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HYDRAULIC CYLINDER CONTROL FOR BULLDOZER

Filed Oct. 5, 1967

2 Sheets-Sheet 1

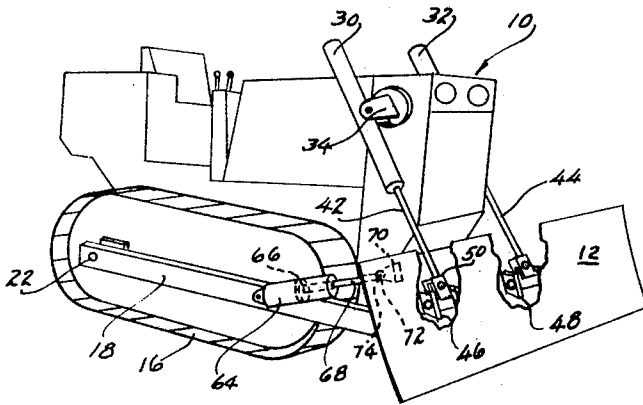


FIG. 1

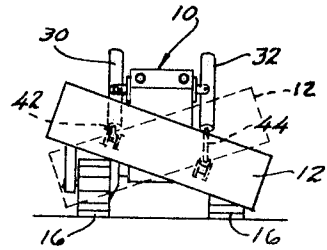


FIG. 2

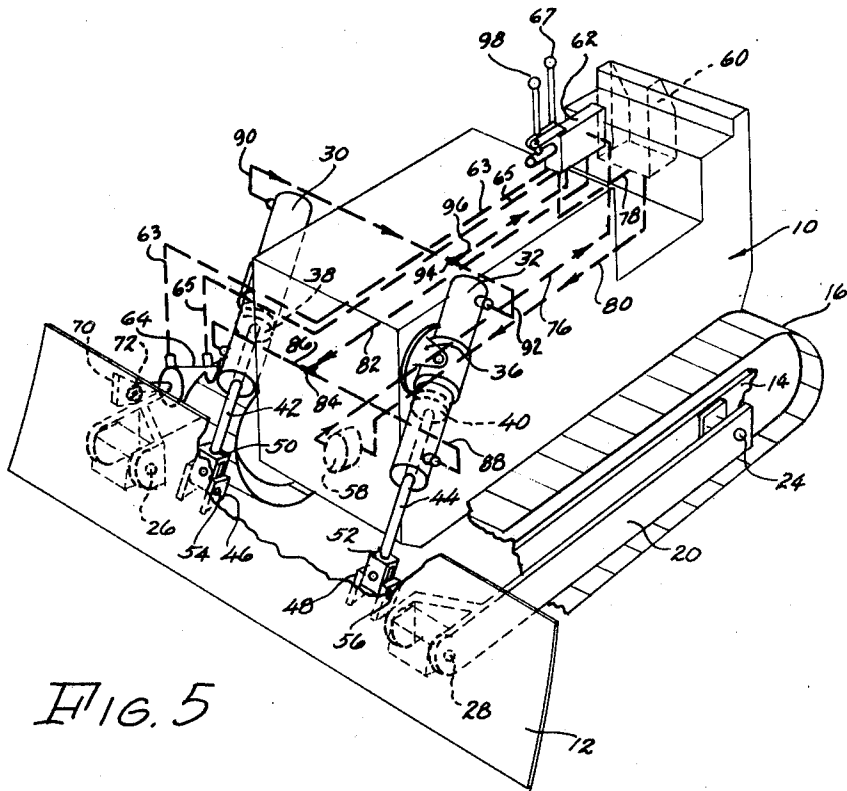


FIG. 5

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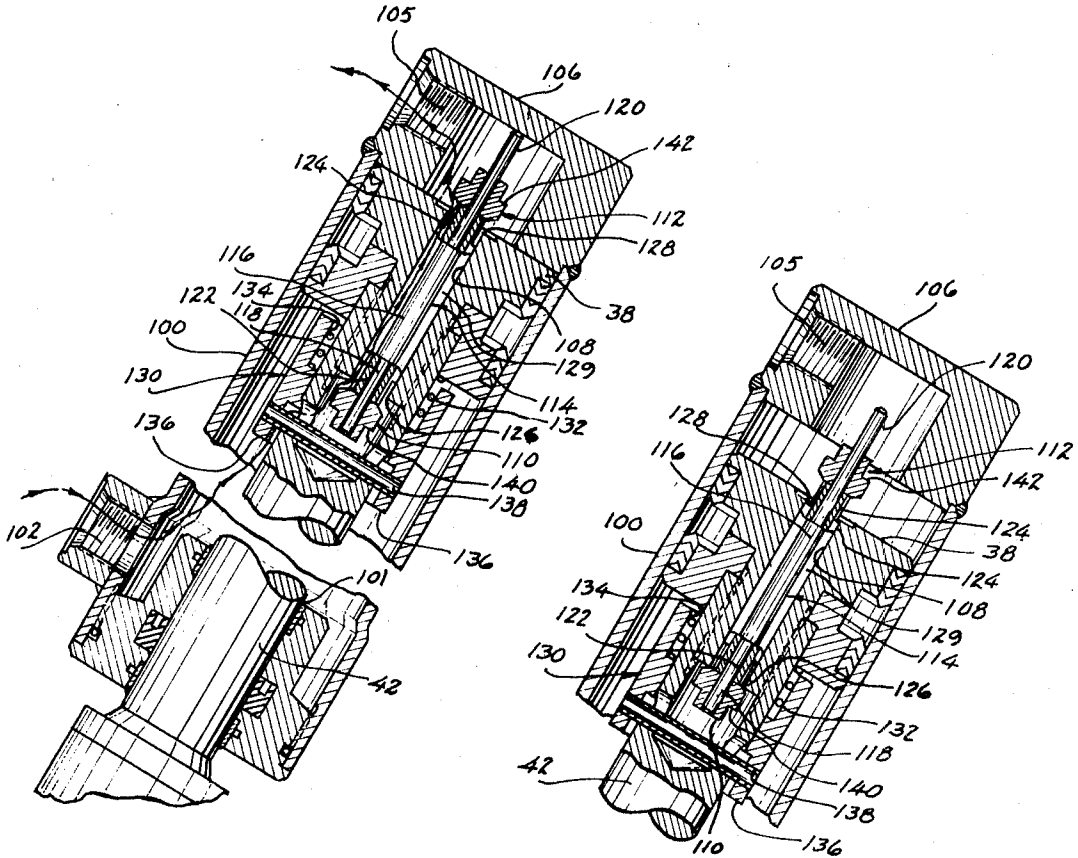


FIG. 3

FIG. 4

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HYDRAULIC CYLINDER CONTROL FOR BULLDOZER

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2 Claims

ABSTRACT OF THE DISCLOSURE

A hydraulic control for a vehicle having a blade, a tilt cylinder, lift cylinders for positioning the blade in relation to the ground, and valves in the lift cylinders for relief of fluid pressure and for allowing by-pass of the fluid. The valves in each lift cylinder are connected by a pin and the relief and by-pass action is actuated by reason of one or the other extremity of the valve mechanism striking a portion of the cylinder.

BACKGROUND OF THE INVENTION

The invention relates to earth working equipment wherein a blade is attached to the front of a vehicle and the blade can be moved in relation to the ground. The prior art relevant to a bulldozer of this type is taught in Long 2,942,363 which shows lift cylinders adjacent the tractor body and strut cylinders for varying the pitch and tilt of the blade. The lift cylinders are pivotally connected to an equalizing bar which is swivelly connected to the blade and enables the blade to be freely moved without strain on the lift cylinders or frame members. A twisting of the blade and frame members should be minimized or eliminated and thus prevent stress and strain on these members. This type of equalizing, however, has limitations due to its mechanical nature, wherein some binding may occur between the cylinder rods and the swivel joint.

Other means of equalizing stresses and strains in dual operation of hydraulic cylinders have been accomplished with unloading or relief valves, which operate when the fluid pressures become sufficiently great. The prior art also shows by-pass valves in cylinders which valves are positioned laterally such that one opens prior to the other when approaching the end of the stroke. These valves permit fluid to by-pass the piston in one cylinder and to flow to the other cylinder. These structures also have limitations when applied to a bulldozer blade because of insufficient flexibility.

SUMMARY OF THE INVENTION

The present invention relates to a tractor carrying a dozer blade on the front, the blade being positioned by means of hydraulic lift cylinders and a tilt cylinder. The invention more particularly relates to a control means for the lift cylinders wherein a pair of poppet valves are contained within each lift cylinder, the valves being aligned and connected by a pin. The pin is positioned such that as the cylinder piston approaches one end of the cylinder, the pin strikes the cylinder end and unseats one of the valves. As the cylinder piston approaches the other end, an actuating sleeve and pin assembly strikes the cylinder gland and the other valve is unseated. When one or the other of the valves is unseated the pressurized fluid by-passes the rod and piston assembly and the fluid is returned to a supply tank. The by-pass pressure is just sufficient to hold the load in any position of the blade.

The lift cylinder rods are connected to and move with the blade and the tilt cylinder is connected to the blade to vary its tilt and pitch. The lift cylinders are free to oscillate when the tilt cylinder is operated since the lift

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cylinders are hydraulically connected in parallel. The hydraulic circuiting permits free movement of the lift cylinders, as the blade is tilted or pitched, by reason of the lift cylinders being directly connected to the blade.

The advantages of the poppet valves in the lift cylinders permit a simpler and less costly frame assembly as this eliminates the use of an equalizer member. It is also important in the operation of the tilt cylinder to have the lift cylinder pressures relieved to the extent that the holding pressure is permitted to return to the tank. Twisting of the tractor frames and blade by the cylinder not yet at the end of its stroke is prevented because the pressure on that cylinder is just sufficient to hold the blade in position.

Other features and advantages will be realized and will become apparent from a reading of the following description taken together with the annexed drawings, in which:

FIG. 1 is a perspective view of a vehicle incorporating the invention;

FIG. 2 is a front view on a reduced scale showing the blade in tilted positions;

FIG. 3 is an enlarged sectional view of a lift cylinder showing the connecting pin, and the valves in the open position;

FIG. 4 is a similar view showing fragmentarily the cylinder with one of the valves closed, and

FIG. 5 is a circuit diagram, imposed in perspective, of the hydraulic system.

As seen in the perspective view in FIG. 1, the invention is applicable to a vehicle shown as a tractor 10 carrying a blade 12 on the front, the combination being a bulldozer of well-known type. Tractor 10 includes a frame 14 propelled by the engine and carried on endless tracks 16. Blade 12 is carried on push arms 18 and 20, also seen in FIG. 5, pivotally mounted from the track suspension system at the rear thereof by pins 22 and 24 and also are pivotally connected to the blade by pins 26 and 28. The blade and push arms are arranged and constructed to be raised and lowered in relation to the ground around pins 22 and 24.

Hydraulic lift cylinders 30 and 32 are pivotally connected to the tractor by means of trunnions 34 and 36 which can rotate on the sides of the tractor to permit the tilting and raising and lowering of the blade 12, as described and shown, so the cylinders 30 and 32 are connected universally at the tractor, as shown. The cylinders include pistons 38 and 40 at the ends of piston rods 42 and 44, the rods being pivotally connected to the rear of blade 12. These connections include lugs or brackets 46 and 48 secured to the blade, and bifurcated portions 50 and 52 of rods 42 and 44 are connected to the lugs by means of pins 54 and 56 and the rods are shown to be universally connected by the pair of pins at the rod end on the blade 12.

A pressurized fluid supply is made available for operation of the blade by means of a hydraulic pump 58 driven from the engine, the pressurized system also includes a reservoir 60, a control valve 62 and interconnecting lines. The fluid lines are connected to the various components and in an arrangement such that the lift cylinders are hydraulically parallel. These connections will be further described in more detail.

In addition to the lift cylinders 30 and 32 for raising and lowering the blade, a tilt cylinder 64 is positioned on the right side of the dozer, as seen in FIGS. 1 and 5. The cylinder is pivotally connected to the push arm 18 and includes a piston 66 and a rod 68, the rod being connected to the blade at one side thereof by means of a lug or bracket 70, a bifurcated portion 72 on the rod and a pin 74. Cylinder 64 is actuated by the pressure fluid to change the position of the blade by tilting one side in relation to the other. FIG. 2 shows the front of the dozer with the

blade in various angles of tilt. Cylinder 64 responds to a control to change the tilt of the blade wherein one side of the blade is moved up or down in relation to the other side. The tilt cylinder and its associated fluid lines 63 and 65 and control 67 are shown in FIG. 5.

The hydraulic line connections will now be described as the parallel operation of the lift cylinders is an important aspect in the practice of the invention. As seen in FIG. 5, pump 58 is located at the front of the engine and an output fluid line 76 is connected to the pump and to the control valve 62. A line 78 is connected from the valve to the reservoir 60 and a return line 80 connects the reservoir and the pump. A fluid line 82 is connected to the valve and runs forward to a T fitting 84 and fluid lines 86 and 88 are connected from the fitting to the rod side of lift cylinders 30 and 32. Lines 90 and 92 are connected to the piston side of the cylinders and join at a T fitting 94 from which a line 96 runs to the valve. The valve includes an operator's handle 98 and is constructed such that actuation of the handle moves the valve spool for desired flow of the pressure fluid for raising or lowering of the blade.

In FIG. 3 is shown a sectional view of one of the lift cylinders incorporating the invention, and only one of the cylinders with its components will be described as the construction in each is the same. As stated, cylinder 30 includes a piston 38 and a rod 42, the rod being generally within the body 100 when the piston is in the retracted position. Of course, a portion of the rod always extends through one end of the body to connect to the back side of the blade. Body 100 includes a sealing gland 101 at the rod end thereof and the rod moves in the gland under operation of the piston and rod. Adjacent the gland is a port 102 which connects one of the fluid lines mentioned above. Rod 42 is secured to piston 38 such that the two move in response to the fluid pressure directed on the piston. A port 105 is positioned at the opposite end 106 of the body 100, and one of the fluid lines is connected thereto. Piston 38 includes a centrally located bore 108 in which is slidably positioned a pair of poppet valves 110 and 112 interconnected by a pin assembly 114.

Pin assembly 114 includes an enlarged portion 116 intermediate end portions 118 and 120. Portion 118 is the lower part and is of a length equivalent to that of poppet valve 110 and a guide vane 122. Portion 120 is the upper part and is longer than portion 118 in that it is enclosed by a guide vane 124 and extends beyond poppet valve 112. Guide vanes 122 and 124 have provision for passage of fluid from one end of the cylinder to the other end as the valves are open. Piston 38 includes valve seats 126 and 128 at the ends thereof and the bore 108 is sufficiently larger than the intermediate portion 116 of the pin assembly to provide a fluid passageway 129 surrounding the pin. The length of the pin assembly 114 and the positions at which the poppet valves 110 and 112 are secured thereto are such that only one of the valves can be seated at a given time. As seen in FIG. 3, portion 120 of the pin extends past the valve 112 and is engageable with the upper end 106 of body 100.

Adjacent the piston and on the rod side thereof is an actuating sleeve and pin structure 130. A spring 132 is contained within a portion 134 of the sleeve and around the rod 42 and biases the sleeve toward the lower end of the cylinder. Sleeve structure 130 also has a portion 136 engageable with gland 101 as the piston is moved to the lower side of the cylinder. A pin 138 is contained by portion 136 and positioned to be engageable with poppet valve 110. As seen in FIG. 3, the poppet valves have enlarged portions 140 and 142 which seat on the piston. FIG. 4 shows the piston 38 in a position wherein valve 110 is seated on portion 126.

The construction of the hydraulic cylinder and control enables the operator to tilt the dozer blade at any elevation of the blade without fear of twisting the push arms or other parts. This is so because the lift cylinders are

directly connected to the blade and the cylinders are hydraulically connected in parallel which allows the pressure fluid to return to the supply tank. The poppet valves are aligned within the cylinder and are positioned to permit flow of the fluid in either direction depending upon the fluid pressure and contact with one or the other end of the connecting pin assembly with the cylinder portion.

In the operation of the hydraulic control, pressurized fluid is available from the engine driven pump 58 to raise and lower the blade and to tilt the blade. In the normal raise circuit the fluid flow is to the rod side of the cylinders as seen in FIG. 5 wherein the piston is moved upwardly and thus pulls the blade up. The pressurized fluid is directed through conduits from the control valve and forces poppet valve 110 onto its seat as the piston is moved upward. As the piston approaches the cylinder end the poppet connecting pin 120 strikes the end of the cylinder and the valves are moved downwardly which unseats valve 110. As this valve is unseated the fluid passes by the valve and flows at load pressure back to the control valve and to the tank.

The action is similar in the normal lowering circuit wherein the pressured fluid is directed on the piston end of the cylinder and the rods are extended. Poppet valve 112 is seated on the piston until the piston approaches the lower end of the cylinder. In this case the actuating sleeve portion 136 strikes the gland and the portion is moved against the bias of the spring. Continued lowering of the piston compresses the spring by reason of portion 136 against the gland and contact of poppet valve 110 and the connecting pin portion 118 with the actuating pin 138 moves the poppet assembly upwardly which unseats poppet 112 from the piston and permits fluid flow through the piston in the downward direction.

In certain positions of the lift cylinders, and as the tilt cylinder is operated, the fluid by-pass pressure are sufficient to hold the load and prevent any twisting of the dozer frame and blade. Since the lift cylinders are in parallel and since the rods are directly connected to the blade as seen in FIG. 2, this twisting is prevented if one of the cylinders is not at the end of its stroke. The pressure on that cylinder is only that required to hold the blade in position.

Another feature of this construction is the provision for substantial flow in a relatively small diameter cylinder. Also the use of the piston rod, rather than the piston itself, for enveloping the poppet valve assembly requires only two poppet sealing surfaces to construct and maintain. The structure requires only one tilt cylinder for tilting the blade either to the right or to the left as the hydraulic lift cylinders are directly connected to the blade and the parallel circuit permits them to move freely in response to the pressurized fluid.

It is thus seen that herein shown and described is a relief or release means in the form of poppet valves which valves are aligned with the piston and are on the same axis with the piston rod, and provide for by-pass of the fluid as the piston approaches one end of the cylinder. While only one embodiment has been shown, variations may occur to those skilled in the art, and it is to be understood that all such variations are contemplated as being within the scope of the invention. The invention is not intended to be taken as limited by the embodiment disclosed, nor in fact, in any manner except as defined in the following claims:

What is claimed as new and desired to be secured by Letters Patent of the United States is:

1. In a vehicle carrying an earth working blade thereon and having push beams pivotally connected to the vehicle and to the blade, hydraulic means on said vehicle and including a hydraulic pump and a hydraulic valve for said pump, a pair of two-way hydraulic lift cylinders pivotally connected to said vehicle and to said blade for raising and lowering said blade and each of said

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lift cylinders including a piston, a single hydraulic tilt cylinder pivotally connected to said vehicle and to said blade for tilting said blade from side to side, hydraulic conduits connected with said hydraulic means and all said hydraulic cylinders and with said pair of lift cylinders being hydraulically connected together in parallel, a hydraulic passageway extending through each of said lift cylinder pistons and having spaced-apart valve seats, a poppet valve movably disposed on each end of each of said lift cylinder pistons and each of said poppet valves being movable onto a respective one of said valve seats, for blocking hydraulic flow through said passageway, valve actuating means operatively connected with each of said poppet valves for moving said poppet valves to open positions on said valve seats, separate abutments included in said lift cylinders for respectively engaging each of said actuating means upon movement of said piston to each end limit of its stroke and thereby moving the respective one of said poppet valves to its open position and relieving hydraulic pressure in the respective one of said lift cylinders, one of said valve actuating means being a rod connected to one of said poppet valves, and the other of said valve actuating means including a spring for yieldingly urging the remainder of said other valve actuating means away from the other of said poppet valves, whereby said poppet valves are responsive to hydraulic pressure when said piston is not at either of its end-limit positions.

2. The subject matter of claim 1, wherein said remainder of said other of said valve actuating means in-

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cludes a sleeve connected with said piston and coaxial therewith and movable along the axis of said piston and being abutable with said cylinder in response to movement of said piston in said cylinder, and said spring axially yieldingly urging said sleeve away from said piston and toward a position of abutment with said cylinder, said poppet valves being disposed coaxial with said piston and being connected together to be arranged for alternate seating on the respective said valve seats.

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60—52; 91—401; 172—666