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(54) **Dual-effect hydraulic actuator handling system for gate moving**

(57) A system for handling gates and the like including a dual-effect hydraulic actuator (11) with a stem traversing one (11b) of its chambers and a supply circuit (14) controlled with oil which alternately moves the oil between the actuator chambers (11a, 11b) for an 'opening' or 'closing' movement. The circuit includes a pump (13) for transfer of the oil between the chambers through piloted locking one-way valves (19, 20), an oil tank (12) and two one-way suction valves (15, 16) each connected between the tank (12) and one of the two sides of the

pump (13) for allowing suction from the tank of the lacking oil. The suction valve (15) connected from the side of the pump opposite the actuator chamber (11a) not traversed by the stem is a one-way valve controlled in such a manner as to open thanks to an overpressure on the hydraulic circuit branch which is for supply of the actuator chamber (11b) traversed by the stem. In this manner the oil in excess during movement of the actuator which is caused by transfer of the oil from the stemless chamber (11a) to the chamber (11b) with stem is dumped into the tank (12).

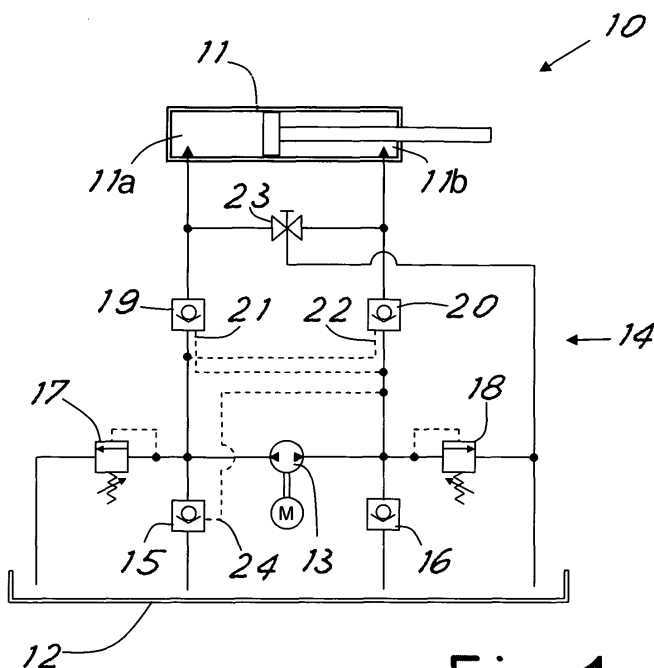


Fig. 1

Description

[0001] This invention relates to a dual-effect hydraulic actuator handling system for moving gates.

[0002] In hydraulic handling devices for gates a defect produced by the use of double-effect hydraulic actuators is noted. They have a difference of volume occupied by the fluid in the two hydraulic cylinder chambers because of the volume part occupied by the piston stem.

[0003] During the 'opening' handling, the stemless chamber is emptied and the stem-traversed chamber is filled. This causes excessive oil (equal to the volume of the stem) which must be returned into the tank. This is possible only through a not completely closed by-pass valve. In the contrary case, overpressures are observed upon suction which tend to 'suffocate' the pump and slow down the actuator in an anomalous manner. The setting of the by-pass valve must therefore allow for this fact and it is not possible for example to take advantage of the maximum thrust of the operator, which would be useful especially with very heavy gates. In addition, the setting of the by-pass valve becomes very delicate and a slight unsetting thereof, always possible especially under onerous outside conditions (for example high thermal changes), compromises the regular operation of the operator, causing jerking and blocking of the movement under load.

[0004] The general purpose of this invention is to avoid the above disadvantages by making available a handling system with dual-effect piston which would allow in a simple, economical and reliable manner compensation of the oil excess. Another purpose is to realize this without interfering with the operation of the by-pass valve.

[0005] In view of this purpose it was sought to provide in accordance with the present invention a system for handling gates and the like including a dual-effect hydraulic actuator with a stem traversing one of its chambers and a supply circuit controlled with oil which alternately moves the oil between the actuator chamber for an 'opening' or 'closing' movement with the circuit including a pump for transfer of the oil between the chambers through the piloted-lock one-way valves with an oil tank and two one-way suction valves each connected between the tank and one of the two sides of the pump for allowing suction from the tank of the lacking oil and characterized in that the suction valve connected from the side of the pump opposite the actuator chamber not traversed by the stem is a controlled one-way valve with control inlet connected to be taken in opening from an overpressure on the hydraulic circuit branch which is for supply of the actuator chamber traversed by the stem meaning allowing through said one-way valve dumping into the tank the oil in excess during movement of the actuator which is caused by transfer of the oil from the stemless chamber to the chamber containing the stem.

[0006] To clarify the explanation of the innovative principles of the present invention and its advantages compared with the prior art there is described below with the

aid of the annexed drawings a possible embodiment thereof by way of non-limiting example applying said principles. In the drawings:

FIG 1 shows a hydraulic diagram of the handling system in accordance with this invention, and FIG 2 shows a view of a piloted valve unit which realizes part of the system of FIG 1.

[0007] With reference to the figures, FIG 1 shows diagrammatically a handling system designated as a whole by reference number 10 realized in accordance with this invention and in particular for handling of gates and the like. The system has a dual-effect hydraulic actuator 11, an oil tank 12, a powered pump 13 and hydraulic circuitry 14 for control of the actuator.

[0008] The hydraulic circuit includes and in good part is symmetrical with two supply branches of the two chambers 11a and 11b of the actuator to control, depending on the pump direction, the opening or closing movement of the actuator (that is, respectively the leftward or rightward movement of the actuator as shown in FIG 1). The pump is connected on each side to a respective one-way suction valve 15, 16 which draws from the tank 12 and to a respective by-pass valve 17, 18 which replaces the oil in the tank when the oil pressure exceeds the valve setting pressure. Each side of the pump is also connected through a respective cutoff valve 19, 20 to one of the two actuator chambers. Each cutoff valve 19, 20 is realized with a one-way valve releasable in the opposite direction through a piloting inlet 21, 22 controlled by the inlet pressure to the other cutoff valve.

[0009] Advantageously the circuit also calls for a manual release tap 23 which connects the two chambers of the actuator directly to the tank 12 to allow manual handling of the actuator if necessary.

[0010] In accordance with the principles of this invention the suction valve 15 connecting the chamber 11a of the actuator opposite the stem is a one-way valve releasable by means of a piloting inlet 24 connected to the hydraulic circuit branch supplying the opposite chamber 11b of the actuator containing the stem. In particular this piloting inlet 24 is connected between the pump and the cutoff valve 20.

[0011] Operation of the circuit is as follows.

[0012] In the opening step (leftward movement of the actuator) the pump is driven to suck the fluid from the left chamber 11a and shift it into the right-hand chamber 11b, in which there is the actuator stem. There will therefore be an excess of oil to be dumped into the tank. Along the delivery duct toward the chamber 11b, pressure higher than atmospheric is generated, pressure which can reach for example 40 bar. Through the piloting duct 24 this overpressure is brought back to the suction valve 15, which is set to be unblocked by said overpressure so as to allow the excess oil arriving from the chamber 11a of the hydraulic cylinder (along the left-hand branch of the circuit) to flow into the tank through the valve 15.

[0013] In the closing step (rightward movement of the actuator) the valve 15 behaves instead like a normal one-way suction valve since the pressure in the right-hand branch of the circuit is no longer sufficient to control release of the valve 14 appropriately set. Indeed, the right-hand branch of the circuit is now the one of return and no longer of delivery. In this step, the valve 15 only allows passage of the oil from the tank to the circuit to compensate for the volume of the stem.

[0014] It is thus clear how the piloted suction valve 15 allows a more satisfactory operation of the actuator in allowing return of the excess oil to the tank independently of the adjustment of the by-passes, whose setting thus influences only the adjustment of the force of the actuator. In particular, the by-pass valves are set for an opening pressure safely higher than the commanded opening overpressure of the suction valve 15.

[0015] FIG 2 shows practical realization of the valve 15. In the figure with 25 and 26 are indicated the two fluid inlet or outlet ducts. The valve includes a one-way cutoff realized by a ball 27 which is pushed by a spring 28 to close the passage between the two ducts 25, 26. The thrust of the spring is such as to allow opening of the passage when there is the normal flow from the tank (duct 25) to the suction pump (duct 26).

[0016] On the same axis as the ball cutoff there is a small piston 31 which is movable toward the ball in the opening direction against the action of a second opposing spring 29 thanks to the pressure of the fluid arriving from the duct 24. The piston has one end or front pin 30 designed for thrust in opening of the ball 27. A plug 32 closes the seat of the valve while packing the various parts.

[0017] The spring 29 is set to allow movement of the piston until opening of the ball valve when the pressure in the control duct 24 reaches overpressure due to unbalance of the transferred oil volumes as mentioned above.

[0018] This way, when the handling system is set for opening, the overpressure carried into the valve from the duct 24 moves the piston 31 while compressing the spring 29 so that the front pin 30 moves the ball and the excess oil arriving from the hydraulic cylinder can traverse the valve and dump into the tank.

[0019] On the other hand, when the handling system is set for closing, the piloting system is completely deactivated since in the duct 24 there is not sufficient pressure to move the piston 31 and move the ball 27 in opening. The valve works this way as a normal one-way valve allowing only passage of the oil from the tank to the circuit to compensate for the stem volume.

[0020] The valve described can be easily integrated in a monobloc valve unit containing all the hydraulic circuitry of the handling system so as to have a strong and not cumbersome system. Using molding plastic for the valve of FIG 2 (except possible the small piston) this is a very economical device.

[0021] It is now clear that the preset purposes have been achieved. The device offers a series of considera-

ble advantages compared with a complexity moderately higher than a normal suction valve. First of all it allows high quickening of the opening step (that is, of return of the stem) which now uses approximately the same time as the closing step.

[0022] In addition, it enables working with completely closed bypasses while making use of the maximum thrust of the operator to the entire advantage of movement of very heavy gates. The more linear operation of the operator in the opening step is also ensured. The simplicity of operation makes it a strong, reliable device.

[0023] Naturally the above description of an embodiment applying the innovative principles of the present invention is given by way of non-limiting example of said principles within the scope of the exclusive right claimed here.

Claims

1. System for handling gates and the like including a dual-effect hydraulic actuator (11) with a stem traversing one (11b) of its chambers and a supply circuit (14) controlled with oil which alternately moves the oil between the actuator chambers (11a, 11b) for an 'opening' or 'closing' movement with the circuit including a pump (13) for transfer of the oil between the chamber through the piloted-lock one-way valves (19, 20) with an oil tank (12) and two one-way suction valves (15, 16) each connected between the tank (12) and one of the two sides of the pump (13) to allow suction from the tank of the lacking oil and **characterized in that** the suction valve (15) connected from the side of the pump opposite the actuator chamber (11a) not traversed by the stem is a controlled one-way valve with control inlet (24) connected to be taken in opening from an overpressure on the hydraulic circuit branch which is for supply of the actuator chamber (11b) traversed by the stem meaning allowing through said one-way valve (15) dumping into the tank (12) the oil in excess during movement of the actuator which is caused by transfer of the oil from the stemless chamber (11a) to the chamber (11b) containing the stem.
2. System in accordance with claim 1 **characterized in that** said controlled suction valve (15) has a control inlet (14) connected between the pump (13) and the cutoff valve (20) connected to the chamber (11b) containing the stem.
3. System in accordance with claim 1 **characterized in that** between each side of the pump (13) and the tank (12) is connected a respective bypass valve (17, 18) for dumping oil into the tank which is set for an opening pressure higher than the commanded opening overpressure of the one-way valve (15).

4. System in accordance with claim 1 **characterized in that** the controlled one-way valve (15) includes a cut-off formed by a closing ball (27) thrust to close by a spring (28) and a control piston (31) moved by a fluid pressure at the control inlet (24) to run axially against the action of an opposing spring (29) and push the ball (27) toward the opening position of the cut-off. 5
5. System in accordance with claim 1 **characterized in that** between the two chambers (11a, 11b) of the actuator and the tank there is a dumping tap (23) to allow manual handling of the actuator. 10

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