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VALVE MECHANISM

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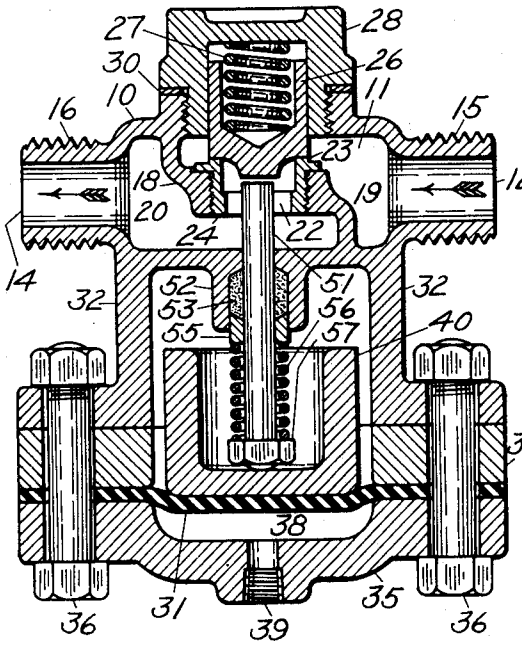

Fig. 1

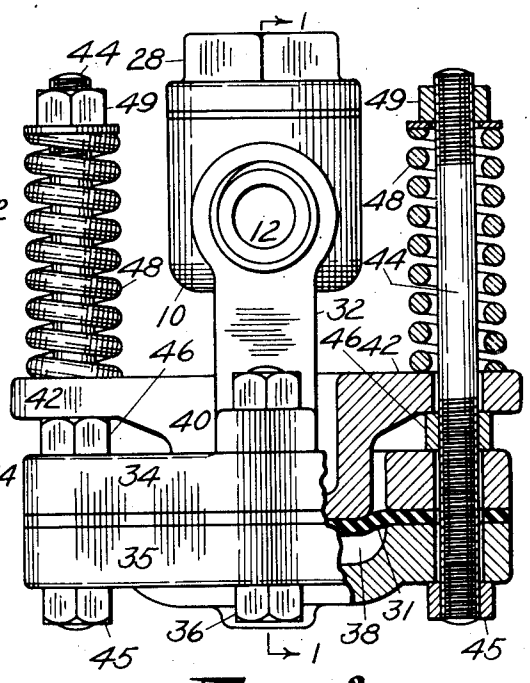

Fig. 2

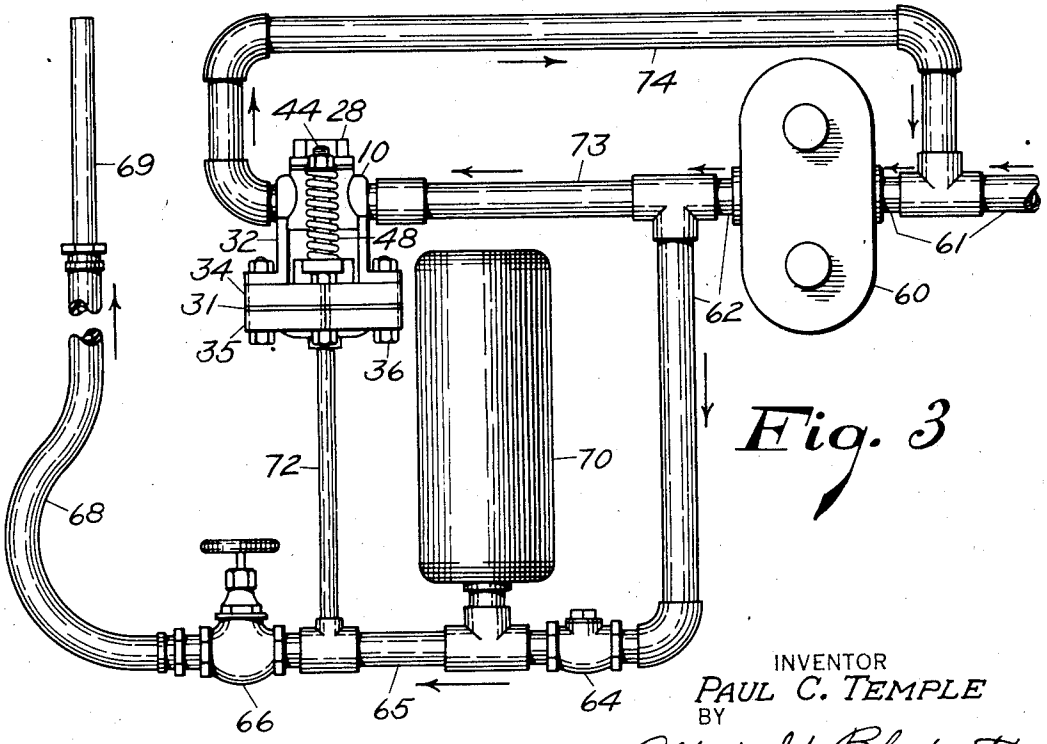

Fig. 3

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VALVE MECHANISM

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This invention relates to valve mechanisms, and more particularly to an unloading valve which is adapted for use in a hydraulic system including a pump and which will open automatically to relieve the discharge pressure of the pump whenever this pressure tends to become excessive as a result of a decrease in the demand for fluid.

In washing automobiles it is customary to use a water discharge nozzle or so-called "gun" which is supplied with water at high pressure from a pump driven by an electric motor. The inlet of the pump is usually connected to the city water supply, and a manually operable valve is provided to control the flow through the nozzle. So long as this valve is wide open and the nozzle is capable of handling the entire discharge capacity of the pump, no difficulty will arise. There are times, however, when it is desired to reduce the nozzle discharge by closing the manually operable valve either partly or entirely, and this will increase the discharge pressure of the pump and overload or stall the driving motor unless some means is provided to relieve the pressure. Moreover, when there is no demand for water, it is desirable in the interest of economy of operation that the pump should operate under substantially no-load conditions, the discharge pressure only slightly exceeding the inlet pressure.

These problems have been recognized and various constructions have been proposed in the past for overcoming these various difficulties. The prior devices have however, been complicated, bulky and expensive. Moreover, many of them have been so arranged that variations in the fluid pressure at the pump inlet would greatly change the adjustment of the unloading valve and cause it to unload at different pressures, which is undesirable.

It is accordingly the main object of my invention to provide an unloading valve which is simple, compact and inexpensive, and particularly to provide such a valve which will open at a definite predetermined pressure that is substantially unaffected by variations in the pressure at the inlet of the pump.

With this and other objects in view, as will be apparent to those skilled in the art, my invention resides in the combination of parts set forth in the specification and covered by the claims appended hereto.

In accordance with my invention I provide a device which by-passes the fluid discharged by the pump whenever the valve at the fluid discharge nozzle is closed. The specific form of device illustrated comprises a casing which forms a passage for the flow of water or other fluid between an inlet and an outlet. The flow through the casing is controlled by a vertically movable valve which is arranged to prevent flow when in its lowermost position. A pair of spaced feet extend downwardly from the casing and support a pressure chamber having a flexible diaphragm as its upper wall. This pressure chamber is arranged to be subjected to the fluid pressure anterior to the nozzle valve. A pressure plate contacts with the upper surface of the diaphragm, and this plate is connected to the vertically movable valve by a vertically slidable rod extending through a stuffing box on the lower wall of the casing. A pair of ears extend outwardly from opposite sides of the pressure plate, and a coiled compression spring is mounted above each ear to urge the pressure plate downwardly. Whenever the nozzle valve is closed and the controlling pressure beneath the diaphragm reaches a sufficiently high value to overcome the force of the springs, the vertically movable valve will be opened and the pump will discharge fluid without material resistance.

Referring to the drawing illustrating one embodiment of the invention, and in which like reference numerals indicate like parts,

Fig. 1 is a section through the center of an unloading valve, taken on the line 1—1 of Fig. 2;

Fig. 2 is a side elevation of the unloading valves, certain parts being broken away for clearness of illustration; and

Fig. 3 is a somewhat diagrammatic elevation showing the unloading valve assembled with other devices to form an automobile washing apparatus.

The embodiment illustrated in the drawing comprises a hollow casing 10 shaped to provide a horizontal passage or conduit 11 leading from an inlet opening 12 to an outlet opening 14. The inlet and outlet are on opposite sides of the casing and in direct line with each other, a construction which facilitates manufacturing operations and simplifies the piping connections to the device. I have indicated external screw threads 15 and 16 on the casing adjacent to the inlet and outlet respectively for connection purposes, but it will be clear that internal screw threads may be used instead, or other equivalent means provided. A Z-shaped partition 18 extends diagonally across the conduit 11 and divides the interior of the casing into an inlet chamber 19 above the partition and adjacent to the inlet 12 and an outlet chamber 20 beneath the partition and adjacent to the outlet 14. This par-

tition is provided with a central opening 22 surrounded on the upper side of the partition by an annular valve seat 23. This valve seat is preferably formed on a ring 24 which is screw threaded into the opening in the partition. With this construction, the valve seat can be formed of a different and more durable material from the casing 10.

A vertically slidable valve 26 is mounted directly above the valve seat 23 and arranged to cooperate therewith in controlling the flow through the conduit 11. This valve 26 is cylindrical in shape and it is preferably recessed from above to receive the upper end of a small coiled compression spring 27 which urges the valve downwardly to its closed position against the seat 23.

The valve 26 and spring 27 are mounted in a hollow cap 28 which is screw threaded into an opening in the top of the casing 10, an annular gasket 30 being provided between the cap and casing to prevent leakage of fluid. The cap 28 fits the outside of the valve rather loosely to avoid friction and binding, and to allow fluid to leave or enter the space above the valve as the valve moves up or down, thereby providing a dash pot action which greatly smooths out the operation of the valve. With this construction the upper surface of the valve is subjected to the fluid pressure existing in the inlet chamber 19.

In order to open the valve 26 automatically when external conditions render such action desirable, I provide a suitable pressure responsive device, such as a flexible diaphragm 31. For the purpose of supporting this diaphragm, a pair of spaced L-shaped feet 32 are formed integral with the casing. These feet 32 extend downwardly from the casing beneath the inlet 12 and the outlet 14 respectively, and they are arranged with their lower portions extending outwardly away from each other. The feet 32 support an annular member or clamping ring 34, and the peripheral portion of the diaphragm 31 is clamped against the lower surface of the ring 34 by means of a cap or disk 35. A pair of bolts 36 extend vertically through openings in the feet 32, ring 34, diaphragm 31 and cap 35, serving to fasten these parts firmly together. The cap 35 has a concave upper surface providing a pressure chamber 38 having the diaphragm as its upper wall, and a tapped hole 39 is provided in the center of the cap in order that fluid pressure may be transmitted to this chamber.

The diaphragm 31 is supported against the fluid pressure in chamber 38 by means of a pressure plate shaped as a flat bottomed circular cup 40 located within the ring 34 directly beneath the casing 10 and in contact with the upper surface of the diaphragm. A pair of ears 42 (Fig. 2) extend outwardly in opposite directions from the upper part of the cup 40 and over the upper surface of the ring 34, the ears 42 and cup 40 forming a yoke which is arranged between the feet 32 and at right angles to the passage 11. Each ear 42 has an opening therein through which passes a vertical stud 44 extending upwardly from the pressure chamber. These studs 44 are threaded for a substantial distance at both ends and their lower ends extend through openings in the ring 34, diaphragm 31 and cap 35. Each stud is provided with a nut 45 at its extreme lower end and a second nut 46 just above the ring 34. With this construction the lower portions of the studs serve as bolts which cooperate with the bolts 36 in clamping the diaphragm between the ring 34 and cap 35.

Surrounding each stud 44 above the corresponding ear 42 is a heavy coiled compression spring 48, which is supported at its upper end by an adjusting nut 49 threaded on to the stud. These springs urge the cup 40 downwardly with a pressure which may be varied as desired by means of the nuts 49. When the fluid pressure in chamber 38 is insufficient to overcome the force of the springs, the ears 42 rest against the tops of the nuts 46, which thus limit the downward movement of the yoke.

The vertical movements of the yoke are transmitted to the valve 26 by a vertical rod or valve stem 51 (Fig. 1). This rod 51 is located directly beneath the valve in axial alignment therewith, and extends through a stuffing box 52 on the lower wall of the casing 10. A suitable packing 53 is provided in this stuffing box, and an annular gland 55 surrounds the rod and serves to compress the packing. In order to maintain a continuous pressure on the packing, I provide a small coiled compression spring 56 which surrounds the rod 51 beneath the gland 55 and which is supported by a nut 57 threaded to the lower end of the rod. This spring 56 forces the gland upwardly against the packing and thus prevents leakage of fluid. The rod 51 is preferably slightly shorter than the distance between the valve and the cup 40 when the latter is in its lowermost position, so that the valve will be sure to close tightly under these conditions.

Referring now to Fig. 3 of the drawing, my improved unloading valve is there shown installed in connection with other parts to form an automobile washing apparatus. I have illustrated a pump 60, which may be of the geared rotary type, and which may be driven by an electric motor (not shown). The pump is supplied with water from a suitable source, such as the city water supply, through a pipe line 61, and the discharge of the pump is connected by a pipe line 62, check valve 64, pipe line 65, manually operable valve 66, and flexible hose 68 to a water discharge nozzle or "gun" 69. An air chamber 70 is connected to the pipe line 65 and subjected to the pressure therein. The diaphragm chamber 38 of the unloading valve is likewise subjected to this same pressure through a pipe line 72 connecting the pipe line 65 with the opening 39 in the cap 35. The inlet 12 of the unloading valve is connected to the pipe line 62 by means of a pipe 73, and the outlet 14 of the unloading valve is connected to the pipe line 61 by means of a pipe line 74.

The operation of the invention will now be clear from the above disclosure. The pump 60 may receive city water at a pressure of perhaps 50 pounds per square inch and deliver the water at a pressure of say 300 pounds. The unloading valve may be adjusted to open at a pressure of say 320 pounds. So long as the manually operable valve 66 is wide open and the nozzle 69 is discharging the full capacity of the pump, check valve 64 will be open and the unloading valve 26 will be closed. If now the manually operable valve 66 is closed, the pressure in pipe lines 62, 65, 72 and air chamber 70 will increase to 320 pounds, and this pressure acting on the diaphragm 31 will be sufficient to overcome the force of springs 48 and the fluid pressure acting on the upper side of valve 26, and immediately open the valve. The pressure in pipes 62 and 73 will at once drop to a value only slightly exceeding the city water pressure, and the pump will circulate

water freely and without any material resistance through pipe 73, the unloading valve, and pipe line 74 back to the pump inlet pipe 61. Check valve 64 will close, trapping the 320 pound pressure in the air chamber 70 and thus holding the unloading valve open. When the valve 66 is again opened to allow water to flow from the nozzle 69, the pressure in the air chamber 70 will immediately decrease, springs 48 will force the yoke downwardly and close the unloading valve 26, the water discharged by the pump will open the check valve 64 and flow through pipe 65, valve 66 and hose 68 to nozzle 69, and the discharge pressure at the pump will increase to 300 pounds. If the valve 66 is closed part way to reduce the flow through the nozzle, the excess water discharged by the pump will be by-passed through the unloading valve without overloading the motor which drives the pump.

The unloading valve is of simple compact construction, and formed of a few parts, all of which can be easily machined and assembled. By using the two springs 48 which extend upwardly at each side of the casing, I greatly reduce the overall dimensions of the apparatus. Moreover, this arrangement places the adjusting nuts 49 in readily accessible positions. When the device is in use, the pump inlet pressure is of course effective in the outlet chamber 20, and if this pressure changes, say from 50 pounds to 100 pounds, this change in pressure will have no material effect on the operation of the valve, since the upper surface of the diaphragm is exposed to atmospheric pressure. As a result the valve will always open at a definite predetermined pressure which is substantially unaffected by variations in the city water pressure.

In certain of the claims appended hereto I have for convenience used such expressions as "horizontal", "above", "beneath", etc., in order to set forth the claimed structure more clearly. It is to be understood, however, that my improved unloading valve will operate in positions other than that illustrated, and that these expressions are not to be considered as limitations except in so far as they define the positions of the parts of the unloading valve itself relative to each other.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent is:

1. A valve mechanism comprising a casing shaped to provide a passage for the flow of fluid, a valve vertically slidable in the casing and arranged to control the fluid flow through the passage, a pair of spaced feet integral with the casing and extending downwardly therefrom, a pressure chamber supported by said feet and having a flexible diaphragm as its upper wall adapted to be subjected to an external controlling pressure, a pressure plate shaped as a flat bottomed circular cup in contact with the upper surface of the diaphragm and located between the feet, a vertically slidable rod extending downwardly into the cup and connecting the pressure plate with the valve, a stuffing box mounted on the lower wall of the casing and surrounding the rod, a pair of ears extending outwardly in opposite directions from the upper part of the pressure plate cup, and a coiled compression spring mounted above each ear and serving to urge the pressure plate downwardly in opposition to the controlling pressure.

2. A valve mechanism comprising a casing shaped to provide a passage for the flow of fluid, a valve vertically slidable in the casing and arranged to control the fluid flow through the passage, a pair of spaced feet integral with the casing and extending downwardly therefrom, a ring supported against the lower surface of said feet, a flexible diaphragm beneath the ring, a cap beneath the diaphragm arranged to clamp the periphery of the diaphragm against the ring and form a pressure chamber, a pressure plate located within the ring and in contact with the upper surface of the diaphragm, a vertically slidable rod extending downwardly from the valve into contact with the pressure plate, a stuffing box on the lower wall of the casing, packing within the stuffing box and surrounding the rod, an annular gland, a coiled compression spring surrounding the rod and arranged to force the gland upwardly against the packing, a pair of ears integral with the pressure plate and extending outwardly in opposite directions therefrom above the ring, and a coiled compression spring mounted above each ear and serving to urge the pressure plate downwardly.

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