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(54) Valve for detection of hydraulic system status

(57) A sensor valve (44) for indicating a status of operation of a hydraulic system (4) ar-ranged on an implement (3) connected to a hydraulic unit (1) and a control system (2) is described, in which a valve housing (441) accommodates a sensor-signal-inducing slide (442) which is displaceable between an inactive, first position (1) and an active, second position (II), an associated sensor (445) generating, in the first posi-tion (I) of the slide, a signal different from a signal which is generated when the slide (442) has been moved to its second position (II), and in which a drain channel (4414) forms a fluid-communicating connection between first and second valve ports (4411, 4412).

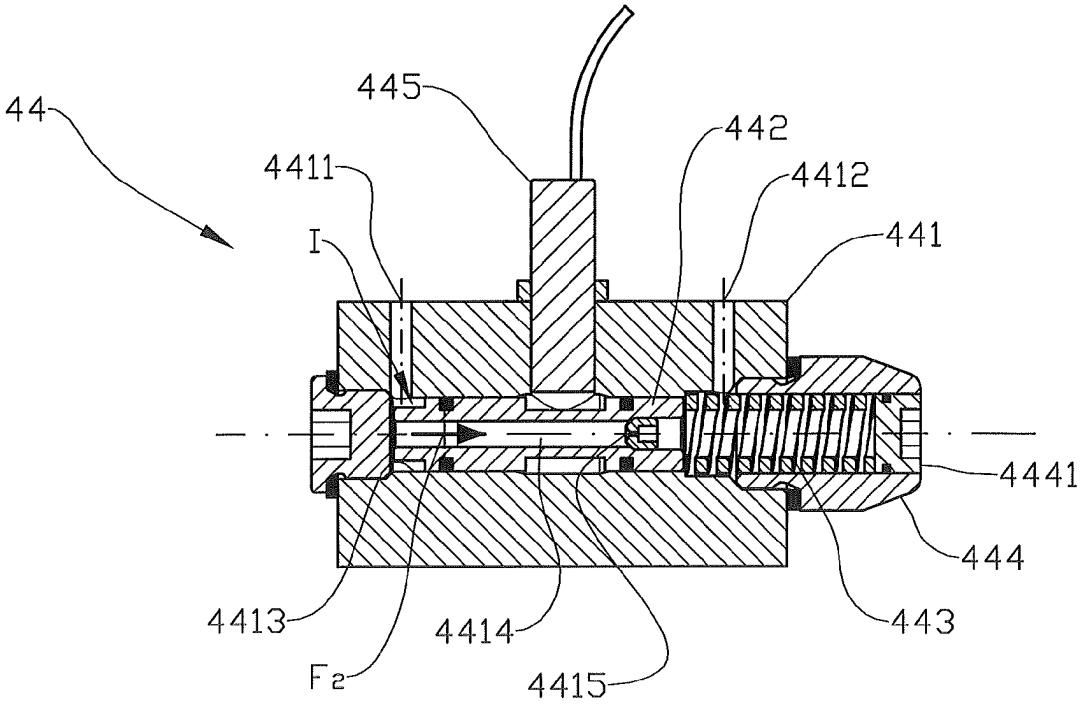

Fig. 2a

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Description

[0001] The invention relates to a sensor valve for indicating the status of operation of a hydraulic system arranged on an implement connected to a hydraulic unit and a control system, the valve housing accommodating a sensor-signal-inducing slide displaceable between an inactive, first position and an active, second position as, in the first position of the slide, an associated sensor generates a signal different from a signal generated when the slide has been moved to its second position.

[0002] On machines entirely or partly using hydraulic actuation and/or operation by a hydraulic system being operated by a connected hydraulic unit being run at constant pumping, for example an agricultural implement in which the hydraulic system is connected to the hydraulic unit of a tractor and in which the hydraulic functions of the implement are operated via a double-acting hydraulic outlet on the tractor, it has become usual to equip the hydraulic system of the implement with monitoring equipment to provide feed-back to the operator or an operation control, a computer-assisted operation system or the like on whether a hydraulic circuit is operating actively or whether it is idle. This is often done by a sensor-valve unit being integrated in the hydraulic circuit or circuits that need(s) monitoring, a sensor being influenced by a hydraulically operated slide which, depending on the state of operation of the hydraulic circuit, is moved between two extreme positions and influences the sensor to switch between the on and off positions.

[0003] A drawback of such sensor valves is that the slide may remain in the on position even if the supply of hydraulic fluid has ceased. This is owing to properties of the type of valve that controls the supply and return of hydraulic fluid to/from the hydraulic unit from/to the hydraulic system of the implement, as the so-called double-acting hydraulic outlet closes both the supply and the return at the same time. This results in the amount of hydraulic fluid present in the hydraulic system of the implement being shut in and remaining under pressure, which results in the sensor valve remaining in its on position. Thereby, the impression is erroneously given that the relevant hydraulic circuit is still in active operation.

[0004] The invention has for its object to remedy or reduce at least one of the drawbacks of the prior art or at least provide a useful alternative to the prior art.

[0005] The object is achieved through features which are specified in the description below and in the claims that follow.

[0006] A sensor valve is provided, which includes a sensor-signal-inducing slide arranged in a valve housing connected to the pressure line of a hydraulic system via a first valve port and a return line via a second valve port. For the slide, a return spring is arranged, applying a push force to the slide in the direction of a first slide position and the first port, the slide, in this position, inducing a first signal in an associated sensor. When the pressure in the first valve port overcomes the push force holding the slide in the first position, that is to say the spring force and a possible hydraulic pressure in the second valve port, the slide is displaced to its second position as a second signal is being induced in the associated sensor.

[0007] To ensure that the slide is moved back to its first position when a supply of hydraulic fluid from a connected hydraulic unit ceases, the sensor valve is provided with a drain channel connecting the first and second valve ports. The drain channel preferably exhibits a flow rate which is considerably lower than the operative flow rate in the pressure line. When the supply of hydraulic fluid to the hydraulic system ceases and the pressure at the first valve port does not drop immediately, hydraulic fluid will flow through the drain channel to the second valve port so that the hydraulic pressure is equalized and the return spring overcomes the pressure force against the slide from the pressure in the first valve port and pushes the slide back into its first position so that a sensor signal is induced, indicating that the supply of hydraulic fluid to the hydraulic system has ceased.

[0008] The sensor valve according to the invention thereby prevents an erroneous status indication in an associated control system which bases its status information on the signal from the sensor valve, among other things.

[0009] The invention relates, more specifically, to a sensor valve for indicating the operating status of a hydraulic system arranged on an implement connected to a hydraulic unit and a control system, in which a valve housing accommodates a sensor-signal-inducing slide which is displaceable between an inactive, first position and an active, second position, an associated sensor generating, in the first position of the slide, a signal different from a signal that is generated when the slide has been moved to its second position, characterized by a drain channel forming a fluid-communicating connection between a first valve port and a second valve port.

[0010] The maximum flow rate of the drain channel may be considerably lower than the maximum flow rate of the hydraulic system. The efficiency of the hydraulic system is thereby not affected to any great extent by the flow in the drain channel.

[0011] The drain channel may be arranged as an axial bore in the slide. The drain channel is thereby easy to produce and easy to maintain by the very fact of the slide being a separate part removable from the slide housing.

[0012] The drain channel may be provided with a replaceable choke nipple. The sensor valve can thereby easily be adapted to hydraulic units of different flow rates and pressures.

[0013] The slide may have a return spring associated with it, which is arranged to apply a push force to the slide in the direction of the first position. The slide may thereby return to its first position before the pressures on the pressure and return sides of the hydraulic system have been equalized.

[0014] The slide may have a return spring associated with it, which is arranged to apply an adjustable push

force to the slide in the direction of the first position, the return spring having an adjustable stop associated with it. The sensor valve may thereby be set for a quicker reaction on a stoppage.

[0015] The return spring may rest against a stop which is adjustable in the axial direction of the return spring. The adjustment of the push force may thereby be provided in an easily accessible portion of the sensor valve, for example a projecting spring jacket.

[0016] In what follows, an example of a preferred embodiment is described, which is visualized in the accompanying drawings, in which:

Figure 1 shows a principle drawing of an implement provided with a hydraulic system connected to an external hydraulic unit via a double-acting hydraulic outlet;

Figure 2a shows, on a larger scale, a principle drawing of an axial section through a sensor valve according to the invention, in which a slide is in a first, not sensor-activating position I;

Figure 2b shows the sensor valve with the slide in a second, sensor-activating position II; and

Figure 3 shows, on a smaller scale, an exploded perspective drawing of the sensor valve.

[0017] Reference is first made to figure 1, in which the reference numeral 1 indicates a hydraulic unit 1 of a kind known *per se,* including a pump and a reservoir, among other things. A double-acting hydraulic outlet 11 forms an interface between the hydraulic unit 1 and the hydraulic system 4 of an implement 3. The hydraulic unit 11 includes a control valve 12, for practical purposes often in the form of a so-called 4/3 directional control valve with a closed centre.

[0018] The hydraulic system 12 that is integrated in the implement 3 includes, in principle, a pressure line 41 and a return line 42 connected to respective ports on a consumer 43, shown here as a motor. A person skilled in the art will understand that the flow direction of the pressure fluid used, typically hydraulic oil, might be controlled in both directions, depending on the setting of the control valve 12, the terms "pressure line" and "return line" not having one meaning then. But in the example shown, the flow direction is determined by the consumer 43 having a particular working direction, and for practical purposes, a wrong flow direction, that is to say supply through the return line 42, can be prevented by the use of a check valve, not shown.

[0019] Between the pressure line 41 and the return line 42, a sensor valve 44 is arranged in parallel, in terms of connection, with the consumer 43.

[0020] Reference is now mainly made to figures 2a and 2b. The sensor valve 44 includes a valve housing 441 with a bore 4413 which accommodates a slide 442. The end portions of the bore 4413 are in fluid communication with respectively first and second valve ports 4411, 4412. The slide 442 is axially movable between a first slide position I (see figure 2a) and a second slide position II (see figure 2b). A return spring 443 is arranged to apply a push force to the slide 442 in the direction of the first slide position I. A hydraulic overpressure in the first valve port 4411 applies a push force to the slide 442 in the direction of the second slide position II. When the pressures in the valve ports 4411, 4412 have been equalized, the slide 442 will accordingly be moved to its first slide position I by means of the return spring 443. The return spring 443 is partially accommodated by a spring jacket 444 fitting fluid-tight against the bore 4413 in the valve housing 441.

[0021] The spring jacket 444 may include a device arranged to adjustably tension the return spring 443, here indicated by the reference numeral 4441 which may be, for example, an adjustable stop in the spring jacket 444.

[0022] A sensor 445 is arranged in the valve housing 441 so that when the slide 442 is in its first position I, the sensor 445 generates a first signal which is readable by the control system 2 in a wireless manner or, as shown in figure 1, via cabling. When the slide 442 is in a second position II, the sensor 445 generates a second signal which is different from the first signal. The position of the slide 445 is thereby readable by means of the control system 2 and gives an indication on the operating status of the hydraulic system 4 on the implement 3.

[0023] A drain channel 4414 connects the first and second valve ports 4411, 4412 in a fluid-communicating manner. The drain channel 4414 is shown here as a centre bore in the slide 442 and is provided with a replaceable choke nipple 4415. The maximum flow rate F_2 of the drain channel 4414 is preferably considerably lower than the maximum, operative flow rate F_1 of the hydraulic system 4 in order for the drain channel 4414 not to represent an unnecessary power loss during ordinary operation of the hydraulic system 4.

[0024] When the hydraulic system 4 of the implement 3 is operated, the hydraulic unit 1 delivers pressure fluid through the control valve 12 by constantly pumping, and the pressure fluid circulates through the hydraulic system 4 so that the consumer 43 is powered. As the operation ceases by the control valve 12 being closed, both ports of the control valve 12 are closed as this is a closed-centre directional control valve. The hydraulic fluid that is in the pressure line 41 of the hydraulic system 4 may remain under pressure since the return line 42 cannot be drained, the connection of the return line 42 to the return side of the hydraulic unit 1 being closed. A possible pressure difference between the pressure line 41 and the return line 42, due, for example to the consumer 43 having reached an end position or, in some other manner, preventing the pressure in the pressure line 41 from being equalized with the pressure in the return line 42, holds the sensor valve 44 in its second, sensor-activating po-

sition II. In this situation, a sensor valve of the ordinary kind will erroneously give the impression that the hydraulic system 4 is operative. But, by the sensor valve 44 according to the invention including the drain channel 4414, pressure fluid will flow through the latter until the pressures in the pressure line 41 and the return line 42 have been equalized, and the slide 442 is pushed back to its first position I by means of the push force from the return spring 443. The sensor 445 thereby generates a signal to the control system 2 about the operation of the hydraulic system 4 having been disengaged.

Claims

1. A sensor valve (44) for indicating a status of operation of a hydraulic system (4) arranged on an implement (3) connected to a hydraulic unit (1) and a control system (2), in which a valve housing (441) accommodates a sensor-signal-inducing slide (442) which is displaceable between an inactive, first position (I) and an active, second position (II), an associated sensor (445) generating, in the first position (I) of the slide, a signal different from a signal which is generated when the slide (442) has been moved to its second position (II), **characterized in that** a drain channel (4414) forms a fluid-communicating connection between first and second valve ports (4411, 4412).

2. The sensor valve (44) in accordance with claim 1, wherein the maximum flow rate (F_2) of the drain channel (4414) is considerably lower than the maximum flow rate (F_1) of the hydraulic system (4).

3. The sensor valve (44) in accordance with claim 1, wherein the drain channel (4414) is arranged as an axial bore in the slide (442).

4. The sensor valve (44) in accordance with clam 1, wherein the drain channel (4414) is provided with a replaceable choke nipple (4415).

5. The sensor valve (44) in accordance with claim 1, wherein the slide (442) has a return spring (443) associated with it, which is arranged to apply a push force to the slide (442) in the direction of the first position (I).

6. The sensor valve (44) in accordance with claim 1, wherein the slide (442) has a return spring (443) associated with it, which is arranged to apply an adjustable push force to the slide (442) in the direction of the first position (I), the return spring (443) having an adjustable stop (4441) associated with it.

7. The sensor valve (44) in accordance with claim 6, wherein the return spring (443) bears against an adjustable stop (4441) which is adjustable in the axial direction of the return spring (443).

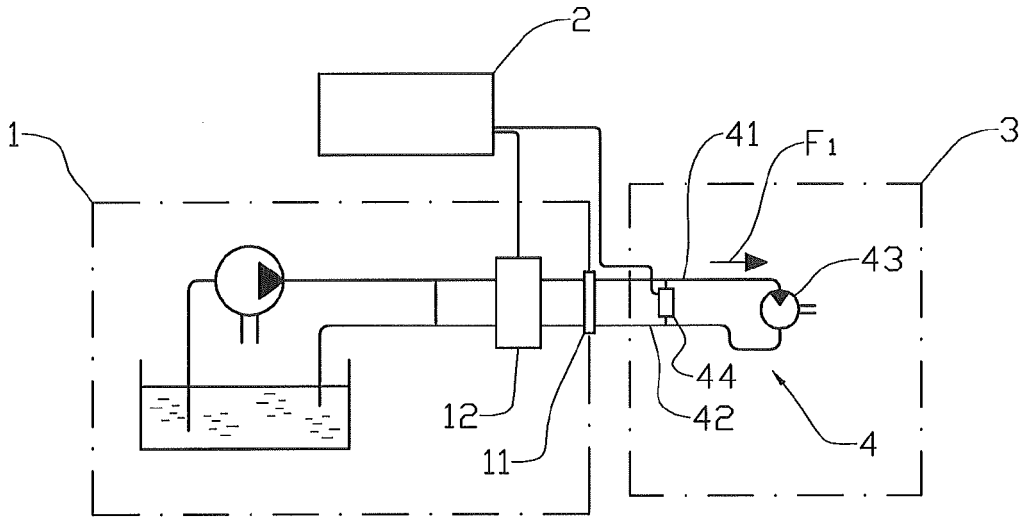
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Fig. 1

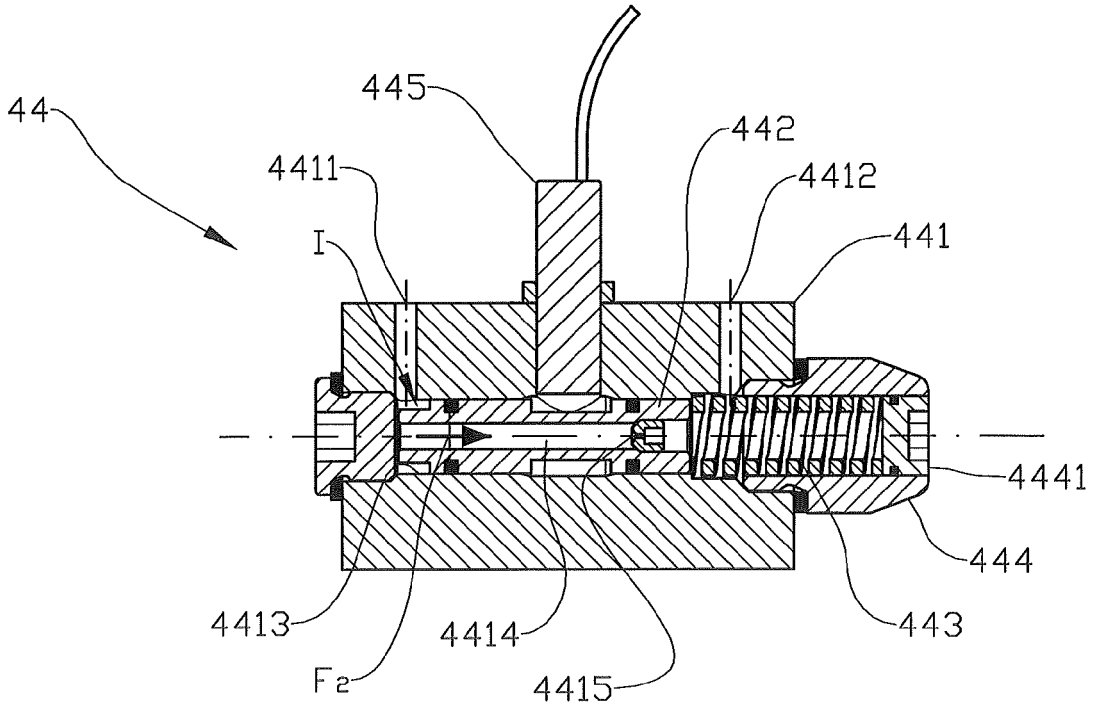
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Fig. 2a

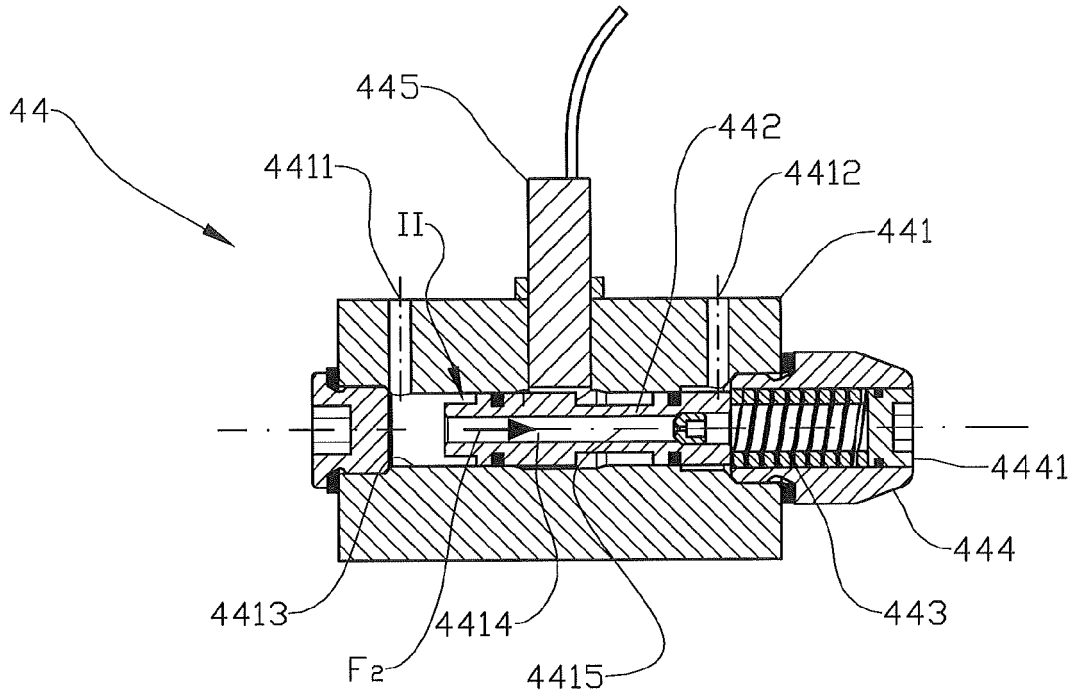
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Fig. 2b

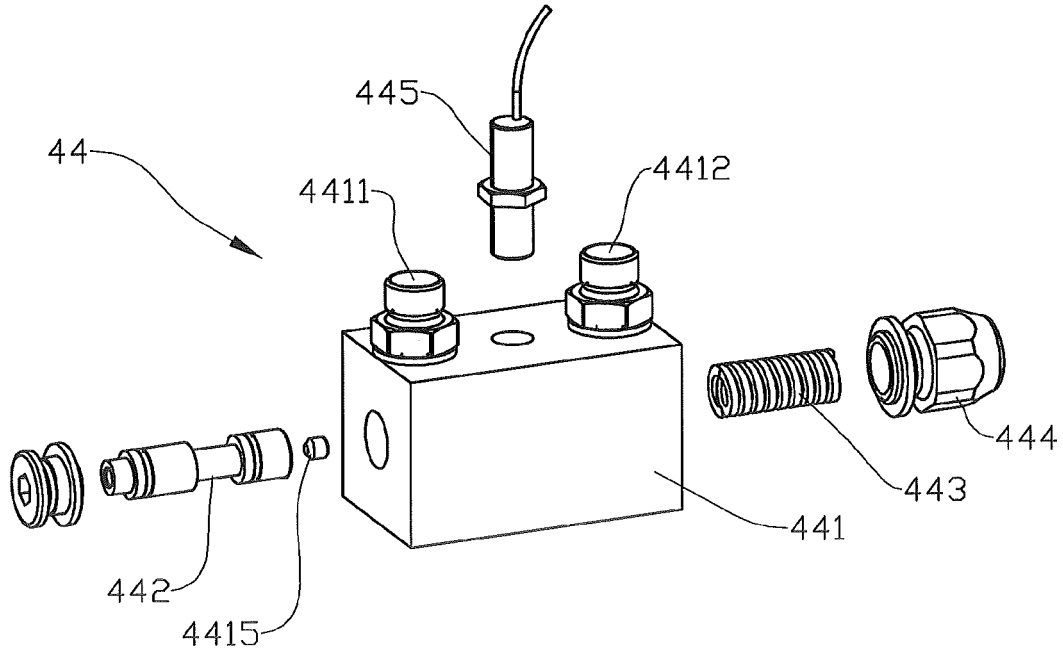
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Fig. 3