United States Patent

Gibbs et al.

[15] **3,677,294**

[45] **July 18, 1972**

[54] HYDRAULIC FLUSH TANK

[72] Inventors: **James W. Gibbs; John L. Gibbs,** both of Hialeah, Fla.

[73] Assignee: **Marine Bank and Trust Company**

[22] Filed: **April 12, 1971**

[21] Appl. No.: **133,242**

[52] **U.S. Cl.**.....**137/572,** 4/26, 251/144

[51] **Int. Cl.**.....**E03d 3/04**

[58] **Field of Search**.....137/572, 576; 251/144; 4/26, 4/29, 30, 31, 47, 48, 60, 61, 65

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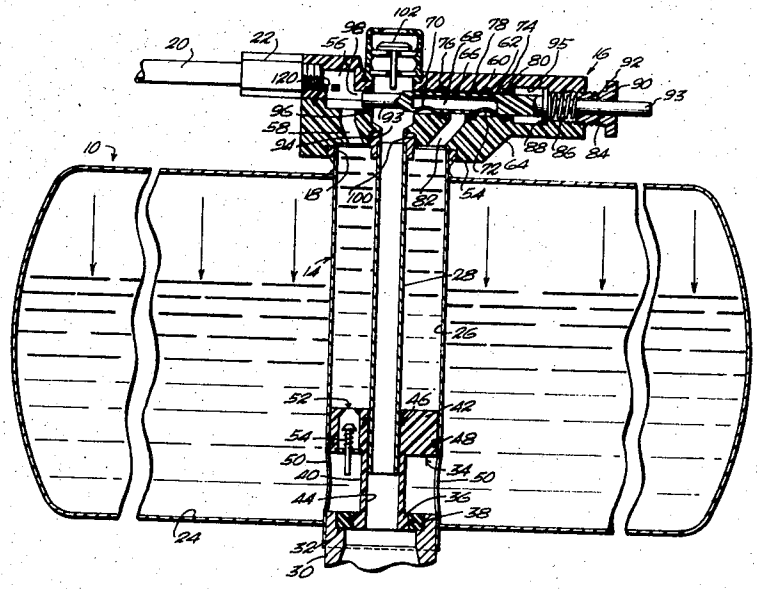
Primary Examiner—William R. Cline

Attorney—John Cyril Malloy

[57] **ABSTRACT**

A hydraulic assembly for filling and rapidly discharging a liquid from a hermetically sealed tank. The assembly includes a flush tank having a cylindrical sleeve extending vertically therethrough and a tubular axially disposed air vent within the sleeve. A valve means, slidably disposed within the sleeve on the tubular air vent adjacent the lower end thereof, is closed by the normal water line pressure, entering through the top of the sleeve, to hermetically seal the flush tank and the chamber within the sleeve, permitting the pressure therein to build until it balances the water line pressure. Manually operated valve means are provided at the top of the sleeve to open the pressurized chamber within the sleeve to the air vent causing the rapid discharge through the air vent of part of the water within the sleeve chamber, which, because of the pressure differential thus created, opens the valve at the bottom of the sleeve causing a rapid discharge of the pressurized water from the tank.

13 Claims, 6 Drawing Figures



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SHEET 1 OF 3

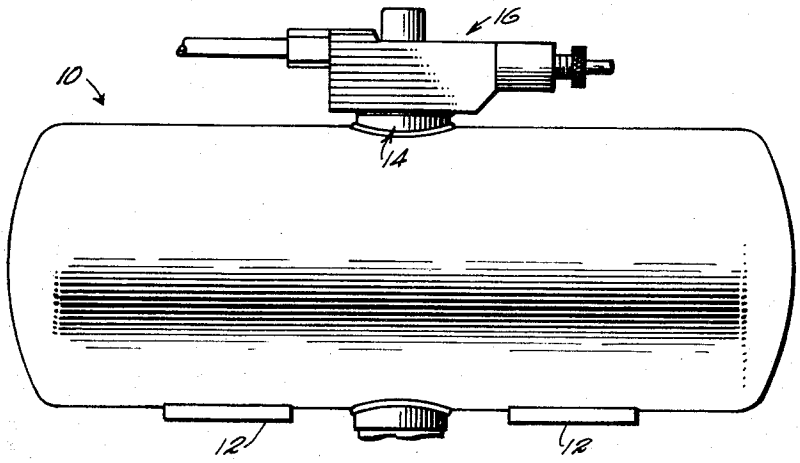


Fig. 1

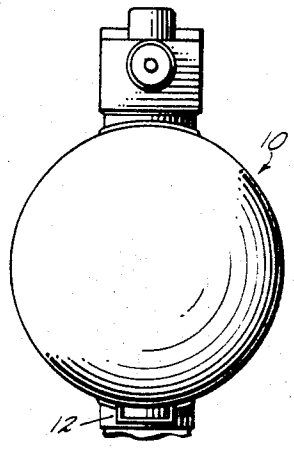


Fig. 2

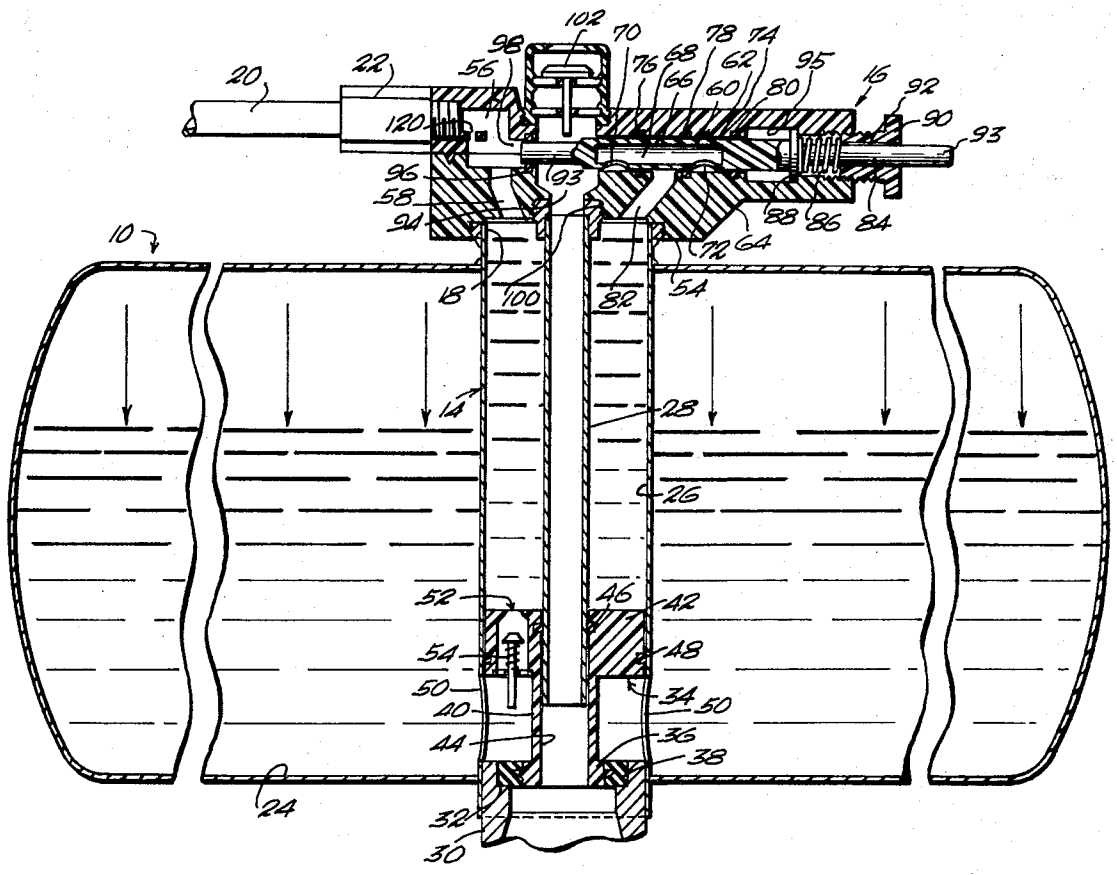


Fig. 3

INVENTOR
JAMES W. GIBBS
BY JOHN L. GIBBS
John Cyril Malloy
ATTORNEY.

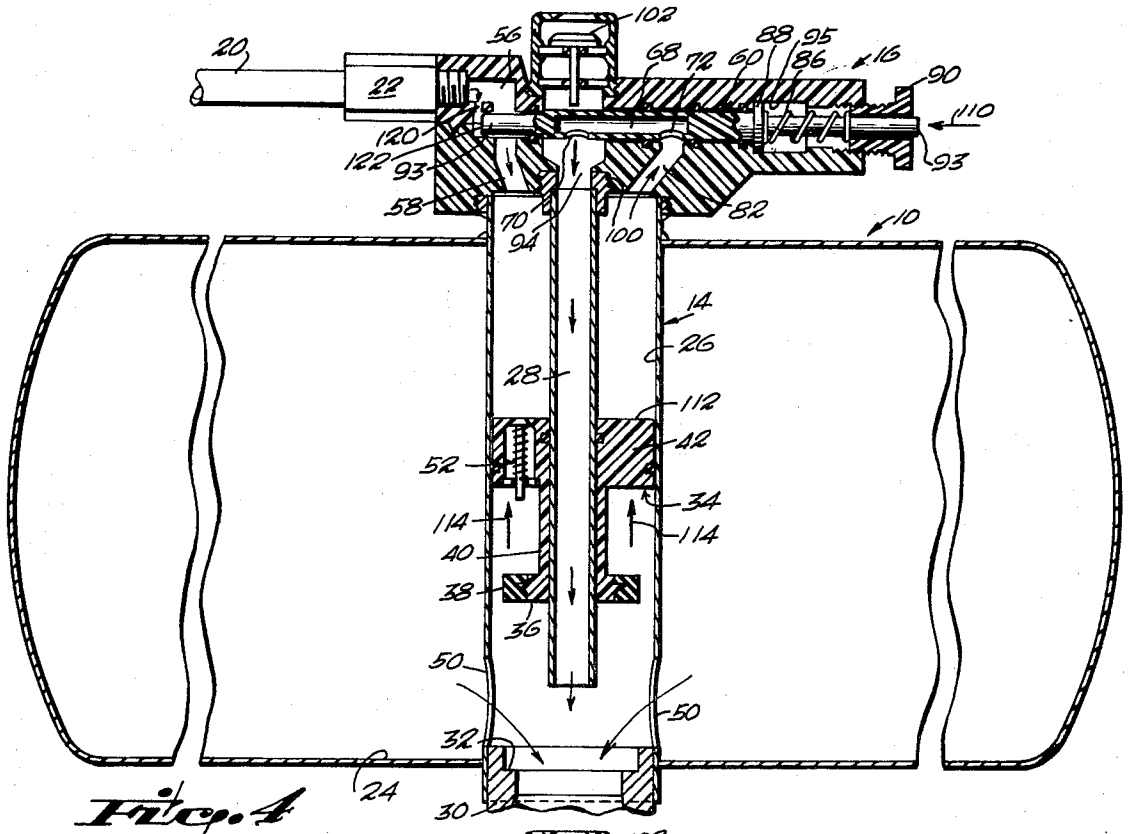


Fig. 4

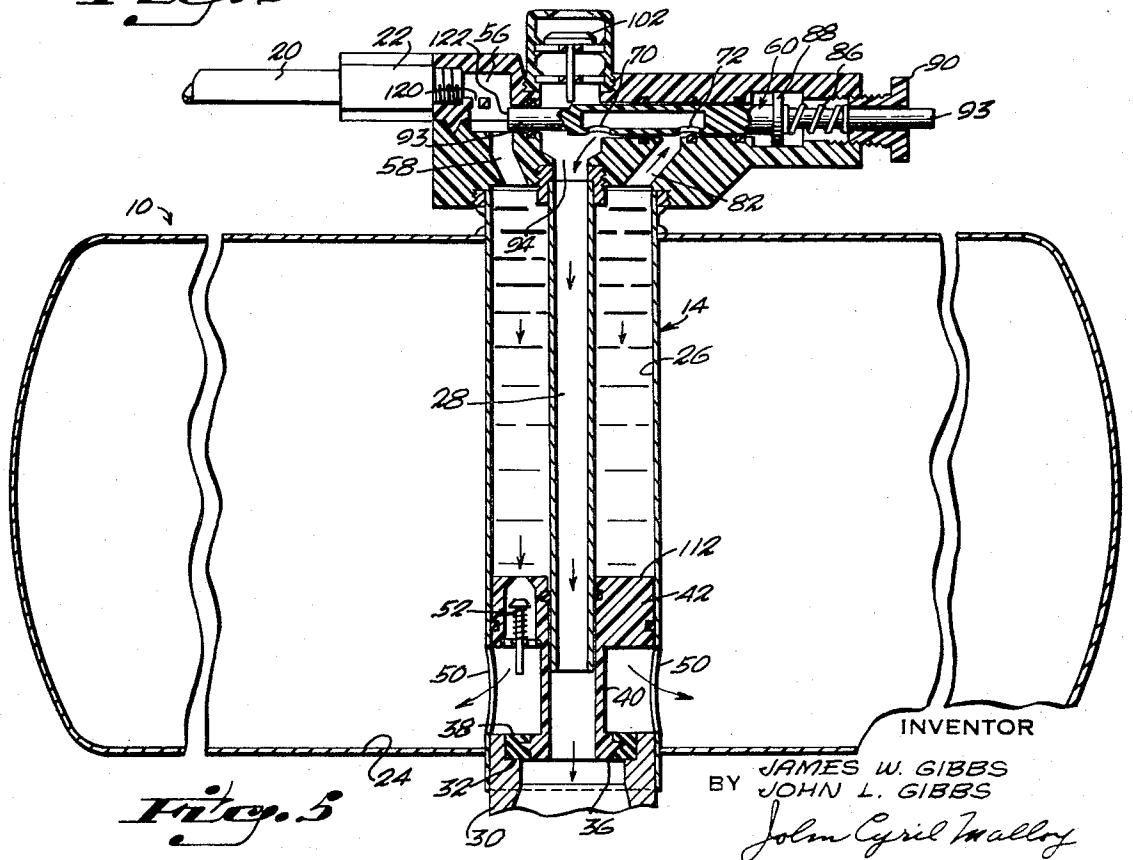


Fig. 5

INVENTOR
JAMES W. GIBBS
BY JOHN L. GIBBS
John Cyril Malloy
ATTORNEY.

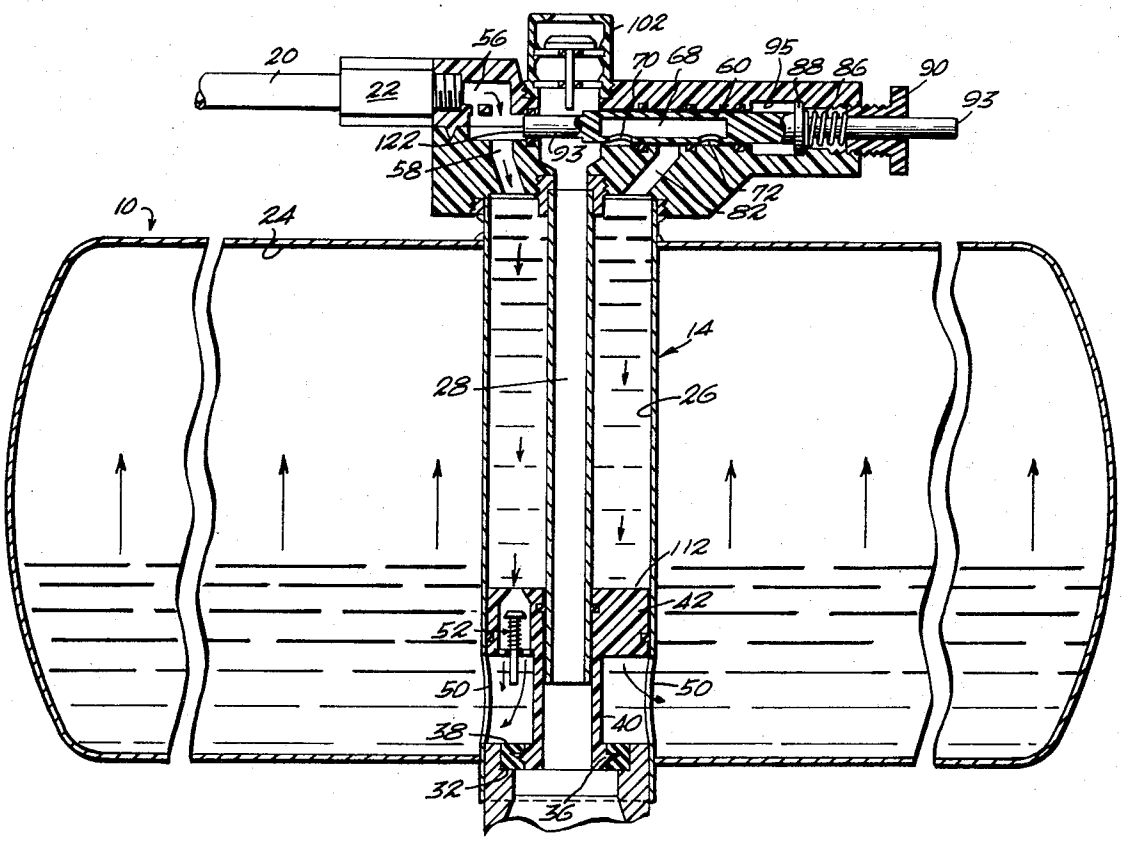


Fig. 6

INVENTOR
JAMES W. GIBBS
BY JOHN L. GIBBS
John Cyril Malloy
ATTORNEY.

HYDRAULIC FLUSH TANK

STATE OF THE PRIOR ART

Most toilet flushing devices now in use depend upon gravitation of water from a tank under normal atmospheric pressure, manual operating means being provided to open a large diameter ball valve which permits the water to flow from the tank to perform the flushing operation. Float means are utilized, first, to open a water inlet valve to refill the tank from a pressurized water supply line and, second, to close the valve when the water in the tank has reached a predetermined level. This type of toilet flushing apparatus is wasteful of water and is not always effective in forcefully flushing and cleaning the toilet bowl.

BACKGROUND OF THE INVENTION

The present invention generally contemplates a hydraulic toilet flushing device which performs a superior flushing operation with a fraction of the amount of water utilized by the gravity type flushing devices commonly in use.

In general, the device of the instant invention provides a primary tank and a secondary tank disposed vertically through said primary tank. A filler tube supplies water to the primary tank through a port in the normally closed upper end of the secondary tank and an air vent tube is axially disposed through the secondary tank in open communication between the atmosphere above and below the primary tank.

Piston valve means are provided adjacent the lower end of the secondary tank to hermetically seal both the primary and secondary tanks by utilizing the normal line pressure entering through the filler tube. A bypass valve is provided in the piston valve means to permit the water from the filler tube to flow through the secondary tank into the primary tank whereby both the primary and secondary tanks are filled with water to a point where the pressure in both tanks balances or is equal to the source pressure supplied by the filler tube.

A manually operated valve means is provided atop the secondary tank which opens said tank to the air vent tube causing a rapid loss of pressure therein with resulting partial discharge of water therefrom through the air vent tube. Simultaneously, an imbalance in pressure is created between the primary and secondary tanks which instantaneously opens the piston valve means discharging the pressurized water from the primary tank as a slug. In this manner a relatively small amount of water performs a flushing operation which is far superior to a gravity flushing operation performed by 5 to 10 times the amount of water.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a longitudinal side view of the water flushing tank assembly of the present invention;

FIG. 2 is an end view of the assembly shown in FIG. 1;

FIGS. 3 through 6 are vertical, longitudinal, sectional views through the flushing tank assembly, illustrating various operational flushing and refilling stages thereof.

DETAILED DESCRIPTION OF THE INVENTION

With reference to the drawings in which like reference numerals designate like or similar parts throughout the various views and with particular reference to FIGS. 1 and 2, the numeral 10 designates a tank which includes conventional means 12 to slidably receive bolts for attachment to a toilet bowl. A sleeve member 14, fixed to and extending vertically through the tank 12, carries a manually operated valve assembly 16 in enclosing relation to the upper end 18 thereof and a filler tube 20, extending from a pressurized water source across a check valve 22 is connected to the valve assembly 16 and supplies water to the tank assembly.

With particular reference to FIG. 3, the tank 10 provides a primary water chamber 24, and the sleeve member 14 provides a secondary water chamber 26. An air vent tube 28 extends vertically, axially through the secondary water chamber 26 and communicates with the atmosphere above and below the tank 10.

The open lower end of the sleeve 14 carries a member 30 providing a seat 32 for a piston valve 34. This member 30 as illustrated fragmentarily in FIGS. 3 through 6 may comprise a portion of a connection fitting to a toilet bowl through which the flush water is conventionally conveyed to the bowl.

With further reference to FIG. 3, the piston valve includes a lower annular flange 36 having an elastomer ring portion 38 for sealing engagement with the valve seat 32. Spaced above the annular flange portion 36 of the piston valve and connected thereto by a reduced diameter neck portion 40 is an enlarged head portion 42.

The piston valve 34 is provided with a vertical through opening 44 for sliding engagement along the air vent tube 28 and as illustrated the enlarged head portion 42 is slidably received within the secondary water chamber 28 provided by the sleeve 14. O-rings 46 and 48 in the through opening 44 and around the head portion 42 provide respective water seals between the air vent tube 28, piston valve 34 and the inner wall of the sleeve 14.

A plurality of port openings 50 are circumferentially spaced about the lower end of the sleeve 14, and, as illustrated in FIG. 3, the only communication between the primary water chamber 24 and the secondary water chamber 26, when the piston valve is seated, is through the openings 50 and a by-pass valve 52 in the valve head 42. The by-pass valve 52 is normally open under the influence of a tension spring 54 when the pressures above and below the head 42 of the piston valve 34 are substantially equal.

With further reference to FIG. 3, the manually operated valve assembly 16 is fixed in enclosing relation to the upper end of the sleeve 14 as by the screw thread means 54. The filler tube 20 opens into a chamber 56 in the valve assembly 16 which, in turn, communicates with the secondary water chamber 26 in the tube 14 through a port 58.

A slide valve 60 extends longitudinally through the valve assembly housing, comprised of top and bottom portions 62 and 64. The central portion 66 of the slide valve provides an internal cavity 68 in communication between a pair of spaced apart ports 70 and 72 and said central portion 66 extends through a bore 74 provided with three spaced apart O-rings 76, 78 and 80. A port 82 communicates between the secondary water chamber 26 in tube 14 and the portion of the bore 74 between the O-rings 76 and 78.

The slide valve includes a reduced diameter outer portion 84, having a compression spring 86 circumposed thereabout between an enlarged annular flange 88 and the inner end of a compression adjustment screw 90. The screw 90 is threaded into the valve assembly housing and provides a through bore 92 for the outward extending portion 93 of the slide valve 60.

The annular flange 88 is slidably engaged in an enlarged inner diameter portion 95 of the bore 74, said portion 95 being of a predetermined length to establish the amount of axial movement of the slide valve 60.

With continued reference to FIG. 3, the slide valve 60 includes a slightly reduced diameter inner end 93 extending across a vertical bore 94 into sliding engagement with an O-ring 96 in a relatively short bore 98 which communicates with the chamber 56 and the port 58.

The vertical bore 94 provides screw thread attachment means 100 adjacent its lower end for the air vent tube 28, and a check valve 102 opening upwardly therefrom to the atmosphere is provided at the upper end of the bore 94.

OPERATION OF THE INVENTION

FIG. 3 illustrates the device in a fully charged and pressurized condition. Water supply tube 20 is illustrated opening into the primary water chamber 24 of the tank 10 via chamber 56, port 58, secondary water chamber 26, check valve 52 and the port openings 50. Therefore, the pressure in the entire system is balanced relative to the pressure of the water from

the source as provided through the supply tube **20** and check valve **22**.

FIG. **4** illustrates the flushing operation. Arrow **110** indicates that the slide valve **60** has been moved manually inwardly until the secondary water chamber **26** is in communication with the air vent **28** via ports **82** and **72**, cavity **68**, port **70** and bore **94**. In this condition the pressure in the secondary water chamber is released and at least a portion of the water therein is discharged downwardly through the air vent tube **28**. Instantaneously, the pressure on the top side **112** of the piston valve **34** is released permitting the upward pressure indicated by the arrows **114** to close the by-pass valve **52** and to move the piston valve **34** upwardly from the valve seat **32** whereby the water under pressure in the primary chamber **24** is discharged through the ports **50** as a slug of water which will sweep everything in its path.

As further illustrated in FIG. **4**, when the push valve **60** is fully depressed, water from the supply tube **20** continues to enter the secondary water chamber **26** around the reduced diameter end **93** of the slide valve **60** via a small bypass port **120**. When the inward pressure on the valve **60** is released, the water pressure from the supply tube **20** reacts on the inner end **122** of the slide valve **60** to provide a partial return thereof as indicated in FIG. **5**.

Water pressure from the supply tube **20** is now flowing through the chamber **56** and port **58** into the secondary water chamber **26**, creating sufficient pressure on the top surface **112** of the piston valve to reseat same on seat **32**. By-pass valve **52** reopens permitting the water from the supply tube to enter the primary water chamber **24** to rebuild the pressure in both the primary and secondary water chambers.

With further reference to FIG. **5** it will be apparent that the slide valve, as previously stated, has not returned to its initial position. Valve port **82** from the secondary water chamber is partially open to the air vent **28** via port **72**, cavity **68** and port **72** to permit a small portion of the water, entering the secondary water chamber from the supply tube, to pass through the air vent tube to refill the toilet bowl to a predetermined level. The spring compression adjustment screw **90** provides means for properly adjusting the resistance forces of the spring **86** to permit the water pressure to close the slide valve **60** at the proper time. As the pressure within the system increases under the influence of the source pressure, the slide valve **60** slowly closes against the forces of the spring **86** and as illustrated in FIG. **6**, when the slide valve is completely closed, all of the water from the supply tube **20** is directed into the primary and secondary water chambers whereby the air in the primary chamber is compressed until a state of pressure equilibrium is reestablished in the system as illustrated in FIG. **3**, the air supply in the primary chamber **24** being replenished by the air vent tube **28** after each flushing operation.

This balanced condition remains until the slide valve is once again depressed as at **110**, and when the source pressure is in the range of 40 to 60 pounds per square inch for example, the flushing operation is practically instantaneous with the actuation of the slide valve and the water from the primary chamber **24** rushes out as a slug of water and accomplishes a most efficient flushing operation.

While a preferred form of the instant invention has been illustrated and described, it will be obvious to those skilled in the art that various modifications and changes can be made therein without departing from the true spirit of the invention as defined by the appended claims.

What is claimed is:

1. A hydraulic flush tank assembly comprising,

A. a main tank providing,

1. a pressure sealable primary liquid storage chamber;

B. a sleeve means fixed to and extending vertically through said tank providing,

1. a secondary liquid storage chamber,

2. an open lower end comprising a discharge outlet,

3. a valve seat above and adjacent to said discharge outlet,

4. apertures, above and adjacent to said valve seat, providing communication between said primary and secondary storage chambers;

C. an air vent tube, extending axially through said sleeve means, opening to the atmosphere above and below said tank;

D. means to enclose the top of said secondary liquid storage chamber;

E. a pressure actuated piston valve means slidably disposed in said secondary liquid storage chamber which is actuated by downward pressures to a closed position on said valve seat to hermetically seal both of said storage chambers, and to an open position by upward pressures to open said primary storage chamber through said apertures to said discharge outlet; said piston valve providing,

1. a by-pass valve operating between said secondary liquid storage chamber and said apertures;

F. inlet conduit means from a pressurized source to direct a liquid downwardly through said secondary storage chamber to close said piston valve and to fill said hermetically sealed primary and secondary storage chambers with the liquid until a state of pressure equilibrium exists relative to the source,

G. manually operated valve means which is operable to open said secondary liquid storage chamber into said air vent tube to destroy the state of pressure equilibrium causing said by-pass valve to close and said pressure actuated piston valve means to open in response to upward pressure whereby said primary liquid storage tank is opened to the atmosphere through said apertures and discharge outlet, permitting the pressurized liquid therein to be very rapidly discharged.

2. A hydraulic flush tank assembly as defined in claim **1** in which said means to enclose comprises the valve body of said manually operated valve means including a connection means for said inlet conduit and a port means from said inlet conduit to said secondary liquid chamber.

3. A hydraulic flush tank assembly as defined in claim **2** including a check valve in said inlet conduit.

4. A hydraulic flush tank assembly as defined in claim **2** in which said manually operated valve means comprises a slide valve movable between an extended position and a depressed position and providing port means which are closed when said slide valve is in said extended position and in open communication between said secondary storage chamber and air vent tube in said depressed position.

5. A hydraulic flush tank assembly as defined in claim **4** in which said slide valve includes an inner end surface and said connection means are positioned relative to said inner end surface whereby said pressurized liquid is directed thereagainst to move said slide valve to and maintain it in its extended position except when said slide valve is manually depressed.

6. A hydraulic flush tank assembly as defined in claim **5** including a compression spring to partially counterbalance the pressure exerted on said inner end surface whereby said port means are maintained in a partially opened condition until a predetermined degree of pressurization has been attained in said primary and secondary storage chambers.

7. A hydraulic flush tank assembly as defined in claim **6** including compression adjustment means for said compression spring.

8. A hydraulic flush tank assembly as defined in claim **7** in which said slide valve includes an enlarged annular flange and said compression adjustment means comprises a nut threaded into said valve body, said compression spring being circumposed about said slide valve between said enlarged annular flange and said nut, said nut being provided with a central through bore and said slide valve having a portion extending outwardly through said bore for manual manipulation.

9. A hydraulic flush tank assembly as defined in claim **8** in which abutment means are provided in said valve housing to cooperate with said enlarged annular flange to establish said extended and depressed positions.

10. A hydraulic flush tank assembly as defined in claim 1 in which said pressure actuated piston valve includes, an elastomer lower portion for sealing engagement with said valve seat, an enlarged head portion spaced upwardly therefrom, a neck portion connecting said lower and head portions and a central axially extending bore, said enlarged head portion and bore being sized to provide sliding movement of said piston valve within said secondary liquid storage chamber in telescopic relation to said air vent tube.

11. A hydraulic flush tank assembly as defined in claim 10 including seal means between said piston valve, and the wall of said secondary liquid storage chamber and air vent tube.

12. A hydraulic flush tank assembly as defined in claim 10 in which said by-pass valve extends through said enlarged head portion between said secondary and primary liquid storage chambers.

13. A hydraulic flush tank assembly as defined in claim 1 including a check valve at the upper end of said air vent tube to prevent an upward discharge of liquid therefrom.

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