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

(11) EP 2 549 124 B1

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
03.09.2014 Bulletin 2014/36

(21) Application number: **12176655.4**

(22) Date of filing: **17.07.2012**

(51) Int Cl.:
F15B 11/044 *(2006.01)* ***F15B 13/02*** *(2006.01)*

(54) **Load supporting valve**

Lastventil

Soupape de charge

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

(30) Priority: **19.07.2011 IT MO20110175**

(43) Date of publication of application:
23.01.2013 Bulletin 2013/04

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Printed by Jouve, 75001 PARIS (FR)

Description

[0001] The invention relates to a load holding valve traversed by a pressurised fluid.

[0002] Load holding valves are known that operate at very high fluid flowrates at very high pressures. Typically, these valves can operate suitably in the presence of fluid pressure up to 420 bar and with flowrates amounting to hundreds of litres per minute.

[0003] Known load holding valves are typically used in the sector of earth-moving machines. These valves are in fact arranged for supporting even very heavy suspended loads, such as, for example, an articulated arm of an excavator, and for maintaining in a desired position the aforesaid suspended loads for a set interval of time, sometimes even for many hours.

[0004] These valves are supplied and traversed by a pressurised fluid, which is sent to an actuator, in general a double-acting hydraulic piston, in turn connected to the arm to be supported. In particular, the pressurised fluid enters the valve from an inlet opening and exits from an exit opening connected to the actuator.

[0005] Known valves can comprise a first channel and a second channel that are traversable by the pressurised fluid that extend longitudinally along a body of the valve and parallel to one another. The first and the second channel communicate reciprocally through a connecting channel, arranged orthogonally to the first channel and to the second channel. Various known components are comprised in the first channel and in the second channel that are arranged for enabling the pressurised fluid to pass from the inlet opening to the outlet opening of the valve, but not vice versa.

[0006] The aforesaid load holding valve is a piloted valve, in particular piloted by an operator via a hydraulic control. The operator can deliver further pressurised fluid - when required - inside the valve, by suitably driving a control device. The further fluid enters the valve through a suitable opening, obtained in the body of the valve. Piloting the valve, i.e. delivering further pressurised fluid, enables the fluid to flow from the outlet opening to the inlet opening, in particular when it is desired to lower the suspended load. The valve further comprises a draining opening, obtained in the body of the valve, through which the pressurised fluid that possibly leaks through the sealing washers comprised in the valve can exit to the exterior and be conveyed to a tank. With the load holding valve disclosed above a pressure relief valve (of known type) can also be associated to limit the maximum pressure reachable by the fluid flowing inside the load holding valve.

[0007] One serious drawback of known load holding valves is that they require accurate and frequent maintenance performed by specialised technicians. Until the technicians have completed the maintenance, the machines with which these valves are associated are not operational and are therefore unusable. It is clear that the frequent maintenance interventions and the time during which the machines are unusable represent a significant cost that the user has to bear. In particular, the maintenance becomes necessary when losses and/or leaks from the valves occur and this can entail certain worn components of the valve being replaced, such as, for example, plugs or sealing elements. If this is not sufficient it may also be necessary to replace the valve completely, with a further increase in costs.

[0008] Another drawback of these valves is that the losses and leaks that can exit the valve drop by the force of gravity to the ground, thus polluting the terrain. Typically, the operating fluid acting in these valves is a suitable industrial oil that is very polluting if it leaks into the terrain. For this reason it is obvious that losses and leaks are very harmful for the environment.

[0009] A further drawback of known load holding valves is that, in use, when losses and leaks occur, there is a risk that the load is no longer correctly supported by the actuator, i.e. that it is no longer maintained by the actuator in the expected position. The load - i.e., for example, the articulated arm - thus lowers by an amount that can be proportional to the quantity of pressurised fluid that has exited the valve. This is extremely dangerous, given the size of the load to be supported, which can amount to several hundred of kilos or even several tonnes.

[0010] Lowering the load, especially if it occurs suddenly and unexpectedly, can thus be very hazardous and cause enormous damage and/or injury to things or people, in particular operators who are near the load.

[0011] The losses and/or leaks of pressurised fluid to the exterior of the valve are caused by the operating conditions of the latter, i.e. in particular by the fact that it is traversed by significant flowrates at very high pressure. The highpressure fluid that flows inside the channels of the valve stresses the components thereof, exerting a thrust action thereupon. This thrust action thus determines a substantially radial force towards the outside of the valve, which force substantially tends to move away from one another mutually adjacent valve components. More or less wide gaps are thus defined through which the fluid can flow and then exit the valve. The gaps are in particular formed in connecting zones between adjacent components. For example, the gap can be formed at a threaded connection, in which the thread and counter thread are moved away from one another by the radial force, thus enabling the fluid to pass. Or, the gap can be formed at a sealing element - for example a sealing washer of the O-ring type - that, due to the aforesaid radial force, no longer completely occupies the seat in which it is housed and thus enables the fluid to pass. Sometimes, the force that acts on the components is so high as to move away from one another the components until very large gaps are defined through which the sealing washers can be expelled from the respective seats.

[0012] According to current regulations, it is compulsory to arrange a load holding valve in machines that are used to lift loads, such as, for example, earth-moving

machines such as excavators.

[0013] Thus, correct operation of the aforesaid valves - without losses and/or leaks of the pressurised fluid- is fundamental for operating the machines safely with which these valves are associated.

[0014] US2009/249776-A1 discloses a lock valve, including a lock valve body having a bore with a valve spool reciprocatingly received therein and a check valve adjacent each end of the bore. Each of the check valves has a check valve member facing the bore and resiliently biased towards a valve seat at each end of the bore. A pressure relief port communicates with the bore near the centre thereof and between lands of the valve spool. A pair of spaced-apart grooves are disposed within the spool valve bore; each groove permits fluid communication past a land of the valve spool when the valve spool is displaced towards one end of the bore by fluid pressure applied to other end of the bore, so as to unseat the check valve member adjacent to one end to the bore and allow pressurized fluid to pass from the one end of the bore, through the groove, and into the relief port.

[0015] CN201021682-Y discloses a high performance sealing hydraulic lock, belonging to a fluid pressure execution mechanism. A lock valve core, a non-metal air-tight ring, a lock bracket and a slide valve are arranged inside the valve body whose two ends are air-tight. The air-tight ring is positioned between the lock valve core and the lock bracket and the slide valve penetrates the lock bracket; the inner side end surface of the lock valve core can press the air-tight ring on the air-tight end surface firmly under the action of the connected spring and/or oil pressure. The lock valve core and air-tight ring can separate from contact under the action of oil liquid and/slide valve, so that a channel can be formed between the oil inlet and the oil outlet.

[0016] US3665810-A discloses a holding valve for selectively preventing discharge flow from a hydraulic motor. The valve is biased to a closed position against the force of fluid tending to discharge from one side of the motor by discharge fluid acting on a piston formed integrally with the holding valve in addition to a spring also tending to close the valve. There is also provided an opposing pilot piston area on the holding valve, which, when pressurized, opens the valve permitting discharge flow from the associated hydraulic motor.

[0017] US3472261-A discloses a directional control valve with holding valve components and providing overload and thermal relief operation comprising: a valve body having a bore, pressure and tank ports connected to the bore, a directional control valve spool movable in the bore, a pair of control ports in the body connectable to a motor to be controlled, first and second flow paths in the body defined by passages extending from spaced-apart sections of the bore and to respective ones of the control ports. Each of the flow paths has a pair of branch passages in parallel and a pair of pilot operated poppet relief valves. Each flow path has: one of the relief valves in one branch, spring-loaded to closed position against a valve seat to oppose fluid flow entering the associated control port and has, in said closed position, a part thereof exposed to the associated control port to be responsive to motor fluid pressure acting against the spring-loading and in a direction exerting valve opening force; a check valve in the other branch of each of the paths, openable by pressure flow to the associated control port. Each of the relief valves has a pilot member and a pilot pressure passage leading from one flow path to the pilot member for the relief valve positioned in the one branch of the other flow path, to open the latter flow path when pressure fluid is in the first flow path.

[0018] EP0049034-A2 discloses a hydraulic sequencing valve, including a movable valve spool (36) within the body (10) to sequence operation of the valve. An aperture (120) through the spool (36) and within a chamber (42) is arranged for direct fluid communication with a tank port (26) upon initial movement of the spool (36) to increase the differential fluid pressure across the chamber (40) and a further chamber (42) and accelerate the sequencing movement of the spool (36).

[0019] One object of the invention is to improve known load holding valves.

[0020] Another object is to provide a very reliable load holding valve, in which the risk of losses and/or leaks of the pressurised fluid is significantly reduced and is thus such as to ensure secure operation of the machines with which the valve is associated.

[0021] A further object is to provide a load holding valve that does not require frequent maintenance, such as to minimise the costs bore by the user.

[0022] According to the invention, a valve as defined in claim 1 is provided.

[0023] The invention can be understood and implemented better with reference to the attached drawings, which show an embodiment thereof by way of non-limiting example, in which:

Figure 1 is a perspective view of a load holding valve according to the invention;

Figure 2 is a perspective and longitudinally sectioned view of the valve in Figure 1;

Figure 3 is a longitudinal section of the valve in figure 1;

Figure 4 is an enlarged, fragmentary and incomplete view of the valve in Figure 3;

Figure 5 is a hydraulic diagram of an example of a circuit comprising the valve according to the invention;

Figure 6 is a view like the one in figure 3 in which an element has been removed for the sake of clarity.

[0024] With reference to Figure 1, a valve 1 according to the invention is shown. The valve 1 comprises a body 2 provided with a plurality of openings through which the pressurised fluid can enter or exit the valve 1. These openings thus enable the valve 1 to be connected to a hydraulic circuit of a machine (that is not shown), for ex-

ample an earth-moving machine. In particular, a first opening 3, a piloting opening 4 and a draining opening 5 are visible, the function of which will be explained in detail below.

[0025] From the body 2, an end portion 6 projects that is arranged for connecting the valve 1 to the machine with which it is associated. In the end portion 6 a plurality of through holes 7 are provided that are suitable for receiving mechanical fixing means (not shown), for example screws, for connecting the valve 1 to the machine. The end portion 6 projects from the body 2 in such a manner that the valve 1, viewed laterally, is approximately "L"-shaped.

[0026] With reference to Figures 2 to 4, in the body 2 a first cavity 8 is made that extends substantially parallel to a first longitudinal axis A of the valve 1. The first cavity 8 comprises a plurality of portions, for example having a substantially cylindrical cross section, made in succession along the axis A. In particular, the first cavity 8 comprises a first portion 10, a second portion 11 (facing the opening 3), a third portion 12, a fourth portion 13 and a fifth portion 14. The various portions 10, 11, 12, 13, 14 can be of different sizes from one another, both longitudinally and radially.

[0027] At the second portion 11, in the body 2 an opening can be obtained that is closed by a threaded plug 45. With the latter a sealing washer 45a can be associated that prevents the pressurised fluid exiting the body 2 of the valve through this opening.

[0028] In the body 2 a second cavity 9 is further made that extends in a substantially parallel manner to a second longitudinal axis B of the valve 1, which is in turn substantially parallel to the axis A. Therefore, the first cavity 8 and the second cavity 9 are parallel to one another and extend longitudinally along the body 2 of the valve 1. The first opening 3 of the valve 1 communicates both with the first cavity 8 and with the second cavity 9.

[0029] The valve 1 comprises a containing element 16 received, at least partially, inside the first cavity 8 and fixed to the body 2 of the valve 1 by a threaded connection 17. On one portion of external side wall 16a of the containing element 16 a thread is made, arranged for coupling with a respective thread made on an internal side wall 10a of the first portion 10. The containing element 16, which is interiorly hollow, comprises an internal side wall 16b, opposite the external side wall 16a and defining a chamber 61 (that will be disclosed in greater detail below).

[0030] The containing element 16 comprises an internal portion 18, received in the first cavity 8 and extending longitudinally along the first portion 10 and the second portion 11, and an external portion 19 that projects outside the body 2 of the valve. Between the internal portion 18 and the external portion 19 a first sealing element 20 is arranged, for example an O-ring made of polymeric material, that surrounds the containing element 16 in an annular manner. The first sealing element 20 is housed in a seat 20a (Figure 4), which is obtained on the external side wall 16a of the containing element 16 and enables the first cavity 8 to be sealed. The internal portion 18 is provided with an end 21 (opposite the external portion 19), on which a plurality of passages is made. The latter are shaped as semicircular recesses and are made in succession on an end edge of the end 21, which is shaped like a hollow cylinder.

[0031] The valve 1 further comprises a closing element 46 that is received inside the second cavity 9 to close a corresponding end portion 9b of the latter. The closing element 46 is fixed to the body 2 of the valve 1 by a further threaded connection 47. On one portion of external side wall 46a of the closing element 46 a thread is made that is arranged for coupling with a respective thread made on an internal side wall 9a of the second cavity 9. With the closing element 46 a second sealing element 48 is associated, for example an O-ring made of polymeric material, that surrounds the closing element 46 in an annular manner. The second sealing element 48 is housed in a seat 48a (Figure 4), which is obtained on the external side wall 46a of the closing element 46 and enables the second cavity 9 to be sealingly closed.

[0032] To the closing element 46 an abutting element 49 is fixed, against which a movable seat 50 is kept pressed that is bush shaped (and thus internally hollow). The movable seat 50 comprises a pair of annular ridges 51 that contact the internal side wall 9a of the second cavity 9. A third sealing element 57 (for example, an O-Ring made of polymeric material) is interposed between the pair of annular ridges 51 to ensure a sealing closure. The movable seat 50 is movable in a two-directional manner along the directions X and Y, parallel to the second longitudinal axis B. As will be explained with greater detail below, the movable seat 50 is moved along the direction Y by the pressurised fluid whilst it is moved along the direction X owing to the presence of a spring 53 arranged outside the movable seat 50.

[0033] The position of the spring 53, which is outside the movable seat 50, is advantageous inasmuch as thus the spring 53 is less subject to stress - and thus to wear - compared with cases in which the spring 53 is arranged inside the movable seat 50. This is due to the fact that, in this latter case, the spring 53 is always immersed in the fluid that traverses the second cavity 9. Vice versa, the spring 53 is more protected - being affected only marginally by the flow of the fluid - when it is positioned outside the movable seat 50.

[0034] In the second cavity 9, at a further end portion 9c opposite the end portion 9b, a respective threaded plug 52 is received that closes the second cavity 9 on the side opposite the closing element 46. With the threaded plug 52 a sealing washer 52a can be associated that prevents the pressurised fluid exiting the second cavity 9 to the exterior.

[0035] Near the further end portion 9c, in the second cavity 9 a hole 54 opens extending around an axis C, which is transverse to a second longitudinal axis B. The second cavity 9 and the hole 54 are thus connected sub-

stantially orthogonally to one another. The hole 54 opens on an external wall 2a of the body 2 of the valve, thus defining a second opening 55 of the valve 1, through which the pressurised fluid can enter or exit the body 2 of the valve 1.

[0036] In the body 2, connecting means 58 (Figure 4) is made that is suitable for making the first cavity 8 and the second cavity reciprocally communicating. In particular, the connecting means 58 is suitable for making the portion 10 of the first cavity 8 and the end portion 9b of the second cavity 9 reciprocally communicating. The connecting means 58 is conduit-shaped and comprises a first portion 59 and a second portion 60 placed in sequence.

[0037] In the illustrated embodiment, the first portion 59 is made in the internal side wall 10a of the first portion 10 (of the first cavity 8) and extends obliquely with respect to the aforesaid internal side wall 10a.

[0038] Similarly, the second portion 60 is made in the internal side wall 9a of the second cavity 9 and extends obliquely with respect to the aforesaid internal wall 9a. Therefore, the first portion 59 and the second portion 60 meet and lead on to one another, defining an angle α that is substantially less than 90°.

[0039] It should be noted that, owing to the connecting means 58, the first cavity 8 and the second cavity 9 are made reciprocally communicating near the containing element 16 and the closing element 46. This means that components positioned inside the valve 1, such as, in fact the containing element 16 and the closing element 46, are stressed evenly by the high pressure of the fluid. In fact, the connecting means 58 ensures that inside the first cavity 8 and the second cavity 9, in particular respectively at the first portion 10 and the end portion 9b, the fluid exerts substantially identical pressure. In this manner, the radial forces are significantly reduced that tend to move away internal, and reciprocally adjacent, components of the valve 1.

[0040] In one non-illustrated embodiment, the connecting means 58 can comprise a conduit that extends substantially orthogonally to the first cavity 8 and/or to the second cavity 9.

[0041] In another non-illustrated embodiment, the connecting means 58 comprises a plurality of conduits made in the internal side walls 9a, 10a.

[0042] The first portion 59 leads into a zone of the internal side wall 10a immediately adjacent to the threaded connection 17. In the containing element 16 a passage 62 is made (which is more clearly visible in the enlargement in Figure 4), which is conduit-shaped and connects the internal cavity of the containing element 16, i.e. the chamber 61, with the exterior of the containing element, i.e. with the first cavity 8. The zone of the containing element 16 in which the passage 62 is made is selected in such a manner that the passage 62 faces the zone of the internal side wall 10a where the first portion 59 leads.

[0043] On the external side wall 16a seat means 63 is made, for example, shaped as an annular groove, which is arranged for receiving sealing means 64, for example a sealing washer made of polymeric material such as an O-ring. The seat means 63 is positioned near a zone interposed between the first portion 10 and the second portion 11, such that the sealing means 64 can prevent the passage of pressurised fluid - outside the containing element 16 - between the first portion 10 and the second portion 11 of the first cavity 8, which are thus sealingly separated. In fact, the zone of the internal side wall 10a into which the first portion 59 leads is interposed between the sealing means 64 and the first sealing element 20, whilst the sealing means 64 is interposed between the first opening 3 and the connecting means 58.

[0044] Similarly, the second portion 60 leads into a zone of the internal side wall 9a immediately adjacent to the further threaded connection 47. On the external side wall 46a further seat means 65 is made, for example shaped as an annular groove, arranged for receiving further sealing means 66, for example a sealing washer made of polymeric material such as an O-ring. The further seat means 65 is made on the external side wall 46a in such a manner as to be interposed between the first opening 3 and the second portion 60, such that the further sealing means 66 can prevent the passage of pressurised fluid from the second cavity 9 to the exterior of the valve. In fact, the zone of the internal side wall 9a where the second portion 60 leads is interposed between the further sealing means 66 and the second sealing element 48, whereas the further sealing means 66 is interposed between the first opening 3 and the connecting means 58.

[0045] The valve 1 further comprises an obturator 30, that extends substantially parallel to the first longitudinal axis A and is received inside the first cavity 8. In particular, the obturator 30 extends substantially from the second portion 11 to the fourth portion 13 and is movable in a two-directional manner according to the directions indicated by the arrows X and Y, parallel to the axis A. The obturator 30 is provided with a through central hole 31, for example cylindrical, that extends substantially over the entire length of the obturator and is traversable by the pressurised fluid. The obturator 30 comprises a plurality of portions, for example cylindrical portions that are connected together. In particular, the obturator 30 comprises a head portion 32, an intermediate portion 33 and an end portion 34, the intermediate portion 33 having a radial extent (i.e. a diameter) that is less than the head portion 32 and than the end portion 34. The head portion 32 and the end portion 34 have the same radial extent (i.e. the same diameter).

[0046] The containing element 16 encloses in the interior a portion of the obturator 30, and in particular part of the head portion 32. A side wall 32a (Figure 4) of the head portion 32 contacts the internal side wall 16b (of the containing element 16), on which a groove 40a is also made in which a fourth sealing element 40 is housed, which enables the end 21 of the containing element 16 to be sealingly separated from the chamber 61 defined inside the containing element 16.

[0047] The containing element 16 further encloses a spring 41 acting on a centring element 42 that presses on the obturator 30, in particular on a bottom wall 32b of the head portion 32. The centring element 42 has a substantially conical shape, that is complementary to the shape of the aforesaid bottom wall 32b, and ensures that the force exerted by the spring 41 on the obturator 30 is balanced, i.e. substantially directed along the axis A. The centring element 42 is provided with a further through central hole 42a, for example cylindrical, that extends substantially over the entire length of the centring element 42 and is traversable by the fluid directed towards the draining opening. The further central hole 42a communicates with the through central hole 31, thus enabling the fluid in the chamber 61 to reach, after traversing in succession the holes 42 and 31, the fifth portion 14, from where it then exits the body 2 of the valve by the draining opening 5. Here in particular a connecting opening 70 is made that enables the fluid that has traversed the through central hole 31 to lead into the annular portion 69 to direct itself towards the draining opening 5.

[0048] In this manner, owing to the holes 31 and 42a the end portions 10 and 9b - respectively of the first cavity 8 and of the second cavity 9 - are always connected to the tank. In other words, a drained region D is defined (shown in Figure 6, from which the spring 41 has been removed for reasons of clarity), comprising: the chamber 61, the passage 62, the connecting means 58, the annular zones situated outside the containing element 16 and the closing element 46. The fluid pressure cannot reach excessively high values in the drained region D, inasmuch as the latter is always connected to the draining opening 5. As said previously, the end portions 10 and 9b are maintained substantially at the same pressure owing to the connecting means 58. This pressure is maintained at limited values owing to the fact that the drained region D is connected to the draining opening 5 by means of the through central hole 31, the further central hole 42a and the passage 62.

[0049] The spring 41 is preloaded and is maintained compressed by a thrust element 43 which is fixed to the internal side wall 16b of the containing element 16 by a threaded coupling 67 (Figure 4). To the thrust element 43 a cover 44 is screwed, by acting on which an operator can adjust the preload of the spring 41.

[0050] The spring 41 and the centring element 42 are thus arranged in the chamber 61, which is therefore bounded by the thrust element 43, by the internal side wall 16b and by the head portion 32 of the obturator 30.

[0051] The third portion 12, in the illustrated embodiment, has a cylindrical cross section having a smaller diameter than the diameter of the first portion 10 and of the second portion 11. The third portion 12 is arranged for receiving a further movable seat 22 that is bush-shaped (and thus internally hollow). The further movable seat 22 comprises a pair of further annular ridges 23 that contact the walls of the third portion 12 so as to separate the second portion 11 and the third portion 12. A fifth sealing element 24 is interposed between the further annular ridges 23 to ensure a sealing closure. The further movable seat 22 is movable in a two-directional manner along the directions X and Y, parallel to the axis A. In particular, as will be explained with greater detail below, the further movable seat 22 is moved along the direction Y by the pressurised fluid and moves along the direction X owing to the presence of a further spring 25, arranged outside the further movable seat 22 and acting on the pair of further annular ridges 23.

[0052] The position of the further spring 25, which is outside the further movable seat 22, is advantageous inasmuch as the further spring 25 is less subject to stress - and thus wear - than the case in which the further spring 25 is arranged inside the further movable seat 22. This is due to the fact that, in this latter case, the further spring 25 is always immersed in the fluid that traverses the first cavity 8. Vice versa, the further spring 25 is more protected - being affected only marginally by the flow of fluid - when it is positioned outside the further movable seat 22.

[0053] Between the third portion 12 and the fourth portion 13, the first cavity 8 is traversed by a connecting channel 26, for example a cylindrical connecting channel 26, arranged transversely to the first cavity 8 and to the second cavity 9. The connecting channel 26 connects the first cavity 8 and the second cavity 9 and leads into an external wall 2b (Figure 2) of the body 2 of the valve. In the zone of the external wall 2b into which the connecting channel 26 leads a threaded plug 27 is provided that is equipped with a sealing washer 27a. The threaded plug 27 is arranged for engaging with a respective thread made on an end portion of the connecting channel 26, enabling the latter to be shut.

[0054] The fourth portion 13 receives the end portion 34 of the obturator 30, on the external side wall 34a of which an annular groove 34b is made that acts as a seat for a sixth sealing element 35, for example an O-ring. The external side wall 34a of the end portion 34 contacts the walls of the fourth portion 13 so as to separate the fifth portion 14 from the connecting channel 26.

[0055] The fifth portion 14 is the end part of the first cavity 8 and therefore leads into an external wall 2c (Figure 3) of the body 2 of the valve 1. In the zone of the external wall 2c into which the first cavity 8 leads a further threaded plug 36 is provided that is provided with a sealing washer 36a. The further threaded plug 36 is arranged for engaging with a respective thread made in the wall of the first cavity 8, enabling the latter to be shut.

[0056] In the fifth portion 14 a piloting piston 37 is received, provided with a shank 38 that projects from the piloting piston 37 to the end portion 34 of the obturator 30, in such a manner as to contact the latter. The piloting piston 37 does not completely occupy the fifth portion 14 but leaves an annular portion 69 thereof free that surrounds the shank 38 and is arranged for receiving, in use, fluid directed towards the draining opening 5 (Figure 3). In the fifth portion 14 a further chamber 68 is further de-

fined that is interposed between the piloting piston 37 and the further threaded plug 36. In the further chamber 68 the piloting opening 4 is opened, by means of which new pressurised fluid can be delivered that enables the valve 1 to be piloted, as will be explained with greater detail below.

[0057] On the side wall 37a of the piloting piston 37 a groove 37b is made that acts as a seat for a seventh sealing element 39, for example an O-ring, which sealingly separates the annular portion 69 from the further chamber 68. The piloting piston 37 is movable in a two-directional manner along the directions X and Y, parallel to the first longitudinal axis A, as will be explained with greater detail in the description of the operation of the valve 1.

[0058] The valve 1 further comprises an opening (not shown) leading into (for example) the connecting channel 26 and arranged for being connected, in use, to a pressure relief valve (not shown). The pressurised fluid can then exit the body of the valve through this opening when the pressure of the fluid reaches excessively high values.

[0059] Below, the operation of the valve 1 is disclosed, with particular reference to the case in which the valve is comprised in an earth-moving machine having a hydraulic circuit like the one shown in Figure 5.

[0060] When it is desired to lift a load, the pressurised fluid, for example an oil provided with suitable chemical and physical features, enters the valve 1 through the opening 3 communicating with both the first cavity 8 and with the second cavity 9.

[0061] Subsequently, the pressurised fluid entering the valve 1 is divided and conveyed along two alternative paths: a part of the fluid enters the first cavity 8 (in particular at the second portion 11 thereof), and the remaining part enters the second cavity 9.

[0062] The pressurised fluid (in particular the part that entered the first cavity 8) reaches the further movable seat 22 and moves the latter in the direction Y, thus moving the further movable seat 22 away from the end 21 of the containing element 16. This is due to the high pressures of the fluid, which are able to overcome the elastic force of the further spring 25, which on the other hand, in the absence of fluid, acts on the further movable seat 22, maintaining the latter abutting on the head portion 32 of the obturator 30.

[0063] The pressurised fluid then traverses the passage, which is defined between the further movable seat 22 and the head portion 32 and can thus flow, inside the further movable seat 22, through the third portion 12 of the first cavity 8 to reach the connecting channel 26, from which it then flows into the second cavity 9.

[0064] The fluid part that from the first opening 3 directly enters the second cavity 9 reaches the movable seat 50 and moves the latter in the direction Y, thus moving the movable seat 50 away from the abutting element 49. This is due to the high pressures of the fluid, which are able to overcome the elastic force of the spring 53, which on the other hand, in the absence of the fluid, acts on the movable seat 50, maintaining the latter abutting on the abutting element 49. The pressurised fluid then traverses the passage that is defined between the movable seat 50 and the abutting element 49 and can thus flow, inside the movable seat 50, into the second cavity 9.

[0065] The pressurised fluid that has traversed the body 2 of the valve 1 in the manner disclosed above thus reaches the hole 54 and exits the body 2 through the second opening 55, from which the fluid flows towards actuating means comprised in the machine, which is in this manner driven to lift the load. When it is desired to lower the load, the pressurised fluid exiting the actuating means enters the valve 1 through the second opening 55. Simultaneously, by the piloting opening 4 a further volume of pressurised fluid enters the body 2 and reaches - by a conduit that is not shown - the further chamber 68. This pressurised fluid pushes the piloting piston 37 in the direction X, in such a manner that the piloting piston 37 and the shank 38 in turn push the obturator 30 in the same direction X. This obturator 30 then moves along the direction X, overcoming the elastic force of the spring 41, which is thus compressed and maintained in this position as long as the pressurised fluid continues to supply the piloting opening 4 and the further chamber 68 is filled by the pressurised fluid. Thus, the obturator 30 is moved to the interior of the containing element 16, such that the head portion 32 of the obturator 30 no longer abuts on the end 21 of the containing element 16. In this manner, the end passages 21 are no longer closed by the head portion 32 and the pressurised fluid entering from the second opening 55 can traverse the aforesaid passages after having travelled through a portion of the second cavity 9, the connecting channel 26 and the third portion 12 of the first cavity 8, such as to exit the body 2 of the valve 1 through the first opening 3. When the pressurised fluid traverses the valve 1 in the manner disclosed above, it cannot reach the first opening 3 directly from the second cavity 9 because the movable seat 50 abuts on the abutting element 49, preventing the passage of the pressurised fluid.

[0066] When it is necessary to interrupt the lowering of the load, the pressurised fluid is no longer supplied to the piloting opening 4 and the residual pressurised fluid located inside the further chamber 68 is made to exit the body 2 of the valve through the piloting opening 4 by means of the piloting piston 37. The latter is moved in the direction Y by the thrust action of the obturator 30, which is in turn pushed by the spring 41, the elastic force of which is no longer contrasted by the pressurised fluid in the further chamber 68.

[0067] If, during the operation disclosed above of the valve 1 excessively high pressures are reached inside the body 2, a suitable quantity of pressurised fluid exits the body 2 through the opening connected to the pressure relief valve.

[0068] With reference to Figure 5, a hydraulic circuit 300 is shown, in which the valve 1 is shown inside a dashed square.

[0069] In the circuit 300 a pressurised fluid flows, for example an oil provided with suitable chemical and physical features, that is supplied from a tank 110 by a pump 120. The pressurised fluid first traverses a distributing valve 130 of known type (for example a four-way and three-position valve, shown in Figure 5 in a rest position) and is subsequently conveyed in actuating means 140, for example a double-acting hydraulic piston. The latter can be associated with an articulated arm (which is not shown) of the machine to command the raising and/or lowering thereof. An operator can command the actuating means 140 to raise or lower the articulated arm through control means 150, for example of the hydraulic type.

[0070] In order to raise the articulated arm, the operator drives the control means 150 in such a manner that the latter takes the distributing valve 130 to a first operating position (not shown). In Figure 5 the connection between the control means 150 and the distributing valve 130 - when the latter takes on the first operating position - is shown schematically by a dashed line indicated by the number 160.

[0071] When the distributing valve 130 is in the first operating position, the pressurised fluid leaving the distributing valve 130 travels along a conduit 190 and enters the valve 1 through the first opening 3. Subsequently, the pressurised fluid traverses the valve 1 - travelling along the first cavity 8 and the second cavity 9 - and exits the valve 1 through the second opening 55. Still subsequently, the pressurised fluid reaches the actuating means 140 by travelling along another conduit 200. The actuating means is thus driven and another fluid exits therefrom that reaches the tank 110 after traversing a further conduit 210 and the distributing valve 130 (arranged in the first operating position).

[0072] In order to lower the articulated arm, the operator drives the control means 150 in such a manner that the latter take the distributing valve 130 to a second operating position (not shown). In Figure 5, the connection between the control means 150 and the distributing valve 130 - when the latter adopts the second operating position - is shown schematically by a dashed line indicated by the number 170. In this manner the valve is piloted at the same time. In Figure 5, piloting of the valve 1 (disclosed previously), with consequent supply of a further volume of pressurised fluid to the body 2 through the piloting opening 4, is shown schematically by a dashed line 180.

[0073] When the distributing valve 130 is in the second operating position, the pressurised fluid exiting the distributing valve 130 travels along the further conduit 210 and enters the actuating means 140, driving the latter to lower the articulated arm. At the same time, from the actuating means 140 fluid exits that travels along the other conduit 200 and enters the valve 1 through the second opening 55. Subsequently, this fluid traverses the valve 1 - travelling through the first cavity 8 in the manner disclosed above - owing to the piloting and exits the valve 1 through the first opening 3. Still subsequently, the fluid exiting the valve 1 travels through the conduit 190 and reaches the tank 110 after having traversed the distributing valve 130 (arranged in the second operating position).

[0074] The valve 1 can be associated with any machine or apparatus, also different from an earth-moving machine, and having a hydraulic diagram different from that one disclosed, merely by way of example, with reference to Figure 5.

[0075] Owing to the invention it is possible to obtain a very reliable load holding valve, in which the risk of losses and/or leaks of the pressurised fluid is significantly reduced.

[0076] The valve 1 according to the invention is such as to enable safe operation of the machines with which it is associated, avoiding sudden and unexpected lowering in the supported load and thus avoiding damage to things and/or injury to people.

[0077] The connecting means 58 ensures that in the end portions 10 and 9b of the cavities 8, 9 pressure is maintained at substantially equal values. This prevents these portions of the valve being stressed by uneven thrusts - i.e. thrusts originated by uneven fluid pressure in the two end portions 10 and 9b - so as to avoid the losses and leaks that characterise known valves.

[0078] Owing to the presence of the drained region D - which is connected to the draining opening 5 by means of the through central hole 31, of the further central hole 42a and of the passage 62 - the pressure of the fluid in the end portions 10 and 9b cannot reach high values. Owing to this, these end portions 10 and 9b are not excessively stressed by the pressure of the fluid, which ensures correct operation of the valve and minimises the risk of faults or malfunctions of the latter.

[0079] Further, the sealing means 64 and the further sealing means 66 cooperate with the through central hole 31, the further central hole 42a and the passage 62 to limit the pressure acting on the internal components of the valve 1 and thus the losses and/or leaks of pressurised fluid to the outside of the valve 1.

[0080] In this manner, the radial forces - which tend to move away from one another adjacent components of the valves 1 that are at the first portion 10 and the end portion 9b - are less. This enables losses and/or leaks of the pressurised fluid to the exterior of the valve 1 to be significantly reduced or even avoided. In this manner environmental pollution due to the dropping of pressurised fluid (which can be very polluting for the environment) onto the ground near the valve 1 can be significantly reduced or even avoided.

[0081] Owing to the sealing means 64 and to the further sealing means 66, the first sealing element 20 and the second sealing element 48 wear significantly less than known valves. Consequently, the valve 1 according to the invention requires maintenance intervals that are less frequent than those of known valves, with consequent money saving.

[0082] Variations on and/or additions to what has been disclosed and/or to what has been shown in the attached drawings are also possible.

Claims

1. Valve (1) comprising:

- a body (2) provided with a plurality of openings (3, 4, 5, 55) through which a pressurised fluid can enter, or exit, said valve (1);
- cavity means (8, 9, 26, 54) made in said body (2) and suitable for receiving said fluid, said cavity means (8, 9, 26, 54) comprising a first cavity (8) and a second cavity (9), said first cavity (8) comprising a portion (10) receiving a containing element (16) and said second cavity (9) comprising an end portion (9b) receiving a closing element (46);
- sealing means (64) housed in an external side wall (16a) of said containing element (16) and arranged for preventing said fluid from reaching said portion (10);
- further sealing means (66) housed in an external side wall (46a) of said closing element (46) and arranged for preventing said fluid from reaching said end portion (9b)

characterised in that it comprises connecting means (58) that is suitable for making said portion (10) and said end portion (9b) reciprocally communicating near said containing element (16) and said closing element (46), so that said containing element (16) and said closing element (46) are evenly stressed by the pressure of said fluid, and **in that** said sealing means (64) and said further sealing means (66) are interposed between said connecting means (58) and a first opening (3) comprised in said plurality of openings (3, 4, 5, 55), said first opening (3) communicating with said first cavity (8) and said second cavity (9).

2. Valve (1) according to claim 1, wherein said connecting means (58) is conduit-shaped.

3. Valve (1) according to claim 1, or 2, wherein said connecting means (58) comprises a first portion (59) and a second portion (60).

4. Valve (1) according to claim 3, wherein said first portion (59) is made in an internal side wall (10a) of said portion (10) and extends obliquely with respect to said internal side wall (10a).

5. Valve (1) according to claim 3, or 4, wherein said second portion (60) is made in an internal side wall (9a) of said end portion (9b) and extends obliquely with respect to said internal side wall (9a), so as to meet, and lead into, said first portion (59).

6. Valve (1) according to claim 4, or according to claim 5 as appended to claim 4, wherein in said containing element (16) a passage (62) is made, which is conduit-shaped and connects the inside of said containing element (16) with the outside of said containing element (16), said passage (62) facing the zone of said internal side wall (10a) into which said first portion (59) leads.

7. Valve (1) according to any one of claims 4 to 6, wherein said containing element (16) comprises an internal portion (18), which is received in said first cavity (8), and an external portion (19), which projects outside said body (2); said containing element (16) being annularly surrounded by a first sealing element (20), which is arranged between said internal portion (18) and said external portion (19) and enables said first cavity (8) to be sealingly closed; said zone of said internal side wall (10a) into which said first portion (59) leads being interposed between said sealing means (64) and said first sealing element (20).

8. Valve (1) according to any one of claims 5 to 7, wherein with said closing element (46) a second sealing element (48) is associated that annularly surrounds said closing element (46) and enables said second cavity (9) to be sealingly closed, the zone of said internal side wall (9a) into which said second portion (60) leads being interposed between said further sealing means (66) and said second sealing element (48).

Patentansprüche

1. Ventil (1) aufweisend:

- einen Körper (2), welcher eine Vielzahl von Öffnungen (3, 4, 5, 55), durch welche ein unter Druck stehendes Fluid in dieses Ventil (1) ein- oder austreten kann, aufweist;
- Hohlräume (8, 9, 26, 54), welche in diesem Körper (2) angeordnet sind und welche zur Aufnahme dieses Fluids eingerichtet sind, diese Hohlräume (8, 9, 26, 54) weisen einen ersten Hohlraum (8) und einen zweiten Hohlraum (9) auf, dieser erste Hohlraum (8) weist einen Abschnitt (10) zur Aufnahme eines Aufnahmeelements (16) auf und dieser zweite Hohlraum (9) weist einen Endabschnitt (9b) zur Aufnahme eines Abschlusselements (46) auf;
- eine Einrichtung zur Abdichtung (64), welche in einer äußeren Seitenwand (46a) dieses Aufnahmeelements angeordnet ist und welche da-

zu eingerichtet ist, zu verhindern, dass dieses Fluid diesen Abschnitt (10) erreicht;
- eine weitere Einrichtung zur Abdichtung (66), welche in einer äußeren Seitenwand (46a) dieses Abschlusselements angeordnet ist und welche dazu eingerichtet ist, zu verhindern, dass dieses Fluid diesen Endabschnitt erreicht;

dadurch gekennzeichnet, dass
dieses Ventil (1) eine Einrichtung zur Verbindung (58) aufweist, welche dazu eingerichtet ist diesen Abschnitt (10) und diesen Endabschnitt (9b) gegenseitig in der Nähe dieses Aufnahmeelements (16) und dieses Abschlusselements miteinander zu verbinden,
so dass dieses Aufnahmeelement (16) und dieses Abschlusselement (46) gleichmäßig mit dem Druck dieses Fluids beaufschlagbar sind, und
dass diese Einrichtung zur Abdichtung (64) und diese weitere Einrichtung zur Abdichtung (66) zwischen dieser Einrichtung zur Verbindung (58) und einer ersten Öffnung (3) angeordnet ist und, dass ein Mehrzahl von Öffnungen (3, 4, 5, 55) diese erste Öffnung (3) aufweist, und
dass diese erste Öffnung (3) mit dieser ersten Hohlraum (8) und dieser zweiten Hohlraum (9) kommunizierend verbunden ist.

2. Ventil (1) nach Anspruch 1, **dadurch gekennzeichnet, dass**
die Einrichtung zur Verbindung (58) rohrförmig gestaltet ist.

3. Ventil (1) nach einem der Ansprüche 1 oder 2, **dadurch gekennzeichnet, dass**
diese Einrichtung zur Verbindung (58) einen ersten Abschnitt (59) und einen zweiten Abschnitt (60) aufweist.

4. Ventil (1) nach Anspruch 3, **dadurch gekennzeichnet, dass**
dieser erste Abschnitt (59) in einer inneren Seitenwand (10a) dieses Abschnitts (10) angeordnet ist und sich in Bezug auf diese innere Seitenwand (10a) schiefwinkelig zu dieser erstreckt.

5. Ventil (1) nach einem der Ansprüche 3 oder 4, **dadurch gekennzeichnet, dass**
dieser zweite Abschnitt (60) in einer inneren Seitenwand (9a) dieses Endabschnitts (9b) angeordnet ist und sich in Bezug auf diese innere Seitenwand (9a) schiefwinkelig zu dieser erstreckt, so dass er diesen ersten Abschnitt (59) trifft und in diesen einmündet.

6. Ventil (1) nach Anspruch 4 oder gemäß Anspruch 5 so wie dieser von Anspruch 4 abhängt, **dadurch gekennzeichnet, dass**
in diesem Aufnahmeelement (16) ein Durchtritt (62) angeordnet ist, welcher rohrförmig gestaltet ist und welcher die Innenseite dieses Aufnahmeelements (16) mit der Außenseite dieses Aufnahmeelements (16) verbindet,
dieser Durchtritt (62) ist auf diesen Bereich der inneren Seitenwand (10a) ausgerichtet, in welchen dieser erste Abschnitt (59) führt.

7. Ventil (1) nach irgendeinem der Ansprüche 4 bis 6, **dadurch gekennzeichnet, dass**
dieses Aufnahmeelement (16) einen inneren Abschnitt (18) aufweist, welcher in dieser ersten Hohlraum (8) aufgenommen ist und einen äußeren Abschnitt (19), welcher sich außerhalb dieses Körpers (2) erstreckt;
dieses Aufnahmeelement (16) ist ringförmig von einem ersten Dichtungselement (20) umgeben, welches zwischen diesem inneren Abschnitt (18) und diesem äußeren Abschnitt (19) angeordnet ist und welches es ermöglicht, dass diese erste Hohlraum (8) dichtend verschlossen ist;
dieser Bereich der inneren Seitenwand (10a), in welchen dieser erste Abschnitt (59) hineinführt, ist zwischen dieser Einrichtung zur Abdichtung (64) und diesem ersten Dichtungselement (20) angeordnet.

8. Ventil (1) nach irgendeinem der Ansprüche 5 bis 7, **dadurch gekennzeichnet, dass**
diesem Abschlusselement (46) ein zweites Dichtungselement (48) angehört, welches dieses Abschlusselement (46) ringförmig umgibt und welches es ermöglicht, dass diese zweite Hohlraum (9) dichtend verschlossen ist,
dieser Bereich der inneren Seitenwand (9a), in welchen dieser zweite Abschnitt (60) hineinführt, ist zwischen dieser weiteren Einrichtung zur Abdichtung (66) und diesem zweiten Dichtungselement (48) angeordnet.

Revendications

1. Valve (1) comprenant:

- un corps (2) pourvu d'une pluralité d'orifices (3, 4, 5, 55) par lesquels un fluide pressurisé peut entrer dans, ou sortir de, ladite valve (1) ;
- des moyens sous forme de cavité (8, 9, 26, 54) pratiqués dans ledit corps (2) et appropriés pour recevoir ledit fluide, lesdits moyens sous forme de cavité (8, 9, 26, 54) comprenant une première cavité (8) et une deuxième cavité (9), ladite première cavité (8) comprenant une portion (10) recevant un élément conteneur (16) et ladite deuxième cavité (9) comprenant une portion d'extrémité (9b) recevant un élément de fermeture (46) ;
- des moyens d'étanchéité (64) logés dans une

paroi latérale externe (16a) dudit élément conteneur (16) et agencés pour empêcher ledit fluide d'atteindre ladite portion (10) ;
- des moyens d'étanchéité supplémentaires (66) logés dans une paroi latérale externe (46a) dudit élément de fermeture (46) et agencés pour empêcher ledit fluide d'atteindre ladite portion d'extrémité (9b)

caractérisée en ce qu'elle comprend des moyens de liaison (58) qui sont appropriés pour rendre ladite portion (10) et ladite portion d'extrémité (9b) réciproquement communicantes au voisinage dudit élément conteneur (16) et dudit élément de fermeture (46), de sorte que ledit élément conteneur (16) et ledit élément de fermeture (46) sont contraints uniformément par la pression dudit fluide, et **en ce que** lesdits moyens d'étanchéité (64) et lesdits moyens d'étanchéité supplémentaires (66) sont interposés entre lesdits moyens de liaison (58) et un premier orifice (3) compris dans ladite pluralité d'orifices (3, 4, 5, 55), ledit premier orifice (3) communicant avec ladite première cavité (8) et ladite deuxième cavité (9).

2. Valve (1) selon la revendication 1, dans laquelle lesdits moyens de liaison (58) ont la forme d'un conduit.

3. Valve (1) selon la revendication 1, ou 2, dans laquelle lesdits moyens de liaison (58) comprennent une première portion (59) et une deuxième portion (60).

4. Valve (1) selon la revendication 3, dans laquelle ladite première portion (59) est pratiquée dans une paroi latérale interne (10a) de ladite portion (10) et s'étend obliquement par rapport à ladite paroi latérale interne (10a).

5. Valve (1) selon la revendication 3, ou 4, dans laquelle ladite deuxième portion (60) est pratiquée dans une paroi latérale interne (9a) de ladite portion d'extrémité (9b) et s'étend obliquement par rapport à ladite paroi latérale interne (9a), de manière à rencontrer, et déboucher dans, ladite première portion (59).

6. Valve (1) selon la revendication 4, ou selon la revendication 5 comme annexe à la revendication 4, dans laquelle dans ledit élément conteneur (16) est pratiqué un passage (62), qui a la forme d'un conduit et qui relie l'intérieur dudit élément conteneur (16) avec l'extérieur dudit élément conteneur (16), ledit passage (62) faisant face à la zone de ladite paroi latérale interne (10a) dans laquelle ladite première portion (59) débouche.

7. Valve (1) selon l'une quelconque des revendications 4 à 6, dans laquelle ledit élément conteneur (16) comprend une portion interne (18), qui est reçue dans ladite première cavité (8), et une portion externe (19), qui se projette en dehors dudit corps (2) ; ledit élément conteneur (16) étant entouré de façon annulaire par un premier élément d'étanchéité (20), qui est agencé entre ladite portion interne (18) et ladite portion externe (19) et qui permet à ladite première cavité (8) d'être hermétiquement fermée ; ladite zone de ladite paroi latérale interne (10a) dans laquelle débouche ladite première portion (59) étant interposée entre ledit moyen d'étanchéité (64) et ledit premier élément d'étanchéité (20).

8. Valve (1) selon l'une quelconque des revendications 5 à 7, dans laquelle avec ledit élément de fermeture (46) est associé un deuxième élément d'étanchéité (48) qui entoure de façon annulaire ledit élément de fermeture (46) et permet à ladite deuxième cavité (9) d'être hermétiquement fermée, la zone de ladite paroi latérale interne (9a) dans laquelle débouche ladite deuxième portion (60) étant interposée entre lesdits moyens d'étanchéité supplémentaires (66) et ledit deuxième élément d'étanchéité (48).

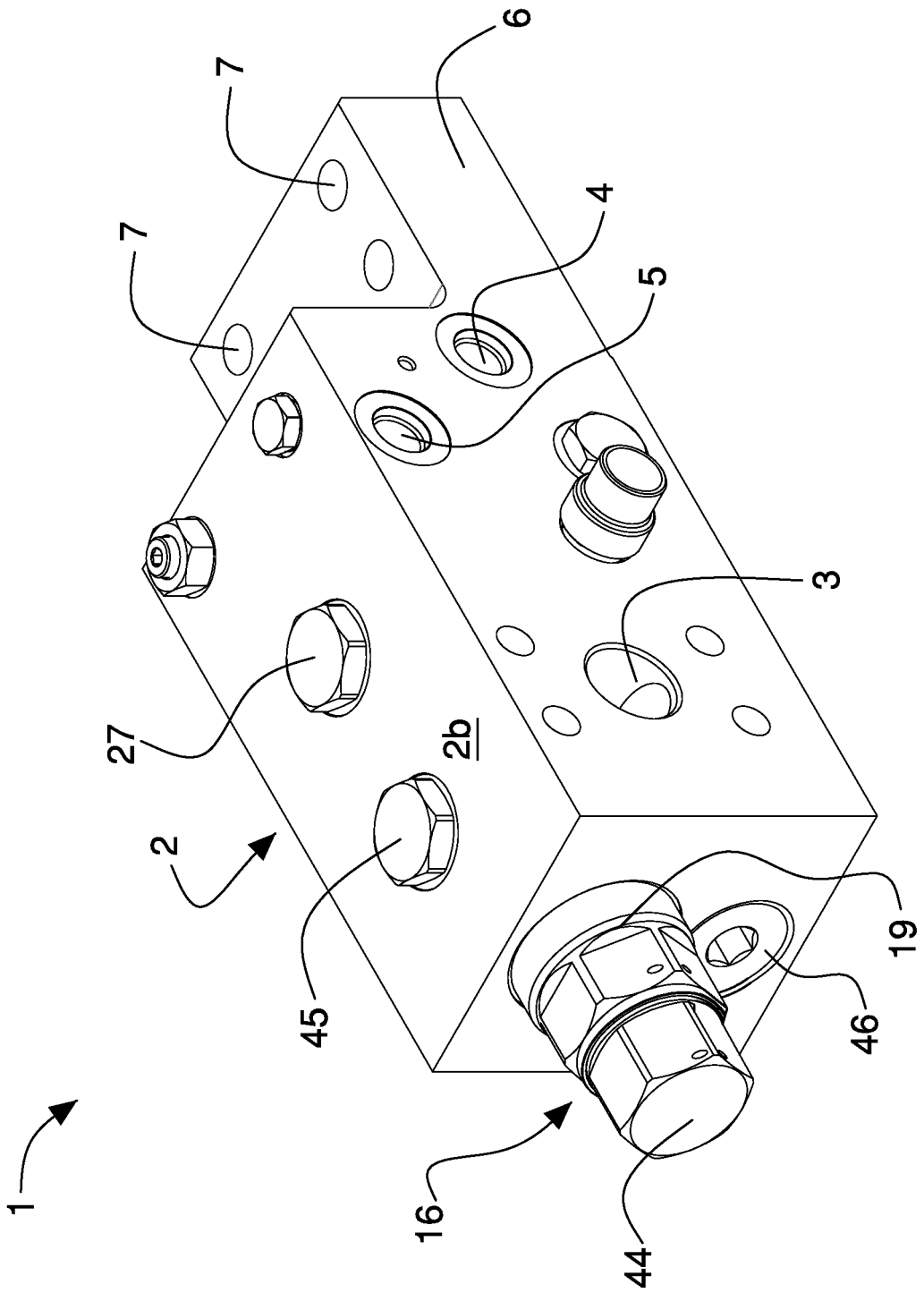


Fig. 1

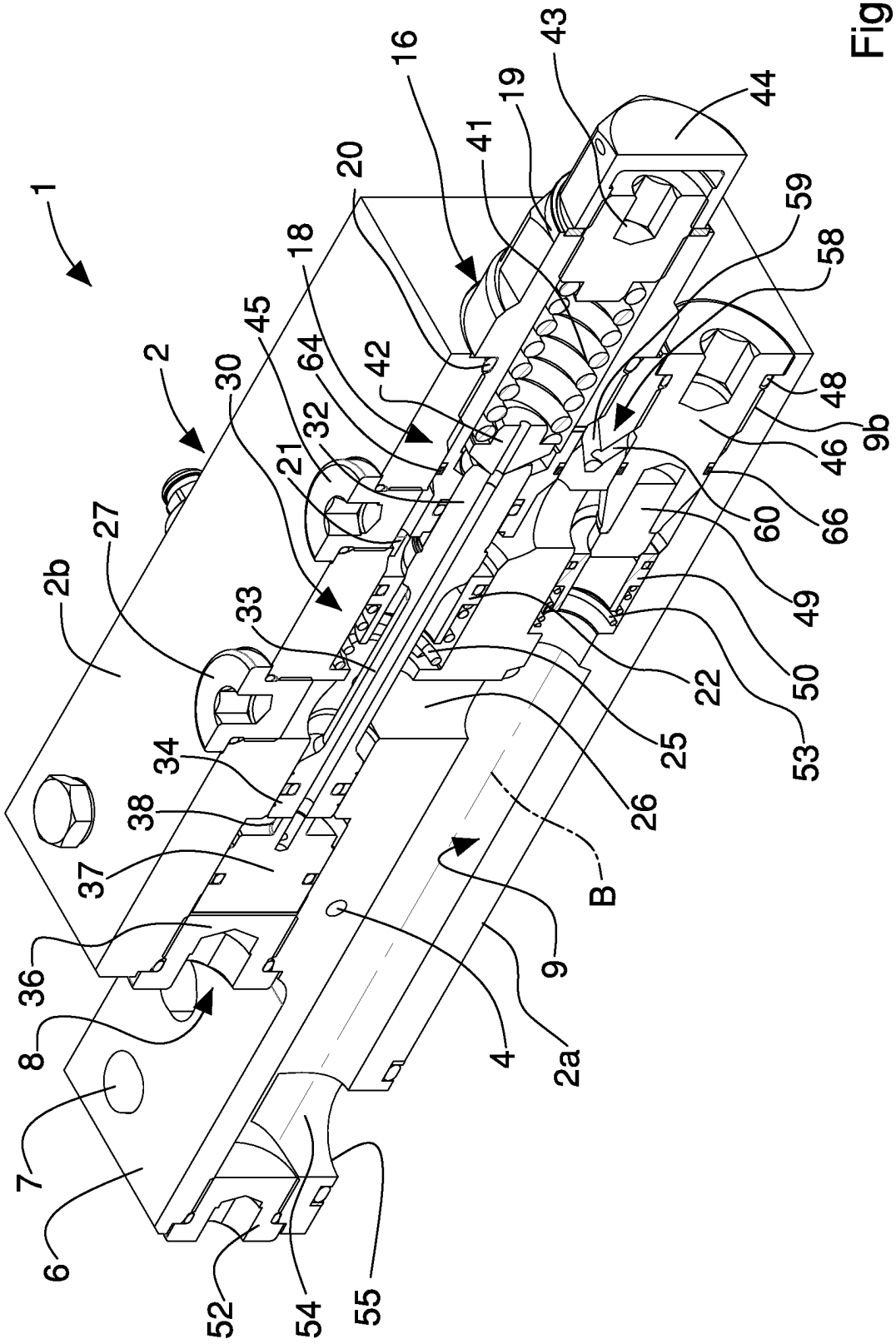

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Fig. 2

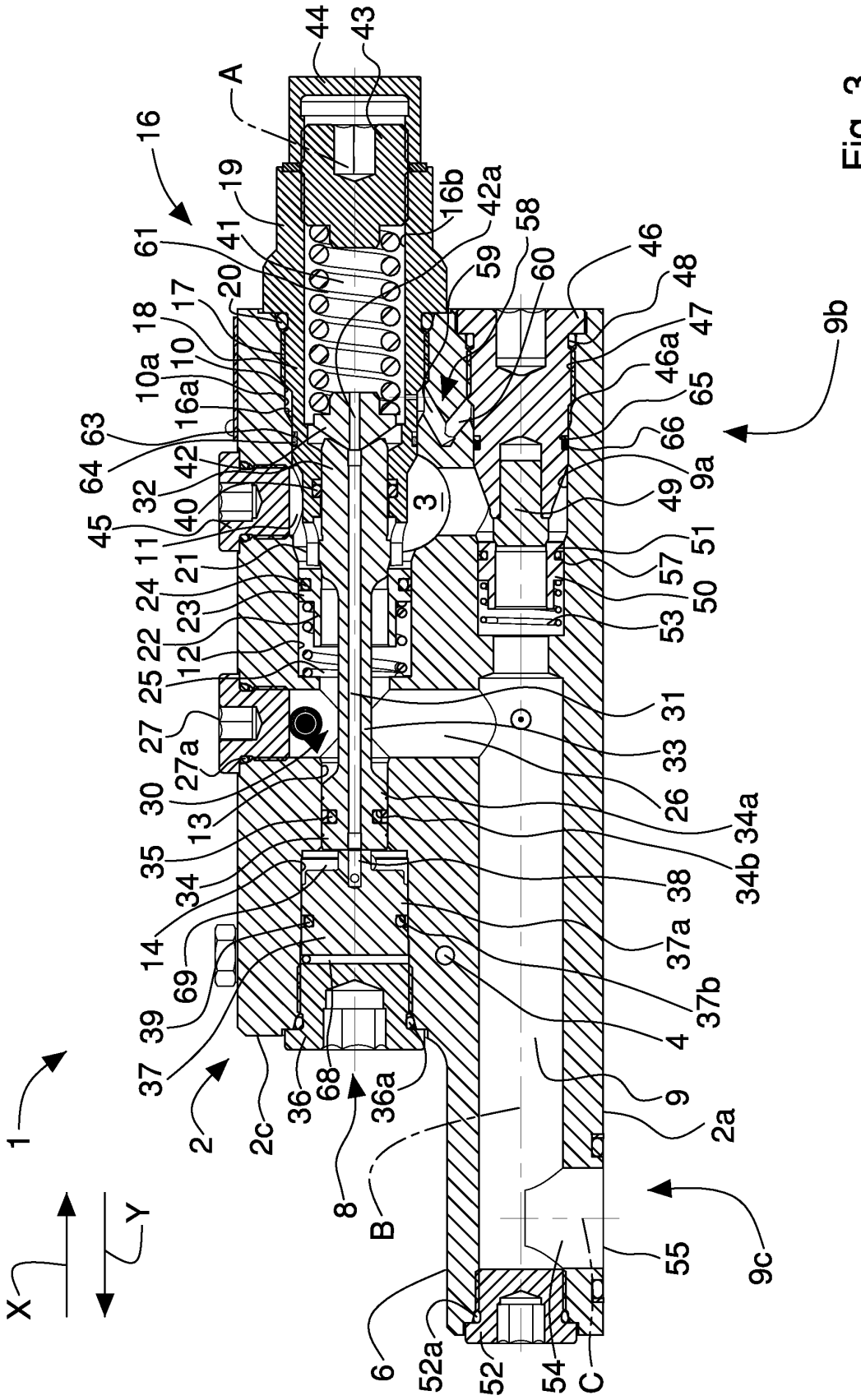

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Fig. 3

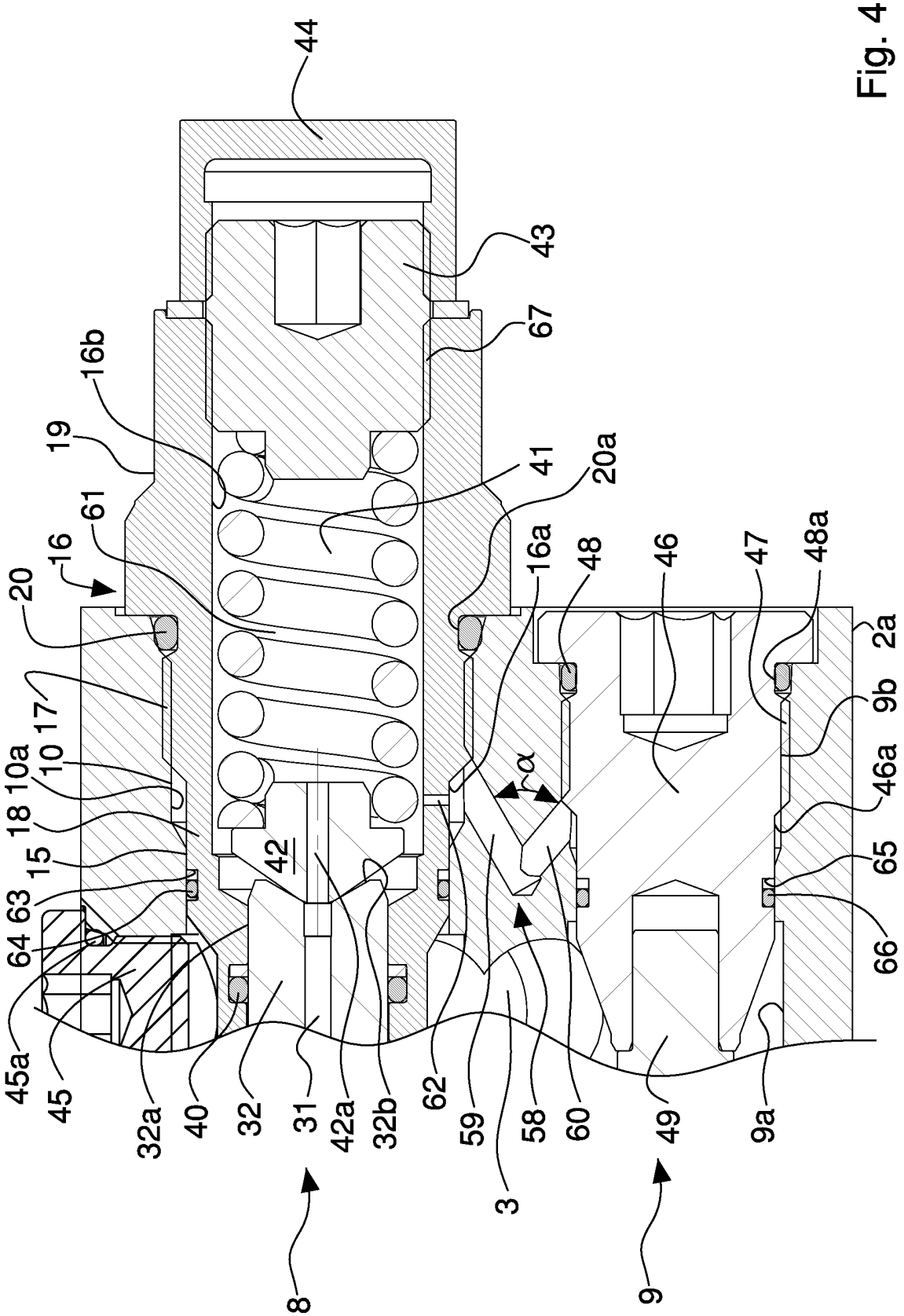

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16b
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16a
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46
47
48a
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2a
17
9b
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10a
18
46a
α
15
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63
64
66
45a
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8
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Fig. 4

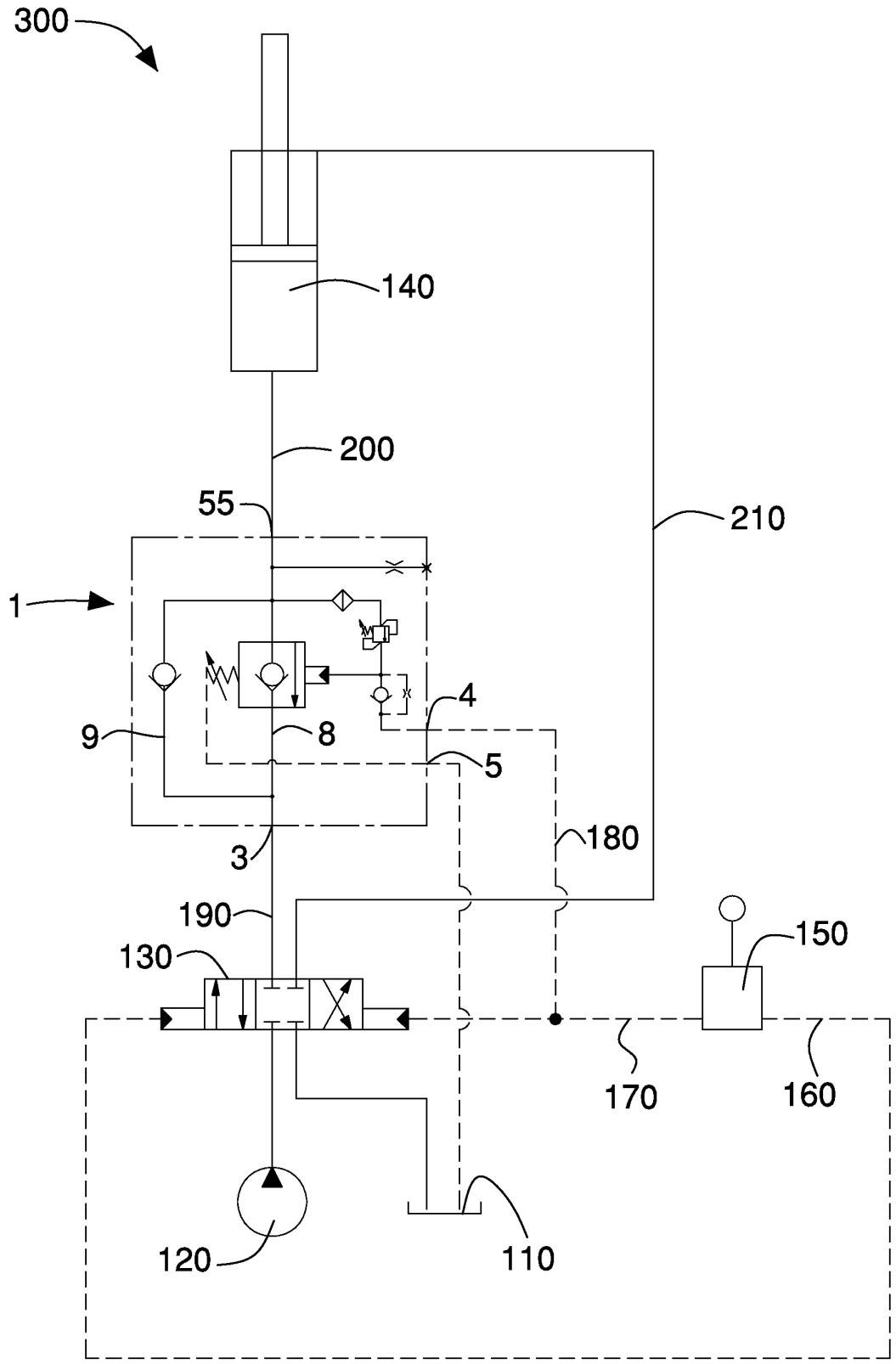


Fig. 5

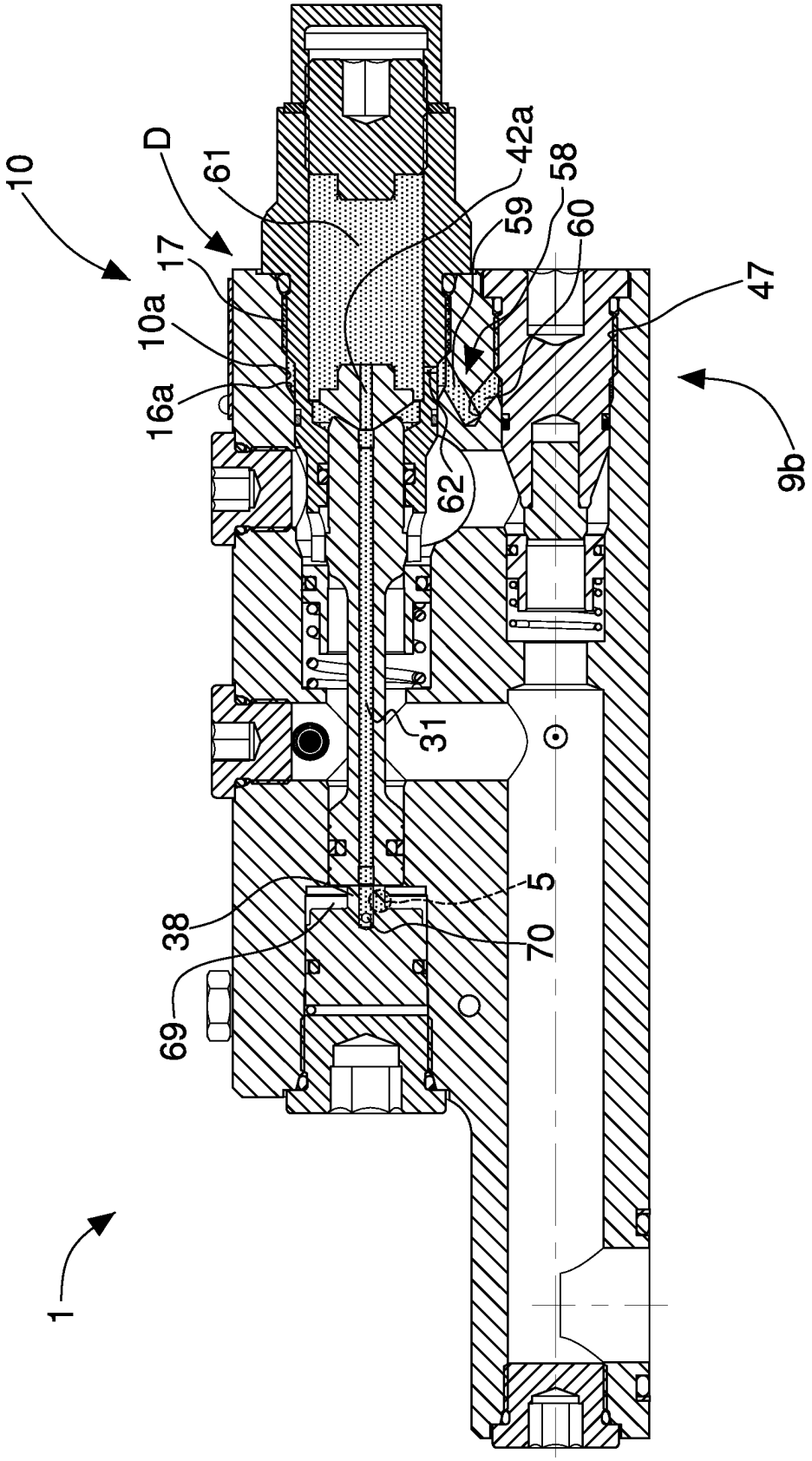


Fig. 6

REFERENCES CITED IN THE DESCRIPTION

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