

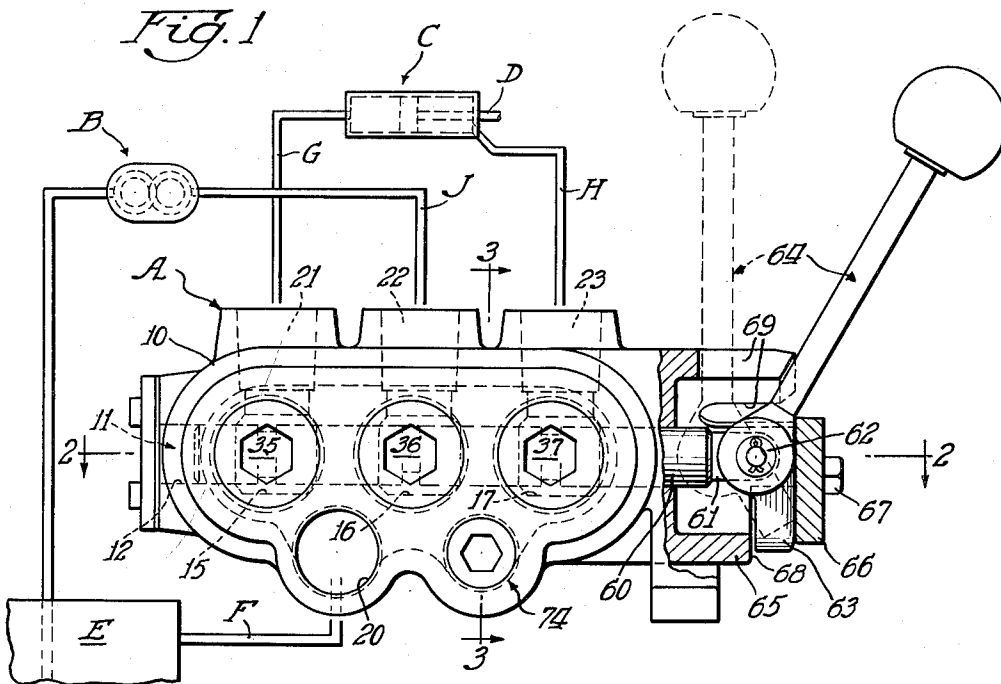
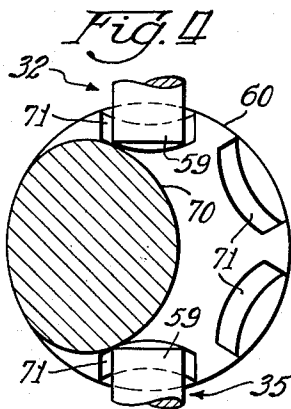
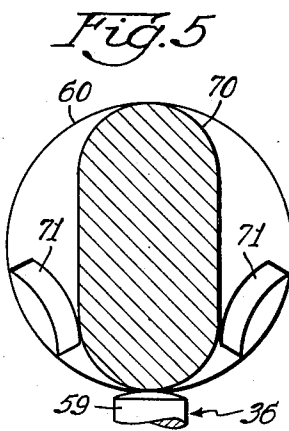
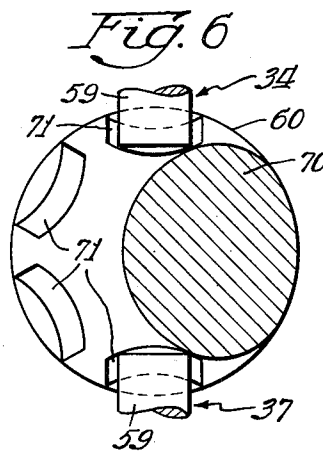
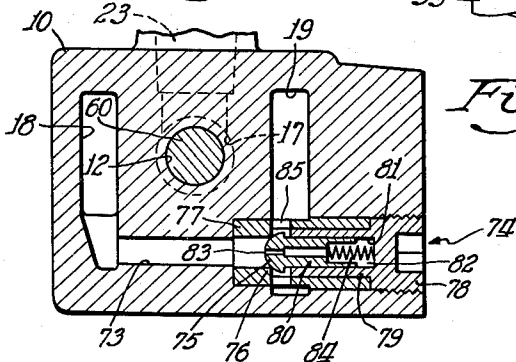
April 4, 1961

W. W. HEADINGS
SELECTOR VALVE ASSEMBLY

2,977,983

Filed Feb. 26, 1959

3 Sheets-Sheet 1



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2,977,983

SELECTOR VALVE ASSEMBLY

Filed Feb. 26, 1959

3 Sheets-Sheet 2

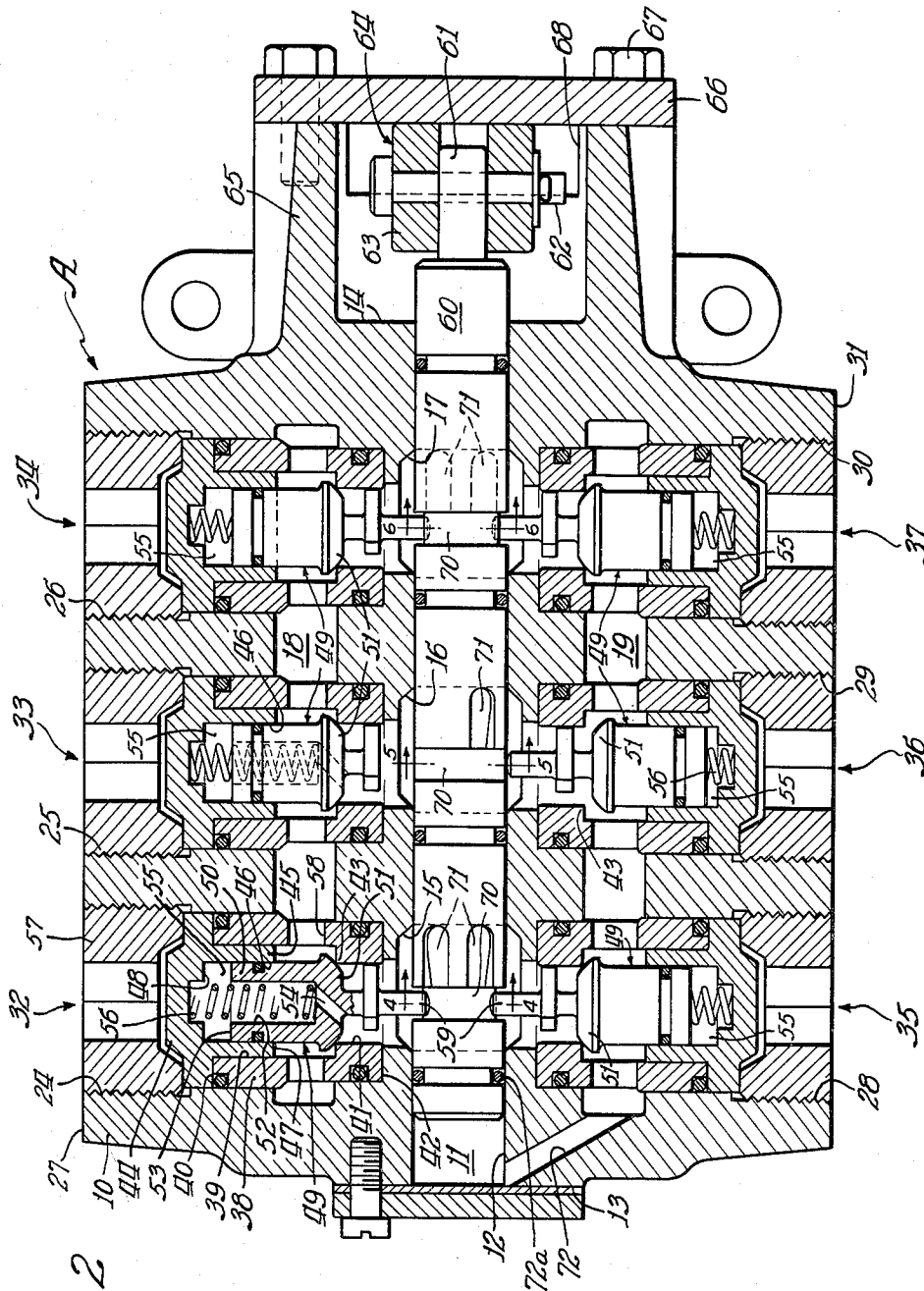


Fig. 2

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SELECTOR VALVE ASSEMBLY

2,977,983

Filed Feb. 26, 1959

3 Sheets-Sheet 3

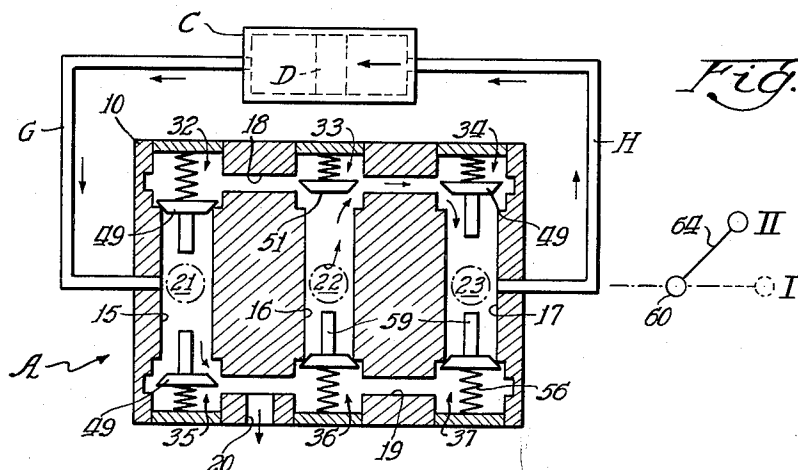


Fig. 7

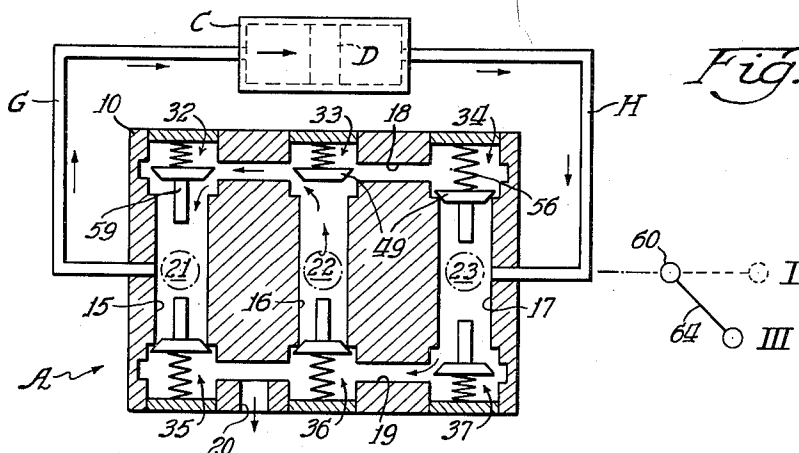


Fig. 8

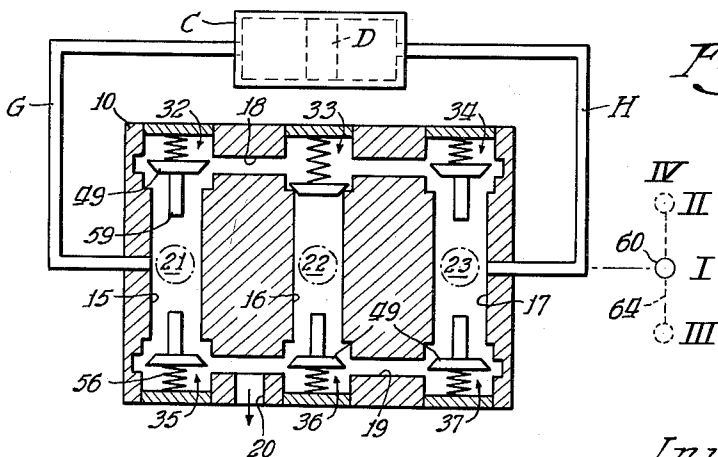


Fig. 9

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2,977,983

SELECTOR VALVE ASSEMBLY

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Filed Feb. 26, 1959, Ser. No. 795,726

2 Claims. (Cl. 137—622)

This invention relates to an improved hydraulic control valve, and, in particular, relates to a hydraulic control valve for controlling the flow of pressure fluid from a source to opposite sides of a pressure fluid operated motor whereby the motor may be operated in one direction, be operated in an opposite direction, be maintained in a particular operating position, or be permitted to seek its own operating position.

It is well known in the art to provide a hydraulic control valve having four operating positions whereby the control valve is adapted to selectively control the flow of pressure fluid from a source of hydraulic fluid to a pressure fluid operated motor, such as a hydraulic lift, to operate the motor in the above-mentioned manner. The hydraulic motor normally comprises a piston and cylinder arrangement, the piston being connected to a load device.

The prior known type of hydraulic control valve, when in one operating or neutral position thereof, maintains the hydraulic fluid within each end of the motor cylinder to thereby maintain the motor piston in its particular operating position. Upon actuation of the control valve to another operating position, the control valve permits a flow of hydraulic fluid from the source to enter one end of the motor cylinder to cause movement of the motor piston in one direction, and simultaneously permits the escape of fluid from the other end of the cylinder to a reservoir. When the control valve is moved to another operating position, the control valve directs hydraulic fluid from the source to the other end of the cylinder to effect movement of the motor piston in the opposite direction, and simultaneously permits the hydraulic fluid at the one end of the cylinder to escape to the reservoir. When the hydraulic control valve is moved to a fourth operating position, the hydraulic control valve permits the hydraulic fluid at each end of the motor cylinder to be fluidly interconnected in such a manner that the motor piston is permitted to seek its own operating position by the load imparted thereto.

Some of the prior known hydraulic control valves each utilize a spool valve for directing the hydraulic fluid in the above described manner, the spool valve permitting relatively accurate control over the flow of the fluid. However, it has been found that in order to facilitate ease of movement of the spool valve relative to the valve housing in order to permit accurate control of the motor operated thereby, a predetermined clearance space must be maintained between the spool valve and its accommodating bore formed in the valve housing. When such a clearance space is provided, it has been found that fluid leakage results thereby permitting the motor piston to seek its own operating position when it is desired to maintain the motor piston in one particular operating position. In order to overcome this disadvantage of the spool type hydraulic control valves, certain other designs of hydraulic control valves have been created whereby a plurality of poppet type valves are utilized.

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The poppet valve is particularly adapted to this type of arrangement because the poppet valve maintains positive contact with its respective valve seat means when in the closed position thereby preventing fluid leakage therearound. However, due to the high pressure values of the pressure fluid utilized in certain hydraulic applications and acting against the poppet valves, a relatively large force is required to actuate the poppet valves between the opened and closed positions thereof and thereby reducing the advantage of sensitive control of the flow of fluid to the hydraulic motor operated thereby.

It is, therefore, an object of this invention to provide an improved hydraulic control valve whereby fluid leakage is held at a minimum and at the same time maintain an ease of operation thereof in order to provide sensitive control.

Another object of this invention is to provide an improved hydraulic control valve utilizing a plurality of poppet type valves which are adapted to control the flow of high pressure fluid with a minimum of fluid leakage and at the same time permit movement thereof between the opened and closed positions with a minimum of effort.

A further object of this invention is to provide a hydraulic control valve assembly comprising a housing having a cavity therein, a pair of bores formed in the housing and intersecting the cavity, a chamber in the housing, a plurality of passage means in the housing respectively interconnecting the bores with the chamber, a plurality of valves disposed respectively in the passage means, whereby each valve when in a closed position prevents fluid communication through the respective passage means and when in an opened position permits fluid communication through the respective passage means, and a movable member disposed in the cavity and being operatively interconnected with the valves to effect operation thereof upon movement of the member relative to the housing whereby, when the member is in a neutral position, fluid communication is prevented between the bores and the chamber; when the member is moved to one position, fluid communication is permitted between one of the bores and the chamber; and when the member is moved to another position, fluid communication is permitted between the other of the bores and the chamber.

Other and more particular objects, advantages, and uses of this invention will become apparent from a reading of the following specification taken in connection with the accompanying drawings forming a part thereof and wherein:

Figure 1 illustrates a side view of a hydraulic control valve formed in accordance with the teachings of this invention.

Figure 2 illustrates, in an axial cross-sectional view, various operating parts of the hydraulic control valve illustrated in Figure 1 and is taken on line 2—2 thereof.

Figure 3 illustrates, in an axial cross-sectional view, other operating parts of the hydraulic apparatus illustrated in Figure 1 and is taken on line 3—3 thereof.

Figure 4 illustrates, in a partial cross-sectional view, certain operating elements of the hydraulic apparatus illustrated in Figures 1 and 2 and is taken on line 4—4 of Figure 2.

Figure 5 illustrates, in a partial cross-sectional view, certain operating elements of the hydraulic apparatus illustrated in Figure 2 and is taken on line 5—5 thereof.

Figure 6 illustrates, in a partial cross-sectional view, certain operating elements of the hydraulic apparatus illustrated in Figure 2 and is taken on line 6—6 thereof.

Figure 7 illustrates, in a schematic view, one of the operating positions of the hydraulic control valve illustrated in Figure 1.

Figure 8 illustrates, in a schematic view, another operating position of the hydraulic control valve.

Figure 9 illustrates, in a schematic view, a fourth operating position of the hydraulic control valve.

Reference is now made to the accompanying drawings wherein like reference numerals and letters are used throughout to designate like parts where appropriate, and particular reference is made to Figure 1 illustrating a hydraulic control valve A adapted to control the flow of fluid from a fluid pressurizing device or source B to a hydraulically operated motor C to effect movement of a motor piston D thereof in opposite directions, maintain the motor piston D in a particular operating position, or permit the motor piston D to seek its own operating position.

As shown in Figures 1 and 2, the hydraulic control valve A comprises a housing 10 having a centrally disposed cavity 11 formed therein, the cavity 11 being defined by a cylindrical bore 12 respectively interrupting end surfaces 13 and 14 of the housing 10 and a plurality of axially spaced, substantially, annular grooves 15, 16, and 17 formed within the bore 12. A pair of chambers 18 and 19 are formed in the housing 10 and are respectively disposed on opposite sides of the cavity 11. The chamber 19 forms a return chamber and is fluidly interconnected with a source or reservoir E of hydraulic fluid by suitable conduit means F fluidly interconnected with the source E at one end thereof and with a passage 20 formed in the housing 10 at the other end thereof, the passage 20 being in fluid communication with the return chamber 19.

A plurality of bores 21, 22, and 23 are formed in the housing section 10 and respectively interconnect the annular grooves 15, 16, and 17 of the cavity 11 with the exterior of the housing 10 (see Figure 1). The bore 21 is fluidly interconnected with the left side of the motor C by suitable conduit means G, and the bore 23 is interconnected with the right side of the motor C by suitable conduit means H, the bores 21 and 23 being hereinafter referred to as motor bores. The bore 22 is suitably interconnected with the hydraulic pressurizing device or source B by conduit means J, the bore 22 being hereinafter referred to as the source bore. It is to be understood that the pressurizing device B receives fluid from the source E, pressurizes the same, and forces the pressurized fluid out through the conduit means J to the source bore 22. It is also to be understood that any other type of pressure fluid supplying means may be utilized and interconnected with the source bore 22 if desired.

The housing 10 is provided with a plurality of spaced, stepped bores or passage means 24, 25, and 26 interrupting a side 27 of the housing 10 and respectively interconnect the annular grooves 15, 16, and 17 of the cavity 11 with the chamber 18. Similarly, a plurality of spaced, stepped bores or passage means 28, 29, and 30 interrupt another side 31 of the housing 10 and respectively interconnect the annular grooves 15, 16, and 17 with the return chamber 19. A plurality of poppet type valve assemblies, indicated generally by the reference numerals 32-37, are disposed respectively in the stepped bores or passage means 24-26 and 28-30. Since each valve assembly 32-37 is substantially the same as the other valve assemblies, except for slight variations hereinafter set forth, only the valve assembly 32 will be described in detail, it being understood that the other valve assemblies 33-37 are formed in substantially the same manner as the valve assembly 32.

The valve assembly 32 comprises a stepped sleeve member 38 disposed within the stepped bore 24. The sleeve member 38 is provided with a bore 39 interrupting an end 40 thereof and interconnecting with a smaller bore 41 interrupting another end 42 thereof, the bores 39 and 41 forming a valve seat 43 at the juncture thereof. A plug member 44 is disposed within the stepped bore 24 and is provided with a cylindrical projection 45

which is telescopically received within the bore 39 formed in the sleeve member 38. The plug member 44 is provided with a bore 46 which interrupts an end 47 of the cylindrical projection 45 and terminates within the plug member 44 to define an end wall 48 thereof. A poppet valve 49 is disposed within the bore 39 of the sleeve member 38 and has a cylindrical portion 50 thereof telescopically received within the bore 46 of the plug member 44. The poppet valve 49 is provided with a valve head 51 which is adapted to engage the valve seat 43 and thereby prevent fluid communication between the bores 41 and 39 in the sleeve member 38. The cylindrical portion 50 of the poppet valve 49 is provided with a bore 52 which interrupts an end 53 thereof and interconnects with an angularly disposed bore 54 formed in the valve head 51. When the poppet valve 49 is seated, the end 53 thereof is disposed spaced from the end wall 48 of the plug member 44 and defines a chamber 55 therewith which is adapted to be in communication with the annular groove 15 by means of the bores 52 and 54. A compression spring 56 is disposed within the bore 52 of the poppet valve 49 and has one end thereof engaging the poppet valve 49 and another end thereof engaging the plug member 44 thereby tending to maintain the valve head 51 of the poppet valve 49 in sealing contact with the valve seat 43. A threaded plug member 57 is disposed within the stepped bore 24 and is utilized to maintain the plug member 44 and the sleeve member 38 in a compact, sealing arrangement within the stepped bore 24. A plurality of radially disposed ports 58 are formed in the sleeve member 38 and fluidly interconnect the chamber 18 with the bore 39. In this manner, it can be seen that, when the poppet valve 49 is unseated, fluid communication is permitted between the motor bore 21 and the chamber 18 through the passage means 24.

The valves 49 of the valve assemblies 32, 34, 35, 36, and 37 are each provided with a projection 59 extending from the valve head 51 thereof and projecting toward the cavity 11. The purpose of the projections 59 will be hereinafter described.

The valve assemblies 32, 33, and 34 are so constructed that the diameters of the cylindrical portions 50 of the valves 49 are slightly smaller than the respective diameters of the valve seats 43. Since any pressure fluid present in the annular grooves 15, 16, and 17 is conveyed to the respective chamber 55 by the bores 54 and 52 when the valves 49 are seated, the force of any pressure fluid present in the annular grooves 15, 16, and 17 acting against the respective valve heads 51 slightly exceeds the force of the pressure fluid conveyed to the respective chambers 55 and acting against the ends 53 of the respective valves 49 and thereby tends to unseat the respective valves 49. The compression force of the springs 56 are set to overcome this effective force of the pressure fluid acting on the valves 49 tending to unseat the valves 49 and thus tends to maintain the valves 49 in sealing engagement with the valve seats 43. When pressure fluid is present within the chamber 18, in a manner later to be described, the force of the pressure fluid in the chamber 18 also tends to maintain the valves 49 in engagement with the respective valve seats 43 with the same force as the effective force acting on the valves 49 tending to unseat the valves. By thus substantially hydraulically balancing the valves 49 of the valve assemblies 32, 33, and 34, only a small force is required to unseat the valves 49 in opposition to the force of the springs 56.

The valve assemblies 35, 36, and 37 differ in construction from the valve assemblies 32, 33, and 34 in the following manner. The diameters of the cylindrical portions 50 of the valves 49 of the valve assemblies 35-37 are slightly larger than the diameters of the valve seats 43. In this manner, when any pressure fluid is present in the annular grooves 15, 16, and 17, the same is con-

veyed to the respective chambers 55 of the valve assemblies 35, 36, and 37 whereby the force of the pressure fluid within the chambers 55 slightly exceeds the force of the pressure fluid acting against the respective valve heads 51 and thereby tends to maintain the respective valves 49 in engagement with the valve seats 43. The springs 56 of the valve assemblies 35-37 are utilized to maintain the valves 49 in their seated positions when no hydraulic pressure exists in the annular grooves 15, 16, and 17. By thus substantially hydraulically balancing the valves 49 of the valve assemblies 35, 36, and 37, only a small force is required to unseat the respective valves 49 in opposition to the compression force of the springs 56 and the effective force of the pressure fluid acting on the respective valves 49.

An elongated movable member or cam shaft 60 is disposed within the bore 12 of the cavity 11 and is adapted to be axially and rotatably movable relative to the housing 10. As shown in Figures 1 and 2, an end 61 of the movable member 60 is pivotally connected by a pin 62 to a bifurcated end 63 of a manually operated control valve handle 64.

The housing 10 is provided with a tubular portion 65 extending from the end 14 thereof. An end plate 66 is suitably secured to the free end of the tubular portion 65 by a plurality of bolts 67. A section of the tubular portion 65 adjacent the end plate 66 is cut away to define an arcuate slot 68 with the end plate 66. The end 63 of the handle 64 is received within the slot 68.

When the handle 64 is in the position illustrated in bold lines in Figure 1, it can be seen that upon rotatable movement of the handle 64 relative to the housing 10, the end 63 thereof is permitted to move within the arcuate slot 68, the slot 68 defining the limits of rotational movement of the handle 64 relative to the housing 10. The upper section of the tubular portion 65 is provided with a plurality of slots 69, each slot being adapted to receive the handle 64 when the handle 64 is moved toward the housing 10. When the handle 64 is rotated into alignment with one of the slots 69, the handle may be moved toward the housing 10, as shown in dotted lines in Figure 1, effecting axial movement of the cam shaft 60 relative to the housing 10 as the end 63 of the handle 64 cams against the end plate 66.

The cam shaft or movable member 60 is provided with a plurality of spaced eccentrically disposed cam surface means 70 and a plurality of spaced sets of axially disposed cam surface means 71, each set of the axially disposed cam surface means 71 being disposed adjacent one of the eccentrically disposed cam surface means 70. (See Figures 4, 5, and 6.) The projections 59 of the valves 49 are adapted to engage the cam surface means 70 and 71 of the movable member 60 in the following manner. Since each poppet valve 49 of the valve assemblies 32, 34, 35, 36, and 37 are spring biased toward their closed positions, the compression force of the springs 56 tends to maintain the projections 59 thereof in engagement with the movable member 60. As shown in Figure 2, when the movable member 60 is in the particular axial position shown, the projections 59 of the valves 49 engage the eccentrically disposed cam surface means 70 thereof. The eccentrically disposed cam surface means 70 are so arranged that upon rotation of the movable member 60 relative to the housing 10 while remaining in the axial position shown in Figure 2, various valves 49 are cammed to their opened positions while others are permitted to move to their closed positions in various sequences set forth hereinafter. The axially disposed cam surface means 71 are disposed about the outer periphery of the movable member 60 in a predetermined pattern whereby as shown in Figures 2, 4, 5, and 6, the left end of each cam surface means 71 cooperates with an eccentrically disposed cam surface means 70. In this manner, when the projections 59 of the valves 49 are respectively in aligned relation with the axially

disposed cam surface means 71, axial movement of the movable member 60 to the left effects openings of the valves 49 in the sequence hereinafter set forth.

In order to permit axial movement of the movable member 60, the left end of the cavity 11 is fluidly interconnected with the return chamber 19 by a passage 72 formed in the housing 10. In this manner, any pressure fluid, which has leaked past suitable O-ring seals 72a carried by the movable member 60 and collected within the left end of the cavity 11, is permitted to escape to the return chamber 19 thereby preventing hydraulic locking of the movable member 60.

As shown in Figure 3, the chamber 18 is adapted to be fluidly interconnected with the return chamber 19 by a passage 73 formed in the housing 10. A relief valve, indicated generally by the reference numeral 74, is disposed within the passage 73 and is adapted to prevent pressure fluid present within the chamber 18 from exceeding a predetermined pressure value in the following manner.

The relief valve assembly 74 comprises a spring biased valve 75 adapted to engage a valve seat 76 formed in a hollow sleeve member 77 disposed in the passage 73. A plug member 78 has a cylindrical portion 79 thereof telescopically received in one end of the hollow sleeve member 77. A cylindrical portion 80 of the valve 75 is telescopically received in a bore 81 formed in the cylindrical portion 79 of the plug member 78 and defines a chamber 82 therewith which is fluidly interconnected with the passage 73 by a restricted orifice 83 formed in the valve 75. A spring 84 is interposed between the valve 75 and the plug member 78 whereby the compression force of the spring 84 tends to maintain the valve 75 in sealing engagement with the valve seat 76. When the valve 75 is unseated fluid communication is permitted between the passage 73 and the return chamber 19 through a plurality of ports 85 formed in the sleeve member 77.

The diameter of the valve seat 76 is slightly larger than the diameter of the bore 81 formed in the plug member 78 whereby the force of any pressure fluid present in the passage 73 acting against the right end of the valve 75 slightly exceeds the force of the pressure fluid in the chamber 82 acting against the left end of the valve 75 and thereby tends to unseat the valve 75. However, the compression force of the spring 84 is selected to overcome this excess force tending to unseat the valve 75 until the excess force exceeds a predetermined value. In this manner, the relief valve 74 tends to prevent the pressure value of the fluid pressure present in the chamber 18 from exceeding a predetermined pressure value.

The orifice 83 formed in the valve 75 tends to prevent excessive hunting and chattering of the relief valve 74 in the following manner. When the valve 75 is unseated by the excess force acting on the left end of the valve 75, the fluid trapped in the chamber 82 is vented out through the orifice 83. Because the fluid in the chamber 82 is displaced by the valve 75 being axially moved toward the plug member 78 during the pressure relieving operation of the relief valve 74, the displaced fluid is forced through the orifice 83 which is restricted in such a manner that the movement of the valve 75 to the right is retarded or dampened by the dash pot effect of the chamber 82 and orifice 83. Similarly, when the valve 75 is being moved to the closed position by the spring 84, the fluid returning to the chamber 82 through the orifice 83 to fill the vacuum created in the chamber 82 by the movement of the valve 75 to the left is retarded by the orifice 83 thereby dampening the movement of the valve 75 to the closed position. In this manner, the movement of the valve 75 between the opened and closed position is retarded and thus the tendency of the relief valve 74 to hunt and chatter is greatly reduced.

The particular details and operation of the pressure relief valve 74 are set forth and claimed in the co-pending patent application, S.N. 795,838, filed February 26, 1959.

The operation of the hydraulic control valve A will now be described. As shown in Figures 1 and 2, the control valve A is in a neutral position, i.e., the cam shaft or movable member 60 is in a first predetermined axial and rotatable position I relative to the housing 10. When the movable member 60 is in this first or neutral position I, the poppet valve 49 of the valve assembly 36 is cammed to its opened position by its respective eccentrically disposed cam surface means 70 of the movable member 60. The poppet valves 49 of the valve assemblies 32, 34, 35, and 37 are permitted to remain in their seated positions as illustrated by their respective eccentrically disposed cam surface means 70. Fluid from the source E is delivered under pressure by the pump B through the conduit J into the source bore 22. The hydraulic pressure fluid within the annular groove 16 of the cavity 11 is permitted to pass through the opened valve assembly 36 to the return chamber 19, which, in turn, is fluidly interconnected with the source E by the conduit F. When the valve assembly 36 is in this opened position, the force of the pressure fluid within the annular groove 16 is prevented from opening the valve 49 of the valve assembly 33. Any fluid present within each end of the motor C is prevented from escaping to the return chamber 19 by the closed poppet valve assemblies 32, 34, 35, and 37, and, therefore, the motor piston D is maintained in its particular operating position by the positive sealing action of the valve assemblies 32, 34, 35, and 37.

When the handle 64 of the control valve A is moved from the neutral or rotatable position I to a rotatable position II, as shown in Figure 7, the motor piston D is moved to the left in the following manner. When the movable member 60 is rotated relative to the housing 10 by the handle 64 being rotated to the rotatable position II, the valves 49 of the valve assemblies 34 and 35 are cammed to their opened positions by their respective eccentrically disposed cam surface means 70 of the cam shaft 60, the valves 49 of the valve assemblies 32 and 37 are permitted to remain in their closed positions by their respective cam surface means 70, and the valve 49 of the valve assembly 36 is permitted to move to its closed position by its respective cam surface means 70. When the valve 49 of the valve assembly 36 has moved to its closed position, the force of the hydraulic pressure conveyed from the source bore 22 into the annular groove 16 acts against the end 51 of the valve 49 of the valve assembly 33 and urges the same to the open position thereby permitting pressure fluid to enter the chamber 18, the chamber 18 being hereinafter referred to as a pressure chamber. The pressure fluid now present within the pressure chamber 18 is permitted to flow to the right side of the hydraulic motor C by passing through the opened valve assembly 34 into the motor port 23, and thus to the right side of the motor C by the conduit H to effect movement of the piston D to the left. Simultaneously, the fluid within the left side of the motor C is permitted to escape back to the source E, when expelled by the resulting movement of the motor piston D to the left, through the conduit means G, motor port 21, annular groove 15, opened valve assembly 35, return chamber 19, and the conduit means F.

If it is desired to operate the motor piston D to the right, the handle 64 of the control valve A is rotated to a rotatable position III as illustrated in Figure 8. When the handle 64 is rotated to the position III, the movable member or cam shaft 60 is simultaneously rotated relative to the housing 10 and cams open the valve assemblies 32 and 37 while permitting the valve assemblies 34, 35, and 36 to be moved to or remain in their closed positions. In this manner, pressure fluid which has passed through the opened valve assembly 33 into the

pressure chamber 18 passes through the open valve 32, motor port 21, and conduit means G into the left side of the hydraulic motor C to effect movement of the motor piston D to the right. Movement of the motor piston D to the right causes the fluid within the right side of the motor C to be expelled through the conduit H, motor port 23, annular groove 17, opened valve assembly 37, return chamber 19, and conduit means F to the source E. It is to be understood that the cam shaft may be rotated to any rotatable position between the positions II and III to provide for partial flow of fluid to either side of the motor C.

As shown in Figure 9, whenever the handle 64 is in one of the rotatable positions I, II, or III, the cam shaft or member 60 may be moved from the axial positions I, II, or III to an axial position IV to thereby permit the motor piston D to seek its own operating position in the following manner. Movement of the handle 64 toward the housing 10 is only permitted when the handle 64 is aligned with any one of the slots 69 formed in the tubular portion 65 of the housing 10. When the handle 64 is moved toward the housing 10 and is received in one of the slots 69, the movable member 60 is axially moved relative to the housing 10. It should be noted that when the cam shaft 60 is in one of the rotatable positions I, II, or III, one of the axially disposed cam surface means 71 of each set thereof is axially aligned with a projection 59 of a respective valve 49. (See Figures 4, 5, and 6.) Upon axial movement of the member 60 to the left from the position illustrated in Figure 2, the cam surface means 71 cams open the valve assemblies 32, 34, 35, 36, and 37 thus permitting fluid communication between the chambers 18 and 19 and the bores 21, 22, and 23. Since the valve assembly 36 is open, the valve assembly 33 is permitted to close as the pressure value of the pressure fluid within the annular groove 16 is insufficient to maintain the same in the opened position. Hydraulic fluid at either side of the motor C is now permitted to flow to the return chamber 19 through the respective conduit means G and H, motor ports 21 and 23, and opened valve assemblies 35 and 37. Therefore, if the load imposed on the motor piston D is tending to move the piston D to the right or left, the movement of the motor piston D is unaffected by hydraulic fluid.

As previously stated, since the valve assemblies 32-37 are substantially hydraulically balanced, the force of the compression springs 56 tending to maintain the valves 49 in their closed position is relatively small, a relatively small force is all that is required to cause movement of the movable member 60 relative to the housing 10 to thereby effect opening and closing of certain of the valves 49 through the various cam surface means 70 or 71. Thus it can be seen that the hydraulic control valve A utilizes poppet type valves for the purpose of preventing fluid leakage in such a manner that the control valve A requires a minimum of effort to operate the same regardless of the relatively high pressure value of the fluid controlled thereby and thereby permits sensitive and accurate control of the flow of fluid.

While this invention has been disclosed in connection with a certain specific embodiment thereof, it is to be understood that this was by way of example rather than limitation, and it is intended that the invention be defined by the appended claims.

What is claimed is:

1. A valve assembly comprising: a housing having a cavity therein; means defining a pair of bores in said housing intersecting said cavity; means defining a pressure chamber and a return chamber in said housing; means defining a plurality of passage means in said housing, a pair of said passage means respectively interconnecting said bores with said pressure chamber, another pair of said passage means respectively interconnecting said bores with said return chamber; a plurality of valves disposed respectively in said passage means, each valve

when in a closed position preventing fluid communication through the respective passage means and when in an opened position permitting said fluid communication; and a movable member disposed in said cavity, said member being adapted to be axially and rotatably movable relative to said housing and being operatively interconnected with said valves to effect operation of said valves upon movement of said member relative to said housing whereby when said member is in a first axial and rotatable position relative to said housing, fluid communication is prevented between said bores and said chambers; when said member is moved to a second rotatable position relative to said housing, fluid communication is permitted between one of said bores and said pressure chamber and between the other of said bores and said return chamber; when said member is moved to a third rotatable position relative to said housing, fluid communication is permitted between said other bore and said pressure chamber and between said one bore and said return chamber; and when said member is axially moved from said first axial position to another axial position relative to said housing, fluid communication is permitted between said bores and said chambers.

2. A valve assembly as set forth in claim 1 wherein the interconnection between said member and said valves

comprises, means defining axially disposed cam surface means on said member; means defining eccentrically disposed cam surface means on said member; means defining a projection extending from each valve; and biasing means carried by each valve tending to maintain the projection of the respective valve in contact with said cam surface means whereby said member upon rotatable movement thereof relative to said housing is adapted to effect operation of said valves between said opened and closed positions by said eccentrically disposed cam surface means, and said member upon axial movement thereof relative to said housing is adapted to effect operation of said valves between said opened and closed positions by said axially disposed cam surface means.

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