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(71) Applicant: **RED HORSE HOLDINGS PTE. LTD.** [SG/SG]; 20 Kallang Avenue, Pico Creative Centre, Singapore 339411 (SG).

(72) Inventors: **CHIA, Siong Lim**; c/o RED HORSE HOLDINGS PTE. LTD., 20 Kallang Avenue, Pico Creative Centre, Singapore 339411 (SG). **LIM, Chun Yong**; c/o RED HORSE HOLDINGS PTE. LTD., 20 Kallang Avenue, Pico Creative Centre, Singapore 339411 (SG).

(74) Agent: **DAVIES COLLISON CAVE ASIA PTE. LTD.**; 10 Collyer Quay #07-01, Ocean Financial Centre, Singapore 049315 (SG).

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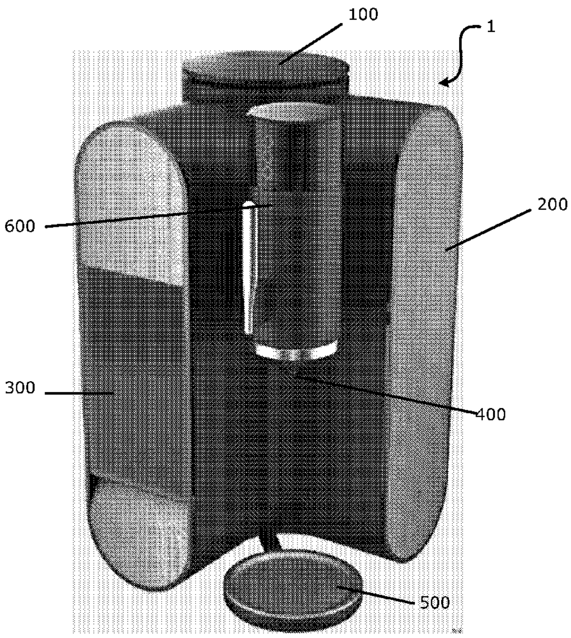


**Figure 1**

(57) **Abstract:** The present disclosure concerns a drink dispensing apparatus comprising a carbonation chamber having a side wall, a base and a top, wherein the carbonation chamber comprises at least one $CO_2$ inlet positioned on the base and/or on the side wall proximate to the base, at least one liquid inlet positioned on the base and/ or on the side wall, mixing means positioned on the base, and an access means positioned on the top and configured to allow a user access to a cavity within the carbonation chamber.

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# DRINK DISPENSING APPARATUS AND COMPONENTS THEREOF

## Technical Field

The present invention relates, in general terms, to a drink dispensing apparatus and its components thereof. The present invention also relates to methods of dispensing a drink from the drink dispensing apparatus.

## Background

The world consumes a large volume of beverages such as soft drinks, sodas, isotonics and other beverages on a daily basis. For instance, the global non-alcoholic beverage market size alcohol is valued at USD 1,337 billion in 2022. This market is anticipated to grow at an estimated CAGR of 5.5%. The global alcoholic beverage market was valued at USD 1,587 billion in 2020.

However, consuming canned or bottled beverages can be problematic. Such beverage containers occupy substantial space in refrigerators. Transportation of bulky and heavy ready-to-drink beverages contributes significant carbon emissions. Further, bottled or canned beverages, once opened, must be consumed within a relatively short period to avoid spoilage (e.g., the flattening of a carbonated soda). In order to accelerate the filling speed of carbonated beverage bottles or cans on a production line, anti-foaming additives like E436 have to be dosed into the beverages which is eventually consumed. Bottled or canned beverages are also packed in aluminium cans and plastic bottles which result in waste. For example, plastic (such as PET) bottles for carbonated beverages must be virgin PET and not recycled PET as the latter has a weaker structural integrity which would cause greater loss of carbonation during storage. Further, canned and bottled soda typically lacks a fresh mouthfeel.

Beverages can be dispensed from a dispenser that mixes a concentrate flavouring, or syrup, with a base fluid like water. For instance, traditional soda fountains and dispensers use bag-in-box (BIB) pumps to deliver syrups to a mix system. The traditional systems mix the beverage components (i.e. carbon dioxide, water, or syrup) via motors and contain numerous moving parts. However, these dispensers are meant for commercial use and are hence too large and expensive to be practical for home use. Additionally, such commercial systems also carry out pre-chilling and pre-carbonation processes and store the cold carbonated water ready to be dispensed. Consumers are unable to customise the temperature as well as the carbonation level (i.e. amount of fizz) of their beverages.

Other home-based cold beverage machines mainly maintain a single batch of cold water ready to be dispensed. However, once the pre-chilled water is depleted, the machines usually have a down-time in terms of hours before the next batch of water is chilled enough. Such designs are not suitable to be applied in home parties where higher throughput of chilled water is required.

Sodastream sells a machine that allows a user to mix carbonated beverages at home. A 1 L bottle is connected to a pump in the sodastream machine so that carbon dioxide may be pumped into the water. The carbonated water can be subsequently mixed with syrup to make a carbonated beverage. However, the sodastream machine does not create single servings of carbonated beverages. This can lead to wastage as the remaining carbonated water can go flat. Additionally, the user has to manually measure and mix the syrup and carbonated water, which can lead to inconsistent quality and flavours. Additionally, safety has been a concern regarding the use of the Sodastream machines as injuries have been reported.

It would be desirable to overcome or ameliorate at least one of the above-described problems.

**Summary**

The present invention provides a drink dispensing apparatus comprising a carbonation chamber having a side wall, a base and a top, wherein the carbonation chamber comprises:

a) at least one $CO_2$ inlet positioned on the base and/or on the side wall proximate to the base;

b) at least one liquid inlet positioned on the base and/or on the side wall;

c) mixing means positioned on the base; and

d) an access means positioned on the top and configured to allow a user access to a cavity within the carbonation chamber.

In some embodiments, the at least one $CO_2$ inlet comprises 4 $CO_2$ inlets.

In some embodiments, the mixing means is a magnetic mixing means or a shaft and rotor mixing means.

In some embodiments, the mixing means comprises blades.

In some embodiments, the access means comprises configured to withstand a pressure of up to about 5 bar.

In some embodiments, the access means is a sliding door or a trap door.

In some embodiments, the access means comprises stainless steel of more than 1.5 mm thick.

In some embodiments, the access means is sealable.

In some embodiments, the access means comprises a locking means.

In some embodiments, the carbonation chamber is integral within the drink dispensing apparatus.

In some embodiments, the carbonation chamber further comprises at least one liquid outlet for draining carbonated liquid.

In some embodiments, the liquid outlet is characterised by an inner diameter of more than about 5 mm.

In some embodiments, the carbonation chamber further comprises thermoelectric cooling (TEC) elements.

In some embodiments, the carbonation chamber has a volume of at least 250 mL.

In some embodiments, the at least one $CO_2$ inlet is fluidly coupled to a $CO_2$ source.

In some embodiments, the drink dispensing apparatus further comprises a $CO_2$ adaptor for connecting to a $CO_2$ canister, wherein the $CO_2$ adaptor comprises a canister attachment means and a gas communication means, wherein the canister attachment means and the gas communication means are configured to be actuated separately and/or sequentially.

In some embodiments, the canister attachment means is a screw hole with female thread.

In some embodiments, the canister attachment means is pivotable to about 90 ° relative to a vertical axis.

In some embodiments, the gas communication means is a lever or a prong.

In some embodiments, the gas communication means is pivotable about 90 ° relative to the vertical axis.

In some embodiments, the carbonation chamber further comprises thermoelectric cooling (TEC) elements.

In some embodiments, the drink dispensing apparatus further comprises a laminar flow means positioned external to a spigot, wherein the laminar flow means is configured to be contactable with an inner surface of a vessel.

In some embodiments, the laminar flow means movable.

In some embodiments, the laminar flow means is a funnel.

In some embodiments, the laminar flow means is flexible.

In some embodiments, the carbonation chamber is positioned higher relative to the laminar flow means with reference to gravity.

In some embodiments, the drink dispensing apparatus further comprises a load cell configured to quantify a weight of the content in the cavity of the carbonation chamber.

In some embodiments, the drink dispensing apparatus further comprises a drip tray, the drip tray comprising an ultrasonicator.

In some embodiments, the drip tray further comprises liquid inlet fluidly coupled to a liquid tank.

In some embodiments, the drink dispensing apparatus further comprises an ultrasonicator proximate to a spigot.

The present invention also provides a method of dispensing a drink from a drink dispensing apparatus comprising a carbonation chamber as disclosed herein, the method comprising:

a) accessing the access means in order to introduce ice into a cavity of the carbonation chamber;

b) flowing a liquid from the at least one liquid inlet into the cavity of the carbonation chamber;

c) flowing $CO_2$ from the at least one $CO_2$ inlet into the cavity of the carbonation chamber; and

d) mixing the liquid in order to obtain a carbonated liquid.

In some embodiments, the method further comprises a step before step a) of connecting a $CO_2$ canister to the drink dispensing apparatus via a $CO_2$ adaptor, wherein the $CO_2$ adaptor comprises a canister attachment means and a gas communication means, wherein the canister attachment means and the gas communication means are configured to be actuated separately and/or sequentially.

In some embodiments, the method further comprises a step after step b) of quantifying an amount of liquid in the carbonation chamber via a load cell.

In some embodiments, the method further comprises a step of mixing the carbonated liquid with a concentrate in order to form a drink.

In some embodiments, the method further comprises a step of flowing the drink into a vessel via a spigot and/or a laminar flow means.

In some embodiments, the method further comprises a step of ultrasonicating the drink prior to it flowing through the spigot.

In some embodiments, the method further comprises a step of positioning a vessel on the drip tray, flooding a drip tray with a liquid and ultrasonicating the vessel.

**Brief description of the drawings**

Embodiments of the present invention will now be described, by way of non-limiting example, with reference to the drawings in which:

**Figure 1** shows a drink dispensing apparatus and its components.

**Figure 2A** shows a schematic of a carbonation chamber.

**Figure 2B** shows an embodiment of the carbonation chamber in a closed configuration.

**Figure 2C** shows an embodiment of the carbonation chamber in an open configuration.

**Figure 2D** shows the access means and the sealing means of the carbonation chamber.

**Figure 3A** shows a schematic of a $CO_2$ adaptor.

**Figure 3B** shows an embodiment of a gas communication means.

**Figure 3C** shows an embodiment of a canister attachment means.

**Figure 4A** shows a schematic of a carbonation chamber, capsule chamber and laminar flow means.

**Figure 4B** shows a flow path from the carbonation chamber to the capsule chamber.

**Figure 4C** shows a flow path from the capsule chamber to the laminar flow means.

**Figure 5A** shows a schematic of a drip tray with an ultrasonicator.

**Figure 5B** shows an embodiment of a drip tray with an ultrasonicator.

**Figure 6A** shows side views of the capsule chamber in the close and open configuration.

**Figure 6B** and **6C** show side views of another capsule chamber during loading of the capsule.

**Figure 7** shows a method of dispensing a drink from a drink dispensing apparatus.

**Figure 8** shows an exemplary work process of dispensing a drink.

**Detailed description**

The present invention is predicated on the understanding that portable water is available and accessible almost everywhere while carbonated water is less available in Asian countries. However, portable water may be carbonated and hence carbonated beverages can be conveniently supplied to a home environment with an appropriate drink dispensing apparatus. It was also found that by allowing the chilling of water prior to the carbonation process, the carbonation rate can be improved. This is in contrast to Sodastream's machine, which does not provide nor facilitate chilling of the water prior to the carbonation process.

The present invention provides a drink dispensing apparatus. It also provides components for use in a drink dispensing apparatus. The present invention also provides a method of preparing drink.

Hereinafter, the present invention will be described in detail with reference to its components and with reference to the accompanying drawings.

As shown in Figure 1, the drink dispensing apparatus 1 is formed from several components. The drink dispensing apparatus comprises a carbonation chamber 100, a $CO_2$ canister chamber 200, a liquid tank 300, a spigot 400, a drip tray 500, and a capsule chamber 600. Other components such as electronic controls, pump, heater can be also be present. These are well known to those skilled in the art, and thus have not been illustrated, nor will they be described further in this specification.

<u>Carbonation Chamber for Simultaneous Carbonation and Chilling Process</u>

As shown in Figure 2A, the drink dispensing apparatus has a carbonation chamber 100 which is accessible to users via an access means 102. The carbonation chamber has a side wall 104, a base 106 and a top 108. The side wall 104, base 106 and top 108 act together to contain the contents of the carbonation chamber 100. The carbonation chamber can be of any shape. For example, the carbonation chamber can be a cylinder or a cuboid. The carbonation chamber 100 comprises at least one $CO_2$ inlet 110 positioned on the base 106 and/or on the side wall 104 proximate to the base and at least one liquid inlet 126 positioned on the base 106 and/or on the side wall 104. The $CO_2$ inlet 110 introduces $CO_2$ into the carbonation chamber 100 and the liquid inlet 126 introduces a liquid into the carbonation chamber 100. The liquid can be water.

For example, the at least one $CO_2$ inlet 110 can be one, two, three, four or five $CO_2$ inlets. The CO2 inlet 110 can further comprise an airstone 112 for breaking up the stream of $CO_2$ into small bubbles. When the size of $CO_2$ bubbles is reduced prior to release into the carbonation chamber 100, the $CO_2$ dissolution into water is improved.

In some embodiments, the at least one liquid inlet 126 can be one, two, three, four or five liquid inlets. A liquid such as water can be eluted from the liquid inlet 126 to fill up the cavity of the carbonation chamber.

A mixing means 114 can be positioned on the base 106. The mixing means mixes the contents of the cavity 122. The mixing means can be a magnetic mixing means. The mixing means can be a shaft and rotor mixing means. The mixing means can comprise blades 116. In addition to mixing, the blades 116 can be used to crush ice to rapidly decrease the temperature of the liquid in the carbonation chamber 100. $CO_2$ is naturally buoyant with respect to the liquid such that without mixing, $CO_2$ bubbles will naturally take a direct route up to the headspace and escape. With mixing, the route taken by $CO_2$ before reaching the headspace can be lengthened via the circular movement caused by the mixing, thereby improving the carbonation efficiency. Movement of the liquid by the mixing means 114 may form a vortex or other configuration such that the liquid moves upwardly along the inner side wall 104 of the carbonation chamber 100 and forms a void around a centre of rotation of the mixing means 114. This arrangement may have two (or more) effects, including increasing the contact surface area between the liquid and the $CO_2$ in the headspace, thereby enhancing dissolution of $CO_2$ in the liquid, and increasing an area and rate of contact between the liquid and the inner surface of side wall 104 of the carbonation chamber 100 (i.e. the surface of the sidewall 104 facing the contents of the chamber 100), thereby enhancing heat transfer and rapidly cooling down the liquid. This can be advantageous if optional heat removing elements along the outer side walls are present. Movement of the liquid may also cause mixing and/or turbulence, which may also enhance gas dissolution and/or heat transfer. The rotating mixing means 114 further breaks up larger $CO_2$ bubbles into smaller ones, thus providing better dissolution of $CO_2$ in water. Preferentially, the $CO_2$ inlets 110 are positioned close to the base 106 of the carbonation chamber 100, which increases the contact time of the $CO_2$ with water and hence improves carbonation efficiency. In this regard, the pathway of the $CO_2$ bubbles in the water is altered from a straight path up into the headspace of the carbonation chamber to one that is going around the carbonation chamber before finally ending up in the headspace.

The mixing means 114 is rotatable by a mixing drive so as to mix a liquid (such as water) in the carbonation chamber 100. The mixing means 114 may be driven by any suitable arrangement, such as a magnetically-coupled motor drive, a drive shaft that extends through a base of the carbonation chamber, or other. The point of rotation of the mixing means 114 can be at a centre or off-centre position of the carbonation chamber 100.

As mentioned, ice may be added into the carbonation chamber 100 in order to cool down the liquid. The carbonation chamber 100 can further comprise a perforated receptacle within the cavity of the carbonation chamber 100. The perforated receptacle can be positioned above the mixing means 114. The perforated receptacle is configured to hold ice while allowing liquid to flow around the ice for rapidly cooling the liquid.

The carbonation chamber may further comprise an ice inlet positioned at the top and/or on the side wall proximate to the top. The ice inlet may allow for automatic addition of ice into the chamber as required. For example, if the temperature within the chamber is sensed to fall below a threshold, ice from a storage compartment may be delivered via the ice inlet into the chamber. Alternatively, ice may be added into the chamber by the user via the access means 102.

As ice is insertable into the carbonation chamber, the drink dispensing device is thus capable of producing continuous back-to-back servings of ice-cold water (4 to 8 °C) within 2 minutes for each serving.

An access means 102 can be positioned on the top 108 of the carbonation chamber 100. The access means 102 is made to be easily accessible, light and strong. The access means 102 opens an orifice to allow the user to add ice into a cavity 122 of the carbonation chamber 100, from which the mixing means 114 facilitates the formation of cold carbonated water. This further improves the carbonation efficiency. For example, the access means 102 can be a sliding door as shown in Figure 2A-D. The access means 102 can also be a trap door. The access means 102 can be made of stainless steel of more than 1.5 mm thick. The access means 102 can further be sealable by sealing means 118, for example by using O-rings. This is more clearly shown in Figure 2D. Alternatively, the sealing means can be a plastic ribbed raft configured to capture the initial internal pressure increase so as to float the access means 102 and seal the carbonation chamber 100. When pressurised with $CO_2$, the internal pressure presses the access means 102 into abutment with an overhang 124, such that the sealing means 118 seats the access means 102 against the overhang 124. This allows the access means 102 to be sealed to further prevent loss of $CO_2$ pressure in the carbonation chamber 100. When access means 102 is closed and carbonation starts, the cover seals the orifice (for example by being lifted up due to the built up pressure) to minimise $CO_2$ loss. A pressurised environment also retains $CO_2$ within the liquid. The cover is configured to withstand up to 5-

bar of gas pressure, thus the carbonation chamber can contain or hold a pressure of up to 5 bar without mechanically failing.

It was found that when the access means 102 is a sliding door, it is relatively easy for the consumer to use. Additionally, due to the increased pressure from a first burst of $CO_2$ into the carbonation chamber, the sliding door auto-seals.

Figure 2B shows the carbonation chamber 100 with the access means 102 closed (closed configuration). Figure 2C shows the carbonation chamber 100 with the access means 102 opened (open configuration). Room temperature water can thus be added from the liquid inlet 126, which can undergo speedy chilling via high speed spinning while in contact with ice cube(s) inserted by the user via the access means 102. The access means 102 may have a handle for handling by the user.

The access means can have a locking means 120. The locking means 120 can be a latch, or can be an electromagnet controllable by a switch, or any other suitable locking mechanism.

The carbonation chamber 100 can comprise a sensor for detecting the state of the access means 102. For example, the sensor can be configured to determine if the access means 102 is closed or open. When the access means 102 is open, the mixing means can be configured to not operate. For example, a sensor may be incorporated into the access means 102, to prevent power being supplied for carbonation until the access means 102 is in the closed configuration.

To further improve cooling of the water, the carbonation chamber 100 can further comprise thermoelectric cooling (TEC) elements. The TEC elements can comprise fins that extend from the side walls of the carbonation chamber. Alternatively, the TEC elements can comprise a coil which extends concentrically along the side walls of the carbonation chamber. The TEC elements can be positioned internally or externally of the carbonation chamber.

By using the above carbonation chamber 100, about 2 to about 5 bar pressure of $CO_2$ may be supplied to the carbonation chamber 100. Preferably, about 4 to about 5 bar pressure may be supplied. The carbonation chamber provides about 75% carbonation efficiency. The carbonation efficiency is the total weight of $CO_2$ dissolved into the liquid divided by the total weight of the $CO_2$ used from the $CO_2$ canister. In comparison, the carbonation efficiency in Sodastream's machine was noted to be highly variable due to the machine setup and higher $CO_2$ pressure. This can lead to higher $CO_2$ wastage.

This carbonation chamber 100 is advantageous for reducing the volume of the beverage dispensing machine as well as reduce $CO_2$ wastage. Carbonation also occurs on demand, generated just-in-time when a drink is to be dispensed. Carbonation occurs only when a drink is being prepared, rather than being stored and subjected to de-carbonation. It also allows the maximum allowable level of carbonation in the beverage, so as to provide for maximum enjoyment of the fizzy beverage.

The carbonation chamber 100 can be integral within drink dispensing apparatus 1. This provides a sleek and compact apparatus, thus making it suitable for home use.

In some embodiments, the carbonation chamber 100 further comprises at least one liquid outlet 128 for draining carbonated water. In certain embodiments, the liquid outlet 128 has a larger inner diameter relative to the liquid inlet 126. For example, the inner dimensions (or diameter) of the liquid outlet 128 (and the downstream tubing connecting the liquid outlet 128 to the capsule chamber and the spigot) may be more than about 5 mm. This ensures that laminar flow is maintained within the tubing and the dissolved $CO_2$ is not inadvertently released. It was found that tubing smaller than 5 mm can cause flow issues as $CO_2$ bubbles may accumulate into a huge bubble, thus blocking the gravitational flow of the carbonated water. In other embodiments, the liquid outlet 128 has a same diameter relative to the liquid inlet 126.

The liquid inlet 126 and the liquid outlet 128 may together be formed as a single port or orifice. In other words, liquid flows into and out of the carbonation chamber 100 via the same port. For example, the port may be connected to a Y-connector in combination with at least one one-way valve. This serves to further reduce the footprint of the drink dispensing apparatus as a result of the compactness of the carbonation chamber, and also to minimise blockage and maintenance due to the fewer tubing, connections and parts.

In some embodiments, the carbonation chamber 100 further comprises a pressure safety release valve. The valve provides a safety mechanism to prevent overpressure of the carbonation chamber 100. For example, when the pressure in the carbonation chamber 100 exceeds about 6 bar, the pressure safety release valve can be activated to release some of the pent up pressure.

The carbonation chamber 100 can have a cavity with a volume of at least about 200 mL, about 220 mL, about 240 mL, about 250 mL, about 260 mL, about 270 mL, about 280 mL, about 300 mL, about 320 mL, about 340 mL, about 360 mL, about 380 mL, about 400 mL, about 420 mL, about 440 mL, about 460 mL, about 480 mL, or about 500 mL. In a preferred embodiment, the volume is at least about 270 mL.

<u>$CO_2$ Adaptor in $CO_2$ Canister Chamber</u>

In general, when the user installs a $CO_2$ canister into a drink dispensing apparatus, it involves a step of screwing the $CO_2$ canister with a release valve into an adaptor on the apparatus. It was found that in some designs, this process results in a loss of $CO_2$ as the $CO_2$ gushes out while the release valve is partially compressed during the connecting process. The user experiences this gush of $CO_2$ which is being released from the $CO_2$ canister as the $CO_2$ canister is being screwed into the adaptor. If the user is slow, a larger amount of $CO_2$ is lost which is wasteful. This may also cause panic to users who are inexperienced with gas canisters, which can be a safety concern.

It was found that the loss of $CO_2$ can be eliminated or at least minimised when attaching the $CO_2$ canister to the drink dispensing apparatus. In this regard, and as shown in Figure 3A, the drink dispensing apparatus 1 can comprise a $CO_2$ adaptor 202 having a canister attachment means 204 and a gas communication means 206. The canister attachment means 204 and the gas communication means 206 are separately and/or sequentially actuated. The canister attachment means 204 engages the canister to maintain the canister in a position for use. The gas communication means 206 fluidly connects the canister to the drink dispensing apparatus 1. The user first attaches the $CO_2$ canister 208 to the $CO_2$ adaptor 202 via the canister attachment means 204. The $CO_2$ canister 208 is attached to the drink dispensing apparatus 1 such that a sealed gas passageway (against external pressure) is formed between the $CO_2$ canister 208 and the drink dispensing apparatus 1 via the canister attachment means 204. However, the sealed gas passageway is not yet fluidly connected. The gas communication means 206 is then actuated which depresses or actuates a release valve (for example a release pin) on the $CO_2$ canister 208, thereby fluidly communicating the $CO_2$ canister 208 with the drink dispensing apparatus 1.

The canister attachment means 204 can be a screw hole with female thread 210. This is more clearly seen in Figure 3C. In this way, a $CO_2$ canister 208 with conventional release valve can be used. Other complementary mating means with the $CO_2$ canister 208 may also be used. The canister attachment means 204 may be rigidly secured in a downward facing position such that the $CO_2$ canister 208 can be mated to the canister attachment means 204 in an upright position. By screwing the $CO_2$ canister 208 into the screw hole 210, the gas passageway is sealed (against external pressure) but not yet opened. The canister attachment means 208 can further comprise O-rings to improve the seal. The $CO_2$ canister 208 is first securely mated to the canister attachment means 204 and thus eliminates the possibility of the user fumbling fitting the $CO_2$ canister while $CO_2$ is being released.

The $CO_2$ canister 208 can then be actuated using the gas communication means 206 such that gas in the canister can be fluidly communicated to the carbonation chamber for carbonation. For example, the gas communication means 206 can be a lever 212 hinged at an upper end 214. The gas communication means 206 is pivotable about the hinge 214. The pivotal movement actuates a pin 216 along a vertical axis which engages the release valve of the $CO_2$ canister 208 and activates it. For example, as shown in Figure 3C, the gas communication means 206 can comprise a gradient wedge 220 which engages and acts on protrusion 218. Protrusion 218 is movable connected to pin 216 such that the pivotal movement of the gas communication means 206 back to a vertical position causes the pin 216 to engage the release valve of the $CO_2$ canister 208. The gas communication means 206 can further act as a protective cover. For example, if the $CO_2$ canister is not properly attached and pops out from the $CO_2$ adaptor, this movement is restricted to a downward movement and will not injure the user.

The gas communication means 206 is pivotable to a position at about 20 ° to about 90 ° relative to the vertical axis (generally, the axis of the pin 216 or the direction along which gas exist the canister), or preferentially to about 45 ° relative to the vertical axis. This is advantageous in reducing the footprint of the drink dispensing apparatus 1.

In another embodiment, the canister attachment means 204 is pivotable in line with the gas communication means 206. For example, the canister attachment means 204 and the gas communication means 206 can be pivotable about 90 ° relative to the vertical axis. When the canister attachment means 204 and the gas communication means 206 are pivoted to a position at about 20 ° to about 90 ° relative to the vertical axis, the canister attachment means 204 is exposed outwardly such that the $CO_2$ canister 208 can be mated with the canister attachment means 204. This allows for greater freedom of motion for attaching the $CO_2$ canister 208. The canister attachment means 204 and the gas attachment means 206 are then pivoted (for example downwards) back to a vertical position. As the canister attachment means 204 and the gas communication means 206 are pivoted back to the vertical position, the pin 216 in the gas communication means 206 is actuated to engage the release valve of the $CO_2$ canister 208 such that when the canister attachment means 204 and the gas communication means 206 are in the vertical position, the $CO_2$ canister 208 is in fluid communication with the drink dispensing apparatus 1. In this position, the $CO_2$ canister 208 is also preferentially located within the drink dispensing apparatus 1. This allows the $CO_2$ canister attachment process to be a two-step process for safety.

In some embodiments, the canister attachment means 204 and the gas communication means 206 are pivoted to a position at about 45 ° relative to the vertical axis. This is advantageous in reducing the footprint of the drink dispensing apparatus 1.

In a further embodiment, the canister attachment means 204 and the gas communication means 206 are separately pivotable. In this case, attachment of the $CO_2$ canister 208 is a three step process: attach the $CO_2$ canister 208 to the canister attachment means 204 when pivoted outwardly; pivot the $CO_2$ canister 208 and the canister attachment means 204 to a vertical position; and pivot the gas communication means 206 to the vertical position for fluid communication.

In a preferred embodiment, the $CO_2$ canister can be attached to the canister attachment means in the insert position. Once securely attached, as the canister attachment means is pivoted towards the ready position, the gas communication means can be actuated to bring the $CO_2$ canister and the drink dispensing apparatus in fluid communication. This allows the $CO_2$ canister attachment process to be a two-step process, instead of a three step process.

The gas communication means 206 can also be a prong, or a motorised means so as to minimise user interaction and improve safety.

The whole process is a silent process and no gas would be leaked from the system at any point and the user would not be experiencing any "gushing" and thereby, no cause for panic. This also allows at least a steady 4 bar pressure of $CO_2$ to be released from the $CO_2$ canister to the carbonation chamber.

Load Cell for Smart System Management and Error Detection

The drink dispensing apparatus can comprise a load cell. A load cell is a transducer which converts force into a measurable electrical output. The load cell is connected to the carbonation chamber 100. The load cell allows for better control during the drink preparation process and in the management of drink dispensing apparatus. For example, the load cell can constantly read weight values and input them into a software programme for the appliance to enable customization in beverage preparation. When an error is detected, for example when the weight of the liquid in the carbonation chamber 100 is constantly dropping, this would indicate a leak in the carbonation chamber 100 and a safety mechanism can be initiated (such as safely release gas pressure and dispense the water into drip tray as waste), and indicate to the user to seek technical help.

The load cell further ensures that the carbonation chamber 100 is properly drained before the next drink is prepared.

It was found that if the motor of the mixing means 114 and carbonation chamber 100 are sitting on the load cell, erroneous readings may result due to the vibration and side movements when the motor is running. Interferences can also be due to the weight values from all the contact and connectivity in the carbonation chamber 100. By further including a damper (for example, spring), the measurements can be further improved. For example, a base plate with a plurality of holes can be sandwiched between the load cell and the carbonation chamber 100. The holes allows for the position of the dampers to be fine-tuned such that the carbonation chamber 100 can be aligned to maintain a vertical position at rest and/or during activation, and as well as to minimize lateral vibrations.

Laminar Flow Means for Minimised Losses of Dissolved $CO_2$ in Carbonated Water

In many systems, water, after carbonation, is directed to the outlet via a pump and directly downwards into a mug. However, agitation and/or turbulence of the carbonated water as it flows out will drive the dissolved $CO_2$ out from the water. For example, this can be observed when shaking a can of soft drink prior to opening the can or pouring a beer directly into the base of the mug. This causes the loss of dissolved $CO_2$ to be high even before the user consumes the beverage, resulting in a flat mouthfeel.

It was found that to improve dissolved $CO_2$ retention and/or dissolution, the carbonation chamber 100 can be positioned at a relatively higher position in the drink dispensing apparatus 1, relative to the spigot 400 (Figure 4A) and the direction of gravitational pull (i.e. downwards in a global reference frame). The spigot 400 can further comprise a laminar flow means 402 to further improve $CO_2$ retention and/or dissolution. The carbonated water can flow gravitationally via the laminar flow means 402 into the vessel 404. The laminar flow means 402 can be contactable with an inner surface of the vessel 404. For example, the laminar flow means 402 can be formed with a gradual gradient and having a smooth surface. The laminar flow means 402 can be a funnel having a concave shape. The laminar flow means 402 can be tapered towards the distal end of the spigot. The laminar flow means 402 can further be movable to accommodate varying sizes of vessels. The laminar flow means 402 can be made of a hard and smooth material such as stainless steel or metal. The laminar flow means 402 can alternatively be flexible in order to increase the contact surface with the inner side of the vessel 404. For example, the laminar flow means 402 can be made of a flexible material such as silicon, PET or PVC. The flexibility allows for the contact surface with the vessel to be maximised such that laminar flow can be further improved. In this way, the maximum allowable level of carbonation in the beverage is retained, so as to provide for maximum enjoyment of the fizzy beverage.

Figure 4B and 4C shows a path taken (indicated by arrows) by the carbonated water out from the carbonation chamber 100 and into the vessel 404. The tubing 406 creates a flow path which is configured to minimise sharp turns along the channel from carbonation chamber 100, into the capsule chamber 600, to the spigot 400 and to the vessel 404. This further improves the laminar flow of the carbonated liquid.

Drip Tray with Ultrasonicator

The drip tray 500 can comprise an ultrasonicator 502. When a vessel 404 is positioned on the drip tray 500, the ultrasonicator 502 can produce ultrasonic waves for ultrasonicating the vessel 404, thereby in turn homogenising the dispensed drink in the vessel 404 as well as provide user customization of aesthetics and carbonation levels of their beverage. For example, the ultrasonicator 502 can be used to create foam heads for beer products. For example, the user is able to customise their beverage by adjusting the carbonation level. The carbonation level in the beverage can be reduced by the user via activating the ultrasonicator 502 to drive out some of the dissolved $CO_2$ in the beverage.

The ultrasonicator 502 can provide an energy of about 50 khz. For example, the power can be about 8 W to about 12 W. The voltage can be about 9 V and the current can be about 1.1 A. The skilled person would understand that these parameters can be varied depending on the piezoelectric material and the desired mouthfeel of the drink.

In some embodiments, the ultrasonicator 502 is intermittently activated during beverage preparation to create a specially designed look for the beverage. The duration of activation can be varied by a software designed to give the best mixing and aesthetics (e.g. beer head for beers) during the course of dispensing the beverage into the vessel 404. Activation could also be initiated by the user should the user want to have a higher foam head or more degassing for a less fizzy beverage. The ultrasonication can have a duration of about 5 s to prevent over-foaming and over-flowing. The duration can be capped to about 5 s for safety. The ultrasonication can be activated by a user to prevent accidental continuous activation of the ultrasonicator 502.

The drip tray 500 can further comprise a liquid inlet 504 which is fluidly coupled to a liquid tank. It was found that having some liquid on the drip tray 500 improves contact between the drip tray 500 and the beverage vessel. This improves the performance of the ultrasonicator 502.

The drip tray 500 can further comprise a recess 506 for containing the vessel. The recess 506 also serves to contain any spill over during the dispensing process of the drink. The recess 506 also allows a liquid reservoir to form for facilitating the function of the ultrasonicator 502.

The ultrasonicator 502 can be a piezoceramic material.

Alternatively, a gel can be positioned in the middle of the recess 506 of the drip tray 500. The gel can improve the contact between the vessel 404 and the drip tray 500, such that energy from the ultrasonicator 502 can be transferred to the liquid in the vessel 404.

<u>Spigot with Ultrasonicator</u>

Alternatively, the ultrasonicator may be positioned adjacent to the tubing 406, along a section between the capsule chamber 600 and the spigot 400. For example, the ultrasonicator may be positioned proximate to the spigot 400. When the carbonated liquid is sonicated as it flow towards the spigot 400, the applied sound waves may convert the carbonation into a foam head. The foam head comprises micro-sized bubbles which may provide a suitably dense foam head to deliver aroma, flavor, and mouthfeel to the user. Alternatively, the carbonation level in the beverage can be reduced by the user via activating the ultrasonicator to drive out some of the dissolved $CO_2$ in the beverage.

The ultrasonicator can provide an energy of about 50 khz. For example, the power can be about 8 W to about 12 W. The voltage can be about 9 V and the current can be about 1.1 A. The skilled person would understand that these parameters can be varied depending on the piezoelectric material and the desired mouthfeel of the drink.

In some embodiments, the ultrasonicator is intermittently activated during beverage preparation to create a specially designed look for the beverage. The duration of activation can be varied by a software designed to give the best mixing and aesthetics (e.g. beer head for beers) during the course of dispensing the beverage into the vessel 404. Activation could also be initiated by the user should the user want to have a higher foam head or more degassing for a less fizzy beverage. The ultrasonication can have a duration of about 5 s to prevent over-foaming and over-flowing. The duration can be capped to about 5 s for safety. The ultrasonication can be activated by a user to prevent accidental continuous activation of the ultrasonicator.

The ultrasonicator can be a piezoceramic material.

The ultrasonicator in the drip tray may be used in combination with the ultrasonciator in the spigot for additional benefits.

<u>Capsule Chamber</u>

With reference to Figure 6A, the capsule chamber 600 includes a cartridge receptacle 602 and a lid 604. The receptacle has an open top configuration and is dimensioned to receive a beverage capsule or cartridge 606. The capsule 606 can include an impermeable but pierce-able container internally subdivided by a filter element into two compartments, one of which contains a dry beverage medium or a liquid concentrate, and the other an alcohol component. Alternatively, the capsule 606 can include a single compartment in which the beverage medium/liquid concentrate is mixed with the alcohol component.

As shown in Figure 6A, the capsule receptacle 602 is pivotable about a lateral axis between a vertical brew position (closed position), and a forwardly inclined open position. Alternatively, the capsule receptacle 602 is slidable along a longitudinal axis such that the capsule receptacle can receive a capsule when in the forward open position.

The lid 604 is pivotable about a lateral axis between a closed position and an open position. This lateral axis can be the same axis as that for actuating the capsule receptacle or can be a displaced second axis. The lid 604 in the open position allows access to the capsule receptacle 602 in the forward open position for convenient insertion and removal of a capsule 606. In other words, the movements of the capsule receptacle 602 and the lid 604 are performed in conjunction with each other.

Figures 6B and 6C show another embodiment in which the capsule receptacle 602 and the lid 604 are both pivotable about a lateral axis between a vertical brew position (closed position), and a forwardly inclined open position. The capsule 606 is slidable into the capsule receptacle 602. When the capsule receptacle 602 is closed, the capsule 606 is positioned upright. In this way, the carbonated liquid passes through the capsule downwards with respect to gravity.

In some embodiments, the capsule chamber 600 can comprise two capsule receptacles 602 for housing two capsules 606. The capsules can separately hold liquid, powder or both in their respective cavities.

The capsule chamber 600 can comprise a probe to pierce the capsule 606 as the lid is closed, thus accommodating a through flow of liquid into the capsule

606 via the probe for infusion with the beverage medium in the capsule 606. The capsule chamber 600 can comprise a second probe for allowing the brewed beverage to be exit and be dispensed. Alternatively, instead of liquid flowing into the capsule 606, the components in the capsule 606 can be drained via the orifices created by the probes, which can then mix with liquid in a separate chamber and dispensed.

When the capsule receptacle 602 is in its open position, the lid 604 and handle 608 are at an angle of approximately 45° with respect to a vertical axis of the drink dispensing apparatus.

At the closed position, the lid 604 and handle 608 are vertically aligned with respect to a vertical axis of the drink dispensing apparatus.

To actuate the open and close positions of the capsule chamber 600, the capsule chamber 600 can be provided with a handle 608. The handle 608 is connected to the lid 604 for pivotal movement.

The tubing 406 may be spilt such that a portion of the carbonated liquid flow through a concentrate in the capsule 606, while another portion of the carbonated liquid by-passes the capsule and flows directly to the spigot 400. In this way, the concentration and mixing of the beverage may be controlled.

<u>Dispensing Method</u>

As shown in Figure 7, the method of dispensing a drink from a drink dispensing apparatus comprising a carbonation chamber comprises:

a) accessing an access means of the carbonation chamber in order to introduce ice into a cavity of the carbonation chamber;

b) flowing a liquid from the at least one liquid inlet into the cavity of the carbonation chamber;

c) flowing $CO_2$ from the at least one $CO_2$ inlet into the cavity of the carbonation chamber; and

d) mixing the liquid in order to obtain a carbonated liquid.

The method allows for a reasonable amount of user interface so as to control the cooling and carbonation of the drink. Further, by allowing the user to add ice to generate cold water, substantial energy savings can be obtained. Less noise pollution is also generated as the need for a generator to cool down water is removed. This also allows for a drink to be dispensed more rapidly as less time is taken to cool down the water.

The method can comprise a step before step a) of connecting a $CO_2$ canister to the drink dispensing apparatus via a $CO_2$ adaptor, wherein the $CO_2$ adaptor comprises a canister attachment means and a gas communication means, wherein the canister attachment means and the gas communication means are configured to be actuated separately and/or sequentially.

The method can comprise a step after step b) of quantifying an amount of liquid in the carbonation chamber via a load cell.

The method can further comprise flowing the carbonated liquid out from the carbonation chamber via a liquid outlet 128. The method can further comprise a step of mixing the carbonated liquid with a concentrate or beverage medium in order to form a drink. The liquid from the liquid outlet 128 can flow through the capsule chamber for mixing with the contents of the capsule to form a mixed liquid.

The method can further comprise a step of flowing the mixed liquid out from the spigot into a vessel via a laminar flow means.

The method can further comprise a step of ultrasonicating the vessel via the ultrasonicator in the drip tray. The drip tray can additionally be flooded with a liquid prior to ultrasonicating the vessel.

The method can further comprise a step of ultrasonicating the tubing via the ultrasonicator proximate to the spigot. In this regard, the drink or a portion of the drink is ultrasonicated as it flows through the tubing proximate to the spigot; prior to it flowing through the spigot.

Figure 8 shows an exemplary process for forming a drink using the drink dispensing apparatus. The user can adjust parameters such as temperature, carbonation and volume for making the drink, or alternatively these parameters can be pre-set.

It will be appreciated that many further modifications and permutations of various aspects of the described embodiments are possible. Accordingly, the described aspects are intended to embrace all such alterations, modifications, and variations that fall within the spirit and scope of the appended claims.

Throughout this specification and the claims which follow, unless the context requires otherwise, the word "comprise", and variations such as "comprises" and "comprising", will be understood to imply the inclusion of a stated integer or step or group of integers or steps but not the exclusion of any other integer or step or group of integers or steps.

Throughout this specification and the claims which follow, unless the context requires otherwise, the phrase "consisting essentially of", and variations such as "consists essentially of" will be understood to indicate that the recited element(s) is/are essential i.e. necessary elements of the invention. The phrase allows for the presence of other non-recited elements which do not materially affect the characteristics of the invention but excludes additional unspecified elements which would affect the basic and novel characteristics of the method defined.

The reference in this specification to any prior publication (or information derived from it), or to any matter which is known, is not, and should not be taken as an acknowledgment or admission or any form of suggestion that that prior publication (or information derived from it) or known matter forms part of the common general knowledge in the field of endeavour to which this specification relates.

**Claims**

1. A drink dispensing apparatus comprising a carbonation chamber having a side wall, a base and a top, wherein the carbonation chamber comprises:
a) at least one $CO_2$ inlet positioned on the base and/or on the side wall proximate to the base;
b) at least one liquid inlet positioned on the base and/or on the side wall;
c) mixing means positioned on the base; and
d) an access means positioned on the top and configured to allow a user access to a cavity within the carbonation chamber.

2. The drink dispenser apparatus according to claim 1, wherein the at least one $CO_2$ inlet comprises 4 $CO_2$ inlets.

3. The drink dispenser apparatus according to claim 1 or 2, wherein the mixing means is a magnetic mixing means or a shaft and rotor mixing means.

4. The drink dispenser apparatus according to any one of claims 1 to 3, wherein the mixing means comprises blades.

5. The drink dispenser apparatus according to any one of claims 1 to 4, wherein the access means is configured to withstand a pressure of up to about 5 bar.

6. The drink dispenser apparatus according to any one of claims 1 to 5, wherein the access means comprises a sliding door or a trap door.

7. The drink dispenser apparatus according to any one of claims 1 to 6, wherein the access means comprises stainless steel of more than about 1.5 mm thick.

8. The drink dispenser apparatus according to any one of claims 1 to 7,

wherein the access means is sealable.

9. The drink dispenser apparatus according to any one of claims 1 to 8, wherein the access means comprises a locking means.

10. The drink dispenser apparatus according to any one of claims 1 to 9, wherein the carbonation chamber is integral within the drink dispensing apparatus.

11. The drink dispenser apparatus according to any one of claims 1 to 10, wherein the carbonation chamber further comprises at least one liquid outlet for draining carbonated liquid.

12. The drink dispenser apparatus according to claim 11, wherein the liquid outlet is characterised by an inner diameter of more than about 5 mm.

13. The drink dispenser apparatus according to any one of claims 1 to 12, wherein the carbonation chamber further comprises thermoelectric cooling (TEC) elements.

14. The drink dispenser apparatus according to any one of claims 1 to 13, wherein the carbonation chamber has a volume of at least 250 mL.

15. The drink dispenser apparatus according to any one of claims 1 to 14, wherein the at least one $CO_2$ inlet is fluidly coupled to a $CO_2$ source.

16. The drink dispenser apparatus according to any one of claims 1 to 15, wherein the drink dispensing apparatus further comprises a $CO_2$ adaptor for connecting to a $CO_2$ canister, wherein the $CO_2$ adaptor comprises a canister attachment means and a gas communication means, wherein the canister attachment means and the gas communication means are configured to be actuated separately and/or sequentially.

17. The drink dispenser apparatus according to claim 16, wherein the canister attachment means is a screw hole with female thread.

18. The drink dispenser apparatus according to claim 16 or 17, wherein the canister attachment means is pivotable to about 90 ° relative to a vertical axis.

19. The drink dispenser apparatus according to any one of claims 16 to 18, wherein the gas communication means is a lever or a prong.

20. The drink dispenser apparatus according to any one of claims 16 to 19, wherein the gas communication means is pivotable about 90 ° relative to the vertical axis.

21. The drink dispenser apparatus according to any one of claims 1 to 20, wherein the drink dispensing apparatus further comprises a laminar flow means positioned external to a spigot, wherein the laminar flow means is configured to contact with an inner surface of a vessel.

22. The drink dispenser apparatus according to claim 21, wherein the laminar flow means movable.

23. The drink dispenser apparatus according to claim 21 or 22, wherein the laminar flow means is a funnel.

24. The drink dispenser apparatus according to any one of claims 21 to 23, wherein the laminar flow means is flexible.

25. The drink dispenser apparatus according to any one of claims 21 to 24, wherein the carbonation chamber is positioned higher relative to the laminar flow means with reference to gravity.

26. The drink dispenser apparatus according to any one of claims 1 to 25, wherein the drink dispensing apparatus further comprises a load cell configured to quantify a weight of the content in the cavity of the carbonation chamber.

27. The drink dispenser apparatus according to any one of claims 1 to 26, wherein the drink dispensing apparatus further comprises a drip tray, the drip tray comprising an ultrasonicator.

28. The drink dispenser apparatus according to claim 27, wherein the drip tray further comprises liquid inlet fluidly coupled to a liquid tank.

29. The drink dispenser apparatus according to any one of claims 1 to 28, wherein the drink dispensing apparatus further comprises an ultrasonicator proximate to a spigot.

30. A method of dispensing a drink from a drink dispensing apparatus comprising a carbonation chamber as disclosed herein, the method comprising:

a) accessing the access means in order to introduce ice into a cavity of the carbonation chamber;

b) flowing a liquid from the at least one liquid inlet into the cavity of the carbonation chamber;

c) flowing $CO_2$ from the at least one $CO_2$ inlet into the cavity of the carbonation chamber; and

d) mixing the liquid in order to obtain a carbonated liquid.

31. The method according to claim 30, further comprises a step before step a) of connecting a $CO_2$ canister to the drink dispensing apparatus via a $CO_2$ adaptor, wherein the $CO_2$ adaptor comprises a canister attachment means and a gas communication means, wherein the canister attachment means and the gas communication means are configured to be actuated separately and/or sequentially.

32. The method according to claim 30 or 31, further comprises a step after step b) of quantifying an amount of liquid in the carbonation chamber via a load cell.

33. The method according to any one of claims 30 to 32, further comprises a step of mixing the carbonated liquid with a concentrate in order to form a drink.

34. The method according to any one of claims 30 to 33, further comprises a step of flowing the drink into a vessel via a spigot and/or a laminar flow means.

35. The method according to any one of claims 30 to 34, further comprises a step of ultrasonicating the drink prior to it flowing through the spigot.

36. The method according to any one of claims 30 to 35, further comprises a step of positioning a vessel on the drip tray, flooding a drip tray with a liquid and ultrasonicating the vessel.

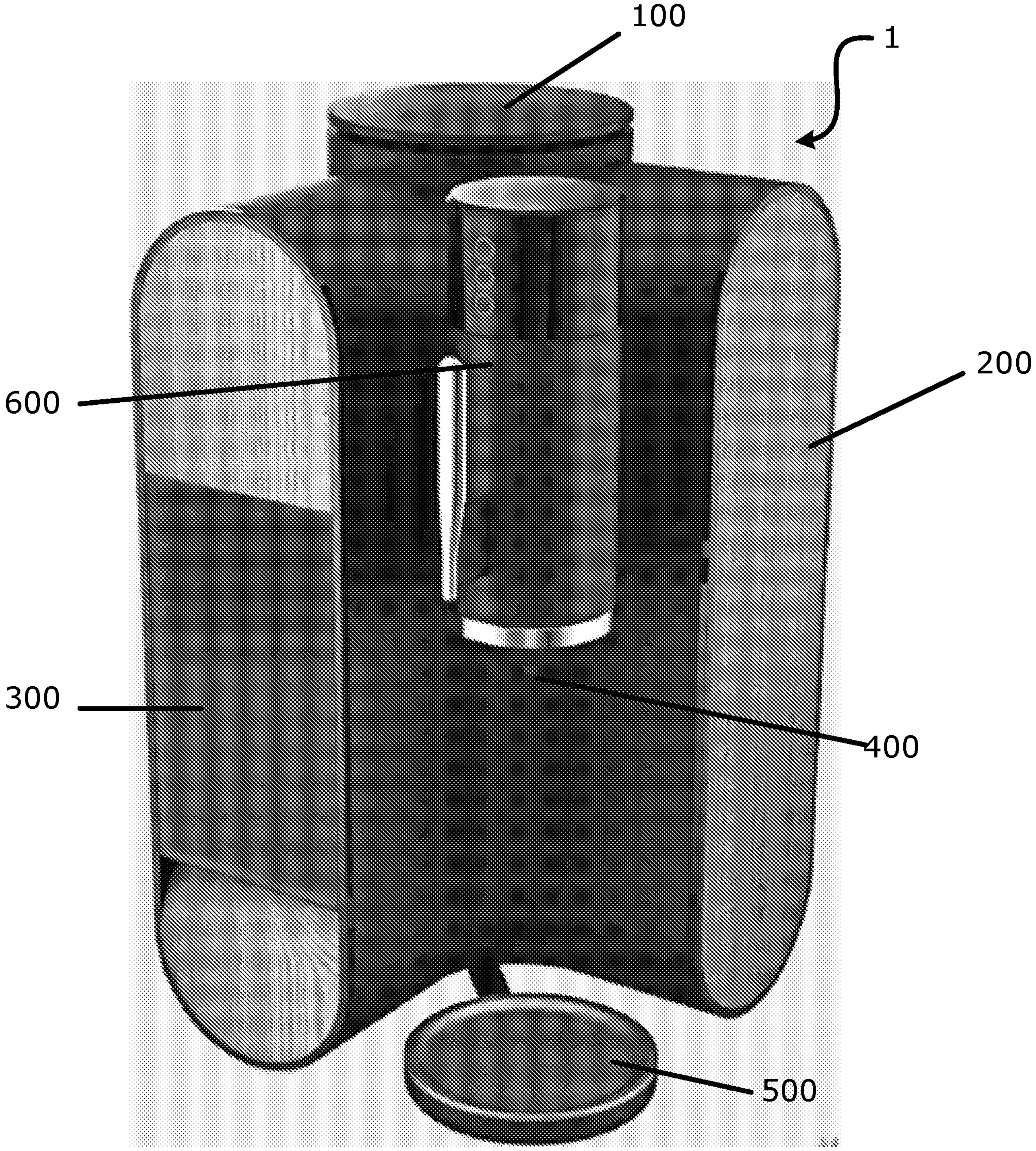


**Figure 1**

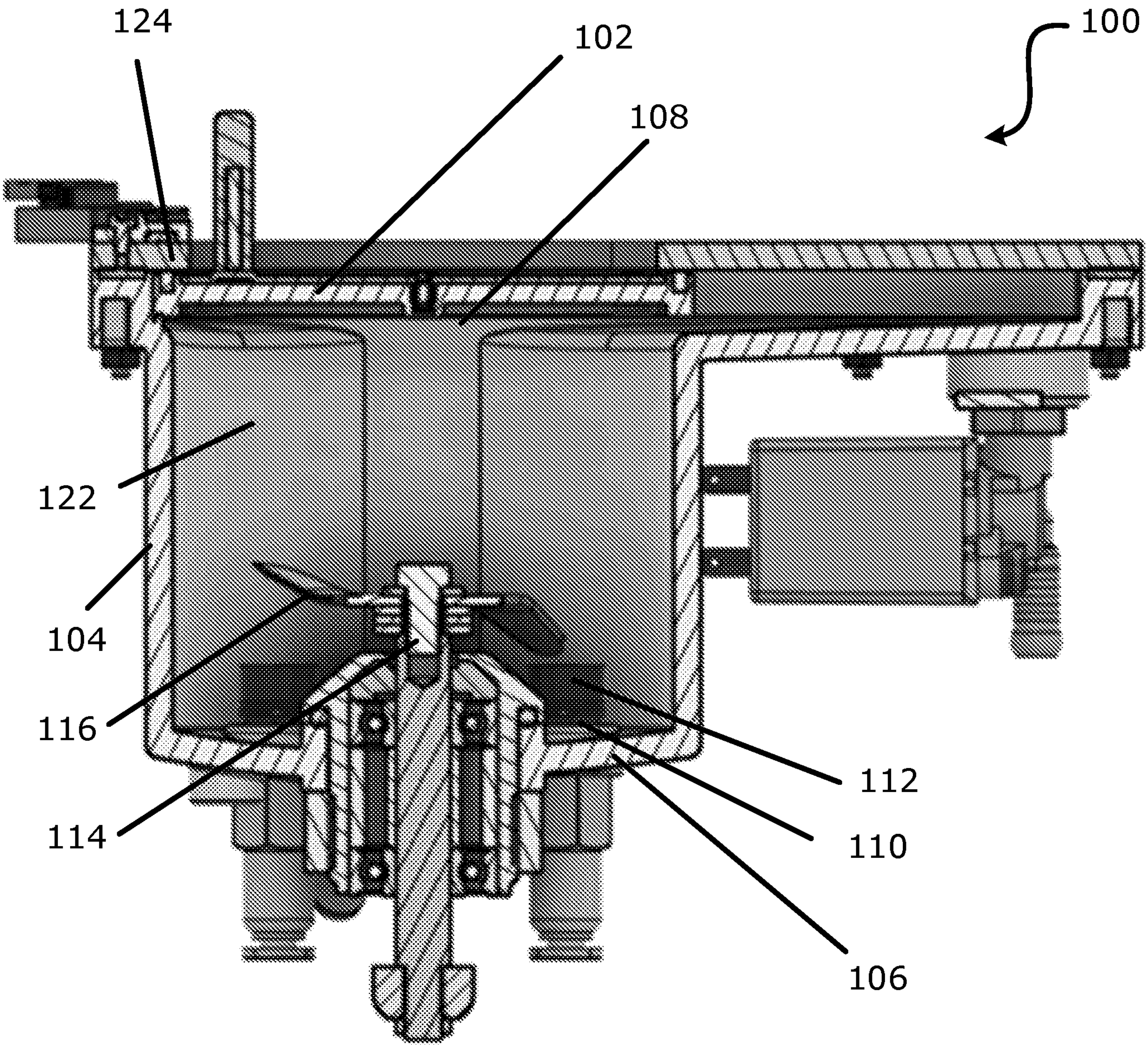


**Figure 2A**

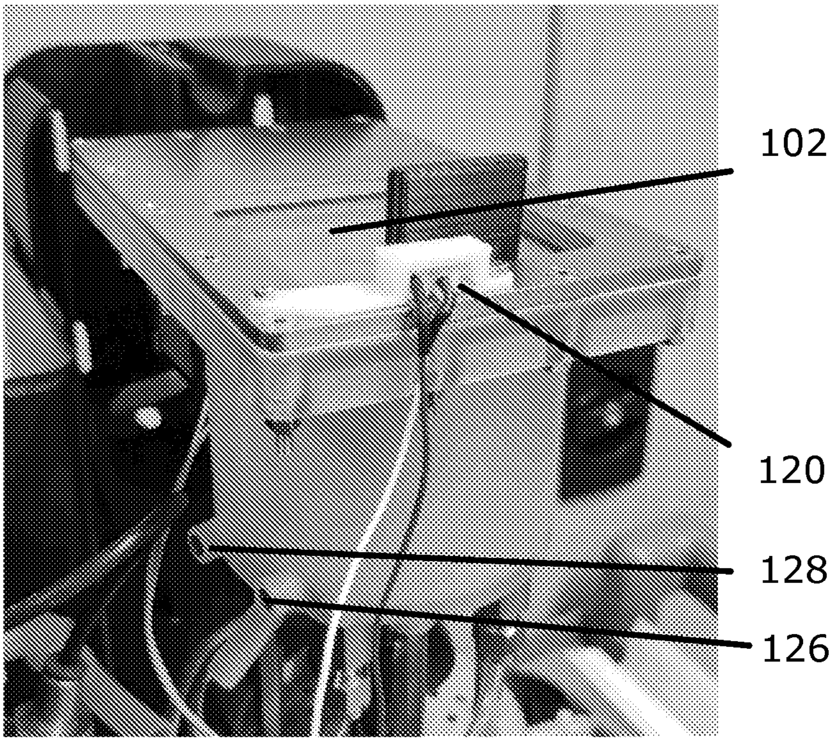


Figure 2B

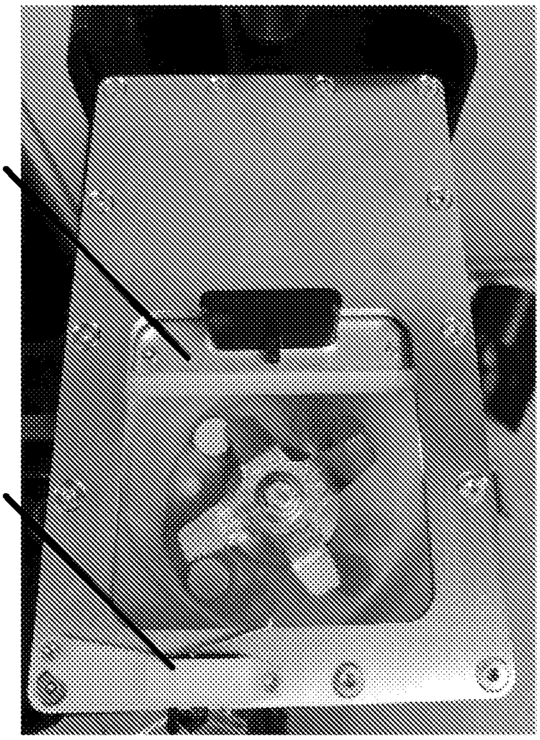

Figure 2C

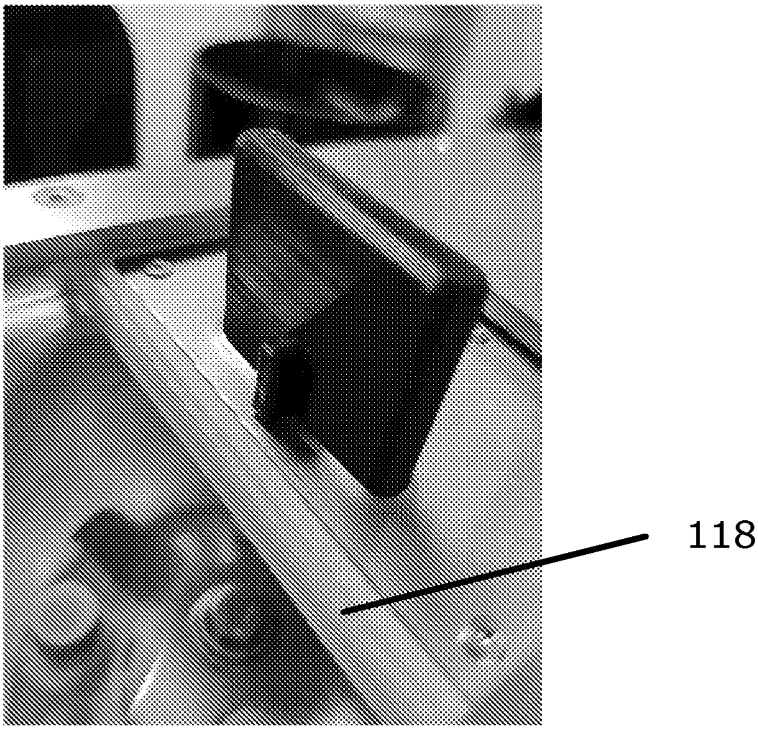


Figure 2D

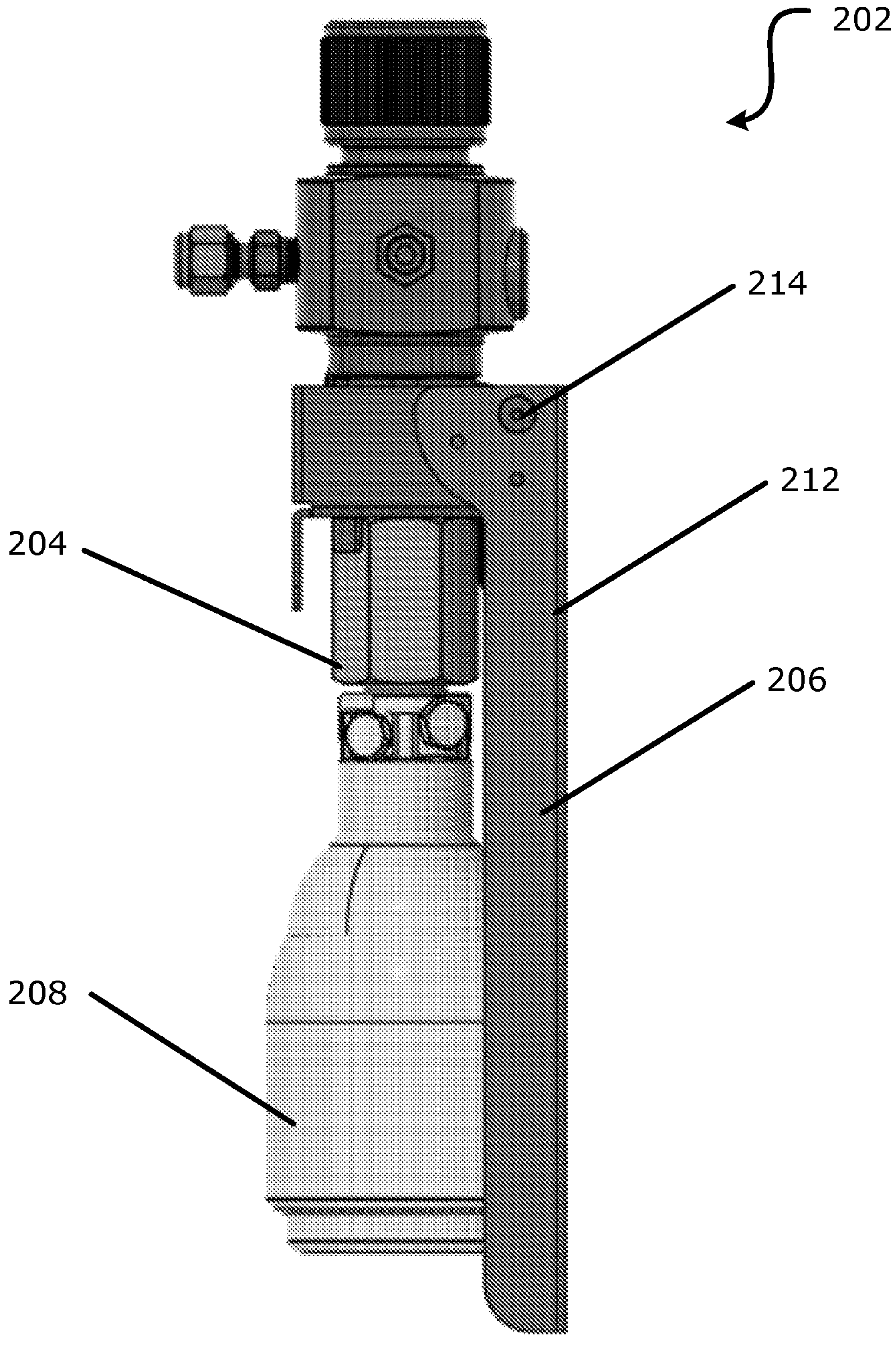


Figure 3A

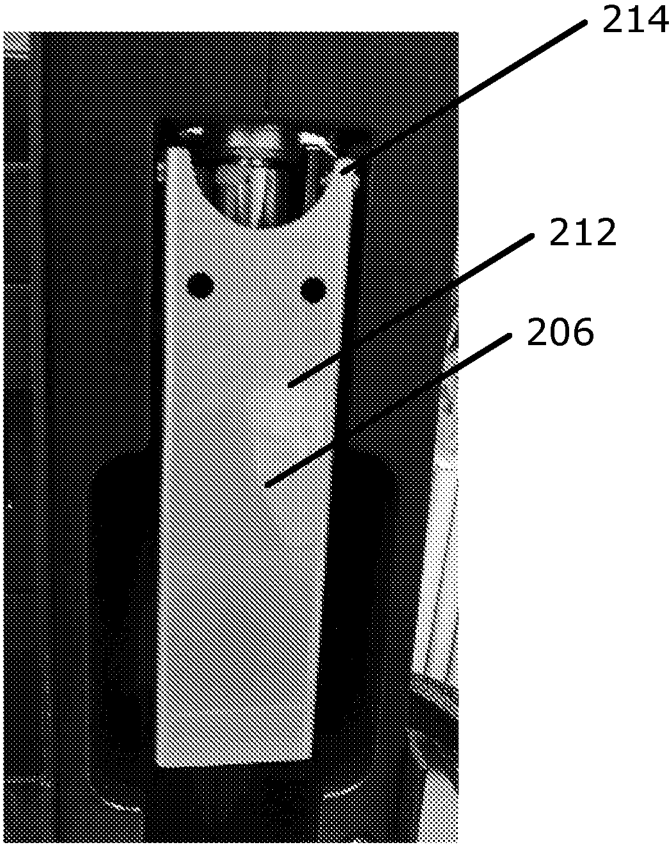


**Figure 3B**

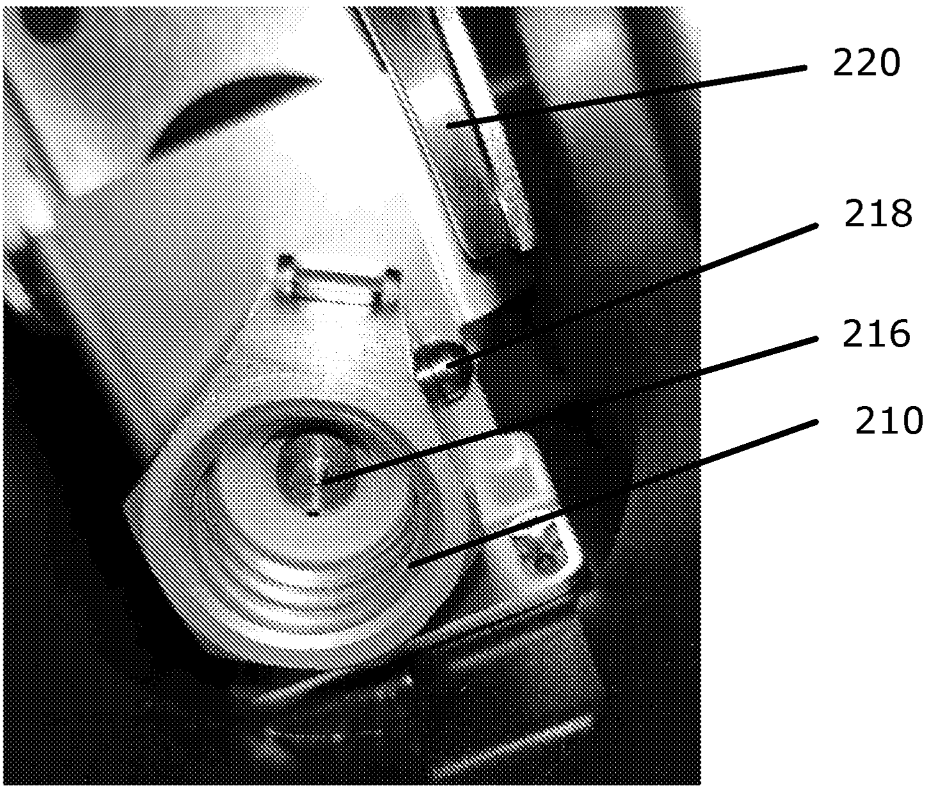


**Figure 3C**

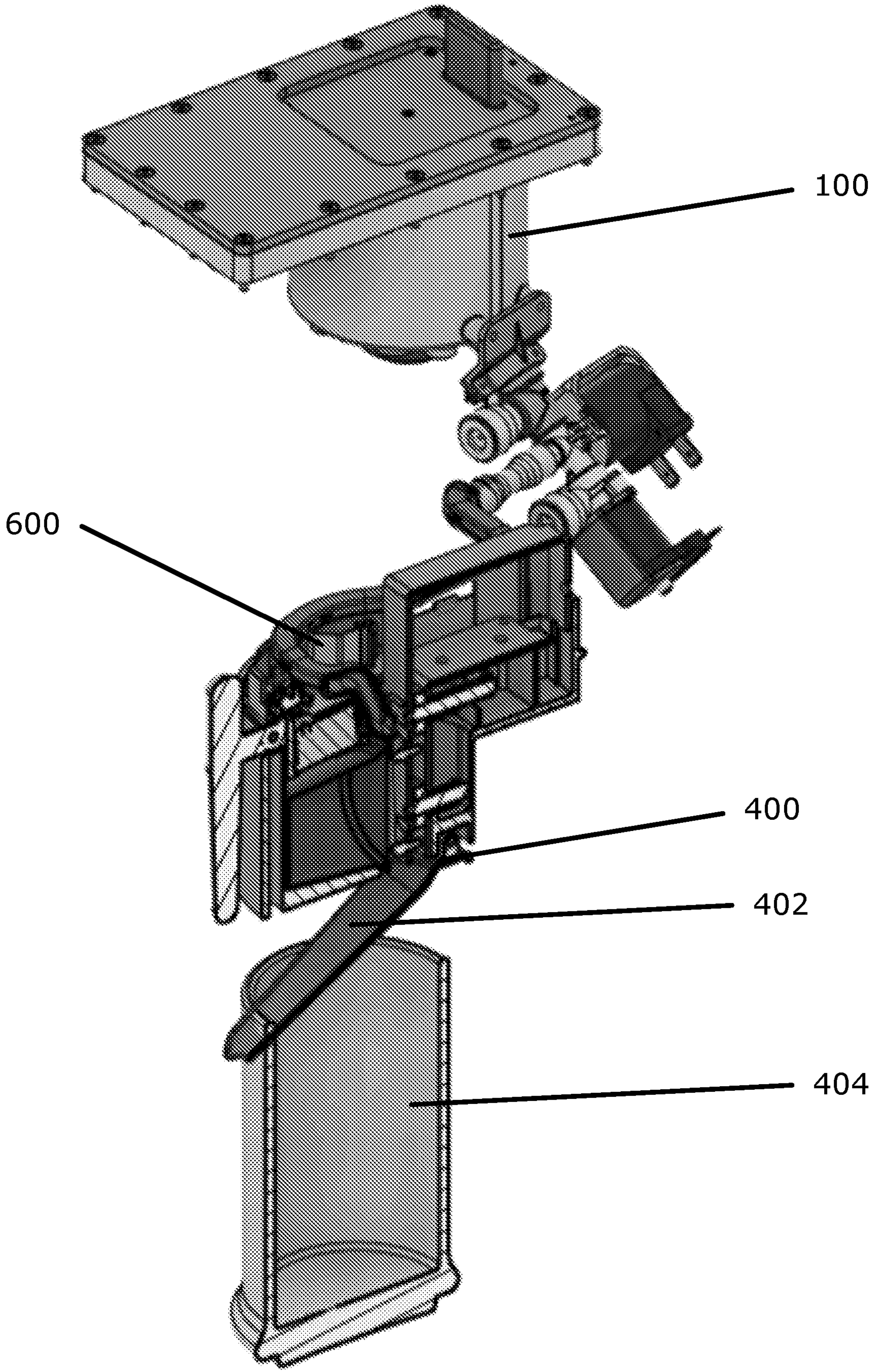


**Figure 4A**

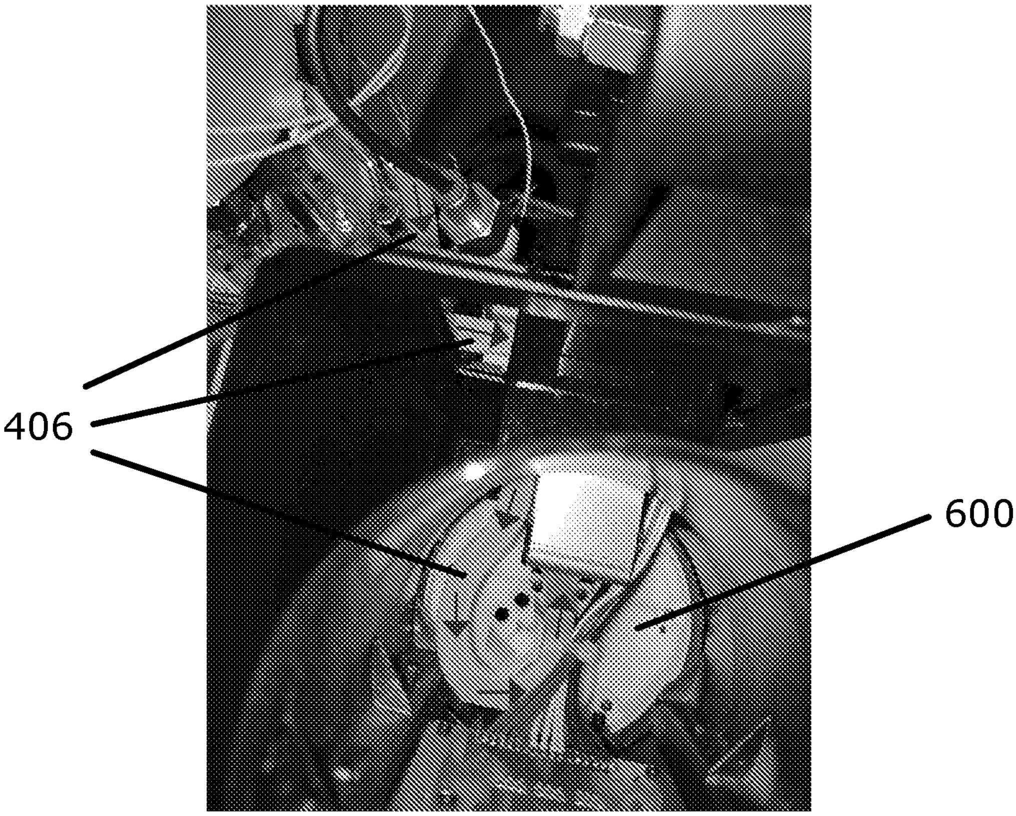


**Figure 4B**

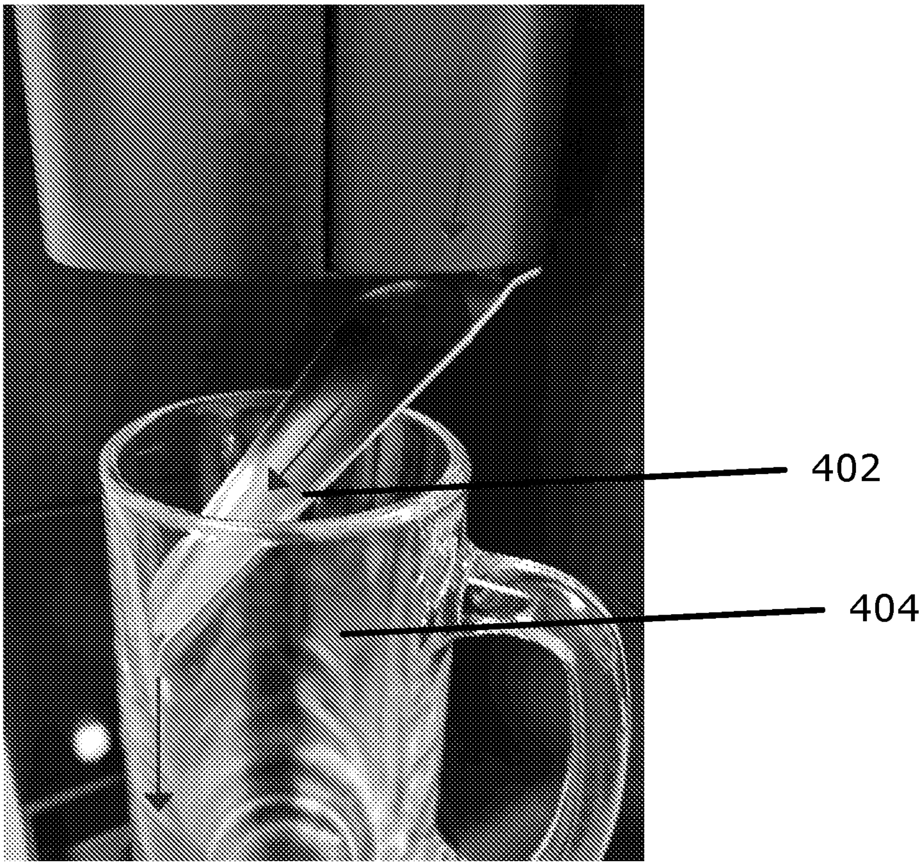


**Figure 4C**

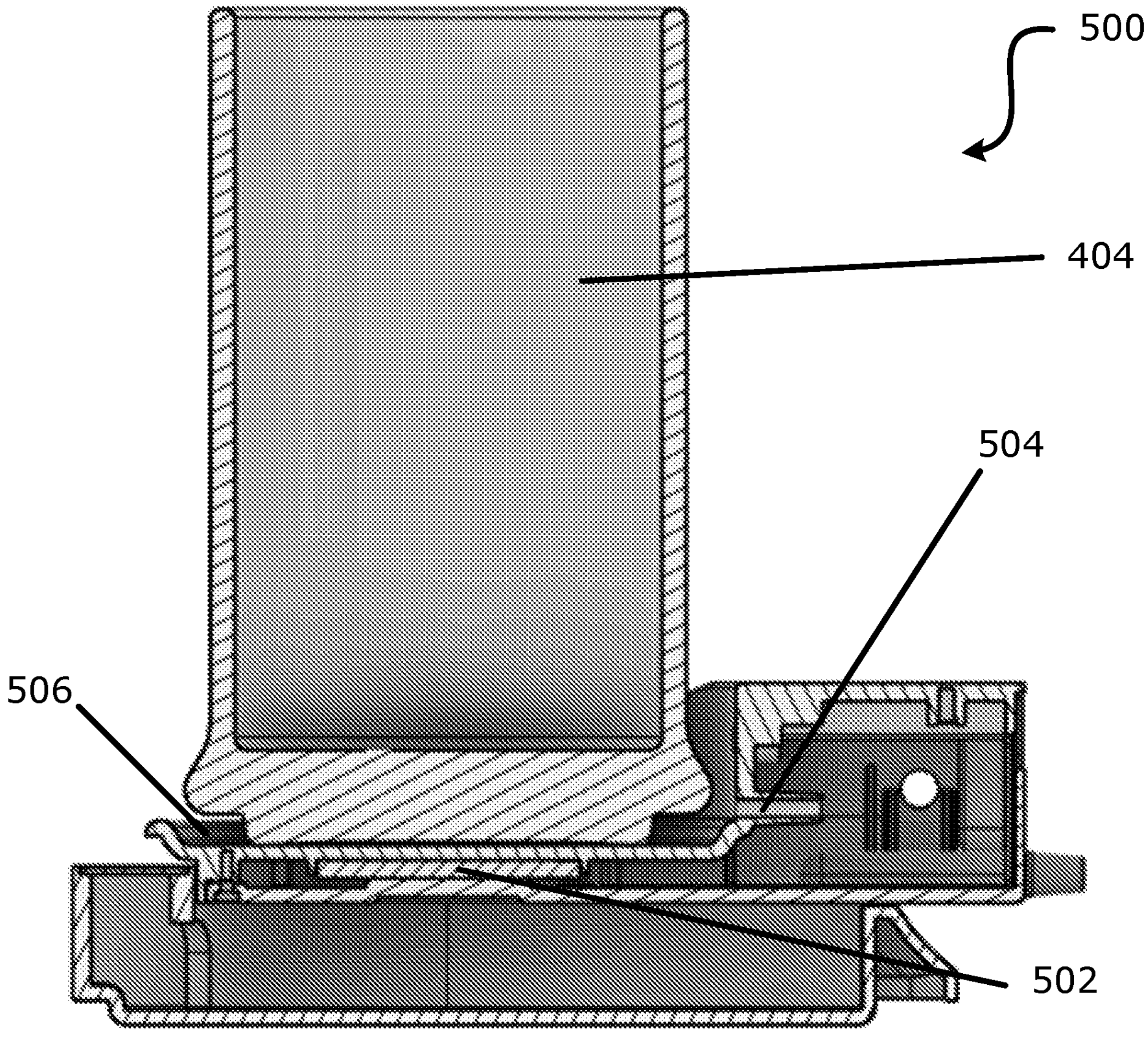


**Figure 5A**

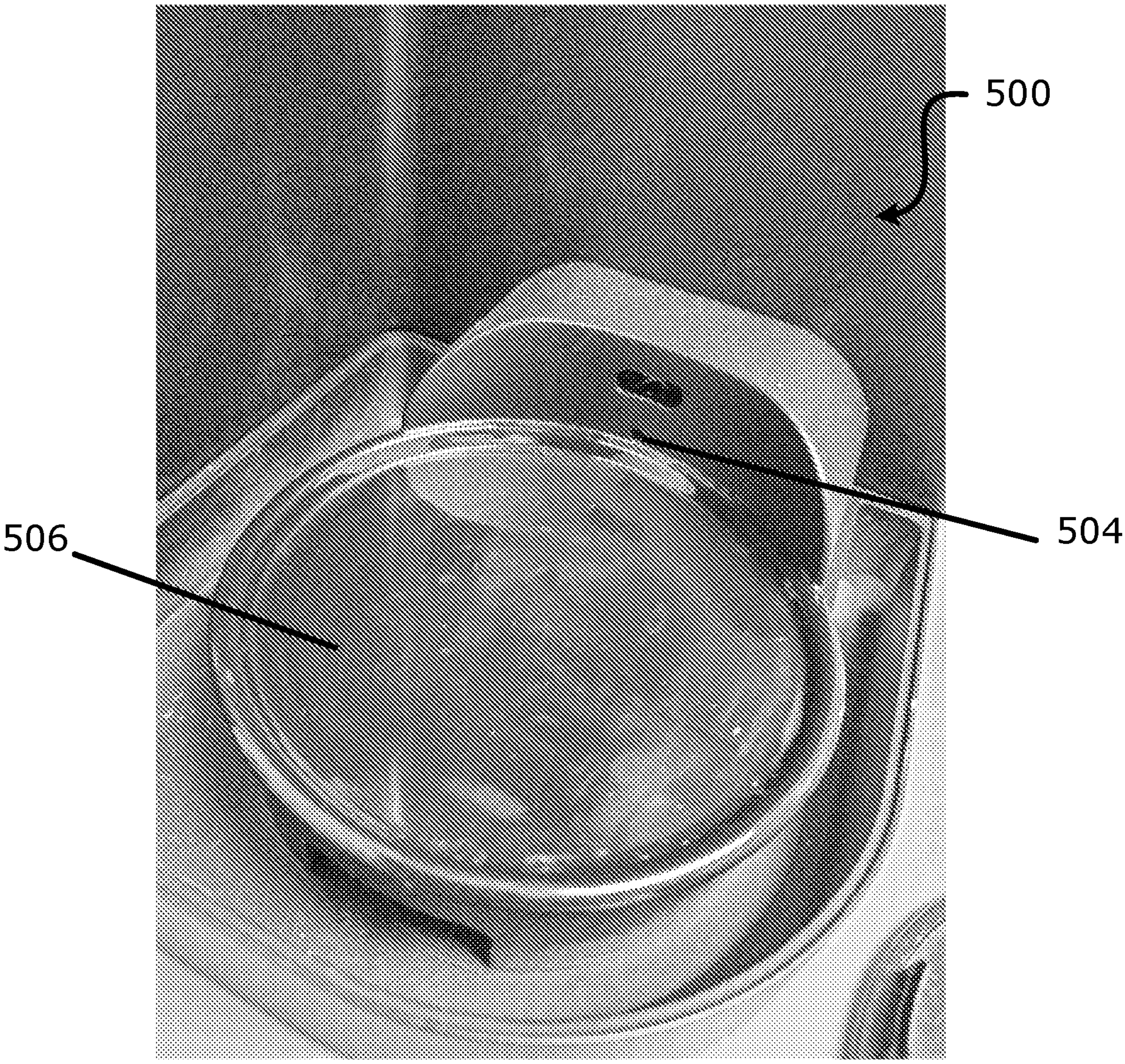


**Figure 5B**

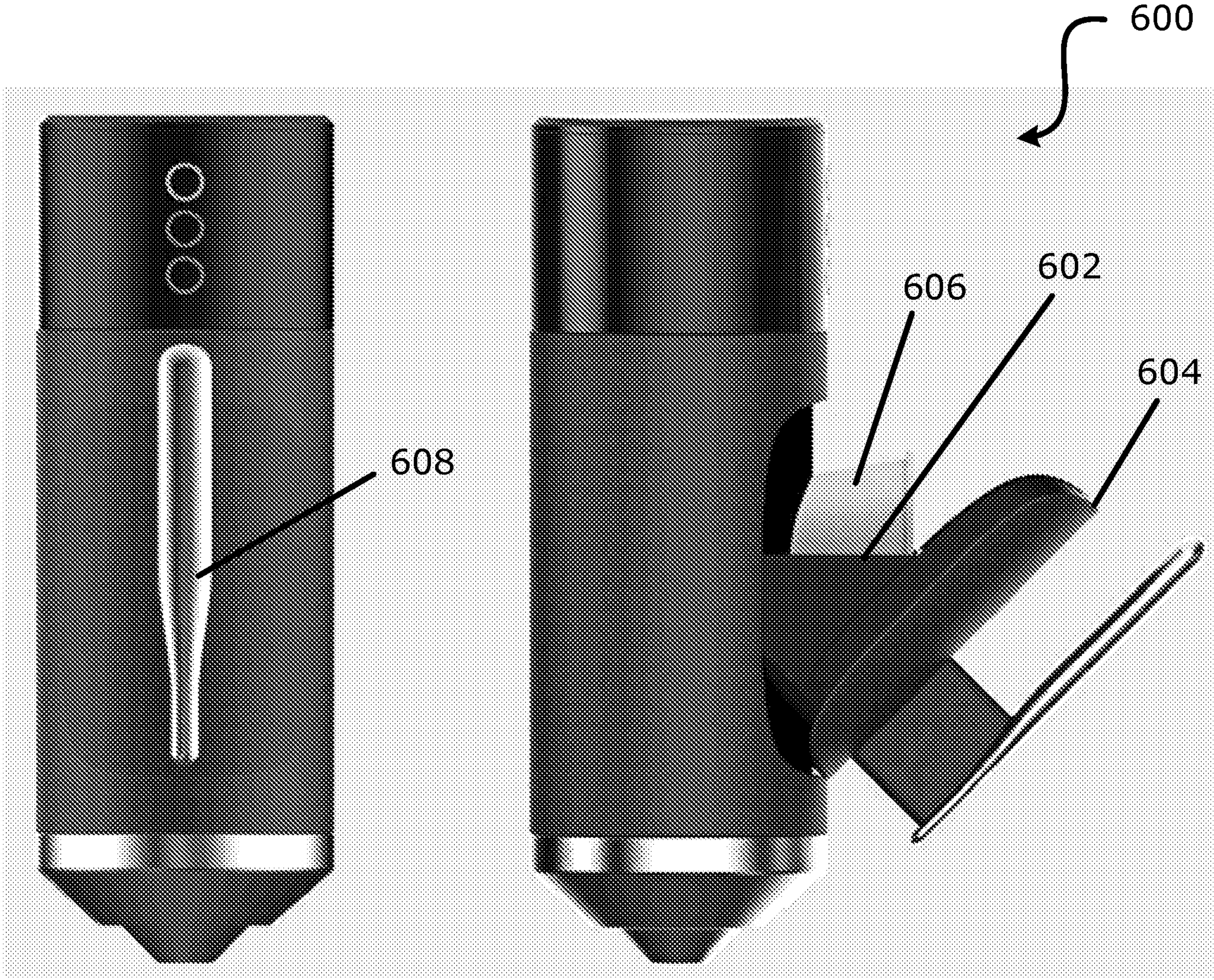


**Figure 6A**

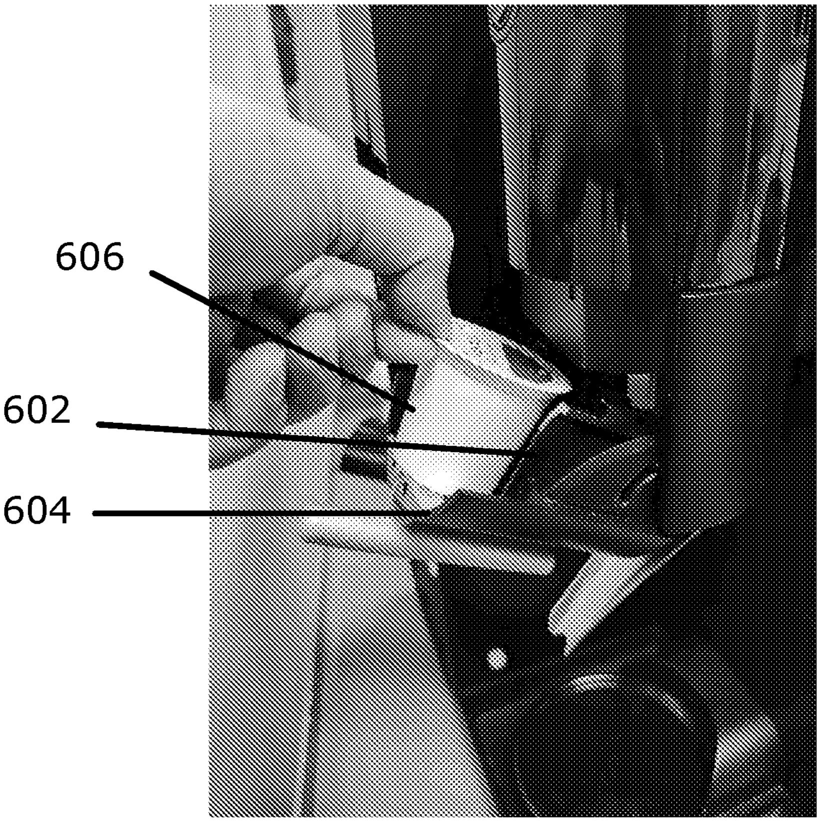


**Figure 6B**

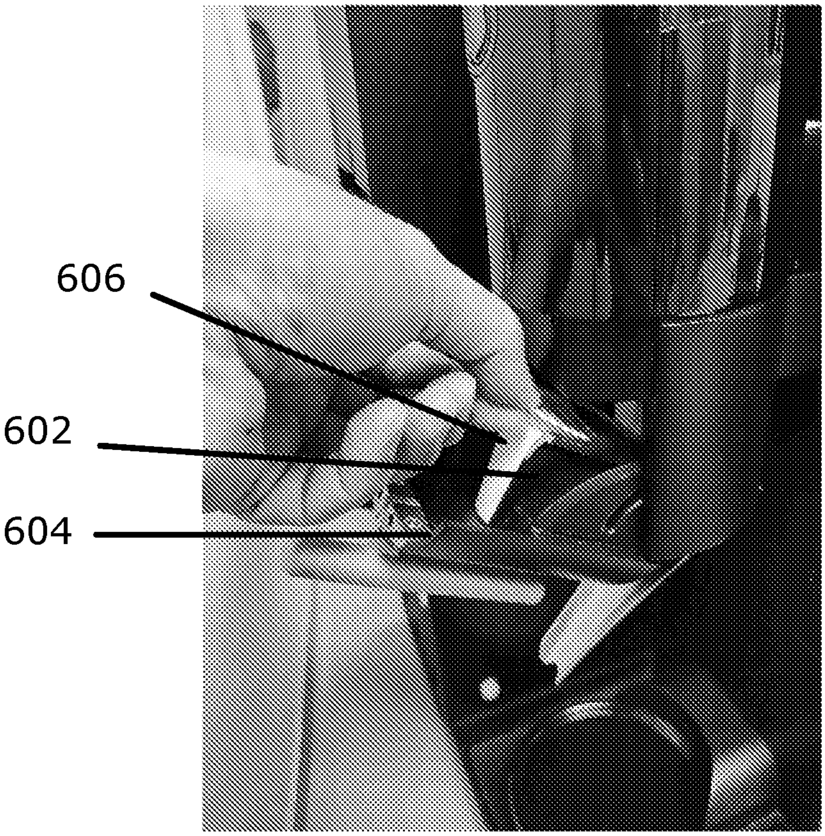


**Figure 6C**

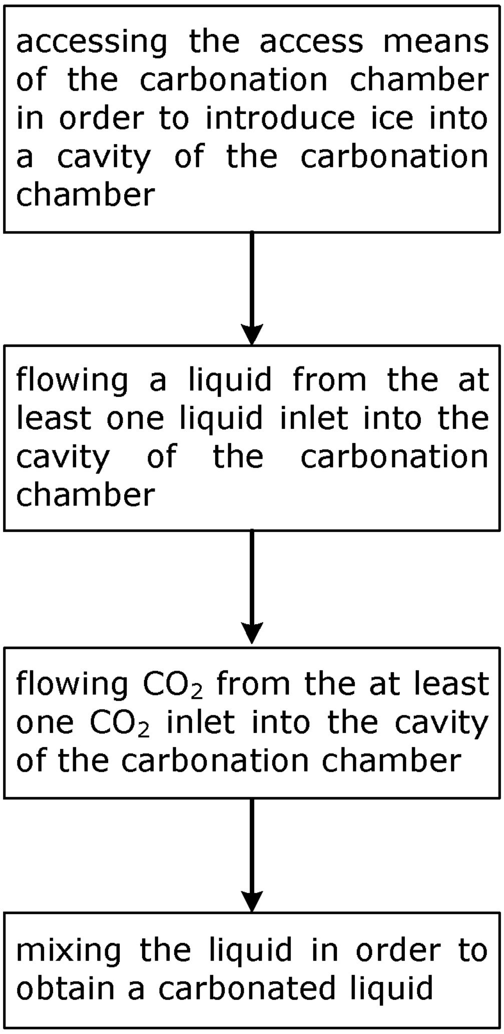
accessing the access means of the carbonation chamber in order to introduce ice into a cavity of the carbonation chamber
flowing a liquid from the at least one liquid inlet into the cavity of the carbonation chamber
flowing $CO_2$ from the at least one $CO_2$ inlet into the cavity of the carbonation chamber
mixing the liquid in order to obtain a carbonated liquid

**Figure 7**

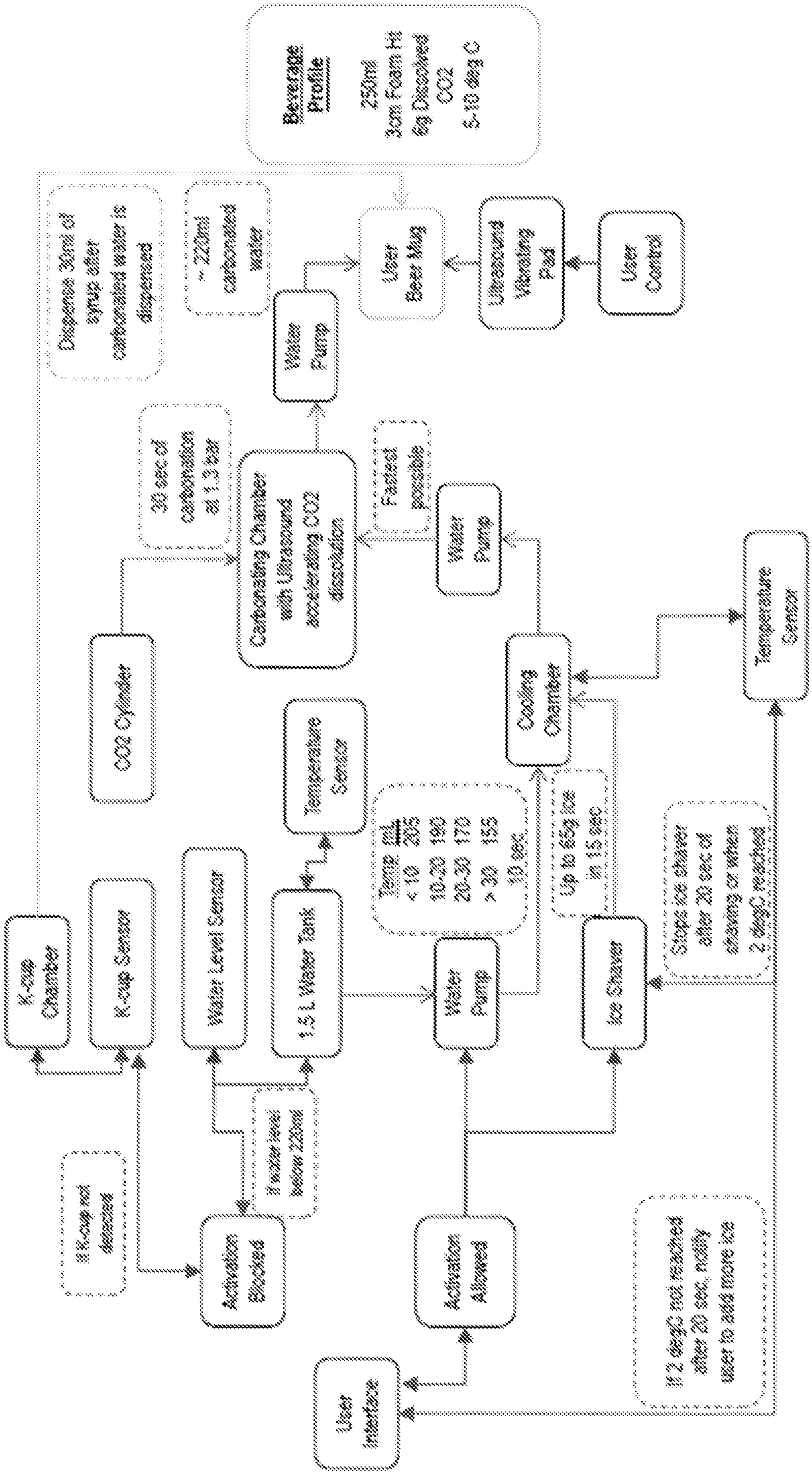
K-cup Chamber
If K-cup not detected
K-cup Sensor
CO2 Cylinder
Dispense 30ml of syrup after carbonated water is dispensed
30 sec of carbonation at 1.3 bar
Activation Blocked
Water Level Sensor
~ 220ml carbonated water
Carbonating Chamber with Ultrasound accelerating CO2 dissolution
If water level below 220ml
1.5 L Water Tank
Temperature Sensor
Water Pump
Beverage Profile
250ml
3cm Foam Ht
6g Dissolved CO2
5-10 deg C
User Interface
User Beer Mug
Temp mL
< 10 205
10-20 190
20-30 170
> 30 155
10 sec
Fastest possible
Activation Allowed
Water Pump
Water Pump
Cooling Chamber
Ultrasound Vibrating Pad
Up to 65g ice in 15 sec
Ice Shaver
User Control
If 2 degC not reached after 20 sec, notify user to add more ice
Stops ice shaver after 20 sec of shaving or when 2 degC reached
Temperature Sensor

**Figure 8**