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QUICK DROP VALVE FOR BULLDOZER BLADE HYDRAULIC CONTROLS

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Fig 1

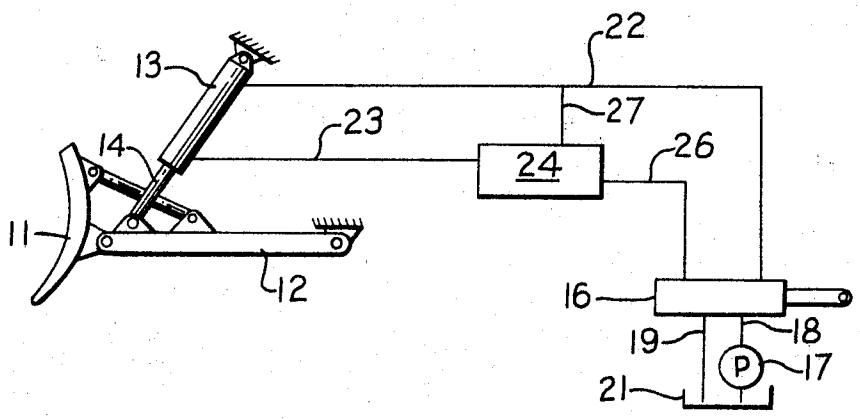
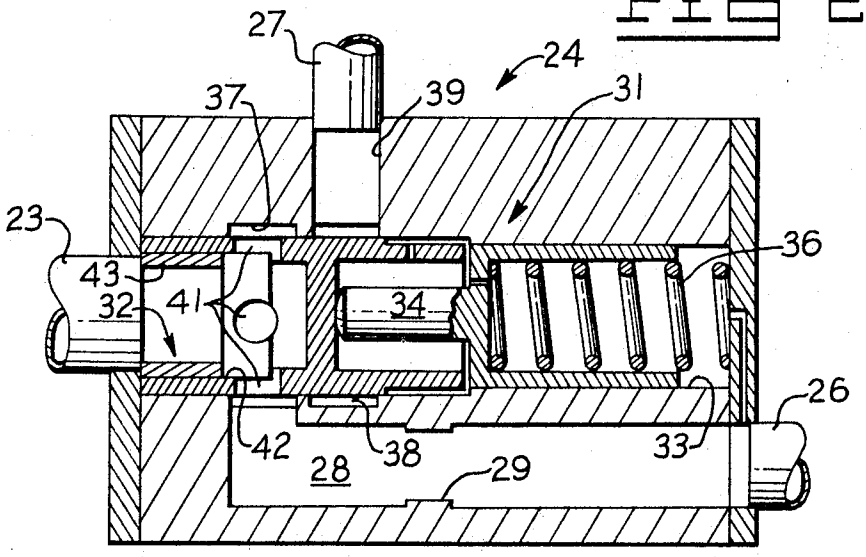


Fig 2



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QUICK DROP VALVE FOR BULLDOZER BLADE HYDRAULIC CONTROLS

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ABSTRACT OF THE DISCLOSURE

A value associated with a double-acting hydraulic jack controlling elevation of a bulldozer blade and permitting rapid extension of the jack and corresponding rapid descent of the blade to ground level while maintaining adequate hydraulic fluid for driving the blade in further descent to a suitable cutting position. The value has a restricted flow path from the rod end of the jack to drain so that increased fluid pressure acts against a spring loaded spool which communicates the rod end of the jack with the head end of the jack. As the weight of the blade increases its rate of descent toward ground level, a corresponding increased rate of flow of fluid from the rod end of the jack moves a sleeve into closing relation with the fluid flow path through the valve to drain. Thus, a substantial portion of fluid from the rod end of the jack is provided to the head end of the jack.

To increase the operating efficiency of a bulldozer it is desirable that the operator be able to lower the blade to the ground very rapidly without the time delay inherent in typical float lowering techniques. Accordingly, bulldozer blades are commonly capable of being freely lowered to ground level under the force of gravity. However, when the lowering of the blade is accompanied by extension of the jack which controls blade elevation, lowering of the blade and extension of the jack by gravity normally results in a time lag of operator control over the blade since the hydraulic pump associated with the jack is not of sufficient capacity to fill the head end of the jack at a corresponding rate. This time lag is undesirable since the operator is unable to force the blade below ground level into a suitable cutting position until the head end of the jack is filled with hydraulic fluid. Undesirable vacuum conditions may also occur within the jack.

The present invention provides a quick drop valve, for employment with a hydraulic motor, which substantially eliminates the undesirable time lag discussed above while still permitting rapid operation according to gravity.

Use of the quick drop valve is particularly advantageous when employed with a double-acting hydraulic jack controlling a bulldozer blade since it permits the blade to be rapidly lowered toward ground level at an initial rate determined by the force of gravity. However, as the bulldozer blade approaches ground level and the fluid flow rate from the lower end of the hydraulic jack reaches a preselected level, the quick drop valve directs most of this fluid to the upper end of the jack so that the upper end of the jack is filled with fluid and the operator may immediately force the bulldozer blade into the ground to a suitable cutting position.

Other advantages and features of the present invention will be apparent from the following description and the accompanying drawings, wherein

FIG. 1 is a schematic representation of the hydraulic control circuit for a double-acting hydraulic jack controlling elevation of a bulldozer blade and

FIG. 2 is a sectional view of a quick drop valve employed within the hydraulic control circuit of FIG. 1 and embodying the present invention.

Referring now to FIG. 1, the bulldozer blade **11** is supported upon conventional push arms **12** while its elevation is controlled by a double acting hydraulic jack **13**. The blade is lowered by extension of a rod **14** of the jack while retraction of the rod into the jack serves to raise the blade. The bulldozer operation positions the blade by manipulating a common spool-type control valve **16** which directs the flow of hydraulic fluid from a pump **17** through a conduit **18** to a return conduit **19** and tank **21**, or alternately to the jack **13**. The control valve is communicated with the head end of the hydraulic jack by a conduit **22** while the rod end of the jack is communicated with the control valve through a conduit **23**, a quick drop valve **24** and another conduit **26**. The quick drop valve **24** is also communicated with the conduit **22** and thus with the head end of the jack by another conduit **27**. When the operator desires to raise the blade, he positions the control valve to direct fluid from the pump through the conduit **26**, the quick drop valve and the conduit **23** to the rod end of the hydraulic jack while the head end of the jack is communicated to drain by the conduit **22**, the control valve and the conduit **19**. To lower the blade, the operator positions the control valve spool to direct fluid to the head end of the jack through the conduit **22** while the rod end of the jack is communicated to drain through the conduit **23**, the quick drop valve, the conduit **26**, the control valve and the conduit **19**.

To briefly summarize the quick drop valve of the present invention, having reference also to FIG. 2, the quick drop valve **24** has substantially no effect on fluid flow when the bulldozer blade is being raised, but rather is effective when the operator positions the control valve to lower the bulldozer blade by extension of the hydraulic jack **13**. During lowering of the bulldozer blade, a fluid flow path from the rod end of the jack to drain is provided by a passage **28** within the quick drop valve. The passage **28** has a restriction or orifice **29** which does not substantially effect the rate of flow of fluid through the passage but which creates a pressure differential across the quick drop valve with the conduit **23** representing the high pressure side and the conduit **26** representing the low pressure side thereof. The relatively high pressure hydraulic fluid in the quick drop valve adjacent the conduit **23** acts against a spring-loaded valve **31** and causes it to place the conduit **23** in fluid communication with the conduit **27** and the head end of the jack. As the rate of fluid flow from the rod end of the jack through the conduit **23** and the quick drop valve to drain reaches a level indicating that the blade is approaching ground level, variable valve means **32** respond to that rate of flow by limiting fluid flow into the passage **28** so that a substantial portion of the fluid from the rod end of the jack is directed to the head end of the jack through the quick drop valve and the conduit **27**. Thus, the present quick drop valve is doubly advantageous since it initially permits the bulldozer blade to be lowered at a rate substantially determined only by the force of gravity. However, as the bulldozer blade approaches ground level, the fluid from the rod end of the jack is directed to the head end of the jack to assist the pump **17** in filling the head end of the jack with fluid. Thus, the quick drop valve of the present invention permits the operator to immediately force the bulldozer blade below ground level into a suitable cutting position by means of the hydraulic jack.

To describe the quick drop valve in structural detail, it has a central bore **33** with the spring-loaded valve **31** comprising a spool **34** disposed for longitudinal motion in the bore and urged leftwardly into the position illustrated in FIG. 2 by a spring **36**. The conduit **23** is communicated directly into the left end of the spool bore **33** while the spool bore is communicated with one end of the passage **28** by means of an annular recess **37**. The other end of the passage **28** is in communication with the conduit **26**. The spool bore is also in communication with the conduit **27** by means of an annular recess **38** and a passage **39**. The spring-loaded spool is recessed at its left end and has radial ports **41** which communicate the recessed left end of the spool with the annular recess **37** when the spool is leftwardly disposed in the bore **33**. When the abovenoted differential pressure exists within the quick drop valve, it drives spool **34** rightwardly against the spring **36** so that the ports **41** are in communication with the annular recess **38** as well as the annular recess **37**. At this point, the flow path of fluid from the conduit **23** is still substantially through the passage **28** since it represents a free path to drain.

To insure that a substantial portion of the fluid flow from the rod end of the hydraulic jack passes to the head end of the hydraulic jack at least when the blade is approaching ground level, the recessed left end of the spool **34** has a counterbore **42** which is only partially coextensive with the ports **41** in the spool. The variable valve means **32** comprises a sleeve **43** which is slidably disposed in the counterbore **42** for cooperation with the ports **41**. When the fluid flow rate from the conduit **23** into the quick drop valve reaches a rate indicating that the bulldozer blade is descending and approaching ground level, the slidable sleeve **43** is carried rightwardly by the fluid flow from the conduit **23** so that it abuts the right end of the counterbore **42**. In this position, the sleeve limits fluid flow to the passage **28** by permitting fluid to flow only through that portion of the port **41** which is not coextensive with the counter bore **42**. A substantial portion of the fluid flows from the rod end of the jack thus through the annular recess **38**, the passage **39**, the conduit **27** and the conduit **22** and assists the pump **17** in filling the head end of the hydraulic jack to prevent any time lag in operator control over the bulldozer blade through the jack. The sizing of the components within the quick drop valve is such as to divided fluid flow from conduit **23** between the conduit **27** and the passage **28** at a ratio of, for example, **80** to **20**. Some fluid flow is always directed back to drain through the restricted passage **28** in order to maintain the pressure differential necessary to hold the spool **34** in its extreme right position within the spool bore **33**

It is also to be noted that when the bulldozer blade is being raised and fluid flow passes through the quick drop valve from the conduit **26** to the conduit **23**, the pressure differential resulting within the valve according to the orifice **29** will not effect the position of the spool **34** since the spool is then on the low pressure side of the orifice. Thus, the spool remains in its extreme left position according to interaction with the spring **26**.

If it is desired to operate the control system so that the blade drops completely to ground level under the force of gravity, the sleeve **43** may readily be removed from the quick drop valve and fluid flow from the rod end of the jack to drain through the passage **28** will not be limited even with a high rate of fluid flow through the quick drop valve.

What is claimed is:

1. A quick drop valve in association with a hydraulic control circuit of a double-acting hydraulic motor which is capable of operating under the force of gravity with hydraulic fluid accordingly expelled from a first chamber of the motor while fluid is provided by a pump to a second chamber of the motor, the combination comprising

a housing defining a bore in effective communication with the two motor chambers and

a conduit having a restrictive orifice for communicating the bore to drain and causing relatively high fluid pressure in the bore when fluid is expelled from the first motor chamber,

a valve spool reciprocably mounted in the bore and normally positioned by a spring to communicate the first motor chamber only with the restricted conduit, the spool being capable of shifting against its spring in response to the relatively high pressure fluid, and

variable valve means effectively formed as a portion of the valve spool to direct a portion of the fluid from the first motor chamber to the second chamber when the spool is shifted against its spring,

a control valve disposed in the circuit to communicate fluid from a pump with the second motor chamber of the motor by a first conduit,

a second conduit communicates the first motor chamber of the motor with the valve bore,

a third conduit communicates the restricted passage with the control valve, and

a fourth conduit communicates the first conduit with the valve bore, the variable valve means being effective to communicate the second conduit with the fourth conduit when the spool is shifted against its spring.

2. A quick drop valve in association with a hydraulic control circuit of a double-acting hydraulic motor which is capable of operating under the force of gravity with hydraulic fluid accordingly expelled from a first chamber of the motor while fluid is provided by a pump to a second chamber of the motor, combination comprising

a housing defining a bore in effective communication with the two motor chambers and

a conduit having a restrictive orifice for communicating the bore to drain and causing relatively high fluid pressure in the bore when fluid is expelled from the first motor chamber,

a valve spool reciprocably mounted in the bore and normally positioned by a spring to communicate the first motor chamber only with the restricted conduit, the spool being capable of shifting against its spring in response to the relatively high pressure fluid, and

variable valve means effectively formed as a portion of the valve spool to direct a portion of the fluid from the first motor chamber to the second chamber when the spool is shifted against its spring.

the valve bore having a first annular recess in communication with one end of the restricted passage and a second annular recess in communication with with the second motor chamber, the spool having at least one port formed by a tubular portion thereof, the port being in selective communication with the two bore recesses according to the position of the spool within its bore.

3. The combination of claim **2** wherein the variable valve means comprises a slidable sleeve disposed in a counterbore of the tubular portion of said spool, said counterbore permitting said sleeve to be shifted by a preselected rate of fluid flow from the first motor chamber into the valve and block a portion of said port in the tubular portion of the spool.

4. The combination of claim **3** wherein

the quick drop valve is effective to permit substantially unimpeded fluid flow from first motor side therethrough the drain except upon operation of said variable valve sleeve,

the tubular portion of the spool comprises a plurality of said ports and

the slidable valve sleeve is removable from the quick drop valve.

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