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(71) Applicant: ODU GmbH & Co KG. 84453 Mühldorf (DE)	

(54)

PLUG-IN CONNECTOR WITH ROTATIONAL LOCKING MECHANISM

- (57)

A plug-in connector comprising a first connecting part and a second connecting part is described, the first connecting part being configured for being mated with the second connecting part in a mating direction. The first connecting part comprises at least one latching element configured for engaging with at least one counterlatching element of the second connecting part when the first connecting part is mated with the second connecting part, and a locking member movably arranged in the first connecting part, wherein the locking member is configured for locking an engagement between the at least one latching element and the at least one counterlatching element in a locking position of the locking member. The first connecting part comprises a forced guid-

ance configured for enforcing a rotational motion of the locking member when the locking member is moved relative to the at least one latching element. The second connecting part is shaped and configured for interacting with the locking member such that a rotational motion of the locking member relative to the first connecting part is enforced when the first connecting part is mated with the second connecting part, wherein the rotational motion comprises moving the locking member from the locking position to a non-locking position and back to the locking position, with the at least one latching element being configured for engaging with the at least one counterlatching element when the locking member is in the non-locking position.

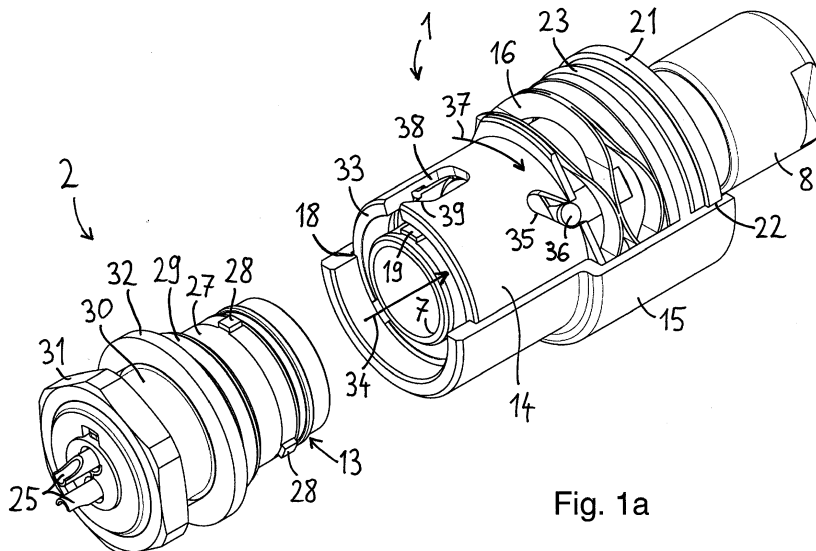


Fig. 1a

Description

Field of the Invention

[0001] The invention relates to a plug-in connector comprising a first connecting part and a second connecting part. The invention further relates to a first connecting part for a plug-in connector, the first connecting part being configured for being mated with a second connecting part of the plug-in connector. The invention further relates to a method for mating a first connecting part and a second connecting part and to a method for unplugging a first connecting part from a second connecting part.

Background of the Invention

[0002] British Patent Application GB 1 501 386 describes a plug suitable for push-pull movement along an axis into and out of connection with a mating receptacle having a retaining stud extending normally to the said axis, the plug including an axially-extending resilient tine with its free end shaped for stud-retaining engagement with the said stud and a locking member axially movable between a release position for mating and unmating the plug with the receptacle and a locking position for locking together the mated plug and receptacle, the locking member having a projection arranged, in the locking position, to engage the free end of the tine and lock it in engagement with the stud.

[0003] US Patent US 5 254 013 describes a push-pull lock connector which includes a square sectioned plug housing for housing a plurality of contacts and has an outer projection on an outside thereof and a first stopper member on the outside above the outer projection; a square sectioned sliding sleeve movable along an upper portion of the plug housing and having a second stopper member which cooperates with the first stopper member to restrict movement thereof; and a pair of leaf springs secured to either the plug housing or the sliding sleeve in a space between the plug housing and the sliding sleeve for biasing the sliding sleeve downwardly.

[0004] German Patent Application DE 10 2010 042 345 A1 describes a method for connecting plug parts of an electrical plug connector, wherein a hollow cylindrical transfer sleeve is arranged movably in the axial direction relative to the first plug part, wherein the spring sleeve is held biased in a first position by at least one prestressing spring and the axial relative movement takes place against the spring force, and wherein the spring element is displaced axially rearwards from the first position. Upon further compression of the plug parts, the transfer sleeve is automatically returned to the first position by the biasing spring, the spring element being arranged between a side of the spring element before the contact of the transfer sleeve with its axial displacement caused by the spring element of the first plug part and an inner side of the transfer sleeve.

Object of the Invention

[0005] The object of the invention is to provide a plug-in connector with a locking mechanism that is robust, works reliably and can be built small.

Summary of the Invention

[0006] According to the invention, a plug-in connector comprising a first connecting part and a second connecting part is provided, the first connecting part being configured for being mated with the second connecting part in a mating direction. The first connecting part comprises at least one latching element configured for engaging with at least one counterlatching element of the second connecting part when the first connecting part is mated with the second connecting part and a locking member movably arranged in the first connecting part, wherein the locking member is configured for locking an engagement between the at least one latching element and the at least one counterlatching element in a locking position of the locking member. The first connecting part comprises a forced guidance configured for enforcing a rotational motion of the locking member when the locking member is moved relative to the at least one latching element. The second connecting part is shaped and configured for interacting with the locking member such that a rotational motion of the locking member relative to the first connecting part is enforced when the first connecting part is mated with the second connecting part, wherein the rotational motion comprises moving the locking member from the locking position to a non-locking position and back to the locking position, with the at least one latching element being configured for engaging with the at least one counterlatching element when the locking member is in the non-locking position.

[0007] The plug-in connector of the present invention comprises a locking mechanism for securing a connection between a first connecting part and a second connecting part. When establishing this connection, the locking member is pushed into a non-locking position first, whereby a rotational movement of the locking member is enforced. In the non-locking position of the locking member, the at least one latching element of the first connecting part is unlocked and can engage with the at least one counterlatching element of the second connecting part. After the engagement between the at least one latching element and the at least one counterlatching element has been established, the locking member returns to the locking position. In the locking position of the locking member, the engagement between the at least one latching element and the at least one counterlatching element is locked.

[0008] The locking mechanism is provided in addition to the at least one latching element and the at least one counterlatching element and is configured for securing the connection between the first and the second connecting part. Firstly, the at least one latching element is en-

gaged with the at least one counterlatching element and secondly, the engagement is locked by the locking member. The locking member is provided as an extra part in addition to the at least one latching element and the at least one counterlatching element, with the locking member being movable relative to the at least one latching element. The locking member is shaped and configured for locking the at least one latching element when the locking member is moved to its locking position. The locking mechanism of the present invention allows for securing the connection between the first connecting part and the second connecting part. Connectors of this type are often referred to as "push-pull connectors". Mating the first connecting part and the second connecting part can be smoothly effected with one single movement in a push operation, and requires only a slight use of force. For example, the push operation can be carried out by gripping the first connecting part's housing or cable and pushing the first connecting part in the axial direction towards the second connecting part. The connection can for example be disconnected by taking hold of the first connecting part's housing and pulling the first connecting part out of the second connecting part. The locking mechanism allows for locking the engagement between the at least one latching element and the at least one counterlatching element, thus making sure that the connection between the first connecting part and the second connecting part cannot be loosened or disrupted inadvertently. In particular, a plug-in connector may for example be exposed to harsh environmental conditions. For example, the connector may be exposed to vibrations, shock-loads or external forces acting on the connector. Without a locking mechanism, it would be likely that the connection is disrupted. By employing a rotational locking mechanism of the kind described above, a reliable and secure connection is provided.

[0009] The rotational locking mechanism can be used in various types of connectors like for example in electric connectors, pneumatic connectors, hydraulic connectors, fluidic connectors, optical connectors and still other connectors. The first connecting part and/or the second connecting part may for example be attached to a cable or mounted in a housing of a device. The particular advantage of the rotational locking mechanism is that it can be built very small. Accordingly, the rotational locking mechanism is well-suited for miniaturised connectors and for highly integrated environments, but may as well be used for large connectors. Only limited installation space is required for implementing the rotational locking mechanism as described above. The rotational locking mechanism can for example be integrated into the housing of the connector. In this case, the rotational locking mechanism is protected by the enclosure of the connector and accordingly, a robust solution is provided that is suitable for rugged environments.

[0010] Further according to the invention, a first connecting part for a plug-in connector is provided, the first connecting part being configured for being mated with a

second connecting part of the plug-in connector in a mating direction. The first connecting part comprises at least one latching element configured for engaging with at least one counterlatching element of the second connecting part when the first connecting part is mated with the second connecting part and a locking member movably arranged in the first connecting part, wherein the locking member is configured for locking an engagement between the at least one latching element and the at least one counterlatching element in a locking position of the locking member. The first connecting part comprises a forced guidance configured for enforcing a rotational motion of the locking member when the locking member is moved relative to the at least one latching element. The locking member is shaped and configured for interacting with the second connecting part such that a rotational motion of the locking member relative to the first connecting part is enforced when the first connecting part is mated with the second connecting part, wherein the rotational motion comprises moving the locking member from the locking position to a non-locking position and back to the locking position, with the at least one latching element being configured for engaging with the at least one counterlatching element when the locking member is in the non-locking position.

[0011] Further according to the invention, a method for mating a first connecting part and a second connecting part in a mating direction is provided. The first connecting part comprises at least one latching element configured for engaging with at least one counterlatching element of the second connecting part when the first connecting part is mated with the second connecting part and a locking member movably arranged in the first connecting part, wherein the locking member is configured for locking an engagement between the at least one latching element and the at least one counterlatching element in a locking position of the locking member. The first connecting part comprises a forced guidance configured for enforcing a rotational motion of the locking member when the locking member is moved relative to the at least one latching element. The method comprises mating the first connecting part with the second connecting part, wherein the second connecting part is shaped and configured for interacting with the locking member when the first connecting part is mated with the second connecting part, enforcing a rotational motion of the locking member relative to the first connection part by an interaction between the second connection part and the locking member and by the forced guidance, wherein the rotational motion comprises moving the locking member from the locking position to a non-locking position and back to the locking position, and engaging at least one latching element of the first connecting part with at least one counterlatching element of the second connecting part when the locking member is in the non-locking position.

[0012] When mating the first and the second connecting part, the locking member is moved from the locking position to the non-locking position. In the non-locking

position, the at least one latching element is engaged with the at least one counterlatching element. Then, the locking member is moved back to the locking position, wherein in the locking position, the engagement between the at least one latching element and the at least one counterlatching element is locked. The rotational locking mechanism allows for mating the first and the second connecting part and for locking the connection in one single operation.

[0013] Further according to the invention, a method for unplugging a first connecting part from a second connecting part is provided. The first connecting part comprises at least one latching element configured for engaging with at least one counterlatching element of the second connecting part when the first connecting part is mated with the second connecting part and a locking member movably arranged in the first connecting part, wherein the locking member is configured for locking an engagement between the at least one latching element and the at least one counterlatching element in a locking position of the locking member. The first connecting part comprises a forced guidance configured for enforcing a rotational motion of the locking member when the locking member is moved relative to the at least one latching element. The method comprises pulling the first connecting part with the locking member relative to the second connecting part in a direction against the mating direction, thereby moving the locking member relative to the at least one latching element from the locking position to a non-locking position, disengaging the at least one latching element and the at least one counterlatching element, and unplugging the first connecting part from the second connecting part.

[0014] By pulling the first connecting part relative to the second connecting part, the locking member is moved to the non-locking position. The locking member is configured for unlocking an engagement between the at least one latching element and the at least one counterlatching element in the non-locking position of the locking member. The at least one latching element and the at least one counterlatching element are disengaged. Then, the first connecting part can be disconnected from the second connecting part. The rotational locking mechanism allows for unlocking the connection between the first and the second connecting part and for separating the first and the second connecting part in one single operation.

Preferred Embodiments of the Invention

[0015] Preferred features of the invention which may be applied alone or in combination are discussed below and in the dependent claims.

[0016] Preferably, the locking member is implemented as a locking sleeve. For example, apart from projections, protrusions, cut-outs, recesses, indentations etc, the locking sleeve may be realised as an essentially rotationally symmetric member, for example as a cylinder sleeve.

Preferably, the locking sleeve is oriented in the mating direction. Preferably, the locking sleeve is suited for being integrated into the first connecting part. This allows for realising a small and compact plug-in connector. The locking sleeve may for example be configured for circumferentially enclosing the latching elements, wherein in the locking position of the locking sleeve, an engagement between the at least one latching element and the at least one counterlatching element is locked. Preferably, the locking sleeve is configured for rotating around an axis oriented in the mating direction. Further preferably, a predominant component of the locking sleeve's axis of rotation may be oriented in the mating direction. Further preferably, when the locking sleeve is moved in an axial direction, the forced guidance is configured for translating the axial movement of the locking sleeve into a rotational movement of the locking sleeve. According to an alternatively preferred example, the locking member may for example be implemented as a movable curved part, as a segment of a locking sleeve or as a rotatable cylinder shaped part.

[0017] Preferably, the first connecting part comprises an inner sleeve, with the locking sleeve enclosing the inner sleeve. Further preferably, the inner sleeve and the locking sleeve of the first connecting part are arranged coaxially with respect to an axis oriented in the mating direction. Thus, the locking sleeve can be moved in an axial direction and rotated around the inner sleeve.

[0018] Preferably, the first connecting part comprises an outer sleeve, with the outer sleeve enclosing the locking sleeve. Further preferably, the locking sleeve and the outer sleeve of the first connecting part are arranged coaxially with respect to an axis oriented in the mating direction. Thus, the movable locking sleeve, which can be moved in an axial direction and rotated around an axis of rotation, is enclosed by an outer sleeve. Preferably, the movable locking sleeve is arranged between an inner sleeve and an outer sleeve.

[0019] Preferably, the locking member is implemented as a locking sleeve and the locking sleeve is implemented as the first connecting part's outer sleeve. The locking sleeve and the outer sleeve are made in one piece, and accordingly, the outer sleeve performs a rotational motion during the mating and disconnecting operation. In this embodiment, for mating the first connecting part and the second connecting part, it is necessary to take hold of the cable of the first connecting part, in order to push the first connecting part into the second connecting part. For disconnecting the connection, it is necessary to grip the locking sleeve.

[0020] Preferably, when the first connecting part is mated with the second connecting part, the locking member is configured for being pushed by the second connecting part in a direction away from a mating end of the first connecting part. When the first connecting part is mated with the second connecting part, the locking member is pushed in a rearward direction.

[0021] Preferably, the locking member comprises an

abutting surface, the abutting surface being configured such that the second connecting part abuts against the abutting surface of the locking member when the first connecting part is mated with the second connecting part. Thus, it is ensured that the second connecting part captures the locking member and pushes the locking member in the backwards direction when the first and the second connecting part are mated.

[0022] Preferably, at least one surface of the second connecting part is shaped and configured for interacting with at least one surface of the locking member when the first connecting part is mated with the second connecting part such that a rotational motion of the locking member relative to the first connecting part is enforced. Preferably, the rotational motion is induced by moving the at least one surface of the second connecting part along the at least one surface of the locking member when the first connecting part is mated with the second connecting part.

[0023] Preferably, the second connecting part is equipped with at least one protrusion, the at least one protrusion being configured for abutting against the locking member when the first connecting part is mated with the second connecting part. The at least one protrusion of the second connecting part may for example be configured for interacting with the abutting surface of the locking member. Preferably, the at least one protrusion is configured for moving the locking member to the non-locking position and back to the locking position when the first connecting part is mated with the second connecting part.

[0024] According to an alternatively preferred embodiment, the locking member is equipped with at least one protrusion. For example, the locking member may be implemented as a locking sleeve comprising at least one protrusion located at the locking sleeve's inner surface. Preferably, the second connecting part comprises an abutting surface configured such that when the first connecting part and the second connecting part are mated, the abutting surface of the second connecting part abuts against the at least one protrusion of the locking member, thereby pushing the locking member in a backwards direction away from the mating end of the first connecting part. The abutting surface of the second connecting part may for example be a front face of the second connecting part's outer enclosure or outer sleeve. Preferably, due to the interaction between the abutting surface of the second connecting part and the at least one protrusion of the locking member, the locking member may for example be moved from the locking position to the non-locking position and back to the locking position when the first connecting part is mated with the second connecting part.

[0025] Preferably, the plug-in connector comprises at least one spring element configured for pressing the locking member towards a mating end of the first connecting part into a locking position. When mating the first connecting part with the second connecting part, the locking member is pushed to the non-locking position against a

spring force exerted by the spring element and as a consequence, energy is stored in the spring element. The resulting spring force may for example be used for moving the locking member back from the non-locking position in the direction towards the locking position after a predetermined rotational position of the locking member is reached. For example, the spring element may be compressed when the locking member is moved to the non-locking position and it may be relaxed when the locking member is moved back to the locking position.

[0026] Preferably, in the locking position of the locking member, the locking member is pressed by the spring element against an inner recess of the first connecting part's enclosure. Accordingly, the locking position is determined by said inner recess of the enclosure.

[0027] Preferably, at least one of the spring elements is configured for exerting a spring force onto the locking member in an axial direction. In an alternatively preferred example, at least one of the spring elements is configured for exerting a spring force onto the locking member in a radial direction. The spring force may also comprise both an axial and a radial component.

[0028] Preferably, at least one of the spring elements is disposed between the inner sleeve and the outer sleeve. Further preferably, at least one of the spring elements is disposed at the rear side of the locking member facing away from the mating end of the first connecting part. A spring element located at a rear end of the locking member is well suited for resiliently pushing the locking member towards the mating end of the first connecting part.

[0029] Preferably, the locking member is implemented as a locking sleeve, with at least one of the spring elements being disposed between the inner sleeve and the locking sleeve. Further preferably, the locking member is implemented as a locking sleeve, with at least one of the spring elements being disposed between the locking sleeve and the outer sleeve.

[0030] Preferably, the at least one spring element comprises at least one of the following: a single-turn wave spring, a multi-turn wave spring, a cup spring, a disc spring, a coil spring, a tension spring, a compression spring. For example, by mounting a multi-turn wave spring on the rear side of the locking member, the required spring force can be provided. Preferably, at least one of the spring elements is implemented as one of the following: a body of polymer resin, a body of resilient material, a body of elastomer. Preferably, at least one of the spring elements is realised in one of the following forms: an O-ring, an X-ring, folding bellows.

[0031] According to an alternatively preferred example, the first connecting part does not comprise a spring element. Preferably, for moving the locking member from the non-locking position back to the locking position, instead of a spring force generated by a spring, at least one of the following forces may act on the locking member: a magnetic force, a pneumatic force, a hydraulic force, a weight force exerted by the locking member's

weight. For example, the force acting on the locking member may be a repulsive force between two repelling magnets. For example, a first magnet may be fixed to the locking member and a further magnet may be fixed to the first connecting part, with a repulsive magnetic force acting between the magnets. As soon as the locking member is not retained in the non-locking position by the second connecting part any more, the repulsive magnetic force may for example push the locking member from the non-locking position back to the locking position. As a further example, in case the first connecting part is disposed above the second connecting part, the weight force of the locking member may be used for moving the locking member back to the locking position. As soon as the locking member is not retained in the non-locking position by the second connecting part any more, the weight force of the locking member's weight may for example push the locking member back to the locking position.

[0032] Preferably, the surface of the locking member is formed and configured such that in the locking member's locking position, an engagement between the at least one latching element and the at least one counterlatching element is positively locked by the locking member. For example, in the locking member's locking position, the surface of the locking member may restrict the movement of the at least one latching element. For example, after the at least one latching element has engaged with the at least one counterlatching element, the engagement can be locked by the locking member. Thus, the connection between the first and the second connecting part is secured.

[0033] Preferably, the locking member is implemented as a locking sleeve, with an inner surface of the locking sleeve being formed such that in the locking sleeve's locking position, an engagement between the at least one latching element and the at least one counterlatching element is positively locked by the locking sleeve's inner surface. In the locking position of the locking sleeve, the inner surface of the locking sleeve restricts the movement of the at least one latching element. For example, after the at least one latching element has engaged with at least one counterlatching element, the engagement can be locked by the locking sleeve, which means that the at least one latching element cannot disengage from the at least one counterlatching element.

[0034] Preferably, the locking member is implemented as a locking sleeve, with an inner surface of the locking sleeve comprising at least one inner groove, wherein, when the locking sleeve is pushed to the non-locking position, the at least one inner groove of the locking sleeve is brought to a position adjacent to the at least one latching element and is configured for permitting a movement of the at least one latching element. Due to the presence of the at least one inner groove, the movement of the at least one latching element is no longer restricted and the at least one latching element can move in an axial direction. For example, in the non-locking po-

sition, the at least one latching element may engage with at least one counterlatching element. Preferably, the locking sleeve comprises a circumferential inner groove. Alternatively, the inner groove or a plurality of inner grooves may be oriented in the locking sleeve's axial direction, with the rotational movement moving the inner groove or the plurality of inner grooves towards the at least one latching element. Further alternatively, the at least one inner groove may be oriented in a slanted direction.

[0035] Preferably, the at least one latching element is implemented as at least one claw. For example, the at least one claw, which may be realised as a resilient member, may engage with at least one counterlatching element of the second connecting part. Preferably, the at least one latching element is implemented as a claw ring comprising at least one claw. Preferably, the claw ring comprises two, three, four or more than four claws. Preferably, the at least one counterlatching element is implemented as at least one recess or as a circumferential groove. Thus, the at least one claw of the first connecting part can engage with at least one recess or with a circumferential groove of the second connecting part. In an alternatively preferred example, a respective claw may comprise a groove or an indentation and the at least one counterlatching element may be implemented as at least one bulge.

[0036] Thus, the at least one claw of the first connecting part can engage with at least one bulge of the second connecting part.

[0037] Preferably, the locking member is implemented as a locking sleeve, with the claw ring being arranged between the inner sleeve and the locking sleeve, and with the at least one claw extending in the direction towards a mating end of the first connecting part. In the locking position of the locking sleeve, the claws are locked by the locking sleeve. Preferably, the claw ring is plugged onto a recess of the first connecting part.

[0038] In an alternatively preferred example, the at least one counterlatching element is implemented as at least one claw. Further preferably, the at least one counterlatching element is implemented as a claw ring comprising at least one claw. In this example, the at least one counterlatching element arranged on the second connecting part is implemented as at least one claw. Preferably, the at least one latching element is implemented as at least one recess or as a circumferential groove. Thus, the at least one claw of the second connecting part can engage with at least one recess or with a circumferential groove of the first connecting part. In a further alternatively preferred example, a respective claw of the second connecting part may comprise a groove or an indentation and the at least one latching element of the first connecting part may be implemented as at least one bulge. Thus, the at least one claw of the second connecting part can engage with at least one bulge of the first connecting part.

[0039] Preferably, the claw ring is plugged onto a re-

cess of the second connecting part, with the at least one claw extending in the direction towards a mating end of the second connecting part.

[0040] Preferably, the forced guidance comprises a guidance slot or a guidance groove located at or in the locking member and a sliding member accommodated in the guidance slot or the guidance groove. Preferably, the sliding member is arranged on a stationary part of the first connecting part.

[0041] Preferably, the locking member comprises a guidance slot or a guidance groove, with a sliding member being accommodated in the guidance slot or the guidance groove, wherein an interaction between the sliding member and the guidance slot or the guidance groove is configured for transforming an axial component of the locking member's movement into a rotational movement of the locking member and vice versa. The interaction between the sliding member and the guidance slot or the guidance groove enforces a rotational movement of the locking member when the locking member is moved.

[0042] In an alternatively preferred example, the forced guidance comprises a sliding member located on the locking member and a guidance slot or a guidance groove, with the sliding member being accommodated in the guidance slot or the guidance groove. Preferably, the guidance slot or the guidance groove is located on a stationary component of the first connecting part.

[0043] Preferably, the second connecting part and the locking member are shaped and configured such that after a predetermined rotational position of the locking member relative to the second connecting part has been reached, the locking member's state changes from a retained state in which the locking member is retained in the non-locking position by the second connecting part to a non-retained state in which the locking member is not retained in the non-locking position by the second connecting part. Further preferably, the first connecting part is configured for moving the locking member back to the locking position as soon as the locking member is not retained in the non-locking position by the second connecting part.

[0044] Preferably, after a predetermined rotational position of the locking member is reached, the interaction between the second connecting part and the locking member causes the locking member to move back to the locking position, thereby positively locking the engagement between the at least one latching element and the at least one counterlatching element. For example, the locking member may be pushed in the direction towards the locking position by means of a spring force exerted by at least one spring element.

[0045] Preferably, the rotational motion comprises a first rotational movement for moving the locking member from the locking position to the non-locking position and a subsequent second rotational movement for moving the locking member from the non-locking position back to the locking position. Preferably, the first rotational movement comprises rotating the locking member in a

first direction of rotation until a predetermined rotational position is reached, thereby moving the locking member from the locking position to the non-locking position. Preferably, the second rotational movement comprises rotating the locking member from the predetermined rotational position in a direction of rotation opposite to the first direction of rotation, thereby moving the locking member from the non-locking position back to the locking position. Preferably, the second connecting part and the locking member are shaped and configured such that when a predetermined rotational position of the locking member relative to the second connecting part is reached, the locking member's direction of rotation is reversed.

[0046] Preferably, the locking member comprises an abutting surface, the abutting surface comprising at least one recess. For example, when a protrusion of the second connecting part reaches the at least one recess at a predetermined rotational position, the first rotational movement is finished and the second rotational movement in the opposite direction of rotation is started, with the second rotational movement moving the locking member from the non-locking position back to the locking position.

[0047] Preferably, the locking member comprises an abutting surface, the abutting surface comprising at least one cut-out, the at least one cut-out being configured for accommodating a respective protrusion of the second connecting part when the locking member reaches a predefined rotational position. Preferably, the locking member's abutting surface comprises at least one cut-out, the cut-out being arranged such that at the predefined rotational position, the at least one protrusion enters a corresponding cut-out. When the protrusion enters the cut-out, the first rotational movement in the first direction of rotation is ended. Preferably, when the protrusion enters the cut-out, the first rotational movement in the first direction of rotation is ended and a subsequent second rotational movement in a direction of rotation opposite to the first direction of rotation is started, with the second rotational movement moving the locking member from the non-locking position back to the locking position. Preferably, when entering the cut-out, the locking member's direction of rotation is reversed. Preferably, the locking member may for example be moved from the non-locking position to the locking position by means of a spring force exerted by a spring element. Preferably, two or more cut-outs are arranged in a regularly spaced pattern around the locking member's circumference. In this case, the locking sleeve may have an n-fold rotational symmetry. Alternatively, two or more cut-outs may be arranged in an irregularly spaced pattern around the locking member's circumference, in order to make sure that the first connecting part is mated with the second connecting part in a predetermined orientation. Preferably, the inner contour of the at least one cut-out is shaped such that the locking member is retained in the non-locking position at least until the engagement between the at least one latching element and the at least one counterlatching element

is established.

[0048] Preferably, instead of or in addition to the at least one cut-out, the locking member's abutting surface may comprise at least one indentation, the at least one indentation being configured for accommodating at least one protrusion of the second connecting part when the locking member reaches a predetermined rotational position.

[0049] According to an alternatively preferred example, the locking member is equipped with at least one protrusion and the second connecting part comprises an abutting surface, said abutting surface being configured for abutting against the at least one protrusion of the locking member when the first and the second connecting part are mated. Preferably, the abutting surface of the second connecting part comprises at least one recess and/or at least one cut-out and/or at least one indentation configured for accommodating at least one protrusion of the locking member when the locking member reaches a predetermined rotational position. For example, at least one indentation may be located on the second connecting part, for example on an outer sleeve of the second connecting part, with the indentation extending to a certain depth of the second connecting part's material. Preferably, the abutting surface of the second connecting part comprises at least one cut-out and/or at least one indentation arranged such that when the locking member reaches a predetermined rotational position, the at least one protrusion of the locking member enters the at least one cut-out and/or the at least one indentation. Preferably, due to the interaction between the second connecting part's abutting surface and the at least one protrusion of the locking member, the locking member is moved from the locking position to the non-locking position and back to the locking position. Preferably, when a respective protrusion of the locking member reaches a corresponding recess or enters a corresponding cut-out or indentation, the first rotational movement in the first direction of rotation is ended and a subsequent second rotational movement in a direction of rotation opposite to the first direction of rotation is started, with the second rotational movement moving the locking member from the non-locking position back to the locking position. Preferably, the second connecting part may comprise an outer sleeve with at least one recess and/or at least one cut-out and/or at least one indentation adapted for accommodating at least one protrusion of the locking member. The second connecting part's outer sleeve may for example be formed by plastic injection moulding or by zinc die casting.

[0050] Preferably, the first and the second connecting part are shaped such that a predetermined orientation of the first connecting part relative to the second connecting part is enforced when mating the first connecting part with the second connecting part.

[0051] Preferably, components of the first connecting part are axially fixed within the first connecting part's enclosure using at least one of the following: a retaining ring, a securing ring, a snap ring, a circlip, a press ring,

flanging, screw fitting. For mounting the first connecting part, the components are arranged in the connecting part's enclosure with the arrangement being axially fixed. This allows for a simple assembly. Preferably, for establishing a connection between the first connecting part's enclosure and a respective end piece, end cap or securing ring, techniques like for example welding, adhesive bonding, flanging, border crimping may be used. This allows for establishing a non-detachable connection between the first connecting part's enclosure and the respective end piece, end cap or securing ring. In particular, a cost-effective non-detachable connection may be established by crimping a respective end piece, end cap or securing ring to the first connecting part's enclosure.

[0052] Preferably, the first connecting part is configured for being connected to a cable and the second connecting part is configured for being connected to a housing of a device. In an alternatively preferred example, the first connecting part is configured for being connected to a housing of a device and the second connecting part is configured for being connected to a cable. In an alternatively preferred example, the first connecting part is configured for being connected to a cable and the second connecting part is also configured for being connected to a cable. According to a further preferred example, the first connecting part is configured for being mounted to a housing of a device and the second connecting part is also configured for being mounted to a housing of a device. Hence, the plug-in connector is a versatile connector that can be used in a variety of different applications.

[0053] Preferably, the plug-in connector is at least one of an electrical connector, an optical connector, a hydraulic connector, a fluidic connector, a pneumatic connector. Furthermore, the plug-in connector may for example be a combination of two or more different types of connectors. Hence, the plug-in connector may for example be implemented as a hybrid connector comprising two or more of an electrical connector, an optical connector, a hydraulic connector, a fluidic connector, a pneumatic connector. For each of the above-mentioned types of connectors, it is advantageous to secure the connection between the first and the second connecting part using a locking mechanism. Thus, it is ensured that vibrations, shock loads and external forces cannot disrupt the connection.

[0054] Preferably, the plug-in connector is an electrical connector, with the first connecting part being implemented as a plug and the second connecting part being implemented as a socket or vice versa. Preferably, the plug-in connector is an electrical connector, wherein the first connecting part comprises an arrangement of at least one connector pin and/or at least one socket and wherein the second connecting part comprises an arrangement of at least one connector pin and/or at least one socket.

[0055] Preferably, the plug-in connector comprises at least one shielding element. For example, the at least one shielding element may comprise at least one of the following: an annular spring, a grounding ring, an earthing

crown, one or more lamellae. Preferably, the at least one shielding element is configured for providing an electrical shielding. Preferably, the at least one latching element is configured as a shielding element. For example, a claw ring with at least one claw may be configured as a shielding element. Preferably, the plug-in connector does not comprise any additional shielding elements besides the at least one latching element. According to an alternatively preferred example, the plug-in connector comprises at least one additional shielding element in addition to the at least one latching element, the at least one additional shielding element comprising at least one of the following: an annular spring, a grounding ring, an earthing crown, one or more lamellae. Alternatively, the plug-in connector may not comprise any shielding element. For example, the plug-in connector may be made of plastic material to the greatest possible extent.

[0056] Preferably, the first connecting part comprises at least one sealing element. Preferably, the first connecting part comprises an outer sleeve, with at least one sealing element being arranged on an inner surface of the outer sleeve. Preferably, the first connecting part comprises an inner sleeve, with at least one sealing element being arranged on an outer surface of the inner sleeve. Preferably, at least one sealing element of the first connecting part is configured for sealing the locking member or for sealing a mating area of the plug-in connector or for sealing both the locking member and the mating area. Preferably, the at least one sealing element comprises at least one of the following: an O-ring, an X-ring, a sealing ring, a labyrinth, a felt ring, a moulded seal.

[0057] Preferably, the second connecting part comprises at least one sealing element. Preferably, the second connecting part comprises an outer enclosure, with at least one sealing element being arranged on an outer surface of the outer enclosure. Preferably, the at least one sealing element comprises at least one of the following: an O-ring, an X-ring, a sealing ring, a labyrinth, a felt ring, a moulded seal. Preferably, each of the first connecting part and the second connecting part comprises at least one sealing element. In case each of the connecting parts comprises at least one sealing element and the first connecting part is mated with the second connecting part, a mating area of the plug-in connector or the locking member or both the mating area and the locking member can be sealed.

[0058] Preferably, at least one component of the first connecting part and the second connecting part is manufactured using at least one of the following techniques: injection moulding, turning, milling, metal casting, punching. Furthermore, any combination of these techniques may for example be used for manufacturing at least one component of the first connecting part and the second connecting part. In this regard, in the first connecting part and/or the second connecting part, combinations of different materials may for example be employed, like for example plastic and metal.

[0059] Preferably, the method for mating a first con-

necting part and a second connecting part in a mating direction further comprises locking an engagement between the at least one latching element and the at least one counterlatching element by moving the locking member back to the locking position.

Brief Description of the Drawing

[0060] The invention is illustrated in greater detail with the aid of schematic drawings.

[0061] It shows schematically:

Figure 1a shows a perspective view of the first connecting part and the second connecting part.

Figure 1b shows a sectional view of the first connecting part and the second connecting part.

Figure 2a shows a perspective view of the second connecting part mated with the first connecting part, the locking sleeve being disposed at the locking position.

Figure 2b shows a sectional view of the first connecting part mated with the second connecting part, the locking sleeve being disposed at the locking position.

Figure 3a shows a perspective view of the plug-in connector, with the locking sleeve being moved to the non-locking position.

Figure 3b shows a sectional view of the plug-in connector, with the locking sleeve being moved to the non-locking position.

Figure 4a shows a perspective view of the plug-in connector, wherein at least one latching element of the first connecting part engages with at least one counterlatching element of the second connecting part.

Figure 4b shows a sectional view of the plug-in connector, wherein at least one latching element of the first connecting part engages with at least one counterlatching element of the second connecting part.

Figure 5a shows a perspective view of the plug-in connector, wherein the locking sleeve is moved back to its locking position.

Figure 5b shows a sectional view of the plug-in connector, wherein the locking sleeve is moved back to its locking position.

Figure 6a shows a perspective view of the plug-in connector, with the second connecting part being pulled out of the first connecting part.

Figure 6b shows a sectional view of the plug-in connector, with the second connecting part being pulled out of the first connecting part.

Detailed Description of Embodiments of the Invention

[0062] In the following description of preferred embodiments of the present invention, identical reference numerals denote identical or comparable components.

[0063] Figure 1a shows a perspective view of a plug-in connector comprising a first connecting part 1 that is configured to be mated with a second connecting part 2. In figure 1b, a longitudinal section of the first connecting part 1 and the second connecting part 2 is shown, with the mating direction 3 being indicated in dashed lines. The plug-in connector shown in figure 1a and figure 1b is equipped with a locking mechanism configured for securing the plug-in connection between the first connecting part 1 and the second connecting part 2.

[0064] Firstly, the structure of the first connecting part 1 will be explained with reference to figure 1 b. The first connecting part 1 is implemented as a plug and comprises a plug insert 4 with a plurality of connector pins 5. The plug insert 4 further comprises a plurality of terminal lugs 6, the terminal lugs 6 being electrically connected with the connector pins 5. The plug insert 4 is circumferentially enclosed by an inner sleeve 7 oriented in the mating direction 3. The first connecting part 1 is configured for being connected to a cable and comprises a cable anchor 8 that is screwed onto a threaded portion 9 at the rear end of the inner sleeve 7. The strands of a cable may be electrically connected to the terminal lugs 6.

[0065] The first connecting part 1 further comprises a claw ring 10 with at least one resilient claw 11, with the claw ring 10 being plugged onto a circumferential recess 12 of the inner sleeve 7. For example, the claw ring 10 may comprise one, two, three or more resilient claws 11 that extend in the mating direction 3. When the first connecting part 1 is mated with the second connecting part 2, the at least one resilient claw 11 engages with a circumferential groove 13 of the second connecting part 2. Each of the resilient claws 11 acts as a latching element configured for engaging with a corresponding counterlatching element of the second connecting part 2. In the present example, the circumferential groove 13 acts as a counterlatching element of the second connecting part 2.

[0066] The first connecting part 1 further comprises a locking sleeve 14 that encloses the inner sleeve 7 and the claw ring 10 with the at least one resilient claw 11. The locking sleeve 14 is arranged between the inner sleeve 7 and the outer sleeve 15. The locking sleeve 14 is implemented as a movable part that can be moved in an axial direction relative to the inner sleeve 7, with the axial direction of the first connecting part 1 being the mating direction 3. As shown in figure 1b, the locking sleeve 14 may be implemented as a spring-loaded locking sleeve. A spring 16 is configured for pressing the locking

sleeve 14 in the direction towards the mating end 17 of the first connecting part 1, with the locking sleeve 14 abutting against a circumferential inner recess 18 of the outer sleeve 15. In the example shown, the spring 16 is a multi-turn wave spring. The locking sleeve 14 can be pushed in a backwards direction away from the mating end 17 against a spring force exerted by the spring 16.

[0067] The first connecting part 1 further comprises a projection 19 arranged on the inner sleeve 7, the projection 19 being configured for engaging with a corresponding groove 20 of the second connecting part 2. When the first connecting part 1 is mated with the second connecting part 2, the engagement between the projection 19 and the groove 20 enforces a predefined orientation of the first connecting part 1 relative to the second connecting part 2. For axially fixing components arranged inside the outer sleeve 15 of the first connecting part 1, a retaining ring 21 may be inserted into a circumferential inner groove 22 at the rear end of the first connecting part 1. In order to seal the interior of the first connecting part 1, a sealing ring 23 may be arranged between the inner sleeve 7 and the outer sleeve 15.

[0068] The second connecting part 2 comprises a socket part 24 with a plurality of sockets configured for mating with the connector pins 5. The second connecting part 2 further comprises a plurality of terminal lugs 25 arranged at the rear end of the second connecting part 2, the terminal lugs 25 being electrically connected with the sockets of the socket part 24. The socket part 24 is enclosed by a grounding ring 26 configured for being inserted into the inner sleeve 7 of the first connecting part 1 when the first connecting part 1 is mated with the second connecting part 2. Preferably, the grounding ring 26 is made of metal and is configured for electrically shielding the electrical connection between the connector pins 5 and the socket part 24. Alternatively, instead of a grounding ring, a plastic ring that does not provide an electrical shielding may be used. The second connecting part 2 further comprises an outer enclosure 27, with the socket part 24 and the grounding ring 26 being arranged inside the outer enclosure 27. The outer enclosure 27 comprises the circumferential groove 13, which serves as a counterlatching element for the at least one resilient claw 11.

[0069] The outer enclosure 27 further comprises at least one protrusion 28 projecting in a radially outward direction. When the second connecting part 2 is mated with the first connecting part 1, the at least one protrusion 28 abuts against the locking sleeve 14 and pushes back the locking sleeve 14 against the spring force exerted by the spring 16. Furthermore, the second connecting part 2 comprises a sealing ring 29, the sealing ring 29 being pressed against the outer sleeve 15 of the first connecting part 1 when the two connecting parts are mated. In the example shown, the first connecting part 1 is configured for being fixed to a cable, whereas the second connecting part 2 is configured for being mounted to the housing of a device. For this purpose, the rear part 30 of the second

connecting part 2 can be inserted into a wall of the device. Then, the nut 31 is tightened, thereby pressing the mounting flange 32 against the wall of the device. In this example, the first connecting part 1 is fixed to a cable and the second connecting part 2 is mounted to a device. Alternatively, the first connecting part 1 may be mounted to a device and the second connecting part 2 may be fixed to a cable. Further alternatively, both the first connecting part 1 and the second connecting part 2 may be attached to respective cables. Further alternatively, both the first connecting part 1 and the second connecting part 2 may be mounted to the housing of a respective device, in order to establish a plug-in connection between two devices.

[0070] From the perspective view shown in figure 1a, it can be seen how the at least one protrusion 28 of the second connecting part 2 interacts with the movable locking sleeve 14 of the first connecting part 1. When the second connecting part 2 is inserted into the first connecting part 1, the at least one protrusion 28 abuts against the abutting surface 33 of the locking sleeve 14 and pushes the locking sleeve 14 backwardly as indicated by arrow 34. This movement of the locking sleeve 14 in the backward direction away from the mating end 17 is performed against the spring force exerted by the multi-turn wave spring 16. The locking sleeve 14 further comprises a guidance slot 35. A sliding member 36 located on the inner sleeve 7 and projecting outwardly is accommodated in the guidance slot 35 and is configured for moving in the guidance slot 35. When the locking sleeve 14 is pushed in the backwards direction by the at least one protrusion 28, the guidance slot 35 and the sliding member 36 enforce a rotational movement of the locking sleeve 14 as indicated by arrow 37. The interaction between the guidance slot 35 and the sliding member 36 provides a forced guidance that transforms an axial movement of the locking sleeve 14 into a rotational movement of the locking sleeve 14.

[0071] As shown in figure 1a, the locking sleeve 14 further comprises a cut-out 38 at the rim of the locking sleeve 14. The cut-out 38 is configured for accommodating the protrusion 28 after a predetermined rotational position of the locking sleeve 14 relative to the second connecting part 2 is reached. When the predetermined rotational position of the locking sleeve 14 relative to the second connecting part 2 is reached, the protrusion 28 enters the cut-out 38. Then, the second connecting part 2 is further inserted into the first connecting part 1 and the protrusion 28 passes the left projection of the cut-out 38 viewed from the first connecting part 1. As soon as the protrusion 28 has passed the left projection of the cut-out 38 and is contained inside the cut-out 38, the locking sleeve 14 is no longer retained by the protrusion 28 and can return towards its initial position, ie to the locking position.

[0072] In the following, the process of plugging the second connecting part 2 into the first connecting part 1 will be explained. In the perspective view of figure 2a, it is shown that the second connecting part 2 is inserted into

the first connecting part 1 so far that the protrusion 28 abuts against the abutting surface 33 of the locking sleeve 14, but the locking sleeve 14 is still in its initial position, ie in the locking position. As can be seen from the longitudinal section shown in figure 2b, in the locking position, the at least one resilient claw 11 is positively locked in its respective position by the inner surface of the locking sleeve 14. The inner surface of the locking sleeve is disposed closely adjacent to the at least one resilient claw 11 and does not permit any movement of the at least one resilient claw 11 in the radial direction. Any movement of the at least one resilient claw 11 is blocked by the locking sleeve 14.

[0073] From the sectional view of figure 2b, it can be seen that the projection 19 of the first connecting part 1 is engaged with the groove 20 of the second connecting part 2, thereby enforcing a predetermined orientation of the first connecting part 1 relative to the second connecting part 2. The grounding ring 26 of the second connecting part 2 is pushed into the inner sleeve 7 of the first connecting part 1 and the connector pins 5 are plugged into corresponding sockets of the socket part 24.

[0074] In figure 3a and figure 3b, the second connecting part 2 is further inserted into the first connecting part 1, with the locking sleeve 14 being pushed by the protrusion 28 in a direction indicated by arrow 40. The locking sleeve 14 is pushed backwardly against the spring force exerted by the spring 16. In addition to the axial movement of the locking sleeve 14, the interaction between the guidance slot 35 and the sliding member 36 enforces a rotational movement of the locking sleeve 14 as indicated by arrow 41. The cut-out 38 is rotated in the direction towards the protrusion 28.

[0075] In figure 3a and 3b, the locking sleeve 14 has reached its non-locking position. As shown in figure 3b, in the locking sleeve's non-locking position, the circumferential inner groove 42 is moved to a position adjacent to the at least one resilient claw 11, and accordingly, the movement of the at least one resilient claw 11 is no longer blocked. In the non-locking position of the locking sleeve 14, the at least one resilient claw 11 is free and can perform movements in a radial direction of the plug-in connector. It is to be noted that in figure 3b, the at least one resilient claw 11 has not engaged with the circumferential groove 13 yet.

[0076] If the locking sleeve 14 is further pushed in the backward direction by the protrusion 28, it will be further rotated in the direction indicated by arrow 41 until it reaches a predetermined rotational position in which the protrusion 28 enters the cut-out 38. This situation is shown in figure 4a and figure 4b. When the second connecting part 2 is further moved in the mating direction 3 towards the first connecting part 1, the protrusion 28 passes along the left projection of the cut-out 38 viewed from the first connecting part 1. In this position, the locking sleeve 14 is still retained in the non-locking position, and as shown in figure 4b, the at least one resilient claw 11 engages with the circumferential groove 13 at the outer enclosure

27 of the second connecting part 2. As soon as the protrusion has completely passed the left projection of the cut-out 38 and is contained inside the cut-out 38, the locking sleeve 14 is no longer retained in the non-locking position by the protrusion 28. The locking sleeve 14 is moved back to the locking position by the spring 16. Depending on the slope of the slanted surface 39, the locking sleeve 14 may either be pushed back to the locking position abruptly or the protrusion 28 may slide along the slanted surface 39 of the cut-out 38.

[0077] In figure 5a and figure 5b, it is shown that the locking sleeve 14 has returned to its locking position, with the protrusion 28 still being contained inside the cut-out 38. From the sectional view of figure 5b, it can be seen that the at least one resilient claw 11 is engaged with the circumferential groove 13. The locking sleeve 14 is located in its locking position, and accordingly, the at least one resilient claw 11 is positively locked by the locking sleeve 14. The movement of the at least one resilient claw 11 is blocked by the inner surface of the locking sleeve 14. Accordingly, the engagement between the at least one latching element of the first connecting part 1 and the at least one counterlatching element of the second connecting part 2 is locked by the locking sleeve 14, thereby securing the connection between the first connecting part 1 and the second connecting part 2. Even in the presence of vibrations, shock loads and external forces acting on the plug-in connector, the connection between the first connecting part 1 and the second connecting part 2 cannot be disrupted. Now, the process of plugging the first connecting part 1 into the second connecting part 2 is finished.

[0078] From figure 5b, it can further be seen that the sealing rings 23, 29 are configured for sealing the interior of the plug-in connector against external influences when the second connecting part 2 is mated with the first connecting part 1.

[0079] In figure 6a and figure 6b, it is shown how the second connecting part 2 is unplugged from the first connecting part 1. The starting point for the unplugging operation is the locked state shown in figure 5a and figure 5b, in which the locking sleeve 14 is disposed in the locking position, thereby positively locking the engagement between the at least one latching element and the at least counterlatching element. For separating the first connecting part 1 and the second connecting part 2, the user grabs the outer sleeve 15 of the first connecting part 1 and pulls the outer sleeve 15 relative to the second connecting part 2 in the direction indicated by arrow 43 in figure 6b. The locking sleeve 14 is disposed in the locking position, wherein the spring 16 presses the locking sleeve 14 towards the inner recess 18 of the outer sleeve 15 such that the locking sleeve 14 abuts against the inner recess 18. When the outer sleeve 15 is pulled in the backwards direction as indicated by arrow 43, the locking sleeve 14 will follow this movement.

[0080] The at least one resilient claw 11 is engaged with the circumferential groove 13 of the second connect-

ing part 2, with this engagement being locked by the locking sleeve 14. As the engagement is locked, the at least one resilient claw 11 and the claw ring 10 remain attached to the second connecting part 2. As a consequence, the at least one claw 11, the claw ring 10 and the inner sleeve 7 of the first connecting part 1 follow the movement of the second connecting part 2. The outer sleeve 15 and the locking sleeve 14 move in the backwards direction relative to the inner sleeve 7, the claw ring 10 and the second connecting part 2 as indicated by arrow 43. As a consequence of the relative movement between the outer sleeve 15 and the inner sleeve 7, a clearance 44 appears at the rear end of the inner sleeve 7.

[0081] By pulling the outer sleeve 15 in the backwards direction, the locking sleeve 14 is moved relative to the at least one resilient claw 11 and the circumferential groove 13. The inner groove 42 of the locking sleeve 14 is moved towards the resilient claw 11. As soon as the inner groove 42 is located adjacent to the at least one resilient claw 11, the resilient claw 11 can disengage from the circumferential groove 13. After the resilient claw 11 and the circumferential groove 13 have disengaged, the first connecting part 1 can be pulled out of the second connecting part 2 entirely.

[0082] The features described in the above description, claims and figures can be relevant to the invention in any combination. Their reference numerals in the claims have merely been introduced to facilitate reading of the claims. They are by no means meant to be limiting.

List of reference numerals

[0083]

- | | |
|----|------------------------|
| 1 | first connecting part |
| 2 | second connecting part |
| 3 | mating direction |
| 4 | plug insert |
| 5 | connector pins |
| 6 | terminal lugs |
| 7 | inner sleeve |
| 8 | cable anchor |
| 9 | threaded portion |
| 10 | claw ring |
| 11 | resilient claws |
| 12 | circumferential recess |
| 13 | circumferential groove |
| 14 | locking sleeve |
| 15 | outer sleeve |
| 16 | spring |
| 17 | mating end |
| 18 | recess |
| 19 | projection |
| 20 | groove |
| 21 | retaining ring |
| 22 | inner groove |
| 23 | sealing ring |
| 24 | socket part |

25 terminal lugs
 26 grounding ring
 27 outer enclosure
 28 protrusions
 29 sealing ring
 30 rear portion
 31 nut
 32 mounting flange
 33 abutting surface
 34 arrow
 35 guidance slot
 36 sliding member
 37 arrow
 38 cut-out
 39 slanted surface
 40 arrow
 41 arrow
 42 inner circumferential groove
 43 arrow
 44 clearance

Claims

1. A plug-in connector comprising a first connecting part (1) and a second connecting part (2), the first connecting part (1) being configured for being mated with the second connecting part (2) in a mating direction (3), the first connecting part (1) comprising

- at least one latching element (11) configured for engaging with at least one counterlatching element (13) of the second connecting part (2) when the first connecting part (1) is mated with the second connecting part (2),
- a locking member (14) movably arranged in the first connecting part (1), wherein the locking member (14) is configured for locking an engagement between the at least one latching element (11) and the at least one counterlatching element (13) in a locking position of the locking member (14),

characterised in that

- the first connecting part (1) comprises a forced guidance configured for enforcing a rotational motion of the locking member (14) when the locking member (14) is moved relative to the at least one latching element (11),
- wherein the second connecting part (2) is shaped and configured for interacting with the locking member (14) such that a rotational motion of the locking member (14) relative to the first connecting part (1) is enforced when the first connecting part (1) is mated with the second connecting part (2), wherein the rotational motion comprises moving the locking member (14)

from the locking position to a non-locking position and back to the locking position,
 - with the at least one latching element (11) being configured for engaging with the at least one counterlatching element (13) when the locking member (14) is in the non-locking position.

2. Plug-in connector according to claim 1, wherein the locking member (14) is implemented as a locking sleeve (14).

3. Plug-in connector according to claim 2, wherein the locking sleeve (14) is configured for rotating around an axis oriented in the mating direction (3).

4. Plug-in connector according to any one of claims 1 to 3, wherein the locking member (14) comprises an abutting surface (33), the abutting surface (33) being configured such that the second connecting part (2) abuts against the abutting surface (33) of the locking member (14) when the first connecting part (1) is mated with the second connecting part (2).

5. Plug-in connector according to any one of claims 1 to 4, wherein the second connecting part (2) is equipped with at least one protrusion (28), the at least one protrusion (28) being configured for abutting against the locking member (14) when the first connecting part (1) is mated with the second connecting part (2).

6. Plug-in connector according to any one of claims 1 to 5, wherein the plug-in connector comprises at least one spring element (16) configured for pressing the locking member (14) towards a mating end (17) of the first connecting part (1) into a locking position.

7. Plug-in connector according to any one of claims 1 to 5, wherein the first connecting part (1) is configured for applying a force to the locking member (14), the force acting on the locking member (14) in a direction towards a mating end (17) of the first connecting part (1), the force being at least one of the following: a magnetic force, a pneumatic force, a hydraulic force, a weight force caused by a weight of the locking member (14).

8. Plug-in connector according to any one of claims 1 to 7, wherein the at least one latching element (11) is implemented as at least one claw.

9. Plug-in connector according to any one of claims 1 to 8, wherein the at least one counterlatching element (13) is implemented as at least one recess or as a circumferential groove (13).

10. Plug-in connector according to any one of claims 1 to 9, wherein the forced guidance comprises a guid-

ance slot (35) or a guidance groove located at or in the locking member (14) and a sliding member (36) accommodated in the guidance slot (35) or the guidance groove.

11. Plug-in connector according to any one of claims 1 to 10, wherein the second connecting part (2) and the locking member (14) are shaped and configured such that after a predetermined rotational position of the locking member (14) relative to the second connecting part (2) has been reached, the locking member's state changes from a retained state in which the locking member (2) is retained in the non-locking position by the second connecting part (2) to a non-retained state in which the locking member (14) is not retained in the non-locking position by the second connecting part (2).

12. Plug-in connector according to any one of claims 1 to 11, wherein the locking member (14) comprises an abutting surface (33), the abutting surface (33) comprising at least one cut-out (38), the at least one cut-out (38) being configured for accommodating a respective protrusion (28) of the second connecting part (2) when the locking member (14) reaches a predefined rotational position.

13. A first connecting part (1) for a plug-in connector, the first connecting part (1) being configured for being mated with a second connecting part (2) of the plug-in connector in a mating direction (3), the first connecting part (1) comprising

- at least one latching element (11) configured for engaging with at least one counterlatching element (13) of the second connecting part (2) when the first connecting part (1) is mated with the second connecting part (2),
- a locking member (14) movably arranged in the first connecting part (1), wherein the locking member (14) is configured for locking an engagement between the at least one latching element (11) and the at least one counterlatching element (13) in a locking position of the locking member (14),

characterised in that

- the first connecting part (1) comprises a forced guidance configured for enforcing a rotational motion of the locking member (14) when the locking member (14) is moved relative to the at least one latching element (11),
- wherein the locking member (14) is shaped and configured for interacting with the second connecting part (2) such that a rotational motion of the locking member (14) relative to the first connecting part (1) is enforced when the first

connecting part (1) is mated with the second connecting part (2), wherein the rotational motion comprises moving the locking member (14) from the locking position to a non-locking position and back to the locking position,
- with the at least one latching element (11) being configured for engaging with the at least one counterlatching element (13) when the locking member (14) is in the non-locking position.

14. A method for mating a first connecting part (1) and a second connecting part (2) in a mating direction (3), the first connecting part (1) comprising

- at least one latching element (11) configured for engaging with at least one counterlatching element (13) of the second connecting part (2) when the first connecting part (1) is mated with the second connecting part (2),
- a locking member (14) movably arranged in the first connecting part (1), wherein the locking member (14) is configured for locking an engagement between the at least one latching element (11) and the at least one counterlatching element (13) in a locking position of the locking member (14),
- wherein the first connecting part (1) comprises a forced guidance configured for enforcing a rotational motion of the locking member (14) when the locking member (14) is moved relative to the at least one latching element (11),

the method comprising:

- mating the first connecting part (1) with the second connecting part (2), wherein the second connecting part (2) is shaped and configured for interacting with the locking member (14) when the first connecting part (1) is mated with the second connecting part (2),
- enforcing a rotational motion of the locking member (14) relative to the first connecting part (1) by an interaction between the second connecting part (2) and the locking member (14) and by the forced guidance, wherein the rotational motion comprises moving the locking member (14) from the locking position to a non-locking position and back to the locking position, and
- engaging at least one latching element (11) of the first connecting part (1) with at least one counterlatching element (13) of the second connecting part (2) when the locking member (14) is in the non-locking position.

15. A method for unplugging a first connecting part (1) from a second connecting part (2), the first connecting part (1) comprising

- at least one latching element (11) configured for engaging with at least one counterlatching element (13) of the second connecting part (2) when the first connecting part (1) is mated with the second connecting part (2),
- a locking member (14) movably arranged in the first connecting part (1), wherein the locking member (14) is configured for locking an engagement between the at least one latching element (11) and the at least one counterlatching element (13) in a locking position of the locking member (14),
- wherein the first connecting part (1) comprises a forced guidance configured for enforcing a rotational motion of the locking member (14) when the locking member (14) is moved relative to the at least one latching element (11),

the method comprising:

- pulling the first connecting part (1) with the locking member (14) relative to the second connecting part (2) in a direction against the mating direction (3), thereby moving the locking member (14) relative to the at least one latching element (11) from the locking position to a non-locking position,
- disengaging the at least one latching element (11) and the at least one counterlatching element (13),
- unplugging the first connecting part (1) from the second connecting part (2).

Amended claims in accordance with Rule 137(2) EPC.

1. A plug-in connector comprising a first connecting part (1) and a second connecting part (2), the first connecting part (1) being configured for being mated with the second connecting part (2) in a mating direction (3),
the first connecting part (1) comprising

- at least one latching element (11) configured for engaging with at least one counterlatching element (13) of the second connecting part (2) when the first connecting part (1) is mated with the second connecting part (2),
- a locking member (14) movably arranged in the first connecting part (1), wherein the locking member (14) is configured for locking an engagement between the at least one latching element (11) and the at least one counterlatching element (13) in a locking position of the locking member (14),
- with the at least one latching element (11) being configured for engaging with the at least one

- counterlatching element (13) when the locking member (14) is in the non-locking position,
- wherein the first connecting part (1) comprises a forced guidance configured for enforcing a rotational motion of the locking member (14) when the locking member (14) is moved relative to the at least one latching element (11),

characterised in that

- at least one surface of the second connecting part (2) is shaped and configured for interacting with at least one surface of the locking member (14) such that a rotational motion of the locking member (14) relative to the first connecting part (1) is enforced when the first connecting part (1) is mated with the second connecting part (2), wherein the rotational motion comprises moving the locking member (14) from the locking position to a non-locking position and back to the locking position.

2. Plug-in connector according to claim 1, wherein the locking member (14) is implemented as a locking sleeve (14).
3. Plug-in connector according to claim 2, wherein the locking sleeve (14) is configured for rotating around an axis oriented in the mating direction (3).
4. Plug-in connector according to any one of claims 1 to 3, wherein the locking member (14) comprises an abutting surface (33), the abutting surface (33) being configured such that the second connecting part (2) abuts against the abutting surface (33) of the locking member (14) when the first connecting part (1) is mated with the second connecting part (2).
5. Plug-in connector according to any one of claims 1 to 4, wherein the second connecting part (2) is equipped with at least one protrusion (28), the at least one protrusion (28) being configured for abutting against the locking member (14) when the first connecting part (1) is mated with the second connecting part (2).
6. Plug-in connector according to any one of claims 1 to 5, wherein the plug-in connector comprises at least one spring element (16) configured for pressing the locking member (14) towards a mating end (17) of the first connecting part (1) into a locking position.
7. Plug-in connector according to any one of claims 1 to 5, wherein the first connecting part (1) is configured for pressing the locking member (14) towards the mating end (17) of the first connecting part (1) into the locking position by applying a force to the locking member (14), the force being at least one of

the following: a magnetic force, a pneumatic force, a hydraulic force, a weight force caused by a weight of the locking member (14).

8. Plug-in connector according to any one of claims 1 to 7, wherein the at least one latching element (11) is implemented as at least one claw. 5
9. Plug-in connector according to any one of claims 1 to 8, wherein the at least one counterlatching element (13) is implemented as at least one recess or as a circumferential groove (13). 10
10. Plug-in connector according to any one of claims 1 to 9, wherein the forced guidance comprises a guidance slot (35) or a guidance groove located at or in the locking member (14) and a sliding member (36) accommodated in the guidance slot (35) or the guidance groove. 15
11. Plug-in connector according to any one of claims 1 to 10, wherein the second connecting part (2) and the locking member (14) are shaped and configured such that after a predetermined rotational position of the locking member (14) relative to the second connecting part (2) has been reached, the locking member's state changes from a retained state in which the locking member (2) is retained in the non-locking position by the second connecting part (2) to a non-retained state in which the locking member (14) is not retained in the non-locking position by the second connecting part (2). 20
12. Plug-in connector according to any one of claims 1 to 11, wherein the locking member (14) comprises an abutting surface (33), the abutting surface (33) comprising at least one cut-out (38), the at least one cut-out (38) being configured for accommodating a respective protrusion (28) of the second connecting part (2) when the locking member (14) reaches a predefined rotational position. 25
13. A first connecting part (1) for a plug-in connector, the first connecting part (1) being configured for being mated with a second connecting part (2) of the plug-in connector in a mating direction (3), the first connecting part (1) comprising 30
 - at least one latching element (11) configured for engaging with at least one counterlatching element (13) of the second connecting part (2) when the first connecting part (1) is mated with the second connecting part (2), 35
 - a locking member (14) movably arranged in the first connecting part (1), wherein the locking member (14) is configured for locking an engagement between the at least one latching element (11) and the at least one counterlatching 40

element (13) in a locking position of the locking member (14),

- with the at least one latching element (11) being configured for engaging with the at least one counterlatching element (13) when the locking member (14) is in the non-locking position,
- wherein the first connecting part (1) comprises a forced guidance configured for enforcing a rotational motion of the locking member (14) when the locking member (14) is moved relative to the at least one latching element (11),

characterised in that

- at least one surface of the second connecting part (2) is shaped and configured for interacting with at least one surface of the locking member (14) such that a rotational motion of the locking member (14) relative to the first connecting part (1) is enforced when the first connecting part (1) is mated with the second connecting part (2), wherein the rotational motion comprises moving the locking member (14) from the locking position to a non-locking position and back to the locking position.

14. A method for mating a first connecting part (1) and a second connecting part (2) in a mating direction (3), the first connecting part (1) comprising 30

- at least one latching element (11) configured for engaging with at least one counterlatching element (13) of the second connecting part (2) when the first connecting part (1) is mated with the second connecting part (2), 35
- a locking member (14) movably arranged in the first connecting part (1), wherein the locking member (14) is configured for locking an engagement between the at least one latching element (11) and the at least one counterlatching element (13) in a locking position of the locking member (14), 40
- wherein the first connecting part (1) comprises a forced guidance configured for enforcing a rotational motion of the locking member (14) when the locking member (14) is moved relative to the at least one latching element (11), 45

the method comprising:

- mating the first connecting part (1) with the second connecting part (2), wherein at least one surface of the second connecting part (2) is shaped and configured for interacting with at least one surface of the locking member (14) when the first connecting part (1) is mated with the second connecting part (2), 50
- enforcing a rotational motion of the locking 55

member (14) relative to the first connecting part (1) by an interaction between the at least one surface of the second connecting part (2) and the at least one surface of the locking member (14) and by the forced guidance, wherein the rotational motion comprises moving the locking member (14) from the locking position to a non-locking position and back to the locking position, and

- engaging at least one latching element (11) of the first connecting part (1) with at least one counterlatching element (13) of the second connecting part (2) when the locking member (14) is in the non-locking position.

15. A method for unplugging a first connecting part (1) from a second connecting part (2), the first connecting part (1) comprising

- at least one latching element (11) configured for engaging with at least one counterlatching element (13) of the second connecting part (2) when the first connecting part (1) is mated with the second connecting part (2),
- a locking member (14) movably arranged in the first connecting part (1), wherein the locking member (14) is configured for locking an engagement between the at least one latching element (11) and the at least one counterlatching element (13) in a locking position of the locking member (14),
- wherein the first connecting part (1) comprises a forced guidance configured for enforcing a rotational motion of the locking member (14) when the locking member (14) is moved relative to the at least one latching element (11),
- wherein at least one surface of the second connecting part (2) is shaped and configured for interacting with at least one surface of the locking member (14) such that a rotational motion of the locking member (14) relative to the first connecting part (1) is enforced when the first connecting part (1) is mated with the second connecting part (2), the method comprising:
 - pulling the first connecting part (1) with the locking member (14) relative to the second connecting part (2) in a direction against the mating direction (3), thereby moving the locking member (14) relative to the at least one latching element (11) from the locking position to a non-locking position,
 - disengaging the at least one latching element (11) and the at least one counterlatching element (13),
 - unplugging the first connecting part (1) from the second connecting part (2).

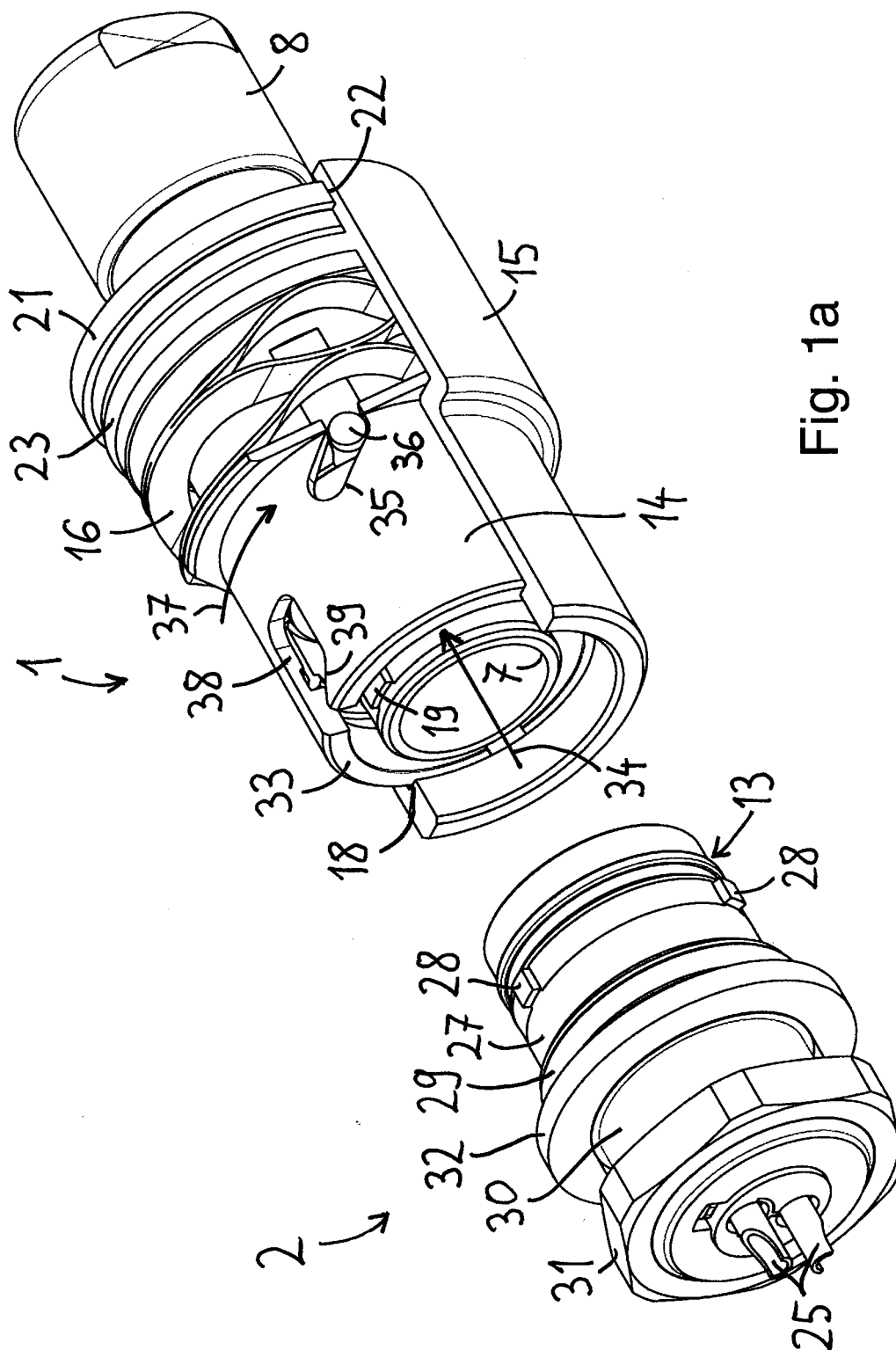


Fig. 1a

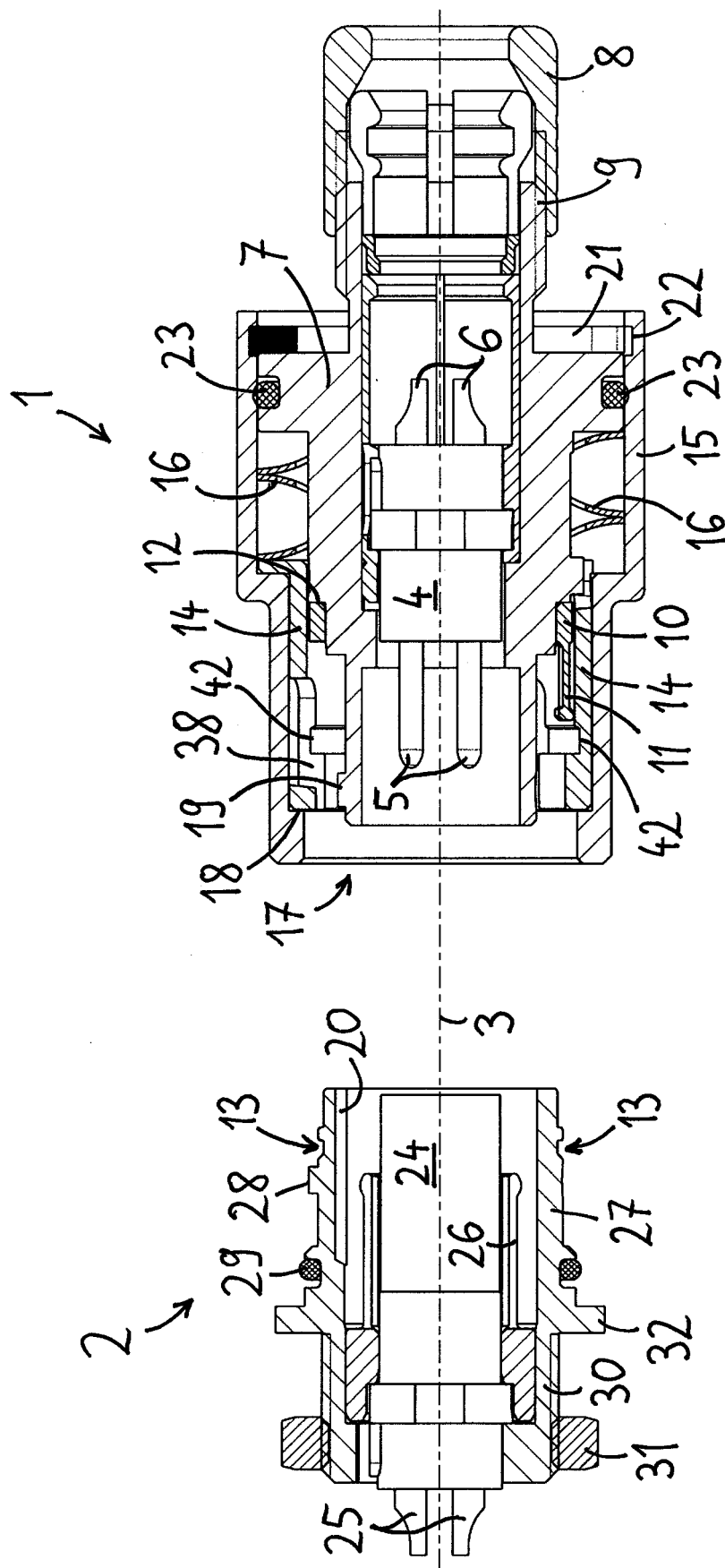
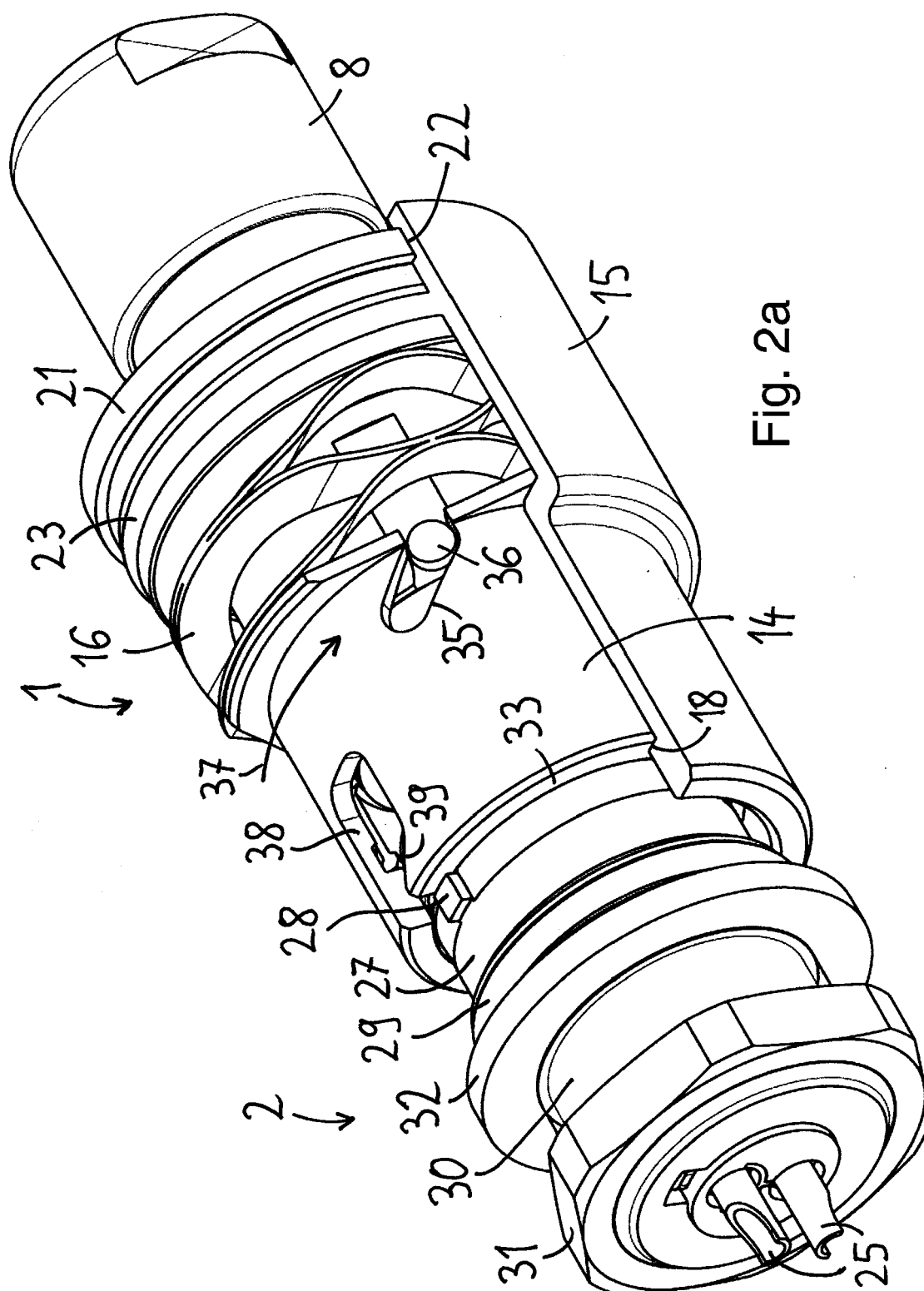


Fig. 1b



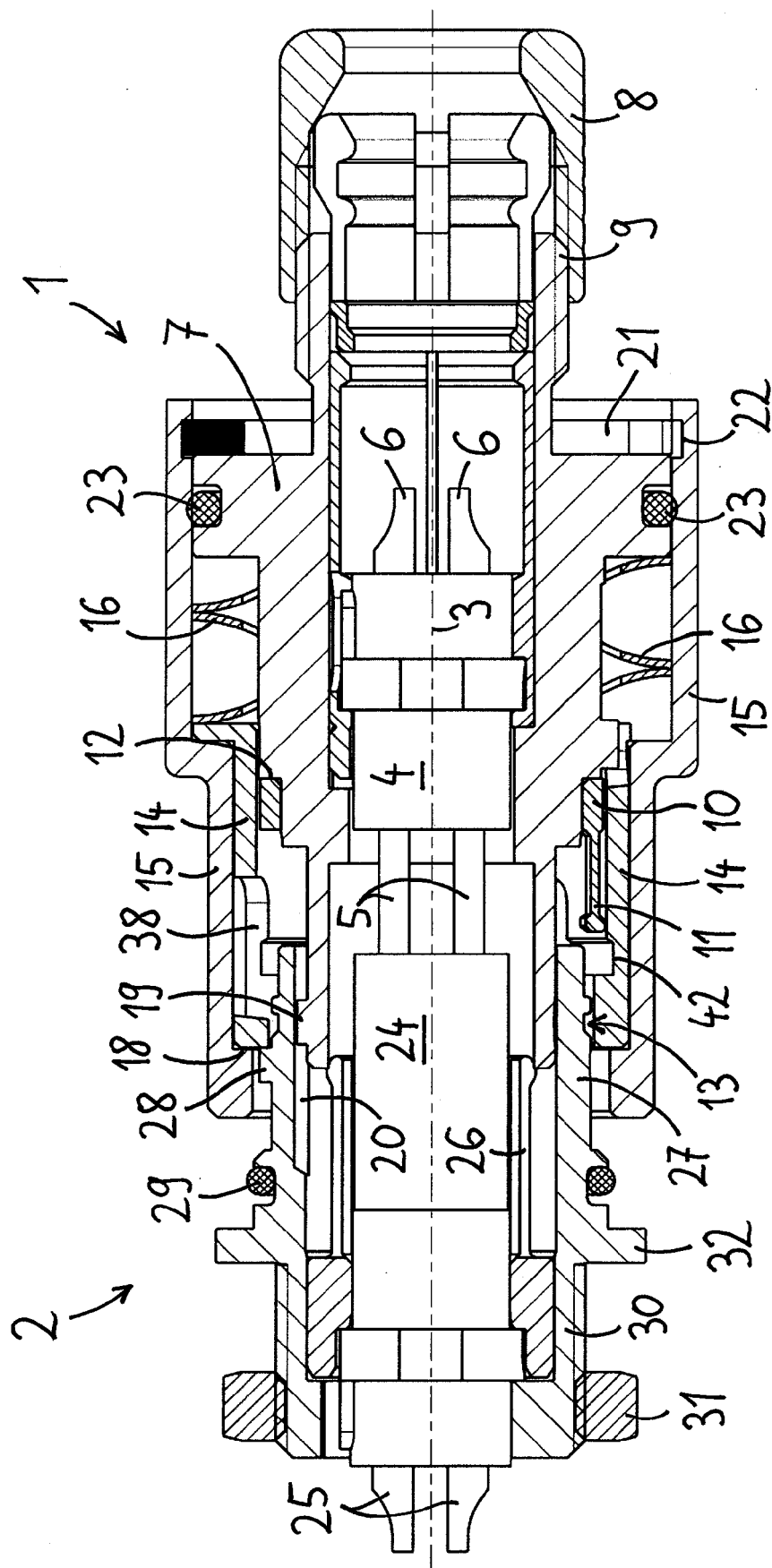


Fig. 2b

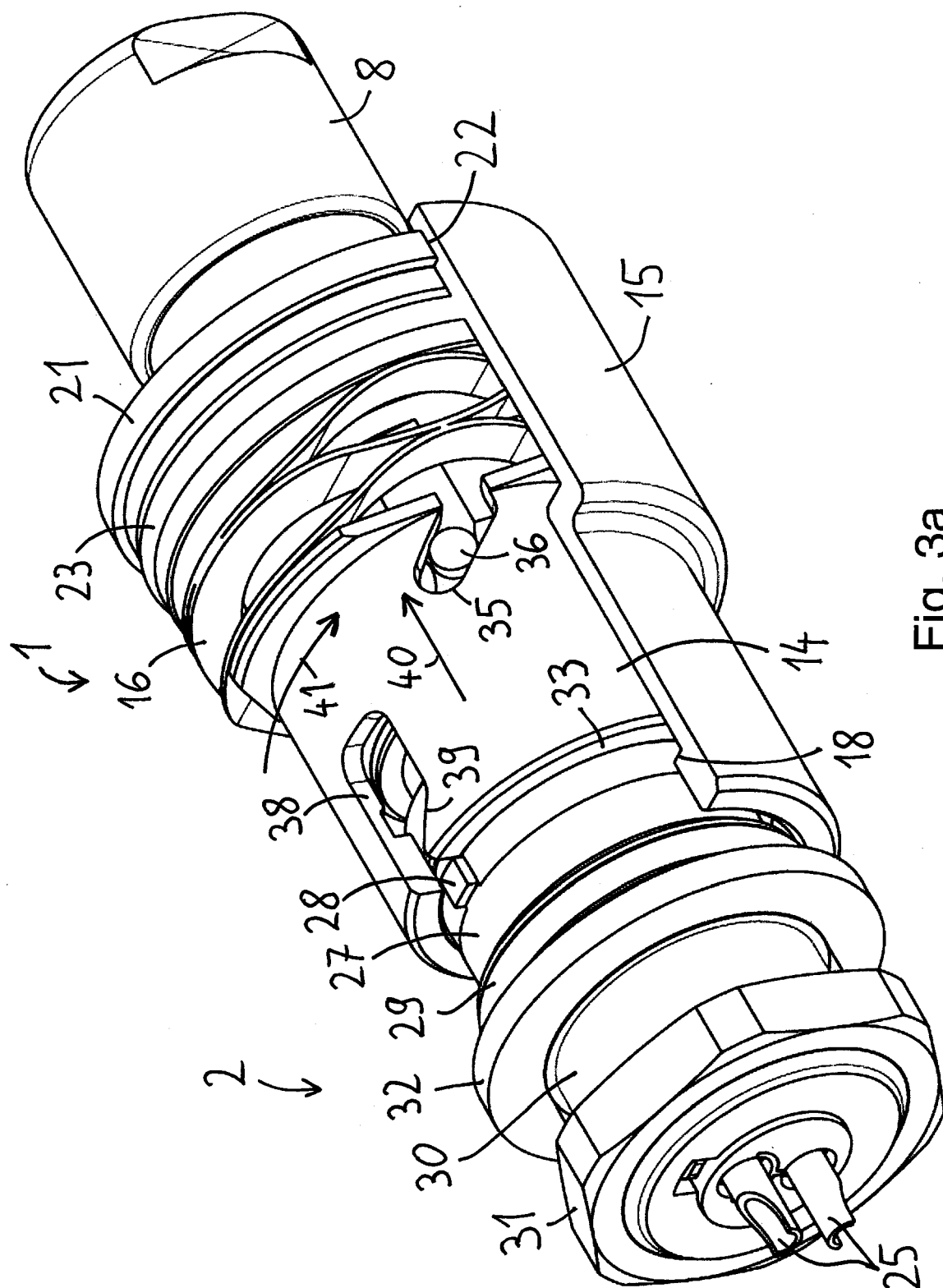
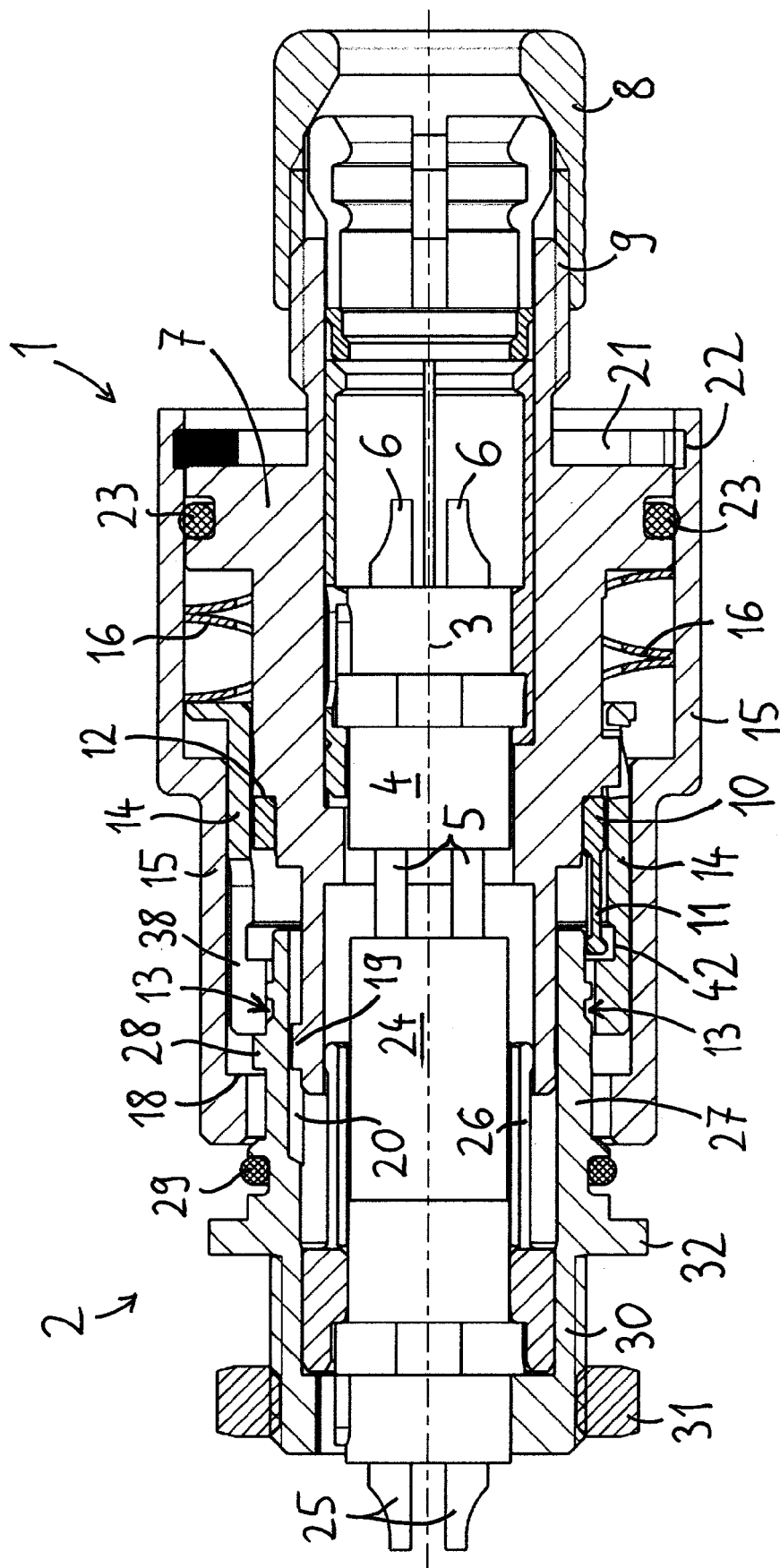


Fig. 3a



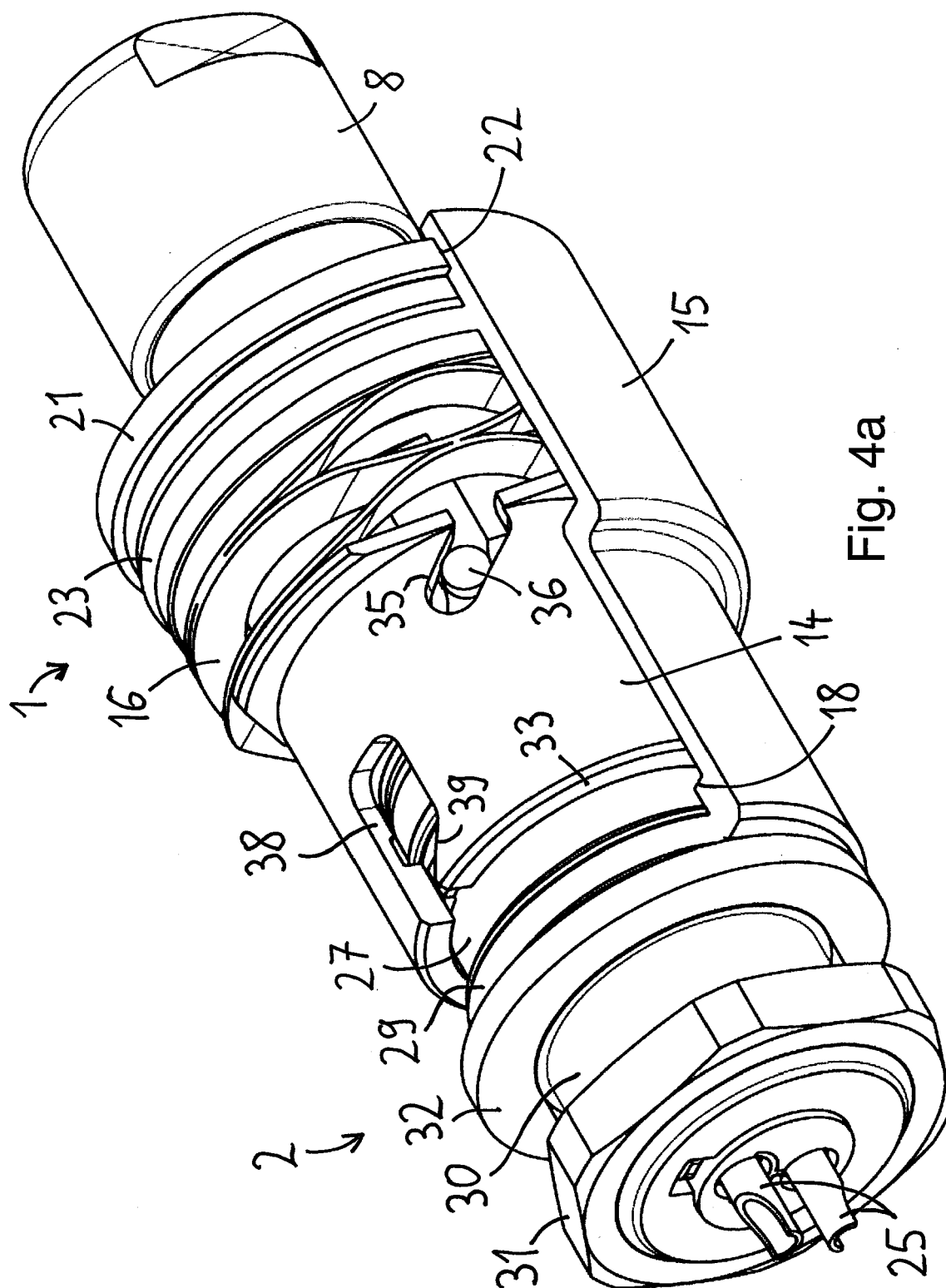


Fig. 4a

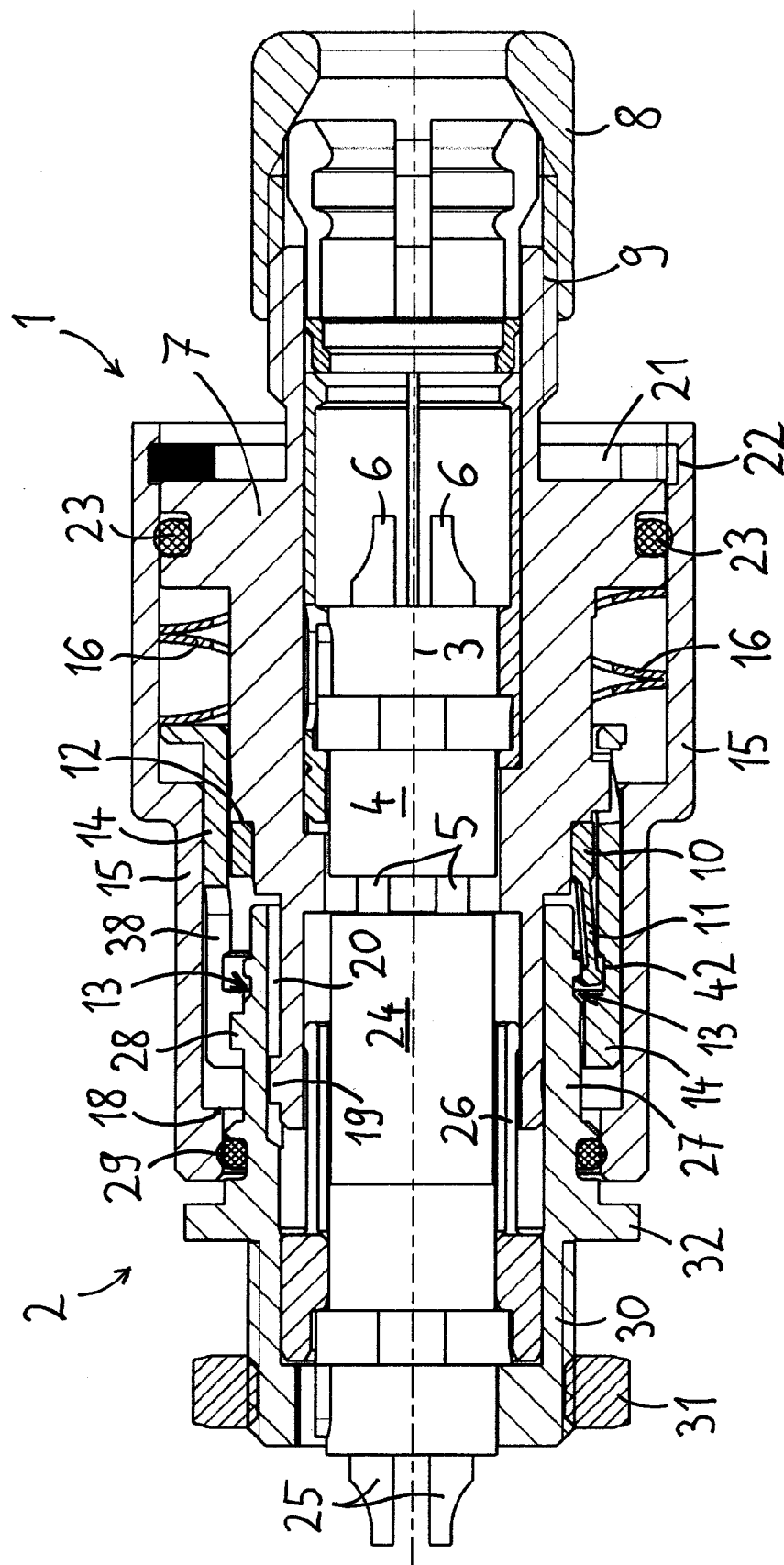


Fig. 4b

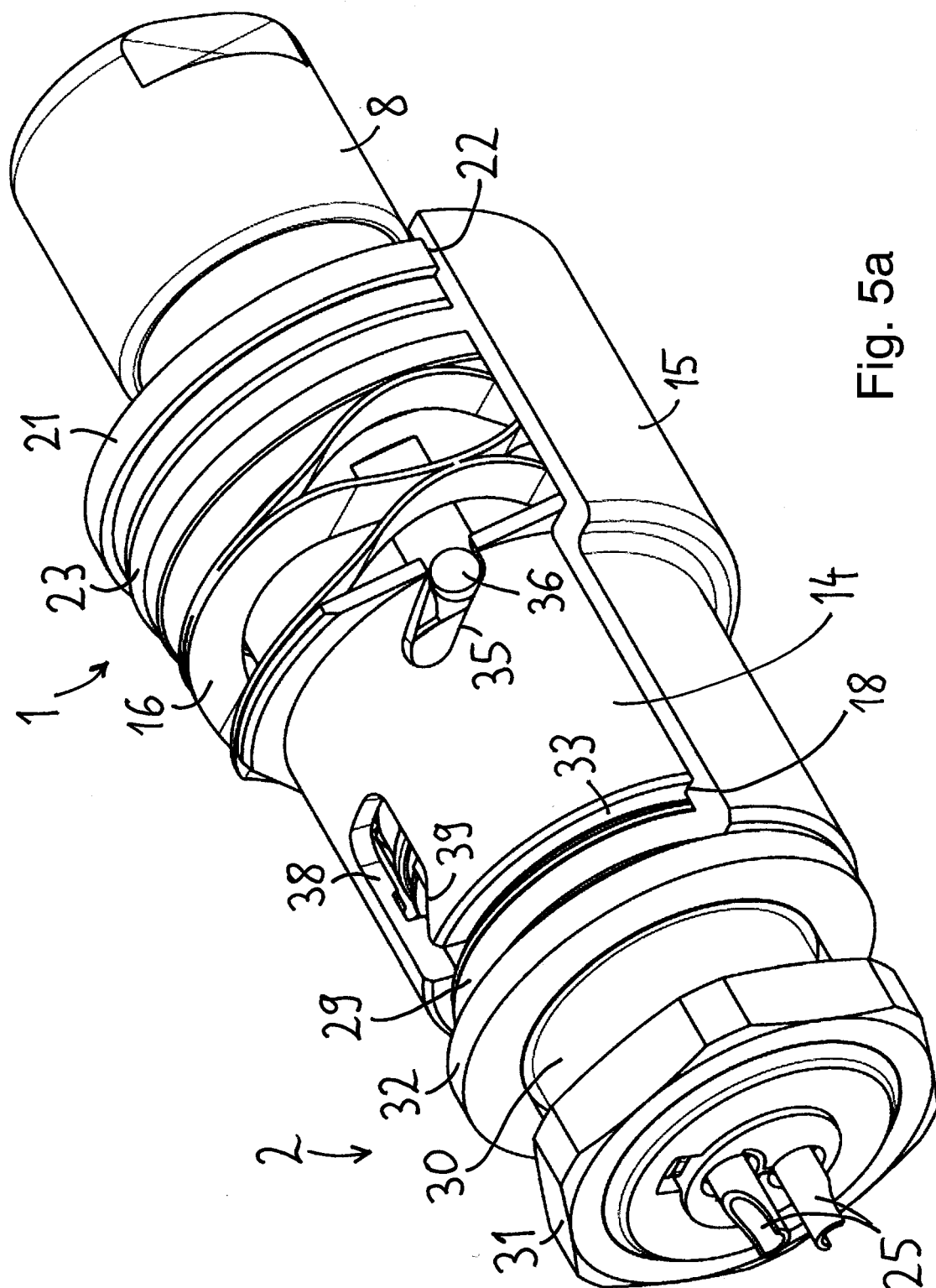


Fig. 5a

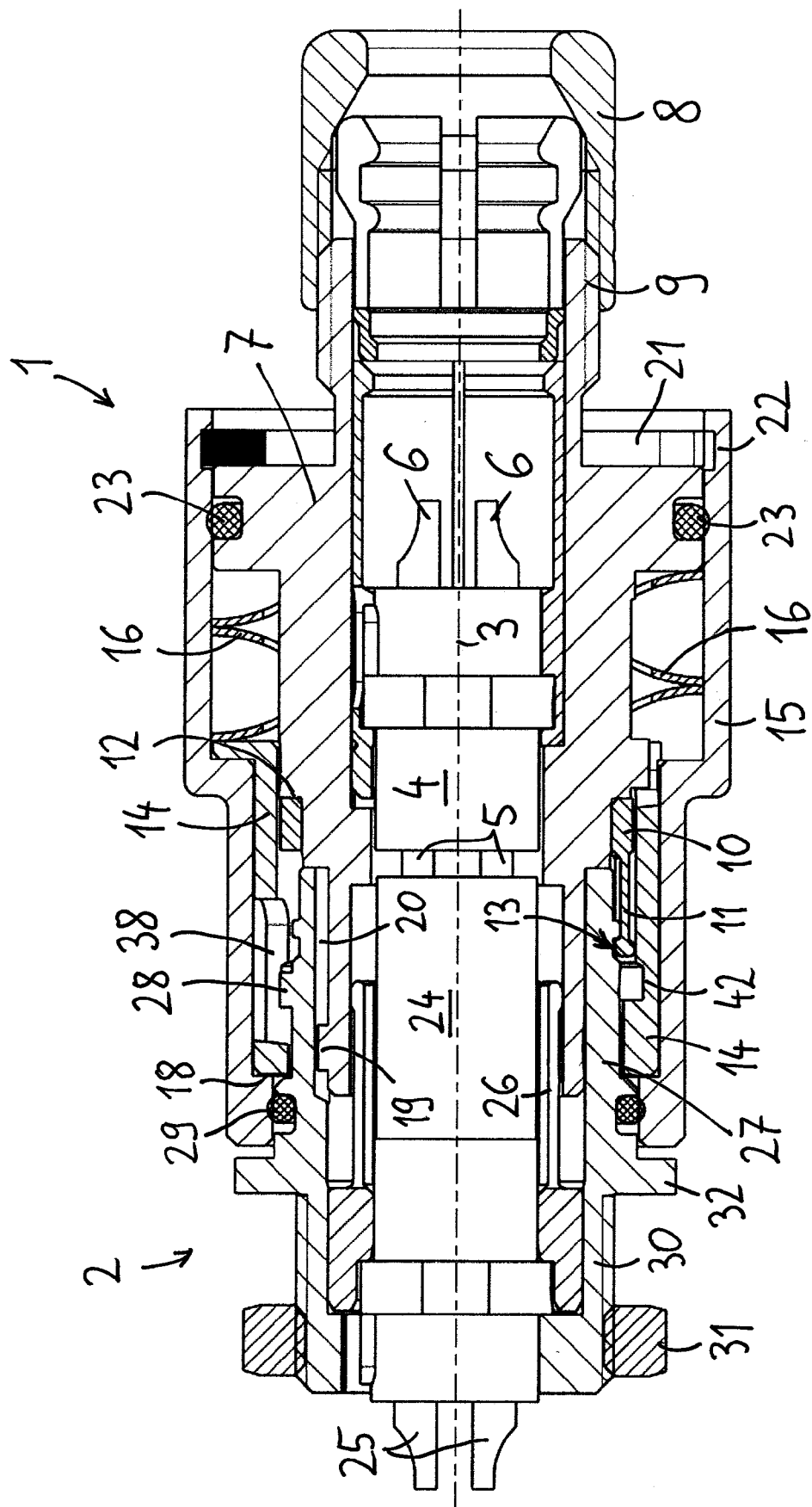
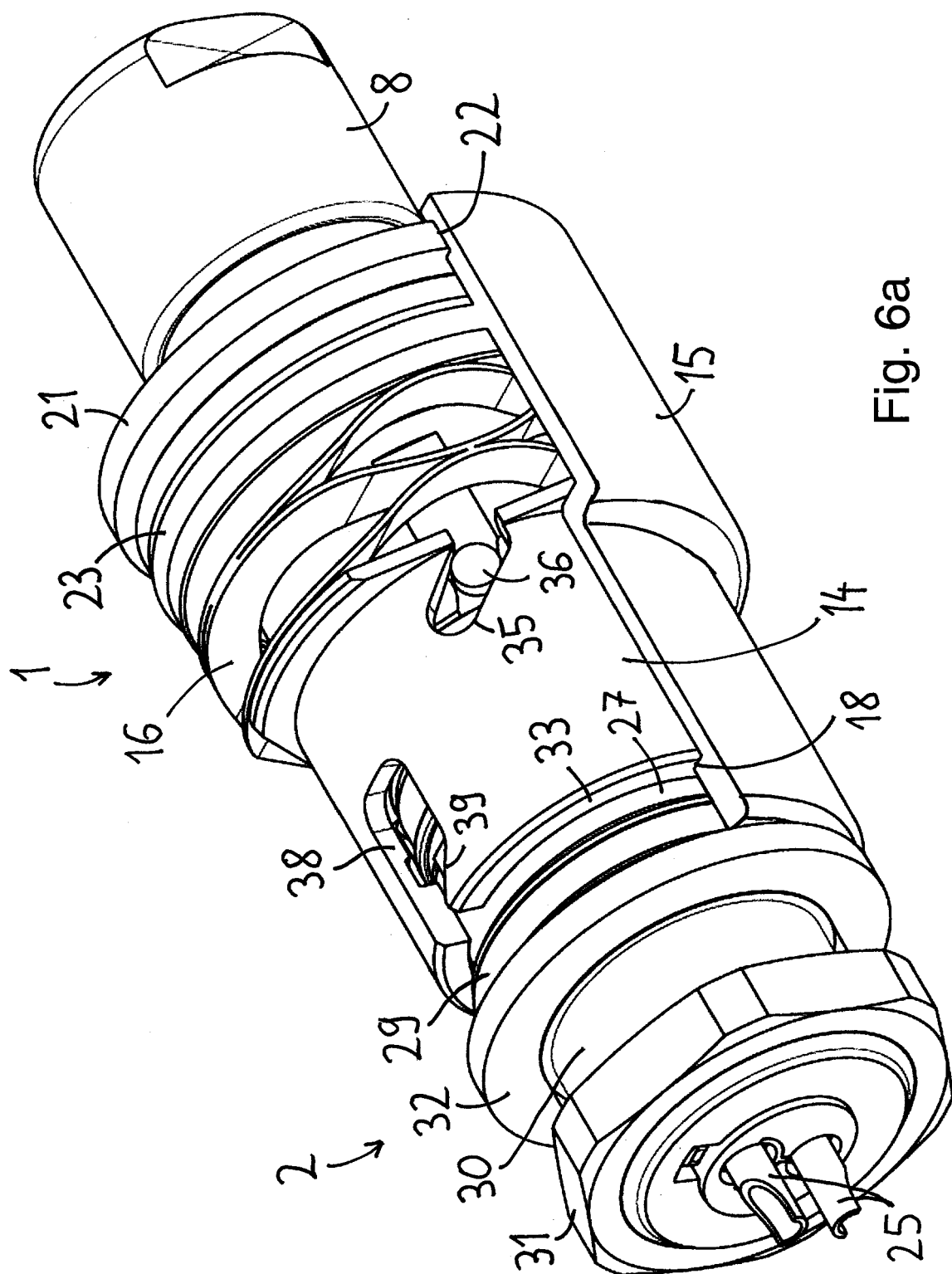


Fig. 5b



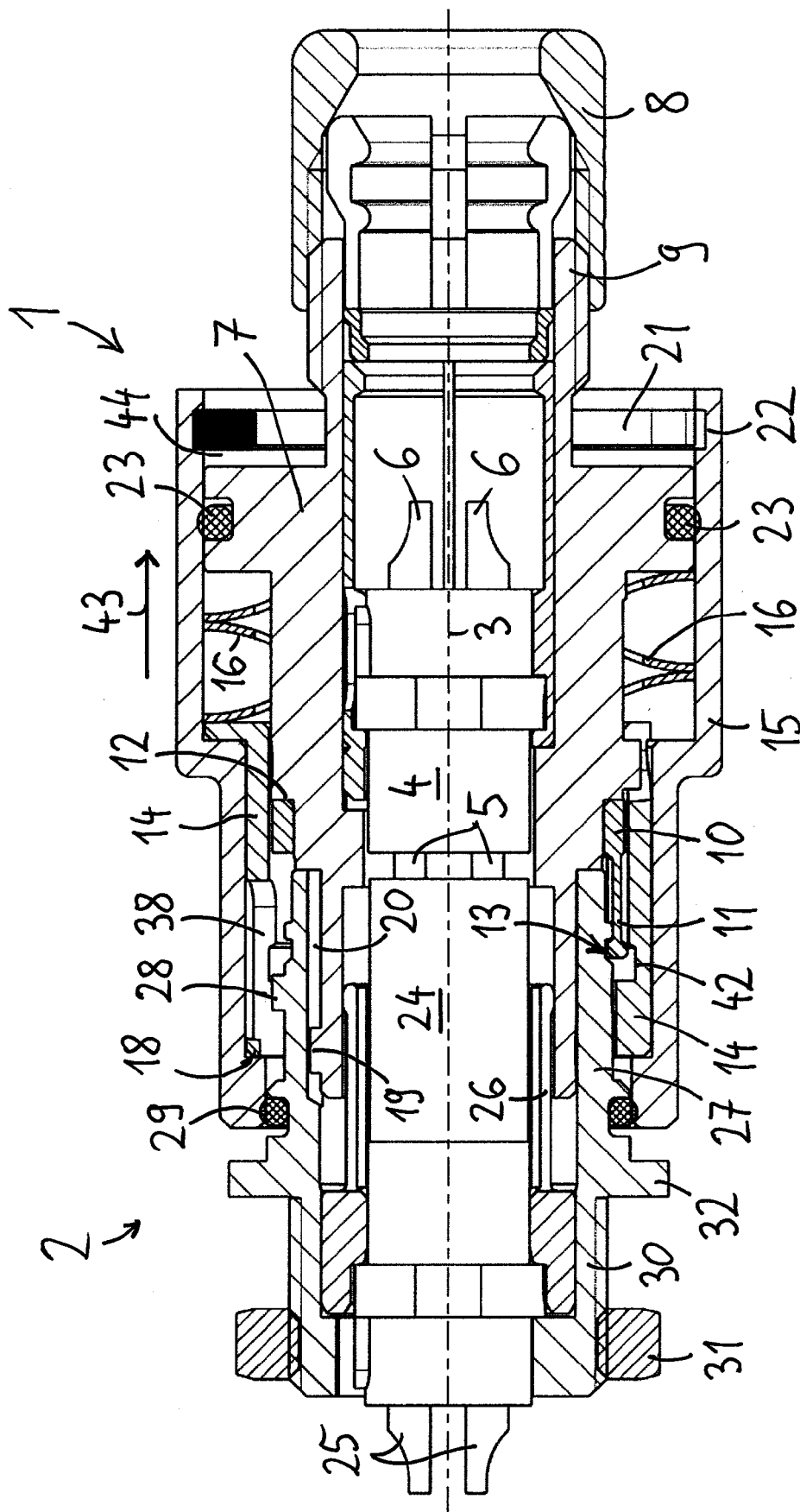


Fig. 6b



EUROPEAN SEARCH REPORT

Application Number
EP 17 19 5189

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Place of search The Hague		Date of completion of the search 6 March 2018	Examiner Kandyla, Maria
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