United States Patent

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[54] AUTOMATIC MACERATOR UNIT

13 Claims, 12 Drawing Figs.

[52] U.S. Cl. 210/143, 210/152
[51] Int. Cl. B01d
[50] Field of Search 210/143, 152, 91, 97

[56] References Cited

UNITED STATES PATENTS

3,451,552 6/1969 Carlson 210/152

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ABSTRACT: A treatment unit for use on toilets 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 after which the effluent flows into a 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. The weight of the chemical tablets exert a pressure on a diaphragm which closes a switch for normal operations of the unit. When the level of tablets is below a preset minimum the switch opens and the macerator will not operate. 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. Two embodiments of the diaphragm and switch are disclosed.

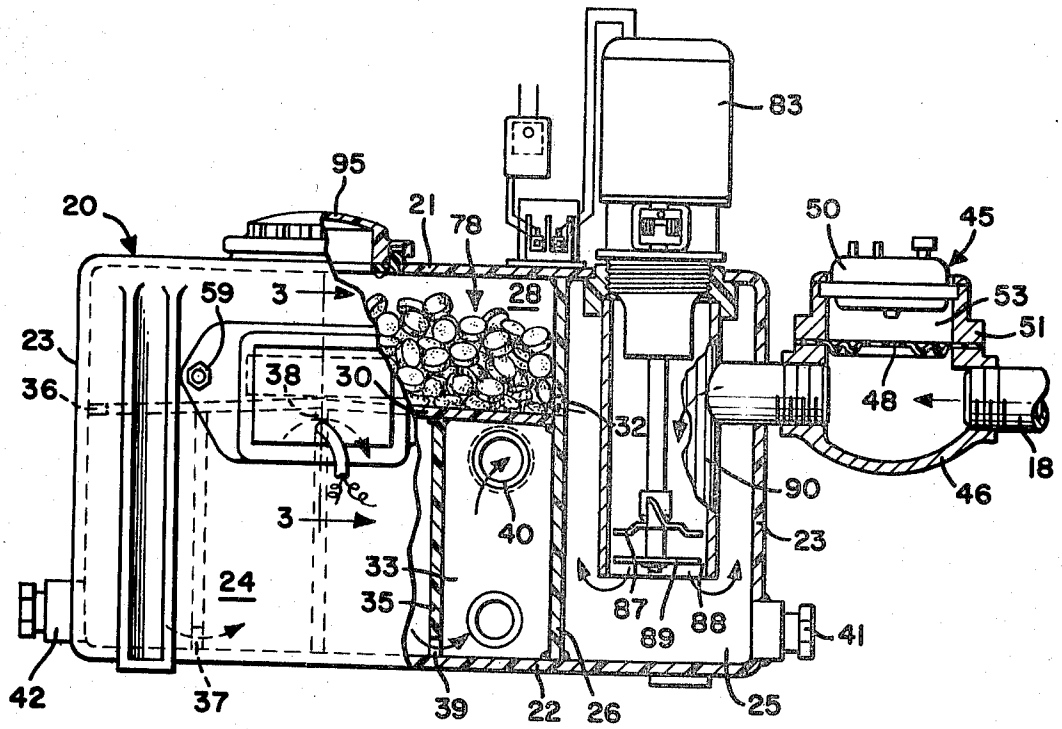


FIG-1

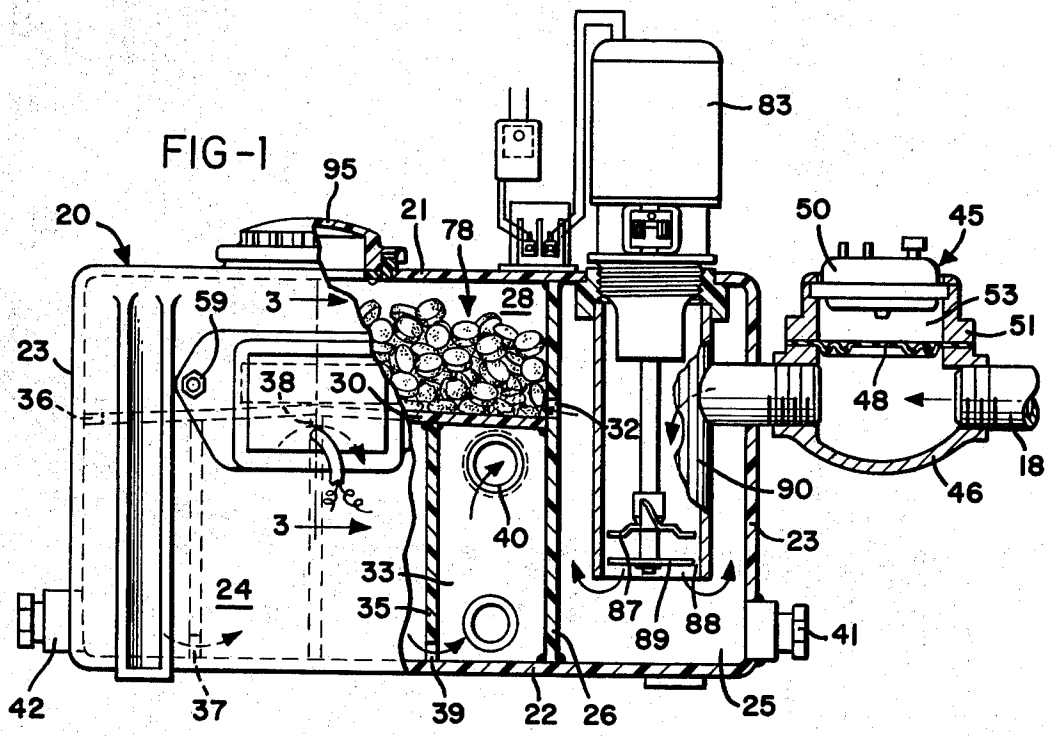


FIG-2

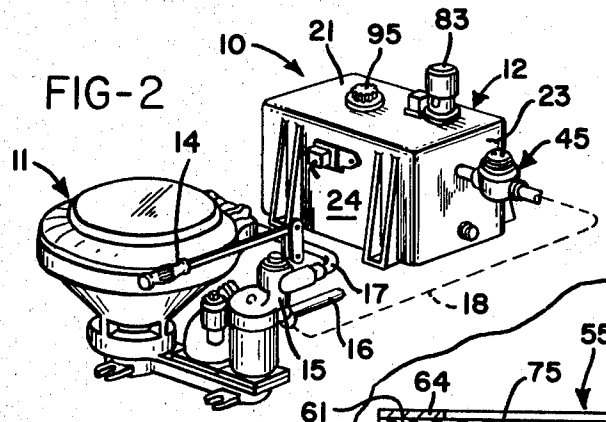
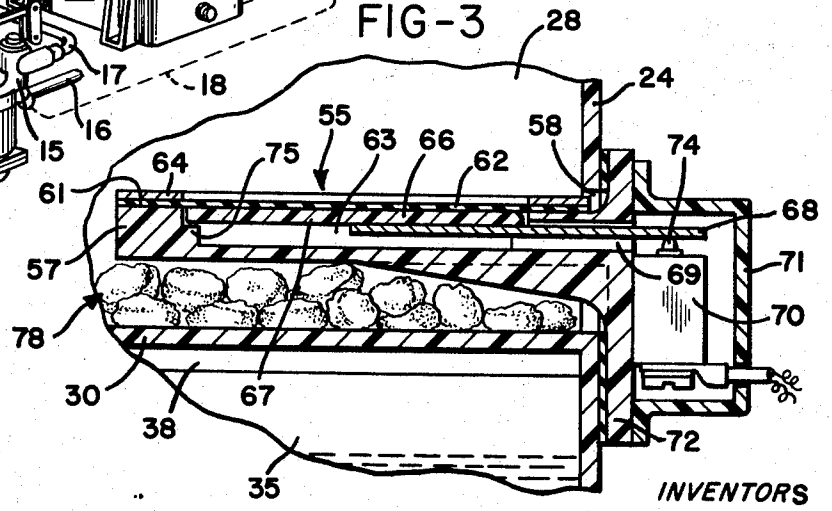


FIG-3



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FIG-4

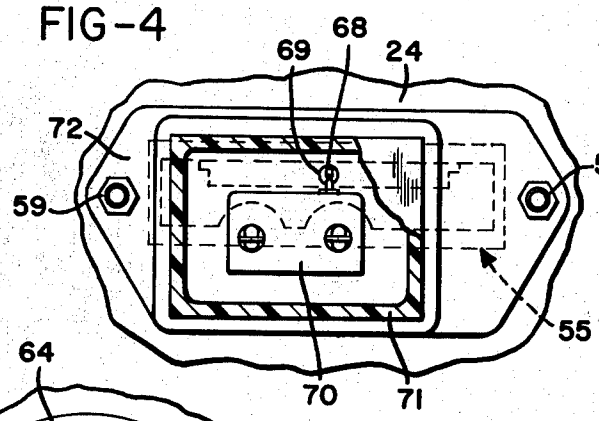


FIG-5

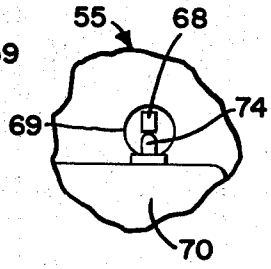


FIG-6

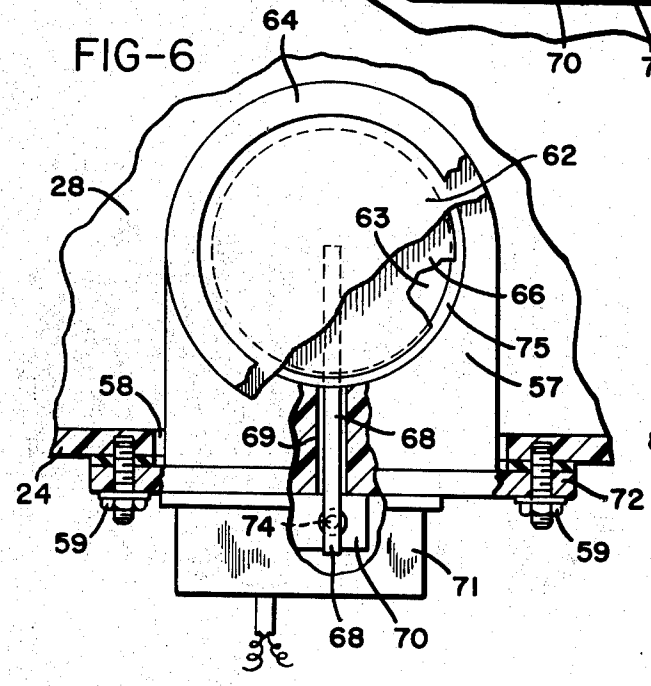


FIG-8

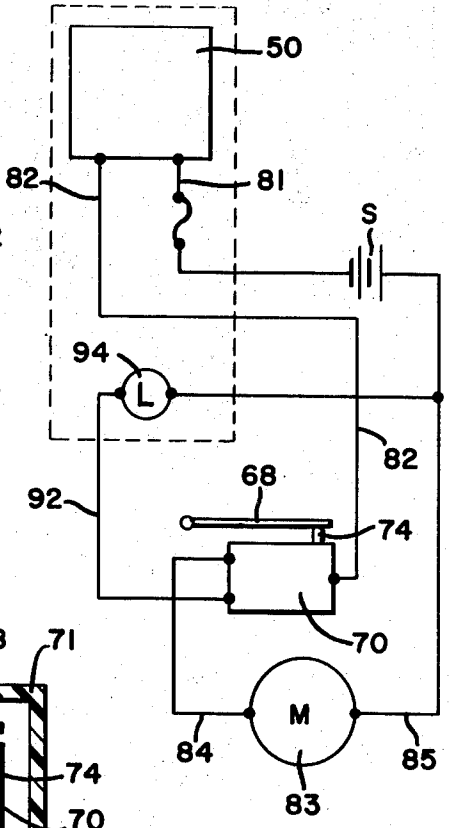


FIG-7

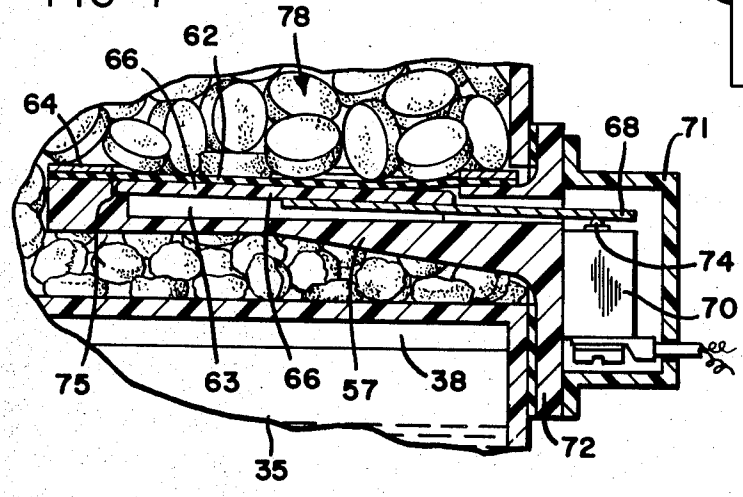


FIG-9

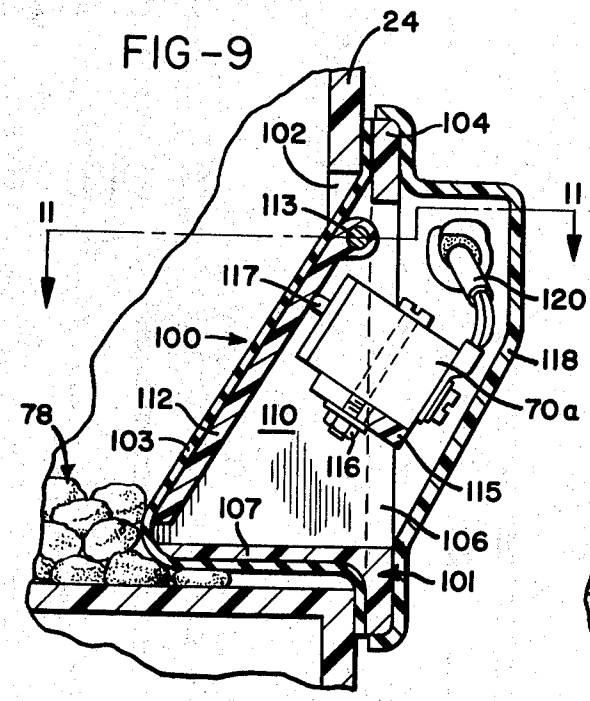


FIG-10

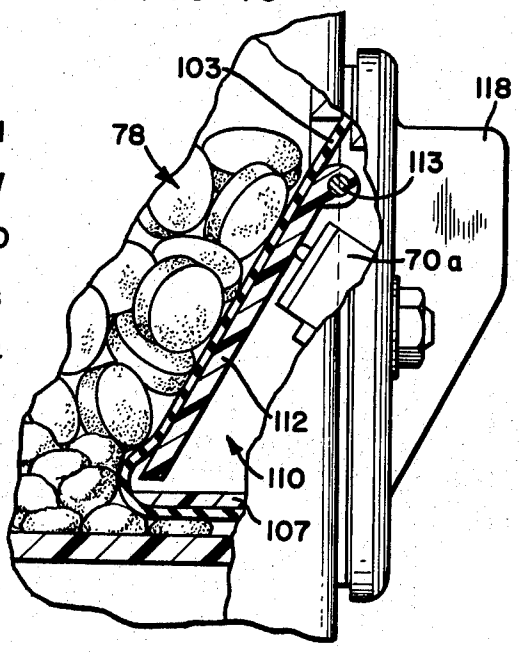


FIG-11

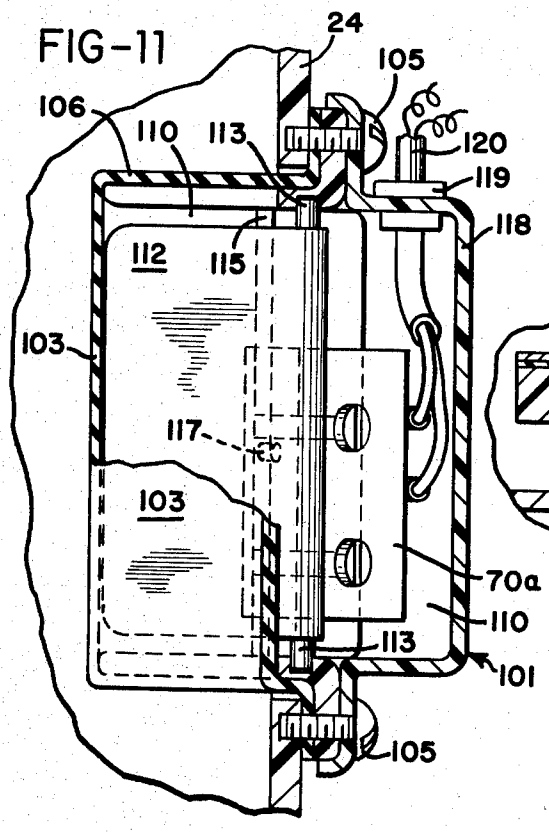
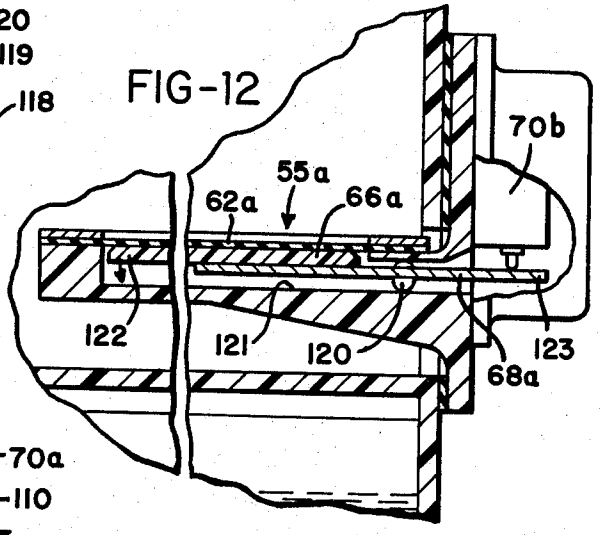


FIG-12



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. 764,769, filed Oct. 3, 1968.

BACKGROUND OF THE INVENTION

This invention relates to a treatment unit for toilets, for example, those 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 application 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

An automatic sensing means for sensing and signaling the level or pressure of a flowable material in a chamber by using a movable diaphragm member against which the material acts to pivot a diaphragm actuated plate to operate an electrical switch. In a preferred combination, the present invention 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.

In the preferred embodiments of the automatic safety means, the chemical tablets normally rest on a diaphragm and force the diaphragm against an electrical switch which closes the circuit and allows the macerator and other components of the system to operate so long as the switch remains closed. When the level of tablets falls below a preset minimum, the switch automatically returns to its normally open position to open the circuit to the macerator and prohibit further operation of the unit.

In one form, the diaphragm is disposed horizontally on a support bracket and has a metal lever secured to the bottom thereof to actuate the switch. In another form, the diaphragm is mounted at an angle to side wall of the unit and has a pivotal actuator member adjacent the diaphragm and which operates the electrical switch.

BRIEF DESCRIPTION OF THE DRAWINGS.

FIG. 1 is a vertical sectional view taken centrally through the macerator unit;

FIG. 2 is a perspective view of the treatment unit in accordance with the invention;

FIG. 3 is a sectional view taken along the line 3–3 of FIG. 1;

FIG. 4 is a fragmentary side view, partially broken away, of the safety means shown in FIG. 3;

FIG. 5 is an enlarged fragmentary view of the contact between the actuator lever and the switch;

FIG. 6 is a plan view, partially in section, of the safety means;

FIG. 7 is a sectional view similar to FIG. 3 but showing the diaphragm in its depressed position;

FIG. 8 is a schematic of the electrical circuitry for the unit shown in FIG. 1;

FIG. 9 is a sectional view taken centrally through another embodiment of the invention;

FIG. 10 is a view similar to FIG. 9 showing the diaphragm in a depressed or actuated position;

FIG. 11 is a sectional view taken along the line 11–11 of FIG. 9; and

FIG. 12 is a sectional view similar to FIG. 3 showing a modified embodiment of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

FIGS. 1 and 2 illustrate the flushing toilet assembly 10 which includes the flush bowl assembly 11 and the macerator chlorinator 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 chlorinator unit 12 for treatment. It is generally acceptable to discharge the effluent into a stream or lake after certain treatment has been accomplished in the macerator chlorinator unit 12.

The macerator chlorinator unit 12 (FIG. 1) includes a rectangular housing 20 having the top and bottom walls 21 and 22, and the end and side walls 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 at 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 side wall 24, and suitable drains 41 and 42 are provided in the housing adjacent the bottom wall for use in cleaning and draining the macerator chlorinator unit 12 for maintenance. The capacity of the holding chamber 33 can be varied, and this chamber may be eliminated entirely.

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 of the housing 46 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 and to continue running during short periods of low pressure such as during the return stroke of the pump handle 14. In particular, the switch 50 may be of the type disclosed in the copending application Ser. No. 735,364, filed June 7, 1968, and assigned to the assignee of this invention.

The safety apparatus for sensing the level of tablets in the treatment chamber is shown in FIGS. 3—8 and includes a diaphragm assembly 55 mounted on the side wall 24 of the housing 20 and extending horizontally into the treatment chamber 28 a short distance above the bottom wall 30 thereof. Specifically, as shown in FIG. 3, the assembly 55 includes a housing 57 which extends through the rectangular opening 58 in the side wall 24 of the housing 20 and is secured thereto by the conventional fastening means 59 (FIG. 4). The top surface

61 of the housing 57 is recessed and the diaphragm 62 is clamped over the recess 63 against the horizontal top surfaces 61 thereof by the ring 64 secured thereto by the screws 65. A thin disk 66 is disposed adjacent the bottom surface 67 of the diaphragm 62 and has the elongated actuator arm 68 rigidly secured thereto and extending through the passage 69 outwardly of the side wall 24.

The electrical switch 70 is secured on housing 57 in the enclosure 71 on the outermost end 72 of the housing 57 with its actuator 74 extending upwardly to be engaged by the actuator arm 68, as shown in FIG. 3. The disk 66 and the actuator arm 68 are interconnected so that they act as a single member with the arm 68 being supported at one end on the spring biased actuator 74 of the electrical switch 70 and the disk 66 being supported at the other end by the shoulder 75 formed in the housing 57. Thus, downward pressure on the diaphragm 62 causes the disk 66 and arm 68 to pivot about the support shoulder 75 to depress the actuator 74 and trip the switch 70.

The weight of the tablets 78 resting on the diaphragm 62 will normally cause the diaphragm 62 to be depressed and the switch 70 closed as long as the preset level of tablets 78 is maintained (FIG. 7). This preset level is determined in accordance with the size and capacity of the unit and is sufficient to insure that the effluent is properly treated as it passes through the chamber 28. Once the level of tablets has fallen below this preset level, the weight of the tablets on the diaphragm 62 is no longer sufficient to close the switch. The distance that the housing 57 and diaphragm 62 are spaced above the bottom wall 30 of the treatment chamber 28 are determined by the preset level of tablets to be maintained as a minimum in the unit.

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 chlorinator unit 12. When the effluent flows through the pipe 18, the pressure therein causes the diaphragm 48 (FIG. 1) to move upwardly and compress the air in the chamber 53 to actuate the switch 50 in the line 81 and 82 (FIG. 8) to complete an electrical circuit to the macerator drive motor 83 through line 81, timer 50, lines 82, switch 70, and lines 84 and 85. The motor 83 then rotates the blade 87 (FIG. 1) at high speed causing the solids to be reduced to a small enough size to pass through the space 88 between the outer periphery of the control plate 89 and the tube 90. 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 78, *e.g.*, chlorine, so that the weight thereof on the diaphragm 62 has closed the switch 70. As a result, the electrical circuit through the lines 82 and 84 is completed by the switch 70*a*. The effluent is treated in the chamber 28 by contact with the chemical tablets 78 so that the waste acquires treating chemical before passing through the opening 36. If the unit has a holding chamber 33, the effluent settles 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, the pressure in the inlet pipe 18 falls and 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 50 opens. As a result, the drive motor 83 continues to operate and the effluent in the pipe 18 and in the tube 90 continues to be processed for a preset short time, after which the switch 50 automatically opens and terminates operation of the motor 58. The switch 50 also functions to maintain constant operation of the macerator as the pump is manually operated in a cyclic manner.

After the unit 12 has been used for a considerable number of cycles, the tablets 78 become depleted to the point that the diaphragm 62 returns to the alternate position under the bias of the actuator 74 to open the circuit through lines 82 and 84 to the drive motor 83 to terminate or prohibit operation of the macerator motor 83. Thereafter, when the operation of the flushing pump 15 closes the switch 50 to operate the macerator, the circuit through the line 82 and 92 is completed to energize the light 94 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 87 and the space 88, thus barring the possibility that effluent which has not been properly treated to kill the bacteria will be discharged. To refill the treatment chamber 28 with tablets 78, it is necessary to apply a slight downward pressure to the cap 95 (FIG. 1) and then turn the same to remove the cap 95 and fill the chamber 28 to again close the switch 70 to enable normal operation of the unit once again.

Another embodiment of the invention is shown in FIGS. 9—11 wherein the diaphragm assembly 100 includes a housing 101 adapted to be inserted through a suitable rectangular opening 102 in the side wall 24 of the housing 20 of the unit 12. The diaphragm or boot 103 is made of rubber or other resilient material and is clamped in place by the peripheral flange 104 of the housing 101 which is secured to the side wall 24 by the connectors 105 (FIG. 11). The internal portion of the housing 101 includes the downwardly tapered side walls 106 having the interconnecting bottom wall 107 defining the interior of the switch chamber 110 which is surrounded and sealed by the tapered front and sides of the diaphragm 103.

The switch actuator is in the form of a rectangular plate 112 pivotally mounted on the pin 113 at its top ends so that the pressure on the front wall of the diaphragm 103 tends to pivot the actuator in a counterclockwise direction, as viewed in FIG. 9. The switch 70*a* is mounted in position on the bracket 115 by the fastening means 116 so that its actuator 117 engages the plate 112 and urges this plate away from the switch 70*a* due to an internal spring in the switch. The outer portion of the switch chamber 110 is enclosed by cover 118 which is also secured in place by the screws 105 and which has a suitable outlet 119 for the electrical conductors 120 (FIG. 11).

When the tablets 78 within the treatment chamber 28 are above a preset level, the weight thereof resting against the front wall of the diaphragm 103 is sufficient to pivot the plate 112 against the bias of the switch actuator 117 to close the switch 70 and maintain normal operation of the unit. However, when the level of tablets falls below the preset level, as shown in FIG. 9, the bias of the switch 70 moves the plate 112 and diaphragm 103 back to their unflexed position wherein the electrical circuit to the macerator motor 83 is opened and further operation of the unit is not possible. Otherwise, this embodiment is substantially identical in construction and operation to that described above in connection with FIGS. 1—8.

A modified form of the diaphragm assembly 55*a* is shown in FIG. 12 wherein the arm 68*a* on the thin disk 66*a* is provided with a pivot 120 midway between its ends and resting on the top surface 121 of the housing 57*a*. The inner end 122 of the disk 66*a* is spaced from the adjacent housing 57*a* and does not pivot on a shoulder as in FIGS. 3 and 7. The switch 70*b* is mounted above the outer end 123 of arm 68*a* so that weight or pressure on the diaphragm 62*a* causes counterclockwise movement of the disk 66*a* to actuate the switch 70*b* against the bias of the switch itself. This embodiment is otherwise identical to the FIGS. 1—8 embodiments in structure and operation.

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 not permitted to operate once the level of tablets or other treatment chemical in the treatment chamber falls below a preset level. In particular, the invention has provided an improved

diaphragm sensing apparatus which senses the weight of the tablets or other treatment chemical normally resting thereagainst so that the unit is permitted to operate only as long as the level of tablets remains at or above the preset level. The sensing apparatus is inexpensive and easily mounted in the treatment of this or other similar units by merely cutting a hole in the side wall thereof and securing the apparatus in place. The pellet sensors **55** and **100** shown are not limited to use in a macerator chlorinator system, and can be useful in other systems to sense and signal pressure or level of liquid or solid particles in a chamber.

While the forms of apparatus herein described constitute preferred embodiments of the invention, it is to be understood that the invention is not limited to these precise forms of apparatus, and that changes may be made therein without departing from the scope of the invention.

We claim:

1. A treatment unit for the effluent from a 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 a preset amount of solid treatment chemicals for purifying the effluent, and diaphragm means mounted in said treatment chamber and adapted to have at least a portion of the solid treatment chemicals resting thereagainst when said treatment chamber contains said preset amount, said diaphragm means having means to sense when the amount of treatment chemicals is below a safe level to provide a signal that the supply of treatment chemicals requires replenishing.

2. A treatment unit as defined in claim **1** wherein said diaphragm means includes a diaphragm housing, means defining an opening in the side wall of said treatment chamber, and means to mount said diaphragm housing on said side wall with a portion thereof extending into said treatment chamber.

3. A treatment unit as defined in claim **1** wherein said diaphragm housing includes a horizontally disposed diaphragm, a switch mounted in said diaphragm housing, and actuator means adapted to interconnect said diaphragm with said switch to enable the weight of treatment chemicals on said diaphragm to actuate said switch.

4. A treatment unit as defined in claim **1** wherein said diaphragm also includes means to inactivate said macerator means.

5. A treatment unit as defined in claim **2** wherein said diaphragm housing includes a sloping diaphragm, a switch mounted in said diaphragm housing, and actuator means adapted to interconnect said sloping diaphragm with said switch to enable the weight of treatment chemicals on said diaphragm to actuate said switch.

6. A treatment unit as defined in claim **3** wherein said actuator means includes a disk-shaped member mounted below said diaphragm, a shoulder on said diaphragm housing adapted to support one end of said disk member, and a link connecting the other end of said disk member with said switch thereby enabling the weight on said diaphragm to pivot said actuator about said shoulder to actuate said switch.

7. A treatment unit as defined in claim **3** wherein said actuator means includes diaphragms support means mounted below said diaphragm, pivot means on said disk support means intermediate the ends thereof, and means connecting one end of said support means with said switch thereby enabling pressure on said diaphragm to pivot said support means about said pivot means to actuate said switch.

8. A treatment unit as defined in claim **5** wherein said sloping diaphragm includes a side and bottom walls adapted to seal said diaphragm housing from said treatment chamber, said actuator means operable to hold said diaphragm in an extended position against the weight of the solid treatment chemicals.

9. A treatment unit as defined in claim **7** wherein said actuator means includes a plate adapted for pivotal movement about its upper end, said switch being mounted in said diaphragm housing to urge said plate against said diaphragm so that the weight of the solid treatment chemicals is operable to actuate said switch when the chemicals exceed said safe level.

10. A treatment unit for the effluent from a toilet, comprising a housing, a treatment chamber adapted to receive the flow of effluent from the toilet, an inlet to said treatment chamber, an outlet from said treatment chamber, macerator means associated with said inlet for reducing solid particles in the effluent to a preset small size, said treatment chamber adapted to receive and hold chemical tablets for purifying the effluent, and diaphragm means against which the tablets are adapted to rest, said diaphragm means sensing when the amount of tablets is below a predetermined safe level to then provide a signal that the supply of treatment chemicals requires replenishing.

11. A treatment unit as defined in claim **10** wherein said diaphragm means also inactivates said macerator when the supply of chemicals falls below said predetermined level.

12. A treatment unit as defined in claim **11** wherein said diaphragm means include a resilient flat surface against which the chemical tablets rest, said surface being disposed a preset distance above the bottom of said treatment chamber.

13. A signal and sensing device, comprising a housing, a chamber adapted to receive a flowable material, an inlet to said chamber, and diaphragm means against which the flowable material is adapted to rest, said diaphragm means sensing when the amount of material is below a predetermined safe level to then provide a signal.