

PATENT SPECIFICATION

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(54) IMPROVEMENTS IN AND RELATING TO TOILET FLUSHING SYSTEMS

(71) We, MICROPHOR, INC., a corporation organised and existing under the Laws of the State of California, United States of America, of 475 E. San Francisco Avenue, Willits, State of California 95490, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

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.

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,

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or within mobile 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% 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.

5 The invention provides a combination water and air flushed toilet requiring reduced amounts of water for flushing as compared with a conventional flushed toilet, comprising a bowl, means for water flushing
10 said bowl, a hollow base in fluid communication with said bowl, means for air flushing the interior of said base including means to introduce a predetermined quantity of air under pressure to the interior of said base, movable valve means between the
15 bowl and the interior of the base, and control means which separately actuate said water flushing and air flushing means, and which initially open said valve means and activate said water flushing means to effect
20 water flushing of said bowl of the toilet and thereafter, via a time delay means, close said valve means and activate said air flushing means to effect air flushing of the interior of said base of the toilet.

25 The invention also provides a method for effecting flushing of a toilet with a minimum amount of water, characterized by the steps of introducing a predetermined, limited amount of water to a toilet bowl to effect
30 flushing of the same, discharging said water and the contents of said toilet bowl to a substantially airtight chamber, closing said airtight chamber, and separately introducing a predetermined quantity of compressed air
35 to said chamber to effect a discharge of the contents thereof to a substantially closed discharge line.

40 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.

45 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.

Referring to the drawing, reference numeral 10 represents a flush toilet provided with a seat 12 and having a bowl
50 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
55 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
60 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 the drawing). The air chamber 18
65 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
70 system, a chemical waste disposal system, or a microbiological waste disposal system, for example as disclosed in United States Patent Specification 3,238,124. Clear or treated effluent from the waste disposal system is discharged in conventional fashion,
75 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
80 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
85 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
90 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
95 Thetford Corporation of Ann Arbor, Michigan under the trade designation Constellation Model 50. In general, mechanisms of this type comprise a suitable slide member
100 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
105 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.
110

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
115 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
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125
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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 valve supplies air pressure through line 109, shifts the valve spool of the pilot valve 100 and simultaneously supplies a predetermined volume of compressed air to the air reservoir 102. Shifting of the spool 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 $1\frac{1}{2}$ inch.

The duration of the period of air flushing is determined, generally, by the quantity of air stored in the air reservoir 102. Thus, valve 88 will reclose on completion of the 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 valve 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 dis-

charge 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 efficient toilet flushing operation, involving both water and air flushing, which is carried out in a relatively short period of time.

The described low water consumption, air flush toilet system is readily adaptable to virtually any type of conventional toilet facility, including both stationary and mobile 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 (1½ inch polyvinyl chloride standard conduit) were connected with a microbiological treating unit of the general type disclosed in United States Patent Specification 3,328,134. 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 of approximately 95%.

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 dwelling to multiple components for municipalities and plants and, in type, from fixed or stationary units to mobile 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.

WHAT WE CLAIM IS:—

1. A combination water and air flushed toilet requiring reduced amounts of water for flushing as compared with a conventional water flushed toilet, comprising a bowl, means for water-flushing said bowl, a hollow base in fluid communication with said bowl, means for air flushing the interior of said base including means to introduce a predetermined quantity of air under pressure to the interior of said base, movable valve means between the bowl and the interior of the base, and control means which separately actuate the said water flushing and air flushing means, and which initially open said valve means and activate said water flushing means to effect water flushing of said bowl of the toilet and thereafter, via a time delay means, close said valve means and activate said air flushing means to effect air flushing of the interior of said base of the toilet.



charge 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 efficient toilet flushing operation, involving both water and air flushing, which is carried out in a relatively short period of time.

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1. A combination water and air flushed toilet requiring reduced amounts of water for flushing as compared with a conventional water flushed toilet, comprising a bowl, means for water-flushing said bowl, a hollow base in fluid communication with said bowl, means for air flushing the interior of said base including means to introduce a predetermined quantity of air under pressure to the interior of said base, movable valve means between the bowl and the interior of the base, and control means which separately actuate the said water flushing and air flushing means, and which initially open said valve means and activate said water flushing means to effect water flushing of said bowl of the toilet and thereafter, via a time delay means, close said valve means and activate said air flushing means to effect air flushing of the interior of said base of the toilet.

2. A flush toilet as in Claim 1 characterized in that said means for water flushing said bowl of the toilet includes valve means adapted to introduce a predetermined quantity of water to said bowl. 50
3. A flush toilet as in Claim 1 characterized in that said time delay means to introduce a predetermined quantity of air under pressure to the interior of said base of the toilet includes a bleed valve. 55
4. A flush toilet as in Claim 3 characterized in that said time delay mechanism and bleed valve is pneumatically operated. 60
5. A flush toilet as in Claim 3 characterized in that said time delay mechanism and bleed valve is hydraulically operated. 65
6. A flush toilet as in Claim 1 characterized in that 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 the interior of said base of the toilet. 70
7. A flush toilet as in Claim 1 characterized in that said control means comprises a control lever mechanically linked to said movable valve means and to said means activating said water flushing and said air flushing means. 75
8. A flush toilet as in Claim 7 characterized in that said control lever is a foot lever positioned adjacent the base of said toilet. 80
9. A flush toilet as in Claim 7 characterized in that said control lever is a hand lever positioned adjacent the bowl of said toilet. 85
10. A flush toilet as in Claim 1 characterized in that the interior of the base includes a substantially airtight chamber, there being provided separate sources for water and air under pressure, valve control means to introduce predetermined amounts of water and air under pressure to said airtight chamber to effect flushing of the same, reversing means for the movable valve control means, control means to operate the reversible valve means, and actuating means responsive to the first said control means to initially activate said means to introduce a predetermined amount of water to the toilet bowl and thereafter to activate said means for introducing a predetermined amount of air to said airtight chamber. 90
11. A flush toilet as in Claim 10 characterized in that 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. 60
12. A method for effecting flushing of a toilet with a minimum amount of water, characterized by the steps of introducing a predetermined, limited amount of water to a toilet bowl to effect flushing of the same, discharging said water and the contents of said toilet bowl to a substantially airtight chamber, closing said airtight chamber, and separately introducing a predetermined quantity of compressed air to said chamber to effect a discharge of the contents thereof to a substantially closed discharge line. 70
13. A method as in Claim 12 characterized in that the amount of water employed to flush the toilet bowl is within the range of from 0.25 to 0.5 gallons. 75
14. A method as in Claim 12 characterized in that said compressed air is at a pressure within the range from about 5 to 75 psi. 80
15. A method as in Claim 12 characterized in that air is introduced to effect said air flushing within a period ranging from about 3 to no more than 15 seconds. 85
16. A flush toilet substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing. 90
17. A method of effecting flushing of a toilet with a minimum amount of water substantially as hereinbefore described with reference to and as illustrated in the accompanying drawing.

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