



Europäisches Patentamt
European Patent Office
Office européen des brevets



(11)

EP 1 580 439 A2

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:
28.09.2005 Bulletin 2005/39

(51) Int Cl.7: **F15B 13/042**

(21) Application number: **05102309.1**

(22) Date of filing: **22.03.2005**

(84) Designated Contracting States:
**AT BE BG CH CY CZ DE DK EE ES FI FR GB GR
HU IE IS IT LI LT LU MC NL PL PT RO SE SI SK TR**
Designated Extension States:
AL BA HR LV MK YU

(72) Inventor: **Garcea, Rocco**
40134 Bologna (IT)

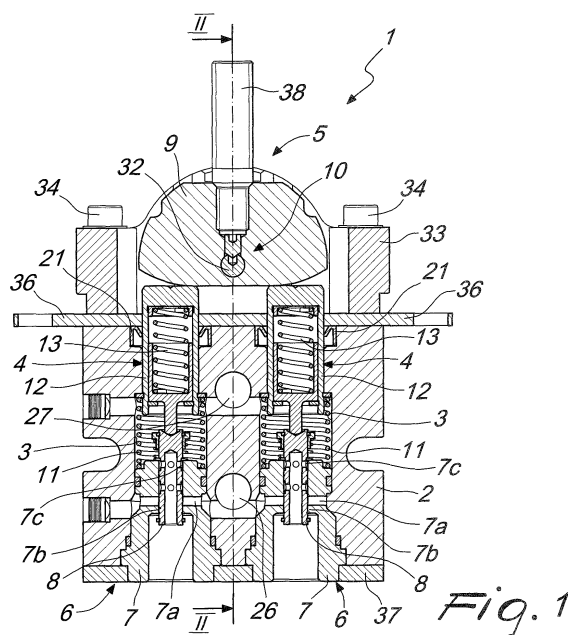
(74) Representative: **Modiano, Guido et al**
Modiano Gardi Patents,
Via Meravigli, 16
20123 Milano (IT)

(30) Priority: **26.03.2004 IT MO20040064**

(71) Applicant: **SALAMI S.p.A.**
I-41100 Modena (IT)

(54) Fluid-operated actuation device

(57) A fluid-operated actuation device (1), comprising at least one supporting body (2), which is associated with at least one substantially through receptacle (3) provided with first and second mutually opposite open ends, at least one preassembled push rod assembly (4), which is inserted so that it can slide along the receptacle (3) at the first end, means (5) for actuating the sliding of the push rod assembly (4) along the receptacle (3) at least toward the second end, and at least one preassembled reduction valve assembly (6), which is associated with the supporting body (2) at the second end and comprises a valve body (7) provided with at least one intake port (7a) for a working fluid at an operating pressure, with at least one port (7b) for the output of the working fluid at a reduced pressure toward a user device, and with at least one discharge port (7c) for the fluid and at least one flow control element (8), which is accommodated within the valve body, can move alternately between an inactive configuration and an active configuration, is interposed between the ports and cooperates with the push rod assembly, the flow control element (8) being adapted to close at least partially the intake port (7a) and to connect the output and discharge ports in the inactive configuration and to close at least partially the discharge port (7c) and connect the intake (7a) and output ports (7b) in the active configuration.



Description

[0001] The present invention relates to a fluid-operated actuation device.

[0002] Fluid-operated actuation devices, known as remote controls, are known which allow to drive, optionally remotely, distribution valves, hydraulic pumps, hydrostatic drives and others.

[0003] These devices comprise a supporting body, which is provided with at least one through receptacle connected to means for feeding a pressurized working fluid, preferably oil.

[0004] Such receptacle is provided with a first end and a second end, which are mutually opposite and proximate to which there are respectively a first section, which acts as a guide for the sliding of a push rod that is arranged inside it and protrudes partially from the first end, and a second section, which is connected to said feeder means and acts as a valve body for a flow control element that cooperates with the push rod in order to reduce the pressure of the fluid in output from the second end of said receptacle.

[0005] The device is provided with first elastic means, which are interposed between the body and the push rod for the return of the push rod to the inactive configuration, with second elastic means, which are interposed between the push rod and the flow control element and are sized so as to modulate the reduction in pressure between the intake and the output from the device, with third elastic means, which are interposed between the flow control element and the body for the return of the element to the inactive configuration, and with sealing means, which are accommodated within the receptacle in order to prevent the outflow of fluid through the first end.

[0006] These means are constituted by loose components, such as elastic compression springs and sealing rings, which must be assembled individually during the manufacture of said devices.

[0007] Further, it is noted that the type of response given by the device according to the actuation imparted by the user depends on the size of the second elastic means.

[0008] The device further comprises means for actuating the sliding of the push rod along the receptacle, which are associated with the supporting body and can be actuated by an operator.

[0009] The actuation means generally comprise an actuation element, such as a lever or pedal, which is hinged to the valve body and is rigidly coupled to a rocker associated with at least one protruding tab, which is formed for example by the head of a screw that is engaged in the rocker and is suitable to press on the push rod as a consequence of the rotation of the element produced by the operator.

[0010] Actuation devices are also known in which the body is provided with at least two receptacles that are associated with respective push rods and respective

flow control elements, in which the rocker is associated with two tabs, each of which cooperates with a respective push rod.

[0011] The receptacles are arranged along an axis that passes through the region where the actuation element is hinged to the body and are arranged on opposite sides of the region.

[0012] These devices are conventionally termed single-axis two-way devices and can be arranged in a pack by interposing suitable interfaces so as to form modular assemblies for example for actuating a plurality of distribution valves.

[0013] Moreover, so-called two-axis four-way actuation assemblies are known in which there are four receptacles distributed around the region where the actuation element is hinged to the body and arranged along two axes, which are mutually perpendicular and intersect at said region.

[0014] The receptacles arranged along a same axis are coupled to a same user device.

[0015] In this case, the rocker can be replaced by a plate, which supports four tabs, each of which cooperates with a corresponding push rod.

[0016] These known actuation devices are not free from drawbacks, including the fact that it is necessary to provide dedicated setups of the devices for each type of adjustment that one wishes to obtain on the reduced pressure in output.

[0017] This fact entails, in order to minimize the resources held in store, the need to keep in store the various loose components which, when a customer order is received, must be individually assembled on a workbench in order to obtain the devices, which must then be tested before shipping.

[0018] Owing to the substantial assembly and testing times, the overall delivery times of known devices can be excessively long and incompatible with the requirements of customers.

[0019] Another drawback of known devices is that the transmission of motion to the push rods by means of rockers or plates provided with protruding tabs is uneven and can require the application of substantial pressures on the part of users.

[0020] The aim of the present invention is to eliminate the above-mentioned drawbacks of known devices, by providing a fluid-operated actuation device that allows to optimize the flexibility of the corresponding production cycle according to the variation of the adjustment curve of the reduced pressure in output.

[0021] Within this aim, an object of the present invention is to facilitate assembly operations, minimizing the associated times and costs.

[0022] Another object of the present invention is to ensure a response of the device that is uniform and progressive in accordance with the actuation imparted by users.

[0023] Another object of the present invention is to obtain a device whose actuation on the part of users does

not cause fatigue and is not onerous.

[0024] Another object of the present invention is to provide a device that is simple, relatively easy to provide in practice, safe in use, effective in operation, and has a relatively low cost.

[0025] This aim and these and other objects that will become better apparent hereinafter are achieved by the present fluid-operated actuation device, characterized in that it comprises at least one supporting body, which is associated with at least one substantially through receptacle provided with first and second mutually opposite open ends, at least one preassembled push rod assembly, which is inserted so that it can slide along said receptacle at said first end, means for actuating the sliding of said push rod assembly along said receptacle at least toward said second end, and at least one preassembled reduction valve assembly, which is associated with said supporting body at said second end and comprises a valve body provided with at least one intake port for a working fluid at an operating pressure, with at least one port for the output of the working fluid at a reduced pressure toward a user device, and with at least one discharge port for said fluid and at least one flow control element, which is accommodated within said valve body, can move alternately between an inactive configuration and an active configuration, is interposed between said ports and cooperates with said push rod assembly, said flow control element being adapted to close at least partially the intake port and to connect the output and discharge ports in the inactive configuration and to close at least partially the discharge port and connect the intake and output ports in the active configuration.

[0026] Further characteristics and advantages of the present invention will become better apparent from the following detailed description of some preferred but not exclusive embodiments of a fluid-operated actuation device, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a partial sectional view, taken along a transverse plane, of a first embodiment of the device according to the invention;

Figure 2 is a sectional view, taken along the line II-II of Figure 1;

Figure 3 is a sectional view, similar to Figure 2 and in enlarged scale, of the actuation means of the device of Figure 1;

Figure 4 is a sectional view, similar to Figure 1 and in enlarged scale, of a portion of the device shown in Figure 1;

Figures 5 and 6 are two sectional views, similar to Figure 1 and in enlarged scale, of respective embodiments of the push rod assembly of the device shown in said figure;

Figure 7 is a sectional view, similar to Figure 1 and in enlarged scale, of the valve assembly of the device shown in said figure;

Figure 8 is a schematic perspective view of a sec-

ond embodiment of the device according to the invention;

Figure 9 is a schematic perspective view of a third embodiment of the device according to the invention;

Figure 10 is a schematic transverse sectional view of the device of Figure 9;

Figure 11 is a schematic sectional view, similar to Figure 10 and in enlarged scale, of a portion of the device of Figure 9;

Figure 12 is a sectional view, similar to Figure 10 and in enlarged scale, of the push rod assembly of the device of Figure 9;

Figure 13 is a plan view of the valve assembly of the device of Figure 9;

Figures 14 and 15 are two enlarged-scale sectional views, taken along the lines XIV-XIV and XV-XV of Figure 13 respectively.

[0027] With reference to the figures, the reference numeral 1 generally designates a fluid-operated actuation device.

[0028] The device 1 comprises at least one supporting body 2, which is associated with at least one through receptacle 3 provided with a first end and a second end, which are open and mutually opposite and are arranged respectively in an upper region and in a lower region with reference to the figures.

[0029] In particular, the receptacle 3 is formed by a through hole provided in the supporting body 2.

[0030] The device 1 further comprises at least one preassembled push rod assembly 4, which is inserted so that it can slide within the receptacle 3 proximate to its first end, and means 5 for actuating the sliding of the push rod assembly 4 along the receptacle 3 at least toward its second end.

[0031] The push rod assembly 4 preferably protrudes partially from the first end of the receptacle 3 toward the actuation means 5.

[0032] The device 1 further comprises at least one preassembled reduction valve assembly 6, which is associated with the supporting body 2 at the second end of the receptacle 3 and comprises a valve body 7, which is provided with at least one intake port 7a for a working fluid at an operating pressure, at least one output or service port 7b for the output of the working fluid at a reduced pressure toward a user, and with at least one discharge port 7c for discharging said fluid and at least one flow control element 8, which is accommodated within the valve body 7 and can move alternately between an inactive configuration and an active configuration, is interposed between the ports 7a, 7b and 7c, and cooperates with the push rod assembly 4.

[0033] In the inactive configuration shown in the figures, the flow control element 8 is arranged in such a position as to close the intake port 7a and connect the output and discharge ports 7b and 7c respectively.

[0034] By way of the actuation means 5 it is possible

to actuate the sliding of the flow control element 8 so as to move it into the active configuration in order to close at least partially the discharge port 7c and connect the intake and output ports 7a and 7b respectively.

[0035] The flow control element 8 is constituted by an elongated element, which is arranged so that a first end lies within the valve body 7 at the output port 7b and a second end, arranged opposite the first end, protrudes outward from the valve body and is associated with the push rod assembly 4.

[0036] The flow control element 8 is provided internally with a cavity that is open at the first end and with two through holes that lie transversely to the cavity: one of the holes, in the inactive configuration, is arranged at the discharge port 7c so as to connect it to the output port 7b in order to evacuate the working fluid, and the other hole, in the active configuration, is arranged at the intake port 7a in order to feed the working fluid toward the user device.

[0037] The working fluid is preferably hydraulic oil or the like.

[0038] Conveniently, according to the invention, the push rod assembly 4 and the valve assembly 6 are constituted by corresponding preassembled and preferably tested cartridges fitted to the supporting body 2.

[0039] Advantageously, the actuation means 5 comprise a cam 9, which is movably associated with the supporting body 2, and means 10 for pivoting about at least one axis, which are interposed between the supporting body and the cam 9.

[0040] The use of the cam 9 allows to obtain a response of the device 1 to the action applied by the user to the actuation means 5 that is highly regular and progressive; moreover, by varying the profile of the cam 9 it is possible to achieve different response curves of the device 1.

[0041] Moreover, by appropriately shaping the cam 9 according to a known method, without changing the movement it is possible to change the rule of motion with which the push rod assembly 4 slides in both directions along the receptacle 3, i.e., obtain differentiated strokes and overtravels.

[0042] The device 1 comprises first elastic means for the retraction of the push rod assembly 4 away from the second end of the receptacle 3, which are constituted by at least one first helical compression spring 11, which is interposed between the assembly and the valve body 7; as an alternative, the first spring 11 can be interposed between the push rod assembly 4 and the supporting body 2.

[0043] The push rod assembly 4 is constituted by a cartridge that can be yield elastically by way of the action imparted by the actuation means 5.

[0044] The push rod assembly 4 comprises a box-like enclosure 12, which is formed by at least one first portion 12a, which cooperates with the actuation means 5, and by a second portion 12b, which is associated with the flow control element 8; such portions are mutually as-

sociated so that they can move toward and away from each other by way of the interposition of second elastic means, which are constituted by at least one second helical compression spring 13.

[0045] The second elastic means may provide two second coaxial springs 13, which mutually cooperate so as to obtain a reduced pressure response curve, according to the movement imparted to the actuation means 5, that is characterized by a double gradient.

[0046] In the embodiments shown, the portions 12a and 12b are substantially cup-shaped and arranged so that their corresponding bottom walls face opposite directions; the second portion 12b is arranged inside the first portion 12a.

[0047] The push rod assembly 4 comprises first stroke limiting means for limiting the relative sliding of the portions 12a and 12b away from each other; such means are constituted for example by an elastic ring 14, which is accommodated so as to protrude from an annular seat formed on the internal wall of the first portion 12a proximate to its open end that is arranged in a lower region with respect to the drawings, so as to form an abutment shoulder for the second portion 12b.

[0048] Further, the ring 14 allows to make the preassembly of the push rod assembly 4 stable.

[0049] Conveniently, the push rod assembly 4 may have second stroke limiting means for limiting the sliding of the portions 12a and 12b toward each other, which are constituted by an insert 15, which is accommodated within the first portion 12a at its bottom, which forms an annular surface for abutment of the second portion 12b.

[0050] Conveniently, the insert 15 is sized so as to limit the useful stroke of the portions 12a and 12b with respect to each other and therefore limit the deflection of the second spring 13 so that it is packed.

[0051] Accordingly, the insert 15 allows to convert the connection between the portions 12a and 12b from an elastic one to a rigid one for a given movement imparted by the user by way of the actuation means 5, so as to achieve a sudden increase in the reduced pressure to a maximum value that is equal to approximately 80% of the input operating pressure.

[0052] It is possible to accommodate, inside the enclosure 12, one or more spring guiding elements 16, which are optionally integrated within the insert 15.

[0053] The push rod assembly 4 further has third means for limiting the stroke of its sliding motion along the receptacle 3 at least toward its first end, such means being constituted for example by a second elastic ring 17, which is accommodated so as to protrude in an annular seat formed on the outer wall of the first portion 12a proximate to its closed end arranged in an upper region with respect to the drawings, so as to form a surface for abutment on a shoulder formed inside the supporting body 2.

[0054] The first portion 12a, which acts as a transfer element, is provided in an upper region with a surface 18, which is arranged in contact with the cam 9 and can

be flat (Figures 5 and 6) or convex (Figure 12).

[0055] The second portion 12b is provided with a protruding tang 19, which enters a corresponding recess 20 provided on the second end of the flow control element 8.

[0056] Further, first sealing means are interposed between the supporting body 2 and the first portion 12a and are constituted by a gasket 21, which is accommodated in a corresponding annular slot provided at the first end of the receptacle 3.

[0057] The valve assembly 6 comprises fourth means for limiting the stroke of the sliding motion of the flow control element 8 along the valve body 7.

[0058] The fourth stroke limiting means comprise a perimetric flange 22, which protrudes outward from the second end of the flow control element 8 and is suitable to abut against the valve body in order to limit the sliding of the flow control element 8 away from the push rod assembly 4.

[0059] The flange 22 is applied to the flow control element 8; in an alternative embodiment, not shown, the flange 22 can be formed for example monolithically with the flow control element 8.

[0060] Further, the fourth stroke limiting means comprise a third ring 23, which is accommodated so as to protrude from an annular seat that is formed on the outer wall of the flow control element 8 at its first end and is suitable to abut against a shoulder formed inside the valve body 7, in order to limit the sliding of the flow control element 8 toward the push rod assembly 4 and allow the preassembly of the valve assembly 6 to be stable.

[0061] The valve body 6 further comprises third elastic means for the return of the flow control element 8 to the inactive configuration upon release of the actuation means 5 by a user, said third means being constituted by at least one third helical compression spring 24, which is interposed between the valve body 7 and the flow control element 8.

[0062] In particular, the third spring 24 wraps around the second end of the flow control element 8 and is interposed between the flange 22 that is associated with it and the valve body 7.

[0063] The valve body 6 further comprises second sealing means, which comprise one or more sealing rings 25 which are interposed between the valve body 7 and the supporting body 2 and are accommodated in corresponding seats provided on said valve body.

[0064] In one possible embodiment, the valve assembly 6 can be inserted in the receptacle 3 at its second end.

[0065] In this case, the intake port 7a is connected to a supply circuit 26, which is formed inside the supporting body 2 and is connected to the outside for coupling with means for supplying the working fluid at the operating pressure, which are not shown because they are of a conventional type.

[0066] Moreover, the discharge port 7c is connected to a discharge circuit 27, which is formed inside the sup-

porting body 2 and is connected to the outside for coupling to means for collecting the working fluid, which are not shown and are constituted for example by a conventional tank.

5 **[0067]** As an alternative, the valve assembly 6 can be associated with the supporting body 2 by way of connection means, preferably of the detachable type, such as threaded elements 28 or the like.

[0068] In this case, the intake port 7a and the discharge port 7c are connected to the outside of the valve body 7 by way of respective ducts 29 and 30, which are formed in the valve body, for coupling respectively to the supply means and to the collection means.

[0069] The actuation means 5 comprise a control element 31 for the movement of the cam 9, such as a lever, a pedal or the like.

[0070] The control element 31 can be provided with means for locking in the inactive configuration or with electric or electronic controls.

20 **[0071]** In an embodiment that is not shown, the device 1 comprises a single receptacle 3, in which there is a push rod assembly 4, which cooperates with a corresponding valve assembly 6 inserted in the supporting body 2 or associated therewith; in this case, the control element 31 is of the pedal type.

[0072] In a first embodiment, shown in Figures 1 to 7, the device 1 is of the single-axis two-way type.

[0073] The supporting body 2 is provided with two receptacles 3, in which respective push rod assemblies 4 are arranged; each assembly cooperates with a corresponding valve assembly 6, which is inserted in said receptacle at the second end.

35 **[0074]** As an alternative, it is possible to provide a single valve assembly 6, which is associated with the supporting body 2 at the second ends of the receptacles 3 and the valve body 7 of which is provided with: two intake ports 7a, which are mutually connected and associated with means for supplying the working fluid at the operating pressure by means of the duct 29; two output ports 7b and two discharge ports 7c, which are mutually connected and are associated with means for collecting said fluid through the duct 30; and two flow control elements 8, which are accommodated so that they can move along the valve body 7, each element being interposed between a respective intake port 7a and the corresponding output and discharge ports 7b and 7c respectively, and cooperates with one of the two push rod assemblies 4.

50 **[0075]** The pivoting means 10 comprise an articulation pivot 32, which is inserted in the cam 9 and defines the rotation axis of said cam.

[0076] The receptacles 3 are arranged along an axis that is perpendicular to the articulation pivot 32 and on opposite sides thereof.

55 **[0077]** In this case, the cam 9 is of the flat type and lies on a plane that is perpendicular to the articulation pivot 32.

[0078] The pivoting means 10 comprise one or, more

preferably, two wings 33 for supporting the articulation pivot 32, which are arranged at the mutually opposite ends of said pivot and are associated with the supporting body 2 at the first ends of the receptacles 3, for example by way of threaded elements 34.

[0079] The pivoting means 10 further have a preassembled friction assembly 35, which is associated with each wing 33; said assemblies are not described in detail since they are of a conventional type.

[0080] A plate 36 for fitting the device 1 on control panels or other elements is interposed between the wings 33 and the supporting body 2.

[0081] The valve assemblies 6 are kept in position within the corresponding receptacles 3 by means of a contrast plate 37, which is fixed to the supporting body 2, for example, by means of threaded elements or other connecting elements, which are not shown.

[0082] As an alternative, the valve bodies 7 might be threaded externally and be screwed into corresponding female threads formed along the receptacles 3 with the interposition of a safety ring.

[0083] A threaded stem 38 is partially inserted in the cam 9 for connection to the control element 31.

[0084] Figure 3 illustrates a control element 31, such as a lever, which is not described in detail since it is of a conventional type.

[0085] It is noted that in the manufacture of the device 1, the actuation means 5 can be preassembled, so as to form a compact subassembly to be fitted to the supporting body 2.

[0086] Figure 8 illustrates a second embodiment, in which a plurality of sections having a single axis and two ways of the type described above, designated respectively by the reference numerals 1a, 1b and 1c, are packed by interposing respective interfaces of a known type so as to form an actuation device with three parallel axes and six ways; each section 1a, 1b, 1c of the device 1 is coupled, during use, to a corresponding fluid-operated component to be driven.

[0087] In a third embodiment, shown in Figures 9 to 15, the device 1 is of the type with two axes and four ways.

[0088] The supporting body 2 is provided with four receptacles 3, in which there are respective push rod assemblies 4, which cooperate with a single valve assembly 6 that is associated with the supporting body 2 at the second ends of the receptacles 3.

[0089] The valve assembly 6 comprises a valve body 7, which is provided with four mutually connected intake ports 7a, which are associated with means for supplying the working fluid at the operating pressure through the duct 29, with four output ports 7b, and with four discharge ports 7c, which are mutually connected and are associated with means for collecting said fluid by means of the duct 30, and four flow control elements 8, which are accommodated so that they can move within the valve body 7, each one being interposed between a respective intake port 7a and the corresponding output

and discharge ports 7b and 7c respectively, and cooperates with one of the two push rod assemblies 4.

[0090] As an alternative, it is possible to provide four valve assemblies 6, each inserted into a corresponding receptacle 3 at its second end and cooperating with a corresponding push rod assembly 4.

[0091] In this case, the valve body 7 of each valve assembly 6 is provided with an intake port 7a, which is connected to the supply circuit 26 formed in the supporting body 2, with an output port 7b, and with a discharge port 7c, which is connected to the discharge circuit 27 formed in said supporting body.

[0092] The pivoting means 10 comprise a ball joint 39, which is interposed between the supporting body 2 and the cam 9.

[0093] The receptacles 3 are distributed around the ball joint 39 along two mutually perpendicular axes, which pass through said joint and are arranged in pairs on opposite sides thereof.

[0094] In this case, the cam 9 is of the front type and is constituted by a disk that has an appropriately contoured surface that faces the push rod assemblies 4.

[0095] The two receptacles 3 arranged on a same axis are coupled to a same fluid-operated component to be driven.

[0096] Moving the control element 31 along one of said axes actuates one of the push rod assemblies 4 and accordingly the corresponding valve assembly 6; by moving the control element 31 transversely to said axes it is instead possible to act simultaneously on two adjacent push rod assemblies 4 and on the corresponding valve assemblies 6.

[0097] The ball joint 39 can be provided with guiding means, which are suitable to allow the rotation of said joint only in directions that are parallel to said axes, so as to prevent "diagonal" actuation or limit the movement along one axis or a so-called half axis.

[0098] Such guiding means can be constituted for example by a plate provided with an appropriately cross-shaped or T-shaped slot, along which the actuation element 31 moves.

[0099] The ball joint 39 is composed of a female element, which is constituted by a recess 40 provided in the upper wall of the supporting body 2, between the receptacles 3, and a male element, which is constituted by a essentially spherical head 41, which is inserted in the recess 40 and is rigidly coupled to a threaded stem 42 for fitting the control element 31, which is not shown and is generally constituted by a lever.

[0100] The cam 9 is screwed onto the stem 42; it is possible to provide a safety nut in order to keep the cam 9 in position on said stem.

[0101] Conveniently, the pivoting means 10 comprise means for locking the rotation of the control element 31 about an axis that is parallel to the sliding direction of the push rod assemblies 4, so as to facilitate the fitting of said element to the stem 42.

[0102] The locking means comprise a first substan-

tially diametrical notch 43, which is formed on the head 41 on a plane that passes through said axis, a corresponding second notch, which is formed in the supporting body 2 and faces the recess 40, and a pin, which is interposed between the first notch and the second notch, said pin and the second notch not being shown in the figures.

[0103] Finally, there is a plate 44, which is fixed in an upper region to the supporting body 2 by way of threaded elements 45 and is perforated at the push rod assemblies 4 and at the head 41.

[0104] At the head 41, the surface of the plate 44 that faces it is spherical, so as to allow the rotation of the head 41 with respect to said plate.

[0105] It should be noted that the adjectives "upper" and "lower" and other similar expressions refer to the orientation of the device 1 in the accompanying drawings.

[0106] The operation of the device according to the invention in the various described embodiments is fully similar to the operation of conventional hydraulic remote controls.

[0107] By acting on the control element 31, the cam 9 is turned and acts on at least one push rod assembly 4, the enclosure 12 of which moves toward the corresponding valve assembly 6.

[0108] The second spring 13 is compressed and pushes the flow control element 8, which causes the total or partial closure of the corresponding discharge port 7c and connects the intake and output ports 7a and 7b respectively.

[0109] The flow control element 8 is arranged in equilibrium between the elastic force applied by the springs 11, 13 and 24 and the pushing force applied by the fluid at the working pressure at the intake port 7a and at the reduced pressure at the output port 7b.

[0110] The value of the reduced pressure is a function of the movement imparted to the control element 31, of the profile of the cam 9 that is used, and of the yielding of the push rod assembly 4.

[0111] Moreover, it is noted that the device 1 is characterized by considerable comfort in use on the part of users; use of the cam 9, combined with the reduced diameter of the flow control elements 8, in fact causes a very limited reaction on the hand or feet of the users who drive said device by means of the control element 31.

[0112] During the assembly of a device according to the invention, the push rod assembly or assemblies 4 are inserted in the corresponding receptacles 3 in an upward direction from below.

[0113] If one or more valve assemblies 6 are inserted in corresponding receptacles 3, these too are inserted in an upward direction from below.

[0114] In practice it has been found that the described invention achieves the intended aim and objects, and in particular achieves the aim of obtaining a modular product that has low manufacturing times and costs.

[0115] In particular, it is noted that it is possible to pre-

assemble, optionally test and keep in store push rod assemblies that have different yielding characteristics and therefore correspond to different reduction curves of the pressure of the fluid in output from the device, which supply the operations for assembling said devices, giving maximum flexibility to the corresponding manufacturing cycle.

[0116] The invention thus conceived is susceptible of numerous modifications and variations, all of which are within the scope of the appended claims.

[0117] All the details may further be replaced with other technically equivalent ones.

[0118] In practice, the materials used, as well as the shapes and the dimensions, may be any according to requirements without thereby abandoning the scope of the protection of the appended claims.

[0119] The disclosures in Italian Patent Application No. MO2004A000064 from which this application claims priority are incorporated herein by reference.

[0120] Where technical features mentioned in any claim are followed by reference signs, those reference signs have been included for the sole purpose of increasing the intelligibility of the claims and accordingly, such reference signs do not have any limiting effect on the interpretation of each element identified by way of example by such reference signs.

Claims

1. A fluid-operated actuation device, **characterized in that** it comprises at least one supporting body, which is associated with at least one substantially through receptacle provided with first and second mutually opposite open ends, at least one preassembled push rod assembly, which is inserted so that it can slide along said receptacle at said first end, means for actuating the sliding of said push rod assembly along said receptacle at least toward said second end, and at least one preassembled reduction valve assembly, which is associated with said supporting body at said second end and comprises a valve body provided with at least one intake port for a working fluid at an operating pressure, with at least one port for the output of the working fluid at a reduced pressure toward a user device, and with at least one discharge port for said fluid and at least one flow control element, which is accommodated within said valve body, can move alternately between an inactive configuration and an active configuration, is interposed between said ports and cooperates with said push rod assembly, said flow control element being adapted to close at least partially the intake port and to connect the output and discharge ports in the inactive configuration and to close at least partially the discharge port and connect the intake and output ports in the active configuration.

2. The device according to claim 1, **characterized in that** said actuation means comprise a cam that is movably associated with said supporting body.
3. The device according to one or more of the preceding claims, **characterized in that** said actuation means comprise means for pivoting about at least one axis, which are interposed between said cam and said supporting body.
4. The device according to one or more of the preceding claims, **characterized in that** it comprises first elastic means for retracting said push rod assembly away from said second end, which are interposed between said push rod assembly and either said supporting body or said valve body.
5. The device according to one or more of the preceding claims, **characterized in that** said push rod assembly yields in a substantially elastic manner.
6. The device according to one or more of the preceding claims, **characterized in that** said push rod assembly comprises a substantially box-like enclosure, which comprises at least one first portion that cooperates with said actuation means and a second portion that is associated with said flow control element, the first and second portions being associated so that they can move toward and away from each other by way of the interposition of second elastic means.
7. The device according to one or more of the preceding claims, **characterized in that** said push rod assembly comprises first stroke limiting means for limiting the relative sliding of said first and second portions away from each other.
8. The device according to one or more of the preceding claims, **characterized in that** said push rod assembly comprises second stroke limiting means for limiting the relative sliding of said first and second portions toward each other.
9. The device according to one or more of the preceding claims, **characterized in that** said push rod assembly comprises third stroke limiting means for limiting its sliding along said receptacle at least toward said first end.
10. The device according to one or more of the preceding claims, **characterized in that** said first portion comprises a substantially flat surface that is in contact with said cam.
11. The device according to one or more of the preceding claims, **characterized in that** said first portion comprises a substantially convex surface that is in contact with said cam.
12. The device according to one or more of the preceding claims, **characterized in that** said second portion comprises a tang that protrudes and is associated with a corresponding recess provided on said flow control element.
13. The device according to one or more of the preceding claims, **characterized in that** it comprises first sealing means, which are interposed between said push rod assembly and said supporting body.
14. The device according to one or more of the preceding claims, **characterized in that** said valve assembly comprises fourth stroke limiting means for limiting the sliding of said flow control element along said valve body.
15. The device according to one or more of the preceding claims, **characterized in that** said valve assembly comprises third elastic means for the return of said flow control element to the inactive configuration, said means being interposed between said valve body and said flow control element.
16. The device according to one or more of the preceding claims, **characterized in that** said valve assembly comprises second sealing means, which are interposed between said valve body and said supporting body.
17. The device according to one or more of the preceding claims, **characterized in that** said first, second and third elastic means comprise at least one respective first, second and third helical compression spring.
18. The device according to one or more of the preceding claims, **characterized in that** said second elastic means comprise at least two of said second springs, which cooperate with each other.
19. The device according to one or more of the preceding claims, **characterized in that** said push rod assembly comprises at least one spring guiding means, which is accommodated inside said enclosure.
20. The device according to one or more of the preceding claims, **characterized in that** said valve assembly is inserted within said receptacle at said second end.
21. The device according to claim 20, **characterized in that** said intake port is connected to a circuit for supplying said fluid, which is associated with said supporting body and is connected to the outside for

coupling with means for supplying said fluid.

22. The device according to claim 20, **characterized in that** said discharge port is connected to a circuit for discharging said fluid, which is associated with said supporting body and is connected to the outside for coupling to means for collecting said fluid. 5
23. The device according to one or more of the preceding claims, **characterized in that** said pivoting means comprise an articulation pivot, said cam being of the flat type. 10
24. The device according to one or more of the preceding claims, **characterized in that** said pivoting means comprise at least one wing for supporting said articulation pivot, which can be associated with said supporting body at said first end. 15
25. The device according to one or more of the preceding claims, **characterized in that** it comprises at least one preassembled friction assembly, which is associated with said wing. 20
26. The device according to one or more of the preceding claims, **characterized in that** said pivoting means comprise a ball joint, said cam being of the front type. 25
27. The device according to one or more of the preceding claims, **characterized in that** said pivoting means comprise means for locking the rotation of said actuation means about an axis that is substantially parallel to the sliding direction of said push rod assembly. 30 35
28. The device according to one or more of the preceding claims, **characterized in that** said actuation means comprise a control element for moving said cam, which can be operated by a user. 40
29. The device according to one or more of the preceding claims, **characterized in that** said control element comprises a lever, a pedal or the like. 45
30. The device according to one or more of the preceding claims, **characterized in that** said supporting body comprises two of said receptacles, which are associated with respective push rod assemblies and are arranged along an axis that is substantially perpendicular to said articulation pivot and on opposite sides of said pivot. 50
31. The device according to claim 30, **characterized in that** said valve assembly comprises a valve body provided with two of said intake ports, which are mutually connected and are associated with said supply means, with two of said output ports and two of 55

said discharge ports, which are mutually connected and are associated with said collection means, and two of said flow control elements, each interposed between a respective intake port and the corresponding output and discharge ports and cooperating with one of said push rod assemblies.

32. The device according to claim 30, **characterized in that** it comprises two of said valve assemblies, each inserted within one of said receptacles at the corresponding second end and cooperating with the corresponding push rod assembly.
33. The device according to one or more of the preceding claims, **characterized in that** said supporting body comprises four of said receptacles, which are associated with respective push rod assemblies distributed around said ball joint on two axes that are substantially perpendicular to each other, pass through said joint, and are arranged in pairs on opposite sides of said ball joint.
34. The device according to claim 33, **characterized in that** said valve assembly comprises a valve body provided with four of said intake ports, which are mutually connected and are associated with said supply means, with four of said output ports and four of said discharge ports, which are mutually connected and are associated with said collection means, and with four of said flow control elements, each of which is interposed between a respective intake port and the corresponding output and discharge ports and cooperates with one of said push rod assemblies.
35. The device according to claim 33, **characterized in that** it comprises four of said valve assemblies, each of which is inserted in one of said receptacles at the corresponding second end and cooperates with the corresponding push rod assembly.

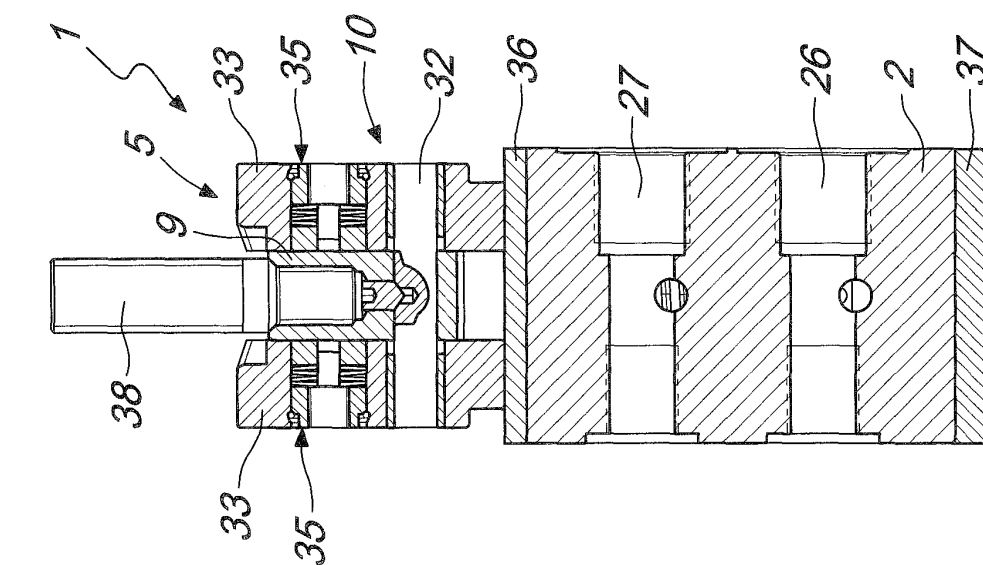


Fig. 2

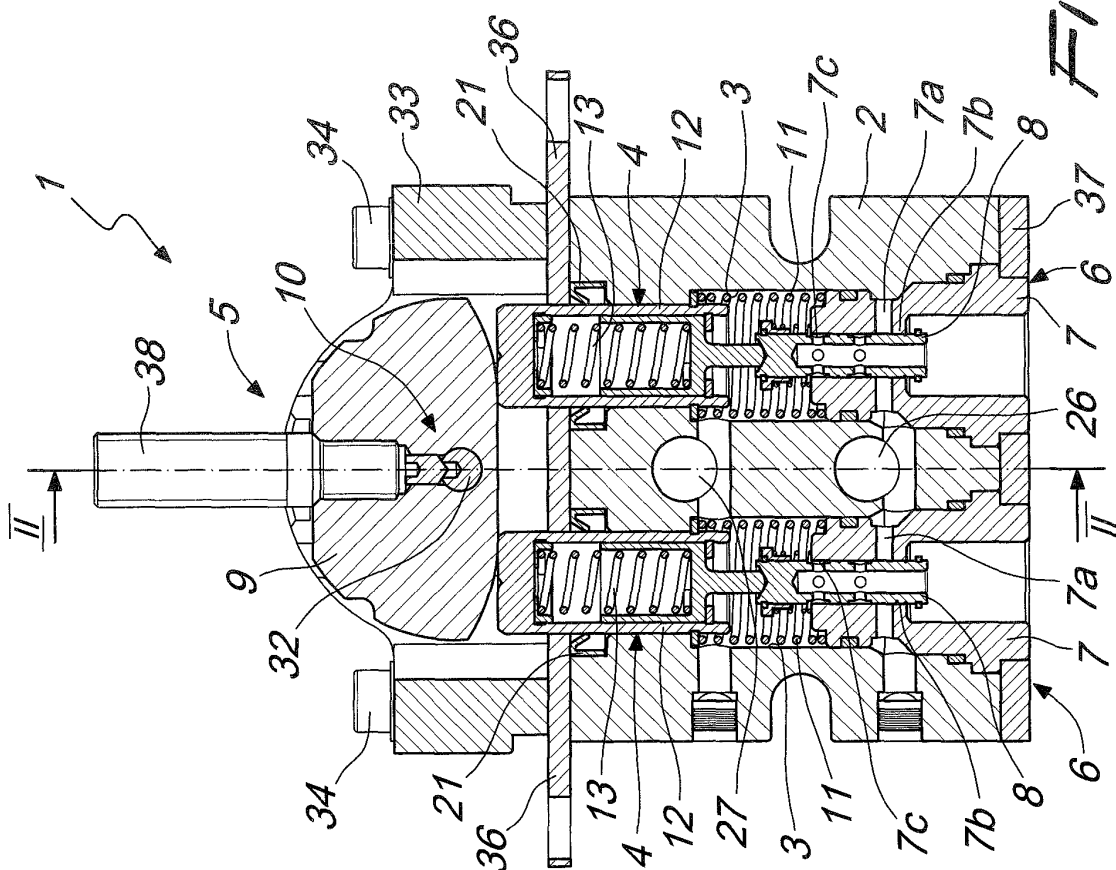


Fig. 1

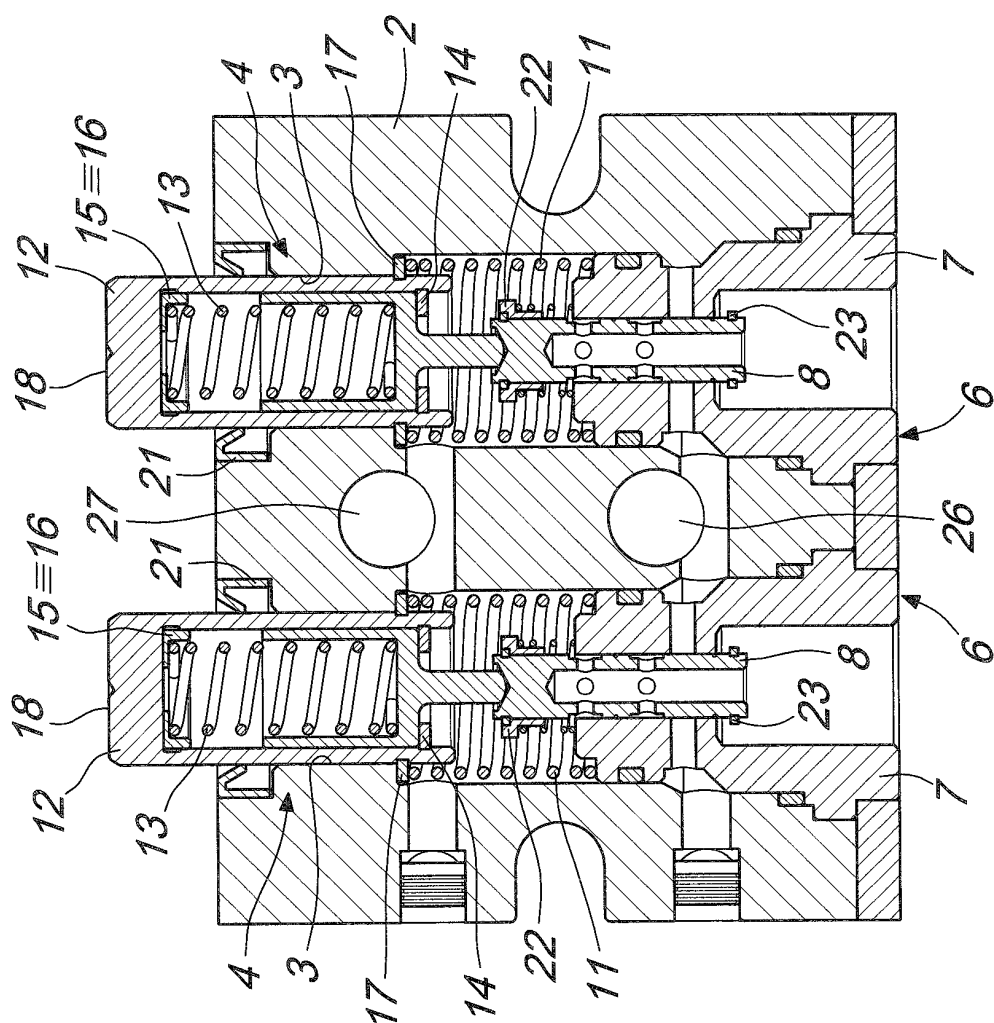


Fig. 4

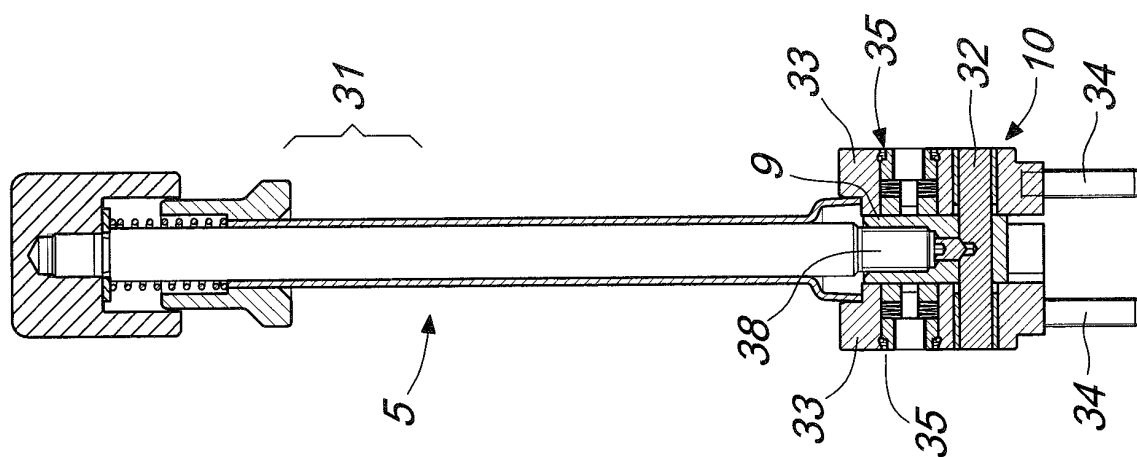


Fig. 3

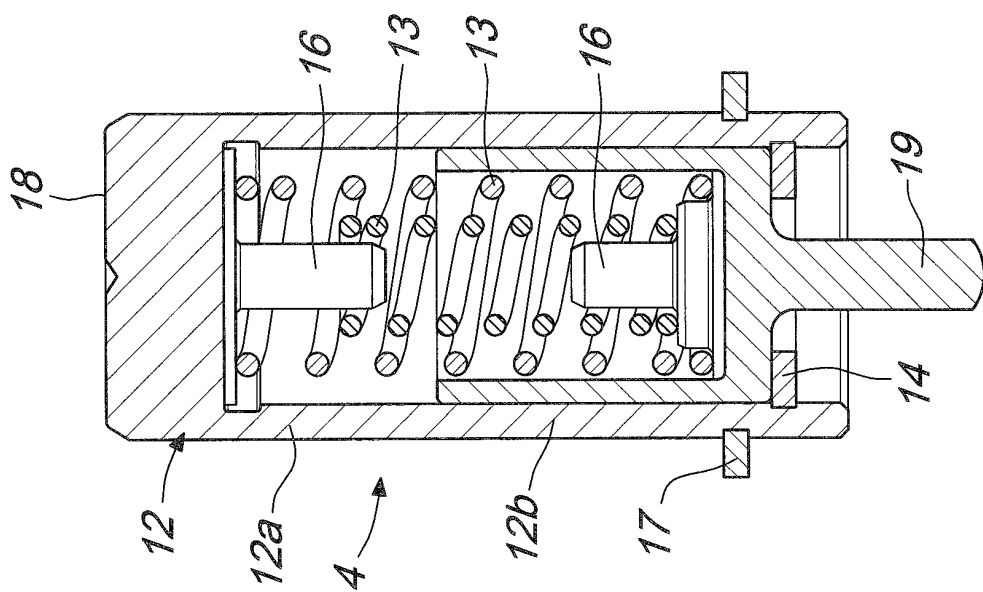


Fig. 6

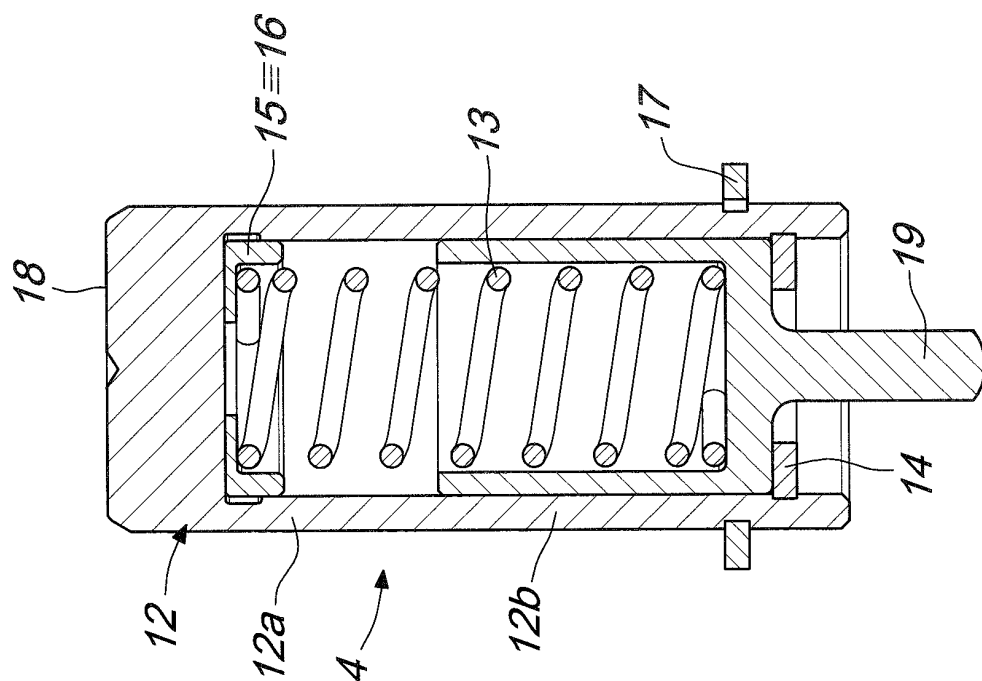


Fig. 5

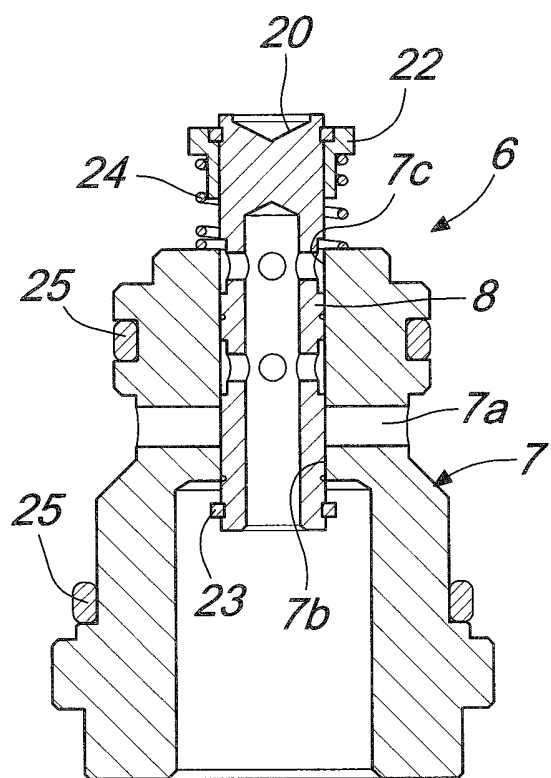


Fig. 7

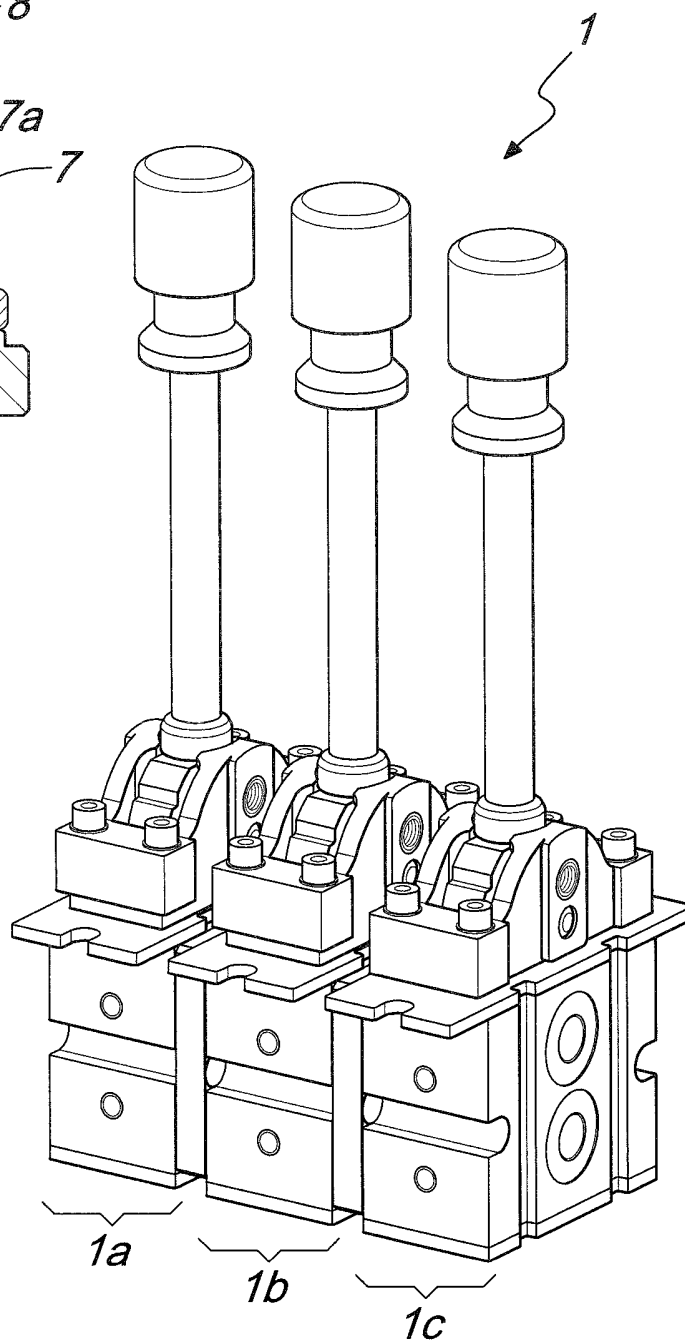


Fig. 8

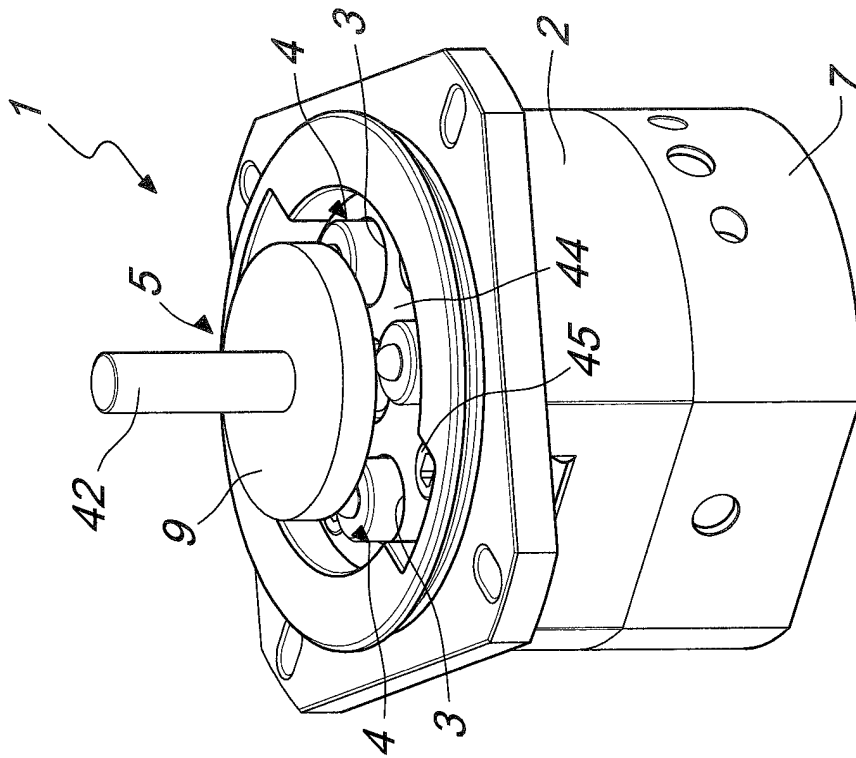


Fig. 9

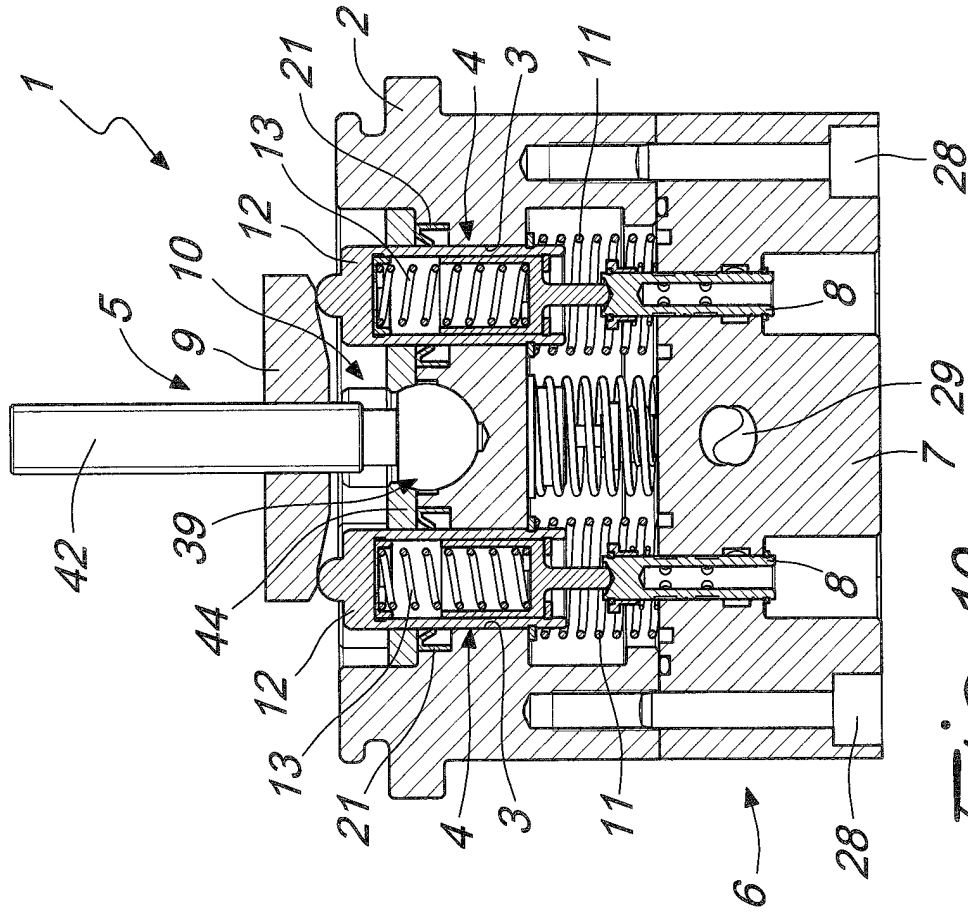


Fig. 10

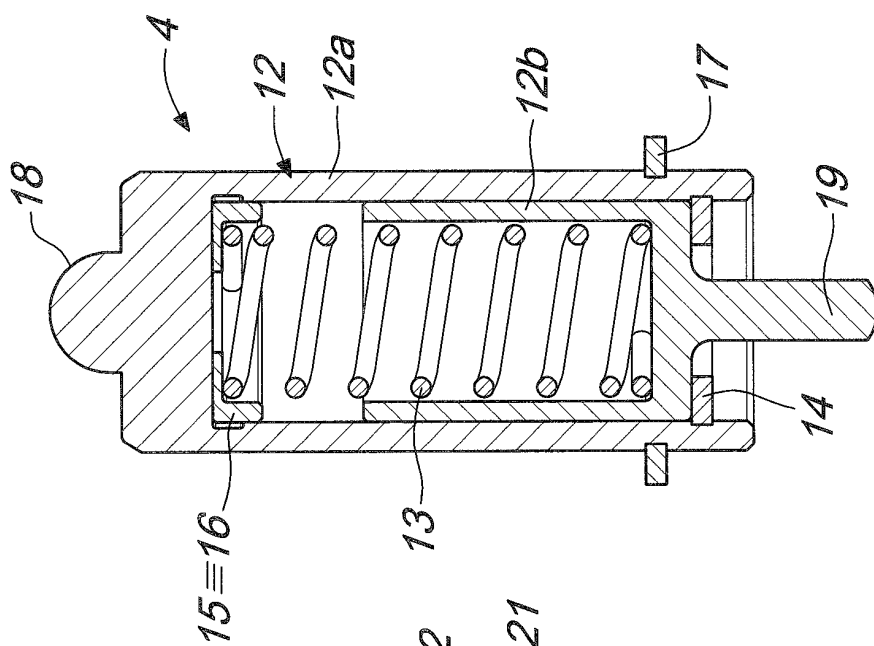


Fig. 12

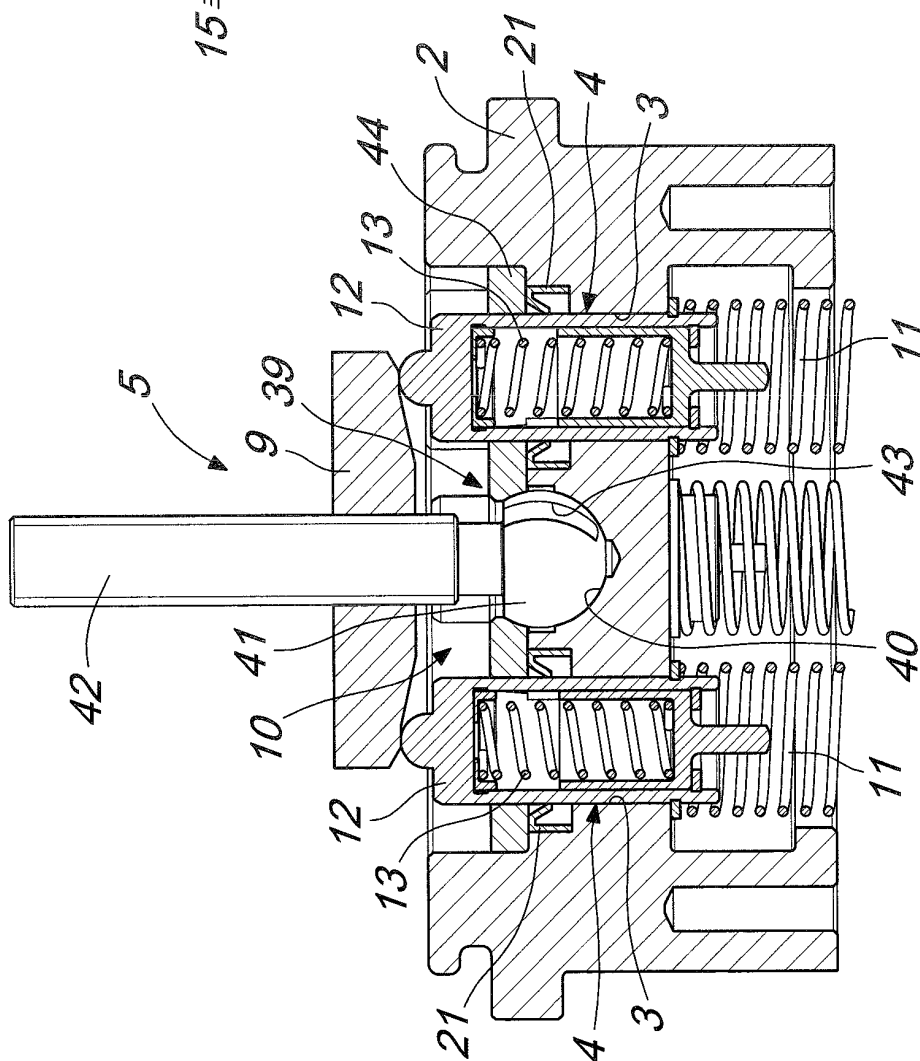


Fig. 11

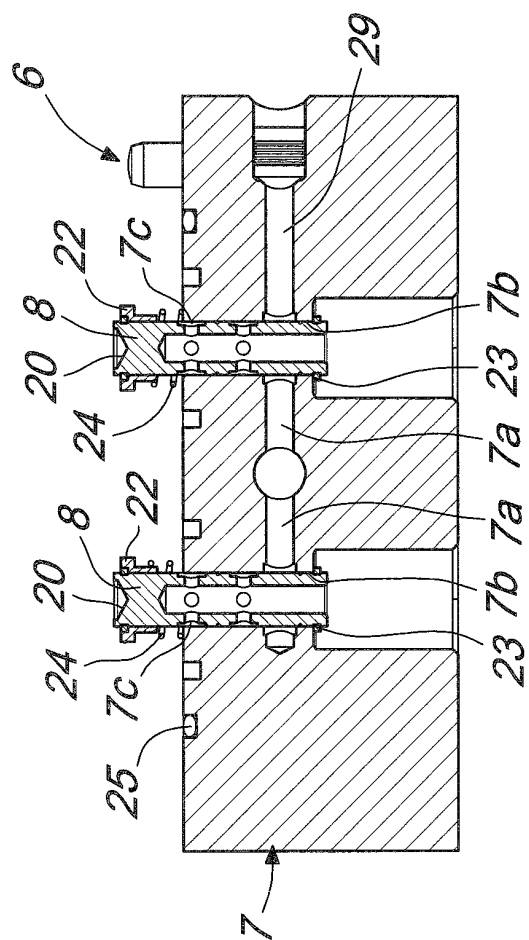


Fig. 14

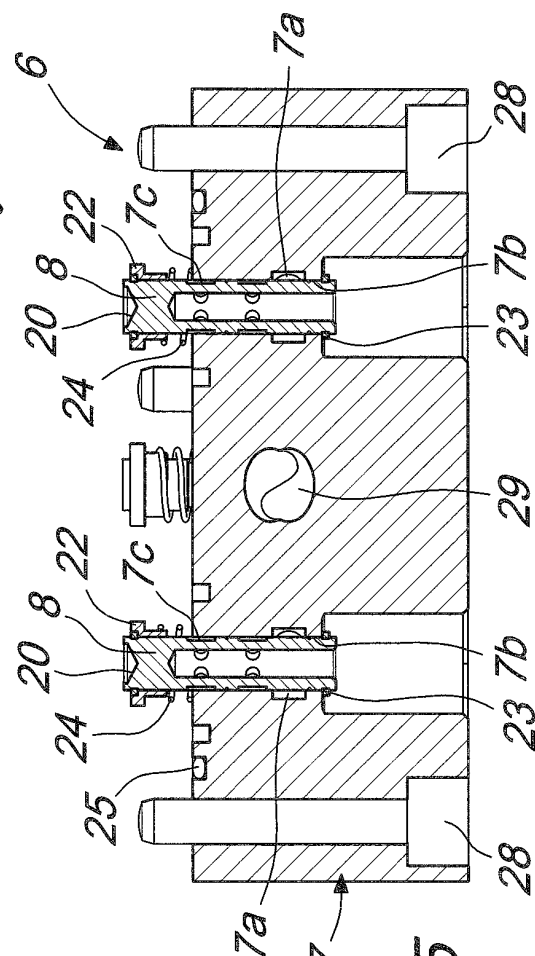


Fig. 15

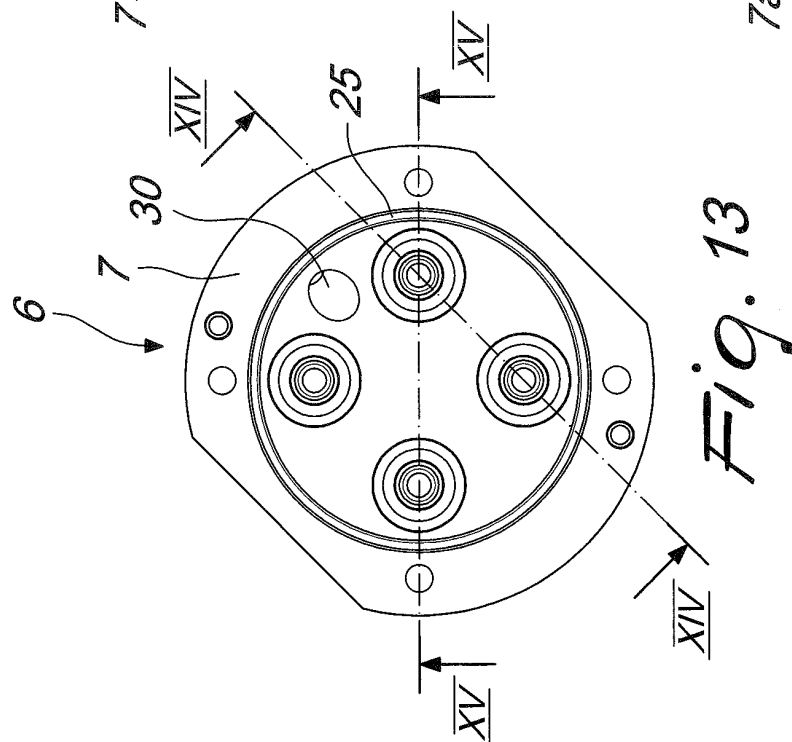


Fig. 13