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EARTHMOVING SCRAPER BOWL

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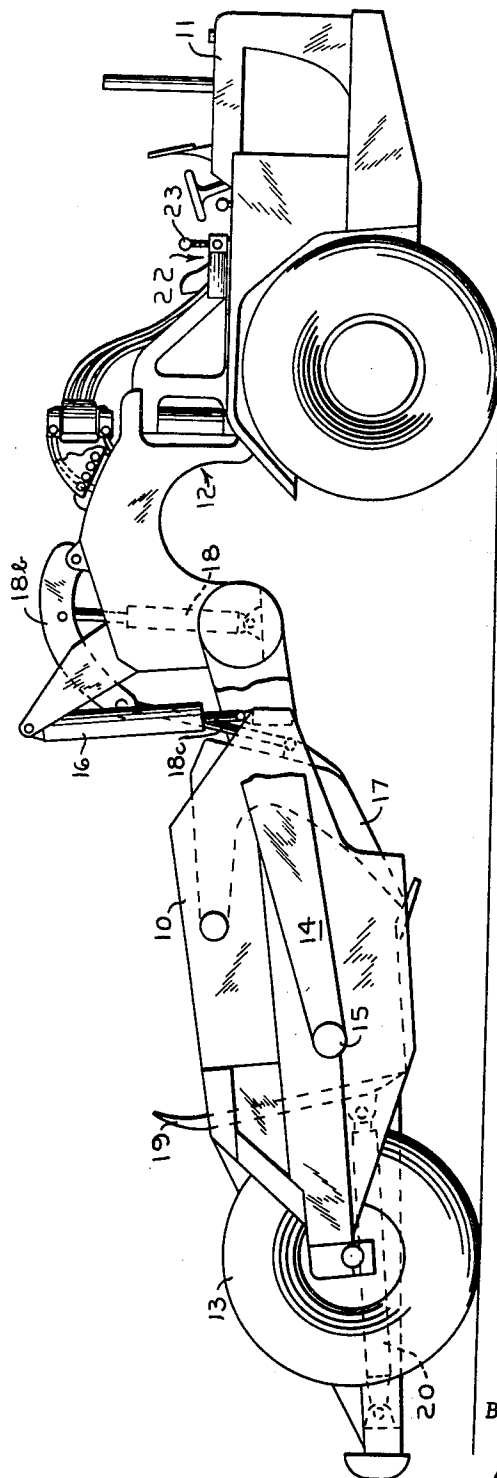


FIG. 1.

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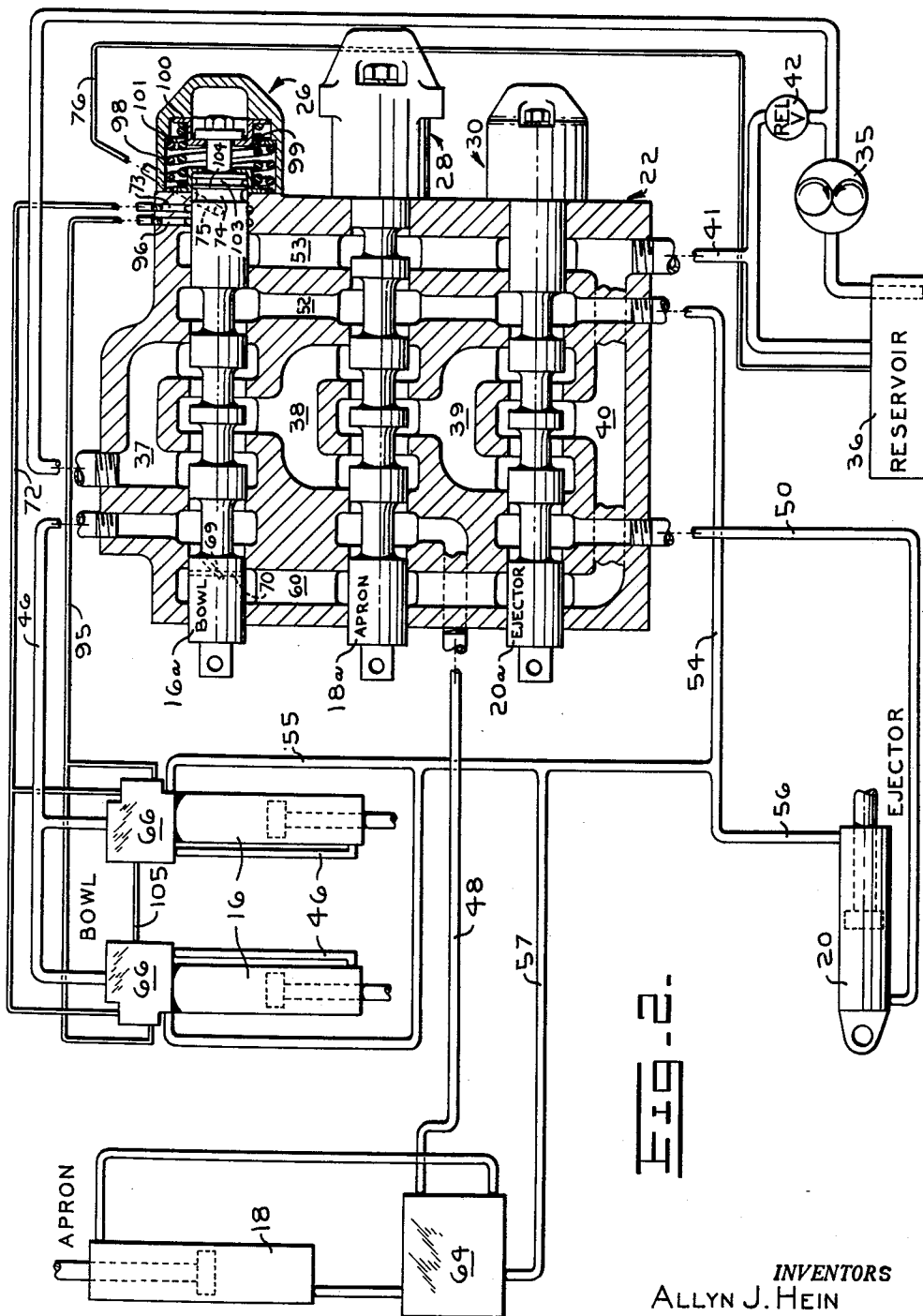


FIG. 2.

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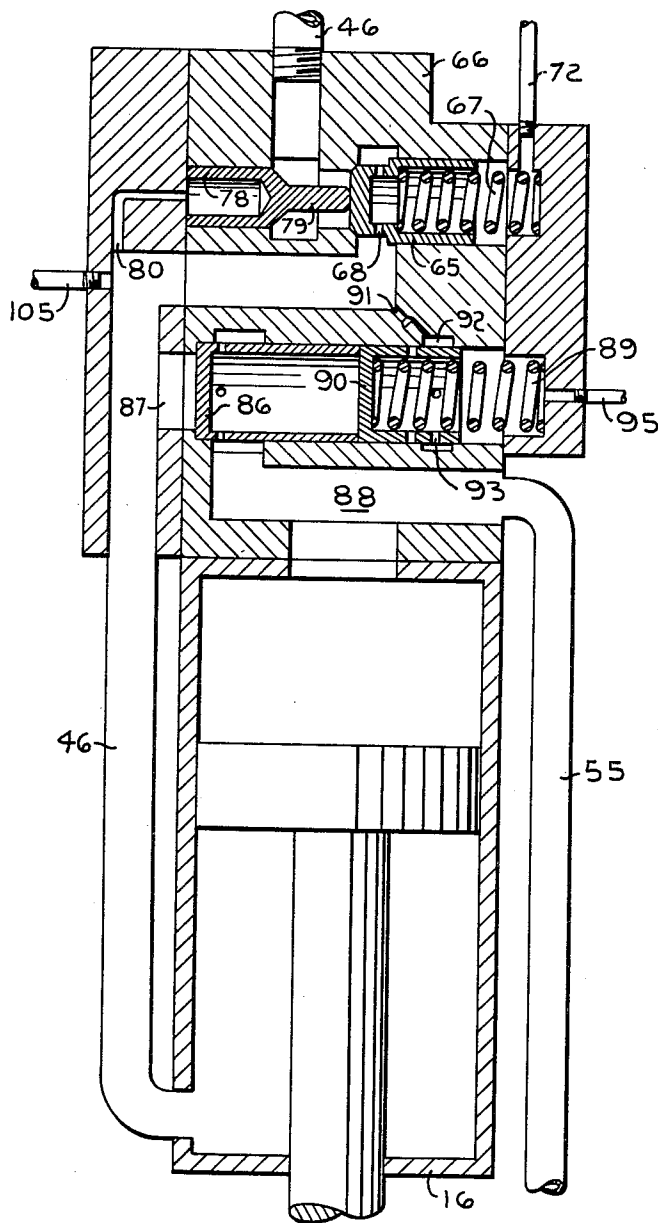
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Fig. 3.



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HYDRAULIC CIRCUIT FOR ACTUATION OF AN EARTHMOVING SCRAPER BOWL

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8 Claims. (Cl. 37-129)

This invention relates to tractor drawn earthmoving scrapers wherein various elements of the scraper are adjusted by hydraulic means in the form of double acting hydraulic jacks and pertains more particularly to that portion of the hydraulic circuit which controls the operation of one or more jacks employed for raising and lowering the bowl of the scraper.

In conventional scrapers, due to the fact that the operator's control valve is located on the tractor and the bowl lift cylinders are necessarily mounted on the scraper, the pressure created by the weight of the scraper bowl and its contents is present in the flexible conduits or hoses connecting the operator's control valve and the bowl lift cylinder. This imposition of high pressure on the hydraulic hoses during travel of the machine results in premature failure of the hoses and also endangers the operator because if one of the hoses bursts, he may be struck by a stream of high temperature and high velocity hydraulic fluid. Furthermore if the control valve is subject to leakage, high pressure in these conduits is undesirable.

Another problem common to hydraulic scraper bowl control circuits is that their normal operating speed is necessarily quite slow and time is wasted in lowering the empty bowl from its travel position into contact with the ground after its contents have been ejected and a loading cycle is to be commenced. Quick lowering or so-called "drop" of the bowl onto the ground is also desirable as a safety factor because the bowl is sometimes used as an emergency brake upon failure or faulty operation of the tractor and scraper brakes.

It is the object of the present invention to provide means to overcome the above mentioned undesirable features of scraper operation and means specifically to provide a hydraulic circuit for the operation of a scraper bowl which will prevent the existence of high pressure in the flexible conduits or hoses which communicate between the controls on the tractor and the bowl actuating jacks when the weight of the bowl and its contents is imposed on the fluid in the system. It is also the object of the invention to provide means under control of the tractor operator to enable quick lowering or dropping of the bowl when desired.

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.

In the drawings:

FIG. 1 is a view in side elevation of a tractor scraper combination illustrating the location of the several components of the hydraulic circuits which control the operation of adjustable elements of the scraper;

FIG. 2 is a schematic view of the hydraulic circuit for the components shown in FIG. 1; and

FIG. 3 is a schematic sectional view of one of the bowl lift jacks shown in FIG. 2, including valve mechanisms associated therewith employed in accomplishing the objects of the present invention.

In FIG. 1, a conventional two-wheel scraper is illustrated at 10 as drawn by a tractor 11 through a hitch or draft connection generally indicated at 12. The main body or bowl of the scraper may be raised and lowered about its pivotal connection with its wheels 13. Draft

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arms 14 pivoted to opposite sides of the scraper bowl, as by connections one of which is shown at 15, enable raising and lowering of the scraper bowl by means of a pair of jacks, one of which is shown at 16. A pivoted apron 17 is adapted to be raised and lowered for opening and closing the forward end of the bowl by means of a jack 18, lever 18b and link 18c, and an ejector 19 is moved forwardly to discharge the contents of the bowl through its forward end by an ejector jack 20, all in a well known manner. A control valve assembly 22 for controlling the flow of fluid to and from the several jacks is disposed on the tractor as are also control levers, one shown at 23, positioned adjacent the operator's station.

Generally speaking, the hydraulic circuits for operating the adjustable elements of the scraper are the same as those disclosed in our assignee's co-pending application entitled, Hydraulic Circuit for Tractor Drawn Scrapers and the Like, filed November 24, 1961, Serial No. 154,790 and will be briefly described herein for the purpose of showing the environment of the present invention.

The control valve assembly 22 is schematically shown in FIG. 2 as comprising a single housing which is suitably bored for the reception of three sliding type valve spools 16a, 18a and 20a for controlling respectively the jacks 16, 18 and 20. Each of the spools is formed at one end for connection to control levers and is fitted at its opposite end with a centering spring assembly shown at 26, 28 and 30. The function of such assemblies is well known and only that pertaining to bowl lift control is shown in detail to be hereinafter described.

A pump 35 delivers fluid under pressure from a reservoir 36 to an inlet passage 37 in the valve housing which is divided to direct fluid selectively toward either one end or the other of the valve spool 16a depending upon its position of adjustment. Similar inlet passages 33 and 39 communicate with each other and with the first passage 37 so that with the valve spools in their neutral positions as shown, there is a constant flow of fluid under pressure from the pump through the passages 37, 38 and 39 and a discharge passage 40 and thence back to the reservoir through a return line 41. A relief valve 42 in the pressure line from the pump also has its discharge side connected with the return line 41.

Each of the jacks or sets of jacks has what may be termed a high pressure and a low pressure end because the work of moving an implement part in one direction, as when it is being raised or moving earth, is usually greater than that of moving it in the other direction. Movement of any one of the spools to the right connects it with the high pressure end of its associated jack. For example, the spool 16a upon movement toward the right opens communication with the inlet chamber 37 containing fluid under pressure from the pump and directs the fluid into a line 46 and lines 46a to the rod ends of the jacks 16 for raising the bowl. Movement of spool 18a to the right similarly connects the inlet passage 38 thereof with a line 48 connecting with the head end of the jack 18 through a valve mechanism 64 described in the above mentioned co-pending application. Upon movement of the spool 20a to the right, fluid under pressure from inlet 39 thereof is directed through a line 50 to the head end of the ejector jack 20. For convenience in following these circuits, the drawings identify the jacks as well as the spools with the part of the implement with which they are associated.

The opposite or low pressure ends of the jacks are all connected with a common manifold 52 which, as shown in the drawing, communicates with each of the three bores which contain the valve spools and is opened by rightward movement of any spool into communication with a discharge manifold 53 also common to all three spools and communicating with the reservoir through

the line 41. Consequently when fluid is directed under pressure to the high pressure side of any of the jacks, fluid on the low pressure side is returned to the reservoir. The common manifold 52 is connected with the jacks through a common line 54 with a branch 55 to the low pressure or head ends of the bowl jack 16, a branch 56 to the rod end of the ejector jack 20 and a branch 57 to the rod end of the apron jack through the valve mechanism 64.

Movement of the jacks in the direction opposite that described above is accomplished by movement of any one of the valve spools in the opposite direction or to the left which communicates high pressure through the actuated spool to the manifold 52 and thence to all of the jacks through line 54 and its branches 55, 56, and 57. The valve spool which has been actuated to the left also opens communication to a discharge passage 60 which is common to all of the spools and similar to the discharge passage 53. The discharge passage 60 permits return of fluid from the jack being actuated through the passage 40 and line 41 to the reservoir. Under the condition just described where a single valve spool is actuated and directs fluid to all three jacks, only the selected jack is moved because return flow from the other jacks is blocked by their respective spools which have remained in their neutral position.

In accordance with the present invention, pressure in the conduits communicating between the bowl jacks 16 on the scraper and the control valve on the tractor is relieved while the bowl is in a raised position so that the lines will be protected against excessive pressure resulting from the dynamic action of the weight of the bowl and its contents when being transported over rough terrain. This is accomplished by a check valve 65 (see FIG. 3) in a housing 66 associated one with each of the jacks 16. This check valve is urged toward its closed position by a spring 67 and is opened by pressure from the pump entering the rod end of the jack 16 through the line 46 during raising of the bowl. When the bowl is held in a raised position, the check valve is closed by the spring 67, the force of which is augmented by fluid pressure within the spring chamber entering through orifices 68 in the valve element. Meanwhile, pressure in the line 46 is relieved, as shown in FIG. 2, through a pair of interconnecting orifices 69 and 70 in the spool 16a, which, when the spool is in its neutral position, relieves the pressure to the common manifold 60, drain passage 40, and conduit 41 to the reservoir. The orifice 70 is closed by movement of the spool 69 to the right during raising of the bowl.

Pressure in the spring chamber of the check valve 65 is reduced when it is desired to lower the bowl, and this is accomplished through a line 72 communicating between the spring chamber and a passage 73 (see FIG. 2) which upon movement of the spool 16a to the left for lowering the bowl, will communicate with a groove 74 in the spool 16a and through this groove with a second passage 75 in the valve housing, a bleed line 76 forms communication between the passage 75 and the reservoir. With fluid pressure thus reduced in the spring chamber 67, pressure in line 46a due to weight of the bowl becomes effective to open the check valve 65 and permit return of fluid from the rod end of jack 16 through the line 46 as previously described. This is accomplished by a hollow piston 78 having an end 79 engageable with the check valve when it is in its closed position. Thus, the pressure from the rod end of the jack is communicated through a passage 80 to the interior of the hollow piston 78 moving it to the right as viewed in FIG. 3, and opening the check valve against the closing force of spring 67.

It is also desirable to provide for dropping or lowering the bowl at a rate in excess of that resulting from normal operation of the control valve for moving the bowl toward its lowered position. It is particularly desirable that such means for dropping the bowl be under

control of the operator rather than automatic, because previously known means for dropping an implement automatically in the event of certain circumstances is hazardous. For example, a bowl dropped into contact with the ground while the implement is moving forwardly at relatively high speed may bring the tractor and scraper to a halt so abruptly as to throw the operator from his seat.

In order to drop the bowl at a speed greater than that caused by flow of fluid under pressure through the line 55 to the head end of the jack 16, communication is provided between the head end and the rod end of the jack so that fluid expelled from the rod end is added to the fluid entering through the line 55, thus creating faster downward movement of the piston and preventing evacuation of the head end of the jack due to the weight of the bowl and its contents.

To provide this communication between opposite ends of the jack, a check or shunt valve 86 normally closes a port 87 between the line 46a and a passage 88 communicating between the line 55 and the head end of the cylinder 16. This check valve is urged toward its closed position by a spring 89 acting against a combination spring retainer and valve 90 slidable in the bore of the check valve 86 and abutting the end of the check valve. The pressure of the spring 89 is augmented by fluid pressure communicated from the line 46a through an orifice 91, an annular groove 92 surrounding the bore of the valve and communicating pressure to the spring chamber through ports 93 in the valve 90. Valve 90 blocks communication between passage 88 and the chamber of spring 89 by closing the end of check valve 86 and prevents the opening of the check when the pressure in passage 88 is less than that in line 46a. When it is desired to permit the check valve 86 to open under pressure of fluid in the line 46a, the pressure in the spring chamber is vented through a line 95. This line (as shown in FIG. 2) communicates with a passage 96 in the control valve housing adjacent the bleed passage 73 previously described, and can be opened by movement of the spool 16a toward the left beyond its bowl lowering position. This further movement of the spool 16a toward the left provides communication between the passage 96 and the passage 75 so that the pressure in the chamber of spring 89 (FIG. 3) is relieved through the line 76 to the reservoir.

To insure against an operator accidentally moving the spool 16a past the normal bowl lowering position to the bowl drop position, a heavy spring 98 in the centering spring assembly 26 is used in addition to the conventional centering spring, which is shown at 99. When the centering spring 99 is compressed by movement of the spool to its bowl lowering position, a flange 100 on the spring seat engages annulus 101 which serves as a seat for the heavier spring 98, providing a stop which can be sensed by the operator. Further leftward movement of the spool is accomplished only by greater operator effort sufficient to compress the spring 98.

A groove larger than that shown at 74 is required for forming communication between the bleed passage 96 and the passage 75. However, a larger groove would permit pressure from the line 95 to enter the housing of the centering spring assembly 26, which would be undesirable because this pressure would tend to effect the position of the spool 16a. Consequently, a second groove 103 is formed in the spool and separated from the first groove by a narrow land 104. This land enters the bore of the spool 16a upon leftward movement thereof to prevent blow-by of pressure from line 72 into the housing of the spring assembly. The spacing of the grooves 74 and 103 and the width of the land 104 is such that the land will bisect the passage 73 in the fast drop position of the spool and pressure from lines 95 and 72 will be communicated through the grooves 74

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and 103 to the passage 75 for simultaneously bleeding the chambers of springs 67 and 89.

It is to be understood that the check valves associated with the jacks 16, as well as the bleed lines associated with them, are identical for both of the bowl jacks. In order to insure balanced pressure in the rod ends of the two jacks, the valve housings 66 are interconnected by a small line 105 which, as shown in FIG. 3, forms communication between the lines 46a communicating with the rod ends of the jacks.

We claim:

1. In combination with a tractor drawn implement wherein a load sustaining element of the implement is held in an elevated position by a hydraulic jack and wherein fluid under pressure is directed to said jack through a control valve on the tractor and through flexible conduits extending between the tractor and the implement, means to prevent communication of pressure from the jack to said flexible conduits when the load sustaining element is in a raised position and the control valve is in a neutral position.

2. In combination with a tractor drawn implement wherein a load sustaining element of the implement is held in an elevated position by a hydraulic jack and wherein fluid under pressure is directed to said jack through a control valve on the tractor and through flexible conduits extending between the tractor and the implement, means to prevent communication of pressure from the jack to said flexible conduits when the load sustaining element is in a raised position and the control valve is in a neutral position and means to relieve pressure from said flexible conduits while the control valve is in neutral position.

3. In combination with a tractor drawn implement wherein a load sustaining element of the implement is held in an elevated position by a hydraulic jack and wherein fluid under pressure is directed to said jack through a control valve on the tractor and through flexible conduits extending between the tractor and the implement, means to prevent communication of pressure from the jack to said flexible conduits when the load sustaining element is in a raised position and the control valve is in a neutral position and means to relieve pressure from said flexible conduits while the control valve is in neutral position, said means to prevent communication of pressure including a normally closed check valve, and means responsive to pressure created upon actuation of the control valve to lower the load sustaining element to open said check valve.

4. In combination with a tractor and an earthmoving scraper drawn thereby through an articulated draft connection wherein the scraper has a bowl adapted to be raised and lowered by hydraulic jacks and wherein fluid under pressure is directed to said jacks through a control valve on the tractor and through flexible conduits extending between the tractor and scraper, means to protect said flexible conduits against excessive pressure created when the bowl is held in an elevated position comprising normally closed valve means between the jacks and the

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conduits, and means to open said valve means only when the control valve is actuated to direct actuating pressure to the jacks.

5. In combination with an earthmoving scraper having a bowl, a double acting hydraulic jack for raising and lowering said bowl, and means including a control valve for directing fluid to said jack, means to permit quick dropping of the bowl comprising a passage adjacent the jack cylinder communicating between the opposite ends thereof, a valve normally closing said passage, and means operable upon actuation of said control valve beyond a bowl lowering position thereof to open said normally closed valve.

6. In combination with an earthmoving scraper having a bowl, a double acting hydraulic jack for raising and lowering said bowl, and means including a control valve for directing fluid to said jack, means to permit quick dropping of the bowl comprising a passage adjacent the jack cylinder communicating between the opposite ends thereof, a valve normally closing said passage, and means operable upon actuation of said control valve beyond a bowl lowering position thereof to open said normally closed valve said last named means including a chamber normally containing fluid under pressure biasing said normally closed valve toward closed position, a normally closed bleed passage for said chamber, and valve means associated with the control valve for opening said bleed passage.

7. In a hydraulic circuit for raising and lowering the bowl of an earthmoving scraper or the like which comprises a double acting jack associated with the bowl, a source of fluid under pressure, and a control valve for said fluid having raise, lower and neutral positions, check valve means adjacent the jack comprising a first normally closed check valve to prevent pressure from the jack when the bowl is raised from entering conduits leading to the control valve, a second normally closed check valve closing communication between opposite ends of the jack and capable of being opened to permit quick dropping of the bowl, pressure chambers associated with both check valves to hold them in closed positions, a bleed line from each of said chambers to the control valve, and means in the control valve to vent the bleed line from the first check valve when the control valve is in lower position and to vent the bleed lines from both check valves when the control valve is moved beyond its lower position.

8. The combination of claim 7 in which the control valve is of the sliding spool type having a centering spring, and a second spring associated with the centering spring and opposing movement of the spool beyond its said lower position.

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