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

(11) **EP 2 824 773 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.01.2015 Bulletin 2015/03

(51) Int Cl.:
H01R 13/629 *(2006.01)*

(21) Application number: **13176416.9**

(22) Date of filing: **12.07.2013**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicant: **Delphi Technologies, Inc.**
Troy, MI 48007 (US)

(72) Inventors:
- **Grudzewski, Michal**
  31-515 Krakow (PL)
- **Kot, Lukasz**
  32-045 Suloszowa (PL)

(74) Representative: **Allart, René Paul Pruli Slamet**
Delphi France SAS
Legal Staff - Patents
Bât. Le Raspail, ZAC Paris Nord II
22, avenue des Nations
95972 Roissy CDG Cedex (FR)

(54) **Connector assembly with integrated lever locking system**

(57) The present invention relates to an electrical connector assembly (10) comprising a housing (200) and a mate assist mechanism comprising a lever (100) pivotably arranged on the housing (200). The lever is adapted to be movable from a preliminary mating position to a fully mated position, and the connector assembly (10) comprises holding means (120; 130) to releasably hold the lever (100) in the preliminary mating position. This is achieved by locking protrusions (121; 131), being adapted to be flexibly movable in one direction and corresponding locking receptions (122; 132) receiving said locking protrusion (121; 131) when the lever is in the preliminary mating position.

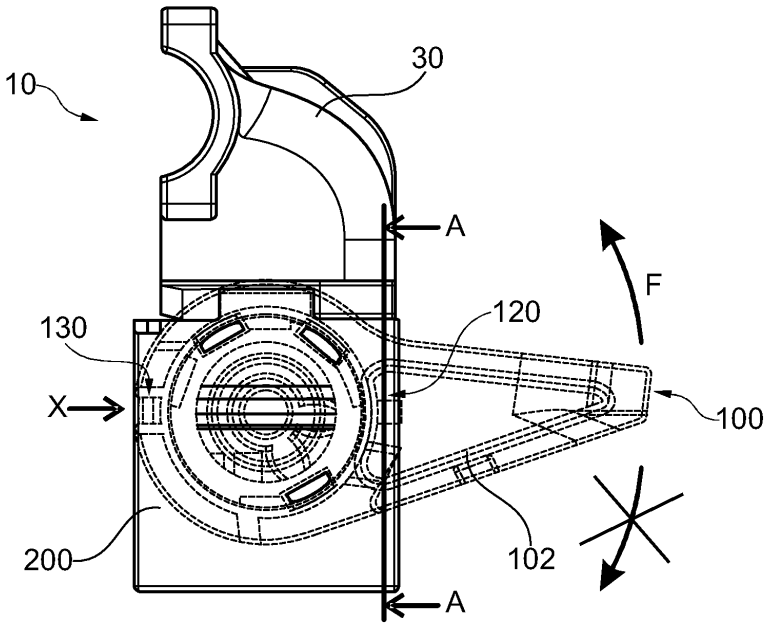

Fig. 4a

EP 2 824 773 A1

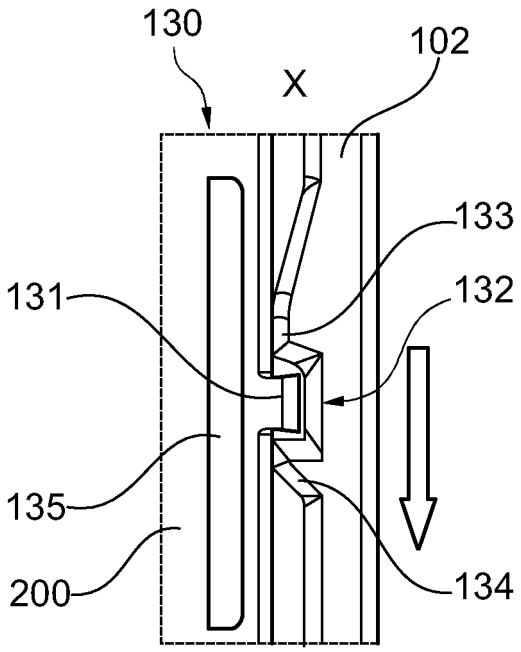
130
X
102
133
131
132
135
200
134

Fig. 4b

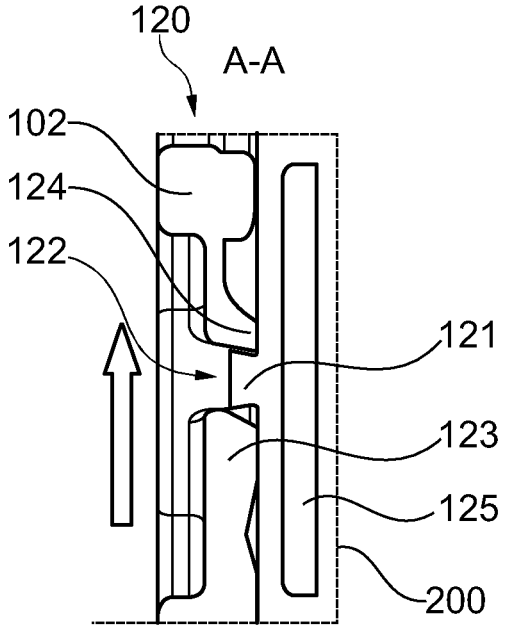
120
A-A
102
124
122
121
123
125
200

Fig. 4c

Description

I. Field of the Invention

[0001] The present invention relates to an electrical connector assembly comprising a mate assist lever, which can be locked in a preliminary mating position.

II. Technical background

[0002] In many fields of applications, in particular in the case of mass production assembly processes, it is important that electrical connectors can be connected easily and fast. In cases where connectors have a plurality of electrical contact terminals to be mated, as it is often the case in the field of automotive applications, it is common that the connectors are provided with mate assist mechanisms in the form of mate assist levers or sliders to facilitate mating of connector and counter connector. Such mate assist mechanisms usually are provided linearly moveable or pivotably on a connector housing. Upon mating of the connector with a corresponding counter connector, the mate assist mechanisms are moved from a first, preliminary mating position, to a second, fully mated position, thereby facilitating the mating process.

[0003] A typical example of a lever mated connector assembly is for example described in WO 2007/098253. In this document, an electrical connector assembly comprising a mate assist lever, which serves to facilitate the mating of the connector assembly, is described. To enable a fast and easy mating of two corresponding connectors, the mate assist lever is pivotably mounted to a first connector and can be moved from a preliminary mating position to a fully mated position. During this movement, a cam element provided on the pivotable lever engages a corresponding cam mechanism of the counter connector, whereby the two connectors are pulled towards each other upon movement of the lever. When moved into the final mated position, a portion of the lever snaps behind a latch member on the connector housing to lock the mate assist lever in said position, thereby also locking the mating of the two connectors.

[0004] A further example of a connector assembly with a mate assist lever is described in US 2006/0089031 A1. Similarly as in the case of the prior art document discussed above, the mate assist lever disclosed in this document is provided pivotably on a connector housing and has generally a u-shape form with two lever arms connected by a common web. Each lever arm has a pivot axis that passes through the lever arm. The lever arms are provided, such that from the preliminary mating position they can only be rotated into the fully mated position, but not in the opposite direction. However, with this prior art construction it is possible that the lever moves unintentionally from the preliminary mating position half way to the fully mated position when no counter connector is present. In such an intermediate position, it is not possible to mate the two connectors, so that an operator has to manually displace the lever back into the preliminary mating position to start the mating process. This requires an additional working step and is undesirable.

[0005] It is therefore an object of the present invention to provide an electrical connector assembly with a mate assist lever of robust and simple construction, whereby it is secured, that the lever stays in the preliminary mating position and does not unintentionally move out of this preliminary position if no counter connector is present. It is a further object of the present invention, to achieve these advantages with an inexpensive product, which can preferably be produced by injection molding.

[0006] These and other objects which become apparent upon reading the following description, are solved by an electrical connector assembly according to claim 1.

III. Summary of the invention

[0007] According to the invention, an electrical connector assembly is provided which comprises a housing and a mate assist mechanism in form of a lever pivotably arranged on or assigned to the housing. The mate assist lever is moveable from a preliminary mating position to a fully mated position. In the preliminary mating position, it is possible to initiate a mating process of the connector housing with a corresponding counter connector housing. In the fully mated position, both housings are fully mated with each other. As it is generally known in the art, by moving the lever from the preliminary mating position to the fully mated position, suitable cam means on lever, connector housing and counter connector housing interact with each other, to pull the two connector parts towards each other in the desired mating position. Further, the connector assembly comprises holding means to releasably hold the lever in said preliminary mating position. In other words, the lever is held in the preliminary mating position, so that it does not unintentionally move to a position, where it is not possible to initiate the mating process between the connector housing and a corresponding counter connector. This has the advantage, that the inventive connector can be shipped to the customers with the lever in the preliminary mating position, so that upon assembly, in for example a vehicle, the operator does not have to align the lever into a position, which allows to initiate the mating process, but the levers always is in the correct position, i.e. the preliminary mating position. Thus, the connector housing can be inserted into a corresponding counter connector (or vice versa) and the mating process can be finished by rotating the lever into the fully mated position.

[0008] According to the present invention, the holding means comprise at least one locking protrusion, which is adapted to be flexibly moveable in one direction and a corresponding locking reception, which receives said locking protrusion when the lever is in the preliminary mating position. To this end, the locking reception has first and second locking walls being arranged on opposite

sides of the protrusion. Upon relative rotation of the lever and the housing from the preliminary mating position to the fully mated position, the first locking wall displaces the protrusion, whereby the lever is released. Thus, upon applying sufficient (e.g. manual) force onto the lever, it is possible to release the lock of the lever so that it can preferably manually be moved into the fully mated position. However, upon relative rotation of lever and housing from the preliminary mating position in the opposite rotating direction, the second wall of the reception is shaped, such that it will engage the protrusion and prevent a rotation in said opposite rotating direction. In other words, the inventive holding means allows a release in one direction if sufficient force is applied, but will in any case block any movement in the opposite direction.

[0009] To provide the desired flexibility of the locking protrusion in one direction, the holding means advantageously comprises a cavity arranged in close proximity to the locking protrusion and in a position, so that the locking protrusion is moved towards said cavity when displaced by the first locking wall.

[0010] Generally preferred, the locking protrusion is provided on the connector housing and the reception on the lever. This allows a particular compact design. In such a configuration, it is advantageous when the protrusion is arranged on an edge of the housing and that the cavity increasing the flexibility is arranged on a side wall in close proximity to said edge. Thereby it is possible to provide a high flexibility of the protrusion in the desired direction, i.e. in the direction which allows a release of the lever, but at the same time the protrusion is very rigid and does not easily move in any other direction.

[0011] Preferably, a protrusion and corresponding reception is provided on both lever arms of the lever, when the same is of the type having a generally u-shape configuration with two lever arms connected by a common web. Such a symmetrical arrangement leads to very controlled release forces, whereby it is possible to adjust the threshold force that is necessary to release the lever and to move it from the preliminary mating position to the fully mated position in a very accurate manner. Thus, generally preferred, the holding means are adapted, such that a predetermined threshold force of at least 10 N, more preferred 40 N, and maximum 50 N has to be applied by an operator to rotate the lever and the housing relatively from preliminary mating to fully mated position.

[0012] Preferably, the locking reception is adapted such that the contact surfaces of the first locking wall and the locking protrusion are oriented in a plane inclined to the rotating direction, such that a force component is directed onto the locking protrusion to displace the same in order to release the lever upon the relative rotation of the lever and the housing from the preliminary mating position to the fully mated position. Similarly, it is preferred that the contact surfaces of second locking wall and locking protrusion, i.e. the two respective surfaces of wall and protrusion, which come into contact, are oriented in a plane essentially perpendicular to the rotating direction and/or such that contact surfaces of the second locking wall and the locking protrusion are oriented such that no force component is directed onto the locking protrusion which would displace the protrusion in a direction to release the lever, upon said relative rotation of lever and housing from the preliminary mating position in the opposite rotating direction, i.e. away from the fully mated position. Thereby, very high holding or locking forces can be realized in this opposite direction, so that the lever can only be released in the rotating direction from preliminary mating position to fully mated position.

IV. Description of the preferred embodiments

[0013] In the following, the invention is described exemplarily with reference to the enclosed figures, in which

Fig. 1 shows a connector assembly in exploded schematic view;

Fig. 2 shows the connector assembly of Fig. 1 in assembled condition;

Fig. 3 contains two side views of the connector assembly of Fig. 2, showing the lever in two different positions;

Figs. 4a to 4c show details of the inventive holding means;

Fig. 5 shows a schematic three dimensional view of a mate assist lever including holding means in accordance with the invention; and

Figs. 6a and 6b show details of a locking protrusion in accordance with the invention.

[0014] Fig. 1 shows a connector assembly 10 in a schematic exploded view. In the shown embodiment, the connector assembly comprises a housing 200 made up of a main part and a housing module 28, which is part of housing 200. Further, a wire shroud 30 is shown as well as a mate assist lever 100, which serves to facilitate a mating process between housing 200 and a corresponding counter connector 40. The working principle of such mate assist mechanisms is in general well known to the skilled person, so that it is refrained herein from giving a more detailed explanation thereof. Inside of housing 200, a mat seal 22 can be arranged, which is fixed in position by a mat seal retainer 24. The assembly 10 further comprises a connector seal 26.

[0015] The connector assembly 10 is shown in Fig. 2 in a three dimensional schematic view in assembled condition. The lever 100 is pivotably arranged on housing 200 and is adapted to be pivotable around a pivot axis 110. The lever 100 has a general u-shape configuration with two lever arms 102, 103 connected by a common web 105, and in the embodiment shown, each lever arm

102, 103 has a pivot axis 110 that passes through the lever arm. Figure 3 shows connector assembly 10 in two side views. In the side view on the left hand of Fig. 3, the lever 100 is shown in the preliminary mating position. In the position shown, it is now possible to plug connector housing 200 onto the counter connector 40 to initiate the mating process. On the right hand side of Fig. 3, the same arrangement is shown with lever 100 in the fully mated position. As the skilled person recognizes, upon turning lever 100 counter clockwise from the preliminary mating position to the fully mated position, for example suitable cam means provided on lever and counter connector interact so that connector housing 200 and counter connector 40 are pulled towards each other to achieve a full mating of the connectors. The functioning of the mate assist mechanism itself is not relevant for the present invention and for the details it is referred to the above described prior art, the teaching of which is included herein by reference.

[0016] In Figs. 4a to 4c, the holding means of the present invention are explained in more detail. Fig. 4a shows the same illustration as Fig. 3, with lever 100 in the open or preliminary mating position. In the shown embodiment, the connector assembly comprises altogether four holding means, two on each lever arm and each pair being arranged on opposite sides of the pivot axis 110.

[0017] Now referring to Fig. 4b and 4c: details of first holding means 120 are shown in Fig. 4c and details of the second holding means 130 are shown in Fig. 4b. It should be noted that the lever arm 103, which is not visible in Fig. 4a due to the perspective, comprises symmetrically arranged identical holding means. Fig. 4b shows details of second holding means 130 as seen from a direction x indicated by the corresponding arrow in Fig. 4a. Thus, Fig. 4b is not a cut view, in contrast to Fig. 4c. In Fig. 4b, the downward directed arrow indicates the direction of movement the lever arm 102 will follow, when lever 100 is moved from the preliminary mating position to the fully mated position, i.e. in direction "F" indicated in Fig. 4a.

[0018] From Fig. 4b one can see that housing 200 is provided with a locking protrusion 131 and the lever arm 102 is provided with a corresponding locking reception 132 receiving the locking protrusion 131 therein, in the preliminary mating position (cf. Fig. 4a). The locking reception 132 has a first wall 133 and a second locking wall 134 being arranged on opposite sides of protrusion 131. A skilled person will recognize, that upon rotation of the lever 102 from the preliminary mating position to the fully mated position, i.e. in the direction of the downward arrow in Fig. 4b, the first wall 133 will come into contact with the upper surface of locking protrusion 131. Since first wall 133 is oriented in a plane suitably inclined to the rotating direction, a force component is directed from first wall 133 onto the locking protrusion 131, which will displace the protrusion in direction of cavity 135, i.e. to the left in Fig. 4b. Thereby, the locking protrusion 131 is displaced to release the lever. However, when trying to rotate the lever in the opposite rotating direction, second wall 134 of reception 132 will likewise engage the lower contact surface of locking protrusion 131. Since second wall 134 and the corresponding contact face of locking protrusion 131 are oriented in a plane essentially perpendicular to the rotating direction no force component in direction to cavity 135 is generated and protrusion 131 is not displaced and remains in engagement with second wall 134 of reception 132. Therefore, it is not possible to rotate in said opposite rotating direction, i.e. in the direction opposite to the direction indicated by the arrow in Fig. 4b. The skilled person will recognize that the connector assembly 10 can and is used in practice in any spatial orientation, so that the expressions up, down, left or right as used herein are only used to facilitate the description of the different elements of the connector assembly shown in the figures.

[0019] Now turning to Fig. 4c, the functioning of the first holding means 120 is explained in detail. The illustration of Fig. 4c shows a cut view along plane A-A in Fig. 4a. As one can see from Fig. 4c, the holding means 120 are similar to holding means 130. Since the first holding means 120 are arranged on the opposite side of pivot axis 110 as the second holding means 130, the direction from the preliminary mating position to the fully mated position in Fig. 4c is indicated by the upward arrow in Fig. 4c. Also holding means 120 comprise a locking protrusion 121 and a corresponding locking reception 122, which is formed by two walls 123 and 124 arranged on opposite sides of protrusion 121. Also in this case, a cavity 125 is arranged in close proximity to locking protrusion 121 to enhance the flexibility of the locking protrusion towards the cavity 125. In other words, due to cavity 125, protrusion 120 can easily be bent or flexed in a direction towards said cavity, i.e. in a direction to the right in Fig. 4c, and thus in a direction to release the lever. Also with holding means 120, one can see that the first wall 123 is suitably inclined to generate a force component directed onto the locking protrusion 121, to displace the protrusion 121 towards said cavity 125 to release the lever. On the other hand, first wall 124 is inclined in such a manner, that it will not generate any force component in the direction of cavity 125 (release direction) but that it will rather generate a force component onto protrusion 121 away from cavity 125, so that protrusion 121 is not displaced or displaced in the wrong direction and cannot release the lever.

[0020] Fig. 5 shows lever 100 in a three dimensional perspective view. As one can take from Fig. 5, each lever arm 102, 103 comprises holding means 120 and 130, being arranged on opposite sides of the pivot axis 110.

[0021] Figs. 6a and 6b show details of the locking protrusion 131 (locking protrusion 121 may have the identical arrangement). As one can see, locking protrusion 131 is arranged on an edge of housing 200, and on face 202 of housing 200. The protrusion 131 has essentially cubic shape. On face 201 perpendicular to face 202 of connec-

tor housing 200, a cavity 135 is arranged in close proximity to the locking protrusion 131, i.e. so close to the protrusion 131 that it enhances the flexibility thereof. Thus, locking protrusion 131 can be moved towards cavity 135, so that it can be displaced by the first locking wall of locking reception 132 (cf. to Fig. 4b). Fig. 6b shows the same arrangement as Fig. 6a from a side view (as seen from direction X in Fig. 4a). One can see that the two contact walls of protrusion 131, i.e. the walls of protrusion 131 which face towards first and second locking walls 133 and 134, are inclined outwardly. Thereby, an improved locking in cooperation with the second locking wall 124 can be achieved and at the same time an improved displacement action when cooperating with first locking wall 133.

Claims

1. Electrical connector assembly (10) comprising
a housing (200); and
a mate assist mechanism comprising a lever (100) pivotably arranged on the housing (200); the lever being movable from a preliminary mating position to a fully mated position, and wherein the connector assembly (10) comprises holding means (120; 130) to releasably hold the lever (100) in the preliminary mating position, **characterized in that**
said holding means (120; 130) comprise a locking protrusion (121; 131), being adapted to be flexibly movable in one direction and a corresponding locking reception (122; 132) receiving said locking protrusion (121; 131) when the lever is in the preliminary mating position;
wherein the locking reception (122; 132) has first (123; 133) and second locking walls (124; 134) being arranged on opposite sides of said protrusion (121; 131);
upon relative rotation of the lever (100) and the housing (200) from the preliminary mating position to the fully mated position the first locking wall (123; 133) displaces the protrusion (121; 131) to release the lever, and
upon relative rotation of lever and housing from the preliminary mating position in the opposite rotating direction the second locking wall (124; 134) engages said protrusion (121; 131) thereby preventing a rotation in said opposite rotating direction.

2. Electrical connector assembly according to claim 1, wherein the holding means (120; 130) comprises further at least one cavity (125; 135) arranged in close proximity to the locking protrusion (121; 131) to enhance said flexibility of the locking protrusion (121; 131), such that said locking protrusion is moved towards said cavity when displaced by said first locking wall (123; 133).

3. Electrical connector assembly according to claim 2, wherein the cavity (125; 135) is arranged on a side wall (201) of the housing (200) and the locking protrusion is arranged on an edge of the housing in close proximity to said side wall.

4. Electrical connector assembly according to any preceding claim, wherein the locking protrusion (121; 131) is arranged on an edge of the housing.

5. Electrical connector assembly according to any preceding claim, wherein the locking protrusion (121; 131) has an essentially cubic shape.

6. Electrical connector assembly according to any preceding claim, wherein a surface of the locking protrusion (121; 131) facing said first locking wall is chamfered and / or wherein the first locking wall is chamfered.

7. Electrical connector assembly according to any preceding claim, wherein the holding means is adapted such that a predetermined threshold force of at least 10 N, more preferred 40 N, and maximum 50 N has to be applied by an operator to rotate the lever and the housing relatively from preliminary mating to fully mated position.

8. Electrical connector assembly according to any preceding claim, wherein the locking reception (122; 132) is adapted such that the contact surfaces of the first locking wall (123; 133) and the locking protrusion (121; 131) are oriented in a plane inclined to the rotating direction such that a force component is directed onto the locking protrusion (121; 131) to displace the protrusion to release the lever upon said relative rotation of the lever and the housing from the preliminary mating position to the fully mated position.

9. Electrical connector assembly according to any preceding claim, wherein the locking reception (122; 132) is adapted such that contact surfaces of the second locking wall (124; 134) and the locking protrusion are oriented in a plane essentially perpendicular to the rotating direction.

10. Electrical connector assembly according to any preceding claim, wherein the locking reception (122; 132) is adapted such that contact surfaces of the second locking wall (124; 134) and the locking protrusion are oriented such that no force component is directed onto the locking protrusion (121; 131) which would displace the protrusion to release the lever, upon said relative rotation of lever and housing from the preliminary mating position in said opposite rotating direction.

11. Electrical connector assembly according to any preceding claim, wherein the locking reception (122; 132) is arranged on the lever (100) and the locking protrusion (121; 131) is arranged on the housing (200).

12. Electrical connector assembly according to any preceding claim, wherein the lever (100) has a U-shape form with two lever arms (102, 103) connected by a common web (105), whereby each lever arm has a pivot axis (100) that passes through the lever arm, and wherein at least one, preferably both, lever arm(s) comprise(s) two locking receptions (122; 132) that are arranged thereon on opposite sides of the pivot axis.

13. Electrical connector assembly according to claim 12, wherein two locking protrusions corresponding to the two locking receptions (122; 132) are arranged each on an edge of the housing.

14. Electrical connector assembly according to any preceding claim, wherein the holding means comprises at least four locking protrusions (121; 131) and four corresponding locking receptions (122; 132).

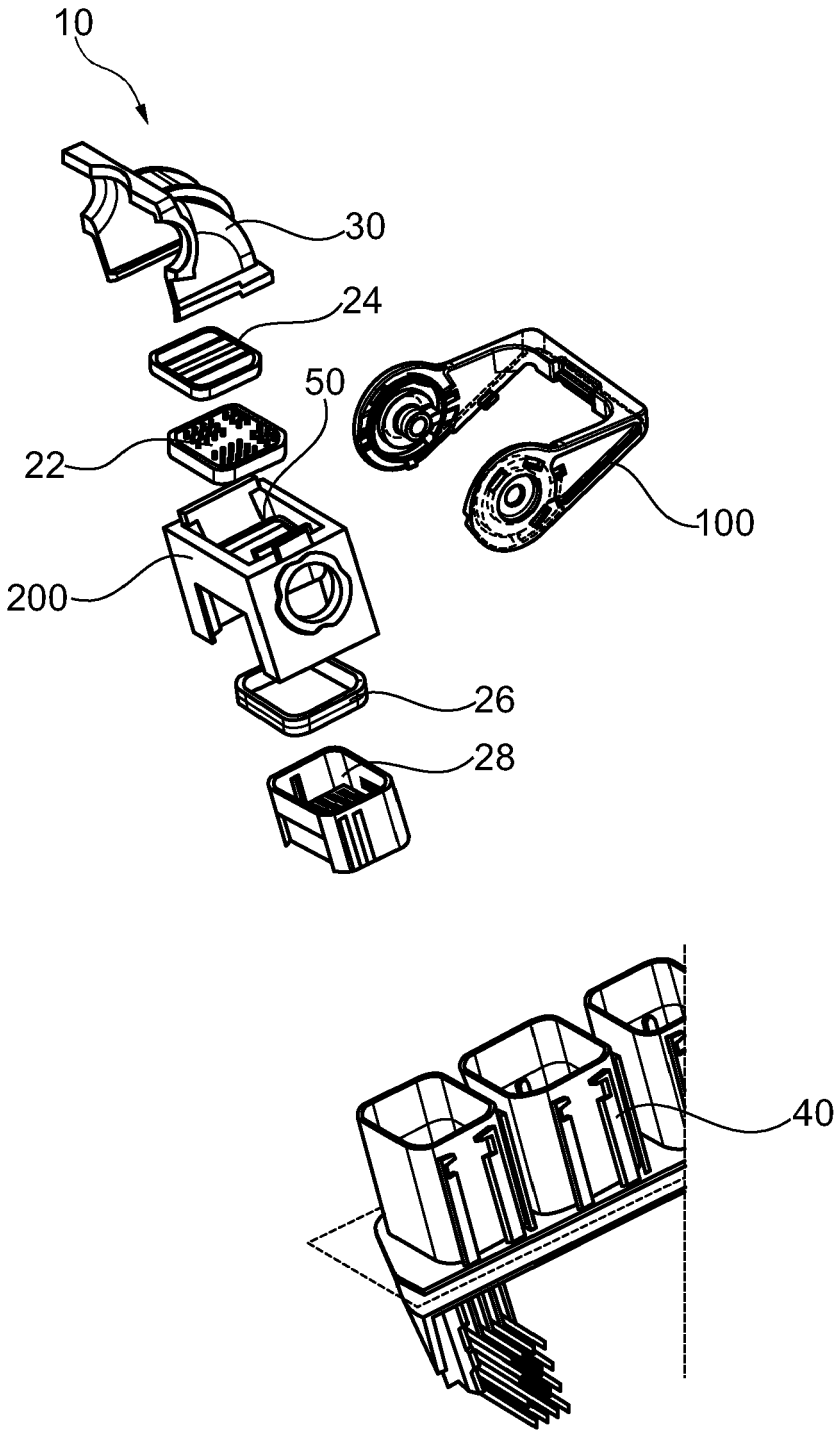

Fig. 1

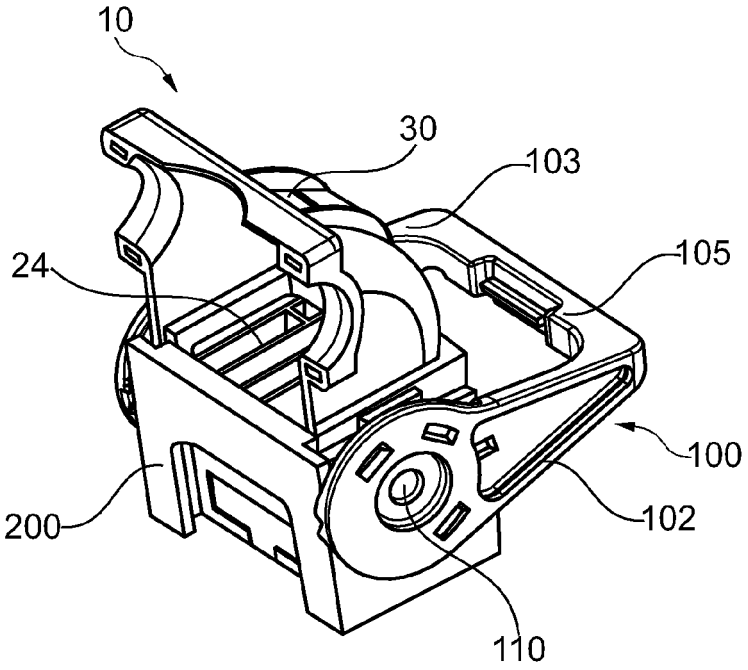

Fig. 2

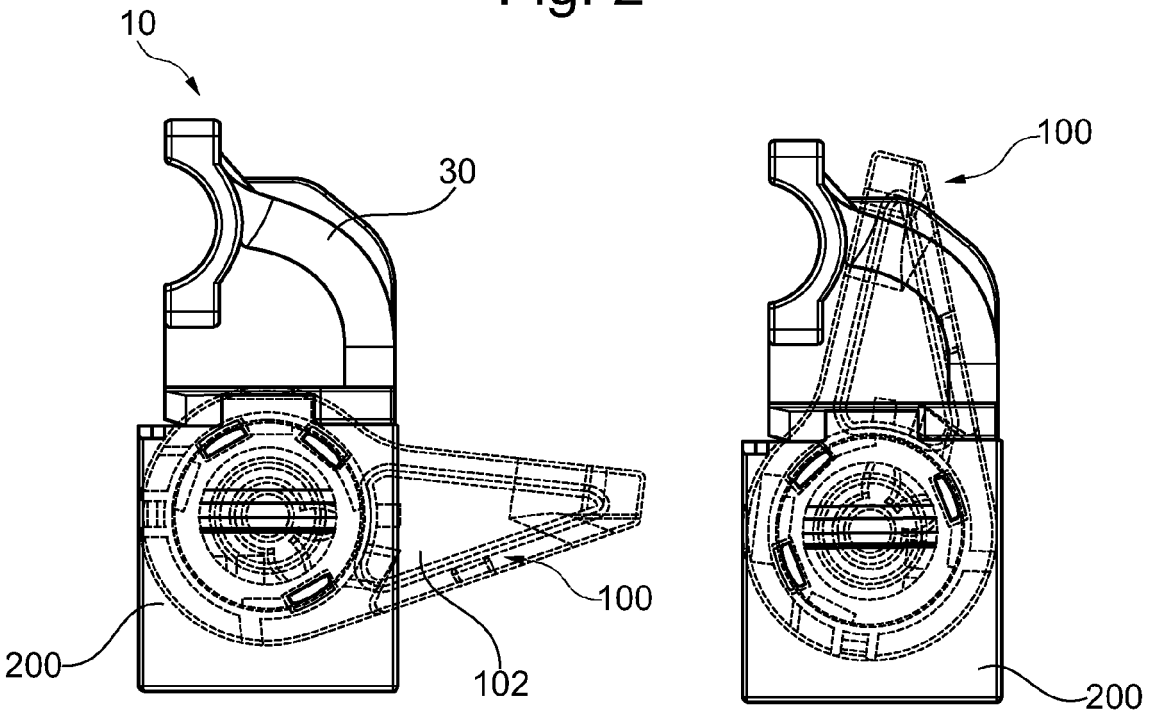

Fig. 3

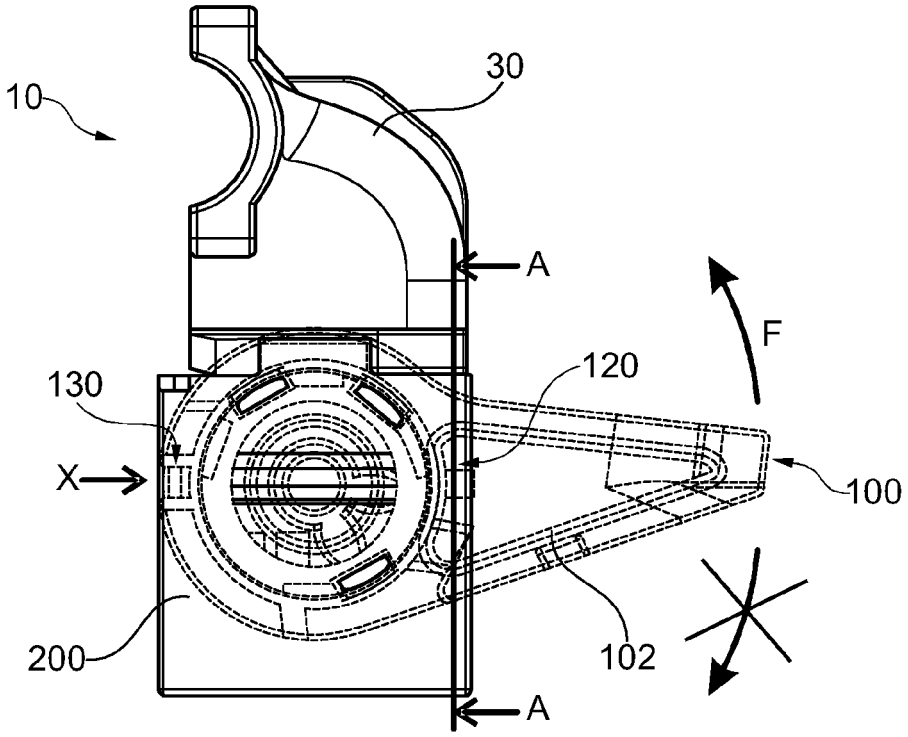

Fig. 4a

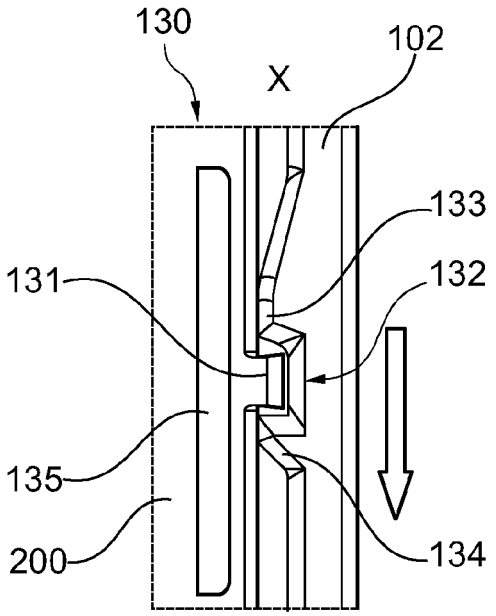

Fig. 4b

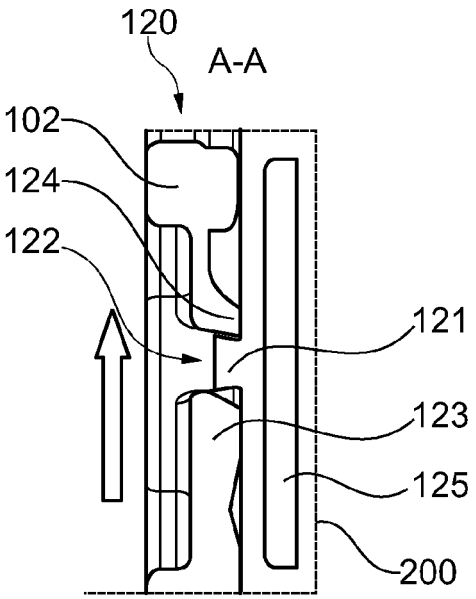

Fig. 4c

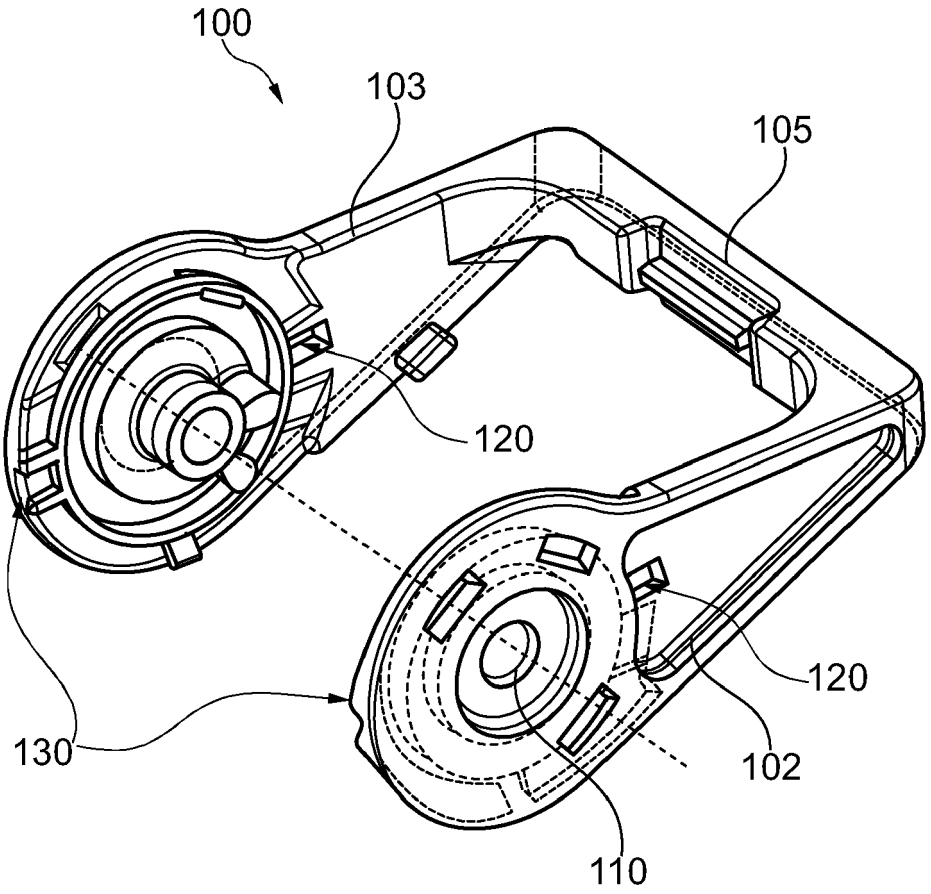

Fig. 5

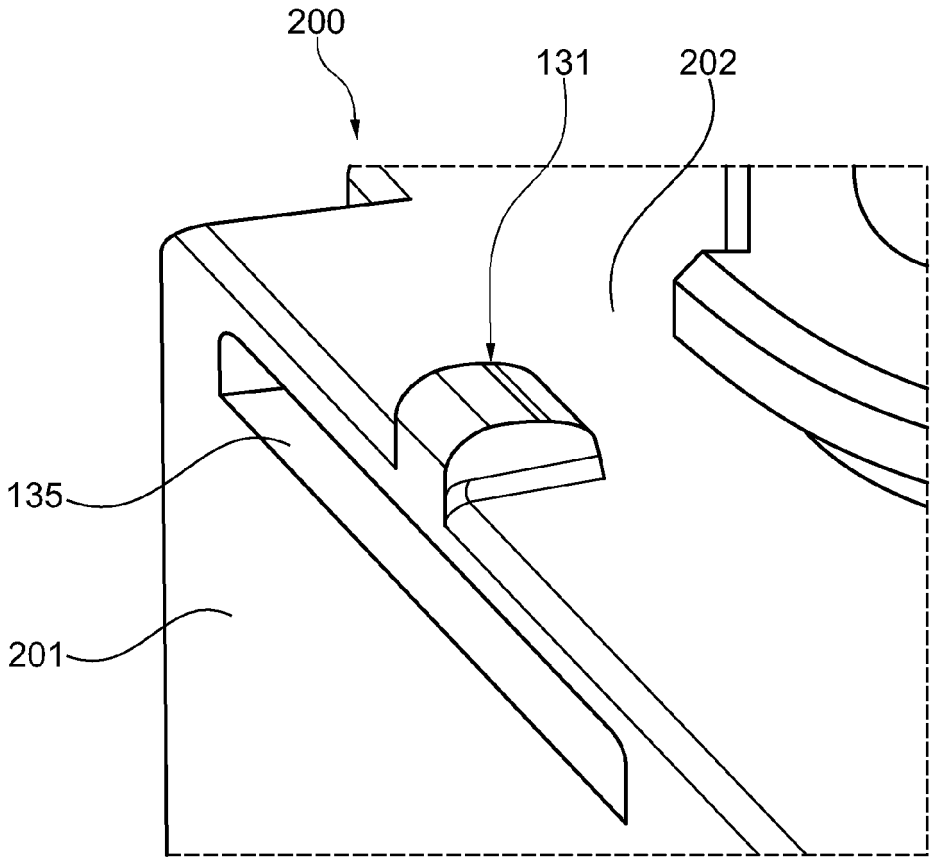

Fig. 6a

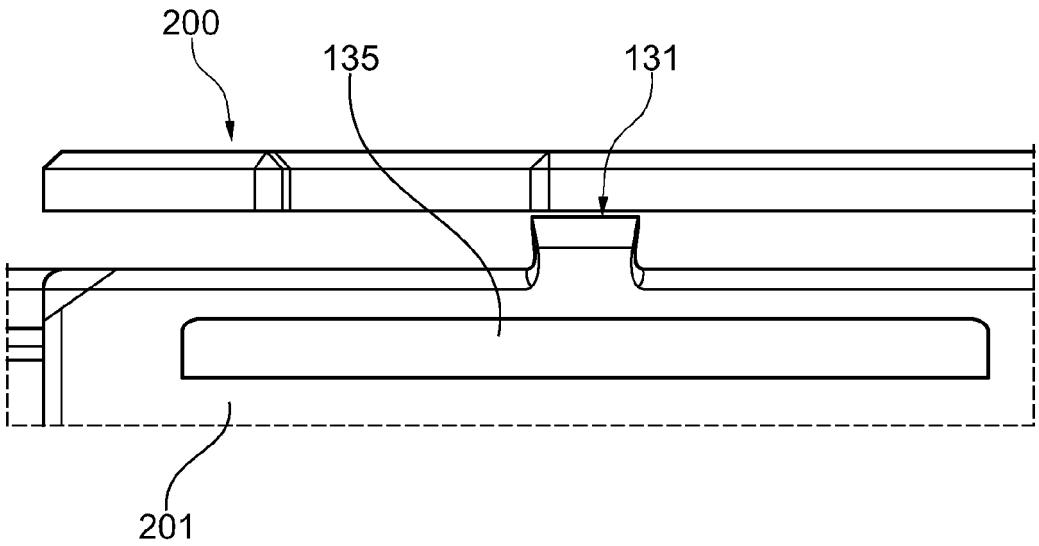

Fig. 6b

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 13 17 6416

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2003/017026 A1 (TACHI HIDESHI [JP]) 23 January 2003 (2003-01-23)	1,2, 5-10,12, 14	INV. H01R13/629
A	* paragraph [0037] - paragraph [0047]; figures 1,2,3,9 *	3,4,11, 13	
A	US 5 172 998 A (HATAGISHI YUJI [JP]) 22 December 1992 (1992-12-22) * column 2, line 55 - column 4, line 12; figures 1,2 *	1-14	
A	US 2005/026484 A1 (DEMUTH ULRICH [DE]) 3 February 2005 (2005-02-03) * paragraph [0015] - paragraph [0033]; figure 3 *	1-14	
			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	13 December 2013	Bouhana, Emmanuel

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 13 17 6416

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.

13-12-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2003017026 A1	23-01-2003	DE 10232969 A1	27-02-2003
		US 2003017026 A1	23-01-2003
US 5172998 A	22-12-1992	JP 2907235 B2	21-06-1999
		JP H04218279 A	07-08-1992
		US 5172998 A	22-12-1992
US 2005026484 A1	03-02-2005	DE 102004013476 A1	04-11-2004
		US 2005026484 A1	03-02-2005

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- WO 2007098253 A **[0003]**
- US 20060089031 A1 **[0004]**