



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
09.09.2020 Bulletin 2020/37

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

(21) Application number: **19160455.2**

(22) Date of filing: **04.03.2019**

(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
Designated Validation States:
KH MA MD TN

(71) Applicant: **Aptiv Technologies Limited**
St. Michael (BB)

(72) Inventors:
• **MENEZ, Frédéric**
78125 HERMERAY (FR)
• **RAMAKRISHNAN, Prasanna**
600117 Chennai (IN)
• **MANNE, Ramakrishna**
522257 GUNTUR (IN)

(74) Representative: **GIE Innovation Competence
Group**
310, avenue Berthelot
69372 Lyon Cedex 08 (FR)

(54) **HIGH VOLTAGE ELECTRICAL CONNECTOR WITH CPA ASSEMBLED ON SLIDER**

(57) An electrical connector (10) comprising a connector housing (12) having a mating axis (X) and a mate assist device (20) attached to the connector housing (12), surrounding the connector housing (10), wherein the mate assist device (20) is movable, along the mating axis (X) in a mating direction (M), from a first position (P1) to a second position (P2), a connector position assurance device (60) attached at the mate assist device (20), movable from a third position (P3) to a fourth position (P4) along the mating axis (X) in the mating direction (M), wherein the connector position assurance device (60) is locked, by first locking means in the third position (P3)

when the electrical connector (10) is not mated to an electrical counter connector (100) and wherein the connector position assurance device (60) is released by first unlocking means, attached at the electrical counter connector (100), when the electrical connector (10) and the electrical counter connector (100) are mated, wherein the released connector position assurance device (60) securely locks the electrical connector (10) to the electrical counter connector (100) by second locking means, attached on the position assurance device (60), when the connector position assurance device (60) is moved to the fourth position (P4).

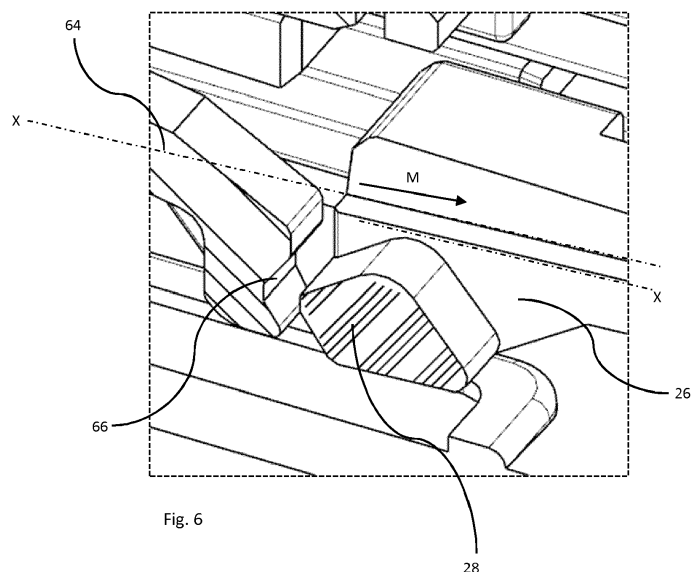


Fig. 6

Description

TECHNICAL FIELD OF INVENTION

[0001] The present invention relates to a high voltage electrical connector having a mate assistance system and the connector position assurance device that locks the electrical connector to a counter connector.

BACKGROUND OF INVENTION

[0002] The upcoming of electrical vehicles affordable for everyone makes it necessary to solve technical problems and lower the price for production of this electrical vehicles. To provide electrical energy to the electrical devices of the electrical vehicles high voltages and also high currents have to be distributed by an electrical wired harness. The wiring of electrical vehicles requires electrical wires with big cross-sections and huge electrical connectors. The electrical connectors have to provide space for big electrical terminals and also improved insulation capability. The result of all this requirements are huge and heavy wire harnesses that makes them difficult to assemble in the car body while production of the electrical vehicle. To make the assembly easier mate assist devices are provided on the electrical connectors. This mate assist devices has integrated gears that support the handicraft while meeting the electrical connector to a counter connector. Document EP Tyler discloses such a connector having a mate assist device. This kind of mate assist devices I used in the art because there are small in size and activation direction is the same as the meeting direction of the electrical connector warts the counter connector. Furthermore, the electrical connector needs a connector position assurance device that makes sure that the mated connectors stay connected while in operation in the electrical vehicle. This connector position assurance devices causes problems when activated before the two electrical connectors are mated properly. Once activated the connector position assurance device blocks a correct meeting and makes a repair and to reset of the connector position assurance device necessary. This is time-consuming and costly especially when parts are damaged.

[0003] Thus, there is the need in the art to provide an electrical high-voltage connector having a mate assist device and a connector position assurance device with improved handling abilities, when mating the electrical connector to a counter connector while assembly often electrical vehicle.

[0004] These and objects which become apparent upon reading the following description are solved by an electrical connector according to independent claim 1.

SUMMARY OF THE INVENTION

[0005] The present application relates to an electrical connector comprising a connector housing having a mat-

ing axis and a mate assist device attached to the connector housing, surrounding the connector housing. The mate assist device is movable, along the mating axis in a mating direction, from a first position to a second position. A connector position assurance device is attached at the mate assist device, movable from a third position to a fourth position along the mating axis in the mating direction. The connector position assurance device is locked, by first locking means in the third position when the electrical connector is not mated to an electrical counter connector and wherein the connector position assurance device is released by first unlocking means, attached at the electrical counter connector, when the electrical connector and the electrical counter connector are mated. The released connector position assurance device securely locks the electrical connector to the electrical counter connector by second locking means, attached on the position assurance device, when the connector position assurance device is moved to the fourth position.

[0006] The disclosed invention uses a position assurance device that is operated along the mating axis of the electrical connector. This makes handling much easier because the worker can activate the position assurance device after mating with his thumb, without taking away his hand from the mate assist device. Because there are means that prevent accidentally activation of the connector position assurance device damages while assembly are not possible. Even if the worker presses on the connector position assurance device while he moves the mate assist device, the connector position assurance device will not be activated.

[0007] Preferably the mate assist device is sleeve shaped and surrounds the connector housing and the mating axis, wherein the mate assist device comprises a cavity adapted to movably hold the connector position assurance device. The cavity is integrated into the mate assist device and the position assurance device can be preassembled into the cavity.

[0008] According to a preferred embodiment the cavity comprises a cavity opening for inserting and operating the connector position assurance device, wherein the cavity opening is located on a second end opposite from a first end of the mate assist device, wherein the first end is facing the counter connector. The connector position assurance device can also be mounted when the mate assist device is already mounted on the connector housing and even shortly before the electrical connector is mated for the counter connector.

[0009] Preferably the cavity comprises guiding means to guide the connector position assurance device while being moved from the third position towards the fourth position along the mating axis.

[0010] Advantageously, the mate assist device comprises a flexible first arm protruding into the cavity, wherein the flexible first arm protrudes against the mating direction.

[0011] Preferably the flexible first arm comprises a first

arm end, wherein the first arm end comprises a rounded or wedge-shaped portion, pointing opposite to the mating direction.

[0012] Advantageously, the connector position assurance device comprises a slider member, comprising a flexible second arm protruding into the cavity, wherein the second arm protrudes in mating direction.

[0013] Preferably the wherein the second arm comprises a second arm end, wherein the second arm end comprises a dented surface facing in the mating direction.

[0014] Preferably the. the rounded or wedge shaped portion of the first arm end is adapted to cooperate with the dented surface of the second arm end, to prevent slipping perpendicular to the mating axis, when the first arm end is pressed against the second arm end, while the electrical connector and the electrical counter connector are in unmated position. Because the shapes of the two end portions of the arms are adapted to fit in each other the danger that the end portions slip away when pressed against each other is not present.

[0015] In a preferred embodiment, the first arm end is hemispherical shaped and wherein the intention in the second arm end is hemispherical shaped.

[0016] Advantageously, the first arm end comprises a rounded bar shape and wherein the intention in the second arm end comprises a u-shaped groove corresponding with the rounded bar shape.

[0017] Preferably the first arm end comprises a wedge shape and wherein the intention in the second arm end comprises a v-shaped groove corresponding with the wedge shaped bar

[0018] Advantageously, the first locking means comprises first protrusions and second protrusions protruding from the connector position assurance device and wherein the mate assist device comprises a support bar. The support bar is arranged between the first protrusions and second protrusions to hold the position assurance device in the third position. This is an easy design that needs no additional parts.

[0019] Preferably the unlocking means comprises a protrusion arranged on a shroud of the electrical counter connector, wherein the protrusion comes in engagement with the flexible first arm end and the flexible second arm end thereby flexible deforming the flexible second arm perpendicular to the mating axis and separate the first arm end from the second arm end thereby unlocking the connector position assurance device.

[0020] Advantageously, the second locking means comprise a locking bar arranged on the connector position assurance device extending along the mating axis, preventing flexible deformation of the flexible first arm when the connector position assurance device is in the fourth position.

Description of the preferred embodiments

[0021] In the following, the invention is described ex-

emplarily with reference to the enclosed figures, in which

- Fig. 1 shows a perspective, view of the electrical connector and the counter connector;
- Fig. 2 shows perspective, view of the connector position assurance device;
- Fig. 3 shows a perspective view to the mate assist device
- Fig. 4 shows a perspective view of the unmated electrical connector
- Fig. 5 shows details of the cavity enter connector position assurance device in blocked position in a cut view;
- Fig. 6 shows the shape of the first arm end and the second arm end enlarged, in cut view;
- Fig. 7 shows a perspective view of the electrical connector in the counter connector in a mated position;
- Fig. 8 shows details of the cavity and connector position assurance device in an activated/released position, in a cut view;
- Fig. 9 shows a perspective view of the electrical connector in the counter connector in a mated position;
- Fig. 10 shows details of the cavity and connector position assurance device in a mated position, in a cut view;
- Fig. 11 shows a perspective view of the electrical connector in the counter connector in a mated position;
- Fig. 12 shows details of the cavity and connector position assurance device in a mated position showing the locking bar, in a cut view;

[0022] Figure 1 shows a perspective, view of the electrical connector 10 and the counter connector 100. The electrical connector comprising a connector housing 12 having a mating axis X and a mate assist device 20 attached to the connector housing 12. The mate assist device 20 surrounding the connector housing 10. The mate assist device 20 is movable, along the mating axis X in a mating direction M, from a first position P1 to a second position P2. A connector position assurance device 60 is attached at the mate assist device 20, movable from a third position P3 to a fourth position P4 along the mating axis X in the mating direction M. The connector position assurance device 60 is locked, by first locking means in the third position P3 when the electrical connector 10 is not mated to an electrical counter connector 100.

[0023] Figure 2 shows perspective, view of the connector position assurance device. The connector position assurance device 60 comprises a slider member 62, comprising a flexible second arm 64. The second arm 64 protrudes in mating direction M. The second arm 64 comprises a second arm end 66, wherein the second arm end 66 comprises a dented surface facing in the mating direction M.

[0024] An electrical connector 10 according to claims

6 and 8, wherein the rounded or wedge shaped portion of the first arm end 28 is adapted to cooperate with the dented surface of the second arm end 66

[0025] Figure 3 shows a perspective view to the mate assist device. The mate assist device 20 is sleeve shaped and surrounds the connector housing 12 and the mating axis X. The mate assist device 20 comprises a cavity 30 adapted to movably hold the connector position assurance device 60. The cavity 30 comprises a cavity opening 34 for inserting and operating the connector position assurance device 60. The cavity opening 34 is located on a second end 24 opposite from a first end 22 of the mate assist device 20, wherein the first end 22 is facing the counter connector 100. The cavity 30 comprises guiding means to guide the connector position assurance device 60 while being moved from the third position P3 towards the fourth position P4 along the mating axis X.

[0026] Figure 4 shows a perspective view of the unmated electrical connector.. The mate assist device 20 is in a first position P1 the connector position assurance device 60 is attached at the mate assist device 20 and hold in the third position P3.

[0027] Figure 5 shows details of the electrical connector 10 shown in figure 4. The cavity 30 and the connector position assurance device 60 is shown in a cut view. The mate assist device 20 comprises a flexible first arm 26 protruding into the cavity 30. The flexible first arm 26 protrudes against the mating direction M. The flexible first arm 26 comprises a first arm end 28. The first arm end 28 comprises a rounded or wedge-shaped portion, pointing opposite to the mating direction M. The flexible second arm 64 of the connector position assurance device 60, protruding into the cavity 30 in mating direction M. The second arm 64 comprises a second arm end 66, wherein the second arm end 66 comprises a dented surface facing in the mating direction M. The rounded or wedge shaped portion of the first arm end 28 is adapted to cooperate with the dented surface of the second arm end 66, to prevent slipping perpendicular to the mating axis X, when the Second arm end 66 is pressed against the first arm end 28, while the electrical connector 10 is in unmated position. The first locking means comprises first protrusions 70 and second protrusions 72 protruding from the connector position assurance device 60 and wherein the mate assist device 20 device comprises a support bar 21. The support bar 21 is arranged between the first protrusions 70 and second protrusions 72 to hold the position assurance device 60 in the third position P3.

[0028] Figure 6 shows the shape of the first arm end 28 and the second arm end 66 enlarged in cut view. The first arm end 28 comprises a wedge shape and wherein the intention in the second arm end 66 comprises a v-shaped groove corresponding with the wedge shaped bar.

[0029] Figure 7 shows a perspective view of the electrical connector 10 and the counter connector 100 in a mated position.

[0030] Figure 8 shows details of the cavity 30 and con-

connector position assurance device 60 in a released position, in a cut view. The connector position assurance device 60 is released by first unlocking means that are attached at the electrical counter connector 100 when the electrical connector 10 and the electrical counter connector 100 are mated. The unlocking means comprises a protrusion 115 arranged on a shroud 110 of the electrical counter connector 100. The protrusion 115 comes in engagement with the flexible first arm 26 and the flexible second arm 64 thereby flexible deforming the second arm 64 perpendicular to the mating axis and separate the first arm end 28 from the second arm end 66 thereby unlocking the connector position assurance device 60. The connector position assurance device 60 is movable to the fourth position P4 along the mating axis X in mating direction.

[0031] Figure. 9 shows a perspective view of the electrical connector 10 in the counter connector 100 in the mated position.

[0032] Figure 10 shows details of the cavity 30 and connector position assurance device 60 in a mated position, in a cut view. The connector position assurance device 60 is releasable hold in the fourth position P4 by the second protrusions 70 interacting with the support bar 21.

[0033] Figure 11 shows a perspective view of the electrical connector 10 in the counter connector 100 in a mated position.

[0034] Figure 12 shows details of the cavity 30 and connector position assurance device 60 in a mated position showing the locking bar, in a cut view. The released connector position assurance device 60 securely locks the electrical connector 10 to the electrical counter connector 100 by second locking means, attached on the position assurance device 60, when the connector position assurance device 60 is moved to the fourth position P4. The second locking means comprise a locking bar 68 arranged on the connector position assurance device 60 extending along the mating axis X, preventing flexible deformation of the flexible first arm 26 when the connector position assurance device 60 is in the fourth position P4.

45 Claims

1. An electrical connector (10) comprising a connector housing (12) having a mating axis (X) and a mate assist device (20) attached to the connector housing (12), surrounding the connector housing (10), wherein the mate assist device (20) is movable, along the mating axis (X) in a mating direction (M), from a first position (P1) to a second position (P2), a connector position assurance device (60) attached at the mate assist device (20), movable from a third position (P3) to a fourth position (P4) along the mating axis (X) in the mating direction (M), wherein the connector position assurance device (60) is locked,

- by first locking means in the third position (P3) when the electrical connector (10) is not mated to an electrical counter connector (100) and wherein the connector position assurance device (60) is released by first unlocking means, attached at the electrical counter connector (100), when the electrical connector (10) and the electrical counter connector (100) are mated, wherein the released connector position assurance device (60) securely locks the electrical connector (10) to the electrical counter connector (100) by second locking means, attached on the position assurance device (60), when the connector position assurance device (60) is moved to the fourth position (P4).
2. An electrical connector (10) according to claim 1, wherein the mate assist device (20) is sleeve shaped and surrounds the connector housing (12) and the mating axis (X), wherein the mate assist device (20) comprises a cavity (30) adapted to movably hold the connector position assurance device (60).
 3. An electrical connector (10) according to the preceding claim, wherein the cavity (30) comprises an cavity opening (34) for inserting and operating the connector position assurance device (60), wherein the cavity opening (34) is located on an second end (24) opposite from a first end (22) of the mate assist device (20), wherein the first end (22) is facing the counter connector (100).
 4. An electrical connector (10) according to any of claims 2-3, wherein the cavity (30) comprises guiding means to guide the connector position assurance device (60) while being moved from the third position (P3) towards the fourth position (P4) along the mating axis (X).
 5. An electrical connector (10) according any of claims 2-4, wherein the mate assist device (20) comprises a flexible first arm (26) protruding into the cavity (30), wherein the flexible first arm (26) protrudes against the mating direction (M).
 6. An electrical connector (10) according to the preceding claim, wherein the flexible first arm (26) comprises a first arm end (28), wherein the first arm end (28) comprises a rounded or wedge-shaped portion, pointing opposite to the mating direction (M).
 7. An electrical connector (10) according to any of the preceding claims, wherein the connector position assurance device (60) comprises a slider member (62), comprising a flexible second arm (64) protruding into the cavity (30), wherein the second arm (64) protrudes in mating direction (M).
 8. An electrical connector (10) according to the preceding claim, wherein the second arm (64) comprises a second arm end (66), wherein the second arm end (66) comprises a dented surface facing in the mating direction (M).
 9. An electrical connector (10) according to claims 6 and 8, wherein the rounded or wedge shaped portion of the first arm end (28) is adapted to cooperate with the dented surface of the second arm end (66), to prevent slipping perpendicular to the mating axis (X), when the first arm end (28) is pressed against the second arm end (66), while the electrical connector (10) is in unmated position.
 10. An electrical connector (10) according to claim 6 and any of claims 8-9, wherein the first arm end (28) is hemispherical shaped and wherein the intention in the second arm end (66) is hemispherical shaped.
 11. An electrical connector (10) according to claim 6 and any of claims 8-9, wherein the first arm end (28) comprises a rounded bar shape and wherein the intention in the second arm end (66) comprises a u-shaped groove corresponding with the rounded bar shape.
 12. An electrical connector (10) according to claim 6 and any of claims 8-9, wherein the first arm end (28) comprises a wedge shape and wherein the intention in the second arm end (66) comprises a v-shaped groove corresponding with the wedge shaped bar.
 13. An electrical connector (10) according to any preceding claim, wherein the first locking means comprises first protrusions (70) and second protrusions (72) protruding from the connector position assurance device (60) and wherein the mate assist device (20) device comprises a support bar (21), wherein the support bar (21) is arranged between the first protrusions (70) and second protrusions (72) to hold the position assurance device (60) in the third position (P3).
 14. An electrical connector (10) according to any preceding claim, wherein the unlocking means comprises a protrusion (115) arranged on a shroud (110) of the electrical counter connector (100), wherein the protrusion (115) comes in engagement with the flexible first arm end (28) and the flexible second arm end (66) thereby flexible deforming the flexible second arm (64) perpendicular to the mating axis and separate the first arm end (28) from the second arm end (66) thereby unlocking the connector position assurance device (60).
 15. An electrical connector (10) according to any preceding claim, wherein the second locking means comprise a locking bar (68) arranged on the connector position assurance device (60) extending along

the mating axis (X), preventing flexible deformation of the flexible first arm (26) when the connector position assurance device (60) is in the fourth position (P4).

5

10

15

20

25

30

35

40

45

50

55

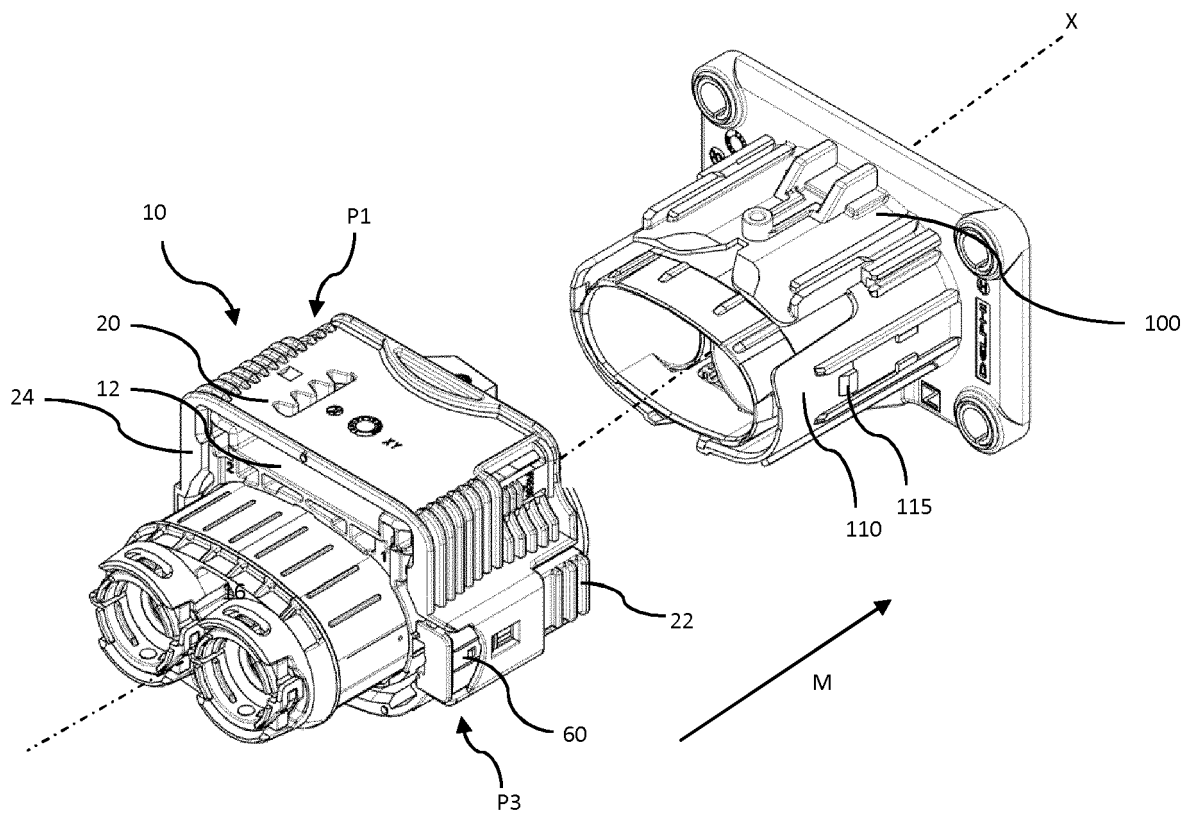
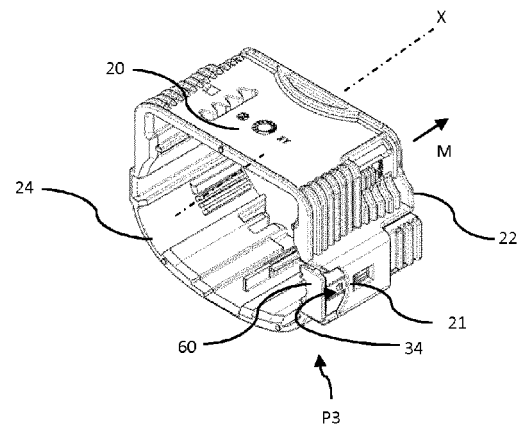
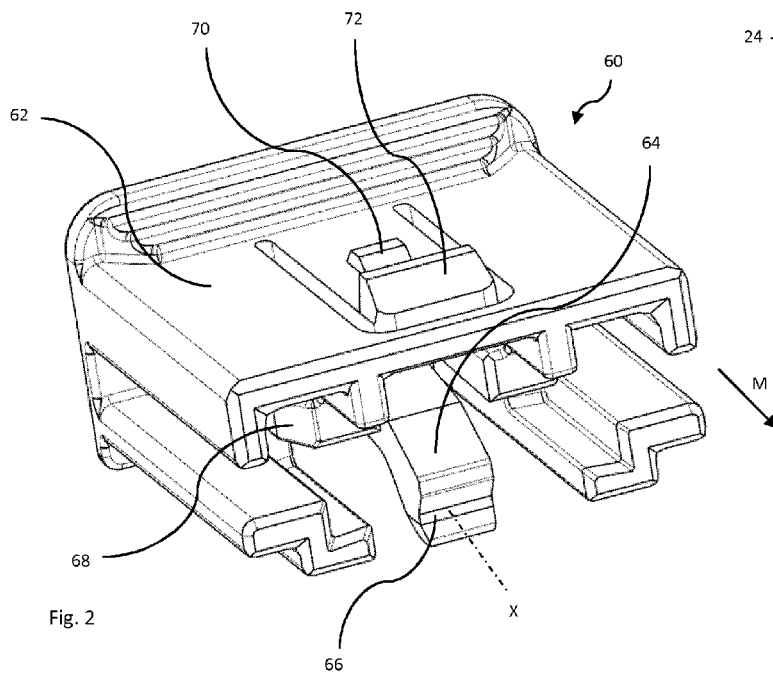
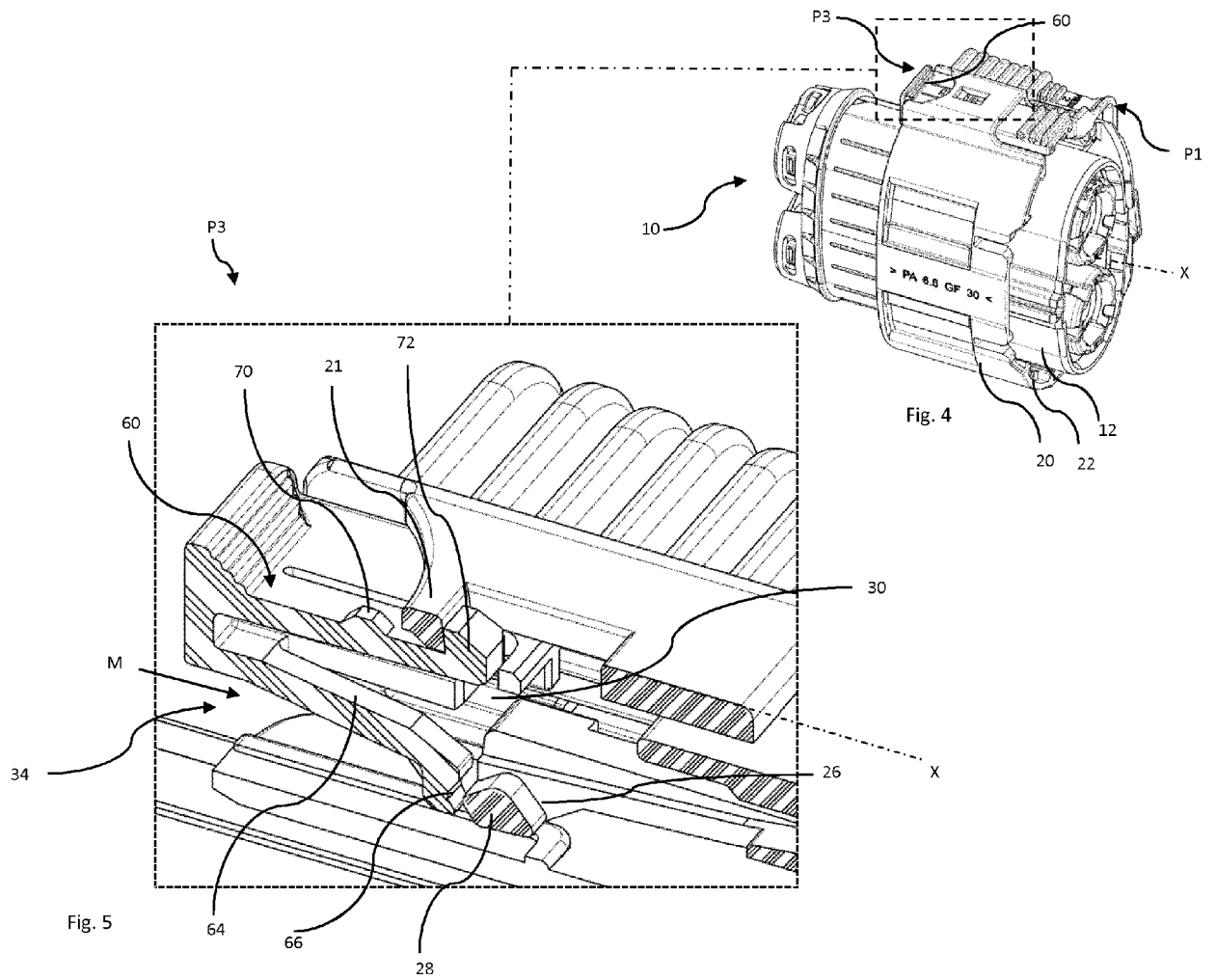
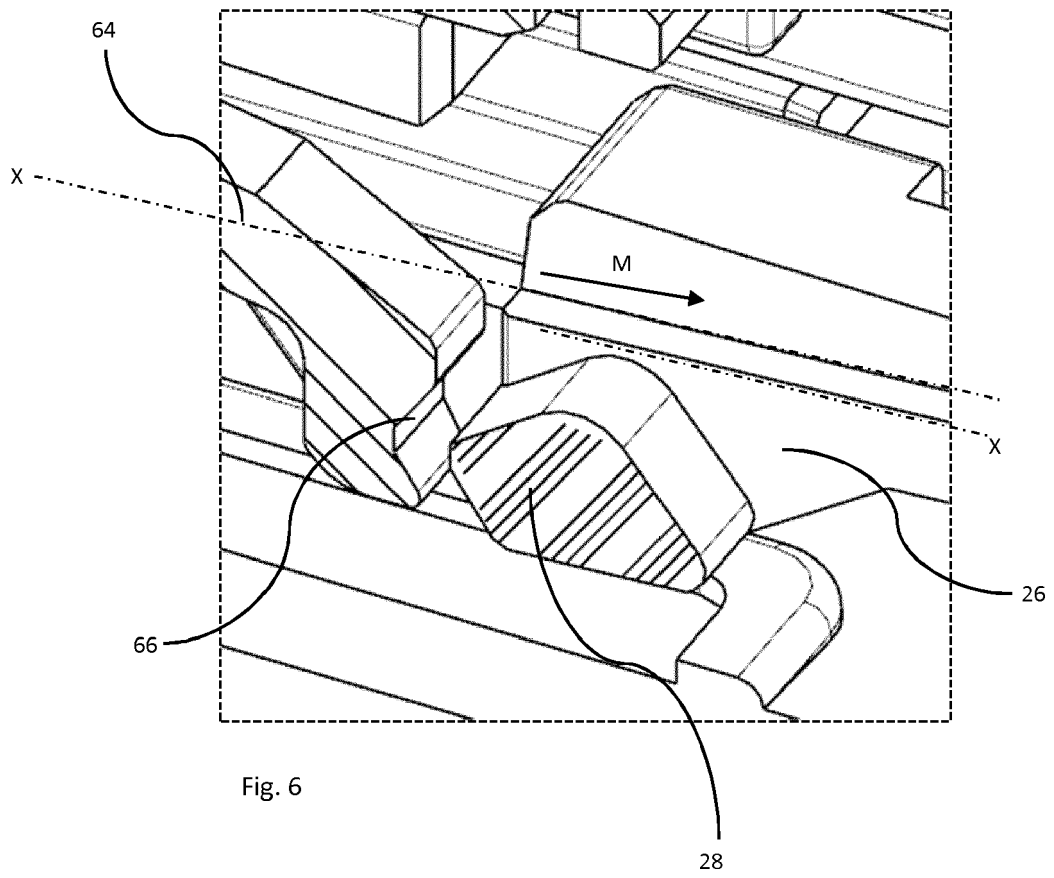
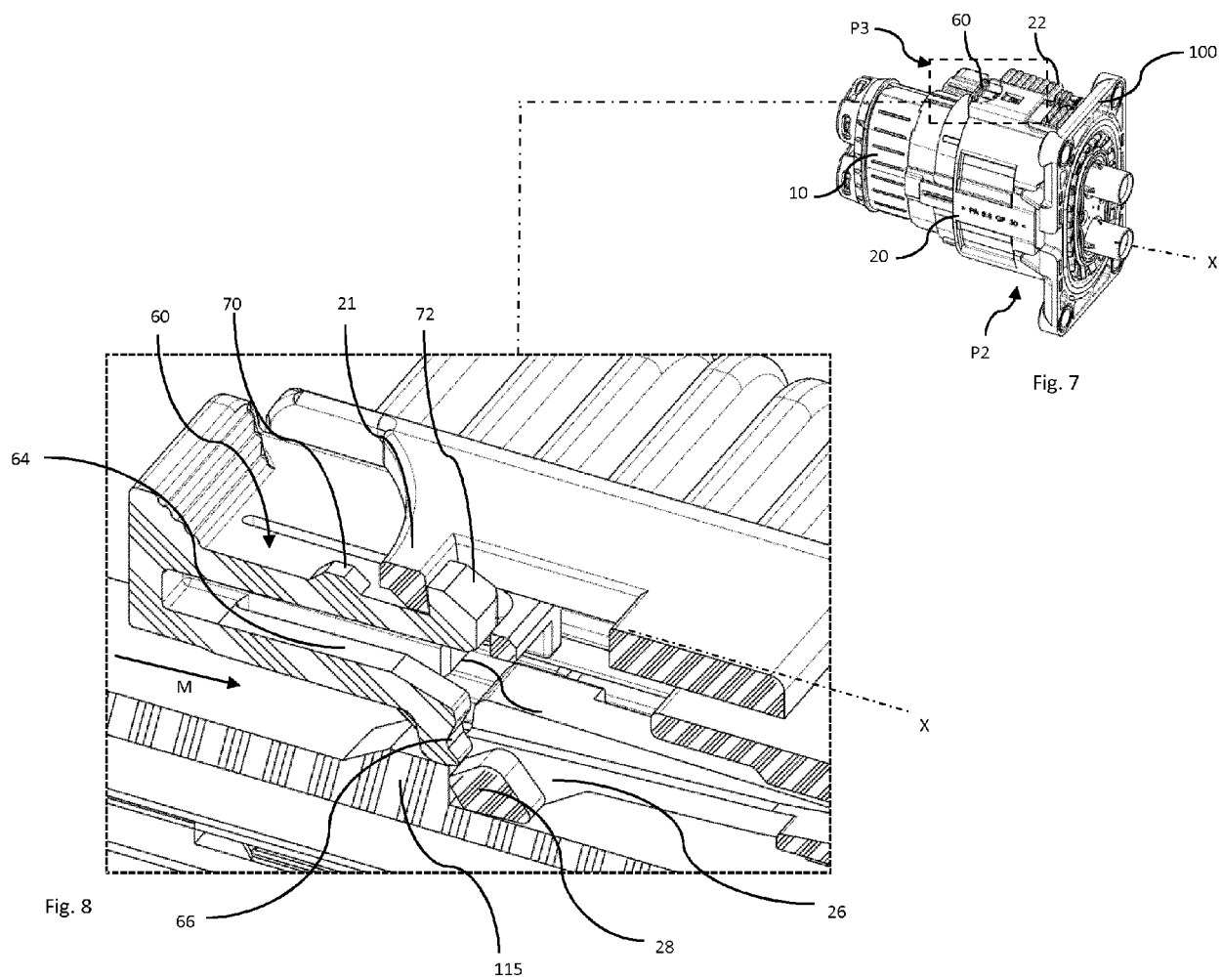


Fig. 1









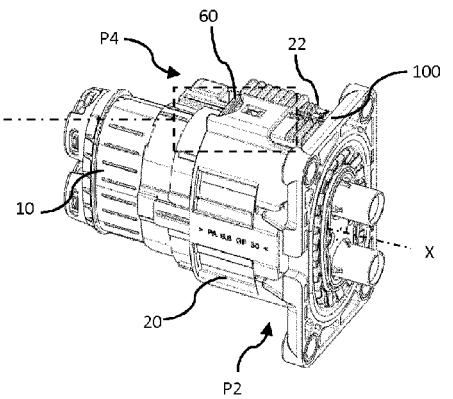


Fig. 9

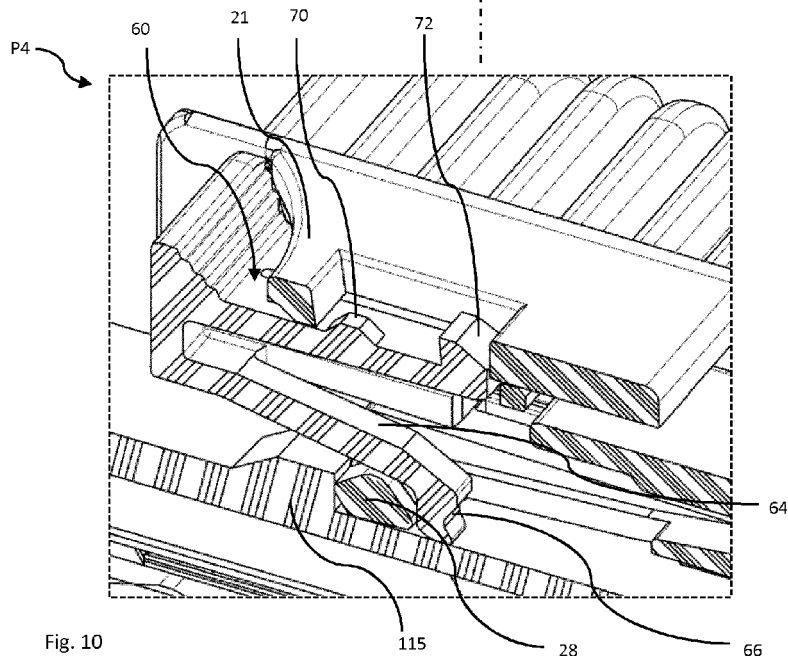


Fig. 10

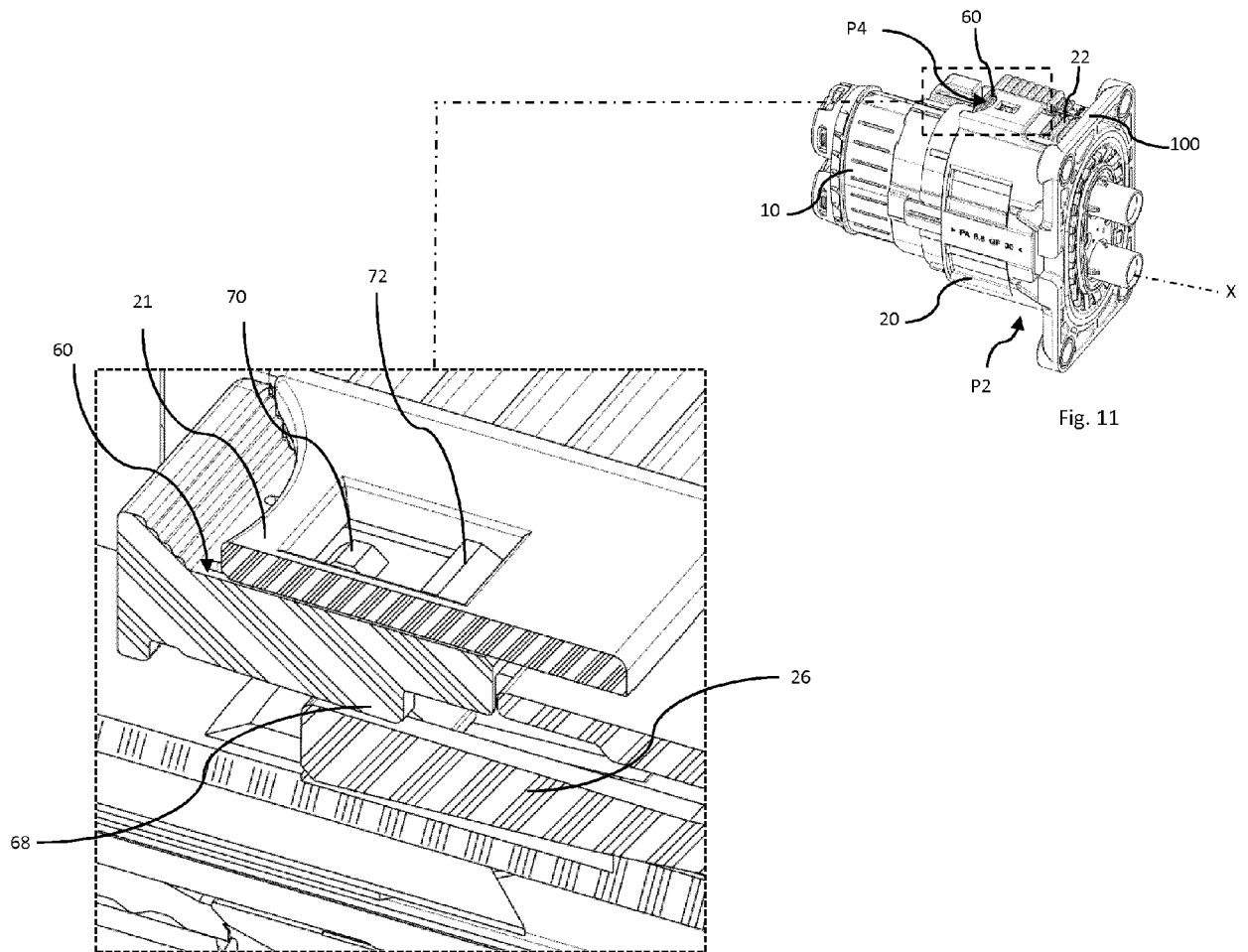


Fig. 12

Fig. 11



EUROPEAN SEARCH REPORT

Application Number
EP 19 16 0455

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 9 455 523 B1 (SUNDARAKRISHNAMACHARI RANGARAJAN [IN] ET AL) 27 September 2016 (2016-09-27)	1-8, 10-15	INV. H01R13/629
A	* column 5, lines 51-65, column 8 line 58 to column 9, line 10; figures 2, 5, 6, 8, 9, 13, 14, *	9	
Y	EP 3 211 729 A1 (DAI-ICHI SEIKO CO LTD [JP]) 30 August 2017 (2017-08-30)	1-8, 10-15	
A	* paragraphs [0054] - [0069]; figures 13-20 *	9	
X	US 2010/227494 A1 (TYLER ADAM P [US] ET AL) 9 September 2010 (2010-09-09)	1,2	
A	* paragraphs [0071], [0075], [0076]; figures 15, 16 *	3-15	TECHNICAL FIELDS SEARCHED (IPC) H01R
A	EP 3 211 730 A1 (DAI-ICHI SEIKO CO LTD [JP]) 30 August 2017 (2017-08-30) * the whole document *	1-15	
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 13 September 2019	Examiner López García, Raquel
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 19 16 0455

5

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.

13-09-2019

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 945523	B1	27-09-2016	NONE
EP 3211729	A1	30-08-2017	CN 107123900 A 01-09-2017
			EP 3211729 A1 30-08-2017
			JP 6213590 B2 18-10-2017
			JP 2017152272 A 31-08-2017
			KR 20170100442 A 04-09-2017
			US 2017250492 A1 31-08-2017
US 2010227494	A1	09-09-2010	US 2008132098 A1 05-06-2008
			US 2010227494 A1 09-09-2010
EP 3211730	A1	30-08-2017	CN 107123898 A 01-09-2017
			EP 3211730 A1 30-08-2017
			JP 6213591 B2 18-10-2017
			JP 2017152273 A 31-08-2017
			KR 20170100443 A 04-09-2017
			US 2017250501 A1 31-08-2017