

Description

[0001] The present invention relates to a housing assembly for an electrical connector with an operating lever, for example, but not exclusively, for automotive applications. In addition, the present invention relates to an electrical connector with such a housing assembly and to a connector assembly with an electrical plug.

[0002] Normally, electrical connectors are used in electric circuits for establishing releasable plug connections for transmitting electrical currents and/or signals between components belonging to the electric circuit. In the course of a mating process for establishing or releasing the plug connection, it may possibly be necessary to overcome substantial resisting forces, which impedingly counteract the mating process. In order to avoid productivity losses during mounting, it is advisable to make use of a manually operated mating assistance system for mechanically assisting the mating process in automotive engineering, inter alia.

[0003] Conventional mating assistance systems often take up a lot of space and/or make it difficult to implement other functions, such as sealing the electrical connector. For example, the entire mechanism of the mating assistance system may be arranged fully on the outside of the electrical connector, so as not to affect the tightness of the electrical connector, but, being located there, it takes up a correspondingly large amount of installation space. On the other hand, parts of the mechanism may be integrated inside the electrical connector, but, for the purpose of manual operation, they must be operatively connected to the outside of the electrical connector, and this will inevitably result in leakage.

[0004] Hence, there is a need for a plug connection with a mating assistance system that takes up the least possible amount of installation space and at the same time does not impair the sealability of the plug connection.

[0005] It is therefore the object of the present invention to provide mating assistance means for a plug connection, which save installation space and are sealable.

[0006] This object is achieved by a housing assembly for an electrical connector that is intermateable with a mating connector along a mating direction, comprising a connector housing and an operating lever pivotably arranged on the connector housing, wherein the operating lever has at least one drive element which is arranged such that it can be brought into engagement with the mating connector, wherein the operating lever has at least one lever arm which is provided with a bearing journal, wherein the connector housing has at least one bearing hole having inserted therein the bearing journal of the at least one lever arm, and wherein at least one bearing seal is arranged between the connector housing and the bearing journal of the at least one lever arm.

[0007] The present invention is advantageous because the operating lever serves the purpose of assisting the mating process due to the presence of the at least one drive element and also contributes to the tightness

due to the arrangement of the bearing journal in relation to the connector housing and the at least one bearing seal. This functional integration at the operating lever allows the housing assembly according to the present invention to be configured in a space-saving and at the same time sealed manner.

[0008] The present invention can be improved still further by the embodiments following hereinafter, each of which is advantageous in itself and can be combined with the other embodiments in an arbitrary manner.

[0009] According to a possible embodiment of the present invention, the connector housing may be an injection molded plastic part so as to save costs and/or weight, the at least one bearing hole being e.g. a substantially circular through-hole, which leads into the interior of the connector housing, preferably perpendicular to the mating direction, and which is formed in the course of the injection molding process. Alternatively, the at least one bearing hole may be a bearing bore, preferably a deburred bearing bore. Optionally, the at least one bearing hole may have provided therein a bearing bush.

[0010] The operating lever may act as an actuation lever, an activation lever and/or an assistance lever and be part of a mating assistance system for assisting a mating process and/or a separation process between the electrical connector and the mating connector.

[0011] The at least one lever arm may have a lever flank so as to produce a leverage effect, the bearing journal being formed at one end of this lever flank. The bearing journal may be an axle journal or a pivot pin with a cylindrical or plug-shaped portion that fits into the at least one bearing hole. In the inserted condition, the bearing journal can form a sealing connection with the at least one bearing seal and thus seal the at least one bearing hole tightly, preferably in a waterproof or at least in a dustproof and/or dirtproof manner.

[0012] In order to allow the pivotability of the operating lever, the bearing journal and the bearing hole can form together a hole bearing, a rotary bearing, a sliding bearing or a tribological pairing with cylindrical contact surfaces. The operating lever can thus be connected to the connector housing such that it is pivotable about a non-varying pivot axis, which preferably extends perpendicular to the mating direction.

[0013] The at least one drive element may be rotatable about the pivot axis in the interior of the connector housing. In particular, the at least one drive element may be formed on the bearing journal of the at least one lever arm, preferably on a side of the bearing journal facing away from the respective lever flank. Furthermore, the at least one drive element may be configured as an externally toothed gear element. In particular, the at least one drive element may include a segment or a section of a gear, a gear rim, an annular gear or a gearlike shaped portion.

[0014] According to a further embodiment of the present invention, the at least one bearing seal may be located between the at least one drive element and the

at least one lever arm. In the case of the embodiment having the drive element formed on the bearing journal, at least one bearing seal may be located between the drive element and the lever flank. It follows that the drive element and the lever arm, in particular the lever flank, can be arranged on respective opposite sides of the at least one bearing seal. For example, the at least one lever arm, in particular its lever flank, may be arranged outside on the connector housing, while the at least one drive element is accommodated inside the connector housing. This allows a compact structural design of the housing assembly in the direction of the pivot axis.

[0015] In order to simplify production, the at least one bearing seal may, according to a further embodiment, form together with the connector housing a two-component part produced by two-component injection molding. In particular, the at least one bearing seal may be injection molded into the at least one bearing hole. The at least one bearing seal can thus be formed together with the connector housing in one and the same manufacturing process, without any additional mounting steps being necessary. Alternatively, the bearing journal of the at least one lever arm may also be overmolded with the at least one bearing seal. Accordingly, the at least one bearing seal will then form a two-component part with the operating lever and will abut, in this case, on an inner wall of the connector housing in the at least one bearing hole.

[0016] According to a further alternative embodiment, the at least one bearing seal may be a prefabricated separate sealing ring, which is either inserted into the at least one bearing hole or attached to the bearing journal of the at least one lever arm. This will improve a replaceability of the at least one bearing seal in the event that repair should be necessary.

[0017] In order to stabilize the operating lever, the connector housing may have two bearing holes according to a further possible embodiment, each bearing hole being configured in accordance with the above description. The two bearing holes may be arranged on two opposite sides of the connector housing, preferably such that they are in alignment along the pivot axis.

[0018] Furthermore, the operating lever may have two lever arms, each lever arm being configured in accordance with the above description. In particular, the two lever arms may each be provided with a bearing journal; preferably, the bearing journals face each other and are arranged in an aligned manner along the pivot axis. In addition, the each of the two lever arms may be inserted with its bearing journal into one of the two bearing holes. Accordingly, the housing assembly has two bearing seals, each bearing seal being arranged between the connector housing and a respective one of the bearing journals.

[0019] Preferably, each bearing hole may be provided for a particular lever arm and its bearing journal. Accordingly, each lever arm with its bearing journal can be inserted only into the bearing hole provided therefor. Alter-

natively, each of the two lever arms may be inserted with its bearing journal into an arbitrary bearing hole.

[0020] The operating lever may be configured in a U-shape. In particular, the two lever arms may engage around the connector housing. This arrangement results in a symmetrical distribution of forces and thus improves the operability.

[0021] According to a further possible embodiment, the operating lever may be a multipart component. The advantage of this embodiment can be seen from the following consideration: a one-piece U-shaped operating lever would have to be elastically spread, so as to allow the bearing journals of its two lever arms to be inserted into the respective bearing holes, and would therefore have lever arms that are oversized in length. As will be seen from the following description of further embodiments, there is no need to oversize the lever arms for reasons of flexibility in the case of a multipart operating lever, whereby a comparatively compact structural design of the operating lever perpendicular to the pivot axis will be possible.

[0022] According to a possible embodiment of the housing assembly comprising a multipart operating lever, the two lever arms may be configured to be joined, preferably to be joined repeatedly and/or in a form fit manner, so as to form a structural unit. For example, freely projecting ends of the two lever arms, which face away from the respective bearing journals, may be plugged into each other, preferably parallel to the pivot axis. Thus, it is also possible to insert each bearing journal into the respective bearing hole parallel to the pivot axis by a linear movement. The term "*linear movement*" is here intended to describe that the movement in question is a purely translational movement which does not involve any pivoting or rotation. The linear movement primarily protects the bearing seals, which could easily be damaged by tilting and/or wedging of the bearing journal in the course of a pivoting movement of the lever arms.

[0023] According to another possible embodiment of the housing assembly comprising a multipart operating lever, the two lever arms may be configured to be separable from each other, preferably in a non-destructive manner or at least repeatedly. Thus, each bearing journal can, if necessary, also be linearly pulled out of the respective bearing hole, which will simplify repair, by way of example.

[0024] According to a further possible embodiment, the operating lever may be a three-part component. In particular, the operating lever may comprise a removable connecting element via which the two lever arms are connectable. Preferably, the connecting element is a separate component, which connects the two lever arms in a bridge-like manner. The two lever arms can thus be mounted on the connector housing independently of one another and can, subsequently, be connected by the connecting element. In particular, the bearing journals of the two lever arms can be inserted independently of one another into the respective bearing hole parallel to the pivot

axis.

[0025] In order to facilitate operation, the connecting element may have a handle, an operating handle, a handhold, a bracket and/or a portion with a gripping surface.

[0026] The connecting element can be attached to the respective freely projecting ends of the lever arms perpendicularly or tangentially to the pivot axis. For example, the two lever arms may each have a T-shaped profiled edge at their freely projecting ends, which can be accommodated in a respective T-shaped groove guide of the connecting element. Preferably, the connecting element may be fixed to the freely projecting ends of the two lever arms, e.g. by a locking connection. Alternatively or additionally, the connecting element may also be glued, screwed, welded and/or pressed. This will avoid an unwanted movement relative to the lever arms and prevent loss of the connecting element.

[0027] According to another possible embodiment, the housing assembly may be provided with a securing device by means of which the at least one lever arm is prevented from being attached to and/or removed from the connector housing outside a mounting position, and by means of which the at least one lever arm is secured in position on the connector housing, when the at least one lever arm is attached to the connector housing and moved away from the mounting position. The mounting position results here from a relative position between the at least one lever arm and the connector housing.

[0028] The securing device may be arranged partly on the connector housing and partly on the at least one lever arm. For example, the securing device may be of a bayonet-type design and have a flange on the connector housing for each bearing hole of the connector housing, said flange extending at least sectionwise around the respective bearing hole in the circumferential direction of the bearing hole in question. In addition, the securing device may have at least one cam on each lever arm, said cam engaging behind the respective flange in a form-fit manner. In order to allow this, the at least one cam may project from an extension arm of the lever arm in the direction of the bearing journal.

[0029] Optionally, the at least one lever arm is releasable from the connector housing at the mounting position. Preferably, the at least one lever arm is attachable to the connector housing and releasable from the connector housing exclusively at the mounting position. For this purpose, each flange of the securing device may be provided with a gap at a fixedly defined location corresponding to the mounting position, the at least one cam of the securing device fitting through this gap when the lever arm, which is at the mounting position, is being mounted. Depending on the width of the gap, the mounting position may be a discrete angular position or a continuous angular area. For reasons of redundancy, each lever arm may have a plurality of cams. The flange may have a corresponding number of gaps.

[0030] According to a further embodiment, the at least one lever arm may have an insertion position resulting

from the position relative to the connector housing. At the insertion position of the at least one lever arm, the at least one drive element of the operating lever abuts on the mating connector, without being in engagement with the mating connector. The electrical connector can thus be attached to the mating connector and detached from the mating connector. The at least one lever arm can be pivoted from the mounting position to the insertion position at least during the mounting process.

[0031] Furthermore, the at least one lever arm may have a final mating position resulting from the position relative to the connector housing. At the final mating position of the at least one lever arm, the at least one drive element of the operating lever is in engagement with the mating connector. This condition corresponds to an electrical connector fully mated with the mating connector. The at least one lever arm can be pivoted from the mounting position to the final mating position at least during the mounting process.

[0032] In the course of the mating process between the electrical connector and the mating connector, the at least one lever arm is moved from the insertion position to the final mating position. During the separation process of the electrical connector from the mating connector, the at least one lever arm is moved from the final mating position to the insertion position.

[0033] The mounting position may be located outside the area between the insertion position and the final mating position, including the insertion position and the final mating position. In other words, the mounting position is not located in the area between the insertion position and the final mating position, including the insertion position and the final mating position.

[0034] Optionally, the at least one lever arm may lockingly engage with the connector housing at the final mating position. To this end, the at least one lever arm may have a locking element, which establishes a locking connection with a locking edge of the connector housing. For example, the connector housing may have a locking aperture in which the locking element is locked in position. Optionally, the locking element may be formed on a flexible bar portion of the at least one lever arm. In addition, the at least one lever arm may be provided with a push button. When this push button is actuated, the flexible bar portion will be deflected, so that the locking element will be moved out of the locking aperture on the connector housing.

[0035] According to a further embodiment of the housing assembly including a multipart operating lever, the multipart operating lever can form a stop, when the lever arms are joined and moved away from the respective mounting position, the stop blocking a movement of the joined lever arms to the respective mounting position. By way of example, the connecting element may form this stop. In particular, the connecting element can prevent the two lever arms from reaching, in a condition connected by the connecting element, the mounting position from the area between the insertion position and the final mat-

ing position, including the insertion position and the final mating position. In this case, the connecting element strikes against the connector housing before the two lever arms reach the mounting position from the area between the insertion position and the final mating position. The two lever arms can therefore not be released from the connector housing in their joined condition. Unintentional loss of the lever arms or of the entire operating lever during operation is thus avoided.

[0036] Optionally, the multipart operating lever may, when located at the stop, lockingly engage with the connector housing. To this end, the connecting element may have e.g. a locking projection, which faces the connector housing. In addition, the connector housing may have formed thereon a locking bump, with which the locking projection of the connecting element establishes a locking connection as soon as the stop is reached. Preferably, the lever arms of the multipart operating lever can thus be retained at the insertion position, so as to prevent unintentional pivoting of the operating lever during the mating process.

[0037] According to a further embodiment, the two lever arms cannot be connected by the connecting element at their respective mounting position. For example, the connector housing is located between the freely projecting ends of the two lever arms, when the two lever arms are at their respective mounting position. In this way, it is ensured that the two lever arms can only be connected by the connecting element, when the two lever arms have been moved away from their respective mounting position.

[0038] Optionally, each lever arm may have provided thereon a straight, web-like or rib-like handle, which extends on an outer side of the respective lever arm and has a characteristic orientation with respect to the connector housing, when the respective lever arm is at the mounting position. For example, the handle is oriented parallel to or perpendicular to an outer edge of the connector housing, when the respective lever arm is at the mounting position. Preferably, the pivot axis runs symmetrically through the handle. This simplifies both automated mounting and manual mounting of the respective lever arm, since the handle not only provides a contact area for a robotic gripping tool, but also constitutes a visual reference mark for manual mounting. In other words, the handle serves as a mounting aid for the respective lever arm.

[0039] According to a further embodiment, each bearing hole may have a sealing face and a bearing face which are offset from each other in an axial direction of the bearing hole, with the inserted bearing journal resting on the sealing face and on the bearing face. Preferably, the sealing face and the bearing face are cylindrical and extend coaxially with respect to one another, the inserted bearing journal resting circumferentially on the sealing face and on the bearing face. In addition, the bearing face may be configured such that it has at least a higher

dimensional stability than the sealing face. The bearing face may e.g. be the running surface of the hole bearing resulting from the bearing journal and the bearing hole and may be formed e.g. by the inner wall of the connector housing. The sealing face may be formed e.g. by the at least one bearing seal. In this way, the inserted bearing journal is centered in the respective bearing hole by means of the bearing face so as to ensure the most uniform pressure distribution possible on the at least one bearing seal.

[0040] The underlying object defined at the beginning can also be achieved by an electrical connector with a housing assembly according to one of the preceding embodiments, wherein the connector housing has a mating face directed in a mating direction and surrounded by a circumferential seal. At least one electrically conductive contact element may be arranged in the mating face, the contact element being configured for contacting with a mating contact of the mating connector. Depending on the field of use of the electrical connector, a plurality of contact elements may optionally be arranged in the mating face. Due to the functionality and advantages of the housing assembly which have already been explained hereinbefore, and in particular due to the presence of the circumferential seal, also the electrical connector according to the present invention can advantageously be configured to save installation space and to be sealed.

[0041] According to a possible embodiment, the mating face may form a reception means for the mating connector. In particular, the at least one bearing hole may lead into the reception means. Preferably, each bearing hole leads into the reception means. It follows that the bearing journal inserted into the respective bearing hole and in particular the at least one drive element can project into the reception means.

[0042] According to a further possible embodiment, the at least one drive element may be located between the at least one bearing seal and the circumferential seal. This leads preferably to a compact arrangement of the at least one drive element.

[0043] Optionally, the circumferential seal may be integrally connected to the at least one bearing seal, so as to avoid an undesired loss of the seals. For example, a sprue, which is formed during two-component injection molding, may monolithically connect the circumferential seal to the at least one bearing seal. In the case of a housing assembly having two bearing holes and two bearing seals, also the two bearing seals may be monolithically connected via a further sprue, which is also formed during two-component injection molding. To this end, a fill channel extending between the two bearing holes may be provided at the connector housing. Further fill channels may lead from the respective two bearing holes to the mating face.

[0044] The underlying object defined at the beginning can also be achieved by a connector assembly comprising an electrical connector according to one of the preceding embodiments and a mating connector that is con-

figured to be intermateable with the electrical connector, wherein the mating connector is provided with at least one driven element that is arranged to be engageable with the at least one drive element of the operating lever, wherein the electrical connector and the mating connector form together a sealed interior, which is sealed, at least sectionwise, by the at least one bearing seal. Preferably, the interior of the connector assembly is sealed by the at least one bearing seal and the circumferential seal.

[0045] Also the connector assembly according to the present invention benefits from the advantages of the housing assembly and, thanks to the sealed interior, can be used in moist and/or dusty and/or dirty surroundings. Furthermore, the connector assembly according to the present invention saves installation space insofar as the at least one drive element of the operating lever cooperates directly with the at least one driven element of the mating plug. In this way, sliders or similar intermediate parts can be dispensed with. This reduces the installation space taken up by the connector assembly with its remaining components and also reduces the total number of components of the connector assembly.

[0046] The at least one driven element of the mating connector is e.g. a toothed rack formed on the mating connector. It follows that, when the at least one drive element of the operating lever and the at least one driven element of the mating connector are in engagement with each other, a pivoting movement of the operating lever will be converted via a rotary movement of the at least one drive element into a linear mating movement between the electrical connector and the mating connector. Preferably, such a driven element is provided for each drive element of the operating lever.

[0047] According to a possible embodiment, the mating connector may have an end face located opposite the mating face of the electrical connector in a mating direction, the circumferential seal resting on the end face in the mated condition of the electrical connector and the mating connector. Preferably, the circumferential seal is pressed onto the end face in the course of the linear mating movement and will thus seal the mating face at least sectionwise. The end face may here be formed by a plate encompassing the rest of the mating connector and extending perpendicular to the mating direction.

[0048] According to a further possible embodiment, the at least one drive element of the operating lever may be in engagement with the at least one driven element of the mating connector in the sealed interior of the connector assembly. Preferably, each drive element of the operating lever is in engagement with the respective driven element of the mating connector in the sealed interior of the connector assembly. It follows that the drive and driven elements are located in surroundings protected against dust and dirt. This will reduce the wear of the drive and driven elements.

[0049] In order to reduce wear caused by dust and dirt, also the bearing face of each bearing hole is preferably

located in the sealed interior of the connector assembly. Accordingly, also the inserted bearing journal preferably rests on the bearing face in the sealed interior of the connector assembly.

[0050] In the following, the present invention will be explained in more detail with reference to the drawings on the basis of a plurality of embodiments, the different features of which can be combined with one another as desired in accordance with the above comments.

Fig. 1 shows a schematic perspective view of a housing assembly disclosed by the present invention according to a first exemplary embodiment;

Fig. 2 shows, in a front view, a schematic sectional view of a housing assembly disclosed by the present invention according to a second exemplary embodiment;

Fig. 3 shows a perspective detail view of a schematic exploded sectional view of a housing assembly disclosed by the present invention according to a third exemplary embodiment;

Fig. 4 shows a perspective detail view of a schematic sectional view of a housing assembly disclosed by the present invention according to a fourth exemplary embodiment;

Fig. 5 shows a perspective detail view of a schematic view of a housing assembly disclosed by the present invention according to a fifth exemplary embodiment;

Fig. 6 shows, in a side view, a schematic sectional view of an electrical connector disclosed by the present invention according to a first exemplary embodiment;

Fig. 7 shows a schematic perspective exploded view of a connector assembly disclosed by the present invention according to a first exemplary embodiment;

Fig. 8 shows, in a side view, a schematic sectional view of the connector assembly according to Fig. 7; and

Fig. 9 shows, in a side view, a schematic sectional view of the housing assembly according to Fig. 1;

[0051] Making reference to Fig. 1 to 5, the schematic structural design of a housing assembly 1 according to the present invention will be explained hereinafter. The schematic structural design of an electrical connector 2 according to the present invention as well as of a connector assembly 4 according to the present invention will

be explained making reference to Fig. 6 to 8.

[0052] Fig. 1 and 2 each show exemplary embodiments of the housing assembly 1 according to the present invention for the electrical connector 2 that is intermatable with a mating connector 6 along a mating direction 8 (cf. Fig. 7). As shown in Fig. 1 and 2, the housing assembly 1 comprises a connector housing 10 and an operating lever 12 pivotably arranged on the connector housing 10. The operating lever 12 has here at least one lever arm 14.

[0053] Fig. 2 and 3 show clearly that the at least one lever arm 14 is provided with a bearing journal 16 and that the connector housing 10 has at least one bearing hole 18 having inserted therein the bearing journal 16 of the at least one lever arm 14 (cf. Fig. 2).

[0054] The at least one lever arm 14 may additionally have a lever flank 20, at one end 22 of which the bearing journal 16 is formed. The bearing journal 16 may be an axle journal 24 with a cylindrical portion 26 that fits into the at least one bearing hole 18.

[0055] The connector housing 10 may be an injection molded plastic part 28, the at least one bearing hole 18 being a substantially circular through-hole 30 which leads into the interior 32 of the connector housing 10, preferably perpendicular to the mating direction 8.

[0056] The bearing journal 16 and the bearing hole 18 together provide a hole bearing 34, a rotary bearing, a sliding bearing or a tribological pairing with cylindrical contact surfaces. Thus, the operating lever 12 can be connected to the connector housing 10 such that it is pivotable about a non-varying pivot axis 36, which preferably extends perpendicular to the mating direction 8.

[0057] From Fig. 3 it can also be seen that the operating lever 12 has at least one drive element 38, which is arranged such that it can be brought into engagement with the mating connector 6. The at least one drive element 38 may be rotatable about the pivot axis 36. In particular, the at least one drive element 38 may be formed on the bearing journal 16 of the at least one lever arm 14. In the exemplary embodiment shown, the at least one drive element 38 is formed on a side of the bearing journal 16 facing away from the respective lever flank 20 and is configured as an externally toothed gear element 40. In particular, the at least one drive element 38 includes a segment 42 of a gear rim 44.

[0058] In Fig. 2 it is shown that at least one bearing seal 46 is arranged between the connector housing 10 and the bearing journal 16 of the at least one lever arm 14. In the inserted condition, the bearing journal 16 of the at least one lever arm 14 establishes a sealing connection 48 with the at least one bearing seal 46, so that the at least one bearing hole 18 is sealed tightly, preferably in a waterproof or at least in a dustproof and/or dirt-proof manner.

[0059] In the exemplary embodiment shown in Fig. 2, the at least one bearing seal 46 is located between the at least one drive element 38 and the lever flank 20 of the at least one lever arm 14. In particular, the lever flank

20 of the at least one lever arm 14 is arranged outside on the connector housing 10, while the at least one drive element 38 is arranged inside the connector housing 10.

[0060] The at least one bearing seal 46 is injection molded into the at least one bearing hole 18 and forms a two-component part 50 with the connector housing 10. Vice versa, the bearing journal 16 of the at least one lever arm 14 may be overmolded with the at least one bearing seal 46, so that the at least one bearing seal 46 forms a two-component part (not shown) with the operating lever 12. Alternatively, the at least one bearing seal 46 may be a prefabricated separate sealing ring (not shown), which is either inserted into the at least one bearing hole 18 or attached to the bearing journal 16.

[0061] In the exemplary embodiments shown in Fig. 1 and 2, the connector housing 10 has two bearing holes 18, each bearing hole 18 being arranged in an aligned manner along the pivot axis 36 on one of two opposite sides 52 of the connector housing 10 (cf. Fig. 2). Furthermore, the operating lever 12 has two lever arms 14, the two lever arms 14 being each provided with a bearing journal 16. As can be seen from Fig. 2, the bearing journals 16 of the two lever arms 14 face each other and are arranged in an aligned manner along the pivot axis 36. In addition, each of the two lever arms 14 is inserted with its bearing journal 16 into one of the two bearing holes 18. Accordingly, the housing assembly 1 has two bearing seals 46, each bearing seal 46 being arranged between the connector housing 10 and a respective one of the bearing journals 16.

[0062] Each bearing hole 18 of the exemplary embodiments shown is provided for a respective bearing journal 16 of a particular lever arm 14. Hence, in the exemplary embodiments shown, each lever arm 14 is inserted with its bearing journal 16 only into the bearing hole 18 provided therefor.

[0063] The operating lever 12 may be configured in a U-shape and the two lever arms 14 may engage around the connector housing 10 (cf. Fig. 7). In addition, the operating lever 12 may be a multipart component. In the exemplary embodiment shown in Fig. 1, the operating lever 12 is a three-part component. In particular, the operating lever 12 comprises, in addition to the two lever arms 14, a detachable connecting element 54. The connecting element 54 is a separate component, which connects the two lever arms 14 in a bridge-like manner. The connecting element 54 has a portion 56 with a gripping surface and thus also serves as a handle.

[0064] The connecting element 54 is attached to respective freely projecting ends 58 of the two lever arms 14, the ends 58 facing away from the respective bearing journals 16. For this purpose, the two lever arms 14 each have a T-shaped profiled edge 60 at their freely projecting ends 58, which is accommodated in a respective complementary T-shaped groove guide 62 of the connecting element 54. Furthermore, the connecting element 54 is fixed to the freely projecting ends 58 of the two lever arms 14 by a locking connection 64. The locking connection

64 comprises, on the connecting element 54, a respective flexible locking lug 66 projecting into one of the T-shaped groove guides 62, and a respective locking notch 68 on the T-shaped profiled edge 60, which is lockingly engaged by the complementary locking lug 66 (cf. Fig. 6).

[0065] As shown in Fig. 2, the two lever arms 14 can be mounted independently of each other on the connector housing 10. In particular, the bearing journals 16 of the two lever arms 14 can be inserted into the respective bearing hole 18 independently of each other parallel to the pivot axis 36 by a linear movement 70 (cf. Fig. 2, on the left). Subsequently, the two lever arms 14 can be connected by the connecting element 54. When the connecting element 54 has been removed, the bearing journals 16 of the two lever arms 14 can, independently of each other, be pulled out of the respective bearing hole 18 parallel to the pivot axis 36 by the linear movement 70 (cf. Fig. 2, on the right).

[0066] According to an alternative embodiment, which is not shown, the freely projecting ends 58 of the two lever arms 14 can be plugged directly into each other. In such an embodiment, the connecting element 54 can be dispensed with.

[0067] The housing assembly 1 may be provided with a securing device 72, as shown in Fig. 4. The securing device 72 prevents the at least one lever arm 14 from being attached to and/or removed from the connector housing 10 outside a mounting position 74. At the mounting position 74, the at least one lever arm 14 is attachable to the connector housing 10. The mounting position 74 results here from a relative position between the at least one lever arm 14 and the connector housing 10. When the at least one lever arm 14 is attached to the connector housing 10 and moved away from the mounting position 74, the at least one lever arm 14 is secured in position on the connector housing 10 by the securing device 72.

[0068] The securing device 72 is arranged partly on the connector housing and partly on the at least one lever arm. In the exemplary embodiment shown, the securing device 72 is of a bayonet-type design and has a flange 76 on the connector housing 10 for each bearing hole 18 of the connector housing 10, said flange 76 extending at least sectionwise around the respective bearing hole 18 in the circumferential direction 78 of the bearing hole 18 in question. In addition, the securing device 72 has at least one cam 80 on each lever arm 14, said cam engaging behind the respective flange 76 in a form-fit manner. As can be seen from Fig. 3, the at least one cam 80 may project from an extension arm 82 of the lever arm 14 in the direction of the bearing journal 16.

[0069] Each flange 76 of the securing device 72 is provided with a gap 84 at a location corresponding to the mounting position 74, the at least one cam 80 fitting through this gap when the lever arm 14, which is at the mounting position 74, is being mounted. Depending on the width of the gap 84, the mounting position 74 may be a discrete angular position or a continuous angular range.

[0070] The at least one lever arm 14 can be pivoted

from the mounting position 74 into an insertion position 86 at least during the mounting process (cf. Fig. 7). The insertion position 86 results from the position of the at least one lever arm 14 relative to the connector housing 10. At the insertion position 86 of the at least one lever arm 14, the electrical connector 2 can be attached to the mating connector 6 or removed from the mating connector 6, as shown in Fig. 7. In the attached condition, the at least one drive element 38 of the operating lever 12 abuts on the mating connector 6, without being in engagement with the mating connector 6.

[0071] In addition, the at least one lever arm 14 may have a final mating position 88 resulting from the position relative to the connector housing 10 (cf. Fig. 1, 6 and 8). The at least one lever arm 14 can be pivoted from the mounting position 74 to the final mating position 88 at least during the mounting process. At the final mating position 88 of the at least one lever arm 14, the at least one drive element 38 of the operating lever 12 is in engagement with the mating connector 6, as shown in the sectional view of Fig. 8. This condition corresponds to an electrical connector 2 fully mated with the mating connector 6.

[0072] In the course of a mating process between the electrical connector 2 and the mating connector 6, the at least one lever arm 14 is moved from the insertion position 86 to the final mating position 88. During a separation process of the electrical connector 2 from the mating connector 6, the at least one lever arm 14 is moved from the final mating position 88 to the insertion position 86. The mounting position 74 is here located outside the area between the insertion position 86 and the final mating position 88, including the insertion position 86 and the final mating position 88.

[0073] Optionally, the at least one lever arm 14 may lockingly engage with the connector housing 10 at the final mating position 88. To this end, the at least one lever arm 14 may have a locking element 90, which establishes a locking connection with a locking edge 92 of the connector housing 10. For example, the connector housing 10 may have a locking aperture 94 in which the locking element 90 is locked in position (cf. Fig. 1). As shown in Fig. 5, the locking element 90 may be formed on a flexible bar portion 96 of the at least one lever arm 14. In addition, the at least one lever arm 14 may be provided with a push button 98. When this push button 98 is actuated, the flexible bar portion 96 will be deflected, so that the locking element 90 will leave the locking aperture 94 and the locking connection will be released.

[0074] As can also be seen from Fig. 5, with the lever arms 14 joined and moved away from the respective mounting position 74, the multipart operating lever 12 can form a stop 100 by means of which a movement of the joined lever arms 14 to the respective mounting position 74 is blocked. In the embodiment shown, the connecting element 54 forms the stop 100 and abuts on the connector housing 10.

[0075] From Fig. 9 it can be seen that the multipart

operating lever 12 may, when located at the stop 100, optionally lockingly engage with the connector housing 10. To this end, the connecting element 54 may have a locking projection 99, which faces the connector housing 10 and which establishes a locking connection with a locking bump 101 formed on the connector housing 10. Preferably, the lever arms 14 of the multipart operating lever 12 can thus be retained at the insertion position 86, so as to prevent unintentional pivoting of the operating lever during the mating process.

[0076] It follows that, at their respective mounting positions 74, the two lever arms 14 cannot be connected by the connecting element 54 because the connector housing 10 is located between the freely projecting ends 58 of the two lever arms 14, when the two lever arms 14 are at their respective mounting positions 74. This is indicated by a dashed line in each of Fig. 5 and 9.

[0077] Optionally, each lever arm 14 may have provided thereon a straight, rib-like handle 102, which extends on an outside of the respective lever arm 14 and has a characteristic orientation with respect to the connector housing 10, when the respective lever arm 14 is at the mounting position 74. For example, as indicated in Fig. 6 by the dashed line 104, the handle 102 is oriented parallel to an outer edge 106 of the connector housing 10, when the respective lever arm 14 is at the mounting position 74. The handle 102 serves as a contact area for a robotic gripping tool and/or as a visual mounting aid. In order to save space, the handle 102 may be countersunk into the bearing journal 16.

[0078] As shown in Fig. 3, each bearing hole 18 may have a sealing face 108 and a bearing face 110 which are offset from each other in an axial direction of the bearing hole 18, with the inserted bearing journal 16 resting circumferentially on the sealing face 108 and on the bearing face 110. In the exemplary embodiment shown, the sealing face 108 and bearing face 110 are cylindrical and extend coaxially with respect to one another. The bearing face 110 is here formed by an inner wall of the connector housing 10 and corresponds to the running surface 112 of the hole bearing 34 resulting from the bearing journal 16 and bearing hole 18. The sealing face 108 is formed by the at least one bearing seal 46.

[0079] Fig. 6 shows an exemplary embodiment of the electrical connector 2 according to the present invention with the housing assembly 1. In the representation shown, the connector housing 10 has a mating face 114 directed in the mating direction 8 and surrounded by a circumferential seal 116. In accordance with the use of the electrical connector 2, electrically conductive contact elements (not shown) may be arranged in the mating face 114, which are configured for contacting with mating contacts of the mating connector 6. The mating face 114 thus forms a reception means 118 for the mating connector 6. As shown in Fig. 2, the at least one drive element 38 is located between the at least one bearing seal 46 and the circumferential seal 116.

[0080] Optionally, the circumferential seal 116 is inte-

grally connected to the at least one bearing seal 46. As can be seen from Fig. 4, a sprue 120 can monolithically connect the circumferential seal 116 to the at least one bearing seal 46. In the case of the housing assembly 1 shown in Fig. 2 and comprising two bearing holes 18 and two bearing seals 46, also the two bearing seals 46 are monolithically connected via a sprue 122.

[0081] Fig. 7 and 8 show an exemplary embodiment of the connector assembly 4 according to the present invention. The connector assembly 4 comprises the electrical connector 2 and the mating connector 6 that is configured to be intermateable with the electrical connector 2. The mating connector 6 is provided with at least one driven element 124 that is arranged to be engageable with the at least one drive element 38 of the operating lever 12. In the exemplary embodiment shown, the at least one driven element 124 of the mating connector 6 is a toothed rack 126 formed on the mating connector 6. It follows that, when the at least one drive element 38 of the operating lever 12 and the at least one driven element 124 of the mating connector 6 are in engagement with each other, a pivoting movement of the operating lever 12 will be converted via a rotary movement of the at least one drive element 38 into a linear mating movement 128 between the electrical connector 2 and the mating connector 6. Preferably, the mating connector 6 has provided thereon a driven element 124 for each drive element 38 of the operating lever 12.

[0082] The electrical connector 2 and the mating connector 6 form together a sealed interior 130 of the connector assembly 4, which can be seen in the sectional view of Fig. 8 and which is sealed, at least sectionwise, by the at least one bearing seal 46. Preferably, the interior 130 of the connector assembly 4 is sealed by the at least one bearing seal 46 and by the circumferential seal 116. Fig. 7 shows clearly that the mating connector 6 may, for this purpose, have an end face 132 located opposite the mating face 114 of the electrical connector 2 in the mating direction 8, the circumferential seal 116 resting on the end face 132 in the mated condition of the electrical connector 2 and the mating connector 6. In particular, the circumferential seal 116 is pressed onto the end face 132 in the course of the linear mating movement 128 and will thus seal the mating face 114 at least sectionwise (cf. Fig. 8). In the embodiment shown in Fig. 7, the end face 132 is formed on a plate 134 which extends flatly perpendicular to the mating direction 8 and encompasses the rest of the mating connector 6.

[0083] From Fig. 8, it can be seen that the at least one drive element 38 of the operating lever 12 is in engagement with the at least one driven element 124 of the mating connector 6 in the sealed interior 130 of the connector assembly 4. Preferably, each drive element 38 of the operating lever 12 is in engagement with the respective driven element 124 of the mating connector 6 in the sealed interior 130 of the connector assembly 4.

[0084] Also the bearing face 110 of each bearing hole 18 is preferably located in the sealed interior 130 of the

connector assembly 4. Accordingly, also the inserted bearing journal 16 preferably rests on the bearing face 110 in the sealed interior 130 of the connector assembly 4.

Reference numerals

[0085]

1 housing assembly
2 electrical connector
4 connector assembly
6 mating connector
8 mating direction
10 connector housing
12 operating lever
14 lever arm
16 bearing journal
18 bearing hole
20 lever flank
22 end
24 axle journal
26 portion
28 injection molded plastic part
30 through-hole
32 interior
34 hole bearing
36 pivot axis
38 drive element
40 gear element
42 segment
44 gear rim
46 bearing seal
48 sealing connection
50 two-component part
52 sides
54 connecting element
56 portion
58 ends
60 edge
62 groove guide
64 locking connection
66 locking lug
68 locking notch
70 linear movement
72 securing device
74 mounting position
76 flange
78 circumferential direction
80 cam
82 extension arm
84 gap
86 insertion position
88 final mating position
90 locking element
92 locking edge
94 locking aperture
96 bar portion

98 push button
99 locking projection
100 stop
101 locking bump
5 102 handle
104 line
106 outer edge
108 sealing face
110 bearing face
10 112 running surface
114 mating face
116 circumferential seal
118 reception means
120 sprue
15 122 sprue
124 driven element
126 toothed rack
128 linear mating movement
130 interior
20 132 end face
134 plate

Claims

- 25
1. A housing assembly (1) for an electrical connector (2) that is intermateable with a mating connector (6) along a mating direction (8), comprising a connector housing (10) and an operating lever (12) pivotably arranged on the connector housing (10), wherein the operating lever (12) has at least one drive element (38) which is arranged such that it can be brought into engagement with the mating connector (6), wherein the operating lever (12) has at least one lever arm (14) which is provided with a bearing journal (16), wherein the connector housing (10) has at least one bearing hole (18) having inserted therein the bearing journal (16) of the at least one lever arm (14), and wherein at least one bearing seal (46) is arranged between the connector housing (10) and the bearing journal (16) of the at least one lever arm (14).
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 2. The housing assembly (1) according to claim 1, wherein the at least one bearing seal (46) is located between the at least one drive element (38) and the at least one lever arm (14).
 3. The housing assembly (1) according to claim 1 or 2, wherein the connector housing (10) has two bearing holes (18) and the operating lever (12) has two lever arms (14), wherein the two lever arms (14) are each provided with a bearing journal (16), and wherein each of the two lever arms (14) has its bearing journal (16) inserted in one of the two bearing holes (18).
 4. The housing assembly (1) according to claim 3, wherein the operating lever (12) is a multipart com-

- ponent.
5. The housing assembly (1) according to claim 4, wherein the two lever arms (14) are configured to be joined so as to form a structural unit. 5
 6. The housing assembly (1) according to claim 4 or 5, wherein the two lever arms (14) are configured to be separable from each other. 10
 7. The housing assembly (1) according to one of the claims 4 to 6, wherein the operating lever (12) includes a detachable connecting element (54) via which the two lever arms (14) are connectable. 15
 8. The housing assembly (1) according to one of the claims 1 to 7, wherein the housing assembly (1) is provided with a securing device (72), which is arranged partly on the connector housing (10) and partly on the at least one lever arm (14) and by means of which the at least one lever arm (14) is prevented from being attached to and/or removed from the connector housing (10) outside a mounting position (74) and the at least one lever arm (14) is secured in position on the connector housing (10), when the at least one lever arm (14) is attached to the connector housing (10) and moved away from the mounting position (74). 20 25
 9. The housing assembly (1) according to claim 8 in combination with claim 5, wherein, with the joined lever arms (14) moved away from the respective mounting position (74), the multipart operating lever (12) forms a stop (100) by means of which a movement of the joined lever arms (14) to the respective mounting position (74) is blocked. 30 35
 10. The housing assembly (1) according to claim 9 in combination with claim 7, wherein the connecting element (54) forms the stop (100). 40
 11. The housing assembly (1) according to one of the claims 1 to 10, wherein each bearing hole (18) has a sealing face (108) and a bearing face (110) that are offset from each other in an axial direction, wherein the inserted bearing journal (16) rests on the sealing face (108) and on the bearing face (110). 45
 12. An electrical connector (2) with a housing assembly (1) according to one of the claims 1 to 11, wherein the connector housing (10) has a mating face (114) directed in a mating direction (8) and surrounded by a circumferential seal (116). 50
 13. The electrical connector (2) according to claim 12, wherein the at least one drive element (38) is located between the at least one bearing seal (46) and the circumferential seal (116). 55
 14. A connector assembly (4) comprising an electrical connector (2) according to claim 12 or 13 and a mating connector (6) that is configured to be intermateable with the electrical connector (2), wherein the mating connector (6) is provided with at least one driven element (124) that is arranged to be engageable with the at least one drive element (38) of the operating lever (12), wherein the electrical connector (2) and the mating connector (6) form together a sealed interior (130) of the connector assembly (4), which is sealed, at least sectionwise, by the at least one bearing seal (46).
 15. The connector assembly (4) according to claim 14, wherein each drive element (38) of the operating lever (12) is in engagement with the respective driven element (124) of the mating connector (6) in the interior (130) of the connector assembly (4).

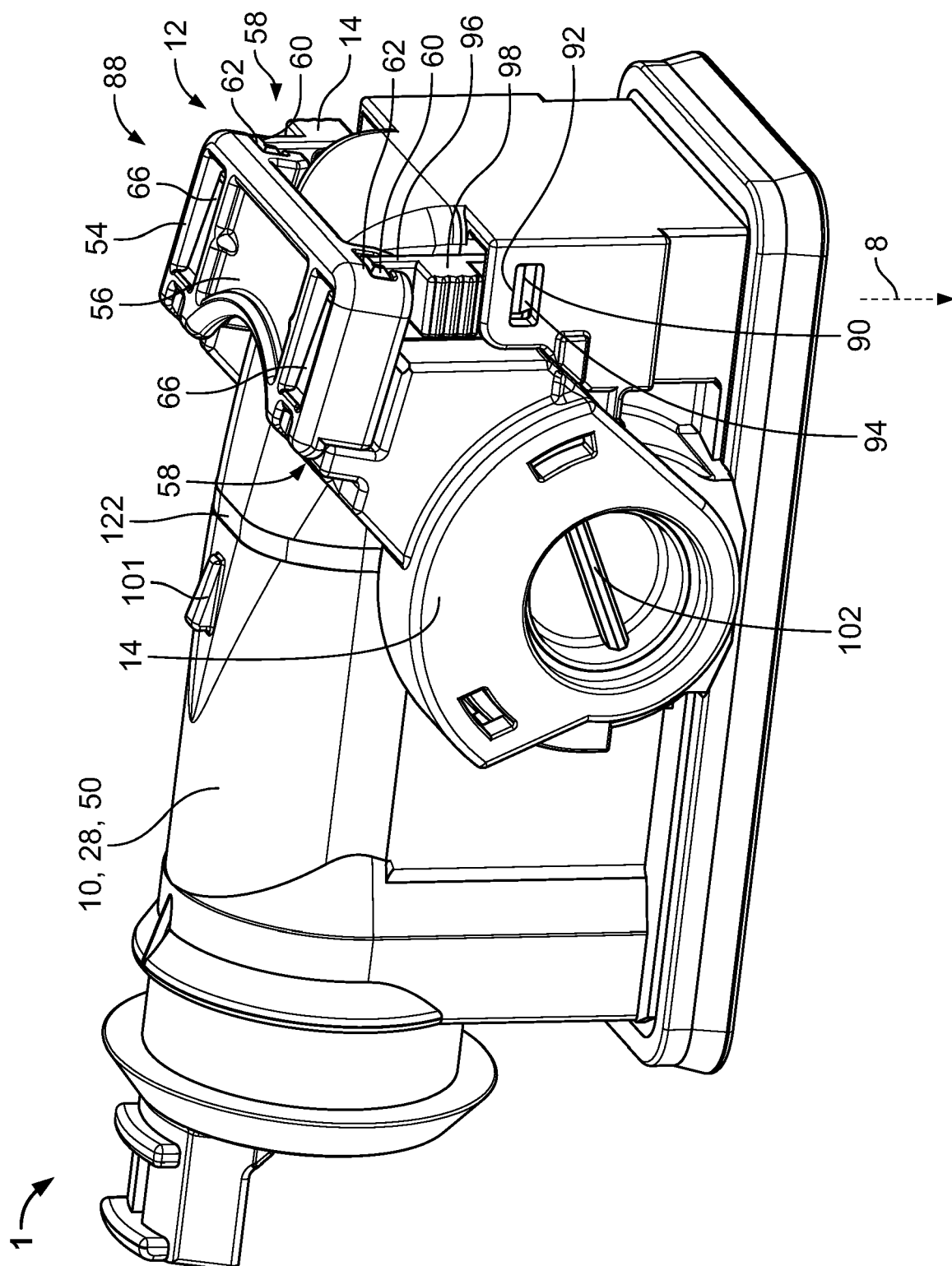


Fig. 1

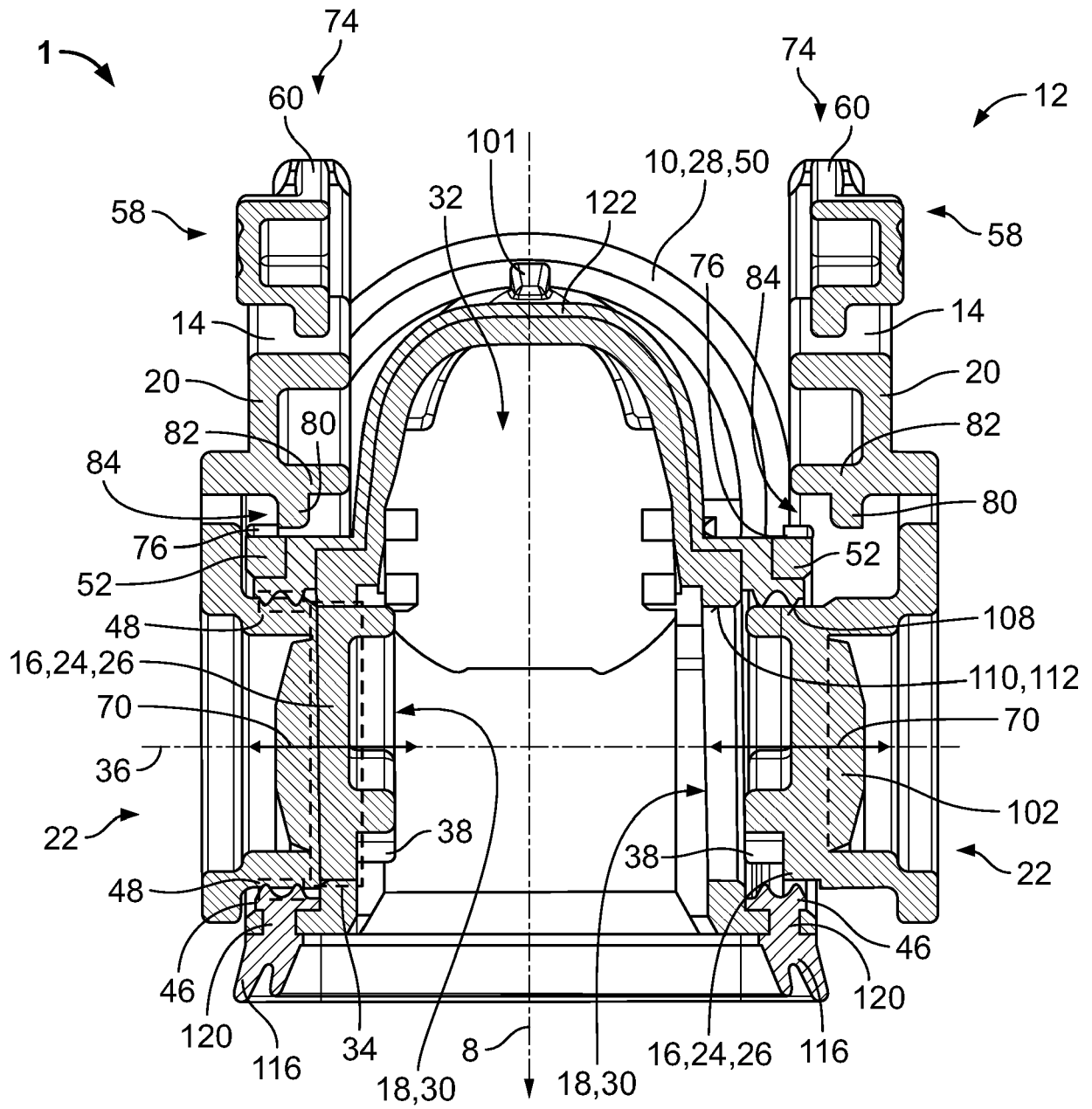


Fig. 2

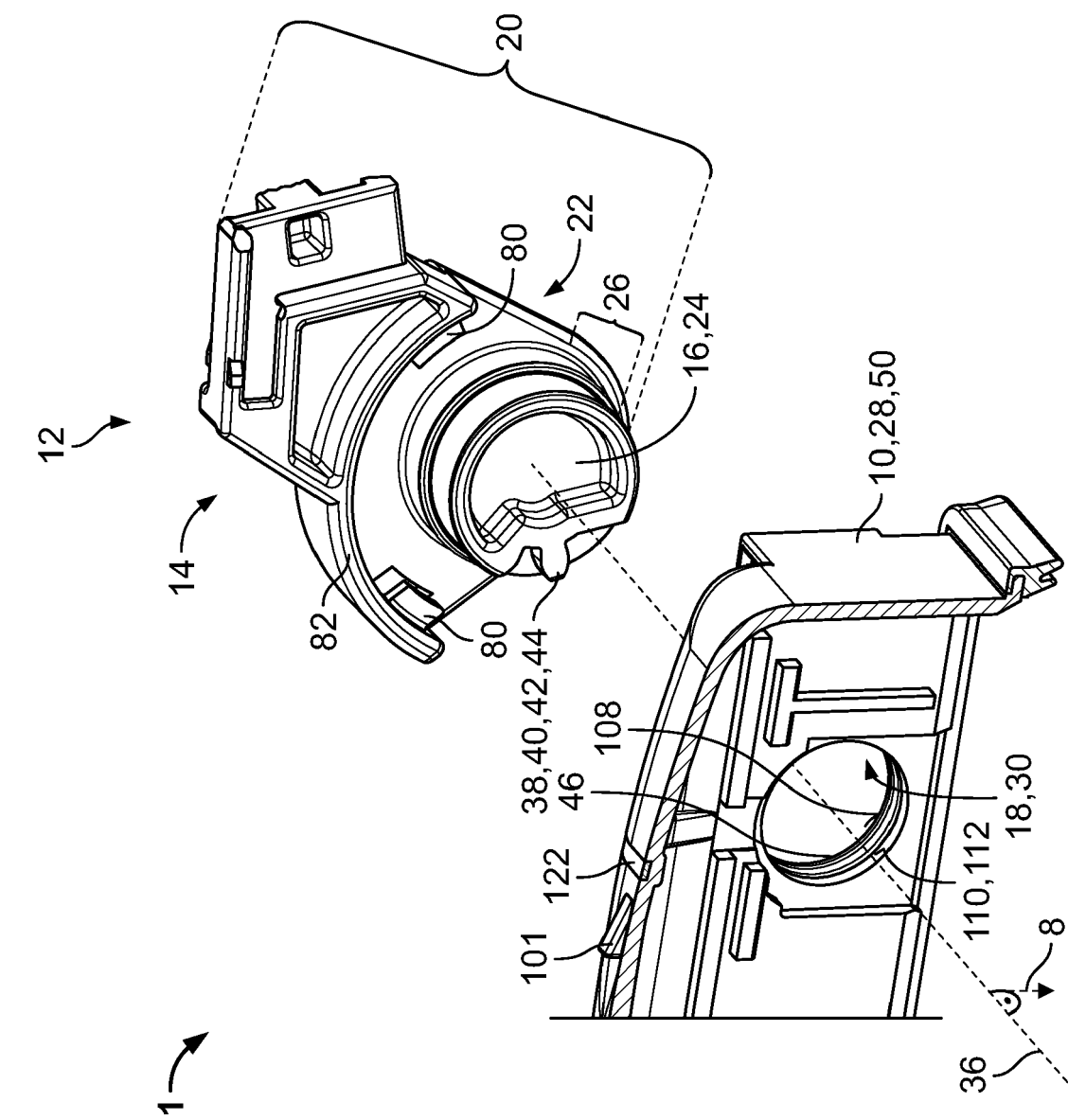


Fig. 3

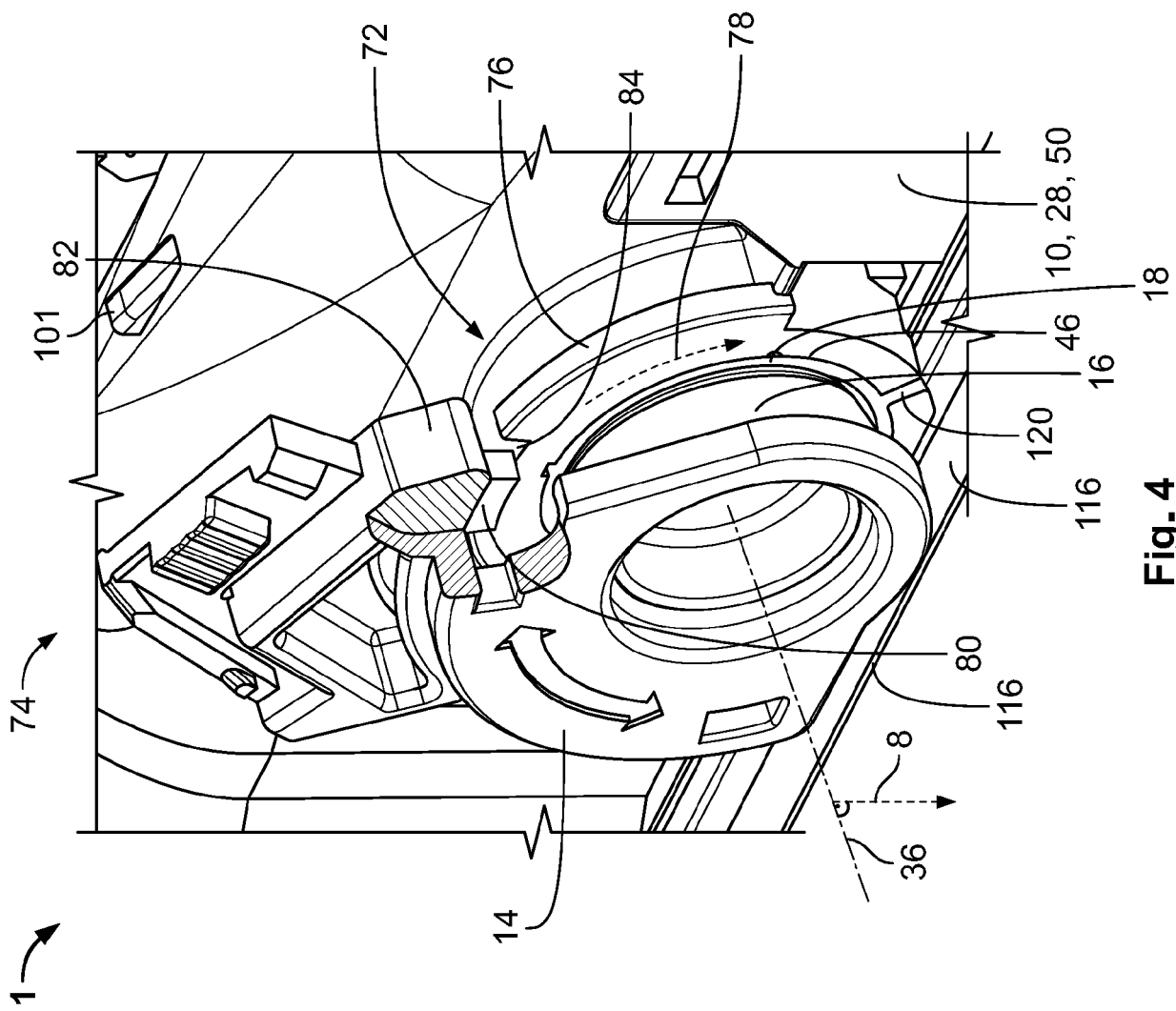


Fig. 4

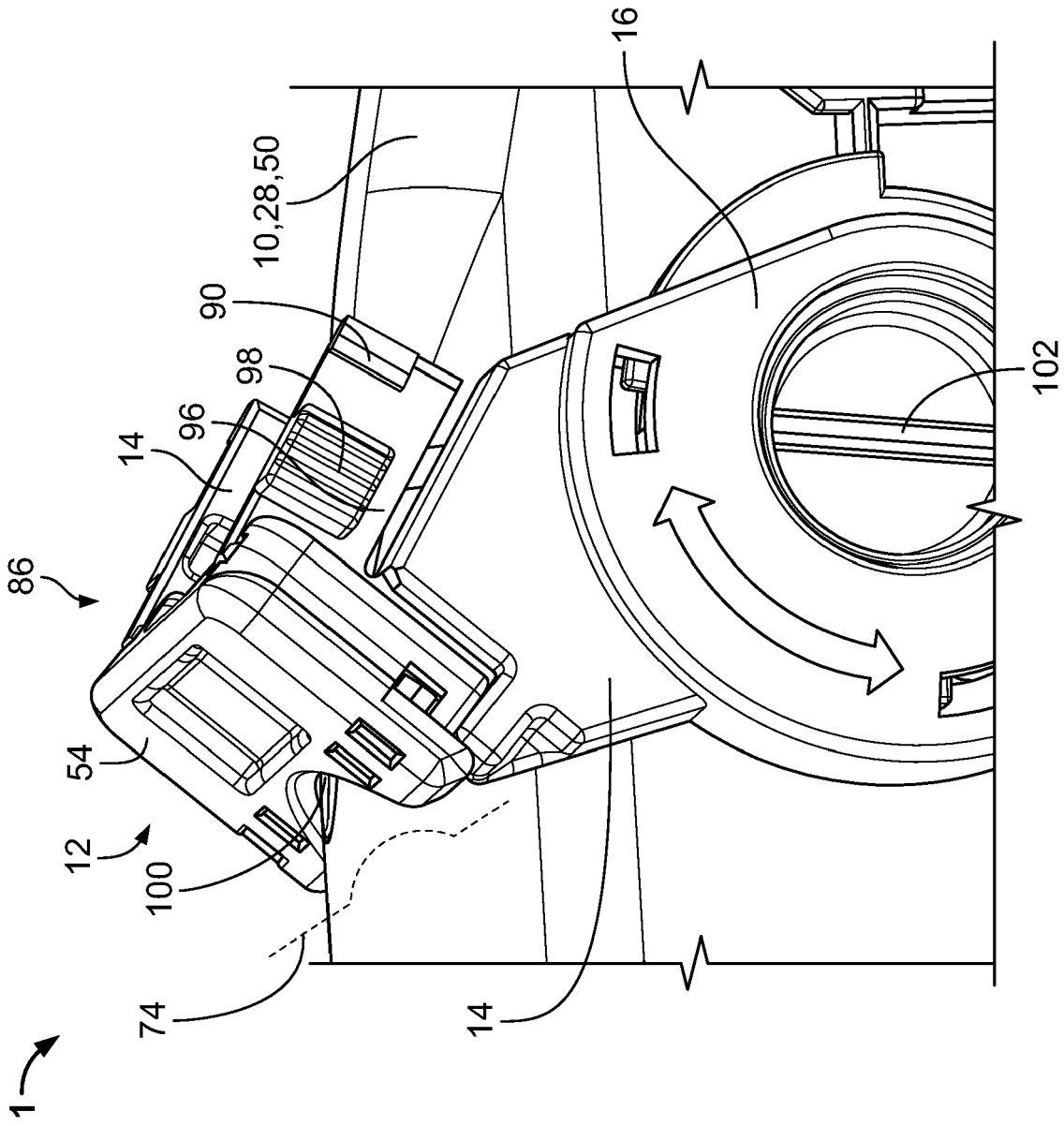


Fig. 5

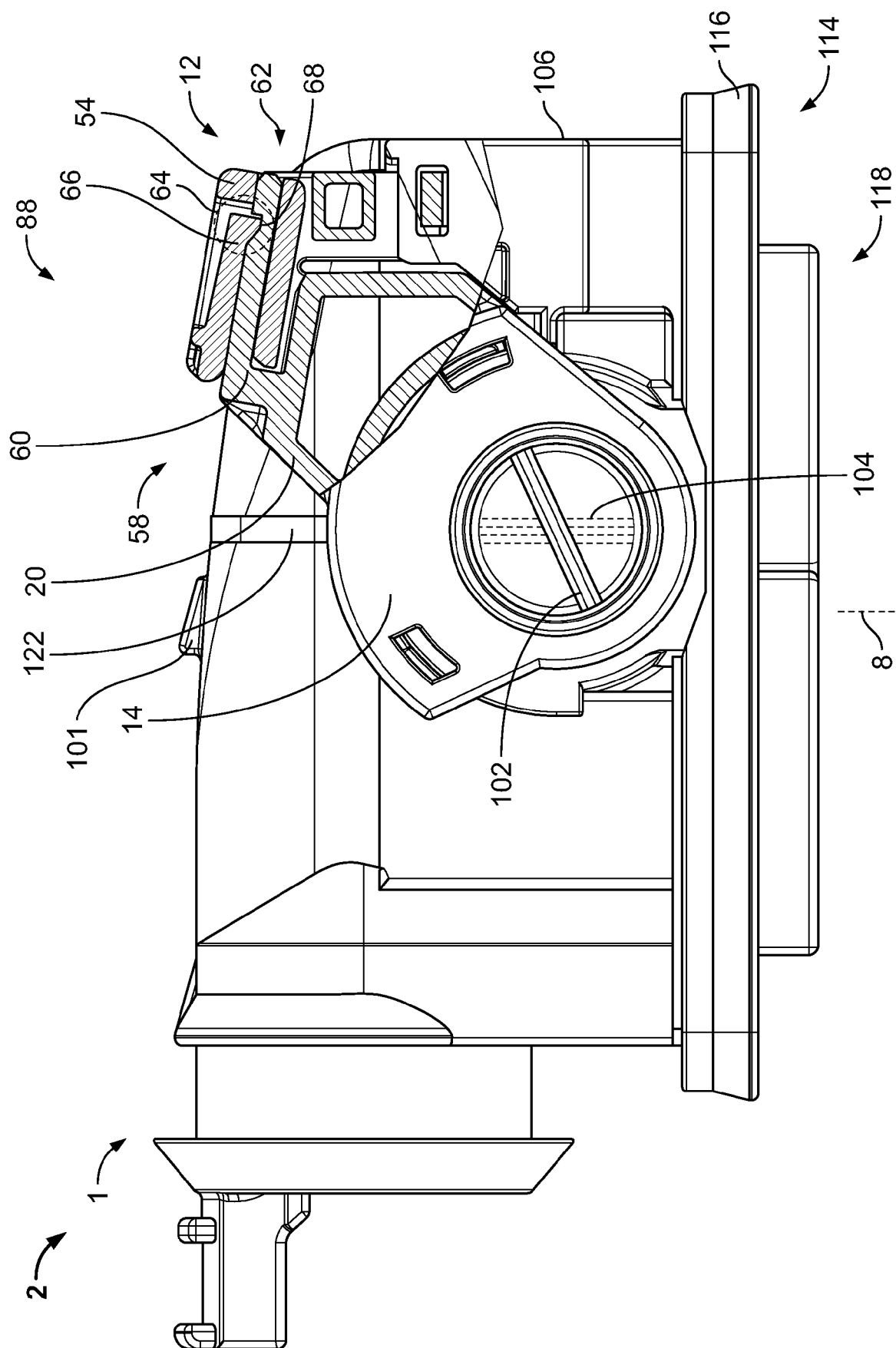


Fig. 6

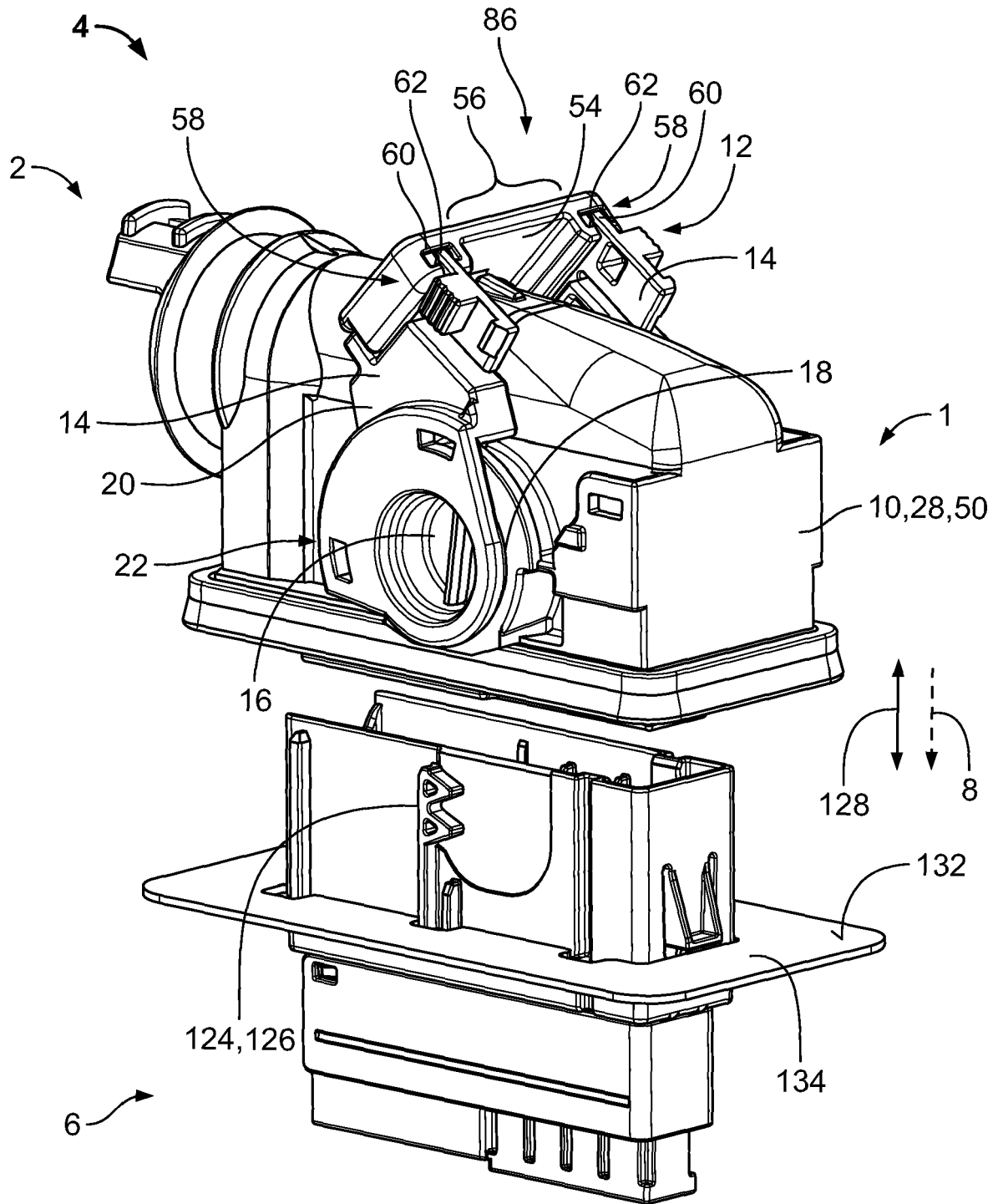


Fig. 7

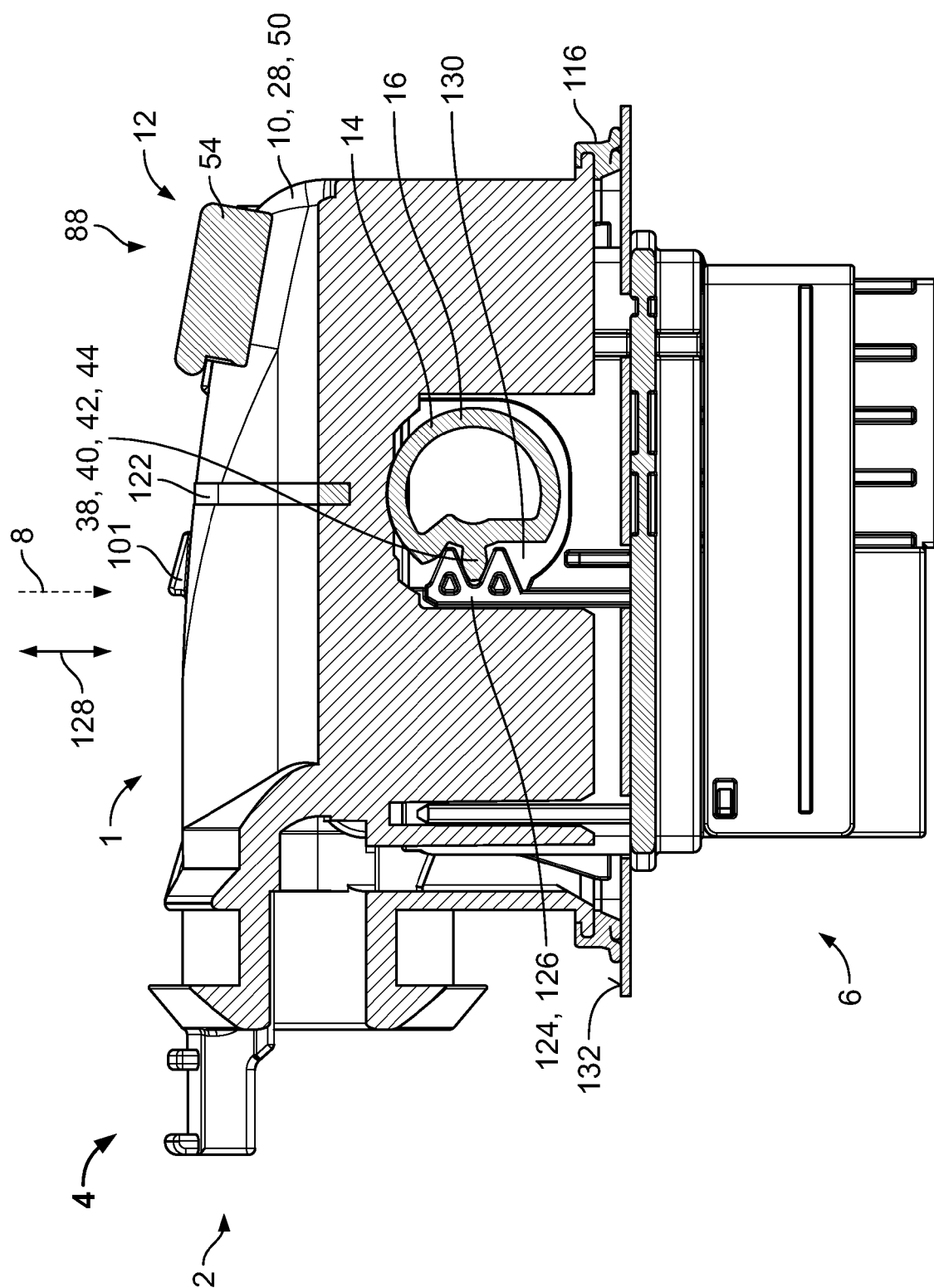


Fig. 8

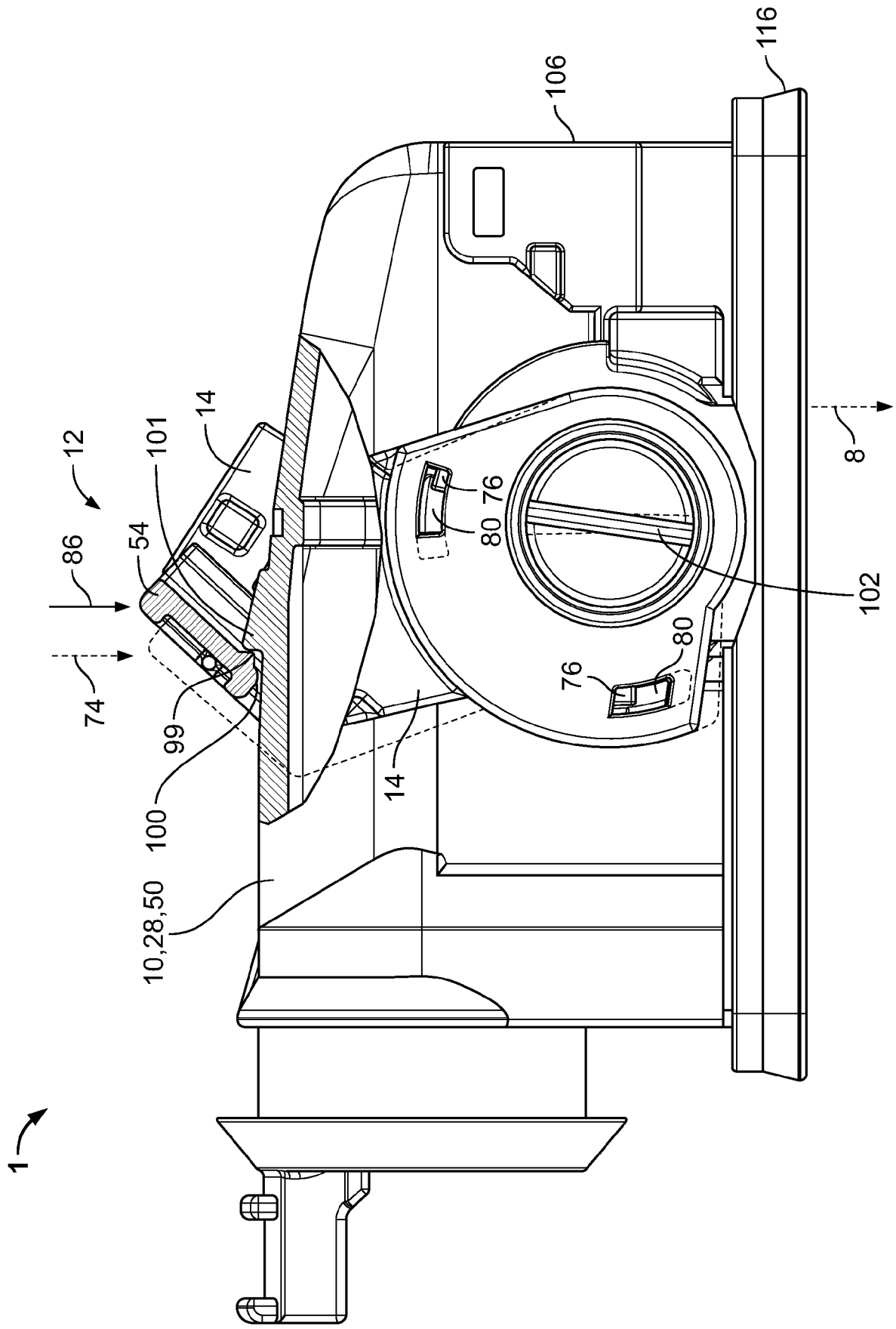


Fig. 9



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Place of search The Hague		Date of completion of the search 7 March 2022	Examiner Bidet, Sébastien
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