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(54) **ELECTRICAL CONNECTOR SYSTEM**

(57) The invention relates to an electrical connector system comprising an electrical connector (102) for receiving a plurality of electrical cables, and a mating second electrical connector (106) for receiving a plurality of electrical cables, wherein the mating second electrical connector (106) is mechanically connectable to the elec-

trical connector (102), and wherein, in the mount state, the mechanical connection is a push pull type connection or a snap fit connection between an electrical connector attachment means (114) and a mating second connector attachment means (124) of the mating electrical receptacle connector (106).

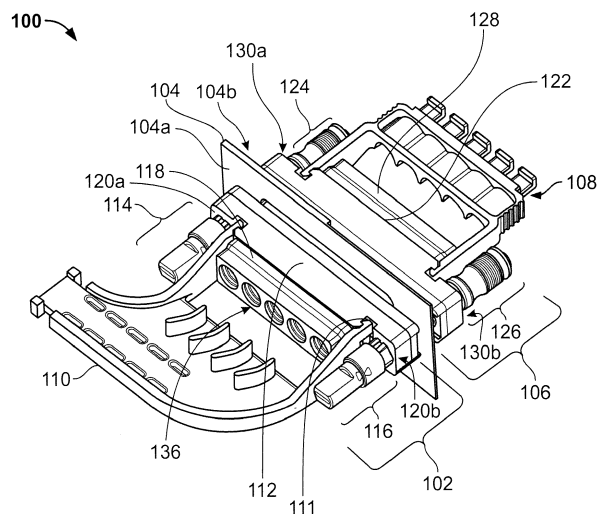


Fig. 1

Description

[0001] The invention relates to an electrical connector system comprising an electrical connector, a panel and a mating second electrical connector, especially for connectors systems used in aircraft interiors for transmitting signals and/or power.

[0002] The electrical connector, also called "receptacle" is fixed against one face of the panel and the second electrical connector, also called "plug" is connected to the receptacle on the other side of the panel. Once the two electrical connectors are mount to the panel, electric cables can be connected to the electrical connectors to establish electrical connections on both sides of the panel to transmit signals and/or power. Such connector systems are, in particular, designed to satisfy the requirements of certain standards of the aeronautics industry, e.g. EN3545 in its version dated November 2008.

[0003] Figure 7 illustrates a state of the art connector system. The first electrical connector 2 or the receptacle, which in this example is a pin connector, comprises two attachment devices in the form of pins 10 to mount the first electrical connector 2 to one main side 4a of a panel 4. The pin 10 is attached to the second electrical connector 2 by a clipping device 18. To mount the first electrical connector 2 to the panel 4, the pin 10 is inserted through a through hole 14' in the panel 4 and mechanically fixed to the panel 4 using a washer and a nut 16 screwed onto a thread of the pin 10 from the other side 4b of the panel 4. The mating second electrical connector 6 or plug, here a socket connector, is then mount onto the pins 10 using screws 8. Cable clamps 12 can be clipped onto the connectors 2 and/or 6.

[0004] This way to attach the electrical connectors is, however, time consuming and needs the use of external tools. In addition, during the attachment process, the loose pieces, like the washers and nuts, can be lost.

[0005] Furthermore, the application of the proper screwing force needs to be controlled by a second person to ensure quality. This adds further time to the assembly process, and more than one person is needed to realize the assembly process according to the state of the art.

[0006] Finally, defects and damages to the coating of the panel can occur when the nut and the lock washer are screwed onto the pin.

[0007] It is thus an objective of the current invention to resolve the problem stated above by providing an electrical connector system with an improved assembly process.

[0008] This object is achieved with an electrical connector system comprising an electrical connector for receiving a plurality of electrical cables, and a mating second electrical connector for receiving a plurality of electrical cables, wherein, the mating second electrical connector is mechanically connectable to the electrical connector, and wherein, in the mount state, the mechanical connection is a push pull type connection or a snap fit connection between an connector attachment means

and a mating second connector attachment means of the mating second electrical connector. The push pull type connection or a snap-fit connection are simple and fast ways of mechanically connecting two elements together.

They do not require any external tools. As a result, the electrical connector and the mating second electrical connector can be assembled quicker than the state-of-the-art connector system.

[0009] According to a variant the electrical connector can comprise a panel, wherein the electrical connector is mount to one main side of the panel via the at least one connector attachment means extending through a through hole in the panel. Thus, the connector attachment means is used to connect both to the panel and to the mating second electrical connector. This connector system is particularly interesting in an aeronautic application.

[0010] According to a variant, the electrical connector and the panel can be mechanically connected via a snap-fit connection. Thus, also for this connection, no tools are needed. The entire assembly process can thus be realized without tools and not needing any loose parts.

[0011] According to a variant, the connector attachment means can comprise a connection axis with a groove and the mating second connector attachment means comprises an inner hollow structure for receiving the connection axis and a movable connecting element, movable in a direction perpendicular to the connection axis, in particular one or more balls, and positioned in the groove in the mount state. Using the movable connecting means a reliable push pull connection can be established.

[0012] According to a variant, the mating second connector attachment means can further comprise a spring configured to impose a force on a movable locking element, the locking element being external to the inner hollow structure and the movable connecting element, wherein the restoring force keeps the locking element in a locked position when the movable connecting element is positioned in the groove and wherein in the locked position the locking element forces the movable connecting element in the groove. The locking element thus essentially automatically locks the connection, once the movable connecting element is positioned in the groove.

[0013] According to a variant, the mating second connector attachment means can comprises visual markings, only visible when the locking element is in the locked position. The presence of visual markings on the mating second attachment means provides a simple verification system of the attachment of the mating second electrical connector to an electrical connector mount onto a panel.

[0014] According to a variant of the invention, the entire mating second connector attachment means can be attached to the mating second connector body. As a result, the design of the mating second attachment means according to the invention is simplified without any loose parts. Furthermore, a faster assembly process of the mating second electrical connector onto the electrical con-

connector mount on a panel can be realized as the attachment can be realized without requiring extra tools and extra verification steps as in the state-of-the-art assembly process.

[0015] According to a variant of the invention, the mating second connector attachment means can comprise mechanical coding means, in particular a slit, aligned with a mating mechanical coding means, in particular a protrusion, of the connector attachment means of the electrical connector. As a result, the alignment of the two parts is simplified.

[0016] The invention may be understood by reference to the following description taken in conjunction with the accompanying figures, in which reference numerals identify features of the invention.

Figure 1 illustrates a connector system according to the invention.

Figure 2a illustrates a three-dimensional view of a connector system comprising an electrical connector mount to a panel and an electrical mating second electrical connector mount onto the electrical connector according to the invention.

Figure 2b illustrates a three-dimensional partial side cut view of the electrical mating second electrical connector being partially mount onto the electrical connector.

Figure 2c illustrates a three-dimensional partial side cut view of the mating second electrical connector being further mount onto the electrical connector.

Figure 2d illustrates a three-dimensional side view of the mating second electrical connector being completely mount and locked onto the electrical connector.

Figure 2e illustrates a three-dimensional view of the connector system according to the invention, the mating second electrical connector being mount and locked onto the electrical connector.

Figure 3a illustrates a three-dimensional view of the mating second connector attachment means of the connector system according to the invention.

Figure 3b illustrates an exploded three-dimensional view of the mating second connector attachment means of the connector system according to the invention.

Figure 4 illustrates an exploded three-dimensional view of a connector system according to the state of the art.

[0017] Figure 1 shows a connector system according

to a first embodiment of the invention. The connector system 100 comprises an electrical connector 102 mount onto a panel 104 and a mating second electrical connector 106 attached to the electrical connector 102. The electrical connector 102 is also called receptacle, whereas the mating second electrical connector 106 is also called plug.

[0018] The electrical connector 102 comprises a connector body 112, two connector attachment means 114, 116 and a connecting portion 118, as shown on fig. 1. The two connector attachment means 114, 116 are located on each side of the connector body 112. Each connector attachment means 114, 116 is inserted into a corresponding through hole 120a, 120b, visible on figs. 2b, of the connector body 112. In a variant of the invention, the electrical connector 102 can comprise one or more than two connector attachment means 114, 116.

[0019] The mating second electrical connector 106 comprises a mating second connector body 122, two mating second connector attachment means 124, 126 and a connecting portion 128. The two mating second connector attachment means 124, 126 are located on each side of the mating second connector body 122, inserted into a corresponding through hole 130a, 130b, visible on fig. 2b, of the mating second connector body 122. In a variant of the invention, the mating second electrical connector 106 can comprise one or more than two mating second connector attachment means 124, 126.

[0020] According to one practical example, the connecting portion 116 can be a pin connector and the mating connecting portion 128 a socket connector. They can be of a sealed or unsealed type and are used for transmitting control signals and/or power. They find application in the aeronautic industry.

[0021] The connecting portion 118 of the electrical connector 102 comprise five contact arrangements 136. In the same way, the connecting portion 128 of the mating second electrical connector also comprises five contact arrangements 138, visible on Figure 2a. In the mount state, the contact arrangements 136 of the electrical connector 102 mechanically and electrically connect with the contact arrangements 138 of the mating second electrical connector 106. Thus, electrical cables connected to the electrical connector 102 on the side 104a of the panel 104 can be connected to electrical cables connected to the mating second electrical connector 106 on the other side 104b of the panel 104.

[0022] The electrical connector 102 further comprises a bent cable clamp 110. The mating second electrical connector 106 further comprises a straight cable clamp 108. The cable clamps 108 and 110 are configured to receive electrical cables and/or male and/or female electrical connectors to be connected with each other within the connector system 100. The cable clamps 108 and 110 can be clipped, see reference numeral 111, onto the connector body 112 and the mating second connector body 120.

[0023] In this embodiment, the straight cable clamp

108 has a straight shape for receiving cables that arrive perpendicularly to the panel 104 while the bent cable clamp 110 has a bent shape for receiving cables that arrive in parallel to the panel 104. Other shapes depending on the direction of the electrical cables or connectors with respect to the panel 104 may be used as well.

[0024] In variants, the bent cable clamp 110 can be connected to the mating second electrical connector 106 and the straight cable clamp 108 can be connected to the electrical connector 102 or two straight cable clamps 108 or two bent cable clamps 110 can be used with the connector system 100.

[0025] The electrical connector 102 is located on one main side 104a of the panel 104 while the mating second electrical connector 106 is located on the opposite main side 104b of the panel 104.

[0026] The electrical connector 102 is attached or mount to the panel 104 via a snap-fit connection using the two connector attachment means 114, 116.

[0027] Using the snap-fit connection allows an easy and fast yet safe mechanical connection, which can be realized without needing a tool to establish the connection. Furthermore, as no loose parts, like washers or nuts are needed, no parts can get lost.

[0028] According to a variant, the electrical connector 102 could also be mount like in the prior art using screws, washers and nuts.

[0029] After mounting the electrical connector 102 to the panel 104, the mating second electrical connector 106 is mount onto the connector attachment means 114, 116 of the electrical connector 102 using the two mating second connector attachment means 124, 126.

[0030] According to a practical example, the electrical connector 102 and the mating second electrical connector 106 are designed and configured to satisfy the EN3545 or ASNE 0390 standard for aeronautical applications.

[0031] The mechanical connection between the two connector attachment means 114, 116 of the electrical connector 102 and the two mating second connector attachment means 124, 126 of the mating second electrical connector 106 will be described in more detail with respect to the Figs. 2a to 2f. Features having the same reference numeral as in Figure 1 will not be described in detail again.

[0032] Figure 2a illustrates a three-dimensional side view of the mating second electrical connector 106 to be mount onto the electrical connector 102 in the sense of the arrow. The electrical connector 102 in turn is already mount to the panel 104.

[0033] Figure 2a illustrates a protruding connecting portion 118c, part of the connecting portion 118 with its five contact arrangements 136. The connecting portion 128 of the mating second connector body 118 comprises corresponding contact arrangements 138 which extend through to a protruding connecting portion 128c of the connecting portion 128.

[0034] The two mating second connector attachment

means 124, 126 of the second mating electrical connector 106 receive the connecting axis 132, 134 of the connector attachment means 114, 116 when the second mating electrical connector 106 is mount onto the electrical connector 102.

[0035] Figure 2b illustrates a three-dimensional partial cut view of the mating second electrical connector 106 now partially mount with the electrical connector 102.

[0036] The protruding connecting portion 118c of the electrical connector 102 is facing the protruding connecting portion 128c of the mating second electrical connector 106.

[0037] The mating second connector attachment means 124 is mount onto the body 122 of the mating second electrical connector 106 with a clipping device 140, like known in the art.

[0038] The end portion 132a of the connection axis 132 of the connector attachment means 114 enters an inner hollow structure 166 of the connector attachment body 142 of the mating second connector attachment means 124

The mating second connector attachment means 124 illustrated in Figure 2b will be described in more details also using Figures 3a and 3b.

[0039] The mating second connector attachment means 124 is an elongated piece comprising different cross sections along its length. The mating second connector attachment means 124 comprises the connector attachment body 142 on its one end portion 124a and which is inserted into a locking element 144, itself connected to a portion carrying visual markings 146 on the other end portion 124b.

[0040] The connector attachment body 142 of the mating second connector attachment means 124 comprises an inner hollow structure 148 into which is inserted a pushing element 150, a first spring 152, a second spring 154 and at least one movable connecting element 156. In Figure 3b, the mating second connector attachment means 124 comprises three movable connecting elements in the form of balls 156. The balls 156 are movable in a direction perpendicular to the central axis X of the inner hollow structure 148 as will be explained in detail further down.

[0041] As illustrated in Figure 2b, the balls 156 are located in through holes 158 situated on the lateral side parallel to the central axis X of the connector attachment body 142. The balls extend partially beyond the outside surface of the connector attachment body 142. On the inside of the hollow structure 148, the balls 156 are flush aligned with the wall of the hollow structure 148 and the pushing element 150 is placed in front of the balls 156, forced by the spring 152 against a stop element 153 on the hollow structure 148.

[0042] The locking element 144 comprises an inner hollow structure with side walls 160 such that the connector attachment body 142 can be partially inserted into the inner hollow structure of the locking element 144 until the end portion 160a of the side walls 160 of the locking

element 144 abuts against a base element 162 of the connector attachment body 142. The through holes 158 with the balls 156 are located inside the hollow structure of the locking element 144, adjacent to the base element 162. The balls 156 abut against a concave section 164 of the sidewall 160. The concave section 164 is pushed against the balls 156 by spring 154. Thus, the balls 156 are kept in place in the through holes 158, when the mating second electrical connector 106 is in its unmount state. At the same time, as the balls 156 are pushed out of the hollow structure 148 by the pushing element 150. The concave section 164 is blocked by the balls 156 even under the force of the spring 154 and cannot move further in the mounting direction.

[0043] The end portion 124a of the mating second connector attachment means 124 has a slit 166 that opens towards the end portion 124a and serves as a mechanical coding means. The slit 166 receives the protrusion 168 located on the connection axis 132 of the connector attachment means 114 and ensures a proper alignment.

[0044] Figure 2b also illustrates the snap fit connection between the electrical connector 102 and the panel 104. Flexible hooks 200 engage with the backside 104b of the panel 104 and thereby mechanically connect the electrical connector 102 to the panel 104.

[0045] Figure 2c illustrates a three-dimensional partial side cut view of the mating second electrical connector 106 being further mount onto the electrical connector 102.

[0046] The connecting axis 132 of the connector attachment means 114 is now further inserted into the mating second connector attachment means 124. The end portion 132a of the connecting axis 132 of the connector attachment means 114 has pushed the pushing means 150 of the mating second connector attachment means 124 against the force of the first spring 152 such that the ball 156 is no positioned next to the end portion 132a of the connecting axis 132.

[0047] In Figure 2d, the connecting operation is completed. The pushing means 150 has been pushed so far by the connecting axis 132 that the ball 156 has entered into the groove 170 provided in the connecting axis 132. Indeed, the position of the ball is no longer blocked by the pushing means 150 or the end portion 132a of the axis and therefore could enter the hollow structure 148. Under the pushing force of the second spring 154, the concave section 164 actually pushed the ball into the groove 170.

[0048] Once pushed in the groove, the ball 156 no longer blocks the way for the locking element 144 and the second spring 154 pushes the locking element further in the mounting direction so that its flat section 172 blocks the ball 156 from moving out of the groove 170. The mechanical connection between the electrical connector 102 and its mating second electrical connector 106 is established and locked. This kind of connection is called a push-pull connection allowing the establishment of a locked connection, as well as its unlocking, without tools.

[0049] If necessary, the user can support the force of the second spring 154 and push the locking element 144 in the mounting direction to realize the mechanical connection and the locking.

[0050] Once the locking element 144 in its final locked position, the visual marking 146 become visible confirming the user that the connection has been correctly realized.

[0051] Figure 2e illustrates a three-dimensional view of the connector system according to the invention, the mating second electrical connector 106 being mount and locked onto the electrical connector 102.

[0052] As can be seen in figure 2e, when the push pull connection is established between the electrical connector 102 and the mating second electrical connector 106 is locked, the visual markings 146, here in the form of a coloured ring, are visible. The visual markings 146 confirm the locked position of the locking element 144.

[0053] The mating second electrical connector 106 is mount and locked to the electrical connector 102 mount on a panel 104 without needing a tool and without loose parts. Due to the visual indication, a user always knows when the connection is correctly established. Thus a simple, yet reliable connection can be realized needing only one person and which is faster than the method of the prior art.

[0054] In order to unlock the connection between the mating second electrical connector 106 and the electrical connector 102, it is necessary to unlock the push-pull connection between the mating second connector attachment means 124 and the connector attachment means 114. To do so, the locking element 144 of the mating second connector attachment means 124 needs to be pushed in the direction opposite, as illustrated by the arrow to the direction of insertion, so that the concave section 164 is positioned next to the balls 156 which thereby become free to move out of the groove 170. Then the mating second electrical connector 106 can be pulled back.

[0055] A number of embodiments of the invention have been described. Nevertheless, it is understood that various modifications and enhancements may be made without departing the following claims.

References

[0056]

- 2 electrical connector
- 4 panel
- 4a front side
- 4b back side
- 6 second mating electrical connector
- 8 screw
- 10 pin
- 12 cable clamps
- 14 through hole
- 16 nut

18 clipping device

100 connector system
 102 electrical connector
 104 panel
 104a,b side of the panel
 104c through central slit of the panel
 104d through holes of the panel
 106 mating second connector
 108 straight cable clamp
 110 bent cable clamp
 111 clipped region
 112 connector body
 114 connector attachment means
 116 connector attachment means
 118 connection portion of the connector body
 118c protruding connection portion of the connector body
 120 through holes of the connector body
 122 mating second connector body
 124 mating second connector attachment means
 124a,b end portion
 126 mating second connector attachment means
 128 connection portion of the mating second connector body
 128c protruding connection portion of the mating second connector body
 130a, b through holes of the mating second connector body
 132 connection axis
 132a end portion of the connection axis
 134 connection axis
 136 contact arrangements
 138 contact arrangements
 140 clipping device
 142 connector attachment body
 144 locking element
 146 visual markings
 148 hollow structure of the connector body
 148a contact
 150 pushing element
 152 first spring
 153 stop element
 154 second spring
 156 movable connecting element
 158 through holes
 160 side walls of the locking element
 162 base element
 164 concave section
 166 mechanical coding means
 168 mechanical coding means
 170 attachment means, groove
 172 flat section

200 flexible hook

Claims

1. Electrical connector system comprising
 - 5 - an electrical connector (102) for receiving a plurality of electrical cables, and
 - a mating second electrical connector (106) for receiving a plurality of electrical cables, wherein, the mating second electrical connector (106) is mechanically connectable to the electrical connector (102), and wherein, in the mount state, the mechanical connection is a push pull type connection or a snap fit connection between a connector attachment means (114) and a mating second connector attachment means (124) of the mating second electrical connector (106).
2. Electrical connector system according to claim 1, further comprising a panel (104), wherein the electrical connector (102) is mount to one main side (104a) of the panel (104) via the at least one connector attachment means (114) extending through a through hole (104d) in the panel (104).
3. Electrical connector system according to claim 2, wherein the electrical connector (102) and the panel (104) are mechanically connected via a snap-fit connection.
4. Electrical connector system according to any one of claims 1 to 3, wherein the connector attachment means (114) comprises a connection axis (132, 134) with a groove (170) and the mating second connector attachment means (124) comprises an inner hollow structure (148) for receiving the connection axis (132, 134) and a movable connecting element (156), movable in a direction perpendicular to the connection axis (132), in particular one or more balls (156), and positioned in the groove (170) in the mount state.
5. Electrical connector system (100) according to claim 4, wherein the mating second connector attachment means (124) further comprises a spring (154) configured to impose a force on a movable locking element (144), the locking element (144) being external to the inner hollow structure (148) and the movable connecting element (156), wherein the restoring force keeps the locking element (144) in a locked position when the movable connecting element (156) is positioned in the groove (170) and wherein in the locked position the locking element forces the movable connecting element (156) in the groove (170).
6. Electrical connector system (100) according to claim 5, wherein the mating second connector attachment means (124) comprises visual markings (146) only visible when the locking element (164) is in the

locked position.

7. Electrical connector system (100) according to any one of claims 1 to 6, wherein the entire mating second connector attachment means (124) is attached to the mating second connector body (122). 5
8. Electrical connector system (100) according to any one of claims 1 to 7, wherein the mating second connector attachment means (124) comprises mechanical coding means (166), in particular a slit, aligned with a mating mechanical coding means (168), in particular a protrusion, of the connector attachment means (114) of the electrical connector (102). 10

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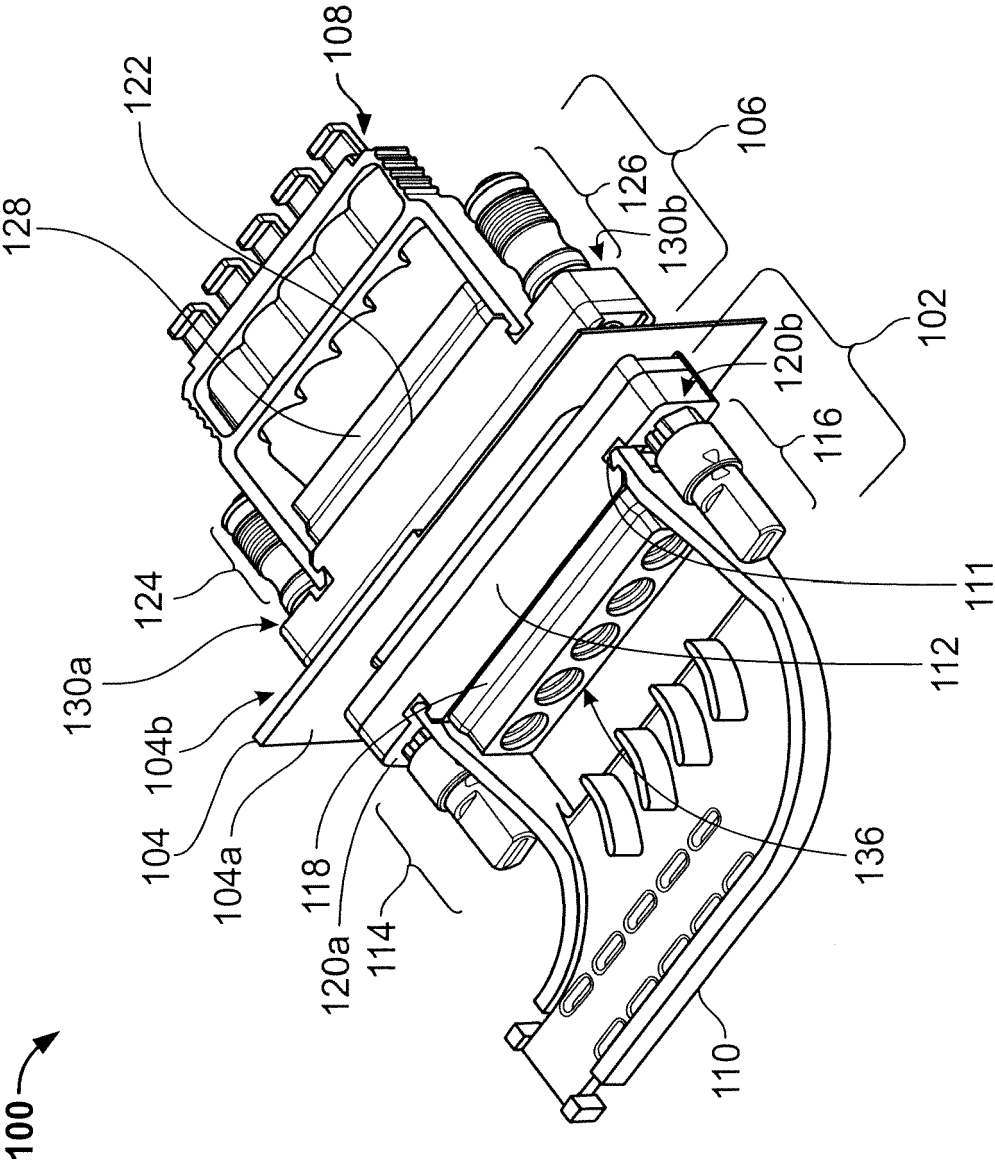


Fig. 1

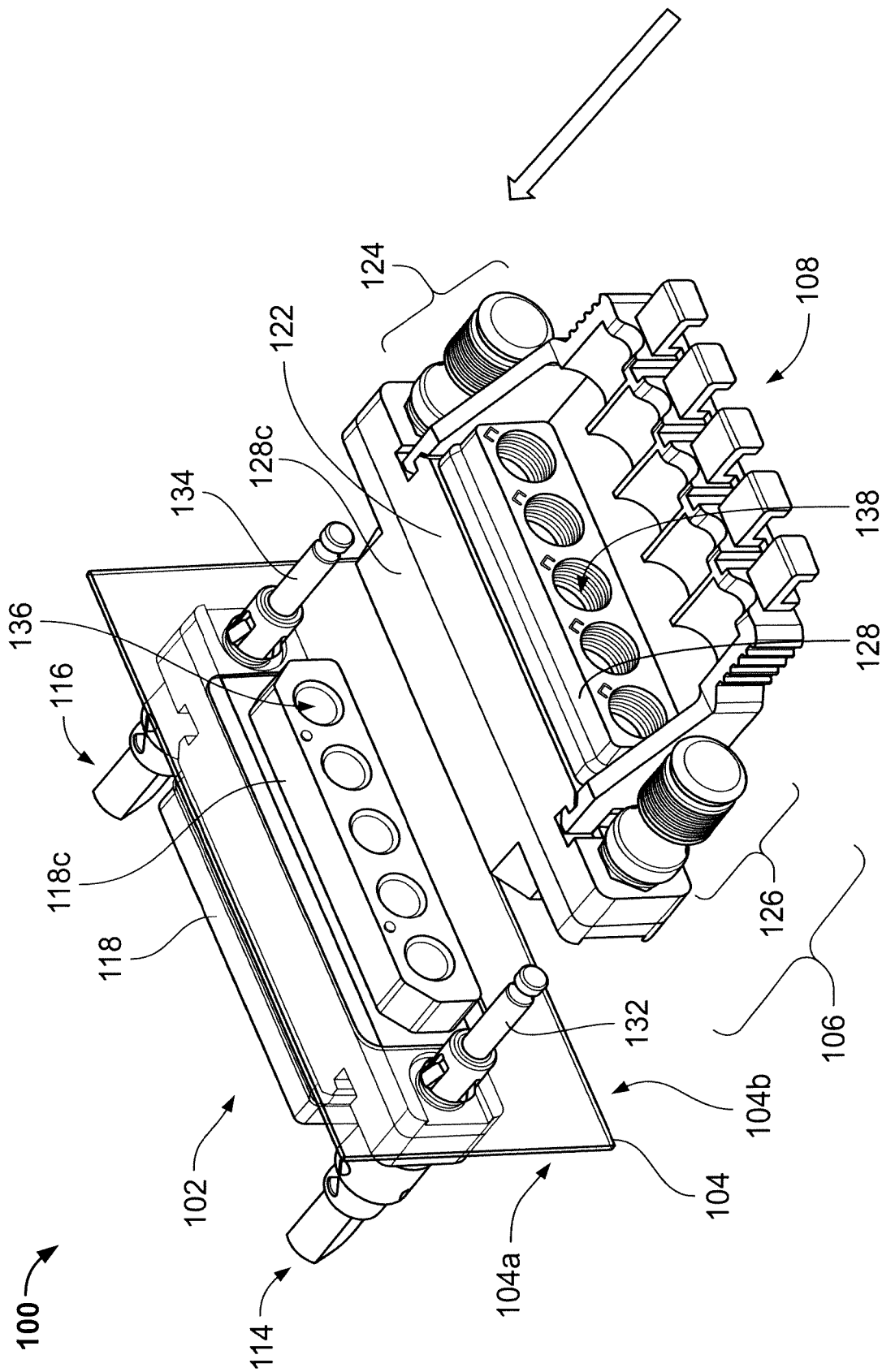


Fig. 2a

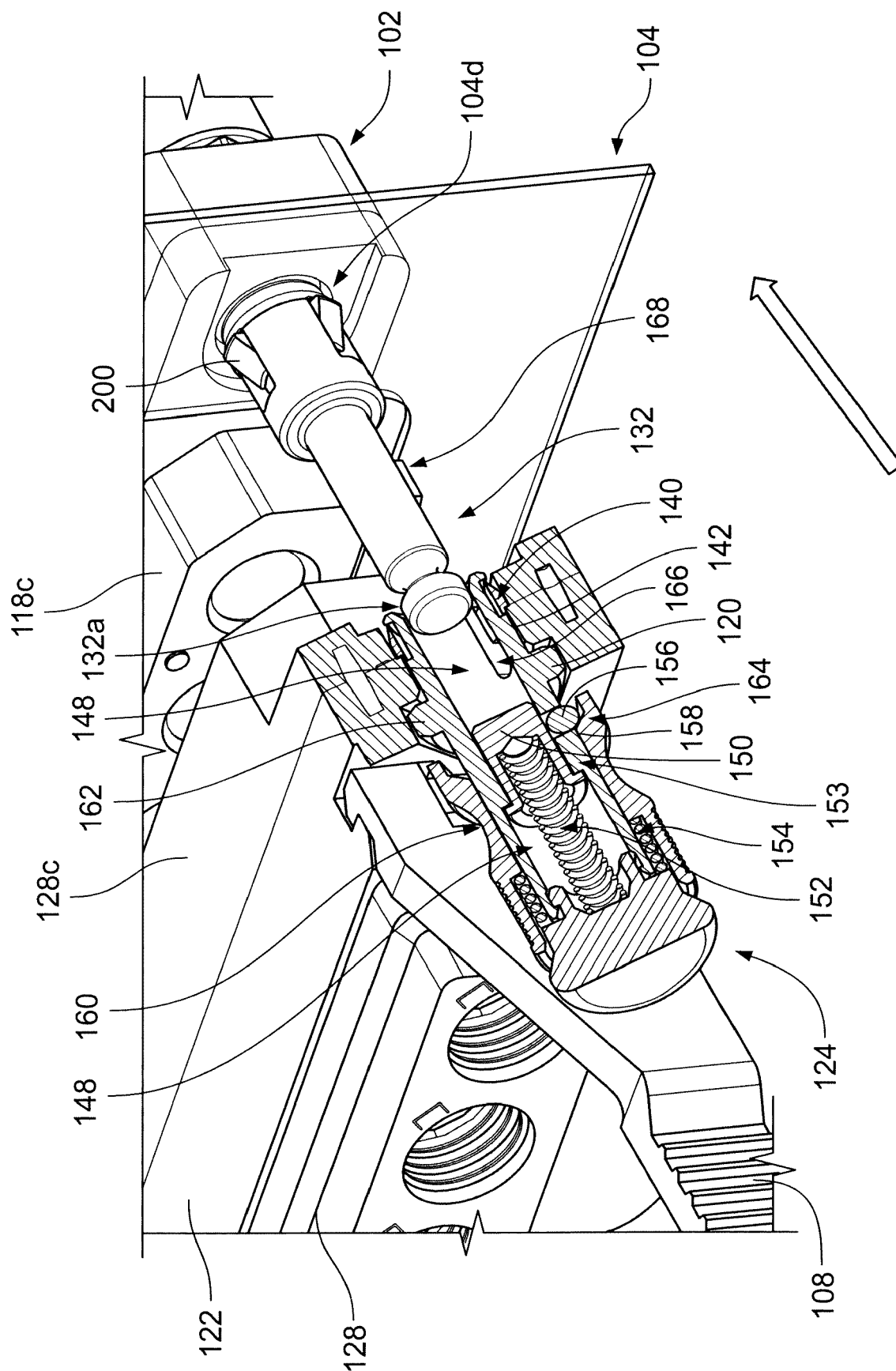


Fig. 2b

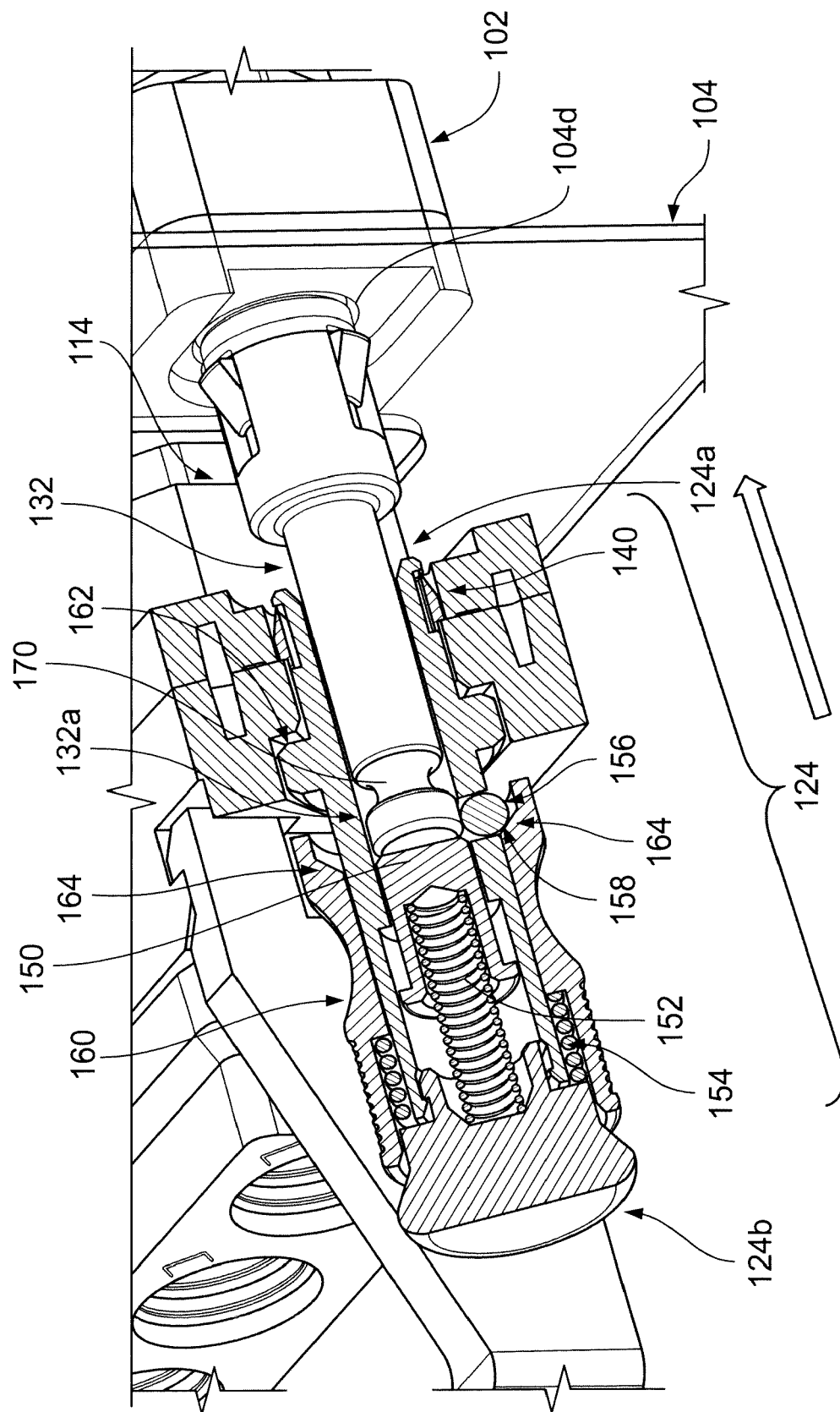


Fig. 2c

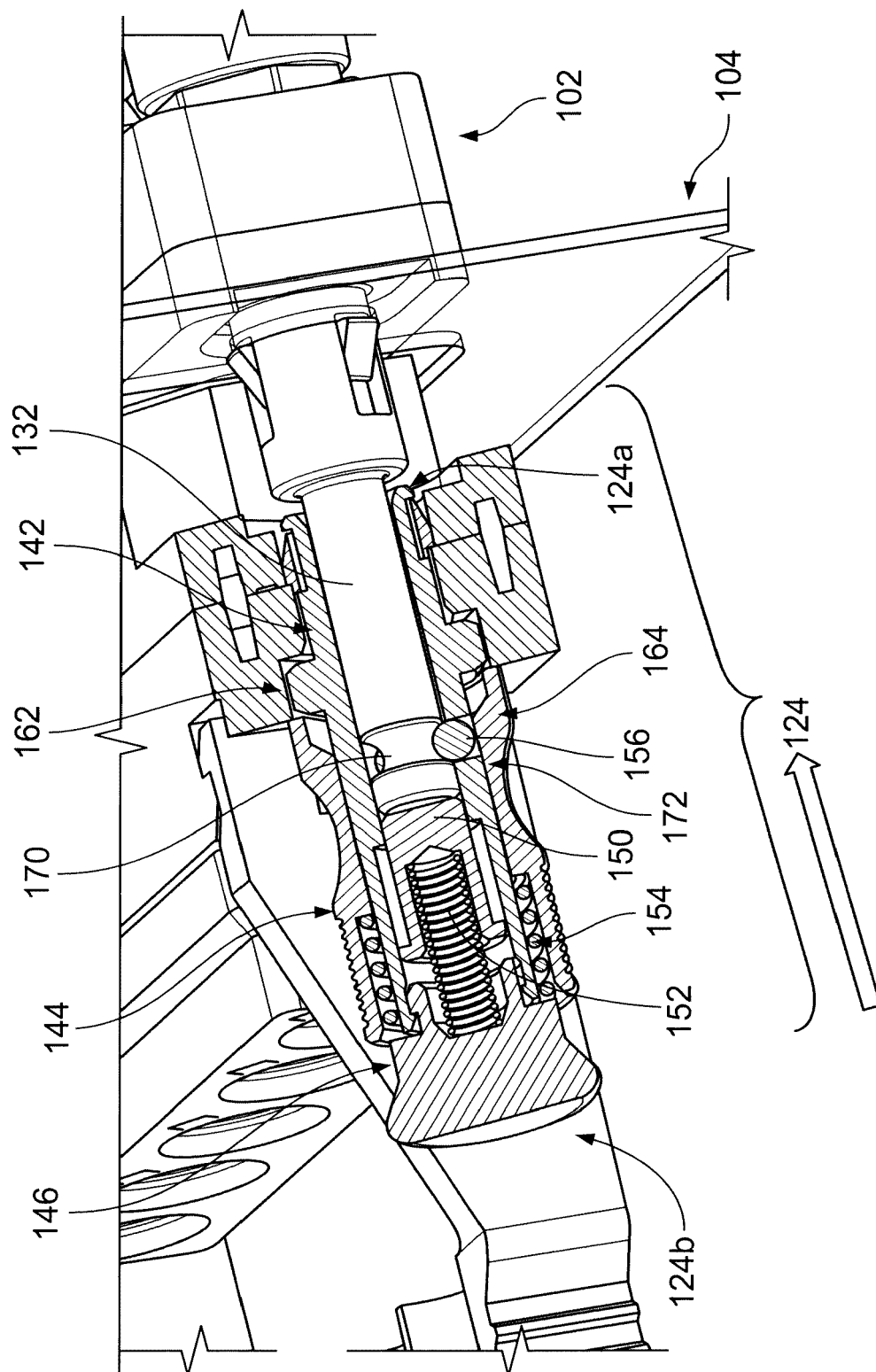


Fig. 2d

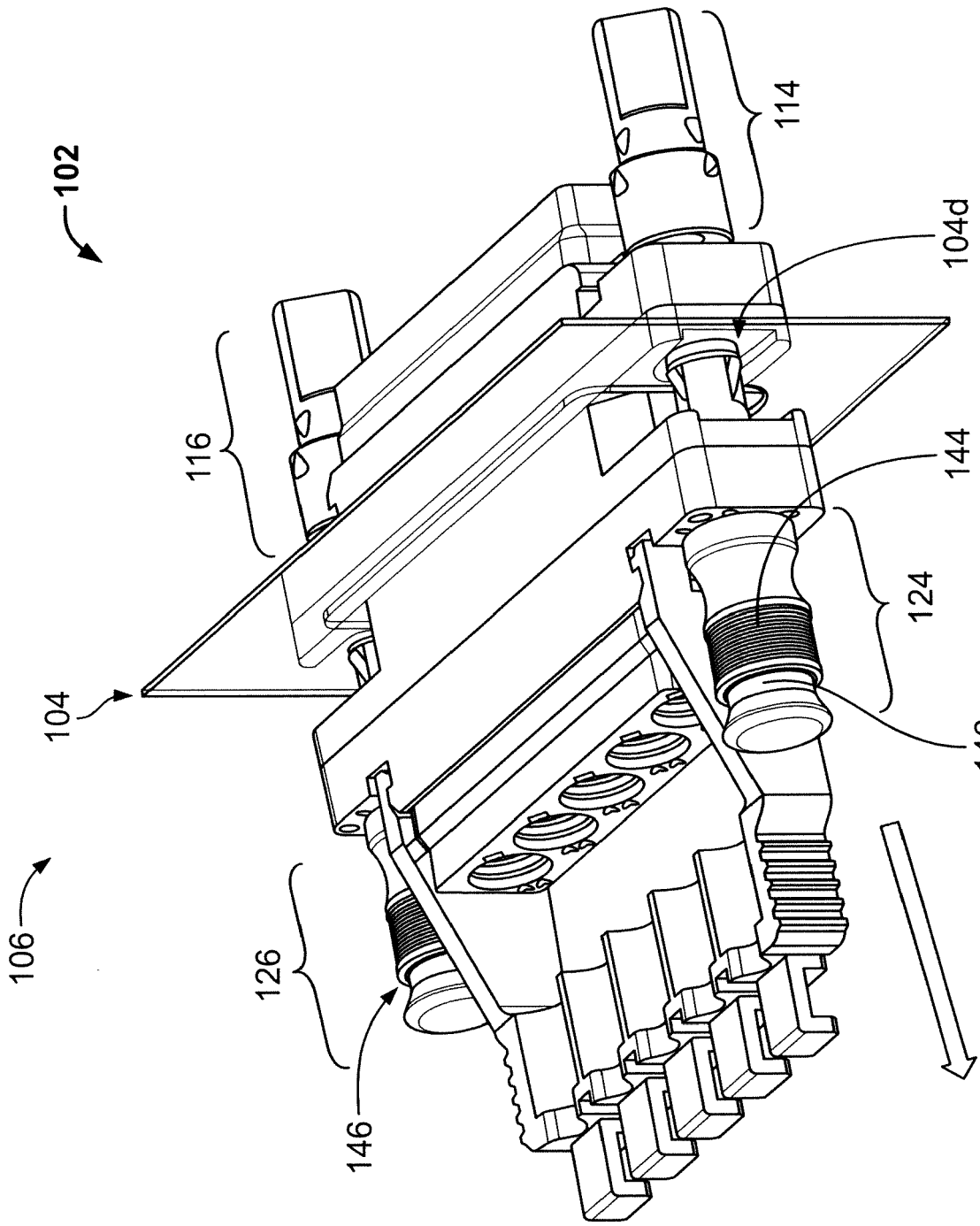


Fig. 2e

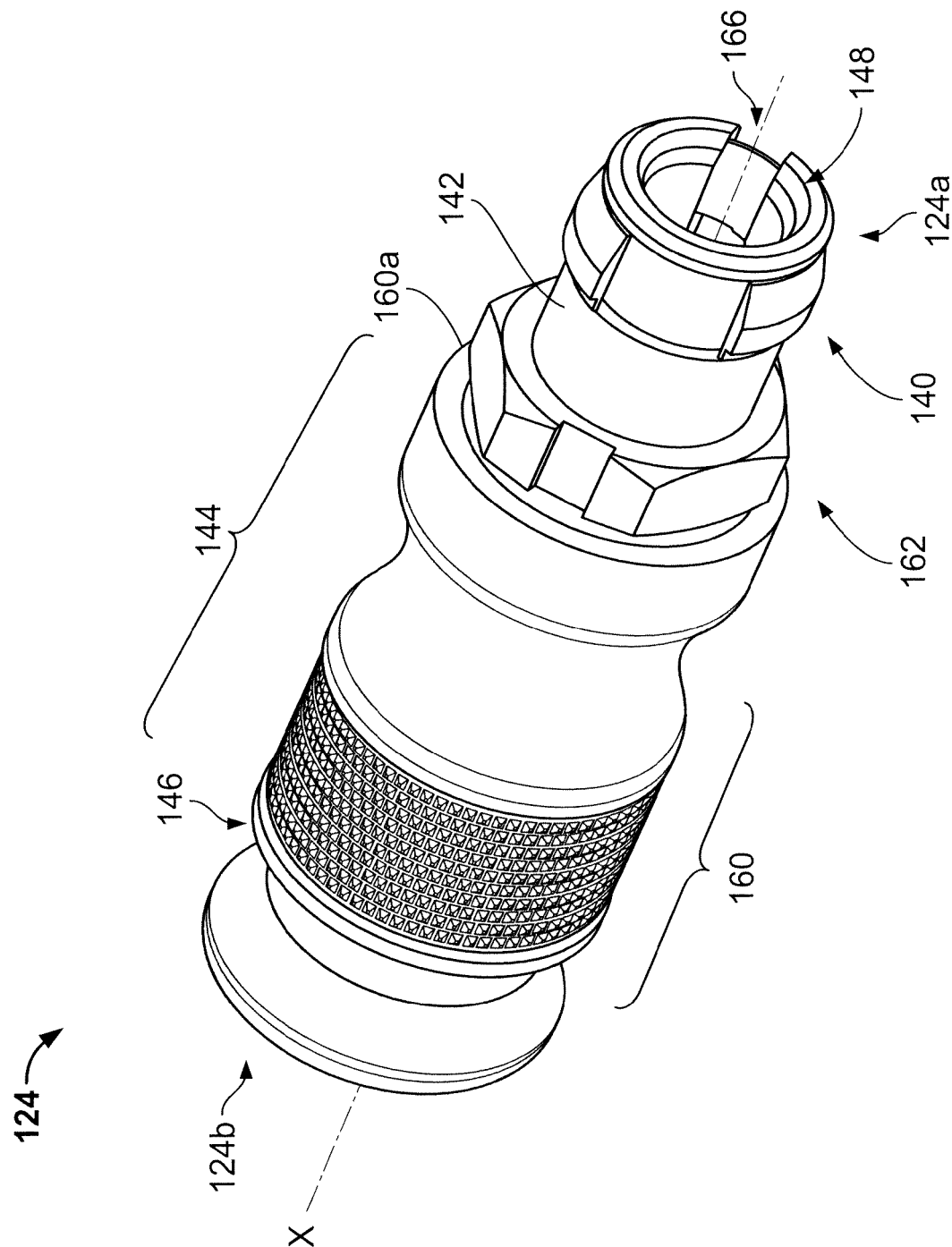


Fig. 3a

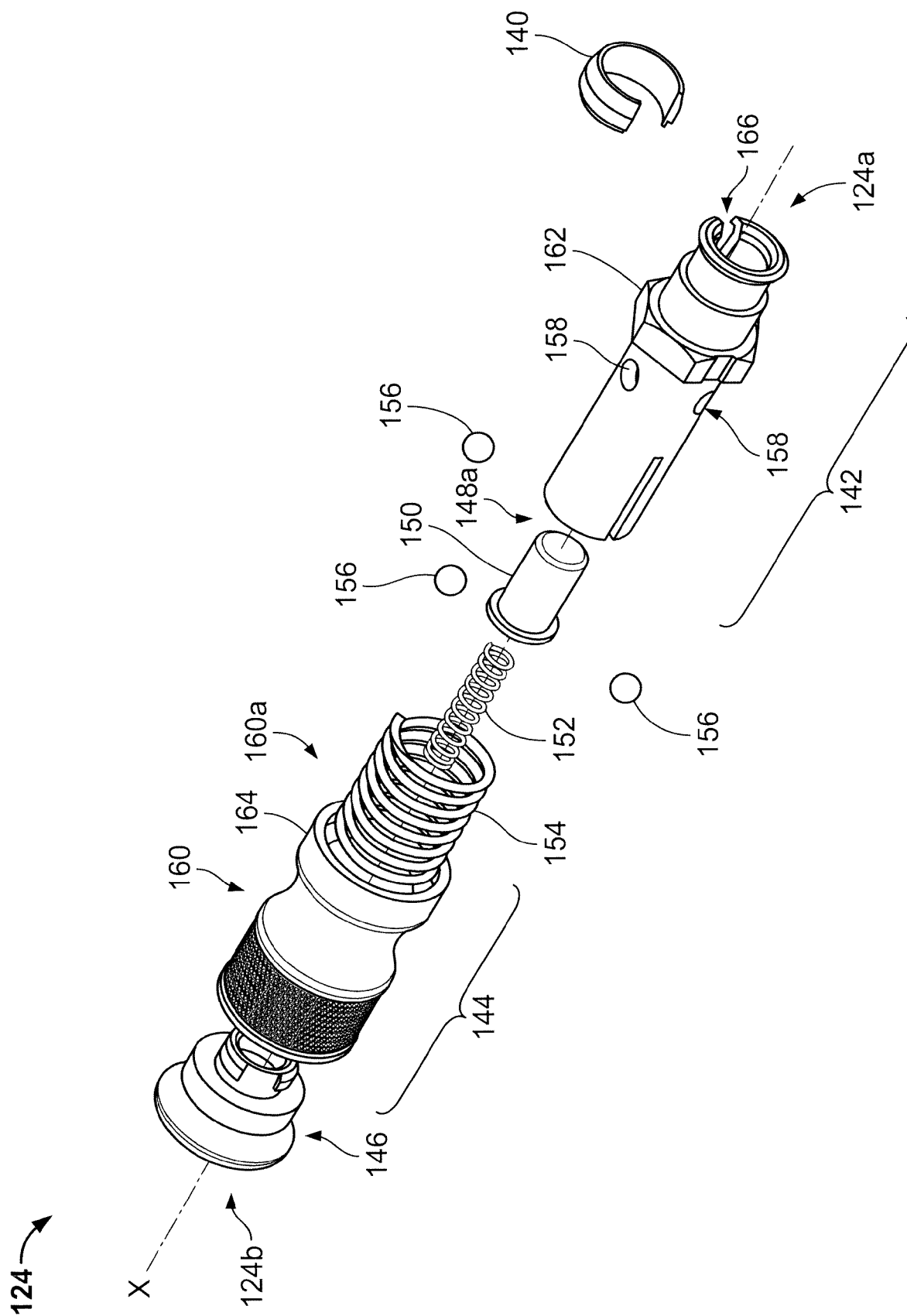


Fig. 3b

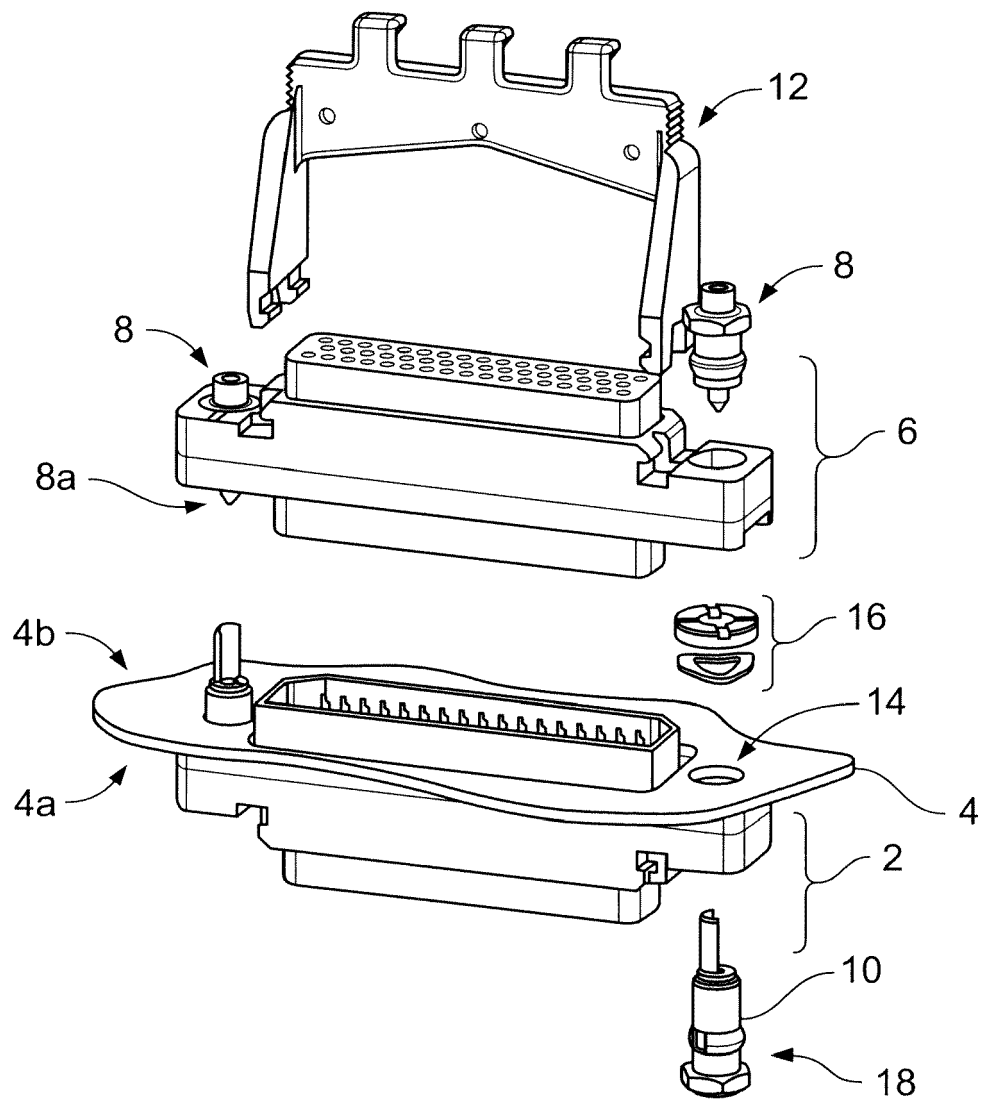


Fig. 4



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Application Number
EP 20 31 5144

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Place of search The Hague		Date of completion of the search 18 September 2020	Examiner Jiménez, Jesús
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EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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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
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