July 3, 1962 V. E. PRATT 3,041,629

FLUSHING APPARATUS

Filed Feb. 2, 1959

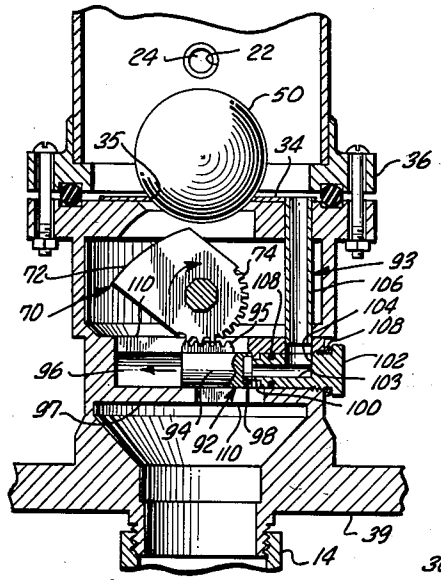


Fig. 3.

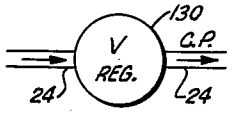


Fig. 4.

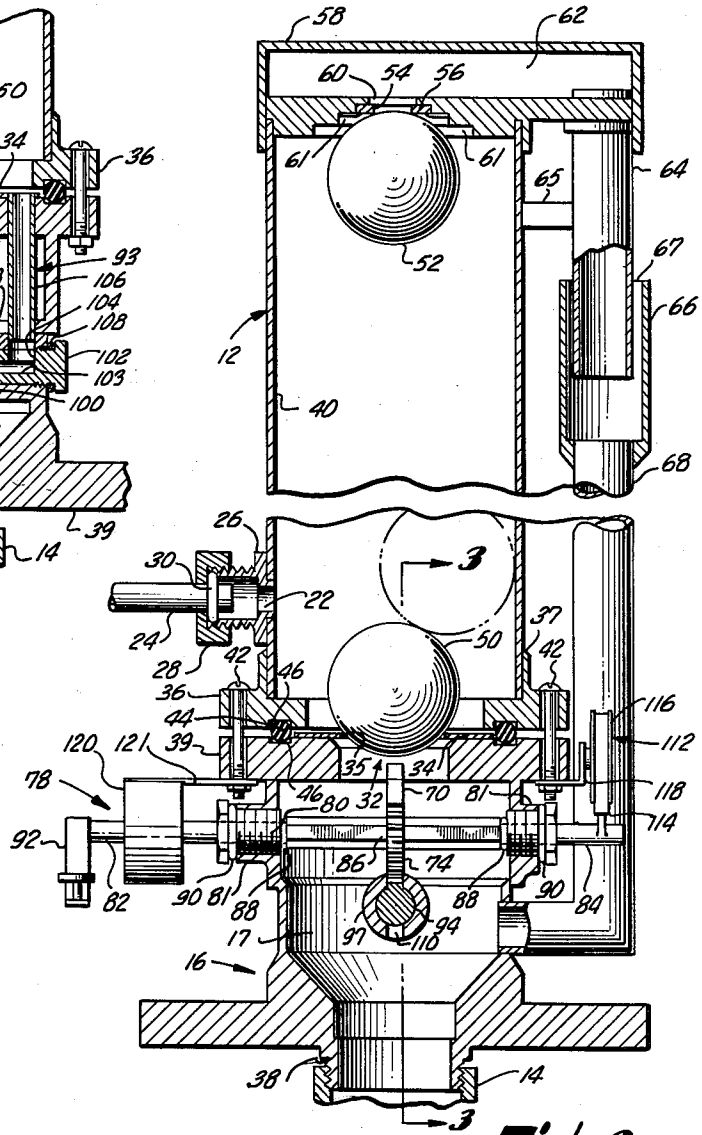


Fig. 2.

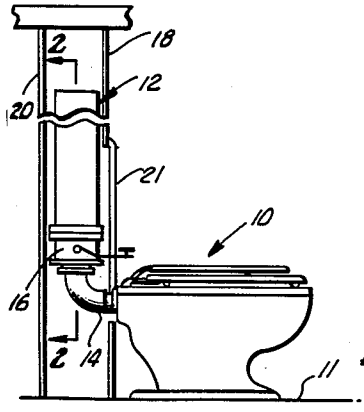


Fig. 1.

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FLUSHING APPARATUS

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2 Claims. (Cl. 4—28)

The present invention relates to flushing apparatus and more particularly to an apparatus for flushing toilet bowls and the like.

The conventional toilet flushing apparatus employs a vitreous tank adapted to impound or hold a certain quantity of water, for example four or five gallons at a ten or eleven inch hydrostatic head, having an inlet adapted to be connected to a source of water under pressure and an outlet connected to a toilet bowl. The conventional flushing apparatus further includes a ball-cock mechanism, eg., a floating hollow ball coupled to a valve in the inlet by means of a suitable leverage mechanism to close the inlet to the tank when the liquid therein reaches a predetermined level. The outlet of the tank is normally closed by a suspended ball that drops, or at least is designed to drop, over a seat which surrounds the outlet in the base of the tank.

This conventional toilet flushing mechanism is complicated, expensive and requires many parts which are constantly exposed to the water within the tank. To prevent excessive corrosion of the parts they are generally made of brass which adds to the manufacturing cost of the conventional flushing apparatus. However, in many areas the water is very corrosive even to brass parts and in such areas conventional ball-cock mechanisms are continually being replaced. Even in other areas where the water is not so corrosive to brass parts such apparatus requires constant attention to maintain it in an operative condition. Furthermore, the conventional toilet flushing apparatus is noisy and unreliable. For example, the water inlet to the tanks of the conventional flushing apparatus is generally located above the maximum water level within the tank so that during the entire refilling operation of the tank a loud and undesirable noise is created by the water gushing from the inlet and striking the surface of the water within the tank. A disturbing whistling noise is also created by the gradually decreasing water flow through the inlet due to the restricting action of the inlet valve as the float is raised by the water level during the refilling operation. These noise signals are rendered more disturbing by the amplifying action of many conventional vitreous tanks which are resonant at the frequencies of the noise signals. Also the floating ball valve frequently fails to close the outlet of the tank after the flushing operation is completed, permitting water to continually dribble into the toilet bowl until the operating handle that is coupled to the ball is jiggled or some more drastic measure is taken to drop the ball to its seat.

The space required by the conventional vitreous china tank is also undesirable, especially in modern homes where the bathrooms are small. To overcome this disadvantage the tanks for storing the flushing water have been placed in the wall between the studs. However, the tanks that have been placed in the wall are merely the standard rectangular vitreous tanks with the same ball-cock mechanisms. While these tanks are out of the way, they still require constant servicing, a large panel in the wall to provide access to the tank, and hold four to five gallons of water with the conventional ten to eleven inch hydrostatic head.

It has been discovered that a more adequate flush of a toilet bowl is obtained by delivering two or three gallons of water to the bowl from a long vertical tank to provide a four or five foot hydrostatic head than by flushing the bowl with twice the amount of water under only a ten or eleven inch head.

Other types of less conventional flushing apparatus have heretofore been proposed in an attempt to eliminate the ball-cock mechanism and its inherent shortcomings, but these types of apparatus have not been used to any great extent for various reasons. See, for example, U.S. Patents No. 1,383,273 issued to A. H. Klahn; No. 1,995,358 issued to C. E. Mace, and No. 2,055,271 issued to P. E. Vuagnat.

These proposed flushing devices include a tank having an unrestricted inlet and an outlet and one or more valve members such as a ball or a plurality of valving discs disposed within the tank and arranged to be normally pressed against one or more seats surrounding the outlet by the water pressure within the tank. A lever mechanism including a handle is provided for lifting the valve member or members from their seats to initiate the flushing operation. While these proposed devices eliminate the necessity for the conventional ball-cock mechanism and its associated problems they encounter another problem as a result thereof. By providing an unrestricted inlet so that the water pressure within the tank controls the flow of water through the inlet the valve member or members for closing the outlet must be lifted against the full pressure of the source that is connected to the inlet. Where the inlet of the tank is connected to a city water main the pressure at the inlet when the outlet is closed may be of the order of 40 to 50 p.s.i. To move even a small valve member against such a high pressure would be a monumental task for the average user of a toilet unless an expensive leverage mechanism were employed with its inherently long operating stroke or some additional source of power were used to open the outlet.

In summary, the previous attempts to produce a better flushing apparatus were too complex, impractical or expensive to manufacture and, therefore, could not meet the economical test that competition in this field dictates.

The above disadvantages have been overcome by the flushing apparatus of the present invention which is reliable, inexpensive to manufacture, simple in structure, quiet and efficient in operation. The apparatus of the present invention also requires little maintenance and may provide a hydrostatic head of several feet by impounding the flushing water within a vertical tank which may conveniently be housed between the studs in the wall of a bathroom so that the tank is completely out of the way.

In accordance with the present invention there is provided a flushing apparatus which includes a tank having an inlet adapted to be connected to a source of liquid, such as water under pressure, and an outlet. Valve means are coupled to the outlet for controlling the flow of water therethrough with the valve means being arranged to close the outlet normally. For example, such valve means may include an impermeable sphere such as a plastic ball disposed within the tank and adapted to cooperate with an annular seat surrounding the outlet so that the sphere or ball is normally forced against the annular seat by the pressure of the water within the tank. Since the inlet to the tank is connected directly to a source of water under pressure the pressure within the tank when the outlet is closed becomes equal to the pressure of the source which may be of the order of 40 or 50 p.s.i. This high pressure insures a good seal between the ball and the annular seat, thereby preventing any water from dribbling into the toilet bowl between flushing operations. The flushing apparatus also includes means for operating the valve means to open the outlet and means to reduce the pressure within the tank prior to operating the valve means. Where the valve means includes a ball and cooperating annular seat

surrounding the outlet, the means for operating the valve means may include a cam, disposed below the ball, for lifting the ball from the seat when the cam is turned and the means for reducing the pressure within the tank may include a conduit in fluid communication with the tank and a plug valve coupled to the conduit for draining water from the tank just before the cam engages the ball to reduce the pressure within the tank and thereby reduce the force required to lift the ball to open the outlet.

The invention is described in more detail in connection with the accompanying drawing in which:

FIG. 1 is an elevation illustrating the apparatus of the present invention connected to a toilet bowl with the water tank disposed within a wall;

FIG. 2 is a sectional view taken along the lines 2—2 of FIG. 1, partly broken away;

FIG. 3 is a sectional view taken along line 3—3 of FIG. 2;

FIG. 4 is an elevational view of a pressure regulator that may be employed with the apparatus of FIGS. 2 and 3.

Referring now to the drawing and more particularly to FIG. 1, a conventional rear spudded washed down type of toilet bowl is indicated generally at **10**. The toilet bowl **10** is supported by a floor **11**. A vertically extending tank, indicated generally at **12**, is secured to the rear of the bowl **10** by means of an elbow **14** and a bracket **16**. The tank **12** is disposed between the usual 6-inch studding within a wall having front and rear surfaces **18** and **20** respectively. A panel **21** is removably fastened by suitable means (not shown) to the front surface **18** to provide access to the tank **12**.

Referring now to FIG. 2, the tank **12** includes an inlet **22** which is connected to a suitable source of liquid or water under pressure by means of an inlet pipe **24** which may, for example, be the standard ⅜ inside diameter service pipe which is inserted into a fitting **26** and secured thereto in a water tight relationship by means of a hexagonal cap **28** and a rubber sealing ring **30**. The tank **12** includes an outlet **32** through which water impounded within the tank **12** may flow into the toilet bowl **10**, as will be more fully described. An annular gasket **34** which may be formed of molded butyl rubber or neoprene is secured between an annular of bracket **36** which forms the bottom of the tank **12** and an upper flange **39** of the bracket **16**. The gasket **34** includes an annular seat **35** which surrounds the outlet **32**. The bracket **16** includes a centrally disposed discharge opening or chamber **17** through which the water impounded in the tank **12** flows to flush the toilet bowl. The bracket **36** includes a vertically extending flange **37** which is suitably secured in a water tight manner to the bottom of a stand pipe **40** which forms the central portion of the tank **12**. The bracket **16** includes a nipple **38** at the lower end thereof which threadedly engages the elbow **14** and the flange **39** at the upper end which is secured to the bracket **36** by means of bolts **42**. An O-ring **44** is disposed between cooperating annular grooves **46** formed in the bracket **36** and the flange **39** of the bracket **16**, as shown, to make the tank **12** water tight.

A valve member such as a plastic ball **50** is disposed within the tank **12** and adapted to cooperate with the annular seat **35** formed by the gasket **34** to provide a water discharge check valve which normally closes the outlet of the tank and prevents water flow therethrough. Another ball **52** which is arranged to float is disposed within the tank **12** and adapted to cooperate with an annular seat **54** formed by a gasket **56** to provide an air release check valve, as will be more fully described. The gasket **56** is suitably secured to a top bracket member **58** that forms the top of the tank **12**. The bracket **58** has a centrally located hole **60** therein which may be formed by a plurality of coaxial annular grooves **61**, as shown, to cause the ball **52** to seat against the gasket **56** and close the opening **60** when the water within the tank reaches a predetermined level. The opening **60** in the bracket **58** is in fluid communication with a chamber **62** formed within the bracket **58** and the chamber **62** is vented to atmosphere by means of a return pipe **64** which is connected to the bracket **58** and extends downwardly therefrom into a concentrically arranged collar **66** of larger diameter than the pipe **64** so that air is free to flow between the top portion **67** of the collar **66** and the pipe **64**. A bar **65** is secured between the pipes **64** and **40** to hold the return pipe in line with the collar **66**. The collar **66** is secured at its lower end to a drain pipe **68** which is in turn connected at its lower end to the bracket **16**, as shown, to drain any water that may flow through the opening **60** and the return pipe **64** into the discharge chamber **17** and the toilet bowl connected thereto.

To lift the ball **50** from its seat **35** and thus open the outlet, a cam **70** having a cam surface **72** on the top portion thereof and a segmental pinion gear on the bottom portion is secured to an operating shaft **78** which is journaled in threaded bushings **80** that are threadedly engaged in hollow bosses **81** of the bracket **16**. The shaft **78** includes cylindrical end portions **82** and **84** which extend through the bushings **80** and an octagonal central portion **86** which is arranged to cooperate with an octagonal centrally disposed opening in the cam **70**. A pair of O-rings **88** are disposed between the octagonal portion **86** and each of the ends **82** and **84** of the shaft **78** to provide a water seal between the shaft **7** and the bushings **80**. Another pair of O-rings **90** are disposed between the bosses **81** and the hexagonal heads of the bushings **80**. An operating handle **92** is suitably secured to one end of the shaft **78** to actuate the cam **70**.

To reduce the pressure within the tank **12** prior to lifting the ball **50** from its seat **34** the cam **70** is arranged to control a pressure released plug valve indicated generally at **92**. See FIG. 3. The plug valve **92** is disposed outside of the tank **12** and is coupled to a conduit indicated generally at **93** which is in fluid communication with the tank **12** and permits water to drain from the tank when the valve **82** is open. The valve **92** includes a plunger **94** which is slidably disposed within a bore **96** in a cylindrical member or tube **97** that extends across the central portion of the bracket **16** and may be formed integrally therewith. The plunger **94** includes a gear rack **95** on the top portion thereof adapted to mesh with the pinion gear **74** so that the plunger **94** is moved in the direction of the arrow in FIG. 3 as the cam member **70** is rotated in a clockwise direction as viewed in FIG. 3. A cylindrical gasket **98** is carried by one end of the plunger and is adapted to cooperate with an annular valve seat **100** formed on the end of a threaded insert **102** having a cylindrical bore **103** therein. The insert **102** forms a part of the conduit **93** and includes an opening **104** in the top portion thereof which is connected to the tank **12** by means of a pipe **106**. The insert **102** threadedly engages one end of the tube **97** and is sealed thereto by means of sealing rings **108** to prevent water within the tank **12** from escaping into the discharge chamber **17** in the bracket **16** when the valve **92** is closed or when the plunger **94** is pressed against the seat **100**. The tube **97** includes slots **110** therein to permit water to flow from the conduit **93** through the tube **97**, into the discharge member **17** and thence into the toilet bowl when the valve **92** is open.

To hold the pressure release valve **92** closed between flushing operations, a spring **112** is coupled at one end of the shaft **78** by means of an arm **114** and at the other end to a spool **116** which is secured to the bracket **16** by means of a bar **118**, as may best be seen in FIG. 2. The spring **112** must urge the shaft **78**, as seen in FIG. 3, in a counterclockwise direction with sufficient force to insure that the pressure within the tank **12** and the conduit **99** will not open the valve **92**.

The operation of the apparatus described above is as follows: Assume that the tank **12** is full of water and that the balls **50** and **52** are pressed against their respec-

tive seats 35 and 54, as shown in FIG. 2 by the pressure of the water in the tank which is equal to the pressure of the incoming water in pipe 24. To flush the toilet bowl 10 the handle 92 is depressed, which turns the shaft 78 and the cam 70 in a clockwise direction, as viewed in FIG. 3. The pinion gear 74 on the cam 70 engages the gear rack 95 on the plunger 94 and retracts the sliding plunger 94 away from the valve seat 100, thereby permitting water to surge from the tank 12 through the conduit 93, through the slots 110 in the tube 97, through the discharge chamber 17, and into the toilet bowl. In turning the cam 70 through a small arc, for example 5° to 7°, enough water has surged through the conduit 93 to lower the water level in the stand pipe 40 and drop the upper ball 52 from its seat 54 so that the water pressure on the top surface of the water within the tank 12 is equal to the atmospheric pressure in spite of the incoming water from the service pipe 24. The cam continues to turn as the handle is further depressed and the cam surface 72 of the cam 70 now engages the ball 50 and rocks the ball 50 to lift it from its seat 51. This opens the outlet 32 and permits the water within the tank 12 to flush the toilet bowl 10.

Since only the weight of the water within the tank 12 is applying pressure on the ball 50 at the time the cam 70 engages the ball, little force is required to lift the ball from its seat. The cam surface 72 further reduces the force that must be exerted on the handle 92 to lift the ball from its seat 51 by rocking the ball 50 instead of lifting it straight up. The water within the tank 12 is quickly delivered to the toilet bowl 10 because, as the water level within the tank drops, air rushes into the tank through the collar 66, the conduit 64, the chamber 62, and through the hole 60 in the top bracket 58. The ball 52 falls to the bottom of the tank 12 as the impounded water therein is drained through the outlet 32 and assumes the position indicated by the dotted lines in FIG. 2 when the tank is almost empty.

To delay the return of the handle 92 and the cam 70 during the flushing operation, a conventional mechanical timer 120 is secured to the bracket 16 by means of a bar 121 and is suitably coupled to the shaft 78. The timer 120 may consist of a simple gear train with or without a final windwheel or an air or oil dashpot. The timer 120 should be arranged to provide little or no resistance to the movement of the shaft 78 in a direction to open the outlet of the tank. Where the tank 12 is arranged to hold only two or three gallons of water and the plumbing code in a particular area requires that four gallons of flushing water be delivered to a toilet bowl, the timer 120 may be arranged to delay the return of the handle 92 for a sufficient length of time to permit the incoming water through the service pipe 24 to deliver the required additional amount of water to the toilet bowl. The timer 120 may be omitted where the ball 50 is also arranged to float in the liquid that is impounded within the tank 12 and where the tank 12 is designed to hold the required amount of water for flushing a toilet bowl or the like.

After the toilet bowl 10 has been flushed the handle 92 and the shaft 78 are returned to their original positions by the spring 112. This operation closes the valve 92 and permits the ball 50 to engage its seat 35. The incoming water through the service pipe 24 now begins to fill the tank 12, causing the ball 52 to rise with the water level. When the tank is full the ball 50 engages its seat 54, thereby sealing the tank 12 to atmosphere and permitting the pressure within the tank to assume the pressure of the incoming water.

The stand pipe 40, the brackets 16, 36 and 58, and the balls 50 and 52 may be made of a polyvinyl chloride plastic which is now extensively used and will withstand pressures of the order of 170 p.s.i. at 74° F. The use of a plastic material for the tank 12 provides a water tank which is nonresonant at the frequencies of the noise signals generated by the flowing water within the tank, thus reducing the noise level during a flushing operation.

By employing spheres for valve members which are free to land on their seats at a different peripheral circle each time, the wear on the valve members is reduced appreciably.

The apparatus of this invention also removes the necessity of having any metallic parts disposed within the tank 12 and thus constantly exposed to the impounded water, as is true in the conventional flushing apparatus. The only parts of the apparatus of this invention which may need to be formed of metal, i.e., the cam 70 and the plunger 94, are exposed to water only during the flushing operation, thus permitting such parts to dry when the toilet is not in use. The apparatus of this invention also provides an effective method of preventing material from depositing or collecting on the valve members or balls 50 and 52 in that these balls are flushed by the incoming water through the service pipe 24 at each flushing operation. Also the tank 12 of this apparatus is filled through an inlet that is disposed near the bottom of the tank which permits most of the tank to be filled by water that is drawn into the tank under the water level therein which appreciably reduces the noise created during the refilling operation.

In regard to the requirements in most plumbing codes that the flushing apparatus acts as a vacuum breaker and an anti-siphon device to prevent contaminated water from the toilet bowl from flowing back into the service pipe 24 in the event of a failure in the city water system, the apparatus of this invention permits only the uncontaminated water within the tank 12 to be drawn into the service pipe 24. When the water level within the tank reaches the level of the service pipe 24 only air can be drawn into the service pipe.

It will be noted that, in installing the apparatus of this invention and preparing for possible future repairs or replacements, a large, unattractive access panel such as is used with "in-the-wall" conventional rectangular tanks, is not required, nor is a full length access panel on the rear opening into a closet or hall required. Because all of the working mechanism is low, the panel 21 may be small and still provide access to all working parts for adjustment, repair or replacement. This panel may be even smaller than the front of the customary vitreous china tank.

In those cases where the toilet bowl itself must be unseated because some foreign object is lodged in it, or it must be replaced due to cracking or breakage, then the tank 12 can be raised sufficiently to permit the plumber to unseat the bowl from its putty and the horn, the horn being usually no longer than one and one-half inches. Dimensions for storing the tank 12 are essentially standard and thus determine the maximum length. For example, toilet bowls are seldom higher than 16 inches from the floor and seldom lower than 15 inches, while the ceiling height within the studs is customarily no more than 96 inches. Accordingly, as an article of manufacture, the tank 12 may be of maximum length of 72 inches, considering that the bracket 16 must occupy a minimum of eight inches, and that some space must be provided between the top of the tank 12 and the ceiling to permit the tank 12 to be raised in order to unseat the bowl.

When codes or convenience in manufacture, installation or shipping so dictate, then standpipe 40 may be in two parts with suitable connecting flanges.

From the foregoing description throughout it will be evident that the present invention, when properly made and assembled, provides a new and unique answer to the problem of water-flushing a standard toilet bowl. From the foregoing description it will be observed that, with very little pressure, the lower ball 50 may be raised for the reason that, before the cam 70 contacts the ball, the pressure above the ball has been reduced to a small value, whereas in former attempts the ball or other valve mem-

ber had to be raised against city water pressure. From the foregoing description it will also be apparent to those skilled in the art that, barring accident, this device should last a lifetime, due to the fact that, within the water chamber there are no metal parts, and the further fact that the valve member or balls **50** and **52** are continuously washed by water under pressure.

If desired, a conventional pressure regulator **130** may be provided at the inlet to the tank **12** or in series with the service pipe **24**, as shown in FIG. 4, to reduce the maximum water pressure within the tank **12**. For example, the regulator **130** may be arranged to provide a maximum pressure of 3 p.s.i. in the tank **12**. Experiments have proven that this low pressure is sufficient to provide a good seal between the balls **50** and **52** and their seats.

What is claimed is:

1. In an apparatus for flushing toilet bowls the combination which comprises a vertically disposed cylindrical tank having an air vent opening in the top portion thereof, an outlet in the bottom portion thereof and an inlet adapted to be connected to a source of water under pressure, a first impermeable buoyant ball disposed within the tank, for closing the air vent opening when the water within the tank reaches a predetermined level, a second impermeable ball disposed within the tank for closing the outlet, means including a bracket having a discharge opening therethrough for connecting the outlet of the tank to the toilet bowl, means including a return pipe connected between the top of the tank and the bracket for venting the air vent opening to atmosphere and for draining off any water that flows through the air vent opening into the discharge opening within the bracket, a conduit connected between the tank and the bracket for draining water from the tank into the discharge opening, a plug valve coupled to the conduit and including a valve seat on one end of the conduit and a plunger slidably disposed within the bracket for selectively engaging the valve seat to close the conduit, the plunger including a gear rack, a cam member rotatably mounted within the bracket and having a segmental pinion gear on one portion thereof and a cam surface on another portion thereof, the pinion gear meshing with the gear rack on the plunger to slide the plunger away from the valve seat and open the conduit when the cam member is rotated in one direction and to slide the plunger toward the valve seat to close the conduit when the cam member is rotated in the other direction, the cam surface being positioned to engage and lift the second ball from the outlet when the cam member is rotated in said one direction after the conduit is opened, means for biasing the plunger toward the valve seat and means for rotating the cam member in said one direction.

2. An apparatus for flushing toilet bowls comprising a tank including a vertically disposed stand pipe, a first bracket having an outlet opening therein connected to the bottom of the stand pipe and a second bracket having an air vent opening therein connected to the top of the stand pipe, the tank further including an inlet opening in the wall of the stand pipe adjacent the lower end thereof, means for connecting the inlet to a source of water under pressure, means defining first and second annular valve seats disposed within the outlet and air vent openings in the first and second brackets respectively, first and second impermeable balls disposed within the stand pipe for cooperating with the first and second valve seats respectively, the second ball being buoyant and arranged to float in the water within the stand pipe for engaging the second valve seat when the water within the stand pipe reaches a predetermined level, a third bracket having a centrally disposed discharge opening therein connected to the first bracket and extending downwardly therefrom for connection to the toilet bowl, the second bracket having a chamber connected with the air vent opening, a first return pipe connected with the chamber in the second bracket and extending downwardly therefrom, a second return pipe connected to the discharge opening in the third bracket at one end and extending generally upwardly therefrom with the upper end of the second return pipe being disposed a predetermined distance below the lower end of the first return pipe, a collar of larger diameter than the first return pipe connected to the top end of the second return pipe and extending upwardly around the lower end of the first return pipe to provide a space between the upper end of the collar and the first return pipe to vent the chamber in the second bracket to atmosphere, a conduit connected between the discharge opening in the third bracket and the interior of the tank, a tubular member having slats therein connected to one end of the conduit and extending across the third bracket, means forming a third annular valve seat on the end of the conduit connected to the discharge opening in the third bracket, a plunger slidably disposed within the tubular member and having a gear rack on one portion thereof, a shaft journaled on opposite sides of the third bracket and extending at least through one side thereof, a cam member connected to the shaft for rotation therewith and having a segmental pinion gear meshing with the gear rack on the plunger to slide the plunger away from the third valve seat when the cam member is rotated in one direction and to slide the plunger toward the valve seat to close the conduit when the cam member is rotated in the other direction, the cam member further including a cam surface for engaging and lifting the first ball from the first valve seat after the plunger has been removed from the third valve seat in response to rotation of the cam member in said one direction, a handle connected to the end of the shaft that extends outside of the third bracket for turning the shaft in said one direction, spring means coupled to the shaft for biasing the shaft in the other direction and a timer coupled to the shaft for delaying the return of the handle and the shaft in said other direction.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,041,629 July 3, 1962

Verneur E. Pratt

It is hereby certified that error appears in the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 43, strike out "of"; column 4, line 26, for "7" read -- 78 --; line 38, for "82" read -- 92 --.

Signed and sealed this 30th day of October 1962.

(SEAL)
Attest:

ERNEST W. SWIDER
Attesting Officer

DAVID L. LADD
Commissioner of Patents