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(54) **Electrical connector and electrical connection assembly**

(57) An electrical connector assembly (1) comprising an electrical connector having a carrier (2) and a mating connector (3) comprising a mate assist system adapted to assist the mating of the electrical connector to the mating connector. The mate assist system has a lever (4) mounted to pivot on the carrier. The lever is adapted to pivot with respect to the carrier at a pivot connection between the pre-locked and a locked position supporting the connection between the carrier and the mating connector. The pivotable lever has a lever arm portion (4b) actuatable by a user, between the locked position corresponding to an upper boundary level of the lever arm portion, and the pre-locked position corresponding to a lower boundary level of the lever arm portion. A flexible leg (5) extending from the lever engages a locking element (8) located on the carrier in order to lock the lever in its pre-locked position.

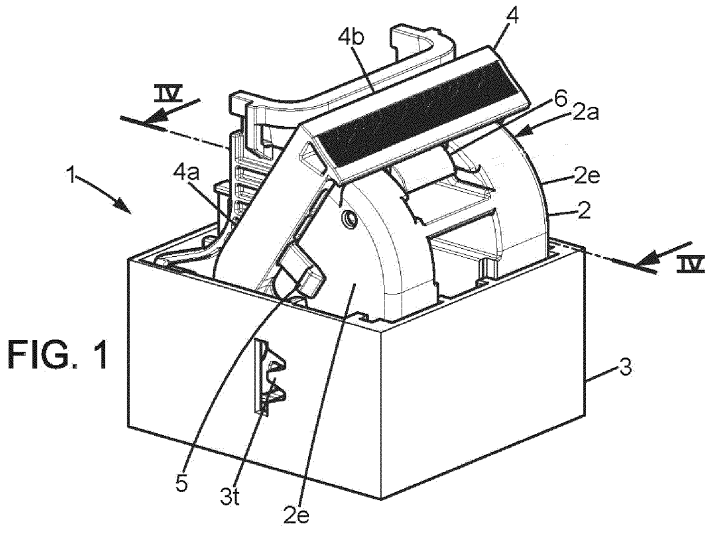

FIG. 1

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Description

FIELD OF THE INVENTION

[0001] The instant invention relates to electrical connectors and electrical connection assemblies comprising such connectors.

BACKGROUND OF THE INVENTION

[0002] In particular, the instant invention is related to an electrical connector assembly having an electrical connector with a carrier, a mating connector, and a mate assist system adapted to assist the mating of the electrical connector to the mating connector. The mate assist system has a pivotable lever mounted on the carrier and has a teeth portion. The mate assist system further has a complementary teeth facing portion on the mating connector. A rotating movement of the lever, with the teeth portion cooperating with the complementary teeth facing portion on the mating connector, causes a mating movement of the carrier and the mating connector along a mating direction with respect to one another.

[0003] An example of such a system is provided for example in US 5,873,745. During transportations or manipulation the lever might move with respect to the carrier. In such a case, the components are not properly placed at the time of operation with the mating connector and the connection might be impaired.

SUMMARY OF THE INVENTION

[0004] To this aim, according to the invention, a locking system of the mate assist system is considered, comprising a locking element on the carrier and a flexible leg portion of the lever, wherein the flexible leg portion is lockably engageable with the locking element and, in a pre-locked position, the rotation of the lever with respect to the carrier is prevented. The flexible leg is able to cooperate with an actuating component upon mating together the carrier and the mating connector to disengage the flexible leg portion from the locking element. The pivotable lever is adapted to pivot with respect to the carrier at a pivot connection between the pre-locked position and a locked position supporting the connection between the carrier and the mating connector. The pivotable lever comprises lengthwise and transverse actuating arm portions, wherein the lengthwise arm portions are pivotable along the two opposite sides of the carrier with respect to a pivot connection and the two lengthwise arm portions are connected with the transverse actuating arm portion. The transverse actuating arm portion is actuable by a user and it is movable with respect to the pivot connection from a locked position to a prelocked position and vice versa. The locked position corresponds to an upper boundary level of the transverse actuating arm portion, said upper boundary level being further away from the mating connector; and the pre-locked position corresponds to a lower boundary level of the lever arm portion, said lower boundary level being closer to the mating connector. The flexible leg of the pivotable lever is lockably engageable with a locking element on the carrier, thereby keeping the pivotable lever in a pre-locked position. By inserting the carrier in the mating connector, the actuating component of the mating connector disengages the flexible leg portion of the pivotable lever from the locking element of the carrier, thereby terminating the locking in pre-locked position. Thus, the pivotable lever is able to move from a lower boundary level to an upper boundary level, thereby a teeth portion of the pivotable lever is able to mesh with a complementary teeth facing portion of a mating connector and thereby the carrier and the mating connector can be fixed to each other. In addition, the pivotable lever in an upper boundary level can be locked by a locking mechanism and by this the mating connector element can be firmly fixed to the carrier. This way, the assembling of the carrier and the mating connector element can be facilitated.

[0005] For the electrical connector assemblies, a firm assembly of a carrier and a mating connector is desirable. While rotating the pivotable lever of the carrier from a lower boundary level to an upper boundary level, a mating connector element is fixed to the carrier. For assembling the two parts, the pivotable lever is in pre-locked position. The actuating component portion on the side of the mating connector cooperates with the flexible leg of the pivotable lever and, upon the assembling movement, the actuating component deflects the flexible locking leg from the locking element and the pivotable lever is unlocked from the pre-locked position, thus it can be pivoted to an upper boundary level. While the pivotable lever approaches the upper boundary level, the teeth portion of the aforementioned pivotable lever meshes with a complementary teeth facing portion of the mating connector and by this the carrier drags along the mating connector element with it. In the upper boundary level, the pivotable lever can be locked by a locking mechanism and, by this, ensures the mating of the carrier and the mating connector.

[0006] The flexible leg is inserted between the locking element of the carrier and a side face of the carrier so as to prevent the locking leg from being broken or unlocked from the locking element during transportation or handling as long as the electrical connector and the mating connector are not mated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] Other characteristics and advantages of the invention will readily appear from the following description of one of its embodiments, provided as a non-limitative example, and of the accompanying drawings.

[0008] On the drawings :

- Fig. 1 is a perspective view of the connector assembly in assembled position,

- Fig. 2 is a perspective view of the carrier with a pivotable lever in an upper boundary position,
- Fig. 2A is a detail view of part of the carrier of Fig. 2,
- Fig. 3 is a perspective view of the mating connector,
- Fig. 4 is a lateral cross-section view of the carrier and the mating connector in assembled position,
- Fig. 5a and 5b are respectively partial front and side views of the carrier and the mating connector with a pivotable lever in a lower boundary level corresponding to a pre-locked position,
- Fig. 6a, 6b and 7a and 7b are views similar to the Figs. 5a, 5b at different connection steps.

[0009] On the different Figures, the same reference signs designate like or similar elements.

DETAILED DESCRIPTION

[0010] For lever type connectors, firm and secure assembling is desirable. Therefore it is necessary to provide this type of connectors with corresponding securing or locking mechanisms for ensuring the proper interlocking of the connector assembly elements.

[0011] As apparent from Fig. 1, the connector assembly 1 comprises:

- an electrical connector 2a having a carrier 2,
- and a mating connector 3, shown in assembled position with the electrical connector 2a on Fig. 1.

[0012] The carrier 2 defines a plastic housing holding a plurality of electrical contacts to be mated with complementary contacts of the mating connector 3. The mating connector 3, itself has a plastic housing holding complementary contacts. The numbers, types, arrangements of the contacts can be according to any requirement compatible with the connector assembly.

[0013] The connector assembly 1 is a lever type connector assembly, having a lever 4 which itself comprises parallel lengthwise arms 4a along two opposite lateral sides 2e of the carrier 2 and a transverse actuating arm portion 4b, thus forming a U-shaped lever. The two lengthwise arms 4a are connected to the ends of the transverse actuating arm 4b, and both lengthwise arms are pivotally mounted on the carrier 2, e.g. by pivots 10 serving as pivoting points and forming pivoting connection.

[0014] From Fig. 2 and 4, it is apparent that the pivots 10 are extensions from the lateral sides 2e of the carrier forming a fulcrum for the pivoting lever 4, and define the rotation axis of the pivoting lever. The pivoting lever 4 also comprises a teeth portion 7, which is an extension from the pivoting lever, in a lateral plane, in the proximity of the pivoting point 10 of the pivotable lever 4. The teeth portion 7 follows an arcuate path, centered on the pivot axis of the lever 4. The teeth portion 7 of the pivotable lever is adapted to cooperate with a facing complementary teeth portion 3t of the mating connector 3, more visible from Fig. 3, and by this forming with the pivotable lever a mate assist system.

[0015] The pivoting movement of the pivotable lever 4, from a lower boundary level to an upper boundary level, enables the teeth portion 7 to cooperate with the complementary teeth portion 3t of the carrier 3 and by this to displace the carrier 2 and the mating connector 3 with respect to each another along the mating direction and to interconnect the carrier 2 and the mating connector 3.

[0016] When the pivotable lever 4 reaches the upper boundary level, the aforementioned connector assembly elements abut against to each other. The abutting of the carrier 2 and the mating connector 3 is a result of the encasement of the teeth portion 7 into the complementary teeth portion 3t, more visible from Fig. 4.

[0017] The rotation movement of the pivotable lever 4, which can be effected by a user by pushing the pivotable lever 4 by its transverse actuating arm portion 4b towards the upper boundary level of the lever, results in a mating movement of the carrier 2 and the mating connector 3 toward each other along the mating direction. The actuatable portion of the lever is the portion with the largest lever arm.

[0018] The pivotable lever 4, further comprises flexible locking legs 5. These legs can be symmetric to one another, and only one will be described. The flexible locking leg comprises an elongated portion 5e, which extends from the lengthwise arm 4a, and is connected to a hook portion 5a. As apparent from Fig. 2a, the hook portion 5a has an inner face 5b, which faces toward the carrier side wall 2e and an outer face 5c, which faces away from said side wall of the carrier.

[0019] Said inner and outer faces 5b, 5c are tapered toward the free end 5f of the flexible locking leg 5 and the outer face 5c is extended by a step portion 5d which is substantially perpendicular to the side faces of the flexible leg portion 5.

[0020] The carrier 2 further comprises locking elements 8 on both lateral side walls 2e of the carrier 2, which are vertical extensions for instance in the form of vertical ribs protruding from the side walls 2e of the carrier, starting from the base of the carrier 2 up to the level of the pivot 10.

[0021] Each locking element 8 further comprises a locking knob 8k, more visible from Fig. 2 and 4, which orthogonally extends from a vertical section of the locking element 8 at the height of the pivot 10, thus forming an opened gap 12 between the side wall of the carrier 2 and the locking knob 8k. The gap 12 is sufficiently broad to allow the hook portion 5a to pass through.

[0022] When manufacturing or cabling the carrier 2, the lever 4 may not be in its pre-locked condition. In this case, before shipment, the pivotable lever 4 is rotated to its lower boundary level.

[0023] During the rotation of the pivotable lever 4, from a top boundary level to a lower boundary level the flexible locking leg 5 approaches the locking knob 8k and, by the cooperation of these two elements, the pivotable lever

can be pre-locked.

[0024] While pivoting the pivotable lever 4, to a lower boundary level, the outer face 5c of the hook portion 5a comes in contact with the inner side of the locking knob 8k and, due to the flexibility of the flexible locking leg 5, the locking leg flexes toward the side wall 2e of the carrier by cam effect, up to the point where the step portion 5d of the hook portion 5a passes under the locking knob 8k. The leg 5 then returns elastically to its initial position, thus locking the hook portion 5a under the locking knob by snap-fitting. This condition is shown on Figs. 5a and 5b. The pre-locked position of the pivotable lever 4 corresponds to a lower boundary level of the lever arm position, wherein the pivotable lever 4, especially the transverse actuating arm portion 4b, is proximal or closer to the mating connector 3. In this position, the lever 4 may abut against a suitable abutment 13 of the carrier 2 to prevent any further movement of the lever in this direction.

[0025] In this position, the locking leg 5 extends, on the one hand, between the locking knob 8b and the side wall 2e and on the other hand, between two ribs 8a, 13b extending substantially along and parallel to the flexible leg 5. One 8a of these ribs supports the locking knob 8k. The other rib 13b supports at one of its ends the abutment 13. Consequently, the flexible leg is well protected in the volume defined by the ribs, the side wall 2e and the knob 8b. This prevents the locking leg 5 from being broken or unlocked from the knob 8 during transportation or handling as long as the electrical connector and the mating connector are not mated.

[0026] As it is visible on Fig. 5a, the hook portion 5a of the leg 5 is broader than the locking element 8, so that a first portion of the step portion 5d cooperates with the locking element 8 to prevent any movement of the lever 4 toward its locked position, and another portion is laterally offset. The carrier 2, with the lever in pre-locked position, is able to mate a mating connector 3. According to a purely illustrative embodiment, the mating connector 3 is adapted to encompass a lower area of the carrier 2, which can extend from the base plane of the carrier to an upper level of the carrier 2. The mating connector also comprises an actuating component 9, more visible from Fig. 3.

[0027] The actuating component 9 is a vertical extension from the inner side of the mating connector, which also comprises an inclined portion 9i, extending from the top of the mating connector 3 to the inner wall of the actuating component. As seen also on Fig 5a, when the carrier 2 and the mating connector 3 are facing each other ready for assembly, the actuating component 9 is laterally offset from the locking element 8. It is facing the offset portion of the hook portion 5a of the locking leg 5.

[0028] While moving the carrier 2, with the pivotable lever in pre-locked position, and the mating connector 3 along the mating direction towards each other, the actuating component 9 is adapted to cooperate with the flexible locking leg 5 of the pivotable lever 4.

[0029] The inclined portion of the actuating component 9i is formed to cooperate with the outer inclined portion of the hook portion 5a of the flexible locking leg 5. During the mating movement, or inserting the carrier 2 into the mating connector 3, the inclined portion of the actuating component 9i and the outer inclined plane of the hook portion 5a faces and gets toeach other and since the hook portion 5a is connected to the flexible locking leg 5, the hook portion 5a can slide on the inclined portion of the actuating component 9i, while pushing the flexible locking leg towards the side wall 2e of the carrier 2. By this, the snap-fit connection of the flexible locking leg 5 and the locking element 8 is disengaged and the pivotable lever is unlocked from its pre-locked position. This condition is shown on Figs. 6a and 6b.

[0030] Thus, the pivotable lever can be rotated from the lower boundary level to an upper boundary level, which was prevented before the cooperation of the actuating component 9 with the flexible locking leg 5.

[0031] While moving the pivotable lever from the lower boundary level to an upper boundary level, the mate assist system, comprising a teeth portion 7 on the pivotable lever 4 of the carrier 2 and the complementary teeth portion 3t of the carrier 3 can cooperate, to engage the carrier 2 and the mating connector 3. This condition is shown on Fig. 7a and 7b, where the locking leg 5 is not seen anymore, further to the rotation of the lever 4.

[0032] While approaching the upper boundary level of the lever, the transverse actuating arm portion 4b is able to cooperate with a flexible latch 6 of the carrier. The flexible latch 6 is connected to the carrier and it comprises a bulging section facing against the transverse actuating arm portion 4b. While rotating the pivotable lever 4 to the upper boundary level of the lever, the bulging section of the flexible latch 6 flexes towards the carrier and slides on a locking peg of the transverse actuating arm portion 4b, and as the pivotable lever reaches the upper boundary level of the lever, the sliding faces of the locking peg and the flexible latch run out, enabling the flexible latch 6 to get back to its initial position and lock the pivotable lever 4 in the upper boundary level of the lever, by snap-fitting.

[0033] The upper boundary level of the lever corresponds to the locked position of the pivotable lever 4, wherein the aforementioned lever 4, especially the transverse actuating arm portion 4b, is in a distal position or further away from the mating connector 3. Due to the mating system, which firmly interlocks the mating connector 3 with the carrier 2, and the locking latch 6, which locks the pivotable lever 4 in the upper boundary level of the lever, the connector assembly 1 is securely and firmly connected. To uncouple the carrier 2 and the mating connector 3 the user has to push the flexible latch 6 towards to the carrier 3, to uncouple it from the locking peg and to enable the pivoting of the pivotable lever 4 from the upper boundary level of the lever to the lower boundary level of the lever. This movement uncouples the mate assist system elements, wherein the complementary

teeth portion 3t of the carrier 3 and the teeth portion 7 of the pivotable lever 4 connected to the carrier 2 disengage. After the pivotable lever 4 is in the lower boundary level of the lever, the carrier 2 and the mating connector 3 can be separated.

Claims

1. An electrical connector assembly (1) comprising:

- an electrical connector (2a) having a carrier (2);
- a mating connector (3) having an actuating component (9);
- a mate assist system adapted to assist the mating of the electrical connector (2a) and the mating connector (3), the mate assist system having a lever (4) mounted to pivot on the carrier, wherein a rotating movement of the lever (4) causes a mating movement of the electrical connector (2a) and the mating connector (3) along a mating direction with respect to one another,
- a locking system of the mate assist system, comprising a locking element (8) on the carrier (2), and a flexible leg portion (5) of the lever (4), said flexible leg portion being lockably engaged with said locking element (8) in a pre-locked position wherein rotation of the lever (4) with respect to the carrier (2) is prevented, and said flexible leg (5) being able to cooperate with the actuating component (9) upon mating together the electrical connector (2a) and the mating connector (3) to release the flexible leg (5) portion out of engagement with the locking element (8);

wherein the pivotable lever (4) is adapted to pivot with respect to the carrier at a pivot connection (10) between the pre-locked and a locked position supporting the connection between the carrier (2) and the mating connector (3); and wherein the flexible leg (5) is inserted in the pre-locked position of the lever (4) between a side wall (2e) of the carrier and the locking element (8).

2. An electrical connector assembly, according to claim 1, wherein the flexible leg (5) extends in the pre-locked position of the lever (4) along a rib (8a) substantially parallel to the flexible leg (5).

3. An electrical connector assembly, according to claim 1 or 2, wherein the flexible leg (5) abuts in the pre-locked position of the lever (4) against an abutment (13) located at one of the ends of a rib (13b) extending along the flexible leg (5).

4. An electrical connector assembly, according to any preceding claim, wherein the pivotable lever has an arm portion (4b) actuatable by a user and wherein the locked position corresponds to an upper boundary level of the actuatable lever arm portion (4b), said upper boundary level being further away from the mating connector (3); and the pre-locked position corresponds to a lower boundary level of the actuatable lever arm portion (4b), said lower boundary level being closer to the mating connector (3).

5. An electrical connector assembly, according to claim 4, wherein the carrier (2) comprises a flexible latch (6) adapted to engage a locking peg of the pivotable lever (4) and thereby locks the pivotable lever in the upper boundary level of the lever, in the locked position.

6. An electrical connector assembly, according to any preceding claim, wherein the actuating component (9) of the mating connector (3) extends from the inner side of the mating connector (3), and upon assembling the carrier (2) with the mating connector (3), the actuating component (9) deflects the locking leg (5) of the pivotable lever (4), thereby allowing the disengagement of the flexible leg (5) with the locking element (8) and unlock the pivotable lever (4) from a pre-locked position.

7. An electrical connector assembly, according to any preceding claim, wherein the flexible leg portion (5) of the pivotable lever (4) comprises an elongated portion (5e) and a hook portion (5a).

8. An electrical connector assembly, according to claim 7, wherein the hook portion (5a) of the flexible leg (5) is able to snap-fit with the locking element (8).

9. An electrical connector assembly, according to any preceding claim, wherein a teeth portion (7) of the pivotable lever (4) is able to mesh with a complementary teeth portion (3t) of the mating connector (3), while the pivotable lever (4) is pivoted from a pre-locked position to a locked position, and thereby fixing the connection between the carrier (2) and the mating connector (3).

10. A method of assembling an electrical connector assembly comprising:

- providing an electrical connector having a carrier (2), a lever (4) mounted to pivot on the carrier (2), a locking element (8) on the carrier and a flexible leg portion (5) extending from the lever (4), said flexible leg portion (5) being lockably engaged with said locking element (8) in a pre-locked position wherein rotation of the lever (4) with respect to the carrier (2) is prevented;
- providing a mating connector (3) having an actuating component (9), a complementary portion to the lever, wherein a rotating movement of the lever (4) causes a mating movement of the elec-

trical connector (2a) and the mating connector (3) along a mating direction with respect to one another; the lever (4) and the mating connector (3) forming a mate assist system adapted to assist the mating of the electrical connector (2a) to the mating connector (3),
wherein the flexible leg (5) is inserted in the pre-locked position of the lever (4) between a side wall (2e) of the carrier and the locking element (8), and wherein said flexible leg (5) cooperates with the actuating component (9) upon mating together the electrical connector (2a) and the mating connector (3) to release the flexible leg (5) portion out of engagement with the locking element (8).

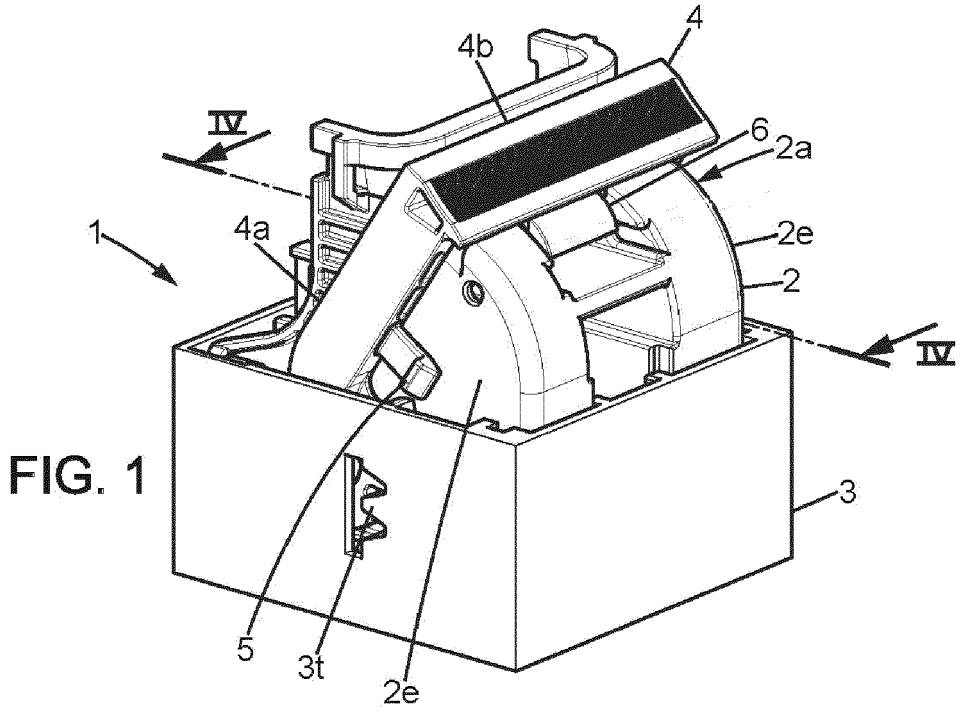
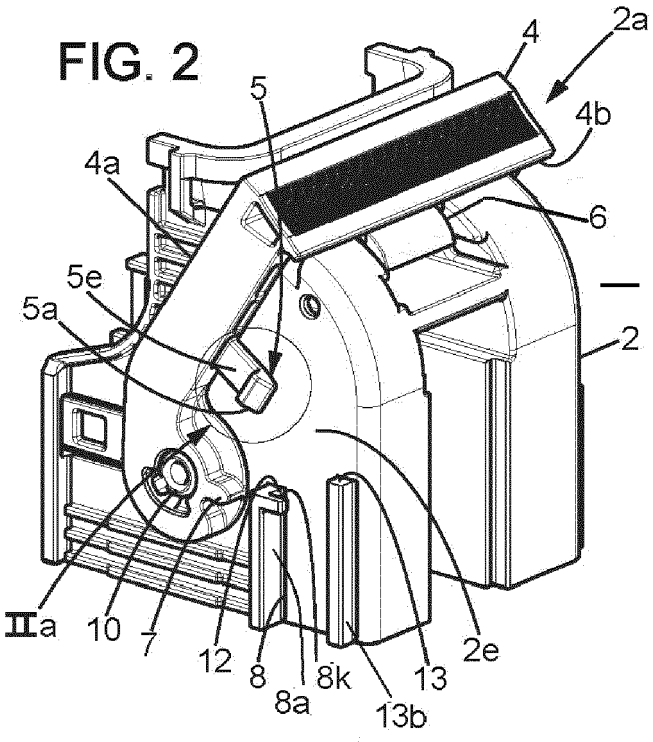


FIG. 1

FIG. 2



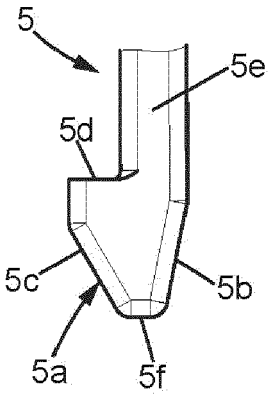


FIG. 2a

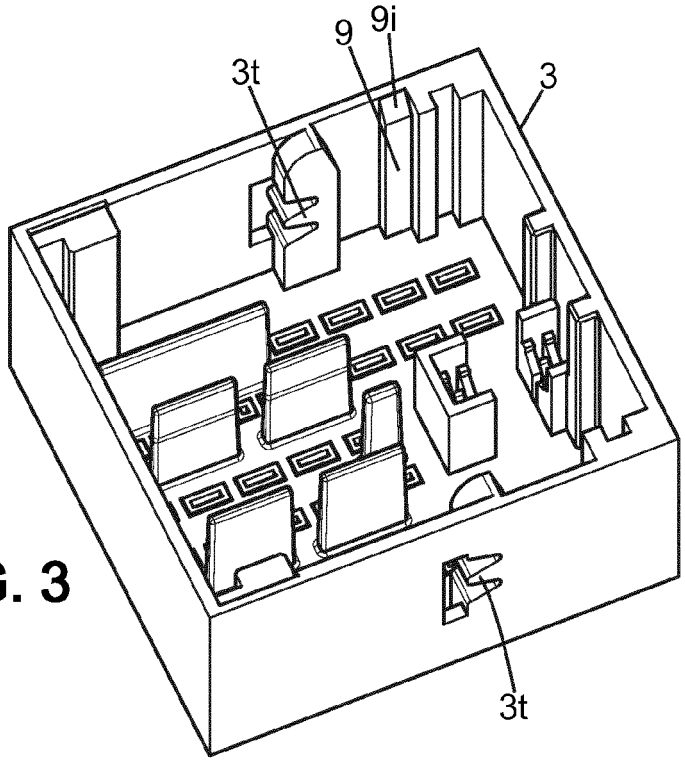


FIG. 3

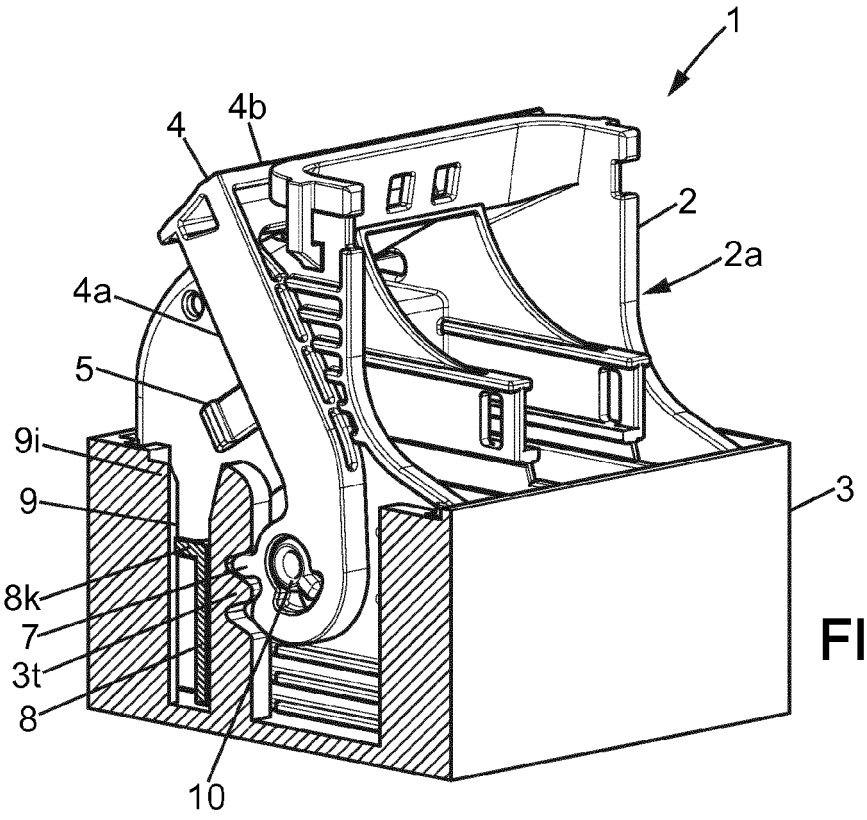


FIG. 4

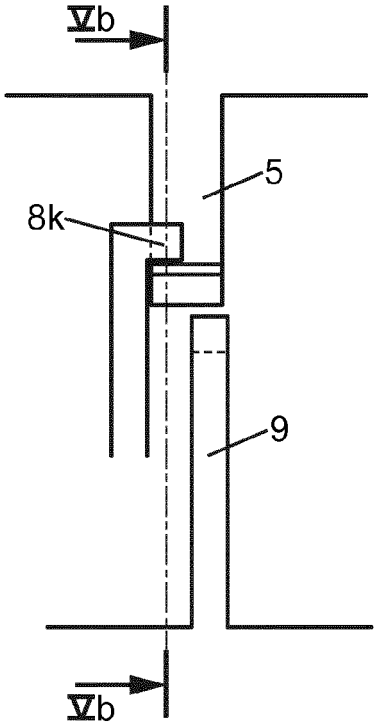


FIG. 5a

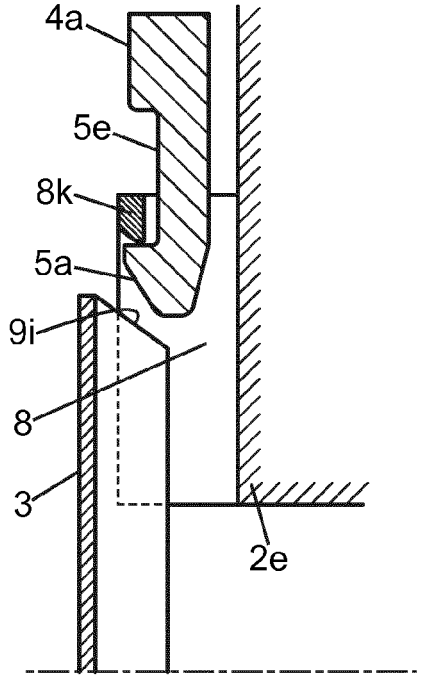


FIG. 5b

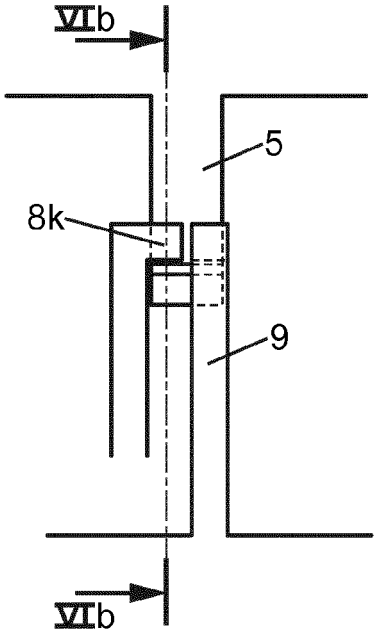


FIG. 6a

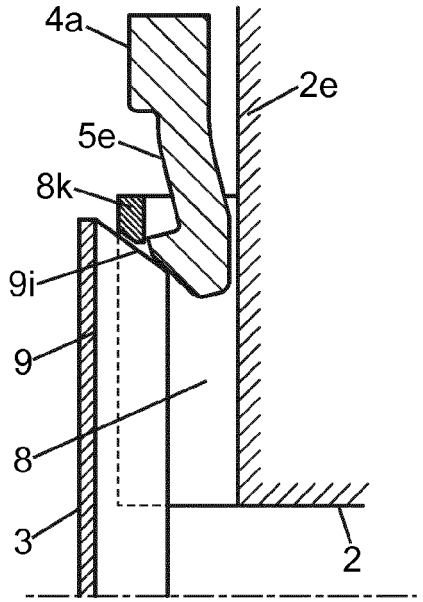


FIG. 6b

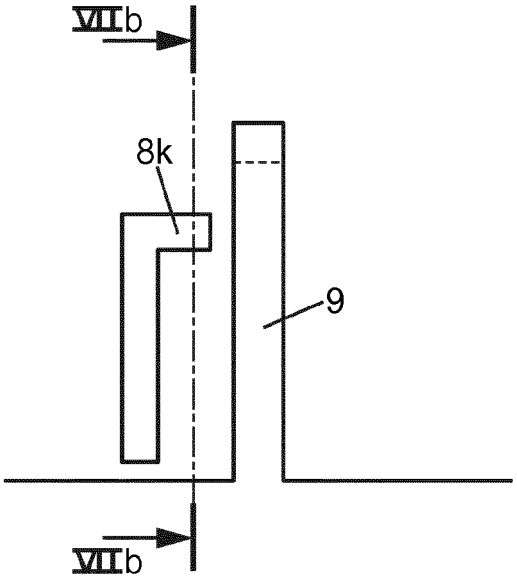


FIG. 7a

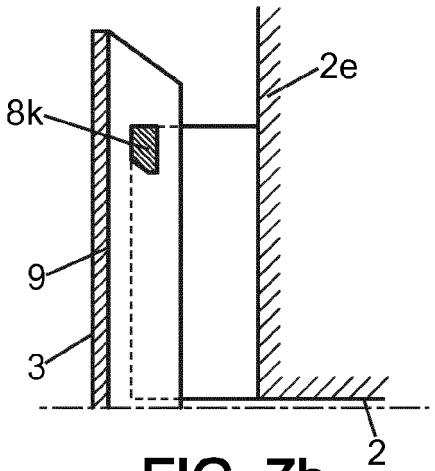


FIG. 7b

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EUROPEAN SEARCH REPORT

Application Number
EP 13 17 3113

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	WO 2013/060772 A1 (DELPHI TECH INC [US]; PAPURCU NECDET [DE]; SCHATTLING JOERG [DE]; WEID) 2 May 2013 (2013-05-02)	1-4,6-10	INV. H01R13/627 H01R13/629
Y	* pages 7-9; figures 3-9 *	4,5	
X	EP 1 077 512 A2 (FRAMATOME CONNECTORS INT [FR]) 21 February 2001 (2001-02-21)	10	
Y	* paragraphs [0013], [0016], [0020]; figures 1-4 *	4,5	
Y	US 2009/246992 A1 (MARTIN GALEN M [US]) 1 October 2009 (2009-10-01)	4,5	
A	* paragraphs [0028], [0029] *	1-3,6-10	
A	WO 2010/058529 A1 (TYCO ELECTRONICS JAPAN G K [JP]; MITO YUSUKE [JP]) 27 May 2010 (2010-05-27) * abstract *	1-10	
A	US 6 439 902 B1 (COLE BRYAN DONALD [US] ET AL) 27 August 2002 (2002-08-27) * paragraphs [0028] - [0010]; figures 3-5 *	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	29 October 2013	López García, Raquel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 17 3113

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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29-10-2013

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