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Brugnoli

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[54] **SIPHON WITH PNEUMATIC PRIMING AND SUCTION**

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[30] **Foreign Application Priority Data**

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[52] **U.S. Cl.** **4/44,** 4/51, 137/144

[51] **Int. Cl.** **E03d 1/04,** E03d 5/04

[58] **Field of Search** 4/36, 42, 44, 43, 45, 46, 48, 4/51; 137/132, 133, 135, 136, 138, 143, 144, 146, 147

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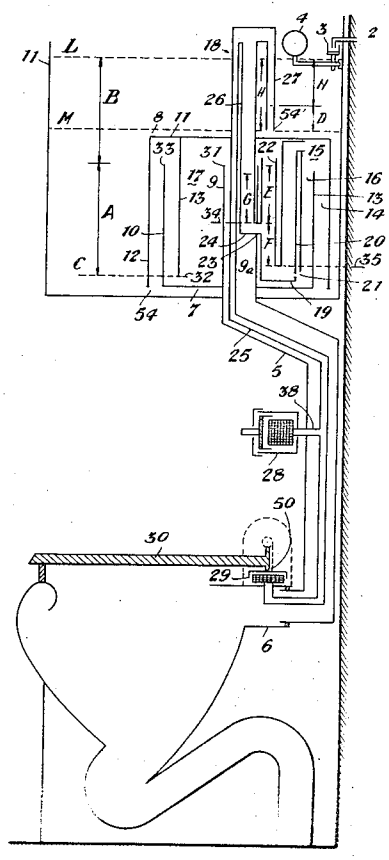
Attorney, Agent, or Firm—Browdy & Neimark

[57] **ABSTRACT**

A siphon device for water closet tanks which includes a double bell siphon submerged in the liquid to be discharged, a liquid discharge pipe extending from the siphon to the closet bowl, a gas delivery and suction pipe, and a priming device which, in the inactive state, retains in the siphon, by means of a liquid column, a compressed air cushion, said compressed air cushion being formed during the submersion of the siphon. A pneumatic pump, connected with the priming device, sucks the liquid in said device and lets the compressed air cushion, which, in the state of rest, prevents the siphon from being primed, freely discharge into the siphon.

6 Claims, 9 Drawing Figures



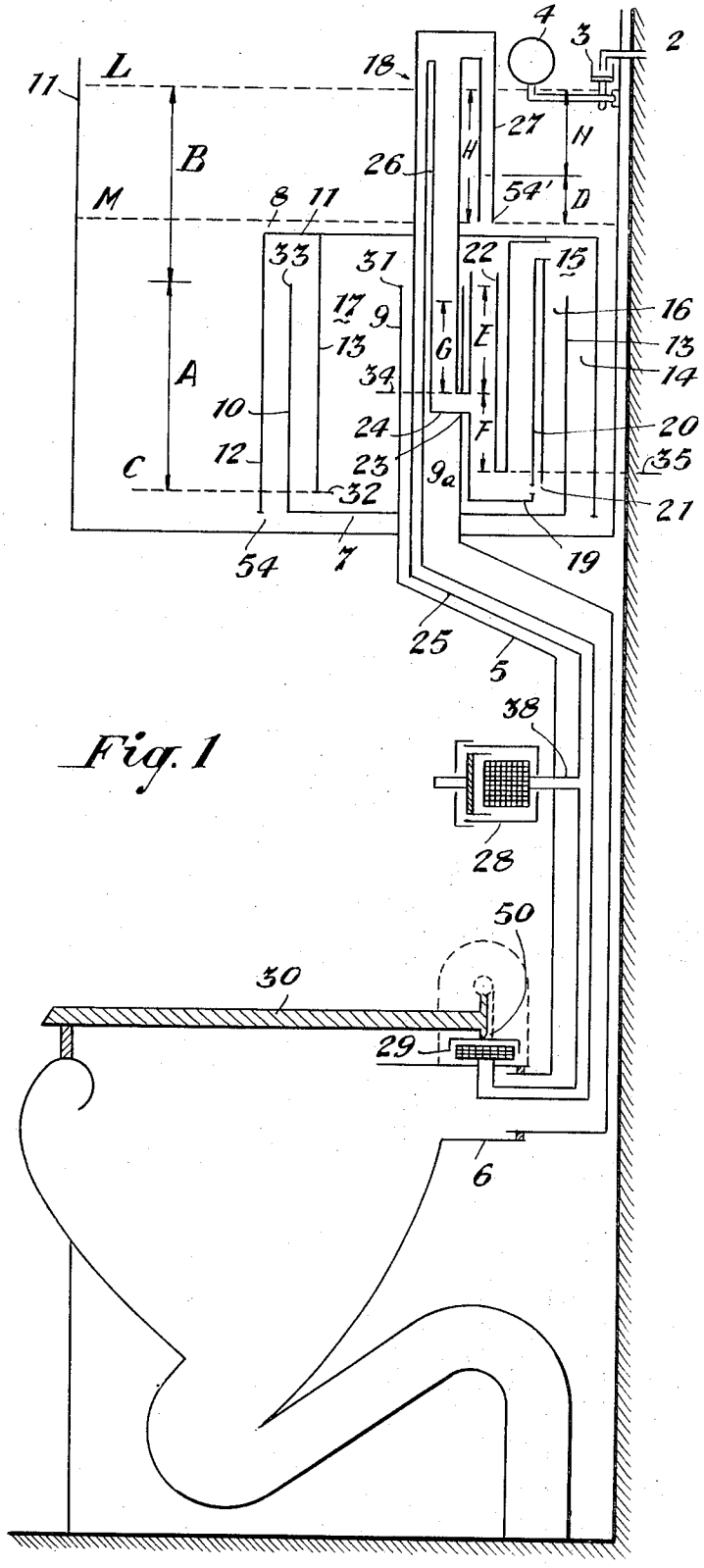

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Fig. 1

Fig. 2

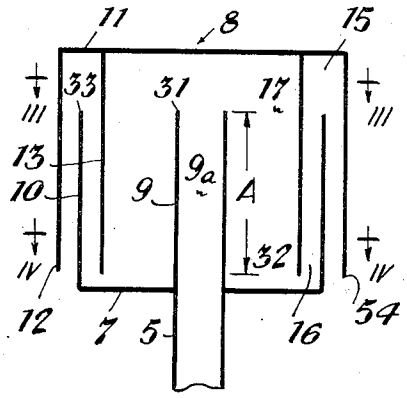


Fig. 3

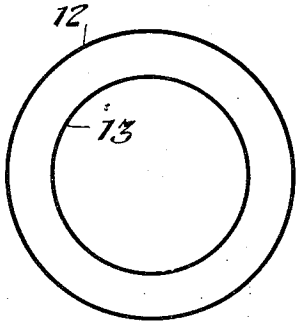


Fig. 4

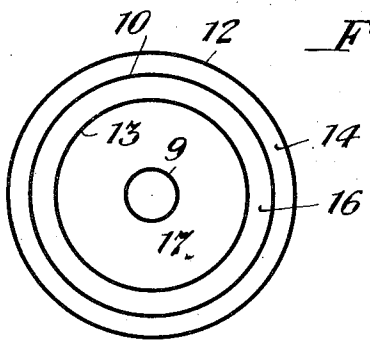
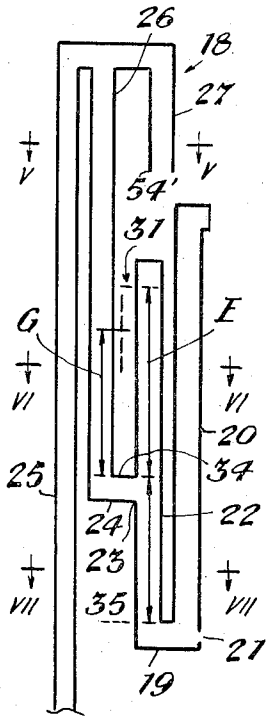
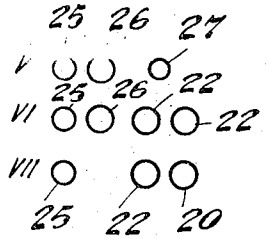


Fig. 5





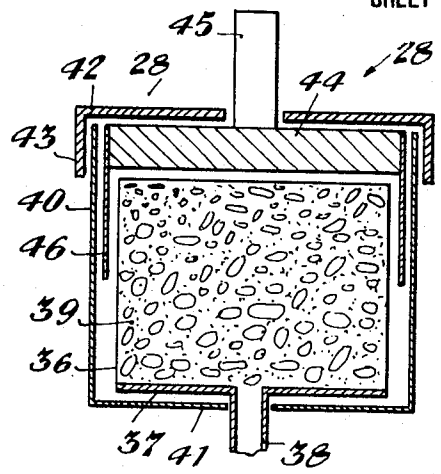


Fig. 6

Fig. 7

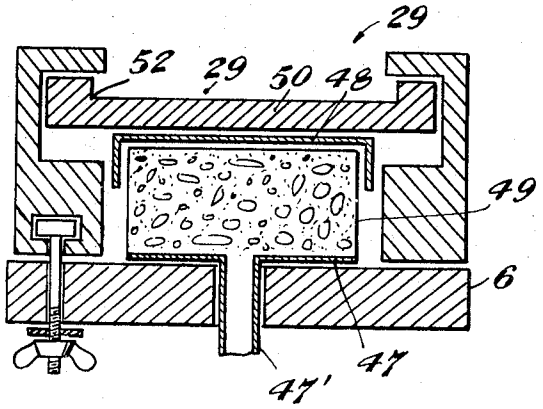


Fig. 8

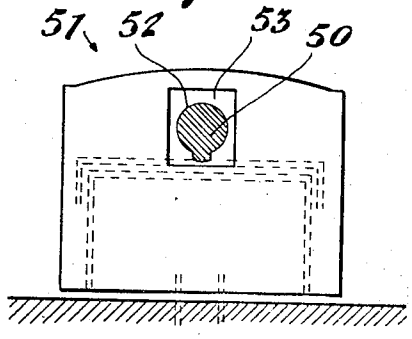
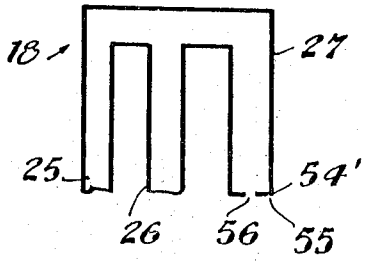


Fig. 9



SIPHON WITH PNEUMATIC PRIMING AND SUCTION

The present invention relates to a siphon to discharge liquids by pneumatic priming and suction.

According to a particular form of embodiment of the invention, the siphon is applied to a flushing tank, such as a tank used for flushing a closet bowl, and such an arrangement presents considerable advantages with respect to any other type of flushing tank.

Some of these advantages are: the automatic discharge of the tank, is here controlled by a pneumatic pump which cooperates with the usual closet seat and acts at the moment when said seat is releaved from the pressure of a person sitting on it; alternately said discharge may be actuated by depressing the push button of a second pump, which may be installed at any suitable location, when it is not desired to operate the first automatic pump; a very simple and inexpensive construction; a very easy installation, inasmuch as the gas pipe, which may also be in the form of a rubber hose and which connects said pumps with the device, may be inserted into an external duct, or may be passed through the discharge pipe of said flushing tank; substantial absence of wear, since the device of the invention does not comprise moving components, which means a greatly extended life.

The invention will be better understood from the following description, made with reference to the attached drawings, of one of its possible embodiments, said description being made for a purely illustrative and in no way limitative purpose.

In said drawings:

FIG. 1 represents schematically the installation of a flushing tank comprising a siphon according to the invention, with its relating discharge pipe and closet bowl;

FIG. 2 is a vertical section, on a larger scale, through said siphon, without the priming device;

FIG. 3 is a horizontal section taken along line III—III of FIG. 2;

FIG. 4 is a horizontal section taken along line IV—IV of FIG. 2;

FIG. 5 is a detail of FIG. 1, and represents the vertical section and three horizontal sections of the priming device, said horizontal section being taken along lines V—V, VI—VI and VII—VII respectively indicated in the vertical section;

FIG. 6 is a schematical section of a pneumatic pump with push button control;

FIG. 7 shows schematically an automatic pneumatic pump, fitted under the closet seat;

FIG. 8 is a cross section of the closet seat bearings; and

FIG. 9 is a partial vertical section of a modification of the device of FIG. 5.

With reference to the FIGS. 1–8, at 1 there is indicated the flushing tank placed above the closet bowl, into which tank the water flows through tube 2, while a conventional float valve 3, controlled by its relating float 4 in the usual manner, interrupts the inflow of the water as soon as the water in the tank has reached its pre-established level L. A discharge pipe 5 leads from the closet bowl 6 through the bottom of tank 1 to the bottom 7 of a siphon generally indicated at 8 and extends therethrough to the vicinity of the top 11 of siphon 8. The section of pipe 5 extending from said bottom 7 to the vicinity of top 11 is indicated at 9. From the periphery of the round siphon bottom there extends upward, to the same height as pipe 9, a cylinder 10 made integral with the siphon bottom 7. From the siphon top 11 depends an internal cylinder 13. From the periphery of top 11 there extends downward an external cylinder 12. The pipe 9 and the cylinders 10, 12 and 13 are coaxial, the cylinder 13 extending downward between the cylinder 10 and pipe 9, while cylinder 12 extends externally of cylinder 10. In this manner, between pipe 9 and the cylinders 13, 10, 12 there are formed concentric annular spaces 17, 16, 15 and 14 as well as a central cavity 9a within the pipe 9 (see FIGS. 3 and 4). The priming device, generally indicated at 18, is located in the spaces 9a and 17. It comprises a short horizontal tubular section 19 located in space 17 and terminating at each side in an upward extending vertical tube 20 and 22 respectively. The top of tube 20 is bent and passes with a watertight fit through a bore provided near top 11 in the wall of cylinder 13, to end in cavity 15. A calibrated hole 21 is provided at the bottom of said tube 20, near its connection with tube 18. Also tube 22 ends at a short distance from top 11. At a level indicated at 23, a horizontal pipe 24 branches from tube 22 and traverses, with a watertight fit, a hole provided in the wall of pipe 9, to extend, within a space 9a, in a vertical tube 26 which passes with a watertight fit through top 11 and bifurcates into two pipe sections, one of which is connected with an air conduit 25 ending in a pump 28 or 29, while section 27 is bent downward to end at point 54', slightly above the siphon top 11 at level M (FIG. 1). In the embodiment shown, the air conduit 25 passes with a watertight seal through siphon top 11 and through the interior of the discharge pipe 5. Through a branch pipe 38 it is connected with a pump 28 and it ends in a second pump 29. L indicates the maximum level of the water contained in tank 1, M indicates the minimum of the water in said tank which is still sufficient for an efficient operation of the siphon; A is the height of the annular cavity 17, from the upper border of pipe 9 to the bottom edge 32 of tube 13. C indicates the level of edge 32. B indicates the height measured from the upper edge of cylinder 10 to level L; H indicates the maximum depth of immersion into the water of the bent tube 27, i.e. the distance between the levels L and M; E indicates the difference of level between the top side of the horizontal tube 24 and the upper edge 31 of pipe 9; G indicates the variable height of a liquid head in tube 26, from the internal top 34 of the horizontal tube 24; D indicates the variable head of a liquid column within tube 27, measured from its lower end 54'. N indicates the difference of level between the top of said last mentioned liquid colum within tube 27 and level L; while F indicates the difference of level between the top of the interior 34 of tube 24 and the top 35 of the interior of the horizontal tube 19.

The pumps may be of any convenient type, such as a membrane or a piston type pump. In the present embodiment, the pump 28 shown in greater detail in FIG. 6 comprises a tubular rubber cylinder 36, closed by a top and a bottom 37, to the center of which the rubber hose 38 is attached, which connects it with the air conduit 25. The rubber cylinder 36 is filled with a resilient spongy material 39 which, when compressed, issues air under pressure and, when released, returns to its original position and thereby sucks the expelled air back.

The rubber cylinder 36 is enclosed within a housing 40, whose bottom 41 presents a hole for the passage through it of the connecting pipe 38. The lid 42 is fixed to the housing by means of a ring nut (not shown) screwed upon the top of said housing 40. A push button 45 is slidably mounted within a central hole provided in lid 42 and is rigid with a disk 44 located between the top of the rubber cylinder 36 and the lid. Disk 44 is surrounded by a cylindrical sheath 46, which is also surrounds the upper portion of said rubber cylinder 36.

The second pump, generally indicated at 29 and shown in greater detail in FIG. 7, also comprises a rubber hose 49, to which is conferred the shape of a rectangular prism. The top of this rubber section is closed hermetically, while from the central portion of its bottom 47 there extends a connecting pipe 47', which is connected with the air conduit 25. A bottomless rectangular box 48 protects the top of the rubber section 49' and part of its vertical walls. The rear border 50 of the closet seat 30 rests upon said box 48, when said seat is in its lowered position. Seat 30 is rotatably hinged in bearing 51 by means of pivots 52. Bearings 51 have elongated holes 53 within which the pivots 52 are both rotatable and vertically movable. Thus, under the weight of a person sitting on the seat, the pivots 52 descend in holes 53 and the rear portion 50 of the seat compresses the tubular section 49. When the seat 30 is relieved from the weight of the person sitting on it, the elastic material contained within section 49 expands, so that the rubber hose 49 reverts to its original shape, it lifts portion 50 of seat 30 and sucks in air from the conduit 25.

The operation of the device is the following: when the water entering the flush tank through pipe 2 rises above the level of rim 33 of bell wall 13 ans successively flows through the bore 21 into the tube 20, it entraps the air in the space 15. When it successively rises above the level M, it also closes the rim or edge 54' of tube 27. Since it has in the meanwhile penetrated through bore 21 and tubes 19, 22 and 24 into pipe 26 and the ends of the air conduit 25 are closed by pumps 28 and 29, a second air lock is formed between conduit 25, pipes 26 and 27. The float valve 3 is positioned at such a level in the flush tank 1, that the water reaches a maximum level L, at which its hydrostatic pressure is counter-balanced by the air lock formed in space 15 in such a manner, that the water within the siphon 8 reaches just below the rim 33 of wall 10 and rim 31 of the extension 9. Under these conditions of balance, the second air lock will counter-balance a liquid column of a given height G in tube 26 and of a given height H in tube 27. In the illustrated example, these equilibrium conditions are assumed to exist if $L = A+B$, wherein A is the difference in level between rims 32 and 33, B is the difference in level between rim 33 and level L, and $A = B$. Similarly the level E+F in tube 22 = B.

The compression of either one of pumps 28 or 29 causes an increase of pressure in the second air lock entrapped between columns G and H. Since the volume of the water in the priming device formed by the tubes 20, 19, 22, 24, 26, and 27 is very small in comparison to the water volume in siphon 8 and flush tank 1, the small amount of water expelled by this increase in pressure from the priming device will bring about an increase in the water levels A and L which is so negligible, that it can not prime the siphon action, but will at the most, cause some water to spill over rims 33 and 31.

The suction caused by the successive release of the precedently compressed pump will decrease the pressure in said second air lock and thus lead to an increase in the heights of G and H, with water being sucked from tube 22 through tube 24 into pipe 26. Bore 21 being very narrow, the water can not pass through it at a flow rate sufficient to compensate this loss of height of the water column in tube 22. This height, which was E+F and equal to B, will no more be able to counter-balance the pressure of the air lock in space 15 and in the upper part of tube 22. Consequently, the air entrapped in space 15 will escape through tubes 20 and 22 into space 17 and thence through extension 9 and discharge pipe 5, thus starting the siphon discharge. As soon as the water has sunk below the level of bell rim 54, the siphon action stops, and air enters a new bell 8.

It is clear that M is the lowest water level at which the siphon can function, because it is the level at which the rim 54' of tube 27 is closed by the water and thus an air lock can build up in the priming device.

FIG. 9 shows a partial vertical section of a modification of the device 18 for priming the siphon 8 with the immission of air. In this variant, the rim 54' of tube 27 is closed by a disk 55, soldered, welded or otherwise fastened to it, through the center of which passes a small bore 56.

If we suppose that the water in the tank 1 is at its minimum level M, just in contact with the small bore 56 and that in tubes 22 and 26 the water is at a level corresponding to water columns of a height under E, and if we suppose that the area of bore 56 is insufficient to permit the passage of all the air delivered by the pump during the compression stage, if we compress the pump, the air, which is unable to pass through the bore 56 in the presence of liquid, will accumulate in tubes 27 and 26 and exert a pressure upon the water surface in tube 26; the compressed air will press the liquid in tube 26 downward, pass into tube 24 and then form bubbles in the water column within tube 22, whose weight will decrease and consequently the hydrostatic pressure therein will sink. The air cushion in the annular spaces 15 and 16, which through tube 20 acts with a greater pressure upon the liquid contained in tube 22, will first cause the remaining water to overflow into tube 22 and thereafter, through the latter, water and air will discharge into the intermediate space 17, which is filled with liquid and thence into the discharge pipe 5.

From the above it is clear that the invention has provided a siphon which comprises a device for priming said siphon by means of the compression and suction of air or any other gas.

In comparison with the known systems, the present siphon has many advantages, such as: a very simple, inexpensive and sturdy construction, the absence of rotating parts or easily damaged mechanisms, a very simple and inexpensive priming system.

It is clear that the invention is not limited to the embodiments just described, but that any variants and changes are encompassed within its scope and concept. Thus, the pumps 28 and 29 may be of any other suitable construction, such as plunger pumps, membrane pumps and the like. Similarly it is within the reach of any expert to replace the bearing and the hinging of the seat 30 on said bearing by any other similar construction.

I claim:

1. A siphon for submersal in a body of liquid, with pneumatic priming and suction, comprising:

a hollow body having a bottom;

a first peripheral wall extending upwards from said bottom, said first peripheral wall having an upper rim;

a top larger than said bottom located above and spaced away from the rim of said first peripheral wall;

a second peripheral wall depending from said top and externally surrounding said first peripheral wall and spaced away therefrom, to form a first cavity communicating with the exterior, said second wall having a lower rim; a third peripheral wall depending from said top and extending internally of said first wall and spaced therefrom to delimit, together with said first wall, a second cavity, said third wall having a lower rim spaced away from said bottom;

a discharge pipe extending through said bottom and reaching up to the level of the rim of said first wall, to delimit with said third wall a third cavity, all three cavities forming concentric spaces and communicating with each other; a priming device comprising a first vertical tube located in said third cavity and opening into said second cavity through an opening near the top of said third wall and having a bore at its lower end, said bore communicating said tube with the bottom of the siphon, a second vertical tube whose lower end communicates with said first tube and whose upper end opens at a level higher than the upper rim of said discharge pipe, a third tube branching from said second tube at a point intermediate between the upper and the lower end thereof, and extending above said top of said hollow body and bifurcating to form a fourth and a fifth tube, said fourth tube being bent downward to end slightly above said top, and an air pipe connected with said fifth tube; and at least one pump located externally to said siphon and communicating with said air pipe of said priming device.

2. A siphon according to claim 1, wherein the difference in level between the lower rim of said third peripheral wall and the upper rim of said first peripheral wall equals one half of the difference of level between the lower rim of said third peripheral wall and the maximum level of the liquid in which said hollow body is immersed.

3. A siphon according to claim 1, wherein the lower rim of the fourth tube of the priming device is located at a level which determines the minimum level of the external liquid surrounding said hollow body, at which level the siphon is still able to operate.

4. A siphon according to claim 1, wherein the levels of the bottom rims of said second and third peripheral walls and the upper rim of said first peripheral wall as well as the heights and the connections of the tubes of the priming device are arranged in such a manner that, in the inoperative state of the submerged siphon, in the upper region of the hollow body a cushion of compressed air is provided, which is kept in balance on one hand by a first liquid column located in the first, outermost annular cavity of said hollow body, and, on the other hand, a second liquid column having the same height as the former one, but located at a higher level within said second tube of said priming device.

5. A siphon according to claim 4, wherein said pump is an air pump connected with said air pipe to discharge air through said fifth tube during its compression stroke and, during its return stroke, to draw in a portion of the liquid column from the second tube, thereby permitting the air cushion to completely expell the water from said second tube and to pass therethrough into said third cavity and thence into said discharge pipe, thereby priming said siphon to discharge the liquid in which said siphon is immersed into said discharge pipe.

6. A water closet utilizing the siphon in accordance with claim 1 comprising:

a closet tank,

said siphon being located in said tank with said discharge pipe passing therethrough;

a closet bowl having a pivotable seat thereon;

wherein said pump is mounted in coacting relationship with said seat in such a manner as to perform an air compression stroke when a weight is placed on said seat and to perform a suction stroke causing the discharge of said siphon and of the liquid surrounding it through said discharge pipe into said closet bowl when said weight is removed from said seat.

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