



(11) **EP 3 166 185 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
06.03.2019 Bulletin 2019/10

(51) Int Cl.:
H01R 13/639 ^(2006.01) **H01R 13/641** ^(2006.01)
H01R 13/627 ^(2006.01)

(21) Application number: **16200193.7**

(22) Date of filing: **16.09.2014**

(54) **SPRING-LOCK CONNECTOR**

SCHNAPPSCHLOSSVERBINDER

CONNECTEUR À RESSORT DE VERROUILLAGE

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **16.09.2013 FR 1358887**
25.11.2013 FR 1361571

(43) Date of publication of application:
10.05.2017 Bulletin 2017/19

(62) Document number(s) of the earlier application(s) in accordance with Art. 76 EPC:
14766709.1 / 3 047 545

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WO-A1-97/41623 DE-A1- 10 202 920

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Description

5 [0001] The invention relates to an electrical connector, in particular a squib connector, making it possible to automatically prevent an incorrect connection with a mating connector. The invention also relates to an electrical connector for a pluggable connection, in particular a squib connector, for a safety restraint system of a motor vehicle, comprising a connection assurance device which makes it possible, together with the action of a locking spring, to automatically prevent an incorrect connection with respect to a mating connector.

10 [0002] It is known, in particular in the field of electrical connections for the automobile industry, to use connectors comprising spring-lock systems, in which at least one traditional spring of the helical type arranged in the connector makes it possible to push back a mating connector, during an attempt to couple the connector to the mating connector, as long as the force applied on the connector and/or the mating connector is not sufficient to couple them correctly. In such systems, it is known that the locking spring is relaxed in the connector in its delivery position, i.e., before any attempt at connecting it to a mating connector, and compressed in its axial direction during a coupling attempt with the mating connector, the compression of the spring then opposing the coupling direction of the mating connectors. Thus, as long as the force exerted to couple the two mating connectors is not sufficient to complete the coupling, i.e., to allow the locking of the two mating connectors with each other, the tension created by the compression of the locking spring makes it possible to push the mating connector back in a direction opposite the coupling direction, thereby avoiding the possibility of an incorrect connection.

20 [0003] In the spring-lock connectors known from the state of the art, the compression of the locking spring must therefore be high enough to allow good ejection of the mating connectors if they are not completely locked with each other. In order to obtain the desired functionality, it is known that the spring locking uses at least one spring, the diameter and number of turns of which are large. Alternatively, it is also known to use several springs with a smaller diameter, but still with a large number of turns. For this reason, it is also known that the dimensions of spring-lock connector housings are larger than those of connector housings not comprising spring locking due to the space necessary for the travel of the locking spring.

25 [0004] It is also known from the state of the art to use connector position assurance (CPA) devices making it possible to monitor and ensure proper coupling of an electrical connector to a mating connector. In the automobile industry, it is in particular known to use CPA devices on the one hand to make sure that two mating electrical connectors are correctly coupled and locked, and on the other hand to strengthen the locking of the mating connectors through additional locking, one purpose of which is to avoid unwanted disconnection of the mating connectors for example due to the many impacts and strong vibrations regularly experienced by the connecting elements of motor vehicles.

30 [0005] It is known that the safety restraint systems commonly used in motor vehicle seat belts or air bags comprise pyrotechnic devices that can activate the locking of a belt or the inflation of an airbag based on impact or vibration information received by sensors of the vehicle. It is also known that the electrical cables connecting a control unit of a sensor to a corresponding pyrotechnic device, or squib, end in an electrical connector, which is generally connected to a mating connector receptacle, or squib carrier.

35 [0006] It is further known from the prior art that squib connectors can incorporate secondary locking systems or connector position assurance (CPA) devices, making it possible to monitor and ensure the maintenance of proper coupling with the squib carrier in an environment that may regularly be subjected to impacts or vibrations, as is typically the case in a motor vehicle. Squib connectors whose secondary locking can use a spring making it possible to move the secondary locking element from one predetermined position to another predetermined position are also known.

40 [0007] It is further known that the airbag squib systems of motor vehicles use standardized squib connectors, the standard for which requires a high degree of compactness and therefore small dimensions relative to connectors used for other systems or electric elements of the vehicle. The standard in particular imposes dimensions that are incompatible with the space necessary for the travel of locking springs like those used in the known spring-lock connectors of the state of the art. In particular, the standardized dimensions of the squib connectors are incompatible with the large diameters and/or the length, in other words the high number of turns, of the helical springs that are necessary to perform the spring locking functionality known from the state of the art.

45 [0008] Thus, although it is possible to use a manual CPA device to ensure proper locking of a standardized squib connector with a mating connector, there is not, however, any solution automatically making it possible to avoid an incorrect connection of the squib connector to the mating connector.

50 [0009] Document WO 2012/055719 A1 in particular discloses a squib connector comprising a secondary locking system having a U-shaped resilient rod, in which the transverse portion of the "U" is fixed in the connector and the ends of the two tabs of the "U" are in contact with a secondary locking element. In this system, the tabs of the spring, that is to say, its end portions, can move in an insertion direction of the connector, and the locking element comprises redirecting surfaces making it possible to redirect the ends of the tabs of the spring in a direction perpendicular to the insertion direction of the connector, in other words in a direction separating the tabs of the spring from each other. However, upon each connection or disconnection of the connector, the tendency to separate the tabs of the spring from one another

during the transition between the two predetermined positions of the secondary locking element can result in deformation and therefore weakening of the spring.

5 [0010] Furthermore, in squib connectors which are known from the prior art and which use a spring type locking system, it is known that the secondary locking element can be moved between a position in which it allows the connector to be inserted into the mating receptacle and a position in which it ensures secondary locking, once the connector has been correctly fitted in the receptacle. In particular it is known, in particular from WO 2012/055719 A1, that the movement of the position assurance element of the connector is carried out substantially in the same direction as the coupling of the connector. Consequently, this movement is carried out precisely in the direction in which the stresses resulting from the vibrations and impacts may bring about an unintentional disconnection between the connector and the mating receptacle thereof. In this manner, vibrations or impacts can therefore also weaken the secondary locking itself and consequently nevertheless result in an unintentional disconnection if the vibrations or impacts are sufficiently intense.

10 DE 102 02 920 A1 discloses a connector system for a safety restraint system, comprising a connector housing with a plug that can be plugged into a mating socket. The system comprises a slider for preventing the plug from withdrawing, as well as another slider movable by a helical spring. Both sliders are movable in the plugging direction.

15 [0011] There is therefore also a need to improve secondary locking systems of squib connectors in order to make them more resistant and more reliable than those of the connectors known from the prior art with respect to impacts and vibrations, in particular in the coupling direction.

20 [0012] It is further known that automotive manufacturers have a tendency to standardize their connector technology elements and therefore to call upon electrical connector suppliers to provide solutions adapted to their standardized elements. Thus, in the case of safety restraint systems, owing to the standardization by automotive manufacturers of the squib carriers or squib counter-connectors, there is a need to provide suitable squib connectors.

25 [0013] One aim of the present invention is therefore to overcome the existing need in the automobile industry to provide a solution making it possible to automatically ensure that a mating connector cannot be incorrectly connected to a squib connector while overcoming the difficulties mentioned above and complying with the standards imposed by the industry for the dimensions and compactness of the squib connectors.

30 [0014] An object of the present invention is therefore also to provide a solution for a squib connector taking into account the requirements above. In particular, an object is to provide a squib connector which is improved with respect to the known prior art, with regard to the reliability of the secondary locking, whilst complying with the constraints of automatic ejection of the connector if it is incorrectly fitted and the constraints resulting from the standardization of the counter-connectors or squib carrier receptacles.

[0015] This is achieved by an electrical connector according to claim 1. Optional features of the invention are described hereafter and in the dependent claims.

35 [0016] The object is achieved with an electrical connector, in particular a squib connector for a safety restraint system of a motor vehicle, which can be coupled to a mating electrical connector in a coupling direction comprising: a locking spring which is relaxed in a delivery state, a loaded state of the spring acting counter to a coupling of the connector to the mating connector; and a first position assurance element of the connector, which element can be moved in the coupling direction when the connector is coupled to the mating connector from a delivery position to the delivery state in order to bring about a loading of the spring as long as the connector and the mating connector are not correctly coupled. According to the present invention, the electrical connector further comprises a second position assurance element of the connector, which element can be moved from a delivery position to the delivery state in a direction which is different from the coupling direction.

40 [0017] A connector according to the present invention comprises a first position assurance element of the connector which can be moved, in the event of contact with a counter-connector, in the coupling direction, thus bringing about a loading of the locking spring. The relaxation of the locking spring, which repels the first position assurance element of the connector, and therefore ultimately the connector relative to the mating connector can then automatically eject the connector if it is incorrectly or partially fitted in the counter-connector, thus preventing incorrect connection. When the connector is correctly fitted in the counter-connector thereof, the first position assurance element of the connector can ensure that the connection is maintained in the coupling direction.

45 [0018] Furthermore, since the main locking is generally carried out in the coupling direction, the present invention enables the main locking action to be reinforced with a second position assurance element which can be moved, however, in a different direction from the coupling direction. The second position assurance element is therefore less susceptible than the first position assurance element or the main locking system to accidentally become unlocked as a result of the vibrations since it can be moved in a direction different from the coupling direction. That is to say, the vibrations and/or impacts which could weaken both the secondary locking produced by the first position assurance element of the connector and the main locking action between the connector and its mating connector and which can therefore lead to unintentional disconnection cannot, however, weaken the secondary complementary locking action produced by the second position assurance element of the connector.

50 [0019] In a preferred embodiment, the connector may be a squib connector for a safety restraint system. It may

therefore be able to be fitted in a standard squib carrier receptacle of a motor vehicle manufacturer. The invention thus allows a solution to be provided which complements a first CPA device, which can be moved in the coupling direction and which carries out, with a locking spring, both a function of automatic ejection and a secondary locking function. The integration of a second CPA device, which can be moved in a direction different from the coupling direction, enables a

weakening of the first CPA device to be prevented and therefore enables a connection to be maintained between the squib connector and the squib carrier receptacle in a more effective manner than a connector known from the prior art. **[0020]** A delivery state of the connector may be a state in which the spring, the first CPA device and the second CPA device are in their respective delivery positions, in the rest state. In the delivery state: the spring may therefore be substantially relaxed or in any case with minimum tension relative to any loaded state resulting from a coupling movement; the first position assurance element of the connector may be in an initial position which is the default position thereof in the rest state before moving into contact with a contact surface of the counter-connector during a coupling operation, in particular in which it is in contact with the locking spring but applies substantially no pressure thereto, and vice versa, the spring applies in a manner of speaking no pressure to the first CPA device; and the second position assurance element of the connector is also in a position in the rest state.

[0021] In the same manner, a loaded state of the connector may be a state in which the spring is loaded as a result of the movement of the first position assurance element of the connector, and/or the second position assurance element of the connector. In a preferred embodiment, a loaded state may be a state in which a first CPA device of the connector according to the invention is pushed against a contact surface of the counter-connector in a coupling phase. Since the position assurance element of the connector is movable, a pushing force of the connector, and therefore of the position assurance element thereof, against a surface of the counter-connector during the coupling operation moves the position assurance element of the connector, consequently bringing about the loading of the spring.

[0022] Preferably, the second position assurance element of the connector may be movable in a direction substantially perpendicular to the coupling direction. It has been found that this variant is advantageous for protecting the correct locking of a squib connector, which is frequently subjected to significant vibrations or impacts.

[0023] Advantageously, the loading of the spring can bring about the movement of the second position assurance element of the connector. It is therefore also possible to combine the advantageous effect of a second CPA device with the functionality of auto-ejection of the locking spring and the first CPA device. In this manner, the movement of the first CPA device can load the spring, which can bring about a movement of the second CPA device.

[0024] In a preferred variant of an advantageous embodiment, during a coupling operation, as long as the connector and the mating connector are not correctly coupled, in the loaded state, the first position assurance element of the connector can be configured to repel the mating connector under the action of a pressure applied by the spring. This variant is advantageous, for example, for a squib connector whose standard counter-connector enables a "plunger" type CPA device to be used which acts as a first position assurance element of the connector.

[0025] Still in a preferred variant, the electrical connector may further comprise at least one main locking element which is provided in a delivery position in the delivery state and which can be redirected in order to allow the coupling, in which the delivery position of the at least one main locking element carries out a first locking action of the connector with respect to the mating connector when they are correctly coupled. In the case of a squib connector, it is therefore possible to provide one or more locking lances which enable locking to a standard squib carrier receptacle since the standard receptacles generally comprise locking zones which allow studs of locking lances to be received.

[0026] Advantageously, the delivery position of the second position assurance element of the connector may prevent redirection of the at least one main locking element. In the case of squib connectors, but in a manner which is not restrictive with respect to them, which typically comprise locking lances, the second CPA device of the connector according to the invention enables it to be ensured, when it is not moved, where applicable, when the spring is not loaded, that the main locking action is maintained when the connector is correctly fitted in a squib carrier receptacle.

[0027] In a preferred variant of an advantageous embodiment, a loaded state of the spring can move the second position assurance element of the connector in order to allow redirection of the at least one main locking element. In this manner, in the delivery state, a second CPA device can serve to ensure the maintenance of the main locking action whilst, in a loaded state, which is a state during which the connector is in the process of being fitted in a counter-connector, the second CPA device can be moved so as to release the element which ensures the main locking action and therefore to allow continuation of the coupling. In the case of a squib connector, typically the studs of the locking lances move into abutment against the squib carrier receptacle and must be redirected in order to allow correct insertion. A loaded state can therefore allow this redirection.

[0028] Furthermore, in an advantageous variant, when the connector and the mating connector are correctly coupled, the connector can return to the delivery state thereof, in particular so that the spring is relaxed, and the first position assurance element of the connector and the second position assurance element of the connector are in their delivery position. Where applicable, the at least one main locking element may also be in the delivery position thereof. In this manner, after the connector has been correctly fitted and locked to a counter-connector, the loading of the spring may act counter to a disconnection since the delivery state of the spring, and therefore the relaxation of the spring, is directly

linked to the respective delivery states of the first and second CPA devices. The combined effects of the two CPA devices can therefore prevent unintentional disconnection in a more advantageous manner than in the squib connectors known from the prior art. Furthermore, when the connector is correctly fitted and locked to the counter-connector, the locking elements, in particular the spring, the two CPA devices and, where applicable, the locking elements are in the rest state.

[0029] Advantageously, when the connector and the mating connector are correctly coupled, the first position assurance element of the connector can produce a second locking action of the connector with respect to the mating connector. This variant has been found to be advantageous in the case of a standard squib carrier receptacle which enables the use, at the side of the squib connector, of a plunger type CPA device which can, under the action of the locking spring, automatically repel the connector as long as it is not correctly fitted and "plunge" into a retention element of a standard squib carrier receptacle in order to produce additional locking.

[0030] In a variant of a preferred embodiment, the electrical connector may further comprise: a main casing in which there may be provided the spring, the first position assurance element of the connector and the second position assurance element of the connector, comprising at least one surface which limits the movement of the second position assurance element of the connector; and a cover which can be fixed to the main casing, comprising a receiving zone which enables the spring to be accommodated in the loaded state thereof and which limits the movement of the first position assurance element of the connector. The invention may therefore provide a solution which is appropriate for the standards of a motor vehicle manufacturer in terms of compactness for the safety retention system squib carrier receptacles.

[0031] The invention will be explained more detail hereinafter using advantageous embodiments and based on the following accompanying figures, in which:

Figure 1 schematically illustrates an exploded view of one example of an electrical connector useful to understand the present invention;

Figures 2A and 2B schematically illustrate two views of the connector shown in Figure 1, assembled;

Figures 3A and 3B schematically illustrate, through two sectional views, the connector example illustrated in Figures 1 and 2A-2B, before coupling to a mating connector;

Figures 4A and 4B schematically illustrate a step of a coupling sequence of the connector illustrated in Figures 1 to 3B with a mating connector, in which the mating connector can be pushed back by the tensed locking spring;

Figures 5A and 5B schematically illustrate another step in a coupling sequence, in which the connector and the mating connector are coupled and the locking spring is again tensed;

Figures 6A and 6B schematically illustrate the coupled and completely locked state of the connector to the mating connector, in which the locking spring is returned to its idle, delivery position;

Figure 7 is a schematic exploded view of an example of a connector according to an embodiment of the present invention;

Figures 8A - 8B are schematic illustrations of a step of a sequence for coupling the connector of the embodiment illustrated in Figure 7, in a delivery state, with a counter-connector;

Figures 9A - 9B are schematic illustrations of another step of a coupling sequence, in which the connector of the embodiment illustrated in Figure 7 is in a loaded state, respectively;

Figures 10A - 10B are schematic illustrations of another step of a coupling sequence, in which the connector of the embodiment illustrated in Figure 7 is in a loaded state, respectively; and

Figures 11A - 11B are schematic illustrations of the connector of the embodiment illustrated in Figure 7 correctly inserted and locked in a counter-connector, respectively.

[0032] Figure 1 illustrates an exploded view of one example of an electrical connector 100 not forming part of the present invention but useful for its understanding. In this example, the connector 100 is a connector of a motor vehicle airbag squib system (not illustrated) able to be coupled by a standardized mating connector. However, in other examples, the connector 100 could be yet another type of connector. For example, the connector 100 could be used for any other system also requiring assurance that incorrect locking of the connector 100 to a mating connector is not possible, but

the arrangement of which in a limited space would require smaller dimensions of the connector 100 relative to a connector known from the state of the art with spring locking.

[0033] The connector 100 illustrated in Figure 1 may comprise a main housing 101 with a main part 102 open on one side, with an essentially parallelepiped geometry, the section of which may be essentially trapezoidal with rounded edges, and a connecting part 103 that is essentially cylindrical, protruding substantially perpendicular to the main part 102 so as to allow advantageous coupling with a mating connector 200 in a space with limited dimensions. The connector 100 can further comprise a cover 104 designed to close the main part 102 of the main housing 101.

[0034] Figures 2A-2B and 3A-3B illustrate the connector 100 assembled in its delivery position, i.e., as it could be delivered for coupling with a mating connector 200. In particular, Figure 2A shows the connector 100 in a biased view from below, whereas Figure 2B shows the connector 100 in a biased view from above, i.e., essentially on the side of the cover 104. Figure 3A illustrates a sectional side view of the assembled connector 100, and Figure 3B illustrates a biased view from above similar to that of Figure 2B, but without the cover 104, in order to clarify the inner arrangement of the assembly of the connector 100.

[0035] As emerges from Figure 1, the main part 102 of the housing 101 can comprise, at one end, grooves 105, 106 suitable for the passage of electrical conductors, also visible in Figures 2A-2B and 3B, then a ferrite receiving cavity 107 suitable for receiving a filtering ferrite 108 through which the electrical conductors 109, 110 pass that are next bent essentially at a right angle such that the terminals 111, 112 at the end of the conductors 109, 110 can be housed in terminal receiving elements 113, 114 of the connecting part 103. Figures 3A-3B illustrate the assembled connector 100 in which the ferrite 108 is housed in the cavity 107, and with the terminals 111, 112 of the conductors 109, 110 housed in the terminal receiving elements 113, 114 of the connecting part 103. Figure 3A also illustrates that the ferrite 108 can be kept in place in the cavity 107 by a maintaining tongue 133 of the cover 104 when the latter closes the housing 101 of the connector 100.

[0036] As illustrated by Figures 1, 2A-2B and 3A-3B, the connection 100 can comprise a connection assurance element 115 that may be of the "plunger piston" type, or CPA plunger 115 hereinafter, i.e., essentially cylindrical, longitudinal and comprising at least one retractable locking element 116, 118 or able to be deflected only when the connector 100 and its mating connector 200 are locked together. In this example, the CPA plunger 115 comprises two locking lances 116, 118 on either side, each ending with a locking lug 117, 118, in particular shown in Figures 1 and 2A. Figure 2A also illustrates that the CPA plunger 115 is partially hollow in the longitudinal direction so as to allow locking lances 116, 118, more particularly locking lugs 117, 119, to be withdrawn toward the inside of the CPA plunger 115 if pressure is exerted on the lugs 117, 118 in a radial direction relative to the longitudinal axis of the CPA plunger 115.

[0037] As emerges from Figure 1 as well as the sectional view in Figure 3A, the main part 102 of the housing 101 comprises an orifice for receiving a connection assurance element 120 that extends in a receiving part for a connection assurance element 128 in the connecting part 103, thus allowing the CPA plunger to protrude in the connection part 103, as also illustrated in the views of Figures 2A and 2B. The CPA plunger 115 comprises a collar 121, visible in particular in Figure 3A, which prevents it from completely coming out of and falling through the connecting part 103.

[0038] The connecting part 103 being the part designed to couple strictly speaking with the mating connector 200, in the case of airbag squib systems, its geometry and dimensions are therefore defined by the standardization of the mating connector 200. One example of a standardized mating connector 200 is shown in Figures 4A-4B, 5A-5B, 6A-6B illustrating a coupling sequence with the connector 100 illustrated in Figures 1, 2A-2B and 3A-3B. The connecting part 103 can therefore be that which will perform the main locking or primary locking with the mating connector 200. To that end, the connecting part 103 can comprise at least one main locking element 122, 124, here two locking lances 122, 124 arranged on both sides of the connecting part 103 and each ending with a respective locking lug 123, 125, and able to retract into a respective orifice 126, 127 of the connecting part 103 when they are forced to do so, for example during a coupling step with the mating connector 200.

[0039] The two mating parts 100, 200 having standardized dimensions for use in a motor vehicle airbag squib system, the connection is done in a limited space. The main part 102 of the main housing 101 is therefore limited in terms of thickness, with the result that integrating a known spring-lock system of the state of the art using a helical spring is not possible due to the lack of space for the travel of such a spring.

[0040] The connector 100 comprises a formed wire locking spring 129, which allows an integration of the spring-locking function and therefore has an improvement relative to the known squib connectors of the state of the art, but also relative to the known spring-lock connectors of the state of the art by making it possible to provide this functionality in reduced spaces. As illustrated in Figures 1 and 3B, the formed wire spring 129 can be formed essentially with a bowed geometry, or U-shaped or horseshoe geometry, such that it can be arranged following the essentially trapezoidal shape of the main part 102, in particular in an inner contour 132 of the main part 102. Furthermore, as emerges from Figure 1, each of the ends 130, 131 of the formed wire spring 129 can be formed so as to produce a tab or a hook essentially perpendicular to the plane formed by the essentially bowed geometry of the spring 129.

[0041] The formed wire spring 129 can be of the "slip socket spring" type, i.e., in addition to its bowed geometry, it may also comprise coils on each side of the arc joining the latter with the ends 130, 131 so as to behave like a "torsion

spring".

[0042] Figures 2A-2B and 3A-3B illustrate the connector 100 assembled and in its delivery position state, i.e., with the spring 129 in its delivery position, in particular in a relaxed state, essentially flat in the inner contour 132 of the main part 102 of the housing 101. In the delivery state of the connector 100, as in particular emerges from Figure 3A, the CPA plunger 115 is in a delivery position in which it is kept level in the main part 102 by its collar 121 and extends essentially in the connecting part 103, as particularly illustrated by Figures 2A, 2B and 3A.

[0043] Furthermore, in the delivery state of the connector 100, the housing 101 is closed by the cover 104, as illustrated by Figures 2A-2B and the sectional view of Figure 3A. To that end, the main housing 101, in particular the main part 102, and the cover 104 can comprise locking elements 134, 135, 136, 137, 138, 139, 140, 141. For example, the main part may comprise a locking lug 134 at the end opposite the grooves 105, 106 for passage of the conductors 109, 110 of the main part 102 allowing locking with a suitable locking aperture 141 of the cover 104, as well as lateral side locking zones 135, 136 allowing locking of the longitudinal sides of the main part 102 with the respective locking lugs 138, 140 of suitable side locking lances 137, 139 of the cover 104.

[0044] Figures 1 and 2B and the sectional view of Figure 3A further illustrate that the cover 104 can comprise a slight protuberance 142 essentially in the shape of a sloped arc, and which is in fact formed by a hollow receiving zone 143 suitable for receiving the locking spring 129 in the cover 104 when it goes from its relaxed state to a tensed or loaded state during a step for coupling the connector 100 to a mating connector 200, for example as in the steps illustrated by Figures 4A-4B and 5A-5B, which will be outlined below. However, in the delivery state of the connector 100, and therefore in the relaxed delivery position of the locking spring 129, the spring 129 is not received in the zone 143 and is essentially flat in the inner contour 132, with the tabs 130, 131 oriented toward the bottom of the main part 102, in particular in the same direction as the protrusion formed by the connecting part 103, i.e., in a direction facing the mating connector 200 during coupling such that a movement of the locking spring 129 by the CPA plunger 115 is resilient and tenses the spring 129, as illustrated by Figures 4A and 5A.

[0045] The motor vehicle airbag squib system connector 100 illustrated in Figures 1, 2A-2B and 3A-3B, in its delivery state in particular illustrated in Figures 2A-2B and 3A-3B, can then be engaged in a coupling sequence with a mating connector 200 also meeting the constraints imposed by airbag squib system standards. One example sequence is described below in reference to Figures 4A-4B, 5A-5B and 6A-6B, which are cross-sections of the connecting part 103 of the connector 100 and the mating connector 200 during possible steps of a coupling. For greater clarity in the illustrations, the cover 104 is only illustrated in Figures 6A-6B.

[0046] Figures 4A-4B in particular illustrate a step where coupling has been initialized between the connector 100 and its mating connector 200. In that step, the force exerted in order to couple the two mating connectors 100, 200 has not been sufficient to perform the primary locking, and the connector 100 is therefore not locked to the mating connector 200. The connection assurance element 115 is pushed back into the main part 102 of the housing 101 by a stop on the mating connector 200, with the result that it resiliently moves the spring 129 into the zone 143 of the cover 104, such that the spring 129 is tensed, or loaded, and then exerts pressure on the CPA 115 in the direction opposing the coupling. The coupling movement is not continued, and the mating connector 200 will therefore be ejected by the CPA 115 automatically under the effect of the tension of the spring 129.

[0047] Figures 5A-5B illustrate a coupling step where the force exerted in order to couple the two mating connectors 100, 200 has been sufficient to achieve the primary locking of the connector 100 with its mating connector 200. The connection assurance element 115 has been maximally pushed back in the main part 102 of the housing 101 by the mating connector 200, thus moving the spring 129 in its maximum travel limited by the dimension of the zone 143 of the cover 104. The loaded spring 129 still exerts pressure on the CPA plunger 115 in a direction opposing the coupling, but, given that the primary locking is done, the CPA plunger 115 is in a state where the locking lances 116, 118 are retracted because the lugs 117, 119 have been deflected by the perimeter of the orifice 120, which makes it possible, under the thrust of the spring 129, for the CPA plunger 115 to advance automatically into a CPA receiving zone 208 of the mating connector 200.

[0048] Lastly, Figures 6A-6B illustrate a coupling step automatically following the step illustrated in Figures 5A-5B, i.e., a step where the connector 100 and its mating connector 200 are locked to each other by their primary locking, and in which the CPA plunger 115 has been pushed back by the spring 129 in the CPA receiving zone 208 of the mating connector 200, with the result that it performs the secondary locking of the assembly, in particular by a stop of the locking lugs 117, 119 against the mating secondary locking zones 209, 210 of the mating connector 200. The CPA device 115 is then in its delivery position. Likewise, the locking spring 129 is also in its delivery position, in particular the spring 129 is relaxed.

[0049] As illustrated by the sectional views of Figures 4A-4B, 5A-5B and 6A-6B, a mating connector 200 meeting the standards for airbag squib systems may comprise a mating main housing 201 with an essentially cylindrical geometry adapted to coupling with the connecting part 102 of the connector 100. In this example, as illustrated in Figures 4A-4B, 5A-5B and 6A-6B, the mating main housing 201 has a diameter larger than that of the connecting part 102 so as to receive the latter during the coupling. These figures also show that the end of the mating connector 200 facing the

connector 100 can further comprise mating locking zones 202, 203 that are suitable for performing the primary locking of the assembly with the locking lances 122, 124 of the connecting part 102 of the connector 100. To that end, the mating locking zones 202, 203 can end, in the direction of the connector 100, with a respective mating locking lug 204, 205 on which the corresponding locking lug 123, 125 of the connecting part 103 slides, so as to be deflected toward the retraction orifices 126, 127 during the advancement of the mating connectors 100, 200. This deflection can then make it possible, if the force exerted in order to couple the two mating connectors is greater than the ejection force exerted by the spring 129 and the CPA plunger 115, to perform the main locking of the assembly when the lugs 123, 125 have advanced enough to pass beyond the mating lugs 204, 205 such that the locking lances 122, 124 return to their initial non-deflected position and the lugs 123, 125 abut against the mating lugs 204, 205, as in particular illustrated in Figures 5A-5B and 6A-6B.

[0050] Figures 4B, 5B and 6B further illustrate that the mating connector 200 can comprise two mating electrical terminals 206, 207 suitable for being received in the receiving elements 113, 114 of the connecting part 103 in order to perform an electrical connection with the terminals 111, 112, in particular with the conductors 109, 110.

[0051] Figures 4A, 5A and 6A lastly illustrate that the mating connector 200 can comprise a CPA plunger receiving zone 208, the diameter of which is smaller than that of the CPA plunger 115 when the latter is in its delivery position, so as to produce a stop for the locking lugs 117, 119 of the CPA plunger 115 against the edges 211, 212 of the CPA receiving zone 208 that are presented to the connector 100 during a coupling movement, thus causing the withdrawal of the CPA plunger 115 toward the main part 102 and therefore the resilient movement of the spring 129 as illustrated in Figure 4A, while the primary locking is not done. Figures 4A, 5A and 6A also show that the CPA receiving zone 208 of the mating connector 200 extends by a wider portion whereof the edges 209, 210 are mating secondary locking zones 209, 210 in order to perform the secondary locking with the locking lugs 117, 119 when, once the primary locking is done, the gap of the locking lances 116, 118 toward the inside of the CPA plunger 115 will allow the latter to "plunge", under the effect of the thrust exerted by the tensed spring 129, in the CPA receiving zone 208 until the locking lugs 117, 119 reach the mating secondary locking zones 209, 210, the wider diameter of which will make it possible for the locking lances 116, 118 to return to their delivery position, the stop of the lugs 117, 119 against the zones 209, 210 then performing the secondary locking, as illustrated in Figure 6A.

[0052] Figure 7 is an exploded view of an embodiment of an electrical connector 10100 according to the present invention. In this embodiment, the connector 10100 is a squib connector for a safety restraint system of a motor vehicle which can be coupled to a standard mating connector, that is to say, a squib carrier receptacle. Such a standard squib carrier receptacle 10200 of a motor vehicle manufacturer is illustrated in Figure 8A and in the following Figures.

[0053] Figures 8A-8B, 9A-9B, 10A-10B and 11A-11B illustrate an example of a sequence for coupling the connector 10100 to a standard squib carrier receptacle 10200. Figures 8A-8B illustrate the establishment of a physical contact between the connector 10100 and the receptacle 10200, the connector 10100 being in a delivery state. Figures 9A-9B and 10A-10B illustrate the forward movement of the connector 10100 into the receptacle 10200, the connector 10100 being in loaded states. Finally, Figures 11A-11B illustrate the connector 10100 in the state correctly plugged and locked to the receptacle 10200 and therefore returned to the delivery state thereof.

[0054] As can be seen from Figure 7, the squib connector 10100 may comprise a main casing 10101 and a cover 10102. The main casing 10101 may in turn comprise a conductor receiving portion 10103 and a connection portion 10104, the connection portion 10104 being configured to be coupled to the standard squib carrier receptacle 10200 of a motor vehicle manufacturer, in particular a squib carrier receptacle 10200 which can receive in a standard manner a "plunger" type CPA device, for example, the "plunger" type CPA device 10135 illustrated in Figure 7, which enables assurance that the connection is maintained in the coupling direction indicated by the arrow 10300, which can be seen in greater detail in particular in Figure 8B. Figure 7 further illustrates that the conductor receiving portion 10103 may comprise two openings for receiving conductors 10105, 10106 and a portion for receiving filtering ferrite 10107 which can receive a first conductor 10108, a second conductor 10109 and an associated filtering ferrite 10110. At the output of the filtering ferrite 10110, the conductors 10108, 10109 are extended with terminals 10111, 10112 which are bent substantially in a perpendicular state so as to terminate with contact terminals 10113, 10114 which are received in tabs 10115, 10116 of the connection portion 10104 which complement the contact pins of the squib receptacle 10200.

[0055] Figure 7 further shows that the cover 10102 of the connector 10100 may comprise locking means, in this instance the locking tabs 10117, 10118 and/or locking zones, in this instance the locking zone 10119, which complement the locking zones 10120, 10121 and/or locking means, in this instance the stud 10122, of the main casing 10101 so as to be fixed thereto when the connector 10100 is assembled. The cover 10102 may further comprise a tongue 10123 which can be seen in Figure 7 and which is directed towards the inner side of the connector 10100 and configured to hold the filtering ferrite 10110 in place in the zone 10107. Figure 7 also shows that the cover 10102 may comprise a reception zone 10124 which allows the locking spring 10125 which is loaded by a pushing force of the plunger type CPA device 10135 in a loaded state of the connector 10100 to be received. It should be noted that, for reasons of clarity in the Figures, which will be evident to the person skilled in the art, the cover 10102 will, however, be made transparent in the Figures 8A-8B, 9A-9B, 10A-10B and 11A-11B which illustrate the coupling sequence example.

[0056] The connector 10100 of the embodiment illustrated in Figure 7 comprises a spring 10125, in particular a resilient

rod of shaped wire, carrying out the function of a locking spring, that is to say, for automatic ejection of the connector 10100 in the case of poor connection, in conjunction with the plunger type CPA device 10135. The spring 10125 is therefore of the "mouse-trap" type, and therefore is substantially "U"-shaped or horseshoe-shaped. In this manner, the spring 10125 comprises a transverse rod 10126 which, in the delivery state illustrated in particular in Figures 8A-8B, that is to say, when the spring 10125 is relaxed, is accommodated in the upper portion of the connection portion 10104. Whether the connector 10100 is in a delivery state or in a loaded state, the transverse rod 10126 rests on the head 10139 of the first CPA device 10135, in particular it may rest on the ramp 10140 in a loaded state. At each of the ends thereof, the rod 10126 extends with a lateral rod 10127, 10128 which terminates with turns 10129, 10130 and finally with a tab 10131, 10132 which forms a predetermined angle with the plane defined by the rods 10126, 10127, 10128. In the connector 10100 assembled as illustrated in Figures 8A-8B, 9A-9B, 10A-10B and 11A-11B, the turns 10129, 10130 may be arranged around elements which form an axle 10133, 10134 of the conductor receiving portion 10103.

[0057] In accordance with the present invention, the connector 10100 comprises a first CPA device, in this instance the plunger type CPA device 10135, which can be moved in the coupling direction 10300, 10301 and in this instance along a housing 10141 provided in the connection portion 10104. As illustrated in particular in Figure 7, the first CPA 10135 comprises a head 10139 provided with a ramp 10140 which allows a return to be facilitated from a loaded state to a delivery state of the connector 10100, as illustrated in particular in Figures 10A-10B. The first CPA 10135 may also comprise two locking lances 10137, 10138, at one side and the other of a main body 10136 in continuation of the head 10139, configured so as to move into contact with a contact surface 10206 of the retention element 10202 of the squib carrier receptacle 10200 as illustrated in Figures 8A-8B and 9A-9B, whilst the force applied to couple the connector 10100 to the receptacle 10200 is not sufficient to ensure main locking. If the force is sufficient to change the connector 10100 to a loaded state, such as that illustrated in Figures 10A-10B, the lances 10137, 10138 may be redirected and thus enable the first CPA 10135 to "plunge" in a receiving zone 10207 provided in a standard manner in the retention element 10202 which will allow the transition to a connected and locked state of the connector 10100 which also corresponds to a delivery state, and which will be described in greater detail with reference to Figures 11A-11B. Regardless of the state of the connector 10100, the first CPA 10135 is configured so that the head 10139 and, where applicable, the ramp 10140 is always in contact with the spring 10125, in particular the transverse rod 10126, as illustrated in particular in Figures 8A-8B, 9A-9B, 10A-10B and 11A-11B which describe an example of an embodiment of a coupling sequence.

[0058] Still in accordance with the present invention, the connector 10100 comprises main locking means, in this instance the two locking lances 10142, 10143 which are illustrated in particular in Figure 7, and which can be redirected so as to allow a main locking action of the connector 10100 to be carried out with respect to the receptacle 10200. In particular, the main locking action can be ensured by a respective locking stud 10144, 10145 of each of the lances 10142, 10143 which is accommodated, when the force which carries out the coupling is sufficient, in respective locking zones 10203, 10204 of the receptacle portion 10201 of the squib carrier receptacle 10200. The main locking action is illustrated in particular in Figures 11A-11B and can therefore take place only after the locking lances 10142, 10143 have been able to be redirected into the respective redirection spaces 10148, 10149 of the connection portion 10104. In the delivery state, however, the locking lances 10142, 10143 are blocked and cannot be redirected into these spaces 10148, 10149. According to a preferred variant of an embodiment of the present invention, the locking lances 10142, 10143 may comprise to this end a respective tab 10146, 10147. The tabs 10146, 10147 may be blocked in a delivery state of the connector 10100 so as to prevent redirection of the lances 10142, 10143, in particular the tabs 10146, 10147 may be blocked by a respective position assurance element 10151, 10152 of a second CPA device 10150 provided in the connector 10100, the second CPA 10150 being able to be moved in contrast to the plunger type CPA device 10135 in a direction which is different to the coupling direction 10300, 10301. Furthermore, in a loaded state, as a result of the movement of the second CPA 10150, the tabs 10146, 10147 may be disengaged in disengagement spaces 10155, 10156 of the second CPA 10150.

[0059] According to the present invention, the connector 10100 therefore comprises a second CPA device 10150 which may also be provided in the main casing 10101, for example, in the region of the connection between the receiving portion 10103 of the conductors 10108, 10109 and the connection portion 10104. According to the present invention, the second CPA device 10150 can be moved in a direction different from the coupling direction 10300, 10301, in particular in a transverse direction relative to the coupling direction 10300, 10301, more particularly in a direction which corresponds to the longitudinal direction of the conductor receiving portion 10103 of the main casing 10101 of the connector 10100. In the embodiment illustrated in Figure 7, and as will be described in greater detail with particular reference to Figure 9B, the second CPA device 10150 can be moved in a direction 10302 which is substantially perpendicular to the coupling direction 10300, 10301 from a delivery position illustrated in Figures 8A-8B, in which it prevents redirection of the locking lances 10142, 10143 to a position which allows redirection of the locking lances 10142, 10143 which is illustrated in Figures 9A-9B and 10A-10B. As illustrated in Figures 11A-11B, after the main locking has been put in place, the second CPA device 10150 can return to the delivery position thereof, thus ensuring that the main locking action is maintained between the connector 10100 and the receptacle 10200.

[0060] Furthermore, according to an advantageous variant of an embodiment of the present invention which is also illustrated in Figure 7, the tabs 10131, 10132 of the locking spring 10125 can be received in blocking holes 10153, 10154 of the second CPA device 10150. Consequently, according to an advantageous variant of a preferred embodiment of the present invention, a loading of the spring 10125 can bring about a movement of the second CPA device 10150. In particular, a pushing force to insert the connector 10100 in the receptacle 10200 will first carry out a movement of the first CPA device 10135 in the ejection direction 10301, moving the connector 10100 from the delivery state illustrated, for example, in Figures 8A-8B, to a loaded state such as that illustrated in Figures 9A-9B, which can therefore bring about a loading of the spring 10125 and consequently also a movement of the second CPA device 10150 in a direction 10302 perpendicular relative to the direction 10300, 10301 which releases the locking lances 10142, 10143, as shown in Figures 10A-10B. In the same manner, when the plunger type CPA device 10135 is "plunged" into the receptacle 10200 under the action of the pressure applied by the spring 10125 which is seeking to relax from the loaded state thereof, the relaxation of the spring 10125 may also bring about a movement of the second CPA device 10150 in a direction counter to the direction 10302, therefore also causing it to return to the delivery state thereof which prevents redirection of the locking lances 10142, 10143 as illustrated in particular in Figures 11A-11B. Figure 7 further illustrates that the second CPA 10150 is substantially "H"-shaped, each of the two lateral tabs of the "H" comprising one of the two disengagement spaces 10155, 10156 provided between one of the two assurance elements 10151, 10152 and one of the two blocking hole portions 10153, 10154.

[0061] A coupling and locking sequence of the connector 10100 of the embodiment illustrated in Figure 7 with a standard squib carrier receptacle 10200 of a motor vehicle manufacturer will be described below with reference to Figures 8A-8B, 9A-9B, 10A-10B and 11A-11B. Figures 8A, 9A, 10A and 11A illustrate the coupling sequence in a three-dimensional perspective view from above. Figures 8B, 9B, 10B and 11B correspond to the same steps as Figures 8A, 9A, 10A and 11A, respectively, but are views which comprise a plane of section in the directions 10300, 10301 and 10302, 10303. Figures 8A-8B, 9A-9B, 10A-10B and 11A-11B illustrate the connector 10100 assembled with all the elements described with reference to Figure 7, with the exception of the cover 10102 which has been made transparent for illustrative reasons which are evident to the person skilled in the art. The filtering ferrite 10110 has also been made transparent in Figure 11B.

[0062] Figures 8A-8B illustrate a delivery state of the connector 10100, which just comes into contact with the receptacle 10200. This is therefore substantially a step of first contact between the connector 10100 and the receptacle 10200. The connector 10100 is in abutment with the receptacle 10200, but is not plugged therein. In particular, the locking lances 10137, 10138 of the first CPA 10135 are in abutment with a contact surface 10206 of the retention element 10202 of the squib receptacle 10200, and the first CPA 10135, or plunger type CPA 10135, is in the lowest position thereof in the housing 10141. In the delivery state, the spring 10125 is relaxed, the transverse rod 10126 thereof resting on the head 10139 of the plunger type CPA 10135, and the second CPA 10150 is also in the initial position thereof, with the retention elements 10151, 10152 wedged behind the tabs 10146, 10147 of the locking lances 10142, 10143 so as to prevent them from being redirected in disengagement or redirection spaces 10148, 10149 of the connection portion 10104.

[0063] If the coupling movement of the connector 10100 with the receptacle 10200 is continued in the insertion direction 10300, the force applied to plug the connector 10100 in the receptacle 10200 will move the connector 10100 into a loaded state such as that illustrated in Figures 9A-9B. The connector 10100 is partially plugged in the receptacle 10200, but the locking lances 10142, 10143 are not yet redirected so that their studs 10144, 10145 move into abutment against the crown 10205 of the receptacle 10200. The coupling movement or insertion movement can be seen in that the pressure of the plunger type CPA 10135 on the contact surface 10206 causes the plunger type CPA 10135 to rise along the housing 10141 in the direction 10301, and the head 10139 of the plunger type CPA 10135 will apply a pressure to the transverse rod 10126 of the spring 10125, loading it relative to the delivery state. This loading of the spring 10125 can be seen in a pivoting action of the tabs 10131, 10133 about the axes 10133, 10134, thus bringing about a forward movement of the second CPA 10150 in the direction 10302, substantially perpendicular relative to the direction 10300, 10301 in this embodiment. The elements 10151, 10152 will therefore move forward in this direction 10302 and progressively make space for the disengagement spaces 10155, 10156.

[0064] In the step illustrated in Figures 9A-9B, if the force applied to carry out the coupling is not adequate, or if the operator stops the coupling movement, the loading of the spring 10125 acting counter to the continuation of the coupling, the plunger type CPA 10135 will therefore be repelled towards the initial position thereof by the spring 10125 which is seeking to relax so that the connector 10100 will be ejected from the receptacle in the ejection direction 10301. Where applicable, the connector 10100 will change back to the delivery state thereof, that is to say that the first CPA 10135, the second CPA 10150 and the spring 10125 will be in their initial position, and the locking lances 10142, 10143 will therefore be blocked by the second CPA 10150.

[0065] If the coupling movement continues, however, the plunger type CPA 10135 will continue its upward movement in the housing 10141 in the direction 10301 owing to the abutment of the locking lances 10137, 10138 against the contact surface 10206 of the retention element 10202 of the receptacle 10200, moving the connector 10100 to a loaded state illustrated in Figures 10A-10B. The movement of the plunger type CPA 10135 will therefore further load the spring 10125,

until the maximum loading of the spring 10125, corresponding to the uppermost position of the plunger type CPA 10135 illustrated in Figures 10A-10B, brings about an adequate movement of the second CPA 10150 in the direction 10302 so that the retention elements 10151, 10152 completely leave space for the disengagement spaces 10155, 10156 behind the tabs 10146, 10147 of the locking lances 10142, 10143. Following the coupling movement, the studs 10144, 10145 of the locking lances 10142, 10143 will consequently be able to be redirected by the crown 10205, and the locking lances 10142, 10143 will therefore be redirected in the direction 10304 and in the direction 10303, respectively, towards the inner side of the connection portion 10104, in particular in the spaces 10148, 10149 thereof, and therefore in the disengagement zones 10210, 10211 of the receptacle 10200.

[0066] Figure 10B illustrates in particular the upper position of the plunger type CPA 10135 in the housing 10141. In this position, either when the spring 10125 is in the most loaded relative state thereof, with in particular the transverse rod 10126 thereof in abutment with the ramp 10140 of the head 10139 of the first CPA 10135, and the second CPA 10150 allows the locking lances 10142, 10143 to be redirected, the locking lances 10137, 10138 of the plunger type CPA 10135 have moved into contact with the neck 10157 of the housing 10141. The contact with the neck 10157 can bring about the redirection of the lances 10137, 10138 in the direction of the main body 10136 of the plunger type CPA 10135, which is therefore free to be "plunged" into the retention element 10202 of the receptacle 10200. The cover 10102 of the connector 10100 may comprise a zone 10124 which is configured to receive the spring 10125 and the plunger type CPA device 10135 in the maximum loaded state.

[0067] The type of spring 10125, the maximum relative loading of the spring 10125 and therefore the maximum rise permitted for the plunger type CPA 10135 and the dimensions of the cover 10102 but also the dimensions of the main casing 10101 and the movement of the second CPA 10150 are parameters which can be adjusted in accordance with the space available for the connection technology elements and in particular the environment in which the standard receptacle 10200 is integrated.

[0068] At this stage, as illustrated in Figures 10A-10B, the locking lances 10142, 10143 are received in the locking zones 10203, 10204 and therefore ensure the main locking of the connector 10100 to the receptacle 10200. The connector 10100 can no longer be ejected from the receptacle 10200. In particular, the connector 10100 can no longer be inserted incorrectly or plugged incorrectly in the receptacle 10200. This is because the plunger type CPA 10135 whose locking lances 10137, 10138 are redirected, will automatically be plunged into the receiving zone 10207 of the retention element 10202 in the insertion direction 10300 under the action of the relaxation of the spring 10125, in particular the pressure applied by the rod 10126 to the ramp 10140 and the head 10139 of the plunger type CPA 10135, the ramp 10140 promoting the action of the spring 10125 on the plunger type CPA 10135. The relaxation of the spring 10125 will also automatically bring about a movement of the second CPA 10150 in a direction counter to the direction 10302.

[0069] In this step, given that the main locking action of the locking lances 10142, 10143 with respect to the locking zones 10203, 10204 is carried out, the connector 10100 will automatically move back to the delivery state thereof, as illustrated in Figures 11A-11B. In particular, the spring 10125 will automatically move back to the delivery state thereof and therefore be substantially relaxed. The plunger type CPA 10135 will also automatically move back to the lowest position thereof as in Figures 8A-8B, but this time in the receiving zone 10207 of the retention element 10202 of the squib carrier receptacle 10200. Surfaces 10208, 10209 of the receiving zone 10207 will be able to prevent the plunger type CPA 10135 from rising in the ejection direction 10301 by producing a stop for the locking lances 10137, 10138. Finally, the relaxation of the spring 10125 will also automatically bring about a movement of the second CPA 10150 to the initial delivery position thereof, that is to say, the position in which the retention elements 10151, 10152 block the tabs 10146, 10147 and therefore prevent the redirection of the locking lances 10142, 10143 as illustrated in Figures 11A-11B.

[0070] In this manner, vibrations which will have a tendency to move the first CPA device 10135 away from its delivery position, which is a position which carries out the secondary locking between the connector 10100 and the receptacle 10200, will not affect the second CPA device 10150 since it can be moved in a different direction. In particular, vibrations which will have a tendency to affect the connector 10100 which is plugged in the receptacle 10200 in the coupling direction 10300, 10301 will not be able to affect the second CPA device 10150 to the same extent. Conversely, vibrations which affect the second CPA device 10150 will have a lesser effect on the first CPA device 10135. Owing to the locking spring 10125, the movements of the two CPA devices 10135, 10150 may be connected and can therefore compensate for each other in the event of vibrations or impacts, thus ensuring good retention of the connection.

[0071] As emerges from the example and the embodiment described using Figures 1 to 11B, the invention in particular has the advantage of being able to reduce the dimensions of spring-lock connector systems so as to be able to be used in reduced or confined spaces. Furthermore, the use of a single formed wire spring is advantageous, as it makes it possible to reduce the costs relative to the systems known from the state of the art comprising several helical springs.

[0072] The invention is particularly interesting for a motor vehicle airbag squib system, since it allows the integration of a spring-lock system, as well as a combination with a CPA device, which was not possible in the connectors of squib systems known from the state of the art. Furthermore, in advantageous alternatives of preferred embodiments, the invention has the advantage that a so-called "plunger piston" type CPA device can detect whether the connector is

correctly coupled. Furthermore, in one advantageous alternative, during the coupling sequence, the CPA device can eject the mating connector. In another advantageous alternative, at the end of the coupling sequence, the connector is locked with the mating connector, and the CPA device can return to its delivery position, and the locking spring can be relaxed.

5 **[0073]** As a result of the different advantageous aspects and embodiments thereof, the present invention therefore enables a connector to be provided which can automatically be ejected in the event of incorrect insertion in a mating connector, whilst being able to ensure that a correct locking action is maintained once correctly plugged in the mating connector. The present invention in particular allows a connector to be provided which comprises a CPA device which can be moved in a direction which is different from the insertion direction of the connector, which therefore allows the locking retention mechanism to be made more effective with respect to impacts and vibrations than in the connectors known from the prior art. An advantageous application of the present invention is the automotive industry and in particular squib connectors for safety restraint systems. The invention allows the specific demands of motor vehicle manufacturers to be complied with in terms of connection safety for standardized squib carrier receptacles.

10 **[0074]** It will be clear to one skilled in the art that the embodiments of the various alternatives described above can all be combined with each other in order to produce more alternatives according to the present invention.

15 **[0075]** The person skilled in the art will understand that the different advantages connected with the embodiments of the present invention can be combined with each other. Furthermore, the person skilled in the art will appreciate that the present invention is not limited to the connection technology of safety restraint systems in motor vehicles, but can be used for any type of connection technology for environments which are regularly subjected to impacts and/or vibrations.

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REFERENCE SIGNS

[0076]

- 25 100 electrical connector
- 101 main housing
- 102 main part
- 103 connection part
- 104 cover
- 30 105 conductor passage groove
- 106 conductor passage groove
- 107 ferrite receiving cavity
- 108 filtering ferrite
- 109 electrical conductor
- 35 110 electrical conductor
- 111 terminal
- 112 terminal
- 113 terminal receiving element
- 114 terminal receiving element
- 40 115 CPA plunger
- 116 locking lance
- 117 locking lug
- 118 locking lance
- 119 locking lug
- 45 120 CPA element receiving orifice
- 121 collar
- 122 locking lance
- 123 locking lug
- 124 locking lance
- 50 125 locking lug
- 126 lance retraction orifice
- 127 lance retraction orifice
- 128 CPA element receiving part
- 129 locking spring
- 55 130 spring tab
- 131 spring tab
- 132 inner contour
- 133 ferrite maintaining tongue

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	134	locking lug
	135	lateral locking zone
	136	lateral locking zone
	137	lateral locking lance
5	138	locking lug
	139	lateral locking lance
	140	locking lug
	141	locking aperture
	142	protuberance
10	143	spring receiving zone
	200	mating electrical connector
	201	mating main housing
	202	mating locking zone
	203	mating locking zone
15	204	mating locking lug
	205	mating locking lug
	206	mating electrical terminal
	207	mating electrical terminal
	208	CPA plunger receiving zone
20	209	mating secondary locking zone
	210	mating secondary locking zone
	211	CPA stop zone
	212	CPA stop zone
	10100	Electrical connector
25	10101	Main casing
	10102	Cover
	10103	Conductor receiving portion
	10104	Connection portion
	10105	Conductor receiving opening
30	10106	Conductor receiving opening
	10107	Filtering ferrite receiving portion
	10108	Electrical conductor
	10109	Electrical conductor
	10110	Filtering ferrite
35	10111	Terminal
	10112	Terminal
	10113	Contact terminal
	10114	Contact terminal
	10115	Contact tab
40	10116	Contact tab
	10117	Locking tab
	10118	Locking tab
	10119	Locking zone
	10120	Locking zone
45	10121	Locking zone
	10122	Locking stud
	10123	Ferrite retention tongue
	10124	Receiving zone
	10125	Spring
50	10126	Transverse rod
	10127	Lateral rod
	10128	Lateral rod
	10129	Turns
	10130	Turns
55	10131	Spring tab
	10132	Spring tab
	10133	Spring axle
	10134	Spring axle

	10135	Plunger type CPA device
	10136	Body
	10137	Locking lance
	10138	Locking lance
5	10139	Head
	10140	Ramp
	10141	Housing of plunger type CPA
	10142	Main locking lance
	10143	Main locking lance
10	10144	Locking stud
	10145	Locking stud
	10146	Tab
	10147	Tab
	10148	Lance redirection space
15	10149	Lance redirection space
	10150	Transverse CPA device
	10151	Lance position assurance element
	10152	Lance position assurance element
	10153	Spring tab blocking hole
20	10154	Spring tab blocking hole
	10155	Disengagement space
	10156	Disengagement space
	10157	Neck
	10200	Squib carrier receptacle
25	10201	Receptacle portion
	10202	Connector retention element
	10203	Locking zone
	10204	Locking zone
	10205	Crown
30	10206	Contact surface
	10207	Plunger type CPA receiving zone
	10208	Secondary locking zone
	10209	Secondary locking zone
	10210	Disengagement zone
35	10211	Disengagement zone
	10300	Coupling direction, insertion direction
	10301	Coupling direction, ejection direction
	10302	Movement direction of the second CPA device
	10303	Redirection direction, redirection direction of the lance 10143
40	10304	Redirection direction, redirection direction of the lance 10142

Claims

- 45 1. Electrical connector (10100), in particular a squib connector for a safety restraint system of a motor vehicle, which can be coupled to a mating electrical connector (10200) in a coupling direction (10300) comprising:
- 50 a locking spring (10125) "U"-shaped or horseshoes-shaped, and comprising a transverse rod (10126) from each end of which extends a lateral rod (10127, 10128) which terminates with turns (10126, 10130) and with a tab (10131,10132),
- the locking spring (10125) which is relaxed in a delivery state, is configured to act counter to a coupling of the connector (10100) to the mating connector (10200) in a loaded state of the spring (10125); and
- 55 a first position assurance element of the connector (10135), comprising a head (10139) configured so that the head (10139) is always in contact with the spring (10125), in particular the transverse rod (10126), configured such that the first position assurance element of the connector (10135) can be moved in the coupling direction (10300, 10301) when the connector (10100) is coupled to the mating connector (10200) from a delivery position to the delivery state and such that the head (10139) of the first position assurance element (10135) applies a pressure to the transverse rod (10126) of the spring (10125), loading it relative to the delivery state

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as long as the connector (10100) and the mating connector (10200) are not correctly coupled, wherein the electrical connector (10100) further comprises a second "H"-shaped position assurance element of the connector (10150) comprising blocking holes (10153, 10154),
5 configured such that the tabs (10131, 10132) of the locking spring (10125) can be received in the blocking holes (10153, 10154) of the second position assurance element of the connector (10150),
such that the second position assurance element of the connector (10150) can be moved by a loading of the spring (10125) from a delivery position to the delivery state in a direction (10302) which is different from the coupling direction (10300, 10301).

10 **2.** Electrical connector (10100) according to claim 1, wherein the second position assurance element of the connector (10150) is movable in a direction (10302) substantially perpendicular to the coupling direction (10300, 10301).

15 **3.** Electrical connector (10100) according to any one of claims 1 to 2, wherein the first position assurance element of the connector (10135) comprises two locking lances (10137, 10138) at one side and the other of a main body (10206) in continuation of the head (10139) and, during a coupling operation, as long as the connector (10100) and the mating connector (10200) are not correctly coupled, in the loaded state, the first position assurance element of the connector (10135) is configured to repel the mating connector (10200) under the action of a pressure applied by the spring (10125) by means of the locking lances (10137, 10138) of the first position assurance element of the connector (10135) being in abutment with a contact surface (10206) of a retention element (10202) of the mating connector (10200).
20

25 **4.** Electrical connector (10100) according to any one of claims 1 to 3, further comprising at least one main locking element (10142, 10143), being at least one locking lance (10142, 10143), comprising a respective locking stud (10144, 10145) and a respective tab (10146, 10147), which is provided in a delivery position in the delivery state and which can be redirected in order to allow the coupling, in which the delivery position of the at least one main locking element (10142, 10143) carries out a first locking action of the connector (10100) with respect to the mating connector (10200) when they are correctly coupled such that the locking stud (10144, 10145) of the at least one main locking element (10142, 10143) is accommodated in a respective locking zone (10203, 10204) of a receptacle portion (10201) of the mating connector (10200).
30

35 **5.** Electrical connector (10100) according to claim 4, wherein the delivery position of the second position assurance element of the connector (10150) prevents redirection of the at least one main locking element (10142, 10143) by means of the tab (10146, 10147) being blocked by a respective position assurance element (10151, 10152) of the second position assurance element of the connector (10150).

40 **6.** Electrical connector (10100) according to claim 5, wherein a loaded state of the spring (10125) moves the second position assurance element of the connector (10150) in order to allow redirection of the at least one main locking element (10142, 10143).

45 **7.** Electrical connector (10100) according to any one of claims 1 to 6, wherein, when the connector (10100) and the mating connector (10200) are correctly coupled, the connector (10100) returns to the delivery state thereof, in particular so that the spring (10125) is relaxed, and the first position assurance element of the connector (10135) and the second position assurance element of the connector (10150) are in their delivery position and, more specifically in combination with any one of claims 4 to 6, the at least one main locking element (10142, 10143) is in the delivery position thereof.

50 **8.** Electrical connector (10100) according to any one of claims 3 to 7, wherein, when the connector (10100) and the mating connector (10200) are correctly coupled, the first position assurance element of the connector (10135) whose locking lances (10137, 10138) are redirected and automatically plunged into a receiving zone (10207) of a retention element (10202) of the mating connector (10200) under the action of the relaxation of the spring (10125), produces a second locking action of the connector (10100) with respect to the mating connector (10200).

9. Electrical connector (10100) according to any one of claims 1 to 8, further comprising:

55 a main casing (10101) in which there are provided the spring (10125), the first position assurance element of the connector (10135) and the second position assurance element of the connector (10150), and a cover (10102) which can be fixed to the main casing (10101), comprising a receiving zone (10124) which enables the spring (10125) to be accommodated in the loaded state thereof and which limits the movement of

the first position assurance element of the connector (10135).

Patentansprüche

5

1. Elektrischer Verbinder (10100), insbesondere ein Zündpillen-Verbinder für ein Rückhaltesystem eines Kraftfahrzeugs, der mit einem elektrischen Gegenverbinder (10200) in einer Kopplungs-Richtung (10300) gekoppelt werden kann, wobei er umfasst:

10

eine Arretier-Feder (10125), die U-förmig oder hufeisenförmig ist und eine Querstrebe (10126) umfasst, von deren beiden Enden sich jeweils eine Längsstrebe (10127, 10128) erstreckt, die mit Windungen (10126, 10130) und mit einem Ansatz (10131, 10132) endet,

15

wobei die Arretier-Feder (10125), die in einem freien Zustand entspannt ist, so eingerichtet ist, dass sie einer Kopplung des Verbinders (10100) mit dem Gegenverbinder (10200) in einem gespannten Zustand der Feder (10125) entgegenwirkt; und

20

ein erstes Positionssicherungs-Element des Verbinders (10135), das einen Kopf (10139) umfasst und so eingerichtet ist, dass der Kopf (10139) ständig in Kontakt mit der Feder (10125), insbesondere der Querstrebe (10126), ist,

25

wobei es so eingerichtet ist, dass das erste Positionssicherungs-Element des Verbinders (10135), wenn der Verbinder (10100) mit dem Gegenverbinder (10200) gekoppelt wird, in der Kopplungs-Richtung (10300, 10301) von einer freien Position in den freien Zustand bewegt werden kann, und so eingerichtet ist, dass der Kopf (10139) des ersten Positionssicherungs-Elementes (10135) einen Druck auf die Querstrebe (10126) der Feder (10125) ausübt und sie relativ zu dem freien Zustand spannt, sofern der Verbinder (10100) und der Gegenverbinder (10200) nicht ordnungsgemäß gekoppelt sind,

30

wobei der elektrische Verbinder (10100) des Weiteren ein zweites, H-förmiges Positionssicherungs-Element des Verbinders (10150) umfasst, das Sperr-Löcher (10153, 10154) umfasst und so eingerichtet ist, dass die Ansätze (10131, 10132) der Arretier-Feder (10125) in den Sperr-Löchern (10153, 10154) des zweiten Positionssicherungs-Elementes des Verbinders (10150) aufgenommen werden können,

35

so dass das zweite Positionssicherungs-Element des Verbinders (10150) durch ein Spannen der Feder (10125) von einer freien Position in einer Richtung (10302), die sich von der Kopplungs-Richtung (10300, 10301) unterscheidet, in den freien Zustand bewegt werden kann.

2. Elektrischer Verbinder (10100) nach Anspruch 1, wobei das zweite Positionssicherungs-Element des Verbinders (10150) in einer Richtung (10302) im Wesentlichen senkrecht zu der Kopplungs-Richtung (10300, 10301) bewegt werden kann.

40

3. Elektrischer Verbinder (10100) nach einem der Ansprüche 1 bis 2, wobei das erste Positionssicherungs-Element des Verbinders (10135) zwei Arretier-Nasen (10137, 10138) an einer Seite und der anderen Seite eines Haupt-Körpers (10206) im Anschluss an den Kopf (10139) umfasst und während eines Kopplungsvorgangs, sofern der Verbinder (10100) und der Gegenverbinder (10200) nicht ordnungsgemäß gekoppelt sind, das erste Positionssicherungs-Element des Verbinders (10135) so eingerichtet ist, dass es in dem gespannten Zustand den Gegenverbinder (10200) unter der Wirkung eines durch die Feder (10125) ausgeübten Drucks dadurch wegdrückt, dass die Arretier-Nasen (10137, 10138) des ersten Positionssicherungs-Elementes des Verbinders (10135) an einer Kontaktfläche (10206) eines Rückhalte-Elementes (10202) des Gegenverbinders (10200) anliegen.

50

4. Elektrischer Verbinder (10100) nach einem der Ansprüche 1 bis 3, der des Weiteren wenigstens ein Haupt-Arretier-Element (10142, 10143) umfasst, das wenigstens eine Arretier-Nase (10142, 10143) ist, das einen entsprechenden Arretier-Bolzen (10144, 10145) sowie einen entsprechenden Ansatz (10146, 10147) umfasst, der sich in dem freien Zustand in einer freien Position befindet und dessen Richtung geändert werden kann, um das Koppeln zu ermöglichen, wobei in der freien Position des wenigstens einen Haupt-Arretier-Elementes (10142, 10143) ein erster Arretier-Vorgang des Verbinders (10100) in Bezug auf den Gegenverbinder (10200), wenn sie ordnungsgemäß gekoppelt sind, ausgeführt wird, so dass der Arretier-Bolzen (10144, 10145) des wenigstens einen Haupt-Arretier-Elementes (10142, 10143) in einer entsprechenden Arretier-Zone (10203, 10204) eines Aufnahmeabschnitts (10201) des Gegenverbinders (10200) aufgenommen wird.

55

5. Elektrischer Verbinder (10100) nach Anspruch 4, wobei in der freien Position des zweiten Positionssicherungs-Elementes des Verbinders (10150) Richtungsänderung des wenigstens einen Haupt-Arretier-Elementes (10142,

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10143) dadurch verhindert wird, dass der Ansatz (10146, 10147) durch ein entsprechendes Positionssicherungs-Element (10151, 10152) des zweiten Positionssicherungs-Elementes des Verbinders (10150) gesperrt wird.

5 6. Elektrischer Verbinder (10100) nach Anspruch 5, wobei in einem gespannten Zustand der Feder (10125) das zweite Positionssicherungs-Element des Verbinders (10150) bewegt wird, um Richtungsänderung des wenigstens einen Haupt-Arretier-Elementes (10142, 10143) zuzulassen.

10 7. Elektrischer Verbinder (10100) nach einem der Ansprüche 1 bis 6, wobei, wenn der Verbinder (10100) und der Gegenverbinder (10200) ordnungsgemäß gekoppelt sind, der Verbinder (10100) in seinen freien Zustand insbesondere so zurückkehrt, dass die Feder (10125) entspannt ist und sich das erste Positionssicherungs-Element des Verbinders (10135) und das zweite Positionssicherungs-Element des Verbinders (10150) in ihrer freien Position befinden, und insbesondere in Kombination mit einem der Ansprüche 4 bis 6, sich das wenigstens eine Haupt-Arretier-Element (10142, 10143) in seiner freien Position befindet.

15 8. Elektrischer Verbinder (10100) nach einem der Ansprüche 3 bis 7, wobei, wenn der Verbinder (10100) und der Gegenverbinder (10200) ordnungsgemäß gekoppelt sind, das erste Positionssicherungs-Element des Verbinders (10135), dessen Arretier-Nasen (10137, 10138) unter der Wirkung der Entspannung der Feder (10125) Richtungsänderung unterzogen werden und automatisch in eine Aufnahme-Zone (10207) eines Rückhalte-Elementes (10202) des Gegenverbinders (10200) eintreten, einen zweiten Arretier-Vorgang (10100) in Bezug auf den Gegenverbinder (10200) bewirkt.

20 9. Elektrischer Verbinder nach einem der Ansprüche 1 bis 8, der des Weiteren umfasst:

25 ein Haupt-Gehäuse (10101), in dem sich die Feder (10125), das erste Positionssicherungs-Element des Verbinders (10135) und das zweite Positionssicherungs-Element des Verbinders (10150) befinden, sowie eine Abdeckung (10102), die an dem Haupt-Gehäuse (10101) befestigt werden kann, eine Aufnahme-Zone (10124) umfasst, in der die Feder (10125) in ihrem gespannten Zustand aufgenommen werden kann, und die die Bewegung des ersten Positionssicherungs-Elementes des Verbinders (10135) einschränkt.

30 Revendications

35 1. Connecteur électrique (10100), en particulier un connecteur d'amorce pour système de retenue de sécurité d'un véhicule automobile, pouvant être accouplé à un connecteur électrique conjugué (10200) selon une direction d'accouplement (10300) comprenant :

un ressort de verrouillage (10125) en forme de « U » ou de fer à cheval, et comprenant une tige transversale (10126) dont une tige latérale (10127, 10128) se terminant par des spires (10129, 10130) et une patte (10131, 10132) s'étend depuis chacune de ses extrémités,

40 le ressort de verrouillage (10125), détendu dans un état de livraison, est configuré pour s'opposer à un accouplement du connecteur (10100) au connecteur conjugué (10200) dans un état chargé du ressort (10125) ; et un premier élément d'assurance de position du connecteur (10135), comprenant une tête (10139) configuré de sorte que la tête (10139) est toujours en contact avec le ressort (10125), en particulier la tige transversale (10126),

45 configuré de sorte que le premier élément d'assurance de position du connecteur (10135) peut être déplacé selon la direction d'accouplement (10300, 10301) lorsque le connecteur (10100) est accouplé avec le connecteur conjugué (10200) depuis une position de livraison à l'état de livraison et de manière à ce que la tête (10139) du premier élément d'assurance de position (10135) exerce une pression sur la tige transversale (10126) du ressort (10125), entraînant une charge du ressort (10125) par rapport à un état de livraison tant que le connecteur (10100) et le connecteur conjugué (10200) se sont pas correctement accouplés,

dans lequel

le connecteur électrique (10100) comprend en outre un deuxième élément d'assurance de position de connecteur (10150) en forme de « H » comprenant des orifices de blocages (10153, 10154),

55 configuré de sorte que les pattes (10131, 10132) du ressort de verrouillage (10125) peuvent être reçues dans les orifices de blocages (10153, 10154) du deuxième élément d'assurance de position de connecteur (10150), de sorte que le deuxième élément d'assurance de position de connecteur (10150) peut être déplacé par la charge du ressort (10125) depuis une position de livraison à l'état de livraison selon une direction différente de la direction d'accouplement (10300, 10301).

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2. Connecteur électrique (10100) selon la revendication 1, dans lequel le deuxième élément d'assurance de position de connecteur (10150) est déplaçable selon une direction (10302) essentiellement perpendiculaire à la direction d'accouplement (10300, 10301).
- 5 3. Connecteur électrique (10100) selon l'une des revendications 1 à 2, dans lequel le premier élément d'assurance de position du connecteur (10135) comprend deux lances de verrouillage (10137, 10138) de part et d'autre d'un corps principal (10136) en prolongation de la tête (10139) et, lors d'un accouplement, tant que le connecteur (10100) et le connecteur conjugué (10200) ne sont pas correctement accouplés, à l'état chargé, le premier élément d'assurance de position du connecteur (10135) est configuré pour repousser le connecteur conjugué (10200) sous l'effet d'une pression exercée par le ressort (10125) au moyen des lances de verrouillage (10137, 10138) du premier élément d'assurance de position du connecteur (10135) qui sont en appui sur une surface de contact (10206) d'un élément de retenue (10202) du connecteur conjugué (10200).
- 10
- 15 4. Connecteur électrique (10100) selon l'une des revendications 1 à 3, comprenant en outre au moins un élément de verrouillage principal (10142, 10143), étant au moins une lance de verrouillage (10142, 10143) comprenant un ergot de verrouillage respectif (10144, 10145) et une patte respective (10146, 10147), prévu dans une position de livraison à l'état de livraison et pouvant être défléchi pour permettre l'accouplement, dans lequel la position de livraison dudit au moins un élément de verrouillage principal (10142, 10143) réalise un premier verrouillage du connecteur (10100) au connecteur conjugué (10200) lorsqu'ils sont correctement accouplés de sorte que l'ergot de verrouillage (10144, 10145) de chacun des au moins un élément de verrouillage principal (10142, 10143) est logé dans une zone de verrouillage (10203, 10204) respective d'une partie prise (10201) du connecteur conjugué (10200).
- 20
- 25 5. Connecteur électrique (10100) selon la revendication 4, dans lequel la position de livraison du deuxième élément d'assurance de position du connecteur (10150) empêche une déflexion du au moins un élément de verrouillage principal (10142, 10143) au moyen de la patte (10146, 10147) étant bloquée par un élément d'assurance (10151, 10152) respectif du deuxième élément d'assurance de position de connecteur (10150).
- 30 6. Connecteur électrique (10100) selon la revendication 5, dans lequel un état chargé du ressort (10125) déplace le deuxième élément d'assurance de position du connecteur (10150) de manière à permettre une déflexion de l'au moins un élément de verrouillage principal (10142, 10143).
- 35 7. Connecteur électrique (10100) selon l'une des revendications 1 à 6, dans lequel, lorsque le connecteur (10100) et le connecteur conjugué (10200) sont correctement accouplés, le connecteur (10100) retourne à son état de livraison, en particulier de telle sorte le ressort (10125) est détendu et le premier élément d'assurance de position du connecteur (10135) et le deuxième élément d'assurance de position du connecteur (10150) sont dans leur position de livraison, et, plus en particulier en combinaison avec l'une quelconque des revendications 4 à 6, l'au moins un élément de verrouillage principal (10142, 10143) est dans sa position de livraison.
- 40 8. Connecteur électrique (10100) selon l'une des revendications 3 à 7, dans lequel, lorsque le connecteur (10100) et le connecteur conjugué (10200) sont correctement accouplés, le premier élément d'assurance de position du connecteur (10135) dont les lances de verrouillage (10137, 10138) sont défléchies et automatiquement plongées dans une zone de réception (10207) d'un élément de retenue (10202) du connecteur conjugué (10200) sous l'effet de la détente du ressort (10125), réalise un deuxième verrouillage du connecteur (10100) au connecteur conjugué (10200).
- 45 9. Connecteur électrique (10100) selon l'une des revendications 1 à 8, comprenant en outre:
- un boîtier principal (10101) dans lequel sont prévus le ressort (10125), le premier élément d'assurance de position du connecteur (10135) et le deuxième élément d'assurance de position du connecteur (10150) ; et un couvercle (10102) pouvant être fixé au boîtier principal (10101), comprenant une zone de réception (10124) permettant d'accueillir le ressort (10125) dans son état chargé et limitant le déplacement du premier élément d'assurance de position du connecteur (10135).
- 50
- 55

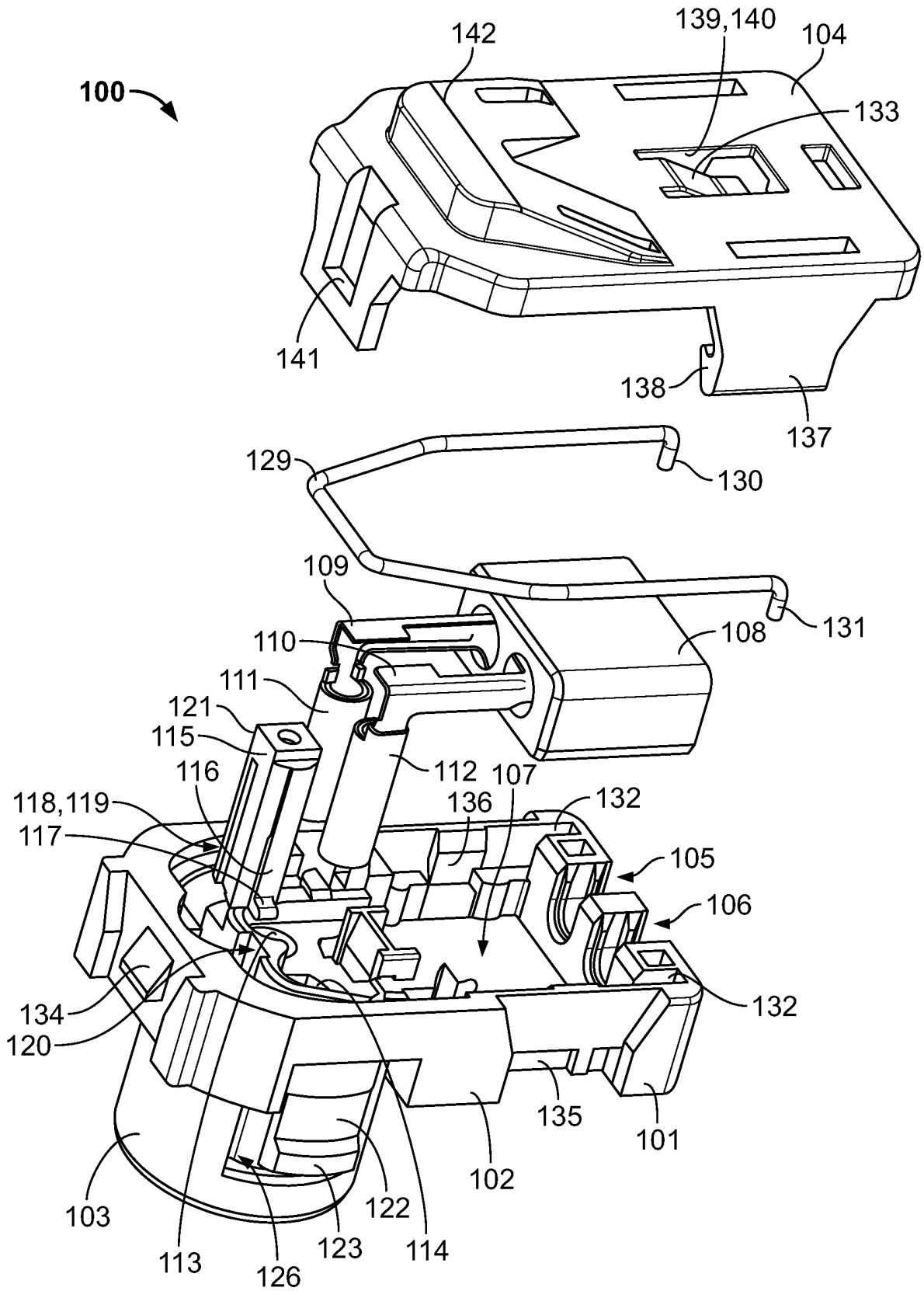


Fig. 1

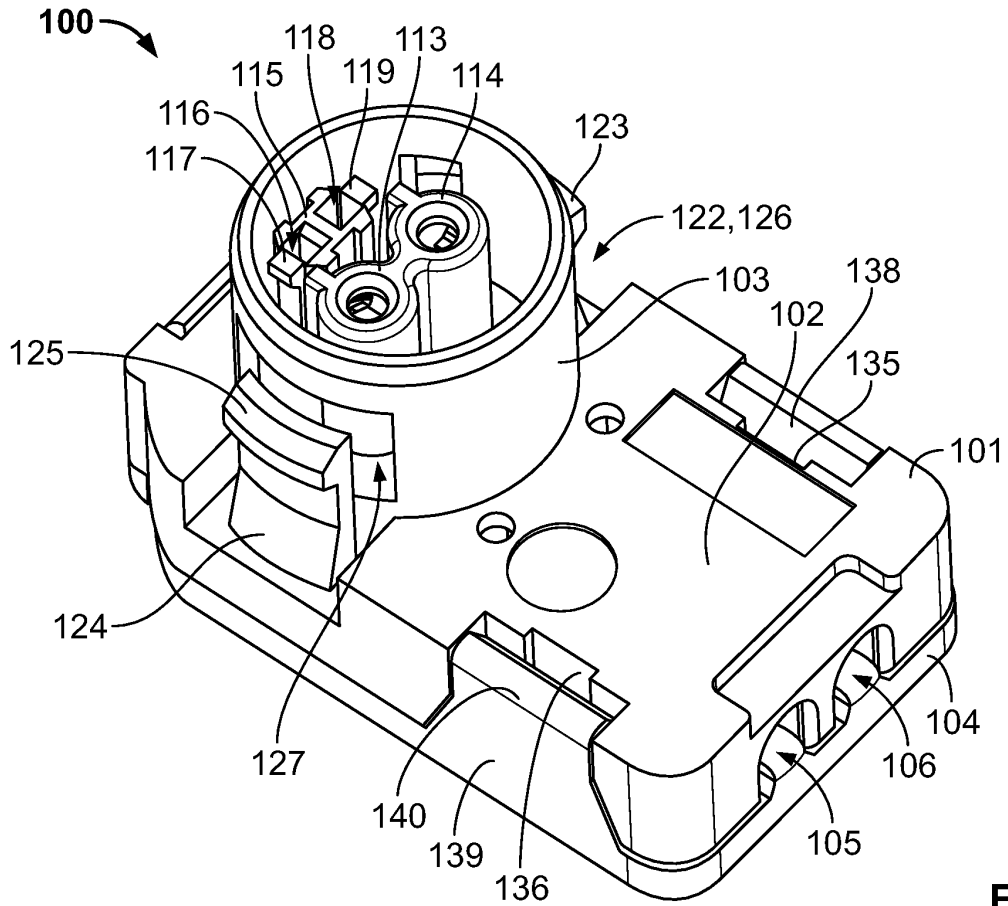


Fig. 2A

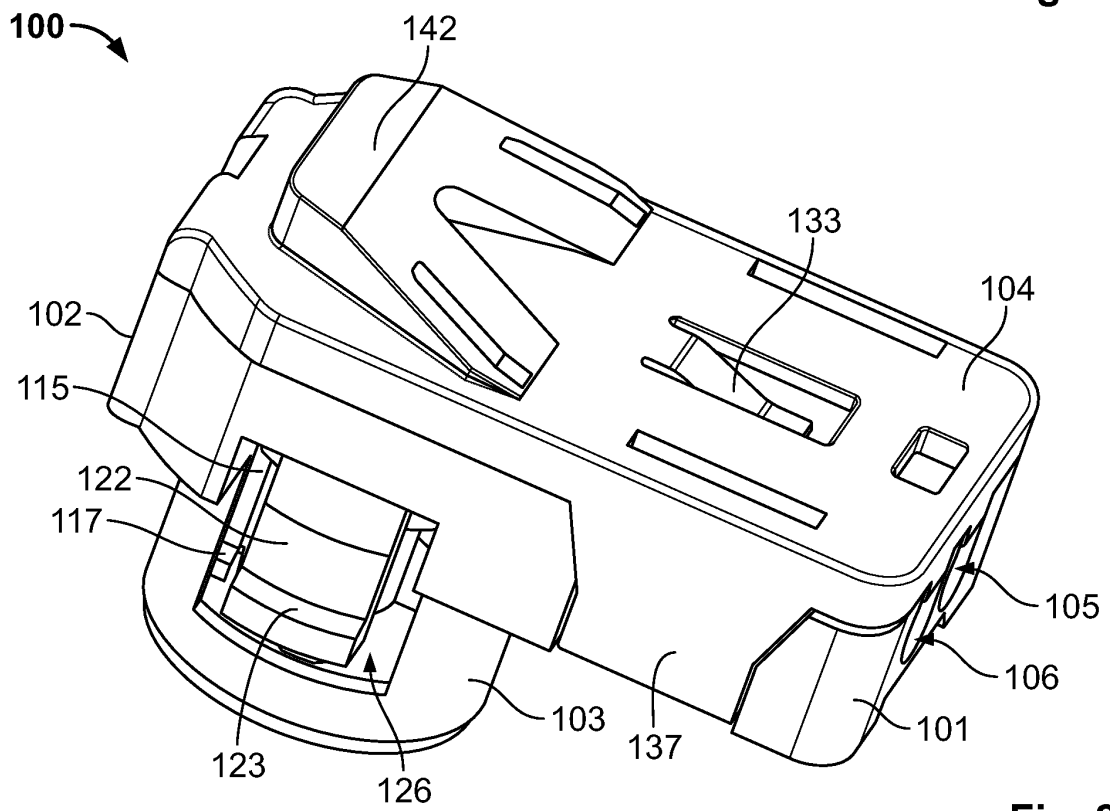
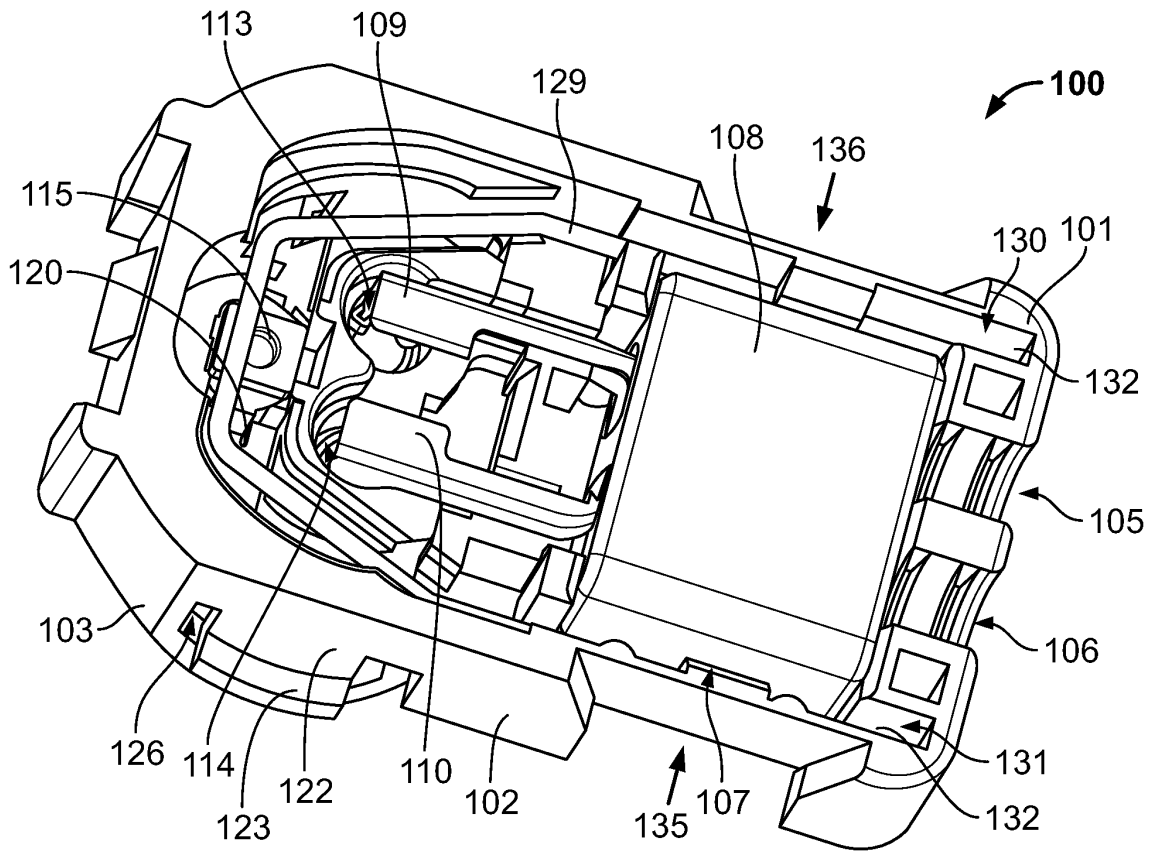
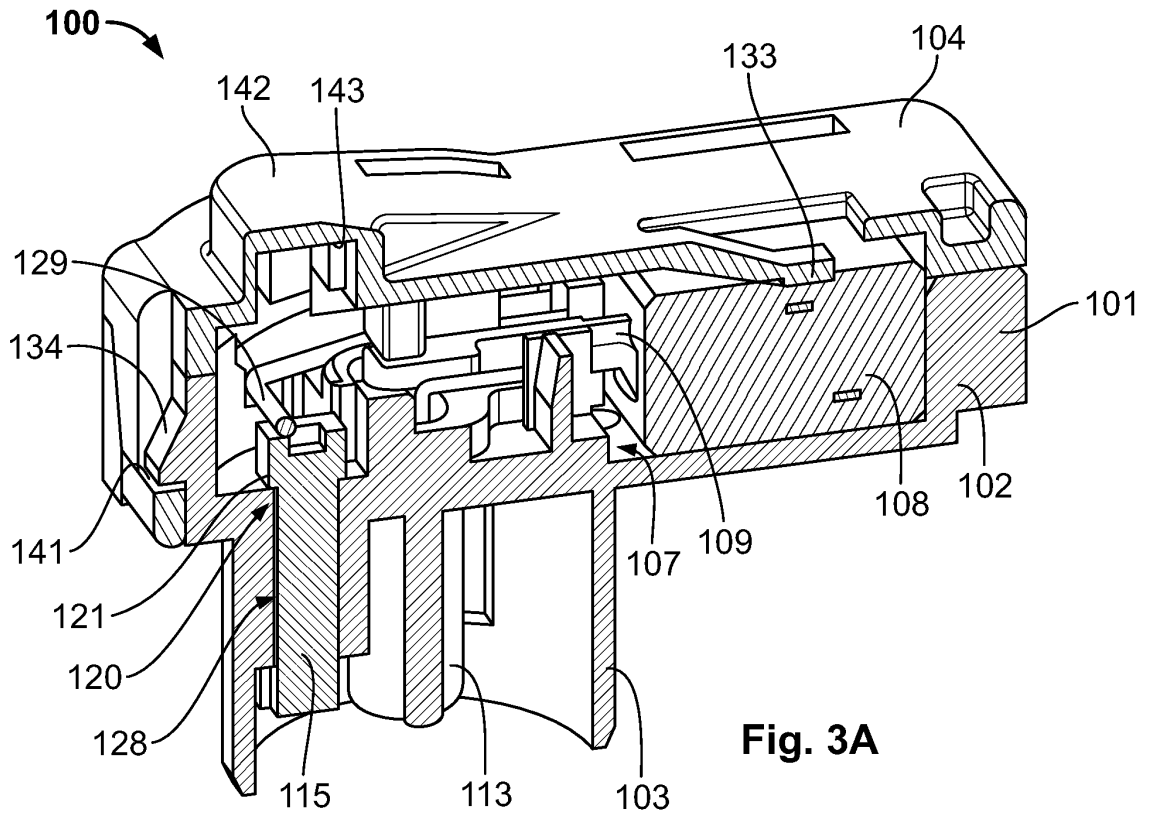


Fig. 2B



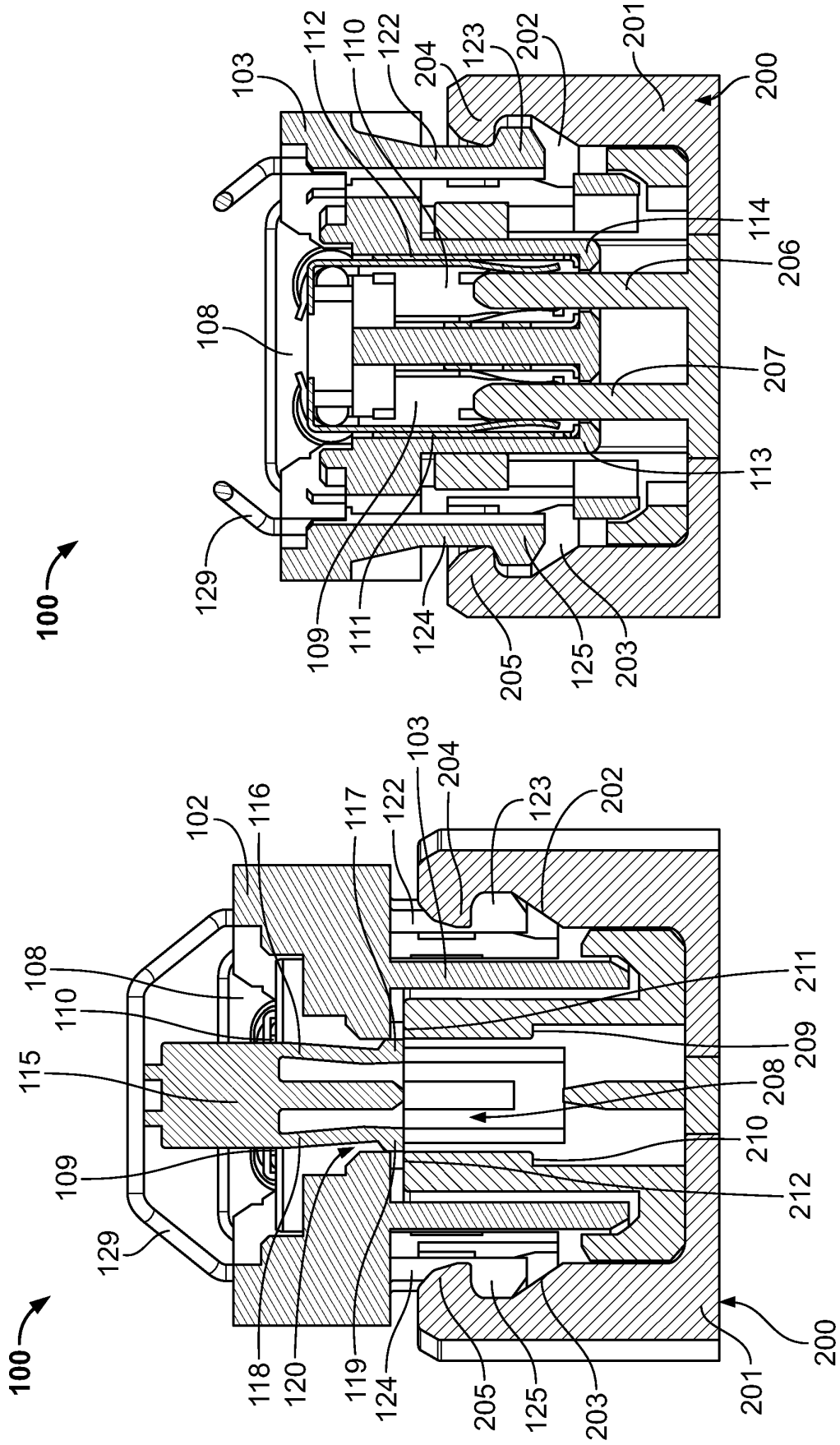


Fig. 5B

Fig. 5A

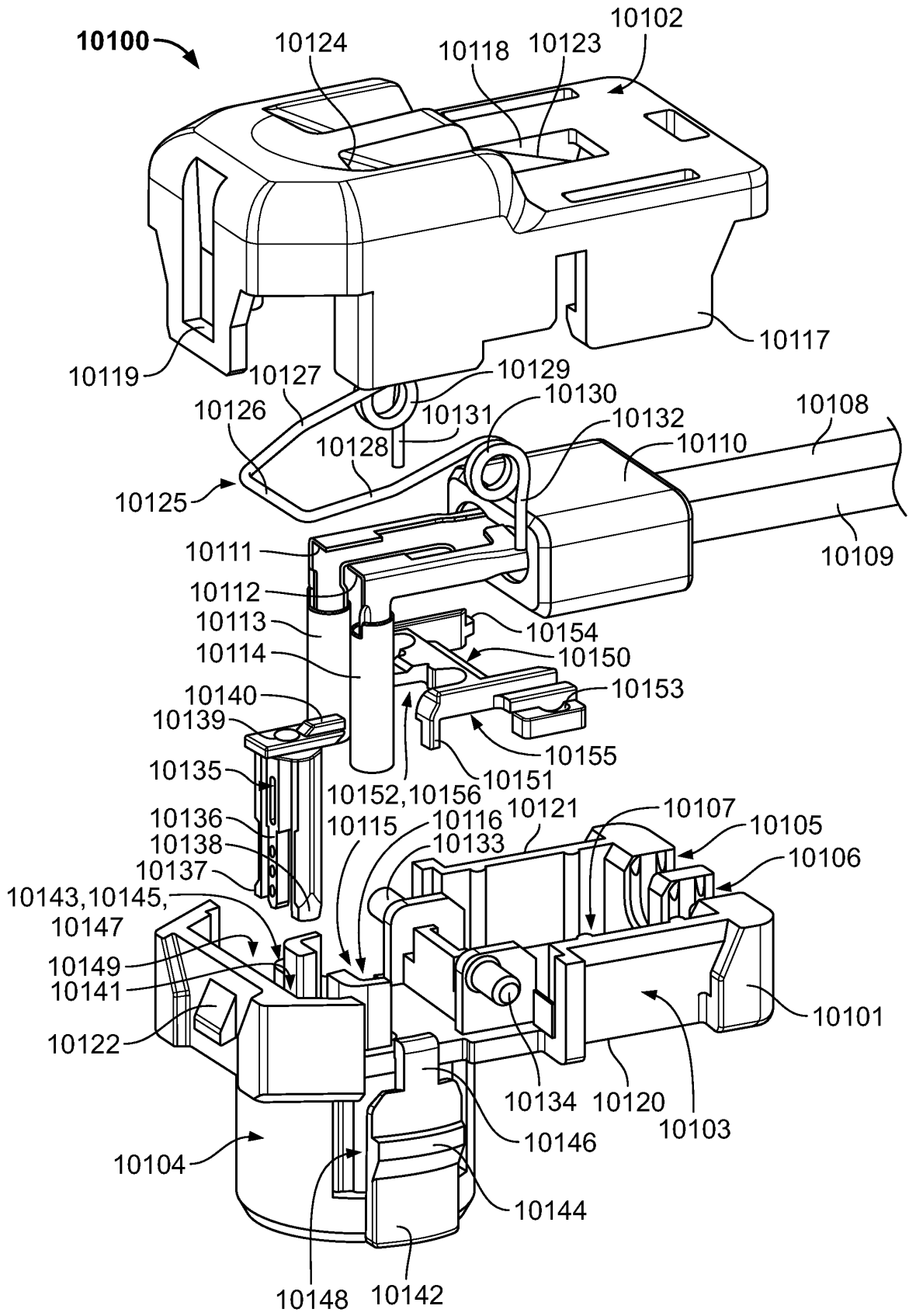


Fig. 7

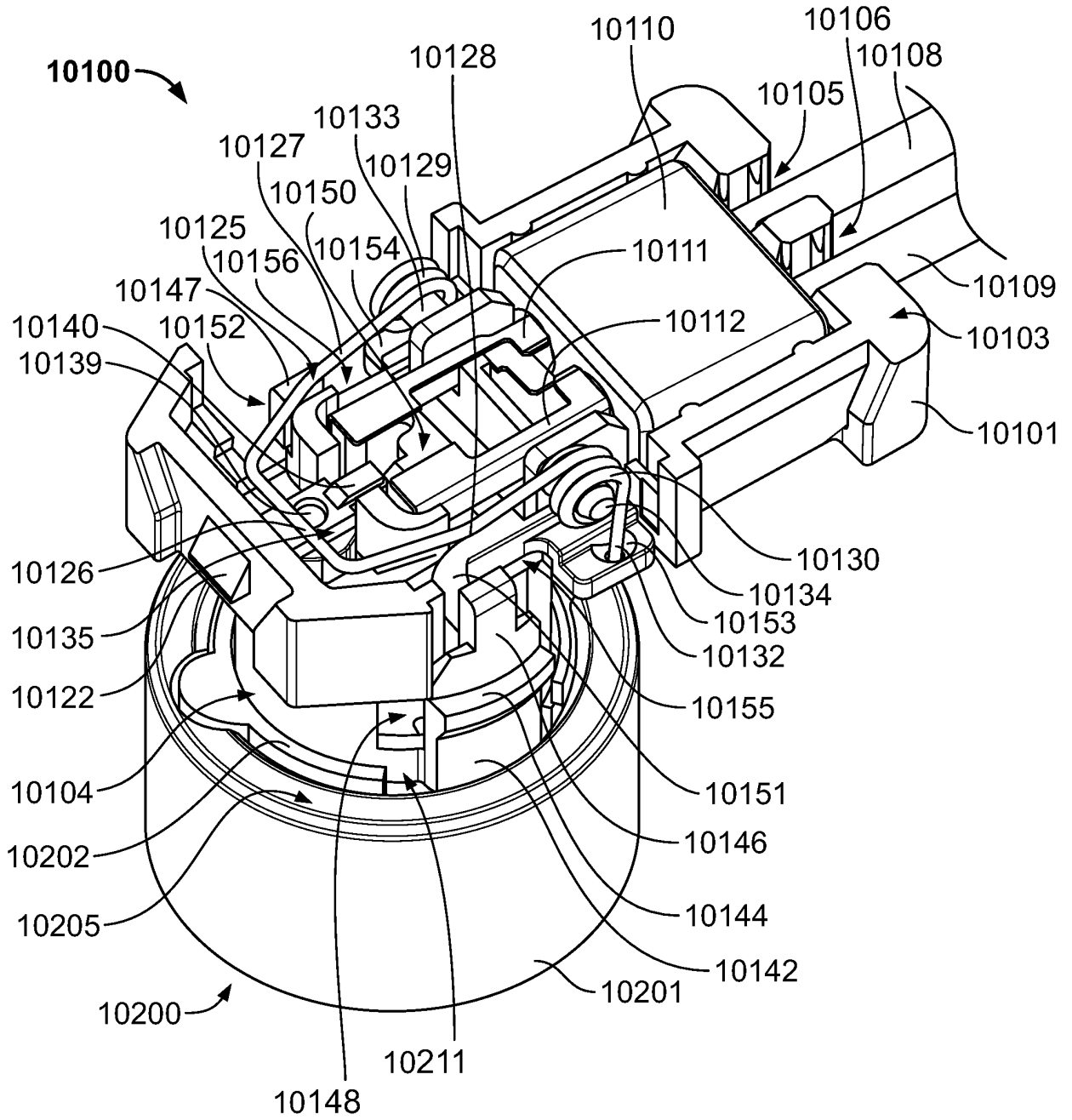


Fig. 8A

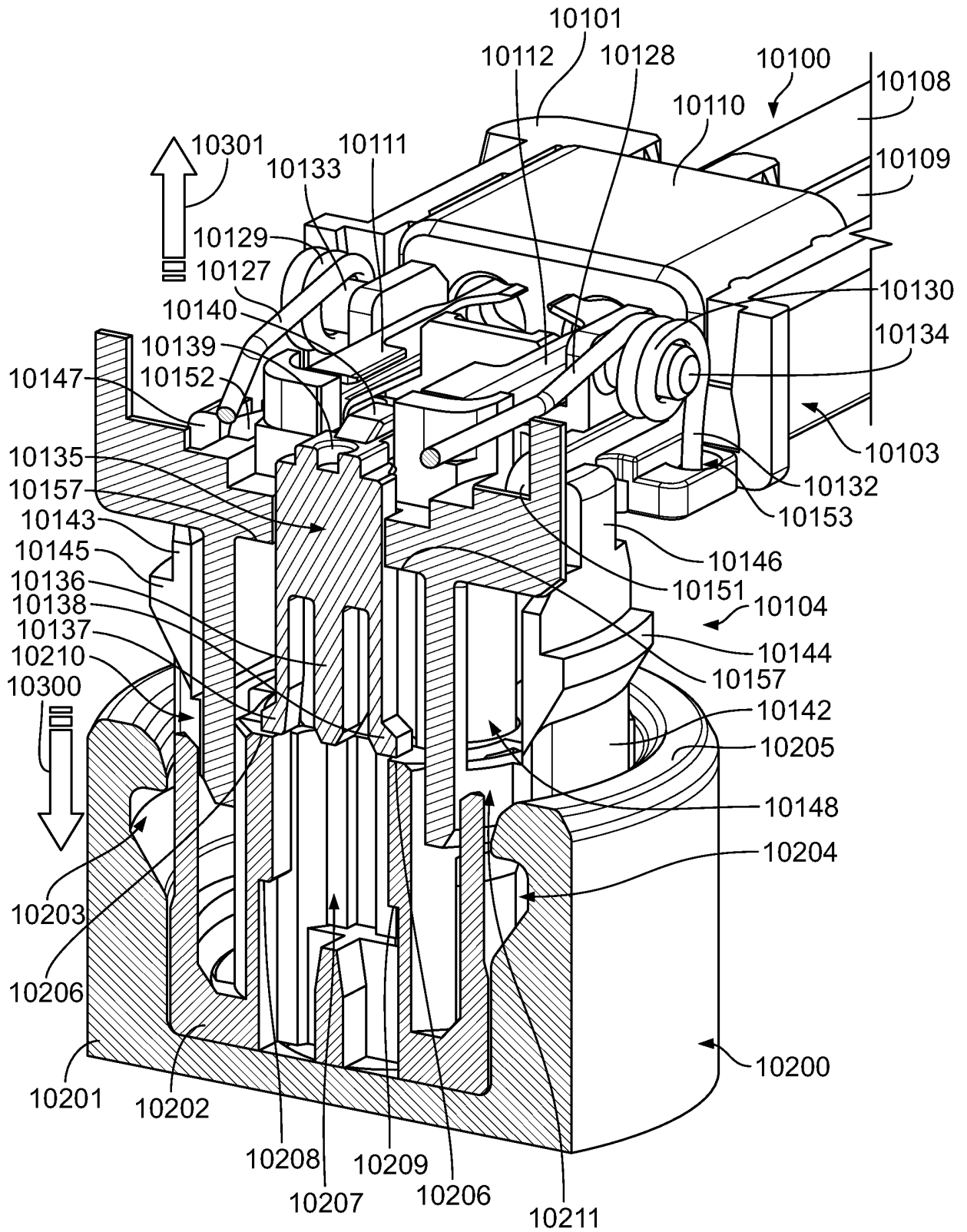


Fig. 8B

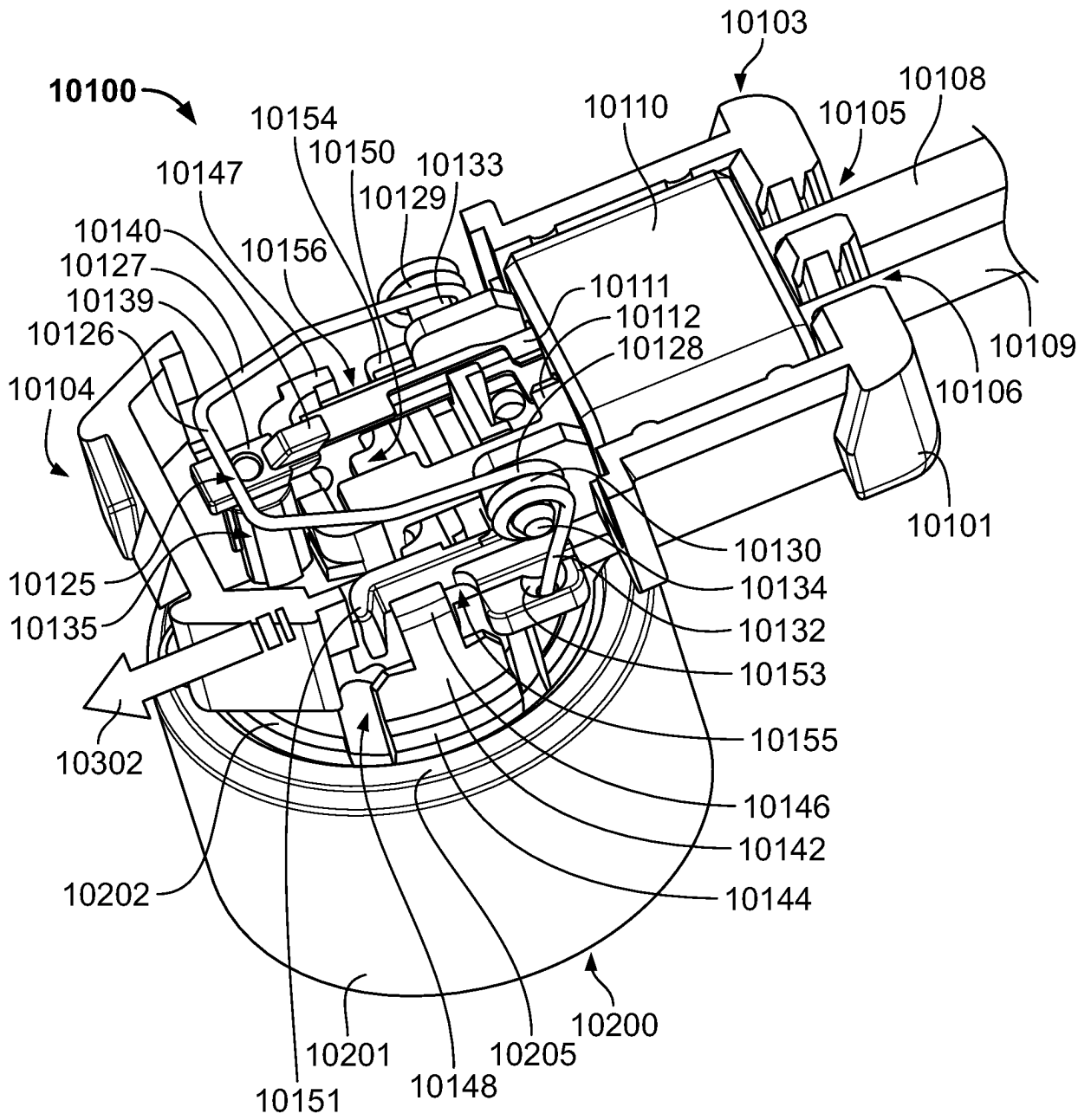


Fig. 9A

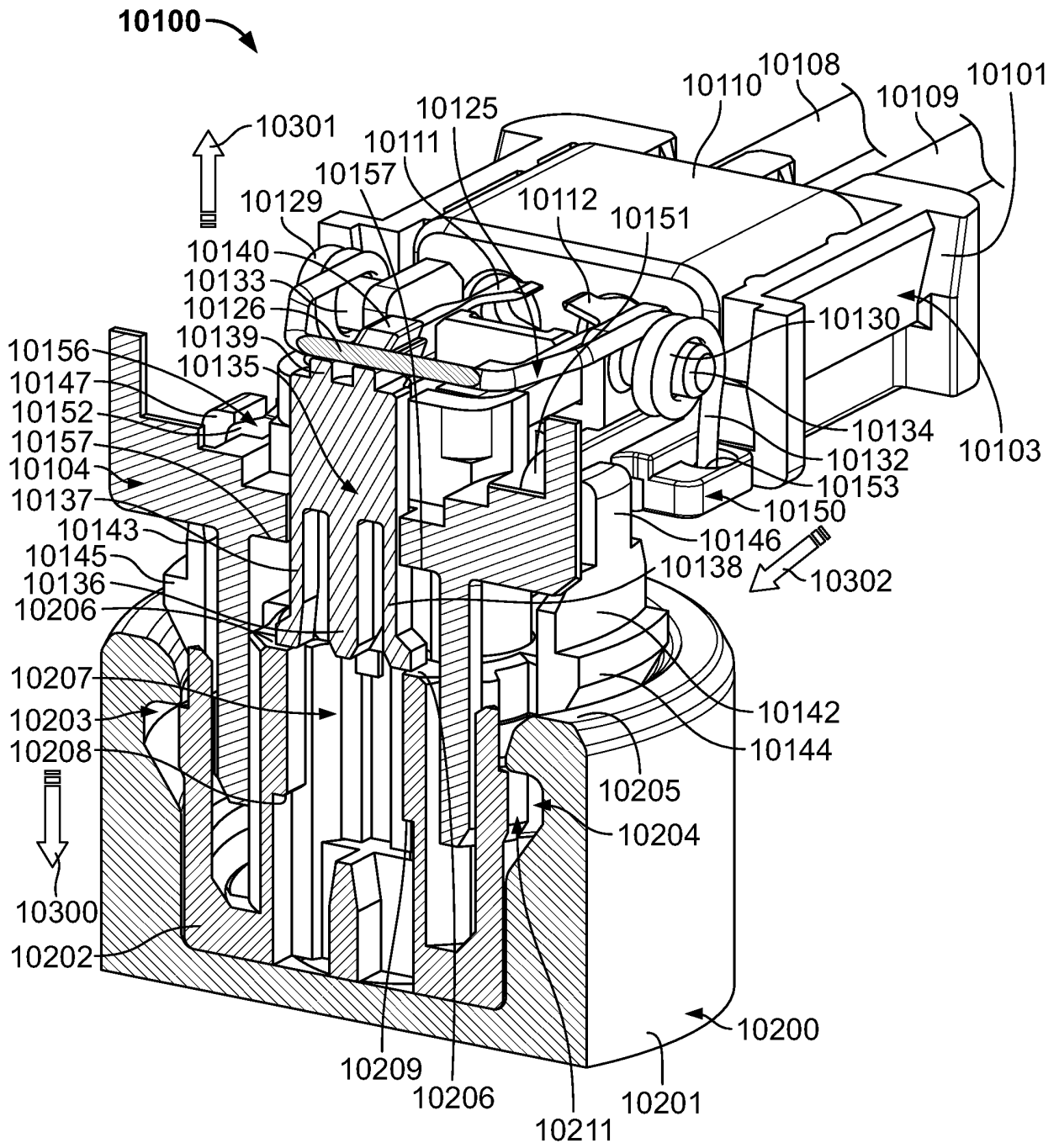


Fig. 9B

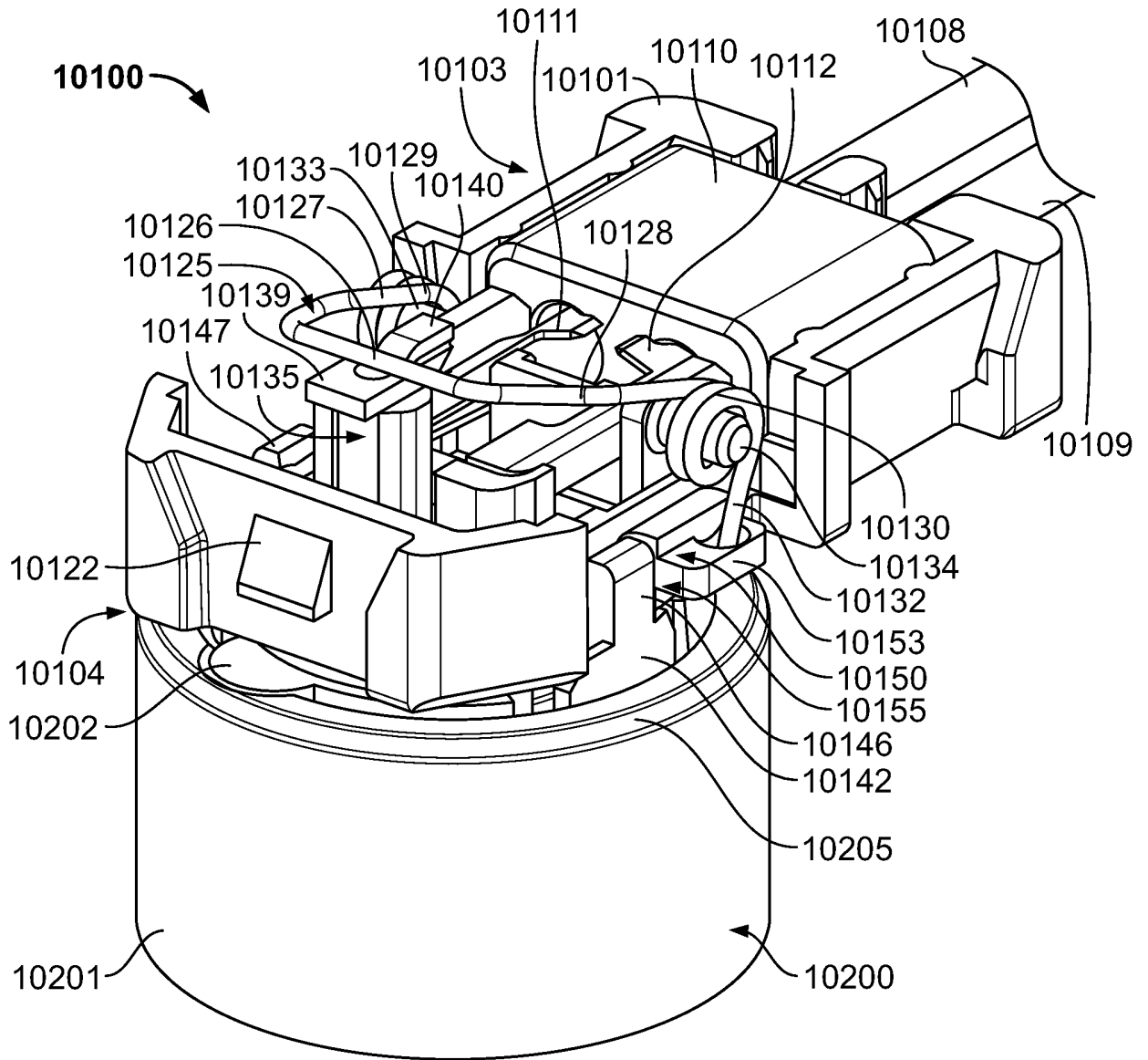


Fig. 10A

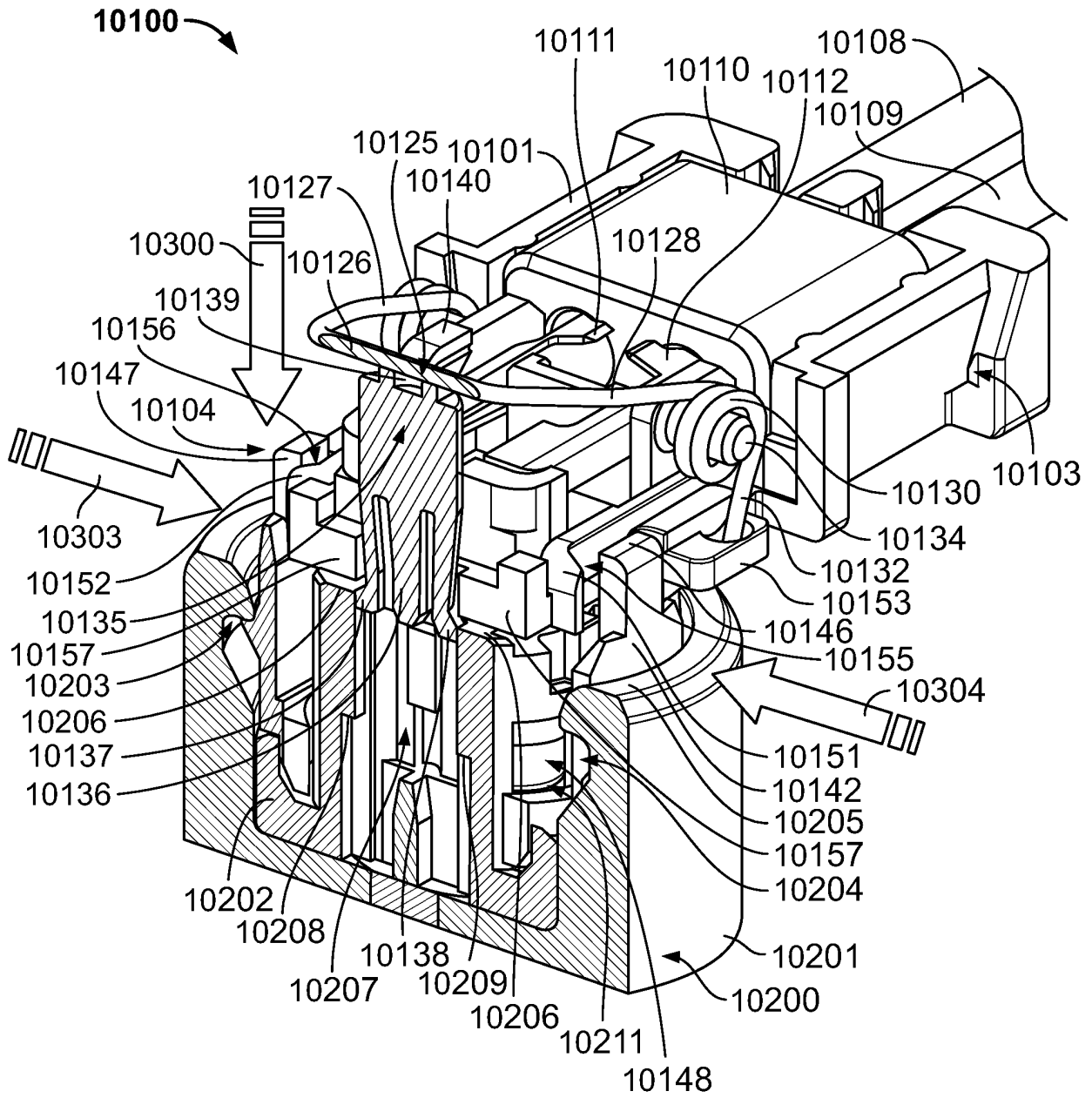


Fig. 10B

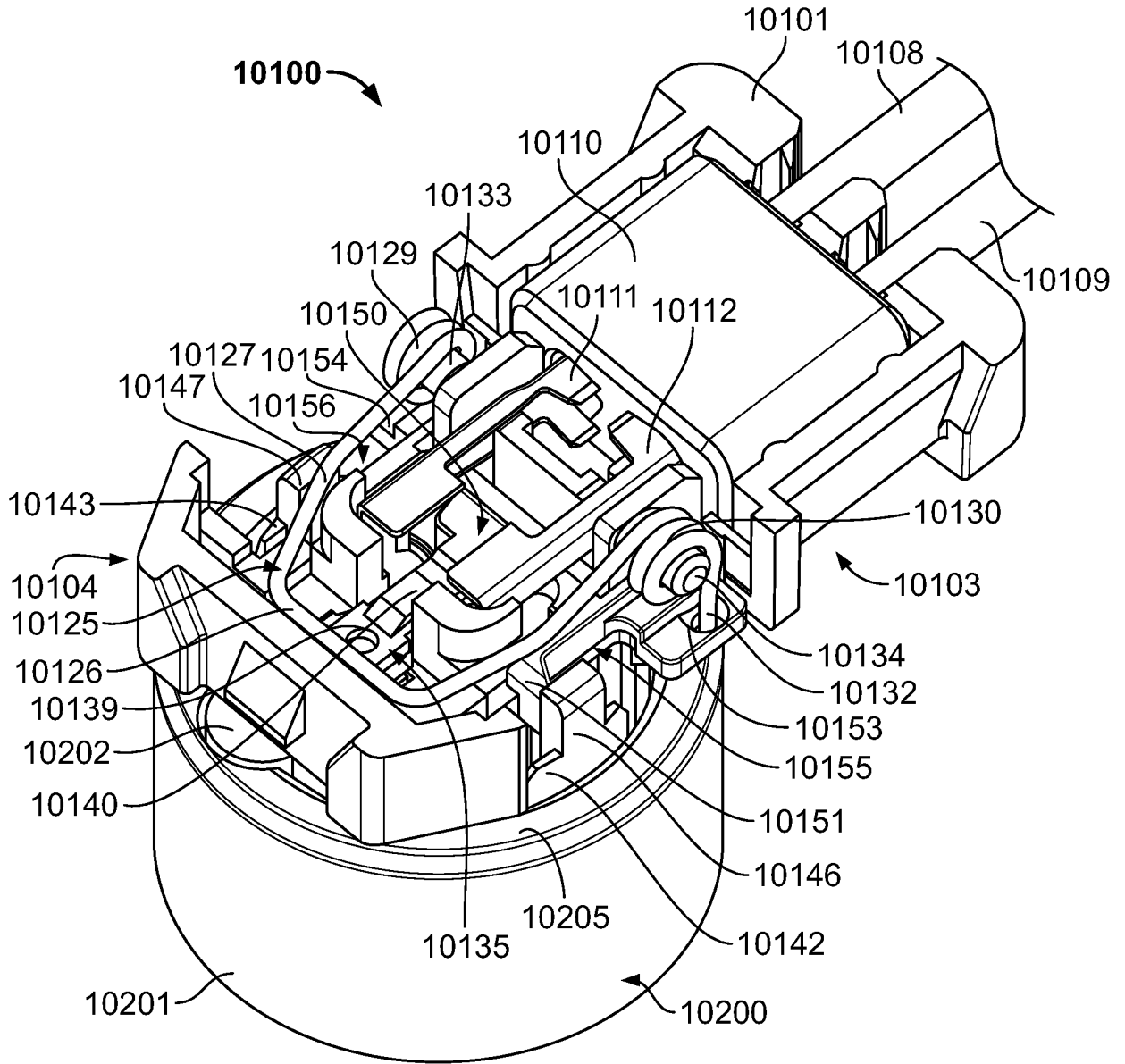


Fig. 11A

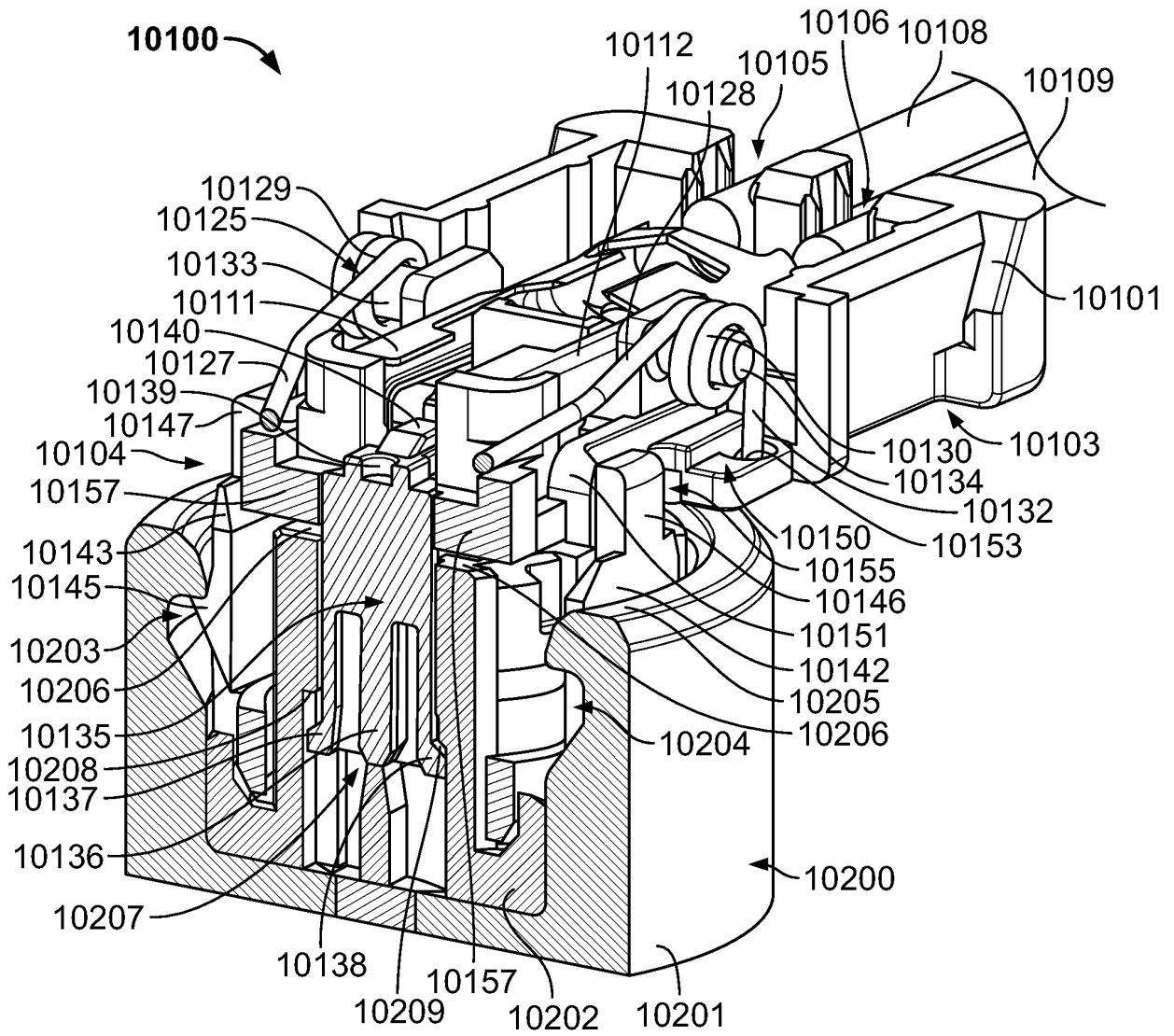


Fig. 11B

REFERENCES CITED IN THE DESCRIPTION

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