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(11) **EP 1 182 741 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
27.02.2002 Bulletin 2002/09

(51) Int Cl.7: **H01R 13/58**

(21) Application number: **01202700.9**

(22) Date of filing: **16.07.2001**

(84) Designated Contracting States:
**AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU
MC NL PT SE TR**
Designated Extension States:
AL LT LV MK RO SI

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(30) Priority: **23.08.2000 EP 00202950**

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(54) **Electrical connector**

(57) The invention concerns an electrical connector 1 for arrangement at one end of an electrical conductor 2, in particular a flat conductor for a motor vehicle, which includes first and second housing portions 3, 4 which can be attached to each other releasably and in which are provided at least one electrical contact portion 5 and tension relief means 8 for the electrical conductor 2.

It is an object of the invention to provide an easy-to-assemble electrical connector which, with little installation space required, allows improved tension relief of the electrical contact portions 5 even when the electrical conductor 2 within the scope of use or installation by the

vehicle manufacturer is not handled with the necessary care.

The object is achieved by the fact that the two housing portions 3, 4 as a result of a lateral displacement, perpendicularly to a longitudinal axis α of the conductor, can be attached to each other releasably by latch means 6, and that for tension relief there is provided at least one retaining arm 9, 10, 11 on the side of the housing portions, which at least partially engages in a conductor loop 12 within the scope of the lateral displacement.

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Description

Technical Field

[0001] The invention concerns an electrical connector with the characteristics of the introductory part of claim 1.

Background of the Invention

[0002] Connectors of this kind are basically known and include two housing portions and at least one electrical contact portion for the contacting of electrical cores of a conductor, in particular a flat conductor. Furthermore basically there is provision of tension relief means which is intended to keep mechanical forces away from the electrical contacting in the region of the contact portion. The location of use of such connectors is basically not limited. A preferred location of use is in motor vehicles for the electrical connection of electrical units such as for example door locking modules, window winders or the like, in particular also using CAN bus technology.

[0003] In particular within the scope of vehicle assembly operations in locations that are not readily accessible or when the conductor path on the vehicle side is highly twisted, during vehicle assembly it is difficult to prevent unacceptably high tensile forces from being transmitted to the conductor and from the latter via a crimp point which is usually provided to an electrical contact portion. This may result in a breakdown of electrical contacting, or pulling out of a crimp point.

Summary of the Invention

[0004] One object of the present invention is to improve known connectors to overcome the above problem. It is a further object of the invention to provide an easy-to-assemble electrical connector which, with little installation space required, allows improved tension relief of the electrical contact portions. One aim in this connection is also to increase the maximum permitted tensile forces. In particular, electrical contact which is optimised under all circumstances is to be provided, even when the handling of a prefabricated (that is, provided with connector) electrical conductor within the scope of use or installation by the vehicle manufacturer is not done with the necessary care.

[0005] These objects are achieved according to the invention by the fact that the two housing portions as a result of a lateral displacement, perpendicularly to a longitudinal axis of the conductor, can be attached to each other releasably by latch means, and that for tension relief there are provided at least one retaining arm on the side of the housing portions, which at least partially engage in a conductor loop within the scope of the displacement in the lateral direction.

Brief Description of the Drawings

[0006] The present invention will now be described, by way of example, with reference to the accompanying drawings, in which:-

Figure 1 is a perspective view of a first embodiment of electrical connector in accordance with the present invention;

Figure 2 is a sectional view on the line II-II of Figure 1;

Figure 3 is a sectional view on the line III-III in Figure 2;

Figure 4 is a perspective view of the first housing portion of the electrical connector of Figure 1 in an assembly step after loop formation and before fitting the second housing portion;

Figure 5 is a perspective view of the second housing portion of the electrical connector of Figure 1;

Figure 6 is a perspective view of the first housing portion of a second embodiment of electrical connector in accordance with the present invention;

Figure 7 is a sectional view on the line VII-VII of Figure 8;

Figure 8 is a side view of the assembled second embodiment of electrical connector with the flat conductor omitted for clarity;

Figure 9 is a perspective view of the first housing portion of a third embodiment of electrical connector in accordance with the present invention; and

Figure 10 is a cross-sectional view of the assembled third embodiment of electrical connector.

Description of the Preferred Embodiment

[0007] A connector 1 in accordance with the present invention is located prefabricated at one end of an electrical conductor 2 shown only partially (Fig. 1). The electrical conductor 2 is a cable, preferably after the fashion of a data bus flat conductor with several electrical cores arranged adjacent to each other. The conductor 2 is for example constructed as a FPC or FFC (flexible printed circuit / flexible flat circuit) and preferably serves for electrical connection of electrical units in a motor vehicle using the CAN protocol. An essential advantage of such flat conductors is their suitability for very restricted installation spaces. Basically the connector 1 is inserted in a corresponding companion part, in particular a connector terminal, not shown, on a central control unit, or on the aforementioned units or on another conductor.

[0008] As can be seen, the connector 1 is largely cuboid and includes a first housing portion 3 and a second housing portion 4 which are releasably attached to each other. The thickness of the connector 1 (in the z direction) is substantially smaller compared with its width in the transverse direction (cable width, y axis). Inside the housing portions 3, 4 is located at least one electrical contact portion 5 which is preferably made of

sheet metal material as a stamped/bent component, and means 8 for tension relief of the conductor 2. These characteristics are shown in the form of the preferred embodiment in greater detail in Figures 2-5.

[0009] In Figure 1 can also be seen a latch arm 6 with at least one latch protuberance which serves for releasably locking the whole electrical connector 1 to a connector terminal, not shown, a connector-in socket or the like.

[0010] As can be seen, the two housing portions 3, 4 are attached to each other releasably in the lateral direction (y axis), perpendicularly to a longitudinal axis a of the conductor as well as parallel to the conductor width, by latch means (latch arms 28, 29).

[0011] In Figures 4 and 5 can be seen tension relief means 8 for the conductor 2. This consists according to the embodiment shown of a total of three retaining arms 9, 10, 11 on the side of the housing portions, which at least partially engage in a conductor loop 12 within the scope of a lateral displacement of the two housing portions 3, 4. As can be seen, the conductor 2 in the region of the retaining arms 9-11 in the widest sense has a double S shape (two S curves one behind the other), and in the region of each of its changes of direction 13, 14, 15 it abuts by a particular section against a segment of the outer circumference of one of the retaining arms 9-11. As a result, the loop 12 has a substantially Ω shape. The loop-like change of direction of the conductor 2 causes force and friction conditions which lead to a transmission of tensile force to the housing components 3, 4 and from the latter via the latch arm 6 to a connector terminal or the like. In other words, no electrical contact portion 5 is located within the force flux of tensile forces which are exerted on the conductor 2, because such forces are diverted directly to the housing portions 3, 4 before they can reach a contact portion 5. Thus tensile forces which may be exerted on the conductor 2 for example within the scope of the wiring of motor vehicles have no effect on electrical contacting. It should be pointed out here that three retaining arms 9-11 are basically not absolutely necessary, but that with a suitable geometrical layout generally a smaller number of retaining arms is enough to obtain the tension relief effect. Basically (assuming a correspondingly sharp deflection of the conductor 2 with correspondingly large angle of wrap) a single retaining arm is sufficient to obtain a tension relief effect as a result of self-locking according to the invention. However, a plurality of retaining arms cause greater protection against failure in the event of one or more of the arms breaking under stress.

[0012] As the figures further show, the first housing portion 3 has a first lateral guide groove 16 for guide sections 17 of the second housing portion 4. Furthermore a second guide groove 18 is provided for second guide sections 19 of the second housing portion 4. These guide sections 17, 19 allow reliable, easy and mechanical connector assembly. In the view according to Figure 1 it can be seen that the two guide grooves 16,

18 have a different cross-section. A first groove 16 has a rectangular cross-section, while the other groove 18 (compared with the first groove 16) in addition to altered size ratios also has a sloping surface 20 at the bottom. Also the grooves 16, 18 are arranged asymmetrically. All these measures, of which basically just one on its own would be sufficient, serve to allow connection of the first housing portion 3 to the second housing portion 4 in only one configuration and position. If consequently within the scope of mechanical assembly there are sizing errors in the supply of parts, incorrect assembly is nevertheless prevented.

[0013] As in particular Figure 4 shows, the two retaining arms 9, 10 provided on the first housing portion 3, 4 are provided in the lateral direction of extent as well as parallel to each other (and to the conductor width) and each have a free end 20, 21 which has a conical section 22, 23 facilitating assembly or some other reduction of cross-section. With this free end 20, 21 each of the retaining arms 9, 10 on the side of the housing portions engages in the assembled state in one associated recess 24, 25 of the other housing portion 4, so that there is reliable support of each retaining arm 9, 10 at each of its ends 20, 21. The embodiment shown in the figures is characterised in that the conductor loop 12 to a certain extent can be fed laterally into the slot 26 between the two retaining arms 9, 10, which slot 26 is open at one end. A further slot 27 in the second housing portion 4 allows passage of the conductor. This passage can if necessary, as moreover can the whole connector, be sealed.

[0014] It goes without saying that according to an embodiment not shown in the figures it is also possible to join together the two free arm ends, so that the retaining arms (in the unassembled state) have a greater bending resistance. In such a case the conductor loop 12 must be introduced in the direction of the longitudinal axis a of the conductor (to a certain extent axially) into the slot. In any case the conductor is passed through automatically with a suitable tool die.

[0015] A third retaining arm 11 provided on the second housing portion 4 is shown in detail in Figure 5. It should be noted that a centre-to-centre distance b between the two retaining arms 9, 10 (of the first housing portion 3) is smaller than the diameter of the third retaining arm 11. The precise centre-to-centre distance b here depends essentially on the thickness and flexibility of the FPC conductor. Moreover the third retaining arm 11 is offset laterally, in the direction of thickness, from the retaining arms 9, 10 which are aligned with each other. As a result of this arrangement, as can be seen in Figure 4, the two aligned retaining arms 9, 10 bring about the first 13 and last 15 of the above-mentioned S curves respectively, while the other (to a certain extent eccentric) retaining arm 11 is responsible for the central deflection 14. This Figure 5 finally also clearly reveals the two different first and second guide sections 17, 19 as well as two latch arms 28, 29 for lateral latch fastening of the

two housing portions 3, 4. The latch fastening can be seen even more clearly in Figure 3. Accordingly, in a wall of the first housing portion 3 for each latch arm 28, 29 is provided a latch recess 30 which has a slope 31 on the introduction side. The slope 31 together with a ramp 32 on the latch arm 28, 29 facilitates introduction and elastic deformation of the latch arm 28, 29 until the latter engages with a latch edge 33 behind the latch recess 30. Laterally of the latch arm 28, 29 the first housing portion 3 has recesses which allow control of the snap-fitted latch arms 28, 29. Naturally the latch arm 28, 29 can be pushed back, for example for dismounting, so that the form-locking effect of the latch arm 28, 29 is eliminated. Laterally mounted ribs 34 in the region of the latch recess 30 protect against accidental release. It should be pointed out that ribs with the same function can also be provided for the latch arm 6 for attachment of the whole electrical connector 1 to a connector terminal.

[0016] Referring to Figure 2, an electrical contact portion 5 made of sheet metal strip material arranged in a partially closed recess 40 of the first housing portion 3, with two elastically yielding contact arms 41, 42. Ribs 43, 44 between each pair of contact arms 41, 42 serve for reliable separation and insulation from each other. As can be seen, the contact portion 5 has at its arm end a certain axial clearance c from a terminal axial boundary 45. No special locking is required in this direction because in this respect only minor pull-off forces (on separation of the connector-in connection) arise, which are moreover taken up by the tension relief means. On the other side each contact portion 5 has at least one elastically radially outwardly pointing spring tongue 46 which engages behind a bottom wall 49 provided on a bottom 47 of a supply channel 48 for the contact portion 5. The spring tongue 46 thus resists pulling out of the contact portion in the direction of the conductor axis a in form-locking relationship. In connection with the guide section 19 engaging radially inwardly in the guide groove 18, a redundant axial form-locking means (second locking means) is provided in the event that the spring tongue 46 fails. As the figure shows, the guide section 19 in the axial direction at least partially blocks the supply channel 48. This means that the contact portion 4 (if the spring tongue 46 breaks) in any case can fit by a rear side 49 against a front 50 of the guide section 19. Thus the connector 1 has extremely stable behaviour even if the tension relief means 8 breaks, and the whole of the tensile force is transmitted via the contact portion 5 to the housing portions 3, 4. As the figure finally reveals, several bent crimp points 51, 52, 53 are provided for electrical contacting and attachment of the contact portion 5 to the conductor 2. Each crimp 51-53 is originally for example angled in a U shape and in each case passes with two arms through the conductor, which are finally bent round at the ends.

[0017] Furthermore the figure shows for optimisation of passage of the conductor a profile which is to some

extent trihedral for the two aligned retaining arms 9, 10, and a round profile for the retaining arm 11 of the second housing portion 4. The retaining arm 11 moreover engages with a free end 54, which is not conical in the embodiment, in a recess of the first housing portion 3. Laterally protruding grip sections 55, 56 or recessed gripping indentations allows easy dismounting of the connector 1.

[0018] In Figure 6 can be seen a modified embodiment of the invention suitable for two flat conductors, wherein automatically operating means for loop formation are also associated with two retaining arms 57, 58 for two flat conductors, not shown. This is made possible by first insertion surfaces 59, 60 which are provided terminally on each of the retaining arms 57, 58, and cooperate with respectively associated second insertion surfaces 61, 62 on the first housing portion 63. One flat conductor is in this case fed slightly (to right or left) off a centre point 64 which is preferably tapered like a cutting edge between the two retaining arms 57, 58 until the conductor is diverted on one first insertion surface 59 or 60 and, on account of the action of the latter, pulled laterally outwards to form a loop. With the continuing lateral displacement of flat conductor and housing portion 63, the flat conductor then impinges on the associated second guide surface 61 or 62 which in the widest sense extends around the retaining arm 57 or 58 concerned, and is inclined inwardly in a direction towards a housing slot 65, but in any case leaves a passage free for the flat conductor. The continuing slide-off operation thus leads to automatic introduction of the flat conductor into the passage and the slot 65, being simultaneously wound by a loop around a retaining arm 57, 58, which retaining arm 57, 58 engages in the loop. In other words, loop formation arises quasi-automatically by simple lateral displacement of flat conductor and first housing portion 63 towards each other.

[0019] It should also be added that the inclination of every second guide surface 61, 62 is rotated from the inclination of the associated first guide surface 59, 60 (Fig. 7).

[0020] In Fig. 8 is finally shown a connector 68 according to the second embodiment, consisting of first housing portion 63, second housing portion 66, and electrical contact portion 67 (with non-deformed crimp arms). By contrast with the first embodiment, the guide means for the two housing portions 63, 66 are here arranged symmetrically so that the construction of a plastic injection moulding tool for manufacture of the housing portions 63, 66 is significantly simplified. These measures can however be converted according to the characteristics of the first embodiment if reliability of assembly is important. Moreover all the characteristics of the first embodiment, particularly also concerning guiding and latching of the two housing portions 63, 66 and the connector on a terminal, can be provided without departing from the invention. A description of them and presentation in detail have however been dispensed

with for the sake of a simplified overview, although equivalent parts have been given the same reference numerals.

[0021] Referring to Figures 9 and 10, the third embodiment of electrical connector 70 is also suitable for two flat conductors 2. The first housing portion 72 comprises a first part 74, and a second part 76 which is attached to the first part by a film hinge 78. The second part 76 has a retaining arm 80 adjacent the free end 82 which extends in the lateral direction as described above. The first part 74 has a groove 84 formed therein which extends in the lateral direction, and which corresponds in shape and size to the retaining arm 80. The retaining arm 80 and the groove 84 have a curved surface. The second part 76 makes a snap fit with the first part 74 by way of a latch tab 86 engaging in an aperture 88. The second housing portion 66 and electrical contact portion 67 are substantially identical to the corresponding parts of the second embodiment shown in Figure 8. The second housing portion 66 is inserted into the first housing portion 64 in the lateral direction, and the second part 76 is snap fitted to the first part 74. The flat conductors 2 are positioned adjacent the groove 84. The flat conductors 2 are pushed by the retaining arm 80 into the groove 84 to automatically form the conductor loop 12. Other features of the third embodiment, such as the guiding and latching of the two housing portions 72, 66 are provided, but not described in further detail.

[0022] It is true of all conceivable embodiments that the lateral displacement described within the scope of manufacture can both be caused by the fact that the conductor 2, in particular a film-like conductor, is unrolled from reels, and then laterally the two housing portions 3, 4, 63, 66, 72 are fitted on. It is however equally conceivable to fix at least one housing portion 3, 63, 72 laterally, and then to insert the conductor 2 and subsequently the other housing portion 4, 66 laterally. In any case insertion surfaces 59, 60, 61, 62, or arm 80 and groove 84, facilitate introduction of the conductor 2 as well as loop formation substantially, because separate tools for conductor loop formation can be eliminated.

Claims

1. Electrical connector (1, 68) for arrangement at one end of an electrical conductor (2), in particular a flat conductor for a motor vehicle, which includes first and second housing portions (3, 4, 63, 66) which can be attached to each other releasably and in which are provided at least one electrical contact portion (5, 67) and tension relief means (8) for the electrical conductor (2), **characterised in that** the two housing portions (3, 4, 63, 66) as a result of a lateral displacement, perpendicularly to a longitudinal axis (a) of the conductor, can be attached to each other releasably by latch means (28, 30), and **in that** for tension relief in the direction of the lon-

gitudinal axis (a) of the conductor there is provided at least one retaining arm (9, 10, 57, 58) on the side of one of the housing portions, which at least partially engages in a conductor loop (12) within the scope of a displacement in the lateral direction (y axis).

2. Electrical connector according to claim 1, wherein the first housing portion (3, 63) is provided with at least one lateral guide groove (16) for guide sections (17) of the second housing portion (4, 66).

3. Electrical connector according to claim 1 or 2, wherein the first housing portion (3, 63) is provided with a second guide groove (18) for second guide sections (19) of the second housing portion (4, 66).

4. Electrical connector according to any one of the preceding claims, wherein the two guide grooves (16, 18) have a different cross-section and/or different size and/or an arrangement asymmetrical to each other or to the second housing portion (4).

5. Electrical connector according to claim 1, wherein several retaining arms (9, 10, 11, 57, 58) extend in a lateral direction and are arranged parallel to each other.

6. Electrical connector according to any one of the preceding claims, wherein two retaining arms (9, 10, 57, 58) are arranged on the first housing portion (3, 63) and aligned with each other in the direction of the lateral direction.

7. Electrical connector according to any one of the preceding claims, wherein at least one of the retaining arms (57, 58) has a first sloping insertion surface (59, 60) for the conductor.

8. Electrical connector according to claim 7, wherein the first insertion surface (59, 60) has a three-dimensional sloping surface for loop formation within the scope of the lateral displacement.

9. Electrical connector according to claim 7 or claim 8, wherein associated with each first insertion surface (59, 60) is a second insertion surface (61, 62) on the side of the housing portions.

10. Electrical connector according to any one of claim 7 to 9, wherein the insertion surfaces (59, 61; 60, 62) associated with each other have rotated directions of inclination.

11. Electrical connector according to any one of claims 6 to 10, wherein a third retaining arm (11) parallel to the other two retaining arms (9, 10) is provided on the second housing portion (4).

12. Electrical connector according to claim 11, wherein each of the retaining arms (9, 10, 11, 57, 58) of one housing portion (3, 4, 63, 66) engages by a free end (20, 21, 54) in a recess (24, 25) of a wall of the other housing portion (3, 4, 66, 63). 5
13. Electrical connector according to claim 11 or claim 12, wherein a centre-to-centre distance (b) between the two retaining arms (9, 10) of the first housing portion (3) is smaller than the diameter of the third retaining arm (11), and in that the third retaining arm (11) is offset from the other two retaining arms (9, 10). 10
14. Electrical connector according to any one of claims 1 to 4, wherein the first housing portion (72) comprises a first part (74) and a second part (76), the second part being attached at one end by a film hinge (78) to the first part, the retaining arm (80) being formed on the second part adjacent its free end (82), and the first part having a corresponding groove (84) formed therein for receiving the retaining arm, the conductor loop (12) being between the surfaces of the groove and the retaining arm. 15
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15. Electrical connector according to any one of the preceding claims, wherein each first housing portion (3) for the attachment of at least one electrical contact portion (5) has a bottom wall behind which engages at least one resilient spring tongue (46), and in that for the electrical contact portion (5) is provided a supply channel (48) in which a section of the second housing portion (4) engages axially at least partially. 30
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16. Electrical connector according to any one of the preceding claims, wherein the second housing portion (4) has at least one laterally protruding, particularly two mutually opposed gripping heels (56, 57), or two laterally recessed and mutually opposed gripping indentations for lateral displacement. 40

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Fig.1.

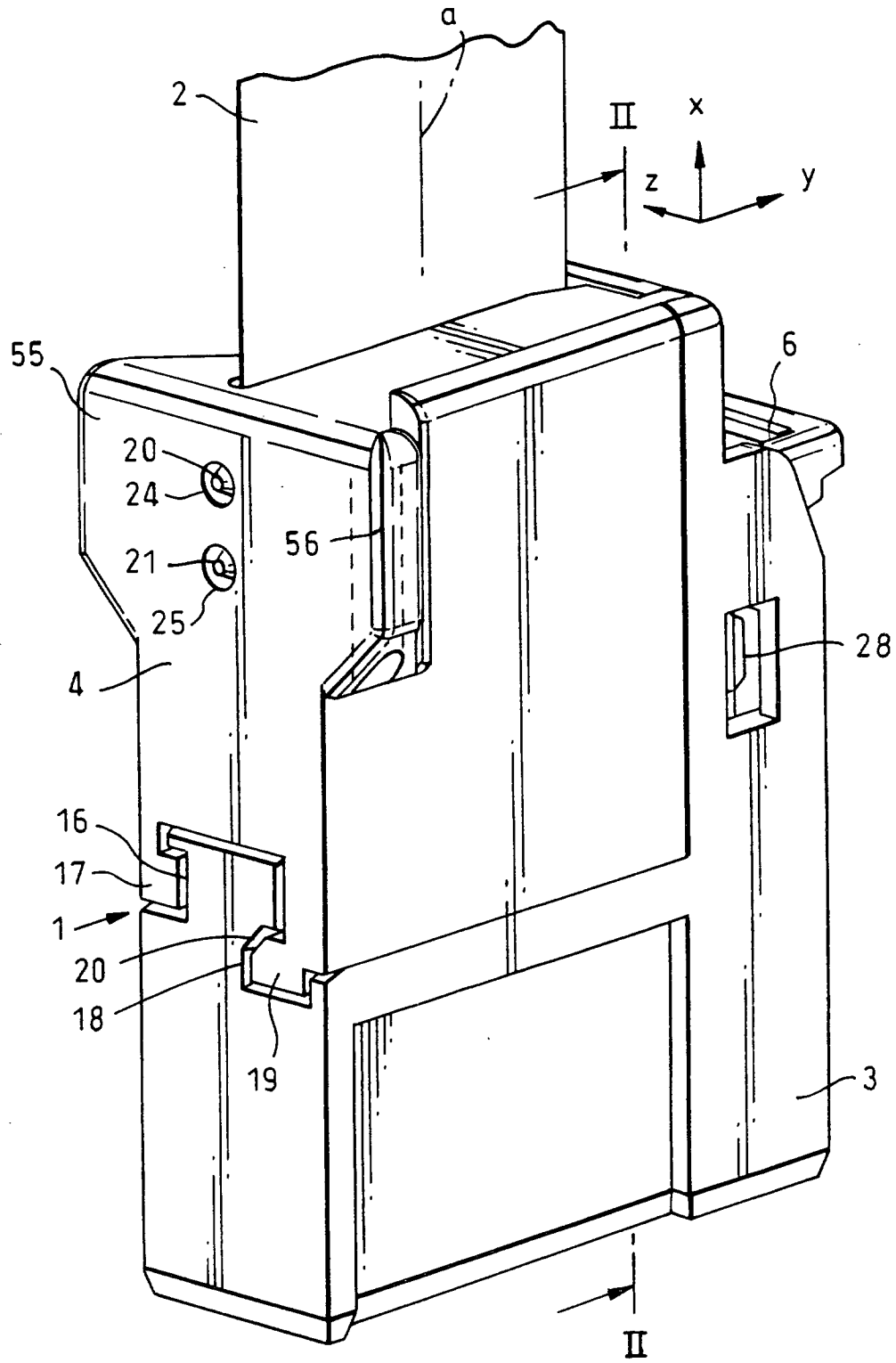


Fig.2.

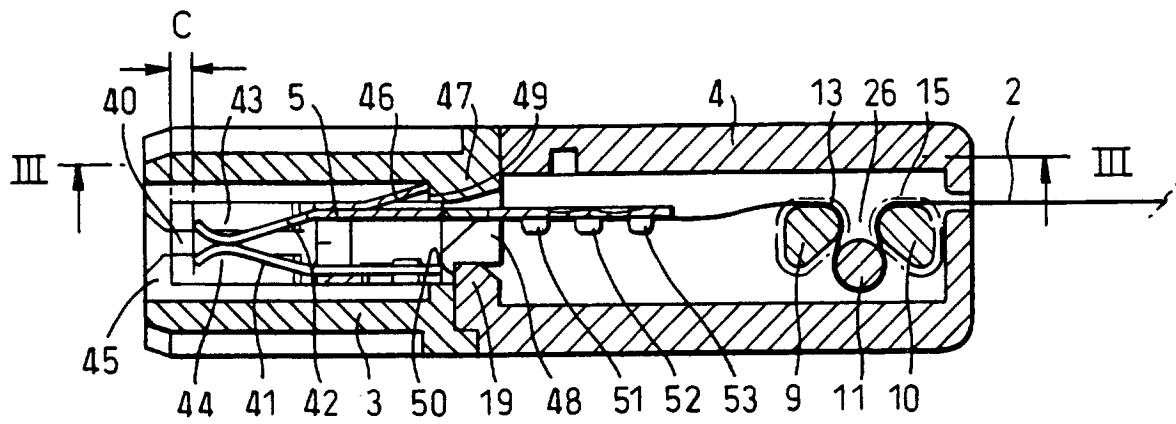


Fig.3.

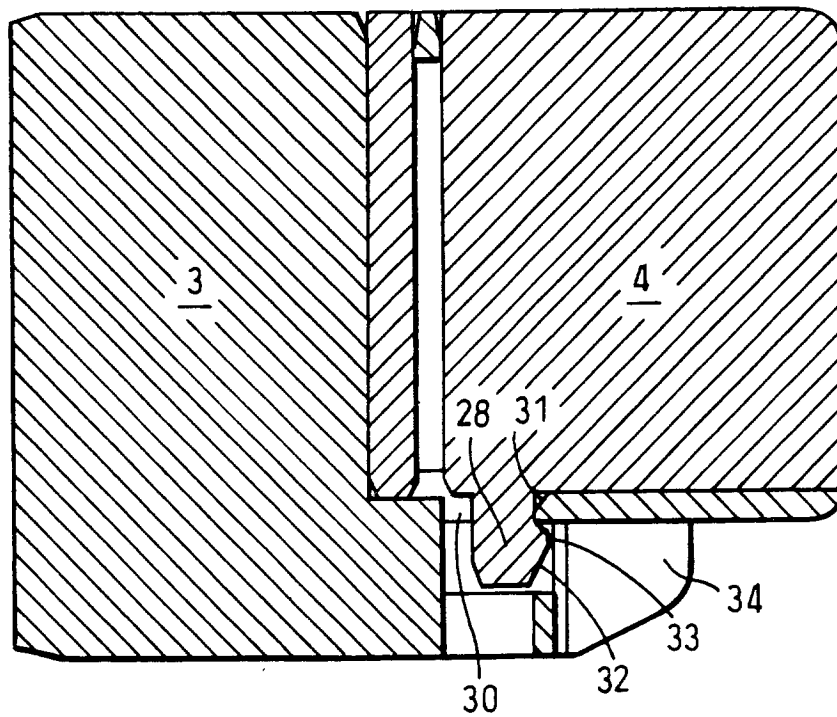


Fig.4.

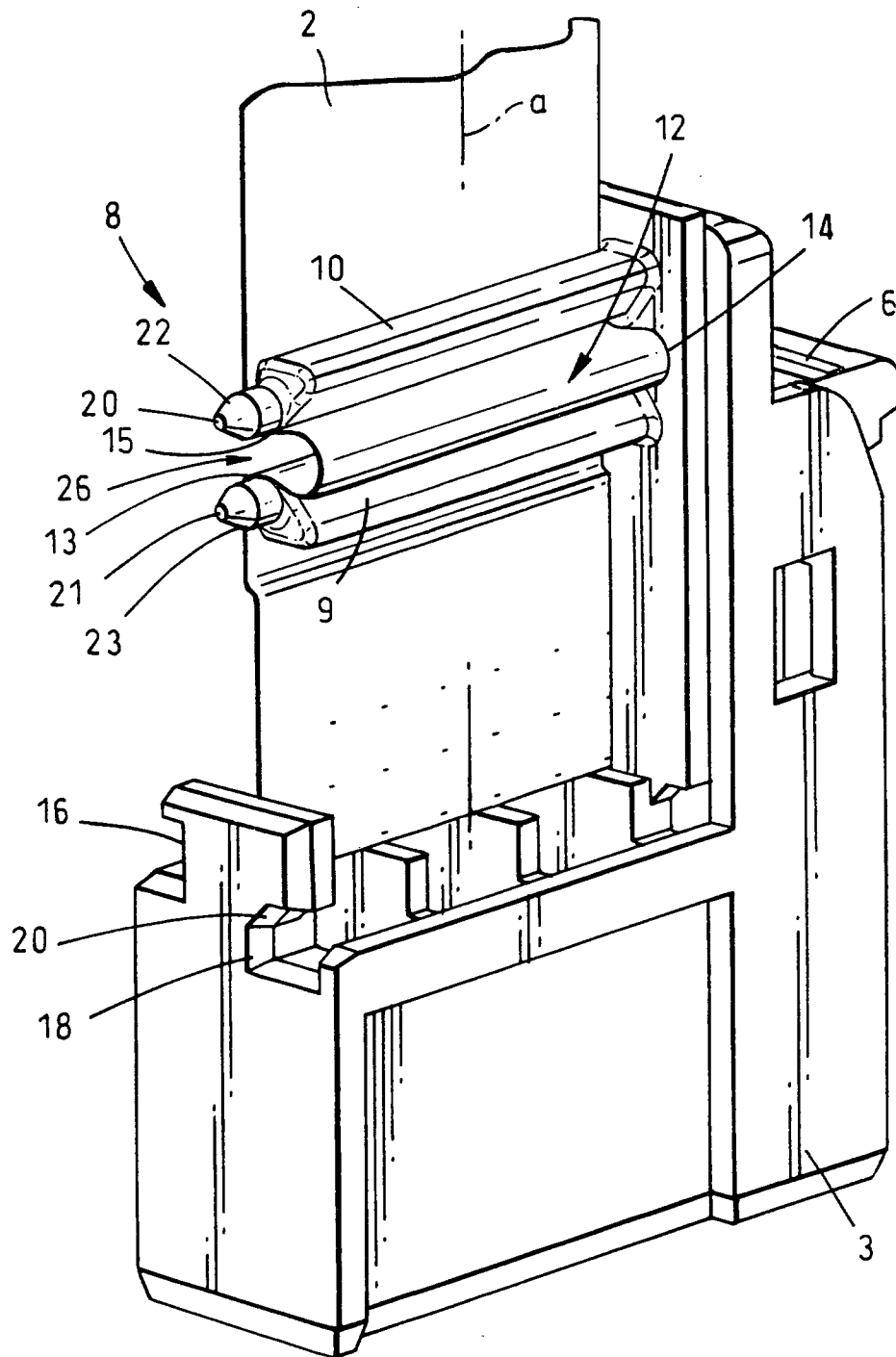


Fig.5.

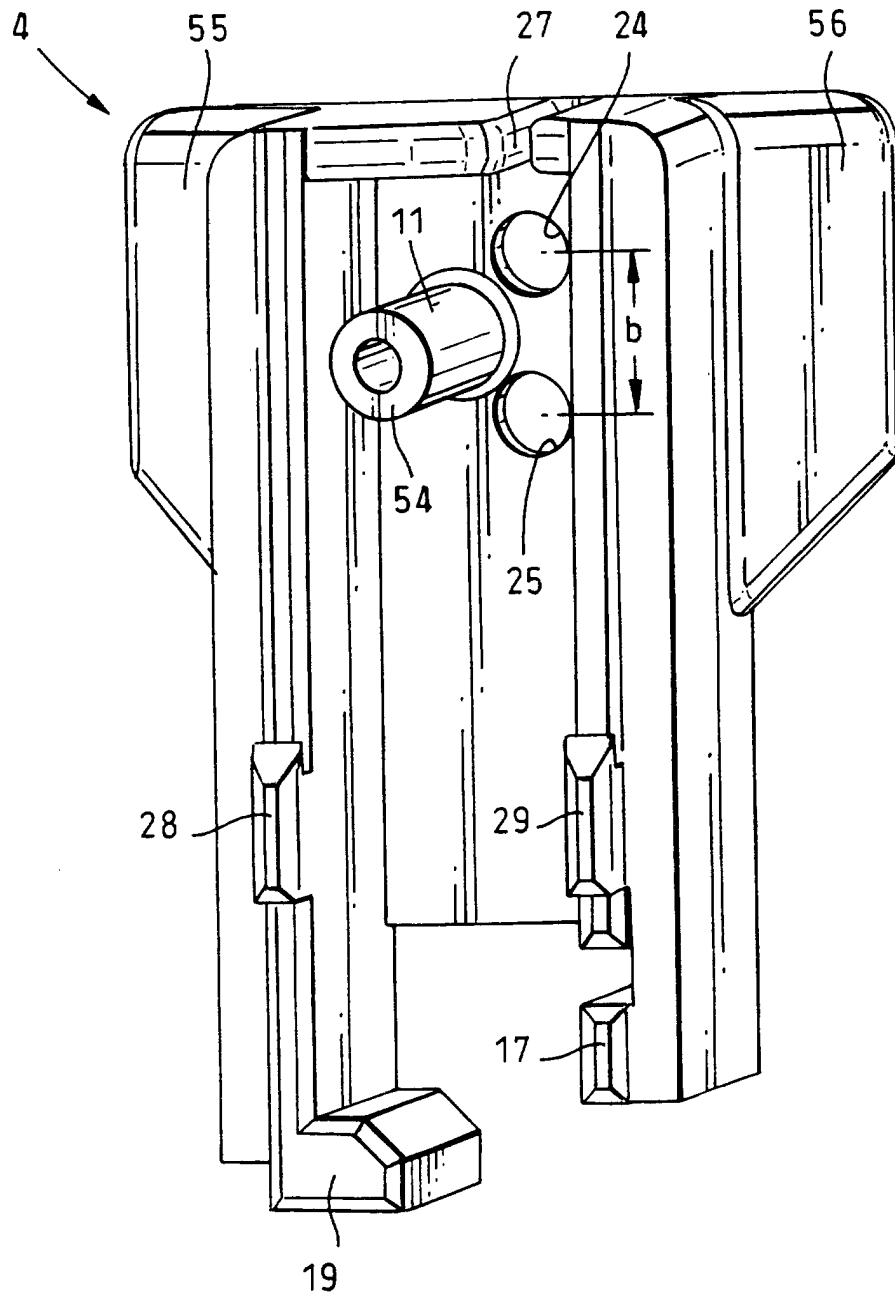


Fig.6.

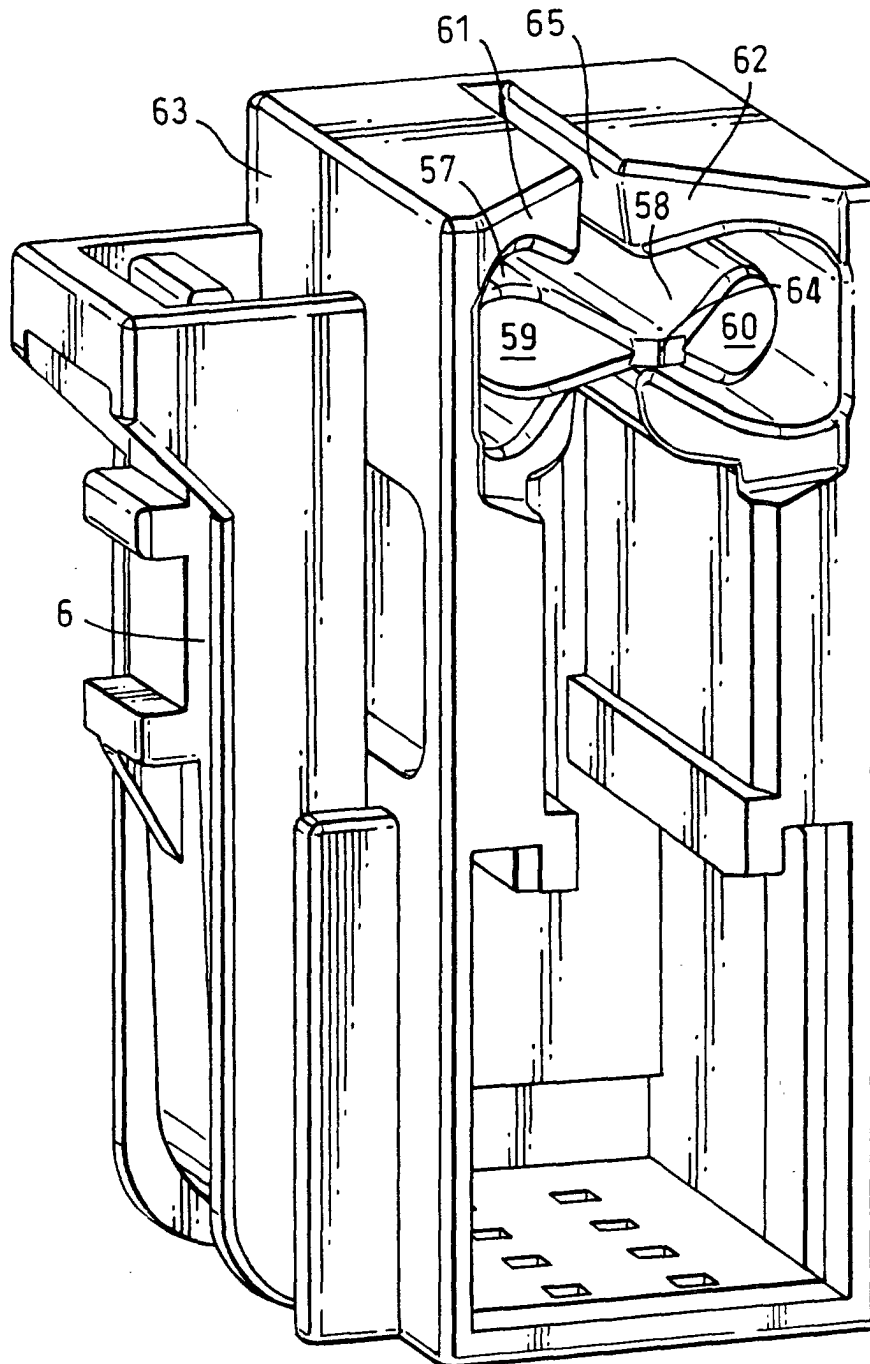


Fig.7.

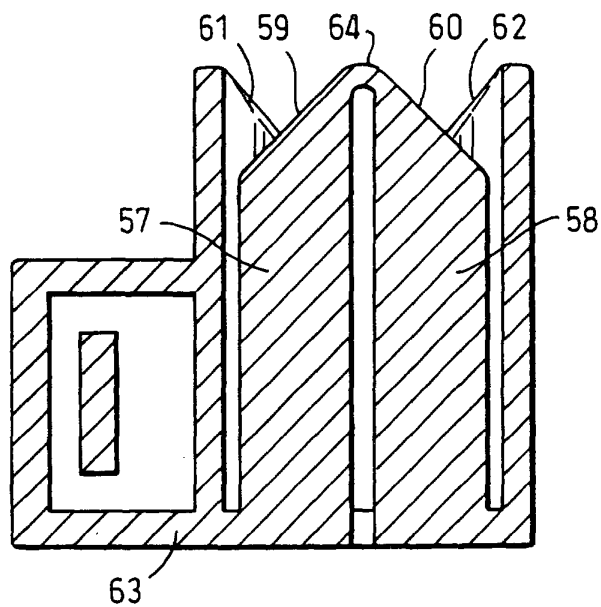
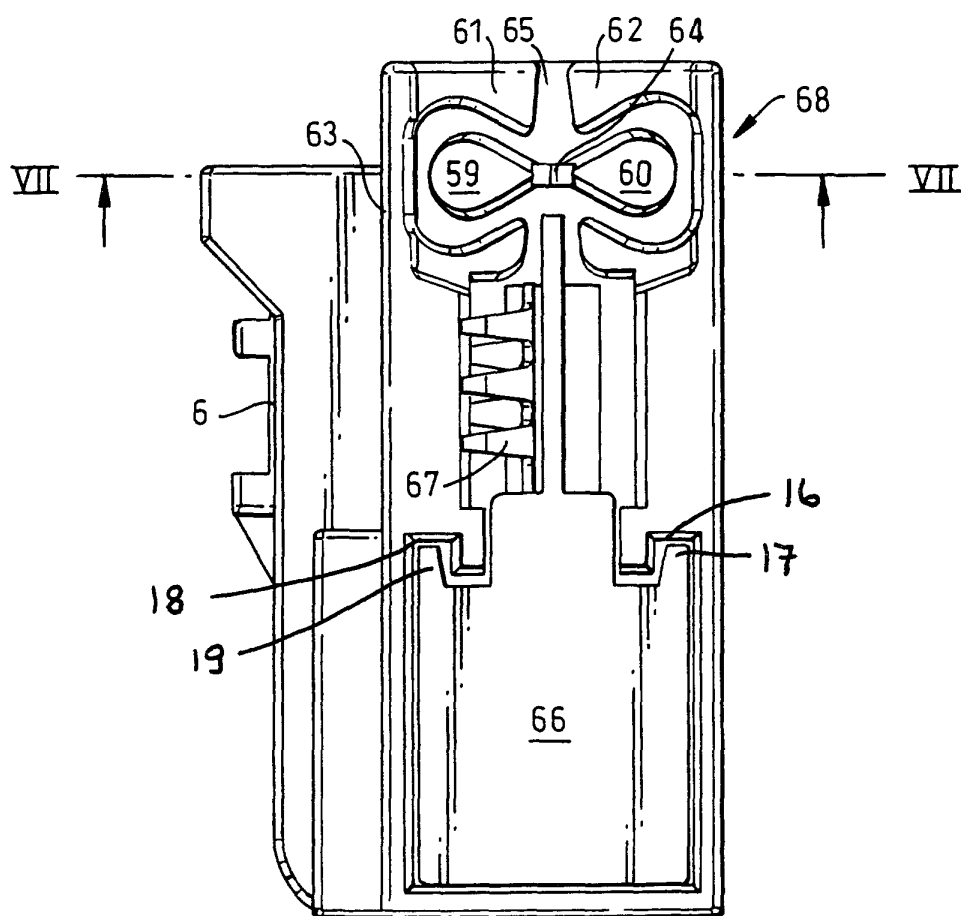


Fig.8.



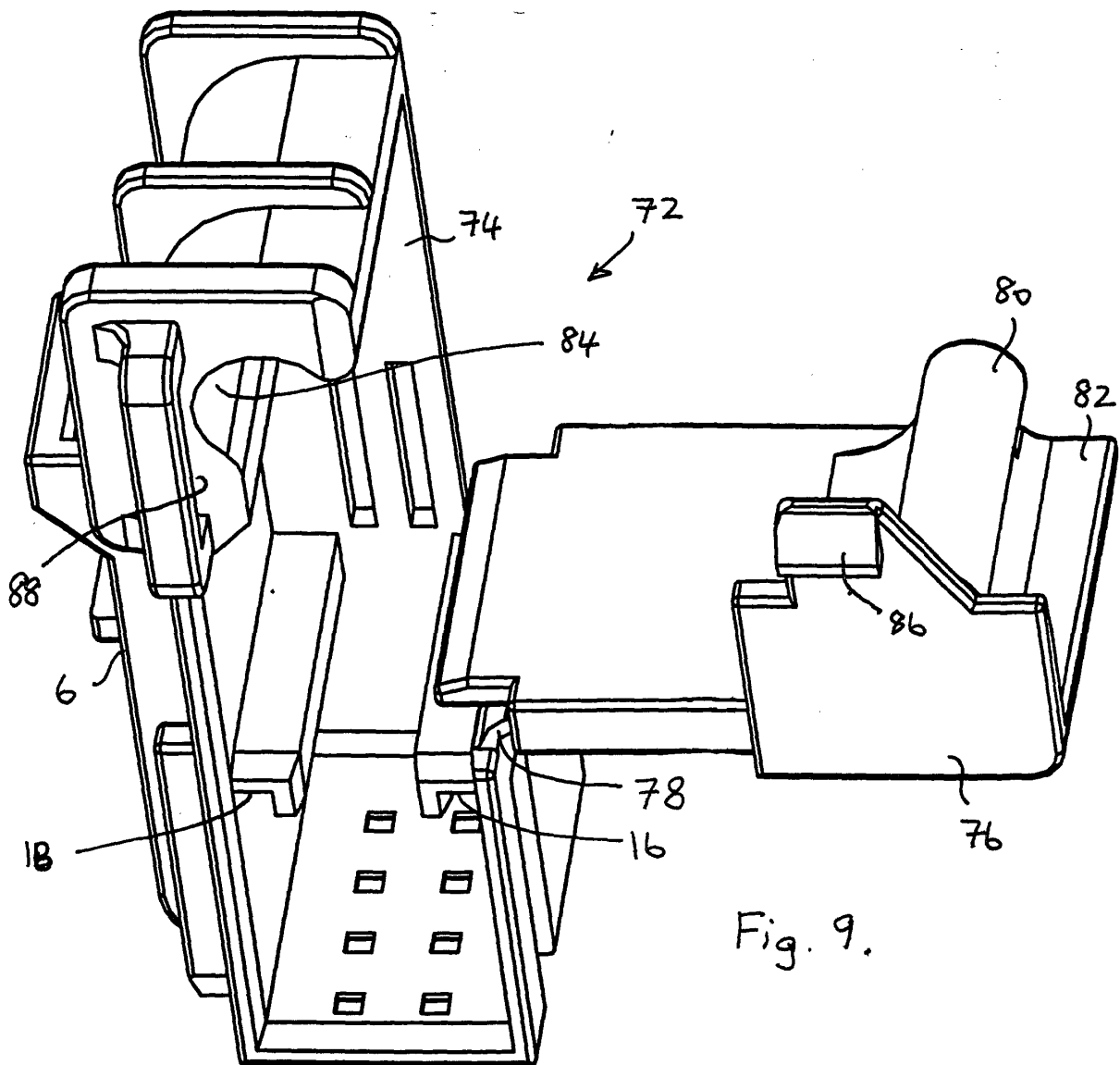


Fig. 9.

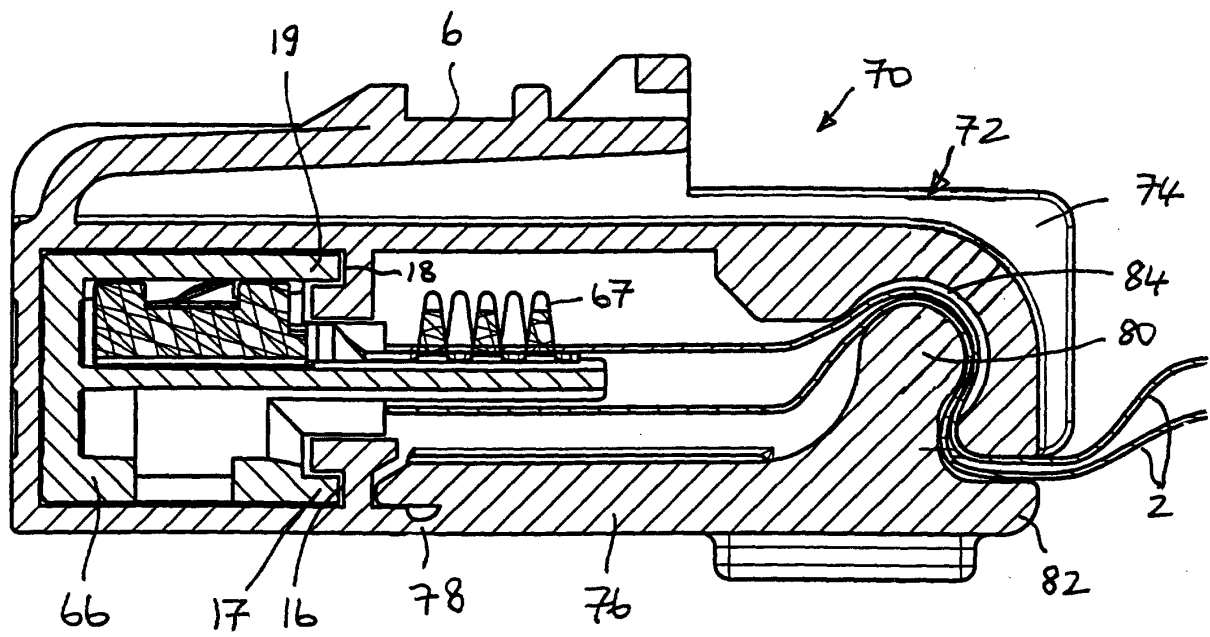


Fig. 10



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EUROPEAN SEARCH REPORT

Application Number
EP 01 20 2700

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)
X	DE 92 15 169 U (ALBERT ACKERMANN GMBH) 7 January 1993 (1993-01-07) * page 4 - page 6; figures 1-3 *	1,5-10, 12,16	H01R13/58
A	US 5 626 491 A (HASIRCOGLU ALEXANDER W) 6 May 1997 (1997-05-06) * column 3, line 19 - column 4, line 16 *	1-16	
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The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.Cl.7) H01R
Place of search BERLIN		Date of completion of the search 24 September 2001	Examiner Stirn, J-P
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**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 01 20 2700

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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24-09-2001

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