

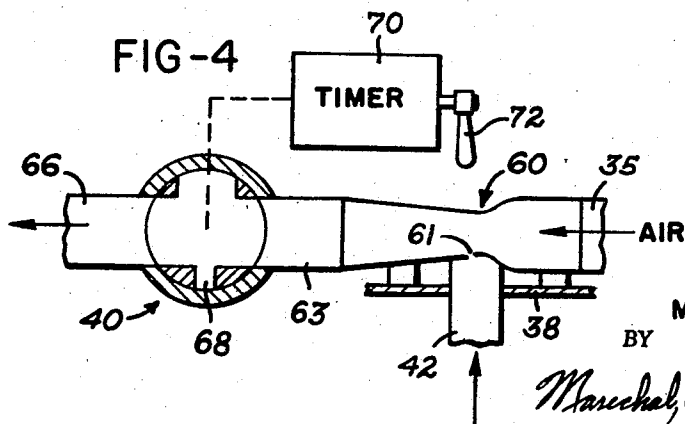
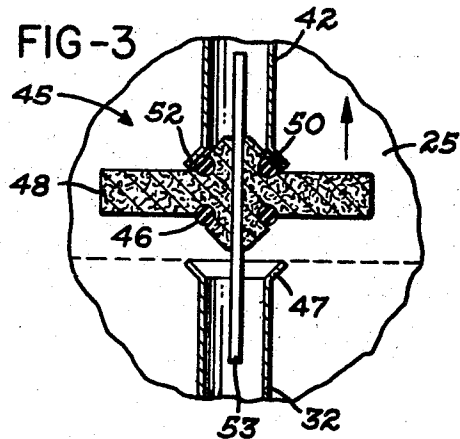
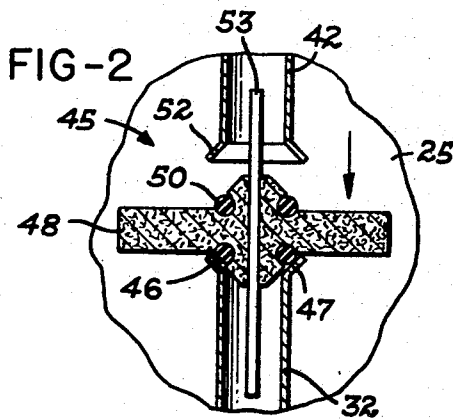
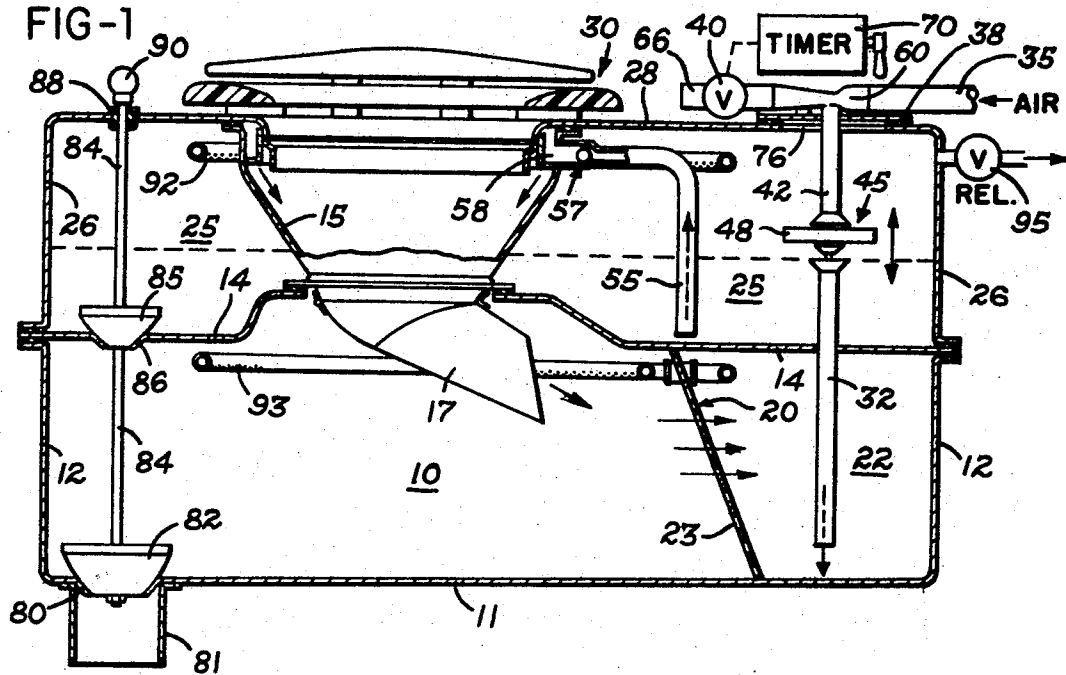
Jan. 6, 1970

M. E. MINNIEAR

3,487,475

PNEUMATICALLY OPERATED SELF-CONTAINED SEWERAGE SYSTEM

Filed Nov. 29, 1966



INVENTOR.

MAX E. MINNIEAR

BY

Marshall, Biebel, French & Bugg
ATTORNEYS

1

2

3,487,475
**PNEUMATICALLY OPERATED SELF-CONTAINED
SEWERAGE SYSTEM**

Max E. Minniear, Dayton, Ohio, assignor to Koehler-
Dayton, Inc., Dayton, Ohio, a corporation of Ohio
Filed Nov. 29, 1966, Ser. No. 597,642
Int. Cl. E03d 1/00, 3/00, 5/00

U.S. Cl. 4—10

10 Claims

ABSTRACT OF THE DISCLOSURE

A self-contained flushing toilet system is disclosed which can be operated from a low pressure air supply. The system uses a lower than ambient air pressure to move liquid from the main holding reservoir into an air-tight chamber. This chamber provides increased holding capacity as well as a source of flushing liquid. By pressurizing this chamber some of the liquid can be forced into the flushing manifold of the bowl. A special float controlled valve unit is provided to limit the pressure conditions in the air-tight chamber and also to limit the maximum quantity of liquid that can be stored in the chamber. The system can operate on vehicles without need for electrical power.

BRIEF SUMMARY OF THE INVENTION

This invention relates to an improved, simplified, and self-contained flushing toilet system which is relatively inexpensive to manufacture and easy to maintain.

Various forms of self-contained flushing toilets, particularly for vehicles such as airplanes, trains, and buses, have been proposed and constructed. One well-known type, such as exemplified in U.S. Patent No. 3,067,433, incorporates a holding tank beneath the toilet bowl, a pump (usually electrically driven) to draw flushing liquid to the tank and circulate the liquid through the bowl back to the tank, and a filter in the inlet to the pump. Such units are flushed by actuating the pump. The capacity of these units is determined by the tank capacity minus the quantity of initial charge of liquid containing disinfectant and deodorant.

Another type of unit employs a smaller chamber below the holding tank for receiving filtered liquid through a screened check valve. Liquid from this chamber is flushed through the bowl by pressurizing the chamber, thus forcing liquid through a connection to the bowl. Under pressure, the valve is closed to prevent backflow from the chamber to the tank. A typical such unit is disclosed in U.S. Patent No. 3,042,933. These units rely on gravity flow to fill the flushing charge chamber, and their capacity is determined by the tank capacity plus the relatively small volume of the lower chamber, minus the volume of the initial charge.

The improved system provided by this invention includes a chamber of relatively large volume into which so-called clean water is drawn from the main holding tank. The capacity of this chamber can be substantially greater than the volume of a flushing charge, and the chamber is preferably located above the tank and to one side of or surrounding the bowl, thus minimizing the over-all size of the unit. The chamber is charged by creating a negative air pressure within it, and discharge from the chamber into the bowl for flushing is caused by pressurizing the chamber. The creation of vacuum or pressure in the chamber can readily be achieved by simple controls, preferably by releasing the air restricting flow through the discharge connection of a simple venturi, and the only power required is a relatively low pressure air flow to the venturi inlet.

The primary object of the invention is to provide a novel, simplified and relatively inexpensive self-contained flushing toilet system as outlined above; to provide such a system having increased capacity with little or no increase in size as compared to presently available units; to provide such a system which has a minimum of mechanical moving parts, and which needs little power for operation; to provide such a system which is quiet and efficient in operation, and easily maintained; and to provide a novel control valve structure for such a system.

Other objects and advantages of the invention will be apparent from the following description, the accompanying drawings and the appended claims.

In the drawings:

FIG. 1 is a somewhat schematic cross-sectional view taken vertically through a system as provided by the invention;

FIGS. 2 and 3 are detail views of a novel air flow control valve which may be employed in the system shown in FIG. 1, which one position of the valve shown in each figure; and

FIG. 4 is a detail view of a timer controlled valve which may be used to actuate the flushing cycle of the system.

Referring to the drawing, which illustrates a preferred embodiment of the invention, and particularly referring to FIG. 1, the main holding tank or reservoir 10 is formed with a bottom 11, sides 12, and a top or horizontal partition 14 through which the discharge from the toilet bowl 15 is received. Preferably the bowl incorporates a movable discharge spout 17 which extends through top 14 and directs the discharge to one side of the center of the bowl. This arrangement prevents viewing the interior of tank 10 through bowl 15, and also acts as a guard tending to prevent the contents of the tank from splashing into the bowl. The spout 17 may be of the type which pivots for emergency use of the system as a gravity unit, such as explained in U.S. Patent No. 3,172,131.

A transverse partition 20 divides the tank and defines a tank section 22 in which liquid is generally free of any waste discharged into the holding tank. A screen 23 in the partition acts to prevent flow of bulk waste into the section 22, and particularly where the system is installed in a vehicle, the surging of liquid back and forth through the screen tends to prevent its clogging. The screen can likewise be of rather large area, and in fact can constitute a major part of all of the partition, and the screen preferably is constructed of a corrosion resistant material, or provided with a coating of such material. Various forms of polyfluoroethylenes are particularly suitable since they present a rather smooth and slippery surface to which the waste tends not to stick.

A closed holding chamber 25 is provided by sides 26, which are preferably extensions of the lower sides 12, and a top 28 which is generally flush with the upper edge of bowl 15. The top 14 of the holding tank provides the bottom of chamber 25, in fact the actual member 14 can conveniently be constructed as a horizontal partition in a unitary outer tank structure. The chamber 25 is thus located in the region around the sides of bowl 15, and the chamber must be essentially air-tight because of the pneumatic operation of the system. The top 28 can provide a suitable mounting for the conventional hinged seat and cover unit 30 which is located over the bowl.

An inlet connection to the chamber 25 is provided by a tube 32 which extends through the reservoir top 14 in the region of section 22, from a location slightly above the bottom of this section to a location substantially above the top 14 and within the chamber 25. This tube 32 provides part of a passage which, including the screen 23, directs filtered liquid from the reservoir 10 into the upper

chamber 25. This so-called "clean water" is drawn into the upper holding chamber by creating a negative pressure or vacuum within such chamber, and some of the liquid is forced from the chamber to flush the bowl 15 during a flushing cycle by reversing the pressure conditions and creating a pressure greater than ambient in the chamber.

A source of air under pressure provides all the power needed to operate the system. Such a source is indicated by the pipe 35, leading to a venturi (later described), which may be conveniently mounted on a cover 38 fastened to the top 28. The discharge side of the venturi leads to a selectively operable restrictor valve 40, and the suction tube 42 extends into chamber 25, terminating above and preferably on the same centerline with tube 32. When restrictor 40 is open fully, air will be drawn from chamber 25 into the venturi, lowering the air pressure in the chamber to below ambient. If the restrictor 40 closes sufficiently to limit air flow past the venturi, back pressure will cause air flow into tube 42, creating air pressure greater than ambient in the chamber.

A float and control valve member 45 operates automatically to control the air flow through tube 42, and liquid flow through tube 32, depending upon the level of liquid in chamber 25. With this chamber empty, or at least the liquid level below normal, the less than ambient pressure will result in liquid flow up from reservoir section 22 through tube 32, unseating the ring seal 46 of the valve member 45. This seal can engage in a seat such as the flared upper end 47 of tube 32.

The liquid flow continues until the float 48 of the valve member is sufficiently immersed to lift this member until its upper seal 50 is close to the upper flared seat 52 at the end of tube 42. The valve member is light enough that the difference in air pressure at this time will draw it upward, closing tube 42. Any liquid in chamber 25 above the seat 47 will flow back into the lower reservoir, and pressure in the chamber 25 can rise to approximately ambient pressure.

In order to keep the valve member 45 aligned with tubes 32 and 42, a rod 53 extends through float 48 and partially into each of these tubes. The rod can be cemented or otherwise secured to the float, or it can even be an integral extension from the float.

In order to flush the unit, an outlet is provided in the form of a tube or pipe 55 which extends from a location near the bottom of the chamber 25, adjacent to the upper surface of the partition 14, through a suitable check valve 57 to the flushing ring or manifold 58 of the bowl 15. The check valve is provided and arranged to prevent a flow of air from the manifold through tube 55 into the upper chamber when that chamber is at a lower pressure than ambient. By reversing the air flow through tube 32, and providing a flow of pressure greater than ambient, it is possible to force liquid from the chamber 25 upwardly through the tube 55 and into the manifold 58 in order to flush the bowl in the lower reservoir 10.

A suitable and simple arrangement for this purpose is provided by a conventional venturi 60 which has its throat opening 61 (FIG. 4) connected to the tube 42. The inlet to the venturi is connected to the air supply line 35. The outlet from the venturi is connected through a short pipe or passageway 63 to the control valve or restrictor 40, details of which are shown schematically in FIG. 4. The outlet 66 from this valve can open to the surrounding atmosphere of the unit, or be discharged to any suitable location.

The valve 40 in its normal position, as shown in FIG. 4, provides an essentially unrestricted connection from the outlet of the venturi, so that a full flow of air through the venturi is possible. As is well known, this will create a vacuum in the line 42 which functions, as mentioned above, to reduce the pressure in chamber 25 to below ambient pressure, thereby causing liquid to be drawn into the chamber 25 until the valve member 45 functions to close the pipe 42, as shown in FIG. 3. In its other posi-

tion, the valve 40 presents a restricted opening 68 to the venturi outlet, substantially reducing the air flow through the venturi. It is possible to employ a complete closure in the valve 40 for this purpose, however the restrictor 68 is preferred since it will assist in limiting the above ambient pressure that can be created in the chamber 25.

Movement of the valve 40 is controlled by any suitable conventional timer 70, which can be set by operating a control handle 72. Thus, by turning the handle the timer can be operated to move valve 40 to its restricting position, and the timer will keep the valve in this position until it runs out, at which time it will automatically return the valve to the position shown in FIG. 4. When the control valve is moved to its restricting position, the limitation on air flow through the venturi causes the air flow in the pipe 32 to reverse, and the pressure in this line approaches the pressure of the supply 35, thereby forcing air under pressure into tube 42. This in turn forces the valve member 45 to drop immediately from the seat 52, where it had been held by the vacuum in the tube.

The valve member drops onto the lower seat 47, thereby sealing off the tube 32, and air under pressure entering the upper chamber will force liquid from the upper chamber through pipe 55 and check valve 57 into the manifold of the flush bowl. This flow continues until the timer 70 returns valve 40 to its opening position. At this time full air flow through the venturi is restored, and the air is drawn upwardly through tube 42 to produce a lower than ambient pressure in chamber 25. As a result, with the light-weight valve member 45 being seated on the seat 47 only by gravity, the difference in pressure between the lower reservoir 22 and the upper chamber 25 is sufficient to cause flow upwardly through tube 32, and this flow continues until the level of liquid in the upper chamber is sufficient to carry the float 48 upward into proximity with the upper seat 52. At this time, as previously mentioned, the entire float control valve member 45 is drawn upwardly and the seal 50 engages the seat 52, cutting off the outflow of air through tube 42. Any liquid above the top of tube 32 flows down that tube, which now functions in the nature of a stand-pipe until it reaches the level indicated generally by the dotted line in FIGS. 1 and 3. During the first few operations after the unit is initially charged, liquid may be withdrawn from the tank 10 to the level of the lower end of tube 32 and not fill the upper chamber to the top of this tube. In such case the lower air pressure in the upper chamber will merely cause air flow up the tube.

A convenient construction is provided by mounting venturi 60 and tube 42 directly on the small cover 38 which is suitably fastened over an aperture 76 in the chamber top 28. This aperture should be sufficiently large to permit the valve member 45 to be withdrawn when the tube 42 is removed.

In order to clean and regenerate the system, an outlet 80 is formed in the bottom 11 of the reservoir, immediately over a discharge tube 81. A valve member 82 seats on the outlet 80, and is fastened to a control rod 84 which also carries a further valve member 85. This valve member is normally seated on an opening 86 formed in the reservoir top 14. The rod 84 extends upwardly through a suitable seal 88 to the exterior of the top 28, where a handle 90 is provided. This handle may also incorporate a connector (not shown) for a remote operation cable. When it is time to service the unit, the rod 84 is lifted upward to open both the valve members 82 and 85. Liquid in the chamber 25 drains through opening 86 into the reservoir 10, and the contents of this reservoir in turn are discharged through the outlet 81. Preferably the unit includes suitable spray rings 92 and 93, in the lower reservoir 10 and the upper chamber 25, whereby a suitable cleaning liquid can be sprayed throughout the interior of the unit before the valves 82 and 85

are closed and a fresh starting charge of liquid is placed in the unit.

Typical presently available equipment has a ten gallon holding capacity, plus three gallons capacity for the initial charge, or a total of thirteen gallons. With the system disclosed herein, the unit occupies the same space and can handle approximately fifteen gallons capacity, with an additional initial charge of four to five gallons. The amount of liquid stored in the upper chamber 25 preferably is about one-half the amount that can be accommodated in the reservoir 10 when the unit is filled to its capacity.

Systems constructed according to the invention are simple and inexpensive to manufacture and to maintain. The system can readily operate without any electrical connection, employing manually operated control valves which may be operated entirely manually, or using a timer arrangement such as described. It is of course possible to use an electrical solenoid-operated valve and a suitable electric timer delay control to achieve the same result. A relatively inefficient and inexpensive venturi will suffice to operate the unit. The pressure required at the supply 35 has not been found to be particularly critical, and satisfactory results have been obtained with a ten p.s.i. pressure drop across the venturi. It is desirable to have components which will handle a relatively large volume of air flow, since this speeds up the operation of the flushing cycle, however, the air pressures involved are relatively low. This in turn does not require that high pressure seals be used. In some instances it may be desirable as a precaution to install a normally closed safety valve 95 in the upper wall of the chamber 25, in order to provide a limit to the air pressure which this chamber will hold.

Suitable air supply to operate the unit can be obtained, for example, from the air conditioning units of aircraft, buses, or trains, or in the case of smaller aircraft which do not have such air conditioning systems, adequate air flow can be obtained in flight from a ram air pick-up to the venturi. The unit will operate quietly, and is not particularly responsive to changes in the pressure of the supply air, or to such air pressure changes as might occur due to minor leakage from the chamber 25. The novel float controlled valve member 25 is particularly desirable in that it provides "fail-safe" features. If there is adequate vacuum, the valve member will be retained against the upper seal 52, hence the upper chamber cannot be overfilled. If the vacuum is not sufficient, then the unit cannot draw liquid into the upper chamber. If for some reason the air pressure supply should remain turned on through the tube 42, for example, if the control valve should stick in the restricting position, the unit will merely proceed to force the liquid through the flush bowl, at which time the unit will merely cease to operate without any overflow.

The reservoir and upper chamber particularly, and other structures, can readily be constructed of suitable plastic or reinforced resin materials, as well as suitable light-weight metals. The entire structure can be formed of a minimum number of parts, and likewise since there is a minimum of moving mechanical parts, the chance of failure is reduced to a minimum.

While the form of apparatus herein described constitutes preferred embodiment of the invention, it is to be understood that the invention is not limited to this precise form of apparatus, and that changes may be made therein without departing from the scope of the invention which is defined in the appended claims.

What is claimed is:

1. In a self-contained sewerage system having a holding tank, a flush bowl including a flushing liquid manifold connected to direct a flow of flushing liquid through said bowl, and an outlet connection from said bowl into said tank; an improved recirculating flushing system comprising,

a closed chamber for storing filtered liquid withdrawn from said tank,
an inlet connection to said chamber including a first valve means arranged to prevent outflow of air from said chamber through said inlet connection,
5 passage means connecting said inlet connection to said tank and including a filter through which liquid passes from said tank into said passage means,
a flushing liquid outlet from said chamber to said manifold including a second valve arranged to prevent air flow from said manifold back into said chamber,
a source of air under pressure,
a vacuum source having a suction connection to said chamber, and
a selectively operable control valve controlling the connection of air from said pressure and vacuum sources whereby one position of said control valve will create a negative pressure in said chamber to draw liquid in from said tank and another position of said control valve will create a positive pressure in said chamber sufficient to force liquid therefrom into said flushing manifold.

2. A system as defined in claim 1, wherein said vacuum source is a venturi having an inlet connection to said air pressure source and a suction line extending into said chamber, said control valve being connected to the outlet of said venturi for causing air flow out of said chamber through said suction line by allowing free air flow through said venturi and for causing air flow into said chamber through said suction line by restricting the venturi outlet.

3. A system as defined in claim 2 wherein said control valve is constructed to limit the air flow through said venturi sufficiently to cause air under pressure to flow through said suction line into said chamber while maintaining some air flow through said venturi outlet.

4. A system as defined in claim 1 wherein said closed chamber is located above said holding tank and adjacent said bowl.

5. A system as defined in claim 4 wherein said closed chamber is constructed as an upward extension of said holding tank separated therefrom by a partition, and said bowl extends through said chamber and terminates in a discharge spout located within said tank and opening thereinto.

6. A system as defined in claim 5 wherein normally closed drainage valves are provided in the bottom of said tank and in said partition, and means for opening said drainage valves to drain the contents of said chamber into said tank and to drain the contents of said tank to an external location.

7. A system as defined in claim 1, wherein inlet connection to said chamber includes a standpipe extending upwardly from the bottom thereof and terminating in a seat, said suction connection including a tube opening into said chamber and having an inverted seat located in vertically spaced axially aligned relation with said seat on said standpipe, a control valve member mounted between said seats and having seal members arranged for engagement with the respective seats, said valve member including a float operative to lift it off said standpipe seat when the liquid level in said chamber rises above said standpipe under vacuum conditions due to suction through said tube, and said control valve member being of such light weight that the suction through said tube is sufficient to hold said control valve member against said inverted seat.

8. A system as defined in claim 7 wherein said chamber is located over said holding tank, said standpipe extending from said chamber downward to a location adjacent to the bottom of said tank for withdrawing liquid at a low level in said tank, and a filter member separating the region of said tank surrounding the lower end of said standpipe from the remainder of said tank.

9. In a self-contained sewerage system having a holding tank, a flush bowl including a flushing liquid manifold connected to direct a flow of flushing liquid through said bowl and an outlet connection from the bottom of said bowl into the top of said tank; the improvement comprising a closed chamber for storing filtered liquid withdrawn from said tank, said chamber being an upward extension of said holding tank separated therefrom by a partition and said bowl extending through said chamber and terminating in a discharge spout located beneath said partition and opening into said tank, an inlet connection to said chamber incorporating passage means extending from said chamber downwardly into said tank and terminating in spaced relation to the bottom of said tank, a flushing liquid outlet from said chamber to said manifold, and means for withdrawing liquid from said tank through said inlet connection to said chamber and for forcing some of said liquid from said chamber through said liquid outlet to flush the contents of said bowl into said holding tank.

10. A system as defined in claim 9 wherein said chamber is constructed to surround said bowl completely from adjacent the upper edge thereof to the region of the joint between said bowl and the top of said holding tank

whereby the part of the system around said bowl is available as useful storage for filtered liquid.

References Cited

UNITED STATES PATENTS

5	930,158	8/1909	Connet	137—502
	1,035,241	8/1912	Ruppel	4—27
	1,303,358	5/1919	Montgomery	4—115
	2,249,739	7/1941	Brownell et al.	4—115
10	2,437,435	3/1948	Moyer et al.	4—28
	2,740,971	4/1956	Weekes	4—115
	3,005,993	10/1961	Corliss	4—115
	3,042,933	7/1962	Garver	4—115
	3,067,433	12/1962	Dietz et al.	4—115
15	3,172,131	3/1965	Herkenhine et al.	4—115
	3,289,214	12/1966	Corliss	4—115

FOREIGN PATENTS

20	14,478	10/1934	Australia.
	163,143	6/1955	Australia.
	1,355,441	2/1964	France.

LAVERNE D. GEIGER, Primary Examiner

D. B. MASSENBERG, Assistant Examiner