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H. E. PAGE
HYDRAULIC VALVE

2,445,334

Filed Oct. 30, 1943

2 Sheets-Sheet 1

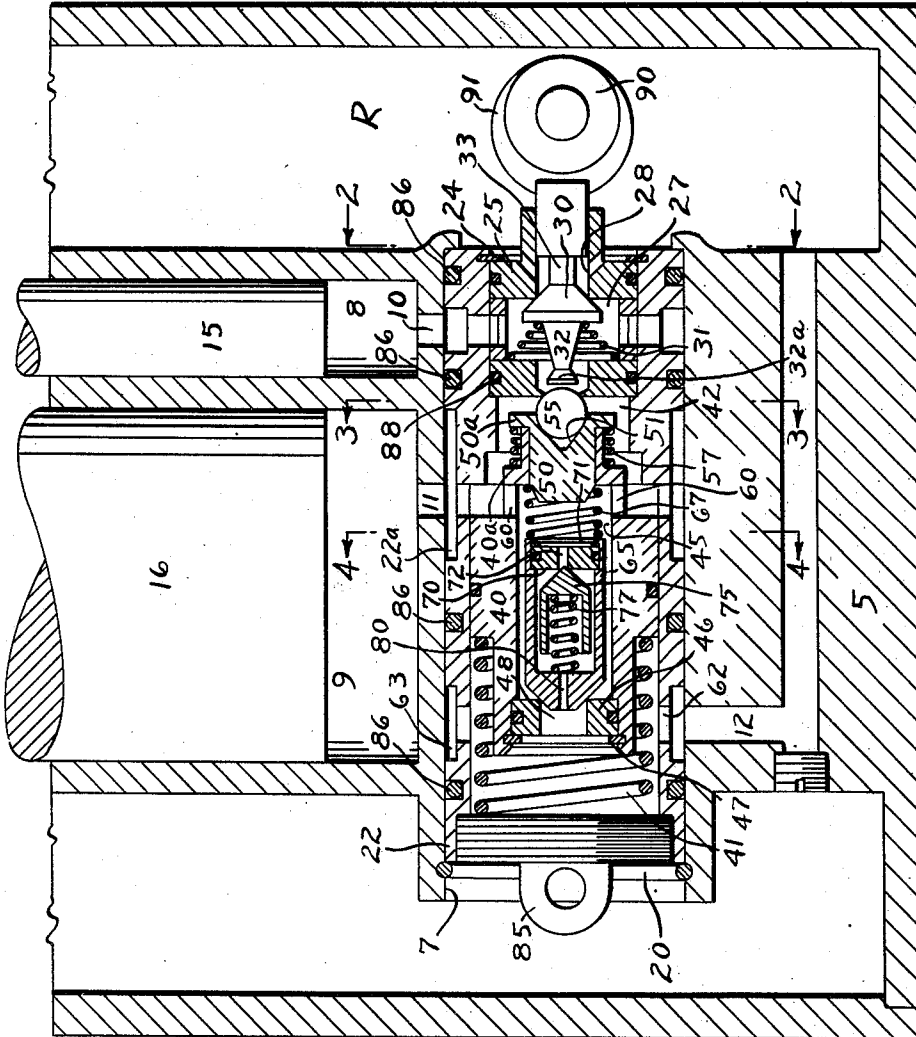


Fig. 1

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Fig. 2

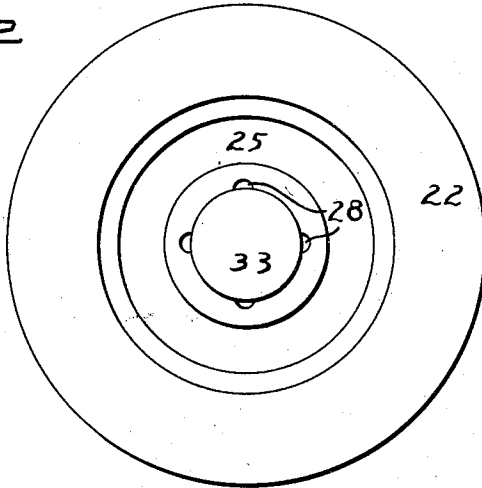
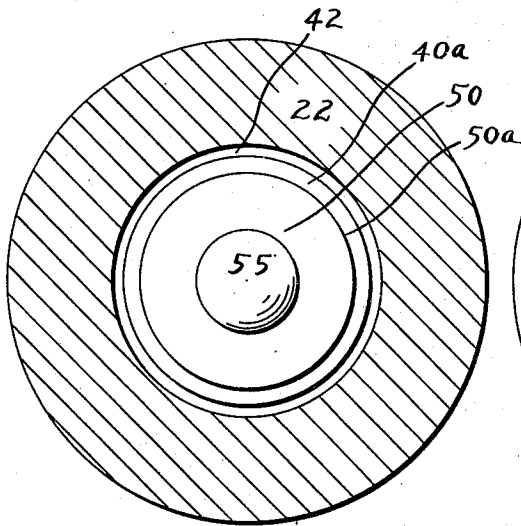
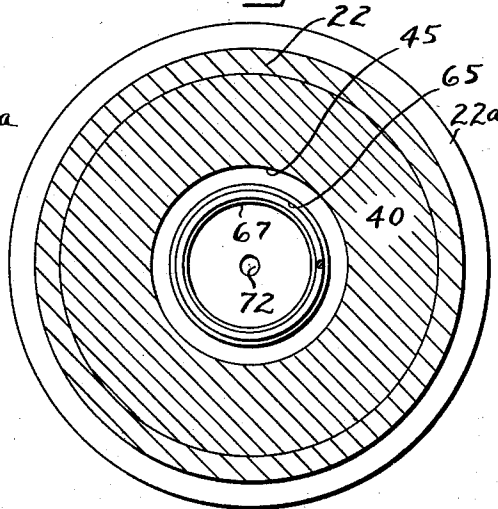


Fig. 3

Fig. 4



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HYDRAULIC VALVE

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7 Claims. (Cl. 277—60)

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This invention relates to hydraulic valves and, in its more particular aspects, relates to valves for use in pressure-generating devices such as hydraulic jacks utilizing a work piston and chamber and a pumping piston for gradually building up pressure in the work chamber.

Prior to my invention, hydraulic valves intended for such purposes have been of such construction that it has not been feasible to obtain in a unitary combination structure a valve capable of performing the multiplicity of functions required, and another rather serious shortcoming has been the fact that when the hydraulic devices in which such valves are used are under pressure, the back pressure on the check valve admitting fluid to the pressure chamber is considerable, with the result that with each pumping operation for the purpose of building up the pressure in the pressure chamber, the operator must overcome not only the fluid back pressure on the check valve, but also the spring pressure normally urging the check valve seated.

It is one of the objects of my present invention to provide a valve element in which the ball or main pressure check valve is freed of the back pressure generated in the work cylinder, so that the effort required to unseat the valve by pressure generated by the pumping piston is reduced to a minimum.

Another object of my present invention is to provide in a single unitary structure not only the controls for the fluid pressure during the pressure-generating operation, but also a safety valve and/or a valve for admitting fluid to the work cylinder directly from the reservoir when there is a vacuum in the work cylinder.

Another object is to provide novel means for releasing the fluid from the chambers, such for instance, as to lower a load lifted by a hydraulic jack.

Another object is the provision of a valve unit which is compact, durable and which may be readily and easily mounted in a hydraulic device or removed therefrom for serving or replacement.

From the following detailed description and explanation of a presently preferred embodiment, it will be apparent to those skilled in this art that my invention has other objects and features of novelty and advantage and that it is susceptible of being embodied in structures differing specifically in physical characteristics from the structure now to be described.

For the purposes of the following description

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I shall refer to the accompanying drawings, in which:

Fig. 1 is a medial vertical sectional view;

Fig. 2 is an enlarged section on line 2—2 of

Fig. 1;

Fig. 3 is an enlarged section on line 3—3 of Fig. 1; and

Fig. 4 is an enlarged section on line 4—4 of Fig. 1.

Referring to the drawings, I show a body 5 which typically may be that of a hydraulic jack, although it will be understood that my valve may be employed to equal advantage in other hydraulic devices.

The body presents an annular hydraulic fluid reservoir R, a valve-receiving bore 7, a pumping cylinder 8, a work cylinder 9, and ports 10, 11 and 12.

A pumping piston 15 is reciprocally mounted in cylinder 8 and a work piston 16 is reciprocally mounted in cylinder 9, the pumping piston being actuated as by conventional lever, not shown. For the purposes of the following description, it may be deemed that the work piston 16 is stationary and the body 5 movable, although the device is operable if the body is fixed and the work piston 16 movable.

Mounted in the bore 7, and normally retained therein as by a snap ring 20, there is a valve body 22. Mounted in the inner end of the valve body and normally held therein by snap ring 24, there is a poppet housing 25 providing an inlet chamber 27 communicating with cylinder 8 through port 10 and communicating with the reservoir through an opening 28. A poppet 30, having oppositely disposed stems 32, 33, seats towards the reservoir and is normally urged against its seat by spring 31.

A plunger 40 is slidably mounted in the outer end of the valve body, being urged inwardly by coil spring 41, a main pressure chamber 42 being provided between the inner end of plunger 40 and the adjacent end of poppet housing 25, chamber 42 being in communication with cylinder 9 through the annular recess 22a provided in the valve housing and through port 11.

Plunger 40 has a longitudinal bore 45, in the left-hand end of which a plug 46 is held by a snap ring 47, the plug having an opening 48. The inner end of the plunger bore 45 has reciprocally mounted therein a secondary plunger 50 whose outer end is recessed at 51 to receive a ball valve 55, the latter seating against the opening through poppet housing 25. A coil spring 57 is provided between the main plunger portion 40a

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and the annular flange 50a on the auxiliary plunger, for the purpose to be later explained.

Ports 60 in plunger 40 provide communication between the plunger bore 45 and cylinder 9, and the bore 45, as well as cylinder 9, having controlled communication with the reservoir through opening 48, port 62, annular recess 63 in the valve housing, and port 12. Opening 48 is controlled by a hollow poppet 65 seating against plug 46. Poppet 65 is normally urged against its seat by a spring 67. A plug 70 fits in the inner end of poppet 65, being held therein by a snap ring 71, and having a port 72 therethrough. A reversely seating poppet 75 is normally urged against its seat, closing port 72, by spring 77, and a port 80 opens through the outer end of poppet 65.

A pull member 85 is provided on a plug threaded into the outer end of the valve housing to facilitate removing the valve element from the body bore, and seal rings 86 are interposed between the valve housing and the body bore. Also, seal rings 88 are interposed between the valve elements 25, 40 and 46 and the valve body.

For manually unseating poppet 30 and ball 55 against pressure in the cylinders to lower a load, for instance, I provide a rotary cam 90 carried by a cam shaft 91, which shaft is journaled in the body 5 and projects outwardly therefrom where it is operable by crank, not shown.

In operation, the suction stroke of piston 15 draws fluid from the reservoir past poppet 30 into cylinder 8. Until the device is moved into contact with the work and encounters sufficient resistance to movement to cause ball 55 to be unseated by the downward or pumping stroke of piston 15, the fluid is trapped between poppet 30 and ball 55 and thus further downward movement of piston 15 relatively rapidly moves the body into contact with the work. However, when the work is contacted, the resistance offered thereby to further movement of the body, causes ball 55 to be moved off its seat and the plunger 40 to be moved to the left against spring 41 and thus the fluid in cylinder 8 and chamber 27 is forced into cylinder 9 to cause relative movement as between the body and plunger 16.

During the initial movement of the body into contact with the work by the trapping of fluid between ball 55 and poppet 30, as before described, the body is moved away from piston 16 and thus a vacuum is created in cylinder 9. This vacuum draws fluid directly from the reservoir through the bore 45 of the plunger, openings 48, 62 and port 12, past poppet 65.

When there is pressure in cylinder 9 it acts against the shoulder or face 40a of the plunger to maintain spring 41 compressed and thus substantially eliminates pressure of plunger 40 against the ball 55, the ball during that period being normally held against its seat by the relatively light spring 57. The auxiliary plunger 50 has its inner end exposed to fluid pressure in cylinder 9 and chamber 42 through openings 60 in the main plunger 40, so that fluid pressure on the respective ends of the auxiliary plunger is equalized. Thus, on each subsequent pumping stroke of piston 15, the only pressure which must be overcome to unseat ball 55 is the relatively small pressure of spring 57 plus the hydraulic pressure in the cylinder 9 acting on the area of the ball 55 covered by the seat in plug 25.

If the pressure in cylinder 9 should become too great, it is automatically relieved by poppet

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75 unseating against its spring 77, thus allowing fluid to escape to the reservoir.

Another feature of my invention is the means now to be described for preventing too rapid downward movement of the work-lifting piston 16 under weight of the load being lifted when the pressure is released to lower the load. As hereinbefore pointed out, the pressure is released by rotating the cam 90 to first move poppet 30 off its seat and then, by virtue of stem 32, to effect a delayed movement of ball 55 off its seat. As will be noted in Fig. 1, stem 32 has an enlarged inner end 32a which is capable of substantially but not entirely filling or closing the port through the partition separating the pressure chamber 42 from the inlet chamber 27. Thus, when stem 32 is moved to unseat ball 55, the enlarged end portion 32a enters said port and limits or restricts the discharge of fluid from the pressure chamber to the inlet chamber, commensurately slowing down the downward movement of piston 16.

I claim:

1. A hydraulic valve comprising a body having walls defining a pressure chamber, a fluid inlet port through one of the walls, a check valve in the chamber and seating towards the inlet to control entry of fluid through said port, a main plunger resiliently mounted in the chamber, said main plunger having a cylindric reduced diameter inner end portion providing a shoulder facing towards the check valve, an auxiliary plunger mounted in said cylindric inner end portion and having its outer end exposed to fluid pressure in the chamber, spring means urging the outer end of the auxiliary plunger against the check valve, and an opening in the main plunger exposing the inner end of the auxiliary plunger to fluid pressure in the chamber, whereby to substantially equalize the fluid pressure on the respective ends of the auxiliary plunger, said shoulder being exposed to fluid pressure in the chamber and being of sufficient area that the main plunger is moved away from the check valve in response to fluid pressure in the chamber.

2. A hydraulic valve comprising a body having walls defining a pressure chamber, a fluid inlet port through one of the walls, a check valve in the chamber and seating towards the inlet to control entry of fluid through said port, a plunger in the pressure chamber normally yieldably exerting seating pressure on the check valve, a longitudinal bore in the outer end of the plunger, a wall closing the outer end of the bore, a port through said wall, a tubular poppet valve resiliently mounted in the bore and seating at its outer end against the wall to normally close the port, a wall closing the inner end of said poppet valve, an opening through the last-mentioned wall, and a check valve resiliently mounted in the tubular poppet valve and normally closing said last-named opening, said poppet valve being yieldable to open the port in response to subatmospheric pressure in the pressure chamber and said last-named check valve being yieldable to open said opening in response to excess pressure in the pressure chamber.

3. In hydraulic apparatus having a pressure chamber, a control valve comprising a body having a main pressure chamber and a fluid inlet chamber adapted to be connected with a source of fluid under pressure, said body presenting a port providing communication between the inlet chamber and the main pressure chamber and a

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passageway for establishing communication between the main pressure chamber and the first-mentioned pressure chamber, a check valve controlling said port and seating towards the inlet chamber, a telescopic plunger in the main pressure chamber consisting of inner and outer sections, the inner section of the plunger bearing against the check valve, spring means urging the plunger into extended position and a second spring bearing inwardly against the outer plunger section to urge said sections towards the check valve, said outer plunger section presenting an inwardly facing pressure-receiving surface exposable to pressure in the main pressure chamber and the first-mentioned chamber to urge the outer plunger section away from the inner plunger section whereby to reduce the seating pressure exerted on the check valve.

4. In hydraulic apparatus having a pressure chamber, a control valve comprising a body having a main pressure chamber and a fluid inlet chamber adapted to be connected with a source of fluid under pressure, said body presenting a port providing communication between the inlet chamber and the main pressure chamber and a passageway for establishing communication between the main pressure chamber and the first-mentioned pressure chamber, a check valve controlling said port and seating towards the inlet chamber, a telescopic plunger in the main pressure chamber consisting of inner and outer sections, the inner section of the plunger bearing against the check valve, spring means urging the plunger into extended position, a second spring bearing inwardly against the outer plunger section to urge said sections towards the check valve, said outer plunger section presenting an inwardly facing pressure-receiving surface exposable to pressure in the main pressure chamber and the first-mentioned chamber to urge the outer plunger section away from the inner plunger section whereby to reduce the seating pressure exerted on the check valve, and spring-loaded pressure release means in the plunger, said pressure release means being actuated in response to predetermined pressure in the main pressure chamber.

5. In hydraulic apparatus, a body providing pressure generating and pressure receiving chambers and a fluid reservoir, a bore in said body communicating at one end thereof with said reservoir and at spaced points intermediate its ends with said pressure generating and said pressure receiving chambers, a bushing in said bore, means for closing one end of said bushing, a first centrally apertured plug in the opposite end of said bushing or that end communicating with the reservoir, a second centrally apertured plug in said bushing spaced inwardly from said first plug, radial ports in said bushing respectively communicating the space between said plugs to said pressure generating chamber and the space between said second plug and the closed end of said bushing to said pressure receiving chamber, a first check valve within the space between said plugs and seating against said first plug in the direction of the reservoir, a second check valve inwardly of said second plug and seating toward said plug, a piston slidably mounted in said bushing inwardly of said second plug and spring pressed toward contact with said second check valve, a spring between said piston and said second check valve, and a pressure re-

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ceiving surface on said piston exposed to the pressure fluid flowing past said second valve and to the pressure of the fluid in said pressure receiving chamber whereby said piston is movable relatively to said check valve in response to pressure variations in said pressure receiving chamber to vary the tension of said spring.

6. Hydraulic apparatus according to claim 5, characterized in that said first valve is formed with a stem extending in one direction through said second plug toward operative engagement with said second check valve and extending in the opposite direction through said first plug for actuation from outside the valve bore to unseat said first and second check valves.

7. In hydraulic apparatus, a body providing pressure generating and pressure receiving chambers and a fluid reservoir, a bore in said body communicating at one end thereof with said reservoir and at spaced points intermediate its ends with said pressure generating and said pressure receiving chambers, a bushing in said bore, means for closing one end of said bushing, means defining a first centrally apertured wall at the opposite end of said bushing or that end communicating with the reservoir, means defining a second centrally apertured wall in said bushing spaced inwardly from said first wall, radial ports in said bushing respectively communicating the space between said walls to said pressure generating chamber and the space between said second wall and the closed end of said bushing to said pressure receiving chamber, a first check valve within the space between said walls and seating against said first wall in the direction of the reservoir, a second check valve inwardly of said second wall and seating toward said wall, a piston slidably mounted in said bushing inwardly of said second wall and spring pressed toward contact with said second check valve, a spring between said piston and said second check valve, a pressure receiving surface on said piston exposed to the pressure fluid flowing past said second valve and to the pressure of the fluid in said pressure receiving chamber whereby said piston is movable relatively to said check valve in response to pressure variations in said pressure receiving chamber to vary the tension of said spring, and means operable from outside said bushing substantially simultaneously to unseat said check valves to provide free communication between said pressure receiving chamber and said reservoir.

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