United States Patent

[11] 3,563,384

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[21] Appl. No. **764,769**
[22] Filed **Oct. 3, 1968**
[45] Patented **Feb. 16, 1971**

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[54] **AUTOMATIC MACERATOR UNIT**
11 Claims, 8 Drawing Figs.

[52] **U.S. Cl.** **210/152,** 4/10
[51] **Int. Cl.** **C02c 1/00**
[50] **Field of Search** 4/10, 15; 210/47, 138, 139, 152, 59, 62, 190, 199, 169; 137/268; 23/267, 272; 241/36

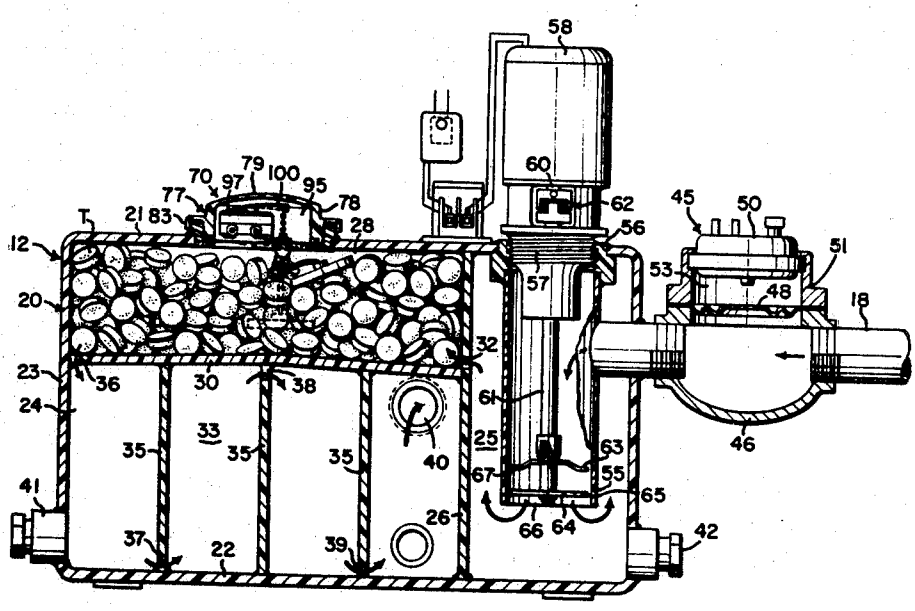
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ABSTRACT: A treatment unit for use on toilets such as used in small ships including a housing having separate holding chambers with a treatment chamber disposed therebetween. A macerator reduces the size of solids in the first chamber from where the effluent flows into the treatment chamber containing a plurality of chemical tablets for purifying the effluent. The effluent then passes into the second holding chamber from which it is discharged from the unit. Sensing apparatus is provided to inactivate the macerator when the level of tablets is below a preset minimum, and a pressure operated time delay switch is utilized to initiate operation of the macerator upon an increase in pressure in the inlet to the unit.



Patented Feb. 16, 1971 3,563,384

2 Sheets-Sheet 1

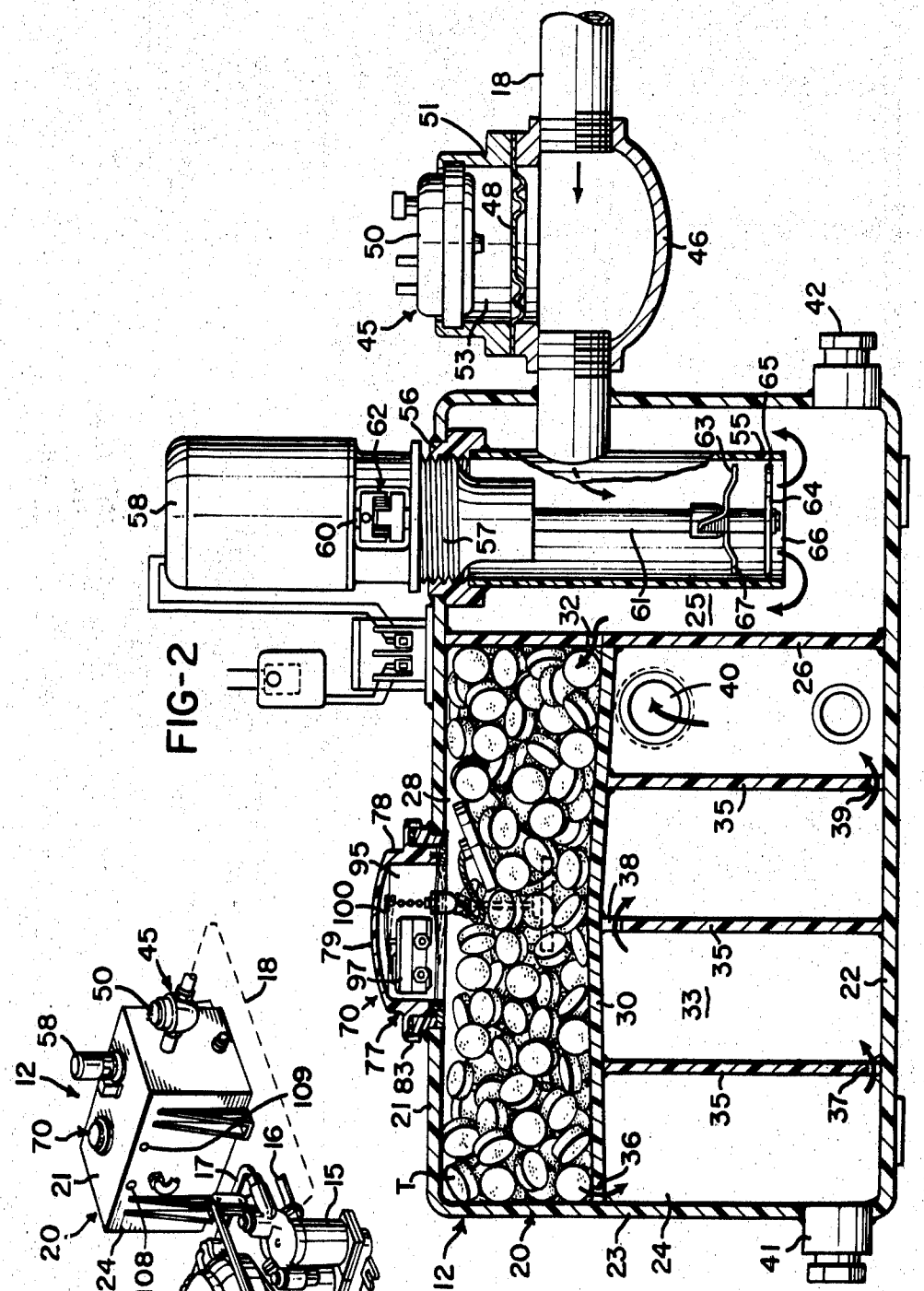


FIG-2

FIG-1

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FIG-3

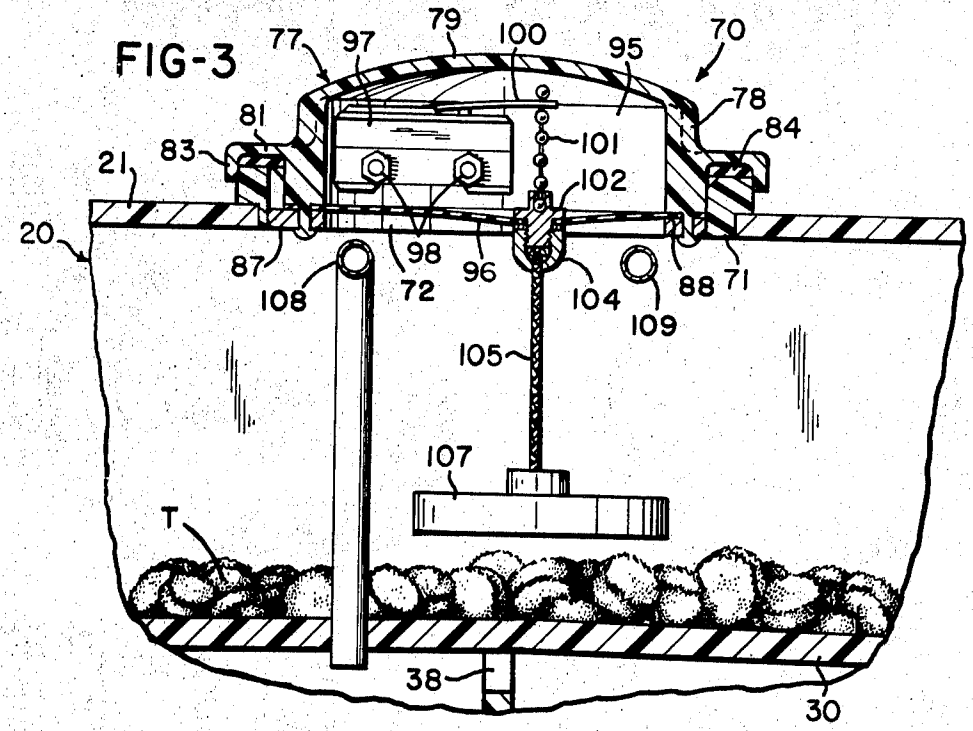


FIG-4

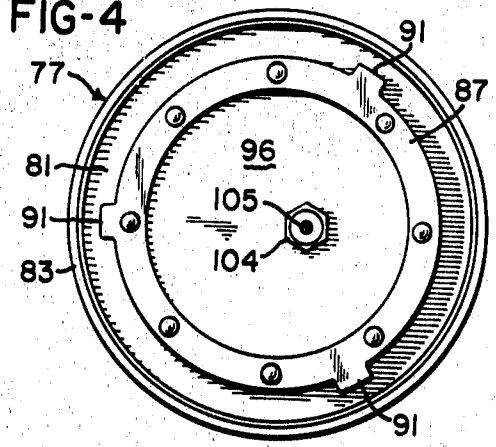


FIG-5

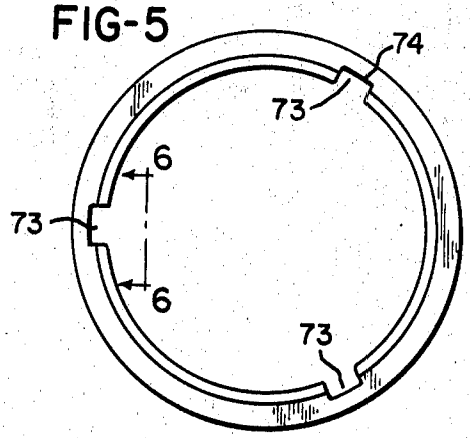


FIG-6

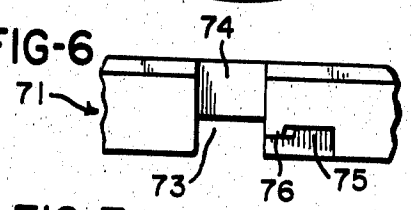


FIG-7

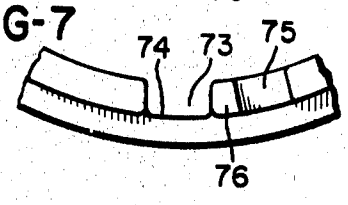
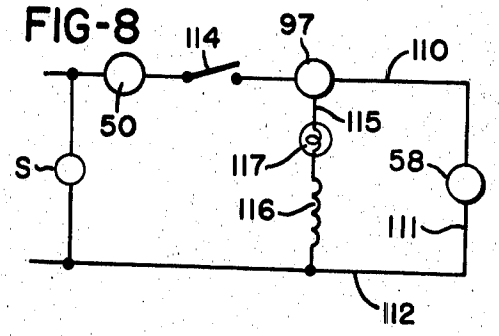


FIG-8



AUTOMATIC MACERATOR UNIT

CROSS REFERENCE OF RELATED APPLICATIONS

This application is related to applications Ser. No. 659,517, filed Aug. 9, 1967, now U. S. Pat. No. 3,510,000; Ser. No. 659,372, filed Aug. 9, 1967, now U. S. Pat. No. 3,451,552 and Ser. No. 735,364, filed Jun. 7, 1968.

BACKGROUND OF THE INVENTION

This invention relates to a treatment unit for toilets, particularly as may be used in boats and other vehicles where the effluent from the toilet must be treated. Prior art devices have included various forms of macerator units, but these units generally have not recognized the desirability of reducing to a predetermined size all solids in the effluent, whereby effective chemical treatment can be achieved to kill substantially all bacteria in the effluent.

In the related applications listed above, the treatment of the effluent is effected by the use of chlorine tablets over which the effluent is passed before flowing into the second holding chamber. These tablets dissolve to purify the effluent by killing the bacteria, and when they are consumed they must be replenished or the effluent discharged from the unit will not be free of bacteria and thus will be unacceptable for discharge into the lakes and streams.

SUMMARY OF THE INVENTION

The present invention therefore provides a treatment unit for flushing toilet accommodations on a boat or the like, wherein a macerator reduces the size of the solids in the effluent prior to passage into a treatment chamber containing treatment chemicals which kill the bacteria. Automatic safety means are provided for inactivating the macerator when the level of treatment chemicals falls below a preset minimum. Automatic pressure-sensing device may also be provided in the inlet to the macerator for initiating operation of the macerator when the pressure in the inlet reaches a predetermined point, and for maintaining operation of the macerator a preset time after such inlet pressure is relieved.

In the preferred embodiment of the safety means, an electrical switch is enclosed in a large cap which is releasably secured to the top wall of the treatment chamber to insert tablets into the treatment chamber. A weight member is adapted to rest on the tablets and is connected by a flexible link to the electrical switch for activation when the weight member no longer rests on the treatment chemicals which occurs when the level is below the preset minimum. A flexible diaphragm may be utilized to seal the switch in the cap to protect it from the effluent, and this cap can be easily removed for inserting additional tablets together with the weight member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of the treatment unit in accordance with the invention;

FIG. 2 is a vertical sectional view taken centrally through the macerator unit;

FIG. 3 is an enlarged sectional view through the tablet-sensing mechanism;

FIG. 4 is a bottom view of the cap;

FIG. 5 is a plan view of the ring to which the cap is secured;

FIG. 6 is a fragmentary view taken along the line 6—6 of FIG. 5;

FIG. 7 is a bottom view of the ring shown in FIG. 6; and

FIG. 8 is a schematic illustration of the electrical system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

FIG. 1 illustrates the flushing toilet assembly 10 which includes the flush bowl assembly 11 and the macerator unit 12. When it is desired to flush the bowl 13, it is merely necessary to pump the handle 14 on the double acting pump 15 which draws water through the pipe 16 from a suitable source and

forces it into the bowl 13 through the pipe 17. An electric pump could also be used in place of the hand pump 15. The pump 15 simultaneously draws effluent from the bottom of the bowl 13 and forces it through the pipe 18 into the macerator unit 12 for treatment. It is acceptable to discharge the effluent into a stream or lake after certain treatment has been accomplished in the macerator unit 12.

The macerator unit 12 includes a rectangular housing 20 having the top and bottom walls 21 and 22, and the end and sidewalls 23 and 24 defining a closed interior which is separated into a plurality of chambers. Thus, the first holding chamber 25 is defined by the upright partition 26, and the elongated treatment chamber 28 is defined by the upper portion of the partition 26 and the horizontal partition 30. This treatment chamber receives flow from the holding chamber 25 through the small opening 32 near the intersection of the partitions 26 and 30. Below the treatment chamber may be located another holding chamber 33 which is formed between the partitions 26 and 30 and includes a plurality of vertical baffles 35 so that effluent travels an upward and downward path from the opening 36 from the treatment chamber through the openings 37, 38 and 39 at the bottom and top of the baffles 35. The discharge outlet 40 from the chamber 33 is provided in the sidewall 24, and suitable drains 41 and 42 are provided in the housing adjacent the bottom wall for use in cleaning and draining the macerator unit 12 for maintenance. The capacity of the holding chamber 33 varies with the planned frequency of usage, etc. and may be eliminated entirely in certain cases.

The first holding chamber 25 receives the effluent from the flush bowl 13 through the inlet pipe 18 having the time delay pressure sensing switch assembly 45 mounted therein. This switch includes a housing 46 between sections of the pipe 18 with the top 46 of the housing closed by a flexible diaphragm 48. A pressure actuated switch 50 is provided in the upper portion 51 of the housing 46 above the diaphragm 48 adapted to have its contacts shifted when a preset pressure is attained in the chamber 53 above the diaphragm 48. This action initiates operation of the macerator unit, as will be further described. The switch 50 is a time delay switch so that, when the pressure in the pipe 18 is relieved, a preset time elapses before the contacts of the switch 50 are shifted thus allowing the macerator to continue operating to process the remaining effluent in the pipe 18. In particular, the switch 50 may be of the type disclosed in the copending application Ser. No. 735,364, filed June 7, 1968 (Docket 4931), and assigned to the assignee of this invention.

The macerator itself is mounted on the housing 20 and includes a downwardly extending tube 55 of large diameter having the inlet pipe 18 connected thereto near the upper end thereof for supplying effluent into the top of this tube. The tube 55 is held in place on the upper wall of the housing by a suitable retainer 56 which is internally threaded for receiving the motor mounted bracket 57. This bracket receives an electric motor 58 mounted above the top wall 21 of the housing 20 and its drive shaft 60 is connected to the drive shaft 61 of the macerator through the coupling 62. The bracket 57 also includes suitable bearings (not shown) mounting the drive shaft 61 of the macerator for rotation within the tube 55. In addition, the bracket 57 includes suitable seals so that the effluent within the tube 55 cannot pass upwardly through the bracket but must pass downwardly through the tube.

Fixed to the lower portion of the shaft 61 are a macerator blade 63 and a discharge control plate 64 whose outer diameter is slightly less than the inner diameter of the tube 55 to create the annular opening 65 to control the maximum size of the solid particles discharged from the outlet end 66 of the tube 55. The blade 63 has upwardly and downwardly flared impellers 67 so that when it is driven at high speed, the solid effluent delivered to the tube is reduced in size for passage from the outlet end 66 of the tube 55.

The cap assembly 70 is shown in detail in FIGS. 3—7 and includes a mounting ring 71 secured rigidly in the opening 72 in

the top wall 21 of the housing 20. This ring has a plurality of vertical slots 73 formed on the inner surface 74 thereof and, at the base of each slot, is a horizontal cutout 75 on the right-hand side thereof, as viewed in FIG. 6. At entrance to each cutout 75 is a small projection 76 which forms a detent, as will be further described. The cap 77 itself is preferably made of plastic material and has the annular sidewalls 78 connected to the top thereof. The radially outward extending flange 81 projects from the sidewalls 78 and has the downwardly extending projection 83 whose diameter is only slightly greater than the outer diameter of the mounting ring 71. A resilient seal 84 is provided below the flange 81 to be compressed against the upper surface 85 of the mounting ring 71 when the cap 77 is locked in place.

The cap 77 is secured in place by the retainer 87 which is secured to the lower edge 88 of the sidewalls 78. This retainer 87 has lock projections 91 formed at spaced intervals on the periphery thereof for engaging the slots 73 in the mounting ring 71 and these projections are precisely spaced to be received in the slots 73. The projections 91 fit into the slots 73 and when the cap is forced downwardly to depress the resilient seal 84 and then the cap 77 is turned, the projections pass into the cutouts 75 beyond the detent projections 76 and are held in place by the projections 76 as the seal 84 urges the retainer 87 upwardly.

A switch chamber 95 is formed in the interior of the cap 77 by the interior surface of the side and top walls 78 and 79 and the flexible diaphragm 96 clamped to the lower edge 88 of the sidewalls 78 by the retainer ring 87. The electrical switch 97 is secured in this chamber by the bolts 98 and the actuator lever 100 of the switch 97 is connected through the flexible chain 101 to the male member 102 which extends through an opening in the diaphragm 96 and receives the female member 104 to seal the diaphragm. The female member 104 is connected through the flexible cord 105 to a disc-shaped weight member 107 of sufficient weight to extend the cord 105, deform the diaphragm 96, and actuate the switch 97 through lever 100 when subjected to the force of gravity, which only occurs when the level of tablets T reaches a preset minimum level. In order to prevent the build up of gases in the chamber 28, a vent port 68 is provided, and similar venting of the holding chamber 33 is accomplished through the conduit 109 and port 109*a*. Both ports 108 and 109*a* are connected to the atmosphere at a remote point by suitable conduits.

The operation of the unit 12 can be best described in connection with the electrical schematic shown in FIG. 8. Thus, when it is desired to flush the bowl 13, the handle 14 is pumped causing water to be forced into the bowl 13 and the effluent to be forced through the pipe 18 into the macerator unit 12. When the effluent flows through the pipe 18, the pressure causes the diaphragm 48 to move upwardly and compress the air in the chamber 53 to actuate the electrical switch 50 in the line 110 (FIG. 8) to complete an electrical circuit to the drive motor 58 in the line 111 so that the source S is connected through the lines 110, 111 and 112. This presupposes that the manual switch 114 in line 110 has been previously moved to its closed position. The motor 58 then rotates the blade 63 at high speed causing the effluent to be forced downwardly and solids to be reduced in size to a small enough size to pass through the space 65 between the outer periphery of the control plate 65 and the tube 55. The effluent fills the holding chamber 25 and then flows into the treatment chamber 28 through the opening 32.

The treatment chamber 28 has been previously filled with chemical tablets T, e.g., chlorine, so that the weight member 107 is resting on the top surface thereof (FIG. 2) and no tension is applied to the cord 105, the diaphragm 96 or the chain 101 so that the actuator lever 100 of the switch 97 remains biased in its upper position. As a result, the electrical circuit through the line 110 is complete and the switch 97 does does not interfere in operation with the drive motor 58. The effluent is treated in the chamber 28 by contact with the chemical tablets T so that the waste acquires treating chemical before passing through the opening 36. If the unit has a holding chamber, the effluent mixes thoroughly as it flows between the baffles 35 through the openings 37, 38 and 39, and then it is subsequently discharged from the unit 12 through the discharge opening 40.

As the flushing cycle is completed and the pressure in the inlet pipe 18 falls the diaphragm 48 returns to its normal position thereby reducing the pressure in the chamber 53 and urging the pressure sensitive switch 50 to its inactive position. However, because this switch is a time delay switch a preset time elapses before the switch 57 opens. As a result, the drive motor 58 continues to operate and the effluent in the pipe 18 and in the tube 55 continues to be processed for a preset short time, after which the switch 57 automatically opens and terminates operation of the motor 58.

After the unit 12 has been used for a considerable number of cycles, the tablets T become depleted to the point that the weight member 107 (see FIG. 3) tensions the cord 105, the diaphragm 96 and the chain 101, and the switch lever 100 is moved to the alternate position to open the circuit through line 110 to the drive motor 58 to terminate or prohibit operation of the macerator motor 58. Thereafter, when operation of the flushing pump 15 closes the switch 50 to operate the macerator, the circuit to the line 115 is completed to energize the buzzer 116 and/or the light 117 to provide a signal that additional tablets must be placed in the treatment chamber 28. Until this is done, no effluent can be discharged from the unit because the pumping action would quickly cause solids to build up around the macerator blade 63, stalling the pump 15 or its equivalent thus barring the possibility that effluent which has not been properly treated to kill substantially all the bacteria will be discharged.

To refill the treatment chamber 28 with tablets T, it is necessary to apply a slight downward pressure to the cap 77 and then turn the same so that the projections 91 align with the vertical slots 74 at which time the cap 77 and weight member 107 can be raised from the opening 72. A supply of tablets T is then placed in the treatment chamber 28 and the cap replaced, as shown in FIG. 3, wherein the weight member 107 rests on the top of the tablets T and the switch 97 is moved to its closed position wherein the circuit may then be completed to its drive motor 58.

Accordingly, the invention has provided an improved macerator unit which is completely automatic and fail safe in that it does not permit effluent which has not been properly treated to be discharged from the unit. The drive motor is controlled by a time delay pressure switch and a sensing mechanism determines whether a sufficient supply of the chemical tablets or other treatment chemical exists in the chamber 21. While a particular type of sensing device 107 has been shown and described in detail, it is within the scope of this invention to use other types of sensing devices so long as they sense the level or quantity of solid treatment chemicals which exists in the treated chamber and shuts down the drive motor when an insufficient supply of chemicals is indicated. It is also possible to use two switches in the cap or other equivalent means to provide one signal when the tablets are reaching the low point and another signal to inactivate the macerator when a second lower point is reached.

While the form of apparatus herein described constitutes a 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:

We claim:

1. A treatment unit for the effluent from a flushing toilet, comprising a housing having partitions therein to divide the interior into separate chambers including a first chamber, a treatment chamber adapted to receive the flow from said first chamber, an inlet to said first chamber, an outlet from said treatment chamber, macerator means associated with said

first chamber for reducing solid particles in the effluent to a preset small size, said treatment chamber adapted to receive and hold solid treatment chemicals for purifying the effluent, and automatic means for sensing when the quantity of treatment chemicals is below a predetermined safe level to then inactivate said macerator means and provide a signal that the supply of treatment chemicals requires replenishing, said automatic means including a member urged into contact with the treatment chemicals to sense the level thereof.

2. A treatment unit for the effluent from a flushing toilet as defined in claim 1 wherein said automatic means includes an electrical switch in series with the drive motor for said macerator means, a weight member adapted to rest on the treatment chemicals when the level of the chemicals is above a said predetermined level, and link means connecting said weight member to said switch so that said weight member actuates said switch when the treatment chemicals fall below said predetermined level to provide a signal to the operator.

3. A treatment unit for the effluent from a flushing toilet as defined in claim 1 wherein said automatic means includes an electrical switch in series with the drive motor for said macerator means, a weight member adapted to rest on the treatment chemicals when the level of the chemicals is above a said predetermined level, and link means connecting said weight member to said switch so that said weight member actuates said switch when the treatment chemicals fall below said predetermined level to terminate operations of said drive motor.

4. A treatment unit for the effluent from a flushing toilet as defined in claim 1 wherein means define a relatively large inlet through said housing to said treatment chamber, cap means adapted to cover and seal said opening, and said electrical switch being mounted on said cap means for removal from said housing with said cap means.

5. A treatment unit for the effluent from a flushing toilet as defined in claim 4 wherein a flexible diaphragm is provided to seal said switch in said cap means to isolate said switch from contact with the effluent, said link means and said switch actuator attached to said diaphragm for actuation of said switch by said weight means.

6. A treatment unit for the effluent from a flushing toilet, comprising a housing, macerator means associated with said housing for reducing solid particles in the effluent to a preset small size, an electrical drive motor for said macerator means, a treatment chamber in said housing adapted to receive the flow from said macerator means, an outlet from said treatment chamber, automatic means for sensing when the quantity of treatment chemicals is below a predetermined safe level to then inactivate said macerator means and provide a signal that the supply of treatment chemicals requires replenishing, and pressure-sensing means for energizing said drive motor when pressure is above a preset level and said automatic means senses that said predetermined level exists or is exceeded.

7. A treatment unit as defined in claim 6 wherein said pressure-sensing means includes time delay means for maintaining said motor in operation a preset time after the pressure in said inlet falls below said preset level.

8. A treatment unit for the effluent from a flushing toilet as defined in claim 6 wherein said automatic means includes an electrical switch in series with said drive motor for said macerator means, a weight member adapted to rest on the treatment chemicals when the level of the chemicals is above a said predetermined level, and means connecting said weight member to said switch so that said weight member actuates said switch when the treatment chemicals fall below said predetermined level to terminate operations of said drive motor.

9. A treatment unit for the effluent from a flushing toilet as defined in claim 8 wherein means define a relatively large inlet through said housing to said treatment chamber, cap means adapted to cover and seal said opening, and said electrical switch being mounted on said cap means for removal from said housing with said cap means.

10. A treatment unit for the effluent from a flushing toilet, comprising a housing having partitions therein to divide the interior into a plurality of separate chambers including a macerator chamber, a treatment chamber adapted to receive the flow from said first macerator chamber, an inlet to said macerator chamber, a discharge outlet from said treatment chamber, macerator means associated with said macerator chamber for reducing solid particles in the effluent to a preset small size, said macerator means having a restricted outlet providing for discharge flow therefrom containing only particles of the preset small size or less, and pressure-sensing means for sensing when the pressure in said inlet reaches a preset level to energize said macerator means to process effluent through the unit.

11. A treatment unit as defined in claim 10 wherein said pressure sensing means is separated from the effluent by a flexible diaphragm.