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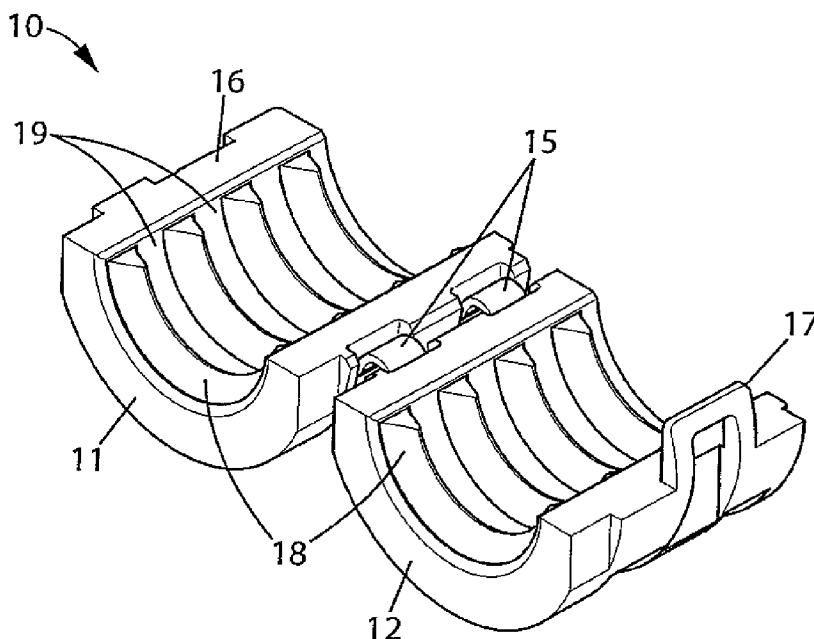
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[Continued on next page]

(54) Title: RETENTION FERRULE FOR CABLE CONNECTOR



(57) Abstract: The invention relates a cable connector assembly for a cable (30) having one or more insulated conductors (31) covered by an insulating sheath (33), said assembly comprising mating first (51) and second (52) shells connected together to form a cable housing, said cable housing having a cavity (50) therein between said first and said second shells, strain relief means (10) tightly surrounding a segment of said insulating sheath, said strain relief means being retained in said cavity when said first and second shells are connected together, wherein said strain relief means comprises at least first (11) and second (12) portions hinged together through hinge means (15) and assembled to surround said segment of said sheath. The invention also relates to an assembly method for such a connector.

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For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

RETENTION FERRULE FOR CABLE CONNECTOR

This invention generally relates to electrical connectors for use with electrical cables and more specifically to shielded electrical connectors for use with shielded electrical cables.

5 Cables are commonly used to interconnect electronic equipment. Cables interconnecting such equipment together as well as the equipment themselves often radiate unwanted electromagnetic radiations (EMR) that can interfere with other equipment as well as radio communications. These radiations are reduced significantly by covering the cable with a braided wire
10 shield which is grounded thanks to shielded cable connectors connected to the equipment ground. Similarly, cables interconnecting some electronic devices can act as antennas that pick up unwanted EMR signals, and shielded cables are used to protect against such unwanted interferences.

 The connection of the cable to the equipment requires a cable
15 connector attached to the cable end portion. To complete the protection against EMR, it is usually necessary to enclose the connector and the cable end portion in a shielded connector housing, thus forming a cable connector assembly, also called a plug.

 Such assemblies generally comprise additional features such as strain
20 relief means for the cable to ensure proper retention of the cable within the housing as well as assembly integrity when for example the assembly is unplugged. Such a cable connector assembly is known from US 4,272,148. The strain relief means comprises a ferrule that securely clamps the cable. Such a ferrule is provided with longitudinal slots that allow the cable plastic
25 sheath to deform and flow into slots to prevent rotation of the cable. Such a ferrule may plastically deform upon assembly of the plug, making it too fragile for a reliable cable connector assembly. Furthermore, this ferrule is generally of a diameter barely greater than the cable sheath outer diameter, and can only be inserted on the cable from the tip of the cable end portion. Any improper
30 alignment of the cable end portion with the ferrule during assembly may result in damage to the end portion, and interconnection problems.

An object of the present invention is to provide an easy to manufacture cable connector assembly with reliable and solid strain relief means.

This object is achieved by providing a cable connector assembly according to claim 1.

5 The invention takes advantage of the two part retention means for easy assembly directly onto and around the cable end portion with no sliding of the strain relief means on the cable involved. The tip of the cable remains clear of any contact with the strain relief means.

10 The invention also relates to a method for assembling a cable connector assembly according to claim 13.

The invention also provides a cable connector assembly that is easy to assemble, with an easy to mount and resistant strain relief means. It also provides a connector assembly with improved strain relief means that substantially prevents damage of the cable end portion.

15 Other features and advantages of this invention will further appear in the hereafter description when considered in connection to the accompanying drawings, wherein:

20 Fig. 1 represents a perspective view of the open strain relief means in a first implementation of the cable connector assembly according to the invention;

Fig. 2 represents a perspective view of the closed strain relief means in a first implementation of the cable connector assembly according to the invention;

25 Fig. 3 corresponds to a perspective view of the cable before assembly with the strain relief means;

Fig. 4 is a perspective view of the cable after assembly with the strain relief means in a first implementation of the cable connector assembly according to the invention;

30 Fig. 5 corresponds to an exploded perspective view of the cable connector assembly in a first implementation according to the invention;

Fig. 6 is a perspective view of the cable connector assembly in a first implementation according to the invention.

Figs. 7A-7C is a partial sketch of a cross-section of the cable connector assembly in another implementation according to the invention.

In the description hereafter, the same elements, unless mentioned otherwise, will carry the same numbers.

5 The cable connector assembly according to the invention, as seen in FIG. 6, allows connection of a cable 30 having one or more insulated conductors 31 covered by an insulating sheath 33 to a given electronic equipment (not shown). The assembly comprises mating first 51 and second 52 shells connected together to form a cable housing. The resulting cable housing
10 has a cavity 50 formed therein, as seen in the exploded view of FIG. 5, between first shell 51 and second shell 52. The cable connector assembly further comprises strain relief means 10 tightly surrounding a segment of the insulating sheath 33. Cavity 50 is adapted to retain strain relief means 10 when first and second shells are connected together.

15 The strain relief means 10 is shown in FIGs. 1 and 2. It comprises first 11 and second 12 portions hinged together through hinge means 15. First and second portions are adapted to surround a segment of sheath 33 when assembled together. Hinge means 15 may be an integral hinge formed on one pair of adjacent edges of first 11 and second 12 portions. The portions 11 and
20 12 may also be separate parts attached together through at least one hinge 15 provided on one pair of adjacent edges of said shells, as seen in FIG. 1.

 In another preferred implementation, as seen in FIGs. 1 and 2, first and second portions 11 and 12 are both semi circular shells. When assembled, they form a ferrule that surrounds a segment of sheath 33 when assembled around
25 said segment.

 Both semi circular shells 11 and 12 are adapted to clamp the cable when both shells 11 and 12 are assembled around the segment of sheath 33. To that effect, ribs 18 are provided on the inner surface of both semi circular shells for example through grooves 19 defined on these inner surfaces. Ribs 18
30 are provided to deform sheath 33, and therefore clamp cable 30 when ferrule 10 is assembled around cable 30. Thus cable 30 is tightly maintained inside ferrule 10.

In another implementation of the strain relief means of the cable connector assembly according to the invention, sealing means 16 and 17 are provided on both semi circular shells 11 and 12 to seal and clamp ferrule 10 around cable 30, as seen in FIG. 4. Sealing means 16 and 17 may be e.g. snap fit connection provided on edges of semi circular shells 11 and 12 opposed to the edges carrying the hinged means 15.

In an additional implementation of the strain relief means of the cable connector assembly according to the invention, grooves 180 are provided on the outer surface of at least one of the semi circular shells. The grooves may be for example circular grooves as seen in FIGs. 2 and 4. Such grooves are to cooperate with corresponding ridges provided on the inside of cavity 50 formed by mating first and second shells 51 and 52, so that ferrule 10 is tightly maintained in the cable connector according to the invention. To that effect, ridges (not shown in FIG. 5) are provided on at least one of the mating shells inner surface.

Ribs 18 as well as grooves 180 on ferrule 10 allow the cable 30 to be retained within the cable housing, preventing any rotation or translation of the cable.

In an additional implementation, a connector 20 is provided to receive the conductors 31 of cable 30 as seen in FIG. 5. Connector 20 is to be located in an extension of cavity 50 and retained therein when mating shells 51 and 52 are connected together.

The cable is mounted into the cable connector as follows. As mentioned earlier and seen in FIG. 3, cable 30 has a plurality of insulated conductors 31 covered by an insulating sheath 33. In a preferred embodiment, and to prevent any EMR problems, cable 30 is provided with a common conductive shield; e.g. a shielding braid, underneath insulating sheath 33 and surrounding the plurality of conductors 31. A portion of sheath 33 is removed to expose the conductors 31 that are to be attached to connector 20. The exposed braid is folded to form at least one strand 32, and preferably two as shown in FIG. 3.

Ferrule 10 is then clamped around the segment of cable 30 adjacent the segment with the removed sheath. Semi circular shells 11 and 12 surround

tightly this segment, thanks to the ribs 18 and the sealing means 15 and 16. Strands 32 are folded onto the outer surface of ferrule 10, as seen in FIG. 4. The cable end portion with the ferrule 10 is then ready for assembly with the mating shells 51 and 52.

5 After conductors 31 are attached to connector 20, mating shells 51 and 52 are placed on both sides of ferrule 10 and connector 20, with the cavity 50 and its extension facing the ferrule and the connector respectively. Clamping means are provided on both mating shells to attach said mating shells together, therefore retaining ferrule 10 and cable 30 in a strain relief manner. In
10 positioning the ferrule 10 within cavity 50, grooves 180 are to cooperate as seen earlier on with corresponding ridges on the mating shells inner surface. The cavity 50 is adapted so that strands 32 come into contact with the inner surface of the mating shells 51 and 52.

 A partial cross section view of the assembled cable connector
15 assembly is shown in FIG. 7A. In FIG. 7A, cable 30 is provided with an additional and optional common shield, e.g. a conducting shielding foil 320, underneath the shielding braid and surrounding the plurality of conductors 31. Foil 320 is not folded back over ferrule 10.

 In another preferred embodiment, as shown in FIGs. 7B and 7C, the
20 cable connector assembly comprises an additional ferrule 40, preferably being electrically conductive, e.g. made of metal, and preferably having a flange 400. The additional ferrule is inserted underneath the shielding braid of cable 30 adjacent the segment with the removed sheath. As shown in FIGs. 7B and 7C, the ferrule 40 is sandwiched between the braid 32 and the additional shielding
25 foil 320 and surrounds the plurality of conductors 31 and said shielding foil 320. In this embodiment, ribs 18 of ferrule 10 deform sheath 33 against ferrule 40 and therefore clamp cable 30 without deformation of the conductors 31 when ferrule 10 is assembled around cable 30. Thus conductors 31 are mechanically
30 protected from the clamping force of ferrules 10 and 40 and cable 30 is more tightly clamped and better maintained inside ferrule 10. Preventing deformation of a conductor 31 and/or its insulation also prevents impedance variations and thus improves the signal transmission of the cable connector assembly, in particular for fast and/or high frequency signals.

The improved clamping due to the use of ferrule 40 allows manufacture of ferrule 10 of a relatively soft and/or more resilient material while maintaining or increasing the resistance to strain relative to an otherwise identical cable connector assembly.

5 In the embodiments of FIGs. 7B and 7C the cable is mounted into the cable connector according to the method described before. However, prior to clamping ferrule 10 to the segment of cable 30, ferrule 40 is inserted under the insulating sheath 33, preferably also underneath the shielding braid. Next ferrule 10 is applied and the shielding braid is folded onto the outer surface of
10 ferrule 10 (FIG. 7B). Alternatively, the shielding braid is folded back, e.g. onto the outer sheath 33, and ferrule 40 is inserted. Then ferrule 10 is applied over the shielding braid and sheath 33, after which the shielding braid is folded forward onto the outer surface of ferrule 10 (FIG. 7C). The latter method, which may equivalently be employed without using ferrule 40, facilitates assembly of
15 the connector. With the embodiment of FIG 7B cable 30 is maintained best inside ferrule 10. Flange 400 facilitates gripping and/or positioning of ferrule 40.

In these embodiments only one of the two ferrules, ferrule 40, needs to be inserted on the cable from the tip of the cable end portion, thus substantially preventing damage of the cable end portion compared to inserting two ferrules.

20 The part of ferrule 40 fitting underneath sheath 33 may be profiled for further improving the holding force of the cable connector assembly.

In the example of FIG. 5 and 6, clamping means are screws 511 and 512 provided on first mating shell 51, and cooperating respectively with threaded holes 521 and 522 provided on second mating shell 52. Other
25 clamping means such as latch means may be provided to assemble and attach the mating shells together.

In a preferred embodiment of the invention, the mating shells 51 and 52 are shielded to electrically connect to the strands 32 of the cable 30. Shells 51 and 52 may be plastic molded and metallized thanks to MID (molded
30 interconnect device) techniques for example. The connector 20 may also be shielded.

Flange 400 of ferrule 40 may be sized to engage the mating shells 51 and 52 as shown in FIG 7C, e.g. in a slot in the shells (not shown), to improve

the electrical connection of the conductive shield to the mating shells 51 and 52. Flange 400 may also be formed to comprise "ears" for folding onto the outer surface of ferrule 10 and further improving the electrical connection of the conductive shield to the mating shells 51 and 52.

- 5 The strain relief means 10 may be plastic molded, and also metallized through MID techniques.

CLAIMS

1. A cable connector assembly for a cable (30) having one or more
5 insulated conductors (31) extending along a longitudinal direction, covered by
an insulating sheath (33), said assembly comprising:
- first (51) and second (52) shells connected together to form a cable
housing, said cable housing having a cavity (50) therein between said first
and said second shells,
 - 10 - first strain relief means (10) surrounding a segment of said cable, said first
strain relief means being retained in said cavity, when said first and second
shells are connected together,
- wherein said first strain relief means comprises at least first (11) and second
(12) portions, hinged together through hinge means (15), extending
15 substantially parallel to the longitudinal direction.
2. A cable connector assembly according to claim 1, further comprising
second strain relief means (40) arranged underneath said insulating sheath
(33) and substantially surrounding said one or more conductors (31).
3. A cable connector assembly according to one of the previous claims,
20 wherein first and second portions are semi circular shells (11, 12) adapted to
surround the segment of the cable when assembled around said segment.
4. A cable connector assembly according to one of the previous claims,
wherein the hinge means comprise an integral hinge (15) formed on one pair of
adjacent edges of first and second portions.
- 25 5. A cable connector assembly according to one of the previous claims 1-3,
wherein the first and second portions are separate portions attached together
through at least one hinge.
6. A cable connector assembly according to one of the previous claims,
wherein ribs (18) are provided on the inner surface of at least one of the first
30 and second portions of said first strain relief means (10) to clamp the segment
of the cable when the first and second portions are assembled around said
segment.

7. A cable connector assembly according to one of the previous claims, wherein grooves (180) are provided on the outer surface of at least one of first and second portions of said first strain relief means (10), and corresponding ridges are provided in the cavity of the cable housing, so that the first strain relief means (10) are retained in said cavity when said first and second shells are connected together
8. A cable connector assembly according to one of the previous claims, further comprising a connector (20) for connection to the conductors, said connector being received in an extension of the cavity of the cable housing.
9. A cable connector assembly according to one of the previous claims 1 to 8, wherein the cable further comprises a conductive shield (32) placed between the conductors (31) and the sheath (33), and wherein the sheath (33) has been removed on a segment of the cable adjacent the segment of the sheath (33) surrounded by the first strain relief means (10), the exposed conductive shield being folded against the outer surface of said first strain relief means, so as to come into contact with the inner surface of at least one of the first and second mating shells (51, 52), when said first and second mating shells are connected together.
10. A cable connector assembly according to claim 9 when dependent on one of the claims 2 - 8, wherein the second strain relief means (40) are arranged underneath said conductive shield (32) and surrounding said one or more conductors (31).
11. A cable connector assembly according to claim 10, wherein the second strain relief means (40) is formed and arranged so as to come into contact with the inner surface of at least one of the first and second mating shells (51, 52), when said first and second mating shells are connected together.
12. A cable connector assembly according to one of the claims 9-11, wherein the first and second mating shells (51, 52) are metallized.
13. A method to assemble a cable connector assembly according to one of the claims 1 or 3 to 12, wherein:
- a cable (30) is provided with at least one conductor (31) covered by an insulating sheath (33), the cable further comprising a conductive shield (32) interposed between said at least one conductor and said sheath,

- the sheath is removed on a first segment to expose the conductive shield,
 - the first strain relief means (10) is positioned around a second segment of the sheath adjacent the first segment, said first strain relief means surrounding said second segment of said cable,
- 5 - folding the exposed shield against the first strain relief means outer surface,
- connecting the first and second mating shells around the first strain relief means so as to retain said first strain relief means inside the cavity with the at least one strand in contact with at least one of first and second mating shells inner surface.
- 10 14. A method according to claim 13 to assemble a cable connector assembly according to one of the previous claims 2-12, wherein said second strain relief means (40) are arranged underneath said second segment of the sheath and surrounding said one or more conductors prior to positioning the first strain relief means (10).

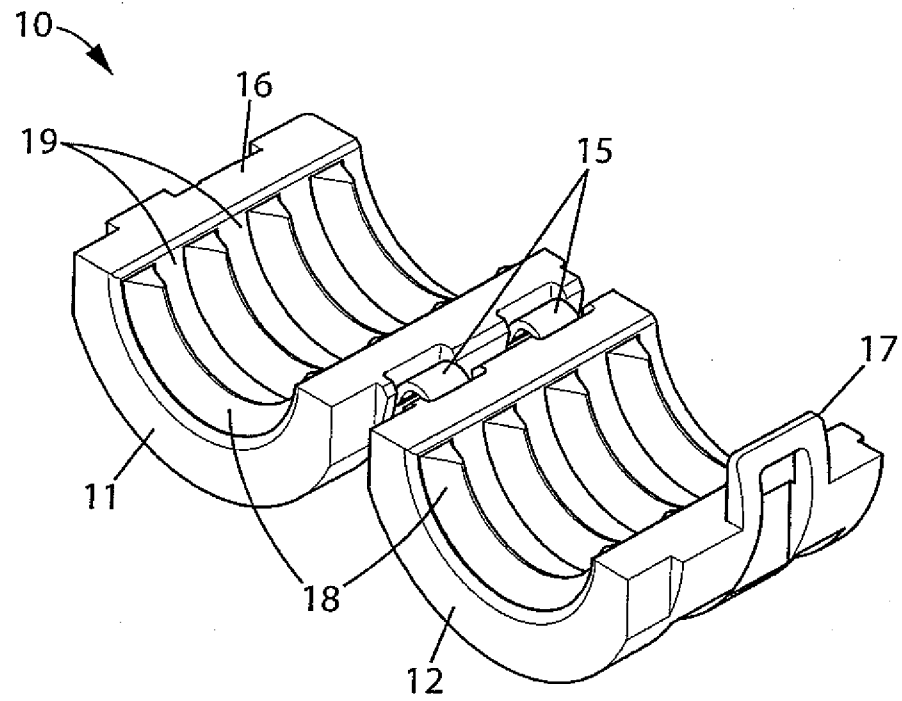


FIG. 1

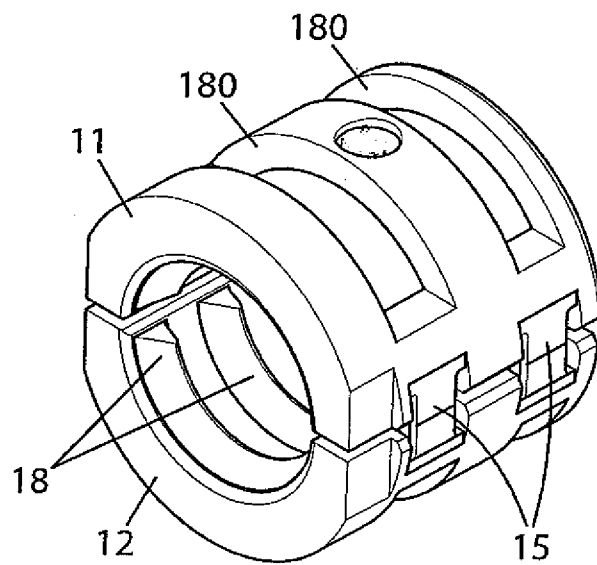


FIG. 2

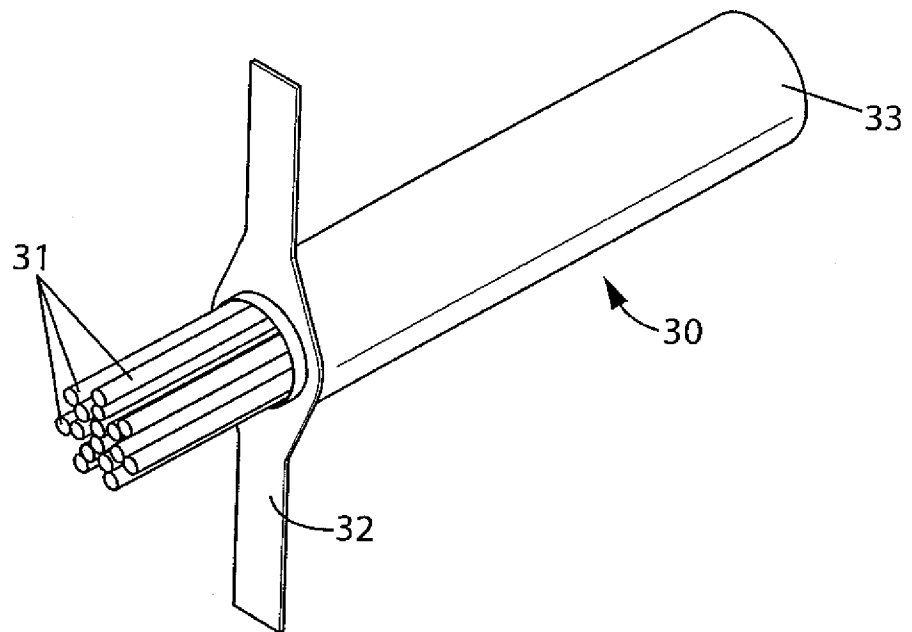


FIG. 3

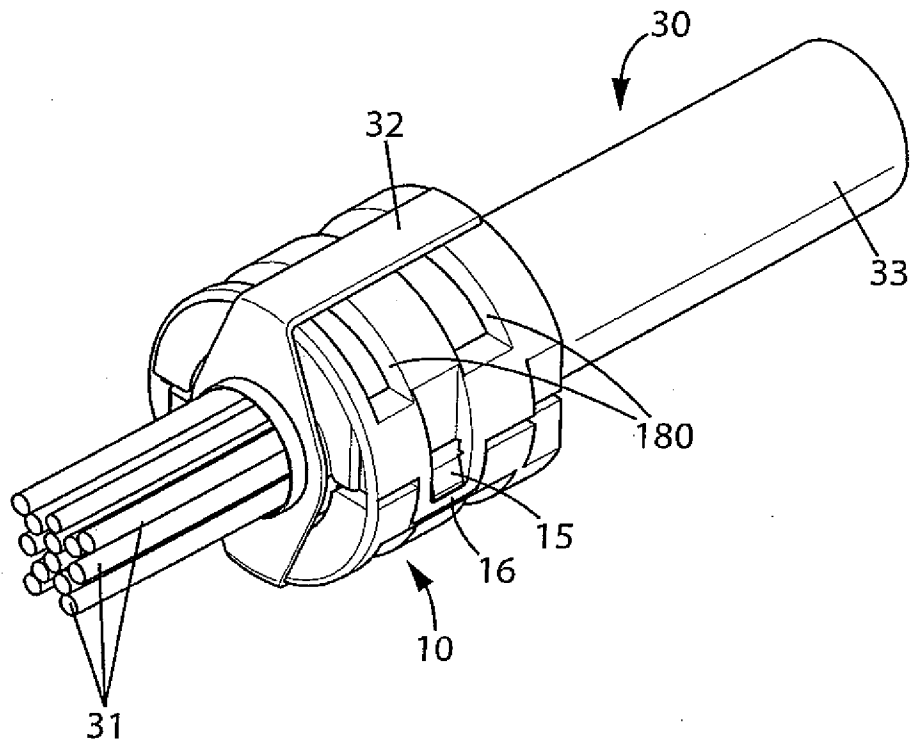


FIG. 4

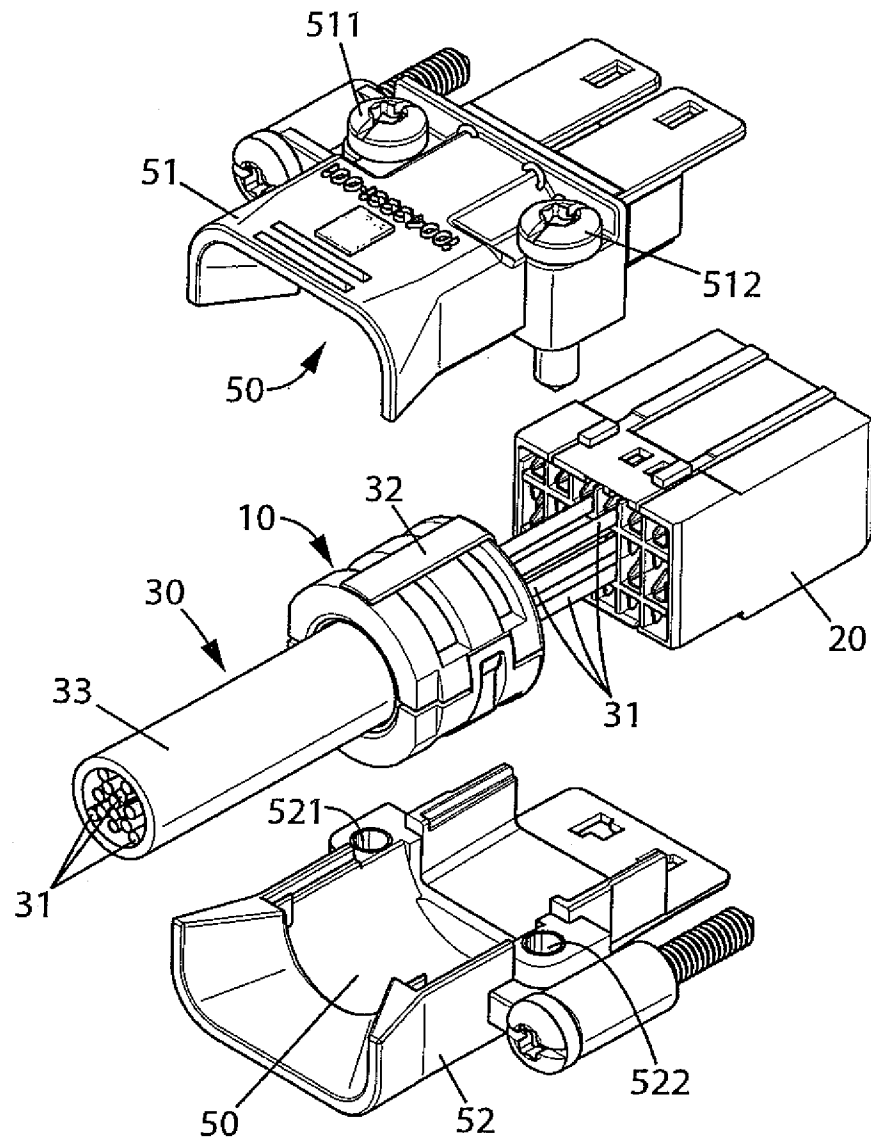


FIG. 5

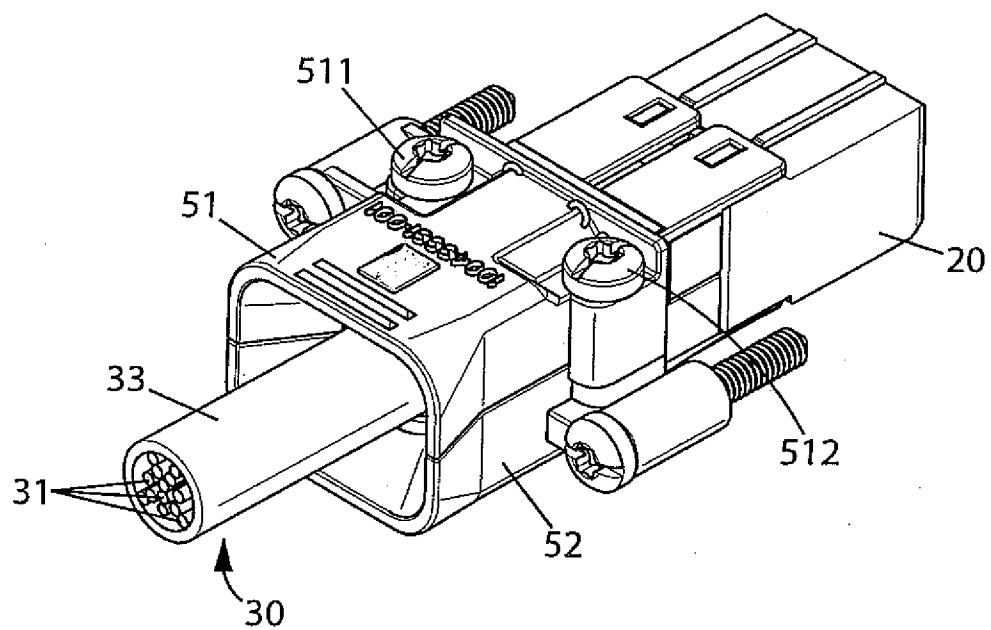


FIG. 6

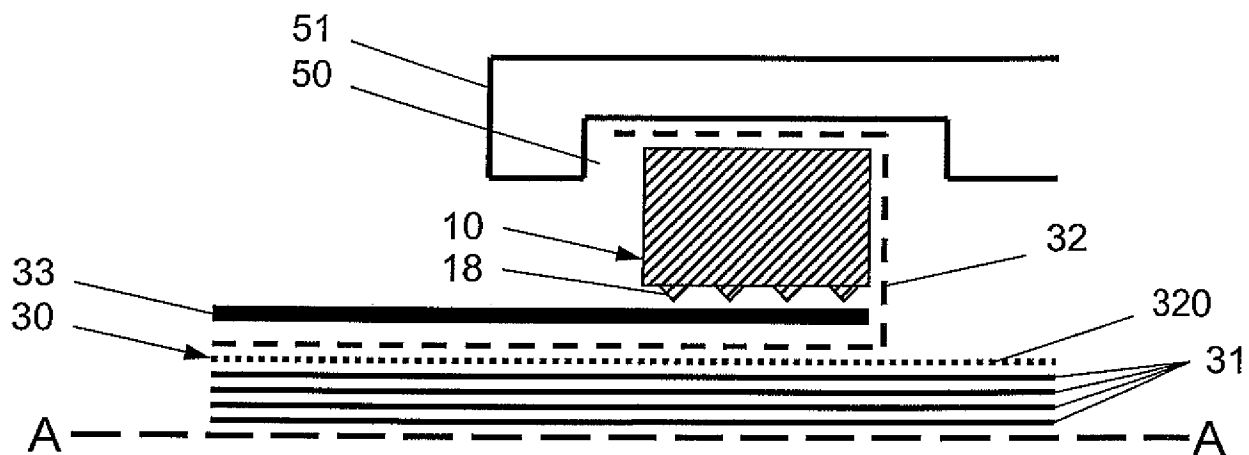


FIG. 7A

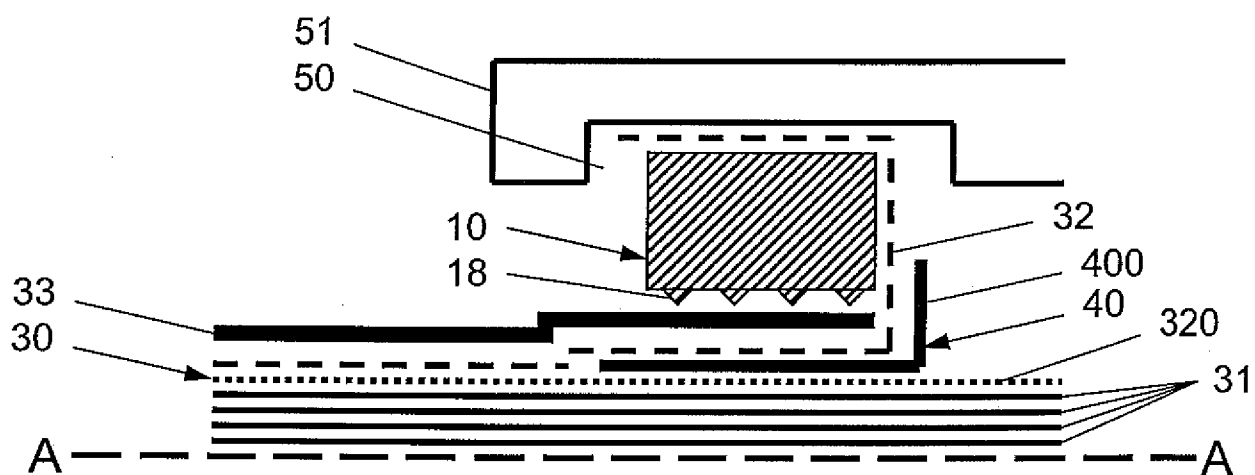


FIG. 7B

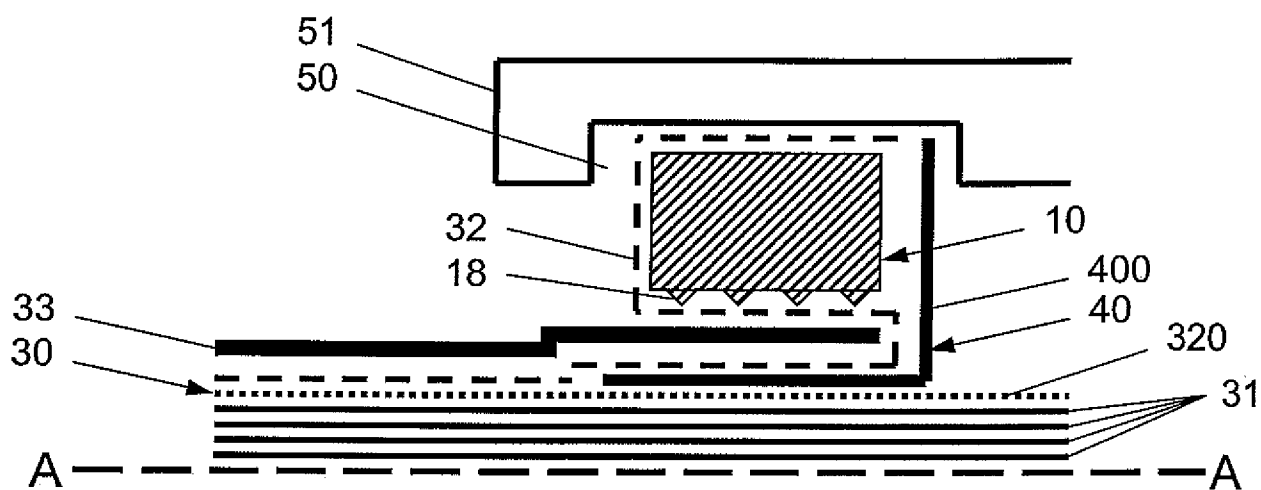


FIG. 7C

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2007/053270

A. CLASSIFICATION OF SUBJECT MATTER

INV. H01R13/58

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)

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	paragraph [0010] - paragraph [0018]	2,6,7,9-14
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Y	DE 297 23 498 U1 (EMSYS ELEKTROMECHANISCHE SYSTE [DE]) 24 September 1998 (1998-09-24) page 5 - page 6; figure 6	2,10,14
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☒ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents :

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Date of the actual completion of the international search

6 June 2007

Date of mailing of the international search report

14/06/2007

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Bertin, Michel

INTERNATIONAL SEARCH REPORT

International application No

PCT/EP2007/053270

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