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(56) Documents Cited:
WO 2013/175288 A1 **WO 2013/166148 A1**
WO 2011/094578 A1 **US 6053400 A**
US 2034739 A **US 20120248127 A1**

(58) Field of Search:
INT CL **A47G, A47J, B01F, B65D**
Other: **WPI and EPODOC**

(54) Title of the Invention: **Mixing vessel for consumable substances**
Abstract Title: **Mixing vessel for consumable substances**

(57) A mixing vessel 200 for consumable substances comprising chamber 215 for receiving consumable substances for mixing and sealing member 210 having at least two stable spatial configurations to change a volume of the chamber wherein the sealing member is arranged to transition between the at least two stable spatial configurations on application of pressure generated within the chamber during mixing to increase the volume of the internal chamber. Ideally, the sealing member comprises a deformable diaphragm with an un-extended spatial configuration and an extended or expanded spatial configuration that increases the volume of the chamber. Ideally, the chamber is located within an outer wall 220 with a cavity 290 between the outer wall and the chamber. A method of using the vessel comprises adding first and second consumable substances to the chamber wherein at least one of the substances is a liquid, sealing the vessel with the sealing member and mixing the substances by shaking the vessel wherein mixing generates a pressure within the chamber that results in the sealing member transitioning from the first to the second spatial configuration with an expansion of the vessel volume. Ideally, the vessel mixes hot beverages. A method of manufacturing the vessel is also disclosed.

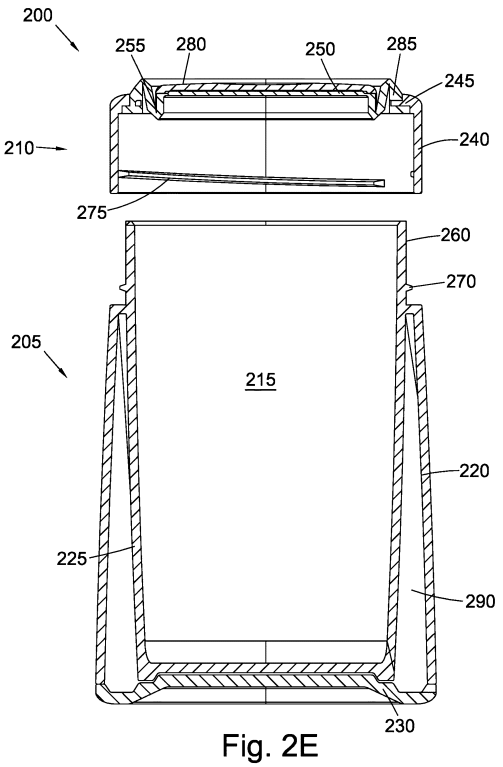

Fig. 2E

GB 2565813 A

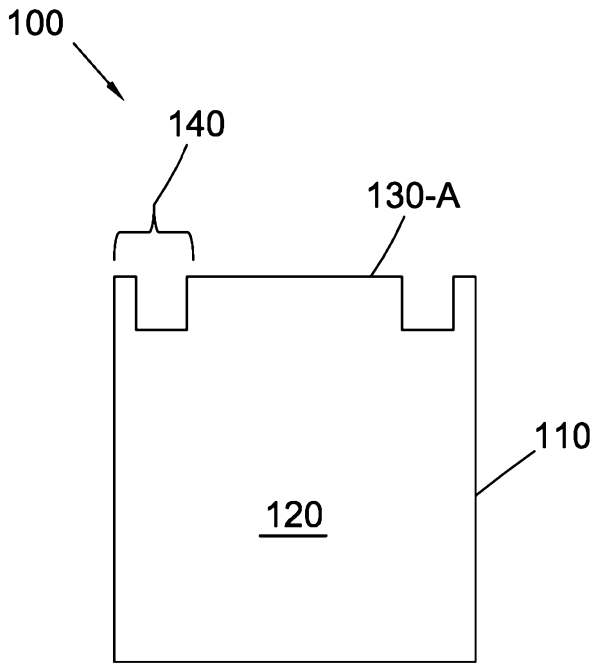

Fig. 1A

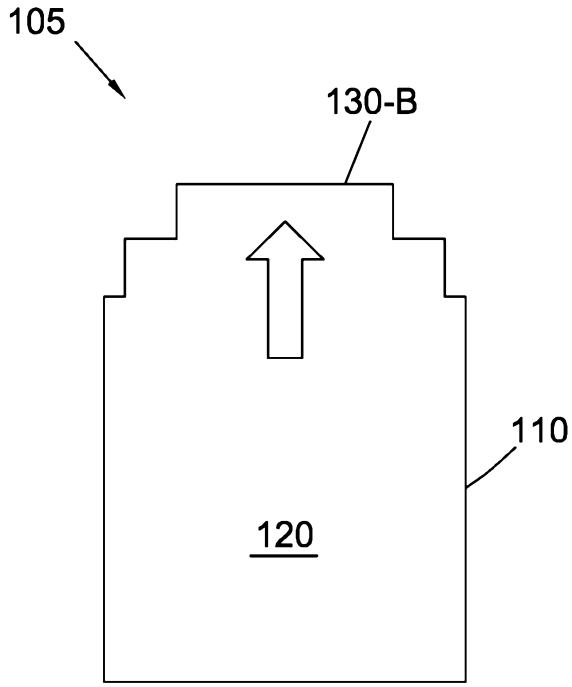

Fig. 1B

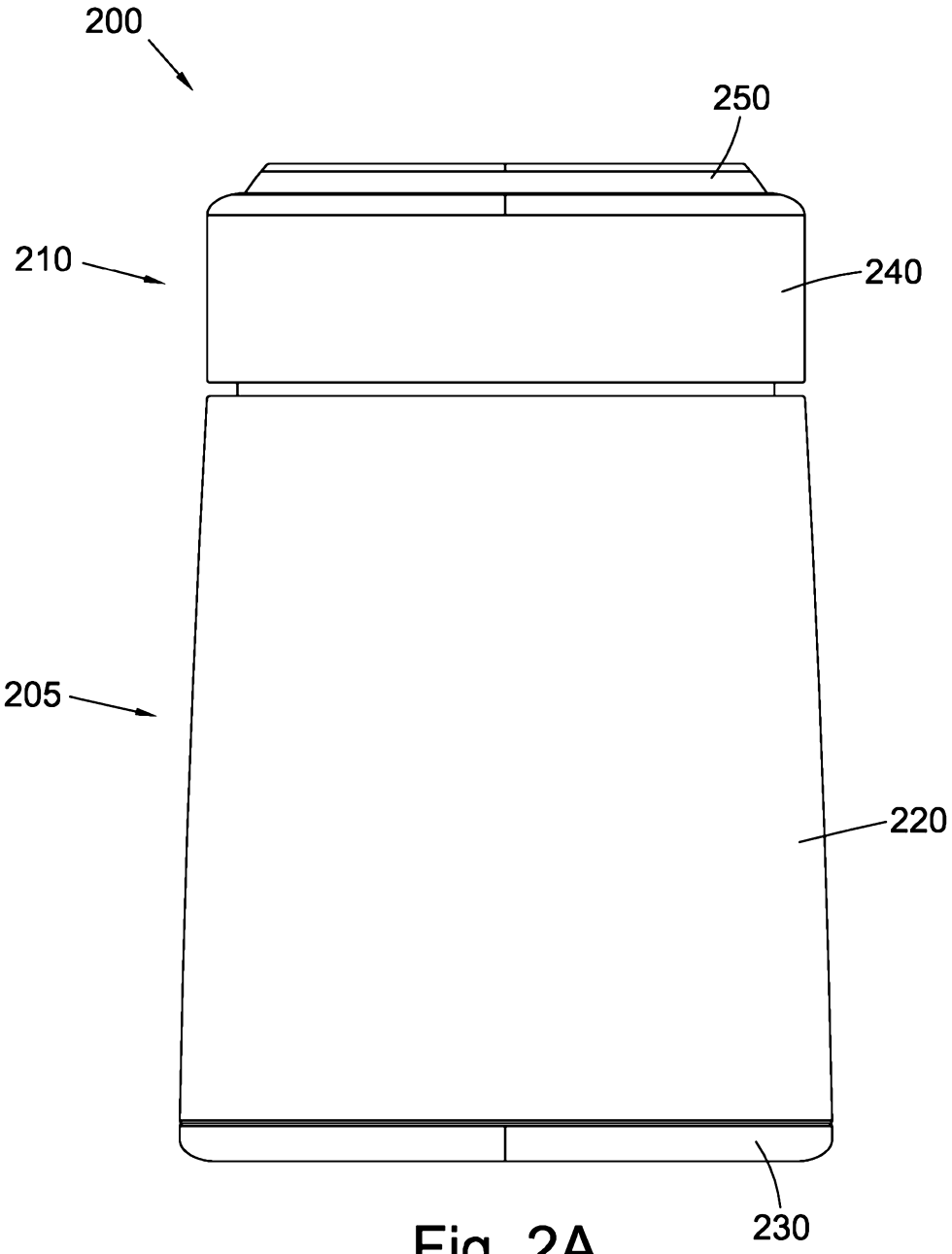

Fig. 2A

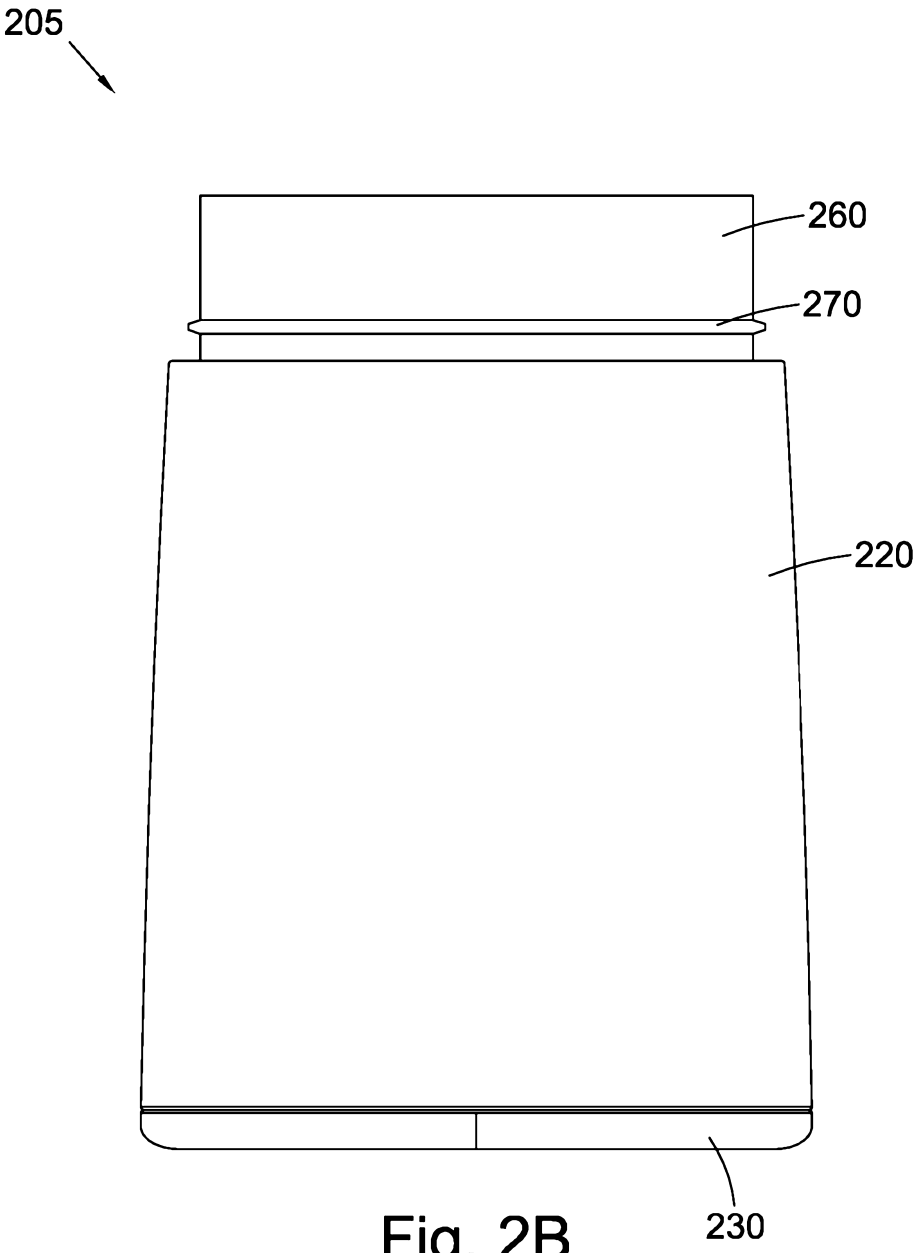

Fig. 2B

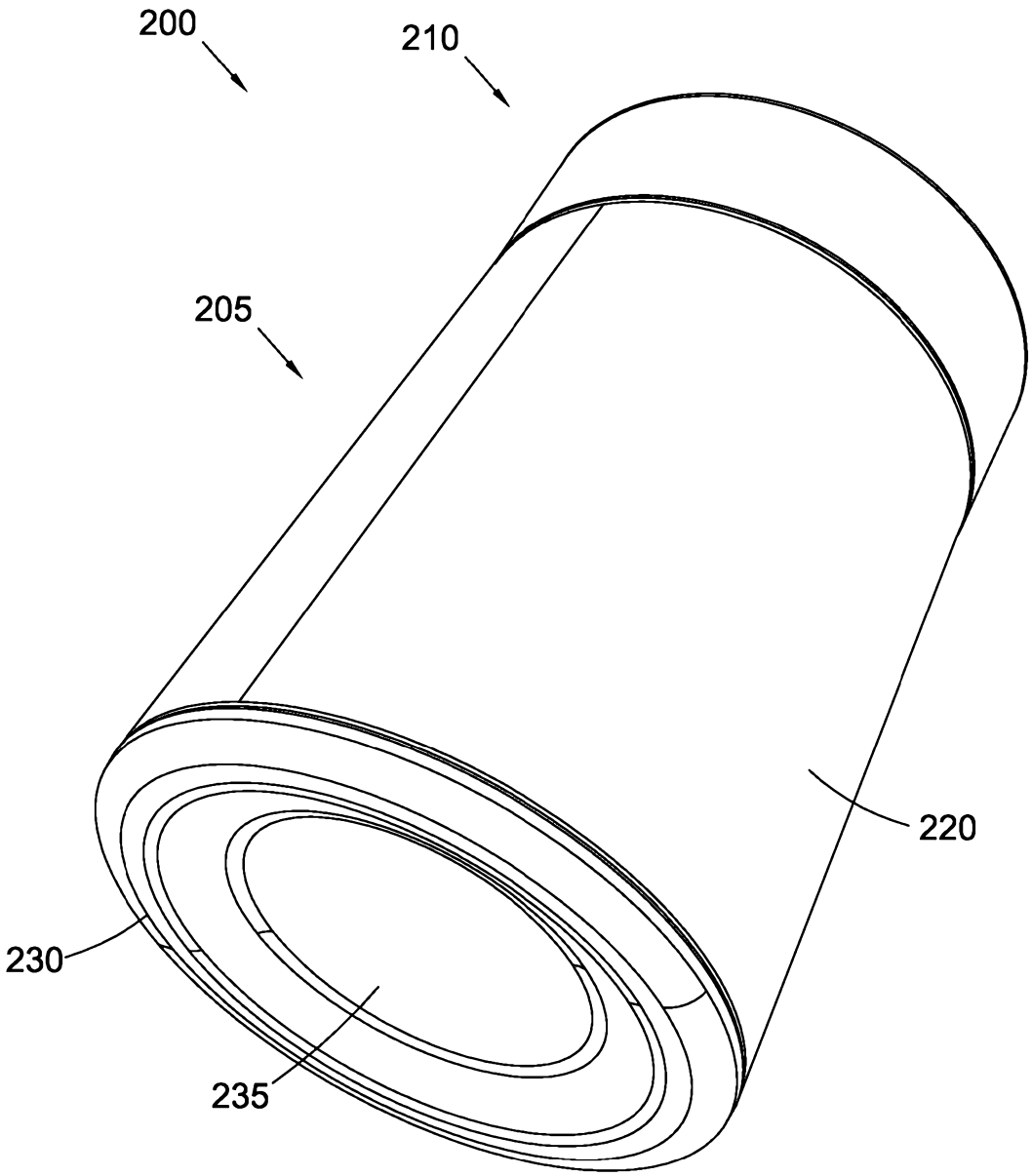

Fig. 2C

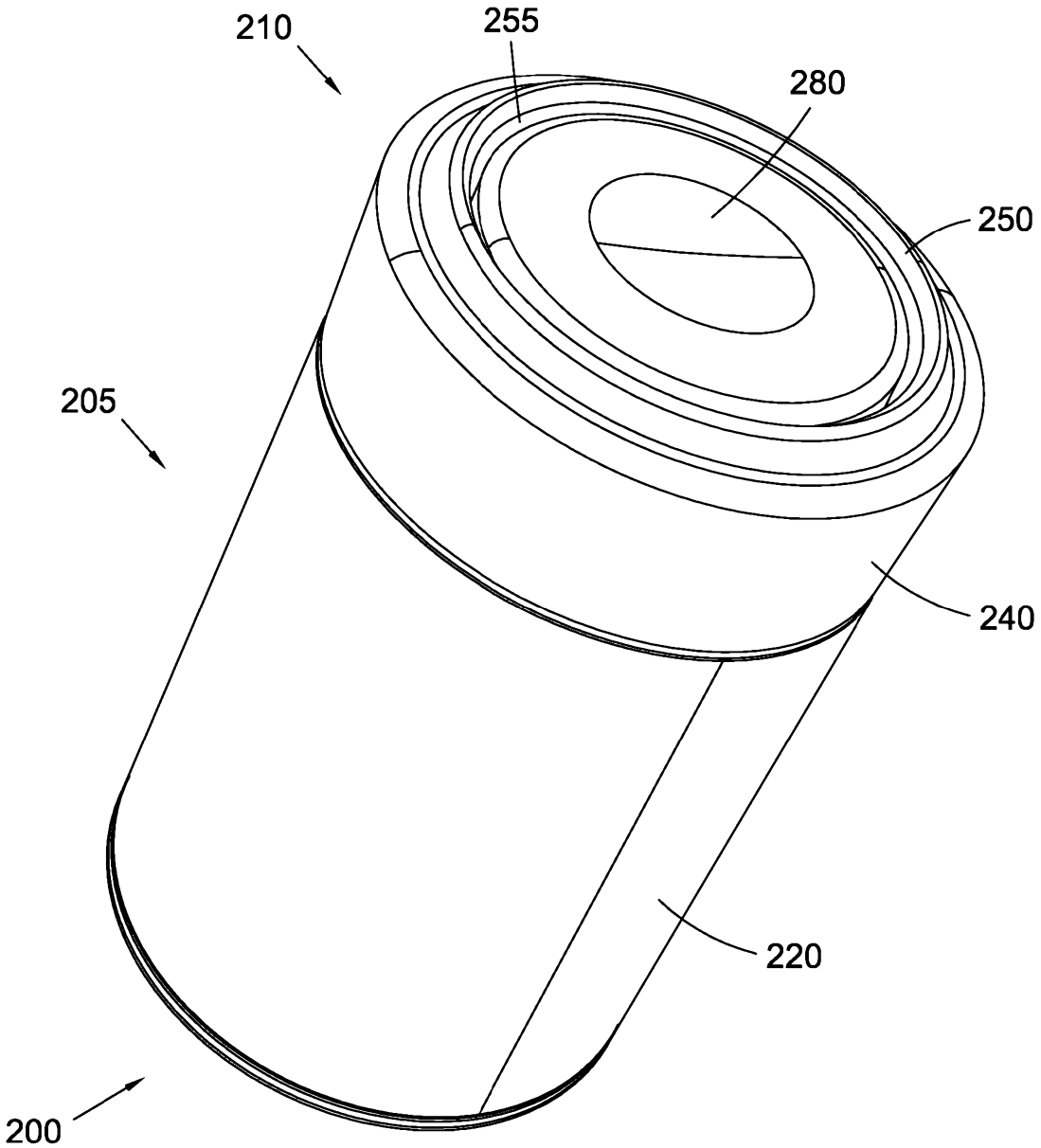

Fig. 2D

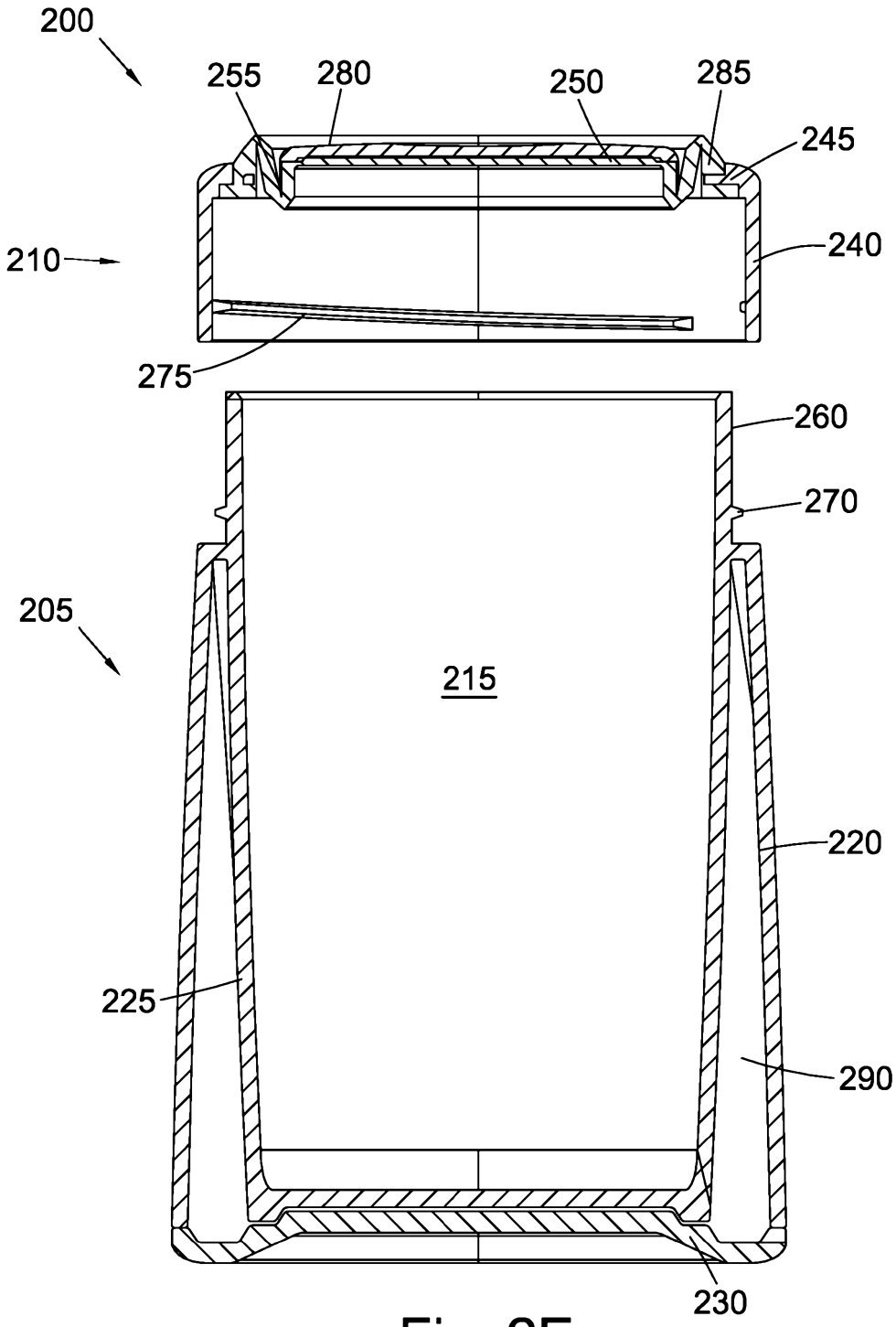
200
255
280
250
285
245
210
240
275
260
270
205
215
220
225
290
230

Fig. 2E

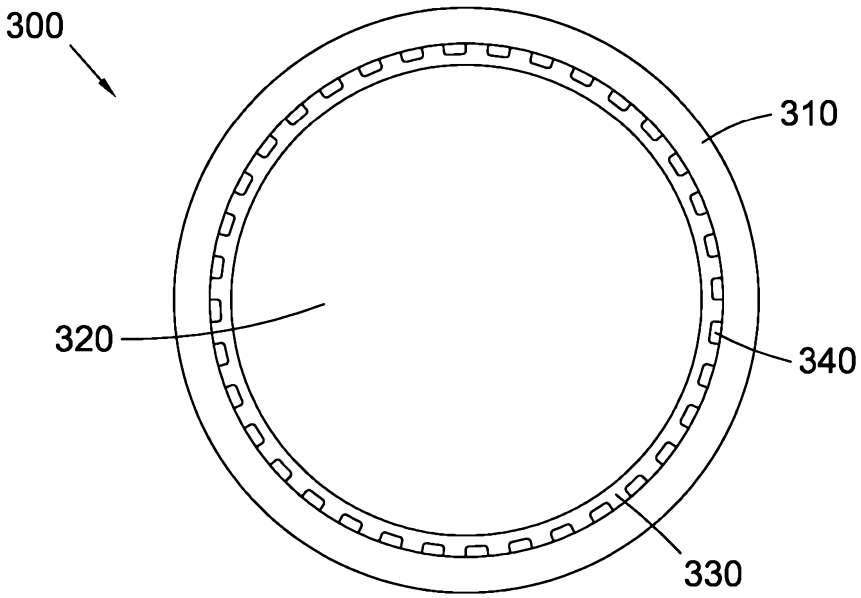

Fig. 3A

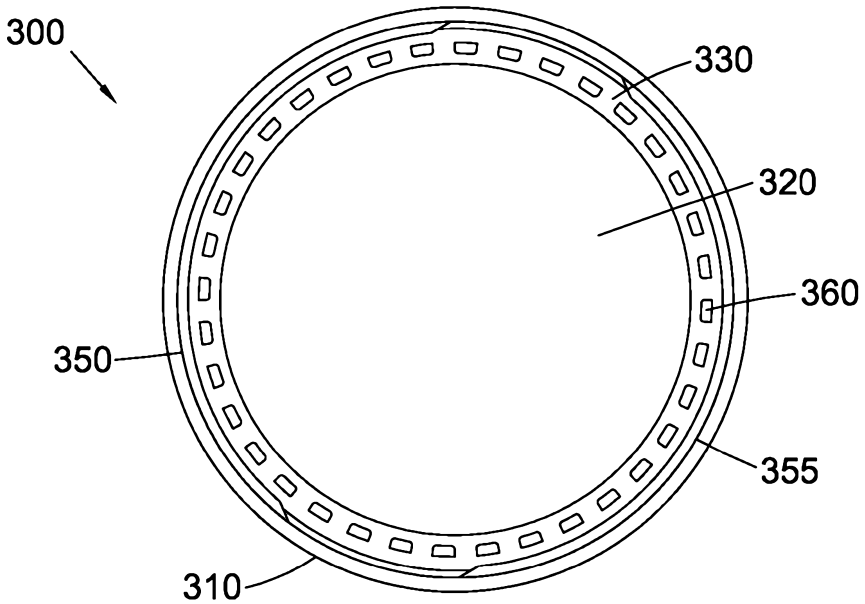

Fig. 3B

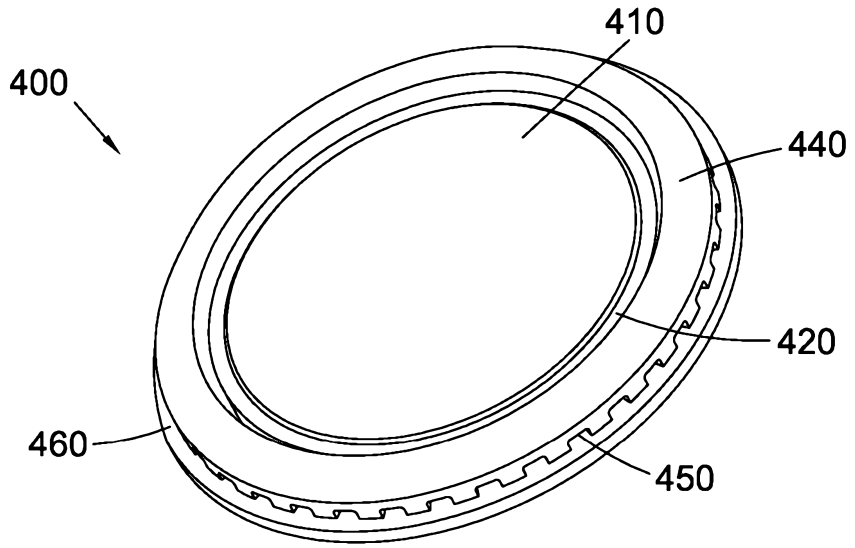

Fig. 4A

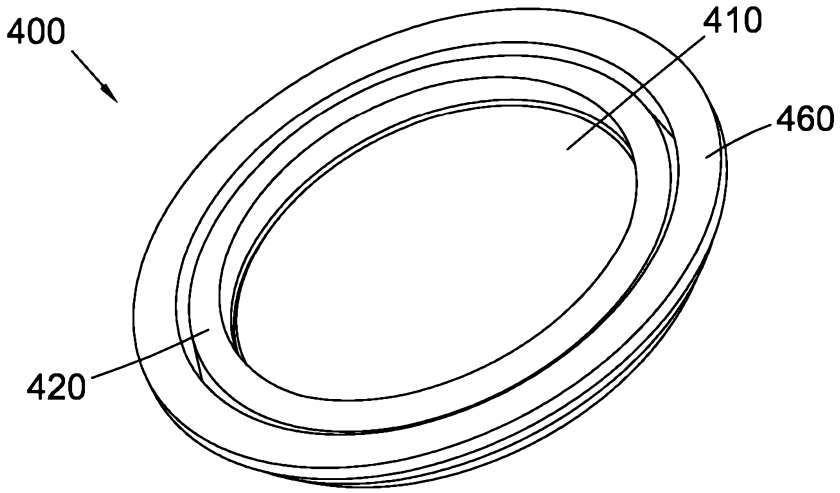

Fig. 4B

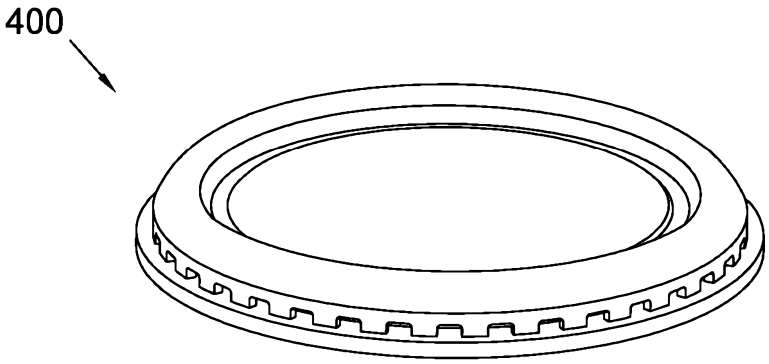

Fig. 4C

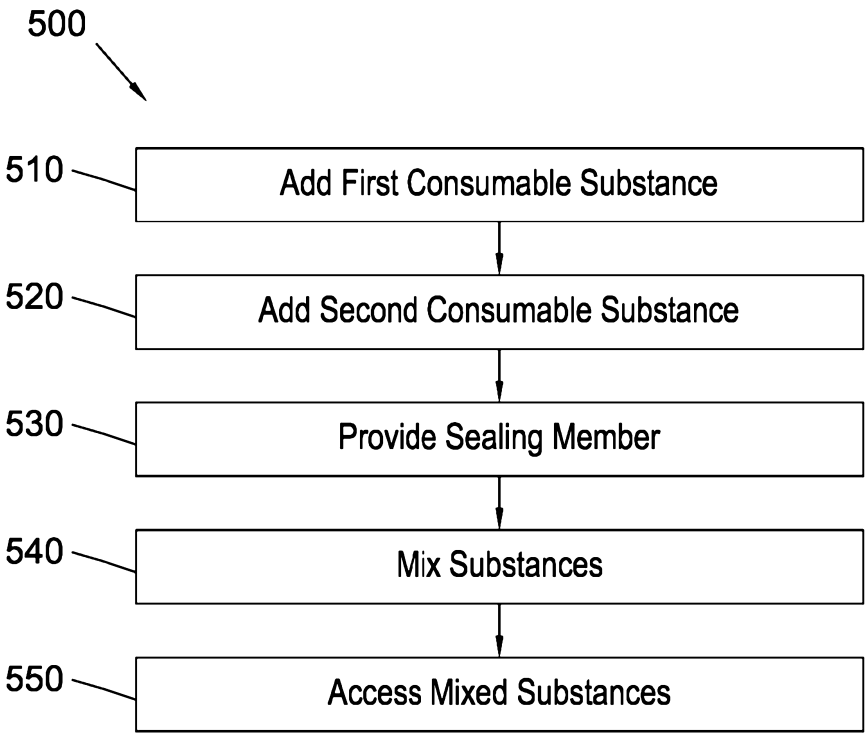
500
510
Add First Consumable Substance
520
Add Second Consumable Substance
530
Provide Sealing Member
540
Mix Substances
550
Access Mixed Substances

Fig. 5

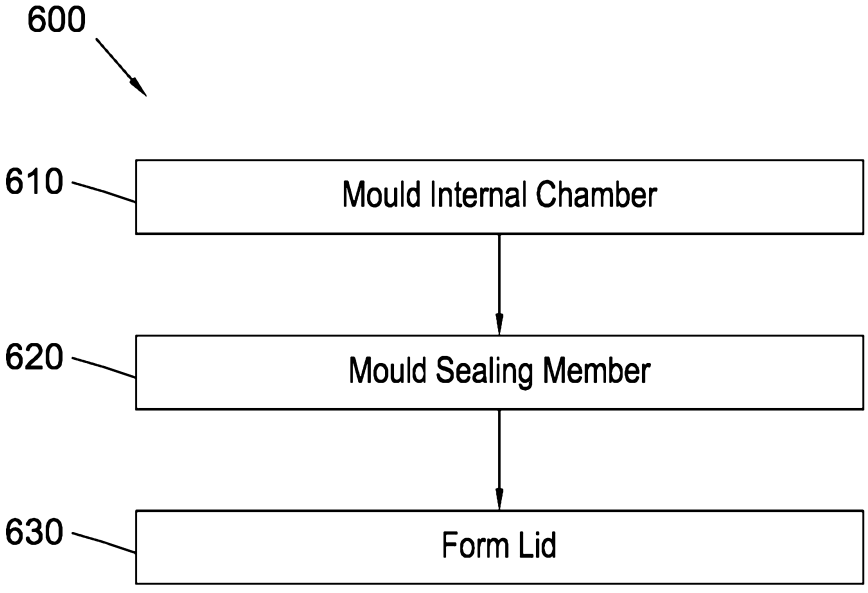
600
610
Mould Internal Chamber
620
Mould Sealing Member
630
Form Lid

Fig. 6

MIXING VESSEL FOR CONSUMABLE SUBSTANCES

Technical Field

The present invention relates to a mixing vessel for consumable substances, a method of using a mixing vessel and a method of manufacturing a mixing vessel. The mixing vessel may be used to produce a consumable liquid, such as a hot beverage.

Background

Many consumable, i.e. potable, liquids involve the mixing of ingredients. For example, hot beverages may require the mixing of a solid consumable substance, such as a powder, with a liquid that is heated above an ambient temperature.

As one example, making "hot chocolate" typically involves heating a liquid, such as milk, and then mixing a cacao-based solid, such as fine chocolate powder or flake, into the liquid. Liquid may be heated in a pan, frothing device or microwave. In one case, the liquid in a continuous form is heated to a melting point of cocoa fats within the chocolate, such as beyond 30 degrees Celsius. The cacao-based solid thus melts on contact with the liquid, and the melted solid is mixed to distribute the insoluble fat content within the liquid. Typically this is achieved by stirring the liquid, such as with a spoon in a cup or a pan. Whilst this disperses the chocolate through the continuous liquid, a full emulsion is not achieved due to the low levels of shear force enacted by the stirring motion. This often results in a drink which has a "grainy" feel within the mouth due to the presence of large fat droplets, and the rapid settling of the cacao-based solid from carried liquid if left to stand.

There are several solutions available for mixing liquids and edible substances. Many of these are designed for mixing alcoholic beverages and operate as variations on a "cocktail shaker". These solutions are not suitable for certain mixtures, such as those involving hot liquids or for substances that react when mixed. Indeed, users are often explicitly informed not to use them for such mixtures, as the construction would pose a safety risk.

US 2012/275258 A1 discloses a mixing tumbler with two or more compartments, each designed to contain a different component used to prepare a desired mixture, which is structured so as to enable the user to initiate the collapse of the

partitions between the compartments, enabling the components to mix and create the desired mixture. The mixing tumbler comprises a flask that is divided into two or more compartments, a cover, and separation discs between the said compartments. Applying pressure on a lid to reduce a volume of the flask compresses the partitions causing them to collapse and mix the contents.

GB 2530800 A discloses a container suitable for foodstuff at least partially defined by an outer wall, a foldable portion and an at least partially removable lid. The container is convertible between a first substantially flattened condition in which at least one compartment is defined within and a second in-use condition by manipulation of the foldable portion. The expandable outer walls may be pulled open, i.e. by hand, to allow the mixing of foodstuff, such as ingredients for a meal, before or after cooking (e.g. with a microwave oven).

DE102007017464 discloses a container that is attachable to beverage cans to enable mixing of drinks, e.g. alcoholic or non-alcoholic cocktails. When the container is fixed to a beverage can, a pressure may be applied to open the beverage can and mix the substances in the container and the can.

Summary

Aspects of the present invention are set out in the appended independent claims. Variations of the present invention are set out in the appended dependent claims.

Further features and advantages of the invention will become apparent from the following description of certain examples, which is made with reference to the accompanying drawings.

Brief Description of the Drawings

Figures 1A and 1B are schematic diagrams showing first and second spatial configurations of a mixing vessel according to an example;

Figure 2A is a side view of an example mixing vessel with an attached sealing member;

Figure 2B is a side view of the example mixing vessel without the sealing member;

Figure 2C is a bottom isometric view of the example mixing vessel with the attached sealing member;

Figure 2D is a top isometric view of the example mixing vessel with the attached sealing member;

Figure 2E is a side cross-section of the example mixing vessel showing an internal chamber and the sealing member;

Figure 3A is a top view of a lid casing according to an example;

Figure 3B is a bottom view of the lid casing of Figure 3A;

Figure 4A is a top isometric view of a sealing member according to an example;

Figure 4B is a bottom isometric view of the sealing member of Figure 4A;

Figure 4C is a side isometric view of the sealing member of Figure 4A;

Figure 5 is a flow diagram showing a method of mixing consumable substances; and

Figure 6 is a flow diagram showing a method of a manufacturing a mixing vessel according to an example.

Detailed Description

Certain examples described herein allow consumable substances to be safely and easily mixed to produce a consumable liquid. The examples described herein may be used to mix "hot" beverages, i.e. liquids with a temperature above an ambient temperature during use. They may also, or alternatively, be used to produce beverages where consumable ingredients react when mixed. Examples may allow consumable substances to be vigorously mixed while preventing liquid spraying onto a user when accessed. To achieve this, a mixing vessel is provided with a sealing member that has at least two stable spatial configurations to change a volume of the mixing vessel. The sealing member is arranged to transition between the at least two stable spatial configurations on application of a pressure generated within the mixing vessel during mixing. This transition increases the volume of the mixing vessel. Hence, pressure increases, e.g. due to a heating of air inside the mixing vessel and/or a chemical reaction within the mixing vessel, may be controlled and rapid depressurisation avoided.

Certain examples described herein may be particularly applied to the creation of hot beverages such as "hot chocolate". In these cases, in order to create a full

emulsion of melted cacao-based solids within a continuous liquid, shear forces may be required. This may be readily achieved by shaking the contents of a mixing vessel as described herein. In certain cases, the mixing vessel may be provided with an internal chamber that allows an air void to be present. This air void may aid two substances to collide during mixing and thus apply the required shear forces.

Figure 1A shows a first configuration 100 of an example mixing vessel 110. The term "vessel" is used herein to refer to a hollow container to hold consumable substances. The vessel has an opening whereby substances may be added to the hollow container. The term "mixing" is used to refer to the use of the vessel for mixing consumable substance, wherein mixing covers, amongst others, dissolving, emulsification, and/or reactions between substances, which may be solids or liquids. The mixing vessel comprises an internal chamber 120 that is defined by a chamber wall. The internal chamber 120 may comprise the inside of a cylindrical cup, flask or beaker. The internal chamber 120 is configured to receive consumable substances for mixing. In this case, consumable is used in the sense of being consumable by an animal, preferably a human being, and may be seen as a synonym for edible or potable substances. In one case, the consumable substances are ingestible by an animal for nutritional benefit, i.e. are not harmful substances for the animal. At least one consumable substance comprises a liquid. As such the internal chamber 120 may be liquid-tight at least around a base portion of the mixing vessel, i.e. internally sealed such that the liquid does not leak from the internal chamber 120. The internal chamber 120 may be moulded, e.g. via injection moulding, to provide a liquid-tight chamber.

Figure 1A further shows a sealing member 130 that is in a first spatial configuration (denoted by 130-A). In the example of Figures 1A and 1B, the sealing member 130 provides a seal for the top of the internal chamber 120, wherein the top may provide an opening for supply of substances to the internal chamber 120. In other examples, the sealing member 130 may provide a seal for one or more of a side of the internal chamber 120 and a base of the internal chamber 120, and the sealing member 130 may be provided in a different location to an opening of the internal chamber 120. The first spatial configuration 130-A is stable, in that the sealing member 130 remains in the first spatial configuration 130-A until an external force is applied. The sealing member 130 may comprise a moulded elastomer. In Figures 1A and 1B the sealing

member 130 comprises folded or undulated portions 140. For a cylindrical mixing vessel, these may comprise annular portions of the sealing member 130.

Figure 1B shows a second configuration 105 of an example mixing vessel 110. In Figure 1B, the second configuration 105 results from the sealing member 130 having a second stable spatial configuration 130-B. The second spatial configuration 130-B may be seen as an extended spatial configuration. As such, the sealing member 130 has two stable spatial configurations in the example of Figures 1A and 1B. The two stable spatial configurations allow a change in volume of the internal chamber 120. In Figure 1, the internal chamber 120 has a first volume, defined as the space within the walls of the chamber, the base of the chamber and the sealing member 130 in the first spatial configuration 130-A. In Figure 1B, the internal chamber 120 has a second volume, defined as the space within the walls of the chamber, the base of the chamber and the sealing member 130 in the second spatial configuration 130-B. The second volume is larger than the first volume.

In the example of Figures 1A and 1B, the sealing member is arranged to transition between the at least two stable spatial configurations on application of a pressure generated within the internal chamber during mixing. For example, a pressure may increase due to the presence within the chamber of a liquid or solid that is heated above an ambient air temperature. In another case, a pressure may increase due to a chemical reaction initiated by the mixing, such as a release of carbon dioxide. When a predefined pressure is applied to the sealing member 130 from the internal chamber, i.e. to the underside of the sealing member 130 in Figure 1A, this provides an external force that triggers a transition from the first stable spatial configuration 130-A to the second stable spatial configuration 130-B. As such, in these examples, the sealing member 130 may be seen as a bimodal sealing member having two states. In other examples a sealing member 130 may have more stable states, e.g. may be able to transition between more than two states depending on an applied pressure from the internal chamber. The sealing member 130 allows an increase in the volume of the internal chamber 120. Over pressurization of the mixing vessel 110 may be further limited by an elastic nature of the sealing member. For example, if the sealing member has elasticity, it may further elastically expand beyond the second stable spatial configuration if excessive pressure is generated.

In the example mixing vessel of Figure 1, the sealing member 130 comprises a pressure seal and an expanding section. In certain cases these may be provided as separate components. For example, a pressure seal may be provided as part of a lid (e.g. in an upper annular wall portion of the mixing vessel and/or as a lower portion of a removable lid) and an expanding section may be provided in a side or base of the mixing vessel 110, or may comprise a separate component of a lid for the mixing vessel 110.

Figures 2A to 2E show a mixing vessel 200 according to another example. This mixing vessel may comprise an implementation of the mixing vessel shown in Figures 1A and 1B. The mixing vessel 200 comprises a flask or lower portion 205 and a lid 210. The flask 205 provides an internal chamber 215 that may be seen as implementing internal chamber 120 of Figures 1A and 1B. The flask 205 may be in the form of a cup or other receptacle that is also suitable for serving a mixed liquid, or may be suitable for pouring a mixed liquid into a serving receptacle. The lid 210 seals an opening at the top of the flask 205 and so may be seen as implementing a sealing member 130 of Figures 1A and 1B. The lid 210 is removable. The lid 210 may be removed to access a mixed substance within the flask 205. The mixed substance may comprise a hot chocolate beverage.

Figure 2A shows the lid 210 affixed atop the flask 205. The flask 205 comprises an external wall 220 and a base 230. In the present example, the external wall 220 is shaped as the frustum of a cone, wherein a neck of the flask 205 extends from an upper plane of the frustum. In other examples, the flask 205 may have other shapes, such as cylindrical or polyhedral configurations. In one case, the flask 205 may be cuboid in shape. Although, in the examples of Figures 2A to 2E, the lid 210 is affixed to the top of the flask 205 such that a plane of the lid 210 and a top of the flask 205 are parallel, in other examples the lid 210 may be affixed in another configuration, e.g. at an angle, at the base or at a side of the flask 205.

The lid 210 in Figure 2A comprises a lid casing 240 and a diaphragm 250. The diaphragm 250 is sealably mounted within the lid casing 240, such that liquid cannot escape the flask 205 when the lid 210 is in place. The diaphragm 250 has at least two deformation states corresponding to respective stable spatial configurations. For example, the diaphragm 250 may be deformable in a similar manner to the sealing member 130 in Figures 1A and 1B. The at least two deformation states may comprise

an unextended spatial configuration and an extended spatial configuration. Figures 2A to 2E show an unextended spatial configuration. In this case, the extended spatial configuration increases the volume of the flask 205 by extending upwards from the perspective of Figure 2A.

Figure 2B shows the flask 205 with the lid 210 removed. In this view, a neck 260 of the flask 205 is visible, the neck extending from a top of the frustum formed by the external wall 220 and forming an upper portion of an internal chamber 215 within the flask 205. The neck 260 surrounds an opening at the top of the flask 205 for providing consumable substances (as shown in more detail in Figure 2E). In Figure 2B, the neck 260 comprises a thread 270 for attaching the lid 210. In other examples, other coupling mechanisms may be used, including latches and/or magnetic couplings. The thread 270 may comprise a half-turn thread. The lid 210 may have a corresponding thread that allows the lid to be screwed onto the top of the flask 205 to seal the flask 205.

Figure 2C shows a bottom isometric view of the mixing vessel 200 with the lid 210 attached to the flask 205. The base 230 of the flask 205 is visible in Figure 2C. The base 230 has an indented centre 235 in the present example. Other configurations are possible in other examples. In the present example, the base 230 may be formed by welding a sealing base disk to the external wall 220 to create a hermetic seal.

Figure 2D shows a top isometric view of the mixing vessel 200. In this view different portions of the lid 210 are visible. The lid casing 240 is formed from a cylindrical portion that has a central aperture. As such the lid casing 240 forms an annular portion of the lid 210. In Figure 2D, the diaphragm 250 resides within the central aperture to form an upper portion of the lid 210. In the present example, a disk 280 is coupled to the diaphragm 250 to form a button. The button is pressable to enable a transition between the extended spatial configuration and the unextended spatial configuration of the diaphragm 250. For example, when the diaphragm 250 is in the extended spatial configuration it may project upwards from the lid casing 240. By applying a downwards force to the disk 280, e.g. using a finger or the like, the diaphragm 250 may be pushed from the extended stable configuration back to the unextended configuration shown in Figure 2D. The disk 280 may also function to

rigidify the diaphragm 250 concentrically. The button may be a "reset" button for the diaphragm 250.

In Figure 2D, folded or concertina portions 255 of the diaphragm 250 are visible. These may be similar to folded portions 140. Folded portions 255 may enable multiple stable spatial configurations of the diaphragm 250.

Figure 2E shows a cross-section through a vertical mid-plane of the flask 205 and lid 210. Figure 2E shows the internal chamber 215 of the flask 205. The internal chamber 215 has an opening at the top of the flask 205 formed by the neck 260. The internal chamber 215 is formed within an inner wall 225 that resides within external wall 220. Between the external wall 220 and the inner wall 225 lies a cavity 290. The cavity 290 may comprise a gas or a vacuum. The cavity 290 may comprise an air cavity (e.g. containing dry air). The cavity 290 may insulate the internal chamber 215. When a liquid with a temperature above an ambient temperature is used, the cavity 290 may both reduce heat loss from the internal chamber 215 and/or reduce a heating of the external wall 220. This may avoid a user of the mixing vessel 200 having to hold an uncomfortably hot vessel. It may also keep a hot beverage warm for a period of time. In other examples, a single wall may be provided together with a heat sleeve, e.g. a silicone heat sleeve, to thermally insulate a hand of a user from the wall of the flask 205.

In Figure 2E, the internal chamber 215 is sealed by a base above base 230. The internal chamber 215 may be constructed from a continuous moulding. The neck 260 of the flask 205 forms an upper portion of the inner wall 225 of the internal chamber 215. In the present example, the outer surface of the base of the inner wall 225 comprises a stepped portion to facilitate location of the base 230 of the flask 205. In Figure 2E, a stepped portion on the outer surface of the base of the inner wall 225 complements a corresponding stepped portion on the underside of the base 230.

In certain examples, one or more of the inner wall 225 and the external wall 220 may comprise a set of markings to facilitate a measurement of consumable substances. The markings may be formed by one or more of embossing, engraving, painting and moulding, amongst others. In certain cases, the inner wall 225 and the external wall 220 may be translucent or transparent. In these cases, a marking on the external wall 220 may be used. If at least one of the external wall 220 and the inner wall 225 is opaque,

then the markings may be formed on an inner surface of the inner wall 225. In this case, measurement may be made against the markings by viewing the inner chamber 215 from above with the lid 210 removed.

The set of markings may comprise a first marking to indicate a fill line for a first consumable substance and a second marking to indicate a fill line for a second consumable substance. For example, if the mixing vessel 200 comprises a "mixer" for "hot chocolate", the first marking may indicate a quantity of a cacao-based solid, such as powdered, flaked, shaved or grated chocolate. The second marking may then indicate a quantity of hot milk, coffee or water (amongst other potable substances).

In one case, mixing may be performed in two stages. In this case, the second marking may indicate an initial quantity of liquid to mix with the first consumable substance. Following an initial mixing, a third marking may be provided to indicate a further quantity of liquid to complete a serving. For example, for a 250ml to 300ml single beverage serving, a second marking may indicate 20-40ml of liquid and the third making may indicate a total of 250-300ml of liquid within the internal chamber 215. The further quantity of liquid may comprise a further quantity of the second consumable substance or a third consumable substance. For example, milk may be used for the initial mixing followed by water or coffee.

Returning to Figure 2E, a cross-section of the lid 210 is shown above the flask 205. The lid 210 comprises the lid casing 240. The lid casing 240 comprises a thread 275 that complements the thread 270 of the neck 260 of the flask 205. The thread 275 may comprise a half-turn thread. In use, the lid 210 may be attached to the flask 205 by placing the lid 210 upon the flask 205 and twisting until the lid 210 is secure.

In the present example, the lid casing 240 has an upper flange 245 that forms an annular edge of the central aperture that houses the diaphragm 250. The flange 245 projects into the centre of the central aperture. In this example, the diaphragm 250 has an annular groove 285 that mates with the flange 245. The annular groove 285 is formed within a lateral portion of the diaphragm 250 between an upper and lower lip. The upper lip forms a seal above the flange 245 of the lid casing 240 and the lower lip extends laterally past the upper lip under the flange 245. The lower lip forms an annular portion of the diaphragm 250 that, when the lid 210 is fastened to the flask 205, contacts an upper annular edge of the neck 260. As such, the annular portion of the diaphragm 250

forms a gasket between the upper annular edge of the internal chamber 215 and inner wall 225. This enables a liquid-tight and air-tight seal to be achieved. If the diaphragm 250 comprises a material such as an elastomer, it may form a soft gasket to which the flask 205 is screwed against. The flange 245 and the annular groove 285 may have a complementary pattern, e.g. a toothed arrangement as discussed later below, such that the diaphragm 250 is statically mounted within the central aperture of the lid casing 240, i.e. does not rotate or otherwise move within the lid casing 240.

Figures 3A and 3B show a lid casing 300 that may be used to implement the lid casing 240 in Figures 2A to 2E. Figure 3A shows a top view and Figure 3B shows a bottom view.

A shown in Figure 3A, the lid casing 300 has a lateral wall 310 formed around a central aperture 320. The central aperture 320 is arranged to accommodate a diaphragm such as 250 in Figures 2A to 2E or 400 in Figures 4A to 4C. The lateral wall 310 of the lid casing 300 has a flange 330 that projects into the central aperture 320. The flange 330 is arranged below a top of the lateral wall 310 such that an upper lip of the diaphragm may be accommodated on top of the flange 330, wherein a side of the upper lip of the diaphragm abuts an inner lateral surface of the lateral wall 310. At a join between an upper surface of the flange 330 and the inner lateral surface of the lateral wall 310 are a series of teeth or castellations 340, i.e. regularly spaced notches. These castellations 340 are configured to mate with corresponding apertures in a side surface of the diaphragm to secure the diaphragm within the central aperture 320.

Figure 3B shows a view of the lid casing 300 from below. An inner surface of the lateral wall 310 below the flange 330 comprises a first thread 350 and a second thread 355 for affixing the lid casing 300 to a chamber body such as flask 205 in Figures 2A to 2E. In other examples, a continuous thread or another coupling mechanism may be provided. The lower surface of the flange 330 is provided with a series of regular-spaced surface features 360. These may extend a few millimetres from the surface to grip a lower lip of the diaphragm, wherein the lower lip is compressed in use between a top of an inner wall of the chamber body and the lower surface of the flange 330.

Figures 4A to 4C show a variety of isometric views of an example sealing member 400. This sealing member 400 may be used to provide diaphragm 250 in Figures 2A to 2E and/or sealing member 130 in Figures 1A and 1B.

Figure 4A shows a top isometric view of the sealing member 400. The sealing member 400 comprises a central planar surface 410. A disk to form a button may be affixed to the central planar surface 410. A set of folded side portions 420 of the sealing member 400 allow the member to have a number of stable spatial configurations. In Figures 4A to 4C, the sealing member 400 is unextended and as such folded side portions 420 form an annular channel around the central planar surface 410. When a pressure is applied to an underside of the central planar surface 410 as shown in Figure 4A, this applies a force to the folded side portions 420 and cause them to transition to an unfolded or extended state such that the central planar surface 410 is displaced upwards. The sealing member 400 may comprise an elastomer, such as one of a thermoplastic elastomer and a silicone. The thermoplastic elastomer may comprise a thermoplastic vulcanizate.

The folded side portions 420 are accommodated within an outer annular portion 440. The outer annular portion 440 has a thickness that is greater than the thickness of the central planar surface 410 and the folded side portions 420. The outer annular portion 440 forms a rim that mates with the flange 330 of the lid casing 300 of Figures 3A and 3B. In Figure 4A, a lateral wall of the outer annular portion 440 has a series of regularly spaced apertures 450. These apertures are formed above a lower lip 460 that forms an annular base of the sealing member 400. The apertures are arranged to receive the castellations 340 of the lid casing 300 as shown in Figure 3A. These secure the sealing member 400 within the central aperture 320 of the lid casing 300. The regular-spaced surface features 360 of the lid casing 300 of Figure 3B are pushed against an upper surface of the lower lip 460 when the lid casing 300 is fastened to a chamber body.

Figures 4B and 4C further show different views of the sealing member 400. The lower surface of the lower lip 460 as shown in Figure 4B is, in use, pressed against an upper annular edge of a chamber body to seal a chamber, such as internal chamber 215. Figure 4B also shows how the folded side portions 420 are laterally nested in an unextended or first stable spatial configuration. Figure 4C shows an orientation of the sealing member 400 when placed into the lid casing 300. In certain implementations, the sealing member 400 may be further affixed to the lid casing 300 by a fastening agent such as glue. In other implementations, the sealing member 400 may be removable from

the lid casing 300, e.g. by deforming the sealing member 400. Removable of the sealing member 400 from the lid casing 300 may aid cleaning of the mixing vessel while still providing a suitable seal.

The castellations 340 (e.g. comb features) around the sealing member 400 and lid casing 300 enable a secure non-bonding over-mould of the sealing member 400 onto the lid casing 300. This may be useful if the sealing member 400 and lid casing 300 are constructed from materials that are difficult to chemically bond, such as thermoplastic elastomers / silicones and polypropylene.

The examples discussed above may be provided at a variety of sizes. For example, the flask 205 may be arranged to mix a single serving of a consumable liquid, e.g. hold between 250-350ml of liquid, or multiple servings, e.g. up to 1l of liquid. For a single serving, the flask 205 may be fashioned in the form of a cup or mug for consuming the mixed liquid. For example, the flask 205 may be provided with one or more arms or handles. In one example, the lid casing 300 may be of a diameter in the range 7.5cm to 12.5cm and the external wall 220 may have a height of between 10cm to 15cm. The lid casing 300 may have a height of between 2.5cm to 5 cm.

Although the lid casing 300 and seal member 400 are shown as circular in the Figures, they may be other shapes in other examples. For example, the lid 210 may comprise a square or rectangular lid casing that is pivotably coupled to a cuboid flask 205 at one side.

The flask 205 as shown in Figures 2A to 2E may be constructed from a moulded polycarbonate and the lid casing 300 may be constructed from a moulded polypropylene. In other examples, the flask 205 may be constructed, at least in part, by formed glass or ceramic materials. The disk 280 may be formed from a moulded polypropylene.

Figure 5 is a flow chart showing a method 500 of mixing consumable substances. The method may be applied using the previously described examples. At block 510, a first consumable substance is added into a mixing vessel. The mixing vessel may comprise the internal chamber 120 or 215 as shown in Figures 1A or 2E. The first consumable substance may comprise a liquid or a solid for mixing. In the latter case, the solid may comprise a powdered, flaked, grated or shaved substance. The first consumable substance may be cacao-based in certain examples. Block 510 may involve

filling an internal chamber of the mixing vessel with a first consumable substance until said substance fills the internal chamber up to a first marking, e.g. on the side of the internal chamber. At block 520, a second consumable substance is added into the mixing vessel. At least one of the first and second consumable substances comprises a liquid. In one case, both substances may be liquids. In another case, only the second substance may be a liquid. The second consumable substance may be added to an internal chamber up to a second marking. The liquid may be a consumable liquid with a temperature greater than an ambient air temperature within the mixing vessel, i.e. a "hot" liquid. A hot liquid may be heated externally to the mixing vessel or within the mixing vessel. In the latter case, a cold consumable liquid may be added on top of the first consumable substance and the mixing vessel may be heated. In this case, the mixing vessel may be heated by placing the mixing vessel on a heat source, such as a hob, or within a microwave. In this case, the cold consumable liquid may be heated to a temperature that is above 50 degrees Celsius.

At block 530 a sealing member is provided to seal the mixing vessel. The sealing member may be separate from the mixing vessel, similar to lid 210, or may be integral to the mixing vessel, e.g. built into a side wall or base. Sealing the mixing vessel includes setting the sealing member to a first stable spatial configuration. In one case, this may comprise attaching a lid such as lid 210 and ensuring that a disk such as 280 is depressed. Providing the sealing member may comprise screwing a lid casing such as 300 onto a flask or chamber such as flask 205, wherein the lid casing comprises a sealing member such as 250 or 400.

At block 540, the first and second consumable substances are mixed within the mixing vessel. If the mixing vessel is sealed, i.e. liquid-tight and air-tight, this may comprise shaking the mixing vessel. For example, this may be performed by holding the external wall 220 of the flask 205 and shaking up and down and/or side-to-side. In another example, the mixing vessel may comprise a mixing mechanism, such as an internal panel or stirring device. The mixing mechanism may be hand-activated or motorised, e.g. using a battery-operated motor. The mixing mechanism may be built into the base 230 of the flask 205. The sealing member ensures that liquid does not escape during mixing.

The mixing at block 540 generates a pressure within the mixing vessel. For example, as a hot liquid is poured into the mixing vessel, it begins to heat the air immediately above it. This air rises as it heats and fresh, cooler air is drawn in to replace it. Once the sealing member is affixed, heated air is contained within the mixing vessel. As liquids such as water and milk have a specific heat capacity of greater than that of air, e.g. up to four times greater, the liquid has sufficient energy contained to heat the air above the liquid to the same temperature. Mixing, e.g. shaking, of the mixing vessel may also increase surface contact between the liquid and the air to further conductive heating. As the air within the sealed mixing vessel is heated, the pressure within the mixing vessel increases. This may also be the case when the first and second consumable substances react during mixing and generate a gaseous by-product. This by-product, as well as or in place of the heating effect, may also increase pressure within the mixing vessel.

Mixing the first and second substances may enable emulsification through the application of shear forces. For example, in making a hot chocolate, shaking the mixing vessel may provide the high shear forces to create a full emulsion of dispersed continuous liquid.

The pressure within the mixing vessel that is generated at block 540 applies a force to the sealing member and causes it to transition to a second stable spatial configuration. This may be in the form of the button 280 "popping up" when a predetermined pressure is reached within the mixing vessel. The predetermined pressure may be set through selection of material properties of the sealing member, e.g. elasticity, and/or configuration of folded portions such as 140. The second stable spatial configuration increases the volume within the mixing vessel, and as such lowers the pressure within. As an additional effect, the transition to the second spatial configuration may also be configured to indicate that a beverage is suitably mixed.

Increasing the volume and lowering the pressure is beneficial. If a pressure that is greater than atmospheric pressure is maintained within the mixing vessel, this can lead to liquid being forced through any seal of the mixing vessel. For example, liquid may leak out of a lid. An expansion in internal volume also increases the internal air volume within the mixing vessel. This enables larger shear forces to be generated through increased air turbulence.

At block 550, the mixed liquid is accessed with the sealing member in the second stable spatial configuration. This may comprise removing the sealing member in the second stable spatial configuration, e.g. by unscrewing lid casing 300 when the sealing member 400 is in a configuration similar to that shown in Figure 1B. By lowering the pressure inside the mixing vessel, an amount of torque required to unscrew the lid casing 300 and open a lid of the mixing vessel is reduced. Moreover, the increase in volume, and reduction in pressure, avoids rapid depressurisation when access to the contents of the mixing vessel is desired. This may avoid spraying a user with hot liquids.

In one variation of method 500, the first or second consumable substance may comprise a quantity of liquid that is small in comparison to a desired quantity of mixed liquid. In this case, the second marking may indicate a first amount of liquid and a third marking may be provided to indicate a full serving or set of servings. Using a small initial amount of liquid may increase emulsification, as a significant air void within the internal chamber may enable the two substances to crash into each other and provide high shear forces. When the first substance is a cacao-based product and the second substance is milk, a brisk shake of the mixing vessel may create an emulsion. A user may top up the second consumable substance by removing the sealing member in the second spatial configuration and adding a further quantity of the second consumable substance, e.g. up to a third marking. The sealing member may then be reset, e.g. by pressing disk, either before or after the sealing member is reattached, e.g. by screwing lid casing 300 onto flask 205. Further mixing of the substances may then be applied to create a larger quantity of mixed liquid, e.g. a serving amount. A user may select a particular quantity of second consumable substance to add dependent on desired strength.

Certain examples described herein provide a pressure-activated sealing member that expands as an internal pressure inside a mixing vessel increases. This increases internal volume in line with a gas volume. A sealing member may be provided in the form of an elastomeric diaphragm. This diaphragm may be bi-modal, i.e. have two stable or "at-rest" states when no force is applied. This ensures that the sealing member does not elastically deform back to an initial state, i.e. prevents the sealing member exerting a pressure back onto the gas within the mixing vessel.

Certain examples described herein combine a pressure seal or gasket and an expanding section or diaphragm into a single component. Providing these elements as a combined unit allows a reduction in complexity and cost, and removes a possible leakage path.

Certain examples described herein provide a mixing vessel that may be upturned and vigorously shaken without spillage.

Certain examples described herein may be beneficial for mixing hot liquids such as, amongst others, hot drinks, hot chocolate, hot alcoholic drinks ("cocktails"), coffees, teas, milk and other protein shakes, hot soups and sauces and milk formula (e.g. infant milk formula). Hot liquids may be mixed safely and easily. A resultant mixed product may have an improved taste compared to previous mixing methods due to the ability to apply high shear forces and successfully provide shear-enacted emulsification.

Figure 6 shows an example method 600 of manufacturing a mixing vessel for consumable liquids. For example, the method may be used to construct the mixing vessel 200 shown in Figures 2A to 2E. At block 610, an internal chamber of the mixing vessel is moulded. This may comprise moulding one or more of external wall 220 and internal wall 225 in Figure 2E. At block 620, a sealing member is moulded over an opening of the internal chamber, the sealing member having at least two stable spatial configurations. This may comprise forming sealing member 400 as shown in Figures 4A to 4C. This ensures a gas and liquid tight seal. At block 630, a lid of the mixing vessel is formed comprising the over-moulded sealing member.

In one example, block 610 may comprise injection moulding a conical frustum having an inner wall and an outer wall, wherein a space between the inner wall and the outer wall comprises an insulating cavity of the mixing vessel. For example, this may comprise forming external wall 220 and inner wall 225 as shown in Figure 2E. This may comprise creating the external wall 220 as a skirt that extends out radially from inner wall 225 in a line of draw, inner wall 225 and neck 260 forming a primary container.

In one example, block 610 may comprise sealing a moulded disk to a base of the moulded internal chamber to create a base of the mixing vessel. For example, the moulded disk may comprise base 230 as shown in Figure 2E. The moulded disk may be ultrasonically welded to a base of an internal chamber having inner wall 225 to create

a hermetic seal. In this way a clear base may be welded to an initial cup or flask to create a sealed clear mixing vessel.

In one example, block 630 may comprise coupling a moulded disk to a centre of the sealing member to form a button to transition between the two stable spatial configurations. The mould disk may comprise disk 280. Block 630 may comprise injection moulding a lid casing such as lid casing 300. The sealing member may be fitted with the lid casing as explained with reference to lid casing 300 and sealing member 400. The internal chamber may be formed from polycarbonate. In one case, the polycarbonate may be clear polycarbonate. The sealing member may comprise one of: a thermoplastic elastomer and a silicone. A casing for the lid may comprise comprises polypropylene.

The above examples are to be understood as being illustrative of the invention. Further examples and variations of the invention are envisaged, for example as indicated in places above. Further examples of variations include: the cavity 290 may be exchanged for, and/or complemented with, a non-conductive band of insulating material (e.g. cork or thermoplastic elastomer); the sealing member may comprise any suitable diaphragm, piston or gland; "hot" may apply to liquids above around 25 degrees Celsius; references to milk may include non-dairy milk substitutes; and liquids may comprise foamed and/or frothed liquids. In certain cases, a removable "glamour cap", cup or further lid may be fitted on top of the lid 210 to hide the diaphragm 250 from view. In certain cases, a mechanism may be provided to prevent the button on the diaphragm from being pressed (i.e. from returning the diaphragm to an unextended configuration) before the lid 210 is opened. This mechanism may comprise a geared system or clutch mounted in combination with a cap or further lid. In certain examples, one or more buttons may be configured on the lid 210 to encourage a user to reset the device once the mixing vessel is opened. For example, a mechanism may be provided to reset the button without user intervention once the lid is removed. In certain variations, a mechanical frame for an elastic member may be provided to enable an extended or unextended state, e.g. using ratcheted movement or the like. It is to be understood that any feature described in relation to any one example of Figure may be used alone, or in combination with other features described, and may also be used in combination with one or more features of any other of the examples or Figures, or any

combination of any other of the examples. Furthermore, equivalents and modifications not described above may also be employed without departing from the scope of the invention, which is defined in the accompanying claims.

CLAIMS

1. A mixing vessel for consumable liquids, comprising:

an internal chamber for receiving consumable substances for mixing, at least one consumable substance comprising a liquid; and

a sealing member for the internal chamber having at least two stable spatial configurations to change a volume of the internal chamber,

wherein the sealing member is arranged to transition between the at least two stable spatial configurations on application of a pressure generated within the internal chamber during mixing to increase the volume of the internal chamber.

2. The mixing vessel of claim 1, wherein the sealing member comprises a diaphragm with at least two deformation states corresponding to the at least two stable spatial configurations.

3. The mixing vessel of claim 2, wherein the at least two deformation states comprise an unextended spatial configuration and an extended spatial configuration, wherein the extended spatial configuration increases the volume of the internal chamber.

4. The mixing vessel of claim 3, wherein the sealing member comprises a disk coupled to the diaphragm to form a button, the button being pressable to enable a transition between the extended spatial configuration and the unextended spatial configuration.

5. The mixing vessel of any one of claims 2 to 4, wherein the diaphragm comprises an elastomer.

6. The mixing vessel of any one of claims 2 to 5, wherein an annular portion of the diaphragm forms a gasket between an upper annular edge of the internal chamber and a casing of the sealing member.

7. The mixing vessel of any one of claims 1 to 6, comprising:

an outer wall, the internal chamber being located within the outer wall; and

a cavity between the internal chamber and the outer wall.

8. The mixing vessel of any one of claims 1 to 7, wherein the internal chamber is configured to receive a consumable liquid with a temperature greater than an ambient air temperature within the internal chamber.

9. The mixing vessel of claim 8, wherein the internal chamber comprises:

a first marking to indicate a fill line for a first consumable substance; and

a second marking to indicate a fill line for a second consumable substance, the second consumable substance comprising the consumable liquid.

10. The mixing vessel of claim 9, wherein the internal chamber comprises:

a third marking to indicate a fill line for an additional amount of the consumable liquid.

11. The mixing vessel of any one of claims 1 to 10, wherein the sealing member comprises a removable lid of the mixing vessel that seals the internal chamber.

12. The mixing vessel of claim 11, wherein the mixing vessel and the lid comprise respective threads to secure the lid to the mixing vessel and seal the internal chamber.

13. A method of mixing consumable substances, comprising:

adding a first consumable substance into a mixing vessel;

adding a second consumable substance into the mixing vessel, wherein at least one of the first and second consumable substances comprises a liquid;

providing a sealing member to seal the mixing vessel, including setting the sealing member to a first stable spatial configuration;

mixing the first and second consumable substances within the mixing vessel, wherein said mixing generates a pressure within the mixing vessel and application of

said pressure to the sealing member causes the sealing member to transition to a second stable spatial configuration that increases a volume of the mixing vessel; and

accessing the mixed consumable substances with the sealing member in the second stable spatial configuration.

14. The method of claim 13, wherein mixing the first and second consumable substances comprises:

shaking the mixing vessel.

15. The method of claim 13 or claim 14, comprising:

adding a further quantity of the second consumable substance into the mixing vessel;

sealing the mixing vessel, including resetting the sealing member to the first stable spatial configuration; and

further mixing the first and second consumable substances.

16. The method of any one of claims 13 to 15, wherein the first consumable substance comprises a cacao-based solid and the second consumable substance comprises a consumable liquid with a temperature greater than an ambient air temperature within the mixing vessel.

17. The method of any one of claims 13 to 16, wherein providing a sealing member to seal the mixing vessel comprises securing a lid onto the mixing vessel, the lid comprising a diaphragm, wherein the first stable spatial configuration comprises an unextended spatial configuration of the diaphragm and the second stable spatial configuration an extended spatial configuration of the diaphragm.

18. The method of any one of claims 13 to 17, wherein mixing the first and second consumable substances comprises emulsifying the first and second consumable substances by applying shear forces to the first and second consumable substances.

19. A method of manufacturing a mixing vessel for consumable liquids, comprising:

moulding an internal chamber of the mixing vessel;

moulding a sealing member over an opening of the internal chamber, the sealing member having at least two stable spatial configurations; and

forming a lid of the mixing vessel comprising the over-moulded sealing member.

20. The method of claim 19, comprising:

sealing a moulded disk to a base of the moulded internal chamber to create a base of the mixing vessel.

21. The method of claim 19 or claim 20, wherein moulding an internal chamber of the mixing vessel comprises injection moulding a conical frustum having an inner wall and an outer wall, wherein a space between the inner wall and the outer wall comprises an insulating cavity of the mixing vessel.

22. The method of any one of claims 19 to 21, comprises:

coupling a moulded disk to a centre of the sealing member to form a button to transition between the two stable spatial configurations.

23. The method of any one of claims 19 to 22, wherein the internal chamber comprises polycarbonate.

24. The method of any one of claims 19 to 23, wherein the sealing member comprises one of: a thermoplastic elastomer and a silicone.

25. The method of any one of claims 19 to 24, wherein the lid comprises polypropylene.

Intellectual Property Office

Application No:	GB1713567.4	**Examiner:**	Miss Elizabeth Price
Claims searched:	1-25	**Date of search:**	23 October 2017

Patents Act 1977: Search Report under Section 17

Documents considered to be relevant:

Category	Relevant to claims	Identity of document and passage or figure of particular relevance
X	1-4, 11-25	WO 2013/175288 A1 (STANTIFORD) see pages 6 to 7 and figs 4 to 8
X	1-3, 5-12, 19-25	WO 2013/166148 A1 (BERRY) see whole document
X	1-3, 5, 6, 8-12, 19-25	WO 2011/094578 A1 (GRAHAM PACKAGING) see paragraph [0022]
X	1-3, 5, 6, 8-12, 19-25	US 2012/248127 A1 (WURSTER) see paragraph [0028]
X	1 and 11	US 2034739 A (BODOR) see figs
X	1	US 6053400 A (REA) see figs

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X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
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Field of Search:

Search of GB, EP, WO & US patent documents classified in the following areas of the UKC^{X} :

Worldwide search of patent documents classified in the following areas of the IPC

A47G; A47J; B01F; B65D

The following online and other databases have been used in the preparation of this search report

WPI and EPODOC

Intellectual Property Office

International Classification:

Subclass	Subgroup	Valid From
B01F	0013/00	01/01/2006
A47J	0043/27	01/01/2006
B01F	0015/00	01/01/2006
B65D	0079/00	01/01/2006