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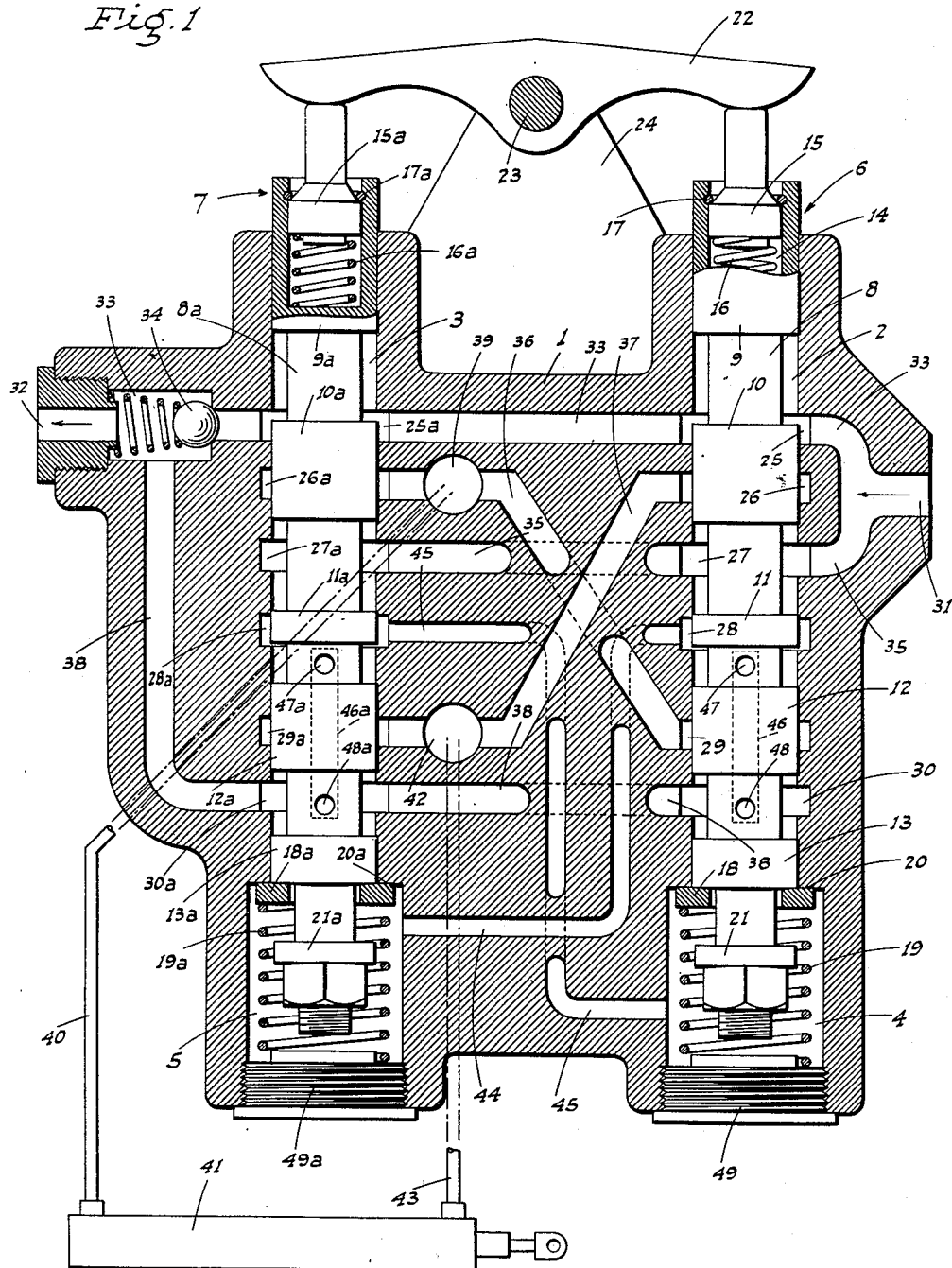
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OPEN-CENTER FOLLOW-UP CONTROL VALVE

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2 Sheets-Sheet 1

Fig. 1



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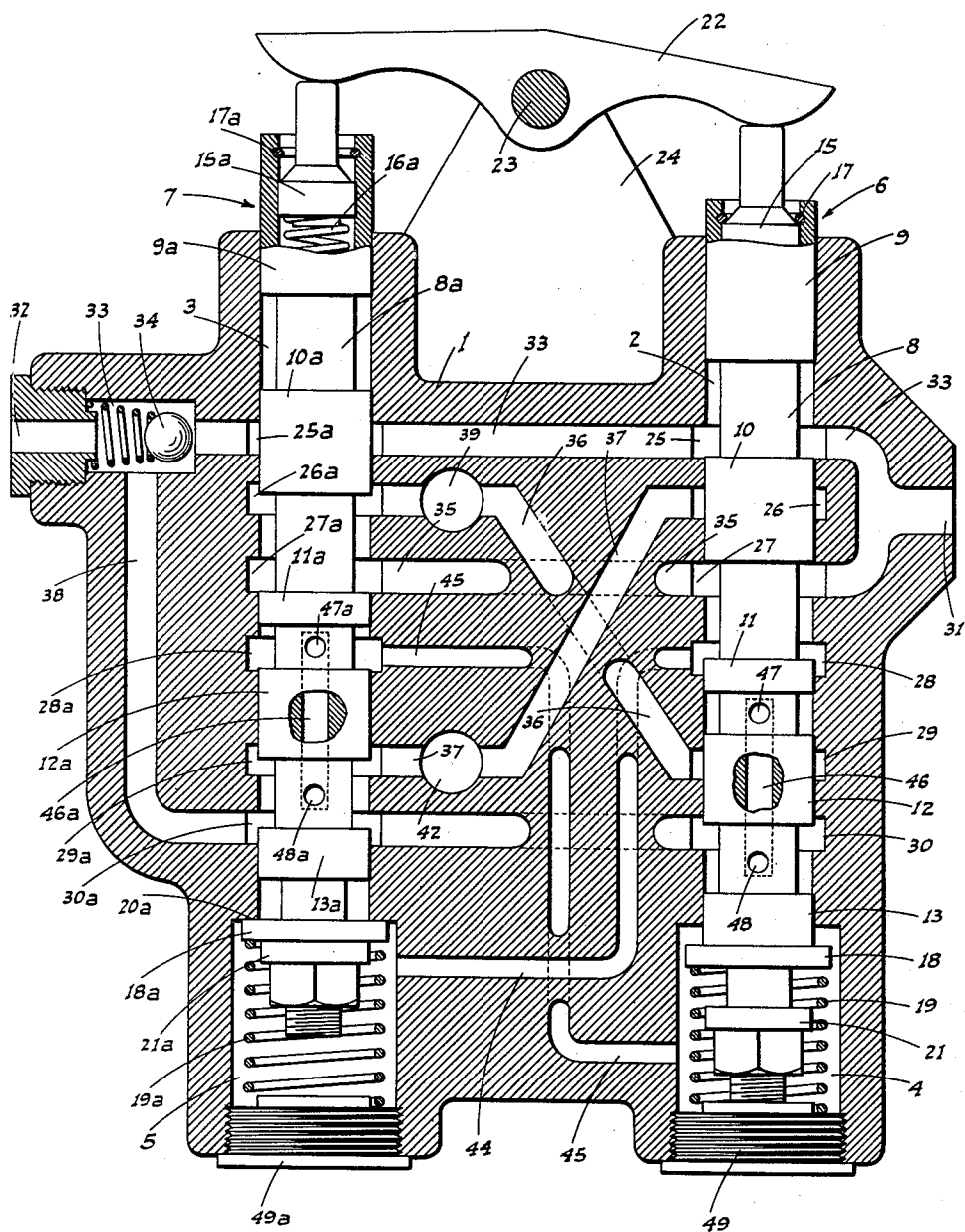
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OPEN-CENTER FOLLOW-UP CONTROL VALVE

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Fig. 2

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OPEN-CENTER FOLLOW-UP CONTROL VALVE

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8 Claims. (Cl. 137—622)

This invention relates to control valves of what are generally known as the open-center or piston type, and particularly adapted for use in a hydraulic-pressure system to control the operation of a hydraulic ram or the like.

One of the objects of this invention is to provide a valve of this general type having a pair of valve pistons interposed in the hydraulic conduit system in such a manner that upon manually or mechanically controlled movement of one piston the other piston will be power-moved to establish a pressure-flow communication between a source of pressure and the ram.

Another object of the invention is to arrange the two pistons in connection with the hydraulic porting and passage means so that either piston may thus be manually depressed and to cause the other piston to be power-moved to establish the desired pressure-flow to and from the ram. By reason of this arrangement a flow through the ram may be readily reversed by the movement of the ram itself, if desired.

A further and important object of the invention is to arrange the piston and passage structure so that a relatively small depressing movement of either piston is sufficient to cause a larger movement to be pressure-imparted to the other piston in the opposite direction, as is necessary and desirable to fully open relatively large fluid-flow passages between the source of pressure and the ram. This is advantageous, since in certain installations a small manually or mechanically controlled movement of the valve is all that can be used, and which small movement would be insufficient to provide the desired wide-open flow through the main conduits between the source of pressure and the ram, as is necessary to give a fast or "snappy" action to the ram.

It is also an object of the invention to provide an open-center follow-up control valve which is designed for ease and economy of manufacture.

Still another object of the invention is to provide a practical, reliable, and durable open-center follow-up control valve, and one which will be exceedingly effective for the purpose for which it is designed.

These objects are accomplished by means of such structure and relative arrangement of parts as will fully appear by a perusal of the following specification and claims.

In the drawings:

Fig. 1 is a sectional elevation of the valve with the plungers in a neutral or pressure bypassing position; the valve being shown in diagrammatic association with a ram.

Fig. 2 is a similar view, but shows one plunger depressed and the other plunger accordingly shifted by the fluid pressure to allow the main flow of fluid to pass to and from the ram controlled by the valve.

Referring now more particularly to the drawings and to the characters of reference marked thereon, the valve comprises a body 1 having a pair of spaced identical bores 2 and 3 extending from end to end of the body and

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including enlarged closed cylinder-forming portions 4 and 5 at one end.

Piston-type valve spools or plungers 6 and 7 of identical form are slidable in bores 2 and 3, respectively. Spool 6 comprises a central portion 8 of smaller diameter than the bore 2 and spaced bore-engaging lands 9, 10, 11, 12, and 13 thereon reading from the end of the spool opposite the enlarged bore portion 4. Land 13 is disposed adjacent said enlarged portion 4 to form a piston as well as to provide a closure or seal between said portion 4 and the main bore 2.

The opposite end land 9 of spool 2 is provided with a blind bore or socket 14 in which a short outwardly projecting plunger 15 is slidable; said plunger being yieldably urged outwardly by a spring 16 in the socket under the plunger, and the latter being limited in its outward movement by a stop ring 17 mounted in the land 9 and overhanging the plunger 15, as shown.

A washer 18 on the spool 6 within the bore portion 4 engages the adjacent end of the piston land 13, and is urged by a spring 19 so that said washer also normally engages the shoulder 20 formed at the junction of the bore portion 4 with the main bore 2, as shown in Fig. 1.

An adjustable stop 21 on the spool within the bore portion 4 and normally spaced from the washer 18 limits the axial movement of the spool land 13 away from said washer. Washer 18 clears the spool, as shown in Fig. 1, so that pressure within the cylinder 4 has access to the piston 13.

Similarly, spool 7 comprises a central portion 8a, and lands 9a, 10a, 11a, 12a, and 13a thereon of the same size, spacing, and arrangement as the lands 9-13 of spool 2. Also, the bore portion or cylinder 5 contains a washer 18a engaging land 13a and held against the same by a spring 19a, and a stop 20 on the spool 7 limiting movement of said spool land 13a away from the washer. The opposed land 9a supports an outwardly projecting plunger 15a mounted and controlled in said land by a spring 16a and a stop 17a in the same manner as plunger 15.

A rocker arm 22 extends over and engages the outer end of both plungers 15 and 15a, and is fixed centrally of its ends on a cross shaft 23 supported in connection with the body 1 by a bracket 24; the shaft being adapted for connection to a suitable actuating lever or the like (not shown).

By reason of the above described arrangement, it will be seen that when no outside pressure is exerted against the spools from either end, said spools will be disposed in horizontally parallel alinement, with washers 18 and 18a abutting their corresponding body shoulders, and with plungers 15 and 15a engaged with their stops 17 and 17a.

Also, it will be seen that rocking of arm 22 in one direction or the other will depress one spool or the other, and the flow of fluid through the valve to and from a ram or the like is controlled by a port and passage arrangement in the valve in the following manner:

Bore 2 is formed with longitudinally spaced annular grooves 25, 26, 27, 28, 29, and 30. The grooves are disposed relative to the spool 6 and the lands thereon so that when the spool is in its normal position groove 25 is open relative to land 10, while groove 26 is closed thereby. Groove 27 is disposed between lands 10 and 11, and groove 28 is closed to said groove 27 by land 11. Groove 29 is closed by land 12 and groove 30 is disposed between lands 12 and 13, all as shown in Fig. 1.

Similarly, bore 3 is formed with annular grooves 25a, 26a, 27a, 28a, 29a, and 30a, arranged in the same relation to the lands of spool 7 as the grooves 25-30 are arranged relative to the lands of spool 6, as above described.

The body 1 is formed on one side with a pressure intake port 31 and on the opposite side with an outlet port 32. A one-way passage 33 connects said ports, and intermediate its ends intersects and communicates with grooves 25 and 25a. Between groove 25a and port 32 a spring-closed check valve 34, opening toward said port, is interposed in the passage between said groove 25a and the port 32.

Another one-way pressure passage 35 connects port 31 and the grooves 27 and 27a. A main two-way pressure passage 36 connects grooves 29 and 26a, while another main two-way pressure passage 37 connects grooves 26 and 29a. A main relief passage 38 connects grooves 30 and 30a and extends thence to a connection with passage 33 between the check valve 34 and the port 32.

A port 39 in the body communicates with passage 36 between grooves 26a and 29, and is connected to a conduit 40 which extends to one end of a hydraulic ram 41 or the like. Similarly, another port 42 in the body communicates with passage 37 between grooves 26 and 29a and is connected to a conduit 43 which extends to the other end of the ram 41.

An auxiliary two-way passage 44 connects the groove 28 and the bore portion 5, while a similar passage 45 connects groove 28a and the bore portion 4.

A bypass passage 46 in the spool 6 terminates in ports 47 and 48 disposed between lands 11 and 12 and lands 12 and 13, respectively. Similarly, spool 7 has a bypass passage 46a and ports 47a and 48a disposed between lands 11a and 12a and lands 12a and 13a, respectively.

With the above described porting and passage arrangement, and with the spools 6 and 7 in their neutral position, as shown in Fig. 1, fluid under pressure entering the valve from port 31 passes quite freely to outlet port 32 through passage 33; the lands 10 and 10a being arranged to uncover grooves 25 and 25a. However, in doing so the fluid must lift the low-pressure relief ball 34 against the holding spring thereof, and which is set to hold back twenty-five or thirty pounds pressure. This retains sufficient pressure in the system to give power action to one valve plunger when the other plunger has been depressed.

At the same time, any pressure previously fed to bore portions (or cylinders) 4 and 5 is relieved therefrom; such pressure leaving cylinder 4—for instance—through passage 45 and passing thence to groove 28a, into the adjacent portion of the bore 3, and into spool passage 46a through port 47a and then out of port 48a and into groove 30a and the main relief or return passage 38. Similarly, and at the same time, pressure may leave cylinder 5 through passage 44, passing thence to groove 28, into the adjacent portion of bore 2, then into spool passage 46 through port 47, and then out of port 48 and into groove 30 and said passage 38.

Both main passages 36 and 37 to and from the ram 41 are then blocked off at both ends by lands 10 and 12 of spool 6, and lands 10a and 12a of spool 7, which close off the corresponding grooves in bores 2 and 3.

Either spool may be depressed by rocking of arm 22 in the corresponding direction; the extent of such depressing movement being limited by engagement of the end of the spool within the corresponding cylinder 4 or 5 with the corresponding outer end closure member 49 or 49a, respectively, of such cylinders.

With such depression of spool 6, as shown in Fig. 2, the lands thereof are of course shifted relative to the various bore grooves. Grooves 26 and 29, communicating with main passages 36 and 37, respectively, are still blocked or closed by lands 10 and 12 respectively. Land 11, however, now closes groove 28 to spool passage 46 and opens said passage to groove 27, and said grooves now communicate by reason of the intervening portion of bore 2.

Fluid under pressure, entering through port 31 and being held to a low pressure by the relief valve 34, is now

free to pass into and through passage 44 into cylinder 5. Such pressure then acts against piston land 13a of spool 7, shifting such spool from the position of Fig. 1 to the position of Fig. 2, or until stop 21a engages washer 18a and limits further movement of the spool 7. It will be noted however that as the plunger 7 has been moved a portion only of its full necessary travel, land 10a blocks off the passage 33, and the full pressure is then available to move the spool through the remainder of its stroke. Such movement of the spool is more than that permitted in the opposite direction, and the plunger 15—which constantly engages the arm 22—is depressed in the land 9a somewhat; the spring 16a being overcome by the greater force of the fluid acting on the piston 13a.

With this position of spool 7, as caused by pressure within the cylinder 5, groove 25a is shut off by land 10a, land 11a blocks communication between grooves 27a and 28a, and land 12 uncovers groove 29a; establishing communication between the grooves 29a and 30a. As a result of this repositioning of the lands relative to the grooves, fluid under pressure flows from the intake port 31 through passage 35 and thence into passage 36, by way of grooves 26a and 27a and the intervening portion of bore 3. The other end of passage 36 being blocked off by land 12 of spool 6, the pressure flows through port 39 and thence to ram 41 through conduit 40. At the same time, fluid from the ram leaves the opposite conduit 43 thereof and passes through port 42 and into passage 37; flowing thence through grooves 29a and 30a and into return passage 38 and out through port 32. It will be understood that ports 31 and 32 are connected to suitable pressure supply and return conduits.

When the hold-down pressure on the spool 6 is relieved by a turning of the rocker arm 22 in the opposite direction, said spool returns to its initial position by spring 19. This shuts off the pressure to cylinder 5, and such pressure returns from said cylinder to relief passage 38 by way of grooves 28 and 30 and the spool passage 46.

The spring 15a being loaded by arm 22, the spring action forces the spool 7 back to its initial neutral position, blocking or shutting off the flow of fluid to and from the ram, and holding the movable member of the latter in whatever position it had been shifted to by the opening of the valve.

Depression of spool 7 by arm 22 causes a similar fluid-actuated movement of the spool 6, and a feeding of fluid to the opposite end of the ram, as will be obvious.

From the foregoing description it will be readily seen that there has been produced such a device as substantially fulfills the objects of the invention, as set forth herein.

While this specification sets forth in detail the present and preferred construction of the device, still in practice such deviations from such detail may be resorted to as do not form a departure from the spirit of the invention, as defined by the appended claims.

Having thus described the invention, the following is claimed as new and useful and upon which Letters Patent are desired:

1. A control valve structure for a fluid pressure system comprising a body having spaced pressure intake and outlet ports, a normally open passage therebetween, and other ports arranged for connection to opposite ends of a fluid power unit, a pair of valve members separately movably mounted in the body, means including other passages in the body between the first named ports and said other ports to cause communication to be established between said first named and other ports in predetermined order upon movement of one valve member in one direction, and to then close said normally open passage upon movement of either valve member in the opposite direction, and means between the valve members and the pressure intake port whereby movement of either member in said one direction will cause the other member to be moved by fluid pressure in said opposite direction.

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2. A valve, as in claim 1, with means included with the valve members and the corresponding passages to cause movement of either member in said other direction to be greater than the movement thereof in the one direction.

3. A control valve structure for a fluid pressure system comprising a body having spaced pressure intake and outlet ports, a normally open passage therebetween, and other ports arranged for connection to opposite ends of a fluid power unit, a pair of piston type valves slidably mounted in the body in spaced side by side relation in intersecting relation to said passage between the intake and outlet ports but normally leaving the passage open, means controlled by predetermined axial movement of either valve to impart predetermined axial movement of the other valve in the opposite direction, control means to so move the valves selectively and alternately, means including other passages in the body between the first named ports and said other ports to cause communication to be established between the first named ports and said other ports in predetermined order, and to then close said normally open passage upon movement of either valve member in said opposite direction; and means included with the valves and corresponding passages arranged so that movement of either valve in said opposite direction will be greater than the movement thereof in the one direction.

4. A control valve structure for a fluid pressure system comprising a body having spaced pressure intake and outlet ports, a normally open passage therebetween, and other ports arranged for connection to opposite ends of a fluid power unit, a pair of piston type valves slidably mounted in the body in spaced side by side relation in intersecting relation to said passage between the intake and outlet ports but normally leaving the passage open, means controlled by predetermined axial movement of either valve to impart predetermined axial movement of the other valve in the opposite direction, control means to so move the valves selectively and alternately, means including other passages in the body between the first named ports and said other ports to cause communication to be established between the first named ports and said other ports in predetermined order, and to then close said normally open passage upon movement of either valve member in said opposite direction; and means included with the valves and corresponding passages arranged so that movement of either valve in said opposite direction will be greater than the movement thereof in the one direction, said last named means comprising plungers slidably mounted in the valves and projecting clear of the body from the end of said valves opposite that toward which the valves are moved in said one direction, springs seated in the valves under and engaging the plungers and resisting depression thereof, and other springs of a lesser strength than the first named springs mounted in the body under and engaging the valves to return said valves to their initial position after a valve shifting pressure on the rocker arm is relieved; the valve control means including a rocker arm pivoted centrally of its ends on the body in overhanging relation to and engaging the outer end of the plungers.

5. A control valve structure for a fluid pressure system comprising a body having spaced pressure intake and outlet ports, a normally open passage therebetween, and other ports arranged for connection to opposite ends of a fluid power unit, a pair of piston type valves slidably mounted in the body in spaced side by side relation in intersecting relation to said passage between the intake and outlet ports but normally leaving the passage open, means controlled by predetermined axial movement of either valve to impart predetermined axial movement of the other valve in the opposite direction, control means

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to so move the valves selectively and alternately, and means including other passages in the body between the first named ports and said other ports to cause communication to be established between the first named ports and said other ports in predetermined order, and to then close said normally open passage upon movement of either valve member in said opposite direction; said first named means including cylinders in the body at the ends of the valves opposite that toward which the valves move in said opposite direction, the valves including pistons on the adjacent ends thereof exposed to fluid pressure within the cylinders, and passage means from each cylinder to the intake port and in which the valve corresponding to the other cylinder is interposed and arranged so that said passage means is opened upon such movement of said corresponding valve in the one direction.

6. A valve structure, as in claim 5, with passage means included with the valves and body to relieve the pressure fed to either cylinder upon return movement of the valve corresponding to the other cylinder to its initial position.

7. A control valve structure for a fluid pressure system comprising a body having spaced pressure intake and outlet ports, a normally open passage therebetween, and other ports arranged for connection to opposite ends of a fluid power unit, a pair of piston type valves slidably mounted in the body in spaced side by side relation in intersecting relation to said passage between the intake and outlet ports but normally leaving the passage open, means controlled by predetermined axial movement of either valve to impart predetermined axial movement of the other valve in the opposite direction, control means to so move the valves selectively and alternately, the body having bores in which the valves are slidable, a relief passage in the body intersected by the bores in series and connected to the outlet port, a two-way passage extending between the bores from predetermined points in the length thereof and connected intermediate its ends to one of said other ports, another two-way passage extending between the valve bores from other predetermined points in the length thereof and connected intermediate its ends to the other one of said other ports, a one-way pressure passage extending between the bores and connected to the pressure intake port, and lands on the valves arranged so that when one valve is moved in said one direction and the other valve is consequently moved in the opposite direction communication from the intake port to the outlet port will be closed off by said other valve and will be established between the first named two-way passage and the one-way passage and also between the other two-way passage and the relief passage; and when said other valve is moved in said one direction and the one valve is moved in the opposite direction communication between the intake and outlet ports will be closed off by said one valve and will be established between said other two-way passage and the one-way passage, and also between said one two-way passage and the relief passage.

8. A valve structure, as in claim 7, in which both valves move the same distance when shifted in said one direction as well as when shifted in said opposite direction.

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