SANITARY WATER CONSERVATION DEVICE

An installation for the intermediate holding and storage of sewage and effluent, said installation comprising a sealable housing 9 having an inlet 1 for receiving said effluent and an outlet for discharging said effluent, a holding reservoir 2 pivoting mounted and positioned within said housing to receive and temporarily store a quantity of said effluent, wherein said holding reservoir is an asymmetrically shaped open bucket adapted to automatically move about said pivot from a first position adapted for receiving and storing said effluent to a second invented position where stored effluent is emptied into said housing under the influence of gravity once the accumulated effluent reaches a sufficient mass wherein said housing includes an effluent race 11 incorporated into the floor of said housing to divert said effluent directly to said outlet.
"Sanitary Water Conservation Device"

Cross-Reference to Related Applications

The present application claims priority from Australian Provisional Patent Application No 2006906729 filed on 30 November 2006, the content of which is incorporated herein by reference.

Introduction to the Invention

This invention relates to water conservation and water measured dosing and in particular, to an installation for reducing the quantity of water used to flush a toilet.

The unit has at least 3 distinct uses.

1. For reducing the quantity of water used to flush a toilet by supplementing the waste water from the toilet for the sewer pipe drainage leg of the transport path with an additional amount from other household water fixtures. IE 1 litre of toilet waste water with say 8 litres from other water fixtures.

2. For providing a measured dosing unit for gray water reuse in the garden for irrigation.

3. For irrigation purposes with fresh potable water as noted in 2.

Background to the Invention

Instance 1

The sanitary flushing of toilets and other waste disposal sanitary fittings involves the use of a sufficient quantity of water at each flush to ensure the contents of the toilet is removed from the bowl completely and transferred to a sewer pipe with sufficient flow to ensure the contents of each flush migrates through the sewer pipes without clogging up.

Historically, toilet flush systems have been designed to provide an adequate flush volume of a toilet to accommodate the removal and movement of stools and solids. This volume of water is often in excess of requirements, particularly where no solids are present.

The amount of water used for the purpose of toilet flushing represents a significant portion of domestic water use.

It would be desirable to reduce the quantity of water required at each flush whilst maintaining sufficient flow through the sewer pipes to avoid clogging.
Instance 2 & 3

The use of the installation as an irrigation means allows for a measured does equal to the volume of the bucket to be delivered at one time. The dosing method allows for a pipe to be connected with a specified number of outlets to the ground. The tipping bucket delivers a measured amount which is then divided to the number of soakage spikes provided to the gravity fed pipe. This use of the installation of the invention can either use fresh water of be connected to household gray water lines.

Statement of the Invention

In a first aspect the invention provides an installation for the intermediate holding and storage of liquid, said installation comprising a sealable housing having an inlet for receiving said liquid and an outlet for discharging said liquid, a holding reservoir pivotally mounted and positioned within said housing to receive and temporarily store a quantity of said liquid, wherein said holding reservoir is an asymmetrically shaped open bucket adapted to automatically move about said pivot from a first position adapted for receiving and storing said liquid to a second inverted position where stored liquid is emptied into said housing under the influence of gravity once the accumulated liquid reaches a sufficient mass wherein said housing includes a liquid race incorporated into the floor of said housing to divert said liquid directly to said outlet.

The liquid may be sewage and effluent.

The holding reservoir may comprise a bucket with a release mechanism for emptying said bucket when sufficient quantity of sewage is accumulated. The bucket may be bias to automatically return to the first position by counterweight action. The holding bucket may be pivoted about an axis and provided with an asymmetric storage capacity either side of said pivot such that once a sufficient quantity of sewage is accumulated in the bucket, the bucket will rotate under gravity and empty the contents therein to said outlet.

The holding bucket preferably includes a spout positioned on a first side for directing the contents of said bucket to said outlet. The bucket may be shaped in cross-section to include a partial circle portion and a tapering spout extending therefrom.

The bucket may be pivotally fitted within said housing on bearings or on a set of open bearings and include a stop to ensure the bucket only rotates in one direction to empty the contents via said spout.

The holding bucket preferably includes a contoured lip associated with the spout configured to divert the effluent toward the race outlet. The interior of the reservoir or
The holding bucket is preferably smoothly contoured to avoid accumulation or trapping of waste materials.

The unladen reservoir or bucket preferably has a centroid of plane area and mass moment of inertia to the right or far side of said pivot point in relation to said spout.

The laden reservoir or bucket preferably has a mass moment of inertia which progressively moves during filling from the right or far side of said pivot relative to said spout to the left or near side of said pivot relative to said spout, thereby causing the reservoir to rotate to the second position.

The reservoir or bucket preferably includes two counterweights to assist in the automatic return of the reservoir once emptied to the first position, said counterweights including a first position counterweight positioned of the farthest distance from the pivot point centroid when in said first position and the second position counterweight positioned at the farthest distance from the pivot point centroid when in said second position.

The housing of the installation may include an inspection opening on the top end thereof and an integral lid fitting to said opening whereby the integral lid includes a support bracket and pivot points for said reservoir.

The invention will now be described with reference to one particular embodiment shown in the figures:

Figure 1 shows a cross-section side view of the installation;
Figure 2 shows a plan view of the installation with the bucket removed;
Figure 3 shows a plan view of the installation with the bucket removed including a section through the race Section A-A;
Figure 4 shows a side view of the installation housing detailing the floor or base angle of the race;
Figure 5 shows a side view of the integral lid and support bracket including pivot points for the reservoir;
Figure 6 shows side, top and front views of the reservoir.
Figure 7 shows a side view of the reservoir in the first position;
Figure 8 shows a side view of the reservoir in the second position;
Figure 9 shows the flow characteristics of the installation in a first stage of deposition;
Figure 10 shows the flow characteristics of the installation at a second stage of deposition.
Referring to the figures, the invention will be described with reference to one particularly preferred embodiment where the installation of the invention is adapted for fitting and incorporation into the toilet flushing system of a domestic house. The installation of the invention can of course be adapted to a wide range of sanitary waste disposal situations and can make good use of water flow and flushing facilities available from gray water and other services available in a typical domestic situation.

Referring particularly to the primary embodiment, the invention provides an installation or system adapted for the intermediate and temporary holding or storage of small or intermediate quantities of sewage and effluent; in particular, where the solid matter included within the sewage and effluent would or may be insufficient to ensure efficient flow and movement of a small or reduced quantity of sewage and effluent through the sewage piping and plumbing facilities into the main sewer network.
The installation shown in Figure 1 includes a generic housing 9 for holding and mounting the various components of the installation. The housing includes an inlet 1 positioned at either or both sides of the upper portion of the housing. The inlet is adapted to receive the outlet from a toilet or other sanitary fitting which is directed into the installation of the invention by way of the standard or routine plumbing accompanying a toilet or other sanitary facility.

The installation of the invention further includes a holding reservoir 2 which is particularly adapted to contain the sewage or effluent flushed through the inlet or inlets 1. The holding reservoir is positioned underneath the inlet 1 and has a volumetric capacity for storing sufficient effluent, including liquid, to ensure that the transfer of the contents of the reservoir from the installation of the invention into the sewer piping system of a domestic house or other situation, is sufficient to adequately transfer sewage and effluent, including solid materials, through the piping system without a risk of clogging or blockage.

The installation of the invention further includes an outlet 3 for conducting the effluent or sewage once emptied from the reservoir 2.

The holding reservoir preferably takes the form of a bucket or other container adapted to receive intermediate deliveries of sewage or effluent and store the intermediate deliveries so as to build up a critical or minimum volume of liquid necessary to ensure the efficient flushing or delivery thereof into the sewer system.

In the one particularly preferred embodiment of the invention shown in figures 6 and 7, the reservoir takes the form of a pivotally rotatable, asymmetrically shaped, bucket which is pivoted around pivot points 5 for rotation about an axis 6. The asymmetric shape of the holding bucket 2 is clearly detailed in figures 6 and 7 where the shape of the bucket is generically formed with the bulk of the reservoir taking the shape of a cut-off of a portion of a full circle with a pouring spout 7 attached as an extension thereof. The shape of the partial full circle is economic in cross-sectional area and allows the unit to be enclosed in a small encasement or housing 9. In addition, the rounded shape of the main portion of the reservoir ensures minimal edges and regions for adherence of waste and allows for a smooth and continuous surface on the inside of the reservoir.

The spout 7 of the bucket includes a contoured lip 17. The contoured lip ensures that the waste exits the tipping reservoir as it moves from position 1 to position 2 such that the exiting waste is concentrated at the exit sewer pipe and the pulse flush provided by the movement of the reservoir from the first to the second position and imparts a velocity to the expelled waste equal to the gravitational fall of the fluid. The
configuration of the spout and contoured lip ensures a concentration of fluid and waste flow towards the lowest point of the housing 9.

The reservoir 2 has a tipping pivot point 5 which balances the unladen centroid of the reservoir and the laden weight of the reservoir plus accumulated waste. The pivot point 5 is positioned to ensure that the reservoir only tips when the waste water reaches the desired level. The pivot point is likewise on a vertical axis placed to ensure that once the reservoir tips the waste material in the bucket is completely evacuated prior to the bucket resetting to the first position. The unladen reservoir position as shown in Figure 6 has a centroid of plane area and mass moment of inertia to the right of the pivot point as displayed and indicated in Figure 6, being removed from the position of the spout. Once the reservoir becomes laden, the mass moment of inertia progressively moves from the right of the pivot point as shown in Figure 6 to the left of the pivot point as shown in Figure 7 thereby causing the reservoir to rotate from the first to the second position and evacuate the reservoir.

In this manner the waste water and waste materials accumulated in the reservoir act as a lever arm to encourage and reinforce the rotation of the reservoir from the first to the second position thereby accelerating the evacuation of waste.

In order to assist the reservoir to return from the second to the first position, the reservoir is provided with counterweights including a first position counterweight 18 which can be seen in Figure 6, where its position is at the farthest distance d from the pivot point centroid. The second position counterweight 19 is clearly shown in Figure 7 being positioned at the farthest distance from the pivot point centroid when the bucket is in the second position.

The asymmetric shape and free pivotal mounting of the bucket 2 allows the bucket to accumulate effluent or sewage and once a critical volume is reached within the bucket the biasing provided by the asymmetric shape of the bucket either side of the pivot point 5 causes the bucket to invert or tip spontaneously, thereby disgorging and releasing the whole contents of the bucket into the bottom of the housing 9 for disposal through the outlet 3 into a sewer pipe 4.

The bucket may be pivoted in an open bearing or bearing surface 12 which allow ready removal of the bucket from the housing for securing etc.

In order to facilitate the reliable and correct asymmetric action of the holding bucket 2, the housing is provided with an integral lid and support bracket 16 as shown in Figure 5. The lid and support bracket are designed to fit in an access point 10 as shown in Figure 4 of the housing 9. The bracket is provided with a pivot point 5 for suspension of the reservoir and is also provided with the stop 13 to prevent the
reservoir from moving too far from the first to the second position. In addition, the stop 13 is adapted to ensure the bucket only empties in one direction about the pivot point 5, thereby ensuring that the intermittent supply of effluent or sewage to the bucket, does not cause instability or movement of the bucket away from the spout 7 being the preferred side for delivery of the contents. The stop is preferably positioned at the rear of the bucket as shown in Figure 1. The bracket is also fitted with a central baffle 22 to separate the two inlet ports 1 of the housing to prevent input to the device passing directly from one inlet to the other.

In addition, the housing 9 may be provided with the sewer race 11 which can be seen in plan view from Figure 2 and 3 and side view in Figure 4. The sewer race ensures the efficient delivery of the contents of the bucket into the outlet 3 and sewer pipe 4 with the slope and tapering of the sewer race ensuring maximum inertia is provided by the dumping of the contents of the holding bucket once the critical volume is reached.

The configuration of the sewer or effluent race includes a floor region or base 14 positioned towards the bottom of the housing 9. The slope provided for the floor or base of the race ensures that effluent dumped from the rotating reservoir is rapidly transmitted down the race into the outlet 3. In addition, the race includes tapered sides 15 which work in concert with the sloped face 14 to ensure that all effluent and wastage is efficiently and precisely directed to the outlet minimising any spaces where sewerage or effluent could accumulate.

In addition to the provision of a streamlined race, the interior of the reservoir is smoothly contoured to likewise eliminate any spaces that could trap sewerage or debris such that the smooth contouring of the interior of the reservoir extending to the spout region 7 ensures an efficient and complete movement of all accumulated waste from the reservoir during the tipping and emptying action. The combination of the positioning of the reservoir and the smooth delivery of contents through the spout onto the tapered and configured race ensures a smooth, splash-free and hygienic delivery of the contents of the reservoir to the outlet of the housing 3.

The installation of the invention may include an inspection cover or access point 10 provided for the housing, preferably on the top thereof to allow ready inspection and maintenance, if necessary. The inspection cover and access 10 most preferably allows for complete sealing of the housing and installation of the invention to ensure adequate and hygienic quarantining of the temporarily stored sewage or effluent from the general environment.
The installation of the invention can be fitted or retrofitted to existing sewage systems by incorporation between the toilet outlet and the sewer pipe 4. In this manner, the installation of the invention can be buried in-ground or attached adjacent the toilet or other sanitary waste fitting to which it is applied. The positioning of the inlet 1 and outlet 3 of the installation of the invention are preferably configured to align with the preferred orientation of plumbing known and provided in standard plumbing incorporation. Such configurations of the installation of the invention allow ready retrofitting of the installation to existing domestic situations and allow for use to the installation of the invention readily and easily in new building constructions.

In use, the installation of the invention can be readily retrofitted or incorporated in new constructions and is specifically designed to allow the amount of water used for flushing toilets and other sanitary installations to be reduced to an absolute minimum for clearing the soiled water including effluent and sewage past the toilet bowl and "p" or "s" trap or any odour barrier and into the installation of the invention. As the amount of water used will be reduced to an absolute minimum, in most cases the flush will not be sufficient to adequately traverse the sewer piping and exterior plumbing of a house or other situation. However, such a reduced flush will be sufficient to allow the movement of soiled water and waste from the toilet or other sanitary fitting into the installation of the invention and out of the immediate environment of the user. The installation of the invention is particularly adapted to accumulate and temporarily store a number of such minimal water usage flushes whereby the gradual accumulation of volume into the holding bucket allows the installation to accumulate, within the reservoir, sufficient volume to allow safe and efficient entry of the accumulated waste into the sewer pipe and septic systems.

Whilst the holding reservoir could adopt a wide range of configurations and permutations, including a wide range of release mechanisms and systems; the particularly preferred embodiment, as detailed in the current application, provides for a highly simplified, gravity operated, passive system where the asymmetric shape of the holding bucket and the positioning of the pivot 5 allowing for the completely passive activation of the bucket. In this manner, the holding bucket securely receives the required number of flushes or inputs in a stable manner. However, once the crucial volume or weight is achieved, the bucket moves from its resting position to immediately adopt an over-centre tilt driven by gravity such that the whole contents of the bucket are immediately and forcefully dispatched into the bottom of the housing 9 down the sewer race 11 and into the sewer pipe 4. In this manner, the accumulation of a plurality of flushes from the toilet outlet are accumulated and only discharged from the
installation of the invention upon achieving a critical mass; that allows for safe, efficient and sanitary delivery of effluent and sewage down a sewer pipe system with minimised chance or incidents of blockage.

The fluid flow characteristics and advantages of the specific configuration of the housing enclosure and race configuration are shown with reference to Figures 9 and 10. Referring firstly to Figure 9, a first stage of action is shown with the combination of the tipping reservoir 2 and the tapered race 11 providing a two-part flow velocity to the waste material. The waste material after leaving the reservoir passes to the lowest point of the enclosure with some solid material 20 tending to exit directly to the sewer line.

The remainder of the waste material, in particular the fluids 21, tend to be forced up the tapered floor toward the rear of the housing and return by gravity to exit the housing as part of the first flow. Referring to Figure 10, the second stage action shows that the fluid characteristics of the waste materials are also governed by the velocity imparted by the installation and the action of the tipping reservoir. This action is predicted in Bernoulli’s equation \( P + \frac{1}{2} \rho v^2 + \rho gh = \text{constant} \)

where

- \( P \) is the pressure
- \( \rho \) is the density
- \( v \) is velocity
- \( h \) is elevation; and
- \( g \) is gravitational acceleration

and is a static head which is the actual elevation of the fluid above the reference level. The reference level for the invention is the base invert of the outlet pipe 3. This static head does not exist at a specific location in a sewer network because the grades are substantially consistent. The unique feature of the enclosure of the invention includes the concentration of a static head which allows the fluid 21 to be given a velocity sufficient to carry the waste water and materials through at least 30 metres of sewer pipe at 1.65% for 100 mm diameter.

The motion and passive activation of the holding bucket of the invention could of course, be provided in a wide range of alternative active forms including electronic, electric, solenoid, valve, vacuum or alternative mechanical discharging systems and all of these embodiments are included within the scope of the current invention.

The compact and serviceable nature of the installation of the invention makes a readily adaptable for in-ground fitting. Alternatively, the installation can be ready adapted for fitting to the exterior wall of a house or other domestic situation at a first floor, second floor or subsequent elevation.
The installation of the invention is primarily adapted to utilize the normal water flows of a reduced flush toilet system; but, can also be modified to utilize gray water availability and can be configured to service public amenities, offices, workshops, factortes etc.

The installation of the invention can include suitable breathers as may be required for waste system installations. The installation may also acts as a backflow prevention device which ensures the movement of accumulated and temporarily stored effluent and sewage cannot be discharged back to the user facility.

It will be appreciated by persons skilled in the art that numerous variations and/or modifications may be made to the invention as shown in the specific embodiments without departing from the scope of the invention as broadly described. The present embodiments are, therefore, to be considered in all respects as illustrative and not restrictive.
CLAIMS:
1. A installation for the intermediate holding and storage of liquid, said installation comprising a sealable housing having an inlet for receiving said liquid and an outlet for discharging said liquid, a holding reservoir pivotally mounted and positioned within said housing to receive and temporarily store a quantity of said liquid, wherein said holding reservoir is an asymmetrically shaped open bucket adapted to automatically move about said pivot from a first position adapted for receiving and storing said liquid to a second inverted position where stored liquid is emptied into said housing under the influence of gravity once the accumulated liquid reaches a sufficient mass wherein said housing includes a liquid race incorporated into the floor of said housing to divert said liquid directly to said outlet.
2. An installation according to claim 1, wherein said liquid includes sewage and effluent.
3. An installation according to claim 1 or 2, wherein said open bucket is biased to automatically return to said first position once emptied.
4. An installation according to any one of claims 1 to 3, wherein said race includes a floor sloped toward said outlet and sides tapered toward said outlet.
5. An installation according to any one of claims 1 to 4, wherein said bucket shape in cross-section includes a circle portion and a tapered spout extending therefrom.
6. An installation according to any one of claims 1 to 5, wherein said spout includes a contoured lip to divert said effluent toward the said race outlet.
7. An installation according to any one of claims 1 to 6, wherein said reservoir includes a smoothly contoured interior.
8. An installation according to any one of claims 1 to 7, wherein said reservoir is pivoted about a set of open bearings and provided with a stop to limit pivotal movement from said first to said second positions to one direction only.
9. An installation according to any one of claims 1 to 8, wherein said unladen reservoir has centroid of plane area and mass moment of inertia to the right of said pivot point.
10. An installation according to claim 9, wherein said laden reservoir has a mass moment of inertia which progressively moves during filling from the right of said pivot to the left of said pivot thereby causing said reservoir to rotate to said second position.
11. An installation according to any one of claims 1 to 10, wherein said reservoir includes two counterweights being a first position counterweight positioned at the farthest distance from the pivot point centroid and a second position counterweight positioned at the farthest distance from the pivot point centroid.
12. An installation according to any one of claims 1 to 11, wherein said housing includes an inspection opening and an integral lid therefore wherein said lid includes a support bracket and pivot point for said reservoir.

13. A sewerage system characterised by incorporating the installation according to any one of claims 1 to 12.

14. A sanitary water disposal system characterised by incorporating the installation according to any one of claims 1 to 12.

15. A liquid dosing system characterised by incorporating an installation according to any one of claims 1 to 12.

16. An installation according to any one of claims 1 to 13, substantially as hereinbefore described.
FIG. 9
## INTERNATIONAL SEARCH REPORT

**International application No.**
PCT/AU2007/001838

### CLASSIFICATION OF SUBJECT MATTER

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According to International Patent Classification (IPC) or to both national classification and IPC:

### FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPAT (Above IPC marks and keywords - intermediate, temporary, pivot, tank, storage and like terms)

### DOCUMENTS CONSIDERED TO BE RELEVANT

<table>
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<td>X</td>
<td>US 3843976 A (MIYA et al.) 29 October 1974 Abstract, figure 4D</td>
<td>1 - 16</td>
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<td>A</td>
<td>CH 590980 A5 (A CEVDET SAATCI) 31 August 1977 Abstract</td>
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[ ] Further documents are listed in the continuation of Box C [X] See patent family annex

* Special categories of cited documents
  'A' document defining the general state of the art which is not considered to be of particular relevance
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  '&*' document member of the same patent family

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This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

END OF ANNEX