Improved, rigid valves for pumps include outlet valve portions having a valve seal portion and one or more surfaces which create pockets between the outlet valve and an interior wall of a pump to collect and trap particulates in a formulation being pumped.
FIG. 1
(PRIOR ART)
FIG. 23
VALVES AND PUMPS USING SAID VALVES

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application is a continuation-in-part of, and claims the benefit of and priority to, U.S. application Ser. No. 13/689,136, entitled “VALVES AND PUMPS USING SAID VALVES,” filed 29 Nov. 2012, and incorporates the same herein by reference in its entirety.

BACKGROUND OF THE INVENTION

[0002] 1. Field of the Invention
[0003] Embodiments of the invention relate to valves for pump devices and more particularly to improved valves having both inlet and outlet components.
[0004] 2. State of the Art
[0005] The personal and beauty care markets utilize a wide variety of different pump mechanisms and devices for delivering fluid-based product to a user. Such pump devices include traditional pumps using ball valves or flap valves. Unique pump devices may also increase the aesthetic value or appeal of the pump device or provide unique functionality to a pump device. For example, as illustrated and described in WO2010/117754, which is incorporated herein in its entirety by reference, a pump may include a base having an inlet passage, an interior chamber, and a discharge passage. A valve having a valve stem, an outlet valve at one end of the valve stem and an inlet valve or valve disc at an opposite end of the valve stem, may be seated in the base such that the outlet valve may open and close a passage through the discharge passage and the inlet valve or valve disc may open and close a passage from a container into the interior chamber of the base.

[0006] A pump 300 as described in WO2010/117754 is illustrated in FIG. 1 and the components thereof are illustrated in FIGS. 2A through 2D. In particular, a pump 300 may include a base 310 having an inlet passage 312, an interior chamber 314, and a discharge passage 318. A valve 330 may be positioned in the base and may include a valve stem 333, an outlet valve 339 at one end of the valve stem 333 and engaged with the discharge passage 318 in a closed position, and a valve disc 336 at a valve stem 333 end opposite the outlet valve 339, engaged with or acting as an inlet valve in the inlet passage 312. A bellow 350 may be secured to the base 310 with a cap 380. The base 310 may be secured to an attachment adapter 325 or container.

[0007] While the pumps and assemblies illustrated and described in WO2010/117754 may provide sufficient operation, one draw-back is the rigidity or stiffness of the valve used therewith, which can impact performance and assembly of a pump. Thus, improvements to such pumps and the valves used with such pumps are desirable.

BRIEF SUMMARY OF THE INVENTION

[0008] According to certain embodiments of the invention, a valve for a pump assembly may include an improved valve stem. According to certain embodiments of the invention, a valve stem may be improved by providing a thicker cross-sectional area than used with prior valve devices. According to other embodiments of the invention, a valve stem may be improved by providing a geometric shape such that the geometric shape may provide increased stiffness to the valve and the valve stem.

[0009] According to still other embodiments of the invention, an improved valve may include an outlet valve portion having a conical shape. In some embodiments of the invention, a conically shaped outlet valve may be configured to seat in a conically shaped discharge passage of a pump base.

[0010] According to other embodiments of the invention, an improved valve may include both an improved valve stem configuration and an improved outlet valve. For example, an improved valve according to various embodiments of the invention may include a conical outlet valve and a valve stem having a width substantially similar to the largest diameter of the conical outlet valve. In other embodiments, an improved valve may include a conical outlet valve and a valve stem having a cross-shaped cross-sectional area. In still other embodiments, an improved valve may include a conical outlet valve and a valve stem having one or more support ribs running at least a partial length of the valve stem.

[0011] According to still other embodiments of the invention, an improved outlet valve may include one or more steps in the outlet valve portion. An outlet valve having one or more steps may allow the collection of particulate matter in the regions of the one or more steps so that such particulates do not hinder operation of the outlet valve.

[0012] According to still other embodiments of the invention, an improved outlet valve may include a valve seal portion seated against an interior wall of a pump, one or more surfaces extending from the valve seal portion towards a valve stem, and a pocket formed between the outlet valve and an interior wall of a pump in which the outlet valve is seated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0013] While the specification concludes with claims particularly pointing out and distinctly claiming particular embodiments of the present invention, various embodiments of the invention can be more readily understood and appreciated by one of ordinary skill in the art from the following descriptions of various embodiments of the invention when read in conjunction with the accompanying drawings in which:

[0014] FIG. 1 illustrates a pump and valve according to the prior art;
[0015] FIGS. 2A through 2D illustrate components of a pump according to various prior art embodiments;
[0016] FIG. 3 illustrates a valve according to various embodiments of the invention;
[0017] FIG. 4 illustrates a cross-sectional view of a valve along its length according to various embodiments of the invention;
[0018] FIG. 5 illustrates a front view of a valve according to various embodiments of the invention;
[0019] FIG. 6 illustrates a rear view of a valve according to various embodiments of the invention;
[0020] FIG. 7 illustrates a valve according to various embodiments of the invention;
[0021] FIG. 8 illustrates a cross-sectional view of a valve along its length according to various embodiments of the invention;
[0022] FIG. 9 illustrates a cross-sectional view of a valve along its width according to various embodiments of the invention;
[0023] FIG. 10 illustrates a perspective view of a valve according to various embodiments of the invention;
FIG. 11 illustrates a cross-sectional view of a pump including a valve according to various embodiments of the invention.

FIG. 12 illustrates a perspective, component view of a pump including a valve according to various embodiments of the invention.

FIG. 13 illustrates a perspective, component view of a pump including a valve according to various embodiments of the invention.

FIG. 14 illustrates a side view of a valve according to various embodiments of the invention.

FIG. 15 illustrates a cross-sectional side view of a valve along its length according to various embodiments of the invention.

FIG. 16 illustrates a perspective view of a valve according to various embodiments of the invention.

FIG. 17 illustrates an enlarged front view of the valve illustrated in FIG. 14.

FIG. 18 illustrates an enlarged side view of an outlet valve portion of a valve according to various embodiments of the invention.

FIG. 19 illustrates an enlarged perspective view of an outlet valve portion of a valve according to various embodiments of the invention.

FIG. 20 illustrates a cross-sectional view of a pump including a valve according to various embodiments of the invention.

FIG. 21 illustrates an enlarged view of the outlet valve portion of the valve in the pump illustrated in FIG. 20.

FIG. 22 illustrates a perspective, component view of a pump including a valve according to various embodiments of the invention; and

FIG. 23 illustrates a valve and multiple outlet valve configurations for a valve according to various embodiments of the invention.

DETAILED DESCRIPTION OF THE INVENTION

According to embodiments of the invention, a valve may include a valve stem, an outlet valve, and a valve disc. The outlet valve and valve disc may be on opposite ends of the valve stem.

A valve according to various embodiments of the invention is illustrated in FIGS. 3 through 6. As illustrated, a valve may include a valve stem having an outlet valve adjacent one end thereof and a valve disc, or inlet valve, located on an end of the valve stem opposite the outlet valve. The outlet valve may be rounded or have a circular or oval shape. According to various embodiments of the invention, a diameter of the outlet valve may be configured or selected such that the outlet valve may serve against a discharge passage of a pump to prevent discharge of a product from the pump until the valve stem is moved, resulting in an unseating of the outlet valve from a discharge passage.

According to some embodiments of the invention, a valve stem may extend from the outlet valve to a valve disc at an opposite end thereof. A valve stem may include a cross-sectional portion having a width as large as a diameter of the outlet valve over at least a portion of the valve stem. At a portion of the valve stem nearing the valve disc, the valve stem may narrow or converge towards a central portion of the valve disc. For example, the valve illustrated in FIGS. 3 through 6 includes a valve stem having a cross-sectional width equal to the largest diameter of the outlet valve over a portion of the valve stem. At a point near the valve disc, the valve stem narrows or converges towards a central portion of the valve disc, creating a narrowed region in the valve stem adjacent the valve disc.

As shown in the cross-sectional view of FIG. 4, the cross-sectional area of the valve stem remains thick as the cross-sectional diameter of the outlet valve across a large portion of the valve stem. Only near the valve disc does the cross-sectional area of the valve stem begin to decrease or narrow.

FIG. 5 illustrates a front view of the valve illustrated in FIGS. 3 and 4 and FIG. 6 illustrates a rear view thereof. As illustrated, the diameter of the valve stem at a forward portion of the valve stem nearest the outlet valve is greater than at the point where the valve stem joins with the valve disc.

According to various embodiments of the invention, a valve having a thicker valve stem—or a valve stem with an initial width or shape equivalent to a cross-sectional area of the outlet valve—would narrow the valve stem adjacent to the valve disc provides a stiffer or more rigid valve than those of the prior art.

According to some embodiments of the invention, a valve stem may be configured or shaped such that the cross-sectional area or width of the majority of the length of the valve stem relative to the cross-sectional area or width of the valve stem at the point of convergence with the valve disc provides a desired force to resist movement of the valve stem relative to the valve disc. In this manner, the force required to open an outlet valve may be adjusted by changing the configuration of the valve stem thickness along the valve stem and at the point of convergence with the valve disc.

A valve according to other embodiments of the invention is illustrated in FIGS. 7 through 9. As illustrated, a valve may have one or more ribs or other stiffening features running along a length—or part of a length—of the valve stem. In other embodiments, ribs or stiffening features may run along portions of the width or circumference of a valve stem.

According to various embodiments of the invention, a valve stem may include four ribs running along a portion of a length thereof as illustrated in FIG. 7. The ribs may extend from the outlet valve end of the valve towards the valve disc. Adjacent to the valve disc, the ribs may narrow or converge towards the valve disc as illustrated.

A cross-sectional view of the valve stem and ribs is illustrated in FIG. 9. As illustrated, the valve stem and ribs may form a cross shape or “X” shape. In other embodiments of the invention, two or three ribs could be used instead of four. In addition, more than four ribs could be used with various embodiments of the invention.

In still other embodiments of the invention, portions of the exterior surface of the ribs may be configured such that they contact the walls of a base when assembled with a base of a pump. Such contact may provide further stability or may be used for assembly purposes to guide a valve into a desired assembled position. In still other embodiments of the invention, one or more support ribs may be configured as part of a valve stem, or on a valve stem, in such a manner that when assembled with a base of a pump, at least some of the one or more support ribs
contact a portion of an interior chamber of the base. During actuation of the pump and movement of the valve 130, contact between those portions of the valve stem 133 and the walls of the interior chamber of the base 310 may prevent flexion or movement in a direction other than parallel to the axis through the pump base 310 from the inlet orifice to the discharge passage 318.

[0048] According to some embodiments of the invention, a valve 130 having ribs 190 may provide a more rigid valve 130 than those of the prior art.

[0049] According to various embodiments of the invention, a valve stem 133 of a valve 130 may be shaped or configured to provide increased rigidity to the valve 130. For instance, a valve stem 133 may be a solid valve stem 133 having a narrowing portion adjacent a valve disc 136. In other embodiments, a valve stem 133 may include shaped features or ribs 190 running along a length or width of the valve stem 133 to provide support, rigidity, and stiffness to the valve stem 133 and the valve 130. In still other embodiments of the invention, the rigidity or stiffness of a valve 130 may be increased by utilizing a valve stem 133 shape which narrows as the valve stem 133 approaches a valve disc 136. Ribs 190 or other features may be added to the valve stem 133 to increase the rigidity or stiffness of the valve 130.

[0050] A valve 130 according to still other embodiments of the invention is illustrated in FIGS. 10 and 11. As illustrated in FIG. 10, a valve 130 may include a conical outlet valve 139. Although rounded outlet valves may be used with various embodiments of the invention, it has been found that the use of a conical outlet valve 139 with a pump base 310 having a corresponding conical shaped discharge passage 318 provides a better seal or valve seat. Thus, in certain embodiments of the invention, a valve 130 may have a conically shaped outlet valve 139.

[0051] A pump assembled with a valve according to various embodiments of the invention is illustrated in FIG. 11. As illustrated, the pump may include a base 310 having a discharge passage 318. A valve 130 may be seated in the base 310 such that the outlet valve 139 seats against the discharge passage 318. An attachment adapter 325 may fit in an opposite end of the base 310 and secure the valve 130 within the base 310. In addition, the attachment adapter 325 may provide an inlet valve seat which mates with or contacts at least a portion of the valve disc 136 to provide an inlet valve for the pump from a container or pouch attached to the base 310 of the pump. A bellow 350 may be secured to the base 310 with a cap 380. Actuation of the bellow 350 with product in the base 310 may apply a force against the valve disc 136, which in turn may apply a force to the valve stem 133 and unseat the outlet valve 139 from the discharge passage 318, allowing product to flow from the pump as known.

[0052] As illustrated in FIG. 11, a valve 130 having a conically shaped outlet valve 139 is seated in a conically shaped discharge passage 318 of a pump base 310. The seat of the conical shaped outlet valve 139 may be matched to the discharge passage 318 to provide a superior seal. In addition, it has been found that the use of a conical shaped outlet valve 139 as illustrated may provide an improved discharge of product. This is especially true where the valve 130 is a stiffer valve according to embodiments of the invention. For example, when using a valve 130 according to embodiments of the invention having a conical shaped outlet valve 139, discharge of a product from the pump is more controlled. The conical shape of the outlet valve 139 and corresponding shape of the discharge passage 318 provides an improved valve seat which stabilizes the flow of product out the discharge valve and provides a cleaner shut-off when the outlet valve 139 re-seats with the discharge passageway 318.

[0053] A pump assembly according to various embodiments of the invention is illustrated in FIG. 12. As illustrated, a pump may include a base 310, a valve 130 fitted in the base 310, an attachment adapter 325 fitted into the base 310 to secure the valve 130 therein, and a bellow 350 secured with a cap 380. In some embodiments of the invention, a base 310 may include a can shape shaped attachment for securing the pump to a pouch or other container. A valve 130 incorporated with—or assembled in—the pump may include a stiffened or rigid valve 130 according to embodiments of the invention. In addition, a valve 130 may include a conically shaped outlet valve 139 portion as illustrated.

[0054] A pump assembly according to various embodiments of the invention is illustrated in FIG. 13. As illustrated, a pump may include a base 310, a valve 130 fitted in the base 310, an attachment adapter 325 fitted into the base 310 to secure the valve 130 therein, and a bellow 350 secured with a cap 380. In some embodiments of the invention, a base 310 may include a can shape attachment having a curved shape for securing the pump to a pouch or other container. A valve 130 incorporated with—or assembled in—the pump may include a stiffened or rigid valve 130 according to embodiments of the invention. In addition, a valve 130 may include a conically shaped outlet valve 139 portion as illustrated.

[0055] A valve 230 according to still other embodiments of the invention is illustrated in FIGS. 14 through 17. A valve 230 may be used in a pump and may include a valve stem 233, an outlet valve 239 and a valve disc 236. The outlet valve 239 and valve disc 236 may be on opposite ends of the valve stem 233.

[0056] As illustrated in FIG. 14, a valve 230 may include one or more ribs 190 or other stiffening features running along a length—or part of a length—of the valve stem 233. In other embodiments, ribs 190 or stiffening features may run along portions of the width or circumference of a valve stem 233.

[0057] According to various embodiments of the invention, a valve stem 233 may include four ribs 190 running along a portion of a length thereof. In other embodiments three or more ribs 190 may be used. For example, a valve 230 may include three ribs 190, four ribs 190, five ribs 190 or more running along a length of a valve stem 233. The ribs 190 may extend from the outlet valve 239 end of the valve 230 towards the valve disc 236. Adjacent to the valve disc 236, the ribs 190 may narrow or converge towards the valve disc 236 as illustrated. Convergence of the ribs 190 may be in a conical shape narrowing to a cylindrical portion between the ribs 190 and the valve disc 236 or in any other desired configuration. In some embodiments, ribs 190 may provide rigidity or support to the valve 230.

[0058] According to various embodiments of the invention, an outlet valve 239 portion of the valve 230 may include one or more steps or surfaces having different angles compared to other surfaces making up the outlet valve 239 portion of the valve 230. For example, as illustrated in FIGS. 19 and 19, an outlet valve 239 may include a valve seal portion 240 at a forward end of the outlet valve 239. One or more surfaces 242 may extend from the valve seal portion 240 towards the valve stem 233 and join therewith. While the illustrated surfaces 242 in FIGS. 18 and 19 include two sloping surfaces, an outlet
valve 239 may include one or more such surfaces extending or sloping away from the valve seal portion 240. 0059. According to various embodiments of the invention, when a valve 230 having an outlet valve 239 according to certain embodiments of the invention is inserted into a base 310 of a pump, the valve seal portion 240 may contact an interior wall of the base 310 of the pump at or near a discharge passage 318 of the base 310 as illustrated in FIG. 20. The valve seal portion 240 may contact the base 310 in such a way that the discharge passage 318 is closed or sealed by the outlet valve 239 such that product from within the pump cannot escape through the discharge passage 318. In addition, one or more pockets, gaps or openings may be formed between the outlet valve 239 and the inner wall of the base 310 adjacent to the valve seal portion 240. For example, FIG. 21 illustrates a blown-up view of the discharge passage 318 and outlet valve 239 illustrated in FIG. 20. As shown, the valve seal portion 240 of the outlet valve 239 seals against an interior wall of the base 310 near the discharge passage 318 to prevent product from escaping the pump. The valve seal portion 240 extends from its seal with the interior wall of the base 310 towards the valve stem 233 and meets the first of two surfaces 242. The surfaces 242 may be configured to provide or form one or more pockets 241, spaces or openings between the outlet valve 239 and the interior wall of the base 310.

0060. The use of a valve 230 having an outlet valve 239 configured to provide a seal between a valve seal portion 240 and an interior wall of a base 310 of a pump, along with the inclusion of one or more pockets 241 may be advantageous when used with product formulations having particulate matter therein. For example, it has been found that use of a valve 130 having a cone shaped outlet valve 139 such as that illustrated in FIG. 10 with products containing particulates may lead to some of the particulates being trapped between the sealing surface of the cone shaped outlet valve 139 and the interior wall of the base 310 of the pump. When such particulates become trapped, there is an increased risk of a seal between the outlet valve 139 and the base 310 not being made and air entering the pump or a loss of prime resulting from air entering the pump chamber past the outlet valve 139. However, the use of an outlet valve 239 as illustrated in FIGS. 18 through 21 avoids these issues and forms a better seal. In part, the one or more pockets 241 may allow the valve seal portion 240 to squeeze particulates back into the one or more pockets 241 such that the valve seal portion 240 is able to form a complete seal with the interior wall of the base 310 of the pump. The one or more pockets 241 may provide additional space into which particulates may congregate as the valve seal portion 240 seals against the interior wall of the base 310 instead of being pinched between the valve seal portion 240 and the interior wall of the base 310.

0061. According to various embodiments of the invention, an outlet valve 239 may include a valve seal portion 240 and one or more surfaces 242 extending away from the valve seal portion 240 towards the valve stem 233 such that when the outlet valve 239 is seated in or near a discharge passage 318 of a pump, the outlet valve 239 creates a seal between the interior wall of a pump and the valve seal portion 240, one or more pockets 241, and a restricted space smaller than the one or more pockets 241 interior to the one or more pockets 241.

0062. A pump assembly according to various embodiments of the invention is illustrated in FIG. 22. As illustrated, a pump may include a base 310, a valve 230 which may be inserted into the base 310, an attachment adapter 325 lifted into the base 310 to secure the valve 230 therein, and a bellow 350 secured to the base 310 by a cap 380. In some embodiments, a base 310 may include a canoe having a straight or winged shape for securing the pump assembly to a pouch or container.

0063. An outlet valve 239 according to still other embodiments of the invention may include one or more ridges 243 encircling all or part of the outlet valve 239 as illustrated in FIG. 22. FIG. 22 shows a valve 230 without an outlet valve 239 on the end and thirteen alternative configurations for an outlet valve 239 which may be used with various embodiments of the invention. As illustrated, one or more ridges 243 formed on a part of the outlet valve 239 may create pockets, spaces, or openings that may trap or contain particulates when an outlet valve 239 seals against a pump. The one or more ridges may be formed to create pockets 241. In addition, an outlet valve 239 may include one or more raised bands 247 capable of creating similar pockets, spaces, or openings relative to an interior of a pump such that particulates may be trapped in the pockets formed between the one or more bands 247 and an interior wall of a pump. In still other embodiments, one or more holes or divots 245 may be formed in the outlet valve 239 to provide pockets 241 between the outlet valve 239 and an interior wall of a pump.

0064. A valve 230 having a particular outlet valve 239 configuration according to various embodiments of the invention may be molded as a unitary component using known molding methods.

0065. According to various embodiments of the invention, a valve disc 236 may be conical in shape as illustrated in FIGS. 3 and 7 or it may be rounded or cup shaped as illustrated in FIGS. 10 and 14. According to some embodiments of the invention, the cup shape of a valve disc 236 may help facilitate movement of a valve 130, 230 in a parallel plane when in use. In some embodiments, the configuration of the cup shape may also be altered to adjust the force required to unseat an outlet valve 139, 239 from its seat against the base 310 of the pump.

0066. Valves 130, 230 according to various embodiments of the invention may be made of a flexible material such as TPE, TPU, silicon or other material as desired. In addition, valves 130, 230 according to other embodiments of the invention may be made of a different plastic or resin material.

0067. Having thus described certain particular embodiments of the invention, it is understood that the invention defined by the appended claims is not to be limited by particular details set forth in the above description, as many apparent variations thereof are contemplated. Rather, the invention is limited only by the appended claims, which include within their scope all equivalent devices or methods which operate according to the principles of the invention as described.

What is claimed is:
1. A valve for a pump, comprising:
   a. a valve stem;
   b. an outlet valve at a first end of the valve stem, comprising:
      a. a valve seal portion;
      b. at least one surface extending from the valve seal portion towards the valve stem;
      c. a valve disc at a second end of the valve stem.
2. The valve of claim 1, wherein the valve disc comprises a conical shape.
3. The valve of claim 1, wherein the valve disc comprises a cup shape.
4. The valve of claim 1, further comprising at least one rib running a portion of the length of the valve stem between the outlet valve and the valve disc.

5. The valve of claim 1, wherein the outlet valve further comprises at least one ridge about a portion of the at least one surface extending from the valve seal portion towards the valve stem.

6. The valve of claim 1, wherein the outlet valve further comprises at least one band about a portion of the at least one surface extending from the valve seal portion towards the valve stem.

7. The valve of claim 1, wherein the outlet valve further comprises at least one pivot in the outlet valve.

8. A pump, comprising:
   a base;
   a bellow seated in the base;
   a cap securing the bellow in the base;
   a valve in an interior portion of the base, the valve comprising:
   an outlet valve comprising a valve seal portion seated against an interior wall of the base and at least one surface extending into an interior of the base;
   a valve stem in communication with the at least one surface;
   a pocket between the outlet valve and the interior wall of the base; and
   a valve disc at an end opposite the outlet valve;
   an attachment adapter seated against the valve disc and securing the valve in the base.

9. The pump of claim 8, wherein the pocket is between the valve seal portion seated against an interior wall of the base and the valve stem.

10. The pump of claim 8, wherein the outlet valve further comprises at least one ridge encircling a portion of the outlet valve.

11. The pump of claim 8, wherein the outlet valve further comprises at least one band encircling a portion of the outlet valve.

12. The pump of claim 8, wherein the outlet valve further comprises at least one pivot in the outlet valve.

13. The pump of claim 8, wherein the valve disc comprises a cup shaped valve disc.

14. The pump of claim 8, wherein the valve disc comprises a conical shaped valve disc.

15. The pump of claim 8, further comprising a product in the pump, the product comprising particulates.