

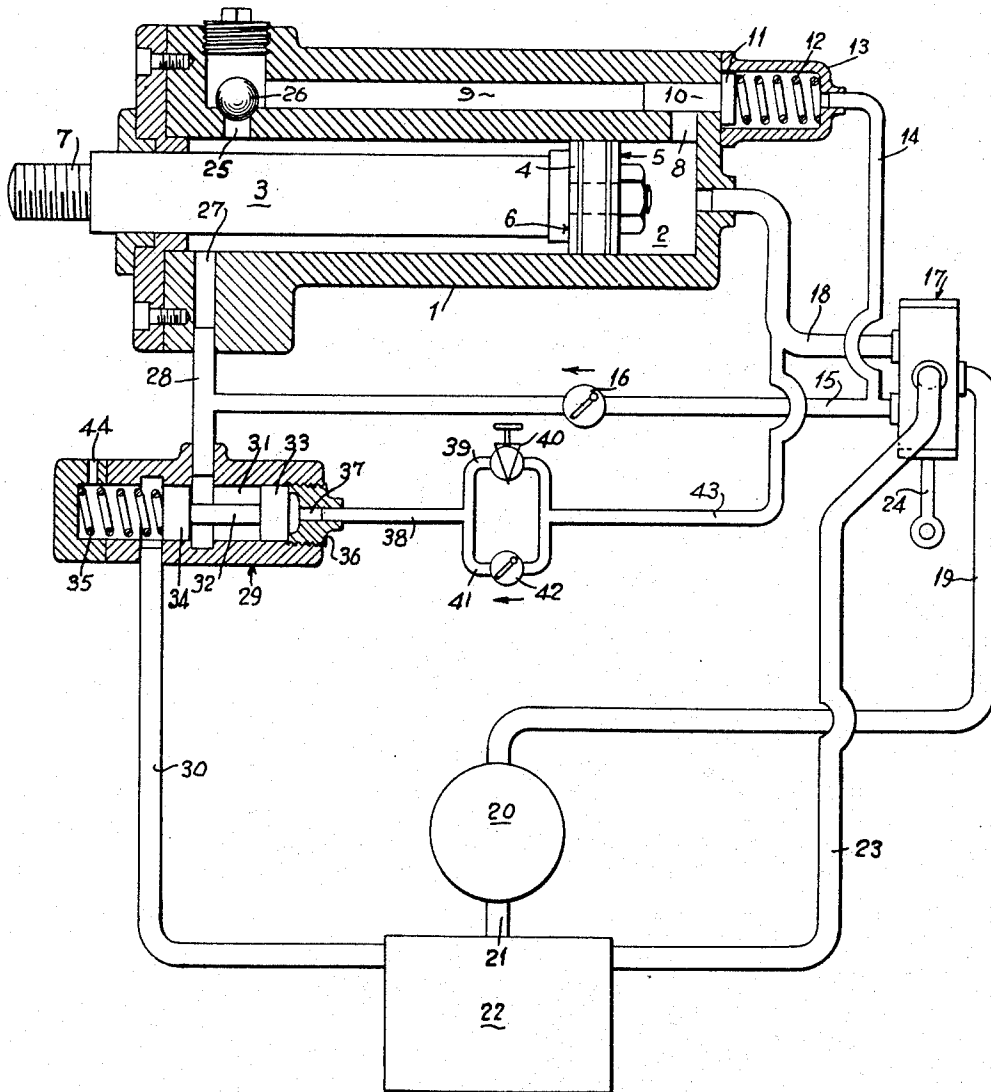
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FLOW CONTROLLING VALVE MEANS FOR HYDRAULIC MOTORS

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FLOW CONTROLLING VALVE MEANS FOR
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1

This invention relates to hydraulic machinery and, in particular, to hydraulic systems including a fluid operable reciprocable plunger.

If, in hydraulic systems of this type, it is desired to move the plunger at a high speed during a portion of its working stroke and subsequently at a lower speed during the successive portion of the working stroke, it was heretofore customary to provide the cylinder, in which the said plunger reciprocates, with surge valve means which automatically establish a fluid connection between a fluid reservoir and the advancing side of the plunger, to pre-fill the adjacent portion of the cylinder. The said surge valve is so arranged as to interrupt the fluid connection between the advancing side of the said plunger and the fluid reservoir, as soon as the plunger encounters a predetermined resistance. In some instances, pre-filling pumps were heretofore provided for pre-filling the cylinder in which the fluid operable plunger reciprocates.

It is an object of this invention to provide a hydraulic system of the above type, in which, however, no surge valve means or pre-filling pumps are required for prefilling the cylinder portion adjacent the advancing side of the working plunger.

It is another object to provide a hydraulic system, including a reciprocable plunger having associated therewith fluid operable advancing and retracting means, in which, during the initial portion of the working stroke of the said plunger, a fluid connection is automatically established between the retracting means and the advancing means, while, during the subsequent portion of the working stroke of said plunger, the said fluid connection is automatically interrupted.

It is a still further object of this invention to provide a hydraulic system, including a plunger having associated therewith fluid operable advancing and retracting means for reciprocating said plunger, in which low pressure responsive valve means associated with said retracting means is adapted, in response to a low pressure acting thereupon, to effect fluid connection between said advancing and said retracting means, whereas control means is associated with the said advancing means making said low pressure responsive means ineffective and connecting said retracting means with an exhaust when a predetermined high pressure acts on said advancing means.

It is still another object to provide a hydraulic system as set forth in the preceding paragraph, in which the low pressure responsive means and

2

the control means are made ineffective during the retracting stroke of the plunger.

These and other objects and advantages will appear more clearly from the following specification in connection with the accompanying drawing illustrating a hydraulic system according to the invention.

General arrangement

10 In general, the hydraulic system according to the invention comprises a cylinder having mounted therein a plunger with fluid operable advancing means and fluid operable retracting means having a smaller effective area than said ad-
15 vancing means, said advancing and retracting means being provided for reciprocating said plunger. The retracting means is hydraulically connected with a control valve which, during the initial portion of the advancing stroke prevents
20 the escape of fluid from the retracting means to an exhaust, while low pressure responsive means is adapted during this period, to establish fluid connection between the retracting means and the advancing means.

25 When a predetermined pressure has built up at the advancing means, this pressure actuates the control means to cause the latter to effect fluid connection between said retracting means and an exhaust, thereby making said low pressure
30 responsive means ineffective and interrupting fluid connection between said retracting means and said advancing means.

Structural arrangement

35 Referring now to the drawings in detail, the structure shown therein comprises a cylinder, generally designated 1, having a bore 2 in which is reciprocably mounted a plunger 3. The
40 plunger 3 has a piston portion 4 with a large advancing area 5 and a smaller retracting area 6. The plunger 3 is provided with a threaded portion 7 for connection with a member or element to be controlled. The right hand portion of the
45 cylinder bore 2 is connected with a passageway 8 adapted to communicate with a passageway or channel 9 provided in the cylinder 1. The fluid communication between the passageway 8 and the channel 9 is controlled by a control plunger
50 10 of a low pressure valve, which plunger has associated therewith a piston portion 11 acted upon by a relatively weak spring 12.

The spring 12, which is housed in a spring casing 13, continuously urges the control plunger 10 into closing position. The spring casing 13 communicates with a conduit 14 leading into a con-

3

duit 15. The conduit 15, which comprises a check valve 16, has one end thereof connected to a 4-way valve, generally designated 17. The valve 17, which may be of any standard type, has connected thereto a conduit 18 leading to the right hand end of the cylinder bore 2. Also connected to the valve 17 is a pressure line 19 leading to the pressure side of a fluid pressure source 20, such as a pump, the suction side of which is connected through a conduit 21 with a fluid reservoir or tank 22.

The tank 22 communicates through an exhaust line 23 with the valve 17. The valve 17 is operable by means of the handle 24 so that when the handle 24 is moved into its upper position, the conduit 18 communicates with the pressure line 19, while simultaneously the conduit 15 is placed into fluid communication with the exhaust line 23.

When the handle 24 is moved into its lower position, the pressure line 19 is brought into fluid communication with the conduit 15, while simultaneously the conduit 18 communicates with the exhaust line 23.

The left hand portion of the cylinder bore 2 communicates with a passageway 25 adapted to communicate with the channel 9. The fluid connection between the passageway 25 and the channel 9 is controlled by a check valve 26. The left end portion of the cylinder bore 2 furthermore communicates through a bore 27 with a conduit 28 leading to a high pressure valve, generally designated 29. The valve 29, which is connected through a conduit 30 with the tank 22, comprises a valve bore 31 having reciprocally mounted therein a valve member 32. The valve member 32 is provided with two piston portions 33 and 34, of the same effective area.

The piston portion 34 is acted upon by a relatively strong spring 35 which continuously urges the valve member 32 toward the right to thereby cause the piston portion 33 to abut the plug 36. The plug 36 is provided with a bore 37 through which communicates with a conduit 38. The conduit 38 branches out into a conduit 39 comprising an adjustable choke 40 and a conduit 41 comprising a check valve 42. The conduits 39 and 41 then converge into the pilot line 43 communicating with the conduit 18. The valve 29 is furthermore provided with a breather opening 44.

Operation

It may be assumed that all parts occupy the position shown in the drawing while the handle 24 occupies its intermediate or neutral position, in which fluid connection between the pressure line 19 and either of the conduits 15 and 18 is prevented. In order to start a working stroke of the plunger 3, the operator shifts the handle 24 into its upper position to thereby connect the pressure line 19 with the conduit 18, while simultaneously connecting the conduit 15 with the exhaust line 23. Pressure fluid delivered by the fluid source 20 then passes through the pressure line 19, the valve 17 and the conduit 18 into the right hand portion of the cylinder bore 2 where it acts upon the advancing area 5 of the piston portion 4.

As a result thereof, the plunger 3 moves toward the left. During this initial leftward movement of the plunger 3, which latter, it may be assumed, does not encounter any resistance during this initial movement, no fluid can escape from the left hand portion of the cylinder bore 2 through conduit 28 into the conduit 30 because the valve member 32 prevents such fluid communication.

4

Therefore, the only way of escape for the fluid from the left hand portion of the cylinder bore 2 is through the passageway 25. Consequently, the fluid acted upon by the retraction area 6 and subjected to a slight pressure opens the check valve 26 and passes into the channel 9 where it acts upon the control plunger 10.

Inasmuch as the spring 12, tending to hold the control plunger 10 in closed position, is rather weak, the pressure on the fluid in the passageway 9 is sufficient to overcome the thrust of the spring 12 and to move the control plunger 10 toward the right so that fluid communication is established between the passageway 9 and the right hand end of the cylinder bore 2. It will, therefore, be clear that, during the initial leftward movement of the plunger 3, the fluid expelled from the left hand portion of the cylinder bore 2 is conveyed to the right hand portion thereof, thereby pre-filling the latter and speeding up the advancing movement of the plunger 3.

As soon as, during the leftward movement of the plunger 3 the latter encounters resistance, the pressure in the left end of the bore 2 drops and pressure builds up in the conduit 18, which pressure is conveyed through the pilot line 43, the check valve 42 and the conduit 38 to the right hand end of the valve bore 31 where it acts upon the piston portion 33 and causes the valve member 32 to move leftwardly against the thrust of the spring 35. In this way, fluid connection is established between the conduit 28 and the conduit 30 leading to the tank 22. As a result thereof, the fluid expelled from the left hand portion of the cylinder bore 2 can escape into the tank 22 and the pressure in the left hand portion of the cylinder bore 2 drops immediately.

In view of the drop in pressure in the left end of the bore 2, the check valve 26 again moves into its closing position. The movement of the control plunger 10 into its closing position may be effected by the spring 12 but it will be apparent that the closing of the check valve 26 is sufficient hydraulically to isolate the right and left hand ends of the bore 2. Therefore, the plunger 3 now performs its working stroke at a reduced speed. If, during this working stroke, slight pressure fluctuations should occur in the pilot line 43, this will not cause a fluttering of the valve member 32, since the choke 40 maintains a predetermined pressure in the conduit 38 sufficient to hold the valve member 32 into position for establishing fluid connection between the conduits 28 and 30.

When the plunger 3 has reached the desired end of its leftward movement, the handle 24 is moved into its lower position, to thereby establish fluid connection between the pressure line 19 and the conduit 15, while simultaneously effecting fluid connection between the conduit 18 and the exhaust line 23. Consequently, pressure fluid delivered by the fluid source 20 now passes through the pressure line 19, the conduit 15, check valve 16, conduit 28 and bore 27 into the left hand portion of the cylinder bore 2 where it acts upon the retraction area 6 and causes the plunger 3 to move toward the right. The fluid expelled from the right hand portion of the cylinder bore 2, during this rightward movement of the plunger 3, escapes through conduit 18 into the exhaust line 23 and from there into the tank 22.

It will be appreciated that as soon as the valve 17 has been moved into position for effecting the retraction stroke of the plunger 3, the pressure in the conduit 38 drops and the spring 35 com-

5

mences to return the valve member 32 into the position shown in the drawing, this being accomplished in a relatively short time, and being effective to interrupt fluid connection between the conduit 28 and the conduit 30. When the plunger 3 has reached the end of its rightward stroke, for instance the position shown in the drawing, the operator may either reverse the valve 17 in order to initiate a new stroke of the plunger 3, or the valve 17 may be moved into its neutral position thereby bringing the plunger 3 to a stop. All parts will then occupy their initial position.

The pressure acting on the retraction area 6 of the plunger 3 during the retraction stroke thereof will open the check valve 26 and be conveyed into the passageway 9. It will, however, be prevented from moving the plunger 10 rightwardly by the pressure conveyed through the conduit 14 and acting upon the piston portion 11.

While the invention has been described in connection with a horizontally moving plunger, it will be clear that the invention may equally well be applied to a vertically reciprocable plunger.

It is, of course, understood that the present invention is by no means limited to the particular arrangement shown in the drawing, but also embraces such modifications as come within the scope of the appended claims.

Having thus fully described and ascertained the nature of my said invention, what I claim as new and desire to secure by Letters Patent is:

1. In a hydraulic system, a plunger, fluid operable advancing and retracting means associated with said plunger for reciprocating the same, low pressure responsive means associated with said retracting means and responsive to a low pressure acting thereupon to effect fluid connection between said advancing and said retracting means, and high pressure responsive means also associated with said retracting means and operable in response to a predetermined high pressure acting on said advancing means to connect said retracting means with an exhaust to make said low pressure responsive means ineffective.

2. In a hydraulic system, a plunger, fluid operable advancing and retracting means associated with said plunger for reciprocating the same, first valve means associated with said retracting means and operable in response to a predetermined low pressure on said retracting means to establish fluid communication between said retracting means and said advancing means, and second valve means normally preventing fluid communication between said retracting means and an exhaust but adapted in response to a predetermined high pressure on said advancing means to establish fluid connection between said retracting means and said exhaust.

3. In a hydraulic system, a plunger, fluid operable advancing and retracting means associated with said plunger for reciprocating the same, a pressure fluid source for selectively supplying pressure fluid to said advancing or said retracting means for actuating the same, conduit means adapted to effect fluid connection between said retracting means and said advancing means, first valve means for controlling said fluid connection, said valve means including a spring urged plunger normally urged into its closing position for preventing said fluid connection, and second valve means associated with said retracting means and comprising a spring urged valve member continuously urged toward position to prevent fluid communication between said retracting means and an exhaust, said valve member also having

6

fluid operable means associated therewith in fluid communication with said advancing means and responsive to a predetermined pressure to move said valve member into position to establish fluid communication between said retracting means and an exhaust.

4. In a hydraulic system, a cylinder, a differential plunger with a small and an opposed larger differential area, said plunger being reciprocally mounted in said cylinder, a fluid pressure source for selectively supplying pressure fluid to one or the other of said differential areas for reciprocating said plunger, conduit means adapted to effect fluid communication between said differential areas, low pressure responsive valve means normally preventing said fluid communication but adapted in response to a predetermined low pressure on said small area during the advancing stroke of said plunger to effect said fluid communication, and high pressure responsive valve means normally preventing fluid connection between said small area and an exhaust but adapted in response to a predetermined high pressure on said larger area to effect said fluid connection.

5. In a hydraulic system, a cylinder, a differential plunger reciprocally mounted in said cylinder, said differential plunger having a large area and an opposed smaller area, a pressure fluid source for selectively supplying pressure fluid to said large or to said smaller area for reciprocating said plunger, conduit means adapted to effect fluid communication between said large area and said smaller area, valve means for controlling said fluid communication, said valve means including a check valve for allowing flow of fluid from said smaller area to said large area while preventing the flow of fluid in the reverse direction, said valve means also including a spring urged plunger continuously urged toward its closing position in which said fluid communication is prevented, and high pressure responsive valve means normally preventing fluid connection between said smaller area and an exhaust but adapted to effect said fluid connection in response to a predetermined pressure acting on said large area.

6. In a hydraulic system, a cylinder, a plunger reciprocally mounted in said cylinder, said plunger having associated therewith fluid operable advancing means and fluid operable retracting means, the effective area of said fluid operable retracting means being smaller than the effective area of said fluid operable advancing means, a fluid source for selectively supplying pressure fluid to said advancing means or to said retracting means, low pressure responsive means for establishing fluid connection between said advancing means and said retracting means in response to a predetermined low pressure on said retracting means, high pressure responsive means associated with said retracting means and adapted in response to a predetermined pressure on said advancing means to establish fluid connection between said retracting means and an exhaust, and means associated with said low pressure responsive means and operable in response to the supply of pressure fluid from said fluid source to said retracting means for preventing fluid communication between said advancing means and said retracting means.

7. In a hydraulic system, a plunger, fluid operable advancing and retracting means associated with said plunger for reciprocating the same, the effective area of said advancing means

7

being larger than the effective area of said retracting means, a fluid pressure source for selectively supplying pressure fluid to said advancing means or to said retracting means, conduit means adapted to effect fluid communication between said advancing means and said retracting means, low pressure responsive means adapted in response to a predetermined low pressure on said retracting means during the advancing stroke of said plunger to effect said fluid communication, yielding means for continuously urging said low pressure responsive means into its closing position to prevent said fluid communication, means responsive to the supply of pressure fluid from said fluid source to said retracting means to convey pressure fluid to said low pressure responsive means to thereby aid said yielding means in its closing action, and high pressure responsive means normally preventing fluid connection between said retracting means and an exhaust but adapted in response to a predetermined high pressure on said advancing means for establishing said fluid connection.

8. In a hydraulic system, a plunger, fluid operable advancing and retracting means associated with said plunger for reciprocating the same, the effective area of said advancing means being larger than the effective area of said retracting means, a fluid pressure source for selectively supplying pressure fluid to said advancing means or to said retracting means, conduit means adapted to effect fluid communication between said advancing means and said retracting means, low pressure responsive valve means adapted in response to a predetermined low pressure on said retracting means during the advancing stroke of said plunger to effect said fluid communication, yielding means for continuously urging said valve means into its closing position to prevent said fluid communication, means responsive to the supply of pressure fluid from said fluid source to said retracting means to convey pressure fluid to said valve means to thereby aid said yielding means in its closing action, high pressure responsive means normally preventing fluid connection between said retracting means and an exhaust but adapted in response to a predetermined high pressure on said advancing means to establish said fluid connection, and check valve means interposed between said retracting means and said low pressure valve means and adapted to allow the flow

8

of fluid from said retracting means to said low pressure responsive valve means while preventing the flow of fluid in the reverse direction.

9. In a hydraulic system, a plunger, fluid operable advancing and retracting means for reciprocating said plunger, the effective area of said retracting means being smaller than the effective area of said advancing means, a fluid pressure source for selectively supplying pressure fluid to said advancing means or to said retracting means, first valve means responsive to a predetermined low pressure on said retracting means during the advancing stroke of said plunger for establishing fluid connection between said advancing and said retracting means, second valve means associated with said retracting means and normally preventing fluid communication between said retracting means and an exhaust, said second valve means including fluid pressure responsive means adapted in response to a predetermined pressure on said advancing means to effect said fluid communication, and control means responsive to the supply of pressure from said fluid source to said retracting means for preventing fluid connection between said retracting means and said advancing means.

10. In a hydraulic system, a reciprocable plunger having a main area and a differential area associated therewith, means for supplying actuating fluid to said main area or to said differential area for reciprocating said plunger, first valve means normally preventing fluid communication between said differential area and exhaust and operable in response to a predetermined pressure on said main area to connect said differential area to exhaust, and a second valve means normally preventing fluid communication between said differential area and said main area and operable in response to a predetermined pressure in said differential area caused by the supply of actuating fluid to said main area to effect fluid communication between said areas.

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