

HORIZONTAL-FLOW OIL-SEALANT-PRESERVING DRAIN ODOR TRAP

The present application is a Continuation-in-Part of both U.S. Patent Application Serial No. 08/548,281, filed October 25, 1995, and PCT Application No.

5 PCT/US95/16064, filed December 11, 1995, both entitled Horizontal-Flow Oil-Sealant-Preserving Drain Odor Trap.

Technical Field

The present invention relates to sealed odor traps for waterless urinals, anti-evaporation floor drain
10 traps, and the like, and it is more particularly directed to improvements in the internal structure of oil-sealed odor traps for prolonging sealant retention and for protection against high pressure water flushing.

15 Background of the Invention

With increasing emphasis on water conservation, there is renewed interest in toilets and urinals designed to minimize the amount of water consumed in flushing to mitigate excessive demands on water
20 supplies as well as on wastewater disposal systems, both of which have tended to become overloaded with increasing populations.

Sanitation codes require urinals to provide an odor seal to contain gasses and odors which develop in
25 the drain system: this function is conventionally performed by the well known P-trap or S-trap in which the seal is formed by a residual portion of the flushing water. This seal effectively locks in sewer odors from the drainpipe beyond the trap, however the upward-facing liquid surface communicates freely with
30 the user environment, so that the trap must be kept free of residual urine by copious flushing to prevent unacceptable odor levels from the liquid in the trap;

therefore a large amount of water is consumed in flushing these conventional urinals. Especially in the U.S. over many years when water was cheap and plentiful, conventional flushing type urinals and water-wasteful toilets held an unchallenged monopoly. However more recently, threatened and real water shortages have aroused new environmental concerns and heightened conservation awareness as evidenced by the introduction of low flush toilets.

As the cost of water increases and budgets tighten, the prospect of a viable waterless urinal system becomes extremely attractive to a wide range of public agencies, cities, states, penal institutions, defence establishments, recreational and parks departments and the like. Waterless urinals utilizing oil-sealed odor traps are becoming viable. However, the present inventor has discovered that a key factor in their potential is the attainment of low maintenance, and that this is largely dependent on the longevity of the liquid sealant, which in turn is related to the internal structure of the odor trap. Thus, the present inventor has recognized that improvements are desirable both in the rate of depletion under normal service conditions and in protection against catastrophic sealant loss due to high pressure water flushing, which though not required, can occur inadvertently.

It is a primary object of the present invention to provide an improved oil sealed odor trap for a flushless urinal or an anti-evaporation floor drain that not only meets the usual objectives of eliminating the need for a P-trap in the drain line while complying with U.S. sanitation standards, being economical and easy to manufacture and install, and performing reliably and efficiently with low maintenance requirements, but more particularly with regard to depletion of oily liquid sealant, it is a primary

object to structure the trap in a manner to largely prevent escape of sealant by causing stray droplets of sealant drifting buoyantly in the flow path to return to the main sealant body.

5 It is a further object to configure the odor trap such that it can be easily installed and removed from a permanent drain terminal plumbing fixture.

It is still further object that the odor trap should be constructed and arranged to prevent loss of
10 sealant in the event of high pressure flushing with water.

List of References

	<u>Patent No.:</u>	<u>Patentee:</u>
	303,822	D'Heureuse
15	1,050,290	Posson
	3,829,909	Rod, et al.
	4,026,317	Ekstrom
	4,028,747	Newton
	4,045,346	Swaskey
20	4,244,061	Webster, et al.
	4,263,934	Redden, et al.
	4,411,286	Ball
	4,432,384	Guiboro
	4,773,441	Biba
25	5,159,724	Vosper
	5,203,369	Hwang
	318264 Germany	Zeigler
	2816597.1 Germany	Ernst
	606,646 Switzerland	Ernst

30 Statement of the Prior Art

U.S. Patent No. 303,822 (D'Heureuse) disclosed a wastewater pipe S-trap into which a disinfectant or deodorizer is introduced.

The use of an oil as a recirculated flushing
35 medium in a toilet system was disclosed in U.S. Patent No. 3,829,909 (Rod, et al.).

The use of oil in toilets to form an odor trap has been disclosed in German Patent No. 121356 (Beck, et al.) and in U.S. Patent Nos. 1,050,290 (Posson) and
40 4,028,747 (Newton).

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Bell traps, essentially a coaxial form of S trap, have been known for over a century: a popular form is exemplified in German Patent No. 318264 (Zeigler). Multiple baffle structure is disclosed in U.S. Patent No. 4,026,317 (Ekstrom). Center-entry coaxial trap configurations are shown in U.S. Patent Nos. 4,045,346 (Swaskey) and 5,203,369 (Hwang).

Beetz introduced an oily liquid layer floating in the trap as an odor barrier through which urine and water can permeate downward. Beetz taught making the oil mixture to have disinfectant properties and to have "innate adhesion power to attach itself to the odor lock parts so that the latter cannot be attacked by urine". Beetz taught daily maintenance, including cleaning, and coating the cast iron parts of the urinal, including the housing of the odor trap, with the oil mixture, stating that "the oil has the property that said parts absorb so much of it that the oil film somehow repels the urine". Beetz' requirement for daily cleaning and maintenance dictated an easily-disassembled three piece structure with a leakage-prone bottom interface joint, and his requirement for the sealant to also act as a disinfectant is now believed to have caused excessive depletion of the sealant.

Other examples of oil-sealed traps are found in German Patent No. 2816597.1, and Swiss Patent No. 606,646 (Ernst), practiced under the trademark SYSTEM-ERNST.

The foregoing examples of traps found limited use in Europe. Typically, they were utilized in a "low flush" rather than a "waterless" manner, e.g. the Beetz patent was classified under water pipe lines, and the specification thereof refers to "water and urine". The odor trap was mounted beneath the floor level and set in a concrete swale, functioning as an occasionally-flushed trough type or stall urinal of a

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type which is no longer recognized in U.S. building and sanitation codes.

A flushless urinal disclosed in U.S. Patent No. 4,244,061 (Webster, et al.) uses no oil, but instead
5 relies on a small "plug flow" entrance opening associated with a P trap, and is based on the premise that "the urine in the trap during normal use will be fresh and therefore without unpleasant odor".

A unitized cylindrical cartridge odor seal for a
10 waterless urinal was disclosed by the present inventor as a joint inventor in U.S. Patent Application 08/052,668 filed 04/27/93 and in a continuation-in-part thereof 08/512,453 filed 08/08/95, in the category of an oil-sealed coaxial edge-entry trap having a cap part
15 with an attached downward-extending tubular vertical partition.

A key parameter of oil-sealed odor traps for waterless urinals is the amount of sealant depletion that takes place under normal service conditions over
20 periods of time and frequency of usage. Related to this is the possible partial or complete loss of sealant due to the abnormal condition of unnecessary but unavoidable high pressure flushing with water. While some modern oil-sealed odor traps are
25 considerably improved over early versions, there remains an unfulfilled need for further improvements in the above-described aspects of sealant preservation: such improvements are provided by the present invention.

30 Statement of the Invention

The above and other objects have been met in the present invention of a unitized plastic oil-sealed odor trap that departs from conventional practice of
predominantly vertical liquid flow through the trap,
35 instead the trap is constructed and arranged in a special manner such that a substantial portion of the

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total flow path is made to be generally horizontal and to be located in a region where stray droplets of sealant, due to buoyancy, will migrate upwardly back to the main sealant body, either directly or as guided by a sloping baffle configuration. Thus, escaping of sealant down the drain is largely prevented.

The odor trap is configured such that it can be economically made from two molded plastic parts, i.e., a main compartment part and a cap/baffle part, that can be molded from plastic and joined by thermal bonding into a unit configured as a replaceable cylindrical cartridge that can be charged with sealant and sealed with a sticker for shipment so that upon installation it is necessary only to install the cartridge and remove the sticker.

In service, required maintenance, i.e. sealant checking and replenishment, if and when needed, can be easily performed with the unit in place.

The cartridge is shaped to be easily pushed into place by hand and held frictionally in a mating recess provided by a casing that can be installed as part of the host plumbing, either in a urinal or in a floor drain. For drain cleaning or replacement purposes, the odor trap can be removed with a special simple hand tool.

The shape of the entry compartment provides a sheltered region to which sealant tends to be temporarily displaced in the event of high pressure water flushing, thus avoiding catastrophic sealant loss.

Brief Description of the Drawings

The above and further objects, features and advantages of the present invention will be more fully understood from the following description taken with the accompanying drawings in which:

FIG. 1 is a cross-sectional view of an oil-sealed coaxial odor trap of known art;

FIG. 1A is functional diagram representing the left hand half of FIG. 1;

5 FIG. 2 is a functional diagram illustrating the principles of the present invention utilizing predominantly horizontal flow;

FIGS. 3 and 4 are functional diagrams illustrating two different baffle configurations in edge-entry coaxial trap structures according to the present invention;

10 FIGS. 5-8 are functional diagrams illustrating different baffle configurations in center-entry coaxial odor trap structures according to the present invention;

15 FIG. 9 is a three-dimensional view of a center-entry cylindrical odor trap cartridge;

FIG. 10 is a three-dimensional cutaway view of an embodiment of a horizontal-flow odor trap cartridge of the present invention having a cylindrical container and a non-coaxial internal configuration with vertical and horizontal baffle portions and an offset tubular drain stand;

20 FIG. 11 shows an alternative illustrative embodiment derived from FIG. 10 with a flat-partitioned drain stand;

FIG. 12 shows a cross-sectional view of a preferred embodiment of the present invention, similar to FIGS. 10 or 11, but having the lower baffle portion sloped for additional recovery of stray sealant;

30 FIG. 13 shows a cross-sectional view of another preferred embodiment of the present invention;

FIG. 14 shows an example of a wall mounted urinal in which an odor trap can be incorporated;

35 FIGS. 15-18 show one preferred construction of the preferred embodiment of FIG. 13. FIG. 15 is a bottom view of a top member thereof; FIG. 16 is a perspective

side view of a middle member thereof; FIG. 17 is a perspective side view of a bottom member thereof (with upper and middle members represented in part in dotted lines); and FIG. 18 is a perspective side view of a plug-handle member capable of being included in this embodiment.

Detailed Description of the Invention

FIG. 1 is a mid cross-sectional view of an odor trap 10A of the edge-entry trap configuration of known art as described above, configured as a cylindrical cartridge.

Odor trap 10A has a main liquid container 14 extending from an outer wall to an inner wall that forms a drain stand pipe 14A defining at its upper edge the overflow level of liquid in the container 14. An overhead cap portion 16 is formed to provide a vertical baffle 16A extending down into container 14 dividing it into an inner discharge compartment and a surrounding entry compartment. A body of residual urine 18 extends up to the overflow level at the top of stand pipe 14A, and in conjunction with the overhead plenum region formed by the cap portion 16, the residual body of urine 18 serves to trap sewer gasses from the external drain line in accordance with plumbing codes.

A body of oily liquid sealant 20, lighter than water or urine, floating in the entry compartment on top of the trapped body of urine 18, serves to trap odors from the urine 18 from escaping from trap 10A.

In operation of the urinal, urine from above, near the outer edge separates into droplets that permeate through the layer of sealant 20 and then join the main body of urine 18. As additional urine enters the body

of urine 18, it overflows the stand pipe 14A and the overflow portion gravitates down the drain.

Known oil-sealed odor traps are configured as in FIG. 1 with a vertical baffle 16A. From actual
5 experience, traces of sealant can escape during usage. Such depletion occurs as follows: in a form of turbulence or emulsification during each usage event, despite the inherent buoyancy of the sealant 20 due to
10 its low density and the non-affinity to water/urine, some droplets of sealant can separate from the main body and get swept downward along with the main flow of urine in the outer chamber. These stray droplets will tend to decelerate due their inherent buoyancy and,
15 depending on downward urine flow velocity and travel depth, some of them may come to rest and then reverse and rise against the flow to return to the main sealant body above, and are thus recovered. However, any droplets that get dragged by the urine flow past the
20 bottom of the baffle 16A, will then accelerate upwardly in the inner compartment 18 due to their buoyancy and will then escape down the drain conduit in stand tube 14A.

The present invention, operating on a modified form of the basic principle described above and
25 teaching novel internal structure, can be implemented with the same general cylindrical exterior shape as that of the odor trap shown in FIG. 1, and can be made to fit into a cavity receptacle that is part of a urinal system having an entry bowl portion 12A above,
30 leading to tapered upper edges of the outer wall of the main liquid container of odor trap 10A and extending downward around the trap 10A to a reduction portion 12B which connects by regular plumbing attachments to the external drain system.

FIG. 1A is a simplified schematic representation of the left hand half of the symmetrical configuration of FIG. 1 which is coaxial about a central axis C-C', showing again the relation of sealant 20, urine 18 and a sealant flow path 22 in the urine in the entry compartment. It is evident that in this configuration due to the vertical orientation of baffle 16A, the flow path 22 is predominantly vertical: downward in the outer compartment as shown and upward in the inner chamber, with only relatively small horizontal components around the bottom of baffle 16A and around the top of stand tube 14A. Flow path 22, having sealant 20 overhead, is the only portion of the total flow path where sealant recovery can occur, thus a corresponding parameter can be estimated as indicated by dimension X, representing the effective sealant-recovery horizontal flow path length. In a typical odor trap of the category of FIGS. 1 and 1A, with the main liquid container 14 having an inside radius R as indicated = 5.4 cm and the baffle 16A having an outside radius of 4 cm, the horizontal recovery dimension X is about 0.8 cm, from which we can express the unitless ratio $X/R = 14.8\%$ characterizing this particular internal structure.

The component X labelled in the FIGS. is an approximate average of the horizontal vector components X of the wastewater flow, extending from the middle of the entry opening (e.g. the point of average entry of the wastewater into the sealant) to a furthest point along the flow path (e.g. around the baffle) in which sealant recovery can occur. Although the invention contemplates a value X based on the approximate average, preferably, generally all of the wastewater will follow a flow path having a component X, e.g. any

wastewater not following such a flow path would be insubstantial enough to effect the proper functioning of the invention -- such as if extraneous openings were provided allowing a minimal volume flow rate therethrough.

5 A vertical vector component Y of the flow path can be approximately defined as the vertical distance from the top of stand pipe 14A to the bottom of baffle 16A. Accordingly, an alternative feature can be based on a ratio X/Y , which can be used to estimate an effective slope of the flow path -- for example, $X/Y < 1$ indicating a predominantly vertical flow path and $X/Y > 1$ indicating a predominantly horizontal flow path.

10 This category of odor trap is vulnerable to total loss of sealant if subjected to water-flushing at high pressure, due to the relatively narrow width of the outer compartment and absence of any sizeable shelter compartment around the entry region to which sealant can be displaced temporarily by the flushing water instead of being forced down the drain.

20 FIGS. 2-8 are simplified cross-sectional functional diagrams representing various odor trap configurations illustrating principles of the present invention, which is directed to preservation of sealant. For simplicity, as in FIG. 1A, only half of symmetrical cross-sections are shown, along with a central axis. The shapes shown generally apply to structure that is coaxial about the axis shown, but the invention could be practiced by applying such cross-sections to other, non-coaxial and/or non-symmetrical configurations such as rectangular containers or cylindrical containers with non-coaxial internal structure.

30 FIG. 2 is a conceptual diagram illustrating basic principles of the present invention wherein an odor trap 10B is structured in a novel manner: rather than making the baffle vertical as in FIGS. 1 and 1A, at

least a portion of the baffle is shaped in a non-vertical manner to cause the liquid flow path to be predominantly horizontal, as a major departure from entirely vertical baffles and consequent predominantly vertical liquid flow that has been universal in known art as described above.

The baffle in FIG. 2 has a vertical portion 16A, facing the vertical wall of drain riser 14A, and an inclined but substantially horizontal portion 16B sloping up to the cover 16C which has an entry opening 16D at the left. The contour of the bottom portion 14B of the main liquid container 14 is shown for simplicity as forming a flow path of substantially constant depth, however in practice there can be a much greater variation in depth along the flow path.

From the entry opening 16D at the left, the flow is to the right. The liquid flow path has two recovery portions 22A and 22B as indicated. In the portion 22A, starting at the entry inlet, the flow is horizontal, passing under the main body of sealant 20. Then in portion 22B the flow path slopes downward but remains predominantly horizontal as directed by the sloping baffle portion 16B. The flow path turns abruptly upward at the plane of vertical baffle portion 16A, to overflow riser 14A and then exits down the drain in the same manner as in FIGS. 1 and 1A.

It is evident that in both flow path portions 22A and 22B the flow path is predominantly horizontal, in distinction from the predominantly vertical flow paths in FIGS. 1 and 1A.

In FIG. 2 within the path length X indicated, practically all stray sealant droplets migrating upwardly to the top side of the flow path will be recovered and returned to the main body of sealant 20.

In flow path portion 22A the body of sealant 20 is directly overhead, and along portion 22B the slope of baffle 16B redirects upwardly-migrating stray sealant back to the main body of sealant 20, as indicated by the curved arrows. Since sealant recovery occurs along both of these portions, the recovery dimension X as shown is the sum of the horizontal components of the two portions.

The cross-section of FIG. 2 can be applied to a coaxial cylindrical structure having a central axis about the line C-C' and the outer wall of cylindrical container being at D-D', such as the wall 14 as shown. Alternatively, the cross-section of FIG. 2 can be applied in reverse manner to provide a coaxial cylindrical odor trap structure of the central-entry type with a central axis at D-D' and the outer wall of the cylindrical container at C-C'.

As a further alternative, the cross-section of FIG. 2 can represent that of an enclosure that is other than cylindrical, e.g. rectangular. In addition, the container can alternatively be made with side walls at both D-D' and C-C' such that a non-symmetrical, non-axial, device is formed.

A coaxial structure based directly on FIG. 2 would tend to be shallower and larger in diameter than cartridges shaped as shown in FIG. 1. As a practical limitation, a minimum liquid depth is required in the trap to meet regulations regarding containment of sewer gas pressure in the drain system: e.g., 2 inches in the United States and 50 mm in Europe. Due to existing urinal space limitations, cylindrical traps are typically limited to a maximum diameter of about 150 mm (5.9") and a maximum height of about 90 mm (3.54"). To function properly in such a compact size, the conceptual example shown in FIG. 2 is preferably

reconfigured in shape with the wasted space between the baffle portions 16A, 16B and the cover 16C more preferably being utilized.

5 The principles and advantages in sealant retention illustrated in FIG. 2 can be realized in various odor trap configurations according to the present invention, constructed and arranged to meet particular practical requirements, such as shown in the following examples.

10 FIG. 3 depicts the structure of an edge-entry odor trap 10C having the baffle configured with a vertical upper portion 16A and a sloped portion 16B as shown, providing a flow path 22 corresponding to horizontal recovery dimension X as shown, extending from an averaged entry point to the extremity of sloped baffle portion 16B.

15 In FIGS. 2 and 3, as viable baffle shape variations, the vertical portion 16A could be located anywhere along the sloped portion 16B between the extremes shown in these two FIGS., while keeping the sloped portion 16B as shown: basic functioning and dimension X would be virtually unaffected.

20 FIG. 4 depicts an odor trap 10D as a variation of FIG. 3 having baffle 16B sloped in its entirety. The flow path 22 and the dimension X are approximately the same as in FIG. 3.

25 FIG. 5 depicts a center-entry odor trap 10E wherein the baffle is configured with a vertical upper portion 16A and a horizontal lower portion 16B flanged outwardly as shown. This creates a folded liquid path having upper portion 22A above and lower portion 22B as shown. Only the upper portion 22A will be effective in returning stray sealant because the baffle 16B is not sloped. Thus, stray sealant in the portion 22B will

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tend to get swept along to the right and escape to the drain along with the effluent. The horizontal recovery dimension X will be as indicated, derived from the upper flow path portion 22A.

5 FIG. 6 depicts an odor trap 10F as a variation of FIG. 5 wherein the lower baffle portion 16B is sloped as shown so as to recapture stray sealant from the lower horizontal flow path 22B, thus adding to the upper path 22A to yield the much greater horizontal
10 recovery dimension X indicated.

 FIG. 7 depicts an odor trap 10G as a variation of FIG. 6 wherein the sloped flange portion 16B is made to have an oppositely-slope upper surface which serves to prevent accumulation of debris on the flange's upper
15 surface which could otherwise occur in this region in the structure of FIG. 6. Dimension X is virtually the same as in FIG. 6.

 FIG. 8 depicts an odor trap 10H as a reversed version of the foregoing center entry coaxial
20 configurations which achieves a form of predominantly horizontal flow path with a simple vertical baffle 16A surrounded by a drain stand wall 14A' which sets the overflow level. Wall 14A', surrounded by an outer wall extending down from the circumference of the cover 16C,
25 is attached to the circumference of the floor 14B so as to form a simple cylindrical main container pan 14 which can be supported by the surrounding cover 16C or drain housing 12B by radial vanes (not shown). The center entry causes the liquid to spread out radially
30 in a sloped but substantially horizontal flow path 22 leading to the bottom edge of the baffle 16A as shown, corresponding to recovery dimension X as indicated.

In FIGS. 5-8, a triangular-shaped empty region can be seen in cross-section above the sealant, as formed by the slope of the cover. This triangular region serves an important function as a sealant shelter region into which the sealant tends to be displaced in the event of high-pressure water flushing, instead of being forced down the drain ahead of the flushing water, as could occur with trap structure of known art, such as in FIGS. 1 and 1A, having the conventional vertical baffle 16A and the conventional predominantly vertical flow paths.

FIG. 9 is a three-dimensional view of a cylindrical odor trap cartridge 10I with center entry 16D in accordance with a preferred embodiment of the present invention. The upper surface slopes downward in a shallow inverted cone toward the center where the entry opening 16D is fitted with a filter screen or a fine perforation pattern formed in the cover material.

The enclosure can be, for example, dimensioned about 4 1/2" (11.4 cm) in diameter and 2 3/4" (7.0 cm) in height. As noted, due to existing industry limitations, the size of the trap is to be limited. For example, the diameter of the trap is preferably between about 2 to 2 1/2 inches. It is preferably molded from polyethylene, or from another suitable plastic material such as polypropylene, ABS or polystyrene, to provide a smooth stain-resistant surface. The material can also include a fiberglass reinforced polyester. Other suitable materials can also be utilized. Typically, the main container 14 and cap/partition part 16 are molded as separate parts and then bonded together to form an integral enclosure, since access to the interior is not normally required. The entry configuration of trap 10I makes it feasible to seal the entry opening 16D (with the bottom exit opening, not visible in FIG. 9, sealed in a similar or other manner)



for shipment as a cartridge already charged with sealant, ready for deployment. For example, to seal the opening 16D, a sticker can be attached thereto, such sticker can further include labelling, etc., such as installation instructions and product labelling.

FIG. 10 is a three-dimensional cutaway view of a center-entry cylindrical odor trap 10J having a non-coaxial interior configuration, shown without liquid for clarity. The baffle has two flat portions: vertical portion 16A extending downward from the upper surface offset to the right of entry opening 16D. At the bottom of vertical baffle portion 16A, a horizontal portion 16B extends fully to the left hand wall of odor trap 10J. A round opening 16E, about the same size as opening 16D, is configured in a horizontal baffle portion 16B at the edge furthest from vertical baffle portion 16A. Opening 16E leads into a lower compartment which is configured with a flat floor 14B of which a portion is extended upwardly at the right hand side to form tubular drain stand 14C whose top edge defines the overflow level of the container as in the FIGS. described above. The two liquid flow paths 22A and 22B are shown and the corresponding recovery path dimension X is indicated as derived from path 22A.

FIG. 11 depicts an odor trap 10K which is a variation having a baffle configured as in FIG. 10 but wherein the drain riser 14D is here configured as a flat vertical riser wall 14D attached integrally to floor 14B and to the interior wall of the main enclosure 14 of odor trap 10L, preferably molded together in one piece.

FIG. 12 is a central cross-section depicting an odor trap that represents an important variation

applicable to both FIG. 10 and FIG. 11. The horizontal baffle portion 16B is sloped in a manner to recover stray sealant and return it to the main body of sealant 10. The resultant horizontal recovery dimension X is much longer than in FIGS. 10 and 11 due to the additional recovery provided by the sloped baffle portion 16B.

It is seen that the cross-sections of FIGS. 10 and 11 generally resemble that of FIG. 5, and the cross-section of FIG. 12 generally resembles that of FIG. 6. However, preferred constructions according to FIGS. 5 and 6 as shown imply fully coaxial internal and external configuration centered on axis C-C' whereas the internal structure in FIGS. 10-12 is clearly non-coaxial with the outlet offset rather than centered and the baffles flat rather than cylindrical.

The relative sealant recovery effectiveness of the above configurations as approximated by the recovery-effective length of the horizontal flow paths X relative to container radius R can be compared in the following estimated table. The following Table 1 lists examples of estimated values which can be achieved for X/R in the illustrated embodiments, the illustrated embodiments not being limited thereto:

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TABLE 1

FIG.	X/R
1, 1A	15%
2	76%
3, 4, 5	50%
6, 7	105%
8	56%
10, 11	71%
12	165%

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Alternatively, the relative sealant recovery effectiveness of the above configurations, as a few examples, can be expressed as a function of the flow path slope X/Y. The following Table 2 lists estimated examples of values which can be achieved for X/Y in the illustrated embodiments, the illustrated embodiments not being limited thereto.

TABLE 2

	<u>FIG.</u>	<u>X/Y</u>
10	1, 1A	0.12
	2	4.64
	3, 4	3.50
	5	5.50
	6	5.75
15	7	8.60
	8	3.67
	10, 11	3.08
	12	5.82

According to the preferred embodiments of the present invention, the inlet and outlet locations and the baffle configuration, etc., result in a predominantly horizontal flow. For example, in some preferred embodiments, the present invention yields preferred values of X/R > 30%, as distinguished, for example, from predominantly vertical flow of known art in the above table. As seen in Table 1, the present invention can even yield values greater than 50%, allowing for a wide margin above the 15% estimated for the noted prior art. As another example, the present invention can yield preferred values of X/Y of greater than 1.0, while the above-noted estimate of the noted prior art achieves a value substantially less than 1.0. Although clearly less preferred, it is contemplated that values less than the preferred examples of X/R

and/or X/Y can, in some cases, be used according to principles of the invention.

It is recognized that as a one-dimensional parameter such as X/R is merely a first approximation
5 of effectiveness: a more refined two-dimensional parameter could take into account the effective horizontal recovery area located above the flow path. An even more refined three-dimensional parameter could take into account fluid viscosities, width, depth and
10 length and resulting flow velocities at various incremental points in the flow paths.

The relative effectiveness indicated by the above tables apply to normal operation and does not necessarily include the additional improvement provided
15 by the present invention in protection against catastrophic loss of sealant under the condition of high pressure water flushing as described above. In this regard, according to another aspect of the invention, a shelter region is provided for the
20 sealant, such a shelter region can be provided in any of the embodiments of the invention. The configurations of the embodiments of, for example, FIGS. 10-12 include entry compartments with shelter regions (e.g., T shown in FIG. 12) wherein
25 high-pressure flushing water tends to take a direct path from entry opening 16D to baffle opening 16E while parting much of the sealant and temporarily pushing it into the shelter regions at both sides. Among other things, the angled top wall and the wide entry
30 compartment helps provide such shelter regions. The shelter region is preferably formed by an airspace above the normal sealant level, such as shown within T in FIG. 12. In order to allow the sealant to quickly enter the shelter region, the device can include one or
35 more air vents to allow air within the shelter region to vent outside thereof. For example, the embodiment shown in FIG. 12 includes at least one air vent 16F at

an upper end of the trap. The air vent 16F is preferably sized to allow air to pass therethrough while substantially preventing fluid flow therethrough, and preferably has a diameter of about 1-2mm. As
5 shown, the air vent is preferably in the top wall of the device. In this manner, in the event the any sealant is forced through the air vent, the sealant can be redirected along the upper surface and into the upper opening 16D so as to return to the body of
10 sealant.

FIG. 13 shows another preferred embodiment of the invention. The device shown in FIG. 13 employs a number of features which are similar to certain features shown in FIGS. 10-12. FIG. 13 is a
15 three-dimensional cutaway view of an odor trap 10M having a non-coaxial interior configuration. The baffle has a generally vertical portion 16A extending downward from the upper surface, offset to the right of entry opening 16D, and a horizontal portion 16B
20 extending fully to the left hand wall of odor trap 10M at the bottom of vertical baffle portion 16A. The horizontal baffle extends only partially across the trap so as to leave an opening 16E at the edge furthest from vertical baffle portion 16A. The opening 16E
25 leads into a lower compartment which is configured with a floor 14B. A tubular drain stand 14C is provided which extends upward at the right hand side of the floor 14B. The top edge of the drain stand 14C defines the overflow level of the container. The two liquid
30 flow paths 22A and 22B shown provide a corresponding recovery path dimension X similar to that shown in FIG. 12 -- e.g., the sum $X_1 + X_2$ from the paths 22A and 22B, respectively. As shown in FIG. 13, a body of wastewater 18 has a sealant layer 18 buoyantly floating

thereon. The wastewater 18 follows the flow path a) 22I into the entry opening 16D, b) 22A above the baffle, c) 22B below the baffle 16B, d) 22C up and over the top edge of the drainstand 14C, and e) 22D down the drainstand 14C.

FIGS. 15-18 show one preferred construction of the embodiment shown in FIG. 13. This preferred construction includes a top member 150 (FIG. 15), a middle member 160 (FIG. 16), a bottom member 170 (FIG. 17), and a plug member 180 (FIG. 18). The top member 150 includes a generally cylindrical perimeter wall 151, a downwardly inclined top wall 152, and an entry opening 153 at the center of the top wall. The top wall 152 is inclined in a manner like that in FIG. 13. As shown, the entry opening preferably includes three holes 154 in the center area of the top wall. The top wall also preferably includes two sealing ridges 155 for receiving and sealing the baffle 165 (discussed below).

The middle member 160 includes a perimeter wall 161 and a baffle having a generally vertical portion 165 and an upwardly inclined portion 166. The portion 166 has a generally straight upper edge 167 providing a fluid passage 168 around the baffle.

The bottom member 170 includes a perimeter wall 171, a bottom wall 172, and a upwardly extending drain stand 173. The drain stand preferably is a cylindrical tube extending above the wall 171 with an upper opening 175 and a lower opening 176. The lower edge of the bottom member can, for example, as shown include a tapered wall 174.

The device is assembled with the middle member fitted such that the perimeter wall 161 snugly fits within the perimeter wall 151 and the baffle portion 165 snugly fits between the ridges 155. The wall 151 only extends down over part of the height of the wall 161. The lower member 170 fits with the drain stand 173 within the area to the right of the baffle portion 165 and the lower portion of the cylindrical wall 161 snugly fitted within the cylindrical wall 171. As a result, a sealed container can be constructed having separately isolated entry and discharge compartments.

FIG. 18 shows a plug-handle member 180 which can be included in this latter embodiment. The plug-handle member 180 preferably includes a tubular member 181, handle projections 182, and L-shaped projections 183 at the upper wall 184. The plug is preferably shaped and sized so as to snugly fit within the drain stand 173. With this construction, the odor trap can be transported with a body of sealant within the assembled structure, if a plug 180 is inserted in the opening 176 and a seal (such as an adhesive backed label) is placed over the opening 153. As shown, the L-shaped projections are sized and shaped to fit within the holes 154 so that the assembled device can be carried by simply inserting the projections into the holes 154 and rotating the plug 180 in the direction L, FIG. 18, so that the L-shaped projections engage under the top wall 152. Thus, the member 180 provide a tool that can be used to seal a new, unused, unit and to remove a dirty, wastewater filled, unit. Although the plug and handle functions are preferably combined into the single tool 180, it is contemplated that separate devices embodying these features can be included and/or

either the plug or handle can be eliminated depending on the desired handling.

The sealant 20 is preferably a biodegradable oily liquid. A preferred composition of liquid 20 comprises an aliphatic alcohol containing 9-11 carbons in the chemical chain, wherein the specific gravity is 0.84 at 68 degrees Fahrenheit. Since the operation of the urinal is based on the differential between the specific gravity of the oily liquid and that of urine, typically near 1.0, the specific gravity of the oily liquid should be made as low as possible, preferably not exceeding 0.9 and, more preferably, well under 0.9. The sealant preferably 20 is chosen to have a very low affinity to water such that sealant and the urine strongly repel each other physically so that there is no chemical or other interaction apart from a purely physical separation which allows urine/water from above to divide finely and permeate downwardly through the sealant layer. The sealant 20 is preferably colored, e.g. blue, for maintenance and identification purposes.

FIG. 14 shows one example of type of urinal into which the various odor traps, shown generally as 10, can be located. The illustrated urinal 140 being a wall mounted unit attached above a floor surface (not shown). The urinal shown is for illustrative purposes only; a trap of the present invention can be used in any type of urinal. More notably, the utility of the invention, while directed in some aspects to waterless urinals as illustrated above, is not restricted thereto. The present odor trap is applicable to other drained surfaces and the like. For example, since the preferred sealant utilized is considerably more stable than water with regard to evaporation, the present invention has widespread utility as floor drains, solving, for example, problems of sewer gas release from conventional S type floor drains resulting from,

for example, total seal failure due to evaporation of the residual water and lack of replenishment thereof, particularly in hot, dry climates.

5 The invention may be embodied and practiced in other specific forms without departing from the spirit and essential characteristics thereof. The present embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims
10 rather than by the foregoing description. Furthermore, all variations, substitutions and changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.



CLAIMS

What is claimed is:

1. A sealed odor trap, for use in drains including waterless urinals and anti-evaporation floor drains, comprising:

a main liquid container having a top cover;

5 a baffle, in said container, having at least a vertical portion extending downwardly from said top cover and dividing said container into 1) an entry compartment receiving wastewater from a waste bowl above and 2) a discharge compartment receiving
10 wastewater from the entry compartment beneath said baffle;

a drain stand, formed in the discharge compartment, having a vertical discharge liquid passageway with an upper edge defining an overflow
15 level of said container and having a bottom outlet communicating with an external drain;

a quantity of low-density liquid adapted to form a sealant layer when said container is has a body of wastewater filled to the overflow level with the layer
20 of liquid sealant floating on the body of wastewater in the entry compartment;

said container and said baffle being constructed and arranged to cause generally all of the wastewater received from the waste bowl to follow a liquid flow
25 path beneath said baffle which is predominantly horizontal, such that a horizontal vector thereof exceeds a vertical vector thereof.

2. The odor trap as defined in claim 1, wherein said baffle includes a non-vertical portion extending
30 toward the entry compartment from a lower end of said vertical portion of said baffle.

3. The odor trap as defined in claim 2, wherein said non-vertical portion of said baffle is sloped in a manner to cause stray low-density liquid droplets

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rising buoyantly from said liquid flow path beneath said baffle to be directed to said body of sealant.

4. The odor trap as defined in claim 3, wherein said container is cylindrical in shape and has a vertical outer wall with a predetermined inside radius, and wherein said baffle and said container are constructed and arranged to provide a low-density liquid recovery length that exceeds 30% of the inside radius, the low-density liquid recovery length being defined as the length of that portion of the liquid flow path located directly beneath said layer of low-density liquid plus the length of any portion of the liquid flow path located directly beneath the sloped region of said baffle.

5. The odor trap as defined in claim 1, wherein $X/Y > 1$, X being defined as a distance from a point of average entry of the wastewater into the sealant to a furthest point along the flow path around the baffle in which sealant recovery can occur, and Y being defined as the vertical distance from the top of stand pipe to a bottom of baffle.

6. The odor trap as defined in claim 4, wherein said radius is about 2 to 2 1/4 inches.

7. The odor trap as defined in claim 1, wherein said container is made from plastic material.

8. The odor trap as defined in claim 1, wherein said container is molded from plastic material selected from a group including polyethylene, polypropylene and fiberglass-reinforced polyester.

9. The odor trap as defined in claim 1, wherein said container is molded from polyethylene.

10. The odor trap as defined in claim 1, wherein said low-density liquid is an oily liquid.

11. The odor trap as defined in claim 1, wherein said low-density liquid includes an aliphatic alcohol.

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12. The odor trap as defined in claim 11, wherein said aliphatic alcohol contains a chemical chain of carbons ranging in number from nine to eleven.

13. The odor trap as defined in claim 1, wherein
5 said low-density liquid has a specific gravity not exceeding 0.9.

14. A system for draining wastewater, comprising:

a) a trap including
10 a main container constructed as a generally leakproof enclosure;

at least one entry opening, at a top region of said container, constructed and arranged to receive generally all of the wastewater from above;

an entry compartment formed in a first
15 portion of said container, constructed and arranged to receive in totality the wastewater from said entry area;

a discharge compartment formed in a second portion of said container, adjoining said entry
20 compartment;

a baffle having at least a vertical portion extending generally downwardly into said container from the top region thereof to substantially separate said entry compartment from said discharge compartment;

25 a drain stand located in said discharge compartment extending upward from a lower region of the container to provide a vertical drain conduit having an upper edge defining a predetermined overflow level of said container and having a bottom discharge opening
30 for discharging to a drain pipe;

a quantity of low-density oily liquid formulated to form a sealant layer when the container is filled by a body of wastewater extending upwardly to the overflow level, the layer of oily liquid sealant
35 floating on said body of wastewater within said entry compartment, said container being constructed and

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arranged to cause said layer of sealant to act in a manner to seal the body of wastewater;

5 said container and said baffle being constructed and arranged to provide a predominantly horizontal liquid flow path for generally all of the wastewater from said entry opening to a lower edge of said baffle;

 b) a draining surface member for directing wastewater into said at least one entry opening.

10 15. The system as defined in claim 14, wherein said draining surface member is a wall mounted urinal.

 16. The system as defined in claim 14, wherein said draining surface member is a floor surface.

15 17. The system as defined in claim 14, further including a tool member fittable within said drain stand and having projections which are engageable with said at least one opening for carrying said trap.

 18. The system as defined in claim 14, wherein a top surface of said container is generally circular and slopes downwards to said at least one opening.

20 19. The system as defined in claim 14, wherein said baffle further includes a non-vertical portion, extending toward the entry compartment from a lower end of said vertical portion of said baffle, and sloped in a manner to cause stray sealant droplets rising buoyantly from said liquid flow path beneath said baffle to be directed to said body of sealant.

25 20. An improved drain odor trap of the type containing a body of wastewater acting as an odor seal against sewer gasses and having a body of liquid sealant, floating on a portion of the wastewater body in an entry compartment of said trap, acting as an odor seal against odor from the contained wastewater, said improved odor trap comprising:

30 a main container having a baffle located therein;

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said main container having at least one entry opening through which generally all of the wastewater enters the main container;

5 said at least one entry opening and said baffle being arranged to provide a predominantly horizontal fluid flow path, through said trap, of generally all wastewater entering said trap.

10 21. The improved drain odor trap as defined in claim 20, wherein said at least one openings are formed in a top surface of said container.

22. The improved drain odor trap as defined in claim 20, wherein said at least one openings are horizontally spaced from an end of said baffle around which said fluid flow path travels, such that
15 wastewater entering said at least one openings travels horizontally around said end of said baffle.

23. The improved drain odor trap as defined in claim 22, wherein said main container includes a shelter region in an upper portion thereof adjacent
20 said at least one entry openings, said shelter region being sized and arranged to accept sealant temporarily displaced by water flushed into said trap following said fluid flow path, thus sheltering the displaced sealant and preventing sealant loss.

25 24. The improved drain odor trap as defined in claim 22, wherein said horizontal spacing is at least 15% of a diameter across said container.

25. The improved drain odor trap as defined in claim 22, wherein said container is generally
30 cylindrical with a substantially circular top surface, such that said horizontal spacing is at least 30% of the radius of said circular top surface.

26. The improved drain odor trap as defined in claim 20, wherein a substantial portion of said fluid
35 flow path is located immediately beneath the body of oily liquid sealant.





27. The improved drain odor trap as defined in claim 20, wherein said baffle includes a sloped portion, located immediately above a substantial portion of said predominantly horizontal flow path and guiding upwardly-migrating stray droplets of sealant arriving at a top surface of said flow path to return to the body of oily liquid sealant.

28. A sealed odor trap, for use in drains including waterless urinals and anti-evaporation floor drains, comprising:

a main liquid container having an integrally attached top cover;

a baffle, in said container, having at least a vertical portion integrally attached to the top cover and extending downwardly therefrom, constructed and arranged to divide said container into (1) an entry compartment receiving wastewater from a waste bowl above and (2) a discharge compartment receiving wastewater from the entry compartment via a liquid flow path beneath said baffle;

a drain stand, formed in the discharge compartment, constructed and arranged to define a vertical discharge liquid passageway having a substantially horizontal upper edge defining an overflow level of said container and having a bottom outlet communicating with an external drain;

a quantity of low-density oily liquid, sized and formulated to form a sealant layer when said trap is filled with a body of wastewater in said container, extending upwardly to the overflow level, the layer of oily liquid sealant floating on the body of wastewater in the entry compartment;

said container having a dimension R, at a height at the bottom of said baffle, from a center of the container to a side thereof, and said container and said baffle being constructed and arranged to cause generally all of the waste water entering the odor trap

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to follow a flow path having a horizontal sealant recovery length X, in which rising sealant floats and returns to the quantity of low-density oily liquid, of at least $X/R = 30\%$.

5 29. The odor trap as defined in claim 28, wherein said container is generally cylindrical and said dimension R is the radius thereof.

10 30. The odor trap as defined in claim 29, wherein said container has a generally constant radius over the entire height of said vertical portion of said baffle extending generally downwardly into said container.

15 31. The odor trap as defined in claim 28, wherein the sealant-recovery length is the length of said liquid flow path located directly beneath at least one of said layer of sealant and a sloped portion of said baffle.

20 32. The odor trap as defined in claim 28, wherein said sealant-recovery length is a horizontal distance of travel of wastewater in the liquid flow path from a point of entry into said layer of sealant to a lowest end of said baffle.

 33. A sealed odor trap, for use in drains including waterless urinals and anti-evaporation floor drains, comprising:

25 a main liquid container having an integrally attached top cover;

30 a baffle, in said container, having at least a vertical portion integrally attached to the top cover and extending downwardly therefrom, constructed and arranged to divide said container into (1) an entry compartment receiving wastewater from a waste bowl above and (2) a discharge compartment receiving wastewater from the entry compartment via a liquid flow path beneath said baffle;

35 a drain stand, formed in the discharge compartment, constructed and arranged to define a vertical discharge liquid passageway having a





substantially horizontal upper edge defining an overflow level of said container and having a bottom outlet communicating with an external drain;

5 a quantity of low-density oily liquid, sized and formulated to form a sealant layer when said trap is filled with a body of wastewater in said container, extending upwardly to the overflow level, the layer of oily liquid sealant floating on the body of wastewater in the entry compartment;

10 said container and said baffle being constructed and arranged with said baffle guiding the wastewater to cause said liquid flow path to have a predominantly horizontal direction, such that a horizontal vector thereof exceeds a vertical vector thereof.

15 34. An odor trap for suppressing odors in a waterless urinal that directs urine downwardly into the trap from which effluent urine is discharged downwardly into a drain pipe of an external drain system, said odor trap comprising:

20 a main container constructed generally as a seamless leakproof bowl;

an entry opening, at a top region of said container, constructed and arranged to receive the urine from above:

25 an entry compartment, formed in part by a first portion of said container, constructed and arranged to receive in totality the urine from said entry opening;

30 a discharge compartment, formed in part by a second portion of said container, adjoining said entry compartment and having a floor portion;

a baffle, having at least a vertical portion extending generally downwardly into said container from the top region thereof, constructed and arranged to substantially separate said entry compartment from said discharge compartment;

35 a drain stand, located in said discharge compartment, having a vertical wall, extending upward





from the floor portion and integrally joined thereto, constructed and arranged to provide a vertical drain conduit having a substantially horizontal upper edge defining a predetermined overflow level of said
5 container, and having a bottom discharge opening communicating with the drain pipe;

a quantity of low-density oily liquid formulated to form a sealant layer when the container is filled by a body of urine extending upwardly to the overflow
10 level, the layer of oily liquid sealant floating on said body of urine within said entry compartment, said container being constructed and arranged to cause said layer of sealant to act in a manner to seal and contain odor from said body of urine and thus prevent such odor
15 from escaping upwardly past said sealant, and to provide an airtight plenum region in the discharge compartment that acts to seal and contain sewer gasses from the external drain;

said container having a dimension R, at a height
20 at the bottom of said baffle, from a center of the container to a side thereof, and said container and said baffle being constructed and arranged to cause generally all of the waste water entering the odor trap to follow a flow path having a horizontal sealant
25 recovery length X, in which rising sealant floats and returns to the quantity of low-density oily liquid, of at least $X/R = 30\%$.

35. A method of decreasing the depletion of an oily liquid in an odor trap from a layer of oily
30 sealant floating on a body of urine, comprising the steps of:

providing a main container with at least one entry opening and with a baffle therein;

35 flowing wastewater through a horizontal layer of oil sealant into said body while separating droplets of sealant from said layer which flows downwardly into said body of urine;





flowing generally all wastewater entering the trap along a predominantly horizontal fluid flow path which passes around the baffle with the separated droplets of sealant flowing upwardly and returning to said layer.

5 36. The method according to claim 35, further including the step of displacing urine from said body out of a drain outlet in said container.

10 37. The method according to claim 35, further including the step of guiding droplets which are not under said layer toward said layer with said baffle.

15 38. The method according to claim 36, further including the step of guiding the oil droplets toward said layer with a sloped baffle connected between the layer and the drain.

20 39. The method according to claim 36, further including the step of providing the oil layer with an oil that is biodegradable, has a specific gravity of no less than 0.8 at room temperature, is generally inert to urine and has essentially no solubility or miscibility for urine and water.

25 40. A method of preventing sealant loss in a wastewater odor trap which retains a body of wastewater for trapping sewer odors, the trap having an entry compartment communicating with an adjacent discharge compartment beneath a baffle separating the compartments, the entry compartment containing a layer of low density sealant floating on the contained wastewater to suppress odor therefrom and receiving wastewater from a top cover entry port, the wastewater permeating through the sealant layer, the discharge compartment having a stand wall leading to an external drain system, the received wastewater following a flow path through the entry compartment under the baffle and into the discharge compartment, overflowing the stand wall and proceeding down the drain system, the method comprising:

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providing a shelter region in an upper portion of the entry compartment adjacent the entry for the wastewater;

5 passing wastewater through the entry with the wastewater following a liquid flow path towards a lower portion of the baffle and said sealant being displaced into said shelter region by the passing wastewater.

10 41. The method of claim 40, further including the step of venting air out of said shelter region through an air vent during said step of passing wastewater and the step of buoyantly rising stray droplets of sealant, separated below the sealant layer by wastewater passing therethrough, to rejoin with the sealant layer from within substantially the entire distance between the
15 wastewater's entry into the body of wastewater and the wastewater's passage to a lowermost end of the baffle.

20 42. The method of claim 41, further including the step of venting air out of said shelter region through an air vent during said step of passing wastewater and the step of directing generally all of the wastewater entering the odor trap along a predominantly horizontal flow path, through the entry compartment, between the wastewater's entry into the body of wastewater and the wastewater's passage around a lowermost end of the
25 baffle.

30 43. The method of claim 40, further including modifying the flow path with a mainly horizontal baffle portion extending into the entry compartment from an upright baffle portion and directing the flow path to double-back around an end of said mainly horizontal baffle portion, so as to create upper and lower oppositely-directed predominantly horizontal sections of the flow path.

35 44. The method of claim 41, wherein said step of buoyantly rising further includes arranging the generally horizontal baffle portion to be sloped upwardly so as to direct vertically-migrating sealant droplets back to the sealant layer.

