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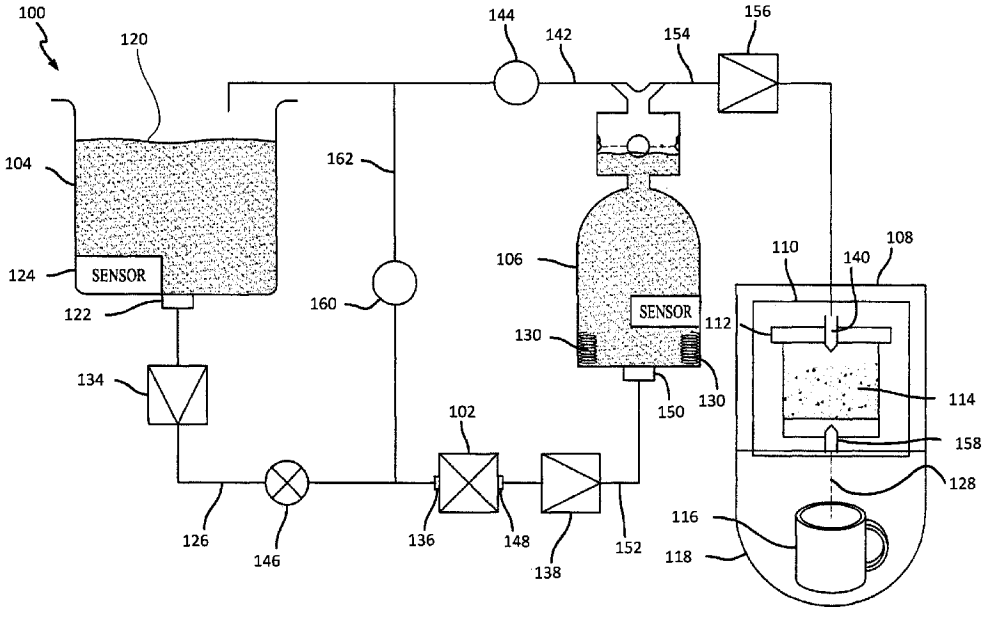

(57) Abrégé/Abstract:
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ABSTRACT

Systems, methods, apparatuses and articles of manufacture for cartridges. A cartridge in accordance with an aspect of the present disclosure comprises a cartridge body, a filter, a beverage material, and a cover.

CELLULOSE-BASED BEVERAGE CARTRIDGE

BACKGROUND

[0001] The present disclosure pertains generally to devices and methods related to single-serve beverage brewers, and more particularly to cellulose-based single-serve beverage cartridges.

[0002] In recent years, single-serve beverage brewers (*e.g.*, those made by Keurig Green Mountain, Inc., of Waterbury, VT and other manufacturers) have become popular among consumers. Single-serve beverage brewers, with their corresponding specialized packages of coffee, tea, or other beverage materials, have become a significant segment of the beverage industry.

[0003] Single-serve beverage brewers pump fluid from a reservoir to a heater tank for heating, and then deliver the heated fluid to a beverage formation chamber, such as a brew head. The beverage formation chamber may be configured to hold a single-serve beverage container, pod, or cartridge (also referred to as a "cartridge" or a "beverage cartridge" herein) containing a beverage medium, e.g., coffee grounds, tea leaves, cocoa mix, dried soup, etc., for mixing with the fluid to make a beverage. Such a cartridge may be referred to as a "K-cup®," or soft pod. In some cartridges, the coffee grounds or other beverage medium can be held within, above, or on a filter within the cartridge if desired. Although referred to as "single-serve" cartridges, such cartridges may provide multiple servings of a beverage.

[0004] Single-serve brewers may employ specialized cartridges, e.g., cartridges with a particular shape, encoded with special characters or codes, etc., such that only certain cartridges may be employed in a particular brewer. The specialized package of coffee, tea, or other beverage materials used in single-serve brewers is most often a closed plastic cup with the

beverage material inside, sealed with aluminum foil or other type of cover. Specialized inks are used to print on the plastic and/or aluminum foil to indicate the type of beverage material inside, lot numbers, etc. The cover is often attached to the plastic cup with an adhesive. The cartridges may include a filter inside the plastic cup to reduce and/or minimize the amount of beverage material (e.g., coffee grounds, tea leaves, etc.) that are transferred from the cartridge to a mug, cup, and/or other receptacle that a person would use for drinking the resultant beverage. The cartridges may also be pressurized with an inert gas, such as nitrogen or carbon dioxide, to reduce oxidation and/or other degradation of the beverage material prior to use in the single-serve brewer.

[0005] To make a beverage, heated fluid, often water, is delivered under pressure to the cartridge via one or more inlet needles, and after the fluid passes through the beverage material is removed from the cartridge via an exit nozzle. As such, the cartridge must be able to withstand the operational temperatures and pressures that are present during brewing.

[0006] Over pressurization of the single-serve cartridge may cause the cartridge to rupture. If pressure inside of the cartridge becomes too great, the adhesive between the plastic cup and cover may be breached, the cover may rupture, and/or the cup portion of the cartridge may crack, causing the beverage material and/or fluid to overflow. Such events, sometimes referred to as "blowouts," may also occur if the beverage material (e.g., coffee grounds, tea leaves, etc.) enter the conduits that are designed to carry fluid, which creates a flow stoppage in the single-serve brewer. Since the pump continues to pump fluid into a blocked conduit, greater than normal pressure is exerted on areas within the brewing system, and the fluid is expelled from the single-serve brewer in undesirable locations.

[0007] Because the cartridge is also exposed to heat from the fluid, and in direct contact with the heated fluid, consumers are concerned that the materials used in manufacturing the plastic cup may break down under the heat and pressure of the single-serve brewer. Plastic is a polymer matrix; at single-serve brewer operational temperatures, portions (monomers) of the polymer chain disengage from the polymer matrix. These monomers are in direct contact with a heated liquid that leaches the monomers into the liquid, and thus may be delivered along with the liquid into a beverage. The consumer may then ingestings these chemicals, e.g., Bisphenol-A (BPA), other monomers, or other potentially hazardous substances, without being aware that they are doing so.

[0008] After the brewing process, some cartridges are difficult to recycle. The design of some cartridges does not allow for easy and/or convenient separation into recyclable, non-recyclable, and/or compostable components. Since approximately 10 billion single-serve containers are produced each year, this design oversight may contribute greatly to environmental issues. Some approaches have been made to make the plastic cup portion out of a material that is recyclable. For example, rather than using "#7" (Other) plastic material, suggestions have been made to use polypropylene (PP) which is a "#5" material and acceptable as recycling in many locales. However, such an approach does not fully address the recycling issue, as the cartridge is still not readily disassembled to recycle the plastic portion. Further, PP still suffers from monomer breakdown and potential health risks associated with plastic cartridges.

SUMMARY

[0009] Aspects of the present disclosure comprise methods and apparatuses for aiding in the recyclable and/or compostable nature of the materials present in single-serve beverage cartridges. Other aspects of the present disclosure comprise reducing health risks associated with current single-serve cartridges.

[0010] A cartridge in accordance with an aspect of the present disclosure may comprise a cartridge body having a closed end and an open end, the open end having a first diameter at an upper edge of the open end, the cartridge body comprising a cellulose-based material, in which the cartridge body is adapted to be received in a receptacle of a single-serve brewer such that the closed end of the cartridge body is piercable by a needle in the single-serve brewer; a filter, coupled to the cartridge body at the open end, such that the filter extends below the upper edge of the open end of the cartridge body; a beverage material, coupled to the filter such that the beverage material extends below the upper edge of the open end of the cartridge body; and a cover, coupled to the cartridge body, such that the cover encapsulates the beverage material within the cartridge body between the filter and the cover, the cover adapted to be pierced by a fluid nozzle in the single-serve brewer.

[0011] The above summary has outlined, rather broadly, some features and technical advantages of the present disclosure in order that the detailed description that follows may be better understood. Additional features and advantages of the disclosure will be described below. It should be appreciated that this disclosure may be readily utilized as a basis for modifying or designing other structures for carrying out the same purposes of the present disclosure. It should also be realized that such equivalent constructions do not depart from the teachings of the disclosure. The novel features, which are believed to be characteristic of the disclosure, both as

to its organization and method of operation, together with further objects and advantages, will be better understood from the following description when considered in connection with the accompanying figures. It is to be expressly understood, however, that each of the figures is provided for the purpose of illustration and description only and is not intended as a definition of the limits of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] FIG. 1 is a schematic view of one embodiment of a beverage system according to an aspect of the present disclosure;

[0013] FIG. 2 illustrates a beverage cartridge in accordance with an aspect of the present disclosure;

[0014] FIG. 3 illustrates a method for recycling a beverage cartridge as described in the related art.

[0015] FIG. 4 illustrates a cross-sectional view of a single-serve beverage cartridge in accordance with an aspect of the present disclosure.

[0016] FIGS. 5 and 6 illustrate exploded perspective views of a single-serve beverage cartridge in accordance with an aspect of the present disclosure.

[0017] FIG. 7 illustrates a cross-sectional view of a single-serve beverage cartridge in accordance with an aspect of the present disclosure.

[0018] FIG. 8 illustrates a controller in accordance with an aspect of the present disclosure.

[0019] FIG. 9A illustrates a cross-sectional view of a beverage cartridge in accordance with an aspect of the present disclosure.

[0020] FIG. 9B illustrates a top view of a beverage cartridge in accordance with an aspect of the present disclosure.

[0021] FIG. 10 illustrates a filter design in accordance with an aspect of the present disclosure.

[0022] FIG. 11 illustrates a filter design in accordance with an aspect of the present disclosure.

[0023] FIG. 12 illustrates a beverage cartridge in accordance with an aspect of the present disclosure.

[0024] FIG. 13 illustrates a beverage cartridge in accordance with an aspect of the present disclosure.

[0025] FIG. 14 illustrates a beverage cartridge in accordance with an aspect of the present disclosure.

DETAILED DESCRIPTION

[0026] The present disclosure is directed toward single-serve cartridges that are able to withstand the operational conditions of single-serve brewing devices that are also more readily recycled than current cartridges. A single-serve cartridge in accordance with an aspect of the disclosure also may mitigate health risks associated with current cartridge materials.

[0027] Embodiments of the disclosure are described herein with reference to cross-sectional view illustrations that are schematic illustrations of embodiments of the disclosure. As such, the actual dimensions of elements can be different, and variations from the shapes of the illustrations as a result, for example, of manufacturing techniques and/or tolerances are expected. Embodiments of the disclosure should not be construed as limited to the particular shapes of the regions illustrated herein but are to include deviations in shapes that result, for example, from manufacturing. A region illustrated or described as square or rectangular may have slightly rounded or curved features due to normal manufacturing tolerances. Thus, the regions illustrated in the figures are schematic in nature and their shapes are not intended to illustrate the precise shape of a region of a device and are not intended to limit the scope of the disclosure. It is understood that the shapes, sizes, and locations in the attached figures may not be to scale.

Overview

[0028] A single-serve cartridge in an aspect of the present disclosure may withstand broader operational characteristics, e.g., temperature, pressure, etc., than current cartridges. Such a cartridge may prevent and/or reduce blowouts and/or other over pressurization issues, which may increase clean-up efforts and endanger users.

[0029] The present disclosure, in an aspect of the present disclosure, may mitigate the lack of sustainable design for single-serve beverage cartridge (e.g., K-cup®) materials and designs. An

embodiment of the present disclosure seals the filter and the cover together, with the beverage material inbetween. This assembly may be removed from the external cup (also referred to as "container" herein) and the beverage material is then contained within the assembly. The external cup is then completely separated from the cover, filter, and beverage material, and could be recycled. The cover/filter/beverage material can be composted or discarded as desired. Through selection of the adhesives or methods of attachment used to attach the cover to the filter, and the combined cover/filter to the plastic cup, pulling on the cover will separate the cover/filter from the external cup as a unit. This aspect of the present disclosure allows the beverage material to be removed as a whole, and maintains the convenience of the single-serve cartridge design while introducing conservation and ecological sustainability into single-serve beverage systems.

[0030] In another aspect of the present disclosure, the external cup materials may be altered to reduce and/or eliminate leaching of monomers into the resultant beverage. Current external cup materials employ plastic materials for the external cup, which when exposed to operational temperatures of single-serve brewing systems will leach various undesirable materials into the beverage to be consumed.

System Description

[0031] FIG. 1 is a schematic view of one embodiment of a beverage system according to an aspect of the present disclosure. In an aspect of the present disclosure, system 100, includes pump 102 that can be configured to pump unheated fluid, e.g., water, from a reservoir 104 to a heater 106, which heats the water to a desired temperature for delivery to a brew head 108. The brew head 108 includes a receptacle 110 that can house a cartridge 112 containing a single-serve or a multi-serve amount of a beverage material 114, e.g., coffee grounds, tea, hot chocolate,

lemonade, etc., for producing a beverage dispensed from the brew head 108. The beverage can be dispensed into a container 116, e.g., mug, carafe, etc. which can be placed on a platen 118.

[0032] The reservoir 104 may store fluid 120, e.g., ambient temperature water, that may be used to brew a serving and/or multiple servings of beverage (e.g., coffee) in accordance with the embodiments and processes disclosed herein. The fluid 120 may exit the reservoir 104 during the brew process via an outlet 122 at the bottom of reservoir 104. The fluid 120 may exit the reservoir 104 from locations other than the bottom, such as the sides or the top such as via a reservoir 104 pickup extending down into the reservoir 104, or other locations as desired or feasible. In an aspect of the present disclosure, the reservoir 104 includes a water level sensor 124 and/or other sensors (not shown) to detect whether the reservoir 104 is sealed by the lid, has a low water level, or other conditions, and may interact with brewer 100 circuitry to prevent initiation of a brew cycle in the event there are undesirable conditions present in brewer 100. The reservoir 104 may be replaced by other fluid 120 sources, such as a water tap connection.

[0033] In an aspect of the present disclosure, the pump 102 pressurizes and/or pumps fluid 120 from the reservoir 104 to the cartridge 112 and/or pumps air to purge remaining fluid 120 and/or brewed beverage from the beverage system 100. In such an aspect, the pump 102 initially pumps fluid 120 from the reservoir 104 through a first conduit 126 to the heater tank 106 where the fluid 120 is heated to a predetermined temperature before delivery to the cartridge 112 to brew the beverage material 114 into beverage 128. At, near, or after the end of the brew cycle, the pump 102 pumps air through the beverage system 100 to purge any remaining fluid 120 or beverage 128 in brewing system 100. As such, the pump 102 is able to operate in both wet and dry conditions, i.e., the pump 102 can switch between pumping water and air without undue wear and tear, although separate pumps for water and air are possible without departing from the

scope of the present disclosure. Many variables exist within brewing system 100 that may affect the overall performance of brewing system 100. Each of these variables may be at least partially accounted for through processor 800 to produce a more consistent performance in beverage system 100.

[0034] Once pierced by nozzle 140, each cartridge 112 provides resistance to the flow of fluid through cartridge 112 to mug 116. This resistance varies based on, among other things, the beverage medium within cartridge 112. For example, and not by way of limitation, bouillon within cartridge 112 may provide less resistance to fluid flow than ground coffee, because bouillon dissolves in the heated fluid 120 from nozzle 140 while coffee grounds do not.

[0035] The pressure drop across the beverage material 114 can result in back pressure against the outlet of check valve 132. If this back pressure is high enough (e.g., equal to or greater than the difference in pressure between the inlet and outlet of the check valve 132), check valve 132 may close, or cartridge 112 (or filter paper that is internal to cartridge 112) may be "blown out" by the pressure created by the incoming pressure of the heated fluid through nozzle 140.

Cartridge Construction

[0036] FIG. 2 illustrates a beverage cartridge in accordance with an aspect of the present disclosure. Cartridge 112 comprises a cartridge body 200, a filter 202, and a cover 204. Although current cartridge bodies 200 are made from various types of plastic, in an aspect of the present disclosure, cartridge body 200 may comprise of a cellulose-based material.

[0037] Filter 202 is inserted into cartridge body 200 and may be adhered to cartridge body 200 at ridge 206. Sides 208 of filter 202 may be pleated or otherwise shaped to fit within a shape of cartridge body 200. For example, and not by way of limitation, cartridge body 200 may be

frustoconical in shape, and filter 202 may be pleated along the sides 208 such that the top of filter 202 sides 208 may be adhered to ridge 206 while sides 208 are proximate the frustoconical shape of the cartridge body 200. The shape and/or depth of filter 202 allows for a space 210 ("X") to reside between a bottom 212 of cartridge body 200 and bottom 214 of filter 202. Space 216, ("X-Delta") is the depth to which outlet needle 158 penetrates into cartridge body 200. Space 210 is often larger than space 216, to ensure that outlet needle 158 does not pierce filter 202, which would allow beverage material 114 to be delivered out of outlet needle 158 to mug 116 (as shown in FIG. 1).

[0038] Cover 204 is adhered to rim 218 with adhesive 220. Adhesive 220, and adhesive 222 used to adhere filter 202 to cartridge body 200, may be a sonic welding adhesion, and/or an adhesive material, which couples cover 204 to cartridge body 200. Cover 204 provides a substantially air-tight seal such that beverage material 114 is not exposed to air, which may oxidize beverage material. Further, cover 204, when adhered to cartridge body 200, may allow for an inert gas, such as nitrogen, to be contained within cartridge 112 to further reduce oxidation and/or other degradation of beverage material 114 between the time beverage material 114 is packaged in cartridge 112 and used in brewing system 100. Such a reduction in degradation of beverage material 114 may improve the flavor and/or consistency of beverage 128 produced in brewing system 100.

Cartridge Body Material

[0039] Cartridge 122, and in particular cartridge body 200, is often made from plastic. Plastic materials may be categorized to by their "recycling number" which is often stamped or otherwise imprinted on plastic materials to indicate the type of plastic used in making a specific container. Depending on the recycling number, plastic materials may or may not be recyclable.

[0040] Plastic #1, Polyethylene Terephthalate (sometimes referred to as "PETE" or "PET"), is often clear or transparent and used to make soda and/or water bottles. Plastic #2, High Density Polyethylene, (sometimes referred to as "HDPE") is often opaque, and may be used to manufacture milk jugs, household cleaner containers, juice bottles, shampoo bottles, and box liner bags. Plastic #3, vinyl (also known as polyvinylchloride, or referred to as "V" or "PVC"), may be used in food wrapping materials, plumbing pipes, and detergent bottles. Plastic #4, Low Density Polyethylene (sometimes referred to as "LDPE") may be found in squeezable bottles, shopping bags, and/or food wrapping materials.

[0041] Plastic #5, Polypropylene (also referred to as "PP" or "polypro") may be used in making yogurt containers, and/or food packaging bottles. Plastic #6, Polystyrene (sometimes referred to as "PS" or "Styrofoam") may be found in compact disc cases, egg cartons, meat trays, and/or disposable plates and cups. Plastic #7 is a "miscellaneous" category, where plastic resins or mixtures of plastic resins that do not fit into categories 1-6 are placed. Plastic #7 may include polycarbonates, and may be used to manufacture sunglasses, computer cases, nylon, and/or other goods.

[0042] Depending on the material used to manufacture cartridge body 200, cartridge body 200 may be recyclable. Although all plastics are theoretically recyclable, many curbside recycling programs will not accept some plastics, e.g., plastic #6, plastic #7, etc., as recyclable materials.

[0043] Further, some plastics may contain chemicals that may leach from the body 200 material under certain conditions. For example, plastic #3 may contain Bis(2-ethylhexyl) adipate, or DEHA. DEHA has been demonstrated to induce liver adenomas and carcinomas in mice, and many people consider DEHA to be a human health risk. As another example, plastic #7 may

contain bisphenol-A (BPA). BPA is also potentially toxic in humans, as BPA is considered to be a hormone disruptor linked to infertility, hyperactivity, reproductive problems, and other health issues.

[0044] Depending on the brewing system 100, several different beverages 128 may be produced. Many brewing systems are able to recognize differences in cartridge 112 to change the brewing conditions, including brewing time, temperature, and pressure. To brew coffee, for example, fluid 120 may be heated to 190 °F and introduced into cartridge 112 for several minutes at a lower pressure. For espresso-style beverages 128, fluid 120 may be heated to approximately 210 °F and introduced into cartridge 112 for a shorter period of time at a higher pressure. Some brewing processes may include fluid 120 temperatures above 212 °F when steam is injected through nozzle 140. These time, temperature, and pressure variables may also be user-selected. As such, cartridge 112, and thus cartridge body 200, may be exposed to a range of temperatures and pressures, and the range of temperatures and pressures may or may not be known prior to cartridge body 200 use. Further, such temperatures and/or pressures may cause degradation of the cartridge body 200 plastic material, resulting in distortion of the cartridge body 200 shape and/or release of leached materials from the cartridge body 200 into the beverage 128.

[0045] Cellulose-based materials that may be employed for the cartridge body 200 in an aspect of the present disclosure include, but are not limited to, recycled paper, paper, organic materials such as plants, etc., and other materials. Such materials may include binding material, such as starches, glue, etc., and/or materials that increase the ability of cartridge body to withstand the conditions of brewer 100.

[0046] FIG. 3 illustrates a method for recycling a beverage cartridge as described in the related art. As shown in FIG. 3, a process 300 for recycling K-cup® cartridges 112 (also known as "pods") is illustrated. Block 302 indicates that cover 204 should be peeled from cartridge body 200 after cartridge 112 has cooled. Cover 204 is grasped by the puncture (hole) in cover 204 made by inlet nozzle 140 and removed from cartridge body 200. Cover 204 is to be disposed after removal.

[0047] In block 304, beverage material 114 is to be emptied from cartridge body 200. Beverage material 114 may be composted or disposed of. Filter 202 (not shown in FIG. 3) is described as remaining in cartridge body 200.

[0048] In block 306, cartridge body 200 is described as being made from Plastic #5, which is polypropylene, and can be recycled once cover 204 is removed and beverage material 114 is emptied out of cartridge body 200.

[0049] However, the related art as shown in FIG. 3 does not provide a time-effective and/or method for recycling cartridge body 200. The user must remove the cover 204 from a hole that is approximately 0.2 inches in diameter, which is inconvenient, and remove the beverage material 114 separately. Further, the cover 204 is difficult to remove from the cartridge body 200 in a single piece, since the user will likely tear out a section of cover 204 from the puncture towards the edge of cover 204. Having to remove the beverage material 114 separately from the cover merely adds to the inconvenience of the related art method.

[0050] Further, and perhaps more importantly, the related art method does not address the decomposition of cartridge body 200 during the operational conditions of beverage system 100. Current cartridge body 200 materials, which are plastic #7, may deform from their original thermoplastically-set shape when exposed to fluid 120 at 205 °F. Plastic #5, which may have a

higher melting point than plastic #7, still may leach materials into beverage 128. Nothing is mentioned in the related art about binders and/or fillers that may be included in plastic #5 when used in cartridge body 200, and how these binders and/or fillers may also be leached into beverage 128.

[0051] The physical processes that occur during thermal decomposition of polymers and/or plastics depends at least in part on the material being used. Further, thermosetting and thermoplastic materials do not often have a well-defined phase transformation at a specified temperature. Instead, thermoplastic and thermosetting materials have a second-order transition between solid and liquid phases.

[0052] For example, and not by way of limitation, thermosetting and thermoplastic materials do not have a single transition curve. Polypropylene (Plastic #5) is 65% crystalline, and has a crystalline melting temperature of 170 degrees Centigrade. Because polypropylene is not 100% crystalline, it is considered as partially amorphous and, thus, is a fluid that, over periods of time, will flow into different shapes and has internal flow within the structure, even at room temperatures. This characteristic of polypropylene, and/or other thermosetting and thermoplastic materials, is similar to window glass, as both materials are amorphous.

[0053] For amorphous and/or semi-amorphous materials, the transition from a glass state to a soft and/or malleable state is called the glass-transition region, and begins occurring at a temperature known as the glass transition temperature. This property of thermoplastic materials is what allows these materials to be formed through the use of heat, and then cooled to the point where they are rigid and in the desired shape. As an example, the cartridge body 200 may begin as a flat sheet of plastic, but is formed into the frustoconical shape of the cartridge body 200 by addition of heat and/or pressure to form the shape of cartridge body 200. Depending on the

binding and/or filler materials used, the "polypropylene" material may have a large number of transition curves and thus leach at different rates for a given temperature.

[0054] Many materials also desorb adsorbed fluids (e.g., water) at elevated temperatures. The activation energy for physical desorption of water is 30 – 40 kilojoules (kJ) per mol, and desorption begins occurring at temperatures below 212 °F. Polypropylene has a glass transition temperature of negative 4 (-4) °F. This means that at room temperature polypropylene has internal fluidic migrations of materials, i.e., the 35% of material in polypropylene that is not crystalline, even though these migrations are not visible to the human eye.

[0055] Further, when cartridge body 200 is exposed to the operational conditions of brewing system 100, cartridge body 200 may be in direct contact with fluid 120 at temperatures between 145-212 °F for several minutes. The fluidic motion of the non-crystalline materials within cartridge body 200, as well as the crystalline polypropylene itself, and/or any fillers and/or binders used in cartridge body 200, would thus be raised even further above the glass transition temperature, and become fluid in the classical sense. The fluid 120 is also pressurized against the cartridge body 200, and the combination of pressure and temperature conditions present in brewing system 100 may create leaching of some of the cartridge body 200 material and/or the fillers and/or binders present in the cartridge body 200 material into beverage 128.

[0056] FIG. 4 illustrates a cross-sectional view of a single-serve beverage cartridge in accordance with an aspect of the present disclosure. In FIG. 4, filter 202 may be attached to cover 204 by adhesive 400. Cover 204 may also be made of a cellulose-based material, and may be made of a different cellulose-based material than cartridge body 200 without departinf from the scope of the present disclosure. Portion 402 of filter 202 is then coupled to rim 218 of cartridge body 200, rather than being coupled to ridge 206. This may simplify the manufacture of

cartridge 112, as filter 202 may be coupled to cover 204 prior to attachment of the then combined filter 202/cover 204 to cartridge body 200. For example, and not by way of limitation, beverage material 114 may be sandwiched in a pod comprising filter 202 and cover 204 (as well as other layers of material if desired), and these pods may then be coupled to rim 218 of cartridge body 200. As long as the bottom 214 of filter 202 would not be pierced by needle 158, the attachment of filter 202 to cover 204 rather than to the ridge 206 of cartridge body 200 is not critical to the operation of cartridge 112 in beverage system 100.

[0057] Because single-serve cartridges 112 are designed to be pierced on the bottom 212 of cartridge body 200, filter 202 is designed to hold beverage material 114 above the level of the needle 158 at all locations. If cartridges 112 were designed to be pierced on the cover 204 for both the inlet nozzle 140 and the outlet needle 158, filter 202 would have no such restriction for having a bottom 214 that sits a distance 210 away from bottom 212. Some cartridges that may be used for multi-serve brewing, such as K-carafe® cartridges, are designed to be pierced on the cover by a second needle for delivering the beverage 128 to mug 116 and are not pierced on the bottom by outlet needle 158. Such cartridges are not considered single-serve cartridges 112, and are not compatible with all brewing systems 100 in the single-serve brewing market. Further, such multi-serving and/or multi-serve cartridges have not been as well accepted in the marketplace as the single-serve cartridges 112 that are pierced on the bottom 212 of cartridge body 200, because the multi-serve cartridges are less convenient than the single-serve cartridges 112. However, such multi-serve cartridges are also considered to be "single-serve" cartridges 112 for the purposes of this disclosure.

[0058] Adhesive 400 may be the same adhesive material as adhesive 220, or may be a different adhesive depending on the materials used in filter 202, cover 204, and cartridge body

200, and/or other considerations as desired. In an aspect of the present disclosure, cover 204 may include tab 404, which extends beyond an outer circumference of rim 218 of cartridge body 200. Tab 404 provides a gripping surface for cover 204, such that cover 204 may be removed from rim 218, rather than attempting to pull cover 204 away from rim 218 via a pierced hole as described with respect to FIG. 3.

[0059] Since cover 204 is now coupled to filter 202, pulling tab 404 may separate filter 202 and cover 404 from cartridge body 200 together, rather than leaving filter 202 in cartridge body 200 as described with respect to FIG. 3. Further, because filter 202 and cover 404 are coupled together, either via adhesive 400 and/or by other methods, beverage material 114 is contained within the combination of filter 202 and cover 204. In many beverage systems 100, beverage material 114 has been purged of most of the fluid 120 used to brew beverage 128 by pumping air through beverage material 114, so removing beverage material 114 along with filter 202 and cover 204 is easier to perform than the method described in FIG. 3.

[0060] In a further aspect of the present disclosure, filter 202 may be made from a biodegradable material, compostable material and/or cellulose-based material. Cover 204 may also be made from a biodegradable material, compostable material and/or cellulose-based material. For example, and not by way of limitation, filter 202 may be made from paper, and cover 204 may be made from a biodegradable plastic or plant-based material. As such, the combination of filter 202, cover 204, and beverage material 114 may be entirely biodegradable, compostable, and/or recyclable. Once separated from cartridge body 200, the combination of filter 202, cover 204, and beverage material 114 may then be used as compost, while cartridge body 200 may then be recycled as plastic and/or other compostable material such as paper. Such

an approach is far simpler, and far more environmentally-friendly, than the related art approach of FIG. 3.

[0061] In another aspect of the present disclosure, filter 220 may comprise tab 406, either alternatively or in conjunction with tab 404 of cover 204. Tab 406 allows for filter 202 to be pulled or otherwise separated from cartridge body 200 when the combination of filter 202, cover 204, and beverage material 114 are removed from cartridge body 200. Tabs 404 and/or 406 may provide additional strength to the bond, connection, and/or coupling between filter 202 and cover 204, and an additional means for providing force to remove the combination of filter 202, cover 204, and beverage material 114 from cartridge body 200.

[0062] FIGS. 5 and 6 illustrate exploded perspective views of a single-serve beverage cartridge in accordance with an aspect of the present disclosure. Cartridge 112 is shown with cover 204, filter 202, and cartridge body 200. Tabs 404 and 406 are shown, however, as described above, aspects of the present disclosure may have only one of such tabs 404 and/or 406 present as desired. Sides 208 of filter 202 are shown as being pleated in FIG. 5, although such pleating is optional in any aspect of the present disclosure.

[0063] A location where inlet nozzle 140 may pierce cover 204 is shown as location 500. Cover 204 may be coupled to filter 202 as shown by arrow 502. This may make a combined unit 504, which may then be inserted into cartridge body 200 as shown by arrow 506. As shown in FIG. 6, part of filter 202, i.e., portion 402, may overlap rim 218. As cover 204 is coupled to filter 202, either as shown by arrow 600 or as a unit 504 described with respect to FIG. 5, cover 204 is coupled to rim 218 of cartridge body 200. Tabs 404 and/or 406 may be used to remove filter 202 and cover 204 from cartridge body 200 while allowing filter 202 and cover 204 to substantially remain coupled together.

[0064] FIG. 7 illustrates a cross-sectional view of a single-serve beverage cartridge in accordance with an aspect of the present disclosure. As with FIG. 4, filter is not coupled to ridge 206 as in the related art. In the aspect of the present disclosure shown in FIG. 7, a liner 700 is placed between the inner surface of cartridge body 200 and filter 202. Liner 700 may comprise tab 702, which may be used alone or in conjunction with tabs 404 and 406 as described with respect to FIG. 4.

[0065] Liner 700 limits the direct contact between fluid 120 that is introduced into cartridge 112 and cartridge body 200. Because cartridge body 200 may leach chemicals and/or other materials into beverage 128, and be delivered via needle 158, liner 700 reduces the possibilities that such leaching will occur. Although heated fluid 120 will still likely leach material from cartridge body 200 through thermal exchange with cartridge body 200, liner 700 reduces and/or eliminates the pathways for such leached material from exiting cartridge 112 through needle 158 as part of beverage 158. Although liner 700 is shown as being substantially similar in shape to cartridge body 200, e.g., conforming to the side and bottom of cartridge body 200, liner 700 may take any shape as desired that limits the contact between fluid 120 and the inner wall of cartridge body 200.

[0066] FIG. 8 illustrates a controller in accordance with an aspect of the present disclosure. The brewer 10 can include a controller or other processing unit, such as a microcontroller 800, shown schematically in FIG. 8. The microcontroller 800 may include an internal memory 802 and/or external memory 804 and can serve many different functions. For example, in one embodiment, the microcontroller 102 may serve to regulate the power provided to the pump 102, control system 100 through readings from sensor 124 and/or other sensors within system 100,

accept input from user controls 806, or other controlling and/or monitoring functions. Many different functions are possible without departing from the scope of the present disclosure.

[0067] The memory, which may be internal memory 802 or external memory 804 to microcontroller 800, may be implemented in firmware and/or software implementation. The firmware and/or software implementation methodologies may be implemented with modules (e.g., procedures, functions, and so on) that perform the functions described herein. A machine-readable medium tangibly embodying instructions may be used in implementing the methodologies described herein. For example, software codes may be stored in a memory and executed by a processor unit (e.g., microcontroller 800). Memory may be implemented within the processor unit or external to the processor unit. As used herein, the term "memory" refers to types of long term, short term, volatile, nonvolatile, and/or other non-transitory memory and is not to be limited to a particular type of memory or number of memories, or type of media upon which memory is stored.

[0068] FIGS. 9A and 9B illustrate a recyclable beverage cartridge in accordance with an aspect of the present disclosure. FIG. 9A shows filter 900 located at a distance 900 from side 208 of the cartridge body 200. Distance 902 is a known distance, and may be approximately 0.25 inches, because cartridge body 200 is designed to fit within receptacle 110 in any orientation, and the outlet needle 158 is in a fixed location within receptacle 110. As such, a toroidal volume may be defined by filter 900, having a height at least as high as dimension 216, with a tolerance for the location of the toroid such that filter 900 is not pierced and/or otherwise compromised by needle 158 when needle 158 pierces cartridge body 200.

[0069] Further, cartridge body 200 may be made from paper, pulp, cellulose and/or celluloid material, plant fibers, or other natural, renewable, recyclable, and/or compostable products, such

that once the cartridge 112 has been used (i.e., nozzle 140 has pierced cover 204 and delivered fluid to cartridge 112 and beverage material 114 to brew a beverage 128), the entire cartridge 112 may be placed in a compost pile rather than separating cover 204 from cartridge body 200. As shown in FIG. 9B, filter 900 covers a cylindrical volume within cartridge 112, such that regardless of the orientation of cartridge 112 when placed in system 100, outlet nozzle 158 will pierce bottom 212 of cartridge 112 on one side of filter 900 while beverage material 114 is on an opposite side of filter 900.

[0070] In an aspect of the present disclosure, cartridge body 200 may be made from wood pulp and/or recycled paper products, which may be combined with food-safe binders such as starches and/or sugars, and/or other adhesives and/or binders that are safe for interactions with consumed products. To minimize leaching of flavors or other possibly undesirable liquids and/or solids from cartridge body 200 in such cases, an optional liner 904, which may be made of a different material than cartridge body 200, e.g., metal foil, a different natural, plant, and/or combination of materials, and/or may have a different density than cartridge body 200, such that contact between fluids entering cartridge 112 and cartridge body 200 are reduced when compared to cartridges 112 that do not include optional liner 904. Optional liner 904 may further comprise an optional portion 906 and/or optional tab 908 without departing from the scope of the present disclosure. The inclusion of liner 904 may minimize and/or prevent seepage of any flavors, binders, and/or other by-products from cartridge body 200, similar to how liner 700 minimizes leaching of by-products when cartridge body 200 is made from plastic.

[0071] Liners 700 and/or 900 may be made from various materials; metal foil, plastic, paper, natural materials, etc. Liners 700 and/or 900 may provide several advantages and/or functions to cartridge 112. For example, and not by way of limitation, liner 700 and/or 900 may provide a

hermetic and/or semi-hermetic seal for a portion of cartridge 112, such that beverage material 114 contained within cartridge 112 is substantially separated from outside air and/or other contaminants or oxidizing materials. Depending on the material used for cartridge 112, cartridge 112 may already provide a hermetic and/or semi-hermetic seal. Further, and not by way of limitation, liner 700 and/or 900, either in addition to or in the alternative, may provide a barrier between any liquid introduced into cartridge 112 and the cartridge body 200, such that the liquid introduced into cartridge 112 does not substantially contact cartridge body 200. Such liners 700 and/or 900 may also prevent any liquids, gasses, or fluids produced by the heat, pressure, and/or other operational conditions within beverage system 100 that are experienced by cartridge 112 from being delivered to mug 116 along with beverage 128.

[0072] FIGS. 10 and 11 illustrate filter designs in accordance with an aspect of the present disclosure. Filter 900 may take any shape desired, and, as shown in FIG. 10, may be conical in shape rather than adopting the frustoconical shape of cartridge body 200 as shown in FIGS. 2 and 4-7. So long as filter 900 is not pierced by needle 158, filter 900 may take any desired shape, which may alter the brewing considerations and/or possibilities for various beverage materials 114. For example, and not by way of limitation, allowing filter 900 to reach the bottom of cartridge body 200, either as a conical shape shown in FIG. 10 or as a stepped frustoconical shape shown in FIG. 11, fluid introduced into cartridge 112 will remain in contact with beverage material 114 present for a longer period of time before being delivered to mug 116 via needle 158. Further, a different type of beverage material 114 may be placed in volume 910, which may also be separated from beverage material 114 by a second filter, to produce a hybrid-brewed beverage of the two beverage materials 114 present in cartridge 112. Such combinations and/or time duration of fluid/beverage material 114 contact differences are not possible in the related

art, as the time duration is driven by fluid flow rates determined by pump 102. By allowing fluid from inlet nozzle 140 to remain in contact with beverage material 114 for a longer period of time, additional and/or other oils, flavors, and/or essences may be removed from beverage material 114 without requiring design changes to beverage system 100 or programming pump 102 to deliver fluid to nozzle 140 at different rates.

Craft Brewing Techniques

[0073] FIG. 12 illustrates a beverage cartridge in accordance with an aspect of the present disclosure. Cartridge 112 may also comprise a mechanism 1200 that may move, tighten, loosen, or otherwise interface with beverage material 114 once inlet nozzle 140 is inserted into cartridge 112. Some systems 100 have inlet nozzles 140 that move and/or rotate after piercing cover 204. Depending on the settings and/or programming of such systems 100, inlet nozzle 140 can rotate in one direction for a first set of settings, and a second direction for a second set of settings. As such, mechanism 1200 may be selectively engaged by inlet nozzle 140 based on the direction of movement and/or rotation of inlet nozzle 140.

[0074] For example, and not by way of limitation, inlet nozzle 140 may comprise a tab 1202 that only engages mechanism 1200 when inlet nozzle 140 rotates in a clockwise direction. One side of tab 1202 may provide a surface that mechanism 1200 catches on and tightens when inlet nozzle 140 rotates in a clockwise direction, while another side of tab 1202 is a ramp or incline that will not engage mechanism 1200 when inlet nozzle 1200 rotates in a counter-clockwise direction. System 100 may allow for user input or automatic selection based on recognition and/or other identification of cartridge 112 to program the inlet nozzle 140 to rotate clockwise, which will allow tab 1202 to engage mechanism 1200 during brewing, or may allow for user input to program the inlet nozzle 140 to rotate counter-clockwise, which will avoid engagement

of mechanism 1200 during brewing. Other types of engagement between inlet nozzle 140 and mechanism 1200 are possible without departing from the scope of the present disclosure.

[0075] If mechanism 1200 is engaged, a first set of conditions, such as pressure, temperature, volume, etc., for beverage material 114 will be created by mechanism 1200. If mechanism 1200 is not engaged, a second set of conditions for beverage material 114 is created, which may be similar to the set of conditions created by system 100 when mechanism 1200 is not present within cartridge 112.

[0076] Mechanism 1200, which is shown as a torsion spring, but may be any mechanism, may provide conditions for brewing that system 100 could not otherwise attain. For craft coffee beverages, e.g., "French press" coffee, "pour over" coffee, etc., system 100 may not be able to provide the pressure conditions within cartridge 112 without the use of mechanism 1200. If mechanism 1200 is not engaged, system 100 would produce a beverage similar to if not identical to the beverage produced if mechanism 1200 is not present. However, if mechanism 1200 is engaged during brewing, different pressures, localized temperatures, reduced volumes, etc., may produce a different beverage from the same cartridge 112.

[0077] Although mechanism 1200 is shown as a torsion spring, other mechanisms are possible within the scope of the present disclosure. Further, beverage material 114 may be located at specific locations within cartridge 112, such as along the side 208, along the bottom 212, etc., such that the combination of type of mechanism 1200 and placement of beverage material 114 within cartridge 112 provides operational advantages within system 100.

[0078] For example, and not by way of limitation, mechanism 1200 may provide additional pressure to beverage material 114 when mechanism 1200 is engaged by inlet nozzle 140. System 100 may be programmed to introduce fluid to cartridge 1200 for a certain amount of time and

then stop introducing fluid. System 100 may then allow the fluid to drain from cartridge 112 for a certain amount of time, and then engage mechanism 1200 to pressurize the added fluid out of cartridge 112 through outlet needle 158. System 100 may then add more fluid to cartridge 112 and repeat these steps. Such an approach is similar to a "pour over" style of coffee brewing. Similar mechanisms 1200, beverage material 114 placement, and/or fluid delivery techniques may be combined to produce other types of brewing techniques in system 100. Such techniques are not currently employed in related systems 100.

Variable Porosity and Flavor Additives

[0079] FIG. 13 illustrates a beverage cartridge in accordance with an aspect of the present disclosure. Cartridge 112 may comprise a filter 1300 which has a variable porosity. A portion 1302 of filter 1300 may have a first porosity value, while portion 1304 of filter 1300 may have a second porosity value. As such, fluid introduced into cartridge 112 may remain in portions of filter 1300 longer than in other portions of filter 1300.

[0080] For example, and not by way of limitation, portion 1302 may be less porous than portion 1304. As such, fluid 120 that is introduced into cartridge 112 will not flow through portion 1302 as fast, or at all, as fluid 120 that reaches the level of portion 1304. This may increase the time that fluid remains in contact with beverage material 114 that is contained within portion 1302. As the fluid level rises in cartridge 112, fluid 120 will flow out of portion 1304. This allows for more precise control of the time that fluid 120 remains in contact with beverage material 114. Through programming of system 100, e.g., fluid delivery flow rate, fluid delivery temperatures, etc., more precise brewing profiles may be achieved with system 100 through the use of variable flow rate filter 1300.

[0081] Further, to allow for increased pressure within cartridge 112 when employed in system 100, cover 204 may be wrapped around rim 218 and adhered to a larger surface of rim 218. The cartridge body 200 may be placed in a receptacle that allows for only small amounts of expansion of the cartridge body 200. In many cartridge 112 designs, the sealing surface of cover 204 to cartridge body 200 along rim 218 is the location of pressure blowouts experienced by cartridge 112. As such, increasing the pressure and force vectors that may be experienced at that location by encasing rim 218 with cover 204, and applying adhesive 400 to a larger surface of rim 218 (e.g., on both sides of rim 218), allows for greater pressure to be applied within cartridge 112 with fluid 120.

[0082] In an aspect of the present disclosure, cartridge body 200 may have a textured surface, specific color, other identifying marks, and/or indicia 1320 such that brewer 100 may recognize cartridge 112 as a specific type of cartridge 112. This recognition may be used to determine brewing characteristics, for rewards programs, and/or for any other reason. However, some users may try to use the same cartridge 112 several times to obtain additional rewards, or may accidentally attempt to reuse a cartridge 112. Because cartridge body 200 may be made from cellulose-based materials, and cartridge 112 may be placed under pressure when fluid 120 is delivered to cartridge 112, the pressure and/or water temperature may soften cartridge body 200. The pressure created by brewer 100 in delivering fluid 120 to cartridge 112 may allow for deformation of the surface of cartridge body 200. Further, the fluid 120, after passing through beverage material 114 and becoming beverage 128, may change the color of cartridge body 200. As such, the use of a given cartridge 112 in brewer 100 may alter and/or otherwise change the indicia 1320 such that the indicia 1320 no longer indicates the same information to brewer 100. Such changes in the indicia 1320 will allow brewer 100 to minimize reuse of the same cartridge

112, by alerting the user to reuse of a given cartridge 112, and/or minimize the recognition of cartridge 112 multiple times in rewards and/or accounting functions performed by brewer 100. Although indicated at a certain location on cartridge 112, indicia 1320 may appear anywhere on cartridge 112 without departing from the scope of the present disclosure.

[0083] Many cartridges 112 have added flavors and/or essences infused into beverage material 114. For example, some coffee beverages have hazelnut or caramel flavors infused or added to the beverage material 114. The process of infusing such flavors into beverage material 114 may add to the cost of cartridge 112, and/or the beverage material 114 may be degraded or otherwise altered by the infusion process. In an aspect of the present disclosure, materials 1306 and/or 1308 may be added to and/or infused into cartridge body 200, which may provide a more economical approach to inclusion of various additives in cartridge 112.

[0084] For example, and not by way of limitation, an essential oil may be added to cartridge body 200 at location 1506 and/or infused into a portion of or all of cartridge body 200. Since cartridge body 200 in an aspect of the present disclosure is cellulose-based, and is manufactured using oils and/or other binders, the infusion process may be less expensive than infusion of the same essential oil into beverage material 114. Further, infusion of the essential oil into cartridge body 200 may have fewer deleterious effects on beverage material 114 as well as fewer deleterious effects on the essential oil. A smaller amount of essential oil may be needed to provide the same flavors and/or other effects in the resultant beverage by placing the essential oil at location 1306 and/or 1308 than with beverage material 114.

[0085] Filter 1300 may also have a specialized shape 1310. Shape 1310 may accommodate inlet nozzle 140, or may be shaped to control one or more process parameters used during and/or after the brewing process. For example, and not by way of limitation, shape 1310 may be used to

control the amount of time that fluid remains in contact with beverage material 114. Many shapes 1310 can be employed without departing from the scope of the present disclosure.

[0086] FIG. 14 illustrates a beverage cartridge in accordance with an aspect of the present disclosure. Some cartridges 112 do not have a body 200 that fully encloses the beverage material 114. Such cartridges 112 may be referred to as "soft pods." One drawback of soft pods is that the beverage material 114 may be exposed to air or other oxidizing environments, which may deleteriously affect the beverage material 114.

[0087] In an aspect of the present disclosure, cartridge 1400 may be designed to have a separation line that exposes filter 1300. When placed in the system 100, cartridge 1400 has a cartridge body 1402 that separates from separated portion 1404 when fluid is introduced into cartridge 1400. The additional pressure introduced into cartridge 1400 by fluid 1400 may provide separation between cartridge body 1402 and separated portion 1404 such that the body 1402 and separated portion 1404 separate along upper separation line 1406 and lower separation line 1408. Separated portion 1404 moves away from body 1402 in direction 1408.

[0088] The upper and lower separation lines 1406/1408 may be a perforation line on cartridge 1400. Since the pressure in system 100 may be controlled, the pressure system 100 produces can be controlled to separate cartridge 1400 into body 1402 and separated portion 1404. Filter 202 may couple body 1402 and separated portion 1404, or separated portion 1404 may not completely separate from body 1402. So long as pressure is released by the separation of body 1402 and separated portion 1404, fluid entering cartridge 1400 will flow through filter 202 once separated portion 1404 has separated from body 1402. In such an aspect of the present disclosure, cartridge 1400 may provide better protection of beverage material 114 than a soft pod, and may further reduce the cost of production of cartridge 1400.

[0089] The present disclosure provides several advantages over the related art approaches. The present disclosure allows for easy separation of compostable and recyclable materials. The present disclosure also allows for safer operation of beverage systems 100 that employ cartridges 112, in that possible unwanted by-products produced by cartridge 112 during the operation of beverage system 100 are not produced and/or consumed.

[0090] Further, the present disclosure allows for different types of filtration of beverage material 114, which may be desirable depending on the volume of beverage 128 to be produced from beverage material 114 in cartridge 112. The present disclosure also allows for additional types of beverages 128 to be produced, as well as allowing for richer, more flavorful beverages to be produced by currently deployed beverage systems 100. The present disclosure also provides upgrades to single-serve beverage systems 100 which may enable these systems to employ brewing methods, such as craft brewing methods, that present systems 100 cannot accommodate.

[0091] If implemented in firmware and/or software, and/or as part of microcontroller 800 and/or memory 802/804, the functions described herein may be stored as one or more instructions or code on a computer-readable medium. Examples include computer-readable media encoded with a data structure and computer-readable media encoded with a computer program. Computer-readable media includes physical computer storage media. A storage medium may be an available medium that can be accessed by a computer. By way of example, and not limitation, such computer-readable media can include RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or other medium that can be used to store desired program code in the form of instructions or data structures and that can be accessed by a computer (e.g., microcontroller 800); disk and disc, as

used herein, includes compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and Blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

[0092] In addition to storage on computer readable medium, instructions and/or data may be provided as signals on transmission media included in a communication apparatus. For example, a communication apparatus may include a transceiver having signals indicative of instructions and data. The instructions and data are configured to cause one or more processors (e.g., microcontroller 800) to implement the functions outlined in the claims.

[0093] Those of skill would further appreciate that the various illustrative logical blocks, modules, circuits, and algorithm steps described in connection with the disclosure herein may be implemented as electronic hardware, computer software, or combinations of both. To clearly illustrate this interchangeability of hardware and software, various illustrative components, blocks, modules, circuits, and steps have been described above generally in terms of their functionality. Whether such functionality is implemented as hardware or software depends upon the particular application and design constraints imposed on the overall system. Skilled artisans may implement the described functionality in varying ways for each particular application, but such implementation decisions should not be interpreted as causing a departure from the scope of the present disclosure.

[0094] The various illustrative logical blocks, modules, and circuits described in connection with the disclosure herein may be implemented or performed with a general-purpose processor, a digital signal processor (DSP), an application specific integrated circuit (ASIC), a field programmable gate array (FPGA) or other programmable logic device, discrete gate or transistor

logic, discrete hardware components, or any combination thereof designed to perform the functions described herein. A general-purpose processor may be a microprocessor, but in the alternative, the processor may be any conventional processor, controller, microcontroller, or state machine. A processor may also be implemented as a combination of computing devices, e.g., a combination of a DSP and a microprocessor, multiple microprocessors, one or more microprocessors in conjunction with a DSP core, or any other such configuration.

[0095] In one or more exemplary designs, the functions described may be implemented in hardware, software, firmware, or any combination thereof. If implemented in software, the functions may be stored on or transmitted over as one or more instructions or code on a computer-readable medium. Computer-readable media includes both computer storage media and communication media including any medium that facilitates transfer of a computer program from one place to another. A storage media may be any available media that can be accessed by a general purpose or special purpose computer. By way of example, and not limitation, such computer-readable media can include RAM, ROM, EEPROM, CD-ROM or other optical disk storage, magnetic disk storage or other magnetic storage devices, or any other medium that can be used to carry or store specified program code means in the form of instructions or data structures and that can be accessed by a general-purpose or special-purpose computer, or a general-purpose or special-purpose processor. Also, any connection is properly termed a computer-readable medium. For example, if the software is transmitted from a website, server, or other remote source using a coaxial cable, fiber optic cable, twisted pair, digital subscriber line (DSL), or wireless technologies such as infrared, radio, and microwave, then the coaxial cable, fiber optic cable, twisted pair, DSL, or wireless technologies such as infrared, radio, and microwave are included in the definition of medium. Disk and disc, as used herein, includes

compact disc (CD), laser disc, optical disc, digital versatile disc (DVD), floppy disk and Blu-ray disc where disks usually reproduce data magnetically, while discs reproduce data optically with lasers. Combinations of the above should also be included within the scope of computer-readable media.

[0096] The present disclosure is described herein with reference to certain embodiments, but it is understood that the disclosure can be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. In particular, the present disclosure is described below in regards to certain modules having features in different configurations, but it is understood that the present disclosure can be used for many other modules and/or configurations. The modules and systems can also have many different shapes beyond those described below.

[0097] All physical dimensions, weights, temperatures, etc. in the description and attached drawings are exemplary in nature. It is understood that embodiments of the present disclosure can have various dimensions/weights/ temperatures/etc. varying from those shown in the attached drawings.

[0098] Although the present disclosure and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made herein without departing from the technology of the disclosure as defined by the appended claims. It should also be understood that when a feature or element may be referred to as being "on" another element, it can be directly on the other element or intervening elements may also be present unless specifically stated otherwise. Furthermore, relative terms such as "inner", "outer", "upper", "above", "lower", "beneath", and "below", and similar terms, may be used herein to describe a relationship of one element or attribute to another. With regard to the figures, it is to

be understood that these terms are intended to encompass different orientations of the device in addition to the orientation depicted.

[0099] Moreover, the scope of the present application is not intended to be limited to the particular configurations of the process, machine, manufacture, composition of matter, means, methods, and/or steps described in the specification. As one of ordinary skill in the art will readily appreciate from the disclosure, processes, machines, manufacture, compositions of matter, means, methods, and/or steps, presently existing or later to be developed, that perform substantially the same function or achieve substantially the same result as the corresponding configurations described herein may be utilized according to the present disclosure. Accordingly, the appended claims are intended to include within their scope such processes, machines, manufacture, compositions of matter, means, methods, and/or steps.

[00100] Although the terms first, second, etc. may be used herein to describe various elements, components, regions, and/or sections, these elements, components, regions, and/or sections should not be limited by these terms. These terms are only used to distinguish one element, component, region, or section from another element, component, region, or section. Thus, a first module, element, component, region, or section discussed below could be termed a second module, element, component, region, or section without departing from the teachings of the present disclosure.

[00101] The description of the disclosure is provided to enable any person reasonably skilled in the art to make or use the disclosure. Various modifications to the disclosure will be readily apparent to those skilled in the art, and the generic principles defined herein may be applied to other variations without departing from the spirit or scope of the disclosure. Thus, the disclosure

is not intended to be limited to the examples and designs described herein but is to be accorded the widest scope consistent with the principles and novel features disclosed herein.

WHAT IS CLAIMED IS:

1. A cartridge, comprising:

a cartridge body having a closed end and an open end, the open end having a first diameter at an upper edge of the open end, and a second diameter at the closed end, the second diameter of the closed end being smaller than the first diameter of the open end, the cartridge body consisting essentially of pulp, wherein the cartridge body is adapted to fit within in a receptacle of a single-serve beverage brewer such that a structure of the closed end of the cartridge body is piercable by a needle in the single-serve brewer;

a liner, coupled to the cartridge body, the liner consisting essentially of a cellulose material and having a structure that limits contact between a fluid introduced into the cartridge body and the cartridge body;

a beverage material contained between the open end of the cartridge body and the closed end of the cartridge body in an interior of the cartridge body and in an interior of the liner; and

a cover, coupled to a rim of the open end of the cartridge body, such that the cover encapsulates the beverage material within the interior of the cartridge body, the cover being adapted to be pierced by a fluid nozzle in the single-serve brewer, the cover consisting essentially of a cellulose-based material, such that a structure of the coupled cartridge body and cover substantially separate the beverage material from at least oxidizing materials external to the beverage cartridge.

2. The cartridge of claim 1, in which the pulp comprises wood pulp.

3. The cartridge of claim 2, in which the cellulose-based material comprises wood pulp.

4. The cartridge of claim 3, in which cellulose material of the liner has a different density than a density of the pulp of the cartridge body.

5. The cartridge of claim 4, in which the cartridge is compostable.

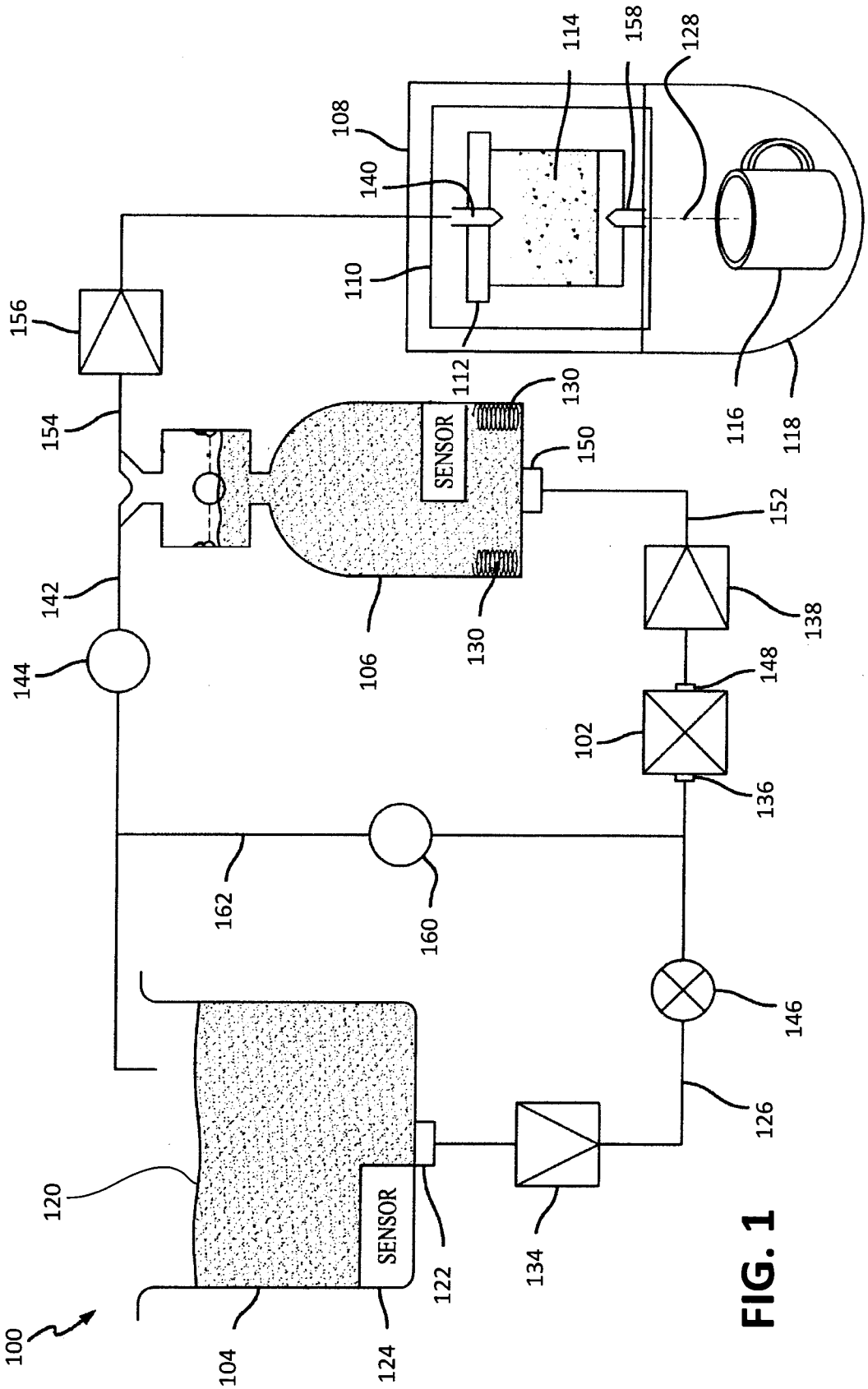
6. The cartridge of claim 5, in which the cellulose-based material of the cover has a different density than the density of the pulp of the cartridge body.

7. The cartridge of claim 6, in which liner further substantially separates the beverage material from at least oxidizing materials external to the beverage cartridge.

8. The cartridge of claim 7, further comprising a filter, coupled to the cartridge body, such that the filter is interposed between the closed end and the beverage material.

9. The cartridge of claim 8, in which the filter comprises wood pulp.

10. The cartridge of claim 9, in which the filter is a substantially frustoconical shaped filter.


100
104
120
122
124
SENSOR
SENSOR
106
108
110
112
114
116
118
128
130
130
134
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146
148
150
152
154
156
158
160
162
102
126

FIG. 1

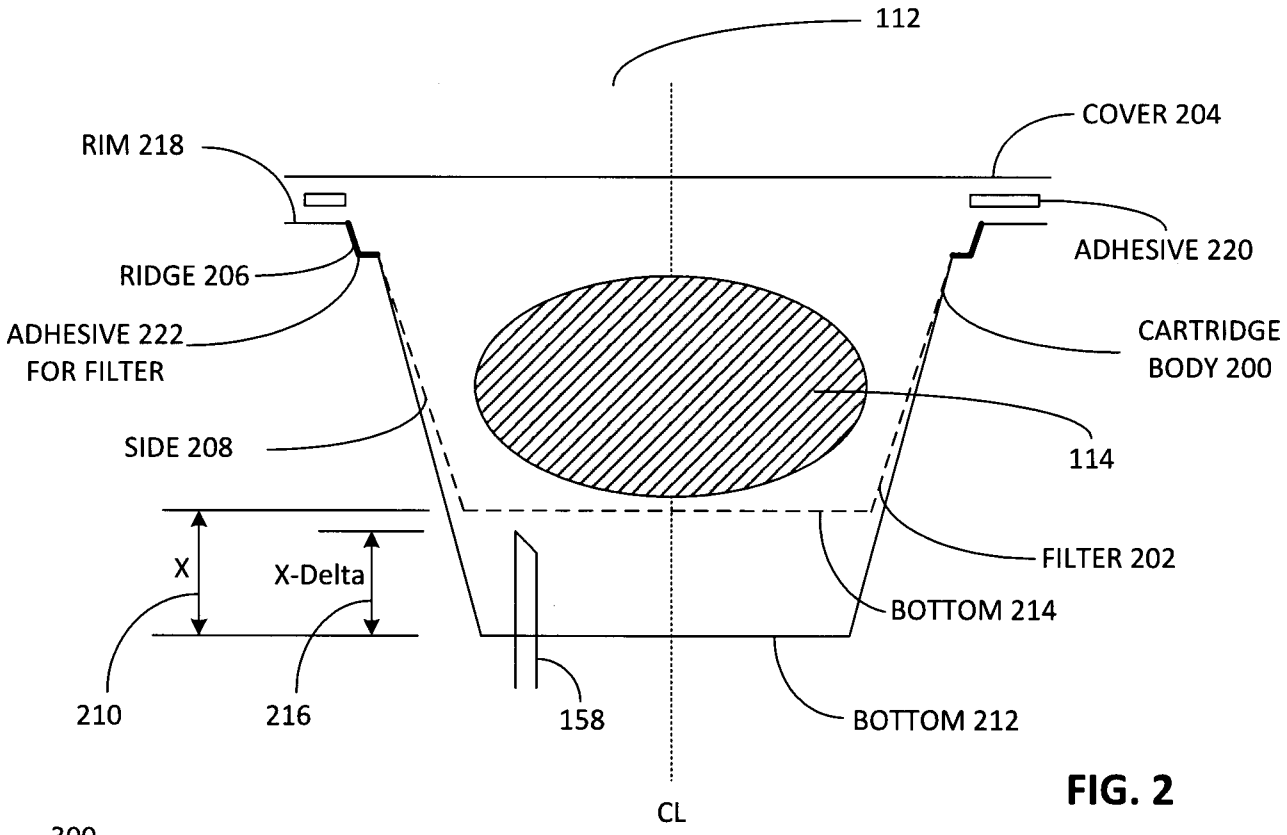

112
RIM 218
COVER 204
ADHESIVE 220
RIDGE 206
ADHESIVE 222
FOR FILTER
CARTRIDGE
BODY 200
SIDE 208
114
X
X-Delta
FILTER 202
BOTTOM 214
210
216
158
BOTTOM 212
CL

FIG. 2

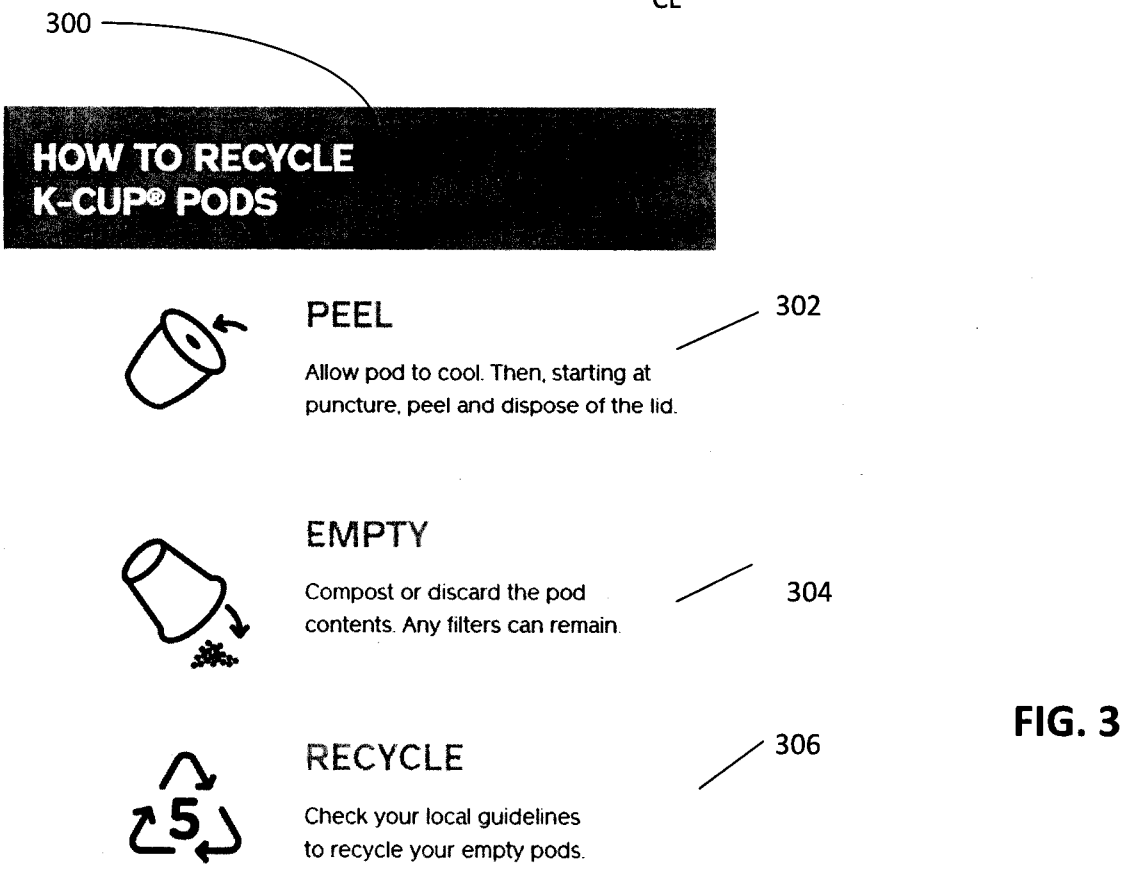

300
HOW TO RECYCLE
K-CUP® PODS
PEEL
302
Allow pod to cool. Then, starting at
puncture, peel and dispose of the lid.
EMPTY
Compost or discard the pod
contents. Any filters can remain.
304
RECYCLE
306
Check your local guidelines
to recycle your empty pods.
5

FIG. 3

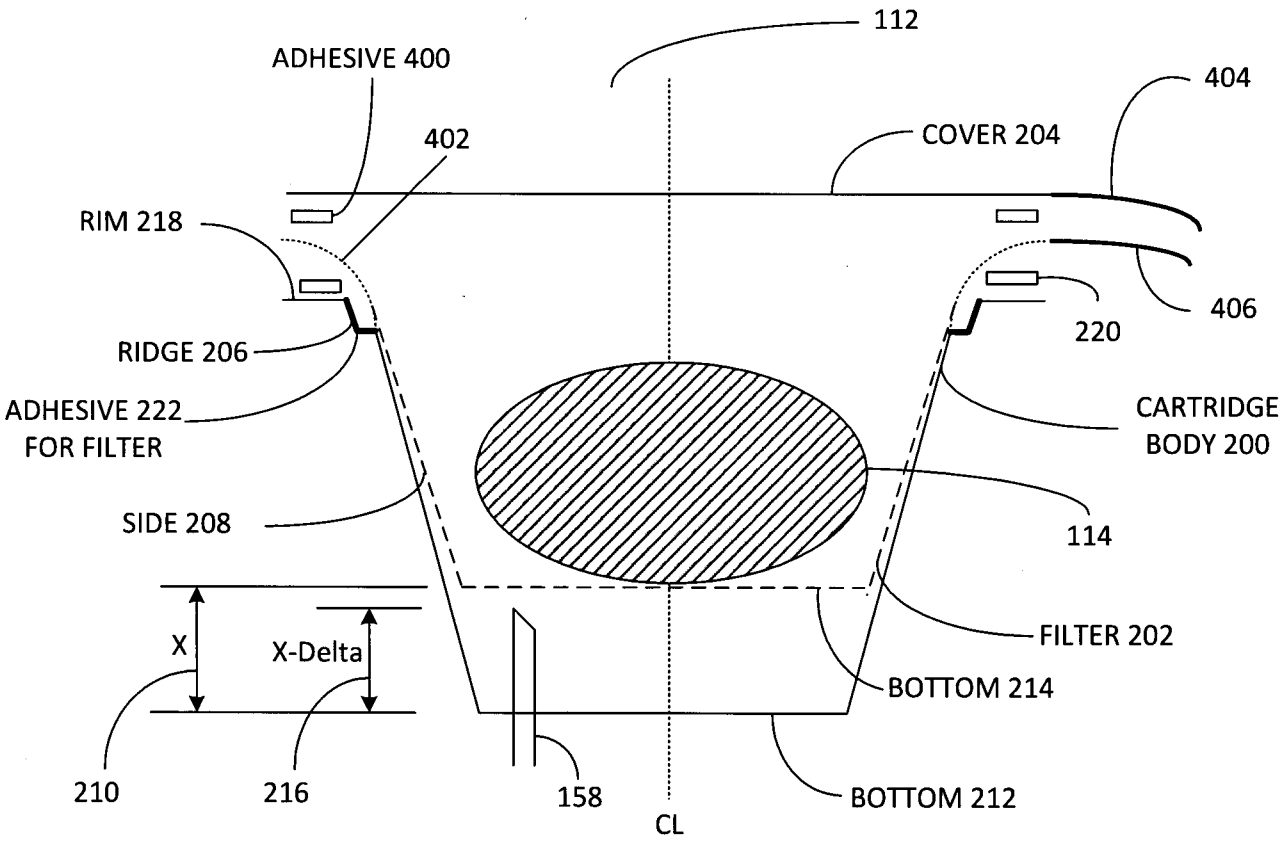

112
ADHESIVE 400
402
404
COVER 204
RIM 218
406
220
RIDGE 206
ADHESIVE 222
FOR FILTER
CARTRIDGE
BODY 200
SIDE 208
114
X
X-Delta
FILTER 202
BOTTOM 214
210
216
158
CL
BOTTOM 212

FIG. 4

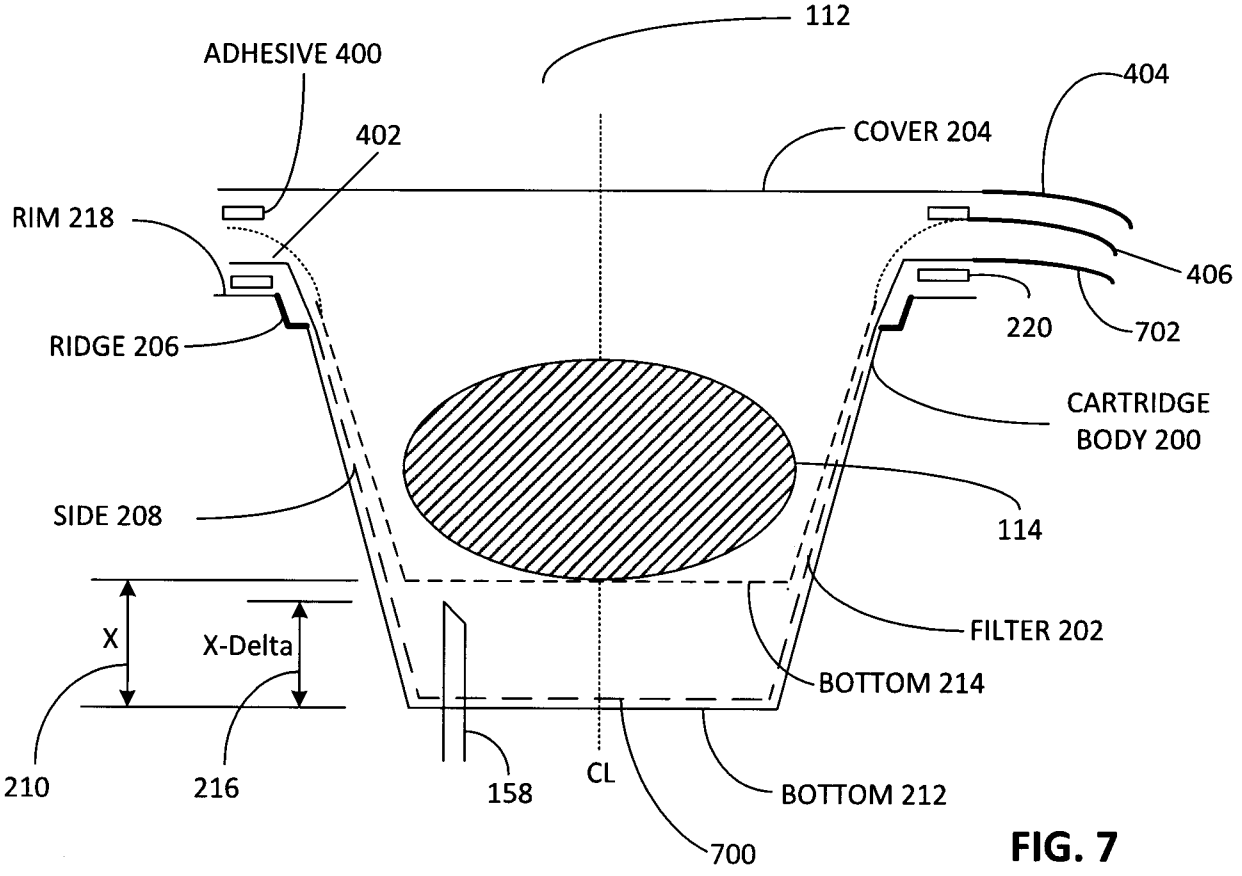

112
ADHESIVE 400
402
404
COVER 204
RIM 218
406
220
702
RIDGE 206
CARTRIDGE
BODY 200
SIDE 208
114
X
X-Delta
FILTER 202
BOTTOM 214
210
216
158
CL
BOTTOM 212
700

FIG. 7

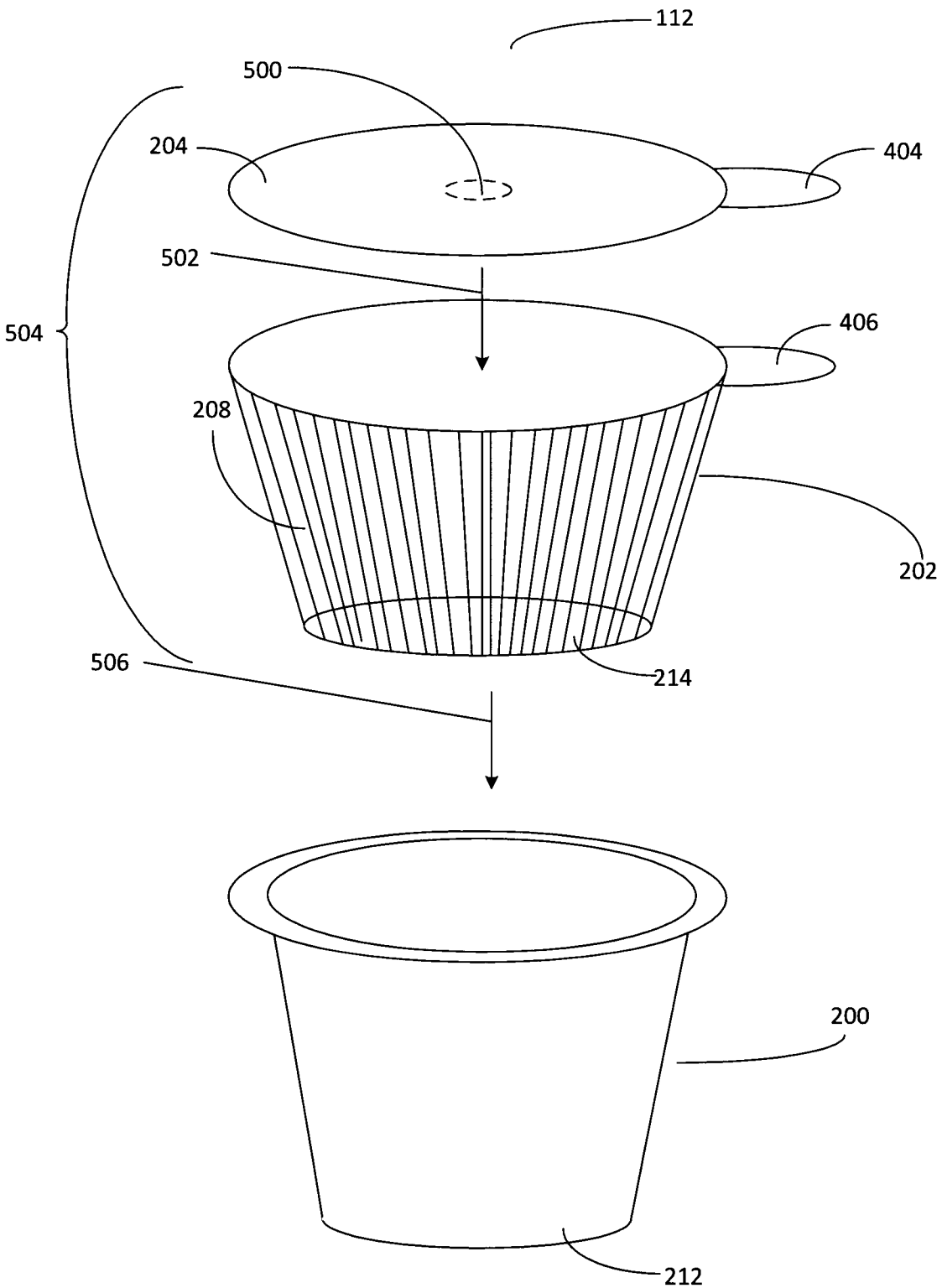


FIG. 5

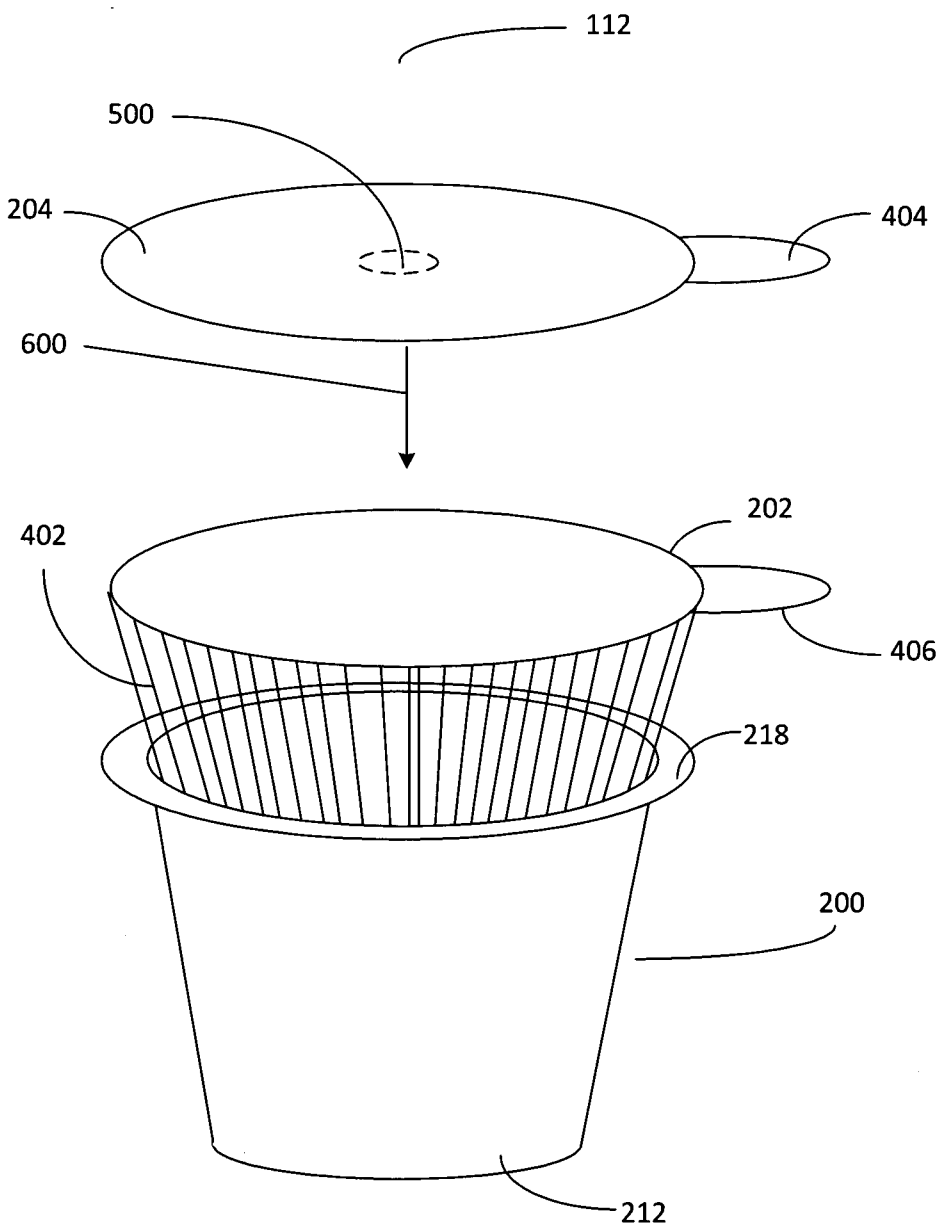


FIG. 6

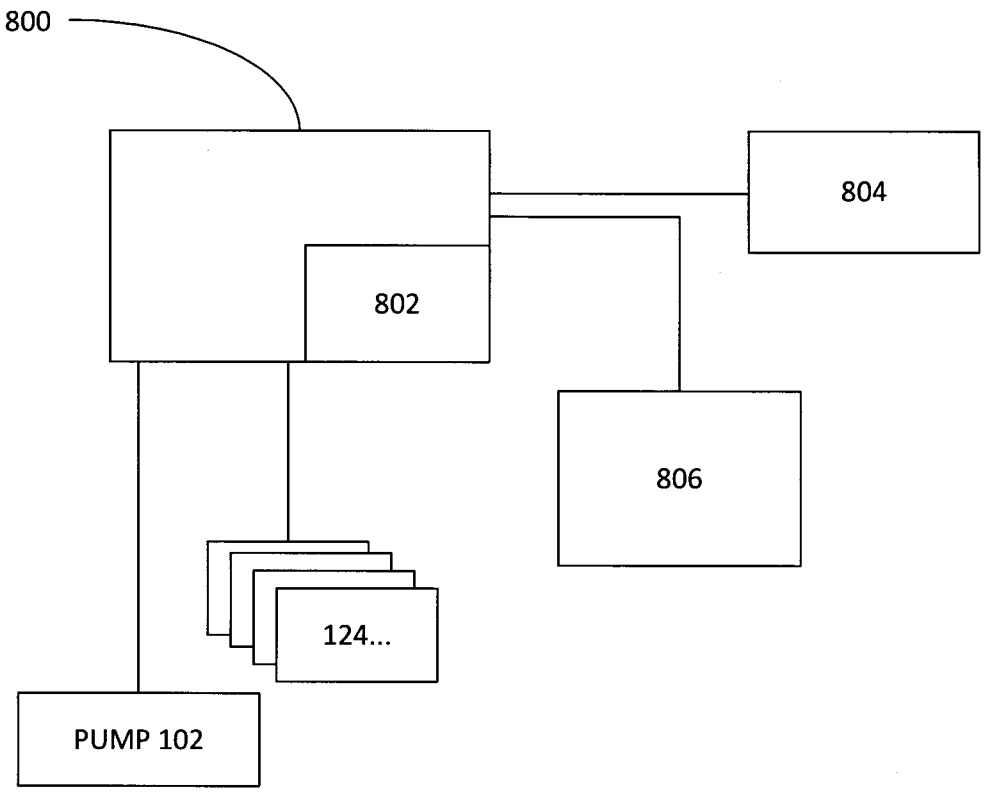


FIG. 8

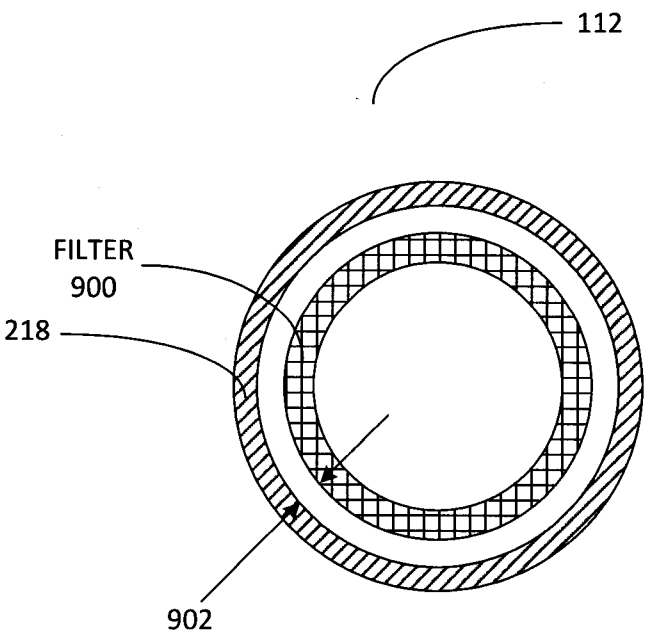


FIG. 9B

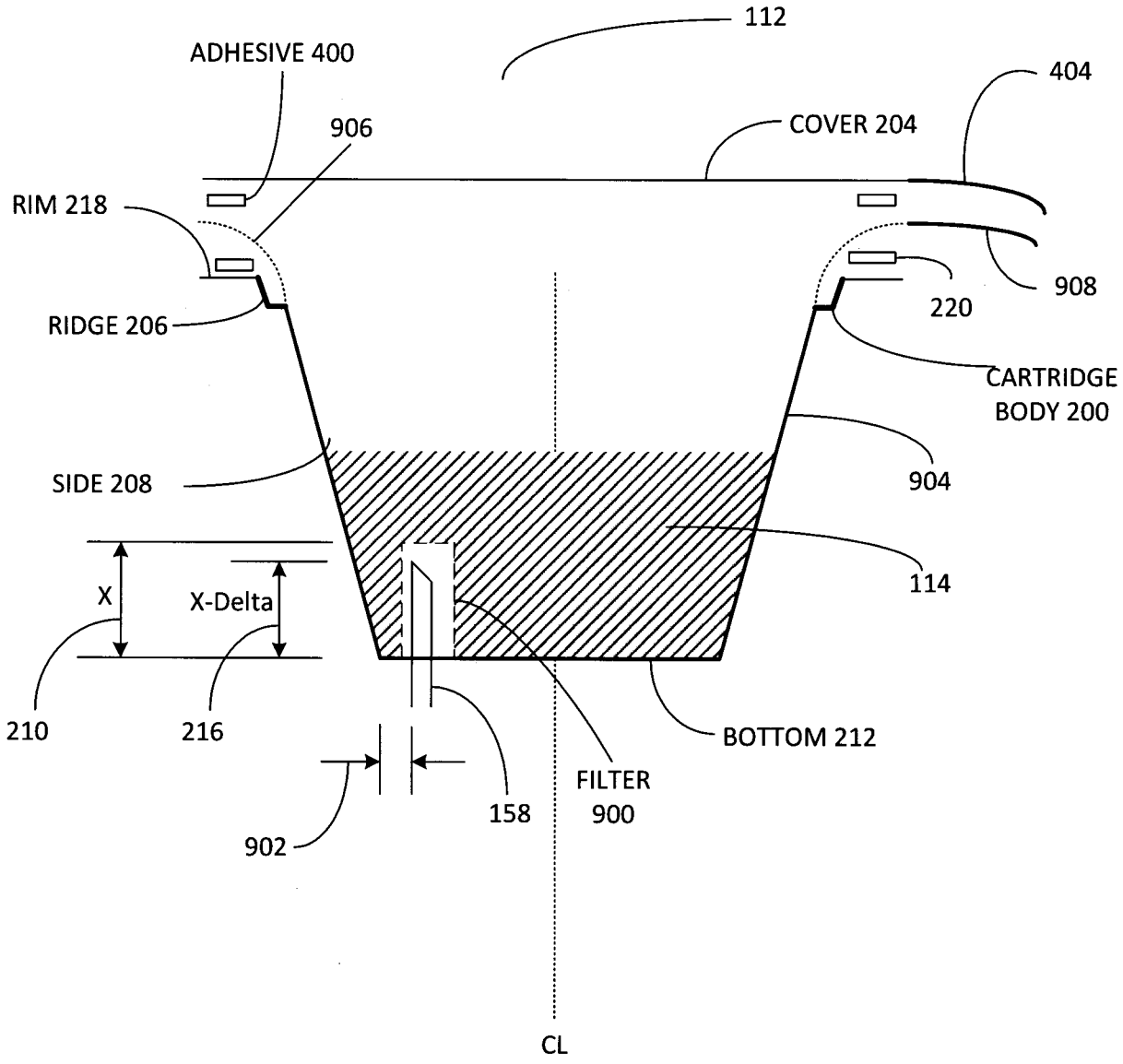

112
ADHESIVE 400
404
906
COVER 204
RIM 218
908
220
RIDGE 206
CARTRIDGE
BODY 200
SIDE 208
904
114
X
X-Delta
210
216
BOTTOM 212
158
FILTER
900
902
CL

FIG. 9A

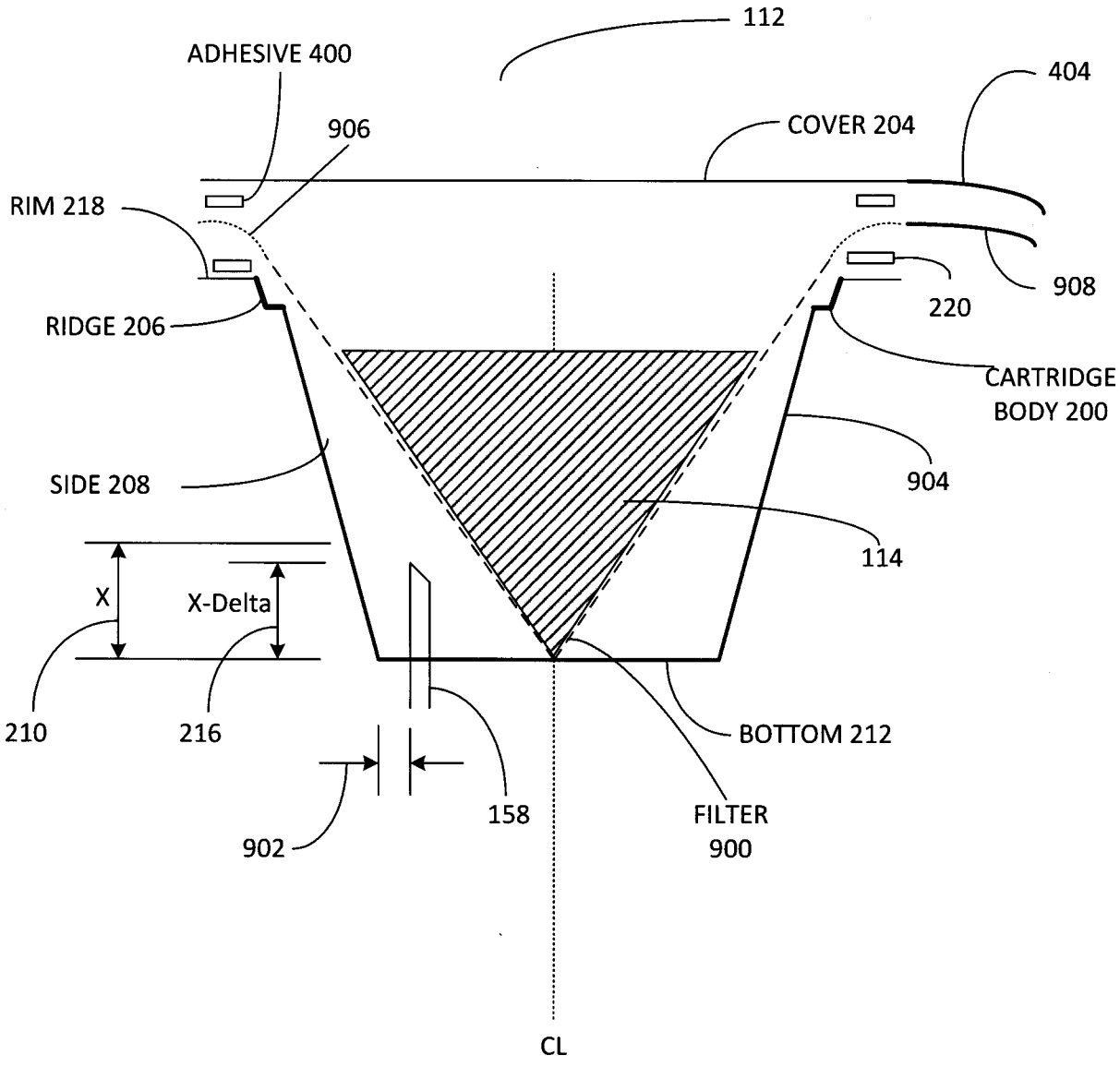
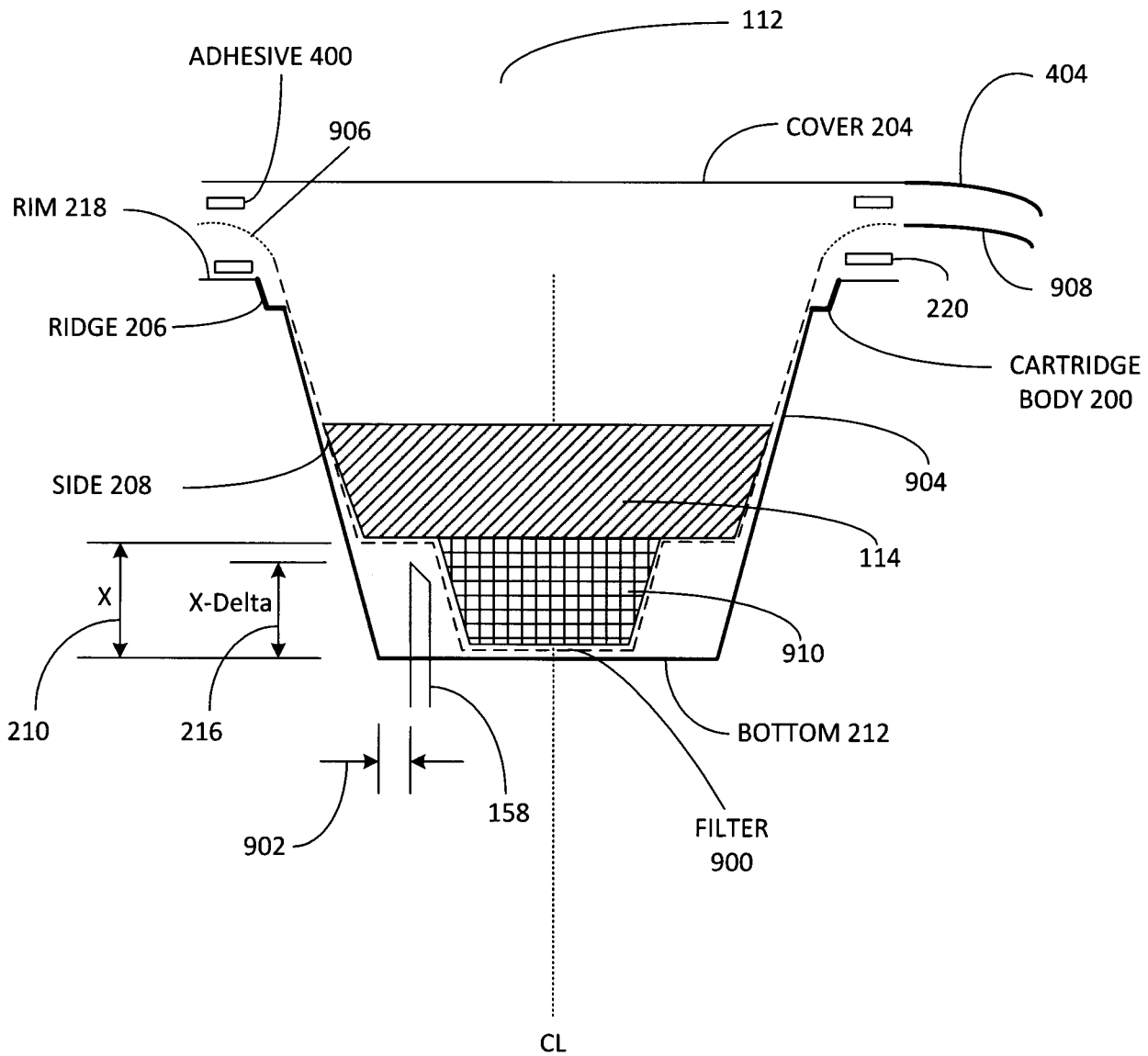

112
ADHESIVE 400
404
906
COVER 204
RIM 218
908
220
RIDGE 206
CARTRIDGE
BODY 200
SIDE 208
904
114
X
X-Delta
210
216
BOTTOM 212
158
FILTER
900
902
CL

FIG. 10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ADHESIVE 400
404
906
COVER 204
RIM 218
908
220
RIDGE 206
CARTRIDGE
BODY 200
SIDE 208
904
114
X
X-Delta
910
210
216
BOTTOM 212
158
FILTER
900
902
CL

FIG. 11

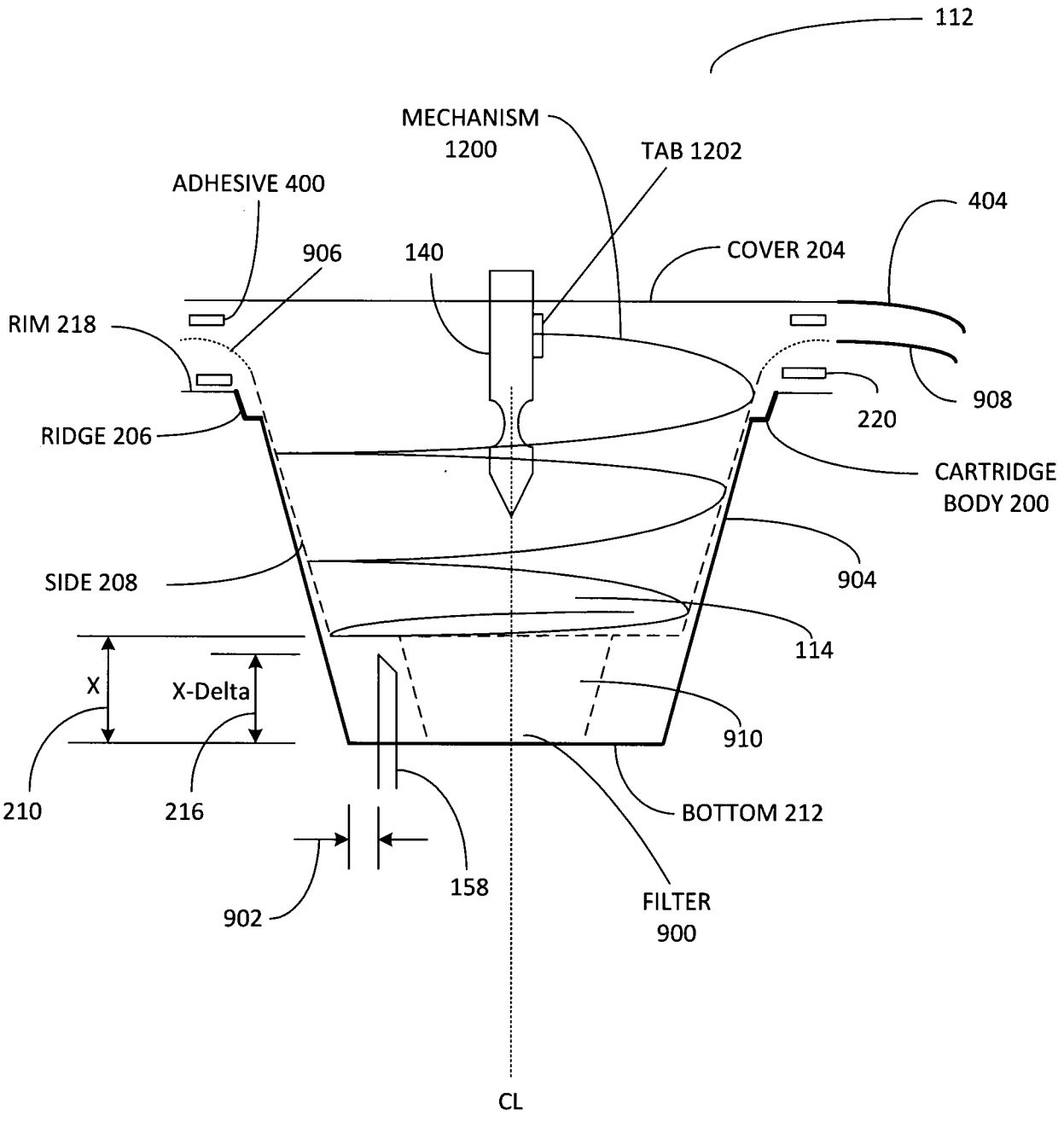

112
MECHANISM
1200
TAB 1202
ADHESIVE 400
404
906
140
COVER 204
RIM 218
908
220
RIDGE 206
CARTRIDGE
BODY 200
SIDE 208
904
114
X
X-Delta
910
210
216
BOTTOM 212
158
FILTER
900
902
CL

FIG. 12

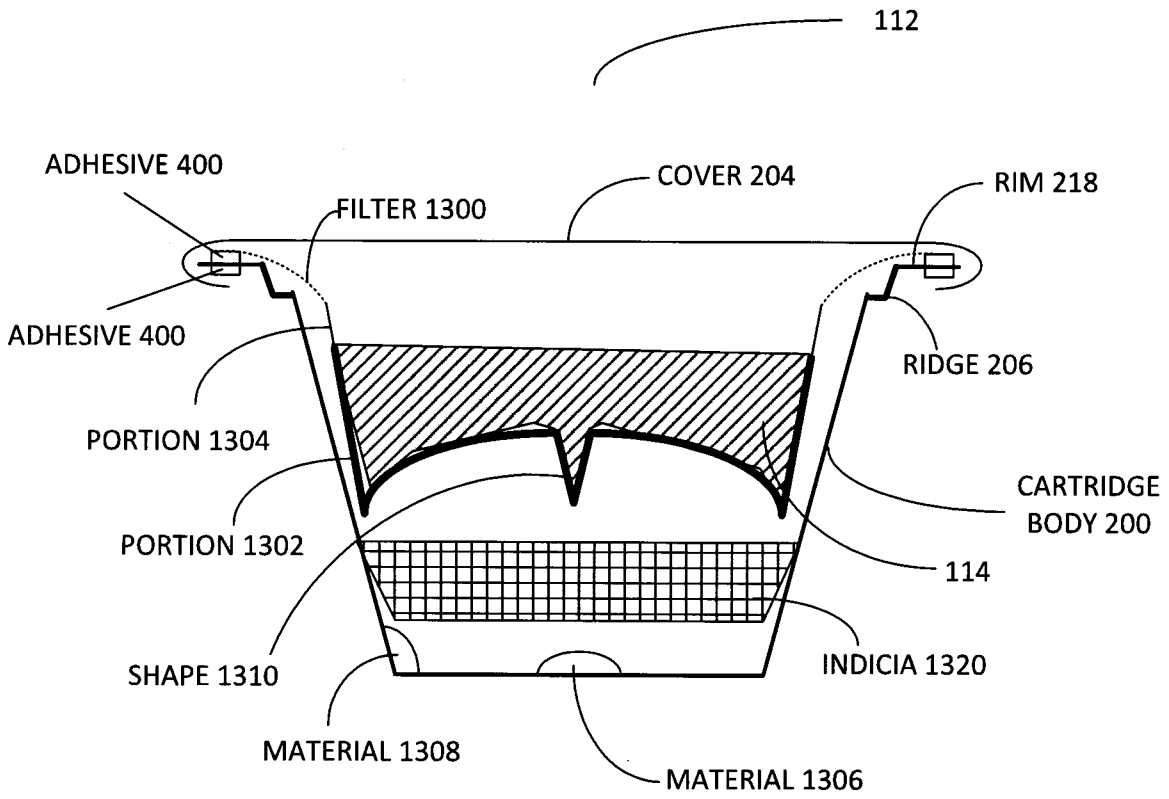

112
ADHESIVE 400
COVER 204
RIM 218
FILTER 1300
ADHESIVE 400
RIDGE 206
PORTION 1304
CARTRIDGE BODY 200
PORTION 1302
114
SHAPE 1310
INDICIA 1320
MATERIAL 1308
MATERIAL 1306

FIG. 13

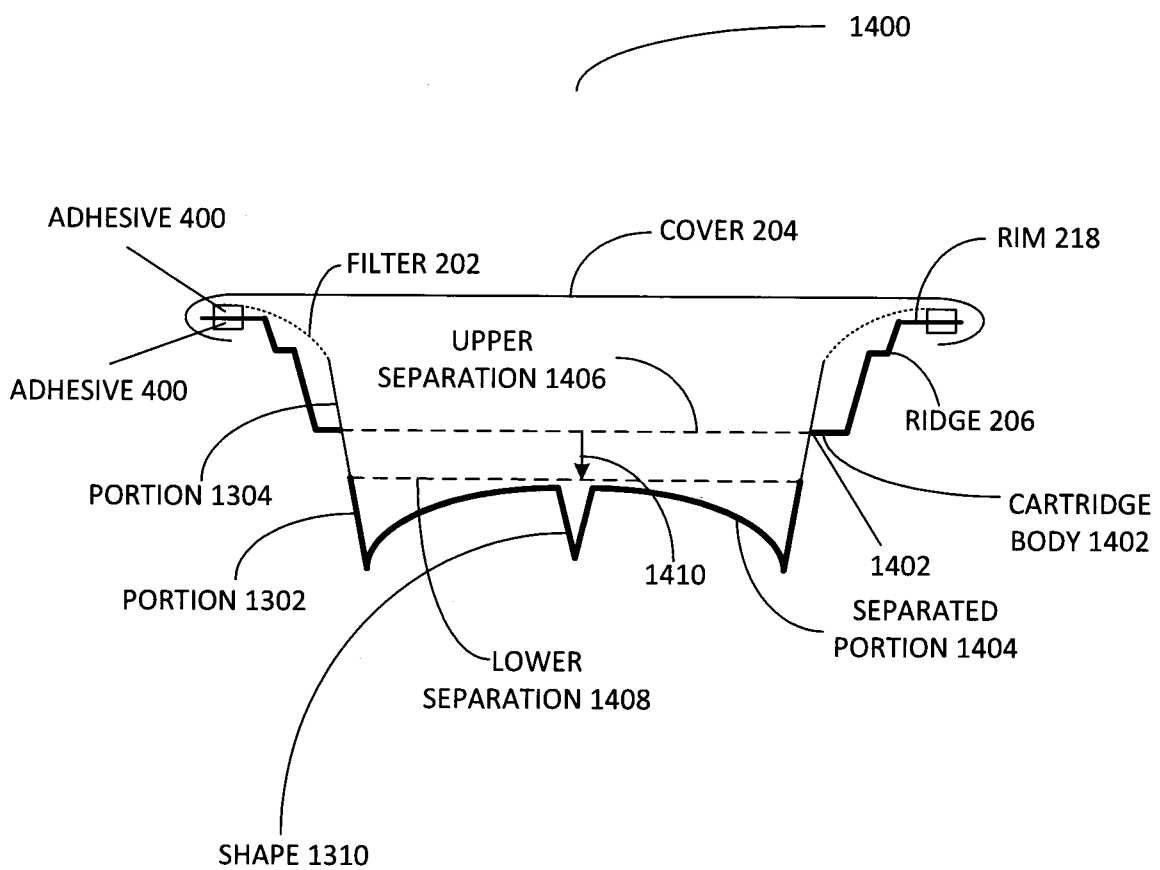
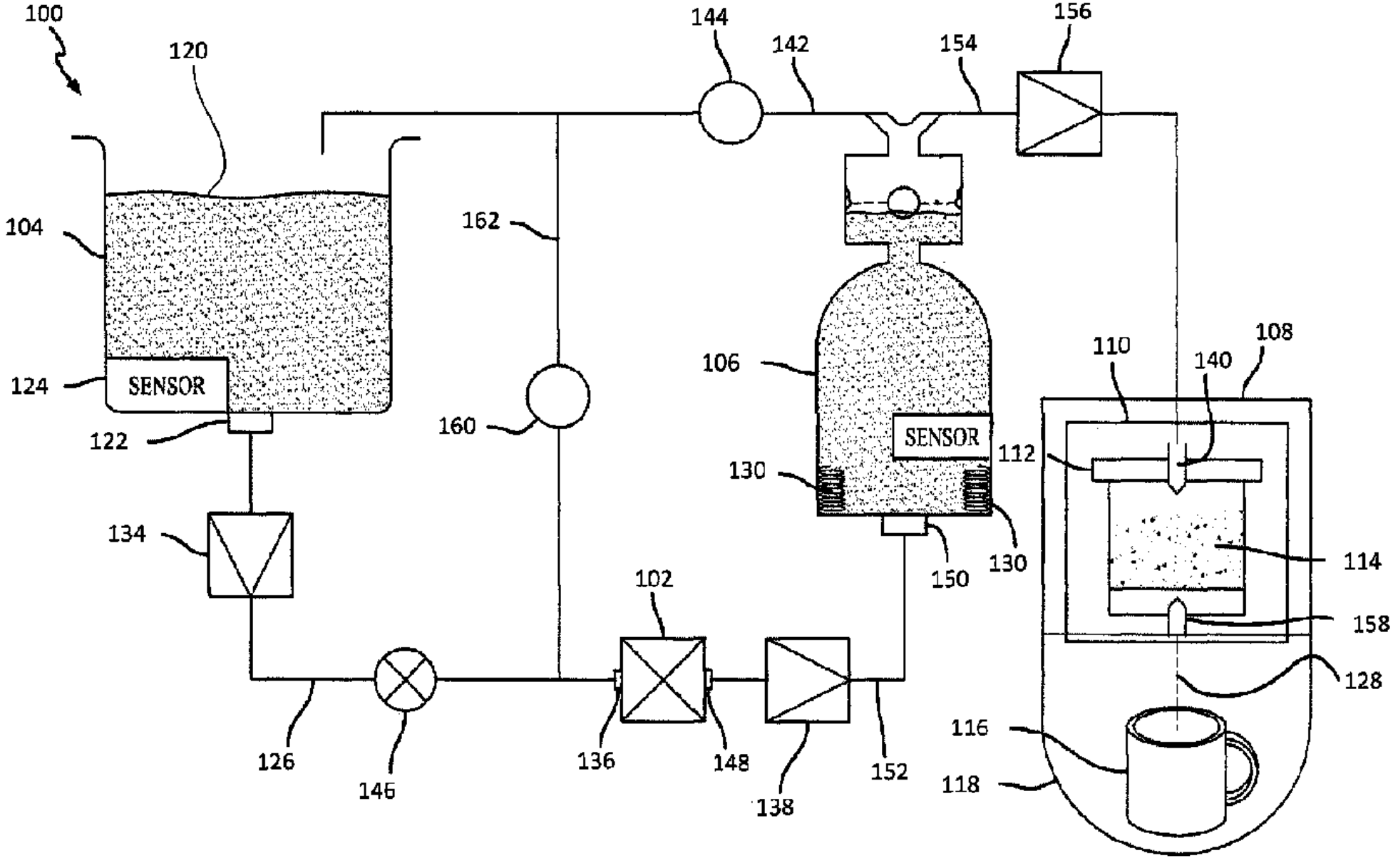

1400
ADHESIVE 400
FILTER 202
COVER 204
RIM 218
ADHESIVE 400
UPPER
SEPARATION 1406
RIDGE 206
PORTION 1304
CARTRIDGE
BODY 1402
1410
1402
PORTION 1302
SEPARATED
PORTION 1404
LOWER
SEPARATION 1408
SHAPE 1310

FIG. 14


100
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SENSOR
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SENSOR
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134
114
130
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102
158
128
126
146
136
148
138
152
116
118