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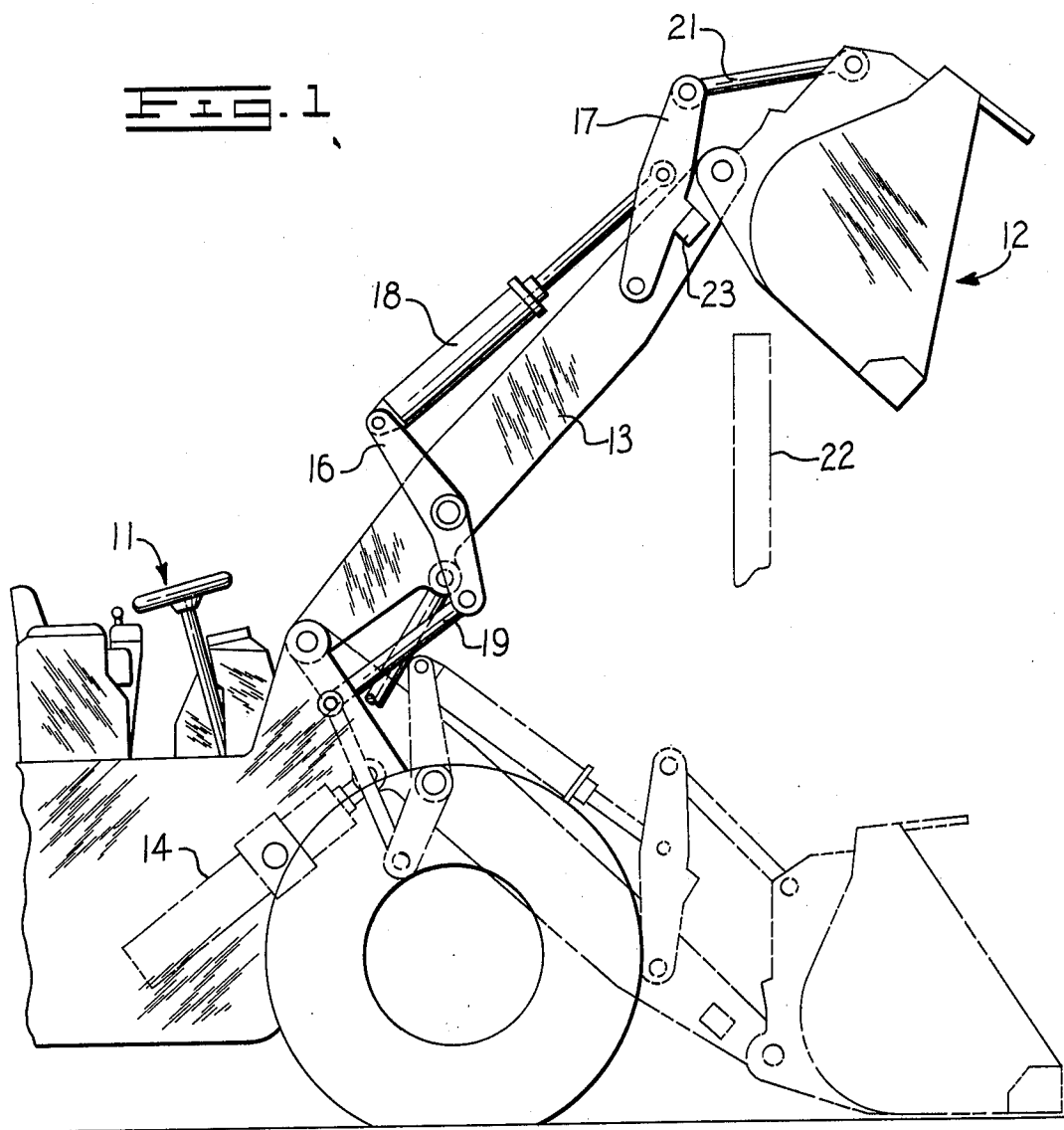
J. R. CRYDER ET AL

3,478,646

RELIEF VALVE FOR HYDRAULIC CIRCUITS

Filed Dec. 20, 1967

2 Sheets-Sheet 1



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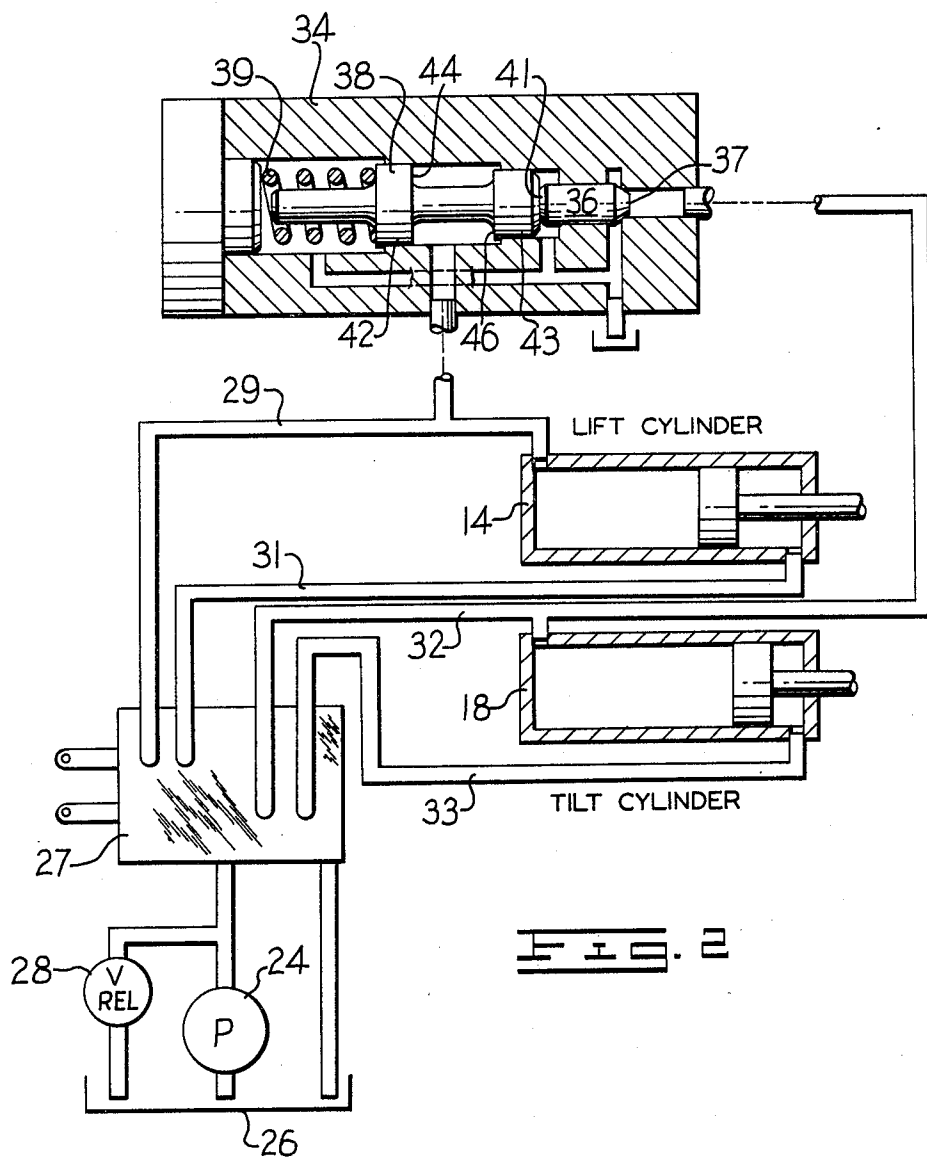
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RELIEF VALVE FOR HYDRAULIC CIRCUITS
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2 Claims

ABSTRACT OF THE DISCLOSURE

A valve for relieving fluid pressure from tilt jacks of a bucket loader when operation of its lift jacks causes a fluid lock in the tilt jacks. The relief valve has a poppet valve for resisting passage of fluid pressure from the tilt jacks thereacross to drain. A spring biased spool tends to close the poppet valve and receives fluid pressure from the lift jack which tends to open the poppet valve.

Cross reference to related U.S. patents

The present relief valve is particularly contemplated for use in the hydraulic circuit of a bucket loader such as was disclosed in U.S. Patent 3,181,430, issued May 4, 1965, to A. L. Freedy et al. and assigned to the assignee of the present invention.

Vehicle mounted bucket loaders typically comprise a bucket pivoted to the ends of lift arms with hydraulic lift jacks for raising and lowering the lift arms. Tilt linkage is actuated by hydraulic tilt jacks to tilt the bucket with respect to its lift arms so that it may be moved between various operating positions in a conventional manner. In such arrangements, operation of the lift jacks also causes tilting motion of the bucket.

In operation of such a loader arrangement, interference between mechanical parts may cause a fluid lock in at least a portion of the hydraulic circuit. The fluid lock may tend to prevent certain desired movements of the bucket and may even lead to damage of the loader parts. Such a fluid lock occurs in the above type of bucket loader when the bucket is raised by its lift arms and is tilted forwardly to a dump position. Continued forward tilting of the bucket is then resisted by a mechanical stop. However, it is commonly desirable to raise the bucket still further by its lift arms from this position, for example, to clear the side wall of a transport vehicle. However, since lifting of the bucket results in some tilting motion of the bucket as well, interaction of the tilt linkage with the mechanical stop and resulting back pressure in the tilt jack creates a fluid lock whereby attempted operation of the lift jack may result in damage to the tilt linkage components. A valve for relieving back pressure from the tilt jacks in this situation was disclosed in U.S. Patent 3,181,430 and reference is made to that patent for a further description of the fluid lock condition referred to above. As noted in that patent, another relief valve is provided between the fluid source and a suitable control valve for relieving excessive pressure arising in the control valve and the hydraulic circuit in communication therewith. However, as noted in that patent, this second relief valve is not suitable for relieving the fluid lock referred to above since the control valve isolates certain portions of the circuit from the valve.

It is therefore an object of the present invention to provide a simplified relief valve operable to prevent the above type of fluid lock from occurring. The simplified form of the relief valve provides for more reliable operation in a hydraulic circuit.

A further object of the invention is the employment of a poppet type valve within the relief valve for positive

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prevention of fluid leakage from the tilt portion of the hydraulic circuit.

Other objects and advantages of the present invention are made apparent in the following description having reference to the accompanying drawings.

In the drawings:

FIG. 1 is a view in side elevation of the forward portion of a loader with a bucket shown in broken lines in its load position and in full line in its dump position; and

FIG. 2 is a schematic presentation of the fluid circuit for the loader together with a sectioned view of the relief valve of the present invention.

A loader vehicle 11 is illustrated in FIG. 1 as having a bucket 12 pivotally carried at the forward end of a pair of lift arms one of which is indicated at 13. A pair of double acting hydraulic jacks, one of which is shown at 14, are pivotally connected to the vehicle and are operable to raise and lower the lift arms 13.

Tilting of the bucket is conventionally accomplished by tilt linkage which includes two pairs of levers 16 and 17 pivoted to the lift arms and interconnected by double acting hydraulic tilt jacks 18. The tilt linkage is connected by links 19 and 21 to the vehicle and the bucket respectively. Operation of the tilt jacks 18 tilts the bucket forwardly and rearwardly on its lift arms through the tilt linkage.

By means of the links 19, raising and lowering of the lift arms automatically tilts the bucket through the tilt linkage without operation of the tilt jack 18.

The manner in which the above noted fluid lock occurs is apparent with reference to FIG. 1 showing the bucket in its dump position. With the bucket in a raised carry position, (not shown), the vehicle suitably positions the bucket with respect to a transport vehicle, (which is not shown but a portion 22 of its side wall over which the bucket is dumped into the vehicle is represented in dotted lines). Forward tilting of the bucket is normally limited at a suitable dump position by mechanical stops 23 which are situated for interaction with each of the levers 17 of the tilt linkage. To clear the bucket over the sidewall of the vehicle after dumping, and permit the vehicle to move away, it is desirable to raise the bucket on its lift arm rather than by tilting the bucket rearwardly. With the bucket in the position shown, continued lifting of the bucket requires accompanying operation of the tilt linkage for continued forward tilting of the bucket. However, continued forward tilting of the bucket is resisted by the stop 23.

The manner in which the present invention permits the above desired operation without interfering with normal operation of the loader during the rest of its cycle is best seen with reference to FIG. 2, wherein only one of the lift cylinder and tilt cylinders is shown for purposes of simplicity. A pump 24 withdraws hydraulic fluid from a reservoir or sump 26 and selectively directs it to the lift and tilt jacks according to a control valve 27. If excessive pressure occurs in a portion of the hydraulic circuit which is open to the pump 24 through the control valve 27, that excess pressure is vented back to the sump 26 by means of a relief valve 28. The setting of the relief valve 28 is sufficiently high to permit normal operation of the loader during its cycle. When the above noted fluid lock occurs, the tilt cylinder is not in communication with the pump 24 through the control valve and therefore is not in communication with the relief valve 28.

The control valve 27 is communicated with the head end of the lift cylinder by a conduit 29 and with its rod end by a conduit 31. Similarly, the control valve is also in communication with the head end of the tilt cylinder by a conduit 32 and with its rod end by another conduit 33.

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To avoid the above described fluid lock, the present invention provides a simple, reliable relief valve 34 which is in communication with the head end of the lift cylinders and tilt cylinders respectively by means of the conduits 29 and 32. Referring momentarily to FIG. 1, when the above noted fluid lock occurs, fluid pressure from the pump 24 is being directed to the head end of the lift cylinder through conduits 29. However, interaction of the mechanical stops 23 with the tilt linkage levers 17 tends to cause retraction of the tilt cylinders and pressure generation in their head end and conduit 32. The relief valve 34 is responsive to simultaneous occurrence of these pressures in the conduits 29 and 32 to vent fluid from the head end of the tilt jacks and thereby prevent damage to the tilt linkage or stalling of the hydraulic system. The valve 34 has a poppet valve 36 which is normally closed to prevent passage of fluid pressure from conduit 32 thereacross to drain. Fluid from the conduit 32 is received at the face 37 of the poppet valve. A spool 38 is biased by means of a spring 39 so that it normally acts against the opposite end 41 of the poppet valve to maintain it in a closed position. However, fluid from the conduit 29 is received between opposing lands 42 and 43 of the spool. Fluid pressure from the conduit 29 acts against end surfaces 44 and 46 of the spool lands 42 and 43 respectively. The end area 44 of the spool land 42 which is generally adjacent the spring 39 is larger than the end area 46 of the other land 43. Accordingly, fluid pressure from conduit 29 urges the spool 38 against its spring 39 so that it tends to permit opening of the poppet valve 36.

Strength of the spring 39, along with sizing of the other valve components, is selected so that fluid pressure occurring in conduits 29 and 32 during normal operation of the loader will not be sufficient to open the poppet valve 36. However, when excessive pressures arise simultaneously in both conduits 29 and 32, as discussed above, those combined pressures are sufficient to shift the spool 38 and the poppet valve 36 against the spring

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39 and permit venting of fluid pressure to drain across the poppet valve 36. Since fluid pressure is thereby vented from the head ends of the tilt cylinder, sufficient retraction of the tilt cylinder occurs to prevent a fluid lock from causing excessive stress in the tilt linkage.

We claim:

1. A relief valve for a hydraulic circuit having a source of fluid under pressure for selective actuation of two hydraulic motors, comprising

a normally closed poppet type valve in communication with one of the motors for controlling flow of fluid under pressure from the one motor to drain, and

a spring loaded spool associated with said valve and tending to close said valve, said spool defining two opposing lands of unequal end area in fluid communication with the other motor, said spool tending to be shifted against its spring for assisting in opening of said valve in response to fluid under pressure from the other motor acting upon the unequal lands.

2. The relief valve of claim 1 wherein each of the motors means is a pair of double acting hydraulic jacks for a bucket loader, the one pair of jacks for tilting the bucket and the other pair of jacks for controlling elevation of the bucket, the head ends of the tilt jacks being in communication with said poppet valve and the head ends of the lift jacks being in communication with said spring biased spool.

References Cited

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3,181,430 5/1965 Freedy et al. ----- 91-413

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U.S. Cl. X.R.

60-52; 91-412; 137-111; 214-762