(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 655 810 A1

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
10.05.2006 Bulletin 2006/19

(51) Int Cl.:
H01R 13/641 *(2006.01)*

(21) Application number: **05023933.4**

(22) Date of filing: **03.11.2005**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK YU

(30) Priority: **04.11.2004 FR 0411760**

(71) Applicant: **Tyco Electronics France SAS**
95300 Pontoise (FR)

(72) Inventors:
- **Auble, Alexandre**
  27120 Pacy sur Eure (FR)
- **Picaud, Jean-Pierre**
  95600 Eaubonne (FR)

(74) Representative: **Heinz-Schäfer, Marion**
Tyco Electronics Logistics AG
Ampèrestrasse 3
9323 Steinach (SG) (CH)

(54) Electrical connector with interengaging shapes

(57) The invention concerns an electrical connector including a casing (3) having a male mechanical connection structure (38) with a complementary element including two connection pins which may be short-circuited with each other by a short-circuit element of the structure, and a button (5) for short-circuit elimination intended to be fitted in the casing, characterised in that the said button (5) includes a stop element (53) and the said structure includes a locking element on a resilient member (38) taking, during the mounting the casing (3) on the complementary element (2), a first position, at stop, of the stop element (53), preventing the said button (5) from reaching a final position in which the latter causes the elimination of the short-circuit, if the said structure is not yet locked into final position on the latter, and a second position separate from the stop element (53), enabling the button (5) to reach the final position if the said structure is locked into final position on the complementary element.

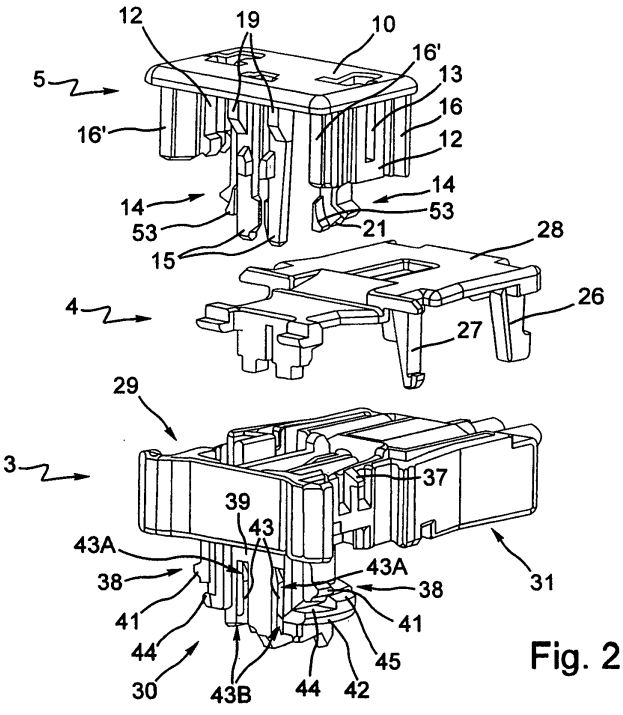

Fig. 2

EP 1 655 810 A1

Description

[0001] The purpose of the invention is to ensure the correct mounting of an electrical connector in a complementary element.

[0002] There are many circumstances in which it is important that it should only be possible to establish or eliminate an electrical connection (such as a short-circuit, for example) when the preliminary assembly phases for the connector have been carried out.

[0003] This is particularly true in the case of assembly of airbag systems where maintaining the short-circuit in the airbag system is an essential safety element.

[0004] A well-known airbag system is composed of a gas generator assembled with a connector linked by two conductors to a control system. When the control system orders deployment of the airbag, it sends an electrical signal to the pins of the gas generator so that the pyrotechnic charge is ignited and the bag then inflates. For safety purposes, the pins of the gas generator should be short-circuited until the connector is perfectly mounted. The short circuit is done by a flexible metal bar to prevent risks of triggering at the wrong time.

[0005] Once the connector is locked (by a first element of the connector, called here a casing), onto the gas generator, a second element of the connector (called the connector position assurance member, here the button) is moved from a first position to a second position and retracts the bar so that the safety short-circuit is eliminated. However there is still a risk of unwanted disconnection if the connector is not correctly locked onto the gas generator.

[0006] It will be shown, with regard to this, that this type of connector includes a male mechanical connection part having locking lugs on the ratchet brackets which can hook onto the gas generator, these brackets having to be bent when the connector is introduced into the housing provided for this purpose in the gas generator. The button is mounted for lateral movement in the casing and also includes ratchet brackets suitable for operating in conjunction with the body of the casing to participate in locking the connector into the gas generator.

[0007] It is therefore important to ensure that the button only reaches its final position (and therefore eliminates the short-circuit between the pins on the gas generator) in the connector if the casing is not only assembled but, specifically, locked into the gas generator and only in these circumstances.

[0008] It is also very important, that the button cannot be pushed into the casing before mounting the connector. If this happens the operator, who has to mount the connector, may install the connector in this position with the button already in the end position into the complementary element and destroy the connection system.

[0009] According to an arrangement, already well-known, from US 5,275,575, an airbag igniter includes a safety catch capable both of ensuring complete locking of the connector after the casing has been locked to the gas generator, and of eliminating the short-circuit, since the connector can only be disconnected by withdrawal of the safety latch which then re-establishes the short-circuit.

[0010] From EP 1369965 a connector with a position assurance member for an airbag system is known. Here the button can be pushed into its final position, when the connector is not received in the complementary element. As the locking arms on the casing do not flex back any more it should not be possible to mate the connector when the button is pushed down to its final position. But if the operator tries to mate the connector to the complementary element the system can be destroyed or at least partly broken..

[0011] A similar design with similar features is described in EP 1207591 and US 6,811,424.

[0012] The object of the present invention is, generally speaking, an arrangement which guarantees locking of the connector into the gas generator before elimination of the short-circuit and where the connector position assurance member can only be moved in the mated position of the connector.

[0013] The present invention therefore proposes an electrical connector with the features of claim 1.

[0014] This system of stopping by interengaging shapes performs, in this case, the function of Connector Positioning Assurance (CPA), since the button can only be mounted once the casing is correctly positioned and locked into the gas generator.

[0015] Such a system also makes it possible to simplify the connector and gas generator assembly since only a single element (the button) is pressed to bring the connector into its locked position in the gas generator, then, with the button still held down, the button this time having released itself and moved laterally to the extent that the connector is in place in the gas generator, to bring the button into its position for short-circuit elimination and locking in the gas generator. So the work of the operator mounting this connector may be greatly facilitated by the arrangement of this invention.

[0016] According to the features of implementation, which are particularly simple and easy both for manufacture and use:

- the said locking element is associated with a groove guiding the said stop element towards the said locking element;
- the said groove is formed by a recess in the flexible body of the said resilient member;
- the said groove extends over approximately three quarters of the length of the said flexible body;
- the said stop element is joined to a bracket locking the said button to the said complementary element;
- the said stop element has a profile which is generally triangular in form;
- the stop element includes a lower free surface which is straight and generally rectangular in form and is perpendicular to the adjacent free surface of the stop

element closest to the said element for short-circuit elimination;
- the free surfaces closest to the short-circuit elimination element are straight and opposite each other;
- the free surfaces adjacent and perpendicular to each stop element are linked by a concave free surface;
- the said first position corresponds to a bending of the flexible body of the said resilient member so that its lug rests against a wall of the complementary element; and
- the said second position corresponds to an introduction of the said lugs into a recess in the said complementary element.

[0017] A preferred embodiment includes an electrical connector, in particular for the ignition of a pyrotechnic charge, including a casing having a female mechanical connection structure, a male mechanical connection structure with a complementary element, specifically a gas generator, including connection pins, a short-circuit element suitable for short-circuiting the connecting pins of the complementary element, a button for short-circuit elimination, the male mechanical connection structure of the connector including locking lugs on resilient brackets, suitable for hooking by complementary means onto the complementary element, to lock the connector onto the gas generator, these resilient brackets having to be bent when the connector and the complementary element are assembled and the button being mounted for lateral movement in the casing and also including resilient brackets fitted with locking lugs suitable for operating in conjunction with the male mechanical connection structure of the casing to hook on by the said complementary means and thus participate in locking the connector to the complementary element, characterised in that the resilient brackets of the male mechanical connection structure and the resilient brackets of the button are adapted to operate in conjunction with each other by interengagement of their shapes to prevent lateral movement of the button when the brackets of the male mechanical connection structure are bent and, consequently, to prevent the button from reaching the final short-circuit elimination position by the action of the latter on the short-circuit element.

[0018] Preferably, each bracket of the male mechanical connection structure includes a stop while each bracket of the button includes a complementary excrescence, for operation in conjunction by interengagement of shapes.

[0019] The characteristics and advantages of the invention will be evident from the description which follows, given as a preferred, but not exhaustive, example, with reference to the attached drawings, in which:

- Fig. 1 is a perspective view of the igniter composed of a connector in accordance with the invention mounted on a gas generator
- Fig. 2 is an exploded view of the different elements of the connector;
- Fig. 3 is a similar view to Fig. 1 but showing separately the structure of the connector which enables short-circuit elimination (button);
- Fig. 4 is an elevation of the connector structure (casing) which makes the mechanical interface with the button and the electrical and mechanical interface with the gas generator;
- Fig. 5 is a plan view of the same casing from above;
- Figs. 6 and 7 are two section-elevation views of the casing mounted on the gas generator with, respectively, the button placed in the intermediate position (short-circuit maintained) and the button placed in the final position (short-circuit eliminated); and
- Figs. 8, 9, 10 and 11 are four schematic views showing respectively the button in intermediate position in the casing before mounting on the gas generator, the button in intermediate position in the casing in intermediate position (not locked) in the gas generator, the button in intermediate position in the casing in final position (locked) in the gas generator and the button in final position (locked) in the casing in final position (locked) in the gas generator (short-circuit eliminated).

[0020] The connector 1 is mounted on as complementary element 2 that can be part of a gas generator as shown in Fig. 1. This connector 1, shown in detail in Figs. 2 to 5, includes a casing 3 to be assembled with a cover 4 and a connector position assurance member, the button 5.

[0021] The button 5 illustrated in Fig. 3 includes a wall 10 with flat surface and general rectangular shape and a male connection structure 11 to the casing 3. Since the plane M perpendicular to the wall 10 and passing through the middle of the long sides of the wall 10 is a plane of symmetry for the button 5, the male connection elements are joined in twos, each being the image of the other in relation to this imaginary plane.

[0022] The male connection structure 11 of the button 5 also includes two rectangular elastic tabs 12 with an aperture 13 close to the short sides of the wall 10 and completely centred in relation to these short sides, together with a pair of legs named resilient brackets 14 locking to the gas generator 2, completely centred in relation to the short sides, longer and arranged so that they are recessed in relation to the tabs 12. The tabs 12 are used to latch the button 5 to the casing 3, when the button is in its final position.

[0023] On both sides of, and close to, the plane of symmetry, in front of the brackets 14, four insertion guide studs 16 and 16' in symmetric pairs are located at the four corners of the wall 10, on both sides of each tab 12.

[0024] Each of these elements is formed in a single part with the wall 10 and obtained by moulding plastics material. They are mechanically linked and completely aligned perpendicularly to the wall 10, projecting in the same direction.

[0025] A pair of legs, so called short-circuit elimination tabs 15, rectangular in form, longer than the brackets 14, are placed on the same side as the studs 16', close to the centre of the wall 10. The tabs 15 open the short circuit in the complementary element when the connector is inserted completely.

[0026] Each tab 15 includes a thin plate 17 close to its free extremity, a lug 18 in its middle and a lug 19 close to its fixed extremity. The thin plates 17 are opposite to each other and are in close relationship when the tabs 15 are in their rest position. When the connector is inserted into the complementary element the thin plates 17 engage a rib in the complementary part and the tabs 15 are pushed apart. In the rest position of the tabs 15 the lugs 18 engage with complementary stops on the casing 3 and the button 5 cannot be moved down therefore. When the tabs 15 are in the pushed apart position, that means the connector has entered the complementary element, the lugs 18 do no longer engage the stops on the casing and the button 5 is free from this locking feature.

[0027] Each locking bracket 14 of the connection structure 11 shown in Fig. 3 includes a flexible body 20, an edge 21 at the free extremity of the bracket and a locking lug 22.

[0028] The locking lug 22 is close to the free extremity of the bracket 14, opposite the gas generator 2 in its assembled state, and has a V profile bordered by two inclined surfaces 23 and 24. When the button 5 is pushed into its final position in the casing 3 and complementary element 2 the locking lugs 22 engage and lock into a groove of the complementary element. To achieve this the locking lugs 22 cooperate with the casing 3.

[0029] The cover 4, illustrated in Fig. 2, includes, on its side, four brackets 26 and 27 to latch onto the casing 3 linked to a wall 28 covering the electrical connection zone of the casing 3.

[0030] The casing 3, illustrated in Figs. 1, 2, 4 and 5, includes a female connection structure 29 for the button 5, a male connection structure 30 for the gas generator 2 and an electrical connection component 31 generally parallelepipedal in form.

[0031] The connection component has two openings 32 for electrical conductors 50 shown in Figs. 6 and 7.

[0032] The female connection structure 29 of the casing 3 includes two slots 33 opposite two slots 34, located at the four corners of this structure, two openings 35 of rectangular form, in front of the male connection structure 30 and separated from each other by a thin vertical wall, two openings 36, on either side of and above the male connection structure 30 and two teeth 37, each placed globally at mid-distance from the two slots 33 and 34.

[0033] The male connection structure 30 of the casing 3 includes an electrical connection structure 39 to the gas generator 2 and two elastic locking brackets 38 forming a mechanical connection structure to the gas generator 2.

[0034] Each bracket 38 includes a flexible body 40 and a locking lug 41 close to the free extremity of the bracket 38, turned towards the internal surface of the gas generator 2 in its assembled state. When the connector is inserted into the complementary element the brackets are moved from their rest position until the locking lugs reach the groove in the complementary element and flex back.

[0035] The electrical connection structure 39 includes two centring pads 42 in the gas generator 2, on either side of two vertical slots 43 each including a large open underface 43A, each slot being bordered by the walls of the electrical connection structure 39. A small open lower side 43B also extends perpendicularly to each large face 43A, between these walls.

[0036] The pads 42 illustrated in particular in Fig. 2 include a hollow part 44, with the help of which each bracket 38 can bend freely towards the interior of the casing 3 and a solid part 45, the upper surface of which is inclined at an angle close to 45°.

[0037] The gas generator 2 as illustrated in section in Figs. 6 and 7 includes two pins 46 maintained in short-circuit before and during the intermediate assembly phases by a short-circuit bar 47 consisting of two elastic leaves 48, the extreme edge 49 of each of which is in contact with a pin 46. A rib is between the leaves in the complementary element.

[0038] During assembly of the casing, each pin 46 is inserted into the electrical connection structure 39 of the casing 3 by the short open side 43B of the slot 43, each pin 46 being then electrically connected to a conducting wire 50 by means of a connection terminal 51 housed in the casing 3.

[0039] During assembly of the button 5 in a first step the tabs 15 are pushed apart from each other by the rib and with that the button becomes free from the engagement of the lugs with the stops on the casing 3. When the button 5 is further moved to its final position, each tab 15 of the button 5 restrains a leaf 48, as illustrated in Fig. 7, in such a way that its extreme edge 49 is no longer in contact with the pin 46 (elimination of the short-circuit).

[0040] The flexible body 40 of the bracket 38 includes, on the side closest to the bracket 14 in the assembled state, a recess 55 forming a groove starting at the attachment base of the bracket 38 and ending in a solid portion 52 constituting a stop for around three quarters of the body 40.

[0041] The bracket 14 of the button 5 includes, on the side closest to the bracket 38 of the casing 3 in the assembled state, an excrescence 53 of triangular profile on the side of the bracket 14 intended to be opposite the groove 55 of the bracket 38 of the casing 3 in the assembled state. The free lower end surface 53A of the excrescence 53 (turned towards the stop 52 in the assembled state) is a straight surface of generally rectangular form, perpendicular to the bracket 14 and to an adjacent straight surface 53B located beside the tabs 15.

[0042] The surfaces 53B of each excrescence are opposite each other while the surfaces 53A and 53B are

linked by a concave surface 53C, freeing the maximum amount of space in front of the excrescence 53, the latter projecting slightly past the extreme edge 21.

[0043] The principle of mounting the connector on the gas generator will now be described.

[0044] Fig. 8 shows the first stage, which consists of pre-mounting the button 5 in the direction of the arrow A in the casing 3. The tabs 15 and the brackets 14 are introduced into the female connection element 29 of the casing respectively through openings 35 and 36. The tabs 15 are also guided into the casing 3 and the lugs 18 engage the stops in the casing.

[0045] Ribs 25 in the studs 16 and 16' are guided into the slots 33 and 34, the bracket 14 of the button 5 follows the electrical connection structure 39 of the casing 3, offset and slightly set back from the bracket 38 of the casing 3. The button, although not locked to the complementary element 2, remains integral with the casing because of the openings 13 in the tabs 12 which hold the teeth 37. Ribs on the studs 16 and 16' enable the button 5 on the casing 3 to be guided to its final position.

[0046] This assembly (button 5 in the casing 3, lugs 18 engage stops in casing 3) is then introduced, as shown in Fig. 9, into the gas generator 2. In a first stage then the tabs 15 are separated by means of blades 17 that cooperate with the rib in the complementary element 2, which disengages the lugs 18 from the stops.

[0047] There are then two possible cases, depending on the state of assembly of the casing 3 if it is required to place the button 5 in final position in the casing 3:

- if the casing 3 is assembled but not locked with the gas generator 2 as illustrated in Fig. 9, the lugs 41 are restrained by the lateral surfaces of the gas generator 2 and the brackets 38 of the casing 3 occupy a first "bending" position, so that if an attempt is made to lock the button 5 while continuing the mounting of the button 5 in the direction of the arrow A, the excrescence 53 of the bracket 14 of the button 5, represented schematically here by a square, follows the guide groove 55 until the surface 53A is stopped against the solid portion 52 of the bracket 38, preventing the button from reaching the final position (maintenance of short-circuit) and,
- if the casing 3 is locked into the gas generator 2, as illustrated in Fig. 10, the lug 41 is housed in a recess 54 of a housing of the gas generator 2, forming a locking notch intended to hook onto the lugs of the brackets 14 and 38, and the brackets 38 of the casing 3 occupy, because of the elastic recovery of the body 40, a second position of rest. The stop 52 then moves aside and releases the excrescence 53 from the bracket 38 of the button 5, thus allowing the button to go to final position and the leaf springs 48 to be separated by the tabs 15 in order to eliminate the short-circuit, as previously described. If the button 5 reaches its final position, the excrescence 53 fits into the hollow part 44 of the pad 42 and the extreme edge 21 of the bracket 14 comes back into contact with the inclined upper surface of the solid part 45 of the pad 42, stressing the bracket 14 until it stretches (elastic bending towards the exterior) so that the locking lug 22 of the bracket 14 of the button 5 moves into the recess 54 at the side of the locking lug 41 of the bracket 38 of the casing 3, as illustrated in Fig. 11, in order to ensure complete locking of the connector 1 on the gas generator 2.

[0048] To dismantle, the button 5 must be pulled to unlock the connector 1. The brackets 14 can then be slid over the studs 42 and, as the separation of the latter reduces, they pass between the casing 3 and the gas generator 2.

Claims

1. Electrical connector (1) in particular an airbag connector for ignition of a pyrotechnic charge, including a casing (3) having a female mechanical connection structure (29) and a male mechanical connection structure (38) for mating with a complementary element (2), specifically a gas generator, including two connection pins (46) which may be short-circuited with each other by a short-circuit element (47), and a button (5) for elimination of the short-circuit intended to be fitted into the said female connection structure (29) and including a first pair of legs (15) for the purpose of eliminating the short-circuit of the connection pins, the said button (5) having a second pair of legs (14) including a stop element (53) on each leg (14) and the said male mechanical connection structure (38) with the said complementary element (2) including a locking element (52) on each of a pair of resilient members (38) which takes, during assembly of the casing (3) to the complementary element (2), a first position, at stop, of the stop element (53) of the said button (5) preventing the said button (5) from reaching a final position in which the latter causes the elimination of the short-circuit by means of its first pair of legs (15), if the said male mechanical connection structure (38) with the complementary element (2) is not yet locked into final position on the latter, and a second position away from the stop element (53) of the said button (5), permitting the said button (5) to reach final position if the said male mechanical connection structure (38) with the complementary element (2) is locked in final position on the latter,

characterised in that the second pair of legs (14) of the button (5) includes a locking lug (22) that locks the button (5) in its final position to the complementary element (2) and further **characterized in that** each of the first pair of legs (15) includes a lug (18) for preventing movement of the button (5) if the legs (15) are in their rest position and that the legs include

opposing thin plates (17) that cooperate with the complementary element (2) when the connector is entered into the complementary element, to move the legs (15) out of their rest position.

2. Electrical connector according to claim 1, **characterised in that** the said locking element (52) is associated with a groove (55) guiding the said stop element (53) toward the said locking element (52).

3. Electrical connector according to claim 2, **characterised in that** the said groove (55) is formed by a recess in the flexible body (40) of the said resilient member (38).

4. Electrical connector according to one of claims 2 and 3, **characterised in that** the said groove (55) extends over approximately three quarters of the length of the said flexible body (40).

5. Electrical connector according to any one of claims 1 to 4, **characterised in that** the said stop element (53) has a profile of generally triangular form.

6. Electrical connector according to claim 5, **characterised in that** the stop element includes a lower free surface (53A) which is straight and of general rectangular form and perpendicular to the adjacent free surface (53B) of the stop element closest to the said short-circuit elimination element (15).

7. Electrical connector according to any one of claims 1 to 6, **characterised in that** the said first position corresponds to a bending of the flexible body (40) of the said resilient member (38) resting its lug (41) against a wall of the complementary element (2).

8. Electrical connector according to any one of claims 1 to 7, **characterised in that** the said second position corresponds to an introduction of the said lugs (41) into a recess (54) of the said complementary element (2).

9. Electrical connector according to any one of the preceeding claims, **characterized in that** the button (5) is blocked from moving by the first set of legs (15) when the connector is in a completely unmated position.

10. Electrical connector according to claim 9, **characterized in that** the button (5) is free to move until blocked by the second pair of legs (14) in cooperation with the pair of resilient members (38) when the first set of legs (15) is deflected as the connector is in a partly mated position.

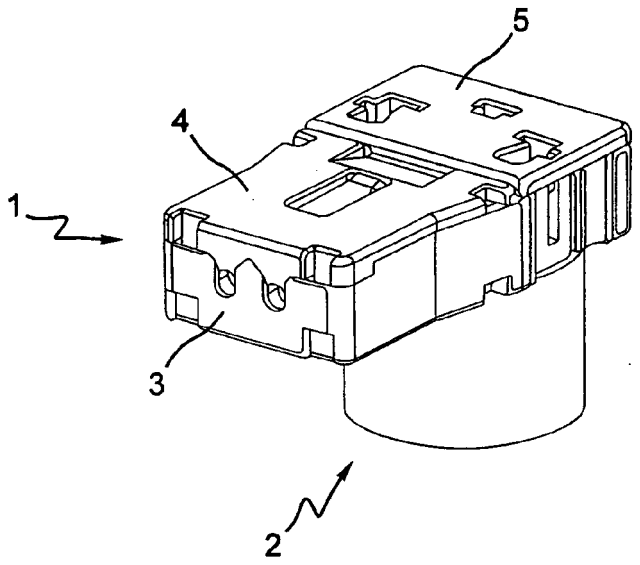
5
4
1
3
2

Fig. 1

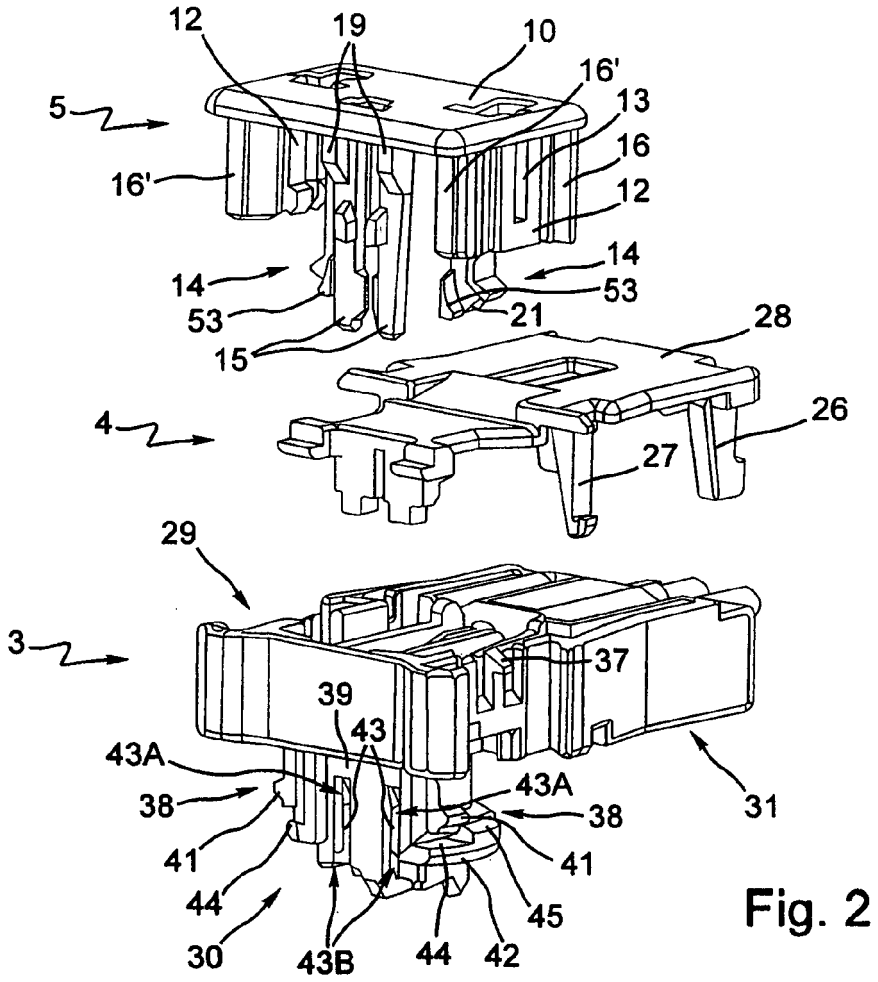
12
19
10
16'
13
5
16
16'
12
14
14
53
53
21
15
28
4
26
27
29
3
37
39
43
43A
43A
38
38
41
41
44
45
30
43B
44
42
31

Fig. 2

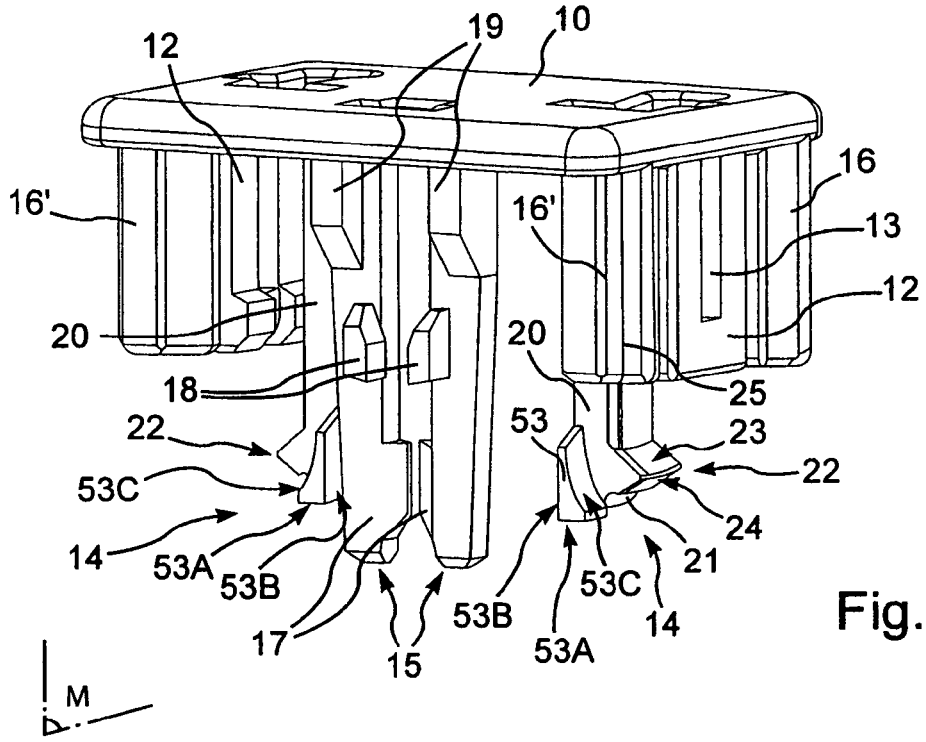
12
19
10
16'
16
16'
13
12
20
20
18
25
22
53
23
22
53C
24
14
53A
53B
21
53C
17
15
53B
53A
14
M

Fig. 3

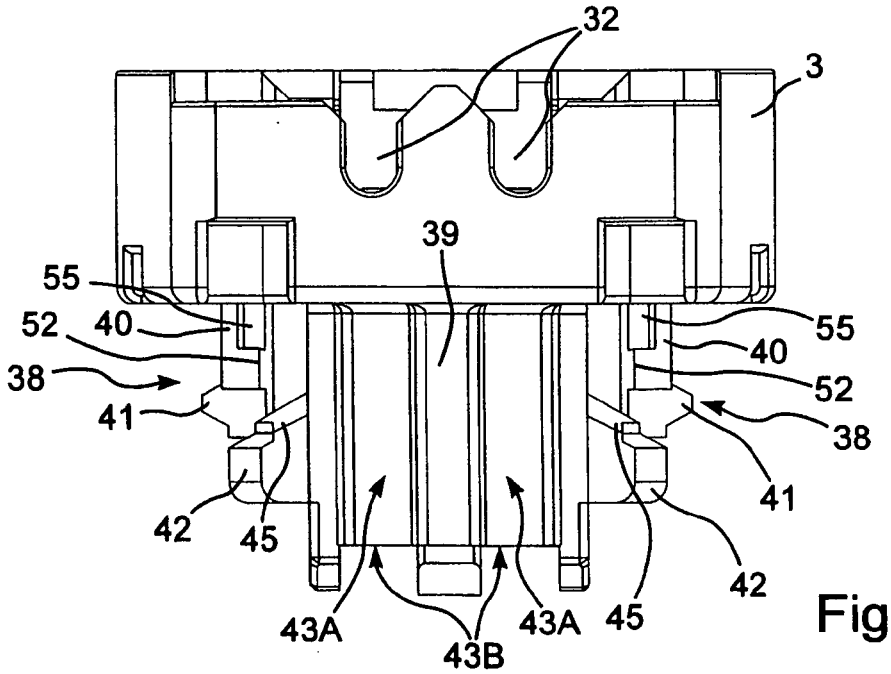
32
3
39
55
52
40
55
40
38
52
41
38
41
42
45
42
43A
43B
43A
45

Fig. 4

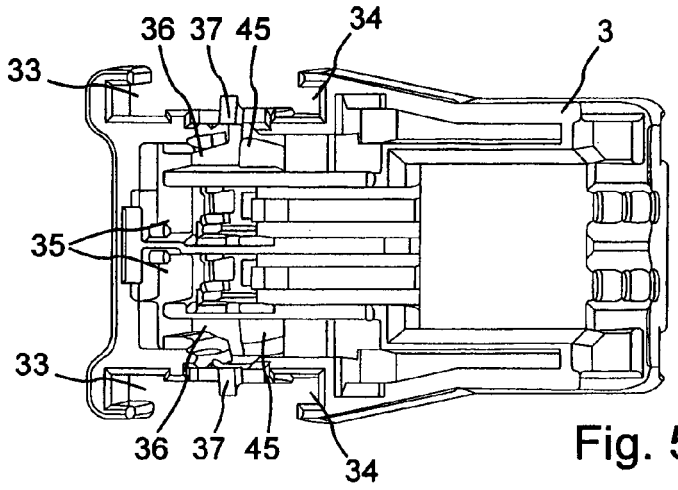

Fig. 5

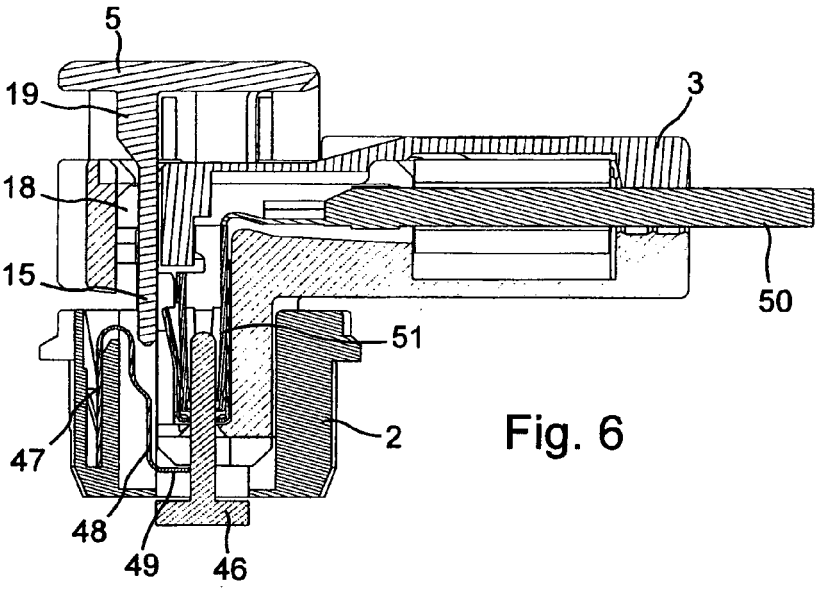

Fig. 6

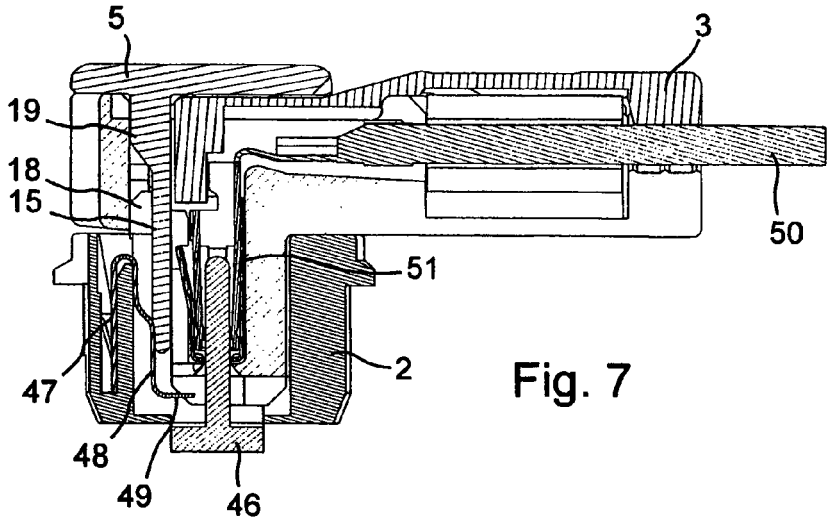

Fig. 7

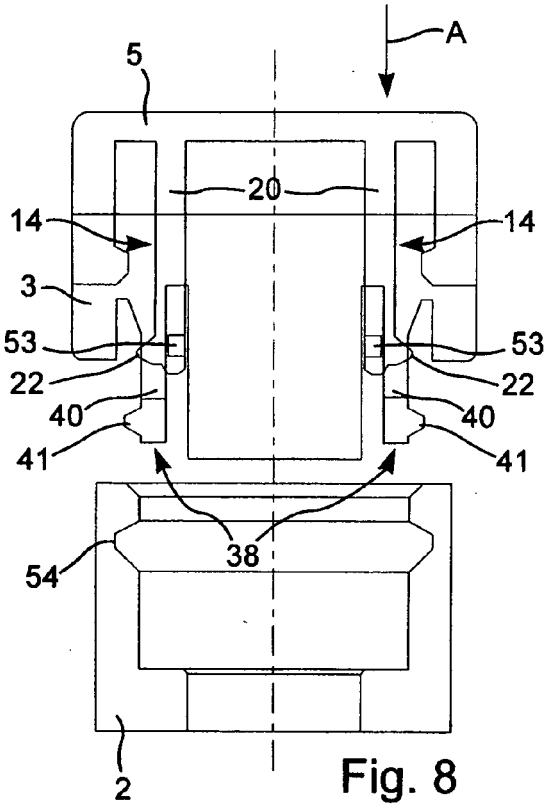

Fig. 8

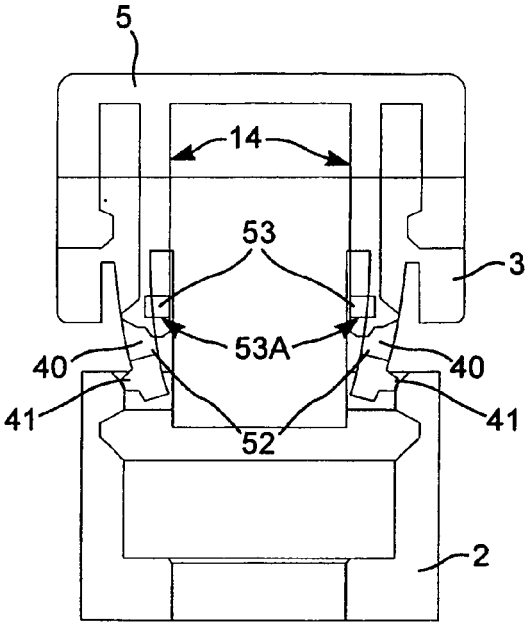

Fig. 9

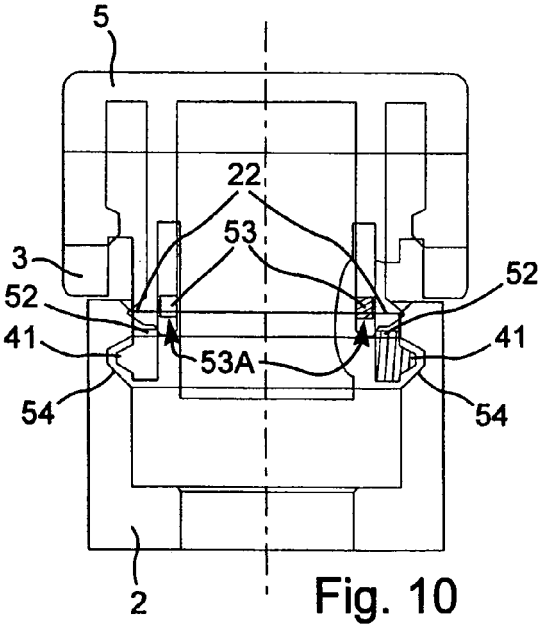

Fig. 10

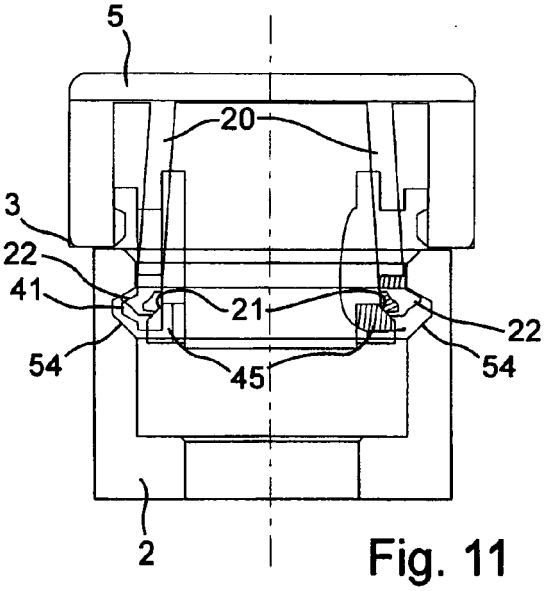

Fig. 11

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 05 02 3933

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	EP 1 369 965 A (J.S.T. MFG. CO., LTD) 10 December 2003 (2003-12-10) * column 12, line 5 - line 12 *	1-10	H01R13/641
A	EP 1 207 591 A (FCI) 22 May 2002 (2002-05-22) * column 4, line 6 - line 43 *	1-10	
A	US 2004/192099 A1 (SEMINARA PHILLIP G ET AL) 30 September 2004 (2004-09-30) * paragraph [0039] - paragraph [0040] *	1-10	

TECHNICAL FIELDS SEARCHED (IPC)

H01R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	18 November 2005	Demol, S

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

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 05 02 3933

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
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-11-2005

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 1369965 A	10-12-2003	CN 1469512 A	21-01-2004
		JP 2004014261 A	15-01-2004
		US 2003228782 A1	11-12-2003
EP 1207591 A	22-05-2002	BR 0105829 A	18-06-2002
		CA 2361961 A1	17-05-2002
		JP 2002198126 A	12-07-2002
		US 2002081888 A1	27-06-2002
US 2004192099 A1	30-09-2004	WO 2004095642 A2	04-11-2004

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82