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[54] **FLUSH TOILET AND METHOD**

[75] Inventor: **Robert E. Harrah,** Willits, Calif.

[73] Assignee: **Microphor, Inc.,** Willits, Calif.

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[58] **Field of Search**.....4/10, 15, 20, 41, 43, 52, 60, 4/56, 61, 67, 68, 79, 83, 94, 96, 103, 105, 106

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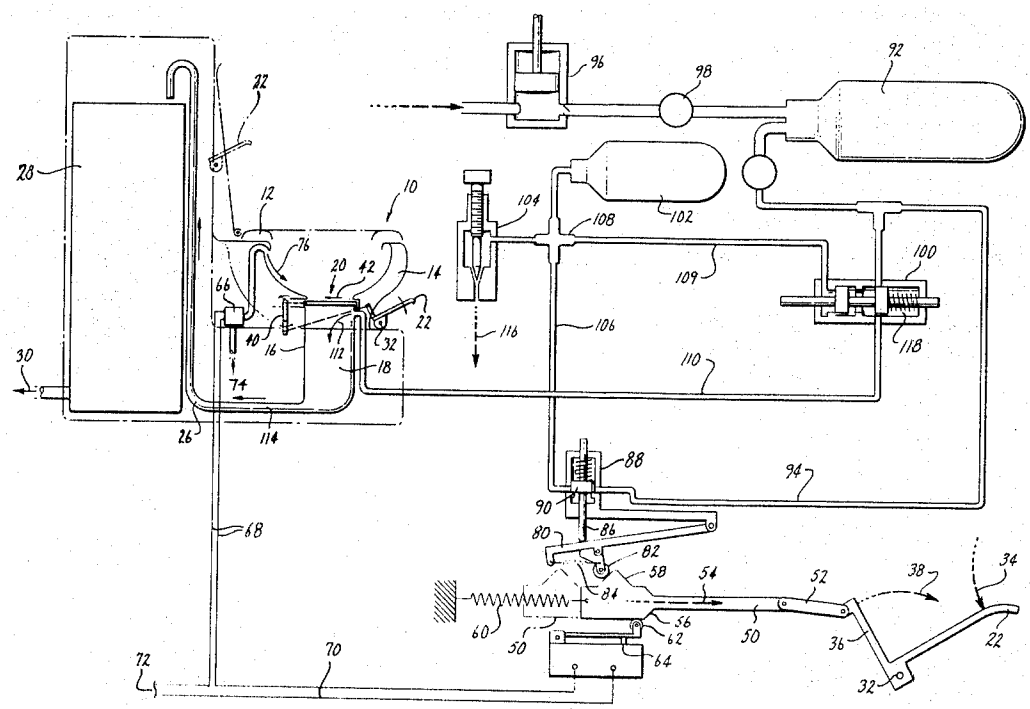
Primary Examiner—Henry K. Artis

Attorney—Flehr, Hohbach, Test, Albritton & Herbert

[57] **ABSTRACT**

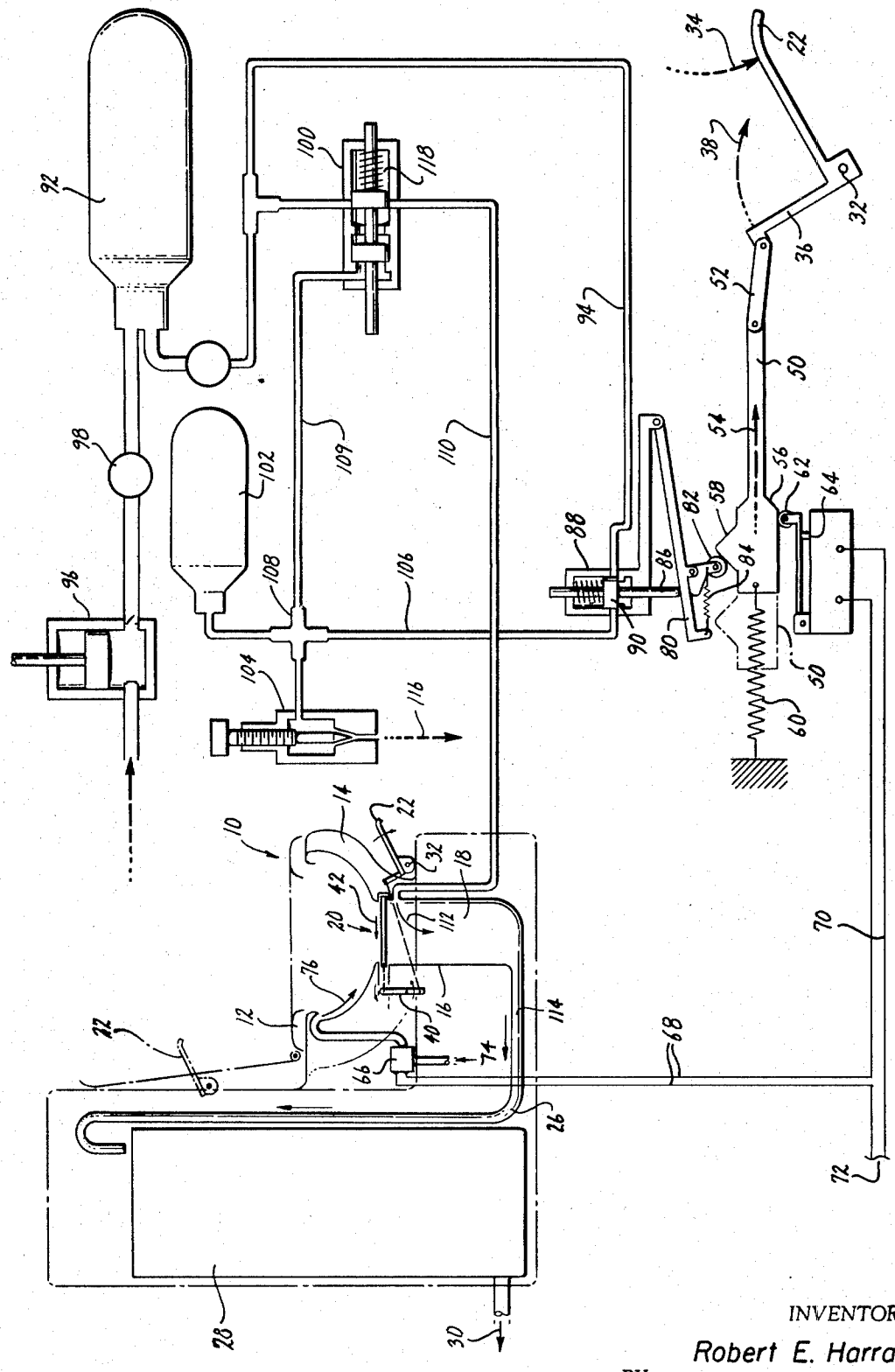
A system (apparatus and method) for reducing the amount of water required for flushing conventional and portable toilets. The system makes use in a toilet combination of a bowl portion and a gas-tight base portion and employs water flush means for the bowl portion in conjunction with air flush means for the base portion. Movable valve means between the bowl and base portions are controlled to retract while water is introduced to flush the bowl portion and to return while a charge of compressed air is introduced to discharge the contents of the toilet to a waste discharge line. This system is effective in conjunction with conventional toilets or waste treating systems or compact biological or chemical waste treating systems.

11 Claims, 1 Drawing Figure



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INVENTOR.
Robert E. Harrah
BY Flehr, Hohbach, Test, Albritton & Herbert
Attorneys

FLUSH TOILET AND METHOD

BACKGROUND OF INVENTION

This invention relates generally to toilet flushing systems and is particularly directed to improved methods and means for effecting the flushing of toilets or water closets by which the amount of water required for flushing is substantially reduced.

Conventional water closets or toilets require a substantially large volume of water to complete the flushing operation, generally averaging about 4 to 6 gallons of water for each such flushing operation. Such relatively large volumes of water are required by the relatively low water pressures and velocities normally employed within the toilet bowl so that a relatively prolonged flushing period is required to insure complete removal of the wastes. Prior attempts to decrease the amount of water employed, for example, by increasing the velocity or force of water employed in the flushing operation, have generally been unsuccessful. Moreover, the prior mechanisms and systems for such purpose have proved to be entirely unsuited for use with conventional toilets or like systems for the disposal of wastes.

SUMMARY OF INVENTION AND OBJECTS

In general, the present invention is directed to improvements on conventional water closet or toilet constructions, and is particularly directed to an improved method and means for reducing the amount of water required for flushing. The invention is further directed to improved systems of this type adapted for use within the confines of relatively compact, self-contained units, such as might be easily employed within homes, business establishments, and the like, or within mobil installations, in rail cars, aircraft, buses, boats and the like, without requirement of pumps, extensive circulatory lines, or other components of forced circulatory systems.

Broadly stated, the improved flushing systems of the present invention depend upon the successive operations of introducing a predetermined, limited quantity of water to the toilet bowl to discharge the same to a sealed chamber below the toilet bowl wherein a charge of gas under pressure (compressed air) is employed to effectively discharge the water and contents of the toilet to waste without any requirement of additional water to complete the flushing operation. The flushing can therefore be accomplished with limited amounts of water, of the order of 1 to 2 quarts (0.25 to 0.5 gallons), with the result that water requirements are reduced to as low as 3 to 5 percent of normal requirements. As hereinafter disclosed, the improved flushing system of the present invention can be easily and effectively incorporated into existing sewage disposal systems, or, alternatively, may be as easily and readily incorporated into various types of self-contained sewage disposal systems (e.g., chemical toilets and biological or microbiologically active sewage disposal systems).

In general, a particular object of the present invention is to provide a relatively simple, highly effective method and means for flushing toilets or water closets wherein the amount of water required for the flushing operation is reduced to a minimum.

Another object of the invention is to provide an improved method and means of the above character which does not require expensive or complicated circulatory systems, pumps or related machinery, and which is adapted to use in the compact space normally available for use with conventional toilet units.

A further object of the invention is to provide a simple, inexpensive system for effecting a combined water and air flushing of the toilet unit, which is readily adaptable to existing toilet constructions and/or waste disposal systems.

Additional objects and advantages of the invention will appear from the following description in which an illustrative embodiment has been set forth in detail in conjunction with the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

The drawing is a schematic view in side elevation of an embodiment of a combination water and air flush toilet system incorporating the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to the drawing, reference numeral **10** represents a flush toilet provided with a seat **12** and having a bowl portion **14**. The bowl portion is integral with or mounted upon a base portion **16** to provide a substantially airtight seal between the toilet bowl and an air chamber **18** within the base portion. A conventional slide valve **20** is mounted between the toilet bowl and air chamber **18** to alternatively provide communication between the toilet bowl and air chamber, and to separate and seal the air chamber as respects the toilet bowl. As hereinafter described, the slide valve **20** is adapted to be operated by a control lever **22** which may be either hand or foot operated (see alternate positions illustrated in he drawing). The air chamber **18** is in fluid communication by means of a relatively small diameter discharge conduit **26** with any conventional waste disposal system, generally represented at **28**. Such waste system may be a municipal waste disposal system, a septic tank and leech line system, a chemical waste disposal system, or a microbiological waste disposal system, for example as disclosed in Burton U.S. Pat. No. 3,238,124. Clear or treated effluent from the waste disposal system is discharged in conventional fashion, as represented by the arrow **30**.

The operation of the flush toilet **10** may be described with reference to the enlarged representation of the control lever **22**, shown in the lower right hand portion of the drawing. To use the flush toilet, the lever **22** is pivoted downwardly about its pivot mount **32**, as represented by the arrow **34**. This causes a crank portion **36** of the control lever to pivot forwardly and in a generally horizontal direction (arrow **38**), to thereby actuate the pull rod mechanism **50** for the flushing means, as hereinafter described. Simultaneously, the lever **22** also acts to laterally displace and open the valve means **20**, as schematically illustrated with reference to the toilet **10**. Thus, by means of a suitable pivot linkage represented at **40**, the flush lever **22** serves to displace the valve means **20** towards the rear of the toilet as represented by the arrow **42**. It will be understood that the slide valve means **20** may comprise any commercially available mechanism of this type, for

example a slide valve as manufactured by the Thetford Corporation of Ann Arbor, Michigan under the trade designation Constellation Model **50**. In general, mechanisms of this type comprise a suitable slide member of plastic, metal, or other appropriate wear-resistant material, retained in leak-tight sliding fashion within a suitable sealing mechanism. As used in the present invention, the slide valve **20** functions in closed position to provide an airtight seal between the toilet bowl **14** and chamber **18** and, in open position, to provide a relatively large discharge opening leading from the toilet bowl into the chamber **18**.

As noted above, the toilet flushing sequence is also initiated by depressing the control lever **22**. Specifically, downward movement of the control lever to retract the slide valve **20** simultaneously effects a forward movement of a cam actuating pull rod **50**, through cooperating movements of the crank **36** and connecting link **52**. The net effect is horizontal movement of the pull rod to an outward or extended position, as represented by the arrow **54**. The pull rod is provided with a first cam actuating surface **56**, for a water flushing sequence, and a second cam actuating surface **58** for an air flushing sequence. As in the case of the slide valve **20**, the pull rod **50** is normally biased to a retracted or inactive position (dotted lines) by suitable biasing means such as the spring **60**. However, upon depressing the flush lever **22**, the cam surface **56** is moved horizontally into engagement with the switch actuator **62**, causing the switch **64** to open the inlet water valve **66**. In the illustrated apparatus, the switch **64** and valve **66** comprise part of a simple electric circuit, represented by the lines **68**, **70** and power source **72**. It will be understood that the valve **66** will operate to introduce flush water from a suitable pressurized source **74** (i.e., city water at, say **40** psi line pressure) to the toilet bowl **14**, as represented by the arrow **76**. In the illustrated apparatus, flush water will be pumped into the toilet bowl **14** only so long as the flush lever **22** is held in the depressed position, since operation of the spring **60** to return the control lever to its normal position will release the valve switch **64**. Alternatively, of course, the valve **66** may operate on a controlled time cycle to introduce a predetermined amount of flush water to the toilet bowl. In general, it has been found that a relatively small quantity of water can be effectively employed to flush the contents of the toilet bowl through the slide valve opening and into the chamber **18**, with no more than about 1 to 2 quarts of water (0.25 to 0.50 gallons) being required.

Referring again to the drawing, the actuator for the air flush cycle includes a pivot arm **80** provided with a spring biased cam follower **82** which operates only on the return stroke of the pull rod **50**. Thus, outward movement of the pull rod in the direction of arrow **54**, causes an outward pivoting of the cam follower **82** against the restraint of the spring means **84**. However, on the return stroke of the pull rod, the cam follower **82** engages the cam **58** and moves the pivot arm **80** in an upward direction to depress the button actuator **86** of the air valve **88**. Actuation of the air valve **88** momentarily displaces the valve member **90** to permit a jet of compressed air to be introduced from the air supply **92** through the line **94**. The air supply **92** may be continuously maintained by means of an air compressor, schematically represented at **96**, which supplies air through the check valve **98** to build up a desired air pressure. For example, satisfactory air pressures for purposes of the present invention are within the range from about 5 to 75 psi, with an optimum air pressure at about 40 psi. In small or portable installations (viz., for use in rural areas, or in rail, boat or other mobil installations), the air supply **92** may be in the form of bottled air with a constant pressure release valve.

As illustrated in the drawing, the air flush sequence is initiated by admitting a jet of compressed air through the valve **88** to a pilot valve **100**, which operates thereafter in a timed sequence as determined by air reservoir **102** and needle valve **104**. Specifically, the compressed air passes through the branch line **106** to the four-way valve **108**, which functions to supply air pressure through line **109** shift the pilot valve **100** and simultaneously to supply a predetermined volume of compressed air to the air reservoir **102**. Shifting of the valve **100** (to the right in the drawing) causes a continuing supply of compressed air to be charged through the line **110** to the air chamber **18** in the base portion of the toilet **10**. It will be understood that release of the flush lever **22** causes the slide valve **20** to return to the closed position illustrated, with the result that air being introduced through line **110** continuously air-flushes and discharges the contents of the sealed chamber **18** through the discharge line **26** (arrows **112** and **114**). The necessary air pressure to effect this air-flushing function is obtained, in part, by restricting the size of the discharge line **26** to a size not greater than about 2 inches in inside diameter, with best results being obtained with an inside diameter of about 1 ¼ inch.

The duration of the period of air flushing is determined, generally, by the quantity of air stored in he air reservoir **102**. Thus valve **88** will immediately close on release of the flush lever and return movement of the pull rod **50**. However, the supply of compressed air in the air reservoir **102** serves to maintain the air pressure in line **109**, causing the pilot value **100** and line **110** leading into the base chamber **18** to remain open, until the air pressure in line **109** has been sufficiently reduced to cause the pilot valve **100** to shift to its normally closed position. As a practical matter, the time required to achieve this reduction in air pressure may be conveniently controlled by the adjustable needle valve **104**. More specifically, the needle valve **104** functions to bleed the various components of the air system (in communication through the four-way valve **108**), until the pressure in line **109** is insufficient to overcome the biasing pressure of the spring **118** in the pilot valve **100**. For example, in a typical operation, the valve **100** can be adjusted to shift to its normally closed position at a pressure of about 5 psi. By appropriate adjustment of the needle valve **104**, a predetermined quantity of air to flush the chamber **18** can be introduced through line **110**, as determined by the period of time required to bleed the system to inactivate pilot valve **100**. It will be appreciated that adjustment is easily accomplished to increase or decrease the rate of bleeding through the discharge orifice (represented by the arrow **116**). In general, it has been found that a rate of bleeding to achieve an air flush cycle of about 3 to 15 seconds (optimum about 5 seconds) is sufficient to discharge the liquid and solid wastes through the discharge line **26**.

To summarize the operation of the apparatus just described, the flush control lever **22** is depressed to actuate the flush water valve **66** simultaneously with displacement of the slide valve **20** to effect discharge of the contents of the toilet bowl **14** into the base toilet chamber **18**. The described water flushing operation is accomplished with a minimum amount of water (1 to 2 quarts as compared with the customary 4 to 6 gallons) due to the relatively simple water flush operation and the relatively large discharge opening provided by displacement of the slide valve **20**. Upon releasing the flush pedal **22**, slide valve **20** returns to its closed position simultaneously with activation of the air valve **88** to introduce a jet of compressed air to the air flushing system. The jet of compressed air activates the air flushing system (through the pilot valve **100**) to introduce a continuous supply of compressed air to the sealed chamber **18**, thereby discharging the contents of the toilet to the waste treating unit **28**. The air flushing operation continues for a controlled period of about 3 to 10 seconds, as determined by operation of the needle valve **104** in conjunction with the supply of compressed air in the reservoir **102**. The result is a very effecient toilet flushing operation, involving both water and air flushing, which is carried out in a relatively short period of time.

The described low water, air flush toilet system is readily adaptable to virtually any type of conventional toilet facility, including both stationary and mobil or portable installations (e.g., aircraft, railway, bus, etc.). By way of illustration, related to operation of a restroom facility at a state park, a five-toilet unit was constructed by replacing the standard toilets with the toilets of the invention. A conventional air compressor and air lines were installed, and the water lines connected to a source of water at city pressure (40 psi). Waste discharge conduits (1 ½ inch polyvinyl chloride standard conduit) were connected with a microbiological treating unit of the general type disclosed in Burton U.S. Pat. No. 3,238,124. The air compressor was operated to produce a line pressure of 40 psi, and the bleed valves for each toilet adjusted to achieve a 5-second air flush cycle. The stroke of the flush lever was also adjusted to introduce 1.5 quarts of water per flushing cycle. On the basis of an average of 600 flushing cycles per day, total water requirements for the five unit installation were 150 gallons per day. This compared with previous requirements of approximately 3,000 gallons per day, or a reduction in water used approximately 95 percent.

From the foregoing, it will be apparent that the present invention makes possible a novel water and air flush cycle whereby a conventional toilet can be effectively flushed in an easy, convenient, economical manner and with greatly reduced water requirements. The flushing method is simple and easily adapted to existing facilities. Since the only moving parts comprise simple pumps and valves and mechanical linkages, an improved flushing system is provided which is readily adapted to existing toilet facilities, ranging from units for single dwellings to multiple components for municipalities and plants and, in type, from fixed or stationary units to mobil units for various applications.

To those skilled in the art to which the present invention relates, many variations in its application and in the specific method and means described will be readily apparent. For example, the time control for the air flush system has been specifically described in conjunction with a system employing a bleed valve and compressed air. It will be appreciated, however, that substantially the same operation could be accomplished by means of a bleed valve or like cut-off valve operating in conjunction with a system employing hydraulic or like pressure fluid (e.g., oil or water). In like fashion, the air flush cycle could be automatically controlled by a timer mechanism responsive to operation of the flush lever. These and other variations are clearly within the scope of the present invention. It should be understood therefore that the disclosures herein are intended to be purely illustrative and not in any way limiting.

I claim:

1. A flush toilet characterized by reduced water requirements comprising: a bowl portion, means for water flushing said bowl portion, a base portion in fluid communication with said bowl portion, means for air flushing said base portion, said air flush means including means to introduce a predetermined quantity of air under pressure to said base portion, movable valve means between the bowl and base portions of said toilet, and control means to initially open said valve means and to activate said water flush means to effect water flushing of said bowl portion of the toilet and thereafter to close said valve means and to activate said air flush means to effect air flushing of said base portion of the toilet.

2. A flush toilet as in claim **1** wherein said means for water flushing said bowl portion of the toilet includes valve means adapted to introduce a predetermined quantity of water to said bowl portion.

3. A flush toilet as in claim **1** wherein said means to introduce a predetermined quantity of air under pressure to said base portion of the toilet includes a time delay mechanism including a bleed valve.

4. A flush toilet as in claim **3** wherein said time delay mechanism and bleed valve is pneumatically operated.

5. A flush toilet as in claim **3** wherein said time delay mechanism and bleed valve is hydraulically operated.

6. A flush toilet as in claim **1** wherein said movable valve means comprises a slide valve mechanism and means normally biasing said slide valve mechanism into a closed position separating said bowl and base portions of the toilet.

7. A flush toilet as in claim **1** wherein said control means comprises a control lever mechanically linked to said movable valve means and to said means activating said water flush and said air flush means.

8. A flush toilet as in claim **7** wherein said control lever is a foot lever positioned adjacent the base portion of said toilet.

9. A flush toilet as in claim **7** wherein said control lever is a hand lever positioned adjacent the bowl portion of said toilet.

10. A combination water and air flush toilet including means to reduce the amount of water required for flushing, comprising: a toilet bowl, a source of water, means introducing a predetermined amount of water from said water source to said toilet bowl to effect water flushing of the same, a toilet base including a substantially airtight chamber, a source of air under pressure, means introducing a predetermined amount of air from said air source to said base chamber to effect air

flushing of the same, reversible valve means between said toilet bowl and said base chamber, control means to operate said reversible valve means, and actuating means responsive to said control means to initially activate said means to introduce a predetermined amount of water to said toilet bowl, and thereafter to activate said means introducing a predetermined amount of air to said base chamber.

11. A flush toilet as in claim 10 wherein said actuating means includes cam means associated with said control means to sequentially energize said respective means for introducing predetermined amounts of water and air to said toilet bowl and base chamber.

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