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### Double chamber device for point of use mixing

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#### Abstract

Disclosed is a double chamber container. The first chamber comprises a stopper coupled to a first end and a cover coupled to a second end. The second chamber comprises a plunger coupled to one end and an open second end. The first chamber is coupled to the second chamber such that the first end of the first chamber is coupled to the second end of the second chamber.

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## Background/Summary

REFERENCE TO RELATED APPLICATIONS (1) This application is a continuation of U.S. application Ser. No. 16/043,400 filed Jul. 24, 2018, which issued as U.S. Pat. No. 10,981,129 on

## BACKGROUND

### 1. Field of the Invention

(1) The invention is directed to a container for holding two matters. In particular, the invention is directed to a container for separately holding two matters to be mixed at the point of use.

### 2. Background of the Invention

(2) In many industries two or more matters need to be maintained separately until the point of use for a variety of reasons. Matters can include solids, liquids, or gasses. For example, certain epoxies are made by mixing two components at the time of use. If the components are mixed prematurely, the epoxy might harden prior to application. Similarly, to obtain better potency, certain medical drugs are preferably mixed at the time of administration. If the drug components are mixed prematurely, the drug may not have the desired effect. Furthermore, the mixed drug may degrade when exposed to air. Another example is in the food industry where if ingredients are mixed too early, the taste or freshness may degrade to undesirable levels prior to consumption.

(3) Therefore, there is a need for a container that can maintain two components separately until the desired time and location for mixing the components. Additionally, it is desirable to be able to mix the components without exposing them to the environment.

## SUMMARY OF THE INVENTION

(4) The present invention overcomes the problems and disadvantages associated with current strategies and designs and provides new tools and methods of maintaining two components separately until the point of use.

(5) One embodiment of the invention is directed to a double chamber container. The container comprises a first chamber, the first chamber comprising a stopper coupled to a first end and a cover coupled to a second end, the first chamber adapted to hold a first matter. The container further comprises a second chamber, the second chamber comprising a plunger coupled to one end and an open second end, the second chamber adapted to hold a second matter separate from the first matter. The first chamber is coupled to the second chamber such that the first end of the first chamber is coupled to the second end of the second chamber. As the plunger is depressed, the second matter is forced into the first chamber and is mixed with the first matter.

(6) In a preferred embodiment, the first chamber further comprises at least one side channel. Preferably, the at least one side channel is adapted to allow fluid to flow around the stopper when the stopper is adjacent to the at least one side channel. The first and second chambers are preferably coupled together with an ultrasonic seal. Preferably, the cover is a luer-lock tip and the luer-lock tip is adapted to receive a needle or a dispensing tip. Preferably, the double chamber container is a single use device. In a preferred embodiment, cover is a self-healing stopper and the self-healing stopper is adapted to be pierced by a needle multiple times. Preferably, double chamber container is a multi-use device.

(7) In a preferred embodiment, the first chamber contains a first matter and the second chamber contains a second matter, wherein the first matter and the second matter mix upon the plunger forcing the second matter through the second chamber, into the stopper, and moving the stopper and the second matter into the first chamber. Upon mixing, the contents of the container is preferably a vaccine, a medication, or an epoxy. Preferably, the first matter is a lyophilized material and the second matter is a liquid diluent. Preferably, the contents are sealed from exposure to the environment.

(8) Another preferred embodiment is directed to a method of assembling a double chamber container. The method comprises the steps of inserting a stopper into a first end of a first chamber, filling the first chamber with a first matter, coupling a cover to a second end of the first chamber, inserting a plunger into a first end of a second chamber, filling the second chamber with a second

matter, and coupling the first end of the first chamber to a second end of the second chamber.

(9) Preferably the method further comprises processing the first matter prior to coupling the first and second chambers. In a preferred embodiment, the processing is a lyophilizing process. Preferably, the coupling step is comprised of ultrasonic sealing. Preferably, the cover is a luer-lock tip and the luer-lock tip is adapted to receive a needle or a dispensing tip. The double chamber container is preferably a single use device. In a preferred embodiment, the cover is a self-healing stopper and the self-healing stopper is adapted to be pierced by a needle multiple times. Preferably, the double chamber container is a multi-use device.

(10) Other embodiments and advantages of the invention are set forth in part in the description, which follows, and in part, may be obvious from this description, or may be learned from the practice of the invention.

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## **Description**

### **DESCRIPTION OF THE DRAWINGS**

- (1) The invention is described in greater detail by way of example only and with reference to the attached drawing, in which:
- (2) FIG. 1 depicts an exploded view of an embodiment of a single dose container.
- (3) FIG. 2 depicts a cut-away view of an embodiment of one chamber of the container shown in FIG. 1.
- (4) FIG. 3 depicts a cut-away view of an embodiment of a second chamber of the container shown in FIG. 1.
- (5) FIG. 4 depicts a cut-away view of an embodiment of the assembled container shown in FIG. 1.
- (6) FIG. 5A depicts a cut-away view of an embodiment of filling the first chamber of the container shown in FIG. 1 with the stopper inserted into chamber.
- (7) FIG. 5B depicts a cut-away view of an embodiment of filling the first chamber of the container shown in FIG. 1 with the luer-lock tip partially placed on the chamber.
- (8) FIG. 5C depicts a cut-away view of an embodiment of filling the first chamber of the container shown in FIG. 1 with the luer-lock tip fully placed on the chamber.
- (9) FIG. 6A depicts a view of the container shown in FIG. 1 in use with the plunger not depressed.
- (10) FIG. 6B depicts a view of the container shown in FIG. 1 in use with the plunger depressed.
- (11) FIG. 7A depicts a view of an embodiment of a multi dose container.
- (12) FIG. 7B depicts an exploded view of an embodiment of a multi dose container.
- (13) FIG. 8A depicts a cut-away view of an embodiment of filling the first chamber of the container shown in FIG. 7 with the stopper removed.
- (14) FIG. 8B depicts a cut-away view of an embodiment of filling the first chamber of the container shown in FIG. 7 with matter inserted into the chamber.
- (15) FIG. 8C depicts a cut-away view of an embodiment of filling the first chamber of the container shown in FIG. 7 with the stopper inserted.
- (16) FIG. 9A depicts a view of the container shown in FIG. 7 in use with the plunger not depressed.
- (17) FIG. 9B depicts a view of the container shown in FIG. 7 in use with the plunger depressed.

### **DESCRIPTION OF THE INVENTION**

(18) As embodied and broadly described herein, the disclosures herein provide detailed embodiments of the invention. However, the disclosed embodiments are merely exemplary of the invention that may be embodied in various and alternative forms. Therefore, there is no intent that specific structural and functional details should be limiting, but rather the intention is that they provide a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the present invention.

(19) A problem in the art capable of being solved by the embodiments of the present invention is

maintaining matters separately until the point of use. It has been surprisingly discovered that two or more abutting cups can be sealed together to create a container having compartments for multiple matters to be mixed at the point of use.

(20) FIG. 1 depicts an exploded side view of an embodiment of a single dose container **100**. Container **100** is preferably comprised of a first chamber **105** and a second chamber **110**. While two chambers or receptacles are shown, container **100** can be made of three or more chambers depending on the number of matters to be held separately. Each chamber **105** and **110** is preferably capable of holding a matter. For example, each chamber **105** and **110** can hold a liquid, solid, or gas. Additionally, each chamber **105** and **110** can hold a combination of matters. For example, each chamber **105** and **110** can hold two or more liquids, two or more solids, two or more gasses, or any combination of liquids, solids, and gasses. The matters can be a suspension, a colloid, a solution, or otherwise mixed. Moreover, upon mixing, the matters in chambers **105** and **110** can form a liquid, solid, gas, suspension, colloid, solution, or other mix. The matters in one or more of chambers **105** and **110** can be maintained under pressure, at atmospheric pressure, in a vacuum, or be unpressurized. Upon mixing, a chemical reaction may or may not occur. The contents of container **100** may have to be vigorously shaken to properly mix. The final mixture may be a vaccine, another medicine, an epoxy, a food, a drink, a cleaning product, or another mixture.

(21) Chambers **105** and **110** are preferably cylindrical tubes with openings at each end. However, outer chambers **105** and **110** can have another shape, for example a cuboid, a cone, a pyramid, or another shape. Furthermore, chambers **105** and **110** may be the same or different shapes. Chambers **105** and **110** may be able to contain the same volume or different volumes.

(22) Chambers **105** and **110** are preferably a plastic material molded into the desired shape. For example, chambers **105** and **110** can be roto-molded, injection molded, blow molded, or welded together. However, chambers **105** and **110** can be made of one or more different materials. For example, glass, metals, fabrics, rubbers, woods, or other natural or manmade materials. The choice of material may depend on the intended contents of chambers **105** and **110**. In certain embodiments, the interior surface of chambers **105** and **110** may be coated. For example, the surface may be coated with plastic, wax, or another material that will not interact with the intended contents of the chamber. Chambers **105** and **110** may be of the same material or different materials.

(23) Chamber **105** preferably has one or more side channels **115** to promote fluid flow, as described herein. Furthermore, chamber **105** preferably has an end cap. In the embodiment shown in FIG. 1, end cap is preferably a luer-lock tip **120** adapted to receive a needle for injecting the solution or a plastic or rubber tip for oral delivery of the solution. Luer-lock tip **120** may be a female or male receptacle, additionally, luer-lock tip **120** may be vented. Preferably luer-lock tip **120** is adapted to fit over the end of chamber **105** and snap into place with tabs **125**. Tabs **125** may fit into slots or recesses **127** in chamber **105**. In other embodiments, luer-lock tip **120** may be secured by friction, threading, screws, bolts, adhesives, or other coupling devices.

(24) FIG. 2 depicts a cut away view of chamber **105**. Preferably, chamber **105** is filled with a matter **135**. In the preferred embodiment, matter **135** is a lyophilized (or freeze dried) material. However, matter **135** may be any liquid, solid, or gas. At the end of chamber **105** opposite the luer-lock tip **120**, preferably a stopper **130** is inserted. Preferably, stopper **130** has a diameter equal to the inner diameter of chamber **105** so that none of matter **135** leaks past stopper **130**. Additionally, the inner diameter of side channels **115** are preferably larger than the diameter of stopper **130** so that material can flow around stopper **130** when stopper **130** is adjacent to side channels **115**.

(25) FIG. 3 depicts a cut away view of chamber **110**. Preferably, chamber **110** is filled with a matter **140**. Preferably, matter **140** is a diluent, however, matter **140** may be any liquid, solid, or gas. Preferably chamber **110** has a plunger **145** positioned within one end and the second end is open. Plunger **145** preferably is a rod with a first end with a seal having a diameter equal to the inner diameter of chamber **110** so that none of matter **140** leaks past the seal and plunger **145** is able to push matter **140** out of chamber **110** into chamber **105**. The second end of plunger **145** preferably

has a top adapted to fit a finger or thumb.

(26) FIG. 4 depicts a cut away of the assembled container **100**. Preferably, chambers **105** and **110** are sealed together (for example using ultrasonic heating, laser welding, adhesive, screwed together, latches, bolts, brads, welds, or otherwise coupled) to create a water and/or air tight connection **150**. FIGS. 5A-C depict an embodiment of the steps of filling and sealing chamber **105**. In FIG. 5A, stopper **130** is preferably inserted into chamber **105**. Chamber **105** is then filled with matter **135**. In FIG. 5B, luer-lock tip **120** is preferably partially placed on chamber **105**. At this point, chamber **105** may be placed in a lyophilizer, a centrifuge, a sanitizer, or another device to process matter **135**. In other embodiments, matter **135** does not need processing. Once matter **135** is processed, in FIG. 5C, luer-lock tip **120** is fully seated onto chamber **105**, thereby sealing matter **135** within chamber **105**. Simultaneously or in succession, chamber **110** may have plunger **145** inserted therein and be filled with matter **140**. Once both chambers **105** and **110** are filled and any necessary processing is completed, the stopper end of chamber **105** is preferably placed over the open end of chamber **110** and the two chambers are sealed together.

(27) As shown in FIGS. 6A and 6B, in use, matters **135** and **140** are held separately in chambers **105** and **110**, respectively, until the time of use. At the time of use, plunger **145** is depressed and pushes matter **140** into stopper **130**. As plunger **145** continues to be depressed, stopper **130** is pushed adjacent to side channels **115**, which allows matter **140** to bypass stopper **130** and mix with matter **135**. Matters **135** and **140** may instantly combine to create mixture **155**, may combine within a specific timeframe, or may need to be shaken to combine. Once combined, plunger **145** can continue to be depressed thereby forcing mixture **155** out of container **100** through luer-lock tip **120** and into either a needle or another tip.

(28) FIGS. 7A and 7B depict exploded side views of an embodiment of a multi-dose container **700**. Container **700** is similar in construction to container **100** (similar numbers are used to indicate similar components). Container **700** is preferably comprised of a first chamber **705** and a second chamber **710**. While two chambers or receptacles are shown, container **700** can be made of three or more chambers depending on the number of matters to be held separately. Each chamber **705** and **710** is preferably capable of holding a matter. For example, each chamber **705** and **710** can hold a liquid, solid, or gas. Additionally, each chamber **705** and **710** can hold a combination of matters. For example, each chamber **705** and **710** can hold two or more liquids, two or more solids, two or more gasses, or any combination of liquids, solids, and gasses. The matters can be a suspension, a colloid, a solution, or otherwise mixed. Moreover, upon mixing, the matters in chambers **705** and **710** can form a liquid, solid, gas, suspension, colloid, solution, or other mix. The matters in one or more of chambers **705** and **710** can be maintained under pressure, at atmospheric pressure, in a vacuum, or be unpressurized. Upon mixing, a chemical reaction may or may not occur. The contents of container **700** may have to be vigorously shaken to properly mix. The final mixture may be a vaccine, another medicine, an epoxy, a food, a drink, a cleaning product, or another mixture.

(29) Chambers **705** and **710** are preferably cylindrical tubes with openings at each end. However, chambers **705** and **710** can have another shape, for example a cuboid, a cone, a pyramid, or another shape. Furthermore, chambers **705** and **710** may be the same or different shapes. Chambers **705** and **710** may be able to contain the same volume or different volumes.

(30) Chambers **705** and **710** are preferably a plastic material molded into the desired shape. For example, chambers **705** and **710** can be roto-molded, injection molded, blow molded, or welded together. However, chambers **705** and **710** can be made of one or more different materials. For example, glass, metals, fabrics, rubbers, woods, or other natural or manmade materials. The choice of material may depend on the intended contents of chambers **705** and **710**. In certain embodiments, the interior surface of chambers **705** and **710** may be coated. For example, the surface may be coated with plastic, wax, or another material that will not interact with the intended contents of the chamber. Chambers **705** and **710** may be of the same material or different materials.

(31) Chamber **705** preferably has one or more side channels **715** to promote fluid flow, as described herein. Furthermore, chamber **705** preferably has an end cap. In the embodiment shown in FIG. **7A**, end cap is preferably a pierceable stopper **720** adapted to be pierced by a needle for removing multiple doses. Stopper **720** may be rubber, cork, or another self-healing material. Preferably, stopper **720** is friction fit into chamber **705**, however, stopper **720** may be screwed, bolted, affixed with adhesive or otherwise coupled to chamber **705**. Preferably, stopper **720** is vented.

(32) As shown in FIGS. **8A-C**, preferably, chamber **705** is filled with a matter **735**. In the preferred embodiment, matter **735** is a lyophilized (or freeze dried) material. However, matter **735** may be any liquid, solid, or gas. At the end of chamber **705** opposite the stopper **720**, preferably a movable stopper **730** is inserted. Preferably, stopper **730** has a diameter equal to the inner diameter of chamber **705** so that none of matter **735** leaks past stopper **730**. Additionally, the inner diameter of side channels **715** are preferably larger than the diameter of stopper **730** so that material can flow around stopper **730** when stopper **730** is adjacent to side channels **715**.

(33) As shown in FIGS. **9A-B**, preferably, chamber **710** is filled with a matter **740**. Preferably, matter **740** is a diluent, however, matter **740** may be any liquid, solid, or gas. Preferably chamber **710** has a plunger **745** positioned within one end and the second end is open. Plunger **745** preferably is a rod with a first end with a seal having a diameter equal to the inner diameter of chamber **710** so that none of matter **740** leaks past the seal and plunger **745** is able to push matter **740** out of chamber **710** into chamber **705**. The second end of plunger **745** preferably has a top adapted to fit a finger or thumb. Preferably, the rod of plunger **745** is shorter than the rod of plunger **145**.

(34) Preferably, chambers **705** and **710** are sealed together (for example using ultrasonic heating, laser welding, adhesive, screwed together, latches, bolts, brads, welds, or otherwise coupled) to create a water and/or air tight connection **750**. FIGS. **8A-C** depict an embodiment of the steps of filling and sealing chamber **705**. In FIG. **8A**, stopper **730** is preferably inserted into chamber **705**. Chamber **705** is then filled with matter **735**. In FIG. **8B**, cover **720** is preferably partially placed on chamber **705**. At this point, chamber **705** may be placed in a lyophiliser, a centrifuge, a sanitizer, or another device to process matter **735**. In other embodiments, matter **735** does not need processing. Once matter **735** is processed, in FIG. **8C**, cover **720** is fully seated onto chamber **705**, thereby sealing matter **735** within chamber **705**. Simultaneously or in succession, chamber **710** may have plunger **745** inserted therein and be filled with matter **740**. Once both chambers **705** and **710** are filled and any necessary processing is completed, the stopper end of chamber **705** is preferably placed over the open end of chamber **110** and the two chambers are sealed together.

(35) As shown in FIGS. **9A** and **9B**, in use, matters **735** and **740** are held separately in chambers **705** and **710**, respectively, until the time of use. At the time of use, plunger **745** is depressed and pushes matter **740** into stopper **730**. As plunger **745** continues to be depressed, stopper **730** is pushed adjacent to side channels **715**, which allows matter **740** to bypass stopper **730** and mix with matter **735**. Matters **735** and **740** may instantly combine to create mixture **755**, may combine within a specific timeframe, or may need to be shaken to combine. Once combined, plunger **745** is preferably fully inserted into container **700** and cannot continue to be depressed. At this point, another syringe can be used to pierce cover **720** and withdraw one or more doses of mixture **755**.

(36) Preferably, containers **100** and **700** comply to medical grade standards. Containers **100** and **700** may be single-use disposable devices or may be reusable. Alternative, portions of containers **100** and **700** may be disposable and other portions may be reusable.

(37) Other embodiments and uses of the invention will be apparent to those skilled in the art from consideration of the specification and practice of the invention disclosed herein. All references cited herein, including all publications, U.S. and foreign patents and patent applications, are specifically and entirely incorporated by reference. It is intended that the specification and examples be considered exemplary only with the true scope and spirit of the invention indicated by

the following claims. Furthermore, the term “comprising of” includes the terms “consisting of” and “consisting essentially of.”

## Claims

1. A double chamber container, comprising: in a pre-use configuration: a first chamber adapted to hold a first matter and comprising a first end and a second end, wherein a stopper is positioned within the first end and a cover is coupled to the second end; a second chamber adapted to hold a second matter separate from the first matter and comprising a first end and a second end, wherein a plunger is coupled to the first end of the second chamber and the second end of the second chamber is open; and an ultrasonic seal coupling the first end of the first chamber to the second end of the second chamber; wherein, upon use, the plunger is adapted to displace the stopper toward the cover and force the second matter into the first chamber to mix with the first matter.
2. The double chamber container of claim 1, wherein the first chamber further comprises at least one side channel.
3. The double chamber container of claim 2, wherein the at least one side channel is adapted to allow fluid to flow around the stopper when the stopper is adjacent to the at least one side channel.
4. The double chamber container of claim 1, wherein, upon the first matter and the second matter mixing, a vaccine, a medication, or an epoxy is produced.
5. The double chamber container of claim 1, wherein the first matter is a lyophilized material and the second matter is a liquid diluent.
6. The double chamber container of claim 1, wherein contents of the first and second chambers are sealed from exposure to the environment.
7. A double chamber container, comprising: in a pre-use configuration: a first chamber adapted to hold a first matter and comprising a first end and a second end, wherein a stopper is positioned within the first end and a luer-lock tip is coupled to the second end; and a second chamber adapted to hold a second matter separate from the first matter and comprising a first end and a second end, wherein a plunger is coupled to the first end of the second chamber and the second end of the second chamber is open; wherein the first end of the first chamber is coupled to the second end of the second chamber; wherein, upon use, the plunger is adapted to displace the stopper toward the luer-lock tip and force the second matter into the first chamber to mix with the first matter; and wherein the luer-lock tip is adapted to receive a needle or a dispensing tip.
8. The double chamber container of claim 7, wherein the first chamber further comprises at least one side channel.
9. The double chamber container of claim 8, wherein the at least one side channel is adapted to allow fluid to flow around the stopper when the stopper is adjacent to the at least one side channel.
10. The double chamber container of claim 7, wherein the first and second chambers are coupled together with an ultrasonic seal.
11. The double chamber container of claim 7, wherein, upon the first matter and the second matter mixing, a vaccine, a medication, or an epoxy is produced.
12. The double chamber container of claim 7, wherein the first matter is a lyophilized material and the second matter is a liquid diluent.
13. The double chamber container of claim 7, wherein contents of the first and second chambers are sealed from exposure to the environment.
14. A double chamber container, comprising: in a pre-use configuration: a first chamber adapted to hold a first matter and comprising a first end and a second end, wherein a stopper is positioned within the first end and a self-healing stopper is coupled to the second end; a second chamber adapted to hold a second matter separate from the first matter and comprising a first end and a second end, wherein a plunger is coupled to the first end of the second chamber and the second end of the second chamber is open; and wherein the first end of the first chamber is coupled to the



second end of the second chamber; wherein, upon use, the plunger is adapted to displace the stopper toward the self-healing stopper and force the second matter into the first chamber to mix with the first matter; and wherein the self-healing stopper is adapted to be pierced by needles multiple times.

15. The double chamber container of claim 14, wherein the first chamber further comprises at least one side channel.

16. The double chamber container of claim 15, wherein the at least one side channel is adapted to allow fluid to flow around the stopper when the stopper is adjacent to the at least one side channel.

17. The double chamber container of claim 14, wherein the first and second chambers are coupled together with an ultrasonic seal.

18. The double chamber container of claim 14, wherein, upon the first matter and the second matter mixing, a vaccine, a medication, or an epoxy is produced.

19. The double chamber container of claim 14, wherein the first matter is a lyophilized material and the second matter is a liquid diluent.

20. The double chamber container of claim 14, wherein contents of the first and second chambers are sealed from exposure to the environment.

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