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(54) **DEVICE FOR TIGHTENING A HYDRAULIC CYLINDER**

(57) A device for tightening a screwable head (T) of a hydraulic cylinder (H) having a cylinder (C) in which a piston slides equipped with a rod (P) with an external joint (E) and slidable through an opening of said screwable head (T), the screwable head (T) having gripping seats (S) at a free end thereof facing in the direction opposite to the center of the cylinder (C).

The device (1) comprises:

- an openable support (50) having a plurality of gripping elements (40) assigned to abut respective gripping seats (S) of the screwable head (T);
- a joint (31) assigned to be coupled with a motor means (M) for the rotation of the device (1) around a longitudinal axis (A) of the device itself, coaxial with the joint (31) and coinciding with the axis of symmetry of the screwable head (T), in correspondence with a tightening closed condition (X);
- a torque transmission means (2) to a connection end (13) of which the joint (31) is fixed and to an opposite gripping end (14, 24) of which the support (50) is fixed, where the torque transmission means (2) is dimensioned in such a way that, in correspondence with the tightening closed condition (X), it does not interfere with the rod (P) nor with the external joint (E) of the hydraulic cylinder (H).

The support (50) comprises first (15) and second (25) guiding elements of concave shape and each having respective gripping elements (40) of the support (50).

The first guiding element (15) is solidly fixed to the gripping end (14) of the torque transmission means (2) and the second guiding element (25) is hinged to the first (15) and at least rotatable with respect to it around a hinge axis (B) parallel to and not coinciding with the longitudinal axis (A) between an opened condition (O), in which the rod (P) can be positioned between the concav-

ities of said guiding elements (15, 25), and the tightening closed condition (X), in which the gripping elements (40) are positioned to engage with their respective gripping seats (S).

In the tightening closed condition (X), the guiding elements (15, 25) are mutually side by side and their respective concavities form an opening (51) for the rod (P) of the hydraulic cylinder (H), the gripping elements (40) are engaged in their respective gripping seats (S), and the rotation of the motor means (M) causes the screwing or unscrewing of the head.

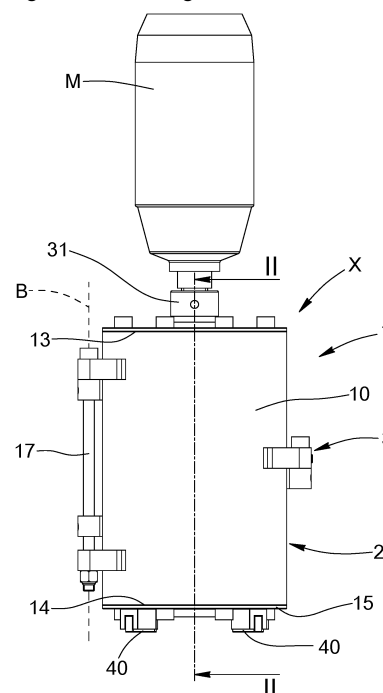


FIG.1

Description

[0001] The present invention relates to the field concerning the assembly of hydraulic and pneumatic actuators, and in particular it relates to a device for tightening a hydraulic cylinder.

[0002] A hydraulic cylinder or jack consists of a piston inserted and sliding inside a hollow cylinder, closed at one end by a welded bottom and at the opposite end by a head screwed into an internal thread of such end and having a central passage. The piston abuts with the inner walls of the cylinder via sealing gaskets, dividing the cavity of the cylinder into two chambers. A rod is connected to the piston and partially emerges from the cylinder, tightly sliding through the central passage of the head of the hydraulic cylinder, and it is thus kept in axis with the cylinder itself. The rod can have elements, such as for example attachment portions, fixed to its end external to the cylinder and with a diameter possibly greater than the diameter of the rod.

[0003] Tools are known for tightening the head of a hydraulic cylinder of the mechanical key or plier type, provided with an abutment portion and an elongated gripping end portion. In an operating condition, an operator approaches the tool to the head of the hydraulic cylinder to be tightened to the side of the hydraulic cylinder itself, with the tool almost perpendicular to the longitudinal axis of the hydraulic cylinder, until the abutment portion engages the head, then in a tightening condition he drives the tool from the gripping end portion to impart torque to the hydraulic cylinder head and screw it securely to the cylinder. In some cases, the abutment portion of the tool has protrusions fit for joining with corresponding couplings on the head of the hydraulic cylinder to make the abutment more secure during tightening in the operating condition.

[0004] Document WO2018017007A1 discloses a tool for the application of bolt joints which comprises movably actuatable locking and wedge elements as well as a central turnable frame part and turnable sleeves surrounding the same. The frame part and the turnable sleeves are provided with threads. The tool is actuated by torsional force whereby pressing, clamping, and pulling force are provided for unscrewing or tightening the bolt or the nut at the bolt joint.

[0005] Document DE102011018465A1 discloses a tightening tool for a screw element with a tool holder and an associated line. A coupling part is designed for positive engagement with the tool holder at a free end, and at the other end merges into a handle or can be coupled to a handle. The coupling part has, at least at its free end, an interior space and at least one lateral opening for insertion, wherein the interior space and the opening extend to the free end and are open there.

[0006] A drawback of the known tools consists in that they are manually operated and therefore their use requires long time and considerable effort for the operator to tighten the head of a hydraulic cylinder, especially in

the case of hydraulic cylinder of large dimensions.

[0007] Another drawback of the known tools consists in that they expose the operator to considerable risks in the tightening condition, since a sudden and accidental disengagement of the tool from the head of the hydraulic cylinder can cause the operator to lose control of the tool itself, with consequent possible risks for his safety.

[0008] An object of the present invention is to propose a device for tightening a hydraulic cylinder which can be operated by means of a motor, so as not to require direct manual intervention by the operator in the tightening condition, eliminating the risks to the operator's safety, and allowing the hydraulic cylinder head to be tightened in a short time and with torques higher than those normally applicable by the operator using a manual tool.

[0009] The characteristics of the invention are highlighted below with particular reference to the attached drawings in which:

- figure 1 shows a front view of the device for tightening a hydraulic cylinder, object of the present invention, in a closed condition and to which a motor means M is associated;
- figure 2 shows a section view along plane II-II of the device of figure 1;
- figure 3 shows a front view of the device of figure 1 in an opened condition O;
- figure 4 shows a section view along plane IV-IV of the device of figure 3;
- figure 5 shows a bottom view of the device of figure 1;
- figure 6 shows a bottom view of the device of figure 3;
- figure 7 shows an axonometric view of the device of figure 1;
- figure 8 shows an axonometric view of the device of figure 3;
- figure 9 shows an exploded view of the device of figure 3;
- figure 10 shows a side view of the device of figure 1 in a tightening closed condition X, applied to the screwable head T of a hydraulic cylinder H to be tightened;
- figure 11 shows a partial section view along plane XI-XI of the device of figure 10;
- figure 12 shows a side view of the device of figure 1 in a tightening closed condition X, applied to the screwable head T fully screwed tight into the cylinder C of the hydraulic cylinder H;
- figure 13 shows a partial section view along plane XIII-XIII of the device of figure 12.

[0010] With reference to figures 1-13, numeral 1 indicates the device for tightening a screwable head T of a hydraulic cylinder H and object of the present invention. This device is capable of, and intended to, also perform the unscrewing of the head, for example for maintenance, inspection and similar purposes.

[0011] The hydraulic cylinder H has a cylinder C in which a piston slides provided with a rod P, which has at

an external end an external joint E and which is slidable through an opening of said screwable head T. The screwable head T has gripping seats S at a free end thereof facing in the opposite direction to the center of the cylinder C, and has a thread at the opposite end, assigned to engage with a complementary thread made at a respective end of the cylinder C. The external joint E can have transversal dimension smaller or even greater than the diameter of the rod P. The device 1 is made to operate even in the presence of external joints which can be even much bulkier than the transversal dimension of the rod P. The gripping seats S can be obtained laterally or on the external face of the free end of the screwable head T, or they can for example consist of a particular geometric conformation of the screwable head itself, for example polygonal or provided with recesses.

[0012] In the preferred embodiment, the device 1 comprises:

- a support 50, having open, i.e. concave or convex, shape and openable with a hollow interior, to which a plurality of gripping elements 40 are fixed, which are assigned to abut respective gripping seats S of the screwable head T;
- a joint 31 assigned to be coupled with a motor means M for actuating the rotation of the device 1 around a longitudinal axis A of the device itself, coaxial to the joint 31 and coinciding with the axis of symmetry of the screwable head T, in correspondence with a tightening closed condition X of the device 1 in which the gripping elements 40 are engaged to their respective gripping seats S;
- a torque transmission means 2, to a connection end 13 of which the joint 31 is fixed, and to an opposite gripping end 14, 24 of which the support 50 is fixed; said torque transmission means 2 is dimensioned in such a way that, in correspondence with the tightening closed condition X, it does not interfere with the rod P or with the external joint E of the hydraulic cylinder H.

[0013] The joint 31 is a shaped seat or socket, or joint with an elastic block, or the like, assigned to be connected to the motor means M, which is for example a drill or similar screwing means, for the rotation of the device 1 in the tightening closed condition X.

[0014] The support 50 preferably comprises a first guiding element 15 and a second guiding element 25 each concave in shape, for example an annulus sector, carrying respective gripping elements 40 of the support 50.

[0015] The gripping elements 40 are suitably shaped and arranged along the support 50 to match in a complementary way the shape and arrangement of the gripping seats S of the screwable head T in the tightening closed condition X. Said gripping elements 40 are for example keys, bars, pins, or similar elements, fixed to the support 50 by means of respective known fixing

means, such as for example screws, dowels, joints, vices or the like. Preferably, the gripping elements 40 are of the replaceable type, for example following breakage or wear, and interchangeable, to allow the use of the same device 1 for tightening hydraulic cylinders H having screwable heads T different in size and/or in the type of gripping seats S by simply mounting the appropriate gripping elements 40 on such device 1. Furthermore, the gripping elements 40 are preferably fixed to the support 50 in an adjustable position, in order to allow for a fine adjustment of the gripping elements 40 with respect to their respective gripping seats S and to prolong their operational life as, during use of the device 1, they wear out.

[0016] The torque transmission means 2 comprises a first side wall 10 and a second side wall 20, each preferably having a concave cylindrical wall sector shape with straight longitudinal side edges. In the tightening closed condition X, each side edge of one side wall 10, 20 is parallel to and faces a respective side edge of the other side wall 20, 10, so that the two side walls 10, 20 form a nearly cylindrical hollow wall.

[0017] The first side wall 10 is rigidly fixed, in correspondence with its transversal and semicircular connection end 13, to the joint 31, and has the first guiding element 15 solidly fixed to the opposite gripping end 14 which is also transversal and semicircular.

[0018] The second side wall 20 has, at a gripping end 24 thereof, transversal, semicircular and opposite to the joint 31, the second guiding element 25.

[0019] The major, i.e. external, semicircular curved edge of each guiding element 15, 25 is welded to the respective gripping end 14, 24 of the corresponding side wall 10, 20, and the guiding elements 15, 25 develop in a transverse and centripetal direction with respect to the longitudinal axis A of the device 1.

[0020] The first 10 and second 20 side walls are mutually rotatably constrained by means of a hinge longitudinal pivot 17, defining and oriented along a hinge axis B parallel to the longitudinal axis A and placed at a distance from the latter equal to or slightly greater than the radius of curvature of the side walls 10, 20, and connected to respective longitudinal edges 11, 21 of said side walls 10, 20.

[0021] Consequently, thanks to the longitudinal pivot 17, the second guiding element 25 is hinged to the first 15 and can rotate with respect to it around the hinge axis B between an opened condition O of the device 1, in which the rod P can be positioned between the concavities of the first 15 and second 25 guiding elements, and the tightening closed condition X, in which the gripping elements 40 are arranged to engage with their respective gripping seats S.

[0022] In correspondence with the tightening closed condition X, in particular, the first 15 and second 25 guiding elements are coplanar and mutually side by side, and their respective concavities form an opening 51 for the rod P of the hydraulic cylinder H. In this tightening closed condition X, the support 50 has the shape of an annulus

closed and extending around the rod P allowing for the free rotation and axial sliding of the device 1 with respect to the rod P.

[0023] The hinge longitudinal pivot 17 is connected to the longitudinal edges 11, 21 of the side walls 10, 20 by means of respective arms, slightly protruding, welded to the latter. The arms of the second side wall 20 allow this, in addition to rotating around the hinge axis B, to slide in the longitudinal direction between a condition in which the first 15 and second 25 guiding elements are coplanar and a condition in which they are staggered.

[0024] In the tightening closed condition X, the first 10 and second 20 side walls are mutually locked by means of a locking element 3 provided with two protruding members, each fixed to a corresponding longitudinal edge 12, 22, opposite the longitudinal edge 11, 21 to which the longitudinal pivot 17 is connected, of a respective side wall 10, 20.

[0025] In the condition in which the first 15 and second 25 guiding elements are coplanar, the members of the locking element 3 are mutually constrained not to rotate by means of a longitudinally oriented pin, fixed to one of the two members and slidably inserted into an eyelet or hole of the remaining member, preventing the rotation of the second side wall 20 with respect to the first side wall 10, i.e. preventing the opening of the torque transmission means 2. Alternatively, the locking element 3 provides for a different constraint means, or the members of the locking element 3 are suitably shaped, for example "L" shaped, so that they too can mutually lock and release due to a longitudinal sliding of the second side wall 20 with respect to the first side wall 10.

[0026] The length of the section of the pin protruding from the member to which it is fixed is less than the maximum sliding of the second side wall 20 along the longitudinal pivot 17, that is, less than the maximum distance between the geometric planes on which the first 15 and second 25 guiding elements lie in the condition in which these are staggered.

[0027] In the latter condition, with the device 1 oriented vertically and with the support 50 positioned below, the members of the locking element 3 are freed by gravity from the constraint of reciprocal non-rotation, allowing the opening of the torque transmission means 2 and allowing the separation of the device 1 from the hydraulic cylinder H when, at the end of the screwing, the device 1 is lifted.

[0028] Optionally, several locking elements 3 are fixed along the longitudinal edges 12, 22, to strengthen the mutual locking of the side walls 10, 20.

[0029] Preferably, the device 1 further comprises spacer elements 16 each fixed to the concave, i.e. internal, edge of a respective guiding element 15, 25, with a calibrated thickness such as to prevent the gripping elements 40, in correspondence with the tightening closed condition X, to come into contact with the end of the cylinder C into which the screwable head T is screwed or is being screwed, damaging the cylinder C and/or the

gripping elements 40 themselves. More precisely, the difference between the protrusion of the gripping elements 40 and the spacer elements 16 with respect to the guiding elements 15, 25 is less than the protrusion of the screwable head T of the hydraulic cylinder H with respect to the end of the cylinder C into which it is completely fully screwed tight.

[0030] The internal edges of the spacer elements 16 are circular and concave and, in the tightening closed condition X, these concave edges form a circular opening with a diameter almost equal to or slightly greater than that of the rod P which, during screwing of the screwable head T, slides in that opening. The opening formed by the spacer elements 16 therefore acts as a centering of the device 1 with respect to the rod P and to its respective cylinder C, avoiding excessive friction and backlash. To facilitate the sliding of the rod P through said opening, the spacer elements 16 are preferably made of material with low friction with the rod itself, for example polytetrafluoroethylene.

[0031] As anticipated, the preferred use of the device 1 provides that the device 1 is oriented with the longitudinal axis A vertical and with the joint 31 positioned upwards, then the device 1 is moved, manually by an operator or automatically by a machine, so as to accommodate in its opened condition O the rod P of the hydraulic cylinder H, in turn arranged vertically with the external joint E at the top, for example in the concavity of the first guiding element 15, and so as to simultaneously accommodate part of the external joint E of the hydraulic cylinder H within the concavity of the side wall 10. Subsequently, the remaining side wall 20 is rotated in the closing direction towards the one already placed around the rod P, with the pin and the eyelet of the members of the locking element 3 mutually aligned, and the two first 15 and second 25 guiding elements are brought, for example manually, to coplanarity, realizing the closed condition, with the external joint E completely enclosed within the cavity of the torque transmission means 2 without interfering with the latter. The device 1 is then lowered onto the screwable head T, being guided along the rod P by the circular opening formed by the spacer elements 16, and is angularly oriented, for example manually or by means of the motor, so as to make the gripping elements 40 correspond and engage with their respective gripping seats S, preferably up to the abutment of the spacer elements 16 with the outer face of the free end of the screwable head T, in the tightening closed condition X. At this point the motor means M, connected to the joint 31, sets the device 1 in rotation and carries out the screwing of the screwable head T into the cylinder C. When screwing is complete, the device 1 is pulled upwards from the side of the joint 31, so that the second side wall 20, due to gravity, remains lower with respect to the first side wall 10, freeing itself from the rotation constraint with respect to the latter as soon as the pin of the members of the locking element 3 disengages from its respective eyelet, and leading the device 1 in the opened condition O to

disengage from the screwable head T.

[0032] Some simple variants are described below, the understanding of which does not require specific figures.

[0033] A variant of the device 1 provides that the gripping elements 40 are fixed directly to the gripping ends 14, 24 of the torque transmission means 2, the lower edge of which therefore constitutes the support 50. In this case the first 15 and second 25 guiding elements can be omitted or optionally adopted to facilitate the centering of the device 1 with respect to the rod P and to guide the coupling of the gripping elements 40 with the gripping seats S.

[0034] In another variant of the device 1, the support 50 is rigid and open, for example in the shape of a horse-shoe, so that the rod P can be received in the cavity of the support 50 without interfering therewith and the gripping elements 40 can engage into their respective gripping seats S. The torque transmission means 2, for example having shape equal or similar to that of one of the side walls of the previous embodiments or in the shape of a bracket, beam or arm, also has a lateral opening, or a shape large enough to contain the external joint E.

[0035] A further variant of the device 1 provides that the second guiding element 25 is directly hinged to the first guiding element 15, with the members of the locking element 3 fixed at the opposite end with respect to the axis of rotation of their respective guiding elements 15, 25. In this way the guiding elements 15, 25, optionally with the aid of the spacer elements 16, encircle the rod P in the tightening closed condition X, bringing the advantage, with respect to the previously described variant, of facilitating the axial centering of the device 1 during its positioning on the screwable head T.

Claims

1. Device for tightening a screwable head (T) of a hydraulic cylinder (H) having a cylinder (C) in which a piston slides equipped with a rod (P) with an external joint (E) and slidable through an opening of said screwable head (T), the screwable head (T) having gripping seats (S) at a free end thereof facing in the direction opposite to the center of the cylinder (C); the device (1) being **characterized in that** it comprises:

- an openable support (50) having a plurality of gripping elements (40) assigned to abut respective gripping seats (S) of the screwable head (T);
- a joint (31) assigned to be coupled with a motor means (M) for the rotation of the device (1) around a longitudinal axis (A) of the device itself, coaxial with the joint (31) and coinciding with the axis of symmetry of the screwable head (T), in correspondence with a tightening closed condition (X);
- a torque transmission means (2) to a connec-

tion end (13) of which the joint (31) is fixed and to an opposite gripping end (14, 24) of which the support (50) is fixed, where the torque transmission means (2) is dimensioned in such a way that, in correspondence with the tightening closed condition (X), it does not interfere with the rod (P) nor with the external joint (E) of the hydraulic cylinder (H).

2. Device according to claim 1 **characterized in that** the support (50) comprises first (15) and second (25) guiding elements of concave shape and each having respective gripping elements (40), the second guiding element (25) being at least rotatable with respect to the first guiding element (15) around a hinge axis (B) parallel to and not coinciding with the longitudinal axis (A) between an opened condition (O), in which the rod (P) can be positioned between the concavities of said guiding elements (15, 25), and the tightening closed condition (X), in which the gripping elements (40) are positioned to engage with their respective gripping seats (S).
3. Device according to claim 2 **characterized in that** the first guiding element (15) is solidly fixed to the gripping end (14) of the torque transmission means (2) and the second guiding element (25) is hinged to the first (15).
4. Device according to claim 2 or 3 **characterized in that** in correspondence with the tightening closed condition (X), the guiding elements (15, 25) are mutually side by side and their respective concavities form an opening (51) for the rod (P) of the hydraulic cylinder (H), the gripping elements (40) are engaged in their respective gripping seats (S), and the rotation of the motor means (M) causes the screwing or unscrewing of the head (T).
5. Device according to any one of claims 2-4 **characterized in that** the torque transmission means (2) comprises two side walls first (10) and second (20), where the first side wall (10) is rigidly fixed to the joint (31) and to the first guiding element (15), and the second side wall (20) has at one end thereof the second guiding element (25) which is hinged to the first (15) by means of a hinge longitudinal pivot (17) defining the hinge axis (B) and which rotatably constrains said first (10) and second (20) side walls.
6. Device according to claim 5 **characterized in that** each of the two side walls (10, 20) is shaped as a cylindrical wall sector with straight side edges, and in the tightening closed condition (X) the two side walls (10, 20) form an almost cylindrical wall.
7. Device according to claim 6 **characterized in that** the hinge longitudinal pivot (17) is connected to re-

spective longitudinal edges (11, 21) of the side walls (10, 20).

(50) in an adjustable position.

8. Device according to any one of claims 5-7 **characterized in that** the first (15) and second (25) guiding elements are shaped as an annulus sector with the major curved edge joined with a respective gripping end (14, 24) of the corresponding first (10) or second (20) side wall. 5
10
9. Device according to any one of claims 5-8 **characterized in that** it comprises at least one locking element (3) provided with two members each fixed to a corresponding longitudinal edge (12, 22), opposite to the longitudinal edge (11, 21) to which the longitudinal pivot (17) is connected, of a respective side wall (10, 20), such members being fit, at least in the tightening closed condition (X), to mutually lock the side walls (10, 20). 15
20
10. Device according to claim 9 **characterized in that** the hinge longitudinal pivot (17) is connected to respective longitudinal edges (11, 21) of the side walls (10, 20) by means of arms which allow the second side wall (20) to slide between a condition in which the first (15) and second (25) guiding elements are coplanar and one in which they are staggered, with the members of the locking element (3) which in said coplanar condition are mutually constrained, preventing the opening of the torque transmission means (2), and which in said staggered condition and in a vertical orientation of the device (1) with the support (50) positioned below mutually disengage by gravity allowing the opening of said torque transmission means (2) and allowing the separation of the device (1) from the hydraulic cylinder (H). 25
30
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11. Device according to any one of claims 2-10 **characterized in that** it further comprises spacer elements (16) each fixed to the concave edge of the guiding elements (15, 25) or near to it, with calibrated thickness to prevent the gripping elements (40), in correspondence with the tightening closed condition (X), to come into contact with the end of the cylinder (C) into which the screwable head (T) is screwed, and/or **in that** the internal edges of the spacer elements (16) are semicircular and concave and, in the tightening closed condition (X), such concave edges form a circular opening with a diameter almost equal to or slightly greater than that of the rod (P) which, during screwing, slides in such opening, with the latter acting as a centering of the device (1) with respect to the rod (P) and to its respective cylinder (C). 40
45
50
12. Device according to any one of the preceding claims **characterized in that** the gripping elements (40) are replaceable and/or interchangeable, and/or **in that** the gripping elements (40) are fixed to the support 55

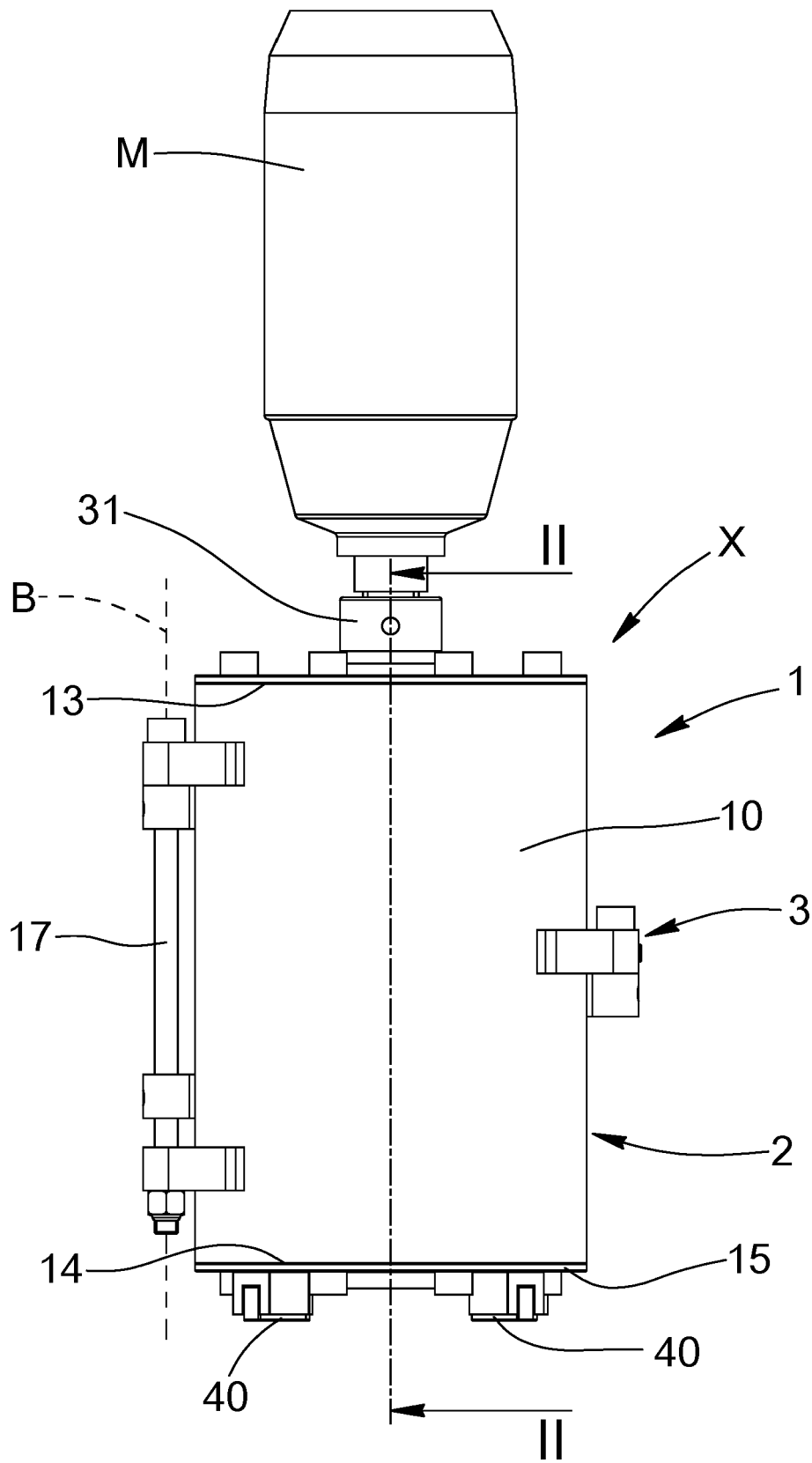


FIG.1

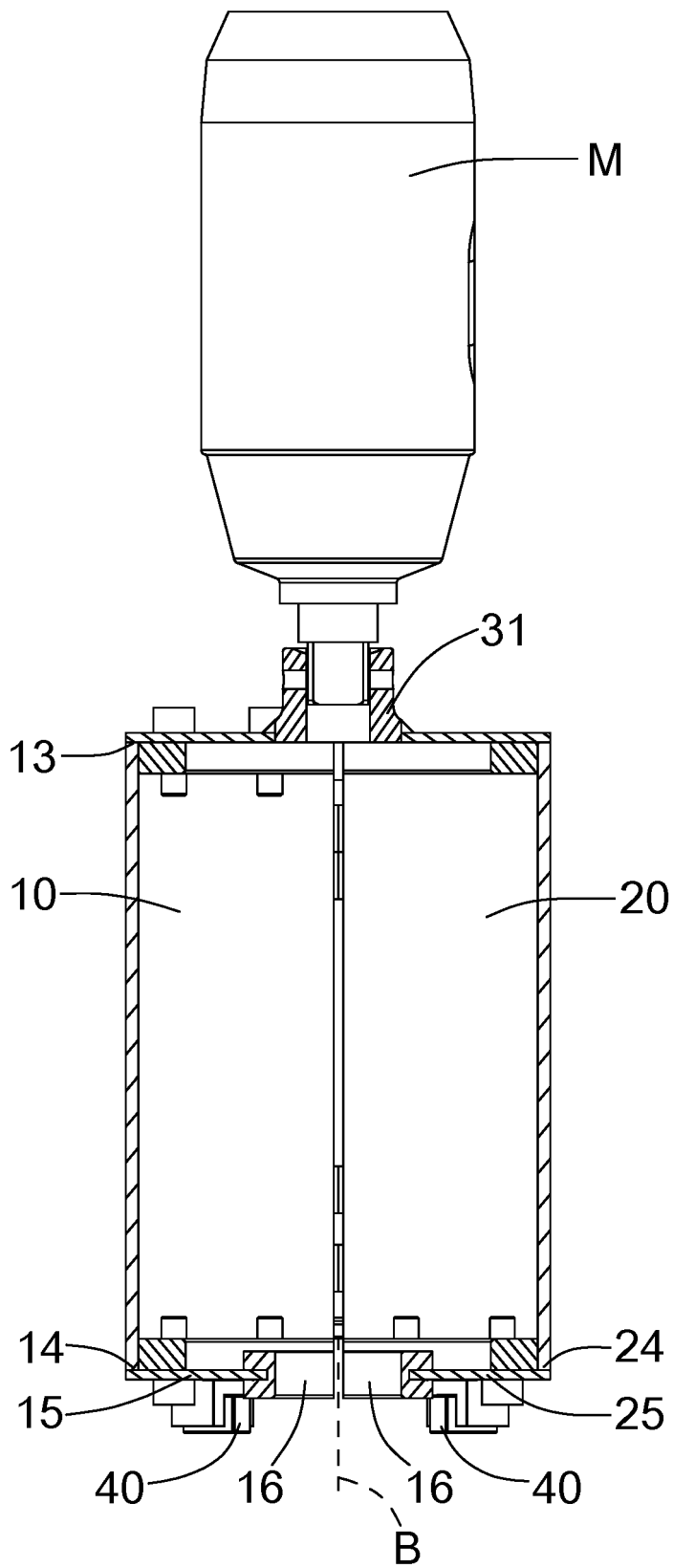


FIG.2

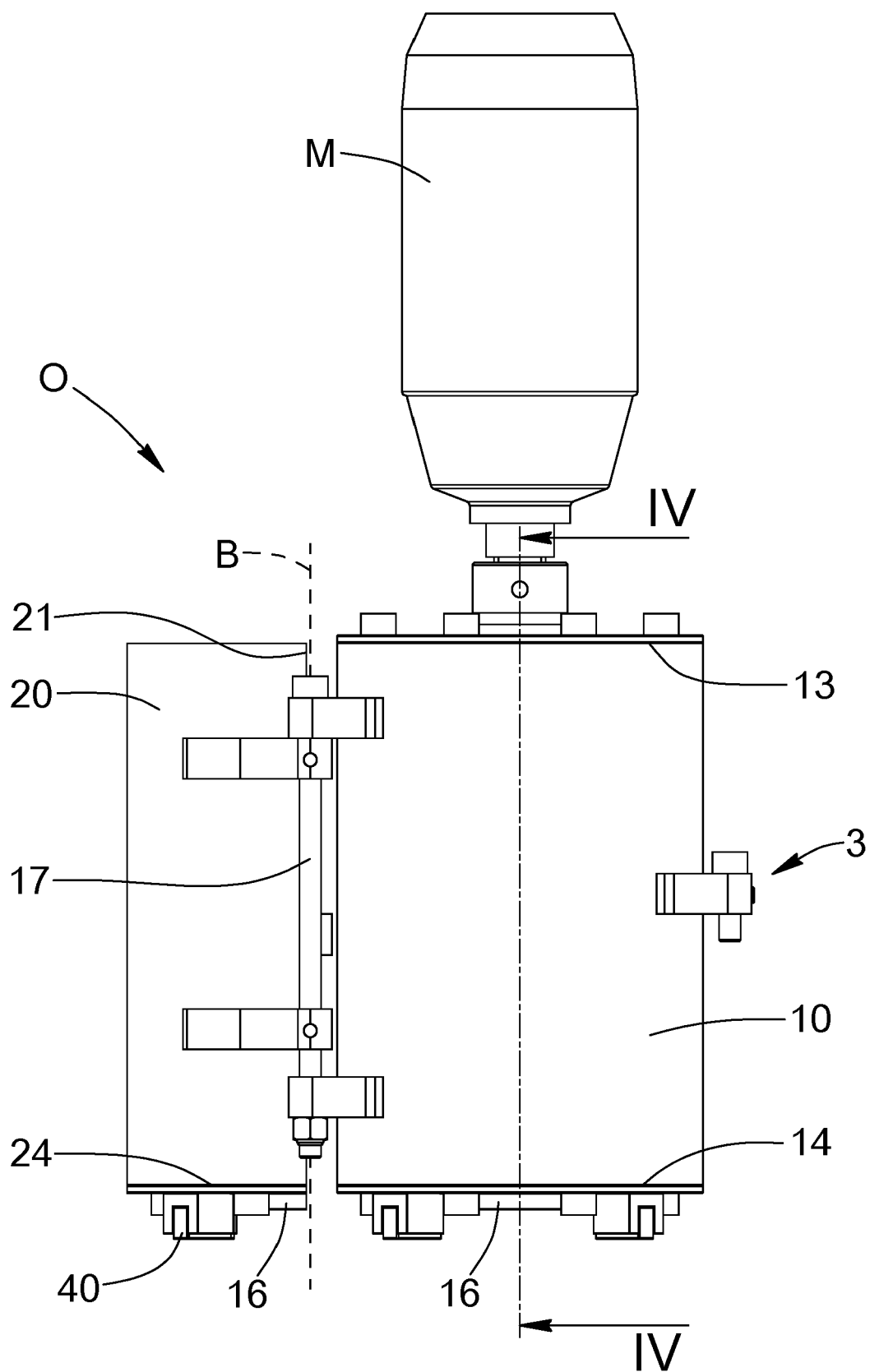


FIG.3

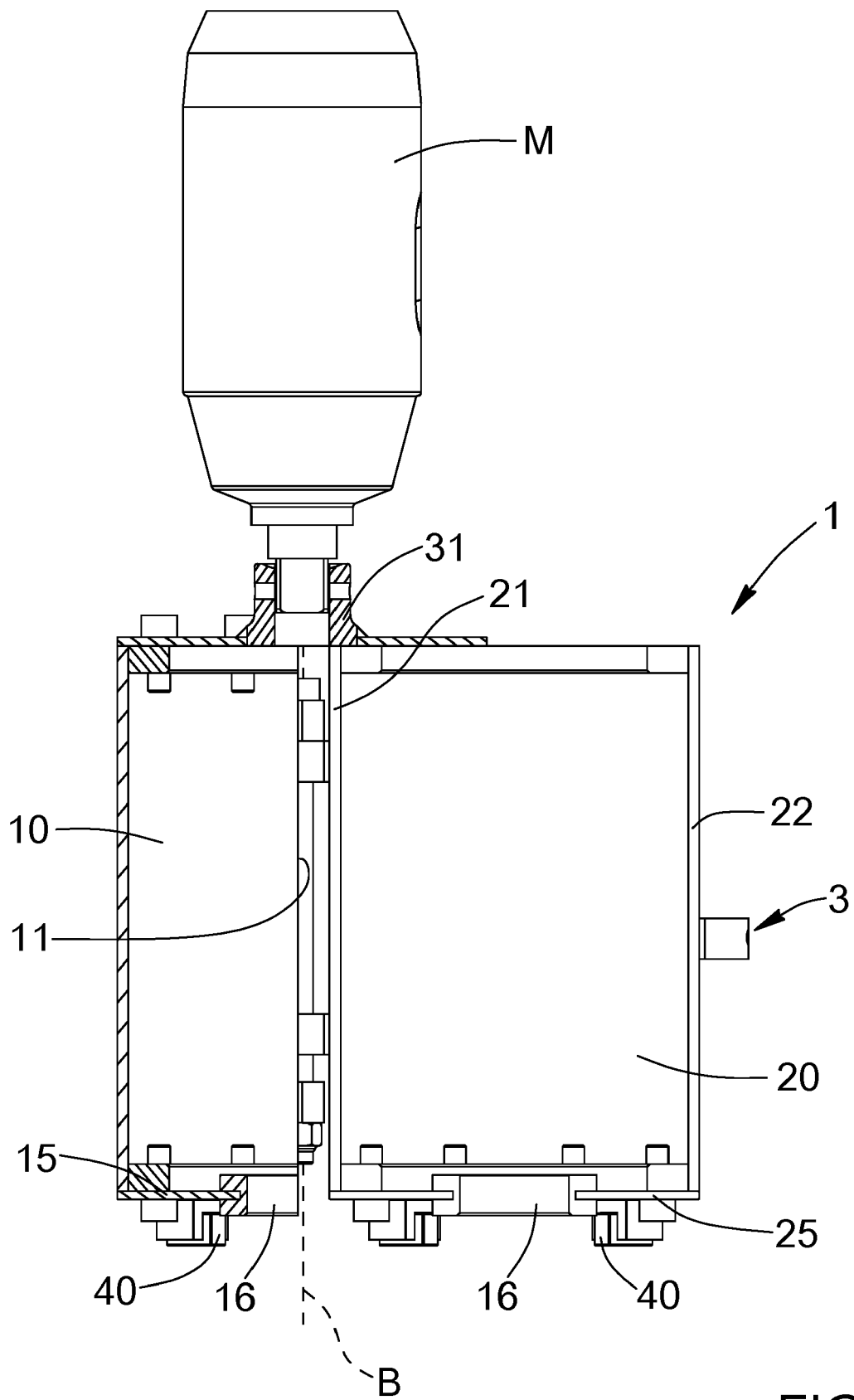


FIG. 4

FIG.5

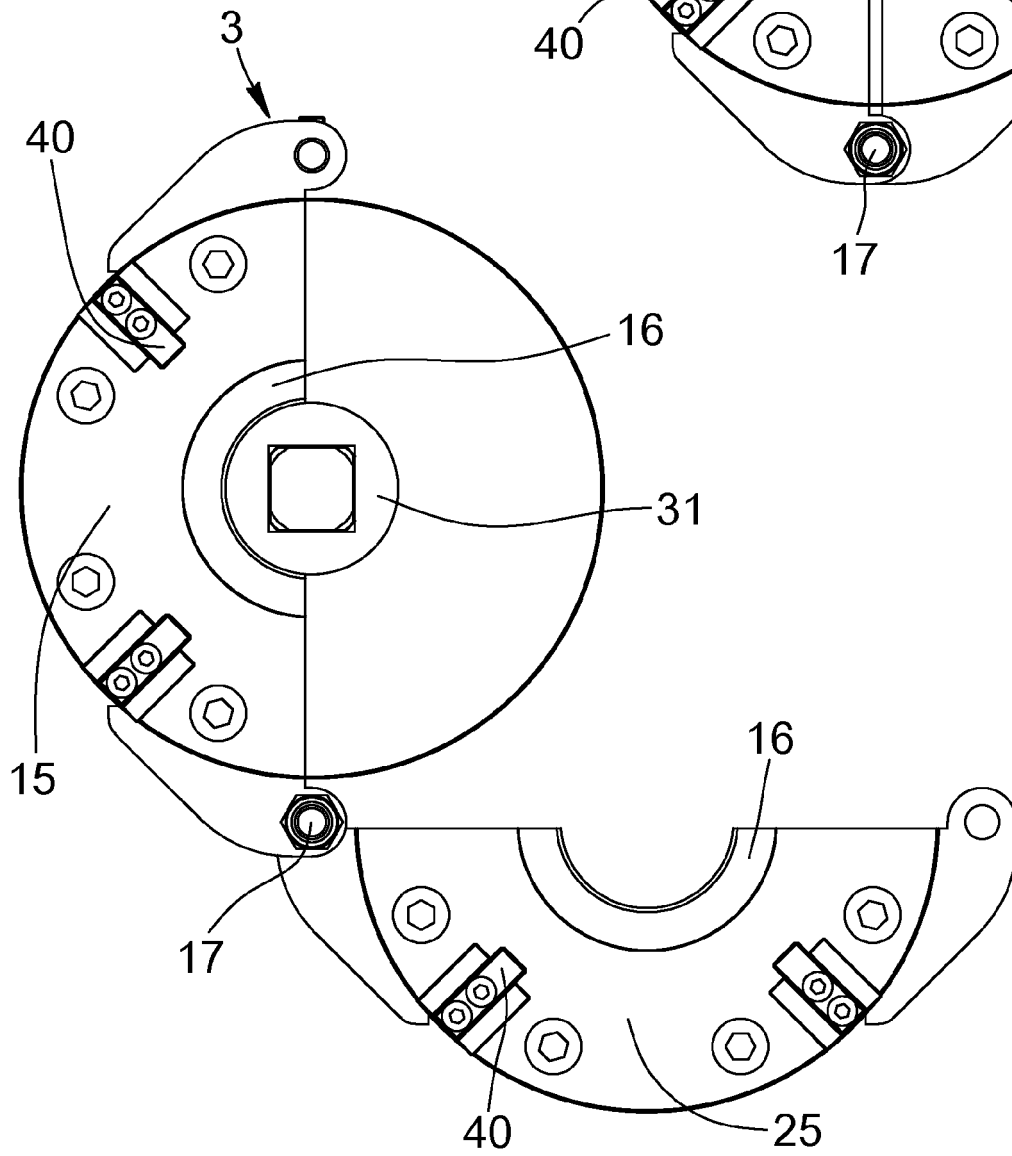
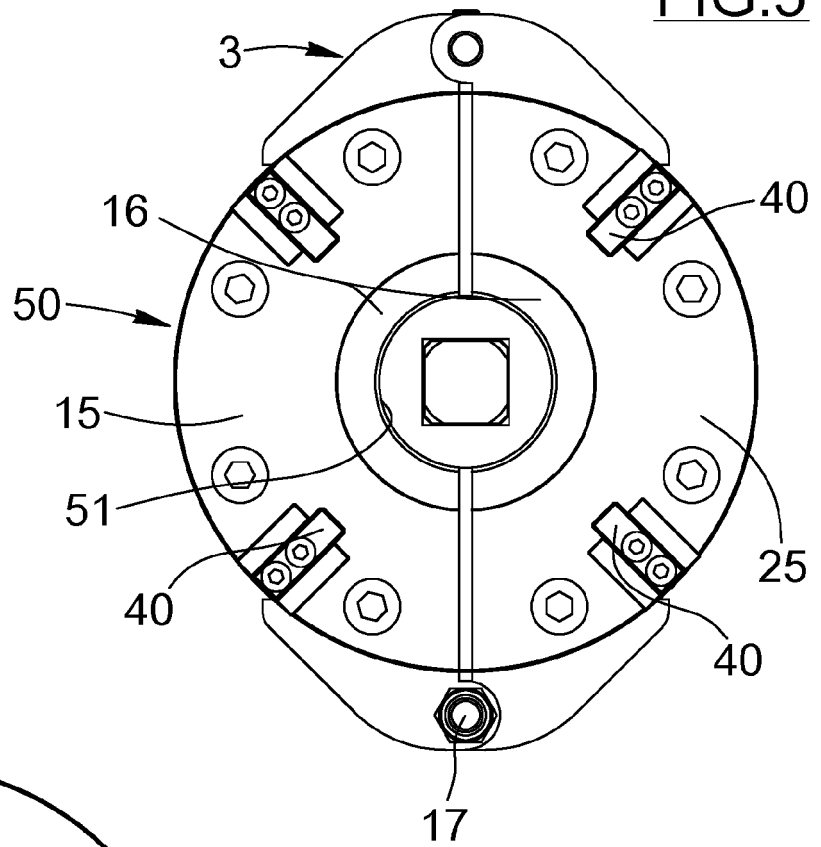


FIG.6

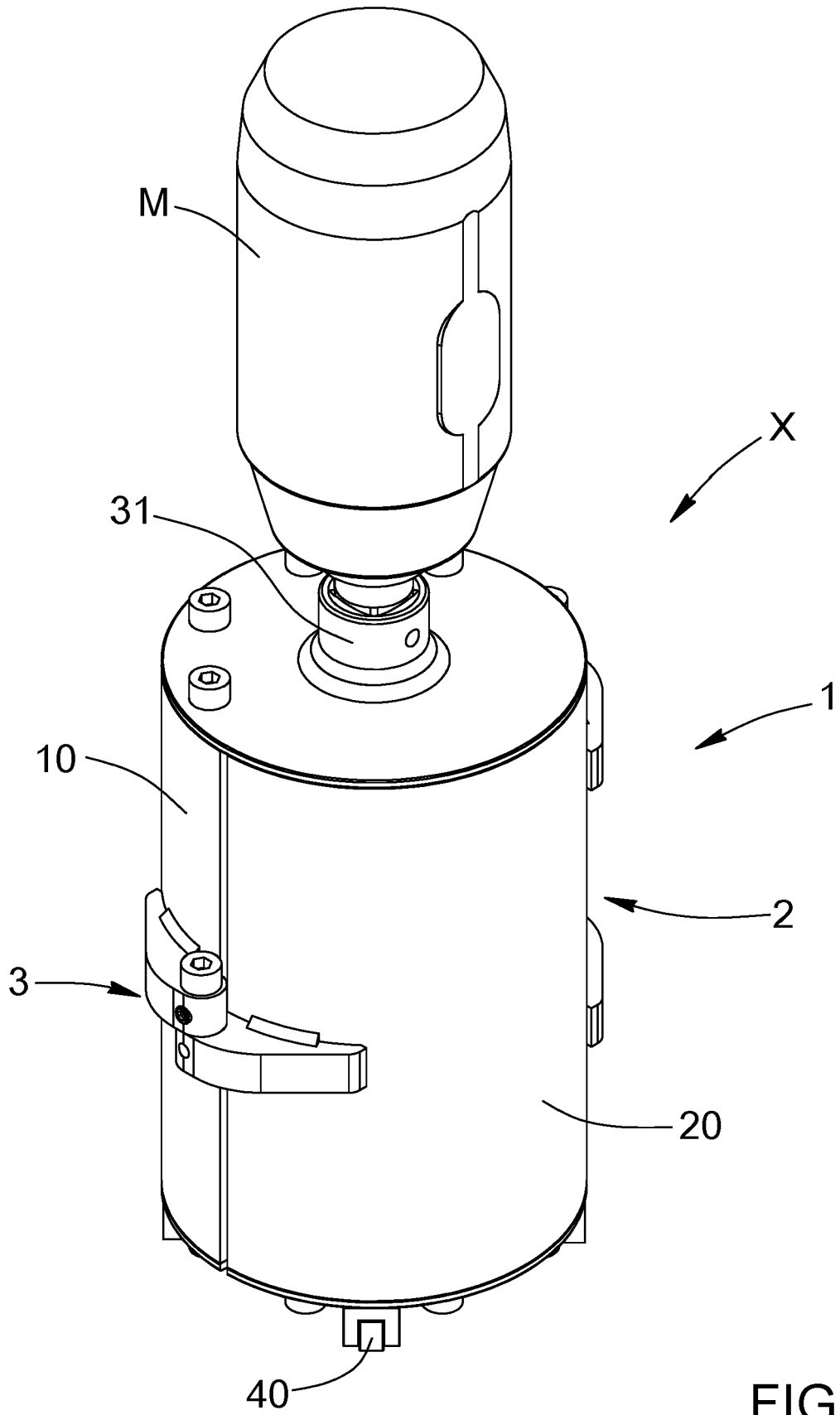


FIG.7

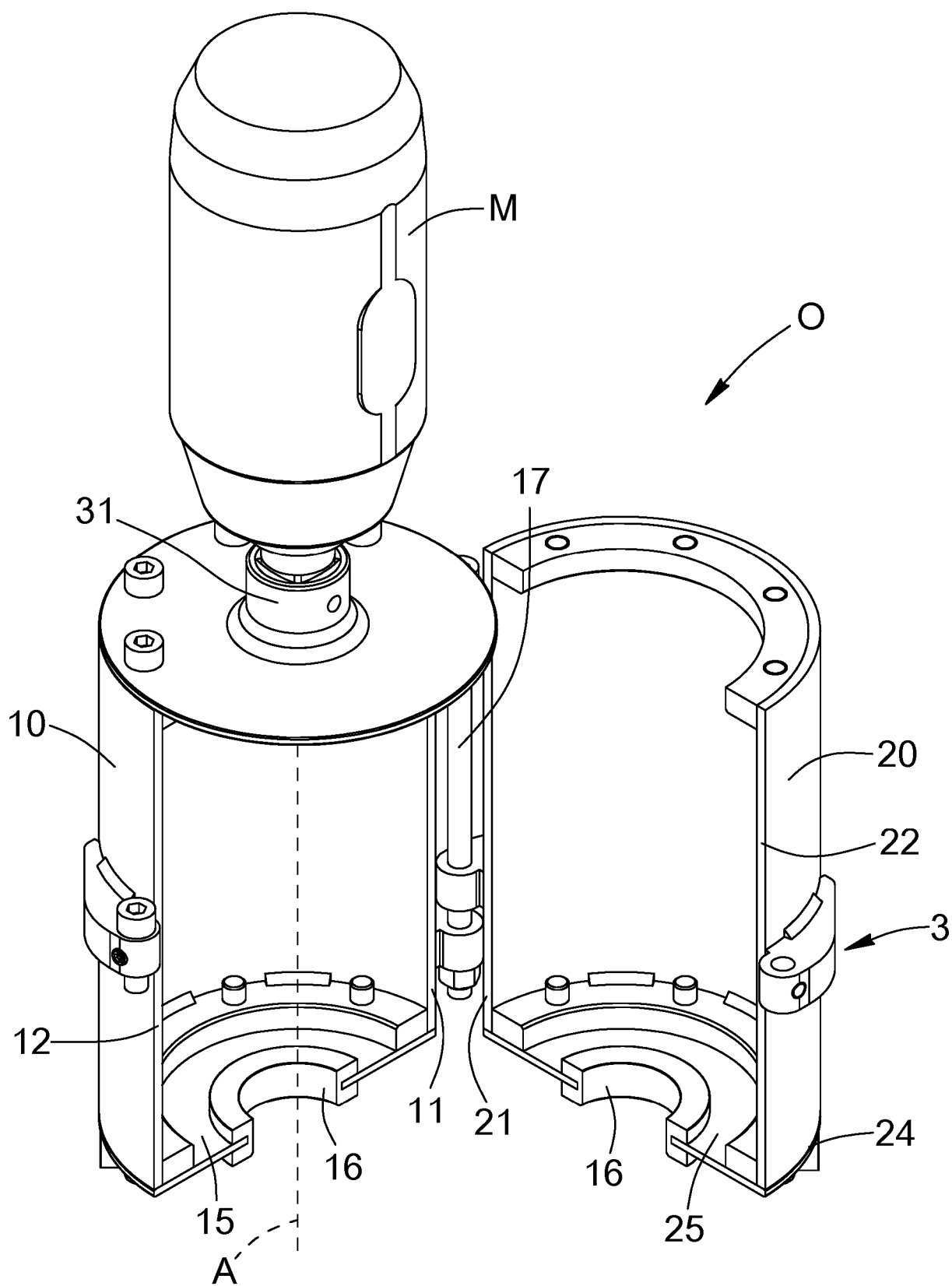


FIG.8

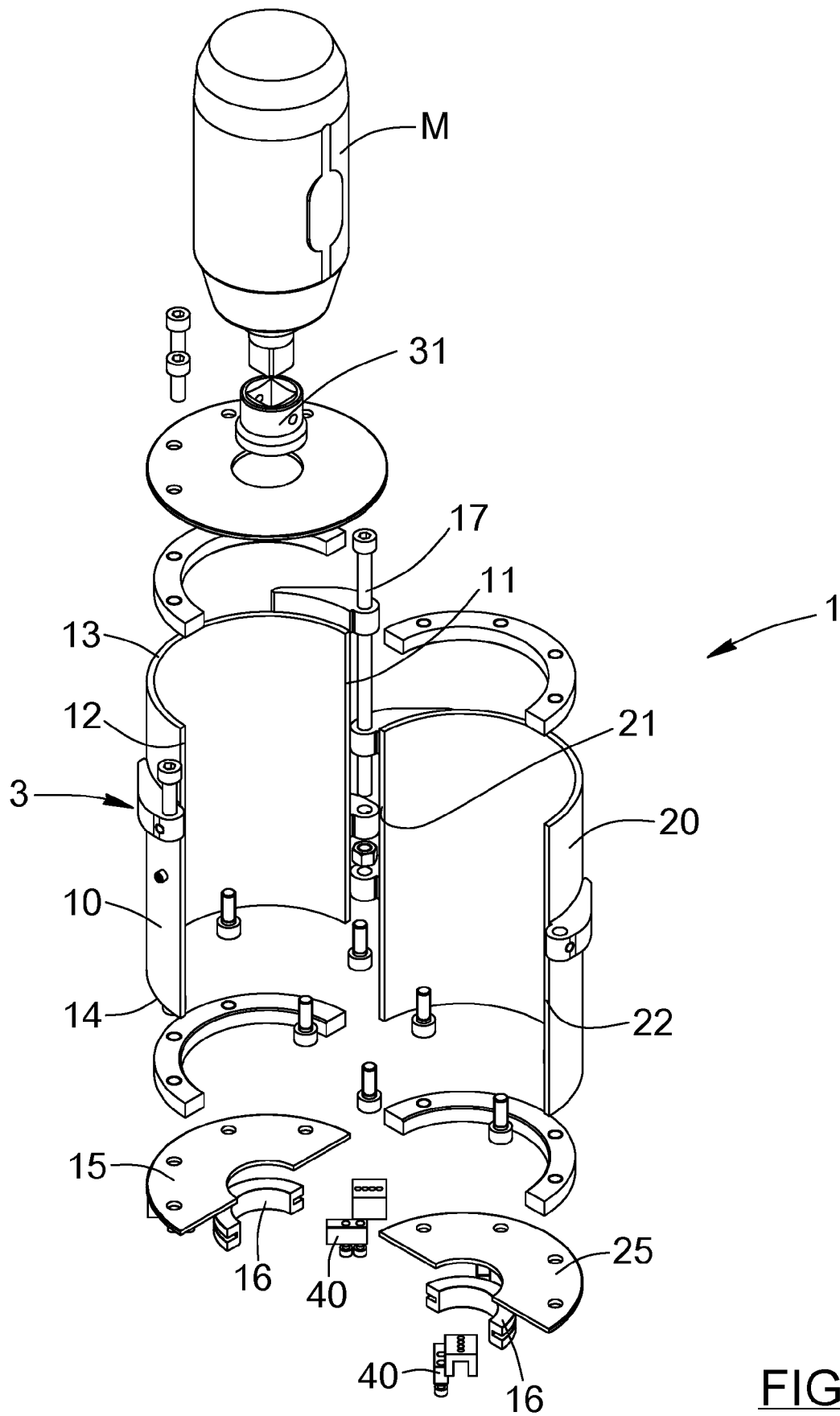


FIG.9

FIG.10

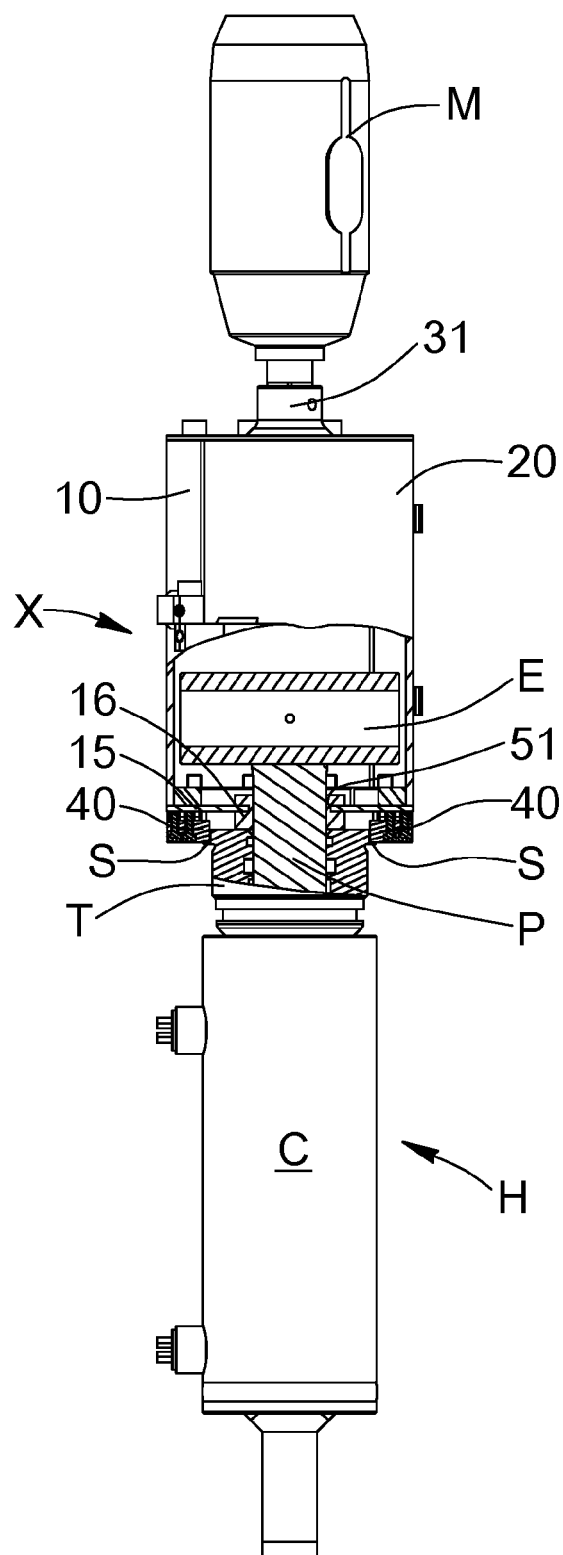
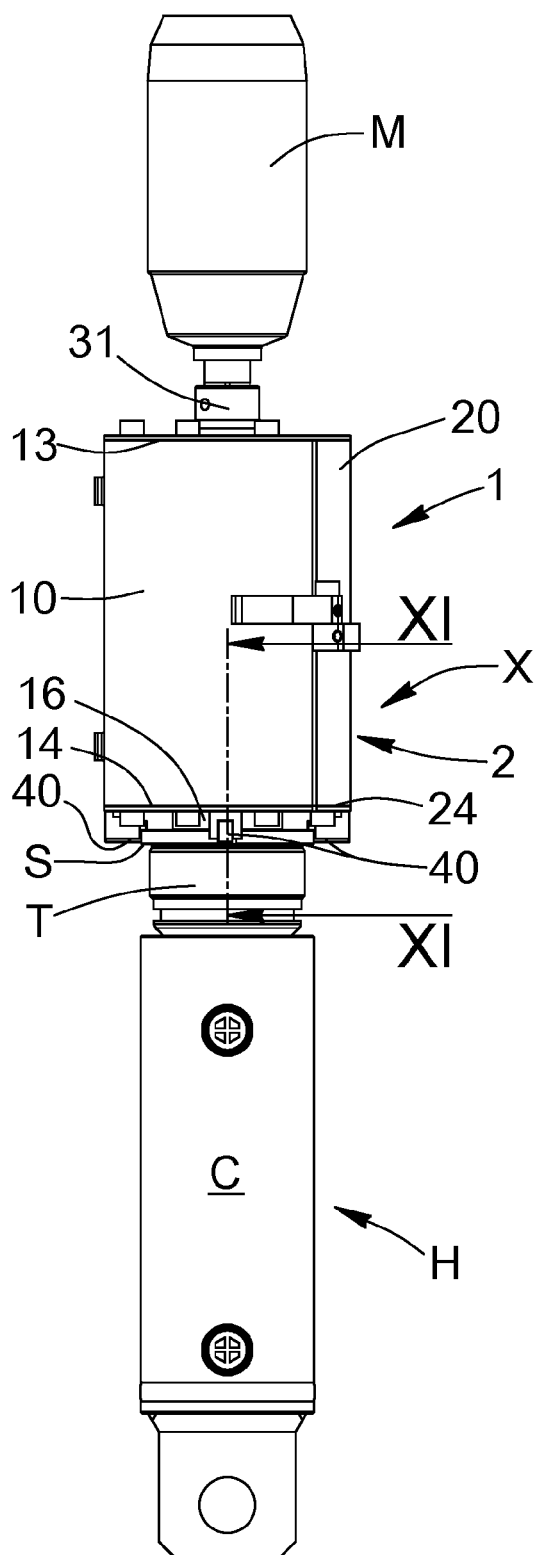


FIG.11

FIG.12

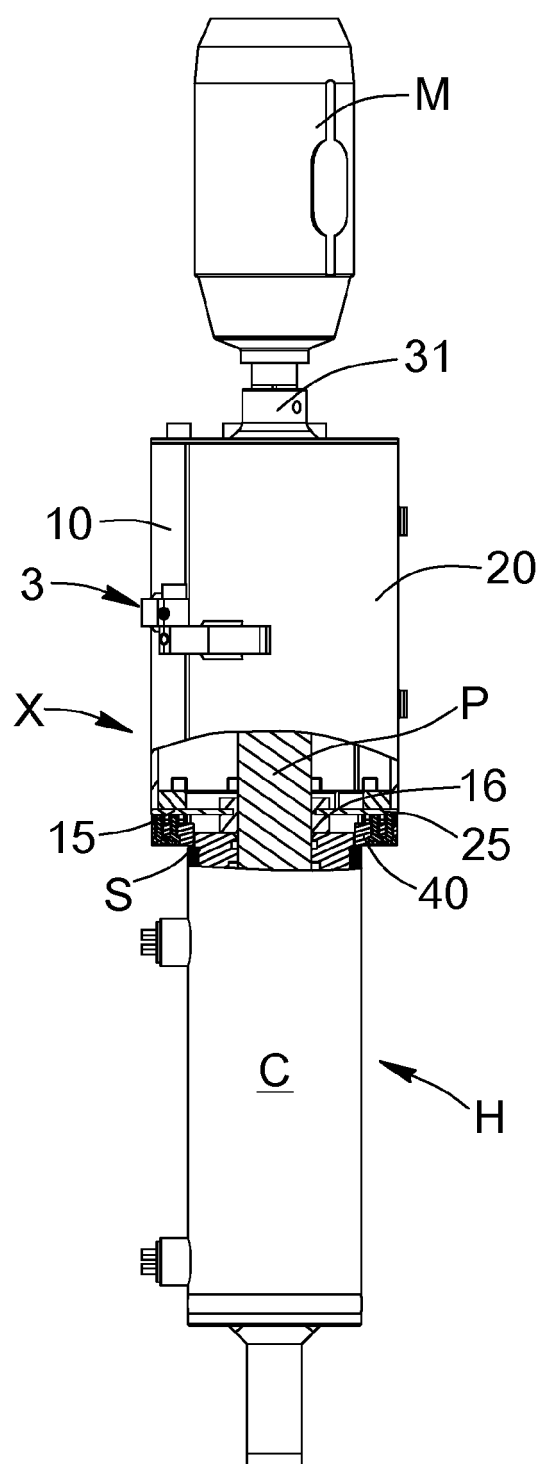
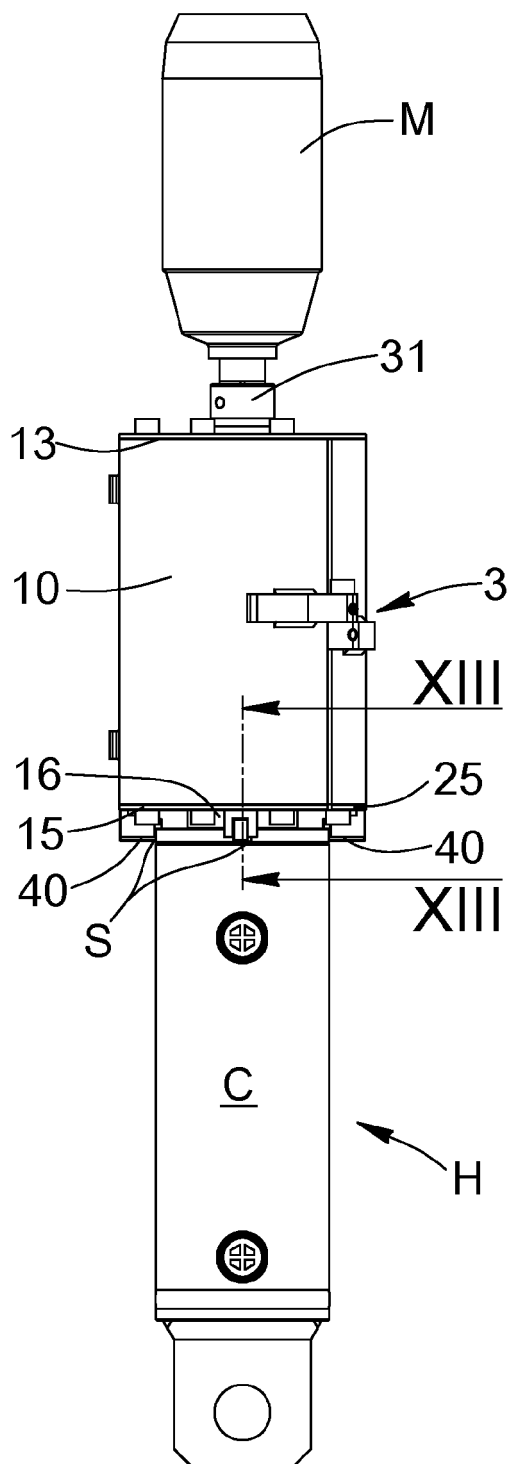


FIG.13



EUROPEAN SEARCH REPORT

Application Number

EP 23 16 6623

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	WO 2018/017007 A1 (LUNDIN-FLODIN INNOVATION AB [SE]) 25 January 2018 (2018-01-25) * page 4 - page 9; figures 1-12 * -----	1-12	INV. B25B13/50 F15B15/14
A	DE 10 2011 018465 A1 (LABOMATIC INSTR AG [CH]) 25 October 2012 (2012-10-25) * abstract; figures 1A, 1B * -----	1-12	
A	US 2011/226097 A1 (ATTEBURY RANDAL L [US] ET AL) 22 September 2011 (2011-09-22) * abstract; figure 6 * -----	1	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (IPC) B25B

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EPO FORM 1503 03.82 (P04C01)

Place of search The Hague	Date of completion of the search 26 July 2023	Examiner Pothmann, Johannes
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**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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26-07-2023

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