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(54) ELECTRICAL CONNECTOR FOR CONNECTOR SYSTEM

(57) The invention relates to an electrical connector (102, 202) comprising a connector body (112) and a connector attachment device (114, 214) for attaching the connector body (112) to a panel (104), characterised in that the connector attachment device (114, 214) is configured to realize a snap-fit connection with the panel (104) in a state in which the electrical connector (102) is attached to the panel (104). The invention also relates to an electrical connector (102, 202) mount to a panel (104), wherein the flexible hooking means (138) extends through a through hole (104d) of the panel (104) realizing a snap-fit connection between the electrical connector (102, 202) and the panel (104). The invention also relates to a system (100) comprising an electrical connector (102, 202) mount to a main side (104a) of a panel (104) and a mating second electricalconnector (106) positioned on the opposite main side (104b) of the panel (104), wherein the mating second electrical connector (106) comprises a mating attachment means configured to realize a snap-fit connection with the second attachment means (134) of the electrical receptacle connector (102, 202).

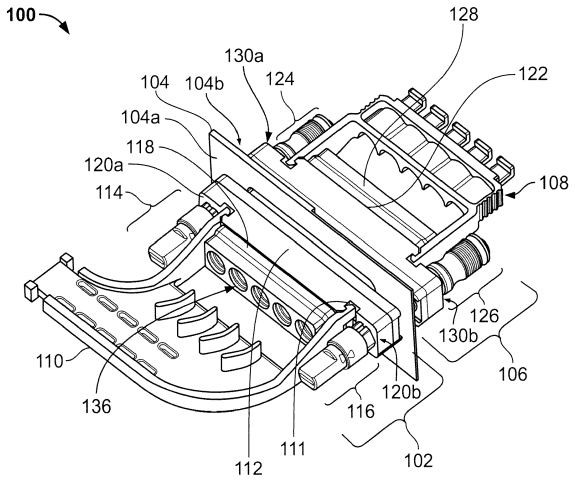

Fig. 1

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Description

[0001] The invention relates to an electrical connector and to a system comprising the 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 connectors are mount to the panel, electrical 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] In known connector systems, as shown in Figure 7 for example, 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 the panel 4. The pin 10 is attached to the 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 main side 4b of the panel 4. The second mating electrical connector 6 or plug, here in the form of 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 connector onto a panel 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 allowing an improved assembly process.

[0008] The current invention relates to an electrical connector, also called receptacle, comprising a connector body and a connector attachment device for attaching the connector body to a panel, characterised in that the connector attachment device is configured to realize a snap-fit connection with the panel in a state in which the electrical connector is attached to the panel. The use of a snap-fit connection reduces the time necessary for the assembly process time to be reduced as snap-fit connections as no external tools are needed and furthermore no loose parts, that could get lost during assembly, are needed anymore.

[0009] According to a variant of the invention, the connector attachment device of the electrical connector can comprise at least one flexible hooking means for realizing the snap-fit connection. The flexible hooking means can move from a retracted position, in which the flexible hooking means can be passed through a through hole in a panel, to an extended position, in which the flexible hooking means engages behind the panel to realise the snap-fit connection with the panel. In particular, the flexible hooking means can be a push type fastener, more in particular a push type retainer.

[0010] According to a variant of the invention, the at least one flexible hooking means can be movably arranged relative to the receptacle body from a retracted to an extended position. On the one hand, this keeps the electrical receptacle connector small in size in the non-mount state and on the other hand, by providing a movable flexible hooking means, the same attachment means can be used for different thicknesses of the panel.

[0011] According to a variant of the invention, the receptacle attachment device can further comprise a spring configured to impose a restoring force acting on the flexible hooking means in the direction from the extended position to the retracted position. In the mount state, the restoring force of the spring will force the hook against the panel thereby adding a force fit contribution to the form fit connection.

[0012] According to a variant of the invention, the receptacle attachment device can further comprise a blocking element configured to block the snap-fit connection. The presence of the blocking element blocks the snap-fit connection so that an unwanted release can be prevented.

[0013] According to a further variant, the locking of the snap-fit connection can be realised as an integral part of the attachment device and therefore does not require any loose parts to be fixed together by a tool.

[0014] According to a variant of the invention, the blocking element can be moveable between an unlocked and a locked position, wherein in the locked position of the blocking element, a movement of the flexible hooking means is inhibited by the blocking element. The movement of the blocking element within the connector attachment device locks the connector attachment mechanism of the connector attachment device by positioning the blocking element directly adjacent the flexible hooking means. Thus, a simpler and faster locking of the connector attachment device to the panel can be realized in particular not needing a second person to confirm the correct attachment.

[0015] According to a variant of the invention, the attachment device can comprise one or more visual markings indicating the position of the blocking element relative to the flexible hooking means, in particular indicating whether the blocking element is in the unlocked or the

locked position. The presence of visual markings on the connector attachment device results in a simple verification system of the attachment of the electrical connector to the panel. In particular, the visual markings can be positioned on the same side as the connector body and therefore the correct position and the locking of the attachment device to the panel, and thus of the electrical connector to the panel, can be checked visibly on the same side as the body thereby simplifying the verification stage.

[0016] According to a variant of the invention, a locking means can be provided that is movable in the direction from the retracted to the extended position of the flexible hooking means, wherein the locking means is configured to position the blocking element in contact with the flexible hooking means in the extended position. A simple yet effective locking means being an integral part of the connector attachment device is thus provided, as no loose parts not being part of the attachment device are necessary for the attachment and locking.

[0017] According to a variant of the invention, a locking means can be provided that is rotatably arranged around the direction from the retracted to the extended position of the flexible hooking means wherein the locking means is configured to position the blocking element in contact with the flexible hooking means in the extended position. A simple yet effective locking means being an integral part of the attachment device is thus provided, as no loose parts not being part of the attachment device are necessary for the attachment and locking.

[0018] According to a variant of the invention, the connector attachment device can comprise three flexible hooking means circularly arranged around the movable blocking element having a rod shape with a triangular cross-section. By providing a threefold snap-fit connection, a reliable and secure attachment of the electrical connector to a panel is realized. The blocking element is formed such that it fits in between the flexible hooking means and can therefore realize a reliable blocking of the snap fit connection against unwanted release.

[0019] According to a variant of the invention, the entire attachment device can be attached to the connector body. As a result, the design of the attachment device according to the invention is simplified without any loose parts. Furthermore, a faster assembly process of the electrical connector onto the 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.

[0020] According to a variant of the invention, the connector attachment device can further comprise second attachment means allowing a connection with a mating attachment means of a mating second electrical connector, in particular configured to realize a snap-fit connection with the mating attachment means. As a result, a mating second electrical connector, also called plug, can subsequently be attached to the electrical connector already mount on a panel in a simple and fast way using a snap-fit connection. The connector attachment device according to the invention allows a reduction of the assembly time.

[0021] The object of the invention also relates to an electrica connector as described abouve mount to a panel, wherein the flexible hooking means extends through a through hole of the panel realizing a snap-fit connection between the electrical connector and the panel. The snap-fit connection is a simple and fast way of connecting two elements together, not requiring external tools to be achieved. As a result, such snap-fit connection between the electrical connector and the panel is therefore a simpler and faster connection compared to the state-of-the-art connection.

[0022] The object of the invention also relates to a connector system comprising an electrical connector as described above mount to a first side of a panel and a mating second electrical connector positioned on the other side of the panel, wherein the mating second electrical connector comprises a mating attachment means realizing a snap-fit connection with the second attachment means of the electrical connector. The snap-fit connection is a simple and fast way of connecting two elements together, not requiring external tools to be achieved. As a result, such snap-fit connection between the electrical connector and the mating second connector for a connector system results in a simpler and faster assembly process compared to the state-of-the-art connector system.

[0023] The object of the invention also relates to a method of assembling a connector system as described above comprising a step of mounting the electrical connector onto a main side of a panel, characterised in that the connector attachment device is partially passed through a through hole of the panel and the flexible hooking means are pushed through the through hole to engage the panel from the side opposite to where the connector attachment device was introduced through the through hole to realize a snap-fit connection.. The snap-fit connection is a simple and fast way of connecting two elements together, not requiring external tools to be achieved.

[0024] 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 an electrical connector according to a first embodiment of the invention that is mount in a connector system comprising the electrical connector and a mating second electrical connector sandwiching a panel.

Figure 2a illustrates a three-dimensional view of the electrical connector according to the first embodiment mount onto the panel.

Figure 2b illustrates a side cut view of the electrical connector in a state not yet completely mount to the

panel.

Figure 2c illustrates a three-dimensional view of a connector attachment device of the electrical connector.

Figure 2d illustrates an exploded three-dimensional view of the connector attachment device of Figure 2c.

Figure 2e illustrates a side cut view of the electrical connector completely mount on the panel as shown in Figure 2a.

Figure 2f illustrates a three-dimensional view of the electrical connector mount and locked on the panel.

Figure 2g illustrates a side cut view of the electrical connector mount and locked on the panel as shown in Figure 2f.

Figure 3a illustrates the locking element of the electrical connector according to the second embodiment of the invention in its locked position.

Figure 3b illustrates the locking element of the electrical connector according to the second embodiment of the invention in its unlocked position.

Figure 4a illustrates a connector attachment device according of the electrical connector according to the first embodiment of the invention, in the locked position.

Figure 4b illustrates a connector attachment device of the electrical connector according to the first embodiment of the invention, in the unlocked position.

Figure 5a illustrates a three-dimensional view of an electrical connector according to a second embodiment of the invention, the electrical connector being mount onto a panel.

Figure 5b illustrates a side cut view of the electrical connector according to the second embodiment, the electrical connector not yet being completely mount onto the panel.

Figure 5c illustrates a three-dimensional view of a connector attachment device according to the second embodiment of the invention.

Figure 5d illustrates an exploded three-dimensional view of the connector attachment device as shown in Figure 5c.

Figure 5e illustrates a side cut view of the electrical connector mount on the panel as shown in Figure 5a.

Figure 5f illustrates a side cut view of the electrical connector mount and locked on the panel.

Figure 6a illustrates a three-dimensional view of the connector system of Figure 1, the mating second electrical connector not yet mount onto the electrical connector of the first embodiment.

Figure 6b illustrates a three-dimensional cut view showing the mating second electrical connector receiving the connector attachment device of the electrical connector.

Figure 6c illustrates the connection between the connector attachment device of the electrical connector mount to the panel and the mating second connector attachment device of the mating second connector of the connector system according to the first embodiment of the invention.

Figure 6d illustrates the locking of the connection between the connector attachment device of the electrical connector mount to the panel and the mating second connector attachment device of the mating second electrical connector of the connector system according to the first embodiment of the invention.

Figure 7 illustrates an exploded three-dimensional view of a connector system according to the state of the art.

[0025] Figure 1 shows a connector system according to a first embodiment of the invention.

[0026] The electrical connector 102 is part of a connector system 100. 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 panel can be part of an aircraft structure or an equipement for an aircraft. The electrical connector 102 is also called receptacle, whereas the mating second electrical connector 106 is also called plug.

[0027] The electrical connector 102 comprises a connector body 112, two connector attachment devices 114 and a connecting portion 116, as shown on Figure 1. The two connector attachment devices 114 are located on each side of the connector body 112 and are inserted into through holes 118, visible on figs. 3a and 3b, of the connector body 112. In a variant of the invention, the electrical connector 102 can comprise one or even more than two connector attachment devices 114.

[0028] In the same way, the mating second electrical connector 106 comprises a mating second connector body 120, two mating second connector attachment devices 122 and a mating connecting portion 124. The two mating second connector attachment devices 122 are located also on each side of the mating second connector

body 120, inserted into through holes 126 (not visible) of the mating second connector body 120. In a variant of the invention, the mating second electrical connector 106 can comprise one or even more mating second connector attachment devices 124.

[0029] According to one practical example, the electrical connector 102 can be a pin connector and the mating electrical connector 106 a socket connector, as shown in Figure 7. The connecting portion 116 of the electrical connector 102 and the connecting portion 124 of the mating second electrical connector 106 are configured to connect or mate together to realise an electrical connection between electrical cables set on either side 104a, 104b of the panel 104. They can be of a sealed or unsealed type and are used for transmitting control signals and/or power.

[0030] The electrical connector 102 further comprises a straight cable clamp 108. The mating second electrical connector 106 further comprises a bent cable clamp 110. 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 onto the connector body 112 and the mating second connector body 120.

[0031] 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.

[0032] 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.

[0033] 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.

[0034] The electrical connector 102 is attached or mount to the panel 104 via a snap-fit connection using the two connector attachment devices 114. The mating second electrical connector 106 is then attached to the already mount electrical connector 102 on the other main side 104b of the panel via the two mating second connector attachment devices 122.

[0035] 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, as washers or nuts are needed, no parts can get lost.

[0036] After mounting the electrical connector 102 to the panel 104, the mating second electrical connector 106 is mount onto the connector attachment devices 114 of the electrical connector 102.

[0037] The additional mechanical connection between the two connector attachment devices 114 of the electrical connector 102 and the two mating second connector attachment devices 122 of the mating second electrical connector 106 will be described in more detail in with respect to the Figs. 6a to 6d.

[0038] 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.

[0039] Figure 2a illustrates a three-dimensional view of the electrical connector 102 according to the invention mount from the front side 4a through a central slit 104c of the panel 104 via the two connector attachment devices 114 that are passed through through holes 104d in the panel 104.

[0040] The same reference numbers will be used when referring to the same features of Figure 1.

[0041] The connector attachment device 114 is mount onto the connector body 112 of the electrical connector 102 through lateral through holes 118 of the connector body 112 in the direction of insertion as shown by the arrow on the Figure 2a. The connector attachment device 114 is locked in position on the connector body 112 by a snap-fit connection. The snap-fit connection between the connector attachment device 114 and the connector body 112 using a clipping device 128 located on the connector attachment device 114 as shown in Figures 2c and 2d. Figures 2b, 2e and 2g illustrate the position of the clipping device 128 when the connector attachment device 114 is mount on the connector body 112.

[0042] As can be seen on Figure 2c and 2d, the connector attachment device 114 has an elongated shape comprising a first and second end portion 114a and 114b. The connector attachment device 114 is mount on the connector body 112 so that the second end portion 114b extends beyond the connector body 112 from the side towards the panel 104. The first end portion 114a extends beyond the connector body 112 on the opposite side.

[0043] The panel 104 onto which the electrical connector 102 is mount can be conform to the EN3545 standard dated November 2008. The standard EN3545 provides allowable dimensions for the panel 104, namely a panel thickness that can vary from 0.7 mm to 2 mm, and two lateral through holes 104d having a dimension of 0.264 + 0.00787/-0 inch or 6,7+0,2/-0 mm. The panel 104 comprises a central through slit 104c and the two through holes 114d (see Figure 4a) located on each side of the slit 104c. The through slit 104c receives the connecting portion 116 of the connector body 112. As can be seen, a protruding connecting portion 116c of the connecting portion 16 protrudes on the side 104b of the panel 104. The protruding connecting portion 116c of the electrical connector 102 is configured to mate with a central part of the mating second electrical connector 106 when mount on the electrical connector 102 as shown in Figures 1 and 6a.

[0044] The two connector attachment devices 114 and in particular the second end portion 114b are configured so that they can be inserted through the lateral through holes 114d of the panel 104 at least partially. In the mount state, the second end portion 114b of the connector attachment device 114 protrudes away from the side 104b of the panel 104.

[0045] On the end portion 114a of the connector attachment device 114, locking means 130 are provided which will be described in more detail further down. Visual markings 132a and 132b indicating the locking state are provided as well.

[0046] On the other end portion 114b of the connector attachment device 114, second attachment means 134 and alignment means 136 of the connector attachment device 114 are visible. The mating second electrical connector 106 can be attached thereto as will be described later.

[0047] We will now describe the connector attachment device 114 according to the invention in details in relation to the Figures 2c and 2d.

[0048] The connector attachment device 114 comprises three main parts (see Figure 2c): a locking means 130, at least one flexible hooking means 138 and an attachment device body 140, all three held together with a pin 150. The connector attachment device 114 forms a push type fastener, in particular a push type retainer, allowing a mechanical connection in a simple, secure and fast manner using the flexible hooking means 138.

[0049] Like illustrated in the exploded view of Figure 2d, a blocking element 144 of the locking means 130 is configured to be inserted into the flexible hooking means 138. The flexible hooking means 138 itself is inserted into the attachment device body 140 from the side 140a of the attachment device body 140. A spring 142 is placed between the flexible hooking means 138 and the attachment device body 140.

[0050] As shown in Figures 2c and 2d, the flexible hooking means 138 of this embodiment comprises three flexible beams with hooks 138a, 138b and 138c on their extremity in direction of the attachment device body 140. The hooks 138a, 138b, 138c extend through elongated windows 162a, 162b, and 162c in the attachment device body 140. The flexible hooking means 138 can be a metallic or a plastic part. The hooks 138a, 138b, 138c together with their flexible beams form a kind of a claw. The flexible hooking means 138 is movably arranged relative to the attachment device body 140 along the central axial direction of the attachment device 114 from a retracted to an extended position, in which the flexible hooking means 138 extends further into the attachment device body 140 than in the retracted position. When pushing the flexible hooking means 138 against the force of spring 142, the flexible hooking means 138 can be pushed beyond the panel 104 through the through hole 104d as illustrated in Figure 2b and in Figure 2e. Once, no pressure is exerted onto the spring 142, the restoring force of the spring 142 pulls the hooking means 138 backwards to force the hook 138a to 138c against the panel 104, as illustrated in Figure 2e.

[0051] The locking means 130, located towards the end portion 114a is moveable between an unlocked and a locked position. In the locked position, a flexing movement of the flexible hooking means 138 is inhibited by the blocking element 144 of the locking means 130 whereas in the unlocked position the flexing is allowed. The blocking element 144 of this embodiment is a triangular rod. To move from the unlocked to the locked position, the locking means 130 is rotated about its longitudinal axis. The locking will be described in more detail with respect to Figures 3a and 3b.

[0052] The locking means 130 and the attachment device housing 140 each comprise a visual marking 132a and 132b on its outer circumference. When the markings 132a, 132b are aligned, the locking means 130 is in its locked position (see Figure 2f). When the markings are not aligned, the locking means 130 is in its unlocked position.

[0053] Between the flexible hooking means 138 and the locking means 130 three balls 146, serving as indexation to ensure proper positioning of the locking means 130 are provided. The balls 146 are arranged in three recesses 156 in the blocking element 144 and extend into one of three slits 148a or one of three recesses 148b in the flexible hooking means 138, depending whether the locking means 130 is in the locked or unlocked position.

[0054] Using the balls 146, defined relative positions between the looking element 130 and the flexible hooking means 138 can be provided. When the locking means 130 is turned from a locked to an unlocked position the balls 146 will move from their recess 148b to a slit 148a as will be explained in more detail with respect to Figures 4a and 4b.

[0055] In this embodiment, the connector attachment devices 114 further comprises a second attachment means 134 to allow a connection with a mating attachment means of a second electrical connector, in particular configured to realize a push pull or a snap-fit connection with the second attachment means 134.

[0056] The second attachment means 134 is located on the one end portion 114b of the connector attachment device 114, in particular at its extremity. The second attachment means 134 as illustrated in Figure 2C has the shape of a groove. In a variant of the invention, it can have a different shape or form, in order to realise a push pull or snap fit connection with the mating attachment means of the mating second electrical connector for a connector system according to the invention.

[0057] The attachment of the mating attachment means could, however also be realized according to the prior art, e.g. using a screw.

[0058] In this embodiment, the connector attachment device 114 also comprises an alignment means 136. The alignment means 136, here in the form of a protrusion, is located on the one end portion 114b of the connector

attachment device 114, between the attachment means 138 and the second attachment means 134. The alignment means 146 ensures correct positioning of the mating attachment means to avoid assembly, mounting or connection errors.

[0059] Figures 2b, 2e and 2g illustrate the inventive mounting process.

[0060] Figure 2b illustrates a side cut view of the connector attachment device 114 of the electrical connector 102 that is not yet completely mount on the panel 104.

[0061] The electrical connector device 102 has been inserted into the central slit 104c of the panel 104 in the direction of insertion as shown by the arrow on the Figure. At the same time, the attachment device housing 140 has been passed through the through holes 104d. In this state, the connector body 112 is in contact 152 with the side 104a of the panel 104 and the sidewalls 104e of the through holes 104d of the panel 104 abut against the connector attachment device 114 at the position 154.

[0062] In this state, the flexible hooking means 138 are still in the retracted position and the hook 138a of the flexible hooking means 138 has not yet completely passed beyond the panel 104.

[0063] Actually, in the position shown in Figure 2b, the hook 138 has been pushed upwards by the sidewall 104e which is possible as the blocking element 144 still allows the flexing movement. The looking element 130 being still in the unlocked position.

[0064] In the unlocked position of the locking means 130, the ball means 146 is located the slit 148a of the flexible hooking means 138.

[0065] By pushing the locking means 130, as illustrated by arrow P in Figure 2e, the flexible hooking means 138 is further pushed, against the force of the spring 142, into the direction of insertion so that the hook 138e of the flexible hooking means 138 completely passes the through hole 104d of the panel 104. Once the pressure released from the locking means the spring 142 pulls back the hook 138a and forces it against the side 104b of the panel 104. The flexible hooking means 138 finds itself now in its extended position and realized a snap fit connection between the connector attachment device 114 and the panel 104.

[0066] The push-pull function of the connector attachment device 114 also allows compensating for different wall thicknesses of the panel 104. One pushes the flexible hooking means 138 until it passes the wall of the panel 104 and the pulling force of the spring 142 forces the hook 138a against the wall.

[0067] Since the locking means 130 is still in its unlocked position, it can be seen that the hook 138a of the flexible hooking means 138 is spaced away from the blocking element 144. Thus, an unwanted disconnecting could happen in case the hook 138a flexes towards the interior of the flexible hooking means 138.

[0068] To prevent this, the locking means 130 is moved from its unlocked position to its locked position, as shown in the three-dimensional view of Figure 2f and the side cut view of Figure 2g. By rotating the locking means 130 around the direction of insertion, the blocking element 144 blocks any movement of the flexible hooking means 138. Indeed, the blocking element 144 is rotated inside the attachment device housing 140 of the connector attachment device 114 and abuts against the backside of the flexible hooking means 138. As a result, the flexible hooking means 138 can no longer flex to a retracted position and is locked in its extended position. An unwanted demounting is prevented.

[0069] When rotating the locking means 130 to the locked position, the ball 146 will move as well from the slot 148a into one of the recesses 148b. The user will feel the repositioning and unwanted rotation of the locking means can be prevented.

[0070] Figure 3a and 3b illustrate the locking mechanism of the electrical connector 102 in more detail.

[0071] Figure 3a illustrates the locked state. The visual marking 132a towards the end portion 114a of the locking means 130 is aligned with the visual marking 132b of the attachment device body 140. In this state, the hooks 138a, 138b, 138c extend beyond the circumference of the attachment device housing 140 and their position is locked by the triangular rod of the blocking element 140. Indeed, the corners of the triangular rod of the blocking element 144 push against the hooks 138a, 138b and 138c. In other words, the claw formed by the hooks can no longer be closed

[0072] In Figure 3b, the unlocked state is illustrated. The visual markings 132a and 132b are no longer aligned. In this state, the hooks 138a, 138b, 138c still extend beyond the circumference of the attachment device housing 140 but their position is no longer blocked by presence of the triangular rod of the blocking element 140. Indeed, by rotating the corners of the triangular rod of the blocking element 144 away from the hooks 138a, 138b and 138c. The spaced freed between the hooks and the triangular rod, allow the hooks 138a, 138b, 138c to flex towards the inside of the attachment device housing 140. The claw can thus be closed. In this state the connector attachment device 114 can be passed through the through hole 104d of the panel 104 either during a process of mounting or demounting.

[0073] Since the visual markings 132a and 132b are located on the side 104a of the panel 104 where the operator is located, the operator knows when the electrical connector 102 is locked in position on the panel 104 without having to check behind the panel 104 like in the prior art. This visual verification is thus fast and automatic, which results in a reduced assembly time compared to a state-of-the-art assembly.

[0074] As can be seen in Figure 4a, the locking element 130 is in the locked position, the visual markings 132a and 132b are aligned. The blocking element 144 prevents the flexible hooking means 138 from any movement through the windows 162a, 162b towards the inside of the attachment device body 140. The ball 146 is located in a slit 148 of the flexible hooking means 138 corre-

sponding to the locked position of the locking means 130. As can be seen on Figure 4b, one of the balls 146 is positioned in recess 148b, whereas the neighbouring slits 148a are empty.

[0075] In Figure 4b, the visual markings 132a and 132b are in their unaligned position. The hooks 138a are no longer blocked by the blocking element 144 and could be pushed inside the attachment device body 140. In this state, the balls 146 have moved from the recesses 148b to the slits 148a.

[0076] To dismount the electrical connector 102, the locking device needs to be positioned into the unlocked position. Then a special tool, for example the standard tool PN 057-0536-60, can be used on the end portion 114b of the connector attachment device 114 so that the flexible hooking means 138 are forced into their retracted position, no longer extending beyond the windows 162a, 162b and 162c. Or in other terms, the claw formed by the hooks is closed using the tool. Then electrical connector 102 can be pushed out of the panel 104 in the direction opposite to the insertion direction.

[0077] In the first embodiment, the entire connector attachment device 114, with all its parts, is attached to the connector body 112 of the electrical connector 102, and thus to the panel 104 onto which the electrical connector 102 is mount on. No loose parts are needed to realize the attachment mechanism between the connector attachment device 114 of the electrical connector 102 and the panel 104.

[0078] Thus, a more secure, reliable and fast assembly process of the connector attachment device with the connector body of the electrical connector compared of the state-of-the-art can be realized.

[0079] In addition, no external tool is necessary and the attachment can be realized from one side of the panel 104 only. Using the locking element with visual markings, no second worker is needed to verify correct connection and locking.

[0080] Figures 5a and 5f illustrate an electrical connector 202 with a connector attachment device 214 according to a second embodiment of the invention. The features carrying the same reference numbers already used in the description of the Figures 2a to 2f, 3a and 3b as well as 4a and 4b will not be described in detail again but reference is made their description further above.

[0081] The main difference with the first embodiment is that the locking means 230 realizes the locking of the elastic hooking means 138 by pushing the locking means 230 from an unlocked to a locked position.

[0082] Like illustrated in Figures 5c and 5d, the connector attachment device 214 comprises a locking means 230, a flexible hooking means 238 and an attachment device housing 240 like in the first embodiment but with a different design. The three parts are put together using pin 150 Like in the first embodiment, the flexible hooking means 238 comprises three flexible beams with hooks 138a, 138b, 138c arranged at the extremity of a hollow shaft 256 to form a claw. Towards the other extremity, the hollow shaft 256 has a wider portion 258 with a gripping surface 260. The flexible hooking means 238 is inserted into the attachment device body 240, such that in the mount state as illustrated in Figure 5c, the hooks 138a, 138b, 138c extend out of corresponding elongated windows 262a, 262b, 262c in the attachment device body 240.

[0083] Like in the first embodiment, a spring 142 is placed between the flexible hooking means 238 and the attachment device body 240.

[0084] The flexible hooking means 238 is movably arranged relative to the attachment device body 240 along the central axial direction of the attachment device 214 from a retracted to an extended position, in which the flexible hooking means extends further into the attachment device body 140 than in the retracted position. When pushing the flexible hooking means 238 against the force of spring 242, the hooking means 238 can be pushed beyond the panel 104 through the through hole 104a as illustrated in Figure 5b. The restoring force of the spring 142 pulls the hooking means 238 backwards to force the hook 138a to 138c against the panel 104, as illustrated in Figure 5e.

[0085] The locking means 230, located towards the end portion 214a is moveable between an unlocked and a locked position. The movement is a linear movement. To lock the attachment, the blocking element 244 is moved between the hooks 138a, 138, 138c of the flexible hooking means 238 thereby inhibited a flexing of the hooks towards the inside of the attachment device body 240. When moving to the unlocked position, a thinner part of the blocking element 244 is positioned next to the hooks thereby allowing flexing.

[0086] The locking means 230 of the second embodiment further comprises a visual marking 232 taking the form of a colour-coded ring located on the first end portion 214a of the connector attachment device 214. In the unlocked position, as shown in Figure 5c, the coloured ring 232 is visible. In the locked position, as can be seen on e.g. Figure 5F, the locking element 230 has been pushed inside the wider portion 258 of the flexible hooking means 238 so that the marking is no longer visible from outside.

[0087] Furthermore, different to the first embodiment of the invention as described in Figure 2d, the blocking element 244 comprises further an elongated rod 254 configured to extend all the way to the end of the second and portion 214b of the connector attachment device 214 when the locking means 230 is in the locked position, as shown in Figure 5f. It then becomes possible to push back the locking means 230 to unlock the device in case the mechanical connection should be released.

[0088] Finally, a positioning means 246 comprises at least one ball 248 and a spring 250. In this second embodiment, the positioning means 246 ensures the positioning of the locking means 230 in its unlocked and locked position.

[0089] The mounting process using the second embodiment will now be described in detail with respect to

Figures 5a, 5b, 5e and 5f.

[0090] As shown in Figure 5a, like in Figure 2a, the electrical connector 202 is inserted into the slit 104c of the panel 104 along the direction of the arrow. At the same time the two attachment devices 214 have been partially introduced through the through holes 104d of the panel 104. The locking device 230 is not yet in its locked position, as the marking 232 is still visible.

[0091] In Figure 5b, like in Figure 2b of the first embodiment, the locking means 230 is in its unlocked position. To keep the locking means 230 in place, the spring 250 pushes the ball 248 into a mating recess 254a inside the wider portion 258 of the hollow shaft 256. In this state, the visible marking 232 is visible from outside.

[0092] The flexible hooking means 138 have not yet completely passed the through hole 104d of the panel 104. As the locking device 230 is still in its unlocked position, the lower sidewall of the through hole 104d pushes the hook 138a upwards inside the attachment device body 240, which is possible as the blocking element 244 is not in direct contact with the flexible beam and the hook 138a of the flexible hooking means 238.

[0093] Next, as illustrated in Figure 5e, comparable to Figure 2e of the first embodiment, a pressure P is applied to the wider portion 258, e.g. using the gripping surface 260 of the connector attachment device 114. As a result, the flexible hooking means 238 is further inserted into the connector body 240 against the force of the spring 142 so that it fully passes the through hole 104d of the panel 104. Once passed through the hole 104d and once no more pressure is applied, the spring 142 will force the flexible hooking means 138 backwards and against the backside 104b of the panel to realize the snap fit connection. The flexible hooking means 138 is now in an extended position. The looking means 230 remains in the unlocked position, the marking 232 remains visible.

[0094] Figure 5f illustrates the locked position of the locking means 230. To lock the snap-fit connection, a pressure P2 is applied in the direction of insertion to the end portion 214 of the locking means 230. The pressure will release the ball 248 from the recess 254a so that the locking means 230 together with its blocking element 244 moves into the hollow flexible hooking means 238 and the attachment device body 240 until the ball 248 is pushed upwards again by spring 250 into mating recess 254b to lock its position.

[0095] In addition, the visible markings 232 are now no longer visible as they are positioned inside the wider portion 258 of the hollow shaft.

[0096] In the locked state, the position of the flexible hooking means 138 are now locked by the wider part of the blocking element 244, which is in direct contact with the flexible hooking means 138. Thus, the hooks 138a cannot flex inside the attachment device body 140 and are forced into engagement with the panel 104.

[0097] As already described, the blocking element 244 further extends towards the end of elongated rod 254 and in the locked state is actually directly located at the end portion 214b of the connector attachment device 214, which is open.

[0098] In order to unlock the locking means 230, it is it is first necessary to push the elongated rod 254 of the blocking element 244 back into the connector attachment device 214, resulting in pushing back the locking means 230 out of the connector attachment device 240. The visual markings 232 become again visible. Then, like for the first embodiment, a tool, for example 057/0536/60, can be used on the end portion 214b of the connector attachment device 214 so that the flexible hooking means 238 are put into their retracted position and the electrical connector 202 can be pushed out of the panel 104 in the direction opposite to the insertion direction.

[0099] Figure 6a and Figure 6b illustrate a three-dimensional view of the connector system of Figure 1. Here, the electrical mating plug connector 106 with its straight cable claim 108 is not yet mount onto the electrical connector 102, itself mount on the panel 104 of the first embodiment.

[0100] The direction of insertion shown by the arrow on Figure 6a, and figs. 6b to 6d, is the direction along which the mating second electrical connector 106 is mount onto the electrical connector 102.

[0101] To connect the second protruding connecting portion 124c of the second connecting portion 124 of the mating second electrical connector 106 with the protruding connection portion 116c of the electrical connector 102, the male end portion 114b of the connector attachment device 114 is introduced into the female portion of the mating second attachment devices 122 of the mating second electrical connector 106. This can be seen in Figure 6b.

[0102] The mating second connector attachment device 122 is fixed in a through hole 126 of the mating second connectorbody 120 with a clipping device 328, like in the electrical connector 102 and known from the state-of-the-art, resulting in a snap-fit connection between the mating second connector attachment device 122 and the second connector body 120.

[0103] The mating second connector attachment device 122 comprises a mating second attachment body 340 in the form of a female portion, mating locking means 330 and a mating attachment means 338.

[0104] The alignment means 136 at the end portion 114b of the connector attachment device 114 are arranged such that they can enter a corresponding slit 342 in the mating attachment device body 340.

[0105] In Figure 6c, the end portion 114b has been further introduced into the attachment device body 340. The end portion 114b now is in contact with the mating attachment means 338 and has pushed it against the force of a first spring 344 to thereby free the access to ball 346.

[0106] In Figure 6d, the connection has been completely established and looked. The end portion 114b of the connector attachment device 114 has been further inserted in the direction of insertion so that the ball 346

can move into the groove 134. The movement of the ball 346 is initiated by a bevelled portion 348 of the locking means 330. The looking means 330 is pushed by a second spring 350 in the insertion direction illustrated by the arrow, which in turn pushes the ball and finally the ball 346 is blocked by a plane portion 352 of the locking means 330. This kind of connection is called a push-pull type connection. Instead of a push pull connection, a snap fit connection could also be realized.

[0107] To secure the locking it might be necessary that the user pushes on the side portion 354 of the locking means 330 to push the locking means to the position shown in Figure 6d. Once locked, a marking 356 becomes visible to the user, confirming the established connection.

[0108] The push pull or the snap-fit connection between the mating second electrical connector 106 and the electrical connector 102 improves assembly process for the connector system compared to the state-of-the-art connector system. They allow to realize a faster yet secure connection compared to the prior art which can be realized by only one person who immediately realized whether the connection is o.k. due to the presence of markings.

[0109] In addition, no external loose parts are required and no tool is needed.

[0110] 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

[0111]

2	first electrical connector
4	panel
4a	one main side of panel
4b	other main side of panel
6	second mating electrical connector
8	screw
10	pin
12	cable clamp
14	through hole
16	washer and nut
18	clipping device
100	connector system
102	electrical connector
104	panel
104a	main side of the panel
104b	opposite main side of the panel
104c	through central slit of the panel
104d	through holes of the panel
104e	sidewalls of the through holes
106	mating second electrical connector
108	straight cable clamp
110	bent straight cable clamp
112	connector body
114	connector attachment device
114a, 114b	end portion of the connector attachment device
116	connection portion of the connector body
116c	protruding connection portion of the connector body
118	through holes of the connector body
120	mating second connector body
122	mating second connector attachment device
124	mating connection portion of the mating second connector body
124c	second protruding connection portion
126	through holes of the mating second connector body
128	clipping device
130	locking means
132a, 132b	visual markings
134	second attachment means
136	alignment means
138	flexible hooking means
138a, b, c	hooks
140	attachment device body
140a	side of the attachment device body
142	spring
144	blocking element
146	ball means
148a	slits
148b	recess
150	pin
152	contact
154	abutment position
156	recess
162a,b,c	windows
202	electrical connector
214	connector attachment device
214a, 214b	end portion of the connector attachment device
230	locking means
232	visual markings
238	flexible hooking means
240	attachment device body
244	blocking element
254	elongated rod
246	positioning means
248	ball
250	spring
252	recess in the locking element
254a,b	mating recesses in flexible hooking means
256	hollow shaft
258	wider portion of the hollow shaft
260	gripping surface
262a,b,c	windows
328	clipping device

330 mating locking means
338 mating attachment means
340 mating attachment device body
342 slit
344 first spring
346 ball
348 bevelled portion
350 second spring
352 plane portion
354 side portion
356 visual marking

Claims

1. An electrical connector comprising:

a connector body (112) and
a connector attachment device (114, 214) for attaching the connector body (112) to a panel (104),
characterised in that
the connector attachment device (114, 214) is configured to realize a snap-fit connection with the panel (104) in a state in which the electrical connector (102) is attached to the panel (104).

2. Electrical connector according to claim 1, wherein the connector attachment device (114, 214) comprises at least one flexible hooking means (138) for realizing the snap-fit connection.

3. Electrical connector according to claim 2, wherein the at least one flexible hooking means (138) is movably arranged relative to the connector body (112) from a retracted to an extended position.

4. Electrical connector according to any one of claims 1 to 3, wherein the attachment device (114, 214) further comprises a spring (142) configured to impose a restoring force acting on the flexible hooking means (138) in the direction from the extended position to the retracted position.

5. Electrical connector according to any one of claims 1 to 4, wherein the attachment device (114, 214) further comprises a blocking element (144, 244) configured to block the snap-fit connection.

6. Electrical connector according to claim 5, wherein the blocking element (144, 244) is moveable between an unlocked and a locked position, wherein in the locked position a movement of the flexible hooking means (138) is inhibited by the blocking element (144, 244).

7. Electrical connector according to any one of claims 5 or 6, wherein the attachment device (114, 214) comprises one or more visual markings (132a, 132b, 232) indicating the position of the blocking element (144, 244) relative to the flexible hooking means (138), in particular indicating whether the blocking element is in the unlocked or the locked position.

8. Electrical connector according to any one of claims 5 to 7, further comprising a locking means (230) movable in the direction from the retracted to the extended position of the flexible hooking means (138), wherein the locking means (230) is configured to position the blocking element (244) in contact with the flexible hooking means (138) in the extended position.

9. Electrical connector according to any one of claims 5 to 7, further comprising a locking means (130) rotatably arranged around the direction from the retracted to the extended position of the flexible hooking means (138), wherein the locking means (130) is configured to position the blocking element (144) in contact with the flexible hooking means (138) in the extended position.

10. Electrical connector (102, 202) according to any one of claims 5 to 9, wherein the connector attachment device (114, 214) comprises three flexible hooking means circularly arranged around the movable blocking element (144, 244) having a rod shape with a triangular cross-section.

11. Electrical connector (102, 202) according to any one of claims 1 to 10, wherein the entire attachment device (114, 214) is attached to the connector body (112).

12. Electrical connector according to any one of claims 1 to 11, wherein the attachment device (114, 214) further comprises second attachment means (134) allowing a connection with a mating attachment means (122) of a mating second electrical connector (106), in particular configured to realize a snap-fit or push pull connection with the second attachment means (134) of the attachment device (114, 214).

13. Electrical connector according to one of claims 1 to 12, mount to a panel (104), wherein the flexible hooking means (138) extends through a through hole (104d) of the panel (104) realizing a snap-fit connection between the electrical connector (102, 202) and the panel (104).

14. System comprising an electrical connector (102, 202) according to claim 13 in combination with claim 12 mount to a main side (104a) of a panel (104) and a mating second electrical connector (106) positioned on the opposite main side (104b) of the panel (104), wherein the mating second electrical connec-

tor (106) comprises a matingattachment means (338)realizing a snap-fit or push pull connection with the second attachment means (134) of the electrical connector (102, 202).

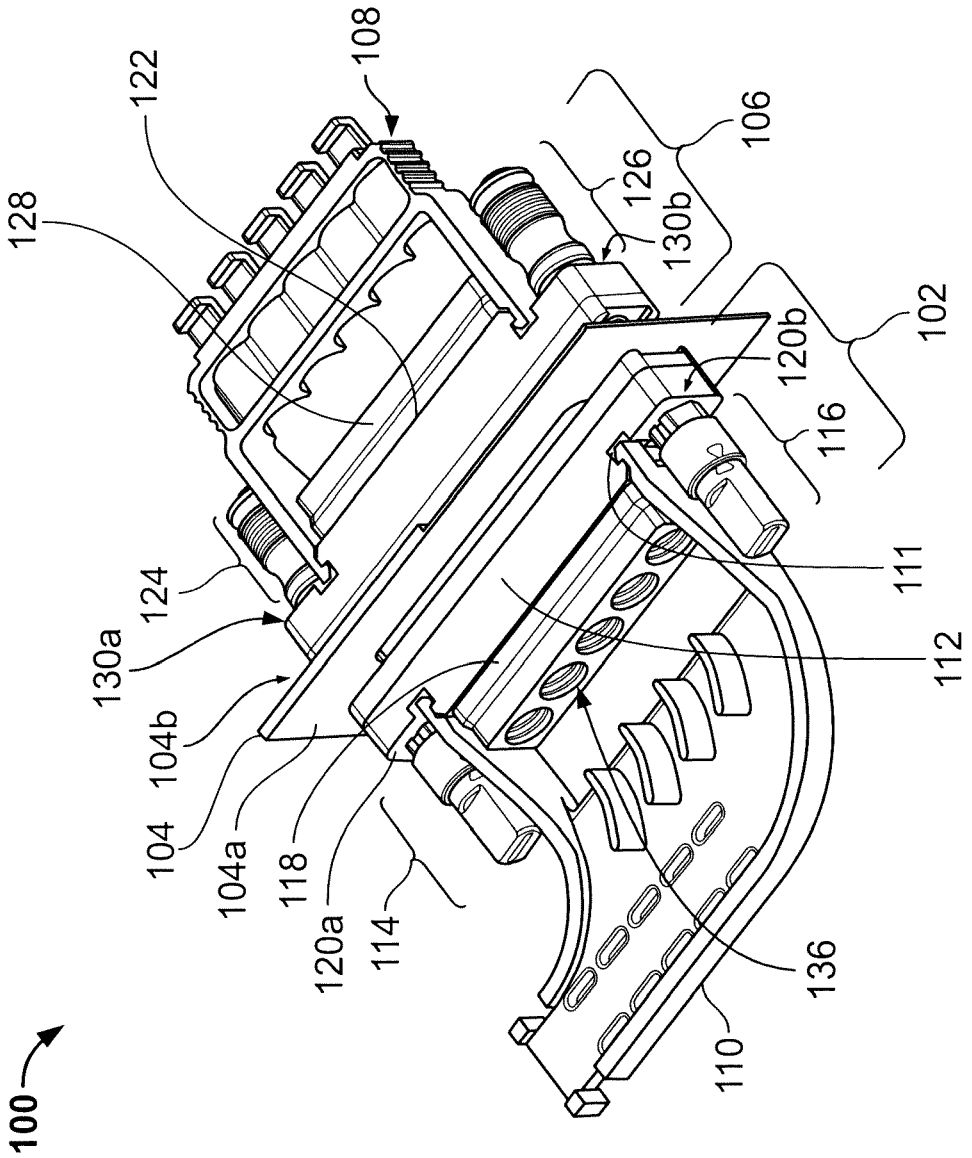

100
128
122
108
106
126
130b
102
120b
116
111
112
124
130a
104b
104
104a
118
120a
114
136
110

Fig. 1

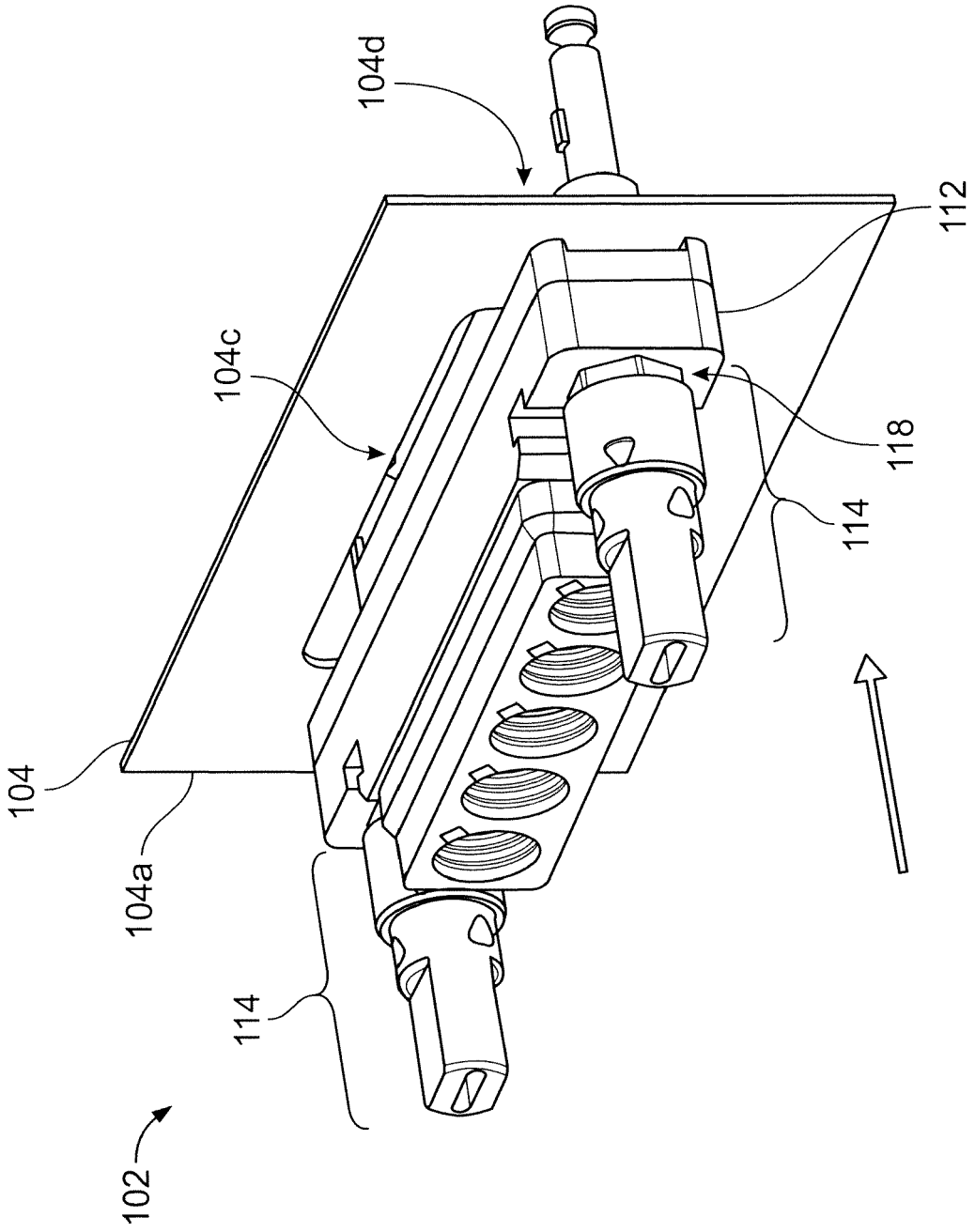


Fig. 2a

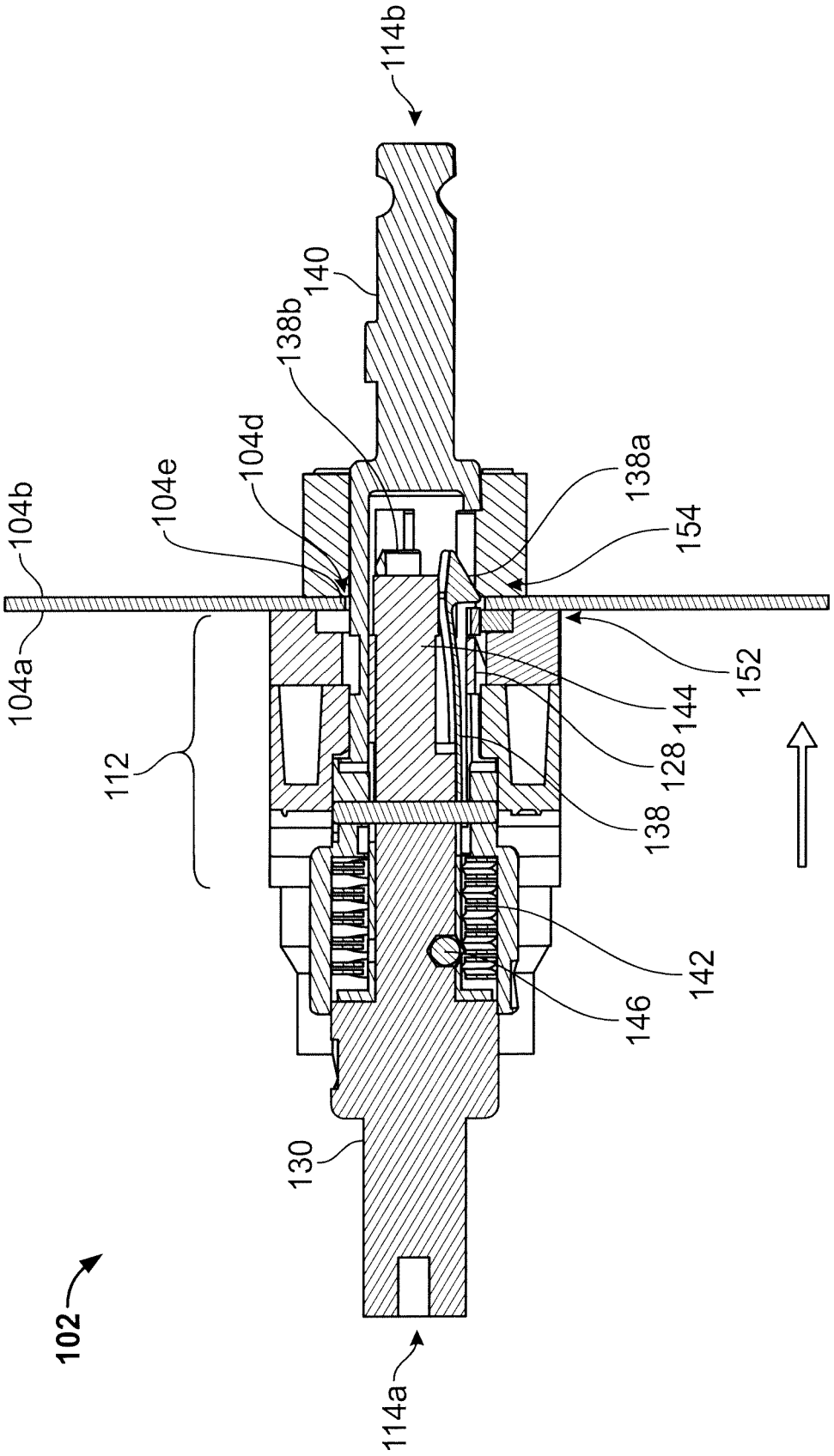
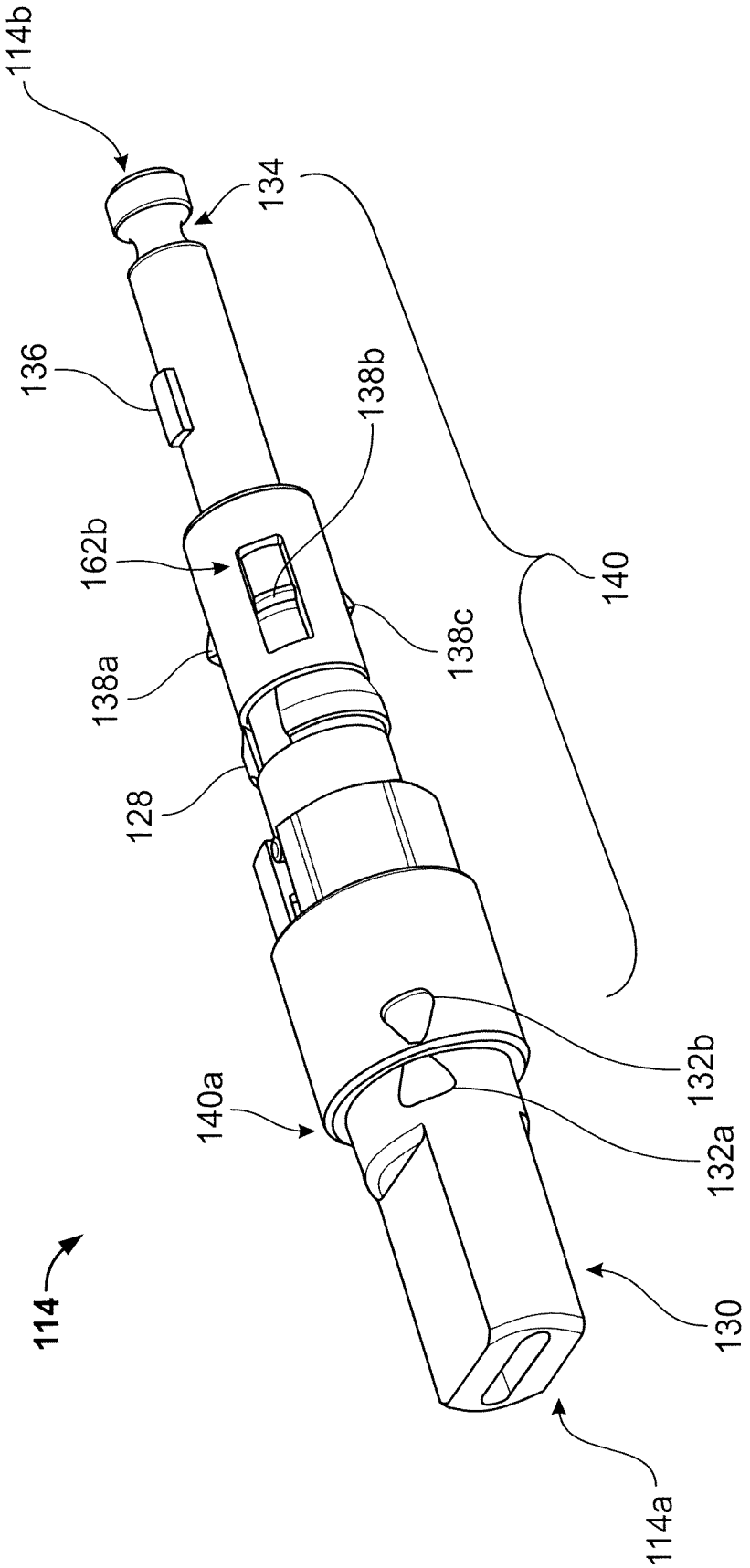

114b
140
138b
104d
104e
104b
104a
112
102
114a
130
138a
154
104
152
144
128
138
142
146

Fig. 2b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134
136
138b
162b
140
138c
138a
128
132b
140a
132a
114
130
114a

Fig. 2c

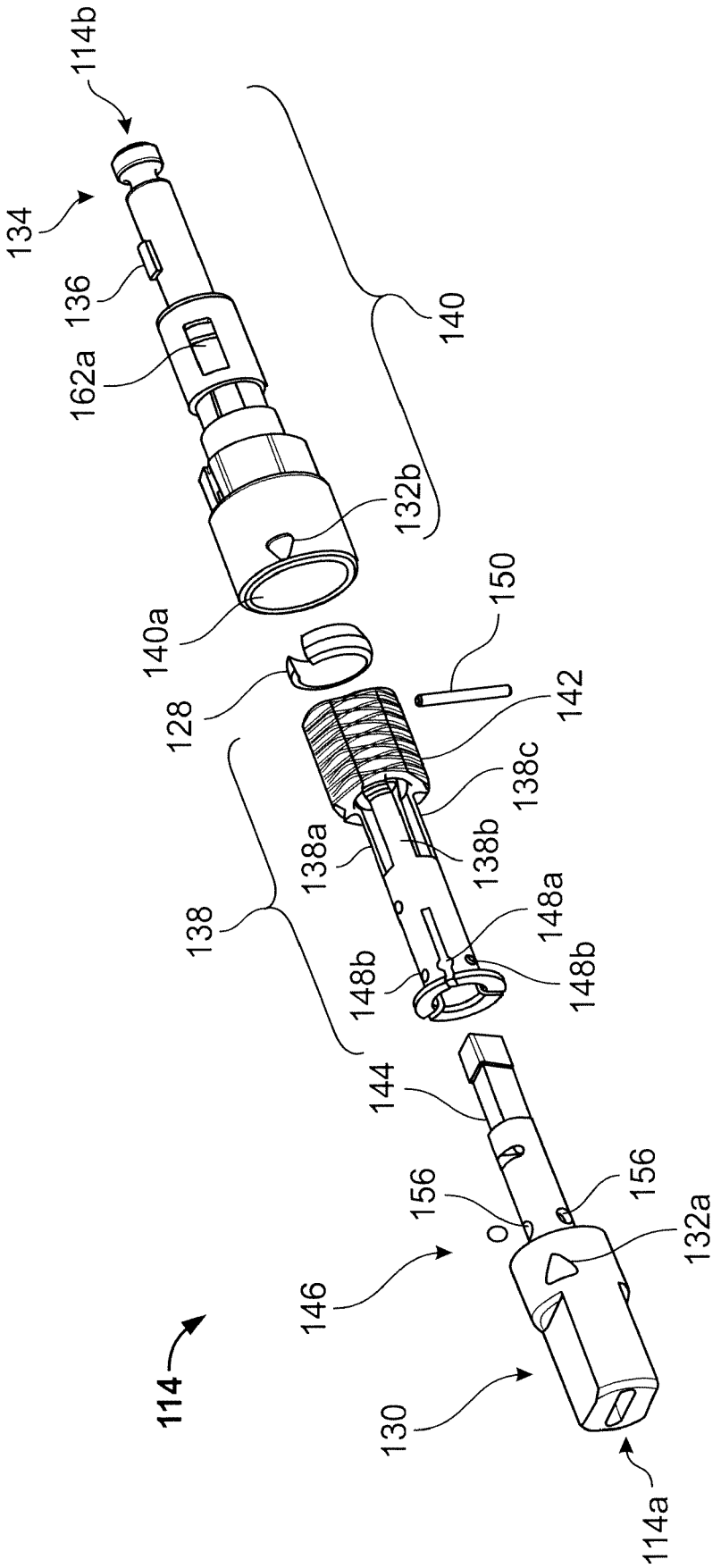

114b
134
136
162a
140
132b
140a
150
128
142
138c
138a
138b
148a
138
148b
148b
144
156
156
132a
146
114
130
114a

Fig. 2d

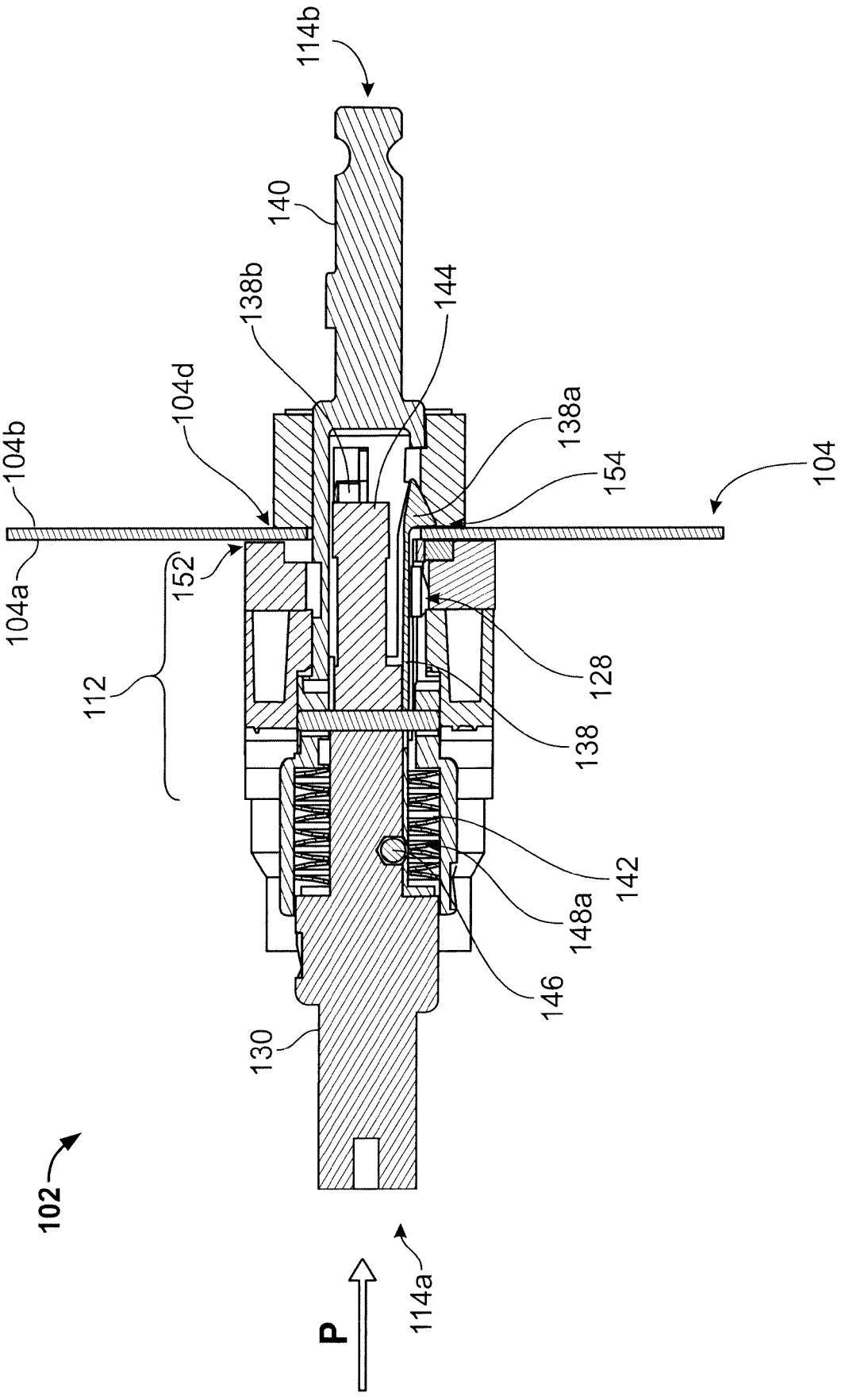

114b
140
138b
144
104d
104b
138a
154
104
104a
152
112
128
138
142
148a
146
130
102
P
114a

Fig. 2e

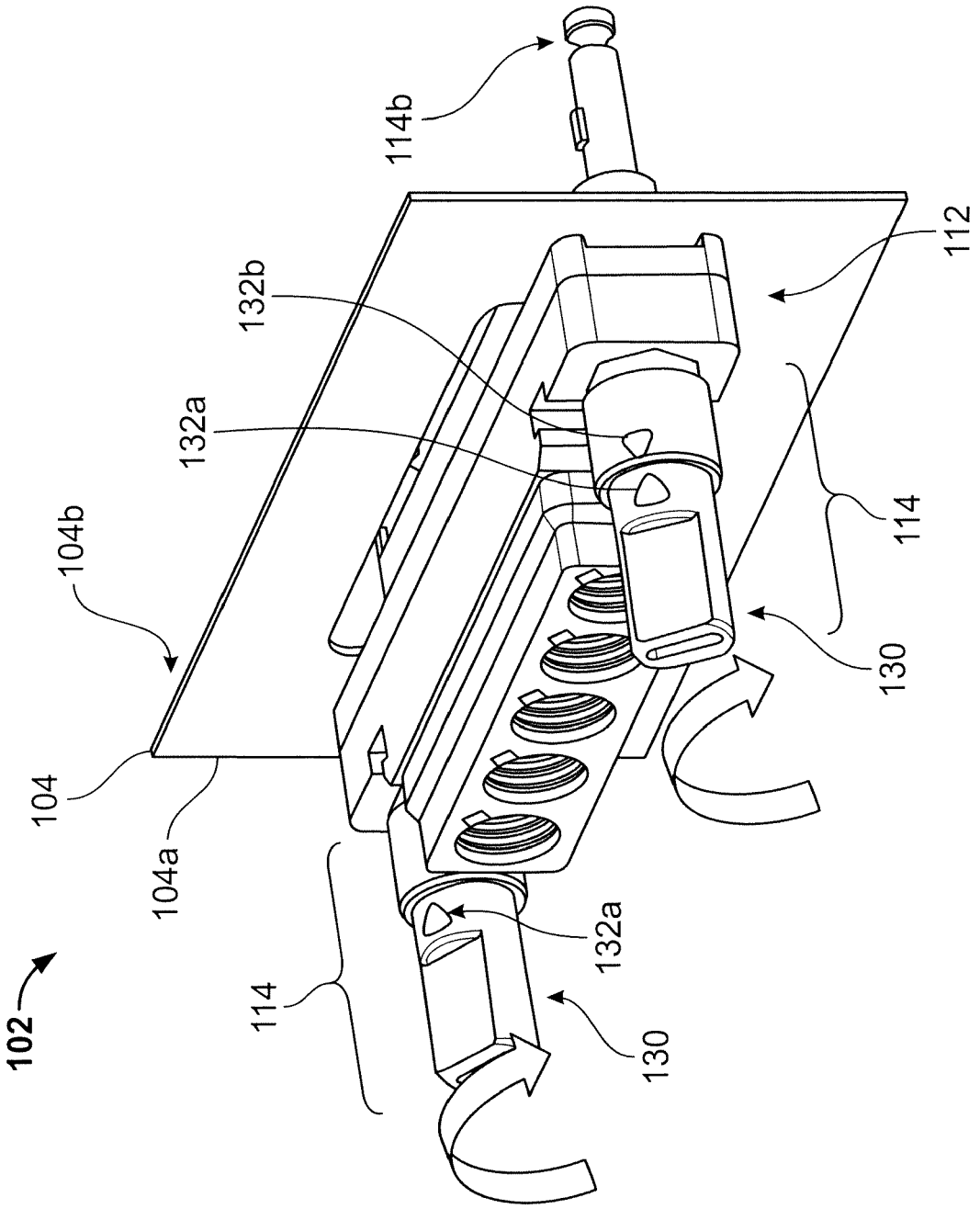


Fig. 2f

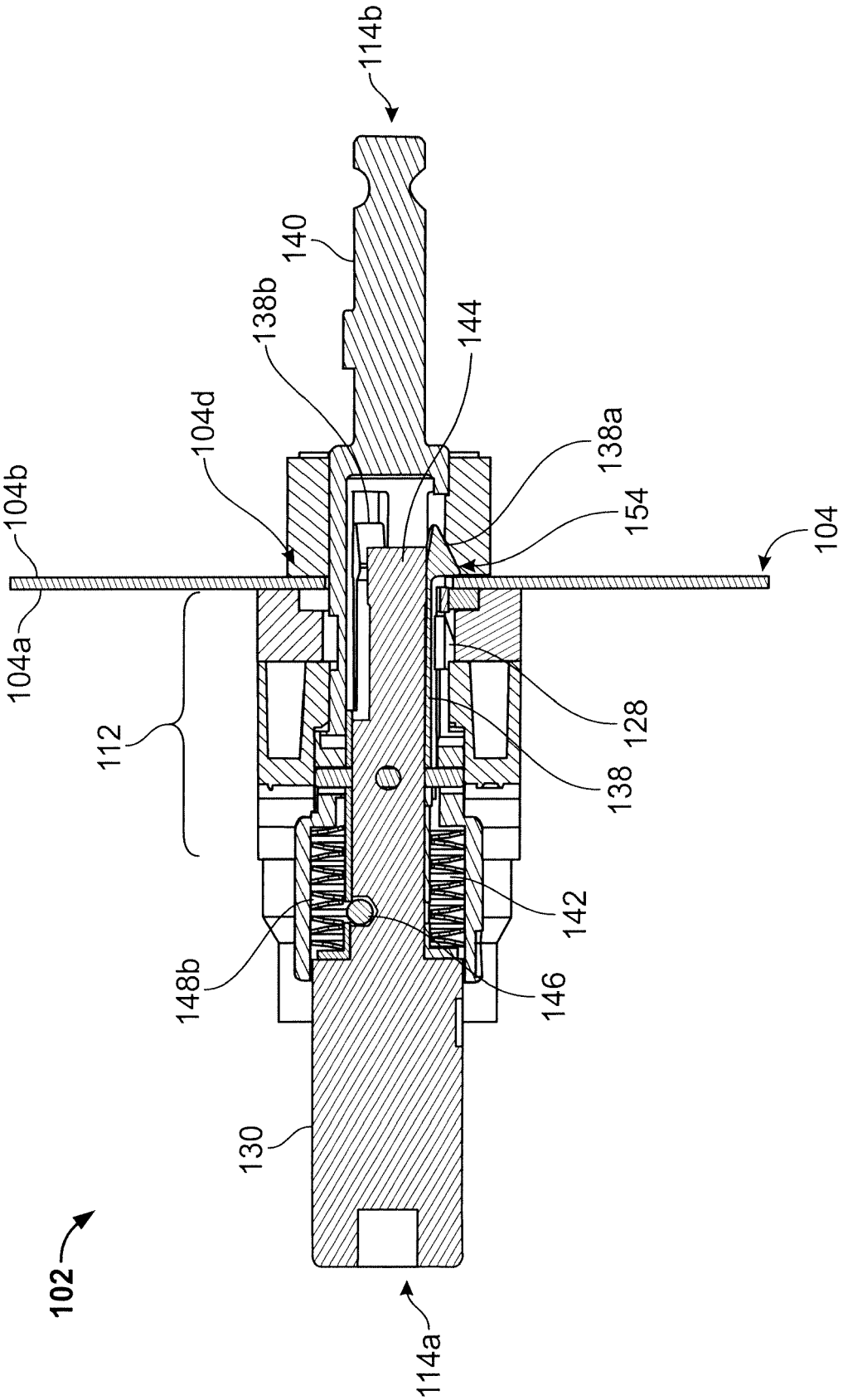

114b
140
138b
144
104d
138a
104b
154
104
104a
112
128
138
142
148b
146
130
102
114a

Fig. 2g

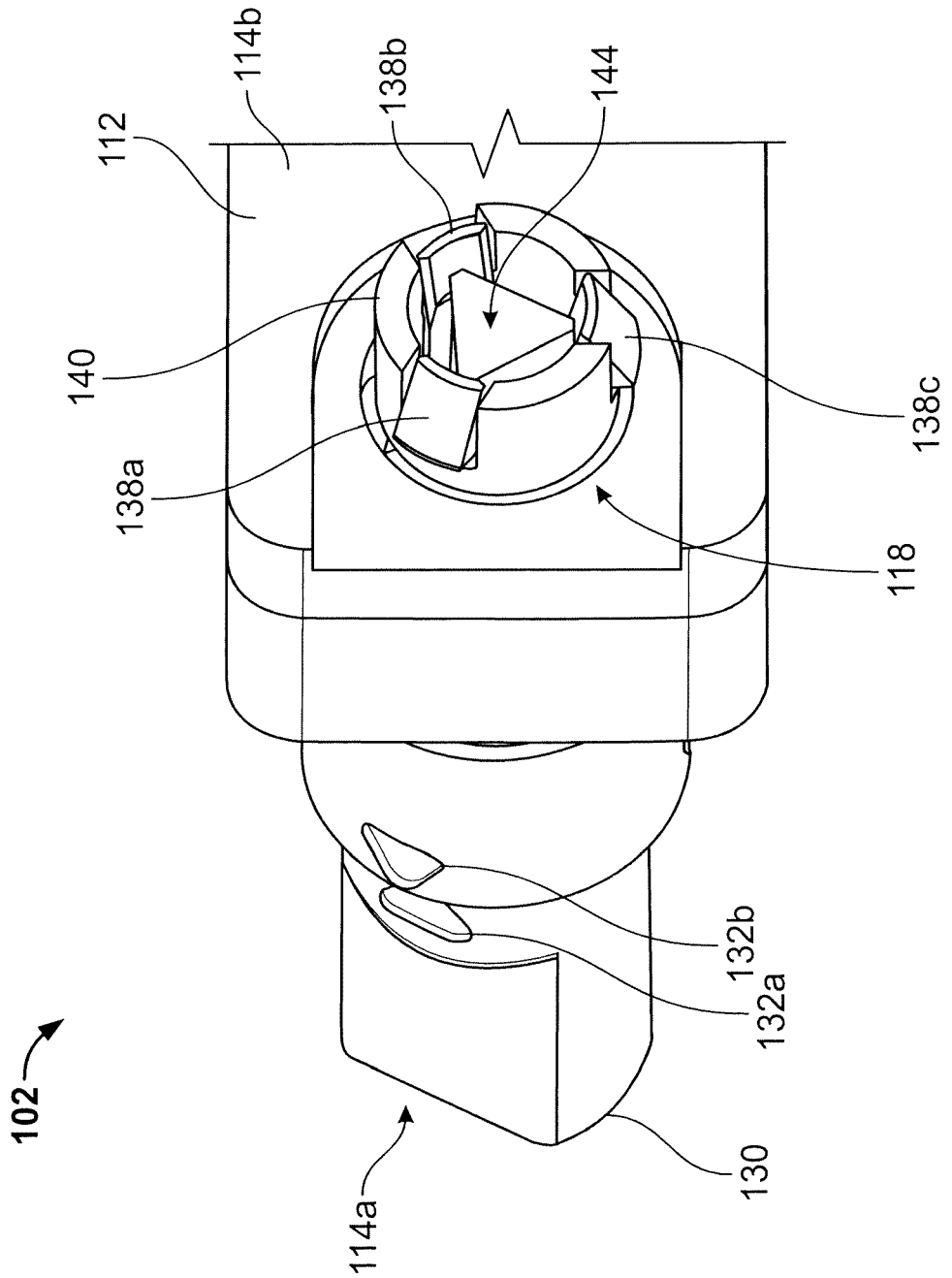


Fig. 3a

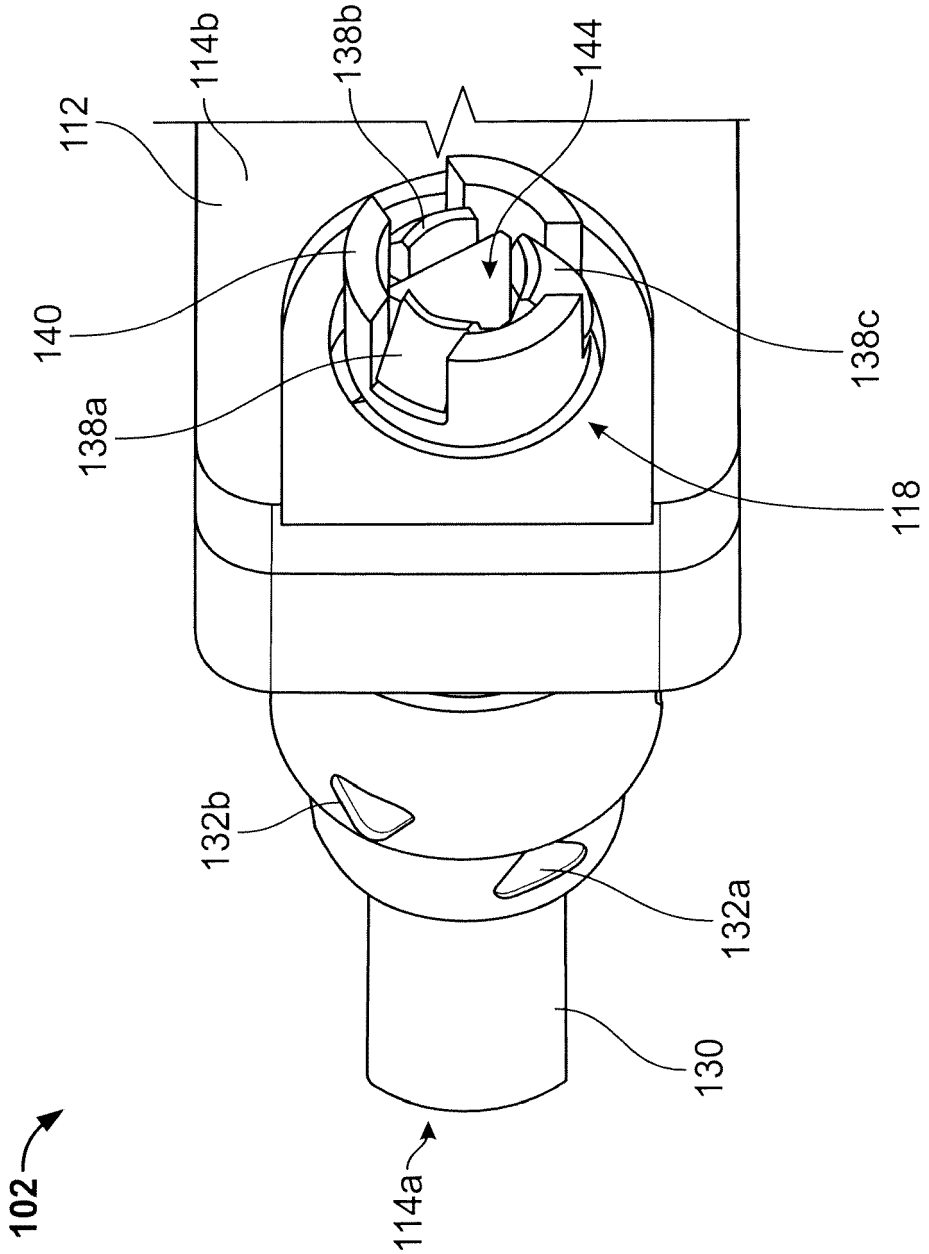
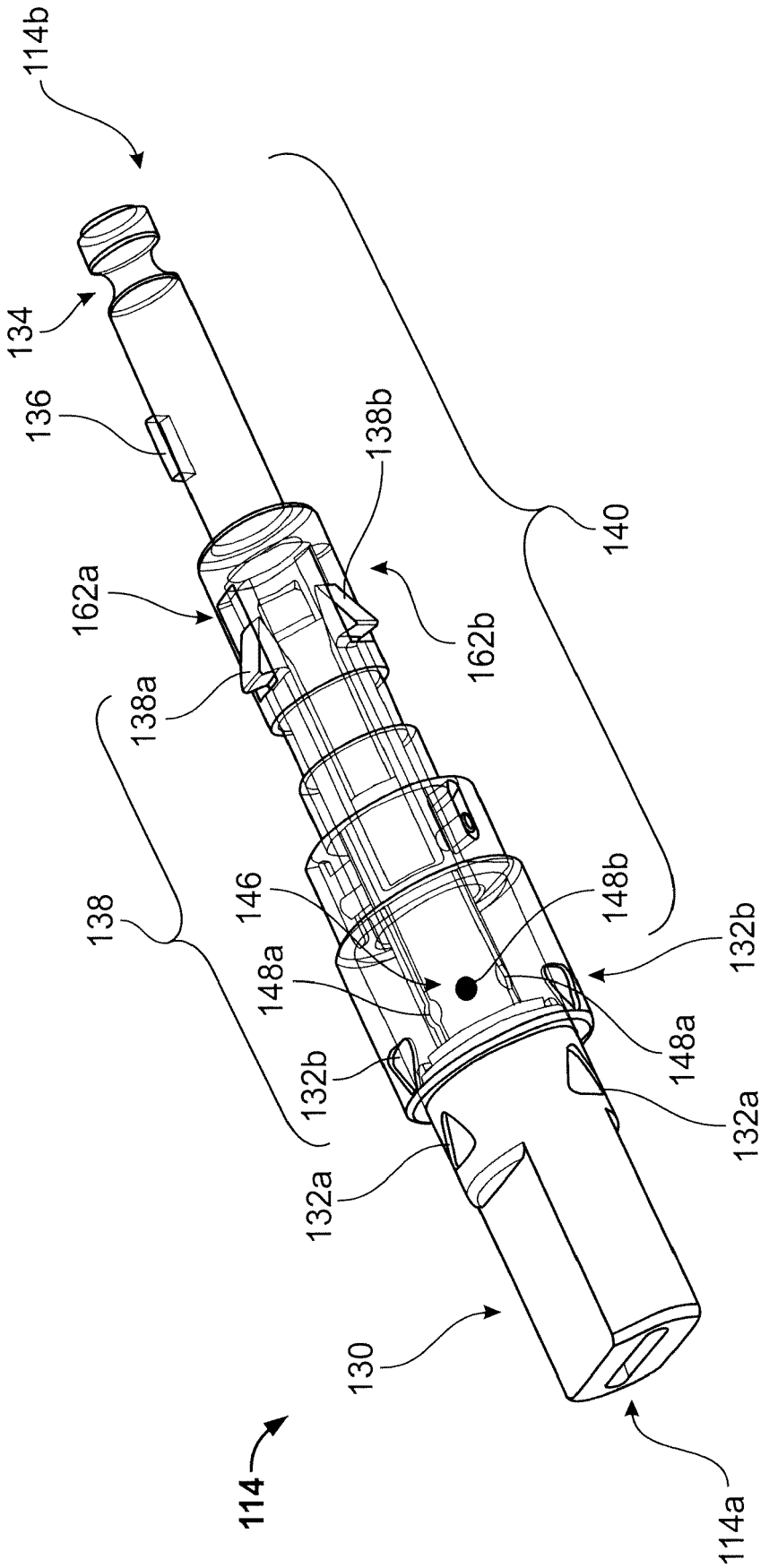


FIG. 3b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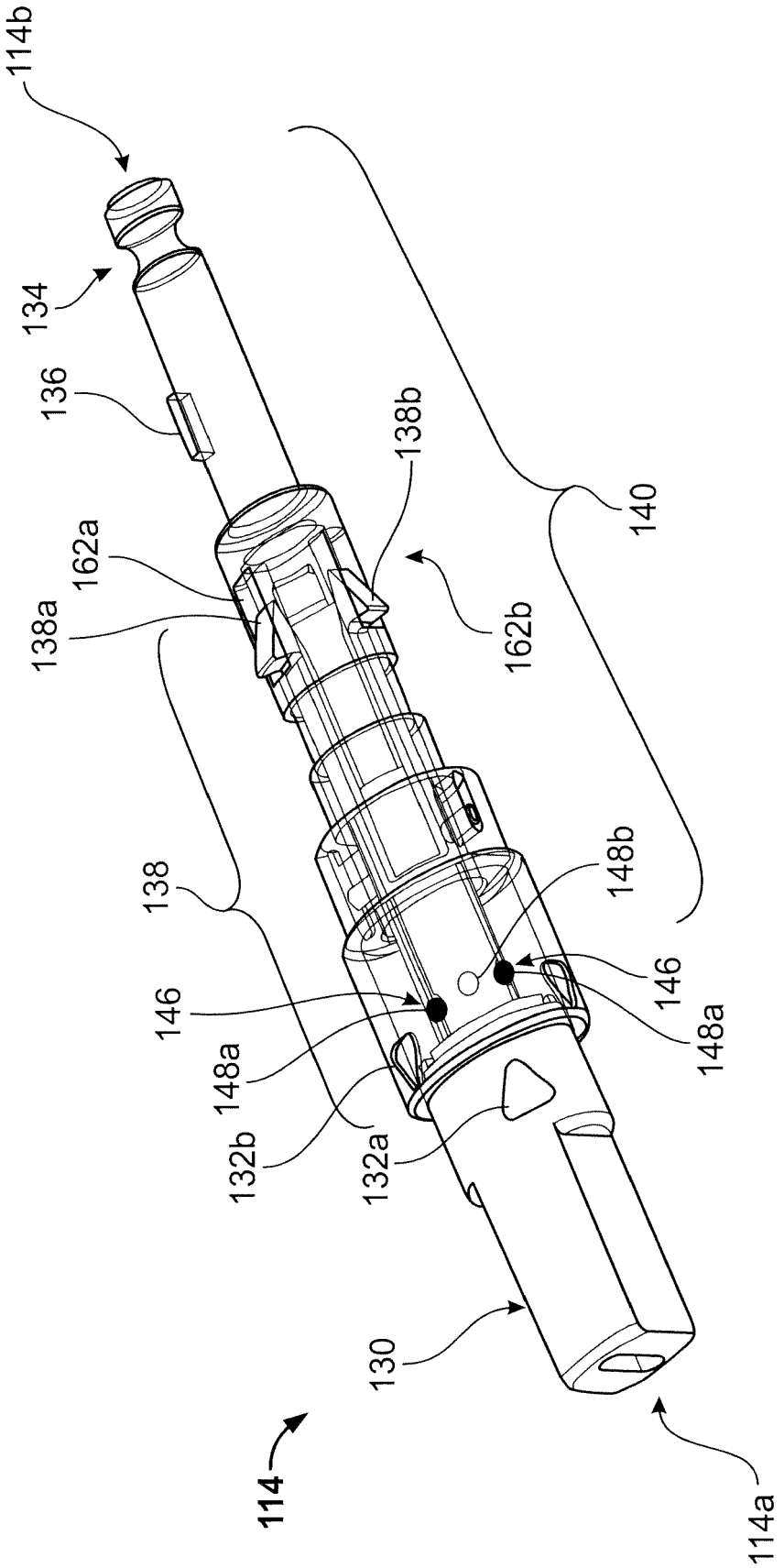
134
136
138b
140
162a
162b
138a
138
146
148b
132b
148a
148a
132b
132a
132a
130
114
114a

Fig. 4a


114b
134
136
138b
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162a
138a
162b
138
148b
146
146
148a
148a
132b
132a
130
114
114a

Fig. 4b

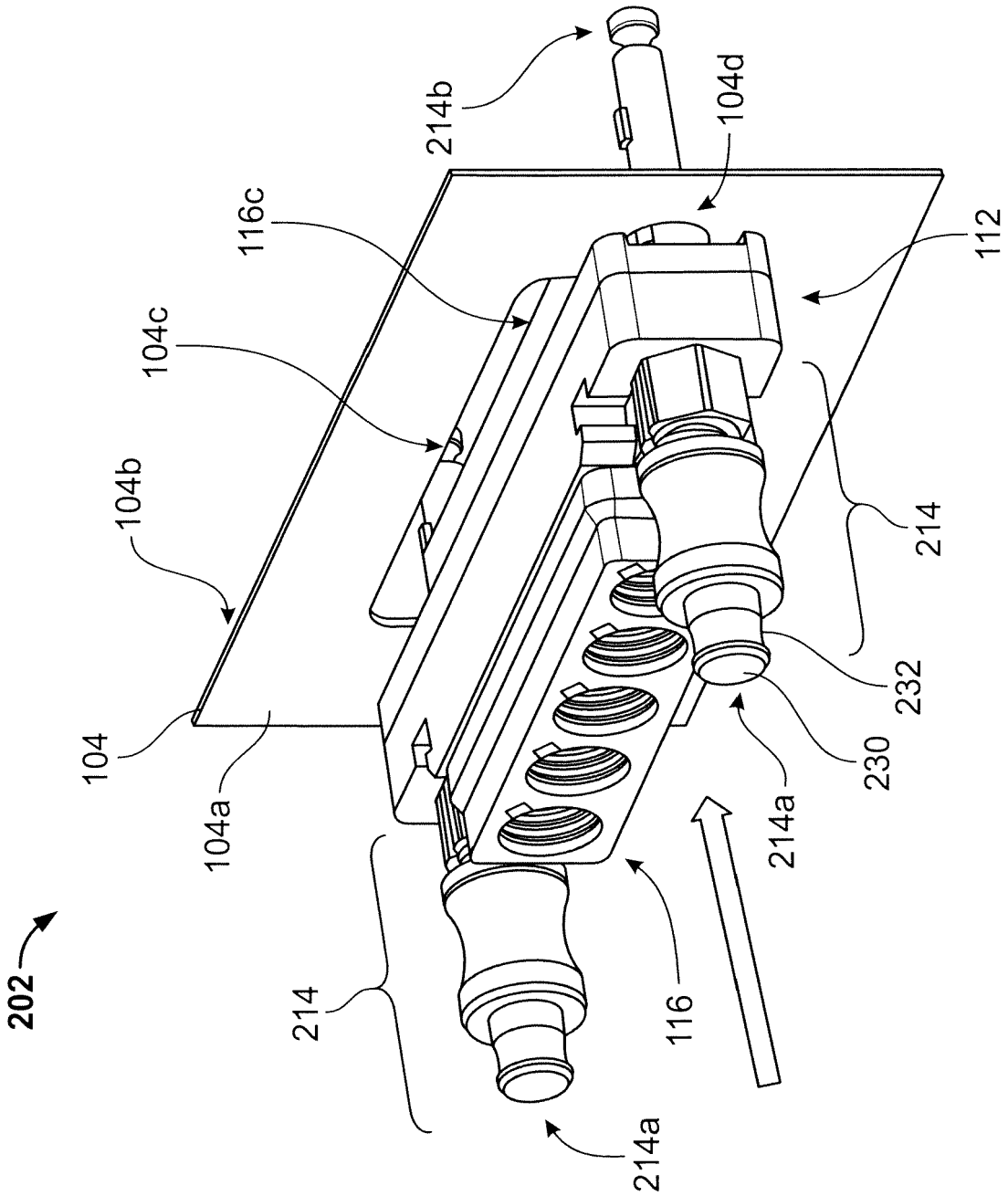


Fig. 5a

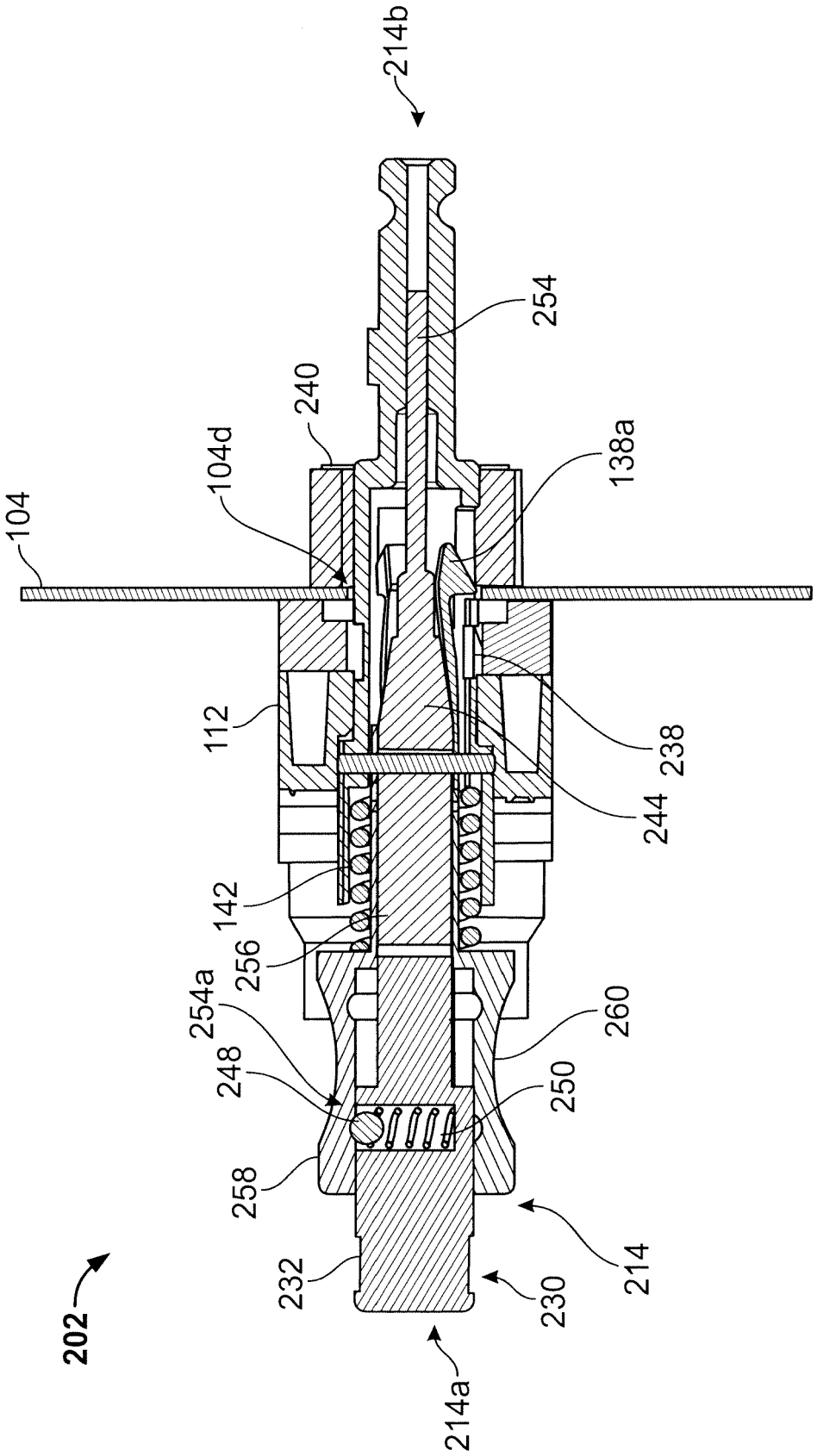
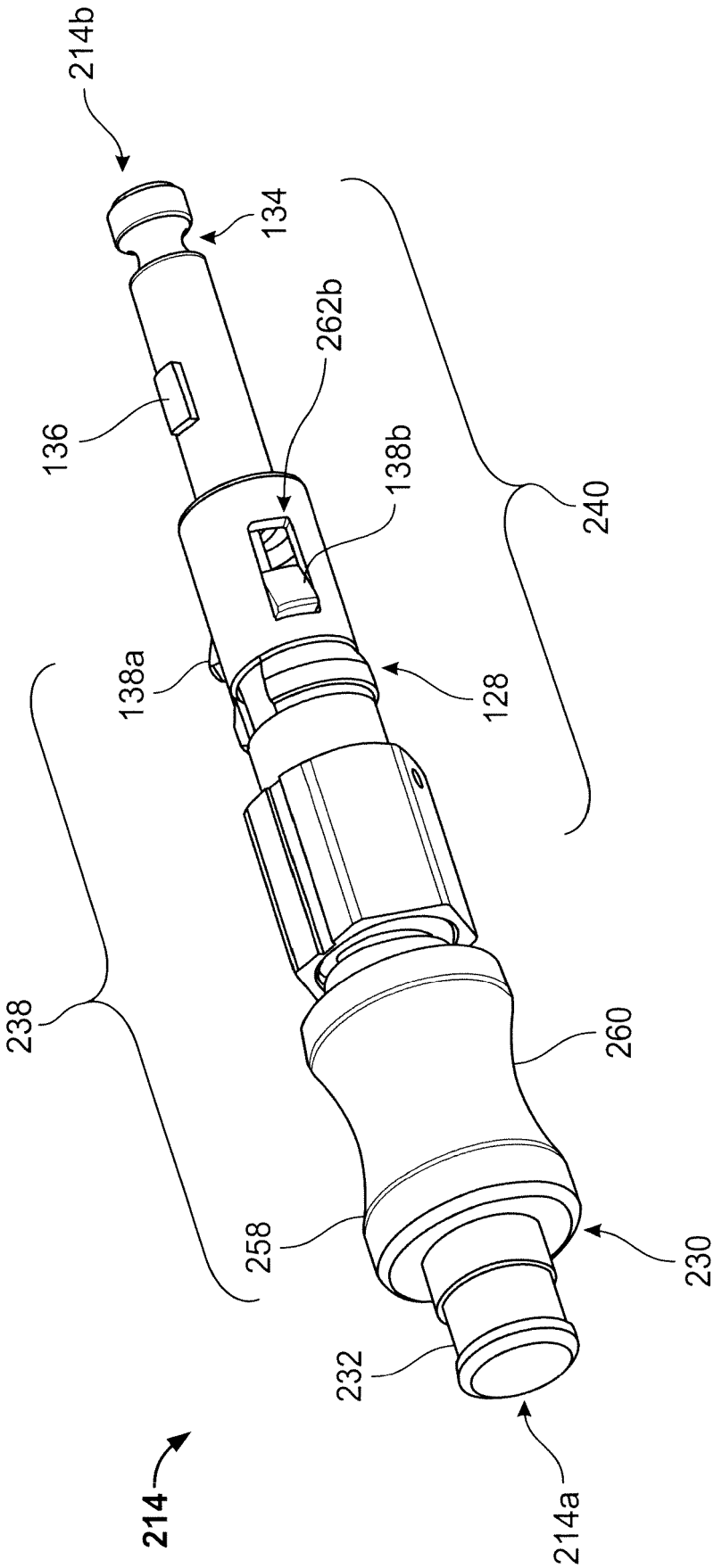

214b
254
240
104d
138a
104
112
238
244
142
256
254a
260
248
250
258
232
214
230
214a
202

Fig. 5b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262b
136
138b
240
138a
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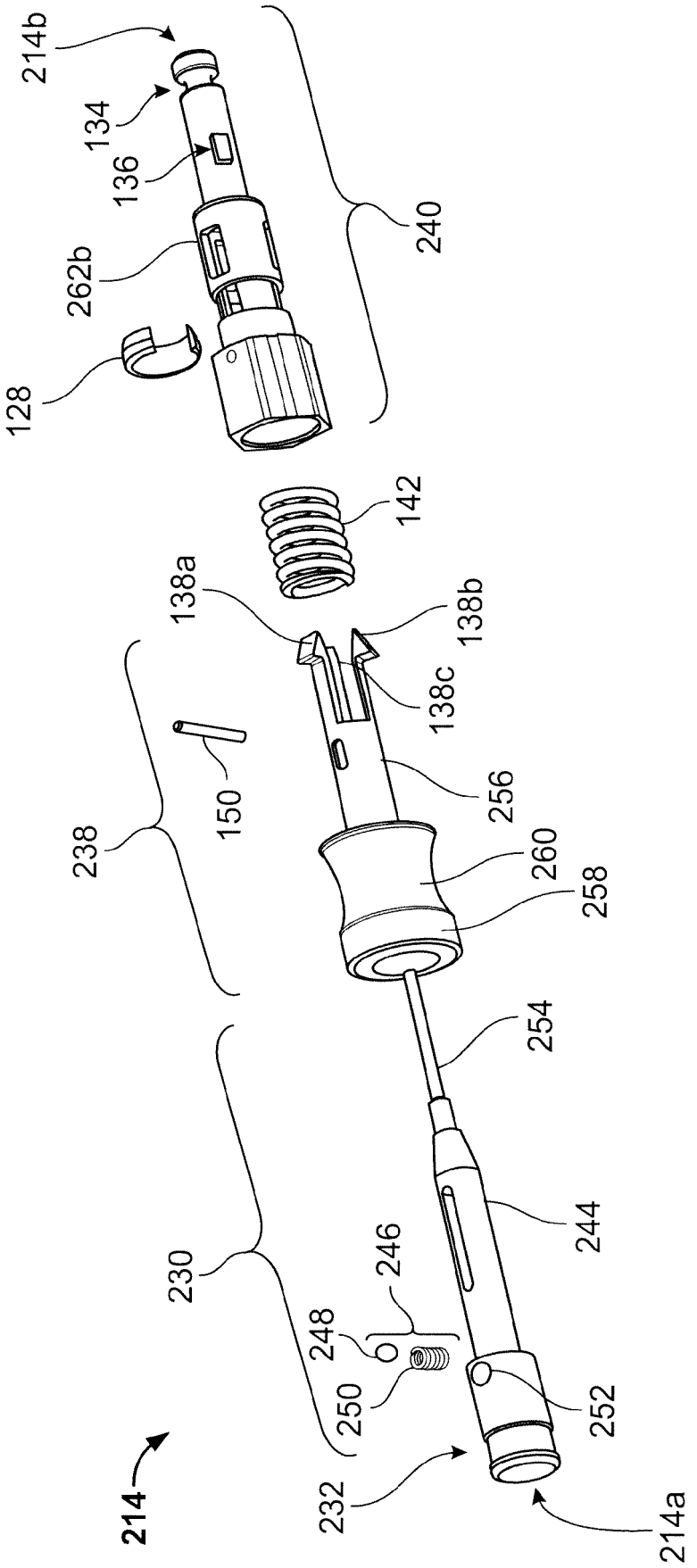
238
260
258
230
232
214
214a

Fig. 5c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262b
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240
142
138a
138b
138c
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260
258
254
244
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246
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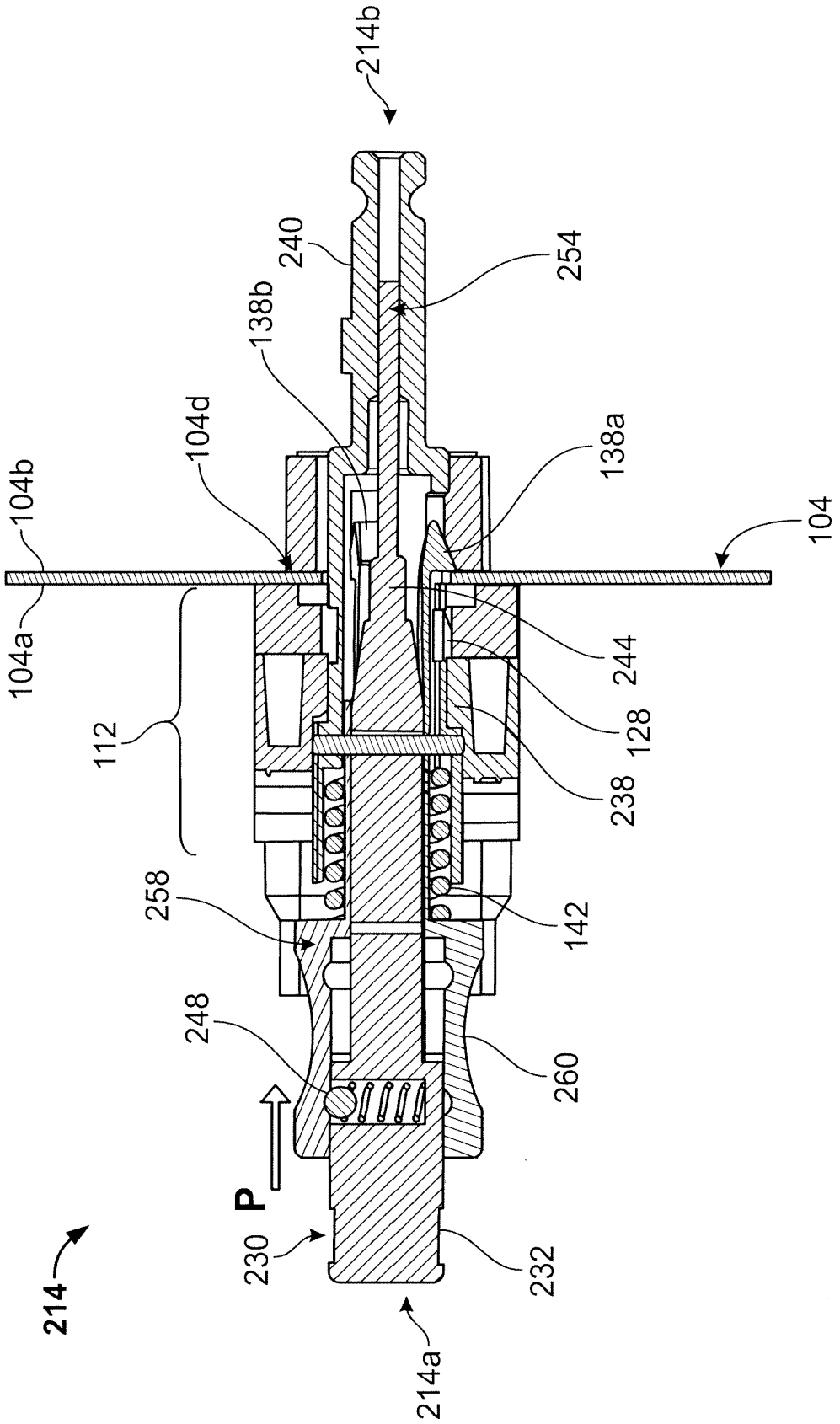
250
252
232
214
214a

Fig. 5d


214b
240
254
138b
104d
138a
104b
104
104a
112
244
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238
258
142
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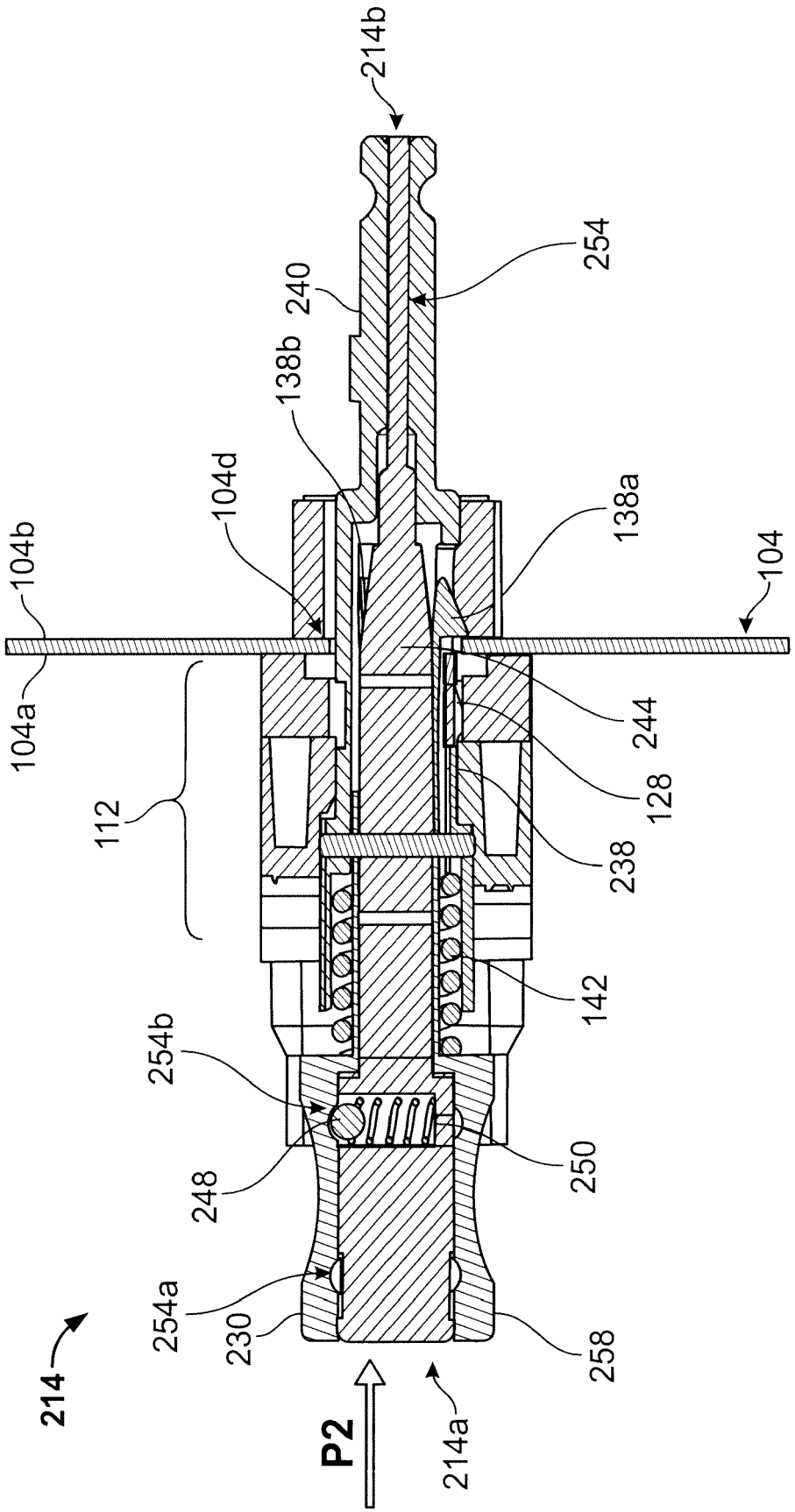
P
230
232
214
214a

Fig. 5e


214b
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138a
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142
254b
248
250
254a
230
258
214
P2
214a

Fig. 5f

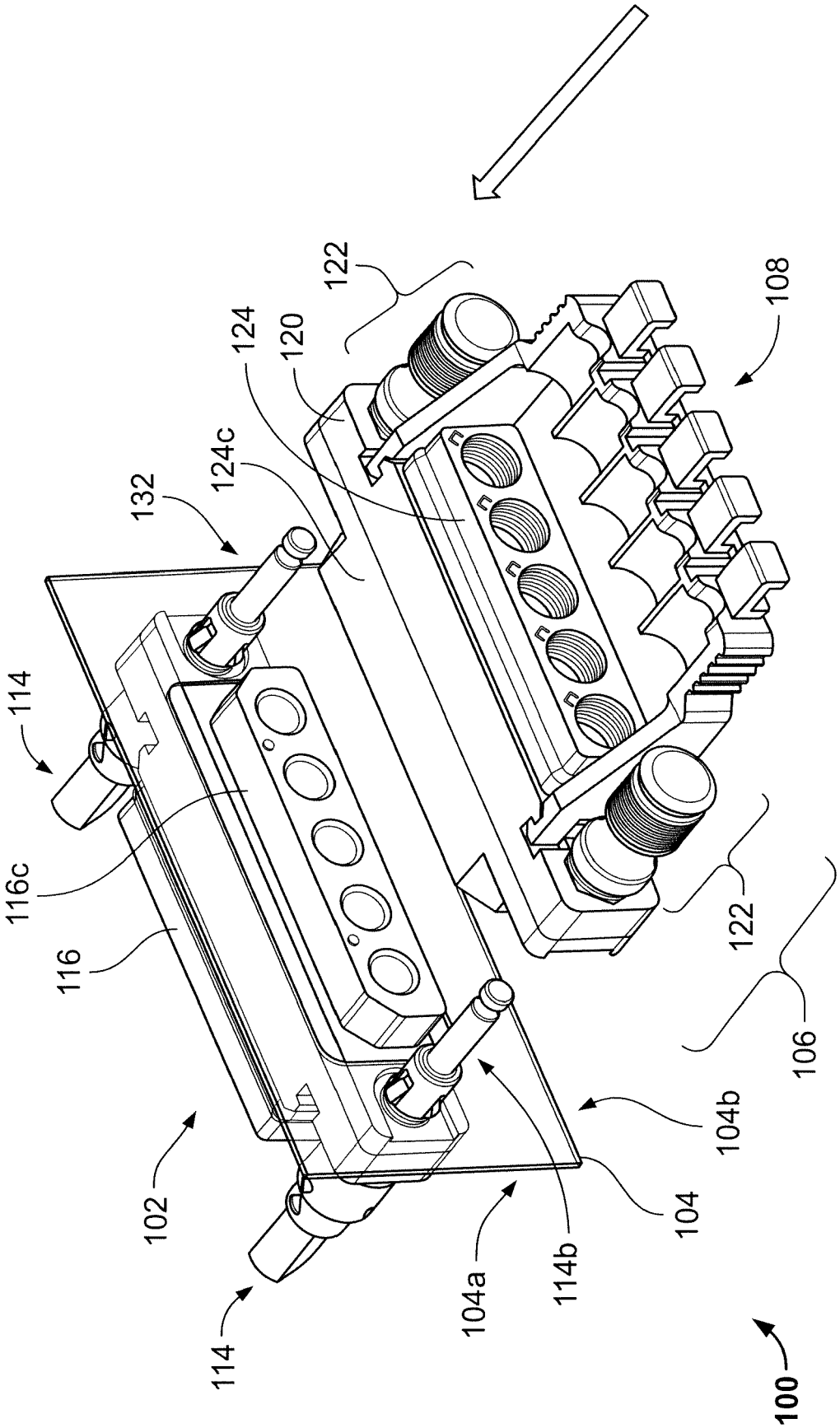
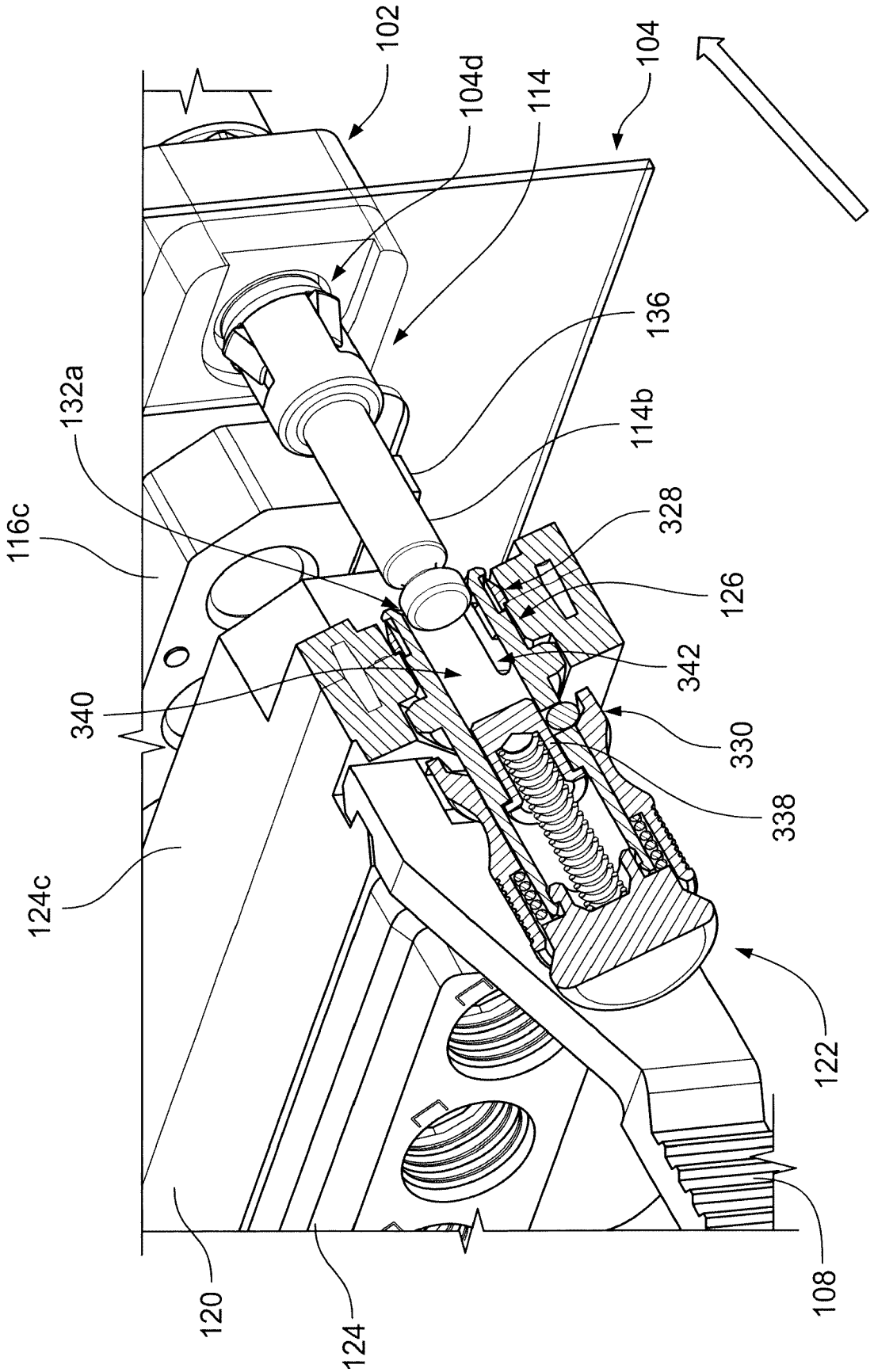

122
124
120
108
124c
132
114
116c
116
102
114
104a
114b
104
104b
106
122
100

Fig. 6a


102
104d
114
104
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132a
114b
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328
126
342
340
330
338
124c
122
120
124
108

Fig. 6b

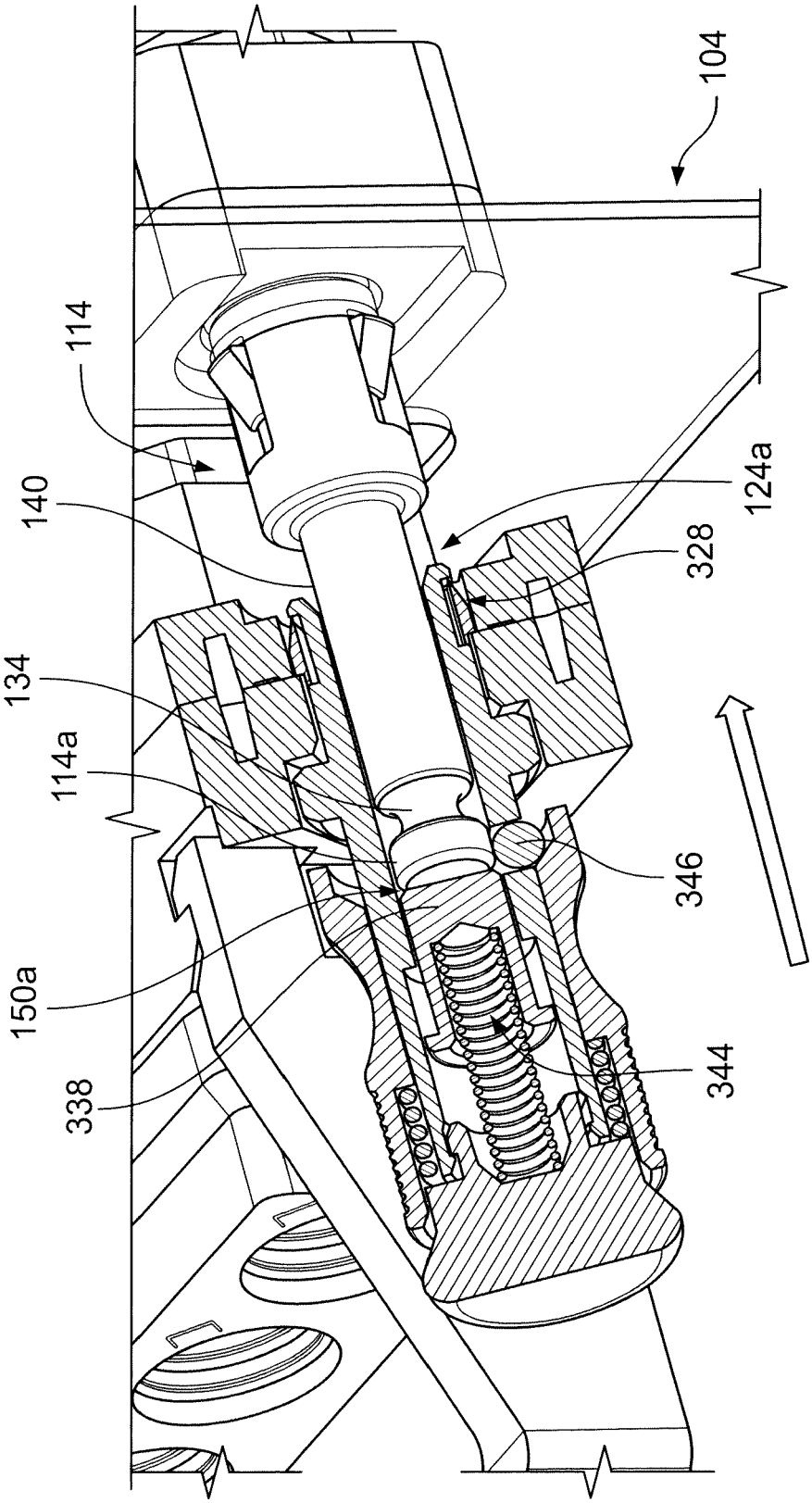

Fig. 6c

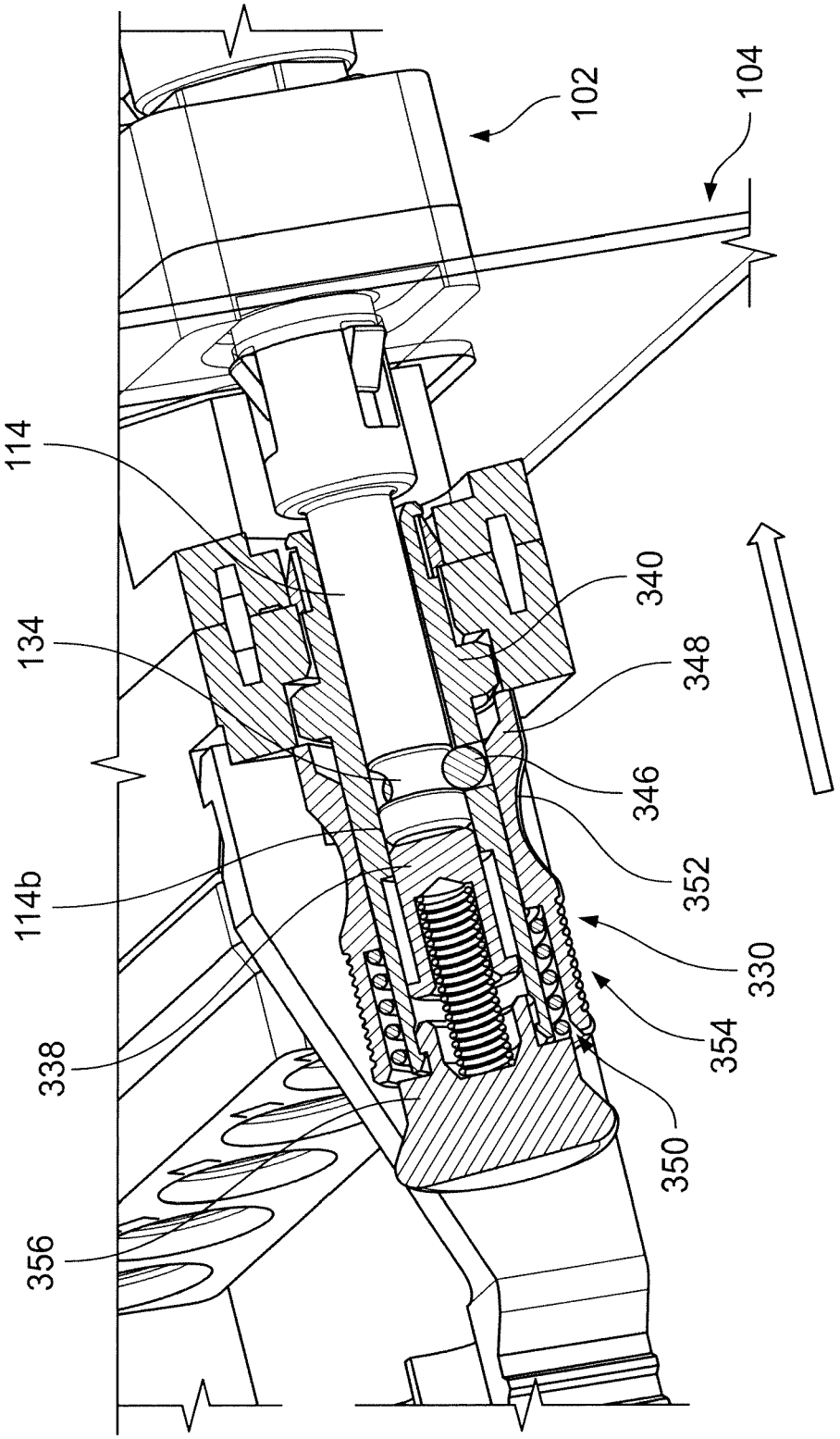

Fig. 6d

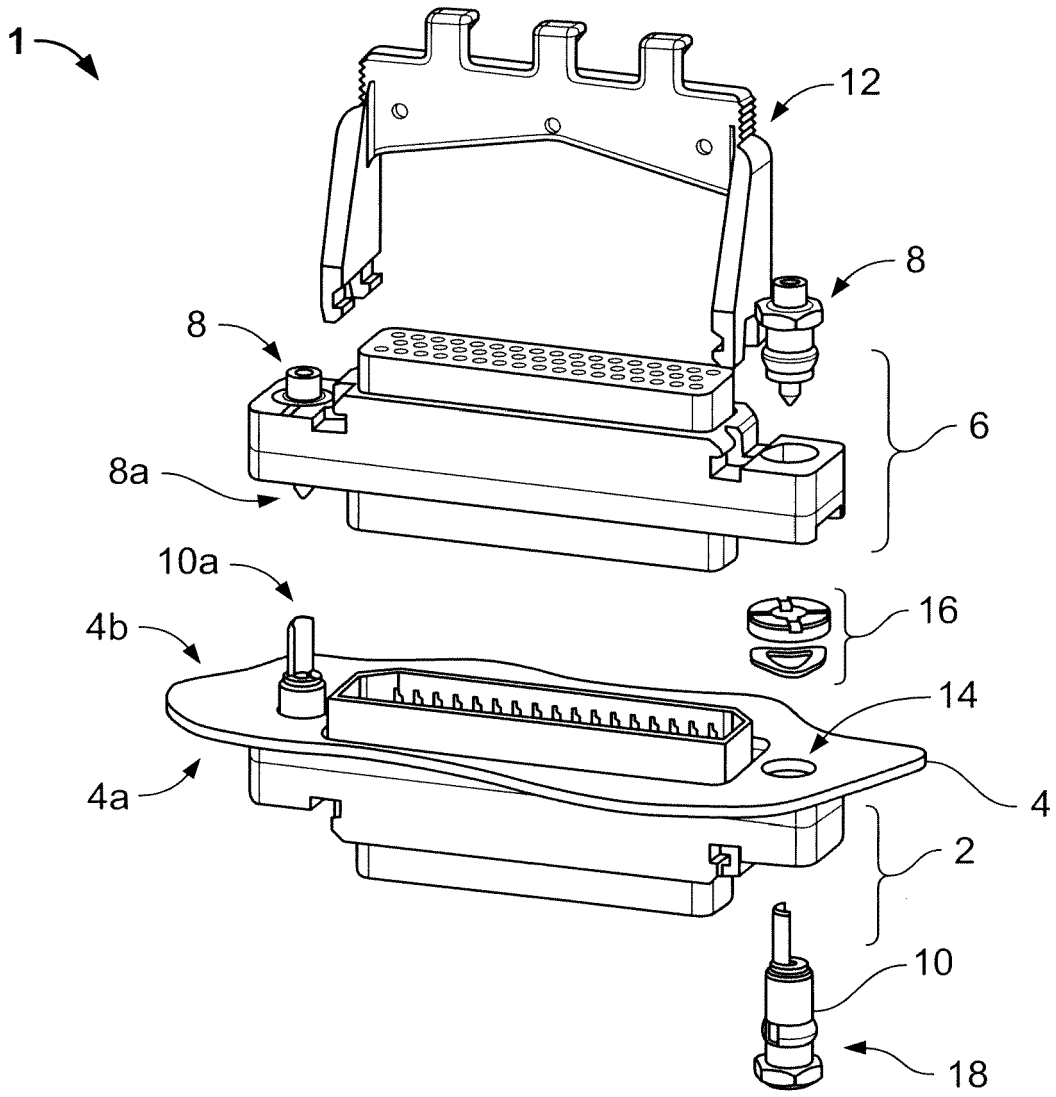

Fig. 7

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Application Number
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Place of search	Date of completion of the search	Examiner
The Hague	16 September 2020	Jiménez, Jesús

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