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(54) Fluid cylinder, preferably for actuating a grab bucket

(57) An actuator device (8), in particular for an orange-peel bucket (1), having a support (9), a hydraulic jack (10) provided with a liner (15) and a rod (18) movable along an actuating axis (19), and a joint (24) hinging in the jack (10) to the support (9); the joint (24) is provided with inner passages to feed oil to the jack (10) without outer flexible pipes.

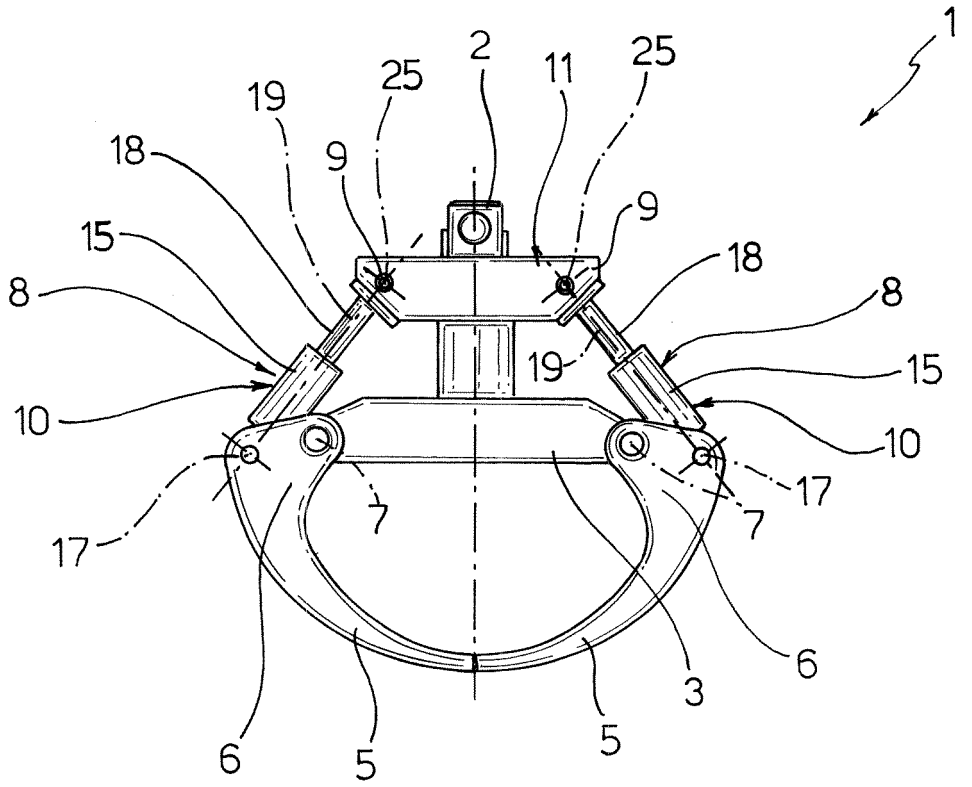


Fig.1

EP 1 688 546 A2

Description

[0001] The present invention relates to an actuator device, particularly for an orange-peel bucket.

[0002] As known, a lot of hydraulically operated machines are equipped with hydraulic actuators. For example, the booms of excavators, loaders and cranes mounted on trucks may be equipped with orange-peel buckets, for loading, raising and moving material: they comprise a plurality of shovels, whose upper ends are hinged to a central supporting column and turn above respective horizontal axes under the action of respective hydraulic jacks between an open position and a closed position.

[0003] The jacks are hinged to the central supporting column, or to another support, so as to turn during the opening and the closing of the shovels and are fed with pressurised oil by means of flexible pipes which are fastened, at their ends, to the liners of the jacks themselves.

[0004] The known solutions described here are not very satisfactory, because the oil feeding pipes are relatively cumbersome, hinder the assembly of possible jack protection panels, and cause assembly complexity of the orange-peel bucket because they require a layout so as to ensure deformation during operation and, consequently, rotation of the jacks, without the curvature ratio of the pipes themselves falling under a predetermined minimum value.

[0005] Furthermore, the oil feeding pipes are relatively close to the orange-peel bucket shovels, consequently relatively high risks of accidental breakage of the pipes themselves during loading, transporting and unloading operations of the material exist. With this regard, standards impose to envisage, downstream of the pipes, automatic protection valves which close the oil outlets from the jacks if pressure drops due to leakage of oil from the pipes, so as to maintain in fixed position the jacks themselves and, therefore, the shovels to prevent falling of material from the orange-peel buckets and to safeguard the safety of the surrounding working environment. Such automatic stop valves, however, are undesirable because they introduce localised loss of load in the oil flow from and to the jacks during normal operative conditions, with consequent and undesired increase of temperature of the oil itself.

[0006] It is the object of the present invention to provide an actuator device, in particular for an orange-peel bucket, which allows to simply and cost-effectively solve the aforementioned problems.

[0007] According to the present invention, it is made an actuator device, in particular for an orange-peel bucket, as defined in claim 1.

[0008] The invention will now be described with reference to the accompanying drawings illustrating a non-limitative embodiment example, in which:

- figure 1 is a lateral schematic view of an orange-peel bucket provided with a preferred embodiment of the actuator device according to the present invention;
- figure 2 schematically shows on a magnified scale and in cross-section according to a vertical section plane, the actuator device of the orange-peel bucket of figure 1;
- figure 3 is similar to figure 2 and shows a variant of the actuator device of figure 1; and
- figures 4 and 5 are related to further variants of the actuator device of figure 2, schematically shown in cross-section according to a section plane orthogonal to the vertical section plane of figures 2 and 3.

[0009] In figure 1, number 1 shows an orange-peel bucket adapted to be fitted to the end of an operative boom of an earth-moving machine or other machine (not shown) and comprising a vertical central support column 2 which ends with a lower plate 3.

[0010] The orange-peel bucket 1 comprises a plurality of shovels 5, whose upper ends 6 are hinged to the plate 3 about respective horizontal axes 7 to turn between an open position and a closed position. The opening/closing rotation is caused, for each shovel 5, by a respective actuator device 8, which comprises a supporting and attaching portion 9 to column 2 and to a hydraulic jack 10.

[0011] With reference to figures 1 and 2, the portions 9 of the devices 8 constitute part of a flange 11 fitted axially to the column 2 in fixed position, and each has a respective pair of channels 12,13, which extend radially from an inner cylindrical surface 14 of the flange 11, where they communicate with the respective distribution channels (not shown) made in column 2 to allow the input/output of oil flows from/to the respective jack 10 under the control of an earth-moving machine hydraulic system (not shown).

[0012] Each jack 10 comprises a liner 15 having an bottom end 16 hinged to the respective shovel 5 about a horizontal axis 17 (figure 1); and a rod 18 extending along an axis 19 orthogonal to axis 17. The liner 15 accommodates a piston 20, which is integrally connected to the inner end of the rod 18 and reciprocally, axially and fluid-tightly separates a chamber 21, defined on end 16, and a chamber 22, which accommodates part of the rod 18.

[0013] The outer end of the rod 18, indicated by reference number 23, is coupled to the respective portion 9 by means of a joint 24 to turn with respect to the flange 11 about a horizontal axis 25 parallel to the axis 17 (figure 1) during the opening/closing rotations of the respective shovel 5. In particular, the joints 24 are spherical to compensate for possible twisting actions on the shovels 5, allowing freedom of rotation of the rods 18 with respect to the flange 11 about axes also different from the axes 25.

[0014] Each joint 24 comprises a spherical head 26 integrally connected to the end 23 and a spherical seat 27, which is engaged by the fluid-tight head 26 by means of seal rings 60,61, has an inlet slot 28 crossed with end clearance 23, and is defined by two bodies 29,30 having essentially cylindrical outer shape. The bodies 29,30 are

coupled to the fluid-tight position 9 by means of seal rings 62,63, are fastened by means of screws (not shown) coupled to a terminal flange of the body 29 and fastened to the portion 9, and are abutly and reciprocally coupled, by interposition of the ring 61, along a flat surface 31 orthogonal to axis 32 of the slot 28, so that the slot 28 is entirely made inside the body 29.

[0015] The joint 24 and the rod 18 have a channelling 33 adapted to put into communication the channels 12,13 with the chambers 21,22 and comprising a cylindrical passage 35, which is made along the axis 19 in the head 26 and in the rod 18 and accommodates in fixed position a coaxial rigid tube 36. The tube 36 radially and fluid-tightly separates an inner conduit 37 from a coaxial annular conduit 38: the conduit 37 communicates with the chamber 21, extends to the axial end of the head 26 and communicates with the channel 12 through a hole 39 made in the body 30 and coaxial with the slot 28; while the conduit 38 is closed, with respect to the chamber 21, by a bushing 40 screwed in the passage 35, communicates with the chamber 22 through a radial hole 41 in the rod 18 and communicates with the channel 13 through two holes 42,43 made in the head 26 and, respectively, in the body 30 in radial directions with respect to the axes 19 and, respectively, 32. The holes 42,43 lead along the coupling surface between the head 26 and the seat 27 with respective openings which have dimensions and/or profiles so as to be permanently in reciprocal communication regardless of the rotation angle of the rod 18 with respect to the portion 9. The considerations presented above for the holes 42,43, obviously, similarly apply to the hole 39 and the conduit 37.

[0016] The opening of a shovel 5 is caused by axially protruding the rod 18 with respect to the liner 15 letting into the chamber 21 a flow of pressurised oil from the distribution channels of the column 2 through the channel 12, the hole 39 and the conduit 37, and letting oil out of the chamber 22 towards such distribution channels through the hole 41, the conduit 38 and the holes 43,42. Obviously, the closing of the shovel 5 is caused by opposite flows of oil than above.

[0017] Figures 3 and 4 illustrate respective variants of the device 8, whose components are shown where possible using the same reference numbers used in figure 2.

[0018] The variant in figure 3 differs from that shown in figure 2 essentially in that the jack 10 is tipped. Indeed, the end 16 comprises an outer appendix which is integrally connected to the head 26 and extends with clearance through the slot 28; the end 23 is hinged to the shovel 5 about the axis 17 in a way not shown; and the channelling 33 is made in the joint 24 and in the end 16. In particular, the hole 41 leads outside the end 16, and is put into communication with the chamber 22 through a rigid tube 45 by the side of the liner 15 and through a radial hole 46 made in the liner 15 itself between the tube 45 and the chamber 22. According to an alternative not shown, the tube 45 is replaced by a gap made directly in the side wall of the liner 15.

[0019] The variant in figure 4 differs from that shown in figure 2 for the following features.

[0020] The bodies 29,30 are replaced by bodies 29a, 30a abutly and reciprocally coupled along a flat surface 31a orthogonal to the axis 25, so that the slot 28 is made half in the body 29a and half in the body 30a. The conduits 37,38 are replaced by holes 37a,38a, which are made in the rod 18 along axes reciprocally distanced and parallel to the axis 19, and end with respective L segments 48,49 leading to the head 26 in reciprocally and diametrically opposite positions. Furthermore, the holes 39,43 are replaced by respective channels 39a,43a made in the bodies 29a and 30a, respectively, and comprise respective end segments 52, which are made along the axis 25, and lead along the spherical surface of the seat 27 with openings having dimensions and/or profiles so as to remain permanently in communication with the segments 48,49, regardless of the angle of rotation of the rod 18 with respect to the portion 9.

[0021] Figure 5 shows a further variant of the device 8, whose components are shown using the same reference numbers used in figures 3 and 4. Indeed, in brief, the variant of figure 5 is a combination of the features shown in figures 3 and 4, therefore is not described in detail to avoid making the present description dull.

[0022] From the above it is evident how the device 8 is not very cumbersome, because the oil feeding conduits cross the joint 24 and, consequently, no outer flexible pipes are needed. Again, thanks to the absence of flexible pipes, it is possible to relatively and simply fit a protective panel of jack 10 and no complex assembly operations are required to determine a particular layout of the pipes themselves.

[0023] Furthermore, the channelling 33, being closed in the joint 24 and in the end 16 or 23 (except the possible tube 45, which however has a rigid wall), is protected from the outside environment during material loading and transporting operations, so that the device 8 has very low risks of breakage and oil leakage, and therefore high degrees of reliability and safety. Thanks to the degree of safety reached, no automatic stop valves which close the oil outlets from the chambers 21,22 in the event of pressure drops and which would cause undesired increases of oil temperature are required.

[0024] The device 8 and, in particular, the channelling are relatively simple to make, while slot 28 in the bodies 29a,30a is simple to make and entails a limited weakening of the bodies 29a,30a themselves.

[0025] Finally, from the above, it is apparent that changes and variations can be applied to the described device 8 without departing from the scope of protection of the present invention.

[0026] In particular, the device 8 may be used for members other than the orange-peel bucket 1, for example to operate the rotation of the operative boom of an earth-moving machine, or for hydraulic crane jacks, or in fields different from that of constructions, for example to actuate aircraft landing gear; and/or the jack 10 may be fed

with a fluid other than oil; and/or the joint 24 may be cylindrical instead of spherical; and/or the seat 27 and the head 26 may be carried by the jack 10 and by the supporting portion 9, respectively.

Claims

1. An actuator device (8), in particular for an orange-peel bucket (1), comprising:

   - supporting means (9),
   - a jack (10) operable by means of a operating fluid and comprising a liner (15) and a rod (18) movable with respect to said liner (15) along an actuating axis (19);
   - a joint (24) for coupling the axial end (23, 16) of either said rod (18) or said liner (15) to said supporting means (9) turnably about at least one rotation axis (25);
   - channelling means (33) for feeding said operative fluid to said jack (10);

   characterised in that said channelling means (33) comprise at least one passage made through said joint (25).

2. A device according to claim 1, **characterised in that** said joint (24) comprises a head (26) integral with either said axial end (16,23) or said supporting means (9), and a seat (27) engaged by said head (27) and integral with the other of said axial end (16,23) and said supporting means (9); said passage comprising a first and a second hole (42,43) leading along a coupling surface between said head (26) and said seat (27) with openings having dimensions and/or profile so as to be permanently in reciprocal communication regardless of the rotation of said jack (10) with respect to said supporting means (9).

3. A device according to claim 2, **characterised in that** said seat (27) has an input opening (28); said second hole (39) being coaxial with said input opening (28).

4. A device according to claim 2, **characterised in that** said second hole (52) is made along the rotation axis (25).

5. A device according to any of the preceding claims, **characterised in that** said channelling means (33) comprise at least one conduit (37,38,37a,38a) made axially in said axis end (16,23) parallelly to said actuating axis (19).

6. A device according to claim 5, **characterised in that** said channelling means (33) comprises two conduits (37,38) made in said axial end (16,23), reciprocally and coaxially, communicating with respective chambers (21,22) of said jack (10).

7. A device according to claim 6, **characterised in that** said conduits (37,38) are radially and fluid-tightly separated by a cylindrical insert (36) accommodated in fixed position in said axial end (16,23).

8. A device according to claim 5, **characterised in that** said channelling means (33) comprise two conduits (37a,38a) made in said axial end (16,23) along reciprocally distanced and parallel axes, communicating with respective chambers (21,22) of said jack (10), and ending with respective L segments (48, 49) which lead from said head (26) in reciprocally diametrically positions.

9. A device according to any of the preceding claims, **characterised in that** said joint (24) is carried by the axial end (16) of said liner (15); and **in that** said channelling means (33) comprise a rigid wall conduit (45), communicating with said passage and carried by said liner (15).

10. A device according to claim 9, **characterised in that** said rigid wall conduit is defined by a rigid tube (45) arranged by the side and integrally connected to said liner (15).

11. A device according to claim 9, **characterised in that** said rigid wall conduit is defined by a gap made in the side wall of said liner (15).

12. A device according to claim 2, **characterised in that** said seat (27) is defined by a first and by a second housing body (29a,30a) abutly reciprocally coupled and having an inlet opening (28) made in part of said first housing body (29a) and part in said second housing body (30a).

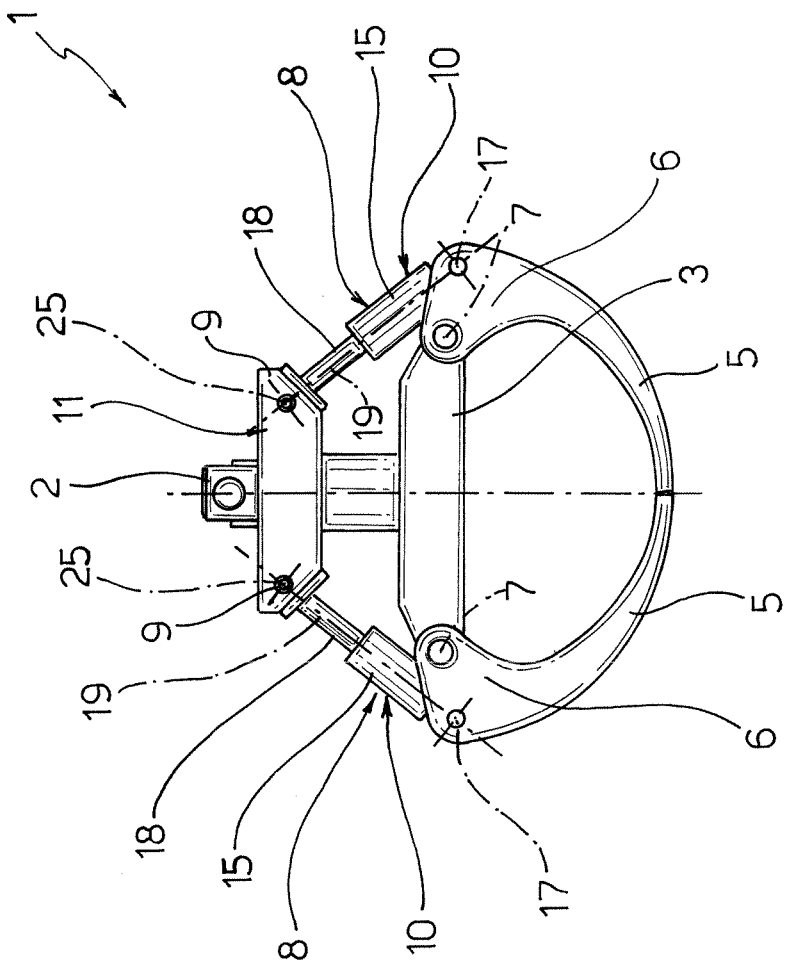
13. An orange-peel bucket (1) comprising a supporting column (2), a plurality of shovels (5) turnable with respect to said supporting column (2) between an opening position and a closing position, and, for each of said shovels (5), a respective hydraulic actuating device (8) comprising:

   - supporting means (9) fixed with respect to said supporting column (2),
   - a hydraulic jack (10) comprising a liner (15) and a rod (18) movable with respect to said liner (15) along an actuating axis (19) to turn said shovel (5);
   - a joint (24) for coupling the axial end (16,23) either said rod (18) or said liner (15) to said supporting means (9) turnably about at least one rotation axis (25);
   - channelling means (33) for feeding oil to said jack (10);

characterised in that said channelling means (33) comprise at least one passage made through said joint (24) .

14. An orange-peel bucket according to claim 13, **characterised in that** said channelling means (10) comprise distribution channels made in said supporting column (2) and communicating with said passages.

Fig.1



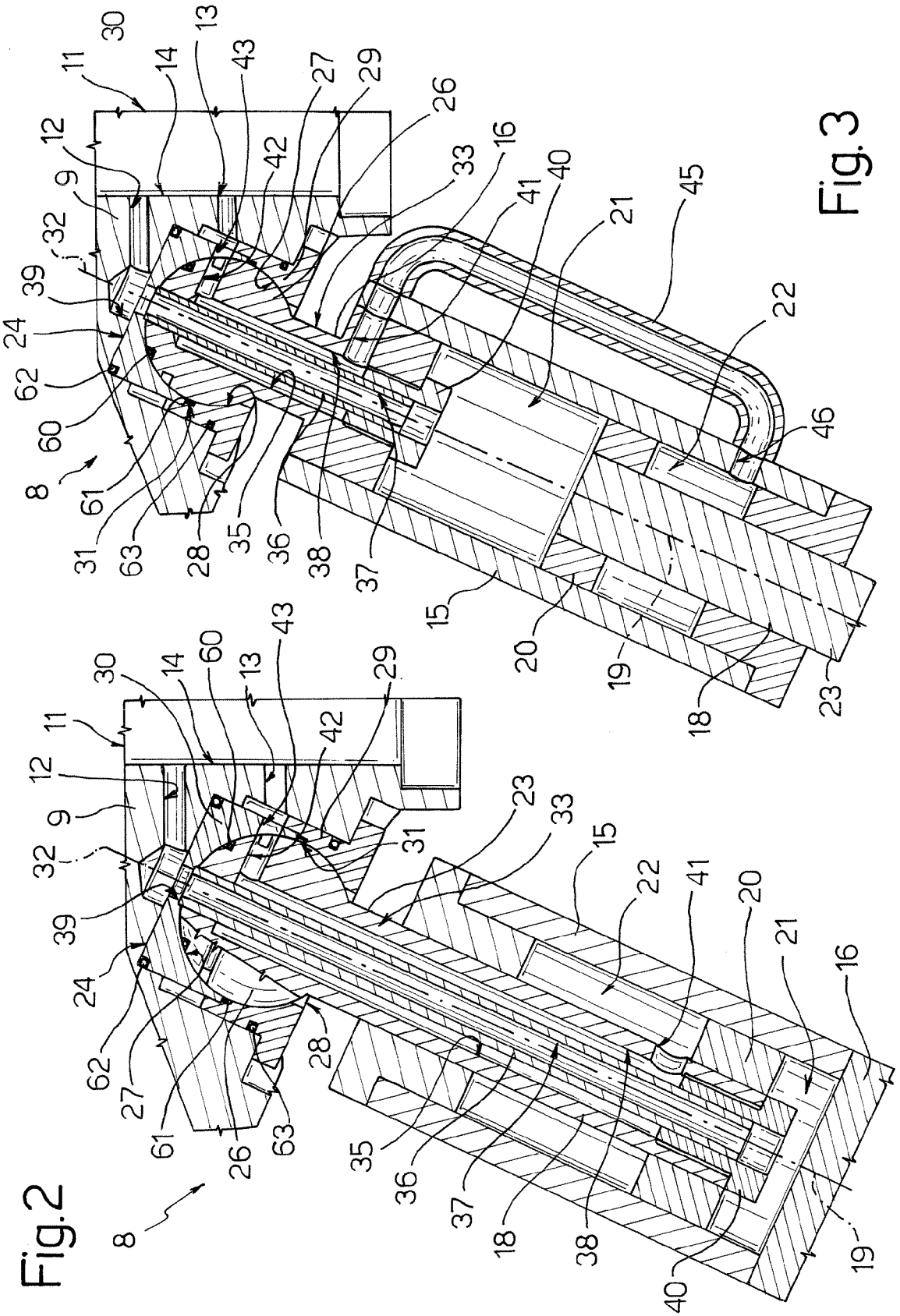

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Fig.3

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Fig.2

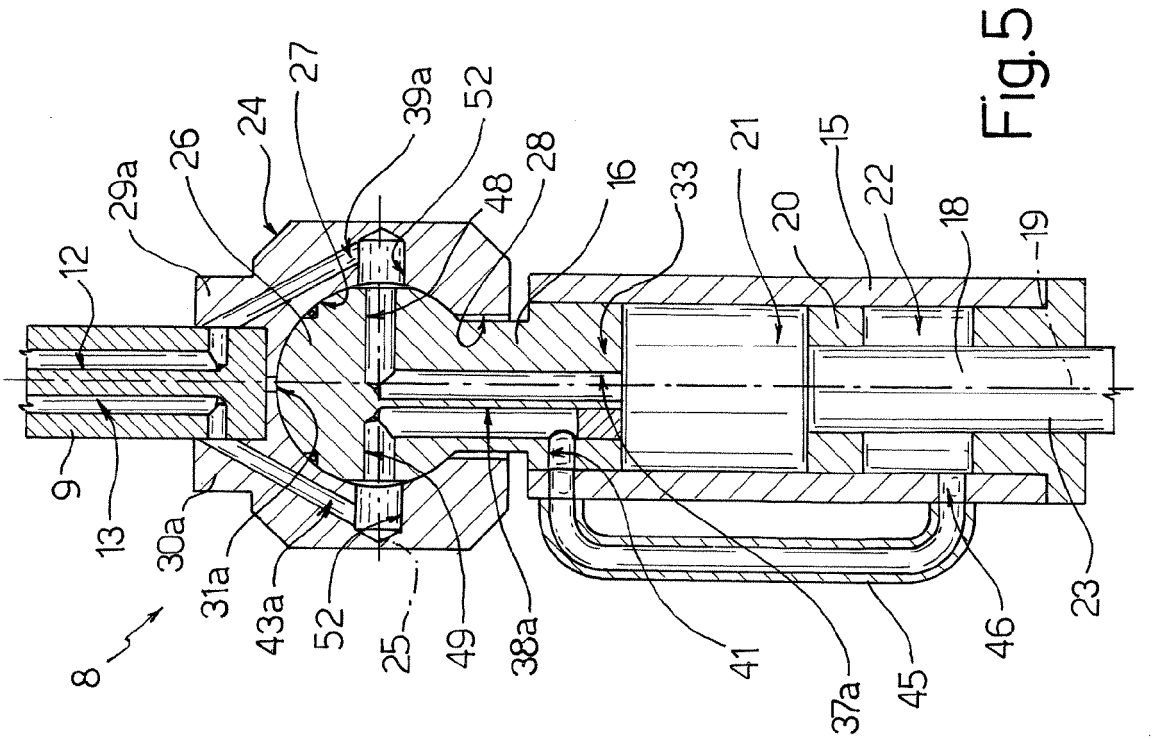
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Fig.5

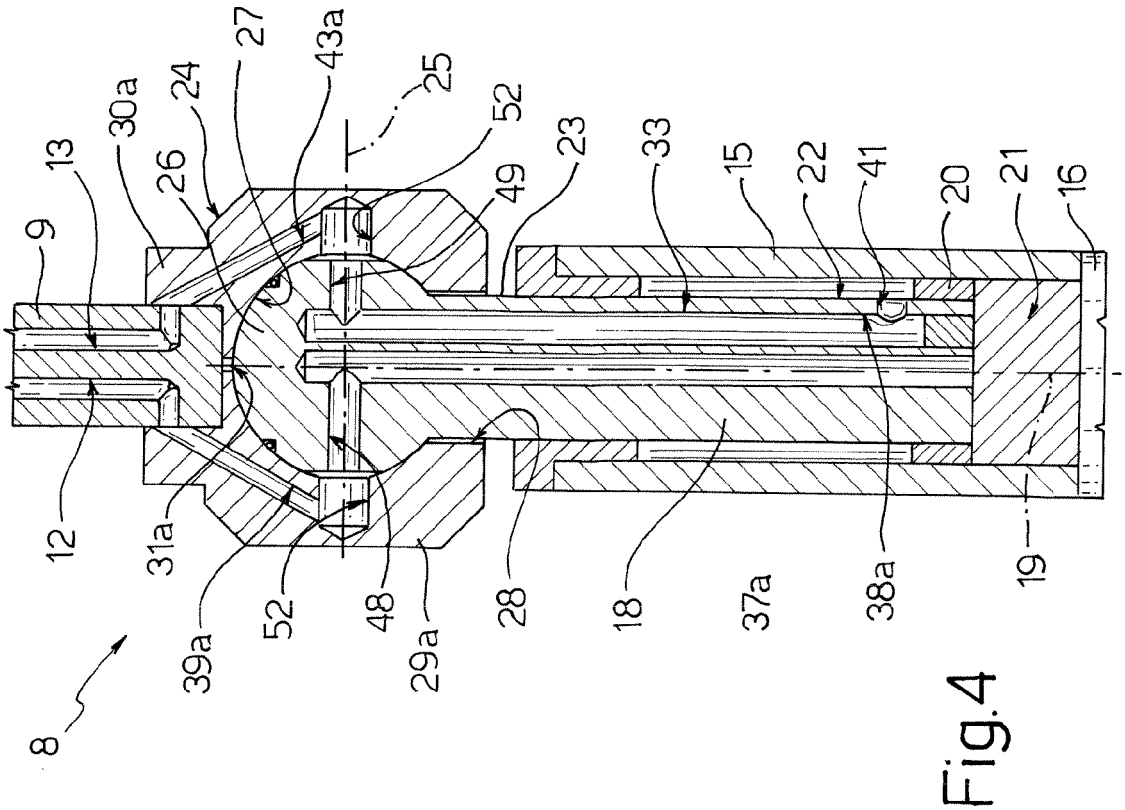
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Fig.4