April 25, 1950 F. T. COURT 2,505,527

VALVE CONTROL MECHANISM FOR HYDRAULIC CIRCUIT

Original Filed Nov. 9, 1945 3 Sheets-Sheet 1

FIG. 2

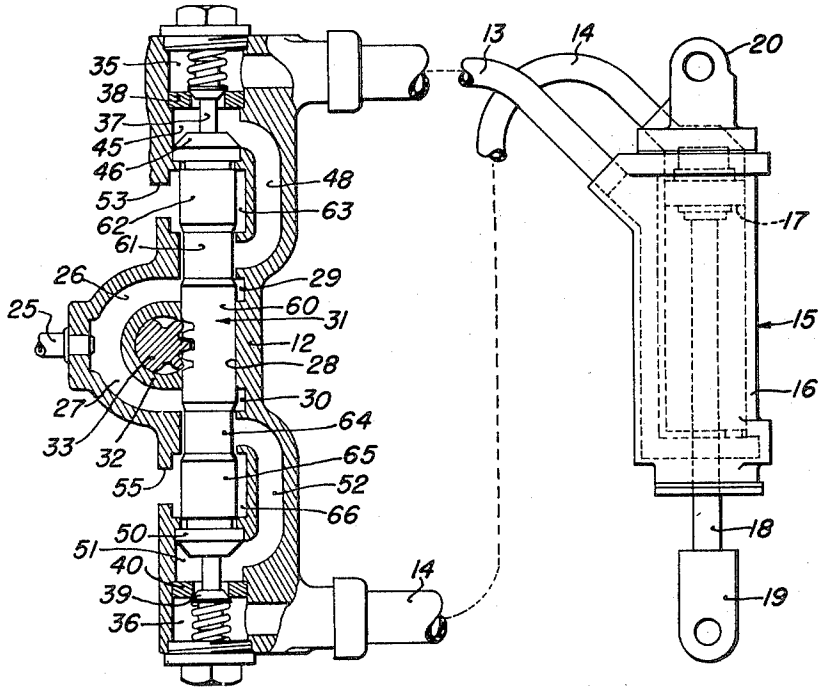
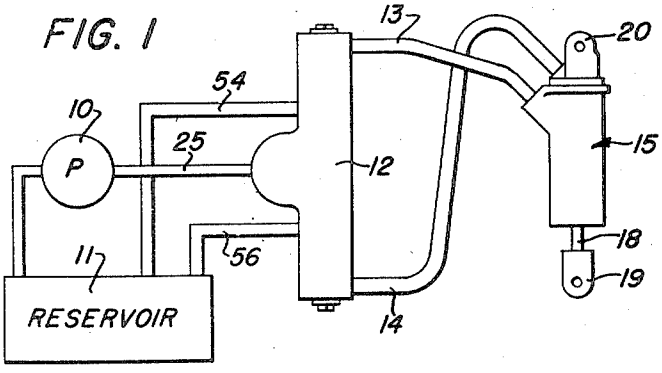


FIG. 1



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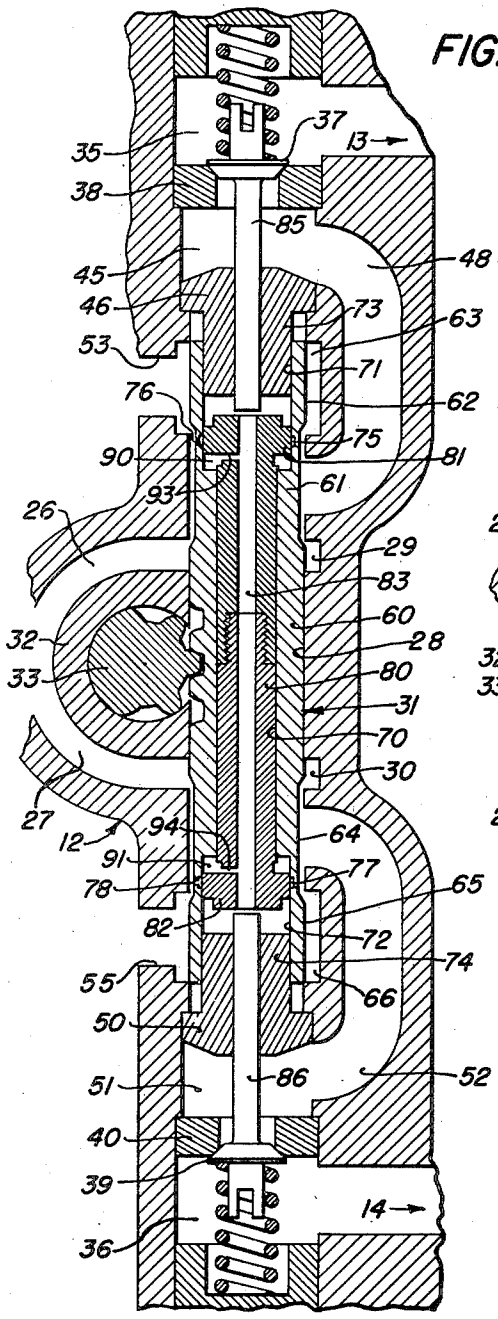
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VALVE CONTROL MECHANISM FOR HYDRAULIC CIRCUIT

Original Filed Nov. 9, 1945 3 Sheets-Sheet 2

FIG. 4



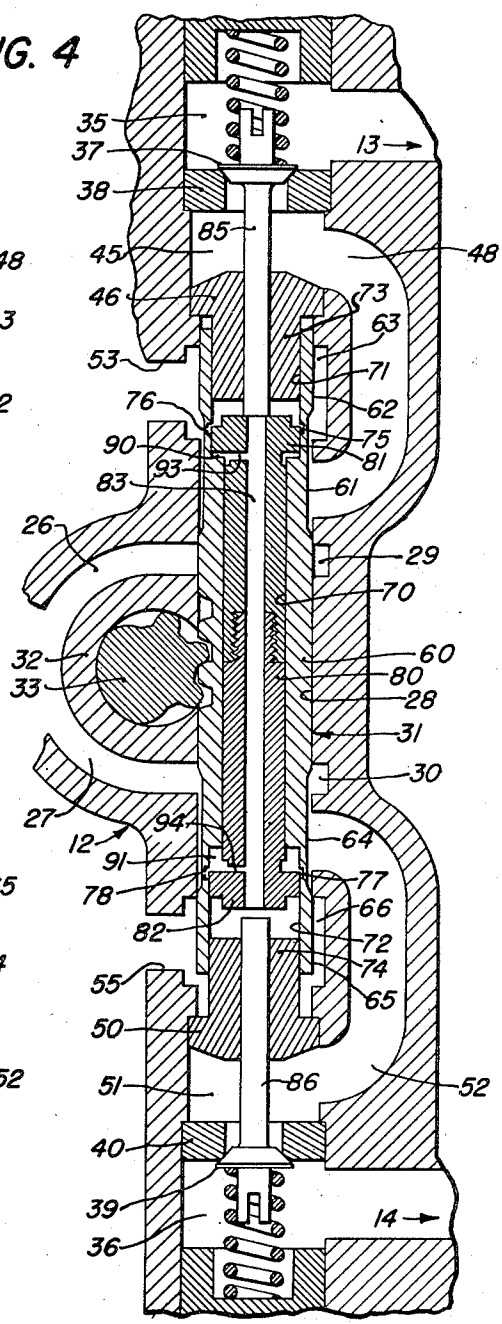


FIG. 3

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April 25, 1950 F. T. COURT 2,505,527

VALVE CONTROL MECHANISM FOR HYDRAULIC CIRCUIT

Original Filed Nov. 9, 1945 3 Sheets-Sheet 3

FIG. 6

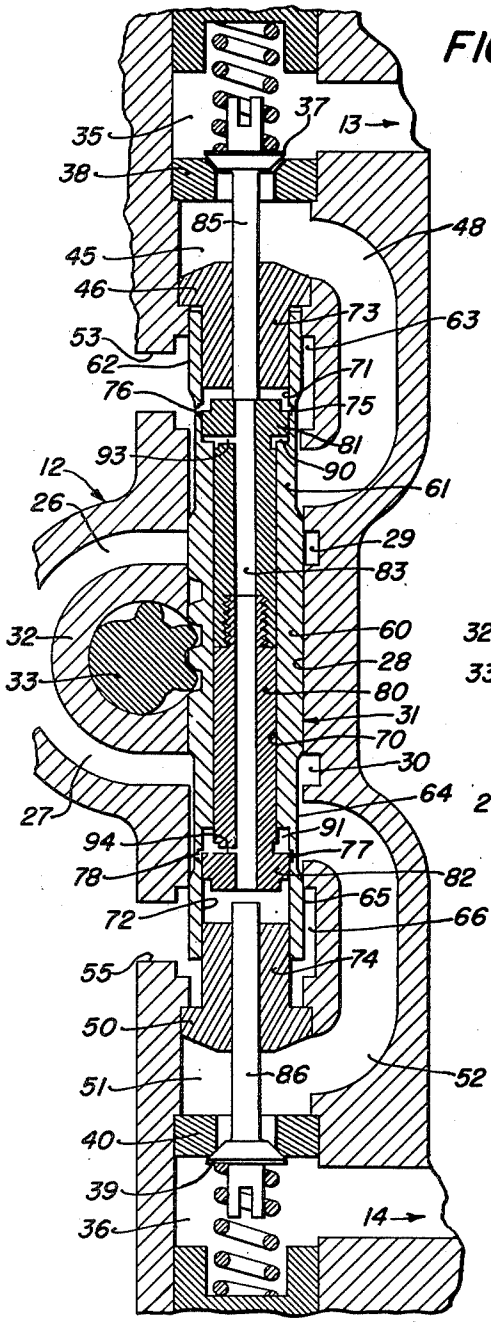
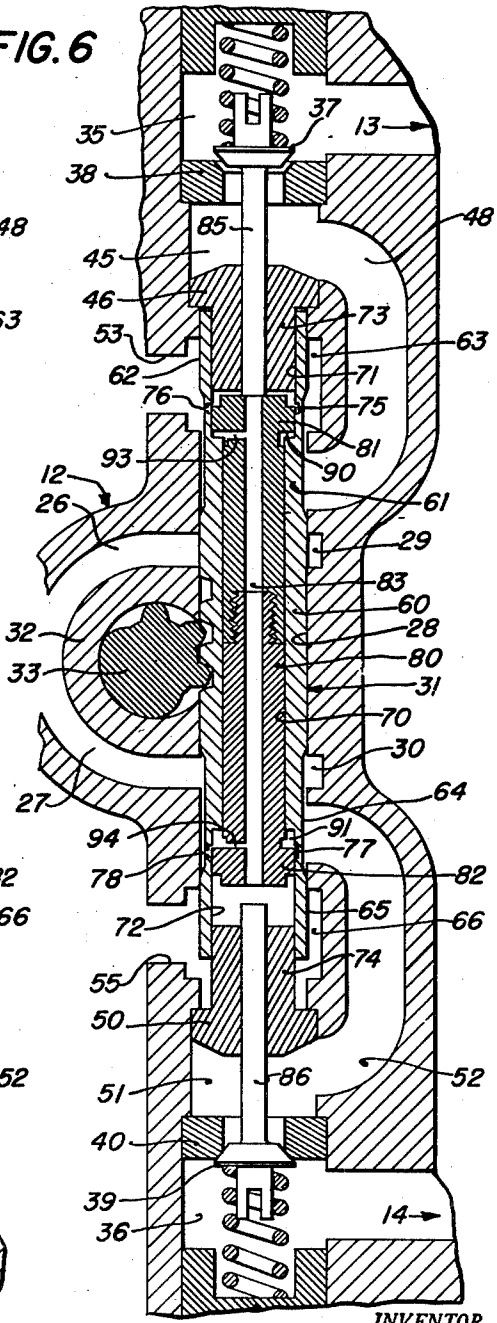


FIG. 5



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Patented Apr. 25, 1950

2,505,527

UNITED STATES PATENT OFFICE

2,505,527

VALVE CONTROL MECHANISM FOR HYDRAULIC CIRCUIT

Frank T. Court, deceased, late of Moline, Ill., by Virginia F. Court, executrix, Rock Island, Ill., assignor to Deere & Company, Moline, Ill., a corporation of Illinois

Original application November 9, 1945, Serial No. 627,681. Divided and this application November 10, 1947, Serial No. 785,023

11 Claims. (Cl. 121—46.5)

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The present application is a division of the co-pending application, Serial No. 627,681, filed November 9, 1945, and the invention herein relates generally to hydraulic power control mechanism and has for its principal object the provision of a novel and improved hydraulic mechanism, which is more sensitively and more accurately controlled than similar mechanisms heretofore known to those skilled in the art, and yet which is simple and inexpensive to manufacture and strong and durable in operation.

Under certain operating conditions, such as when adjusting the operating position of a tractor mounted implement, it is desirable to have the hydraulic motor operate slowly in order to facilitate an accurate adjustment of the implement, but under other conditions, such as when raising the implement to a transport position, it is desirable to have the hydraulic mechanism operate as quickly as possible. Another object of the present invention, therefore, relates to the provision of means for controlling the speed of response of the hydraulic motor.

Still another object relates to the provision of a novel and improved hydraulic control valve, which provides for a more accurate and positive adjustment of the load by the hydraulic motor. In the operation of a hydraulic power transmitting system, air, oil vapor, and other gases frequently become trapped in the hydraulic circuit, which introduces a certain amount of resiliency in the circuit which prevents the hydraulic motor from holding the load rigidly in adjusted position, but rather allows a certain amount of movement of the load to the extent to which the entrapped air may be compressed. In the accomplishment of this object, the valve is so designed that as the valve is shifted to stop the motor, the return duct from the motor is closed off shortly before the pressure is relieved from the motor, whereby pressure is built up in the motor circuit which is maintained after the motor has stopped and thus holds under considerable pressure any trapped gases, thereby eliminating substantially all of the resiliency within the hydraulic circuit. As to this feature, the present invention is an improvement over an invention disclosed in a co-pending application, Serial No. 561,433, filed November 1, 1944, and issued as Patent No. 2,482,249 on September 20, 1949. This feature applies to a hydraulic motor in the form of a double acting cylinder, in which pressure can be applied to either side of the piston, selectively. When starting the motor, the pressure is applied to one side of the piston an instant before the

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fluid is released from the other side of the piston, thereby maintaining a considerable pressure in the cylinder.

Still a further object of the present invention relates to the provision of novel and improved means for actuating the hydraulic control mechanism by fluid pressure in order to relieve the operator from operating certain unbalanced valves against the pressure of the piston. More particularly, the double acting cylinder is provided with a pair of check valves in the two duct connections thereto, respectively, and provision is made for applying pressure to one side of the piston and then opening the check valve on the other side of the piston to relieve the pressure therein. It is an object of this invention to provide hydraulic control means for opening the last named check valve against the pressure which tends to hold it shut. A more specific object has to do with the provision of a follow-up control for the check valve operating mechanism, which provides for incremental movement of the check valve responsive to a corresponding increment of movement of the manually controlled control lever. In the accomplishment of this object, a piston is provided which engages the end of the check valve stem, the piston head being larger in area than the check valve, so that when the same pressure is applied to both the piston and the check valve, the unbalance in total pressures will open the check valve.

The foregoing and other important objects and desirable features inherent in and encompassed by the present invention will become apparent from the following detailed description, taken in conjunction with the accompanying sheets of drawings wherein there is shown, by way of example, a preferred form of the invention.

In the drawings:

Figure 1 is a diagrammatic view of the hydraulic circuit;

Figure 2 is an enlarged sectional view of the control valve shown as associated with a double acting cylinder; and

Figures 3, 4, 5 and 6 are enlarged sectional views showing the valve components in various stages of operation.

The preferred form of hydraulic circuit shown schematically in Figure 1 is taken from the type of system that has met with large success in use in agricultural tractors for the purpose of adjusting implements carried by or connected to the tractor. The illustration is, of course, by no means to be taken as limiting the scope of the basic principles involved in the present invention.

There is shown in Figure 1 a pump 10 which is associated with a fluid supply reservoir 11 for the purpose of supplying fluid under pressure to a control valve, indicated generally by the numeral 12. The control valve has at opposite ends thereof fluid conduit connections to fluid lines 13 and 14, the latter being appropriately connected to a piston and cylinder assembly designated generally by the numeral 15. As illustrated in Figure 2, the fluid line 13 is connected in fluid-carrying relationship with the lower end of the cylinder, numbered 16, and the fluid line 14 is similarly associated with the upper end of the cylinder 16. The fluid motor 15, or piston and cylinder assembly, is thus of the double acting type wherein fluid is supplied at either end and exhausted from the opposite ends, the fluid lines 13 and 14 alternately assuming the dual role of supplying fluid or of carrying exhausted fluid. The piston is designated by the numeral 17 and is shown as including a piston rod 18 to one end of which is connected a clevis 19. The closed end of the cylinder 16 is provided with a clevis 20 very similar to the clevis 19. The clevises 19 and 20 provide connecting points for mounting the cylinder and piston assembly 15 in place on an implement, for example, for the purpose of adjusting an implement part.

For the purpose of accomplishing the objects of the invention as set forth above, and other objects and features that will occur to those skilled in the art as the description progresses, there is connected between the pump 10 and valve control assembly 12 a high pressure conduit 25 which enters the control valve housing at a central portion thereof and which is divided into two streams by means of passages 26 and 27 in communication with a cylindrical bore 28 formed in the valve housing. The passages 26 and 27 are formed respectively with continuations 29 and 30 that encircle the bore 28 and a reciprocable piston valve 31 carried therein.

An interior portion of the housing 12 around which the high pressure fluid is divided provides a bearing 32 for a rotatable toothed control member 33. The teeth on the member 33 mesh with complementary teeth formed on the reciprocable valve 31 so that rotation of the former will shift the latter axially in either of two directions. The member 33 may be ultimately controlled by means of the control system shown in the first mentioned co-pending application referred to above.

For the purpose of clarity and brevity in description, it will be assumed that the valve control housing occupies the position illustrated in the drawing and reference will be had to opposite ends thereof as upper and lower; although, it is obvious that the structure may assume any of several forms and positions. The upper end of the valve housing is provided with a chamber 35 in constant communication with the fluid line 13 and at times communicable with either the high or low pressure side of the valve housing. The lower portion of the valve housing is provided with a similar chamber 36 in constant communication with the fluid line 14 and at times communicable with the high or low pressure side of the valve. In the neutral position of the valve 31, as shown in Figure 2, the chamber 35 is closed against communication with either the high or the low pressure side of the circuit by means of a check valve 37 spring loaded into seating position on a seat insert 38 provided in the proximate end of the cylindrical bore 28. A spring loaded check valve 39 cooperates with a seat insert 40 at the other end of the cylindrical bore 28 to seal the lower chamber 36 off from either the high or low pressure side of the circuit. The valve seat insert 38 at the upper end of the valve assembly separates the chamber 35 from an adjacent chamber 45 provided as part of the cylindrical bore 28. The bore 28 at this point carries a guide 46 which is drilled axially to provide a bearing for the stem of the check valve 37. A fluid passage 48 extends a short distance parallel to the axis of the bore 28 and serves to establish communication between the chamber 45 and the fluid supply passage 29.

The opposite end of the valve assembly is similarly constructed and the bore 28 is provided with a guide 50 which is drilled axially to provide a bearing for the stem of the check valve 39, and at the same time establishing a chamber 51 next adjacent to the lower chamber 36. A passage 52, similar in form to the passage 48 previously described, connects the chamber 51 with the fluid supply passage 30.

The valve assembly 12 is provided at a portion thereof intermediate the control member 33 and the upper chamber 45 with an opening providing a spill or exhaust port 53 in communication via a fluid line 54 with the reservoir 11. The valve assembly is provided symmetrically with a second exhaust or spill port 55 in communication through a fluid line 56 with the reservoir. In the neutral position of the valve 31, as shown in Figures 2 and 3, the high pressure passages 26 and 27 are in constant communication respectively with the spill ports 53 and 55, and the pump 10 will operate with no appreciable pressure, since no fluid will be either delivered to or received from the fluid motor or piston and cylinder assembly 15.

The following description will pertain to the outer construction and appearance of the shiftable valve 31 and no reference for the time being will be made to the interior construction thereof. That portion of the valve 31 intermediate its ends is provided as a spool 60 that slidably fits the bore 28. The spool 60 tapers at its upper end into a reduced cylindrical portion 61 of the valve which, in the neutral position of the valve, is in line with the lower end of the passage 48. The next adjacent portion of the valve 31 is provided as a spool 62 which has substantially the same diameter as the spool portion 60. The spool portion 62 is, in the neutral position of the valve 31, in substantial alignment with the upper spill port 53 and the valve housing is provided at this portion with a spill chamber 63 in communication with the port 53. The opposite ends of the valve 31 are symmetrical and the lower end thereof is provided with a reduced portion 64 and an adjacent spool 65. In the neutral position of the valve 31 the spool portion 65 is within a chamber 66 opening to the spill port 55, and the reduced portion 64 is at the upper end of the fluid passage 52. Further, in the neutral position of the valve 31, as shown in Figures 2 and 3, the reduced portions 61 and 64 respectively connect the fluid pressure passages 26 and 27 with the spill ports 53 and 55, communication being established past the reduced portions 61 and 64; and, although fluid may enter the passages 48 and 52, the fluid will not escape through the chambers 35 and 36 since these chambers are closed by the check valves 37 and 39, respectively.

Construction of the valve 31 is illustrated in Figures 3 to 6. Figure 3 shows the valve and its associated parts in neutral position and in

that respect corresponds to Figure 2. The valve body is provided with an axial bore 70 opening at its opposite ends into counterbores 71 and 72, respectively. The counterbores respectively receive reduced cylindrical portions 73 and 74 formed on the bearing guides 46 and 50, respectively. The interior portion of the counterbore 71 adjacent its junction with the bore 70 is provided with an annular recess 75 which communicates through a radial port 76 with the main bore 28 of the valve assembly 12. The port 76 is located substantially at the junction between the reduced portion 61 and the spool portion 62 of the valve 31. The counterbore 72 in the opposite end of the valve body 31 is provided with a similar annular recess 77 which communicates through a radial port 78 with the valve bore 28.

The axial bore 70 in the valve body 31 carries for axial shifting with respect to the valve 31 a plunger 80 provided at its opposite ends with enlarged head portions 81 and 82, respectively, the heads being received in the counterbores 71 and 72, respectively, and providing pistons cooperable with the annular recesses and ports 75—76 and 77—78, respectively. The plunger 80 is drilled axially at 83 to provide fluid communication between opposite ends of the plunger.

The check valve 37 includes a stem 85 which, as aforesaid, is carried in the bearing guide 46 and extends therethrough in proximity to the end of the plunger 80, the stem 85 having a diameter slightly larger than the diameter of the bore 81 in the plunger. In the neutral or balanced position of the parts, as shown in Figure 3, the end of the stem 85 is slightly spaced away from the proximate end of bore 83. The check valve 39 similarly includes a stem 86 associated with the lower end of the bore 83 in the same manner as the stem 85 is associated with the upper end of the bore.

When the valve parts are in their neutral positions, as shown in Figure 3, the inner faces of the heads 81 and 82 on the plunger 80 are spaced axially respectively from the junctions of the counterbores 71 and 72 with the axial bore 70 of the valve 31, thus providing respectively, a pair of chambers 90 and 91. The axial bore 83 in the plunger 80 opens to the space or chamber 90 by means of a radial port 93; and the bore 83 opens to the space or chamber 91 by means of a radial bore or port 94.

The foregoing completes the description of the operating parts of the hydraulic circuit and the improved valve control means therefor. For the sake of clarifying the description of the structure and operation of the valve assembly, certain details have been omitted as being merely mechanical expedients well known to those skilled in the art. To this end, then, there have been disregarded various seals, auxiliary cored passages and drilled passages and refinements of assembly, the illustration of which would unduly complicate the disclosure of the basic principles of the invention.

The operation of the hydraulic circuit depends, of course, upon the controlling influences applied to the valve control member 33, in response to which the valve member 31 is shifted axially in the selected direction. In addition, the plunger 80 within the valve body 31 moves automatically in response to the application of fluid pressure for the purpose of accomplishing opening of the selected check valve 37 or 39. When the valve parts are in their neutral position shown in Figures 2 and 3, fluid supplied from the high

pressure line 25 to the passages 26 and 27 is exhausted back to the reservoir through the spill ports 53 and 55. The piston or head portions 81 and 82 on the plunger 80 respectively close off the ports 76 and 78 and there is thus no admission of fluid under pressure to the bore or passage 83 in the plunger. In short, the parts are static and the fluid circuit is inactive, except in so far as either of the check valves 37 or 39 retains pressure in either of the lines 13 and 14, depending upon the position of the piston 17 in the cylinder 16.

Figure 4 shows the positions of the parts after the valve control member 33 has been rocked slightly in a counterclockwise direction to raise the valve body 31 slightly upwardly. When the valve 31 moves upwardly to the position shown, the central spool portion 60 thereof intersects the passage 26—29 and closes this passage off from the central bore 28. At the same time the reduced portion 64 at the other end of the valve 31 is of sufficient length to retain its function of establishing fluid connections between the passage 27—30 and the passage 52 extending toward the bottom of the valve assembly 12, thus directing fluid under pressure against the inner face of the lower check valve 39. Simultaneously, the enlarged spool portion 65 at the lower end of the shiftable valve 31 closes the point of communication between the bore 28 and the exhaust chamber 66, thus preventing any exhaust of fluid through the spill port 55 back to the reservoir 11. The pressure of fluid will, of course, open the check valve 39 and the fluid will flow thence through the fluid line 14 to the upper end of the fluid motor 15 for the purpose of forcing the piston 17 downwardly therein.

As the piston 17 moves downwardly in the cylinder 16, it will compress the fluid therein and the fluid in the line 13, the latter communicating with the chamber 35 in which is positioned the check valve 37. However, the check valve 37 remains closed temporarily and the pressure in this portion of the circuit is built up. The purpose of this arrangement is to provide for the compression of any air, gas or vapor in the cylinder 16, and thus to eliminate resiliency in the circuit.

The pressure thus built up is of a considerable value and is, of course, applied to the outer side of the check valve 37. Therefore, it is necessary to overcome this pressure in order that the check valve 37 can be opened to permit operation of the fluid motor 15. According to the present invention, the opening of the check valve 37 is accomplished hydraulically to relieve the operator of the necessity for the application of the considerable effort required to open the check valve against the pressure built up in the line 13. This result is accomplished as set forth below:

When the valve 31 is moved upwardly from the position shown in Figure 3 to that shown in Figure 4, it carries with it the piston or plunger 80, because of friction between the parts, until the upper end of the latter engages the inner end of the stem 85 of the check valve 37. When the parts are in these positions, relative movement between the piston 80 and valve 31 caused by engagement of the former with the stem 85 of the check valve 37 effects uncovering of the port 78 by the lower head 82 of the piston or plunger 80; and oil under pressure now flows through the port 78 and through the port 94 of the piston or plunger 80 and thence into the interior bore 83 of the latter, finding its way into the chamber between the head 82 and extension 74 on the

lower check valve guide 50 within the counterbore 72 at the lower end of the valve 31. The pressure on the bottom of the head 82 in the chamber just defined is now equal to the pressure of the fluid on the check valve 37; however, the area of the end of the head 82 is appreciably larger than the area of the head of the check valve 37, and therefore the total pressure against the piston or plunger 80 tending to open the check valve 37 is greater than pressure resisting the opening of the check valve, with the result that the piston or plunger 80 and check valve 37 begin to move upwardly. The fluid does not run out of the upper end of the inner bore 83 of the plunger 80, for the reason that the inner end of the stem 85 of the check valve 37 closes the upper end of the bore 83 and thus prevents passage of oil therethrough. At the same time, the port 76 in the valve member 31 is not opened by the upper head 81 of the plunger 80 and there is no communication therewith through the port 93. That is to say, the port 76 is closed off from communication to the central bore 83 of the plunger 80; on the other hand, the port 76 is open to the chamber within the counterbore 71 and defined by the upper end of the piston head 81 and the inner end of the cylindrical portion 73 on the upper check valve guide 46, thus eliminating hydraulic lock in the chamber just referred to.

As the piston or plunger 80 and check valve 37 move upwardly the inner edge of the lower piston head 82 cuts off the fluid flow to the annular port 78, thereby stopping the opening movement of the upper check valve 37. The valve parts are now in the position illustrated in Figure 5, with the annular port 78 closed and the check valve 37 cracked open. Hence, it is evident that the check valve 37 can be opened in as small increments of movement as desired, which are controlled by the increments of movement of the valve control member 33 which, as aforesaid, may be under the manual control of the operator. Since the entire pressure necessary to open the check valve 37 acts against the lower head 82 of the piston or plunger 80 and reacts against the inner end of the housing portion in the vicinity of the check valve 39 and surrounding the chamber 36, there is substantially no effort required by the operator to open the valve 37. As the operator continues, by means of the control member 33, to move the valve plunger 31 upwardly, the piston or plunger 80 is moved upwardly to raise the check valve 37 whenever the lower annular port 78 is uncovered by the lower piston head 82 to permit fluid to flow through the port 94 in the piston or plunger 80; but as soon as the piston head 82 covers the annular port 78, the upward movement stops.

Of course, as soon as the check valve 37 cracks open, the pressure on the head of the valve is relieved so that the last part of the opening movement will require very little fluid pressure. Figure 6 shows the various parts of the valve in position just before the check valve is completely open. The plunger 31 has been moved to its final position, while the piston or plunger 80 is just moving upwardly to close off the annular port 78 to stop the movement of the valve 37 at its wide open position.

Since the valve construction and the parts thereof are symmetrical, shifting of the valve piston 31 downwardly to accomplish movement of the piston 16 in the opposite direction, will be accompanied by similar results in reverse order; that is, the piston or plunger 80 will operate to open the lower check valve 39 to admit fluid from the fluid line 14.

When the valve plunger 31 is moved downwardly from the position of Figure 6 to the neutral position of Figure 3, for the purpose of stopping the fluid motor 15, the check valve 37 closes slightly before fluid pressure is cut off from the passage 52 to the chamber 36 and fluid line 14, whereby pressure is built up in the motor circuit which is maintained after the motor has stopped and thus holds under considerable pressure any trapped gases, thereby eliminating substantially all of the resiliency within the hydraulic circuit.

The foregoing illustrates and describes the exemplary features of the invention as achieved in a preferred form thereof. The assembly is compact and easy to manufacture and occupies little space in connection with the hydraulic circuit and the fluid supply pump, which is of particular importance in the use of hydraulic controls with agricultural tractors and implements. Other features and advantages of the invention will undoubtedly occur to those skilled in the art, as will likewise many modifications and alterations of the preferred form of construction set forth. It is, therefore, not intended to limit the scope of the invention by the detail structure illustrated and described.

What I claim as the invention of said Frank T. Court, deceased, and desire to secure by Letters Patent is:

1. In hydraulic mechanism, a control valve assembly for controlling a fluid pressure motor, said valve comprising a valve cylinder having inlet and exhaust ports and a port adapted to be connected with said motor, a valve plunger slidable in said cylinder and having portions for directing fluid from said inlet port to said exhaust port or said motor port, selectively, and an axially extending passage within said plunger, a check valve in one end of said cylinder and connected in series with said motor port for blocking return of fluid from the motor, and means for opening said check valve against pressure comprising a piston slidable in said passage and having one end engageable with said check valve, said plunger having valve means for admitting fluid under pressure to the other end of said piston to force the latter to open said check valve.

2. In hydraulic mechanism, a control valve assembly for controlling a fluid pressure motor, said valve comprising a valve cylinder having inlet and exhaust ports and a motor supply port, a valve plunger slidable in said cylinder and having portions for directing fluid from said inlet port to said exhaust port or said motor port, selectively, and an axially extending passage therein, closure means at opposite ends of said passage, respectively, a valve seat in one end of said cylinder having a duct connection with said motor port, a poppet type check valve in said seat having a stem extending through an aperture in said closure means, and means for opening said check valve against pressure thereon comprising a piston slidable in said passage and engageable with said valve stem, said plunger having valve means for admitting fluid under pressure to the other end of said piston to force the latter to open said check valve.

3. The combination set forth in claim 2 including the further provision that said last named valve means comprises a port in said plunger through which fluid is admitted, and a cut-off edge on said piston normally disposed adjacent said port for blocking the admission of fluid to said passage after said piston has been shifted a

predetermined amount, said port being again opened by movement of said plunger relative to said piston.

4. In hydraulic mechanism, a control valve assembly comprising a valve cylinder having spaced inlet and exhaust ports, and a pair of motor supply ports, a valve plunger slidable in said cylinder and having portions for directing fluid from said inlet port to said exhaust port or to one of said motor supply ports, selectively, and an axially extending passage therein, closure means at opposite ends of said passage, respectively, a pair of valve seats in the ends of said cylinder, respectively, connected by duct means with said motor supply ports, respectively, poppet type check valves in said seats having stems extending through apertures in said closure means, respectively, and means for opening either of said check valves against pressure thereon comprising a piston slidable in said passage and engageable with said valve stems, selectively, said plunger having valve means adjacent each end of said piston for admitting fluid to said passage responsive to relative movement of said plunger and said piston therein, for forcing the latter against either of said valve stems to open the respective valve.

5. In hydraulic mechanism, a control valve assembly comprising a valve cylinder having spaced inlet and exhaust ports, and a pair of motor supply ports, a valve plunger slidable in said cylinder and having portions for directing fluid from said inlet port to said exhaust port or to one of said motor supply ports, selectively, and an axially extending passage therein, closure means at opposite ends of said passage, respectively, a pair of valve seats in the ends of said cylinder, respectively, connected by duct means with said motor supply ports, respectively, poppet type check valves in said seats having stems extending through apertures in said closure means, respectively, and means for opening either of said check valves against pressure thereon comprising a piston slidable in said passage and engageable with said valve stems, selectively, and having an axial bore adapted to be closed by the end of the valve stem engaged by said piston, said valve plunger and said piston having ports adapted to be moved into register by movement of said plunger to shift said piston in either direction into engagement with one of said valve stems, thereby admitting fluid under pressure through said bore to the end of the piston opposite the engaged check valve to force the latter open, movement of said piston being effective to shift said ports in said plunger and said piston out of register, thus providing for incremental movement of said piston and engaged valve responsive to corresponding increments of movement of said plunger.

6. In hydraulic mechanism, a control valve assembly for controlling a double acting fluid pressure motor, comprising in combination, a valve cylinder having a pair of spaced motor supply ports and inlet and exhaust ports on opposite sides of each of said motor supply ports, respectively, a manually controlled valve plunger slidable in said cylinder and having portions connecting said inlet and exhaust ports when said plunger is in an intermediate inactive position, said plunger being shiftable in either direction to cut off said inlet ports from said exhaust ports and to connect one of said motor supply ports to an inlet port and the other of said motor supply ports to an exhaust port, an apertured closure in each end of said cylinder, a valve seat around each aperture, duct connections between said valve seats and said motor supply ports, respectively, a poppet type check valve seated in each of said seats and having a stem extending into said cylinder and into the end of said plunger, the latter having an axially extending passage therethrough, a closure in each end of said passage apertured to receive the stem of the adjacent check valve, and means for opening either of said check valves against pressure thereon comprising a piston slidable in said passage and engageable with said valve stems and having an axial bore adapted to be closed by the end of either of said valve stems during engagement therewith, said plunger and said piston having cooperative ports adapted to be moved into register by movement of said plunger to shift said piston into engagement with one of said valve stems, thereby admitting fluid under pressure through said bore to the end of the piston opposite the engaged check valve to force the latter open, movement of said piston being effective to shift said ports in said plunger and said piston out of register, thus providing for incremental movement of said piston and engaged check valve responsive to corresponding increments of movement of said valve plunger.

7. In a hydraulic system, an unbalanced type valve adapted to be subjected to an appreciable higher fluid pressure on one side than on the other and hydraulically actuated means for moving said valve against the higher pressure comprising a sleeve member, a piston member slidable therein and engageable with one end of said valve, closure means for the opposite end of said sleeve, said sleeve having a port for admitting fluid under pressure to the closed end thereof to force said piston to open said valve, means on said piston movable therewith into blocking relation with said port to cut off the admission of fluid therethrough, and control means for shifting said sleeve to open said port.

8. In a hydraulic system, a pair of poppet valve check valves disposed in coaxial arrangement with stems extending toward each other, and means for selectively opening said valves against hydraulic pressure comprising, in combination, a sleeve disposed between said valves and coaxial therewith, a piston slidable axially within said sleeve into engagement with either of said stems and having an axially extending bore therein, adapted to be closed by the end of either of said stems when engaged thereby, a closure at each end of said sleeve apertured to slidably receive the associated valve stem, said sleeve having ports near each end thereof for admitting fluid under pressure to force said piston to open either of said valves, selectively, means on said piston movable therewith into blocking relation with each port to cut off admission of fluid, and control means for shifting said sleeve in either direction to open said ports, respectively, said piston having heads at opposite ends, respectively, of greater area than said check valves, whereby when the same fluid pressure is applied to one of said heads and to the corresponding check valve to be opened thereby, the total pressure against said piston is greater than the total pressure against the valve, effecting an opening of the latter.

9. In hydraulic mechanism, a control valve assembly for controlling a fluid pressure motor, said valve comprising a valve chamber having inlet and exhaust ports and a port adapted to be connected with said motor, a valve member mov-

able in said cylinder and having portions for directing fluid from said inlet port to said exhaust port or said motor port, selectively, and a passage within said member, a check valve in said valve chamber and connected in series with said motor port for blocking return of fluid from the motor, and means for opening said check valve against pressure comprising an element movable in said passage of said valve member and having a portion engageable with said check valve, said valve member having secondary valve means for admitting fluid under pressure to said element to force said element to open said check valve.

10. In a hydraulic mechanism having a fluid motor, means for supplying fluid under pressure to the motor, and means for receiving fluid exhausted by the motor: valve control mechanism, comprising a check valve normally closing the fluid supply means; a check valve normally closing the fluid exhaust means; and control means including a pair of relatively movable members and means providing an expansible chamber between said members, one of said members being constructed and arranged to first admit fluid under pressure to the supply check valve and to the expansible chamber, and said other member being constructed and arranged to be moved by said fluid pressure to subsequently open the exhaust check valve.

11. In a hydraulic mechanism having a fluid motor, means for supplying fluid under pressure to the motor, and means for receiving fluid exhausted by the motor: valve control mechanism, comprising a valve normally closing the fluid supply means; a valve normally closing the fluid exhaust means; and a movable control element including a first part for first opening the supply valve, a second part engageable with the exhaust valve, and lost-motion means interconnecting said parts for delaying effectiveness of the second part for opening the exhaust check valve subsequent to opening of the supply valve.

VIRGINIA F. COURT,
Executrix of the Estate of Frank T. Court, Deceased.

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