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(54) **Electrical connector for braided cables**

(57) To attach a cable that comprises at least one conductor and a braid partially surrounding the conductor, a connector comprises a housing (4) having an opening (20) for receiving the cable, a recess (24) on an inner surface (22) of the opening (20), and a clamping member (30) for fixing the cable, the clamping member having a passageway (32) and is insertable into the recess (24). The clamping member (30) is adapted to be

insertable between the braid (34) and the at least one conductor so that the at least one conductor extends through the passageway (32) of the clamping member (30) and so that the braid (34) is pressed into the recess (24) when the clamping member (30) is inserted into the recess (24). The braid (34) is thereby folded in such a shape that a high friction is provided between the braid (34) and the housing.

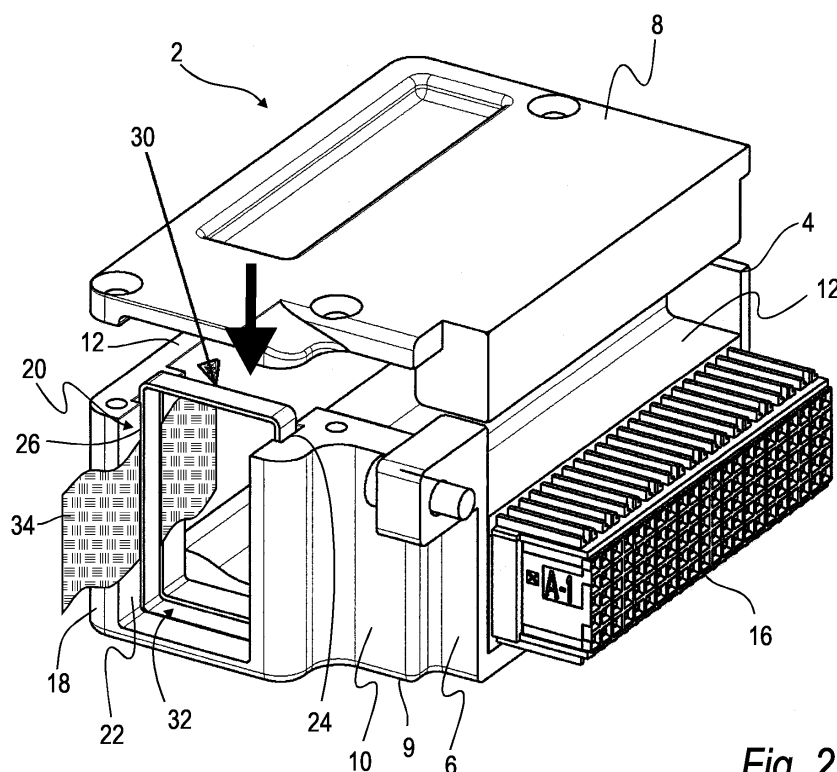


Fig. 2

Description

[0001] The present invention relates to electrical connectors and in particular to an electrical connector for braided cables and a connector assembly comprising an electrical connector and a braided cable.

[0002] Cables are used to interconnect electronic components or devices. A typical cable comprises one or more mutually insulated conductors, which are surrounded by an outer insulation jacket. A high-frequency cable further comprises a shielding surrounding the conductors. To reduce strain being exerted on the conductors when the cable is bent, twisted or pulled, a tension relief shell supplements the components of the cable.

[0003] If, for instance, a detachable electrical connection between a cable and an electronic component is desired, an electrical connector for terminating the cable is used to provide an standardised interface. A connector typically comprises a housing having contact members connected to the conductors. To minimise mechanical stress acting on the electrical contact members and their joints to the conductors, the outer insulation jacket and/or the tension relief shell of the cable is fixed to the housing of the connector so that strain acting on the cable is transmitted to the connector housing and not to the electrical contact members.

[0004] An example of an electrical connector is disclosed in US 5,895,292, which describes a connector system comprising a plug and a socket. The plug, which constitutes an electrical connector terminating a cable, is formed by a two-part housing having an opening on its rear end for inserting the cable. Both parts of the housing have a semicircular slot formed on their respective inner surfaces. The semicircular slots form a circular slot when both parts of the housing are assembled. The cable comprises a plurality of insulated conductors surrounded by an outer shielding which in turn is covered by a cable sheath. To connect the cable with the connector, the sheath of the cable is partially removed at one end of the cable to expose the shielding and the conductors. Further, a ring is pushed over the sheath and the shielding is folded back over the outer side of the ring. The thus prepared end of the cable is inserted into the housing of the connector with the ring being placed in the circular slot. Since the ring is firmly held by the circular slot the folded-back portions of the outer shielding are clamped between the ring and the slot to provide a strain relief for the cable.

[0005] The connector described above is adapted for cables having an outer cable sheath. However, for many applications cables are used which comprise one or more insulated conductors which are only surrounded by a braid, typically a woven or fabric braid.

[0006] It is therefore an object of the invention to provide an electrical connector for braided cables. It is a further object of the invention, to provide a connector with an improved stress relief.

[0007] This and other objects of the invention which

are apparent from the following description of the invention are solved by the connector according to claim 1 and the connector assembly according to claim 11.

[0008] According to the invention, the connector comprises a housing having an opening for receiving a cable, a recess on an inner surface of the opening, and a clamping member for fixing the cable. The cable comprises at least one conductor and a braid that at least partially surrounds the at least one conductor. The clamping member having a passageway can be inserted into the recess. For providing a stress relief, the clamping member is adapted to be insertable between the braid and the at least one conductor so that the at least one conductor extends through the passageway of the clamping member. Once the clamping member is inserted into the recess, the braid is pressed into the recess and thereby clamped between the clamping member and the recess. Typically, the conductor is insulated.

[0009] The braid is thus - generally speaking - attached to the housing by folding around at least one folding edge, which is formed by the recess or any other suitable structure formed on the inner surface of the opening. The clamping member forces the braid into the recess such that the braid preferably lines at least substantially the whole inner surface of the recess. The braid is thereby disposed or folded in such a configuration or shape that a high friction is provided between the braid and the housing. Since the recess runs perpendicular to the longitudinal axis of the cable the folding edge is also perpendicularly orientated with respect to the longitudinal axis of the cable. This ensures a maximum friction with respect to axial forces exerted on the braid. In addition to that, the braid is also fixed with respect to rotational or bending forces acting on the cable. The recess can also comprise further folding edges cooperating with the clamping member.

[0010] A further folding edge is typically provided by the clamping member. This further folding edge is arranged in the recess when the clamping member is inserted into the recess and also runs perpendicular to the longitudinal axis of the cable. The at least double folded braid is firmly clamped between the clamping member and the recess.

[0011] The clamping member is adapted to be insertable under the braid of already manufactured cables and provides therefore a versatile mean to firmly attach any prefabricated cable having a braid to a connector housing. Even cables, which do not have an outer jacket or sheath, can be easily fixed to the housing. Therefore, cables that only comprise a braid surrounding the conductors can be reliably attached to the connector. The clamping member, which is placed on the inner side of the braid, acts like a counterpart to the recess that surrounds the braid. Therefore, the outer shape of the clamping member corresponds to the inner surface of the recess. To allow the clamping member to be inserted into the recess, a small clearance is provided between

the clamping member and the recess, which substantially equals the thickness of the braid.

[0012] The recess preferably runs circumferentially along the inner surface of the opening to maximise the friction and to ensure an uniform fixation. Accordingly, the clamping member is preferably ring-like in shape.

[0013] To further improve the fixation of the braid, the recess is formed by a slot running along the inner surface of the opening. The slot provides a further folding edge and a more stable fit of the clamping member. In addition to that, the slot engages with opposite arranged edges of the clamping member inserted to ensure a folding of the braid along these edges.

[0014] According to a further aspect of the invention, the inner surface of the opening has a rectangular cross-section. Therefore, the recess or slot also runs in a rectangular manner and the clamping member has a corresponding outer rectangular-like cross-section. This arrangement provides an improved fixation of the braid with respect to rotational forces, and facilitates the insertion of the clamping member into the recess or slot. Preferably, the clamping member is insertable into the recess or slot in a direction perpendicular to the longitudinal axis of the cable.

[0015] Preferably, the passageway of the clamping member has substantially the same cross-sectional area as the opening of the housing. The inner surface of clamping member formed by the passageway is thus substantially coplanar with adjacent portions of the inner surface of the opening to avoid any edges or steps which could damage the at least one conductor.

[0016] To facilitate the insertion of the cable, the housing preferably has a base part and a cover part. Both parts together form the opening. Portions of the recess or slot are formed on both parts such that a continuous recess or slot is formed when these parts are assembled. Both housing parts are assembled after the clamping member has been inserted into the recess or slot of one of the two housing parts to fully encapsulate the clamping member and the braid.

[0017] To ensure a stable and reliable clamping of the braid, the clamping member is preferably made of a rigid material to provide sufficient rigidity and strength of the clamping member. In addition to that, the clamping member can be electrically conductive to improve electrical connection between the braid and the housing when the braid also functions as a shield. Therefore, a clamping member made of a metal and being ring-like in shape is preferred. In this case, the braid may be a woven metal mesh. If a shield is not required or provided by another shell of the cable, a woven or fabric braid preferably of synthetic fibres can be used.

[0018] According to a further aspect of the invention, a connector assembly comprises a housing having an opening, a cable having at least one conductor and a braid that at least partially surrounds the at least one conductor. The cable extends through the opening. A recess is formed on an inner surface of the opening into

which a clamping member is inserted to fix the cable. The clamping member is placed between the braid and the at least one conductor so that the at least one conductor extends through the passageway of the clamping member and so that the braid is pressed into the recess by the clamping member.

[0019] All aspects and advantages outlined above with respect to the connector apply mutatis mutandis to the connector assembly and are therefore not reiterated here to avoid superfluous repetition.

[0020] Having described some of the main features of the invention, a more detailed description of the invention, from which further features will come apparent, is set forth in the remainder of the specification in conjunction with the accompanying drawings which show in:

[0021] Figure 1 a perspective view of an opened connector;

[0022] Figure 2 the connector of Figure 1 with an inserted clamping member and a braid;

[0023] Figure 3 a top view of a slot of the connector with a clamping member and braid inserted thereto; and

[0024] Figure 4 a top view of a further embodiment of a slot.

[0025] Reference will now be made in detail to the presently preferred embodiments of the invention, examples of which are illustrated in the drawings. Each example is provided by way of explanation of the invention, and is not meant as a limitation of the invention. For example, features illustrated or described as part of one embodiment can be used on or in conjunction with other embodiments to yield a further embodiment. It is intended that the present invention includes such modifications and variations.

[0026] With reference to Figures 1, 2 and 3 an embodiment of an electrical connector 2 according to the invention is described which comprises a housing 4 having a base part 6 and a cover part 8. Base part 6 has a substantially rectangular base 9 and vertically extending lateral walls 10, 12 forming a cavity 14. On one of its two longer lateral walls 12 a plurality of contact members 16 is arranged, each of the contact members is adapted to receive a respective contact of a mating connector not shown. One of the two shorter lateral walls 10 of the base part 6 comprises an extension 18 extending from base 9 to an upper edge of the lateral wall 10. Extension 18 has an opening 20 that extends through the lateral wall 10 and runs from the upper edge of the lateral wall 10 nearly to the base 9 of base part 6. The opening 20 is rectangular in shape with rounded corners. On inner surface 22 of opening 20 a notch-like slot portion 24 is formed which runs in a U-like manner around opening 20. Slot portion 24 has two edges 26 and 28 running parallel to each other and perpendicular to the axis of a cable that extends through opening 20. Each edge constitutes a folding edge for folding a braid 34 of the cable or - in other words - to dispose the braid 34 in such a configuration that a high friction is provided between the braid 34 and the slot.

[0027] As shown in Figure 2, a rigid ring 30 is pushed into slot portion 24 from the open end of opening 20 perpendicular to the axis of the opening as indicated by the arrow in Figure 2. The inserted ring 30 constitutes in this embodiment the clamping member of the invention. In the fully inserted position, ring 20 projects above the upper edge of lateral wall 10 to engage with a slot portion correspondingly formed on the inner surface of cover part 8. Both slot portions form together the slot in which ring 30 is fully accommodated when the base part 6 and the cover part 8 are assembled. In this particular embodiment, cover part 8 is substantially plate-like in shape, covers the cavity 14 of base part 6 and closes the open end of opening 20. Cover part 6 is fixed to base part 8 by screws (not shown) to provide a detachable connection. However, other connection means allowing a detachable connection between base part 6 and cover part 8 are also possible.

[0028] Due to the extension 18, lateral wall 10 has an increased wall thickness such that the extension of the inner surface perpendicular to the inner wall is substantially increased. This enables the formation of a wide slot to increase the contact area between the braid 34 and the slot for improving the fixation of the braid 34.

[0029] The wall thickness of ring 30 substantially equals or is slightly less than the depth of slot 24 to allow a clearance between ring 30 and slot 30 when the ring 30 is inserted without a braid. The clearance is roughly adjusted to the thickness of the braid such that the inner surface of ring 30 and the inner surface 22 of opening 20 are coplanar when the ring is inserted together with the braid 34. In other words, the cross-section of opening 20 of the housing 4 equals the cross-section of ring-opening 32 which constitutes in this embodiment the passageway. The overall available passage area for the conductors of the cable is therefore not constricted and no edges or projections are introduced by the ring 30 on which the conductors passing through the passageway 32 could be damaged. Figures 1 and 2 show only a portion of a braid.

[0030] With reference to Figures 3 and 4, showing a top view of sketches of two embodiments of slot 24, the fixation principle of the invention is explained in more detail. The main difference between the embodiments shown is the width of the slot 24, which is adjusted to meet specific needs. For fixation of the cable, ring 30 is fully inserted under a braid 34 of a cable 36 from a free end of the braid 34 such that this free end extends beyond the ring 30 by a given amount to ensure that the braid can be folded on both edges of the ring. The insulated conductors 38 of the cable, one of which is illustrated in Figure 3, are surrounded by the ring and extends through the passageway 32. The thus prepared cable 36 is inserted into the housing 4 by sliding the ring 30 into slot 24 in the direction indicated by the arrow in Figure 2. Once the ring is fully inserted, cover part 8 is attached to base part 6 such that the slot portion formed on the inner surface of cover part 8 also engages with

ring 30. Ring 30 is now fully accommodated in slot 24 and hence clamps the braid in slot 24 along the circumferential outer surface of ring 30.

[0031] As indicated in Figures 3 and 4, slot 24 has folding edges 26 and 28 along which the braid is folded. Further folding edges are provided by ring 30 such that the braid 34 is folded outwardly in a U-shaped manner. This configuration provides a high friction in particular with respect of axial forces exerted on the braid 34 as indicated by arrows in Figure 4. A stretching of the braid 34 upon the exertion of axial forces will even increase the friction in particular on edge 26 arranged in the direction of the acting force. To ensure a sufficiently high friction, ring 30 presses the braid 34 into the desired shape in slot 30 to provide not only a contact along the edges but also a surface contact between ring, braid and slot. The perimeter of the ring should be such that it slightly exceeds the perimeter of the braid to provide a tight fit of the ring in the braid and to ensure that the braid is stretch-fitted into the slot. Any axial, lateral, bending or rotation forces acting on the cable are transmitted via the inventive fixation of the braid 34 to the housing 4 and thereby an effective strain relief is provided.

[0032] Preferably, woven or fabric braids are used since they exhibit a certain flexibility and elasticity for the desired stretch-fit. Further, woven and fabric braids allow an insertion into slot 24 perpendicular to the longitudinal axis of the cable as indicated by the arrows in Figure 2 since the mesh of the fibres prevents a pile up of individual fibres on the open end of the opening upon insertion.

[0033] When a shield is required, the braid can also be made of woven conductive fibres such as thin wires. In this case, both parts of the housing 4 are conductive as well and the ring presses the conductive braid in the slot of the housing to ensure a reliable electrical connection. Hence, two functions are provided by the clamping of the braid. The two functions are strain relief and electric contact.

[0034] Having described the invention by way of example, it will be evident to those skilled in the art that other embodiments and modifications are possible as well. For instance, the base and the cover part of housing 4 can be of the same size like symmetrically formed parts of a shell. Moreover, the clamping member can be of different shape or can comprise a corrugated outer surface corresponding to a corrugated surface of the slot or recess to even further increase the friction between the braid and the housing.

Parts List

[0035]

2	electrical connector
4	housing
6	base part

8	cover part	
9	base	
10, 12	lateral walls (10 short, 12 long)	
14	cavity	
16	contact members	5
18	extension	
20	opening	
22	inner surface	
24	slot portion / slot	
26, 28	folding edges (26 towards force)	10
30	clamping member / ring	
32	ring-opening / passageway	
34	braid	
36	cable	
38	conductor	15

Claims

1. Connector for a cable that comprises at least one conductor (38) and a braid (34) that at least partially surrounds the at least one conductor (38), the connector comprising
 - a housing (4) having an opening (20) for receiving the cable,
 - a recess (24) on an inner surface (22) of the opening (20), and
 - a clamping member (30) for fixing the cable, the clamping member (30) having a passageway (32) and being insertable into the recess (24),

wherein the clamping member (30) is adapted to be insertable between the braid (34) and the at least one conductor (38) so that the at least one conductor extends through the passageway (32) of the clamping member (30) and so that the braid (34) is pressed into the recess (24) when the clamping member (30) is inserted into the recess (24).
2. Connector of claim 1, **characterised in that** the recess (24) runs circumferentially along the inner surface (22) of the opening (20).
3. Connector of claim 1 or 2, **characterised in that** the clamping member (30) is ring-like in shape.
4. Connector of any of the claims 1 to 3, **characterised in that** the inner surface (22) of the opening (20) has a rectangular cross-section along which the recess (24) runs and **in that** the clamping member (30) has an outer rectangular-like cross-section that corresponds thereto.
5. Connector of any of the claims 1 to 4, **characterised in that** the recess (24) is formed by a slot (24) formed on the inner surface (22) of the opening (20).

6. Connector of any of the claims 1 to 5, **characterised in that** the passageway (32) of the clamping member (30) has substantially the same cross-sectional area as the opening (22) of the housing (4).
7. Connector of any of the claims 1 to 6, **characterised in that** the housing (4) has a base part (6) and a cover part (8) and **in that** the opening (20) is formed by both parts.
8. Connector of claim 7, **characterised in that** the clamping member (30) is insertable into the recess or slot (24) in a direction perpendicular to a longitudinal axis of the cable (36).
9. Connector of claim 7 or 8, **characterised in that** the recess or slot (24) is formed on the base part (6) and the cover part (8) .

10. Connector of any of claims 1 to 9, **characterised in that** the clamping member (30) is made of metal.

11. Connector assembly comprising

- a housing (4) having an opening (20),
- a cable (36) having at least one conductor (38) and a braid (34) that at least partially surrounds the at least one conductor (38), the cable (36) extending through the opening (20),
- a recess (24) on an inner surface (22) of the opening (20), and
- a clamping member (30) for fixing the cable (36), the clamping member (30) having a passageway (32),

wherein the clamping member (30) is inserted between the braid (34) and the at least one conductor (38) so that the at least one conductor (38) extends through the passageway (32) of the clamping member (30) and in that the braid (34) is pressed into the recess (24) by the clamping member (30).

12. Connector assembly of claim 11, **characterised in that** the recess (24) is formed by a slot (24) running along the inner surface (22) of the opening (20).

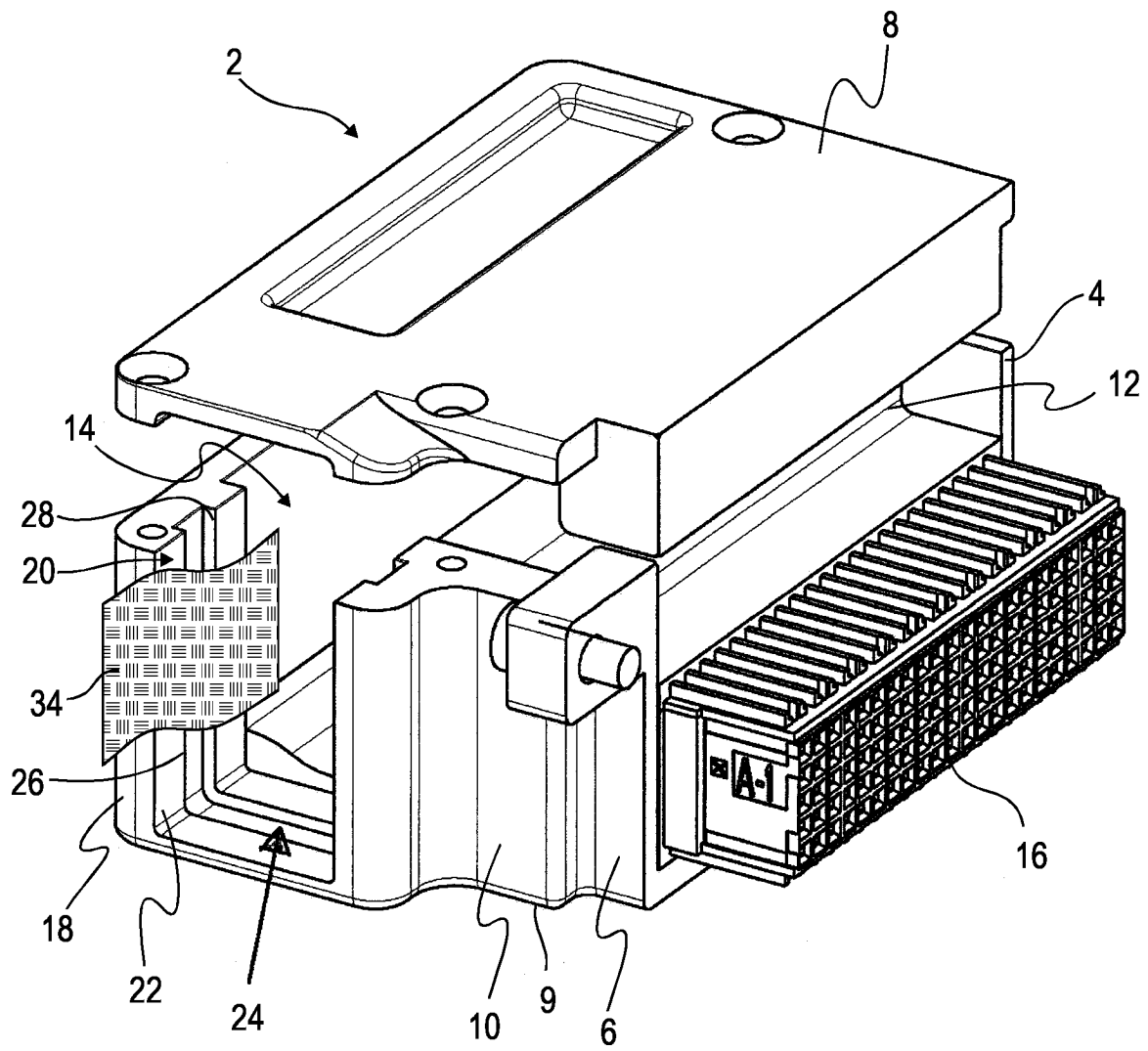


Fig. 1

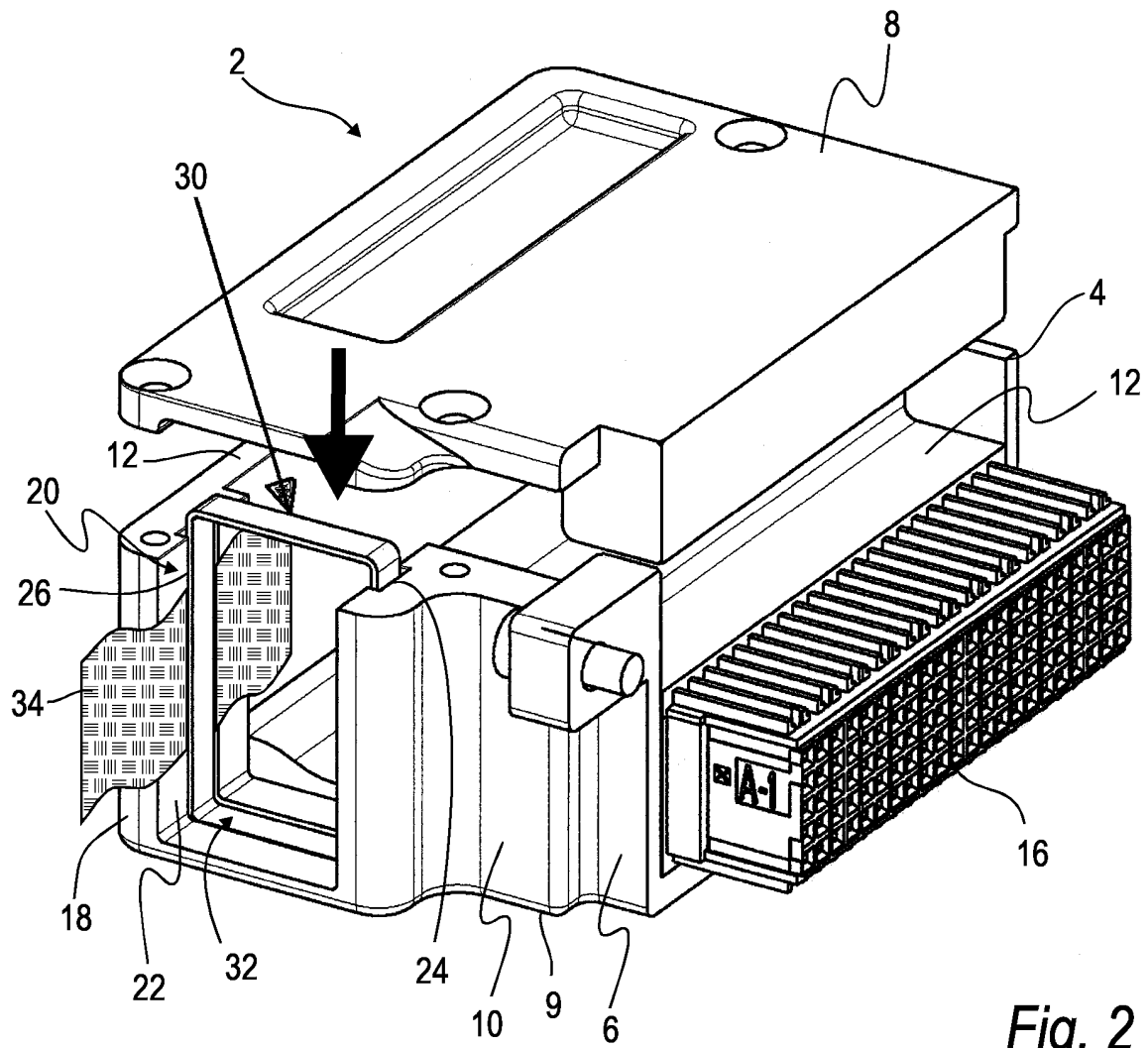


Fig. 2

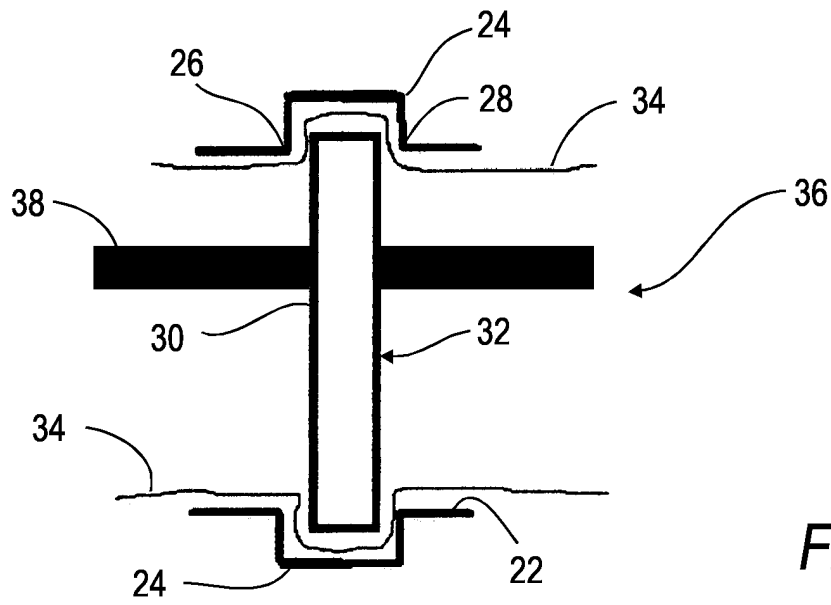


Fig. 3

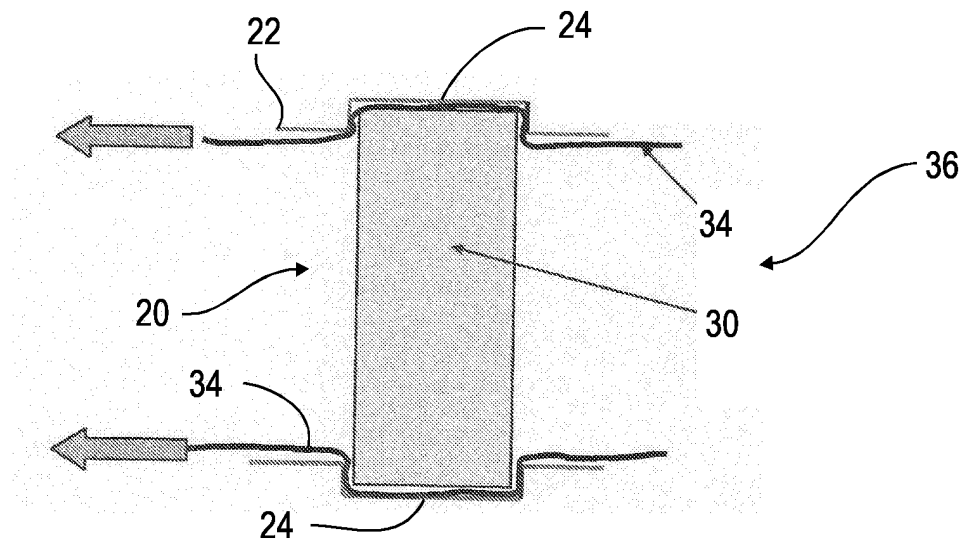


Fig. 4



European Patent
Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 10 3410

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.7)
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			TECHNICAL FIELDS SEARCHED (Int.Cl.7)
			H01R
The present search report has been drawn up for all claims			
Place of search Berlin		Date of completion of the search 25 August 2005	Examiner Alexatos, G
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 05 10 3410

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
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25-08-2005

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