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Shani

(54) VOLUME ADJUSTED PRESERVATION CONTAINMENT SYSTEM

(76) Inventor: **Gidi Shani**, Gesher Haziv (IL)

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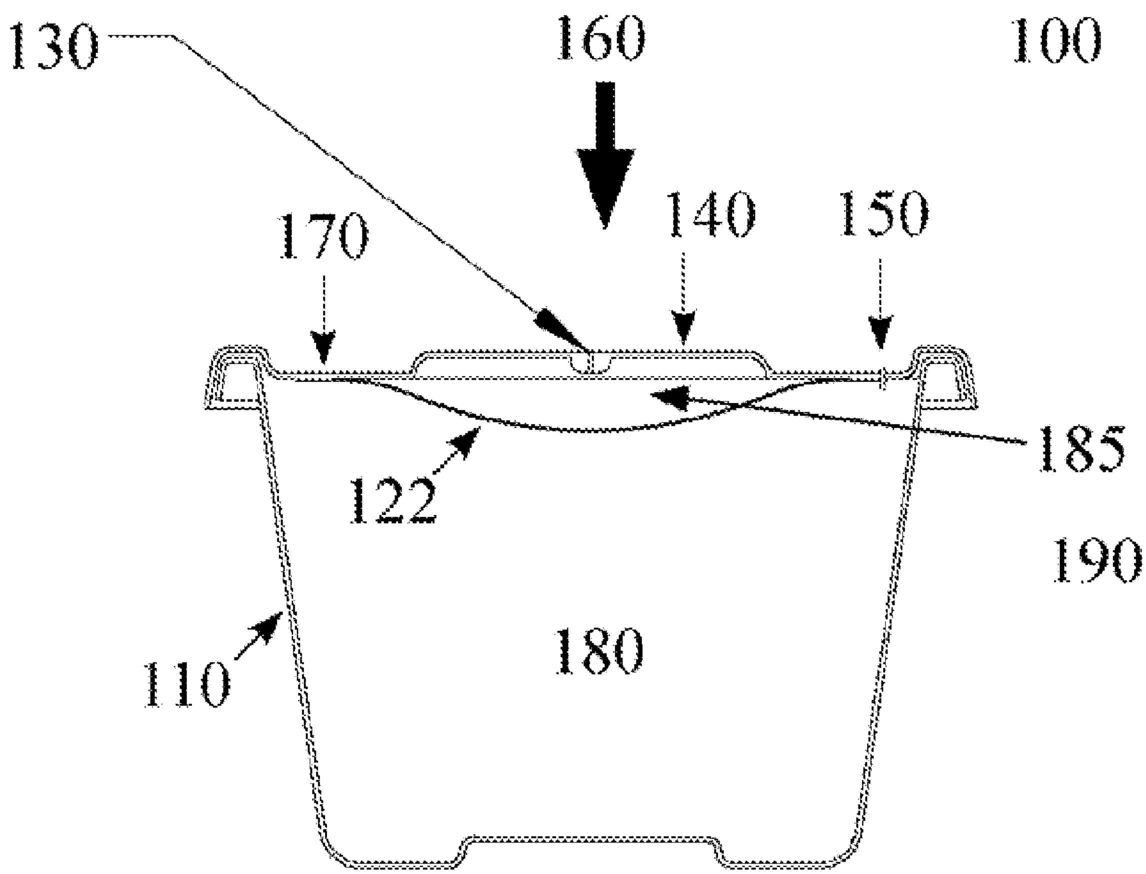
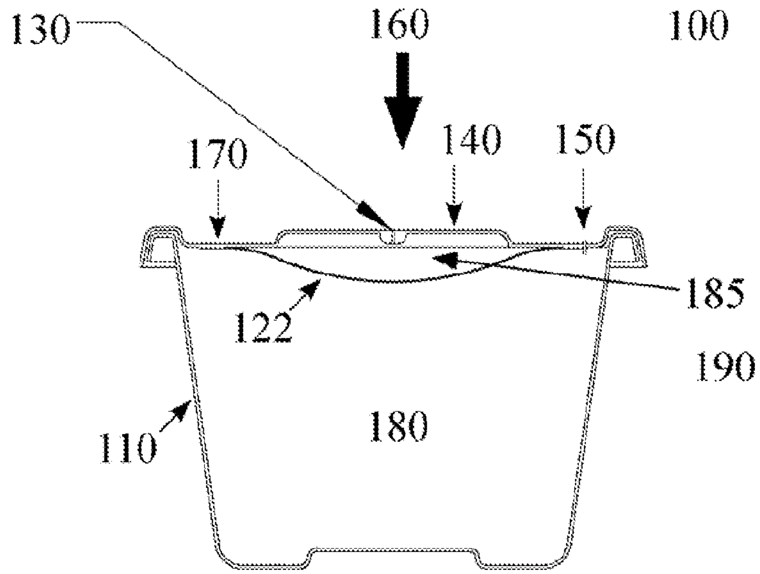
(52) **U.S. Cl.** **53/408**; 53/79

(57) **ABSTRACT**

In an embodiment of the invention, reactant sensitive substances are stored in a container where a diaphragm inside the container is expanded to reduce air in contact with the substances. In an embodiment, an inner diaphragm is expanded by pushing on an outer diaphragm and forcing the inner diaphragm towards the substance where the gas containing the reactants is forced out a one-way valve. In an embodiment of the invention, a second one-way valve allows air into a container void space between the inner and outer diaphragms when a force is applied to the outer diaphragm that pumps out the gas and brings the inner diaphragm into contact with the substance. To open the container, the vacuum can be released by pressing a first one-way conditional valve which releases air into the container. A second one-way conditional valve can release the air trapped in the container void space.

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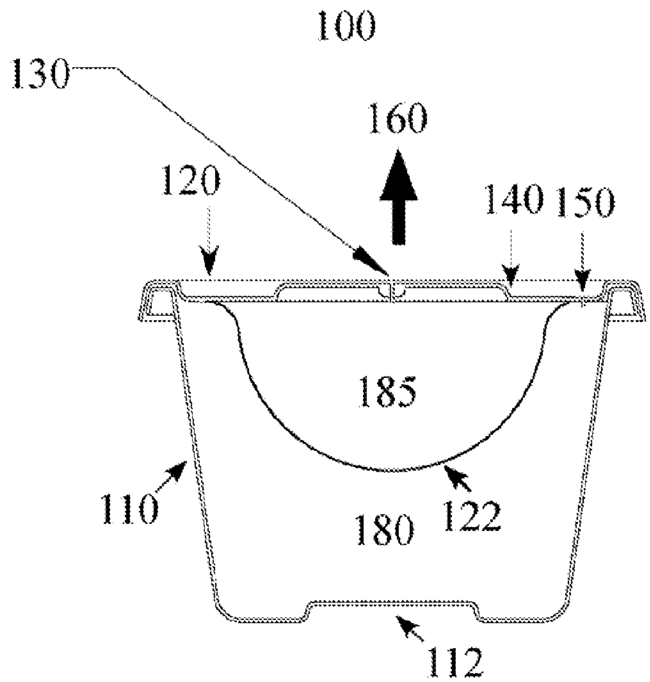
(A)

Figure 1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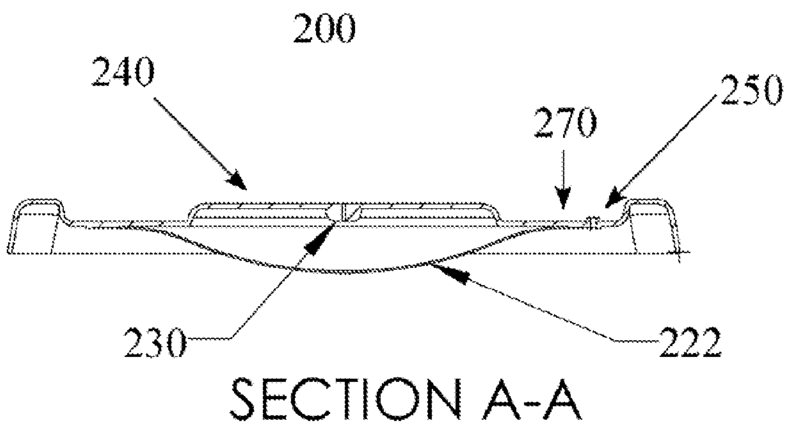
(B)

Figure 2A



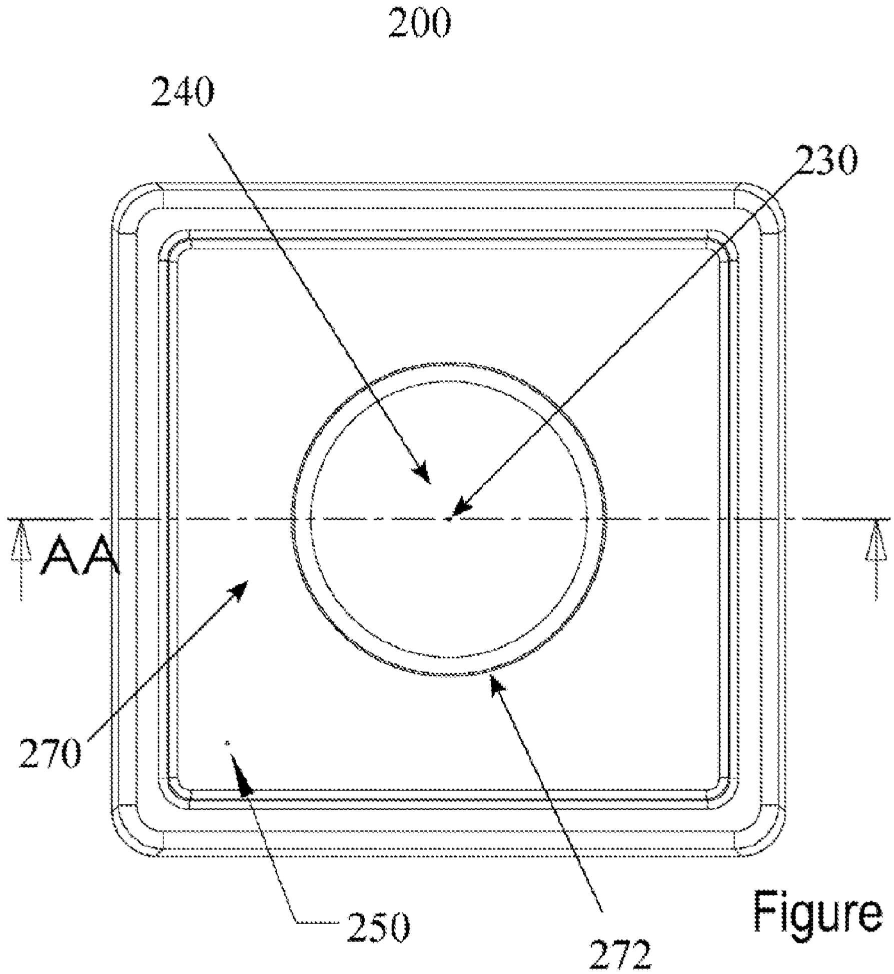
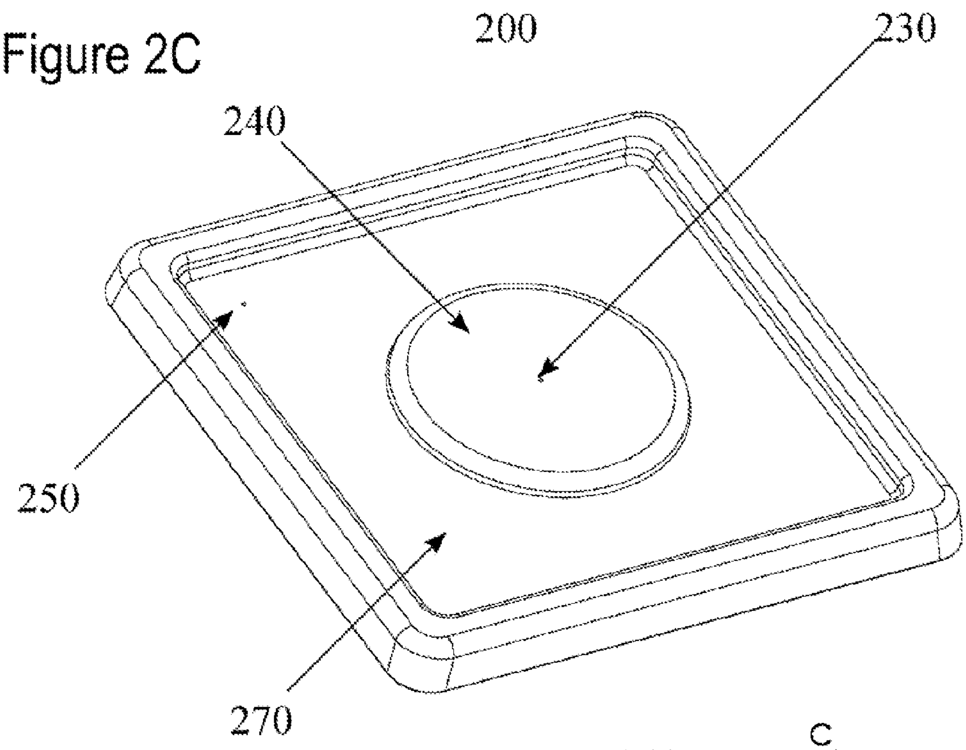


Figure 2B

Figure 2C



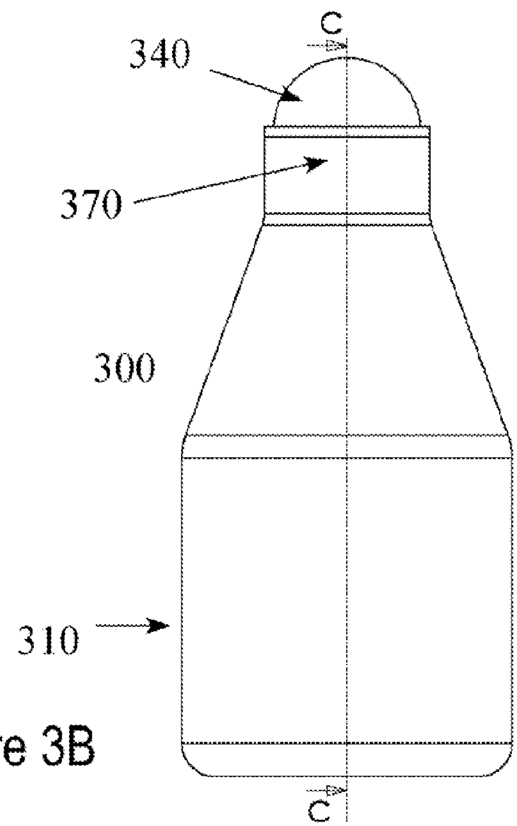
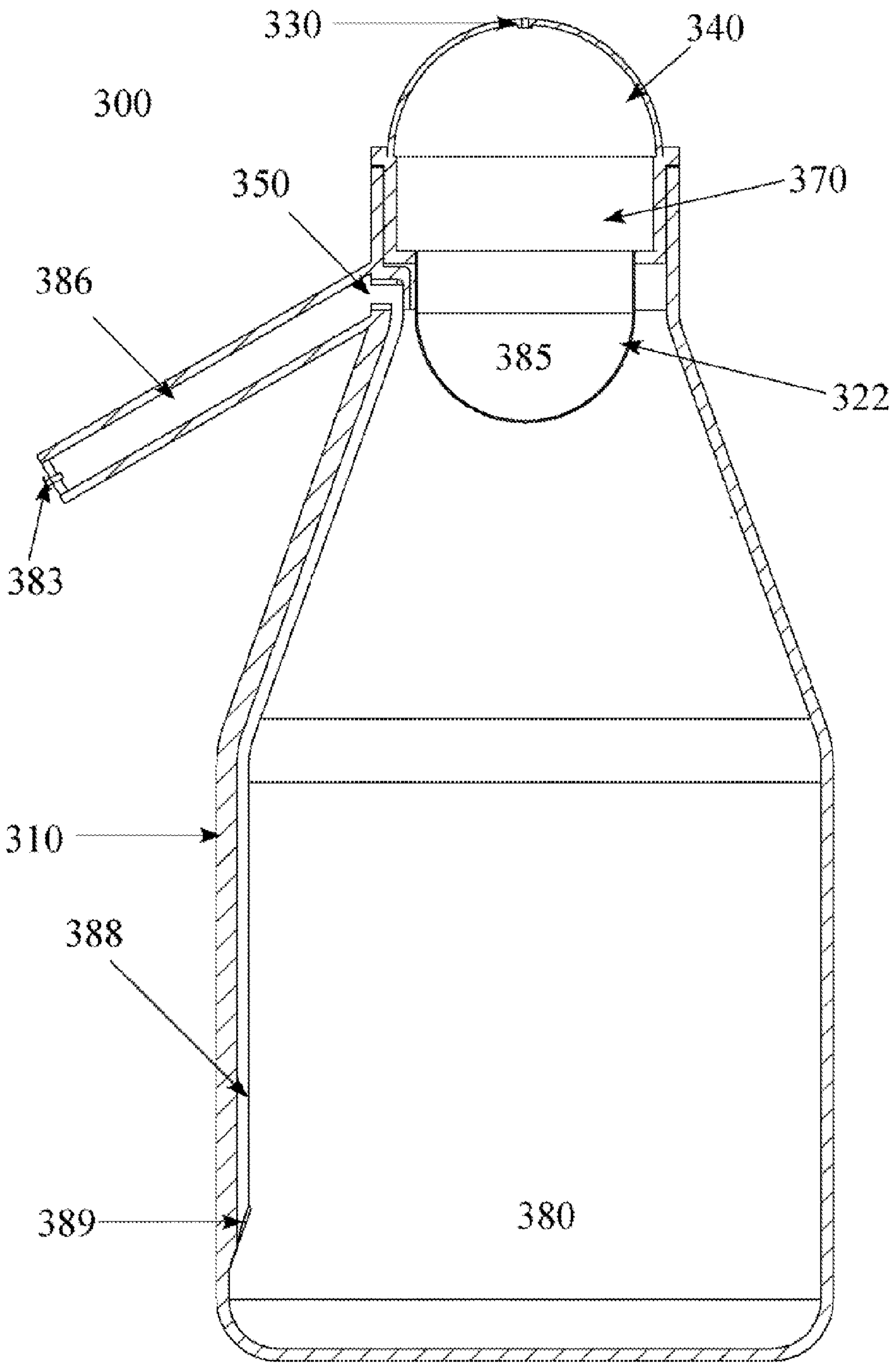


Figure 3B



SECTION C-C

Figure 3A

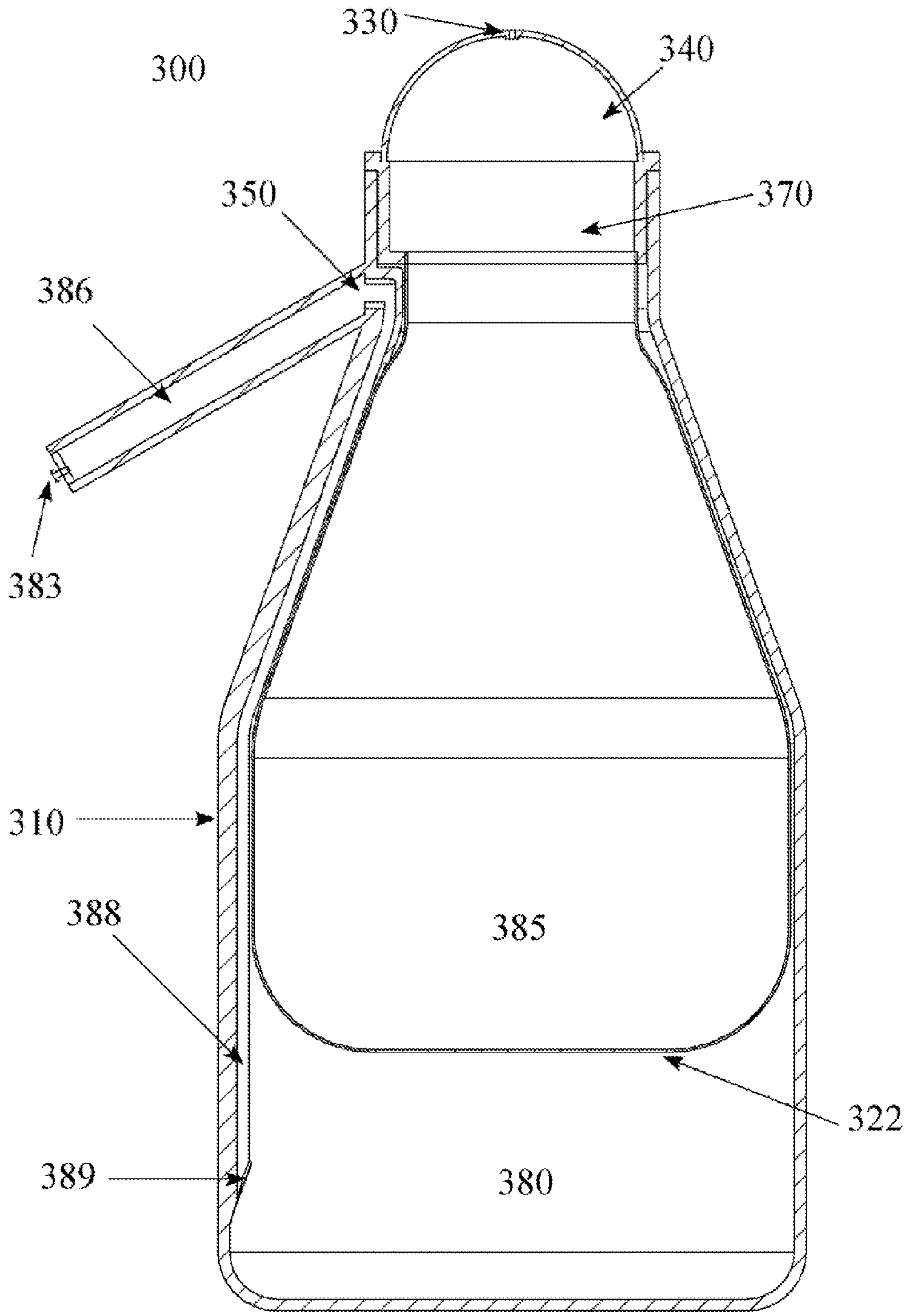


Figure 3C

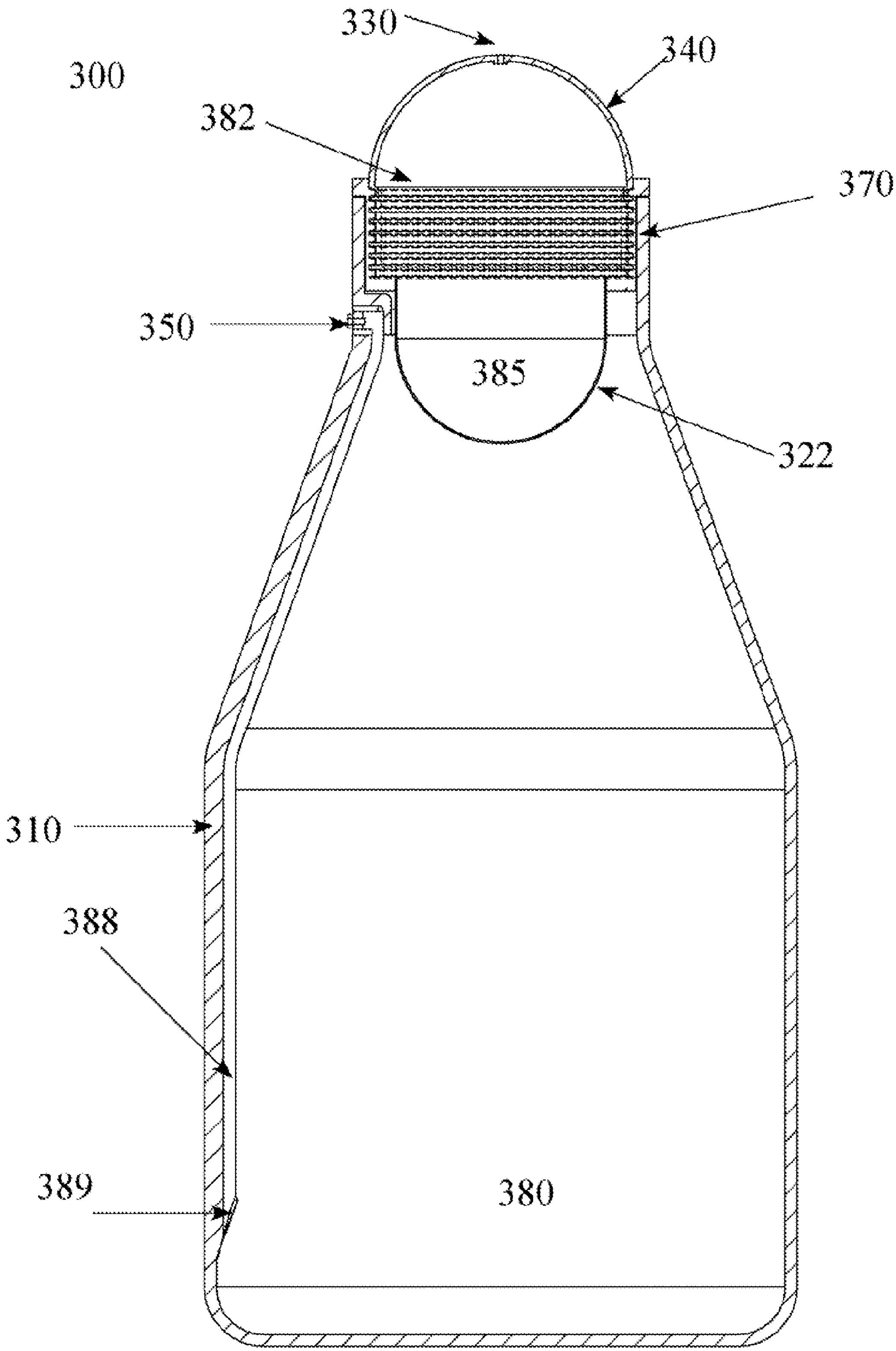


Figure 3D

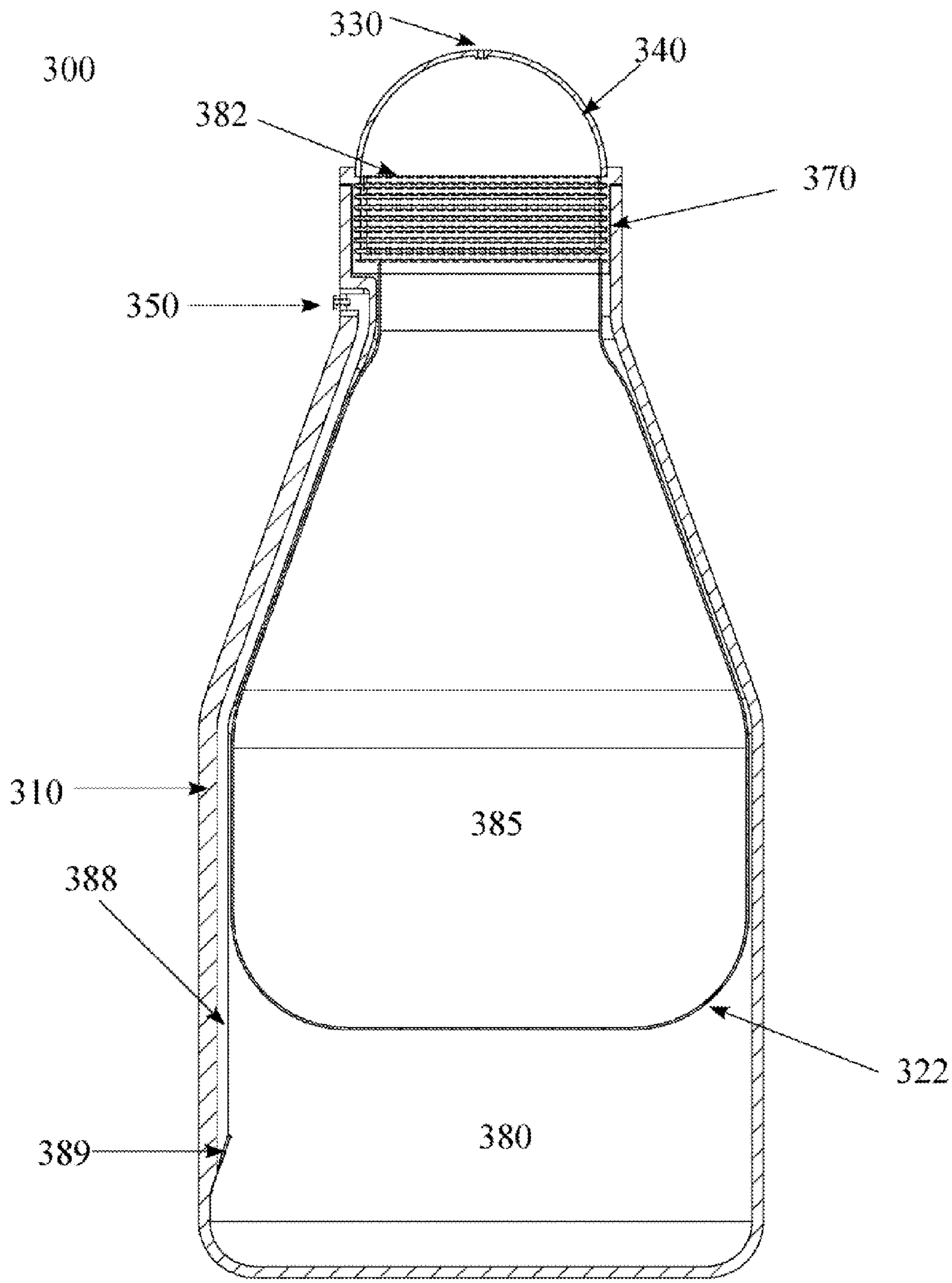


Figure 3E

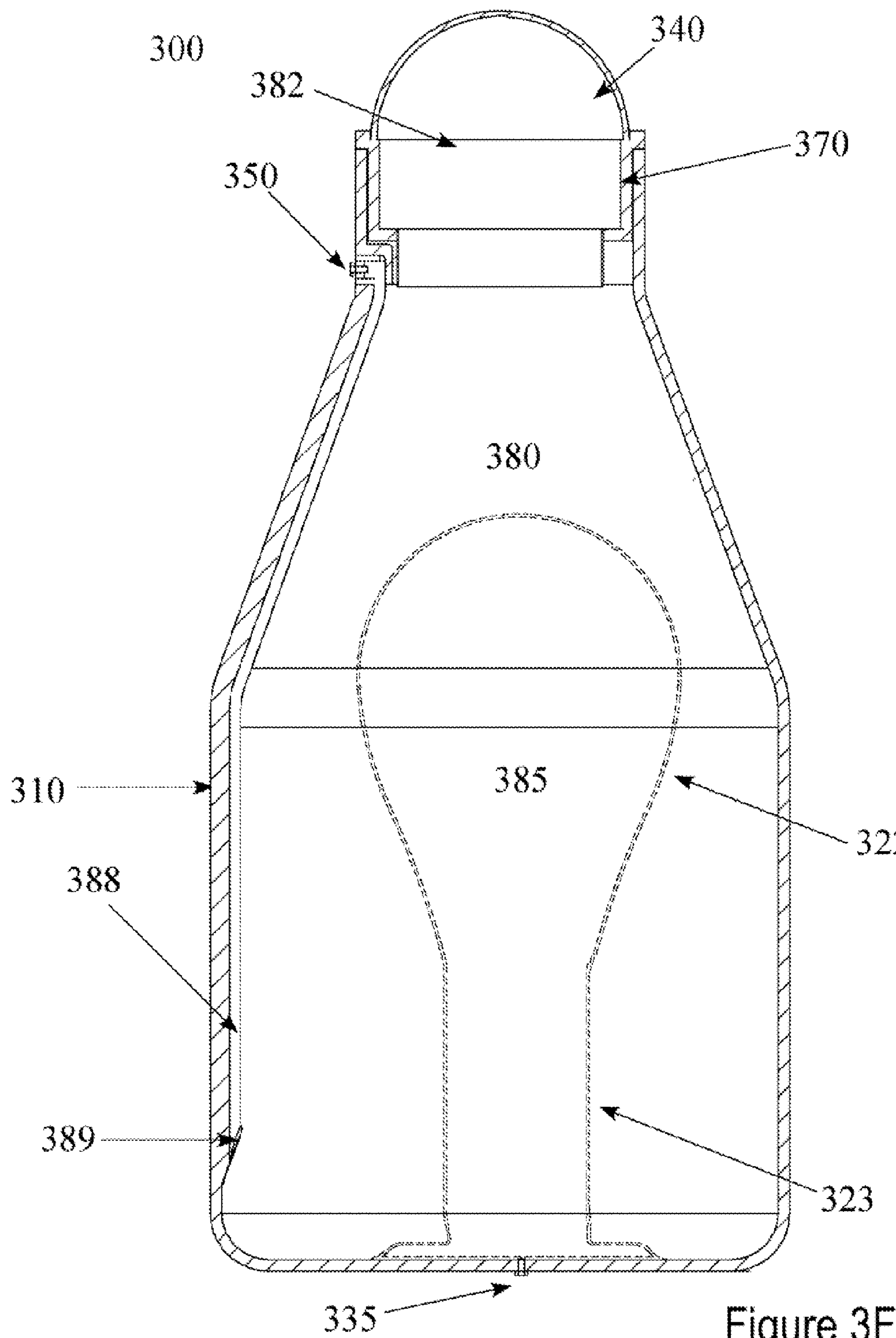


Figure 3F

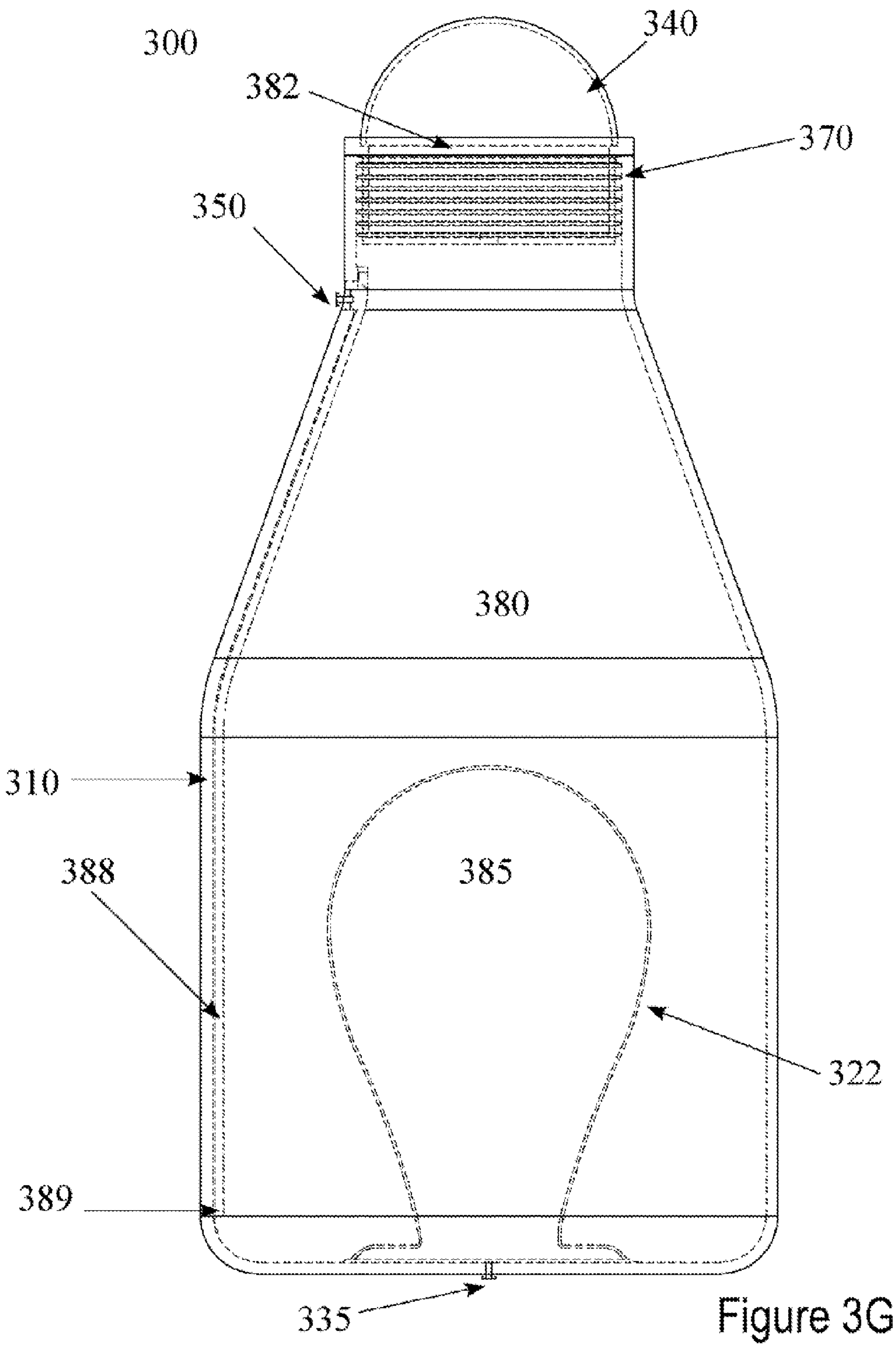


Figure 3G

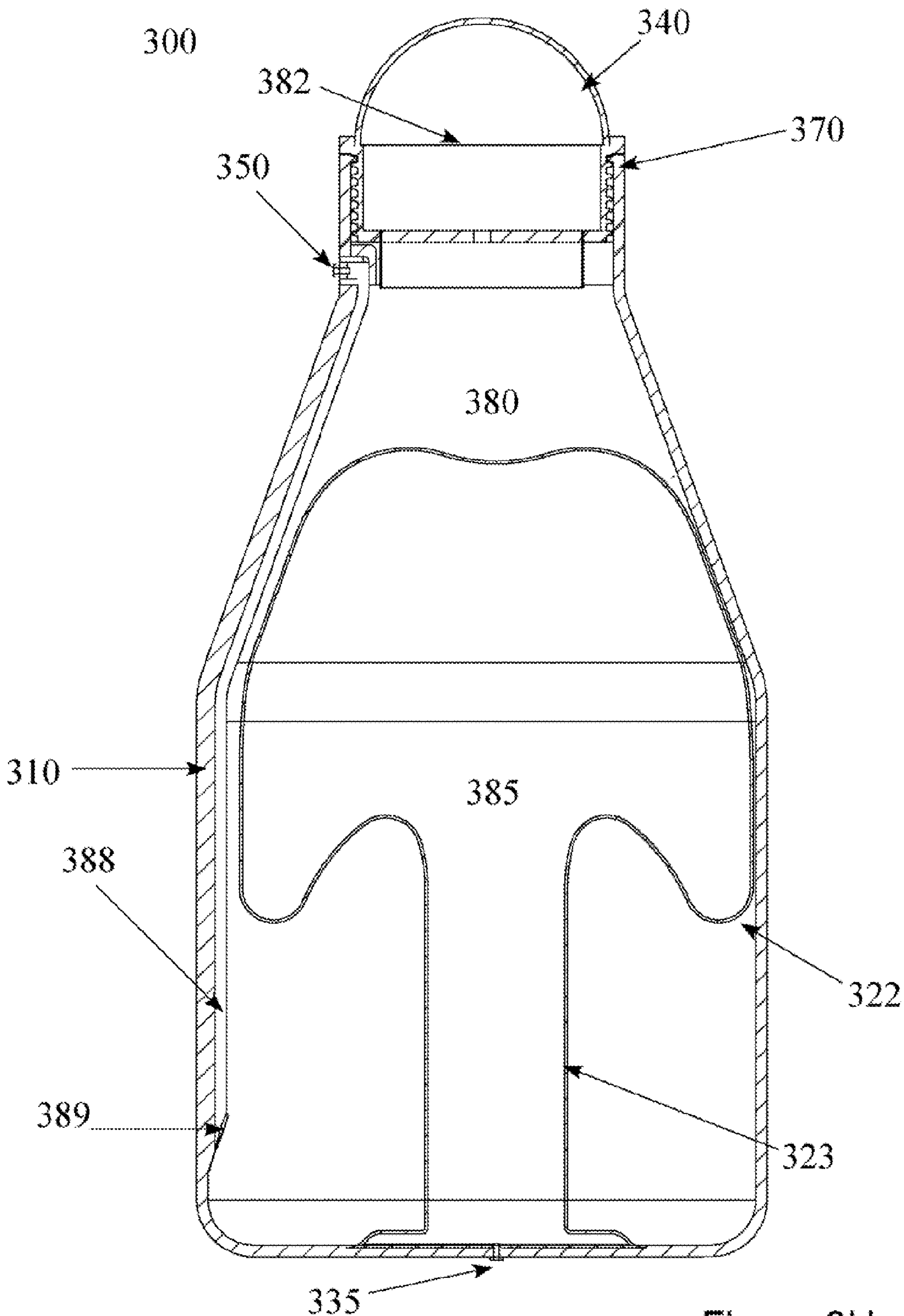


Figure 3H

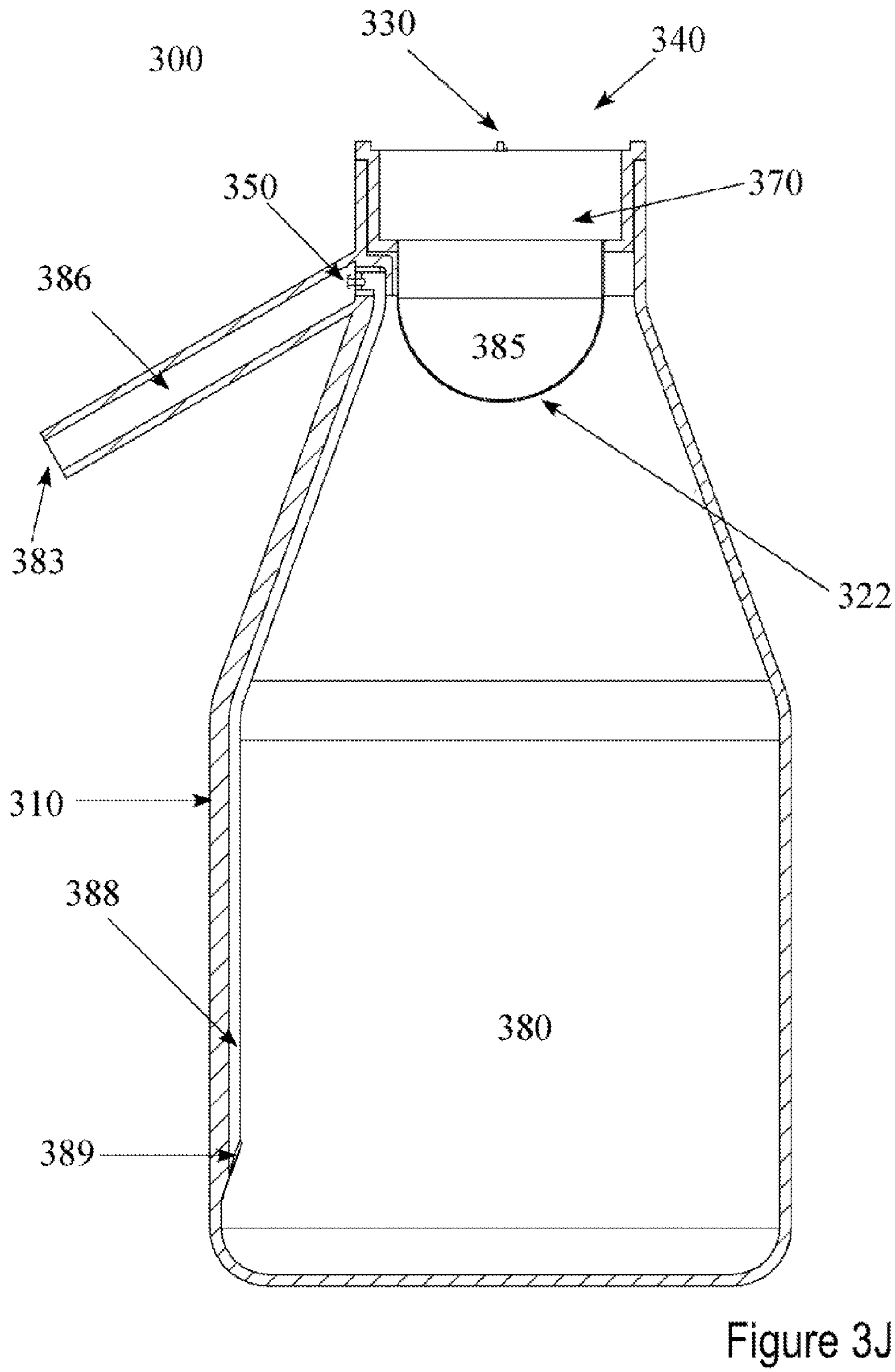


Figure 3J

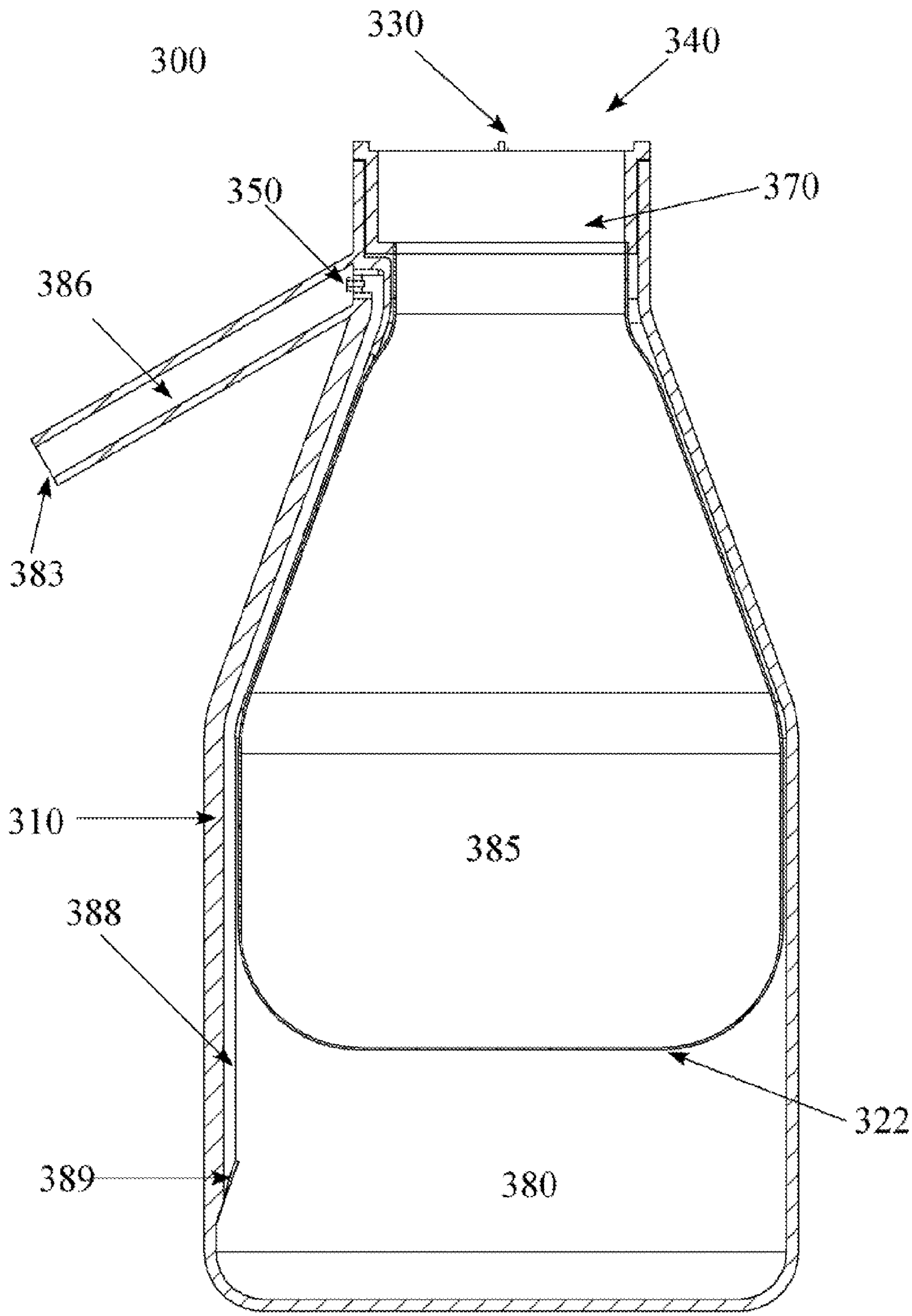


Figure 3K

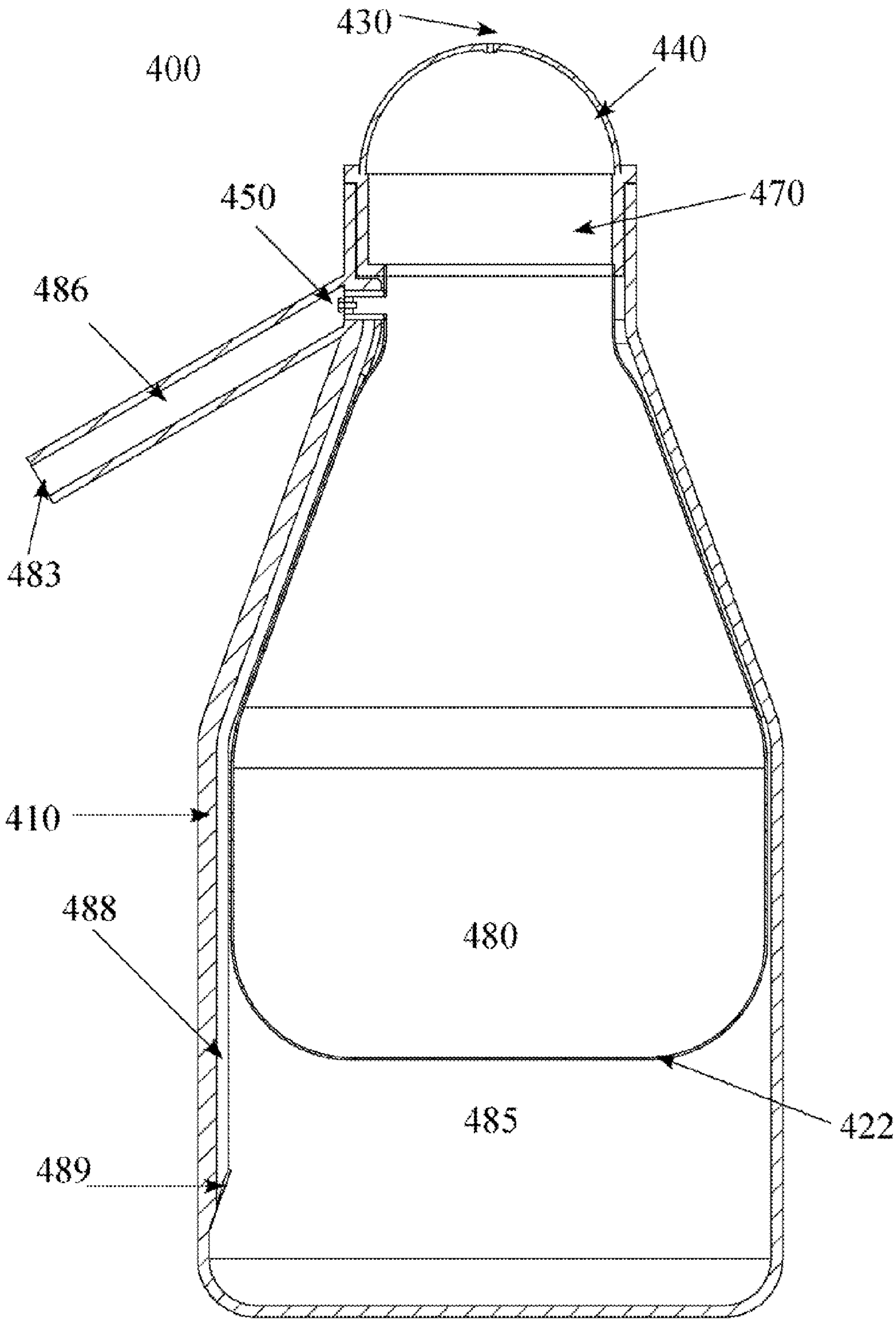


Figure 4A

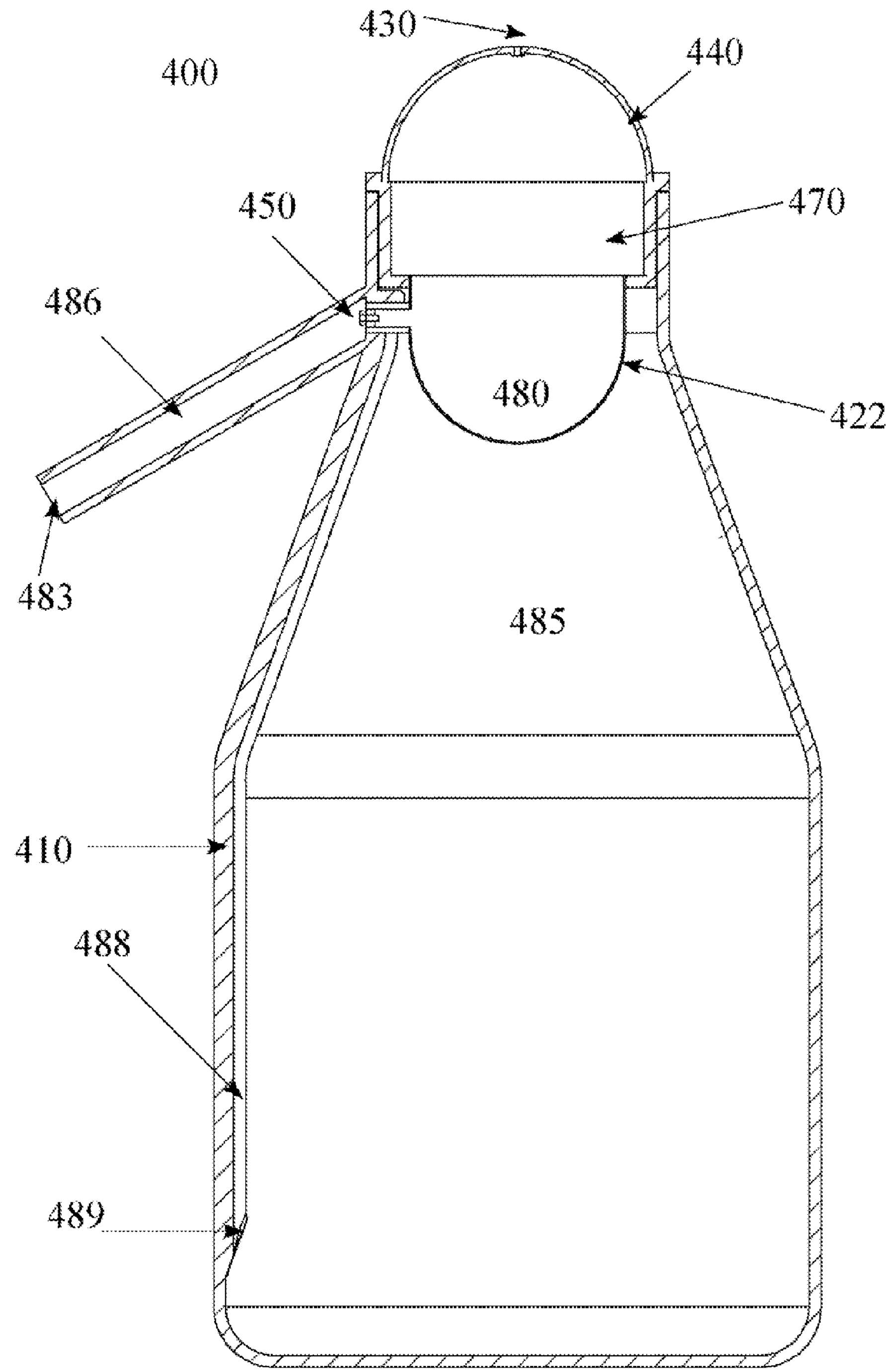


Figure 4B

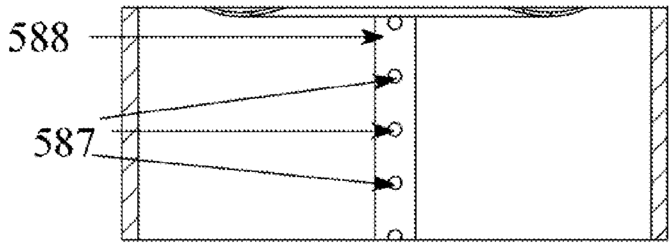


Figure 5A

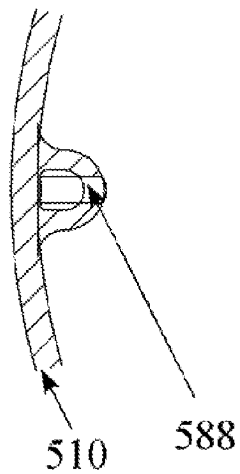


Figure 5B

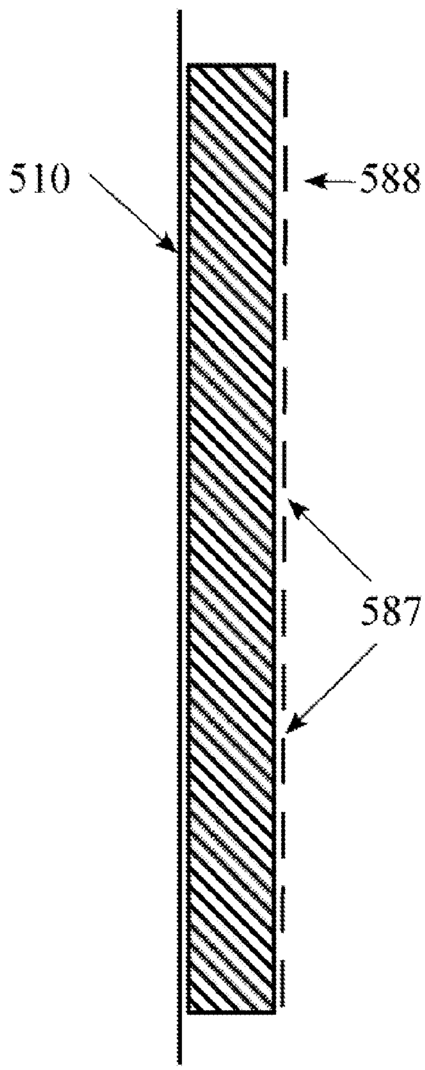


Figure 5C

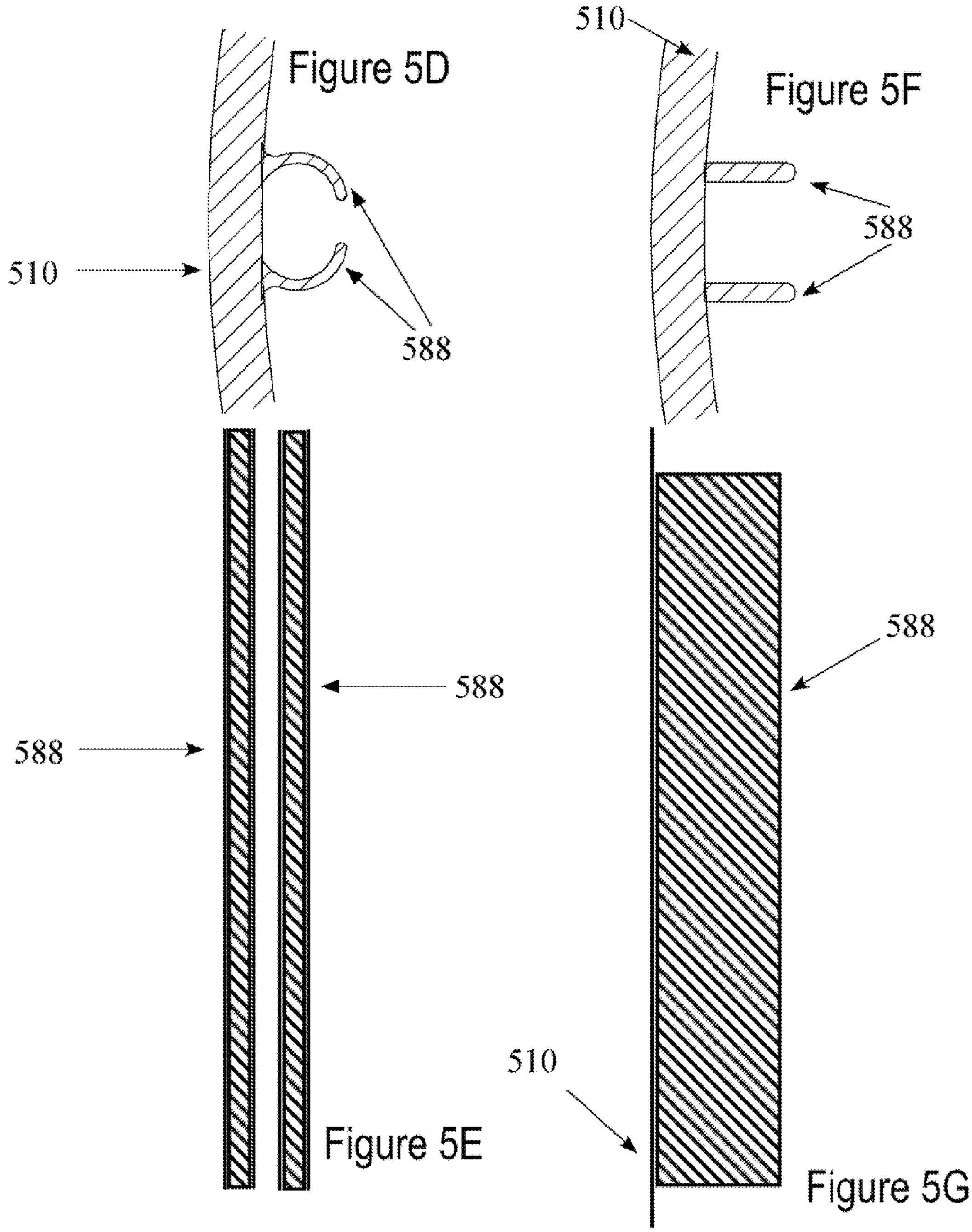


Figure 5D
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Figure 5F
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Figure 5E
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Figure 5G

Figure 5H

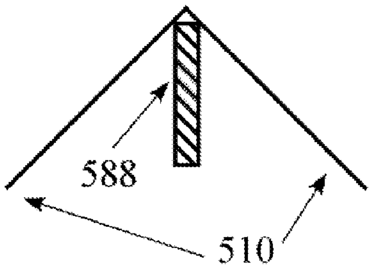
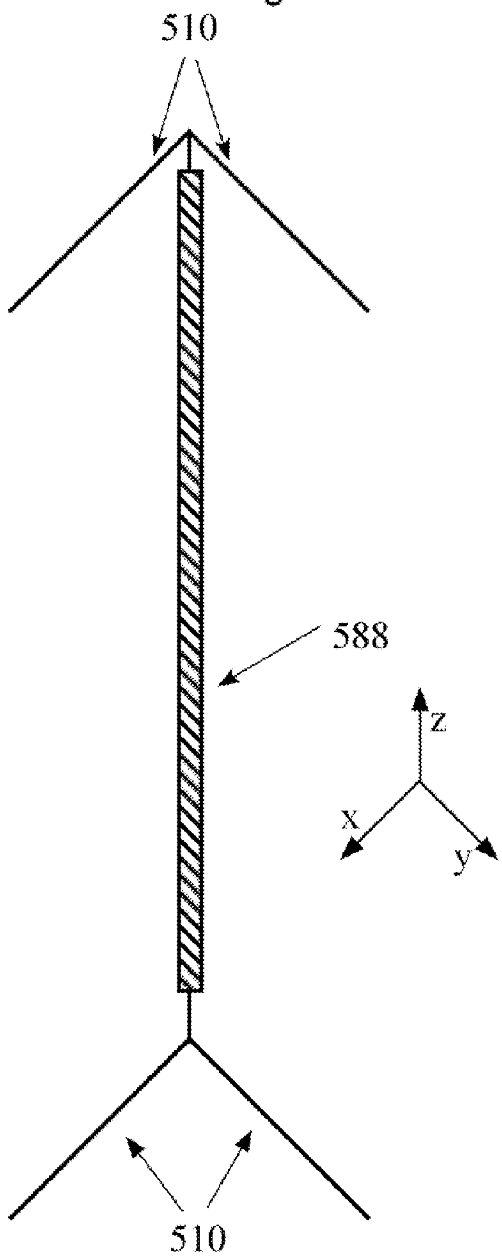


Figure 5J



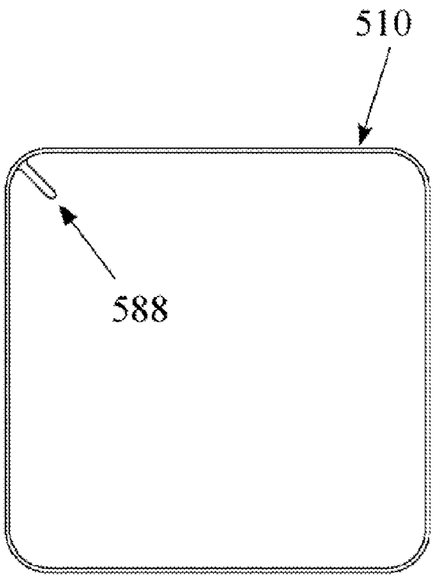


Figure 5K

VOLUME ADJUSTED PRESERVATION CONTAINMENT SYSTEM

PRIORITY CLAIM

[0001] This application claims priority to U.S. provisional Patent Application No. 61/157,129, entitled "VOLUME ADJUSTED PRESERVATION CONTAINING SYSTEM" by Gidi Shani, filed Mar. 3, 2009, the specification and drawings of which are incorporated herein by reference.

FIELD OF THE INVENTION

[0002] The present invention relates to a sealable container for preservation of substances that are oxidation-sensitive, moisture-sensitive, or otherwise reactive.

BACKGROUND OF THE INVENTION

[0003] Food storage systems can allow food to be preserved under better conditions than if the food were stored without such systems. One way to improve the storage of food is to replace the air and more specifically the oxygen in a container containing the food with an inert gas. If the inert gas is heavier than air, it can readily be trapped in the container and will not be displaced by air.

SUMMARY OF THE INVENTION

[0004] In an embodiment of the invention, a device for minimizing exposure of a substance to one or more reactants comprises a container, wherein the substance is inserted into the container. A rim, wherein the rim has a first perimeter, wherein when the rim is attached to the container the first perimeter of the rim forms a first vacuum seal with the container. A flexible inner diaphragm, wherein the flexible inner diaphragm forms a second vacuum seal with the rim at a second perimeter, wherein the second perimeter is enclosed within the first perimeter, wherein the container, the rim and the inner diaphragm form a vacuum-sealed first compartment containing the substance. A first one-way valve, wherein the first one-way valve allows a gas containing the one or more reactants inside the first compartment to be displaced outside of the first compartment, wherein the flexible inner diaphragm adjusts to occupy the first compartment volume.

[0005] In an alternative embodiment of the invention, a device for minimizing exposure of one or more gasses or liquids to one or more reactants comprises a container, wherein the one or more gasses or liquids are transferred into the container. A rim, wherein the rim has a first perimeter, wherein when the rim is attached to the container the first perimeter of the rim forms a first vacuum seal with the container. A flexible inner diaphragm, wherein the flexible inner diaphragm forms a second vacuum seal with the rim at a second perimeter, wherein the second perimeter is enclosed within the first perimeter, wherein the container, the rim and the inner diaphragm form a vacuum-sealed first compartment containing the substance. A first one-way valve, wherein the first one-way valve allows the one or more gasses or liquids inside the first compartment to be displaced outside of the container, wherein the flexible inner diaphragm adjusts to occupy the reduced first compartment volume after dispensing the one or more gasses or liquids.

[0006] In another embodiment of the invention, a rim for use with a substance storage container, wherein the rim comprises a surface with an opening, wherein the surface has an outer perimeter and an inner perimeter, wherein the inner perimeter is enclosed within the outer perimeter, wherein the outer perimeter is adapted to attach and form a first vacuum seal with the substance storage container. An outer diaphragm, wherein the outer diaphragm has an outer edge and an inner edge, wherein the inner edge is enclosed within the outer edge, wherein the outer diaphragm is more flexible than the surface, wherein the outer edge forms a second vacuum seal with the surface. An inner diaphragm, wherein the inner diaphragm forms a third vacuum seal with the inner edge of the outer diaphragm, wherein the inner diaphragm is more flexible than the outer diaphragm. A first one-way valve, wherein the first one-way valve allows gas to pass from inside the substance storage container through the one-way valve out of the substance storage container, wherein, when the first one-way valve is activated, gas can pass from outside the substance storage container into the substance storage container, wherein when a force is applied to the outer diaphragm, the force moves one or both the outer diaphragm and the inner diaphragm inside the substance storage container forcing the gas inside the substance storage container out the first one-way valve and thereby forming a vacuum in the substance storage container, wherein pressing the first one-way valve allows gas to pass from outside the container through the first one-way valve into the substance storage container releasing the vacuum. A second one-way valve associated with the outer diaphragm, wherein the second one-way valve allows gas to pass from outside the container through the second one-way valve into the container void space between the inner diaphragm and outer diaphragm, wherein, when the second conditional one-way valve is depressed, gas can travel from the container void space between the outer diaphragm and the inner diaphragm through the second conditional one-way valve and exit the container.

[0007] In another alternative embodiment of the invention, a method of preserving a substance in a container comprises placing the substance in the container. Attaching a rim to the container, wherein the rim forms a first vacuum seal with the container, wherein the rim includes an outer diaphragm, wherein the outer diaphragm forms a second vacuum seal with the rim. An inner diaphragm, wherein the inner diaphragm forms a third vacuum seal with the outer diaphragm. A first one-way valve and a second one-way valve associated with the outer diaphragm. Applying a force to the outer diaphragm, wherein the force acts on both the outer diaphragm and the inner diaphragm forcing gas in the container out the first one-way valve. Removing the force, wherein when the outer diaphragm returns to its original position gas is drawn through the second one-way valve into a container void between the outer diaphragm and the inner diaphragm. Repeatedly applying the force to the outer diaphragm, wherein the force acts on both the outer diaphragm and the inner diaphragm forcing gas in the container out the first one-way valve and removing the force, wherein when the outer diaphragm returns to its original position gas is drawn through the second one-way valve into a container void between the outer diaphragm and the inner diaphragm until no change in the container can be detected. Storing the container at a desired temperature to maximize preservation of the substance.

[0008] In an embodiment of the invention, a system for one or both isolating and storing a compound comprises a container, a flexible inner diaphragm, wherein the inner diaphragm forms a vacuum seal with a first compartment of the container in which the compound is enclosed. A first one-way valve which allows gas to pass from inside the first compartment through the first one-way valve, wherein when suction is applied to the one-way valve gas inside the first compartment is forced out the first one-way valve thereby reducing the gas in the system. A second one-way valve, wherein the second one-way valve allows air to pass from outside the container through the second one-way valve into a container void space in the container, wherein the inner diaphragm separates the first compartment from the container void compartment.

[0009] In an alternative embodiment of the invention, a storage system for dispensing one or more gasses and liquids comprises a container, wherein the container has an outside surface and an inside surface, wherein the container is flexible, wherein the container has a volume at standard temperature and pressure. An inner diaphragm, wherein the inner diaphragm is situated at least partially inside the container, wherein the inner diaphragm divides the volume of the container into a first compartment and a container void compartment, wherein the first compartment contains the one or more gasses and liquids. A first one-way valve which allows air to pass from outside the container through the first one-way valve into the container void compartment. A second one-way valve, wherein the second one-way valve allows one or both the gas and the liquid to exit the container, wherein when a force is applied to the outside surface the force compresses one or both the air inside the container void compartment and the one or more gasses and liquids inside the first compartment and dispenses the one or more gasses and liquids out the second one-way valve, wherein upon removing the force from the outside surface air is drawn from outside the container through the first one-way valve into the container void compartment.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] Various embodiments of the present invention will be described in detail based on the following figures, wherein:

[0011] FIG. **1** is a schematic diagram of a cross-sectional view of a container and rim according to an embodiment of the invention, where (A) shows the position of the inner diaphragm before displacing gasses and (B) shows the position of the inner diaphragm after displacing gasses;

[0012] FIG. **2**A is a schematic diagram of a cross-sectional view of the container rim according to an embodiment of the invention;

[0013] FIG. **2**B is a schematic diagram of a top view of the container rim according to an embodiment of the invention;

[0014] FIG. **2**C is a schematic diagram of a side view of the container rim according to an embodiment of the invention;

[0015] FIG. **3**A is a schematic diagram of a cross-sectional view of a flask type container for storing and dispensing substances which are present as or produce a liquid or gaseous phase by pumping where the container void space is small and the inner diaphragm has not been expanded, where the first one way valve is located at the end of the spout, according to an embodiment of the invention;

[0016] FIG. **3**B is a schematic diagram of a cross-sectional view of the container shown in FIG. **3**A according to an embodiment of the invention;

[0017] FIG. **3**C is a schematic diagram of a cross-sectional view of the container shown in FIG. **3**A where the inner diaphragm has expanded to enclose a larger container void space, where the first one way valve is located at the end of the spout, according to an embodiment of the invention;

[0018] FIG. **3**D is a schematic diagram of a cross-sectional view of a screw cap flask type container for storing and dispensing substances which are present as or produce a liquid phase, where the liquid phase is dispensed by removing the screw cap and pouring through the cap, where the container void space is small and the inner diaphragm has not been expanded according to an embodiment of the invention;

[0019] FIG. **3**E is a schematic diagram of a cross-sectional view of a screw cap flask type container for storing and dispensing substances which are present as or produce a liquid phase, where the liquid phase is dispensed by removing the screw cap and pouring through the cap, where the inner diaphragm has expanded to enclose a larger container void space according to an embodiment of the invention;

[0020] FIG. **3**F is a schematic diagram of a cross-sectional view of a flask type container for storing and dispensing substances which are present as or produce a liquid or gaseous phase, where the inner diaphragm has expanded to enclose a larger container void space, where the first one way valve for dispensing the liquid or gas is located on or near the container top, according to an embodiment of the invention;

[0021] FIG. **3**G is a schematic diagram of a cross-sectional view of a screw cap flask type container for storing and dispensing substances which are present as or produce a liquid phase, where the container void space is small and the inner diaphragm has not expanded, according to an embodiment of the invention;

[0022] FIG. **3**H is a schematic diagram of a cross-sectional view of a flask type container for storing and dispensing substances which are present as or produce a liquid or gaseous phase by pumping as in FIG. **3**F where the container void space has expanded to enclose a larger container void space than in FIG. **3**F according to an embodiment of the invention;

[0023] FIG. **3**J is a schematic diagram of a cross-sectional view of a flask type container for storing and dispensing substances which are present as or produce a liquid or gaseous phase by squeezing the container, where the container void space is small and the inner diaphragm has not expanded, where the first one way valve for dispensing the liquid or gas is located on or near the container top prior to the spout, according to an embodiment of the invention;

[0024] FIG. **3**K is a schematic diagram of a cross-sectional view of a flask type container for storing and dispensing substances which are present as or produce a liquid or gaseous phase by squeezing the container, where the inner diaphragm has expanded to enclose a larger container void space, where the first one way valve for dispensing the liquid or gas is located on or near the container top prior to the spout, according to an embodiment of the invention;

[0025] FIG. **4**A is a schematic diagram of a cross-sectional view of a flask type container for storing and dispensing substances which are present as or produce a liquid or gaseous phase by pumping, where the container void space is small and the inner diaphragm has not been expanded, where the second one way valve for dispensing the liquid or gas is located on the container cap prior to the spout, according to an embodiment of the invention;

[0026] FIG. **4**B is a schematic diagram of a cross-sectional view of a flask type container for storing and dispensing substances which are present as or produce a liquid or gaseous phase by pumping, where the inner diaphragm has expanded to enclose a larger container void space, where the second one way valve for dispensing the liquid or gas is located on the container cap prior to the spout, according to an embodiment of the invention;

[0027] FIG. **5**A is a schematic diagram of a front view of a delivery vent for dispensing liquids or gasses out of containers containing diaphragms, according to an embodiment of the invention;

[0028] FIG. **5**B is a schematic diagram of the overhead view of the delivery vent for dispensing liquids or gasses mounted to a container wall as shown in FIG. **5**A, according to an embodiment of the invention;

[0029] FIG. **5**C is a schematic diagram of the side view of the delivery vent for dispensing liquids or gasses out of containers containing diaphragms as shown in FIG. **5**A, according to an embodiment of the invention;

[0030] FIG. **5**D is a schematic diagram of an overhead view of the delivery vent for dispensing liquids or gasses mounted to a container wall, according to an embodiment of the invention;

[0031] FIG. **5**E is a schematic diagram of the front view of the delivery vent for dispensing liquids or gasses out of containers containing diaphragms as shown in FIG. **5**D, according to an embodiment of the invention;

[0032] FIG. **5**F is a schematic diagram of an overhead view of the delivery vent for dispensing liquids or gasses mounted to a container wall, according to an embodiment of the invention;

[0033] FIG. **5**G is a schematic diagram of the front view of the delivery vent for dispensing liquids or gasses out of containers containing diaphragms as shown in FIG. **5**F, according to an embodiment of the invention;

[0034] FIG. **5**H is a schematic diagram of an overhead view of the delivery vent for dispensing liquids or gasses mounted to the corner of two container walls, according to an embodiment of the invention;

[0035] FIG. **5**J is a schematic diagram of the front view of the delivery vent for dispensing liquids or gasses out of containers containing diaphragms as shown in FIG. **5**H, according to an embodiment of the invention; and

[0036] FIG. **5**K is a schematic diagram of the overhead view of the delivery vent for dispensing liquids or gasses out of containers containing diaphragms as shown in FIG. **5**H, according to an embodiment of the invention.

DETAILED DESCRIPTION OF THE INVENTION

Definitions

[0037] Container means a dispenser, bottle, flask, tub, jar or other article which together with one or more other articles including a lid, top, cap or spout can be used to form a gas sealed article. Displaced means transferred with or without pumping. Gasses include one or more substances in the gaseous phase, for example gasses include air which comprises a mixture of at least oxygen, nitrogen and water. Exposure means physical or chemical contact allowing a physical or chemical reaction. Pumping means applying suction to a compartment of a container either via a manual or mechanized action, including applying a force to a diaphragm or squeezing the container wall. A one-way conditional valve allows gas to pass through the valve in one specified direction when the valve is not activated and allows gas to pass through the valve in the reverse direction only when the valve is activated. A one-way non conditional valve allows gas to pass through the valve in one specified direction. A one-way valve can include a one-way conditional valve and a one way non conditional valve. Organelle refers to a membrane that acts in the fashion of a biological membrane. An inner diaphragm can change to the adjusted first compartment volume by either expanding or contracting to adjust to a greater or reduced volume respectively. An organelle is used to describe an inner diaphragm and an outer diaphragm that are formed in a single process, or formed from a single material or as a single entity. In an embodiment of the invention, where the inner diaphragm and the outer diaphragm are made separately and assembled together as a single entity, the organelle is then fitted onto the rim. Substance includes food and drink in which the spoilage of the substance can be delayed by removing reactants from the substance's environment. Reactants are molecules that physically or chemically react with the reactive substance and include air, gasses, water and liquids which are capable of oxidizing food and drink. Reactants also include gaseous odors which can become physically adsorbed to molecules in food and drink.

[0038] Containers or other storage systems that limit the access of airborne agents have been shown to produce very good results in protecting food from certain microorganisms, bacteria, pests, mould and fungal growth. This principle also applies for non-food substance that would harbor the growth of the microorganisms, bacteria, pests, mould and fungi. Furthermore, the container helps to prevent the food from oxidizing. One way to improve the storage of food is to replace the air and more specifically the oxygen in a container containing the food with an inert gas. If the inert gas is heavier than air, it can readily be trapped in the container and will not be displaced by air. The requirement of keeping an inert gas available at all times and the cost of the inert gas and storage equipment limit the applicability of this approach. An alternative approach is to remove the oxygen without replacing it with an inert gas, such that the oxygen cannot seep back into the container, i.e., to keep the food in a container under vacuum.

[0039] Removing the air also helps remove excess moisture and thereby theoretically should also maintain the moisture level of the food. Air can be removed from a vessel by the formation of a vacuum. However, a problem with generating a vacuum is that the vacuum causes the food to release liquids. In the case of cellular substances, the vacuum can disrupt the cell membranes and as a result moisture can be sucked out of the substance. The release of liquids can generate an environment that actually accelerates food spoilage. A strong vacuum is generally not suitable for storing a liquid, since the liquid will bubble violently as any air in the liquid is removed and thereby splatter onto the inside container surfaces. When applied for extended periods of time, the vacuum can concentrate a liquid as the volatile components of the liquid are essentially 'boiled off'.

[0040] In an embodiment of the invention, the air surrounding oxidation- or moisture-sensitive material in a storage container is replaced by altering the shape of the container top surface to mimic the shape of the material. In an alternative embodiment of the invention, the air surrounding oxidation- or moisture-sensitive material in a storage container is replaced by altering the shape of the container bottom surface to mimic the shape of the material. In another embodiment of the invention, the air surrounding oxidation- or moisture-sensitive material in a storage container is replaced by altering the shape of one or more of the container side surface to mimic the shape of the material. In an embodiment of the invention, the air surrounding food in a storage container is replaced by altering the shape of the container top, bottom, or one or more of the side surface to mimic the shape of the food. In an embodiment of the invention, the air surrounding a gas or liquid in a storage container is replaced by altering the shape of the container top, bottom, or one or more of the side surface to mimic the shape of the liquid. In another embodiment of the invention, the air surrounding oxidation- or moisture-sensitive material in a storage container is replaced by altering the shape of the container top, bottom, or one or more of the side surface to mimic the shape of the oxidation- or moisture-sensitive material, and generating mild vacuum conditions that do not cause the suction of liquids out of the oxidation- or moisture-sensitive material. In another embodiment of the invention, the air surrounding food in a storage container is replaced by altering the shape of the container top, bottom, or one or more of the side surface to mimic the shape of the food, and mild vacuum conditions are created that do not cause suction of fluids out of the food. In another embodiment of the invention, the air surrounding liquids in a storage container is replaced by altering the shape of the container top, bottom, or one or more of the side surface to mimic the volume of the container occupied by the liquid, and mild vacuum conditions are created that do not cause suction of air out of the liquid. In various embodiments, oxidation of oxidation-sensitive material can be reduced by reducing the volume of air in contact with the oxidation-sensitive material. In various embodiments, spoilage of moisture-sensitive material can be reduced by reducing the volume of air in contact with the moisture-sensitive material.

[0041] In an embodiment of the present invention, a storage system minimizes oxidation of food stored at room temperature or ambient temperature for relatively short periods of time (e.g., food that is packed for carryout picnics, catering or lunch boxes). In an embodiment of the present invention, a storage system minimizes oxidation of stored gasses or liquids that are stored at room temperature or ambient temperature. In another embodiment of the present invention, a storage system minimizes spoilage of solids, liquids or gasses stored at 4° C. In an alternative embodiment of the present invention, a storage system minimizes spoilage of solids, liquids and gasses stored at minus 20° C. In an alternative embodiment of the present invention, a storage system minimizes the moisture in contact with the material and thereby minimizes the moisture required for many types of bacteria, mold and fungus to survive. In an alternative embodiment of the invention, a storage system isolates stored liquids and gasses from the atmosphere or other reactive agents, or from dispersing.

[0042] In an embodiment of the present invention, a rigid container with defined dimensions can be equipped with an internal flexible diaphragm to modulate the inner volume of the container. In an embodiment of the present invention, by reducing the volume of the container, much less air is available to cause oxidation of the food. In an embodiment of the present invention, by replacing the air with a mild vacuum, less moisture is available to cause spoilage of the food.

[0043] In various embodiments of the present invention, the vacuum applied to material in a storage container can be between approximately 700 Torr and approximately 10 Torr. In an embodiment of the present invention, a vacuum applied to material in a storage container can be approximately 400 Torr. The phrase "approximately in the pressure range of 400 Torr" typically equates to a pressure of more than 200 Torr and less than 600 Torr. In an embodiment of the present invention, a vacuum applied to material in a storage container can be approximately 100 Torr. The phrase "approximately in the pressure range of 100 Torr" typically equates to a pressure of more than 80 Torr and less than 120 Torr.

[0044] In an embodiment of the present invention, one or more diaphragms can be vacuum seal attached to a rim of a container. The rim can make a vacuum seal with the body of the container. In an embodiment of the invention, a soft rubber gasket and clamps can be used to form the vacuum seal between the rim and the container. U.S. Pat. No. 7,040,356 describes a soft rubber gasket that forms a vacuum seal by means of a cam and lever. U.S. Pat. No. 7,040,356 is explicitly incorporated by reference into this application in its entirety. The diaphragms can be adhesively sealed to the rim using materials including modified polypropylene or modified polyethylene. In an alternative embodiment of the invention, the diaphragms can be vacuum seal attached to the rim of the container with a heat seal. U.S. Pat. No. 5,743,942 describes uncoated but compatible film materials that form stronger seals than adhesive coated seals. U.S. Pat. No. 5,743,942 is explicitly incorporated by reference into this application in its entirety.

[0045] A first conditional one-way direction valve can be positioned at the periphery of the rim, allowing only gasses to leave the container volume and creating a vacuum inside the container. European Patent No. 0644128 describes a one-way conditional valve received in a cylindrical depression in the container rim. One-way conditional valves or push-button manual relief valves that can be mounted in panels are available commercially from a number of suppliers including Smart Products (http://www.smartproducts.com/), where the 330 manual relief valve can be received in any 300 series modular check valve. These valves can be releasably received in a panel or other surface to give a vacuum seal.

[0046] In an embodiment of the invention, an annular periphery of a depression forms a sealing surface within a one-way conditional valve. If gasses are pressurized within the container, then a one-way conditional valve opens and the gasses flow out of the container. In an embodiment of the invention, the one-way conditional valve closes as soon as the pressure in the container is less than the pressure outside the container. In an embodiment of the invention, the one-way conditional valve is located in the rim. In an embodiment of the invention, the one-way conditional valve is formed by a diaphragm that is elastically pre-stressed in its initial position so that the diaphragm blocks the flow path when the diaphragm is in the rest state. In the evacuated state, the rim can no longer be separated from the container because the force on the sealing surface between the rim and the container is too great, due to the existing pressure difference. As a result, in order to subsequently open the container to remove the food, the vacuum in the container space must first be released. In an embodiment of the invention, the opening of the valve is achieved by manually pulling on a pin formed on the sealing sleeve until the sealing surface of the valve lifts away from the valve seat. Alternatively, the opening of the valve may be achieved via squeezing on the valve in such a way that it forces the valve out of its position so that air or other gasses can traverse the valve freely and flow according to the pressure difference on both sides of the valve. Air or gasses are then able to flow into the container until the pressure in the atmosphere and the pressure in the container are equalized. After the pressure has been equalized, the cover can be easily removed from the container, and food can be removed from the container. In an embodiment of the present invention, a one-way conditional valve is used according to European Patent No. 0644128. European Patent No. 0644128 is explicitly incorporated by reference into this application in its entirety.

[0047] In an embodiment of the present invention, when the first conditional one-way direction valve is activated or depressed, gasses can traverse in the opposite direction from outside the container into the container to release the vacuum. The outer diaphragm can be made from natural latex rubber or a material with similar flexural modulus. U.S. Pat. No. 6,051,320 discloses a thin walled natural rubber latex material that would be suitable for forming the outer diaphragm and is explicitly incorporated by reference into this application in its entirety. A conditional one-way direction valve can be inserted into the outer diaphragm which allows air to pass from outside the container through the valve into the container void compartment between the outer diaphragm and the inner diaphragm. When this conditional one-way valve is depressed, gas can traverse in the opposite direction from the container void between the outer diaphragm and the inner diaphragm out of the container.

[0048] In an embodiment of the present invention, the inner diaphragm can be made of rubber with a flexural modulus greater than the outer diaphragm. In an embodiment of the present invention, the inner diaphragm is made of a rubber/silicon material. U.S. Pat. No. 4,257,934 which is explicitly incorporated by reference into this application in its entirety describes a number of rubber-based materials with additives that increase the flexural modulus of the material by up to 100%. In an alternative embodiment of the present invention, the inner diaphragm is made of a polymer material with a thin layer of silicon dioxide. U.S. Pat. No. 5,279,873 describes a composite material made from a polymer layer with a transparent thin layer of silicon oxide provided on one surface of the polymer layer that is able to act as a barrier to helium and other larger atomic radii gasses and that would be suitable for the inner membrane. The polymer base layer is selected from one or more materials including nylon film, nylon film coated with a vinylidene chloride resin, polyester film, polyethylene terephthalate film coated with a vinylidene chloride resin, polypropylene film, ethylene-vinyl alcohol copolymer film, polyethylene film, polyvinyl alcohol film, and polyvinylidene chloride film. The silicon oxide layer has an atomic ratio of silicon to oxygen of approximately 1:0.3 to 2. U.S. Pat. No. 5,279,873 is explicitly incorporated by reference into this application in its entirety. In another embodiment of the present invention, the inner diaphragm is made of latex. In another alternative embodiment of the present invention, the inner diaphragm is made of polyethylene, polypropylene or blends thereof. In an embodiment of the present invention, the inner diaphragm is made of ethylene vinyl alcohol copolymer or saran which is substantially impervious to oxygen. U.S. Pat. No. 4,542,029 which is explicitly incorporated by reference into this application in its entirety describes polyethylene, polypropylene, ethylene vinyl alcohol copolymer, saran for sealing containers. In another embodiment of the present invention, the inner diaphragm is made of Diolon, a low-oxygen permeability film. The inner diaphragm can be expanded into the void of the container. As a result when mechanical force is exerted on the outer diaphragm, both the outer diaphragm and inner diaphragm are forced into the container and the inner diaphragm replaces the air that is forced out of the container through a conditional one-way valve. On releasing the force, the outer diaphragm returns to its normal position while air entering through a second conditional one-way valve fills the container void between the outer diaphragm and the inner diaphragm. In an embodiment of the invention, a lid can be placed on top of the container rim and the container can be stored.

[0049] As shown in FIG. **1**A, when a material needs to be stored in a preservation storage system **100** a user can attach the rim **170** to the container **110** and then apply a force **160** on the outer diaphragm **140** pitch. Two one-way valves can be located on the preservation storage system. A first one-way valve **150** can connect the inside of the container to the outside. A second one-way valve **130** can bypass the outer diaphragm to let air into the void between the outer diaphragm and the inner diaphragm. The two one-way valves **130** and **150** can create a simple pump that will suck air from inside the container **180** out through the first one-way valve **150** outside the container **190**. As the force **160** is removed, air can be drawn through the second one-way valve **130** into the container void space **185** between the inner diaphragm **122** and the outer diaphragm **140**. The force **160** can be applied and released repetitively acting on the diaphragms **140** and **122** to act as a pump to expand the inner diaphragm **122** into the container void **185** and generate the vacuum inside the container **180** and around the contents of the container.

[0050] As shown in FIG. **1**B, after the force has been released the inner diaphragm **122** extends towards the inside of the container **180** and the container void space **185** between the diaphragms **140** and **122** has increased in volume. In this static situation, the first one-way conditional valve **150** does not allow air back into the container. The second one-way valve **130** does not allow the air trapped in the container void **185** to escape outside the container. In an embodiment of the invention, a lid **120** can then be placed on top of the rim and the outer diaphragm **140** and the preservation storage system **100** can be placed in a refrigerator or other cold storage area for storage. In an embodiment of the invention, the dimensions of the base **112** of the container **110** allow one container **110** to be stacked on top of the lid **120** of another container **110**. In an alternative embodiment of the invention, the base **112** of the container **110** allows one container **110** to be stacked on top of the rim of another container **110**.

[0051] In an embodiment of the invention, in order to access the contents of the container, the rim **140** (see FIG. **1**A) can be removed from the container **110** by simply removing the lid **120** and pressing on a first conditional one-way valve **150** to release the vacuum in the container. The rim **170** and the diaphragms **140** and **122** can then be removed from the container **110** and the contents of the container removed. In order to release the air trapped between the inner **122** and outer **140** diaphragms a second conditional one-way valve **130** can be depressed. Once the pressure is released, the inner diaphragm **122** will naturally flex back to its original position.

[0052] FIG. **2**A shows a cross-section of the vacuum container rim system **200** where the outer diaphragm **240** and the inner diaphragm **222** are both connected with a vacuum seal to the rim **270**. The first one-way valve **250** can be located anywhere in the periphery of the rim **270** that does not interfere with the action of the inner diaphragm. The second one-way valve **230** can be located in the center of the outer diaphragm **240**. A lid can be placed on top of the vacuum container rim system **200**. FIG. **2**B shows a view from above the vacuum container rim system **200** where the outer diaphragm **240** connects with the rim **270** at circumference **272**. The first one-way valve can be located in the periphery of the rim **250**. The second one-way valve **230** can be located in the center of the outer diaphragm **240**. FIG. 2C shows a perspective view of the vacuum container rim system **200** where the outer diaphragm **240** is connected to the rim **270**. A first one-way valve can be located in the rim **250**. The second one-way valve **230** can be located in the center of the outer diaphragm **240**.

[0053] FIG. 3A shows a cross-section of an alternative embodiment of the invention, where a vacuum container flask system **300** with an outer diaphragm **340** and an inner diaphragm **322** are both connected with a hermetic seal to one or both the flask rim **370** and the flask **310**. The first one-way valve can be located at the spout exit **383** or anywhere along the spout **386** (in an alternative embodiment of the invention, a first one way conditional valve can be located at the exit of the container **350**, and a probe can be inserted up the spout to activate the valve). The first one-way valve **383** allows liquid or gasses **380** to leave the container flask system **300** only and prevents air from flowing into the container flask system **300** such that the liquid or gasses **380** can be isolated from contact with air until the liquid or gas is pumped out. The second one-way valve **330** can be located at the top of the container flask system **300** in the center of the outer diaphragm **340** or anywhere associated with the outer diaphragm **340**. The liquid and/or gas **380** to be dispensed (or a solid which liquefies or sublimes) can be stored in the bottom of the flask **300**. A delivery vent **388** that extends to the bottom of the container **389** can run up the side of the vacuum container flask system **300** and can be connected to the spout **386** through the opening **350**. In an embodiment of the invention, an optional third valve can be used to control flow out of the opening **350**.

[0054] FIGS. 5A-5K show a number of different embodiments of the delivery vent **588**. In FIGS. 5A-5C the delivery vent **588** comprises a tube with venting holes **587** drilled through the tube at regular intervals along the length of the tube. In FIG. 5B the delivery vent **588** is shown relative to the container wall **510**. In FIG. 5C the delivery vent **588** is shown oriented in position with venting holes **587** relative to the container wall **510**. In FIGS. 5D-5E the delivery vent **588** comprises a tube with a slit machined, longitudinally through the tube. In FIG. 5D the delivery vent **588** is shown oriented in position relative to the container wall **510**. In FIGS. 5F and 5G the delivery vent **588** comprises two sheets arranged parallel to each other and at a short distance (1 mm-10 mm) from each other, where each sheet is perpendicular to the container wall **510**. In FIGS. 5H-5K the delivery vent **588** comprises one sheet arranged in a corner at an acute angle (between)10-80° to two container flask walls **510**. In FIGS. 5A-5K the delivery vent **588** extends from the bottom of the flask wall **510** up to the one way conditional valve or the entry to the spout. The delivery vent **588** can be made of plastic, metal, glass, ceramic or a composite material. The delivery vent **588** can be molded, affixed, adhered, machined or otherwise stably oriented in position relative to the container wall **510**. In each embodiment, the delivery vent **588** allows liquid or gas in one area of the container to flow into another area of the container. FIG. 5A is a schematic diagram of a front view of a delivery vent **588** for dispensing liquids or gasses out of containers containing diaphragms, according to an embodiment of the invention. FIG. 5B is a schematic diagram of the overhead view of the delivery vent **588** for dispensing liquids or gasses mounted to a container wall as shown in FIG. 5A. FIG. 5C is a schematic diagram of the side view of the delivery vent **588** for dispensing liquids or gasses out of containers containing diaphragms as shown in FIG. 5A. FIG. 5D is a schematic diagram of an overhead view of the delivery vent **588** for dispensing liquids or gasses mounted to a container wall, according to an alternative embodiment of the invention. FIG. 5E is a schematic diagram of the front view of the delivery vent **588** shown in FIG. 5D. FIG. 5F is a schematic diagram of an overhead view of the delivery vent **588** for dispensing liquids or gasses mounted to a container wall, according to another embodiment of the invention. FIG. 5G is a schematic diagram of the front view of the delivery vent **588** shown in FIG. 5F. FIG. 5H is a schematic diagram of an overhead view of the delivery vent **588** for dispensing liquids or gasses mounted to the corner of two container walls, according to an alternative embodiment of the invention. FIG. 5J is a schematic diagram of the front view of the delivery vent **588** shown in FIG. 5H. FIG. 5K is a schematic diagram of the overhead view of the delivery vent **588** shown in FIG. 5H.

[0055] FIG. 3B shows a section of the flask shown in FIG. 3A, where a vacuum container flask system **300** with an outer diaphragm **340** is connected with a hermetic seal to one or both the flask rim **370** and the flask **310**.

[0056] FIG. 3C shows a cross-section of the vacuum container flask system **300** shown in FIG. 3A, with an outer diaphragm **340** and an inner diaphragm **322** both connected with a hermetic seal to one or both the flask rim **370** and the flask **310**. The first one-way valve can be located at the spout exit **383** or anywhere along the spout **386** (in an alternative embodiment of the invention, a first one way conditional valve can be located at the exit of the container **350**, and a probe can be inserted up the spout to activate the valve). The first one-way valve **383** allows liquid or gasses **380** to leave the container flask system **300** only and prevents air from flowing into the container flask system **300** such that the liquid or gasses **380** can be isolated from contact with air until the liquid or gas is pumped out. The second one-way valve **330** can be located at the top of the container flask system **300** in the center of the outer diaphragm **340** or anywhere associated with the outer diaphragm **340**. The liquid and/or gas **380** to be dispensed (or a solid which liquefies or sublimes) can be stored in the bottom of the flask **300**. A delivery vent **388** which extends to the bottom of the container system **389** can run up the side of the vacuum container flask system **300** and can be connected to the spout **386** through the opening **350**. An optional third valve can be used to control flow out of the opening **350**.

[0057] In an embodiment of the invention, the gas and/or liquid **380** is expelled from the container flask system **300** by using the inner **322** and outer **340** diaphragms as a pump to eject the gas and/or liquid **380** through the delivery vent **388** and the one way valve **350**. In various embodiments of the invention, as the liquid **380** is used, the inner diaphragm **322** can extend to increase the container void space **385** in the inner **322** diaphragms and ensure that the liquid and/or gas **380** does not come in contact with air.

[0058] FIGS. 3D and 3E show a cross-section of the vacuum container flask system **300** with a screw cap **382** which inserts into the flask rim **370**, an outer diaphragm **340** and an inner diaphragm **322** both connected with a hermetic seal to one or both the flask rim **370** and the flask **310**. The first one-way valve can be located at or near the top of the container **350** (in an alternative embodiment of the invention, the container can include a spout and a first one-way conditional valve can be located anywhere along the spout). The first one-way valve **350** allows gas or liquid **380** to leave the container flask system **300** only and prevents air from flowing into the container flask system **300** such that the gas and/or liquid **380** can be isolated from contact with air until it is pumped out. The second one-way valve **330** can be located at the top of the container flask system **300** in the center of the outer diaphragm **340** or anywhere associated with the outer diaphragm **340**. The liquid and/or gas **380** to be dispensed can be stored in the bottom of the flask **300**. A delivery vent **388** which extends to the bottom of the container system **389** can run up the side of the vacuum container flask system **300** and can be connected to the one-way valve **350**. An optional spout can be attached to the one-way valve **350**. In FIG. **3**D the inner diaphragm **322** has not been extended and the void compartment **385** is small. This would correspond with the situation before a significant amount of the container contents had been dispensed or before the pump had been used to generate a vacuum. In FIG. **3**E the inner diaphragm **322** has been significantly extended and the void compartment **385** is large. This would correspond with the situation after a significant amount of the container contents had been dispensed.

[0059] In the alternative embodiment of the invention shown in FIGS. **3**F-**3**H, the inner diaphragm **322** can be positioned at the bottom of the container flask system **300** and can expand upwards such that the gas and/or liquid **380** can be forced upwards (towards the top of the container flask system **300**). FIGS. **3**F-**3**H show cross-sections of the vacuum container flask and cap system **300**, in which a cap **382** inserts into the flask rim **370** where the cap includes an outer diaphragm **340** connected with a hermetic seal to the cap **382**. An inner diaphragm **322** connects with a hermetic seal to one or both the flask **310** and the flask rim **370**. The first one-way valve can be located at or near the top of the container **350** (in an alternative embodiment of the invention, the container can include a spout and a first one-way conditional valve can be located anywhere along the spout and a probe can be inserted up the spout to activate the valve). The first one-way valve **350** allows gas or liquid **380** to leave the container flask system **300** only and prevents air from flowing into the container flask system **300** such that the gas and/or liquid **380** can be isolated from contact with air until it is pumped out. The outer diaphragm **340** can be located in the cap **382** at the top of the container flask system **300**. The liquid and/or gas **380** to be dispensed can be stored in the flask **300**. A delivery vent **388** which extends to the bottom of the container system **389** can run up the side of the vacuum container flask system **300** and can be connected to the one-way valve **350**. A second one way valve positioned at the bottom of the flask **335** can be used to allow air from outside the container into the void compartment **385**. In FIGS. **3**G and **3**H the cap **382** is a screw cap which screws into the flask rim **370**.

[0060] In FIG. **3**G the inner diaphragm **322** has not been extended and the void compartment **385** is small. This would correspond with the situation before a significant amount of the container contents had been dispensed or before the pump had been used to generate a vacuum. In FIG. **3**F the inner diaphragm **322** has been extended and the void compartment **385** is larger than in FIG. **3**G. This would correspond with the situation after a significant amount of the container contents had been dispensed. In FIG. **3**H the inner diaphragm **322** has been significantly extended and the void compartment **385** is large. This would correspond with the situation after most of the container contents had been dispensed.

[0061] In an embodiment of the invention, (see FIGS. **3**F and **3**H) the inner diaphragm can be designed to expand with a trunk **323** of less flexible material compared with the bulbous portion of the inner diaphragm **322**. This arrangement will allow for the inner diaphragm **322** to inflate from the top and keep the liquid at the bottom leaving the container through the delivery vent **388**.

[0062] In an embodiment of the invention, the gas and/or liquid **380** is expelled from the container flask system **300** by squeezing on the container flask rather than pressing on an outer diaphragm. FIGS. **3**J and **3**K shows a cross-section of the vacuum container flask system **300**, with an inner diaphragm **322** connected with a hermetic seal to one or both the flask rim **370** and the flask **310**. The first one-way valve can be located near the top of the container **350** (in an alternative embodiment of the invention, a first one way conditional valve can be located or at the spout **386** exit **383**). The first one-way valve **350** allows liquid or gasses **380** to leave the container flask system **300** only and prevents air from flowing into the container flask system **300** such that the liquid or gasses **380** can be isolated from contact with air until the liquid or gas is pumped out. The second one-way valve **330** can be located at or near the top of the container flask system **300**. The liquid and/or gas **380** to be dispensed (or a solid which liquefies or sublimes) can be stored in the bottom of the flask **300**. A delivery vent **388** which extends to the bottom of the container system **389** can run up the side of the vacuum container flask system **300** and can be connected to the spout **386** through the one-way valve opening **350**. An optional third valve can be used to control flow out of the spout **383**.

[0063] In FIG. **3**J the inner diaphragm **322** has not been extended and the void compartment **385** is small. This would correspond with the situation before a significant amount of the container contents had been dispensed or before the pump had been used to generate a vacuum. In FIG. **3**K the inner diaphragm **322** has been significantly extended and the void compartment **385** is large. This would correspond with the situation after a significant amount of the container contents had been dispensed.

[0064] In various embodiments of the invention, the gas and/or liquid **380** is expelled from a container flask system **300** by using the inner **322** and outer **340** diaphragms as a pump to eject the gas and/or liquid **380** through the spout **386**, as shown in FIGS. **3**A, **3**C, **3**J and **3**K. In an embodiment of the invention, as the gas and/or liquid **380** is used, the inner diaphragm **322** can extend to increase the container void space **385** and ensure that the gas and/or liquid **380** does not come in contact with air. In another embodiment of the invention, as the gas and/or liquid **380** is used, the inner diaphragm **322** can extend to increase the container void space **385** and ensure that the gas and/or liquid **380** does not come in contact with additional air.

[0065] In an embodiment of the invention, the air can be pumped out of the container flask system **300**. FIGS. **3**E, G and H show a cross-section of the vacuum container flask system **300** with a screw cap, where the outer diaphragm **340** is connected with a vacuum seal to the screw cap, while the inner diaphragm **322** is connected with a vacuum seal to the flask rim **370**. In these embodiments, the liquid **380** can be accessed by unscrewing the cap **382** and pouring the liquid **380** out of the flask container system **300**. In an embodiment of the invention, the cap **382** can make a hermetic screw fit with the container flask system **300**. The cap **382** can be screwed back onto the container flask system **300** and the air can be pumped out simultaneously as the inner diaphragm **322** is inflated to expand to occupy the volume in the flask container system **300** not occupied by the liquid **380** according to the same principle. The remaining liquid **380** can be stored for later use. A first one-way conditional valve **350** allows air out only. A second one-way conditional valve **330** is "in only" and can be located in the center of the outer diaphragm **340**. A liquid **380** can be stored in the bottom of the flask **300**. A small tube or pipe **388** runs up the side of the vacuum container flask system **300** and is connected with the first one-way conditional valve **350**. The delivery vent **388** has a slot or groove opening exposed towards the inside of the container flask system **300**. As the inner diaphragm **322** inflates it pushes against the slot or groove opening in the delivery vent **388** and makes a contact seal that allows the delivery vent **388** to act as an evacuation tube and to evacuate the air inside the flask container system **300** from the section of the delivery vent **388** where the inner diaphragm is sealing the slot or groove opening. As a result the delivery vent **388** extends only as far as the inner diaphragm **322** so that the air is expelled from inside the flask container system **300**, up the delivery vent **388** and out of the container system **300**. Thus, the air travels via the delivery vent **388** to the first one-way conditional valve **350** and out the container flask system **300**. This embodiment ensures that the air is always evacuated as the inner diaphragm **322** is expanded from the unexpanded point, until the inner diaphragm **322** has expanded to the interface between the air and liquid **380**. In this manner, no air is trapped in the container flask system **300**. In an embodiment of the invention, once the liquid **380** starts traveling up the delivery vent **388**, the force being applied to generate the pumping can be stopped. In another embodiment of the invention, the pumping can be stopped as the first drop of liquid **380** is exiting the first one-way valve. In an alternative embodiment, the one-way valve can be chosen so that it can only be traversed by air and not by liquid **380**. In these embodiments, the conditional one-way valves **330**, **335** and **350** allow air to be vented into the container or air vented out of the void compartment wherein the container and diaphragms can be cleaned and available for re-use.

[0066] As depicted in FIGS. **3**F-**3**H in various embodiments of the invention, there is no constraint on the direction on the pump. In an embodiment of the invention, the outer diaphragm **340** does not overlap with the inner diaphragm **322**. In an embodiment of the invention, the outer diaphragm **340** can be placed on top of the first one-way conditional valve **350** and the pumping action can suck the air out of the container flask system **300** while forcing an inner diaphragm **322** to expand into the container flask system **300** from a different position within the flask container system **300**. In this embodiment, a third one-way valve is located to connect the inner diaphragm with the flask **310** and allow air to enter the void compartment **385** and the inner diaphragm **322**. In this embodiment, to expand the inner diaphragm **322** and remove the air from inside the container **300**, the outer diaphragm **340** is depressed and the air is forced out the first one-way conditional valve **350**, after releasing the force from the outer diaphragm **340**, air is sucked into the container through the third one-way valve **335** to extend the inner diaphragm **322** into the container **300** in place of the air that is pumped out the second one-way valve **350**. The pumping can occur as the user releases the pressure from the outer diaphragm **340** and it flexes back outwards. In this embodiment of the invention, the first one-way valve **350** will allow air to leave the container only, while the second one-way valve **335** will be "in only". The inner flexible diaphragm **322** can be located anywhere on the container rim, bottom, handle or the periphery. In an embodiment of the invention, the pump can be located on the screw cap **382** and the inner diaphragm **322** can extend inwards from the bottom as a trunk **323** that has a softer bulbous inner diaphragm **322**, while the liquid **380** remains at the bottom replacing the air from the upper part of the container flask system **300**.

[0067] In an embodiment of the invention (see FIGS. **3**F-**3**H) the gas or liquid can also be stored at the top of the flask container system. In an embodiment of the invention, the inner diaphragm **322** can be positioned at the bottom of the container flask system **300** such that the gas or liquid **380** can be forced upwards (towards the top of the container flask system **300**) as the air is evacuated out of the container flask system **300**.

[0068] In various embodiments of the invention, (see FIGS. **3**J and **3**K) the flexible properties of the container can be used as the pumping method and the modulation of its volume will force the liquid out of the inner diaphragm and the flask container system **300**. In an embodiment of the invention, the container flask system **300** can be squeezed to force a gas or liquid **380** out of the container flask system **300** and an inner diaphragm **322** can be filled with air to compensate for the volume of the gas or liquid **380** expelled. In this embodiment of the invention, the flexible properties of the container can be used as the pumping method and the modulation of its volume will force the gas or liquid **380** out of the flask container system **300**. Releasing the grip on the flask container system **300** can allow air into the inner diaphragm **322** container void space **385**. Applying pressure on the container flask system **300** at any point (sides, bottom, handle or cap) can reduce the inner volume of flask container system **300** and force some gas or liquid **380** out the first one-way conditional valve **350** and dispensed out the spout **386**. As the container flask system **300** flexes back to its original position, the inner diaphragm **322**, which can be located anywhere on the container flask system **380**, expands inwards, as the container flask system **300** expands back outwards. The increase in the inner diaphragm **322** can be commensurate with the increase in volume of the container flask system **300**. The second one-way conditional valve **330** ensures that the inner diaphragm **322** cannot deflate backwards as the pressure is reapplied and the flask container system **300** is squeezed again to force more liquid **380** out of the flask container system **300**. Thus, the air in the container void space **385** between outer diaphragm **340** and the inner diaphragm **322** cannot be forced out the second one-way conditional valve **330** since this valve only allows air to flow into the container void space **385**. In this embodiment, an outer diaphragm is not required. In an alternative embodiment, the flask **310** acts as an outer diaphragm. In various embodiments of the present invention, the system prevents contact between the gas and/or liquid **380** with air, prior to the gas and/or liquid being dispersed from the container flask system **300**.

[0069] FIGS. **4**A and **4**B are schematic diagrams of cross-sectional views of a container flask system **400** where a gas or liquid **480** is stored inside an inner diaphragm **422** in the container flask system **400** and where pressing on the sides of the flask container system **400** forces the gas or the liquid **480** out of the container flask system **400**. FIGS. **4**A and **4**B show a cross-section of a vacuum container flask system **400** with an outer diaphragm **440** connected with a hermetic seal to one or both the flask rim **370** and the flask **310** and an inner diaphragm **422** connected with a hermetic seal to the first one-way valve **450**. Alternatively, the t one-way valve can be located at the spout exit **43** or anywhere along the spout **46** (in an alternative embodiment of the invention, a first one way conditional valve can be located at the exit of the container **450**, and a probe can be inserted up the spout to activate the valve). The first one-way valve **450** allows liquid or gasses **480** to leave the inner diaphragm **422** only while air can enter the container flask system **300** through a second one way valve **430**. The second one-way valve **430** can be located at the top of the container flask system **300** in the center of the outer diaphragm **440** or anywhere associated with the outer diaphragm **440**. The liquid and/or gas **380** to be dispensed (or a solid which liquefies or sublimes) can be stored in the inner membrane **422**. A delivery vent **488** that extends to the bottom of the container **489** can run up the side of the vacuum container flask system **300** and can be connected to the spout **486** through the opening **450**. In an embodiment of the invention, an optional third valve can be used to control flow out of the opening **483**.

[0070] In an embodiment of the invention, the liquid can be stored inside an inner diaphragm **422**, which is contained inside a container flask system **400**. Applying pressure to the container by squeezing the container **410** or pressing the outer diaphragm **440** either directly applies pressure to the inner diaphragm **422** or alternatively applies pressure by compressing the air in the container flask system **400** which then applies pressure to the inner diaphragm **422** to force the liquid **480** out of the inner diaphragm **422**. When the pressure is withdrawn, air is allowed to travel inwards via the second one-way valve **430** (in only) to accommodate the volume of gas or liquid **480** that was expelled from the inner diaphragm **422**. This can be done repetitively until the inner diaphragm **422** is completely empty and the air inside the container flask system **400** fills the volume of the container flask system **400**. The first one-way valve **450** (out only) ensures that air cannot flow back into the inner diaphragm **422**.

[0071] In FIG. **4**A the inner diaphragm **422** has been significantly extended and the first compartment **480** is large. This would correspond with the situation before a significant amount of the container contents had been dispensed. In FIG. **4**B the inner diaphragm **422** has been reduced and the first compartment **480** is small. This would correspond with the situation after a significant amount of the container contents had been dispensed.

[0072] In various embodiments of the invention, the one-way valves can be non-conditional. In an embodiment of the invention, the container flask system can be disposable, in which case it can be unopened and so the inner diaphragm is not released.

[0073] In various embodiments of the invention, the first, the second and/or the third conditional one-way valve can be replaced by a series of conditional one-way valves. In various embodiments of the invention, either the first, the second and/or the third conditional one-way valve can be replaced by a series of simple tube, where by closing the tube at an appropriate point in time the tube acts as a one way valve. In various embodiments of the invention, the container can be round or spherical. In other embodiments of the invention, the container rim and bottom can be round and the sides can be planar and contour to the shape of the rim and bottom. In various embodiments of the invention, the shape of the container can be elliptical or ovaloid. In other embodiments of the invention, the container rim and bottom can be an ellipse or an oval and the sides can be planar and contour to the shape of the rim and bottom. In various embodiments of the invention, the rim and bottom can be of equal dimension and the sides can vertically contour to the rim and bottom. In other embodiments of the invention, the rim can exceed the dimension of the bottom and the sides can be planar and adjust to the differing contours of the rim and bottom. In other embodiments of the invention, the bottom can exceed the dimension of the rim and the sides can be planar and adjust to the differing contours of the rim and bottom. In various embodiments of the invention, the container can be square, rectangular, trapezoid or any other shape.

[0074] In an embodiment of the present invention, the inner flexible diaphragm **322** can be made of multiple disposable layers that will enable reuse of a lid and diaphragm with a new inner diaphragm by simply discarding the old contaminated inner diaphragm **322**. In an embodiment of the present invention, rims with the one or more inner diaphragms **322** can be designed for existing containers. In an alternative embodiment of the present invention, the product can be designed as a rim for existing containers or as a new container with a new rim.

[0075] In another embodiment of the present invention, the inner and outer diaphragms can be made as one organelle that will clip into a preexisting slot that is prepared on the rim. This may serve to simplify assembly and circumvent the use of glue or other adhesives that can be sensitive to high temperatures applied in the cleaning/washing process. In various embodiments of the present invention, the rim and container can be microwave-friendly. Since gasses can leave the container through the one or the one way valves, a simple microwave heating can result in the release of gasses rather than causing the lid to 'pop off' as happens with other sealed containers. In an embodiment of the invention, the temperature of the substance can be visualized by the position of the inner diaphragm while the food stored in the container is being heated.

[0076] In an embodiment of the invention, (see FIG. **3**) when food needs to be stored the user will close the rim **370** and cause a force to be exerted on the outer diaphragm **340** one or more times. The two one-way valves **330** and **350** will create a simple pump that will suck out gasses around the food in the container and can bring the inner flexible diaphragm into contact with the stored food. In order to open the container **300**, the user will release the vacuum via the conditional valve **330** and simply open the container. Subsequently, the conditional one-way valve **350** can be pressed to release the air pressure and flex the inner membrane back to its original position.

[0077] An advantage of the invention is that it allows storage of remaining food after a meal for better preservation either in 4° C. or at any other temperature. Alternately the container can be utilized to store food in the form of a lunch box or as carryout for take-away food, picnics, travel and catering. The container can also be used to store tissue samples and other liquids or gasses that can be sensitive to oxidation or excessive moisture. The container can be used to store food liquids such as juice, wine and milk to minimize the oxidation of the food liquid via air contact. The container can be used to store other liquids such as cell growth media and minimize the oxidation of the media via air contact. The container can also be used as a convenient method to store gasses to avoid mixing or dispersal of the gas with the atmosphere.

[0078] When food is to be stored in the refrigerator after a meal, a container just big enough to accommodate the food, but not too big, is advantageous so that the minimal amount of air is trapped with the food. However, this requires different size containers. Different size containers are not suitable for stacking and often result in clutter in a storage compartment or refrigerator. In an embodiment of the invention, a standard size container can be used to enable storage of food in vacuum conditions for better preservation and extension of shelf life under both a commercial as well as a domestic household setting. The base and rim and/or lid of the containers are made so that it is possible to stack one container on top of another to make best use of the space available for storage.

[0079] Pyrotechnic devices combine high reliability with very compact and efficient energy storage, in the form chemical energy which is converted to expanding hot gases either through deflagration or detonation. The controlled action of a pyrotechnic device (initiated by any of several means, including an electrical signal, optical signal or mechanical impetus) can initiate a wide range of automated and/or remote mechanical actions. For example, deployment of a pump to deliver a substance for safety equipment and services. The employment of a pump to deliver a substance for a precisely timed release sequences can also be controlled by a pyrotechnic device. In various embodiments of the invention, technical pyrotechnic devices use propellants in their function. In an embodiment of the invention, technical pyrotechnic devices use primary or secondary explosives to obtain very fast and powerful mechanical actions. In an embodiment of the invention, a pyrotechnic device uses propellants to obtain cutting actions.

[0080] In an embodiment of the invention, the force acting on the outer membrane can be generated by a mammal. In an alternative embodiment of the invention, the force acting on the outer membrane can be generated by a natural force. In another embodiment of the invention, the force acting on the outer membrane can be generated by a motor or a pyrotechnic device.

[0081] The inner diaphragm and the outer diaphragm form an organelle which can be releasably received in the inner circumference of the rim when the organelle can form a vacuum fit with the rim, which can subsequently be detached from the rim. In an embodiment of the present invention, the organelle can form a vacuum fit with the rim, which can subsequently be detached from the rim and then re-attached to the rim.

[0082] In an embodiment of the invention, a device for minimizing exposure of a substance to one or more reactants comprises a container, a rim and a first one-way conditional valve, wherein the substance is inserted into the container. The rim has a first perimeter, wherein when the rim is attached to the container the first perimeter of the rim forms a first vacuum seal with the container. The flexible inner diaphragm forms a second vacuum seal with the container, wherein two or more of the container, the rim and the inner diaphragm form a vacuum-sealed first compartment containing the substance. The first one-way conditional valve allows a gas containing the one or more reactants inside the first compartment to be displaced outside of the first compartment thereby adjusting the first compartment volume, wherein the flexible inner diaphragm changes to occupy the adjusted first compartment volume.

[0083] A storage system comprising a rim, wherein the rim has an inner circumference and an outer circumference, wherein the outer circumference forms a vacuum seal with a container. An inner diaphragm, wherein the inner diaphragm forms a vacuum seal with the inner circumference of the rim. A first one-way conditional valve which allows gas to pass from inside the container through the first one-way conditional valve out of the container, wherein when a force is applied to the inner diaphragm, air inside the container is forced out the first one-way conditional valve, thereby reducing the air in the storage system, wherein pressing the first one-way conditional valve allows air to pass from outside the container through the first one-way conditional valve into the container, thereby allowing the rim to be removed from the container and the storage system to be accessed.

[0084] A preservation storage system comprising a rim, wherein the rim has an inner circumference and an outer circumference, wherein the outer circumference forms a hermetic seal with a container. An inner diaphragm, wherein the inner diaphragm forms a hermetic seal with the inner circumference of the rim. A first one-way conditional valve which allows gas to pass from inside the container through the first one-way conditional valve out of the container, wherein when a force is applied to the inner diaphragm, air inside the container is forced out the first one-way conditional valve thereby reducing the air in the storage system, wherein pressing the first one-way conditional valve allows air to pass from outside the container through the first one-way conditional valve into the container thereby allowing the rim to be removed from the container and the storage system to be accessed.

[0085] The preservation storage system, wherein replacing the rim on the container and re-applying a force to the inner diaphragm re-evacuates air out of the storage system. The preservation storage system, wherein the first one-way conditional valve comprises a plurality of one-way conditional valves. The preservation storage system, wherein a portion of the container is made transparent to allow the position of the inner membrane to be observed. The preservation storage system, wherein the force moves the inner diaphragm to touch an oxidation- or moisture-sensitive substance placed in the storage system. The preservation storage system, wherein the oxidation- or moisture-sensitive substance is food.

[0086] The preservation storage system, wherein an air-tight seal is formed in the container through the action of the force applied. The preservation storage system, further comprising a plurality of inner diaphragms to allow two or more substances to be successively stored without cross-contamination of the two or more substances, wherein each of the plurality of inner diaphragms independently forms a vacuum seal with the inner circumference of the rim, wherein a first inner diaphragm is one of the plurality of inner diaphragms positioned distal to the outer diaphragm and the second inner diaphragm is one of the plurality of inner diaphragms positioned next to the first inner diaphragm, wherein a first vacuum is formed in the re-sealable food system with a first substance, wherein after the vacuum has been released the first inner diaphragm can be removed, exposing the second inner diaphragm, wherein a second vacuum is formed in the re-sealable food system with a second substance.

[0087] The preservation storage system, further comprising an outer diaphragm, wherein the outer diaphragm forms a vacuum seal with one or both the inner circumference of the rim and the inner diaphragm, wherein when a force is applied to the outer diaphragm, the force moves one or both the outer diaphragm and the inner diaphragm inside the container thereby forcing the air inside the container out the first one-way conditional valve and thereby reducing the air in the storage system. The preservation storage system, further comprising a second one-way conditional valve associated with the outer diaphragm, wherein the second one-way conditional valve allows gas to pass from outside the container through the second one-way conditional valve into the container void space between the inner diaphragm and outer diaphragm, wherein, when the second conditional one-way valve is depressed, gas can travel from the container void space between the outer diaphragm and the inner diaphragm through the second conditional one-way valve and exit outside the container. The preservation storage system, wherein a vacuum is formed in the container through the action of the force being applied to the outer membrane and then released one or more times. The preservation storage system, wherein replacing the rim on the container and applying a force reseals the storage system. The preservation storage system, wherein the second one-way conditional valve comprises a plurality of one-way conditional valves.

[0088] The preservation storage system, wherein the inner diaphragm and the outer diaphragm form an organelle which can be releasably received in the inner circumference of the rim. The preservation storage system, wherein the container is evacuated to a vacuum of between a lower limit of approximately 1×10^2 Torr and an upper limit of approximately 7×10^2 Torr. In an embodiment of the invention, the container of the preservation storage system is evacuated to a vacuum of between a lower limit of approximately 1×10^1 Torr and an upper limit of approximately 5×10^2 Torr. The preservation storage system, wherein the container can be placed in a microwave oven and heated, wherein volatile gasses formed from heating a substance in the storage system exit the container through the first one-way conditional valve. The preservation storage system, wherein the position of the inner diaphragm is used as an indicator of the temperature of the substance while the container is being heated in the microwave oven.

[0089] A rim for use with a food storage container, wherein the rim has an outer circumference, an opening and an inner circumference, wherein the outer circumference forms a vacuum seal. The food storage container further comprising an inner diaphragm, wherein the inner diaphragm forms a vacuum seal with the inner circumference of the rim. A first one-way conditional valve which allows gas to pass from inside the food storage container through the one-way conditional valve out of the food storage container, wherein, when the first one-way conditional valve is depressed, gas can traverse from outside the food storage container into the food storage container. An outer diaphragm, wherein the outer diaphragm forms a vacuum seal with one or both the inner circumference of the rim and the inner diaphragm, wherein when a force is applied to the outer diaphragm, the force moves one or both the outer diaphragm and the inner diaphragm inside the food storage container forcing the air inside the food storage container out the first one-way conditional valve and thereby forming a vacuum in the food storage container, wherein pressing the first one-way conditional valve allows gas to pass from outside the container through the first one-way conditional valve into the food storage container releasing the vacuum. A second one-way conditional valve associated with the outer diaphragm, wherein the second one-way conditional valve allows gas to pass from outside the container through the second one-way conditional valve into the container void space between the inner diaphragm and outer diaphragm, wherein, when the second conditional one-way valve is depressed, gas can travel from the container void space between the outer diaphragm and the inner diaphragm through the second conditional one-way valve and exit outside the container.

[0090] A method of preserving a food in a container, comprising: place the food in the container. Attach a rim to the container, wherein the rim includes an inner diaphragm, wherein the inner diaphragm forms a vacuum seal with the rim. A first one-way conditional valve. An outer diaphragm, wherein the outer diaphragm forms a vacuum seal with one or both the rim and the inner diaphragm. A second one-way conditional valve associated with the outer diaphragm. Apply a force to the outer diaphragm, wherein the force acts on both the outer diaphragm and the inner diaphragm moving the inner diaphragm towards the food in the container, wherein air in the container is forced out the first one-way conditional valve. Remove the force, wherein the outer diaphragm returns to its original position and air is drawn through the second conditional one-way valve into the container void between the outer diaphragm and the inner diaphragm. Repeat applying the force and removing the force until the desired amount of air has been forced out of the container. Store the container at a desired temperature to maximize preservation of the food. The method of preserving food in a container, wherein the container is at least partially transparent and applying the force and removing the force are repeated until no change in the position of the inner diaphragm with respect to the food is observed.

[0091] Example embodiments of the methods, systems, and components of the present invention have been described herein. As noted elsewhere, these example embodiments have been described for illustrative purposes only, and are not limiting. Other embodiments are possible and are covered by the invention. Such embodiments will be apparent to persons skilled in the relevant art(s) based on the teachings contained herein. For example, it is envisaged that, irrespective of the actual shape or position depicted in the various Figures and embodiments described above, the rim and container or the diaphragms and the rim can form any of a variety of vacuum connections.

[0092] Thus, the breadth and scope of the present invention should not be limited by any of the above-described exemplary embodiments, but should be defined only in accordance with the following claims and their equivalents.

1-5. (canceled)

6. A method of preserving a substance in a container, comprising:

i. placing the substance in the container;

ii. attaching a rim to the container, wherein the rim forms a first vacuum seal with the container, and wherein the rim comprises:

an inner diaphragm, wherein the inner diaphragm forms a second vacuum seal with the container, and wherein two or more of the container, the rim and the inner diaphragm form a vacuum sealed first compartment in which the substance is enclosed;

a first one-way valve; and

iii. evacuating gas that is contained in the vacuum-sealed first compartment out through the first one-way valve;
iv. repeating said evacuating up to the point in which the current level of the volume of the vacuum-sealed first compartment closely equals the level measured prior to the current step of evacuating;
v. storing the container at a desired temperature to maximize preservation of the substance.

7. The method of preserving a substance of claim **6**, wherein the container is at least partially transparent and step iv of claim **6**, is substituted with the following step:
iv'. repeating said evacuating until no change in the position of the inner diaphragm with respect to the substance is observed.

8. A system for one or both isolating and a ring a substance comprising:
a container for receiving substance;
a rim, wherein the rim comprises
a first perimeter, wherein when the rim is attached to the container the first perimeter of the rim forms a first vacuum seal with the container;
a flexible inner diaphragm, wherein the flexible inner diaphragm forms a second vacuum seal with the container, and wherein two or more of the container, the rim and the inner diaphragm form a vacuum-sealed first compartment for containing the substance, and
a first one-way valve which allows gas to pass from inside the vacuum-sealed first compartment through the first one-way valve out, and
means for evacuating gas from said vacuum sealed first compartment.

9. A storage system for dispensing one or more gasses and liquids comprising:
a container, wherein the container has an outside surface, and wherein the container is flexible, and wherein the container has a volume at standard temperature and pressure;
an inner diaphragm, wherein the inner diaphragm is at least partially placed inside the container, wherein the inner diaphragm divides the volume of the container into a first compartment and a container void compartment, and wherein the first compartment provides for enclosing the one or more gasses and liquids;
a first one-way valve which allows air to pass from outside the container through the first one-way valve into the container void compartment; and
means for evacuating which include at least a second one way valve, wherein the second one way valve allows one or both the gases and the liquids to exit the container, when the outside surface is inwardly forced thereby compressing the one or more gasses and liquids inside the first compartment to be dispensed out the second one-way valve.

10. A system as in claim **8**, wherein said rim is releasably attached to said container.

11. A system as in claim **10**, wherein said means for evacuating include at least another one-way valve, which is the second one way valve and is different from said first one way valve, and wherein said another one-way valve allows air to pass from outside the container through said another one-way valve into a container void space in the container, wherein a respective inner diaphragm separates additional compartment, which is different from said first compartment, from the container void compartment.

12. A system as in claim **8**, wherein said means for evacuating include at least a third one-way valve, wherein the third one-way valve allows air to pass from outside the container through the third one-way valve into a container void space in the container, wherein the inner diaphragm separates the first compartment from the container void compartment.

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