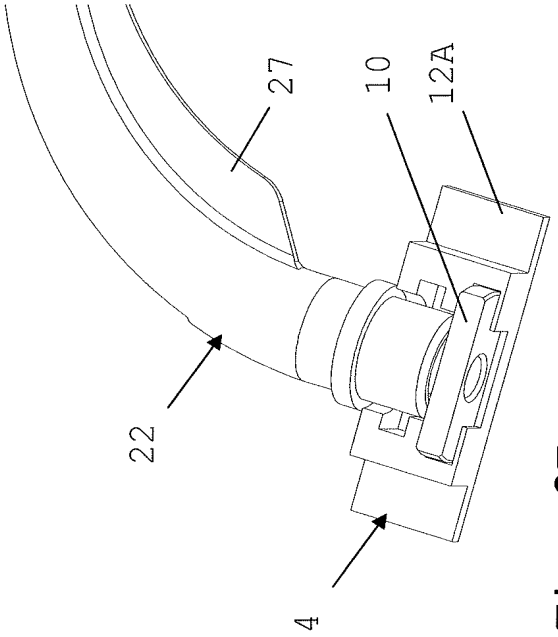


Fig. 2E

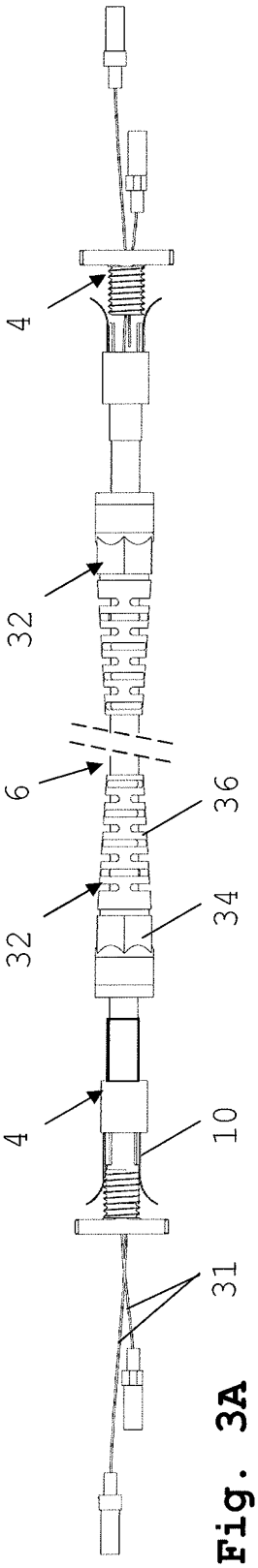


Fig. 3A

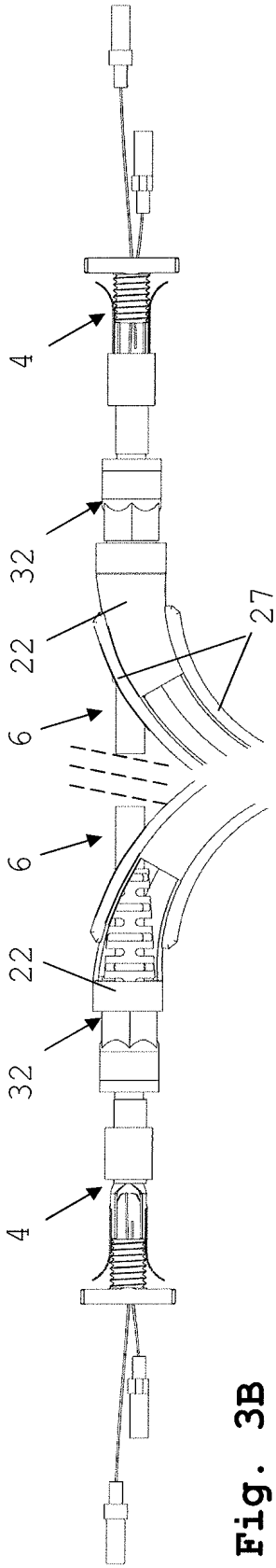


Fig. 3B

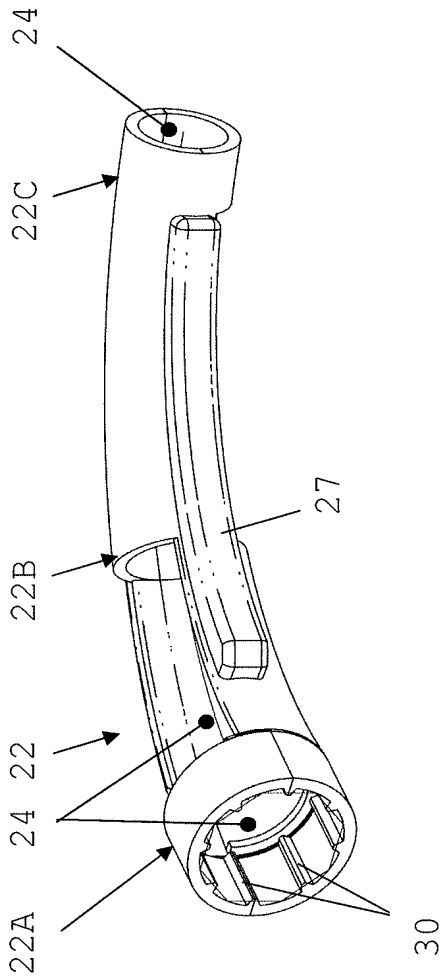


Fig. 3C

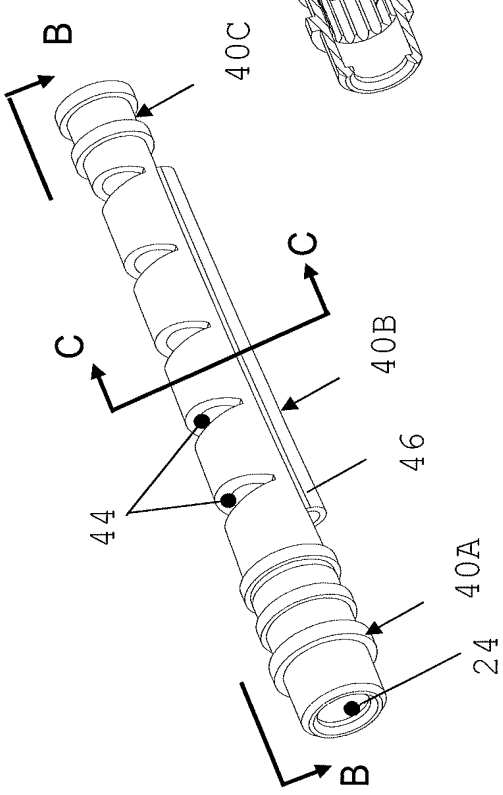


Fig. 4A

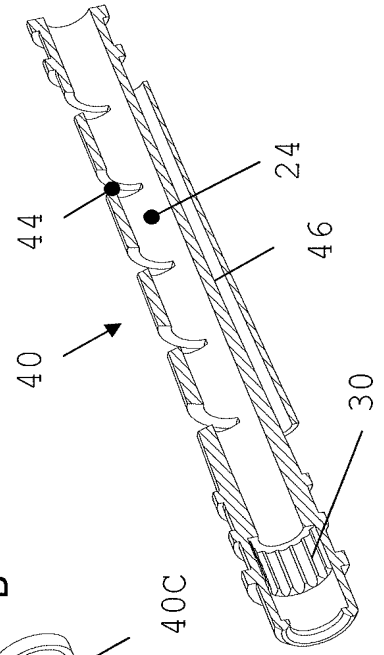


Fig. 4B

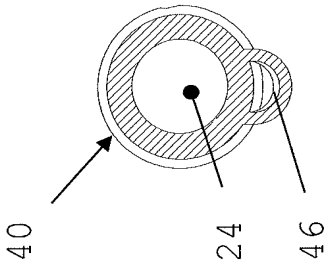


Fig. 4C

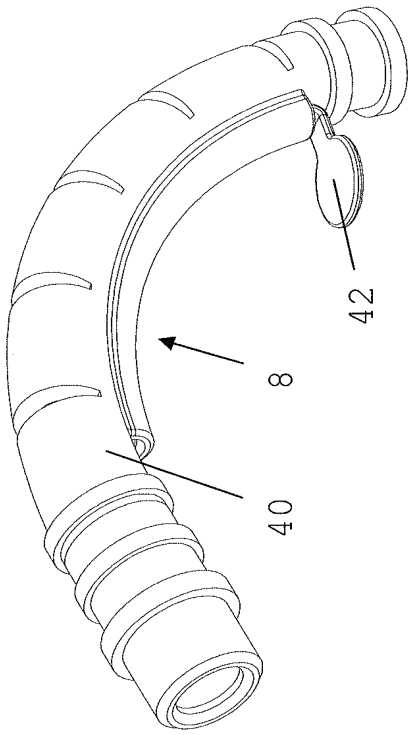


Fig. 4F

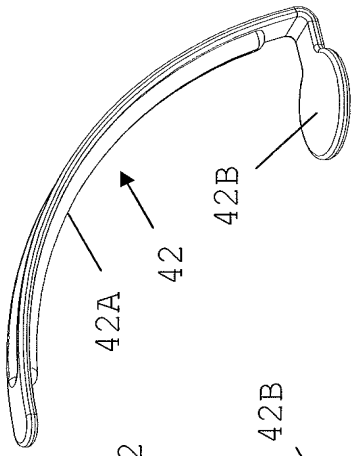


Fig. 4E

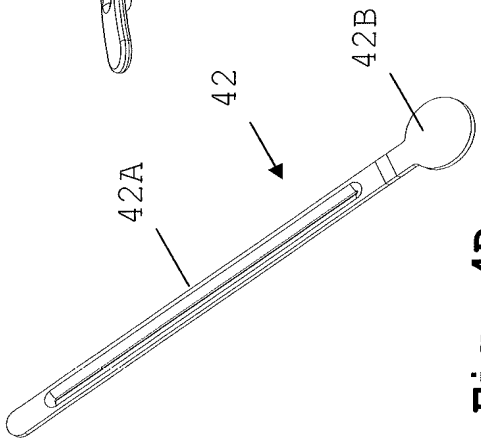


Fig. 4D

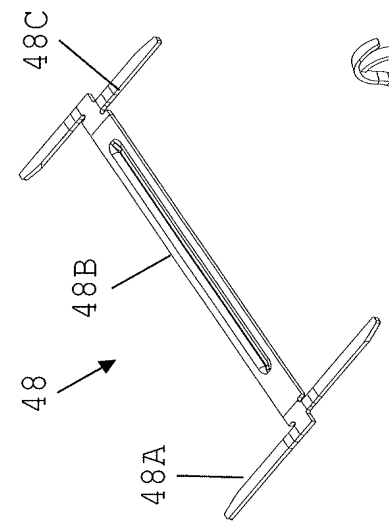


Fig. 5C

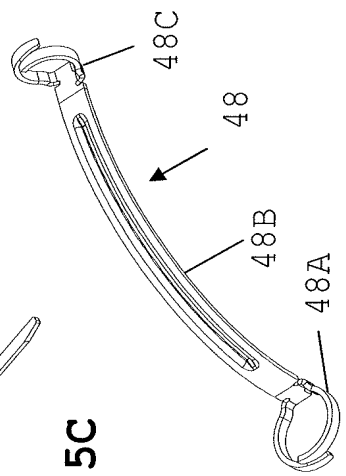


Fig. 5D

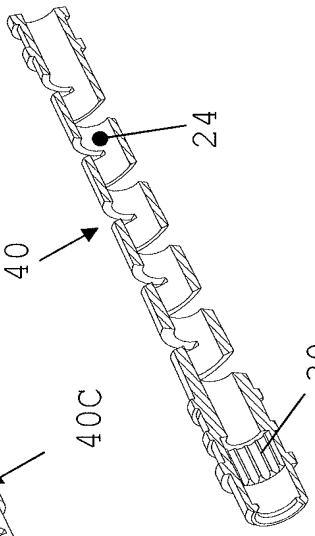


Fig. 5B

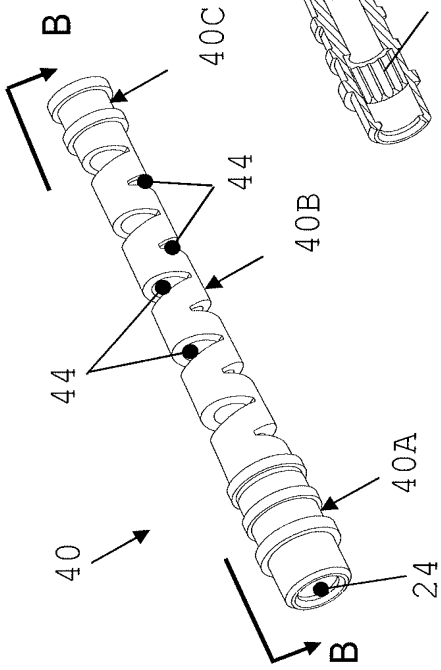


Fig. 5A

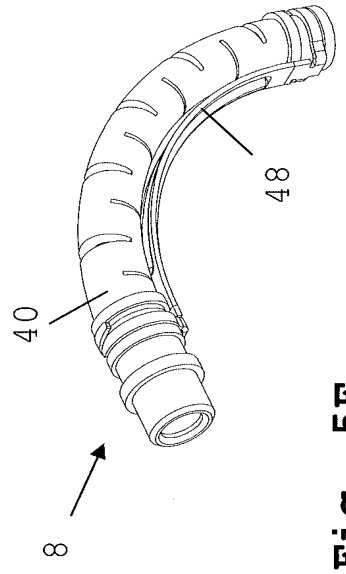


Fig. 5F

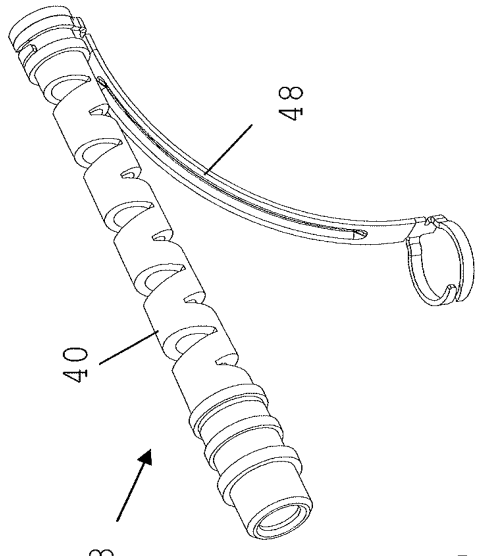


Fig. 5E

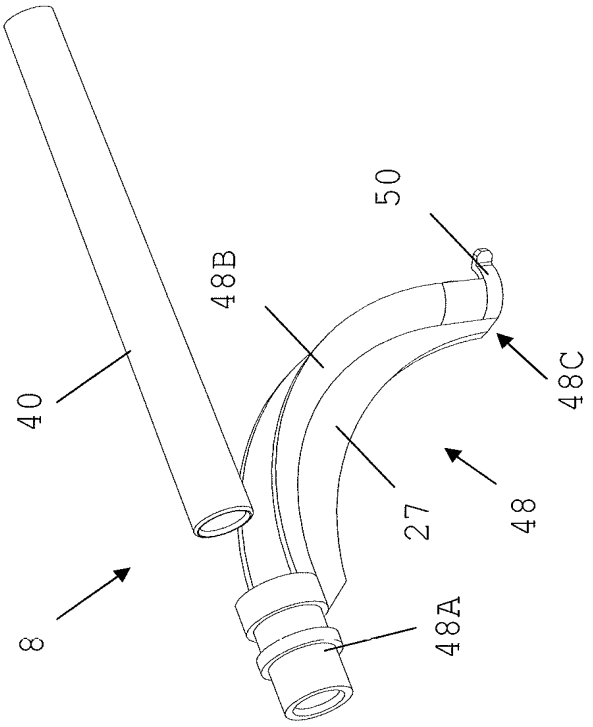


Fig. 6A

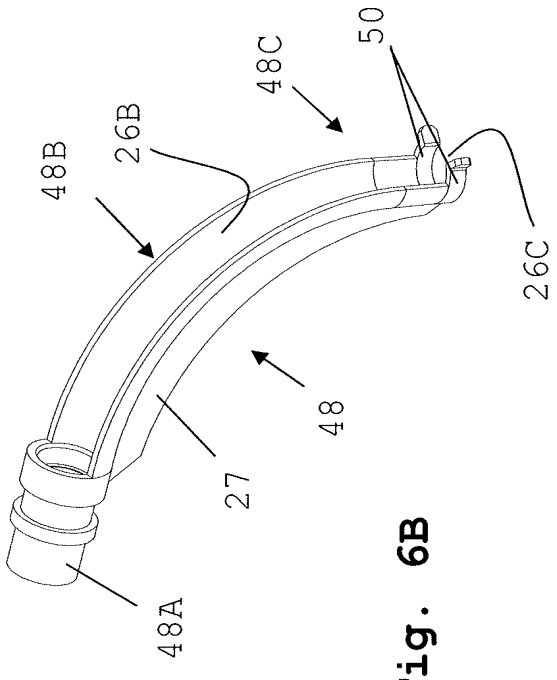


Fig. 6B

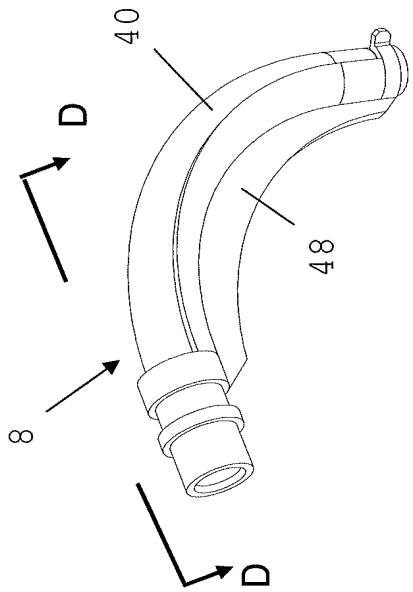


Fig. 6C

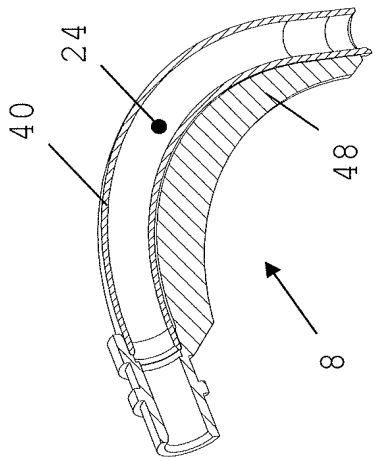


Fig. 6D

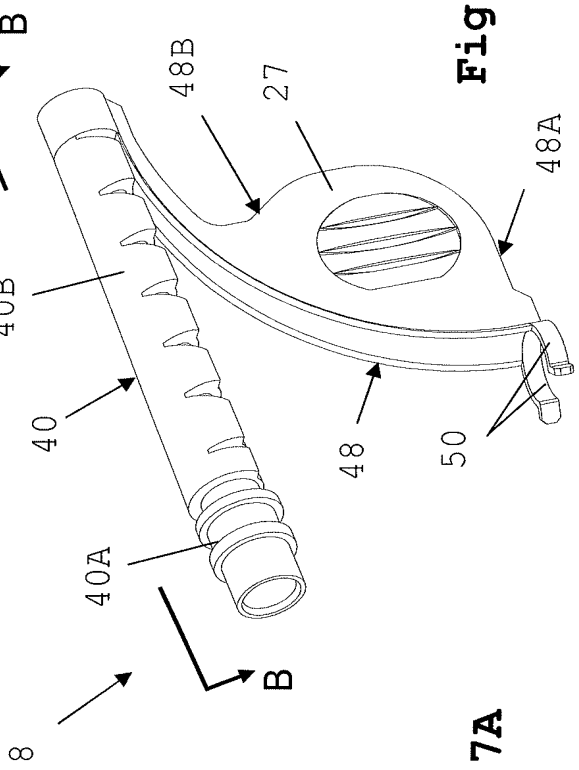


Fig. 7A

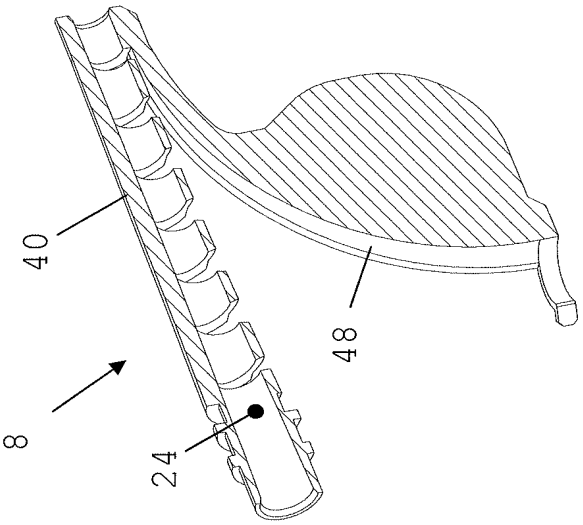


Fig. 7B

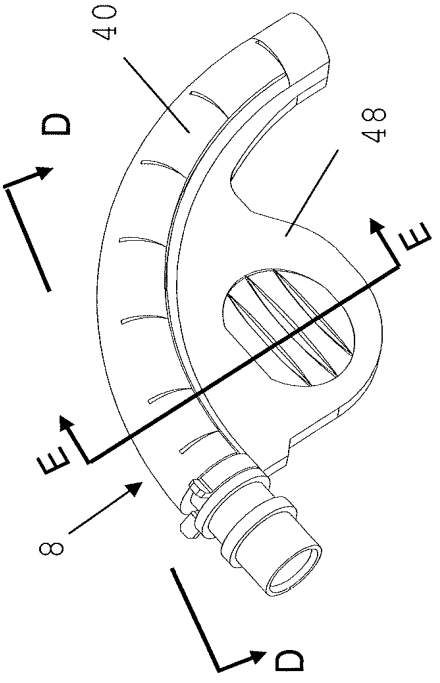


Fig. 7C

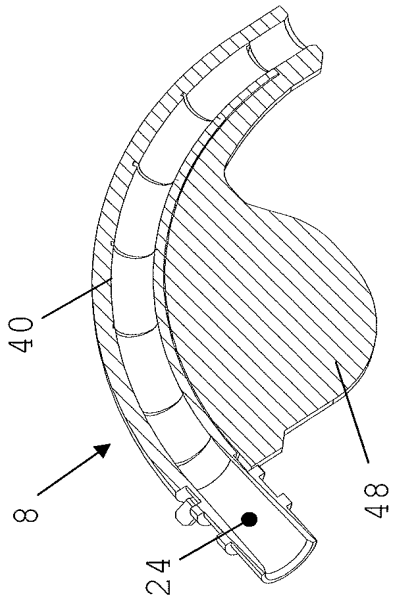


Fig. 7D

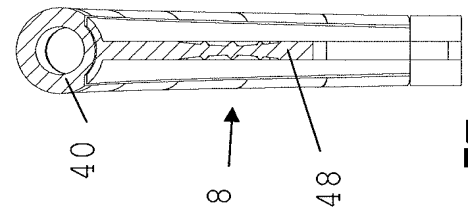


Fig. 7E

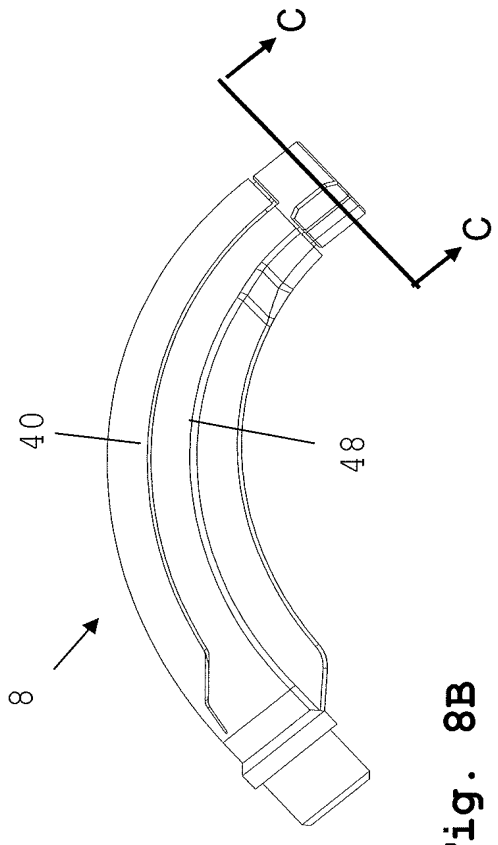


Fig. 8B

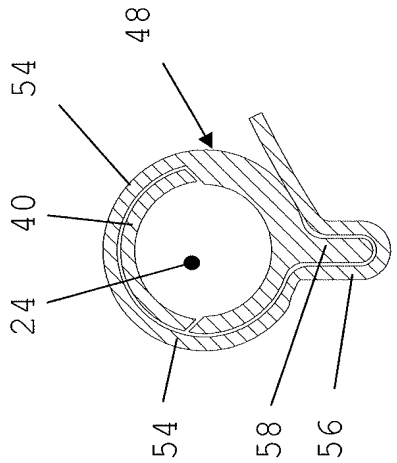


Fig. 8C

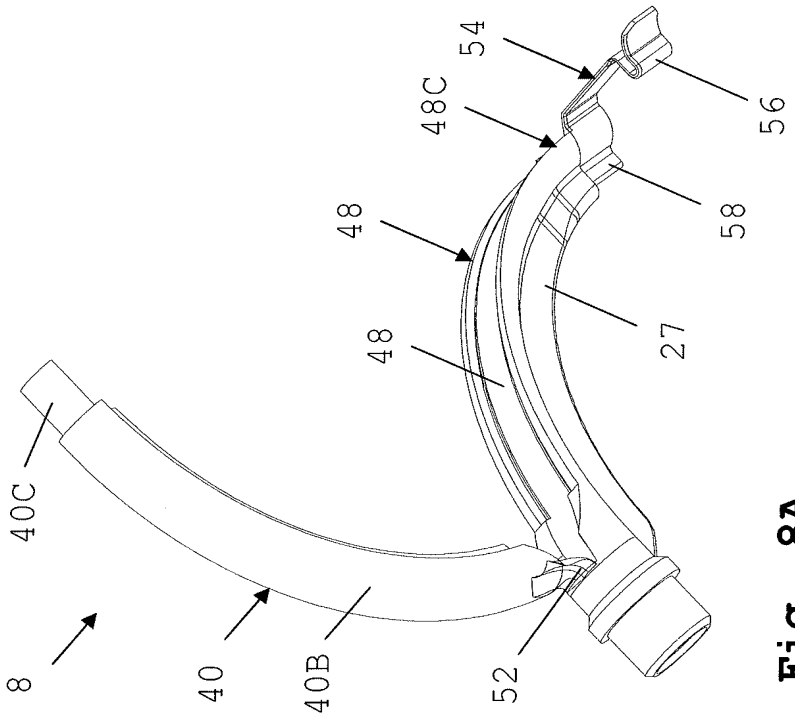


Fig. 8A

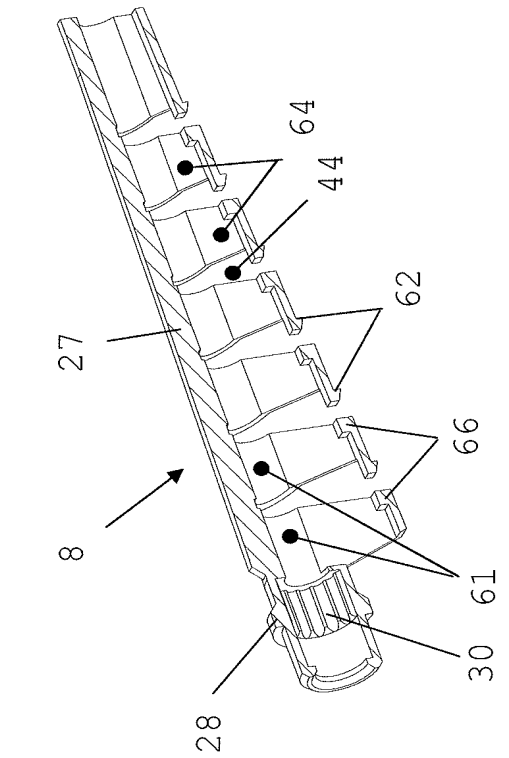


Fig. 9B

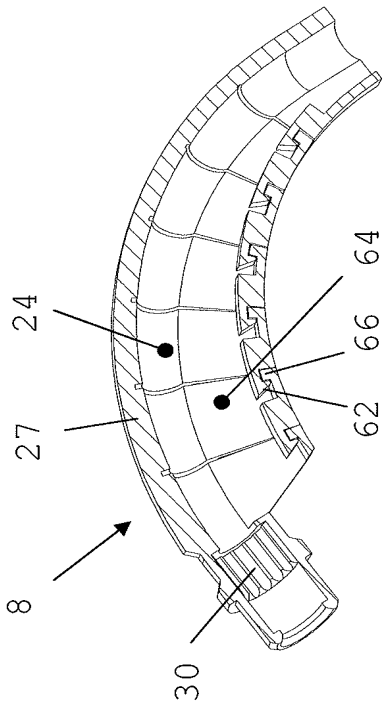


Fig. 9D

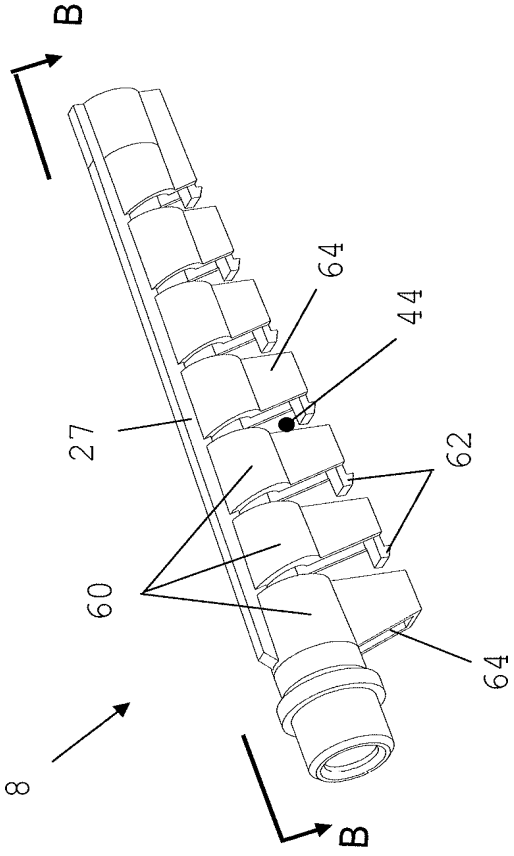


Fig. 9A

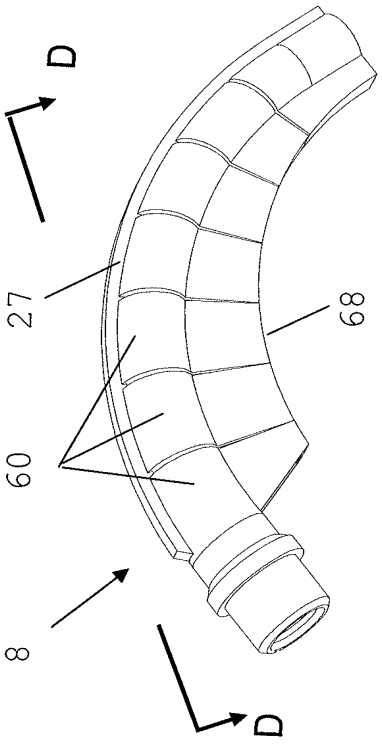


Fig. 9C

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2012/056158

A. CLASSIFICATION OF SUBJECT MATTER
INV. G02B6/38 G02B6/44
ADD.

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
G02B

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

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2004/121646 A1 (IAMARTINO JOSEPH [US] ET AL) 24 June 2004 (2004-06-24)	1-4,11, 13
Y	paragraph [0039] - paragraph [0067]; figures 3-8	12

X	EP 1 251 379 A2 (FRAMATOME CONNECTORS INC [FR] FRAMATOME CONNECTORS INT [FR]) 23 October 2002 (2002-10-23)	1-4,11, 13
Y	paragraph [0013] - paragraph [0025]; figures 1-12	12

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 June 2012	14/09/2012

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Frisch, Anna Maria

1

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/EP2012/056158

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2004121646 A1	24-06-2004	NONE	
EP 1251379 A2	23-10-2002	AT 417294 T	15-12-2008
		CA 2380906 A1	17-10-2002
		CN 1381744 A	27-11-2002
		EP 1251379 A2	23-10-2002
		JP 3851209 B2	29-11-2006
		JP 2002357753 A	13-12-2002
		US 2002150352 A1	17-10-2002

INTERNATIONAL SEARCH REPORT

International application No.
PCT/EP2012/056158

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.:
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:

see additional sheet

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 fees, this Authority did not invite payment of additional fees.

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.:

1-4, 11-13

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.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. claims: 1-4, 11-13

   Subject 1 relates to a cable guide boot assembly with connector made of two mating parts and allowing different angular positions of the boot, to details of the mating parts and their relative positon, and to a corresponding method of terminating a cable.

   ---

2. claims: 5, 6

   Subject 2 also relates to a cable guide boot assembly with connector made of two mating parts and allowing different angular positions of the boot, and to the fixing of the cable strength members via a first boot part.

   ---

3. claim: 7

   Subject 3 also relates to a cable guide boot assembly with connector made of two mating parts and allowing different angular positions of the boot, and to details of the flexibility of the two parts.

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4. claims: 8-10, 14

   Subject 4 also relates to a cable guide boot assembly with connector made of two mating parts and allowing different angular positions of the boot, to a variable bending of the boot, and to a corresponding method of terminating a cable.

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(84) Designated States *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

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— *with international search report (Art. 21(3))*

(54) **Title**: TRUE ONE PIECE HOUSING FIBER OPTIC ADAPTER

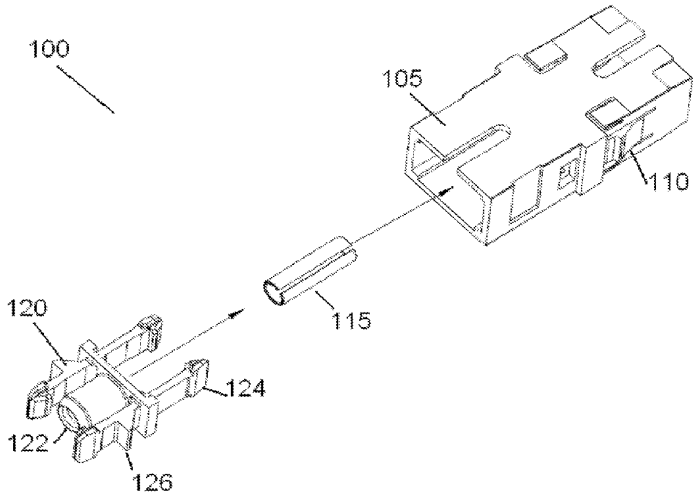


FIGURE 2

(57) **Abstract**: A fiber optic adapter includes a one piece housing, a dual connector latch, and an alignment sleeve. The one piece housing includes a first alignment cylinder configured to receive a first optic fiber and at least one snap receiving recess. The dual connector latch includes a second alignment cylinder configured to receive a second optic fiber and at least one snap feature configured to engage within the snap receiving recess such that the connector latch locks within the housing. The alignment sleeve is configured to be placed within the first alignment cylinder and the second alignment cylinder such that the alignment sleeve

WO 2012/162385 A1

A. TITLE:

TRUE ONE PIECE HOUSING FIBER OPTIC ADAPTER

B. - E. NOT APPLICABLE

F. BACKGROUND

[0001] The present disclosure relates to an adapter or a coupling for holding two fiber optic connectors in alignment. More specifically, the present disclosure relates to an adapter or coupling having a one piece, unibody housing.

[0002] Recently, the use of fiber optics for communications purposes has grown immensely. Data, voice, and other communication networks are increasingly using fiber optics to carry information. An optical fiber is generally a glass fiber configured to carry light. Individual fibers may be grouped into a line capable of carrying large amounts of data simultaneously.

[0003] When constructing a fiber optic network, each individual fiber is generally connected to both a source and a destination device. Additionally, along the fiber optic run between the source and the destination, various connections or couplings may be made on the optical fiber to adjust the length of the fiber. Each connection or coupling requires a connector and adapter to align the fibers such that the light can transmit without interruption. A typical connector includes two symmetrical housings, each housing having a connector latch. An alignment sleeve is placed within the connector latches to ensure the fibers are properly aligned. Then, the two housings are welded (i.e., via ultrasonic welding), riveted, or otherwise attached to each other, thereby forming a coupling. Individual optic fibers are then places within each connector latch, the alignment sleeve aligning the fibers.

[0004] This exemplary coupling is expensive to produce as numerous parts are required (each of which may require separate manufacturing), and a welding, riveting or other attachment process must be done to connect the two symmetrical housings. Additionally, alignment issues may result from the attachment process as the two symmetrical housing components may shift during welding.

[0005] One approach to reduce the amount of components required is shown in U.S. Patent No. 5,317,663 (the '663 patent), issued May 31, 1994 to Beard et al, the contents of which are incorporated herein by reference. In the '663 patent, an adapter is taught which includes a single piece housing in which both connector latches are placed, along with n alignment sleeve, to provide an adapter. However, to place the components within the housing, a window is provided in the housing. A housing cover is provided which is welded to the housing to cover the window. While the design of the '663 patent may eliminate any issues with alignment resulting from the attachment of the two housing components, it still requires numerous components and multiple assembly steps including welding the housing cover over the window.

G. SUMMARY

[0006] This disclosure is not limited to the particular systems, devices and methods described, as these may vary. The terminology used in the description is for the purpose of describing the particular versions or embodiments only, and is not intended to limit the scope.

[0007] As used in this document, the singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise. Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art. Nothing in this document is to be construed as an admission that the embodiments described in this document are not entitled to antedate such

disclosure by virtue of prior invention. As used in this document, the term "comprising" means "including, but not limited to."

[0008] In one general respect, the embodiments disclose a fiber optic adapter. The fiber optic adapter includes a one piece housing, a dual connector latch, and an alignment sleeve. The one piece housing includes a first alignment cylinder configured to receive a first optic fiber and at least one snap receiving recess. The dual connector latch includes a second alignment cylinder configured to receive a second optic fiber and at least one snap feature configured to engage within the snap receiving recess such that the connector latch locks within the housing. The alignment sleeve is configured to be placed within the first alignment cylinder and the second alignment cylinder such that the alignment sleeve is positioned prior to the dual connector latch being locked into the housing.

[0009] In another general respect, the embodiments disclose an alternative fiber optic adapter. The fiber optic adapter includes a one piece housing comprising a first alignment cylinder configured to receive a first optic fiber, a dual connector latch comprising a second alignment cylinder configured to receive a second optic fiber, and an alignment sleeve configured to be placed within the first alignment cylinder and the second alignment cylinder, wherein the alignment sleeve is positioned prior to the dual connector latch being locked into the housing.

H. BRIEF DESCRIPTION OF THE DRAWINGS

[0010] FIG. 1 illustrates an exemplary fiber optic adapter including a one piece housing according to an embodiment.

[0011] FIG. 2 illustrates an exploded view of the fiber optic adapter of FIG. 1.

[0012] FIG. 3a illustrates a cross-sectional view of the one piece housing of FIG. 1.

[0013] FIG. 3b illustrates a cross-sectional view of the fiber optic adapter of FIG. 1.

I. DETAILED DESCRIPTION

[0014] FIG. 1 illustrates an exemplary fiber optic connector or adapter **100** including a one piece housing **105**. The housing **105** may be made from a plastic or polymer via various manufacturing methods. For example, the housing **105** may be made from an injection molded polymer. The housing **105** may include various external features such as one or more integral bulkhead latches **110** for latching the housing (and thus the adapter **100**) to another device such as the input port on a network router.

[0015] FIG. 2 illustrates an exploded view of adapter **100**. In this exemplary embodiment, the adapter **100** includes three major components: (1) the single piece housing **105**, (2) an alignment sleeve **115**, and (3) a dual connector latch **120**. The dual connector latch may include several components such as an alignment cylinder **122** for receiving a first topic fiber, retaining clips **124** configured to frictionally hold or engage a fiber optic tip enclosure, and one or more snap features **126**. As shown in FIG. 2, two sets of retaining clips **124** are integrated into the dual connector latch **120**, a first set for engaging a first optic fiber and a second set for engaging a second optic fiber. An optic fiber is typically terminated in a grip housing including notches for engaging with the retaining clips **124**. Within each grip housing is an end of the optic fiber including a ferrule and a ferrule holder. However, manufacture of optic fibers, including terminations and associated housings is well known in the art and will not be discussed in additional detail. As also shown in FIG. 2, the snap features **126** are small, integral protrusions positioned and shaped to frictional hold or engage one or more snap receiving recesses within the housing **105**. Similar to the housing **105**, the dual connector latch **120** may be manufactured as a single injection molded component.

[0016] FIG. 3a illustrates a cross-sectional view of the housing **105**. The housing **105** may include several features such as an integral alignment cylinder **130** (similar to

alignment cylinder **122** of the dual connector latch **120**) configured to frictionally hold an optic fiber. The integral alignment cylinder **130** may be formed along with the housing **105** during a single injection molding process. The housing **105** may also include one or more snap receiving recesses **132**. The snap receiving recesses **132** may be positioned and sized to accept the snap features **126** of the dual connector latch **120**. In this example, the snap receiving recesses **132** are indentations in the sidewall of the housing **105** such that, when pushed into the housing, the snap features **126** of the dual connector latch **120** grab against the receiving recesses, thereby locking the dual connector latch into the housing.

[0017] FIG. 3b illustrates a cross sectional view of adapter **100** after the alignment sleeve **115** and the dual connector latch **120** have been assembled within the housing **105**. As shown in FIG. 3b, the snap features **126** of the dual connector latch **120** are positioned within the snap receiving recess **132**, thereby locking the dual connector latch within the housing. Similarly, a set of retaining clips **124** of the dual connecting latch **120** are positioned about the integral alignment cylinder **130** such that any optic fiber placed into the integral alignment cylinder will be held in place by the retaining clips.

[0018] Referring again to FIG. 2, to assemble the adapter **100**, the alignment sleeve **115** is positioned such that it is aligned with both the alignment cylinder **122** of the dual connector latch **120**, as well as the alignment cylinder **130** of the housing **105**. After aligning, the dual connector latch **120** is placed within the housing **105** and a force is applied on the dual connector latch until the snap feature **126** locks into the snap receiving recess **132** of the housing. Once the snap feature **126** is locked, assembly of the adapter **100** is complete. In this configuration, only 3 components are required and no assembly techniques beyond the application of a pushing force is required.

[0019] The one piece adapter housing as taught herein eliminates the need to ultrasonically weld the components together as is required by the prior art. This reduces the

cost of manufacturing and assembling additional components. Additionally, depending on the design of the snap features and associated snap receiving recesses, the adapter may be disassembled to replace a worn part (e.g., if a retaining clip on the dual latch connector breaks) or otherwise repair the adapter. This feature would not be possible in the prior art as the adapters are permanently welded into a solid piece.

[0020] The various components described above may be constructed by manufacturing methods well know in the art. Materials for use in construction of the various components listed above may include various polymers, plastics, metals, glass, and other similar suitable materials. For example, the housing **105** may be manufactured via an plastic injection molding process. Alternatively, the housing **105** may be manufactured from a suitable metal via a milling process. Additional materials and manufacturing methods will be well known to those skilled in the art.

[0021] The above examples are not intended to limit the invention, but merely to serve as an illustration of how the invention might be constructed and operated.

[0022] Various of the above-disclosed and other features and functions, or alternatives thereof, may be combined into many other different systems or applications. Various presently unforeseen or unanticipated alternatives, modifications, variations or improvements therein may be subsequently made by those skilled in the art, each of which is also intended to be encompassed by the disclosed embodiments.

J. CLAIMS

What is claimed is:

1. A fiber optic adapter comprising:

a one piece housing comprising

a first alignment cylinder configured to receive a first optic fiber, and

at least one snap receiving recess;

a dual connector latch comprising:

a second alignment cylinder configured to receive a second optic fiber, and

at least one snap feature configured to engage within the snap receiving recess such that the connector latch locks within the housing; and

an alignment sleeve configured to be placed within the first alignment cylinder and the second alignment cylinder, wherein the alignment sleeve is positioned prior to the dual connector latch being locked into the housing.

2. The fiber optic adapter of claim 1, wherein the first alignment cylinder is integral to the housing.

3. The fiber optic adapter of claim 1, wherein the at least one snap receiving recess is an indentation in a sidewall of the housing.

4. The fiber optic adapter of claim 3, wherein the at least one snap feature is a protrusion from the dual connector latch corresponding to the indentation in the sidewall of the housing.

5. The fiber optic adapter of claim 1, wherein the housing is a single injection-molded component.

6. The fiber optic adapter of claim 1 wherein the dual connector latch is a single injection molded component.

7. The fiber optic adapter of claim 1, wherein the dual connector latch further comprises:

a first set of retaining clips for engaging a first optic fiber; and

a second set of retaining clips for engaging a second optic fiber.

8. A fiber optic adapter comprising:

a one piece housing comprising a first alignment cylinder configured to receive a first optic fiber;

a dual connector latch comprising a second alignment cylinder configured to receive a second optic fiber; and

an alignment sleeve configured to be placed within the first alignment cylinder and the second alignment cylinder, wherein the alignment sleeve is positioned prior to the dual connector latch being locked into the housing.

9. The fiber optic adapter of claim 8, wherein the housing further comprises at least one snap receiving recess.

10. The fiber optic adapter of claim 9, wherein the dual connector latch further comprises at least one snap feature configured to engage within the snap receiving recess such that the connector latch locks within the housing.

11. The fiber optic adapter of claim 8, wherein the first alignment cylinder is integral to the housing.

12. The fiber optic adapter of claim 8, wherein the at least one snap receiving recess is an indentation in a sidewall of the housing.

13. The fiber optic adapter of claim 12, wherein the at least one snap feature is a protrusion from the dual connector latch corresponding to the indentation in the sidewall of the housing.

14. The fiber optic adapter of claim 8, wherein the housing is a single injection-molded component.

15. The fiber optic adapter of claim 8 wherein the dual connector latch is a single injection molded component.

16. The fiber optic adapter of claim 8, wherein the dual connector latch further comprises:

a first set of retaining clips for engaging a first optic fiber; and

a second set of retaining clips for engaging a second optic fiber.

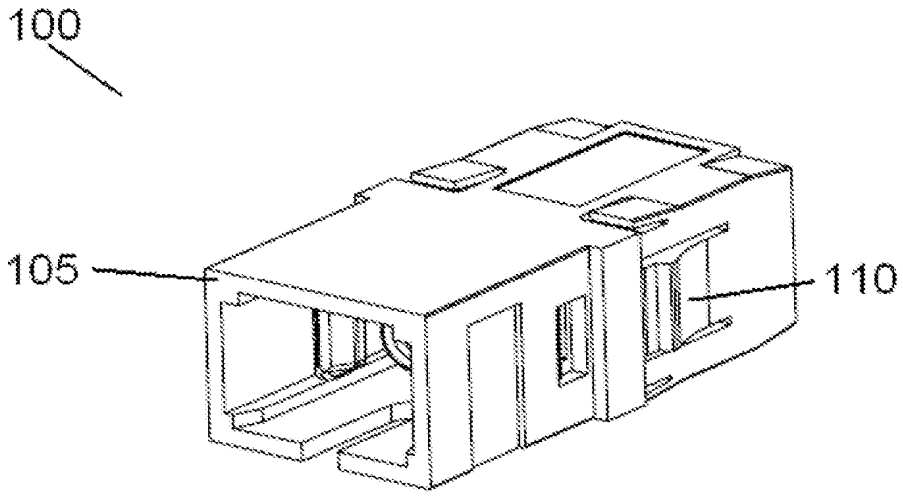


FIGURE 1

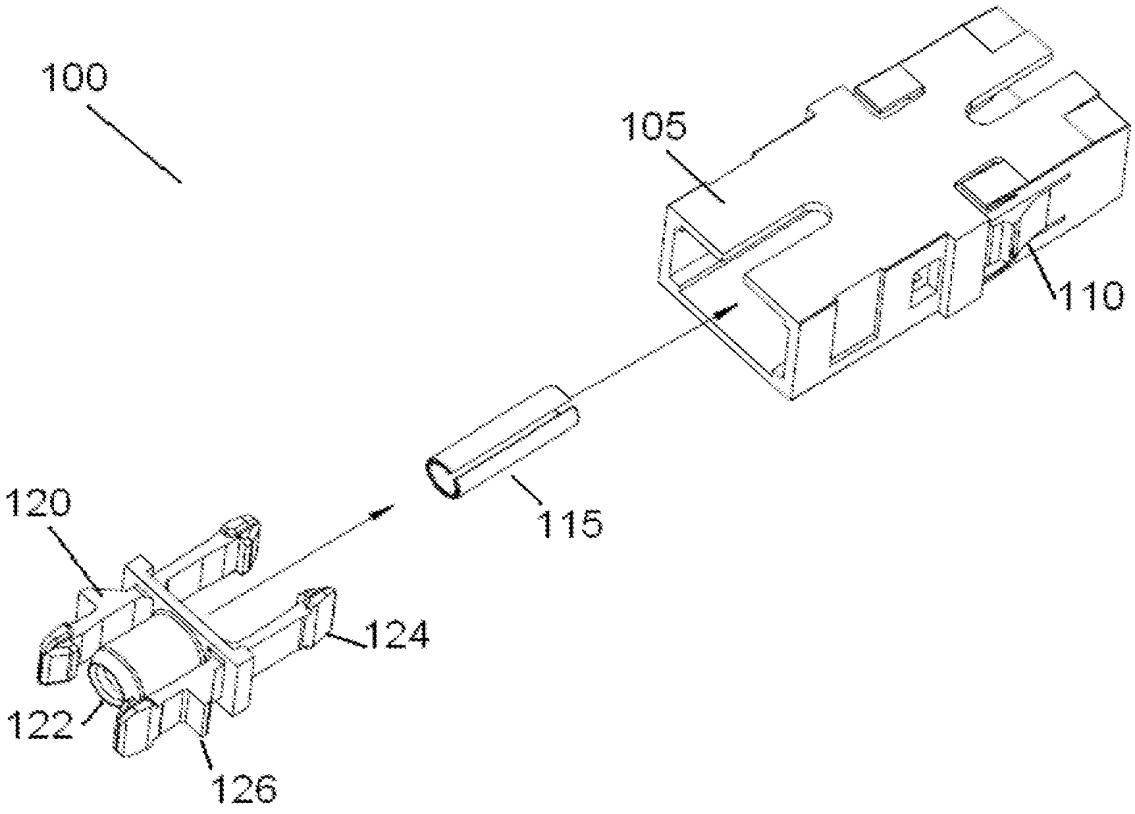


FIGURE 2

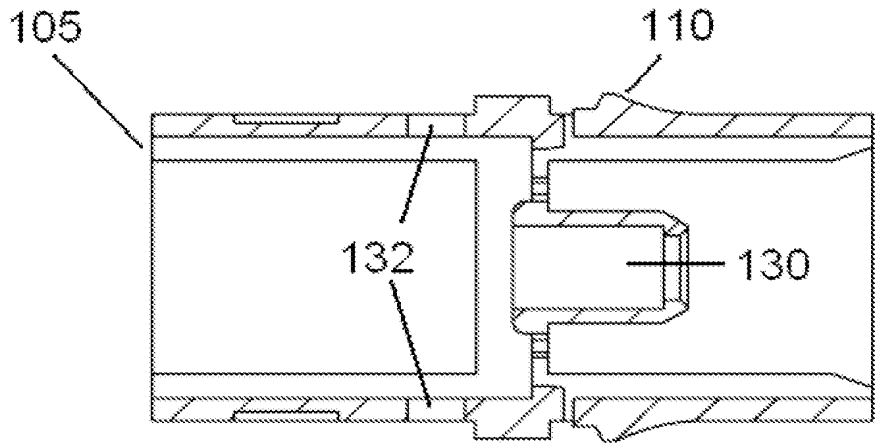


FIGURE 3a

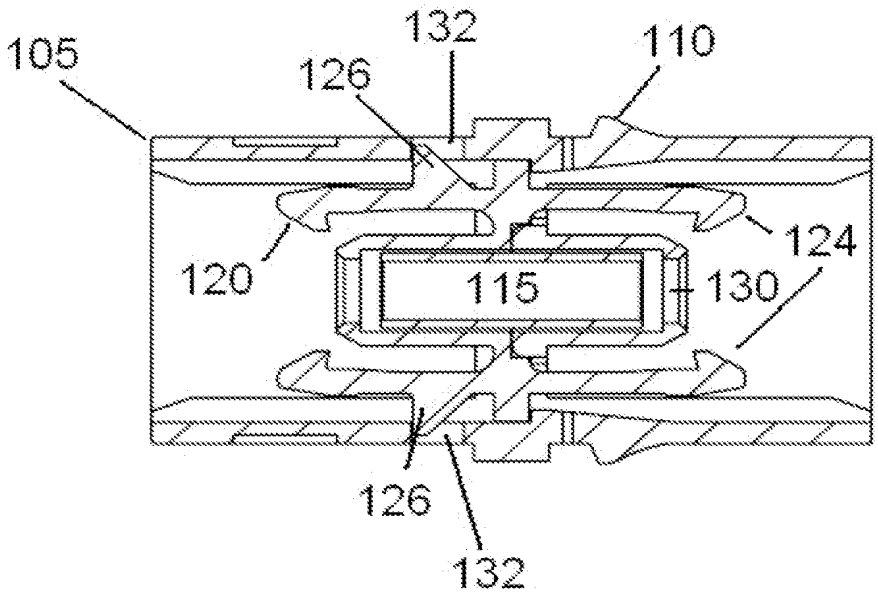


FIGURE 3b

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2012/039126

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - G02B 6/38 (2012.01)
USPC - 385/56
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 6/36, 6/38, 6/40 (2012.01)
USPC - 385/55, 56, 60, 62

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)
PatBase, Google Patents, Google

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 2009/0028507 A1 (JONES et al) 29 January 2009 (29.01.2009) entire document	1-16
Y	US 5,971,626 A (KNODELL et al) 26 October 1999 (26.10.1999) entire document	1-16
A	US 6,206,581 B1 (DRISCOLL et al) 27 March 2001 (27.03.2001) entire document	1-16
A	US 7,695,199 B2 (TEO et al) 13 April 2010 (13.04.2010) enitre document	1-16

☐ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
06 August 2012	27 AUG 2012

Name and mailing address of the ISA/US	Authorized officer:
Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

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(71) **Applicant** *(for all designated States except US)*: **SENKO ADVANCED COMPONENTS, INC.** [US/US]; 225 Cedar Hill Street, Marlboro, MA 01752 (US).

(72) **Inventors; and**

(75) **Inventors/Applicants** *(for US only)*: **GNIADEK, Jeffrey** [US/US]; 419 Kelly Road, Northbridge, MA 01534 (US). **CHANG, Jimmy** [US/US]; 52 Upland Street, Worcester, MA 01607 (US).

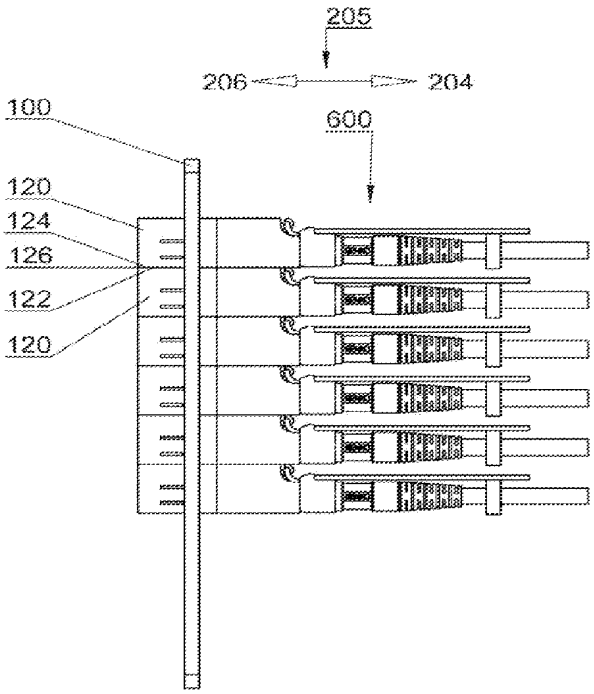
(74) **Agent**: **RIZK, Adam**; Pepper Hamilton LLP, One Mellon Center, 500 Grant Street, Pittsburgh, PA 15219 (US).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KM, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) **Title**: LATCHING CONNECTOR WITH REMOTE RELEASE



(57) **Abstract**: In one aspect the present disclosure provides a latching connector. The latching connector comprises a housing that is configured to engage with a mating connector along a coupling axis. The housing includes a lever connected to the housing. The lever is configured to selectively disengage the latching connector from the mating connector. The housing further includes an extending member connected to the lever.

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— *with international search report (Art. 21(3))*

TITLE:

LATCHING CONNECTOR WITH REMOTE RELEASE

CLAIM OF PRIORITY

This application claims the benefit of priority to United States Provisional Application No. 61/543,419 filed on October 5, 2011 and entitled "Remote Release of Latching Connector," which is incorporated by reference herein in its entirety.

BACKGROUND

[0001] The present disclosure relates to interconnect technology. More specifically, the present disclosure relates to interconnect technology used in electrical and optical systems.

[0002] Recently, there has been unprecedented growth in communication networks. In such highly competitive markets, network providers continuously struggle to find better ways to improve the quality of service at a lower cost.

[0003] One way in which network providers have tried to improve the quality of service while reducing cost has been to deploy high density interconnect panels. Data, voice, and other communication networks are increasingly using interconnect to carry information. High-density panels are designed to consolidate the increasing volume of interconnections necessary to support the fast-growing networks into a compacted form factor, thereby increasing quality of service and decreasing costs such as floor space and support overhead. However, the deployment of high-density interconnect panels has not fully realized the stated goals.

[0004] In communication networks, such as data centers and switching networks, numerous interconnections between mating connectors are compacted into

high-density panels. Panel and connector manufacturers optimize for such high densities by shrinking the connector size and/or the spacing between adjacent connectors on the panel. While both approaches are effective ways by which to increase the panel connector density, shrinking the connector size and/or spacing increases the support cost and diminishes the quality of service.

[0005] A cable is generally constructed using a transmission medium such as an optical fiber or an electrical conductor. An electrical conductor is generally a copper wire configured to carry electrical power. An optical fiber is generally a glass fiber configured to carry light. Individual cables may be grouped into a line capable of carrying large amounts of data simultaneously. When constructing a communication network, a cable assembly typically includes a jacket to protect the underlying cable, and terminating connectors at each end of the cable. These terminating connectors may be used to optically and/or electrically couple a first cable assembly to a mating connector of a second cable assembly.

[0006] A typical connector may include a latching mechanism adapted to lock the engagement of a latching connector with a mating connector, and a release mechanism adapted to disengage the first latching connector from the mating connector. In the engaged configuration, an operator may disengage the engaged connectors by applying a vertical force upon the release mechanism by squeezing the release mechanism between the operator's thumb and forefinger.

[0007] In a high-density panel configuration, adjacent connectors and cable assemblies obstruct access to the individual release mechanisms. This physical obstruction impedes the ability for the operator to minimize the stresses applied to the cables and connectors. For example, these stresses may be applied when the user reaches into a dense group of connectors and pushes aside surrounding optical fibers

and connectors to access an individual connector release mechanism with the thumb and forefinger. Overstressing the cables and connectors may introduce latent defects, compromise the integrity and/or reliability of the terminations, and potentially cause serious disruptions to the network performance.

[0008] While an operator may attempt to use a tool, such as a screwdriver, to reach into the dense group of connectors, and activate the release mechanism, the adjacent cables and connectors can obstruct the operator's line of sight, making it difficult to guide the tool to the release mechanism without pushing aside the surrounding cables. Moreover, even when the operator has a clear line of sight, guiding the tool to the release mechanism is a time consuming process. Therefore using a tool is not effective at reducing support time and increasing the quality of service.

[0009] Quality of service and support time is further disadvantaged by exposure of the cable termination to the surrounding environment, and vulnerability of being scratched, chipped, cracked, or otherwise damaged by dust particles, grease, contaminants, and other foreign objects when the operator disengages the release mechanism. Such damage to the cable may potentially cause serious disruption to the network performance. While dust covers may be used to prevent such damage, small and loose hardware, such as dust covers, bears the tendency to become lost, misplaced, or otherwise not easily accessible to the operator when it is needed.

SUMMARY

[0010] This disclosure is not limited to the particular systems, devices and methods described, as these may vary. The terminology used in the description is for

the purpose of describing the particular versions or embodiments only, and is not intended to limit the scope.

[0011] As used in this document, the singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise. Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art. Nothing in this document is to be construed as an admission that the embodiments described in this document are not entitled to antedate such disclosure by virtue of prior invention. As used in this document, the term "comprising" means "including, but not limited to."

[0012] In one aspect the present disclosure provides a latching connector. The latching connector comprises a housing that is configured to engage with a mating connector along a coupling axis. The housing includes a lever connected to the housing. The lever is configured to selectively disengage the latching connector from the mating connector. The housing further includes an extending member connected to the lever.

[0013] In some designs the extending member can comprise a hook or a loop. In other designs the latching connector can comprise a multi-port connector. In various designs, the mating connector can be configured to engage with an LC connector.

[0014] In another aspect, the present disclosure provides an adaptive release member. The adaptive release member includes a release configured to receive a first force that is opposite to a latching connector coupling direction, and to disengage the latching connector from the mating connector by transmitting a component of the first force to the latching connector. The latching connector includes a housing configured to engage with a mating connector along the coupling direction. The housing itself

includes a lever connected to the housing. The lever configured to selectively disengage the latching connector from the mating connector. The housing also includes an extending member connected to the lever and configured to cooperate with the release to actuate the lever. The latching connector also includes a guide connected to the release and configured to cooperate with the latching connector to restrict the release range of motion. In some designs, the latching connector can comprise a multi-port latching connector.

[0015] In a further aspect, the present disclosure provides an extender comprising an actuator configured to receive a first force that is opposite to a latching connector coupling direction, and to disengage the latching connector from the mating connector by transmitting a component of the first force to the latching connector. In this design, the latching connector comprises a housing configured to engage with a mating connector along the coupling direction. The housing includes a lever connected to the housing and configured to selectively disengage the latching connector from the mating connector. The housing further includes an extending member connected to the lever and configured to cooperate with the actuator to actuate the lever.

[0016] In some designs, the extender can include an actuator which comprises a hook or a loop. In other designs, the extender can further include a plurality of ridges and grooves disposed along a length of the extender. In one design, the extender can further include a dust cover attached to the extender and configured to protect a transmission medium. Optionally, the extender can include a jacket clamp attached to the extender. In another design, the extender can include a link that is connected to the actuator and configured to adjust a length of the extender. The extender can also include an identification tag connected to the extender.

[0017] In another aspect, the present disclosure provides an extender comprising an actuator configured to receive a first force that is opposite to a latching connector coupling direction, and to transmit a component of the first force to an adaptive release member. The adaptive release member includes a release configured to receive a component of the first force and to disengage the latching connector from the mating connector by transmitting a second force to the latching connector.

[0018] In this design, the latching connector comprises a housing configured to engage with a mating connector along the coupling direction. The housing includes a lever connected to the housing and configured to selectively disengage the latching connector from the mating connector. The housing also includes an extending member connected to the lever and configured to cooperate with the release to actuate the lever. The latching connector also includes a guide connected to the release and configured to cooperate with the latching connector to restrict the release range of motion.

[0019] In one design, the extender can optionally include a plurality of ridges and grooves disposed along a length of the extender. In another design, a link can be connected to the actuator and configured to adjust a length of the extender. Optionally, a dust cover can be attached to the extender and configured to protect a transmission medium. The extender can further include a jacket clamp attached to the extender. The extender can also include an identification tag connected to the extender.

[0020] In a further aspect, the present disclosure provides a cable assembly comprising a jacket. The cable assembly further comprises a latching connector, itself comprising a housing configured to engage with a mating connector along a coupling direction. The latching connector includes a lever connected to the housing and

configured to selectively disengage the latching connector from the mating connector. The latching connector also includes an extending member connected to the lever. The cable assembly further comprises a transmission medium disposed within the jacket and the housing.

[0021] In one design, the cable assembly can include an extender, itself including an actuator configured to receive a first force that is opposite to a latching connector coupling direction, and to disengage the latching connector from a mating connector by transmitting a component of the first force to the extending member. In this design, a guide is positioned on the latching connector and configured to restrict the extender range of motion. The extender can further include a plurality of ridges and grooves disposed along a length of the extender. In one design, the extender can include a dust cover attached to the extender and configured to protect the transmission medium. In another design, the extender can include a jacket clamp attached to the extender. Optionally, a link can be connected to the actuator and configured to adjust a length of the extender. The extending member can comprise a hook, and the actuator can comprise a loop configured to cooperate with the hook. The cable assembly can further include an identification tag connected to the extender. In one design, the guide can comprise a boot including a strain relief that is configured to protect the transmission medium. Optionally, a restoring member can be connected to the boot, and can be configured to cooperate with a stop, itself connected to the extender, to restore the position of the lever to a natural position.

[0022] In another design, the cable assembly can further comprise an adaptive release member. The adaptive release member includes a release configured to receive a first force that is opposite to a latching connector coupling direction, and to disengage the latching connector from the mating connector by transmitting a

component of the first force to the extending member. The adaptive release member also includes a guide connected to the release and configured to cooperate with the latching connector to restrict the release range of motion.

[0023] In this design, the cable assembly can further include an extender. The extender includes an actuator configured to receive a second force that is opposite to a latching connector coupling direction, and to disengage the latching connector from the mating connector by transmitting a component of the second force to the release. The extender can further include a plurality of ridges and grooves disposed along a length of the extender. In one design, the extender can include a dust cover attached to the extender and configured to protect the transmission medium. In another design, the extender can include a jacket clamp attached to the extender. Optionally, a link can be connected to the actuator and configured to adjust a length of the extender. The extending member in this design can optionally comprise a loop, and the release can comprise a hook that is configured to cooperate with the loop. The cable assembly can further include an identification tag connected to the extender.

[0024] In another aspect, the present disclosure provides a high-density panel, itself including a panel including a mounting surface. The high density panel further includes a first mating connector disposed on the mounting surface and having a first edge and a second mating connector disposed on the mounting surface and having a second edge. The distance between the first edge and the second edge is less than 1.25 millimeters. In one design, the distance between the first edge and the second edge is greater than or equal to 0 millimeters. Optionally, the first edge can abut the second edge. The panel can optionally comprise a printed circuit board. In one design, the first and second mating connectors are each configured to engage with a LC connector.

[0025] In a further aspect, the present disclosure provides a method of extracting a latching cable assembly from a panel. This method comprises applying a force to an extender along a coupling axis of a latching connector in a direction opposite to a coupling direction of the latching connector and increasing the force applied to the extender until the latching connector disengages from a mating connector.

[0026] These and other features of the invention are described in detail below.

BRIEF DESCRIPTION OF THE DRAWINGS

[0027] FIG. 1 is a high density panel including a plurality of couplers.

[0028] FIG. 2A is a coupler including mating connectors.

[0029] FIG. 2B is a side view depicting the sidewall of the mating connectors of FIG. 2A.

[0030] FIG. 3A is an isometric view of a cable assembly for interconnection on a high density mating connector panel.

[0031] FIG. 3B is a perspective view of a cable assembly for interconnection on a high density mating connector panel.

[0032] FIG. 4 is an exploded view of the cable assembly of FIG 3A.

[0033] FIG. 5 is a perspective view depicting the engagement of an array of cable assemblies.

[0034] FIG. 6A is an isometric view of a multi-port cable assembly for interconnection on a high density mating connector panel.

[0035] FIG. 6B is an exploded view of the cable assembly of FIG 6A.

[0036] FIG. 7 is a perspective view of the multi-port cable assembly of FIG. 6A.

[0037] FIG. 8 is a perspective view depicting the engagement of an array of cable assemblies.

[0038] FIG. 9A is an isometric view of a cable assembly for interconnection on a high density mating connector panel.

[0039] FIG. 9B is an exploded view of the cable assembly of FIG 9A.

[0040] FIG. 10 is a perspective view depicting the engagement of an array of cable assemblies.

[0041] FIG. 11A is an isometric view of a multi-port cable assembly for interconnection on a high density mating connector panel.

[0042] FIG. 11B is an exploded view of the multi-port cable assembly of FIG 11A.

[0043] FIG. 12 is a perspective view depicting the engagement of an array of multi-port cable assemblies.

[0044] FIG. 13 is an isometric view of a cable assembly for interconnection on a high density mating connector panel.

[0045] FIG. 14 is an exploded view of the cable assembly of FIG 13.

[0046] FIG. 15 is a perspective view depicting the engagement of an array of cable assemblies.

[0047] FIG. 16 is a perspective view depicting the stackability of the couplers of FIG. 3A.

[0048] FIG. 17 is an isometric view of a multi-port cable assembly for interconnection on a high density mating connector panel.

[0049] FIG. 18 is an exploded view of the cable assembly of FIG 17.

[0050] FIG. 19 is a perspective view depicting the engagement of an array of cable assemblies.

[0051] FIG. 20 is a perspective view depicting the stackability of the couplers of FIG. 3A.

[0052] FIG. 21 is an isometric view of a cable assembly for interconnection on a high density mating connector panel.

[0053] FIG. 22 is an exploded view of the cable assembly of FIG. 21.

[0054] FIG. 23 is a cross sectional view of the cable assembly of FIG. 21.

[0055] FIG. 24 is a perspective view depicting the stackability of the couplers of FIG. 3A.

DETAILED DESCRIPTION

[0056] Referring to FIG. 1, a high density panel 100 includes a mounting surface 110. The panel 100 can include a printed circuit board. A plurality of couplers 120, are disposed on the mounting surface 110, and are arranged generally in close proximity to one another in a plurality of rows and columns. Each coupler 120 has a first edge 122 and a second edge 124. The density of the panel 100 can be increased by decreasing the distance 126 between the first edge 122 of a first coupler 120 and the second edge 124 of a second coupler 120. The couplers 120 are configured to accept connectors that will be shown and described below. The couplers 120 can also be configured to engage with a LC connector.

[0057] Referring also to FIGS. 2A and 2B, the coupler 120 can generally include mating connectors 150. Each mating connector 150 includes symmetrical sidewalls 160. Each sidewall 160 is attached to and includes a top rail 170, a bottom rail 180, and a trap 190. The top rail 170 and the bottom rail 180 protrude from the inner surface of the sidewall 160.

[0058] Each mating connector 150 or coupler 120 may comprise any type and form of shape, design and/or dimensions. In some designs, the mating connector 150

or the coupler 120 may comprise conical, circular, tube-like, square-like, spherical or rectangular components or shapes. The mating connectors 150 or the couplers 120 may include any number of components of each of these shapes which may be integrated and interfaced into the connector. In some designs, the mating connectors 150 or the couplers 120 may interface or latch with a latching connector along a length dimension which may be parallel with the actual optical fiber or electrical conductor running through the mating connector 150 or the couplers 120. The mating connectors 150 or the couplers 120 may also include a width and a height orthogonal to the length, where the width and length are orthogonal to each other.

[0059] Regardless of the shape of the mating connectors 150 or the couplers 120, which may vary based on the design, the width and the height of a coupler 120 may be any length between 0.01 millimeter and 10 centimeters, such as a length between 1mm and 5mm. In some designs, the width of a mating connector 150 coupler 120 may be any size, such as 0.01 millimeters, 0.05 millimeters, 0.1 millimeters, 0.5 millimeters, 1 millimeter, 1.5 millimeters, 2 millimeters, 2.5 millimeters, 3 millimeters, 3.5 millimeters, 4.0 millimeters, 4.5 millimeters, 5.0 millimeters, 5.5 millimeters, 6.0 millimeters, 6.5 millimeters, 7.0 millimeters, 7.5 millimeters, 8.0 millimeters, 8.5 millimeters, 9.0 millimeters, 9.5 millimeters, 10 millimeters, 12 millimeters, 15 millimeters, 18 millimeters, 25 millimeters, 50 millimeters or 100 millimeters. In further designs, the height of a mating connector 150 may be any size, such as 0.01 millimeters, 0.05 millimeters, 0.1 millimeters, 0.5 millimeters, 1 millimeter, 1.5 millimeters, 2 millimeters, 2.5 millimeters, 3 millimeters, 3.5 millimeters, 4.0 millimeters, 4.5 millimeters, 5.0 millimeters, 5.5 millimeters, 6.0 millimeters, 6.5 millimeters, 7.0 millimeters, 7.5 millimeters, 8.0 millimeters, 8.5 millimeters, 9.0 millimeters, 9.5 millimeters, 10 millimeters, 12

millimeters, 15 millimeters, 18 millimeters, 25 millimeters, 50 millimeters or 100 millimeters.

[0060] In some designs, a high-density panel of mating connectors 150 or couplers 120 may include a plurality of mating connectors 150 or couplers 120 arranged into an array or rows of and columns. The rows and columns may be parallel and perpendicular to each other, or may be shifted to be non-parallel or arranged in any other orderly or disorderly manner.

[0061] In one design, a panel 100 comprises a set of 30 mating connectors 150 or couplers 120, arranged in 6 columns and 5 rows. The distance between each of the mating connectors 150 or the couplers 120 in the panel 100 along the width of the panel 100 may be an distance between 0 and 30 millimeters, such as 0.001 millimeters, 0.005 millimeters, 0.01 millimeters, 0.03 millimeters, 0.05 millimeters, 0.08 millimeters, 0.1 millimeters, 0.25 millimeters, 0.5 millimeters, 0.75 millimeters, 0.90 millimeters, 1 millimeter, 1.1 millimeters, 1.2 millimeters, 1.3 millimeters, 1.4 millimeters, 1.5 millimeters, 1.6 millimeters, 1.8 millimeters, 2 millimeters, 2.5 millimeters, 5 millimeters, 10 millimeters or any other distance. In some designs, the distance between each of the mating connectors 150 or the couplers 120 in the panel 100 along the height of the panel 100 may be any distance between 0 and 30 millimeters, such as 0.001 millimeters, 0.005 millimeters, 0.01 millimeters, 0.03 millimeters, 0.05 millimeters, 0.08 millimeters, 0.1 millimeters, 0.25 millimeters, 0.5 millimeters, 0.75 millimeters, 0.90 millimeters, 1 millimeter, 1.1 millimeters, 1.2 millimeters, 1.3 millimeters, 1.4 millimeters, 1.5 millimeters, 1.6 millimeters, 1.8 millimeters, 2 millimeters, 2.5 millimeters, 5 millimeters, 10 millimeters or any other distance.

[0062] In another design, a panel 100 comprises a set of 30 mating connectors 150 or couplers 120, arranged in non-parallel and/or non-perpendicular manner. The distance between each of the mating connectors 150 or the couplers 120 in the panel along the width of the panel 100 may be any distance between 0 and 30 millimeters, such as 0.001 millimeters, 0.005 millimeters, 0.01 millimeters, 0.03 millimeters, 0.05 millimeters, 0.08 millimeters, 0.1 millimeters, 0.25 millimeters, 0.5 millimeters, 0.75 millimeters, 0.90 millimeters, 1 millimeter, 1.1 millimeter, 1.2 millimeters, 1.3 millimeters, 1.4 millimeters, 1.5 millimeters, 1.6 millimeters, 1.8 millimeters, 2 millimeters, 2.5 millimeters, 5 millimeters, 10 millimeters or any other distance. In some designs, the distance between each of the mating connectors 150 or the couplers 120 in the panel along the height of the panel may be any distance between 0 and 30 millimeters, such as 0.001 millimeters, 0.005 millimeters, 0.01 millimeters, 0.03 millimeters, 0.05 millimeters, 0.08 millimeters, 0.1 millimeters, 0.25 millimeters, 0.5 millimeters, 0.75 millimeters, 0.90 millimeters, 1 millimeter, 1.1 millimeters, 1.2 millimeters, 1.3 millimeters, 1.4 millimeters, 1.5 millimeters, 1.6 millimeters, 1.8 millimeters, 2 millimeters, 2.5 millimeters, 5 millimeters, 10 millimeters or any other distance.

[0063] It should thus be clear that the dimensions of the mating connectors 150 or the couplers 120, as well as the distances in a panel 100, on each side of the mating connector 150 or coupler 150, may vary dependent on the design.

[0064] Referring to FIG. 3A and 3B, a push-pull cable assembly 200 is configured to connect to the mating connector 150. The push-pull cable assembly 200 generally includes a cable assembly 210, an adaptive release member 240, and an extender 260.

[0065] Referring also to FIG. 4, the cable assembly connector 210 includes a latching connector 216, a transmission medium 212, and a jacket 218. The latching connector 216 includes an outer housing 220, an inner housing 214, a lever 222, front stops 228, and rear stops 230. The transmission medium 212 is concentrically disposed within the inner housing 214 and the jacket 218. The transmission medium 212 can comprise an optical fiber or an electrical conductor. A first end of the lever 222 is attached to the outer housing 220. A second end of the lever 222 is not attached to the outer housing 220. The lever includes latches 224 and an extending member 226 for extending the lever 222. The latches 224 are symmetrically attached to and protrude from both sides of the lever 222. The extending member 226 is attached to the second end of the lever 222, and comprises a loop. Front stops 228 and rear stops 230 are attached to and protrude from the outer housing 220, and are symmetrically disposed along both sides of the outer housing 220.

[0066] The adaptive release member 240 includes and is attached to guides 242, a release 252, a tab 248, and snap bearings 250. Each guide 242 is symmetrically disposed on the adaptive release member 240, protruding downwardly from the adaptive release member 240 bottom surface for a length that is approximately equal to the height of the outer housing 220, and curves inwardly towards the center of the adaptive release member 240. The release 252 includes a lever space 244. The lever space 244 is generally sufficiently wide enough to accommodate the width of the extending member 226. The release 252 also includes and is attached to symmetrical release members 246. Each of the release members 246 protrude inwardly into the lever space 244, collectively forming a channel that is narrower than the width of the extending member 226. The tab 248 protrudes from

the top surface of the adaptive release member 240. The snap bearings 250 are symmetrically disposed on both sides of the adaptive release member 240.

[0067] The extender 260 includes and is attached to an actuator 261, ridges 266, a jacket clamp 274, and a dust cover 272. The actuator 261 includes snaps 264 and a slot 262. The slot is sized to cooperate with the tab 248. The snaps 264 protrude symmetrically on each side of the extender 260 and are sized to cooperate with the snap bearings 250. Each ridge 266 protrudes downwardly from the bottom side of the extender 260. A groove 268 is disposed between each pair of successive ridges 266. The dust cover bearing 270 is appropriately sized to cooperate with the dust cover 272. The dust cover 272 has an outer diameter that is appropriately sized to fit inside the housing inner surface 214, and includes a cavity 276 which is appropriately sized to accommodate the diameter of the transmission medium 212. The dust cover 272 base is attached to a pair of lips 278. The lips 278 protrude outwardly along the circumference of the dust cover 272. The lips 278 are spaced to cooperate with the dust cover bearing 270 thickness. The jacket clamp 274 is sized to accommodate the diameter of the jacket 218.

[0068] The inner and outer housings 214 and 220 are configured to engage with a mating connector 150 along a coupling direction 206. The transmission medium 212 acts as a conduit to carry a signal over a distance spanning the length of the transmission medium 212. The jacket 218 protects the transmission medium 212 from damage during operation. The lever 222 is configured to receive a force in a direction normal to the top of the outer housing 220 and to transmit a proportionate force acting in the same direction to the latches 224, thereby selectively disengaging the latching connector 216 from the mating connector 150.

[0069] The adaptive release member 240 is configured to receive a force opposite to the coupling direction 206, and to disengage the latching connector 216 from the mating connector 150 by transmitting a component of the received force to the latching connector 216. The release members 246 are configured to cooperate with the extending members 226 to compress the lever 222. The lever space 244 is configured to provide a resting space for the lever 222. The guides 242 cooperate with the outer housing 220, front stops 228 and rear stops 230 in order to restrict the release 252 range of motion to the coupling axis 205 of the latching connector 216 and to further restrict the adaptive release member 240 range of motion to the space between front stops 228 and the rear stops 230. The tab 248 and the snap bearings 250 mechanically couple with corresponding structures of the slot 262 and the snaps 264. The snap bearings 250 cooperate with the snaps 264 to provide freedom for the extender 260 to move in the direction normal to the coupling axis 205.

[0070] While the extending member 226 comprises a loop in this particular design, it should be understood that the extending member 226 can comprise any other shape which cooperates the release 252 to compress of the lever 222.

[0071] The extender 260 includes an actuator 261 that is configured to receive a force that is opposite to the coupling direction 206, and to transmit a component of the received force to the adaptive release member 240. The ridges 266 and the grooves 268 provide enhanced flexibility along the length of the extender 260. The jacket clamp 274 is configured to clamp the jacket 218 and to prevent the extender 260 from dangling. The dust cover bearing 270 receives and holds the dust cover 272 in place. The dust cover 272 plugs the cavity between the transmission medium 212 and the housing inner surface 214, thus protecting the transmission medium 212 when it is not in use.

[0072] Referring again to FIGS. 2A and 2B, the mating connector 150 receives the latching connector 216 of the cable assembly 200. An operator may engage the latching connector 216 with the mating connector 150 by guiding the leading edge of the latching connector 216 into the mating connector 150 and applying a force in the coupling direction 206. The operator applied force in turn causes the top inner surface of the mating connector 150 to compress the lever 222, and thereby align the leading edge of each latch 224 between the respective top rail 170 and bottom rail 180. When the trailing edge of each latch 224 then crosses the interface between the respective top rail 170 and bottom rail 180, each latch 224 becomes sandwiched in between the respective top rail 170 and bottom rail 180 thereby maintaining the lever 222 in the compressed position. When the trailing edge of each latch 224 crosses into the respective trap 190, the lever 222 becomes decompressed, thereby trapping the lever 222 in the traps 190. In this trapped position, the latching connector 216 is said to be engaged with the mating connector 150.

[0073] The cable assembly 200 is disengaged from the mating connector 150 by applying a force that is opposite to the coupling direction 206, to the extender 260 until the latching connector 216 disengages from the mating connector 150. The extender 260 transmits a component of this force to the adaptive release member 240. The adaptive release member 240 in turn transmits a component of this force to the guides 242 and to the release members 246. Accordingly, the release members 246 cooperate with the extending members 226 to compress the lever 222 until each of the latches 224 are aligned between the respective top rail 170 and bottom rail 180. The leading edge of each latch 224 then crosses the interface between the respective top rail 170 and bottom rail 180, freeing the lever 222 from the traps 190. In this position,

the top rail 170 and the bottom rail 180 compresses the lever 222, and the latching connector 216 is said to be disengaged from the mating connector 150. The force guides the latching connector 216 outside of the mating connector 150. In this disengaged position, the transmission medium 212 can be protected by folding the extender 260 over and plugging the dust cover 272 in the cavity between the transmission medium 212 and the housing inner surface 214.

[0074] Referring to FIG. 5, the couplers 120 are engaged with an array of cable assemblies 200. The push-pull cable assembly 100 permits the spacing of couplers 120 to be in close proximity to each other.

[0075] Referring to FIGS. 6A and 6B, a multi-port push-pull cable assembly 300 can generally include a multi-port cable assembly 310, an adaptive release member 340, and an extender 360.

[0076] The multi-port cable assembly 310 includes a plurality of cable assemblies 310a and 310b. Cable assemblies 310a and 310b each can generally include a latching connector 316, a transmission medium 312, and a jacket 318. The latching connector 316 includes an outer housing 320, an inner housing 314, a lever 322, front stops 328, and rear stops 330. The transmission medium 312 is concentrically disposed within the inner housing 314 and the jacket 318. The transmission medium 312 can comprise an optical fiber or an electrical conductor. A first end of the lever 322 is attached to the outer housing 320. A second end of the lever 322 is not attached to the outer housing 320. The lever includes latches 324 and an extending member 326 for extending the lever 322. The latches 324 are symmetrically attached to and protrude from both sides of the lever 322. The extending member 326 is attached to the second end of the lever 322, and comprises a loop. Front stops 328 and rear stops 330 are attached to and protrude from the outer

housing 320, and are symmetrically disposed along both sides of the outer housing 320.

[0077] The adaptive release member 340 can generally include and is attached to guides 342a and 342b, a plurality of releases 352, a tab 348, and snap bearings 350. Each guide 342a is symmetrically disposed on the adaptive release member 340, protruding downwardly from the adaptive release member 340 bottom surface for a length that is approximately equal to the height of the outer housing 320, and curves inwardly towards the center of adaptive release member 340. The guide 342b is disposed between guides 342a, protruding downwardly from the adaptive release member 340 bottom surface for a length that is approximately equal to the height of the outer housing 320, and forking outwardly towards the sides of adaptive release member 340. Each release 352 includes a lever space 344 that is generally sufficiently wide enough to accommodate the width of the extending member 326. Each release 352 also includes and is attached to symmetrical release members 346. Each of the release members 346 protrude inwardly into the respective lever space 344, collectively forming a channel that is narrower than the width of the extending member 326. The tab 348 protrudes from the top surface of the adaptive release member 340. The snap bearings 350 are symmetrically disposed on both sides of the adaptive release member 340.

[0078] The extender 360 includes and is attached to an actuator 361, ridges 366, jacket clamps 374, and dust covers 372. The actuator 361 includes a slot 362 and snaps 364. The slot 362 is sized to cooperate with the tab 348. The snaps 364 protrude symmetrically on each side of the extender 360 and are sized to cooperate with the snap bearings 350. Each ridge 366 protrudes downwardly from the bottom side of the extender 360. A groove 368 is disposed in between each pair of successive

ridges 366. Each dust cover bearing 370 is appropriately sized to cooperate with the respective dust cover 372. Each dust cover 372 has an outer diameter that is appropriately sized to fit inside the housing inner surface 314, and includes a cavity 376 which is appropriately sized to accommodate the diameter of the transmission medium 312. Each dust cover 372 base is attached to a pair of lips 378. The lips 378 protrude outwardly along the circumference of each dust cover 372. The lips 378 are appropriately spaced to cooperate with the dust cover bearing 370 thickness. Each jacket clamp 374 is appropriately sized to accommodate the diameter of the jacket 318.

[0079] The inner and outer housings 314 and 320 are configured to engage with a mating connector 150 along a coupling direction 206. Each transmission medium 312 acts as a conduit to carry a signal over a distance spanning the length of the transmission medium 312. Each jacket 318 protects the respective optical fiber 312 from damage during operation. Each lever 322 is configured to receive a force in a direction normal to the top of the outer housing 320 and to transmit a proportionate force acting in the same direction to the respective latches 324, thereby selectively disengaging the latching connector 316 from the mating connector 150.

[0080] The adaptive release member 340 is configured to receive a force opposite to the coupling direction 206, and to disengage the latching connector 316 from the mating connector 150 by transmitting a component of the received force to the latching connector 316. The release members 346 cooperate with the extending members 326 to compress the lever 322. Each lever space 344 provides a resting space for the lever 322. The guides 342a and 342b cooperate with the outer housing 320, front stops 328 and rear stops 330 in order to restrict the release 352 range of motion to the coupling axis 205 of the latching connector 316 and to further restrict

the adaptive release member 340 range of motion to the space between front stops 328 and the rear stops 330. The tab 348 and the snap bearings 350 mechanically couple with corresponding structures of the slot 362 and the snaps 364. The snap bearings 350 cooperate with the snaps 364 to provide freedom for the extender 360 to move in the direction normal to the coupling axis 205.

[0081] While the extending members 326 comprises loops in this particular design, it should be understood that the extending members 326 can comprise any other shape which cooperates the releases 352 to compress the levers 322.

[0082] The extender 360 includes an actuator 361 that is configured to receive a force that is opposite to the coupling direction 206, and to transmit a component of the received force to the adaptive release member 340. The ridges 366 and the grooves 368 provide enhanced flexibility along the length of the extender 360. Each jacket clamp 374 is configured to clamp the jacket 318 and to prevent the extender 360 from dangling. Each dust cover bearing 370 receives and holds the respective dust cover 372 in place. Each dust cover 372 plugs the cavity between the transmission medium 312 and the housing inner surface 314, thus protecting the transmission medium 312 when it is not in use.

[0083] Referring to FIG. 8, a high density panel 100 includes a plurality of couplers 120, arranged in close proximity with each other in a plurality of rows and columns, and engaged with plurality of multi-port push-pull cable assemblies 300.

[0084] Generally, the latching mechanisms of the multi-port push-pull cable assembly 300 shares many similarities with the latching mechanism of the single port push-pull cable assembly 200 of FIG. 4. More specifically, an operator may engage the multi-port push-pull cable assembly 300 by aligning the multi-port push-pull cable assembly 300 with the mating connectors 150 and applying a force in the coupling

direction 206 until the multi-port push-pull cable assembly 400 engages with the mating connectors 150.

[0085] Referring to FIGS. 9A and 9B, an extender may have an adjustable length. A push-pull cable assembly 400 can generally include a cable assembly 210, an adaptive release member 240, and an adjustable length extender 460 according to an embodiment.

[0086] The adjustable length extender 460 includes and is attached to a plurality of links 462, and an end link 466. Each link 462 is attached to and includes an actuator 461 and snap bearings 450. The actuator 461 includes snaps 464. A plurality of snaps 464 are disposed on a first edge of each link 462, protruding symmetrically on each side of the link 462. A plurality of snap bearings 450 are disposed on a first edge of each link 462, and are symmetrically disposed on each side of the link 462. The snap bearings 450 of each link 462 are sized to cooperate with the snaps 464 of the adjacent link 462 in the chain. The end link 466 includes and is attached to a jacket clamp 474 and a dust cover 472. The end link 466 also includes a dust cover bearing 470 that is appropriately sized to cooperate with the dust cover 472. The dust cover 472 has an outer diameter that is appropriately sized to fit inside the housing inner surface 114, and includes a cavity 476 which is appropriately sized to accommodate the diameter of the transmission medium 112. The dust cover 472 base is attached to a pair of lips 478. The lips 478 protrude outwardly along the circumference of dust cover 472. The lips 478 are appropriately spaced to cooperate with the dust cover bearing 470 thickness. The jacket clamp 474 is appropriately sized to accommodate the diameter of the jacket 118.

[0087] The links 462 are configured to adjust the length of the extender 460 by adding or removing links 462 from the chain. Each link 462 is configured to

attach to an adjacent link 462, the adaptive release member 240, or the end link 466. The extender 460 includes an actuator that is configured to receive a force that is opposite to the coupling direction 206, and transmit a component of the received force to the adaptive release member 340. The jacket clamp 474 is configured to clamp the jacket 218 and to prevent the extender 460 from dangling. The dust cover bearing 470 receives and holds the dust cover 472 in place. The dust cover 472 is configured to plug the cavity between the transmission medium 212 and the housing inner surface 214, thus protecting the transmission medium 212 when it is not in use.

[0088] Referring to FIG. 10, a high density panel 100 includes a plurality of couplers 120, arranged in close proximity with each other in a plurality of rows and columns, and engaged with plurality of push-pull cable assemblies 400. The latching mechanisms of the push-pull cable assembly 400 shares many similarities with the latching mechanism of the push-pull cable assembly 200 of FIG. 4. More specifically, an operator may engage the push-pull cable assembly 400 by aligning the push-pull cable assembly 400 with the mating connectors 150 and applying a force in the coupling direction 206 until the push-pull cable assembly 400 engages with the mating connectors 150.

[0089] The push-pull cable assembly 400 can be disengaged from the mating connector 150 by applying a force that is opposite to the coupling direction 206 to the extender 460 until the multi-port push-pull cable assembly 400 disengages from each mating connector 150.

[0090] Referring to FIGS. 11A and 11B, the extender 560 of a multi-port push-pull cable assembly 500 has an adjustable length. The multi-port push-pull cable assembly can generally include a multi-port cable assembly 310, an adaptive release member 340, and an adjustable extender 560.

[0091] The adjustable length extender 560 includes and is attached to a plurality of links 562, and an end link 566. Each link 562 is attached to and includes an actuator 561 and snap bearings 550. The actuator 561 includes snaps 564. A plurality of snaps 564 are disposed on a first edge of each link 562, protruding symmetrically on each side of the link 562. A plurality of snap bearings 550 are disposed on a first edge of each link 562, and are symmetrically disposed on each side of the link 562. The snap bearings 550 of each link 562 are sized to cooperate with the snaps 564 of the adjacent link 562 in the chain. The end link 566 includes and is attached to a plurality of jacket clamps 574 and a plurality of dust covers 572. The end link 566 also includes a plurality of dust cover bearings 570 that are appropriately sized to cooperate with the dust cover 472. Each dust cover 572 has an outer diameter that is appropriately sized to fit inside the housing inner surface 314, and includes a cavity 576 which is appropriately sized to accommodate the diameter of the transmission medium 312. Each dust cover 572 base is attached to a pair of lips 578. The lips 578 protrude outwardly along the circumference of each dust cover 572. The lips 578 are appropriately spaced to cooperate with each dust cover bearing 570 thickness. The jacket clamp 574 is appropriately sized to accommodate the diameter of the jacket 318.

[0092] The links 562 are configured to adjust the length of the extender 560 by adding or removing links 562 from the chain. Each link 562 attaches to an adjacent link 562, the adaptive release member 340, or the end link 566. The extender 560 is configured to receive a force that is opposite to the coupling direction 206, and to transmit the received force to the adaptive release member 340. The jacket clamp 574 is configured to clamp the jacket 318 and to prevent the extender 560 from dangling. The dust cover bearing 570 is configured to receive and hold the dust cover

572 in place. The dust cover 572 is configured to plug the cavity in between the transmission medium 312 and the housing inner surface 314, thus protecting the transmission medium 312 when it is not in use.

[0093] Referring to FIG. 12, a high density panel 100 includes a plurality of couplers 120, arranged in close proximity with each other in a plurality of rows and columns, and engaged with plurality of multi-port push-pull cable assemblies 500. The latching mechanisms of the multi-port push-pull cable assembly 500 shares many similarities with the latching mechanism of the single port push-pull cable assembly 200 of FIG. 4. More specifically, an operator may engage the multi-port push-pull cable assembly 500 by aligning the multi-port push-pull cable assembly 500 with the mating connectors 150 and applying a force in the coupling direction 206 until the multi-port push-pull cable assembly 500 engages with the mating connectors 150.

[0094] The multi-port push-pull cable assembly 500 can be disengaged from the mating connectors 150 by applying a force that is opposite to the coupling direction 206 to the extender 560 until the multi-port push-pull cable assembly 500 disengages from each mating connector 150.

[0095] Referring to FIG. 13, a low-profile push-pull cable assembly 600 can generally include a cable assembly 610, a guide 640, and an extender 660.

[0096] Referring to FIG. 14, the cable assembly 610 generally includes a latching connector 616, a transmission medium 612, and a jacket 618. The latching connector 616 can generally include an outer housing 620, an inner housing 614, a lever 622, front stops 628, and rear stops 630. The transmission medium 612 is concentrically disposed within the inner housing 614 and the jacket 618. The transmission medium 612 can comprise an optical fiber or an electrical conductor. A first end of the lever 622 is attached to the outer housing 620. A second end of the

lever 622 is not attached to the outer housing 620. The lever 622 includes latches 624 and an extending member 626 for extending the lever 622. The latches 624 are symmetrically attached to and protrude from both sides of the lever 622. The extending member 626 is attached to the end of the lever 622, and comprises a hook. Front stops 628 and rear stops 630 are attached to and protrude from the outer housing 620, and are symmetrically disposed along both sides of the outer housing 620.

[0097] The guide 640 can generally include and is attached to sidewalls 642, and an aperture 644. Each sidewall 642 is symmetrically disposed on the guide 640, protruding downwardly from the guide 640 bottom surface for a length that is approximately equal to the height of outer housing 620, and curves inwardly towards the center of guide 640. The aperture 644 protrudes upwardly from the top surface of the guide 640.

[0098] The extender 660 includes and is attached to an actuator 664, a jacket clamp 674, and a dust cover 672. The dust cover 672 has an outer diameter that is appropriately sized to fit inside the housing inner surface 614, and includes a cavity 676 which is appropriately sized to accommodate the diameter of the transmission medium 612. The jacket clamp 674 is appropriately sized to accommodate the diameter of the jacket 618. As shown in FIG. 14, the actuator 664 has a curvature. The actuator 664 may also be flat, or have a curvature that is different than what is shown in FIG. 14.

[0099] The inner and outer housings 614 and 620 are configured to engage with a mating connector 150 along a coupling direction 206. The transmission medium 612 acts as a conduit to carry a signal over a distance spanning the length of the transmission medium 612. The jacket 618 protects the transmission medium 612 from damage during operation. The lever 622 is configured to receive a force in a

direction normal to the top of the outer housing 620 and to transmit a proportionate force acting in the same direction to the latches 624, thereby selectively disengaging the latching connector 616 from the mating connector 150.

[00100] The guide 640 sidewalls 642 are configured to cooperate with the outer housing 620, front stops 628 and rear stops 630 in order to restrict the extender range of motion to the coupling axis 205 of the latching connector 616 and to further restrict the guide 640 range of motion to the space between front stops 628 and the rear stops 630. The aperture 644 is configured to cooperate with the sidewalls 642 and the latching connector 616 to restrict the extender 660 range of motion to the coupling axis 205.

[00101] The extender 660 includes an actuator 664 that is configured to receive a force that is opposite to the coupling direction 206, and to transmit a component of the received force to the extending member 626, thereby causing a compression of the lever 622. The jacket clamp 674 is configured to clamp the jacket 618 and to prevent the extender 660 from dangling. The dust cover 672 is configured to plug the cavity in between the transmission medium 612 and the housing inner surface 614, thus protecting the transmission medium 612 when it is not in use.

[00102] Referring to FIGS. 15 and 16, a high density panel 100 includes a mounting surface 110. A plurality of couplers 120, are disposed on the mounting surface 110, and arranged generally in close proximity to one another in a plurality of rows and columns. The plurality of couplers 120 are engaged with plurality of push-pull cable assemblies 600. Each coupler 120 has a first edge 122 and a second edge 124. It is illustrated that the distance 126 between a first edge 122 of a first coupler 120 and the second edge 124 of a second coupler 120, generally with no or with a

substantially small spacing that is less than 1.25 millimeters between the adjacent couplers. The couplers 120 can also be configured to engage with a LC connector.

[00103] Referring to FIG. 17, a multi-port push-pull cable assembly 700 can generally include a multi-port cable assembly 710, a guide 740, and an extender 760.

[00104] Referring to FIG. 18, the multi-port cable assembly 710 includes a plurality of cable assemblies 710a and 710b. Cable assemblies 710a and 710b each can generally include a latching connector 716, a transmission medium 712, and a jacket 718. The latching connector 716 can generally include an outer housing 720, an inner housing 714, a lever 722, front stops 728, and rear stops 730. The transmission medium 712 is concentrically disposed within the inner housing 714 and the jacket 718. The transmission medium 712 can comprise an optical fiber or an electrical conductor. A first end of the lever 722 is attached to the outer housing 720. A second end of the lever 722 is not attached to the outer housing 720. The lever 722 includes latches 724 and an extending member 726 for extending the lever 722. The latches 724 are symmetrically attached to and protrude from both sides of the lever 722. The extending member 726 is attached to the end of the lever 722, and comprises a hook. Front stops 728 and rear stops 730 are attached to and protrude from the outer housing 720, and are symmetrically disposed along both sides of the outer housing 720.

[00105] The guide 740 can generally include and is attached to sidewalls 742a and 742b, and an aperture 744. Each sidewall 742a is symmetrically disposed on the guide 740, protruding downwardly from the guide 740 bottom surface for a length that is approximately equal to the height of outer housing 720, and curves inwardly towards the center of guide 740. The sidewall 742b is disposed between sidewalls 742a, protruding downwardly from the guide 740 bottom surface for a length that is

approximately equal to the height of outer housing 720, and forking outwardly towards the sides of the guide 740. The aperture 744 protrudes upwardly from the top surface of the guide 740.

[00106] The extender 760 includes and is attached to a plurality of actuators 764, a plurality of jacket clamps 774, and a plurality of dust covers 772. Each dust cover 772 has an outer diameter that is appropriately sized to fit inside the housing inner surface 714, and includes a cavity 776 which is appropriately sized to accommodate the diameter of The transmission medium 712. Each jacket clamp 774 is appropriately sized to accommodate the diameter of the jacket 718. As shown in FIG. 18, the actuators 764 are flat, however the actuators 764 may also have a curvature.

[00107] The inner and outer housings 714 and 720 are configured to engage with a mating connector 150 along a coupling direction 206. Each transmission medium 712 acts as a conduit to carry a signal over a distance spanning the length of the transmission medium 712. Each jacket 718 protects the respective optical fiber 712 from damage during operation. Each lever 722 is configured to receive a force in a direction normal to the top of the outer housing 720 and to transmit a proportionate force acting in the same direction to the respective latches 724, thereby selectively disengaging the latching connector 716 from the mating connector 150.

[00108] The guide 740 sidewalls 742a and 742b are configured to cooperate with the outer housing 720, front stops 728 and rear stops 730 in order to restrict the extender 760 range of motion to the coupling axis 205 of the latching connector 716 and to further restrict the guide 740 range of motion to the space between front stops 728 and the rear stops 730. The aperture 744 is configured to cooperate with the

sidewalls 742 and the latching connector 716 to restrict the extender 760 range of motion to the coupling axis 205.

[00109] The extender 760 includes actuators 764 that are configured to receive a force that is opposite to the coupling direction 206, and to transmit a component of the received force to each extending member 726. Each jacket clamp 774 is configured to clamp the jacket 718 and to prevent the extender 760 from dangling. Each dust cover 772 is configured to plug the cavity in between The transmission medium 712 and the housing inner surface 714, thus protecting The transmission medium 712 when it is not in use.

[00110] Referring to FIGS. 19-20, a high density panel 100 includes a mounting surface 110. A plurality of couplers 120, are disposed on the mounting surface 110, and arranged generally in close proximity to one another in a plurality of rows and columns. The plurality of couplers 120 are engaged with plurality of push-pull cable assemblies 700. Each coupler 120 has a first edge 122 and a second edge 124. It is illustrated that the distance 126 between a first edge 122 of a first coupler 120 and the second edge 124 of a second coupler 120, generally with no or with a substantially small spacing that is less than 1.25 millimeters between the adjacent couplers. The couplers 120 can also be configured to engage with a LC connector.

[00111] Referring to FIG. 21, a low-profile push-pull cable assembly 800 can generally include a cable assembly 810, a boot 840, and an extender 860.

[00112] Referring to FIG. 22, the cable assembly 810 generally includes a latching connector 816, a transmission medium 812, a jacket 818, and a trap 828. The latching connector 816 can generally include an outer housing 820, an inner housing 814, a lever 822. The transmission medium 812 is concentrically disposed within the inner housing 814 and the jacket 818. The transmission medium 812 can comprise an

optical fiber or an electrical conductor. A first end of the lever 822 is attached to the outer housing 820. A second end of the lever 822 is not attached to the outer housing 820. The lever 822 includes latches 824 and an extending member 826 for extending the lever 822. The latches 824 are symmetrically attached to and protrude from both sides of the lever 822. The extending member 826 is attached to the end of the lever 822, and comprises a hook. The trap 828 is disposed in between the latching connector 816 and the jacket 818.

[00113] The boot 840 can generally include and is attached to a strain relief 842, a passageway 844, a stop space 847, a restoring member 849, a protruding member 851, and a flexible membrane 853. The strain relief 842 is sized to cover a distance of the transmission medium 812 entering into the latching connector 816. The passageway 844 runs parallel to the coupling axis 205 along the top of the boot 840. The stop space 847 is disposed along the passageway 844, and is connected to a restoring member 849. The restoring member 849 protrudes outwardly from the stop space 847 in a direction opposite to the coupling direction 206. The flexible membrane is sized to fit around the jacket 818. The protruding member 851 is disposed on the inner surface of the strain relief 842.

[00114] The extender 860 includes and is attached to an actuator 864, a stop 865, and an identification tag 867. The actuator is sized to cooperate with the extending member 826, and comprises a loop. The stop 865 protrudes from the extender 860 top surface and is sized to cooperate with the stop space 847 and the restoring member 849. As shown in the figure, the stop 856 comprises a dorsal fin. The extender 860 width and height is sized to cooperate with the width and height of the passageway 844 width and height. The identification tag 867 is sized to accommodate the dimensions of user defined identifications.

[00115] The inner and outer housings 814 and 820 are configured to engage with a mating connector 150 along a coupling direction 206. The transmission medium 812 acts as a conduit to carry a signal over a distance spanning the length of the transmission medium 812. The jacket 818 protects the transmission medium 812 from damage during operation. The lever 822 is configured to receive a force in a direction normal to the top of the outer housing 820 and to transmit a proportionate force acting in the same direction to the latches 824, thereby selectively disengaging the latching connector 816 from the mating connector 150. Referring to FIG. 23, the trap 828 is configured to cooperate with the protruding member 851. The trap 828 is configured to cooperate with the protruding member 851 to restrict the movement of the boot 840 along the coupling axis 205.

[00116] The strain relief 842 is configured to protect the transmission medium 812 from flexure near the area of termination. The protruding member 851 is configured to cooperate with the trap 828 to restrict the movement of the boot 840 along the coupling axis. The passageway 844 is configured to accept the extender 860. The stop space 847 is configured to provide a resting place for the stop 865 when the lever 822 is in the natural position. The restoring member 849 is configured to overcome the friction between the extender 860 surfaces and the inner walls of the passageway 844 in order to restore the lever 822 to the natural position. The flexible membrane 853 is configured to provide a flexible transition in between the cable 818 and the strain relief 842.

[00117] The extender 860 includes an actuator 864 that is configured to receive a force that is opposite to the coupling direction 206, and to transmit a component of the received force to the extending member 826, thereby causing a compression of the lever 822. The stop 865 is configured to cooperate with the

restoring member 849 to overcome the friction between the extender 860 surfaces and the inner walls of the passageway 844 in order to restore the lever 822 to the natural position following the application of a user-applied force to the extender 860 opposite to the coupling direction 206. The identification tag 867 is configured to provide a customizable area for display of a user-defined identification of the cable assembly.

[00118] Referring to FIG. 24 a high density panel 100 includes a mounting surface 110. A plurality of couplers 120, are disposed on the mounting surface 110, and arranged generally in close proximity to one another in a plurality of rows and columns. The plurality of couplers 120 are engaged with plurality of push-pull cable assemblies 800. Each coupler 120 has a first edge 122 and a second edge 124. It is illustrated that the distance 126 between a first edge 122 of a first coupler 120 and the second edge 124 of a second coupler 120, generally with no or with a substantially small spacing that is less than 1.25 millimeters between the adjacent couplers. The couplers 120 can also be configured to engage with a LC connector.

[00119] The cable assemblies as taught herein reduces the support cost and enhances the quality of service of using high-density panels in communication systems. Additionally, depending on the design of the snap features and associated snap receiving recesses, the adaptive release member and/or extender may be disassembled to replace a worn part (e.g., if a link breaks or wears out) or otherwise repair the adaptive release member and/or extender. Additionally, the low-profile of the cable assemblies taught herein permits system integrators to eliminate the spacing between mating connectors on a high-density panel.

[00120] The various components described above may be constructed by manufacturing methods well known in the art. Materials for use in construction of the various components listed above may include various polymers, plastics, metals,

glass, and other similar suitable materials. For example, the adaptive release members, latching connectors, and extenders may be manufactured via a plastic injection molding process. Alternatively, the various adaptive release members, latching connectors, and extenders may be manufactured from a suitable metal via a milling process. Additional materials and manufacturing methods will be well known to those skilled in the art.

[00121] The above examples are not intended to limit the invention, but merely to serve as an illustration of how the invention might be constructed and operated.

[00122] Various of the above-disclosed and other features and functions, or alternatives thereof, may be combined into many other different systems or applications. Various presently unforeseen or unanticipated alternatives, modifications, variations or improvements therein may be subsequently made by those skilled in the art, each of which is also intended to be encompassed by the disclosed embodiments.

CLAIMS

What is claimed is:

1. A latching connector comprising:

a housing configured to engage with a mating connector along a coupling axis including:

a lever connected to the housing, the lever configured to selectively disengage the latching connector from the mating connector; and

an extending member connected to the lever.

2. The latching connector of claim 1, wherein the extending member comprises a hook.

3. The latching connector of claim 1, wherein the extending member comprises a loop.

4. The latching connector of claim 1, wherein the latching connector comprises a multi-port connector.

5. The latching connector of claim 1, wherein the mating connector is configured to engage with an LC connector.

6. An adaptive release member comprising:

a release configured to receive a first force, the first force opposite to a latching connector coupling direction, and to disengage the latching connector from the mating connector by transmitting a component of the first force to the latching connector, the latching connector comprising:

a housing configured to engage with a mating connector along the coupling direction, the housing including:

a lever connected to the housing, the lever configured to selectively disengage the latching connector from the mating connector, and

an extending member connected to the lever and configured to cooperate with the release to actuate the lever; and

a guide connected to the release and configured to cooperate with the latching connector to restrict the release range of motion.

7. The adaptive release member of claim 6, wherein the latching connector is a multi-port latching connector.

8. An extender comprising:

an actuator configured to receive a first force, the first force opposite to a latching connector coupling direction, and to disengage the latching connector from the mating connector by transmitting a component of the first force to the latching connector, the latching connector comprising:

a housing configured to engage with a mating connector along the coupling direction, the housing including:

a lever connected to the housing, the lever configured to selectively disengage the latching connector from the mating connector, and

an extending member connected to the lever and configured to cooperate with the actuator to actuate the lever.

9. The extender of claim 8, wherein the extending member comprises a hook.

10. The extender of claim 9, wherein the actuator comprises a loop.

11. The extender of claim 10, wherein the extender further includes a plurality of ridges and grooves disposed along a length of the extender.

12. The extender of claim 10, further including a dust cover attached to the extender and configured to protect a transmission medium.

13. The extender of claim 10, further including a jacket clamp attached to the extender.

14. The extender of claim 10, wherein a link is connected to the actuator, the link configured to adjust a length of the extender.

15. The extender of claim 10, further including an identification tag connected to the extender.

16. An extender comprising:

an actuator configured to receive a first force, the first force opposite to a latching connector coupling direction, and to transmit a component of the first force to an adaptive release member, the adaptive release member including:

a release configured to receive a component of the first force and to disengage the latching connector from the mating connector by transmitting a second force to the latching connector, the latching connector comprising:

a housing configured to engage with a mating connector along the coupling direction, the housing including:

a lever connected to the housing, the lever configured to selectively disengage the latching connector from the mating connector, and

an extending member connected to the lever and configured to cooperate with the release to actuate the lever; and

a guide connected to the release and configured to cooperate with the latching connector to restrict the release range of motion.

17. The extender of claim 16, wherein the extender further includes a plurality of ridges and grooves disposed along a length of the extender.

18. The extender of claim 16, wherein a link is connected to the actuator, the link configured to adjust a length of the extender.

19. The extender of claim 16, further including a dust cover attached to the extender and configured to protect a transmission medium.

20. The extender of claim 16, further including a jacket clamp attached to the extender.

21. The extender of claim 16, further comprising an identification tag connected to the extender.

22. A cable assembly comprising:

a jacket;

a latching connector comprising:

a housing configured to engage with a mating connector along a coupling direction including:

a lever connected to the housing, the lever configured to selectively disengage the latching connector from the mating connector, and

an extending member connected to the lever; and

a transmission medium disposed within the jacket and the housing.

23. The cable assembly of claim 22, further comprising:

an extender including an actuator configured to receive a first force, the first force opposite to a latching connector coupling direction, and to disengage the latching connector from a mating connector by transmitting a component of the first force to the extending member; and

a guide positioned on the latching connector, the guide configured to restrict the extender range of motion.

24. The cable assembly of claim 22 further comprising an adaptive release member including:

a release configured to receive a first force, the first force opposite to a latching connector coupling direction, and to disengage the latching connector

from the mating connector by transmitting a component of the first force to the extending member; and

a guide connected to the release and configured to cooperate with the latching connector to restrict the release range of motion.

25. The cable assembly of claim 23, wherein the extending member comprises a hook.

26. The cable assembly of claim 23, wherein the transmission medium comprises an optical fiber.

27. The cable assembly of claim 23, wherein the transmission medium comprises an electrical conductor.

28. The cable assembly of claim 23, wherein the mating connector is configured to engage with a LC connector.

29. The cable assembly of claim 23, wherein the extender further includes a plurality of ridges and grooves disposed along a length of the extender.

30. The cable assembly of claim 23, further including a dust cover attached to the extender and configured to protect the transmission medium.

31. The cable assembly of claim 23, further including a jacket clamp attached to the extender.

32. The cable assembly of claim 23, wherein a link is connected to the actuator, the link configured to adjust a length of the extender.

33. The cable assembly of claim 23, further including an identification tag connected to the extender.

34. The cable assembly of claim 23, wherein the guide comprises a boot including a strain relief configured to protect the transmission medium.

35. The cable assembly of claim 24 further comprising an extender including:

an actuator configured to receive a second force, the second force opposite to a latching connector coupling direction, and to disengage the latching connector from the mating connector by transmitting a component of the second force to the release.

36. The cable assembly of claim 35, wherein the extender further includes a plurality of ridges and grooves disposed along a length of the extender.

37. The cable assembly of claim 35, further including a dust cover attached to the extender and configured to protect the transmission medium.

38. The cable assembly of claim 35, further including a jacket clamp attached to the extender.

39. The cable assembly of claim 35, wherein a link is connected to the actuator, the link configured to adjust a length of the extender.

40. The cable assembly of claim 35, wherein the extending member comprises a loop.

41. The cable assembly of claim 35, further including an identification tag connected to the extender.

42. The cable assembly of claim 30, wherein the actuator comprises a loop configured to cooperate with the hook.

43. The cable assembly of claim 34, further including:

a restoring member connected to the boot; and

a stop connected to the extender and configured to cooperate with the restoring member to restore the position of the lever to a natural position.

44. The cable assembly of claim 40, wherein the release comprises a hook configured to cooperate with the loop.

45. A high-density panel comprising:

a panel including a mounting surface;

a first mating connector disposed on the mounting surface and having a first edge;

a second mating connector disposed on the mounting surface and having a second edge;

wherein the distance between the first edge and the second edge is less than 1.25 millimeters.

46. The high-density panel of claim 45, wherein the distance between the first edge and the second edge is greater than or equal to 0 millimeters.

47. The high-density panel of claim 45, wherein the first edge abuts the second edge.

48. The high-density panel of claim 45, wherein the panel comprises a printed circuit board.

49. The high-density panel of claim 45, wherein the first and second mating connectors are each configured to engage with a LC connector.

50. A method of extracting a latching cable assembly from a panel, which comprises:

applying a force to an extender along a coupling axis of a latching connector in a direction opposite to a coupling direction of the latching connector; and

increasing the force applied to the extender until the latching connector disengages from a mating connector.

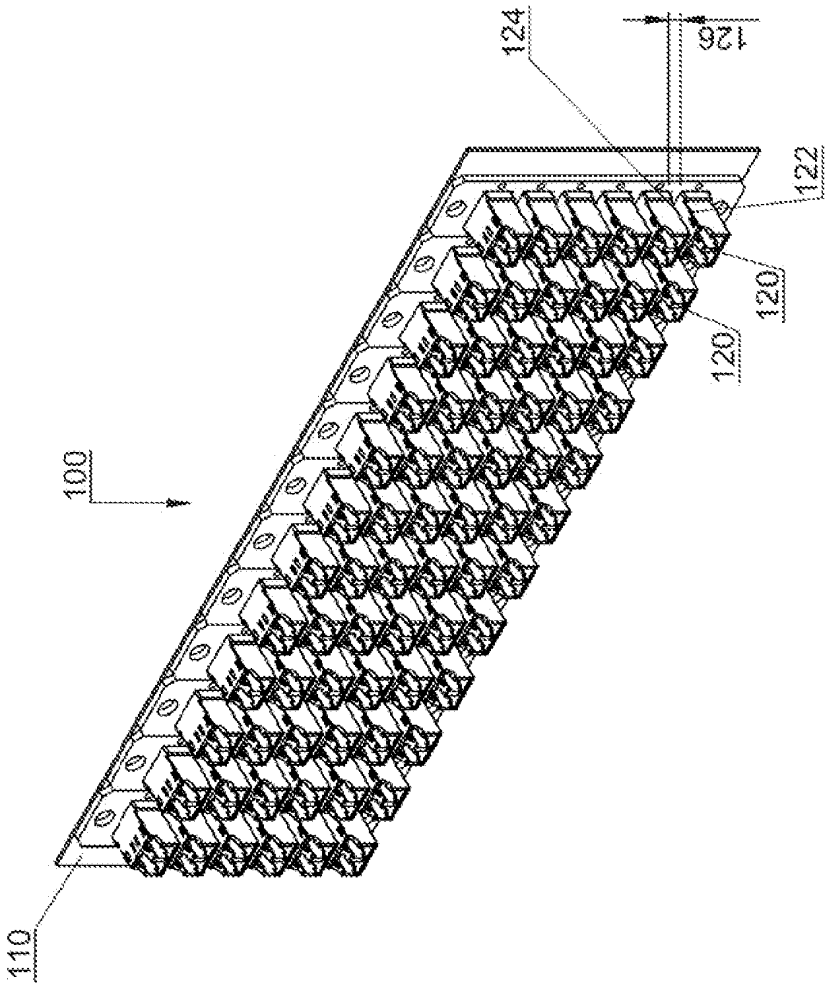


FIG. 1

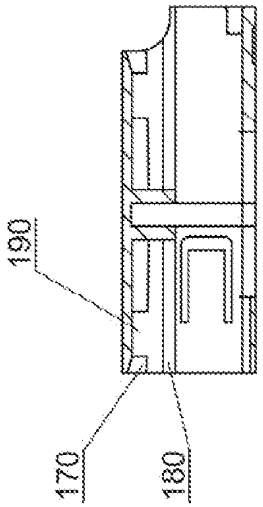


FIG. 2B
SECTION VIEW OF 150

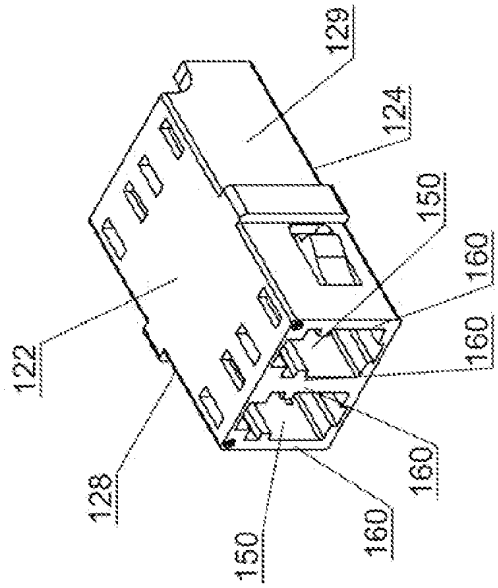


FIG. 2A

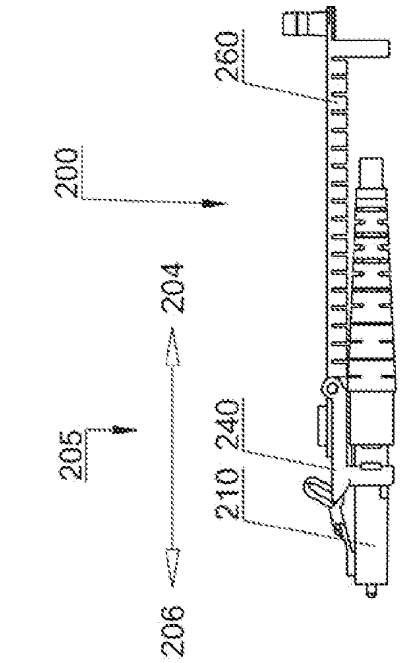


FIG. 3B

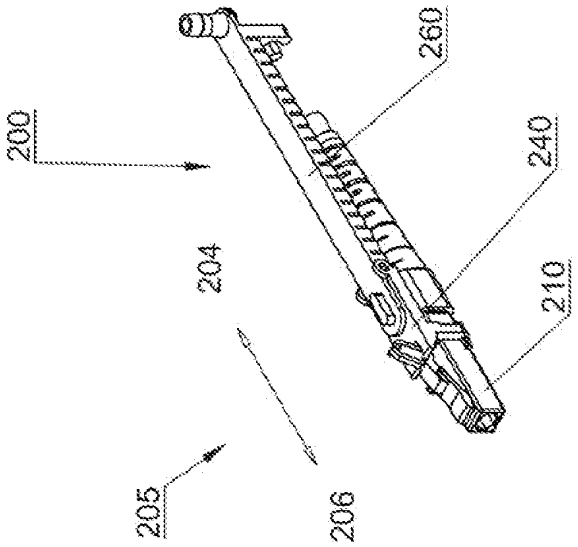


FIG. 3A

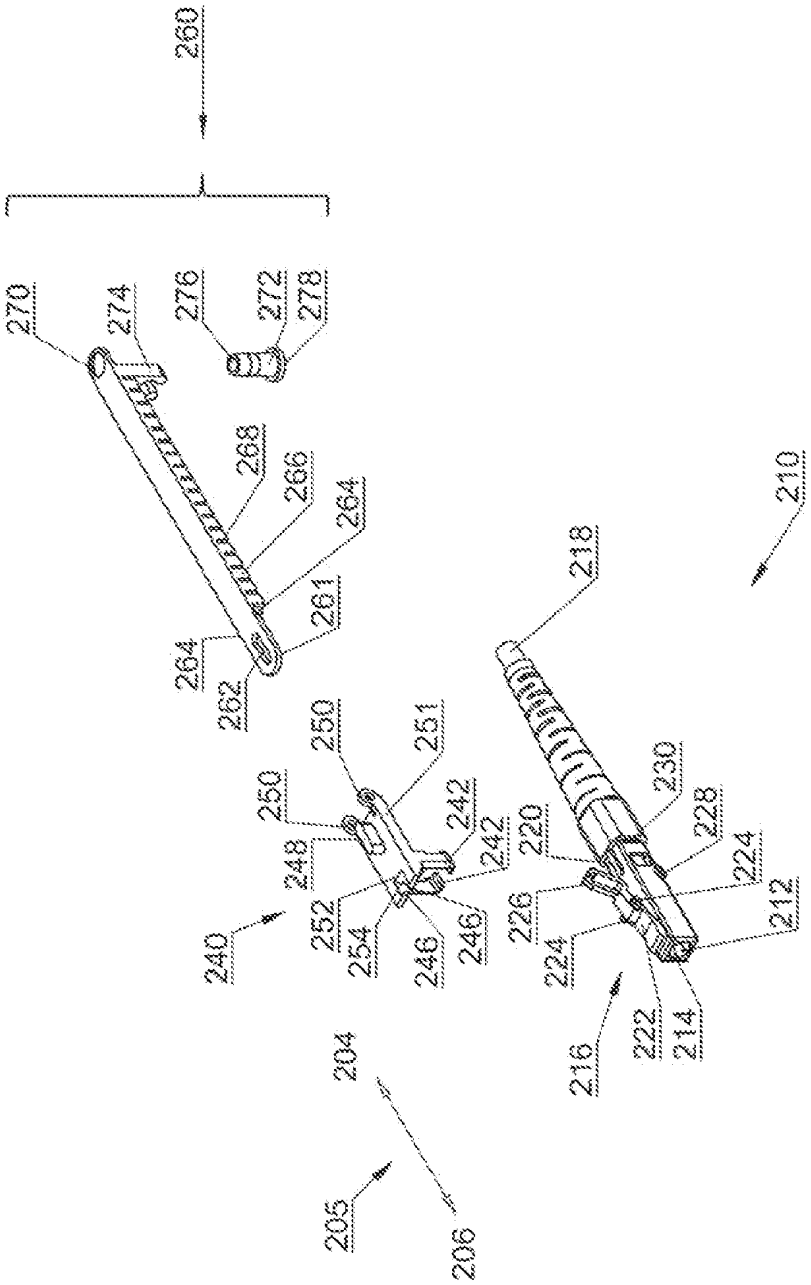

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FIG. 4

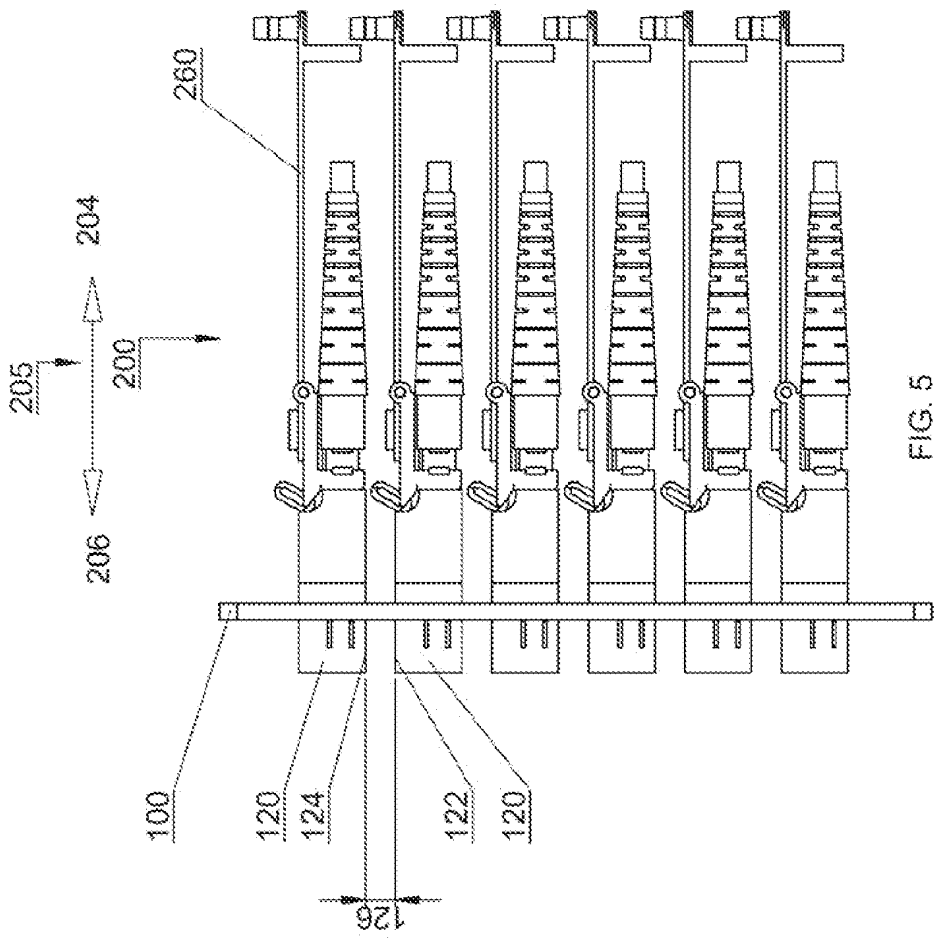


FIG. 5

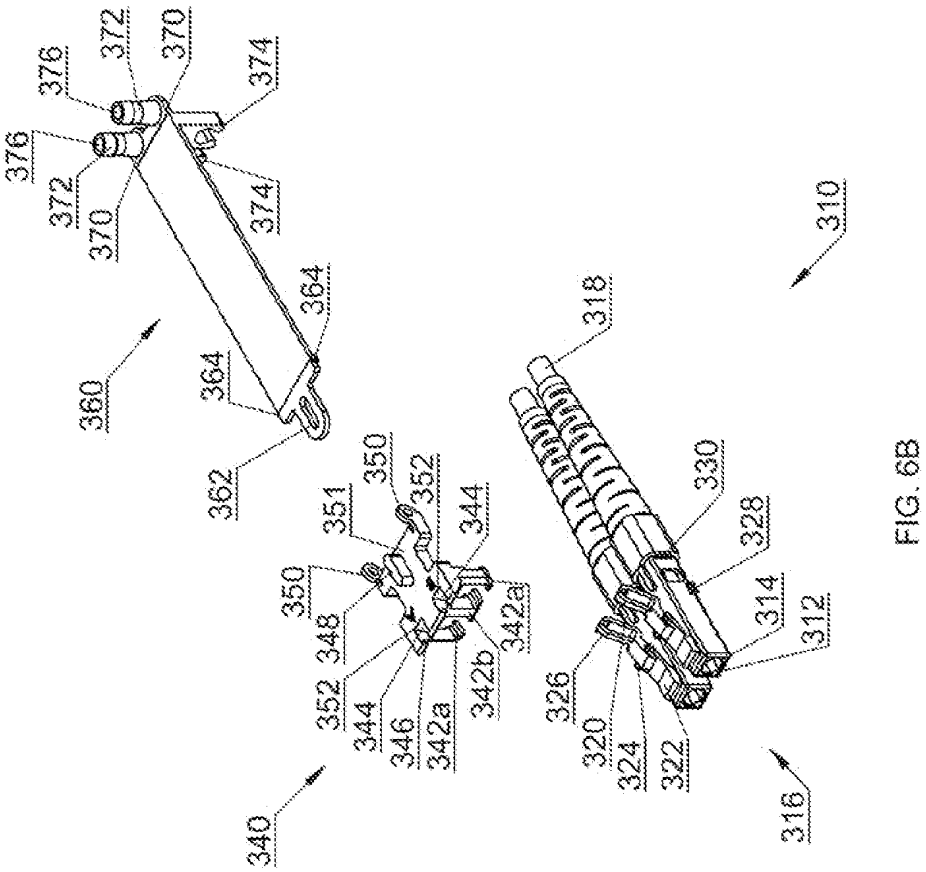

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FIG. 6B

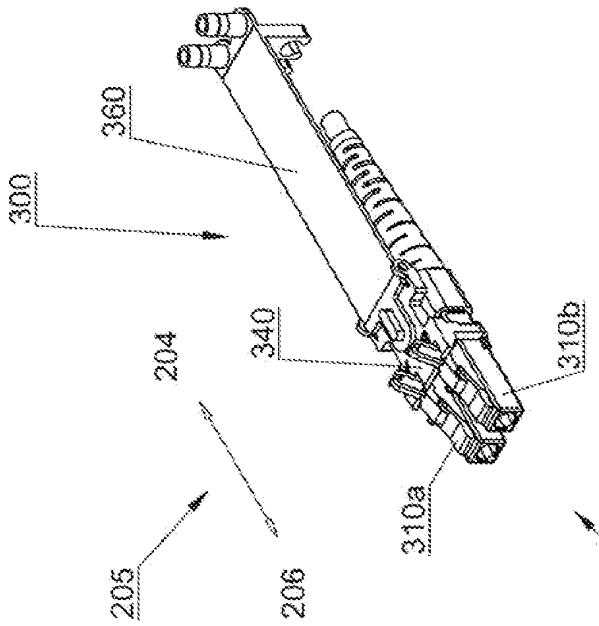

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FIG. 6A

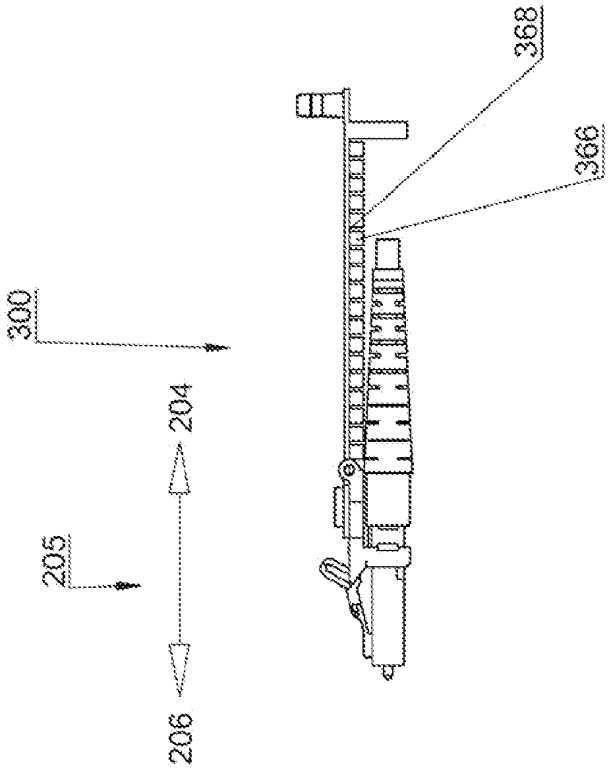


FIG. 7

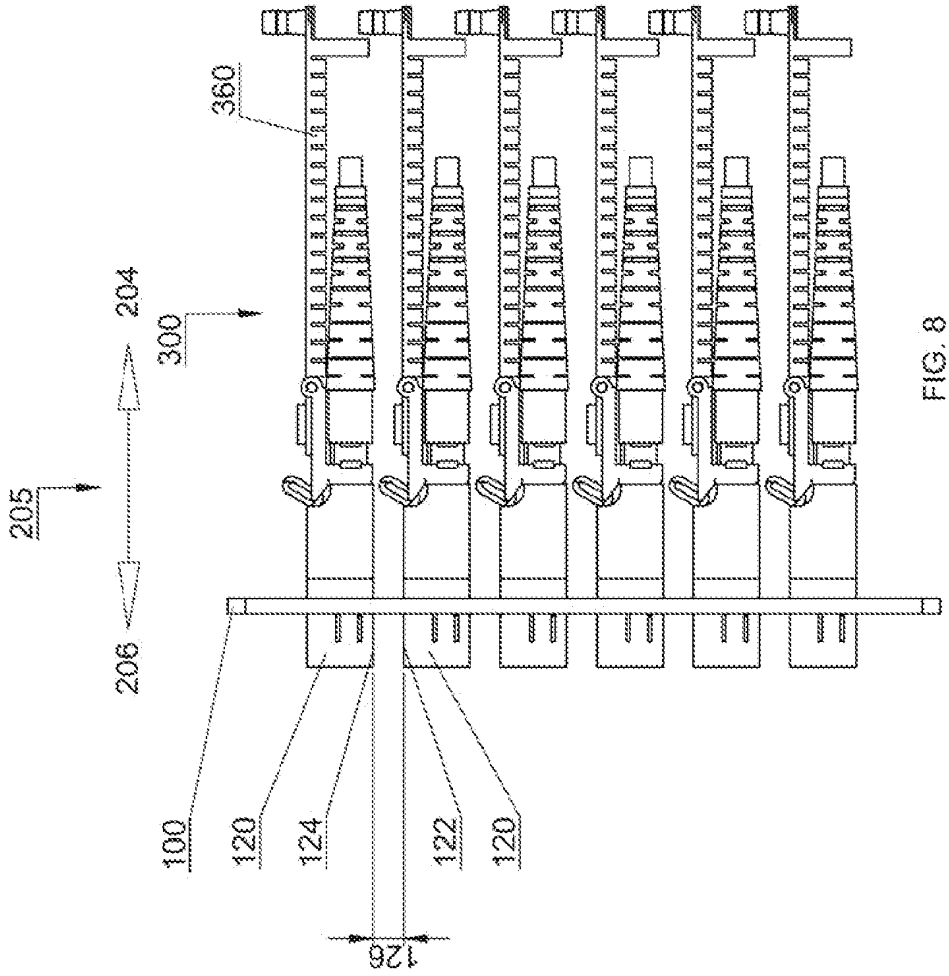


FIG. 8

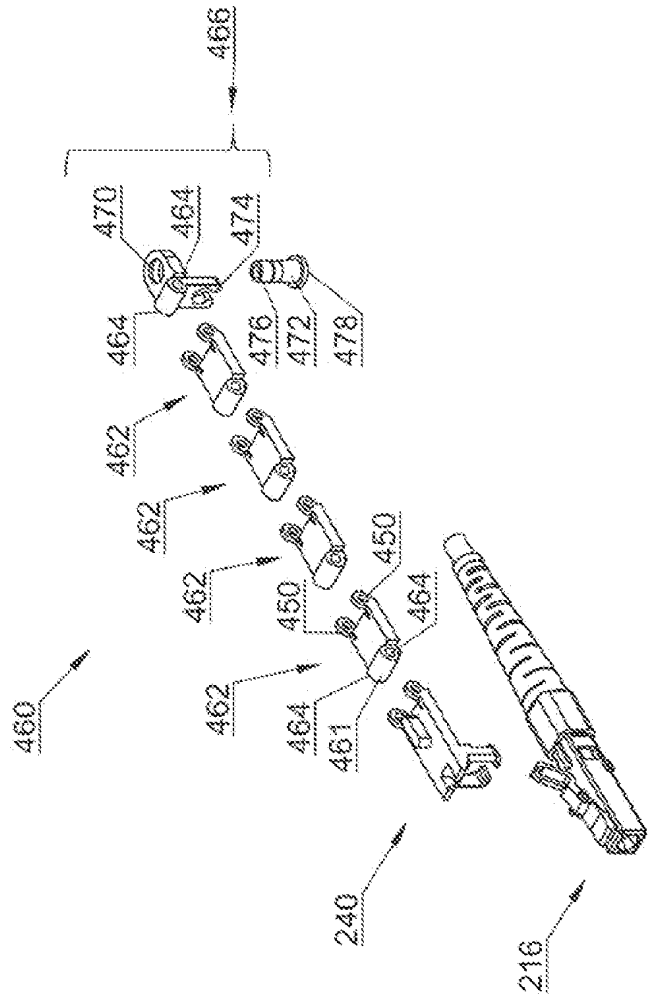

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FIG. 9B

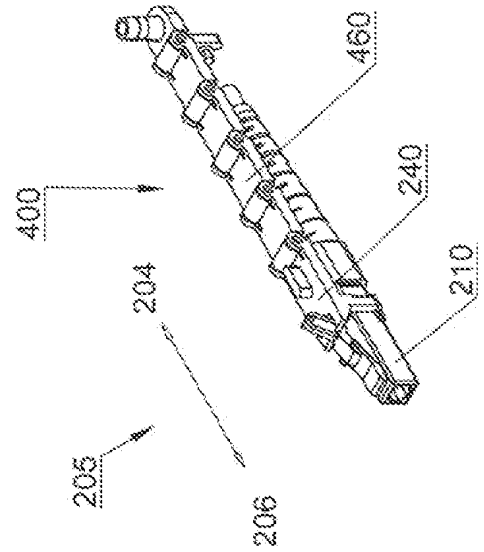

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FIG. 9A

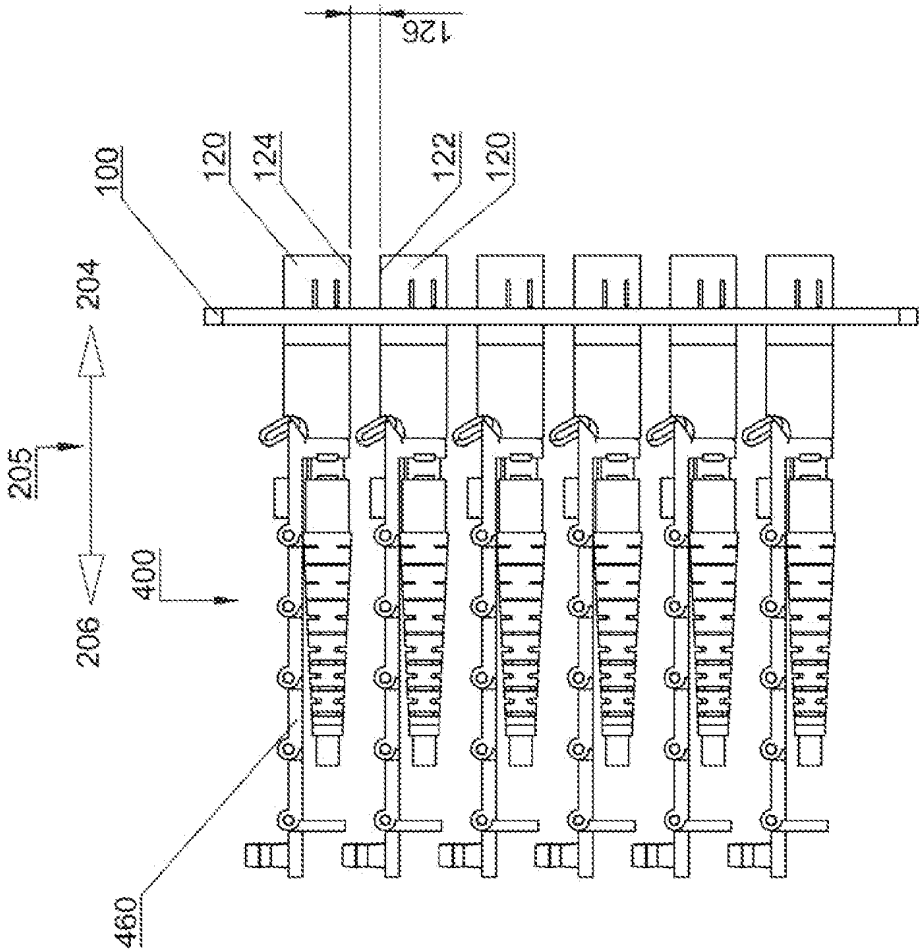


FIG. 10

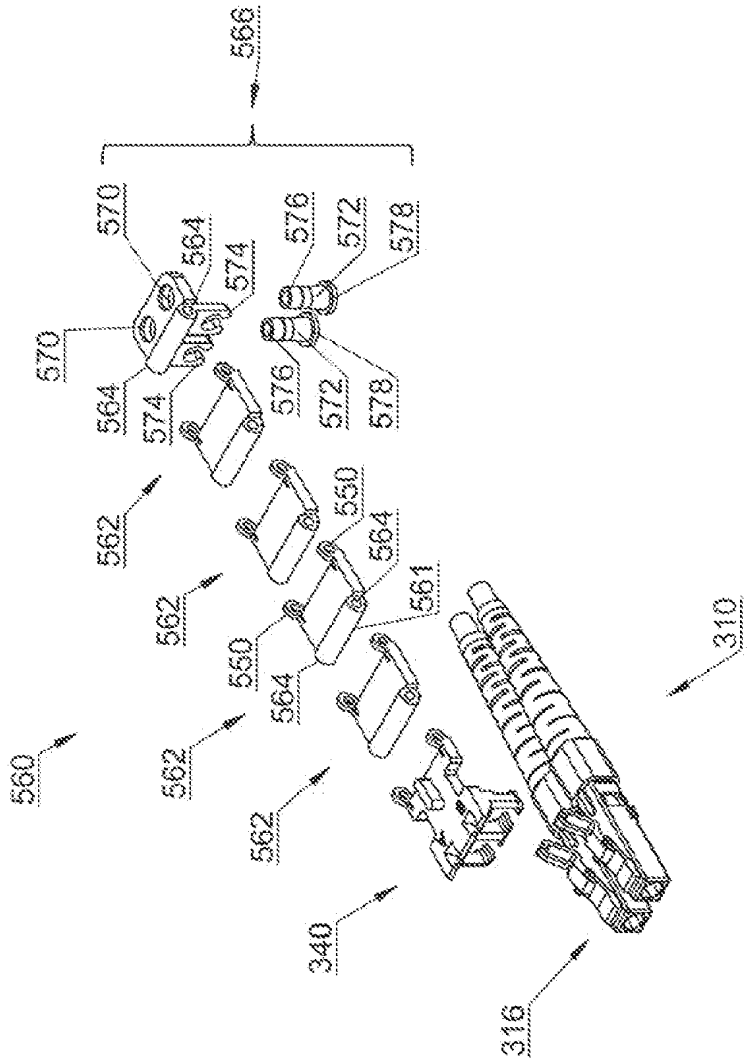


FIG. 11B

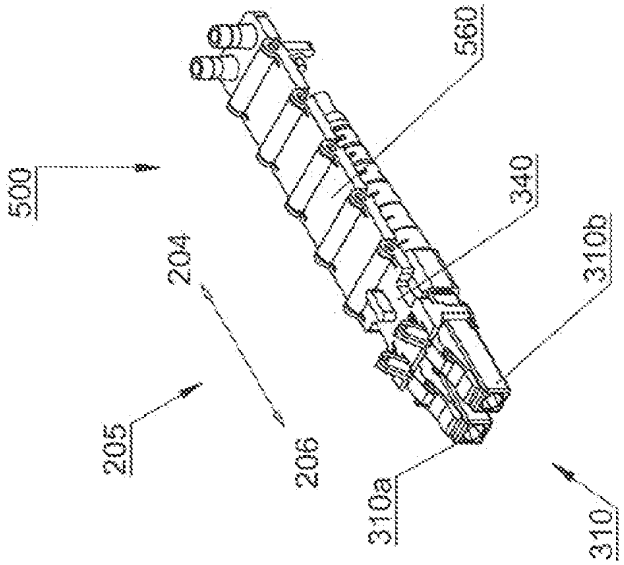


FIG. 11A

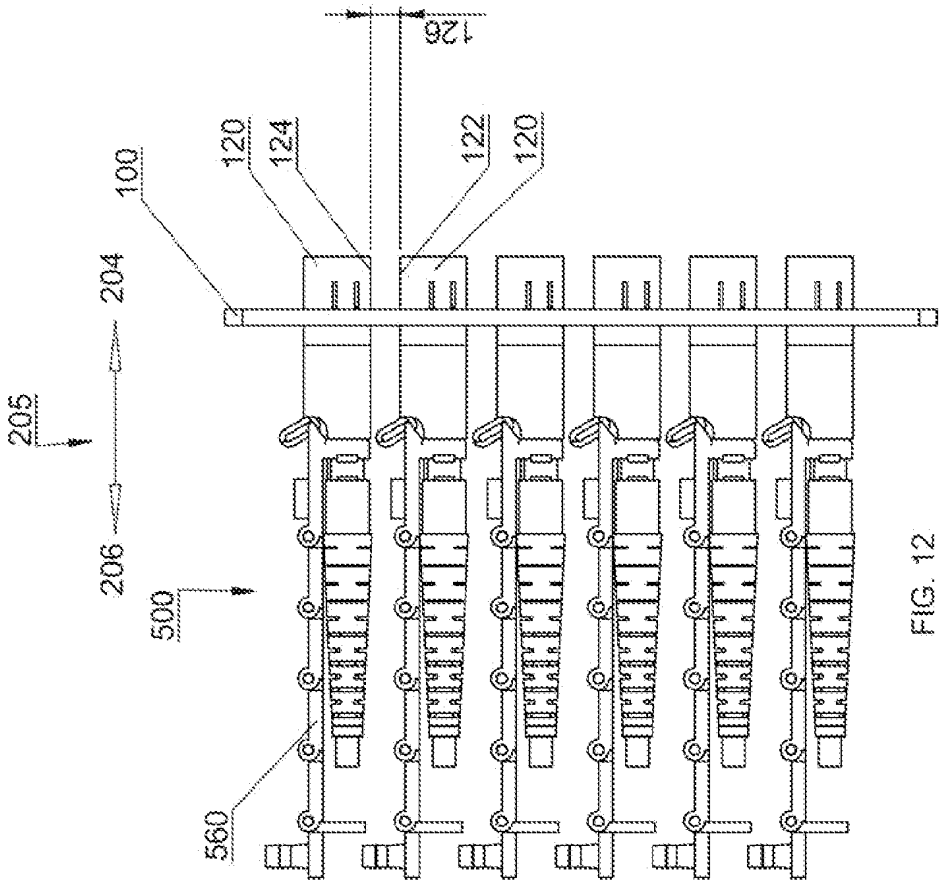


FIG. 12

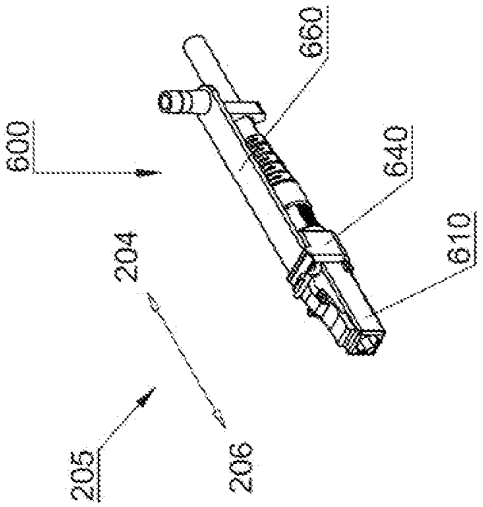


FIG. 13

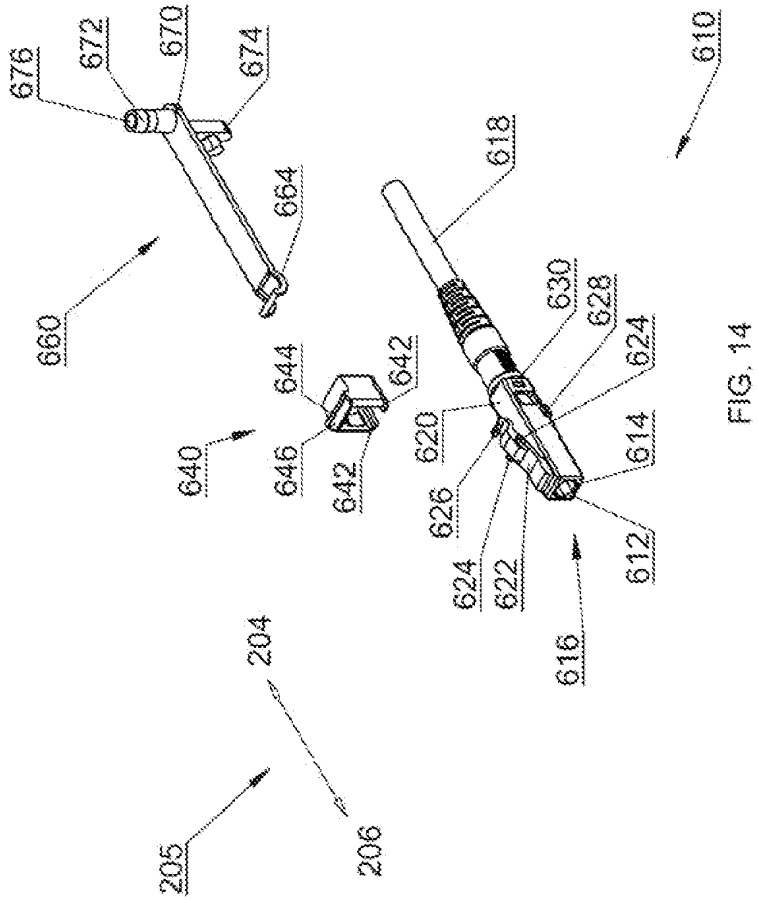

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FIG. 14

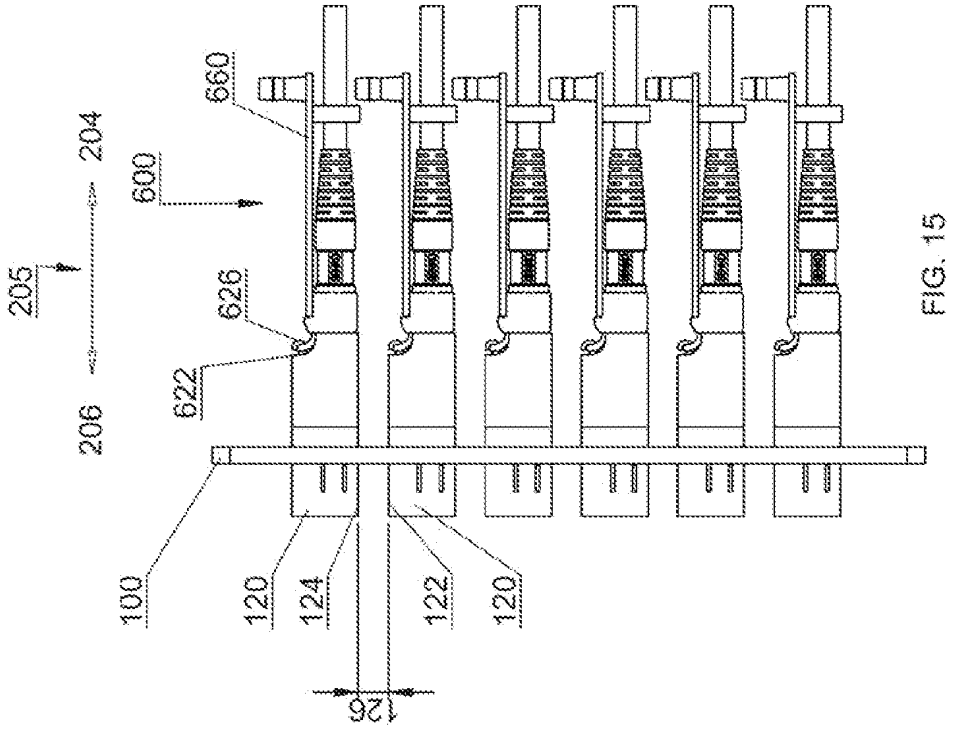


FIG. 15

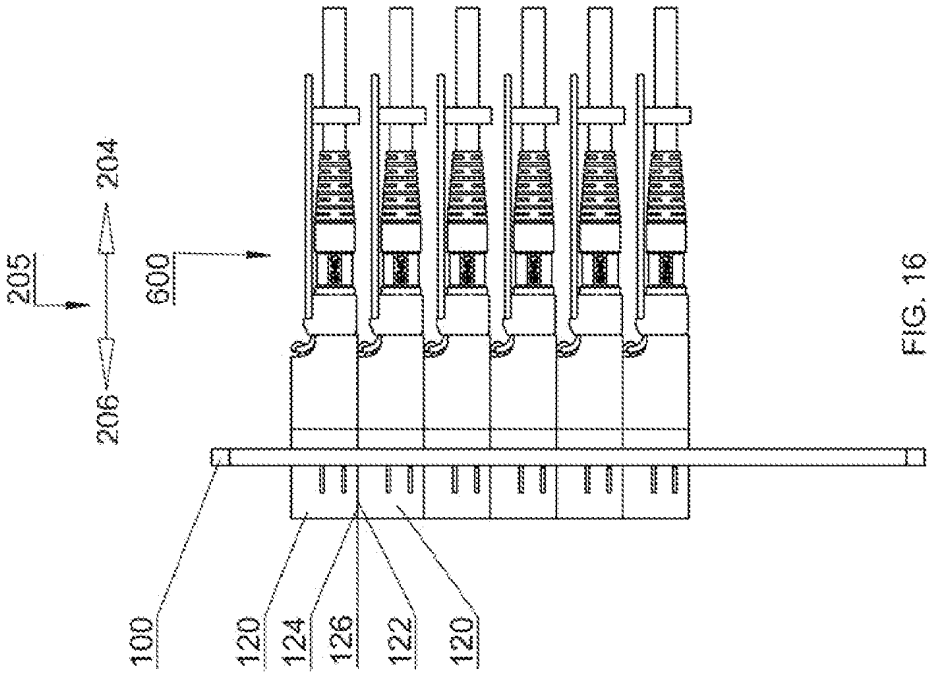


FIG. 16

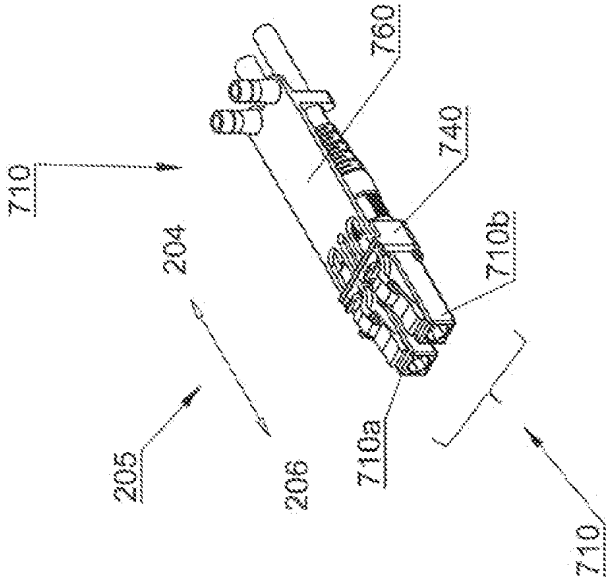


FIG. 17

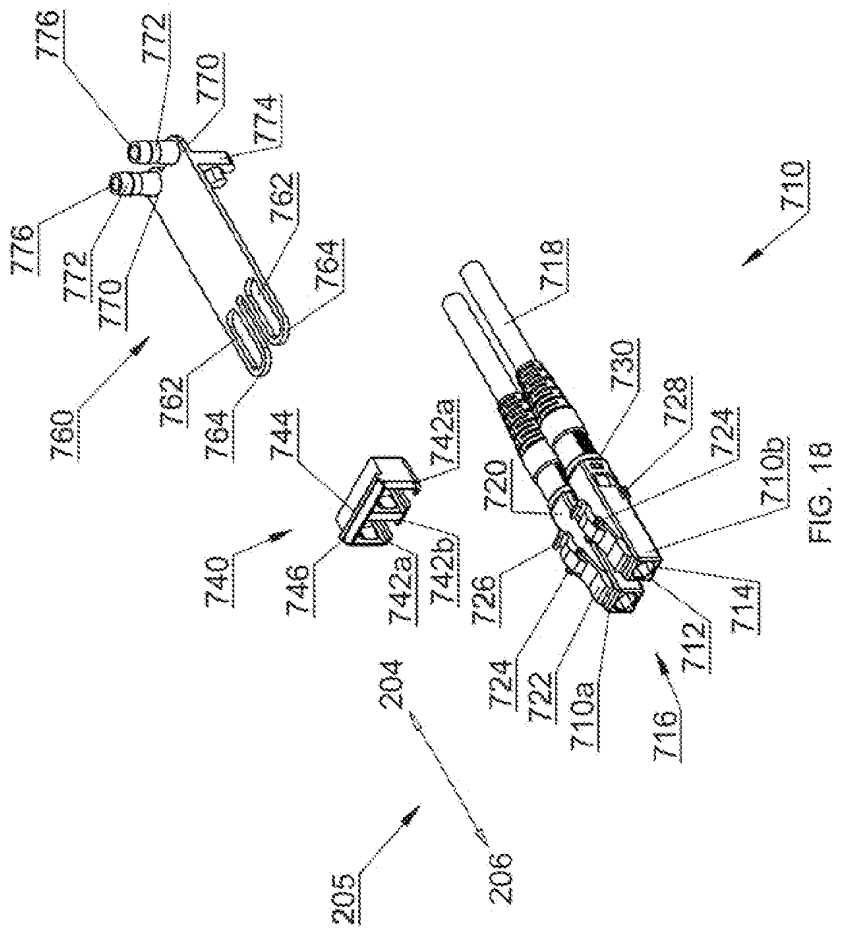

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FIG. 18

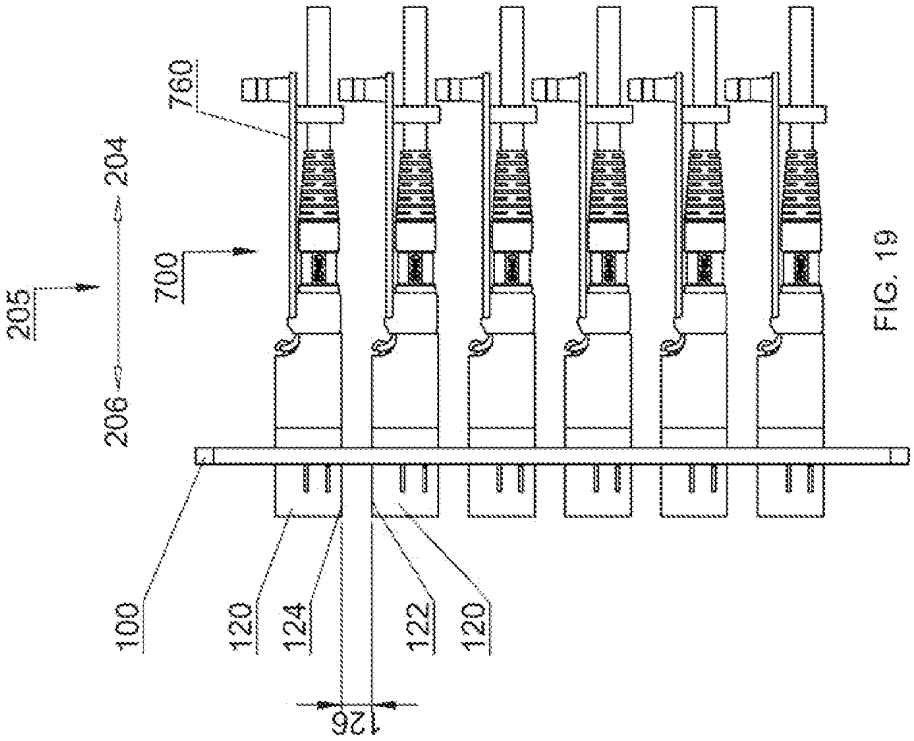


FIG. 19

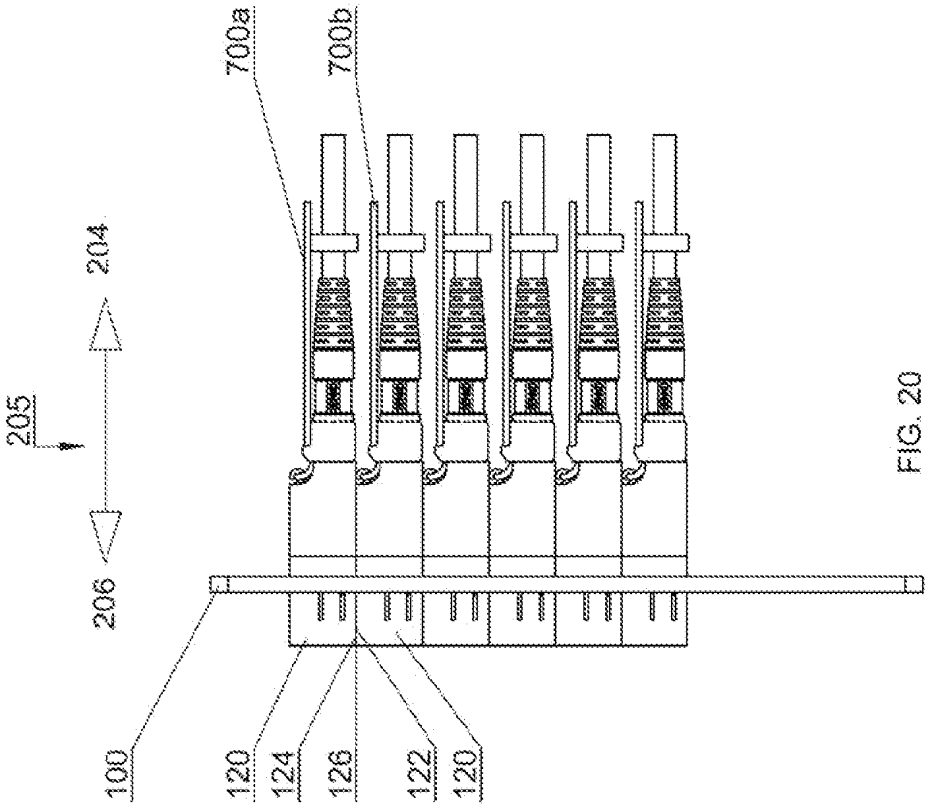


FIG. 20

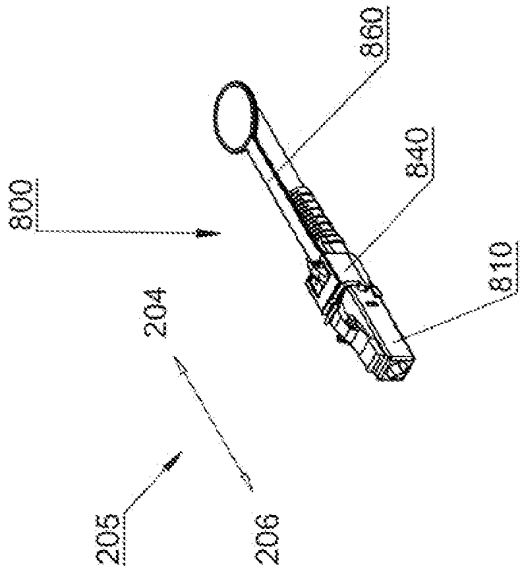


FIG. 21

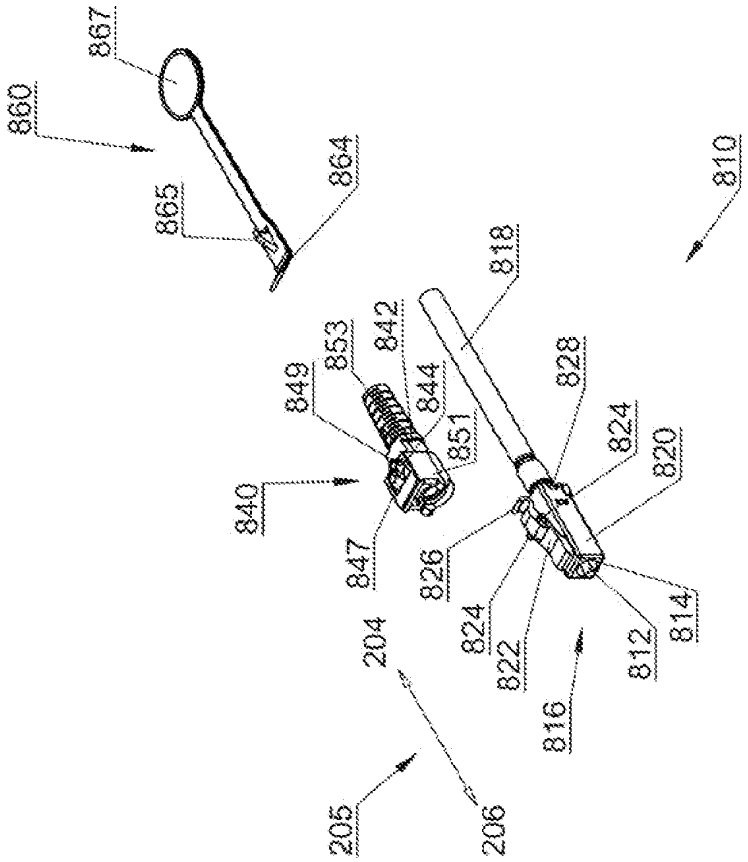

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FIG. 22

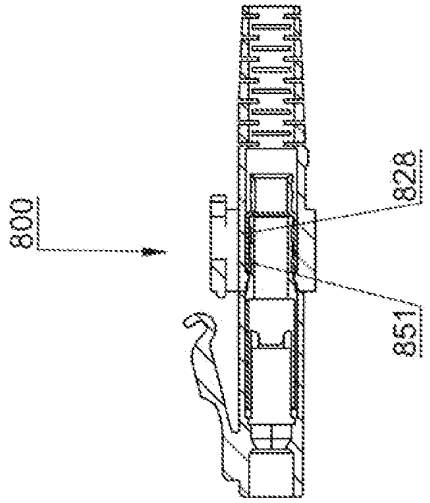


FIG. 23
SECTION VIEW OF 800

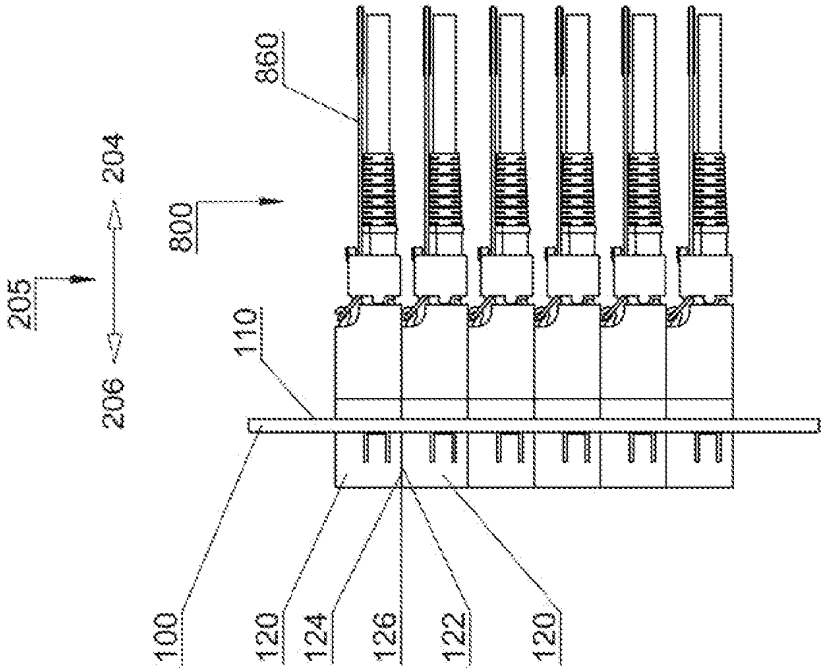


FIG. 24

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 11/58799

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - H01R 13/627 (2012.01)
USPC - 499/352
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)
USPC: 439/352

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
USPC: 439/282, 350, 352, 353, 357, 358, 953 (text search - see terms below)

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
PubWEST(USPT,PGPB,EPAB,JPAB); Google
Search Terms: connector, latch, disengage, lever, extender, multi port, aspect ratio, high, 1.25 mm, 1.25 millimeters, hook, loop, extend, snap, selectively, fiber, LC

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 6,478,472 B1 (ANDERSON et al.) 12 November 2002 (12.11.2002), entire document especially Abstract; Fig 1; col 3, lns 26-28; col 5, lns 19-25	1-2, 4-5, 22 ---------- 3, 6-21, 23-44
X	US 6,854,894 B1 (YUNKER et al.) 15 February 2005 (15.02.2005), entire document especially Fig 5; col 2, lns 13-15; col 6, lns 17-22	45-49
X -- Y	US 2011/0131801 A1 (NELSON) 09 June 2011 (09.06.2011), entire document especially Figs 8 -10; paras [0022], [0027]-[0031]	50 ---------- 6-21, 23-44
Y	US 7,824,113 B2 (WONG et al.) 02 November 2010 (02.11.2010), entire document especially Fig 7	3
Y	US 6,041,155 A (ANDERSON et al.) 21 March 2000 (21.03.2000), entire document especially the Abstract; Fig 13	12, 19, 30, 37, 42
Y	US 2011/0044588 A1 (LARSON et al.) 24 February 2011 (24.02.2011), entire document especially para [0045]	13, 20, 31, 38
Y	US 5,937,130 A (AMBERG et al.) 10 August 1999 (10.08.1999), entire document especially col 2, lns 7-20; col 4, lns 19-21	14-15, 18, 21, 32-33, 39, 41
Y	US 6,551,117 A (POPLAWSKI et al.) 22 April 2003 (22.04.2003), entire document, especially Fig. 10	11, 17, 29, 36

☒ Further documents are listed in the continuation of Box C. ☐

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
21 April 2012 (21.04.2012)	27 APR 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Lee W. Young PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774

Form PCT/ISA/210 (second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 11/58799

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 7,594,766 B1 (SASSER et al.) 29 September 2009 (29.09.2009), entire document	1-50
A	US 5,481,634 A (ANDERSON et al.) 02 January 1996 (02.01.1996), entire document	1-50
A	US 2011/0177710 A1(TOBEY) 21 July 2011 (21.07.2011), entire document	1-50
A	US 2004/0161958 A1 (TOGAMI et al.) 19 August 2004 (19.08.2004), entire document	1-50

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 11/58799

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.:
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:
This application contains the following inventions or groups of inventions which are not so linked as to from a single general inventive concept under PCT Rule 13.1. In order for all inventions to be examined, the appropriate additional examination fees must be paid.

Group I: Claims 1-44 and 50, drawn to a latching connector.
Group II: Claims 45-49, drawn to a high-density panel.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

The technical feature of Group I is a lever connected to the housing, which is not present in Group II.
The technical feature of Group II is a specified distance between a first and second mating connector, which is not present in Group I.

Accordingly, unity of invention is lacking under PCT Rule 13.1.

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 additional fees, this Authority did not invite payment of additional fees.

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.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
20 February 2014 (20.02.2014)

WIPO | PCT

(10) International Publication Number
WO 2014/028527 A2

(51) **International Patent Classification**:
G02B 6/36 (2006.01)

(21) **International Application Number**:
PCT/US2013/054784

(22) **International Filing Date**:
13 August 2013 (13.08.2013)

(25) **Filing Language**: English

(26) **Publication Language**: English

(30) **Priority Data**:
13/587,907 16 August 2012 (16.08.2012) US

(71) **Applicant**: **SENKO ADVANCED COMPONENTS, INC.** [US/US]; 450 Donald Lynch Blvd, Unit D, Marlborough, Massachusetts 01752 (US).

(72) **Inventor**: **CHANG, Jimmy Jun-Fu**; 52 Upland Street, Worcester, Massachusetts 01607 (US).

(74) **Agents**: **McCARTHY, Alison L.** et al.; Pepper Hamilton LLP, Suite 500, 500 Grant Street, Pittsburgh, Pennsylvania 15219-2507 (US).

(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

(84) **Designated States** *(unless otherwise indicated, for every kind of regional protection available)*: ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— *without international search report and to be republished upon receipt of that report (Rule 48.2(g))*

WO 2014/028527 A2

(54) **Title**: FIBER OPTIC CONNECTOR

(57) **Abstract**: A connector for a fiber optic cable is disclosed, as well as a housing therefor, wherein the housing is formed as a single unitary piece to simplify construction and assembly. A ferrule assembly may be configured in conjunction with the housing to provide a retentive coupling between the assembly and the housing upon insertion of the assembly into the housing.

FIBER OPTIC CONNECTOR

BACKGROUND

[0001] The use of fiber optics for communications purposes continues to grow. Data, voice, and other communication networks are increasingly using fiber optics to carry information. In a fiber optic network, each individual fiber is generally connected to both a source and a destination device. Additionally, along the fiber optic run between the source and the destination, various connections or couplings may be made on the optical fiber to adjust the length of the fiber. Each connection or coupling requires a connector and adapter to align the fibers such that the light can transmit without interruption.

[0002] The connector or connectors, in joining fiber ends, for example, has, as its primary function, the maintenance of the ends in a butting relationship such that the core of one of the fibers is axially aligned with the core of the other fiber to maximize light transmissions from one fiber to the other. Another goal is to minimize back reflections. An alignment can be extremely difficult to achieve. A good connection (low insertion loss) of the fiber ends is a function of the alignment, the width of the gap (if any) between the fiber ends, and the surface condition of the fiber ends, all of which, in turn, are inherent in the particular connector design. The connector must also provide stability and junction protection and thus it must minimize thermal and mechanical movement effects. These same considerations apply to arrangements where the fiber, terminated in a plug connector, is to be used with active or passive devices, such as, for example, computers or transceivers and the like.

[0003] There are numerous, different, connector designs in use for achieving low insertion loss and stability. In most of these designs, a pair of ferrules (one in each connector or one in the connector and one in the apparatus or device), each containing an optical fiber

end, are butted together end to end and light travels across the junction. Zero insertion loss requires that the fibers in the ferrules be exactly aligned, a condition that, given the necessity of manufacturing tolerances and cost considerations, can be virtually impossible to achieve, except by fortuitous accident. As a consequence, most connectors are designed to achieve a useful, preferably predictable, degree of alignment.

[0004] Fiber optic connectors can be relatively expensive to produce as numerous parts are required, and each of the parts may require a separate manufacturing process. In addition, an attachment process must be done to connect the parts together. There remains a need for a less expensive connector that is able to also provide a necessary degree of alignment.

SUMMARY

[0005] Presently disclosed is a fiber optic connector which has a reduced number of parts to minimize assembly, and reduce costs associated with the connector.

[0006] In an embodiment, an optical fiber connector includes a housing having a first end for receiving an optical fiber, a second end opposite the first end, and a longitudinal passage extending from the first end to the second end, a ferrule assembly having a ferrule holder and ferrule, the ferrule assembly for being inserted into and disposed within the passage, and longitudinally movable within the passage, the ferrule assembly being configured for retaining an optical fiber therein, and at least one of the housing and the ferrule holder includes a portion for engaging the other of the housing and the ferrule holder for retaining the ferrule assembly within the passage.

[0007] In a further embodiment, the connector includes a resilient member for biasing the ferrule assembly towards the second end of the housing, and at least one of the housing and the ferrule holder includes a portion for engaging the other of the housing and the ferrule

holder for retaining the ferrule assembly within the passage in opposition to the bias of the resilient member.

[0008] In another embodiment, the portion for engaging includes at least one integral projecting portion of the one of the housing and the ferrule holder, and the other of the housing and the ferrule holder includes at least one integral recessed portion for receiving and engaging with corresponding projecting portions.

[0009] In another embodiment, the housing is a one-piece unitary body.

[0010] In another embodiment, the connector further includes a resilient member for being disposed in the passage for biasing the ferrule assembly towards the second end of the housing. In addition, the ferrule holder has a first end for being disposed toward the first end of the housing, and a second end for retaining the ferrule adjacent the second end of the housing, and the ferrule holder includes at least first and second radial projections spaced apart from one another in a circumferential direction about the ferrule holder. The passage includes corresponding recessed portions extending radially outwardly from the passage for receiving and retaining the radial projections therein.

[0011] In another embodiment, the passage, adjacent the second end of the housing, defines a first internal dimension, and the recessed portions define a second internal dimension greater than the first internal dimension. In addition, the radial projections include flanges integral with the ferrule holder and extending radially outwardly adjacent the second end of the ferrule holder to define a first flange position. The flanges in the first flange position define a distance greater than the first internal dimension and corresponding substantially to the second internal dimension. The flanges are radially inwardly displaceable from the first flange position to a second flange position and have a resilience for returning to the first flange position from the second flange position, the flanges in the second flange position define a distance less than the first internal dimension for insertion of the ferrule

holder into and along at least a portion of the passage. The flanges are configured for resiliently returning from the second flange position towards the first flange position within the passage upon insertion into the passage and encountering the recessed portions within the passage.

[0012] In another embodiment, the passage includes a first cylindrical passage portion adjacent the first end of the housing and a second cylindrical passage portion adjacent the second end of the housing. In addition, the first cylindrical passage portion includes a first cylindrical wall defining a first diameter, and the second cylindrical passage portion includes a second cylindrical wall defining a second diameter of the first internal dimension. The first diameter is less than the second diameter, and the passage includes a first spring seat extending radially outwardly from the first cylindrical wall to the second cylindrical wall. The ferrule holder includes a first body portion for being disposed in the first cylindrical passage portion and a second body portion for being disposed within the second cylindrical passage portion. The first body portion has a third diameter less than the first diameter, and the second body portion has a fourth diameter greater than the first and third diameters and less than the second diameter. The ferrule holder includes a second spring seat extending radially outwardly from the first body portion to the second body portion. The resilient member includes a spring for being disposed around the first body portion for engagement between the first spring seat and the second spring seat, and the second body portion includes a substantially cylindrical wall that includes the flanges.

[0013] In another embodiment, the first and second radial projections include first and second flanges spaced apart 180° from one another in a circumferential direction about the ferrule holder. In addition, the corresponding recessed portions include openings extending through the housing from the second cylindrical wall to an exterior of the housing, wherein the openings are defined by a perimetrical wall and at least a first portion of the perimetrical

wall is disposed towards the second end of the housing. The ferrule holder is insertable into the passage in a first longitudinal direction to compress the spring between the first and second spring seats, and the spring is for biasing the ferrule holder in a second longitudinal direction opposite the first longitudinal direction. The first and second flanges are configured to be radially displaceable from the first flange position to the second flange position upon insertion into the passage in the first direction, and the first and second flanges are configured for engaging the first perimetrical wall portions upon movement of the ferrule holder within the passage in the second longitudinal direction under bias of the spring.

[0014] In another embodiment, the first and second flanges have a circumferential dimension, the corresponding recesses have a circumferential dimension, and the circumferential dimension of the flanges and the circumferential dimension of the corresponding recesses are configured with respect to one another for preventing rotation of the ferrule holder within the housing when the ferrule holder is inserted into the housing and the flanges are disposed in the recesses.

[0015] In another embodiment, the passage, adjacent the first end of the housing, defines a first internal dimension, and the recessed portions define a second internal dimension greater than the first internal dimension. In addition, the first end of the ferrule holder includes at least first and second axially extending arms spaced radially from one another, wherein each of the arms has a first end integral with the ferrule holder and a second end disposed axially away from the first end. The radial projections extends radially outwardly adjacent the second end, and the axial arms have a first position wherein the projections define an external dimension greater than the first internal dimension and corresponding substantially to the second internal dimension. The axially extending arms are radially inwardly displaceable from the first position to a second position and have a resilience for returning to the first position from the second position. The projections in the

second arm position define a distance less than the first internal dimension for insertion of the first end of the ferrule holder into and along at least a portion of the passage, and the axially extending arms are configured for resiliently returning from the second position towards the first position within the passage upon insertion into the passage and the projections encountering the recessed portions.

[0016] In another embodiment, the passage includes a first cylindrical passage portion adjacent the first end of the housing and a second cylindrical passage portion adjacent the second end of the housing, wherein the first cylindrical passage portion includes a first cylindrical wall defining a first diameter of the first internal dimension, and the second cylindrical passage portion includes a second cylindrical wall defining a second diameter greater than the first diameter. The first diameter is less than the second diameter, and the passage includes a first spring seat extending radially outwardly from the first cylindrical wall to the second cylindrical wall. The ferrule holder includes a first body portion for being disposed in the first cylindrical passage portion and a second body portion for being disposed within the second cylindrical passage portion, wherein the first body portion has a third diameter which is less than the first diameter, and the second body portion has a fourth diameter greater than the first and third diameters and less than the second diameter. The ferrule holder includes a second spring seat extending radially outwardly from the first body portion to the second body portion, and the resilient member is a spring for being disposed around the first body portion for engagement between the first spring seat and the second spring seat.

[0017] In another embodiment, the at least first and second axially extending arms include first, second, third and fourth axially extending arms disposed at about 90° from an adjacent arm in a circumferential direction about the ferrule holder. In addition, the corresponding recessed portions include one of: an annular enlargement of the first

cylindrical passage portion adjacent the first end of the housing, wherein the annular enlargement defines a ring-shaped surface disposed away from the first housing end towards the second end of the housing; and an end surface of the first housing end, wherein the end surface defining a ring-shaped surface. The first end of the ferrule holder is insertable into the passage in a first longitudinal direction to compress the spring between the first and second spring seats, and the spring is for biasing the ferrule holder in a second longitudinal direction opposite the first longitudinal direction. The first, second, third and fourth axially extending arms are configured to be radially displaceable from the first position to the second position upon insertion into the passage in the first direction. In addition, the projections of the first, second, third and fourth axially extending arms are configured for engaging the ring-shaped surface upon movement of the ferrule holder within the passage in the second longitudinal direction under bias of the spring.

[0018] In another embodiment, one of the ferrule holder and the housing includes an additional radial projection, and the other of the ferrule holder and the housing includes a longitudinal slot for receiving the additional radial projection therein upon insertion of the ferrule holder into the passage to prevent rotational movement of the ferrule body within the passage.

[0019] In another embodiment, the ferrule holder is insertable into the passage through the second end of the housing in a first longitudinal direction, and the housing includes a retainer for being inserted through at least a portion of the housing to block at least a portion of the passage to retain the ferrule holder in the passage after insertion of the ferrule holder into the passage through the second end of the housing.

[0020] In another embodiment, the connector further includes a resilient member for biasing the ferrule holder in the passage towards the second end of the housing; and the

retainer is configured for retaining the ferrule holder in the passage in opposition to the biasing of the resilient member after insertion of the ferrule holder into the passage.

[0021] In another embodiment, the retainer is a U-shaped clip having a base portion with spaced apart legs extending from the base portion, and the housing includes a slot for receipt of the clip therein. In addition, the spaced apart legs are for being inserted into the slot with the ferrule of the ferrule assembly located therebetween, wherein the legs are then disposed for retaining the ferrule holder in the passage in opposition to the biasing of the resilient member.

[0022] In another embodiment, each leg of the clip has a tip portion disposed away from the base of the clip, wherein the tip portions have an outwardly disposed projection extending laterally away from the corresponding tip for engaging with corresponding recesses of the slot to retain the clip in the slot, and each projection has a laterally outward end disposed away from the corresponding tip potion.

[0023] In another embodiment, the spaced apart legs in a first position define a first distance between the laterally outward ends of the tip portions, and the legs are resiliently displaceable in a direction towards one another to a second position wherein the laterally outward ends of the tip portions are disposed a second distance from one another. The second distance is less than the first distance. In addition, the slot includes: an opening in a surface of the housing, a bottom spaced apart from the opening, and first and second ends spaced apart and defining a slot length; a depth dimension into the housing extending from the opening to the bottom of the slot and corresponding to a length of the clip from the base of the clip to the tip portion; and each slot end includes an outwardly disposed recess adjacent the bottom of the slot and defining an edge for engaging with the projection of the tip portion, wherein the slot has a first length dimension extending from the opening to the edge and corresponding to the second distance to displace the legs from the first position to the second

position upon insertion of the clip into the slot. The slot has a second length dimension at the recesses corresponding to the second distance for return of the legs from the second position to the first position when the projections enter the recesses to engage the projections with the edges.

[0024] In another embodiment, the ferrule holder includes a first end for retaining the ferrule therein and a second end opposite the first end for being inserted into the passage through the second end of the housing, and an outer peripheral surface having a longitudinal slot disposed therein extending in a direction from the first end to the second end, and the clip includes a projection for engaging with the longitudinal slot of the ferrule holder for preventing rotation of the ferrule holder within the passage.

[0025] In another embodiment, the base and legs of the clip define a plane, and the clip base includes the projection, wherein the projection extends from the base in a direction transverse to the plane of the clip.

[0026] In an addition embodiment, a one-piece housing for an optical fiber connector is disclosed, wherein the connector has a ferrule assembly for being movably disposed within the housing under bias of a resilient member, and the housing includes a one-piece unitary body having a first end and a second end opposite the first end, a longitudinal passage extending from the first end to the second end for receipt of the ferrule assembly therein, and at least one of the body and the ferrule assembly includes a portion for engaging the other of the housing and the ferrule assembly for retaining the ferrule assembly within the passage in opposition to the bias of the resilient member.

[0027] In a further embodiment, the portion for engaging includes at least one integral projecting portion of the one of the housing and the ferrule holder, and the other of the housing and the ferrule holder includes at least one recessed portion for receiving and engaging with corresponding projecting portions.

[0028] In a further embodiment, the housing includes the at least one recessed portion disposed within the passage and extending radially outwardly from the passage for receiving and retaining radial projections of a ferrule holder therein.

BRIEF DESCRIPTION OF THE FIGURES

[0029] FIG. 1A-1C depict end, cross-sectional and expanded views of a fiber optic connector assembly according to an embodiment.

[0030] FIG. 2 depicts a connector housing according to an embodiment.

[0031] FIGS. 3A-3C depict end, cross-sectional and expanded views of a one-piece connector housing according to an embodiment.

[0032] FIGS. 4A-4D depict end, cross-sectional and expanded views of a one-piece connector housing according to an embodiment.

[0033] FIGS. 5A-5D depict end, cross-sectional and expanded views of a one-piece connector housing according to an embodiment.

[0034] FIGS. 6A-6B depict an alternate configuration of a one-piece connector housing according to an embodiment.

DETAILED DESCRIPTION

[0035] Optical fibers are used in a wide variety of applications, including the telecommunications industry in which optical fibers are employed in a number of telephony and data transmission applications. The variety of applications in which optical fibers are used are continuing to increase, due, at least in part, to the extremely wide bandwidth and the low noise operation provided by optical fibers. For example, optical fibers no longer serve as merely a medium for long distance signal transmission, but are being increasingly routed directly to the home for computer and television transmissions. With the ever increasing and

varied use of optical fibers, it is apparent that efficient and inexpensive methods of coupling optical fibers, such as to other optical fibers, or to various remote terminals, is needed.

[0036] One type of connector in accordance with an embodiment of the invention is shown in FIGS. 1A-1C. While the figures generally relate to SC-type connectors, all of the aspects presented herein may also apply to LC-type connectors and other types of connectors as well. A connector **100** may have a single-piece housing **110**, a ferrule holder **114**, a ferrule **116**, and a resilient member **120**. The housing **110** may generally be viewed as having two housing parts, a main housing body **110a**, and a housing tailpiece **110b**. In an embodiment, and as discussed in more detail below, the housing **110** may be formed in a single integral piece.

[0037] The housing **110** has a first end **135**, which may be the connection end, and a second end **136**, which may be the cable receiving end for receiving a fiber optic cable **140.** The housing also includes a passage **144** extending between the first end **135** and second end **136** with a first passage portion **144a** disposed towards the first end and a second passage portion **144b** disposed towards the second end. The ferrule holder **114**, ferrule **116** and resilient member **120** may be positioned in the passage for longitudinal displacement therewithin. The housing passage **144** may have a shoulder **150** located at an intermediate position within the passage. The shoulder **150** may provide a seat for seating and positioning the spring element **120** within the passage **144**. Resilient member **120** may be a coil spring, as shown, or may be any type of biasing device which is capable of instilling a biasing force to bias the ferrule holder **114** and ferrule **116** in a direction towards the first end **135**.

[0038] Housing tailpiece **110b** extends rearward from housing body **110** and terminates at the housing second end **136**. Housing tailpiece **110b** may further include surface gripping features, such as grooves **155**, for retaining strength members **158** of the optical cable **140**. The strength members **158** may be arimid yarns, such as Kevlar®, in a

layer beneath the cable jacket **160** of the cable **140**. If the connector **100** is to be attached to an optical fiber cable **140** having strength members **158**, the strength members may be exposed by removing a portion of the cable jacket **160**. The strength members **158** may then be placed over the gripping features **155** of housing tailpiece **110b** and a clamping element, such as a crimp ring **130,** may be crimped about the housing tailpiece, thereby capturing the strength members between the tailpiece and the clamping element. The gripping features **155** effectively increase the surface area of the tailpiece **110b** beneath the clamping element **130**, and aid in attaching the strength members **158** to housing **110**. Although the gripping features in FIG. 1 are depicted as grooves **155**, the gripping features may be other surface features such as, for example, ridges or dimples.

[0039] A boot **170** may be mounted on housing **110** in a manner which encircles the tailpiece **110b** and crimp ring **130**. The boot **170** may have a projecting lip **172** which fits into a groove **175** formed between the crimp ring **130** and the housing body **100a**. A sleeve **178** may be disposed about the housing **110** and boot **170** to retain the lip **172** of the boot in the notch **175** and prevent the boot from moving off of the tailpiece **110b**. Other complementary mating features and components may also be used for retaining the boot **170** on the housing **110**, such as, for example, an additional crimping ring similar to the ring **130**.

[0040] Depending on the final desired usage of the connector **100**, a housing **210** may include additional features such as keying features, which may be chamfered corners **278** as depicted in FIG. 2, or a latching mechanism, such as a latching arm **280** for retaining the connector in its receiving component once inserted therein. In general, a latching arm **280** may include an attachment end **282** attached to housing body **210a** and a cantilevered distal end **284** projecting away from the housing body. The latching arm **280** may also include latching lugs **286** for securing the housing **210** within an adapter for mating the connector to another connector, or to a fiber optic module. Latching arm **280** may be sufficiently resilient

to allow the latching arm to be depressed, thereby deflecting distal end **284** toward housing body **210a**. Such a latching arm may also be integrally molded with the housing **210** to maintain an integral one-piece housing component. The depicted latching arm is meant as an example only, and other configurations of latching arms may also be provided.

[0041] In an embodiment, the housing **110** may be formed in a single piece, for example, by injection molding. Materials for use in construction of the housing **110** may include various polymers, plastics, metals, glass, and other similar suitable materials. As an example, the housing **110** may be manufactured via a plastic injection molding process. Alternatively, the housing **110** may be manufactured from a suitable metal or other solid material via a milling process. Additional materials and manufacturing methods may also be used. By forming a housing as a single piece, the cost of the housing may be reduced by eliminating parts and assembly steps.

[0042] FIGS. 3A-3C depict an embodiment of a housing **310** which may be used in the connector **100** of FIGS. 1A-1C. A one-piece housing **310** may have a main body section **310A** and a tailpiece section **310b**. A longitudinal passage **344** is disposed within the housing for receipt of a resilient member, such as spring **320**, and ferrule assembly (ferrule **316** and ferrule holder **314**) therein. The ferrule assembly is longitudinally movable within the passage **344**. Within the passage **344** there may be a seat **350** to provide a surface against which the resilient member **320** can press to provide a bias to the ferrule holder **314** to bias the ferrule **316** outwardly. In an assembled configuration as shown in FIG. 3B, the resilient member **320** may be in a compressed state to provide the bias for the ferrule **314**.

[0043] For assembly, the resilient member **320** may be inserted into the passage **344**, followed by the ferrule assembly. Or alternatively, the resilient member **320** may be inserted over the ferrule holder end **314b**, and the resilient member and ferrule assembly may be inserted simultaneously into the passage **344**. The ferrule holder **314** may be formed with

integral protruding extensions **315** that extend radially from the holder head **314a**. The housing body **310** may have corresponding guide grooves **317** for receipt of the extension **315** therein during insertion of the holder **314** into the passage **344**. The guide grooves may terminate at openings **319**. The extensions **315** may be resiliently compressible in a radially inward direction to allow the holder **314** to be inserted into the passage **344**.

[0044] Holder **314** is movable longitudinally into the passage **344** with minimal resistance until the resilient member **320** is engaged between the seat **350** and the head portion **314a** of the holder **314**. At this engagement location, the extensions **315** will be pressed radially inwardly within the passage **344**. By applying a pressure to force the ferrule assembly further into the passage **344**, the resilient member **320** will compress allowing holder **314** to move further into the passage wherein the extensions **315** will move into the openings **319** and return radially outwardly to their original, non-compressed, configuration. The applied pressure to move the ferrule assembly further into the passage may then be released, and with the extensions **315** disposed in the openings **319** as shown in FIG. 3B, the leading edge of the extensions will engage the forward edge **318** of the openings to thereby retain the holder **314** within the passage **344** against the pressure of the resilient member **320**. Extensions **315**, along with guide grooves **317** and openings **319** may be configured to prevent, or at least minimize rotation of the holder **314**, and attached ferrule **316**, within the housing **310**.

[0045] In an alternative configuration, openings **319** may be indentations in the circumferential wall of the passage **344** and may not extend completely from the passage through the housing. Further, while two extensions **315**, two grooves **317** and two openings **319** are shown at a 180° offset, additional embodiments may include more than two extensions with corresponding grooves and openings (or indentations). For example, possibly three extensions **315** with corresponding indentations **319** at about 120° offsets, or

four extensions with corresponding indentations/openings at about 90° offsets. An embodiment may also not include guide grooves **317**, wherein the circumferential wall of the passage **344** may radially compress the extensions **315** until the openings are reached.

[0046] FIGS. 4A-4D illustrate an additional embodiment of a one-piece housing **410** which may be used in the connector **100** of FIGS. 1A-1C. Similar to the earlier embodiment of FIGS. 3A-3C, a one-piece housing **410** may have a main body section **410A** and a tailpiece section **410b**. A longitudinal passage **444**, with a first passage portion **444a** and a second passage portion **444b**, is disposed within the housing **410** for receipt of a resilient member **420**, such as a spring, and ferrule assembly (ferrule **416** and ferrule holder **414**) therein. The ferrule assembly is longitudinally movable within the passage **444**. Within the passage **444** there may be a seat **450** to provide a surface against which the resilient member **420** can press to provide a bias to the ferrule holder **414** to bias the ferrule **416** outwardly. In an assembled configuration as shown in FIG. 4B, the resilient member **420** may be in a compressed state to provide the bias for the ferrule **414**.

[0047] For assembly, the resilient member **420** may be inserted into the passage **444**, followed by the ferrule assembly. Or alternatively, the resilient member **420** may be inserted over the ferrule holder **414**, and the resilient member and ferrule assembly may be inserted simultaneously into the passage **444**. The ferrule holder **414** may be formed with integral protruding guide members **403** that extend radially from the holder head portion **414a**. The housing body **410** may have corresponding guide grooves **405** for receipt of the guides **403** therein during insertion of the holder **414** into the passage **444**.

[0048] In addition, the end **414b** of the ferrule holder **414** may include radially displaceable flanges **407** which may be forced radially inwardly, but which have a resiliency to return to their non-compressed, natural state. The flanges **407** may include a protruding edge **408** which will define a larger diameter than a diameter of the tubular portion forming

the end **414b**. The passage portion **444b** may be configured to have a diameter that is greater than the diameter of the tubular portion of the end **414b** but less than the diameter at the edges **408**. Upon insertion of the end **414b** into the passage portion **444b** the flanges **407** will be radially inwardly diverted to reduce the diameter the edges **408** to allow the holder end **414b** to be inserted through the passage portion **444b**.

[0049] Holder **414** will be movable longitudinally into the passage **444** with minimal resistance until the resilient member **420** is engaged between the seat **450** and the head portion **414a** of the holder **414**. At this engagement location, the flanges **407** will be pressed radially inwardly within the passage **444b**. By applying additional pressure to force the ferrule assembly further into the passage **444**, the resilient member **420** will compress allowing holder **414** to move further into the passage wherein the ridges **408** will move past the edges **401** in the housing tail portion **410b**, at which point the diameter of the passage **444b** increases, allowing the flanges **407** to return radially outwardly to their original, non-compressed, configuration. The applied pressure to move the ferrule assembly further into the passage may then be released, and with the ridges **408** disposed beyond the edges **401** as shown in FIG. 4B, the ridges **408** will engage the edge **401** to thereby retain the holder **414** within the passage **444** against the pressure of the resilient member **420**. Guides **403**, along with guide grooves **405** may be configured to prevent, or at least minimize rotation of the holder **414**, and attached ferrule **416**, within the housing **410**.

[0050] In an alternative configuration, as depicted in FIG. 4D, edges **401** in the circumferential wall of the passage **444b** may be formed by the end **436** of the housing tail piece **410b**. Further, while four flanges **407** are shown separated by dividing slots **409**, larger spaces may define the dividing slots, and additional embodiments may possibly include only two or three flanges, or alternatively, more than four flanges. In an embodiment similar to that of FIGS. 4A-4C, possibly only two opposing ones of the flanges **407** may be present, and

there may only be space therebetween (the space which is shown in FIGS. 4A-4C as occupied by the other two opposing flanges). An additional embodiment may also not include guide grooves **405** and projections **403**, but may have an alternative arrangement for substantially preventing rotation of the ferrule holder **414** in the housing **410**. Such an arrangement, for example, may be a pin-shaped projection of the inner wall in the tail piece **410b** which engages in a slot **409**.

[0051] FIGS. 5A-5C illustrate an additional embodiment of a one-piece housing **510** which may be used in the connector **100** of FIGS. 1A-1C. Similar to the earlier embodiments, a one-piece housing **510** may have a main body section **510A** and a tailpiece section **510b**. A longitudinal passage **544**, with a first passage portion **544a** and a second passage portion **544b**, is disposed within the housing **510** for receipt of a resilient member **520**, such as a spring, and ferrule assembly (ferrule **516** and ferrule holder **514**) therein. The ferrule assembly is longitudinally movable within the passage **544**. Within the passage **544** there may be a seat **550** to provide a surface against which the resilient member **520** can press to provide a bias to the ferrule holder **514** to bias the ferrule **516** outwardly. In an assembled configuration as shown in FIG. 5B, the resilient member **520** may be in a compressed state to provide the bias for the ferrule **514**.

[0052] For assembly, the resilient member **520** may be inserted into the passage **544**, followed by the ferrule assembly. Or alternatively, the resilient member **520** may be inserted over the ferrule holder end **514b**, and the resilient member and ferrule assembly may be inserted simultaneously into the passage **544**. The head **514a** of the ferrule holder **514** may be formed with integral protruding guide members **527** that extend radially from the head portion and which are separated by depressions **528**. The outer diameter at the members **527** may correspond to the inner diameter of the passage portion **544a** for radially centering the ferrule in the passage **544.**

[0053] Holder **514** will be movable longitudinally into the passage **544** with minimal resistance until the resilient member **520** is engaged between the seat **550** and the head portion **514a** of the holder **514**. At this position, the front face **526** will not have yet been pushed past the slot **524**. By applying additional pressure to force the ferrule assembly further into the passage **544**, the resilient member **520** will compress, allowing holder **514** to move further into the passage wherein the face **526** will be moved past the slot **524**. A clip **522** may then be inserted into the slot **524** to block at least a portion of the passage **544** to hold the ferrule holder **514** within the passage. The applied pressure to move the ferrule assembly further into the passage may then be released, and with the clip **522** disposed in the slot **524** as shown in FIG. 5B, the front face **526** of the ferrule head portion **514a** will engage the clip to thereby retain the holder **514** within the passage **544** against the pressure of the resilient member **520**.

[0054] As shown in FIGS. 5A and 5B, to prevent, or minimize rotation of the ferrule assembly **514** and attached ferrule **516** within the housing **510**, the clip **522** may have a protruding tab **522b** which extends into and engages in a depression **528** between two of the guides **527**. Alternatively, the internal wall of the passage **544** may include at least one projection which extends into at least one of the depressions **528**.

[0055] In an embodiment as depicted in FIGS. 5C and 5D, the clip **522** may be substantially U-shaped with two projecting legs **522a** which are spaced apart a sufficient distance to permit the ferrule **516** to fit therebetween as shown in greater detail in FIG. 5D. The ends of the legs **522a** may be configured with a projecting edge **522c** that is configured for engaging with a ledge **524c** in the slot **524** to thereby retain the clip in the slot. Upon insertion of the clip **522** into the slot **524** the legs **522a** deflect slightly inwardly towards one another until the clip is fully inserted into the slot as shown in FIG. 5D, wherein the legs may return to their natural position with the edges **522c** engaged with the ledges **524c**. Because of

the configuration of the projecting guide members **527** and depressions **528**, if the ferrule holder **514** is not aligned correctly for receipt of the tab **522b** into a depression **528** the tab will contact the guide member **527** and the clip will not be able to be inserted fully into the slot **524** for engagement of the edges **522c** with the ledges **524c**.

[0056] Alternate embodiments of clip/retaining configurations and rotation prevention configurations may also be provided for such a housing. For example, a housing may be configured for receipt of two individual pins which may be used in place of the legs **522a** of the clip **522**. In addition, various embodiments as presented herein may be used in combination with others of the embodiment. For example, the extensions **315** of FIGS. 3a-3c may be used in conjunction with the flanges **407** of FIGS. 4a-4c whereby if one part were to possibly malfunction a second retention mechanism would still be in place to retain the ferrule assembly in the housing.

[0057] In a further embodiment as schematically depicted in FIGS. 6A and 6B, instead of the ferrule holder having a portion which is displaceable radially inwardly by the housing upon insertion into the housing, a housing **610** may have opposing wall portions **660** (one shown) which are displaceable radially outwardly upon insertion of a ferrule holder **614** into the housing. The housing wall portion **660** may be defined by slits **661** and being separated from the main housing portion, may be deflectable outwardly to allow the ferrule holder **614** to pass through the opening **644**. The wall portion **660** will have a resiliency to return to its original location once the ferrule holder **614** has passed as represented schematically in FIG. 6, so that a projection **662** on the inside of the wall portion will then engage the edge **614c** of the ferrule holder and hold the ferrule assembly in the housing **610** against the pressure of the resilient member **620**. As in others of the embodiment, a configuration may also be provided to prevent rotation, such a key and slot configuration (403, 405) is shown in FIG. 4C.

[0058] This disclosure is not limited to the particular systems, devices and methods described, as these may vary. The terminology used in the description is for the purpose of describing the particular versions or embodiments only, and is not intended to limit the scope.

[0059] In the above detailed description, reference is made to the accompanying drawings, which form a part hereof. In the drawings, similar symbols typically identify similar components, unless context dictates otherwise. The illustrative embodiments described in the detailed description, drawings, and claims are not meant to be limiting. Other embodiments may be used, and other changes may be made, without departing from the spirit or scope of the subject matter presented herein. It will be readily understood that the aspects of the present disclosure, as generally described herein, and illustrated in the figures, can be arranged, substituted, combined, separated, and designed in a wide variety of different configurations, all of which are explicitly contemplated herein.

[0060] The present disclosure is not to be limited in terms of the particular embodiments described in this application, which are intended as illustrations of various aspects. Many modifications and variations can be made without departing from its spirit and scope, as will be apparent to those skilled in the art. Functionally equivalent methods and apparatuses within the scope of the disclosure, in addition to those enumerated herein, will be apparent to those skilled in the art from the foregoing descriptions. Such modifications and variations are intended to fall within the scope of the appended claims. The present disclosure is to be limited only by the terms of the appended claims, along with the full scope of equivalents to which such claims are entitled. It is to be understood that this disclosure is not limited to particular methods, reagents, compounds, compositions or biological systems, which can, of course, vary. It is also to be understood that the terminology used herein is for the purpose of describing particular embodiments only, and is not intended to be limiting.

[0061] As used in this document, the singular forms "a," "an," and "the" include plural references unless the context clearly dictates otherwise. Unless defined otherwise, all technical and scientific terms used herein have the same meanings as commonly understood by one of ordinary skill in the art. Nothing in this disclosure is to be construed as an admission that the embodiments described in this disclosure are not entitled to antedate such disclosure by virtue of prior invention. As used in this document, the term "comprising" means "including, but not limited to."

[0062] While various compositions, methods, and devices are described in terms of "comprising" various components or steps (interpreted as meaning "including, but not limited to"), the compositions, methods, and devices can also "consist essentially of" or "consist of" the various components and steps, and such terminology should be interpreted as defining essentially closed-member groups.

[0063] With respect to the use of substantially any plural and/or singular terms herein, those having skill in the art can translate from the plural to the singular and/or from the singular to the plural as is appropriate to the context and/or application. The various singular/plural permutations may be expressly set forth herein for sake of clarity.

[0064] It will be understood by those within the art that, in general, terms used herein, and especially in the appended claims (*e.g.*, bodies of the appended claims) are generally intended as "open" terms (*e.g.*, the term "including" should be interpreted as "including but not limited to," the term "having" should be interpreted as "having at least," the term "includes" should be interpreted as "includes but is not limited to," etc.). It will be further understood by those within the art that if a specific number of an introduced claim recitation is intended, such an intent will be explicitly recited in the claim, and in the absence of such recitation no such intent is present. For example, as an aid to understanding, the following appended claims may contain usage of the introductory phrases "at least one" and "one or

more" to introduce claim recitations. However, the use of such phrases should not be construed to imply that the introduction of a claim recitation by the indefinite articles "a" or "an" limits any particular claim containing such introduced claim recitation to embodiments containing only one such recitation, even when the same claim includes the introductory phrases "one or more" or "at least one" and indefinite articles such as "a" or "an" (*e.g.*, "a" and/or "an" should be interpreted to mean "at least one" or "one or more"); the same holds true for the use of definite articles used to introduce claim recitations. In addition, even if a specific number of an introduced claim recitation is explicitly recited, those skilled in the art will recognize that such recitation should be interpreted to mean at least the recited number (*e.g.*, the bare recitation of "two recitations," without other modifiers, means at least two recitations, or two or more recitations). Furthermore, in those instances where a convention analogous to "at least one of A, B, and C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (*e.g.*, " a system having at least one of A, B, and C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). In those instances where a convention analogous to "at least one of A, B, or C, etc." is used, in general such a construction is intended in the sense one having skill in the art would understand the convention (*e.g.*, " a system having at least one of A, B, or C" would include but not be limited to systems that have A alone, B alone, C alone, A and B together, A and C together, B and C together, and/or A, B, and C together, etc.). It will be further understood by those within the art that virtually any disjunctive word and/or phrase presenting two or more alternative terms, whether in the description, claims, or drawings, should be understood to contemplate the possibilities of including one of the terms, either of the terms, or both terms. For example, the phrase "A or B" will be understood to include the possibilities of "A" or "B" or "A and B."

[0065] In addition, where features or aspects of the disclosure are described in terms of Markush groups, those skilled in the art will recognize that the disclosure is also thereby described in terms of any individual member or subgroup of members of the Markush group.

[0066] As will be understood by one skilled in the art, for any and all purposes, such as in terms of providing a written description, all ranges disclosed herein also encompass any and all possible subranges and combinations of subranges thereof. Any listed range can be easily recognized as sufficiently describing and enabling the same range being broken down into at least equal halves, thirds, quarters, fifths, tenths, etc. As a non-limiting example, each range discussed herein can be readily broken down into a lower third, middle third and upper third, etc. As will also be understood by one skilled in the art all language such as "up to," "at least," and the like include the number recited and refer to ranges which can be subsequently broken down into subranges as discussed above. Finally, as will be understood by one skilled in the art, a range includes each individual member. Thus, for example, a group having 1-3 cells refers to groups having 1, 2, or 3 cells. Similarly, a group having 1-5 cells refers to groups having 1, 2, 3, 4, or 5 cells, and so forth.

[0067] Various of the above-disclosed and other features and functions, or alternatives thereof, may be combined into many other different systems or applications. Various presently unforeseen or unanticipated alternatives, modifications, variations or improvements therein may be subsequently made by those skilled in the art, each of which is also intended to be encompassed by the disclosed embodiments.

CLAIMS

What Is Claimed Is:

1. An optical fiber connector comprising:

a housing having a first end for receiving an optical fiber, a second end opposite the first end, and a longitudinal passage extending from the first end to the second end;

a ferrule assembly comprising a ferrule holder and ferrule, the ferrule assembly for being inserted into and disposed within the passage, and longitudinally movable within the passage, the ferrule assembly being configured for retaining an optical fiber therein; and

at least one of the housing and the ferrule holder comprising a portion for engaging the other of the housing and the ferrule holder for retaining the ferrule assembly within the passage.

2. The connector of claim 1, further comprising:

a resilient member for biasing the ferrule assembly towards the second end of the housing; and

at least one of the housing and the ferrule holder comprising a portion for engaging the other of the housing and the ferrule holder for retaining the ferrule assembly within the passage in opposition to the bias of the resilient member.

3. The connector of claim 1, wherein the portion for engaging comprises at least one integral projecting portion of the one of the housing and the ferrule holder, and the other of the housing and the ferrule holder comprises at least one integral recessed portion for receiving and engaging with corresponding projecting portions.

4. The connector of claim 1, wherein the housing comprises a one-piece unitary body.

5. The connector of claim 4, wherein:

the connector further comprises a resilient member for being disposed in the passage for biasing the ferrule assembly towards the second end of the housing;

the ferrule holder has a first end for being disposed toward the first end of the housing, and a second end for retaining the ferrule adjacent the second end of the housing;

the ferrule holder comprises at least first and second radial projections spaced apart from one another in a circumferential direction about the ferrule holder; and

the passage comprises corresponding recessed portions extending radially outwardly from the passage for receiving and retaining the radial projections therein.

6. The connector of claim 5, wherein:

the passage, adjacent the second end of the housing, defines a first internal dimension, and the recessed portions define a second internal dimension greater than the first internal dimension;

the radial projections comprise flanges integral with the ferrule holder and extending radially outwardly adjacent the second end of the ferrule holder to define a first flange position, the flanges in the first flange position define a distance greater than the first internal dimension and corresponding substantially to the second internal dimension;

the flanges are radially inwardly displaceable from the first flange position to a second flange position and have a resilience for returning to the first flange position from the second flange position, the flanges in the second flange position define a distance less than the first internal dimension for insertion of the ferrule holder into and along at least a portion of the passage; and

the flanges are configured for resiliently returning from the second flange position towards the first flange position within the passage upon insertion into the passage and encountering the recessed portions within the passage.

7. The connector of claim 6, wherein:

the passage comprises a first cylindrical passage portion adjacent the first end of the housing and a second cylindrical passage portion adjacent the second end of the housing, the first cylindrical passage portion comprises a first cylindrical wall defining a first diameter, the second cylindrical passage portion comprises a second cylindrical wall defining a second diameter of the first internal dimension, the first diameter being less than the second diameter, and the passage comprises a first spring seat extending radially outwardly from the first cylindrical wall to the second cylindrical wall;

the ferrule holder comprises a first body portion for being disposed in the first cylindrical passage portion and a second body portion for being disposed within the second cylindrical passage portion, the first body portion having a third diameter less than the first diameter, the second body portion having a fourth diameter greater than the first and third diameters and less than the second diameter, and the ferrule holder comprises a second spring seat extending radially outwardly from the first body portion to the second body portion;

the resilient member comprises a spring for being disposed around the first body portion for engagement between the first spring seat and the second spring seat; and

the second body portion comprises a substantially cylindrical wall comprising the flanges.

8. The connector of claim 7, wherein:

the first and second radial projections comprise first and second flanges spaced apart 180° from one another in a circumferential direction about the ferrule holder;

the corresponding recessed portions comprise openings extending through the housing from the second cylindrical wall to an exterior of the housing, the openings being defined by a perimetrical wall and at least a first portion of the perimetrical wall is disposed towards the second end of the housing;

the ferrule holder is insertable into the passage in a first longitudinal direction to compress the spring between the first and second spring seats, the spring being for biasing the ferrule holder in a second longitudinal direction opposite the first longitudinal direction;

the first and second flanges are configured to be radially displaceable from the first flange position to the second flange position upon insertion into the passage in the first direction; and

the first and second flanges are configured for engaging the first perimetrical wall portions upon movement of the ferrule holder within the passage in the second longitudinal direction under bias of the spring.

9. The connector of claim 8, wherein the first and second flanges have a circumferential dimension and the corresponding recesses have a circumferential dimension, and the circumferential dimension of the flanges and the circumferential dimension of the corresponding recesses are configured with respect to one another for preventing rotation of the ferrule holder within the housing when the ferrule holder is inserted into the housing and the flanges are disposed in the recesses.

10. The connector of claim 5, wherein:

the passage, adjacent the first end of the housing, defines a first internal dimension, and the recessed portions define a second internal dimension greater than the first internal dimension;

the first end of the ferrule holder comprises at least first and second axially extending arms spaced radially from one another, each of the arms having a first end integral with the ferrule holder and a second end disposed axially away from the first end, the radial projections extending radially outwardly adjacent the second end, and the axial arms having a

first position wherein the projections define an external dimension greater than the first internal dimension and corresponding substantially to the second internal dimension;

the axially extending arms are radially inwardly displaceable from the first position to a second position and have a resilience for returning to the first position from the second position, the projections in the second arm position define a distance less than the first internal dimension for insertion of the first end of the ferrule holder into and along at least a portion of the passage; and

the axially extending arms are configured for resiliently returning from the second position towards the first position within the passage upon insertion into the passage and the projections encountering the recessed portions.

11. The connector of claim 10, wherein:

the passage comprises a first cylindrical passage portion adjacent the first end of the housing and a second cylindrical passage portion adjacent the second end of the housing, the first cylindrical passage portion comprises a first cylindrical wall defining a first diameter of the first internal dimension, the second cylindrical passage portion comprises a second cylindrical wall defining a second diameter greater than the first diameter, the first diameter being less than the second diameter, and the passage comprises a first spring seat extending radially outwardly from the first cylindrical wall to the second cylindrical wall;

the ferrule holder comprises a first body portion for being disposed in the first cylindrical passage portion and a second body portion for being disposed within the second cylindrical passage portion, the first body portion having a third diameter less than the first diameter, the second body portion having a fourth diameter greater than the first and third diameters and less than the second diameter, and the ferrule holder comprises a second spring seat extending radially outwardly from the first body portion to the second body portion; and

the resilient member comprises a spring for being disposed around the first body portion for engagement between the first spring seat and the second spring seat.

12. The connector of claim 11, wherein:

the at least first and second axially extending arms comprise first, second, third and fourth axially extending arms disposed at about 90° from an adjacent arm in a circumferential direction about the ferrule holder;

the corresponding recessed portions comprise one of:

an annular enlargement of the first cylindrical passage portion adjacent the first end of the housing, the annular enlargement defining a ring-shaped surface disposed away from the first housing end towards the second end of the housing; and

an end surface of the first housing end, the end surface defining a ring-shaped surface;

the first end of the ferrule holder is insertable into the passage in a first longitudinal direction to compress the spring between the first and second spring seats, the spring being for biasing the ferrule holder in a second longitudinal direction opposite the first longitudinal direction;

the first, second, third and fourth axially extending arms are configured to be radially displaceable from the first position to the second position upon insertion into the passage in the first direction; and

the projections of the first, second, third and fourth axially extending arms are configured for engaging the ring-shaped surface upon movement of the ferrule holder within the passage in the second longitudinal direction under bias of the spring.

13. The connector of claim 12, wherein one of the ferrule holder and the housing comprises an additional radial projection, and the other of the ferrule holder and the housing

comprises a longitudinal slot for receiving the additional radial projection therein upon insertion of the ferrule holder into the passage to prevent rotational movement of the ferrule body within the passage.

14. The connector of claim 1, wherein:

the ferrule holder is insertable into the passage through the second end of the housing in a first longitudinal direction; and

the housing comprises a retainer for being inserted through at least a portion of the housing to block at least a portion of the passage to retain the ferrule holder in the passage after insertion of the ferrule holder into the passage through the second end of the housing.

15. The connector of claim 14, further comprising:

a resilient member for biasing the ferrule holder in the passage towards the second end of the housing; and

the retainer being configured for retaining the ferrule holder in the passage in opposition to the biasing of the resilient member after insertion of the ferrule holder into the passage.

16. The connector of claim 15, wherein:

the retainer comprises a U-shaped clip having a base portion with spaced apart legs extending from the base portion;

the housing comprises a slot for receipt of the clip therein; and

the spaced apart legs for being inserted into the slot with the ferrule of the ferrule assembly located therebetween, the legs being disposed for retaining the ferrule holder in the passage in opposition to the biasing of the resilient member.

17. The connector of claim 16, wherein each leg of the clip has a tip portion disposed away from the base of the clip, the tip portions having an outwardly disposed projection

extending laterally away from the corresponding tip for engaging with corresponding recesses of the slot to retain the clip in the slot, and each projection having a laterally outward end disposed away from the corresponding tip potion.

18. The connector of claim 17, wherein:

the spaced apart legs in a first position define a first distance between the laterally outward ends of the tip portions, and the legs are resiliently displaceable in a direction towards one another to a second position wherein the laterally outward ends of the tip portions are disposed a second distance from one another, the second distance being less than the first distance; and

the slot comprises:

an opening in a surface of the housing, a bottom spaced apart from the opening, and first and second ends spaced apart and defining a slot length;

a depth dimension into the housing extending from the opening to the bottom of the slot and corresponding to a length of the clip from the base of the clip to the tip portion; and

each slot end comprises an outwardly disposed recess adjacent the bottom of the slot and defining an edge for engaging with the projection of the tip portion, wherein the slot has a first length dimension extending from the opening to the edge and corresponding to the second distance to displace the legs from the first position to the second position upon insertion of the clip into the slot, and the slot has a second length dimension at the recesses corresponding to the second distance for return of the legs from the second position to the first position when the projections enter the recesses to engage the projections with the edges.

19. The connector of claim18, wherein:

the ferrule holder comprises:

a first end for retaining the ferrule therein and a second end opposite the first end for being inserted into the passage through the second end of the housing; and

an outer peripheral surface having a longitudinal slot disposed therein extending in a direction from the first end to the second end; and

the clip comprises a projection for engaging with the longitudinal slot of the ferrule holder for preventing rotation of the ferrule holder within the passage.

20. The connector of claim 19, wherein:

the base and legs of the clip define a plane;

the clip base comprises the projection; and

the projection extends from the base in a direction transverse to the plane of the clip.

21. A one-piece housing for an optical fiber connector, the connector having a ferrule assembly for being movably disposed within the housing under bias of a resilient member, and the housing comprising:

a one-piece unitary body having a first end and a second end opposite the first end;

a longitudinal passage extending from the first end to the second end for receipt of the ferrule assembly therein; and

at least one of the body and the ferrule assembly comprising a portion for engaging the other of the housing and the ferrule assembly for retaining the ferrule assembly within the passage in opposition to the bias of the resilient member.

22. The housing of claim 21, wherein the portion for engaging comprises at least one integral projecting portion of the one of the housing and the ferrule holder, and the other of the housing and the ferrule holder comprises at least one recessed portion for receiving and engaging with corresponding projecting portions.

23. The housing of claim 22, wherein the housing comprises the at least one recessed portion disposed within the passage and extending radially outwardly from the passage for receiving and retaining radial projections of a ferrule holder therein.

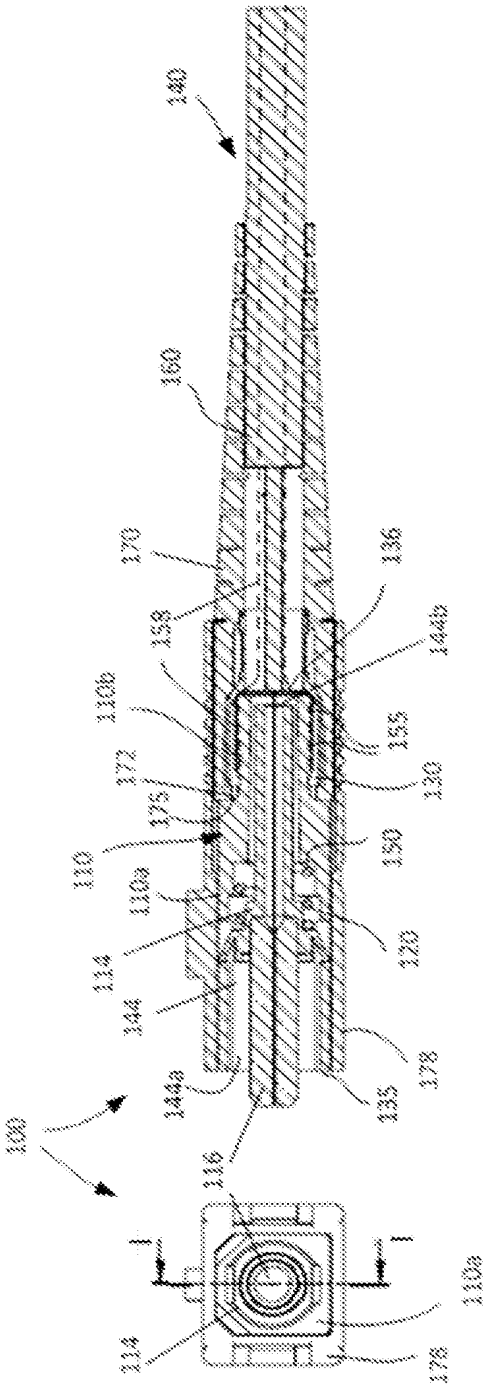


FIG. 1A

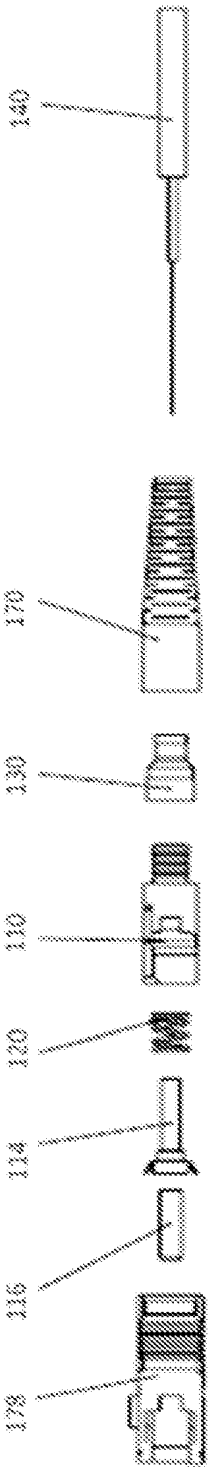


FIG. 1B

FIG. 1C

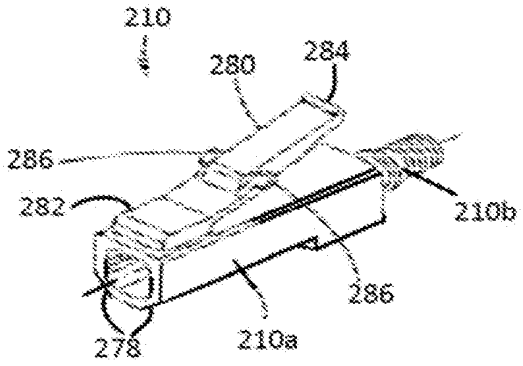


FIG. 2

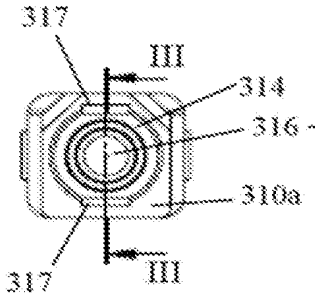


FIG. 3A

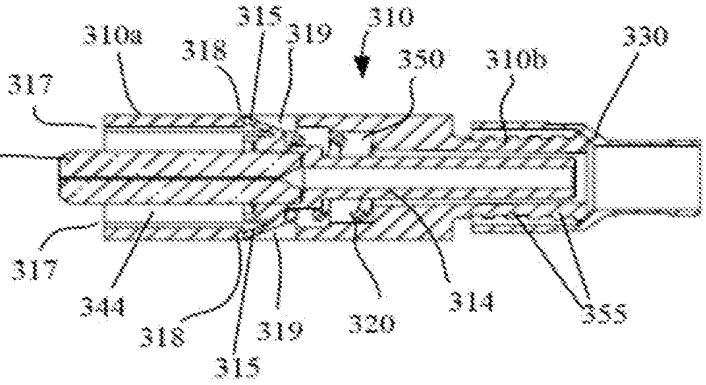


FIG. 3B

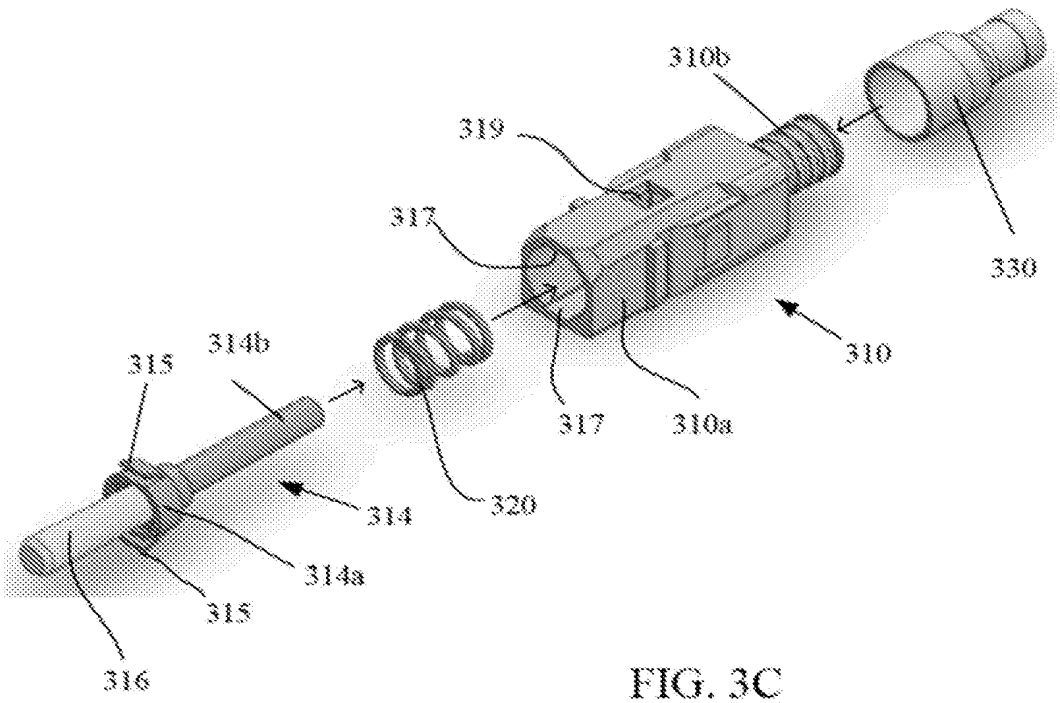


FIG. 3C

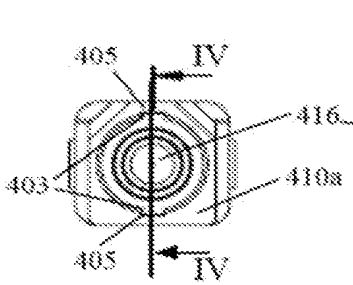


FIG. 4A

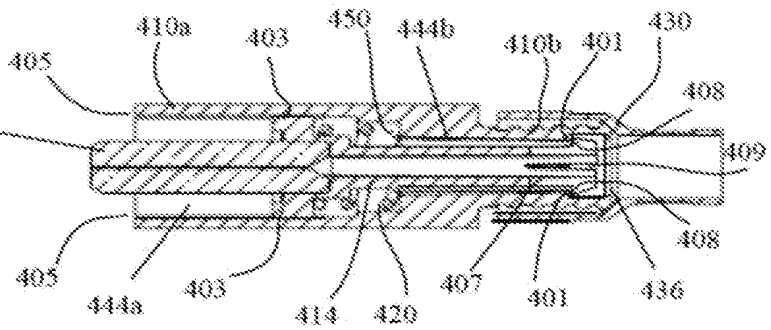


FIG. 4B

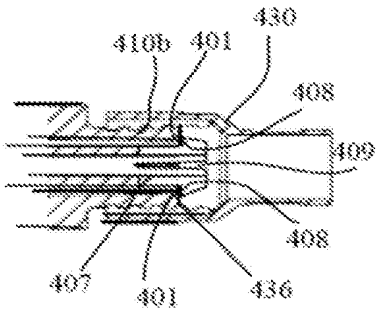


FIG. 4D

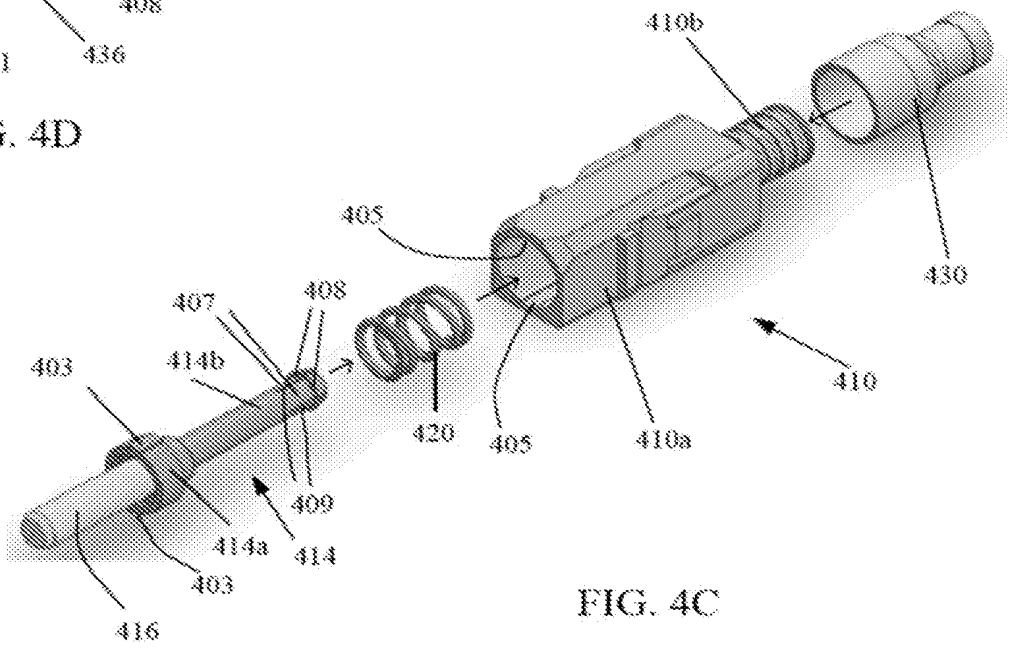


FIG. 4C

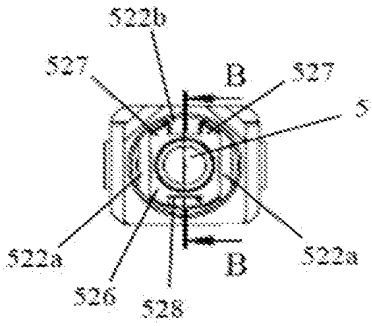


FIG. 5A

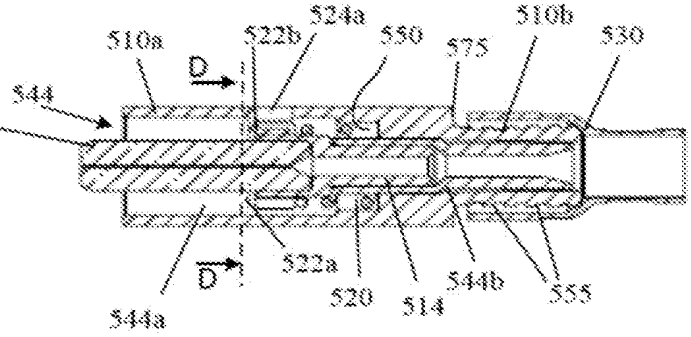


FIG. 5B

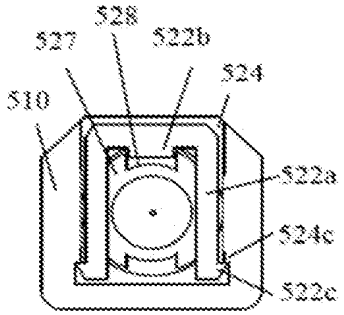


FIG. 5D

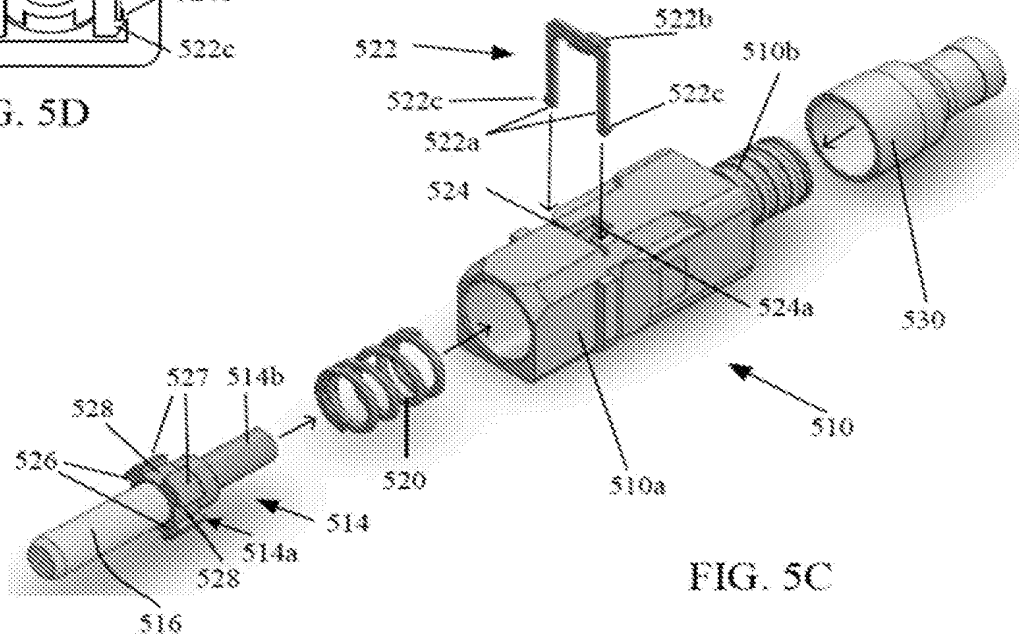


FIG. 5C

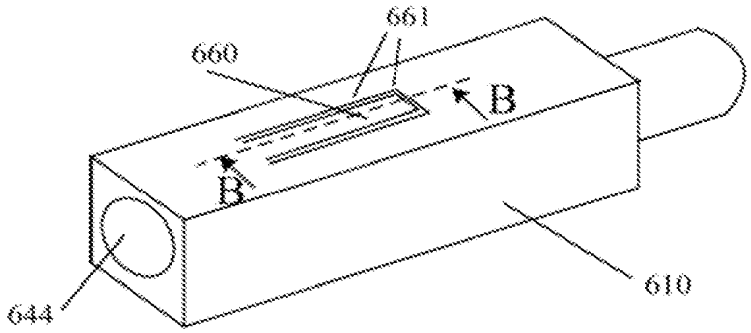


FIG. 6A

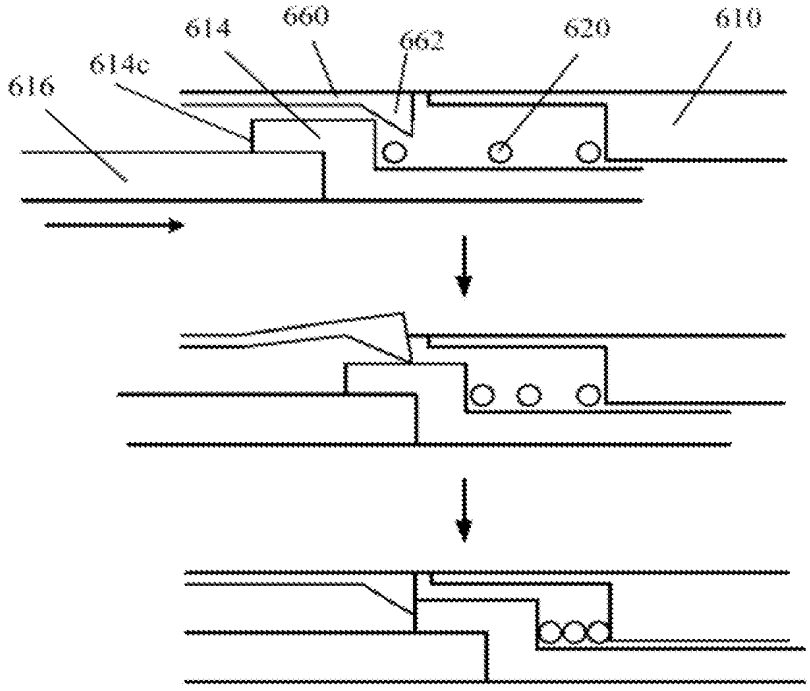


FIG. 6B

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(81) **Designated States** *(unless otherwise indicated, for every kind of national protection available)*: AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.

[Continued on next page]

(54) **Title**: INTERLOCKABLE FIBER OPTIC CONNECTOR ADAPTORS

(57) **Abstract**: Adaptors for providing a connection between fiber-optic cables may be configured to be interlocked in both side-by-side and top-to-bottom orientations with adjacent adaptors to eliminate wasted spaced between adjacent rows and/or columns of adaptors in a junction panel. Fiber optic connector adaptors, that may include internal alignment sleeves or surfaces, are frequently utilized to facilitate the mating of one or more fiber optic connectors and the fiber optic cables associated therewith

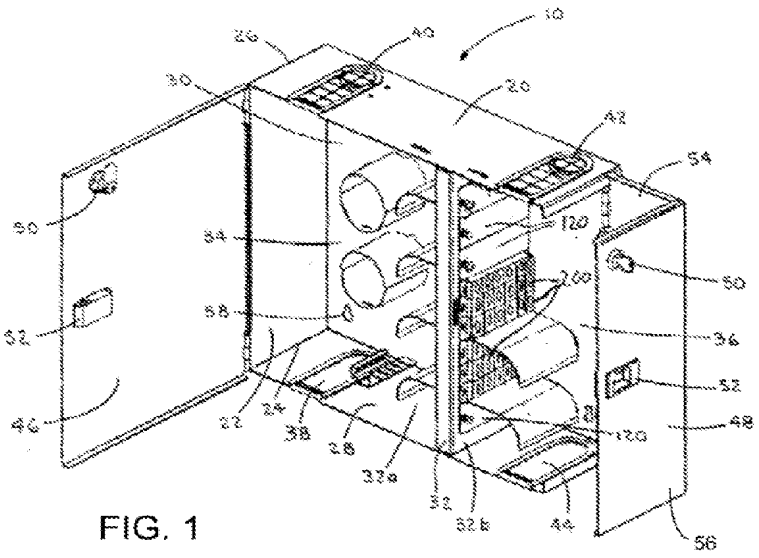


FIG. 1

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Published:

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Interlockable Fiber Optic Connector Adaptors

BACKGROUND

[0001] Fiber optic connector adaptors, that may include internal alignment sleeves or surfaces, are frequently utilized to facilitate the mating of one or more fiber optic connectors and the fiber optic cables associated therewith. In this regard, a pair of fiber optic connectors can be inserted into the opposed ends of a fiber optic connector adaptor, and the adaptor serves to align the fiber optic connectors to a degree such that the optical fibers upon which the fiber optic connectors are mounted are appropriately aligned. Fiber optic connector adaptors can be mounted in a patch panel within an enclosure, or the like, so as to align a pair of fiber optic connectors inserted into opposite ends of the fiber optic connector adaptor. A metal or plastic plate or surface in the patch panel may include openings into which the adaptors may be disposed, and the adaptors may be designed to be held in position in the openings with screws or other fasteners.

[0002] A variety of fiber optic connector adaptors may be arranged together in a single row or in a single column in such a manner that two abutting surfaces of two or more adjacent adaptors are touching. In other words, the adaptors are arranged in a one dimensional or one directional array. The adaptors may be fixed, or interlocked with one another to form a single interlocked row or column that may be installed as a unit in a corresponding aperture in a patch panel. In this arrangement, however, at least two sides of the adaptors within the row or column are adjoining the metal or plastic panel or bulkhead that is used to hold the adaptors in a stationary and stacked position within the panel. The panel therefore has some minimum distance or space remaining between one single directional row or column of adaptors and another single directional row or column of similar adaptors, or in other words, between adjacent rows or adjacent columns of the adaptors.

[0003] With the use of optical fibers increasing at a rapid rate, there is a growing need to increase the number of optical fibers at any given installation. Thus, there remains a need to maximize the density of fiber interconnection sites at an interconnection location.

SUMMARY

[0004] The density of fiber interconnection sites may be maximized by configuring the adaptors to be interconnectable with one another from essentially any side, thereby allowing the adaptors to be arranged and interconnected in a two dimensional or two directional array. Each adaptor may thereby interlock with all other adjacent adaptors. With such an embodiment, adjacent rows and columns of adaptors will be abutting, thereby eliminating wasted panel spacing from between adjacent rows or adjacent columns.

[0005] In an embodiment a fiber optic adaptor for providing a connection between at least two fiber optic connectors may include at least first and second cavities for receiving fiber optic connectors therein, and connecting members configured for directly interconnecting the adaptor with at least two additional adaptors in both first and second directions of a two-directional array to provide an interconnected two-directional array of adaptors with interconnections in each of the two directions.

[0006] In an embodiment, a two-directional array of interconnected fiber optic adaptors for providing connections between fiber optic connectors may include adaptors having connection elements for releasably coupling each adaptor to immediately adjacent adaptors in both directions of the array.

BRIEF DESCRIPTION OF THE FIGURES

[0007] FIGS. 1 and 2 depict a representative panel box for fiber optic cable connections according to an embodiment.

[0008] FIGS. 3A and 3B depict representative fiber optic connector adaptor arrays according to an embodiment.

[0009] FIGS. 4A – 4E show perspective views of 90° adaptors according to embodiments.

[0010] FIGS. 5A – 5C show perspective views of 45° adaptors according to embodiments.

[0011] FIG. 6 illustrates a connection clip according to an embodiment.

[0012] FIG. 7 depicts a cut-away view of adaptors held together via connection clips.

[0013] FIGS. 8 and 9 illustrate cross-sectional views of a 90° adaptor of FIG. 4B according to embodiments.

[0014] FIGS. 10A and 10B depict adaptor latches for adaptors according to an embodiment.

[0015] FIGS. 11A and 11B depict cross-sectional views of 90° adaptors and adaptor disposed within the adaptors according to an embodiment.

[0016] FIGS. 12 and 13 illustrate cross-sectional views of a 45° adaptor of FIG. 5B according to embodiments.

[0017] FIGS. 14A and 14B depict cross-sectional views of 45° adaptors and adaptor disposed within the adaptors according to an embodiment.

DETAILED DESCRIPTION

[0018] As shown in FIGS. 1 and 2, a fiber optic wall mount cabinet **10** may have a side wall **22** connected at a first end **24** to a bottom wall **28** and at a second end **26** to a top wall **20**. A back wall **30** may be substantially perpendicular to edges of the top wall **20**, the side wall **22**, and the bottom wall **28** so that the side wall, bottom wall, top wall, and back