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(71) Applicant: **Parker Hannifin Aktiebolag**
501 78 Boras (SE)

(72) Inventors:
- **Martyn, Gordon**
  CV36 4FD Warwickshire (GB)
- **Persson, Bengt Göran**
  51831 Sandared (SE)

(74) Representative: **Mossmark, Anders Lennart**
Albihns Göteborg AB
Box 142
401 22 Göteborg (SE)

(54) Ride control system

(57) The invention relates to a hydraulic system for a wheeled loader having a loader arm assembly, which is connected to the wheeled loader at a first end and carries a working implement at a second end, and which loader arm is movable between raised and lowered positions by means of a hydraulic cylinder (5), wherein a hydraulic accumulator means (18, 19) is connected to the hydraulic cylinder (5) to provide a suspension arrangement for the hydraulic cylinder (5). Each chamber of the hydraulic cylinder (5) is connected to a selection valve means (9) via conduits adapted to supply fluid under pressure to raise or lower the loader arm assembly. The hydraulic system is provided with a number of valves for preventing any unintentional downward movement of the lift arm assembly due to a sudden loss of pressure in the supply conduit or a slow leak through the selection valve means (9). The invention further relates to a wheeled loader provided with such a hydraulic system.

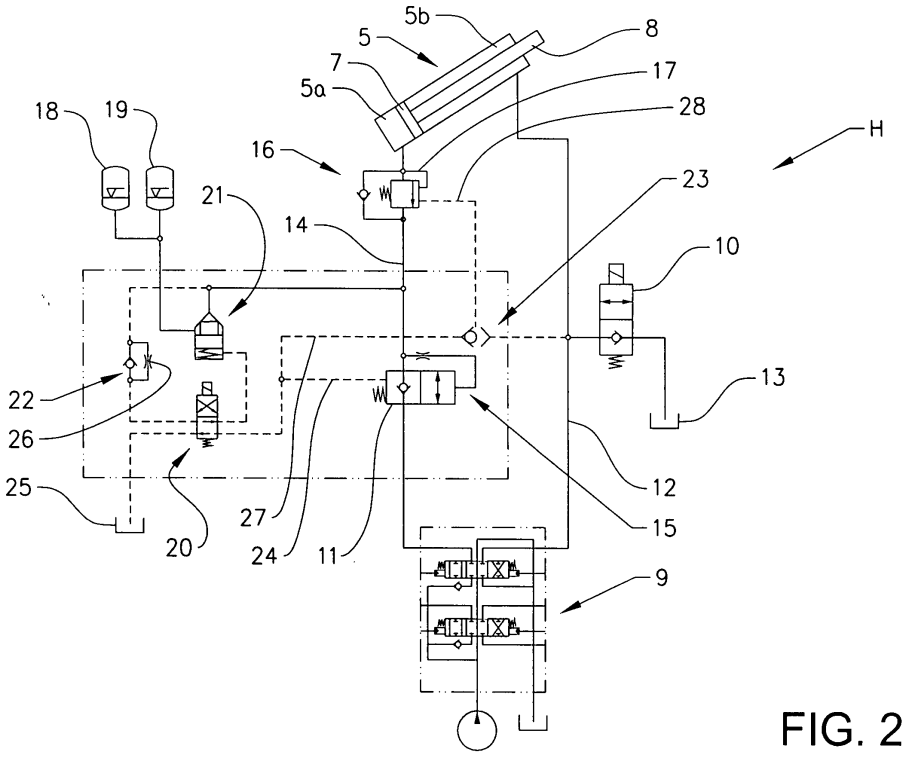

FIG. 2

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Description

TECHNICAL FIELD

[0001] This invention relates to a hydraulic system for wheeled loaders having a loader arm assembly which carries an implement and in which the loader arm assembly is connected to the body and which is moveable between raised and lowered position by means of a hydraulic ram.

BACKGROUND ART

[0002] It is known to improve the ride properties of a wheeled loader, with the introduction of a hydraulic accumulator into the hydraulic hose which feeds fluid into the lift side of the rams for the raise and lower loader arm assembly. The result is that when the wheel loader is travelling across a site, or at speed on a road, the loader arm assembly is suspended in a spring like manner by the accumulator. Sudden movements of the arm caused by the vehicle travelling over an uneven surface can be dampened by allowing pressure variations in the supporting cylinder(-s) to be absorbed by the accumulator. In this way, the wheeled loader is able to travel with less pitch and bounce than would otherwise have been the case.

[0003] A wheeled loader where the lift side of the hydraulic ram moves the lift arm up or down in relation to the body has to be protected by some form of hose burst valve, which valve may be directly mounted to the ram without the use of hose and this valve has to be in the circuit at all times too prevent unintentional movement down in the event of a hose failure.

[0004] The European patent application EP 1 157 963 A2 discloses a system, where the accumulators are mounted directly on the cylinders and piped into the lift side of the hydraulic ram between the ram and the hose burst valve using steel pipes.

[0005] A problem with the latter solution is that the burst valve and the rigid steel pipes attached onto the cylinder will require space and may impose limitations on the freedom of design for such a hydraulic ram. In some cases the hydraulic ram is not the most convenient place for an accumulator and associated controllers, as the required position may create a conflict with a desired design or function of a hydraulic ram or a similar device.

[0006] The invention aims to solve the above problems by providing an improved suspension system, allowing the accumulator and associated control valves in the hosepipe feeding fluid from the directional valve to lift side of the ram to be mounted at any convenient position on the machine without affecting the function of the hose failure valve.

[0007] The invention further aims to achieve full suspension of the loader arm assembly whilst travelling without the loader arm gradually dropping due to the leakage in the hydraulic circuit.

DISCLOSURE OF INVENTION

[0008] The above problems are solved by a hydraulic system according to the invention, as claimed in claim 1, and a wheeled loader provided with such a hydraulic system, as claimed in claim 12.

[0009] In the subsequent text the invention will be described in relation to a wheeled loader of a type commonly referred to as a telehandler, comprising a telescopic arm provided with lifting or gripping means. However, the invention is applicable to all types of travelling vehicles comprising at least one hydraulically or pneumatically actuated cylinder for lifting and lowering an arm, boom, crane or similar equipment.

[0010] According to a first embodiment, the invention relates to a hydraulic system for a wheeled loader having a loader arm assembly, which is connected to the wheeled loader at a first end and carries a working implement at a second end. The loader arm is movable between raised and lowered positions by means of at least one hydraulic cylinder, or ram means, wherein at least one hydraulic accumulator may be connected to the hydraulic ram means. The ram means may be provided with two chambers separated by a piston, where the piston is connected to a piston rod that raises and lowers the loader arm. Each chamber of the hydraulic ram means may be connected to a selection valve means adapted to supply fluid under pressure to a first chamber of the ram means and to drain fluid at a lower pressure from a second chamber of the ram means in order to raise the loader arm assembly, or to supply fluid under pressure to said second chamber of the ram means and drain fluid at a lower pressure from said first chamber of the ram means to lower the loader arm assembly. The selection valve provided may be a manually, hydraulic remote or electro-hydraulic operated directional control valve.

[0011] The hydraulic system is provided with a number of valves for controlling fluid flow. These valves comprise at least a first and second valve means each of which is movable between a first position, in which passage of hydraulic fluid there through is prevented in one direction, and a second position, in which passage of hydraulic fluid there through is permitted. The first valve means is connected between said second chamber and a low pressure region, such as a reservoir or a drain tank. This first valve means may be a solenoid controlled valve, or similar, which valve is spring loaded to a first position preventing fluid flow from the selection valve or the second chamber to a drain tank. When actuated, the solenoid opens the valve against the force of the spring to allow fluid flow to a drain tank, primarily from the second chamber during rising of the loader arm.

[0012] The second valve means is connected between said first chamber and said selection valve means. This second valve means may be spring loaded towards its first position, where a check valve or similar permits flow in the direction of the first chamber. The second valve

means may have a first hydraulic fluid responsive means to move the second valve means towards its second position, where fluid flow is permitted in both directions. For this purpose, means may be provided to connect said hydraulic fluid responsive means to said first chamber so as to move said second valve means to its second position. The check valve in the second valve means can be used to prevent the loader arm from dropping due to a leakage across the selection valve.

[0013] A third valve means is connected between the first chamber and the second valve means whereby the third valve means is normally closed to prevent fluid under pressure passing from said first chamber to the selection valve means . The third valve means may comprise a non-return valve and a load control valve. The load control valve has a hydraulic fluid responsive means in the form of a fluid conduit arranged to open the load control valve against the force of a spring and bypass said non-return valve. The fluid conduit is connected directly to the first chamber and to the fluid conduit between the second and third valve means via the non-return valve, when the check valve is open. When sufficient pressure is supplied to the fluid conduit, the load control valve is moved against the force of the spring to its open position to allow fluid flow in both directions. The spring is dimensioned to balance the hydraulic pressure acting on the load control valve through the fluid conduit , so that this valve is normally closed.

[0014] The hydraulic system is further provided with one or more accumulator means or tanks connected between the second valve means and the third valve means via a valve arrangement . The system further comprises a valve arrangement that is selectively movable between a first state in which passage of hydraulic fluid between the first chamber and the accumulator means is prevented and a second state, in which passage of hydraulic fluid between the first chamber and the accumulator means is permitted. The first state is preferably, but not necessarily, selected during operation of the hydraulic ram when the vehicle is stationary, for instance during loading or unloading operations. The second state is preferably, but not necessarily, selected when the wheeled loader is being driven, irrespective of whether the hydraulic ram when the vehicle is being operated or not. In the latter case the accumulator means are connected to the hydraulic ram means in order to act as dampers, allowing movement up and down relative to an initial position of the loader arm.

[0015] The valve arrangement may comprise a fourth valve means which is movable between a first position, in which hydraulic fluid passes through said fourth valve means to act on a fifth valve means to prevent said fifth valve means from opening, and a second position, in which hydraulic fluid passes through said fourth valve means to a second hydraulic fluid responsive means in the second valve means to move the second valve means to its first position. The fourth valve means may be a solenoid controlled valve, or similar, which valve is spring loaded to its first position for closing said fifth valve means . When actuated, the solenoid opens the valve against the force of the spring to allow the pressure applied by the fourth valve means onto the fifth valve means to be drained to a low pressure region, such as a tank. The said low pressure region may be a number of separate tanks or a single, common tank provided for the hydraulic system.

[0016] The fifth valve means may be movable between a first position, in which passage of hydraulic fluid through said fifth valve means between the first chamber and the accumulator means is prevented, and a second position, in which passage of hydraulic fluid between the first chamber and the accumulator means is permitted. The fifth valve means may comprise a seated valve, or spool valve, with a piston having different diameters. The fifth valve means may also be spring loaded towards its first, closed position. Hence, when both sides or chambers of the fifth valve means are acted on by pressure from the same source, the valve will remain closed under the action of said spring. When the pressure from the side controlled by the fourth valve means is removed, the fifth valve means will open and connect the first chamber and the accumulator means. The fifth valve means is preferably, but not necessarily, maintained in its first position by hydraulic pressure from the selection valve when the fourth valve means is in its first, inactive position. The fifth valve means is preferably, but not necessarily, maintained in its second position by hydraulic pressure from the selection valve or the first chamber when the fourth valve means is in its second, active position.

[0017] In addition, the valve arrangement may further comprise a sixth valve means, preferably, but not necessarily comprising a check valve. The sixth valve means is connected between the first chamber and the fourth valve means . The sixth valve means may be arranged to allow hydraulic fluid to pass unrestricted from said first chamber towards the fourth valve means. This sixth valve means may also be provided with a restrictor arranged to bypass the check valve in said sixth valve means to allow a limited flow of hydraulic fluid through said sixth valve means at all times. When the fourth valve means is in its first position, the first chamber is disconnected from the accumulator means. In this case, the restrictor reduces any flow in a direction away from the fifth valve means to ensure that it remains closed. When the fourth valve means is in its second position, the restrictor dampens fluid flow from the second pressure responsive means of the third valve means to ensure that it remains open. Simultaneously, it dampens fluid flow from a second pressure responsive means of the second valve means to ensure that it remains in its first, closed position.

[0018] The hydraulic system may further be provided with a seventh valve means that is preferably connected between the fourth valve means and a further hydraulic fluid responsive means arranged to open the third valve means, when the fourth valve means is in its second, active position. This seventh valve means is preferably

also connected to the fluid conduit between the second chamber and the selection valve means. When the second chamber is pressurized, this conduit supplies hydraulic pressure to the hydraulic fluid responsive means of the third valve means to open said third valve means. This ensures that the first chamber is allowed to drain when the second chamber is pressurized to lower the loading arm. For the purpose of dampening pressure pulses, the first hydraulic fluid responsive means, arranged to open the second valve means, is provided with a restrictor for limiting the hydraulic flow to the first fluid responsive means of said second valve means. Hydraulic fluid forced from the first chamber when the second chamber is pressurized will cause the second valve means to open, so that hydraulic fluid may be drained through the selection valve.

[0019] The invention further relates to a wheeled loader provided with a hydraulic system as described above.

BRIEF DESCRIPTION OF DRAWINGS

[0020] In the following text, the invention will be described in detail with reference to the attached drawings. These drawings are used for illustration only and do not in any way limit the scope of the invention. In the drawings:

Figure 1 shows a wheeled loader provided with a hydraulic system according to the invention.

Figure 2 shows a schematic illustration of a hydraulic system according to a preferred embodiment of the invention.

Figure 3 shows the schematic hydraulic system of Figure 2 with an active suspension arrangement.

EMBODIMENTS OF THE INVENTION

[0021] Figure 1 shows a wheeled loader provided with a hydraulic system according to the invention. The wheeled loader in Figure 1 is a telehandler 1 provided with a telescopic loader arm 2. The loader arm 2 is attached to the vehicle at a pivot axle 3 at one end and is provided with a lifting means 4 at the other end. The telescopic loader arm 2 is provided with a hydraulically actuated cylinder 5, or ram that is extended for lifting and retracted for lowering the loader arm 2. Control means (not shown) are provided in the drivers cab to allow the driver to operate said telescopic arm using the hydraulic system 6 (indicated in dashed lines), as well as a number of other electrically and hydraulically operated functions. This type of wheeled loader is well known and its general construction will not be described in further detail.

[0022] Figure 2 shows a schematic illustration of a hydraulic system H according to a preferred embodiment of the invention. As shown in the figure, the hydraulic cylinder 5 is provided with two chambers 5a, 5b separated by a piston 7, where the piston is connected to a piston rod 8 that raises and lowers the loader arm. Each chamber of the hydraulic cylinder may be connected to a directional control selection valve means 9 adapted to supply fluid under pressure to a first chamber 5a of the ram means 5 and to drain fluid at a lower pressure from a second chamber 5b of the hydraulic cylinder 5 in order to raise the loader arm assembly, or to supply fluid under pressure to said second chamber 5b of the hydraulic cylinder 5 and drain fluid at a lower pressure from said first chamber 5a of the hydraulic cylinder 5 to lower the loader arm assembly. The selection valve provided may be a manually, hydraulic remote or electro-hydraulic operated directional control valve.

[0023] The hydraulic system is provided with a number of valves for controlling fluid flow. These valves comprise a first and second control valve means 10, 11 each of which is movable between a first position, in which passage of hydraulic fluid there through is prevented in one direction, and a second position, in which passage of hydraulic fluid there through is permitted. The first valve means 10 is connected to a fluid conduit 12 between the selection valve means 9 and the second chamber 5b, connecting said second chamber to a drain tank 13. This first valve means 10 is a solenoid controlled valve, which valve is spring loaded to a first position preventing fluid flow from the selection valve 9 or the second chamber 5b to the tank 13. When actuated, the solenoid opens the control valve means 10 against the force of the spring to allow fluid flow to the tank 13, primarily from the second chamber 5b while raising the loader arm.

[0024] The second valve means 11 is placed in a fluid conduit 14 between said first chamber 5a and said selection valve means 9. This second valve means 11 is spring loaded towards its first position, whereby a check valve permits flow in the direction of the first chamber 5a. The second valve means 11 has a first hydraulic fluid responsive means in the form of a restricted conduit 15 to move the second valve means 11 towards its second position, where fluid flow is permitted in both directions. For this purpose, the restricted conduit 15 is connected to the conduit 14 between the second valve means 11 and the first chamber 5a. When sufficient pressure is supplied to the restricted conduit 15, the second valve means 11 is moved against the force of a spring to its second position. The check valve in the second valve means 11 is used to prevent the loader arm from dropping due to a leakage across the selection valve 9.

[0025] A third valve means 16 is connected between the first chamber 5a and the second valve means 11 so that the third valve means 16 is normally closed to prevent fluid under pressure passing from said first chamber 5a to the second valve means 11 and the selection valve 9. The third valve means 16 comprises a non-return valve and a load control valve. The load control valve has a hydraulic fluid responsive means in the form of a fluid conduit 17 arranged to open the load control valve

against the force of a spring and bypass said non-return valve. The fluid conduit 17 is connected directly to the first chamber 5a and to the fluid conduit 14 via the non-return valve, when the check valve is open. When sufficient pressure is supplied to the fluid conduit 17, the load control valve is moved against the force of the spring to its open position to allow fluid flow in both directions. The spring is dimensioned to balance the hydraulic pressure acting on the load control valve through the fluid conduit 17, so that this valve is normally closed. The load control valve is arranged to open if excessive pressure pulses are generated in the first chamber 5a. In order to actively open the load control valve a further fluid responsive means is provided, which means will be described below.

[0026] The hydraulic system is further provided with a pair of accumulators 18, 19 connected to the fluid conduit 14 between the third valve means 16 and the second valve means 11 via a valve arrangement 20, 21, 22, 23. The system further comprises a valve arrangement 20, 21, 22, 23 that is selectively movable between a first state in which passage of hydraulic fluid between the first chamber 5a and the accumulators 18, 19 is prevented, and a second state, in which passage of hydraulic fluid between the first chamber 5a and the accumulators 18, 19 is permitted. The first state is selected during operation of the hydraulic cylinder 5 when the wheeled loader is stationary, for instance during loading or unloading operations. The second state is selected when the wheeled loader is being driven, irrespective of whether the hydraulic ram when the vehicle is being operated or not. In the latter case the accumulators 18, 19 are connected to the first chamber 5a of the hydraulic cylinder 5 in order to act as dampers, allowing movement up and down relative to an initial position of the loader arm.

[0027] The valve arrangement 20, 21, 22, 23 comprises a fourth valve means 20 which is a 4-way, two position directional valve This fourth valve means 20 is movable between a first position, in which hydraulic fluid passes through said fourth valve means 20 to act on a fifth valve means 21 to prevent said fifth valve means 21 from opening, and a second position, in which hydraulic fluid passes through said fourth valve means 20 to a second hydraulic fluid responsive means in the form of a fluid conduit 24 connected to a second pressure responsive means on the second valve means 11 at the opposite side relative to the restricted conduit 15. When sufficient pressure is supplied to the conduit 24, this pressure acts with the spring to move the second valve means 11 to its first position. The fourth valve means 20 is a solenoid controlled valve, which valve is spring loaded to its first position for closing said fifth valve means 21. When actuated, the solenoid opens the fourth valve means 20 against the force of the spring to allow the pressure applied by the fourth valve means 20 onto the fifth valve means 21 to be drained to a tank 25. This tank 25 is preferably, but not necessarily the same as tank 13. As a rule all hydraulic liquid drained from a valve in this type of system is returned to a common tank.

[0028] The fifth valve means 21 is movable between a first position, in which passage of hydraulic fluid through said fifth valve means 21 between the first chamber 5a and the accumulators 18, 19 is prevented, and a second position, in which passage of hydraulic fluid between the first chamber 5a and the accumulators 18, 19 is permitted. The fifth valve means 21 comprises a seated valve, or spool valve, with a piston having different diameters. The fifth valve means 21 is also spring loaded towards its first, closed position. Hence, when two sides or chambers of the valve are acted on by pressure from the same source, that is the fluid conduit 14, the valve will remain closed. When the pressure from the side controlled by the fourth valve means 20 is removed, the fifth valve means 21 will open against the force of a spring and connect the first chamber 5a and the accumulators 18, 19. The fifth valve means 21 is maintained in its first, closed position by hydraulic pressure from the selection valve 9 or from the first chamber 5a when the fourth valve means 20 is in its first, inactive position. The fifth valve means 21 is maintained in its second, open position by hydraulic pressure from the selection valve 9 or the first chamber 5a when the fourth valve means 20 is in its second, active position.

[0029] In addition, the valve arrangement 20, 21, 22, 23 comprises a sixth valve means 22, comprising a check valve. The sixth valve means 22 is arranged to allow hydraulic fluid to pass unrestricted from said first chamber 5a towards the fourth valve means 20. This sixth valve means 22 is also provided with a restrictor 26 arranged to bypass the check valve to allow a limited flow of hydraulic fluid through said sixth valve means. When the fourth valve means 20 is in its first position, the restrictor 26 limits fluid flow from the fifth valve means 21, to ensure that it remains closed.

[0030] Fluid pressure is also supplied to an additional pressure responsive means in the form of a fluid conduit 28 connected to the load control valve in the third valve means 16 in parallel with the fluid conduit 17. The fluid conduit 28 is provided to ensure that the third valve means 16 remains open, in order to allow the hydraulic cylinder 5 to be dampened by the accumulators 18, 19. This is achieved by providing the hydraulic system with a seventh valve means 23 connected between the fourth valve means 20 and the fluid conduit 28 to open the load control valve in the third valve means 16, when the fourth valve means 20 is in its second, active position. The seventh valve means 23 comprises a shuttle valve. When the fourth valve means 20 is in its second position, the restrictor 26 dampens fluid flow from the fluid conduit 28 to ensure that the check valve 16 remains open. At the same time it also dampens fluid flow from the fluid conduit 24 to ensure that the second valve means 11 remains closed in the direction of the selector valve 9. This fluid flow can occur when travelling with the accumulators connected to the ram, whereby ram movements will cause pressure fluctuations that may cause flow past the check valve and/or the restrictor 26 in the sixth valve means 22.

[0031] The seventh valve means 23 is also connected between the second chamber 5b and the fluid conduit 28 to open the third valve means 16. The latter connection ensures that the first chamber 5a is allowed to drain when the second chamber 5b is pressurized to lower the loading arm. For this reason, the fluid conduit 15 arranged to open the second valve means 11 is provided with a restrictor for limiting the hydraulic flow to the fluid conduit 15 of said second valve means 11. Hydraulic fluid forced from the first chamber 5a when the second chamber 5b is pressurized will thereby cause the second control valve 11 means to open, so that hydraulic fluid may be drained through the selection valve 9.

[0032] Figure 2 shows the schematic hydraulic system with an inactive suspension arrangement, where the suspension for the hydraulic cylinder is disengaged. In this mode, the fourth valve means 20, when de-energised, vents the spring chamber of the second valve means 11 through the conduit 24 to the tank 25. This allows a free flow of oil from the selection valve 9 to the first chamber 5a of the hydraulic cylinder 5 and from the first chamber 5a back to the directional control valve 9 via the third valve means 16. The fourth valve means 20, when de-energised also balances the pressure both sides of the normally closed fifth valve means 21 keeping this valve closed and preventing free flow of oil from the full bore side of the first chamber 5a of the hydraulic lift cylinder 5 to the accumulators 18, 19.

[0033] With the first valve means 10 and the fourth valve means 20 de-energised the hydraulic system operates in the normal way with the accumulators 18, 19 completely isolated from the system. In this mode the third valve means 16 acts as a hose failure valve, in the event of conduit 14 failing either side of the second valve means 11. If a sudden leak should occur, the third valve means 16 will close and prevent an unintended lowering movement of the piston rod 8 that controls the loader arm. Similarly, a sudden leak in the conduit 12 during lowering of the loader arm will also cause the third valve means 16 to close and stop the lowering movement.

[0034] Figure 3 shows the schematic hydraulic system with an active suspension arrangement, where the suspension for the hydraulic cylinder is engaged.

[0035] To engage the suspension arrangement, the first valve means 10 and the fourth valve means 20 have to be energised. This method of operation ensures that any interruption of the electric supply will result in the suspension system being disengaged and the vehicle will return to the normal operational mode.

[0036] The solenoid operated normally closed first valve means 10, when energised, connects the annulus side of the second chamber 5b of the hydraulic cylinder 5 directly to tank 13 without going through the directional control valve 9.

[0037] The fourth valve means 20, when energised, connects spring chamber of the second valve means 11 to the first chamber 5a of the lift cylinder 5 via the second valve means 11. As the pressures on both sides of valve 11 are now balanced it will close. At the same time the pressure in the first chamber 5a of the lift cylinder 5 is now connected to the pressure responsive side of the load control valve in the third valve means 16 via seventh valve means 23 and the conduit 28. Consequently, the third valve means 16 will open. The solenoid-operated fourth valve means 20, when energised, also vents the spring chamber of the fifth valve means 21, which now opens and connects the accumulators 18, 19 to the first chamber 5a of the lift cylinder 5.

[0038] The suspension arrangement is now engaged, so that the lift cylinder 5 is suspended on the accumulators 18, 19 and is free to move up and down.

[0039] When the vehicle is travelling, oil can flow in and out of the first chamber 5a of the lift cylinder 5 via the load control valve in the third valve means 16 and the fifth valve means 21. At the same time oil can flow in and out of the second chamber 5b of the lift cylinder 5 from and to the tank 13 via the solenoid-operated first valve means 10. Any leakage across the spool type directional control selection valve 9 is isolated from the first chamber 5a of the hydraulic cylinder 5 by the second valve means 11, preventing a gradual lowering of the lift arm assembly. Fluctuations in pressure in the first chamber 5a of the lift cylinder 5 and/or in the accumulators 18, 19 during the travel mode are isolated from the rest of the system by means of the second valve means 11. This ensures that a stable pressure is always available to maintain the second valve means 11 closed and the third valve means 16 open.

[0040] In the event of conduit 14 failing there would be a sudden loss of pressure in this conduit. This loss of pressure would be seen on the pilot side of the load control valve in the third valve means 16, which would cause it to close and prevent any unintentional downward movement of the lift arm assembly.

[0041] By inserting a low leakage device in the form of the second valve means 11 in the conduit 14 it is possible to achieve full suspension of the loader arm assembly while travelling without the loader arm gradually dropping, under controlled conditions, due to a leakage of hydraulic fluid occurring across the spool type directional control selection valve 9.

[0042] This system is engaged by means of a manually operated switch actuated by the operator. However, it is also possible to actuate the suspension arrangement automatically, using a control signal indicating that the vehicle is in motion. Any suitable signal, such as a vehicle speed signal may be used for this purpose.

[0043] If the lowering mode of loader arm assembly is selected by the operator using the directional control valve 9 the solenoid operated first valve means 10 and fourth valve means 20 have to be automatically de-energised to disengage the suspension function and return the system to its normal working mode. This can be done using an electrical signal from selection valve 9 actuated by the operator.

[0044] The system can be controlled by a directional

control selection valve 9 that is operated directly via a manual lever, operated via a lever operated hydraulic remote pilot valve or operated If a electro hydraulic remote control system.

[0045] If a manually operated directional control selection valve is used, an electric switch is mounted at the end of the spool which can be automatically switched as soon as the spool is selected. A hydraulic remote operated directional control valve from a lever operated hydraulic remote pilot valve may comprise an electric pressure switch inserted in the hydraulic hose feeding to the directional control selection valve to sense when a spool is being activated or a mechanical switch on the lever of the hydraulic remote pilot valve.

[0046] Finally, an electro-hydraulically operated directional control selection valve from a lever operated remote electronic controller may be used. An electronic signal from the electronic controller or any of the previously described methods can be used to control the arrangement.

[0047] The invention is not limited to the embodiments described above and may be varied freely within the scope of the appended claims.

Claims

1. A hydraulic system for a wheeled loader having a loader arm assembly, which is connected to the wheeled loader at a first end and carries a working implement at a second end, and which loader arm is movable between raised and lowered positions by means of a hydraulic cylinder (5), wherein hydraulic accumulator means (18, 19) is connected to the hydraulic cylinder (5) and where each chamber of the hydraulic cylinder (5) is connected to a selection valve means (9) adapted to supply fluid under pressure to a first chamber 5a of the ram means (5) and to drain fluid at a lower pressure from a second chamber (5b) of the ram means (5) in order to raise the loader arm assembly or to supply fluid under pressure to said second chamber of the ram means and drain fluid at a lower pressure from said first chamber of the ram means to lower the loader arm assembly, **characterized in that** the hydraulic system is provided with a number of valves for controlling fluid flow, wherein said valves comprise
   a first and second valve means (10, 11) each of which is movable between a first position, in which passage of hydraulic fluid therethrough is prevented in one direction, and a second position, in which passage of hydraulic fluid therethrough is permitted,
   said first valve means (10) being connected between said second chamber and a low pressure region,
   said second valve means (11) being connected between said first chamber 5a and said selection valve means (9) and having a first hydraulic fluid responsive means to open the second valve means (11) and there being means to connect said hydraulic fluid responsive means to said first chamber (5a) so as to move said second control valve to its second position, and
   a third valve means (16) being connected between the first chamber (5a) and the second valve means (11) so that the check valve (16) is normally closed to prevent fluid under pressure passing from said first chamber (5a) to the selection valve means (9) and having a hydraulic fluid responsive means to open said third valve means (16) and there being means to connect said hydraulic fluid responsive means to said first chamber (5a) so as to open the check valve.

2. Hydraulic system according to claim 1, **characterized in that** the accumulator means is connected between the third valve means (16 and the second valve means (11) via a valve arrangement (20, 21, 22, 23).

3. Hydraulic system according to claim 2, **characterized in that** the hydraulic system further comprises; a valve arrangement (20, 21, 22, 23) that is selectively movable between a first state in which passage of hydraulic fluid between the first chamber and the accumulator means is prevented and a second state, in which passage of hydraulic fluid between the first chamber (5a) and the accumulator means (18, 19) is permitted.

4. Hydraulic system according to claim 3, **characterized in that** the valve arrangement (20, 21, 22, 23) comprises:

   a fourth valve means (20) which is movable between a first position, in which hydraulic fluid passes through said fourth valve means to act on a fifth valve means (21) to prevent said fifth valve means from opening, and a second position, in which hydraulic fluid passes through said fourth valve means (20) to a second hydraulic fluid responsive means in the second valve means (11) to move the second valve means (11) to its first position, where
   the fifth valve means (21) which is movable between a first position, in which passage of hydraulic fluid through said fifth valve means between the first chamber (5a) and the accumulator means (18, 19) is prevented, and a second position, in which passage of hydraulic fluid between the first chamber and the accumulator means is permitted.

5. Hydraulic system according to claim 4, **characterized in that** the valve arrangement (20, 21, 22, 23) further comprises:

a sixth valve means (22) connected between the first chamber (5a) and the fourth valve means (20) so that the check valve is arranged to allow hydraulic fluid to pass from said first chamber (5a) to the fourth valve means (20), and having a restrictor arranged to bypass the sixth valve means (22) to allow a limited flow of hydraulic fluid from the fourth valve means (20).

6. Hydraulic system according to claim 4, **characterized in that** the fifth valve means (21) is maintained in its first position by hydraulic pressure from the selection valve when the fourth valve means (20) is in its first, inactive position

7. Hydraulic system according to claim 4, **characterized in that** the fifth valve means (21) is maintained in its second position by hydraulic pressure from the selection valve or the first chamber when the fourth valve means is in its second, active position.

8. Hydraulic system according to claim 4, **characterized in that** a seventh valve means (23) is connected between the fourth valve means (20) and the hydraulic fluid responsive means for opening the third valve means (16) when the fourth valve means (20) is in its second, active position.

9. Hydraulic system according to any one of the above claims, **characterized in that** a seventh valve means (23) is connected between the second chamber (5b) and the hydraulic fluid responsive means to open the third valve means (16).

10. Hydraulic system according to any one of the above claims, **characterized in that** the first hydraulic fluid responsive means arranged to open the second valve means (11) is provided with a restrictor for limiting the hydraulic flow to the first fluid responsive means of said second valve means (11).

11. Hydraulic system according to any one of the above claims, **characterized in that** the accumulator means (18, 19) are connected to the hydraulic cylinder (5) when the wheeled loader is being driven.

12. Wheeled loader provided with a hydraulic system according to claim 1.

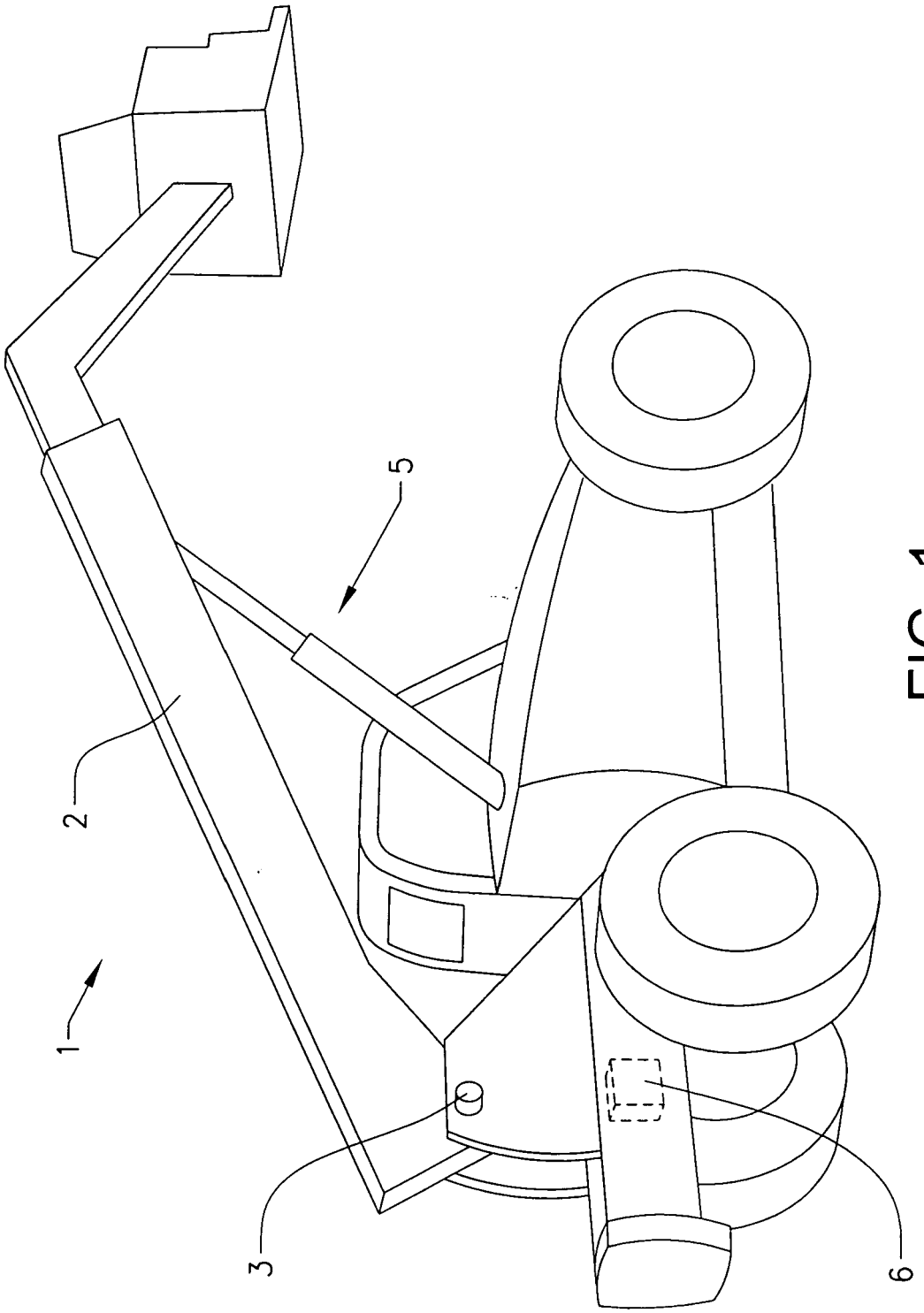

FIG. 1

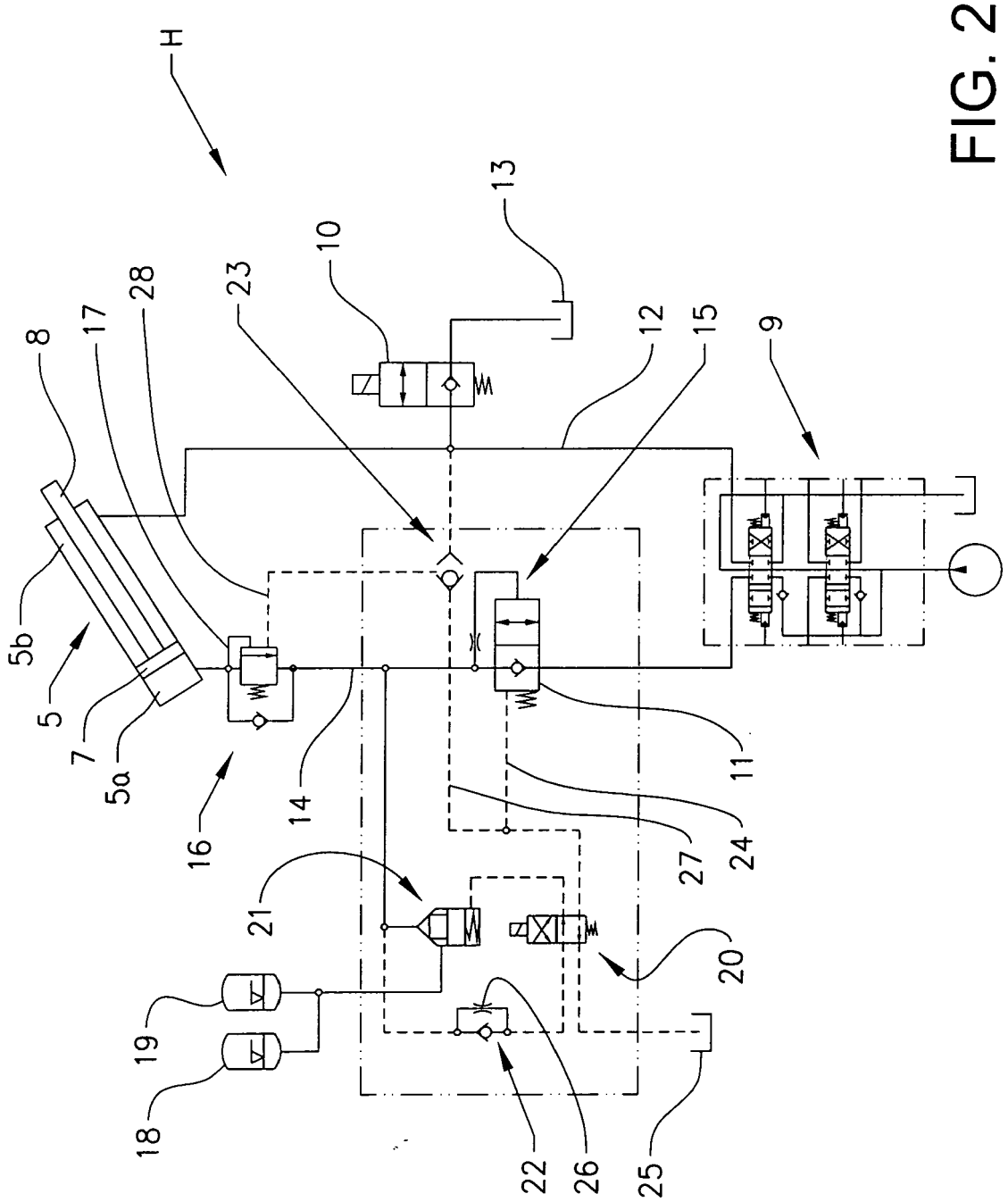

FIG. 2

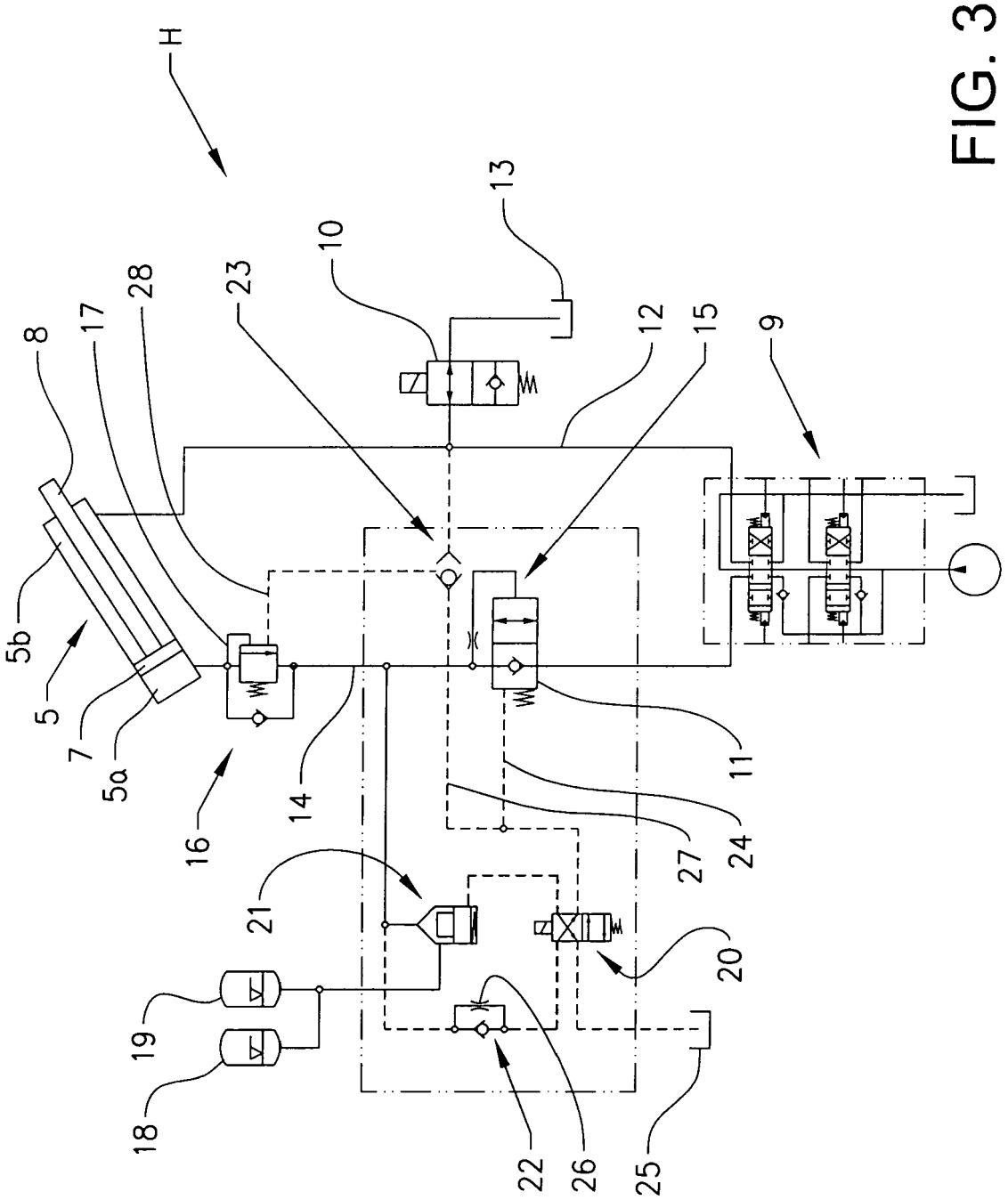

FIG. 3

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EUROPEAN SEARCH REPORT

Application Number
EP 04 02 6904

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	21 March 2005	Masset, M

CATEGORY OF CITED DOCUMENTS

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