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(71) Applicant: **Bosch Rexroth Oil Control S.p.A.**
20149 Milano (MI) (IT)

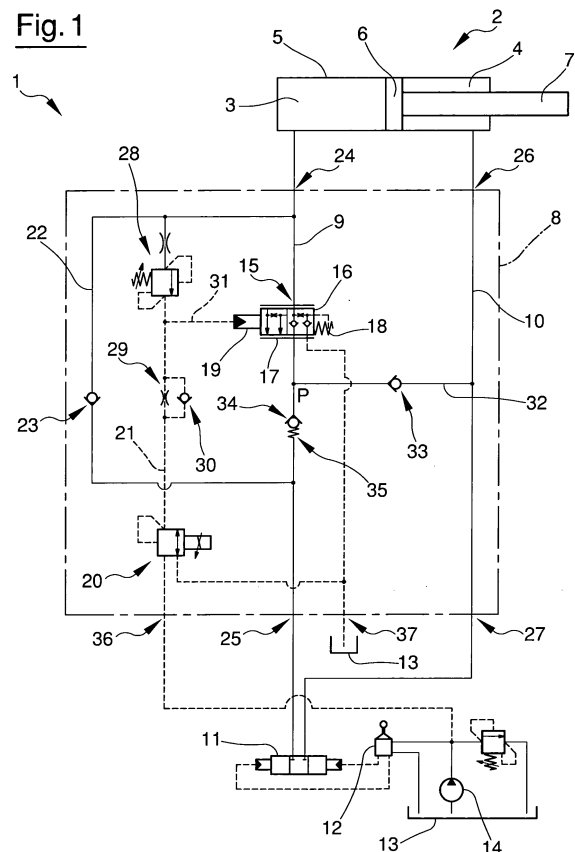
(72) Inventor: **Storci, Andrea**
41015 Nonantola (Modena) (IT)

(74) Representative: **Colò, Chiara**
BUGNION S.p.A.
Via M. Vellani, 20
41124 Modena (IT)

(54) **A hydraulic device for controlling an actuator.**

(57) A hydraulic device for controlling an actuator (2), comprises a body (8) having a first conduit (9; 109) destined to be connected to a first chamber (3) of the actuator (2), the body (8) having a second conduit (10; 110) destined to be connected to a second chamber (4) of the actuator (2), a control valve (15) being arranged along the first conduit (9; 109) in order to enable an operating fluid to be selectively discharged from the first chamber (3), the control valve (15) comprising an obturator element (16); the hydraulic device further comprises a pilot valve (20) for sending a pilot fluid to the control valve (15) such as to move the obturator element (16) in a controlled way, a component (34) having a hydraulic resistance being arranged along the first conduit (9; 109), the body (8) having a connecting conduit (32) connecting the first conduit (9; 109) and the second conduit (10; 110) in order to send the operating fluid coming from the first chamber (3) towards the second chamber (4).

Fig. 1



Description

[0001] The invention relates to a hydraulic device for controlling an actuator, in particular an actuator which moves an arm of a mobile work vehicle.

[0002] Work vehicles, such as for example excavators or lift trucks, usually comprise one or more arms supporting a work tool, for example a bucket, a fork or the like. Each arm is provided with an actuator cylinder which moves the arm between a raised position and a lowered position. In particular, when the arm is to be raised, an operating fluid is sent into a first chamber of the actuator cylinder, while a second chamber of the actuator cylinder is connected to a tank such as to discharge the operating fluid initially present in the second chamber. The opposite happens when the arm is to be lowered.

[0003] Known work vehicles often comprise a control valve, mounted near the actuator cylinder, which blocks the cylinder when the arm has reached a desired raised position. In particular, the control valve prevents the arm from moving downwards, for example due to leakage of operating fluid in the hydraulic components associated to the actuator cylinder, or from falling to the ground should a hydraulic component break, or an operator involuntarily activate a control organ, or other undesired accidental events occur.

[0004] The control valve can be gradually opened by the operator when the operator wishes the arm to move downwards in a controlled fashion. To this end, the operator acts on a manipulating organ, for example a joystick, arranged in the cabin of the work vehicle and connected via a control conduit to an obturator of the control valve.

[0005] By moving the manipulating organ, the operator pressurises the oil contained in the control conduit and displaces the obturator of the control valve into an open position. In this way, the arm is lowered.

[0006] Known work vehicles have a drawback in that by using the manipulating organ arranged in the cabin the operator can regulate the position of the control valve obturator only in a fairly imprecise way. It is not therefore possible to move the arm with close precision, as would be required in some types of application.

[0007] Further, in order to move the obturator, a relevant quantity of oil has to be pressurised, i.e. all the oil contained in the control conduit which connects the manipulator device to the control valve. This leads to rather long operative times, especially in a case in which the tool has just begun working and the oil is still relatively cold.

[0008] In known work vehicles the force of gravity is often used due to the weight of the arm, plus any load supported by the arm, in order rapidly to move the arm downwards. In other words, the arm is left to fall due to the action of gravity, while the operating fluid contained in the first chamber is rapidly discharged into the tank. However, if the operating fluid exits from the first chamber very rapidly, it might happen that the operating fluid can-

not equally rapidly fill the second chamber. In this case, when the tool arrives in contact with the ground, it is necessary to wait for a certain period of time before continuing work. This period of time is necessary for the operating fluid to completely fill the second chamber, after which the actuator cylinder can continue to push the arm downwards. The above-described phenomenon is known as actuator cylinder cavitation and undesirably lengthens the duration of the work cycle.

[0009] An aim of the invention is to improve hydraulic devices for controlling an arm of a work vehicle.

[0010] A further aim is to provide a hydraulic device which enables an operator to control with precision the position of the arm of the tool.

[0011] A further aim is to provide a hydraulic device which enables rapid control of the position of the arm in the work vehicle, i.e. with rapid response times.

[0012] A further aim is to reduce the duration of the work cycle of work vehicles which have at least an arm moved by an actuator.

[0013] According to the invention, there is provided a hydraulic device for controlling an actuator, which comprises a body having a first conduit destined to be connected to a first chamber of the actuator, the body having a second conduit destined to be connected to a second chamber of the actuator, a control valve being arranged along the first conduit in order to enable an operating fluid to be selectively discharged from the first chamber, the control valve comprising an obturator element, **characterised in that** it comprises a pilot valve for sending a piloting fluid to the control valve such as to move the obturator element in a controlled way, a component having a hydraulic resistance being arranged along the first conduit, the body having a connecting conduit connecting the first conduit and the second conduit in order to send the operating fluid coming from the first chamber towards the second chamber.

[0014] The pilot valve enables precisely regulating the position of the obturator element of the control valve, such that a desired flow rate of the operating fluid contained in the first actuator chamber is discharged through the control valve. If the actuator is used to move the arm of a work vehicle, by controlling flow rate of the operating fluid passing through the control valve it is possible to precisely control the position of the arm.

[0015] Further, since the pilot valve is included in the hydraulic device, the distance between the pilot valve and the control valve is relatively short. This enables a rapid modification of the position of the control valve obturator and thus a reduction in device response times.

[0016] Further, the hydraulic device of the invention is protected against the risk of emptying of the second chamber of the actuator. If the operating fluid contained in the first chamber is discharged too quickly, the connecting conduit sends the operating fluid directly from the first chamber to the second chamber, such as to keep the second chamber filled, even if a pump arranged externally of the hydraulic device cannot send operating

fluid into the second chamber sufficiently quickly. The component having a hydraulic resistance obstructs the discharging of the operating fluid, which is thus sent more easily into the connecting conduit. This enables cycle times to be reduced.

[0017] In a version of the invention, the control valve and the pilot valve are arranged in the same body of the hydraulic device.

[0018] This enables a very compact hydraulic device to be obtained, which can be mounted near the actuator, thus further reducing the response times.

[0019] Further characteristics and advantages of the invention will more clearly emerge from the detail description made herein below with reference to the accompanying figures of the drawings, provided purely by way of nonlimiting example, in which:

figure 1 is a diagram of a hydraulic device for controlling an actuator;

figure 2 is a diagram illustrating a hydraulic device like that of figure 1, in an alternative version.

[0020] Figure 1 illustrates a hydraulic device 1 for controlling an actuator 2, in particular in a mobile work vehicle.

[0021] The work vehicle can be, for example, a lift truck or an earth moving machine such as a digger. The actuator 2 can be used to move an arm of the work vehicle, for example a telescopic arm in the case of a lift truck or an oscillating arm in the case of an earth moving machine. The arm can be formed by several mutually-mobile parts, for example rotatable or slidable to one another, or it can be made of a single structure.

[0022] In general, the arm moved by the actuator 2 can support a work tool, for example a bucket, a backhoe or a fork.

[0023] The actuator 2 comprises a first chamber 3 and a second chamber 4, obtained for example internally of a cylinder 5. The first chamber 3 and the second chamber 4 are destined to receive an operating fluid, for example oil. The first chamber 3 and the second chamber 4 are separated by a piston 6, mobile inside the cylinder 5. A stem 7 associated to the arm (not illustrated) of the work vehicle is fixed to the piston 6.

[0024] In the illustrated example, the work tool is raised when the operating fluid is sent into the first chamber 3 and discharged from the second chamber 4, such that the stem 7 exits from the cylinder 5. Conversely, the work tool lowers when the operating fluid is sent into the second chamber 4 and discharged from the first chamber 3, such that the stem 7 penetrates internally of the cylinder 5.

[0025] It is however possible to use a different arrangement, not illustrated, in which the work tool is raised when the stem retracts into the respective cylinder, and vice versa.

[0026] The hydraulic device 1 comprises a body 8, inside which a first conduit 9 and a second conduit 10 are

obtained. The first conduit 9 opens onto the body 8 at a first opening 24 and a second opening 25. The second conduit 10 opens onto the body 8 at a further first opening 26 and a further second opening 27.

[0027] The first conduit 9 is destined to communicate with the first chamber 3 through the first opening 24, while the second conduit 10 is destined to communicate with the second chamber 4 through the further first opening 26. The first conduit 9 is connectable, through the second opening 25, to a distributor provided with a slide valve 11, shown only schematically in figure 1. The second conduit 10 is also connectable to the distributor via the further second opening 27.

[0028] Thanks to the distributor, the first conduit 9 and the second conduit 10 can be selectively connected to a main pump, not illustrated, or to a tank 13.

[0029] The distributor can be a three-way distributor, i.e. the slide valve 11 can be mobile among three working positions. In a first position, the slide valve 11 connects the first conduit 9 to the main pump and the second conduit 10 to the tank 13. In the first position, the tool is thus moved upwards. In a second position, by means of the slide valve 11 the first conduit 9 is connected to the tank 13 and the second conduit 10 is connected to the main pump in order to move the tool downwards. Finally, in a central position, interposed between the first position and the second position, both the first conduit 9 and the second conduit 10 are disconnected from the main pump.

[0030] The work vehicle comprises a command organ, for example a lever 12, arranged to move the slide valve 11 between the three above-described work positions. The lever 12 can be positioned in a cabin of the work vehicle such that the operator can reach the lever 12 when she or he is manoeuvring the vehicle. The lever 12 is inserted in a piloting circuit, represented by a broken line in figure 1, in which the piloting fluid circulates, for example oil. The piloting fluid can be taken from the tank 13 by means of an auxiliary pump 14. Alternatively, if the auxiliary pump 14 is not present, the piloting fluid can be removed from the line supplied by the main pump.

[0031] The hydraulic device 1 is mounted near the actuator 2. The body 8 of the hydraulic device 1 can be connected to the actuator 2 by means of short pipes which join the first conduit 9 to the first chamber 3 and the second conduit 10 to the second chamber 4. Alternatively, the hydraulic device 1 can be directly mounted on the actuator 2, for example by fastening the body 8 to a flange of the actuator 2 by means of threaded connecting elements. In both cases, the hydraulic device 1 is arranged externally of vehicle cabin.

[0032] The hydraulic device 1 comprises a control valve 15 arranged along the first conduit 9 for controlling the flow of the operating fluid in the first conduit 9. During use, the control valve 15 is interposed between the first chamber 3 of the actuator 2 and the distributor including the slide valve 11.

[0033] The control valve 15 comprises an obturator element 16, for example a slide valve. The obturator ele-

ment 16 is mobile internally of a seating 17, which can be cylindrical, in order to open and close the first conduit 9 gradually. In other words, the control valve 15 has a passage section which can be regulated such as to vary the flow rate of the operating fluid flowing from the first chamber 3.

[0034] A spring 18 contrasts the opening of the obturator element 16. The obturator element 16 is kept closed by the operating fluid pressure in the first conduit 9, even in the absence of forces applied by the spring 18.

[0035] A driving element 19, for example a piloting piston, acts on the obturator element 16 in the opposite direction to the spring 18. The driving element 19 is moved by the pilot fluid pressure, said pressure being provided and regulated by the pilot valve 20.

[0036] The control valve 15 acts like a block and flow rate control valve in order to block and/or control the flow rate of operating fluid through the first conduit 9. In other words, the control valve 15 enables the arm to be kept in a predetermined position, preventing it from moving, for example, in a downwards direction due to leakage through the hydraulic components of the work vehicle. The control valve 15 further prevents the arm from accidentally falling to the ground, for example if a pipe breaks or if a command organ is unintentionally operated.

[0037] By controlling the flow rate of operating fluid flowing through the first conduit 9, the control valve 15 further enables the controlled movement of the work vehicle arm and in particular the controlled descent of the arm towards the ground.

[0038] To this end, the hydraulic device 1 comprises a pilot valve 20 for controllingly sending the piloting fluid to the control valve 15, such as to move the obturator element 16. The pilot valve 20 can comprise a proportional valve, in particular a pressure control proportional valve, i.e. a valve which generates in outlet a piloting fluid pressure which is proportional to a command signal in input. The command signal in input can be an electric signal.

[0039] The pilot valve 20 is interposed between the control valve 15 and a pressurised circuit which sends the pilot valve 20 the piloting fluid at a relatively high pressure. The pressurised circuit can comprise the auxiliary pump 14. The piloting fluid which exits the pilot valve 20 has a variable pressure according to a predetermined law. The piloting fluid pressure in outlet from the pilot valve 20 can be selected by the operator via a selection device, for example a manipulator.

[0040] In this way, the operator can precisely regulate the piloting fluid pressure in outlet from the pilot valve 20. Consequently, it is possible to regulate the position of the obturator element 16 of the control valve 15 exactly, and therefore the flow rate of the operating fluid passing through the control valve 15. This enables precise control of the movement of the stem 7 and therefore the arm of the work machine.

[0041] The pilot valve 20 and the control valve 15 are both inserted into the body 8 of the hydraulic device 1.

Consequently the pilot valve 20 and the control valve 15 are connected to one another by means of a line 21 which is very short. Thanks to its shortness, the line 21 enables the pilot valve 20 to command the control valve 15 with no delay. The hydraulic device 1 thus has short response times.

[0042] A delivery conduit 22 is obtained internally of the body 8, which delivery conduit 22 starts from a first portion of the first conduit 9 and connects up to a second portion of the first conduit 9, such as to bypass the control valve 15. The delivery conduit 22 has thus a first end and a second end, both connected to the first conduit 9. A one-way valve 23 is arranged along the delivery conduit 22, which enables the operating fluid to flow only from the distributor towards the first chamber 3 and prevents the flow of operating fluid in the opposite direction.

[0043] The hydraulic device 1 further comprises a pressure limiter valve 28, interposed between the delivery conduit 22 and the line 21. As will be better explained herein below, when the pressure limiter valve 28 opens, it causes total opening of the obturator element 16 in order to prevent excessive build-up of pressure in the first chamber 3.

[0044] A choke device 29 is arranged along the line 21, in a position interposed between the pilot valve 20 and the pressure limiter valve 28. A further one-way valve 30 is included along the line 21, the further one-way valve 30 being mounted in parallel to the choke device 29 and being suitable for enabling a fluid flow only from the pilot valve 20 towards the control valve 15.

[0045] A branch 31 connecting the line 21 to the driving element 19 of the control valve 15 runs from a portion of the line 21 interposed between the choke device 29 and the pressure limiter valve 28.

[0046] The pressure limiter valve 28 is a normally-closed valve that opens when the operating fluid pressure in the first chamber 3 of the actuator 2 exceeds a predetermined limit value. This can happen, for example, because the tool has accidentally impacted against an obstacle such as a rock. If the pressure limiter valve 28 opens, the operating fluid present in the first chamber 3 passes into the line 21. The choke device 29 is so dimensioned that if the pressure limiter valve 28 opens, in the tract of line 21 interposed between the choke device 29 and the pressure limiter valve 28 a sufficient pressure is created to move the obturator element 16 via the branch 31, the obturator element 16 being brought into a completely open position. In this way, the operating fluid present in the first chamber 3 passes through the control valve 15 and exits the hydraulic device 1 through the second opening 25. The fluid is then discharged through the distributor, near which a further pressure limiter valve is arranged, not illustrated, which in turn opens. Thus excessive pressures are not generated in the first chamber 3 of the actuator 2.

[0047] A connecting conduit 32 is obtained in the body 8, which connecting conduit 32 connects the first conduit 9 and the second conduit 10. The connecting conduit 32

starts from a point P on the first conduit 9, the point P being interposed between the control valve 15 and the second opening 25. A one-way valve 33 is arranged along the connecting conduit 32, which one-way valve 33 opens at low pressure to enable the operating fluid coming from the first chamber 3 and thus from the first conduit 9 to flow towards the second conduit 10. The one-way valve 33 can be uncalibrated, i.e. can be kept closed or open only by the difference between the pressures acting on an obturator organ the valve 33 is provided with.

[0048] The hydraulic device 1 further comprises a component 34 having a hydraulic resistance, the component 34 being arranged along the first conduit 9 in a position interposed between the point P and the second opening 25. The component 34 opposes the operating fluid flow from the first chamber 3 towards the second opening 25, i.e. towards the distributor, though without completely preventing said flow. The component 34 can comprise a non-return valve which opens at a relatively high pressure, for example 15 bar. To this end, the non-return valve is provided with a spring element 35, which has to be compressed by the operating fluid in order to open the non-return valve, such that the non-return valve opens only when the difference between the pressures acting on two opposite sides of the valve exceeds a predetermined level. If the pressure difference is less than the predetermined level, the component 34 is opposed to the operating fluid flow towards the second opening 25. The operating fluid is thus preferentially sent towards the second conduit 10 via the connecting conduit 32.

[0049] The one-way valve 33 and the component 34 act as an anti-cavitation device preventing the second chamber 34 from emptying when the operating fluid is made to flow rapidly out of the first chamber 3. This can happen when the arm of the work machine is moved downwards, exploiting the force of gravity due to the weight of the arm, the tool and any load supported by the tool. In this case, the operating fluid exits the first chamber 3 of the actuator 2 very rapidly, passes through the control valve 15, which is completely open, and is discharged by means of the distributor. However, the hydraulic resistance of the component 34 contrasts the flow of the operating fluid towards the distributor. The operating fluid is thus deviated along the connecting conduit 32, which has a lower hydraulic resistance, defined by the one-way valve 33 which opens at low pressure. The operating fluid passes from the connecting conduit 32 into the second conduit 10 and thus into the second chamber 4. In this way it is ensured that the second chamber 4 is filled with the operating fluid also when the operating fluid flow-rate delivered from the main pump towards the second chamber is lower than necessary for guaranteeing the filling of the second chamber 4.

[0050] Finally, the body 8 has an inlet 36 through which the piloting fluid supplied at high pressure, for example by the auxiliary pump 14, can be sent towards the pilot valve 20 and an outlet 37 through which any excess pi-

loting fluid is sent to the tank 13.

[0051] To improve the clarity of the figures of the drawings, and to prevent lines from superposing on one another, figure 1 illustrates two distinct tanks 13, although in reality the work machine comprises one only.

[0052] During functioning, the operator wishing to raise the arm activates the lever 12 such that the slide valve 11 of the distributor is brought into the first position, in which the first conduit 9 is connected to the main pump and the second conduit 10 is connected to the tank 13. The operating fluid enters the body 8 through the second opening 25 and passes through the delivery conduit 22, exits the first opening 24 and passes into the first chamber 3. At the same time the operating fluid in the second chamber 4 is discharged into the tank 13 through the second conduit 10 and the distributor. Consequently, the stem 7 exits the cylinder 5 and the arm is raised.

[0053] If on the other hand the arm is to be moved downwards, the operator moves the lever 12 into the second position, in which the slide valve 11 connects the first conduit 9 to the tank 13 and the second conduit 10 to the main pump. The operating fluid processed by the main pump enters the body 8 through the further second opening 27 and, after having run through the second conduit 10, enters the second chamber 4 of the actuator 2. At the same time the operating fluid is evacuated from the first chamber 3 via the first conduit 9 such that the stem 7 moves towards the inside of the cylinder 5.

[0054] The pilot valve 20 is used to command the displacement of the obturator element 16 of the control valve 15 into a desired position, such that the control valve 15 allows a precisely-determined flow rate of the operating fluid to pass. This brings the arm downwards in a controlled way.

[0055] If it is desired to move the arm downwards as quickly as possible, the pilot valve 20 positions the obturator element 16 in a completely open configuration and the operating fluid is discharged through the control valve 15 at maximum flow. The operating fluid is discharged through the distributor when the operating fluid pressure in the first conduit 9 is sufficient to overcome the force of the spring element 35. In the opposite case, a part of the operating fluid coming from the first chamber 3 goes into the connecting conduit 32, opens the one-way valve 33 and fills the second chamber 4. This prevents the second chamber 4 from emptying if the operating fluid exits the first chamber 3 very quickly. This ensures that when the work tool, falling by effect of the force of gravity, touches the ground, the second chamber 4 is already filled with operating fluid. Thus it is possible immediately to provide power to the work tool, by sending further operating fluid into the second chamber 4 by means of the main pump. The work machine cycle times can thus be significantly shortened.

[0056] Note that the body 8 housing the control valve 15 also houses the pilot valve 20 and the anti-cavitation device. This makes the hydraulic device very compact and enables the hydraulic device 1 to be mounted near

the actuator 2.

[0057] In other words, the hydraulic device 1 defines a sort of valve unit which enables the operating fluid flow from and towards the actuator 2 to be regulated.

[0058] Figure 2 shows a hydraulic device 101 in a further embodiment. The components of the hydraulic device 101 common to the hydraulic device 1 of figure 1 are denoted using the same reference numbers as used for figure 1, and are not further described in detail.

[0059] A first conduit 109, a second conduit 110 and a delivery conduit 122 are obtained in the body 8 of the hydraulic device 101. The first conduit 109 opens on the body 8 at a first opening 124 and a second opening 125. The first opening 124 is destined to be connected to the first chamber 3 of the actuator 2, while the second opening 125 is intended to be connected directly to the tank 13, without passing through the distributor.

[0060] The second conduit 110 opens on the body 8 at a further first opening 126 and a further second opening 127, destined to be connected respectively to the second chamber 4 of the actuator 2 and to the distributor including the slide valve 11.

[0061] Finally, the delivery conduit 122 has an end that opens on the body 8 at an inlet opening 40 destined to be connected to the distributor. A further end of the delivery conduit 122 joins the first conduit 109 at a point of the first conduit 109 that is interposed between the control valve 15 and the first opening 124.

[0062] When the work tool is to be lifted, the main pump sends the operating fluid into the delivery conduit 122 through the distributor and the inlet opening 40. The operating fluid passes from the delivery conduit 122 into the first conduit 109 and reaches the first chamber 3. At the same time, the operating fluid in the second chamber 4 is discharged through the second conduit 110.

[0063] If the work tool is to be lowered, the slide valve 11 is positioned such as to connect the main pump to the second conduit 110. Consequently the operating fluid is sent into the second chamber 4. At the same time, the control valve 15 is opened by the desired amount to enable the operating fluid to flow from the first chamber 3 towards the tank 13. If necessary, a part of the operating fluid coming from the first chamber can reach the second chamber 4 through the connecting conduit 32.

[0064] In the hydraulic device 101, the operating fluid coming from the first chamber 3 is thus discharged into the tank 13 without passing through the distributor. In this way the hydraulic resistance the operating fluid has to overcome in order to be discharged is reduced, as the hydraulic resistance defined by an eventual connecting line connecting the first conduit to the distributor is eliminated. This enables the duration of the work cycle to be reduced and the temperature of the operating fluid to be limited.

Claims

1. A hydraulic device for controlling an actuator (2), comprising a body (8) having a first conduit (9; 109) destined to be connected to a first chamber (3) of the actuator (2), the body (8) having a second conduit (10; 110) destined to be connected to a second chamber (4) of the actuator (2), a control valve (15) being arranged along the first conduit (9; 109) in order to enable an operating fluid to be selectively discharged from the first chamber (3), the control valve (15) comprising an obturator element (16), **characterised in that** it comprises a pilot valve (20) for sending a piloting fluid to the control valve (15) such as to move the obturator element (16) in a controlled way, a component (34) having a hydraulic resistance being arranged along the first conduit (9; 109), the body (8) having a connecting conduit (32) connecting the first conduit (9; 109) and the second conduit (10; 110) in order to send the operating fluid coming from the first chamber (3) towards the second chamber (4).
2. The hydraulic device of claim 1, wherein the control valve (15) and the pilot valve (20) are housed in said body (8).
3. The hydraulic device of claim 1 or 2, wherein the pilot valve (20) is a proportional valve.
4. The device of one of the preceding claims, wherein the pilot valve (20) is a proportional valve for pressure control in order to generate in outlet a pilot fluid pressure which is proportional to a command signal in input.
5. The device of one of the preceding claims, wherein the first conduit (9; 109) defines a first opening (24; 124) and a second opening (25; 125) on an external surface of the body (8), the first opening (24; 124) being intended to be connected to the first chamber (3), and wherein the connecting conduit (32) starts from a point (P) of the first conduit (9; 109), said point (P) being interposed between the first opening (25; 125) and the component (34) having a hydraulic resistance.
6. The device of claim 5, wherein said point (P) is interposed between the control valve (15) and the component (34) having a hydraulic resistance.
7. The device of claim 5 or 6, wherein the component (34) having a hydraulic resistance is a non-return valve which enables the operating fluid either completely or partially to flow from the first opening (24; 124) to the second opening (25; 125), a spring element (35) being associated to the non-return valve in order to open the non-return valve when the pres-

sure difference of the operating fluid at two opposite ends of the non-return valve is greater than a predetermined amount.

8. The device of claim 7, and further comprising a one-way valve (33) arranged along the connecting conduit (32) to enable the operating fluid to flow from the first conduit (9; 109) to the second conduit (10; 110), the one-way valve (33) being designed to open when at ends thereof a pressure difference is applied which is lower than the pressure difference required to open the non-return valve. 5
9. The device of one of the preceding claims, wherein a delivery conduit (22) is obtained in the body (8) for sending the operating fluid towards the first chamber (3), the delivery conduit (22) having a first end and a second end, both of which are connected to the first conduit (9) in order to by-pass the control valve (15). 10 15 20
10. The device of one of claims from 1 to 8, wherein a delivery conduit (122) is obtained in the body (8) for sending the operating fluid towards the first chamber (3) without passing through the control valve (15), the delivery conduit (122) having an end that opens on an external surface of the body (8) and a further end connected to the first conduit (109). 25
11. The device of one of the preceding claims, wherein a pressure limiter valve (28) is housed in said body (8) in order to discharge a part of the operating fluid from the first chamber (3) and pilot the control valve (15) when a pressure greater than a predetermined level is generated in the first chamber (3). 30 35
12. The device of claim 11, wherein the pressure limiter valve (28) is connected to the pilot valve (20) by a line (21), a choke device (29) being interposed along the line (21) for generating in output at the pressure limiter valve (28) a pressure which is sufficient to open the obturator element (16) of the control valve (15). 40
13. A mobile work vehicle, comprising an arm supporting a work tool, an actuator (2) for moving the arm and a hydraulic device (1) of one of the preceding claims for controlling the actuator (2). 45
14. A mobile work vehicle, comprising an arm supporting a work tool, an actuator (2) for moving the arm and a hydraulic device (1) according to claim 9 for controlling the actuator (2), wherein the first conduit (9) has a terminal portion which is connected to the first chamber (3) of the actuator (2) and a further terminal portion connected to a distributor device, the second conduit (10) having a terminal part connected to the second chamber (4) of the actuator (2) and a further 50 55

terminal part connected to the distributor device.

15. A mobile work vehicle, comprising an arm supporting a work tool, an actuator (2) for moving the arm and a hydraulic device (1) according to claim 10 for controlling the actuator (2), wherein the first conduit (109) has a terminal portion connected to the first chamber (3) of the actuator (2) and a further terminal portion connected to a discharge tank, the second conduit (10) having a terminal part connected to the second chamber (4) of the actuator (2) and a further terminal part connected to a distributor device, the end of the delivery conduit (122) which opens on the external surface of the body (8) being connected to the distributor device.

Fig. 1

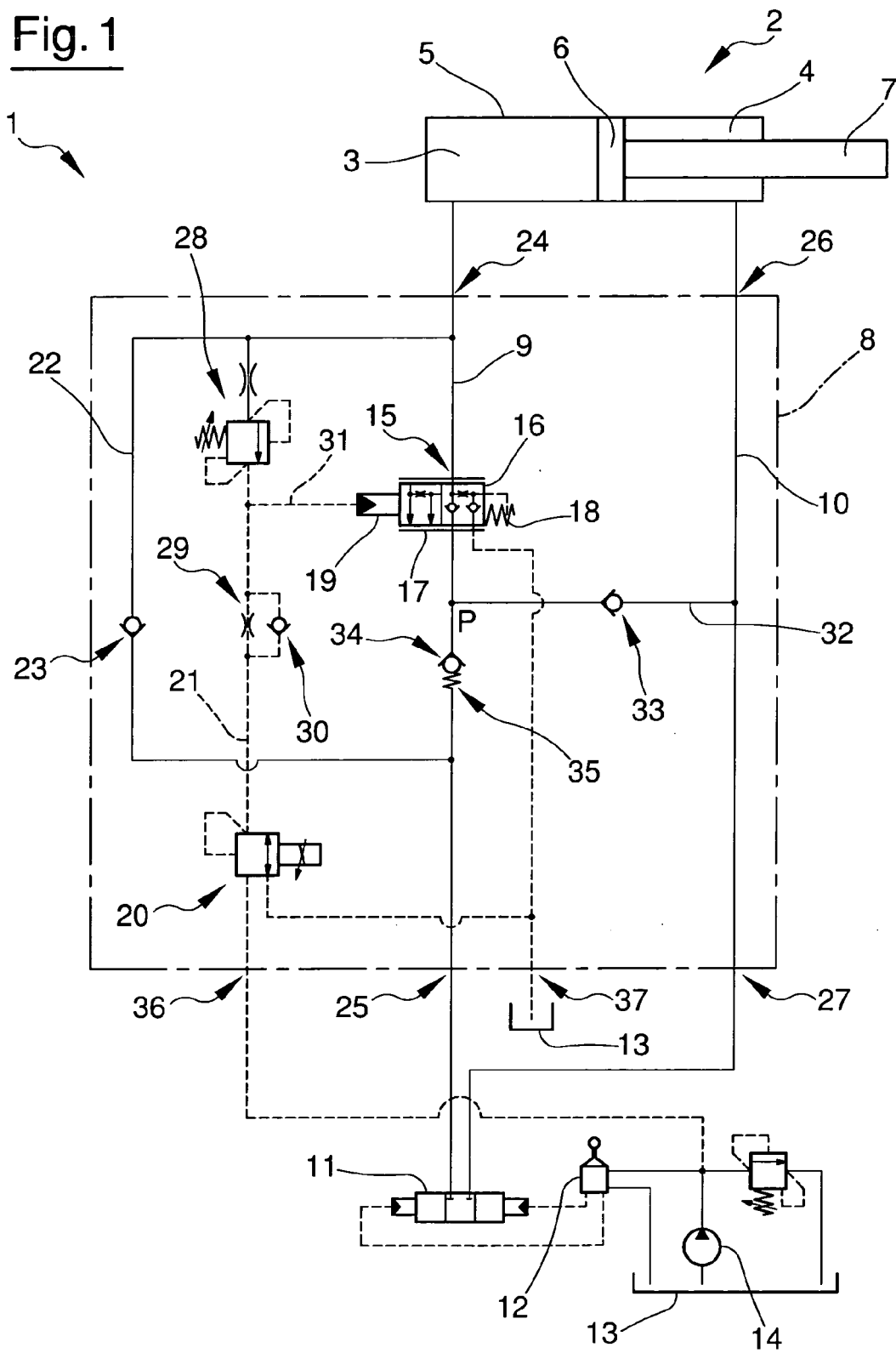
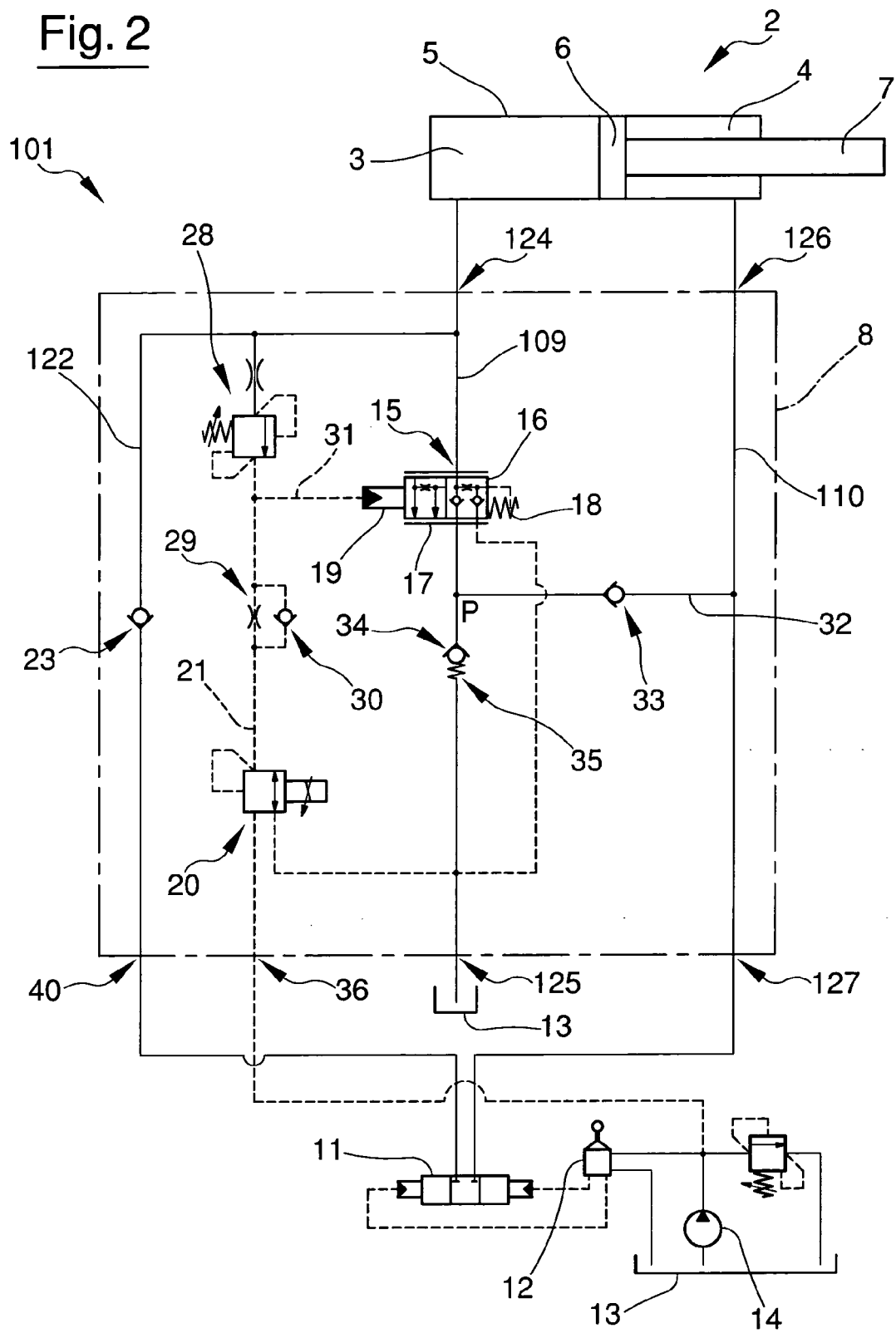


Fig. 2





EUROPEAN SEARCH REPORT

Application Number
EP 08 42 5741

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 26 March 2009	Examiner Toffolo, Olivier
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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