ABSTRACT

The invention relates to a method for operating a drive device for a dual-cylinder slurry pump and to a drive device for a dual-cylinder slurry pump, comprising two drive cylinders that are actuated by means of a fluid (1, 2), said cylinders alternately charging a common delivery line with slurry, in particular concrete, via a pipe switch (RW), in particular indirectly by means of driven delivery cylinders (FR, FL). According to the invention, the pipe switch is likewise actuated by means of a fluid using an actuator cylinder (SZ) and as early as the final displacement of the piston of each drive cylinder in its stroke, prior to said piston reaching its final position, at least part of the fluid stream that is provided to actuate the drive cylinder is used to actuate the actuator cylinder.
FIG. 2
EINKREISSYSTEM
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FIG. 3
ZWEI KREISSYSTEM
Stand der Technik
DRIVE DEVICE FOR A DUAL-CYLINDER SLURRY PUMP AND METHOD FOR OPERATING SAID PUMP

[0001] The present invention relates to a method for operating a dual-cylinder slurry pump and a drive device for a dual-cylinder slurry pump in accordance with the generic part of claim 1 and the generic part of claim 8.

[0002] Dual-cylinder slurry pumps are used, for example, to pump concrete. For this, the concrete is pumped over substantial heights and distances, e.g., via corresponding distributing masts. In such dual-cylinder slurry pumps, the delivery cylinders are connected via a switch, especially a pipe switch, to a common delivery line, with the switch alternately connecting the one or other delivery cylinder to the delivery line, such that overall the flow of slurry or concrete is virtually continuous.

[0003] However, the unavoidable changes of connection between the delivery cylinders to the common delivery line by means of the switch create brief interruptions in delivery during the switching operations.

[0004] This may be seen for example in the block diagram of FIG. 2, which shows an hydraulic drive for a dual-cylinder slurry pump with a pipe switch. This is a block diagram of a so-called single-circuit system in which the drive cylinders 1, 2 of the delivery cylinders FR, FL and the actuator cylinder SZ of the pipe switch are supplied with hydraulic oil by means of one supply device only or in which the working pressure is generated. This sole supply device has two pumps P1 and P2, which are connected via oil lines L1 and L2 to the switching block 3, which, depending on the operating status, makes the oil delivered by pumps P1 and P2 available to the drive cylinder 1 or the drive cylinder 2 for the delivery cylinders FR and FL via lines L4 or, via further lines L4a, to the actuator or swiveling cylinder SZ of the pipe switch RW.

[0005] However, relativly long switching operations occur here because it is only after a stroke of the drive cylinder 1 or 2 that the control block 3 switches such that the full pump capacity of the pumps P1 and P2 is made available to the actuator or swiveling cylinder SZ.

[0006] Only after the pipe has swivelled due to actuation of the actuator or swiveling cylinder SZ is the full pump capacity of the pumps P1 and P2 then made available again to the drive cylinders 1 or 2 by switching in the control block 3.

[0007] It is known from the prior art that such long switching times can be avoided with a so-called dual-circuit system (see FIG. 3) in which the pumps P1 and P2 are provided separately for the drive cylinders 1 and 2 of the delivery cylinders FR and FL on one hand, and for the actuator or swiveling cylinder SZ of the pipe switch RW on the other.

[0008] Thus, a so-called dual-circuit system has two independent pump devices, each having at least one pump P1 and P2. This means it is possible to actuate the delivery cylinders and the actuator cylinder(s) in parallel time to shorten the interruption in pumping.

[0009] However, the disadvantage here is the need for two separate pump devices, with pump P1 especially needing a design large enough to provide the necessary hydraulic volume flow to operate drive cylinders 1 and 2.

[0010] It is therefore the object of the present invention to ensure rapid switching of the switch for connecting the two delivery cylinders to the common delivery line, while minimizing the outlay on switching and the outlay on the hydraulic drive of the drive or delivery cylinders and of the actuator cylinder of the switch.

[0011] This object is solved by a method and a drive device having the characteristics of claims 1 and 8. Advantageous embodiments are the object of the dependent claims.

[0012] The invention draws on the knowledge that when a fluid, especially an hydraulic oil, is used to drive the drive cylinders or delivery cylinders of a dual-cylinder slurry pump, full drive power is no longer needed toward the end of the piston displacement, that is at the end of a stroke. Armed with this knowledge, it is possible to use the superfluous drive power to shorten the switching time in such a way that the superfluous drive power can already be used for the actuation of the switch, especially for the drive of a swiveling or actuator cylinder for a pipe switch. Consequently, it is no longer necessary to wait for the stroke in the drive or delivery cylinder to finish, but rather the switching operation and thus the actuation of the pipe switch can be initiated already before the end of a stroke.

[0013] For this purpose, the invention provides for monitoring or determining the position of the piston in the drive cylinder or delivery cylinder, and for locating it, at least in a certain position shortly before it reaches the final position, such that, starting with this information, some of the fluid volume flow, preferably hydraulic oil volume flow, can be made available for actuation of the actuator or swiveling cylinder of the switch.

[0014] The device employed for the determination may be of mechanical, electrical or hydraulic type, with the last-mentioned especially suitable when overall control over the drive proceeds largely by means of a fluid or hydraulic oil. In that case, it is a simple matter to use corresponding switching valves that are activated via known hydraulic control lines.

[0015] Further, in a preferred embodiment, a corresponding device for locating the piston position of the actuator cylinder of the pipe switch may be provided in order that this information may be used for the switching operation.

[0016] Preferably, the hydraulic switch may be constructed such that two pump devices are used for providing a corresponding fluid stream or operating pressure, which said pump devices, in a manner comparable to the dual-circuit system, are used primarily independently for the drive of the drive cylinders on one hand and for the drive of the actuator or swiveling cylinder for the switch on the other. On account of the idea of the invention, namely that the drive power for the drive or delivery cylinder no longer has to be 100% shortly before the necessary switching operation of the switch, the two independent pump devices may be combined with each other in a manner such that, during the stroke of the drive cylinder or the delivery cylinder, the second pump device makes its capacity available for the drive or delivery cylinder, whereas, shortly before the switching operation, the second pump device is used exclusively for actuation of the actuator or swiveling cylinder of
In this way, it is possible to use the pump or pump capacity of the drive effectively—and to use components of lower capacity.

Preferably, the drive is designed such that the operating pressure, especially of the second pump device, is available at the actuator or swiveling cylinder during the entire operation.

Diversion of the fluid volume flow may be realized simply by a corresponding switching valve, so that the overall switching outlay can be kept very low.

Although the device is described below using the example of a hydraulic drive with hydraulic oil as fluid, it goes without saying that the invention is also feasible with other suitable fluids and corresponding devices for pressure generation and/or fluid delivery.

Further advantages, characteristics and features of the present invention are apparent from the following detailed description of an embodiment using the enclosed drawings. The drawings show in purely schematic form

FIG. 1 a block diagram of the drive device of the invention;

FIG. 2 a block diagram of a known single-circuit system; and

FIG. 3 a block diagram of a known dual-circuit system.

FIG. 1 shows a block diagram of an hydraulic drive of a dual-cylinder slurry pump with a first drive cylinder 1 and a second drive cylinder 2, which are connected via the corresponding pistons to a first delivery cylinder FR and a second delivery cylinder FL.

The delivery cylinders FL and FR are connected via a pipe switch RW to a common delivery line, such that alternating strokes of the delivery cylinders FL and FR provide almost continuous pump activity for the slurry. For this purpose, the pipe switch RW must be brought via an actuator or swiveling cylinder SZ into a connecting position such that it alternates between the first delivery cylinder FR and common delivery line and the second delivery cylinder FL and common delivery line.

The hydraulic drive is supplied by two pump devices P1 and P2, each of which may have one or more pumps connected in parallel. The block diagram shows only one pump for each pump device.

The pump devices P1 and P2 are connected via the supply lines L1 and L2 to the control block 3 in which the switching valves 3.1 and 3.2 are accommodated, which in turn are connected to hydraulic lines L4 and L4a.

For mutual connection between the supply lines L1 and L2, a link line with switching valve 6 is provided, which is connected with a supply line L1 is pumped through the first pump device P1, can be pumped into the second supply line L2. However, the switching valve 6 especially ensures that hydraulic oil, which is pumped from the second pump device P2 in the supply line L2, can pass into first supply line L1 to maintain a sufficient oil flow to actuate the drive cylinders 1 and 2.

Switching valve 3.2 then makes the hydraulic oil in the supply line L1 alternately available to the first drive cylinder 1 and the second drive cylinder 2 via the supply lines L4 in order that the delivery cylinders FR and FL may be actuated via said drive cylinders. The oil returns via line L9.

Switching valves VFR and VFL for controlling the alternating stroke displacement of the drive cylinders 1 and 2 are provided at drive cylinders 1 and 2. Because of the alternating stroke displacement of the drive cylinders 1 and 2, these are coupled hydraulically to each other via the control lines SL5, SL6, SL7 and SL9.

The switching values VFR and VFL additionally form so-called proximity switches by means of which the piston position in the drive cylinders 1 and 2 can be determined. Simultaneously, through the corresponding pistons of the piston drive in the drive cylinders 1 and 2, the control lines SL8 and SL10 connected to the switching valves VFR and VFL are pressurized accordingly, which in turn corresponding drive the switching valves 3.1 and 3.2 in the control block 3, or the switching valve 6.

This occurs in a manner such that, during a change of delivery stroke from the delivery cylinder FR to the delivery cylinder FL, or vice versa, the pipe switch has to be actuated accordingly by the actuator or swiveling cylinder SZ. For this purpose, switching valve 3.1 supplies the actuator cylinder SZ with corresponding hydraulic oil or pressure through the second pump device P2 and the supply lines L1 and L4a.

To obtain the fastest possible switching, before attainment of the respective final stroke position of the drive cylinder 1 or 2 triggered by the hydraulic signals by means of the control lines SL8 and SL10, the switching valve 3.1 and the switching valve 6 are correspondingly switched via the switching valve 6.

For this, the switching valve 6 closes the connecting line between the supply lines L1 and L2 such that oil can no longer flow from the supply line L2 to the supply line L1 and thus supply the drive cylinders 1 and 2. Instead, the full pump capacity of the second pump device P2 is made available to the swiveling cylinder SZ, with the switching valve VSP for controlling the actuator or swiveling cylinder SZ also being actuated through the corresponding hydraulic control lines SL18 and SL19, or sending corresponding control signals to the switching valve 6.

The use of the switching valve 6 enables the oil volume flow, which is normally also used by the pump device P2 to actuate the drive cylinders 1 and 2 and which is no longer absolutely necessary in the final displacement of the respective drive cylinders 1 and 2, to be used earlier to actuate the actuator cylinder such that an interruption to the pumping of the slurry pump is reduced.

Moreover, since the second pump device P2 is directly connected via the supply line L2 to the switching valve 3.1 or via the hydraulic lines L4a to the swiveling or actuator cylinder SZ, the operating pressure of the second pump device P2 is immediately available to the swiveling cylinder SZ during the entire operation.

The embodiment shown is thus an advantageous combination of a single-circuit and a dual-circuit system in which the pump capacity of the second pump device is variably used both for the actuation of the drive cylinders 1
and 2 and of the swiveling or actuator cylinder SZ. Especially at the end of a piston displacement, when the full pump capacity of the pump devices down to the final position is not necessary for the actuation of the drive cylinder, the advantageous possibility thereby rises of making some of the oil volume flow available for the actuation of the actuator or swiveling cylinder of the pipe switch in order that any interruption of the pump flow may be shortened to a minimum.

1. Method for operating a dual-cylinder slurry pump, preferably for conveying concrete, comprising two alternately actuated delivery cylinders (FL, FR), which charge a common delivery line with slurry via a switch (RW), wherein the delivery cylinders (FR, FL) are actuated via a drive cylinder (1, 2) by means of a fluid and the switch (RW) is actuated via an actuator cylinder also by means of a closed, wherein a first pump unit (P1) is provided, whose fluid volume flow is provided by means of a first supply line (L1) primarily to the drive cylinders (1, 2) and a second pump unit (P2), whose fluid volume flow is provided by means of a second line (L2) primarily to the actuator cylinder (SZ), characterized by the fact that, during the piston stroke of a drive cylinder (1, 2), at least some of the fluid volume flow of the second pump device (P2) transfers to the fluid volume flow of the first pump unit (P1) for the drive cylinders (1, 2).

2. Method in accordance with claim 1, characterized by the fact that, the fluid volume flow in the second supply line to the swivel cylinder (L2) or a part thereof can transfer into the first supply line to the drive cylinders (L1) via a linking line in which a switching device is installed.

3. Method in accordance with claim 1, characterized by the fact that, the fluid volume flow in the first supply line (L1) is made alternately available to the first drive cylinder (1) or the second drive cylinder (2) by a switching valve (3.2).

4. Method in accordance with claim 1, characterized by the fact that, just before the final position of a drive cylinder (1, 2) is reached, the switching device blocks the link line between the supply lines (L1) and (L2), such that fluid volume flow can no longer transfer from the second supply line (L2) into the first supply line (L1).

5. Method in accordance with claim 1, characterized by the fact that, the final piston position in the drive cylinders (1, 2) is determined by means of a proximity switch, in order that the switching device may be driven accordingly.

6. Method in accordance with claim 1, characterized by the fact that, the fluid volume stream is generated by 1 or 2 pump devices (P1, P2) each with one or more pumps.

7. Method in accordance with claim 1, characterized by the fact that, the fluid is hydraulic oil.

8. Method in accordance with claim 1, characterized by the fact that the drive cylinders (1, 2), the actuating cylinder (SZ) and/or the switching valves needed for operation are controlled hydraulically.

9. Drive device for a dual-cylinder slurry pump with two drive cylinders (1, 2) that are actuated by means of a fluid, said cylinders alternately charging a common delivery line with slurry, especially concrete, via a switch (RW), especially a pipe switch, especially indirectly via driven delivery cylinders (FR, FL), with the pipe switch also being actuated via an actuating cylinder (SZ) by means of a fluid, especially for performing the method in accordance with any of the previous claims, with at least one pump device (P1, P2) by means of which the fluid is provided via supply lines under working pressure to the drive cylinders and the actuating cylinder, wherein are provided a switching device (6) for diverting at least part of the fluid stream generated by at least one pump device to the actuating cylinder and a determination device (VF1, VF1) for locating at least one piston position of each drive cylinder, characterized by the fact that, the termination device is designed such that the piston position in the final displacement region is determined before the final position of the stroke is reached and, after determination of the position, the switching device is actuated.

10. Drive device in accordance with claim 9, characterized by the fact that, a single pump device with one or more pumps for supplying the drive cylinders and the actuator cylinder is provided.

11. Drive device in accordance with claims 9, characterized by the fact that, two pump devices (P1, P2) are each provided with one or more pumps, wherein the first pump device is provided via a first supply line primarily for supplying the drive cylinders and the second pump device via a second supply line primarily for supplying the actuator cylinder, wherein between first and second supply line is provided a link line to the switching device, wherein the switching device facilitates supply to the drive cylinders through the second pump device and/or supply to the actuator cylinder through the first pump device.

12. Drive device in accordance with claim 9, characterized by the fact that, the fluid is hydraulic oil.

13. Drive device in accordance with claim 9, characterized by the fact that, the determining device (VF1, VF1) has one or more mechanical, electrical, or hydraulic sensors for determining the piston position.

14. Drive device in accordance with claim 9, characterized by the fact that, the determination device (VSZ) for determining the position of the piston of the actuator or swiveling cylinder of the pipe switch has one or more mechanical, electrical, or hydraulic sensors for determining the position of the actuator or swiveling cylinder.

15. Drive device in accordance with claim 9, characterized by the fact that, the drive cylinders (1, 2) are coupled hydraulically, such that only one or two sensors are provided at one of the drive cylinders for determining the piston position in the respective drive cylinders.

16. Drive device in accordance with claim 9, characterized by the fact that, the switching device is hydraulically controlled and especially comprises a switching valve (6).