United States Patent [19]

Larson

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[54] **FLUID CONTROL MECHANISM**

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[52] **U.S. Cl.** **4/31,** 4/26

[51] **Int. Cl.** **E03d 3/00,** E03d 3/04, E03d 3/06

[58] **Field of Search** 4/1, 26, 18, 20, 27–31, 4/33, 41, 40, 43, 52, 60, 61; 137/572; 251/144, 55

[56] **References Cited**

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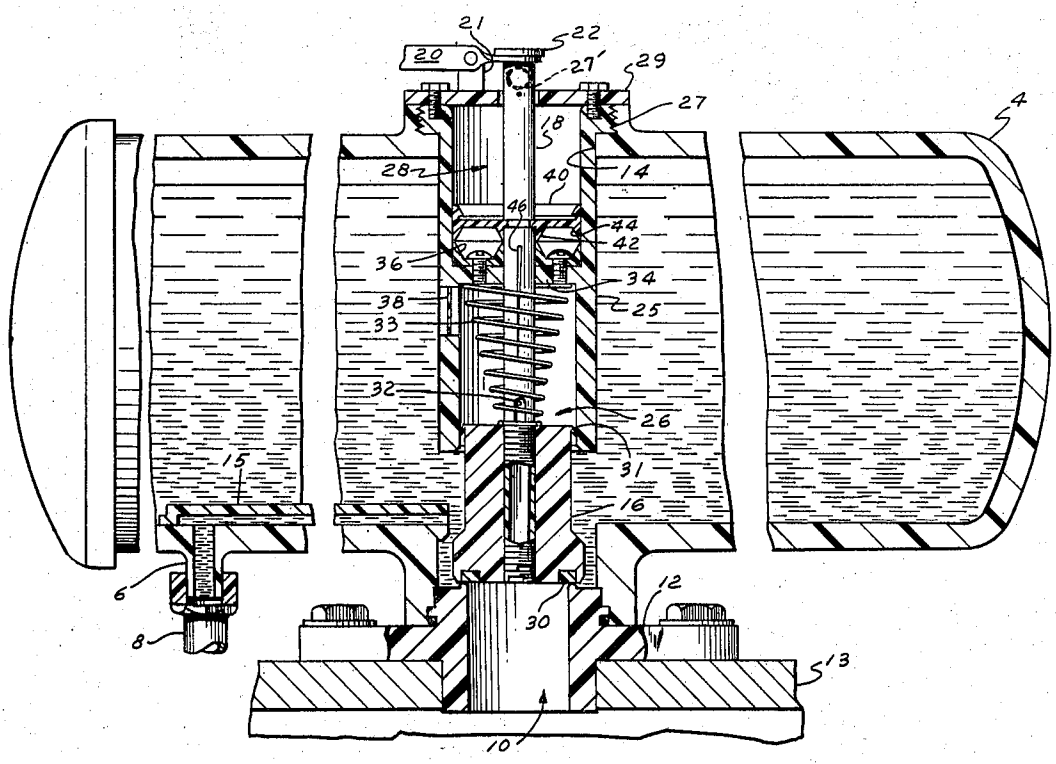
Primary Examiner—Henry K. Artis

Attorney, Agent, or Firm—Chapin, Neal and Dempsey

[57] **ABSTRACT**

Hydraulic discharge systems having a pressurizable water tank with an inlet for supplying water under pressure to the tank and a water discharge port with a piston valve to control the opening and closing of the port and a spring urging said valve to its closed position. A vented chamber and dashpot chamber are disposed within said tank with the piston valve operating in the vented chamber. A rod extends from said piston through said chambers and a dashpot piston is axially affixed thereto and is reciprocably movable in the dashpot chamber. An air bleed conduit interconnects the dashpot and vented chambers to control the rate of closing of the piston valve under the influence of said spring.

5 Claims, 2 Drawing Figures



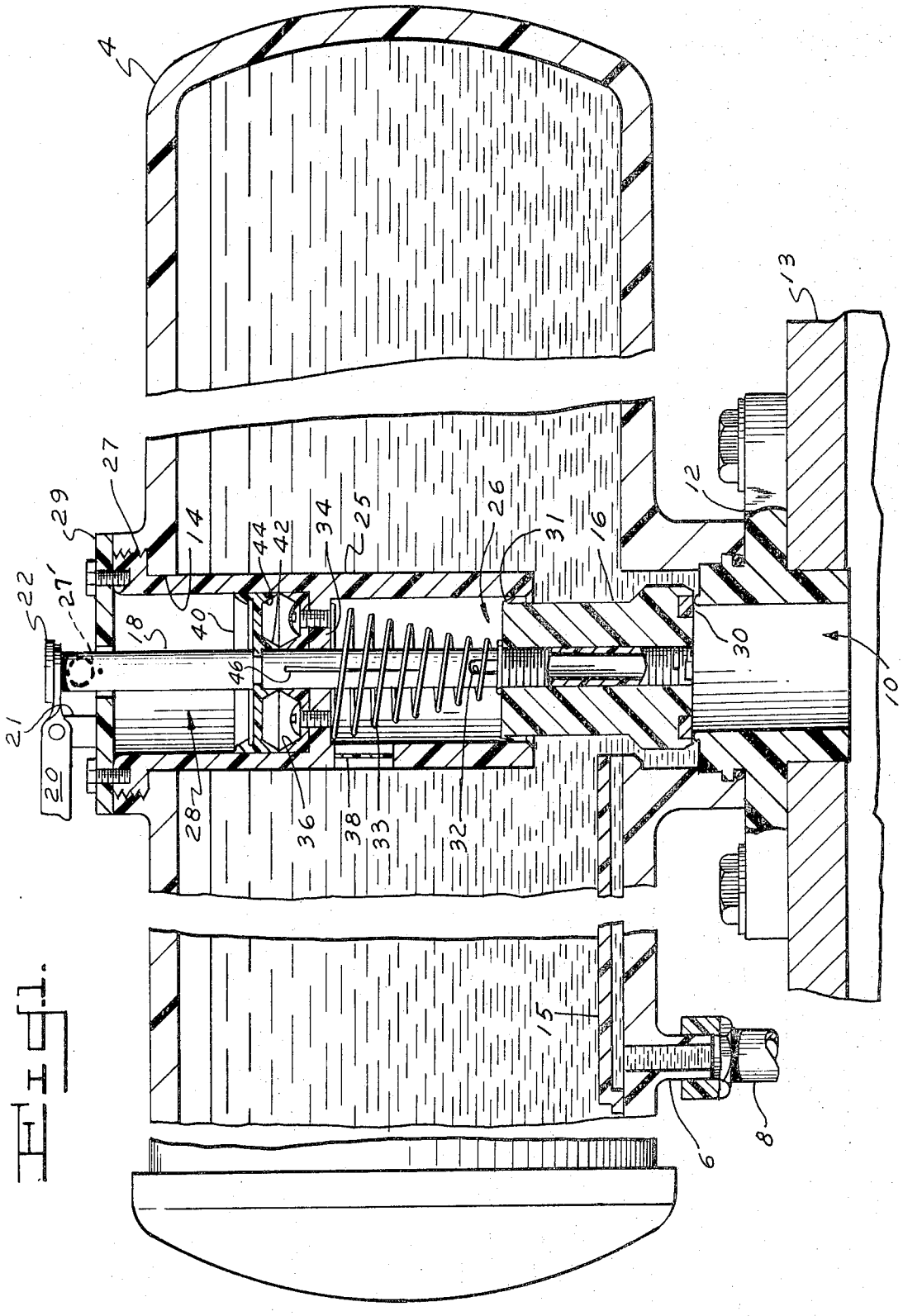

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FIG. 1.

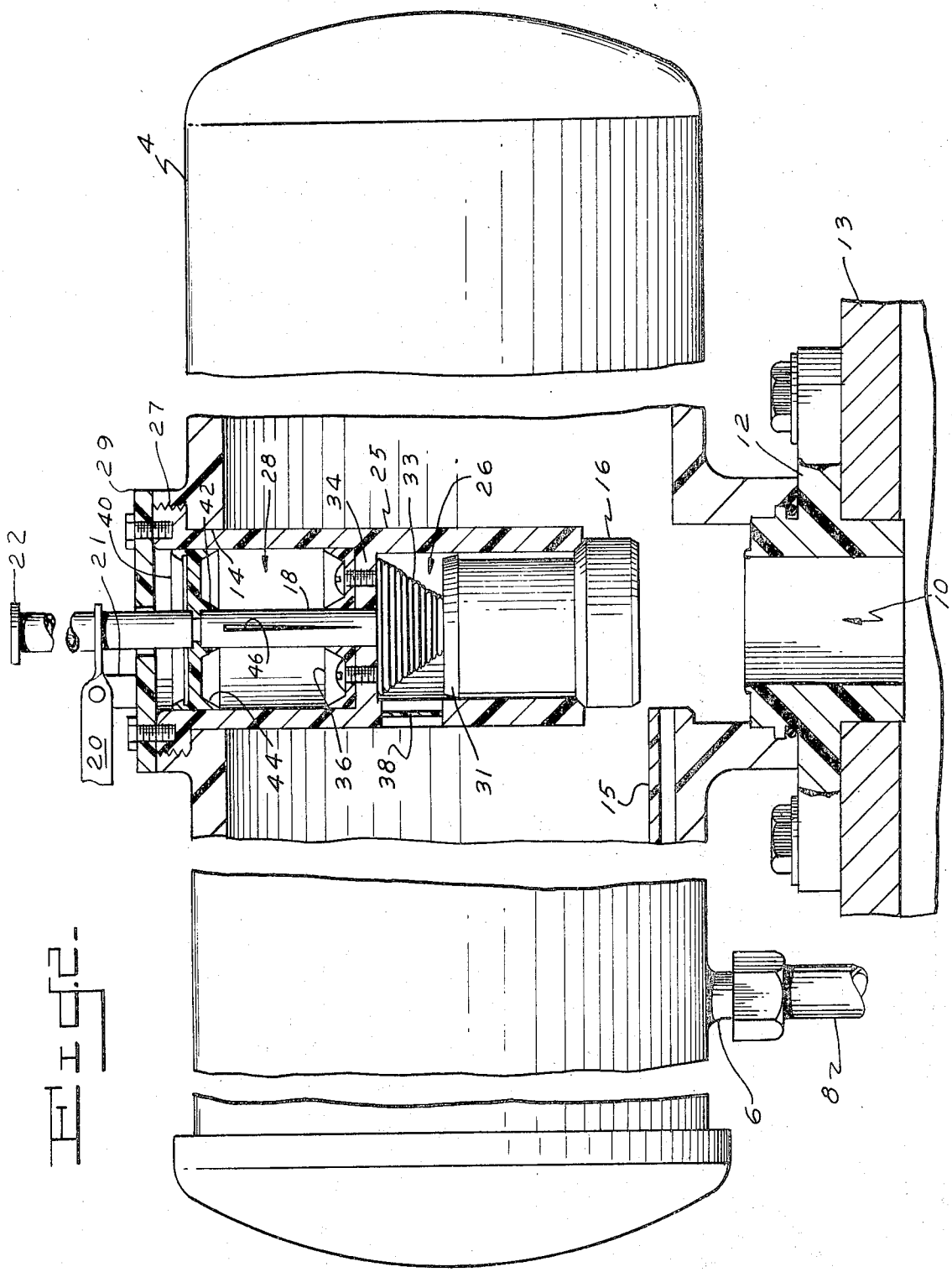
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FIG. 2

FLUID CONTROL MECHANISM

BACKGROUND

While most hydraulic discharge systems, such as currently available for toilet flushing devices, are dependent upon gravity water flow from a water storage tank, there have been a number of devices disclosed in recent patents which contemplate pressurized toilet flushing. One such device is disclosed in U.S. Pat. No. 3,677,294 and another in my copending application Ser. No. 281,350, filed of even date herewith, wherein the flush tank water is discharged forcefully under pressure so that effective flushing is economically achieved with a much smaller volume of water than used in conventional gravity systems.

This invention relates to a liquid discharge system wherein a piston valve is operated for the discharge of liquid from the system and includes a time controlled closure of the valve. The system has wide applications varying from industrial use for supplying liquid additives to various liquid systems to home toilet flushing devices. The instant invention provides an improved hydraulic discharge system, particularly with respect to the so-called "dribble flow" by which the vessel or bowl into which the system discharges is refilled with water to a predetermined level after the flushing phase of the cycle.

The principal object of this invention is to provide an improved discharge system having pressurized water discharge characterized by an effective time controlled refill of the vessel being flushed whereby a predetermined quantity of water refills the vessel subsequent to the discharge of the supply tank and prior to the refill of the supply tank.

A further object of this invention is to provide an improved discharge system of the above type which is of simple construction, effective in operation and in which parts subject to wear can be readily replaced by the average homeowner without requiring the services of a trained technician.

Another object of this invention is to provide an improved discharge system of the above type in which a dashpot is provided for time controlled operation of at least a portion of the valve cycle.

The above and other objects and advantages of this invention will be more readily apparent from the following description and with reference to the accompanying drawings, in which:

FIG. 1 is a cross sectional view showing a water discharge assembly embodying the present invention; and

FIG. 2 is a cross sectional view similar to FIG. 1 with the movable components disposed in different operative relation.

Referring in detail to the drawings, in FIGS. 1 and 2 is shown a pressurizable tank **4**, having a capacity of about two gallons, which may be fabricated, such as by injection molding of any suitable material, for example a synthetic plastic, such as ABS resin. The tank has a water inlet **6** adapted to be connected to the household plumbing, as indicated by the tube **8**. The tank **4** is hermetically sealed so that the tank will be charged to a level such that the water pressure in the tank equals the inlet water pressure, such as normal household pressure of about 30 psi.

The tank is also provided with a discharge opening or port **10**, which in the embodiment shown, is provided with a valve seat **12** appropriately affixed thereto. Of course, the valve seat may be molded integral with the body of the tank. The tank is used in conjunction with a suitable discharge receiving vessel, such as a toilet bowl, a portion of which is indicated at **13** to which the tank is bolted. A conduit **15**, as shown, may be provided to conduct the inlet water directly into the discharge opening to insure positive refilling of the toilet bowl after each flushing operation. The top of the tank **4** is provided with an opening **14** disposed opposite the discharge opening **10**.

Control means provides for sequential operation of the system, including (a) pressurized discharge of water from the storage tank **4**, (b) recharging the discharge vessel or bowl **13** to the proper level and (c) recharging of the storage tank **4**. The control means comprises a piston valve **16** affixed to one end of a vertically-movable, tubular rod **18**. The upper end of the rod is slidably engaged by an actuating lever **20** pivotable about upstanding fulcrum **21**. As shown, the rod **18** includes a flange or cap **22** whereby downward operation of the outer end of the lever **20** serves to lift the rod **18** sufficiently to break the seal between the piston valve **16** and the valve seat **12**. When the seal is broken, the pressurized water in the tank **4** will be forcefully disgorged through the port **10** and the piston **16** will be forced upwardly by the water pressure to its FIG. **2** position. When this occurs, rod **18** will slide upwardly through the lever **20** which may be appropriately shaped to accommodate this movement.

The control means further comprises a cylinder **25** which depends from the top of the tank and is open at its lower end terminating in spaced opposed relation to the tank's discharge port **10**. The upper end of the cylinder **25** has an externally threaded rim **27** which screws into a threaded recess in the tank. A plate **29** is appropriately fitted to close the top of the cylinder which provides a vent chamber **26** and a dashpot chamber **28** which cooperate in the operation of the piston valve **16** in both its opening and closing strokes.

The valve **16** may be fabricated of any suitable material and may be integrally molded of a suitable material, such as ABS resin and provided with an elastomeric sealing ring **30** engageable with the valve seat surrounding the discharge opening. Alternatively, the piston valve may be integrally molded of a resilient material, such as polypropylene, without the provision of a separate sealing ring. About its upper edge, the piston has a sealing ring configuration **31** such that pressurized water is kept out of the vent chamber **26** above the piston.

A hole **32** opens through the wall of the tubular rod **18** and provides communication between the vent chamber **26** and the inside of the tubular rod which in turn is vented to atmospheres both above the tank through the top of the rod **18** and below the tank into the bowl **13**. Should water escape around the top seal **31** of the piston valve **16**, it will be discharged through the hole **32** and into the toilet bowl **13**. A coil spring **33** has one end seated on the top surface of the piston **16** and it other end engaged with a transverse wall **32** which divides the cylinder **25** into two separate chambers, the vent chamber **26** below the wall **34** and the dashpot chamber **28** above the wall. The spring serves to urge the piston valve **16** toward its closed position

and to return the valve to its closed condition after each flushing cycle. A sealing disc **36** is attached to the transverse wall **34** and provides for an hermetic seal about the slidable rod **18** such that the chambers **26** and **28** are hermetically sealed from each other.

A rupture disc **38** is formed in the wall of the cylinder **25** in the event excessively high pressures develop in the tank. The disc is designed to rupture before any structural element of the system and upon breakage of the disc, water under pressure will escape into the vent chamber **26** and thus into the toilet bowl by way of discharge hole **32.**

A dashpot piston **40** is axially affixed to the rod **18** and includes inner and outer seals **42** and **44** respectively whereby on upward strokes of the rod **18** air will flow around the periphery of the dashpot piston so that atmospheric pressure is maintained on opposite sides of the dashpot piston. On the downward stroke, the sealing edge **44** of the piston blocks air flow about the periphery of the piston. A longitudinally extending groove **46** of uniform depth but gradually tapered width from end-to-end thereof is scribed into the surface of the rod to permit gradual and controlled release of air from the dashpot chamber **28** as the dashpot piston **40** moves downward under the influence of the return spring **33.** At first the movement of the piston rod **18** is quite slow since the groove **46** is of very minute cross section at its lower end. As the piston moves slowly downward, the width of groove **46** communicating between the dashpot and vent chambers increases gradually and the downward rate of movement of the rod **18** increases. During this time controlled closing movement of piston **16,** water flowing into the tank from inlet **6** discharges directly through outlet **10** and into the toilet bowl whereby the bowl is refilled to a predetermined level, usually about 2 quarts.

OPERATION

In operation, assuming the tank is filled and the control means is in its FIG. **1** position, when it is desired to operate the system it is only necessary to press the outer end of the operating lever **20** downward. The opposite end of this lever engaged with the flanged head **22** of the rod **18** lifts the rod sufficiently to break the seal between the piston valve **16** and the valve seat **12.** Immediately, the pressurized water will be forcefully disgorged in the nature of a slug from the tank through the discharge opening **10** and will effect a rapid and thorough flushing of the toilet bowl **13.** It has been found that approximately two gallons of water discharged under pressure in this manner is more effective than twice the volume of water released from a gravity flow system.

As water courses through the discharge opening, it pushes the piston valve **16** and rod **18** upwardly, compressing coil spring **33.** A sealing ball **27'** prevents water surge through the tubular rod **18.** The dashpot piston **40** is carried upwardly by the rod **18.** Air is vented from chamber **26** through the discharge port **32** while the air in the dashpot chamber, because of the configuration of the seal **44** of the dashpot piston, flows about the periphery of the piston and equalizes on both sides thereof so that in its FIG. **2** position atmospheric pressure is maintained above and below the dashpot piston. As soon as the water level drops below the bottom surface of the piston valve **16,** expansion of coil spring **33** commences. At this time, however, it will be noted that the fine groove **46** provided in the surface of the piston rod **18** has its narrowest dimension communicating between the vent chamber **26** from the dashpot chamber **28.** This fine line permits air to bleed slowly from the dashpot chamber into the vent chamber **26.** As a result of this gradual release of air from the dashpot chamber, the piston **16** moves only slowly at the beginning of its downstroke. During this time, water from the inlet **6** flows into the discharge port **10** and fills the discharge vessel or toilet bowl to its predetermined level usually requiring about two quarts of water. With continued downward movement of the piston **16** under the influence of coil spring **33** there is an increased rate of air exhausted from the dashpot chamber because groove **46** provides a bleed channel of increasing cross sectional size between the dashpot and vent chambers. As a result, the dashpot piston permits the piston **16** and rod **18** to be moved downward at a faster rate until the piston valve engages the valve seat and completely closes and seals the discharge port **10.** At this time the continued flow of water from the inlet port **6** recharges the tank until pressure in the tank equals the water pressure of the inlet line. The system is then ready for another cycle of operation.

Having thus disclosed my invention, which is claimed is:

1. Liquid discharge apparatus for controlling the discharge of liquid into a receiving vessel comprising a pressurizable tank having an inlet for supplying liquid under pressure into said tank, a liquid discharge port for discharging liquid under pressure from said tank, a piston valve reciprocably operable to open and close said port, means releasably urging said piston valve to a closed position, a piston rod associated with said valve extending outwardly of said tank for retracting said valve from its closed position, a vent chamber and dashpot chamber disposed within said tank, and having a dashpot piston carried on said piston rod in the dashpot chamber, and means controlling the rate of dashpot descent whereby said piston valve closes at a varying rate.

2. Liquid discharge apparatus for controlling the discharge of liquid into a receiving vessel comprising a pressurizable tank having an inlet for supplying liquid under pressure into said tank, a liquid discharge port for discharging liquid under pressure from said tank, a piston valve reciprocably operable to open and close said port, means releasably urging said piston valve to a closed positon, a piston rod associated with said valve extending outwardly of said tank for retracting said valve from its closed position, a vent chamber and dashpot chamber disposed within said tank, and having a dashpot piston carried on said piston rod in the dashpot chamber, and an interconnecting conduit of varying cross section for the controlled release of air from the dashpot chamber whereby said piston valve closes at a varying rate.

3. Liquid discharge apparatus for controlling the discharge of liquid into a receiving vessel comprising a pressurizable tank having an inlet for supplying liquid under pressure into said tank, a liquid discharge port for discharging liquid under pressure from said tank, a piston valve reciprocably operable to open and close said port, means releasably urging said piston valve to a closed position, a piston rod associated with said valve extending outwardly of said tank for retracting said valve from its closed position, a vent chamber and

a dashpot chamber disposed within said tank, and having a dashpot piston carried on said piston rod in the dashpot chamber, and an interconnecting groove in the surface of said piston rod which tapers in width longitudinally of the rod and is of generally uniform depth throughout its length and having its widest cross section toward the upper end of said rod, said interconnecting groove controlling the release of air from said dashpot chamber whereby said piston valve closes at a varying rate.

4. Liquid discharge aparatus as set forth in claim **3** in which said piston rod is tubular, open to the atmosphere at the top and bottom ends thereof, and in which an opening is provided through the wall of said rod to provide communication between said vent chamber and the atmosphere, the lower end of said piston rod extending through the piston valve and opening into said discharge port.

5. Liquid discharge apparatus as set forth in claim **4** in which said vent chamber and dashpot chamber are provided by a cylinder which extends into said tank and has a transverse wall dividing the cylinder into said dashpot and vent chambers, said cylinder being provided with a rupture disc in the wall thereof for providing release of liquid from said tank into said vent chamber.

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