



(11) **EP 3 817 154 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
05.05.2021 Bulletin 2021/18

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

(21) Application number: **19206558.9**

(22) Date of filing: **31.10.2019**

(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) Inventor: **Tecza, Tomasz
30-348 Kraków (PL)**

(74) Representative: **Manitz Finsterwald
Patent- und Rechtsanwaltspartnerschaft mbB
Martin-Greif-Strasse 1
80336 München (DE)**

(54) **CONNECTOR ASSEMBLY**

(57) The present disclosure relates to a connector assembly comprising a first connector and a second connector connectable with each other along an axial direction to form the connected state.

EP 3 817 154 A1

Description

FIELD

[0001] The present disclosure relates to a connector assembly comprising a first connector and a second connector connectable with each other along an axial direction to form a connected state.

BACKGROUND

[0002] Connector assemblies are commonly known in the state of the art. Such connector assemblies comprise a first connector and a second connector, which can be connected with each other to form a connected state of the connector assembly. In most of the cases, one of the two connectors is constructed as a male connector, the respective other connector is constructed as a female connector. Such connector assemblies can be used for instance to provide an electric and/or electronic connection.

[0003] During the connection procedure of the two connectors of the connector assembly it usually is necessary to insert a plurality of contact pins of the male part of the connector assembly into respective contact receptions of the female part of the connector assembly. Especially if long contact pins are used, the relative movement of the two connectors should be parallel to these contact pins, in particular along an axial direction of the connector assembly. On the other hand, during the connection procedure, and similar during a disconnection procedure, connection forces acting between the two connectors of the connector assembly, for instance frictional forces, have to be overcome. This often results in a rocking movement during the connection process of the connector assembly, which can cause damage to the contact pins and/or the contact receptions.

[0004] Accordingly, there is a need to provide elements and/or systems for assistance of the connection procedure for an at least essentially rocking-free connection movement.

SUMMARY

[0005] The present disclosure provides a connector assembly according to the independent claim. Embodiments are given in the subclaims, the description and the drawings.

[0006] In an aspect, the present disclosure is directed at a connector assembly comprising a first connector and a second connector connectable with each other along an axial direction to form a connected state, wherein the first connector comprises two tightening protrusions protruding from opposite side of the first connector, wherein the second connector comprises two rotational elements rotatably supported on opposite sides of the second connector, each comprising a tightening groove configured to cooperate with one of the tightening protrusions to

tighten the first connector and the second connector in their connected state, and wherein during the connection of the first connector and the second connector the tightening protrusions are mechanically guided by the respective tightening groove and thereby an axial force is generated to drive the first connector and the second connector into their connected state.

[0007] A connector assembly according to the present disclosure essentially comprises two parts, a first connector and a second connector. In particular, one of the two connectors can be constructed as a male part of the connector assembly, and the respective other part can be constructed as a female part of the connector assembly. The first connector and the second connector can be connected with each other along an axial direction to form a connected state. In the connected state, the connector assembly according to the present disclosure provides a connection, in particular an electric and/or electronic connection.

[0008] The connector assembly according to the present disclosure further comprises an assistance system to ensure an essentially rocking-free movement during connecting and disconnecting the first connector and the second connector. This assistance system comprises two tightening protrusions arranged at the first connector. These two tightening protrusions are protruded from opposite sides of the first connector. In other words, the two tightening protrusions protrude in different directions, in particular in antipodal directions from opposite sides of the first connector, for instance from two opposite sides of a housing of the first connector.

[0009] Other elements of the assistance system are arranged at the second connector. In particular, two rotational elements are arranged at the second connector and are especially rotatably supported on opposite sides of the second connector. In addition, each of the two rotational elements comprises a curved tightening groove configured to cooperate with one of the tightening protrusions. In other words, the two rotational elements are arranged such on the second connector, for instance on opposite sides of a housing of the second connector, that upon connecting the first connector and the second connector, a cooperation between a respective pair of tightening protrusion and rotational element is possible.

[0010] Hereby each of the tightening grooves comprise an outer opening for an insertion of a respective tightening protrusion into the tightening groove and extends along its curved path radially inwards into the respective rotational element towards an inner end of the respective tightening groove. With a tightening protrusion arranged at the inner end of the respective tightening groove, tightening the first connector and the second connector together in their connected state can be provided.

[0011] In particular, during the connection procedure of the first connector and the second connector, the tightening protrusions are mechanically guided by the respective tightening groove. As mentioned above, the respective tightening protrusion enters the respective tightening

groove through its outer opening and during the connection of the first connector and the second connector is guided towards the inner end of the respective tightening groove, in particular by a rotational movement of the respective rotational element triggered during the connection procedure. Thereby an axial force is generated which drives the first connector and the second connector into their connected state.

[0012] In other words, the force generated by the movement of the two tightening protrusions in the respective curved tightening groove of the two rotational elements is directed in the axial direction parallel to the axial movement of the first connector with respect to the second connector into their connected state during the connection procedure. This parallelism between the axial force and the axial movement is provided by providing two tightening protrusions and two rotational elements with respect to the tightening grooves, each respectively arranged on opposite sides of the first and second connector. Hence, each pair of a tightening protrusion and a rotational element generates axial force on its own, the force acting on the respective opposite side of the first and second connector. A respective tilt of the first connector with respect to the second connector, which can occur with only one respective pair of tightening protrusion and rotational element, can therefore be avoided.

[0013] In summary, in a connector assembly according to the present disclosure, the first connector and the second connector can be driven into their respective connected state by the forces generated during the connection process, whereby these forces act parallel to each other on different sides of the first and second connector and hence a parallelism of the generated and acting forces to the intended axial connection movement can be provided. A rocking-free or at least essentially rocking-free connection procedure of the first connector and the second connector of a connector assembly according to the present disclosure can be provided.

[0014] Additionally, the aforementioned features with respect to a connection procedure vice-versa can be provided also for a disconnection procedure.

[0015] According to an embodiment of a connector assembly according to the present disclosure, the two rotational elements are rotatable about a common rotational axis. In this embodiment, additional to the arrangement of the two rotational elements on opposite sides of the second connector, the rotational elements are also arranged such, that their respective rotational axes are identical. At the force generated by guiding the respective tightening protrusion in the tightening groove of the respective rotational element acts on the support of the rotational element, which is arranged around the rotational axis, the parallelism of the acting forces with the axial connection movement can be enhanced.

[0016] Further, in the connector assembly according to the present disclosure, the two rotational elements can be rotated in opposite directions with respect to each other upon connecting the first connector and the second

connector. As mentioned above, the rotational movements of the rotational elements can provide the guidance of the tightening protrusion in the respective tightening grooves and thereby generate the axial forces used to tighten the first connector and the second connector in their connected state. However, these rotational movements of the tightening protrusions in the tightening grooves can also cause additional rotational forces acting on the second connector via the respective bearing of the rotational elements. By providing that the two rotational elements are rotated in opposite direction with respect to each other, it can be provided easily that these rotational forces cancel each other at least partly, in particular completely. Again, a parallelism of the resultant acting forces on the second connector during the connection movement of the two connectors into the connected state of the connector assembly can be enhanced.

[0017] In addition, the two rotational elements may be constructed identically or at least approximately identically. In other words, during production of a connector assembly according to the present disclosure, only one type of rotational element has to be provided. An overall production cost can therefore be lowered.

[0018] According to an embodiment of a connector assembly according to the present disclosure, one of the connectors comprises a slider movably supported along the axial direction, the slider comprising actuating elements mechanically coupled to the rotational elements to convert an axial movement of the slider into a rotational movement of the rotational elements. In this embodiment of a connector assembly according to the present disclosure, a slider is provided as additional component of the connector assembly and in particular of the system for assisting the connection procedure. This slider can be arranged at one of the connectors, in particular on the second connector, and is movably supported for a movement along the axial direction. In other words, the movement direction of the slider is the same as the direction of the relative movement of the first and second connector with respect to each other during the connection procedure.

[0019] Essentially, the slider comprises actuating elements mechanically coupled to the rotational elements. This allows converting the axial movement of the slider into a rotational movement of the rotational elements due to the mechanically coupling between the slider and the rotational elements provided by the respective actuating element. During a connection procedure of a connector assembly according to the present disclosure, the second connector is, for instance manually, moved along the axial direction and additionally also the slider is moved also along the axial direction. The rotational movement of the rotational elements caused by the axial movement of the slider provides the relative movement of the tightening protrusions in the respective tightening grooves and hence the generation of the axial forces driving the first connector and the second connector into their

connected state. In summary, by providing the axially movable slider, the connection procedure of a connector assembly according to the present disclosure can be simplified.

[0020] In an improved embodiment of a connector assembly according to the present disclosure, the actuating elements of the slider may each comprise a toothed rack and the rotational elements each comprises a gear portion mechanically engaged with the respective toothed rack. A mechanical engagement between a toothed rack and a gear portion form-fittingly ensures that the axial movement of the slider is converted into a rotational movement of the rotational element, especially with respect to a simple frictional connection as actuating element. In addition, by accordingly choosing the size and number of teeth of the toothed rack and gear portion, respectively, a gear ratio between the axial movement of the slider and the rotational movement of the rotational elements can be adjusted easily.

[0021] Further, the slider may be generally U-shaped and comprise a base section and two leg sections may extend from the base section in the axial direction. As mentioned above, the two rotational elements are arranged on opposite sides of the second connector. By providing a generally U-shaped slider, the slider, especially actuating elements arranged at the leg sections of the slider, can be configured to be easily mechanically connected to both rotational elements.

[0022] According to a further embodiment of the connector assembly according to the present disclosure, one of the connectors comprises at least one locking element movably supported on the one of the connectors and movable between an open position and a closed position, the connector assembly further comprising a locking counterpart for interacting with the at least one locking element in its closed position for form-fittingly and/or force-fittingly locking the connector assembly in its connected state. In other words, such a locking element and a locking counterpart can be part of a connector position assurance (CPA) system. In particular, the locking element can be arranged at the second connector, for instance on the slider. Further, the locking element can in particular be movable along the axial direction. In particular, the at least one locking element is arranged such that interacting with the locking counterpart is possible when the connector assembly and hence the first and second connectors are in their connected state. An unintentional loosening of the connector assembly out of its connected state can thereby be prohibited. For instance, the locking element and the locking counterpart can lock the slider in its second axial position, and via the mechanical engagement of the toothed racks of the slider with the gear portion of the respective rotational element, also a movement of the rotational element out of its second rotational position, which corresponds to the connected state of the connector assembly according to the present disclosure, is prohibited. Hence, the connector assembly is locked in its connected state.

[0023] A connector assembly according to the present disclosure can be improved by that the one of the connectors comprises a holding means for form-fittingly and/or force-fittingly holding the at least one locking element in its closed position. The respective one of the connectors can, as mentioned above, be the second connector. Also an arrangement of the locking element and hence of the holding means on the slider is possible. By form-fittingly and/or force-fittingly holding the at least one locking element in its closed position it can be ensured that a once induced blocking of the rotational movement of the rotational element by a locking element in its closed position stays blocked. The above mentioned unintentional loosening of the connected state of the connector assembly can hence thereby be prohibited further.

[0024] In addition, at least one of the rotational elements, in particular each of the rotational elements, may comprise a blocking reception and the second connector may comprise at least one blocking element movable between an unblocking position and a blocking position, wherein the blocking element in its unblocking position is positioned outside of the blocking reception for unblocking the rotational movement of the rotational element, and wherein the blocking element in its blocking position engages into the blocking reception for blocking the rotational movement of the rotational element. A blocking element engaging into the respective blocking reception of a rotational element allows securing the respective rotational element against any rotational movement. In particular, by the interaction of blocking element and blocking reception the rotational element can be fixed in a first rotational position, in which the tightening groove of the respective rotational element is positioned such that a tightening protrusion can enter into the tightening groove upon connecting the first connector and the second connector. Vice versa, a blocking element in its unblocking position is positioned out of the blocking reception and hence a rotational movement of the rotational element is possible, for instance to provide a mechanical guidance of a tightening protrusion in a tightening groove of the respective rotational element.

A further improved embodiment of a connector assembly according to the present disclosure can comprise that the blocking reception is arranged in the tightening groove of the respective rotational element such that it is movable by one of the tightening protrusions from its blocking position in its unblocking position upon connecting the first connector and the second connector. In particular, the blocking reception can be arranged at an outer opening of the tightening groove in the outer rim of the respective rotational element. An deactivation of the blocking element, namely a movement of the blocking element out of its blocking position into its unblocking position, by the tightening protrusion can ensure on the one hand that a rotational movement of the rotational element is possible during the connection procedure of the connector assembly, and on the other hand that no dedicated additional element is necessary to deactivate

the blocking element. In summary, a construction of a connector assembly according to the present disclosure can thereby be simplified without drawbacks with respect to functionality and security.

[0025] In particular, the first rotational position can be constructed such that outer openings, through which the tightening protrusions can enter into the respective tightening grooves, are facing in the axial direction. The aforementioned entering of the tightening protrusions into the tightening grooves can therefore easily be provided during the connection procedure, in which the first and second connector are also moved with respect to each other in the axial direction. A second rotational position, which is rotated by at least 45°, in particular by at least 90°, with respect to the first rotational position, ensures, as the second rotational position correspond to the connected state of the connector assembly, together with the curved shape of the tightening groove that the tightening protrusion is securely arranged in the tightening groove, in particular on its inner end. Loosening the connector assembly out of its connected state can therefore be prohibited further.

[0026] In addition, the first connector may comprise a receiving section enclosing a receiving volume in which at least parts of the second connector are arranged in the connected state, wherein the tightening protrusions are arranged on opposite sides of the receiving section and protrude into the receiving volume. The receiving section of the first connector can for instance be constructed as part of a housing of the first connector. In the connected state of the connector assembly, the second connector is arranged at least partly in the receiving volume enclosed by the receiving section, whereby an additionally force-fit and/or form-fit between the first connector and the second connector can be used to enhance the stability of the connected state of the connector assembly according to the present disclosure.

[0027] In particular, the two tightening protrusions are arranged on opposite sides of the receiving section and protrude into the receiving volume. In other words, the second connector with its rotational elements is arranged within the receiving section and the respective receiving volume of the first connector and all aforementioned advantages provided by the tightening protrusions and the tightening grooves can be provided without any elements arranged outside the receiving volume. An especially compact embodiment of a connector assembly according to the present disclosure can therefore be provided.

[0028] According to a further embodiment of a connector assembly according to the present disclosure, the opposite side of the first connector, on which the tightening protrusions are arranged, extend along a transverse direction perpendicular to the axial direction, and wherein the tightening protrusions are arranged in the center or at least approximately in the center of the respective side with respect to the transverse direction. By arranging the tightening protrusions in the center or at least approximately in the center of the side with respect to the trans-

verse direction, also the force generated by the cooperation between the tightening protrusion and the tightening groove acts in the center at least approximately in the center of the respective side with respect to the transverse direction. A respective tilt between the two connectors caused by an axial force acting off-center during the connection procedure of the two connectors of the connector assembly can therefore be prohibited or at least be decreased.

[0029] In addition, the first connector may be a male connector comprising at least one contact pin and the second connector may be a female connector comprising at least one contact reception for receiving the at least one contact pin, or wherein the second connector may be a male connector comprising at least one contact pin and the first connector may be a female connector comprising at least one contact reception for receiving the at least one contact pin, wherein the female connector comprises at least one guiding reception arranged in the axial direction such that upon connecting the first connector and the second connector the at least one contact pin of the male connector first enters the at least one guiding reception and after traversing the guiding reception subsequently enters the at least one contact reception. In a connector assembly according to the present disclosure the first connector can be constructed as a male connector and the second connector can be constructed as a female connector and vice versa. In particular, the male connector may comprise at least one contact pin, in particular a plurality of contact pins, and the female connector may comprise a corresponding number of contact receptions. Further, the female connector may comprise at least one guiding reception, in particular a corresponding number of guiding receptions, arranged in the axial direction before the contact receptions. Hence, during the connection procedure of the connector assembly, the respective contact pins at first are guided in the guiding reception and afterwards enter the contact reception. To provide an electrical contact, the contact reception has to be constructed such that it physically contacts the respective contact pin, in particular that an area for this physical contact is maximized. This constraint is not valid for the guiding reception and hence the guiding reception can be constructed such that small deviations of the position of the contact pins from its ideal position can be met and especially can be corrected. Thereby damages on the respective contact pins during the contact connection procedure can be avoided and the physical contact between the contact pins and the respective contact receptions can be enhanced.

[0030] A connector assembly according to the present disclosure can be improved by that a diameter of the at least one guiding reception decreases or at least section-wise decreases towards the at least one contact reception. For instance, the at least one guiding reception can comprise at least one guiding section shaped as truncated cone or pyramid. In an alternative or additional embodiment, the at least one guiding reception can com-

prise at least two cylindrical guiding sections, whereby the two cylindrical guiding sections comprise different diameters decreasing towards the contact reception. Also a combination of one or several truncated cone- or pyramid-shaped guiding sections and cylindrical guiding sections is possible.

[0031] Therefore, an especially good guidance of the respective contact pin while traversing the guiding reception towards the contact reception can be provided.

DRAWINGS

[0032] Exemplary embodiments and functions of the present disclosure are described herein in conjunction with the following drawings, showing schematically:

- Fig. 1 two different isometric side views of a connector assembly,
- Fig. 2 an explosion view of a connector assembly,
- Fig. 3 a connection procedure of a connector assembly,
- Fig. 4 a locking element shown in two positions,
- Fig. 5 two partial sectional views of a connector assembly during the connection procedure,
- Fig. 6 a side view of a second connector, and
- Fig. 7 a deactivation process of a blocking element.

DETAILED DESCRIPTION

[0033] Fig. 1 and 2 show a connector assembly 10 according to an embodiment of the present disclosure, wherein in Fig. 1 two different side views of the connector assembly 10, and in Fig. 2 an explosion view of the respective connector assembly 10 are depicted. In the following, Fig. 1 and 2 are described together, whereby on special features depicted in the respective Figures are referred respectively.

[0034] A connector assembly 10 comprises a first connector 40 and a second connector 48. In the depicted embodiment the first connector 40 is constructed as a male connector 20 comprising a plurality of contact pins 22. Respectively, the second connector 48 is constructed as female connector 30, comprising a plurality of contact receptions 32, arranged within an element which also carries a guiding element 34 (see Fig. 2). In addition, the second connector 48 also comprises a cavity 14 for an insertion of an electric terminal crimped on a cable (not shown).

[0035] The two connectors 40, 48 can be connected to each other in a connection procedure via a movement along an axial direction 110. To ensure a locking-free connection procedure, the connector assembly 10 according to the current embodiment of the present disclosure comprises in particular tightening protrusions 42 and rotational elements 50 with respective tightening grooves 52. The tightening protrusions 42 are arranged on the first connector 40, especially on a receiving section 44. The receiving section 44 encloses a receiving volume 46

for an arrangement of the second connector 48. In particular, the tightening protrusions 42 are arranged such that they protrude into the receiving volume 46 and further that they are arranged in the center of the respective side of the receiving section 44 with respect to a transverse direction 114 perpendicular to the axial direction 110.

[0036] The other main elements are the aforementioned rotational elements 50 arranged at the second connector 48. In particular, the rotational elements 50 are arranged such that they can rotate around a common rotational axis 100. The rotational elements 50 are constructed identically. Blocking elements 90 provided by the second connector 48 can engage into blocking receptions 96 of the rotational elements 50 to block a rotational movement of the rotational element 50, in particular when the respective rotational element 50 is in its first rotational position 56 (see Fig. 6). The blocking elements 90 can be moved by the tightening protrusions 42 from their blocking position 94 into their unblocking position 92 (see Fig. 7).

[0037] During the connection procedure of the first connector 40 and the second connector 48 into their connecting state 12 (see Fig. 3), the tightening protrusions 42 are mechanically guided in the respective tightening groove 52 during a rotational movement of the rotational elements 50 and hence an axial force 112 (see Fig. 3) is generated which drives the two connectors 40, 48 into their connected state 12. As this force 112 is parallel to the axial direction 110, a rocking-free connection movement of the two connectors 40, 48 into their connected state 12 of the connector assembly 10 can be provided.

[0038] To provide the aforementioned rotational movement of the rotational elements 50, a connector assembly 10 according to the present embodiment further comprises a slider 60 movably supported on and by the second connector 48. The slider 60 is essentially U-shaped with a base section 62 and two leg sections 64 extending along the axial direction 110. The leg sections 64 are provided with actuating elements 66 mechanically connected to the rotational elements 50. To enhance this mechanically connection, the actuating elements 66 are constructed as toothed racks 68 and the rotational elements 50 comprise respective gear portions 54. Hence an axial movement of the slider 60 from its first axial position 70 into its second axial position 72 (see Fig. 3), results in a rotational movement of the respective rotational elements 50 from their first rotational position 56 into their second rotational position 58, thereby generating the force 112 by mechanically guiding the tightening protrusions 42 in the tightening grooves 52 and hence driving the two connectors 40, 48 into their connected state 12. As depicted, the positions of the pairs formed by a toothed rack 68 and a respective gear section 54 are opposed with respect to each other. Hence, upon actuation by the slider 60 during a connection procedure, the rotational elements 50 are rotated in opposite directions with respect to each other.

[0039] Additionally, the slider 60 movably supports

locking elements 80, shown in their open position 82, which can interact with locking counterparts 86 arranged on the second connector 48. In particular, the locking element 80 can interact with the locking counterparts 86, when the connector assembly 10 is in its connected state 12 (see Fig. 4). Hence an unintentional loosening of the connector assembly 10 out of its connected state 12 can be avoided. As a further security element, the slider 80 comprises holding means 88 (see Fig. 4) to force-fittingly and/or form-fittingly hold the locking element 80 in its respective closed position 84 (see Fig. 3). Hence, also an unintentional movement of the locking element 80 out of its closed position 84 into its open position 82 can be prohibited.

[0040] Fig. 3 shows a connection procedure of a connector assembly 10 according to the present disclosure as described above with respect to Fig. 1 and 2. For a detailed description of the elements of the connector assembly 10 is referred to the description above with respect to Fig. 1 and 2.

[0041] On the left side in Fig. 3, the connector assembly 10 is shown at the beginning of the connection procedure. The connector assembly 10 is not yet in its connected state 12. Nevertheless, the second connector 48 is already partly inserted into the receiving volume 46 of the first connector 40. The tightening protrusions 42 are located at the outer openings of the tightening grooves 52 of the rotational elements 50, which are positioned in their respective first rotational positions 56. The slider 80, movable supported by the second connector 48, is in its first axial position 70.

[0042] As depicted on the right side of Fig. 3, the connection procedure is finished and the connector assembly 10 is in its connected state 12. It is clearly visible that the slider 80 is moved into its second axial position 72. Thereby the mechanical connection between the toothed racks 68 of the slider 60 and the gear portions 54 of the rotational elements 50 has driven the rotational elements 50 in their respective second rotational positions 58. By rotating the rotational elements 50 from their first rotational position 56, shown in the left picture, into their second rotational position 58, the tightening protrusions 42 are mechanically guided in the tightening grooves 52 and therefore an axial force 112 is generated which drives the two connectors 40, 48 along the axial direction 110 into their connected state 12 and additionally also tightens the connector assembly 10 as a whole in this connected state 12.

[0043] In Fig. 4, two possible positions 82, 84 of a locking element 80 of a connector assembly 10 according to the present disclosure are depicted. In the left picture of Fig. 4, the locking element 80 is in its open position 82, in the right picture of Fig. 4 in its closed position 84. As shown, the locking element 80 can be arranged and movably supported at a slider 60 as part of the second connector 48, the slider 60 depicted in Fig. 4 in its second axial position 72. The movement of the locking element 80 between its open position 82 into its closed position

84 can in particular be along the axial direction 110. In particular, in its closed position 84 the locking element 80 can interact with a locking counterpart 86 (see Fig. 1 to 3), and lock the slider 60 in its second axial position 72. This automatically blocks a rotational movement of the respective rotational elements 50 by the mechanical engagement of the toothed racks 68 of the slider 60 and the gear portions 54 of the rotational elements 50, see Figs. 1 to 3. As the rotational element 50 is mechanically connected to the tightening protrusion 42, an unintentional loosening of the connector assembly 10 out of its connected state 12 can therefore be prohibited. In addition, holding means 88 form-fittingly and/or force-fittingly secure the locking elements 80 in their closed position 84 and hence provide an increased security against an unintentional loosening of the connector assembly 10 out of its connected state 12.

[0044] Fig. 5 shows partial sectional views of a connector assembly 10 during a connection procedure, especially a contact pin 22 of a male connector 20 and the assigned contact reception 32 of a female connector 30. In the upper picture, a status at the begin of the connection procedure is shown, in the lower picture a connector assembly 10 in its connected state 12 is depicted after completing the connection procedure. In particular, along the axial direction 110 in front of the contact reception 32, a guiding element 34 with a guiding reception 36 is arranged. In the present embodiment, this guiding reception 36 comprises four guiding sections 38, whereby a diameter of the respective guiding section 38 decreases towards the contact region 32. Especially, the guiding reception 36 comprises two guiding sections 38 shaped as truncated cones alternately arranged with cylindrical shaped guiding sections 38. Small deviations of the actual position of the contact pins 22 from its ideal position can hence be corrected by the guiding reception 36 of the guiding element 34. A damage of the contact pin 22 and also a good physical contact between the contact reception 32 and the contact pin 22 can be provided.

[0045] Fig. 6 and 7 are focused on the functionality provided by the blocking element 90 and the blocking reception 96. Hence, Fig. 6 and 7 are described together in the following.

[0046] Fig. 6 shows a side view of a second connector 48, constructed as female connector 30, of a connector assembly 10 according to an embodiment of the present disclosure. A slider 60 in its first axial position 70 as part of the second connector 48 is mechanically engaged with a gear portion 54 of a rotational element 50, the rotational element 50 positioned in its first rotational position 56. The slider 60 further comprises a locking element 80 in its open position 82.

[0047] In particular, the rotational element 50 comprises a blocking reception 96 arranged at an outer opening of the tightening groove 52 of the rotational element 50. A blocking element 90, provided as part of the second connector 48, can engage into this blocking reception 96, when the blocking element 90 is in its blocking posi-

tion 94. In this state, a rotational movement of the rotational element 50 is prohibited by the interaction of the blocking element 90 and the blocking reception 96.

[0048] Three steps of an unblocking procedure of the blocking element 90 are shown in Fig. 7. Starting from the left, three sectional views of the second connector 48 described with respect to Fig. 6 are shown together with respective sectional views of a first connector 40 in different steps of the unblocking procedure of the blocking element 90, which happens automatically during a connection procedure of a connector assembly 10 according to an embodiment of the present disclosure.

[0049] In the leftmost drawing of Fig. 7, the second connector 48 of Fig. 6 is positioned above a first connector 40 constructed as male connector 20. The first connector 40 comprises a receiving volume 46 enclosed by a receiving section 44. The receiving volume 46 further is home to pins 22 to be inserted in a guiding element 34 and connected to a contact reception 32 of the second connector 48, respectively. In addition, the first connector 40 comprises a tightening protrusion 42 protruding inwards into the receiving volume 46.

[0050] In the middle drawing of Fig. 7, the second connector 48 is already partly inserted into the receiving volume 46 along the axial direction 110. In this particular position, the tightening protrusion 42 contacts the blocking element 90, which is still in its blocking position 94. Please note that both the tightening protrusion 42 and the blocking element 90, respectively, comprise inclined contact surfaces with respect to each other.

[0051] These inclined contact surfaces allow, as shown in the rightmost drawing of Fig. 7, an especially secure and easy displacement of the blocking element 90 out of its blocking position 94 into its unblocking position 92 by the tightening protrusion 42 during a further movement of the second connector 48 along the axial direction 110 into the receiving volume 46. In other words, as the displacement of the blocking element 90 is provided by the tightening protrusion 42, no additional element is needed for this task. After the replacement of the blocking element 90 into its unblocking position 92 by the tightening protrusion 42, a rotational movement of the rotational element 50 and hence a guidance of the tightening protrusion 42 in the tightening groove 52 of the rotational element 50 for providing the improved tightness of the connector assembly 10 according to the present disclosure in its connected state 12 (see Fig. 3) is possible.

Reference numeral list

[0052]

10 connector assembly
12 connected state
14 cavity

20 male connector

22 contact pin

30 female connector
32 contact reception
5 34 guiding element
36 guiding reception
38 guiding section

40 first connector
10 42 tightening protrusion
44 receiving section
46 receiving volume
48 second connector

15 50 rotational element
52 tightening groove
54 gear portion
56 first rotational position
58 second rotational position

20 60 slider
62 base section
64 leg section
66 actuating element
25 68 toothed rack
70 first axial position
72 second axial position

80 locking element
30 82 open position
84 closed position
86 locking counterpart
88 holding means

35 90 blocking element
92 unblocking position
94 blocking position
96 blocking reception

40 100 rotational axis

110 axial direction
112 axial force
114 transverse direction
45

Claims

1. Connector assembly (10) comprising a first connector (40) and a second connector (48) connectable with each other along an axial direction (110) to form a connected state (12),
wherein the first connector (40) comprises two tightening protrusions (42) protruding from opposite sides of the first connector (40),
55 wherein the second connector (48) comprises two rotational elements (50) rotatably supported on opposite sides of the second connector (48), each com-

- prising a curved tightening groove (52) configured to cooperate with one of the tightening protrusions (42) to tighten the first connector (40) and the second connector (48) in their connected state (12), and wherein during the connection of the first connector (40) and the second connector (48) the tightening protrusions (42) are mechanically guided by the respective tightening groove (52) and thereby an axial force (112) is generated to drive the first connector (40) and the second connector (48) into their connected state (12).
2. Connector assembly (10) according to claim 1, wherein the two rotational elements (50) are rotatable about a common rotational axis (100).
 3. Connector assembly (10) according to claim 1 or 2, wherein the two rotational elements (50) are rotatable in opposite directions with respect to each other upon connecting the first connector (40) and the second connector (48).
 4. Connector assembly (10) according to any one of the preceding claims, wherein the two rotational elements (50) are constructed identically or at least approximately identically.
 5. Connector assembly (10) according to any one of the preceding claims, wherein one of the connectors (40, 48) comprises a slider (60) movably supported along the axial direction (110), the slider (60) comprising actuating elements (66) mechanically coupled to the rotational elements (50) to convert an axial movement of the slider (60) into a rotational movement of the rotational elements (50).
 6. Connector assembly (10) according to claim 5, wherein the actuating elements (66) of the slider (60) each comprises a toothed rack (68) and the rotational elements (50) each comprises a gear portion (54) mechanically engaged with the respective toothed rack (68).
 7. Connector assembly (10) according to claim 5 or 6, wherein the slider (60) is generally U-shaped and comprises a base section (62) and two leg sections (64) extending from the base section (62) in the axial direction (110).
 8. Connector assembly (10) according to any one of the preceding claims, wherein one of the connectors (40, 48) comprises at least one locking element (80) movably supported on the one of the connectors (40, 48) and movable between an open position (82) and a closed position (84), the connector assembly (10) further comprising a locking counterpart (86) for interacting with the at least one locking element (80) in its closed position (84) for form-fittingly and/or force-fittingly locking the connector assembly (10) in its connected state (12).
 9. Connector assembly (10) according to claim 8, wherein the one of the connectors (40, 48) comprises a holding means (88) for form-fittingly and/or force-fittingly holding the at least one locking element (80) in its closed position (84).
 10. Connector assembly (10) according to any one of the preceding claims, wherein at least one of the rotational elements (50), in particular each of the rotational elements (50), comprises a blocking reception (96) and the second connector (48) comprises at least one blocking element (90) movable between an unblocking position (92) and a blocking position (94), wherein the blocking element (90) in its unblocking position (92) is positioned outside of the blocking reception (96) for unblocking the rotational movement of the rotational element (50), and wherein the blocking element (90) in its blocking position (94) engages into the blocking reception (96) for blocking the rotational movement of the rotational element (50).
 11. Connector assembly (10) according to claim 10, wherein the blocking reception (96) is arranged in the tightening groove (52) of the respective rotational element (50) such that it is movable by one of the tightening protrusions (42) from its blocking position (94) in its unblocking position (92) upon connecting the first connector (40) and the second connector (48).
 12. Connector assembly (10) according to any one of the preceding claims, wherein the first connector (40) comprises a receiving section (44) enclosing a receiving volume (46) in which at least parts of the second connector (48) are arranged in the connected state (12), wherein the tightening protrusions (42) are arranged on opposite sides of the receiving section (44) and protrude into the receiving volume (46).
 13. Connector assembly (10) according to any one of the preceding claims, wherein the opposite sides of the first connector (40), on which the tightening protrusions (42) are arranged, extend along a transverse direction (114) perpendicular to the axial direction (110), and wherein the tightening protrusions (42) are arranged in the center or at least approximately in the center of the respective side with respect to the transverse direction (114).
 14. Connector assembly (10) according to any one of

the preceding claims,

wherein the first connector (40) is a male connector (20) comprising at least one contact pin (22) and the second connector (48) is a female connector (30) comprising at least one contact reception (32) for receiving the at least one contact pin (22), or
 wherein the second connector (48) is a male connector (20) comprising at least one contact pin (22) and the first connector (40) is a female connector (30) comprising at least one contact reception (32) for receiving the at least one contact pin (22),
 wherein the female connector (30) comprises least one guiding reception (36) arranged in the axial direction (110) such that upon connecting the first connector (40) and the second connector (48) the at least one contact pin (22) of the male connector (20) first enters the at least one guiding reception (36) and after traversing the guiding reception (36) subsequently enters the at least one contact reception (32).

5

10

15

20

- 15. Connector assembly (10) according to claim 14, wherein a diameter of the at least one guiding reception (36) decreases or at least section-wise decreases towards the at least one contact reception (32).

25

30

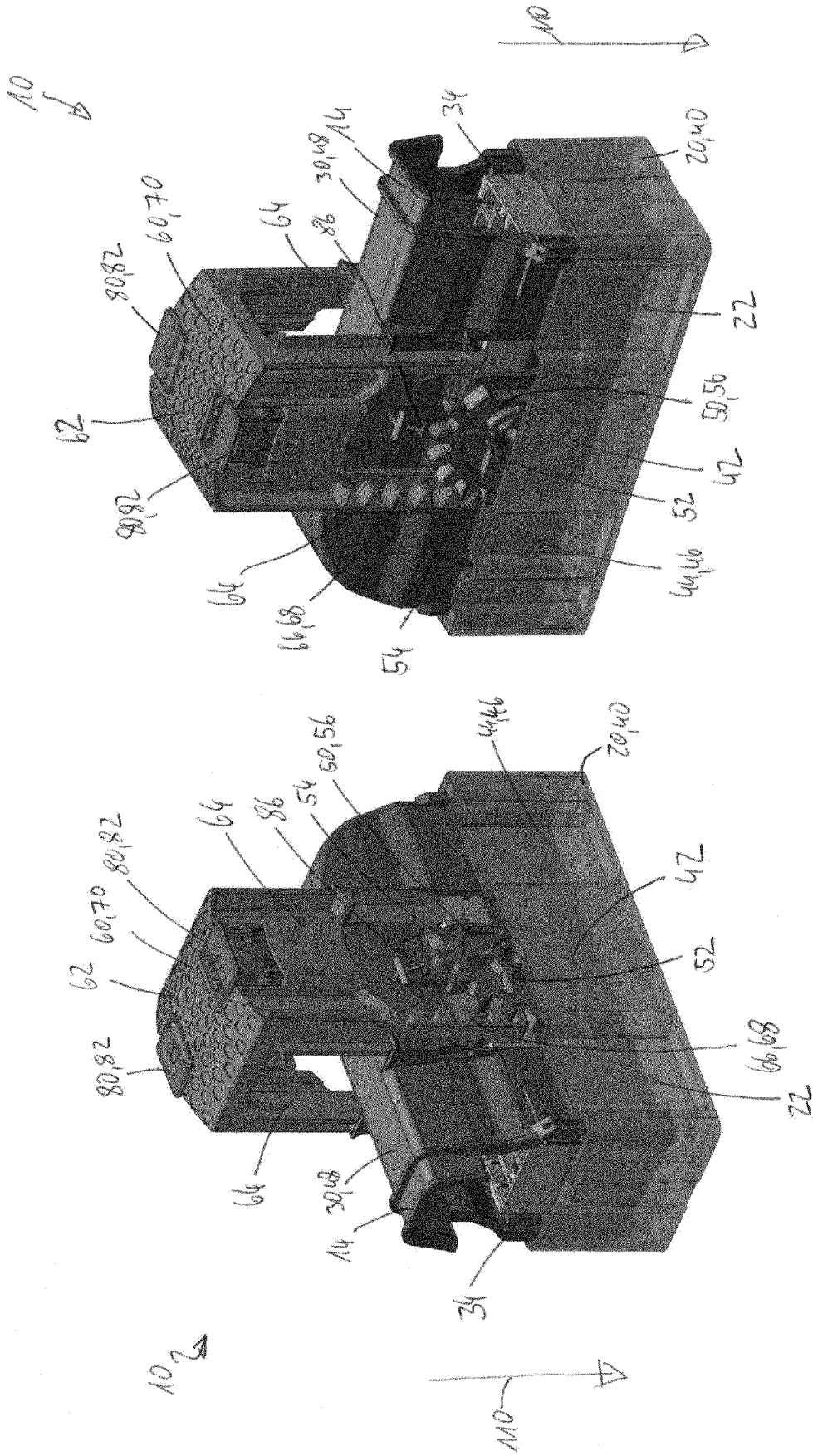
35

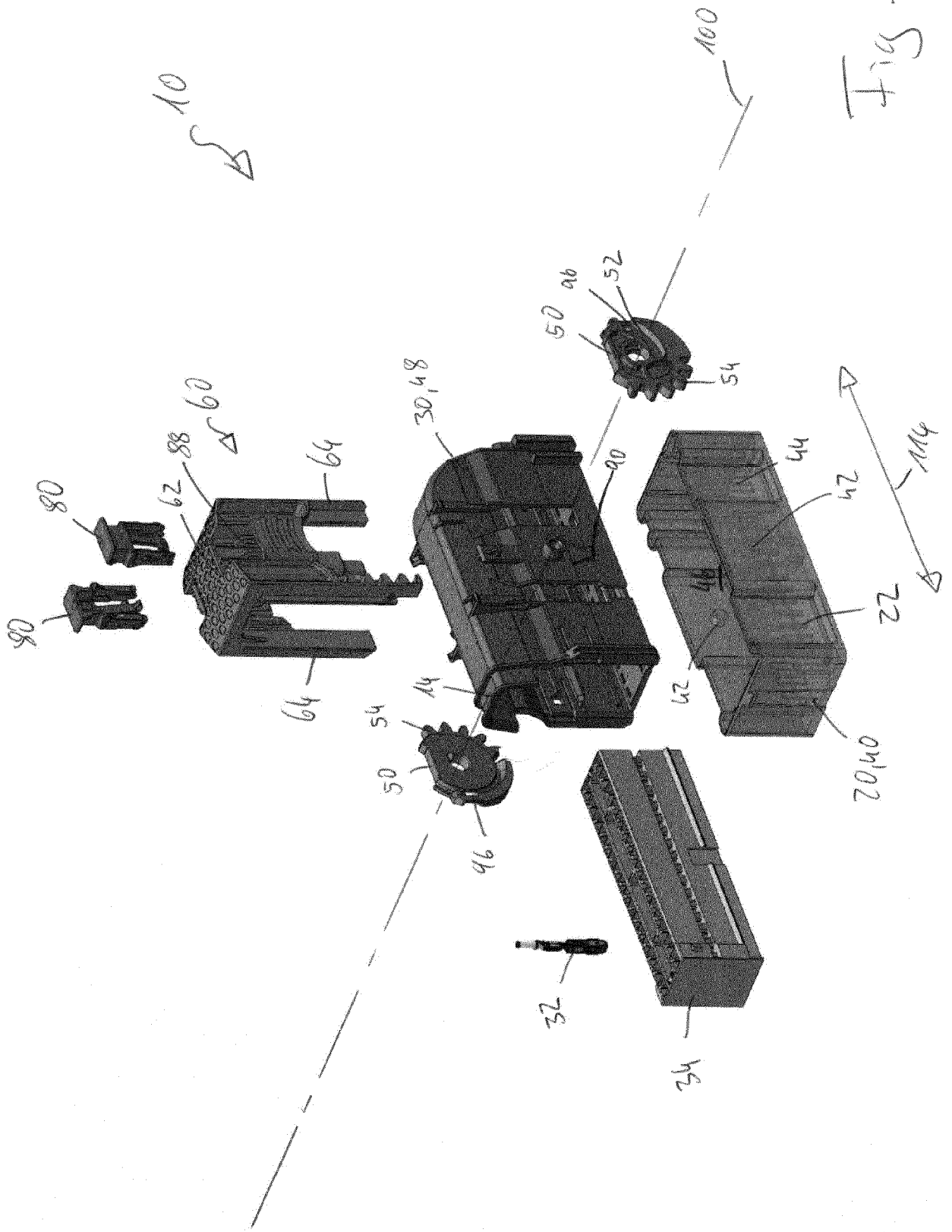
40

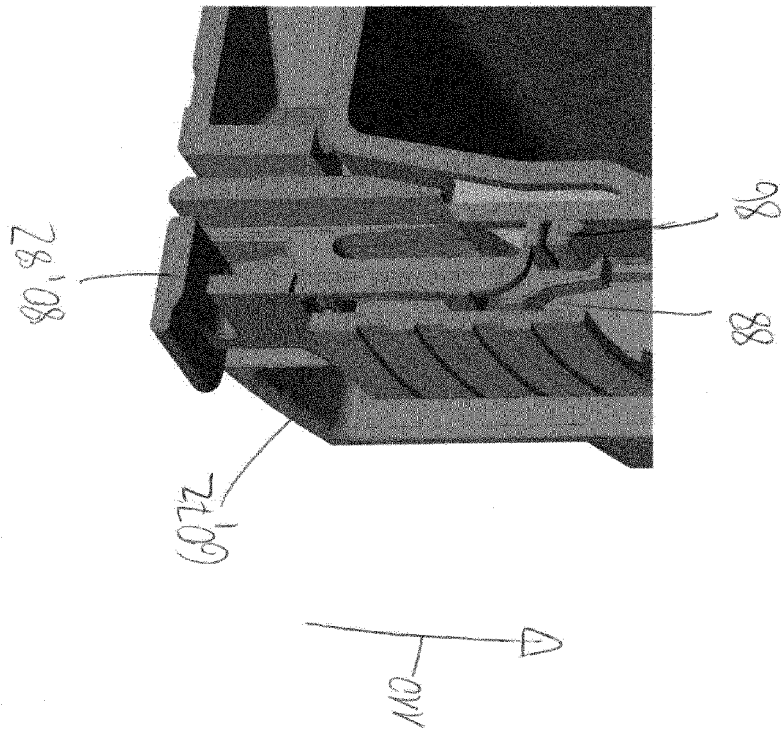
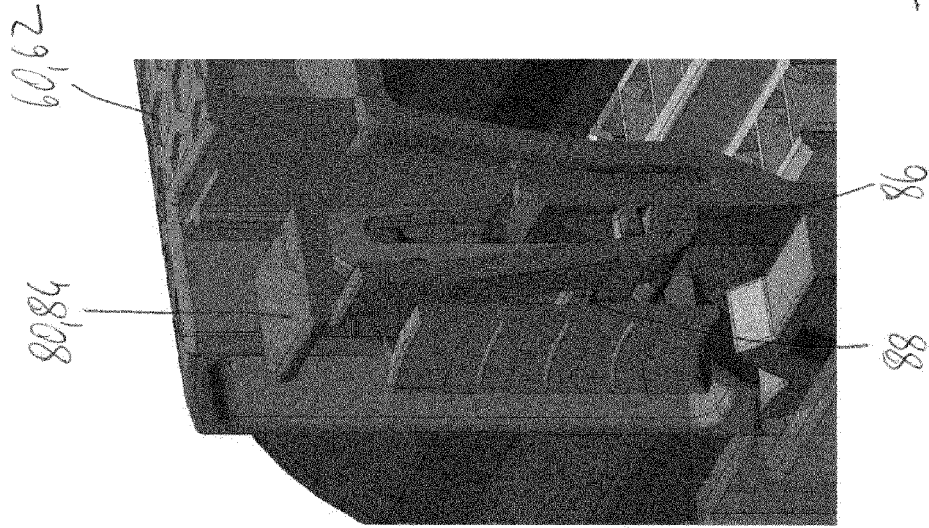
45

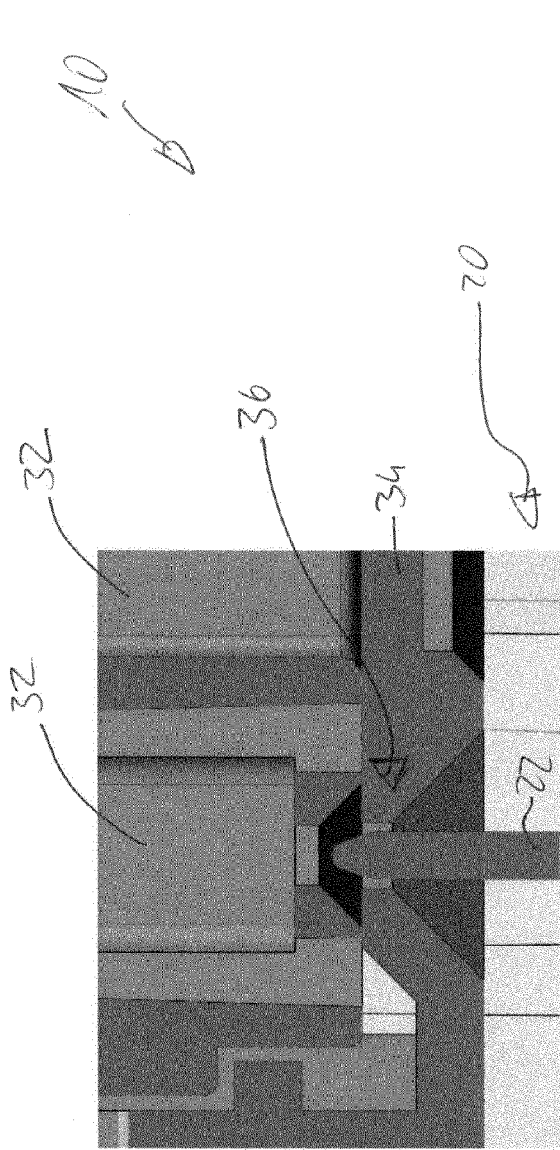
50

55









10

32

36

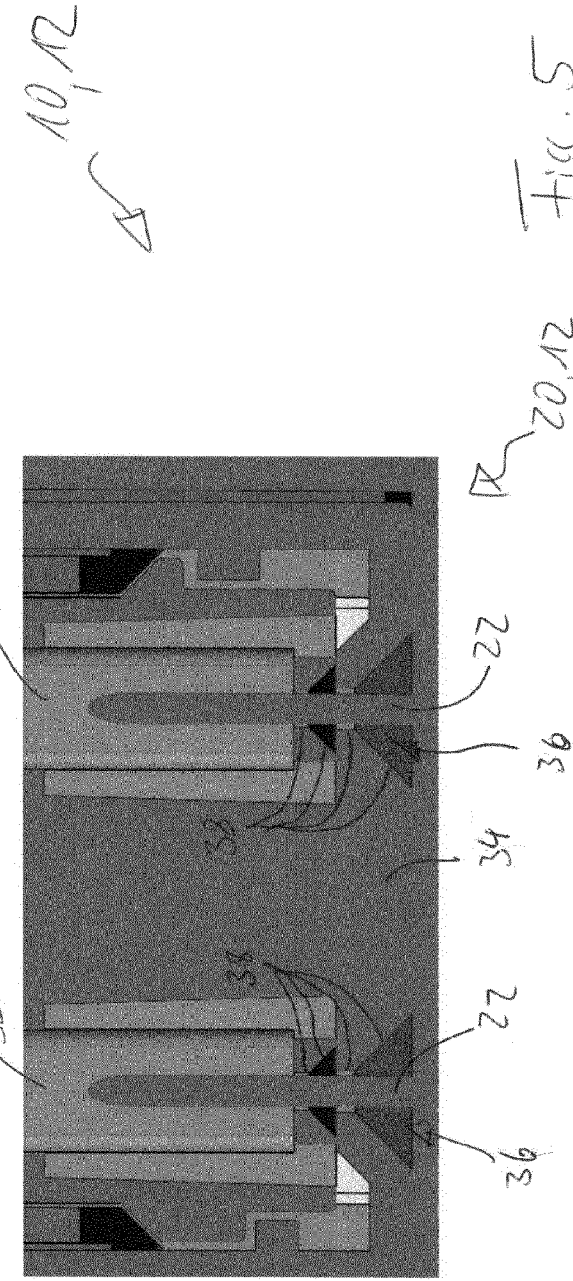
34

70

A-A

302

A-A



10, 12

32

22

36

34

22

36

A-A

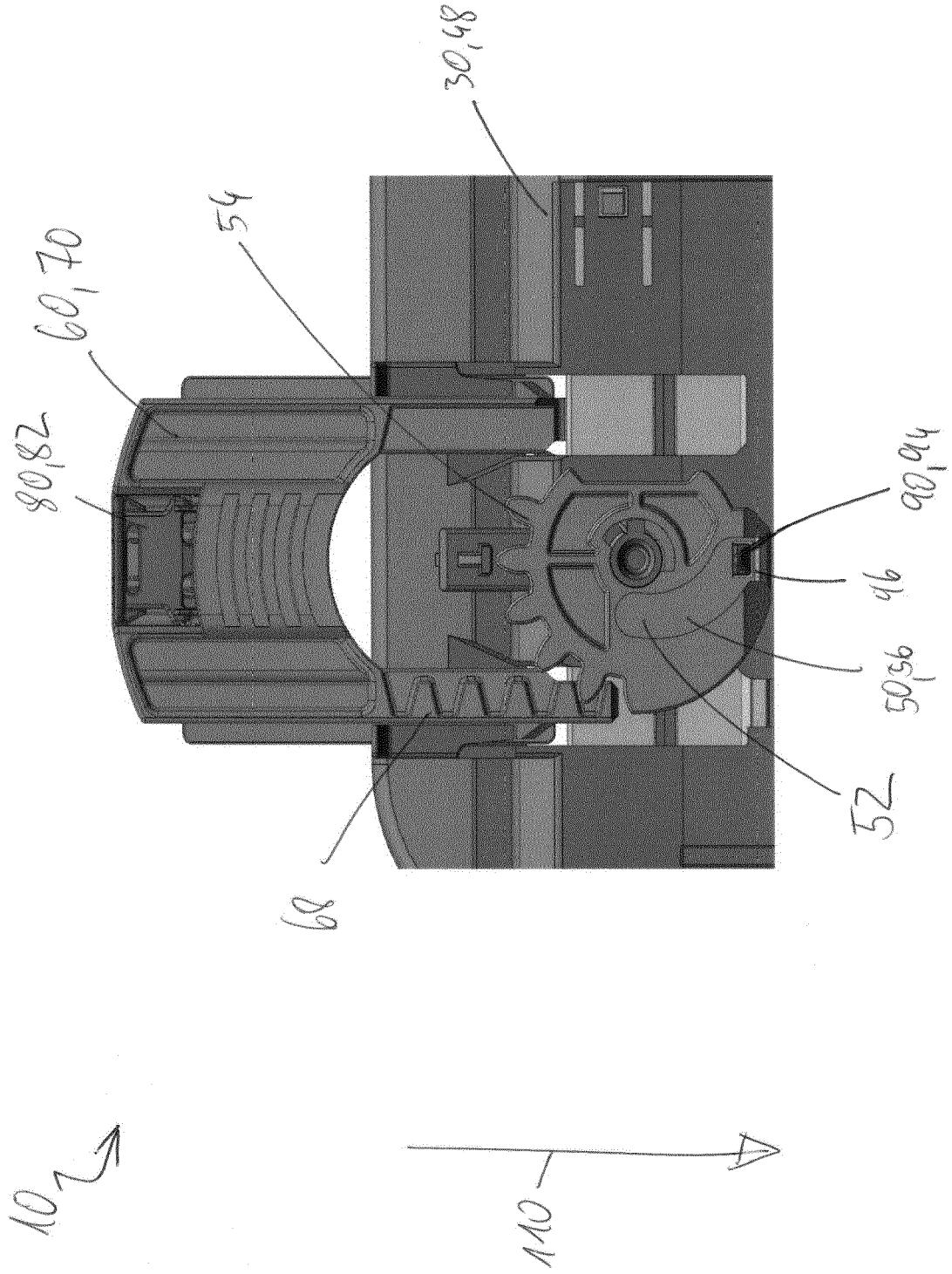
Fig. 5

70, 12

302

A-A

Fig. 6



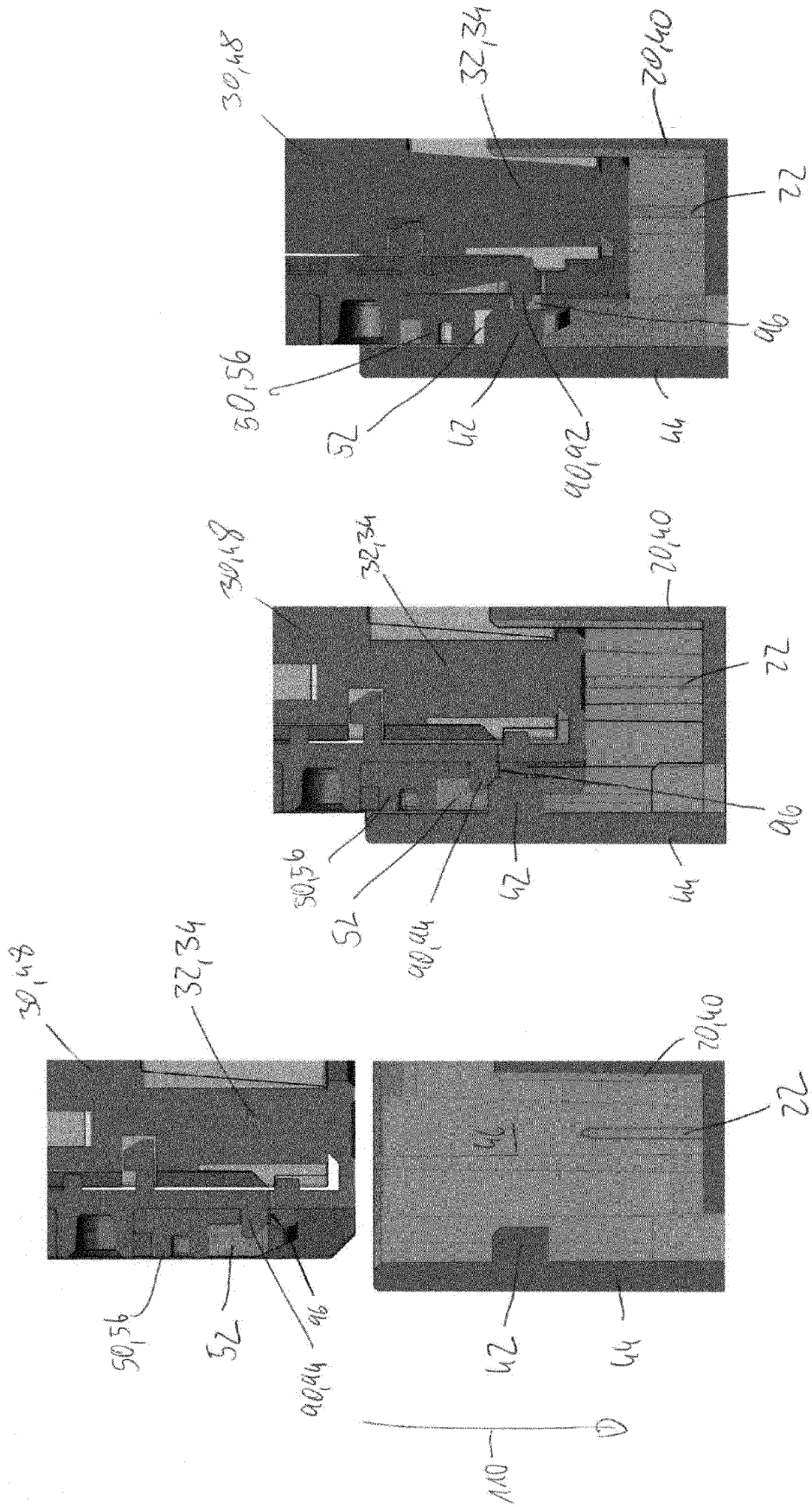


Fig. 7



EUROPEAN SEARCH REPORT

Application Number
EP 19 20 6558

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)
X	US 7 611 365 B1 (NG JENVUN [US] ET AL) 3 November 2009 (2009-11-03) * columns 4,5,6; figures 1,4,6,9 *	1,2,4-7, 12,13	INV. H01R13/629
X	EP 1 180 826 A1 (AUTONETWORKS TECHNOLOGIES LTD [JP] ET AL.) 20 February 2002 (2002-02-20) * paragraphs [0050], [0059], [0068], [0069]; figures 1,2 *	1,2,4,5, 8-11	
X	JP 2011 253655 A (SUMITOMO WIRING SYSTEMS) 15 December 2011 (2011-12-15) * paragraph [0038] - paragraph [0052] *	1,2, 4-11, 13-15	
X	JP 2006 278109 A (YAZAKI CORP; TOYOTA MOTOR CORP) 12 October 2006 (2006-10-12) * paragraph [0023]; figures 1-5 *	1-4	
A	WO 2007/037958 A2 (FCI AMERICAS TECHNOLOGY INC [US]; FRAMATOME CONNECTORS INT [FR] ET AL.) 5 April 2007 (2007-04-05) * paragraph [0026]; figures 6,7 *	14,15	TECHNICAL FIELDS SEARCHED (IPC) H01R
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 19 March 2020	Examiner Vautrin, Florent
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 03.02 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.

EP 19 20 6558

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.

19-03-2020

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 7611365	B1	03-11-2009	NONE
EP 1180826	A1	20-02-2002	EP 1180826 A1 20-02-2002
			EP 2003740 A2 17-12-2008
			US 2002019160 A1 14-02-2002
JP 2011253655	A	15-12-2011	NONE
JP 2006278109	A	12-10-2006	NONE
WO 2007037958	A2	05-04-2007	CN 101273497 A 24-09-2008
			EP 1941585 A2 09-07-2008
			US 2007082548 A1 12-04-2007
			WO 2007037958 A2 05-04-2007