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(54) **PUMP DEVICE AND METHODS OF MAKING THE SAME**

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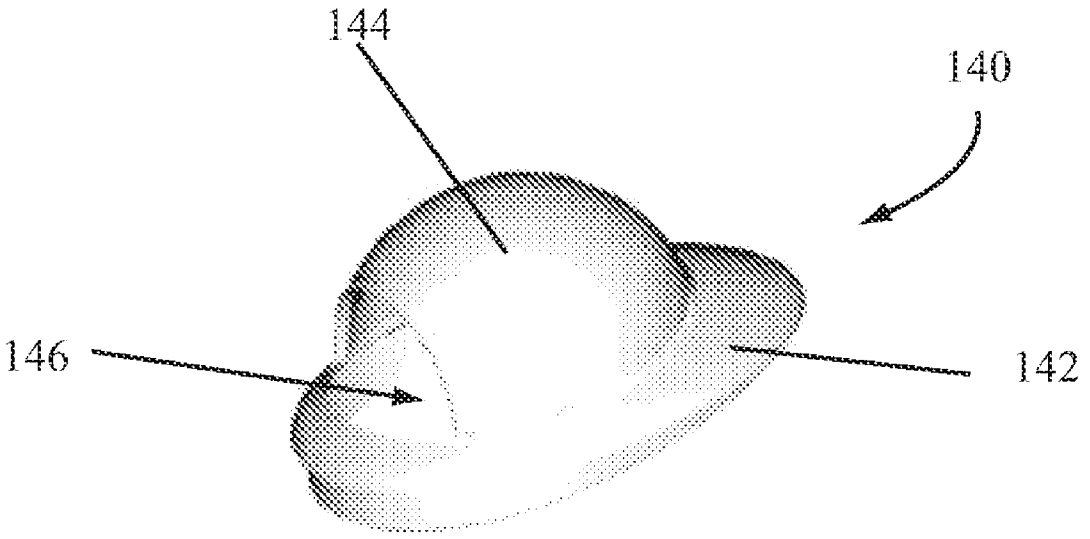
(57) **ABSTRACT**

A pump including a flexible membrane and a body defining a fluid pump chamber therebetween may be fitted with an overlying, removable, rigid cap to protect inadvertent actuation of the membrane pumping mechanism.



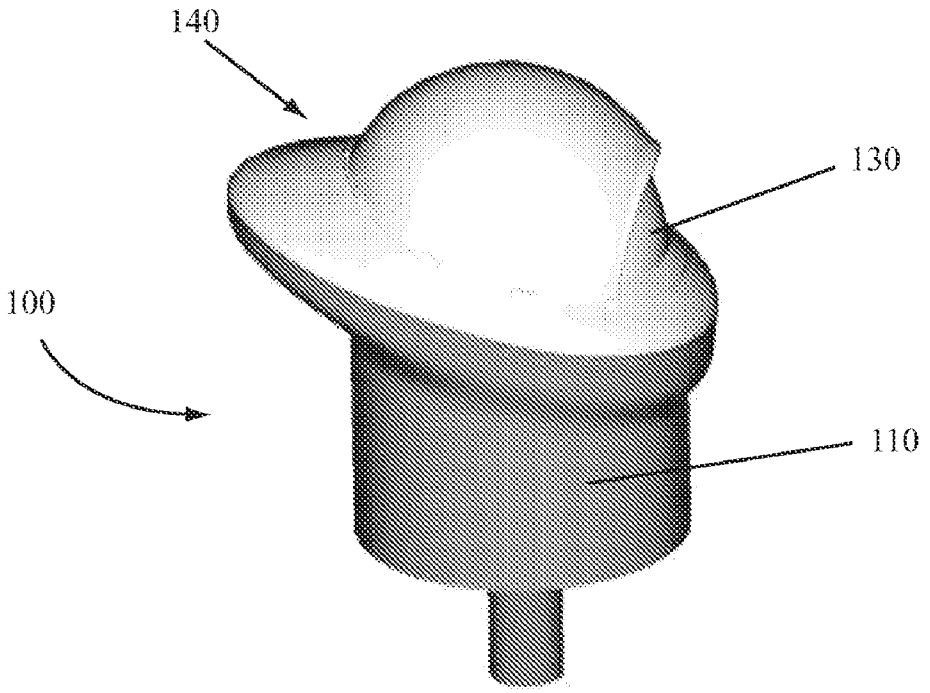


FIG. 1

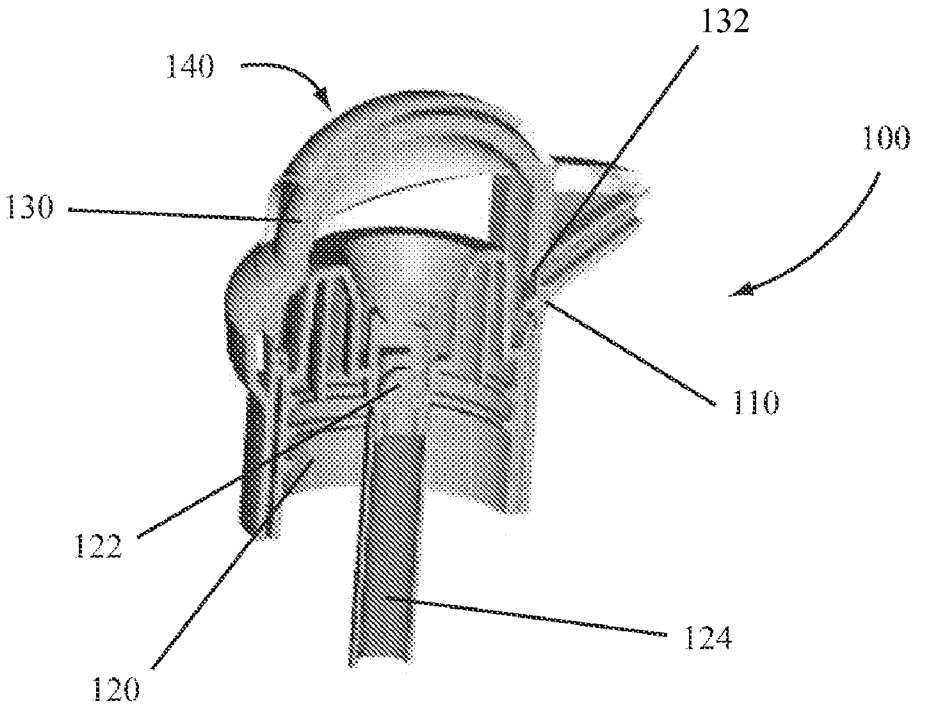


FIG. 2

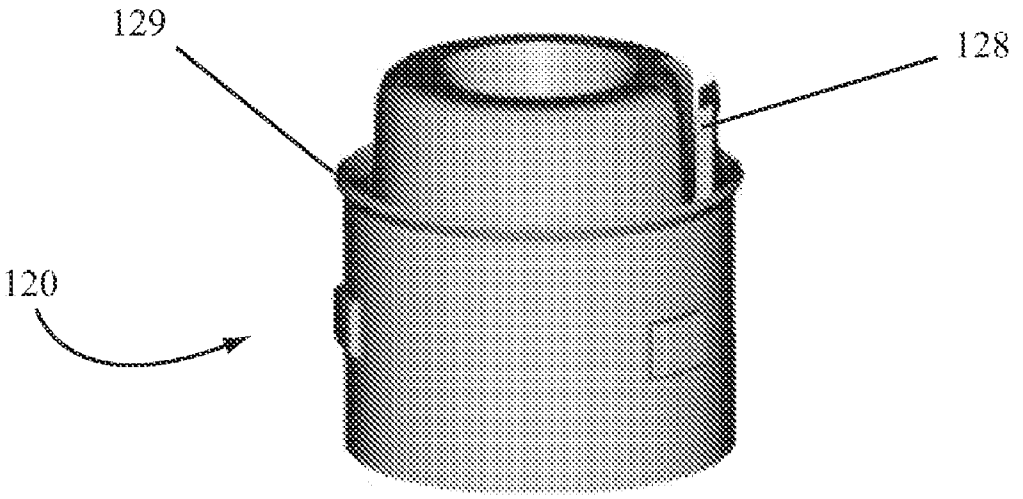


FIG. 3

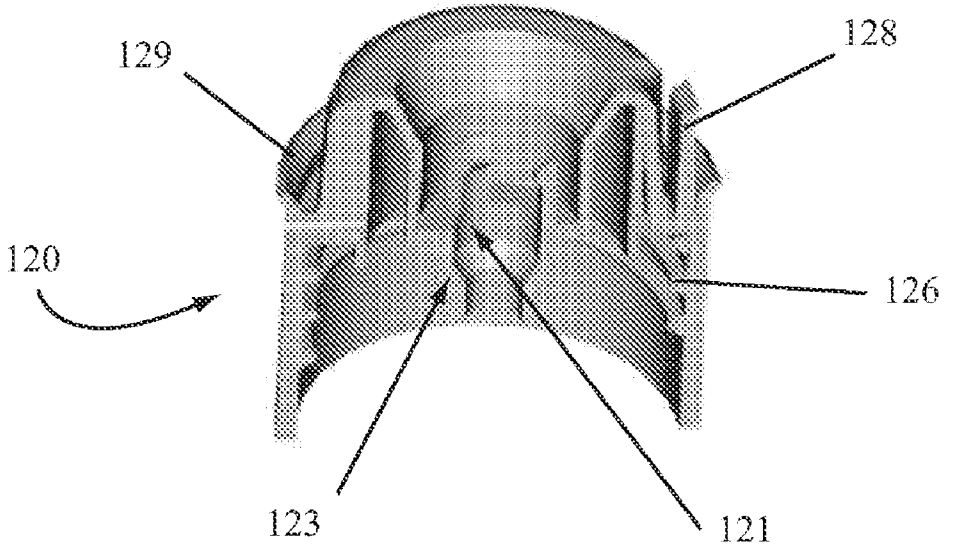


FIG. 4

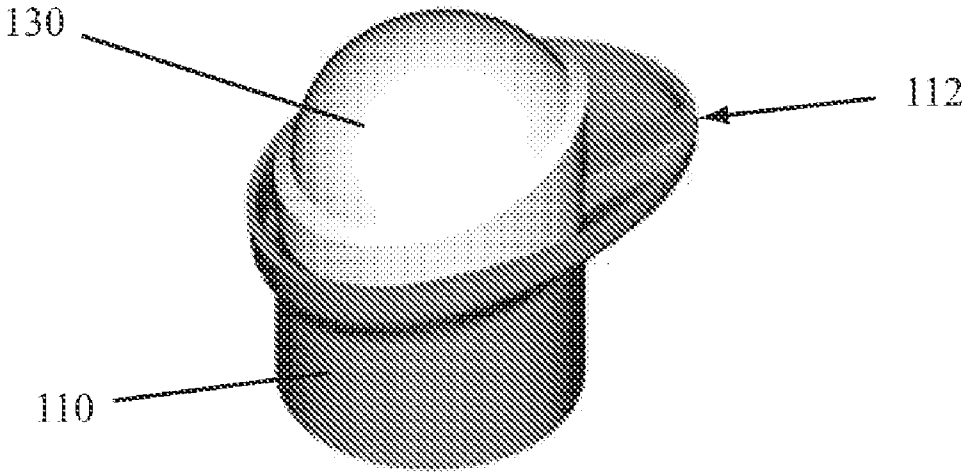


FIG. 5

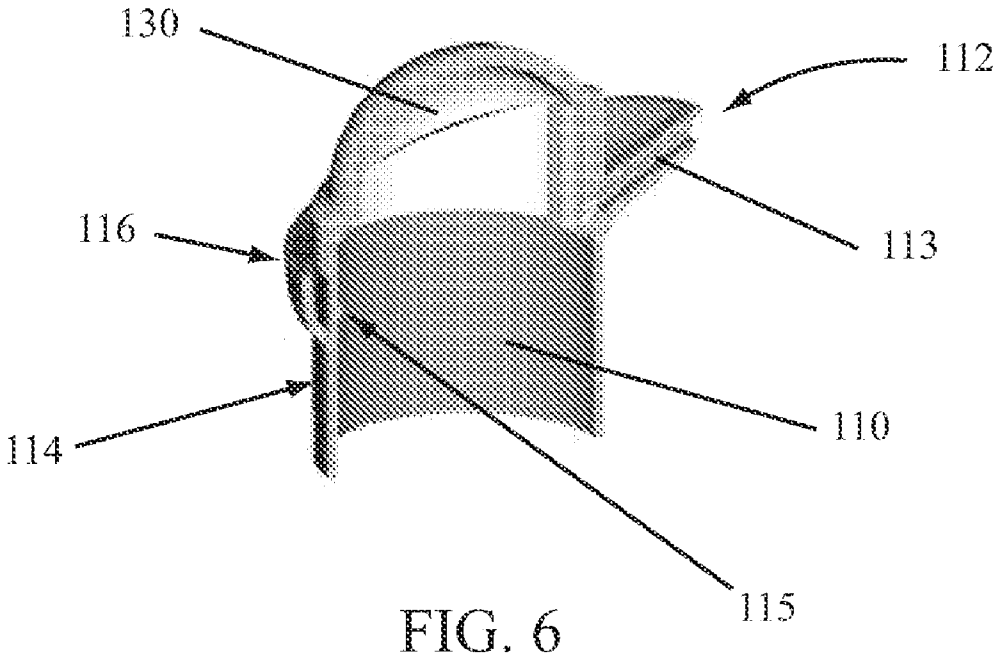


FIG. 6

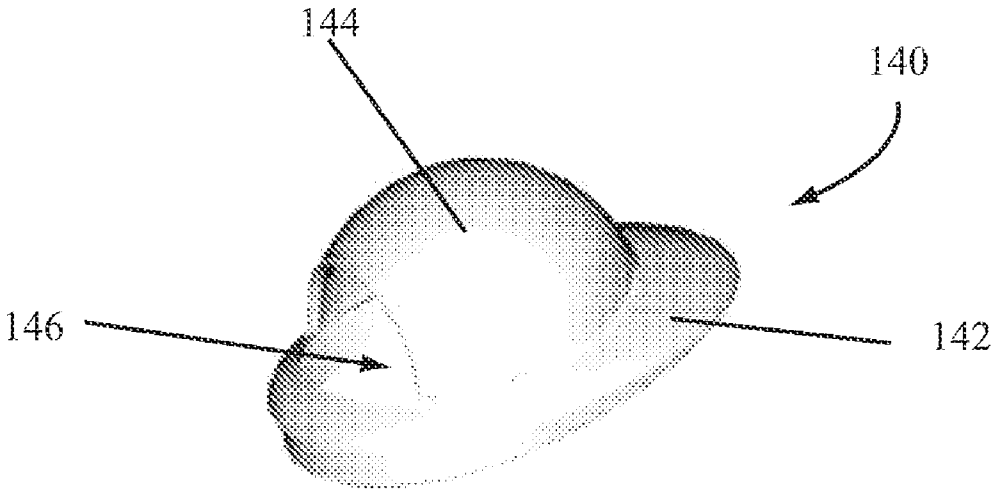


FIG. 7

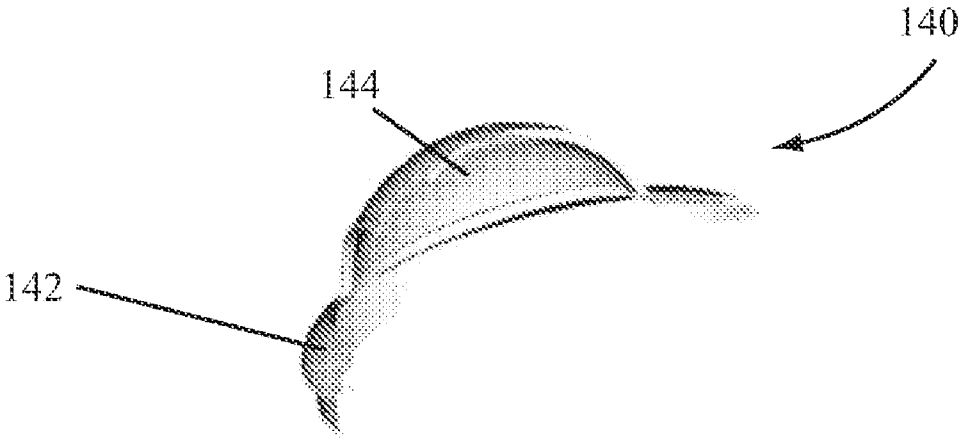


FIG. 8

PUMP DEVICE AND METHODS OF MAKING THE SAME

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims the benefit of U.S. Provisional Application No. 61232085, entitled "PUMP DEVICE AND METHODS OF MAKING THE SAME," filed Aug. 7, 2009, 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 fluid pump devices and more particularly to fluid pump devices which may be mounted to containers for pumping fluids from the containers utilizing a deformable membrane.

[0004] 2. State of the Art:

[0005] Pump devices are well known and are used on a variety of products to pump liquids. For example, pump devices are generally attached to liquid containing containers in order to facilitate evacuation of the liquid from the container. Conventional pump systems include piston pump systems and membrane-type pump systems.

[0006] Conventional piston pumps are well known and typically include a piston positioned within an accumulator. A valve in the accumulator may prevent or allow liquid from a container to flow into the accumulator depending on the stroke of the piston. A spring typically biases the piston. When the piston is pushed downward into the accumulator, commonly referred to as the downstroke, a fluid flow path around the piston opens and the accumulator valve remains shut such that any fluid accumulated in the accumulator may be forced through the fluid flow path. A spring force acts against the piston. When the piston is released from the downstroke the spring biases the piston back into its starting position; this is also known as the upstroke. During the upstroke, movement of the piston opens the accumulator valve, pulling fluid into the accumulator for delivery during the next downstroke. Operation of conventional piston pumps is well known and may vary from the foregoing.

[0007] Membrane-type pump devices typically include a deformable membrane defining a pump chamber. Application of a force to the membrane pushes liquid product out of the pump chamber through a valve or liquid flow path. Release of the force on the membrane allows the membrane to return to its original form. During the return of the membrane to its original form a valve may be opened allowing liquid to flow into the pump chamber from a container or other liquid storage device. For example, U.S. Patent Application Publications 20070181611 and 2007164052 disclose such membrane-type pump devices.

[0008] Membrane-type pump devices may be less expensive than conventional piston pumps in some instances because they typically include fewer moving parts and are easier to assemble. However, membrane-type pumps may sacrifice quality and functionality to achieve such lower costs and ease of assembly. Therefore, it is desirable to decrease the cost of membrane-type pumps and/or to improve the functionality of membrane-type pumps.

BRIEF SUMMARY OF THE INVENTION

[0009] According to certain embodiments of the invention, a pump may include a body, a closure, a membrane and a cap, wherein the body and the closure are fitted together and the membrane is fitted to the body such that a cavity is formed between the membrane and the closure. A cap fitted over the membrane may include a removable cap portion.

[0010] According to various embodiments of the invention, a cap may include a cap body and a removable cap portion. In some embodiments, the removable cap portion may be configured to protect the membrane from actuation. In other embodiments, the removable cap portion may be configured to support a top load. In still other embodiments of the invention, the removable cap portion may be configured to evidence tampering with the membrane or the pump.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] 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:

[0012] FIG. **1** illustrates a pump according to various embodiments of the invention;

[0013] FIG. **2** illustrates a cross-sectional view of a pump according to various embodiments of the invention;

[0014] FIG. **3** illustrates a closure for a pump according to various embodiments of the invention;

[0015] FIG. **4** illustrates a cross-sectional view of a closure according to various embodiments of the invention;

[0016] FIG. **5** illustrates a body and membrane for a pump according to various embodiments of the invention;

[0017] FIG. **6** illustrates a cross-sectional view of a body and membrane for a pump according to various embodiments of the invention;

[0018] FIG. **7** illustrates a cap for a pump according to various embodiments of the invention; and

[0019] FIG. **8** illustrates a cross-sectional view of a cap for a pump according to various embodiments of the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0020] According to embodiments of the invention, a pump for dispensing fluid products may include a flexible or elastomeric membrane attached to a body wherein the membrane and the body define a pump chamber. The membrane and the body may be a molded plastic part, a bi-injected plastic part including at least two plastic or moldable materials, or separate molded or formed parts fitted together. A closure device may be attached to, fitted with, integrally formed, or otherwise associated with the body for attaching the pump to a container or fluid source. The membrane may include one or more sealable openings through which a fluid product may be dispensed when a force is applied to the membrane. A cap may be fitted over a portion or all of the membrane and a portion of the cap may be removable such that a portion of the

cap prevents activation of the membrane or the application of a force to the membrane until the portion of the cap is removed.

[0021] A pump **100** according to various embodiments of the invention is illustrated in FIG. **1**. The pump **100** may include a body **110**, a closure mechanism (not shown), a membrane **130**, and a cap **140** covering at least a portion of the membrane **130**. A dip tube **124** may be attached to the pump **100** and the pump **100** may be attached to a container or other fluid source.

[0022] A cross sectional view of a pump **100** according to various embodiments of the invention is illustrated in FIG. **2**. As illustrated, a pump **100** may include a body **110**, a closure **120**, a membrane **130**, and a cap **140**. The closure **120** and the body **110** may be fitted together such that the closure **120** fits inside the body **110** and is secured or attached thereto. In some embodiments, the closure **120** may be frictionally fit or attached to the body **110**. In other embodiments, the closure **120** may be welded, melted, or otherwise attached to or secured to the body **110** as desired. In still other embodiments, the closure **120** and body **110** may be a single component molded or otherwise formed together. The membrane **130** and the body **110** may also be secured or attached together. In some embodiments, the membrane **130** and the body **110** may be formed of two plastic or moldable materials that are bi-injected in a single molded piece. The cap **140** may also be attached or secured to the body **110**. The cap **140** may include a removable cap portion protecting at least a part of the membrane **130**.

[0023] A closure **120** according to various embodiments of the invention is illustrated in FIGS. **3** and **4**. A closure **120** may include one or more of a ball seat **121**, a tube retainer **123**, a closure mechanism **126**, and a valve post **128**.

[0024] A ball seat **121** may include any conventional ball seat **121** or mechanism for retaining a ball **122** for a valve. In other embodiments of the invention, a ball seat **121** and ball **122** may be substituted with an alternative valve such as a flap valve or other valve system as conventionally known.

[0025] A tube retainer **123** may include any conventional tube retaining mechanism. For example, the tube retainer **123** illustrated in FIG. **4** may include ribs, bumps, or other features to retain a dip tube **124** to the closure **120** as illustrated in FIG. **2**. In addition, the tube retainer **123** may include a larger diameter than a dip tube **124** such that a dip tube **124** overlying the tube retainer **123** is frictionally fitted to the tube retainer **123**. In other embodiments, a dip tube **124** may be retained on an interior surface of the tube retainer **123** rather than on the exterior surface as illustrated in FIG. **2**. Any conventional method or structure for retaining a dip tube **124** to the closure **120** may be used with various embodiments of the invention.

[0026] The closure mechanism **126** illustrated in FIG. **4** includes a screw-type closure as conventionally known. Other closure mechanisms **126** may also be used with various embodiments of the invention. For example, the closure mechanism **126** may include a snap-on closure system or a bayonet closure system. The closure mechanism **126** may be used to secure or fit a pump **100** to a bottle or container using conventional methods.

[0027] According to various embodiments of the invention, the closure **120** may also include a valve post **128**. The valve post **128** may extend from the closure **120** vertically or in another direction such that when the closure **120** is mounted or attached to the body **110**, the valve post **128** abuts or otherwise contacts at least a portion of the membrane **130**.

[0028] A closure **120** may also include a lip **129** or a partial lip **129** circumscribing the closure **120**. The lip **129** may be used to retain the closure **120** within a body **110** of a pump **100**.

[0029] A closure **120** according to various embodiments of the invention may be a single piece. For example, the closure **120** may be a single molded plastic part. In other embodiments, the closure **120** may be made of one or more parts which have been attached together or otherwise joined to form the closure **120**.

[0030] A body **110** and membrane **130** combination of a pump **100** according to embodiments of the invention is illustrated in FIGS. **5** and **6**. As illustrated in FIG. **5**, the membrane **130** may appear to rest on the top portion of the body **110**. In some embodiments, the membrane **130** and body **110** may include two separate components attached or otherwise joined together. In other embodiments, the body **110** and membrane **130** may include two or more different materials joined together, such as by being bi-injected together.

[0031] A body **110** according to embodiments of the invention may be formed of a plastic or other material and in some instances, a moldable material. As illustrated in FIG. **6**, a body **110** may include a spout **112** having a passageway **113** from an interior of the body **110** to an exterior of the body **110**. A body **110** may also include a main wall **114** and a secondary wall **116** extending outwardly from the main wall **114**. The main wall **114** may be attached to, in communication with, or otherwise joined with a membrane **130**. One or more projections **115** on an interior surface of the main wall **114** may also be included with the body **110**.

[0032] A membrane **130** according to embodiments of the invention may include an elastomeric material, flexible material, or material which may be deformed and which will return substantially to its original shape after being deformed. In some embodiments of the invention, the membrane **130** includes an elastomeric material bi-injected with the body **110** such that the membrane **130** and body **110** are a single part. In other embodiments of the invention, a membrane **130** may be attached to, secured to, or otherwise joined with a body **110** to form a body **110** and membrane **130** structure as illustrated in FIG. **5**.

[0033] According to embodiments of the invention, a membrane **130** may include a valve **132**. A valve may include a slot cut in the membrane **130**, a flap in the membrane **130**, or other structure in the membrane **130** or attached to the membrane **130** to act as a valve between an interior space between the membrane **130** and the closure **120** and the passageway **113** through the body **110**. For example, the membrane **130** illustrated in FIG. **2** may include a slot cut in the membrane **130** wherein the slot abuts the valve post **128** of the closure.

[0034] A closure **120** may be fitted on an interior of the body **110** as illustrated in FIG. **2**. The closure **120** may be snap-fitted, frictionally fit, or otherwise attached to the body **110**. In some instances, the lip **129** of a closure **120** may snap past one or more projections **115** of a body **110** to retain the closure **120** within the body **110** or to assemble the closure **120** with the body **110** of a pump **100**. When a closure **120** is fitted with the body **110** a valve post **128** of the closure **120**, if there is one, may abut against or otherwise touch a portion of the membrane **130**. In some embodiments of the invention, a valve post **128** may cover a portion of the membrane **130** having a valve **132** or slit through which a fluid product may

pass. Contact between the valve post **128** and the valve **132** of the membrane **130** may improve sealing of the valve **132** or may help prevent air entering the spout **112** from passing through the valve **132** to contact a fluid product in the pump **100**.

[0035] A cap **140** according to embodiments of the invention may be fitted to the body **110** around or over the membrane **130**. A cap **140** may include one or more of a cap body **142**, a removable cap portion **144**, and a cap opening **146**.

[0036] For example, a cap **140** according to embodiments of the invention is illustrated in FIGS. **7** and **8**. The cap **140** illustrated in FIGS. **7** and **8** includes a cap body **142** which may be attached to the body **110** to help define the shape of the pump **110**. The cap **140** also includes a removable cap portion **144** which partially covers the membrane **130** with the cap **140** is attached to the body **110**. A cap opening **146** between the cap body **142** and removable cap portion **144** provides a space through which the membrane **130** may be seen or by which leverage may be applied to the removable cap portion **144** to separate the removable cap portion **144** form the cap body **142**.

[0037] According to some embodiments of the invention, a removable cap portion **144** of a cap **140** may protect the membrane **130** under the removable cap portion **144** from actuation. For example, a cap **140** as illustrated in FIGS. **1** and **2** may include a removable cap portion **144** covering most of the membrane **130**. A force applied to the removable cap portion **144** may not be transferred to the membrane **130** due to the rigidity of the removable cap portion **144**. Thus, the removable cap portion **144** protects the membrane **130** from inadvertent actuation. In addition, the removable cap portion **144** may be strong enough to support additional weight such that pumps **100** may be stacked on top of one another during shipment without the worry that the additional weight caused by the stacking of the pumps **100** will cause actuation of the membrane **130**.

[0038] Inclusion of a removable cap portion **144** with pumps **100** according to embodiments of the invention also provides notification to a purchaser or user of tampering. For example, if a removable cap portion **144** is intact with the cap body **142** tampering may not have occurred. However, if the removable cap portion **144** is missing or has been partially separated from the cap body **142**, evidence of tampering is visually apparent.

[0039] A removable cap portion **144** may be formed with the cap during molding or production of the cap. For example, the removable cap portion **144** illustrated in FIGS. **7** and **8** includes tabs between the cap body **142** and the removable cap portion **144**. The tabs may be molded during formation of the cap **140** and may allow the removable cap portion **144** to be removed or separated from the cap body **142**. Other devices, structures, or features may also be incorporated with embodiments of the invention to fit the cap body **142** and the removable cap portion **144** together.

[0040] In some embodiments of the invention, a vent in the pump **100** allows the interior of a container to which the pump **100** is attached to equilibrate with atmospheric pressure.

[0041] According to various embodiments of the invention, a pump **100** may be assembled by providing a closure **120**, a body **110**, a membrane **130** and a cap **140**. A ball **122** may be fitted in a ball seat **121** of the closure **120** and a dip tube **124** may be attached or otherwise joined to a tube retainer **123** portion of the closure **120**. The closure **120** may be snap fitted or otherwise joined with the body **110** such that a fluid chamber between a top surface of the closure **120** and an interior surface of a membrane **130** connected to the body **110** is formed. A membrane **130** may be attached to the body **110** or may be integral with the body **110** prior to joining the closure **120** with the body **110**. A cap **140** may be positioned over the membrane **130** and body **110** and joined to the body **110** to finalize the pump **100**.

[0042] According to certain embodiments of the invention, the assembly of the pump **100** may include the cutting of a valve **132** in the membrane **130**. In further embodiments, the closure **120** and body **110** may be aligned prior to joining such that a valve post **128** of the closure **120** mates with, abuts, or otherwise contacts a valve **132** in the membrane **130** in the assembled form.

[0043] A pump **100** according to embodiments of the invention may be used in any desired manner. According to some embodiments, a pump **100** may include a removable cap portion **144** preventing actuation of the pump **100**. Removal of the removable cap portion **144**, such as by prying or otherwise pulling the removable cap portion **144** from the cap body **142**, may expose the membrane **130** and allow operation of the pump **100**. An application of force on the membrane **130** may collapse or deform the membrane **130**, forcing a fluid product in the pump chamber between the membrane **130** and the closure **120** out a valve **132** of the membrane **130**.

[0044] For example, the pump **100** illustrated in FIG. **2** may be attached to a container containing a fluid and used in the following manner. The removable cap portion **144** of the cap **140** may be removed from the pump **100** to expose the membrane **130**. The membrane **130** may be actuated by pushing on the membrane **130**. Upon actuation, the membrane **130** deforms pushing air or other fluid in the pump chamber out of the valve **132** in the membrane **130**. Release of the force on the membrane **130** allows the membrane **130** to return to its original shape, while at the same time forming a vacuum which opens the ball valve, pulling fluid from within the container into the pump chamber. The priming of the pump **100** may continue in this fashion as known until the pump chamber is filled with fluid from the container. Actuation of the membrane **130** then forces fluid stored in the pump chamber out through the valve **132**, along passageway **113** and out spout **112**, thereby dispensing the fluid product to the user.

[0045] Pump devices according to various embodiments of the invention may include membranes **130** made from one or more elastomeric materials. An elastomeric material may include any material capable of being subjected to a resilient deformation sufficient to fulfill the requirements of the one or more embodiments of the invention. Elastomeric materials used with embodiments of the invention may include plastic materials such as for example polypropylene. Other materials may also be used to form the membranes or part of the membranes **130** according to various embodiments of the invention.

[0046] According to embodiments of the invention, the various components of a pump **100** may be made in any desired shape or form and are not limited to those illustrated. Further, the components may be made from different materials, different colored materials, or different textured materials to add aesthetic effects to the pumps **100**.

[0047] While various embodiments of the invention are described with respect to the delivery or pumping of fluid products or liquids, it is understood that such embodiments may also be used to deliver and/or pump products made of a combination of any of liquid, solid, or gas. For example, a

fluid product including a liquid having solid particles mixed therein may be pumped or dispensed utilizing various embodiments of the invention.

[0048] 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 be 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 pump, comprising:
a body;
a membrane secured to an open end of the body;
a closure attached to the body;
a fluid chamber defined between the membrane and the closure; and
a passageway in communication with the fluid chamber.

2. The pump of claim **1**, wherein the body and the membrane comprise a bi-injected component.

3. The pump of claim **1**, wherein the body comprises the passageway.

4. The pump of claim **1**, wherein the closure further comprises:
a ball seat;
a tube retainer;
a closure mechanism; and
a valve post.

5. The pump of claim **4**, wherein the valve post comprises a valve post extending from the closure and contacting the membrane.

6. A pump, comprising:
a body;
a membrane secured to an open end of the body;
a closure attached to the body;
a fluid chamber defined between the membrane and the closure;
a passageway in communication with the fluid chamber; and
a cap fitted to the body and overlying at least a portion of the membrane.

7. The pump of claim **6**, wherein the cap further comprises:
a cap body attached to the body of the pump; and
a removable cap portion partially covering the membrane.

8. The pump of claim **7**, further comprising a cap opening between the cap body and the removable cap portion.

9. A pump, comprising:
a body;
a membrane secured to an open end of the body;
a closure, comprising:
a ball seat;
a tube retainer;
a closure mechanism; and
a valve post, wherein the closure is attached to the body;
a fluid chamber defined between the membrane and the closure; and
a passageway between the fluid chamber and an exterior of the body.

10. The pump of claim **9**, further comprising a lip circumscribing at least a portion of the closure and configured to attach the closure to the body of the pump.

11. The pump of claim **9**, further comprising a cap, comprising:
a cap body; and
a removable cap portion at least partially covering the membrane.

12. The pump of claim **11**, further comprising a cap opening between the cap body and the removable cap portion.

13. The pump of claim **9**, wherein the body further comprises:
a main wall attached to the membrane; and
a secondary wall.

14. The pump of claim **9**, wherein the membrane further comprises a valve.

15. The pump of claim **14**, wherein the valve post abuts against the valve.

16. The pump of claim **9**, wherein the body and the membrane are secured through bi-injection.

17. The pump of claim **9**, wherein the membrane comprises a material selected from the group consisting of an elastomeric material, a flexible material, and a deformable material.

* * * * *