Aug. 2, 1949. C. C. WORSTELL 2,477,710

PRESSURE FLUID FOLLOW-UP SERVOMOTOR

Filed Oct. 15, 1945 4 Sheets-Sheet 1

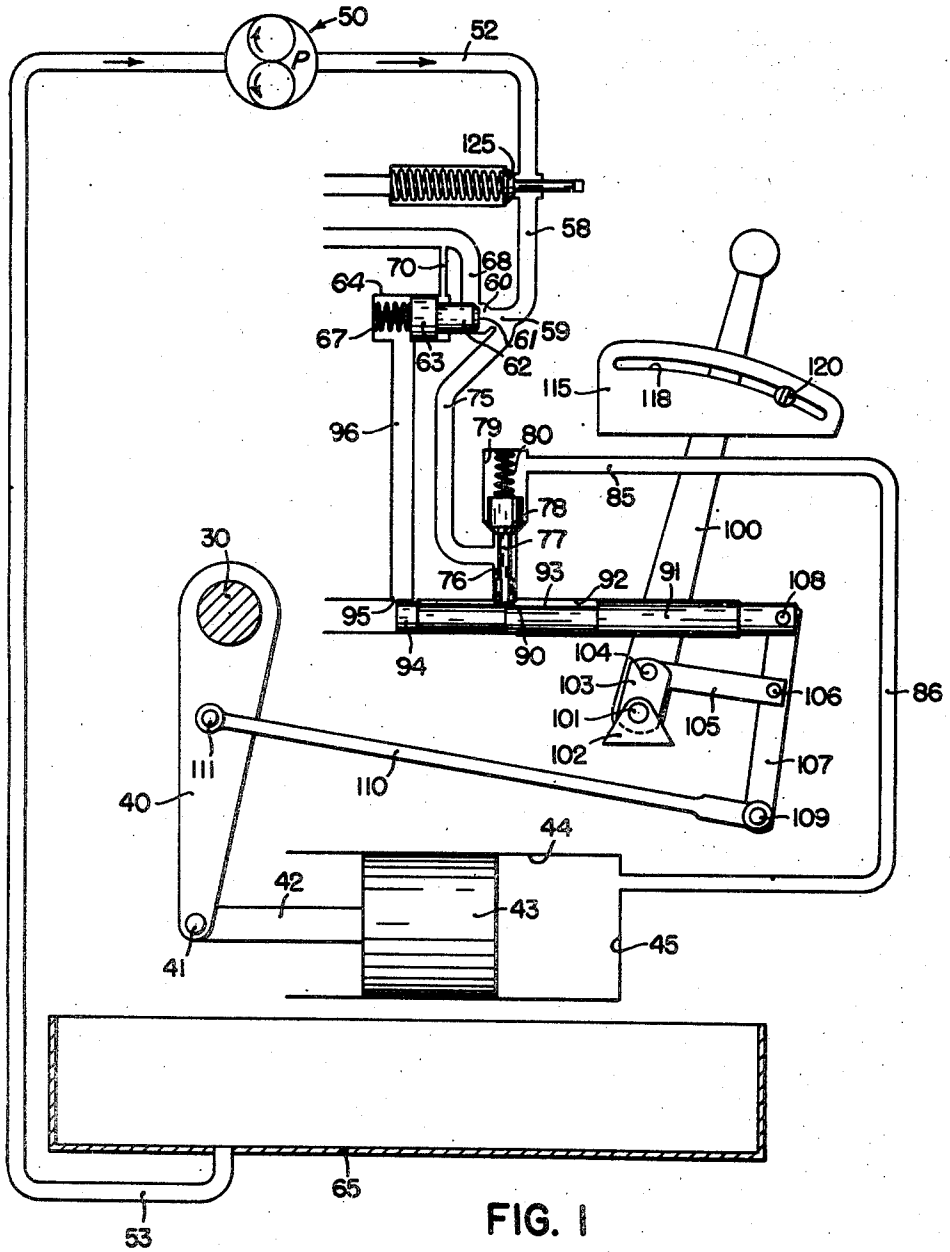


FIG. 1

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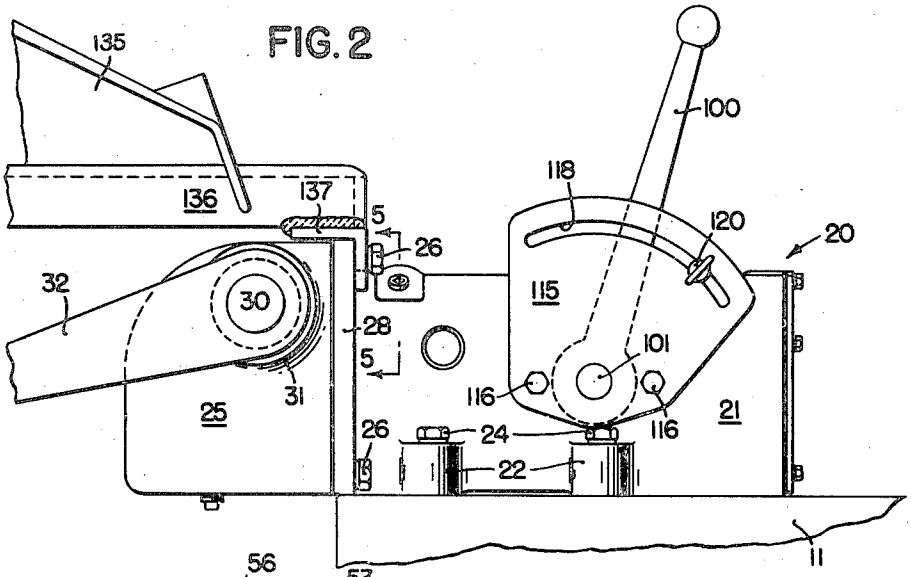
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PRESSURE FLUID FOLLOW-UP SERVOMOTOR

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FIG. 2



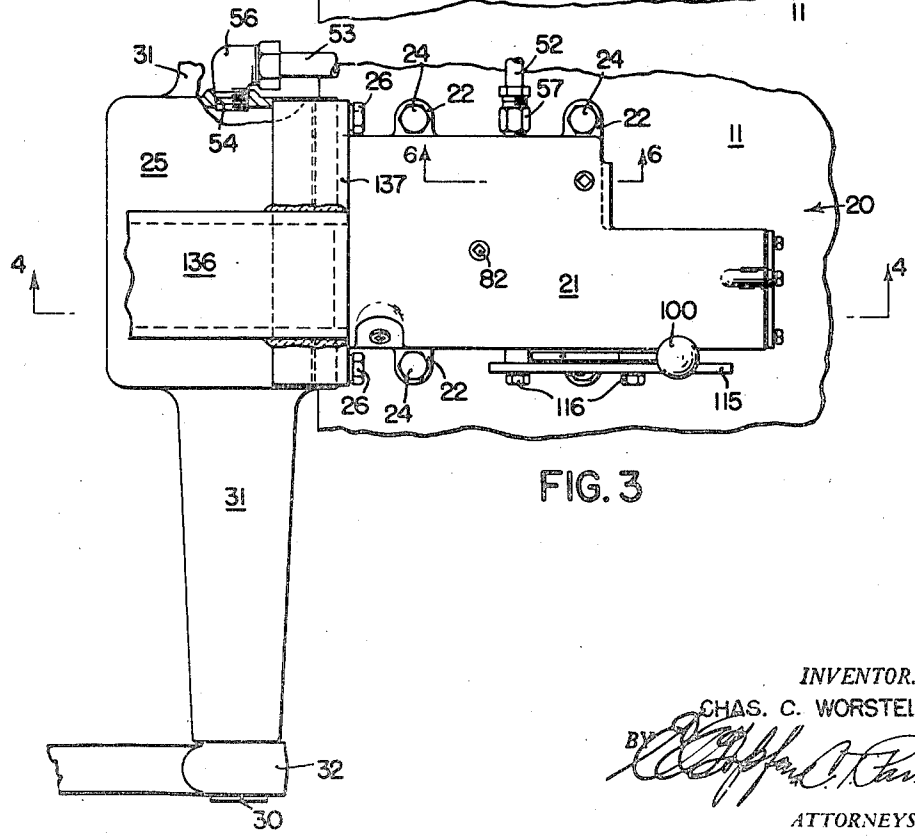


FIG. 3

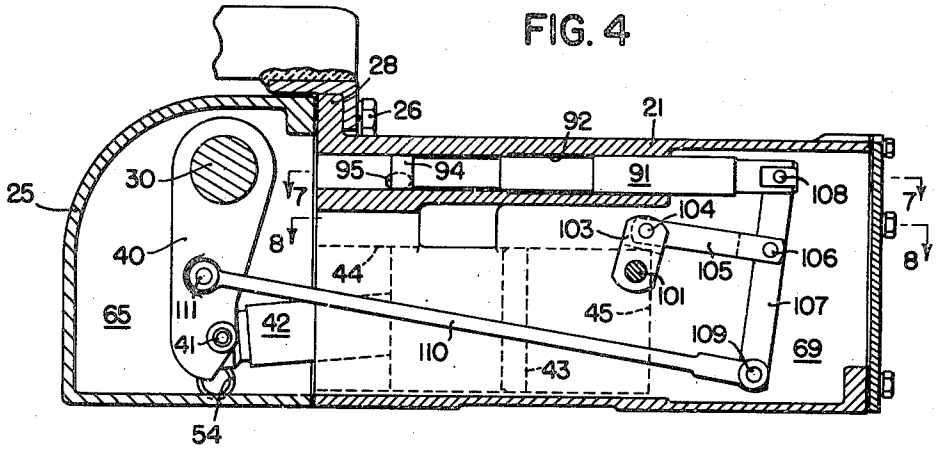
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PRESSURE FLUID FOLLOW-UP SERVOMOTOR

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FIG. 4



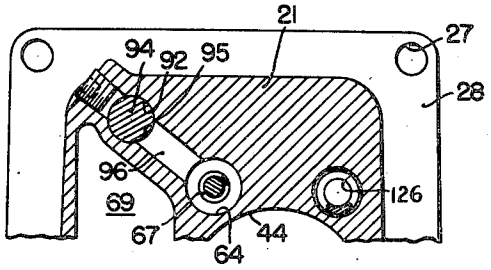


FIG. 5

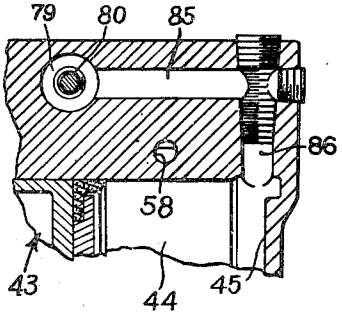


FIG. 6

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PRESSURE FLUID FOLLOW-UP SERVOMOTOR

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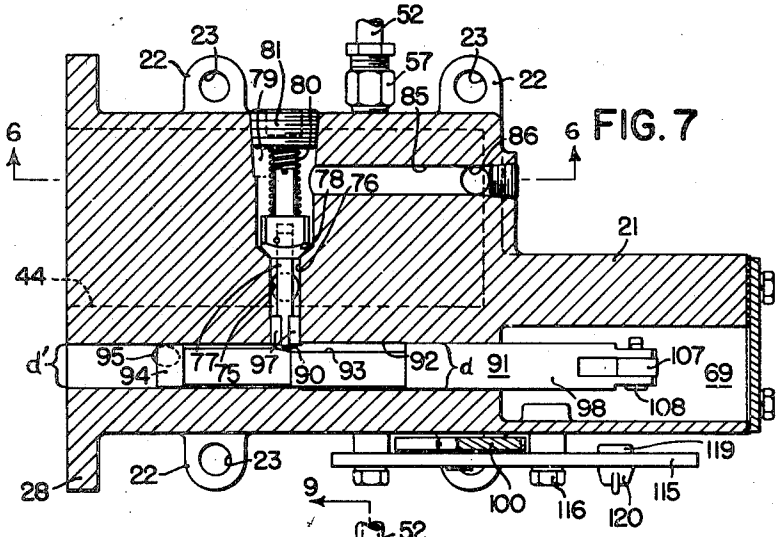


FIG. 7

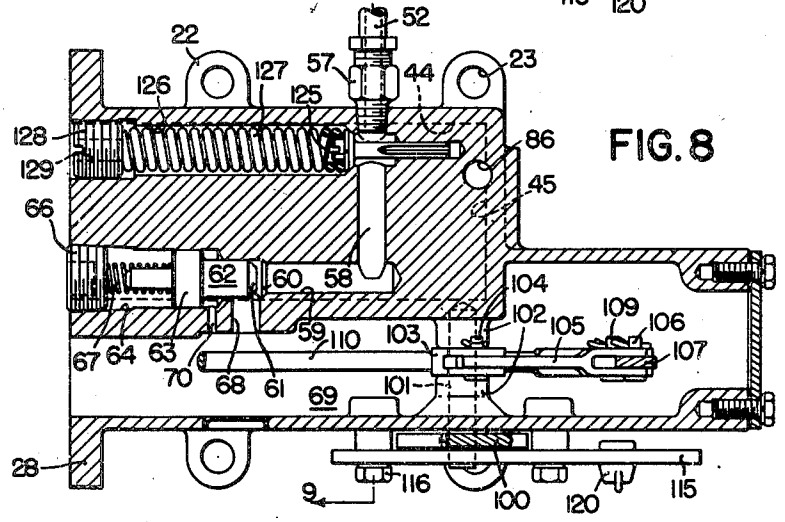


FIG. 8

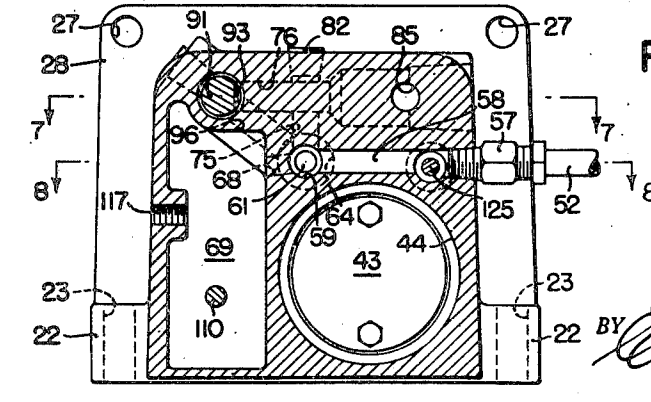


FIG. 9

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Patented Aug. 2, 1949

2,477,710

UNITED STATES PATENT OFFICE

2,477,710

PRESSURE FLUID FOLLOW-UP SERVOMOTOR

Charles C. Worstell, Moline, Ill., assignor to Deere & Company, Moline, Ill., a corporation of Illinois

Application October 15, 1945, Serial No. 622,242

16 Claims. (Cl. 121—41)

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The present invention relates generally to hydraulic mechanism and is particularly well adapted for use with tractors and the like for lifting and controlling implements associated therewith.

The principal object of the present invention relates to the provision of a novel and improved hydraulic control mechanism, which is simpler in construction and smoother in operation, but which is strong and durable and inexpensive to manufacture.

A further object relates to the provision of a hydraulic control mechanism, in which the movement of the fluid pressure motor is substantially proportional to the extent of movement of the manual control lever, whereby the position of the manual control lever is an indication of the position or extent of movement of the fluid pressure motor. Heretofore, in hydraulic mechanisms of this general class, as the fluid pressure motor approaches the position for which it is adjusted, the valve approaches a closed position, thus throttling the fluid flow through the valve and slowing down the movement of the fluid motor. This action is cumulative, with the result that the fluid is caused to leak through the nearly closed valve for a relatively long period of time during the final seating of the valve. While this is not serious in low pressure systems, it is the cause of concentrated wear on the valve surfaces in high pressure circuits, due to the wire drawing effect, producing a considerable degree of localized friction, accompanied by generation of heat. More specifically, it is a further object of the present invention to provide a hydraulic system of this general class, in which the control valve, which is opened by the manual control lever and closed by the movement of the fluid motor, does not control the main flow of fluid to the fluid motor. In the accomplishment of this object, a differential valve is provided by which the pressure in the hydraulic circuit is controlled. Both ends of this differential valve are subjected to the pressure in the supply duct, but since the two ends of the valve are unequal in area, the valve is biased toward a closed position. However, the differential valve is opened and closed by the control valve, which merely controls the fluid pressure against the large diameter end of the differential valve. Hence, the amount of oil flowing through the control valve is negligible, with the result that not only is the wear on this valve negligible, but the action thereof is extremely smooth and the fluid motor can be very accurately controlled.

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These and other objects and advantages of my invention will be apparent to those skilled in the art, after a consideration of the following description, in which reference is had to the drawings appended hereto, in which

Figure 1 is a schematic diagram of hydraulic mechanism embodying the principles of my invention;

Figure 2 is a side elevational view of the hydraulic mechanism;

Figure 3 is a top plan view of the mechanism, a portion of which is broken away to show the connection of the pump intake duct to the reservoir;

Figure 4 is a sectional elevational view taken along a line 4—4 in Figure 3 and drawn to an enlarged scale;

Figure 5 is a fragmentary elevational view taken in section along a line 5—5 in Figure 2 and drawn to an enlarged scale;

Figure 6 is a fragmentary sectional elevational view taken along a line 6—6 in Figure 3 and drawn to an enlarged scale, or along a line 6—6 in Figure 7;

Figure 7 is a sectional plan view taken along a line 7—7 in Figure 4 and drawn to an enlarged scale, or along a line 7—7 in Figure 9;

Figure 8 is a sectional plan view taken along a line 8—8 in Figures 4 and 9 and drawn to the same scale as Figure 7 and

Figure 9 is a sectional elevational view taken along a line 9—9 in Figure 8.

Referring now to the drawings, the hydraulic control mechanism is indicated generally by reference numeral 20, and includes a control housing 21 having laterally outwardly projecting lugs 22, provided with vertically extending apertures 23 adapted to receive bolts 24 for securing the housing 21 in operating position on a tractor or the like. A rockshaft housing 25 is disposed at the rear of the control housing 21 and is rigidly connected thereto by bolts 26, which extend through apertures 27 in a vertically disposed flange 28 in the control housing 21. The rockshaft housing 25 encloses a transversely disposed rockshaft 30, which is journaled in a pair of laterally extending quills 31, which are preferably formed integral with the housing 25, and the rockshaft 30 extends laterally outwardly of the quills and carries a pair of lifting arms 32 on the outer end thereof, which are rigidly fixed thereto in a manner well known to those skilled in the art.

The rockshaft 30 is rocked by means of a rocker arm 40 within the housing 25, which arm

is pivotally connected at 41 to a piston rod 42, the latter extending forwardly into a cylinder 44, formed integrally with the control housing 21 and engages a piston 43. The piston 43 and cylinder 44 comprise a fluid pressure actuated motor in the form of a ram, which controls the rocking of the rockshaft 30. The forward end of the cylinder 44 is closed by a cylinder head 45, which is preferably cast integrally with the housing 21.

Fluid is supplied under pressure to the forward end of the cylinder 44, thereby forcing the piston 43 rearwardly and rocking the rockshaft 30 in a clockwise direction, as viewed in Figure 4. The fluid is supplied under pressure by means of a conventional constant displacement type gear pump 50 connected with the control housing 21 through a high pressure supply duct 52 and a low pressure return duct 53. The return duct 53 is connected to an opening 54 near the bottom of the rockshaft housing 55 by means of an elbow fitting 56 (Figure 3). Thus, the rockshaft housing 25 also serves as a reservoir for the hydraulic fluid, such as oil.

The high pressure supply duct 52 is connected by means of a suitable fitting 57 with a supply duct passage 58 within the housing 21 above the cylinder 44, the duct 58 extending laterally inwardly from one side of the housing 21 and intersecting a rearwardly extending passage 59. An exhaust port 60 in the rear end of the passage 59 provides a seat for a poppet type valve 61 (Figure 8), which is part of a differential valve 62, which also includes a piston 63, formed integrally with the poppet valve 61. The piston 63 is of larger diameter than the valve 61 and is slidably disposed in a cylindrical passage 64, which extends rearwardly into communication with the reservoir 65 in the housing 25, but is closed by means of a threaded plug 66. Normally, the differential valve 62 is urged by means of a spring 67 behind the piston 63 toward a closed position in the seat of the exhaust port 60, but can be forced away from the seat 60 by pressure within the passage 59, to permit fluid therein to be discharged through an opening 68, which communicates with a reservoir 69 within the control housing 21. The rear end of the reservoir 69 communicates with the reservoir 65 in the rockshaft housing 25. A relief hole 70 prevents any pressure from building up between the piston 63 and the forward end of the enlarged passage 64, the hole 70 also communicating with the reservoir 69.

Immediately in front of the seat 60 is a vertically extending passage 75, which connects the passage 59 with a check valve passage 76, within which is disposed a check valve 77 of the poppet type having a head 78 disposed within a chamber 79 at one end of the passage 76. The head 78 of the check valve 77 is seated in the end of the passage 76 and is urged toward seated relation by a compression spring 80, which bears against a plug 81 in the outer end of the chamber 79. A plug 82 closes the other end of the passage 75 (Figures 3 and 9).

A forwardly extending duct 85 intersects the chamber 79 at its rear end and intersects a downwardly extending passage 86 at its forward end. The passage 86 communicates with the forward end of the cylinder 44 of the fluid pressure motor.

The stem of the check valve 77 bears against a camming surface 90 of a valve plunger 91, which is slidably disposed in a fore and aft extending cylindrical passage 92, which communicates at its forward end with the reservoir 69 and

at its rear end with the reservoir 65 in the housing 25 (Figure 4). The camming portion 90, against which the check valve 77 bears, is so inclined that the valve head 78 is moved away from its seat in the end of the passage 76 when the valve plunger 91 is shifted forwardly in the cylindrical passage 92, but the camming surface 90 has a forwardly extending flat portion 93 which permits the valve 77 to remain closed under the action of its compression spring 80 when the valve plunger 91 is shifted rearwardly within the passage 92. The forward end of the valve plunger 91 has a piston 98, which fits closely within the forward end of the passage 92, thereby preventing any flow of fluid forwardly into the reservoir 69, and is also provided with a spool or piston portion 94 at the rear end of the valve plunger 91, which prevents any flow of fluid from the passage 76 rearwardly into the reservoir 65. Between the two spool or piston portions 98, 94, the valve member is of smaller diameter to permit a flow of oil therealong.

The valve cylinder 92 is provided with a valve port 95, which communicates through a downwardly and inwardly inclined passage 96 with the cylinder 64 in which the differential valve piston 63 is slidably disposed. The valve port 95 is controlled by the piston portion 94 of the valve member 91, which can be shifted axially within the cylinder 92 between a normal or inactive position, as shown in Figure 7, in which the valve port 95 is open slightly to the rear of the piston 94, thereby relieving the pressure within the differential valve cylinder 64, and an active position in which the piston 94 closes the port 95 against discharge of fluid rearwardly into the reservoir 65 and connects the port 95 in communication with the check valve passage 76 to permit fluid to flow from the latter along grooves 97 in the stem of the check valve 77 into the cylindrical passage 92 and from there into the cylinder 64 through the valve port 95.

The operation of the mechanism thus far described is as follows:

With the valve member 91 in its inactive position shown in the drawings, the fluid supplied by the pump through the conduit 52 flows through ducts 58, 59, through the exhaust port 60 past the poppet valve 61, and into the reservoir 69 through the discharge aperture 68. Only a slight pressure is required to force open the differential valve 62, for the spring 67 is a weak spring. The fluid in the passage 59 is also free to flow upwardly (Figure 7; downwardly in Figure 2) through the vertical passage 75 into the check valve passage 76, and into the valve cylinder 92. The valve port 95, however, is closed against flow of fluid from the cylinder 92, and since the check valve 77 is seated by the spring 80 which is stronger than the differential valve spring 67, no fluid flows through the check valve 77 into the main cylinder 44. Hence, all of the fluid from the supply duct 52 is returned to the reservoir 69 through the discharge opening 68.

The load on the lifting arms 32 can be raised by shifting the valve member 91 rearwardly until the piston 94 uncovers the valve port 95 to permit fluid to flow through the latter into the differential valve cylinder 64, thereby substantially equalizing the pressure in the differential valve cylinder 64 and in the passage 59, but, as shown in Figure 8, the cross sectional area of the differential valve piston 63 is appreciably greater than the area of the head of the poppet valve 61, and therefore the force of the oil pressure against

the piston 63 overcomes the force which reacts against the head of the valve 61, with the result that the differential valve 62 is shifted to the right, as viewed in Figure 8, until the poppet valve 61 seats in the exhaust port 60.

The fluid pressure within the supply passages 58, 59 now increases, and forces the check valve 78 from its seat in the end of the passage 76 against the pressure of the spring 80, thereby permitting the oil to flow through the vertical passage 75, past the check valve 78 and through the cylinder supply ducts 85, 86 into the forward end of the cylinder 44 of the fluid pressure motor. The fluid pressure in the cylinder 44 causes the piston 43 to move rearwardly, thereby acting through the connecting rod 42 and rocker arm 40 to swing the rockshaft in a clockwise direction of rotation as viewed in the drawings. The movement of the piston 43 can be stopped at any time by shifting the valve member 91 forwardly to its inactive position, and as soon as the valve port 95 is opened to the reservoir 65, the pressure of the oil in the valve cylinder 64 is relieved, thereby permitting the differential valve 62 to be opened rearwardly by the pressure against the valve head 61, exhausting the fluid from the supply passages 58, 59 through the opening 68. This permits the check valve 78 to close against its seat by the action of the spring 80 and by the pressure of the fluid in the cylinder 44 due to the weight of the load on the rockshaft, which is thus locked in adjusted position.

Inasmuch as only a very small quantity of oil passes through the port 95, either when starting or stopping the fluid motor, the wear on the port 95 and spool or piston 94 is negligible. Furthermore, the action of the differential valve 62 in opening and closing the exhaust port 60 is fast and positive, for as soon as the pressure in the cylinder 64 acting against the piston 63 overbalances the pressure against the valve head 61 it closes the latter with a quick positive action. Similarly, when the pressure is relieved from the cylinder 64, the pressure against the head 61 suddenly and positively opens the valve 61, so that there is no protracted time in which the valve 61 is cracked open under pressure and therefore there is very little friction against the valve seat or valve and very little heat developed.

The valve member 91 is controlled by a manually operated lever 100, which is fixed to a pivot shaft 101 journaled in a pair of bosses 102 within the reservoir portion 69 of the housing 21. A crank arm 103 is fixed to the pivot shaft 101 between the bosses 102 and has a bifurcated end that is pivotally connected by a pin 104 to a link 105 which extends forwardly therefrom. The link 105 is pivotally connected by a pin 106 to a beam 107 intermediate the ends thereof, which is disposed generally vertically in the forward end of the reservoir 69. The upper end of the beam 107 is swingably connected by a pin 108 to the forward end of the valve member 91, the latter being bifurcated to receive the upper end of the beam 107. The lower end of the beam 107 is pivotally connected by a pin 109 to a longitudinally extending connecting link 110, which extends rearwardly through the reservoir 69 into the rockshaft housing 25, where it is connected by a pivot bolt 111 to the rocker arm 40 between the rockshaft 30 and the piston rod connection 41.

The beam 107 constitutes a differential connection between the manually controlled lever 100, the valve member 91, and the arm 40 on the rockshaft 30, which provides a follow-up action in which the manually controlled lever 100 can be moved by the operator to any desired position, whereupon the piston 43 will move within the cylinder 44 to a position corresponding to the setting of the lever 100, upon which the valve member 91 will be shifted to its inactive position to stop the piston 43 the desired point in its range of movement.

For example, the load can be raised a predetermined extent by moving the lever 100 rearwardly an amount proportional to the extent of desired movement of the load, thereby pulling the link 105 rearwardly and swinging the beam 107 in a counter clockwise direction about the axis of the lower pivot 109, as viewed in Figure 4. The position of the pivot 109 is momentarily fixed because the rockshaft 30 is locked in its present position of adjustment, and hence the swinging of the beam 107 shifts the valve member 91 rearwardly within the valve cylinder 92, admitting fluid pressure through the port 95 to the differential valve cylinder 64 and effecting a rearward movement of the piston 43 in the manner described above. As the piston 43 and rocker arm 40 move rearwardly, the beam 107 is swung angularly in a clockwise direction about the pivot pin 106 as a fulcrum to shift the valve member 91 forwardly, returning the latter to the neutral or inactive position, for there is sufficient friction in the mounting of the control lever 100 to prevent it being shifted by movement of the piston. Hence, when the piston 43 reaches the desired position as predetermined by the position of the lever 100, the valve piston 94 uncovers the valve port 95 and relieves the pressure in the valve cylinder 64 thereby causing the movement of the piston 43 to be arrested.

Conversely, the load can be lowered by moving the lever 100 forwardly to any desired position within its range, thereby swinging the beam 107 in a clockwise direction about the pivot 109 and shifting the valve member 91 forwardly from its neutral position, thereby moving the camming surface 90 against the stem of the check valve 77, forcing the latter away from its seat in the end of the passage 76 and releasing fluid from the cylinder 44 through the passages 86, 85 and 79. In this direction of movement of the valve member 91, the valve piston 94 merely uncovers the valve port 95 to a greater extent, which does not affect the differential valve 62 but permits the flow of oil from the supply passages 58, 59 to exhaust through the opening 68 to the reservoir. The fluid from the cylinder 44 flows downwardly through the vertical passage 75 and also flows through the exhaust port 60 and is discharged through the opening 68, allowing the piston 43 to move forwardly in the cylinder 44 and acting through the link 110 to shift the beam 107 in a counter clockwise direction about the pivot 106, thereby restoring the valve member 91 to its neutral position and letting the check valve 78 drop into its seat, with the result that when the piston 43 reaches the position predetermined by the setting of the control lever 100, the check valve 78 closes and locks the piston and rocker arm 40 against further movement.

A guide plate 115 for the control lever 100 is secured to the side of the housing 21 by means of a pair of bolts 116, which extend into threaded apertures 117 in the side of the housing 21. The guide plate 115 is provided with an arcuate slot 118, which receives a bolt 119 secured within the slot 118 by a thumb nut 120. By loosening the thumb nut 120, the bolt can be adjusted to any

desired position within the slot 118 and serves as a stop against which the control lever 100 engages when the operator shifts the latter forwardly to lower the implement to working position. Thus, the bolt 119 can be set at positions corresponding to the desired working position of the implement and therefore facilitating the control of the implement. A similar limit bolt can be placed in the slot 118 to determine the upper limit of movement of the implement, but in most cases this is not necessary since the implement is usually lifted to the full extent of movement of the rockshaft.

In case the load on the rockshaft is excessive, or in case the implement encounters an obstruction during the raising operation, the pressure in the supply ducts 58, 59 is limited by means of an excess pressure relief valve 125 of the poppet type, disposed within a passage 126 in the housing 21 intersecting the supply duct 58. A strong compression spring 127 holds the valve 125 in its seat during normal operation, the spring 127 bearing against a plug 128, threaded in the rear end of the passage 126 and the plug 128 is provided with an axially extending aperture 129, through which the fluid is returned to the reservoir 65 when the pressure in the passage 58 becomes great enough to lift the check valve 125 against the action of the spring 127.

In order to place the control lever 100 in a position convenient to the operator, the operator's seat 135 is supported on a forwardly extending standard 136, which is rigidly fixed, as by welding, to a transversely extending angle member 137, which lies along the upper edge of the flange 28 on the housing 21 and has a downwardly turned flange which is apertured to receive the bolts 26. Thus, when the operator sits in the seat 135, the control lever 100 is disposed conveniently between his knees.

The areas of the inner surfaces of the piston portions 94, 98 of the valve member 91 which are subjected to fluid pressure within the valve passage 92 are made intentionally unequal to bias the member 91 in one direction and thus to take up any looseness in the pivot joints between the valve member 91, the beam 107, link 105, arm 103, rod 110, and rocker arm 40. Specifically, the area of the piston portion 98 exposed to pressure within the passage 92, indicated at d, is slightly greater than that indicated at d' of the portion 94, thereby tending to urge the valve member 91 forwardly against the pivot pin 108. The forward and rear portions of the passage 92 have corresponding portions d, d' of unequal diameter to accommodate the respective valve portions 98, 94. This eliminates lost motion in all of the joints and provides greater accuracy in control.

I do not intend my invention to be limited to the exact details shown and described herein, except as set forth in the claims which follow.

I claim:

1. Hydraulic mechanism comprising a fluid pressure motor and a control housing associated therewith having a fluid supply duct connected with said motor and an exhaust port communicating with said duct, a check valve in said duct between said port and said motor adapted to normally prevent fluid from flowing through said duct from said motor, a differential valve in said housing controlling said port, and a control valve member for controlling said differential valve, said valve member being shiftable into engagement with said check valve to open the latter.

2. Hydraulic mechanism comprising a fluid pressure motor, a fluid supply duct connected with said motor, said duct having an exhaust port, a check valve in said duct between said port and said motor adapted to normally block the duct against flow of fluid away from said motor, a differential valve comprising a poppet type valve head for closing said port and a piston for controlling said valve head, means defining a passage communicating with said supply duct for subjecting said piston to the pressure in said duct in opposition to the pressure against said valve head, said piston having a greater area than said head for biasing the latter toward closed position in said port when subjected to equal pressure, and a control valve in said passage means for relieving the pressure against said piston to permit said valve head to be forced away from said port by the fluid pressure in said duct, whereby the fluid is by-passed through said exhaust port and said check valve closes to prevent return flow from said motor, and a common control element for said control valve and said check valve, said element being shiftable to open both said control valve and said check valve to permit flow of fluid from said motor to said port.

3. Hydraulic mechanism comprising a fluid pressure ram and a control housing associated therewith having a fluid supply duct connected with said ram and an exhaust port communicating with said duct, a check valve in said duct between said port and said ram adapted to normally block the duct against flow of fluid away from said ram, a differential valve comprising a valve head seatable in said exhaust port and shiftable axially away from said port by fluid pressure within said duct and a piston for controlling said valve head, a cylinder in which said piston is slidably disposed, passage means in said housing connecting said supply duct with said cylinder for applying fluid pressure to said piston in a direction tending to close said port against pressure in said duct, said piston having a greater area than said head for closing the latter when subjected to equal fluid pressure, and a control valve in said passage means for relieving the pressure against said piston to permit said valve head to be forced away from said port by the fluid pressure in said duct, whereby the fluid is by-passed through said exhaust port and said check valve closes to prevent return flow from said ram, and a common control element for said control valve and said check valve, said element being shiftable to open both said control valve and said check valve to permit flow of fluid from said ram to said port.

4. Hydraulic mechanism comprising a fluid pressure ram and a control housing associated therewith having a fluid supply duct connected with said ram and an exhaust port communicating with said duct, a check valve in said duct between said port and said ram adapted to normally block the duct against flow of fluid away from said ram, a differential valve comprising a valve head seatable in said exhaust port and shiftable axially away from said port by fluid pressure within said duct and a piston attached to said head for controlling the latter, a cylinder in which said piston is slidably disposed, passage means in said housing connecting said supply duct with said cylinder for applying fluid pressure to said piston in a direction tending to close said port against pressure in said duct, said piston having a greater area than said head for closing the latter when subjected to equal fluid pressure, a compression spring disposed within said cylinder

engaging said piston for urging said differential valve toward closed position, and a control valve in said passage means for relieving the pressure against said piston to permit said valve head to be forced away from said port by the fluid pressure in said duct, whereby the fluid is by-passed through said exhaust port and said check valve closes to prevent return flow from said ram, and a common control element for said control valve and said check valve, said element being shiftable to open both said control valve and said check valve to permit flow of fluid from said ram to said port.

5. Hydraulic mechanism comprising a fluid pressure motor and a control housing associated therewith having a fluid supply duct connected with said motor and an exhaust port communicating with said duct, a check valve in said duct between said port and said motor adapted to normally block the duct against flow of fluid away from said motor, a differential valve comprising a valve head seatable in said exhaust port and shiftable axially away from said port by fluid pressure within said duct and a piston for controlling said valve head, a cylinder in which said piston is slidably disposed, an inlet port in said cylinder through which fluid can be conducted for applying pressure to said piston in a direction tending to shift said valve head into closing relation with said exhaust port, said housing having a cylindrical passage communicating with said supply duct and having a valve port connected with said cylinder inlet port, a spool valve member slidable over said valve port to control fluid flow into said valve cylinder, said piston having a greater area than said valve head for biasing the latter toward closed position in said exhaust port when subjected to the pressure in said supply duct, and a common control element for said spool valve member and said check valve, shiftable in one direction to shift said spool valve member to open said valve port to pressure within said passage to actuate said differential valve to close said exhaust port and direct the fluid to said motor, said control element being shiftable in the opposite direction to slide said spool valve member over said valve port to block off fluid pressure thereto, said control element being shiftable further into engagement with said check valve to open the latter and exhaust fluid from said motor.

6. Hydraulic mechanism comprising a fluid pressure motor and a control housing associated therewith having a fluid supply duct connected with said motor and an exhaust port communicating with said duct, a check valve in said duct between said port and said motor adapted to normally block the duct against flow of fluid away from said motor, a differential valve comprising a valve head seatable in said exhaust port and shiftable axially away from said port by fluid pressure within said duct and a piston for controlling said valve head, a cylinder in which said piston is slidably disposed, an inlet port in said cylinder through which fluid can be conducted for applying pressure to said piston in a direction tending to shift said valve head into closing relation with said exhaust port, said housing having a cylindrical passage communicating at one end with said supply duct and having a discharge port at the other end thereof and an intermediate valve port connected with said cylinder inlet port, a valve plunger slidable in said cylindrical passage and having a spool valve member slidable over said valve port to selectively connect the latter with said supply duct or with said discharge port, said piston having a greater area than said valve head for biasing the latter toward closed position in said exhaust port when subjected to the pressure in said supply duct and means on said valve plunger engageable with said check valve to open the latter when said valve plunger is shifted to a position in which said valve port is connected with said discharge port.

7. Hydraulic mechanism comprising a fluid pressure motor and a control housing associated therewith having a fluid supply duct, an exhaust port in said duct and a passage connecting said supply duct with said motor, a differential valve comprising a valve head seatable in said exhaust port and shiftable axially away from said port by fluid pressure within said duct and a piston for controlling said valve head, a cylinder in which said piston is slidably disposed, an inlet port in said cylinder through which fluid can be conducted for applying pressure to said piston in a direction tending to shift said valve head into closing relation with said exhaust port, said housing having a cylindrical passage communicating at one end with said supply duct and having a discharge port at the other end thereof and an intermediate valve port connected with said cylinder inlet port, and valve member slidable in said cylindrical passage and having a spool valve member slidable over said valve port to selectively connect the latter with said supply duct or with said discharge port, said piston having a greater area than said valve head for biasing the latter toward closed position in said exhaust port when subjected to the pressure in said supply duct, and a check valve disposed in said motor connected passage for locking fluid in said motor, said valve member having a camming surface engageable with said check valve when said valve member is shifted to connect said valve port with said discharge port.

8. The combination set forth in claim 7, including the further provision of a manual control lever and mechanical means differentially connecting said lever, said fluid pressure motor, and said valve member, so constructed and arranged that said valve member can be actuated by said lever to connect said valve port with said supply duct, thereby closing said differential valve to block said exhaust port, diverting fluid to said motor to drive the latter, said motor acting through said differential connecting means to shift said valve member to connect said valve port with said discharge port, thereby opening said differential valve to stop said motor.

9. Hydraulic mechanism comprising a fluid pressure ram and a control housing associated therewith having a fluid supply duct connected with said ram and an exhaust port communicating with said duct, a check valve in said duct between said port and said ram adapted to normally prevent fluid from flowing through said duct from said ram, a differential valve in said housing controlling said port, a control valve member for controlling said differential valve, said valve member being shiftable into engagement with said check valve to open the latter, a manual control lever, a control beam, and link means connecting said control valve member, said control lever and said ram with said control beam, so constructed and arranged that said valve member can be actuated by said control lever to effect a movement of said ram, the latter acting through said beam to actuate said valve member

to stop said ram at a position determined by the position of said lever.

10. Hydraulic mechanism as set forth in claim 9, including the further provision of means for imposing fluid under equal pressure on said control valve member continuously in relatively opposite directions, said member having surfaces of slightly unequal area, against which said pressure is imposed, thereby biasing said valve member lightly in one direction to take up any looseness in connections of said link means.

11. Hydraulic mechanism comprising a fluid pressure ram, a fluid supply duct connected with said ram, said duct having an exhaust port, a check valve in said duct between said port and said ram adapted to normally block the duct against flow of fluid away from said ram, a differential valve comprising a valve head for closing said port and a piston for controlling said valve head, means defining a passage communicating with said supply duct for subjecting said piston to the pressure in said duct in opposition to the pressure against said valve head, said piston having a greater area than said valve head for biasing the latter toward closed position in said port when subjected to equal pressure, a control valve in said passage means for relieving the pressure against said piston to permit said valve head to be forced away from said port by the fluid pressure in said duct, whereby the fluid is bypassed through said exhaust port and said check valve closes to prevent return flow from said ram, a common control element for said control valve and said check valve, said element being shiftable in one direction to open both said control valve and said check valve to permit flow of fluid from said ram to said exhaust port, a manual control lever, a control beam, and link means connecting said element, said control lever and said ram with said control beam, so constructed and arranged that said common control element can be actuated by said control lever to effect a movement of said ram, the latter acting through said beam to actuate said element to stop said ram at a position determined by the position of said lever.

12. Hydraulic mechanism comprising a fluid pressure motor and a control housing associated therewith having a fluid supply duct connected with said motor and an exhaust port communicating with said duct, a check valve in said duct between said port and said motor adapted to normally block the duct against flow of fluid away from said motor, a differential valve comprising a valve head seatable in said exhaust port and shiftable axially away from said port by fluid pressure within said duct and a piston for controlling said valve head, a cylinder in which said piston is slidably disposed, an inlet port in said cylinder through which fluid can be conducted for applying pressure to said piston in a direction tending to shift said valve head into closing relation with said exhaust port, said housing having a cylindrical passage communicating with said supply duct and having a valve port connected with said cylinder inlet port, a spool valve member slidable over said valve port to control fluid flow into said valve cylinder, said piston having a greater area than said valve head for biasing the latter toward closed position in said exhaust port when subjected to the pressure in said supply duct, and a common control element for said spool valve member and said check valve, shiftable in one direction to shift said spool valve member to open said valve port to pressure within said passage to actuate said differential valve to close said exhaust port and direct the fluid to said motor, said control element being shiftable in the opposite direction to slide said spool valve member over said valve port to block off fluid pressure thereto, said control element being shiftable further into engagement with said check valve to open the latter and exhaust fluid from said motor, a manual control lever, a control beam, and link means connecting said common control element, said lever and said motor with said control beam, so constructed and arranged that said common control element can be actuated by said control lever to effect a movement of said motor, the latter acting through said beam to actuate said element to stop said motor at a position determined by the position of said lever.

13. Hydraulic mechanism comprising a fluid presssure motor and a control housing associated therewith having a fluid supply duct connected with said motor and an exhaust port communicating with said duct, a check valve in said duct between said port and said motor adapted to normally block the duct against flow of fluid away from said motor, a differential valve comprising a valve head seatable in said exhaust port and shiftable axially away from said port by fluid pressure within said duct and a piston for controlling said valve head, a cylinder in which said piston is slidably disposed, an inlet port in said cylinder through which fluid can be conducted for applying pressure to said piston in a direction tending to shift said valve head into closing relation with said exhaust port, said housing having a cylindrical passage communicating at one end with said supply duct and having a discharge port at the other end thereof and an intermediate valve port connected with said cylinder inlet port, a valve plunger slidable in said cylindrical passage and having a spool valve member slidable over said valve port to selectively connect the latter with said supply duct or with said discharge port, said piston having a greater area than said valve head for biasing the latter toward closed position in said exhaust port when subjected to the pressure in said supply duct, means on said valve plunger engageable with said check valve to open the latter when said valve plunger is shifted to a position in which said valve port is connected with said discharge port, a manual control lever, a control beam, and link means connecting said plunger, said lever, and said motor with said control beam, so constructed and arranged that said plunger can be actuated by said control lever to effect a movement of said motor in either direction, said motor acting through said beam to actuate said plunger to stop said motor at a position determined by the position of said lever.

14. Hydraulic mechanism as set forth in claim 13, including the further provision that said plunger is provided with a piston portion spaced from said spool member and having a reduced diameter portion therebetween extending across the opening to said supply duct, said spool member and said piston portion having slightly unequal opposed areas subjected to the pressure in said supply duct to lightly bias said plunger in one direction to take up any looseness in connections of said link means.

15. In fluid-pressure apparatus having a source of fluid-pressure supply and a fluid-pressure-receiving device: control means comprising means providing a fluid-pressure-transmitting duct having an inlet port for connection to the source of fluid-pressure and an outlet port for connection

to the fluid-pressure-receiving device; means providing an exhaust port communicating with said duct intermediate the inlet and outlet ports thereof to enable a portion of the duct to accommodate return of fluid pressure from the fluid-pressure-receiving device; means including a check valve normally effective to close the duct between the exhaust and outlet ports against the return of fluid pressure from the fluid-pressure-receiving device; differential valve means cooperative with the exhaust port to control opening and closing thereof; and a positionable control member for controlling the differential valve means and cooperative with the check valve to open said check valve.

16. In fluid-pressure apparatus having a source of fluid-pressure supply and a fluid-pressure-receiving device: control means comprising means providing a fluid-pressure-transmitting duct having an inlet port for connection to the source of fluid-pressure supply and an outlet port for connection to the fluid-pressure-receiving device; means providing an exhaust port communicating with said duct intermediate the inlet and outlet ports thereof to enable a portion of the duct to accommodate return of fluid pressure from the fluid-pressure-receiving device; means including a check valve normally effective to close the duct between the exhaust and outlet ports against the return of fluid pressure from the fluid-pressure-receiving device; means for opening and closing the exhaust port, including a positionable differential valve having a pair of fluid-pressure-receiving areas, one of which is greater than the other, and passage means connected between said differential valve and the duct for subjecting said areas to equal fluid pressure from

said duct, said differential valve being thereby biased to exhaust-port-closing position; a control valve cooperative with said passage means for relieving fluid pressure on the greater area portion of the differential valve so that fluid pressure on the smaller area causes the differential valve to effect opening of the exhaust port and fluid pressure carried by the duct from the inlet port is by-passed through the exhaust port while the aforesaid check valve means is closed; and a common control element cooperative with both the control valve and the check valve means and positionable to effect opening of the check valve means and pressure-relieving action of the control valve on the differential valve to effect return of fluid pressure through the duct from the fluid-pressure-receiving device to the opened exhaust port.

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