HYDRAULIC RAM AND CONTROL THEREFOR

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5 Claims. (Cl. 121—40)

This application is a continuation of our former application Ser. No. 689,732, filed August 10, 1946, now abandoned.

The present invention concerns double-acting hydraulic ram devices and relates more particularly to apparatus of a character suitable for use as a power-lift upon tractors or the like, and wherein the ram pistons are caused to move selectively responsively to movement of a manual control member both in direction and amount of the movement of such member.

The general object of this invention is the provision of a compact economically produced double-acting hydraulic ram apparatus, wherein the ram pistons are accurately adjusted under the supervision of a control member which is manipulatable by manual force of extremely small magnitude.

A more specific object of the invention is the provision of a hydraulic ram apparatus including a novel arrangement of check valves, operating motors for such check valves, and a control valve for selectively introducing fluid through said check valves to opposite ends of the ram cylinder, concurrently with operating the motor for opening the other check valve to expedite exhaust of fluid therethrough from the opposite end of the ram.

A further object is the provision of a hydraulic ram apparatus employing a single block or casing containing a plurality of bores in an advantageous arrangement wherein one or more of the bores forms a cylinder of the ram device and other bores contain various valves for controlling delivery and exhaust of fluid from the cylinder forming bore.

These and other desirable objects inherent in and encompassed by the invention will be more readily understood from the ensuing description and the annexed drawings, wherein:

Figure 1 is a perspective view of a tractor and a preferred embodiment of the invention installed on the tractor wherein it is serviceable as a power-lift for controlling the position of implements and the like which may be attached to the tractor;

Figure 2 is a diagrammatic view taken in perspective and with parts of units in section for illustrating the complete hydraulic circuit of the ram and control apparatus contained in the embodiment of Figure 1;

Figure 3 is a vertical sectional view taken on a plane extending fore and aft of the Figure 1 embodiment and at the position illustrated by the line 3—3 in Figure 4, this view showing one of the control valves, one of the hydraulic ram devices in the upper part of the figure and a check valve and operating hydraulic motor therefor between the ram device and the control valve;

Figure 4 is a horizontal sectional view taken on the line 4—4 of Figure 3 and illustrating in section the pairs of check-valves and their associated hydraulic operating motors, said pairs of check valves and their associated motors are respectively for the two ram devices of the apparatus;

Figure 5 is a transverse sectional view taken on the line 5—5 of Figure 4 for illustrating certain of the casing passages associated with one pair of check valves and fluid motors therefor.

Figure 6 is another horizontal sectional view, taken on the line 6—6 of Figure 5, showing the control valves for the respective hydraulic ram devices and certain of the control passages having ports adapted to be covered or uncovered by lands of the slide valve members.

Figure 7 is a vertical sectional view taken on the line 7—7 of Figure 6 for illustrating the position of a restrictive flow passage and a diverting passage which are instrumental in the control of a pressure regulating device embodied in the apparatus.

Figure 8 is a vertical sectional view taken on the line 8—8 of Figure 4 and showing a portion of the pressure regulating unit and a safety pressure relief valve unit.

Figure 9 is a vertical sectional view substantially taken on the line 9—9 of Figure 4 to show one of the check valves and the conduit connection therewith and its associated ram cylinder.

Figure 10 is a vertical sectional view corresponding to Figure 9 but taken sectionally through a second embodiment of the invention.

The first embodiment of the invention is illustrated in Figure 1 as it is adapted to be mounted upon a tractor 11. A casing 12 of the hydraulic ram apparatus is mounted upon a waist 13 of the tractor frame between the engine 14 and a change-speed gear compartment 15. Casing 12 carries a bearing 16 having a transverse bore in which there are coaxial concentric rock-shafts of which one designated 17 has its end exposed in Figure 1. This end of the rock-shaft has an implement operating arm 18 mounted thereon and constrained for oscillation therewith. Rocking or oscillating movement is imparted to the rock-shaft 17 by an arm 19 having a hub portion 21 attached to such arm. The other concentric rock-shaft has rocking motion imparted thereto by a short arm 22. The other ends of the concentric rock-shafts carry rock-shaft arms shaped similarly to the arm 18 but not shown since they are at the opposite side of the tractor. Hydraulic rams within the casing 12 have their piston rods connected with the upper ends of the short arms 19 and 22 for imparting rocking motion thereto. The upper end portion of the arm 19 is shown in Figure 3 as well as its pivotal connection 23 with the front end of the rod pod 24 of a ram 25. The corresponding ram is designated 25S in Figure 2 and its piston rod is there designated 24S. The piston rod 24LS of Figure 2 is pivotally connected with the upper end of the rock-shaft operating arm 23 of Figure 1.

Fluid for operating the hydraulic rams is circulated through a pump 26 of Figure 1 which is connected to and constantly driven by the tractor engine 14. The pump draws the fluid from a reservoir portion of the casing 12 through a conduit 27 and discharges the fluid back to the hydraulic ram apparatus through a conduit 28. A pressure regulating unit within the casing 12 and presently to be described permits the fluid delivered to the apparatus through the conduit 28 to by-pass into the casing reservoir at a relatively low pressure, excepting during energization of the hydraulic rams, at which time the pressure regulating unit becomes effective to terminate the unloaded or by-pass condition and cause the fluid to be delivered by the pump at the pressure required to move the ram pistons in opposition to the resistance offered by the load applied to the rock-shaft arms as 18.

One of the hydraulic rams is controlled in the direction of movement and also in the distance of such movement by a control lever 29 which is accessible to a driver on the tractor seat for adjustment along a quadrant 31. The other hydraulic ram device is similarly controlled by a manually operated lever 32. Lever 29 is constrained for
rotation with a shaft 33 as is an arm 34, whereby an endwise controlling motion is imparted to a rod 35 in accordance with the direction of movement of the control lever 29. The lower and forward end of the link 35 carries a head 36 (see Figure 3) pivotally connected at 37 to the lower end of a walking beam member 38. An intermediate portion of the link 35 is pivotally connected at 39 with an axially slideable control valve 41, whereas the upper end of said walking beam element is pivotally connected at 42 with a bracket 43 which is constrained for endwise movement with the piston rod 24.

Manual movement of the control lever 29 in either direction along the quadrant 31 will incur a corresponding movement of the piston 44 of the hydraulic ram device 25. For instance, a forward movement of the upper end of the control lever 29 will incur a rearward endwise movement of the link 35 and thus cause clockwise swinging of the walking beam 38 about the then fixed pivot 42 and endwise movement of the control valve element 41 rearwardly to the left as viewed in Figure 3. This rearward movement of the control valve element will cause fluid to be introduced into the left end of the cylinder 45 of the ram device 25, in the manner hereinafter explained, whereby the ram piston 44 is moved forward to carry with it the upper end of the walking beam lever, and in this manner cause said walking beam lever to pivot about its then fixed pivot 37 until the control valve element is moved forwardly to its initial neutral position. Movement of the control lever 29 counterclockwise will move the control valve element 41 forwardly, while swinging the walking beam about its then fixed pivot 42. Such forward movement of the control valve element causes the introduction of fluid into the forward end of the cylinder 45 and exhaust of fluid from the rear or left end of the cylinder, as viewed in Figure 3, and rearward movement of the piston 44. When the piston has been moved rearwardly an amount equal to the amount of counter-clockwise movement of the control lever 29, the walking beam 38 will have been swung counterclockwise about the pivot 37 an amount for displacing control element 41 rearwardly to its neutral position for causing the ram piston 44 to become stationary. Corresponding control linkages is disposed between the manual control lever 32, the control valve element relating to the second ram device and the piston rod of the second ram device for causing corrosion of movement in amount and direction of the second ram piston with respect to the lever 32. The second ram device, the control valve element thereof and the various passages and elements relating to such second ram device are shown schematically in Figure 2 where the ram device is designated 25LS, its piston rod 24LS and its associated control valve elements 41LS. All of the reference characters in Figure 2 include the letter "S" to signify that the parts designated thereby are diagrammatically or schematically shown, although they correspond respectively to parts shown in the other figures of the drawings. These parts associated with the left-hand hydraulic ram device are also designated by reference characters including the letter "L" in Figure 2. The parts designated by the reference character including the letter "L" correspond to or are identical with the parts shown in the right-hand part of Figure 2 designated by the same reference characters without the "L." This expedient of reference character designation is employed so that, in a shorter description directed primarily to the elements, parts, and passages pertaining only to the right-hand hydraulic ram will suffice, it being understood from the description of the right-hand parts that the left-hand parts are similar and cooperate in a like manner in their operation.

Compactness of the apparatus and ease of manufacturing the same is expedited by the symmetrical arrangement of various elements within the casing. In Figure 6 it can be seen that the control valve elements 41 and 41LS are contained within control valve casing bores 51 and 51LS which are within a common horizontal plane indicated by the line 6-6 of Figure 3. In a plane above that of the Figure 6 showing and as indicated by the line 4-4 in Figure 3, there are four check valve bores with check casings, shown in Figure 4. Two of these bores, 52 and 53, contain check valves 54 and 55 associated with the hydraulic ram device 25. The other pair of check valve bores are designated 56 and 57 and contain check valves 54L and 55L relating to the other hydraulic ram device shown in Figure 2 where it is designated 25LS. The ram device corresponding to the device 25LS is disposed above the check valve bores 56 and 57, whereas the ram device 25 is disposed above the check valve bores 52 and 53 as illustrated in Figure 3. All of these bores communicate with the left end of the casing which is covered by an end plate 61 which contains elements of passages communicating between the various bores of the casing proper as it will appear hereinafter.

Fluid delivered to the casing 12 from the pump 26 through the conduit 28 enters through an admission passage 62, Figures 3 and 6, and designated 62S in Figure 2. Passage 62S intersects a spring chamber 63, Figure 6, of a pressure regulating unit 64. This pressure regulating unit comprises a valve seat 65 onto which a spring 66 urges a ball 67 for closing the valve. A plunger 70 when forced to the right, as viewed in Figure 8, by fluid pressure within a chamber 68 is adapted to unseat the ball 67 against the urge of the spring 66. Chamber 68 is also shown in Figures 6 and 7, and in Figure 7 this chamber 68 is shown communicative with the fluid inlet passage 62 through a restricted flow capacity passage 69 and into the chamber 68 in which is effective for moving the plunger 70, Figure 8, to the right for maintaining the unloading valve ball 67 unseated, whereby the fluid entering the spring chamber 63, Figure 8, from the admission passage 62 can escape past the ball 67, and thereby through an exhaust passage 75 into a control casing reservoir 76 for recirculation back to the pump at low pressure. This condition of low pressure unloading through the pressure regulating unit will prevail so long as fluid is trapped within the chamber 68 for pressing against the front end of the plunger 70.

A high pressure condition can be caused to prevail in the system by movement of the control valve element 41 in either axial direction from the neutral position illustrated in Figure 3. Such movement of the control valve element from neutral will cause fluid to escape from the chamber 68 at the front end of the plunger 70 through a fluid diversion passage 77. This passage 77, Figures 3 and 6, has ports 78 and 79 which are both covered by lands 81 and 82 of the slide valve element which it is in neutral position. However, forward movement of this slide valve element will cause the registration of an annular exhaust chamber or cavity 84 with the port 78, whereas rearward movement of said element will cause the registration of an annular exhaust chamber or cavity 84 with the port 79. Fluid entering the exhaust chamber 83 can escape to the reservoir 76 through a hole 85 and fluid entering the exhaust chamber 83 can escape to the reservoir through a corresponding hole 86. Therefore, when the control valve element is moved in either axial direction from the neutral, one of the fluid diversion passage ports 78 or 79 will be caused to communicate with the reservoir and cause the fluid to be diverted from the chamber 68, Figures 6, 7 and 8, more rapidly than the fluid can be delivered to said chamber from the admission.
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passage 62 through the restricted passage bore 71. Consequently, the pressure from the forward end of the plunger 70 will be diminished rapidly to an amount readily overcome by the force of the spring 66 for seating the valve half 67. Where this occurs, fluid can no longer escape from the delivery passage 62 and the constant delivery pump is thereby able to build up a high pressure in the apparatus.

The amount of pressure which can be built up in the apparatus is limited by a pressure relief valve 87, Figure 8. This relief valve includes a hollow member 88 slidable within a casing 89 which communicates with the spring chamber 63 of the pressure regulating valve and hence with the admission passage 62 through a vertical passage 91, Figures 6 and 8. Normally the slidable hollow member 88 will be retained in the position shown in Figure 8 by the force of the spring 92 pressing a head 93 thereon against the forward or left end of the member 88. Upon the creation of an inordinate pressure in the apparatus, and consequently in the passage 91, the member 88 will be forced to the left for successively placing holes 94 thereof in registry with the upper end of the exhaust passage 75 and thereby permit the escape of fluid and prevent the occurrence of pressures exceeding that desired.

In Figure 6 laterals 95 and 96 of the fluid diversion passage 77 are visible, as well as their ports 78L and 79L, which are cooperable with the control valve element 41L in the manner hereinabove explained with respect to the ports 78, 79, and the control valve 41 for diverting fluid from the chamber 68 and thereby incurring the high pressure condition of the fluid in the apparatus.

When the control valve element 41 is moved forward or to the left as viewed in Figure 5, fluid introduced into an annular admission chamber 98 between axially spaced lands 99 and 101 of the valve element from the admission passage 62 through a vertical lateral passage 102 can flow outwardly of said passage 98 through a passage 103 into an intermediate chamber 104 in the check valve bore 52. The pressure fluid in the chamber 104 presses against the inner end of a slidable check valve member 105, displacing it from its seat 106 whereby the fluid enters a passage 107 which communicates with the left or rearward end of the ram cylinder 45 for moving the ram piston 44 to the right.

Concurrently with the impression of fluid into the intermediate chamber 104 associated with the check valve 54, fluid is impressed upon a hydraulic motor 108 for the check valve 55, see Figure 4. This concurrent impression of fluid is through a branch 109 of the passage 103, branch 109 including a component 111, Figures 3 and 4, which communicates with a pocket 112 at the front end of the hydraulic motor plunger 113. A high pressure fluid in the pocket 112 forces the plunger 113 to the right for unseating the spring urged slidable member 114 of the check valve 55 so that this valve can then serve as an exhaust valve through which fluid is discharged from the right end of the cylinder 45. In Figure 9 the fluid from the right end of the cylinder 45 can be seen dischargeable through a passage 115 and thence through a passage 116, Figures 9 and 5, thence through the check valve 55 into the intermediate chamber 117 associated with this check valve, downwardly through a passage 118, Figures 9 and 5, thence rearwardly through a passage 119, Figures 9 and 5, lateral passage 120, Figures 9, 5, and 3, and to the reservoir 76 through a reversible flow passage 122, the annular exhaust passage 84, an axial passage 124 in the control valve element (such passage having ports connecting respectively with the exhaust chambers 83 and 84), exhaust chamber 83 and hole 85.

Movement of the control valve element 41 rearwardly or to the right, as viewed in Figure 3, causes the exhaust chamber 84 to register with the port 79 and incur the high pressure condition within the apparatus in the manner explained hereinabove. This rearward movement of the control element also causes the slide valve land 101 to uncover the port of the reversible flow passage 122 so that this passage registers with the annular admission chamber 98, and causes the land 99 to uncover the port of the reversible flow passage 103, whereby this passage is caused to communicate with the annular exhaust chamber 83. The fluid at high pressure then enters the passage 122 from the admission chamber 98 and passes through the branch 121 of said passage, Figures 3, 5, and 9, and the additional branches 119 and 118 to the intermediate chamber 117 of the check valve 55. The pressure of this fluid opens the check valve 55, whereby the fluid flows through the passages 116 and 115 to the back end of the ram cylinder 25. Fluid thus introduced to the rear end of the cylinder forces the piston 44 forwardly. Consequently exhaust fluid from the forward end of the cylinder 45 is made possible by the opening of the check valve 54, Figures 3 and 4, by the operation of fluid motor 125 under the influence of fluid from the passage 122 into a pocket 126 at the rear end of the motor plunger 127. With the check valve thus opened by the motor 125, the exhaust fluid from the front end of the cylinder moves downwardly through the passage 107 and thence past the open check valve into the intermediate chamber 104, through the reversible flow passage 103, the exhaust chamber 83, axial passage 124 in the valve element 41, exhaust chamber 84, and through the hole 89 to the reservoir. Movement of the piston 44 continues until the walking beam 38 restores the valve element to the neutral position. Fluid is recirculated from the reservoir to the pump through the conduit 27 shown in Figure 1.

The above operation of these parts of the apparatus associated with the hydraulic ram device 25 can be traced in Figure 2 where the schematically arranged parts are designated by the same respective reference numerals with the addition of the letter "S." Identical operation of corresponding parts associated with the other hydraulic ram device can also be traced in Figure 2 where the elements, because of their being located on the left-hand side of the apparatus, are designated by the same reference characters as those on the right-hand side of Figure 2 but with the further addition of the letter "L."

The loaded or working stroke of the ram piston 44 occurs when fluid is introduced into the front end of the cylinder through the reversible flow passage 103—107. At this time the motor 125 remains energized whereas the large diameter portion 131 of the motor-operated valve stem 132 has no throttling effect of the passage 103—107 at the ports 133. However, when fluid is introduced into the rear end of the cylinder through the reversible passage 122—115, the motor 125 is energized and in opening the check valve 54 projects the valve stem enlargement 131 over the holes 133 whereby the parts 131—133 function as a throttling valve. This means of limiting the exhaust rate from the front end of the cylinder prevents the load (as implements raised to transport position by the forward movement of the piston) returning the piston toward the rear end of the cylinder at an inordinate rate. The effect of fluid pressure on the front end of the piston will normally be the prevailing factor determining the rearward retractive movement of the piston or plunger and consequently even relatively heavy loads remain in the passage 103—107. Hence, sufficient speed to jerk or bounce the vehicle should the engine be stopped quickly. In Figure 2 it will be observed that valves 131S—133S and 131LS—133LS, corresponding to the valve 131—133, are operable only by the motors 54S or 54LS. No throttling action is needed or desired when exhausting through the valves 55S or 55LS from the front ends of the ram cylinders 45S or 45LS.

Figure 10 shows a modified form of apparatus having a single hydraulic ram device 151 including a cylinder 152 formed by a bore within a casing 153. This hydraulic ram device includes a piston 154 from which a piston
rod 153 extends outwardly of the casing through a sealed bushing 156. The hydraulic ram device 151 is also twoway acting in the respect that the piston is hydraulically forcible in both directions of its reciprocative movement.

An important feature of this second embodiment 153 is characterized by the parallel arrangement of check valve bores 157 and 158 and of a control valve bore 159, all substantially within a common plane so that each of these bores is intersected by each of two reversible flow bores 161 and 162. The desired feature is further characterized by said common plane bores being in such a relatively short lengthwise relation that one of the two vertical reversible flow bores intersects the control valve bore in the position to be cut off by the control valve element 163 while in the neutral position and intersects one of the check valve bores in a position to operate the hydraulic check valve-opening motor M and intersecting the other of the check valve bores at a position introducing fluid to open and pass the check valve CK therein, while the other reversible flow bore also intersects the control valve bore in a position to be cut off thereby while the control valve element 163 is in neutral position and intersects the two check valve bores in the manner explained with respect to the one reversible flow bore but with the relation to the check valve bores reversed.

The apparatus is adapted to receive fluid from a constant delivery pump, not shown, through a port 163 of fluid admission passage 164 which communicates with an annular fluid admission chamber 165 within the casing bore 159 between axially spaced lands 166 and 167 of the slidable control valve element 165. A lateral, represented schematically by dot-dash lines, of the admission passage 164, communicates with a diagrammatically represented pressure regulator 168 through a restricted flow passage 169, also represented by dot-dash lines, and containing a small bore plug 171 corresponding to the plug 72 of the first embodiment. The pressure regulator may also be of the character illustrated in the first embodiment, wherefore so long as the fluid pressure of the fluid passing through the small aperture member 171 is impressed upon the pressure regulator, such regulator will be operable to create an unloading or by-passing condition, whereby fluid is discharged to the reservoir 172 from the fluid admission passage 165 through a conduit 173. A fluid diversion passage 174, also diagrammatically illustrated by dot-dash lines, has ports 175 and 176 covered respectively by end enlargements or lands 177 and 178 when the valve element 163 is in neutral. Excessive pressure in the device is prevented by a pressure relief valve 179 which may be similar to that of the first embodiment designated 87 in Figure 8. Discharge of excessive fluid through the pressure relief valve 179 can reach the reservoir 172 through a conduit 181.

Manual control apparatus similar to that described in the first embodiment may be associated with the piston rod 155 and the control valve element 163 so that the walking beam of the control apparatus will be effective for restoring the element 163 to the neutral position after the piston rod has moved a direction and amount correlated with the direction and amount of movement of the manually controlled lever.

Assuming that the control element 163 has been moved to the left as observed in Figure 10, the diversion passage port 175 will be caused to communicate with an annular exhaust passage 182 between the control valve element lands 166 and 177, whereby the control pressure on the pressure regulator 168 will be relieved and the pressure regulator 168 is adjusted for preventing by-pass through the conduit 173. A reversible flow passage 161 will be caused to register with the admission chamber 168 so that fluid under pressure will be caused to flow upwardly through the passage 161. Fluid thus reaching the check valve bore 157 and flow past the check valve CK in this bore, thence through a passage 183 into the left end of the cylinder 152 for moving the piston 154 to the right. Fluid entering the check valve bore 158 from the reversi-
passage leading from said unit to divert the restricted fluid from thereon and incur the diminished pressure fluid from a source thereof to a double-acting piston and cylinder device and from said device to a place of exhaust, a casing containing a plurality of parallel bores lying substantially in a common plane, a pair of reversible flow bores spaced apart lengthwise of said plurality of bores and intersecting each thereof, one of said parallel bores constituting a control valve bore, a control valve slidably in the control valve bore and having axially spaced lands cooperable with their bore to form there with an admission chamber between opposed ends of such lands and exhaust chambers at the opposite ends of said lands, said admission chamber being communicative with said source and said exhaust chambers being communicative with said place of exhaust, said control valve being axially movable in opposite directions from a neutral setting wherein said lands respectively register with the reversible flow bores to preclude communication thereof with said admission chamber, movement of the control valve in one direction from neutral being effective to displace said lands for incurring communication between one of the reversible flow bores and said source through said admission chamber and communication between the other reversible flow bore and the place of exhaust through one of said exhaust chambers wherein movement of the control valve in the opposite direction from neutral is effective for incurring communication between the other reversible flow bore and said source through the admission chamber and communication between the one reversible flow bore and the place of exhaust through the other exhaust chamber, two of said parallel bores constituting check valve bores, check valves respectively in said bores, motor pistons also respectively in said bores and axially spaced from the valves in such bores to provide an intermediate chamber therebetween, said check valves being operable by fluid pressure in their associated intermediate chambers to provide communication respectively with the ends of the cylinder of said device, each of said check valve bores also having a pocket portion wherein fluid under pressure displaces the piston therein for opening its associated check valve, one of said reversible flow bores communicating with the intermediate chamber of one check valve bore and with the pocket of the other check valve bore, and the other reversible flow bore communicating with the intermediate chamber of the other check valve bore and with the pocket of the one check valve bore.

In apparatus for controlling the delivery and exhaust of operating fluid to and from a fluid-operated device; passages communicative with said device for causing operation thereof in respectively opposite directions when fluid is delivered to the device therefrom, each of said passages also being for the exhaust of fluid from the device pursuant to delivery of fluid to the device through the other passage, a control valve bore, said passages having respective ports communicative with said bore at axially spaced positions, a control valve member slidably axially in said bore and having axially spaced enlargements respectively registered with said ports to close the same when said valve member is in a neutral position, said enlargements cooperating with said bore to form a central chamber between the opposed ends of such enlargements and end chambers at the opposite ends of such enlargements respectively adjacent to said ports, said central chamber being adapted for maintenance therein of a fluid pressure different from that in the end chambers, said chambers having ports for the passage of fluid for the maintenance of their respective pressures, said valve member being oppositely movable from the neutral position to selectively register said passage ports with the central chamber while registering the other of such passage ports with the end chamber adjacent thereto; the ports of end chambers being so disposed axially of the bore that each is communicative with its respective chamber at least while the passage port adjacent to its chamber is in communication with the central chamber, and said valve member containing a channel communicative between said end chambers exclusively of the central chamber.

4. In apparatus for controlling the delivery and exhaust of operating fluid to and from a fluid-operated device; passages communicative with said device for causing operation thereof in respectively opposite directions when fluid is delivered to the device therefrom, each of said passages also being for the exhaust of fluid from the device pursuant to delivery of fluid to the device through the other passage, a control valve bore, said passages having respective ports communicative with said bore at axially spaced positions, a control valve member slidably axially in said bore and having axially spaced enlargements respectively registered with said ports to close the same when said valve member is in a neutral position, said enlargements cooperating with said bore to form a chamber between the opposed ends of such enlargements and to cooperate with said bore to form end cavities respectively at the opposite ends of such enlargements, said chamber being adapted for maintenance therein of a fluid pressure different from that in the cavities, said valve member being oppositely movable from the neutral position to selectively register said passage ports with the chamber while registering the other of such passage ports with the cavity adjacent thereto, the valve member containing a channel communicative between the cavities exclusively of the chamber, and opening means communicative with at least one of the cavities and through the valve member channel with the other cavity to provide pressure therein differing from the pressure in the central chamber.

5. In apparatus for controlling the delivery and exhaust of operating fluid to and from a fluid-operated device; passages communicative with said device for causing operation thereof in respectively opposite directions when fluid is delivered to the device therefrom, each of said passages also being for the exhaust of fluid from the device pursuant to delivery of fluid to the device through the other passage, a control valve bore, said passages having respective ports communicative with said bore at axially spaced positions, a control valve member slidably axially in said bore and having axially spaced enlargements respectively registered with said ports to close the same when said valve member is in a neutral position, said enlargements cooperating with said bore to form a fluid admission chamber between opposed ends of such enlargements and exhaust spaces respectively at the opposite ends of such enlargements, the valve member being oppositely movable from the neutral position to selectively register said passage ports with the admission chamber while registering the other of such passage ports with the exhaust space adjacent thereto, the valve member containing a channel communicative between the exhaust spaces exclusively of said admission chamber, and exhaust opening means communicative with at least one of the exhaust spaces.

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