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[54] **HYDRAULIC CONTROL SYSTEM WITH LOCKING VALVE TO PREVENT ACCIDENTAL OR UNAUTHORIZED LOWERING OF A TRACTOR IMPLEMENT**

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[51] **Int. Cl.** **F15b 13/01**

[58] **Field of Search** ..... 91/411 R, 414, 420; 137/106

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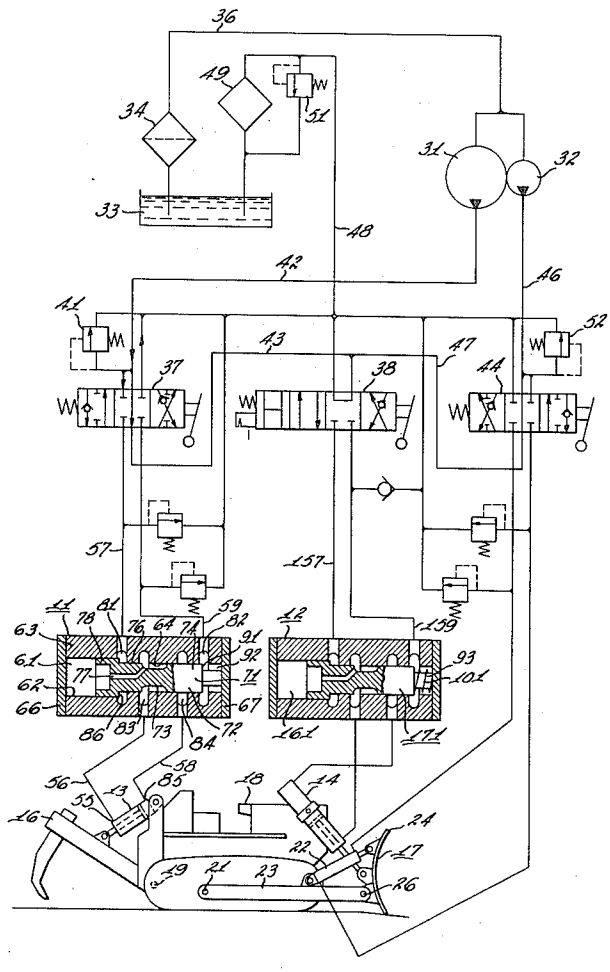
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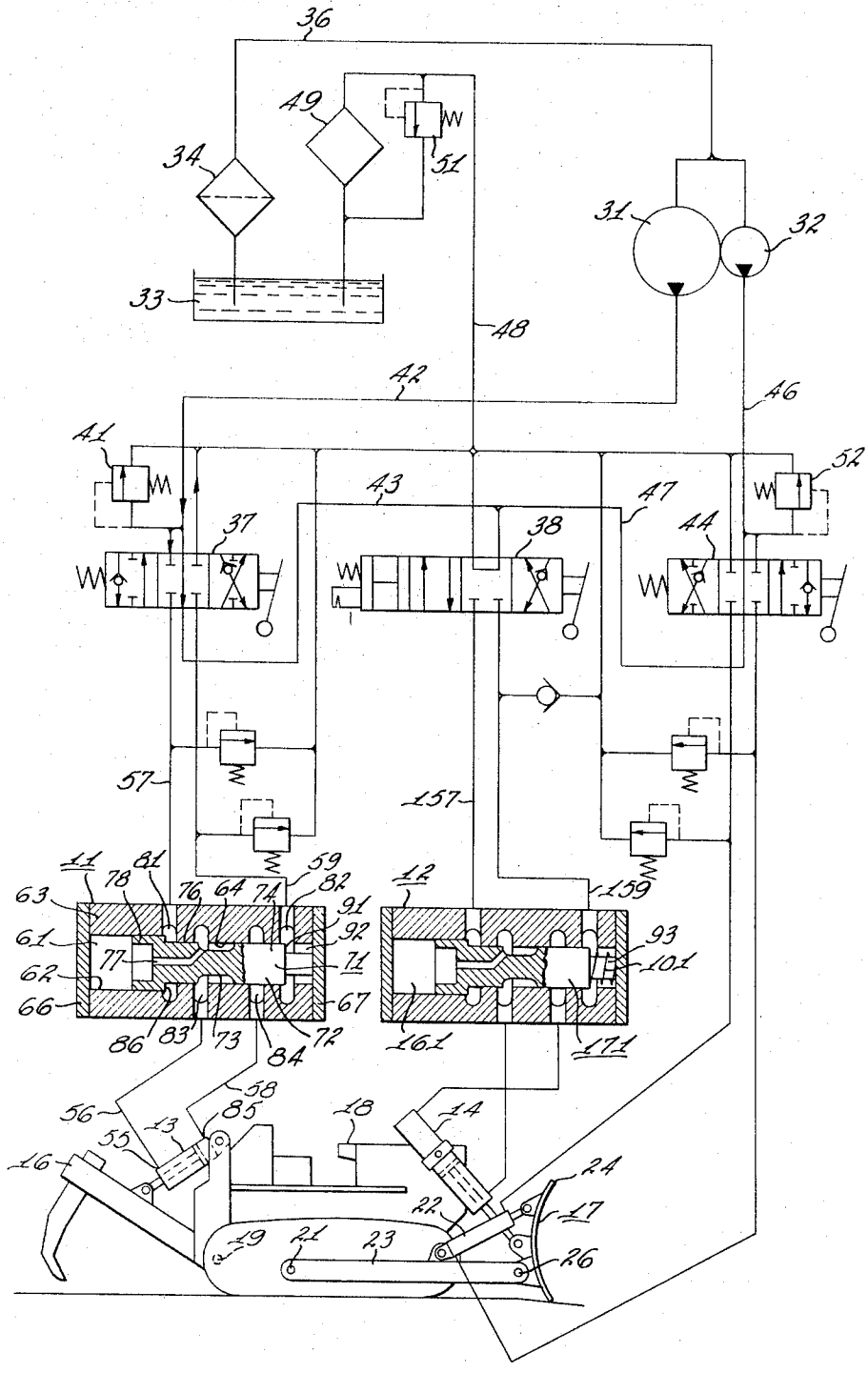
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[57] **ABSTRACT**

A hydraulic control system for a tractor implement includes a locking valve which is interposed between the control valve and the lift motor. The locking valve prevents accidental or unauthorized lowering of the implement when the tractor engine is not running. The control valve for the system may include a float position in which event the locking valve will include a spring for biasing it toward its open position so as to insure fluid communication between opposite sides of the hydraulic motor when the tractor is being operated with the implement control system in a float condition.

15 Claims, 1 Drawing Figure




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HYDRAULIC CONTROL SYSTEM WITH LOCKING VALVE TO PREVENT ACCIDENTAL OR UNAUTHORIZED LOWERING OF A TRACTOR IMPLEMENT

BACKGROUND OF THE INVENTION

This invention relates to pressure sensitive valve means employed in a hydraulic control system to prevent return of the fluid from a hydraulic lift motor to reservoir when the pump is not being driven to deliver fluid pressure to the system. More particularly this invention relates to a locking valve operating automatically to prevent accidental or unintentional lowering of an implement when the tractor engine is not running. A tractor operator may carelessly or intentionally leave the blade of a dozer or other implement elevated above the ground and in this condition it may be possible for a person to move the control valve to its implement lowering position whereby the blade may be lowered even though the tractor engine is not running. If someone happens to be under the blade, series injury could result. Heretofore others have suggested locking valves interposed between the control valve and the lift motor, one such arrangement being shown in U.S. Pat. No. 3,274,902, R. M. Kleckner, Hydraulic Control System, issued Sept. 27, 1966.

BRIEF DESCRIPTION OF THE INVENTION

In the present invention a specially designed spool valve serves as a locking valve between the control valve and the lift motor which is employed to raise and lower an implement. A first hydraulic actuator means is utilized to hold the spool of the locking valve in its closed position wherein fluid cannot flow from the motor back to the control valve. This first actuator means is in fluid communication with the side of the motor which is pressurized by the weight of the implement on the motor. Second hydraulic actuator means are employed to hold the spool of the locking valve in its open position when either of the lines leading from the control valve to the motor are pressurized. The spool of the locking valve is biased by a spring toward its open position so as to insure that the locking valve will remain in its open position during the floating operation of the control system.

DETAILED DESCRIPTION OF THE INVENTION

Referring to the drawing, the invention is illustrated in hydraulic control systems for a ripper and for a bulldozer mounted on opposite ends of a crawler tractor. Locking valves 11 and 12 are associated with reversible hydraulic motors 13 and 14 utilized to respectively control the elevation of a ripper 16 and a dozer 17. The ripper 16 is pivotally connected to the rear of the crawler tractor 18 for pivotal movement about a transverse axis 19 and the dozer 17 is pivotally connected to the crawler tractor for vertical swinging movement about a transverse pivot axis 21. A tilt cylinder 22 is interconnected between a pusharm 23 of the dozer 17 and a blade 24, the latter being pivotally connected to the pusharm 23 by a suitable transverse pivot pin 26. It should be understood that, as is conventional in crawler dozer construction, a second pusharm is installed on the opposite side of the tractor with an appropriate connection to the blade 24. It should also be understood that a second lift motor 14 is mounted on the opposite side of the tractor and appropriately connected to the crawler tractor 18 and the blade 24.

The illustrated hydraulic control system includes a large pump 31 and a small pump 32 which are driven by the tractor engine, not shown, and have their input sides connected to a fluid reservoir 33 through a screen 34 installed in a supply conduit 36. The pump 31 delivers pressure fluid to a control valve 37 having raised hold and lower positions for controlling the ripper motor 13. An appropriate relief valve 41 is provided for the pump 31. When the control valve 37 is in its illustrated hold position, fluid delivered by pump 31 to the valve 37 by way of a conduit 42 passes through the valve 37 to a second control valve 38 by way of a passage 43. The control valve 38 controls operation of the lift motor 14 associated with the dozer attachment 17. The fluid pump 32 is connected to the tilt cylinder control valve 44 by a delivery conduit 46 and is provided with a relief valve 52. When the control valve 44 is in its illustrated hold position, fluid delivered by pump 32 passes through the control valve 44 to the lift cylinder control valve 38 by way of a conduit 47. When all three control valves are in their hold positions, as illustrated in the drawings, all hydraulic fluid delivered by the pumps 31, 32 returns to the reservoir 33 by way of a return conduit 48 in which a full flow filter 49 is interposed. A suitable relief valve 51 is provided in bypassing relation to the filter 49.

As illustrated, the locking valve 11 is in its closed position of adjustment. In this closed position, fluid is prevented from flowing between passages 56 and 57. Also fluid is prevented from flowing between passages 58 and 59. The passage 56 is connected to an alternate inlet 55 on the rod side of the motor 13, which side is pressurized by the weight of the ripper 16 and this pressurization of fluid in the passage 56 also pressurizes the fluid in a chamber 61 of the locking valve 11. The locking valve includes a housing 63 in which a large diameter bore 62 and a small diameter bore 64 are coaxially formed. A receiving port 81 is formed in the housing at the junction of bores 62 and 64. End caps 66, 67 are secured to the housing by cap screws, not shown, in a conventional manner. A flow control element in the form of a stepped diameter spool 71 is reciprocably positioned in the bores 62, 64. The flow control element 71 has a small diameter portion 72 which includes a recess 73 and a pair of lands 74, 76 on opposite sides of the recess 73. A longitudinally extending passage 77 extends from the recess 73 to the axially outer end of a large diameter portion 78 of the flow control element 71, the large diameter portion 78 and the chamber 61, defined by bore 62 and cap 66, comprise a hydraulic actuator for moving the flow control element 71 axially to the right from its open position to its illustrated closed position wherein fluid is not permitted to flow between the control valve 37 and motor 13. The housing 63 of the locking valve 11 includes a pair of receiving ports 81, 82 and a pair of motor ports 83, 84 all axially spaced from one another in relation to and opening into the bore 64.

When the control valve 37 is moved to the right, which is its raised position, the passage 57 will be pressurized thereby pressurizing the fluid in port 81. The walls defining the port 81, the shoulder 86 and land 76 comprise a hydraulic actuator which, when pressurized by delivery of pressure fluid to the port from pump 31, will force the flow control element 71 axially to the left

in opposition to the pressure in chamber **61** created by the weight of the ripper **16** on the lower end of the motor **13.** Upon movement of the flow control element **71** to the left, the receiving port **81** will be connected to the motor port **83** by way of the recess **73** in the flow control element **71** and the receiving port **81** will be connected to the motor port **84** inasmuch as the land **72** will be moved sufficiently to the left to permit communication between the ports **82** and **84.** Thus as fluid is delivered by the pump to the lower end of motor **13,** fluid will be exhausted from an alternate inlet **85** at the top of the motor by way of the conduit **58,** the port **84,** a chamber **92,** the port **82** and the conduit **59.** The chamber **92** is formed by the small bore **64** and end cap **67** and together with the axially outer end of the small diameter portion **72** of flow control element **71** defines a hydraulic actuator.

In the event the operator chooses to lower the ripper, the flow control valve **37** is moved to the left from its illustrated hold position to a lower position wherein fluid from the pump is delivered to the passage **59.** If the locking valve **11** is in its illustrated locking position at such time, the fluid pressure in port **82,** and chamber **92,** will act on the axially outer end surface **91** of the small diameter portion **72** of the flow control element **71** thereby forcing the latter to the left to its open position.

After a day's work is done, the operator will normally place the control valve in a lower position to lower the tool to the ground so there can be no accidental lowering of the tool thereafter by repairmen, trespassers or others. If, by choice or accident, the ripper **16** should be in a raised position, the locking valve **11** will prevent the ripper from being lowered so long as the engine of the tractor is not running to drive the pumps **31, 32.** This system is believed effective to prevent some accidental injuries that might otherwise occur due to the carelessness of the operator or repairmen or the unauthorized handling of the valve control by trespassers.

The locking valve **12** utilized in the hydraulic control circuit for the lift motor **14** for the dozer attachment **17** is similar to the locking valve **11** except for the inclusion of a resilient biasing means in the form of a compression type coil spring **101** installed loosely around the reduced diameter end **93** of the right end of the flow control element **171.** The use of the spring **101** permits the operator to utilize the float position of control valve **38** without risking undesired closing of the flow control element **171,** which might otherwise occur because of pressure surges in the hydraulic motor **14** due to up and down movement of the blade over uneven terrain during a float operation. It will be noted that in the float position, passages **157, 159** will be interconnected to one another at the control valve **38** and also connected to the reservoir **33** and the pumps **31, 32.** The flow control element **171** of the locking valve **12** will be in its open position (shifted axially to the left) and the spring **101** will exert sufficient axial force against the flow control element **171** to hold it in its open position in opposition to the pressure experienced in chamber **161** during a float operation.

As illustrated, the load in the form of dozer **17** is being held in an elevated position by the reversible hydraulic motor **14** with the control valve **38** in a hold position. In this condition of the hydraulic system the pressure in chamber **161,** which is created by the weight of the dozer **17** on the rod end of motor **14,** is sufficient to overcome the spring **101** and force the flow control element **171** to the right to its illustrated closed position. So long as the tractor engine is not running the weight of the load on the motor **14** will keep the flow control element **171** in its closed position even though the control valve **38** is moved to any of its float, raise and lower positions.

The embodiments of the invention in which an exclusive property of privilege is claimed are defined as follows:

1. A hydraulic system comprising:

a source of fluid pressure including an associated reservoir,

a reversible hydraulic motor having a pair of alternate inlets and operatively connected to an elevatable load,

a control valve means operatively connected to said source of fluid pressure and to said fluid reservoir and having a pair of delivery ports,

a locking valve having

a bore,

a receiving port opening into said bore,

a motor port opening into said bore, and

a shiftable flow control element having a first control position in which fluid is permitted to flow between said receiving port and said motor port and having a second control position in which fluid is prevented from flowing between said supply and motor ports,

a first passage means interconnecting one of said alternate inlets and said motor port, said first passage means being subject to pressurization of fluid in said motor by the weight of said load when the latter is elevated,

a second passage means interconnecting one of said delivery ports with said receiving port,

a third passage means interconnecting the other of said alternate inlets and the other of said delivery ports,

first hydraulic actuator means operatively associated with said flow control element and connected in fluid communication with said first passage means, said first hydraulic actuator being operable to move said flow control element to its second control position when said second and third passage means are not pressurized by delivery of fluid from said source and the weight of said load on said motor pressurizes the fluid in said first passage means,

second hydraulic actuator means operatively associated with said flow control element and in fluid communication with said second passage means, said second actuator being operable to shift said flow control element from its second control position to its first control position when the fluid pressure in said second passage means has a predetermined relationship to the pressure in said first actuator means, and

third hydraulic actuator means operatively associated with said flow control element and in fluid communication with said third passage means, said third actuator being operable to shift said flow control element from its second control position to its first control position when the fluid pressure in said third passage means has a predetermined relationship to the pressure in said first actuator means.

2. The invention of claim 1 wherein said control valve has float, lower, hold, and raise positions and wherein said locking valve includes resilient biasing means urging said control element toward its first control position.

3. A hydraulic system comprising:
a source of fluid pressure including an associated reservoir,
a reversible hydraulic motor operatively connected to an elevatable load and having a pair of alternate inlets,
a control valve means operatively connected to said source of fluid pressure and to said fluid reservoir and having a pair of delivery ports,
a locking valve having
a bore,
a pair of receiving ports in said bore,
a pair of motor ports in said bore, and
a shiftable flow control element having a first control position in which fluid is permitted to flow between one of said receiving ports and one of said motor ports and between the other of said receiving ports and the other of said motor ports and having a second control position in which fluid is prevented from flowing between said supply and motor ports,
a first passage means interconnecting one of said alternate inlets and one of said motor ports, said first passage means being subject to pressurization of fluid in said motor by the weight of said load when the latter is elevated by said motor,
a second passage means interconnecting the other of said alternate inlets and the other of said motor ports,
third and fourth passage means interconnecting said delivery ports with said receiving ports, respectively,
first hydraulic actuator means operatively associated with said flow control element and in fluid communication with said first passage means, said first actuator means being operable to shift said flow control element to its second control position when said third and fourth passage means are not supplied pressurized fluid by said source and the weight of said load is imposed on said motor thereby pressurizing the fluid in said first passage means,
second hydraulic actuator means operatively associated with said flow control element and in fluid communication with said third passage means, said second actuator means being operable to shift said flow control element from its second control position to its first control position when the fluid pressure in said third passage means has a predetermined relationship to the fluid pressure in said first actuator means, and
third hydraulic actuator means operatively associated with said flow control element and connected in fluid communication with said fourth passage means, said third hydraulic actuator means being operable to move said flow control element to its first control position when the fluid pressure in said fourth passage means has a predetermined relationship to the fluid pressure in said first actuator means.

4. The invention of claim 3 wherein said shiftable flow control element is a valve spool having a large diameter portion and a small diameter portion with an axially facing annular shoulder at the junction of said portions, wherein the axially outer end of said large diameter portion is the piston component of said first hydraulic actuator means, wherein said shoulder is a piston component of said second hydraulic actuator means and wherein the axially outer end of said reduced diameter portion is a piston component of said third hydraulic actuator means.

5. The invention of claim 3 wherein said control valve has float, lower, hold and raise positions and said locking valve includes resilient biasing means urging said flow control element toward its first control position.

6. A hydraulic system comprising:
a source of fluid pressure including an associated reservoir,
a reversible hydraulic motor having a pair of alternate inlets and operatively connected to a load to elevate the latter,
a control valve means operatively connected to said source of fluid pressure and to said fluid reservoir and having
a pair of delivery ports, and
a shiftable flow control member with float, lower, hold and raise positions,
a locking valve having
a receiving port,
a motor port,
a shiftable flow control element having a first control position in which fluid is permitted to flow between said receiving and motor ports and having a second control position in which fluid is prevented from flowing between said receiving and motor ports, and
resilient biasing means urging said flow control element toward its first control position,
a first passage means interconnecting one of said alternate inlets and said motor port, said first passage means being subject to pressurization of fluid in said motor by the weight of said load when the latter is elevated by said motor,
a second passage means interconnecting one of said delivery ports with said receiving port,
a third passage means interconnecting the other of said alternate inlets and the other of said delivery ports,
first hydraulic actuator means operatively associated with said flow control element and connected in fluid communication with said first passage means, said first hydraulic actuator being operable to move said flow control element to its second control position when the weight of said load on said motor pressurizes the fluid in said first passage means and said second and third passage means are not pressurized by delivery of fluid from said source, and
second hydraulic actuator means operatively associated with said flow control element and with said second and third passage means, said second hydraulic actuator means being operable to shift said flow control element from its second control position to its first control position when the fluid pressure in either of said second and third passage means has a predetermined relationship to the pressure in said first hydraulic actuator means.

7. The invention of claim 6 and further comprising flow control means operatively associated with said second passage means preventing delivery of pressurized fluid through said second passage means to said motor when said flow control element is in its second control position.

8. The invention of claim 7 wherein said second hydraulic actuator means comprises a pair of hydraulic actuators operatively associated with said flow control element and in fluid communication with said second passage means and said other delivery port, respectively.

9. The invention of claim 8 wherein said flow control element is a valve spool having a large diameter portion and a small diameter portion with an axially facing shoulder at the junction of said portions, wherein the axially outer end of said large diameter portion comprises a component of said first hydraulic actuator means, wherein said shoulder comprises a component of said hydraulic actuator in fluid communication with said second passage means, and wherein the axially outer end of said small diameter portion comprises a component of said hydraulic actuator in fluid communication with said other delivery port.

10. Locking valve means comprising:

a valve housing having

a stepped diameter bore including a large diameter section and a small diameter section,

a pair of receiving ports adapted for connection to the delivery ports of a control valve and opening into said bore at spaced points thereof, and

a pair of motor ports adapted for connection to opposite sides of a hydraulic lift motor and opening into said bore at spaced points thereof,

a flow control spool having a large diameter portion in said large diameter section, a small diameter portion in said small diameter section and an axially facing shoulder at the junction of said portions,

wall means including said large diameter section of said bore defining a first pressure chamber, said first pressure chamber and the axially outer end of said large diameter portion of said spool comprising a first hydraulic actuator,

passage means connecting said first hydraulic actuator in fluid communication with one of said motor ports,

wall means including said small diameter section of said bore defining a second pressure chamber, said second pressure chamber and the axially outer end of said small diameter portion of said spool comprising a second hydraulic actuator,

wall means including the axially inner end of said large diameter section of said bore defining a third pressure chamber, said third pressure chamber and said shoulder comprising a third hydraulic actuator,

one of said motor ports being in fluid communication with said first hydraulic actuator and said receiving ports being in fluid communication with said second and third hydraulic actuators respectively, and

said flow control spool being axially shiftable from a locking position wherein flow between said receiving and motor ports is prevented to an open position wherein flow between said receiving and motor ports is permitted.

11. The invention of claim 10 and further comprising resilient biasing means urging said flow control spool toward its open position.

12. The invention of claim 10 and further comprising an annular recess in said small diameter portion of said spool in fluid communication with said one motor port and an axially extending passage in said spool placing said first hydraulic actuator and said recess in fluid communication.

13. The invention of claim 12 and further comprising resilient biasing means urging said flow control spool toward its open position.

14. A hydraulic system comprising:

a source of fluid pressure including an associated reservoir,

a reversible hydraulic motor having a pair of alternate inlets and operatively connected to an elevatable load,

a control valve means operatively connected to said source of fluid pressure and to said fluid reservoir and having a pair of delivery ports, said control valve means having float lower, hold and raise positions of adjustment,

a locking valve having

a housing with

a bore,

a pair of receiving ports opening into axially spaced points of said bore, and

a pair of motor ports opening into axially spaced points of said bore, and

an axially shiftable flow control spool in said bore having an open position in which fluid is permitted to flow between said receiving ports and said motor ports and having a closed position in which fluid is prevented from flowing between said receiving and motor ports,

a first passage means interconnecting one of said alternate inlets and said one of said motor ports, said first passage means being subject to pressurization of fluid in said motor by the weight of said load when the latter is elevated,

a second passage means interconnecting the other of said alternate inlets and the other of said motor ports,

third and fourth passage means interconnecting said delivery ports with said receiving ports, respectively, and

fluid pressure actuating means operatively associated with said spool and with said first, third and fourth passage means, said fluid pressure actuating means being operative to shift said spool to its open position when either of said third and fourth passage means is pressurized and to shift said spool to its closed position when said first passage means is pressurized by the weight of said load on said motor and said third and fourth passage means are not pressured.

15. The invention of claim 14 wherein said locking valve includes resilient biasing means urging said spool toward its open position.

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