(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 525 295 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
14.08.2019 Bulletin 2019/33

(51) Int Cl.:
H01R 13/52 *(2006.01)* ***H01R 13/627*** *(2006.01)*
H01R 13/629 *(2006.01)* *H01R 107/00* *(2006.01)*

(21) Application number: **19155886.5**

(22) Date of filing: **07.02.2019**

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

(30) Priority: **13.02.2018 IT 201800002640**

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(54) SEALED CONNECTOR WITH AXIAL ASSEMBLY

(57) Sealed, multipolar connector (1), comprising a male sub-assembly (2) comprising a plurality of pins (27), a female sub-assembly (3) comprising a plurality of sockets (37), wherein said pins are configured so that they engage said sockets when the connector is closed, characterized in that said male sub-assembly (2) comprises a co-molded element (21) in plastic and rubber; said female sub-assembly (3) comprises a co-molded element (31) in plastic and rubber, and a locking ring (38); said co-molded elements (21, 31) comprise clamping teeth (217, 317) configured to be engaged with each other when said elements (21, 31) are coupled, and in that said ring (38) is slidingly fastened to said female element (31) so that, after a translation of said ring (38), said clamping teeth (317) of said female element can be radially widened so that respective clamping teeth (217) provided on the male connector are not engaged.

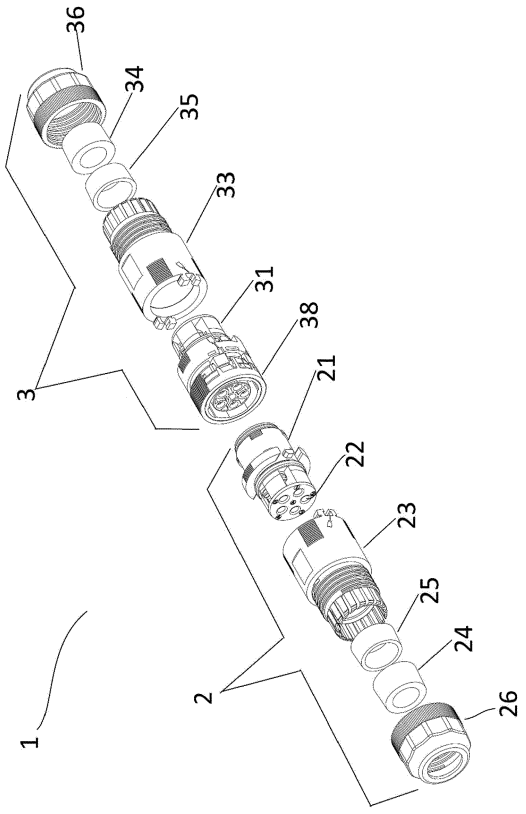

Fig. 6

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Description

[0001] Object of the present Patent application is a multi-phase connector for electrical cables, provided with a co-molded seal which guarantees its sealing, configured to be particularly comfortable in assembling step, and in particular to allow the connector to be assembled and disassembled using only the tip of a common tool (as for example a screwdriver) and with axial movements of the elements.

State of the art

[0002] At the state of the art there are known many embodiments of connectors to realize the electrical connection of unipolar and multipolar cables.

[0003] An example is described in the Italian application MI2008A001759, where it is described a structure for two or three poles socket and plug type electrical connection. Another example is described in document US2015/0180167, where it is described a sealed multipolar connector where a male connector and a female one are held in position, after the contact is provided, by manually rotating a locking ring.

[0004] Another example is described in US2009/264003, which describes a multipolar connector where a ring (130), by axially sliding, compresses elastically deformable tongues (142) on which there are provided clamping teeth which, after the ring is translated, engage respective clamping teeth provided on the other element of the connector. The ring (130) in US2009/264003 is held in position by triangular projections (not shown in the drawings but described in section 36 of the description) provided on the tongues (142) which engage suitable inner circumferential teeth provided on the ring. Therefore, in order to assemble and disassemble the connector it is needed to apply an axial force, in the desired direction, sufficient to make the ring (130) pass the triangular projections provided on the tongues. The tongues are not engaged in their rest position.

Aim

[0005] Aim of the present invention is to provide a sealed, multipolar connector, provided with a different closing and assembly mechanism other than what known at the state of the art.

[0006] According to another aim, the present invention provides a sealed, multipolar connector, wherein socket and plug (or, similarly, the female and male) can be coupled and decoupled by using the tip of a common tool (as for example a screwdriver), and wherein rotation movements between the pieces are not needed for coupling and decoupling.

Brief description

[0007] The present invention reaches the prefixed aims since it is a sealed, multipolar connector (1), comprising:

- a male sub-assembly (2) comprising a plurality of pins (27),
- a female sub-assembly (3) comprising a plurality of sockets (37),
  wherein said pins are configured so that they engage said sockets when the connector is closed, characterized in that
- said male sub-assembly (2) comprises a co-molded element (21) in plastic and rubber,
- said female sub-assembly (3) comprises a co-molded element (31) in plastic and rubber, and a locking ring (38),
- said co-molded elements (21, 31) comprise, in a plurality of circumferential positions, clamping teeth (217, 317) configured to be engaged with each other when said elements (21, 31) are coupled, said clamping teeth (217, 317) being positioned on elastically deformable tongues and being configured so that the clamping teeth (217, 317) are engaged when said tongues are in rest position,

in that said ring (38) is provided with high tongues (383) configured so that said elastically deformable tongues can be radially outwards deformed after an axial translation, so that the clamping teeth (317) of the female element do not engage the respective clamping teeth (217) provided on said male connector, and in that said ring (38) can rotate between a first position, in which its axial sliding leads said high tongues to deform said elastically deformable tongues, and a second position, in which its axial sliding is hindered by a suitable block element (382).

Figures

[0008] In figure 1 there are shown views from many angles of the co-molded male; in figure 2 there are shown views from many angles of the co-molded female; in figures 3, 4 and 5 there are shown panoramic views of the closed connector in blocked condition, unblocked condition step 1 and step 2, respectively; in figure 6 it is shown an exploded view of the connector mounting assembly, shown assembled in figure 7; in figures 8 to 16 there are shown various mounting steps of the assembly, described in detail in the following; in figure 17 it is shown the ring de-blocking by the tip of a common tool (as for example a screwdriver); in figure 18 it is shown the decoupling of the cone with the tip of a common tool (as for example a screwdriver); in figure 19 it is shown the coupling of the cone; in figure 20 it is shown a section view of the female body; in figure 21 it is shown a section view of the male body; in figure 22 it is shown an exploded view with the fastening system between the male element

and respective clamping cone highlighted; in figures 23 and 24 there are shown the male element and female element fastened to respective clamping cones; in figure 25 it is shown a section view of the connector in the assembled condition; in figure 26 it is shown an axonometric view of the locking ring; in figure 27 it is shown an axonometric view of male and female connectors assembled. In figure 28 there is shown a view of another embodiment of the clamping cone.

Detailed description of the invention

[0009] As it is shown in the appended drawings, and with particular reference to figure 6, where it is shown an exploded view of the connector (1), the connector (1) is made up of a male connector sub-assembly (2) and a female connector sub-assembly (3), each one of which being made up of a plurality of elements. The male connector sub-assembly (2) comprises:

- a co-molded element (21),
- a plug (22),
- a clamping cone (23),
- a big seal (24) of the clamping cone (23),
- a small seal (25) of the clamping cone (23),
- a stop nut (26),
- a plurality of pins (27),

[0010] The female connector sub-assembly (3) comprises:

- a co-molded element (31),
- a plug (32),
- a clamping cone (33),
- a big seal (34) of the clamping cone (33),
- a small seal (35) of the clamping cone (33),
- a stop nut (26),
- a plurality of sockets (37), equal in number to the pins (27) comprised in the male sub-assembly,
- a locking ring (38).

[0011] Preferably, the seals (24, 25, 34, 35) of the clamping cones (23, 33), both in the male sub-assembly and female sub-assembly, are realized in thermoplastic rubber, the nuts (26, 36), the clamping cones (23, 33), the ring (38) and the plugs (22, 32) are realized in suitable thermoplastic material; the male (21) and female (31) central bodies are co-molded, i.e. obtained by molding two different materials able to guarantee the maximum compactness and structural uniformity at the end of the molding step. The pins of the male (27) and the sockets of the female (37) are realized in conductive material. As it will be clear from the following description, the nut (26, 36) and respective clamping cone (23, 33) are coupled by screwing, while the clamping cone (23, 33) and respective male (21) or female body (31) is are snap-coupled. The plugs (22, 32) and respective male (21) or female bodies (31) are coupled by interference, while the two bodies (21, 31) are mutually multi-snap blocked.

Description of the female body and respective sub-assembly

[0012] The female body (31) is realized by a plastic portion (311) bonded to a co-molded seal (312), as it is shown in the section view of figure 20. The seal is configured to exert sealing both between the female connector (3) and the male connector (2), and between the plastic body (31) and the clamping cone (33).

[0013] The plastic body (311) comprises a plurality of housings (313), preferably five in number, for introducing respective female sockets (37), which can be introduced already pre-assembled with the screw. The sockets (37) are elements in electrically conductive material, configured to allow an electrical cable to be blocked to an end, by inserting the cable in a hole, arranged on the socket, and by following clamping by means of a screw with orthogonal axis to the axis of said hole, and to house at the other end a respective pin (27) provided on the male connector (to which a cable is fastened in turn), so that the connector (1) can guarantee the electrical contact of the two cables.

[0014] In order to assemble the female sub-assembly (3) of the connector (1), the sockets (37) are inserted inside respective housings (313) which, as shown for example in figure 10, are laterally open so that the clamping screw is accessible after the connector is assembled.

[0015] The sockets (37) are blocked inside the female body (31) by means of a plug (32), shown in figure 10 as well, which is provided with holes (321) at the position of the sockets (37). Such holes (321) have such a diameter that the sheathed cable (i.e. completed with the thickness of the isolation) can enter therein.

[0016] The shape of the plastic body (31) of the female connector comprises, in the portion coupling with the male, an outer cylinder (315), an empty circular crown, apt to house the male element, and an inner cylinder (316) in which there are obtained both the housing holes of the sockets (37) and a central shaped hole (39), configured to house a respective shaped projection (29) provided on the male body (21), so that coupling is not allowed if the two connectors (21, 31) are rotated to each other. On the inner side of said outer cylinder (315) there are provided a plurality of clamping teeth (317), configured so that the portion of the plastic body supporting them is flexible, and can be elastically deformed outwards to allow the connector to be decoupled, as described in the following.

[0017] As it is shown in figures, the clamping teeth are preferably provided in a plurality of circumferential positions. When the connector is closed, and the portion of plastic body supporting them is in rest position, the clamping teeth are engaged in respective clamping teeth of the male element.

[0018] To the female body (31) it is also fastened a locking ring (38), snap-coupled at the end of the plastic

body (31), which can be coupled with the male (21).

Description of the male body and respective sub-assembly

[0019] The male body (21) is realized by a plastic portion (211) bonded to a co-molded seal (212), as it is shown in the section view of figure 21. The seal (212) is configured to exert sealing both between the male connector (2) and the female connector (3), and between the plastic body (21) and the clamping cone (23).

[0020] The plastic body (211) comprises a plurality of spaces (213), preferably five in number, for introducing respective pins (27) already pre-assembled with the screw. The pins (27) are elements in conductive material, configured to allow an electrical cable to be blocked to an end, by inserting the cable in a hole (271), arranged on the pin (27), and by clamping a screw (272) with orthogonal axis to the axis of said hole, and to be inserted, with the other end, inside a respective socket (37) provided on the female connector (to which a cable is fastened in turn), so that the connector (1) can guarantee the electrical contact of the two cables by means of the coupling between pin and respective sockets.

[0021] In order to assemble the male sub-assembly (2) of the connector (1), the pins (27) are inserted inside respective housings (213) which, as shown in figure 13, are laterally open so that the clamping screw (272) is accessible after the connector is assembled.

[0022] The pins (27) are blocked inside the male body (21) by means of a plug (22) which is provided with holes (221) at the position of the pins (27), with such a diameter that the sheathed cable (i.e. completed with the thickness of the isolator) can enter therein.

[0023] The shape of the plastic body (21) of the male connector comprises, in the portion coupling with the female, an outer cylinder (214) configured to be introduced in the empty circular crown, provided on the female body, inside which it is provided a shaped projection (29) configured to be coupled with the respective shaped hole (39) provided on the female connector, so that the coupling is not allowed if the two connectors are rotated to each other.

[0024] On the outer side of said cylinder (214) there are provided a plurality of clamping teeth (217), configured to be coupled with the inner clamping teeth (317) provided on the female body. Preferably both the clamping teeth provided on the male body and on the female body are provided in a plurality of positions along the circumference, for example in three positions offset to each other of 120°, or in four positions offset to each other of 90°.

Coupling of clamping cone with plastic portions

[0025] The clamping cone (23, 33) and the stop nut (26, 36) are completely similar both for the male (2) and female assembly (3).

[0026] Each clamping cone (23, 33) is coupled with the respective co-molded male/female portion by means of a snap-system, which can be actuated by a simple axial translation of the clamping cone.

[0027] To such aim, on each clamping cone (23, 33) is provided a couple of pliers (231, 331), diametrically opposed to each other, and on each male (21) and female (31) body it is provided a wedge element (219, 319), configured so that when the clamping cone (23, 33) approaches the body (21, 31), the wedge (219, 319) widens the respective pliers (231, 331), which closes then by grasping the wedge element and thus guaranteeing that the cone is coupled with the respective co-molded body. According to another embodiment, shown in figure 28, on each male (21) and female body (31) there are provided a plurality of reliefs (2191), and the surface of the clamping cone facing the corresponding male (or female) body is provided, in corresponding positions, with invitations (2391) configured to allow said reliefs (2191) to enter by means of axial movement. After the coupling is occurred, a relative rotation of the two elements allows to bring the reliefs (2191) in a position not suitable for decoupling, thus guaranteeing that the cone is coupled with the respective co-molded body.

[0028] In figures 23 and 24 there are shown the male body and female body fastened to a respective clamping cone, respectively. In figure 22 it is shown a clamping cone (23) in position to be assembled with its own male body (21); in figure 19 it is shown a side view of the female body (31) fastened to its own cone (33), with a detail of the coupling between pliers (331) and wedge (319).

[0029] A particularly advantageous aspect of the realized coupling type is that the cone can be disassembled from the respective body by using a common tool (as for example a screwdriver, a tool always at disposal of an electrician, since it is used for many aims, and in particular also to assemble the other elements of the connector according to the present invention) which, by widening the two ends of the pliers (331) provided on the cone, allows that the two pieces are removed.

Coupling of male body with female body

[0030] In order to couple the male body (21) with the female body (31), the first one is introduced in the second one. The shape of the two bodies, considering what yet described, are such that the coupling can occur only if the two pieces are approached in the correct relative position.

[0031] After insertion of the male body (21) inside the female body (31), the outer teeth (217) of the male (21) and the inner teeth (317) of the female (31) are coupled. In figure 25 it is shown a section view of the two elements coupled, in which the respective teeth are engaged to each other.

[0032] After coupling the four teethed sectors, the ring remains still in the initial rest position.

[0033] It is to be precised that the ring (38) comprises

low tongues (381) and high tongues (383) configured to be introduced without or with interference respectively in a respective space (314) provided on the female body (31).

[0034] The space (314) in which the tongues are introduced is arranged at the elastically deformable portion of the piece on which there are provided the clamping teeth, and the high tongues (383), while entering this space, deform elastically outwards this deformable portion, widening the clamping teeth. Obviously, there are provided as many spaces (314) and respective deformable portions of the female body (31) as are the positions where the clamping teeth are provided.

[0035] In order to carry out the coupling of male and female in block position, after inserting the two elements into each other until the respective clamping teeth are engaged, it is needed to translate the ring (38) so that the low tongues (381) are introduced without interference in the space (314) of the female body (31) and the projecting tooth (382) of the ring goes in the block position, shown in figure 3, thus avoiding the possibility that the ring slides axially. In such a way it is guaranteed the coupling of the four inner teethed sectors, avoiding at the same time that the two male/female bodies are removed. The unblocking operation is allowed only by inserting the tip of a common tool (as for example a screwdriver) in the space corresponding to the position of the tooth. The tool makes the ring (38) roto-translate which, by virtue of the geometry of the elements, translates axially and goes again in the initial rest condition.

[0036] The decoupling step of the two co-molded male/female bodies occurs by translating onward the ring (in fig. 27 it is represented the starting position of such step): the insertion with interference of the high tongues (383) in the respective space (314) of the female body causes the displacement outwards of the flexible tongue (320) of the female body (31) on which there are provided the clamping teeth (317). In such way, the inner teeth of the female body are decoupled from the outer ones arranged on the male body, thus allowing two bodies to be decoupled by simple traction.

[0037] It is to be observed that the ring (38) acts on the female body by means of axial translation, and in fact it does not have even a thread in its geometry.

Claims

1. Sealed, multipolar connector (1), comprising:

- a male sub-assembly (2) comprising a plurality of pins (27),
- a female sub-assembly (3) comprising a plurality of sockets (37),

wherein said pins are configured so that they engage said sockets when the connector is closed, **characterized in that**

- said male sub-assembly (2) comprises a co-molded element (21) in plastic and rubber,
- said female sub-assembly (3) comprises a co-molded element (31) in plastic and rubber, and a locking ring (38),
- said co-molded elements (21, 31) comprise, in a plurality of circumferential positions, clamping teeth (217, 317) configured to be engaged with each other when said elements (21, 31) are coupled, said clamping teeth (217, 317) being positioned on elastically deformable tongues and being configured so that the clamping teeth (217, 317) are engaged when said tongues are in rest position,

in that said ring (38) is provided with high tongues (383) configured so that said elastically deformable tongues can be radially outwards deformed after an axial translation, so that the clamping teeth (317) of the female element do not engage the respective clamping teeth (217) provided on said male connector, and **in that** said ring (38) can rotate between a first position, in which its axial sliding leads said high tongues to deform said elastically deformable tongues, and a second position, in which its axial sliding is hindered by a suitable block element (382).

2. Sealed, multipolar connector (1), according to claim 1, **characterized in that** said male sub-assembly (2) further comprises:

- a plug (22),
- a clamping cone (23),
- a big seal (24) of the clamping cone (23),
- a small seal (25) of the clamping cone (23),
- a stop nut (26),

and **in that** said female sub-assembly (3) further comprises:

- a plug (32),
- a clamping cone (33),
- a big seal (34) of the clamping cone (33),
- a small seal (35) of the clamping cone (33),
- a stop nut (26).

3. Sealed, multipolar connector (1) according to claim 2, **characterized in that** said female co-molded element (31) comprises a plastic portion (311) bonded to a co-molded seal (312), configured to exert sealing both between the female sub-assembly (3) and the male sub-assembly (2), when assembled, and between the co-molded element (31) and the clamping cone (33), and said male co-molded element (21) comprises a plastic portion (211) bonded to a co-molded seal (212), configured to exert sealing both between the male sub-assembly (2) and the female sub-assembly (3), and between the co-molded ele-

ment (21) and the clamping cone (23).

4. Sealed, multipolar connector (1) according to claim 3, **characterized in that** the shape of the co-molded element (31) of the female connector comprises, in the portion coupling with the male, an outer cylinder (315), an empty circular crown, apt to house the male element, and an inner cylinder (316) in which there are obtained both the housing holes of the sockets (37) and a central shaped hole (39), configured to house a respective shaped projection (29) provided on the male body (21), and **in that** said clamping teeth (317) are positioned on the inner side of said outer cylinder (315) and are configured so that the portion of the plastic body supporting them is flexible (320), and can be elastically deformed outwards to allow the connector to be decoupled.

5. Sealed, multipolar connector (1) according to claim 4, **characterized in that** each clamping cone (23, 33) is coupled with the respective co-molded male/female portion (21, 31) by means of a snap-system, which can be actuated by a simple axial translation of the clamping cone,
in that each clamping cone (23, 33) comprises a couple of pliers (231, 331), diametrically opposed to each other,
and **in that** on each male (21) and female (31) body it is provided a wedge element (219, 319), configured so that when the respective clamping cone (23, 33) is assembled in the body (21, 31), the wedge (219, 319) widens the respective pliers (231, 331), which closes then by grasping the wedge element and thus guaranteeing that the cone is coupled with the respective co-molded body.

6. Sealed, multipolar connector (1), according to claim 5, **characterized in that** said ring (38) comprises low tongues (381) and high tongues (383) configured to be introduced without or with interference respectively in a respective space (314) provided on the female body (31), and a tooth (382) configured to take a block position, where it fastens the ring in axial direction to the female body, thus avoiding its relative sliding.

7. Sealed, multipolar connector (1), according to claim 6, **characterized in that** said high tongues (383) are configured to widen radially said clamping teeth (317) provided on said female co-molded element (31) after an axial translation of said ring (38), and **in that** said low tongues (381) are configured so that when introduced without interference in said space (314) of the female body (31), said projecting tooth (382) of the ring (38) is in a block position, where it fastens the axial sliding of said ring (38).

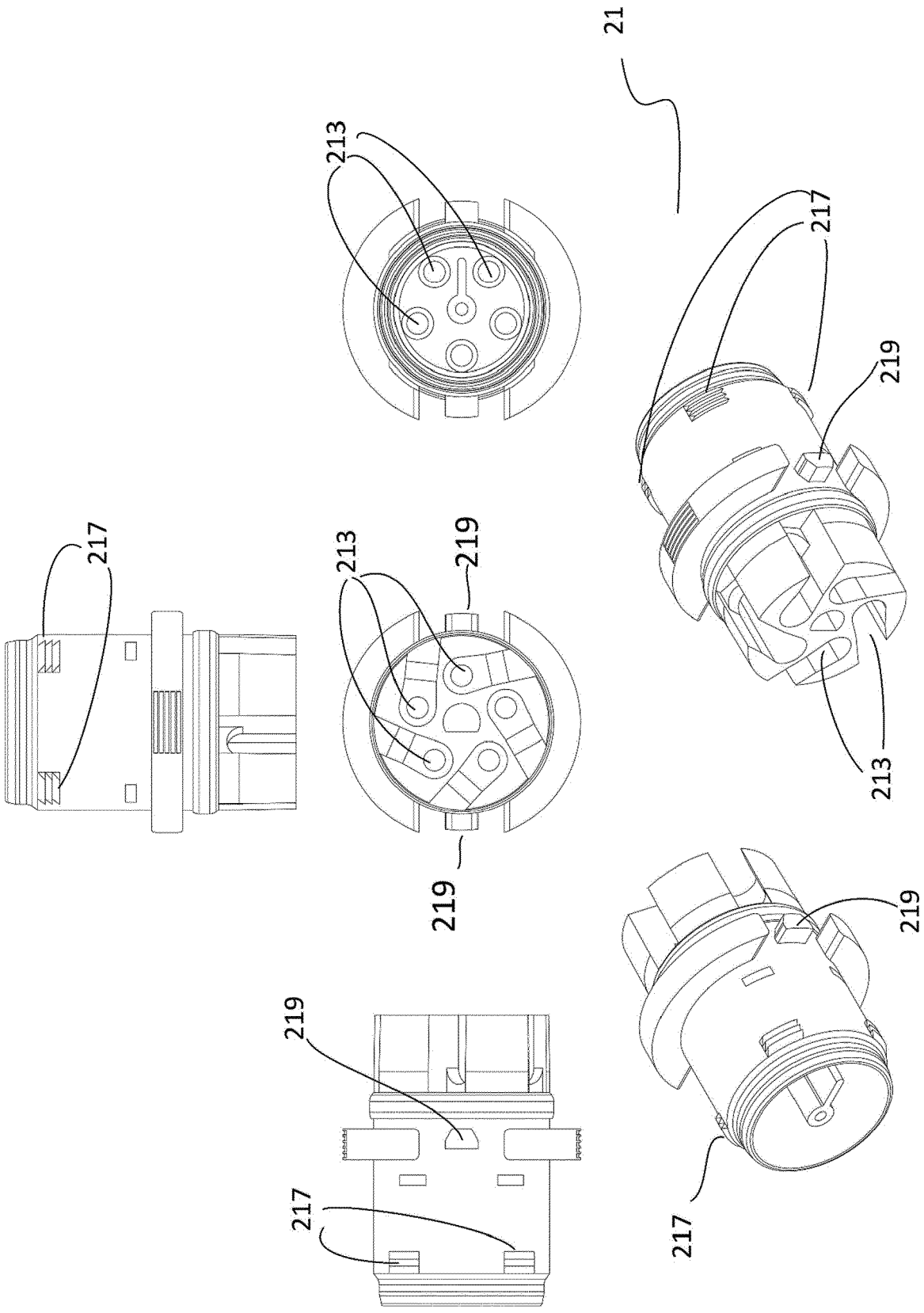


Fig. 1

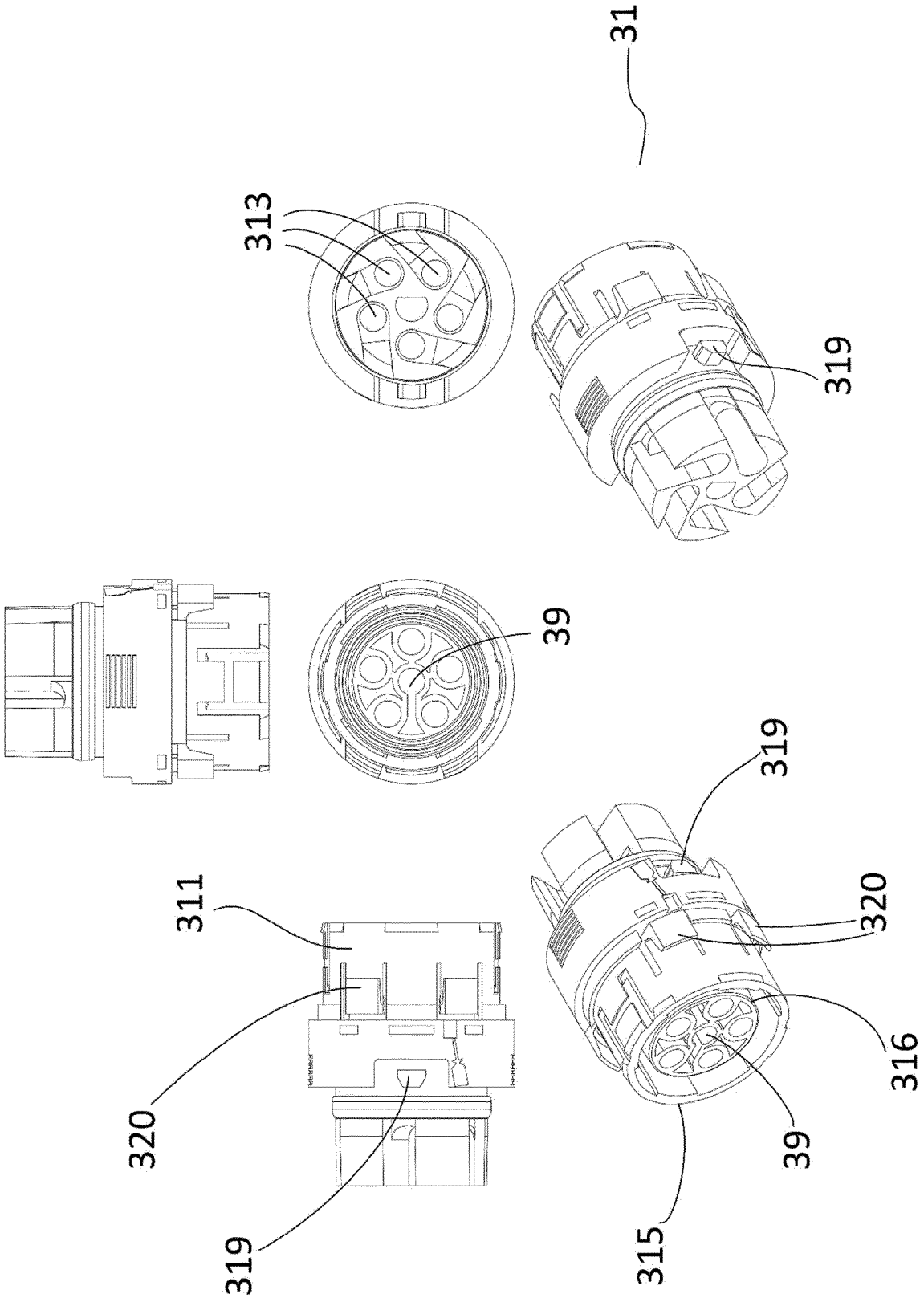


Fig. 2

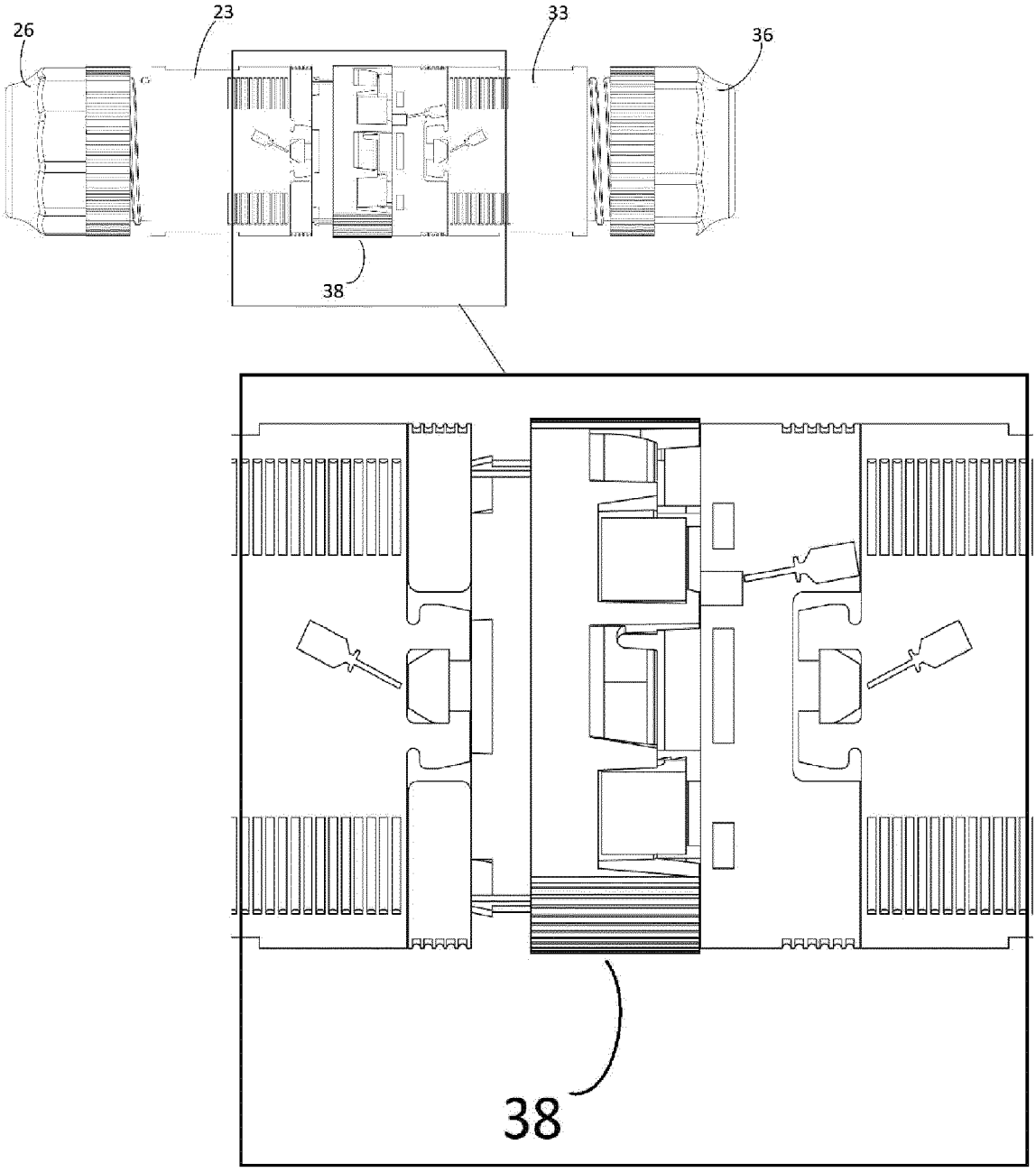


Fig. 3

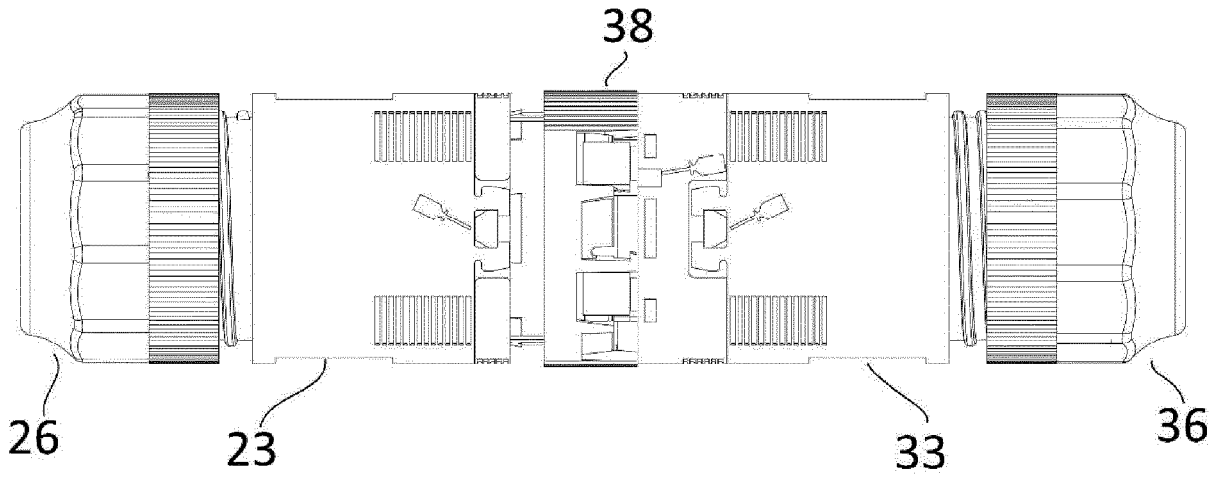


Fig. 4

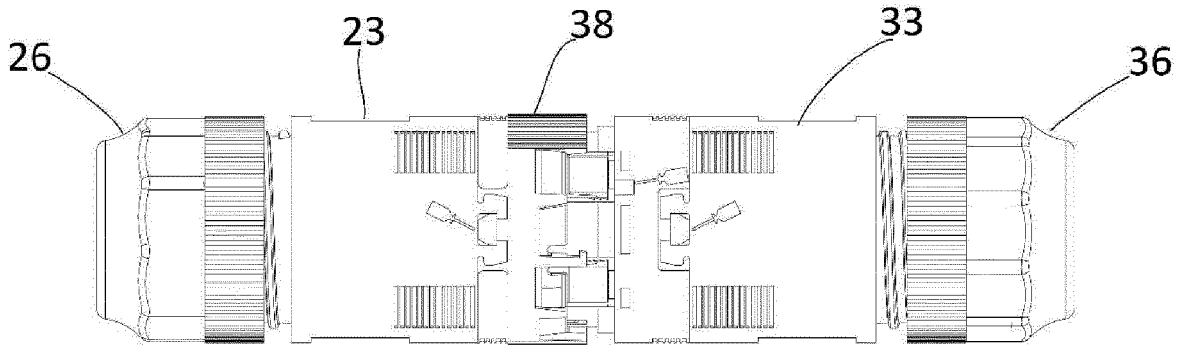


Fig.5

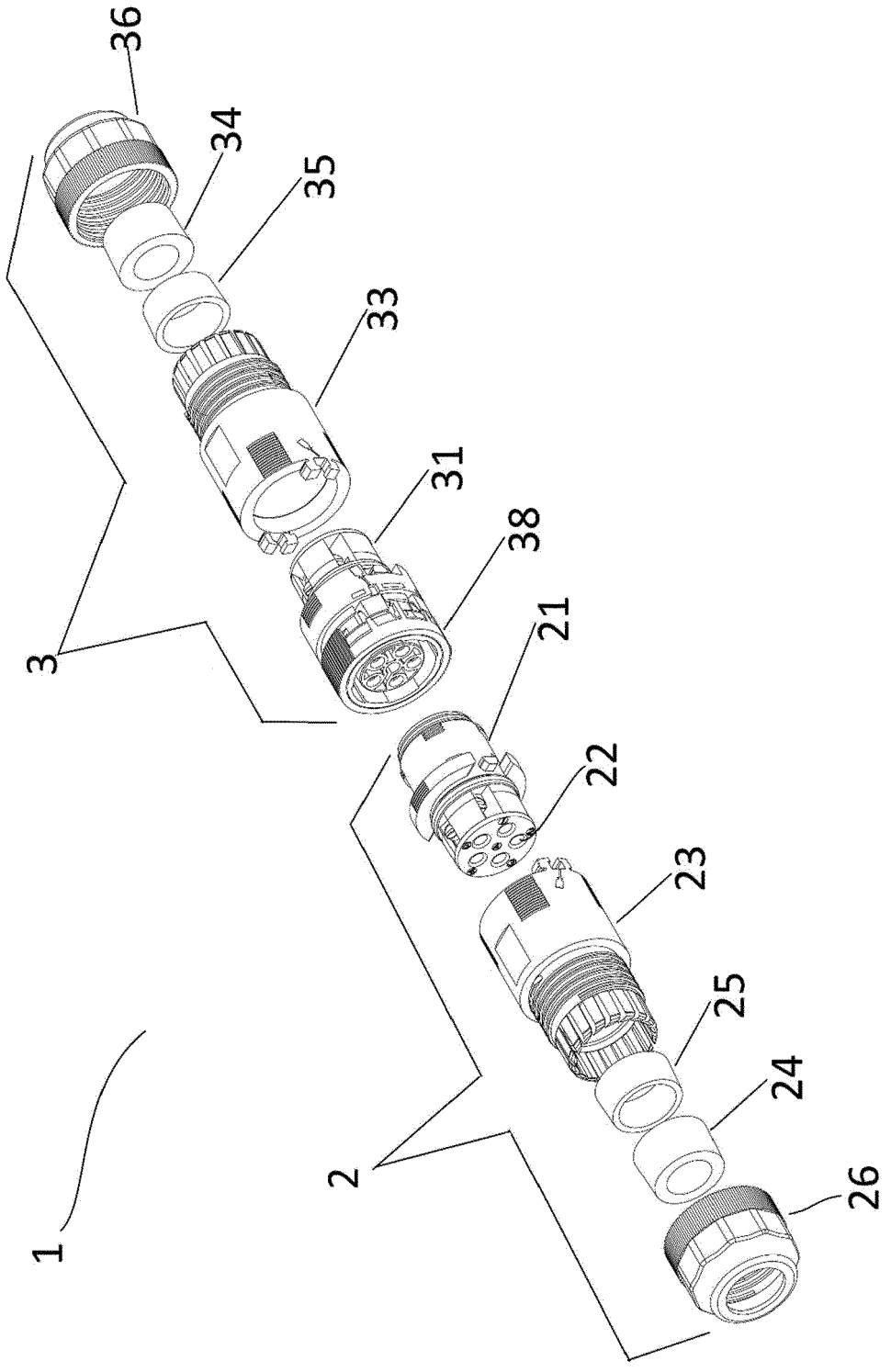


Fig. 6

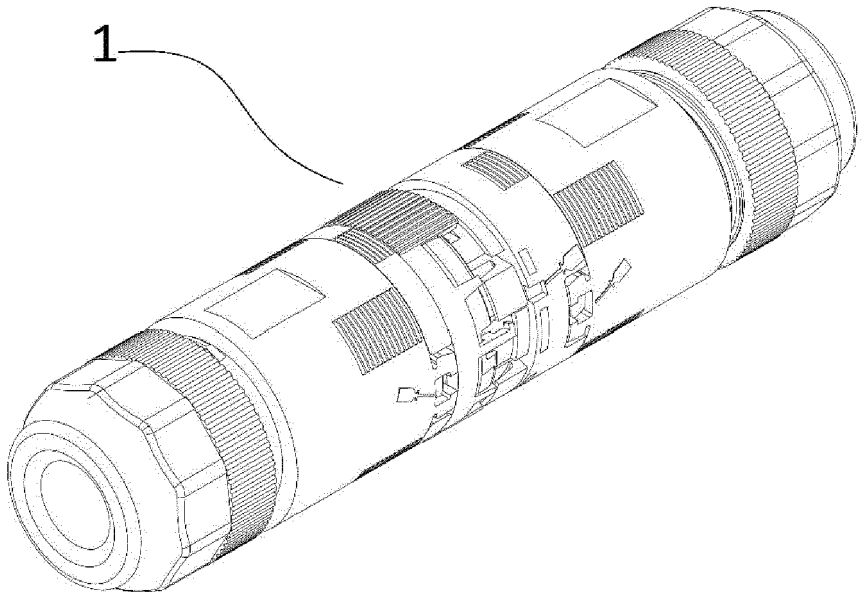


Fig-7

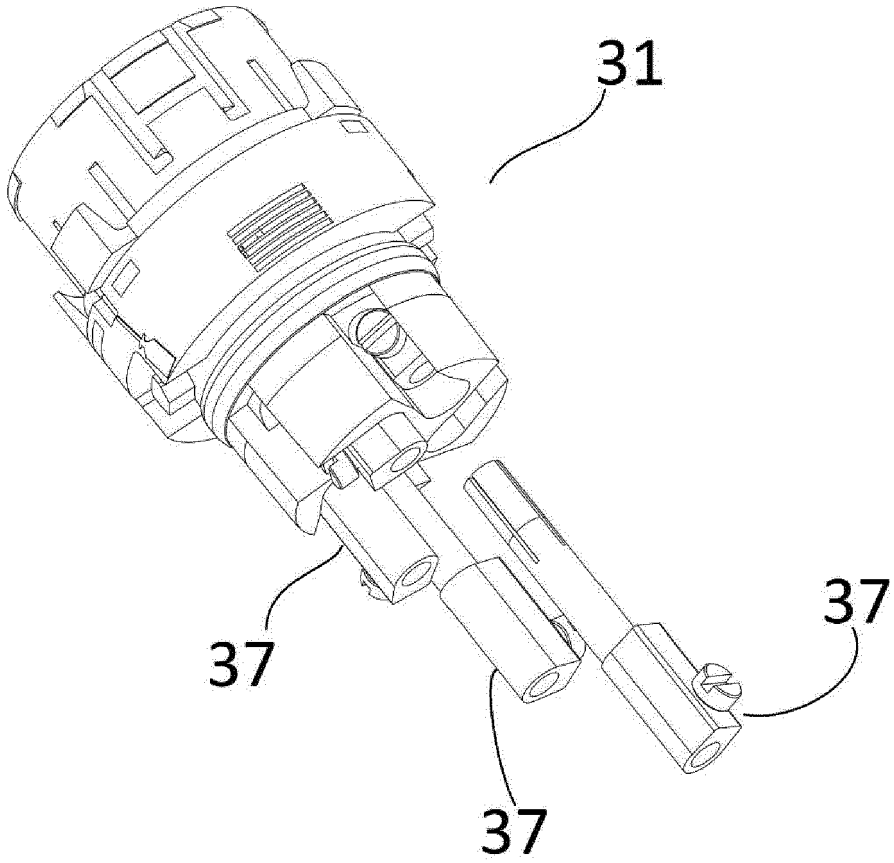


Fig. 8

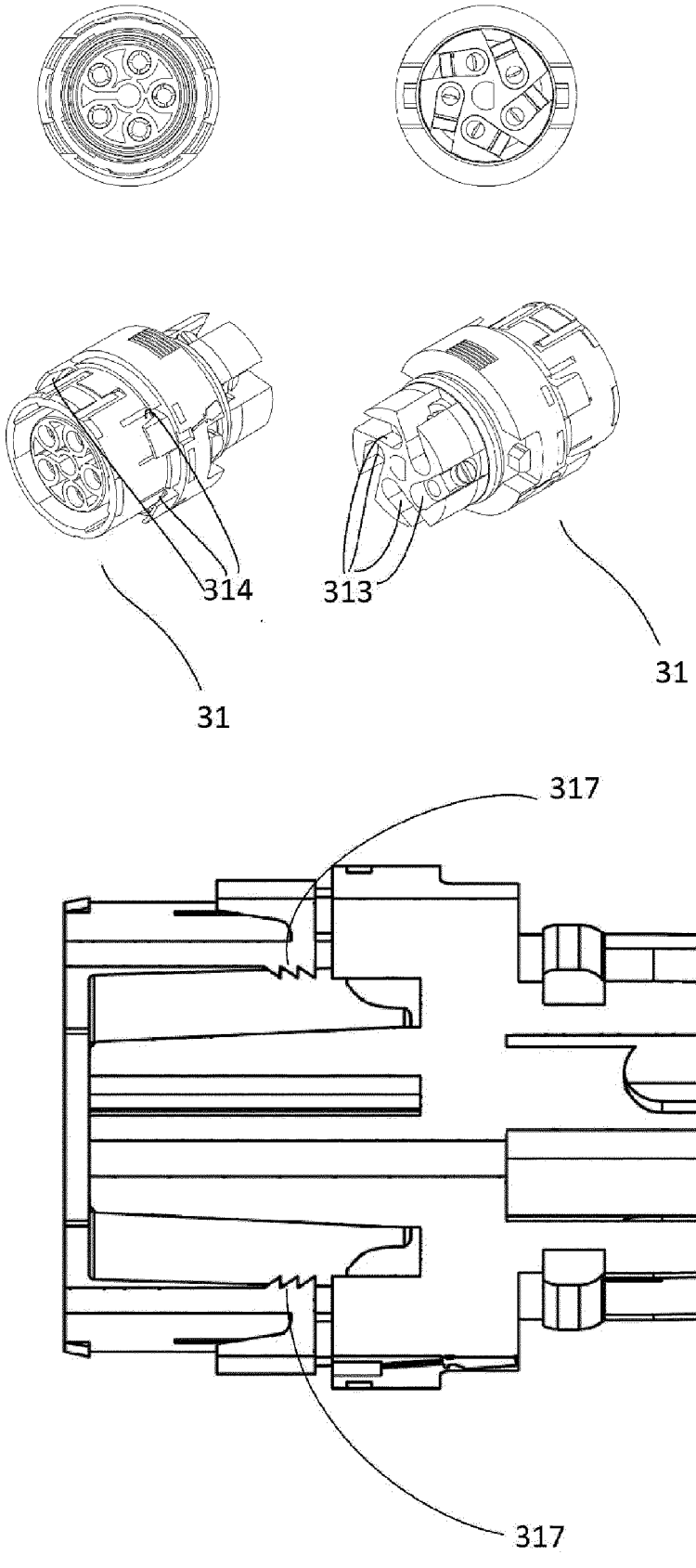


Fig. 9

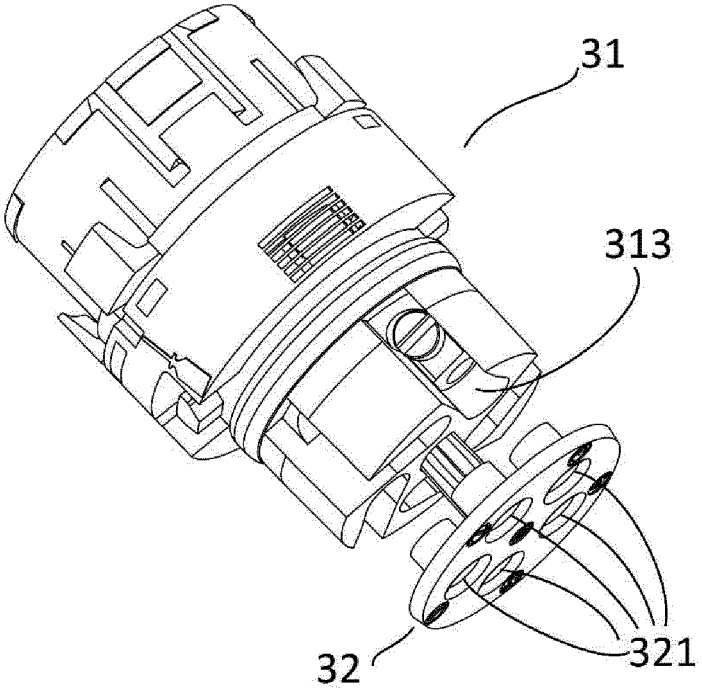


Fig. 10

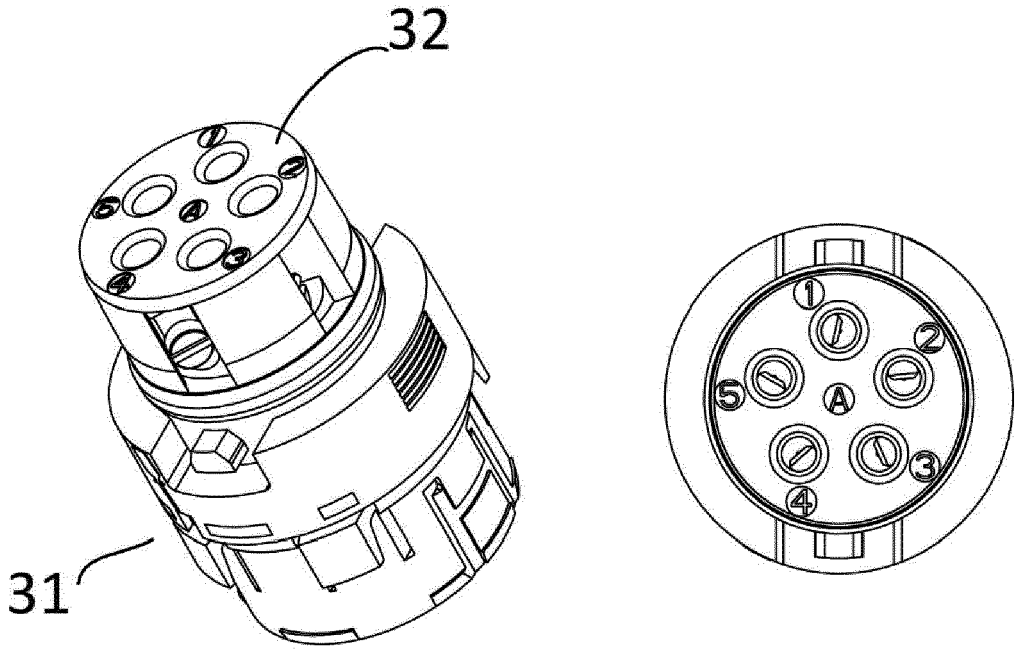
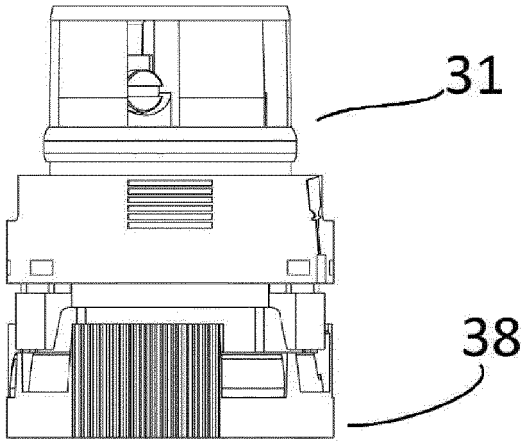
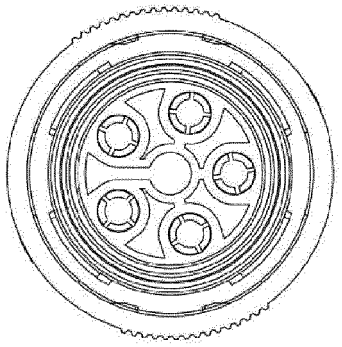
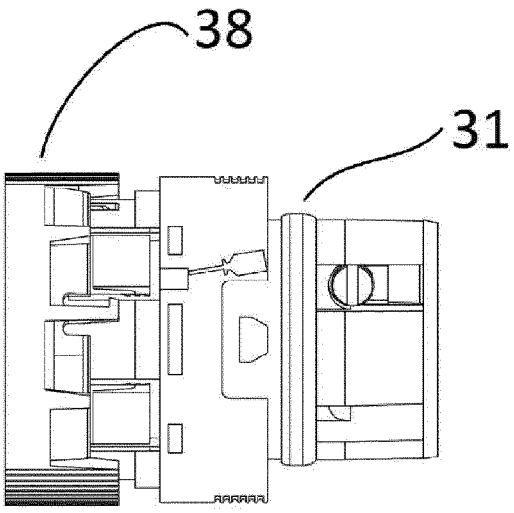


Fig. 11







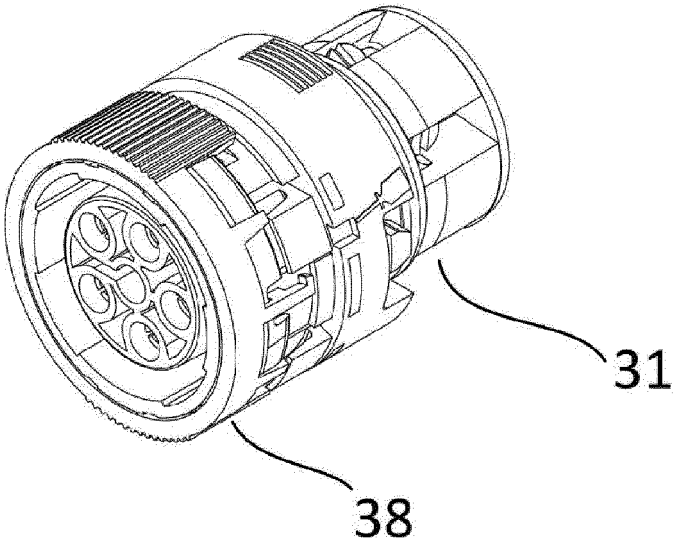


Fig. 12

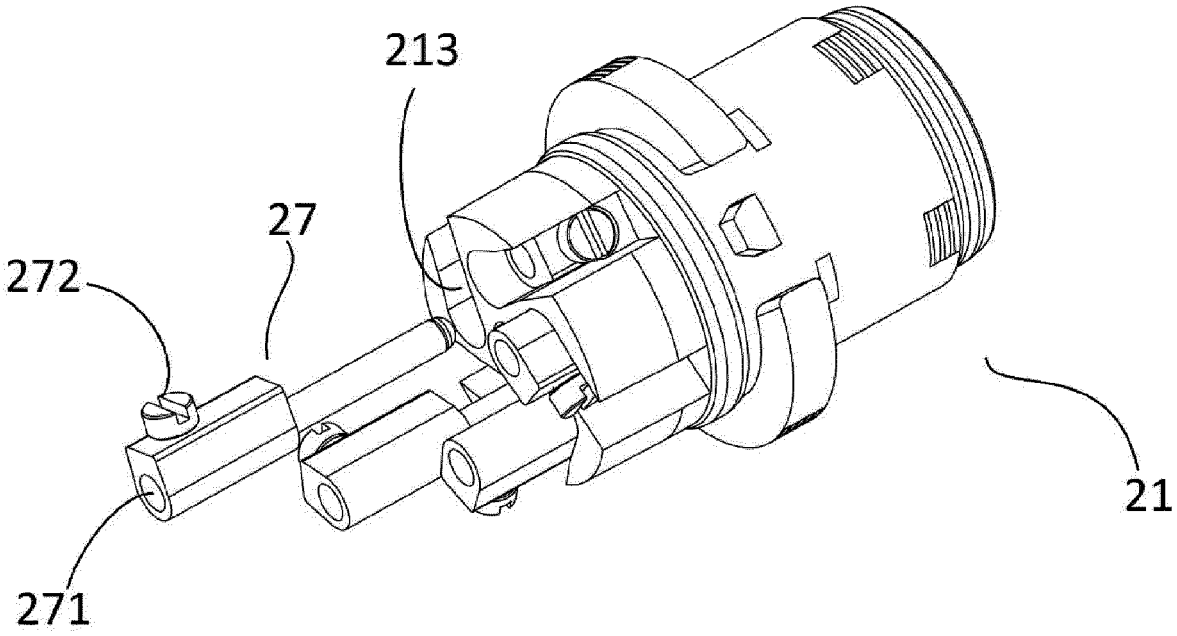
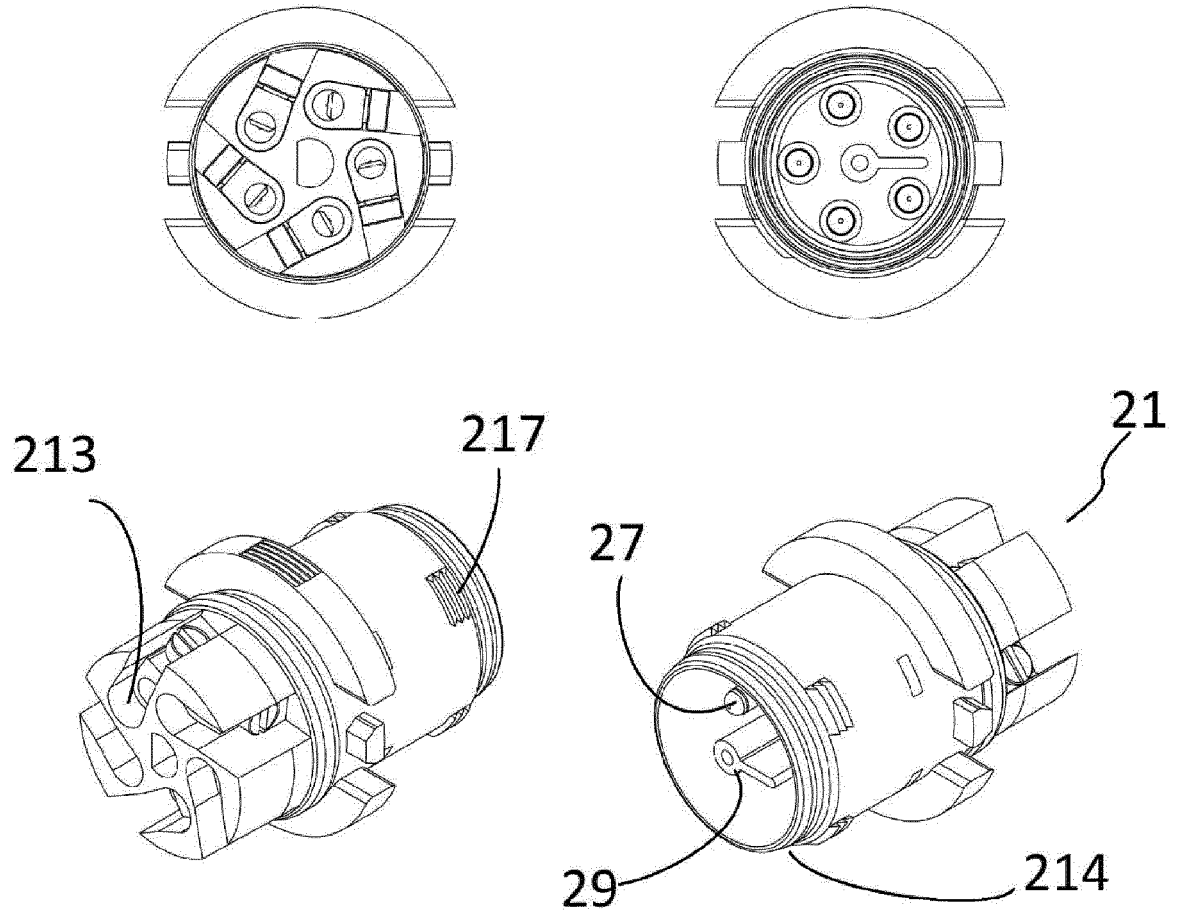


Fig. 13



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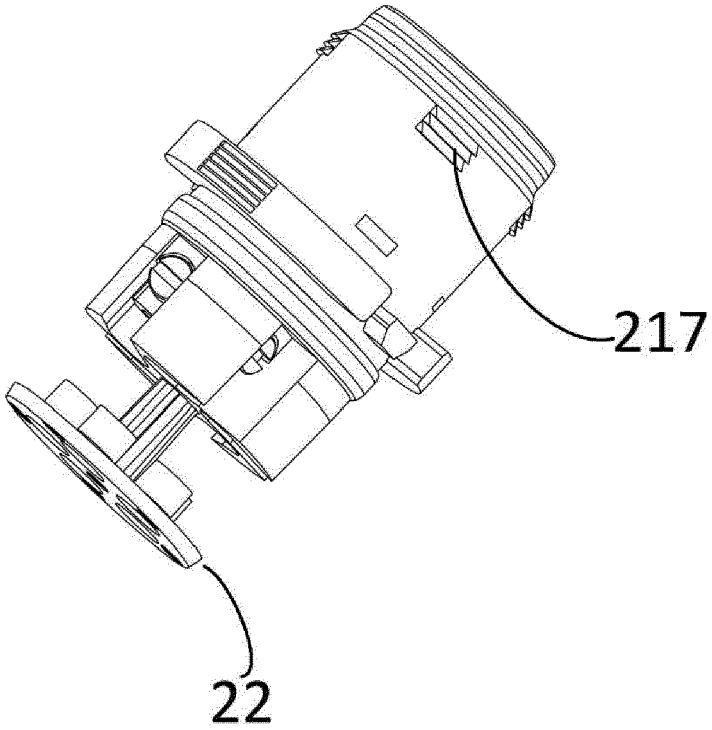

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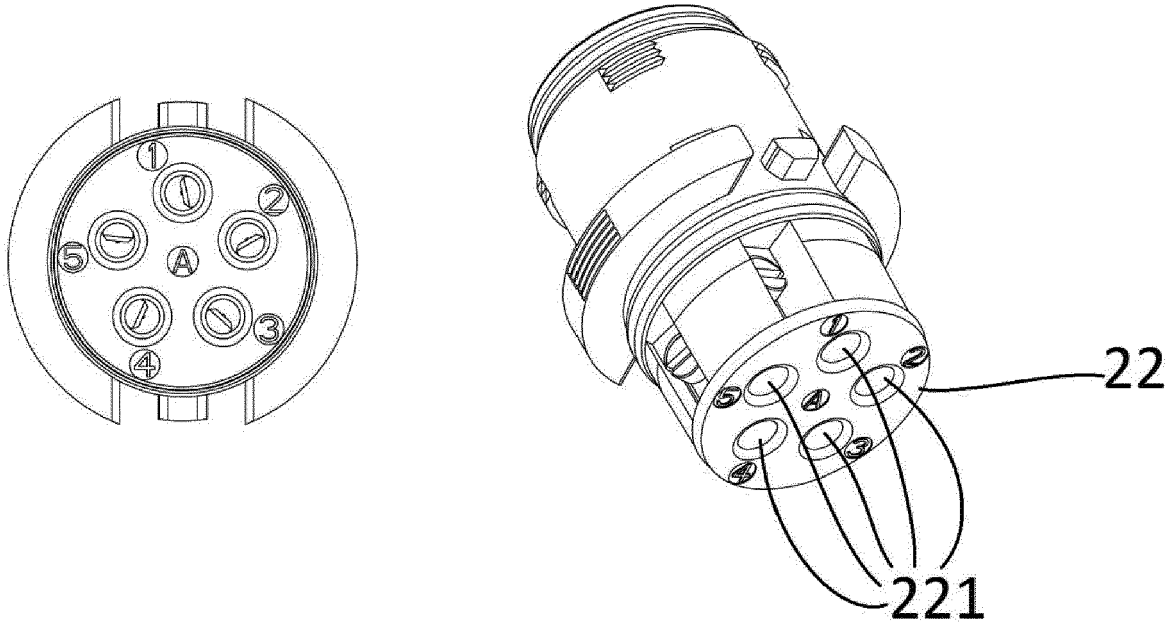

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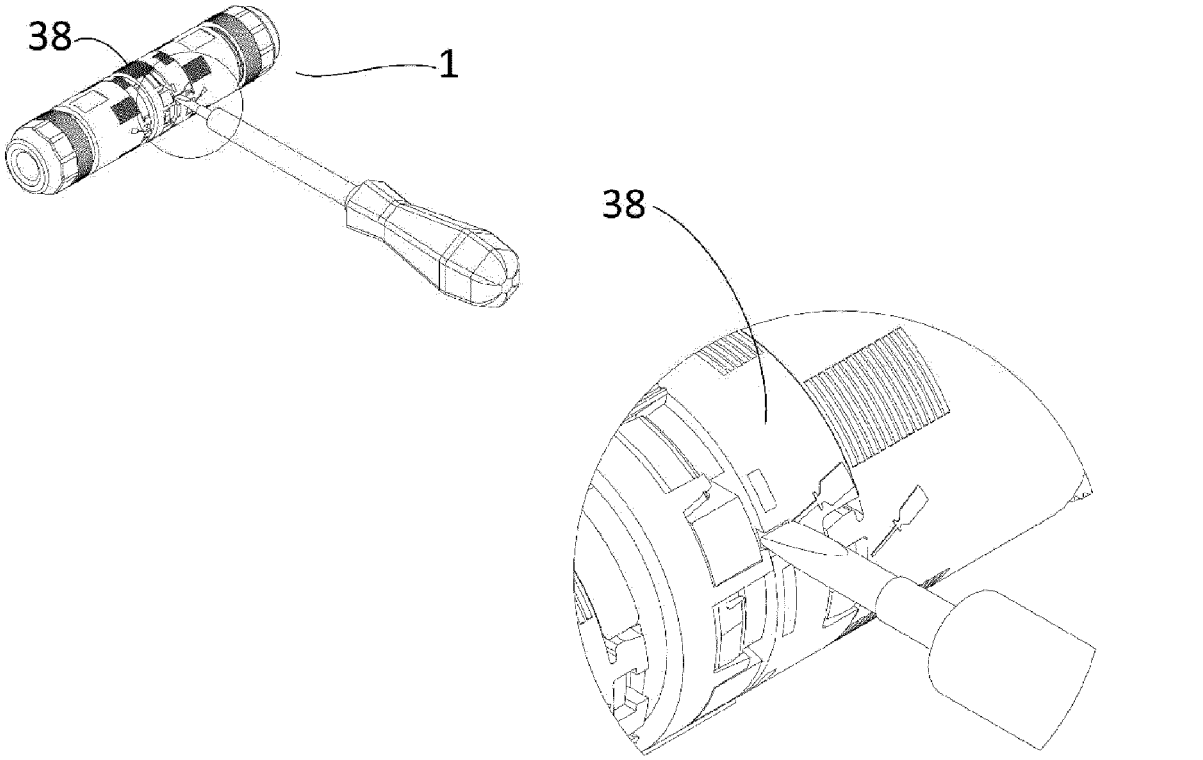


Fig. 17

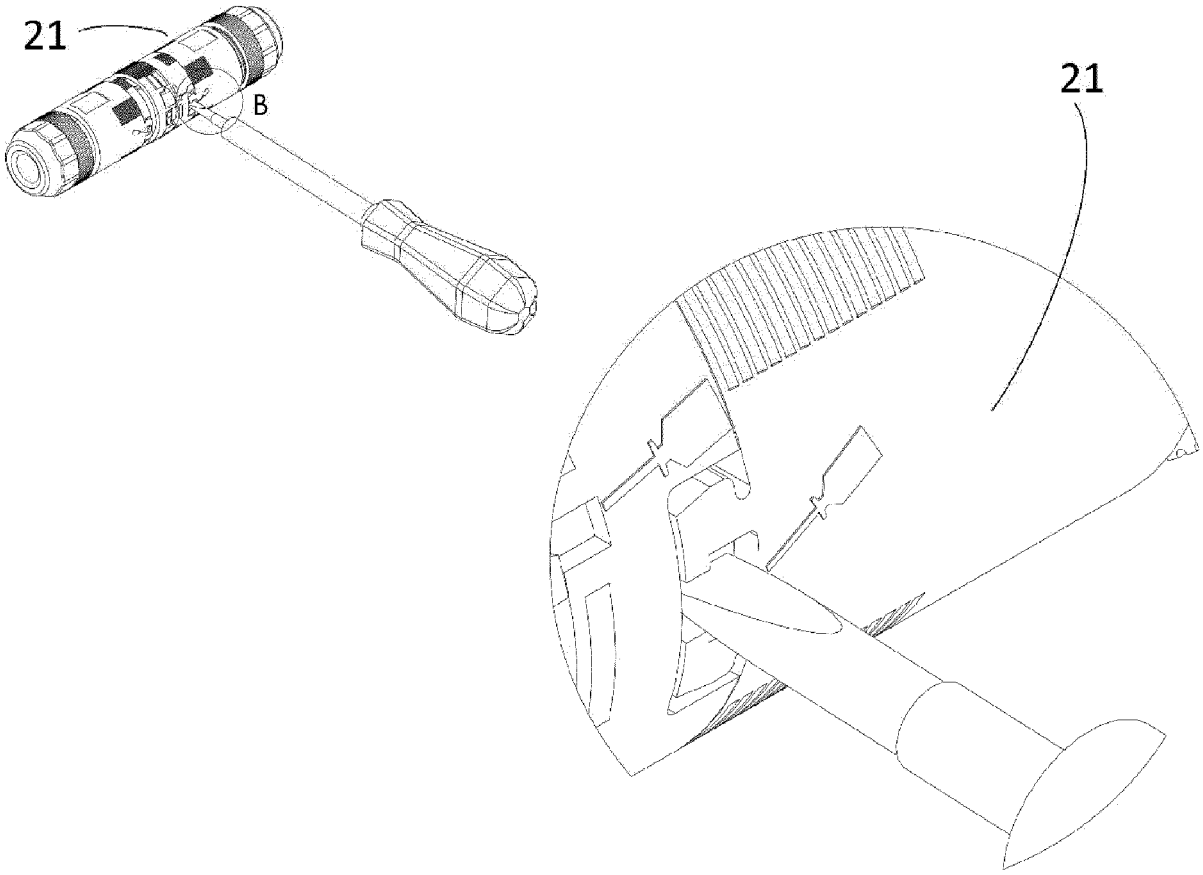
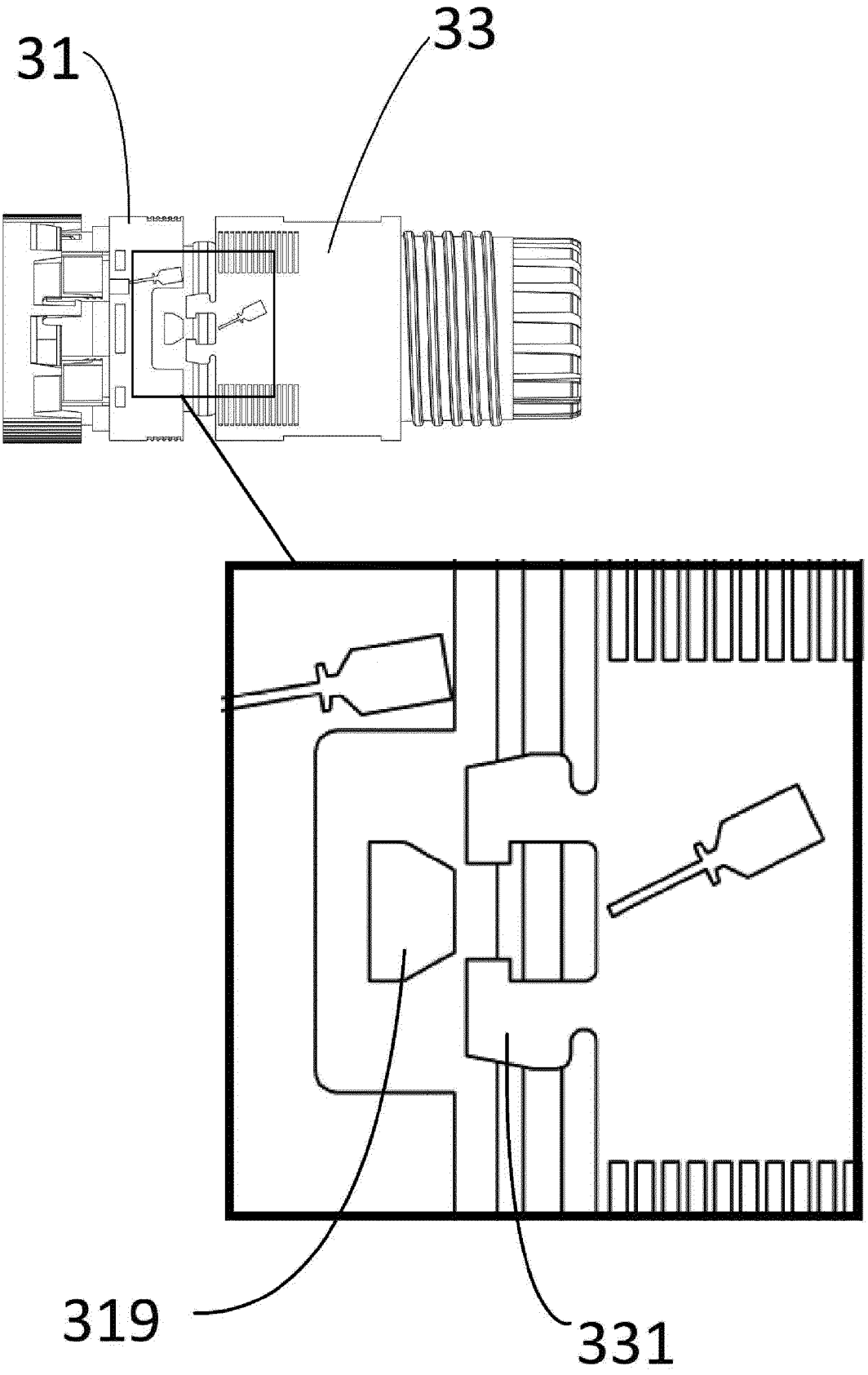


Fig. 18



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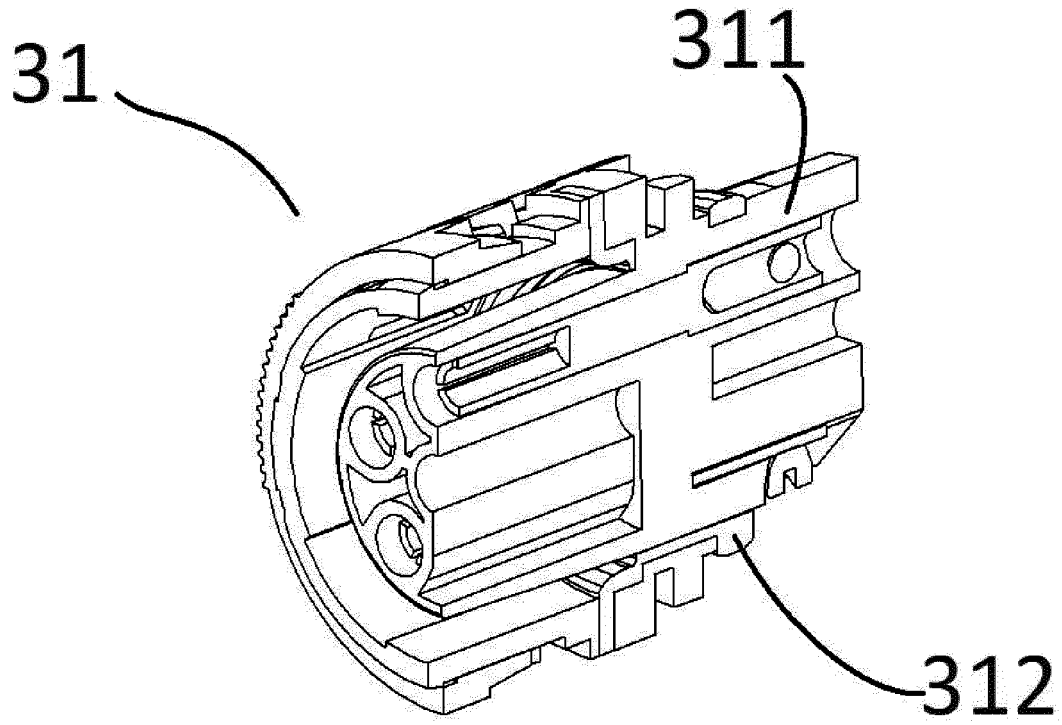

Fig. 20

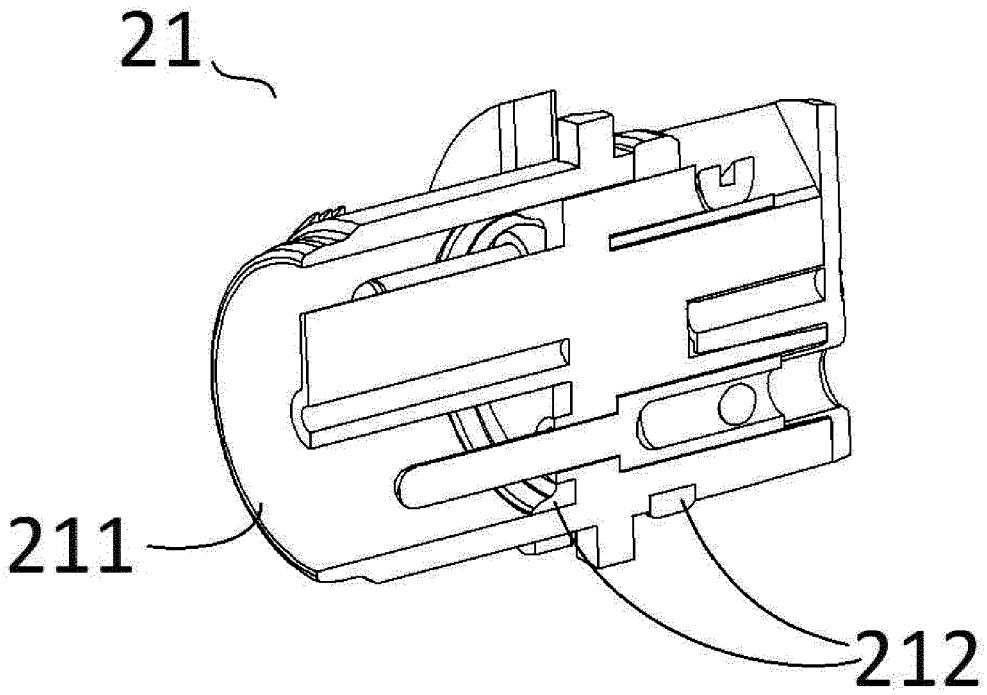

Fig. 21

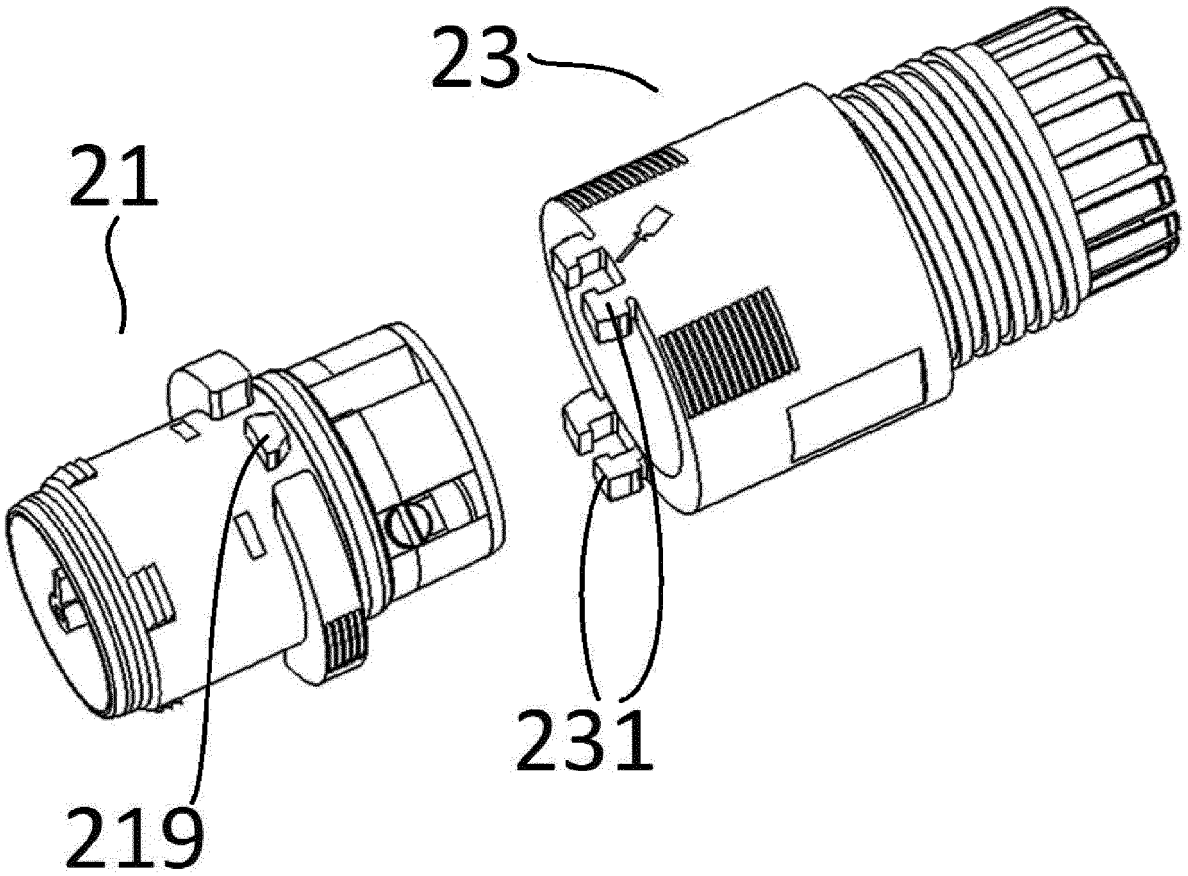

Fig. 22

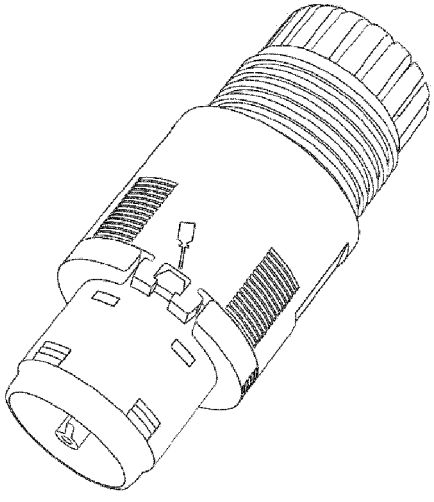

Fig. 23

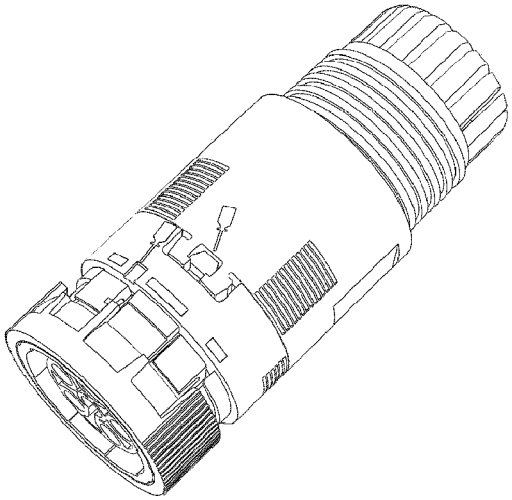

Fig. 24

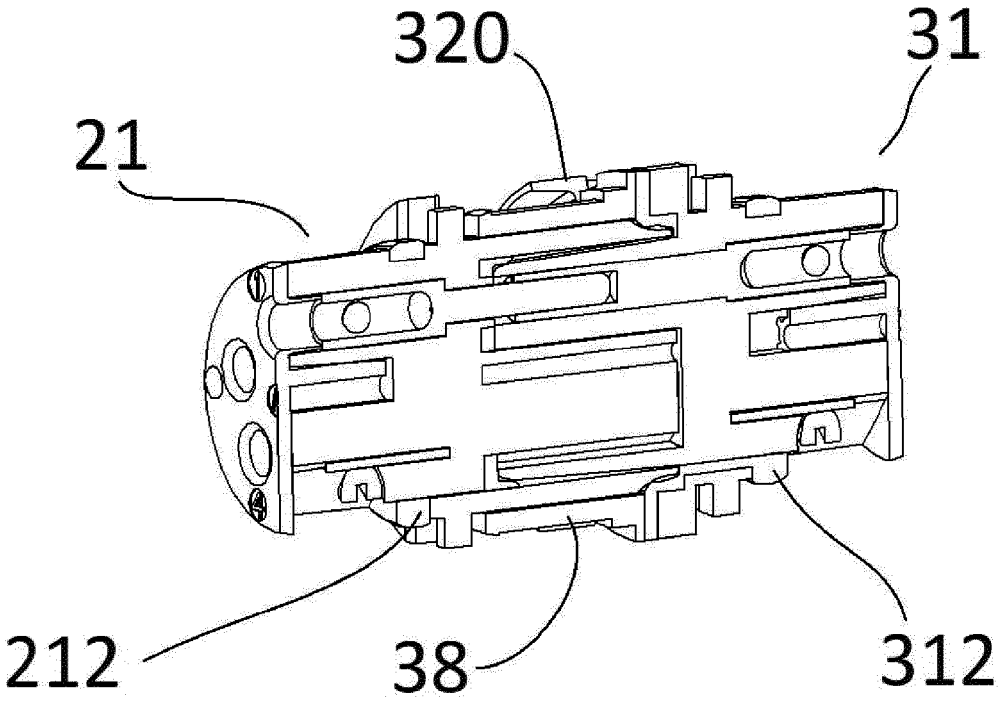

Fig. 25

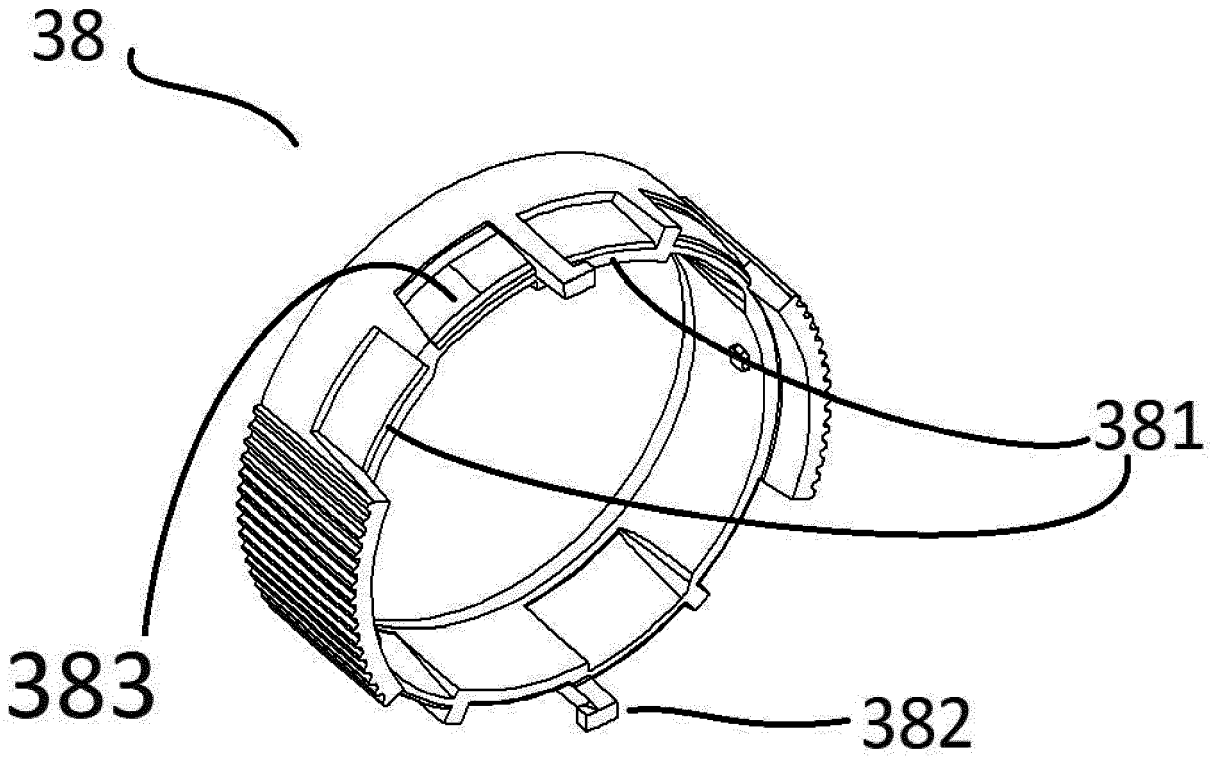

Fig. 26

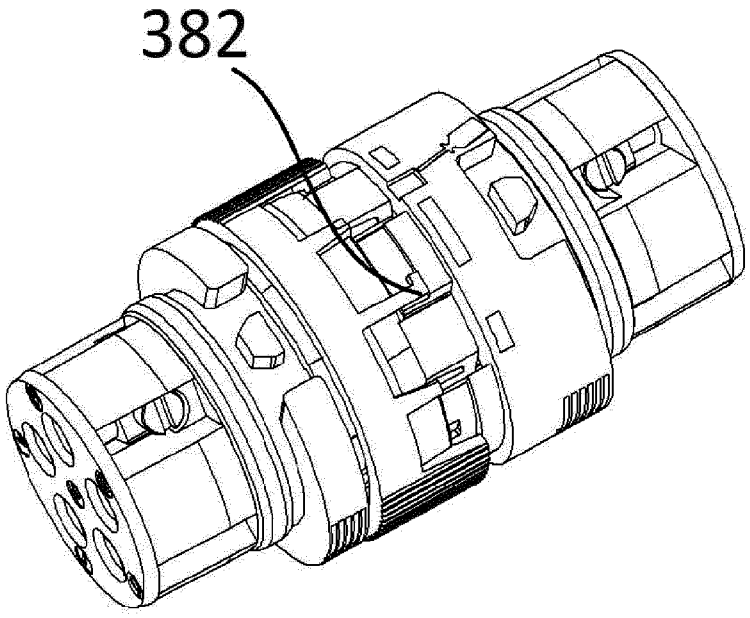

Fig. 27

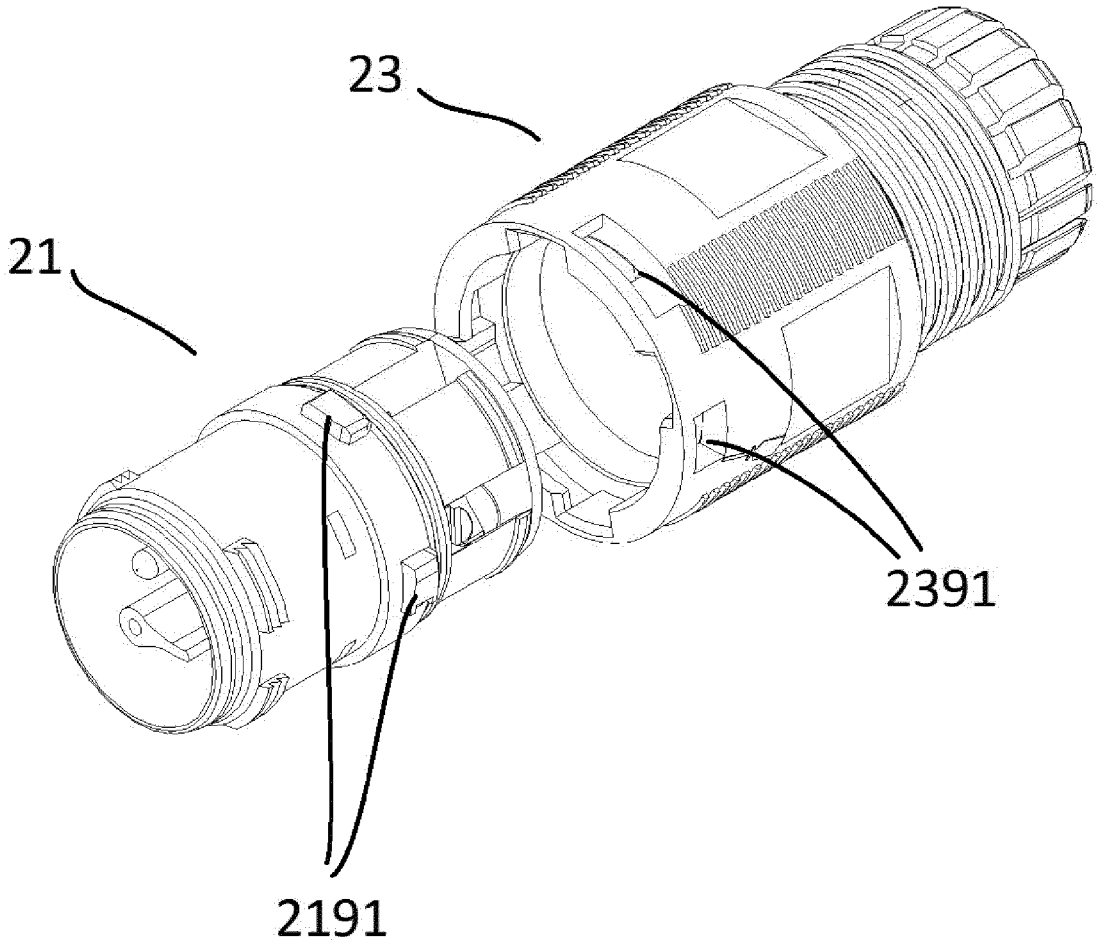

Fig. 28

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Application Number
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	19 June 2019	Philippot, Bertrand

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