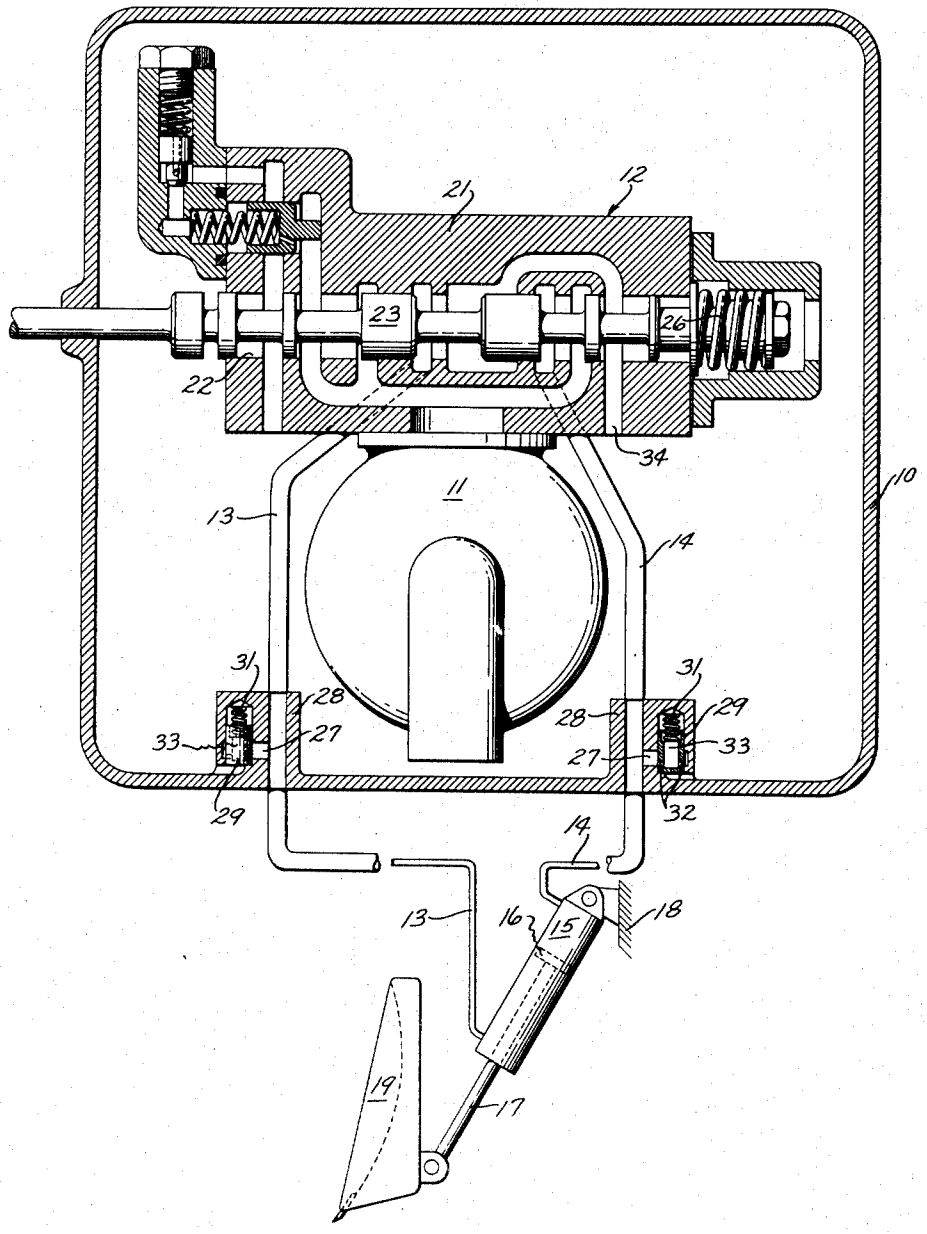
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PUMP AND MOTOR HYDRAULIC SYSTEM AND CONTROL THEREFOR

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PUMP AND MOTOR HYDRAULIC SYSTEM AND CONTROL THEREFOR

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1

This invention relates to a hydraulic control mechanism for directing fluid under pressure to one or more double-acting hydraulically actuated jacks.

The present invention will have many applications but is particularly adapted for use with, and will be described herein in connection with a hydraulically actuated jack for controlling the movement of an earth-working implement such as a tractor-mounted bulldozer or the like.

A hydraulic circuit for controlling the movement of a tractor-mounted bulldozer or the like usually comprises one or more double-acting hydraulically actuated jacks, a fluid reservoir, a pump, and a control valve for controlling the flow of fluid to and from the jacks. The control valve is usually provided with four operating positions, namely, neutral or hold, raise, lower, and a float position in which the working implement is free to move in response to external forces. One of the principal difficulties encountered in conventional hydraulic systems of this type is that under certain operating conditions, the load on the working implement causes it to move faster than the rate at which the pump can supply fluid to the jacks. As a result the fluid displaced from the jacks is returned to the supply tank at a greater rate than it is withdrawn by the pump thus causing excessive pressure which may result in damage to the hydraulic system as for instance bursting of the fluid supply tank. Another disadvantage in conventional hydraulic systems is that the speed at which the working implement is moved is limited by the pump output even when external forces are applied urging it in the desired direction. This is particularly undesirable during lowering of the bulldozer blade at which time it is desirable to bring the blade downwardly into its working position in the shortest possible time. Although in conventional hydraulic circuits, it is possible for the bulldozer to move ahead of pump output resulting in a partial vacuum in the pressure end of the jack so that even though the bulldozer is brought into the working position rapidly, down pressure on the blade cannot be exerted until the jack cylinder is filled from the pump.

It is, therefore, an object of the present invention to provide an improved hydraulic system for controlling movement of an earth working implement or the like having means permitting fluid to flow directly from the supply tank into the power line receiving pump output when the pressure in the supply tank exceeds the pressure in the power line thus preventing excessive

2

pressure in the system as well as permitting more rapid movement of the implement under the influence of external forces. Other objects and advantages of this invention will be made apparent in the following description wherein reference is made to the accompanying drawing.

In the drawing, a hydraulic system embodying the present invention is illustrated schematically in its association with a double-acting hydraulically actuated jack for controlling the movement of an earthmoving bulldozer.

The hydraulic circuit shown in the drawing comprises a fluid supply tank 10, a pump 11, and a control valve 12 for directing fluid under pressure through power lines 13 and 14 to either end of a double-acting hydraulic jack. This jack is shown as comprising a cylinder 15 containing a reciprocal piston 16 carried on a piston rod 17. The cylinder is pivotally supported from a tractor or the like, a part of which is indicated at 18, while the piston rod is pivotally secured to a bulldozer blade 19. Although it is not shown, the bulldozer blade may be provided with a pair of push arms pivotally secured to the tractor in a manner to permit raising or lowering of the bulldozer in response to movement of the piston rod 17.

The control valve 12 is disposed within the supply tank 10 and comprises a valve body 21 having an elongated bore 22 for the reception of a valve spool 23 adapted for a sliding movement therein. The valve spool is provided with a plurality of spaced collars adapted to cooperate with suitable recesses and passages in the control valve body to effect direction of fluid from the pump to either end of the jack cylinder through power line 13 or 14 and to return fluid displaced from the cylinder back to the supply tank. The valve spool 23 extends through a suitable opening provided in the tank and at its extending end is connected to suitable manual control means (not shown) for controlling the position of the valve spool. A spring illustrated at 26 is associated with the opposite end of the valve spool normally urging it toward its neutral or hold position.

Each of the power lines 13 and 14 communicates directly with the interior of the tank below the fluid level therein by way of a passage 27 provided in a boss 28 which may be formed in the bottom wall of the tank as shown. Each of the passages 27 is normally closed by a check valve or make-up valve 29 which is urged toward its closed position by a spring 31 as well as fluid pressure in the power line. Fluid pressure in the power line is transmitted to the spring

side of the valve through passages **32** communicating with a recess **33** provided in the valve. In practice the spring **31** exerts a relatively small force on the valve so that it can be readily opened when the pressure in the tank exceeds the pressure in the power line. Upon opening of the valve, fluid is free to flow from the tank to the power line through passage **27** without passing through the pump or control valve.

This arrangement of parts is particularly advantageous in the event that external forces acting on the bulldozer cause the jack to move at a greater rate than the pump can transfer fluid from one side of the piston to the other. Under these conditions fluid is returned to the tank faster than it is removed by the pump resulting in an increase in the pressure within the tank. Simultaneously a negative pressure is produced in the opposite end of the cylinder causing the make-up valve **29** to open allowing fluid in the tank to flow directly to the low pressure end of the cylinder without passing through the pump and control valve. In practice it has been found that this condition frequently occurs during lowering of the bulldozer from its raised position which is accomplished by positioning the valve spool as shown in the drawing.

In operation, as the bulldozer is being lowered, its weight urges the piston **16** downwardy in the cylinder so that the fluid beneath the piston is displaced through the power line **13** and flows into the valve body and thence into the tank **10** by way of a discharge passage shown at **34**. The exact course taken by the fluid through the valve body is immaterial to an understanding of the present invention and since the valve is of more or less conventional construction, the operation of which is well understood in the art, it need not be described in further detail. As the fluid tends to be returned to the tank **10** at a rate exceeding the capacity of the pump **11**, the pressure in the tank will become greater and sometimes excessive unless otherwise relieved. This high pressure in the tank is, with the present structure, relieved through the make-up valve **29** in the line **14** which permits the fluid to flow back into the jack above the piston. When the bulldozer is moving upwardly as it sometimes may under external forces which exceed the tendency of the pump to lift the bulldozer, the reverse of the above described operation takes place. That is, the fluid above the piston flows to the tank **10** through the line **14**, the valve and the discharge passage **34** and if pressure builds up within the tank, it will be relieved through the make-up valve **29** from which it may be passed by way of line **13** to the lower end of the jack cylinder **15**.

We claim:

1. In a hydraulic circuit which comprises a double acting hydraulic jack, a fluid reservoir, a pump, fluid passage means for connecting the pump inlet with the reservoir, conduits connecting the pump outlet with opposite ends of the jack, and a control valve for selectively directing fluid under pressure from the pump through either of said conduits to one end of the jack while fluid from the opposite end returns through the other conduit back through the valve and into the reservoir, a make-up valve communicating between the reservoir and one conduit at a point between the control valve and the jack to relieve fluid from the reservoir to the jack without flowing through the control valve if the rate of fluid returning to the reservoir exceeds the output of the pump.

2. In a hydraulic circuit which comprises a double acting hydraulic jack, a fluid reservoir, a pump, fluid passage means for connecting the pump inlet with the reservoir, conduits connecting the pump outlet with opposite ends of the jack, and a control valve for selectively directing fluid under pressure from the pump through either of said conduits to one end of the jack while fluid from the opposite end returns through the other conduit back through the valve and into the reservoir, a make-up valve communicating between the reservior and each of the conduits at positions between the control valve and the jack to relieve fluid from the reservoir to the jack without flowing through the control valve if the rate of fluid returning to the reservoir through one conduit exceeds the output of the pump directed to the jack through the other conduit.

3. In a hydraulic circuit which comprises a double acting hydraulic jack, a fluid reservoir, a pump, fluid passage means for connecting the pump inlet with the reservoir, conduits connecting the pump outlet with opposite ends of the jack, and a control valve for selectively directing fluid under pressure from the pump through either of said conduits to one end of the jack while fluid from the opposite end returns through the other conduit back through the valve and into the reservoir, a make-up valve between the reservoir and each of the conduits to relieve fluid from the reservoir to the jack if the rate of fluid returning to the reservoir through one conduit exceeds the output of the pump directed to the jack through the other conduit, said make-up valves being disposed within the reservoir below the liquid level and communicating with said conduits at points intermediate the control valve and the jack.

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