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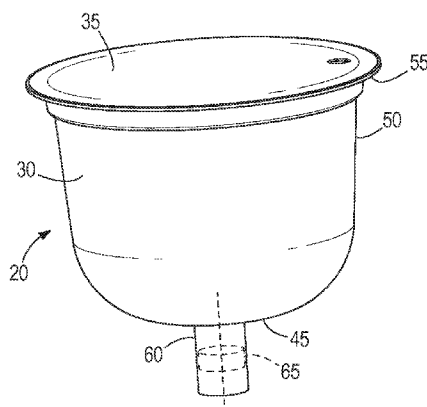


FIG. 2a

(57) **Abstract:** A nutritional powder pod (20) for use with a beverage dispensing device (15) includes a body (30) at least partially defining an enclosed volume, and an outlet member (60) extending from the body (30) and in fluid communication with the enclosed volume. The outlet member (60) has a first end and a second end, and the first end is disposed adjacent the body (30). The nutritional powder pod (20) further includes an actuation member (65) at least partially positioned within the outlet member (60) between the first end and the second end and configured to selectively control the flow of fluid through the outlet member (60).



**POD FOR USE WITH A BEVERAGE DISPENSING DEVICE AND INCLUDING A
VALVED OUTLET MEMBER**

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Patent Application No. 62/027,024, filed July 21, 2014, the entire content of which is incorporated herein by reference.

BACKGROUND

[0002] The present invention relates to a pod for use with a beverage dispensing device, and in particular to a pod including a valved outlet member.

SUMMARY

[0003] In one embodiment a nutritional powder pod for use with a beverage dispensing device includes a body at least partially defining an enclosed volume, and an outlet member extending from the body and in fluid communication with the enclosed volume. The outlet member has a first end and a second end, and the first end is disposed adjacent the body. The nutritional powder pod further includes an actuation member at least partially positioned within the outlet member between the first end and the second end and configured to selectively control the flow of fluid through the outlet member.

[0004] In one embodiment a pod for use with a beverage dispensing device includes a body at least partially defining an enclosed volume, and an outlet member extending from the body and in fluid communication with the enclosed volume. The outlet member has a first end and a second end. The first end is disposed adjacent the body. The pod further includes an actuation member at least partially positioned within the outlet member between the first end and the second end and configured to selectively control the flow of fluid through the outlet member. The enclosed volume is configured to temporarily retain a reconstituted formula and the actuation member is configured to dispense the reconstituted formula from the enclosed volume in an open configuration. The outlet member is positioned with respect to the beverage dispensing device such that the entirety of the reconstituted formula is dispensed free of contact with the beverage dispensing device.

[0005] In one embodiment a pod for use with a beverage dispensing device includes a body having a generally arcuate bottom wall and a side wall extending from the bottom wall to at least partially define an enclosed volume. The pod also includes an engagement member formed or coupled to one of the bottom wall and the side wall. The engagement member is configured to engage a portion of the beverage dispensing device and orient the pod with respect thereto. The pod also includes an outlet member extending from the body and in fluid communication with the enclosed volume, the outlet member having a first end and a second end, the first end disposed adjacent the body. The enclosed volume is configured to temporarily retain a reconstituted formula for dispensing from the pod, and the outlet member is positioned with respect to the beverage dispensing device such that the entirety of the reconstituted formula is dispensable free of contact from the beverage dispensing device.

[0006] Other features and aspects of the invention will become apparent by consideration of the following detailed description and accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. 1 is a schematic representation of a fluid dispensing system including a pod according to one embodiment.

[0008] FIG. 2a is a perspective view of the pod of FIG. 1.

[0009] FIG. 2b is an additional perspective view of the pod of FIG. 1.

[0010] FIG. 3a is a perspective view of a pod according to an alternative embodiment.

[0011] FIG. 3b is an additional perspective view of the pod of FIG. 3a.

[0012] FIG. 4a is a perspective view of a pod according to another alternative embodiment.

[0013] FIG. 4b is an additional perspective view of the pod of FIG. 4a.

[0014] FIG. 5 is a perspective view of a pod according to another alternative embodiment.

[0015] FIG. 6a is a cross-sectional view of a duck-bill valve usable with any of the pods of FIGS. 2-5 and illustrated in a closed configuration.

[0016] FIG. 6b is a cross-sectional view of the duck-bill valve of FIG. 6a in an open configuration.

[0017] FIG. 7a is a cross-sectional view of an umbrella valve usable with any of the pods of FIGS. 2-5 and illustrated in a closed configuration.

[0018] FIG. 7b is a cross-sectional view of the umbrella valve of FIG. 7a in an open configuration.

[0019] FIG. 8a is a cross-sectional view of a burst disk usable with any of the pods of FIGS. 2-5 and illustrated in a closed or intact configuration.

[0020] FIG. 8b is a cross-sectional view of the burst disk of FIG. 8a in a ruptured or open configuration.

[0021] FIG. 9a is a cross-sectional view of a check ball valve usable with any of the pods of FIGS. 2-5 and illustrated in a closed configuration.

[0022] FIG. 9b is a cross-sectional view of the check ball valve of FIG 9a in an open configuration.

[0023] FIG. 10a is a cross-sectional view of a reed valve usable with any of the pods of FIGS. 2-5 and illustrated in a closed configuration.

[0024] FIG. 10b is a cross-sectional view of the reed valve of FIG. 10a in an open configuration.

[0025] FIG. 11a is a schematic representation of another valve usable with any of the pods of FIGS. 2-5 and illustrated in a closed configuration.

[0026] FIG. 11b is a schematic representation of the valve of FIG. 11a illustrated in an open configuration.

[0027] FIG. 12a is a schematic representation of another valve usable with any of the pods of FIGS. 2-5 and illustrated in a closed configuration.

[0028] FIG. 12b is a schematic representation of the valve of FIG. 12a illustrated in an open configuration.

[0029] FIG. 13a is a schematic representation of another valve usable with any of the pods of FIGS. 2-5 and illustrated in a closed configuration.

[0030] FIG. 13b is a schematic representation of the valve of FIG. 13a illustrated in an open configuration.

[0031] FIG. 14a is a cross-sectional view of an outlet member of any of the pods of FIGS. 2-5 engaged by an actuating portion of a beverage dispensing device.

[0032] FIG. 14b is a cross-sectional view of the outlet member of FIG. 14a in an unengaged state.

[0033] FIG. 15a is a cross-sectional view of an outlet member of any of the pods of FIGS. 2-5 engaged by a clip or compression member.

[0034] FIG. 15b is a cross-sectional view of the outlet member of FIG. 14a in an unengaged state.

[0035] FIG. 16a is a cross-sectional view of an outlet member including a screen for use with any of the pods of FIGS. 2-5.

[0036] FIG. 16b is a cross-sectional view of an outlet member including a soluble membrane for use with any of the pods of FIGS. 2-5.

[0037] FIG. 17a is a cross-sectional view of an outlet member including a removable seal for use with any of the pods of FIGS. 2-5.

[0038] FIG. 17b is a cross-sectional view of the outlet member of 17a with the seal being removed.

[0039] FIGS. 18-21 illustrate mixing features for incorporation into an outlet member of any of the pods of FIGS. 2-5.

[0040] FIG. 22 is a perspective view of a pod according to another embodiment.

[0041] FIG. 23 is a perspective view of a pod according to a further embodiment.

[0042] FIG. 24 is a perspective view of a pod according to another embodiment.

[0043] Before any embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of construction and the arrangement of components set forth in the following description or illustrated in the following drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is to be understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DETAILED DESCRIPTION

[0044] FIG. 1 is a schematic of a beverage dispensing system 10 including a beverage dispensing device 15 configured to combine water with a pre-packaged nutritional powder or liquid concentrate provided in a disposable container or pod 20 to produce a reconstituted formula. The beverage dispensing device 15 is then operable to dispense the reconstituted formula into a drinking vessel 25, such as a bottle, mug, or cup.

[0045] Referring also to FIGS. 2a and 2b, the pod 20 includes a container body 30 and a flexible lid 35 that collectively define an enclosed storage volume ranging from approximately 60 milliliters (ml) to approximately 170 ml in one or more chambers. The container body 30 includes a bottom wall 45 and a side wall 50 extending from and integrally formed as one piece with the bottom wall 45. The side wall 50 terminates in a generally flat rim or flange 55 at an open upper end of the container body 30. In some applications, at least a portion of the bottom wall 45 and/or side wall 50 may have a generally arcuate shape.

[0046] The pod 20 is sized to receive from approximately 2 grams to approximately 150 grams of the nutritional powder or liquid concentrate through the open upper end, after which the lid 35 is hermetically sealed to the flange 55. The powder has a bulk density of approximately 0.3 g/cc to approximately 0.8 g/cc with a particle size from approximately 10 microns to approximately 500 microns, occupying between approximately 60% and approximately 90% of the enclosed volume. The container body 30 is molded, thermoformed, or otherwise constructed from a food-safe plastic material, such as polypropylene or polyethylene, and may include additional materials in a multi-layer structure. As one example, a gas barrier material such as ethylene vinyl alcohol (EVOH)

may constitute a portion of the container body 30. The lid 35 can be made of a polymer film, metal foil, or any other material suitable for affixing to the flange 55.

[0047] At least one of the lid 35 and the container body 30 is configured to receive an injector or similar device (not shown) through which water, air, or other fluids may be introduced to assist in mixing and reconstitution of the nutritional powder or liquid concentrate within the enclosed volume. The introduced fluid(s) may be pre-filtered or alternatively pass through a filtration unit disposed within the pod 20. Additionally, the introduced fluid(s) may be pressurized to a pressure greater than atmospheric pressure.

[0048] An outlet member 60 extends from the container body 30 and is positioned for dispensing from the pod 20, with the assistance of the introduced fluid(s), a nutritional product incorporating the nutritional powder or liquid concentrate. The dispensed product volume can range from approximately 5 ml to approximately 1000 ml. The product may be dispensed through the outlet member 60 at a flow rate between about 1 milliliter per second (ml/s) and about 10 ml/s. The temperature of the dispensed nutritional product is product dependent and can range from approximately 5 °C or 41 °F to approximately 50 °C or 122 °F.

[0049] The outlet member 60 includes a first end adjacent the bottom wall 45, a second or distal end through which the nutritional product is dispensed, and a longitudinal axis extending between the first and second ends. The outlet member 60 has a length, measured along the longitudinal axis from the first end to the second end, between approximately 5 millimeters (mm) and approximately 40 mm. Accordingly, in some embodiments, the outlet member 60 may be greater than about 5 mm in length. In other embodiments, the outlet member 60 may be greater than about 10 mm in length. In other embodiments, the outlet member 60 may be greater than about 20 mm in length. In any and all configurations hereinafter described, the outlet member is sized and positioned with respect to the beverage dispensing device such that the entirety of the reconstituted formula may be dispensed free of contact with any portion of the beverage dispensing device 15.

[0050] In the illustrated embodiment, the outlet member 60 is a generally cylindrical conduit having an inner diameter greater than about 4 mm and preferably between approximately 4 mm and approximately 8 mm. In some embodiments, the inner diameter of the outlet member 60 is approximately half the length of the outlet member 60. In other embodiments, the inner diameter is approximately one fourth of the length of the outlet

member 60. In some embodiments, the inner diameter is greater than about one-sixth the maximum outer diameter of the container body 30.

[0051] The outlet member 60 extends in a normal direction from the center of the bottom wall 45. As such, the pod 20 may be oriented substantially upright, as illustrated in FIGS. 2A and 2B, to dispense the nutritional product through the outlet member 60. Alternatively, the outlet member 60 can extend from the wall at an angle less than 90 degrees, from the position of FIGS. 2a and 2b, as shown in FIG. 5. The angle may range, for example, from approximately 30 degrees to approximately 90 degrees. In such embodiments, the nutritional product dispensed through the outlet member 60 is directed to impinge on a sidewall of the drinking vessel 25, resulting in reduced foaming and additional mixing within the drinking vessel 25. The outlet member 60 can also have a variety of different cross-sectional shapes (e.g., elliptical, elongated, rectangular, non-uniform, varying, etc.) and can extend from the bottom wall 45 at any location with respect to the container body 30. In some embodiments, the outlet member 60 can include one or more bends or turns along its length. For example, the outlet member 60 may initially extend from the container body 30 as shown in FIGS. 2A and 2B and thereafter include a bend or curve that alters the trajectory of the dispensed product.

[0052] Referring to FIGS. 3A and 3B, in one embodiment, a pod 120 includes an outlet member 60 that extends in a normal direction from the side wall 50 so that the pod 120 may be oriented on its side to dispense the nutritional product through the outlet member 60. Alternatively, the outlet member 60 can extend from the side wall 50 at an angle so that the pod 120 may be positioned in any other desired orientation to dispense the nutritional product.

[0053] In another embodiment, illustrated in FIGS. 4A and 4B, a pod 220 includes an outlet member 60 extending beyond the lid 35. The outlet member 60 is curved such that the pod 220 may be oriented on its side to dispense the nutritional product through the outlet member 60. Alternatively, the outlet member 60 can extend beyond the lid 35 substantially perpendicular to the lid 35 so that the pod 220 may be oriented upside down to dispense the nutritional product. In the illustrated embodiment, the outlet member 60 extends along the exterior of the sidewall 50. A plurality of openings 52 formed in the side wall permits the nutritional product to flow into the outlet member.

[0054] With reference to FIGS. 2-5, an actuation member 65, such as a valve or burst disk, is disposed within the outlet member 60 between the first and second ends to selectively control the flow of fluid through the outlet member 60. The actuation member 65 separates the outlet member 60 into an upstream side in fluid communication with the first end of the outlet member 60 and the enclosed or storage volume, and a downstream side in fluid communication with the second end of the outlet member 60. The actuation member 65 can be located proximate the midpoint of the outlet member 60, between the first and second ends. Alternatively, the actuation member 65 can be located at any position along the longitudinal axis of the outlet member 60.

[0055] The container body 30 and the outlet member 60 may be formed separately (e.g., using an injection molding, thermoforming, 3-D printing, or other process) and subsequently assembled together using adhesive, mechanical fasteners, welding, to include induction welding, ultrasonic welding, conductive welding, or rotational welding, or any other suitable process. The actuation member 65 can be inserted into or integrally formed with the outlet member 60 prior to assembling the outlet member 60 with the container body 30. Alternatively, the container body 30 and the outlet member 60 can be integrally formed together as a single part, and the actuation member 65 subsequently inserted into the outlet member 60. In other embodiments, the outlet member 60 can be formed around the actuation member 65 such that the actuation member 65 is captured within the outlet member 60.

[0056] The actuation member 65 is normally closed to inhibit the ingress of air and any foreign matter into the enclosed volume prior to dispensation of the nutritional product. In other words, the pod 20 is maintained as a closed system and its contents are isolated from the surrounding environment. When opened, the actuation member 65 permits fluid flow from the upstream side to the downstream side to dispense the nutritional product. The actuation member 65 may provide a delay between the introduction of water or other fluid(s) into the enclosed volume and dispensing the reconstituted nutritional product to facilitate thorough mixing of the nutritional powder or liquid concentrate with the water or other fluid(s). In some embodiments, the actuation member 65 may open between approximately 2 seconds and approximately 90 seconds after the water or other fluid enters the enclosed volume of the pod.

[0057] The actuation member 65 may take a variety of different structures, features, or means of operation, and various embodiments of the actuation member 65 are described in

greater detail below. In some embodiments, the actuation member 65 may be actuated when a pressure difference between the upstream side and the downstream side exceeds a predetermined pressure. In other embodiments, the actuation member 65 may be automatically opened in response to other environmental conditions, such as elevated temperature or exposure to liquid. In yet other embodiments, the actuation member 65 may be automatically opened through engagement with one or more components of the dispensing device 15 (FIG. 1).

[0058] FIGS. 6a-10b illustrate a variety of actuation members that may be incorporated into the pod. Each of these actuation members, as described in greater detail below, is automatically actuated or opened in response to a pressure differential or other environmental condition.

[0059] FIGS. 6a and 6b illustrate a duck-bill valve 65a having a valve body from which first and second resilient members 67a, 69a extend. The duck-bill valve 65a can be integrally formed with the outlet member 60 and the remainder of the pod as a single piece (e.g., using a molding process). Alternatively, the duck-bill valve 65a can be formed separately and inserted into the outlet member 60. The first and second resilient members 67a, 69a are angled inwardly toward the longitudinal axis to generally form the shape of a duck-bill. The ends of the resilient members 67a, 69a bear against each other to define a normally-closed configuration (FIG. 6a) in which fluid flow through the valve 65a is substantially inhibited. The valve 65a automatically opens when a pressure difference between the upstream side and the downstream side exceeds a predetermined value (e.g., between approximately 3500 Pascals (Pa) or 0.50 pounds per square inch (psig) and approximately 240,000 Pa or 35 psig). Accordingly, when the pressure on the upstream side of the valve 65a is sufficiently higher than the pressure on the downstream side, the pressure force acting on the resilient members 67a, 69a causes the ends of the resilient members 67a, 69a to elastically deform away from the longitudinal axis to define an open configuration (FIG. 6b) in which fluid may flow from the upstream side to the downstream side. When the pressure on the upstream side drops below the predetermined pressure required to maintain the valve 65a in the open configuration, the resilient members 67a, 69a return to the closed configuration (FIG. 6a).

[0060] FIGS. 7a and 7b illustrate an umbrella or diaphragm valve 65b having a valve body 71b, a stem 73b affixed to the valve body 71b, and a curved sealing member 75b extending radially outwardly from an end of the stem 73b. As such, the stem 73b and curved

sealing member 75b generally form the shape of an open umbrella. The valve body 71b includes one or more orifices 77b that are sealed by the sealing member 75b at the downstream side to define a normally-closed configuration (FIG. 7a) in which fluid flow through the valve 65b is substantially inhibited. The valve 65b automatically opens when a pressure difference between the upstream side and the downstream side exceeds a predetermined value (e.g., between approximately 3500 Pa or 0.50 psig and approximately 240,000 Pa or 35 psig). When the pressure on the upstream side of the valve 65b is sufficiently higher than the pressure on the downstream side, the pressure force acting on the sealing member 75b causes the sealing member 75b to elastically deform away from the orifices 77b to define an open configuration (FIG. 7b) in which fluid may flow through the orifices 77b, from the upstream side to the downstream side. When the pressure on the upstream side drops below the predetermined pressure required to maintain the valve 65b in the open configuration, the sealing member 77b returns to the closed configuration (FIG. 7a).

[0061] FIGS. 8a and 8b illustrate a relatively thin sheet of material 65c spanning the interior of the outlet member 60. The sheet 65c is made of an impermeable material such as metal foil or polymer film. When intact, the sheet 65c substantially inhibits fluid flow through the outlet member 60 (FIG. 8a). The sheet 65c ruptures to automatically create an opening when a pressure difference between the upstream side and the downstream side exceeds a predetermined value (e.g., between approximately 3500 Pa or 0.50 psig and approximately 240,000 Pa or 35 psig). When the pressure on the upstream side is sufficiently higher than the pressure on the downstream side, the pressure force acting on the sheet 65c causes the sheet 65c to fail and create an opening (FIG. 8b) through which fluid may flow from the upstream side to the downstream side. In alternative embodiments, the sheet 65c may be configured to fail when exposed to other predetermined environmental conditions. For example, the sheet 65c may be made of a soluble material that dissolves when exposed to the fluid that is injected into the pod, or to the reconstituted nutritional product, during operation of the beverage dispensing device 15. Once the sheet 65c is sufficiently dissolved, it fails and creates an opening as described above. The sheet 65c may also be made of a temperature-sensitive material that fails upon reaching a predetermined, elevated temperature, such as the temperature of heated fluid injected into the pod during operation of the fluid dispensing device 15.

[0062] FIGS. 9a and 9b, illustrate a ball check valve 65d having a valve body 71d, a sealing member 75d, a biasing member 79d, and a support 81d. An orifice 77d extends through the valve body 71d and includes a seat on the downstream side thereof. The sealing member 75d is received by the seat to substantially seal the orifice 77d and define a normally-closed configuration (FIG. 9a) in which fluid flow through the valve 65d is substantially inhibited. In the illustrated embodiment, the sealing member 75d is a ball; however, the sealing member 75d may alternatively include a pointed tip or any other geometry suitable for creating a seal with the seat. The biasing member 79d, which is a coil spring in the illustrated embodiment, is compressed between the sealing member 75d and the support 81d to bias the sealing member 75d into engagement with the seat. The support 81d is disposed downstream of the valve body 71d and includes one or more passages 83d to allow fluid to flow past the support 81d. The valve 65d opens when a pressure difference between the upstream side and the downstream side exceeds a predetermined value (e.g., between approximately 3500 Pa or 0.50 psig and approximately 240,000 Pa or 35 psig). When the pressure on the upstream side of the valve 65d is sufficiently higher than the pressure on the downstream side, the pressure force acting on the sealing member 75d overcomes the biasing force of the biasing member 79d to unseat the sealing member 75d, thereby defining an open configuration of the valve 65d (FIG. 9b). In the open configuration, fluid may flow through the orifice 77d, from the upstream side to the downstream side. When the pressure on the upstream side drops below the predetermined pressure required to maintain the valve 65d in the open configuration, the sealing member 75d returns to the closed configuration under the influence of the biasing member 79d (FIG. 9b).

[0063] FIGS. 10a and 10b illustrate a flapper or reed valve 65e having a resilient arm 85e extending across the outlet member 60. A distal end of the resilient arm 85e engages a seat 87e to define a normally-closed configuration (FIG. 10a) in which fluid flow through the valve 65e is substantially inhibited. The valve 65e automatically opens when a pressure difference between the upstream side and the downstream side exceeds a predetermined value (e.g., between approximately 3500 Pa or 0.50 psig and approximately 240,000 Pa or 35 psig). When the pressure on the upstream side of the valve is sufficiently higher than the pressure on the downstream side, the pressure force acting on the resilient arm 85e bends the arm 85e away from the seat 87e to create an opening (FIG. 10b) through which fluid may flow from the upstream side to the downstream side. When the pressure on the upstream side drops below the predetermined pressure required to maintain the valve 65e in this open

configuration, the resilient arm 85e returns to its natural state in the closed configuration (FIG. 10a).

[0064] FIGS. 11a-13b illustrate other actuation members that may be incorporated into the pod. Each of these actuation members, as described in greater detail below, is actuated between an open configuration and a closed configuration by an actuating portion of the dispensing device 15. The actuating portion may be configured to open the actuation member manually (e.g., in response to manual input from a user) or automatically (e.g., in response to an actuating signal generated by a controller of the fluid dispensing device). The actuating signal may be generated a predetermined time period after the dispensing unit begins the reconstitution process, as previously noted. Alternatively, the actuating signal may be generated in response to a sensed condition. For example, the dispensing device 15 may include one or more optical sensors able to measure the relative proportion of nutritional powder or liquid concentrate to reconstituted fluid. The actuating signal may be generated when it is sensed that at least approximately 75 percent of the nutritional powder or liquid has been reconstituted. The outlet member 60 may include one or more substantially transparent portions to improve performance of the one or more optical sensors.

[0065] FIGS. 11a and 11b schematically illustrate a valve 65f that is actuated by a pressure signal (e.g., pneumatic or hydraulic fluid pressure) sent from the actuating portion to a control port 89f on the outlet member 60. The control port 89f may be remotely coupled to the actuating portion by a tube or the like suitable for transmitting the pressure signal from the actuating portion to the control port. The valve 65f may include, for example, a displaceable piston (not shown) that moves to open the valve 65f in response to the pressure signal being received at the control port 89f.

[0066] FIGS. 12a and 12b schematically illustrate a valve 65g having a magnetic portion (i.e. a portion made of a ferromagnetic or other magnetically responsive material) that is displaced relative to the outlet member 60 via a magnetic force generated by the actuating portion. The actuating portion may include an electromagnet or a permanent magnet to produce the magnetic force.

[0067] FIGS. 13a and 13b schematically illustrate a mechanically-actuated butterfly valve 65h. Such a valve may require a rotational or other mechanical input (e.g., a rotational input) from the actuating portion of the dispensing device 15 to actuate the valve 65h. In one

embodiment (not shown), the actuating portion includes a linearly-displaceable rack that meshes with a pinion coupled to the valve 65h. To actuate the valve 65h, the rack is displaced, causing the pinion to rotate along the rack and thereby providing a rotational input to the valve 65h. In other embodiments, the actuating portion can include one or more servos, solenoids, or other actuators coupled to the valve 65h by one or more gears, linkages, or any other suitable arrangements. In addition, other types of mechanically-actuated valves may be used, examples including but not limited to a globe valve, ball valve, or gate valve.

[0068] FIGS. 14a-15b illustrate embodiments in which the outlet member 60 is made of a flexible material. In these embodiments, the outlet member 60 itself acts as the actuation member 65 and is compressed, pinched, or otherwise deformed to define a closed configuration. In the embodiment of FIGS. 14a and 14b, the actuating portion includes two opposed compression members 93i that apply pressure to the sides of the outlet member 60 upon insertion of the pod into the device 15. The pod includes a soluble membrane to retain the nutritional powder within the enclosed volume. Once fluid is introduced into the pod, the membrane dissolves. The compression members 93i may then selectively release the outlet member 60, allowing it to expand and permitting fluid flow through the outlet member 60 (FIG. 14b). In the embodiment of FIGS. 15a and 15b, a clip 95j pinches the outlet member 60 to define a closed configuration. The actuating portion is operable to remove the clip 95j to release the outlet member 60, allowing it to expand and permitting fluid flow through the outlet member 60 (FIG. 15b).

[0069] In the development of pods according to various embodiments herein described, pods having different inlet configurations were tested at multiple actuation member opening pressures corresponding to internal pod pressures. The experiments revealed unexpected performance improvements when the actuation member was opened to evacuate the pod contents in response to an elevated pressure inside the pod. As one example, an elevated opening pressure under certain conditions resulted in less clumping within the reconstituted nutritional product.

[0070] The pods were tested using a specially designed apparatus built to function as an automated beverage dispensing device. The testing apparatus allowed for introduction of fluid through the top lid of the pod or through the side wall of the pod at a precisely controlled flow rate. In addition, the test apparatus regulated the temperature of the inlet

fluid by controlling the bulk temperature of a fluid supply tank to the desired temperature of the inlet fluid.

[0071] A pressure sensor was used to actively measure the pressure inside each tested pod. When the pressure inside the pod reached a specified threshold pressure, a computer control system actuated the actuation member to permit reconstituted nutritional product to flow through the outlet member and out of the pod. For these tests, the actuation member was a pneumatically-actuated ball valve.

[0072] During testing, the computer control system controlled all the inputs to the pod, monitored the pressure sensor, and pneumatically operated the actuation member in order to change the state of the actuation member to the open or closed state. The apparatus was programmed through a graphical user interface on the computer. In addition, the computer recorded temperature and pressure measurements throughout the various tests.

[0073] For all tests, powdered formula similar to Similac® Advance®, available from Abbott Laboratories, was used as the nutritional product. One serving (e.g., 35.1 grams) of powder was placed inside the pod to begin each test. The computer control system initiated a reconstitution cycle and heated water to approximately 104 °F. Next, the test apparatus injected the heated water into the pod at a flow rate of about 6 ml per second, increasing the pressure within the pod. Once the pressure sensor indicated that the pressure within the pod had reached the target pressure (e.g., 0 psig, 15 psig, or 35 psig), the computer control system opened the actuation member to allow reconstituted nutritional product to be discharged from the pod. The test apparatus continued to pump the heated water through the pod until approximately 240 ml of heated water had been introduced into the pod. Then, the test apparatus injected air into the pod to expel any remaining reconstituted nutritional product. The target final liquid temperature for the dispensed nutritional product was 100 °F +/- 5 °F. The target volume of nutritional product dispensed from the pod was 260 ml +/- 10%.

[0074] Measurements were recorded during or after each test, including the temperature of reconstituted nutritional product, the volume of reconstituted nutritional product evacuated from the pod, the volume of foam created in the dispensed nutritional product, the number of clumps larger than 1 mm in diameter evacuated from the pod into the nutritional product (i.e., dispersibility), and the mass of any nutritional powder remaining in the pod after cycle completion. The temperature and volume of reconstituted nutritional product were measured

as confirmation checks that the general operating parameters of the test apparatus noted above were acceptable for each test and consistent between successive tests.

[0075] Volume measurements were taken using a graduated cylinder. Clumps in the nutritional product were identified by pouring the reconstituted nutritional product through a sieve able to retain all clumps 1 mm and larger. The mass of nutritional powder remaining in the pod, referred to as utilization, was measured by dissolving all remaining nutritional product in water and measuring the percent solids remaining in the solution. A microwave solids analyzer was used to obtain the percent solids measurement, which was multiplied by the volume of water used to dissolve the remaining nutritional powder to calculate the utilization.

[0076] A test plan was created to allow for comparison of reconstitution performance between variations of the pod design and different actuation member opening pressures. Three pairs of pod and actuation member opening pressure configurations were selected for evaluation and are listed in Table I.

Table I

Name	Inlet Port(s)	Total Flow Rate into Pod (ml/sec)	Actuation Member Opening Pressure (psig)
Pair I-A	(1) Top	6	15
Pair I-B	(1) Top	6	0
Pair II-A	(1) Side	6	15
Pair II-B	(1) Side	6	0
Pair III-A	(1) Side	6	15
Pair III-B	(1) Side	6	35

[0077] Pair I pods were tested at actuation member opening pressures of 0 psig and 15 psig, respectively, with the test apparatus introducing fluid through the top of the pod. Pair II pods were tested at actuation member opening pressures of 0 psig and 15 psig, respectively, with the test apparatus introducing fluid through the side wall of the pod. Pair III pods were tested at actuation member opening pressures of 15 psig and 35 psig, respectively, with the test apparatus introducing fluid through the side wall of the pod. Replicates were created for each test to establish a data set that could be used for statistical analysis.

[0078] After the tests were completed, the mean value for each population was calculated. Table II lists the mean results of the tests, including the volume of foam present

in the dispensed nutritional product, the number of clumps present in the dispensed nutritional product, and the utilization.

Table II

Description	Measurements		
Name	Foam (ml)	Number of Clumps	Utilization (g)
Pair I-A	74	16	1.23
Pair I-B	68	29	0.48
Pair II-A	26	20	0.68
Pair II-B	13	84	0.34
Pair III-A	26	20	0.68
Pair III-B	22	22	0.09

[0079] Statistical analysis was performed on the experimental data. Specifically, a normality test was performed on each data set to confirm whether the population followed a normal distribution. The data was deemed to be non-normal if the normality test returned a p-value less than or equal to 0.05. Depending upon the distribution of the data set (i.e. normal or non-normal) an appropriate statistical tool was selected for comparing the probability of there being a statistical difference in the mean value of each population. For two normally distributed populations, a two-sample t-test was performed with a significance level of five percent. For a comparison involving at least one non-normal data set, a Mann-Whitney test was performed to compare the mean values of the two data sets. The confidence level for the Mann-Whitney test was established as ninety-five percent.

[0080] The p-values or equivalent p-values generated by the two-sample t-tests and Mann-Whitney tests are provided in Table III. If the two-sample t-test or Mann-Whitney test returned a p-value less than or equal to 0.05, then the difference in the mean values of the two compared populations was considered to be statistically significant. If the two-sample t-test or Mann-Whitney test returned a p-value greater than 0.05, then the difference in the mean values of the two compared populations was not considered to be statistically significant.

Table III

Description	Pair I-A vs. Pair I-B	Pair II-A vs. Pair II-B	Pair III-A vs. Pair III-B
Foam	0.121	0.013	0.230
Number of Clumps	0.017	0.002	0.799
Utilization	0.014	0.083	0.010

[0081] From the first experimental pair (Pair I), in which the test apparatus introduced fluid through the top of the pod, it was unexpectedly discovered that opening the actuation member once the internal pod pressure reached 15 psig (Pair I-A) advantageously reduced clumping in the dispensed nutritional product. From the second experimental pair (Pair II), in which the test apparatus introduced fluid through the side wall of the pod, it was again unexpectedly discovered that opening the actuation member once the internal pod pressure reached 15 psig (Pair II-A) reduced clumping. From the third experimental pair (Pair III), in which the test apparatus again introduced fluid through the side wall of the pod, it was unexpectedly discovered that opening the actuation member once the internal pod pressure reached 35 psig (Pair III-B) improved nutritional powder utilization over a 15 psig opening pressure (Pair III-A).

[0082] The tests demonstrated that opening the actuating member at an elevated pressure of 15 psig reduced the overall number of clumps appearing in the reconstituted nutritional product as compared to opening the actuating member at atmospheric pressure. When fewer clumps appear in the dispensed nutritional product, more of the nutritional powder has been fully reconstituted, achieving a more accurate mixing ratio and a more homogeneous product. In addition, the tests demonstrated that opening the actuating member at an even higher pressure of 35 psig improved utilization of nutritional powder in the pod as compared to opening the actuating member at 15 psig.

[0083] FIGS. 16a-23 illustrate various additional features that may be incorporated, alone or in combination, into any of the pods described herein.

[0084] With reference to FIGS. 16a and 16b, any of the pods described herein may further include a screen 101 (FIG. 16a) or a soluble membrane 103 (FIG. 16b) at the first end of the outlet member 60 to inhibit nutritional powder from entering the outlet member 60 before being reconstituted. The screen 101 may include a metal or polymer mesh, a paper, fabric, or fiber filter, or any other means for substantially inhibiting particles ranging from approximately 10 microns to approximately 500 microns or larger from passing through into the outlet member 60. The soluble membrane 103 at least partially dissolves once exposed to the water or other fluid introduced into the pod during operation of the fluid dispensing device 15. The screen 101 and the soluble membrane 103 may reduce the likelihood of the actuation member 65 becoming clogged with nutritional powder prior to use. Alternatively, the screen 101 or membrane 103 can be positioned within the outlet member 60 nearer the

actuation member 65, either on an upstream or downstream side. In some embodiments, the soluble membrane 103 may be replaced by a pressure and/or temperature sensitive burst disk, such as those previously described with reference to FIGS. 8a and 8b.

[0085] Referring to FIGS. 17a and 17b, any of the pods described herein may include an end seal 105 at the second end of the outlet member 60. The end seal 105 inhibits foreign matter from entering the outlet member 60 through the second end to maintain a sanitary environment within the outlet member 60. In one embodiment, the end seal 105 is a metal foil or polymer film adhered to the second end. Before use, the seal 105 is removed (e.g., peeled off) by a user (FIG. 17b). Alternatively, the seal 105 may be configured to rupture when exposed to a predetermined pressure or temperature, or the seal 105 may be a soluble membrane that at least partially dissolves once exposed to the water or other fluid introduced into the pod, or the reconstituted contents within the pod, during operation. In other embodiments, the end seal 105 can be a plug or solid tip that is cut off by the user or by a cutting apparatus included on the dispensing device 15 before the pod is used, or otherwise removed by engagement with a portion of the dispensing device 15 during operation. The plug or solid tip can be integrally formed with the second end of the outlet member 60 or can be otherwise affixed to the second end. For example, the second end may be dipped in wax to provide a solid tip or plug on the second end.

[0086] Referring to FIGS. 18-21, any of the pods described herein may include one or more mixing or flow affecting features located within the outlet member 60. These features may facilitate mixing of the nutritional powder or concentrate liquid with the fluid injected into the pod, minimize foaming that may occur when the nutritional product is dispensed into the drinking vessel 25 (FIG. 1), inhibit gurgling within the outlet member 60, or further streamline the flow of fluid as it is dispensed from the outlet member 60.

[0087] Referring to FIG. 18, in one embodiment, the outlet member 60 includes a flow-affecting portion 107 having a plurality of internal, helical depressions 109. Helical ridges 111 are formed between adjacent depressions. The depressions 109 and ridges 111 create rifling within the outlet member 60 and influence the fluid flow through the outlet member 60 to induce a swirling or vortex effect within the fluid. The flow-affecting portion 107 of FIG. 18 may advantageously be positioned downstream of the actuation member 65 in order to reduce turbulence in the fluid before it is dispensed through the second end of the outlet member 60. This in turn may reduce overspray or undesirable foaming.

[0088] Referring to FIG. 19, in another embodiment, baffles 113 are integrally formed along an inner circumferential surface of the outlet member 60 and are positioned within the outlet member 60 to agitate fluid flowing through the outlet member 60. Each of the baffles 113 includes an upstream surface and a downstream surface as referenced with respect to the direction of fluid flow through the outlet member 60. The baffles 113 may be positioned proximate the first end of the outlet member 60 upstream of the actuation member 65 to provide additional mixing before the reconstituted nutritional formula flows through the actuation member 65. Alternatively or additionally, the baffles 113 may be positioned proximate the second end, downstream of the actuation member 65 to provide additional mixing after the nutritional formula flows through the actuation member 65. In the illustrated embodiment, each of the baffles 113 is substantially planar and is oriented perpendicular to the longitudinal axis of the outlet member 60. Alternatively, one or more of the baffles 113 may have an arcuate shape. In some embodiments, the upstream surface of one or more of the baffles 113 may be angled between approximately 30 degrees and approximately 45 degrees with respect to the longitudinal axis. In other embodiments, the upstream surface of one or more of the baffles 113 may be angled between approximately 10 degrees and approximately 35 degrees with respect to the axis. The illustrated baffles 113 are staggered such that each baffle at least partially overlaps in the axial direction (i.e. along the longitudinal axis). Alternatively, the baffles 113 may be positioned so that the baffles do not overlap in the axial direction.

[0089] Referring to FIGS. 20 and 21, in another embodiment, the cross-sectional area of the outlet member 60 may vary along the length of the output member. The cross-sectional area may vary due to a varying wall thickness along the outlet member 60 or due to a varying diameter of the outlet member 60. Additionally or alternatively, the cross-sectional shape of the outlet member 60 may vary along the length of the output member. In the embodiment illustrated in FIG. 20, the outlet member 60 converges and diverges to create a venturi or half-venturi effect that promotes mixing. In the embodiment illustrated in FIG. 21, the outlet member 60 is generally frustoconical or tapered and converges at a constant rate.

[0090] FIG. 22 illustrates a pod 320 according to another embodiment. A plurality of engagement members 115 in the form of fins or keys extends along the side wall 50 between the flange 55 and the bottom wall 45. The engagement members 115 cooperate with corresponding keyways located in a pod receptacle (not shown) of the beverage dispensing

device 15 to releasably couple the pod 320 and the beverage dispensing device 15, and/or to orient and/or stabilize the pod 320 within the beverage dispensing device 15. The engagement members 115 can be integrally formed with the side wall 50 or the bottom wall 45 or can be affixed to either via any suitable means, such as welding, to include induction welding, ultrasonic welding, conduction welding, or rotational welding. Although illustrated as fins, the engagement members 115 can be of various shapes, e.g., knobs, blocks, ridges, or any form of projection. In some applications, only one engagement member 115' is associated with the container body 30 (FIG. 23). In the embodiment of a pod 420 illustrated in FIG. 23, the engagement member 115' is a rounded lobe that cooperates with a corresponding keyway (not shown) in the pod receptacle.

[0091] With reference to FIG. 24, in one embodiment, a pod 520 includes a plurality of circumferentially-spaced engagement members 117 that extends axially along the exterior of the outlet member 60. The engagement members 117 provide spacing between the outlet member 60 and the beverage dispensing device 15 to reduce the likelihood of the dispensed nutritional product coming into contact with any portion of the beverage dispensing device 15. Furthermore, the engagement members 117 may serve to orient and/or stabilize the pod 520 within the beverage dispensing device 15. The engagement members 117 can be integrally formed with the outlet member 60 or can be affixed to the outlet member 60 via any suitable means, such as welding as previously described. Although illustrated as fins, the engagement members 117 can be of various shapes, e.g., knobs, blocks, ridges, or any form of projection.

[0092] In operation, at the direction of a user, the beverage dispensing device 15 (FIG. 1) commences a reconstitution process that combines fluid with a beverage base (e.g., solid powder or liquid concentrate) to produce a nutritional product. The beverage dispensing system 10 may produce infusion-type beverages including coffee and tea, mixed beverages such as sports drinks, specialty beverages for infants or toddlers, or other beverages types.

[0093] The user selects a pod 20, 120, 220, 320, 420, 520 for a particular beverage, pours a quantity of fluid (e.g., water) into a reservoir (not shown) of the fluid dispensing device 15, and initiates operation of the system 10 (e.g., via a user interface, not shown). The fluid may be heated or cooled, after which it is pumped or otherwise displaced through an injector (not shown) and into the pod, for mixing with the nutritional powder or liquid concentrate within the pod. After a predetermined time period and/or in response to a predetermined pressure or

environmental condition(s), the actuation member 65 opens to allow the nutritional powder or liquid concentrate, now reconstituted with the fluid, to flow through the outlet member 60. The nutritional product is dispensed into the drinking vessel 25 for eventual consumption. The pod may then be removed from the fluid dispensing device 15 and discarded. As discussed above, the fluid dispensing system 10 is configured such that during the course of ordinary operation the nutritional product does not come into direct contact with any components of the fluid dispensing device 15.

[0094] Thus, in one aspect, a nutritional powder pod for use with a beverage dispensing device includes a body at least partially defining an enclosed volume, and an outlet member extending from the body and in fluid communication with the enclosed volume. The outlet member has a first end and a second end, and the first end is disposed adjacent the body. The nutritional powder pod further includes an actuation member at least partially positioned within the outlet member between the first end and the second end and configured to selectively control the flow of fluid through the outlet member.

[0095] In some aspects, the first end is integrally formed as one piece with the body.

[0096] In some aspects, the actuation member is a pressure-activated actuation member.

[0097] In some aspects, the actuation member is a valve.

[0098] In some aspects, the valve is a one-way valve.

[0099] In some aspects, the valve is a check ball valve.

[00100] In some aspects, the valve is a flapper valve.

[00101] In some aspects, the valve is a diaphragm valve.

[00102] In some aspects, the valve is a butterfly valve.

[00103] In some aspects, the valve is a globe valve.

[00104] In some aspects, the valve is a gate valve.

[00105] In some aspects, the valve is a reed valve.

[00106] In some aspects, the valve is a duck-bill valve.

[00107] In some aspects, the actuation member is a burst disk.

[00108] In some aspects, the burst disk is a foil burst disk.

[00109] In some aspects, the actuation member is configured to permit the flow of fluid from the first end toward the second end and impede the flow of fluid from the second end toward the first end.

[00110] In some aspects, the actuation member is actuatable between an open configuration, wherein fluid is permitted to flow between the first end and the second end, and a closed configuration, wherein fluid is not permitted to flow between the first end and the second end.

[00111] In some aspects, the actuation member is actuatable between the open configuration and the closed configuration based at least in part on a temperature of fluid in contact with the actuation member.

[00112] In some aspects, the actuation member is actuatable between the open configuration and the closed configuration based at least in part on a pressure of fluid in contact with the actuation member.

[00113] In some aspects, the actuation member is actuatable between the open configuration and the closed configuration in response to fluid contact.

[00114] In some aspects, the actuation member is actuatable between the open configuration and the closed configuration based at least in part on a mechanical input from the beverage dispensing device.

[00115] In some aspects, the enclosed volume is configured to temporarily retain a reconstituted formula, wherein the actuation member is configured to dispense the reconstituted formula from the enclosed volume in the open configuration, and further wherein the outlet member is positioned with respect to the beverage dispensing device such that the entirety of the reconstituted formula is dispensed free of contact with the beverage dispensing device.

[00116] In some aspects, the outlet member is positioned with respect to the fluid dispensing device such that the fluid dispensing device actuates the actuation member from

the closed configuration to the open configuration free of any contact with the reconstituted formula.

[00117] In some aspects, the actuation member is actuatable between the open configuration and the closed configuration by rotating the second end with respect to the first end.

[00118] In some aspects, the pod further includes a mesh screen positioned at least partially within the outlet member between the first end and the second end.

[00119] In some aspects, the mesh screen is positioned proximate the first end.

[00120] In some aspects, the mesh screen is positioned proximate the second end.

[00121] In some aspects, the mesh screen is positioned upstream of the actuation member.

[00122] In some aspects, the mesh screen is positioned downstream of the actuation member.

[00123] In some aspects, the valve is a first valve, the pod further comprising a second valve positioned within the outlet member between the first end and the second end.

[00124] In some aspects, the first valve is a water soluble valve positioned proximate the first end, and the second valve is a one-way valve positioned downstream of the first valve.

[00125] In some aspects, the first valve is a pressure-actuated valve positioned proximate the first end, and the second valve is a one-way valve positioned downstream of the first valve.

[00126] In some aspects, the first valve is a water soluble valve positioned proximate the first end, and the second valve is a beverage dispensing device-actuated valve positioned downstream of the first valve.

[00127] In some aspects, the first valve is a pressure-actuated valve positioned proximate the first end, and the second valve is a beverage dispensing device-actuated valve positioned downstream of the first valve.

[00128] In some aspects, at least one of the first valve and the second valve are actuated between an open position and a closed position by the beverage dispensing device.

[00129] In some aspects, the enclosed volume is configured to temporarily retain a reconstituted fluid therein, and wherein the beverage dispensing device actuates the at least one of the first valve and the second valve free of contact from the reconstituted formula.

[00130] In some aspects, the pod further includes a seal removably coupled to the second end.

[00131] In some aspects, the seal includes a wax plug.

[00132] In some aspects, the seal is configured for mechanical removal from the second end.

[00133] In some aspects, the seal is positioned downstream of the actuation member.

[00134] In some aspects, the pod further includes a mesh screen, and wherein the seal is positioned downstream of the mesh screen.

[00135] In some aspects, the outlet member is greater than 5 mm in length.

[00136] In some aspects, the outlet member is greater than 10 mm in length.

[00137] In some aspects, the outlet member is greater than 20 mm in length.

[00138] In some aspects, an inner diameter of the outlet member is greater than 4 mm.

[00139] In some aspects, the pod includes a generally arcuate bottom wall and a side wall side wall extending from the bottom wall to form a flange, wherein the pod defines a height between the bottom wall and the flange, and wherein a length of the outlet member is greater than the height of the pod.

[00140] In some aspects, the pod includes a generally arcuate bottom wall and a side wall side wall extending from the bottom wall to form a flange, wherein the pod defines a height between the bottom wall and the flange, and wherein a length of the outlet member is greater than half the height of the pod.

[00141] In some aspects, the pod includes an open upper end defining a first outer diameter, and wherein an inner diameter of the outlet member is greater than one-third of the first outer diameter of the pod.

[00142] In some aspects, the pod includes an open upper end defining a first outer diameter, and wherein an inner diameter of the outlet member is greater than one-sixth of the first outer diameter of the pod.

[00143] In some aspects, the outlet member is circular in cross-section.

[00144] In some aspects, the outlet member is elliptical in cross-section.

[00145] In some aspects, the outlet member is elongated in cross-section.

[00146] In some aspects, the outlet member includes an integrally formed baffle configured to agitate any fluid flowing therethrough.

[00147] In some aspects, the baffle is positioned proximate the first end.

[00148] In some aspects, the baffle is positioned proximate the second end.

[00149] In some aspects, the outlet member defines an axis along its length, and wherein the baffle is substantially planar and oriented at an angle with respect to the axis.

[00150] In some aspects, an upstream surface of the baffle is angled from 30 degrees to 45 degrees with respect to the axis.

[00151] In some aspects, an upstream surface of the baffle is angled from 10 degrees to 35 degrees with respect to the axis.

[00152] In some aspects, the baffle is perpendicular to the axis.

[00153] In some aspects, the baffle is positioned upstream of the actuation member.

[00154] In some aspects, the baffle is positioned downstream of the actuation member.

[00155] In some aspects, the baffle is substantially planar.

[00156] In some aspects, the baffle is arcuate.

[00157] In some aspects, the baffle is one of a plurality of baffles, wherein each baffle is positioned along an inner circumference of the outlet member, and wherein each baffle at least partially overlaps in the axial direction.

[00158] In some aspects, the baffle is one of a plurality of baffles, wherein each baffle is positioned along the inner circumference of the outlet member, and wherein each baffle does not overlaps adjacent baffles in an axial direction.

[00159] In some aspects, the baffle is positioned upstream of a screen mesh.

[00160] In some aspects, the baffle is positioned downstream of a screen mesh.

[00161] In some aspects, the pod also includes an engagement member configured to engage and orient a portion of the pod within the beverage dispensing device.

[00162] In some aspects, the engagement member is integrally formed as one piece with the pod.

[00163] In some aspects, the engagement member is welded to the pod.

[00164] In some aspects, the engagement member is a substantially planar fin.

[00165] In some aspects, the engagement member is a knob.

[00166] In some aspects, the engagement member releasably couples the pod to the dispensing device.

[00167] In some aspects, the pod includes a generally arcuate bottom wall and a side wall extending from the bottom wall, and wherein the engagement member is positioned along the side wall.

[00168] In some aspects, the pod includes a generally arcuate bottom wall and a side wall extending from the bottom wall, and wherein the first end of the outlet member is coupled to the bottom wall.

[00169] In some aspects, the outlet member extends normally to the arcuate bottom wall.

[00170] In some aspects, the outlet member extends from the arcuate bottom wall at an angle less than 90 degrees.

[00171] In some aspects, the outlet member extends from the arcuate bottom wall at an angle of between 60 degrees and 30 degrees.

[00172] In some aspects, the pod includes a generally arcuate bottom wall and a side wall extending from the bottom wall, and wherein the first end of the outlet member is coupled to the side wall.

[00173] In another aspect, a pod for use with a beverage dispensing device includes a body at least partially defining an enclosed volume, and an outlet member extending from the body and in fluid communication with the enclosed volume. The outlet member has a first end and a second end. The first end is disposed adjacent the body. The pod further includes an actuation member at least partially positioned within the outlet member between the first end and the second end and configured to selectively control the flow of fluid through the outlet member. The enclosed volume is configured to temporarily retain a reconstituted formula and the actuation member is configured to dispense the reconstituted formula from the enclosed volume in an open configuration. The outlet member is positioned with respect to the beverage dispensing device such that the entirety of the reconstituted formula is dispensed free of contact with the beverage dispensing device.

[00174] In some aspects, the actuation member is a one-way valve.

[00175] In some aspects, the actuation member is actuatable between an open configuration, wherein fluid is permitted to flow between the first end and the second end, and a closed configuration, wherein fluid is not permitted to flow between the first end and the second end.

[00176] In some aspects, the outlet member is positioned with respect to the beverage dispensing device such that the beverage dispensing device can actuate the actuation member between the open configuration and the closed configuration.

[00177] In some aspects, the actuation member is a duck-bill valve.

[00178] In some aspects, the actuation member is a check ball valve.

[00179] In some aspects, the actuation member is a flapper valve.

[00180] In some aspects, the actuation member is a diaphragm valve.

[00181] In some aspects, the actuation member is a butterfly valve.

[00182] In some aspects, the actuation member is a gate valve.

[00183] In some aspects, the pod also includes a baffle positioned at least partially within the outlet member between the first end and the second end, wherein the baffle is configured to agitate fluid flowing through the outlet member.

[00184] In some aspects, the pod also includes a mesh screen positioned at least partially within the outlet member between the first end and the second end.

[00185] In some aspects, the pod also includes a flow-affecting portion disposed between the first end and the second end of the outlet member, the flow-affecting portion including rifling within the outlet member to induce swirling in fluid flowing through the outlet member.

[00186] In another aspect, a pod for use with a beverage dispensing device includes a body having a generally arcuate bottom wall and a side wall extending from the bottom wall to at least partially define an enclosed volume. The pod also includes an engagement member formed or coupled to one of the bottom wall and the side wall. The engagement member is configured to engage a portion of the beverage dispensing device and orient the pod with respect thereto. The pod also includes an outlet member extending from the body and in fluid communication with the enclosed volume, the outlet member having a first end and a second end, the first end disposed adjacent the body. The enclosed volume is configured to temporarily retain a reconstituted formula for dispensing from the pod, and the outlet member is positioned with respect to the beverage dispensing device such that the entirety of the reconstituted formula is dispensable free of contact from the beverage dispensing device.

[00187] In some aspects, the pod also includes an actuation member at least partially positioned within the outlet member between the first end and the second end and configured to selectively control the flow of fluid through the outlet member.

[00188] In some aspects, the engagement member is integrally formed as one piece with the body.

[00189] In some aspects, the engagement member is welded to the body.

[00190] In some aspects, the engagement member is positioned proximate the side wall of the body.

[00191] In some aspects, the engagement member releasably couples the pod and the beverage dispensing device.

[00192] In some aspects, the engagement member is a substantially planar fin.

[00193] In some aspects, the engagement member is a knob.

[00194] In some aspects, the actuation member is a gate valve.

[00195] In some aspects, the actuation member is a one-way valve.

[00196] In some aspects, the one-way valve is a duck-bill valve.

[00197] In some aspects, the one-way valve is a check ball valve.

[00198] In some aspects, the one-way valve is a flapper valve.

[00199] In some aspects, the one-way valve is a diaphragm valve.

[00200] In some aspects, the one-way valve is a butterfly valve.

[00201] In some aspects, the one-way valve is a reed valve.

[00202] In some aspects, the pod also includes a baffle positioned at least partially within the outlet member between the first end and the second end, the baffle configured to agitate fluid flowing through the outlet member.

[00203] In some aspects, the pod also includes a flow-affecting portion disposed between the first end and the second end of the outlet member, the flow-affecting portion including rifling within the outlet member to induce swirling in fluid flowing through the outlet member.

[00204] In another aspect, a pod for use with a beverage dispensing device includes a body having a first wall and a second wall extending from the first wall to at least partially define an enclosed volume, and an outlet member extending from the body and in fluid communication with the enclosed volume. The outlet member includes a first end disposed

adjacent the body, a second end opposite the first end, and a flow-affecting portion disposed between the first end and the second end, the flow-affecting portion including rifling within the outlet member positioned to induce swirling in fluid flowing through the outlet member.

[00205] In another aspect, a nutritional powder pod for use with a beverage dispensing device includes a body at least partially defining an enclosed volume, and an outlet member extending from the body and in fluid communication with the enclosed volume. The outlet member has a first end and a second end. The first end is disposed adjacent the body. The nutritional powder pod further includes an actuation member in operable contact with the outlet member and movable between an open configuration in which fluid is permitted to flow between the first end and the second end, and a closed configuration in which fluid is not permitted to flow between the first end and the second end.

[00206] In some aspects, the actuation member is configured to compress the outlet member to restrict the flow of fluid therethrough in the closed configuration.

[00207] In some aspects, the actuation member is removed from the outlet member in the open configuration.

[00208] In some aspects, the actuation member is actuatable between the open configuration and the closed configuration based at least in part on a mechanical input from the beverage dispensing device.

[00209] In some aspects, the actuation member is in operable rotational contact with the outlet member.

[00210] Various features of the invention are set forth in the following claims.

WHAT IS CLAIMED IS:

1. A nutritional powder pod for use with a beverage dispensing device, the pod comprising:
 - a body at least partially defining an enclosed volume;
 - an outlet member extending from the body and in fluid communication with the enclosed volume, the outlet member having a first end and a second end, the first end disposed adjacent the body; and
 - an actuation member at least partially positioned within the outlet member between the first end and the second end and configured to selectively control the flow of fluid through the outlet member.
2. The pod of claim 1, wherein the first end is integrally formed as one piece with the body.
3. The pod of claim 1, wherein the actuation member is a pressure-activated actuation member.
4. The pod of claim 1, wherein the actuation member is a valve.
5. The pod of claim 1, wherein the actuation member is actuatable between an open configuration, wherein fluid is permitted to flow between the first end and the second end, and a closed configuration, wherein fluid is not permitted to flow between the first end and the second end.
6. The pod of claim 5, wherein the actuation member is actuatable between the open configuration and the closed configuration based at least in part on a temperature of fluid in contact with the actuation member.
7. The pod of claim 5, wherein the actuation member is actuatable between the open configuration and the closed configuration based at least in part on a pressure of fluid in contact with the actuation member.
8. The pod of claim 5, wherein the actuation member is actuatable between the open configuration and the closed configuration in response to fluid contact.

9. The pod of claim 5, wherein the actuation member is actuatable between the open configuration and the closed configuration based at least in part on a mechanical input from the beverage dispensing device.
10. The pod of claim 9, wherein the enclosed volume is configured to temporarily retain a reconstituted formula, wherein the actuation member is configured to dispense the reconstituted formula from the enclosed volume in the open configuration, and further wherein the outlet member is positioned with respect to the beverage dispensing device such that the entirety of the reconstituted formula is dispensed free of contact with the beverage dispensing device.
11. The pod of claim 10, wherein the outlet member is positioned with respect to the fluid dispensing device such that the fluid dispensing device actuates the actuation member from the closed configuration to the open configuration free of any contact with the reconstituted formula.
12. The pod of claim 5, wherein the actuation member is actuatable between the open configuration and the closed configuration by rotating the second end with respect to the first end.
13. The pod of claim 4, wherein the valve is a first valve, the pod further comprising a second valve positioned within the outlet member between the first end and the second end.
14. A pod for use with a beverage dispensing device, the pod comprising:
a body at least partially defining an enclosed volume;
an outlet member extending from the body and in fluid communication with the enclosed volume, the outlet member having a first end and a second end, the first end disposed adjacent the body; and
an actuation member at least partially positioned within the outlet member between the first end and the second end and configured to selectively control the flow of fluid through the outlet member,
wherein the enclosed volume is configured to temporarily retain a reconstituted formula and the actuation member is configured to dispense the reconstituted formula from the enclosed volume in an open configuration, and wherein the outlet member is positioned with respect to the beverage dispensing device such that the entirety of the reconstituted formula is dispensed free of contact with the beverage dispensing device.

15. The pod of claim 14, wherein the actuation member is actuatable between an open configuration, wherein fluid is permitted to flow between the first end and the second end, and a closed configuration, wherein fluid is not permitted to flow between the first end and the second end.
16. The pod of claim 15, wherein the outlet member is positioned with respect to the beverage dispensing device such that the beverage dispensing device can actuate the actuation member between the open configuration and the closed configuration.
17. A pod for use with a beverage dispensing device, the pod comprising:
a body having a generally arcuate bottom wall and a side wall extending from the bottom wall to at least partially define an enclosed volume;
an engagement member formed or coupled to one of the bottom wall and the side wall, the engagement member configured to engage a portion of the beverage dispensing device and orient the pod with respect thereto; and
an outlet member extending from the body and in fluid communication with the enclosed volume, the outlet member having a first end and a second end, the first end disposed adjacent the body,
wherein the enclosed volume is configured to temporarily retain a reconstituted formula for dispensing from the pod, and wherein the outlet member is positioned with respect to the beverage dispensing device such that the entirety of the reconstituted formula is dispensable free of contact from the beverage dispensing device.
18. The pod of claim 17, further comprising an actuation member at least partially positioned within the outlet member between the first end and the second end and configured to selectively control the flow of fluid through the outlet member.
19. The pod of claim 17, wherein the engagement member is integrally formed as one piece with the body.
20. The pod of claim 17, wherein the engagement member releasably couples the pod and the beverage dispensing device.

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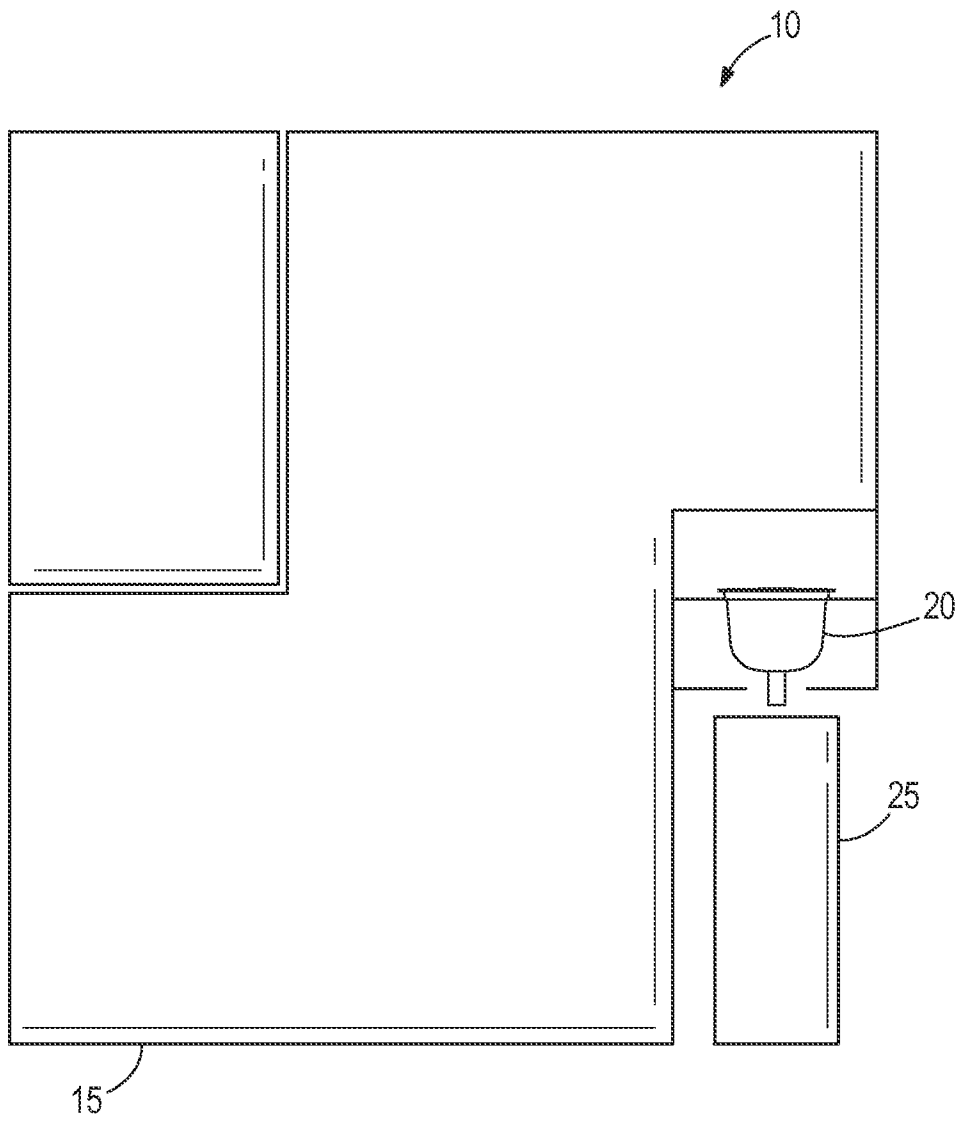


FIG. 1

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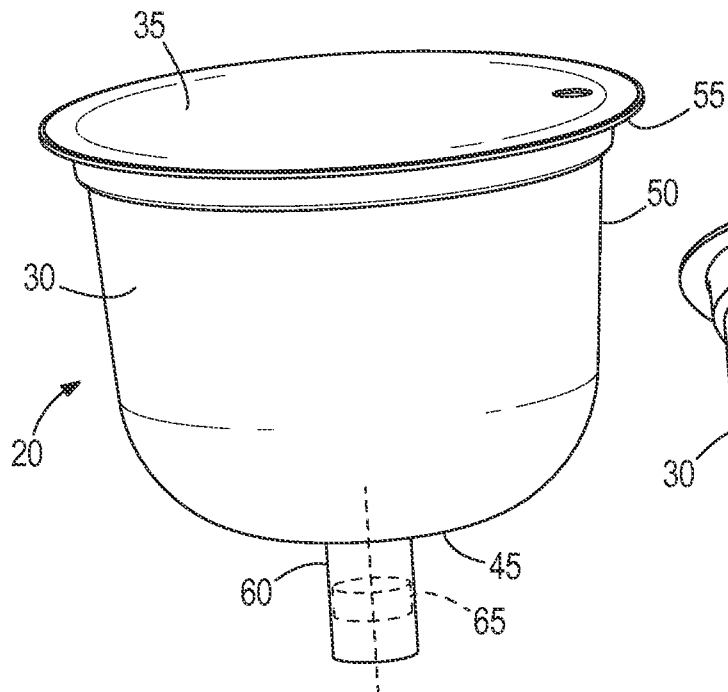


FIG. 2a

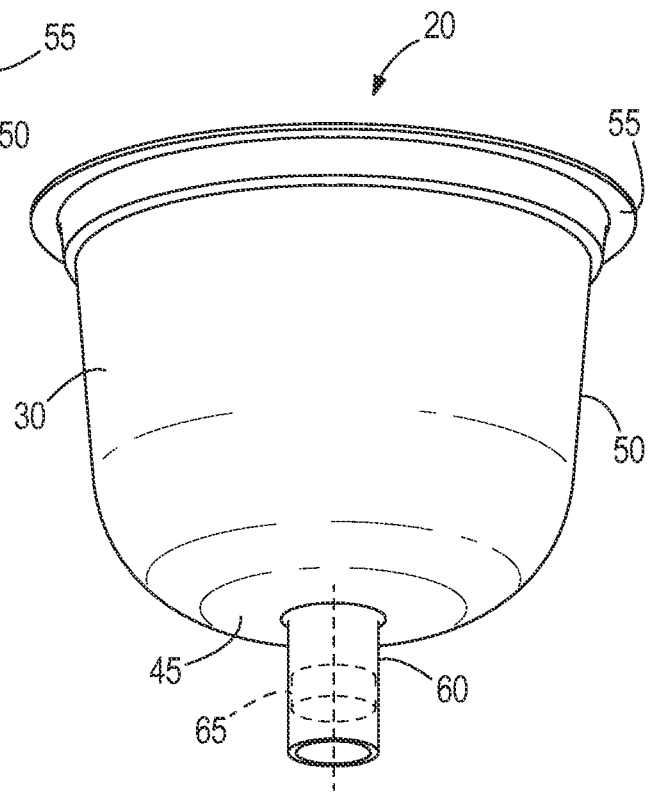


FIG. 2b

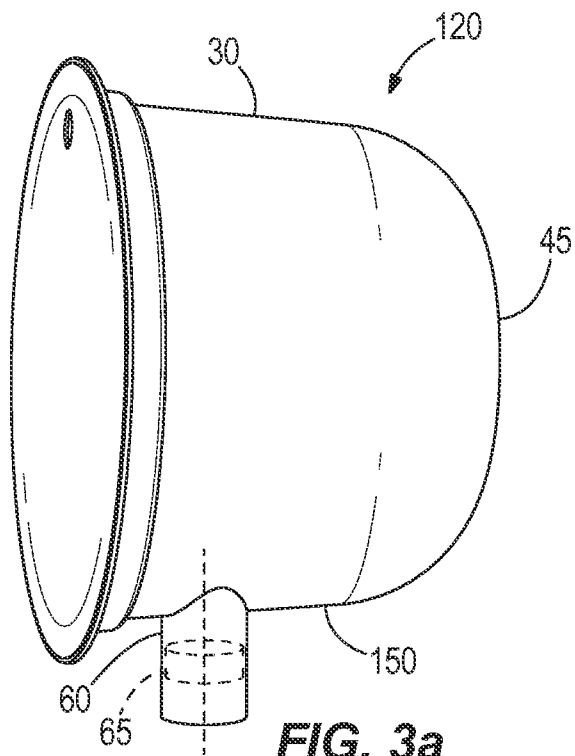


FIG. 3a

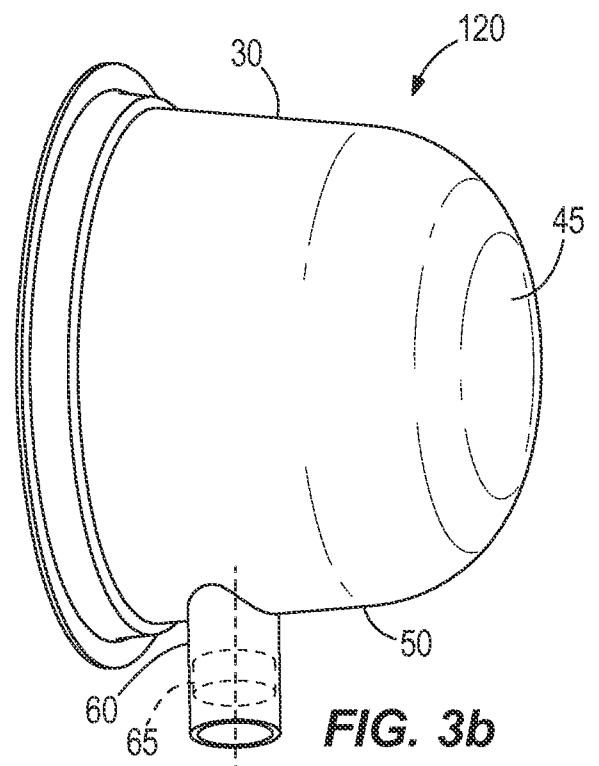
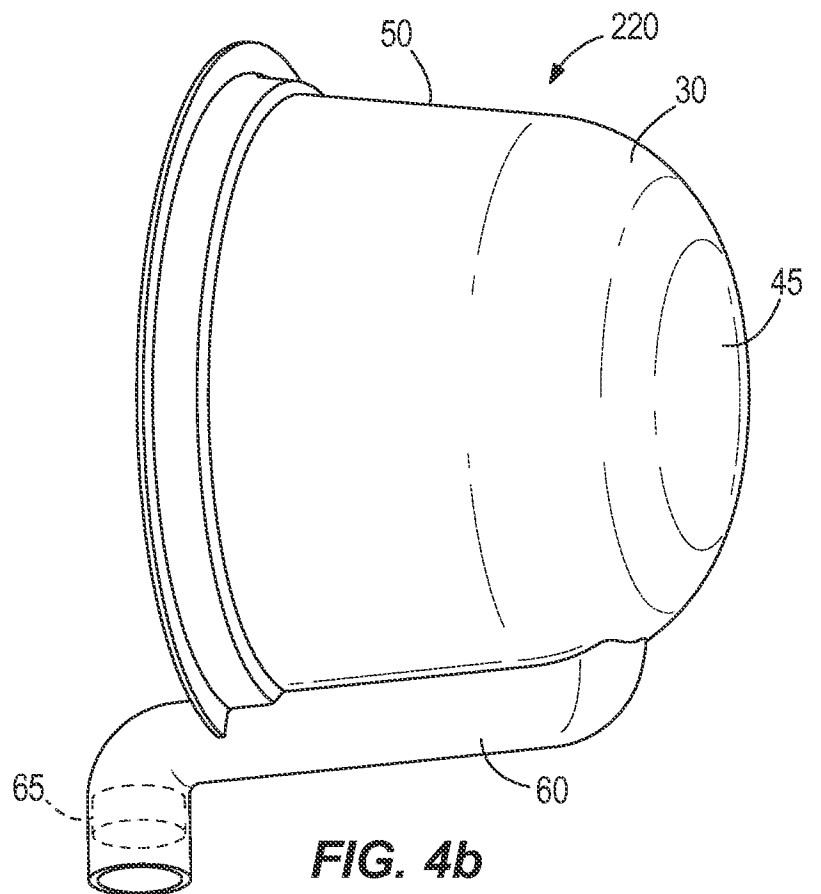
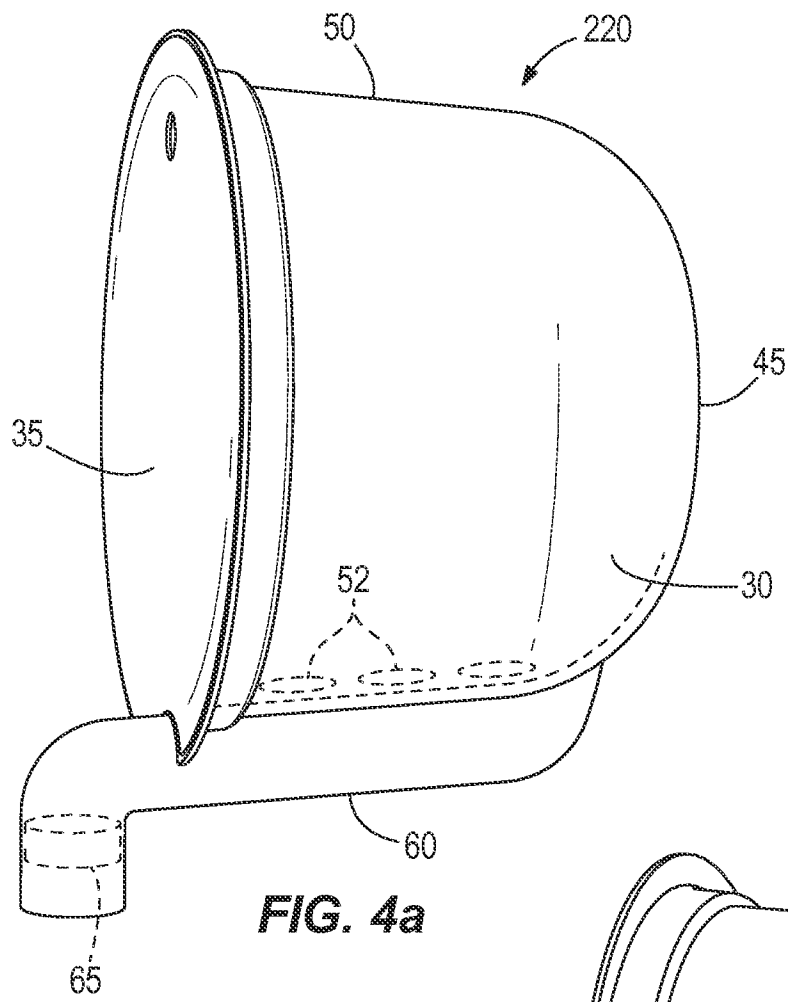


FIG. 3b

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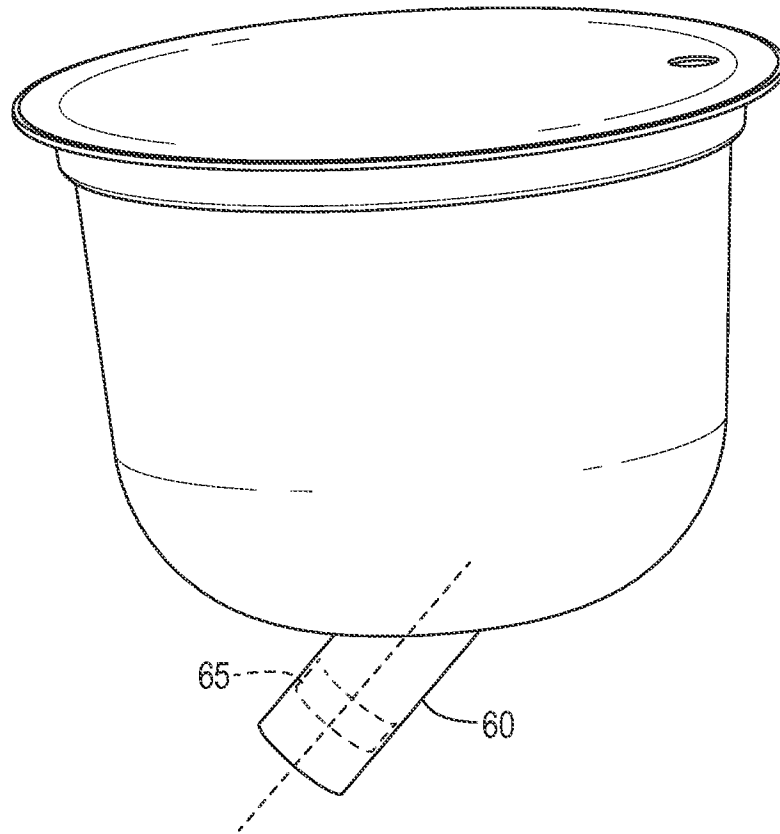


FIG. 5

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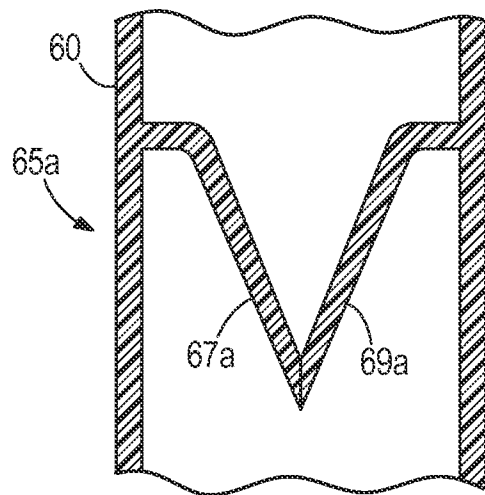


FIG. 6a

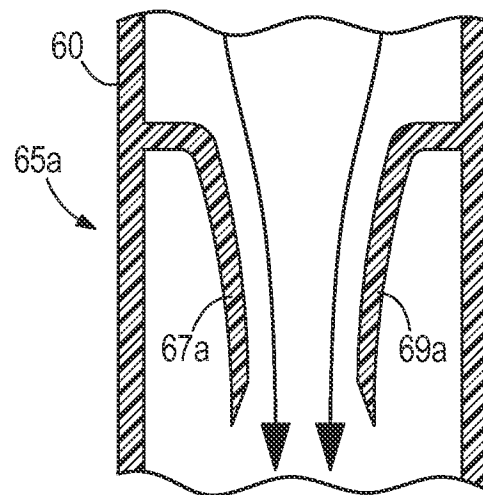


FIG. 6b

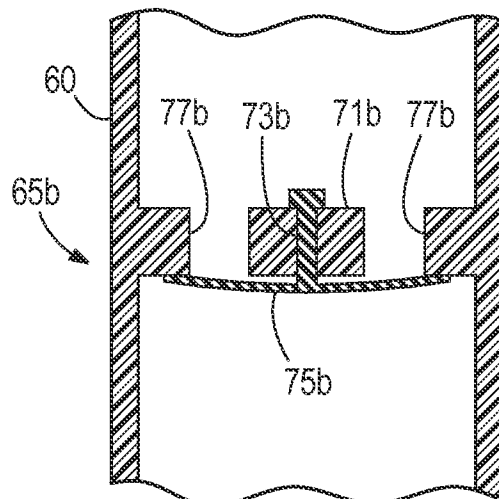


FIG. 7a

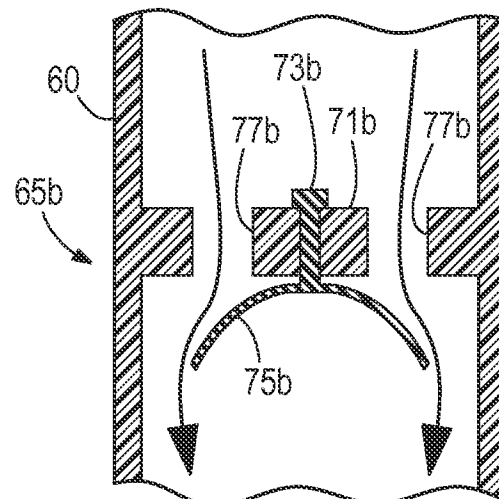


FIG. 7b

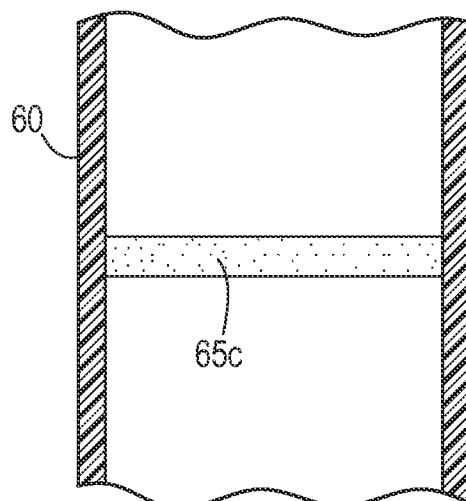


FIG. 8a

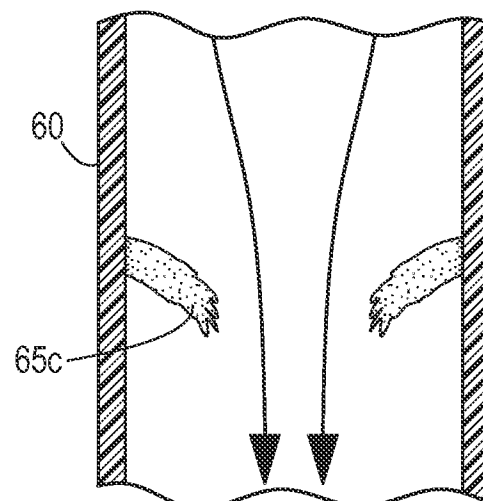


FIG. 8b

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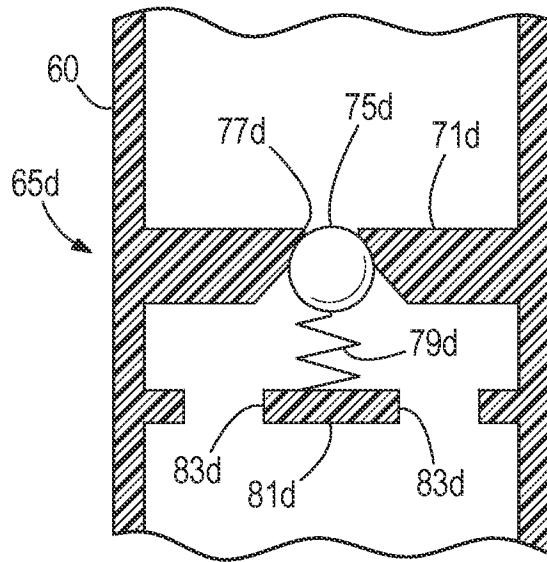


FIG. 9a

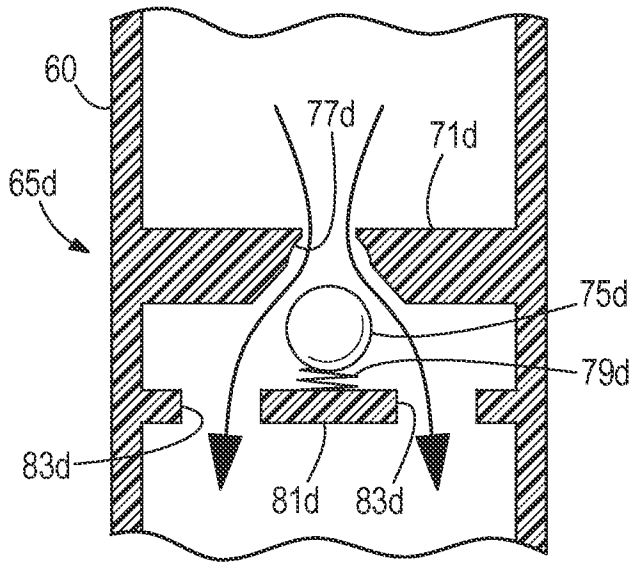


FIG. 9b

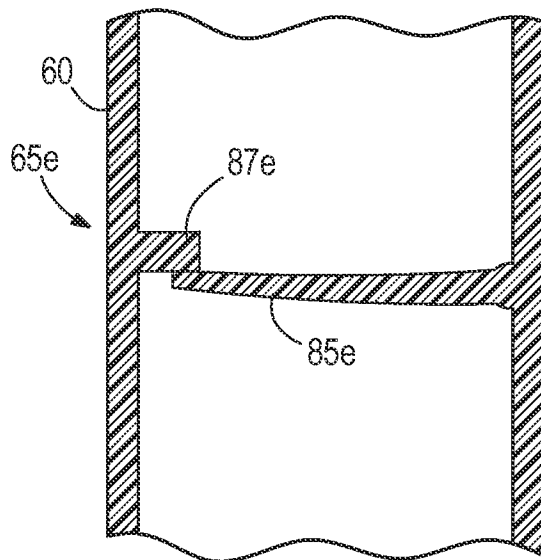


FIG. 10a

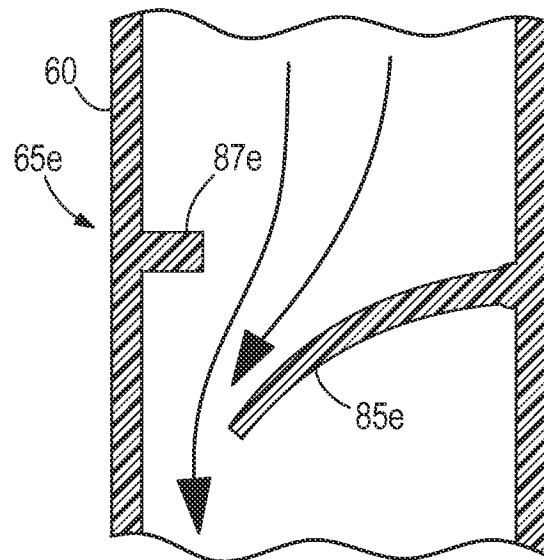
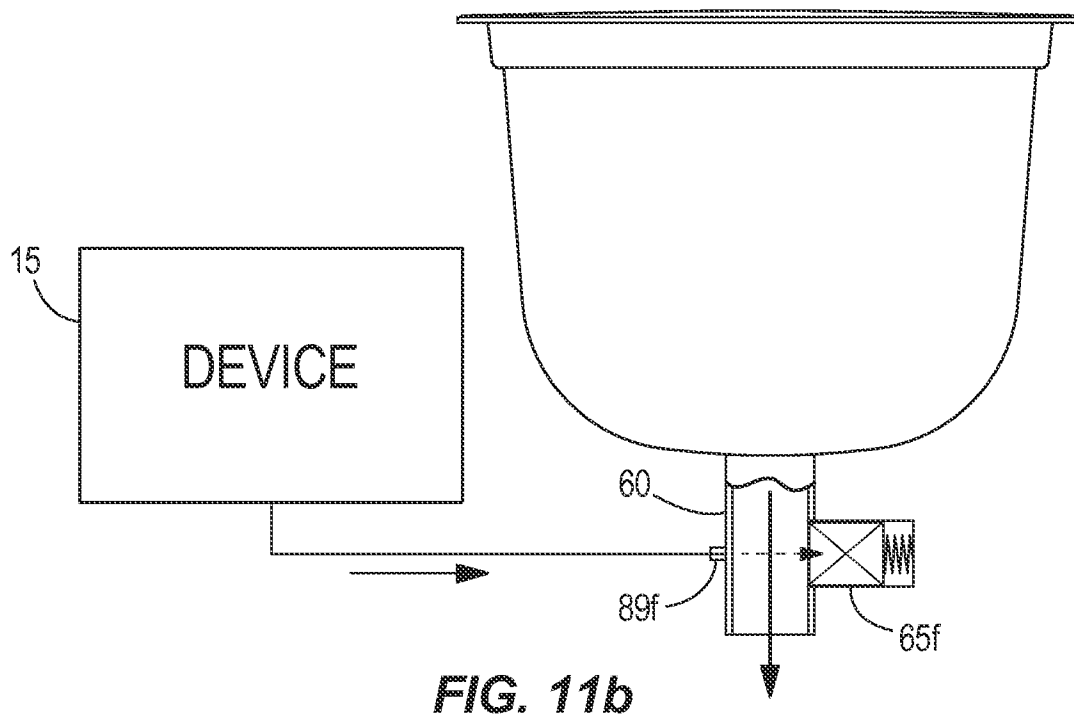
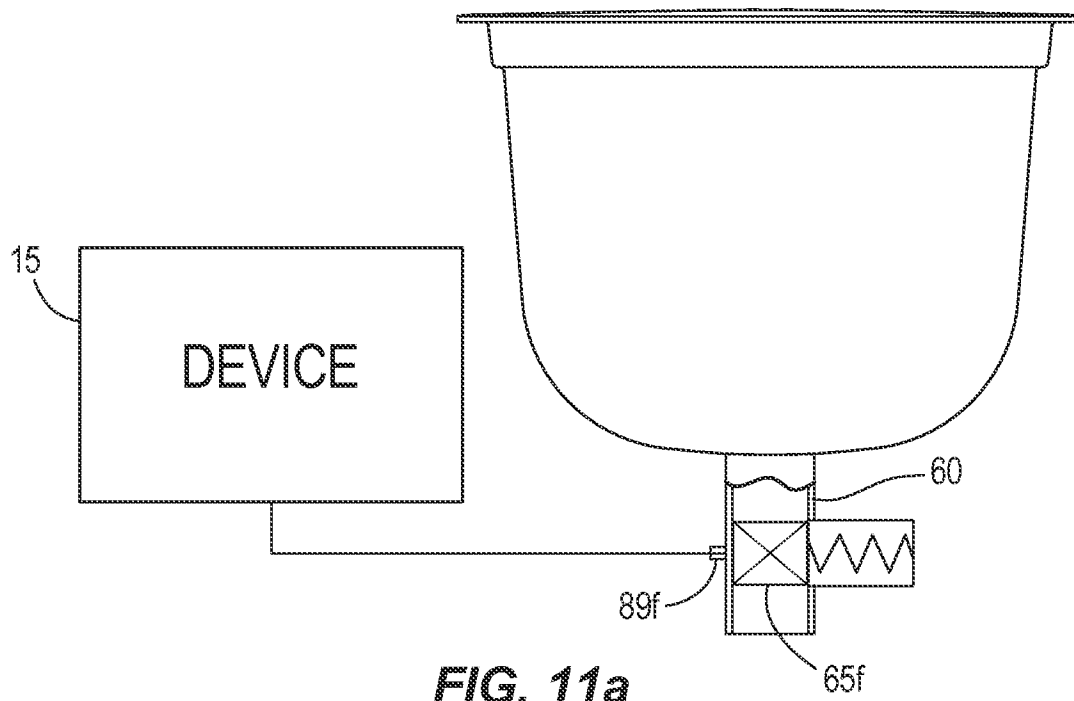
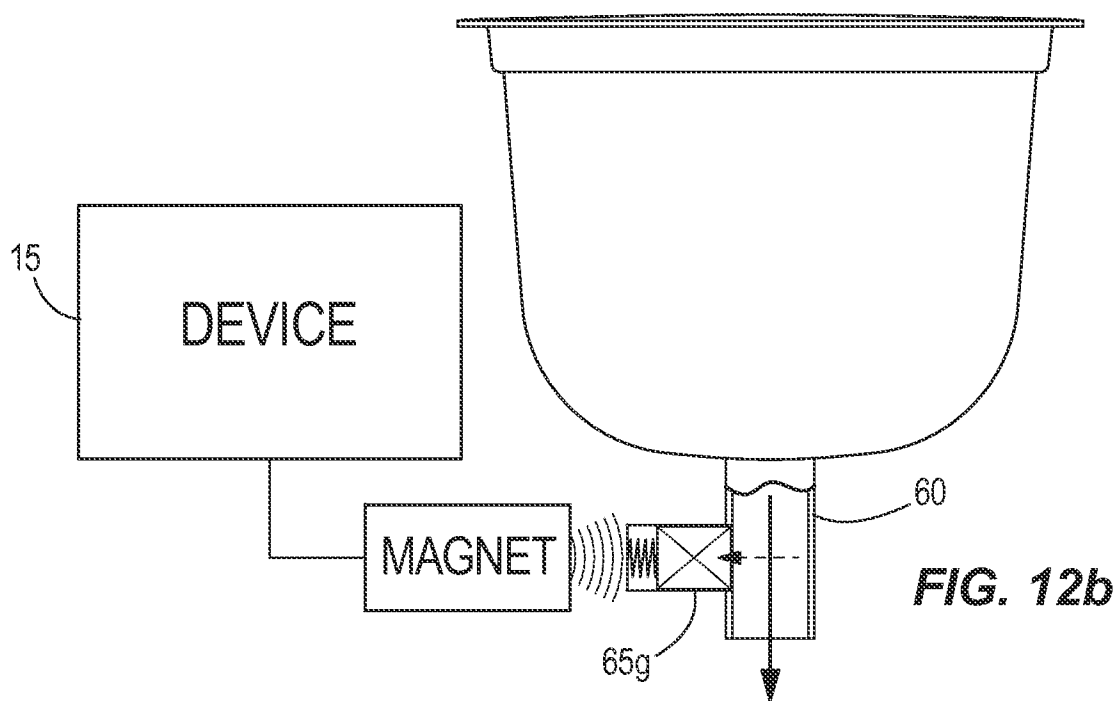
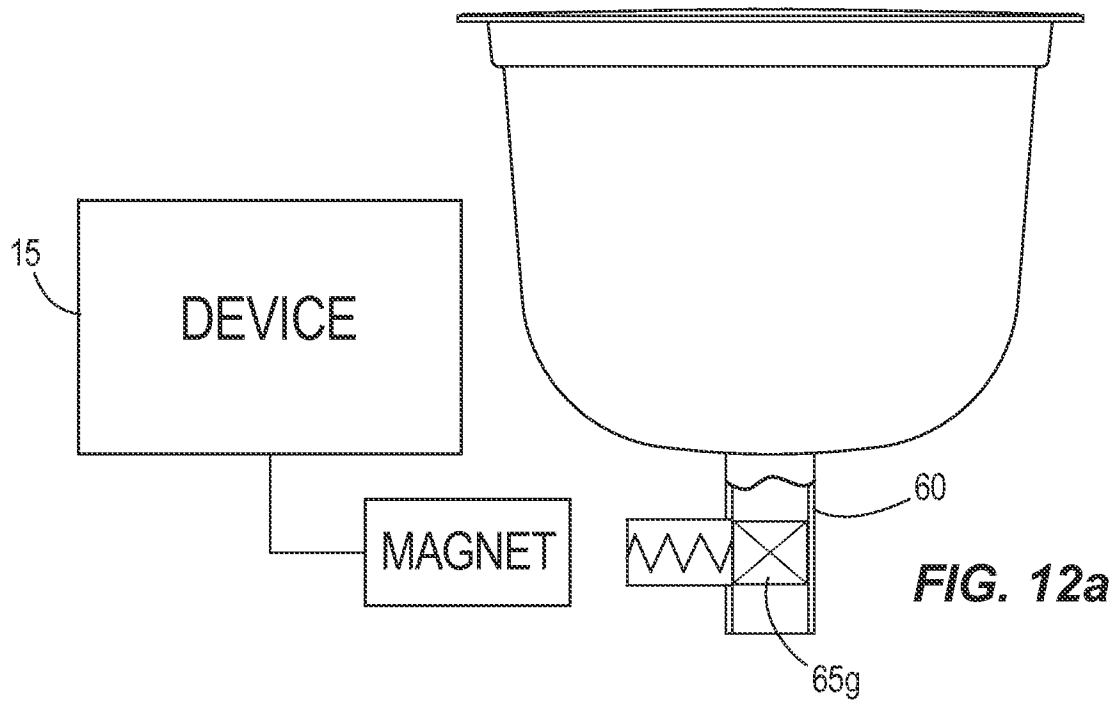


FIG. 10b

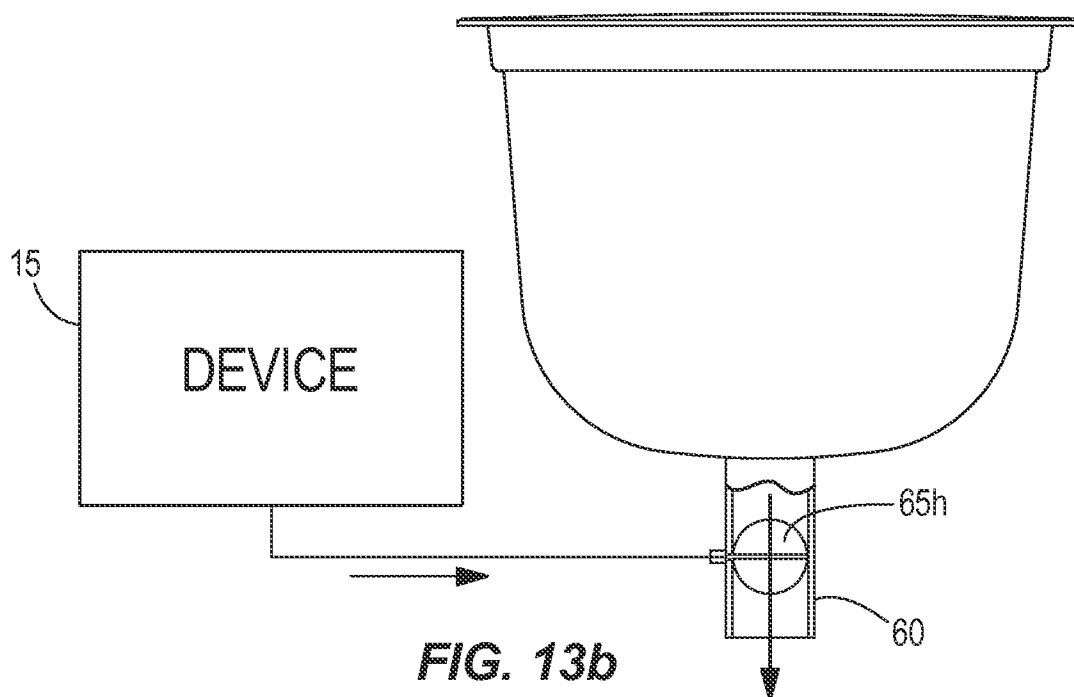
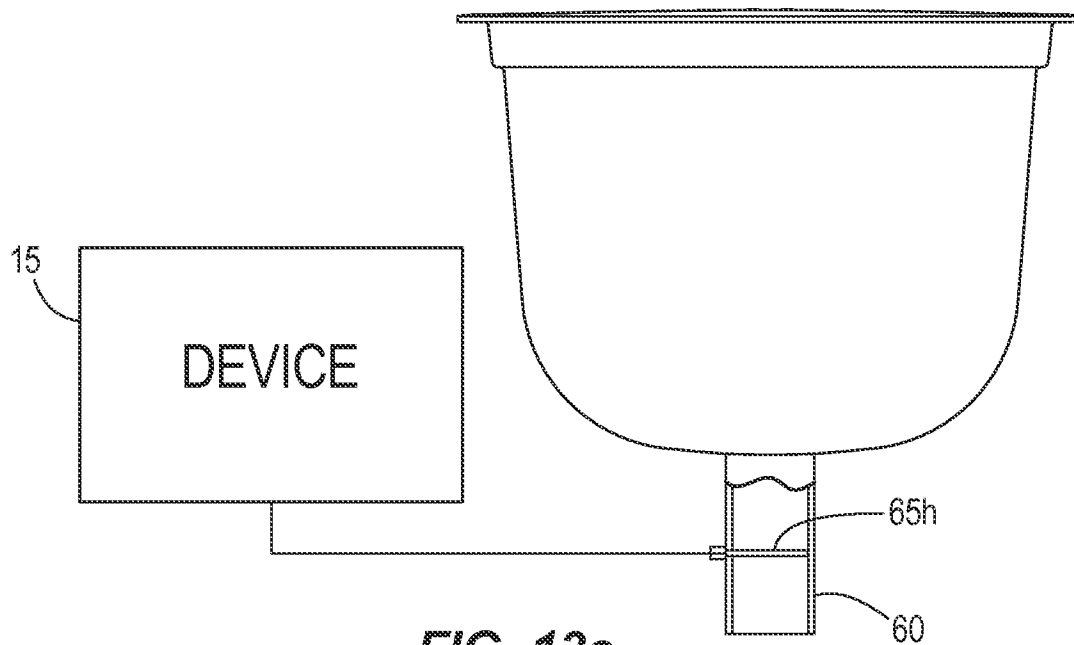
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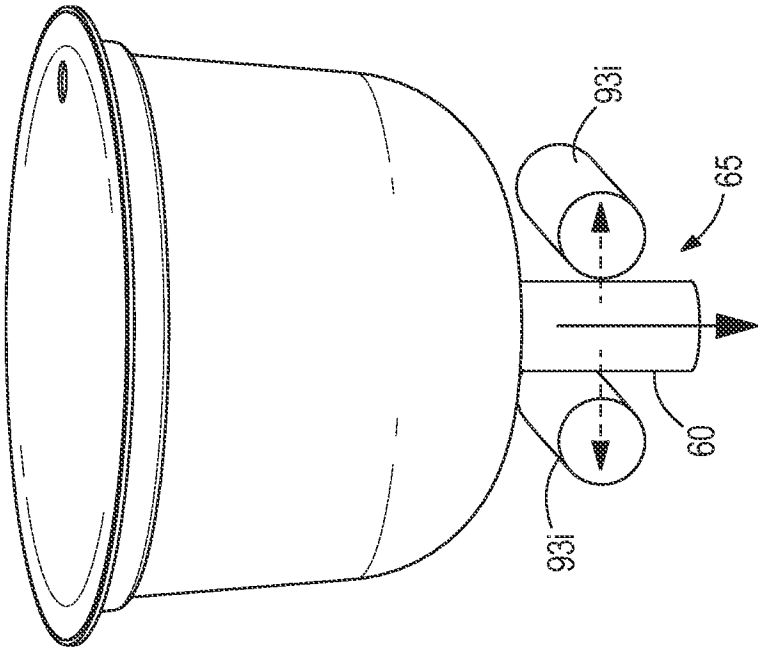


FIG. 14a

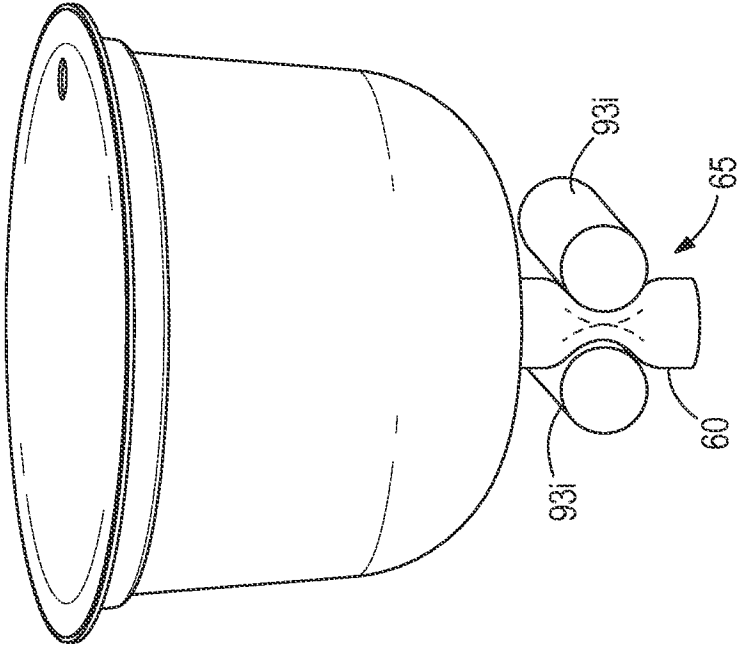


FIG. 14b

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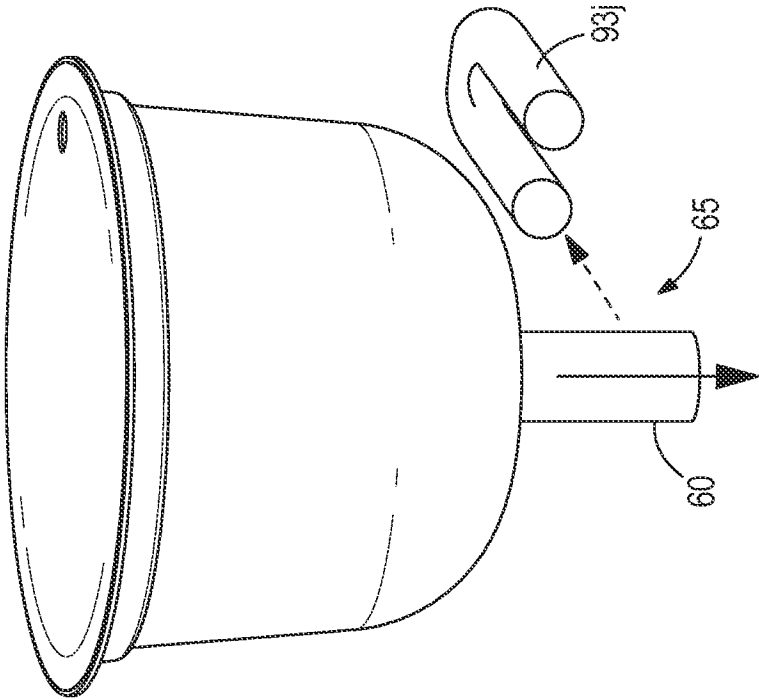


FIG. 15b

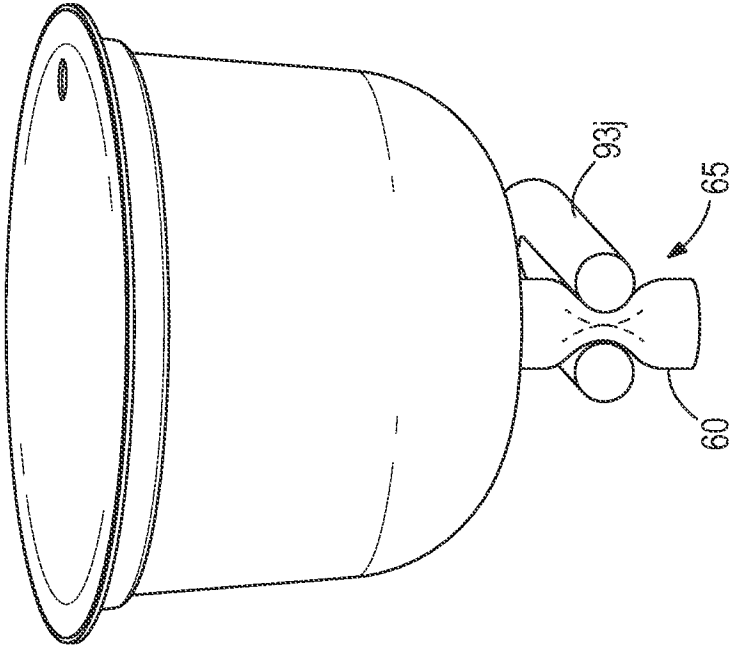


FIG. 15a

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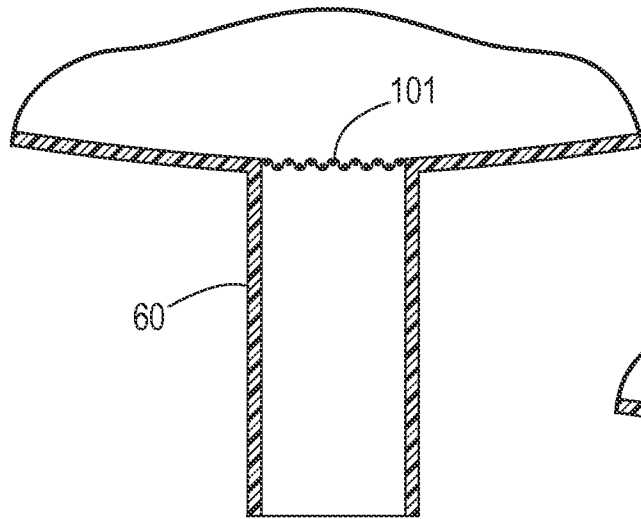


FIG. 16a

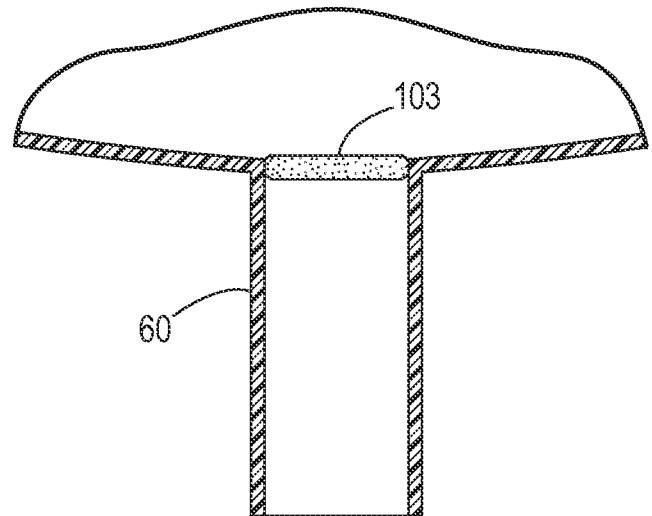


FIG. 16b

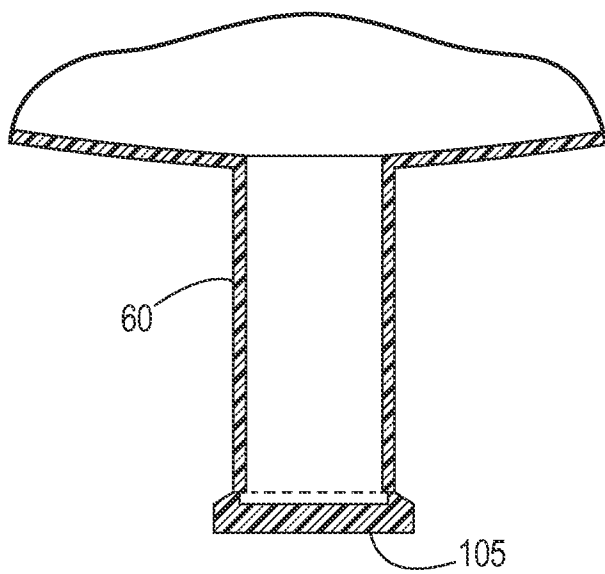


FIG. 17a

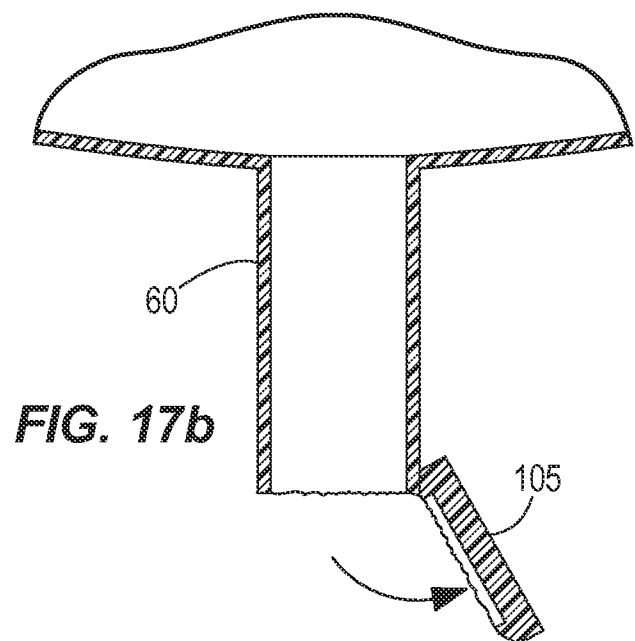


FIG. 17b

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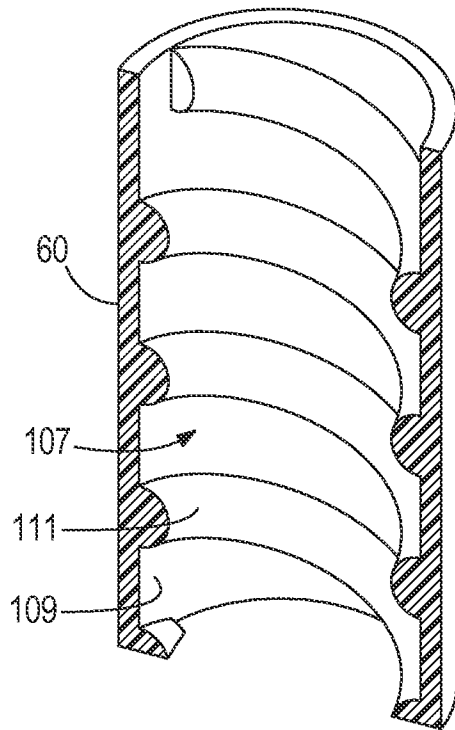


FIG. 18

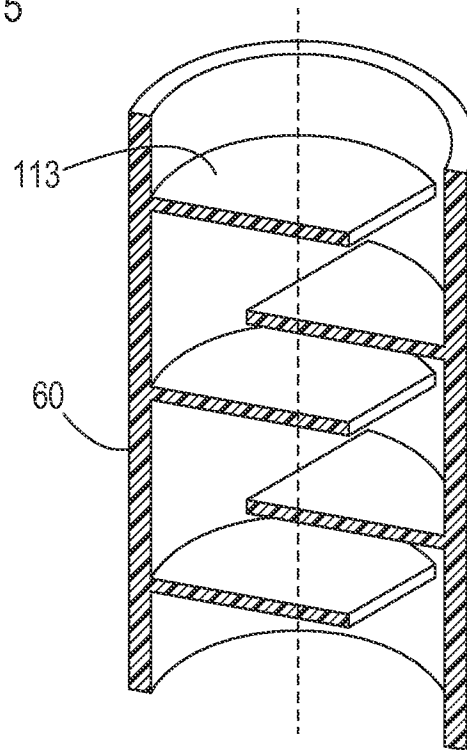


FIG. 19

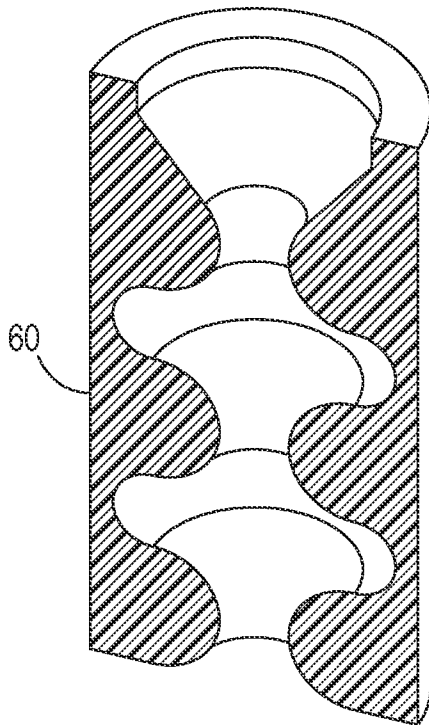


FIG. 20

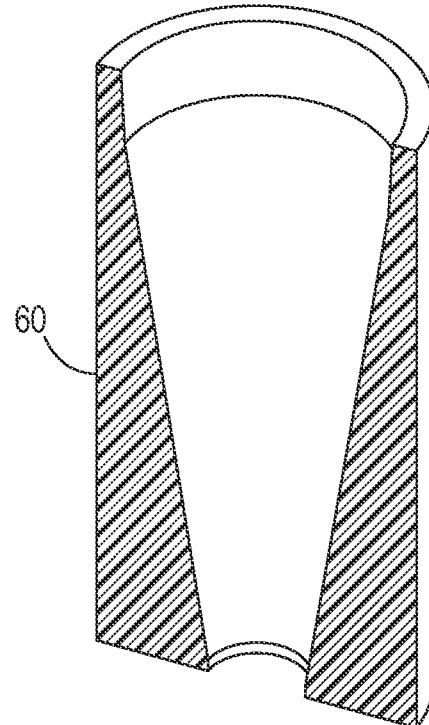
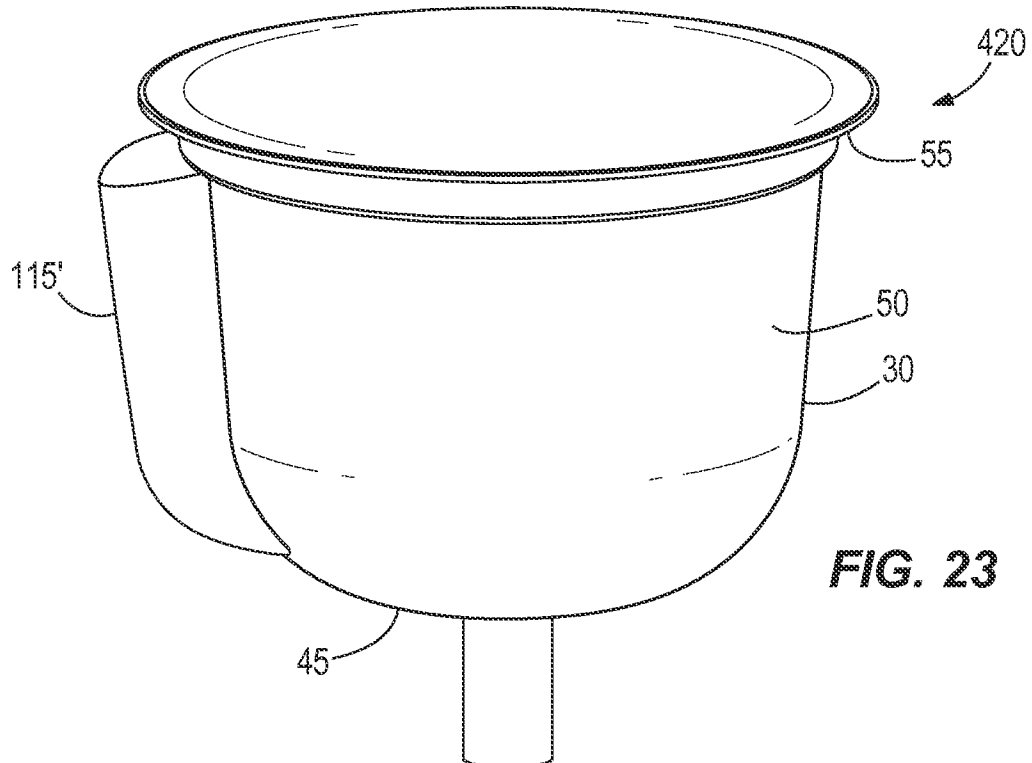
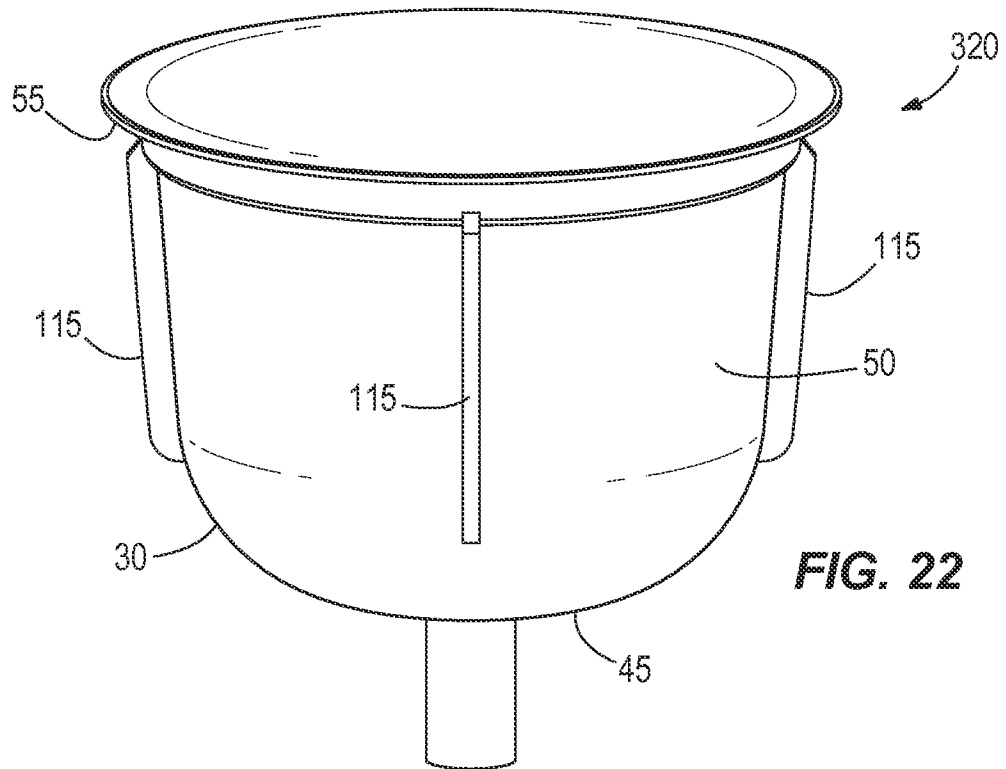


FIG. 21

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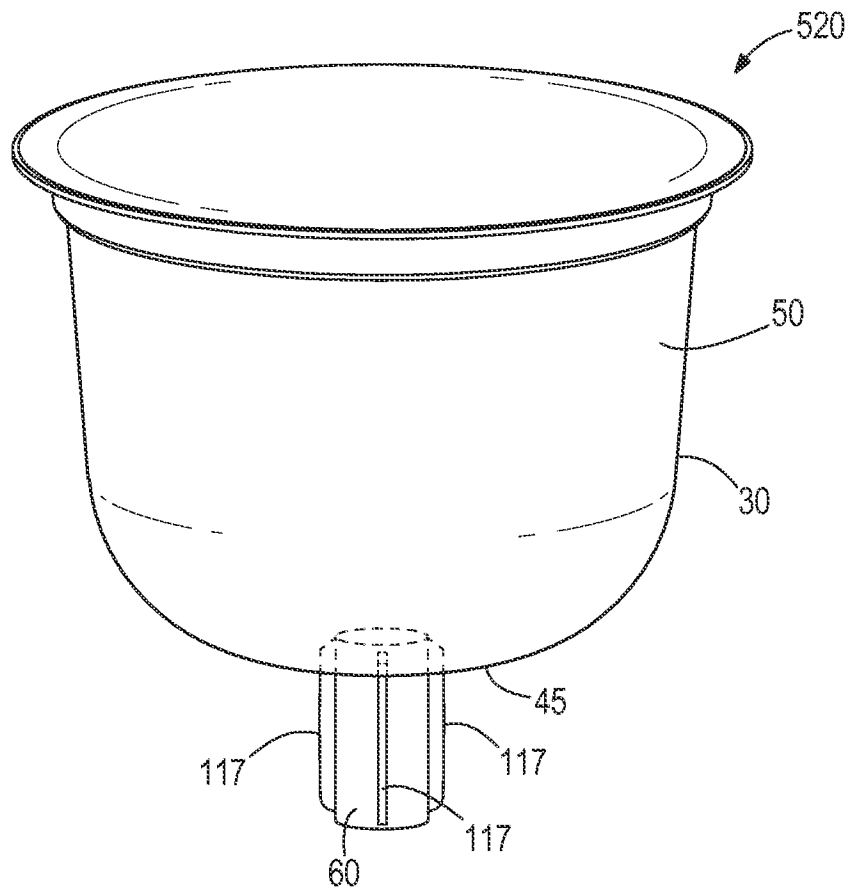


FIG. 24

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/041367

A. CLASSIFICATION OF SUBJECT MATTER
INV. B65D85/804 A47J31/40
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B65D A47J B65B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2010/159078 A1 (SKALSKI LUKASZ D [US] ET AL) 24 June 2010 (2010-06-24) paragraph [0083] - paragraph [0139] figures 1a-18	1-20
X	----- WO 2014/033339 A1 (UNION TOSTADORA S A [ES]) 6 March 2014 (2014-03-06) page 11, line 24 - page 17, line 36 figures 1-6	1-20
X	----- US 2002/078831 A1 (CAI EDWARD ZHIHUA [US]) 27 June 2002 (2002-06-27) paragraph [0042] - paragraph [0072] figures 1-7b	1-20
	----- -/-	



Further documents are listed in the continuation of Box C.



See patent family annex.

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

17 September 2015

Date of mailing of the international search report

28/09/2015

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Fax: (+31-70) 340-3016

Authorized officer

Rodriguez Gombau, F

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2015/041367

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 2013/105036 A1 (SARONG SPA [IT]) 18 July 2013 (2013-07-18) page 4, line 12 - page 16, line 9 figures 1-23 -----	1-20
X	US 2008/028948 A1 (KIRSCHNER JONATHAN [US] ET AL) 7 February 2008 (2008-02-07) paragraph [0022] - paragraph [0050] figures 1-8 -----	1-20

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2015/041367

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