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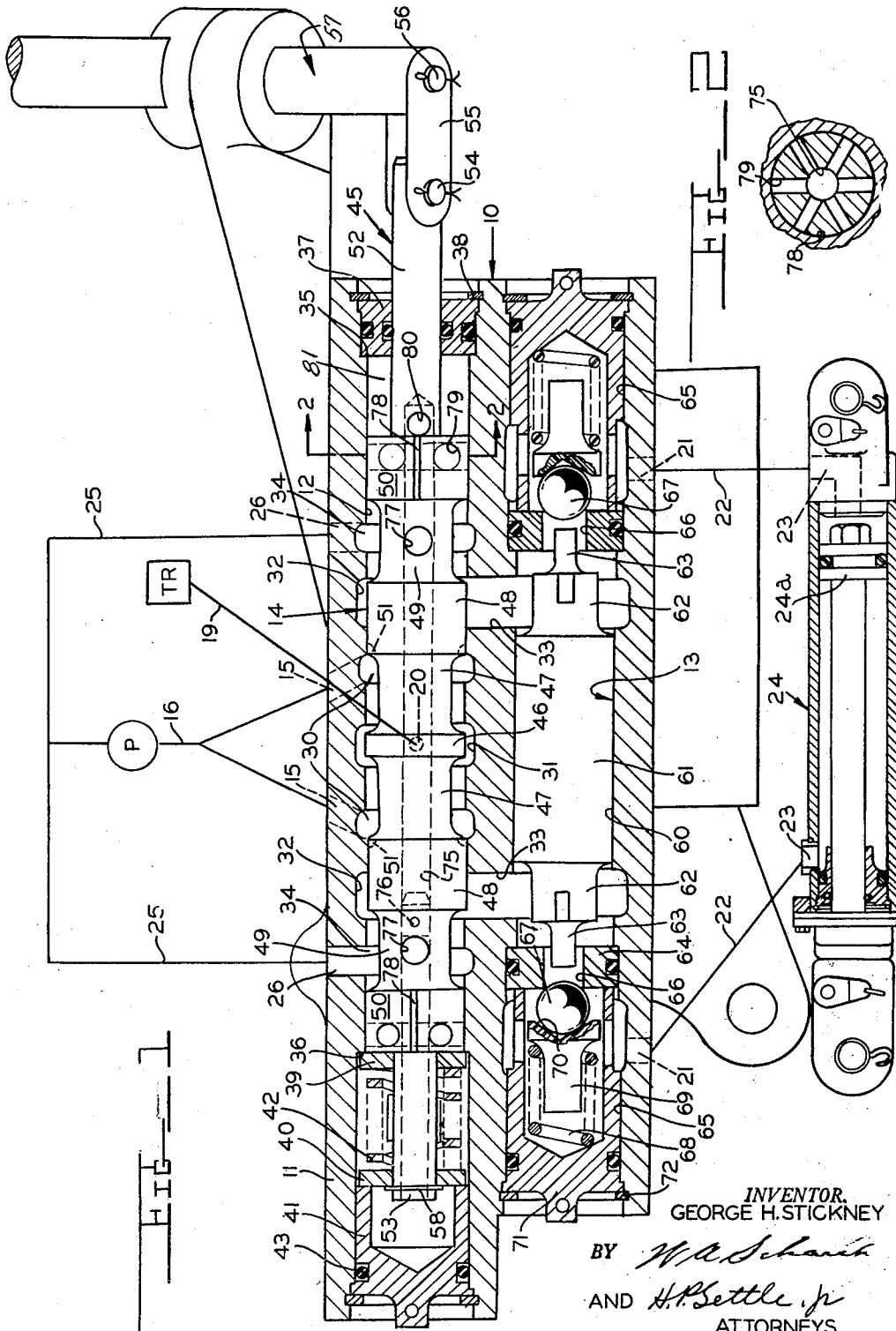
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DUAL ACTION HYDRAULIC CONTROL VALVE

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2 Sheets-Sheet 1



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DUAL ACTION HYDRAULIC CONTROL VALVE

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The present invention relates to a manually actuatable control valve for a fluid motor and more particularly to such a valve for a double acting fluid pressure actuated cylinder, the valve being effective to selectively actuate the cylinder, either in direct response to the extent of valve actuation or for a complete cylinder stroke without the necessity of holding the valve open.

In the control of remotely located fluid pressure actuated cylinders, particularly for use in farm implements, it has been proposed that a control valve be provided which is effective to actuate the cylinder through an entire cylinder piston stroke to an extreme position by utilizing the back pressure from the cylinder piston to hold the valve in open position without the necessity of manually retaining the valve open. However, for the operation of a great number of implements, it is desirable to provide a valve which also may be utilized to accurately control movement of the cylinder piston, under complete manual control, to less than its full extent, so as to afford better positioning control for the implement to which the cylinder is attached.

The present invention provides an improved control valve which is operable in this fashion. The valve is manually controlled through an actuating handle so that, when the handle is moved to an extreme position, the valve is effective to actuate the cylinder for a complete cylinder piston stroke, with the piston back pressure holding the valve in open position and to automatically return the valve to a centered position upon completion of the piston stroke. Thus, it is not necessary to hold the handle and the valve in open position to complete the cylinder stroke, nor is it necessary to actuate the valve to stop cylinder movement at the end of its stroke. If the handle is moved to a lesser extent, i. e., to less than an extreme position, the cylinder is actuated in accordance with the valve position and accurate manual control of the range of piston movement is obtained.

It is, therefore, an important object of the present invention to provide an improved manually actuatable control valve for a fluid motor.

Another object of the present invention is to provide an improved valve for a double acting fluid pressure actuated cylinder which is selectively manually actuatable to a holdover position effective to cause complete movement of the cylinder through an entire range of movement, and to a manually adjusted position effective to cause cylinder actuation under direct manual valve control.

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A further important object is the provision of a control valve for a fluid motor having a valve spool selectively manually movable to a pair of operating positions, including an extreme position at which fluid motor back pressure holds the valve spool in open position until the fluid motor stroke is completed and a second position short of said extreme position at which actuation of the cylinder to a selected position may be accomplished under complete manual control.

The specific nature of this invention, as well as other objects and advantages thereof, will become apparent to those skilled in the art from the following detailed description, taken in conjunction with the attached sheets of drawings on which, by way of preferred example only, is illustrated one embodiment of this invention.

On the drawings:

Figure 1 is a longitudinal sectional view of a control valve of the present invention forming a portion of a schematically represented hydraulic control circuit for a fluid pressure motor;

Figure 2 is a sectional view taken along the plane 2—2 of Figure 1;

Figure 3 is a sectional view of Figure 1 illustrating the valve in a first adjusted position; and

Figure 4 is a view similar to Figures 1 and 3 illustrating the valve in a second adjusted position.

As shown on the drawings:

In Figure 1, reference numeral 10 refers generally to a control valve of the present invention including a valve housing 11 having a longitudinal, substantially cylindrical spool bore 12 therein and a lower second bore 13 substantially axially parallel to the bore 12. A valve spool 14 is disposed within the housing 11 and the spool 14 is effective to control the flow of fluid through the housing bores.

The cylinder housing is provided with a pair of primary inlet passages 15 communicating with the bore 12 and with a branched pressure discharge conduit 16 from a pump P. Preferably, the pump P is driven by a tractor or similar prime mover having a tractor operated hydraulically actuated control system, indicated schematically at TR, such as the hydraulic system for a well-known type of tractor adapted for the control of tractor mounted implements.

The tractor system TR receives fluid under pressure through a conduit 19 which communicates with an outlet passage 20 opening to the bore 12. The housing lower bore 13 communicates, as through passages 21, with conduits 22 leading to the fluid pressure ports 23 of a fluid motor, such as a double acting hydraulic cylinder.

der 24 having an interior reciprocable piston 24a. The bore 12 also communicates with a pair of return conduits 25 communicating with the intake side of the pump P and with return passages 26 formed in the housing 11.

More specifically, the valve 10 is provided with axially spaced primary inlet ports 30 in full communication with the bore 12 for the reception of fluid under pressure from the inlet passages 15 and with a primary outlet port 31 located axially intermediate the inlet ports 30 and communicating with the primary outlet passage 20. The valve housing also includes a pair of pressure discharge ports 32 disposed axially outwardly from the primary inlet ports 30 and communicating, as through depending pressure discharge passages 33, with the lower bore 13. The return passages 26 communicate with return ports 34 which are axially separated from and adjacent the pressure discharge ports 32.

The opposite ends of the bore 12 are counter-bored to provide internal shoulders 35 and 36, respectively. An annular retainer 37 is seated against the shoulder 35 to close the end of the bore and a snap ring 38 is utilized to retain the retainer in position. A washer 39 is seated against the shoulder 36 in spaced relation to a second washer 40 which is normally urged against a retainer 41 by a helical coil spring 42 for a purpose to be hereinafter more fully described. The retainers 37 and 41 are provided with annular seal rings 43 to seal the bore against the escape of fluid under pressure.

The bore 12 slidably journals a valve spool 45 for longitudinal axial movement therein. The spool 45 has a single centrally located primary land 46 which is centrally located within the primary outlet port 31 when the spool is centered in the bore 12. On either side of the primary land 46, the spool has axially elongated pressure grooves 47 which terminate at flow directing lands 48. The grooves 47 are normally effective to establish communication between the primary inlet ports 30 and the primary outlet port 31 so that, when the valve is in its central position, fluid flow from the pump P and the conduit 16 is merely circulated through the ports 30 and the bore into the outlet port 31 for passage through the tractor hydraulic system TR through the line 19 and the port 23.

The flow directing lands 48 are of a diameter substantially the same as the diameter of the bore 12, so that these lands effectively close off communication between the inlet ports 30 and the pressure discharge ports 32 when the valve is in its position illustrated in Figure 1. Axially outwardly of each of the flow directing lands 48, the valve spool is provided with reduced diameter return grooves 49 which normally bridge the return ports 26 and which terminate at terminal back pressure lands 50 formed on the spool and disposed within the bore axially outwardly of the return ports.

The flow directing lands 48, at their axially inner faces, are provided with pressure relieving grooves 51 for a purpose to be hereinafter more fully described. The valve spool 45 is provided with reduced diameter end portions 52 and 53 which respectively project axially beyond the bore and into the retainers 37 and 41. The right hand spool end portion 52 is pivotally connected, as by pin 54 and link 55, to the reduced end 56 of a centrally pivoted handle 57. It will be appreciated that actuation of the han-

dle 57 will effect reciprocation of the spool within the bore 12, the direction of reciprocation depending upon the direction of handle actuation. The other end 53 of the spool 45 projects through the annular washers 39 and 40 and through the bore of the centralizing spring 42 to carry a snap ring 58 against which the end washer 40 is seated when the washer is not seated against the retainer 41.

The lower bore 13 includes a central bore section 60 within which is mounted a reciprocable shuttle or cylinder 61 having reduced ends 62 projecting through the pressure discharge passages 33 which establish communication between the bores 12 and 13. The shuttle terminates in opposed ends 63 which project through annular valve seats 64 bottomed with enlarged valve chambers 65 concentric with the lower bore 13. The valve seats 64 are centrally apertured, as at 66, for cooperation with spherical lock valves 67 urged against the valve seats by compression springs 68 acting on valve retainers 69 having relieved forward concave faces 70 contacting the valves 67. The springs 68 are confined against the valve retainers 69 by valve blocks 71 inserted into the counterbores 65 and retained therein by annular lock rings 72.

It will be noted that the lock valves 67 are interposed between the pressure discharge passages 33 and the cylinder discharge passages 21, so that no flow of fluid from the bore 12 to the cylinder 24 can occur until the lock valves have been removed from their seats 64. Also, the lock valves 67 serve to lock fluid within the cylinder 24, so that a chosen position of the piston 24a will be retained until such time as the lock valves are opened and fluid is permitted to escape from the cylinder. In this connection, it will be noted that the passages 21 communicate with the interior of the valve blocks 71 through grooves 73 and passages 74 located rearwardly of the lock valves 67. Thus, return pressure from the cylinder 24 will not open the valves 67 from their seats 64.

The valve spool 45 is axially counterbored, as at 75, through substantially the entire bore length, and a plug 76 is inserted in the counterbore 75 between the two return grooves 49. Each of the grooves 49 is radially bored, as at 77, for communication with the counterbore 75, but communication between the two return grooves is prevented by the plug 76.

The back pressure land 50 at each end of the spool is provided with an axially extending back pressure bleed groove or passage 78 (best seen in Figure 2) for a purpose to be hereinafter more fully described, and each back pressure land is provided with a plurality of radial back pressure escape orifices 79 communicating with the central counterbore 75, also as best seen in Figure 2. In addition, the reduced end 52 of the spool is provided with radial relief passage 80 which is immediately adjacent the land 50. It will be noted from Figure 1 that the land 50 is spaced from the adjacent retainer 37 when the spool is in its central position of Figure 1 to provide a back pressure chamber 81.

Operation

As hereinbefore explained, the valve of the present invention is effective to cause either complete movement of the cylinder to the end of its stroke even though the valve handle is manually released, or to complete manual adjustment of the cylinder to a desired position in accord-

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ance with the movement of the handle. These two types of operation of the handle will be separately explained as follows:

Manually controlled operation

Upon actuation of the handle 57 in a clockwise direction as viewed in Figure 1, the primary land 46 is moved beyond the primary outlet port 31 to close off the left hand primary inlet port 30 from the primary outlet port 31. At the same time, the right hand flow directing land 48 is moved to close off the right hand primary inlet port 30.

The feathering groove 51 in the flow directing land 48 on the right hand side of the spool serves to gradually cut off the flow of pressured fluid from the right hand port 30 to the tractor port 20, while at the same time the left hand fluid directing land 43 is being interposed between the left hand pressure port 32 and the return port 26. The feathering groove 51 on the left hand fluid directing land 48 serves to gradually establish communication between the left and primary inlet port 30 and the left hand pressure discharge port 32. Thus, by the provision of the feathering grooves 51, close control can be maintained over the speed of piston movement, and there is no possibility of completely shutting off fluid pressure flow through the valve housing at any time during valve-spool movement.

When the valve spool assumes its position illustrated in Figure 3, it will be seen that the flow of fluid pressure from the pump P to the tractor system TR has been completely interrupted and the entire output of the pump is passing through the left hand branch of the conduit 16 through the left primary inlet port 30 and the left hand pressure discharge port 32. The left hand movement of the spool has compressed the centralizing spring 42 between the two washers 39 and 40 and, if the handle 57 is released, the spring will return the spool to its central position at which the washer 39 abuts the terminal shoulder 36 of the bore.

Fluid pressure flow from the pressure discharge port 32 is directed downwardly through the fluid pressure passage 33 into the lower bore 13, inasmuch as the land 48 is interposed between the discharge port 32 and the return port 34. The pressure in the bore 13 is confined to the left hand side of the freely movable shuttle 61, and such pressure causes the shuttle to move to the right effecting engagement of the projection 63 with the right hand spherical lock valve 67 urging the valve against the adjacent valve retainer 69 and away from the seat 64 to accommodate return fluid from the cylinder 24 as will be hereinafter described.

The same fluid pressure which is effective to move the shuttle 61 is also exerted upon the left hand spherical lock valve 67. This pressure is sufficient to overcome the compression spring 68 and to move the left hand lock valve away from its seat 64.

Fluid flow will now be accommodated through the valve 67 and the associated passage 66, then through the cylinder line 22 to the cylinder bore 23, causing movement of the cylinder piston 24a toward the right hand side of the cylinder spool.

Movement of the cylinder piston will generate back pressure on the right hand side of the cylinder piston, inasmuch as a double acting piston of this type is always full of fluid on both sides of the piston. Fluid under this back pressure will

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escape through the right hand fluid conduit 22 upwardly beyond the lock valves 67 and past the shuttle projection 62 into the right hand pressure discharge passage 33. The shuttle projection 62 is slotted, as at 62a, to insure the passage of return fluid even though the shuttle projection may abut the lock valve seat 64.

Fluid from the right hand passage 33 will flow into the right hand pressure discharge port 32 and then through the return groove 49 of the spool into the right hand return port 34, the fluid passing through the right hand return conduit to the pump P. Thus, it will be appreciated that the flow of pressured fluid through the valve is under the control of the handle when the handle is actuated in accordance with the foregoing description.

Minute adjustments in actuation of the cylinder piston 24a may be made by merely cracking the valve to an open position at which communication between the primary inlet port and the associated pressure discharge port takes place only through the corresponding venting groove 51 and any degree of valve opening from a mere feathering opening to a full flow opening may be obtained. Of course, it will be appreciated that the piston 24a may be moved to the left by merely actuating the handle 57 in a counterclockwise direction. In either instance, the operation is the same as hereinbefore described.

Valve holdover operation

The valve 10 may also be utilized for holdover operation of the cylinder, that is movement of the handle to an exaggerated position will effect movement of the valve spool to such a degree that the valve is held open until the cylinder piston reaches the end of its stroke, at which time the valve will be returned to a centered position.

The movement of the valve to an extreme position is illustrated in Figure 4 of the drawings, wherein it will be noted that the valve handle has been moved so that the valve spool has been urged to the left well beyond the degree of movement illustrated in Figure 3. More particularly, the valve has been moved to the left so that the right hand back pressure land 50 completely shuts off the corresponding right hand return groove 34. Also, it will be noted that the primary land 46 is still interposed between the primary outlet port 31 and the left hand primary inlet port 30. The venting grooves 51 are well beyond the associated ports 30 and 32 so that the valve is now in its fully opened position and pump flow is being fully delivered to the left hand side of the cylinder piston 24a.

The spherical lock valves 67 are both fully open and the flow of fluid to the left hand side of the cylinder piston is substantially the same as that described in connection with Figure 3. Return flow of fluid from the right hand side of the piston again occurs through the piston conduit 22 through the right hand lock valve 67, through the right hand pressure discharge passage 33 and into the right hand pressure discharge port 32. Pressured fluid within the port 32 cannot escape to the tractor system TR, since the right hand flow directing land 48 is imposed between the port 22 and the port 30, nor can fluid escape through the right hand return groove 34 to the pump P, since the back pressure land 50 at the right hand end of the spool covers this port 26.

Fluid flow is thus directed through the radial by-pass port 77 in the spool into the axial back pressure passage 75. Back pressure fluid can escape from the passage 75 through the radial

port 80 on the right hand side of the back pressure land 50 into the chamber 81 defined between the back pressure land 50 and the right hand re-
tainer 37. Fluid within this chamber 81 will exert pressure within the chamber and against the right hand face 82 of the back pressure land to urge the valve spool toward the left against action of the compression spring 42.

It will be appreciated that back pressure will be generated within the chamber 81 at any time that the back pressure land 50 fully covers the return port 34, and this pressure will urge the spool further toward the left against the action of the spring until the spring is fully compressed or until pressure is vented from the chamber 81.

In Figure 4, the valve spool is illustrated in its furthest leftward position and it will be noted that the radial back pressure escape orifices 79 communicate with the return port 34, so that pressure within the back pressure passage 75 will be vented to the port 34 through the orifices 79. However, there will still be a substantial pressure within the chamber 81 which is sufficient to hold the valve in its left hand position, since restricted communication only is possible between the escape orifices and the escape port and the back pressure generated will be sufficient to hold the valve spool against the spring 42.

Thus, it will be seen that the valve will be held in its position toward the left against the action of the spring so long as substantial back pressure exists within the chamber 81, i. e., so long as a substantial back pressure is generated within the cylinder. When the cylinder reaches the end of its stroke, there is no fluid on the right hand side thereof, the fluid has been exhausted back to the pump P and there is no back pressure within the passage 75 or the chamber 81.

At this time, the spring 42 urges the valve from its position of Figure 4 toward its position of Figure 1. Any fluid remaining within the chamber 81 is forced from the chamber through the bleed passage 78 into the return groove 49 and thence through the return line 25 to the pump. Thus, the valve spool is recentered within the housing and the valve is ready for actuation, as desired to effect another cycle of operation of the cylinder.

Operation of the valve upon movement of the handle in a counterclockwise position is substantially the same as that hereinbefore described. Upon movement of the valve spool to the right, the spring 42 is compressed between the washer 40 backed by the snap ring 58 and the washer 39 backed against the housing shoulder 35. When the land 50 at the left end of the spool covers the left hand port 34, holdover action occurs as hereinbefore described.

From the foregoing description of the structure and function of the present invention, it will be appreciated that the present invention provides a manually controlled valve for effecting actuation of a cylinder piston through either its full stroke or through a portion of the stroke. The valve may be moved to an extreme position so that the valve is automatically held open until such time as the cylinder piston stroke has been completed or the cylinder stroke may be limited under complete manual control upon movement of the actuating handle to a position short of its extreme position.

It will, of course, be understood that various details of construction may be varied through a wide range without departing from the principles of this invention and it is, therefore, not the purpose to limit the patent granted hereon otherwise

than necessitated by the scope of the appended claims.

I claim:

1. A control valve adapted to be interposed between a source of fluid pressure and a fluid motor having a cylinder and a piston reciprocable therein, comprising a valve casing having an interior bore connecting a pressure fluid inlet to a first cylinder port means on one side of said piston, said valve bore also connecting a second cylinder port means on the other side of said piston and an exhaust outlet connected to said source, a movable valve spool in said casing having an enlarged terminal portion and an enlarged land interposed between said pressure fluid inlet and said exhaust outlet when said spool is in its normal central position, means resiliently urging said spool to its central position, additional valve means normally interposed between said second cylinder port means and said exhaust outlet, said spool being manually movable from its central position to connect said pressure fluid inlet and said first cylinder port means, thereby moving said piston in said cylinder, working motor pressure being effective to actuate said additional valve means, said spool enlarged terminal portion being interposed between said second cylinder port means and said exhaust outlet, said spool having a by-pass conduit accommodating the flow of exhaust fluid past said terminal portion to a portion of said bore closed by said terminal portion, said terminal portion having a restricted orifice accommodating partial flow of exhaust fluid to said exhaust outlet, thereby generating pressure upon said terminal portion acting in opposition to said resilient means to retain said spool in its moved position so long as working pressure is present in said motor.

2. A control valve adapted to be interposed between a source of fluid pressure and a fluid motor having a cylinder and a piston reciprocable therein, comprising a valve casing having an interior bore connecting a pressure fluid inlet to a first cylinder port means on one side of said piston, said valve bore also connecting a second cylinder port means on the other side of said piston to an exhaust outlet connected to said source, an axially movable valve spool in said bore having an enlarged terminal portion and an enlarged land interposed between said pressure fluid inlet and said exhaust outlet when said spool is in its normal central position, spring means contacting one end of said spool in opposed relation to said enlarged portion resiliently urging said spool to its central position, additional valve means normally interposed between said second cylinder port means and said exhaust outlet, said spool being manually movable from its central position against the spring means to connect said pressure fluid inlet and said first cylinder port means, thereby moving said piston in said cylinder, working motor pressure being effective to actuate said additional valve means, said enlarged terminal portion being interposed between said second cylinder port means and said exhaust outlet, said spool having an axial by-pass conduit accommodating the flow of exhaust fluid past said terminal portion to a portion of said bore closed by said terminal portion, said terminal portion having a restricted orifice registerable with said exhaust outlet accommodating only limited flow of exhaust fluid to said exhaust outlet, thereby generating pressure upon said terminal portion acting in opposition to said spring means to retain said spool in its moved position.

tion so long as working pressure is present in said motor.

3. A control valve adapted to be interposed between a source of fluid pressure and a fluid motor having a cylinder and a piston reciprocable therein, comprising a valve casing having an interior bore connecting a pressure fluid inlet to a first cylinder port means on one side of said piston, said valve bore also connecting a second cylinder port means on the other side of said piston and an exhaust outlet connected to said source, a movable valve spool in said casing having an enlarged terminal portion and an enlarged land interposed between said pressure fluid inlet and exhaust outlet when said spool is in its normal central position, mean resiliently urging said spool to its central position, additional valve means normally interposed between said second cylinder port means and said exhaust outlet, said spool being manually movable from its central position to connect said pressure fluid inlet and said first cylinder port means, thereby moving said piston in said cylinder, working motor pressure being effective to actuate said additional valve means, said enlarged terminal portion being interposed between said second cylinder port means and said exhaust outlet, said spool having a by-pass conduit accommodating the flow of exhaust fluid past said terminal portion to a portion of said bore closed by said terminal portion, said terminal portion having a restricted orifice accommodating only restricted flow of exhaust fluid to said exhaust outlet, thereby generating pressure upon said terminal portion acting in opposition to said resilient means to retain said spool in its moved position so long as working pressure is present in said motor, and said enlarged terminal portion being provided with an aperture communicating with the spool by-pass conduit and registerable with said exhaust outlet only after said spool has been moved by said pressure acting on said terminal portion, thereby accommodating full flow of exhaust fluid while holding said spool in opposition to said resilient means.

4. A control valve adapted to be interposed between a source of fluid pressure and a double acting fluid motor having a reciprocable piston comprising a valve housing having a cylindrical interior bore connecting a pressure fluid inlet to a pair of cylinder ports on opposing sides, respectively, of said piston, said valve bore also connecting said pair of cylinder ports to exhaust outlets connected to said source, a valve spool axially movable in said bore having radially enlarged lands interposed between said pressure fluid inlet and said cylinder ports, respectively, and having radially enlarged terminal heads fitting snugly in said bore, said spool having separate axial by-pass passages at the opposite ends thereof bridging said terminal heads, respectively, resilient means biasing said spool to a central position in said bore, means for moving said spool axially in said bore to place one of said cylinder ports in communication with said pressure fluid inlet to subject one side of said motor piston to pressured fluid and to generate exhaust pressure on the other side of said piston due to piston movement, movement of said spool taking place against the biasing force of said resilient means and spool movement preventing exhaust fluid flow to the exhaust outlet normally in communication with said other side of said piston by positioning the corresponding one of said terminal heads across said port, so that flow of exhaust

fluid occurs through the by-pass passage bridging said one terminal head and the exhaust fluid pressure is exerted on said one head to hold said spool in its moved position against the biasing force of said resilient means, and said head having a vent passage registerable with the associated exhaust outlet only after the subjection of the head to exhaust fluid pressure to accommodate the escape of exhaust fluid through said exhaust outlet.

5. A control valve adapted to be interposed between a source of fluid pressure and a fluid motor having a reciprocable piston, comprising a valve casing having a cylindrical interior bore connecting a pressure fluid inlet to a first cylinder port on one side of said piston, said valve bore also connecting a second cylinder port on the other side of said piston and an exhaust outlet connected to said source, a generally cylindrical movable valve spool in said casing having an enlarged terminal portion defining an end face at one end of the spool and an enlarged land interposed between said pressure fluid inlet and said cylinder port when said valve is closed, spring means acting on the other end of the spool resiliently urging said spool to the position at which said valve is closed, additional valve means normally interposed between said second cylinder port and said exhaust outlet, said spool being manually movable from its closed position to connect said pressure fluid inlet and cylinder port, thereby moving said piston in said cylinder, piston movement generating exhaust pressure in said fluid motor effective to actuate said additional valve means to normally establish communication between said second cylinder port and said exhaust outlet, said enlarged terminal portion being interposed between said second cylinder port and said exhaust outlet, a by-pass passage accommodating the flow of exhaust fluid past said terminal portion to a portion of said bore closed by said terminal portion and communicating with the end face of the spool, said spool having a restricted orifice accommodating only restricted flow of exhaust fluid past said terminal portion to said exhaust outlet, thereby generating pressure upon said end face acting in opposition to said resilient means to retain said spool in its moved position so long as exhaust pressure is generated by piston movement, and said enlarged portion is provided with an aperture communicating with the spool by-pass conduit and registerable with said exhaust outlet only after said spool has been moved by said pressure acting on said end face, thereby accommodating full flow of exhaust fluid while holding said spool in opposition to said resilient means.

6. A control valve adapted to be interposed between a source of fluid pressure and a double acting fluid motor having a reciprocable piston, comprising a valve housing having a cylindrical interior bore connecting a pressure fluid inlet to a pair of cylinder ports on opposing sides, respectively, of said piston, said valve bore also connecting said pair of cylinder ports with exhaust outlets connected to said source, a valve spool axially movable in said bore having radially enlarged lands interposed between said pressure fluid inlet and said cylinder ports, respectively, and having radially enlarged terminal heads fitting snugly in said bore to define exhaust pressure chambers at either end of said bore, said spool having separate axial by-pass passages at the opposite ends thereof bridging said terminal heads, respectively, resilient means biasing said

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spool to a central position in said bore, means for moving said spool axially in said bore against the bias of said resilient means to place one of said cylinder ports in communication with said pressure fluid inlet to subject one side of said motor piston to pressured fluid and to generate exhaust pressure on the other side of said piston due to piston movement, spool movement closing the exhaust outlet in communication with the other side of said piston through the other of said cylinder ports by positioning the corresponding one of said terminal heads across said outlet, so that flow of exhaust fluid into the adjacent exhaust pressure chamber occurs through the by-pass passage bridging said one terminal head, the exhaust pressure in said one chamber acting on said head to hold said spool in its moved position

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against the biasing force of said resilient means, and said head having a vent passage registerable with the associated exhaust outlet only after the subjection of the head to exhaust pressure to accommodate the escape of pressure from said exhaust pressure chamber to said exhaust outlet.

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