May 25, 1965 K. R. LOHBAUER ETAL 3,184,920

LEAKAGE CONTROL FOR BULLDOZER PITCH JACK CIRCUIT

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FIG. 1.

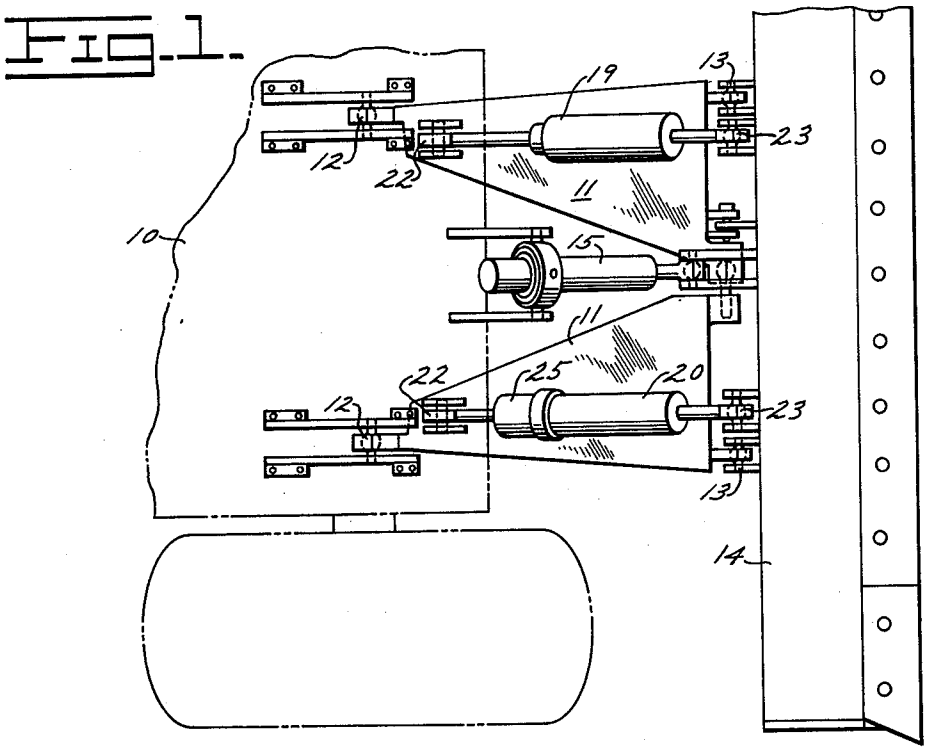
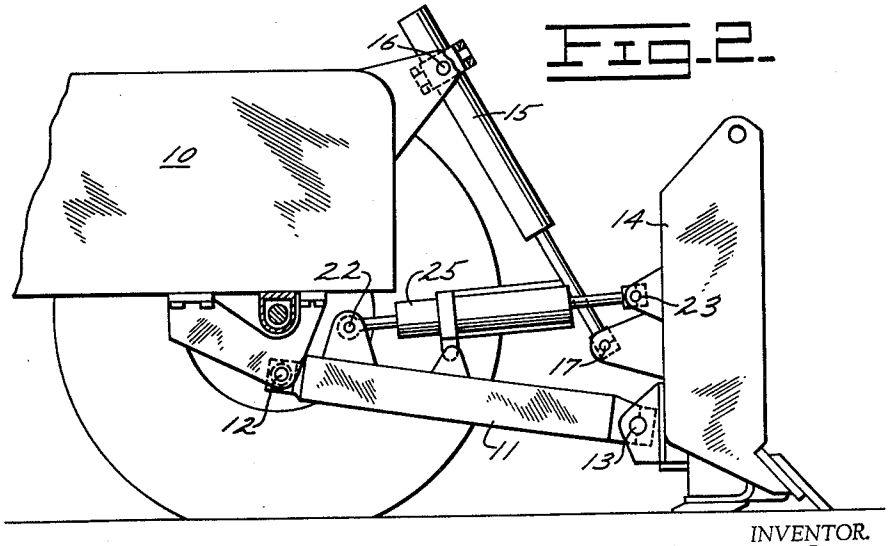


FIG. 2.



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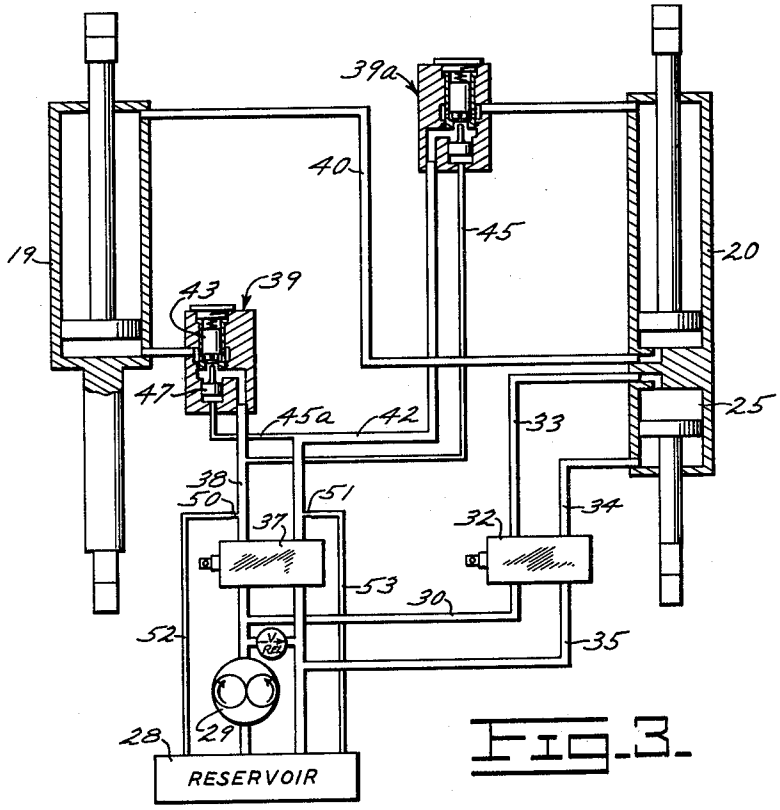

FIG. 3.

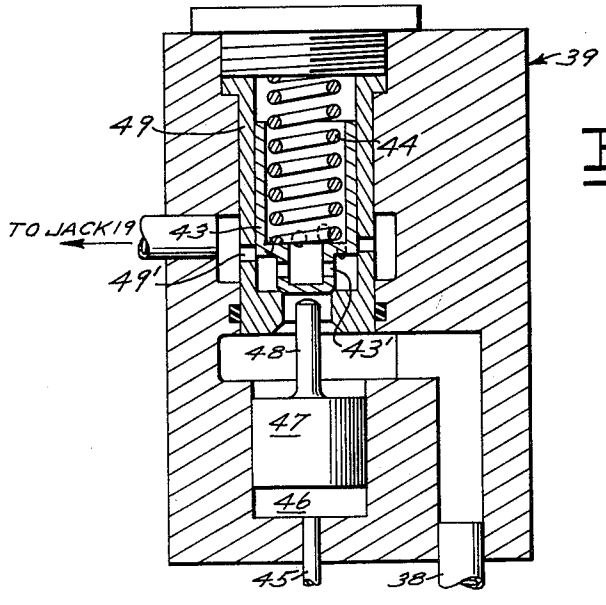

FIG. 4.

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LEAKAGE CONTROL FOR BULLDOZER PITCH JACK CIRCUIT

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This invention relates to bulldozers and particularly to improvements in the hydraulic circuit which controls fluid pressure to the jacks which vary the pitch of a bulldozer blade.

In a well known type of bulldozer, push arms extend forwardly from a tractor and support a blade which is pivoted to the push arms adjacent its lower edge. A brace in the form of an extensible double acting hydraulic jack extends between each push arm and the blade adjacent its upper edge. Adjustment of the length of both jacks therefore controls the pitch of the blade by swinging its upper edge forwardly or rearwardly. Spool type control valves are customarily used for directing fluid under pressure to the jack and retaining the fluid in the cylinders for maintaining a desired pitch. When great forces are exerted on the blade and jacks during operation, leakage permits undesired adjustment which can change the pitch as well as the tilt of the blade.

It is the object of the present invention to provide means to overcome the above mentioned difficulty and more specifically to provide a system with positively seating check valves to prevent flow of fluid out of the cylinders of a pair of jacks as a result of external pressure but to permit such flow upon the incidence of internal or pump pressure in the system.

Further and more specific objects and advantages of the invention are made apparent in the following specification wherein reference is made to the accompanying drawings illustrating a preferred form of the invention.

In the drawings:

FIG. 1 is a plan view of the forward end of a tractor and a bulldozer mounted thereon with parts being broken away;

FIG. 2 is a view in side elevation of the bulldozer shown in FIG. 1;

FIG. 3 is a schematic view of the hydraulic circuit of the pitch jacks of the bulldozer shown in FIGS. 1 and 2; and

FIG. 4 is an enlarged schematic sectional view of a check valve which forms a part of the invention.

Referring first to FIGS. 1 and 2, the forward end of a tractor is shown at 10 as having a pair of push arms 11 pivoted thereto as at 12 and extending forwardly to pivotal connections 13 adjacent the lower edge of a bulldozer blade 14. The blade can be raised and lowered with respect to the ground by means of a lift jack 15 pivotally connected with suitable brackets at the forward end of the tractor as shown at 16 and to the blade as at 17. A hydraulic circuit (not shown) and suitable controls of well known type are associated with the lift jack 15. A pair of pitch jacks shown at 19 and 20 are pivotally connected betweeen the push arms as at 22 and the blade toward its upper edge as at 23. A tilt jack 25 is arranged in alignment with the pitch jack 20 and is operable independently thereof so that upon extension or retraction thereof one of the pitch jack assemblies is in effect longer than the other to impart a tilt to the blade which is a condition in which one end of the blade is lower than the other.

The circuitry of the pitch and tilt jacks and the valve mechanism of the present invention are shown in FIG. 3. In this figure, the rod ends of the pitch jacks 19 and 20 would be connected to the bulldozer blade which is not shown while the opposite end of the pitch jack 19 is connected to one push arm while the rod of the tilt jack 25 is connected to the other push arm. The tilt jack 25 does not form a part of the present invention but is actuated by a conventional mechanism including a reservoir 28 and a pump 29 for directing fluid under pressure to either end of the cylinder of jack 25 through a line 30, a spool-type control valve 32 of conventional construction and thence through a line 33 to the head end of the jack or a line 34 to the rod end thereof. Exhaust fluid is returned through the valve and a return line 35 to the reservoir.

The pitch jacks 19 and 20 with which the present invention is associated operate somewhat differently as they are mounted in series and in such a manner that pressure from the pump 29 is delivered to one end of one jack while return fluid from that jack is directed to the same end of the other jack. For example, pressure from the pump 29 is controlled by a conventional spool-type valve 37 which serves to direct pressure through a line 38, through a check valve, generally indicated at 39, and to the head end of jack 19. Fluid expelled from the rod end passes through a line 40 to the head end of jack 20. Consequently both jacks are extended which results in imparting a forward pitch to the blade. The cylinder of jack 19 is made slightly larger than that of jack 20 to compensate for the volumetric displacement of the piston rod therein. Retraction of the jack is similarly accomplished by adjustment of the control valve 37 to direct pump pressure through a line 42 and a valve 39*a* which is identical in construction and operation to the valve 39 and thence to the rod end of the jack 20. As the jack piston moves inwardly, fluid is displaced from the head end through the line 40 to the rod end of jack 19 so that both jacks are retracted and a rearward pitch is imparted to the bulldozer blade.

Exceptionally great forces are imparted to the pitch jacks and sometimes to one jack as when one end of the blade encounters a relatively immovable object. This has been found to cause leakage through the spool valve 37 accompanied by movement of the jack piston in the cylinder so that one jack assembly is longer than the other imparting an undesired tilt to the blade. The present invention prevents such undesired movement of the jack by the use of check valves 39 in line 38 and 39*a* in line 42. These check valves are identical and FIG. 4 is an enlarged view of the valve 39. As shown in FIG. 4, a spring loaded check valve 43 normally closes communication between the line 38 and the jack 19 but is arranged to be opened by pressure in line 38 opposing the force of its spring 44. However pressure in the head end of jack 19 is communicated through a plurality of ports 43′ to the chamber of spring 44 to close the check valve and, therefore, prevent leakage from the jack cylinder as the result of forces originating at the bulldozer blade. The check valve 39*a* operates in the same manner in preventing the discharge and leakage of fluid from the rod end of the jack 20.

Recalling the manner in which the jacks 19 and 20 operate, it becomes necessary upon retraction of the jack 19 to transfer fluid from its head end to the rod end of jack 20 and also necessary upon extension of the jacks to transfer fluid from the rod end of jack 20 to the head end of jack 19. To permit this to take place, the check valves 39 and 39*a* are arranged to be opened by fluid pressure in the system. For example when pump pressure is delivered through line 38 and valve 39 to the head end of jack 19 and fluid is transferred through line 40 to the head end of jack 20, pressure is communicated from line 38 through a line 45 to a cylinder 46 in the valve 39*a* (see FIG. 4) and urges a piston 47 upwardly so that a rod 48

thereon opens the check valve 43 against pressure of the spring and thus permitting the fluid displaced from the rod end of jack 20 to be directed back to reservoir 28 by way of line 42, valve 48 and line 35. Similarly when line 42 is pressurized to direct fluid to the rod end of jack 20 and fluid passing through the transfer line 40 urges the piston inwardly of jack 19, the valve 39 is opened by pressure in line 45*a* which, like the line 45, communicates pressure from the line 42 to the check valve opening cylinder of check valve 39. Thus while both jacks act normally under internal pressure, pressures originating externally as by forces communicated to the jacks through the bulldozer blade are opposed by positively seating check valves which prevent the usual leakage through the sliding spool-type control valves.

In practice, it has been found that adjustment of the blade pitch under certain conditions results in chattering of the check valves 43 and, as a result, erratic action of the blade. For example, when valve 37 is conditioned to extend jacks 19 and 20 with an external force acting upwardly on the piston of jack 20, as check 43 of valve 39*a* is opened the jack piston tends to move ahead of the fluid, thus reducing pressure in the circuit. This allows valve 39*a* to close and interrupt movement of the jacks. To overcome this, check 43 is disposed in a sleeve 49 containing a plurality of axially offset, radial ports 49' which cooperate with a shoulder 43*a* of check 43 to modulate fluid flow through valves 39 and 39*a* as the check 43 moves between its opened and closed positions. Thus, under the above described conditions, check 43 assumes a position which modulates the flow of fluid returning to reservoir 28 to maintain a constant pressure in the system and prevent erratic action of the jacks. Although most of the ports 49' are blocked when check 43 is in its closed position, as shown in FIG. 4, sufficient communication is provided through the lowermost ones of ports 49' to permit pressure in the jacks to be communicated to the chamber of spring 44 and thus hold check 43 in its closed position when the control valve 37 is in neutral or hold as previously described.

Another possibility of leakage occurs when the tilt jack is energized and pressure in the line 30 might leak through control valve 37 creating pressure in lines 38 or 42 which will be effective to open the check valves 39 and 39*a* or cause otherwise undesirable adjustment in the pitch jack circuit. To avoid this, the pressure of any such leakage is relieved through small orifices 50 and 51 in lines 52 and 53 which communicate between lines 38 and 42, respectively, and the reservoir where atmospheric

pressure prevails. These orifices are of just sufficient size to relieve pressure caused by leakage but not sufficiently large to materially reduce the full pump pressure which actuates the jacks upon manipulation of the control valve 37.

We claim:

1. In a hydraulic circuit comprising a pair of jacks and a conduit communicating between the head end of one jack and the rod end of the other jack whereby both jacks can be moved in one direction by directing fluid under pressure to one end of one jack, a source of fluid under pressure, a valve for directing pressure selectively to one end of either jack, a normally closed check valve means for each jack preventing reverse flow from said jacks and leakage at said valve, means actuated by pressure directed to either jack to open said normally closed check valve for the other jack, the check valves being spring closed and having pressure actuated pistons for opening them in opposition to spring pressure, means communicating pressure directed to either jack to the valve opening piston associated with the other jack and means whereby leakage through the first named valve toward the jacks is prevented from opening the check valves by restricted orifices in said means for communicating pressure or bleeding said leakage to the atmosphere.

2. In a hydraulic circuit comprising a pair of jacks and a conduit communicating between the head end of one jack and the rod end of the other jack whereby both jacks can be moved in one direction by directing fluid under pressure to one end of one jack, a source of fluid under pressure, a valve for directing pressure selectively to one end of either jack, a normally closed check valve means for each jack preventing reverse flow from said jacks and leakage at said valve, means actuated by pressure directed to either jack to open said normally closed check valve for the other jack, and separate means cooperating with the check valve to modulate fluid flow from the jacks to the source.

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