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761,731
[45] Patented **Oct. 27, 1970**
[73] Assignee **General American Transportation**
Corporation
a corporation of New York

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[54] **WASTE TREATMENT AND STORAGE SYSTEM**
49 Claims, 24 Drawing Figs.

[52] U.S. Cl..... 210/97,
4/10
[51] Int. Cl..... B03d 3/00
[50] Field of Search..... 4/10,
90, 115, 131; 210/97

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ABSTRACT: A system, that receives and treats waste from and preferably furnishes flushing liquid to a toilet, includes a temporary holding tank to receive the waste from a toilet, a volume-reductive storage tank, a conduit between these tanks to transfer waste from the holding tank to the storage tank, valve means to close the conduit, heater means to evaporate at least part of the waste in the storage tank, and one or more of: an automatic system including an operation of the valve means; a movable spout in the holding tank communicating with an opening in the top wall to communicate with a bottom outlet of a toilet; an automatic metering system, along with an automatic accumulator or supply system that includes a novel replaceable canister to replenish the metering system, for periodic automatic introduction of a novel disinfectant concentrate composition, preferably containing a dye, into the holding tank upon completion of automatic waste transfer through the conduit, so as to have in the holding tank, during toilet use and regardless of the number of toilet uses between operations, an adequate concentration of disinfectant and preferably, also, of dye; a special configuration of the upper surface of the bottom wall of the holding tank; location and construction of the conduit and the valve means to insure a minimum liquid level for a pump in the holding tank after automatic waste transfer; and an override of the automatic waste transfer system to rinse the holding tank with complete drainage or to service both tanks with complete drainage.

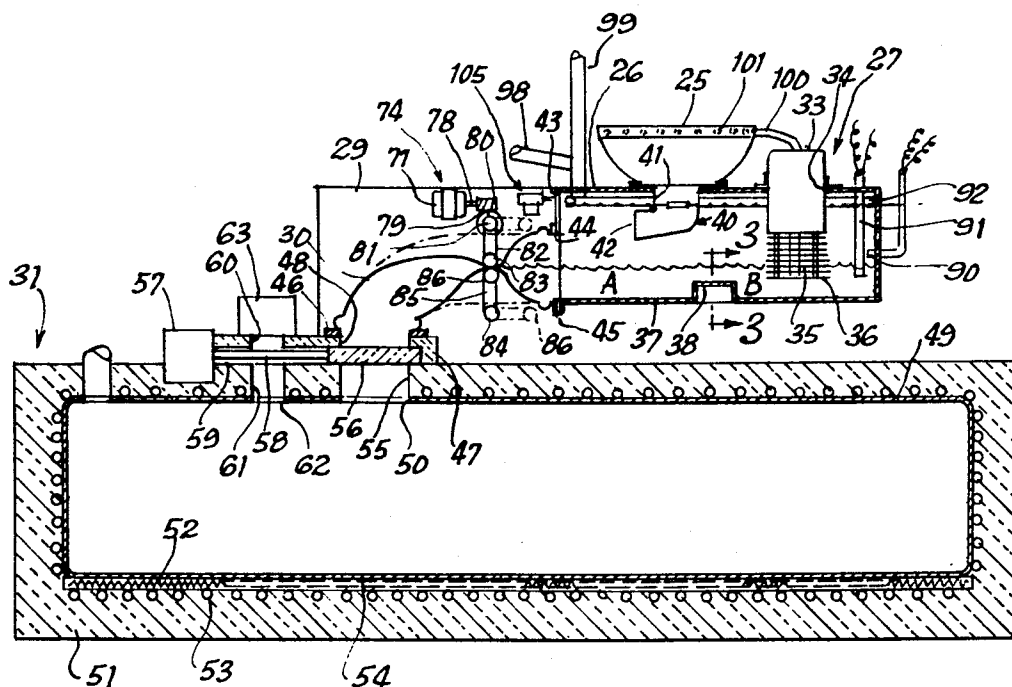


FIG. 1

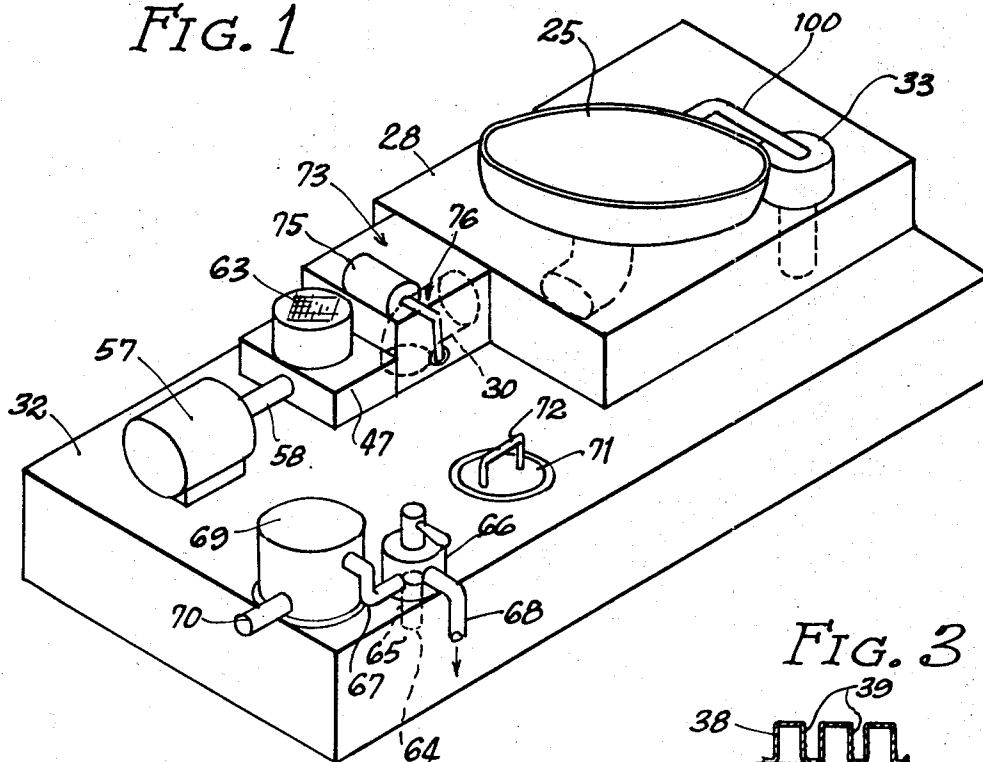


FIG. 3

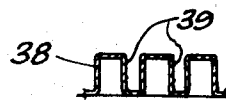
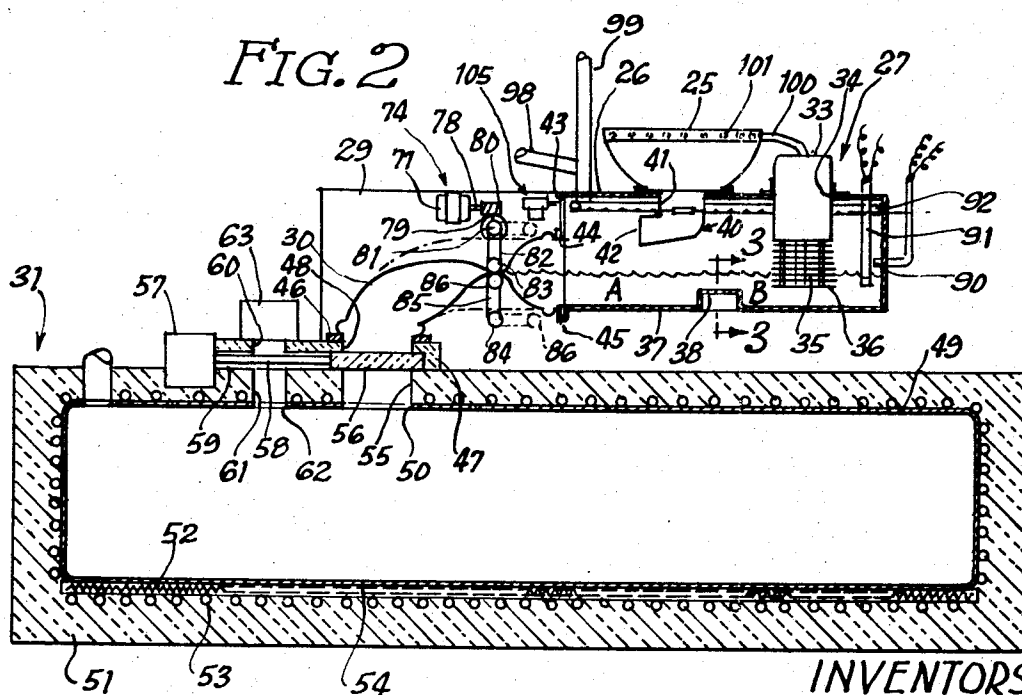


FIG. 2



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FIG. 4

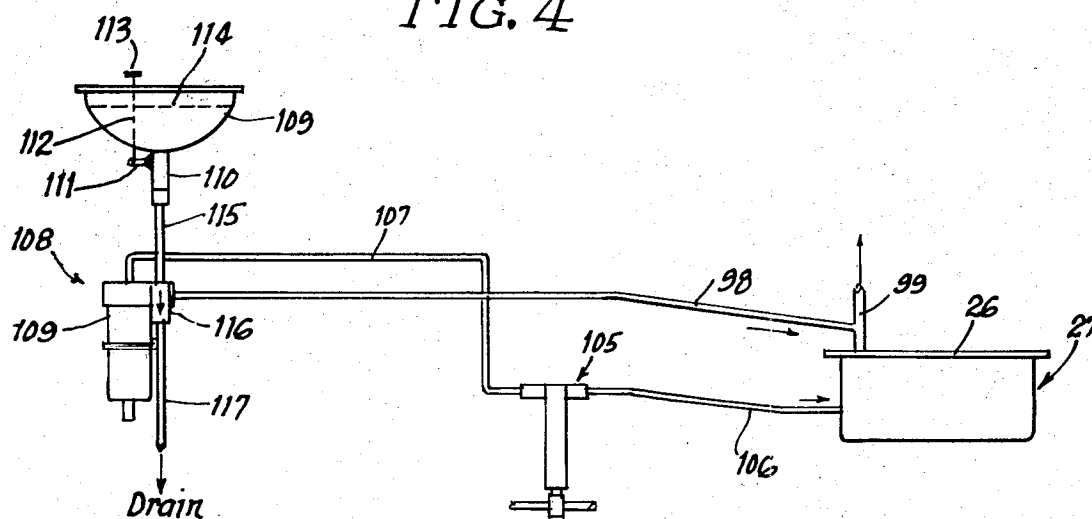


FIG. 5

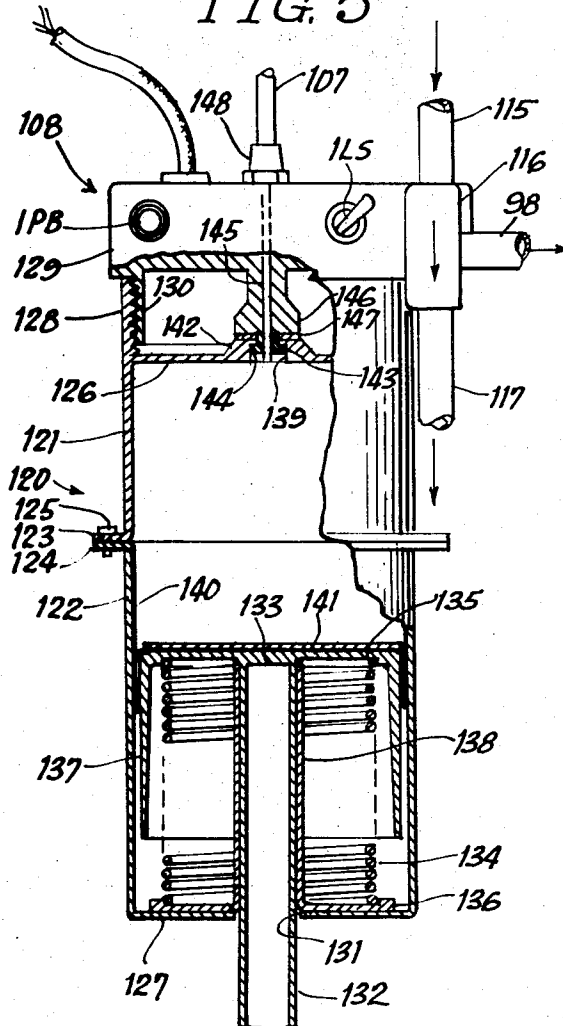


FIG. 6

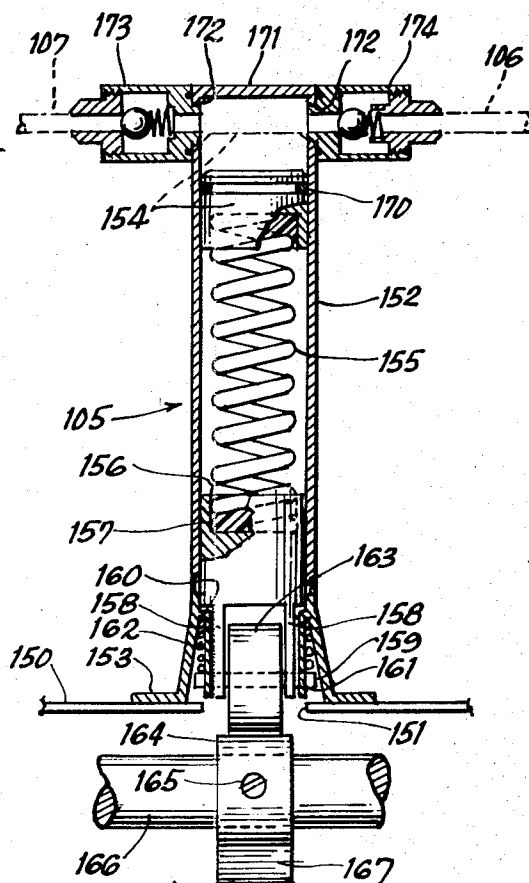


FIG. 7

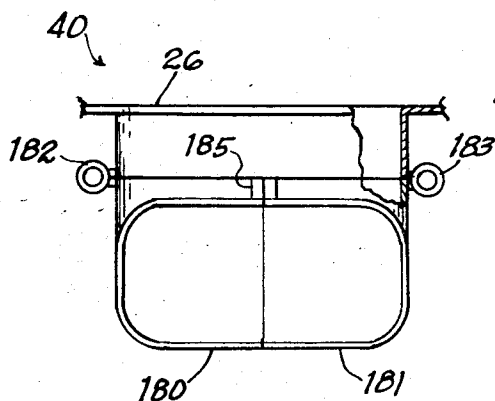


FIG. 8

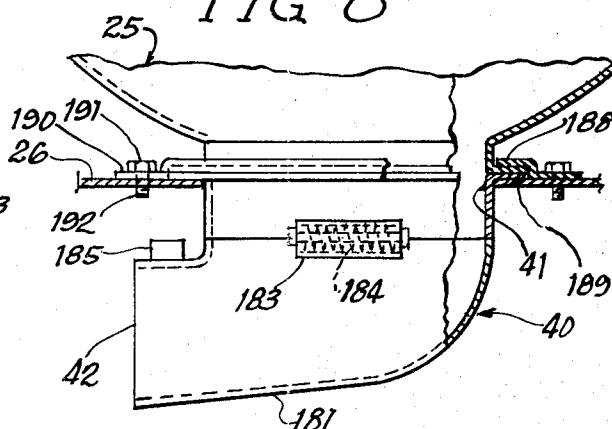


FIG. 9

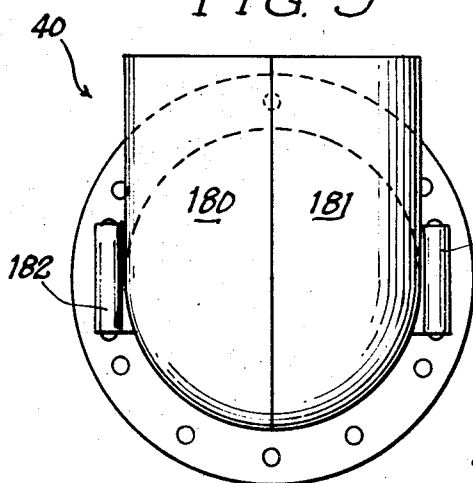


FIG. 10

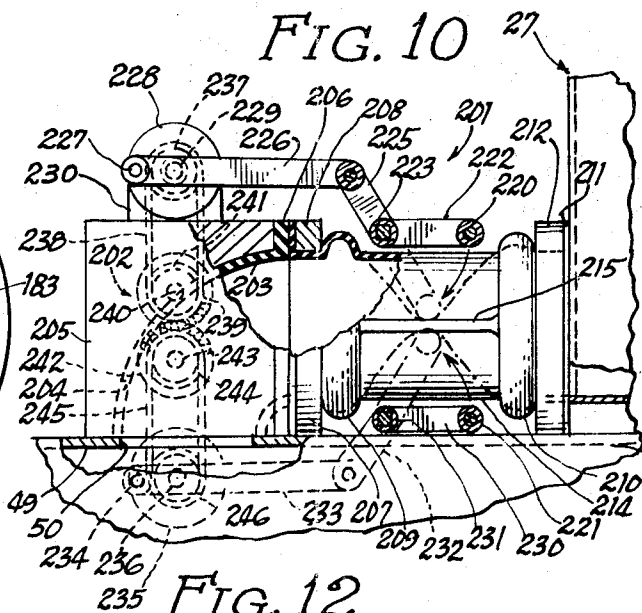


FIG. 14

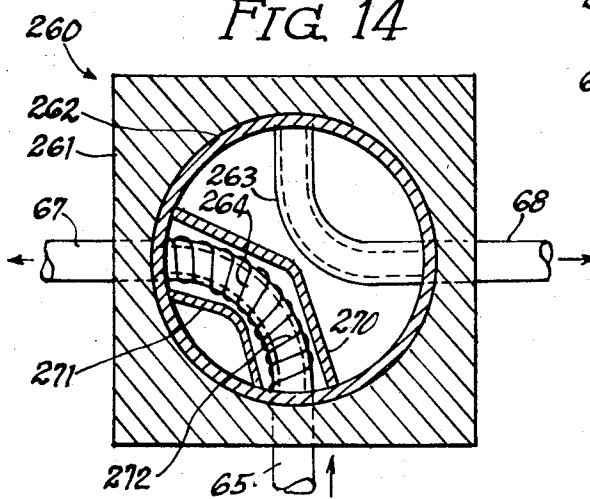


FIG. 12

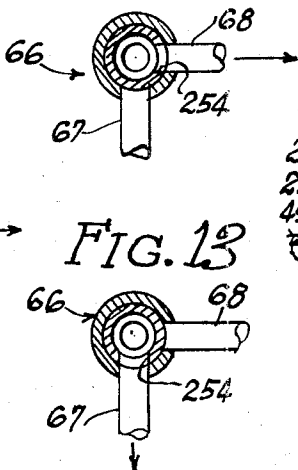
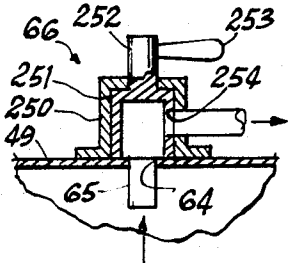


FIG. 11



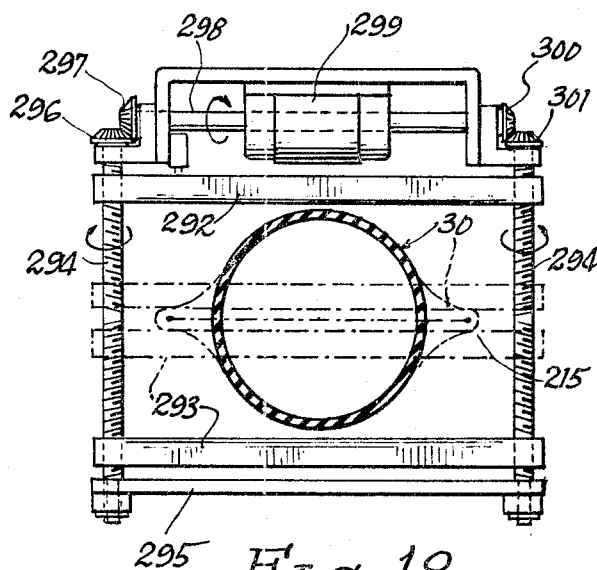
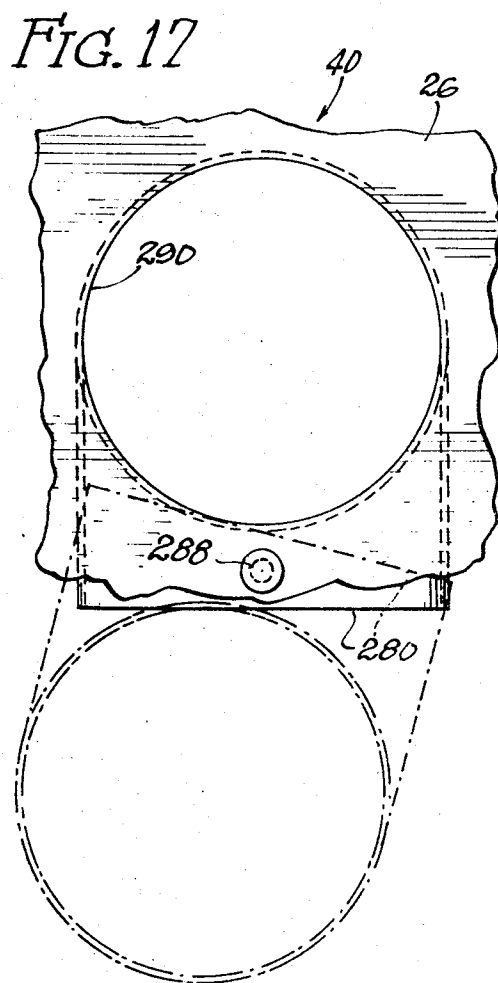
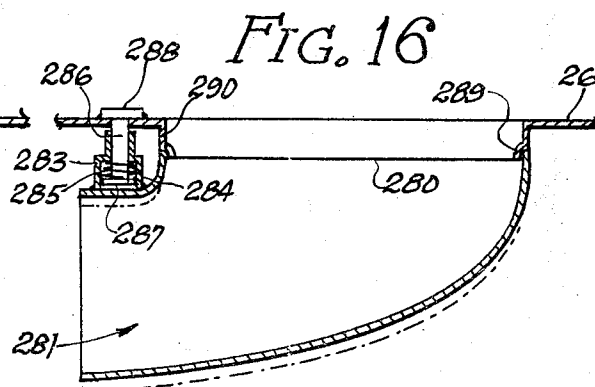
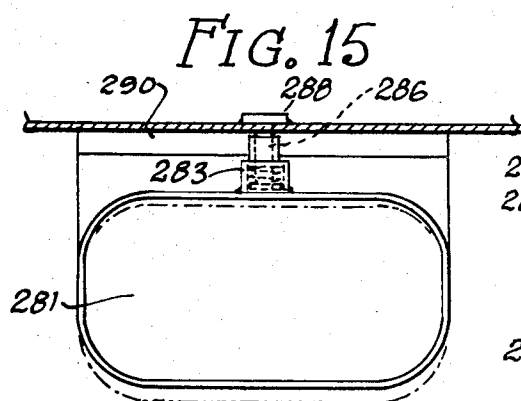


FIG. 19

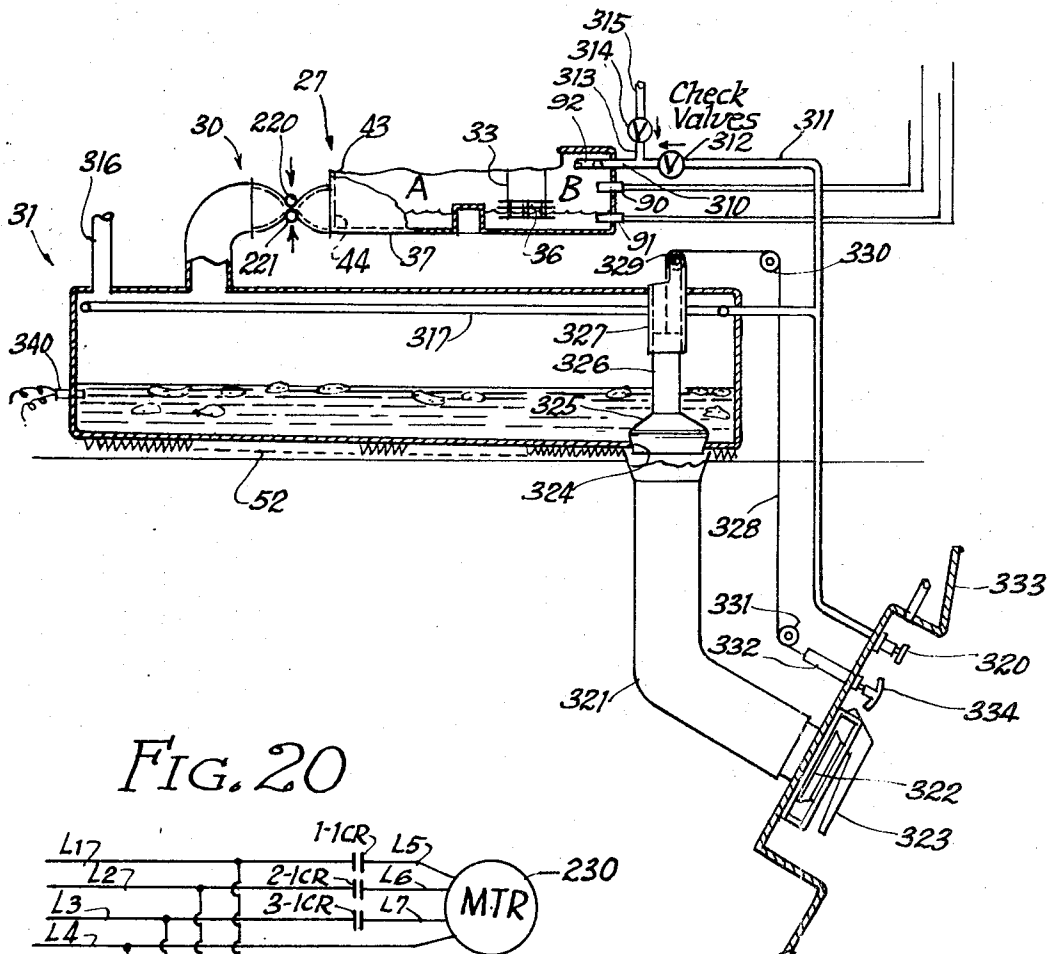


FIG. 20

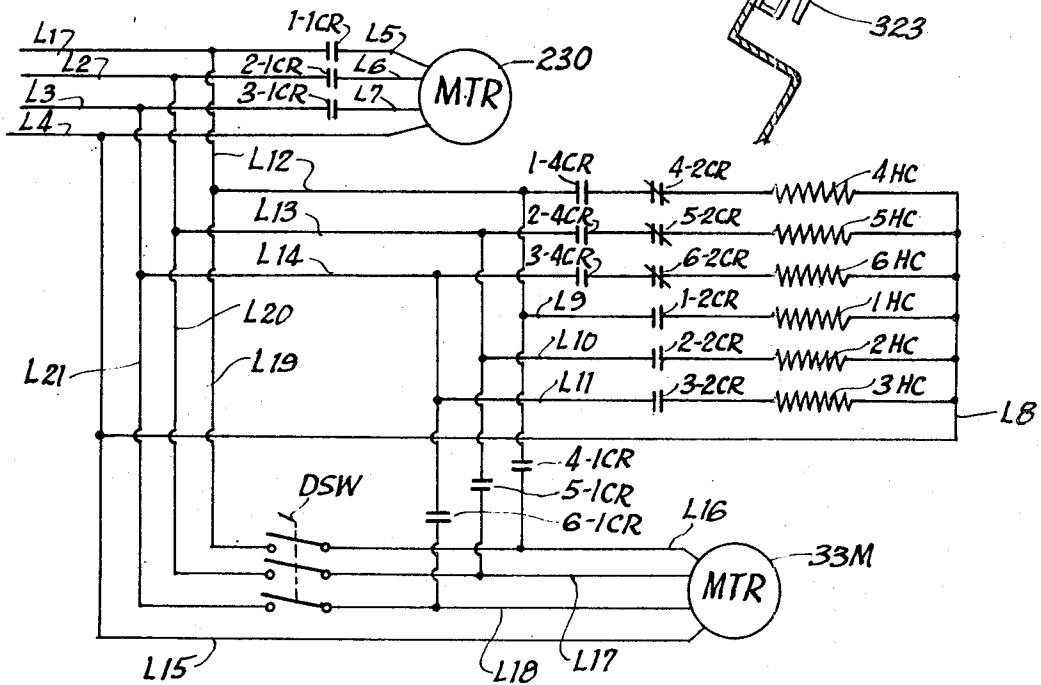


FIG. 21

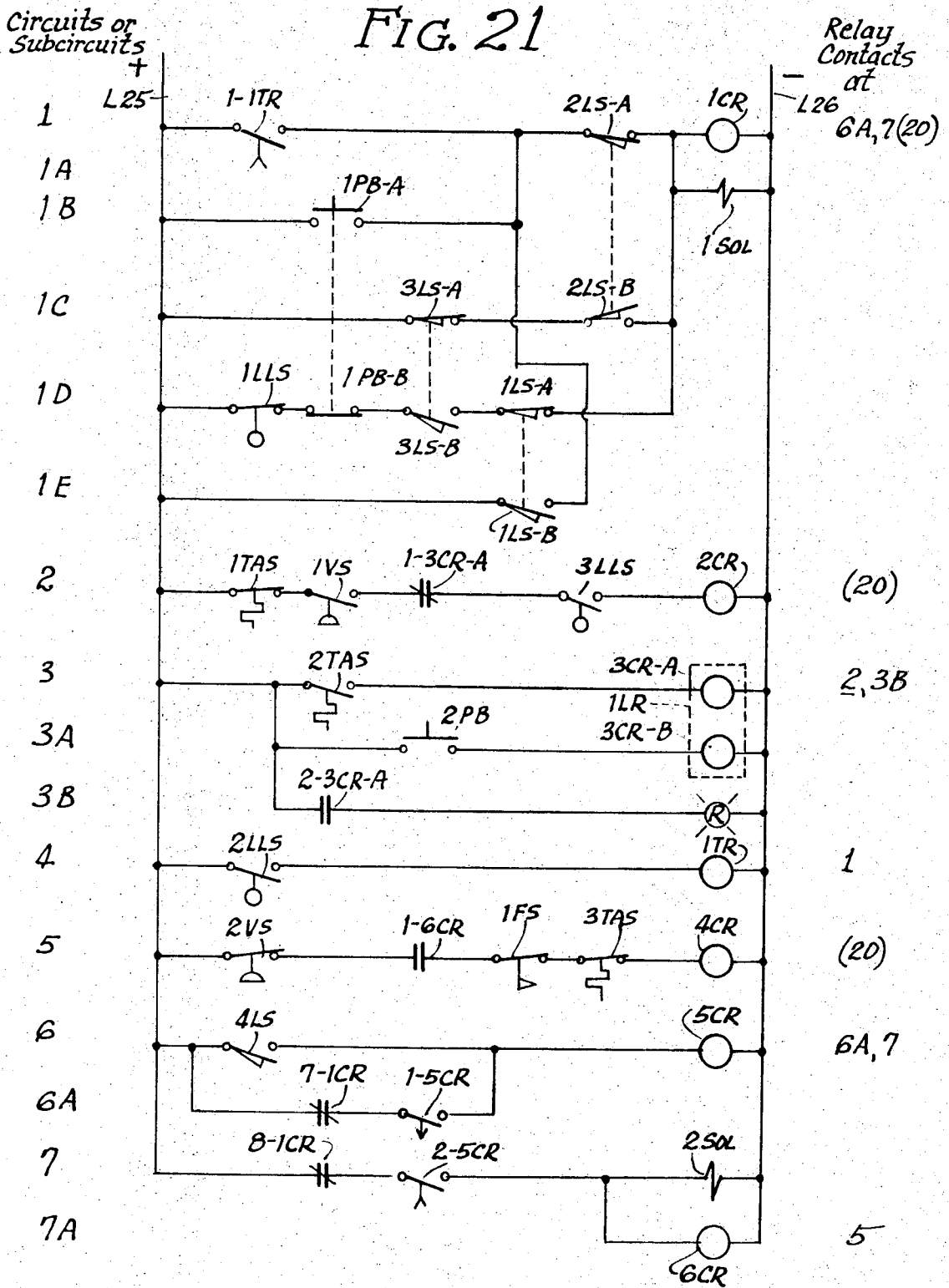


FIG. 22

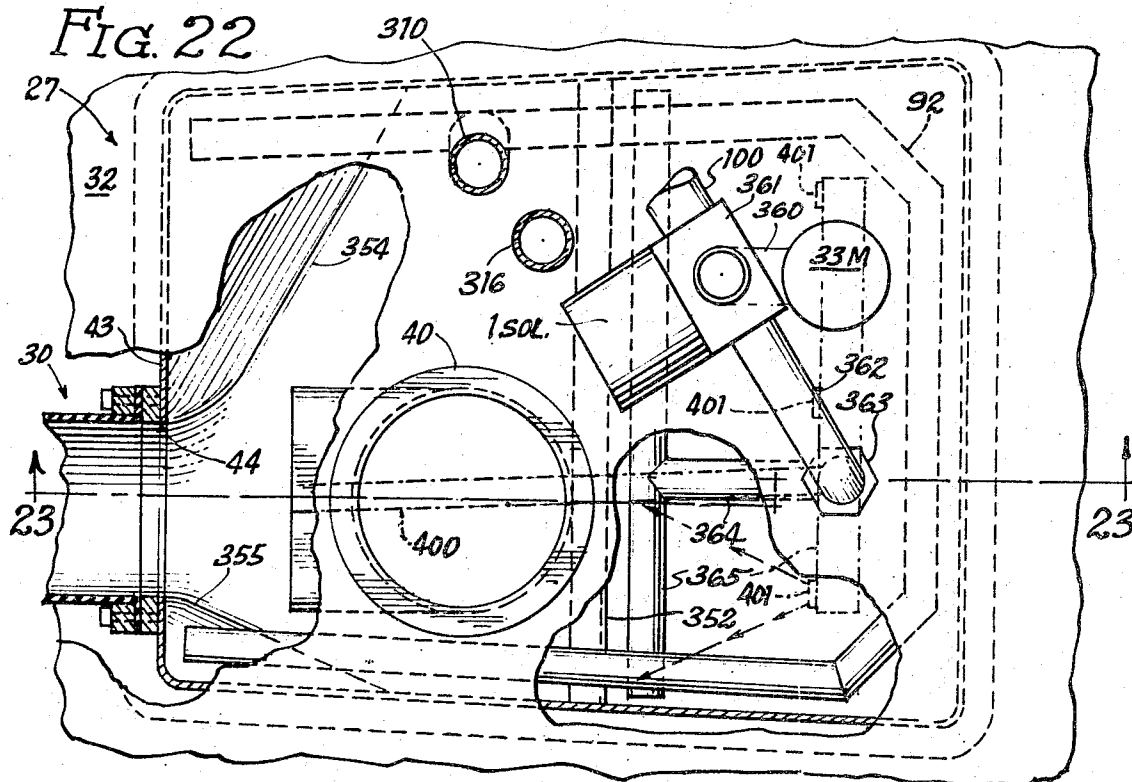


FIG. 23

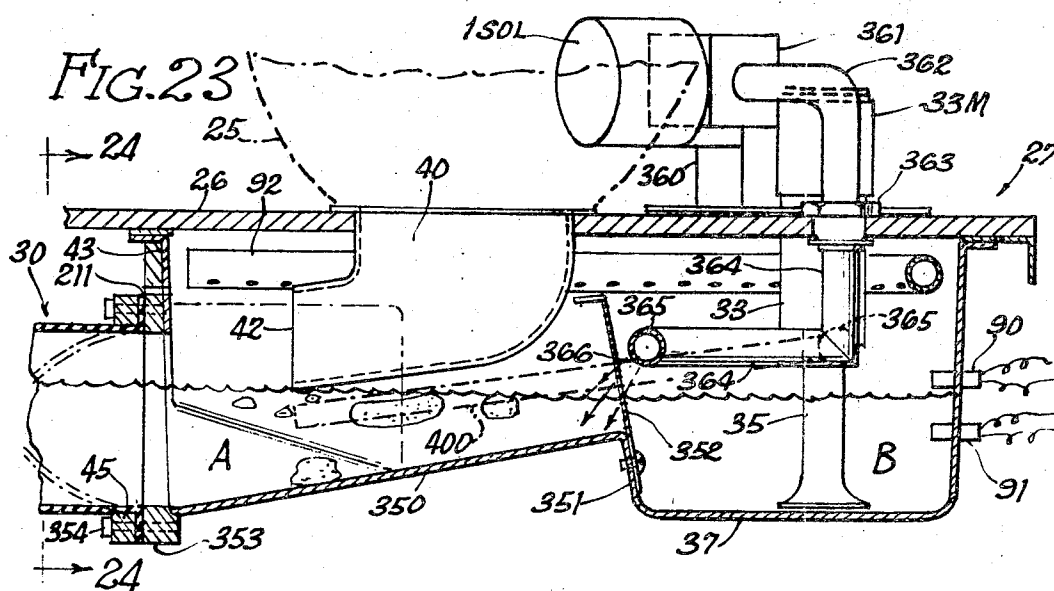
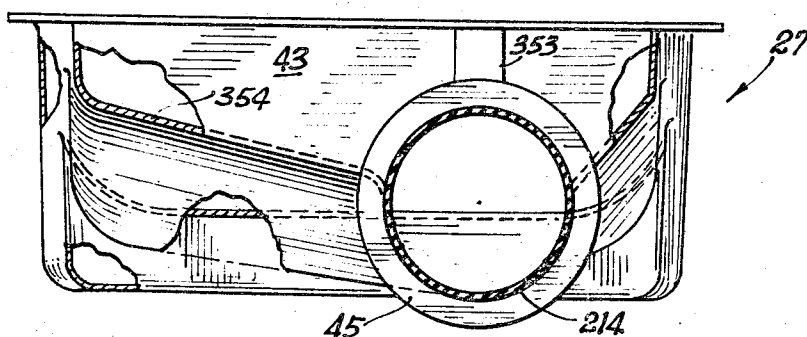


FIG. 24



WASTE TREATMENT AND STORAGE SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of our U.S. Pat. application Ser. No. 692,062, entitled "Toilet and Waste Storage System" filed on Dec. 20, 1967.

BACKGROUND OF THE INVENTION

1. Field of the Invention

This invention relates to a system or apparatus and to a method for receiving human body wastes and periodically transferring part of the waste for treatment to remove at least part of the liquid content and preferably retaining part of the liquid for use as a flushing liquid for a toilet.

2. Description of the Prior Art

In various vehicles, such as airplanes, buses, boats and trains, and sites lacking conventional sewage treatment systems there has existed a need for the storage and disposal of wastes received from toilets.

As described in our copending patent application mentioned above, under the conditions where a water supply is very limited it has been proposed to use a waterless toilet. An illustrative system in the incinerator toilet described and claimed in U.S. Pat. No. 3,169,497. The human wastes are transferred from a toilet bowl to an incinerator chamber in which the waste is converted to ash. The volatile material is removed from the incinerator chamber by a blower. None of the aqueous content of the human waste is utilized.

Several developments have produced systems that are referred to as self-contained sewage or toilet systems. These systems have a flush toilet bowl mounted on a tank that contains at the start of service of the system, an aqueous solution suitable for flushing the toilet. The aqueous solution also contains chemicals to provide a deodorization of waste material received in the tank from the toilet. During service use the volume of liquid in the tank increases. Eventually, the amount of liquid in the tank precludes any further use of the system until it has been serviced. In this system there is provided a combination of a filter and a pump by which the mixture of waste liquid and initial water in the tank is drawn to the filter which permits the passage of filtrate to the inlet of the pump. Flushing liquid in the form of this filtrate is fed to the toilet bowl by the outlet of the pump. Such systems are described in U.S. Pat. Nos. 3,067,433 and 3,343,178. Another patent (U.S. Pat. No. 3,172,131) describes and claims a specific improvement that is especially useful with the system of U.S. Pat. No. 3,067,433. U.S. Pat. No. 3,067,433 states that a self-cleaning filter of known construction can be used. An alleged improved filter is disclosed and claimed in U.S. Pat. No. 3,342,341 which also discloses the entire self-contained sewage system.

The systems described in the next preceding paragraph utilize a relatively deep tank and provide an initial charge of aqueous liquid in an amount to occupy less than one-half of the volumetric capacity of the tank, i.e., the capacity beyond which the system should not be used until serviced. In each of such systems the distance from the top of the tank to the top of the initial charge of aqueous liquid is required to be substantial so as to permit the use of the system for a considerable number of times before the system requires servicing. For this reason the outlet of the toilet bowl is required to be at the topmost portion of the tank and for a number of other reasons this outlet is required to extend laterally within this topmost portion of the tank.

A previous system is exemplified by U.S. Pat. No. 2,858,939 in which the waste liquid from the toilet is ground and filtered. The filtrate is transferred to another tank for later use in a flushing operation. The filter transfers the solids to a tank below the filter.

In U.S. Pat. No. 3,079,612 there is disclosed and claimed a tank receiving human body waste from two toilets and a double drive filter and pump that selectively provides flushing liquid to one or the other toilet.

SUMMARY OF THE INVENTION

This invention relates to a system capable of receiving of human body wastes, transferring and treating part of the wastes, and utilizing another part of the human body wastes as a flowing liquid for and to a toilet. The apparatus of the invention reduces substantially the volume of waste that is received in one tank and transferred to a second tank from which part of the material of the waste is disposed in a form that avoids substantially atmospheric pollution. Because of the apparatus, there is a decrease in the gross weight of an occupied vehicle, such as an airplane, during the multiple operation of the apparatus in a flight. Furthermore, the apparatus of the present invention increases the number of times that the toilet can be used before it becomes necessary to provide a service operation that completely removes human waste received by the apparatus. Other advantages, especially those for specific combinations that are embodiments of the apparatus, will be mentioned later.

The apparatus of this invention comprises a temporary holding tank, a volume-reductive storage tank, a conduit communicating these tanks with each other for transfer of flowable material from the holding tank to the storage tank, means to close the conduit, and heater means to heat the storage tank for removal of at least volatile material in the human waste in the storage tank.

The holding tank has an opening in its upper portion for communication with the bottom opening of an outlet of a toilet so that the holding tank receives human waste from the toilet. This opening is preferably in the top wall of the holding tank. The holding tank has an outlet in the lower portion and one end of the conduit is connected to that tank to communicate the holding tank with the conduit at that outlet. The storage tank has an inlet opening in the upper portion, preferably in the top wall, and the other end of the conduit communicates with the storage tank via that opening in the storage tank. The storage tank also has an outlet for removal of volatized material from the tank.

In some of the various embodiments of the apparatus of the invention, the apparatus necessarily uses a pump having an inlet in the holding tank to remove liquid from that tank and an outlet to provide the removed liquid to the toilet for the flushing of the latter. In some of these embodiments a filter is present to provide a filtered liquid to the pump. In one of these embodiments the presence of a filter is not absolutely required, although its presence may be desired as a precaution. That embodiment has a holding tank with a top surface that is shaped, as described later, to minimize movement of solids to the pump inlet.

In one embodiment of the apparatus of the invention the heater means for removing volatile material from the storage tank and thus reducing the volume of waste in the storage tank comprises a heater that has a thermal capacity, sufficient to raise the temperature in the tank to provide a substantial water vapor pressure, and a heater that has a capacity, sufficient to convert waste material in the tank to an incinerated product. Of course, the latter heater can include the heater for removal of water in vapor form. In that case, the heater for the incineration treatment would constitute the evaporative heater and an additional heater. Alternatively, the incinerative heater can be an entirely separate heater.

In this embodiment of the apparatus the normal use of the heater means would be the use only of the evaporative heater. However, under certain conditions the apparatus would utilize the heater that provides for the incineration of material in the storage tank. This change in operation of the heater means from the normal operation of the evaporative heater to the incinerative heater could involve merely the manual switching in electrical circuitry to provide power to the incinerative heater. When the evaporative heater is part of the heater system for the incineration, the evaporative heater would continue to be operative and the only difference would be the

operation also of the supplemental heater to obtain the higher temperature. In the normal operation of the heater means of the present apparatus, the temperature in the storage tank is preferably controlled to avoid too high a temperature for the tank. When the apparatus is in an airplane in flight, it is preferably used for evaporation only of volatilizable material, specifically water, from that tank. This avoids a fire hazard, namely, the creation of a hot zone within the airplane. The apparatus of this embodiment has one aspect that includes a control to prevent operation of the incinerative heater when the airplane is moving or has some other operating condition, so that the incinerative heater can operate only when the airplane is on the ground and is safe to provide such incineration.

In this embodiment the heater that provides for the evaporation of at least part of the aqueous content of the waste in the storage tank is preferably combined with a control that prevents an operation of the heater after a predetermined extent of use until a subsequent transfer of waste is effectuated from the holding tank to the storage tank. This control system also includes a control that prevents an operation of the heater during the transfer of material from the holding tank to the storage tank in a partial or a complete service operation. The partial service operation provides for the transfer of rinse liquid into the holding tank and then from the holding tank via the conduit to the storage tank. The complete service operation also transfers material from the storage tank to an external storage or transfer system such as tank truck or pipe line.

This complete servicing of the apparatus can be scheduled to be performed after a number of flights that exceeds manyfold the number of flights of an airplane that can be made before complete servicing is necessary for apparatus presently available. Of course, such schedules are based upon the expected maximum number of toilet uses per flight.

In another embodiment of the present invention the outlet of the holding tank is required to be in the sidewall of the holding tank rather than merely in the lower portion of the holding tank. In this embodiment of the apparatus, the lowermost portion of the outlet in the sidewall is at the plane of the portion of the inner top surface of the bottom wall of the holding tank adjacent that outlet. For most effective removal of solids of the human waste received by the holding tank, the portion of the top surface of the bottom wall is preferably the lowest part of the top surface of that wall in the zone of the tank in which such solids would be expected to settle to the bottom wall. In addition, in this embodiment of the apparatus the conduit includes a horizontal flexible portion having its lowermost inner surface in horizontal alignment with the lowermost portion of the outlet of the holding tank. This embodiment of the apparatus includes also means to raise an intermediate part of this flexible portion so as to raise part of that lowermost inner surface of the horizontal portion. This raising means may be a part of the means to close the conduit so as to stop transfer of material from the holding tank via the conduit to the storage tank.

Failure to close completely the horizontal flexible portion of the conduit will not affect the upward movement of the bottom portion of the flexible portion to a sufficient elevation that will prevent complete transfer of flowable material through the incompletely closed conduit. When the level of flowable material in the holding tank drops to the horizontal plane passing through the raised inner surface of bottom wall of the flexible horizontal portion of the conduit, flow will cease. This construction is important in the embodiment in which it is necessary to maintain a minimum level of pumpable liquid in the holding tank and that level is above the horizontal plane at the lowermost part of the outlet of the holding tank.

In another embodiment of the apparatus of this invention the apparatus includes means to thermally shield the conduit adjacent its communication with the storage tank to prevent transfer of thermal energy, in the form of high-temperature gases, from the holding tank to the storage tank when the latter is incinerating material in that tank. This shielding

means is movable between such operative position to a nonoperative position. The movement to the operative position can be made manually but preferably is automatically moved by a mechanical device that is rendered operative only in coordination with the initiation of the heater means for an incineration operation. Also, the apparatus includes a control system that moves the shield to an inoperative position where it does not interfere with the use of the conduit as a transfer for material from the holding tank. This control is initiated upon the ceasing of the operation of the incinerative heater. This thermal shield in its operative position prevents transfer from the holding tank and thus is moved by the control system before the conduit can be opened as part of a cycle of operation of the means to close the conduit. Also the means to move the shield to the operative position is operative only by the control that permits the use of the incinerative heater.

In a further embodiment of the apparatus of the invention the apparatus includes a scoop that is mounted on the top wall of the holding tank at the inlet opening of the latter. Preferably the scoop extends upwardly through the top opening of the holding tank. The scoop communicates with a bottom outlet of a toilet. Preferably the bottom outlet of a toilet is mounted directly above the holding tank. This scoop extends downwardly and laterally in the holding tank. The lateral extension is in direction away from the pump inlet. This lateral extension and its direction are important when the bottom wall of that tank has an upper surface configuration that minimizes transfer of solids from the zone of the tank having the outlet of the tank to the zone in which the pump inlet is located. In that case, the outlet of the scope deposits waste in the former zone.

The scoop of this embodiment of the apparatus has two aspects of construction. In both aspects the scoop has a lower portion that is movable relative to an upper portion. The mounting for this movement of the lower portion includes means to bias the two portions together to retain a continuous scoop from inlet to outlet. In one aspect the lower portion of the scoop has two components that are separately pivotally mounted on the upper portion of the scoop. Their mounting means urge these components into abutment with each other to constitute the lower portion of the scoop which, of course, includes the lateral extension. In this construction the two parts of the bottom portion of the scoop can be moved away from each other to permit easy access through the toilet bowl for the purpose of manual searching for an object that has inadvertently dropped into the toilet and passed through the scoop into the holding tank. However, it is necessary to overcome the biasing force to maintain the two components spaced away from each other during this manual search. Because these two components of the bottom portion of the scoop are urged toward each other by the mounting means, they return to their normal butting position defining a lower part of the scoop as soon as the force that separates them has been removed.

In the second aspect of construction of the scoop of this embodiment of the apparatus, the upper portion and the lower portion are separately mounted on the top wall of the tank. The upper portion preferably extends upwardly through the top wall of the holding tank. The lower portion is mounted on a vertical rod of a support means. The rod is mounted on the top wall of the holding tank. The support means to mount this lower portion is constructed to permit a downward movement of that portion relative to the top portion of the scoop so that they can be vertically spaced from each other. The support means also is constructed to permit movement of this downwardly spaced lower portion about the vertical axis of the rod. This permits lateral arcuate movement of the main portion of the scoop away from the top portion and this is done when it is necessary to search for and retrieve an object inadvertently dropped into the toilet. The downward movement of the lower portion of the scoop is opposed by resilient means to move that portion upwards. The lower portion of the scoop is the main portion of the scoop. It is preferably one

piece and contains the lateral extension and the main part of the vertical part of the scoop.

In the first aspect, the two components of the lower portion of the scoop pivot about parallel axes but these are not necessarily horizontal. They can be mounted for downward and then lateral arcuate movement about spaced vertical axes as in the case of the second aspect.

In another embodiment of the apparatus of the present invention the bottom wall of the holding tank has a top surface that is raised in an intermediate zone of the tank between the zone having the pump inlet in it and the zone having the outlet of the scoop in it and with the outlet in its sidewall. This raised portion extends transversely but has longitudinal grooves in it, preferably, to the depth of the top surface of the bottom wall at opposite sides of the raised portion. These grooves are sufficiently narrow to decrease substantially and preferably to prevent the movement of solid and semisolid objects from the zone with the spout in it to the other zone having the pump inlet in it.

In a further embodiment of the apparatus of this invention, the system includes a disinfectant metering device that provides automatically a controlled amount of colored disinfectant composition, which is a liquid concentrate, to the holding tank each time there is a cycle of operation for a transfer of waste material from the holding tank to the storage tank. This introduction of disinfectant liquid concentrate is effectuated at the completion of that cycle, which occurs when the conduit is closed to prevent further transfer of waste material in the holding tank below the predetermined minimum level desired by that material for the flushing of a toilet by the pump in that tank. In the preferred aspect of this embodiment the minimum level is accomplished regardless of the complete closing of the conduit by virtue of the construction of the conduit mentioned above, namely, the construction in which the conduit has a horizontal portion that can be raised with respect to its lowermost inner surface to insure retention of liquid in the holding tank. In this embodiment, that uses the automatic metering system, the apparatus includes the pump that is used to pump fluid to the toilet from the holding tank.

In connection with this last embodiment of the apparatus of the present invention, the invention uses an automatic metering system, that includes an accumulator, and a supply system. The supply system includes a canister of supply of colored disinfectant liquid concentrate and means to mount the canister and at the same time to provide an opening in it for communication with the accumulator. The canister is constructed to be self-unloading during metering of liquid concentrate and to provide a visual indication of the extent of concentrate remaining in the canister. This metering system and this canister are also separate but related apparatus of the present invention.

A further embodiment of this invention is the colored disinfectant composition and its use in one embodiment of the method of the invention. The composition is liquid at normal temperatures encountered within the room having the supply system and the metering system including the pipe to the holding tank. The composition is a concentrated aqueous solution of a disinfectant and a compatible dye. The disinfectant is a material that has a suitable antibacterial spectrum as regards bacteria in human waste. It must also retain adequate solubility in the aqueous medium created by the depositing of human waste in water added to the holding tank with a relatively small amount of the disinfectant composition.

Furthermore, the disinfectant must retain adequate solubility, preferably complete solubility, in the aqueous medium when the latter, after transfer to the storage tank is heated to an elevated temperature for the removal of at least part of the water content. Such water removal concentrates the disinfectant in the aqueous medium. Unsatisfactory disinfectants, if not precipitated by materials from human waste in the holding tank, will precipitate in the holding tank due to thermal degradation, the concentration exceeding its solubility, or that of a compound formed with material in the human waste or

the water to which the concentrate is added, *e.g.*, the presence of uric acid in the waste and the presence of calcium ions in the water.

In view of the foregoing it is seen that the disinfectant used in this embodiment of the invention has complete solubility in the concentrated composition that is added in a small amount to water in the holding tank, has complete solubility in that water even with the addition of substantial human waste and that hot concentrate from the latter solution upon heating to an elevated temperature, *e.g.*, the boiling point of the aqueous medium, retains an effective amount of the disinfectant in solution. Preferably all disinfectant remains dissolved. Disinfectants, that meet these requirements, are soluble in water in an effective amount in the holding tank and are sufficiently soluble in a liquid solvent that is miscible with water, to provide a concentrate composition as a solution that contains at least 1 percent, preferably at least 10 percent, and especially preferably at least 25 percent of the disinfectant compound. These compositions contain a small amount, *i.e.*, less than 5 percent by weight water-soluble dye. The preferred liquid solvent is water. Suitable water-soluble disinfectants include alkali metal salts. Preferred disinfectants are alkali metal salts of N-hydroxy-2-pyridinethiones and alkali metal salts of phenols. The disinfectant of the composition must have a suitable antibacterial spectrum for use against bacteria in human waste to prevent putrefaction while the materials are accumulated in the holding tank and in the storage tank and are later concentrated in the latter without appreciable, preferably without any, loss by evaporation during evaporative removal of part of the water content. The disinfectant must be effective against these bacteria in a concentration of disinfectant in water that is 0.1 percent by weight of the aqueous solution and this preferably as low as 0.01 percent.

In addition to water and the disinfectant, the disinfectant composition of the invention contains the compatible dye that is soluble in water to the extent sufficient to impart an adequate color to the initial water in which the composition is dissolved in the holding tank and to retain that color for the aqueous medium during the addition of human waste to the holding tank until partial transfer to the storage tank. The color must be pleasing to the viewer of the toilet when the liquid is pumped from that tank to flush the toilet. It must mask the color of human waste that would be apparent but for the presence of the dye.

Masking dyes of acceptable color have been added to water in a tank receiving human waste and from which liquid has been pumped for toilet flushing. However, the dyes were not required to be compatible with disinfectants, at least a disinfectant required to have the properties that are stated above and that exist only by virtue of the system of our invention, that is the subject of our copending application mentioned above, and the modifications of the system that are the subject of the present patent application.

Regarding the compatibility requirement for the dye, it must be soluble in the disinfectant concentrate, that can contain as high as about 50 percent by weight of disinfectant compound. As stated above, alkali metal salts that are highly water soluble and that are disinfectants under the conditions of the use of the present system impart substantial alkalinity to the aqueous concentrate. This excludes various types of water-soluble dyes, such as aniline dyes, from the group of compatible dyes for use in the concentrate composition of the present invention. Suitable dyes include the class of dyes containing at least one sulfonic acid group as an alkali salt of that group. The term "alkali" includes "ammonium" and the alkali metals. An illustrative and preferred member of this class of compatible dyes is the ammonium salt of the product obtained by condensing o-formylbenzenesulfonic acid with alpha-(N-ethyl-anilino)-m-toluenesulfonic acid and then oxidizing the condensation product. The formula and the foregoing description of the preparation of the compound appear under colour index No. 42090 on page 3351, Volume 3, "Colour Index", Second Edition, published by The Society of Dyers and

Colourists, Yorkshire, England. The dye is available as F.D. and C. Blue Dye No. 1 from Warner-Jenkinson Mfg. Co., St. Louis, Missouri. On page S870 of the 1963 "Supplement of Colour Index", also published by the Society of Dyers and Colourists that manufacturer's dye of such designation refers to colour index No. 42090 for information.

Referring back to the preferred types of alkali metal salts as the disinfectant compound, the alkali metal salts of the unsubstituted and the substituted N-hydroxy-2-pyridinethiones that are described along with methods for their preparation in U.S. Pat. No. 2,686,786. The substituted compounds used here are as taught in that patent. The assignee of that patent, presently Olin Mathieson Chemical Corp., New York, New York, supplies an aqueous concentrate of 50 percent by weight of sodium 2-pyridinethione-N-oxide and balance water under the trademark OMACIDE-6. This salt is especially preferred, as seen later. A brochure (AD-1423-967) of Olin Mathieson Chemical Corp. states that OMACIDE-6 is a chelating agent and should not be used in the presence of other chelating agents; however, the latter is a precaution. Mixtures of this class of compounds can be used in the present invention. Other chelating agents that do not affect the alkalinity should be all right to use with that class of compounds.

The less preferred alkali metal salts are those of phenols. An illustrative salt is the tetrahydrate of the sodium salt of o-phenylphenol, sold by Dow Chemical Co., Midland, Michigan under the trademark "Dowicide A". This salt is less preferred because it precipitates in time, at least to some extent, during its use, in the manner described above for the method of the invention. This precipitation is probably due to the formation of insoluble calcium salt. The effectiveness as a disinfectant is greater obviously when the phenol compound is in the liquid than when present as a solid.

Another embodiment of the invention is the method of using the disinfectant composition in the waste management system. In the method broadly speaking it is not necessary to require the presence of compatible dye. It is apparent that broad embodiments of the apparatus that do not require and do not use liquid from the holding tank to flush the toilet can utilize water from another source, e.g., that used to provide water to the wash basin. In this method, the disinfectant composition is introduced into the holding tank along with fresh water during each partial and each complete servicing. It is also introduced into the material remaining in the holding tank at the completion of each cycle of transfer from the holding tank to the storage tank. This addition, of course, can use the colored composition.

Still another embodiment of the apparatus includes a low-level sensing means in the storage tank to shut off the evaporative heater whenever the latter has removed water from the tank's contents after transfer cycles to a predetermined minimum level of material in that tank. This avoids overheating and failure of an evaporative heater that is not built to function as part of an incinerative heater. Furthermore, this control of the evaporative heater avoids a high temperature for that tank during use in an airplane in flight when the temperature-sensing system for that tank becomes inoperative.

DESCRIPTION OF THE DRAWINGS

Preferred embodiments of the toilet and waste storage system of the present invention are illustrated in the drawings in which generally similar parts are identified by the same numerals and in which:

FIG. 1 is a fragmentary perspective view of the assembly of some of the components of the system with a toilet mounted on one of the shrouds for the assembly.

FIG. 2 is a fragmentary cross-sectional view that passes as a vertical plane through the outlet of the holding tank and the inlet for the storage tank but is forward (as viewed in FIG. 1) of that plane toward the ends of the assembly.

FIG. 3 is a fragmentary transverse cross section of the bottom wall of the holding tank taken along the line 3-3 of FIG. 2.

FIG. 4 is a fragmentary elevation of the assembly showing the holding tank, a wash basin with drain pipe, piping to feed water from the drain pipe to the holding tank, and the supply device and the metering device of the disinfectant composition introduction system also connected to that tank.

FIG. 5 is a fragmentary elevation, partially broken away, of the drain valve and pipe for the basin and the disinfectant supply system, including the self-unloading canister, mounted on a service control panel.

FIG. 6 is a fragmentary cross section of the supply system, the metering device and part of the means to operate the latter during the closing of the conduit between the holding tank and the storage tank.

FIG. 7 is an elevation, partially broken away, of one scoop of the present invention.

FIG. 8 is a fragmentary cross section of the scoop of FIG. 7 mounted with a toilet bowl on the holding tank.

FIG. 9 is a bottom plan of the scoop of FIG. 7.

FIG. 10 is a fragmentary elevation, partially broken away of the holding and storage tanks, the conduit between them, and the valve to close the latter in a manner to provide a dam for liquid in the holding tank.

FIG. 11 is a fragmentary cross section of the storage tank, its outlet for vapor, and a three-way valve controlling the direction of flow of that vapor.

FIGS. 12 and 13 are top plans, partially broken away, showing two positions of the spool of the valve for the two directions of vapor flow for dumping.

FIG. 14 is a cross section in a vertical plane of an alternative three-way valve associated with the storage tank outlet and the two piping systems for dumping of vapor or volatilized solids.

FIG. 15 is a fragmentary transverse cross section of the top wall of the holding tank and an elevation of another form of the scoop of the invention along with the means for resiliently and pivotally mounting it on that top wall.

FIG. 16 is a longitudinal cross section of part of the top wall of the holding tank and of the scoop and the mounting means shown in FIG. 15.

FIG. 17 is a top plan of a portion of the top wall of the holding tank and showing in dotted lines the resilient pivoted mounting means and the normal position of the scoop of FIG. 15 and showing in phantom lines a position of the scoop after it has been forced downwardly and moved from below the opening in that top wall to provide access for retrieval of articles.

FIG. 18 is an elevation of another embodiment of valve means to close a flexible conduit between the two tanks and shows a cross section of the flexible conduit, along with dotted lines showing the position of the closing bars of the valve means and the conduit thereby closed.

FIG. 19 is a fragmentary cross section of another embodiment of the apparatus of the present invention showing a storage tank with evaporative heater only, and showing a fragmentary cross section of an airplane fuselage along with valved inlet for flushing fluid, external valve operator, and a conduit for complete external servicing.

FIG. 20 presents electrical circuitry of a part of the automatic control system and shows circuits that provide electrical energy to the pump, that is used when fluid in the holding tank is pumped as flushing liquid, and to electrical energy to the two heaters for the storage tank.

FIG. 21 presents another part of the electrical circuitry of the automatic control for operation of the apparatus of the invention in which the various components of the various embodiments are present.

FIG. 22 is a top plan of a fragmentary portion of another embodiment of the waste management system of the invention.

FIG. 23 is a fragmentary cross section taken along the line 23-23 of FIG. 22.

FIG. 24 is an end view of the holding tank shown in FIGS. 22 and 23 taken along the line 24-24 of FIG. 23.

DETAILED DESCRIPTION

Referring to FIGS. 1 and 2, the system of the present invention is illustrated with a toilet 25 that is mounted on a top wall 26 of a temporary holding tank generally indicated at 27 (FIG. 2) within a cover or shroud 28 that has an extension 29 in which is located a flexible, resilient conduit 30. The apparatus has, also, a storage tank (FIG. 2) generally indicated at 31 within a shroud 32 (FIG. 1).

In this illustrative system tank 27 is above a portion of tank 31 and is supported by means (not shown). Of course, as described in our copending patent application, it is not necessary that tank 27 be mounted above tank 31. As a matter of fact, as mentioned in that application, several tanks 27 can be connected by conduits, such as conduit 30, to a common tank 31.

The apparatus of FIGS. 1 and 2 illustrates the use of liquid from tank 27 for flushing of toilet bowl 25. For this part of the system a pump 33 is mounted on roof or top wall 26 of tank 27. The pump 33 having motor 33M extends generally through an opening 34 in wall 26 so that an inlet pipe 35 for pump 33 has its bottom open end in a lower portion of tank 27. In this apparatus there is shown a self-cleaning filter 36 which permits fluid only to pass to inlet pipe 35 from this bottom portion of tank 27.

The filter 36 is not necessary in this apparatus because of the construction of floor or bottom wall 37 of tank 27. The bottom wall 37 has a number of intermediate, raised, transversely spaced portions 38 that partially separate the lower portion of tank 27 into a zone A and a zone B. Because the raised portions 38 of bottom wall 37 are spaced from one another there is a number of U-shaped longitudinal channels 39. The channels 39 are narrow in width so that the movement of solids through channels 39 from zone A to zone B is minimized. Thus zone B receives from zone A a material that is substantially, if not entirely, liquid material.

A scoop generally indicated at 40 is mounted on top wall 26 of tank 27 at an opening 41 so that the top open end of scoop 40 is below and in communication with the bottom outlet of toilet 25. The scoop 40 has its bottom portion extending laterally in tank 27 in a direction so that scoop 40 has its outlet 42 directed away from zone B and outlet 42 is above zone A of the lower portion of tank 27. This human waste received in tank 27 from toilet 25 via scoop 40 is deposited in zone A and movement to zone B of solids and semisolid material must pass, after settling in zone A to zone B only by passing through channels 39. In view of the dimensions of channel 39, such movement from zone A to zone B is greatly restricted.

The tank 27 has an end wall 43 with a circular opening 44 that has its lowermost portion in the horizontal plane of the upper surface of bottom wall 37. The flexible conduit 30 has one of its open ends secured and sealed to wall 43 by a ring 45 on wall 43. That open end of conduit 30 is in full communication with opening 44 of end wall 43.

The other end of conduit 30 is mounted by a ring 46 on a plate 47 securely mounted on tank 31. The ring 46 is concentric with and preferably having the same diameter as a circular opening 48 in plate 47. The tank 31 has a roof or top wall 49 with a circular opening 50 of the same diameter and concentric with opening 48. The tank 31 is surrounded by a heat-insulating material 51 in which are embedded a heater 52 and a heater 53. The heaters 52 and 53 are electrical heater coils and are adjacent bottom wall 54 of tank 31. In addition heater 53 extends substantially completely around all walls of tank 31. The heater 52 is used to provide for evaporation of volatile material, such as water, transferred into tank 31 from tank 27. The heater 53, alone or with heater 52, provides the heat required to incinerate material within tank 31. The connection of these heaters to a power source is not shown except by lines in the circuitry in FIG. 20 that will be described later.

The heat-insulating material 51 has an opening 55 concentric with openings 50 of tank 31 and opening 48 of plate 47.

Thus this other end of conduit 30 communicates with the interior of tank 31.

In view of the high temperature reached within tank 31 when heater 53 is operated, with or without heater 52 according to the design, the apparatus includes heat-shielding means 56 that is a plate movable by a hydraulic cylinder 57 having a piston rod 58 connected at this end to plate 56. The plate 56 is preferably a laminate of two sheets of stainless steel and a heat-insulating sheet between them. The plate 47 has an elongated slot 59 in which plate 56 is moved by piston rod 58 from a normal position to the position shown in FIG. 2. In the latter position plate 56 closes the bottom portion of opening 48 so that hot gases from tank 31 during incineration are prevented from entering conduit 31. This keeps conduit 30 relatively cool and thus prevents all heat transfer to the contents in tank 27. It would be undesirable to raise the temperature of the contents of tank 27 because this would provide an evaporation and perhaps boiling of material in tank 27. This would be undesirable because tank 27 is open to the air in the toilet room via toilet 25.

The plate 56 is shown in its protective position described above. Its normal position is at a location where it closes an opening 60 in plate 46 that is concentric with and in communication with an opening 61 in heat-insulating material 51 and an opening 62 in top wall 49 of tank 31. A blower 63 is mounted on plate 47 so that the outlet of blower 63 communicates with openings 60, 61 and 62 to provide for inlet of ambient air into tank 31 during an incineration operation.

The top wall 49 of tank 31 has an opening 64 with which communicates a pipe 65 that communicates at its other end with three-way valve 66 to which outlet pipe 67 and 68 are connected at the other openings of valve 66. The pipe 67 enters the top portion of a chamber of biological filter 69 which contains conventional material to provide sterility to the effluent gases from an evaporative operation of tank 31. These gases pass out filter 69 to a pipe 70 that extends to an opening in the fuselage wall of an airplane. Through that opening vapors are dumped to the atmosphere outside the plane. The pipe 68 likewise extends through the wall of the fuselage for dumping of the vapor when it is used for incineration rather than evaporation.

The valve 66 has its spool turned to the position for communicating pipe 65 with pipe 67 when the heating operation in tank 31 is the evaporative type. The valve 66 has its spool turned to communicate pipe 65 with pipe 68 when there is incineration in tank 31. This prevents passage of very hot gases from an incinerative operation through biological filter 69. Its filter material would be destroyed by the temperature of the very hot gases.

As seen in FIG. 1, top wall 49 of tank 31 and heat-insulating material 51 above it are provided with an opening that is closed by a cover plate 71 having a handle 72 that provides access to tank 31, whenever such is desired.

The conduit 30 is flexible, i.e., can be closed by providing opposing forces to an intermediate section of conduit 30 so as to push the opposite side walls towards each other. In FIG. 1 the valve for closing conduit 30 illustrates somewhat sketchily one construction of a valve that is shown in more detail in FIG. 10. A valve means generally indicated at 74 in FIG. 2 illustrates a different construction. In both cases the closing of a zone of conduit 30 is effected. This zone is an intermediate portion of conduit 30. The lowermost part of that part of conduit 30 is raised while the opposing part of that portion of conduit 30 is lowered until these opposing parts are touching each other. As a matter of fact the opposing wall sections constituting the full periphery of conduit 30 are then in abutting relationship. This prevents flow through conduit 30. At the same time the lower half of the portion of conduit 30 adjacent to this raised portion and toward tank 27 is also raised to provide a dam effect external of tank 27 and upstream of the closed zone area.

Referring to FIG. 1, valve means generally indicated at 73 includes a motor 75 disposed so that its longitudinal axis is

horizontal. The motor 75 rotates linkage generally indicated at 76. The nature of linkage 76 and how it operates transverse rods to close conduit 30 and then move these rods away so that conduit 30 opens are described later.

Referring to valve means 74 in FIG. 2, it includes a reversible motor 77 that has a shaft 78 on which is mounted a worm 79 that meshes with a gear 80 fixedly mounted on a shaft 81. The shaft 81 is rotatably mounted on a pair of fixed supports (not shown). A pair of arms 82 are fixedly mounted on shaft 81. The arms 82, at their distal end, rotatably support a cylindrical rod 83.

As described later for FIG. 10, there are a chain and two sprockets (one fixedly mounted on shaft 81), a pair of gears, and another chain and two sprockets including a sprocket (not shown) that is fixedly mounted on a shaft 84 rotatably mounted by support means (not shown).

The motor 77 by gears 79 and 80 through the construction described above move rods 83 in an arcuate manner from a position shown in phantom lines to the right of shaft 81 to a closer position for rod 83. The shaft 84 is directly below open conduit 30 and shaft 81. A pair of arms 85 are fixedly mounted on shaft 84 to be moved from a horizontal position, during the lowering of arms 82, to a position vertically disposed above arms 85. The arms 85 rotatably support at their distal ends a cylindrical rod 86 so that rods 83 and 86 are moved towards each other during the forward operation of motor 77. This movement of rods 83 and 86 results in the closing of an intermediate portion of conduit 30 as seen in full lines in FIG. 2. The dotted lines indicate the normal outline of open conduit 30. The reversing operation of motor 77 results in the movement of rods 83 and 86 away from conduit 30. Because conduit 30 is resilient, as well as flexible, it returns to its original shape.

Referring to FIG. 2, the tank 27 is provided with a high-level, liquid-sensing means 90 and a low-level, liquid-sensing means 91 that extend into tank 27. As seen later, these sensing means initiate the closing and opening, respectively, of conduit 30. The level of waste material and water, as a mixture, in tank 27 is shown by the wavy line that is above the minimum level at which sensing means 91 is operative via two wires and below the level at which sensing means 90 becomes operative via two other wires. These four wires are in circuits shown in FIG. 21 that will be described later.

The tank 27 has a spray ring 92 that is mounted just below top wall 26 and extends around the perimeter of tank 27. The spray ring 92 is furnished rinsing water in the servicing of tank 27, as described later. This water is furnished from a wash basin (not shown in FIG. 2) by a pipe 98 that is connected to vent pipe 99. The pipe 99 extends through an opening in top wall 26 of tank 27 and is connected to spray ring 92. The pump has an outlet pipe 100 that is connected to a spray ring 101 mounted in toilet 25 at its upper portion.

The apparatus of FIG. 2 also has a supply system generally indicated at 105 that is shown in more detail in FIG. 6. It is a metering system to furnish disinfectant concentrate composition to tank 27.

The channels 39 in the raised portion 38 of bottom wall 37 of tank 27 are seen in FIG. 3.

Referring to FIG. 4, it is seen that tank 27 is connected to a metering system generally indicated at 105 by a pipe 106. The metering system 105 is connected by pipe 107 to a supply system generally indicated at 108.

The pipe 98 that is connected to tank 27 via vent pipe 99 is connected to a wash bowl 109 that has an outlet valve 110 connected to its drain opening. The valve 110 is operated by a lever 111 and a linkage 112 joined to a handle 113 above bowl 109 in a conventional manner of construction. This permits the usual partial filling of wash bowl or basin 109 for washing of the hands and permits the furnishing of a predetermined amount of water to tank 27. In the latter case, water is added to wash basin 109 up to a volume indicia 114 on the inside surface of bowl 109. The valve 110 communicates with a drain pipe 115 that is connected to a three-way valve 116 that

usually communicates pipe 115 with a drain pipe 117. The valve 116 can communicate pipe 115 with pipe 98 to provide water to tank 27 as described later. The drainpipe 117 usually dumps the water to the atmosphere through an opening in the fuselage of the plane.

Referring to FIG. 5, which shows the construction of the supply system 108 for the disinfectant concentrate composition of the present invention, the supply system 108 includes a canister 120. A housing of canister 120 is provided by a top tubular member 121 and a bottom tubular member 122 that are secured end to end at their opposed outwardly extending flanges 123 and 124, respectively, by bolts 125. At these opposing ends members 121 and 122 are open but are closed at their other ends by walls 126 and 127, respectively, that provide the top and bottom walls, respectively, of canister 120. The tubular member 121 has an internally-threaded cylindrical flange 128 above wall 126 for threaded mounting canister 120 on a support member 129 that has an externally-threaded, downwardly-extending, cylindrical flange 130 to which flange 128 is engaged. The canister 120 has a central opening 131 in bottom wall 127. A hollow central extension 132 of a piston 133 extends downwardly through opening 131. Except for the lower portion of extension 132, piston 133 is within canister 120.

The piston 133 is urged upwardly by a spring 134 that has its top end in an annular recess 135 in the bottom surface of piston 133. The spring 134 has its bottom end in an annular recess in a plate 136 secured on wall 127 within canister 120. The piston 133 has a downwardly-extending skirt 137 that is spaced from the sidewall of canister 120. Thus skirt 137 does not provide for a vertical guiding of piston 133. The plate 136 has a central hollow extension 138 between spring 134 and extension 132 of piston 133. The hollow extension 138 serves as a guide for piston 133.

The canister 120 has a flexible tubular sealing member 140 that is impervious to the liquid in canister 120. The upper end of member 140 is outwardly turned and secured between flanges 123 and 124. The other end of member 140 is secured on the top surface of piston 133 by a plate 141 fixed on piston 130 by means (not shown). Of course, it can be adhered to this end by member 140 and the latter adhered to piston 133. From its end between flanges 123 and 124 tubular member 140 extends downwardly beside wall 122 and then changes direction to extend upwardly beside the top part of skirt 137 to the end mounted on piston 133. As piston 133 is moved upwardly by spring 134, the place in sealing member 140 at which there is this turn in its direction changes during all of the upward movement of piston 130. At all times member 140 prevents loss of liquid from the inside of canister 120.

The canister 120 has a central opening 139 in its top wall 126 which has a top central boss 142 providing a continuation of opening 139 but the upper portion is of smaller diameter to provide a downwardly facing shoulder 143. A silicone rubber seal 144 is mounted in opening 139 including the portion of smaller diameter. The shoulder 143 serves as a stop for seal 144. Thus, canister 120 has its chamber closed at the top by seal 144 until canister 120 is raised with rotation about its longitudinal axis for mounting on support member 29. As canister 120 is being moved upwardly, a hollow needle 145 centrally located in support 129 and extending vertically through a downwardly directed central boss 146 has its lower extremity substantially below boss 146. The hollow needle 145 completely penetrates seal 144 and extends with its bottom open end in the chamber of canister 120 at the time canister 120 is fully mounted on support 129. At this point central bosses 142 and 146 are separated only by a silicone rubber seal ring 147 that prevents loss of fluid from canister 120. Liquid may pass between needle 145 and wall 126 but can not pass between bosses 142 and 146 to the outside because of ring 147.

When the bottom open end of needle 145 communicates with the chamber of canister 120, fluid in the chamber is forced upwardly through needle 145 and out its top end where

it communicates with a fitting 148 and thereby with pipe 107. Liquid is forced from canister 120, through pipe 107 to metering system 105 due to the movement, now permitted, of piston 133 in an upward direction by spring 134.

From the foregoing description of FIG. 5 it is seen that the supply system of the invention includes a replaceable canister having a chamber in which liquid is placed, means within the canister to apply a pressure to the liquid in a particular direction and a sealable, penetrable member mounted in a wall of the canister in the direction of force against the liquid. The overall supply system further includes a support means for the canister, and hollow means mounted on the latter to penetrate the sealable member on the canister during the relative movement between the support means and the canister to provide an outlet from the chamber of the canister.

Referring to FIG. 6, a support means 150 of the apparatus has an opening 151. The metering system 105 includes a cylindrical housing 152 open at the bottom end above opening 151. The housing 152 has its lowermost sidewall portion downwardly flared and at its distal end there is provided outwardly-directed radial flange 153 that is mounted on support 150 to secure housing 152 in a fixed vertical disposition. With its longitudinal axis concentric with the center of opening 151, a piston 154 is mounted in housing 152. The piston 154 is supported by a spring 155 extending into a hollow recess at the bottom of piston 154. The bottom end of spring 155 is mounted in a recess 156 in the top of a piston 157 that has a spaced pair of downwardly-extending flat flanges 158 that are in the bottom flared part of housing 155. The flanges 158 are on opposite sides of the longitudinal axis of housing 152 and adjacent their distal ends they rotatably support a pin 159.

The outwardly-flared portion of housing 152 includes a radially-inward flange 160 that extends inwardly only a short distance and from flange 160 extends downwardly a tubular extension 161 having a pair of vertical slots through which extends the end portions of pin 159. A spring 162 is mounted around extension 161 so that the top end abuts the flange 160 and the bottom end abuts pin 159. Thus, pin 159 is urged downwardly by spring 162.

The pin 159 supports a cam follower 163 which abuts a cam 164 fixed by set screw 165 on shaft 166. The cam 164 has the same radius throughout most of the periphery. Only a small portion 167 has an increasing radius followed by a decreasing radius to the normal radius. Thus the rotation of shaft 166 through one cycle provides for a momentary raising of piston 154 from its normal elevation shown in full lines to its maximum elevation shown by a phantom line for its top surface. This occurs when surface 167 abuts cam follower 163 that raises piston 157 to compress spring 155 following which there is the complete raising of piston 154 for a short period of time. As contact between surface portion 167 and follower 163 is at decreasing distance of the contacted part of surface 167 from the axis of shaft 166, piston 154 is moved downwardly by the weight of piston 157 and its follower 163, through the action of spring 155, and as a result of its own weight. The piston 154 has a ring seal 170 to prevent passage of liquid downwardly between piston 154 and housing 152.

The chamber is provided by the top end 171 of housing 152, the sidewall of housing 152 and piston 154. The liquid is received and then partially forced out of the chamber by the upward movement of piston 154.

The upper part of the sidewall of housing 152 has a pair of threaded openings 172. In one opening 172 there is mounted a check-valve fitting 173 to which is connected pipe 107 for introducing liquid from canister 120 into the chamber of housing 152. A check-valve fitting 174 is mounted on cylinder 152 at the other opening 172 to provide also for unidirectional flow but from the chamber of housing 152 to pipe 106 that is connected to fitting 174. Illustratively the check valve of fitting 173 has a crack pressure of from 1 to 2 p.s.i. absolute, whereas the crack pressure of the check valve of fitting 174 is from 20 to 30 p.s.i. absolute.

Initially, air is in pipes 107 and 106. When needle 145 pierces seal 144 of canister 120, fluid is forced from canister 120, by the force of spring 134 that raises piston 133, into pipe 107 and then into the chamber of housing 152. This pressure provided by spring 134 is insufficient to open check-valve fitting 174. However, when piston 154 is raised by the rotation of cam 167 as described above, sufficient pressure is imparted to liquid in the chamber of housing 152 to open check-valve fitting 174. The liquid is forced into pipe 106. The other end of pipe 106 communicates with tank 27 as described earlier. Thus liquid is transferred to tank 27. Because of the lost motion construction of metering system 105, only a small amount of liquid is rapidly transferred into tank 27. The dimensions of pipes 107 and 106 and of metering system 105 are such that the quantity of disinfectant concentrate composition introduced for one cycle of rotation of shaft 166 is, for example, about 0.5 cubic centimeter.

After the small quantity of liquid has been forced through fitting 174 and pipe 106 into tank 27, replenishment liquid is received in the chamber of housing 162 because the lowering of piston 154 releases pressure that was imposed on the liquid. This results in the opening of check-valve fitting 173 due to the higher pressure being maintained in canister 120 by spring 134. As a result, liquid flows from canister 120 into the chamber in the top part of housing 152.

In view of the foregoing description of the metering system, it is apparent that the system 105 includes a chamber having a piston and having an inlet with check means providing unidirectional flow from a supply source into the chamber, along with unidirectional flow from the chamber via an outlet. The metering system further includes broadly means to raise and lower the piston within the chamber in a cycle of operation, particularly in the present utilization in a cycle that includes a closing first of a conduit from the tank to which the outlet of the metering system provides transfer of liquid from the system.

Referring to FIGS. 7, 8 and 9, spout 40 has in this embodiment a lower portion that is in two halves 180 and 181 that are pivotally mounted about a horizontally-spaced pair of longitudinal axes by hinges 182 and 183, respectively. Each of hinges 182 and 183 has a spring 184 (FIG. 8) that urges half-portions 180 and 181 into abutment with each other. The two halves can be locked in position by a latch 185 (FIGS. 7 & 8), but ordinarily this is unnecessary. In view of springs 184, it is apparent that the movement away from each other of portions 180 and 181 must be a forced movement, that must be continued throughout the time that it is desired to have these portions moved out of the way. This opening of spout 40 is utilized to retrieve material very conveniently from areas of tank 27 as described earlier. Also described earlier is the manner of mounting of spout 40 of tank 27. One advantage of this construction is the access thus provided for a relatively shallow tank. Because tank 27 is a tank for temporarily holding of waste, it is relatively shallow to minimize weight, etc.

As seen in FIG. 8, the toilet 25 has its bottom opening above and concentric with opening 41 of top wall 26 of tank 27. The lowermost portion of toilet 25 is an upwardly-extending flange 188 that rests on an outwardly-extending radial flange 189 of the top portion of scoop 140. The flanges 188 and 189 are held in sealing abutment with each other by a mounting ring 190 that is secured to top wall 26 by bolts 191 in threaded openings 192 in wall 26. By this manner of construction, scoop 40 can be supported by tank 27 so that outlet 41 faces in the direction shown in FIG. 8 but toilet bowl 25 can be rotated 180° about a vertical axis so that the hinge mountings for a toilet and for a toilet cover are properly placed. This requirement occurs because sets of toilets are installed left and right.

Referring to FIG. 10, conduit 30 in this illustration has a horizontal portion generally indicated at 201 adjacent to tank 27 and downwardly directed curved portion 202, adjacent to tank 31 that provide a continuous passageway from material from tank 27 to tank 31. The conduit portion 202 includes a

plastic lining 203 in an arcuate passageway 204 of a block 205. The lining 203 has a thickened flange 206 at its upstream end. The flange 206 is abutted by an outwardly turned end part 207 of conduit portion 201. The end part 207 of conduit portion 201 and flange 206 of lining 203 are retained in position against block 205 by a ring 208 mounted on block 205 by bolts (not shown).

The upstream conduit portion 201 is a tubular conduit that is flexible and resilient. It is made of a material, such as rubber, to provide these properties. The wall of conduit portion 201, adjacent its downstream end and upstream end, diverges and converges to provide annular ribs 209 and 210, respectively. The upstream end of conduit portion 201 is outwardly turned to provide a flange 211 which is held in abutment against wall 43 of tank 27 by a ring 212. Thus, the construction stated above provides conduit portion 201 with rigidly fixed ends and annular ribs adjacent these ends so that the two ends are retained in position while the intermediate part 214 of conduit portion 201 can be inwardly moved towards its longitudinal axis until conduit portion 201 is closed at a horizontal plane containing that longitudinal axis. The intermediate part 214 has longitudinal ribs 215 that oppose each other and are at the horizontal plane mentioned above and cooperate to provide the desirable closing of conduit portion 201 when opposing forces are applied at the top and bottom of intermediate part 214.

The ribs 215, as in the case of ribs 209 and 210, are not provided by thicker walls at those locations. Thus, the configuration of these ribs assist in the appropriate change in direction of the opposed walls of conduit portion 201 when these opposed forces are applied to close conduit portion 201.

The opposing forces are supplied by a transverse, horizontal roll 220 above conduit portion 201 at the intermediate part 214 and a similar roll 221 below intermediate part 214.

The roll 120 is rotatably mounted at its ends on a pair of arms 222 that are fixed on a shaft 223 that is rigidly mounted on a fixed support means (not shown). The shaft 223 is moved about its longitudinal axis by an arm 225 fixedly mounted on shaft 223 and pivotally connected to an end of an arm 226. The other end of arm 226 is rotatably mounted on a pin 227 eccentrically mounted on a plate 228 fixedly mounted on a shaft 229 of a motor 230. With this construction, rotation of plate 228 through 180° moves pin 227 so that roll 220 and arms 222 are brought down to the position shown in phantom lines. During this movement of roll 220, it has pressed downwardly along intermediate part 214 to bring the central zone of intermediate part 214 to the horizontal axis as shown in phantom lines. At the same time roll 221 is raised to the position shown in phantom lines so that the central zone of intermediate part 214 has its inner surface abutting the opposing surface of the top half to serve as a valve that closes conduit 30. The raised lowermost portion of intermediate part 214 provides a liquid dam upstream to tank 27.

The raising of roll 221 is accomplished in synchronism with the lowering of roll 220 during the half cycle rotation of plate 228 mentioned above. A pair of arms 230 rotatably support roll 221 at one of their ends. The arms 230 are fixedly mounted on a shaft 231 that is rotatably mounted on a fixed support means (not shown). The shaft 231 is rotated by an arm 232 secured at one end on shaft 231 and pivotally connected at its other end to an arm 233 rotatably mounted at its other end on a pin 234 that is eccentrically mounted on a plate 235 fixedly mounted on a shaft 236. A sprocket 237 fixedly mounted on shaft 229 drives a chain 238 that engages and drives a sprocket 239 fixed on a shaft 240 rotatably mounted on a fixed support means (not shown). The shaft 240 has a gear 241 fixedly mounted on it. The gear 241 meshes with a gear 242 that is fixedly mounted on a shaft 243 mounted on a fixed support means (not shown). A sprocket 244 fixedly mounted on a shaft 243 drives a chain 245 that engages and drives a sprocket 246 mounted on shaft 236 for its rotation.

Referring to FIGS. 11, 12 and 13, a three-way valve 66 provides alternatively for flow of gases from tank 31 to pipe 68

when there is incineration and to pipe 67 when there is merely evaporation. The valve 66 has a housing 250 that encloses a spool 251. Housing 250 is mounted on top wall 49 of tank 31. The spool 251 is hollow, closed at its top end and open at its bottom end to provide a chamber that communicates with opening 64. The spool 251 has a top boss extension 252 that extends upward through and above an opening in housing 250. A handle 253 extends radially from boss 252 above housing 250 for manual rotation of spool 251 about its vertical longitudinal axis. The spool has a circular opening 254 in its sidewall. The housing 250 has circular openings in its sidewall at the same elevation as opening 254. Each opening in the sidewall of housing 250 receives one end of pipe 67 or pipe 68. As a result, the movement of rotation of spool 251 through 90° can alternatively provide connection of pipe 65 with either pipe 67 or pipe 68. FIG. 12 shows opening in spool 251 communicating with pipe 68. FIG. 13 shows spool 251 in its other position by which opening 254 communicates with pipe 67.

Referring to FIG. 14, an alternative three-way valve, generally indicated at 260, is shown for selectively connecting pipe 65 with pipe 67 or pipe 68. The valve 160 has a block 261 with a cylindrical recess in a sidewall. A hollow cylindrical spool 262 is in the recess. Within spool 262 there are mounted two curved pipes 263 and 264 that have their ends connected to spool 262 at openings that are radii at right angles to each other. Each end of both pipes is coaxial with one end of the other pipe. Pipes 67 and 68 extend horizontally into block 261 where they are coaxial with each other. Pipe 65 extends vertically upward into block 261. With this construction, pipe 64 can communicate pipe 65 with pipe 67 but rotation of spool 262 for 90° about its horizontal longitudinal axis communicates pipe 65 with pipe 68.

A chamber completely encloses pipe 264 within spool 262. The chamber is defined by curved plates 270 and 271, the base of the recess in block 261 and a cover (not shown). The pipe 263 is thermally shielded from hot pipe 264 by this construction. The pipe has an electrical heater coil 272 helically wound around it to maintain pipe 264 at a high temperature to insure the continuous flow of gas without deposition of incinerative material from tank 31 during the use of that tank for such operation. Because of the high temperature of pipe 264, it is necessary to thermally shield pipe 263 and the foregoing construction enclosing plates 270 and 271 provides this shield. In the absence of thermal shielding, pipe 263 would become too hot and would raise the temperature of gas passing from pipe 65 to pipe 68 to a high temperature that would destroy the biological filter, as described earlier.

Referring to FIGS. 15, 16 and 17, there is shown an alternative construction of a scoop that receives the waste material from a toilet and transfers it into tank 27 on which the scoop 40 is mounted.

As best seen in FIG. 16, scoop 40 is a one-piece construction that has a top circular inlet 280 and an outlet 281 that is facing horizontally in tank 27. The scoop 40 extends downwardly and then laterally. The shape of outlet 281, as seen in FIG. 15, is generally rectangular with rounded corners and the major axis is horizontal. The uppermost part of the wall of scoop 40 that constitutes the lateral extension has mounted on it a hollow cylindrical boss 283 with its uppermost portion having a smaller inner and outer diameters. The small inner diameter provides a shoulder 284 that serves as a stop for one end of a spring 185 mounted on a bolt 286 having its head 287 within boss 283. The bolt 286 extends through the top of boss 283 and wall 26. A nut 288 is on bolt 286 to securely mount bolt 286 on top wall 26 of tank 27. The head 287 of bolt 286 is a bottom stop for spring 185. This construction permits relative movement between bolt 286 and scoop 40. This occurs when it is desired to move scoop 40 downward as described later. In that case, spring 285 is compressed between shoulder 283 and head 287.

Normally spring 285 urges scoop 40 upwardly. When scoop 40 is in operative position, the top periphery of scoop 40 at upper inlet 280 engages an annular shoulder 289 present in

the outer surface a downwardly extending annular flange 290 of top wall 26 at the location of inlet 280. The shoulder 289 is present in flange 290 because flange 290 has a portion adjacent its end portion converging in a downward direction, i.e., the end portion is offset inwardly. A bottom periphery portion of toilet 25 would be mounted on tank 26 so that it would be within flange 290 and abut the internal surface of flange 290 at the offset in the wall of the flange.

In the event that it is desired to move scoop 40 from its operative position, it is only necessary to push down on the bottom wall of scoop 40 until the inlet peripheral portion of the wall is moved below the bottom extremity of flange 290 of top wall 26. While maintaining this lower position, scoop 40 can then be moved in an arcuate manner about the vertical axis of bolt 286 to any of a number of positions, including that shown by phantom lines in FIG. 17 in which scoop 40 is completely away from the opening in top wall 26. This permits easy manual access of all parts of tank 27. To return scoop 40, it is merely necessary to provide again the downward force and to move scoop 40 about the pivotal axis of bolt 286 until inlet 280 is in alignment with flange 290. Release of the downward force results in the upward movement of scoop 40 by the force of spring 285 to put the scoop 40 in the position shown in FIG. 16.

Referring to FIG. 18, there is shown another embodiment of the means to close the conduit means and at this same time provide a dam effect for liquid adjacent to and in tank 27. In this case, the apparatus for closing a horizontal portion of conduit 30 adjacent tank 27 applies a closing force against an intermediate part of a portion 201 of conduit 30 adjacent to tank 27 in a manner similar to that shown in FIG. 10. In the apparatus of FIG. 18, the closing force is provided by an upper rod 292 and a lower rod 293 that are moved downwardly and upwardly, respectively, in a transverse vertical plane with respect to portion 201 so as to lower and raise the top half and bottom half of the flexible, resilient conduit 30 at intermediate portion 201. The movement is at the transverse plane of abutment by rods 292 and 293 against intermediate portion 201 of conduit 30. The apparatus differs from the apparatus shown in FIG. 10 in which rolls 220 and 221 must move through arcuate paths about axes transverse to the longitudinal axis of portion 201 during their downward and upward movement for closing conduit 30.

The rods 292 and 293 have threaded vertical holes at their ends through which pass a pair of threaded rods 294 that have opposite directions for their threads. The rods 294 thus support horizontal rods 292 and 293. The threaded rods 294 are rotatably supported at the bottom ends by a bar 295 that is part of a fixed support means (otherwise not shown). One of the threaded rods 294 is rotated by a gear 296 fixed on one of threaded shafts 294 and meshing with a gear 297 fixed on a shaft 298 that is rotated by a reversible motor 299. The shaft 298 extends through motor 299 and its other end is fixedly mounted on a gear 300 that meshes with a gear 301 fixedly mounted on the other rod 294. By this construction, both ends of each of rods 292 and 293 are moved at the same speed by motor 299. The rods 292 and 293 move toward each other to close conduit 30. The reversal of motor 299 results in movement of rods 292 and 293 away from each other whereby a flexible intermediate portion 201 that is resilient returns to its original open configuration for the purpose of transferring flexible material from tank 27 to tank 31.

In FIG. 19, there is an illustration of the two-tank system of the present invention such as disclosed in our earlier copending patent application along with modifications that utilize some of the embodiments of the present invention.

In this embodiment tank 27 has pump 33 with filter 36 in zone B while the sidewall outlet is in zone A. These zones are separated by raised portions 38 in bottom wall 37 of tank 27. The side outlet in zone A, i.e. opening 44 in end wall 43, communicates with conduit 30 which is illustrated in its closed position obtained by rolls 220 and 221, which are shown without equipment to support or to move them.

The tank 27 is shown with high-level, liquid-sensing means 90 and low-level, liquid-sensing means 91 mounted in zone B. Also shown is spray ring 92 that is connected, in this embodiment, with a pipe 310 that is connected to a pipe 311 by a check valve 312 and is connected to a pipe 313, a check valve 314 and a pipe 315 to a water source (not shown). In the use of the system in an airplane, pipe 311 can be connected to drain pipe of a wash basin, such as described earlier in connection with FIG. 4.

The conduit 30 provides flow of waste material from tank 27 to tank 31 having heater 52 that provides sufficient thermal energy for an evaporative operation as described earlier in connection with FIGS. 1 and 2. The tank 31 has a vent pipe 316 that permits dumping of water vapor from tank 31 to the air outside of the plane.

For the purpose of complete servicing of the apparatus of this embodiment of the invention, tank 31 has a spray ring 317 that is connected to pipe 311 so that rinse water is added to tank 31 simultaneously with the addition of rinse water to tank 27 by connector 320 and pipe 311. The connector 320 is joined to a pipe (not shown) extending from a truck or pipe line containing rinse liquid. The truck is furnished also with a tank or there is another pipe line for receiving waste and rinse material from tanks 31 and 27 by a conduit 321 and a connector 322 which is shown in FIG. 19 as closed by a hinged cap 323.

The conduit 321 has its top open end connected to tank 27 at an opening 324 in which is normally disposed a bulbous valve 325 that is mounted on the bottom end of a shaft 326. A sleeve 327 is supported by and extends through top wall 49 of tank 31. The shaft 326 extends upwardly in sleeve 327. A cable 328 is connected to the top of shaft 326 and extends around pulleys 329, 330 and 331. The cable 328 passes through sleeve 332 mounted on a wall 333 of a fuselage of an airplane. A handle 334 is connected to this end of cable 334. By pulling handle 334 away from wall 333 of the fuselage, valve 325 is raised to permit flow of fluid from tank 27 into conduit 321 and then out through the wall 333 of the fuselage to a connector 322. The connector 320 also extends through wall 333. Tanks 27 and 31 are furnished with flushing liquid via connector 320 and pipe 311 that passes out through spray rings 92 and 317.

Of course, check valves 312 and 313 prevent flow of rinse liquid furnished by pipes 311 and 315, respectively, in a direction other than into tank 27.

Before a receiving pipe is joined to connector 322, a pipe is joined to connector 320 to furnish rinse liquid via pipe 311 for a complete servicing operation that is initiated as described later.

To provide a control in the degree of evaporation of water from tank 31 so that the contents of that tank do not become dry and thus damage the electrical heater 52, a minimum liquid level is maintained in tank 31 in this preferred embodiment. For this purpose, tank 31 has a minimum-level, liquid-sensing means 340 mounted at a predetermined elevation in tank 31.

Referring to FIG. 20, electrical power is furnished to motor 230 that operates one of the two valve closing mechanisms that have been described above and that are shown in FIGS. 10 and 18, respectively. The motor 230 is furnished electrical power by lines L1, L2, L3 and L4 that are connected illustratively to an alternating current of three-phase input. Line L4 is the neutral line. Lines L1, L2, and L3 are connected by normally open contacts 1-1CR, 2-1CR, and 3-1CR to lines L5, L6, and L7, respectively, that are connected along with line L4 to motor 230.

The heater 52 is represented in FIG. 20 by heater coils 1HC, 2HC, 3HC, that are connected to line L4 by a line L8 and that are connected respectively to lines L1, L2, and L3 by line L9, L10, L11 through lines L12, L13 and L14, respectively. The lines L9, L10 and L11 are connected to the three heater coils through normally open contacts 1-2CR, 2-2CR, and 3-2CR, respectively.

The heater 53 has heater coils 4HC, 5HC, 6HC that are connected by line L8 to line L4 and that are connected by subcircuits that are joined to lines L12, L13 and L14, respectively. The subcircuit containing coil 4HC includes a normally open contact 1-4CR and normally closed contact 4-2CR. The subcircuit containing coil 5HC includes a normally open contact 2-4CR and a normally closed contact 5-2CR. Similarly, the third subcircuit containing coil 6HC includes a normally open contact 3-4CR and a normally closed contact 6-2CR.

The motor 33M of pump 33 is operated by being connected to a power source, as illustrated in FIG. 20 by the connection of motor 33M to lines L1, L2, L3 and L4. The motor 33M is connected by line L15 to line L4 via line L8. The motor 33M is connected to lines L12, L13 and L14 (connected to lines L1, L2 and L3) by lines L16, L17 and L18 that are connected to three contacts of a disconnect switch DSW that are connected by lines L19, L20 and L21 to lines L12, L13 and L14. The motor 33M is also connected to lines L12, L13 and L14 by parallel circuits that are connected to lines L16, L17 and L18 through normally open contacts 4-1CR, 5-1CR and 6-1CR.

Normally motor 33M is operated by closing switch DSW to flush the toilet. When the waste management system utilizes the components shown in the embodiment of FIGS. 22 through 24, motor 33M is also operated when conduit 30 is open. The operation of motor 33M results in water being pumped back into tank 27 as described later in connection with that embodiment of FIGS. 22-24. The contacts in the parallel circuits mentioned above provide for such operation whenever coil 1CR is energized, i.e., whenever conduit 30 is opened.

Referring to FIG. 21, the circuitry is provided with direct current by lines L25 and L26 that are connected to a direct voltage source (not shown). The plus and minus signs for lines L25 and L26 indicate a direct current potential. To the left of line L25 in FIG. 21 is a column of numerals, with or without a letter of the alphabet, directly opposite circuits or subcircuits. A numeral represents a circuit. A subcircuit is a number and a letter. A subcircuit is in parallel with a part of a circuit having the same numeral. Of course it is really a circuit having in series the components of the so-called subcircuit and one or more, but not all, of the components of the so-called circuit. To the right of line L26 is a column of numerals, with and without letters, that indicate the circuit or subcircuit in which there is a contact of a relay affected by the coil of the relay in the circuit or subcircuit to the left of such numeral. The numeral and letter, if present, is underlined to indicate the location of a normally closed contact.

The numeral "20" in that right column indicates that contacts, associated with the coil, can be found in FIG. 20.

The circuit 1 includes a coil 1CR of a relay having contacts 1-1CR, 2-1CR, etc. The circuit 1 includes in series with coil 1CR a normally open, time-closing contact 1-1TR (of a timer relay 1TR that is referred to later in connection with circuit 4) and a normally open, held-closed limit switch 2LS-A of a switch 2LS that is operated as described later.

A subcircuit 1A has solenoid coil 1SOL in parallel with coil 1CR of circuit 1 and thus has contact 1-1TR and switch 2LS-A in series with coil 1SOL between lines L25 and L26. Coil 1SOL is energized whenever coil 1CR is energized.

A subcircuit 1B that is connected to line L25 and to circuit 1 between switch 2LS-A and switch 2LS-A, has a normally open push-button switch 1PB-A of switch 1PB that is shown in FIG. 5.

A subcircuit 1C is connected to line L25 and to circuit 1 between switch 2LS-A and coil 1CR. The subcircuit 1C includes a normally closed limit switch 3LS-A and a normally closed, held open limit switch 2LS-B that is operated in unison with switch 2LS-A, mentioned above as being in circuit 1.

A subcircuit 1D is connected to line L25 and to circuit 1 between switch 2LS-A and coil 1CR as in the case of subcircuit 1C. The subcircuit 1D includes a low-level, liquid-sensing, normally closed switch 1LLS and a push-button switch 1PB-B,

that is normally closed but is open when switch 1PB-A in subcircuit 1B is manually closed. The subcircuit 1D further includes a normally open limit switch 3LS-B, that is closed when switch 3LS-A is opened, and a normally closed limit switch 1LS-A.

A subcircuit 1E is connected to line L25 and to circuit 1 between contact 1-1TR and switch 2LS-A as in the case of subcircuit 1B. The subcircuit 1E has a normally open limit switch 1LS-B that is closed when switch 1LS-A in subcircuit 1D is opened.

A circuit 2 includes in series a normally closed temperature-actuated switch 1TAS, a normally open vacuum switch 1VS, a normally closed contact 1-3CR-A (of a latch-in relay 1LR having coils 3CR-A and 3CR-B mentioned below), a normally open, minimum-level, liquid-sensing switch 3LLS, and a coil 2CR of relay having contacts 1-2CR, 2-2CR, etc.

A circuit 3 includes in series a temperature-actuated, normally open switch 2TAS and a coil 3CR-A of latch-in relay 1LR.

A subcircuit 3A is connected to circuit 3 between line L25 and switch 2TAS. The subcircuit 3A has in series a push-button contact 2PB and a coil 3CR-B of latch-in relay 1LR. A subcircuit 3B likewise is connected between line L25 and switch 2TAS of circuit 3 and includes a normally open contact 2-3CR-A and a red light. Of course, subcircuits 3A and 3B could be connected directly to line L25 rather than into circuit 3, but for convenience of reading from FIG. 21 the significance of these circuits, they have been shown as subcircuits.

A circuit 4 includes in series between lines L25 and L26 a normally open, liquid-level sensing switch 2LLS and a coil 1TR of time-delay relay having contact 1-1TR.

A circuit 5 includes in series a normally closed vacuum switch 2VS, a normally open contact 1-6CR (of a relay having a coil 6CR in subcircuit 7A mentioned later), a normally closed flow switch 1FS, a normally closed, temperature-actuated switch 3TAS and a coil 4CR (of a relay having normally open contacts 1-4CR, 2-4CR, and 3-4CR shown in FIG. 20).

A circuit 6 includes in series a normally open limit switch 4LS and a coil 5CR of a relay, having normally open contacts 1-5CR and 2-5CR.

A subcircuit 6A includes, in parallel with limit switch 4LS, a normally closed contact 7-1CR and a normally open, time-opening contact 1-5CR. The subcircuit 6A is a holding subcircuit for coil 5CR with which it is in series.

A circuit 7 includes a normally closed contact 8-1CR and a normally open, time-closing contact 2-5CR in series with a solenoid 2SOL.

A subcircuit 7A has a coil 6CR in parallel with solenoid 2SOL and thus is connected between the latter and contact 2-5CR so that both solenoid 2SOL and coil 6CR are energized at the same time and are deenergized at the same time.

Referring to FIGS. 22 through 24, the embodiment of the system of the invention, that is shown, has a different construction for temporary holding tank 27 than that shown in the other embodiments that have been described above. For simplification, various components of the system are not shown. For example, pipe 106 of metering system 105 is not shown although it enters tank 27 in a preferred aspect of this embodiment by which disinfectant concentrate composition is added automatically into tank 27 after each transfer of waste material from tank 27 to tank 31 via conduit 30.

In this embodiment, tank 27 has an isosceles trapezoidal outline, as viewed from the top. The parallel walls are the front and rear walls of tank 27. The end wall 43 is not as wide as the other end wall. The main difference between this tank 27 and tanks 27 described above in connection with other embodiments is the nature of the shape of bottom wall 37. This tank 27 does not have raised portions 38, as in earlier embodiments to provide zones A and B. The bottom wall 37 below lower portion zone B in this embodiment is flat and horizontal, whereas a portion 350 of lower wall 37 below zone A is upwardly inclined in a direction away from opening 44 in end

wall 43. This upward inclination continues to a maximum height at an intermediate portion of wall 37 from which there is a steeply inclined portion 351 down to the horizontal portion of wall 37 below zone B. As a result, the inclined portion 350 adjacent this sharply downwardly inclined portion 351 provides a partial separation between zone B and the part of zone A that is adjacent opening 44. A further separation between zones A and B is afforded by a plate 352 having perforations and mounted in tank 27 against an inclined portion 351. The plate 352 and the shape of inclined portion 350 provide a substantial barrier to movement of waste material, other than liquid, from zone A to zone B. The plate 352 is inclined toward wall 43.

The toilet 25 is mounted on top wall 26 and directly below the outlet of toilet 25 the scoop 40 is mounted on top wall 26. Their manner of mounting is shown diagrammatically rather than the specific way described in connection with earlier embodiments. For simplification scoop 40 is shown as having a one-piece construction and it is not mounted for movement relative to top wall 26 or toilet 25. However, outlet 42 faces end wall 43 so that material is transferred from toilet 25 via scoop 40 to the lowermost portion of zone A of tank 27. A mounting ring 353 is mounted on the outside surface of end wall 43. The mounting ring 45 is mounted on ring 353 by bolts 354. The outwardly turned end of flexible conduit 30 is secured between rings 45 and 353. The conduit 30 is closed, when required, in the manner described above for either embodiments. The shape of this end of conduit 30 by this closing, which is by a pinching action, is shown in FIG. 23 by phantom lines.

The portion 350 of bottom wall 37 that is below zone A has its corner parts raised adjacent end wall 43 and a part of the front and rear walls of tank 27. The area of raised rear corner part 354 is greater than that of front corner part 355. This is because opening 44 in wall 43 has its center in a vertical longitudinal plane forward of the central longitudinal line of tank 27. In other words, opening 43 is offset forward. The bottom of opening 43 is at the lowermost point of the top surface of wall portion 350. By this construction, there is a deep trough in wall 37 adjacent opening 44. Because of the upward slant of wall portion 350 and the decreasing slope of parts 354 and 355, away from wall 43 the depth of this trough decreases toward plate 352 to a minimum depth of trough that extends almost to juncture with portion 351. This trough is present as the rear part 356 and the front part 357 of wall 37 beyond corner parts 354 and 355 are downwardly inclined toward each other. As a result, a shallow depth of material in zone A will flow toward the trough and then toward opening 44. At the juncture of portions 350 and 351, the wall portion 350 is flat.

In this embodiment, wall 37 below zone B is in the horizontal plane of the lowest portion of wall portion 350 but it can be higher or lower.

As in the embodiment shown in FIG. 2, tank 27 is provided with liquid-sensing means 90 and 91 that extend into zone B of tank 27. The liquid-sensing means 91 is preferably located at a height to sense the level of liquid in zone B in a plane corresponding to the juncture between portions 350 and 351 by bottom wall 37. Of course, liquid-sensing means 90 is above liquid-sensing means 91.

The inlet pipe 35 of pump 33 is located in zone B adjacent bottom wall 37. The motor 33M of pump 33 is mounted on top of pump 33 and it is seen from FIG. 22 that pump 33 and its inlet pipe 35 are located behind the longitudinal central plane of tank 27. A pipe 360 is connected to the outlet of pump 33. The other end of pipe 360 is connected to an inlet of a solenoid-operated, three-way valve 361 that is normally connected to pipe 100 that provides flushing liquid to toilet 25 as in the other embodiments. When the solenoid 1SOL, that is mentioned above in connection with FIG. 21, is energized, the spool of valve 361 is moved to communicate pipe 360 with a pipe 362 instead of with pipe 100. The pipe 362 is connected by a coupling 363 at top wall 26 of tank to a pipe 364 that ex-

tends vertically and then horizontally in tank 27 above zone B and toward perforated plate 352. The pipe 364 is connected at its end to a horizontal pipe 365. This connection is intermediate the ends of pipe 365. The pipe 365 extends transversely within tank 27, i.e., from the front to the rear. The pipe 365 has a number of openings 366 that face downwardly and toward plate 352. Thus, the transversely-shaped openings 366 provide water spray.

Wash liquid obtained from zone B by pump 33 through valve 361 and ultimately sprayed out openings 366 of pipe 365 against plate 352 to open any apertures in plate 352 that are clogged with solid. The liquid passes through these perforations of plate 352 into zone A to flush material in zone A to opening 44 and then through conduit 30 to tank 31. This diversion of pumped flushing liquid occurs when conduit 30 is being opened in a cycle of operation that transfers waste material from tank 27, as described for other embodiments. This opening of conduit 30 is initiated by liquid-sensing means 90.

As seen in FIG. 21, the solenoid 1SOL is energized whenever coil 1CR is energized. The motor 230 that is energized by coil 1CR opens conduit 30.

As shown by phantom lines in FIGS. 22 and 23, the apparatus utilizing diverted pumped liquid can be modified to include a jet pipe 400 that extends in a downwardly inclined manner from modified and repositioned pipe 365 into zone A toward opening 44. The open end of pipe 400 is generally below opening 42 of scoop 40 so that pumped liquid from pipe 400 provides a blasting force for solids to ensure their removal through conduit 30. Instead of openings 366, modified pipe 365 has widely spaced openings in which are placed nozzles 401 that are flared in the direction of the axis of pipe 365 to provide an overlapping spray against plate 352.

In another modification, solenoid 1SOL would not be in subcircuit 1A. It would be a circuit (not shown) in a series with a normally closed, held-open limit switch, a minimum level normally open sensing switch (that is closed by liquid above the level of sensor 91), and a coil of a relay having three normally open contacts in circuits in parallel with contacts 4-LCR, 5-LCR, and 6-1CR (FIG. 20). That limit switch is closed by a cam operated by the rotation of plate 228 during the opening of conduit 30. The cam opens that switch and keeps it open until plate 228 starts the second one-half of a complete revolution. As a result pump 33M is operated and valve 360 has its spool at the position to provide pumped liquid from zone B to pipe 365 from the time that conduit 30 is being opened until the level of material in tank 26 falls to the minimum level. This is especially desirable when the jet pipe 400, mentioned above, is used.

The spray ring 92 that is shown in FIGS. 22 and 23 is used in the partial servicing or the general servicing for flushing tank 27. The washing liquid is furnished to spray ring 92 via pipe 310. The vent pipe 316 for tank 27 is shown in FIG. 22 only.

Earlier in this specification, reference was made to the use of a conduit with a flexible resilient portion and to raising means for the movement upwardly of the lowermost inner surface of part of the flexible portion of the conduit as part of the pinching action to close the conduit. Instead of this specific construction, the conduit 30 can be constructed of rigid pipes and swivels to permit raising of a part of the conduit, preferably adjacent tank 27. A valve would be mounted in conduit 30, e.g., between two pipes of conduit 30. The pipe to provide the dam would be arcuate with its intermediate portion normally below the ends that are at the same horizontal plane. By rotation of this pipe about swivels at its ends, the intermediate portion is raised to provide the dam within conduit 30. This prevents flow of material from the holding tank in the event that the valve in the conduit does not close. In this construction the valve would not serve the dual function of closing the conduit and providing the dam by raising a part of the conduit, as described above in connection with the illustrative embodiments of the invention.

OPERATION

In the description that follows for the initiation of and each cycle of operation between partial servicing or complete servicing, it is assumed that motor 230 and the equipment that it operates, as shown in FIG. 10, are used. At the start of the use of the equipment, plate 228 is at the position in FIG. 10 by which rolls 220 and 221 are away from portion 201 of conduit 30. When shaft 229 of motor 230 is at this position, driven shaft 166 is positioned through a drive system (not shown) connecting shafts 229 and 166 so that cam follower 163 abuts cam 164 at a non-camming position so that during the normal one-half rotation of shaft 166 and thus cam 164, the cam follower 163 will be in abutment with cam portion 167 and then in abutment with the surface of cam 164 just beyond portion 167 at the end portion of this rotation that occurs during the closing of conduit 30.

At this initiation of the operation, it is assumed also that canister 120 is mounted as shown in FIG. 5 so that disinfectant concentrate composition has passed into the chamber of housing 152 of supply system 105. Checkvalve fitting 174 stops further flow of the composition. The valve 110 is closed and water is added to wash basin 109 until the water level reaches indicia 114. The valve 116 has been turned from its normal position so that it no longer provides drainage from pipe 115 to pipe 117 but rather communicates pipe 98 with pipe 115.

When conduit 30 is open and plate 228 is at the position mentioned above, limit switch 2LS has its switch 2LS-A in open position and its switch 2LS-B in closed position. These switches have been moved to those positions by their springs. A cam is mounted on shaft 166 or shaft 229 or another shaft (not shown) that is driven by motor 230. The camming action occurs once during rotation of the cam through 360°, i.e., when conduit 30 is completely closed by rolls 220 and 221. Thus when conduit 30 is closed, the cam provides the closing and opening of switches 2LS-A and 2LS-B, respectively.

When conduit 30 is completely open because rolls 220 and 221 have been moved to the positions shown in FIG. 10, a cam (not shown) engages switch 3LS so that switch 3LS-A is open and switch 3LS-B is closed. Whenever one of the shafts, e.g., shaft 229 is at any position other than that at which conduit 30 is open, switch 3LS-A is closed and 3LS-B is open. The service switch 1LS is already at the operative position so that switch 1LS-A is open and switch 1LS-B is closed.

At this initiation of the operation, there is no liquid in tank 27. Thus level switch 1LLS is closed. The level switch 2LLS is open and thus coil 1TR is not energized so that contact 1-1TR is open.

Because push-button switch 1PB is not being pressed, contact 1PB-A is open and contact 1PB-B is closed.

In view of the open conditions of some switches and contacts, coil 1CR and solenoid 1SOL are not energized. The motor 230 is started by moving service switch 1LS to the inoperative position so that switch 1LS-A is closed. This results in the energization of coil 1CR through subcircuit 1D. Contacts 4-1CR, 5-1CR and 6-1CR close to start motor 230. As motor 230 is operated, the cam for limit switch 3LS is rotated so that the camming action no longer occurs and switch 3LS-R opens. Energization of coil 1CR continues because, at the time switch 3LS-B opens, switch 3LS-A closes to utilize subcircuit 1C as a holding circuit.

When motor 230 has operated sufficiently to close conduit 30, the cam for limit switch 2LS has been rotated to the camming position whereby limit switch 2LS-A is closed and switch 2LS-B is opened. The opening of switch 2LS-B results in the opening of holding circuit 1C and the deenergization of coil 1CR. The contacts 4-1CR, 5-1CR and 6-1CR open and motor 230 stops.

With conduit 30 now closed by rolls 220 and 221, valve 110 is opened to allow flow of water from bowl 109 into tank 27. Just before conduit 30 was completely closed, cam 164 had operated supply system 105 to provide a hydraulic pressure in

the chamber of housing 152 to open the check valve in fitting 174 so as to provide a metered amount of disinfectant concentrate composition into tank 27 via pipe 106. With the introduction of water from wash bowl 109 into tank 27 and with the introduction of the disinfectant concentrate composition as described above, tank 27 now has a proper amount of water containing a suitable concentration of disinfectant and dye. The toilet system is now ready for use.

As waste material flows from toilet 25 and is flushed from it to tank 27 via scoop 40, the liquid level in tank 27 rises. Ultimately low-level, liquid-sensing means switch 1LLS is opened when it, shown in some drawings as the level-sensing means 91, detects this level of liquid. By further use of the toilet system, there is a further rise in the level of material in tank 27 until the level reaches sensing means 90, which is high-level, liquid-sensing switch 2LLS that is thereby moved to the closed position. When this occurs, coil 1TR is energized to initiate the closing of contact 1-1TR. After a predetermined period of time, e.g., 60 seconds, contact 1-1TR closes.

The time-delay relay containing coil 1TR and time-closing contact 1-1TR is used instead of a relay having a normally open contact to avoid an energization of coil 1CR in the event that switch 2LLS is closed merely by lateral movement of material within tank 27. Such movement occurs, e.g., when the airplane is tilted about its longitudinal axis during flight. Such rise in level in a part of tank 27 occurs for a short period of time. It would produce a false signal that would result in the energization of coil 1CR and the opening of conduit 30 before the real level of material in tank 27 had reached the height sufficient to close switch 2LLS.

It has been stated above that switch 2LS was moved by its operating cam when conduit 30 was returned to its closed position. At that time, the holding circuit 1C was opened and switch 2LS-A was closed. Accordingly, this closing of contact 1-1TR, as described above, results in the utilization of circuit 1 to energize coil 1CR for the initiation phase of this opening of conduit 30. When motor 230 has operated for a short period of time the cam for switch 2LS is no longer operative so that switch 2LS-A opens and switch 2LS-B closes. From the time that motor 230 had been operated for a short period of time in order to close conduit 30, switch 3LS-A had been returned by its spring to the closed position. Thus, subcircuit 1C provides continuation of the energization of coil 1CR until the cam for switch 3LS opens switch 3LS-A. This occurs when rolls 200 and 221 have been moved away completely from conduit 30. Because it is resilient at the area to be pinched for closing, conduit 30 opens. The deenergization of coil 1CR results in the stopping of motor 230.

When conduit 30 has opened, flowable material moves out of tank 27, through conduit 30 and into tank 31. This flow continues until the level of material in tank 27 is lowered to the point at which switch 1LLS closes. When this happens, subcircuit 1D initiates the energization of coil 1CR until the cam for switch 3LS rotates to be inoperative so that switch 3LS-B opens. At the same time, switch 3LS-A closes to provide holding circuit 1C for the continued energization of coil 1CR. This continues the operation of motor 230 to complete the closing of conduit 30 as described above in connection with the condition for the closing of conduit 30 prior to the adding of water from wash bowl 109. This completes the cycle of operation of the opening and closing of conduit 30 that is started when the real level of material in tank 27 has reached the predetermined maximum level and is concluded after the level in tank 27 has dropped to the lower predetermined level with the resultant closing of conduit 30.

Each time that conduit 30 is almost closed in such cycle a metered quantity of disinfectant concentrate composition is moved from metering system into tank. Water from bowl 109 is not added. Thus, the composition replenishes tank 27 with disinfectant and dye approximately at the end of a cycle. Most of these materials added at the previous closing of conduit 30 is in the transferred material and thus in tank 31. The automatic addition of composition provides the replenishment.

The toilet system is used only when the airplane is in flight. As soon as the airplane has risen to a predetermined minimum elevation, such as 10,000 feet, the decrease in pressure is sensed by vacuum switch 1VS and it closes. (In that illustrative case, it opens on landing before 7,000 feet.) This results in a closed condition for circuit 2 so that coil 2CR is energized. The contacts 1-2CR, 2-2CR, and 3-2CR then close and current flows through heater coils 1HC, 2HC, and 3HC, i.e., heater 52. The temperature in tank 31 rises until temperature-actuated switch 1TAS is opened to shut off heater 52 by deenergizing coil 2CR and thereby opening contacts 1-2CR, 2-2CR, and 3-2CR. As soon as the temperature in tank 31, as sensed by switch 1TAS has decreased, that switch will reclose with the resultant operation of heater 52. This tank 21 will be maintained at the desired maximum temperature, e.g., 220°F., for boiling of water content in the waste matter transferred to tank 31 from tank 27 during the cycle of operation of opening and closing conduit 30 that has been described above.

To prevent the heating of tank 31 by heater 52 prior to the introduction of sufficient waste material and to prevent during the latter cyclic use of the transfer system the reduction in level of material in tank 31 below a predetermined height, switch 340 senses the rise of material in tank 31 to that level. The switch 340, which is designated minimum level, liquid-sensing switch 3LLS, is a normally open switch in circuit 2. As a result, heater 52 is inoperative until the amount of waste matter transferred to tank 31 reaches a level sufficient to close switch 3LLS.

In the event that the temperature in tank 31 slightly exceeds the predetermined maximum temperature permitted by switch 1TAS, the continued rise of temperature by the use of heater 52 is prevented by the closing of switch 2TAS to energize coil 3CR-A. Illustratively this occurs at 224°F. This results in the opening of contact 1-3CR-A in circuit 2 to deenergize coil 2CR and thus shut down heater 52. When the temperature drops below that temperature at which 1TAS closes, the energization again of coil 2CR is prevented by now open contact 1-3CR-A. The use of heater 52 is prevented until switch 2PB in subcircuit 3A is manually closed to energize coil 3CR-B that returns coil 3CR-A to its deenergized condition. Thus, switch 2TAS serves as a safety switch and its closing to operate latch-in relay 1LR prevents further use of heater 52 until switch 2PB is momentarily closed. The necessity for momentarily closing switch 2PB is indicated by the red light of subcircuit 3B. That light glows so long as coil 3CR-A is energized. This is because circuit 3B has contact 2-3CR-A which is closed by and remains closed during the energization of coil 3CR-A.

When the embodiment of the system of the present invention includes an incineration operation as described earlier, heater 53 is used. The use of heater 53 is prevented whenever the plane is at least a predetermined level above the ground because the decrease in atmospheric pressure opens switch 2VS. As a further safeguard, the incineration cannot be performed as long as the engines are operating because the flow of exhaust gas will open flow switch 1FS and because switch 3TAS will be opened by the temperature of one operating engine. These openings of switches prevent the energization of coil 4CR that must be energized to close contacts 1-4CR, 2-4CR, and 3-4CR for current flow to heater coils 4HC, 5HC, and 6HC.

Furthermore, the incineration operation is prevented until plate 56 is moved into a position to prevent hot gases in tank 31 from passing into conduit 30. The system has switch 4LS that is momentarily trip closed just before conduit 30 is completely closed. This closing of switch 4LS energizes coil 5CR to close contact 1-5CR. The coil 5CR is deenergized as soon as switch 4LS opens, but there is a delay in the opening of contact 1-5CR. During that delay coil 1CR is deenergized and contact 7-1CR closed. This results in a holding circuit 6A until coil 1CR is energized. At the same time circuit 7 is prevented from energizing solenoid 2SOL until coil 5CR is energized for longer than the momentary energization provided by switch 4LS. This is because contact 2-5CR is time retarded in its closing when coil 5CR is energized.

The solenoid 2SOL is the solenoid for the valve that controls the operation of hydraulic cylinder 57. When solenoid 2SOL is energized, the spool of the valve is moved to introduce fluid into the rear chamber of hydraulic cylinder 57 and exhausts fluid from the forward chamber so that piston rod 58 is moved from left to right (as viewed in FIG. 2). Thus, the energization of solenoid 2SOL moves plate 56 into its thermal shielding position at opening 55 of heat-insulating material 51. Upon the deenergization of solenoid 2SOL, plate 56 is retracted by cylinder 57 to close opening 60 and to return communication between conduit 30 and tank 31. In view of the foregoing, it is seen that the thermal shield, i.e., plate 56, is never in the shielding position when conduit 30 is open and, in view of circuit 5, it can never be moved into shielding position when the airplane is moving on the ground or is in the air or even when an engine is operating and the airplane is stationary on the ground.

As mentioned earlier, the thermal shield 56 is moved into protective position for the incineration. The operation of heater 53 is dependent upon the energization of coil 6CR that is energized only when solenoid 2SOL is energized. The energization of coil 6CR closes a contact 1-6CR in circuit 5 to energize coil 4CR if the other conditions with respect to the airplane, that have been stated above, are present. The energization of coil 4CR results in the utilization of heater 53 with heater 52 for an incineration of material in tank 31.

The following will describe first the partial servicing operation and then the complete servicing operation for the system in which only heater 52 is utilized. From that description the operations for partial and complete servicing with incineration will be obvious.

When the airplane has completed a lengthy flight, with or without a number of intermediate stops, or has completed a number of shorter flights, it is desirable to provide a partial servicing of the system. This limited servicing effectuates a removal of most, if not all, of the waste material remaining in tank 27 by a flushing action with a new supply of water. Of course, the flushed material will be transferred via conduit 30 into tank 31. This servicing operation is performed preferably while the airplane is on the ground.

To perform this partial servicing operation, valve 110 is closed and valve 116 is turned to communicate pipe 115 with pipe 98. Water is added to wash bowl 109 until the level of water in bowl 109 rises to indicia 114. The operator presses pushbutton switch 1PB to energize coil 1CR. Motor 230 starts to operate and switch 2LS-A, being no longer held closed, opens. However, the energization of coil 1CR continues through holding subcircuit 1C until conduit 30 is completely open. As waste material is draining from tank 27, the operator opens valve 110 to introduce flushing water into tank 27 via spray ring 92. When the embodiment of the apparatus is that shown in FIGS. 22 through 24, solenoid 1SOL is energized whenever coil 1CR is energized. As a result pipe 360 communicates with pipe 362 instead of communicating with pipe 100. In view of this, the operator presses a conventional pushbutton that is used to operate motor 33M in the normal flushing operation for toilet 25. This is done when pushbutton switch 1PB is pressed. The pumped water is diverted by valve 361 to pipe 362 and ultimately to pipe 365. This water passes out openings 366 to backwash plate 352. By this means, liquid is transferred from zone B to zone A and helps to wash away waste material in zone A while conduit 30 is open. When the level in tank 31 falls below the predetermined minimum, switch 1LLS closes to energize coil 1CR to operate motor 230. This closes conduit 30. During this energization of coil 1CR, solenoid 1SOL is energized so that pump 33 will again pass liquid to pipe 365 if the operator is pressing the pushbutton that operates motor 33M.

In the event that the operator is still pressing the pushbutton for the toilet to operate motor 33M while conduit 30 is open, water is pumped from zone B to toilet 25, because solenoid 1SOL is not energized. This water flows from toilet 25, through scoop 40 and into zone B of tank 27.

If switch 1LLS (i.e., sensing means 91) is in zone B as shown in FIG. 23, it will close before the material in zone B has fallen to that level by passing out opening 43. This is because some of the water from pipe 365 will pass through the holes in plate 352 and thus into zone A. To prevent this result, the operator can keep pushbutton 1PB depressed along with the pushbutton that operates motor 33M. The switch 1PB-B remains open so that the closing of switch 1LLS does not result in the energization of coil 1CR to close conduit 30. In this case, 1SOL is also not then energized. The pump 33 will remove practically all, if not all, water from zone B and send it to zone A via toilet 25 and scoop 40. In the meantime, material is flowing from zone A into conduit 30.

The operator ceases the pressing of these two pushbuttons. Then subcircuit 1C energizes coil 1CR to close conduit 30 and pump 33 stops. After closing valve 110, water is added to bowl 109 up to the indicia. Conduit 30 is opened by closing switch 1PB-A momentarily. As soon as it is fully opened, switch 3LS-B closes to initiate the closing of conduit 30. The metered amount of disinfectant concentrate composition is added to tank 27 from system 105 as conduit 30 closes completely. The valve 110 is opened to drain water from bowl 109 into tank 27. The valve 116 is turned to communicate bowl 109 with drain pipe 117. This completes the partial servicing operation.

The complete servicing is illustrated by the use of a truck having a tank of water and a tank to receive waste material. The operator joins a hose from the truck's water tank to connector 320 (FIG. 19) and a hose from the truck's other tank to connector 322. The handle 334 is pulled to raise valve 325 so that flowable material in tank 31 will enter conduit 321 and the hose connected to the truck's tank to receive waste material.

A pump on the truck forces water from the truck's water tank into pipe 311 and thus into spray pipe 317 in tank 31 and spray pipe 92 in tank 27. The level of material in tank 27 will rise to close switch 2LLS. As a result, as described earlier for the normal use, conduit 30 is opened. The water from the tank on the truck flushes the waste from tank 27 into tank 31.

Instead of awaiting this closing of switch 2LLS, it is preferred that most of the waste material be drained from tank 27 before introducing flushing water from the truck's water tank. This is accomplished by moving switch 1LS to the operative position to close switch 1LS-B and thus energize coil 1CR for the operation of motor 230. The conduit 30 is thereby opened. At the same time switch 1LS-A is opened so that the closing of switch 1LLS by the drop in level in tank 27 does not initiate the reclosing of conduit 30. Then water is pumped from the truck to thoroughly flush waste matter from tank 27 into tank 31 and to flush tank 31. Then the pump that supplies water from the tank's water tank is stopped. The hose from that tank and to pipe 311 is disconnected.

After drainage from tank 31 stops, valve 325 is allowed to fall into position to close opening 324. The hose connected to the truck's other tank is disconnected and cap 323 is returned to the position closing the end of connector 322. The switch 1LS is moved to its inoperative position to close switch 1LS-A that initiates the closing of conduit 30 as described earlier for the initiation of the operation of the system. The rest of the steps for this initiation that provides water and disinfectant concentrate composition in tank 27 are described above for the original initiation or preparation for use of the system.

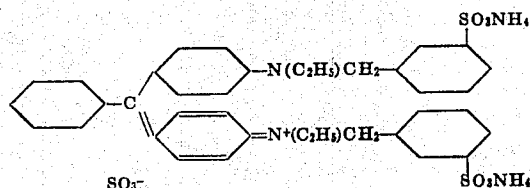
When the system of the present invention utilizes tank 27 shown in FIGS. 22 through 24 and the associated equipment that includes plate 352, valve 361, solenoid 1SOL, etc., it is necessary to modify the operation described above for a complete servicing of the system. This is because liquid in zone B will not drain completely into zone A. For such apparatus, pump 33 by its motor 33M is operated during the introduction of flushing water from a tank on the truck. During the opening of conduit 30 there is a backwashing action of plate 352 as described above for the partial servicing. During the flushing with the external water and without motor 33M being operated, liquid in zone B is transferred to zone A by a

dilution action in zone B and movement of diluted liquid through plate 352. Before the completion of drainage mentioned above, the operator presses the pushbutton for the toilet to pump out the liquid remaining in zone B and to transfer it to zone A via toilet 25 and scoop 40.

Earlier in connection with colored disinfectant concentrate compositions of the invention, there is presented some description of a specific dye and the class of suitable dyes to which it belongs. Among the suitable dyes to be used in the composition of the present invention are the triarylmethane acid dyes. The nature of this type of dye is described on page 3345, Volume 3, "Colour Index", Second Edition, described earlier. On that page is stated that triarylmethane matters, i.e., triarylmethane dyes, contain the quinonoid grouping as the chromophore. This grouping may appear as $\text{C}=\text{Ar}=\text{NH}$

(as in Baeyer's fuchsonimine) or $\text{C}=\text{Ar}=\text{O}$ (as in Baeyer's fuchson) (Ar=aromatic nucleus). Two aryl groups attached to the methane C-atom complete the chromogen, the dyes being formed by the introduction of two or three auxochromes, usually in para-position to the methane C-atom.

It is pointed out that for these dyes the introduction of sulfonic acid groups provides acid dyes. Acid dyes are the dyes of the present invention and preferred are the acid dyes of the triarylmethane type. The specific dye, mentioned earlier as eminently suitable for the required use and having colour index No. 42090, is a diamino derivative of triphenylmethane. This narrower class of triarylmethane dyes is especially preferred as the dye in the colored disinfectant concentrate composition of the present invention. The dye of colour index No. 42090 has the formula



In FIG. 21, liquid level switches 1LLS, 2LLS, and 3LLS are shown schematically in the standard manner that would indicate they are float devices. However, other level sensors can be used. For example, ultrasonic devices are available for this purpose and they could be tuned to be conductive when surrounded by material of certain physical characteristics. In this case they are tuned to be electroconductive when surrounded by waste liquid. These would be suitable in the circuitry of FIG. 21 for switches 2LLS, 3LLS but not as a simple substitute for switch 1LLS. A modification of the circuitry would be necessary. One modification would utilize a coil of a relay in series with such ultrasonic level sensor and the relay would have a normally closed contact in subcircuit 1D in place of switch 1LLS.

It was stated early in this specification that in the embodiment of FIGS. 1 and 2, there is a blower 63 that is utilized when there is an incineration operation in tank 31. The motor of blower 63 can be operated automatically by connecting it to a power source through a limit switch that is closed when piston rod 58 is in its extended position by which shield plate 56 is in its effective position shown in FIG. 2. Thus, blower 63 operates only when there is this incineration.

In the foregoing description, plate 228 on which pin 227 is mounted makes one complete revolution to open and close conduit 30. Obviously motor 230 can make a number of rotations for such complete rotation of plate 228 and for this purpose a small gear would be fixedly mounted on the shaft of the motor. The gear would mesh with a gear of much larger diameter to provide one revolution of the larger gear for several rotations of the shaft of the motor. In that case, the larger gear would be fixedly mounted on shaft 229 on which circular plate 228 is mounted.

As seen in FIG. 2, heater 52 is mounted on the bottom portion of tank 31 to provide heat to the contents of tank 31, whereas heater 53 is mounted on tank 31 to surround substantially the entire tank so as to heat all walls, i.e., top, sides and bottom, of tank 31 to a high temperature sufficient to incinerate the waste transferred into tank 31 and to avoid condensation of material on the sidewalls and the top wall. Of course, in the preferred aspect heater 52 is used with heater 53 for the incineration operation. The heater 52 can also extend up the sidewalls but the maximum level is preferably limited to about the minimum level of contents in tank 31 permitted for the concentration by evaporation when using liquid-level sensing means 340, i.e., switch 3LLS.

With reference to the colored disinfectant concentrate composition, an illustrative preferred composition is 97 percent OMACIDE-6 and 3 percent of the F.D. and C. Blue Dye No. 1 mentioned earlier.

With reference to perforated plate 352, the holes are illustratively 3/16 inch in diameter. For spray pipe 365, the openings 366 are illustratively about the same diameter.

The foregoing has presented many embodiments of the system of the present invention and has presented the method of the invention along with the composition, colored or not colored, that is another aspect of the invention. Many variations will be obvious to one skilled in the art in view of the foregoing description and the drawings. The embodiments have been presented solely for purpose of illustration and not for the purpose of limitation of the invention that is limited only by the claim that follows.

We claim:

1. A waste storage system for a toilet which comprises:
 - a temporary holding tank to receive human body waste from a toilet bowl, said tank having an inlet in a top portion to receive such waste and having an outlet in a bottom portion of the tank;
 - a volume-reductive storage tank having an inlet and an outlet in a top portion of the tank;
 - conduit means connecting said outlet of the holding tank to said inlet of the storage tank to provide a communication between the tanks for transfer of the waste from the holding tank to the storage tank, said conduit means having a portion in horizontal alignment with the bottom portion of the holding tank;
 - heater means mounted on the storage tank to volatilize out said outlet of the storage tank at least part of the flowable material transformed to the storage tank from the holding tank;
 - valve means operatively associated with the conduit means and moveable between a first position and a position that closes the conduit means;
 - motor means operatively associated with the valve means to move the valve means between the two positions;
 - means operatively associated with the conduit means and moveable between a lowered position and a raised position that raises at least a part of said portion of the conduit means in horizontal alignment with the bottom portion of the holding tank to provide a dam effect for flowable material when present in the holding tank;
 - motor means operatively associated with the raising means to move the raising means between the lowered position and the raised position;
 - liquid-level sensing means mounted in the holding tank and responsive to a predetermined maximum level of flowable material in the holding tank;
 - means responsive to the sensing means to initiate the operation of said motor means, associated with the valve means, to move said valve means to said first position and the operation of said motor means, associated with the raising means, to move said raising means to said lowered position for opening the conduit means and lowering the said portion of the conduit means to transfer flowable material out the outlet of the holding tank to the storage tank; and

means responsive to a predetermined condition during the transfer of flowable material to initiate the operation of said motor means associated with the valve means to move said valve means to the position that closes the conduit means and to initiate the operation of said motor means associated with the raising means to move said raising means to the raised position to provide the dam effect.

2. The system of claim 1 wherein said means responsive to a predetermined condition includes:

liquid-level sensing means mounted in the holding tank and responsive to a predetermined minimum level of flowable material in the holding tank; and

means responsive to the minimum level-sensing means to initiate said closing and raising operations.

3. The waste storage system of claim 2 wherein:

said portion of the conduit means in horizontal alignment with the bottom portion of the holding tank is flexible and resilient, so as to be closeable by a pinching force and to open upon removal of said force; and

said means to raise said portion of the conduit means includes a rod that is moved upwardly against the portion by the motor means so that said raising means lifts a part of said portion to a higher elevation to provide said dam effect.

4. The storage system of claim 3 wherein said valve means comprises:

a pair of opposed rods on opposite sides of said portion of the conduit means; and

means to move said rods toward each other to provide a pinching action on said portion of the conduit means for closing the conduit means and to move said rods away from each other to permit said portion to reopen.

5. The system of claim 4 wherein said rods extend transversely of the axis to the said portion of the conduit means and wherein the lower of said pair of rods provides said rod of said raising means.

6. The system of claim 1 wherein said means responsive to said maximum liquid-level sensing means provides said initiations of operations of said motor means that result in opening of the conduit and removal of the dam effect is effective to do so only after a delay of a predetermined period of time.

7. The system of claim 1 wherein said outlet in the bottom portion of the holding tank is in a sidewall and the lowermost portion of that outlet is at the plane of the top surface of the bottom wall of the holding tank adjacent that outlet.

8. The system of claim 1 and further including:

second heater means mounted on the stage tank to surround substantially the storage tank so as to provide a sufficiently high temperature throughout the storage tank to incinerate waste in the storage tank;

heat-shielding means mounted on the storage tank and moveable between a first position away from said inlet of the storage tank communicating with the conduit means and a second position preventing communication between that inlet and the conduit means;

motor means to move the heat-shielding means between the first and second positions; and

means responsive to the open condition of the conduit means to prevent operation of the motor means for moving the heat-shielding means to its second position and to prevent the operation of the second heater means that provides incineration in the storage tank.

9. The system of claim 8 wherein:

the storage tank has another opening in the top portion; the system further includes a blower mounted on the storage tank and communicates with said another opening; and

the first position of the heat-shielding means is at and closes said another opening so that volatilized matter does not pass out through said blower when said heat-shielding means is at its first position and so that the blower communicates with the storage tank only when said motor has moved the heat-shielding means to close the inlet of the

storage tank communicating the storage tank with the conduit means.

10. The system of claim 8 and further including means responsive to at least one condition of an airplane, in which the system is to be utilized, said condition indicating that the airplane is other than stationary with its engines shut down, said airplane-condition means preventing the operation of the heater means for incineration.

11. The system of claim 10 and further including:

a conduit to the exterior of the airplane;

a biological filter;

a valved means communicating with said outlet in the top portion of storage tank and alternatively with the biological filter and with said conduit to the exterior of the airplane; and

a conduit to the exterior of the airplane and communicating with the biological filter, whereby use of the filter can be limited to the evaporative operation and by-passed during the incinerative operation.

12. The system of claim 1 wherein:

the outlet of the holding tank is in an end sidewall and has its lowermost portion at the plane of the top surface of the bottom wall of the holding tank adjacent that outlet;

the bottom wall of the holding tank has a raised portion intermediate the end sidewalls to provide one zone adjacent the end sidewall with said outlet and another zone adjacent the other end sidewall, said raised portion providing a restriction in the movement of material other than liquid from said one zone adjacent said outlet to the other zone and wherein said inlet of the holding tank is above one zone; and

the system further includes a pump mounted on the holding tank and having its inlet in said other zone of the holding tank.

13. The system of claim 12 wherein the raised portion of the bottom of the holding tank comprises a number of transversely-spaced, raised parts intermediate said end sidewalls with an amount of spacing between the raised parts that restricts movement of other than liquid from said one zone to the other zone of the holding tank.

14. The system of claim 12 wherein the raised portion is provided by an incline of the bottom surface of the holding tank upwardly in a direction away from the outlet in the end sidewall of the holding tank that communicates with the conduit means to an intermediate zone in that tank adjacent to which there is also connected a steep decline of the bottom surface to provide one of the walls of said another zone.

15. The system of claim 14 wherein the outlet that communicates with the conduit means is offset in the sidewall from a central longitudinal plane passing through both zones and the inclined surface from that outlet to the maximum height is a trough of decreasing depth.

16. The system of claim 15 wherein the corner portions of the bottom surface of the holding tank adjacent the wall having the offset outlet communicating with the conduit means are substantially raised to provide a deeper trough adjacent that opening.

17. The system of claim 16 wherein at the juncture of the inclined surface and the steep surface forming one wall of said other zone there is located a perforated plate that provides a screening action to limit the movement of material other than liquid from said one zone to said other zone.

18. The system of claim 17 and further including:

means mounted above said other zone in the holding tank and having a conduit and a spray pipe connected to that conduit and with openings spaced transversely in the tank to provide liquid spray to the perforated plate for backwashing of material against openings in the plate and for the movement of that material toward the outlet communicating with the conduit means;

flushing valve means moveable between two positions to alternatively direct liquid from the pump to a conduit for providing flushing liquid for toilet bowl and to said con-

duit connected to the spray pipe for providing such liquid for the backwashing of the perforated plate; and means responsive to the operation of the motor means for the valve means to open the conduit means so as to move the flushing valve means to shift from the normal communication of the pump with the conduit for the toilet bowl to the conduit connected to the spray pipe, whereby the normal manual action of flushing of the toilet bowl while said conduit means between said tanks is being opened results in liquid from the holding tank being pumped to the spray pipe for the backwashing operation instead of being pumped to the toilet bowl.

19. The system of claim 1 and further including:

a scoop supported in the holding tank at the inlet of the holding tank to receive waste passing through that inlet from a toilet bowl and to direct it laterally within the tank, said scoop having a lower portion that is in two complementary parts;

a pair of hinge means mounted on the upper portion of the scoop and pivotally mounting said two parts at horizontally-spaced pair of horizontal axes of pivotal movement; and

springs mounted on said upper portion of said scoop to urge said two parts into abutment with each other, whereby the lower portion of said scoop can be opened by pivotal movement of the two parts against the forces of the spring means to provide access to the holding tank.

20. The system of claim 1 and further including:

a scoop mounted in the holding tank at the opening at the top portion of the holding tank to receive waste through that opening and to direct it laterally within the tank, said scoop having a top circular inlet and an outlet within the holding tank that is facing horizontally;

Support means mounted on the top wall of the tank and extending downwardly to mount said scoop at the lateral extension for pivotal movement with a vertical axis; and

spring means on the extension of the support means to urge upwardly the scoop, whereby the scoop in its normal position is urged upwardly and in communication with the inlet in the top wall of the holding tank but can be moved downwardly and pivoted about the vertical axis to be moved out of the way for any desired access to the holding tank.

21. The system of claim 20 wherein:

said holding tank at said inlet has a downwardly extending annular flange with a portion adjacent its end portion that converges in the downward direction to provide an external annular shoulder; and

said scoop at the top periphery of its upper inlet engaging said annular shoulder when the scoop is in operative position and urged upwardly by said spring means, whereby waste passing through said inlet of the holding tank can contact the scoop only below the periphery of the top inlet of the scoop and movement of the scoop about said vertical axis while in the operative position is prevented.

22. The system of claim 1 and further including a metering system operatively associated with means to close the valve means so as to provide a predetermined quantity of disinfectant concentrate composition from the metering system to the holding tank during a cycle of operation of the valve means that ends with the conduit means being in closed condition, so that the holding tank after each closing of the conduit means contains at least said predetermined quantity of such composition.

23. The system of claim 22 wherein the metering system includes:

a cylindrical housing having an inlet and an outlet in the top portion and a bottom opening;

a piston mounted in the housing below said inlet and said outlet;

a cam follower mounted below and supporting the piston; cam means below the housing to abut the cam follower so as to provide by one complete rotation of the cam means an

upward movement of the piston to a position still below said inlet and said outlet of the housing only for a short interval of time;

a shaft rotatably mounted and fixedly mounting said cam means, said shaft being operatively associated with said motor means, operatively associated with the valve means, whereby said shaft is rotated once about its axis during one cycle of operation of the valve means to provide said vertical movement of the piston during the completion phase of the cycle of operation that is provided for said valve means;

means mounted on the housing and communicating with said inlet of the housing to provide unidirectional flow of liquid into the housing; and

means mounted on the housing and in communication with said outlet of the housing to provide unidirectional flow of liquid from the housing for transferring a metered quantity of such composition to the holding tank by a conduit.

24. The system of claim 23 wherein said metering system to support the piston by the cam follower and includes:

a spring supporting the piston; and

a second piston supporting the spring and supported by the cam follower, and wherein the follower is maintained against the cam means by a spring means within the housing urging the cam follower downwardly, so that the piston supported by the spring is urged upwardly upon the raising of the cam follower with a lost motion action.

25. The system of claim 22 and further including a supply system to replenish automatically the metering system with such composition, said supply system comprising:

a replaceable canister;

support for the canister; and

a hollow needle mounted on the support and extending from it to puncture the supported canister, said canister comprising:

a housing having a top end wall with a portion penetratable by said needle when said canister engages said support and having at its bottom end wall a central opening from which extends an annular guide flange;

a piston within the housing and spaced from the sidewall of the housing, said piston having a downwardly extending central boss guided by said annular flange of said bottom end wall of the canister;

a spring between the piston and the bottom end wall to urge the piston upwardly toward the top end wall; and

a flexible tubular sealing member in the housing, said member being secured at one end to the housing at a position intermediate the end walls above the piston, being secured at the other end to said piston, and having an intermediate portion having a reverse bend to maintain a seal between the part of the housing below the piston and the part of the housing above the piston.

26. The system of claim 25 wherein said downwardly extending boss of said piston in the housing is sufficiently elongated to extend through the opening in the end wall when the canister is at least partially filled with liquid.

27. The system of claim 26 wherein:

the support for the canister has an externally threaded, downwardly-extending cylindrical flange and has a bottom coaxial boss through which the needle extends; and wherein the canister has an internally-threaded cylindrical flange engaging the flange of the support and has, for the penetratable part of the top end wall, a central opening with a downwardly facing shoulder and a penetratable sealing material secured in the opening.

28. The system of claim 27 wherein the housing of the canister is in two parts secured together intermediate the ends to permit easy loading and reloading.

29. The system of claim 26 and further including in the replaceable canister a disinfectant concentrate composition comprising:
water; and

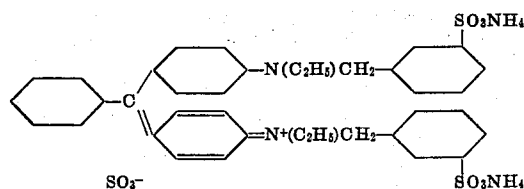
at least 10 percent by weight disinfectant compound dissolved in said water.

30. The system of claim 29 wherein the disinfectant is an alkali metal salt compound selected from the group consisting of N-hydroxy-2-pyridinethiones and phenols.

31. The system of claim 30 wherein the composition contains a small concentration of a water-soluble dye.

32. The system of claim 31 wherein the dye is a triaryl-methane acid dye containing sulfonic acid groups.

33. The system of claim 32 wherein the dye has the formula



Aand is present in a concentration of about three percent by weight of the composition and the disinfectant is sodium 2-pyridinethione-N-oxide present in a concentration of about 50 percent by weight of the composition.

34. The system of claim 1 wherein said storage tank has a bottom outlet and the system further includes:

a valve closing said bottom outlet;

means to open the valve to withdraw flowable contents from the storage tank;

conduit means to introduce flushing liquid to said storage tank;

means to render ineffective said means responsive to a predetermined condition in the holding tank so as to prevent the operation of the valve means that would close the conduit means between the tanks so as to provide a flushing of the holding tank and the storage tank when the valve for the bottom opening of the storage tank is moved away from that opening; and

means to initiate the operation of the motor means that provides an opening of the conduit means between the tanks, said initiating means being other than said maximum liquid-level sensing means.

35. A waste storage system for a toilet which comprises:

a temporary holding tank to receive human body waste from a toilet bowl, said tank having an inlet in a top portion to receive such waste and having an outlet in a bottom portion of the tank;

a volume-reductive storage tank having an inlet and an outlet in a top portion of the tank;

conduit means connecting said outlet of the holding tank to said inlet of the storage tank to provide a communication between the tanks for transfer of the waste from the holding tank to the storage tank;

heater means mounted on the storage tank to volatilize out said outlet of the storage tank at least part of the flowable material transformed to the storage tank from the holding tank;

valve means operatively associated with the conduit means and moveable between a first position and a position that closes the conduit means;

motor means operatively associated with the valve means to move the valve means between the two positions;

liquid-level sensing means mounted in the holding tank and responsive to a predetermined maximum level of flowable material in the holding tank;

means responsive to the sensing means to initiate the operation of said motor means to move said valve means to said first position for opening the conduit means to transfer flowable material out the outlet of the holding tank to the storage tank;

means responsive to a predetermined condition during the transfer of flowable material to initiate the operation of said motor means to move said valve means to the position that closes the conduit means;

liquid-level sensing means mounted in the storage tank and responsive to a decrease to a predetermined minimum level of material in the storage tank; and

means responsive to the sensing means in the storage tank to prevent the operation of said heater means when the level of the material in the storage tank does not exceed that predetermined minimum level.

36. A waste storage system for a toilet which comprises:

a temporary holding tank to receive human body waste from a toilet bowl, said tank having an inlet in a top portion to receive such waste and having an outlet in a bottom portion of the tank;

a volume reductive storage tank having an inlet and an outlet in a top portion of the tank;

conduit means connecting said outlet of the holding tank to said inlet of the storage tank to provide a communication between the tanks for transfer of the waste from the holding tank to the storage tank;

first heater means mounted on the storage tank to volatilize out said outlet of the storage tank at least part of the flowable material transformed to the storage tank from the holding tank;

valve means operatively associated with the conduit means and moveable between a first position and a position that closes the conduit means;

motor means operatively associated with the valve means to move the valve means between the two positions;

liquid-level sensing means mounted in the holding tank and responsive to a predetermined maximum level of flowable material in the holding tank;

means responsive to the sensing means to initiate the operation of said motor means to move said valve means to said first position for opening the conduit means to transfer flowable material out the outlet of the holding tank to the storage tank;

means responsive to a predetermined condition during the transfer of flowable material to initiate the operation of said motor means to move said valve means to the position that closes the conduit means;

second heater means mounted on the storage tank to surround substantially the storage tank so as to provide a sufficiently high temperature throughout the storage tank to incinerate waste in the storage tank; and

means responsive to the open condition of the conduit means to prevent the operation of the second heater means that provides incineration in the storage tank.

37. The system of claim 36 and further including means responsive to at least one condition of an airplane, in which the system is to be utilized, said condition indicating that the airplane is other than stationary with its engines shut down, said airplane-condition means preventing the operation of the heater means for incineration.

38. A waste storage system for a toilet which comprises:

a temporary holding tank to receive human body waste from a toilet bowl, said tank having an inlet in a top portion to receive such waste and having an outlet in a bottom portion of the tank;

a volume reductive storage tank having an inlet and an outlet in a top portion of the tank;

conduit means connecting said outlet to the holding tank to said inlet of the storage tank to provide a communication between the tanks for transfer of the waste from the holding tank to the storage tank;

heater means mounted on the storage tank to volatilize out said outlet of the storage tank at least part of the flowable material transformed to the storage tank from the holding tank;

valve means operatively associated with the conduit means and moveable between a first position and a position that closes the conduit means;

motor means operatively associated with the valve means to move the valve means between the two positions;

liquid-level sensing means mounted in the holding tank and

responsive to a predetermined maximum level of flowable material in the holding tank;

means responsive to the sensing means to initiate the operation of said motor means to move said valve means to said first position for opening the conduit means to transfer flowable material out the outlet of the holding tank to the storage tank;

means responsive to a predetermined condition during the transfer of flowable material to initiate the operation of said motor means to move said valve means to the position that closes the conduit means;

a scoop supported in the holding tank at the inlet of the holding tank to receive waste passing through that inlet from a toilet bowl and to direct it laterally within the tank, said scoop having a lower portion that is in two complementary parts;

a pair of hinge means mounted on the upper portion of the scoop and pivotally mounting said two parts at horizontally-spaced pair of horizontal axes of pivotal movement; and

springs mounted on said upper portion of said scoop to urge said two parts into abutment with each other, whereby the lower portion of said scoop can be opened by pivotal movement of the two parts against the forces of the spring means to provide access to the holding tank.

39. A waste storage system for a toilet which comprises:

a temporary holding tank to receive human body waste from a toilet bowl, said tank having an inlet in a top portion to receive such waste and having an outlet in a bottom portion of the tank;

a volume-reductive storage tank having an inlet and an outlet in a top portion of the tank;

conduit means connecting said outlet of the holding tank to said inlet of the storage tank to provide a communication between the tanks for transfer of the waste from the holding tank to the storage tank;

heater means mounted on the storage tank to volatilize out said outlet of the storage tank at least part of the flowable material transformed to the storage tank from the holding tank;

valve means operatively associated with the conduit means and moveable between a first position and a position that closes the conduit means;

motor means operatively associated with the valve means to move the valve means between the two positions;

liquid-level sensing means mounted in the holding tank and responsive to a predetermined maximum level of flowable material in the holding tank;

means responsive to the sensing means to initiate the operation of said motor means to move said valve means to said first position for opening the conduit means to transfer flowable material out of the holding tank to the storage tank;

means responsive to a predetermined condition during the transfer of flowable materials to initiate the operation of said motor means to move said valve means to the position that closes the conduit means;

a scoop mounted in the holding tank at the opening at the top portion of the holding tank to receive waste through that opening and to direct it laterally within the tank, said scoop having a top circular inlet and an outlet within the holding tank that is facing horizontally;

support means mounted on the top wall of the tank and extending downwardly to mount said scoop at the lateral extension for pivotal movement about a vertical axis; and

spring means on the extension of the support means to urge upwardly the scoop, whereby the scoop in its normal position is urged upwardly and in communication with the inlet in the top wall of the holding tank but can be moved downwardly and pivoted about the vertical axis to be moved out of the way for any desired access to the holding tank.

40. The system of claim 39 wherein:

said holding tank at said inlet has a downwardly extending annular flange with a portion adjacent its end portion that converges in the downward direction to provide an external annular shoulder; and

said scoop at the top periphery of its upper inlet engaging said annular shoulder when the scoop is in operative position and urged upwardly by said spring means, whereby waste passing through said inlet of the holding tank can contact the scoop only below the periphery of the top inlet of the scoop and movement of the scoop about said vertical axis while in the operative position is prevented.

41. A waste storage system for a toilet which comprises:

a temporary holding tank to receive human body waste from a toilet bowl, said tank having an inlet in a top portion to receive such waste and having an outlet in a bottom portion of the tank;

a volume-reductive storage tank having an inlet and an outlet in a top portion of the tank;

conduit means connecting said outlet of the holding tank to said inlet of the storage tank to provide a communication between the tanks for transfer of the waste from the holding tank to the storage tank;

heater means mounted on the storage tank to volatilize out said outlet of the storage tank at least part of the flowable material transformed to the storage tank from the holding tank;

valve means operatively associated with the conduit means and moveable between a first position and a position that closes the conduit means;

motor means operatively associated with the valve means to move the valve means between the two positions;

liquid-level sensing means mounted in the holding tank and responsive to a predetermined maximum level of flowable material in the holding tank;

means responsive to the sensing means to initiate the operation of said motor means to move said valve means to said first position for opening the conduit means to transfer flowable material out the outlet of the holding tank to the storage tank;

means responsive to a predetermined condition during the transfer of flowable materials to initiate the operation of said motor means to move said valve means to the position that closes the conduit means;

a metering system operatively associated with means to close the valve means so as to provide a predetermined quantity of disinfectant concentrate composition from the metering system to the holding tank during a cycle of operation of the valve means that ends with the conduit means being in closed condition, so that the holding tank after each closing of the conduit means contains at least said predetermined quantity of such composition.

42. The system of claim 41 wherein the metering system includes:

a cylindrical housing having an inlet and an outlet in the top portion and a bottom opening;

a piston mounted in the housing below said inlet and said outlet;

a cam follower mounted below and supporting the piston;

cam means below the housing to abut the cam follower so as to provide by one complete rotation of the cam means an upward movement of the piston to a position still below said inlet and said outlet of the housing only for a short interval of time;

a shaft rotatably mounted and fixedly mounting said cam means, said shaft being operatively associated with said motor means, operatively associated with the valve means, whereby said shaft is rotated once about its axis during one cycle of operation of the valve means to provide said vertical movement of the piston during the completion phase of the cycle of operation that is provided for said valve means;

means mounted on the housing and communicating with said inlet of the housing to provide unidirectional flow of liquid into the housing; and

means mounted on the housing and in communication with said outlet of the housing to provide unidirectional flow of liquid from the housing for transferring a metered quantity of such composition to the holding tank by a conduit.

43. The system of claim 42 and further including a supply system to replenish automatically the metering system with such composition, said supply system comprising:

a replaceable canister;

support for the canister; and

a hollow needle mounted on the support and extending from it to puncture the supported canister,

said canister comprising:

a housing having a top end wall with a portion penetratable by said needle when said canister engages said support and having at its bottom end wall a central opening from which extends an annular guide flange;

a piston within the housing and spaced from the sidewall of the housing, said piston having a downwardly extending central boss guided by said annular flange of said bottom end wall of the canister;

a spring between the piston and the bottom end wall to urge the piston upwardly toward the top end wall; and

a flexible tubular sealing member in the housing, said member being secured at one end to the housing at a position intermediate the end walls above the piston, being secured at the other end to said piston, and having an intermediate portion having a reverse bend to maintain a seal between the part of the housing below the piston and the part of the housing above the piston.

44. The system of claim 43 wherein said downwardly extending boss of said piston in the housing is sufficiently elongated to extend through the opening in the end wall when the canister is at least partially filled with liquid.

45. The system of claim 44 wherein:

the support for the canister has an externally threaded, downwardly-extending cylindrical flange and has a bottom coaxial boss through which the needle extends; and

the canister has an internally-threaded cylindrical flange engaging the flange of the support and has, for the penetratable part of the top end wall, a central opening with a downwardly facing shoulder and a penetratable sealing material secured in the opening.

46. The system of claim 45 and further including:

heat-shielding means mounted on the storage tank and moveable between a first position away from said inlet of the storage tank communicating with the conduit means and a second position preventing communication between that inlet and the conduit means;

motor means to move the heat-shielding means between the first and second positions; and means responsive to the open condition of the conduit means to prevent operation of the motor means for moving the heat-shielding means to its second position.

47. The system of claim 46 wherein:

the storage tank has another opening in the top portion; the system further includes a blower mounted on the storage tank and communicates with said another opening; and

the first position of the heat-shielding means is at and closes said another opening so that volatilized matter does not pass out through said blower when said heat-shielding means is at its first position and so that the blower communicates with the storage tank only when said motor has moved the heat-shielding means to close the inlet of the storage tank communicating the storage tank with the conduit means.

48. The system of claim 46 wherein:

the outlet of the holding tank is in an end sidewall and has its lowermost portion at the plane of the top surface of the bottom wall of the holding tank adjacent that outlet;

the bottom wall of the holding tank has a raised portion intermediate the end sidewalls to provide one zone adjacent the end sidewall with said outlet and another zone ad-

adjacent the other end sidewall, said raised portion being provided by an incline of the bottom surface of the holding tank upwardly in a direction away from the outlet in the end sidewall of the holding tank that communicates with the conduit means to an intermediate zone in that tank adjacent to which there is also connected a steep decline of the bottom surface to provide one of the walls of said another zone and the corner portions of the bottom surface of the holding tank adjacent the wall having the offset outlet communicating with the conduit means are substantially raised to provide a deeper trough adjacent that opening;

at the juncture of the inclined surface and the steep surface forming one wall of said other zone there is located a perforated plate that provides a screening action to limit the movement of material other than liquid from said one zone to said other zone;

means mounted above said other zone in the holding tank away from the perforated plate and having a conduit, a pipe connected to that conduit and with openings spaced transversely in the tank, and nozzles mounted on that pipe at the openings to provide liquid spray to the perforated plate for backwashing of material against openings in the plate and for the movement of that material toward the outlet communicating with the conduit means;

flushing valve means moveable between two positions to alternatively direct liquid from the pump to a conduit for

providing flushing liquid for toilet bowl and to said conduit connected to the pipe with nozzles for providing such liquid for the backwashing of the perforated plate;

a pump mounted on the holding tank and having its inlet in said other zone of the holding tank;

a motor for the pump;

means responsive to the operation of the motor means for the valve means to open the conduit means so as to initiate the operation of the motor for the pump and to move the flushing valve means to shift from the normal communication of the pump with the conduit for the toilet bowl to the conduit connected to the pipe with nozzles, whereby liquid from the holding tank is pumped to the nozzles for the backwashing operation during the time that the conduit is opening and is open;

liquid-level sensing means in the holding tank and responsive to a predetermined minimum level of flowable material in the holding tank; and

means responsive to said predetermined minimum level sensing means to initiate the stopping of the motor for the pump and to allow the shift of the flushing valve means to cease communication with the nozzles.

49. The system of claim 48 and further including a jet pipe connected to the pipe having nozzles and extending from said another zone into said one zone and directed toward said outlet in the sidewall of the holding tank to provide a blasting force of liquid to move solids from said one zone through said conduit, when open, into the storage tank.