Oct. 29, 1946. F. J. WRIGHT 2,410,375

HYDRAULIC APPARATUS

Filed June 19, 1943 2 Sheets-Sheet 1

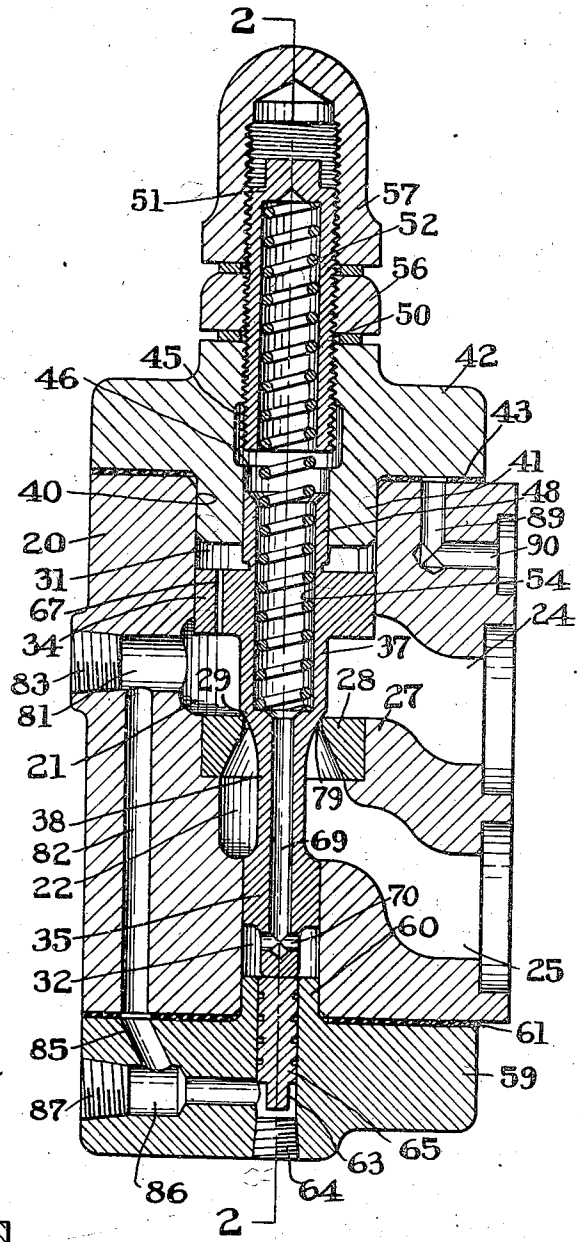
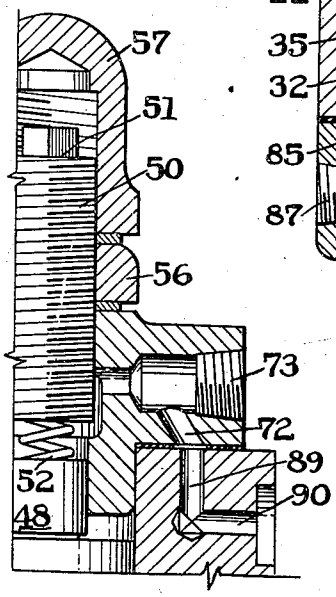


FIG. 1.

FIG. 3



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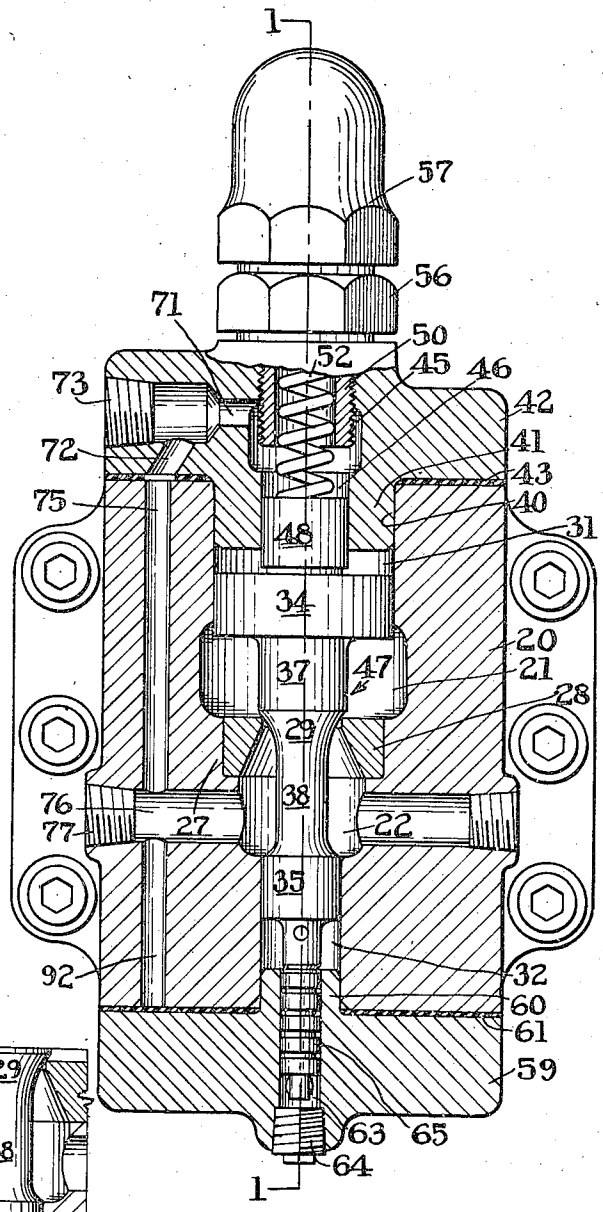


FIG. 2.

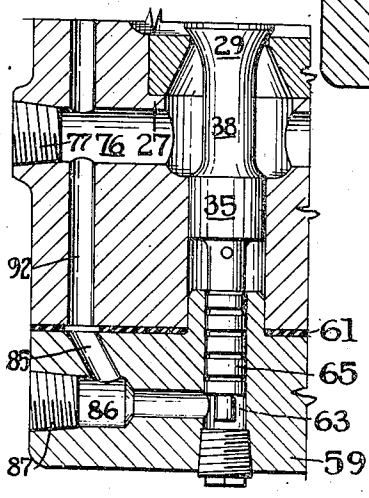


FIG. 4.

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HYDRAULIC APPARATUS

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Application June 19, 1943, Serial No. 491,499

12 Claims. (Cl. 137—153)

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The present invention relates to valves of the fluid pressure operated type and more particularly to valves for controlling the flow of liquid and which are actuated by hydraulic pressure.

One of the objects of the present invention is to provide a fluid pressure operated valve employing a poppet valve which divides the valve into high and low pressure chambers and which the movement thereof is dampened by a piston slidable in a cylinder, the dampening action being effected by providing for restricted flow of fluid between the ends of the cylinders, i. e., the spaces in the cylinders on opposite sides of the piston.

In carrying out this object, it is a further object of the present invention to provide an orifice extending longitudinally through the pistons so as to provide restricted communication between the ends of the cylinder.

A further object of the present invention is to subject the poppet valve to the pressure in one of the aforementioned chambers so as to vary the position thereof in response to variation in pressure in such chamber and also to utilize the piston and the restricted passage or orifice to prevent fluttering of the valve in the event of pulsation of pressure in said chamber.

A still further object of the present invention resides in the provision of a valve including a movable body which slides in remotely spaced cylinders and which is provided with a longitudinally disposed passage for interconnecting remotely disposed spaces.

Still another object is to provide such movable valve body with a piston and to interconnect opposite ends of the cylinder, for such piston, by an orifice.

In carrying out the foregoing objects, it is a further object to subject such movable valve body to an element which is responsive to pressure independent of the pressure of the fluid in the longitudinal passage of the body.

Further objects and advantages of the present invention will be apparent from the following description, reference being had to the accompanying drawings wherein a preferred form of embodiment of the invention is clearly shown.

In the drawings:

Fig. 1 is a longitudinal sectional view of a valve, the section being taken on a plane on line 1—1 of Fig. 2;

Fig. 2 is a longitudinal sectional view of the valve but showing the movable valve body in elevation, the section being taken on a plane on line 2—2 of Fig. 1;

Fig. 3 is a fragmentary view in section showing the top or end cover shifted 90° from that shown in Fig. 1; and

Fig. 4 is a fragmentary view partly in section showing the bottom end cover shifted 90° from that shown in Fig. 1.

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While it will be apparent from the following that the present invention is directed broadly to pressure operative valves for maintaining a desired pressure in a system, I have specifically shown the same as a pressure building valve or a sequence valve. Referring more specifically to the drawings, there is shown a valve body 20 having a high pressure chamber 21 and a low pressure chamber 22. The chambers 21 and 22 are connected respectively with intake port 24 and outlet port 25. Chambers 21 and 22 are separated from one another by a wall 27, a valve seat in the form of an inserted ring 28 and a valve 29.

The valve body 20 is provided with axially aligned and longitudinally disposed cylinders 31 and 32, cylinder 31 being shown at the top, and cylinder 32 at the bottom, and in the present case, cylinder 31 is of considerably larger diameter than the cylinder 32. These cylinders receive, respectively, pistons 34 and 35, and in the present illustration, these pistons and the valve 29 are formed integrally into a movable body. It will be observed that the valve body portion 37 in the chamber 21 is somewhat smaller than the piston 34 for the free flow of fluid thereabout, and also that the valve portion or stem 38 which extends through the valve seat ring 28, and which is disposed in the chamber 22 is somewhat smaller than the seat portion 29 of the valve so that the fluid may freely flow thereabout in chamber 22.

The bore 40 which is the extension of the cylinder 31, extends through the top of the valve body 20 and receives a boss 41 of a top cover 42. The gasket 43 is interposed between the cover 42 and body 20. Cover 42 is hollow to form a chamber 45 which terminates into a cylinder 46. This cylinder receives a piston or guide 48 which extends upwardly and is formed integrally with the movable valve body 47. Piston 48 is of somewhat smaller diameter and preferably approximately the same diameter as piston 35. A plug 50 is threaded into the upper part of the cover 42; this plug 50 is disposed axially of the cylinders in the body 20 and cover 42. Plug 50 is hollow, but closed at the upper end 51 and receives an upper section of a coil spring 52. The movable valve body 47 is also hollow as shown at 54 for receiving the lower section of spring 52. Plug 50 can be adjusted longitudinally to vary the tension of the spring 52. This plug 50 is locked in position by a lock nut 56 and a cap 57.

The lower end of the valve body 20 is closed by a cover 59 having an upwardly extending boss 60 of approximately the same diameter as the cylinder 32 by which it is received; a gasket 61 is interposed between the body 20 and the cover 59. The cover 59 provides a cylinder 63 which is aligned axially with the cylinders in the body

20. The lower end of this cylinder is closed by a plug 64. This cylinder 63 receives a piston 65, which may be formed integrally with the movable valve body 47 but is herein shown as a separate element. The cylinder 63 and piston 65 are of somewhat smaller diameter than the piston 35.

It will be seen that the port 25, chambers 21 and 22 provide a passage for the flow of fluid through the valve when the valve 29 is lifted from the seat 28. The cylinder 31 is subjected to the mean pressure of the fluid in the chamber 21 and in order to accomplish this, a bypass is provided in one of the bodies which leads from chamber 21 to cylinder 31, and, in the present illustration, this bypass is in the form of a restricted passage 67 which extends longitudinally through the piston 34. The restriction offered by this passage is such that the pressure in cylinder 31 will correspond to the mean pressure in chamber 21 and will not follow the pulsations, if present, in chamber 21. The movable valve body 47, in addition to the bore 54, is provided with a longitudinally extending passage 69 which extends through the piston 35 and is connected with laterally extending passage 70 leading into the cylinder 32. Thus, the cylinder 32 and cylinder 46 are in open communication and the same pressure prevails in each. Any fluid which escapes by the piston 35 into the cylinder 32 can flow upwardly through the passages 69, and 54 and into the cylinder 46. Likewise, any fluid which escapes from cylinder 31 about piston 48 will also flow into cylinder 46 which is also in open communication with chamber 45.

As shown in Figures 1 and 2, this fluid can escape to the chamber 22 and for this purpose, the cover 42 is provided with a laterally extending passage 71 which is connected with chamber 45 and with a downwardly extending passage 72. The end of passage 71 is closed by a plug 73. When the cover is in the position shown in Figures 1 and 2, and reference is particularly made to Fig. 2, passage 72 is aligned with a longitudinally extending passage 75 in the body 20 which, in turn, is connected to a laterally extending passage 76 connected with the chamber 22. The outer end of passage 76 is closed by a plug 77.

Since the diameter of cylinders 46 and 32 are substantially the same, and since the pressures therein are the same, such pressures will have no influence to move the movable valve body 47. Also the diameter of the opening 79 in the valve seat ring 28 is substantially the same as the diameter of the piston 48. Thus, the total area on the underside of the valve body above the valve seat is equal to the area of the top of piston 34. Consequently when the pressure in chamber 21 is the same as the pressure in 31, it will have no effect upon movement of the valve body 47. The valve 29 is urged constantly toward its seat 28 by the spring 52 and the valve body is moved upwardly by applying pressure to the bottom of piston 35 from within the cylinder 63. In the present illustration, fluid is conducted into the cylinder 63 from chamber 21 and for this purpose, the valve body is provided with a laterally extending passage 81 which connects with chamber 21 and a longitudinally extending passage 82 which is in open communication with passage 81. The outer end of passage 81 is closed by a plug 83. In the embodiment illustrated in Figs. 1 and 2, passage 82 registers with a passage 85 in bottom cover 59 and this passage 85 terminates in a laterally extending passage 86 which is in open communication with the cylinder 63. The outer end of passage 86 is closed by a plug 87.

Thus, it is apparent that when the upward force of the pressure exerted upon the piston 65 exceeds the weight of the valve body 47, and the tension of the spring 52, the valve 29 will be lifted from its seat to permit the flow of fluid from chamber 21 to chamber 22. By proper adjustment of the tension of the spring 52, any desired differential may be maintained between the pressures in chambers 21 and 22. As the pressure in chamber 21 increases, the valve 29 will be lifted further from its seat to permit an increased flow of fluid to chamber 22, and, likewise, when the pressure recedes in chamber 21, the valve 29 will move toward a closed position.

The restricted passage 67 in the piston 34 prevents chattering or fluttering of the valve 29 since, in order to move the piston 34 upwardly or downwardly, it is necessary to displace or fill the cylinder 31, and this flow from and to the cylinder 31 is through the restricted passage. Consequently, pulsations in chamber 22, which would tend to cause such fluttering or chattering, are not present in the cylinder 31, and therefore, the valve will assume a position corresponding to the pressure differential between that in chamber 22 and the mean pressure in chamber 21. In this manner, chattering of the valve upon its seat with the consequent effects of noise and wear are eliminated.

Under certain circumstances, it is not desirable to drain the fluid from chamber 45 through the outlet chamber 22 but to drain to a tank or reservoir direct. In this event, the cover 42 is shifted 90° to the position shown in Figure 3, it being understood that the cover is bolted to the valve body 20 by bolts (not shown). When the cover 42 is shifted 90°, the passage 72 is then aligned with a longitudinally extending passage 89 which terminates at a laterally disposed passage 90. This passage 90 is suitably connected to a reservoir or tank. It will, of course, be understood that when cover 42 is shifted 90°, the upper end of passage 75 will be blocked by the bottom surface of said cover.

When the bottom cover 59 is shifted to a position in which passage 85 thereof is aligned with passage 82, as shown in Fig. 4, the valve may be used as a pressure build up valve by connecting the pressure side of the system to the port 25 and the outlet to the port 24. In this event, the pressure upon the movable body 47 within the chamber 22 will be balanced since the area of the opening in the valve seat 28 is substantially equal to the area of the top side of piston 35. Except for the spring 52, the pressure areas on opposite sides of the valve body within the chamber 21 will be the same and the orifice 69 will function to dampen pulsations.

Opening and closing movement of the valve can be controlled through a remote or extraneous pressure system whether the port 24 is an inlet port and the port 25 functions as an outlet port, or if port 25 is an inlet port and port 24 is an outlet port. This is accomplished by shifting the cover 59 90° in the opposite direction from that previously described. In which event, the passage 85 will be blocked by the bottom side of the valve body 20. A pressure then can be supplied to the cylinder 63 for lifting the piston 65 through pressures supplied to passage 86 from a remote or extraneous source. To accomplish this,

the plug 87 is removed and the passage 86 connected to the extraneous pressure at this point.

While the form of embodiment of the present invention as herein disclosed constitutes a preferred form, it is to be understood that other forms might be adopted, all coming within the scope of the claims which follow.

I claim:

1. A fluid pressure operated valve comprising, in combination, a valve body having a passage therethrough including high and low pressure chambers, one of said chambers forming a cylinder; a movable body in said passage including a piston slidable in said cylinder and including a valve, one of said bodies providing a restricted passage leading to opposite ends of the piston; a valve seat in the body interposed between the high pressure chamber and the low pressure chamber, said valve being disposed so as to be movable onto and away from the seat for controlling the flow of fluid between the chambers, said valve body forming a second cylinder communicating with one of said chambers, said movable body including a piston slidable in the second mentioned cylinder, said valve body forming a third cylinder extending outwardly from the first mentioned cylinder, said movable body including a piston extending outwardly from the first mentioned piston and slidable in the third mentioned cylinder, said movable body including a stem connecting the first and second mentioned pistons and extending through the valve seat and through one of said chambers, said valve body forming a fourth cylinder, a fourth piston operatively associated with the movable body, said fourth cylinder being connected with one of said chambers, one of said bodies forming a passage connecting the second and third mentioned cylinders.

2. A fluid pressure operated valve comprising, in combination, a valve body having a passage therethrough including high and low pressure chambers, one of said chambers forming a cylinder; a movable body in said passage including a piston slidable in said cylinder and including a valve, one of said bodies providing a restricted passage leading to opposite ends of the piston; a valve seat in the valve body interposed between the high pressure chamber and the low pressure chamber, said valve being disposed so as to be movable onto and away from the seat for controlling the flow of fluid between the chambers, said valve body forming a second cylinder communicating with one of said chambers, said movable body including a piston slidable in the second mentioned cylinder, said valve body forming a third cylinder extending outwardly from the first mentioned cylinder, said movable body including a piston extending outwardly from the first mentioned piston and slidable in the third mentioned cylinder, said movable body including a stem connecting the first and second mentioned pistons and extending through the valve seat and through one of said chambers, a fourth piston operatively associated with the movable body, said valve body forming a cylinder for the last mentioned piston, said fourth cylinder being connected with one of said chambers, said movable body forming a passage connecting the second and third mentioned cylinders.

3. A fluid pressure operated valve comprising, in combination, a valve body means having four longitudinally disposed cylinders, a valve seat interposed between the two innermost cylinders,

said valve body means having inlet and outlet ports connected, respectively, to the confronting ends of the two innermost cylinders; and a movable body means forming four pistons, each slidable in one of said cylinders and forming a valve movable onto and away from said valve seat for controlling the flow of fluid between the confronting ends of the innermost cylinders, one of said body means providing a restricted passage between opposite ends of one of the innermost cylinders, one of the body means forming a passage connecting the innermost ends of one of the innermost cylinders with the outermost end of one of the outermost cylinders, one of the body means providing a passage connecting the outermost end of the other of said innermost cylinders with the outermost end of the other of the outermost cylinders.

4. A fluid pressure operated valve comprising, in combination, a valve body means having four longitudinally disposed cylinders, a valve seat interposed between the two innermost cylinders, said valve body means having inlet and outlet ports connected, respectively, to the confronting ends of the two innermost cylinders; and a movable body means forming four pistons, each slidable in one of said cylinders and forming a valve movable onto and way from said valve seat for controlling the flow of fluid between the confronting ends of the innermost cylinders, one of said body means providing a restricted passage between opposite ends of one of the innermost cylinders, one of the body means forming a passage connecting the innermost end of one of the innermost cylinders with the outermost end of one of the outermost cylinders, said movable body means providing a passage connecting the outermost end of the other of said innermost cylinders with the outermost end of the other of the outermost cylinders.

5. A fluid pressure operated valve comprising, in combination, a valve body means having four longitudinally disposed cylinders, a valve seat interposed between the two innermost cylinders, said valve body means having inlet and outlet ports connected, respectively, to the confronting ends of the two innermost cylinders; and a movable body means forming four pistons, each slidable in one of said cylinders and forming a valve movable onto and away from said valve seat for controlling the flow of fluid between the confronting ends of the innermost cylinders, said movable body means providing a restricted passage between opposite ends of one of the innermost cylinders, one of the bodies forming a passage connecting the innermost end of one of the innermost cylinders with the outermost end of one of the outermost cylinders, one of the body means providing a passage connecting the outermost end of the other of said innermost cylinders with the outermost end of the other of the outermost cylinders.

6. A fluid pressure operated valve comprising, in combination, a valve body having inlet and outlet ports, said body forming a series of communicating cylinders, certain of which are connected with said inlet and outlet ports; a valve seat in said body between the cylinders connected with said ports; a movable body having piston sections disposed for movement in certain of said cylinders, said movable body also having a valve section movable into and out of engagement with said seat to control fluid flow from said inlet to said outlet port, one of said bodies forming a passage leading to opposite ends of

one of said piston sections and a second passage connecting the opposite ends of a pair of piston sections disposed on opposite sides of said seat; and a piston disposed in another of said cylinders, said valve body having a passage establishing communication between the last-mentioned cylinder and the inlet port of said body whereby fluid at inlet port pressure will be applied to said last-mentioned piston to actuate said movable body.

7. A fluid pressure operated valve comprising, in combination, a valve body having inlet and outlet ports, said body forming a series of communicating cylinders, certain of which are connected with said inlet and outlet ports; a valve seat in said body between the cylinders connected with said ports; a pair of cylinders on opposite sides of said valve seat being of equal cross-sectional area; a movable body having piston sections disposed for movement in certain of said cylinders including said pair of equal cross-sectional area, said movable body also having a valve section movable into and out of engagement with said seat to control fluid flow from said inlet to said outlet port, one of said bodies having a passage leading to opposite ends of one of said piston sections and a second passage connecting the opposite ends of the pair of piston sections disposed in said pair of cylinders having equal cross-sectional area; and a piston disposed in another of said cylinders, one of said bodies having a passage establishing communication between the last-mentioned cylinder and the inlet port of said body whereby fluid pressure will be applied to said last-mentioned piston to actuate said movable body.

8. A fluid pressure operated valve comprising, in combination, a valve body having inlet and outlet ports, said body forming a series of communicating cylinders, certain of which are connected with said inlet and outlet ports; a valve seat in said body between the cylinders connected with said ports; a movable body having piston sections disposed for movement in certain of said cylinders, said movable body also having a valve section movable into and out of engagement with said seat to control fluid flow from said inlet to said outlet port, means tending to urge said movable body to a position wherein said valve engages said seat, one of said bodies forming a passage leading to opposite ends of one of said piston sections and a second passage connecting the opposite ends of a pair of piston sections disposed on opposite sides of said seat; and a piston disposed in another of said cylinders, one of said bodies having a passage establishing communication between the last-mentioned cylinder and the inlet port of said body whereby fluid pressure will be applied to said last-mentioned piston to move the same in opposition to said urging means.

9. A fluid pressure operated valve comprising, in combination, a valve body having inlet and outlet ports and a passage establishing communication between said ports; a valve seat in said passage; a valve member disposed for movement in said body into and out of engagement with said seat; said valve member having guiding pistons of substantially equal diameter adjacent each end, said body forming guide cylinders for receiving said pistons; means formed with said valve member to govern the speed of movement thereof; passage means establishing communication between the ends of said equal diameter pistons and the outlet port of said body; spring means tending to urge said valve toward said seat, said body having an additional cylinder; a piston in said cylinder; and passage means in said body for supplying fluid under inlet port pressure to said last-named piston to move said valve member in opposition to said spring means.

10. A fluid pressure operated valve comprising in combination, a valve body formed with high and low pressure chambers; a valve seat disposed in said body between said chambers; said valve body having a plurality of communicating cylinders on opposite sides of said seat; a movable body having a poppet valve section for cooperation with said seat to control communication between said chambers, said movable body also having piston sections slidably received by the cylinders in said valve body, a piston section on one side of said valve seat being equal in area to that of a piston section on the other side of said seat, both of these piston sections being exposed to equal oppositely directed fluid pressures; the other piston sections being of unequal areas; and passage means provided in one of said bodies, said passage means providing for the application of equal fluid pressures to opposite sides of the larger of said other piston sections and unequal fluid pressures to opposite sides of the smaller of said other piston sections whereby the latter piston section will impart movement to said movable body.

11. A fluid pressure operated valve comprising, in combination, a valve body formed with high and low pressure chambers; a valve seat disposed in said body between said chambers; guide cylinders in said body on either side of said seats; a movable body having a poppet valve section for cooperation with said seat to control communication between said chambers and piston sections movable in said guide cylinders, the oppositely facing surfaces of said movable body being equal in area; passage means provided in at least one of said bodies to apply equal fluid pressures to said oppositely facing areas of said movable body; an actuating piston slidably disposed in said valve body at one end of said movable body; and passage means for conducting fluid under pressure to one end of said actuating piston to effect movement of said movable body.

12. A fluid pressure operated valve comprising, in combination, a valve body formed with high and low pressure chambers; a valve seat disposed in said body between said chambers; guide cylinders in said body on either side of said seat; a movable body having a poppet valve section for cooperation with said seat to control communication between said chambers and piston sections movable in said guide cylinders, the oppositely facing surfaces of said movable body being equal in area; passage means provided in at least one of said bodies to apply equal fluid pressures to said oppositely facing areas of said movable body; resilient means normally tending to urge the poppet valve section of said movable member toward said seat; an actuating piston slidably disposed in said valve body at one end of said movable body; and passage means for supplying fluid under pressure to one end of said actuating piston to move said movable body in opposition to said resilient means.

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