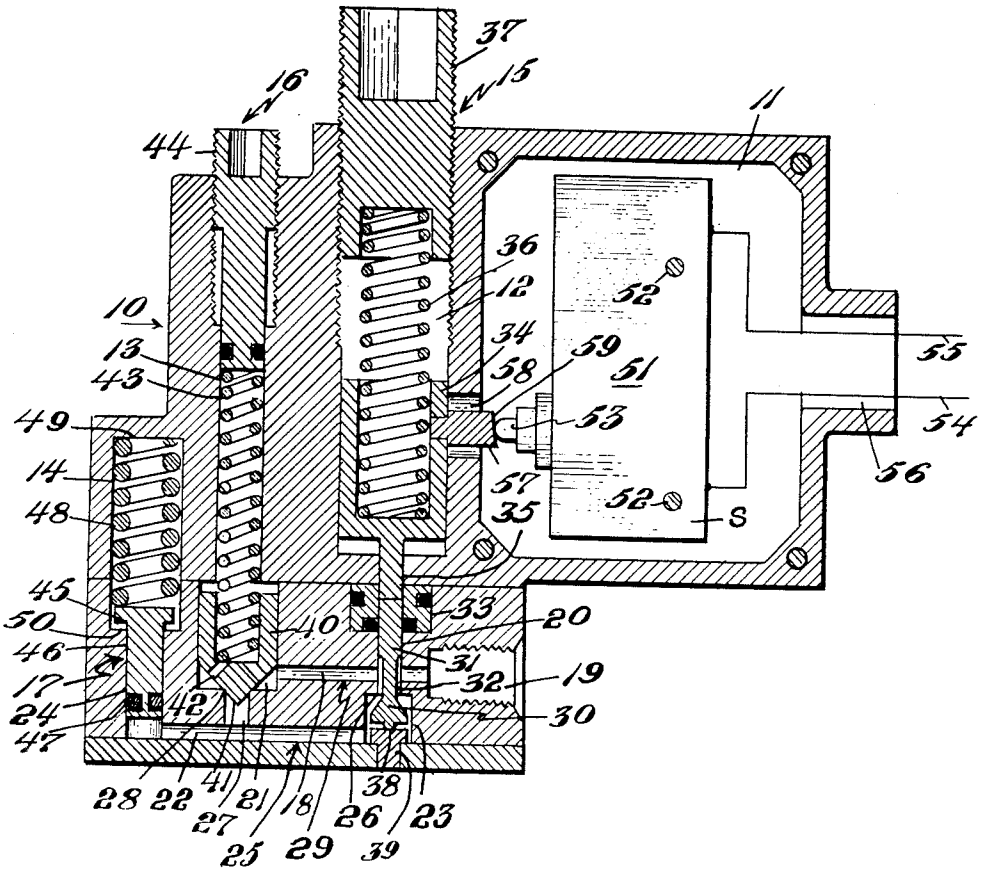
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HYDRAULICALLY OPERATED VALVE DEVICE

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HYDRAULICALLY OPERATED VALVE DEVICE

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This invention relates to a hydraulically operated valve device, particularly adapted for opening and closing an electric switch.

An object of this invention is to provide a hydraulically operated valve device having a fluid pressure operated valve closure adapted to be moved to closed and open position at predetermined high and low fluid pressures.

Another object of the invention is to provide a hydraulically operated valve device having a valve closure which upon being moved to closed position will remain closed and be moved to open position at a predetermined low fluid pressure very much less than the closing pressure.

Another object is to provide a hydraulically operated valve device for opening and closing an electric switch.

Another object of the invention is to provide a hydraulically operated valve device having a pressure operated valve closure provided with pressure applying areas thereon such as to be unbalanced to a force acting thereon in a direction to urge the closure to closing position and in which said pressure applying areas upon initial closing movement of the said closure will be further unbalanced in a direction to increase the effects of the said force acting thereon in the direction to move the closure to closed position.

With these and other objects in view, the invention consists of certain novel features of construction as will be more fully described and particularly pointed out in the appended claims.

The figure of the drawing is a longitudinal sectional view through a hydraulically operated valve device embodying my invention.

Referring to the drawing in more detail, **10** designates generally a casing in which there is formed a generally rectangular cavity or chamber **11** and three vertical bores **12**, **13**, **14** in which are housed valve mechanism **15**, **16** and a pressure applying plunger **17**, respectively. The axes of the bores are parallel and in the same plane and are reduced or enlarged along their lengths to the extent corresponding to the particular parts of the mechanism interfitting therewith as will hereinafter appear. A lateral bore **18** extends from a pressure port **19** laterally across a reduced bore portion **20** of bore **12** and opens into the lower portion **21** of the enlarged portion of bore **13**. A lateral bore **22** extends from the larger portion **23** of bore **12** to the lower end extremity of the reduced portion **24** of the bore **14** and forms with bores **18**, **23**, and **22** a first passageway designated generally **25** from the port **19** to the bore **24**. The bore portion **23** is made larger than bore portion **20** and forms an annular valve seat **26** at the junction therewith.

The lower end portion of bore **13** is reduced as at **27** to form an annular valve seat **28** at the junction of the bore portions **21** and **27**. The bore portion **27** opens into the bore **22** and forms with bores **18**, **21**, **27**, **22** a second passageway designated generally **29** from port **19** to the bore **24**.

The port **19** is adapted to be connected to a fluid pressure source which is to be controlled. The flow of fluid

past valve seat **26** is controlled by the mechanism **15** which is composed of a conical valve closure **30** adapted to engage against valve seat **26** to block the flow past the seat **26**. The closure **30** has a stem **31** which is slidably received in bore **20** and is reduced between the ends thereof to provide a neck portion **32** which is at a position to intersect bore **18** and permit the flow of fluid past the said stem from the port **19** through the second said passageway **29**. The stem **31** above the neck portion **32** is sealed against leakage by a seal **33** which surrounds said stem. A hollow piston **34** having an open upper end is slidably received in the bore **12** and has a depending stem **35** which slidably extends into the bore portion **20** into engagement with the stem **31**. Within the bore **12** is arranged a compression spring **36**, the lower end portion of which is received in the hollow of piston **34** to abut against said piston and the other end of which abuts against a plug **37** which is screw threaded to the wall of the upper portion of the bore **12** for adjustment of the pressure of spring **36**. The stem **35** is thus held in engagement with the stem **31** and by adjusting the plug **37**, the bias pressure applied to the closure **30** tending to move the same from valve seat **26** can be altered as desired.

The closure **30** is provided with a projecton **38** which, in the open position of closure **30**, abuts against the upper flat surface of a plug **39** which spaces the lower end of the closure therefrom to expose the same to fluid pressure from port **19**. When the closure **30** is in the open position as shown in the drawing, the surface areas thereof exposed to pressure from port **19** are such as to provide an unbalanced force acting on the closure **30** in a direction tending to move the same to seat **26**. The area of the closure **30** exposed to this force is an area equal to the area of the valve stem **31** minus the end surface area of projection **38** which contacts plug **39**. This force is opposed by the bias of spring **36** tending to move the closure to open position. Thus, the area exposed to this force may be increased or decreased by a choice of end surface area of the projection **38**. The pressure of spring **36** may be adjusted to predetermine the force required for closing the closure **30**. It may be pointed out that upon the closure **30** being separated from the plug **39** to expose the surface area of projection **38**, the surface area exposed to a force tending to move the closure **30** to its seat **26** is increased by the area of projection **38** times the pressure of the liquid, and this increase in surface area produces a quick closing movement of closure **30**.

The flow of fluid from port **19** through the second passageway **29** to bore **24** is controlled at the valve seat **28** by the valve mechanism **16** which has a hollow valve head provided with a conical end **41** which is normally engaged against valve seat **28** to block the flow of fluid therethrough to bore **24**. The head **40** has generally radial openings which extend inwardly to the hollow of the head. These openings form conduits for the passage of fluid to the upper end of said valve head **40**. In the bore **13** is arranged a compression spring **43**, one end of which abuts against the head **40** within the hollow thereof and the other end of which abuts against a plug **44**. The plug **44** is screw threaded in the bore **13**. Thus, by adjusting the plug **44**, the bias of spring pressure applied on the valve head **40** can be altered as desired.

When the head **40** is seated, the surface areas thereof exposed to pressure from port **19** through bore **18** are such as to provide a force acting on the valve head **40** in a direction tending to move the same toward its seat **28**. The area of the valve head exposed to this force is an area equal to the area of the bore **21**. The surface area of the valve head **40** exposed to pressure of the fluid in bore **22** is such as to provide a force acting on the

valve head 40 in a direction tending to move the valve head from seat 28 when the valve 30 is open. The area of the valve head exposed to this force is an area equal to the area of the valve seat 28. The difference of the areas of bore 21 and valve seat 28 times the pressure is the pressure exerted to close the valve head 40.

The plunger 17, the purpose of which will hereinafter appear, is composed of a cylindrical head 45 which is received in the bore 14 and has a stem 46 slidably projecting in the reduced bore portion 24. The stem 46 is sealed against leakage past the same by an O-ring 47. In the bore 14 there is positioned a compression spring 48, one end of which abuts against the head 45 and the other end of which abuts against the end wall 49 of the said bore 14. Thus, a bias is provided on the plunger 17 tending to move the same against a stop shoulder 50 which is formed at the junction of the bore 13 and reduced bore portion 24 thereof. The fluid pressure acting against the end of the stem 46 is opposed by the pressure of spring 48.

Within chamber 11 there is positioned the electric switch S to be controlled by the mechanism hereinabove described. The switch S may be of any approved manufacture and is illustrated more or less conventionally having a body 51 secured to the walls of the chamber as by fastening indicated 52. The switch S has a push button 53 which when depressed will open the switch contact (not shown). The switch contacts may be connected by leads 54, 55 to the particular electric circuit controlled by the said switch S. The leads 54, 55 pass outwardly of the said chamber 11 through an opening 56 in the chamber wall.

There is secured to the piston 34 a pin 57 which projects therefrom into chamber 11 through an elongated opening 58 in the wall of the casing separating the bore 12 from the chamber 11. The pin 57 is at a location opposite to the button 53 and has an inclined cam surface 59 which engages the said button. The relation between the said pin and button is such that when the valve 15 is in the open position, as shown in the drawing, the button 53 will be in the extended position and the switch S will be in the closed position. Upon the seating of valve 15, the piston will have moved upwardly, carrying the pin therewith, and the cam surface 29 thereon will have engaged the button to retract or move the same inwardly of the switch body and open the electric contacts of the switch.

The electric switch operating device hereinabove described is adapted for use in various hydraulic systems wherein the pressure of a supply source may be electrically controlled. As by way of example, assume the device is to be employed for controlling a fluid supply source to an accumulator (not shown) and said supply source is an electric motor driven pump (not shown). Assume the port 19 connected to the accumulator and the switch S connected in the electric circuit of the motor of the pump. Further assume the fluid supply to the accumulator is to be shut off upon a pressure of 3,000 pounds at the accumulator and the supply is to be turned on upon a pressure drop to 1,000 pounds at the accumulator. The valve closure 30 is in the normal open position and fluid will flow from port 19 to plunger 17, the spring bias of which is predetermined to yield at a pressure in excess of 1,000 pounds thereon. Fluid from port 19 will flow through bore or conduit 18 to bore portion 21. The pressure in conduit 18 is that of pressure in conduit 22, and the valve head 40 will be in balance to this pressure, since the opposite areas exposed to this pressure are equal to each other.

Upon the pressure of port 19 reaching 3,000 pounds, this force will act on closure 30 as hereinabove described and overcome the resistance of the bias of spring 36 thereon, which has been adjusted to yield at 3,000 pounds. The closure 30 will move to engage seat 26 and block the flow of fluid through the passage 25 to the plunger 17. As the closure 30 is moved to seat 26, the piston 34 will move upwardly and the cam surface will move the button 53 inwardly of the switch to open the electric contacts thereof and thus open the said motor circuit (not shown). The fluid in conduit 22 will be trapped between the plunger 17 and the valve seat 26 and be under pressure of the force of spring 48. The pressure of the fluid trapped in bore 22 of passageway 25 is that of the pressure of the fluid at port 19 at the closing of closure 30, and this pressure is maintained in bore 22 by the plunger 17 under bias of spring 48. The surface area of closure 30 now exposed to the pressure in bore 22 acting thereon in a direction tending to move the closure 30 seated is a surface area equal to the area of the valve seat 26. Thus, the effective area on closure 30 has been increased by an area equal to the surface area of projection 38. When the closure 30 is seated, the surface areas thereon exposed to pressure of port 19 fluid are such as to provide a balanced force acting on the valve closure on the port side thereof. As hereinabove described, the opposite effective surface areas on valve head 40 exposed to fluid pressure of bores 18 and 22 are equal to the area of valve seat 28 and thus the forces of the fluid acting on the valve head 40 are in balance. The bias of spring 43 is set to yield when the pressure in bore or passageway 29 drops to 1,000 pounds.

Upon a drop in pressure of fluid from port 19 to 1,000 pounds, the spring 43 will yield and valve head 40 will move to open position under fluid pressure in bore 22 due to spring 48 and vent the same, dropping plunger 17 to its shoulder 50. This will dissipate the pressure acting on closure 30, and the same will move to open position under urge of the bias of spring 36. The opening of closure 30 will move the piston 34 downwardly and move the cam surface 59 to a position to permit the button 53 to move outwardly of the switch body to cause the electric contacts thereof to be moved to closed position and close the electric circuit controlled thereby and resume supply of fluid to the accumulator, after which head 40 will close and pressure will be built up again and supplied to conduit 22 to again raise plunger 17 to the full line position shown.

From the hereinabove description it will be readily seen that the valve mechanism 15 operates to shut off a fluid pressure supply at a high pressure and that valve mechanism operates to resume the supply at a predetermined low pressure. It also will be readily seen that there may be a very wide difference between the closing and opening pressures.

The valve controlled device has been described in an embodiment for controlling the opening and closing of an electric switch. However, it will be readily apparent that the device may be adapted to other situations wherein a great difference may be required in the opening and closing pressures of the valve device.

I claim:

1. A hydraulically operated valve device comprising a casing having a port adapted to be connected to a fluid supply source under pressure, a resiliently mounted plunger in said casing, a first passageway leading from said port to said plunger, fluid pressure responsive valve means in said first passageway for controlling the flow of fluid to said plunger, said means normally being in the open position thereof, a second passageway leading from said port to said plunger, a second fluid pressure responsive valve means in said second passageway for controlling the flow of fluid between said port and said plunger, said second valve means being normally in closed position to block communication between said port and said plunger, whereby upon movement of the first said valve means to closed position under pressure of the fluid from said port, the fluid in said first passageway will be trapped between said first valve means and said plunger and be

under pressure of said plunger to act on said first valve means to hold the same in the closed position.

2. A hydraulically operated valve device as set forth in claim 1 wherein said second valve means include a valve closure having pressure applying surface areas thereon exposed to the fluid pressures in said passageways such as to provide a balanced pressure force acting thereon.

3. A hydraulically operated valve device as set forth in claim 1 wherein said first valve means include a closure having a resilient bias thereon acting thereon in a direction to oppose closing movement thereof and said plunger has a bias thereon of a force to maintain said fluid at the closing pressure of said first valve means.

4. A hydraulically operated valve device comprising a casing having a port adapted to be connected to a fluid supply source under pressure, a resiliently mounted plunger in said casing, a passage leading from said port to said plunger, pressure responsive valve means for controlling the flow of fluid from said port to said plunger, said valve means being normally in the open position thereof and moved to closed position upon a predetermined pressure of said fluid to trap the fluid in said passageway between the said valve means and the said plunger whereby the fluid trapped in said passageway will be under pressure of said plunger to act against said valve means to maintain the same in the closed position, and means operable upon a predetermined drop in pressure at said port to vent said passageway and permit the valve means to return to open position.

5. A hydraulically operated valve device comprising a casing having a port adapted to be connected to a fluid supply source under pressure, a resiliently mounted plunger in said casing, a first passageway leading from said port to said plunger, a valve seat in said passageway, a normally open fluid pressure responsive closure for said valve seat and having pressure applying surface areas thereon exposed to the fluid pressure in said passageway such as to provide an unbalanced force acting on said closure in a direction to move the same on to said seat, means for applying a resilient bias on said closure for opposing said force, a second passageway leading from said port to said plunger, a second valve seat in said second passageway, a second pressure responsive valve closure for said seat and resiliently biased for movement toward said second seat, said second closure having pressure applying surface areas exposed to the pressures in said passageways such as to provide a balanced force acting on said second closure whereby

said bias thereon will hold said second closure normally seated and block communication between said port and said plunger where upon the fluid pressure acting on the said first closure overcoming the said bias thereon to move the said first closure to seated position, the fluid in said first passageway will be trapped between the first valve seat and said plunger and be under pressure of said plunger to act against said first closure to hold the same seated against said bias thereon.

6. A hydraulically operated valve as set forth in claim 5 wherein an abutment is provided in said first passageway and said first closure has a projection thereon extending into engagement with said abutment when said closure is in open position, whereby upon closing movement of said closure said projection will be spaced from said abutment and the effective areas on said closure exposed to fluid pressure in said first passageway will be increased by a surface area equal to the surface area at the end of said projection.

7. A hydraulically operated valve device comprising a casing having a port adapted to be connected to a fluid supply source under pressure, a resiliently mounted plunger in said casing, a first passageway leading from said port to said plunger, fluid pressure responsive valve means in said first passageway for controlling the flow of fluid to said plunger, said means being normally in the open position, a second passageway leading from said port to said plunger, a second fluid pressure responsive valve means in said second passageway for controlling the flow of fluid between said port and said plunger, said second valve means being normally in closed position to block communication between said port and said plunger, whereby upon movement of the first said valve means to closed position under pressure of the fluid from said port, the fluid in said first passageway will be trapped between said first valve means and said plunger and be under pressure of said plunger to act on said first valve means to hold the same in the closed position, and an electric switch connected to said first valve means and moved to a closed and open position upon movement of said valve means to and from open position.

8. A hydraulically operated valve device as set forth in claim 7 wherein the connection between the said switch and said first valve means includes a cam carried by said first valve means and extending therefrom into engagement with said electric switch.

No references cited.