TANK VALVE ASSEMBLIES AND METHODS

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ABSTRACT
Embodiments can provide tank valve assemblies and associated methods. According to one aspect, a valve assembly can be provided. The valve assembly may include a valve body defining a hollow bore extending therethrough. A plunger having at least one passageway formed longitudinally partially therethrough and a spring associated with the plunger may be provided. The plunger is slideably positioned within the hollow bore of the valve body and retained in a closed position by a force exerted by the at least one spring against the valve body. The valve assembly may include a valve body o-ring positioned within the hollow bore, wherein the valve body o-ring substantially contacts the surface of the plunger when the plunger slides within the hollow bore of the valve body.
TANK VALVE ASSEMBLIES AND METHODS

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61/242,187, filed on Sep. 14, 2009, entitled “Tank Valve Assemblies,” which is incorporated herein by reference in its entirety.

FIELD OF THE INVENTION

[0002] This invention relates generally to valves, and more specifically to tank valve assemblies.

BACKGROUND OF THE INVENTION

[0003] Liquid tanks, such as those used during wine preparation processes, have undergone significant advances. For example, tank materials have changed, thus permitting the development of additional or improved wine preparation techniques. One such improvement is in the materials from which wine tanks are formed, such as polymers, which can further permit tank molding and the addition of other features or devices with the tanks.

[0004] During the preparation of wine (or other materials), and during storage, there is a need to extract a sample, such as for tasting or chemical testing. In addition, there also exists a need to introduce gases into the tanks, such as during sparging or micro-oxygenation, or to introduce other materials, such as introducing additives or topping-off the liquid volume in the tank.

[0005] Accordingly, there exists a need for improved valve assemblies, which can be advantageously formed or otherwise installed in a tank wall or tank lid. There exists a further need for valve assemblies that reduce contamination, clogging, and/or sediment flow, and that can be cleaned without introducing foreign materials into the corresponding tank.

SUMMARY OF THE INVENTION

[0006] Embodiments can provide tank valve assemblies and associated methods. According to one aspect, a valve assembly can be provided. The valve assembly may include a valve body defining a hollow bore extending therethrough. A plunger having at least one passageway formed longitudinally partially therethrough and a spring associated with the plunger may be provided. The plunger is slideably positioned within the hollow bore of the valve body and retained in a closed position by a force exerted by the at least one spring against the valve body. The valve assembly may include a valve body o-ring positioned within the hollow bore, wherein the valve body o-ring substantially contacts the surface of the plunger when the plunger slides within the hollow bore of the valve body.

[0007] According to another aspect, a method of installing a valve assembly can be provided. In one embodiment, the method may include positioning a valve body through a wall in a liquid container; threadably securing the valve body to the liquid container; and positioning a plunger and at least one spring within a hollow bore of the valve body, such that the spring retains the plunger in a closed position until actuated, and a valve body o-ring substantially contacts the surface of the plunger when the plunger slides within the hollow bore of the valve body. In one embodiment, the valve body may be secured to the liquid container by a bulkhead type assembly. In another embodiment, the valve body may be secured to the liquid container using a container insert secured to the liquid container and threading the valve body into the container insert. In yet another embodiment, the valve body or a container insert may be molded into a wall of the liquid container.

[0008] According to yet another aspect, a liquid container lid with a valve body can be provided. In one embodiment, a valve body can be secured to a liquid container lid. The valve body has a hollow bore extending therethrough and a valve body o-ring positioned within the hollow bore. A plunger can be provided that has at least one passageway formed longitudinally partially therethrough and at least one spring associated therewith. The plunger is slideably positioned within the hollow bore of the valve body and retained in a closed position by a force exerted by the spring against the valve body. The valve body o-ring substantially contacts the surface of the plunger when the plunger slides within the hollow bore of the valve body.

[0009] Additional apparatus, methods, features, and aspects are realized through the techniques of various embodiments described herein. Other embodiments and aspects are described in detail herein and are considered a part of that disclosed, and other features will be understood with reference to the description and to the drawings.

BRIEF DESCRIPTION OF FIGURES

[0010] Having thus described the invention in general terms, reference will now be made to the accompanying drawings, not necessarily drawn to scale, which are included to provide further understanding of the invention. The drawings are incorporated in and constitute a part of this specification, illustrate embodiments of the invention, and together with the description serve to explain the principles of the invention. In the drawings:

[0011] FIG. 1 illustrates a schematic view of a valve assembly in a closed position in accordance with one embodiment of the invention.

[0012] FIG. 2 illustrates a partial cross-sectional view of a valve assembly in accordance with one embodiment of the invention.

[0013] FIG. 3 illustrates a schematic view of a plunger of a valve assembly in accordance with one embodiment of the invention.

[0014] FIG. 4 illustrates a schematic view of a valve assembly in an open position in accordance with one embodiment of the invention.

[0015] FIG. 5 illustrates a partial view of a valve assembly and associated tank in accordance with one embodiment of the invention.

[0016] FIGS. 6A-6C illustrate a perspective view of components of a valve assembly in an assembled state in accordance with one embodiment of the invention.

[0017] FIGS. 7A-7B illustrate perspective views of a tank insert in accordance with one embodiment of the invention.

[0018] FIGS. 8A-8B illustrate perspective views of a valve body in accordance with one embodiment of the invention.

[0019] FIGS. 9A-9B illustrate perspective views of a plunger in accordance with one embodiment of the invention.

[0020] FIG. 10 illustrates a perspective view of an assembled valve assembly in accordance with one embodiment of the invention.

[0021] FIG. 11 illustrates a partial cross-sectional view of a valve assembly in accordance with one embodiment of the invention.
FIG. 12 illustrates a schematic view of a tank and valve assembly associated with a tank lid in accordance with one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Example embodiments will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, the invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one to variously employ the present invention in virtually any appropriately detailed structure. Like numbers refer to like elements throughout.

Example embodiments disclosed herein are directed toward valve assemblies for use with liquid tanks or other liquid containers. The valve assemblies may be operable to remove liquid from the associated tank, such as for inspection, sampling, and the like. The valve assemblies may also be operable to introduce matter into the associated tank, such as to introduce gas or liquid. In one example embodiment, the valve assemblies may be manufactured into, or otherwise integrated with, a polymer wine tank for maturing and/or storing wine.

According to various embodiments, the valve assembly can include a valve body permitting integration with newly manufactured tanks and/or retrofitting with existing tanks, and a spring actuated plunger slidably positioned within the valve body and having at least one passageway extending longitudinally through the plunger to selectively permit fluid flow therethrough. Moreover, according to one embodiment, the valve assembly can include at least one o-ring positioned within the valve body such that the plunger is in slideable communication therewith. The o-ring can serve both to seal the valve body and plunger, restricting flow through the valve body only through the plunger when in an open position, and to cleanse the one or more plunger passageways as the plunger slides across the o-ring. This type of cleansing can be quite beneficial when used in a wine tank because sediment and other tank debris can be removed from the valve assembly during and after use. Moreover, in one embodiment, the exterior end of the plunger can be configured to include a nipple fitting to permit attaching external devices, such as a hose, to the end of the plunger. For example, the external hose may permit introducing additional gas and/or fluid, such as during sparging, or may serve as an extension when extracting fluid from the tank. Additional features can be included as part of the valve assembly construction, as further discussed herein.

According to one embodiment, the valve body can be configured as a bulkhead-type fitting, such that the valve body includes threads insertable through a tank for receiving a bulkhead nut on the interior of the tank. In this embodiment, the valve assembly can be affixed to a tank after assembly.

In another embodiment, a valve assembly can include a threaded tank insert molded into a tank during manufacturing. The valve body can include complementary threads that permit the valve body to be screwed into the threaded tank insert.

Accordingly, example valve assembly embodiments, configured as described herein or in another similar manner, permit simple and cost-effective construction and installation, into newly manufactured tanks and/or retrofitting into pre-existing tanks. In addition, the unique configuration of the valve assembly, and especially the placement of the o-ring, permits simple operation and effective self-cleansing and sealing of the valve assembly during use, and permits rinsing the passageway of the valve assembly with water or other liquid from the exterior. Moreover, its simple installation allows the valve assembly to be adapted for various uses, such as when installed at one or more positions on the wall of the tank for sampling and/or sparging, or when installed on a tank lid for sparging.

FIG. 1 provides a schematic view of a valve assembly in accordance with one embodiment of the invention. The valve assembly 100, as illustrated, can include a valve body 105 through which a valve plunger 110 (also interchangeably referred to herein as a “plunger”) extends. FIG. 1 illustrates the valve assembly 100 in a closed orientation. In an open orientation, as illustrated in FIG. 4, the interior end 115 of the plunger 110 (oriented interior of the tank, as opposed to exterior of the tank), can extend from the valve body 105 into the interior of the tank, exposing one or more passageways to the interior of the tank, and permitting fluid and/or gas flow therethrough. In one embodiment, a retaining clip 120 can be removably positioned on the interior end 115 of the plunger 110, such that it retains the plunger 110 within the valve body 105 against the pressure of a spring 125 positioned over a partial portion of the plunger 110 and exerts force against the valve body 105, which retains the valve assembly 100 in a closed position unless otherwise acted upon and compressed. According to one embodiment, the retaining clip 120 can be removed from the plunger 110, permitting simple disassembly of the plunger 110 from the valve body 105. In other embodiments, however, the retaining clip 120 may be integrated with and/or formed as part of the plunger 110 such that it is not removable.

The example valve body 105 illustrated in FIG. 1 is configured with an interior portion 145 having a frustoconical shape; though, the interior portion 145 may be formed in other shapes as may be desired. The frustoconical shape of the interior portion 145 can further contain a recessed interior, such that it provides a shroud to protect the plunger 110 when extended into the tank (see FIG. 4), which may aid in reducing the amount of sediment or other debris from clogging the valve assembly 100. In other embodiments, the shape of the interior portion 145 may differ, such as, but not limited to, hemispherical, cylindrical, flat, and the like.

The valve body 105 of this example embodiment may be formed from any tank compatible material, such as, but not limited to, natural or synthetic polymer (e.g., Polyoxymethylene, also referred to as Delrin by DuPont Chemicals), metal (e.g., stainless steel, aluminum, titanium, brass, etc.), any combinations thereof, and the like. It is appreciated that certain materials may not be suitable for some applications, and therefore this list is intended as illustrative only; the design choice can be dependent upon the application of the valve assembly, the tank, and their intended use.

The example valve assembly 100 illustrated in FIG. 1 is of a bulkhead type, such that the valve assembly can be inserted into a tank and secured with a threaded bulkhead fitting. As such, in this embodiment, the valve body 105 may be configured to include threads 135 for receiving one or
more bulkhead nuts 150. During installation, the valve body 105 may be installed from the interior of the tank, leaving the threads 135 at least partially extending out of the tank. The bulkhead nut 150 can then be threadably positioned over the threads 135, securing the valve body 105 against the interior of the tank and the bulkhead nut 150 against the exterior of the tank. In one embodiment, a tank o-ring 140 may be positioned over the valve body 105 for compression and sealing against the tank during installation. The tank o-ring 140 may be positioned external to the tank or internal to the tank. Moreover, though not illustrated, one or more washer fittings and/or additional o-rings or other sealing means may further be included to aid in securing the valve body 105 within the tank. As used herein, the term “o-ring” generally refers to any sealing member or gasket adapted for positioning over any article to create at least a partial seal between the article and the o-ring’s interface with another article. The term “o-ring” is not limited to a torus-shaped member with a circular cross-section, but may also refer to a sealing member having any number of other cross-sectional geometries, such as, but not limited to, an oval cross-section, an “x” cross-section (also referred to as an “x-ring” or a “q-ring”), a rectangular cross-section, or any other polygonal or other custom-formed cross-sectional shape. Moreover, as used herein, an “o-ring” does not have to be annular-shaped, but may be formed in any shape to fit around the valve body 105, such as if the area of the valve body 105 is not cylindrical (e.g., it may be square, polygonal, etc.), and/or within any groove or grooves formed therein.

As illustrated, in one embodiment, the plunger 110 can further include a tip 130 at its exterior end (oriented exterior to the tank and opposite the interior end), which may be configured for adaptation with one or more external devices, such as, but not limited to, a hose, a tap, a spigot, a spout, a plunger actuating handle, a gas sparging device, and the like. As illustrated in FIG. 1 and further described with reference to FIG. 2, the tip 130 may be configured as a nipple fitting, which can accept a hose of one or more inner diameters. Moreover, in one embodiment, the interior tip of the tip 130 may be angled, chamfered, or otherwise formed for accepting a complementary formed tip of an external device, such as a gas or sparging hose, or any other device, as may be desired.

The plunger 110 may be formed by drilling a rod to form at least one passageway through the approximate center of the plunger and one or more cross-drilled holes across the plunger and intersecting with the passageway (as illustrated in FIG. 3). The plunger 110 may also be formed, such as by turning, molding, brazing, and/or welding, to include a plunger collar to retain a spring and a tip.

Although FIG. 1 illustrates a bulkhead type valve assembly 100, in other embodiments, securing mechanisms other than a bulkhead type means may be used, such as those illustrated in FIGS. 6-11, for example. Moreover, the valve assembly 100 may be installed using any other suitable installation techniques, as will be apparent upon reviewing the various embodiments described herein. For example, in one embodiment, rather than being constructed as a bulkhead type fitting, the valve assembly may be molded into the tank during manufacture, such as by molding a valve body in the tank, and subsequently inserting the plunger, spring, and associated o-ring(s). In another embodiment, a National Pipe Thread fitting (“NPT fitting”) can be molded or otherwise integrated into the tank wall, for accepting a matching taper threaded valve body fitting having similar design and features as described herein. In this example embodiment, the valve body would have exterior facing tapered threads in lieu of the threaded bulkhead fitting and bulkhead nut illustrated in FIG. 1, and would not have an interior portion forming a shroud on the valve body when installed in the tank, because such a design may hinder threading the valve body into the tank. However, in either of these other embodiments, the interior tank wall may be molded to include a shroud having similar features as illustrated in FIG. 1. Accordingly, in various other embodiments, the valve assembly 100 may be configured in various manners, such that it would still include one or more of the features described herein. Moreover, in various other embodiments, the valve assembly 100 may be installed or otherwise integrated with a tank in any number of means.

FIG. 2 provides a partial cross-sectional view taken along line A illustrated in FIG. 1, illustrating a cross-section of the valve body 105, tank o-ring 140, valve body o-ring 220, and bulkhead nut 150, and a complete view of the plunger and associated components, according to an example embodiment. FIG. 2 also illustrates a plan view (not in cross-section) of an example valve assembly 100 in a closed position. In one embodiment, the valve body 105 has a bore having a first diameter through which the plunger 110 is slideably inserted, and retaining the portion having a second diameter greater than the first diameter, creating a seat 205 for the spring 125. In one embodiment, the plunger 110 can further include a plunger collar 210 against which the spring 125 opposite the seat 205 is positioned. Thus, according to this embodiment, the spring 125 exerts opposing forces against the valve body 105 and the plunger 110 at the seat 205 and the plunger collar 210, respectively, forcing the valve assembly in a closed position unless further acted upon.

In other embodiments, the spring may be retained by other means, such as being affixed to the valve body 105 and/or to the plunger 110, integrated with the valve body 105 and/or with the plunger 110, or by any other means. In one example embodiment, the plunger collar 210 may have an outer diameter the same or slightly less than the inner diameter of the retaining portion of the valve body 105, such that the plunger collar 210 may extend into the valve body 105 when in an open position. In yet another embodiment, the plunger collar 210 and/or the inner diameter of the valve body 105 may include a chamfered edge to ease insertion of the plunger collar 210 into the valve body 105 while opening.

In another embodiment, the plunger collar 210 may facilitate opening the valve assembly 100. For example, the plunger collar 210 may provide a surface area against which an operator’s finger or a specially adapted tool can be placed. As another example, the plunger collar 210 may further facilitate attachment of one or more specialized devices, such as, but not limited to, a hose, a tap, a spigot, a spout, a gas sparging device, and the like.

FIG. 2, with further reference to FIG. 3, illustrates one or more cross-drilled holes 215 formed laterally through the plunger 110 near its interior end 115 and in fluid communication with one or more passageways 305 internal to the plunger 110. According to one embodiment, a passageway is formed longitudinally through the approximate center of the plunger 110, extending at least to the one or more cross-drilled holes 215, but not through the interior end 115 of the plunger 110. Thus, the passageway extends from the tip 130 of the plunger 110 up to and exiting each of the cross-drilled
holes 215. In operation, upon opening the valve assembly 100 by sliding the plunger into the tank, the cross-drilled holes 215 extend into the tank and provide fluid communication between the interior of the tank and the exterior via the cross-drilled holes 215 and the passageway 305. [0041] In addition, the valve body 105 includes a valve body o-ring 220 positioned within the bore of the valve body 105 such that it will be in contact with the plunger 110, as illustrated in FIG. 2. The valve body o-ring 220 may be formed from any resilient but partially non-rigid material, such as a natural or synthetic electromotive polymer. The valve body o-ring 220 configured and positioned in this manner serves multiple purposes. A first purpose is to further seal the contents of the tank from passing through the bore of the valve body when in a closed position. Without the valve body o-ring 220 positioned between the plunger 110 and the valve body 105 bore, fluid may undesirably seep through the bore and leak outside of the tank, either through the passageway 305 or around the plunger 110.

[0042] Another purpose served by the valve body o-ring 220 is to further seal the valve assembly 100 when the plunger 110 is in an open position, restricting fluid from passing through the bore. Existing conventional valve assemblies have been configured such that an o-ring or other sealing mechanism is positioned on the end of the plunger. In these conventional devices, when the plunger is in an open position, fluid may flow through the plunger and around the plunger.

[0043] Yet another purpose of the valve body o-ring 220 configured in the manner illustrated is to provide a means for self-cleansing the cross-drilled holes 215. During operation, when releasing an extended plunger 110 from an open position to a closed position, the cross-drilled holes 215 pass the valve body o-ring 220, such that the tight seal created by the valve body o-ring 220 scrapes the plunger 110 and the cross-drilled holes 215, causing any sediment or other debris to be released back into the tank. In an embodiment in which the valve assembly 100 is used with a wine tank, removing or otherwise preventing sediment and other debris may be desired. For example, when using a valve assembly 100 to extract sample wine from the tank, it may be desirable to avoid, or at least to reduce, the amount of sediment in the sample. In another example, when using a valve assembly 100 to introduce additional gas and/or fluid to the tank, such as by using a gas sparging device or any other means, excessive debris may clog or otherwise interfere with the introduction device being used. A valve assembly 100 configured with a valve body o-ring 220 in this manner beneficially cleanses the plunger and passageway to avoid these undesirable circumstances, with no additional cleansing or prevention steps required by the operator.

[0044] Yet another purpose served by the advantageous placement of the valve body o-ring 220 is to permit flushing the plunger 110 and valve body 105 when in a closed position, whereby the plunger prevents fluid or debris within the valve body from entering the tank. Instead, the valve body o-ring 220 seals the bore of the valve body 105 from the interior of the tank, causing any fluid or debris to run through the passageway(s) 305 of the plunger 110 or through the bore of the valve body 105 around the plunger 110, and out of the valve body 105 external to the tank. For example, after sampling tank contents, a user may connect a hose with water or other fluid to the tip of the plunger 110 and flush any undesirable contents from within the valve body 105 and plunger 110. Without the inclusion of a valve body o-ring 220 as described herein, an attempt at flushing the valve assembly in this manner would cause fluid and/or debris to be forced into the tank, which may be largely undesirable, depending upon the contents and purpose of the tank.

[0045] FIG. 4 illustrates an example embodiment of a valve assembly 100 in an open position. As shown, in comparison to FIGS. 1 and 2, upon exerting a force on the plunger 110 towards the valve body 105 (e.g., into the tank), the spring compresses and the plunger 110 extends from the valve body 105 interior portion 145 and into the tank (not shown). The plunger 110 and spring travel are designed such that the cross-drilled holes 215 become exposed when the plunger 110 is depressed, permitting fluid or gas flow through the cross-drilled holes and the passageway. As also can be seen in this example embodiment, the retaining clip 120 remains in a fixed position relative to the plunger 110 and its interior end 115. Thus, when the force on the plunger 110 is released, the plunger 110 retracts into the valve body 105, and the retaining clip 120 retains the plunger in its closed position, seated against the valve body 105.

[0046] As can be seen in the embodiment illustrated in FIG. 4, in an open position, at least a portion of the plunger can still be protected by the shroud design of the interior portion 145, which acts to limit the flow of sediment or other debris into the valve assembly 100, such as through the cross-drilled holes 215 or around the plunger 110. However, in other embodiments, as described above, the interior portion 145 may have a different shape and/or may be formed as part of the tank wall instead of, or in addition to, the valve body 105.

[0047] FIG. 5 illustrates a partial exploded view of an example valve assembly 100 and associated tank, according to one embodiment. A partial tank 505 is illustrated, showing a tank wall having a cut-out 510 providing a partial interior view of the tank 505. In this example embodiment, the valve assembly 100 is of a bulkhead type fitting, as described above with reference to FIGS. 1 and 2. As can be seen in the exploded view, a valve body 105 can be inserted through a hole in the tank wall (or formed therein during manufacture), positioning the interior portion 145 of the valve body 105 within the interior of the tank. Also, as illustrated by this example valve assembly 100, the interior portion 145 may be formed in a frustoconical or other shape to provide a shroud to protect the plunger and passageways from the sediment and other debris existing in the tank interior. A bulkhead nut 150 can be threadably secured over the threads 135 of the valve body 105 to secure the valve body 105 against the tank 505. The tank o-ring 140 is compressed between the interior portion 145 of the valve body 105 and the tank wall. Upon securing the bulkhead nut 150, the plunger 110 is inserted through the valve body 105 from the exterior. The retaining clip 120 is then secured over the interior end 115 of the plunger 110, securing it within the valve body 105.

[0048] While the plunger 110 is described as being inserted after securing the bulkhead nut 150, in other embodiments, the plunger may be inserted and secured into the valve body 105 prior to being inserted through the tank 505 and being secured by the bulkhead nut 150. Similarly, for embodiments that do not use a bulkhead type assembly, the plunger 110 may be installed into a valve body already molded into or otherwise integrated with the tank 505, or a valve body may first be threaded into an already molded into or otherwise integrated NPT fitting, into which the plunger may be installed. As stated above, various valve assembly configurations and associated installation techniques may be employed.
According to one embodiment, the valve assembly 100 may be installed to have a slight downward angle relative to the wall of the tank 505, to facilitate draining the liquid out of the valve assembly 100 and reducing undesirable back flow contamination into the tank 505. In example embodiments, this may be accomplished by forming a slightly angled recess within the tank wall, such that the bulkhead type valve assembly 100 will be secured at the same angle as the recess. In other embodiments, however, one or more angled washers, shims, or the like may be used to create the angle desired. In yet other embodiments, the valve body may be molded or otherwise integrated into the tank at the desired angle during manufacture. Similarly, in other embodiments, an NPT fitting may be molded or otherwise integrated into the tank at an angle, such that a complementary valve body can be threadably installed at the desired angle. It is appreciated that in other embodiments, the valve assembly 100 may not be installed at a downward angle, but instead may be installed substantially perpendicular to the tank wall, or at any other angle.

Figs. 6-11 illustrate other example embodiments of a valve assembly, which include a threaded tank insert moldable into a tank during manufacture of the tank. Figs. 6A-6C provide perspective views of the valve body 605 in a disassembled state according to this embodiment. The components include a valve body 605 in FIG. 6A, a valve plunger 610 in FIG. 6B, and a threaded tank insert 650 in FIG. 6C. FIG. 10 illustrates a perspective view of this example valve assembly 600 after assembly.

The valve plunger 610 of this embodiment can be configured in a manner similar to that described above with reference to FIG. 1, including an interior end 670, a removable (or fixed) retaining clip 675, a spring 680, an internal passageway 685, one or more cross-drilled holes 690 in fluid communication with the internal passageway, and an optional tip 695 opposite the interior end configured for adaptation with one or more devices. FIGS. 9A-9B illustrate the valve plunger 610 in closer detail.

The valve body 605, illustrated in closer detail by FIGS. 8A-8B, has external threads 635 that can be threadably inserted into a complementary interior threads 655 of a corresponding threaded tank or container insert 650. The valve body 605 can also include a lip 640 extending radially from the valve body and adjacent the threads 635. The exterior of the valve body 605 may also include two opposing detents 645 or flattened areas formed at or near the end opposite the tank end, which allow for a tool (e.g., wrench, pliers, etc.) to grasp for tightening or loosening the valve body 605 within the tank insert 650. Accordingly, when tightened into a tank insert 650, the lip 640 of the valve body 605 can abut the tank insert. In one embodiment, an o-ring can fit between the two abutting surfaces of the tank insert 650 and the lip 640 of the valve body 605 (shown as o-ring 1105 in FIG. 11 below).

The interior of the valve body 605 includes a bore extending therethrough and having a first diameter through which the plunger 610 is slideably inserted, and retaining the portion having a second diameter greater than the first diameter, creating a seat 630 for retaining a spring for actuating the plunger 610, in a manner similar to that described with reference to FIG. 2 above.

Inside the valve body 605 is a valve body o-ring 620 positioned within the bore of the valve body 605 such that it will be in contact with the plunger 610. The valve body o-ring can be configured and can function in a manner similar to that described with reference to FIG. 2. The valve body o-ring 620 acts to further seal the contents of the tank from passing through the bore of the valve body and around the plunger 610 when in a closed or open position. The valve body o-ring 620 also provides a means for self-cleansing the cross-drilled holes in the valve plunger 610. In addition, when the plunger 610 is in a closed position, fluid can be delivered through the bore of the plunger 610 to rinse out the plunger 610. The o-ring 620 acts to prevent fluid from passing into the tank from within the valve body, while rinsing out the plunger 610, and any sediment or other debris and the rinsing fluid to drain out of the valve body 605 and the bore of the plunger 610.

The tank insert 650, also shown in more detail in FIGS. 7A-7B, is designed to be formed within a tank or other container during manufacture of the tank. The tank insert 650 is generally annular in shape and has an exterior groove 625 cut around the insert for receiving the wall of the tank. The interior of the tank insert 650 forms a bore with a threaded portion and an unthreaded portion 660. The threaded portion includes interior threads 655 extending partially along the length of the bore, which are complementary to the external threads 635 of the valve body 605. In one embodiment, the remaining, unthreaded portion can have a diameter larger than the diameter of the threaded portion. This larger diameter serves to increase the volume within the tank insert 650 and around the valve plunger 610 when in open position, to improve fluid flow into the valve.

The valve body 605, plunger 610, and/or tank insert 650 of this example embodiment may be formed from any tank compatible material, such as, but not limited to, metal (e.g., stainless steel, aluminum, titanium, brass, etc.), natural or synthetic polymer (e.g., Polyethylene, also referred to as Delrin by DuPont Chemicals), any combinations thereof, and the like. In one embodiment, the tank insert 650 can be made of brass, such as if the valve body is made of stainless steel, to prevent thread galling (i.e., adhesion or seizure of the threads). In other embodiments, the valve body 605 and the tank insert 650 can be made of any metals having dissimilar hardness to prevent thread galling. As stated above, it is appreciated that certain materials may not be suitable for some applications, and therefore this list is intended as illustrative only; the design choice can be dependent upon the application of the valve assembly, the tank, and their intended use.

FIG. 11 illustrates a cross-section view of a valve assembly 600 according to the embodiment described with reference to FIGS. 6-10. Accordingly, as can be seen in FIG. 11, the tank insert 650 and its exterior groove 625 fit securely within the wall of a tank or other container. The valve body 650 can then be threadably inserted into the tank insert 650. If an o-ring 1105 is included, the lip 640 of the valve body 605 can compress the o-ring 1105 against the edge of the tank insert 650. In one embodiment, the tank insert 650 and/or the valve body 605 can be radiused to accommodate the o-ring 1105. The orientation of the spring 680 with reference to the plunger 610 and the bore of the valve body 605 is also shown by FIG. 11. Aside from the different configuration of the valve body 605 and the tank insert 650, the valve assembly 600 can be configured, and can function, in a manner similar to the valve assembly described with reference to FIGS. 1 and 2.

FIG. 12 illustrates yet another embodiment of the invention, whereby a valve assembly 1200 may be installed or otherwise integrated with a tank lid 1205. A valve assembly
1200 integrated with a tank lid 1205 may be used to facilitate the introduction of gas or liquids into the tank, such as may be used during sparging, topping-off, or introducing additives, when preparing wine. According to this example embodiment, any of the aforementioned valve assembly configurations and/or installation techniques may be suitable. For example, a bulkhead type valve assembly, similar to that illustrated with reference to FIGS. 1-2 and 4-5, may be installed into the lid 1205, either during manufacture or as a retrofit. In another example, a valve insert may be molded or otherwise integrated into the lid 1205 during manufacture, similar to that described with reference to FIGS. 6-11.

[0060] It is appreciated that in various embodiments, because the lid 1205 may not be in constant contact with tank liquid, the valve assembly 1200 may not need to include each of the components as described with reference to the example valve assemblies above. For example, according to one embodiment, the valve assembly 1200 may not include an o-ring between the valve body and the lid, like the tank o-ring described in the previous embodiments. According to another embodiment, the valve assembly 1200 may not include a valve body o-ring inserted into the valve body and in communication with the plunger. In one embodiment, instead of being inserted into the valve body, the plunger may include an o-ring at its interior end, such that it moves with the plunger, sealing the valve assembly 1200 when in a closed position. It is appreciated though, in other embodiments, one or more of these components may be included in the valve assembly 1200, serving the same or similar purposes as described above.

[0061] Accordingly, described herein are various embodiments of one or more valve assemblies that can be used with a tank. The valve assemblies permit extracting the tank’s contents (such as for sampling) through the use of a unique valve design and installation. Further, upon depressuring and releasing the valve assembly, the unique inclusion and placement of one or more valve body o-rings can facilitate cleansing the valve assembly, reducing sediment or debris, and avoiding clogged valves, as may otherwise occur, while also sealing the valve assembly when in both an open and closed position. The placement of the valve body o-rings also permits flushing the valve with an external fluid when in a closed position without introducing the fluid to the tank when in a closed position.

[0062] The valve assemblies may also be used to introduce additional materials to the tank, such as the introduction of gas during sparging processes, or the introduction of additional liquids. Again, the unique inclusion and placement of the valve body o-ring prevents unwanted sediment or debris from flowing back into the device used to introduce the additional materials. Moreover, the various valve assembly techniques create unique manufacturing advantages, both by creating substantial cost savings by reducing the cost and number of components and the simplicity of installation. In addition, various valve assembly embodiments can be retrofitted to existing tanks, both into tank walls and/or tank lids, creating new opportunities for widespread use.

[0063] While the above example embodiments have been described with reference to wine tanks used during preparation and/or storing, tanks serving other purposes may also be prepared to include valve assemblies similar to those described herein. Accordingly, the subject matter disclosed herein is not intended to be limited to wine preparation devices or techniques, but rather is intended for widespread application.

[0064] Many modifications and other embodiments related to that described herein will be apparent having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the subject matter described herein is not to be limited to the specific embodiments disclosed and that numerous substantial variations, changes, substitutions, and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

What is claimed is:
1. A valve assembly, comprising:
a valve body defining a hollow bore extending therethrough and comprising a valve body o-ring positioned within the hollow bore;
a plunger comprising at least one passageway formed longitudinally partially therethrough; and
at least one spring associated with the plunger;
wherein the plunger is sliptably positioned within the hollow bore of the valve body and retained in a closed position by a force exerted by the at least one spring against the valve body; and
wherein the valve body o-ring substantially contacts the surface of the plunger when the plunger slides within the hollow bore of the valve body.
2. The valve assembly of claim 1, wherein the valve body comprises an interior portion adapted for positioning within an interior of a liquid container, and an opposing exterior portion adapted to extend through a wall of the liquid container and external to the liquid container; wherein the plunger comprises an interior end and an exterior end; wherein when in an open position the interior end extends from the interior portion of the valve body and further into the interior of the liquid container.
3. The valve assembly of claim 1, wherein the plunger further comprises at least one cross-drilled hole formed through the plunger and in fluid communication with the passageway; and wherein when moving between the closed position and an open position the at least one cross-drilled hole passes the valve body o-ring.
4. The valve assembly of claim 3, wherein the plunger comprises an interior end and an exterior end, the at least one cross-drilled hole located proximate the interior end and the passageway opening proximate the exterior end; and wherein when the plunger is in the closed position the valve body o-ring at least partially seals the at least one cross-drilled hole from the interior of the liquid container, and when the plunger is in the open position the at least one cross-drilled hole is in liquid communication with the interior of the liquid container.
5. The valve assembly of claim 1, wherein the plunger comprises a tool fitting at its exterior end adapted for receiving one or more tools used with the valve assembly.
6. The valve assembly of claim 5, wherein the one or more tools comprise at least one of: (a) a gas hose; (b) a sparging hose; (c) a liquid supply; (d) a tap; (e) a spigot; (f) a spout, or (g) an actuating handle.
7. The valve assembly of claim 1 wherein the plunger comprises a nipple connector at its exterior end adapted for slideably receiving one or more devices thereover.
8. The valve assembly of claim 1, wherein the valve body is adapted for installation in a side wall of a liquid container.

9. The valve assembly of claim 1, wherein the valve body further comprises threads along a portion of its body, and further comprising a bulkhead nut for threadably securing the valve body to a liquid container when threaded over the threads of the valve body.

10. The valve assembly of claim 1, wherein the valve body further comprises threads along a portion of its body adapted for threadably securing to complementary threads formed in a liquid container.

11. The valve assembly of claim 1, wherein the valve body further comprises external threads along a portion of its body, and further comprising a container insert adapted for securing to a wall of the liquid container and comprising inner threads adapted to receive the external threads of the valve body for threadably securing the valve body to the liquid container.

12. The valve assembly of claim 1, wherein the valve body is adapted for installation in a lid of a liquid container.

13. A method of installing a valve assembly within a liquid container, comprising:

   providing a valve body defining a hollow bore extending therethrough and comprising a valve body o-ring positioned within the hollow bore;

   providing a plunger comprising at least one passageway formed longitudinally partially therethrough;

   positioning the valve body through a wall in a liquid container;

   threadably securing the valve body to the liquid container;

   positioning the plunger and the at least one spring within the hollow bore of the valve body, such that the at least one spring retains the plunger in a closed position until acted on, and the valve body o-ring substantially contacts the surface of the plunger when the plunger slides within the hollow bore of the valve body.

14. The method of claim 13, wherein positioning the valve body through the wall in the liquid container further comprises:

   securing a container insert to the wall of the liquid container, wherein the container insert comprises inner threads adapted to receive external threads of the valve body; and

   threadably securing the valve body to the container insert.

15. The method of claim 13, wherein the container insert is molded to the wall of the liquid container.

16. The method of claim 13, wherein the valve body has an interior portion forming a bulkhead type fitting, and wherein positioning the valve body through the wall in the liquid container further comprises:

   positioning the interior portion of the valve body within the liquid container with an exterior threaded portion extending through the wall of the liquid container to the exterior;

   threadably securing a bulkhead nut over the exterior threaded portion securing the wall of the liquid container between the bulkhead nut and the interior portion of the valve body.

17. The method of claim 13, wherein positioning the valve body through the wall in the liquid container further comprises:

   molding the valve body in a wall of the liquid container;

   positioning the plunger within the valve body.

18. A liquid container lid, comprising:

   a valve body secured to the liquid container lid and defining a hollow bore extending therethrough and comprising a valve body o-ring positioned within the hollow bore;

   a plunger comprising at least one passageway formed longitudinally partially therethrough; and

   at least one spring associated with the plunger, wherein the plunger is slidably positioned within the hollow bore of the valve body and retained in a closed position by a force exerted by the at least one spring against the valve body; and

   wherein the valve body o-ring substantially contacts the surface of the plunger when the plunger slides within the hollow bore of the valve body.

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