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Inventor(s)	Engstrom; Connor Paul et al.

System and method for dispensing fluid

Abstract

A dispensing cap may include a cap body and a sealing assembly. The cap body may include a first opening, a second opening distinct from the first opening, and one or more guiding surfaces. The first opening may be configured to dispense a fluid (e.g., a liquid), and the second opening may be configured to pass a gas. The sealing assembly may be slidably attached to the one or more guiding surfaces of the cap body and may be translatable between a first position and a second position. In the first position, the sealing assembly seals the first opening and stops a flow of the gas through the second opening. In the second position, the sealing assembly does not seal the first opening and does not stop the flow of the gas through the second opening.

Inventors: **Engstrom; Connor Paul (Ventura, CA), Whetsell; Francis Kenyon (Ventura, CA)**

Applicant: **Nexa3D Inc.** (Ventura, CA)

Family ID: **1000008762663**

Assignee: **STRATASYS, INC. (Minnetonka, MN)**

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Primary Examiner: Durand; Paul R

Attorney, Agent or Firm: Faegre Drinker Biddle & Reath LLP

Background/Summary

FIELD OF THE INVENTION

(1) The present invention relates to a dispensing cap, and more specifically relates to a system and method that utilizes the dispensing cap for dispensing a fluid.

BACKGROUND

(2) While many advancements have been made in the field of three-dimensional (3D) printing, there is still room for improvement on certain aspects including the fluid dispensing system that dispenses resin from a bottle into the tank of a 3D printing system.

SUMMARY OF THE INVENTION

(3) In accordance with one embodiment of the invention, a dispensing cap may include a cap body and a sealing assembly. The cap body may include a first opening, a second opening distinct from the first opening, and one or more guiding surfaces. The first opening may be configured to dispense a fluid (e.g., a liquid), and the second opening may be configured to pass a gas. In one embodiment, the one or more guiding surfaces may be formed by one or more guide rods of the cap body.

(4) The sealing assembly may be slidably attached to the one or more guiding surfaces of the cap body via ring members, and may be translatable between a first position and a second position. In the first (lowered) position, the sealing assembly seals the first opening and stops a flow of the gas through the second opening. In the second (elevated) position, the sealing assembly does not seal the first opening and does not stop the flow of the gas through the second opening.

(5) Respective springs coiled about each of the guide rods may bias the sealing assembly toward the first opening. More specifically, the sealing assembly may include a plunger with sides affixed to the ring members of the sealing assembly, and the respective guide rods may be inserted through the ring members. The movement of the springs may be constrained between ridges (e.g., formed by washers) of the guide rods and the ring members of the sealing assembly. The position of the ridges may be fixed on the respective guide rods, so that the expansion of the springs causes the ring members to be translated downwards along the respective guide rods, thereby biasing the sealing assembly towards the first opening.

(6) The dispensing cap may be secured to an opening of a bottle containing a fluid (e.g., photo-curing resin) to form a fluid container. Even if the fluid container is inverted (i.e., with the opening of the bottle pointing downwards), the fluid contained within the fluid container does not leak out of the fluid container, as the dispensing cap is designed to be sealed in the default mode of operation. To form a dispensing system, the fluid container may be inserted into a container receptacle until tabs of the container receptacle latch onto a projecting rim of the dispensing cap. At the same time as the fluid container is inserted into the container receptacle, a projecting portion of the container receptacle may displace the sealing assembly of the dispensing cap (e.g., in an upwards direction), allowing fluid from the bottle to flow out of the first opening of the cap body and gas to flow into the second opening of the cap body.

(7) The dispensing system is self-regulating in that the fluid stops flowing from the fluid container when the fluid reaches a fill line of a tank disposed adjacent to (e.g., below) the dispensing system. More specifically, the flow of fluid from the fluid container (i.e., through the first opening of the cap body) may create a partial vacuum within the fluid container which partially impedes the flow of additional fluid from the fluid container into the tank. Intermittently, gas may flow into the fluid container (i.e., through the second opening of the cap body), reducing the partial vacuum within the fluid container and allowing additional fluid to flow into the tank. Eventually, when the fluid reaches a fill line of the tank, an equilibrium may be reached between the forces exerted on the fluid within the tank and the forces exerted on the fluid within the fluid container, causing the fluid to stop flowing from the fluid container into the tank. As fluid is consumed within the tank by printing operations, the top surface of fluid within the tank may intermittently decrease below the fill line, causing additional fluid from the fluid container to flow into the tank until the fluid reaches

the fill line again.
(8) These and other embodiments of the invention are more fully described in association with the drawings below.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) FIG. **1**A depicts a perspective view of a fluid container in which the fluid container is sealed by a sealing cap, in accordance with one embodiment of the invention.
(2) FIG. **1**B depicts a side view of a fluid container in which the fluid container is sealed by the sealing cap, in accordance with one embodiment of the invention.
(3) FIG. **1**C depicts a side view of a fluid container in which the sealing cap has been unscrewed from the fluid container, in accordance with one embodiment of the invention.
(4) FIG. **2**A depicts a perspective view of a dispensing cap, in accordance with one embodiment of the invention.
(5) FIG. **2**B depicts a side view of the dispensing cap, in accordance with one embodiment of the invention.
(6) FIG. **2**C depicts a bottom view of the dispensing cap, in accordance with one embodiment of the invention.
(7) FIGS. **2**D and **2**E depict cross-sectional views of the dispensing cap along line I-I shown in FIG. **2**C, in accordance with one embodiment of the invention. In FIG. **2**D, the sealing assembly is disposed in the default (sealed or resting) position, whereas in FIG. **2**E, the sealing assembly is disposed in an elevated (unsealed or retracted) position.
(8) FIG. **2**F depicts an exploded perspective view of the dispensing cap, in accordance with one embodiment of the invention.
(9) FIG. **3**A depicts a perspective view a fluid dispensing system including a fluid container that has been secured to a container receptacle, in accordance with one embodiment of the invention.
(10) FIG. **3**B depicts an exploded perspective view of the fluid dispensing system depicted in FIG. **3**A, in accordance with one embodiment of the invention.
(11) FIG. **3**C depicts a cross-sectional view of the fluid dispensing system immediately before a projecting portion of the container receptacle displaces the sealing assembly of the dispensing cap into the elevated position, in accordance with one embodiment of the invention.
(12) FIG. **3**D depicts a cross-sectional view of the fluid dispensing system after the projecting portion of the container receptacle has displaced the sealing assembly of the dispensing cap into the elevated position, in accordance with one embodiment of the invention.
(13) FIG. **4** depicts an enlarged perspective view of the container receptacle, in accordance with one embodiment of the invention.
(14) FIG. **5**A depicts a top view of a fluid dispensing system coupled to a tank of a 3D printing system, in accordance with one embodiment of the invention.
(15) FIG. **5**B depicts a cross-sectional view along line II-II shown in FIG. **5**A, in accordance with one embodiment of the invention.
(16) FIG. **6**A depicts a perspective view of the sealing assembly, in accordance with one embodiment of the invention.
(17) FIG. **6**B depicts a side view of the sealing assembly, in accordance with one embodiment of the invention.
(18) FIG. **6**C depicts a bottom view of the sealing assembly, in accordance with one embodiment of the invention.
(19) FIG. **7**A depicts a perspective view of a cap body, in accordance with one embodiment of the invention.

(20) FIG. **7**B depicts a top view of the cap body, in accordance with one embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

(21) In the following detailed description of the preferred embodiments, reference is made to the accompanying drawings that form a part hereof, and in which are shown by way of illustration specific embodiments in which the invention may be practiced. It is understood that other embodiments may be utilized and structural changes may be made without departing from the scope of the present invention. Descriptions associated with any one of the figures may be applied to different figures containing like or similar components/steps.

(22) FIG. **1**A depicts a perspective view of a fluid container **10** that is used to contain a fluid (e.g., photo-curable resin) for a 3D printing system (not shown). Additional details of the 3D printing system may be found in U.S. Pat. No. 11,498,275, which is incorporated by reference herein in its entirety. The fluid container **10** may include a bottle **14** and a dispensing cap **16** that are both responsible for forming a cavity **78** (see FIG. **5**B) for containing a fluid. The structure of the dispensing cap **16** will be described in detail below in connection with FIGS. **2**A-**2**F. The fluid container **10** may also include a handle **12** for a human operator to easily grasp the top portion of the fluid container **10** (e.g., allowing the human operator to carry the fluid container **10** from one location to another location). When the fluid container **10** is not inserted into a container receptacle **54** (see FIG. **4**), the dispensing cap **16** alone may be sufficient to form an air-tight seal and seal the fluid within the fluid container **10**. However, for added redundancy and to prevent accidental opening of the dispensing cap **16** when the fluid container **10** is being stored in a storage location or is being transported, a sealing cap **18** may be attached (e.g., screwed) onto an end of the dispensing cap **16**, as shown in FIGS. **1**A and **1**B. For increased clarity, FIG. **1**C depicts the sealing cap **18** detached (e.g., unscrewed) from the dispensing cap **16**. While the sealing cap **18** may be secured to the dispensing cap **16** via a threaded coupling (which includes a threaded cylindrical outer surface **20** of the dispensing cap **16**) as shown in FIG. **1**C, it is understood that other forms of coupling may be employed, such as a friction fit coupling, a bayonet mount, etc.

(23) FIGS. **2**A and **2**B depict perspective and side views of the dispensing cap **16**, respectively. The major components of the dispensing cap **16** may include a cap body **24** (see FIGS. **2**F, **7**A and **7**B) and a sealing assembly **26** (see FIGS. **6**A-**6**C). The cap body **24** may include a shell portion **25** and one or more guide rods **36***a*, **36***b*. The shell portion **25** may include the previously discussed threaded cylindrical outer surface **20** for attaching the dispensing cap **16** to the sealing cap **18**. The shell portion **25** may also include a threaded cylindrical inner surface **22** for attaching the dispensing cap **16** to the threaded neck **58** (see FIG. **3**B) of bottle **14**. While the dispensing cap **16** may be secured to the bottle **14** via a threaded coupling, it is understood that other attachment means may be possible, such as a friction fit coupling, a bayonet mount, etc. The shell portion **25** may also include a projecting rim **23**, the purpose of which will be better appreciated in the context of FIG. **3**B.

(24) Each of the guide rods **36***a*, **36***b* may include a guiding surface **38***a*, **38***b* for guiding the sealing assembly **26** from the default (sealed) position to the elevated (unsealed position). Such positions will be more fully explained in FIGS. **2**D and **2**E.

(25) FIG. **2**C depicts a bottom view of the dispensing cap **16**, in which an opening **46***a* for dispensing a fluid (e.g., a liquid) from the bottle **14** and an opening **46***b* for passing a gas (e.g., air) into the bottle **14** are visible. Opening **46***b* may also be known as an air vent. As should be understood, when fluid is dispensed from the bottle **14**, gas may be passed through the opening **46***b* to equalize the pressure within the bottle **14**, thereby allowing additional fluid to be dispensed from the bottle **14**. As shown in FIG. **2**C, opening **46***a* may be distinct from opening **46***b*. Opening **46***a* may be present on surface **44***a* of the cap body **24**, while opening **46***b* may be present on surface **44***b* of the cap body **24**. As more clearly depicted in the cross-sectional views of FIGS. **2**D and **2**E, surface **44***b* may be offset from surface **44***a*. The reason for the offset will be better understood in

the context of FIG. **5**B. In the bottom view, stopper **34***a* may be visible within opening **46***a* and stopper **34***b* may be visible within opening **46***b*. The threaded cylindrical outer surface **20** (to which the sealing cap **18** attaches to) may encircle the surfaces **44***a*, **44***b*.

(26) FIGS. **2**D and **2**E depict cross-sectional views of the dispensing cap along line I-I shown in FIG. **2**C. In FIG. **2**D, the sealing assembly **26** is disposed in the default (sealed) position, whereas in FIG. **2**E, the sealing assembly **26** is disposed in the elevated (unsealed) position. As more completely shown in FIGS. **2**D and **2**E, the sealing assembly **26** may include a plunger **28** that is slidably attached to the one or more guiding surfaces **38***a*, **38***b* of the cap body **24**. In one embodiment, the one or more guiding surfaces **38***a*, **38***b* may be formed by the surfaces of one or more guide rods **36***a*, **36***b* which are disposed parallel to an extent of the plunger **28**. More specifically, the slidable attachment of the plunger **28** may be provided by ring member **30***a* of the sealing assembly **26** which is disposed around a circumference of guide rod **36***a*. The slidable attachment of the plunger **28** may also be provided by ring member **30***b* of the sealing assembly **26** which is disposed around a circumference of guide rod **36***b*. While the ring members **30***a*, **30***b* resemble cylinders in the depicted embodiments, it is noted that the ring members **30***a*, **30***b* need not fully encircle the circumference of the guide rods **36***a*, **36***b*. In such case, the ring members may be better referred to as guide members and more closely resemble a celery stalk (i.e., with a cross section that resembles a U-shape or a parenthesis ")").

(27) A stopper **34***a*, affixed to one end of the plunger **28**, may control a flow of fluid from the dispensing cap **16**. In a first position (as shown in FIG. **2**D), the stopper **34***a* may seal opening **46***a* preventing any fluid from flowing out of opening **46***a*. In a second position (as shown in FIG. **2**E), the stopper **34***a* may be positioned away from opening **46***a* allowing fluid to flow out from opening **46***a*. To provide a better seal, stopper **34***a* may include a gasket **52** disposed within a groove about the circumference of the stopper **34***a*.

(28) As shown in FIGS. **2**D and **2**E, the guide rod **36***b* may include an orifice **50** that is fluidly connected to a cavity **48** of the guide rod **36***b*, and the cavity **48** of the guide rod **36***b* may further be fluidly connected to the opening **46***b* of the cap body **24**. A stopper **34***b*, affixed to another end of the plunger **28** via a stopper holder **32**, may be used to control the flow of gas through the opening **46***b* of the cap body **24**. In a first position (as shown in FIG. **2**D), the stopper **34***b* may seal orifice **50** preventing any gas from flowing through opening **46***b*. In a second position (as shown in FIG. **2**E), the stopper **34***b* may be positioned away from the orifice **50** allowing gas to flow through opening **46***b* (and into the bottle **14**). The vertical distance between stopper **34***a* and stopper **34***b* may equal the vertical distance between the opening **46***a* and orifice **50**, such that the sealing of the opening **46***a* and orifice **50** may occur simultaneously and the unsealing of the opening **46***a* and orifice **50** may occur simultaneously (i.e., in response to the displacement of the sealing assembly **26**).

(29) Plunger **28** may be biased toward opening **46***a* by one or more springs **42***a*, **42***b* which are coiled about the respective one or more guide rods **36***a*, **36***b*. That is, spring **42***a* may be coiled about guide rod **36***a* and spring **42***b* may be coiled about guide rod **36***b*. As shown in FIGS. **2**D and **2**E, a movement of the spring **42***a* may be constrained between a ridge **40***a* on a surface of the guide rod **36***a* and the ring member **30***a* of the sealing assembly **26**. Similarly, a movement of the spring **42***b* may be constrained between a ridge **40***b* on a surface of the guide rod **36***b* and the ring member **30***b* of the sealing assembly **26**. In one embodiment, the ridges **40***a*, **40***b* may be formed by washers **40***a*, **40***b* which are inserted about the respective circumferences of the guide rods **36***a*, **36***b*.

(30) The position of the ridges **40***a*, **40***b* may be fixed on the respective guide rods **36***a*, **36***b*, so that the expansion of the springs **42***a*, **42***b* causes the ring members **30***a*, **30***b* to be translated downwards along the respective guide rods **36***a*, **36***b*, thereby biasing the sealing assembly **26** towards the opening **46***a*. In the reverse motion, a projecting portion **64** of a container receptacle **54** (see FIGS. **3**C, **3**D and **4**) may be used to push the stopper **34***a* away from the opening **46***a*, causing

ring members **30***a*, **30***b* to be translated upwards along the guide rods **36***a*, **36***b*, and further causing the spring **42***a* to become compressed between the ridge **40***a* and the ring member **30***a* and the spring **42***b* to become compressed between the ridge **40***b* and the ring member **30***b*.

(31) The use of two (or more) guide rods **36***a*, **36***b* helps to balance the downward force imparted by the springs **42***a*, **42***b* on the plunger **28**, allowing the ring members **30***a*, **30***b* to smoothly translate along the guide rods **36***a*, **36***b*, and centering the stopper **34***a* within opening **46***a*. In a less preferred embodiment, guide rod **36***a*, ring member **30***a*, spring **42***a*, and ridge **40***a* may be omitted, and the biasing of the sealing assembly **26** towards the opening **46***a* may be facilitated solely by guide rod **36***b*, ring member **30***b*, spring **42***b*, and ridge **40***b*. In this less preferred embodiment, the plunger **28** may pivot slightly about its attachment region to the guide rod **36***a*, potentially causing more friction to occur between the ring member **30***b* and the guiding surface **38***b* and causing a slight misalignment between the stopper **34***a* and opening **46***a*. However, such an embodiment (even if less preferable) may still provide the desired operation of the dispensing cap **16**.

(32) FIG. **2**F depicts an exploded perspective view of the dispensing cap **16**. To assemble the dispensing cap **16**, the gasket **52** may be first secured within a groove of the stopper **34***a*. Then, the guide rod **36***a* may be inserted through ring member **30***a*, spring **42***a*, and washer **40***a*. Similarly, the guide rod **36***b* may be inserted through ring member **30***b*, spring **42***b*, and washer **40***b*. The guide rods **36***a*, **36***b* may be slightly tapered, such that the washers **40***a*, **40***b* may initially slide freely along the guide rods **36***a*, **36***b* before becoming fixed in place along the guide rods **36***a*, **36***b* due to friction between the contacting surfaces between the washers **40***a*, **40***b* and the guide rods **36***a*, **36***b*. Finally, the stopper **34***b* may be secured to the stopper holder **32**. As should be apparent, the lateral spacing between the two ring members **30***a*, **30***b* should match the lateral spacing between the two guide rods **36***a*, **36***b*.

(33) FIG. **3**A depicts a perspective view of a fluid dispensing system **80** formed by a the fluid container **10** and a container receptacle **54**, after the fluid container **10** has been secured to the container receptacle **54**. Tabs **56** of the container receptacle **54** may be disposed about a circumference of the dispensing cap **16** for securing the fluid container **10** to the container receptacle **54**. While four tabs **56** are present in the example container receptacle **54** depicted in FIGS. **3**A and **3**B, it is understood that one or more tabs **56** may be present in other embodiments.

(34) FIG. **3**B depicts an exploded perspective view of the fluid dispensing system **80**, in which the bottle **14**, the dispensing cap **16** and the container receptacle **54** are shown separately from one another. To assemble the components, the dispensing cap **16** may first be inserted through the opening **60** of the bottle **14**. Next, the dispensing cap **16** may be secured to the bottle **14** by securing the threaded cylindrical inner surface **22** of the dispensing cap **16** to the threaded neck **58** of the bottle **14** (e.g., by a screwing motion). The fluid container **10** (including the bottle **14** and dispensing cap **16**) may be oriented such that the opening **60** of the bottle **14** is pointed towards the container receptacle **54**. Finally, the fluid container **10** may be inserted into the container receptacle **54**, until tabs **56** of the container receptacle **54** latch onto a projecting rim **23** of the dispensing cap **16**. It is understood that while tabs **56** and the projecting rim **23** may be used to secure the fluid container **10** to the container receptacle **54**, other securing mechanisms may be employed, such as a threaded coupling, a friction fit coupling, a bayonet mount, etc. For clarity, it is noted that the threaded cylindrical outer surface **20** (for securing the dispensing cap **16** to the sealing cap **18**) may not serve any purpose when the fluid container **10** is secured to the container receptacle **54**.

(35) FIG. **3**C depicts a cross-sectional view of the fluid dispensing system **80** immediately before a projecting portion **64** of the container receptacle **54** displaces the sealing assembly **26** of the dispensing cap **16** into an elevated position. In the view of FIG. **3**C, opening **46***a* of the cap body **24** and orifice **50** of the guide rod **36***b* are sealed by stopper **34***a* and stopper **34***b*, respectively, preventing any fluid from being dispensed from bottle **14** or gas from flowing into the bottle **14**. Further, the projecting rim **23** of the cap body **24** has yet to engage with the tabs **56** of the container receptacle **54**.

(36) FIG. **3**D depicts a cross-sectional view of the fluid dispensing system **80** after the projecting portion **64** of the container receptacle **54** has displaced the sealing assembly **26** of the dispensing cap **16** into an elevated position. Due to this displacement, the opening **46***a* of the cap body **24** and orifice **50** of the guide rod **36***b* are unsealed, allowing fluid to flow from the bottle **14** through the opening **46***a* and gas to flow into the bottle **14** through the opening **46***b*. In the view of FIG. **3**D, tabs **56** of the container receptacle **54** have latched onto the projecting rim **23** of the dispensing cap **16**.
(37) FIG. **4** depicts a magnified view of the container receptacle **54**, showing the four tabs **56** and projecting portion **64** in greater detail. As shown in FIGS. **3**A, **3**B and **4**, projecting portion **64** may project from a base portion **62** of the container receptacle **54**. The base portion **62** includes one or more openings **63**, allowing fluid from the bottle **14** to flow through the container receptacle **54** into a tank **66** (see FIGS. **5**A and **5**B) located below the container receptacle **54**.
(38) FIG. **5**A depicts a top view of the fluid dispensing system **80** fluidly coupled to a tank **66** of a 3D printing system. The tank **66** may be used to contain the fluid **72** dispensed from the fluid container **10**. The sides of the tank **66** may be formed by tank sidewalls **70**, and the bottom of the tank **66** may be formed by a radiation-transparent flexible membrane **68** that allows radiation from a light source (not depicted) below the tank **66** to enter into the tank **66**. Additional details of the light source of the 3D printing system may also be found in U.S. Pat. No. 11,498,275.
(39) FIG. **5**B depicts a cross-sectional view along line II-II shown in FIG. **5**A. In the view of FIG. **5**B, the sealing assembly **26** is displaced by the projecting portion **64**, allowing fluid **72** to flow out of the opening **46***a* into the tank **66** and gas **76** (e.g., ambient air) to flow through the opening **46***b* and into the cavity **78**. The flow of fluid **72** from the fluid container **10** may create a partial vacuum within the fluid container **10** (i.e., in the portion of the cavity **78** occupied by the gas **76**) which partially impedes the flow of additional fluid **72** from the fluid container **10** into the tank **66**. Fluid level **74** represents the top level of the fluid **72** within the cavity **78**. Intermittently, gas **76** (e.g., shown as gas bubbles within the fluid **72**) may flow into the fluid container **10** through opening **46***b*, reducing the partial vacuum within the fluid container **10** and allowing additional fluid **72** to flow into the tank **66**. Eventually, when the fluid **72** reaches a fill line **82** of the tank **66**, an equilibrium may be reached between the forces exerted on the fluid **72** within the tank **66** and the forces exerted on the fluid **72** within the fluid container **10**, causing the fluid **72** to stop flowing from the fluid container **10**. As the fluid **72** is consumed within the tank **66** by printing operations, the top surface of the fluid **72** within the tank **66** may intermittently decrease below the fill line **82**, causing additional fluid **72** from the fluid container **10** to flow into the tank **66** until the fluid **72** reaches the fill line **82** again. For clarity, it is noted that the fill line **82** is meant to represent a fixed vertical elevation which approximately corresponds to the maximum fluid level of the fluid **72** within the tank **66**.
(40) The surface **44***b* in which the opening **46***b* is present may be elevated above the fill line **82** in order to configure opening **46***b* as the air vent. If opening **46***a* and **46***b* were present at the same vertical elevation, gas and fluid may pass through each of the openings **46***a* and **46***b*, which is less desirable as the flow of fluid from the dispensing cap **16** may become more irregular (e.g., a large flow of fluid may be followed by a slow trickle).
(41) FIGS. **6**A and **6**B depict perspective and side views of the sealing assembly **26**, respectively, which may include plunger **28**, ring members **30***a*, **30***b*, stopper holder **32**, stopper **34***a* and stopper **34***b* (not depicted). Stopper **34***a* may be affixed to one end of the plunger **28**, while stopper holder **32** may be affixed to the other end of the plunger **28**. Ring members **30***a*, **30***b* may be affixed to opposing sides of the plunger **28**. Stopper **34***b* (not depicted) may be secured to the stopper holder **32**. The respective cavities **31***a*, **31***b* of the ring members **30***a*, **30***b* are visible in the bottom view depicted in FIG. **6**C.
(42) FIGS. **7**A and **7**B depict perspective and top views of the cap body **24**, respectively, which may include a shell portion **25** and one or more guide rods **36***a*, **36***b* affixed to the shell portion **25**.

Whereas the guiding surfaces **38***a*, **38***b* may have been obscured in the previous views by the ring members **30***a*, **30***b* and/or springs **42***a*, **42***b*, the guiding surfaces **38***a*, **38***b* are clearly visible in the perspective view of FIG. **7**A. The orifice **50** of the guide rod **36***b* and openings **34***a*, **34***b* of the cap body **24** are visible in the top view of FIG. **7**B. For clarity, it is noted that the orifice **50** of the guide rod **36***b* and the opening **34***b* of the cap body **24** are aligned with one another in the top view of FIG. **7**B. While not previously discussed, it is further noted that guide rod **36***a* may similarly include a cavity (corresponding to cavity **48** of guide rod **36***b*) and an orifice (corresponding to orifice **50** of guide rod **36***b*). However, the cavity and orifice of guide rod **36***a* may not serve any functional purpose, so in another embodiment, guide rod **36***a* could be constructed as a solid rod without any cavity or orifice.

(43) Thus, a system and method for dispensing a fluid have been described. It is to be understood that the above-description is intended to be illustrative, and not restrictive. Many other embodiments will be apparent to those of skill in the art upon reviewing the above description. The scope of the invention should, therefore, be determined with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

LIST OF REFERENCE NUMERALS

(44) **10** Fluid container **12** Handle of fluid container **14** Bottle **16** Dispensing cap **18** Sealing cap **20** Threaded cylindrical outer surface **22** Threaded cylindrical inner surface **23** Projecting rim **24** Cap body **25** Shell portion **26** Sealing assembly **28** Plunger **30***a*, **30***b* Ring members **31***a*, **31***b* Cavities of ring members **32** Stopper holder **34***a*, **34***b* Stoppers **36***a*, **36***b* Guide rods **38***a*, **38***b* Guiding surfaces **40***a*, **40***b* Ridge, washers **42***a*, **42***b* Springs **44***a*, **44***b* Surfaces of the cap body **46***a*, **46***b* Openings of cap body **48** Cavity of guide rod **50** Orifice **52** Gasket **54** Container receptacle **56** Tabs **58** Threaded neck of bottle **60** Opening of bottle **62** Base portion **63** Opening of base portion **64** Projecting portion **66** Tank **68** Membrane **70** Tank sidewall **72** Fluid **74** Fluid level **76** Gas **78** Cavity of fluid container **80** Fluid dispensing system **82** Fill line

Claims

1. A dispensing cap, comprising: a cap body with a first opening, a second opening distinct from the first opening, and one or more guiding surfaces, the first opening for dispensing a fluid, and the second opening for passing a gas; a sealing assembly slidably attached to the one or more guiding surfaces of the cap body and translatable between a first position and a second position, wherein in the first position, the sealing assembly seals the first opening and stops a flow of the gas through the second opening, and wherein in the second position, the sealing assembly does not seal the first opening and does not stop the flow of the gas through the second opening; wherein the sealing assembly comprises: a plunger; a first stopper affixed to the plunger, wherein in the first position of the sealing assembly, the first stopper is configured to seal the first opening of the cap body; and, wherein the one or more guiding surfaces are formed by a first guide rod disposed parallel to an extent of the plunger; and, wherein the sealing assembly comprises a ring member, and wherein the first guide rod is inserted through the ring member of the sealing assembly.

2. The dispensing cap of claim 1, wherein the first guide rod comprises an orifice that is fluidly connected to a cavity of the first guide rod, and wherein the cavity of the first guide rod is fluidly connected to the second opening of the cap body.

3. The dispensing cap of claim 2, wherein the sealing assembly further comprises a second stopper affixed to the plunger, and wherein in the first position of the sealing assembly, the second stopper is configured to seal the orifice of the first guide rod.

4. The dispensing cap of claim 1, further comprising a first spring coiled about the first guide rod, the first spring configured to bias the plunger towards the first opening of the cap body.

5. The dispensing cap of claim 1, wherein a movement of a first spring is constrained between a ridge on a surface of the first guide rod and the ring member of the plunger.

6. The dispensing cap of claim 1, wherein the one or more guiding surfaces are formed by a second guide rod disposed parallel to the extent of the plunger.
7. The dispensing cap of claim 6, wherein a movement of the second spring is constrained between a ridge on a surface of the second guide rod and the ring member of the plunger.
8. The dispensing cap of claim 1, wherein the first opening of the cap body is disposed on a first surface of the cap body and the second opening of the cap body is disposed on a second surface of the cap body that is offset from the first surface.
9. A fluid dispensing system, comprising: a fluid container formed by (i) a bottle and (ii) the dispensing cap of claim 1 secured to an opening of the bottle; and a container receptacle comprising a projecting member that protrudes from a base portion of the container receptacle, the projecting member for displacing the sealing assembly of the dispensing cap from the first position to the second position, wherein the fluid container is secured to the container receptacle.
10. The fluid dispensing system of claim 9, wherein the container receptacle further comprises a plurality of tabs disposed about a circumference of the dispensing cap for securing the fluid container to the container receptacle.
11. A dispensing cap, comprising: a cap body with a first opening, a second opening distinct from the first opening, and one or more guiding surfaces, the first opening for dispensing a fluid, and the second opening for passing a gas; a sealing assembly slidably attached to the one or more guiding surfaces of the cap body and translatable between a first position and a second position, wherein in the first position, the sealing assembly seals the first opening and stops a flow of the gas through the second opening, and wherein in the second position, the sealing assembly does not seal the first opening and does not stop the flow of the gas through the second opening; wherein the sealing assembly comprises: a plunger; a first stopper affixed to the plunger, wherein in the first position of the sealing assembly, the first stopper is configured to seal the first opening of the cap body; and, wherein the one or more guiding surfaces are formed by a first guide rod disposed parallel to an extent of the plunger; wherein the one or more guiding surfaces are formed by a second guide rod disposed parallel to the extent of the plunger; and, a second spring coiled about the second guide rod, the second spring configured to bias the plunger towards the first opening of the cap body.
12. A dispensing cap, comprising: a cap body with a first opening, a second opening distinct from the first opening, and one or more guiding surfaces, the first opening for dispensing a fluid, and the second opening for passing a gas; a sealing assembly slidably attached to the one or more guiding surfaces of the cap body and translatable between a first position and a second position, wherein in the first position, the sealing assembly seals the first opening and stops a flow of the gas through the second opening, and wherein in the second position, the sealing assembly does not seal the first opening and does not stop the flow of the gas through the second opening; wherein the sealing assembly comprises: a plunger; a first stopper affixed to the plunger, wherein in the first position of the sealing assembly, the first stopper is configured to seal the first opening of the cap body; and, wherein the one or more guiding surfaces are formed by a first guide rod disposed parallel to an extent of the plunger; wherein the one or more guiding surfaces are formed by a second guide rod disposed parallel to the extent of the plunger; and, wherein the sealing assembly comprises a ring member, and wherein the second guide rod is inserted through the ring member of the sealing assembly.