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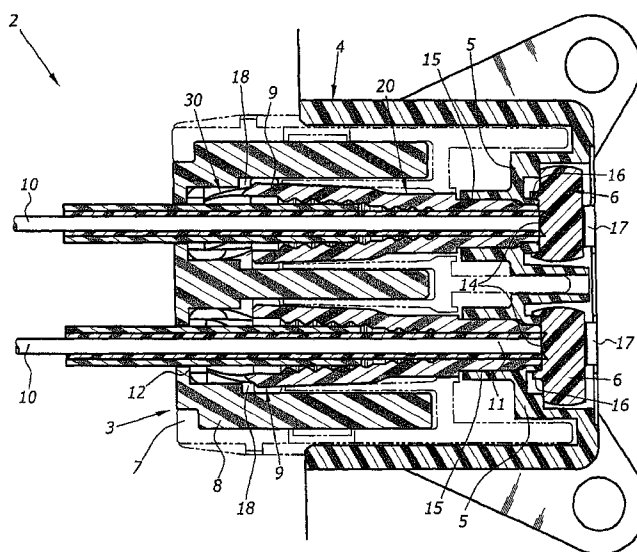
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(54) Title: SPRING FERRULE



(57) Abstract: The invention concerns a spring ferrule (9) intended to be retained in a casing (3) comprising an elongated body (20) enclosing a longitudinal conduit (11) destined to receive an optical fibre (10), an elastic element (30) enclosing the longitudinal conduit (11) destined to receive the optical fibre (10), axially aligned with the elongated body (20) along the longitudinal conduit (11), the elastic element (30) being axially compressible between a first contact surface (14) defined on the elongated body (20) and a second contact surface (12) defined on the elastic element (30). Said elastic element (30) is of unitary construction with said elongated body (20). The invention has an application in a connector for an optical fibre.

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SPRING FERRULE

The present invention concerns a spring ferrule retaining an optical fibre and intended to be placed in a connector. Such spring ferrules protect and ensure accurate optical fibre positioning in the connector housing.

5 A spring ferrule known in the state of the art has an elongated body enclosing a longitudinal conduit destined to receive an optical fibre. The elongated body has two extremities, one acting as an entrance for the optical fibre namely the entrance extremity and the other is where the signal carried by the optical fibre exits, the signal extremity. The elongated body has a contact
10 surface at each extremity in a plane perpendicular to its length.

 An elastic ring, capable of being deformed axially completes the spring ferrule. This elastic ring encloses a longitudinal conduit destined to receive the optical fibre and has a contact surface at each extremity in a plane perpendicular to its length. One of these extremities is in contact with the entrance extremity of
15 the elongated body, the elastic ring being axially aligned with the elongated body along the axis of the longitudinal conduit following the length of said longitudinal conduit.

 The signal exiting at the signal extremity of the spring ferrule is collected by a signal collection device such as a lens, a detector, a fibre optical
20 transceiver or another optical fibre. The optimum collection of the signal requires the distance between the spring ferrule and the fibre optical transceiver for example to be a minimum and maximum collection of the signal is achieved when each one is pressed right up against each other.

 This is achieved using a connector containing a casing and a housing.
25 The casing comprises a holder, a detachable locking part and the spring ferrule retaining the optical fibre. The housing contains the above mentioned signal collection device retained in a fixed position. The holder retains the spring ferrule and the locking part is attached to the holder. The elastic ring of the spring ferrule is arranged in a chamber of this locking part and the locking part makes contact
30 with the remaining free contact surface of the elastic ring. The elastic ring is compressed between the locking part and the elongated body and thus pushes the elongated body and the optical fibre in a longitudinal direction following the longitudinal conduit. As a result, the contact surface of the signal extremity of the spring ferrule makes the sought contact with a signal collection device when the

casing is inserted into the housing. The signal collection device is situated at one end of this longitudinal axis and the locking part at the other end with the spring ferrule located between the two of them.

5 The use of a spring ferrule overcomes a problem previously encountered with these connectors. Such connectors used a springless ferrule and the resulting distance between its signal extremity and the signal collection device when the ferrule was mounted in the connector depended on the manufacturing tolerance and the relative positioning accuracy of the constituent components of the connector. The use of a spring ferrule allows the distance
10 between the signal extremity and the signal collection device to be completely eliminated.

However, this spring ferrule has the inconvenience that its assembly is time consuming requiring the optical fibre to be guided through two individual elements namely the elastic ring and the elongated body.

15 The present invention allows this problem to be overcome through the realisation of a spring ferrule where the elastic element is of unitary construction with the elongated body. This spring ferrule permits the above assembly time to be reduced to the assembly time of just one element while still fulfilling the role of optimising the contact with a signal collection device.

20 Another advantage is obtained from the fact that the diameter of the entrance extremity of the elastic element is wider than the diameter of the optical fibre as the positioning of the elastic element relative to the elongated body is assured by the solidarity of the elastic element with the elongated body. As a result the optical fibre easily enters the elastic element and has now only to be
25 guided into the elongated body.

Other details and different variants of the invention are defined in the dependent claims.

Another aspect of the invention comprises a cable containing the spring ferrule according to the invention and an optical fibre.

30 Yet another aspect of the invention includes a connector containing the above cable.

The invention will be better understood with the help of the following detailed description and the accompanying drawings illustrating possible embodiments of the invention:

- Figure 1 is a horizontal cross sectional view of a connector comprising two spring ferrules according to the invention each retaining an optical fibre ;

5 - Figure 2 is a horizontal cross sectional view of a cable comprising a spring ferrule according to the invention and an optical fibre extracted from figure 1 ;

- Figure 3 is a horizontal cross sectional view of another embodiment of a connector comprising two spring ferrules according to the invention arranged in a casing for the purpose of coupling the ends of the optical fibres together ; and

10 - Figure 4 is a perspective view of the spring ferrule according to the invention.

Figure 1 shows a connector 2 containing a plug and a socket corresponding respectively to a casing 3 and a housing 4. The housing 4 contains a body 5 and has two signal collection devices 6 such as a detector or fibre
15 optical transceiver. The casing 3 comprises a holder 7, a locking part 8 and two spring ferrules 9 each one retaining an optical fibre 10. The locking part 8 is detachable from the casing 3. When positioned in the casing 3, the locking part 8 has a chamber that encloses partially the spring ferrule 9 making contact with the spring ferrule 9 at a contact surface 12. The spring ferrule 9 retained in the holder
20 7 is free to move in a longitudinal direction. The signal collection device 6 is in a fixed position along the axis of the spring ferrule 9 and faces a contact surface 14 of the spring ferrule 9.

The body 5 delimits a passage 15 and encloses an extremity of the spring ferrule 9 containing the contact surface 14. The interior of passage 15 has
25 a form complementary to that of the extremity of the spring ferrule 9 and the position of the spring ferrule 9 is thus fixed in the plane perpendicular to its longitudinal axis.

The signal collection device 6 has five legs that are inserted in the base of the housing 4 (unillustrated). The device 6 has a contact face 16 partially
30 in contact with the contact surface 14 and a face opposite the contact face 16 that is in contact with a leaf spring 17. The contact face 16 has a form that is complementary to an exterior portion of body 15 that surrounds the contact surface 14.

The form of the contact face 16 together with the leaf spring 17 pressing against the device 6 hold the signal collection device 6 against the body 15. The position of the device 6 is thus fixed in the plane perpendicular to the longitudinal axis of the spring ferrule 9.

5 The signal collection device 6 is thus aligned relative to the spring ferrule 9 in the plane perpendicular to the longitudinal axis of the spring ferrule 9. The spring ferrule 9 is only free to move in a longitudinal direction.

 The connector 2 contains a longitudinal play spacing 18 situated between the elongated body 20 and the locking part 8. This play spacing 18
10 allows the elongated body 20 of the spring ferrule 9 to move with respect to the locking part 8 in a longitudinal direction in the connector 2.

 Referring to Figure 2, a cable 19 containing the spring ferrule 9 and the optical fibre 10 is shown alone. The spring ferrule 9 has an elongated body 20 enclosing a longitudinal conduit 11 which retains the optical fibre 10. The
15 elongated body 20 is tapered longitudinally. It has an entrance extremity 26 acting as an entrance for the optical fibre 10 into the longitudinal conduit 11 and a signal extremity 28 where the signal carried by the optical fibre exits the optical fibre 10. The optical fibre and the elongated body 20 are flush at the signal extremity 28.

20 The contact surface 14 is destined to make contact with a signal collection device 6 such as a lens, a detector, a fibre optical transceiver or another optical fibre (figure 1).

 The spring ferrule 9 comprises an elastic element 30 which is of unitary construction with said elongated body 20 and is constituted of the same
25 material as the elongated body 20. The spring ferrule 9 is fabricated as a single entity from one single mould. In a particular embodiment the elastic element 30 and said elongated body 20 can be fabricated as a single entity but using different substances for the elastic element 30 and said elongated body 20. The elastic element 30 comprises an outer ring 32 and an elastic helicoidal support
30 33. The outer ring 32 is connected to the elongated body 20 by the elastic helicoidal support 33. It is not necessary that the outer ring 32 and the elongated body 20 are linked by an elastic helicoidal support 33. In another embodiment for example they are connected by one or several elastic membranes functioning in the same manner as a bellows. The outer ring 32 has an internal diameter at

least 1.05 times greater than the diameter of the longitudinal conduit of the elongated body. The internal diameter is thus wider than the longitudinal conduit allowing the optical fibre 10 to be easily passed through the outer ring 32.

The elastic helicoidal support 33 comprises three elastic helicoidal legs as seen in figures 1 to 4. Only two of these legs 36, 37 are visible in figures 1 to 3. The number of elastic helicoidal legs 36, 37 employed is typically between two and five.

Each elastic helicoidal leg 36, 37 of this elastic support 33 defines, at its point of contact with the plane of the outer ring 32, an angle α (figure 4) between 10 and 75 degrees, the angle α being 45 degrees in the example shown in figures 1 to 4. Furthermore each elastic helicoidal leg 36, 37 extends angularly, around the axis of the conduit 11 from the outer ring 32 to the elongated body 20, over an angle β between 10 and 60 degrees, the angle β being 25 degrees in the example shown in figures 1 to 4. Advantageously, this angle is less than 360 degrees.

The outer surface at the extremity of the outer ring 32 forms the contact surface 12 destined to make contact with the locking part 8 (figure 1). The elastic helicoidal legs 36, 37 are separated from each other and a lateral window 38 is formed between them permitting the entrance extremity 26 acting as the entrance for the optical fibre 10 into the longitudinal conduit 11 of said elongated body 20 to be visible (figure 4).

The spring ferrule 9 is made of metal, plastic or any other suitable material.

Regarding the spring ferrule shown in figure 2, the optical fibre 10 is inserted into the spring ferrule 9 easily being passed through the elastic element 30 whose internal diameter is made larger than that of the optical fibre 10. The optical fibre is subsequently guided into the entrance 26 of the elongated body 20, which is visible through the lateral window 38 formed between two elastic helicoidal legs 36, 37, completing the assembly of the optical fibre 10 in the spring ferrule 9. The signal exiting the optical fibre 10 at the signal extremity 28 of the spring ferrule 9 is collected by a signal collection device 6 such as a lens, a detector, a fibre optical transceiver or another optical fibre (figure 1). The optimum collection of the signal requires the distance between the spring ferrule 9 and the fibre optical transceiver for example to be a minimum. This is achieved

using the connector 2 shown in figure 1 which has a casing 3 and a housing 4. The spring ferrule 9 is placed in the holder 7 where it is free to move along a longitudinal axis. The signal collection device 6 is fixed at one end of this longitudinal axis and at the other end is the locking part 8 when the casing 3 is inserted into the housing 4. The locking part 8 when inserted into the holder 7 makes contact with the contact surface of the elastic element 12. The locking part 8 pushes against the contact surface of the elastic element 12 and the spring ferrule 9 moves longitudinally. When the casing 3 is placed into the housing 4, the contact surface 14 at the signal extremity 28 of the elongated body 20 makes the sought contact with a signal collection device 6. The spring ferrule with elastic element 30 is compressed between these two contact surfaces 12, 14 and the compression of the elastic element 30 allows this optimum contact to be made and maintained. The play spacing 18 permits the elongated body 20 of the spring ferrule 9 to move longitudinally when the elastic element 30 is compressed and the optimum contact between the contact surface 14 and the signal collection device 6 to be achieved.

According to another embodiment the elongated body 20 has longitudinally a constant section and has any desired form such as an elongated cylinder, an elongated square or an elongated rectangle.

In two other embodiments the elongated body 20 is either tapered internally only or externally only.

In yet another embodiment as illustrated in figure 3, a connector 39 comprises a casing 40 with two spring ferrules 9 identical to those shown in figure 2, each retaining an optical fibre 10, two locking parts 46, 48 and a holder 50. The spring ferrules 9 are aligned, with their signal extremities 28 facing each other, along an axis situated at the centre of their longitudinal conduit 11 and that follows the length of said longitudinal conduit 11. Each locking part 46, 48 is detachable from the housing 40 and when positioned in the casing 40 they make contact with the elastic element 30 of spring ferrule 9 at the contact surface 12. As a result each spring ferrule 9 is pushed towards the other to optimise the coupling of the signal between the signal extremities 28 of the two optical fibres 10.

Claims

1. Spring ferrule (9) intended to be retained in a casing (3) comprising:
an elongated body (20) enclosing a longitudinal conduit (11) destined
to receive an optical fibre (10),
5 an elastic element (30) enclosing the longitudinal conduit (11) destined
to receive the optical fibre (10), axially aligned with the elongated body (20) along
the longitudinal conduit (11),
the elastic element (30) being axially compressible between a first
contact surface (14) defined on the elongated body (20) and a second contact
10 surface (12) defined on the elastic element (30)
characterised in that said elastic element (30) is of unitary construction
with said elongated body (20).
2. - Spring ferrule (9) according to claim 1 characterised in that said
elastic element (30) is constituted of the same material as said elongated body
15 (20).
3. - Spring ferrule (9) according to claim 1 or 2 characterised in that
said elastic element (30) comprises an elastic helicoidal support (33) extending
outwards from the elongated body (20) and around the axis of the longitudinal
conduit (11).
- 20 4. - Spring ferrule (9) according to claim 3 characterised in that said
elastic element (30) comprises an outer ring (32) defining the second contact
surface (12) and an elastic helicoidal support (33), said elastic helicoidal support
(33) connecting said outer ring (32) to the elongated body (20).
5. - Spring ferrule (9) according to claim 4 characterised in that said
25 elastic helicoidal support (33) comprises at least two separated helicoidal legs
(36, 37) forming a lateral window (38) which opens onto the entrance (26) of the
longitudinal conduit (11) of said elongated body (20).
6. - Spring ferrule (9) according to claim 5 characterised in that said
elastic element (30) contains between 2 and 5 elastic helicoidal legs (36, 37).
- 30 7. - Spring ferrule (9) according to any one of claims 4 to 6
characterised in that said outer ring (32) has an internal diameter which is at least
1.05 times greater than the diameter of the longitudinal conduit (11).
8. - Spring ferrule (9) according to any of claims 5 to 7 characterised in
that said elastic helicoidal legs (36, 37) extends angularly around the axis of the

longitudinal conduit (11) from the outer ring (32) to the elongated body (20), over an angle less than 360 degrees.

9. - Spring ferrule (9) according to any of claims 1 to 8 characterised in that said elongated body (20) is tapered longitudinally.

5 10. - Cable (19) comprising an optical fibre (10) and spring ferrule (9) according to any of claims 1 to 9, the optical fibre (10) being firmly retained axially in the longitudinal conduit (11) of the elongated body (20) with the elastic element (30) enclosing the optical fibre (10).

10 11. - Connector (2 ; 39) comprising a casing (3 ; 40) and at least one cable (19) according to claim 10 arranged within said casing (3 ; 40), the second contact surface (12) adjoining the casing to compress the elastic element (30) of the spring ferrule.

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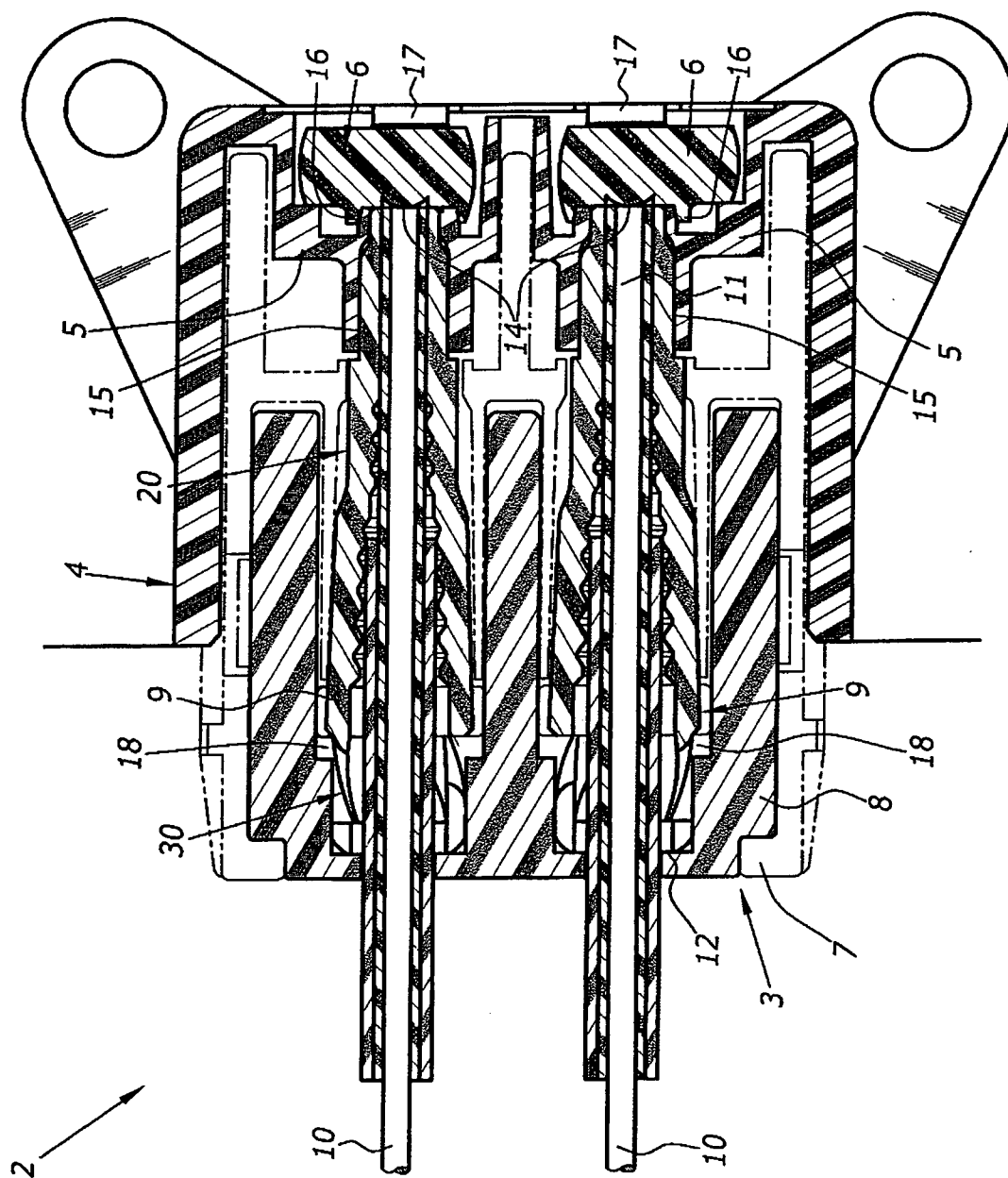


FIG.1

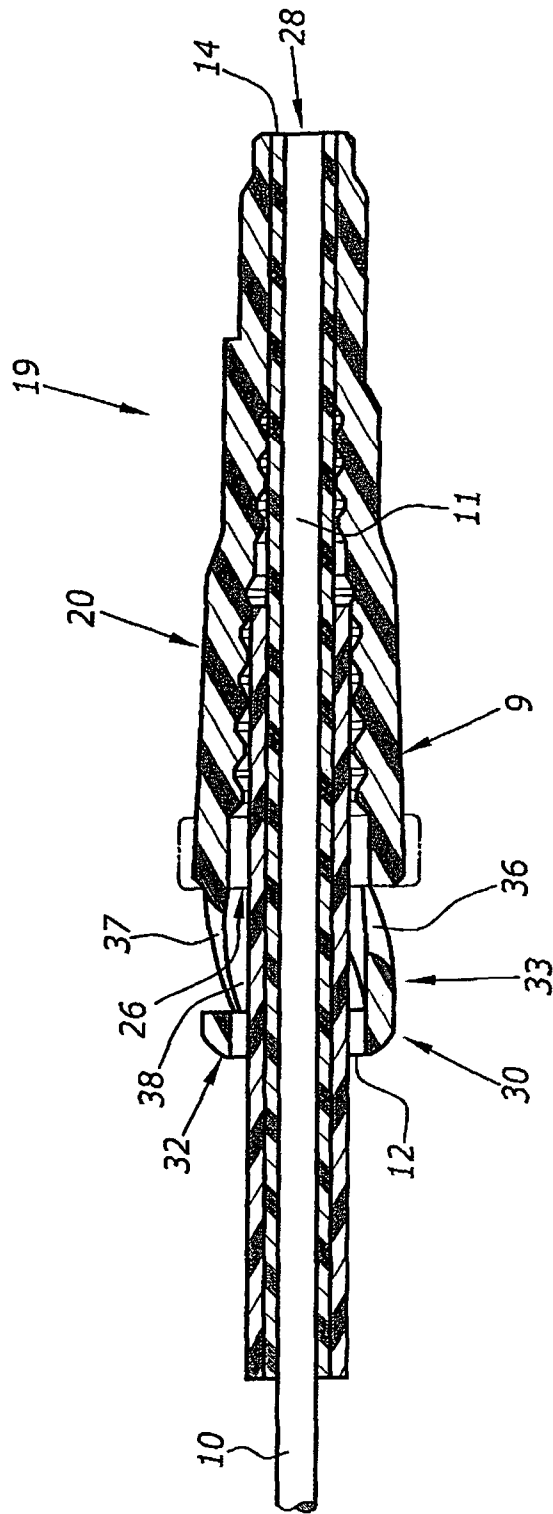


FIG.2

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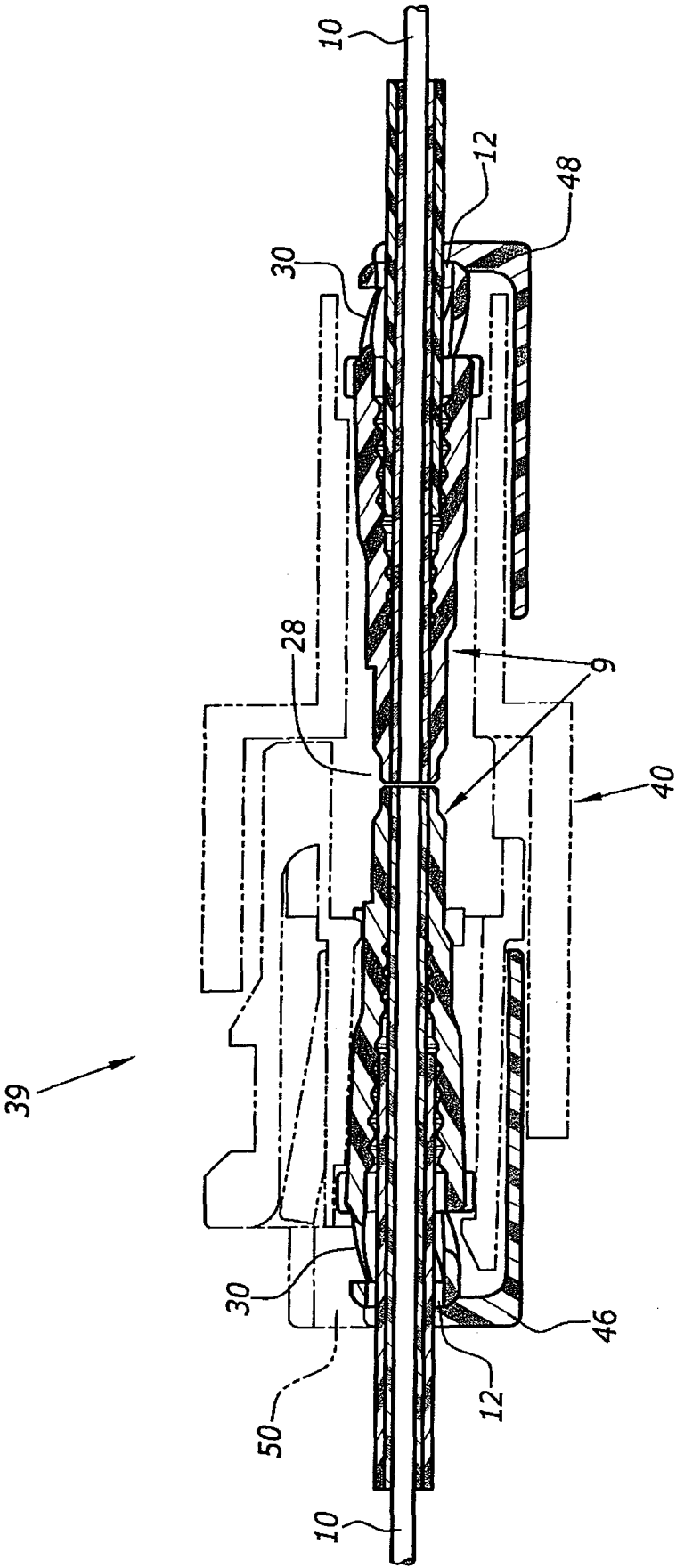
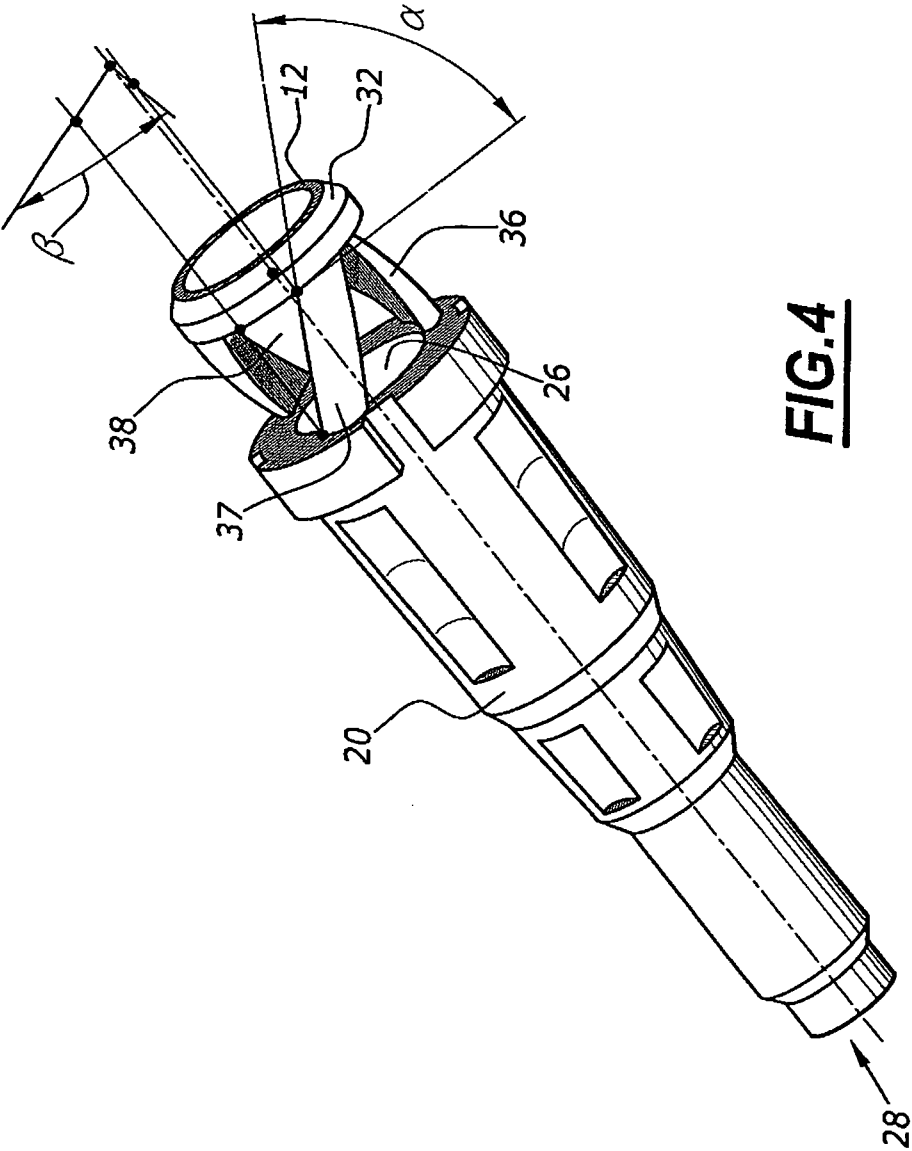


FIG. 3



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

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

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)

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C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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X	----- US 5 303 317 A (MARAZZI ET AL) 12 April 1994 (1994-04-12) figures 1,3 abstract	1
A	----- EP 0 803 748 A (FRAMATOME CONNECTORS INTERNATIONAL) 29 October 1997 (1997-10-29) figure 1 abstract	1

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

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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